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SLOVAK GEOGRAPHY AT THE BEGINNING OF THE 21st CENTURY

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PREFACE

Slovak geography is developing in the new democratic society and is open to contemporary international research trends and co-operation. The Slovak Geographical Society committed itself in 2006 to strengthen the position of Slovak geography at the international level. In 2007 it was decided to prepare an overview of Slovak geography for international community and to analyse the state of the main research clusters at the beginning of the 21st century. The result of this activity is the monograph in *Geographia Slovaca* series prepared for the occasion of the *EUGEO 2009*, the *Second Congress on the Geography of Europe* in Bratislava.

The idea for this book aroused out of our mutual interest in the interrelationship among the modern history of geography in Slovakia, geographical thought and methodology. As originally conceived, this book is to be used as a basic reference work on geographical themes in Slovakia. Our only charge to the authors of the individual contributions was that they present an overview of the concrete ideas of the research philosophy, stress it relevance and impact on various aspect of geography.

Several persons deserve mention in connection with the effort involved in producing this book. For their patience and their insistence that this book be completed, we extend our thanks to Hana Contrerasová, Rút Facunová, Erika Mészarosová, Magdaléna Nováková, Lenka Prešovská and Elena Zabadalová. Martina Cebecauerová also deserve thanks for designing the cover of this publication. Our appreciation is also extended to reviewers for their valuable work.

August 2009

Vladimír Ira and Ján Lacika
editors

GEOGRAPHIA SLOVACA, 26, 2009

THEORETICAL AND QUANTITATIVE GEOGRAPHY IN SLOVAKIA: A BRIEF ACCOUNT

*Ján Paulov**

Teoretická a kvantitatívna geografia na Slovensku: stručná charakteristika
Tento príspevok poskytuje základnú predstavu o teoretickej a kvantitatívnej geografii na Slovensku. Sú v ňom identifikované a stručne charakterizované hlavné smery v tejto oblasti od šesťdesiatych rokov 20. storočia až po súčasnosť. S cieľom poskytnúť konkrétnejšiu predstavu bola vypracovaná osobitná bibliografická časť, v ktorej sú obsiahnuté najvýznamnejšie publikácie z tejto oblasti, vrátane ich autorov.

Kľúčové slová: smery, publikácie, teoretická a kvantitatívna geografia, Slovensko

The primary objective of this paper is to give a basic idea, which, however, does not pretend to be an assessment, about theoretical and quantitative geography in Slovakia. The way the author has chosen to achieve it consists in suggesting main directions and citing the main writings, including their authors, characterizing this field. The writings and their authors are given in a specific and relatively large bibliographic section, which in such a way makes it possible to gain a more complete idea about this area. It is, however, noteworthy that the topic discussed in this paper, including selection of the writings and their authors, depends in a great measure on the personal "philosophy" as well as the scope of the pertinent author. The reader should therefore realize that another author could present this topic entirely differently.

If one considers the paper *Exceptionalism in geography: a methodological examination* by Schafer (1953), the book *Theoretical geography* by Bunge (1962) and the book *Locational analysis in human geography* by Haggett (1965) to be the beginning of the movement called in the world-wide context "theoretical and quantitative geography" then the paper *Some problems and aspects of the process of exactization in geography* published in the *Geografický časopis* (*Geographical Journal*) by Paulov (1966) could perhaps be considered the beginning of Slovak theoretical and quantitative geography. This paper emphasizes the need for a theoretico-methodological conversion of geography if it strives to overcome the status of a purely descriptive science. This paper also suggests what exactization means and brings. The year when this paper was published (1966) as well as its character may justify the claim that Slovak geography caught in principle, without a great delay, this new and essential trend in world geography. However, it is also necessary to say that in creating the initial ideas about theoretical and quantitative geography in Slovakia the papers of some Polish geographers (mainly Chojnicki and Domański) and the papers of some Soviet-Russian geographers (mainly Medvedkov) were relevant. Later the book *Explanation in geography* by Harvey (1969) became very important. This book has been considered to be the most comprehensive presentation

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something like the "bible" of theoretical geography. It also played a decisive role in establishing a specific lecture devoted to theoretical geography for geography students at Comenius University in Bratislava.

Although a relatively small set of geographers in Slovakia have been engaged in doing theoretical and quantitative geography its development has taken different directions. One of them, which has been rather strong and which is permanently present, concerns geography as a science, its nature, its internal division, its position within the system of sciences, its relation to other sciences, its basic concepts and methods, its philosophy, its methodological character (idiographic, nomothetic or idiographic-nomothetic), etc. We realize that this topic is sometimes considered to be not a strict theoretical geography, but rather a methodology of geography or metageography, nevertheless we consider it to be theoretical geography in a broader sense and therefore we included it in this paper. The main contributors to this topic are as follows (according to alphabetic order): Drdoš (2004), Drdoš and Oťaheľ (2006), Matlovič (2006a, 2006b and 2007), Mazúr and Urbánek (1982, 1983 and 1984), Mičian (1983c, 1984b, 1988a, 1989, 1995, 1996a and 1996c), Paulov (1966, 1968, 1969, 1984, 1986, 1996b, 1997, 2001, 2002a, 2006 and 2009) and Žigrai (2006).

It is well known that the initial period of quantification in geography was characterized by a large application of statistical methods. Among them multidimensional statistical methods became especially relevant, as for instance factor and component analyses, numerical taxonomy, etc. These methods are nowadays usually termed "regional taxonomy". In Slovak quantitative geography they were both discussed und used in a series of papers (Bezák 1987, 1988a, 1988b, 1991, 1992a, 1992b, 1993a, 1993b, 1995 and 1996) as well as in the monograph (Bezák 1993).

In the initial period of quantification in geography some attention was also given to the analysis of the shape of geographical entities, e. g. analysis of settlements' shape. In Slovak quantitative geography papers also appeared dealing with this question, for example Bezák (1982) and Bezák and Horáková (1984).

The highly relevant direction, the key direction, in theoretical and quantitative geography represents mathematical modelling. In Slovak theoretical and quantitative geography this direction found its clear manifestation. Already in the initial period a paper by Bezák (1975) appeared, later papers by Bezák (1989) and by Paulov (1989). They are review papers.

It is important to stress that in Slovak theoretical and quantitative geography the most attention has been given to gravity or interaction models and among them to entropy maximizing interaction models (including entropy as a scientific concept and its use in geography). There is a set of papers having a review character and a set of papers in which these models are calibrated (mainly on migration data). There are also papers which aim at developing these models. They are as follows: Paulov (1975, 1982, 1985, 1987, 1991a, 1991b, 1991c, 1995, 2000, 2002, 2004a, 2004b and 2004c), Paulov and Poláčik (1979 and 1982), Paulov and Bezák (1993), Bezák (2000b, 2006 and 2008a). It is also necessary to mention a monograph by Paulov (1993).

However, not only gravity or interaction models but also some other models were discussed. It is worth mentioning Clark's model, which was calibrated on population density data in the city of Bratislava (Paulov and Bezák 1984 or Bezák and Paulov 1984) and models designed for population projection (Bezák and Ho-

lická 1995a and 1995b). An attempt was also made to formulate models based on the concept of control or regulation (Paulov 1970 and 1972).

The new mathematical methods developed and used in world geography, such as catastrophe theory, fractal geometry and the so-called local statistical methods were discussed in Slovak geography in the form of review papers (Paulov 1995, 1996 and 2002).

There are also further review papers dealing with development of a world quantitative and theoretical geography (Paulov 2000) or with an analysis of qualitative spatial data (Bezák 1994). The state-of-the art of quantitative world geography was discussed in a paper by Bezák (2008).

Quantitative geography also found some application in thematic cartography (Paulov 1996 and 2004).

The spatial approach, in the form of an analysis of spatial organization, as an inherent aspect of theoretization and quantification of geography, already appeared relatively early as well as later in Slovak geography, explicitly in papers by Bezák (1970, 1981 and 1997), and specifically with an analysis of one of the fundamental concepts of theoretical human geography, namely the functional urban or city region. The papers by Bezák (1990 and 2001) and the monograph by the same author (Bezák 2000) are to be explicitly mentioned.

Theoretical and quantitative geography became established in the world mostly, as is well known, in human geography. A similar situation can be observed in Slovakia. However, this does not mean that it has not been important in physical geography. Just the contrary, there is also a relatively rich literature dealing with theoretical and quantitative problematics in physical geography. The richest literature, as in geography as a whole, concerns physical geography as a science or as a constituent branch of geography, its nature, its basic concepts, such as landscape, its relation to other sciences or to scientific discipline, as for instance to landscape ecology or geoecology, its internal division, etc. There are also papers dealing specifically with some disciplines of physical geography, such as soil geography. The main contributor to this field has been Mičian (1965, 1967, 1969, 1971a, 1971b, 1973, 1977, 1983a, 1983b, 1984a, 1988b, 1990, 1992a, 1992b, 1993, 1996b, 1996d, 1998 and 1999), Drdoš and Oťahel (2006). This topic was also discussed in other papers, such as those by Urbánek (1992 and 2006) and Urbánek et al. (1980).

In physical geography theoretical and quantitative geography became established most strongly in an analysis of the georelief. There are papers studying the georelief in close connection with the modern methodology of science. The author of these papers is Urbánek (2000a, 2000b and 2004). However, the most original and the most fundamental studies analysing the georelief from the point of view of quantitative geography and in close connection with maps are the studies by Krcho. This author originated, for instance, entirely new kinds of isolines and he developed morphometric analysis of the georelief on the basis of geometric aspects of the field theory which enables complex modelling of the georelief in close connection with maps. The results of his studies are published in numerous papers and in a set of monographs. This set is as follows: Krcho (1983, 1990, 1992 and 2000).

Another author who has analysed the georelief from the theoretical and quantitative point of view as well as in close connection with maps has been Minár (1993, 1998, 1999 and 2006) or Minár in collaboration with Evans (2008). His monograph should also be mentioned (Minár 1995).

It is perhaps worth noticing that some papers from theoretical and quantitative geography crossed the border of geographical periodicals and were also published in non-geographical periodicals, from fields such as philosophy (classical or analytico-philosophical), mathematics and economics (Paulov 1968, 1982, 2002, 2004a and 2004b).

It is also perhaps worth noticing, to complete the matter discussed in this paper, that Slovak theoretical and quantitative geography has played an organizational as well as an intellectual role in world theoretical and quantitative geography. Two corresponding members, A. Bezák and J. Paulov, of the former IGU Commission on Quantitative Geography (Chair: Professor M. M. Fischer, Vienna University of Economics and Business Administration) organized a symposium of this commission in Bratislava in 1994.

REFERENCES

BEZÁK, A. (1970). Central places in the Region of Upper Hron. *Acta Geographica Universitatis Comenianae*, *Economico-Geographica*, 9, 157-174.

BEZÁK, A. (1975). Niekoľko poznámok k matematickému modelovaniu v ekonomickej geografii. *Geografický časopis*, 27, 9-15.

BEZÁK, A. (1981). Nodálna štruktúra systému slovenských miest. *Geografický časopis*, 33, 18-31.

BEZÁK, A. (1982). Metódy merania formy v geografii. *Geografický časopis*, 34, 177-191.

BEZÁK, A. (1987). Sociálno-priestorová štruktúra Bratislavy v kontexte faktorovej ekológie. *Geografický časopis*, 39, 272-292.

BEZÁK, A. (1988a). Regionálne typy sociálno-priestorovej štruktúry Bratislavay. *Geografický časopis*, 40, 311-328.

BEZÁK, A. (1988b). Niekoľko predbežných úvah o faktorovej ekológii Bratislavy. In *Sborník prací*. Brno (Geografický ústav ČSAV), pp. 167-187.

BEZÁK, A. (1989a). Matematické modely a urbánne plánovanie. In Drgoňa, V., ed. *Diagnosticko-prognostické postupy a racionálne využívanie územia*. Nitra (SGS pri SAV), pp. 33-39.

BEZÁK, A. (1989b). Urbánne modelovanie: postupy, problémy a perspektívy. In Bezák, A., ed. *Nové trendy v geografii*. Bratislava (SGS pri SAV), pp. 23-38.

BEZÁK, A. (1990). Funkčné mestské regióny v sídelnom systéme Slovenska. *Geografický časopis*, 42, 57-73.

BEZÁK, A. (1991a). Migračné toky a regionálna štruktúra Slovenska: nehierarchistická regionalizácia. *Geografický časopis*, 43, 265-275.

BEZÁK, A. (1991b). Migračné toky a regionálna štruktúra Slovenska: hierarchistická regionalizácia. *Geografický časopis*, 43, 193-202.

BEZÁK, A. (1992a). Funkčná regionalizácia: problém, metódy a empirický príklad. In Drdoš, J., ed. *Zborník referátov z X. zjazdu Slovenskej geografickej spoločnosti pri SAV*, Bratislava (SGS pri SAV), pp. 1-15.

BEZÁK, A. (1992b). Komparatívna analýza nehierarchických metód regionálnej taxonómie (rastové typy obcí v Gemeri ako príklad). *Geografický časopis*, 44, 127-139.

BEZÁK, A. (1993). *Problémy a metódy regionálnej taxonómie*. Geographia Slovaca, 3. Bratislava (Geografický ústav SAV).

BEZÁK, A. (1993a). Funkčná regionalizácia Slovenska na základe dát o medziokresných migráciách. In Očovský, Š., Volná, A., eds. *Populačné zdroje regionálneho rozvoja Slovenska*, Bratislava (Slovenská štatistická a demografická spoločnosť), pp. 11-16.

BEZÁK, A. (1993b). Prístupy k analýze vnútornej štruktúry miest: prehľad a zhodnotenie. *Acta Facultatis Rerum Naturalium Universitatis Comenianae*, *Geographica*, 32, 287-298.

BEZÁK, A. (1994). Prístupy k analýze kvalitatívnych priestorových dát. *Geographia Slovaca*, 7, 7-20.

BEZÁK, A. (1995). Functional regionalization of Slovakia. In *Environment and quality of life in Central Europe: problems of transition. Conference proceedings*. Prague (Albertina Icome and Charles University, Faculty of Science), CD-ROM.

BEZÁK, A. (1996). Regional taxonomy: a review of problems and methods. *Acta Facultatis Rerum Naturalium Universitatis Comenianae*, *Geographica*, 38, 43-59.

BEZÁK, A. (1997). Priestorová organizácia spoločnosti a územno-správne členenie štátu. *Acta Universitatis Matthiae Belii*, *Geografické štúdie*, 3, 6-13.

BEZÁK, A. (2000a). *Funkčné mestské regióny na Slovensku.* Geographia Slovaca, 15. Bratislava (Geografický ústav SAV).

BEZÁK, A. (2000b). Interregional migration in Slovakia: some tests of spatial interaction models. *Geografický časopis*, 52, 15-32.

BEZÁK, A. (2001). Niekoľko poznámok o revízii systému funkčných mestských regiónov na Slovensku. *Acta Facultatis Rerum Naturalium Universitatis Mathiae Belii*, *Geografické štúdie*, 8, 36-40.

BEZÁK, A. (2006). Hlavné smery v modelovaní interregionálnych migrácií. *Acta Geographica Universitatis Comenianae*, 47, 35-46.

BEZÁK, A. (2008a). Distančne vážené migračné miery a ich aplikácia pri analýze interregionálnych migrácií na Slovensku. *Geografická revue*, 4, 31-41.

BEZÁK, A. (2008b). Quo vadis kvantitatívna geografia? *Acta Geographica Universitatis Comenianae*, 50, 79-94.

BEZÁK, A., HOLICKÁ, A. (1995a). Komparatívna analýza extrapolačných modelov pre regionálne populačné projekcie. *Geografický časopis*, 47, 233-246.

BEZÁK, A., HOLICKÁ, A. (1995b). Testovanie účinnosti troch tried modelov pre populačné projekcie na regionálnej úrovni. In Hofman, E., ed. *Postavení regionální geografie České republiky a Slovenské republiky v kontextu nových podmínek rozvoje*. Brno (Pedagogická fakulta Masarykovy university), pp. 18-22.

BEZÁK, A., HORÁKOVÁ, E. (1984). Tvary pôdorysu slovenských miest. *Geografický časopis*, 36, 243-251.

BEZÁK, A., PAULOV, J. (1984). Calibrating and testing the intraurban population density model: the case of the city of Bratislava. *Acta Facultatis Rerum Naturalium Univeristatis Comenianae, Geographica*, 24, 55-61.

DRDOŠ, J. (2004). O holistickom prístupe v geografii: tradície a súčasnosť. *Acta Facultatis Studiorum Humanitatis at Naturae Univeritatis Prešoviensis, Folia Geographica*, 7, 28-43.

DRDOŠ, J., OŤAHEL, J. (2006). Poznámky k vývoju integračného myslenia vo fyzickej geografii na Slovensku v posledných desaťročiach. *Acta Facultatis Studiorum Humanitatis at Naturae Univeritatis Prešoviensis, Folia Geographica*, 10, 123-139.

KRCHO, J. (1973). Morphometric analyse of relief on the basis of geometric aspects of field theory (Monograph). *Acta Geographica Univeritatis Comenianae*, 1, p. 233.

KRCHO, J. (1990). *Morfometrická analýza a digitálne modely georeliefu*. Bratislava (Veda).
KRCHO, J. (1992). Georelief and its cartographic modelling by complex digital model from geographical information system (GIS) point of view. *Acta Facultatis Rerum Naturalium Univeritatis Comenianae*, *Geographica,* 33, 3-131.
KRCHO, J. (2001). *Modelling of georelief and its geometrical structure using DTM: positional and numerical accuracy*. Bratislava (Q111).
MATLOVIČ, R. (2006a). Geografia – hľadanie tmelu. *Folia geographica*, 9, 6-43.
MATLOVIČ, R. (2006b). K problematike hľadania platformy symbiózy idiografického a nomotetického spôsobu produkcie geografických poznatkov. *Geografická revue*, 2, 25-39.
MATLOVIČ, R. (2007). Hybridná idiograficko-nomotetická povaha geografie a koncept miesta s dôrazom na humánnu geografiu. *Geografický časopis*, 59, 3-23.
MAZÚR, E., URBÁNEK, J. (1982). Kategória priestoru v geografii. *Geografický časopis*, 34, 309-325.
MAZÚR, E., URBÁNEK, J. (1983). Space in geography. *GeoJournal*, 7, 139-143.
MAZÚR, E., URBÁNEK, J. (1984). Hľadanie základov. *Geografický časopis*, 36, 316-330.
MIČIAN, Ľ. (1965). K otázke pôdnografických zákonitostí so zvláštnym zreteľom na územie Slovenska. *Geografický časopis*, 17, 289-330.
MIČIAN, Ľ. (1967). K otázke predhorskej (príhorskej) zonálnosti pôd so zvláštnym zreteľom na strednú a juhovýchodnú Európu. *Sborník Československé společnosti zeměpisné*, 72, 342-354.
MIČIAN, Ľ. (1969). Geografia pôd – jej postavenie, obsah a definícia. *Sborník Československé společnosti zeměpisné*, 74, 49-62.
MIČIAN, Ľ. (1971a). Nejednotnosť názorov na systém fyzicko-geografických vied. *Geografický časopis*, 23, 156-159.
MIČIAN, Ľ. (1971b). Problém zaradenia geomorfológie do systému vied. *Sborník Československé společnosti zeměpisné*, 76, 122-134.
MIČIAN, Ľ. (1973). Morfogeografia: geografický prístup k predmetu geomorfológie. *Folia Facultatis Scienciarum Naturale Universitatis Purkynianae Brunensis, Geographia*, 9, 27-33.
MIČIAN, Ľ. (1975). O niektorých termínoch a pojmoch používaných pri výskume geografickej krajiny. *Geografický časopis*, 27, 45-51.
MIČIAN, Ľ. (1977). How to understand the contemporary physical geography. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 15, 3-13.
MIČIAN, Ľ. (1983a). The system approach to the landscape and the sciences realizing it with a special aspects to the system of geographical sciences. *Ekológia*, 2, 421-429.
MIČIAN, Ľ. (1983b). Pokus o klasifikáciu názorov na fyzickú geografiu. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 22, 3-20.
MIČIAN, Ľ. (1983c). Syntetizujúce, jadrové disciplíny geografie a ich pozícia v systéme geografických vied. *Zprávy geografického ústavu ČSAV*, 3, 29-51.
MIČIAN, Ľ. (1984a). Pokus o novú definíciu krajinnej ekológie (geoekológie). *Ekológia*, 3, 109-121.
MIČIAN, Ľ. (1984b). The analysis and comparison of the selected conceptions of geographical sciences system. *Acta Facultatis Rerum Naturalium Universitatis Comenianae*, *Geographica*, 24, 41-54.
MIČIAN, Ľ. (1988a). Problém pozície geografie v sytéme vied. *Sborník Československé geografické společnosti*, 93, 292-301.

MIČIAN, Ľ. (1988b). Some problems concerning conception of landscape ecology. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 19, 11-15.
MIČIAN, Ľ. (1989). Hľadanie pozície geografie v systéme vied a jej vnútornej štruktúry. In *Nové trendy v geografii.* Bratislava (SGS), pp. 7-12.
MIČIAN, Ľ. (1992a). Nová koncepcia vertikálnej zonálnosti pedosféry Slovenska a jej kritika z komplexných pozícií. *Geographica Slovaca*, 1, 17-22.
MIČIAN, Ľ. (1993). The landscape ecology – the integration of a geographical and ecological approach in the research of landscape environment. *Acta Environmentalica Universitatis Comenianae*, *Special Issue*, 1, 55-57.
MIČIAN, Ľ. (1995). Problémy metageografie a metakartografie vo svetle východoeurópskej a stredoeurópskej literatúry. *Geografický časopis*, 47, 63-73.
MIČIAN, Ľ. (1996a). Position of regional geography within the system of geographical sciences. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 38, 26-41.
MIČIAN, Ľ. (1996b). Geoekológia a fyzická geografia. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 39, 3-17.
MIČIAN, Ľ. (1996c). K problematike regionálnej geografie a jej vzťahov ku krajinnej ekológii. *Geografické informácie*, 4, 18-20.
MIČIAN, Ľ. (1996d). O dvoch cestách ku krajinnej syntéze. In Hrnčiarová, T., ed. *Celostnosť – syntéza – ochrana životného prostredia. Zborník zo seminára*. Bratislava (Ústav krajinnej SAV), pp. 35-39.
MIČIAN, Ľ. (1998). Dva prúdy fyzickej geografie v medzinárodnej literatúre. *Acta Facultatis Rerum Naturalium Universitatis Comenianae*, *Geographica*, 41, 3-12.
MIČIAN, Ľ. (1999). Geografia, fyzická geografia, krajinná ekológia, geoekológia: ich interpretácia a funkcia. *Geografický časopis*, 51, 331-345.
MIČIAN, Ľ., BEDRNA, Z. (1990). Renesancia problému predhorskej zonálnosti pôd (prírodného prostredia). *Geografický časopis*, 42, 251-263.
MIČIAN, Ľ., BIZUBOVÁ, M. (1992b). To the problem of lithosphere analysis from geographical point of view. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 32, 23-33.
MINÁR, J. (1993). The position of geomorphology in the landscape research. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 32, 35-49.
MINÁR, J. (1995). Niektoré teoreticko-metodologické problémy geomorfológie vo väzbe na tvorbu komplexných geomorfologických máp. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 36, 7-125.
MINÁR, J. (1998). Definícia v význam elementárnych foriem georeliéfu. *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis, Folia geographica*, 2, 315-321.
MINÁR, J. (1999). Morfologická analýza polí a jej využitie v geoekológii. *Geografický časopis*, 51, 261-277.
MINÁR, J. (2006). Fuzzy approach in geomorphological mapping. *Geomorhologia Slovaca*, 6, 8-13.
MINÁR, J., EVANS, I. S. (2008). Elementary forms for land surface segmentation: the theoretical basis of terrain analysis and geomorphological mapping. *Geomorphology*, 95, 236-259.
PAULOV, J. (1966). Niektoré problémy a aspekty exaktizačného procesu v geografii. *Geografický časopis*, 17, 252-268.

PAULOV, J. (1968): Snahy o premenu teoreticko-metodologického modelu geografie. *Filozofia*, 23, 55-68.
PAULOV, J. (1969). Syntetizačno-integračné úsilie v geografii a exaktné postupy. *Sborník Československé společnosti zeměpisné*, 74, 127-140.
PAULOV, J. (1970). Control process in regional analysis. In *Regional studies, methods and analysis*. Budapest (Akademiai Kiadó), pp. 49-60.
PAULOV, J. (1972). Náčrt kybernetického modelovania v regionálnej analýze. *Acta Geographica Universitatis Comenianae*, 11, 9-12.
PAULOV, J. (1975). Entropia a priestorová šturktúra. *Geografický časopis*, 27, 52-60.
PAULOV, J. (1982). Teória informácií a regionálna analýza. *Pokroky matematiky, fyziky a astronómie*, 27, 218-226.
PAULOV, J. (1984). Das Problem der wissenschaftlichen Methode in der Geographie. *Wissenschaftliche Beiträge der Martin Luther Univesität*, 29, 117-124.
PAULOV, J. (1985). Gravitačný model: analytický nástroj štruktúrneho výskumu v geografii. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 25, 79-99.
PAULOV, J. (1986). Spory o pozitivizmus v súčasnej západnej geografii (A positivismus debate in contemporary western geography). *Geografický časopis*, 38, 259-273.
PAULOV, J. (1987). Gravitationsmodell: Ein analytisches Mittel geographischer Strukturfaschung. In *Strukturen und Processe in der Geographie*. Gotha (Hermann Haack), pp. 103-116.
PAULOV, J. (1989). Úvod do kalibrácie priestorového modelu. In *Nové trendy v geografii*. Bratislava (SGS pri SAV), pp. 33-38.
PAULOV, J. (1991a). Entropie in der Humangeographie: einleitende konzepzionelle Übersicht. *Petermanns Geographische Mitteilungen*, 135, 89-98.
PAULOV, J. (1991b). Gedanken zur Interactionsmodellierung. *Wissenschaftliche Zeitschrift der Humboldt Universität zu Berlin, Reihe Mathematik, Naturwissenschaft*, 40, 37-41.
PAULOV, J. (1991c). The zone-size dependent entropy formula and interaction modelling: a note on some implications. *Environmental and Planning*, 23A, 557-570.
PAULOV, J. (1993). *Entropia v urbánnej a regionálnej analýze: konceptuálny rámec a základy aplikácie*. Geographia Slovaca, 2, Bratislava (Geografický ústav SAV).
PAULOV, J. (1995a). Spatial interaction modelling: selected approaches. *Acta Universitatis Carolinae, Geographica*, 30, 95-117.
PAULOV, J. (1995b). Fractal geometry and geography: fractal dimension concept. In *Vybrané problémy súčasnej geografie a príbuzných disciplín*. Bratislava (Prírodovedecká fakulta UK), pp. 239-247.
PAULOV, J. (1996a). Towards comparison of two entropy formulae. *WSG Discussion Papers*, 51, 1-17.
PAULOV, J. (1996b). The situation of regional geography: some open questions. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 38, 9-16.
PAULOV, J. (1996c). Catastrophe theory and system dynamics: some basic ideas. *Ekológia*, 15, 47-52.
PAULOV, J. (1996d). K problému určovania veľkosti geometrických diagramov na tematických mapách. *Geografický časopis*, 48, 126-141.
PAULOV, J. (1997). Postmodern geography: a brief characterization. *Acta Universitatis Carolinae, Supplement*, 40-50.

PAULOV, J. (1998). Niekoľko úvah o geografii na prelome 20. a 21. storočia a 2. a 3. tisícročia. *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis, Folia geographica*, 2, 11-22.
PAULOV, J. (2000a). K vývoju kvantitatívnej a teoretickej geografie. *Geografický časopis*, 52, 3-14.
PAULOV, J. (2000b). The zone-size dependent entropy formula and spatial interaction modeling: an additional note. *Journal of Geographical Systems*, 2, 185-199.
PAULOV, J. (2001). K hypoteticko-deduktívnej metóde vo vedeckom bádaní: niekoľko poznámok k štúdii J. Urbánka: „Hypotéza v slovenskej geomorfológii". *Geografický časopis*, 53, 211-215.
PAULOV, J. (2002a). Komplexita a geografia. *Geografický časopis*, 54, 393-398.
PAULOV, J. (2002b). Entropia a modelovanie. *Organon*, 9, 157-175.
PAULOV, J. (2002c). Problém globálneho a lokálneho v kvantitatívnej geografii. *Geographia Slovaca*, 18, 143-150.
PAULOV, J. (2004a). On an estimation of interaction flows from transportation costs. *Geografický časopis*, 56, 173-185.
PAULOV, J. (2004b). Čo je „Maximum entrpy principle". *Obzory matematiky, fyziky a informatiky*, 33, 24-30.
PAULOV, J. (2004c). Entropiu maximalizujúcae modely v regionálnej analýze. *Ekonomický časopis*, 52, 901-909.
PAULOV, J. (2004d). The problem of determining the internal structure of geometric diagrams on thematic maps. *Geografický časopis*, 56, 267-276.
PAULOV, J. (2006). K problému idiografickosti a nomotetickosti geografie s osobitným zreteľom na regionálnu geografiu. *Acta Universitatis Comenianae, Geographica*, 47, 27-32.
PAULOV, J. (2009). Je geografia idiografická, nomotetická alebo idiograficko-nomotetická veda? *Acta Geographia Universitatis Comenianae*, 50, 5-17.
PAULOV, J., BEZÁK, A. (1984). Calibrating and testing the intraurban population density model: the case of the city of Bratislava. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 24, 55-61.
PAULOV, J., BEZÁK, A. (1985). Kalibration und Test des Clarkschen Modells der innerstädtischen Bevőlkerungsdichte am Beispiel der Stadt Bratislava. *Wissenschaftliche Beiträge der Martin Luther Universität*, 31, 117-124.
PAULOV, J., BEZÁK, A. (1993). Die Kalibration des Interactionsmodells am Beispiel der interregionalen Wanderungen in Őösterreich. *Klagenfurter Geographische Schriften*, 11, 143-150.
PAULOV, J., POLÁČIK, Š. (1979). Kalibrácia a testovanie gravitačného modelu na migračných dátach. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 17, 209-232.
PAULOV, J., POLÁČIK, Š. (1982). Interakčný model: kalibraácia a testovanie. *Studia Geographica*, 74, 74-94.
URBÁNEK, J. (1974). Geomorfologický proces alebo koncepcie pohybu v geomorfológii. *Geografický časopis*, 24, 205-227.
URBÁNEK, J. (1992). Krajina – vec alebo proces. *Geografický časopis*, 44, 217-236.
URBÁNEK, J. (2000a). Geomorfologická analýza – hľadanie systému. *Geografický časopis*, 52, 197-210.

URBÁNEK, J. (2000b). Geomorfologická analýza – hľadanie pravdy. *Geografický časopis*, 52, 291-302.
URBÁNEK, J. (2004). Hypotéza a metastabilita reliéfu. *Geografický časopis*, 56, 125-139.
URBÁNEK, J. (2006). Krajinné systémy. *Geografický časopis*, 58, 85-98.
URBÁNEK, J., MAZÚR, E., DRDOŠ, J. (1980). The search for the new way of the landscape study. *Geografický časopis*, 32, 108-118.
ŽIGRAI, F. (2006). Význam a pozícia geografie na rozhraní nomotetických a idiografických disciplín. *Geografická revue*, 2, 748-758.

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A NEW STATE IN CENTRAL EUROPE – THE CHANGING POLITICAL GEOGRAPHY OF THE SLOVAK REPUBLIC

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Nový štát v strednej Európe – meniaca sa politická geografia v Slovenskej republike
Politická geografia sa mohla začať slobodne rozvíjať na Slovensku až po roku 1989. Potom si však okamžite našla pomerne široké spektrum zaujímavých tém, kombinujúcich najmä štúdium dôsledkov vývoja po období studenej vojny, postkomunistickej transformácie a integračných procesov. V tejto kapitole sumarizujeme vývoj vo vybraných oblastiach politickej geografie, ktoré najviac zaujali slovenských politických geografov za posledných 20 rokov. Zdá sa pritom, že špecifická situácia Slovenska ako malej, postkomunistickej, vnútrozemskej krajiny nie je problémom pre v súčasnosti už medzinárodne dobre integrovaný štát. Keďže na dejinách v našom regióne záleží, nemohli sme sa vyhnúť historickému politicko-geografickému diskurzu, zameranému na otázky formovania štátu, jeho územia a hraníc. Pravdepodobne najviditeľnejším výsledkom súvisiacim s vývojom po r. 1989 je geopolitický posun z „Východu“ späť na „Západ“ (hoci inak chápaný ako kedysi), potvrdený konečne aj formálnym vstupom do EÚ a NATO. Slovenská politická geografia nezanedbáva ani volebnú geografiu, ako jednu z jej najtypickejších častí. Meniace sa volebné preferencie občanov tranzitívnej spoločnosti v čase a priestore sú jednou z kľúčových výziev na štúdium a interpretáciu. Značná pozornosť sa venuje vývoju na úrovni miestnej a regionálnej samosprávy. Práve tu nachádzame obrovskú zmenu a energiu vynaloženú v úsilí o ich presadenie a následne efektívnejšie fungovanie prostredníctvom reforiem zameraných na decentralizáciu a modernizáciu. Najmä miestna úroveň sa stala stabilným prvkom demokracie, hoci sa musí vyrovnávať s ťažkosťami ako sú veľký počet malých obcí, či zvládnutím samosprávy v multietnických obciach alebo veľkých mestách. Jedným z najmladších prvkov v politickej organizácii štátu je regionálna samospráva, ktorá však bude potrebovať dlhšie obdobie, kým dosiahne pozíciu vplyvnejšej a verejnosťou viac rešpektovanej úrovne verejnej správy.

Kľúčové slová: štát, hranice, územie, voľby, politické strany, miestna samospráva, regionálna samospráva, Slovenská republika

INTRODUCTION

The Slovak Republic is one of results of substantial changes that happened in Central Europe after the fall of the Iron Curtain. The origin of the new state in this case was peacefully negotiated by the Czech and Slovak political elites within the framework of the predecessor state – Czechoslovakia. In reality, two “velvet”

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events, the "velvet revolution" in 1989 and "velvet divorce" in 1993 are behind the existence of the new independent state and have generated a strong historical commitment to the future of Slovak society. The last two decades have been characterized by a hectic period of changes, affecting of all spheres of the functioning. The serious long term social and economic transformation, which started in 1989, was after a few years combined with the complicated process of establishing and building the structures of a new independent state. Later it was followed by the accession processes to EU and NATO. The outcome is clear — Slovakia has changed during that period from a part of the Czechoslovak federation with a centrally planned economy and totalitarian political system with one ruling party, to an independent democratic state with market oriented economy and a member state of the EU and NATO.

Political geography almost did not exist during communist regime, so it can be considered as a younger part of Slovak geography. It could freely develop only after 1989 and it has immediately found exceptionally interesting topics for study. The deep changes in Slovak's geopolitical position, new democratic political environment, reformed mode of governance attracted more geographers. In this paper, the group of scholars joined together to summarise development in selected political geographical issues in Slovakia. It also reflects the most typical research topics that attract Slovak political geographers after 1989. We started by considerations concerning specific position of Slovakia as small, post-socialist state in current world. It provides traditional basic thoughts on limits of new state functioning. Because history matters in this region, we could not avoid historical political geographical discourse. It focuses on formation of the state territory, its borders and related conflicts. Probably the most visible outcome related to development after 1989 is geopolitical shift from "East" back to the "West" extensively debated e.g. by Blažík (1999 and 2002), Buček (1994 and 1996), Michaeli and Ištok (2002), confirmed finally by joining EU and NATO. Nevertheless, its position in Central Europe, at the current eastern edge of the EU and NATO, gives Slovakia a certain specific location. The next section explains issues below the central state level. It is a crucial area for understanding the substantial shift toward a democratic society and its more efficient governance. We pay attention to the political system, main political parties and electoral geography. Almost permanent public administration reforms and related territorial adjustments have also been a fruitful field of investigation for political geography in Slovakia. We could not avoid emphasizing development in the field of local government, including such specific issues as inter-municipal cooperation, self-government in ethnically mixed territories or governing large cities. The final section presents regional self-government as the latest level of government introduced in Slovakia. Although this chapter provides only a basic introduction into the above mentioned issues, it can be considered as an efficient guide to Slovak political geography, including rich references at the end of this chapter.

SLOVAKIA AS A SMALL, POST-SOCIALIST, LAND-LOCKED STATE

Regarding the area (49 034 km^2) Slovakia is ranked as the 126th out of all the states of the world and regarding the population it is ranked as the 110th. These data might imply that Slovakia ranks among small-sized states. This status of Slovakia is supported by political and geographical classifications, since in all of them it is ranked as a small-sized state.

The criterion of size, however, appears to be vague and imprecise since it may be relatively subjective, in other words it may depend on who is responsible for the categorization. Thus, in the given context it is important to take into consideration how a state is viewed by its citizens (both laymen and experts) as well as its political representatives or foreign observers. A state is regarded as small if it is regarded as such by both its citizens and foreigners (Drulák 1997).

Whereas the former Czechoslovakia was regarded as a medium-sized state, with both of its successors this is not the case. Not only Slovak geographers but also political scientists rank Slovakia as a small state, for examply Ivanička (1999) holds that with regard to population and area Slovakia is a small state. Similarly, Šmihula (2000) claims that "regarding the geographic and demographic parameters Slovakia ranks among the small Central European states". These assessments result from essential geographical information – the area and population.

Recently the number of small-sized states has increased and, what is more, these states are flourishing. After the cold war a number of independent states came into existence whose population and area classify them as small-sized states, however, the open system of the world economy enhances the independent existence of small states (Drulák 1998). These facts are optimistic also for Slovakia.

The size of a state, however, does not depend solely on the population and area and, therefore, other factors need to be taken into account. Thus, a number of authors have dealt with the hierarchical typology, for example the criteria for designing a typology in political geography have been outlined by Ištok (2004).

In order to determine the size of a state it is important to assess the scope of its power in the sense of capability to influence the behaviour of its neighbours in accordance with its intentions or interests in various regions. This capability may, however, be limited. In this sense, the attribute "small" is actually equivalent to "not being very powerful" (Drulák 1997). The above-mentioned capabilities depend on a number of factors and the essential geographical data (area and population) are significant but not always decisive in the given context. When analysing Slovakia's status (in terms of the scope of power) and relation to the immediate neighbours or other Central European countries, is possible to conclude that in this space Slovakia appears to be "the least powerful" state. What is more, for almost all the neighbouring countries Slovakia appears to be "the least powerful" neighbour (except Austria and Hungary, for which it is Slovenia that is regarded as "the least powerful" neighbour).

Status seems to be a significant factor influencing the activities of a state; however, other factors (such as the level of economic development, geographical position, type and stability of the political system or institutional structure are of considerable importance as well. Therefore, as a rule, the fact that some states that are similar in their area and population does not necessarily mean that are they are similar in other characteristics as well. If a comparison is made within the group of the states with comparable population and area (Bosnia and Herzegovina, Denmark, Finland, Georgia, Croatia, Jordan, Kirgizstan, Nicaragua, Papua New Guinea and Turkmenistan), it is possible to conclude that the group in question is heterogeneous comprising states of various categories of "bigness". Within this group, after considering a number of criteria, Slovakia may be categorized as one of the biggest states.

In summary, with regard to the issue of "bigness" or "smallness" of Slovakia, it is necessary to stress that in addition to the above-mentioned factors an important role is played by the international prestige resulting from successful domestic and foreign policy, economic development, achievements of science and research, participation in integration processes and in international humanitarian activities or peace forces. With regard to all these factors the status of Slovakia has improved since the late 1990s.

One of Slovakia's characteristics is the fact that it is a landlocked country. This, however, in relatively small Europe, unlike in large continents, does not appear to be a disadvantage. Slovakia's geographical position is compensated for by the access to the Danubian route. Klein (2000) refers to this situation as follows: "even though the Danube touches Slovakia's border only in the South-west, this European communication corridor has affected Slovakia's geopolitical space in a decisive manner". The Danube supports the economy, transportation and links Slovakia with those countries of South-east Europe with which Slovakia lacks a direct contact. Last but not least, the Danube enables the access to the Black Sea and by means of the Rhine – Main – Danube Canal also enables access to the North Sea.

Another potential advantage for Slovakia is the development of transit transport supported by intensive business contacts amongst the countries of the integrating continent. The traditional weakness of a landlocked country, having land boundaries that are barriers obstructing the access to the sea, has thus been removed owing to the creation and expansion of the Schengen system joined by Slovakia at the end of 2007.

Since the splitting of Czecho-Slovakia into two independent states the Slovak republic has followed a complicated path marked by her ambition to become a part of Western civilization including all the political and economic consequences. Achieving this goal has been affected by a number of circumstances. First of all, gaining independence in 1993 was a new experience for Slovakia. Unlike the neighbours until that date Slovakia used to be a weak part of larger political structures. The advantage of gaining independence was the fact that it was acknowledged by all the world powers as well as by the majority of other states.

The period following the year 1993 can be characterized as a period of searching for its own way of transformation strategy affected by a number of difficulties resulting from internal political changes. In addition, Slovakia's political and economic development has also been affected by the lack of experience in solving new problems related to the transformation of the political and economic system. In spite of this fact, during the past decades the political elite have succeeded in partly modernizing and mainly opening up the economy, thus following the example of advanced Western democracies.

The Slovak Republic referred to as a post-communist country has gradually become a fully accepted country of the international community. The assumption that within international interaction Slovakia can take far more advantage of its geographical position, human, economic and natural resources than in the ineffective unitary Czechoslovak Federation (Zatlkaj 1992) has proved to be right. Nevertheless, as Halás (2005) holds, even today Slovakia faces "a challenge of finalizing, stabilizing and transforming the political, economic and social systems". Slovakia's present development supports the viewpoint expressed by Verešš (2005). He regards establishing Slovakia as a climax in the political and geographical develop-

ment and an ideal framework for completing the ethnic and national development of the Slovaks.

FORMATION OF SLOVAKIA AND ITS BOUNDARIES

Slovakia as a state is one of youngest among the states in Europe. From the 10th century until 1918 Slovakia was an integral part of Hungary (Fig. 1). As an administrative territory, it was demarcated on the map of Europe only after the end of the First World War and after the disintegration of the historic Kingdom of Hungary. Nevertheless the ethno genesis of the Slovak nation in the region of Western Carpathians can be observed since the migration of nations, since the time of settlement of this territory by Slavs. The research of the own history was of special importance for the Slovak already from the 18th century (Matej Bel), and in particular from the 19th century. In respect to the existing political and national conditions on the Slovak territory, the fundamental ideological task of research was to prove the independence and autonomy of the Slovaks as a nation. The research on the formation of the nation and its territory was almost exclusively historiographical and not historico-geographical. Untill 1918 the concept of the territory of Slovakia was formulated mostly very vaguely, usually as part of more complex political programs of self-government within the former Hungary, or Austria-Hungary (Klimko 1980).

The events close to the end of the First World War and the origin of Czechoslovakia fundamentally changed the circumstances in Slovakia. Czechoslovakia was already before its official creation considered, due to its foreign resistance, as allied to the victorious states. Hungary, in contrast to Austria-Hungary, tried to preserve its integrity even at the end of 1918. However, as the loser state, it had to accept, although unwillingly, the dictat of Great Powers. In this context, demarcation lines were set (Fig. 2), and this allowed the Czechoslovak army to occupy the territory of Slovakia. Attempts of the Hungarian governments to reverse the situation (Romsics 2006) were not successful and the established demarcation line became the basis for peace negotiations, which culminated in signing a peace treaty at Trianon in 1920. Paradoxically, this key moment, still does not receive the attention it deserves where the historical geography of Slovakia concerned, aspects from a narrow group of aspects (Deák 1996, Hronský 1998, Klimko 1980), is at present not dedicated a relevant respect concerning the historical geography of Slovakia. Due to the contemporary political circumstances, the boundaries established at Trianon were more convenient for the Slovaks, regarding the number of minorities. For this reason, particularly during the first half of the 20th century main research attention, even historical-geographical was directed, destined to supporting the idea of a Slovak Slovakia. The aspects of Slovakian-Hungarian ethnic boundaries development were discussed in detail from the Middle Ages until the 20th century (Houdek 1931, Varsik 1940).

The second main issue was political geographical, or geopolitical research of the territory of Czechoslovakia (Korčák 1938), or of Slovakia (Bokes 1944), which was conducted in the sense of classical German political geography. One of the most significant moments in Slovakia's territorial formation was the events of the years 1938 and 1939. The signing of the Munich Agreement, was followed by the quick collapse of Czechoslovakia as known during the period between two world wars. Slovakia reached on the one hand the desired autonomy, but with noticeable features of a totalitarian system. On the other hand, significant disadvantageous modi-

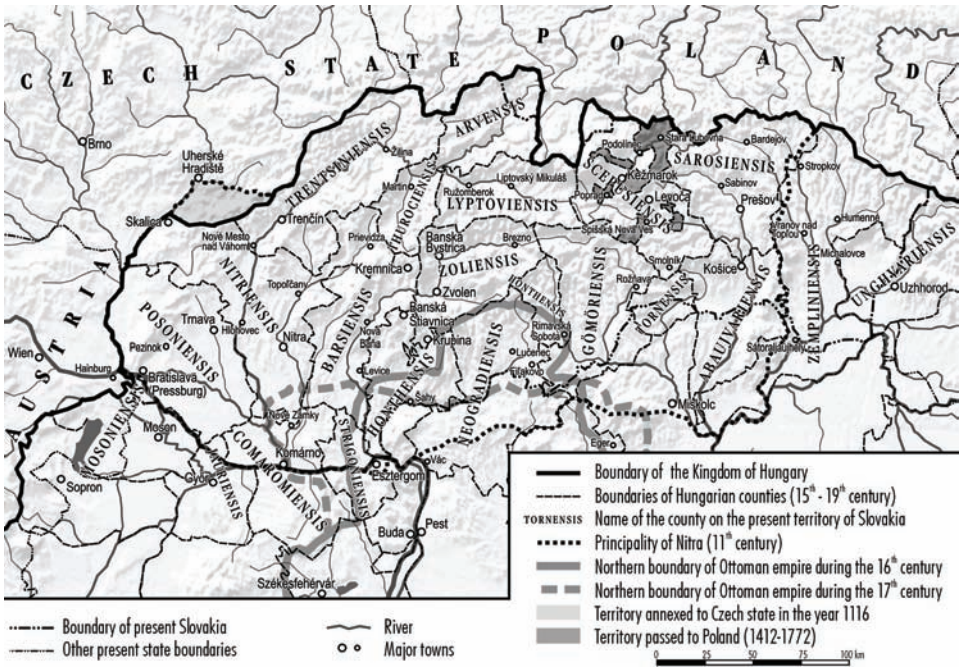

Fig. 1. Slovakia within Hungary

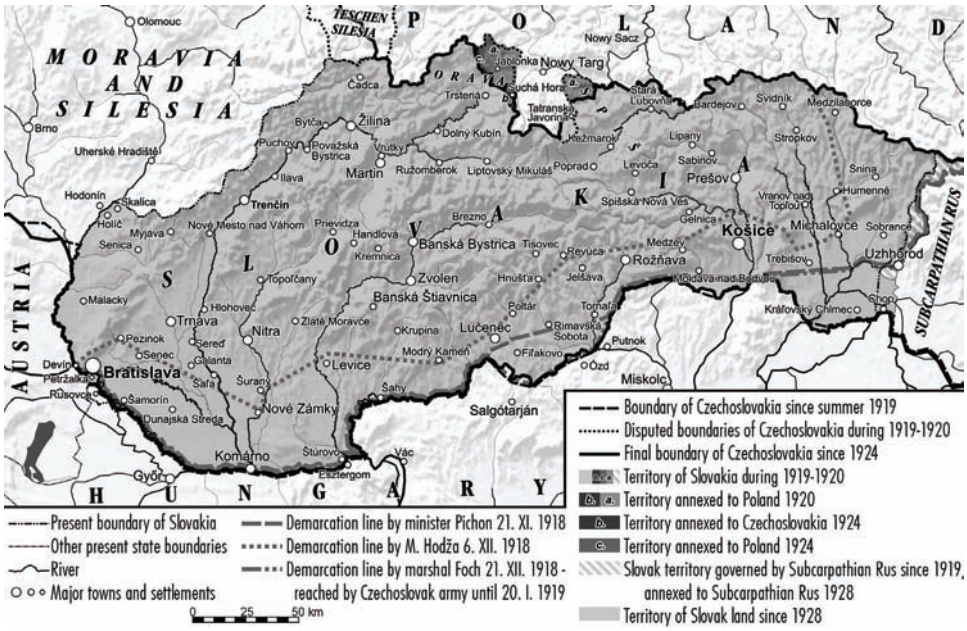

Fig. 2. Slovakia 1918-1925

fications were made to the Slovak border. Based on the decision of the 1st Vienna Arbitration, Hungary obtained 21.5% of its original territory and 25.6% of the population. At the same time Poland occupied smaller border areas (0.4% of the territory, 0.3% of the population) to the north of Slovakia (see Fig. 3). The hectic developments of this period culminated in the year 1939 with tge declaration of the independence of Slovakia under the protection of Germany and other border changes on March 14th 1939. Hungary took advantage of alleged inconsistencies in the definition of the eastern border (it was not the part of the 1st Vienna Arbitration), and militarily occupied (during so-called "Little War") another 3.5% of the original Slovak territory with 2% of the population (Lacko in Kršák 2009). Subsequently southern border was also slightly modified. The last updating of the border in this period was the recovery of territories occupied by Poland. Slovakia also obtained the former Hungarian territories occupied by Poland in 1920.

The period of problematic independence of Slovakia during the World War II had a major impact on the historic-geographical research concerning the Slovak territorial formation. This influence is remarkable also at present and still polarizes politically and ideologically the society, together with the historical- and partly historical-geographical research. From 1939 a group of the intelligentsia associated with the former regime understood the contemporary events as the culmination of the development of the state and nation. After the end of World War II, this ideological group had to emigrate, but after the collapse of the communist regime it again won a significant position in society, especially after the establishment of an independent Slovak Republic in 1993 (Vnuk 1994). The second ideological group was involved during World War II in the anti-fascist resistance and consequently also against the official regime. This movement culminated in the restitution of Czechoslovakia in 1945. The perception of World War II in Slovakia by this group followed the official allied positions, which, from the viewpoint of international law, rejected any changes in the years 1938-1944, and saw them as a sign of expansion of Nazi Germany in Central Europe. In this context, both ideological groups have different perceptions of the continuity of Slovak statehood. Whereas the first group is openly committed to the idea of continuity (1st and 2nd Slovak Republic; Verešš 2005), the second rejects such a continuity, especially with reference to the totalitarian nature of the regime in Slovakia in the years 1939-1945 (using the term "Slovak State"; Kamenec 1992, Smith 1998). Discussions between both groups were discouraged by the beginning of communist totalitarianism, which more or less suppressed most of the historical and geographical research concerning the themes of Slovak territorial formation: partly also the question of the liberation of Slovakia in 1918-1919 (origin of "capitalist" Czechoslovakia and the fight against the Bolshevik regime in Hungary) and in particular the question of frontier changes (the ceding of Subcarpathian Rus to Soviet Union in 1945 and subsequent modifications of the eastern border of the Slovakia, questions connected to the historical and current borders with Poland in Orava and Spiš regions). Attention was given mainly to the oldest ethno genesis of Slovak nation (Ratkoš 1972), formation of the Slovak territory as a whole (Klimko 1980, Lukniš 1988), and to research on the development of its administrative divisions (Žudel 1984).

The collapse of the totalitarian system and the subsequent origin of the Slovak Republic had an essential impact on the development of historical geographical research concerning the formation of the Slovak territory. However, it should be noted that the focus on the formation of the Slovak border as a whole represents

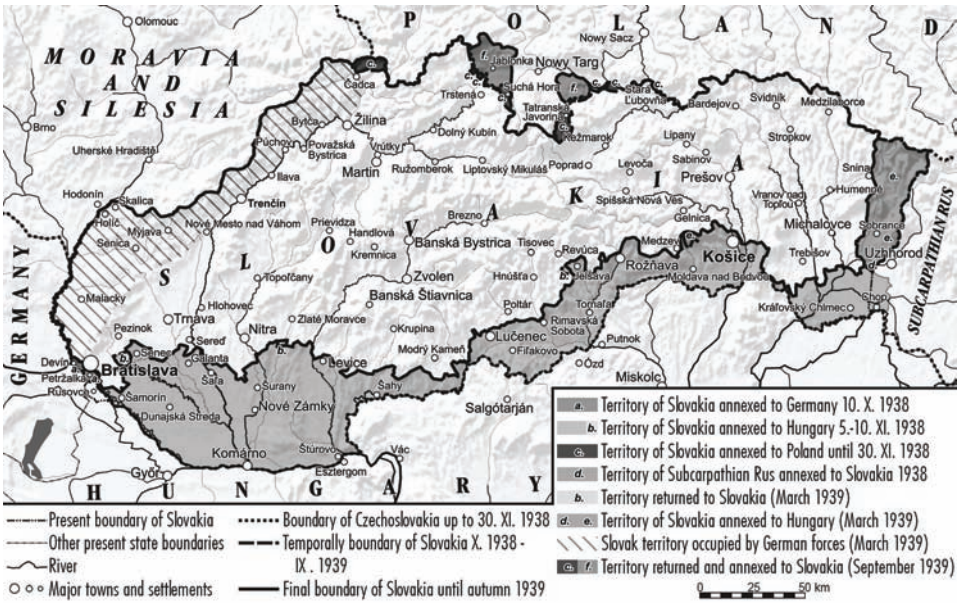

Fig. 3. Slovakia 1938-1939

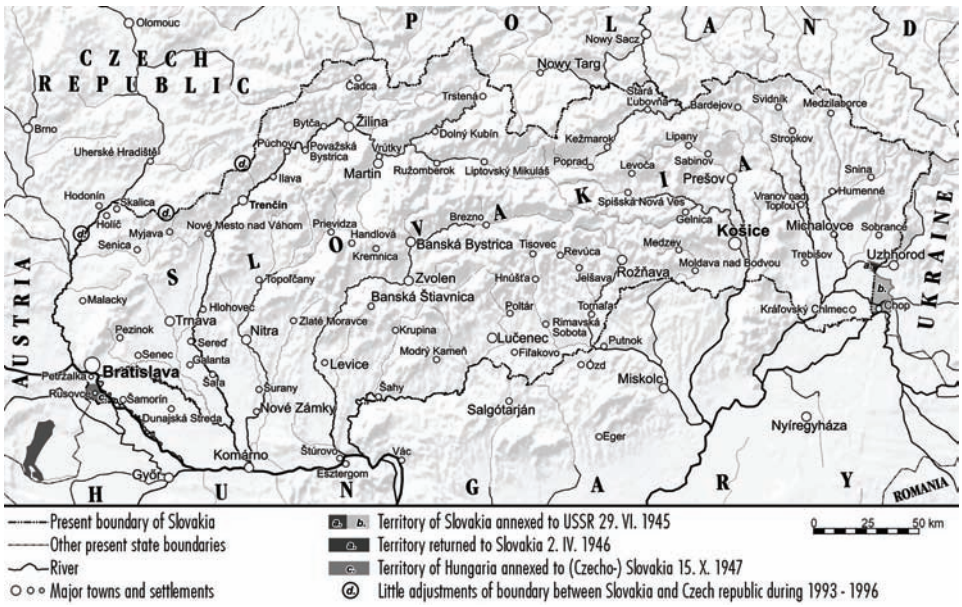

Fig. 4. Slovakia since 1945

a rather marginal position (Deák 1992), more dominant is the research on the Slovak territory, for example on its administrative division (Atlas krajiny Slovenskej republiky 2002, Gurňák 2002). There are some major issues in the recent research on the development of the Slovak territory. There is the issue of the Slovak territorial formation in the early Middle Ages (Nitra principality), and its inclusion into the medieval Hungary (Avenarius 1992, Čaplovič 1998, Steinhübel 2004). This topic raises controversies in the domestic, as well as in the international professional scene especially with respect to limited historical materials and their different interpretations. The second issue is the question of the Slovak-Hungarian border during the 20th century, often as part of broader analysis of Slovak-Hungarian relations, ethnic borders etc. (Deák 1996, Hronský 1998). Some revival occurred in the research reflecting the border changes with Poland in the Orava and Spiš regions (Ištok and Lovacká 2006). The problems linked to the formation of the eastern border of Slovakia, as well as the western border are still on the edge of scientific interest (Duleba 2000). In addition to the state border analysis, there emerged studies oriented to the position of the Slovak territory formation within the wider Central European context. The biggest weakness of historical and geographical research in this field in Slovakia has been the more or less only general co-operation and interdisciplinary connection between the historical and geographical approaches. A significant joint success in this area was the first edition of the historical atlas of Slovakia (Kršák ed. 2009), for the first time focusing only on the present territory of Slovakia. With its more professional and cognitive character, it represents a major synthesis and presentation of historical and geographical research in Slovakia.

DEVELOPMENT OF THE SLOVAK POLITICAL SYSTEM AND ELECTORAL GEOGRAPHY

The establishment of parliamentary democracy with a plurality of political parties was among the most important turns after 1989. The transformation of the society had to be accompanied and supported by rapid and overall development of the political system. It has developed during the transition period on four levels – local, regional, state and European.

The local level can be considered as the basic level, functioning on principles of self-government since 1990 in about 2,900 municipalities. Five elections have been held on local level in regular four years period (1990, 1994, 1998, 2002 and 2006). The regional level of self-government did not exist for a longer period. After heavy disputes on various issues (especially territorial division at this level) the first elections to regional councils were held in 2001 and the second in 2005. The third election should be held at in the end of 2009.

The state level, represented by the Parliament and President of the Republic is according to the Constitution the most important and decisive part of the Slovak political system. This level went through major changes in electoral rules and its stability was the weakest.

It was divided into federal and national level in the first two Parliamentary elections in 1990 and 1992. The Slovak political system was an integral part of the political system of the Czechoslovak federation. Parliamentary elections were held to Slovak National Council with 150 deputies and to the two houses of the Federal Assembly (House of People and House of Nations). Together with the process of ongoing disintegration of federation, the importance of the Slovak National Council

rose between the two elections while that of the Federal Assembly diminished. Slovakia was divided to four electoral regions (West, Central, East Slovak region and Bratislava). The Political parties had to produce different lists of their candidates in each electoral region. The main change in rules between the elections in 1990 and 1992 to the Slovak National Council was the raising of the limit for entrance of single political party to parliament from 3% to 5% of valid votes.

From January 1993, when the independed Slovak Republic started its official history, the National Council of the Slovak Republic remained as, the only directly elected parliamentary body at the state level. The Federal Assembly dissolved itself together with the Czech and Slovak Federal Republic on 31 December 1992.

The first parliamentary elections in Slovakia as an independent state in autumn 1994 were premature, after a serious political crisis. They brought to power a nationalist and populist government of Prime Minister Vladimír Mečiar. This government tried to concentrate power in its hands during its four year period and a few times broke the Constitution and performed some steps which were against the principles of democracy. By the end of its period the ruling coalition had changed the electoral law for parliamentary elections which were held at the regular time in 1998. The four electoral regions were cancelled and the territory of Slovakia became one electoral unit. Each political party could present only one list of their candidates with a maximum of 150 names. The limit for entrance of a coalition of two or three parties to parliament was raised up from 7% to 10% of valid votes and the coalition of four and more parties to at least 15% of all valid votes. The limit of 5% for one party remained unchanged. This rule led to the creation of electoral parties, where political parties were united, instead creating coalitions. The New parliament, after election in 1998, changed back the second rule, but did not renew the electoral regions and Slovakia has remained one electoral unit. There was no other significant change in the election rules for parliamentary elections and they were held in 2002 and 2006 according to them.

The permanent struggle between Prime Minister and President in the period of years 1994-1998 led the new government to change the system of presidential election to a two round direct election. The first direct election of the Slovak president was held in 1999 and an other two (2004 and 2009) followed in regular five years period.

The European level is represented by the European parliament (EP) because Slovakia has become a member of the European Union since May 2004. The election to the European Parliament was first held in the same year in June. Slovakia had 14 mandates in the EP. The next election to EP was held in June 2009, but the number of deputies representing the Slovak Republic was reduced to 13.

The Slovak political scene

The deep and relatively rapid processes of transformation of the whole society have their reflection in the development and constant transformation of the Slovak political scene. The result of these processes was the instability of political subjects. During the period of 20 years we could not find a relevant political subject, which a in all six parliamentary elections and entered Parliament. There were ongoing processes of integration and disintegration of political parties and movements, with politicians shifting between parties.

The plural political scene was renewed after the velvet revolution and new political parties and movements were established. Some of them rose up from various legal and illegal religious, ecological and civic movements and groups, which had already been active during the last decade of the communist regime. Among those new subjects the strongest were Public Against Violence (VPN), the winner of elections in 1990, the Christian Democratic Movement (KDH) and the Green Party (SZ). The traditional parties that remained active or were included the Communist Party (KSS), the winner of elections in 1946, Democratic Party (DS) Social Democratic Party (SDSS) and Slovak National Party (SNS). The hungarian minority was represented at the beginning by three parties – Coexistence (EGY), Hungarian Christian Democratic Movement (MKDH) and Hungarian Civic Party (MOS). They ran together in all parliamentary elections, with the exception of the first elections in 1990, where the Hungarian Civic Party was in coalition with Public Against Violence. They have created, forced by the new electoral law in 1998, a new political subject Hungarian Coalition Party (SMK).

The largest transformations have occurred on the left side of the political scene. The former ruling Communist Party (KSS) entered the Parliament in democratic elections 1990. It was transformed into the Party of the Democratic Left (SDĽ) and ran in elections and entered parliament in 1992 and 1998. In 1994 elections, it had created a not very successful coalition Common Choice (SV) together with Slovak Social Democratic Party (SDSS), Slovak Green Party (SZS) and Movement of Slovak Farmers (HP). The new political party Smer, which was formed in 1999 as centrist party, has transformed after the 2002 elections into Smer – Social Democracy and integrated under its umbrella the Party of the Democratic Left (SDĽ), Slovak Social Democratic Party (SDSS) and some other small left wing parties. The extremist newly emerged Communist Party (KSS), which ran in elections from 1994 and entered the Parliament in 2002 remained independed. For one period 1994-1998, the radical left wing Slovak Workers Association (ZRS) was in parliament.

Because of the specific conditions of the 1998 parliamentary elections, two parties from the left side of the political spectrum, the Slovak Social Democratic Party (SDSS), and Slovak Green Party (SZS) ran within the artificially made electoral party Slovak Democratic Coalition (SDK) together with three right wing or centrist groups: the Christian Democratic Movement (KDH), Slovak Democratic Union (DU) and Democratic Party (DS). The last two of them created a new political group the Slovak Christian and Democratic Union (SDKU-DS), which ran in the elections of 2002 and 2006 and entered Parliament as the strongest right wing party. The Christian Democratic Movement (KDH) participated as an independent group in all parliamentary elections with the exception of 1998. The leading party on the political scene for a period of ten years was the Movement for a Democratic Slovakia (HZDS), which originated from a splitt in the broad movement Public Against Violence (VPN). This party has run in all elections since 1992, entered the Parliament in all of them and was the strongest in 1992, 1994, 1998 and 2002. The Slovak National Party (SNS) has participated in all democratic elections since 1990, but in 2002 it did not reach the quorum to enter Parliament, because at time it was divided and the Right Slovak National Party (PSNS) took its votes. Three liberal political parties have occurred and were able to enter parliament as independent groups each for one period: Slovak Democratic Union – DU (1994-1998), Party of Civic Understanding SOP (1998-2002), Alliance of the New Citizen ANO (2002-2006). Nevertheless, many small political parties (about 90) are registered in Slovakia, the ma-

jority of them with no chance to enter parliament. It should be noticed that 17-19 political groups ran each parliamentary elections.

Slovak electoral geography

Slovak electoral geography started its development in the 1990s by analysis of the results of the first parliamentary election held in 1990. Its main focus during the whole period has concentrated on evaluation of different spatial aspects of support for political parties in parliamentary elections. The pioneer study was written by Mariot (1991), who could be considered the founder of modern Slovak electoral geography. In this study the results of the first parliamentary election hold after 1989 were evaluate on the level of municipalitie . The territorial aspects of electoral support for specific parties in parliamentary elections were the subject of numerous studies by this author (Mariot 1993, 1994, 1997, 1998, 1999, 2000a, 2001, 2003a, 2003b and 2004). Comprehensive analysis of the 1992 parliamentary election was provided by Brunn and Vlčková (1994). Baráthet al. (1995) and Szőllős (2000 and 2006) studied the regional stability of electoral support for the parties. The connection of electoral preferences with the location of administrative units and with regions of maximum unemployment was studied by Podhorský (2001). Electoral geography is also an important part of the research of the sociologist Krivý (1999a and 1999b). Very valuable and comprehensive book evaluating the historical, sociological and cultural aspects of electoral behaviour in the regions of Slovakia was written by Krivý et al. (1996). The geographical aspects of the parliamentary elections in 1990, 1992 and 1994 are evaluated in a monograph by Vlčková (1995). The presidential, municipal, regional or European elections are on the margin of interest. Only the study of Mariot (2000b) was dedicated to analysis of the first direct presidential elections in 1999. A theoretical study evaluating the model of the Slovak political scene was written by Mariot (2001). All the above mentioned studies included the whole territory of Slovakia. The only study related to support for political parties in municipalities of a specific region was published by Madleňák (2006). It is important for further development of Slovak electoral geography to widen its subject from parliamentary to other types of elections (local, regional, presidential, European), extend the application of more diverse methods and attitudes in analysis of spatial aspects of elections, as well as to attract more geographers into this field.

Regions of electoral support for parties in parliamentary elections

We can observe some stability of support and voter preferences in the regions of Slovakia caused by various factors. The main factors influencing preferences in elections seem to be economic and social conditions, level of education, nationality, religion. Differences in political orientations between rural and urban territories are also important. A long term decrease of electoral participation concerns all levels of political organization and many emerge as an important problem. The basic political streams represented by the respective political parties are gradually developing and gainging or losing their political support.

We have analysed the stability of electoral support of six recent parliamentary political parties in all parliamentary elections from 1990, in which they or their ideological or organizational predecessors took part. We have specified as the region of support of the specific political party those districts (there are 79 districts, now serving as statistical spatial units only), in which the party has achieved

a higher percentage of support than its average in the whole. The stability of support is evaluated according to the number of parliamentary elections in which the party surpassed its state average result in specific districts. The results are shown in maps (Fig. 5, 6, 7, 8, 9 and 10).

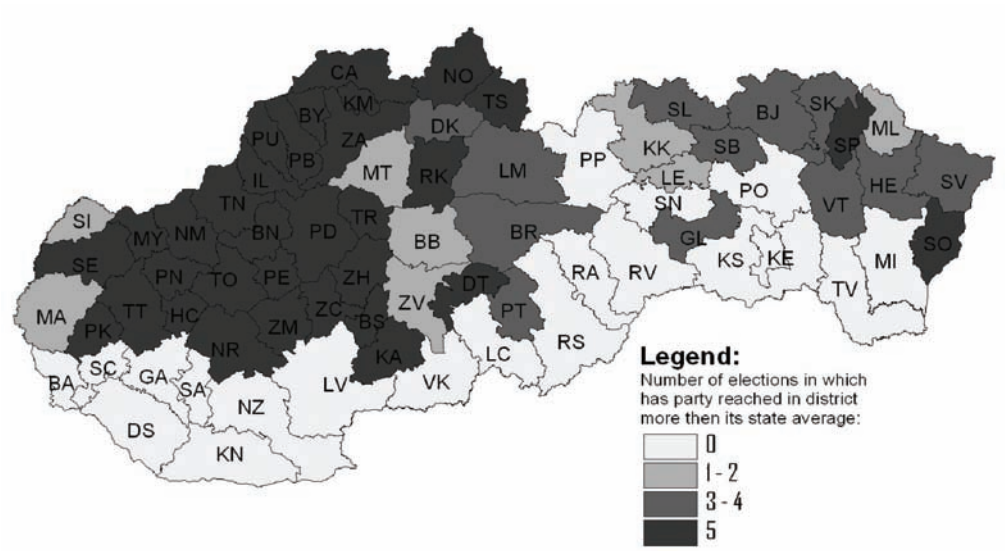

Fig. 5. Electoral support for HZDS in parliamentary elections

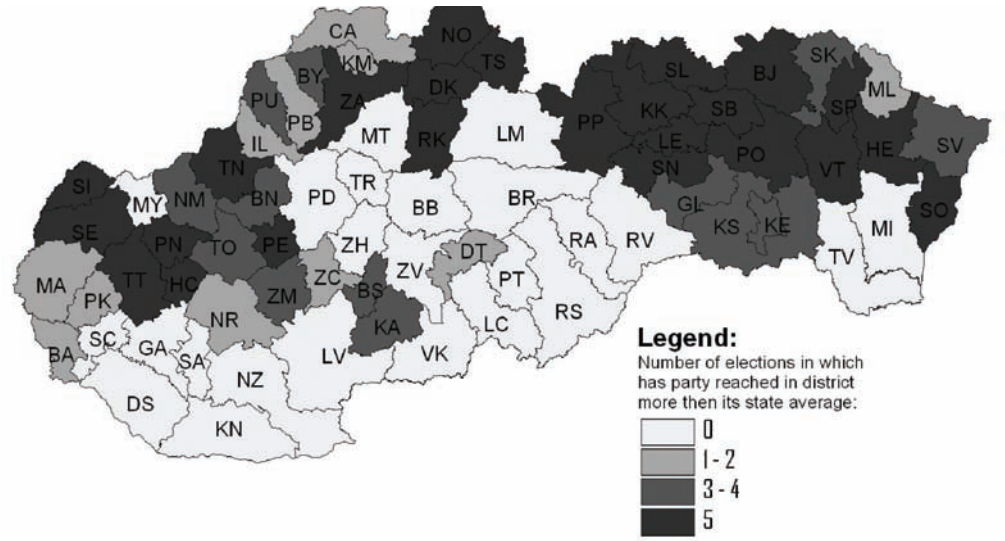

Fig. 6. Electoral support for KDH in parliamentary elections

Movement for Democratic Slovakia – Peoples Party (HZDS –ĽS)

HZDS has participated in five parliamentary elections and achieved the highest support in four of them. The Voter preferences of this centrist party, strongly related to the popularity of its leader, have declined from 37.26% in 1992 to 8.79% in 2006. The region of support for this party is concentrated in large territory of districts in north-western part of Slovakia with a high level of industrialization (Fig. 5).

Christian Democratic Movement (KDH)

KDH is a conservative rightwing party and has participated in all parliamentary elections (in 1998 as a part of SDK). Its support has declined from 19.21% (1990) to 8.31% (2006). The main territory of its electoral support covers rural areas of north-eastern and north Slovakia, with high level of religiosity. A third territory is formed by five districts in western Slovakia around Trnava, which is traditionally the main centre of the Roman Catholic Church (Fig. 6).

Slovak Democratic and Christian Union – Democratic Party (SDKÚ-DS)

SDKÚ has existed on the political scene only since 2000 and has run in the last two parliamentary elections, but the DS, unified with SDKÚ, participated in elections already from 1990. We have counted the results of other civic right wing or liberal parties, which were predecessors of SDKU and ran in elections, like ODÚ (1992) and DÚ (1994). This party is now the leading centre – right party with some liberal characteristics. Its support has increased from 15.09% (2002) to 18.35% (2006). The increase of support as a result of unification is even more obvious in comparison with the above mentioned small right wing civic parties ODÚ and DS, which could not pass the 5% limit to enter parliament, or with DÚ (8.57%). SDKÚ and the above mentioned parties had the best election results in districts around the biggest cities of Slovakia (Bratislava, Košice, Prešov, Banská Bystrica), in three districts under Tatras, and in Zahorie region in western Slovakia (Fig. 7).

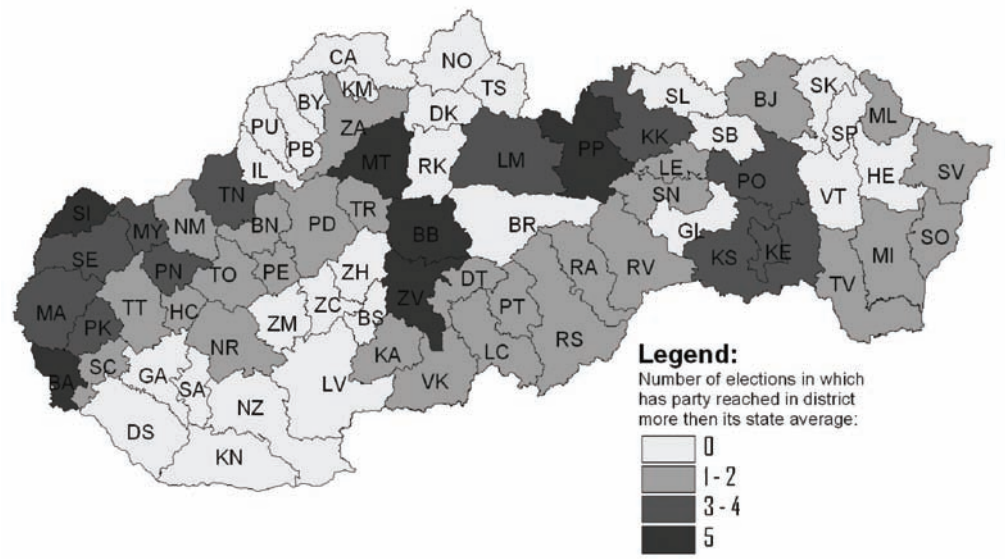

Fig. 7. Electoral support for SDKÚ-DS (ODÚ, ODS-DS, DÚ) in parliamentary elections

SMER – Social Democracy (SMER-SD)

Unification on the left side of the political scene has brought to life SMER-SD as a social-democratic party after 2002, although SMER has existed since 1999. Its support has increased from 13.46% (2002) to 29.14% (2006). Increase of support for the left side of the political scene is even more obvious then on the right side. The support of its main predecessor SDĽ varied from 14.70% in 1992 to 10.41% (in coalition SV in 1994) and 14.66% in 1998. Specific for the support for these kinds of parties is, that they enjoy some level of support in almost all districts of Slovakia (Fig. 8), with the exception of six districts in the south-western part with strong support for the Hungarian parties and two districts in the northern part with strong support for Christian-democratic and national parties. The territory of strongest voter preferences is in districts of the north-eastern and eastern parts of Slovakia. The second region of support is in districts of central Slovakia and the third is in the western part of the country.

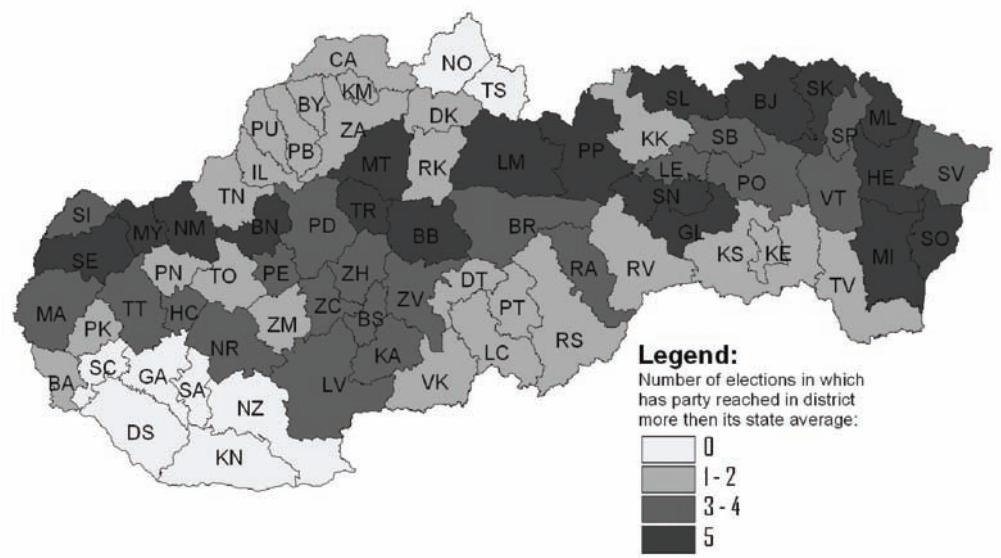

Fig. 8. Electoral support for SMER-SD (SDĽ, SV, SDSS) in parliamentary elections

Hungarian Coalition Party (SMK)

SMK has developed on a national basis and represents mainly the interests of the Hungarian minority. It has unified in 1998 three original Hungarian political parties Együttélés, MKDH and MOS, which ran together already as a coalition in all elections, with the exception of MOS in 1990 and 1992. Its support is stable and varies around 10%, which is the share of the Hungarian minority in Slovakia. The fact, that this party gained the support of almost the entire Hungarian minority in all parliamentary elections is obvious from Fig. 9. The region of support for SMK is in the 15 districts along the southern border of Slovakia, where the Hungarian minority lives and where the parties of the Hungarian coalition have gained more than their state average in every election. Their support in the rest of the territory of Slovakia is minimal.

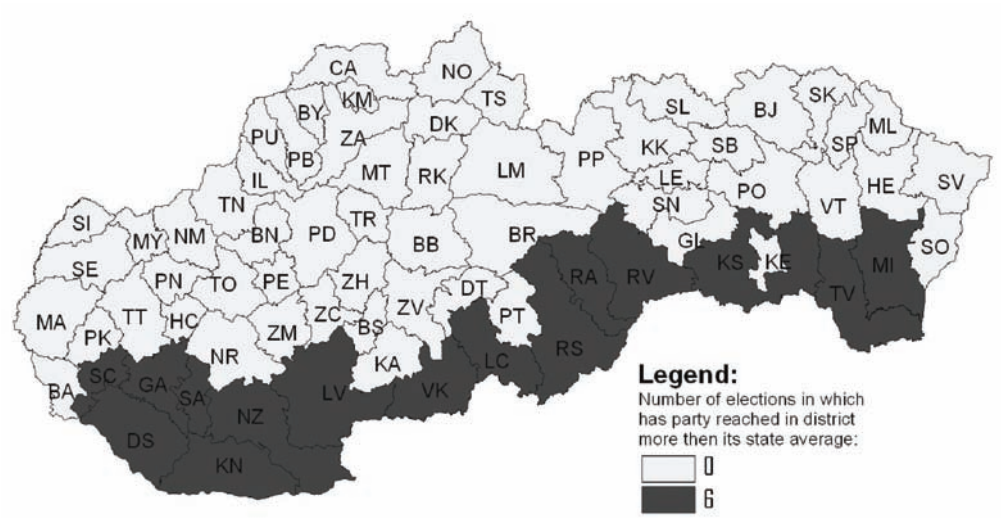

Fig. 9. Electoral support for SMK (MKDH, EGY, MOS) in parliamentary elections

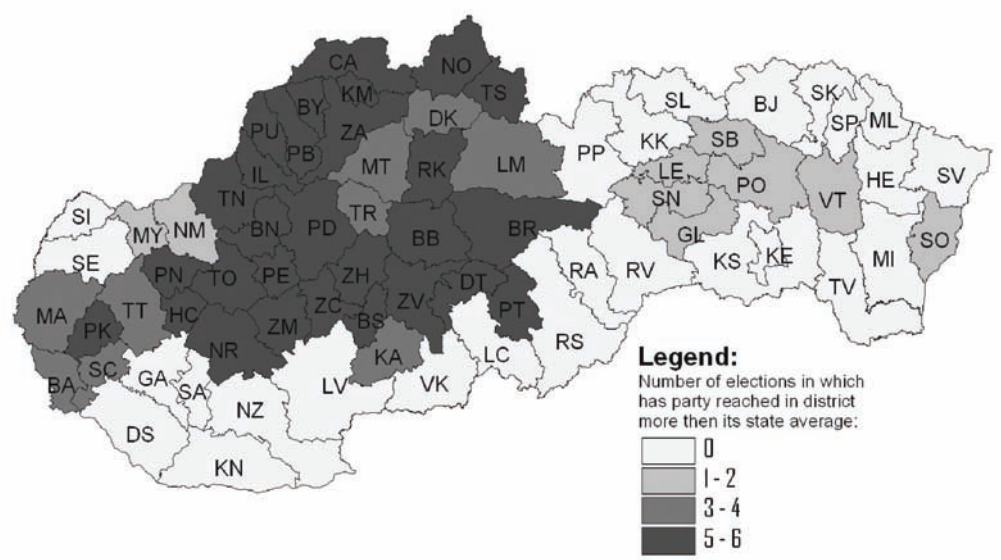

Fig. 10. Electoral support for SNS in parliamentary elections

Slovak National Party (SNS)

SNS declares that it is a conservative right wing party and its main goal is to protect the interests of the Slovak nation. It has run in all parliamentary elections and could not enter the parliament only in 2002, when it was divided into two parties. Its electoral support has varied from 13.94 % in the first election in 1990 to its minimum of 5.4% in 1994 after its main goal, the creation of an independent Slovakia was achieved and grew back to 11.73% in 2006. The region of electoral support for SNS is almost identical with the region of support for HZDS and is concentrated in the north-western part of the country (Fig. 10).

TERRITORIAL ADMINISTRATIVE DIVISION – HISTORICAL EXPERIENCES AND THE LATEST REFORMS

Return to some of the historical models is relatively often applied when creating a new model of the spatial arrangement of public administration. For this reason, information on all historical stages and knowledge of related circumstances are rather important. Numerous historical changes are also reflected in the developmnet of the territorial administrative division in the present territory of Slovakia. Historical experiences were widely studied (e.g. Slavík and Žudel 1994 and Gurňák 2002) and evaluated within the new context after 1989 as one of the sources serving in drawing new territorial administrative division of the country.

During the long lasting historical period, from the 11th century up to 1990, ten major stages of territorial-administrative arrangement functioned in the territory of Slovakia. There are two main periods. First period concerns Slovakia as part of Hungary (from the mid 19th century within the Austro-Hungarian Empire) until 1918. During this time span of approximately nine centuries, five major stages of territorial-administrative arrangement existed. However, we equally register next five stages of territorial-administrative arrangement during the second period – from the establishment of Czechoslovakia to the year 1990 (i.e. the time span of 72 years). It has to be noted that this division is simplified and does not include some shorter stages of a transitional character that are considered the individual stages of development especially by historians (Tab. 1).

Tab. 1. Historical stages of territorial-administrative division of Slovakia until 1990

Stage	Territorial-administrative units					
	Makro	Number	Meso	Number	Local	Number
Hungary, Austria-Hungary						
11.-13.ct.	-	-	castle counties	17	castle areas	
13.ct.-1848	-	-	counties	21	districts	
1785-1790	military units	3	counties	21	districts	
1850-1860	military units	2	counties	17	districts	
1867-1922	-	-	zhupas	21	districts	95
Czechoslovakia, Slovak State during World War II						
1923-1928	-	-	great zhupas	6	districts	79
1928-1938	Land	1	-	-	districts	77
1940-1945	-	-	great zhupas	6	districts	60
1949-1960	-	-	regions	6	districts	99-100
1960-1990	great regions	3-4	-	-	great districts	33-38

Source: Slavík 2000

Almost a 1000 years of development of the spatial organization of the public administration on the territory of Slovakia until 1990 provides an opportunity to emphasize certain important points and add some general comments. The historical outline of the individual stages indicates a strong correlation between the changes of territorial-administrative organization and the principal changes in given state transformation processes. The only exception is represented by the year of 1960 when larger administrative units (regions, districts) inspired by the Soviet example were implemented. For the individual historical stages it may be concluded that the spatial organization of public administration had been determined by the natural environment (relief conditions) of Slovakia as well as of the state units within which the changes of territorial-administrative arrangement were taking place. While during medieval Hungarian Kingdom or later during the Austro-Hungarian Monarchy, the systems of territorial-administrative organization were marked by a the high degree of stability, during the Czechoslovak era the frequent change of individual models – often antagonistic – occurred. It is important to know that during the territorial-administrative development up to 1990, Slovakia was only once delineated as a single territorial-administrative entity (as "land" during 1928-1938) and only once was it a separate state unit (1940-1945). Surprisingly Bratislava fulfilled the function of capital city twice in its history. Besides the above mentioned period of 1940-1945 it was during the stage of counties for approximately 350 years, when the central parts of Hungary were under the control of the Ottoman Empire.

Basically four types of regions were applied so far in all historical stages – regions (as castle comitats, counties, zhupas in the number of 17 to 21, see Fig. 1), large zhupas and regions (6 units), military units and large regions (2-4 units) and land arrangement (one unit). Out of them, the system of counties – zhupas was the most stable, of longest duration and continuity, with minimal changes from the 13th century to the beginning of the 20th century. It is interesting that during the Czechoslovak era the last model – that of large regions in 1960-1990 – was the longest in operation. It was due to the totalitarian system with the maximum degree of state power centralization. During the entire period of the communist regime, the three level system of state administration (so called "national committees" at local, district and regional level) was implemented without any existence of self-government. At the lower level two types of districts were usual. The districts corresponding to natural gravitation areas (in the number of 77 to 100) were strongly prevailing, because the system of larger districts (33 to 38) was applied only once during the socialist period.

Public administration reforms after 1989 and their spatial aspects

The political organization below state level underwent substantial changes after 1989. It was clear that deep societal changes inevitably require a different public administration system. Despite optimistic expectations that reform of the public administration will be a simple and quick process, the opposite has been true – reforms in this field were in fact very long and almost permanent. Public administration was only one among various significant reforms that the post-socialist and new state needed. Destruction of inherited "socialist" public administration structures has been accompanied by many changes and related interim structures in the search for a more optimal sub-state government model. Nevertheless, certain features remained permanent and solid (based on Slavík 2000, Buček 2006b). It is especially

the case of the so called "dual model" of public administration represented by two separated lines of self-government and state administration, with strict distribution of powers between them expressed in legislation. The second main feature has been transition from a three level model of public administration (applied during socialism) to a two level model (local and regional), applied in both lines – self-government, as well as state administration. The third feature reflects the decentralization approach to reform. While the role of the institutions of self-government have been expanding, the state administration underwent substantial reduction of its position below the central state.

Local self-government has developed into a highly respected level of the government and one of crucial democratic institutions in Slovakia. Its renewal in 1990 can be considered the starting point of reforms in the field of public administration. Even thanks to the very consistent representation of more than 2800 municipalities by its two associations (Association of Towns and Municipalities, Union of Cities), local self-government has systematically built its respected position. Later, various reform documents (concepts, strategies) were prepared and selected changes were introduced into practice. All public administration reforms were strongly dependent on political will, were realized to a certain extent, different compared to the original proposals. The most typical case has been that of the originally proposed territorial division of the country on 12 regions finally not accepted by the Slovak Parliament in favour of 8 regions (despite preliminary political agreement), as presented on Fig. 11 and Fig. 12. It also meant that more than 10 years was needed until the second level of self-government was introduced in practical life. Regional self-government has been introduced only since 2002, and it gained more powers from the decentralization reform of 2002-2005.

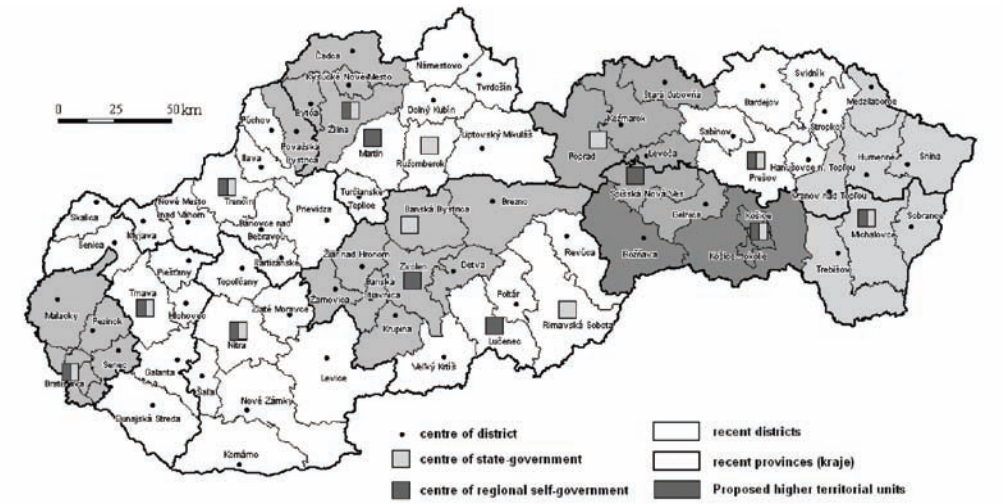

Fig. 11. Proposal for the administrative division of Slovakia into 12 regions

It was especially the state administration that underwent frequent changes and alternations of central governmental approaches, including extensive changes in the spatial distribution of its offices (see e.g. Slavík and Švoňavec 1996, Skyba 2007). Strong identification with the communist regime caused immediate cancellation of

the regional state administration in 1990. The district level organization inherited from socialist period remained valid until 1996. As a result of reforms a two level model of state administration with 8 regions and 79 districts was applied in the period 1996-2003. After decentralization there remained only a very narrow range of powers under the control of the state administration. This led to cancellation of both levels of general state administration (district offices in 2004, regional offices in 2007). Residual powers of state administration are executed by network of 50 area offices and by a networks of specialized field offices (tax offices, cadastral offices etc.) at present (more details on the current state administration functioning in Slovakia can be found in documents prepared by Ministry of Interior in 2007 and 2008).

Fig. 12. Territorial organization of local state administration since 1996

MAIN FEATURES OF THE DEVELOPMENT OF LOCAL SELF-GOVERNMENT AFTER 1989

The real "meaning" of self-governments is probably the crucial point when evaluating its role in a democratic political system. It can be concluded that during the nineties, under the pre-reform situation in public administration until 2001, the position of local self-government was characterized by less powers and more autonomy. As Buček (2006b) concluded, the current situation seems to have different features – increase in local self-government powers (strengthening of local autonomy in one sense) is balanced by more restrictions and rules in some fields (reducing local autonomy in an other sense). Local self-government has been satisfied with its strengthened position, expressed in more powers, more resources, more freedom in setting selected local tax rates, although there are still disputes on transfer of certain powers or sufficiency of available resources. Although it can be concluded that the role of state institutions was reduced and local self-government strengthened, specific balancing approaches such as sharing of powers and delegation of powers were also applied. The position of local self-government was also strengthened by the abolition of district offices of the state administration.

A more detailed legal framework for the functioning of local self-government functioning has been formulated within the reform. It reflects the need for more efficient decision-making, as well as for their clearer and less conflicting functioning. Certain limits, more sophisticated conditions and more demands on the functional of local self-government have been inevitable by-product of a far more demanding and quickly developing society. Such limits also confirm local self-government as a more important institution than before, having more powers and more resources under its control. They have partly reduced the scale of previous freedom. This is the case of legal rules introduced into local self-government activities previously without any guidelines (local self-government could act according to its own consideration). It gives local self-governments in many cases a more standard or less vulnerable position towards potential competitors. For example, a more detailed framework has been developed for intra-state as well as for international inter-municipal co-operation, as well as associations of municipalities. Significant change has come from new rules, which have stopped the never ending process of disintegration of municipalities. Nevertheless, these changes do not undermine local autonomy in a decisive way. Thanks to the changes, more rules and limits to local self-government are also balanced by clearer rules for outside intervention into their domain.

As a result of decentralization, many new powers are executed directly, more efficiently, with much higher local involvement and in respect to local interests. Local self-government now decides about important local issues like kindergartens and primary schools, social assistance and social care, health services, environmental protection, planning and development regulation and so on. The financial dimension of decentralization is clearly confirmed, for example, by increase of the incomes of local self-government. While before decentralization, the total income of local self-government was 32 718 mil SK (in 2001), it grew to 76 221 mil. SK in 2004 (current prices, Ministry of Finance 2002 and 2005). An important part of decentralization has been the right to free setting of local taxes rates valid since 2005 (including the main property tax), as well as clear determination of the local self-government share (70.3%) of personal income tax by legislation (Acts No. 564/2004 and No. 582/2004). However, moderate central state regulation in the local fiscal sphere has been reinforced by set of limits completely applied since 2005. It was a consequence of the financial troubles of more local self-government, especially in the field of local borrowing (Buček 2004b). More sophisticated budgetary rules, local budget structure, multi-annual and project based budgeting extensively modernized local finance practice. On the other hand, they simultaneously circumscribed freedom in local financial decision making (disputes over sufficiency of resources are not addressed in this contribution). Large attention has been paid to internal as well as external audit strengthening by setting more detailed and sophisticated conditions. The role of internal auditing, represented especially by the "chief auditor" (Slov. hlavný kontrolór) affiliated to local office, has continually increased. External auditing of final account's and public procurement procedures is obligatory. More precise budgetary and accounting rules have been introduced. After the amendment of the Slovak Constitution (in 2005) the powers of National Auditing Office have been extended to all property, property rights and resources of local self-government, as well as to legal entities with their capital participation since 2006.

The Slovak system of local public administration has to adapt to problem of very fragmented local self-government units. The high number of local government units

(about 2,900) and the high share of very small municipalities among them (1930 municipalities had less than 1,000 people in 2006), has been a more pressing issue after decentraliyation of important powers to the local level. They cannot be efficiently administered in each separate municipality. This resulted in wider expansion of various forms of inter-municipal co-operation and associative life among municipalities as than before. Various problems, optimum organization, experiences in the field of inter-municipal co-operation in Slovakia have been analysed in Buček 1997, Kling 2003, Lovacká 2006, Slavík and Bačík 2007 and other works. The total number and forms of associations and co-operations is quite high and covers the whole country. They co-operate according to various kind of legislation – on local self-government, Business Code (establishment of joint "public" companies), or legislation on non-profit organizations. Many others are more functionally oriented for example towards the promotion of local economic development, tourism, infrastructure development (water and sewage), waste collection and disposal, environmental and sustainable development issues. We can find larger regional associations of local self-government unit as well as micro-regional ones representing co-operation between rural communities. At present, the most typical form of inter-municipal cooperation is the joint municipal office, serving the administration of various, mostly delegated powers for several municipalities. The most frequent powers covered by joint offices are land use and building order, local roads administration, daily social care, local schools administration, nature protection. The existence and scope of powers administered depend on the decision of the participating local self-government units. Despite the growing number of joint offices especially since the beginning of this decade, there are still some municipalities not included in joint office structures and applying execute selected powers individually. Due to difficulties with the administration of certain powers especially in such municipalities, the central state is preparing legislation that will force communes to co-operate in joint offices at least in certain powers. Due to the strong opposition of local self-government, we can only hardly expect such processes as amalgamation in Slovakia in the near future.

One of the key challenges for Slovak public administration system is the existence of ethnically mixed municipalities and regions. According to Buček (2004a) representation of minorities in local self-government improves the chances for more responsive decision making respecting minority needs. While participation of some minorities in local self-government is well developed, in the case of others it is not achieved. When focusing on the two most numerous minority populations in Slovakia – Hungarians and Romas, we can see differences in their ability to participate in managing local affairs by means of elected bodies. In the case of the Hungarian minority the effective control of local council is quite frequent and the number of mayors is quite high. However, in the case of the Roma minority only a few municipalities, although their number is slowly growing (Tab. 2). This overview is influenced by a widely exploited alternative used in Slovakia to stand for posts in local government an independent candidate (e.g. about one third of elected mayors in Slovakia act as independent). It should be mentioned that Slovak self-government has developed a large effort in successful management of various aspects of local life in ethnically mixed municipalities (see e.g. Buček 2001).

Besides general structure of local self-government organization, there developed specific arrangements concerning local self-government in the large Slovak cities. The two largest cities of the country (Bratislava and Košice) apply in full scale two

tier model of metropolitan self-government. Both levels – city wide and city quarters (Bratislava has 17 city-quarter, Košice 22 city quarters) self-government units have equal status according to legislation. Each city-wide, as well as city quarter self-government units has its own budget, and issues its own by-laws. Mayors on both levels are directly elected and citizens also elect councils on both levels. Their more detailed functioning is described in the Charter of the cities (e.g. concerning sensitive issues suxh distribution of as powers and finances). For example, city-wide and city quarter level share particular parts of their income including as property tax and yield from personal income tax. The local self-government arrangement especially in Bratislava has been the subject of disputes (e.g. Buček 1999) and initiatives focusing on amendment or adoption of "new" individual national legislation on Bratislava and Košice. While there are supporters of a more centralized arrangement, there are also proponents of a more decentralized model of relations between city-wide and city quarter self-government.

Tab. 2. Position of the two largest minorities' political parties in local self-government

Election year	Minority	Mayors	Mayors** (in %)	Councillors	Councillors** (in %)
1990	Hungarian	164	6.00	4,052	11.0
	Roma	2	0.07	88	0.2
1994	Hungarian	249	8.90	4,404	13.0
	Roma	2	0.07	72	0.2
1998	Hungarian	227+25*	8.70	3,841+324*	12.0
	Roma	6+2	0.30	100	0.3
2002	Hungarian	233	8.00	2,050	10.0
	Roma	11	0.40	112	0.5
2006	Hungarian	235	8.00	1,952	9.0
	Roma	14	0.50	213	1.0

* elected minority parties' candidates plus coalitions with minority parties' candidates
** percentages from total number of mayors/councillors elected in Slovakia
Sources: Statistical Office of the Slovak Republic (1990, 1994, 1998, 2002 and 2006), Roma Press Agency (2006)

Other larger cities often used alternative in Councils of City Quarters (VMCs). They have great potential for improvement of local democracy, more efficient self-government, and quality of local life. VMCs meetings are an important form of sub-local decision-making and a useful participatory field (Buček 1998). It is efficient link between the city and city quarters. It supports information flow on the work of City Council and City Office (explanation of decisions, strategies) to the city quarter. In the other direction, it is a channel indicating the problems of city quarters, presenting proposals for improvement, representing interests of city quarter citizens to the city-wide level. They are focused on many practical issues like environmental issues, physical environment, transport, public service delivery, the local schools system. Formulation of expenditure priorities concerning particular city quarters is one of the main roles of VMCs from a financial point of view. However, within the last decade, more cities reduced number of VMC, confirming the tendency toward larger units.

BUILDING REGIONAL SELF-GOVERNMENT

As was expressed in earlier sections, the meso-level of government was typical for territorial administrative organization in Slovak territory. Despite permanent debate after 1989, regions emerged as a level of the political and territorial organization of the country again only in 1996, but only as state administration bodies. Eight Regional Offices were established to administer set of powers de-concentrated from the central state. Regional self-government started to function from 2002 following elections in 2001. As Buček (2009) noted, the first period of its existence (2002-2005) can be interpreted as "starting and transitional", dealing with practical issues of its establishment (buildings, staff, property), dealing with more stages of transfers of powers (mostly from the regional state administration) and circumscribed by missing autonomy in financial matters.The second period (2005-2008) is focusing on building the position of a more respected and efficient level of government. Their role has been strengthened by cancellation of the Regional Offices of the state administration since October 2007. The powers from these offices have been transferred to regional self-government and to specialized field offices of selected ministries. It has offered regional self-government status of dominant player at regional level of territorial and political organization.

Regional self-government was one of the key pillars of a general decentralizing reform. It had obtained its main powers in secondary education, the higher level of health care centres, social services, transport (regional roads), and regional culture. In most cases regional self-governments has extensively reorganised the services it manages, focusing on higher efficiency in their delivery (e.g. schools networks, hospitals). It has also turned to more diverse forms of delivery of public services – establishing of its own legal entities of various kind (companies, non-profit organizations etc.), or making contracts with external providers. Regional self-government has also taken an over important role in managing economic and social conditions in their respective regions thanks to their powers in regional planning. It is responsible for implementation, regular evaluation and updating of the Plan of for Economic and Social Development, more intensively intervening into shaping of national level regional development and policy. While state grants were the main source of finance for regional self-government activities until 2004, more autonomous financing started in 2005 (main source is 23.5% own portion of shared taxes). Efficient public services delivery, well focused decisions, combined with already achieved higher financial autonomy can improve the reputation of Slovak regional self-government.

Internationalization and Europeanization of regional self-governments is one of the important fields of its activities. There are no doubts that acceleration of the introduction of regional self-government and a substantial shift in the field of regional policy was strongly influenced by the general goal of integration into EU (e.g. Buček 2002, Korec 2005). As a result, regional self-government has been strongly oriented towards the EU. They regional institutions concentrate on three main directions in this perspective – efficient representation in Brussels, building partnerships and cooperation with other regions, improving their position toward managing EU funds. The regions are building their own international bilateral interregional cooperation on the formal (expressed by agreements), as well as the informal level. Usually regions have signed agreements with all neighbouring regions, regions from all neighbouring states and a set of other regions mostly from Europe. The

Slovak regions also followed ambitions of other European regions and turned their activity directly towards the European Union institutions. The house of Slovak Regions has functioned in Brussels as the joint representative office of the Slovak regions since 2005. The delegates are working on behalf of their region as well as in favour of Slovak regional government in general. The main aim of this mission is to improve information flows related to EU institutions, coordinate activities with other European regions, to intervene in fields of their interests, to act more extensively and efficiently in programming and implementation processes. Their last task is improving slowly since most of the powers concerning EU funds have remained in the hands of the central state.

Nevertheless, after less than ten years regional self-government can still be perceived as a newcomer to the Slovak political structure. The general perception of this level as less visible, less powerful, having less resources and initiative was reflected in both regional elections. They were characterized by very low electoral participation compared to all other elections hold in Slovakia. For example, participation in the regional elections in 2005 was below 20% (Buček 2009). This seriously challenged the legitimacy of the main representative regional self-government bodies – chairperson and council, as well as reflecting the rather marginal role of the regions in Slovak political life. It is clear that quite a long period will be needed to develop a more stable and influential position within the Slovak political environment. This would make them a more powerful partner of already well established central state and local self-government institutions in Slovakia.

CONCLUSION

The new state development and transition situation has been accompanied by with various changes, adjustments and contradictory decisions concerning social and political life in Slovakia. It has encouraged quick expansion of political geographical research. The outline of developments in Slovak political geography presented here cannot be considered exhaustive. We cannot forget more theoretical works such as there by Ištok (1997) on political geography and the state, or Buček and Smith (2000) on local democracy. There are emerging new fields and new authors that will strongly influence the future direction of Slovak political geographical research. Among the new and quickly expanding fields we can consider cross-border co-operation that has attracted many geographers (Drgoňa 2001, Spišiak 2004 and Halás 2002 and 2005). Among the emerging group of younger Slovak political geographers we have to mention Verešš (2005), Gurňák (2007), or Fogaš (2008). Among the important contributions to political geography we can also find Slovak geographers working mostly in other fields of human geography. We can mention for example Paulov (1992 and 1996), Bezák (1996 and 1998), Ira (1996), Kollár (1996), Bašovský (1997), Ivanička (1999), Korec (2000 and 2005), Lauko (2000), Mládek (2001). Although the development of Slovak political geography is very hopeful, there are still some research directions not sufficiently covered (e.g. according to Buček 2006a).

Political geography is a solid part of geographical training in the Slovak universities. It is also a frequent part of the training of other social scientists (e.g. political scientists). Slovak political geographers are strongly linked to the decision making

authorities of Slovak society. Many of them participated in shaping important social and political reforms. The most typical case has been various stages of public administration reform. Geographers frequently provide consultations, analytical studies for various public sector bodies, including ministries in Slovakia, as well as for many other foreign institutions mostly in the EU dimension. One of the specific fields of activity close to political geography is preparation of specialists for public administration and self-government (especially at the Comenius University geography).

REFERENCES

Act No. 369/1990 Coll. on local self-government as amended.

Act No. 221/1996 Coll. on territorial and administrative arrangement.

Act No. 302/2001 Coll. on self-government of higher territorial units.

Act No 416/2001 Coll. on transfer of powers from state administration to municipalities and higher territorial units.

Act No. 523/2004 Coll. on budgetary rules of public administration.

Act No. 564/2004 Coll. on budgetary allocation of income tax yield to territorial self-government.

Act No. 582/2004 Coll. on local taxes and local fee on municipal waste and small construction waste.

Act No. 583/2004 Coll. on budgetary rules of territorial self-government.

AVENARIUS, A. (1992). Začiatky Slovanov na strednom Dunaji: autochtonická teória vo svetle súčasného bádania. *Historický časopis*, 40, 1-16.

Atlas krajiny Slovenskej republiky. (2002). Bratislava, Banská Bystrica (Ministerstvo životného prostredia, Slovenská agentúra životného prostredia). http://enviroportal.sk/atlas/online

BARÁTH, J., SZÖLLÖS, J., ČERNÁK, P. (1995). Analýza stability územia volebnej podpory vybraných politických strán (na základe výsledkov volieb 1990, 1992 a 1994). *Geografický časopis*, 47, 247-259.

BARBAG, J. (1987). *Geografia polityczna ogólna.* Warszawa (PWN).

BAŠOVSKÝ, O. (1997). Administratívno-správne členenie Slovenska: vedecká realita a prax. *Geografické Štúdie*, 3, 14-22.

BEZÁK, A. (1996). Vývoj predstáv o regionálnom členení Slovenska (od Jána Kollára k Michalovi Luknišovi). *Luknišov Zborník*, 2, 19-27.

BEZÁK, A. (1998). Regionálna štruktúra a nové kraje na Slovensku. *Geografie*, 10, 4-8.

BLAŽÍK, T. (1999). Geopolitické postavenie Slovenska na konci 90. rokov. In Minár, T., Trizna, M., eds. *Teoreticko-metodologické problémy geografie a ich aplikácie.* Bratislava (Univerzita Komenského), pp. 161-166.

BLAŽÍK, T. (2002). Slovensko – perspektívy vstupu do NATO a geopolitické súvislosti v stredoeurópskom priestore. *Acta Studiorum Humanitatis et Naturae Universitatis Prešoviensis, Folia Geographica*, 6, 17-23.

BOKES, F. (1944). *Über die etnwicklung des Gebietes der Slowaken.* Bratislava (SAVU).

BRUNN, S. D., VLČKOVÁ, V. (1994). Parties, candidates and competitive regions in the 1992 Slovak National Council elections. *Geografický časopis*, 46, 231-246.

BUČEK, J. (1994). Paradigma jadro – periféria a geoekonomická pozícia Slovenskej republiky. In Baran, V., ed. *Geopolitické trendy v stredoeurópskych regiónoch a ich vplyv na regionálne štruktúry.* Banská Bystrica (Univerzita Mateja Bela), pp. 44-47.

BUČEK, J. (1996). Mesto, štát a územie. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 36, 131-250.

BUČEK, J. (1997). Settlement system and intermunicipal co-operation: chance for flexible system of public administration in Slovakia (in Slovak). In Delmartino, F., Vermessen, E., Miháliková, S., Falťan, Ľ., eds. *Nové podoby verejnej správy (Slovenská a Flámska skúsenosť).* Bratislava (Sociological Institute of the Slovak Academy of Sciences), pp.162-177.

BUČEK, J. (1999). The city-wide/district relationship and the question of integrity: a case study of Bratislava. In Kimball, J. D., ed. *The transfer of power – decentralisation in Central and Eastern Europe.* Budapest (Local Government and Public Service Reform Initiative), pp. 79-96.

BUČEK, J. (1998). Decentralizácia v samospráve veľkých miest na Slovensku po roku 1990. *Sociológia – Slovak Sociological Review*, 30, 345-362.

BUČEK, J. (2001). Responding to diversity: solutions at the local level in Slovakia. In Biró, A. M., Kovács, P., eds. *Diversity in action: local public management of multi-ethnic communities in Central and Eastern Europe.* Budapest (Local Government and Public Service Reform Initiative), pp. 273-306, 375-381.

BUČEK, J. (2002). Regionalization in the Slovak Republic – from administrative to political regions. In Marcou, G., ed. *Regionalization for development and accession to the European Union: a comparative perspective.* Budapest (Local Government and Public Service Reform Initiative), pp. 141-178.

BUČEK, J. (2004a). Flexibility in local public administration: responses to size and ethnic structure of communes in Slovakia. In Barlow, M., Wastl-Walter, D., eds. *New challenges in local and regional administration.* Aldershot: (Ashgate), pp. 95-108.

BUČEK, J. (2004b). La réforme de l'autonomie locale en Slovaquie: avancées et reculs. In V. Rey, et al., eds. *L'élargisement de l'Union Européenne: réformes territoriales en Europe Centrale et Occidentale.* Paris (L'Harmattan), pp. 105-112.

BUČEK, J. (2006a). Hlavné smery a problémy výskumu súčasnej politickej geografie. *Geografický časopis*, 58, 353-371.

BUČEK, J. (2006b). The position of local self-government after main phase of public administration reform in Slovakia. *Acta Geographica Universitatis Comenianae*, 48, 167-178.

BUČEK, J., SMITH, B. (2000). New approaches to local democracy: direct democracy, participation and the third sector. *Environment and Planning C: Government and Policy*, 18, 3-16.

BUČEK, J. (2009). The regional government in Slovakia. In Dieringer, J., Sturm, R., eds. *Regional governance EU-member states.* Leverkusen (Verlag), in print.

ČAPLOVIČ, D. (1998). *Včasnostredoveké osídlenie Slovenska.* Bratislava (Academic Electronic Press).

DEÁK, L. (1992). O hraniciach Slovenska od roku 1918 do súčasnosti. *Medzinárodné otázky*, 1, 32-37.

DEÁK, L. (1996). Trianonská mierová zmluva. *Slováci a Maďari: súbor štúdií.* Martin (Matica slovenská).

DRGOŇA, V. (2001). Euroregióny – nový prvok regionálnej štruktúry Slovenskej republiky. In Novák, S., ed. *Geografické aspekty středoevropského prostoru.* Brno (MU), pp. 26-30.

DRULÁK, P. (1997). Co dělat, když jste malý. *Mezinárodní politika*, 21(5), 6-7.
DRULÁK, P. (1998). Malé státy ve velkém tisku. *Mezinárodní politika*, 22(7), 20-21.
DULEBA, A. (2000). *Ukrajina a Slovensko*. Bratislava (Veda).
FOGAŠ, A. (2008). Historic-geographical a political-geographical aspects of genesis of the Arab Israel conflict in the Near East region. *Acta Geographica Universitatis Conmenianae*, 51, 83-98.
GURŇÁK, D. (2002). Stabilita administratívneho členenia územia Slovenska v 20. storočí. In Dubcová A., Kramáreková H., ed. *Geografické informácie 7 – I. diel.* Nitra (UKF), pp. 80-87.
GURŇÁK, D. (2007). *Vývoj politickej mapy stredovýchodnej a juhovýchodnej Európy – historickogeografická analýza.* Bratislava (Kartprint).
HALÁS, M. (2002). Hranica a prihraničný región v geografickom priestore (teoretické aspekty). *Geographia Slovaca*, 18, 49-55.
HALÁS, M. (2005). *Cezhraničné väzby - Cezhraničná spolupráca.* Bratislava (Univerzita Komenského).
HOUDEK, F. (1931). *Vznik hraníc Slovenska*. Bratislava (Prúdy).
HRONSKÝ, M. (1998). *Boj Slovensko a Trianon 1918-1920.* Bratislava (Národné literárne centrum).
IRA, V. (1996). Etnická a religiózna štruktúra obyvateľstva východného Slovenska a percepcia etnických a religióznych napätí. *Geografický časopis*, 48, 13-33.
IŠTOK, R. (1997). Štát na politickej mape sveta. *Geografické práce*, 1, 170.
IŠTOK, R. (2004). *Politická geografia a geopolitika.* Prešov (Prešovská univerzita).
IŠTOK, R., LOVACKÁ, S. (2006). North border of Slovakia – political-geographical and historical-geographical context. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 48, 77-88.
IVANIČKA, K. (1999). *Slovensko. Genius loci.* Bratislava (Eurostav).
KAMENEC, I. (1992). *Slovenský stát*. Praha (Anomal).
KLING, J. (2003). Separate existence above all else: local self-governments and service delivery in Slovakia. In Swianiewicz, P., ed. *Consolidation or fragmentation? The size of local governments in Central and Eastern Europe.* Budapest (OSI/LGI), pp. 19-59.
KLEIN, B. (2000). Náčrt geopolitického vývoja Slovenska do začiatku 20. storočia. In Pekník, M., et al. *Pohľady na slovenskú politiku.* Bratislava (Veda), pp. 37-60.
KLIMKO, J. (1980). *Vývoj územia Slovenska a utváranie jeho hraníc.* Bratislava (Obzor).
KOLLÁR, D. (1996). Geographische Aspekte der Ostoffnung an Beispiel der Slowakischen Republik. *Mitteilungen der Osterreichische Geographische Geselschaft*, 138, 223-246.
KORČÁK, J. (1938). *Geopolitické základy Československa.* Praha (Orbis).
KOREC, P. (2000). Hodnotenie novej geopolitickej a geoekonomickej polohy regiónu Bratislavy. *Miscellanea Geographica,* l, 7, 128-141.
KOREC, P. (2005). *Regionálny rozvoj Slovenska v rokoch 1989-2004* (Regional development of Slovakia 1989-2004). Bratislava (Geografika).
KOVÁČ, D. (1998). *Dejiny Slovenska*. Praha (NLN).
KREJČÍ, O. (2001). *Mezinárodní politika.* Praha (Ekopress).
KRIVÝ, V. (1999a). Územné celky a skupiny obcí v parlamentných voľbách 1998. *Sociológia*, 31, 51-77.
KRIVÝ, V. (1999b). *Čo prezrádzajú volebné výsledky? Parlamentné voľby 1998.* Bratislava (IVO).

KRIVÝ, V., FEGLOVÁ, V., BALKO, D. (1996). *Slovensko a jeho regióny. Sociokultúrne súvislosti volebného správania.* Bratislava (Nadácia Média).
KRŠÁK, P., ed. (2009). *Ottov historický atlas Slovensko*. Praha (Ottovo nakladatelství).
LAUKO, V. (2000). Vybrané problémy administratívnych teritoriálnych štruktúr Slovenska. *Geografické štúdie*, 7, 12-17.
LAUKO, V., TOLMÁČI, L. (2004). *Geografia pre 2. ročník gymnázií.* Bratislava (Orbis Pictus Istropolitana).
LOVACKÁ, S. (2006). Importance and forms of intercommunal co-operation for regional development (in Slovak). *Folia Geographica*, 10, 335-339.
LUKNIŠ, M. (1988). The concept of Slovakia and the development of its frontiers. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 31, 3-10.
MADLEŇÁK, T. (2006). Politicko-geografická analýza volebných preferencií obyvateľov regiónu Oravy. *Geografická revue*, 2, 630-649.
MARIOT, P. (1991). Priestorové hodnotenie výsledkov volieb do SNR (1990). *Geografický časopis*, 44, 231-249.
MARIOT, P. (1993). Die Wahlen in dem Slowakischen Nationalrat in den Jahren 1990 und 1992. *Geographische Zeitschrift*, 81, 82-97.
MARIOT, P. (1994). Spatial aspects of the 1994 elections for the National Council of the Slovak Republic. *Moravian Geographical Reports*, 4, 52-60.
MARIOT, P. (1997). Slovak Republic Nationalities-Religiousness-Electoral Preferences. *Földrajzi Értesítő,* 46, 183-189.
MARIOT, P. (1998). Three levels of territorial differentiation of political preferences in the territory of the SR. *Geographica Slovenica*, 31, 223-229.
MARIOT, P. (1999). Štruktúra volebných preferencií obyvateľov najväčších miest Slovenska. *Geografický časopis*, 51, 153-175.
MARIOT, P. (2000a). Špecifiká politických subjektov podporovaných maďarským etnikom žijúcim na území SR. *Geografické štúdie*, 7, 199-207.
MARIOT, P. (2000b). Regional aspects of results of the 1999 presidential elections in Slovakia. *Moravian Geographical Reports*, 2, 14-24.
MARIOT, P. (2001). Model politickej scény na Slovensku. In Mariot, P., Mikulík, O., eds. *Stav a vývoj socioekonomického systému v SR a ČR na prelome tisícročí. Zborník referátov z 5. slovensko-českého akademického geografického seminára 13. december 2000.* Bratislava (Geografický ústav SAV), pp. 71-76.
MARIOT, P. (2003a). Teritoriálne aspekty volebnej podpory HZDS. *Geografický časopis*, 55, 3-19.
MARIOT, P. (2003b). Electoral behaviour of the Hungarians living on the territory of the Slovak Republic. *Földrajzi Értesítő*, 52, 63-74.
MARIOT, P. (2004). Regionálne aspekty akceptovania nových subjektov na slovenskej politickej scéne. *Sborník České geografické společnosti*, 109, 1-14.
MICHAELI, E., IŠTOK, R. (2002). Die Enstehung des Gebietes der heutigen Slowakei unter Berűcksichtigung der geographischen und geopolitischen Aspekte seiner Lage. *Acta Studiorum Humanitatis et Naturae Universitatis Prešoviensis, Folia Geographica*, 5, 106-119.
MINISTRY OF FINANCE (2002, 2005). *Final Accounts of the Slovak Republic 2001, 2004* (in Slovak).
MINISTRY OF INTERIOR (2007). *Organisation and Execution of State Administration in the Slovak Republic* (in Slovak), p. 323.

MINISTRY OF INTERIOR (2008). *Territorial units of Area Offices supervised by Ministry of Interior of the Slovak Republic* (in Slovak), p. 215.
MLÁDEK, J. (2001). Roma demographic behaviour – a potential factor of social and ethnic conflict. In Šimko, D., Hauman, H., eds. *Peace perspectives for Southeast Europe.* Praha (Academia), pp. 77-83.
PAULOV, J. (1992). K novému rámcu regionálneho rozvoja Slovenska. *Geographica Slovaca*, 1, 23-28.
PAULOV, J. (1996). K zmenám geografickej a geopolitickej polohy Slovenska v historickom kontexte. *Luknišov Zborník*, 2, 137-154.
PODHORSKÝ, F. (2001). Poloha administratívnych celkov a volebné preferencie. *Geografické štúdie*, 8, 131-138.
RATKOŠ, P. (1972). Otázky vývoja slovenskej národnosti do začiatku 17. storočia. *Historický časopis*, 20(1), 19-64.
ROMA PRESS AGENCY (2006). Information on Roma representatives. *Press Report*. December 28, 2006.
ROMSICS, I. (2006). *Trianonská mierová zmluva*. Bratislava (Kalligram).
SKYBA, R. (2007). Dislocation of the offices of the local state administration in the Žilina Region (in Slovak). *Geografia Cassoviensis*, 1, 163-167.
SLAVÍK, V. (1994). Transformation of regions of public administration in the Slovak Republic. In Koter, M., ed. *Inner divisions, region and regionalism*. Łódź (University of Łódź, Silesian Institute in Opole), 81-91.
SLAVÍK, V. (1997) Priestorová organizácia verejnej správy v Slovenskej republike 1990-1996. In Delmartino, F., Versmessen, E., Miháliková, S., Falťan, Ľ., eds. *Nové podoby verejnej správy - slovenská a flámska skúsenosť*. Bratislava (Sociologický ústav SAV), pp. 91-110.
SLAVÍK, V. (2000). Priestorové aspekty reformy verejnej správy v SR. *Geografické štúdie*, 7, 18-28.
SLAVÍK, V., BAČÍK, V. (2007). Microregions as a basis for municipal reform in the Slovak Republic (in Slovak). *Geografia Cassoviensis*, 1, 169-173.
SLAVÍK, V., ŠVOŇAVEC, M. (1996). Spatial organization of local state administration in the Slovak Republis. *Acta Facultatis Rerum Naturalium, Geographica*, 37, 256-263.
SPIŠIAK, P. (2004). Geografické aspekty euroregiónov Slovenska. In Falťan, Ľ., ed. *Regionálny rozvoj Slovenska v európskych integračných kontextoch.* Bratislava (Inter-lingua), pp. 109-130.
STATISTICAL OFFICE OF THE SLOVAK REPUBLIC (1990, 1994, 1998, 2002, 2006). *Local self-government election results*.
STEINHÜBEL, J. (2004). *Nitrianske kniežatstvo*. Bratislava (Veda).
SZÖLLÖS, J. (2000). Stabilita volebnej podpory vybraných politických strán a ich zoskupení na Slovensku v rokoch 1990-1998. *Geografický časopis*, 52, 243-267.
SZÖLLÖS, J. (2006). Regióny volebnej podpory vybraných politických strán v parlamentných voľbách 1998, 2002 a 2006. *Geografická revue*, 2, 650-669.
ŠMIHULA, D. (2000). Priestor pre Slovensko. *Literárny týždenník,* 13 (13), 5.
VARSIK, B. (1940). *Slovensko-maďarská etnická hranica v posledných dvoch storočiach*. Bratislava (Slovenská učená spoločnosť).
VEREŠŠ, M. (2005). *Slovensko. Formovanie sa územia a národa.* Bratislava (Univerzita Komenského).

VLČKOVÁ, V. (1995). *Geografické aspekty výsledkov volieb do SNR a Národnej rady SR (1990, 1992, 1994)*. Bratislava (Elita).

VNUK, F. (1994). Slovensko v predstavách a plánoch politickej emigrácie (1944-1948). In *Slovenská otázka v dejinách Česko-Slovenska (1944-1992): Zborník príspevkov z vedeckého kolokvia.* Bratislava (SAV).

ZATLKAJ, P. (1992). Geopolitické postavenie Slovenska. *Medzinárodé otázky*, 1(4), 21-31.

ŽUDEL, J. (1984). *Stolice na Slovensku*. Bratislava (Obzor).

ŽUDEL, J. (1994). Územnosprávne členenie Slovenska na princípe historickej kontinuity. In Snopko, L., ed. *Práva miest a ich ochrana - decentralizácia Slovenska.* Košice a Bratislava (Nadácia D. Naumanna, Klub primátorov SR, Nadácia 21. storočia), pp. 118-124.

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POPULATION PROCESS CHANGES IN SLOVAKIA AT THE END OF THE 20th AND THE BEGINNING OF THE 21st CENTURIES

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Zmeny populačných procesov Slovenska na konci 20. a na začiatku 21. storočia
Zmeny populačného vývoja Slovenska pútajú zaslúženú pozornosť najmä zásluhou veľkej intenzity, ktorou sa prejavili v priebehu obdobia transformácie. Demografické zmeny pozorujeme predovšetkým v oblastiach reprodukčného a rodinného správania obyvateľstva. Pokles počtu narodených detí našiel odraz v znížení mier plodnosti a reprodukcie na minimálnu úroveň. V rodinnom správaní sa prejavil pokles početnosti, ako aj intenzity sobášnosti a rast rozvodovosti. Starnutie obyvateľstva Slovenska sa prejavuje ako v dlhodobom trende, tak aj v období posledných 20 rokov. Práve posledné obdobie charakterizuje starnutie zdola zásluhou poklesu fertility. Starnutie zhora je taktiež evidentné, aj keď jeho prejavy nie sú také významné. Po období výrazne koncentračných tendencií vnútornej migrácie (až do roku 1995 – fáza extenzívnej urbanizácie) sa začiatkom nového tisícročia v migračnom správaní obyvateľstva začína prejavovať dekoncentračný typ (procesy suburbanizácie, ktoré sa prejavujú v zázemí všetkých miest Slovenska). V období rokov 1990-2006 možno pozorovať deštrukčnú fázu (90. roky) a fázu stabilizovaného vývoja (od roku 2000). Poslednú môže vystriedať fáza kompenzačného charakteru, vývoj ktorej by mohli podporiť zlepšujúce sa životné podmienky, ako aj určitý populačný potenciál (početná generácia žien 70. rokov). Podobný vývoj naznačujú aj prognózy populačného vývoja na Slovensku, pričom prírastky jeho obyvateľstva budú saturované najmä severo- a východoslovenskými regiónmi.

Kľúčové slová: reprodukčné správanie, rodinné správanie, pohyb obyvateľstva, starnutie obyvateľstva, prognóza populačného vývoja, Slovensko

INTRODUCTION

The existing long-term trend of population change in Slovakia oriented to wards stable population and simple reproduction is perhaps the natural consequence of the social development. This trend has been observed, albeit modified, in all European populations and the less developed countries presumably face similar developments.

Changes in demographic behaviour first afflicted the countries of Northern and Western Europe in the second half of the 20th century and by the end of the century, they were manifested in those of Southern, Central and Eastern Europe. These changes resulted in fall of reproduction, fertility, natural change rates and the ten-

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dency to the model of simple reproduction accompanied by a futile natural increase (sometimes even decrease) of population. The settled balance of the natural change is only the consequence of an extensive set of changes evident in the demographic behaviour of population, the dominant feature of which is individualism and emphasis on personal freedom in all spheres of life. The compulsory condition of such behaviour is a certain level of education and motivation to develop one's talents. Simultaneously, a certain level of economic security guaranteeing economic and social independence is necessary. Due to the intensity and scale of these changes, they are referred to as the second demographic transition (Van de Kaa 1960 and 1987, Birg 1966, Lesthage 1983, Pastor 1997 and 2002, Mládek 1998 and 1999, Marenčáková and Pastor 2006, Mládek et al. 2006a).

The changes in demographic behaviour in the post-socialist countries including Slovakia possess special features. The transition processes in the economic and social systems in Slovakia acted as accelerators of many demographic processes. They speeded up the long-term trends.

Transformation of the economic system was accompanied by many problems and negative phenomena accompanying the complicated change of the system from a centrally planned and directed economy into the system with the dominant principles of market economy. The review of the progress of transition reveals several characteristic stages. Dorbritz (2003) sorted out five although three are perhaps more realistic: destructive, stabilizing and developmental-compensational (Mládek and Kroll 1995). These terms suggest the prevailing character of changes, which took place in individual stages. Population phenomena can be considered part of the social development and the periods of intensive changes considerably influence them. Simultaneously, certain "autonomy" of the population change must be taken into account, as it is not possible to automatically identifity transformation of the society with the changes in the demographic behaviour of the particular population. It also means a complicated search for and explanation of the causes (and consequences) of such changes. Radical changes over a short time in the development of population phenomena are not probable. There is a certain momentum in a population's behaviour as population processes are controlled by special laws although economic changes can considerable influence them.

Changes of demographic behaviour in Slovakia are manifest in four related spheres: reproductive behaviour, family behaviour, migration and ageing of the population. These changes are substantial for population forecasting. In the following parts of the paper, an attempt will be made to identify the main general changes in the development of population in Slovakia.

Changes of reproductive behaviour

Two very closely related and hardly separable fields can be distinguished in the demographic behaviour. The first of them is the *reproductive behaviour*, which mainly includes the relation of an individual or group of people, to such processes as natality, mortality, or abortion rate. The second field is *family behaviour*, which includes the relation of an individual or a group of people to the processes of formation and break-up of families (nuptiality, divorce rate, family formation) (Marenčáková 2003).

While evaluating the population processes of the natural movement of population, we can observe two regularities is the behaviour of these processes – the time differentiation and the spatial differentiation of population processes.

Time differentiation of reproductive behaviour

The basic developmental trends in population reproduction can be demonstrated by many indices in the construction of which the annual numbers of newborn children play an important role. In the course of the last thirty years, a distinctive change took place at the end of the 1970s. In 1979, 100,000 children were born (crude rate of live births 19.1‰ while in the following year, their number dropped by 5 thousand. From 1980, a permanent decrease of births followed; in 1994, the drop by 7 thousand compared with the preceding year meant another turning point. Further decrease in the number of newborn under the effects of transition processes became obvious. The last year of this "destructive" period was 2001 with 51 thousand births. A distinct change after this year can be considered the onset of the stabilizing stage. The number of births settled at the level of 51-54 thousand, i.e. around 10‰ of the crude rate of live births (Fig. 1).

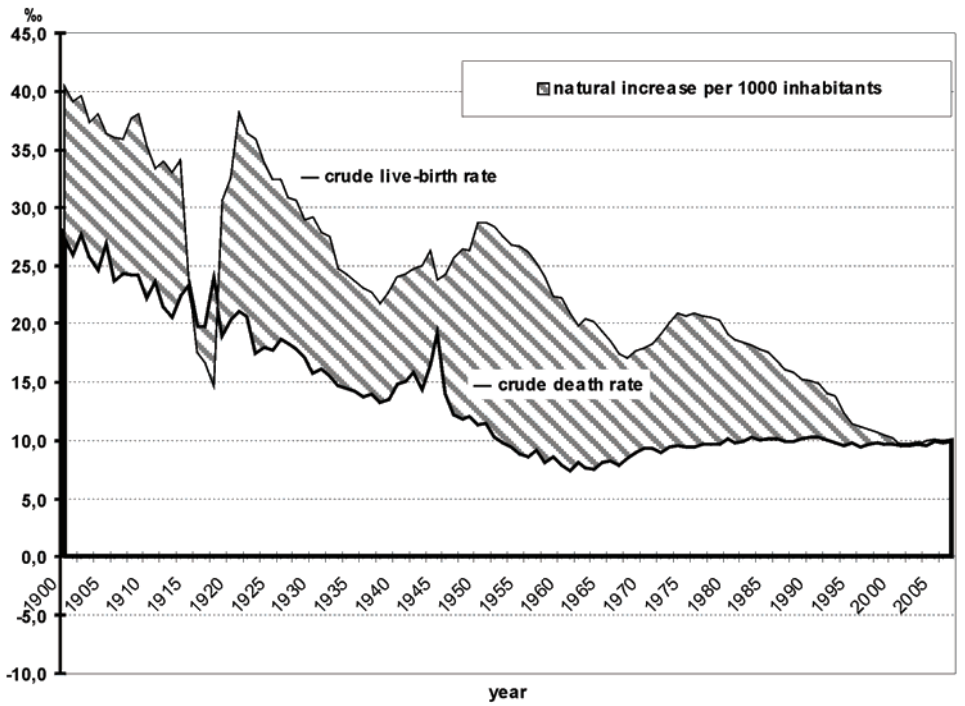


Fig. 1. Development of the natural increase of population in Slovakia

With regard to the relative stability of deaths (50-55 thousand) and the derived crude rate of mortality (9-10‰), the number of births had a decisive effect on the natural population increase. It was 52 thousand (9‰) in 1979, but after the systematic decrease it reached 20 thousand at the beginning of the 1990s. The distinct decline of increase also manifested in 1994 (15 thousand or 2.8‰) with the persisting

tendency to further decrease (to 2.5 thousand in 2000) and even to the negative natural increase in 2001 (800 individuals). Changes in the following years were not so dramatic and a three-year period of minimum natural decrease was replaced by a period of minimum increase. This situation suggests the stabilization of the population increase ranging between -1 and +1 ‰.

The changes in the natural increase that took place in the 1990s are important for a long-term estimation of the population change in Slovakia. They meant the end of the long period of increase through natural change. It can be considered the definite conclusion of the developmental stage of the first and beginning of the second demographic transition.

The decline of the total fertility rate in the same period was almost uniform with its value decreasing below the replacement level (2.1 children). However, the most conspicuous decrease up to the limit of 1.2 was observed in 1994 and in the following years (Tab. 1). A certain degree of stability can be seen since 2001 with variation between 1.1 and 1.2 children (Fig. 3). Changes of the specific fertility of females by age prove it. In 1990, the maximum fertility was confirmed in the 21-22 age categories and by 2006 it had to the category of 27-29.

The developmental stages of the net reproduction rate are very similar. The decrease started in the second half of the 1970s and reached an important turning point in 1980. It decreased below the replacement level (1.00 daughter) in 1989 and again decreased markedly in 1994. The decrease lasted until 2001 and then it was followed by the stage of certain stabilization reproduction rate at a very low level of 0.56-0.60 (Tab. 1).

Tab. 1. Development of selected indicators of reproduction behaviour in Slovakia

Year	Crude live-birth rate (‰)	Total Fertility rate	Share of births out of wedlock (%)	Average age of woman at first birth	Natural increase per 1,000 inhabitants	Net reproduction rate
1989	15.18	2.081	7.20	22.65	4.97	0.998
1990	15.10	2.085	7.63	22.66	4.79	0.993
1991	14.87	2.049	8.98	22.52	4.53	0.980
1992	14.07	1.992	9.80	22.52	4.00	0.957
1993	13.76	1.932	10.58	22.63	3.86	0.915
1994	12.41	1.669	11.74	22.83	2.80	0.801
1995	11.45	1.522	12.63	23.01	1.63	0.730
1996	11.19	1.470	14.06	23.18	1.65	0.700
1997	10.98	1.428	15.13	23.39	1.30	0.685
1998	10.68	1.374	15.35	23.60	0.82	0.661
1999	10.42	1.329	16.94	23.83	0.71	0.641
2000	10.21	1.292	18.30	24.16	0.45	0.625
2001	9.51	1.198	19.79	24.35	-0.16	0.566
2002	9.45	1.185	21.65	24.72	-0.13	0.569
2003	9.61	1.199	23.39	25.01	-0.10	0.575
2004	9.99	1.241	24.84	25.35	0.35	0.594
2005	10.10	1.253	26.03	25.69	0.18	0.601
2006	10.00	1.239	27.51	25.95	0.11	0.596
2007	10.08	1.251	28.83	26.15	0.11	0.602

Source: Výskumné demografické centrum (2009)

Another general feature of natural population change and the associated processes is their spatial differentiation. It can be observed at all levels. With a bit of simplification, two extreme regions are identifiable in Slovakia based on the selected indicators The area of the north and north-east of Slovakia forms the region with the highest natality and fertility levels and consequently the highest level of natural increase that is still positive. The second extreme region is the area of west and south-west Slovakia with the lowest rates of natality and fertility, the lowest natural increase that is characterized by negative values in various districts in this region at the beginning of the 1990s.

Synthesis of spatial differentiation analyses concerning the natural population change based on their inFHdicators led to a complex regional typology of all the pro-cesses involved in the natural population change. In addition it led to identification of regional types of reproduction behaviour of Slovakia's population.

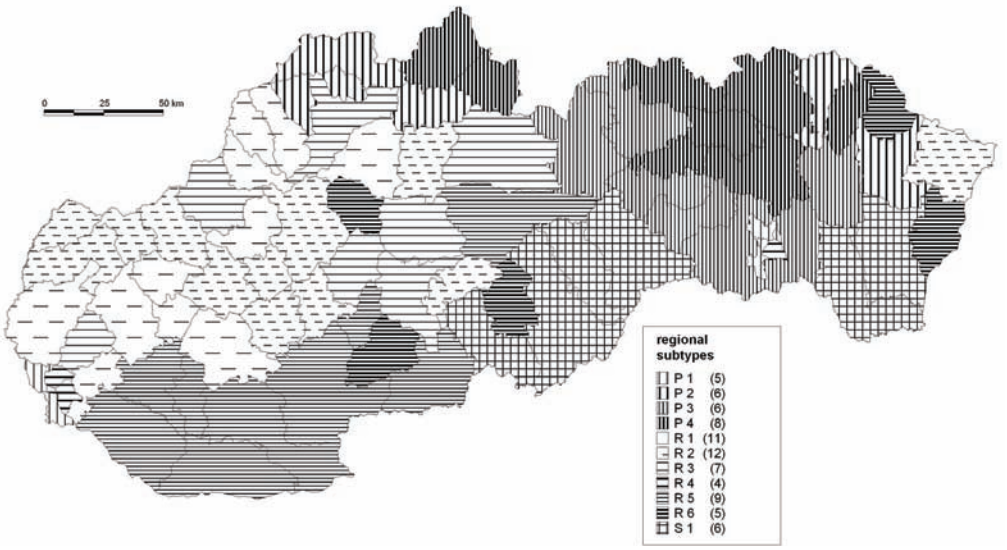
The input data of the regional analysis consisted of 27 indicators of reproductive behaviour indicators computed for all districts of the SR at the beginning 21st century. As a consequHence of significant correlating dependencies of several variables, in an effort to classify and arrange the tangled correlation implications between the variables, the method of factor analysis was applied. In case of the reproductive behaviour the solution with five common factors seemed the most appropriate ones. These factors can be based on variables that highly saturate they can be expressed as: natality and fertility intensity factor, induced abortion intensity factor, spontaneous abortion intensity factor, mortality intensity and timing factor, natality and abortion timing factor.

The method of cluster analysis was applied in calculation of individual factors (i. e. factor score) for the statistical units – districts. Cluster analysis appeared to be ideal for the delimitation of three regional types of reproductive behaviour – the progressive type with the positive natural increase, the regressive type with negative natural increase and the stationary type with natural increase close to zero (Fig. 2). Within them, several subtypes were sorted out according to the prevailing features of the reproductive behaviour (in the progressive type four subtypes and in the regressive types six subtypes), taking into account the level of selected characteristics and position regarding the national average. Several distinct differences emerged between subtypes of one type in spite of having a common feature, that is the value of the natural increase (positive, negative or zero).

Urban districts of Bratislava and Košice with significantly different reproduction behaviour of their inhabitants' compared to other regions, they are in special positions in this typology. Even these urban districts are far from being homogeneous in terms of population behaviour. They can be found in several subtypes of reproductive behaviour.

Regarding reproductive behaviour, districts of the northern and central parts of eastern Slovakia, as well as some urban districts seem to be progressive. This regional type is internally differentiated, for instance, based on extramarital natality, where the subtype with the below-average and the subtype with the above-average share of children born out of wedlock are observed. Other characteristics of reproductive behaviour (mean age of woman at the first childbirth, induced abortion intensity, fertility rate in selected age categories, etc.) also determine the internal he-

terogeneity of this regional type and divide them into subtypes. Regressive types were observed in the area of western and south-western Slovakia where considerably different subtypes were identified. They differ in several characteristics of reproductive behaviour assessed according to their position with regard to the national average. The area of the southern part of eastern Slovakia is a transitory one; the natural population increase here is close to zero – as a consequence of the above-average natality, and fertility, as well as of the above-average general mortality. As far as the ofter characteristics are concerned in this region, there are above-average intensity of extramarital natality and induced abortion, but also below-average age of women at their first childbirth.



Regional type	Regional subtype	Prevalent features of reproduction behaviour							
		1	2	3	4	5	6	7	8
Progressive	P 4	High increase	+	+	+	–	–	–	–
	P 3	High increase	+	+	+	+	–	o	–
	P 2	Increase	+	+	o	–	o	–	–
	P 1	Increase	–	–	o	+	+	+	–
Stationary	S 1	Close to 0	+	+	o	+	–	+	+
Regressive	R 1	Decrease	–	–	o	–	o	o	o
	R 2	Decrease	–	o	–	–	o	o	+
	R 3	Decrease	–	–	o	–	+	o	o
	R 4	High decrease	–	–	–	o	+	+	+
	R 5	High decrease	–	o	–	+	o	+	+
	R 6	High decrease	o	+	o	o	–	o	+

Fig. 2. Regional types of reproduction behaviour in Slovakia

Prevalent features: 1 – natural increase, 2 – intensity of natality and fertility, 3 – intensity of fertility at the age 20-24, 4 – intensity of fertility at the age 25-29, 5 – share of births out of wedlock, 6 – average age of woman at 1st. live birth, 7 – intensity of induced abortion, 8 – intensity of mortality.

Evaluation: + - above average, o - average, – - below average

Changes of family behaviour

Both, the effects of long-term developmental trends and those of transition found reflections in changes of family behaviour. The changes touched family formation, social status of the family, its significance for reproduction, but also its disintegration. If family formation is estimated by the number of concluded marriages, the period of its decrease started in 1980. It decreased from 42-44 thousand of yearly concluded marriages (crude nuptiality rate 8-9‰) to the historic minimum (23 thousand, 4.4‰ – Fig. 3) in 2001. Nuptiality is a processes, which immediately responds to changes of social conditions. It means that the marked decrease of number of marriages was noticed right at the beginning of the transition in 1991-1994. A certain period of stabilization is also recognizable in this process, when in the period 2000 – 2007 the number of marriages varied around 25-26 thousand (4.5-5.0‰) with an appreciable inter-year variability.

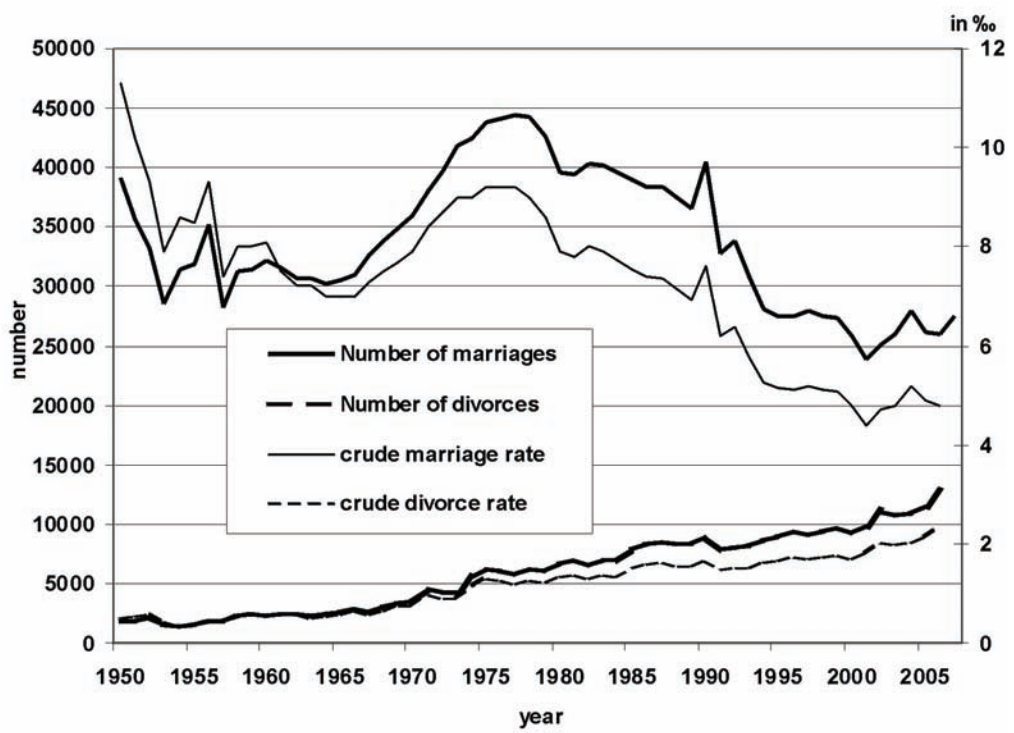


Fig. 3. Development of marriages and divorces in Slovakia

Decrease of the nuptiality rate is most often explained by the postponement of marriage to later age categories. This process is very well demonstrable by comparison of nuptiality rates by age in the last decades. The traditional distribution of nuptiality by age was characterized by a distinct maximum in the 20-40 age categories of both sexes. In males, this maximum slowly started to move towards the 25-29 age categories already by the end of the 1990s, and it has been first observed in females only in recent years. Simultaneously, quite a marked decrease of the nuptiality rate in younger age categories is observable. The increase of nuptiality rate in

both sexes manifests in the age exceeding 30 years and it also proves the postponement of marriage (Figs. 4 and 5). Increase of the average age at marriage and the average age at the first marriage are also the indices that confirm the outlined trend .

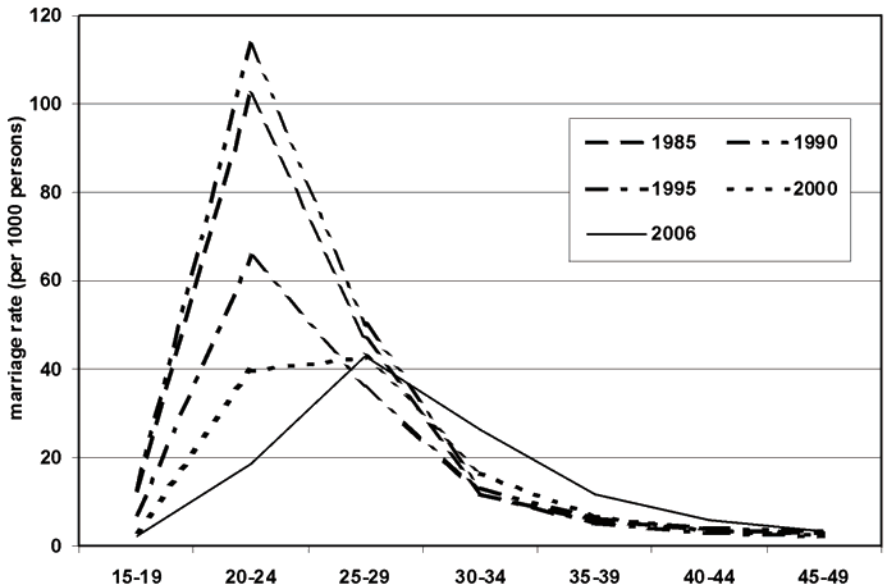


Fig. 4. Nuptiality by age – males

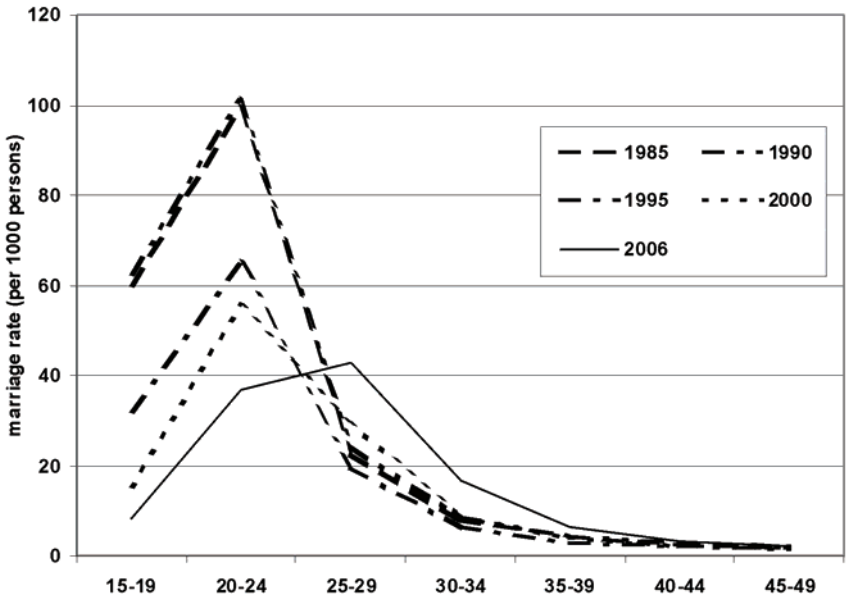


Fig. 5. Nuptiality by age – females

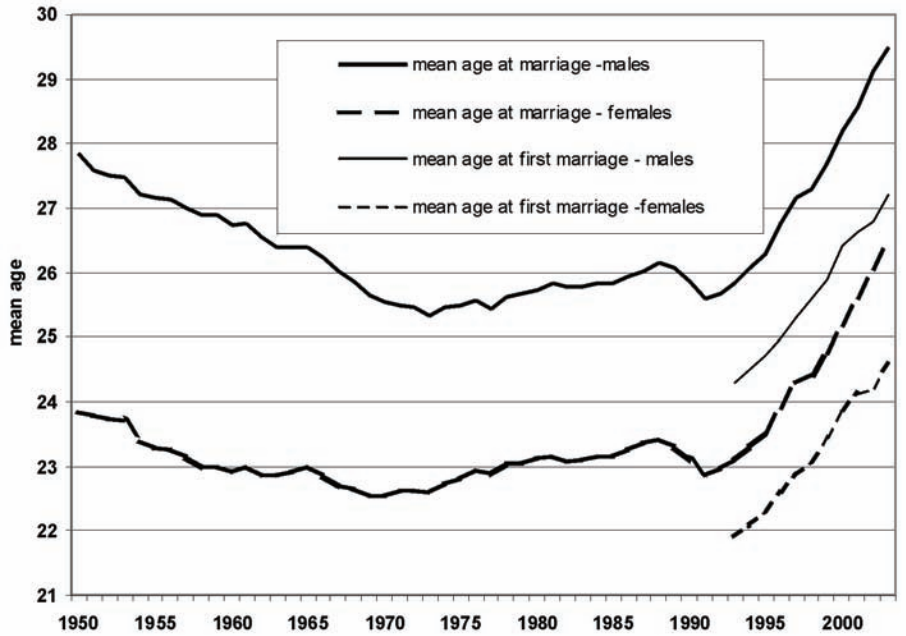


Fig. 6. Development of mean marriage age in Slovakia

The propagation of the new family and household forms became the typical feature of family behaviour. New forms of incomplete families, the number of one-person households, cohabitations and divorce now increasingly accompany the dominant type of a nuclear family consisting of parents and their children.

Evaluation of the household by the number of its members revealed that one-person households were most abundant in 2001. They represented 30% of all households and their number increased by 60% in the last decade. This increase is connected with the new life style of young age categories but also with the increase of the number of older persons (above all females) who have lost their partners. Their number is growing as the population gradually ages.

The crude divorce rate and its increase points to a certain instability of families and maybe a search for other forms of coexistence. It is the process, which concerns marriages concluded before many years but also young families. Long-term effects may combine with difficult family situations caused by the transition processes. The essential feature is the constant increase of divorce. It amounted to 12.7 thousand in 2006. Estimating by the indicator of total divorce rate (0.40), the overwhelming total 40% married in divorce. No indices of stabilization of this process have been observed in recent years (Fig. 3).

Cohabitations represent a form of coexistence of two partners of opposite sex who live together; they reside together and share the household economy without being married. Children of one or both partners can also live in such bond. Conditions favouring the spread of cohabitation are housing, social recognition/tolerance of such forms of coexistence, emancipated relationship between the partners and

reliable hormonal contraception. In Slovakia (1991), 42 thousand partners admitted cohabitation in an informal bond and their number increased to almost 61 thousand in 2001. Cohabitations are more common than the pre-marriage cohabitations; their number will increase while the partners increasingly conserve such bond after childbirth (Mládek and Širočková 2004).

The number of cohabitations is also often derived from out-of-wedlock fertility data. It is assumed that the children born out of the wedlock are born precisely in such informal bonds. Before the end of the 1980s, the share of children born out of wedlock did not exceed 8% of total births. Already in 2006, this share reached 27.5 %. The number of births out of wedlock is above all connected with the dramatic decrease of the number of children born to married couples (Fig. 7).

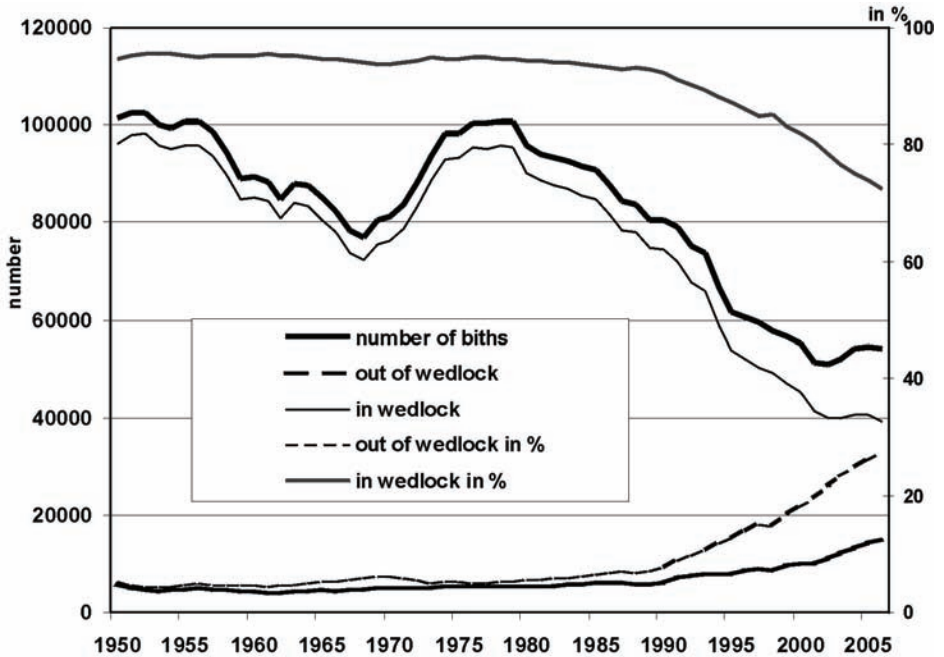


Fig. 7. Development of the marital and non-marital natality in Slovakia

Perhaps the most radical changes occurred in the abortion process. After the Mini-Interruption Act was adopted in 1986, their number shot up (in 1988 to 59 thousand, including 51 thousand induced abortions). The following period is characterized by the marked decrease of the number and rate of abortions and represents one of the typical changes in demographic behaviour in transition period. Several factors contributed to this positive development. Propagation of modern, especially hormonal contraception has prevented undesired pregnancies and abortions. The obligatory condition was the accessibility of modern contraception, the wide choice of means and increased informedness of the population. The effect of sexual education imparted not only in school but also drawn from accessible literature, mass media, the introduction of fees, and the action of civil organizations, is evident as well. Abortion experienced the most dramatic drop in the 1990s with 23.5 thousand abor-

tions including 18 thousand induced in 2000. The decrease of induced abortion slowed down in the following years. Presumably, in the given legal environment and at the given level of social development, indicators of abortion may reach certain limits.

Migration

The political, economic and social changes that took place in Slovakia after 1989 along with dramatic changes in demographic behaviour of population have decisively influenced the nature and spatial characteristics of internal migration. The change from the concentrating nature of migration to the deconcentrating type emerged as a new phenomenon and the spatial pattern of several types of migration changed as well. In the second half of the 1990s, the rapid decrease, both of volume and rates of internal migration faded out when in the period of 1996-1999 the average annual number of internal migrations represented about 81 thousand (compared to 100 thousand at the end of the 1980s) and the crude annual migration rate was then around 15‰ (against 19‰ at the end of the 1980s). After 2000 the volume and intensity values of internal migratioFn started to increase up to the present 89 thousand (16.6‰) when migration started to contribute again to spatial redistribution of the population in Slovakia. A long-term lower level of population mobility is the consequence of a traditionally cautious approach to change of the place of residence, but also some (above all financial and in sometimes legal) limits connected with moving.

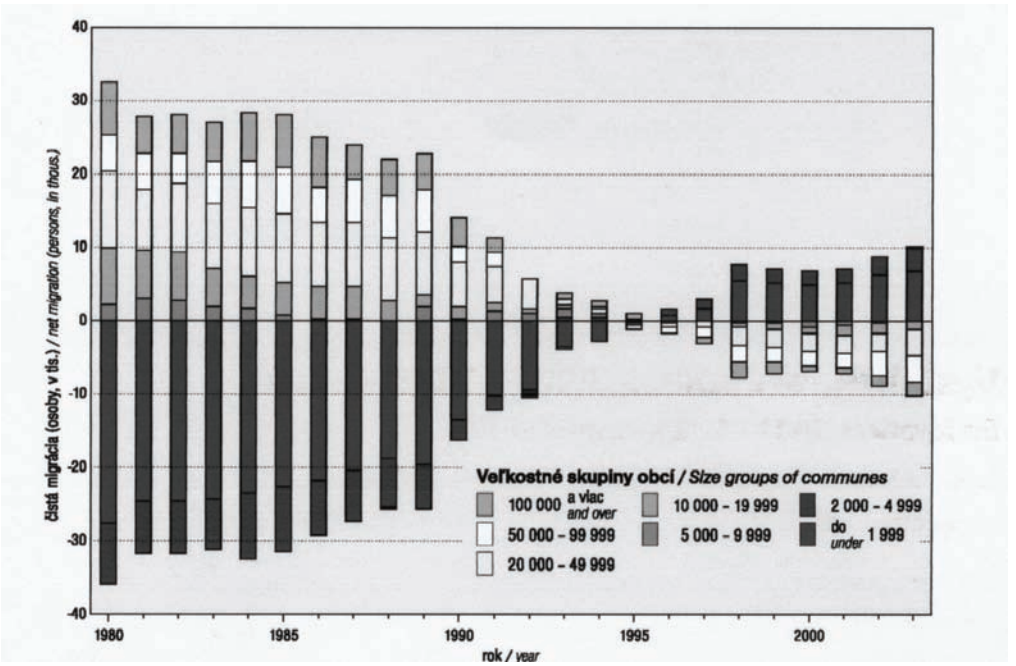


Fig. 8. Internal net migration by size groups of communes

Another significant trait of internal migration in Slovakia is the change of net migration in individual size categories of municipalities. While from the beginning of the 1990s, municipalities with population over 10 thousand experienced the greatest increase, small municipalities with population up to 2 thousand suffered migration loss. A fundamental change came in 1995 – the rural municipalities (up to population 5 thousand) started to gain. A very important factor is their geographical position. The municipalities situated in the hinterland of cities are characterized by the highest increases. On the other side, towns with populations over 10 thousand are characterized by a continuous and ever more distinct migration loss since the mid-1990s. The decisive part of their migration loss corresponds to that in favour of rural municipalities in their hinterland wich reflects the processes of deconcentration and suburbanization processes. The migration decrease of the Slovak cities was not only caused by an increased rate of their emigration but also by decline of immigration flows.

A spatial trend, almost continuously and regularly decreasing from the southwest to the northeast of the country is found in the regional pattern of net migration values. Meanwhile, population loss by internal migration is characteristic for the northern and eastern parts of Slovakia (Bezák 2006). The presumed dependency of out-migration and economic development – moves from economically weaker to economically stronger regions – has been confirmed only to a limited extent in Slovakia. The reason can be found in economic problems and financial inaccessibility of housing in economically advanced centres and the relations to the original environment where people live. Commuting and temporary migration to the economically advanced countries in the EU also plays a certain role in this context. It often compensates for the financial inaccessibility of the principal centres of economic development in Slovakia (Podolák 2006).

International migration

The turnover of officially registered but above all unregistered international migration of Slovak citizens along with irregular movement over our frontiers dramatically increased after 1989. Slovakia gradually gained the position of a transit country for political and economic migrants from the developing countries with the absolute majority of them illegally trying to get through our territory to the advanced areas of Western Europe. Historically, Slovakia is an emigration type of country, however, the development after 1992 brought about a contrary trend when Slovakia changed into a country with migration increase. While the natural increase has declined, the share of net migration in total population change is increasing. Since 2001 migration increase has been higher than the natural increase and it provides the greater part of total population increase in the country.

The statistics of international migration of the SR runs into the problem of underestimated official data about emigrants. As a matter of fact, few of the leaving persons provide information about their departure or for how long they are going to stay abroad though it is their legal duty. As a consequence, statistics concerning emigrants are often confused with those about commuters and temporary migrants. Some estimates quote 15 thousand emigrants a year. Losses due to international migration of Slovak citizens are notable and in certain circumstances they can also imply demographic or socio-economic consequences for the future. Recently though, a considerable part of the emigrants have returned to their homeland because of the financial crisis and other economic reasons.

After 1989, a new phenomenon appeared in the SR: irregular migrants. The number of irregular migrants in the SR in the context of Central and Eastern European countries was (especially during the 90's) one of the highest, both absolutely and relatively (in relation to total population). The Slovak Republic evidently represented the buffer zone between the European Union and regions (Asia above all) that produce migrants (Divinský 2006). Since 2002 the situation has changed and number of illegal migrants has significantly declined (3,400 in 2007 in comparison with more than 15,000 in 2001).

The population ageing of Slovakia

Population ageing has become the most remarkable feature of the population development in the 20th and 21st centuries in connection with the second demographic transition, which involves decline and therefore the of the number of children born and improvement of mortality conditions

The ageing of the population of Slovakia appears, both in the long term (Verešík 1974) and in the period of the last 20 years. The recent period is characterized by ageing from the bottom, which means the decline of the number and proportion of the youngest age categories, because of the decline of fertility. Ageing from top, meaning the growth of the number and proportion of the oldest age categories, as a consequence of the increase of average life expectancy is evident as well, although this does not give such a distinctive manifestation. The processes of population ageing need to deal with the whole range of serious social problems (of the economic and socio-medical character).

The ageing of the Slovak population is evident and it is present in the sense of its basic definitions (Káčerová 2005). Table 2 also confirms the total growth and the decline of the number of subject age groups – the processes of ageing from the bottom and from the top is happening simultaneously.

Tab. 2. Indicators of population age structure in Slovak Republic

Year	0-14 (number in thousand)	0-14 (%)	65+ (number in thousand)	65 + (%)	Billeter's index
1900	1,033	37.0	131	4.7	44.7
1910	1,104	37.8	148	5.1	46.3
1921	980	32.7	160	5.3	30.7
1930	1,062	31.9	200	6.0	28.8
1950	995	28.9	230	6.7	18.6
1961	1,315	31.5	292	7.0	19.6
1970	1,233	27.2	418	9.2	9.5
1980	1,302	26.1	519	10.4	3.5
1991	1,314	24.9	543	10.3	0.7
2001	1,015	19.0	611	11.5	-14.3
2002	975	18.1	616	11.5	-17.6
2003	944	17.6	620	11.5	-17.0
2004	919	17.1	626	11.6	-22.0
2005	894	16.6	633	11.7	-24.1
2006	870	16.1	639	11.9	-26.3

Source: Verešík (1974), Federální statistický úřad (1985), Štatistický úrad SR (1992 and 2002), Vaňo, ed. (2001), Štatistický úrad SR (2003-2007)

The standardly evaluated population ageing based on age groups of population in terms of 1950-2006 of the Slovakia is identified by a decrease of the children's component (0 – 14-year old people) from 28.9% to 16.1% and an increase of the old population of 65 and more years from 6.7% to 11.9%. The population of the age of 15 – 64 stands for the productive age group and its size increased for almost 42% in the analysed period. The total number rose from 2,242 thousand in 1950 to 3,883 thousand in 2006. At this evaluation level, it can be said that none of the value characteristics being reviewed, which are observable in 2006 has been reached yet. The portion of children is the lowest one; the portion of 15 – 64-year old people is maximal like the portion of the old population. The evident culmination of the number and proportion of the productive age group is affected by those born in the compensation phase after World War II (who will start to exceed the limit of the 60th year of life in 2010) and at the same time by the population boom in the 70's (who are currently formed by the generation of 30-year old people).

Ageing from bottom

The proportion of the child constituent of the population decreased. In the period 1961-1991, the child constituent stood for more than a quarter of the whole population. In total numbers, the maximum number of children is recorded in years 1961-1964 and 1985-1988 with more than 1,300,000 children in the population. The absolute peaks in the number of children are direct consequences of the increased numbers of births.

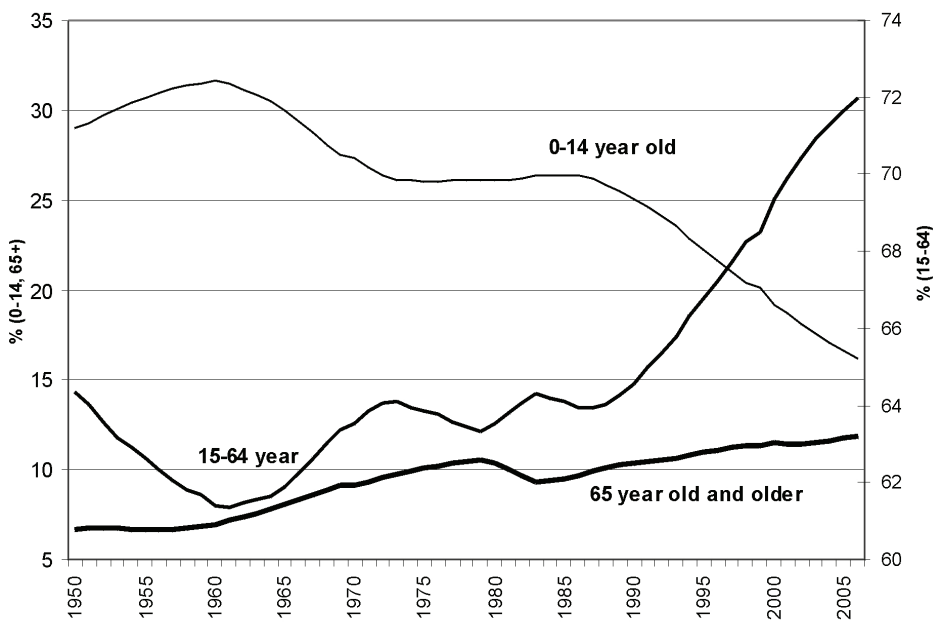


Fig. 9. Productive age groups in SR (1950-2006)

The first peak is a consequence of the improved socio-economic conditions immediately after the Second World War. We can thus identify a compensative period

in the population course of Slovakia. The second peak is related to the increased fertility in 1973-1979. This is a secondary increase, given by a high number of women in the age of the highest fertility that has been reinforced by pro-natal measures (Vaňo 2001). The number of the child constituent reached its historical minimum in 2006 (870,000). This is a consequence of the radical decline of natality in the 90's (Fig. 9).

Ageing from top

We have found that the age groups of over 60 years, over 65 years and over 80 years register their maximum levels in 2006, which is caused by the improvement of mortality circumstances, by the elongation of the life expectancy and by the shift of the mentioned age groups (waves).

The number and the proportion of the age group over 65 years bears a temporal progress similar to the previous age group. For the possibility to compare the rates internationally, this age group has a more substantial meaning. The curve of the proportion of this population declines in 1979-1984, as a result of the move of the very small number of persons born during the First World War into this age group. The number of old people (over 65 years) had increased on average by 1.8% per year. Since 1950, the number of old people in the population of Slovakia increased from 232,700 (6.7%) to 639,600 (11.7%); which stands for grow of more than 2.5 times.

The population ageing of Slovakia from a regional point of view

Any higher territorial unit can be characterized by the presence of different population structures in its particular sub-units. The difference is apparent in terms of different number of population, its dynamics, structure and migration. The level of the differentiation of demographic behaviour in particular territorial units of Slovakia is evident from the changes of age structures and from the different level of ageing. The ageing from the bottom is evident in districts of the SR from observation of the share of 0 to 14-year olds (Fig. 10). The highest representation of the child component is observed in the districts of northern and eastern Slovakia. On the contrary, the lowest values were found in districts of the western, central and southern parts of the country. The share of the 65-year old and older persons demonstrates the ageing from the top at the regional level. Their spatial distribution in the districts of the SR (Fig. 11) is the mirror reflection of the child component share.

One of the measures, which has been awarded a great weight in population ageing studies is Billeter's index (Billeter 1954). It is defined as the ratio of the difference between the child population and the postreproductive category to the reproductive population category. The significant spatial difference of the population age structure is shown by Billeter's index (Fig. 12). These measure can also come down, to negative values. The average value of the ageing measure for Slovakia in year 2006 was – 26,3%, whereby 43 districts showed a level under the average.

While the numerousness of the 0-14 years old age category is greater than that of those 50 years old and older, the ageing measure value has a positive values. There were still 17 districts with positive values of the measure in 1996. The fact that the process of ageing is advancing fairly quickly, is shown by the decrease of number of these districts to 3 in 2006.

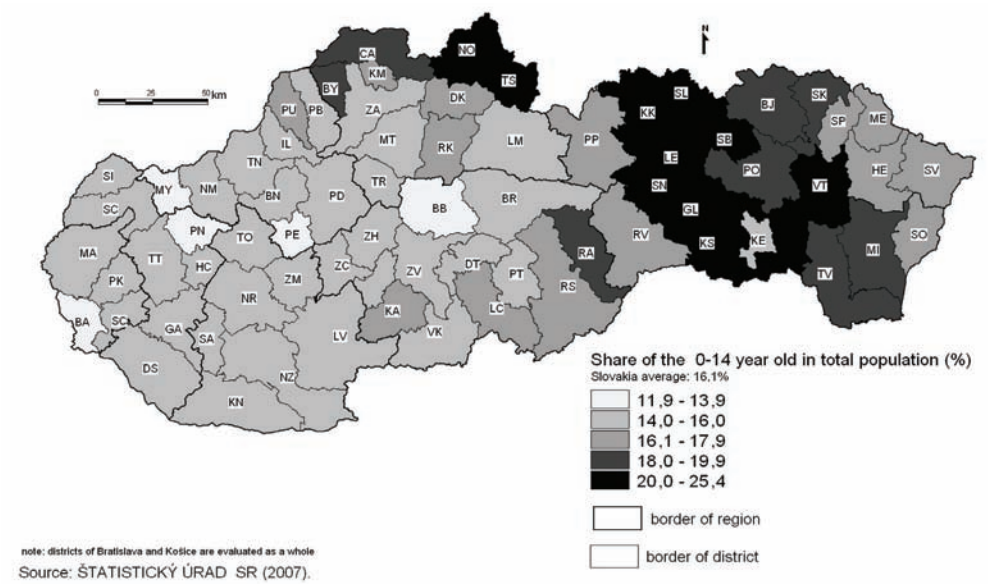


Fig. 10. Population in 0-14 age category (2006)

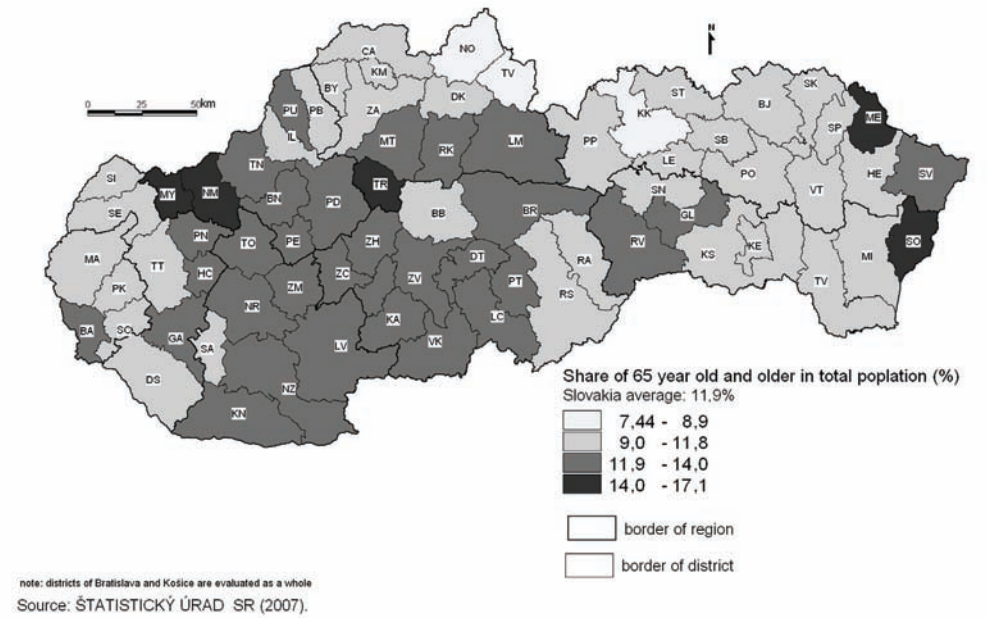


Fig. 11. Population in 65 and over age category (2006)

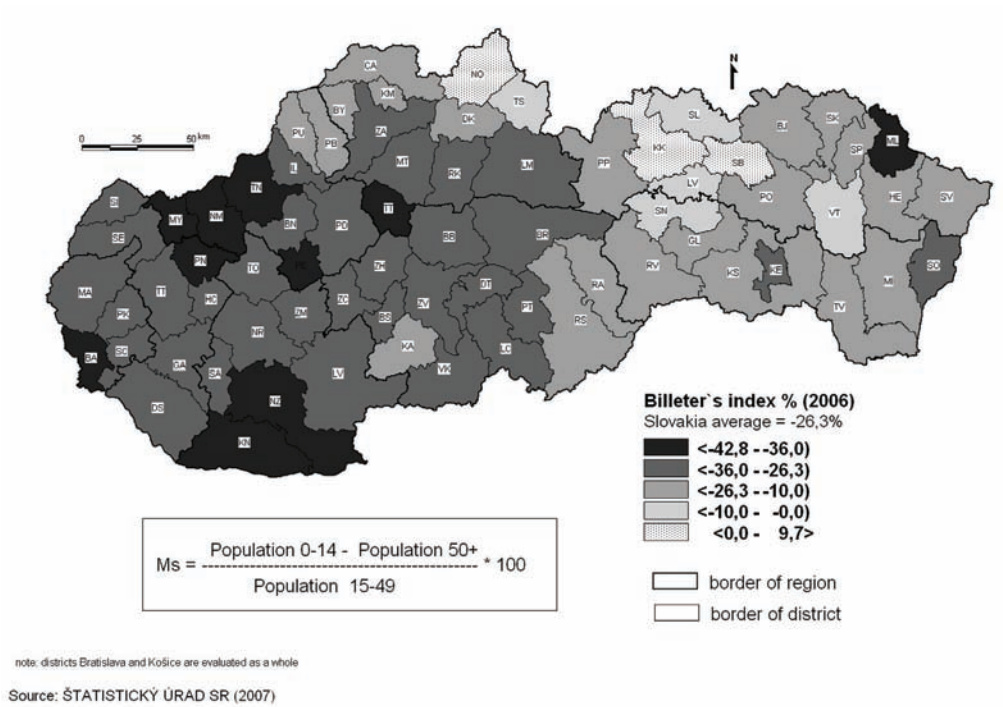


Fig. 12. Billeter's index % (2006)

Slovakia can be demarcated into two large regional units in terms of age structure and the intensity of ageing (Mládek et al. 2006a, Mládek and Káčerová 2008). In terms of typology, the border can be drawn through the line of the districts of Púchov, Žilina, Ružomberok, Liptovský Mikuláš through Brezno to Rožňava. To the north from this line, we can consider *the regional type of a young age structure;* to the south from the line (including these districts) we identify *the regional type of an old age structure*. Regarding selected indicators of the age, national and religious structures of the population, we have derived the following characteristics of the particular regional types. The dominant factor of the regional types identification is different fertility level.

The regional type of a young age structure – an impact of the higher level of religiosity is present here (more than 90% of the population in the regions of Orava and Kysuce are religious). These are mostly Roman Catholic populations with the typical higher level of natality and families with more children.

The regional type of an old age structure – similarly to the young regional types, we can talk about the influence of the age structure having a negative impact on the intensity of natality and of the natural increase. Again, we can consider the impact of the religiosity and nationality structure of the population on ageing. The population of the Hungarian nationality with a higher proportion in the southern districts mostly avow an affiliation with Reformed Christian churches preferring a lower intensity of natality and the model of a single-child family. The same attitude towards the extent of a family is shared by the Evangelical church of the Augsburg Confes-

sion believers, having a high average proportion in several districts. A similar character of the reproductive processes can be also seen in the population without any confession. A higher level of urbanisation in the Western Slovakia arguably contributes to the more intensive process of ageing.

The parameters of the migration imply, paradoxically, that the young regional type is losing due to migration while the old regional type achieves a positive increase by migration.

Population forecasting – assumptions and draft results

The latest official forecast assumes the gradual rise of the total fertility rate (TFR) in Slovakia, especially thanks to recuperation of births as a consequence of the strong postponement of fertility over the last two decades. The assumptions from several sources are portrayed in Fig. 13. Each institution presumes the increase of the TFR until 2025, 2050 respectively. As Potančoková (2008) noted, cohort fertility will not fall below 1.6 in the likeliest scenario, thus corresponding to the assumption of the official forecast. Hence, the biggest scepticism evinced the EUROSTAT assumption. According to the national forecast, the mean age at birth will finish its rise at the level of 29.5-30.0 years approximately, in spite of the very young maternity of the Romanies (7-8% of the total population).

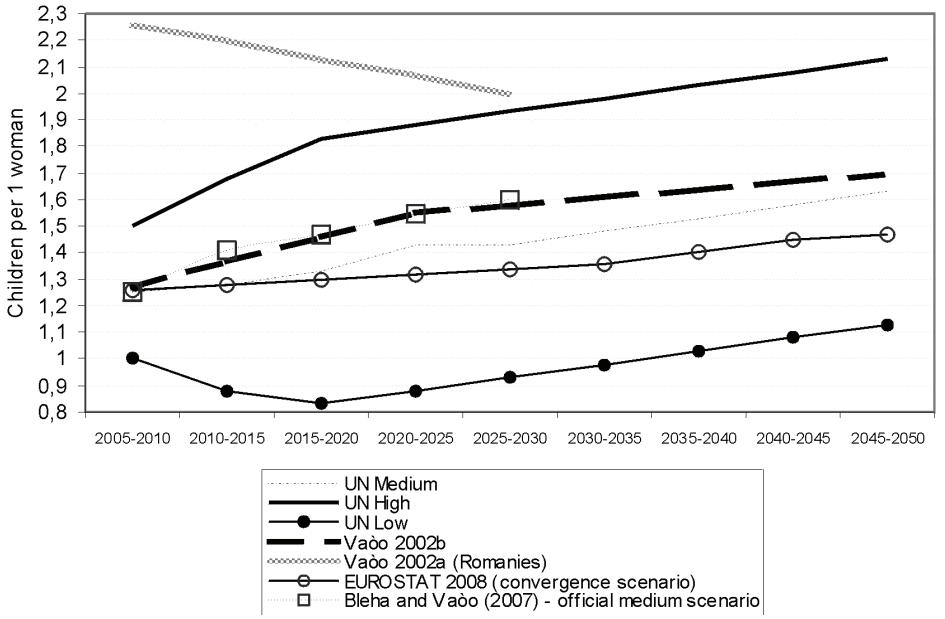


Fig. 13. Fertility assumptions

Mortality seems to be a less uncertain and not very "problematic" component, for that reason we just mention that the life expectancy is sure to rise futher. As for migration, the official forecast supposes the growing positive balance associated with improvement of the social-economic conditions in the country, thus changing

from a transit to a target area. However, taking into consideration the concept of replacement migration, predicted numbers of immigrants will not be enough to stop the population ageing, thus being probably the quickest among all the EU-27 countries.

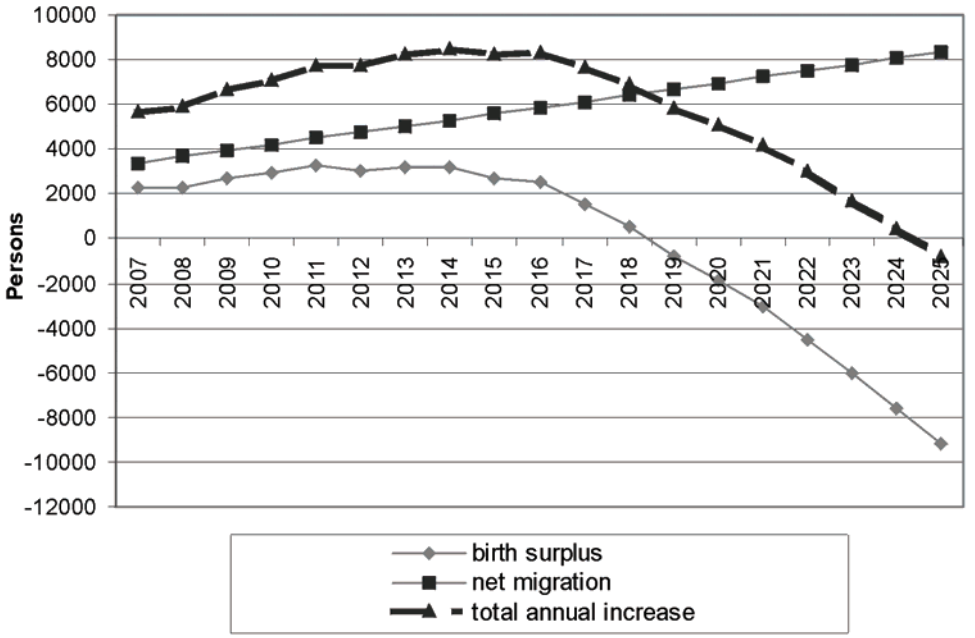


Fig 14. Future population dynamics

As mentioned above, the existing particular spatial differences within Slovakia deserve an exceptional interest. By using the Ward cluster methods, the authors of sub-national forecasts (Bleha and Vaňo 2007, 2008 and 2009) created seven clusters on fertility, the same number on mortality, and finally, ten on migration.

Some statistical indicators, which help us to measure the variability of processes, have declined recently. This corresponds to their theoretical assumption of future lowering of the demographic disparities. Somewhat for Thornton and Philipov (2007) argued in their study, might be seen also within country at sub-national level, in countries like Slovakia characterized by the big cultural, ethnic heterogeneity. We took into consideration the theoretical concept of the second demographic transition. We tell about the Central-Eastern Europe version of the transition. The changes in Slovakia were quicker than those in the Western Europe, and different factors influenced the changes including the economic transformation. Fertility also differs through the timing of fertility. We suppose the tempo effect is stronger in the urban regions, especially in Bratislava region. The recuperation has been much more noticeable in such regions in last three-four years. Authors also tried to stress the most important factors causing the overall uncertainty of the assumptions (Bleha 2007). Romany fertility represents one of the most significant, in contrast to the majority population, the Romanies' TFR will fall to a value of two children in several

decades, whereas the overall TFR in Slovakia lies at the very-low level of 1.3 already. With this fact is also connected the uncertainty of future policy measures. Some allowances, which could preserve the higher fertility intensions and intensity of higher parities, have been launched recently, thus "conserving" the present, adverse situation. Thus we talk about the "high fertility trap" (see also Hemmi 2003) as the opposite of the hypotheses introduced by Lutz – Skirbekk (2005).

Migration influences the spatial redistribution of the Slovak population in the broadest way. The biggest surplus from international migration is presumed in urban regions like Bratislava, Košice and other districts with the biggest cities and towns. Nevertheless, in comparison to internal migration, international migration is not so important, as regards population change and spatial redistributiony. The polarization could affect the spatial portrait of the direction of migration flows. Two polarizations are likely to be distinguished.

Finally, we can identity two main regions of depopulation. Actually, the complete set of the Western and Central districts (except the suburban zone of Bratislava and the very conservative northern region of Orava) will experience substantial depopulation, whereas the biggest part of Eastern Slovakia will still record a total surplus, especially thanks to young age structure of the Roma combined with their higher fertility.

CONCLUSION

Observing the intensity changes in population processes in the period 1990-2007, it is possible to identify a destructive phase and a phase of stable development. The destructive phase (the 1990s) can be characterized by intensive changes in the population processes. They were greatly influenced by the negative features of the socio-economic development, however the effect of the long-time population trends are manifested as well. Stabilization of the population development (approximately since 2000) is manifested in ever smaller differences some processes in successive years. It is connected with the effect of several positive features, which manifest in the socio-economic development.

The phase of stable development may be replaced by that of a compensating nature. This development may be supported by several factors. One of them is the expected economic growth in the next years and the consequential improvement of the living conditions. Reduction of the social risk could positively influence the reproduction and family behaviour of the population. Another factor is the particular population potential, which represents the marriageable population, as well as the large generation of women born in the 1970s, which can realize the delayed marriages and childbirths. The compensating phase will probably be massively less sharp than the destructive phase of the population development.

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REFERENCES

BEZÁK, A. (2006). Migration between functional urban regions. Basic characteristics of interregional migration. Major migration flows between urban regions. Regional differences in net migration. In Mládek, J., Kusendová, D., Marenčáková, J., Podolák, P., Vaňo B., eds. *Demographical analysis of Slovakia*. Bratislava (Comenius University), pp. 80-84.

BILLETER, E. P. (1954). Eine Massazahl zur Beurteilung der Altersverteilung einer Bevőlkerung. *Schweizerische Zeitschrift fűr Volkswirtschaft und Statistik*, 90, 496-505.

BIRG, H. (1996). *Die Weltbevölkerung. Dynamik und Gefahren.* In der Beck`schen Reihe 2050. München.

BLEHA, B. (2007). Conception of spatial units appropriate for regional population forecasts. *Conference of European Statisticians, Bucharest: United Nations Statistical Commision.* http://www.unece.org/stats/documents/ece/ces/ge.11/2007/wp.3.e.pdf

BLEHA, B., VAŇO. B. (2007). *Prognóza vývoja obyvateľstva SR do roku 2025*. Bratislava (Infostat).

BLEHA, B., VAŇO. B. (2008). *Prognóza vývoja obyvateľstva v okresoch SR do roku 2025.* Bratislava (Infostat).

BLEHA, B., VAŇO. B (2009). *Demografická budúcnosť okresov SR. Približovanie či divergencia?* Bratislava (Infostat).

DIVINSKÝ, B. (2006). International migration. In Mládek, J., Kusendová, D., Marenčáková, J., Podolák, P., Vaňo B., eds. *Demographical analysis of Slovakia*. Bratislava (Comenius University), pp. 72-76.

DORBRITZ, J. (2003). Social, political and economic transformation. In *Demographic consequences of economic transition in countries of Central and Eastern Europe*. Population Studies, No. 39. Starsbourg (Council of Europe Publishing), pp. 21-68.

FEDERÁLNÍ STATISTICKÝ ÚŘAD (1985). *Historická statistická ročenka ČSSR*. Praha (Alfa).

HEMMI, N. (2003). The poverty trap with high fertility rates. *Economic bulletin*, 9, 1-4.

JURČOVÁ, D. (2006). Internal net migration by size of communes. In *Population Atlas of Slovakia.* Bratislava (Comenius Uiversity), p. 67.

KÁČEROVÁ, M. (2005). Demografické starnutie populácie Slovenska a Európy. In *Naša demografia, súčasnosť a perspektívy. Zborník z 10. demografickej konferencie v Smoleniciach.* Bratislava (Slovenská štatistická a demografická spoločnosť), pp. 97-102.

LESTHAGE, R. (1983). A century of demographic and cultural change in Western Europe: An Exploration of underlying dimensions. *Population and Development Review*, 9, 411-435.

LUTZ, W., SKIRBEKK, V. (2005). Policies addressing the tempo effect in low-fertility countries. *Population and Development Review*, 31, 699-720.

MARENČÁKOVÁ, J. (2003). Theoretical and methodological aspects of analysis of natality and fertility. In Kowalczyk, A., ed. *Geographical space at the turn of the century. Theoretical and methodological challenges*. Warszawa (Warsaw University, Faculty of Geography and Regional Studies), pp. 29-37.

MARENČÁKOVÁ, J., PASTOR, K. (2006). Časová diferencovanosť prorodzeného pohybu obyvateľstva. In Mládek, J., Kusendová, D., Marenčáková, J., Podolák, P., Vaňo B., eds. *Demographical analysis of Slovakia*. Bratislava (Comenius University), pp. 27-44.

MLÁDEK, J., KÁČEROVÁ, M., MARENČÁKOVÁ, J., ŠIROČKOVÁ, J. (2006a). New trends of population development in Slovakia at the end of the 20th century and the beginning of the 21st century. *Acta Geographica Universitatis Comenianae*, 48, 189-210.
MLÁDEK, J., KÁČEROVÁ, M. (2008). Analysis of population ageing in Slovakia: time and regional dimensions. *Geografický časopis*, 60, 179-197.
MLÁDEK, J. (1998). Druhý demografický prechod a Slovensko. *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis, Folia Geographica*, 2, 42-52.
MLÁDEK, J. (1999). Population development in Slovakia in the European context. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica, Supplementum*, 2/1, 59-71.
MLÁDEK, J., KROLL, G. (1995). Die Industrie im Wirtschaftlichen Transformationsprozess der Slowakei. *Europa Regional*, 3, 28-34.
MLÁDEK, J., ŠIROČKOVÁ, J. (2004). Kohabitácie ako jedna z foriem partnerského spolužitia obyvateľstva Slovenska. *Sociológia*, 36, 423-454.
MLÁDEK, J., MARENČÁKOVÁ, J., ŠIROČKOVÁ, J. (2006b). Demografické správanie vysokoškolákov Slovenska. 1. časť – reprodukčné správanie. *Slovenská štatistika a demografia*, 16, 22-48.
PASTOR, K. (1997). Súčasný populačný vývoj na Slovensku a demografické teórie. *Slovenská štatistika a demografia*, 7, 45-58.
PASTOR, K. (2002). Rodina a rodinná politika v druhej demografickej revolúcii. In *Rodina v ohrození - výzva pre sociálne vedy. Zborník k 10. výročiu obnovenia Trnavskej Univerzity v Trnave.* Trnava (Katedra sociológie, Fakulta humanistiky Trnavskej univerzity), pp. 30-41.
PODOLÁK, P. (2006). Spatial mobility of population – internal migration in Slovakia. In Mládek, J., Kusendová, D., Marenčáková, J., Podolák, P., Vaňo, B., eds. *Demogeographical analysis of Slovakia*. Bratislava (Comenius University), pp.71-88.
POTANČOKOVÁ, M. (2008). *Plodnosť žien na Slovensku v období rokov 1950-2007 v generačnom pohľade.* Bratislava (Infostat).
THORTNON, A., PHILIPOV, D. (2007). Developmental idealism and family and demographic change in Central and Eastern Europe. *European Demographic Research Papers*, 3. 1-85 p.
VAN DE KAA, D. J. (1980). Recent trends in fertility in Western Europe. In Hiorns, R. W., ed. *Demographic Patterns in Developed Societies.* London (Taylor and Francis), pp. 55-83.
VAN DE KAA, D. J. (1987). Europe's second demographic transition. *Population Bulletin*, 42, 1-57.
VAŇO, B. (2001). *Obyvateľstvo Slovenska 1945-2000.* Bratislava (Výskumné demografické centrum, Infostat).
VEREŠÍK, J. (1974). Štruktúra obyvateľstva podľa pohlavia a veku. In Lukniš, M., Princ, J., eds. *Slovensko 3. Ľud - 1. časť.* Bratislava (Obzor).
VÝSKUMNÉ DEMOGRAFICKÉ CENTRUM (2009). *Tabuľka údajov SR.* (http://www.infostat.sk/vdc/sk/index.php?option=com_wrapper&Itemid=35),
ŠÚ SR (1992). *Sčítanie ľudu domov a bytov 1991.* Bratislava (Štatistický úrad SR).
ŠÚ SR (2002). *Sčítanie obyvateľov domov a bytov 2001.* Bratislava (Štatistický úrad SR).
ŠÚ SR (2003-2007). *Vekové zloženie obyvateľstva Slovenskej republiky 2002-2006.* Bratislava (Štatistický úrad SR).

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URBAN STRUCTURES AND THEIR TRANSFORMATION (THE CONTRIBUTION OF SLOVAK GEOGRAPHY)

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Urbánne štruktúry a ich transformácia (príspevok slovenskej geografie)
V príspevku sa, po stručnom úvode charakterizujúcom formovanie urbánnej geografie pred rokom 1989, sústreďuje pozornosť na najnovšie výsledky výskumov, ktoré boli na Slovensku získané v ostatných dvoch decéniách. Príspevok sa sústreďuje na výsledky štúdia urbánnych štruktúr z intersídelnej a intrasídelnej objektívnej perspektívy, skúmania subjektívnych aspektov (percepcie) urbánnych štruktúr a ich transformácie, ako aj na pokusy o komplexné objektívno-subjektívne posúdenie urbánnych štruktúr.

Kľúčové slová: geografický výskum, intersídelná perspektíva, intrasídelná perspektíva, urbánna geografia, urbánne štruktúry, transformačné procesy, Slovensko

INTRODUCTION

Urban geography is usually referred to as a prominent part of human geography. This position is justified by its considerable input into the formation of the theoretical and methodological basis of human geography. The point is that cities are among the most complex and most dynamic subjects of geographical research. They are the territories with elevated concentration of population and human activities along with the highest level of transformed natural environment. Their present form is mostly the result of the long-term effects of various processes. The territories of cities are remarkable for a distinct inner differentiation caused by numerous factors such as the morphology and nature of urban fabric, functional use of areas, socio-economic, cultural and demographic features of population, environmental quality. For its complexity, the issue requires combination of various scientific approaches, concepts, research methods, and techniques.

The development of urban geography in Slovakia reflects the above quoted facts. To a certain extent, some aspects were already studied, for instance by Očovský (1993). Ira et al. (2005), Ira et al. (2006) and Matlovič (2007 and 2008), In this paper, after a short introduction devoted to a brief overview of developments in urban geography in Slovakia before 1989, the authors will concentrate on the novel research results obtained in Slovakia in the last two decades including those of the urban structure studies consideved both from objective inter-settlement and intra-settlement perspectives; study of subjective aspects (perception) of urban structures and their transformation as well as the attempts at a comprehensive objective/ subjective estimation of urban structures.

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DEVELOPMENT OF URBAN/GEOGRAPHICAL RESEARCH IN SLOVAKIA BEFORE 1989

The beginnings of urban geography in Slovakia are closely connected with formation of human and settlement geography. Geographical knowledge in Slovakia has already been assessed by Martinka (1964), Lukniš (1983) and most recently by Tibenský and Urbancová (2003). The first efforts in the study of settlements are represented by descriptive works mostly of cities in the framework of broadly conceived works that may be referred to as homeland studies such as *Notitia Hungariae novae historico-geographica* (1735-1742) by Matej Bel and *Geographisch-historisches und Produkten Lexikon von Ungarn* from 1786 by Ján Matej Korabinský. G. Hidi wrote a dissertation about the towns in the Kingdom of Hungary (Prikryl 1980) at the University of Trnava in 1701. In the 19th century, several descriptions of Slovak towns were written by various authors (P. Ballusa, E. Janota, J. Mikulik, J. Kompánek, K. Krasznyanszky, etc. (for more details see Matlovič 1998).

The modern Slovak geography of settlements emerged already in the 1930s when the only academic centre focused on geography existed at the Comenius University in Bratislava. It was established with a huge contribution of Czech geographers from Prague while the greatest input in favour of geography of settlements were studies of Ján Hromádka, who prepared an exemplifying monograph of Bratislava (Hromádka 1933 and 1935). The French anthropogeographical school considerably inspired Hromádka during his stay in Paris where he learned about the works of E. de Martonne, A. Demangeon and J. Brunhes. In his monograph, the urbanist Mencl (1938) synthesized the knowledge concerning spatial development and ground plans of Slovak towns. Statistical and demographic currents in the investigation of Slovak towns characterized the studies of Bokes (1938 and 1941). The initial phase of existence of Slovak urban geography also includes the works of Lamoš (1948) about Kremnica, Krpelec (1935) about Bardejov, or those of Fekete (1947 and 1948) about Petržalka and the ground plan development of Bratislava.

In spite of the fact that the majority of studies written in the initial stage of urban geography were monographs, which emphasized the individual features of analysed cities, the first indication of a split trajectory of the geographical research concerning the cities and gradual profiling of various approaches to research of spatial structure of a city became evident. It is comparatively clearly observable in morphological/genetic, socio-ecological, functional, spatial, demographic and cultural/genetic approaches.

After the Second World War, the geographical research intensified due to the extension of centres existing in Bratislava and foundation of new ones outside the capital at the universities of Prešov, Nitra, Banská Bystrica and Trnava. In this period of real socialism (1948-1989), Slovak geography disengaged from anthropogeography and followed the Soviet geographical school firmly embedded in the ideological basis of the dialectic and historic materialism. This change was symbolically concluded by the theoretical/methodological conference in 1961 in Bratislava. At this conference, Bašovský (1963a, p. 82) formulated the tasks of settlement geography identifying six basic thematic clusters: "structure of the individual settlements, structure of the settlement network, relationships between the city and its hinterland, urbanization processes, rural settlements and classification of settlements". Geographical research of the spatial city structure then became one of the

priority tasks of settlement geography. The practical sphere required it. Many geographers collaborated in processing the territorial-planning documentations of cites and regions. But the development of settlement geographical research cannot be separated from the overall development of human geography in Slovakia in the 1960s - 1980s. Human geography developed mostly in the reduced form of an economic geography in that time. Emphasis was laid on the geography of production, location factors for industries, questions about how to ensure a sufficient work force and so on. Little attention was given to social and cultural aspects. It was manifested in the gradual abandonment of the morphological-physiological aspects of urban fabric with an increasing stress on research into functional intraurban structures with a practical ending in the area of territorial planning. The development in the world geographical thinking was reflected in Slovakia with a slight delay. By the end of the 1960s, the first attempts to reflect the onset of quantitative geography appeared. It led to application of mathematical models and multidimensional statistical methods in urban-geographical research. In the 1980s, social issues were dealt with and the first studies involved with behavioural and humanistic geography emerged. The main research capacities were concentrated in Bratislava but the centres outside the capital also contributed to research on urban structures. Verešík (1955, 1956, 1966 and 1974), who was also responsible for the preparation of the chapter on population and settlements for the *Atlas SSR* was conserned with the issue of the city ground plan, functions of cities and inner urban structure at the Institute of Geography of the SAS. Later on Ira (1982 and 1984), delimited 15 basis functional structures of the urban landscape of Bratislava and Bezák (1987, 1988 and 1989) processed the studies of factor ecology of Bratislava (he identified four basic dimensions of the socio-spatial structure of the capital: stage of the individual's life cycle, socio-professional status, productive age and economic participation along with the size and occupancy of dwellings). He assessed the main currents in urban modelling; with Paulov he tested Clark's city model (Bezák and Paulov 1984), and with Horáková he processed the subject of ground plan shapes of the Slovak cities (Bezák and Horáková 1984). The work of Očovský (1989) about the pool of houses and flats in Slovakia was also a relevant contribution to the urban structure studies. Bašovský (1964) worked on the theme at the Comenius University producing a study about Košice and in cooperation with Paulov and Ira also about Bratislava (Bašovský et al. 1981, Bašovský 1991). The question of functional city classification and typology (Bašovský 1963b, 1975 and 1986), those of urbanization processes (Bašovský 1972, 1980 and 1984, Slavík 1986 and 1987) and formation of settlement agglomerations and centres (Bašovský 1966 and 1977) were also solved. The third centre in Bratislava was the Institute of Construction and Architecture of SAS, where Radváni (1982, 1983, 1985, 1989 and 1990) investigated geographical aspects of the city´s spatial structure. He applied the Lynch concept of city image to Bratislava and the Malé Karpaty Mts. vine growing townlets of Modra, Pezinok and Svätý Jur.

Apart from Bratislava, geographical research on the spatial structure of city's also went on in other centres. In Prešov, it was Karniš and Mihály (1971), Kandráčová and Michaeli (1982) and later Matlovič (1989) who identified four basic dimensions of the socio-spatial intraurban structure of Prešov by the method of principal components. In Banská Bystrica, Baran (1964) concentrated on the study of urban structures.

DEVELOPMENT OF URBAN GEOGRAPHICAL RESEARCH IN SLOVAKIA AFTER 1989

After the socio-political changes in 1989, conditions for the accomplishment of urban-geographical research have substantially changed. Opening to an ample international cooperation meant the possibility of diversifying theoretical and methodological approaches. A number of new phenomena emerged, which called for investigation. Transformation of the spatial city structure under the effects of socio-economic transition and globalization and the associated conceptualization of the post-communist or post-socialist city became the greatest challenge. In the sphere of inter-settlement research, questions of the hierarchical structure of settlements linked to the regional development and metropolizing processes became relevant. This research was also stimulated by the fact that Bratislava became the capital of a new state on the political map of the world in 1993. The interest of geographers in urban geography also increased for pragmatic reasons. The demand for fresh knowledge concerning restoration of the self-administering functions of cities increased. The accessibility of data, which was incomparably better than in the case of research into the productive and/or unproductive activities, played a certain role. For these reasons, the number of geographers involved with research on cities increased. Along with empirical studies, the work with the theoretical and methodological issues of the geographical research dealing with intraurban studies attracted attention (Bezák 1993, Korec 1996, Matlovič 1992, 1994, 1996, 1997, 1998, 1999a, 1999b, 2000c and 2002).

The following part of the paper will be dedicated to a brief summary of results achieved by the above-mentioned efforts. Regarding the scope of the theme, they will grouped and evaluated in four thematic clusters: study of urban structures both from the intrasettlement and intersettlement points of view, study of subjective aspects (perception) of urban structures and their transformation and attempts in comprehensive objective/subjective estimation of urban structures.

URBAN STRUCTURES: OBJECTIVE INTERSETTLEMENT ASPECT

The unceasingly developing and changing process of settlement is an infinite source of missing information both about its partial or global phenomena. Settlement or the settlement system can be comprehensibly but also analytically captured only by generalization and selection. Inconsistent for some and anticipated for other is the fact that the settlement system is an unstable secondary element of landscape, which rapidly adapts to external impulses. The settlement system can be considered in this context as the material carrier of the historic continuity in the landscape. An idea about ways of life of the preceding generations and simultaneously our possibilities and those of future generations is gained in the "scene" of the settlement. The settlement is the place of close interaction between humans and the landscape. The process of settlement formation is well reflected by the geographical science, the position of which, regarding the knowledge obtained, is located on a favourable multidisciplinary interface. Geographical sciences consider equivalent the material and social dimensions of the settlement. Likewise, equal attention should be given to the whole spectrum of settlement components: natural and by humans created material elements, structure and organization of accomplished activities and finally the character of the society and humans. In fact though, geographical research is fragmented into a variegated bundle of not necessarily communicating currents and

traditions, description of which has been exposed by Bezák (1993) and Matlovič (1994, 1996, 1997 and 1998).

Since the beginning of the 1990s, studies have appeared that correctly estimate the depth of the relevant events that determined the settlement developments in Slovakia in the preceding years. They discuss the probable consequences of these events for the future of the settlement system in Slovakia. In order to understand it, Bašovský and Divinský (1991) reached into the past, to the period of the beginning of modern urbanization (last third of the 19th century) and they consequently explained the four determining decades of communist history. Paulov (1992) assessed the position of settlement in Slovakia in a qualitatively new situation in the centres of the Central European macrospace pointing to the favourable position of the country in terms of transport. He predicted the need to complement and complete the transport, technological and information infrastructure as the indispensable prerequisite for the emerging options of cooperation between Vienna and Bratislava. Paulov also considered desirable an improved infrastructure in the region of Bratislava with regard to the special role of the capital in the national settlement framework. He stressed that the potential innovating effects of the neighbourhood will only develop if accompanied by a fully functional economic mechanism and the necessary level of human capital. Indirectly he predicted the long-term stagnation in transformation of this settlement space, which only ended in Bratislava with the accession to the EU. Mládek et al. (1998) evaluated the expected development of relationships between Bratislava and Vienna. Apart from disclosing the present developmental potential of this urban space, an interesting part of this study is the retrospective about how the inter-settlement relationships of these two cities formed. The situational aspect of Bratislava's potential in the settlement system of the Central European space was further analysed by Korec and Galasová (1994), Korec (1998 and 2002). In the last quoted study, Korec also assessed the change in Bratislava's position in the settlement system of Central Europe in the context of the political and social development in the region. Michálek (1994) discussed the possibilities of further development of the settlement system in Slovakia in relation to the launched transition of the economic sphere and questioning the past interventions into the settlement system. He assumed that its "reconstruction" would depend on the effects of numerous factors and trends, the force of which was impossible to predict. Bašovský (1995) presented an equally oriented study and exposed the determinants of the development of settlement structure in Slovakia and the principal inner factors shaping this structure in the period of social transformation after 1989. An interesting study, which evaluated the development of the settlement system in the country in the first ten years of transformation, is that of Matlovič (1999c), as the author explains the stagnation of population increase in the biggest Slovak cities.

Slavík et al. (2005), after obtaining an additional ten years of experience, returned to the subject of the settlement system of Slovakia in the transition period and focused on the development of the biggest urban centres in the country. They describe the development of their positions in the Slovak city system and analyse the institutional aspects above all the organization and implementation of territorial planning, but they also take into account some selected aspects of the functional structure of cities. The studies of Divinský (Divinský 2001 and 2001b), who analysed changes in the settlement systems of the Central European capitals through the development of demographic characteristics are also interesting in the context of exposed themes. The aim of his study was to point to the relative position of Brati-

slava among these capitals. A comparatively frequently treated theme in the past 15 years is also evaluation of Bratislava's position in the system of Central European cities. This phenomenon became the subject of studies by Korec (2003), Slavík (2003), Slavík and Grác (2008) and others.

Regarding the scale of research appropriate for capturing the intersettlement perspective, studies which asses the material aspects of settlement are rare. The morphological spatial structure of settlements in Slovakia became the subject of Hurbánek's (2006) study where the author tries to quantify and compare the relevant methodological approaches to the analysis of morphometric attributes. Motivation of this study has been the construction of an indicator of morphological rurality and setting of an objective boundary between the compact and dispersed spatial forms.

Empirical works concentrating on the socio-demographic and functional spatial structures of the Slovak settlement system dominated in the Slovak geographical literature. However, the methodological study of Paulov (1991) evaluating the relationships and development of the settlement system based on spatial-interaction approach is an exception. The author deals with the issue of derived spatial interaction models applying the theory of entropy. He unfolds entropy in urban and regional analysis describing its genesis as a scientific concept and the existing methodology (Paulov 1993). He works with the decomposition of entropy, location, and interaction and entropy maximizing models. Paulov (2004) removes the deficit of the model in the missing effect of distance of interactive sources and aims, by introducing a variable that expresses the level of transported loads and its integration into the original model. He proposes a model of the gravitational type suitable for the preliminary estimates of interactive intersettlement flows.

Migration was the key mechanism in evaluation and management of urbanization during the preceding social order. Sources of its long-term dynamics were removed by the change of the social order and substituted with the spontaneous reconstruction of the settlement system. Bezák (2000a) observed the development of migration flows between settlements and regions of Slovakia from the mid-1980s and tried to model them by several alternative spatial-interaction tools. Bezák (2006) abandoned the basis of the aggregated study of this phenomenon by the analysis of anonymized migration data. He experimented with specification of flows in the system of functional urban regions between the city and the rural area and demonstrated the depth of the change that took place in the core of the migrational redistribution in the post-communist period. Michniak (2003a) complemented the picture of the redistribution of population in the settlement system of Slovakia. He noted the accessibility aspect in centres of the settlement system regarding the hierarchically lower settlements and evaluated the basic principles of spatial organization of settlements based on spatial efficiency and justice. The method of evaluation that Michniak applied makes it possible to present the Slovak settlement system as one with a high rate of irregularity in terms of accessibility of big centres. In connection with Paulov's (1992) interpretations, it is an important study, which clarifies reasons for the present nature of settlements in Slovakia. The settlement system of the country tends to concentration on a small scale and simultaneously to dispersion on a large scale. This conclusion directly communicates with the research intent of Hurbánek (2006). However, the results of Michniak's (2003a) work are distorted by the missing time dimension of the potentially linked full format morphogenetic study of the settlement study. Michniak (2003b) also offered addi-

tional interesting results of the settlement system research against the background of a study devoted to commuting to regional centres of Slovakia in 2001. The documented intensity of links between the cities in a region and the regional centres is an important output of this study.

Nodal organization in the settlement system has been dealt with by Bezák (1990). Bezák worked with the hierarchy of settlements defining their cores and the network corresponding to the network of links, the intensity of which decreases with the increasing distance from the core. Regarding the accessibility of information about different forms of intersettlement links, his method leans on the basis of commuting between settlements. The core settlements discerned by their functional significance were aligned hierarchically lower settlement units of the system according to the mechanism of flows in the 1980 census. Bezák (2000b) later adapted his results by up dating the status recorded in the census year of 1991. The work of Očovský (1994), where he assessed the changing situation of the hierarchic links in the settlement system is limited to the region of the Capital only, but his attitudes are quite original. He asserted that in the integrated whole of the settlement agglomeration of Bratislava so far existing developmental factors were disappearing to be replaced by the market-based forces and innovation impulses. Očovský also confronted the region of Bratislava in the settlement hierarchy of Slovakia with the ideas of the classicistic socio-ecological models. Slavík et al. (2005) applied a similar method and identified the hierarchy of settlement centres in Slovakia by means of the commuting data. He also identified a set of settlements with the potential of a microregional core and captured links of settlements with these cores by the method of the maximum commuting flow of the first and the following orders. Evantually, he defined the cores by commuting to work and modified the obtained relations by commuting to schools and other auxiliary criteria into the presented form.

URBAN STRUCTURES: INTRASETTLEMENT OBJECTIVE PERSPECTIVE

A city is an individual element in the settlement system, the existence of which is also supported by the contemporary economic theory. The spatial concentration of population and their activities seems to be an advantageous form of organization, which brings a number of positive and negative externalities to the participating actors. The material dimension of the inner city structure is again presented in a limited way in the Slovak geographical bibliography while studies focused on functional/spatial and socio-demographic aspects dominate. Sporadically some more comprehensive studies emerge.

The aspiration of Matlovič' monograph (1998) was to bring a more comprehensive approach to the issue of intraurban structures. The spatial city structure is interpreted as a multilayered superstructure formed by interlinked and mutually determined partial intraurban structures: The physiographic intraurban structure is formed by the spatial differentiation of urban territory in terms of its natural potential (suitability) for the development of individual functions and types of urban fabric. This structure generates certain conditions for the development of additional intraurban structures. *Morphological intraurban structure* is formed by spatial differentiation of the material substance (morphological city elements). The principal morphological elements include streets, squares, plots and buildings. Elements can form hierarchically higher units such as a street network, urban blocks or quarters. However, the morphological intraurban structure also possesses its outer (physiognomic) and inner (purely morphological) sides. The outer side concerns the

architectural forms such as the style, building material and roofing of buildings, while the inner side is about urbanistic forms (ground plan). Physical structure is the term also often used for such structure. *The functional intraurban structure* consists of the spatial mosaic of location of economic activities existing in the city territory. They tend to occupy the best position in the city and thus create relatively homogenous functional areas. *Social-demographic intraurban structure* expresses the spatial differentiation of population, its biological, social, cultural, and economic/structural characteristics of its dynamic in the city territory. These four intraurban structures are connected and interlinked and interdependent. Change of one triggers transformation of the other three. The dynamics of transformation processes in each of them is different. The morphological structure is the one with the greatest momentum among the anthropogenically-determined structures. In turn, the social-demographic intraurban structure is the one that changes most rapidly. These partial intraurban structures are understood as complementary characteristics of the entire superstructure. The spatial structure (superstructure) of the city is always an immediate manifestation of a certain stage of its development. It includes elements of old structures and creates conditions for the emergence of new ones (Matlovič 1998).

Physiographic spatial structure found reflection in the landscape-ecological ground. Divinský and Pauditšová (2002) dealt with the environmental urban evaluations. They sought a connection between the city-forming mechanisms and the feedback of environmental factors. They mapped stress factors, the meaning of landscape capacity, ecological stability and suitability of anthropogenic activities. Hrnčiarová et al. (2006) focused on the urban ecosystem of the city of Bratislava. The authors assert, that environmental problems are due to the growth of the built-up parts of the city and expansion of its functions at the expense of the natural environment. The optimal development of a city, the authors report, means providing more space for landscape-ecological planning, an example of which is eventually their study. Out of numerous characteristics of elements that determine the functional-spatial development of a city (geomorphological division, geological substrate, inclination of relief, soil types, solar radiation and climate types, secondary landscape structure and the principal biotopes, nature conservation, territorial system of ecological stability, protection of natural resources, cultural and historical monuments, selected geophysical and geodynamic phenomena, air quality, water source quality, degraded soils and vegetation damaged by emissions) they also produced a synthesis by gradual superposition of partial syntheses of individual landscape elements. The study established the limits for the main groups of activities in a city (construction of dwellings and family houses, arable land, vineyards, orchards and gardens, summer and winter recreation, etc).

Matlovič (1998) systematically analysed the morphological spatial structure of the city for the needs of his comprehensive study. It is a continuation of his numerous works written earlier. Korec and Ondoš (2004) describe interventions into the city morphology in the Capital of the SR that took place during the 1990s. These are explained by the processes of transformation of the functional structure attributed to the central territory. The effects of the abrupt invasion of the financial sector into the development of the functional and morphological structure of Bratislava's centre was the theme chosen by Buček and Pitoňák (1997). They also treated commercialization in general which was first manifested in the historic city core and initiated the process of its revitalization. Korec and Smatanová (2000) evaluated the historic spatial development of the residential area constructions in Bratislava. They

defined the factors, which have probably guided it and the periods when it critically changed in terms of quantity and space or distribution. In the opinion of the authors, these change in the development of residential areas in Bratislava, corresponded to the political turbulences in Czechoslovakia of 1968 and 1989. Pouš and Hlásny (2006) working with the problem of un-urbanized enclaves in the territory of the city of Banská Bystrica drew closer to the rules generating the mechanisms of morphogenesis. The study represents a retreat from the traditional land use mapping to the simulated modelling of the last generation. It is a continuation to the preceding study of Pouš (1998), where the author pointed to disproportions in the functional use of the territory of Banská Bystrica obviously expecting their gradual removal. Popjaková (1998) brought a critical evaluation of the functional spatial structure in relation to new requests concerning use of the city territory using the example of Bardejov. Meanwhile, the work of Korec and Husárová (1994) was an attempt at a comprehensive assessment of the new social conditions and their effects on the development of functional use of city territory using the example of Bratislava.

Elements of a functional spatial structure in Bratislava and its evident dynamics in the transition period inspired several studies of a different nature. Bučeková (2007) documented the increase of tourism in Bratislava and its possible effect on intraurban city structure. Factors determining the development of tourism were analysed in the framework of functional spatial structure. She attempted to explain the observed location of tourism activities in the urban space. Her analysis reached back to the mid-1970s. The development of tourist activities were described either in relation to the administrative division of the city or to concentric zones depending on distance from the centre. The authoress identified the trend of spatial deconcentration and expansion of this function. Korec (2000) showed the trend of functional fragmentation of extensive monofunctional areas in the city using the example of eastern Bratislava. Székely (2002) presented the methodology of selection of an ideal locality for the scientific and technological park in Bratislava. He assessed the potential localities by an expert method based on the significance of presumed factors. Križan (2007) measured the different accessibility aspects of a selected retail category in the territory of Bratislava. He chose an aggregated base of source circles of clients and the target establishments for his research and subsequently applied regional taxonomy to the result of the accessibility of retail shops using the procedure of hierarchical clustering.

Buček (1996) moved in the field of institutional approaches to the assessment of changes in the intraurban structure. He paid attention to the State as an actor that formulates/creates conditions for the formation of spatial structure. The relationship of the city and the changing political environment of a historically transformed State is the central theme of his empirical study of Bratislava. The same author, (1998) was interested in decentralization of the big city administration and its possible effect on its spatial structure. He studied the representation of the local community in the context of searching for its harmony with city interests in nine cities. In his other study, Buček (2000) returned to his theme of the analysis of decentralization types. He evaluated the communal sector previously controlled by the State now changed into the form of the united public, public-private and private firms providing services in the city. Local self-government is perceived as an irreplaceable mediator of the civic society and local democracy. Slavík and Grác's (2008) contribution also deals with the quoted subject.

Ondoš and Korec (2006) tried to deal with the problem of heterogeneity proper to the urban population. The reality of the transforming city was very distinctly reflected in its socio-spatial intraurban structure, which is generally considered the most dynamic of the partial inner city structures. The characteristics of residential areas also contain hidden parameters of their populations. The study was based on an exploratiory approach of the socio-ecological tradition applied by Bezák (1987 and 1988) to Bratislava two years ago. However, this approach did not allow capturing of the directions of the shift of the socio-spatial structure over time. This is the reason why the results only confirm the continuity of Bratislava's known features and the spatial patterns of its socio-spatial structures. Analysis of Bleha and Popjaková (2007) tried to predict the development of the emigration component of the population dynamics on the local level. The subject of their work is Petržalka as a special part of Bratislava. The contemporary situation in migration in Petržalka is described in terms of the structure of migrants. The authors analysed factors of contemporary changes and in the following step generated the trio of variants of expected development in migration. The theme of the study is linked to the works mapping the same field in the mid-1990s (Mládek ed. 1994, Cibuľková 1994 and other).

Urbanization is the general process forming the settlements of urban type. Urbanized space can exist in different stages of development. Enlargement of the urbanized area is interpreted either as additive expansion of the urban way of life or the development of urban focuses proceeding to the full urbanity. Urbanization possesses morphological, economic, infrastructural-technical, social and functional dimensions of social perception (Matlovič 1998 and 2002). The urbanizing process is traditionally studied in macroregional and mesoregional scales by simple or less often more sophisticated techniques. In individual periods, the spatial pattern of an area with a different grade of urbanization appears, and this finds support in the urban-rural continuum, phased city growth, cyclic nature of additional morphological processes or developmental stages of urbanization. The synthesizing works concentrate on the concept of urbanization. Matlovič (1998) considered crucial the morphological, functional and socio-demographic attributes of urbanization. He empirically represented them by twenty measures to synthesize them afterwards by multidimensional statistical tools. The result is the confirmation of a comprehensive differentiation of the intraurban structure for the city of Prešov. As expected, he positively tested the narrow bond between the quoted attributes. But the technology he used did not allow him to abandon the aggregated base of an otherwise theoretically outstandingly constructed study.

Along with the concept of the differentiated rate of intraurban urbanization, Matlovič (2002) also drew attention to the application of the quality of life concept with a synthesized interpretation of intraurban structures. These efforts are also recognizable in a papers by Ira and Andráško (2008). Their paper was based on the results of two inner structure studies involved with the objective dimension of the quality of life or living conditions within the territory of Bratislava. They were applying practically the same methodology in two different periods with a temporal gap of twenty years between the data collections. The first of the two compared studies was based on research conducted in the 1980s (Ira 1984). The analysis showed that the quality of life was markedly differentiated in the study area. After an interval of more than 20-years, a study of the quality of living condition in the territory of Bratislava has been produced (Andráško 2006, 2007 and 2008). Its content and methodology are

the follow-ups to the above-mentioned paper (Ira 1984). By methods of multidimensional analysis or classification, groups or regional spatial structure types were compiled. Spatial differentiation of regional types shows that the degree of intraurban variability in QoL is very high. Interpretation and comparison of the regional typology of Bratislava's quarters based on the selected indices was considered the final aim of study. With respect to the number of the identified regional types (14 in the first case study and 12 in the second), no marked difference was found. The paper represents a practically unique comparison of two studies in the Slovak geographical literature involving the quality of the population's living conditions in a particular urban environment separated by a 20 year time span, but with almost the identical research methodology applied in both of them. The comparison of results obtained from the two studies nevertheless suggests that not even differences in sets of input variables and spatial units observed inevitably pose a compelling problem and that identification of some similarities or changes of territory in the given time interval is possible. Both works proved the existence of the common features to quality of living conditions in given spatial units on the one side, but also pointed out that the rate of such similarity is limited. It ensues from a certain rate of uniqueness attributable to the conditions of the particular spatial unit (locality) of the city at a certain time.

Divinský (1999) dealt with the possibility of expressing the transforming inner structure of Bratislava and planned to rely on the scope of its morphological spatial structure. The intention though, was reduced to the delimitation of the continuously built-up territory with the occurrence of urban functions and a supplementary criterion of a threshold population density. He carried out a socio-ecologically inspired regional typification complemented by the construction of a land use map. Ira (2003) tried to present the basic picture of the changing intraurban spatial structure of Bratislava in the 1990s in a period of the dramatic transition processes. He delimited five zones: historic core, inner city, villa quarter, residential quarters and periphery. He located the basic transformation processes and investigated how they are perceived by the inhabitants. This study bears features of a general model of transformation later elaborated by Matlovič (2004).

Matlovič worked in this study with the dynamics of the inner spatial structure of cities within a general framework of the post-communist Central Europe. He considered its cities temporary forms between a socialist and capitalist variation. Adaptation of structures to the new conditions is determined by transition and globalization factors. The core of the study is identification of the characteristic features of transformation processes in individual partial intraurban structures. The author built upon Sýkora's study (2000 and 2001) which asserted that the geographical model of a post-communist city must contain not only a description of changes in spatial structure, or the results of transformation but also an analysis of the processes that led to such changes. The approach was applied in the work on the international project supported by the Research Support Scheme No. 2176/308/1999 *Transformation of spatial intra-urban structures and their reflection in perception: A comparative study of Prague, Bratislava, Olomouc and Prešov* (Matlovič et al. 2001a and 2001b). Other studies, relevant because they consider the phenomenon of transforming urban structures, for instance those of Baran (1999), Bašovský (1995), Dická (2006b and 2007b), Divinský (2002), Chorvát (2008), Ira (2001 and 2003), Korec (1999 and 2006), Korec and Smatanová (1997), Matlovič (2003 and 2004),

Matlovič and Sedláková (2007a), Ondoš and Korec (2008), Slavík et al. (2005) also implicitly or explicitly apply the processual approach. The summarizing work of Mládek ed. (1994) brought some valuable knowledge about the development and topical situation in urban structure of Petržalka.

Studies endeavouring in practical application of the knowledge in the area of territorial planning constitute a separate group (Slavík 1999, Slavík and Chlapovič 2003). The indivisible part of efforts of Slovak geographers is their participation in production of monographs about individual cities (for instance Zlaté Moravce, Skalica, Senec, Modra, Banská Bystrica, Poprad, Sabinov etc.).

Tab. 1. Transformation processes and their projection into partial intraurban processes and individual city zones

Intraurban structure	Morphological	Functional	Socio-demographic
Transformation process	suburbanization (E) gentrification (B, A) revitalization (A,B,C,D,E) recession and urban fallow (B, D,E)	suburbanization (E) commercialization (A,E,B,D,C) deindustrialization (B) demilitarization (B) sacralization (A,B,C,D,E) functional fragmentation (A,B,E)	suburbanization (E) gentrification (B,A) segregation (B,D,E) separation (A,B,E) status regression (D)

Zones: A - Centre, B – Inner city, C – Villa quarters, D – Housing estates, E - Periphery
Source: Matlovič 2004, p. 147.

Transformation processes of intraurban structures are characterized by the level of comprehensiveness of their effects. This is the reason why it is necessary to study the effects of individual transformation processes when exploring changes in the spatial structure of cities. On the basis of conceptualization of a city's spatial structure as a superstructure of three mutually dependent and interlinked partial intraurban structures (more in Matlovič 1998) these effects were studied on the level of morphological functional and socio-demographic intraurban structure. According to the effect in relation to the quoted intraurban structures, they are (tab. 1) *complex transformation processes* (where the three partial structures change), *partially complex processes* (changing two partial intraurban structures) and *elementary transformation processes (*where one intraurban structure changes). These processes are mutually dependent (Matlovič 2001 and 2004). An other important feature of transformation processes is their differentiated course in individual city parts. In this context, there is the need to delimit a smaller observation zone in the territory of the studied city, which will serve the study of transformation effects. Respecting the spatial and morphological development of the city, five basic zones can be identified: centre (old town), inner city, villa quarters, housing estates and periphery. The medieval core with its closest environs represents the centre. The inner city is a compact urban fabric linked to the industrial phase of urbanization in the 19th and beginning of the 20th centuries, which normally surrounds the core of the city. Villa quarters are residential areas where family houses built prevailingly in the course of the 20th century dominate. Housing estates are extensive series of blocks of flats built in the time of the socialist urbanization (1950s-1980s). The periphery consists

of suburban parts with less compact urban fabric normally formed by areas of agglomerated rural settlements and functionally heterogeneous areas, e.g. industry, technical infrastructure, warehouses, agriculture and/or recreation (Sýkora 2001, Matlovič 2004).

Slovak geographers treated transformation processes of intraurban structures in different ways due to the different frequency of such processes in Slovak cities. The greatest attention has been devoted to *suburbanization.* It is, the process, which is manifesed on the level of all three partial intraurban structures. It is, therefore a complex transformation process. This process is quite distinct in the post-communist cities due to the fact that changes are manifested above all in those parts of cities where the use of space does not correspond to the new socio-economic conditions. As Sýkora (2003) reports, these spaces include the city centre and some contiguous quarters of the inner city, but on the other side they are the edges of the city and the suburban zone. Suburbanization logically concerns suburban zones and is manifested by the development of new settlement structures. In terms of function, residential and commercial suburbanizations are discerned. Consequently, it is the development of residential and commercial areas at the cost of farmland or *greenfields*. Regarding the significance of this transformation process, Slovak geographers have frequently treated the theme. An extensive study containing conceptualization of this process and empirical verification of its frequency in the suburban zone of Prešov was written by Matlovič and Sedláková (2004), while the following also dealt with the subject in their other works: Matlovič and Sedláková (2007a and 2007b), Sedláková (2005a and 2005b), Sedláková and Matlovič (2008). Other authors who wrote about suburbanization include: Czaková (2008), Dická (2006a and 2007a), Slavík and Chlapovič (2003), Slavík et al. 2005, Slavík and Kurta (2007), Spišiak and Danihelová (1998), Spišiak and Kulla (2008), and Zubriczký (2005). *Commercialization* is the process, which manifests above all in the framework of intraurban structure. It is characterized by an increasing share of areas with commercial activities (commerce, servicing, commercial offices, and the like) at the cost of other than commercial and economically less lucrative activities such as dwelling, culture, education, etc. (Sýkora 2001). Commercialization in turn provokes changes in the morphological intraurban structure (revitalization, intensification, addition). Commercialization is often accompanied by functional fragmentation. Its direct consequence is the retreat of the residential function. It is connected with the arrival of new users or new owners. Types of commercialization are residential, servicing and industrial. The principal possible effects of residential commercialization is the construction of new condominiums while the result of servicing commercialization are new shopping centres with hypermarkets, shopping galleries, and leisure centres. The effect of industrial commercialization appears in the form of new industrial, technical and research parks. Several authors (Ira et al. 2001, Kandráčová 2000, Matlovič 2001 and 2004, Popjaková 1998, Sedláková 2005a, Slavík et al. 2005, etc.) pointed to the occurrence of commercializing processes. Another process identified in the Slovak cities is *revitalization*. It is manifested the level of the morphological intraurban structure. It is one of the elementary transformation processes involving the gradual adaptation, reconstruction and broadening (horizontal and vertical addition) of the existing structures or exchange of older structures for new ones (substitution). Reconstruction of transport corridors, construction of pedestrian zones, adaptation and construction of small-scale

architecture above all in historic city cores are also parts of revitalization. Revitalization is determined by processes that take place on the socio-demographic (gentrification) level and functional intraurban structure (commercionalization, functional fragmentation). It is normally initiated by the change of owner or user. Revitalization is a process that can occur in all city zones but it is most notable in the central zone. Ira (2001), Korec and Ondoš (2004), Matlovič (2000a) and other were the geographers who drew attention to the process of revitalization.

Gentrification, like suburbanization is the process linked to a particular space of the city. It is migration of younger population with higher socio-economic status in to older quarters of the inner city followed by substitution of the original older population with low social status, change of ownership, renovation and modernization of the neglected dwelling pool (Sýkora 2001). Hence, gentrification is directly linked with the socio-demographic structure and with additional secondary links to the morphological intraurban structure. The theme of gentrification has not been frequently addressed by Slovak geographers as it is normally associated with a city size that is absent in Slovakia.

*Recession and urban fallow***.** is a process that is manifested on the level of morphological intraurban structure by degradation of the existing urban fabric, gradual deterioration of the technical and aesthetic condition of buildings and streets. In extreme case, a complete abandonment of buildings and spontaneous or controlled liquidation (urban fallow), follow with the consequent reduced density of the urban fabric. Recession can be determined by many processes on the functional (deindustrialization, demilitarisation) or socio-demographic (segregation, ghettoization) levels of intraurban structures. Recession also sometimes follows unsettled ownership and lingering lawsuits. If the recession is steered it can be interpreted as a short and temporary stage when the morphological processes precede the developmental stage. Recession can occur in any city zone. In Slovak geographical literature it was Matlovič (1995 and 1998) who partially worked with the theme of city urban fallow. occurrence. Pouš and Hlásny (2006 and 2007) drew attention to the functional disproportion and not fully exploited areas of the city of Banská Bystrica.

Functional fragmentation is a process manifeste on the level of functional intraurban structure. It is connected with the post-modern trend, which in contrast to modernism, prefers multifunctionality and functional mixture of urban areas to a strict separation of functions. The processes manifested in a gradual dissection of originally monofunctional structures and areas into smaller parts, which later acquire different functions depending on organization, user or owner appurtenance. Functional fragmentation is notable in centres and inner city parts (this is mostly fragmentation of areas belonging to administration, especially typical for small and medium sized cities) and periphery (fragmentation of industrial areas, warehouse areas and permanent agricultural structures). Ira (2001), Matlovič (2000a) and others mentioned fragmentation.

Deindustrialization is the process evident on the level of functional intraurban structures. It means the reduction of industrial, warehousing and technical infrastructure areas (for instance, ports) in favour of other functions or in favour of unused areas. This process is determined by transformation of industrial production with its transition to the post-Ford model and changes of industrial location factors. It can also result from the respect for ecological factors where the aim is to elimi-

nate the negative effects of unsuitably located industry in the environmental quality. Deindustrialization is evidently typical for industrial areas situated in the inner town. One consequence of deindustrialization is often recession or even urban fallow on the level of the morphological intraurban structure. The result is devastated and contaminated areas (*brownfields*) difficult to revitalize, although those with attractive positions have better chances.

Sacralization is a process that takes place on the level of the functional intraurban structure. In the strict sense of the word, it is expansion of the sacred area at the cost of the profane one. The sacred area can mean the space exclusively dedicated to servicing and cult purposes. In a wider sense of the word, sacralization means expansion of the space for any religious function including churches, monasteries, administrative buildings of churches, church schools, shops with religious objects and so on. Sacralization depended on the restoration of religious freedom in the post-communist countries. It is determined by the rate of population's religiousness. Matlovič (2000b) analysed the process in more details.

Separation occurs on the level of the socio-demographic intraurban structure. It is spatial separation of a certain population group from the majority population based on socio-economic characteristics while this is an active and voluntary separation stemming from people´s proper preferences. Normally it is the process in which a population group with high socio-economic status or the representatives of the new elite take part. As a consequence of separation, closed, isolated and often guarded residential areas sometimes combined with commercial use are formed. These areas of superstandard dwellings exist in the centre, the inner city or the periphery. Smatanová (1999) was one Slovak author who dealt with the issue of superstandard dwelling in Bratislava.

Segregation is manifested on the level of the socio-demographic intraurban structure. Factors causing it are similar to those that lead to separation. Segregation is preceded by social polarization. It is the spatial separation of a population group because of its low socio-economic status or ethnic, racial and religious features. However, segregation is not the result of people's own preferences but of an open or latent discrimination by the majority. Hence, it is the case of a forced spatial separation. The extreme consequence of segregation is ghettoization: creation of areas, which assume negative links to their environs (ghettos). Local governments sometimes build residential areas for socially disadvantaged or those unwilling to adapt that can bear features of ghettos (in Slovakia see, Luník IX in the city of Košice).

Status regression appears on the level of socio-demographic intraurban structure. This involves a slow decrease of the socio-economic status of population without spatial movement or shift of such population within the urban organism. This processes associated with specified features of the socio-demographic intraurban structure in the communist era when the aim was to build an egalitarian city. The dwelling policy led to the formation of extensive residential quarters with equal living conditions that were occupied by members of individual socio-professional population groups. This policy strove to wipe out the differences in the socio-economic statuses between the individual residential areas. Several studies concerned with the issue (for instance Bezák 1987) have shown that cities in the communist countries were internally differentiated above all in terms of family status

that is by demographic indicators. Studies in factor ecology of Polish cities have also identified, apart from the dominating socio-spatial status, dimensions that correspond to family status (Węcławowicz 1988). The result of this development is the existence of residential areas in different stages of the life cycle (both of the families and the buildings). It seems a significant factor in the process of regression of the socio-economic status which emerges mostly in residential areas where the inhabitants have reached the advanced stage of their life cycle (Matlovič 2001). An income drop, a shrinking share in power and social prestige, and often an overall pauperization of the concerned persons and city quarters, accompany the retirement. Status regression can also strike persons in other stages of the life cycle (for example in the case of loss of job) but it seldom gains such reflection in urban space as the regression caused by reaching the advanced stage of the life cycle (Matlovič 2001).

The sociologist Gajdoš (2002) considered this theme. He understands city as a settlement unit and a social community and investigates its formation in the context of the whole society and its general changes. Gajdoš described the problems of a city as a settlement type and its critical reflection in social sciences. Simultaneously, the city for him is the socio-cultural milieu of a modern society. He pointed to the need to humanize it and to improve the quality of life. He addressed the new spatial urban forms and estimated effects of globalization on the settlement process, and especially on the development of cities.

URBAN STRUCTURES AND THEIR TRANSFORMATION – SUBJECTIVE PERSPECTIVE

The last two decades in Slovakia were years of changing (intra-) urban patterns, which arise from various processes conditioned by political, economic and social changes symptomatic for the post-socialist, transition period. The cities, and the processes that produce them have changed and will continue to change. There are many processes that have contributed, and are still contributing to the changes of urban patterns. Cities are characterized by the gradual development of new life styles, changes in demographic structure and behaviour, social and economic changes, polarization of society, and technological changes.

The behavioural approach in urban geography is less concerned with the production of descriptive models of urban form and more with the production of interpretative insight into the relationship between people and their environment. Some urban studies are based on the behavioural approach and concentrate on the perception of spatial, social, cultural, economic and institutional transformation, sustainable development and quality of life in the urban environment. The emphasis on people's view of the environment and its dynamics, and the resultant mental image encouraged human geographers to think in terms of environmental perception and mental images. Perception can be regarded as helping to build a world of identifiable things.

Many processes have contributed to the changes of intra-urban patterns. The paper by Ira (2003) outlined some implications of the intersection of political, economic, social, cultural, demographic, technological and other trends for urban change in Bratislava in the late twentieth century. Many of them were primarily caused or accelerated by the political changes in 1989 and the following transition.

The processes, which transformed the urban pattern in Bratislava in the last decade of the 20th century had specific manifestation in various types of zones within the city (historical core, inner city, villa quarters, housing estates, and the periphery).

Investigation of perception of the urban environment and its dynamics (Ira 2003) relied on surveys conducted among respondents (University students) in Bratislava in 2000. Among the positive features of the city´s development during the period of transition respondents identified reconstruction, renovation, modernization, new shops, supermarkets, hypermarkets, development and improvement of infrastructure, renewal, reconstruction of the historical town, more and better quality of greenery, more job opportunities, new constructions, development of tourism and recreation facilities, better quality of services, and improvement in aesthetic quality and tidiness as the most important. Among the major negative features of the city´s development during the last ten years, respondents identified the environmental pollution, deterioration of the environmental quality, less security, drug crime, crime, vandalism, bad situation in traffic and the deteriorated public transport, aggressive commercialization, construction of new supermarkets and hypermarkets, unemployment, weak infrastructure, insufficient overall development, and lower aesthetic quality of the urban environment as the most important.

Examination of selected changes in five zones showed that in respondents' opinion, radical improvement in availability of shopping, basic services and aesthetic quality of the environment was recorded in the historical core. Respondents estimated security as worsening or radically worsening. In housing estates, the students estimated changes in the area of shopping availability, basic services (improving or radically improving) and public security, interrelations between people, environmental quality (worsening or radically worsening) to be most serious. In villa quarters, only changes in housing quality and aesthetic level were favourably perceived. There was no radical polarization in perception of changes in the peripheral zone.

The opinion concerning trends of the economically, socially and environmentally balanced, that is sustainable development showed that trends in the historical core were perceived by most of respondents as favourable. The developmental trends in housing estates were estimated by almost one half of respondents to be unsustainable. As far as the estimates of the development trend in 17 municipal districts are concerned, the best situation was found in the old town (three quarters of respondents estimated the trends to be sustainable) and the worst situation was attributed to the housing estate of Petržalka (estimated by almost one half of respondents to be unsustainable).

Through use of the subjective (perceptual) approach, the author was able to identify various features of the urban development and to comprehend the "geographical reality". Studies of elements of the reality through the perception of urban development and urban environment can be brought together constructively in order to promote improved further development and conditions for sustainable living. Subjective images are important components in identifying reality as perceived by individuals or groups within the population, and in selecting information for decision making that may alter that reality.

COMPLEX EVALUATION OF URBAN STRUCTURES (SUBJECTIVE AND OBJECTIVE DIMENSIONS) IN THE CONTEXT OF THE QUALITY OF LIFE

The post-socialist cities can be characterized by a transition developmental stage connected with the dynamic changes related to the adaptation of intraurban structures and behaviour of urban population to new conditions (Matlovič 2004). Significant political, social, and economic changes in the post-socialist countries and the technological progress have increased an interest in issues relating to quality of live (QoL).

Cities are diverse from the natural, economic and socio-cultural points of view, and can generate various conditions for living. In recent years, the post-socialist transformation accelerated intraurban diversification of cities and towns. The usefulness of measuring the differences in quality of life within cities is of central importance in the current applied urban geographical research in Slovakia. Urban geographers engaged in quality of life research have identified several outputs of value to social scientists and policy makers. These include identification of spatial differentiation and trends over time, knowledge of how satisfaction and dissatisfaction are distributed through society and across space, understanding how people combine their feelings about individual life concerns into an overall evaluation of QoL, and monitoring the effects of urban policies.

Several researchers agree that the meaningful definition of QoL must recognize two linked dimensions to the concept. With respect to the first dimension, several terms have been used for example individual/personal QoL, subjective well-being, or life satisfaction. For the second dimension there are different levels and terms used, for example, urban QoL, community QoL, quality of place, environmental QoL. It is often argued that is important to combine both dimensions (Massam 2002). In order to obtain a proper understanding of urban QoL it is necessary to employ both objective and subjective evaluations. In other words, both ‘the city on the ground‘ and ‘the city in the mind‘ should be considered (Pacione 2003). In at least three urban geographical studies (Ira 2005, Andráško 2007, Ira and Šuška (2006 and 2008) the above-mentioned two basic approaches were employed to illustrate the application of ‘the city on the ground‘ and ‘the city in the mind‘ concepts.

In the first study (Ira 2005), two quite distinct types of indicators were analysed in the city of Bratislava. The first approach comprised objective indicators describing the environments people live in. Applying the concept of territorial indicators (employing objective measures derived from analysis of census-based, and other urban environment data sets) spatial variations in QoL were identified and analysed within city wards. The second approach was based on a survey conducted among inhabitants of Bratislava. A large-scale sample survey of 520 respondents was conducted in 2003 to analyse the meaning of the phrase quality of life, to measure spatial variation of overall QoL as well as the levels of importance of various aspects of life. It was found that in Staré Mesto (old town), the QoL was high, and in Petržalka (the largest housing estate in Slovakia built in the late 1970s) it was low. The analysis of subjective indicators intended to describe the ways inhabitants of Slovak capital perceive and evaluate the urban environment conditions.

Respecting the consensus, that QoL consists of two dimensions, Andráško (2007) analysed the level of objective and subjective QoL in city wards in a separate way. The objective dimension of the quality of life in Bratislava city wards was

investigated by two separate approaches. The first inspired by the social indicators research stresses the importance of socio-demographic and economic characteristics. The second approach emphasized the assessment of the living conditions. Selected domains of the quality of life in Bratislava were analysed including the housing quality, environment, transportation, crime and amenities. Regularities of internal spatial differentiation in the city were investigated. By means of multivariate statistical techniques, regional types of internal structure of Bratislava from the viewpoint of living conditions quality were identified.

The survey focused on the subjective quality of life dimension was conducted by the means of questionnaires (874 respondents – city inhabitants). Wards with the highest and lowest perceived level of the quality of life were identified. Apart from other things, the results of the survey showed that the quality of the life in the worst evaluated urban district Petržalka (large-scale housing estate) was more negatively perceived by the inhabitants not living there. At the level of city wards, satisfaction with selected criteria of the quality of life was analysed. The selection of criteria covered the most important life domains and living conditions. From the whole city perspective, satisfaction with the accessibility of food store, local schools and city centre reached the highest level. On the contrary, the lowest satisfaction related to the activities of the local self-government, amount of personal influence on what goes on in the area and the tidiness of the streets and surrounding areas. Overall satisfaction with the area as a living place was analysed separately showing in general that satisfaction prevails.

Using the values of satisfaction and importance as the quantitative and qualitative aspects of quality of life criteria, modification of the simple additive weighting index was employed to provide an overall quality of life score for each city ward. Based on the scores, the ranking of wards was produced, showing the differences in achieved level of quality of life. Linking the knowledge about the objective and subjective dimensions of life quality in Bratislava enabled the author to acquire a summarized and comprehensive perspective.

Two complementary approaches were also employed to illustrate spatial variations of the QoL within a small industrial town. The papers published by Ira and Šuška (2006 and 2008) briefly documents the development of the intraurban structure of the young industrial town of Partizánske (the Baťa factory established in 1930s) in the context of and in relation to the urban geographical approach to the QoL research. The first approach was based on selected objective indicators of the QoL (clustered in five domains: location and accessibility, demographic situation, housing and amenities, environmental situation, and economic situation), using experts' assessment of their relevance. The analysis of subjective perception of the QoL in the city through its inhabitants was the core of the second approach the authors used. Respondents commented the issue of the importance of in advance defined QoL domains (which agree with those used in the first approach), hence in fact the theoretical question of the QoL model. They also evaluated the comprehensive QoL in observed urban districts of Partizánske; which means the actually perceived QoL in the territory of the town.

Comparison of results obtained in both approaches has pointed to partial agreement that appeared in identification of the most important areas that affect QoL and in identification of spatial units characterized by the top and or the lowest QoL level values. The comparison also brought about a number of contradictory conclusions,

which in fact support the views that argue the need to apply both approaches (research on objective and subjective QoL dimensions). Different perception of important aspects of QoL and their levels point to the significance of social characteristics corresponding to individual groups of respondents.

CONCLUSION

Urban geography in Slovakia has responded to the general developments in the human-geographical thinking of the recent two decades. Its development was greatly stimulated by the demand of the practical sphere for geographical knowledge. Urban geographers play an important role in preparation of the strategic developmental documents where the settlement analysis is a key factor. Among such documents were: *The Concept of the Territorial Development of Slovakia* (2001), *Strategy of the Public Administration Reform* (1999), and the *Concept of Public Administration: Decentralization and Modernization* (2000). It is expected that the stress on the holistic view of relationships existing between the society and the environment will increase. The spatial or geographical view will still be needed in the search for the substance of the fluid reality we are living in. Hence, synthesis is the central task of geography; it always brings something new and superior to the mere summarization of several independent parts (Ira et al. 2006). In such effort, the combination of idiographic and nomotetic approaches accompanied by consideration of both the subjective and objective perspective will undoubtedly play an important role. Urban geography in Slovakia will presumably proceed by supplying proofs and the *in situ* research method important for the comprehension of contexts and identities (Ira et al. 2006). An increased emphasis on the methodological framework based on processes (processes that generate and transform urban structures) is expected. One of the possible paths is further elaboration and application of the concept *place* in its three-structured version (more in Matlovič 2007), or application of network concepts (more in Matlovič 2009). A challenge for the urban-geographical research is the increased demand for applied research results. Slovak urban geography can offer valuable impulses and knowledge for the sphere of public administration, territory marketing (for instance Matlovičová 2008), territorial planning, and strategic planning, while the aim of the applied knowledge should be an environmentally and economically sustainable development and increased quality of life.

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REFERENCES

ANDRÁŠKO, I. (2006). Percepcia kvality života v mestských štvrtiach Bratislavy. *Geografická revue*, 2, 227-240.

ANDRÁŠKO, I. (2007). *Vnútorná štrurkúra mesta z hľadiska kvality života*. Dizertačná práca, Geografický ústav SAV, Bratislava.

ANDRÁŠKO, I. (2008). Regionálne typy vnútornej štruktúry Bratislavy z hľadiska kvality životných podmienok. *Geographia Slovaca* 25, 159-173.

Atlas Slovenskej socialistickej republiky (1980). Bratislava (Slovenský úrad geodézie a kartografie, SAV).

BARAN, V. (1964). Moldava nad Bodvou – geografia mesta. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 4, 321-338.

BARAN, V. (1999). Zmeny v urbánnej štruktúre Bystrického podolia a Sliačskej kotliny. *Geografické štúdie*, 6, 217-221.
BAŠOVSKÝ, O. (1963a). Predmet, metódy a vývinové smery geografie sídiel. *Acta Geologica et Geographica Universitatis Comenianae, Geographica*, 3, 73-88.
BAŠOVSKÝ, O. (1963b). Príspevok k funkcionálnej klasifikácii miest a prechodných sídiel Slovenska podľa stavu v roku 1950. *Geografický časopis*, 15, 6-29.
BAŠOVSKÝ, O. (1964). Košice – geografia mesta. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 4, 295-320.
BAŠOVSKÝ, O. (1966). Genesis, functions and perspectives of towns of East Slovak Region. *Acta Geologica et Geographica Universitatis Comenianae, Geographica*, 6, 93-144.
BAŠOVSKÝ, O. (1972). Niektoré problémy urbanizácie Slovenska. *Acta Geographica Universitatis Comenianae, Geographica*, 11, 49-66.
BAŠOVSKÝ, O. (1975). Premeny vo funkciách miest Slovenska vroku 1950-1970. *Studia Geographica*, 52, 13-24.
BAŠOVSKÝ, O. (1977). Formovanie sa aglomerácií Banská Bystrica-Zvolen a Martin-Vrútky. *Acta Geographica Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 15, 49-76.
BAŠOVSKÝ, O. (1980). Vývin urbanizácie európskych socialistických krajín. *Acta Geographica Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 18, 75-104.
BAŠOVSKÝ, O. (1984). Fundamental geographical specifities and the problem of urbanisation of the C.S.S.R. *Acta Geographica Facultatis Rerum Naturalium Universitatis Comenianae, Geographica,* 24, 3-27.
BAŠOVSKÝ, O. (1986). Funkcie miest a ich interpretácia z hľadiska vývoja regionálnej štruktúry SSR. *Geografický časopis*, 38, 126-136.
BAŠOVSKÝ, O. (1991). Priestorová štruktúra Bratislavy, jej rozvoj a ekologické problémy. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Formatio et Protectio Naturae*, 14, 69-76.
BAŠOVSKÝ, O. (1995). Súčasný stav a prognóza urbánnej a regionálnej štruktúry Slovenska a ekonomická transformácia. *Sborník České geografické společnosti*, 100, 78-92.
BAŠOVSKÝ, O. (1999). Formation of urban system in Central Slovakia. *Acta Geographica Facultatis Rerum Naturalium Universitatis Comenianae, Geographica, Supplementum*, 2, 203-212.
BAŠOVSKÝ, O., PAULOV, J., IRA,V. (1981). Ekonomický rozvoj Bratislavy a problémy jej životného prostredia. A*cta Facultatis Rerum Naturalium Universitatis Comenianae, Formatio et Protectio Naturae*, 6, 1-23.
BAŠOVSKÝ, O., DIVINSKÝ, B. (1991). The development of modern urbanisation in Slovakia and its present problems. *Revue Belge de Geographie*, 115, 265-277.
BEZÁK, A. (1987). Sociálno-priestorová štruktúra Bratislavy v kontexte faktorovej ekológie. *Geografický časopis*, 39, 272-292.
BEZÁK, A. (1988). Regionálne typy sociálno-priestorovej štruktúry Bratislavy. *Geografický časopis*, 40, 311-328.
BEZÁK, A. (1989). Urbánne modelovanie: prístupy, problémy a perspektívy. In *Nové trendy v geografii.* Bratislava (SGS), pp. 23-28.
BEZÁK, A. (1990). Funkčné mestské regióny v sídelnom systéme Slovenska. *Geografický časopis*, 42, 57-73.

BEZÁK, A. (1993). Prístupy k analýze vnútornej štruktúry miest: prehľad a zhodnotenie. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 32, 287-298.

BEZÁK, A. (2000a). Interregional migration in Slovakia: some tests of spatial interaction models. *Geografický časopis*, 52, 15-32.

BEZÁK, A. (2000b). Funkčné mestské regióny na Slovensku. *Geographia Slovaca*, 15. Bratislava (Geografický ústav SAV).

BEZÁK, A. (2006). Vnútorné migrácie na Slovensku: súčasné trendy a priestorové vzorce. *Geografický časopis*, 58, 15-44.

BEZÁK, A., HORÁKOVÁ, E. (1984). Tvary pôdorysu slovenských miest. *Geografický časopis*, 36, 243-251.

BEZÁK, A., PAULOV, J. (1984). Calibrating and testing the intraurban population density model: the case of the city of Bratislava. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 24, 55-61.

BLEHA, B., POPJAKOVÁ, D. (2007). Migrácia ako dôležitý determinant budúceho vývoja na lokálnej úrovni – príklad Petržalky. *Geografický časopis*, 59, 265-291.

BOKES, F. (1938). Vývin osídlenia Bratislavy. *Sborník Muzeálnej slovenskej spoločnosti*, 32/33, 33-66.

BOKES, F. (1941). *Slovensko a jeho mestá vo vývine 150 rokov*. (Slovenská liga).

BUČEK, J. (1996). Mesto, štát a územie: prípadová štúdia hlavného mesta Slovenskej republiky Bratislavy. *Acta Facultatis rerum naturalium Universitatis Comenianae. Geographica*, 36, 127-250.

BUČEK, J. (1998). Decentralizácia v samospráve veľkých miest na Slovensku po roku 1990. *Sociológia*, 30, 345-362.

BUČEK, J. (2000). Sublocal decentralisation – the case of Slovak big cities. *Environment and Planning C*, 18, 57-78.

BUČEK, J., PITOŇÁK, D. (1997). City-centre transformation in Bratislava – modernisation and financial sector invasion. *Prozesse und Perspektiven der Stadtetwicklung in Ostmitteleuropa, Münchener Geographische Hefte*, 76, 157-168.

BUČEKOVÁ, I. (2007). Vývoj priestorovej štruktúry siete hotelov na území Bratislavy. *Geografický časopis*, 59, 65-81.

CIBUĽKOVÁ, J. (1994). Migration movements of Petržalka population. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 34, 61-70.

CZAKOVÁ, G. (2008). Suburbanizácia mesta Nitra v roku 2005. In *Mladí vedci 2008: vedecké práce doktorandov a mladých vedeckých pracovníkov*. Nitra (UKF), pp. 431-439.

DICKÁ, J. (2006a). Suburbanizácia mesta Košice a jeho zázemia. *Geografická revue*, 2, 295-309.

DICKÁ, J. (2006b). Vplyv transformačného procesu na priestorovú štruktúru mesta Snina. *GEOinformations*, 2, 168-172.

DICKÁ, J. (2007a). Diferenciácia sociálno-demografickej štruktúry v zázemí mesta Košice – z aspektu suburbanizácie. *Geographia Cassoviensis*, 1, 19-25.

DICKÁ, J. (2007b). Vybrané transformačné procesy sociálno-demorafickej intraurbánnej štruktúry mesta Košice. In Kraft, S., Mičková, K., Rypl, J., Švec, P., Vančura, M., eds. *Česká geografie v evropském prostoru*. České Budějovice (Jihočeská univerzita), pp. 548-554.

DIVINSKÝ, B. (1999). The modern urban cartography of present-day Bratislava. Research Support Scheme Electronic Library. http://en.scientificcommons.org/8416304

DIVINSKÝ, B. (2001a). Bratislava within the system of selected central european metropolises – a population analysis. *European Spatial Research and Policy*, 8, 91-103.
DIVINSKÝ, B. (2001b). Postavenie Bratislavy v stredoeurópskom metropolitnom systéme z populačného hľadiska. *Geografický časopis*, 53, 171-190.
DIVINSKÝ, B. (2002). Globalizácia a jej dôsledky: ekonomicko-sociálne a priestorovo-štrukturálne transformácie miest. In *Globalizácia a jej vplyv na transformujúce sa ekonomiky (pozitíva a negatíva*). Rajecké Teplice (Žilinská univerzita v Žiline), pp. 50-56 .
DIVINSKÝ, B., PAUDITŠOVÁ, E. (2002). Some modern approaches to environmental urban evaluations. *Ekológia*, 21, 331-340.
FEKETE, Š. (1947). *Tri prímestské osady na pravom brehu Dunaja pri Bratislave so stránky sídelnej.* Práce z vedeckých ústavov SAVU, rad B., sv.1, Bratislava (SAVU).
FEKETE, Š. (1948). Pôdorysný vývoj Bratislavy a národnostný vývoj obyvateľstva. *Slovanská Bratislava*, 1, 47-60.
GAJDOŠ, P. (2002). Mesto a jeho vývoj v sociálno-priestorových a civilizačných súvislostiach. *Sociológia*, 34, 305-326.
HRNČIAROVÁ, T. et al. (2006). *Krajinnoekologické podmienky rozvoja Bratislavy*. Bratislava (Veda).
HROMÁDKA, J. (1933). *Zemepis okresu bratislavského a malackého*. *Diel I.* Bratislava (Nakl. Učiteľstva).
HROMÁDKA, J. (1935). *Zemepis okresu bratislavského a malackého. Diel II.* Bratislava (Nakl. Učiteľstva).
HURBÁNEK, P. (2006). *Exploratívna analýza metód kvantifikácie morfometrických atribútov osídlenia indikujúcich vidieckosť na Slovensku*. Dizertačná práca, Katedra humánnej geografie a demogeografie PRIF UK, Bratislava.
CHORVÁT, T. (2008). Banská Bystrica a České Budějovice v transformačnom období – závery z komparácie. *Miscellanea Geographica Univesitatis Bohemiae Occidentalis*, 14, 47-56.
IRA, V. (1982). Zmeny v rozložení obyvateľstva a vo využití zeme prírodných krajinných celkov Bratislavy. In Drdoš, J., ed. *Geografia a životné prostredie*. Bratislava (SGS), pp. 126-137.
IRA, V. (1984). *Priestorový a ekonomický rozvoj Bratislavy a problémy jej životného prostredia.* Kandidátska dizertačná práca, Prírodovedecká fakulta UK, Bratislava.
IRA, V. (2001). Transformačné procesy a vnútromestská štruktúra Bratislavy v 90. rokoch. In Mariot, P., Mikulík, O., eds. *Stav a vývoj socioekonomického systému v SR a ČR na prelome tisícročí*. Bratislava (GÚ SAV), pp. 58-62.
IRA, V. (2003). The changing intra-urban structure of the Bratislava city and its perception. *Geografický časopis*, 55, 91-107.
IRA, V. (2004). City in the mind: behaviorálno-geografické hodnotenie kvality života v meste. *Geografické štúdie*, 12, 46-52.
IRA, V. (2005). Quality of life and urban space (case studies from city of Bratislava, Slovakia). *Europa XXI*, 12, 83-96.
IRA, V., MATLOVIČ, R., SÝKORA, L., SZCZYRBA, Z. (2001). Przekształcenia przstrzeni wymiany handlowej miasta postscojalistycznego na tle koncentracji w handlu detalicznym w Republice Czeskiej i Słowacji (przykład Pragi, Bratysławy, Ołomuńca i Preszowa). In Jażdżewska, I., ed. *Miasto postsocjalistyczne - organizacja przestrzeni miejskiej i jej przemiany*. Łódź (UŁ, ŁTN, KGOiL PTG), pp, 243-251.
IRA, V., MICHÁLEK, A., PODOLÁK, P. (2005). Humánna geografia v Geografickom ústave SAV v období transformácie spoločnosti v SR. *Geografický časopis*, 57, 327-343.

IRA, V., HUBA, M., LEHOTSKÝ, M. (2006). Príspevok do diskusie o súčasnosti a budúcnosti geografického výskumu na Slovensku v medzinárodnom kontexte. *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Presoviensis, Folia Geographica*, 9, 56-60.

IRA, V., ANDRÁŠKO, I. (2008). Quality of life in the urban environment of Bratislava: two time-spatial perspectives. *Geografický časopis*, 60, 149-178.

IRA, V., ŠUŠKA, P. (2006). Percepcia kvality života v mestskom prostredí (na príklade mesta Partizánske). *Geografická revue*, 2, 309-332.

IRA, V., ŠUŠKA, P. (2008). Premeny mladého industriálneho mesta a ich dopady na kvalitu života na príklade mesta Partizánske. In Kallabová, E., Smolová, I., Ira, V., eds. *Změny regionálních struktur České republiky a Slovenské republiky*. Brno, Olomouc (Ústav geoniky AV ČR, Univerzita Palackého v Olomouci), pp. 67-73.

KANDRÁČOVÁ, V. (2000). Vybrané aspekty funkčnej transformácie historického jadra mesta Prešov. *Urbánny vývoj na rozhraní milénií. Urbánne a krajinné štúdie*, 3, 118-125.

KANDRÁČOVÁ,V., MICHAELI, E. (1982). Príspevok ku geografii Prešova. *Přírodní vědy ve škole*, 10, 383-386.

KARNIŠ, J. MIHÁLY, M. (1971). Geografia Prešova. In *Problémy geografického výskumu*. Zborník referátov z X. zjazdu čs. geografov v roku 1965 v Prešove. Bratislava (SAV), pp. 111-128.

KOREC, P. (1996). Methodological aspects in the research of transitional period in Bratislava. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 37, 155-162.

KOREC, P. (1998). Transformation of the border transport system in the Vienna-Bratislava-Györ Region. *European Planning Studies*, 6, 599-609.

KOREC, P. (1999). Predpoklady zmien sociálno-priestorovej štruktúry slovenských miest. *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis, Folia Geographica*, 3, 28-35.

KOREC, P. (2000). Vývoj funkčnej intraurbánnej štruktúry Bratislavy. In Matlovič, R., ed. *Urbánny vývoj na rozhraní milénií. Urbánne a krajinné štúdie,* 3, 90-98.

KOREC, P. (2002). The transformation of basic functions of Bratislava after 1989: trends and spatial consequences. *Acta Universitatis Carolinae, Geographica*, 37, 85-103.

KOREC, P. (2003). Bratislava, hlavné mesto Slovenskej republiky: potenciál, dlhodobé trendy a scenáre vývoja. *Acta Facultatis Rerum Naturalium Universitatis Comenianae Geographica*, 42, 53-68.

KOREC, P. (2006). Changing urban structure of Bratislava at the beginning of 21st century. *Acta Geographica Universitatis Comenianae*, 46, 141-159.

KOREC, P., GALASOVÁ, S. (1994). Geografická poloha Bratislavy v nových hospodársko-politických podmienkach. *Geografický časopis*, 46, 75-86.

KOREC, P., HUSÁROVÁ, K. (1994). Územie Bratislavy z hľadiska perspektívy jeho využívania. *Geographia Slovaca*, 7, 61-72.

KOREC, P., ONDOŠ, S. (2004). Prehľad a interpretácia stavebného rozvoja centra Bratislavy v postsocialistickom období. *Geografický časopis*, 56, 153-168.

KOREC, P., SMATANOVÁ, E. (1997). Vplyv transformačných procesov na zmeny priestorovo-funkčných vzťahov v regióne Bratislavy. In *Aktuálne problémy regionálneho rozvoja.* Banská Bystrica (UMB), pp. 162-169.

KOREC, P., SMATANOVÁ, E. (2000). Development of distribution of the flat pool in the territory of Bratislava, the laws and specific features of the process. *Geografický časopis*, 52, 51-65.
KRIŽAN, F. (2007). Regionálna typológia územia Bratislavy na základe dostupnosti supermarketov a hypermarketov. *Geografický časopis*, 59, 373-386.
KRPELEC, B. (1935). *Bardejov a jeho okolie dávno a dnes.* Bardejov (Miestny odbor Matice Slovenskej v Bardejove).
LAMOŠ,T. (1948). *Sídelný zemepis Kremnice.* Bratislava (SAVU).
LUKNIŠ, M. (1983). K vývinu geografického poznávania Slovenska. *Geografický časopis*, 35, 225-246.
MARTINKA, J. (1964). Geografické poznávanie Slovenska. *Geografický časopis*, 16, 340-352.
MASSAM, B. H. (2002). Quality of life: public planning and private living. *Progress in Planning*, 58, 141-227.
MATLOVIČ, R. (1989). Vybrané geografické aspekty vnútornej štruktúry mesta Prešov. In Michaeli, E., ed. *Zborník referátov z geografického seminára.* Prešov (KG PdF UPJŠ), pp. 169-174.
MATLOVIČ, R. (1992). Behaviorálna geografia, geografia percepcie a výskum vnútornej štruktúry mesta (na príklade Prešova). In Drgoňa, V., ed. *Regionálne systémy životného prostredia.* Nitra – Wien (SGS), pp. 139-143.
MATLOVIČ, R. (1994). Morfologicko-genetický prístup v kontexte geografického bádania vnútornej štruktúry mesta. *Urbánne a krajinné štúdie*, 1, 84-94.
MATLOVIČ, R. (1995). Morfologické procesy v historickom jadre Prešova vo svetle Conzenovej urbánnomorfologickej koncepcie. *Geographia Slovaca*, 10, 141-149.
MATLOVIČ, R. (1996). Sociálno-ekologická orientácia geografického bádania intraurbánnych štruktúr a jej slovenské reflexie. *Geografický časopis*, 48, 271-284.
MATLOVIČ, R. (1997). Hlavné smery geografických výskumov intraurbánnych štruktúr. *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis, Prírodné vedy*, 27, 149-175.
MATLOVIČ, R. (1998). Geografia priestorovej štruktúry mesta Prešov. *Geografické práce*, VIII., Prešov (FHPV PU).
MATLOVIČ, R., (1999a). Urbanization conception of synthetic geographical interpretation of intraurban structures. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica, Supplementum*, 2, 235-244.
MATLOVIČ, R. (1999b). Postmodernistické reflexie v urbánnej geografii. *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis, Folia Geographica*, 3, 45-53.
MATLOVIČ, R. (1999c). Osłabienie wzrostu dużych miast słowackich jako skutek transformacji społeczno-ekonomicznej w ostatnim dziesięcioleciu. In Kaczmarek, J., ed. *Przestrzeń miejska - jej organizacja i przemiany*. XII Konwersatorium Wiedzy o Mieście. Łódź (ŁTN i UŁ), pp. 81-90.
MATLOVIČ, R. (2000a). Transformačné procesy intraurbánnych štruktúr Prešova ako odraz celospoločenských zmien v ostatnom decéniu. In Matlovič, R., ed. *Urbánny vývoj na rozhraní milénií. Urbánne a krajinné štúdie*, 3, 27-38.
MATLOVIČ, R. (2000b). Sakralizacja – cząstkowy proces transformacji przestrzeni miejskiej miasta postkomunistycznego na przykładzie Preszowa. In Jażdżewska, I., ed. *Miasto postsocjalistyczne - organizacja przestrzeni miejskiej i jej przemiany*. Łódź (UŁ a ŁTN), pp. 121-128.

MATLOVIČ, R. (2000c). Struktura przestrzenna miasta Preszowa w świetle koncepcji urbanizacji wewnątrzmiejskiej. *Acta Universitatis Lodziensis, Folia Geoographica Socio-Oeconomica*, 3, 131-156.
MATLOVIČ, R. (2001). Transformačné procesy a ich efekty v intraurbánnych štruktúrach postkomunistických miest. *Acta Facultatis Rerum Naturalium Universitatis Matthiae Belii, Geografické štúdie*, 8, 73-81.
MATLOVIČ, R. (2002). Teoreticko-metodologický rámec komplexnej geografickej interpretácie priestorovej štruktúry mesta. *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis, Prírodné vedy, XXXVIII., Folia Geographica,* 6, 127-143.
MATLOVIČ, R. (2003). Ville postsocialiste – nouvelle dynamique des structures intraurbaines. *Hommes et Terres du Nord*, 4, 28-41.
MATLOVIČ, R. (2004). Tranzitívna podoba mesta a jeho intraurbánnych štruktúr v ére postkomunistickej transformácie a globalizácie. *Sociológia*, 36, 2, 137-158.
MATLOVIČ, R. (2007). Slovak geography at the beginning of 21st century. In Strzyż, M., ed., *Geography in the Regional Studies*, V, pp. 45-64.
MATLOVIČ, R. (2008). The brief profile of the Slovak geographical community. *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis, Folia Geographica,* 12, 6-24.
MATLOVIČ, R. (2009). K problematike novej systemizácie regionálno-geografických poznatkov. *Acta Geographica Universitatis Comenianae*, 54, in press.
MATLOVIČ, R., IRA, V., SÝKORA, L., SZCZYRBA, Z. (2001a). *Transformation of spatial intra-urban structures and their reflection in perception: A comparative study of Prague, Bratislava, Olomouc and Prešov.* Final Report of the RSS Project No. 2176/308/1999. Research Support Scheme, Prague.
MATLOVIČ, R., IRA, V., SÝKORA, L., SZCZYRBA, Z. (2001b). Procesy transformacyjne struktury przestrzennej miast postkomunistycznych (na przykładzie Pragi, Bratysławy, Ołomuńca oraz Preszowa). In Jażdżewska, I., ed. *Miasto postsocjalistyczne - organizacja przestrzeni miejskiej i jej przemiany II*. Łódź (UŁ, ŁTN, KGOiL PTG), pp. 9-21.
MATLOVIČ, R., SEDLÁKOVÁ, A. (2004). Suburbanizácia – transformačný proces priestorovej organizácie postkomunistických miest (empirický príklad Prešova). *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis, Folia Geographica*, 7, 75-103.
MATLOVIČ, R., SEDLÁKOVÁ, A. (2007a). Transformation processes of the urban space in postcommunist cities. In Malikowski, M., Solecki, S., eds. *Przemiany przestrzenne w dużych miastach Polski i Europy Środkowo-Wschodniej.* Kraków (Nomos), pp. 32-46.
MATLOVIČ, R., SEDLÁKOVÁ, A. (2007b). The impact of suburbanisation in the hinterland of Prešov (Slovakia). *Moravian Geographical Reports*, 15, 22-31.
MATLOVIČOVÁ, K. (2008). *Marketing miesta v regionálnom rozvoji: teoretická báza a empirická aplikácia.* Dizertačná práca, Katedra geografie a regionálneho rozvoja, Fakulta humanitných a prírodných vied, Prešovskej univerzity v Prešove, Prešov.
MENCL,V. (1938). *Středověká města na Slovensku*. Bratislava (Práce Učené společnosti Šafárikovy).
MICHÁLEK, A. (1994). Tendencia vývoja osídlenia na Slovensku vo vzťahu k súčasným politicko-ekonomickým premenám. *Geographia Slovaca*, 7, 111-118.

MICHNIAK, D. (2003a). Accessibility of district centres in Slovakia. *Geografický časopis*, 55, 21-39.
MICHNIAK, D. (2003b). Dochádzka do zamestnania do krajských miest na Slovensku v roku 2001. In Vaishar, A., Ira, V., eds. *Geografická organizace Česka Slovenska v současném období*. Brno (ÚG AVČR), pp. 53-64.
MLÁDEK, J. ed. (1994*). Petržalka - transformation of socioeconomic and spatial structure of the town district, humanization of environment*. Bratislava (Univerzita Komenského).
MLÁDEK, J., BUČEK, J., KOREC, P. (1998). Historical aspects and current development of relations in the Bratislava-Vienna space. *Region and Regionalism*, 3, 264-269.
OČOVSKÝ, Š. (1989). *Domy, byty, bývanie (geografická analýza materiálnej substancie sídiel a bývania)*. Bratislava (Veda).
OČOVSKÝ, Š. (1993). Humánno-geografický výskum na Geografickom ústave SAV. *Geografický časopis*, 44, 335-346.
OČOVSKÝ, Š. (1994). Zmeny sídelnej štruktúry v zázemí Bratislavy. *GeographiaSlovaca*, 7, 119–125
ONDOŠ, S. (2003). Revitalizačné procesy v historickom jadre Bardejova z pohľadu geografie mesta. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 42, 135-151.
ONDOŠ, S., KOREC, P. (2006). Súčasné dimenzie sociálno-demografickej priestorovej štruktúry Bratislavy. *Sociológia*, 38, 49-82.
ONDOŠ, S., KOREC, P. (2008). The rediscovered city: a case study of post-socialist Bratislava. *Geografický časopis*, 60, 199-213.
PACIONE, M. (2003). Urban environmental quality and human wellbeing – a social geographical perspective. *Landscape and Urban Planning*, 65, 19-30.
PAULOV, J. (1991). The zone-size-dependent entropy formula and spatial interaction modelling: a note on some implications. *Environment and Planning A*, 23, 557-570.
PAULOV, J. (1992). K novému rámcu regionálneho rozvoja Slovenska. *Geographica Slovaca*, 1, 23-28.
PAULOV, J. (1993). *Entropia v urbánnej a regionálnej analýze: koncepčuálny rámec a základy aplikácie*. Geographia Slovaca, 2. Bratislava (GÚ SAV).
PAULOV, J. (2004). On an estimation of interaction flows from transportation costs. *Geografický časopis*, 56, 173-185.
POPJAKOVÁ, D. (1998). Funkčné využitie intravilánu mesta Bardejov. *Acta Facultatis Studiorum Humaninatis et Naturae Universitatis Prešoviensis, Folia Geographica*, 1, 303-316.
POUŠ, R. (1998). Funkčné disproporcie v intraviláne Banskej Bystrice. *Acta Universitatis Matthiae Belii, Geografické štúdie*, 5, 45-49.
POUŠ, R., HLÁSNY, T. (2006). *Banská Bystrica – rezervné plochy a ich potenciál pre verejnú zeleň.* Banská Bystrica (Zephyros – agentúra pre geovedy a vzdelávanie).
POUŠ, R., HLÁSNY, T. (2007). Priestorová analýza mestsky nevyužitých plôch v intraviláne mesta Banská Bystrica. *Geografická revue*, 3, 2, 141.
PRIKRYL, Ľ. V. (1980). Vyučovanie zemepisu a tvorba učebníc v Uhorsku so zreteľom na Slovensko do počiatkov 19. storočia. *Geografický časopis*, 32, 28-43.
RADVÁNI, P. (1982). Priestorová štruktúra mesta – negatívne tendencie jej rozvoja, možnosti ich riešenia (na príklade Žiliny). In Drdoš, J., ed. *Geografia a životné prostredie.* Bratislava (SGS), pp. 103-114.
RADVÁNI, P. (1983). Mesto a jeho obraz. *Geografický časopis*, 35, 395-408.

RADVÁNI, P. (1985). Vybrané aspekty obrazu podmalokarpatských miest. *Geografický časopis*, 37, 46-60.
RADVÁNI, P. (1989). Mesto a jeho racionálna priestorová organizácia. *Geografický časopis*, 41, 293-306.
RADVÁNI, P. (1990). Bratislava a jej obraz. *Životné prostredie*, 24, 117-121.
SEDLÁKOVÁ, A. (2005a). Komerčná suburbanizácia – nový fenomén post-komunistických miest (prípadová štúdia města Prešov). *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis, Folia Geographica,* 8, 89-107.
SEDLÁKOVÁ, A. (2005b). The city-periphery migration and the process of suburbanisation in Czech and Slovak post-communist cities. In Michalski, T., ed. *Geographical sspects of transformation process in Central and East-Central Europe*. Pelplin (Wydawnictwo Bernardinum), pp. 71-78.
SEDLÁKOVÁ, A., MATLOVIČ, R. (2008). K otázke existencie komunity v suburbánnej zóne Prešova a Olomouca. In Malikowski, M., Piegza, J., eds. *Przemiany przestrzeni wiejskiej w Polsce i na Slowacji*. Rzeszów (UR), pp. 81-94.
SLAVÍK, V. (1986). Ukazovatele a metódy skúmania urbanizácie. *Geografický časopis*, 38, 393-411.
SLAVÍK, V. (1987). Vyjadrenie stupňa urbanizácie vidieckych obcí pomocou analytického a komplexného ukazovateľa na príklade Západoslovenského kraja. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 26, 147-165.
SLAVÍK, V. (1999). Settlement conceptions and planning in Slovakia during transformation period. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica, Supplementum*, 2, 253-268.
SLAVÍK, V. (2003). Bratislava in the European capital city system. In *Geographical space at the turn of the century.* Warszawa (Warsaw University), pp 151-158.
SLAVÍK, V. et al. (2005). *Analýza mikroregiónov SR*. Bratislava (PRIF UK).
SLAVÍK, V., GRÁC, R. (2008). Developing the capital city functions of Bratislava. *Moravian Geographical Reports*, 16, 16-24.
SLAVÍK, V., CHLAPOVIČ, T. (2003). Územné plány ako predpoklad suburbanizácie. *Geografie XIV., Sborník prací Pedagogické fakulty Masarykovy Univerzity*, Sv. 169, řada přírodních věd, č. 22, 137-141.
SLAVÍK, V., KOŽUCH, M., BAČÍK, V. (2005). Big cities in Slovakia: development, planning, contemporary transformation. *European Spatial Research and Policy*, 12, 47-69.
SLAVÍK, V., KURTA, T. (2007). Rezidenčná suburbanizácia v zázemí Bratislavy – nový trend v migrácii obyvateľstva. *Forum Statisticum Slovacum*, 3, 201-207.
SMATANOVÁ, E. (1999). Problémy rozvoja nadštandardného bývania v Bratislave. *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Presoviensis, Folia Geographica*, 3, 361-369.
SPIŠIAK, P., DANIHELOVÁ, D. (1998). Niektoré otázky kvality života v suburbánom priestore Bratislavy. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 41, 155-163.
SPIŠIAK, P., KULLA, M. (2008). Suburbanisation in the Košice hinterland. In Svatoňová, H. et al., eds. *Geography in Czechia and Slovakia. Theory and practice at the onset of 21 st. century*. Brno (Masaryk University), pp. 370-374
SZÉKELY, V. (2002). An intraurban location choice for a science and technology park in Bratislava: a feasibility study. *Geografický časopis*, 54, 319-340.

SÝKORA, L. (2000). Post-communist city. In Jaździewska, I., ed. *Miasto postsocjalistyczne. Organizacja przestrzeni miejskiej i jej przemiany.* Łódź (UŁ, ŁTN a PTG), pp. 41-45.
SÝKORA, L. (2001). Klasifikace změn v prostorové struktuře postkomunistických měst. *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis, Folia Geographica*, 4, 194-205.
SÝKORA, L. (2003). Suburbanizace a její společenské důsledky. *Sociologický časopis*, 39, 2, 217-233.
TIBENSKÝ, J., URBANCOVÁ, V. (2003). *Slovensko očami Európy 900-1850.* Bratislava (AEP).
VEREŠÍK, J. (1955). Vývoj pôdorysu Nitry. *Geografický časopis*, 7, 193-208.
VEREŠÍK, J. (1956). Príspevok ku geografii obyvateľstva Trnavy. *Geografický časopis*, 8, 65-85.
VEREŠÍK, J. (1966). Príspevok k funkcionálnej klasifikácii miest Slovenska v roku 1961. *Geografický časopis*, 18, 18-43.
VEREŠÍK, J. (1974). Geografická charakteristika väčších miest Slovenska. In *Slovensko 3 - ľud, 1.časť,* Bratislava (Obzor), pp. 579-636.
WALMSLEY, D., J., LEWIS, G. J. (1993). *People and environment: behavioural approach in human geography.* Harlow (Longman).
WĘCŁAWOWICZ, G. (1988). *Struktury społeczno-przestrzenne w miastach Polski*. Wrocław (Instytut Geografii i Przestrzennego Zagospodarowania PAN, Ossolineum).
ZUBRICZKÝ, G. (2005). Rezidenčné a populačné tendencie suburbanizácie Bratislavy. *GEOinformations*, 2, 538-544.

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QUALITY OF LIFE: GEOGRAPHICAL RESEARCH IN SLOVAKIA

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Kvalita života: geografický výskum na Slovensku
Geografický výskum širokospektrálne interpretovateľnej koncepcie kvality života sa i na Slovensku teší čoraz väčšiemu záujmu. Dokazujú to viaceré výskumné projekty a práce, ktoré sa u nás riešením tejto problematiky zaoberajú. Štúdia sa sústreďuje na krátky teoreticko-metodologický vstup a na historický prehľad relatívne krátkeho obdobia, počas ktorého sa geografický výskum venuje otázkam kvality života. Uvádza príklady štúdií, ktoré sa venujú doménam a základným dimenziám kvality života, ako aj komplexnému štúdiu kvality života na miestnej a regionálnej úrovni. Venuje sa aj postsocialistickým transformačným procesom, ktoré zaujímajú geografov v kontexte kvality života. Štúdia reflektuje aj práce publikované v Atlase obyvateľstva Slovenska a komplementárnej textovej publikácii Demogeografická analýza Slovenska.

Kľúčové slová: kvalita života, priestorová diferenciácia, Atlas obyvateľstva Slovenska, domény a dimenzie kvality života, transformácia, Slovensko

INTRODUCTION

The quality of life concept is becoming ever more popular both in Europe and the world at large. The term is a subjective one to a considerable extent or in other words interpretable in a subjective way. The consequence is a great number of definitions, ways of interpretations and approaches to quantification of the quality of life. But the same reason can be considered the principal source of its increasing popularity in public and in the political and decision making spheres.

One of the basic traits of quality of life (QoL) is its interdisciplinary or rather multidisciplinary nature. Among the sciences that are involved with the quality of life issue sociology, economics and medicine dominate. The extent of geographically oriented studies dealing with the subject is, however much smaller compared to the other sciences. It is so even in spite of the circumstance that the phenomenon of quality of life possesses, apart from other, a distinct spatial aspect which is manifested, for instance in spatial differentiation of the quality of life level. For geography, the comprehensive hence synthesizing nature of life quality may seem attractive, as it represents a promising research framework not only in human geography but also in geography in general (for example, as an appropriate platform for cooperation of experts in the field of human geographical and physical geographical research). Andráško (2009) points to the fact that the relation between geography and quality of life can be considered in two ways. Firstly, he emphasizes the role and position of geography and geographers in research of quality of life and secondly the significance of such research for geography itself.

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Although, as already mentioned, geography does not play the principal role in research on quality of life; there are a number of geographically oriented studies dealing with the issue. Studies of authors like Helburn (1982), Rogerson et al. (1989), Rogerson (1995 and 1999), Massam (1999and 2002), and others prove it. Special attention should be given to several (theoretical, methodological but also applied) works of Pacione (1982, 1986, 1990, 1993, 2003a and 2003b), that are also highly stimulating and inspiring in terms QoL research in Slovak geography.

The aim of this paper is to explain geographical approach to research into quality of life and to present its implementation in works of Slovak geographers. In the review, results of works focused on analyses of two basic dimensions (objective and subjective), several domains, and transformation processes in relation to QoL are presented. The attention is also paid to works published in the *Population Atlas of Slovakia* and results of comprehensive urban and regional studies of QoL.

THEORETICAL/METHODOLOGICAL ASPECTS OF QUALITY OF LIFE RESEARCH

Specialized literature contains a great number of studies dealing with questions of the theory and methodology of the QoL. In spite of this, plurality or only partial, consensus prevails in opinion on the given theme. Even if it may seem that this situation is the result of the multidisciplinary nature of QoL, the differing views on the concept appearing in studies pertaining to the same scientific disciplines consistently point to the highly subjective nature of the concept. It is manifested in subjective perception and interpretation of QoL by any individual regardless of his/her qualifications or specialization. From the point of view of the scientific approach to QoL, above all definition or interpretation of the content of the concept, the related terminology, methodological basis and criteria dependence or criteria by which the QoL is estimated are the factors where a considerable plurality of views exists. It is only possible to talk about partial consensus when the idea of a "two-dimensional" or "multidimensional" structure of QoL is accepted. In spite of terminological similarity (which is confusing to some extent) the two characteristics of QoL possess their individual content and meaning.

Two-dimensionality is the expression of duality of the QoL, a comparatively widely accepted assertion about the existence of its two basic dimensions: the objective and subjective (see for instance Pacione 1982 and 2003b, Raphael et al. 1994, Dissart and Deller 2000, Hancock 2000, Jones 2002, Marans 2003 and others). Ira and Andráško (2007) interpret the objective dimension of QoL as (external) conditions and effects and life circumstance of humans which in the majority of cases are classified as social, economic and environmental. In a terminological expression this dimension is often referred to as social, environmental or public. Subjective dimension in turn represents a set of subjective inputs of every human such as views, attitude, individual scale of values, capacity to adapt, how the surrounding environment is perceived, etc. in confrontation with the life circumstance of every individual. This is also the reason why this dimension may be denoted individual, private or personal (Andráško 2005).

Multidimensionality represents the concept frequently used for expression of the complexity of human life perceived as a certain type of "complex quantity" formed by numerous different dimensions. These can overlap and various kinds of links ex-

ist between them. As QoL, can be understood as a phenomenon representing the character or evaluation of human life (Andráško 2005), the term of multidimensionality is quite frequent in the relevant research (e.g. Cummins 2000, Massam 2002). However, the terminology is also inconsistent in this case. In a given context apart from the concept dimension is often replaced by concepts like component, aspect, or domain of QoL (van Kamp et al. 2003). Manifestations of multidimensionality are projected into studies devoted to QoL research. In this regard, Andráško (2007) points to two basic types of approaches. The first of them tries to evaluate QoL in the most comprehensible way possible, that is to say, to include a wide spectrum of "relevant" domains. An example of such output of so oriented studies may be the compendious QoL indices (see Sharpe 2000). The second approach is represented by studies which are mostly oriented to evaluation of QoL in relation to one of its domains. Typical example include the works concentrated on quality of dwelling which is generally considered the key area of QoL (DETR 1999, Jones 2002 and Ira 2003). Neither approaches can be denoted more appropriate as both of them involve disadvantages. The first "comprehensive" approach typically runs into the question of choice of areas that might be considered representative in terms of QoL. As such a choice is determined by many factors including the availability of the necessary data, it is often questioned. Helburn (1982) in this context rightly point to the fact that encompassing all aspects of human (quality of) life is practically impossible. Zhu (2001) for instance, believes that measurement of QoL limited to certain areas is not correct.

Although an attempt was made to discern the content of two-dimensionality and multidimensionality, it is true that the term dimension still appears in the context of QoL in dual meaning. Hence for the terminological distinction, Andráško (2007) proposes the term "basic dimensions of QoL" for the subjective dimension and the term "domain" for the objective dimension in order to cover the extensive spectrum of components of human (quality of) life.

As already said, many components of QoL research are characterized by highly fragmented views and interpretations. Regarding the fact that the scope of this study does not allow for their individual analysis (it is not the aim of the authors either) the emphasis will be laid on the basic question of how to define and interpret the content of QoL (the question of plurality in terminology will be mentioned in the relevant context). Plurality of views of what is QoL is caused by several factors, but especially by its subjective nature (see for instance Massam 2002). An interesting aspect of the concept is that it is composed of the words quality and (human) life. Neither of the two words, above all the latter is interpreted in a generally accepted way. Differences in understanding of the quality of life as a matter or fact, are related to differences in approaches to its study which means that the corresponding definitions are often adapted to the needs or orientation of research (Andráško 2007). Acceptance or rejection of its dimensionality (see for instance Felce and Perry 1995, Gajdoš 2002, Pacione 2003a and others) plays an important role in defining QoL. In the Slovak geographical literature, for instance, Andráško (2005, 2007, 2008a, 2008b and 2009), tried to define QoL taking into account the above-quoted aspects and characteristics as follows "the quantitative evaluation of human life subjectively expressed as a feeling of happiness and satisfaction, results of effects and interactions of external (environmental, economic and social) and internal (psychological) factors on the life of humans" (Andráško 2007, p. 21), or simply as the "measure" by which a set of an individual's life characteristics fulfils his/her individual requirements (Andráško 2008b and 2009).

In connection with the question of defining the QoL but also of the relevant terminology the use of so-called metaconcepts (van Kamp et al. 2003) should also be mentioned. They are concepts with meanings closely connected with the concept of QoL, and regarding terminology often equivalents, which as Dissart and Deller (2000) report, is caused by a high rate of their mutual correlation. Like QoL itself, these concepts lack a unanimously accepted definition. Among the most frequently applied metaconcepts are: well-being, life satisfaction, happiness, health, quality of place, sustainability, and liveability. A broader discussion about the differences and use of these concepts can also be found in the works of Andráško (2007), Bacsó (2007a), Ira and Andráško (2007), and Murgaš (2009). However, individual metaconcepts are still chaotically used to some extent in particular disciplines. Based on an extensive overview of the meta-concepts, Andráško (2007) arrived at the conclusion that due to their contents they all can be broadly comprised in the common quality of life concept.

QUALITY OF LIFE RESEARCH IN SLOVAK GEOGRAPHY

Geographical research of the widely interpreted QoL concept in Slovakia also enjoys ever bigger popularity and interest. Several research projects and works involved with the issue prove it.

The term of QoL was adopted by the Slovak geography comparatively late, in the latter half of the 1990s. Until then it only sporadically appeared above all in connection with theoretical or theoretical/methodological research aspects and requirements in studies primarily involved with other subjects. These included the works of Kollár (1992), later occasionally in those of Matlovič (1998 and 2002), Hanušin et al. (2000) or Huba (2005b). As far as empirical studies are concerned, undoubtedly the papers published at the turn of the 1970s and the 1980s by the Department of Regional Geography of the Faculty of Natural Sciences, Comenius University in Bratislava should be mentioned. Their orientation and methodology largely corresponded to the modern concept of QoL research although they used the then more "acceptable" notion of the quqlity of environment. This group also comprises the works of Ira and Paulov (1976), Bašovský et al. (1981) and Ira (1984). Even with the 20-year timing interval, the effect of those studies can be noticed in the outputs of some research projects realized at the Institute of Geography SAS (for instance Ira 2003, Ira et al. 2005, Andráško 2005 and 2007, Ira and Šuška 2006, Ira and Andráško 2008).

The works explicitly concentrated on QoL research and applying the appurtenant terminology started to emerge in the Slovak geographical literature above all in the last decade, for example the study of Spišiak and Danihelová (1998) devoted to the questions of QoL in the suburban parts of Bratislava, and the study of Ira (1999) focused on QoL in 3 regions (Dolné Pomoravie, Tatry and Východné Karpaty) through the perception of the local population.

DOMAINS AND DIMESIONS OF QUALITY OF LIFE

Domains of quality of life

QoL can be perceived as a phenomenon representing the character or evaluation of human life itself. The complexity of human life is formed by a number of its parts (domains), that can overlap and different kinds of links exist between them.

According to Massam (2002), QoL consists of a set of domains that represent the partial components of human life and are evaluated by means of selected types of indicators. However, additional possible equivalents of the concept of QoL domain appear in literature such as component or aspect (van Kamp et al. 2003, Murgaš 2005).

Basic QoL domains (components) can be identified by their theoretical delimitation applying the direct contact with people (acquisition of initial data by means of techniques like the questionnaire or interview – e.g. Ira 2005) and expert analysis (for instance Ira and Šuška 2006 and 2008, Murgaš 2008). Assessment of the key domains of QoL is based on the opinion of scientists, representatives of self-government, etc. (Pacione 2003b). QoL domains can be determined by approaches used in individual sciences, or by a selected perspective for investigation of the subject (van Kamp et al. 2003). There are views according to which practically all attributes of the environment and all characteristics of people are relevant in investigation for the relationship between man and environment (Mitchell et al. 2001).

Geographical works focused on only one domain of QoL or the effects of such a domain on QoL constitute a big group.

Life expectancy at birth, infant mortality, total population increase/decrease, educational level as well as the group of socio-economic indicators such as unemployment level; characteristics of low-income families are the demographic QoL indicators of primary significance (Michálek and Podolák 2004 and 2007, Mészáros 2005). Another group contains indicators such as different ways of assessing the age structure of the population, migration attractiveness (values of migration balance), various ways of assessing for public health/morbidity, abortion rate and changes in population density (Podolák 2002, Bacsó 2008, Michaeli et al. 2008, Mládek and Káčerová 2008).

Life in a healthy environment is increasingly interpreted as one of the fundamental civil rights in the developed countries. The basic material needs of the majority of people are saturated in the developed countries thus the high quality environment is beginning to be perceived as the important domain of the quality of life (Huba 2005b, Ira et al. 2005 and 2006, Hanušin et al. 2008).

Housing is one of the key QoL components, which appeared in the studies of Ira (2003) Halás and Džupinová (2007), Bacsó (2007b) and Szőllős (2008). A very important QoL domain is that of material comfort and social safety (Michálek 2004). This domain is present in a scale of factors starting with the situation on the labour market, social conditions and stability and ending with the dwelling conditions observed by means of wide group of relevant parameters (Michálek 2006, 2007 and 2008c).

Quality of life is distinctly affected by many undesirable phenomena connected with the population's safety. As is obvious from analyses and research concerning QoL but also public opinion enquiries, the most important phenomenon in terms of safety is crime (Michálek 2008a). Increase of both the quantity and gravity of crime reduces the population's quality of life above all in cities and their environs (Michálek 2008b). As a matter of fact, the safety dimension that apart from crime also includes other undesirable socio-pathological phenomena is among those determining the QoL domains.

Household equipment expresses the qualitative characteristics of dwellings and possession of durables and real estate. In the conditions of the Slovak Republic, it seemed reasonable to work in QoL research with variables from the Census on the national (Ira 2003, Mládek et al. 2006a) or regional level (Ferťalová and Sedláková 2007).

The education-informational domain of the quality of life was also studied in connection with regional differentiation of QoL (e.g. Ira et al. 2006 and 2008a).

Other specific domains also arouse interest. The study *Direct transport connections as a quality of life indicator: a case study of former district towns in Slovakia* is about transports and QoL (Székely 2008). *The job-housing balance in districts of Slovakia in the quality of life context* was evaluated by Michniak (2008). Two indicators (based on the 2001 census data), shares of jobs and dwellings in a district, and share of jobs in a district and the number of working persons residing in the district were used for measuring the jobs-housing balance in individual districts.

Analyses of several QoL domains appear in geographical research on the subject in Slovakia. For example in the intraurban analysis of Bratislava (Ira 2005b), six important domains were selected: dwelling equipment, social and demographic situation, physical and social health conditions, information and communication technologies facilities/equipment, social infrastructure and environmental quality problems. Another urban study (Ira and Šuška 2008) clustered QoL analyses in five domains: location and accessibility, demographic situation, housing and amenities, environmental situation, and economic situation. Ira et al. (2006 and 2008b) applied the concept of territorial indicators and analysed spatial variations in QoL in 6 domains (demographic, education-informational, security, material comfort and social security, equipment of households, and environmental quality) to give a comprehensive picture of quality of life in Slovakia. In the papers of Murgaš (2008 and 2009), three domains (prosperity, deprivation, human capital) were applied in the research on QoL and its spatial differentiation in the Slovak Republic. Seven domains of QoL (social, economic, demographic, environmental, research and education, health and information-communication) were viewed as integral to define a broad picture of national well-being in Slovakia in comparison to its neighbours Austria, Czechia, Poland, Ukraine, Hungary and an other 4 new EU member countries, Slovenia, Estonia, Latvia, and Lithuania (Ira 2005a)

Dimensions of quality of life

Geographers in Slovakia agree that the meaningful definition of QoL must recognize two linked dimensions to the concept. With respect to the first dimension, several terms have been used, for example subjective, individual, personal, and private. For the second dimension different levels and terms used, for example objective, public, social, and environmental. Since QoL is such a complex multifaceted concept, it is often argued that is important to combine two dimensions to provide a complete picture of QoL for a person or place (Massam 2002). Hence, QoL can be interpreted as the result of interaction between these two dimensions or between external factors and internal "environment" of the human. The components "society", "economy", and "the environment", which exist more or less objectively, normally characterize external factors. In turn, the effects of the internal human "environment" are exerted by means of subjective inputs such as perceptions, emotions, attitudes, preferences, states of mind, and soon.

In the study focused on quality of life in the urban space of Bratislava two basic approaches were employed to illustrate the application of 'the city on the ground' and 'the city in the mind' concepts (Ira 2004 and 2005b). The first approach comprised objective indicators describing environments people live in. The second approach was based on a large-scale sample survey conducted among inhabitants of the city wards in Bratislava. The meaning of the phrase quality of life, spatial variation of overall QoL as well as levels of importance of various aspects of life were analysed.

Andráško (2007) also analysed the objective and subjective QoL dimensions of city wards in a separate way. The objective dimension of the QoL in Bratislava city wards was investigated by two separate approaches. The first inspired by the social indicators research stresses the importance by socio-demographic and economic characteristics. The second approach emphasized the assessment of the living conditions including the housing quality, environment, transportation, crime and amenities. The survey focused on the subjective quality of life dimension was conducted by means of questionnaires and wards with the highest and lowest perceived level of the quality of life were identified.

Two basic QoL dimensions were studied in the town of Partizánske (Ira and Šuška 2006 and 2008). The first dimension was analysed by means of selected objective indicators of the QoL, using experts' assessment of their relevance. The analysis of perception of the QoL in the town through its inhabitants was the core of the second approach focused on a subjective dimension. Respondents evaluated the comprehensive QoL in observed urban districts; meaning the actually perceived QoL in the territory of the town. The comparison brought about a number of contradictory conclusions, which support the views that there is a need to apply both approaches (research of objective and subjective QoL dimensions).

Images and a general perception of places of basic living functions play an important role in the formation of people's relationships with their environs. The quality of life perception through places of important life functions is one of the prerequisites necessary for the real and potential population's migration. Kollár (2008) in his study devoted to subjective aspects of QoL tried to explain the aspects of spatial feelings and preferences for places of living and holidays of the population in Slovakia. The points of topophilia and topophobia were presented as dependent variables, explanation of which is based on the socio-demographic features of respondents and the real places of residence and holidays.

TRANSFORMATION PROCESSES AND QUALITY OF LIFE

Quality of life is the result of a wide range of processes. Comprehension of the present QoL requires the awareness of what has principally determined it. It will then be possible to identify factors that may also determine QoL in the future.

Processes that took place in the second half of the 20th century have influenced the present QoL of the Slovak population. The socialist industrialization and urbanization brought some distinct changes in QoL aspects. Compared to the preceding period, the situation improved in terms of some indicators such as educational level, health care and quality of housing but the 1980s and 1990s meant a slowed down growth or deterioration of other indicators (environmental indicators, those concerning the population's physical and mental health). An important feature of the

period in question was also the limited human rights and freedoms that became a barrier to the development of social and cultural capital.

The transformation phase of social development is characterized by an unusual dynamics of differentiating tendencies. Their nature is different even controversial between social groups or territorial communities with the tendency to increase the inner socio-economic and territorial polarization. In fact, it is the response to the long-term levelling efforts of the socialist State in the past. The unusual extremeness of transformation is historically unique. At present, there are numerous aspects of transformation that are manifested in the population's quality of life. Ira and Murgaš (2008) in their study *A geographical view of the quality of life and changes within society in Slovakia* have analysed some of them (civilization changes, globalization, structural economic changes, socio-cultural changes and environmental changes) in more details.

The gradual diversification of the socio-economic situation in Slovakia after 1989 caused distinct changes in stratification of society and led to an increase of regional disparities in terms of varied characteristics of the QoL. Since 1989, the Slovak society has been subject to important and rapid changes that also include its structure and stratification. Transition to the new social arrangements brought about an increase of social and economic disparities and changed the trajectory of the social structure and stratification development. The profile of Slovak society based on income distribution in varied social classes and layers differs from that of societies in economically advanced countries (Podolák and Michálek 2008). The graphic model representing the analysis of the Slovak society's profile is pear-shaped; it suggests a certain stagnation in terms of economic possibilities, financial sources and their distribution. An important feature that distinguishes society in Slovakia from the profile of advanced societies is the position of the studied household types with regard to unequal income distribution. This fact sometimes arouses a concern and doubts about the rapid advancement and success of transition in Slovak society. Stratification is manifested in the QoL, lifestyle, and cultural level including thought and action (Michálek and Podolák 2006).

Slovak society has undergone an important phase of transformation and development in the 1990's, which, apart from positive changes, meant numerous problems of a socio-economic nature (loss of social security connected with the decline of the standard of living during the last decade of the 20th century, increased poverty, unemployment, social pathology and other problems that partly influenced the demographic development and behaviour of the population in the country). Knowing the local/spatial dimension of poverty is one of the important aspects, which can play a role in the progressive elimination of poverty in afflicted communities (a more efficient and better targeted aid). Michálek and Podolák (2001) presented in their study one of possible analyses concerning the spatial differentiation of poverty or identification of poverty cores at the level of communities. The obtained results provided a picture of spatial distribution and concentration of poverty in communities (its level expressed by poverty indicator values) and also showed their position in the studied territory. It was found that there was a very serious situation in 419 communities where the poverty indicator reached critical values. The poverty level in these communities distinctly negatively affected all aspect of the local population's life. More than half of the poorest communities formed continuous poverty regions (8) mostly in those areas of Slovakia that were also historically the poorest parts of the country. The high poverty level in these regions (communities) was linked to many his-

torical, natural, political, and socio-economic phenomena and processes. Interregional differences were also aggravated by vertical socio-economic polarization. The complexity of the situation in Slovakia was determined by the fact that disparities and problematic dimensions both socio-economic and spatial met in the struck regions. Socio-demographic problems were attributable to anomalous population structure and lower qualitative level of its social potential for further development. Poverty in Slovakia was characterized by traits, which are consequences of an entire series of external, internal, and individual causes: rural poverty (in terms of settlement size), that of children/elderly people (in terms of life cycle), poverty of the Roma ethnicity (aspect of minority), new poverty (related to exclusion from the labour market) or sectoral poverty (employment in the primary sector).

Lauko et al. (2006) and Rajčáková (2007) also dealt with the subject of transformation processes at the level of regions and with values of QoL parameters.

The debate about QoL was often linked to the effect of the European integration and accelerating changes in the European countries caused by the forces of the globalizing technology and markets. In this Information Age we are keenly interested in our changing societies using the QoL indicators to portray a richer picture of trends and reality. In the paper *Quality of Life: Position of Slovakia from the international comparison perspective* (Ira 2005a), seven quality of life domains (social, economic, demographic, environmental, research and education, health and information-communication) were viewed as integral to defining a broad picture of the national well-being in Slovakia, its neighbours Austria, Czechia, Poland, Ukraine, Hungary and an other four countries (Slovenia, Estonia, Latvia, and Lithuania). Analysis of the quality of life indicators that range far beyond the traditional accounts of GDP and other money-dominated indexes showed considerable differences resulting from culture, geographical situation, economic development, the "socialist heritage" and stages in the transition process.

QUALITY OF LIFE IN THE POPULATION ATLAS OF SLOVAKIA

In the *Population Atlas of Slovakia* (Mládek et al. 2006a), the QoL was assessed on two levels. It was the first time that the complex QoL index was expressed on a map and cartographic representations of it partial components such as the life expectancy at birth, living conditions and the human development, crime, poverty, drug addiction, etc. were also included on the other.

A combination of statistical and cartographic analysis was applied to identify the QoL in Slovakia on the level of districts. The approach applied comprises type of "objective" indicators describing the environments people live in. Applying the concept of territorial indicators, spatial variations in QoL were identified and analysed. Indicators were measured on the district level (72 spatial units) to give a comprehensive picture about QoL in Slovakia. They were grouped under six quality of life domains: demographic, education-informational, security, material comfort and social security, household equipment of, and environmental.

Individual variables were transformed on a consistent scale (0.1). A quality of life index for six individual dimensions and an aggregated index were calculated resulting in a complex map of *Population Atlas of Slovakia* (Mládek et al. 2006a: 154) enabling identification of basic territorial disparities. The study of Ira et al. (2006) brings the theoretical basis, applied methodology, and interpretation of car-

tographic outputs. The next series of maps in the Atlas presents important partial indicators of the QoL level. Maps of the life expectancy at birth on the level of districts (Mládek et al., eds. 2006a:140-141) reflect the fact that in these values Slovakia considerably lags behind the most advanced countries of Europe, (in females by 4-5 years and in males in by 5-6 years) and the future increase of the mean life expectancy is expected to be quite slow. With some degree of generalization (with few exceptions), Slovakia seems to be divided into the northern part where there are districts with prevalingly higher values of life expectancy at birth and the southern part where regions with lower values dominate. The series of maps depicting the socio-pathological phenomena demonstrates the spatial implication of socially negative facts. The most frequent type of crime is Slovakia is property crime, which, along with economic crime, dominates in the more advanced area of western Slovakia with the dominance of Bratislava and other districts with big cities. The most hazardous in terms of violent crime seem to be the districts of Central Slovakia (Mládek et al., eds. 2006a: 148-149). The maps about socio-pathological phenomena are complemented by one of the first maps ever about the spatial differentiation of drug addiction in Slovakia which points to a very distinct differentiation between the west and east of the country. In the consequence of the multifactor essence of drug addition occurrence, Bratislava, as the principal economically most advanced centre with high purchasing power and a developed network of drug importers, dealers, distribution, sales and consumption dominates in Slovakia (Mládek et al., eds. 2006a:151).

The poverly index for the municipalities of Slovakia was assessed on the basis of the unemployment rate, share of persons with elementary education only, share of incomplete or large housholds, over-occupancy and poor equipment of dwellings. The cartographic representation reflects a distinct regional differentiation between the west and north-west of the country on one side and the south or east of Slovakia with the most unfavourable values on the other (Mládek et al., eds. 2006a:150-151). Similar characteristics of regional differentiation are manifested in the complex index of human development (Mládek et al., eds. 2006a: 155) or in values of the partial human development index (index of death age, employment index and index of economic potential). The quoted characteristics of a socio-economic nature are supplemented by cartographic presentation of mean wages of employees (Mládek et al., eds. 2006a:155), where again the west-east gradient decreasing from the west and north west to the east and south of Slovakia appears. Similar characteristics of spatial differentiation are proper to another important component of the QoL level. It is housing quality (Mládek et al., eds. 2006a:154-155), where the dwelling conditions were assessed by the share of dwelling categories. The *Atlas* is complemented by the monograph *Demogeographical analysis of Slovakia* (Mládek et al., eds. 2006b) bringing a detailed analytical and synthesized assessment of the present situation and the future population development in the SR.

COMPREHENSIVE URBAN AND REGIONAL STUDIES OF QUALITY OF LIFE

The existence of a "geographical dimension to the quality of life" is confirmed by several comprehensive urban and regional studies. Their orientation corresponds to that of geography to understand the essence of the "man – environment" relation-

ship. They pay attention to differences in QoL between various spatial units (communes, city wards, districts and regions).

One of the first studies explicitly devoted to QoL issues in Bratislava was published in the paper of Spišiak and Danihelová (1998). They analysed QoL in Bratislava's suburban area (in the city wards of Vajnory, Záhorská Bystrica, Devín, Jarovce, Rusovce, and Čunovo – in the past suburban rural settlements with agricultural production for Bratislava). The QoL was studied by means of indicators concerning environment, living standard, household equipment, geographical position, and demographic situation. Part of information on the QoL came from a survey conducted among local inhabitants. They expressed their opinions about the advantages and disadvantages of living in the studied suburban area. High-quality environment, suitable commuting positions to the city centre and relatively good social conditions in the settlements were the key elements of quality of life in the studied suburban area.

Two quite distinct types of indicators were analysed in the study focused on the QoL within the city of Bratislava (Ira 2004 and 2005b). The first approach comprised objective indicators describing the environment people live in. Applying the concept of territorial indicators (employing objective measures derived from analysis of census-based, and other urban environment data sets) spatial variations in QoL were identified and analysed within 17 city wards. The second approach was based on survey conducted among inhabitants of Bratislava. Large-scale sample survey of 520 respondents from 17 city wards was conducted in 2003 with the aim of analysing the meaning of the phrase *quality of life*, and measuring the spatial variation of overall QoL as well as the levels of importance of various aspects of life. The study presented several conclusions important for future research related to the relationship between objective and subjective indicators of QoL and several outputs of geographical research of relevance for decision-makers seeking to improve the everyday life environment in the city were identified.

The effort to understand better the intraurban differentiation of QoL was also recognizable in several papers by Ira and Andráško One of their papers was based on the results of two inner structure studies involved with the objective dimension of the QoL or living conditions within the territory of Bratislava (Ira and Andráško 2008). They were applying practically the same methodology in two different periods with a temporal gap of twenty years between the data collections. The first of the two compared studies is based on research conducted in the 1980s (Ira 1984). The analysis showed that the QoL was markedly differentiated in the study area. After an interval of more than 20-years, another, study of the quality of living in the territory of Bratislava has been produced (Andráško 2006a, 2006b, 2007 and 2008a). Its content and methodology were the follow-ups to the above-mentioned paper (Ira 1984). By methods of multidimensional analysis or classification, groups or regional spatial structure types were compiled. The spatial differentiation of regional types showed in both cases that the degree of intraurban variability in QoL was very high. Interpretation and comparison of the regional typology of Bratislava's quarters based on selected indices was considered the final aim of the study. With respect to the number of identified regional types (14 in the first case study and 12 in the second), no marked difference was found. The paper represents a practically unique comparison of two studies in the Slovak geographical literature involving the quality of the population's living conditions in a particular urban en-

vironment separated by a 20 year time span, but with almost identical research methodology applied to both of them. The two works proved the existence of common features to the quality of living conditions in a given spatial unit on one side, but also pointed out that the similarity is limited. It ensues from a certain rate of uniqueness attributable to the conditions of the particular spatial unit (locality) of the city at a certain time.

The study of changes in the young industrial town of Partizánske and their impact on the quality of life (Ira and Šuška 2006 and 2008) briefly documented the development of the intra-urban structure of the town (where Baťa factory was established in the 1930s) in the context of the urban geographical approach to the QoL research. The first approach applied in the study was based on selected objective indicators of the QoL clustered in five domains (location and accessibility, demographic situation, housing and amenities, environmental situation, and economic situation), using experts' assessment of their relevance. The analysis of subjective perception of the QoL in the town through its inhabitants was the core of the second approach. Respondents commented on the issue of importance of previously defined QoL domains (which agree with those used in the first approach). They also evaluated the comprehensive QoL in the observed urban districts of Partizánske; which means the actually perceived QoL in the territory of the town. Comparison of results obtained in both approaches has pointed to partial agreement that appeared in identification of the most important areas that control QoL and in identification of spatial units characterized by the top and or the lowest QoL level values. The different perception of important aspects of QoL and their overall levels pointed to the significance of social characteristics corresponding to individual groups of respondents.

Spatial differentiation is an important attribute of the QoL. It is possible to characterize and evaluate it through territorial disparities. Regional disparities in general characterize the different socio-cultural, economic, demographic and environmental conditions of individual regions (spatial units) while they simultaneously determine the quality of life of the population and territorial development. Research into regional differentiation and disparities at different levels (international, regional and local) contributed to the geographical knowledge of QoL. Analyses of spatial differentiation and regional disparities also solved several methodological problems. They included that of selection of suitable territorial units for observation and use of appropriate indicators, statistical tools and measures facilitating the spatial and temporal comparisons. In papers by Ira, Michálek and Podolák, geographers from the Institute of Geography of the SAS, the concept of territorial indicators (employing objective measures derived from analysis of census-based, and other environmental, social and economic data sets) was applied and spatial variations in QoL were identified and analysed (Ira et al. 2005 and 2008b). Indicators were measured at the district level (72 spatial units) to give a comprehensive picture of the quality of life in Slovakia. They were grouped under 6 quality of life domains (demographic, education-informational, security, material comfort and social security, equipment of households, and environmental quality). Correlation statistics were used for a more detailed description of spatial differentiation between individual domains in the territory of Slovakia (Ira et al. 2008b). Coefficient of variance pointed to the high degree of differentiation above all in the domain of material comfort and that of education/information. Regarding the level of urbanization and the degree of economic progress of regions measured by average wages, a positive correlation with the do-

main of dwelling comfort and educational/informational domain has been found. Concentration of crime in urbanized areas of Slovakia is demonstrated by the negative correlation of the safety domain with the degree of urbanization and average wages. The effect of what is referred to as the west-east gradient was observable in Slovakia. It is evident in several indicators of an economic nature. This gradient was most obvious in the domain of material comfort and the demographic domain. Spatial distribution of individual domains or individual indicators in Slovakia was not regular as caused by the physical-geographical conditions, historical factors, the present socio-economic and political dynamics, and rather inefficient regional policy.

Quality of life and its spatial differentiation in the Slovak Republic also became the object of a research study worked out by Murgaš (2008 and 2009). The research study was involved with measuring QoL. Twenty-one indicators were set while seven indicators represented each of three domains (prosperity, deprivation, human capital). The alternative of assigning weight to individual indicators by a panel of experts was chosen. The rate of regional disparities in QoL was quantified by means of the Gini coefficient. In Murgaš' studies of spatial differentiation of the QoL in Slovakia the administrative Regions (NUTS 3) and districts were evaluated by individual indicators, domains, and the aggregated QoL index according to ranking in pentils. The relationship between the QoL and some socio-economic phenomena, such as urbanization, average age, share of creative jobs and the "west-east gradient" were the themes of the research. The correlation of these phenomena with domains of prosperity, deprivation, human capital and the aggregated QoL index was analysed. Spatial differentiation of the QoL on the two observation levels of. administrative regions and districts of Slovakia showed differences caused by another information scale.

The aim of the regional study devoted to selected aspects of sustainability and quality of life in the Myjava River Basin (western Slovakia) was to assess and partially compare the real state of QoL and the landscape management with the perception of the representatives of the local municipalities (Hanušin et al. 2008). The real state of QoL and landscape management in the area studied was analysed by authors using the objective data about social, economic and demographic preconditions and land use. Perception of the landscape management, sustainability and QoL issues was assessed through the analysis of interviews with local mayors. The results showed that the perception analysis offers complementary information to the "objective" assessment and it is important for decision-making. It is evident that better quality of life and sustainable way of living in the region should require changes in the way people view and manage the landscape.

Another regional study carried out by geographers from the IG SAS was aimed at providing the basic idea of issues related to quality of life and sustainable development in a territory characterized by important natural-landscape and cultural-landscape values namely the Protected Landscape Area (PLA) of Poľana (Ira et al. 2008a). Specific features of nature conservation and the local culture were analysed and followed by an analysis of selected aspects of the basic socio-demographic situation in the area studied. Reflections about sustainability and quality of life of the population in the PLA resulted in analysis of the recent situation on the basis of subjective estimates by local decision- and opinion-makers. The research (interview technique) focused on evaluation of the community's development, perception of the environmental and nature-conservation problems, the community's milieu, will-

ingness of inhabitants to contribute to sustainable development, as well as on the evaluation of the image of the community and regional sustainable development programmes. The results showed that the PLA provides an opportunity to change the way people look upon and utilize the landscape.

CONCLUSION

Research focused on the QoL in Slovakia is becoming ever more interesting for various scientific disciplines (e. g. sociology, social anthropology, psychology, medical sciences, economics, environmental science, human ecology, geography). It was developed in a more or less isolated manner under individual sciences and their branches. In spite of the great number of scientific studies devoted to the issue, its fragmentation in terms of content and the distinct absence of a comprehensive approach are still evident.

A comprehensive approach should investigate above all the interaction between the human and the environment, which appears to be a key factor in terms of QoL. This fact along with the assumption that the QoL is primarily linked with humans and a certain space (as human's living environment) with some features of spatial differentiation, determines the significance and role of geography in its research.

Inspite of the prevailing general disunity in QoL research there are also aspects in geographical research where it is possible to admit a certain consensus of opinion. Apparently, the most important and comparatively widely accepted assumption is the existence of two basic dimensions of QoL: subjective (individual, personal, and private) and objective (public, social, and environmental). Hence, QoL can be interpreted as the result of interactions between these two dimensions or between the external factors and the internal "environment" of the human being.

In the last decade, the QoL theme in geographical research in Slovakia has appeared in connection with observation of inner urban, regional and international differences in several domains and it has two basic dimensions. Some results were published in the *Population Atlas of the SR* (Mládek et al., eds. 2006a). The QoL was assessed on two levels. It was the first time in Slovak geography that the complex QoL index was expressed on a map and cartographic representations of its partial components such as the life expectancy at birth, living conditions and human development, crime, poverty, drug addiction, etc. were also included.

In future, consideration should be given to various types of geographical research on QoL. One of them should be basic research, which attempted to define, refine and understand the QoL concept in order to ascertain whether it could meaningfully be measured. The second type of research would be oriented towards the means of interpreting spatial differentiation of QoL and another type would focus on the best possible manner in which to elicit the views, concerns and values of inhabitants with respect to their meaningful, valid, healthy, and balanced living (personal, societal and environmental well-being). In this context, theory development should rest on questionnaires and interviews as well as the focus on interconnection of subjective and objective dimension. The QoL concept represents for geography the advanced possibility to interpret spatial structures in a comprehensive and integrated manner. What is more, the research makes it possible to use both, the objective and subjective indicators and to highlight specific local or regional features and problems. Research results in this field represent suitable outputs for the decision-making sphere.

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REFERENCES

ANDRÁŠKO, I. (2005). Dve dimenzie kvality života v kontexte percepcií obyvateľov miest a vidieckych obcí. In Vaishar, A., Ira, V., eds. *Geografická organizace Česka a Slovenska v současném období*. Brno (Ústav geoniky AV ČR), pp. 6-13.

ANDRÁŠKO, I. (2006a). Percepcia kvality života v mestských štvrtiach Bratislavy. *Geografická revue*, 2, 227-240.

ANDRÁŠKO, I. (2006b). Sociálno-demografická dimenzia kvality života v Bratislave (vo svetle multivariačnej analýzy). *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis, Folia Geographica*, 10, 10-17.

ANDRÁŠKO, I. (2007). *Vnútorná štrurkúra mesta z hľadiska kvality života*. Dizertačná práca, Geografický ústav SAV, Bratislava.

ANDRÁŠKO, I. (2008a). Regionálne typy vnútornej štruktúry Bratislavy z hľadiska kvality životných podmienok. In Ira, V., ed. *Ľudia, geografické prostredie a kvalita života. Geographia Slovaca 25.* Bratislava (Geografický ústav SAV), pp. 159-173.

ANDRÁŠKO, I. (2008b). Kvalita života ako súčasť profilu konkurencieschopného regiónu? In *XI. mezinárodní kolokvium o regionálních vědách: sborník příspevků z kolokvia konaného v Pavlově 18. - 20. června 2008*. Brno (Masarykova univerzita), pp. 39-44

ANDRÁŠKO, I. (2009). The role and status of geography in the quality of life research. In Poštolka, V., Lipský, Z., Popková, K., Šmída, J., eds. *GEODNY LIBEREC 2008: sborník příspěvků.* Liberec (Technická univerzita), pp. 210-215.

BACSÓ, P. (2007a). K teoreticko – metodologickým aspektom kvality života. *Geografické informácie 11 - Problémy geografického výskumu Česka a Slovenska*. Nitra (FPV UKF), pp. 20-26.

BACSÓ, P. (2007b). Vybrané indikátory kvality bývania v obvode Štúrovo. In *VIII. vedecká konferencia doktorandov a mladých vedeckých pracovníkov - zborník príspevkov*. Nitra (FPV UKF), pp. 554-562.

BACSÓ, P. (2008). Quality of life context of the population in Štúrovo ward. In Svatoňová H. et al., ed. *Geography in Czechia and Slovakia. Theory and practise at the onset of 21st century.* Brno (Pedagogická fakulta, Masarykova univerzita), pp. 356-360.

BAŠOVSKÝ, O., PAULOV, J., IRA, V. (1981). Ekonomický rozvoj Bratislavy a problémy jej životného prostredia. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Formatio et Protectio Naturae*, 6, 1-21.

CUMMINS, R. A. (2000). Objective and subjective quality of life scale: an interactive model. *Social Indicators Research*, 52, 55-72.

DETR – Department of the Environment, Transport and Regions (1999). *A better quality of life: a strategy for sustainable development in the United Kingdom.* London (TSO).

DISSART, J. C., DELLER, S. C. (2000). Quality of life in the planning literature. *Journal of Planning Literature*, 15, 135-161.

FELCE, D., PERRY, J. (1995). Quality of life: its definition and measurement. *Research in Development Dissabilities*, 16, 51-74.

FERŤALOVÁ, J., SEDLÁKOVÁ, A. (2007). Kvalita bývania v urbánnom a suburbánnom priestore mesta Prešov. *Geografické informácie*, 11, 68-73.

GAJDOŠ, P. (2002). *Človek, spoločnosť, prostredie. Priestorová sociológia*. Bratislava (Sociologický ústav SAV).

HALÁS, M., DŽUPINOVÁ, E. (2007). Vývoj a priestorové rozloženie bytového fondu Bratislavy. *Urbanismus & územní rozvoj*, 10, 27-35.

HANCOCK, T. (2000). *Quality of life indicators and the DHC*. Southeastern Ontario District Health Council, (http://www.dhcarchives.com/).

HANUŠIN, J., HUBA, M., IRA, V., KLINEC, I., PODOBA, J., SZÖLLÖS, J. (2000). *Výkladový slovník termínov z trvalej udržateľnosti*. Bratislava (STUŽ/SR).

HANUŠIN, J., HUBA, M., IRA, V. (2008). Využívanie územia, manažment krajiny a problémy spojené s udržateľnosťou a kvalitou života v povodí rieky Myjavy. *Geographia Slovaca*, 25, 123-143

HUBA, M. (2005a). Aktuálny vývoj Slovenska v období pred vstupom do EÚ (vo svetle vybraných ukazovateľov). In Vaishar, A., Ira, V., eds. *Geografická organizace Česka a Slovenska současném období*. Brno (Ústav geoniky AV ČR), pp. 22-29.

HUBA, M. (2005b). Quality and sustainability of life with a special emphasis on regional environmental aspects. *Europa XX1*, 12, 97-102.

HELBURN, N. (1982). Presidential address: geography and the quality of life. *Annals of the Association of American Geographers*, 72, 445-456.

IRA, V. (1984). *Priestorový a ekonomický rozvoj Bratislavy a problémy jej životného prostredia*. Kandidátska dizertačná práca, Prírodovedecká fakulta Univerzity Komenského, Bratislava.

IRA, V. (1999). Životné prostredie, kvalita života a trvalo udržateľný rozvoj vo vnímaní a predstavách obyvateľov (v regiónoch Dolné Pomoravie, Tatry a Východné Karpaty). *Acta Facultatis Studorium Humanitatis et Naturae Universitatis Prešoviensis, Folia geographica*, 3, 338-347.

IRA, V. (2003). Územná diferenciácia vybavenosti bytov v SR ako jednej z dimenzií kvality života. In Vaishar, A., Ira, V., eds. *České a slovenské regiony na počátku třetího milénia (Sborník 6. česko – slovenského akademického semináře z geografie)*. Brno (Ústav Geoniky AV ČR), pp. 20-26.

IRA, V. (2004). City in the mind: behaviorálno-geografické hodnotenie kvality života v meste. *Geografické štúdie*, 12, 46-52.

IRA V. (2005a). Kvalita života a postavenie Slovenska z hľadiska medzinárodných porovnaní. In Vaishar, A., Ira, V., eds. *Geografická organizace Česka a Slovenska v současném období*. Brno (Ústav geoniky AV ČR), pp. 30-38.

IRA, V. (2005b). Quality of life and urban space (case studies from city of Bratislava, Slovakia). *Europa XXI*, 12, 83-96.

IRA, V., ANDRÁŠKO, I. (2007). Kvalita života z pohľadu humánnej geografie. *Geografický časopis*, 59, 159-179.

IRA, V., ANDRÁŠKO, I. (2008). Quality of life in the urban environment of Bratislava: two time-spatial perspectives. *Geografický časopis*, 60, 149-178.

IRA, V., HUBA, M., PODOLÁK, P. (2008a). Kvalita života obyvateľov v chránenom území a jeho udržateľný rozvoj (na príklade vybraných aspektov v CHKO Poľana). *Geographia Slovaca*, 25, 97-121.

IRA, V., MICHÁLEK, A., PODOLÁK, P. (2005). Kvalita života a jej regionálna diferenciácia v Slovenskej republike. *Životné prostredie*, 39, 290-294.

IRA, V., MICHÁLEK, A., PODOLÁK, P. (2006). Quality of live and human environment. In Mládek, J., ed. *Demogeographical Analysis of Slovakia*. Bratislava (Comenius University), pp. 148-151.

IRA, V., MICHÁLEK, A., PODOLÁK, P. (2008b). Evaluation of the territorial dispatities in selected aspects of life quality in Slovakia. In Gajdoš, P., ed. *Regional disparities in Central Europe*. Bratislava (Slovenská komisia pre UNESCO, NK-MOST Bratislava, Sociologický ústav SAV), pp. 157-179.

IRA, V., MURGAŠ, F. (2008). Geografický pohľad na kvalitu života a zmeny v spoločnosti na Slovensku. *Geographia Slovaca*, 25, 7-24.

IRA, V., PAULOV, J. (1976). Die Bewertung der Umweltqualität von Bratislava mittels Expertenschätzung. In *Sborník IV. medzinárodného sympózia o problémoch ekologického výskumu krajiny*. Bratislava (Ústav experimentálnej biológie a ekológie SAV), pp. 263-267

IRA, V., ŠUŠKA, P. (2006). Percepcia kvality života v mestskom prostredí (na príklade mesta Partizánske). *Geografická revue*, 2, 309-332.

IRA, V., ŠUŠKA, P. (2008). Premeny mladého industriálneho mesta a ich dopady na kvalitu života na príklade mesta Partizánske. In Kallabová, E., Smolová, I., Ira, V., eds. *Změny regionálních struktur České republiky a Slovenské republiky*. Brno, Olomouc (Ústav geoniky AV ČR, Univerzita Palackého v Olomouci), pp. 67-73.

JONES, A. (2002). *A guide to doing quality of life studies*. Birmingham (CURS, School of Public Policy, University of Birmingham).

KOLLÁR, D. (1992). Sociálna geografia a problematika výskumu priestorového správania človeka. *Geografický časopis*, 44, 149-161.

KOLLÁR, D. (2008). Subjektívne aspekty kvality života: percepcia miest základných životných funkcií obyvateľov Slovenska. In Ira, V., ed. *Ľudia, geografické prostredie a kvalita života.* Geographia Slovaca, 25. Bratislava (Geografický ústav SAV), pp. 85-96.

LAUKO, V., TOLMÁČI, L., GURŇÁK, D. (2006). Geografia. In Pekarovičová, J., Vojtech, M., eds. *Slovacicum. Súčasné Slovensko. Studia Academica Slovaca*. Bratislava (Stimul), pp. 24-98.

MARANS, R. W. (2003). Understanding environmental quality through quality of life studies: the 2001 DAS and its use of subjective and objective indicators. *Landscape and Urban Planning*, 65, 73-83.

MASSAM, B. H. (1999). The classification of quality of life using multi-criteria analsysis. *Journal of Geographic Information and Decision Analysis*, 3, 1-8.

MASSAM, B. H. (2002). Quality of life: public planning and private living. *Progress in Planning*, 58, 141-227.

MATLOVIČ, R. (1998). Geografia priestorovej štruktúry mesta Prešov. *Geografické práce VIII (1).* Prešov (Prešovská univerzita).

MATLOVIČ, R. (2002). Teoreticko-metodologický rámec komplexnej geografickej interpretácie priestorovej štruktúry mesta. *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis, Folia Geographica*, 6, 127-143.

MÉSZÁROS, J. (2005). Stredná dĺžka života v okresoch Slovenskej republiky v období od 1995 do 2003. *Slovenská štatistika a demografia*, 15, 32-41.

MYERS, D. (1987). Community-relevant measurement of quality of life: a focus on local trends. *Urban Affairs Quarterly*, 23, 108-125.

MICHAELI, E., MATLOVIČ, R.; DRAVECKÁ, B., HOFIERKA, J., IVANOVÁ, M. (2008). Kvalita života rómskej komunity v meste Levoča. *Miscellanea Geographica Universitatis Bohemiae Occidentalis*, 14, 129-136.

MICHÁLEK, A. (2004). Meranie chudoby v regiónoch (okresoch) SR. *Sociológia*, 36, 7-30.

MICHÁLEK, A. (2006). Sociálno – priestorová identifikácia obyvateľov Slovenska s nízkym príjmom. *Geografický časopis*, 58, 151-174.

MICHÁLEK, A. (2007). Regionálne mzdové nerovnosti na Slovensku. *Geografický časopis*, 59, 181-209.
MICHÁLEK, A. (2008a). Dynamika vývoja kriminality a drogovej závislosti v okresoch Slovenska. *Slovenská štatistika a demografia*, 18, 86-107.
MICHÁLEK, A. (2008b). Regióny Slovenska a ich zmeny z aspektu vývoja kriminality In Kalabová, E., Smolová, I., Ira, V., eds. *Změny regionálních struktur České republiky a Slovenské republiky*. Brno (Ústav geoniky Akadémie věd ČR), pp. 95-99.
MICHÁLEK, A. (2008c). Regionálne mzdové nerovnosti v kontexte kvality života na Slovensku. *Geographia Slovaca*, 25, 25-45.
MICHÁLEK, A., PODOLÁK, P. (2001). Transformation of the society in Slovakia and its effect on demographic behaviour. *European Spatial Research and Policy*, 8, 23-37.
MICHÁLEK, A., PODOLÁK, P. (2004). Podmienenosť a regionálna diferenciácia strednej dĺžky života na Slovensku. *Geografie: Sborník České geografické společnosti*, 109, 236-251.
MICHÁLEK, A., PODOLÁK, P. (2006). Sociálna stratifikácia obyvateľstva v regiónoch Slovenska (na báze príjmovej úrovne domácností). *Geografický časopis*, 58, 175-195.
MICHÁLEK, A., PODOLÁK, P. (2007). Selected determinants of regional differentiation of life expectancy at birth in Slovakia. *Geografický časopis*, 59, 305-322.
MICHNIAK, D. (2008). Rovnováha práce a bývania v jednotlivých okresoch na Slovensku v kontexte kvality života. *Geographia Slovaca*, 25, 47-61.
MITCHELL, G., NAMDEO, A., KAY, D. (2001). A new disease – burden method for estimating the impact of outdoor air quality on human health. *Science of the Total Environment*, 246, 153-163.
MLÁDEK, J., KÁČEROVÁ, M. (2008). Analysis of population ageing in Slovakia: time and regional dimensions. *Geografický časopis*, 60, 179-197.
MLÁDEK, J., KUSENDOVÁ, D., MARENČÁKOVÁ, J., PODOLÁK, P., VAŇO, B. eds. (2006b). *Demogeographical analysis of Slovakia*. Bratislava (Comenius University).
MLÁDEK, J., KUSENDOVÁ, D., MARENČÁKOVÁ, J., PODOLÁK, P, VAŇO. B., eds. (2006a). *Population atlas of Slovakia*. Bratislava (Prírodovedecká fakulta UK).
MURGAŠ, F. (2005). Konceptuálny rámec kvality života v geografii. In Vaishar, A., Ira, V., eds. *Geografická organizace Česka a Slovenska v současném období*. Brno (Ústav geoniky AV ČR), pp. 65-74.
MURGAŠ, F. (2008). *Kvalita života a jej priestorová diferenciácia v Slovenskej republike.* Dizertačná práca, Geografický ústav SAV, Bratislava.
MURGAŠ, F. (2009). Kvalita života a jej priestorová diferenciácia v okresoch Slovenska. *Geografický časopis*, 61, 121-138.
PACIONE, M. (1982). The use of objective and subjective measures of quality of life in human geography. *Progress in Human Geography*, 6, 495-514.
PACIONE, M. (1986). Quality of life in Glasgow: an applied geographical analysis. *Environment and Planning*, A 18, 1499-1520.
PACIONE, M. (1990). Urban liveability: a review. *Urban Geography*, 11, 1-30.
PACIONE, M. (1993). The quality of the urban lifespace – a geographical perspective. In Bonnes, M., ed. *Perception and evaluation of urban environmental quality*. Rome (UNESCO), pp. 17-42.
PACIONE, M. (2003a). Introduction on urban environmental quality and human wellbeing, *Landscape and Urban Planning*, 65, 1-3.
PACIONE, M. (2003b). Urban environmental quality and human well-being – a social geographical perspective. *Landscape and Urban Planning*, 65, 19-30.

PODOLÁK, P. (2002). Population ageing in Slovakia. *Europa XXI*, 7, 35-46.
PODOLÁK, P., MICHÁLEK, A. (2008). Profile of the present Slovak society and its regional differences. *Social Indicators Research*, 87, 157-167.
RAJČÁKOVÁ, E. (2007). Súhrnná charakteristika ekonomickej a sociálnej úrovne regiónov SR v období rokov 1990-2001. In Falťan, Ľ., Štrbavá, Ľ., eds. *Regionálna diferenciácia, regionálny rozvoj v Slovenskej republike v kontexte integračných dosahov*. Bratislava (Sociologický ústav SAV), pp. 220-266.
RAPHAEL, D., RENWICK, R., BROWN, I., ROOTMAN, I. (1994). Quality of life indicators and health: current status and emerging conceptions. *Social Indicators Research*, 39, 65-88.
ROGERSON, R. J. (1995). Environmental and health-related quality of life: Conceptual and methodological similarities. *Social Science and Medicine*, 41, 1373-1382.
ROGERSON, R. J. (1999). Quality of life and city competitiveness. *Urban Studies*, 36, 969-985.
ROGERSON, R. J., FINDLAY, A. M., MORRIS, A. S., COOMBES, M. G. (1989). Indicators of quality of life: Some methodological issues. *Environment and Planning*, A21, 1655-1666.
SHARPE, A. (2000). *A survey of indicators of economic and social well-being*. Background Paper prepared for Canadian Policy Research Networks, www.cprn.org
SPIŠIAK, P., DANIHELOVÁ, D. (1998). Niektoré otázky kvality života v suburbánnom priestore Bratislavy. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 41, 155-163.
SZÉKELY, V. (2008). Priame dopravné prepojenia ako indikátor kvality života: príklad bývalých okresných miest Slovenska. *Geographia Slovaca*, 25, 63-83.
SZŐLLŐS, J. (2008). Základná infraštruktúra bytov v okresoch SR v roku 2001 ako ukazovateľ kvality života. *Geografický časopis*, 60, 395-411.
VAN KAMP, I., LEIDELMEIJER, K., MARSMAN, G., DE HOLLANDER, A. (2003). Urban environmental quality and human well-being: Towards a conceptual framework and demarcation of concepts; a literature study. *Landscape and Urban Planning*, 65, 5-18.
ZHU, J. (2001). Multidimensional quality-of-life measure with an application to Fortune's best cities. *Socio-Economic Planning Sciences*, 35, 263-284.

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REGIONAL STRUCTURE OF THE SLOVAK REPUBLIC IN THE WORKS OF SLOVAK GEOGRAPHERS

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Reflexie regionálnej štruktúry Slovenskej republiky v prácach slovenských geografov
Predložená štúdia sleduje dva základné ciele. Prvým je diskusia k vedeckým prácam publikovaných v uplynulých dvadsiatich rokoch, ktoré sa zameriavajú na hodnotenie regionálnej štruktúry Slovenskej republiky. Príspevok najskôr analyzuje „externé zdroje" slovenskej geografie k tejto výskumnej téme a potom samotné geografické štúdie. Hodnotenie geografických štúdií je urobené podľa základných relatívne samostatných problémových oblastí. Druhým cieľom práce je demonštrovanie jednej možnej metodiky výskumu regionálnej štruktúry Slovenska a ukázanie základných empirických výsledkov. Príspevok predstavil široký rozptyl výskumných oblastí pri štúdiu regionálnej štruktúry Slovenska, poukázal na pestrosť metodiky pri riešení problémov a viac-menej potvrdil pomerne zreteľnú diferenciáciu regionálnej štruktúry Slovenska.

Kľúčové slová: regionálna štruktúra, Slovenská republika, spoločenská transformácia, územno-správne členenie, regionálne disparity, regionálna typizácia

INTRODUCTION

Assessment of Slovakia's regional structure was one of the key research subjects of several sciences, especially geography, in the past 20 years. Increased interest in the issue was provoked by two facts. The transition that started after 1989 in Slovakia was characterized by dramatic dynamics in differentiation of the regional structure (1). In the consequence of such development, great regional differences both in the economic and social sphere emerged and were referred to as regional disparities (2). The development of Slovakia's regional structure during transition is also interesting for researchers for various reasons including the historical uniqueness of the process and the opportunity to compare with other countries in post-communist Europe.

Research into regional structures is undoubtedly an interdisciplinary task. Geographers in Slovakia contribute to the enlightenment of individual questions connected with such research and cooperate with other scientists or apply their research results. Comprehensivly, cooperation with and knowledge of other transition countries of Europe are also especially valuable for the Slovak geographers. In this context, there are three important external sources the Slovak geography drew on in research into country's regional structure. The first are the Prague geographers around Hampl, Dostál and Blažek; the second is composed of (regional) economists from the University of Economics members of Buček's team and the third is the team of sociologists at the Institute of Sociology of the SAS concentrated around Gajdoš,

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Falťan and Pašiak. The fact that in spite of the declared pronounced interdisciplinarity of the subject the majority of researchers more or less adhere to a single science is somewhat surprising. Likewise, international research teams are absent.

The aims of their study are two. First of all, it will point to the contribution of the three above-mentioned external sources of the Slovak geography and evaluate the works of Slovak geographers in the sphere of research involved with the regional structure of Slovakia after 1989. The second aim is to show one approach to the study of the regional structure of Slovakia pointing to some methodological questions and the basic empirical results.

SLOVAK GEOGRAPHY IN THE CONTEXT INTO RESEARCH OF REGIONAL STRUCTURE

External sources for Slovak geography

The Prague school of social and regional geography has undoubtedly most influenced Slovak geographers. It is not only the consequence of the common history, identical problems or language closeness but above all it is the result of the erudition and inventiveness of this school. One of the first works that aroused great response in Slovakia was the study of Dostál and Hampl (1992). In it, the authors pointed to the consequences of geopolitical and geo-economic changes in Europe in relation to the development of regional structures in post-communist countries. The geographical situation of regions was presented in connection with the formation of a new economic zone in Eastern Europe as an important factor determining the regional development. Three monographic studies: Hampl (2001), Blažek and Uhlíř (2002) and Hampl (2005) were extraordinarily interesting. Hampl (2001) for the first time presented not only the specific features of the Czech social transformation but also offered a general theory of such transformation. The author of the first study also pointed to three main polarities of geographical research into the development of regional structure which has forced geographers to reflect over their research orientation. Blažek and Uhlíř (2002) offered a unique study evaluating the theory of regional development. Apart from classification of individual theories of regional development by different classification traits and their basic characteristics exposing the relationships between the theories of regional development, theoretical/philosophical approaches and the regional policy of the State.

In the second monograph, Hampl (2005) demonstrated the research methodology of society's geographical organization using the example of the Czech Republic. He considered precisely orientation towards research into society's geographical organization neglected by geographers in the polarity of subjects "geography of social transformation" versus "transformation of geographical organization of society". In the past twenty years, the Prague school has devoted balanced attention to practically all relevant questions connected with the development of regional structure both on the national and supernational levels. Its studies evaluating regional differences in the Czech Republic or regional typification of the State's territories include above all Hampl's studies (2001, 2005 and 2007). Drbohlav and Sýkora (1997), Dostál and Hampl (2003), Hampl (2005), Dostál (2008) and others analyzing the territorial/administrative division of the State and the role of big agglomerations in the context of regional structure. Studies of the Prague researchers devoted to the assessment of the effect of regional policy on regional development

(Blažek and Kára 1992, Blažek 1993, 1998 and 2003) are also many. The quoted studies deal with the regional policy on the national level and on the level of the European Union. Studies exclusively dedicated to the effect of integration (EU) and globalization on the regional development of the transforming post communist countries (Pavlínek 1992 and 2004, Dostál 2000, 2002 and 2006) are also interesting. In connection with the great regional differences in individual transforming countries among the new EU members, Dostál (2006) emphasized that considering the different primary and secondary potential of regions in these countries and globalization effects, reduction of these differences would be very difficult. Perhaps the most numerous group of works has been recently that concerned with the stagnant regions Marada and Chromý (1999), Hampl (2000), Chromý (2000 and 2003), Havlíček and Chromý (2001), Marada (2001), Chromý and Janů (2003), Havlíček (2003), Jeřábek et al., eds. (2004), Havlíček et al. (2005) Marada and Hudeček (2006) and others dealt with theoretical and methodological questions of identification and approaches to assessment of peripheral regions and conduct empirical research in different types of peripheral region.

The majority of researchers in the area of regional development accept the fact that the key phenomenon of success or failure of a region is its economy. The group of (regional) economists from the University of Economics at Bratislava published several notable studies where, among other things, they point to the task of the economy in regional development. A distinct emphasis on the relationship between the "conditions for the development of the economy" and "the regional development" is observable in several studies by these researchers" (Gašparíková et al. 2003, Brzica et al. 2004, Tvrdoň 2005 and others). Tvrdoň et al. (1995) in their study devoted to the general theory and methodology in the context of regional development proposed to classify regions of Slovakia into three categories based on the success of their economic transformation: successful regions, partially adapted regions and stagnating regions. This classification was later also adopted by geographers. A stimulating study with regard to the expected development of the regional structure of Slovakia is that of Buček (2003). The author not only points to the basic factors determining the regional differentiation in Slovakia but also proposes ways to mitigate the unfavourable development in some regions. He asserts that the important factor of regional development is the potential of their centres. The incentives directed to regional centres in stagnating but also in development regions is, according to him, one of the key tools of economic development of Slovakia as a whole as well as of its regions. The studies of economists about regional policy and regional development (Tvrdoň et al. 1995, Žárska 2005, Buček et al. 2006 and others) are interesting for geographers. Buček et al. (2006) in a follow-up to the study by Blažek and Uhlíř (2002) presented new theoretical concepts of regional development while stressing the importance of the new economic geography. Economic indicators dominate in research focused on assessment of regional disparities or typification of regions in Slovakia according to their level socio-economic development (Buček 1999, Tvrdoň 2007 and others). Buček (2003 and 2006) directly or indirectly pointed to the necessity of considering the consumption indicators of the population in regional typification based on the criterion "level of socio-economic development". The first of the quoted works contains valuable reflections of the author about areas that should become objects of regional policy of the Slovak Republic and exposition factors that may be decisive for the changed regional structures in future.

Spatial sociologists from the Institute of Sociology of the SAS enriched research into the development of regional structure in Slovakia during the post communist period with a wide spectrum of knowledge. First of all it is a contribution to the theory and methodology connected with research into regional development and its level in the perspective of spatial sociology (Gajdoš 2002b and 2005, Pašiak 2004 and 2005, Krivý 2004, Gajdoš and Pašiak 2006 and others). These authors assess the reflection of regionalism in sociology with a stress on interpretation of new regionalism in the time when the foundation of the EU's regional policy were formed; they were involved with questions of typification of spatial units according to the level of regional development; they offered new qualitative and quantitative research methods and elaborated additional theoretical and methodological knowledge. It is not surprising that a great number of the works by spatial sociologists come from the area of marginal territories of Slovakia and give importance to the origins, spread and assessment of poverty (Falťan et al. 1995, Pašiak et al. 2001, Gajdoš and Moravanská 2005, Čambáliková 2005 and others). These authors also pointed to the fact that stagnation and poverty in selected regions of Slovakia is not the matter of development after 1989, but also a consequence of long-term developmental trends in the regional structure of Slovakia. Gajdoš and Moravanská (2005) for instance, emphasize the effect of specific features of settlement in Slovakia while precisely the rural nature of territories in the south of central Slovakia and a great part of eastern Slovakia is considered a factor that determines their marginality and stagnation. The spatial sociologists have presented several interesting studies with typification of Slovak regions by the levels of socio-economic development they have reached (Pašiak et al. 2001, Gajdoš 2002a, 2005 and 2008 and others). Gajdoš' (2005) paper presenting the spatial distribution of regional types according to the level of widely interpreted social development of Slovakia is worthy of attention because it is a "summarizing typology". This work, like other by spatial sociologists is based on the analytical part from 79 districts defined in the 1996 territorial-administrative division and each district represents one regional type in the synthesized part. The interesting thing about this paper is that the basic analytical framework of typification consisted of eleven factors, each of them was fed by a variety of indicators. They were: economic performance (1), employment and the labour market (2), landscape-ecological situation (3), environmental infrastructure (4), amenities (technical and information infrastructure) in the given territory (5), human potential, population situation (6), human potential, population change (7), human potential, educational level (8), social situation (9), level of urbanization (10), and settlement (11). Typological analysis resting on application of mathematical and statistical analyses (factor analysis, cluster analysis and bivariation analysis) made it possible to sort out eight types of regions. However, the fact that the basic spatial observation units and typological regions are districts led to the identification of very different regional types in a close neigh-bourhood (Poprad – Kežmarok, Humenné – Medzilaborce, Michalovce – Sobrance, Zvolen – Krupina, Detva, Košice environs and other). From the point of view of comprehensiveness of approach, monographs by Gajdoš (2002) and Gajdoš and Pašiak (2006), where authors demonstrate the complexity and specifity of spatial sociology in the study of regional development, are worthy of attention.

Development of Slovakia's regional structure in the studies of Slovak geographers

The themes of regional structure in Slovakia are indeed various. This fact does not surprise because the development of regional structure has been influenced by numerous phenomena and processes and on the other side regional structure determines the development of many socio-economic phenomena in the region. Such phenomena are factors and processes determining regional differentiation, relation of the territorial-administrative division to regional structure, relation of regional policy to regional structure, problems of regional development of selected regions, peripheral areas and regional typification showing the level of socio-economic development of regions.

Works that evaluate factors and processes determining the differentiated regional development are abundant (Paulov 1992, 1995 and 1996, Bašovský 1995, Rajčáková 1996, Korec and Smatanová 2000, Buček 2003, Korec 2004, 2005, Korec and Ondoš 2006, Smith and Rochovská 2006, Fogaš 2003, Ira 2005 and other). Paulov (1992 and 1996) as one of the first, pointed to the significance of the changed geographical position of individual regions in Slovakia after 1989. He referred to the new geographical position as an important developmental potential of regions asserting that the region of Bratislava would profit most from the new geographical position. Bašovský (1995) ventured to highlight the new development conditions and their consequences for the regional structure of Slovakia. He separately analysed the main transition conditions of the regional structure of Slovakia in the international contexts and the main inner transition factors. Korec (2004 and 2005) described the ten most important factors for the development of regions in Slovakia in the period of transition. For him, the three most important are the issues of settlement hierarchy, macro-positional attractiveness and economic specialization of regions. Ira (2005) critically addressed the study of Korec (2004) and added another two to the ten described factors, that of human resources and environmental situation which gained importance above all after 2000, when foreign investments and regional policy played an essential role.

All researchers involved with the effect of the territorial-administrative division of the State on the development on its regional structures admit its increasing significance. It is surprising that not many authors dealt with it after 1989. The studies of Bezák (1996, 1997 and 1998) and Slavík (1997) made the greatest contribution in this field. As Bezák (1998) reports, the aim of changes in the territorial-administrative division of the State should be definitely a more efficient functioning of the public administration in terms of space and adds that efficient functioning of the public administration is a fundamental condition of for achieving the optimal regional development in the State. A valuable contribution of the study by Bezák (1996) is the assessment of three basic criteria for the quality of the territorial-administrative division of the State. In another study, Bezák (1998) assumed a critical view of the regional structures and new administrative regions which, resulted from the territorial-administrative division worked out in 1996. He points to four basic failures of this document evaluating the basic function of administrative regions. Slavík (1997) also dealt with the development of the territorial-administrative division of Slovakia emphasizing the period until 1990. The author evaluated the effect of territorial-administrative division on the regional development in individual historic stages. An important part of this study is the demonstration of the principal generalizations which affect decision-making about territorial-administrative

division in individual periods. The studies of Bezák (1990, 2000 and 2001) constitute a separate group involved with the relation between the territorial-administrative division and regional structure of the State. The author deals with functional urban regions considering them appropriate territorial units on the level of districts. In general, there are three main contributions of these studies. The first is an ample discussion with the world literature on the subject of functional urban regions; the second is presentation of a detailed theoretical basis for the identification of functional urban regions and finally the third is the constructive comparison of functional urban regions identified in Slovakia in 1991 and the districts of the 1996 territorial-administrative division. The subject will be addressed in more details in the following part of this paper.

Mitigation of regional differences in Slovakia will, according to several researchers, require an efficient and advanced regional policy including optimization of the powers held by regional and municipal self-governments. The task of regional policy in regional development is the theme of several authors where those who contributed most include Rajčáková (2005, 2008 and 2009), Rajčák (1996 and 2001) and Kling (2002, 2003 and 2004). Rajčáková (2009) in her monograph concentrated upon the key questions of the relationship of regional policy on the national and on the European levels to regional development. After the overview of general and theoretical problems of the role regional policy assessment plays in regional development, the authoress proceeds to a critical view of the regional policy applied by the European Union in connection with its effect on the development of regions and evaluated the application of regional policy tools in Slovakia. An interesting part of this study is the analysis of individual phases in the development of the EU regional policy and assessment of regional policy in Slovakia in comparison with the policies of individual branches of the economy. The studies of Kling (2002, 2003 and 2004) where he evaluates "events" in the area of regional policy in Slovakia in a bygone year are special. Their positive feature is not only their factographic value but also author's discussion about the effect of regional policy on the regional structure of Slovakia in a given year. Rajčák (1996) also talks about individual approaches to regions taking into consideration the particular conditions that determine their problems and applied solutions.

Evaluations of the level of regional development of selected regions of Slovakia have become a very attractive research theme. Understandingly, researchers concentrate above all on stagnating regions where apart from their general characteristics and comparison with other regions they try to identify factors causing stagnation. The studies include those of Matlovič (2004), Matlovič and Matlovičová (2005), Ira (2005), Korec and Ondoš (2006), Ira and Lehotský (2005 and 2008) as well as others. Matlovič and Matlovičová (2005) evaluated the position of the administrative region of Prešov in the context of the regional structure of Slovakia as documented by several simple or more complicated indicators of economic and social development of the region. In the conclusion of the study, they show and substantiate the main causes of the existing situation. According to them, the causes include unfavourable geographical position, bad condition of the major transport infrastructure, high population concentration with low socio-economic status and inadequate regional policy of the State. The administrative region of Prešov regarding its distinct stagnation is often a subject of research. Korec and Ondoš (2006) identified three stagnating regions: the south of Central Slovakia and the east of the Slovakia and the north-eastern of the Slovakia. This classification is based on val-

ues of the economic aggregate in the years 1997 and 2004, its dynamics in the quoted period, the indicator of transition success and five phenomena associated with regional development (primary potential, historic development, demographic structure, economic structure and the potential for development). Pursuing the quoted phenomena, they analysed the regions in question. Works of Ira and Lehotský (2005 and 2008) are original both in terms of targets and research methodology. They showed spatial organization of regional systems along with the description of regional developmental problems in selected regions and identified factors influencing developmental possibilities and limitations using graphical models of the regional system. In the first and the second studies, six and two model territories respectively were used. They were stagnating districts of Slovakia from 1996 (Topoľčany and Levice in the west, Námestovo and Rimavská Sobota in central Slovakia and Bardejov and Spišská Nová Ves in the east; or Bardejov and Rimavská Sobota in second work).

The issue of peripheral regions in the sense of their socio-economic stagnation and remoteness with respect to cores of Slovakia has been researched the last ten years. One of the first authors who started to systematically deal with this theme was Halás (2002, 2005 and 2008). Simultaneously several other studies appeared (Zubriczký 2002, Hurbánek 2004, 2005 and 2007, Horňák and Rochovská 2007, Rochovská and Horňák 2008 and other). The contribution of Halás' studies (2002, 2005 and 2008) lies above all in working out of theoretical aspects of the study of peripheral regions. He pays increased attention to the methodology and study of boundary areas. In the last of the quoted works, the author offers a detailed picture of the spatial polarization of the society in Slovakia and focuses on peripheral regions. Hurbánek (2004, 2005 and 2007) and Zubriczký (2002) concentrated on rural area of Slovakia in the context of peripherality. Horňák and Rochovská (2007) and Rochovská and Horňák (2008) dealt with the quality of life and phenomenon of poverty in peripheral regions. They applied qualitative research methods where the main information source is the perception of the region by its population. The monograph of Džupinová et al. (2008), where the authors try to assume a comprehensive approach to peripherality and spatial polarization in Slovakia is also worth noting. In three relatively independent parts, they present theoretical and methodological aspects of research on peripheral areas, indicators of peripherality in Slovakia and identification as well as classification of peripheral regions of the country.

The group of works with the ambition to present the regional typification of Slovakia regarding the level of its socio-economic development is also rather populous (Rajčák 1998, Kling 2002, Rajčáková and Švecová 2002 and 2008, Korec and Ondoš 2004, 2008a and 2008b, Korec et al. 2008 and other). Kling (2002) divided the districts of Slovakia into four regional types: advanced regions, regions with the potential to advance, less advanced regions and stagnating regions. This regional typification was accomplished by a summarizing indicator which "takes into account economic, social and demographic parameters along with selected parameters of technical infrastructure". Rajčáková and Švecová (2002 and 2008) presented interesting studies of the regional typification of Slovakia. They evaluated the socio-economic level of districts by means of four partial and one complex indicator which is in fact the arithmetical average of the four partial ones. The partial indicators include production performance, employment, demographic and supplementing indicators. These studies are interesting above all in relation to the relevancy and comprehensiveness of the applied characteristics. Rajčáková and Švecová (2002

and 2008) divided the districts of Slovakia into five regional types based on the value of the complex indicator. As they applied the same methodology in two time horizons, it helped them to observe the dynamics of regional differentiation as well. In all three above evaluated cases, the decline of advancement or a stagnating character of regions from the west to the east have been maintained. The basic spatial units applied were the 79 districts of Slovakia from 1996. A special feature of the study by Korec and Ondoš (2008a) is the fact that the regional typification was made on the basis of decomposed increase of the economic aggregate in the period 1997-2005. In Korec et al. (2008), the authors attempted a regional typification of the country's territory and based on the differing development of individual economic sectors in the period 1997-2006. The basic spatial units were approximated functional urban regions and economic aggregate in its social form. There is an obvious west-east gradient of spatial differentiation of regions and the region of Bratislava is extremely separated from the rest in a positive direction.

ATTEMPT TO IDENTIFY THE REGIONAL STRUCTURE OF THE SLOVAK REPUBLIC

Several methodological notes

In order to reach the aim of showing the regional structure or regional development on the national level it is necessary to solve two questions. The first is delimitation and establishment of the number of suitable spatial units which represent the basis of regional research. The second is the selection of an appropriate indicator of the level of regional development (this selection is limited by the accessibility of statistical data according to chosen spatial units). The immanent part of the second question is the construction of aggregated or synthesizing indicators of economic and social or complex social level in the development of the observed territorial units (Bezák 2000, Hampl 2001, Korec et al. 2005, Blažek and Csank 2007 and others).

The decision about what spatial units will be used in the analysis of the regional development level cannot rely on a great choice. In the majority of attempts to evaluate the level of social development in regions including the regional typification of Slovak Republic, individual researchers most often use the districts established by the territorial-administrative division from 1996 (Benč 2002, Kling 2002, Gajdoš 2002 and 2005, Rajčáková and Švecová 2002 and 2008). A similar situation also occours if the regional differentiation of the Slovak Republic is evaluated according to partial indicators, such as the level of unemployment, avera-ge monthly wages of employees, share of social beneficiaries and other. It is comprehensible with regard to the very good accessibility of statistical data about these units. Districts though, are not the most appropriate basic observation units because of two reasons: they are not internally integrated and are not comparable in terms of size (area and population number). The fact is that no unit in the gradation of municipality-district-region represents a suitable spatial unit (Bezák 1996 and 1997, Korec and Ondoš 2004 and 2009). As a matter of fact though, use of districts as basic spatial units in research of the regional structure in Slovakia cannot be principally rejected but in interpretation of results it is recommended to point out "deformations" ensuing from the above mentioned lack of internal integrity of districts and their different size, as well as the different geographical character of the nine urban dis-

tricts. The reader should be aware that the "sharp differences" between neighbouring districts (Martin – Turčianske Teplice, Zvolen – Krupina, Poprad – Kežmarok, Prešov – Sabinov, urban districts of Košice – Košice environs and other cases) are mostly consequences of choosing districts as basic spatial units. The reason is that in the quoted cases core areas are compared with their peripheries.

Appropriate basic spatial units appear to be the functional urban regions (FUR) in the study of the regional development levels, regional structure and regional typification of the Slovak Republic with regard to the level of socio-economic development. The theoretical basis and the methodology of FUR identification and their basic characteristics have been laid and presented by Bezák (1990, 2000 and 2001). Among eight principles to be respected in identification of FUR as recommended by this author, it is important to draw attention to the first of them, according to which FURs are units created primarily for the needs of regionally oriented research and the fifth which expresses the autonomy of the FUR. It means that the FUR should be internally integrated and externally completely closed (Bezák 2000, p. 27-29). With regard to the accessibility of statistical data in this paper, like in other studies (Korec et al. 2005, Korec and Ondoš 2004 and 2009, Halás and Hurbánek 2008), the approximated functional urban regions (AFUR) system applied is somewhat different from the FUR system 91-A identified by Bezák (2000). However, differences are negligible and the research results were in no case influenced. Korec (2007) has dealt with these differences in one of his preceding studies. As a matter of fact, they are two: the FUR of Bratislava is more closely delimited (in favour of the FUR Dunajská Streda and Senica in our system and Nové Zámky and Trebišov in our AFURs compared to the study of Bezák (2000) Štúrovo and Kráľovský Chlmec are independently conceived. Hence our AFUR system consists of 49 regions (Tab. 1, Fig. 1). The quoted differences result from the fact that the data necessary for research are only accessible on the level of districts.

The economic aggregate (EA) is considered a suitable indicator of economic development or of the economic level reached by a region. The EA is obtained as a product of the number of jobs in region and the average monthly wages of employee in the region. Construction of the EA is forced, beside other, by the limited basis of data in the Slovak regional statistics. Use of EA in research on the level of regional economic development has also been substantiated by Hampl (2005). According to him, the EA regarding the inner social and cultural homogeneity of individual transition countries of Europe is of an economic but also an overall social nature. This is the reason why it is also suitable for synthesized evaluation of the advancement in territorial units. The EA is expressed in relative values in two ways. If the size of EA in a region is calculated to the area of a region the result is what is referred to as the territorial variant and if it is calculated to the number of the population the result is the social variant (Hampl 2005 and 2007). According to the cited author (Hampl 2007), distinction and evaluation of these two basic forms of geographical distribution and development of the EA is a very important methodological question connected with identification of the regional structure of a country.

The level of regional development is here evaluated for the decade 1997-2006. The choice of 1997 as the beginning of the study period is due to a certain extent to data accessibility. On 24 July 1996, the now valid territorial-administrative division of Slovakia was approved, which means that the data for today's existing districts are available from 1997. Primarily, three classes of data for the years from 1997 to

Tab. 1. Economic aggregate of the Slovak Republic by the approximated functional regions

ID'Y	FURs	EA per person		Growth 1997-2006	Share of FUR in EA of SR 2006	Changes of share 1997-2006	Relative EA per person	
		1997	2006				1997	2006
BA	Bratislava	4,467	19,547	4.3	27.58	7.07	178	245
BB	Banská Bystrica	3,213	10,477	3.2	2.70	0.01	128	131
BJ	Bardejov	1,357	4,033	3.0	0.72	-0.03	54	51
BN	Bánovce nad Bebravou	1,958	6,267	3.2	0.55	-0.01	78	79
BR	Brezno	2,327	5,312	2.2	0.80	-0.34	93	67
CA	Čadca	1,428	4,023	2.8	0.87	-0.11	57	50
DK	Dolný Kubín	2,498	5,616	2.3	0.52	-0.21	100	70
DS	Dunajská Streda	1,646	5,759	3.6	1.55	0.18	66	72
GA	Galanta	1,663	5,833	3.5	2.02	0.19	66	73
HC	Hlohovec	2,349	6,713	2.8	0.71	-0.09	94	84
HE	Humenné	2,064	5,570	2.6	0.99	-0.20	82	70
IL	Ilava	2,239	7,239	3.2	1.03	-0.01	89	91
KE	Košice	3,419	9,655	2.8	7.78	-0.97	137	121
KN	Komárno	1,921	5,425	2.8	1.35	-0.21	77	68
LC	Lučenec	1,958	4,367	2.2	0.97	-0.43	78	55
LM	Liptovský Mikuláš	2,674	7,642	2.8	1.31	-0.18	107	96
LV	Levice	2,415	6,002	2.4	1.65	-0.52	96	75
MI	Michalovce	2,249	5,228	2.3	1.62	-0.58	90	66
MT	Martin	2,729	7,368	2.7	1.96	-0.37	109	92
NM	Nové Mesto nad Váhom	2,471	8,088	3.2	1.18	0.01	99	101
NO	Námestovo	1,131	5,001	4.8	0.68	0.22	45	63
NR	Nitra	2,368	8,228	3.5	3.13	0.27	95	103
NZ	Nové Zámky	1,765	5,312	2.9	1.82	-0.17	70	67
PB	Považská Bystrica	1,830	6,884	3.7	1.03	0.14	73	86
PD	Prievidza	2,681	7,196	2.6	2.33	-0.48	107	90
PN	Piešťany	1,999	7,832	3.9	1.17	0.22	80	98
PO	Prešov	1,839	5,359	3.0	2.75	-0.13	73	67
PP	Poprad	2,203	5,915	2.8	2.35	-0.32	88	74
PU	Púchov	3,177	10,759	3.4	1.14	0.06	127	135
RK	Ružomberok	2,393	6,929	2.9	0.95	-0.11	96	87
RS	Rimavská Sobota	1,778	3,309	1.9	0.63	-0.45	71	41
RV	Rožňava	1,992	4,339	2.2	1.03	-0.48	80	54
SE	Senica	2,582	6,075	2.3	1.26	-0.47	103	76
SI	Skalica	1,997	7,933	4.0	0.87	0.18	80	99
SK	Svidník	1,418	4,205	3.0	0.53	-0.03	57	53
SL	Stará Ľubovňa	1,412	4,000	3.0	0.48	-0.04	56	50
SN	Spišská Nová Ves	1,775	5,107	3.0	1.89	-0.10	71	64
SV	Snina	1,507	4,711	3.1	0.43	-0.01	60	59
TN	Trenčín	2,729	8,108	3.0	2.13	-0.17	109	102
TO	Topoľčany	1,881	5,394	2.8	1.52	-0.19	75	68
TS	Tvrdošín	2,060	4,194	2.1	0.35	-0.18	82	53
TT	Trnava	3,205	11,575	3.6	3.43	0.42	128	145
TV	Trebišov	1,755	4,395	2.6	1.07	-0.25	70	55
VK	Veľký Krtíš	1,846	3,480	1.9	0.37	-0.27	74	44
VT	Vranov nad Topľou	1,470	3,665	2.6	0.67	-0.15	59	46
ZA	Žilina	2,527	8,536	3.4	4.42	0.30	101	107
ZH	Žiar nad Hronom	2,587	5,934	2.3	1.27	-0.52	103	74
ZM	Zlaté Moravce	1,847	4,179	2.2	0.42	-0.18	74	52
ZV	Zvolen	2,531	7,123	2.8	2.04	-0.31	101	89
SR	Slovak Republic	2,504	7,974	3.2	100	0.00	100	100

Source: Regional comparison in the Slovak Republic, Statistical Office of the Slovak Republic, 2007

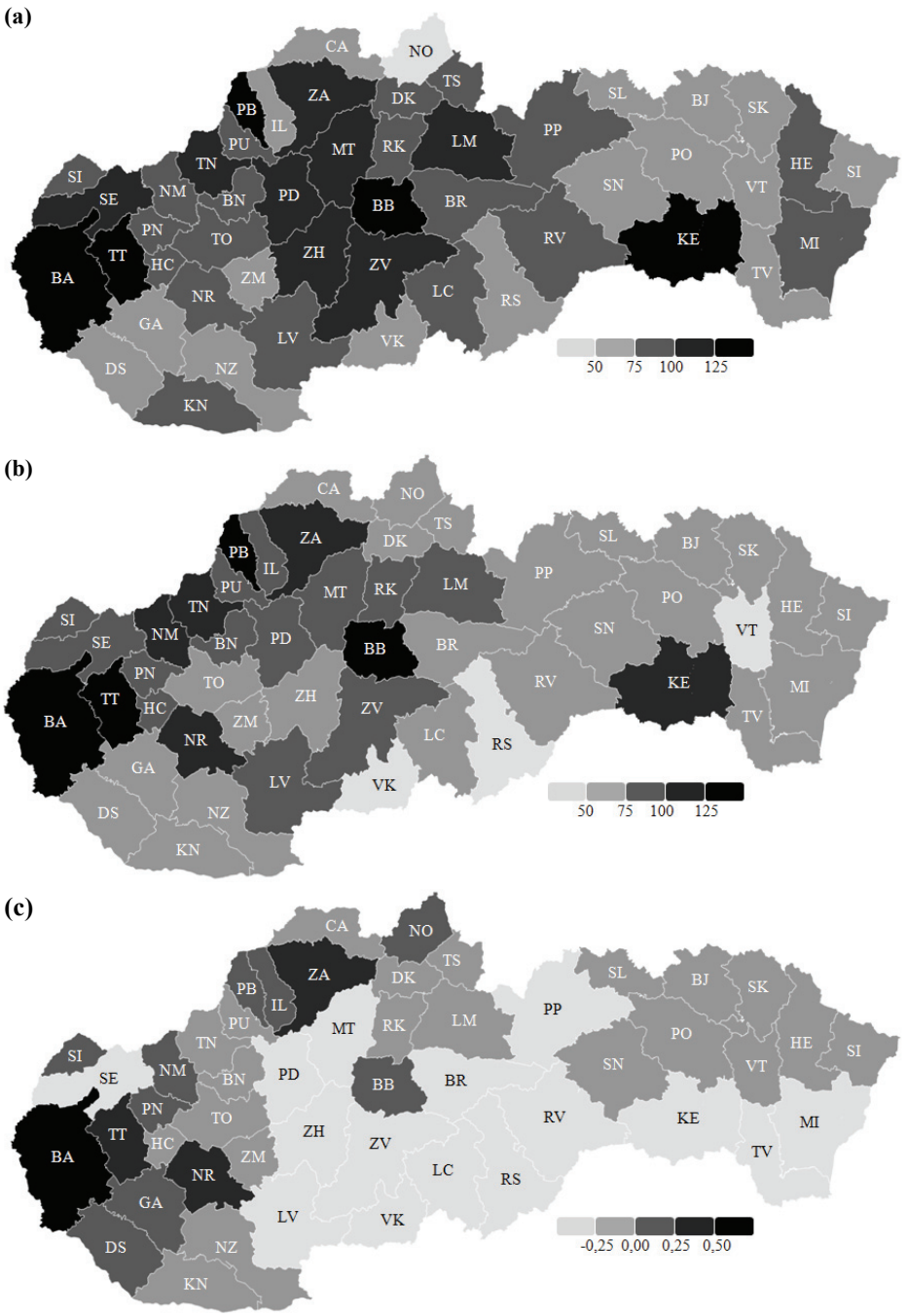

Fig. 1. Economic aggregate in the approximated functional regions of the Slovak Republic as (a) relative level per capita 1997, (b) relative level per capita 2006, (c) change in regional share of the nation´s totals between 1997 and 2006

2006 relating to districts (population number, number of available jobs in companies with over 20 employees and average wages of employees) were used in this study. On the other side, it must be noted that 1997 can be considered a kind of a milestone not only in the development of Slovakia's economy but also in the development of its regional structure in the first stage of the post-communist transformation. As a matter of fact, it was "destruction" of the centrally controlled economy of the country (it involves above all the disintegration of big industrial and agricultural firms) and started after 1989. The "big" privatisation that took place in Slovakia in the years 1995 and 1996 can also by considered the end of this destruction. The end of the evaluated period, 2006, was also the end of the (first stage) of social transformation that started after 1989. Several facts lead to this assertion among which are: implementation of basic reforms (above all the neo-liberal political reforms carried out in 1998-2006 including the reform of the social security system, pension system, tax reform - introduction of the 19% income tax, amendment of the Work Code and other, Smith, Rochovská 2006); successful conclusion of Slovakia's effort to join the Euro-Atlantic structures (EU and NATO); a relatively stabilized "new pattern" of regional structure at the beginning of the 21st century, etc. In the following period, some distinct effects of the regional policy pursued by the EU and the State itself on the development of regional structure of Slovakia and, of course, interventions by the State into the economy and social area as a results of the economic crisis are expected. The result of such changes does not have to be necessarily a new trajectory in the regional development of Slovakia; but it is quite realistic to expect a decline of divergent forces. The period 1997-2006 can be considered relatively homogeneous in terms of qualitative characteristics of the environment and factors determining the regional development in Slovakia.

Empirical results of the study of regional structure in Slovakia

Regional GDP is considered an essential quantitative indicator when one's objective is to describe a spatial pattern of differentiated economic performance. Statistical resources, however, limit research ambitions significantly in terms of scale. The level of statistical aggregation in the Slovak Republic allows construction of a regional GDP dataset consisting of eight NUTS3 units. For a more detailed spatial overview it is necessary to find an appropriate approximation as close as possible to the regional GDPs measure.

A principle for an alternative methodological approach can be found in Geary and Stark (2002), Crafts (2005) and Hampl (2007). Regional GDP is estimated on the basis of labour market indices, regional employment and average annual regional wages, commonly available at a finer aggregation level than the regional GDP. In Slovakia it is on the level of the 79 districts introduced in the year 1996. The national GDP volume is defined as a sum of all regional GDP volumes that depend on the number of workers and average value added by workers. This dependence can be estimated by average wages paid across different regions. Sector differentiation will not be considered here although its usefulness was demonstrated (Geary and Stark 2002, Crafts 2005). Like Hampl (2007), we define the estimation as the economic aggregate of a region EA_i being a complementary element of the national economic aggregate $EA_i = E_i \cdot W_i$, $EA = \Sigma EA_i$ (E_i – *number of workers in* FUR_i, W_i – *average wages in* FUR_i).

Tab. 1 and the Fig. 1 illustrate two levels of relatively expressed regional economic aggregate in the years 1997 and 2006. The spatial units are approximated functional urban regions consisting of the districts aggregated according to Bezák (2000). The period captures a unique phase in the country's transition process during which it was politically and economically redirected towards EU membership between 1998 and 2004. The Slovak economy entered the ongoing international competition during that time easily thanks to its low wage level and suitable position within the Central European territory serving emerging markets.

Change in the regional economic performance has been significant mostly as a result of foreign investment in manufacturing. Slovakia's economy developed a significant automotive industry cluster, but other selected sectors have also grown. The visual comparison between the levels in 1997 and 2006 directs attention to how spatial patterns were transformed. Generally, spatial concentration is evident leaving the second country's metropolitan region of Košice as the last remaining above national average in the south and the east of the country. Four relatively well performing regions have also decreased to the level of their neighbours. Originally a wide cluster around Banská Bystrica was decomposed leaving its central region as the last remaining above average in the centre of the country's territory. The best performing territory in 2006 was concentrated in a narrow strip between the capital city region and Žilina. In fact a contiguous circle was spatially formed including the regions of Nitra, Levice, Zvolen, Banská Bystrica, Ružomberok and some others connected to these. All of them were successful in attracting investments in local decisions responsible for the aggregated result presented.

The third map supports our findings mentioned above with an illustration of how an individual regions's share of the national economic aggregate changed during the period between 1997 and 2006. A total of 20 regions increased and 29 regions decreased their shares. All of the more successful ones were located on or directly contacting the western edge of the country's territory. The Bratislava region is a single outlier among them with its 7.07% increase. The nine following regions in a decreasing order are Trnava 0.40%, Žilina 0.30%, Nitra 0.27%, Námestovo 0.22%, Piešťany 0.22%, Galanta 0.19%, Dunajská Streda 0.18%, Skalica 0.18% and Považská Bystrica 0.14%. The region suffering the worst loss is the region of Košice with -0.97%. The following nine regions in increasing order are Michalovce – 0.58%, Žiar nad Hronom – 0.52%, Levice – 0.52%, Prievidza – 0.48%, Rožňava – 0.48%, Senica – 0.47%, Rimavská Sobota – 0.45%, Lučenec – 0.43%, and Martin – 0.37%.

The territory of Slovakia is characterized by an extremely differentiated development potential (Korčák 1938, Hromádka 1943, Lukniš 1985, Paulov 1992 and others). Three factors that decisively influence the development are regionally of regional structure of Slovakia after 1989 and above all on the economic development are regionally differentiated. Practically all authors involved with social transformation in post-communist countries agree that these factors are: settlement hierarchy, macroposition in combination with elements of major transport infrastructure and economic specialization of regions. It must be emphasized that the development of regional structure of the country in the period of transition occurred in three parallel processes triggered precisely by the political changes of 1989. They were the processes of rectification of the regional structure deformed by communism, transition of society from the industrial to the post industrial developmental stage and globalization.

As far as the transition of society from the industrial to the post industrial stage is concerned, it must be noted that apart from the generally known shift from the dominance of industry to that of services (tertiary and quaternary sectors), its direct consequences for the development of the economy and regional structure in general are also important. These consequences include above all the four following: the selectivity of concentration of economic activities and simultaneously the intensity of this process increased precisely in the post industrial stage which, of course, led to a responded by the distinct increase of regional differences (1), the dominance and role of metropolitan regions in the regional structure of the State increases (2), the polarization of the meaning of economic and social systems in general moves from the type of "rich-poor" to that of "managing-managed" (3) and finally, in the post industrial stage the population distribution does not significantly change but a distinct increase is obvious in the concentration of work opportunities in the tertiary and quaternary sectors (4) (Hampl 2005). Slovakia is a small country. Practically all the factors that determine regional development after 1989 where concentrated in its capital and that in an extremely positive sense. Regarding the quoted "smallness" of the country, the region of Bratislava saturates with activities of the tertiary and quaternary sectors practically the whole territory of Slovakia and suppresses the opportunities of other cities and regions. This fact is well illustrated by the concentration of the biggest companies active in area of information technologies, media, survey agencies, providers of Internet services, business companies and other progressive activities.

One note is, perhaps, also appropriate in connection with globalization. Authors writing about globalization agree on one thing globalization favours the market "fundamentalism". In words of Soros (2002), market fundamentalism is the capacity of private capital to move investments into the most profitable localities in terms of efficiency. It must be admitted without discussion that in the past twenty years such localities were the regions of Bratislava, south-west Slovakia, central Považie, and the regions of selected metropolitan cities outside these areas (Banská Bystrica and Košice).

Regarding the above quoted fact, it is not surprising that two distinct levels of polarities have formed in the regional structure. The first is the polarity of Bratislava vs. the rest of the territory and the second polarity on the hierarchically lower level of distinction is that between the more urbanized areas of western Slovakia and selected metropolitan regions against the less developed rural area of the southern part of central Slovakia and the whole of eastern Slovakia. This basic pattern of regional structure can be considered natural if it is admitted that the first stage of social transformation delimited by years 2006-2008 (Blažek and Csank 2007, Korec and Ondoš 2008b) is the subject of evaluation.

CONCLUSION

The societal transformation in post-communist European countries has been one of the most important research themes in the social sciences in Slovakia in the last 20 years. Research on the regional structure of Slovakia is a complicated interdisciplinary problem where the obtained plurality of approaches and results is rather unavoidable. The contribution of geography, as a scientific discipline, is clearly to express the objective position in the evaluation of regional structures evolving in post-communist Slovakia. This paper tries to point to the wide range of problems

dealt with in Slovak geography in the past period in connection with the development of the regional structure of Slovakia. It is obvious, that the above evaluation of geographical studies must be interpreted as a presentation of research into the basic relevant themes. Some attractive research themes concerning the regional structure of Slovakia often treated by geographers were not included with regard to their specialized nature (for instance poverty, unemployment and others). Several conclusions can be articulated on the evaluation of the regional structure of Slovakia. The Bratislava region – "rest of Slovakia" polarity is significantly apparent in the first hierarchical level of the regional structure of Slovakia. An extraordinary concentration of the positive effects of particular factors and processes determining the regional development towards the Bratislava region is reflected by the growing the differences between Bratislava and the other regions. On the lower level of resolution, we can see a clear polarity of a more urbanized western Slovakia against a more rural eastern Slovakia in the regional development of Slovakia. We believe that the explanation of this aspect is to be found in the two already mentioned factors, the factor of the settlement hierarchy (more urbanized vs. more rural) and the factor of the historically formed macro-location attractiveness (western vs. eastern).

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REFERENCES

BAŠOVSKÝ, O. (1995). Súčasný stav a prognóza urbánnej a regionálnej štruktúry Slovenska a ekonomická transformácia. *Sborník České geografické společnosti*, 100, 78-91.

BENČ, V. (2002). Regionálna politika. In Marcinčin, A., ed. *Hospodárska politika na Slovensku 2000-2001.* Bratislava (Slovenská spoločnosť pre zahraničnú politiku), pp. 289-321.

BEZÁK, A. (1990). Funkčné mestské regióny v sídelnom systéme Slovenska. *Geografický časopis*, 42, 57-73.

BEZÁK, A. (1996). Reflexie nad novým administratívnym členením Slovenskej republiky. *Geografické informácie*, 4, 7-9.

BEZÁK, A. (1997). Priestorová organizácia spoločnosti a územno-správne členenie štátu. *Acta Universitatis Matthiae Belii, Geografické štúdie*, 3, 6-13.

BEZÁK, A. (1998). Regionálna štruktúra a nové kraje na Slovensku. Sborník prací Pedagogické fakulty Masarykovy Univerzity. *Geografie*, 10, 4-8.

BEZÁK, A. (2000). *Funkčné mestské regióny na Slovensku*. Geographica Slovaca, 15. Bratislava (Geografický ústav SAV).

BEZÁK, A. (2001). Niekoľko poznámok o revízii systému funkčných mestských regiónov na Slovensku. *Acta Facultatis Rerum Naturalium, Universitatis Matthiae Belii, Geografické štúdie*, 8, 36-40.

BLAŽEK, J. (1993). Regionální vývoj a regionální politika: hlavní přístupy v zemích západní Evropy. In Sýkora, L., ed. *Teoretické přístupy a vybrané problémy v současné geografii*. Praha (UK Praha), pp. 120-146.

BLAŽEK, J. (1998). Regional development and regional policy in Central East European countries in the perspective of the EU eastern enlargement. In Hampl, M., ed. *Geography of societal transformation in the Czech Republic*. Praha (DemoArt), pp. 181-207.

BLAŽEK, J. (2003). Forthcoming accesion: an outline of impacts in the sphere of regional development and regional policy in the Czech Republic. *European Spatial Research and Policy*, 10, 27-47.

BLAŽEK, J., KÁRA, J. (1992). Regional policy in the Czech Republic in the period of transition. In Gorzelak, G., Kuklinski, A., eds. *Dilemmas of regional policies in Eastern a Central Europe*. Warsaw (University of Warsaw), pp. 7-94.

BLAŽEK, J., UHLÍŘ, D. (2002). *Teorie regionálního rozvoje*. Praha (Karolinum, UK).

BLAŽEK, J., CSANK, P. (2007). Nová fáze regionálního rozvoje v ČR? *Czech Sociological Review*, 43, 945-965.

BRZICA, D., GAŠPARÍKOÁ, J., NEMCOVÁ, E. (2004). The impact of industrial and regional diferentiation on SMEs in Slovak Republic. *Ekonomický časopis*, 52, 820-834.

BUČEK, J. (2003). Les investissements étrangers direct (IED) en Slovaquie. Les conditions de leur action et les aspects d´espace-temps. *Hommes et Terres du Nord,* 3-17.

BUČEK, M. (1999). Regional disparities in transition in the Slovak Republic. *European Urban and Regional Studies*, 6, 360-364.

BUČEK, M. (2003). Regionálna integrácia Slovenskej republiky: stratégia využitia podpory Európskej únie. *Ekonomický časopis*, 51 (8), 982-996.

BUČEK, M., REHÁK, Š., PÁSTOR, R., ŠIPIKAL, M., JEŽKOVÁ, R. (2006). *Regionálny rozvoj – novšie regionálne koncepcie*. Bratislava (Ekonóm).

CHROMÝ, P. (2000). Historickogeografické aspekty vymezování pohraničí jako součást geografické analýzy. *Sborník ČGS*, 105, 63-75.

CHROMÝ, P. (2003). Historical-geographical and cultural-geographical research of the development in border, margine and peripheral regions in Czechia. In: Kowalczyk, A., ed., Theoretical and Methodological Aspects of Geographical Space at the Turn of Century. Warsaw University, Warsaw, 187-192.

CHROMÝ, P., JANŮ, M. (2003). Regional identity, activation of territorial communities and the potential of the development of peripheral regions. *Acta Universitatis Carolinae Geographica*, 38 (1), 105-117.

CRAFTS, N. (2005). Regional GDP in Britain, 1871-1911: some estimates. *Scottish Journal of Political Economy*, 52, 54-64.

ČAMBÁLIKOVÁ, M. (2005). Sociálna situácia a ľudský potenciál: vybrané okresy a vybrané problémy vo svetle sociologického výskumu. In Ira, V., et al. eds. *Podoby regionálnych odlišností na Slovensku*. Bratislava (Sociologický ústav SAV), pp. 116-141.

DOSTÁL, P. (2000). Reintegrating Central European region: challenges of trans-border spatial development. *Informationen zur Raumentwicklung*, 3/4, 183-192.

DOSTÁL, P. (2002). EU enlargement and the public opinion on the Czech Republic: an explanatory analysis. *Sborník ČGS*, 107, 121-138.

DOSTÁL, P. (2006). Quo vadis European union? The core, peripheries and the public opinion. *Acta Geographica Universitatis Comenianae*, 48, 7-32.

DOSTÁL, P. (2008). The post-comunist capital city, effects, transactional activities and regional development in Czech Republic in the 1990s: a modelling approach. In. Strubelt W., Gorzelak, G., eds. *City and region*. Opladen & Farmington Hills (Budrich UniPress), pp. 15-42.

DOSTÁL, P., HAMPL, M. (1992). Urbanization, administration and economies: future geopolitical and geo-economic changes. In Dostál, P., Illner, M., Kára, J., Barlow, M. eds. *Changing territorial administration in Czechoslovakia – international viewpoints*. Amsterdam (University of Amsterdam), pp. 191-203.

DOSTÁL, P., HAMPL, M. (2003). Geography and territorial administration in the Czech Republic: issues of fragmentation and rescaling. Lecture held in conference „Territorial Administration and Public Policy: Restructuring Big Government, Welfare State and Local Economies, Prague, 19th and 20th of September 2003.

DOSTÁL, P., HAMPL, M. (2008). Development of national settlement systems in the industrial and post-industrial eras: a general discussion and the case of the Czech Republic. In Strubelt, W., Gorzelak, G. eds. *City and Regions*. Opladen & Farmington Hills (Budrich UniPress), pp. 43-54.

DRBOHLAV, D., SÝKORA, L. (1997). Gateway cities in the proces sof regional integration in Central and Eastern Europe: the case of Prague. In *Migration, free trade, and regional integration in Central and Eastern Europe*. Wien (Verlag Österreich), pp. 215-237.

DŽUPINOVÁ, E., HALÁS, M., HORŇÁK, M., HURBÁNEK, P., KÁČEROVÁ, M., MICHNIAK, D., ONDOŠ, S., ROCHOVSKÁ, A. (2008). *Periférnosť a priestorová polarizácia na území Slovenska*. Bratislava (Geografika).

FALŤAN, Ľ. (2008). Micro and macro-social context and problems of regional development in Slovakia. In Gajdoš, P., ed. *Regional disparities in Central Europe*. Bratislava (Sociologický ústav SAV), pp. 116-134.

FALŤAN, Ľ, GAJDOŠ, P., PAŠIAK, J. (1995). Sociálna marginalita území Slovenska. Bratislava (S.P.A.C.E.).

FOGAŠ, A, (2003). Regionálna politika Európskej únie, geografické aspekty stredoeurópskeho priestoru. *Geografie* 14, 31-35.

GAJDOŠ, P. (2001). K vybraným problémom transformácie sociálno-priestorovej situácie Slovenska. *Sociológia*, 33, 185-206.

GAJDOŠ, P. (2002a). Mesto a jeho vývoj v sociálno-priestorových a civilizačných súvislostiach. *Sociológia*, 34, 305-326.

GAJDOŠ, P. (2002b). *Človek, spoločnosť, prostredie (priestorová sociológia)*. Bratislava (Sociologický ústav SAV).

GAJDOŠ, P. (2005). Teoretický a metodologický rámec klasifikácie a typológie regiónov Slovenska v kontexte teritoriálnych disparít. In Ira, V., et al., eds. Podoby *regionálnych odlišností na Slovensku*. Pezinok (Sociologický ústav SAV, FORMÁT), pp. 25-46.

GAJDOŠ, P. (2008). Current state and development of regional disparities in Slovakia (with emphasis on underdeveloped regions. In Gajdoš, P., ed. *Regional disparities in Central Europe*. Bratislava (Sociologický ústav SAV), pp. 98-115.

GAJDOŠ, P., MORAVANSKÁ, K. (2005). Reflexia stavu životných podmienok a rozvojových možností obcí modelového území. In Ira, V., et al., eds., *Podoby regionálnych odlišností na Slovensku*. Bratislava (Sociologický ústav SAV), pp. 190-217.

GAJDOŠ, P., PAŠIAK, J. (2006). *Regionálny rozvoj Slovenska z pohľadu priestorovej sociológie*. Bratislava (Sociologický ústav SAV).

GAŠPARÍKOVÁ, J., BUČEK, M., REHÁK, Š. (2003). Small and medium enterprises and thein role in regional development (case Bratislava). *Ekonomický časopis*, 51, 50-71.

GEARY, F., STARK, T. (2002). Examining Ireland's post-famine economic growth performance. *The Economic Journal*, 112, 919-935.

HALÁS, M. (2002). Hranica a prihraničný región v geografickom priestore (teoretické aspekty). *Geographia Slovaca*, 18, 49-55.

HALÁS, M. (2005). Marginalita a prihraničné regióny. *Geografie*, 16, 202-210.

HALÁS, M. (2008). Priestorová polarizácia společnosti s detailným pohľadom na periférne regióny Slovenska. *Czech Sociological Review*, 44, 349-369.

HALÁS, M., HURBÁNEK, P. (2008). Identifikácia a klasifikácia periférnych regiónov (pokus o syntézu). In Džupinová et al., eds. *Periférnosť a priestorová polarizácia na území Slovenska*. Bratislava (Geo-grafika), pp. 109-136.

HAMPL, M. (2000). Pohraniční regiony České republiky: současné tendence rozvojové diferenciace. *Sborník ČGS*, 105, 241-254.
HAMPL, M. (2001). Regionální vývoj v období transformace. Hampl, M., et al., eds. *Regionální vývoj: specifika české transformace, europská transformace a obecná teorie*. Praha (DemoArt), pp. 17-41.
HAMPL, M. (2005). *Geografická organizace společnosti v České republice: transformční procesy a jejich obecný kontext*. Praha (Univerzita Karlova).
HAMPL, M. (2007). Regionální diferenciace současného socioekonomického vývoje v České republice. *Czech Sociological Review*, 43, 889-910.
HAMPL, M. (2007). Geographical/environmental systems: possibilities and limits of knowledge. In. Dostál, P., Langhammer, J., eds. *Modeling natural environment and society*. Prague (Charles University in Prague), pp. 15-28.
HAMPL, M., BLAŽEK, J., ŽÍŽALOVÁ, P. (2008). Faktory-mechanizmy-procesy: aplikace konceptu kritického realizmu. *Ekonomický časopis*, 56, 696-711.
HAVLÍČEK, T. (2003). Are border regions peripheral territories? In Kowalczyk, A., ed. *Theoretical and methodological aspects of geographical space at the turn of century*. Warsaw (Warsaw University), pp. 193-197.
HAVLÍČEK, T., CHROMÝ, P. (2001). Příspěvek k teorii polarizovaného vývoje území se zaměřením na periferní oblasti. *Sborník ČGS*, 106, 1-11.
HAVLÍČEK, T., CHROMÝ, P., JANČÁK, V., MARADA, M. (2005). Vybrané teoreticko-metodologické aspekty a trendy geografického výskumu periferních oblastí. In Novotná, M. ed. *Problémy periferních oblastí*. Praha (Univerzita Karlova), pp. 6-24.
HORŇÁK, M., ROCHOVSKÁ, A. (2007). Vybrané aspekty kvality života vo vnútorných periferiach Slovenska. *Geographia Cassoviensis,* 1, 55-60.
HROMÁDKA, J. (1943). Všeobecný zemepis Slovenska. In Novák, Ľ., ed., *Slovenská vlastiveda*, Bratislava (SAVU), pp. 83-332.
HURBÁNEK, P. (2004). Zmeny úlohy priestorového aspektu v interpretácii pojmov periférnosť (marginalita) a vidiek. In Wahla, A., ed. *Geografie a proměny poznání geografické reality*. Ostrava (Ostravská univerzita), pp. 102-110.
HURBÁNEK, P. (2005). Vývoj a nové prístupy v interpretácii vidieka: priestorový aspekt, periférnosť a koncentrovanosť systému osídlenia. In Spišiak, P., et al., eds. *Agrorurálne štruktúry Slovenska po roku 1989*. Bratislava (Geo-grafika), pp. 95-114.
HURBÁNEK, P. (2007). *Exploratívna analýza metód kvantifikácie morfometrických atribútov osídlenia indikujúcich vidieckosť Slovenska*. Dizertačná práca, PRIF UK, Bratislava.
IRA, V. (2005). Rozvojové možnosti a obmedzenia vybraných regionálnych systémov (okresov) identifikované na základe rozvojových faktorov. In Ira, V., et al., eds. *Podoby regionálnych odlišností na Slovensku*. Bratislava (Sociologický ústav SAV), pp. 325-342.
IRA, V., LEHOTSKÝ, M. (2005). Modely rozvojových možností a obmedzení vo vybraných regionálních systémech (okresoch). In Ira, V., et al., eds. *Podoby regionálnych odlišností na Slovensku*. Bratislava (Sociologický ústav SAV), pp. 343-357.
IRA, V., LEHOTSKÝ, M. (2008). Developmental posibilities and limits in models of selected regional systems. AFSHN UP. *Folia Geographica*, 12, 122-130.
JEŘÁBEK, M., DOKOUPIL, J., HAVLÍČEK, T., eds. (2004). *České pohraničí. Bariéra nebo prostror zprostředkování?* Praha (Academie).
KLAMÁR, R. (2008). Slovakia and the Analysis of its Disparities. AFSHN UP. *Folia Geographica*, 12, 145-162.

KLING, J. (2002). Regionálna politika a regionálny vývoj. In Kollár, M., Mesežnikov, G., eds. *Slovensko 2002. Súhrnná správa o stave spoločnosti II*. Bratislava (IVO), pp. 109-126.

KLING, J. (2003). Regionálna politika. In Mesežnikov, G., Kollár, M., eds. *Slovensko 2003. Súhrnná správa o stave spoločnosti*. Bratislava (IVO), pp. 493-510.

KLING, J. (2004). Regionálna politika. In Kollár, M., Mesežnikov, G., eds. *Slovensko 2004. Súhrnná správa o stave spoločnosti*. Bratislava (IVO), pp. 567-583.

KORČÁK, J. (1938). *Geopolitické základy Československa, jeho kmenové oblasti*. Praha (Orbis).

KOREC, P. (2004). Faktory podmieňujúce regionálnu diferenciáciu Slovenska. AFR-NUMB. *Geografické štúdie*, 12, 76-90.

KOREC, P. (2005). *Regionálny rozvoj Slovenska v rokoch 1989-2004*. Bratislava (Geografika).

KOREC, P. (2007). Vplyv post-industriálneho štádia vývoja spločnosti a globalizácie na regionálny vývoj Slovenska. *Geographia Cassoviensis*, 1, 75-80.

KOREC, P., ONDOŠ, S. (2004). New pattern of the regional structure of Slovakia. Przekstalcenia regionalnych struktur funkcjonalno-przestrzennych VIII/1. Universitet Wrocławski, Wrocław, 173-185.

KOREC, P., ONDOŠ, S. (2006). Less developed regions of Slovakia: identification and characteristics. *Acta Geographica Universitatis Comenianae*, 48, 55-74.

KOREC. P.. ONDOŠ. S. (2008a). Regionálny vývoj Slovenska: dekompozícia ekonomického agregátu 1997-2005. *Acta Geographica Universitatis Comenianae*, 50, 117-133.

KOREC, P., ONDOŠ, S. (2008b). Regional development of the Slovak Republic from 1997 to 2006. In Gajdoš, P., ed. *Regional disparities in Central Europe*. Bratislava (Sociologický ústav SAV), pp. 135-155.

KOREC, P., HORŇÁK, M., ONDOŠ, S. (2008). Dynamics of regional development of Slovakia by economic sectors. In Dolzblasz, S., Raczyk, A., eds. *Przekstalcenia regionalnych struktur funkcjonalno-przestrzennych, Europa bez granic, nova jakosc przestrzeni*. Wrocław (Universitet Wrocławski), pp. 231-243.

KOREC, P., SMATANOVÁ, E. (2000). Hodnotenie novej geoekonomickej polohy regiónu Bratislavy. *Miscellanea Geographica*, 7, 128-141.

KRIVÝ, V. (2004). *Okresy SR cez prizmu faktorovej a clustrovej analýzy*. Bratislava (Sociologický ústav SAV).

LUKNIŠ, M. (1985). Regionálne členenie Slovenskej socialistickej republiky z hľadiska jej racionálneho rozvoja. *Geografický časopis*, 37, 137-163.

MARADA, M. (2001). Vymezení periferních oblastí oblastí a studium jejich znaků pomoci statistické analýzy. *Sborník ČGS*, 106, 12-25.

MARADA, M., CHROMÝ, P. (1999). Contribution to studies on peripheral regions of Czechia. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica, Supplementum*, 2/1, 241-255.

MARADA, M., HUDEČEK, T. (2006). Accessibility of peripheral regions: a case of Czechia. *Europa XXI,* 15. 43-49.

MATLOVIČ, R. (2004). Prešovský kraj v kontexte vývoja vybraných regionálních disparit na Slovensku. In Kuzmišin, P., ed. *Podnikateľské prostredie a regionálne aspekty rozvoja, II.* Prešov (ManaCon), pp. 88-107.

MATLOVIČ, R., MATLOVIČOVÁ, K. (2005). Vývoj regionálnych disparít na Slovensku a problémy regionálneho rozvoja Prešovského kraja. AFSHN UP, *Folia Geographica*, 8, 66-88.

PAŠIAK, J. (2004). *Sociologický kontext regionalizmu a regionalizácie. Vybrané otázky teoretickej a metodologickej problematiky*. Bratislava (Sociologický ústav SAV).
PAŠIAK, J. (2005). *Teoretický rámec regionálneho rozvoja a regionálnej politiky*. Bratislava (Sociologický ústav SAV).
PAŠIAK, J., GAJDOŠ, P., FALŤAN, Ľ. (2001). Regional paterns in Slovak development. In Gorzelak, G., Ehrlich, E., Falťan, Ľ., Illner, M., eds. *Central Europe in transition: towards EU membership.* Warszawa (Regional studies association.), pp. 330-364.
PAULOV, J. (1992). K novému rámcu regionálneho rozvoja Slovenska. *Geographia Slovaca*, 1, 23-28.
PAULOV, J. (1995). Some notes of border as geographical factor. *Geographical Studies*, 1, 5-9.
PAULOV, J. (1996). K zmenám geografickej a geopolitickej polohy Slovenska v historickom kontexte. In *Zborník z konferencie venovanej 10. výročiu úmrtia M. Lukniša 2. diel*. Bratislava (GÚ SAV), pp. 137-154.
PAVLÍNEK, P. (1992). Regional transformation in Czechoslovakia: towards a market economy. *Tijdschrift voor economische en sociale geografie*, 83, 361-371.
PAVLÍNEK, P. (2004). Regional development implications of FDI in Central Europe. *European Urban and Regional Studies*, 11, 47-70.
RAJČÁK, M. (1996). District and socio-economic regions of the Slovak Republic under their adaptability to new socio-political conditions and tasks of Slovak regional policy. *Acta Facultatis Rerum Naturalium Universitatis Comenianae*, *Geographica*, 38, 157-168.
RAJČÁK, M. (1998). Regional typologies and the new territorial structure of Slovakia. In Smith, A., ed. *Reconstructing the regional economy*. Cheltenham (E. Elgar), pp. 32-39.
RAJČÁK, M. (2001). Koncepcia a nástroje regionálnej politiky. In Gindlová, D., Kusý, I., eds. *Socio-economic aspects of spatial development*. Bratislava (FA STU), pp. 78-85.
RAJČÁKOVÁ, E. (1996). Potential as a precondition of regional development possibilities. *Acta Facultatis Rerum Naturalium Universitatis Comenianae*, *Geographica*, 38, 143-148.
RAJČÁKOVÁ, E. (2005). *Regionálny rozvoj a regionálna politika*. Bratislava (Univerzita Komenského).
RAJČÁKOVÁ, E. (2008). Regionálny rozvoj a regionálna politika s dôrazom na Slovensko. *Životné prostredie*, 42, 5-10.
RAJČÁKOVÁ, E. (2009). *Regionálny rozvoj a regionálna politika Európskej únie a Slovenska*. Bratislava (Geo-grafika).
RAJČÁKOVÁ, E., ŠVECOVÁ, A. (2002). Postavenie okresov a krajov Slovenska z hľadiska hodnotenia vybraných sociálnych a ekonomických znakov. *Geographia Slovaca*, 18, 167-175.
RAJČÁKOVÁ, E., ŠVECOVÁ, A. (2008). *Regionálna typizácia okresov Slovenska z hľadiska ich sociálno-ekonomického rozvoja*. Referát prednesený na V. medzinárodnom geografickom kolokviu, Danišovice, 5.-7.11.2008.
ROCHOVSKÁ, A., HORŇÁK, M. (2008). Chudoba a jej percepcia v marginálnych regiónoch Slovenska. *Geographia Cassoviensis II*, 1, 152-156.
SLAVÍK, V. (1997). Vývoj územno-správneho usporiadania SR do roku 1990. *Geografia*, 5, 48-53.
SMITH, A., ROCHOVSKÁ, A. (2006). Neo-liberalism and post-socialist urban transformation: poverty, inequality and the city. *Acta Geographica Universitatis Comenianae*, 48, 43-54.

SOROS, G. (2002). *Globalizácia*. Bratislava (Kaligram).
TVRDOŇ, J. (2002). Formation of assumption and conditions possibilities for the increase of atractivity of regions in the period of integration Slovak Republic to the European Union. *Ekonomický časopis*, 50, 694-718.
TVRDOŇ, J. (2005). Hospodárska štruktúra vybraných okresov na Slovensku. In Ira, V., et al., eds. *Podoby regionálnych odlišností na Slovensku*. Bratislava (Sociologický ústav SAV), pp. 85-115.
TVRDOŇ, J. (2007). Dimenzia hospodárstva – typológia regiónov. In Falťan, L., Štrbavá, Ľ., eds. *Regionálna diferenciácia, regionány rozvoj v Slovenskej republike v kontexte integračných dosahov*. Bratislava (Sociologický ústav SAV), pp. 67-81.
TVRDOŇ, J., HAMALOVÁ, M., ŽÁRSKA, E. (1995). *Regionálny rozvoj*. Bratislava (Ekonóm).
ZUBRICZKÝ, G. (2002). Analýza rurálneho prostoru Slovenska z hľadiska rozvojových perspektív jeho osídlenia. In Tolmáči, L., ed. *Regionálno-geografické štúdie*. Bratislava (MAPA Slovakia), pp. 67-120.
ŽÁRSKA, E. (2005). Regional cohesion and regional policy. *Ekonomický časopis*, 53, 92-106.

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AN INSIGHT INTO ENVIRONMENTAL GEOGRAPHY IN SLOVAKIA

*Mikuláš Huba**

Environmentálna geografia na Slovensku
Štúdia je zameraná na environmentálne orientované výskumy uskutočnené slovenskými geografmi v nedávnej minulosti. Začiatok takéto druhu výskumov na Slovensku spadá do polovice 70. rokov minulého storočia. Postupne sa vyvinuli a diferencovali do viacerých výskumných smerov: od štúdií prevažne teoretického charakteru, cez geografické (resp. geoekologické) výskumy globálnych, makroregionálnych, národných, regionálnych či miestnych environmentálnych problémov (vrátane environmentálnych hazardov a rizík), pokračujúc participáciou geografov na posudzovaní vplyvov činností na životné prostredie či na strategickom environmentálnom hodnotení, environmentálnom plánovaní a formulovaní politík, až po výskumy percepcie a hodnôt vo vzťahu k životnému prostrediu, ako aj životného prostredia ako dôležitej súčasti výskumov týkajúcich sa udržateľnosti a kvality života. Štúdia prináša prehľad publikovaných prác, klasifikáciu a stručnú charakteristiku relevantných výskumných smerov, ako aj vybrané príklady dosiahnutých výsledkov.

Kľúčové slová: environmentálny výskum, environmentálna geografia, udržateľnosť a kvalita života, Geografický ústav SAV, slovenská geografia

INTRODUCTION

The beginnings of environmental research in Slovak geography and landscape ecology (particularly at the Institute of Geography SAS – IG) date to the mid-1970s. Researchers around Mazúr 1977, Urbánek 1977 and Drdoš 1978 were at beginnings of such research. Somewhat later, P. Mariot, J. Jakál, J. Oťaheľ, M. Lehotský, M. Huba, V. Ira, J. Hanušin, A. Grešková and others joined them. The pioneer maps involved with the environment appeared in the *Atlas of the SSR* in 1980, especially in chapter *XV The Environment*. In the same time geographers from the Comenius University started to deal with environmental issues, too (see e.g. Ira and Paulov 1976, Bašovský et al. 1977 and 1981).

Drdoš summarized this stage in his contribution *Environmental research in Slovakia: foundations, current state, perspectives* (Drdoš 1994b). A year later Drgoňa and Kramáreková (1995a) published the university textbook (Environmental Geography). This study will be devoted to research and other's activities in the sphere of the environment and the engagement of – mainly – the IG SAS workers and briefly other ones in this respect after 1994. The main aim is to bring an overview of relevant activities and to comment on them, to incorporate them into the international context, to classify and to "organize" them into a structure, to deal with them in the context of sustainability, quality of life and other current and promissing concepts. The ambition of the study is also to characterize briefly all these themes as well as to introduce several research results achieved.

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The final part of the article is devoted to the future perspectives of the topic in the Slovak conditions.

ENVIRONMENTAL GEOGRAPHY AND ENVIRONMETAL RESEARCH IN SLOVAK GEOGRAPHY

The Internet browser Google (www.google.com) recorded more than 14 million queries to the entry *environmental geography* up to 31 March 2009. Tens of universities from Canada to China and from Scotland, Denmark and France to Australia offer courses in environmental geography (EG). Analysis of more than a hundred web pages of these universities shows that the content of the EG courses differs considerably. Sometimes it is a matter of an independent subject, sometimes EG is closer to human and sometimes to physical geography. Authors sometimes consider it the integrating element between the more traditional subdisciplines of geography. Among the issues normally lectured about in the framework of EG, geographical aspects of hazards and risks with an emphasis on the global climate change, seismicity, desertification and land use dominate. Where EG is closer to human geography, the impact of environmental problems on humans and society or the perception of environmental problems is rather spoken about. Some studies, however, also deal with EG in connection with an interest in gender issues in geography.

One of the first books (in three volumes) with the title *Environmental geography* was published in Australia and written by Paine (1988-1989). The recently published study *Environmental geography in China: retrospect and prospect* (Shu et al. 2004) is the proof that not only Anglo-Saxon or Francophone geographers are involved with the subject.

Perhaps the most topical contribution to the topic, which comprehensively and systematically maps the contemporary state of the art and trends in EG is a book called *A companion to environmental geography,* edited by Castree et al. (2009). The introduction, provided by four editors, describes their aim to demonstrate "the size, breadth and multiplicity of geographical work at the people-environment interface" (p. 2) by "the accessible introduction to a wide range of key ideas, methods and debates" (p. 3). Their "expanded definition" of EG is really very wide: "…any form of geographical inquiry which considers formally some element of society or nature relative to each other…" (p. 6). Apart from the introduction the book consists of 4 parts: Concepts, Approaches, Practices and Topics and presents 32 contributions written by different authors. They deal with different problems and aspects: such as nature, water, energy, sustainability, biodiversity, complexity, chaos, emergence, uncertainty, risk, vulnerability, resilience, land change, natural and political ecology, environmental history, landscape, cultural and regional studies, ecological modernization, industrial transformation, remote sensing, Earth, observation, modelling, simulation, integrated assessment, ethnography, deliberative and participative approaches, ecosystem prediction and management, natural hazards, Commons, food and agriculture in a globalizing world, environment and health, etc.

In Slovakia it was Drdoš (1990b) who used the concept of environmental geography for the first time. The cited author (at that time a leading worker of the IG SAS) referred to EG as one of the basic currents in geographical research. He defined the aim of EG research as the perception of reality on the Earth's surface as an "interface", that is as the contact zone between of matters of varied nature and action of varied laws in order to secure varied human needs among which in case of

threat to nature in the form of technical civilization the question of human survival dominates. In this way, Drdoš (1990b) asserts, EG ensures one of the principal tasks – humanization of the civilization process.

Environmental geography studying the environment and human/social impacts on the environment constitutes a certain connecting link between physical and human geography. EG research is also moving toward prognostics. It studies the environment as an anthropized natural space, which provides society with renewable and unrenewable resources with the particular that it is not only a substantial and spatial but also a temporal category. It also studies this space in terms of conditions offered to human life. This means that EG deals with the environmental quality and quality of life including the causal relationships. It means, the issues of life quality become subject of interest not only of human but also environmental geography.

The cited author attributes to human geography the top-down approach of proceeding from humans to the environment, while the approach of the environmental geography is the bottom-up type – from the environment to humans.

Four years later, the same author published the study *Environmental research in Slovakia: foundations, current state, perspectives* (Drdoš 1994a) where he deals with several examples of environmental research by geographers in Slovakia. As the editor of the special issue of *Geografický časopis* devoted to the subject of environmentally focused geographical research, Drdoš (1994b) stated that the tradition of Slovak geography in the field of environmental research is rich. In the past, asserts the author, research of this type concentrated on the solution of the landscape-ecological problems, landscape potential, and search for the rational land use or in the sphere of landscape planning. He added that the protection of the environment requires an alternative approach to landscape research. The centre of attention of some Slovak geographers (protagonists of the *Landscape syntheses* school) became the interpretation of landscape as the home to humans in the global sense. Understanding of the landscape potential gradually settled in agreement that it is the capacity of landscape to satisfy human needs, while its long-term productive and reproductive capacities are also protected (for more details see Huba 1980, 1982 and 1984, Drdoš 1982 and Mazúr and Drdoš 1984). It is a principal change in approach compared with the past interpretations of landscape as an unlimited source satisfying unregulated human needs. The situation provoked the need to search for solutions while the concept of landscape as a home to humans and the related concept of sustainable development (SD) or sustainable way of life/existence have a lot in common (see Huba and Ira 1996, Huba 2004 and 2006b, Žigrai and Huba 2004, and others). The two concepts were formulated independently in the same time, in 1970s, which is certainly no accident as it was probably the analogous response of different authors to the same challenge. It is appreciable that among the pioneers of such an approach were the workers of the IG SAS. Paraphrasing Drdoš (1994b), the conclusion is that the new approach to landscape is gradually changing geography and landscape ecology from purely academic or objectivist disciplines to a humanistic, engaged science.

Another incentive and challenge in this context came in the form of the systemic social changes after 1989 and the implicated environmentally oriented projects in science, the economy and legislation. Geographers in cooperation with landscape ecologists participated in the preparation of the new environmental legislation what culminated in the preparation of the *Environmental Impact Assessment Act* includ-

ing its special part on the strategic environmental assessment (see e.g. Drdoš and Kozová 1992, Tremboš 1992, Kozová 1993).

Solutions to practical tasks also lead to ever more intensive cooperation of between geographers and landscape ecologists with representatives of numerous humanities. The link, the common denominator, or the common platform in this case is the environmental approach and the common solution to the environmental problems. Suitable conceptual and at the same time strategic – even political – framework for such an integrated approach to the environment is represented by the concept of the sustainable development with a series of fundamental features shared with geography.

In Slovak geography doyens of studies involved with the most varied geographically relevant environmental studies have been published in the field referred to as environmental geography or environmentally oriented geography the last two decades. They are classifiable into several groups/clusters of different kinds and different fields of research, first of all:

- Theoretical and methodological basis for environmental studies in geography,
- Global environmental problems and efforts in their classification,
- Spatial and temporal aspects of pollution and devastation of the environment,
- The environment in Europe,
- The environment in Central and Eastern Europe, or in the V4 Region,
- The environment in the Slovak Republic and its regions,
- Carrying capacity/environmental hazards and risks,
- Environmental Impact Assessment and Strategic Environmental Assessment,
- Assessment of impacts on individual landscape elements/the environment,
- Environmental strategies, policy, planning and management,
- Results of environmental monitoring and assessment of the existing state and developmental trends,
- Environmental space,
- Environmental dimension of SD,
- The environment/quality of life relationship,
- Research on protected areas and their networking,
- Research cultural-historical and social topography as well as historic landscape structures,
- Integrated landscape management,
- Environmental ethics and axiological aspects in the relationship to the environment.

The attempt to classify these studies into the basic groups may reveal that only the smaller part of papers precisely corresponds to the above-quoted “strict” definition of EG and is based on application of geographical approaches and methods to investigation of complex environmental problems.

The spectrum of varied approaches applies a similar wide choice of methods. The basic methodological frameworks used in several studies were those of the OECD referred to as the Pressure – State – Response model. The model is based on mutual links and causal relationships of between the effects on the environment

(environmental impact), state of the environment and the response of the environmental policy. This is how the model at least partially overcomes the traditional approach using partial aspects of the care for the environment. It creates the premise for wider application of the horizontal approach. In the assessment of the countries or other administrative units, the same sets of indicators were applied. It made the comparison with other countries or regions possible. This leads to another approach, the comparative method. Some studies elaborated and applied the theoretical-methodological concept of the environmental space, white others use the method of enquiries and/or structured interviews.

The SWOT analysis type methods or multivariate prognostic scenarios are successfully used in studies of the strategic nature. In the analysis of environmental changes numerous methods of remote sensing are applied. Ever more frequently the GISs are used. Some newly introduced tools such as the territorial systems of ecological stability, environmental impact assessment, strategic environmental assessment used in Slovakia led to generation of new or at least adapted methodological approaches, application of which relies on manuals also produced by Slovak geographers. The original theoretical/methodological approach to the definition and assessment of sustainable development at the regional level according to the selected indicators and their groups and the Synthetic Index of SD was elaborated at the Institute of Geography of the SAS (for more details see Huba et al. 2004).

The primary contribution of the study is the original theoretical and methodological approach to the definition and assessment of sustainable development at the regional level.The findings of the analysis point to a considerable imbalance in individual indicators and their groups and similar imbalance in the state and development of individual regions while the integrated Synthesized SD Index contradictorily shows small differences between regions of the SR which confirms the hypothesis that several favourable and adverse environmental characteristics tend to compensate each other (for instance the denaturalized landscape with lower level of ecological stability against a better environmental infrastructure, etc.).

The cultural-historical-social topography that the team of workers of the IG SAS tries to apply along with other co-workers to a model territory (see lower) is also an original and authentic methodological procedure.

BRIEF CHARACTERISTIC OF INDIVIDUAL RESEARCH CLUSTERS RELATED TO EG AT DIFFERENT HIERARCHY LEVELS

Theoretical and methodological basis for environmental studies in geography

The studies of Mazúr (1977) *Geography-landscape-environment*, Drdoš (1978) *Geography and its tasks in environmental protection and formation* and that by the author team Drdoš et al. (1980) *Landscape syntheses and their role in solving the problems of environment*, are some of the pioneer works of the kind.

Somewhat later, the issue has been further considered in other studies like those by Huba (1984) *Stability – dynamic balance of the landscape system*, Mazúr and Drdoš (1984) *Conception of resources or conception of the landscape potential in geographical research,* or in the introductory parts of the monograph *Landscape synthesis of the Liptovská kotlina basin* by Oťaheľ and Poláčik (1987).

All new stages of the theoretical and methodological research came in waves. First it was the period that followed immediately after the systemic changes in

1989, for instance Drdoš (1990a,b), Drgoňa et al. (1992) *Environmental land use risk analysis,* Drdoš (1992): *Natural environment: resources, potentials, carrying capacities and hazards*, but also Lehotský (1994a) *Landscape carrying capacity (Some methodological remarks to the problem)*, Kozová et al. (1994): *Methodological handbook for the developmental concept assessment from the point of view of the environmental impact*.

The second wave covers the studies from the second half of the1990s. So far, the last wave of interest is represented by the studies of Lehotský (2003): *The postmodern and epistemiology of the landscape with the stress on the fluvial geosystems*, Huba (2003): *Resistance of ecological and social systems – the conditions of sustainable development*, Huba (2004): *Sustainability concept and environmentally oriented integrated sciences on landscape and society,* or Žigrai and Huba (2004): *Some metascientific remarks concerning the sustainable development of the society and the environment* as well as Ira et al. (2006): *Quality of life and the environment.*

Global environmental problems and efforts in their classification

In the course of the last three or four decades, the global problems have become the subject of ever more intensive research. A special and significant category of global problems is that connected with the global threat to the environment. The intensity and dynamics of the global environmental changes is increasing along with the increasing interest and engagement of the public due to the global information media. The global environmental changes are generally perceived and discussed; they have become part of the global political agenda and as such they will ever more influence the course and nature of the economic, political and safety processes even regardless of what the real situation and development on the Earth will be.

In other words, these changes and processes are among the most important parts of the global awareness and the need for engagement has become part of the global ethos. This issue has been also treated in other studies of Huba (1993a, 1994b, 1996a and 2006a), Nováček and Huba eds. 1995, Nováček et al. 1998).

Between the global and national research levels

European, Central and Eastern European and V4 Regional levels (CEE)

Some studies are devoted to the environment on the all-European level, others concentrate on the regions of Central and Eastern Europe (CEE) and the extensive chapter *Slovak Republic* written by Huba (1997) contributed to the extensive consideration of the whole region.

Workers of the IG SAS devoted great attention to the scale of research that moved between the global and national and particularly the region of what is referred to as the V4 (Visegrad Region including the Czech Republic, Hungary, Poland and Slovakia). Their contributions include a share in the authorship of the monograph Třebický et al. (2003). *Road to sustainability – economic, social and environmental dimension of sustainability in Visegrad countries* and monograph Hu-ba et al. (2003). The research confirmed the prevalence of the common features in the orientation of the individual countries in the region and also pointed to the specific features of such development in individual countries. Generally, each of these countries displays its positives and negatives in the improvement of the envi-

ronment and implementation of a sustainable future, although the overall trend is far from satisfactory.

The environment of the Carpathians

Several workers of the IG SAS headed by the author of this article participated in preparation of the material *Carpathians Environment Outlook* in 2005-2007. The publication brings comprehensive information about the state and development of the environment in the Carpathian region encompassing seven countries of the Central and South-Eastern Europe (for more details see Balteanu et al. 2007). The material is based on the analysis of the background situation and continues with the analysis of the socio-economic driving forces of the social development and environmental changes. The most detailed chapter is devoted to the state of the environment in the Carpathians including the existing political, managerial and legal tools that should lead to its improvement. The authors analyse the development of the region since 1975 and try to model its development until 2020 by means of three developmental scenarios. The final chapter contains a summary of framework recommendations for the improvement of the environment and provision for sustainable development in the regions. As far as methodology is concerned, the process of preparation and realization of the *Carpathians Environment Outlook* is an example of integrated approach.

Cultural-historical and social topography of the Carpathian Region

Seven IG SAS scientists participated in the international project overarched by the project scheme under the title: *Cultural-historical and social topography* (CHST) with a special stress on the model territory of the Biele Karpaty Mts. (Hanušin et al. 2008b). Such methodology should be subsequently applied in any similar region in Carpathians. The introductory chapters setting the study territory into the spatial and temporal context form the structure of the resulting document at the regional scale. It is followed by the analytical part dealing with the natural and cultural landscape or the landscape framework with all demographic and socio-economic, cultural-historical and socio-cultural implications. The evaluating and synthesizing parts ending in the SWOT analysis and assessment of overall developmental prerequisites of the territory in question in terms of sustainability follow. The final part of the CHST document consists of the strategy for the sustainable development of the territory itemized into the corresponding recommendations and proposals.

Networking of protected areas (PAs) in Central and Southern Europe (INTERREG region CADSES)

The team of authors from the IG SAS led by J. Hanušin participated in the international project "*Network of protected areas – establishment and management of corridors, networks and cooperation"*(INTERREG IIIB CADSES). The aim of the Project was the proposal for improvement of the functional elements of the PAs network and increased participation of local communities in activities connected with nature conservation in accordance with the sustainability concept.

The issue of PAs optimization and networking should make the management of PAs more efficient with preservation of their primary function, which is the protection of natural diversity. The Project consists both of international and national seg-

ments. The international part brought valuable results especially from the international questionnaire applied among the stakeholders (experts, decision-makers, representatives of the public adminsitration, leaders of the non-governmental organizations, etc.) about the state and development of nature conservation in the CADSES region (see Hanušin 2007b, Ira et al. 2007).

The national level – results of the environmental monitoring and assessment

The environment in Slovakia

For many years till now the scientists of the IG SAS have been systematically participating in monitoring and assessment as well as forecasting of the environment on the national level. The results include others five volumes of materials under the title (*Slovakia after November 1989 (in relation to the environment and sustainable development*)) as well as chapters of *Global report on the state of society in Slovakia* (published by the Institute for Public Affairs), dedicated to the environmental and sustainable development authored by Huba and Trubíniová, which have been appearing yearly since 1996. Huba is also the author of the chapter on the environment in several Slovak *National Reports on Human Development* (UNDP). However, many other studies can be classified in this category, for example Lehotský et al. (1989), Drgoňa et al. (1992), Drdoš (1994b), Ira and Kollár (1994), Lehotský (1994b), Huba (1996b, 1996c, 1998a, 1998b and 2003), Huba et al. (2003 and 2004), Hanušin et al. (2000).

Environmental space "consumption" in Slovakia

The *Towards Sustainable Slovakia* Project, the output of which is the eponymous National Report (Huba et al. 1995, Hanušin et al. 1997), was the integral part of the all-European campaign. The central theoretical and methodological concept of the Project was the *environmental space* defined as the atmospheric absorption capacity, or the amount of energy, non-renewable resources, water, farmland and forest, or timber usable without threatening the option of future generations to use these resources/capacities as well. The comparison of sustainable and really used environmental space showed that Slovakia exceeds by several times the recommended limits of the exploitation in the majority of monitored commodities in its environmental space (particularly in the primary energy consumption and the related combustion of fossil fuels, CO_2 production and nuclear energy use). The position of Slovakia in the sphere of non renewable non-energy raw materials and the production and consumption of derived commodities (cement, raw iron, aluminium) is even worse. The positive exception is the area of protected territories which approximates to recommended level (the state and the regime of the protection in our PAs is a greater problem than their territories) and the proportion of built-up areas, which is lower compared with the EU average. Renewable energy resources are also less intensively used in Slovakia than recommended. The study eventually concludes that Slovakia inherited a very unpropitious structure of the raw material along with an energy demanding and simultaneously extensive economy. The only viable solution in the long term seems to be the changeover from the unsustainable way of development to the sustainable way applying the positive international experience along with the domestic potential including the relatively high educational level of the people.

Analysis of the development of environmental indicators in the SR in the 1990s

Research in this field demonstrated that the majority of statistically recorded environmental indicators have developed prevailingly positively in the last decade of the 20th century. On the other hand, investments in the environment both in absolute and relative figures (share of GDP and the overall volume of investments) were almost continuously negative from 1992 until the end of the decade. Insufficient application of the pro-environmentally acting economic tools also contributed to underfinancing of the environment. The general legal awareness is still low. In spite the drawbacks, the overall balance concerning the selected indicators characterizing the development in the environment in individual spheres in Slovakia seems to be positive above all in comparison with other SD dimensions (Huba 2005).

Regional (sub-national) dimension of EG

The introduction

Today classic landscape-synthesizing regional studies *Tatranská Lomnica and its hinterland* by Mazúr et al, 1985; *Landscape synthesis of the Liptovská kotlina basin* by Oťaheľ and Poláčik 1987; *Landscape synthesis of areas with hamlet settlements* by Huba 1986, *Štiavnické vrchy Mts*. by Lehotský 1991 were, even by the most recent criteria, distinctly environmentally oriented.

In the first half of the 1990s, the team of IG SAS workers minutely dealt with varied environmental aspects in the region of Upper Nitra. The results of this research also appeared in the special issue of *Geografický časopis* compiled by Drdoš (1994 a,b) and in the special article of Drdoš (1994c).

In the recent past, an original approach to defining and assessing SD at the regional level was worked out (Huba et al. 2003 – *Regional sspect of development towards sustainable Slovakia).* The most unfavourable situation in the environmental dimension is in the administrative region of Košice due to air pollution. The majority of regions with relatively high rates of pollution simultaneously enjoy environmental infrastructure at levels exceeding the national average which improves their overall environmental situation.

The Tatra Region was studied by a large team of authors led by the author of this article (Huba et al. 2005), and by Ira et al. (2007). The paper of Ira et al. (2006a) is devoted to the Biosphere Reserve of Poľana.

However, the majority of regional-geographical studies, written in this period at the IG SAS, exclusively dealt with a selected landscape component, for instance water, or its share in the formation of the relief or its behaviour in the framework of the studied river basin. Examples include the studies of Lehotský and Hanušin (2002), Lehotský et al. (2001) and some other.

Environmental spatial structures were studied by Lehotský (1994b) and the position of the rural landscape in the process of environmental planning on the example of the Záhorská Lowland was the theme of the study by Oťaheľ and Feranec (1997).

Oťaheľ et al. (1997) were involved with the principles and procedures of environmental planning using the example of several case studies from different parts of Slovakia while Oťaheľ et al. (1993) studied land use as the basis for environmental planning.

The relief of the Nature Reserve Demänovská dolina is the theme of the study by Lacika (1991) while the geomorphological research of the same region from the point of view of relief sensitivity to anthropic activities was dealt with by Lacika and Lehotský (1996 and 2000).

Environmental research in the basin of the Myjava River

Hanušin et al. 2008a concentrated on the environmental research and application of the sustainability paradigm in two areas. The first represents the impact assessment for the water component of the landscape. Three groups of hydroecological types (HETs) and their assessment as well as five levels of the impact on the water landscape component were taken as the basis. Results were presented both in the text and map forms. The second research field was that of evaluation of the results obtained by the structured interviews with mayors of towns and villages in the basin of the Myjava river and the proposed measures supporting SD in the region.

Environmental indicators of SD in the cities

Any measurable data or group of data that provide information on the trend of the city in the light of SD principles and criteria with special stress on the environmental aspects are considered environmental SD indicators. As there are ever more cities in Slovakia that joined some of the networks of sustainable cities or they initiated their own campaigns in the area of the local Agenda 21, it is only natural that the need to work out and apply an appropriate set of sustainability indicators for the individual cities emerged (for more details see Huba et al. 2000 and Huba 2001).

Research on protected areas and biosphere reserves

Apart from the National parks (NP). Protected landscape areas (PLA) and the Small area protected territories (SAPT) the special research themes concerning the protected areas (PAs) also include the Biosphere reserves (BR) under the MaB UNESCO Programme. Workers of the IG SAS have devoted several dozen studies - published at home and abroad – to this theme. Geographical aspects and sustainable management of large PAs (above all NPs and BRs) became subject of (Huba 1999a and 1999b, Huba and Ira 2000, Ira et al. 2006a and 2007) and other.

The NPs, BRs, PLAs and SAPTs and their counterparts in the whole of Europe have not developed in isolation, but they exist in interaction with humans. So the task of PA protection and management with respect to application of the sustainability concept will be the elimination of the negative anthropic effects on the one hand and regulation of those activities that cannot be excluded from the PAs on the other. It will also have to support those activities or their manifestation which are desirable because they contribute to their protection or help conserve or develop attributes and values which are not of a purely natural character (the concept of the BR where the search for the paths of harmonious coexistence of the human with nature is the main aim, is similar).

The aim of the national segment of the above-mentioned INTERREG IIIb CADSES Project was the proposal aiming at improvement of functional elements of the PAs network and an increased participation of local associations in activities connected with nature protection in agreement with the SD concept in the Tatra Region. The focus of the Project work was the formulation of the detailed methodo-

logy for the PAs networking optimalization. It was also necessary to produce an evaluation of important contemporary socio-cultural and economic changes in the landscape and social structure, which actually and/or potentially disturb the PAs network integrity. Evaluation of the perception and expectations of interest groups toward PAs was also an important tool.

In the period 1996-2007 more than 200 detailed structured interviews were conducted with the representatives of the decision – and opinion – making spheres in several model large-scale PAs (NP, PLA, BR). The themes were the PLA Záhorie, PLA Malé Karpaty, PLA Biele Karpaty, PLA Východné Karpaty, PLA and BR Poľana, Tatra NP (TANAP), or BR Tatry and NP Poloniny. Some direct or indirect questions concerned the relationships of the local stakeholders or inhabitants of villages or regions to nature protection or the bodies involved in nature protection (for more details see e.g. Huba and Ira 1999a, 1999b and 2000, Ira et al. 2006a and 2007, etc.).

PAs, their research and proposals for improvement of protection, management and sustainable development were the themes of several additional studies authored by Lacika (1991), Lacika and Lehotský (1996 and 2000), Huba (1987 and 1999a,b) and others. Research on protected karstic landscape and karstic phenomena represents an independent field of research, too (see e.g. Jakál 2005).

Environmental planning, strategies, policy and management

The notions of landscape, landscape-ecological or environmental planning were immanent already in the concept of landscape synthesis, which emerged at the IG SAS in the second half of the 1970s. They appear in Mazúr (1977), Drdoš (1978) and other works. Articles by Mazúr et al. (1985) *Landscape Synthesis of the Liptovská Kotlina Basin,* Huba (1986) *Landscape synthesis of the Aarea of Tatranská Lomnica,* Oťaheľ and Poláčik (1987*) Landscape Synthesis of the Hamlet settlement using the Example of Javorníky*; Lehotský (1991) *Functional Landscape Structures (Štiavnické vrchy Mts.*; Oťaheľ et al. (1993) *Landscape use as a basis for environmental planning (case studies Bratislava and Nitra hinterlands)* are important contributions in this field. Papers of Lehotský and Oťaheľ (1995), or those of Oťaheľ and Feranec (1997) are involved with environmental planning.

Some team works produced at the Institute (see e.g. Grešková et al. 1994) specialized in the landscape ecological aspects of hydroecological plans (HEPs). The authors proceeded in three steps: assessment of ecological limits (three basic landscape types) followed by assessment of anthropogenic limits (seven groups of anthropogenic impacts), the relationship of the ecological and hydrological interests including the assessment of the carrying capacity (see e.g. Hanušin and Lehotský 1998). Lehotský et al. (2001) applied the above-mentioned approach to the principal river basins in Slovakia.

Studies and expertise reports involved with environmental strategies and policies occupy an important position among the works of the IG SAS researchers. Some authors participated in formulation of the environmental legislation, policy and the overall organizational and institutional framework for the care of the environment. During the 1997-2007 decade, for instance, Huba compiled ten volumes of miscellany *Chapters of the environmental policy* containing analyses of the state and development of the environmental policy in Slovakia and the World from 1989 until

the present. There are more works dealing with the same theme mapping the situation and development of the environment with emphasis on the last two decades. Other works in the field include the one devoted to the comprehensive approach to the environment of Slovakia by Huba (1997), and the team work (Szőllős et al. 1997) dealing with creation of environmental capacities in Slovakia.

Cebecauerová (2007) published an article dealing with ecological network dynamics and environmental consideration in planning for renewable energy.

The author of this article also dealt with regionalization of environmental problems of the World (see e.g. Huba 1993a and 1994b). Monographs about the existing threats to the planet Earth and its biosphere such as that by Nováček et al. (l998) have a similar content.

Special attention has also been given to the assessment of results from the decisive international conferences and other milestone concerning the environment and SD, above all as follow-ups to the Earth Summit in Rio de Janeiro in 1992 and the World Summit on SD in Johannesburg in 2002 either as assessments of the event in relation to the Slovak Republic or to the whole region (Huba 1994b, 2003 and 2007b).

Environmental impact assessment and strategic environmental assessment

The pioneers in environmental impact assessments for the proposed activities, at least in Slovakia were the trio of authors from the IG SAS: Ira, Lehotský and Oťaheľ who already in the 1980s, long before the approval of the corresponding law, dealt with the landscape-ecological assessment of the expected impact of motorway construction on the landscape. They worked out a special environmental-ecological approach. See for example Oťaheľ et al. (1989 and 1997), or Lehotský et al. (1989).

The preparation of the EIA Act and the related standards, regulations and methodological manuals – see e.g. Drdoš and Kozová (1992) *Methodology and manuals for environmental impact assessment in the Slovak Republic*; Kozová (1993) *Environmental impact assessment process – Present state of its methodology, legislation, implementation and education in the conditions of the Slovak Republic* and Kozová et al. (1994) *Methodological manual for assessment of developmental concepts in terms of their environmental impact.*

The strategic environmental assessment of the Energy Policy of the SR since 2000 stressing its relation to SD can be used as an example. IG workers participated in the preparation of this document, while the inevitability of transformation of the energy systems, particularly divergence from the unrenewable energy resources, diversification of the resource base and deconcentration of power production (Szőllős 1998, Mistríková et al. 2001) was confirmed. Criterial frameworks focused on planning, construction and evaluation of big dams in Slovakia were also produced (Hanušin and Huba 1997, Hanušin et al. 2000).

It was Huba, who elaborated the issue for the first time in Slovakia in the manual Kozová et al. (1994), prepared for the needs of the Ministry of the Environment of the SR. The same author returned to the theme two years later in his paper devoted to the principles, criteria and indicators of SD in application to the strategic environmental assessment - SEA (Huba 1996c). At the same time, Ira (1996) concentrated on the social dimension of the SEA in its confrontation with the remaining SD dimensions.

Impact assessments of activities on individual landscape or environmental components also fall into this category of research. Several of them concerned the water element (Lehotský et al. 2001, Lehotský and Hanušin 2002 or Grešková and Lehotský 2003).

Environmental loadability / Carrying capacity

The research in the field of the carrying capacity of the landscape and environmental systems at the IG SAS enjoys a long tradition and is connected with development of the landscape synthesis concept, particularly in the sphere of purpose characteristics of the landscape. Among numerous works involved with the theme, the studies of Huba (1984): *Stability or dynamic equilibrium of the landscape system*; Drdoš (1990a): *Contri-bution to the carrying capacity of the landscape using the example of the Tatra National Park* or Lehotský (1994a): *Landscape carrying capacity (some methodological remarks to the problem)* stand out. Huba (1987, 1993b, 1994a, 1995, 1998a, 2003 and others) wrote several papers to the subject – starting with the above-mentioned study from 1984, and continuing with that from 1987: *Searching for the rate of the carrying capacity of landscape use in the Malá Fatra PLA and its protected zone*; studies from the mid-1990s such as *Threat of the chosen types of landscape of Slovakia by anthropological activities* and *productivity – stability (homeostasis) – sustainability* and from 2003: *Resistance of ecological and social systems – prerequisite of sustainable development.*

Lacika and Lehotský (1996 and 2000) worked out the issue of relief vulnerability both in the general way and in application to the model territory of the Demänovská dolina valley, while the team of workers of the IG SAS consisting of Hanušin, Grešková and Lehotský were involved with the hydrological aspects of the water element of the landscape and the anthropic impact (see e.g. Hanušin et al. 1999, Lehotský et al. 2001 and Hanušin 2007a).

This category of works also covers the study of flood incidence in Slovakia over many years (see e.g. Solín 2008). The analysis includes that of frequency of floods in communes of Slovakia, classification of flood situations into types and analysis of flood situation in terms of stream size. A brief description characteristic of the most important flood situations in the period 1996-2006 is also included. The spatial analysis is focused on identification and enlightenment of configuration in spatial distribution of flood incidence by means of the regional variability of flood threat in small basins of Slovakia.

Environmental risks and hazards

The question of loadability is immediately connected with that of environmental threats and risks. Among the first papers concerned with them at the IG SAS was that of the team consisting of Drgoňa et al. (1992) along with the study of Drdoš (1992).

The Earth Summit in Rio de Janeiro (1992) has brought about the increased interest in the issue both at national and international scale, see, for example, (Huba 1994b) and Nováček et al. (1998). Ira and Kollár (1994) wrote about technological risks in relation to the environment.

Other areas of environmental research

Perception of landscape and the environment

The subject of landscape or environment perception has also long been studied at the IG SAS with Oťaheľ (1980, 1994 and 1999) in the lead. Ira (1992 and 1996) is involved with perception in connection with the environmental awareness of population above all in areas with impaired environment. However, many other authors studied the aesthetic aspects of the landscape and environment and their perception.

Axiological/ethical aspects of the environment: environment and values

A separate category of environmentally oriented research concerning the IG SAS researchers is the sphere of values compatible with the idea of sustainable living, which should respect nature and the environment. This issue was researched by Huba (1993b, 2006a and 2007a), Szőllős (2001) and Ira (2002), but several references to this theme can also be found in the teamwork of Hanušin et al. (2000). Many relevant contributions have been published in the proceedings from the conference with international participation organized by the Society for Sustainable Living in Liptovský Ján and called: *Religion-environment-values for the sustainable future (*Huba, ed. 2002).

Quality of life and the environment

The most recent research unfolded in the IG SAS with stress on the environmental aspect is that involved with quality of life in the relation to environmental quality (see e.g. Ira et al. 2006b). So far obtained knowledge shows that then environmental quality represents one of the most important attributes of life quality.

EXAMPLES OF ENVIRONMENTALLY ORIENTED RESEARCH IN THE GEOGRAPHY DEPARTMENTS OF THE SLOVAK UNIVERSITIES

Analysis of accessible outputs reveals that the university departments of geography in the Slovak Republic devoted less attention to the research directly aimed at the issue of the environment than the Institute of Geography of the SAS. In spite of this, almost all university departments were involved in similar activities classifiable into several categories. With respect to the orientation and scope of this article the list and evaluation of such research-scientific and publication activities will be illustrative and informative rather than exhaustive.

The Faculty of Natural Science at the Comenius University in Bratislava includes the Department of Physical Geography. Perhaps the most important relevant output of the Department is its terminological dictionary *Selected terms of geography, ecology and environmental science* by Machová and Tremboš (1995). Environmental limits in relation to landscape ecological carrying capacity and the methodology for preparation of the documents about local territory systems of ecological stability was the theme studied by Tremboš (1992 and 2003). Trizna et al. (1997) dealt with the environmental studies in the framework of the EIA process for several stretches of motorway. Trizna (1998) was involved in the vulnerability assessment of the territory in identification of flood risk. Minár and Tremboš (1995) and

Kolény (2002) assessed natural hazards. Stankoviansky (2003) wrote a monograph on the geomorphological response to environmental changes in the area of the Myjavská pahorkatina hill land. The authors of the comparative analyses for the ecological landscape stability assessment in the model territory of Gajary in the Záhorská nížina lowland are Durilová and Saksa (2003).

Workers of the Department of Human Geography and Demogeography of the Faculty of Natural Sciences at the Comenius University, particularly Spišiak and Bartková (1998) wrote the study devoted to the impact of economic activities in the region of Turčianske Teplice on the environment. Spišiak was probably closest to the environmental subject among the workers of the Department in the last years being involved with ecological agriculture, exploitation of biomass and other alternative energy sources or sustainable tourism, and so on. Ever more tutors guide the students and advise them to take up environmental themes including their various aspects such as the financial aims of environmental policy or the topical research on the relationship between the environment and transport.

Perhaps the greatest interest in research into relationship between mankind and the environment would be expected from the workers of the Department of Regional Geography, Landscape Protection and Planning of the Faculty of Natural Sciences, Comenius University as their priorities include the study of regional structure, with emphasis on rational and ecological use of their potential. However, in the last years it is not easy to find contributions explicitly involved with this issue that should be authored by the workers of the Department. The most significant activity in this sense is the participation of the workers of the Department led by Prof. Lauko in the preparation of the Regional Agenda 21 for the central part of the Pohronie region (REC 2000) and their share of work in the *Landscape atlas of the Slovak Republic* (Atlas krajiny SR 2002). The study of Lauko et al. (1993) devoted to the environmental education of future geography teachers is one of the older works. Kasala (1994) also treated albeit marginally, the issue of the environment.

One of the principal scientific and educational aims of the Department of Cartography, Geo-Information Science and Remote Sensing is the design of geographical databases for the environmental applications. Among the environmentally relevant outputs produced by the workers of the Department the work of Kolény et al. (2004): *Use of orthophotomaps in survey of accelerated water erosion*, that of Čerňanský and Kožuch (2001): *The monitoring of changes in high mountain landscape National park Nízke Tatry with methods of digital photogrammetry,* or the dissertation thesis of Boroš (2007): *Concept of geographical database for the protection of surface and ground waters) are worth mentioning.*

Among the currently active workers of the Department of Geography of the Faculty of Natural Sciences at the University of Matej Bel in Banská Bystrica it is above all Čižmárová (1997 and 1998) who deals with the environmental issue and its didactic aspect. Novodomec (1998) was involved with the similar research theme but to a in lesser extent. Gajdoš (2003) studied the environmental landscape loading in connection with extraction of heavy metals. Čuka (1997) in turn researched conflicts of interests between tourism and other activities (including nature and environmental protection) in the territory of the Starohorské vrchy Mts. Hilbert Jr. systematically deals with the environmental problems in the basin of the Ilijský potok brook in the Štiavnické vrchy Mts. (see for instance Hilbert 2002). Cross-border environmental problems generated by extraction were studied by Mazúrek

(1999). It should be added that in the 1990s, the prominent landscape ecologist Hubert Hilbert Sr. – who published numerous environmental studies – was also working at the above mentioned Department of the University of Matej Bel.

Prof. Drdoš at the Department of Geography of the Faculty of Humanities and Natural Sciences at the University of Prešov used his long-year experience working with the whole spectrum of environmental themes. His publications from this period include the two-volume university textbook *Geoecology and environmental science, part one)* initiated and compiled by Drdoš 1999 and 2004a; and *Geoecology and environmental science, part two*, compiled by Drdoš and Michaeli 2001 and 2005. There are also works devoted to the application of geography and landscape ecology to environmental planning (Drdoš 2001, 2004b and 2005) or the common study of Drdoš and Hrnčiarová (2005) devoted to the methodological approaches in assessment of the landscape carrying capacity and its limits. Apart from theory the above-mentioned author also pays attention to applied aspects, above all in the field of the environment impact assessment. Other environmentally oriented works of the workers of the Department, like the studies *Effect of undermined territories on the geoecological landscape structure near Slovinky*, (Krokusová 2006), or the study of Michaeli (1995) involved with the local territorial system of ecological stability using the example of Drieňov, the study of the same authoress dedicated to transformation of the natural environment and the urban-ecological stability (Michaeli 1999), or to the physical situation of the National Nature Reserve Čergovský Minčol and the selected geoecological aspects of its protection should be mentioned, too (Michaeli 2001). Vilček (2006) studies the ecological-environmental aspects of soil use and protection.

At the Department of Geography of the Faculty of Natural Sciences of the Constantine the Philosopher University in Nitra, Drgoňa and Kramáreková (1994, 1995a, 1995b and 1999), dealt with transformation of the landscape under the impact of the anthropogenic activities in large-area protected areas (with the stress on the Protected Area of Ponitrie in connection with sustainable development). They also produced the above mentioned pioneering university text book *Environmental Geography I* which, among other things,focuses on the explanation of opinions concerning the study of the human-environment system, that of the basic notions, individual subsystems and environmental changes in Europe (including the current state and outlooks). Its annex contains the list of generally binding legal provisions in the area of the environment. Drgoňa also cooperated in team studies with the subject of environmental planning (e.g. Oťaheľ et al. 1993 and 1997).

The Institute of Geography at the Faculty of Natural Sciences of the Pavol Jozef Šafárik University in Košice presented environmentally oriented studies led by Prof. Spišiak. His activities are also mentioned above in connection with the Department of Human Geography of the Comenius University in Bratislava. Environmental features can also be found in the works of Hochmuth (1991), Košťálik (1998 and 2001) and some other workers of the Institute.

Among the workers of the Department of Geography of the Faculty of Education of the Catholic University in Ružomberok. Prof. Zaťko was involved with the environmental aspects of the hydrosphere. Bella (2007) is one of the younger workers of this Department who studies the problems of research and protection of the karstic landscape. The works of Murgaš (e.g. 2007) are devoted to the quality of life and the environment as one of its important aspects. Some works of Novodomec and Nižňanský also contain an environmentally relevant orientation.

CONCLUSION

The brief survey of the publication activities of scientists at the IG SAS and Geography Departments at Slovak universities in the sphere of environmentally focused research represents only part of their activities in this field. For example, the fact that there were several hundred of responses to the cited studies a significant part of them captured by an international database is also worth mentioning.

As far as the tutoring activities are concerned, the theme has been projected into the tuition of subjects like Human Ecology, Urban Ecology, New trends in Landscape Ecological Planning, Environmental Approaches to Research into Sustainability, Globalism and Global Problems as well as Selected Chapters from Environmental Geography at the Comenius University in Bratislava and at Palacký University in Olomouc. Moreover, subjects like Ecology and Environmental Studies are found at the Academy of Fine Arts in Bratislava and the subject of Environmental Policy and Management at Academia Istropolitana Nova in Svätý Jur. Ph.D. students are trained in the corresponding branches and a organization of seminar has been organized for British and Slovak Ph.D. students in the issue of National parks and Biosphere reserves management, etc.

The active participation of Slovak geographers in many national and international conferences including the Earth Summit and the World Summit on Sustainable Development (Rio de Janeiro, Johannesburg), in all six so far held Pan-European conferences of the ministers of environment, at Pugwash conferences on science and world issues in Kolymbari and Hiroshima, at the First World Congress on the Environment and Health in Madrid and in other events is also important.

Slovak geographers are co-authors of relevant expert reports and strategic documents: *National strategy for sustainable development of the SR, Vision of long-term development of Slovakia until 2020, The national developmental plan of the SR, Action plant for sustainable development of the SR, Towards a sustainable Tatra Region* and others. They participated in preparation of the draft of the *Act on landscape planning,* several EIAs, etc.

They participated in the Advisory Board of the Committee for the Environment and Nature protection of the National Council of the SR, in the Advisory body of the Ministry of the Environment for the Integrated Management of River Basins, in the executive committees of the European EcoForum, European Environmental Bureau, ANPED and in several other relevant committees, international scientific organizations, in the editorial board of the international journal *Carpathi – Journal for Nature Conservation, Monitoring and management in Carpathian protected areas*, or at the expert panel for the World Congresses *Integrated Resource Management R'2000* in Toronto*, R'2003* in Geneva and *R'2005* in Beijing. An IG SAS worker has been the co-chairman of the Working Group for the Environment at the National Convent for the EU.

There are dozens of scientific and science disseminating activities: events for the media, lectures and educational meetings, recently in connection with the presentation of research conducted in model territories and solutions of the situation in the Tatra Region after the 2004 wind calamity. Special attention has been given to the conservation of karst and protected karst phenomena.

The IG SAS and university departments of geography have obtained several national and international awards for the above-mentioned activities. Some of this IG

SAS individuals and the Institute as a whole are considered leaders in the EG field absolutely in the national, partially in the international-macroregional (especially in the V4 countries) and in the EU contexts and occasionally in the wider international framework (see publications, invited lectures, positions, awards and activities in the international field).

The results attained so far and the ever more urgent need to solve the environmental problems is also a challenge for Slovak geography to continue the activities it has started on the one side, and to identify new relevant problems and develop methods for their research on the other.

A brief contemplation of the future of geography in this field leads to the conclusion that it is desirable to continue, to expand the research in new projects, to enter the promising international cooperation, and to publish in internationally recognized journals. The conceptual and practical "marketing" aspects urge us to stress the important and irreplaceable nature of geography (its comprehensiveness, research on the relationship between humans and nature, stress on the temporal and spatial aspects, etc.) in the field of environmental research. Environmental research is one of the attributes of the sustainability and quality of life, and conducted in the regional conditions (cities, urban regions, protected areas, etc.) it certainly has good outlooks. Comparative studies of the environment in individual regions may also be also attractive. Slovak geography could concentrate more on the area of the strategic environmental assessment and planning. With regard to the tradition and perspectives, it is necessary to consider the research oriented to the solution of environmental problems as one of the main research streams.

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REFERENCES

Atlas SSR (1980). Bratislava (SAV a SÚGK).

ATLAS KRAJINY SR (2002). Bratislava, Banská Štiavnica (MŽP SR, Esprit).

BALTEANU, D., BUSUIOC, A., HUBA, M., POMÁZI, I., SANDULESCU, M., WITKOWSKI, Z. Contributing authors: J. Beták, J. Hanušin, V. Ira, J. Lacika, J. Urbánek, et al. (2007). *Carpathians Environment Outlook 2007*. Geneva (UNEP).

BAŠOVSKÝ, O., MARIOT, P., MLÁDEK, J. (1977). Transformácia ekonomickogeografických štruktúr SSR a problémy životného prostredia. *Životné prostredie*, 3, 131-134.

BAŠOVSKÝ, O., PAULOV, J., IRA, V. (1981). Ekonomický rozvoj Bratislavy a problémy jej životného prostredia. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Formatio et Protectio Naturae*, 6, 1-21.

BELLA, P. (2007). Environmentálne problémy využívania a ochrany krasu v kotlinách a podoliach Západných Karpát. *Geographia Cassoviensis*, 1, 11-19.

BOROŠ, R. (2007). *Koncepcia geografickej databázy pre ochranu povrchových a podzemných vôd.* Dizertačná práca, Prírodovedecká fakulta Univerzity Komenského, Bratislava.

CASTREE, N., DEMERITT, D., LIVERMAN, D., RHOADS, B. eds. (2009). *A companion to environmental geography.* Chichester (Wiley-Blackwell).

CEBECAUEROVÁ, M. (2007). Ecological network dynamics and environmental consideration in planning for renewable energy. *Geografický časopis*, 59, 227-250.

ČERŇANSKÝ, J., KOŽUCH, M. (2001). The monitoring of changes high mountains landscape National park Nízke Tatry with methods of digital photogrammetry. *Geodetický a kartografický obzor*, 8/9, 1-11.

ČIŽMÁROVÁ, K. (1997). Aktuálne problémy životného prostredia v Banskej Bystrici. *Geografické štúdie*, 2, 81-83.

ČIŽMÁROVÁ, K. (1998). Environmentálne vzdelávanie v geografii na univerzitách. Zborník z konferencie *Environmentálna výchova a vzdelávanie na školách v SR*. Zvolen (TU), p. 6.

ČUKA, P. (1997). *Strety záujmov cestovného ruchu s inými aktivitami na území Starohorských vrchov.* Banská Bystrica (UMB, Metodické centrum), pp. 88-93.

DRDOŠ, J. (1978). Geografia a jej úlohy pri ochrane a tvorbe životného prostredia. *Geografický časopis*, 30, 218-226.

DRDOŠ, J. (1982). Krajina a životné prostredie. O potrebe integrovaných krajinných podkladov. In Drdoš, J., ed. *Geografia a životné prostredia.* Bratislava (SGS), pp. 3-15.

DRDOŠ, J. (1990a). Príspevok k únosnosti krajiny (na príklade Tatranského národného parku). *Geografický časopis*, 42, 3-22.

DRDOŠ, J. (1990b). *Environmentálna geografia.* Manuscript. Bratislava (Geografický ústav SAV).

DRDOŠ, J. (1992). Prírodné prostredie: zdroje – potenciály – únosnosť – hazardy – riziká. *Geografický časopis*, 44, 30-39.

DRDOŠ, J. (1994a). Environmental research in Slovakia: foundations, current state, perspectives. *Geografický časopis*, 46, 117-129.

DRDOŠ, J. (1994b). Preface. *Geografický časopis*, 46, 116.

DRDOŠ, J. (1994c). Natural environment and its utilisation in Upper Nitra Region. *Geographia Slovaca*, 6, 125-136.

DRDOŠ. J. (1999). *Geoekológia a environmentalistika I. časť, Krajinná ekológia-geoekológia, krajina, životné prostredie.* Prešov (FHPV UP).

DRDOŠ, J. (2001). Krajinná ekológia (geoekológia) v pohľade environmentálnej praxe. *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis, Folia Geographica*, 4, 13-40.

DRDOŠ. J. (2004a). *Geoekológia a environmentalistika I. Krajinná ekológia/geoekológia, jej environmentálne poslanie a cesty.* Prešov (FHPV UP).

DRDOŠ, J. (2004b). Geografická paradigma v environmentálnom plánovaní. *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis, Folia Geographica*, 44-61.

DRDOŠ, J. (2005). O geografickom myslení v environmentálnom plánovaní. *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis, Folia Geographica*, 214-218.

DRDOŠ, J., HRNČIAROVÁ, T. (2005). Únosnosť – metodika na stanovenie limitov využívania krajiny. *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis, Folia Geographica*, 219-232.

DRDOŠ. J., KOZOVÁ, M. (1992). Metodológia procesu a tvorba manuálov pre hodnotenie vplyvov činností na životné prostredie v Slovenskej republike. In Drgoňa, V., ed. *Regionálne systémy životného prostredia.* Nitra (Nitrianska univerzita), pp. 57-61.

DRDOŠ, J., MICHAELI, E. (2001). *Geoekológia a environmentalistika II. časť, Environmentálne plánovanie.* Prešov (FHPV UP).

DRDOŠ, J., MICHAELI, E. (2005). *Geoekológia a environmentalistika II. časť, Environmentálne plánovanie v regionálnom rozvoji.* Prešov (FHPV UP).

DRDOŠ, J., URBÁNEK, J., MAZÚR, E. (1980). Landscape syntheses and their role in solving the problems of environment. *Geografický časopis*, 32, 119-129.

DRGOŇA, V., KRAMÁREKOVÁ, H. (1994). Lokálne a regionálne záujmy vo veľkoplošných chránených územiach na príklade CHKO Ponitrie. In *Trvalo udržateľný rozvoj a krajinneoekologické plánovanie v európskych horských regiónoch*. Zvolen (FEE TU vo Zvolene), pp. 101-107.

DRGOŇA, V., KRAMÁREKOVÁ, H. (1995a). *Environmentálna geografia I.* Nitra (FPV VŠPg).

DRGOŇA, V., KRAMÁREKOVÁ, H. (1995b). *Predpoklady trvalo udržateľného rozvoja v podmienkach CHKO Ponitrie.* Nitra (Rosalia), pp. 5-14.

DRGOŇA, V, KRAMÁREKOVÁ, H. (1999). Kultúrna krajina CHKO Ponitrie. *Acta Facultatis Rerum Naturalium Universitatis*, *Geografické štúdie, 6,* 231-237.

DRGOŇA, V., OŤAHEĽ, J., IRA, V. (1992). Environmentálna analýza rizík využívania krajiny. *Geografické štúdie*, 1, 9-35.

DURILOVÁ, A., SAKSA, M. (2003). Comparative analysis of methodical procedures for evaluation of ecological landscape stability (Study area Gajary). *Ekológia (Bratislava)*, *22, Supplement*, 119-129.

GAJDOŠ, A. (2003). Vybrané environmentálne aspekty ťažby Cu-Ag rúd v oblasti Špania dolina. In Rusková, J., Rusko, I., Jeleň, S., Andráš, P., Gajdoš, A., eds. *Meď v Európe.* Zborník z medzinárodného seminára, Banská Štiavnica (Slovenské banské múzeum, SAŽP), pp. 103-107.

GREŠKOVÁ, A., HANUŠIN, J., LEHOTSKÝ, M. (1994). Metodické aspekty typológie hydro-ekologických jednotiek. In *Prírodná časť krajiny, jej výskum a návrhy na využitie.* Bratislava (Prírodovedecká fakulta UK), pp. 25-27.

GREŠKOVÁ, A., LEHOTSKÝ, M. (2003). Ekologické aspekty hodnotenia riečneho systému (výzva pre fluviálnu geomorfológiu). In Mentlík, P., ed. *Geomorfologický zborník 2.* Plzeň (Katedra geografie Západočeské univerzity v Plzni, Česká asociace geomorfologů), pp. 75-80.

HANUŠIN, J., GREŠKOVÁ, A., LEHOTSKÝ, M. (1999). Hydroekologické aspekty hodnotenia stupňa záťaže vodnej zložky krajiny – príklad Slovenska. In Hrnčiarová, T., Izakovičová, Z., eds. *Krajinnoekologické plánovanie na prahu 3. tisícročia*. Bratislava (ÚKE SAV), pp. 95-102.

HANUŠIN, J. (2007a). Narušenie hydrologického cyklu v povodí Hornádu ľudskou činnosťou. *Geographia Cassoviensis*, 1, 37-40.

HANUŠIN, J. (2007b). Krajinnoekologické aspekty ochrany prírody v oblasti Tatier. In Herber, V., ed. *Fyzickogeografický zborník 5*, Brno (Přírodovědecká fakulta MU), pp. 118-123.

HANUŠIN, J., HUBA, M. (1997). Možnosti trvalo udržateľného vodného hospodárstva vo východoslovenskom regióne (prípadová štúdia). In Harčár, J., Nižňanský, B., eds. *Krajina východného Slovenska v odborných a vedeckých prácach. Zborník z konferencie*. Prešov (Prešovská univerzita), pp. 191-204.

HANUŠIN, J., HUBA, M., IRA, V. (2007). Environmental situation in Slovakia since 1990 in context of sustainability. In *Pollution and Water Resources, Columbia University Seminar Proceedings: Environmental problems in US and Central Europe including social aspects of both areas*. Bratislava (Institute of Hydrology, SAS), pp. 242-263.

HANUŠIN, J., HUBA, M., IRA, V. (2008a). Conflicts assessment and integrated landscape management (case study Myjava river basin). In Boltižiar, M. ed. *Implementation of*

Landscape Ecology in New and Changing Conditions : Proceedings of the 14th International Symposium on Problems of Landscape Ecology Research 4-7 October 2006, Stara Lesná, Slovakia. Nitra (Institute of Landscape Ecology, SAS), pp. 105-107.

HANUŠIN, J., HUBA, M., HUDEK, V., IRA, V., MINAROVIČ, M., PODOBA, J., PODOLÁK, P., SPIŠIAK, P., TVRDOŇ, M. (2008b). *Monografia kultúrno-historickej a spoločenskej topografie mikroregiónu Zdroje Bielych Karpát*. Bratislava (REC Slovensko, Geografický ústav SAV).

HANUŠIN, J. et al. (1997). Vývojové trendy využívania vybraných prírodných krajinných zdrojov na Slovensku z aspektu trvalej udržateľnosti. *Geografický časopis*, 49, 127-143.

HANUŠIN, J., LEHOTSKÝ, M. (1998). Landscape-ecological aspects of hydroecological plans (case study Čierna voda, Šúrsky kanál basin). *Ekológia (Bratislava), Supplement 1*, 142-152.

HANUŠIN, J. at al. (2000). *Výkladový slovník termínov z trvalej udržateľnosti*. Bratislava (STUŽ/SR).

HILBERT, H. H. (2002). Miestny územný systém ekologickej stability a stresových faktorov v povodí Ilijského potoka v Štiavnických vrchoch. *Acta Univesitatis Matthiae Belii, séria Environmentálna ekológia (krajinná ekológia)*, II/1, 31-43.

HOCHMUTH, Z. (1991). Typy súčasnej krajiny Humenského podolia a možnosti jej racionálneho využitia. *Prírodné vedy*, 23, 31-45.

HUBA, M., (1980). *Krajinný potenciál extravilánu Bratislavy.* Interná správa, Geografický ústav SAV, Bratislava.

HUBA, M., (1982). Štrnásť krokov na ceste za krajinným plánom. *Geografický časopis*, 34, 145-160.

HUBA, M. (1984). Stabilita (dynamická rovnováha) krajinného systému. *Geografický časopis,* 36, 267-285.

HUBA, M. (1986). *Krajinná syntéza oblastí kopaničiarskeho osídlenia na príklade Javorníkov*. Kandidátska dizertačná správa, Geografický ústav SAV, Bratislava.

HUBA, M.(1987). *K hľadaniu miery únosnosti a efektívnosti využívania krajiny CHKO Malá Fatra a jej ochranného pásma. Zborník zo seminára*. Bratislava (ÚŠOP), pp. 78-87.

HUBA, M. (1993a). Regionalizácia environmentálnych problémov sveta. *Životné prostredie*, 27, 104-107.

HUBA, M. (l993b). K hľadaniu koreňov schizoidného vzťahu obyvateľov bývalého Československa k prírode a svojmu prostrediu. In Nováček, P., Vavroušek, J., eds. *Lidské hodnoty a trvale udržitelný způsob života.* Olomouc (STUŽ a PFUP), pp l4-27.

HUBA, M. (1994a). Threathening of chosen types of landscape of Slovakia by antrophic activities. *Geografický časopis*, 46, 189-203.

HUBA, M. (1994b). Geography of the world environmental problems on the basis of their perception by the heads of the States at the Earth Summit 1992. In Bianchi, E., ed. *Global Change Perception.* Milano (Guerini), pp. 73-78.

HUBA, M. (1995). Productivity – stability (homeostazis) – sustainability. In Izakovičová, Z., Eliáš, P., eds. *Report on sustainability in Slovakia.* Bratislava (Slovak SCOPE Committee), pp. 12-22.

HUBA, M. (1996a). The environment – a new dimension of the global stability. In *Towards a War-Free World - Proceedings of the 44. Pugwash Conference on Science and World Affairs*. Singapore (World Scientific), pp. 365-372.

HUBA, M. (1996b). Environment and sustainable development in Slovakia 1989-1995. *Südosteuropa. Zeitschrift für Gegenwartsforshung,* 45, 282-294.

HUBA, M. (1996c). Uplatnenie zásad trvalej udržateľnosti pri hodnotení environmentálnych vplyvov rozvojových koncepcií. *Životné prostredie*, 30, 19-21.
HUBA, M. (1997). Slovak Republic. In Klärer, J., Moldan, B., eds. *The environmental challenge for Central European economies in transition.* Chichester (Wiley), pp. 231-270.
HUBA, M. (1998a). Productivity – stability (homeostasis) – sustainability. *Ekológia (Bratislava), Supplement*, 34-42.
HUBA, M. (1998b). Návrh environmentálnych indikátorov trvalej udržateľnosti pre vybrané mestá. In Izakovičová, Z., Kozová, M., Pauditšová, E., eds. *Implementácia trvalo udržateľného rozvoja*. Smolenice (SNK SCOPE), pp. 40-53.
HUBA, M. (1999a). Predpoklady uplatňovania koncepcie trvalej udržateľnosti v chránených územiach Slovenska. In Vološčuk, I., ed. *Starostlivosť o prírodné dedičstvo chránených území a biosférických rezervácií Karpát.* Zvolen (Technická univerzita), pp. 89-95.
HUBA, M. (1999b). Stratégia trvalo udržateľného rozvoja regiónu Vysokých Tatier – východiská, ciele, opatrenia. In Midriak, R., ed. *Prírodné rezervácie na Slovensku II.* Zvolen (Technická univerzita), pp. 75-88.
HUBA, M. (2001). Stav rozpracovanosti problematiky indikátorov trvalo udržateľného rozvoja. *Geografický časopis*, 53, 75-92.
HUBA, M. ed. (2002). *Náboženstvo- životné prostredie - hodnoty pre udržateľnú budúcnosť*. Bratislava (STUŽ/SR).
HUBA, M. (2003). Odolnosť ekologických a spoločenských systémov – podmienka udržateľného rozvoja. *Životné prostredie*, 3, 125-128.
HUBA, M.(2004). Sustainability concept and environmentally oriented integrated sciences on landscape and society. *Ekológia (Bratislava), Supplement 1*, 69-76.
HUBA, M., BETÁK, J., BÍZIKOVÁ, L., HANUŠIN, J., IRA, V., LACIKA, J., KLUVÁNKOVÁ-ORAVSKÁ, T. (2005). *Smerom k trvalo udržateľnému tatranskému regiónu : (nezávislá štúdia strategického charakteru) - súhrn*. Bratislava (REC Slovensko a STUŽ/SR).
HUBA, M. (2006a). Values for a sustainable future vs. global problems and threats. *Filozofia*, 61, 520-532.
HUBA, M. (2006b). Trvalo udržateľný rozvoj spoločnosti ako predmet výskumu na Geografickom ústave SAV. *Geografický časopis*, 58, 329-351.
HUBA, M. (2007a). Ľudské hodnoty, etika, udržateľnosť a kvalita života: teória a prax. *Filozofia*, 62, 675-685.
HUBA, M. (2007b). Medzníky starostlivosti o životné prostredie a udržateľný rozvoj na pôde OSN (s dôrazom na Summit Zeme). *Životné prostredie*, 4, 178-183.
HUBA, M., BERKOVÁ, A., HANUŠIN, J., IRA, V., KLUVÁNKOVÁ-ORAVSKÁ, T., KOZOVÁ, M., TOPERCER, J., LACIKA, J., BETÁK, J., et al. (2005). *Smerom k trvalo udržateľnému tatranskému regiónu (nezávislá štúdia strategického charakteru).* Bratislava (REC Slovensko, STUŽ/SR).
HUBA, M., IRA, V. (1996). O koncepcii trvalej udržateľnosti vo vzťahu k niektorým geografickým aspektom vývoja Slovenska. *Geografický časopis*, 48, 285-299.
HUBA, M., IRA, V. (1999a). Preconditions for sustainable development of the Tatras. *Geographica Slovenica*, 31, 189-201.
HUBA, M., IRA, V. (1999b). Border regions and its development from the sustainability perspective (case of lower Morava river). *Moravian Geographical Reports*, 7, 32-39.
HUBA, M., IRA, V. (2000). *Stratégia trvalo udržateľného rozvoja vo vybraných regiónoch*. Bratislava (STUŽ/SR).

HUBA, M., IRA, V., HANUŠIN, J., LEHOTSKÝ, M., SZŐLLŐS, J. (2004). Regional aspect of development towards sustainable Slovakia. *Ekológia, (Bratislava), Supplement*, 66-78.

HUBA, M., IRA, V., HANUŠIN, J., LACIKA, J., SZŐLLŐS, J. (1995). *Towards Sustainable Slovakia* Bratislava (STUŽ/SR).

HUBA, M., IRA, V., MAČÁKOVÁ, S., ŠVIHLOVÁ, D., ZÁBORSKÁ, Z. (2000). *Indikátory trvalo udržateľného rozvoja miest*. Košice (ETP, STUŽ/SR).

HUBA, M., TŘEBICKÝ, V., IRA, V., NOVÁK, J., STODULSKI, W, ERI, V., HANUŠIN, J., HUDEK, V. (2003). *Višegradský región desať rokov po Riu*. Praha, Bratislava (STUŽ/SR).

IRA, V. (1992). Percepcia a environmentálne vedomie obyvateľstva oblastí s narušeným životným prostredím. In Drgoňa, V., ed. *Regionálne systémy životného prostredia.* Nitra (Nitrianska univerzita), pp. 87-89.

IRA, V. (1996). Social dimension of strategic environmental assessment. In Kozová, M., Moncmanová, A., eds. *Proceedings of the internation seminar Management and protection of environment.* Bratislava (Comenius University Bratislava), pp. 109-112.

IRA, V. (2002). Kresťanstvo a zodpovednejšia budúcnosť. In Huba, M., ed. *Náboženstvo - životné prostredie - hodnoty pre udržateľnú budúcnosť. Zborník z konferencie s medzinárodnou účasťou, Liptovský Ján, 14.9.2001*. Bratislava (STUŽ/SR), pp. 26-30.

IRA, V., HANUŠIN, J., BETÁK, J., CEBECAUEROVÁ, M., GREŠKOVÁ, A., HUBA, M., LACIKA, J., LEHOTSKÝ, M., PODOLÁK, P. (2007). Sieť chránených území v regióne Tatier z hľadiska udržateľného rozvoja. *Geographia Cassoviensis*, 1, 61-66.

IRA, V., KOLLÁR, D. (1994). Behavioural-geographical aspects of environmental quality. *GeoJournal*, 32, 221-224.

IRA, V., HUBA, M. (1999). Chages of rural space in Slovakia from sustainability perspective. *Geographica Slovenica*, 31, 151-162.

IRA, V., HUBA, M., PODOLÁK, P. (2006a). Sustainable development of mountainous rural areas in Slovakia (with the case study Poľana BR). In Floriańczyk, Z., Czapiewski, K., eds. *Endogenous factors stimulating rural development - rural areas and development.* Warsawa (European Rural Development Network, Institute of Agricultural and Food Economics National Research Institute, Institute of Geography and Spatial Organization Polish Academy of Sciences), pp. 181-200.

IRA, V., MICHÁLEK, A., PODOLÁK, P. (2006b). Quality of life and the environment. In Mládek, J., Kusendová, D., Marenčáková, J., Podolák, P., Vaňo, B., eds. *Demogeographical analysis of Slovakia.* Bratislava (Comenius University), pp. 146-149.

IRA, V., PAULOV, J. (1976). Die Bewertung der Umweltqualität von Bratislava mittels Expertenschätzung. In *IV. medzinárodné sympózium o problematike ekologického výskumu krajiny : Ekologické podklady pre optimálne využitie krajiny*. Bratislava (Ústav experimentálnej biológie a ekológie SAV), pp. 263-267.

JAKÁL, J., ed. (2005). *Jaskyne svetového dedičstva na Slovensku.* Žilina. (Knižné centrum).

KASALA, K. (1994). *Some remarks on perspectives of Slovakia in the coming are of the new society.* Conference Abstracts of the IGU Regional Conference, Prague, p. 66.

KOLÉNY, M. (2002). Propedeutika k monitoringu prírodných katastrof Slovenka z hľadiska pôd. *Acta Environmentalica Universitatis Comenianae, Supplement*, pp. 151-158.

KOLÉNY, M., ČERŇANSKÝ, J., KOŽUCH, M. (2004). Využitie ortofotomáp v prieskume urýchlenej plošnej vodnej erózie. *Kartografické listy*, 12, 29-36.

KOŠŤÁLIK, J. (1998). *Mapa zosuvov v CHKO Poľana.* Sprievodná správa, Archív Katedry aplikovanej ekológie FEE TU, Zvolen.

KOŠŤÁLIK, J. (2001). Exploatácia magnezitov na strednom Gemeri v jej dopad na geoekológiu krajiny. In Konrád, V., Rácz, A., Kočická, E., eds. *Súčasný stav a perspektívy ekológie a environmntalistiky*. Zborník z medzinárodnej vedeckej konferencie. Zvolen (FEE TU Zvolen), pp. 265-270.

KOZOVÁ, M. (1993). *Environmental impact assessment process – present state of its methodology, legistation, implementation and education under conditions of the Slovak Republic*. Interná správa, Prírodovedecká Fakulta Univerzity Komenského, Bratislava.

KOZOVÁ, M., SPÁČILOVÁ, R., HUBA, M., et al. (1994). *Metodická príručka k hodnoteniu rozvojových koncepcií z hľadiska ich vplyvov na životné prostredie.* Bratislava (Ministerstvo životného prostredia SR).

KROKUSOVÁ, J. (2006). Vplyv poddolovaných území na geoekologickú štruktúru krajiny pri Slovinkách. *Folia Geographica*, 10, 285-290.

LACIKA, J. (1991). Reliéf štátnej prírodnej rezervácie Demänovská dolina. *Slovenský kras*, 30, 89-102.

LACIKA, J., LEHOTSKÝ, M. (1996). Úloha reliéfu v hodnotení citlivosti krajiny. In Bezák, A., Paulov, J., Zaťko, M., eds. *Luknišov zborník 2*. Bratislava (SGS, GgÚ SAV), pp. 103-113.

LACIKA, J., LEHOTSKÝ, M. (2000). Citlivosť reliéfu Demänovskej dolinu ako jedna z imanentných vlastností prírodnej krajiny. In Lacika, J., ed. *Exkurzný sprievodca – 1, Konferencia ASG pri SAV*. Bratislava (GgÚ SAV), pp. 51-59.

LAUKO, V., SEKO, L., TOLMÁČI, L. (1993). Environmental education of geography teacher applicants during their field-works. *Acta Environmentalica Universitatis Comenianae*, 1, 51-54.

LEHOTSKÝ, M. (1991). *Funkčná štruktúra krajiny (Štiavnické vrchy).* Bratislava (Veda).

LEHOTSKÝ, M. (1994a). Landscape carrying capacity (some methodological remarks to the problem). In Richling, A., ed. *Landscape research and its applications in environmental management.* Warszawa (Faculty of Geography and Regional Studies, Warsaw University), pp. 207-212.

LEHOTSKÝ, M. (1994b). Environmental spatial structures-the example of East Slovakia lowland. In *Environment and quality of life. IGU Regional Confetence Proceedings.* Prague (UK), CD-ROM. pp. 88-99.

LEHOTSKÝ, M. (2003). Postmoderna a epistemiológia krajinného priestoru s akcentom na fluviálne geosystémy. In Herber, V., ed. *Fyzickogeografický zborník 1. Fyzická geografia – vzdelávanie, výskum, aplikácie.* Brno (Přírodovědecká fakulta MU), pp. 146-151.

LEHOTSKÝ, M, GREŠKOVÁ, A., HANUŠIN, J. (2001). Hydro-ecological evaluation of load of water component in main Slovak river basins. In Staroszolsky, O., ed. *International conference on water and nature conservation in the Danube-Tisza river basins*. Debrecen (Magyar Hidrológiai Társaság), pp. 244-250.

LEHOTSKÝ, M., HANUŠIN, J. (2002). Assessment of environmental aspects of the hydrological cycle (case study Horný Žitný ostrov – Slovakia). In Matlovič, R., Žigrai, F., eds. *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis, Folia Geographica 5,* 92-97.

LEHOTSKÝ, M., IRA, V., OŤAHEĽ, J. (1989). Hodnotenie vplyvu diaľnice na krajinu: environmentálny prístup (projekt v Podtatranskej kotline). *Geografický časopis*, 41, 71-92.

LEHOTSKÝ, M., OŤAHEĽ, J. (1995). Landscape ecological problems in urban planning. In Vaishar A., ed. *Papers of the 1st Moravian geographical conference CONGEO 95*. Brno (Ústav geoniky AV ČR), pp. 88-93.

MACHOVÁ, Z., TREMBOŠ, P. (1995). *Terminologický slovník: Vybrané termíny používané v geografii, ekológii a environmentalistike*. Bratislava (Prírodovedecká fakulta UK).
MAZÚR, E. (1977). Geografia – krajina – životné prostredie. *Životné prostredie*, 3, 117-119.
MAZÚR, E., DRDOŠ, J. (1984). Conception of resources or conception of the landscape potential in the geographical research? *Geografický časopis*, 36, 305-315.
MAZÚR, E., DRDOŠ, J., BUČKO, Š., HUBA, M., OŤAHEĽ, J., OČOVSKÝ, Š., TARÁBEK, K. (1985). *Krajinná syntéza oblasti Tatranskej Lomnice.* Bratislava (Veda).
MAZÚREK, J. (1999). *Chránené územia prírody na Slovensku*. Banská Bystrica (Metodické centrum).
MICHAELI, E. (1995). Miestny územný systém ekologickej stability na príklade katastra Drienov. In Hochmuth, Z., ed. *Reliéf a integrovaný výskum krajiny.* Prešov (PdF UPJŠ), pp. 140-146.
MICHAELI, E. (1999). Náčrt transfomácie prírodného prostredia a súčasnej urbánno-ekologickej stability vo vybraných lokoregiónoch Prešova. *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis, Folia Geographica*, 1, 347-355.
MICHAELI, E. (2001). Fyzickogeografické pomery Národnej prírodnej rezervácie Čergovský Minčol a vybrané geoekologické aspekty jej ochrany. *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis, Folia Geographica*, 4, 75-100.
MINÁR, J., TREMBOŠ, P. (1995). The evaluation of natural hazards in landscape planning. *Acta Environmentalica Universitatis Comenianae*, 4-5, 211-222.
MISTRÍKOVÁ, M., KOZOVÁ, M., HUBA, M., SZÖLLÖS, J. et al. (2001). *Alternatívna koncepcia rozvoja slovenskej energetiky.* Bratislava (Energia 2000).
MURGAŠ, F. (2007). Endogénne a exogénne predpoklady rastu kvality života. *Geographia Cassoviensis*, 1, 133-136.
NOVÁČEK, P., HUBA, M., eds. (1995). *Šok z prosperity - čítanka z globální problematiky II.* Olomouc (Univerzita Palackého).
NOVÁČEK, P., HUBA, M., MEDERLY, P. (1998). *Ohrožená planeta na prahu 21. století.* Olomouc (Univerzita Palackého).
NOVODOMEC, R. (1998). *Súčasný stav a úlohy environmntálnej výchovy na stredných školách v SR. Zborník z 2. národnej konferencie Environmntálna výchova a vzdelávanie na školách v SR*. Zvolen (TU), pp. 165-169.
OŤAHEĽ, J. (1980). Štúdium percepcie krajinnej scenérie a jeho prínos k lokalizácii zariadení cestovného ruchu. *Geografický časopis*, 32, 250-261.
OŤAHEĽ, J. (1994). Visual landscape perception research for the environmental planning. *Geographia Slovaca*, 6, 97-103.
OŤAHEĽ, J. (1999). Visual landscape perception: landscape pattern and aesthetic assessment. *Ekológia, (Bratislava)*, 18, 63-74.
OŤAHEĽ J., LEHOTSKÝ M., IRA V. (1989). Krajinno-ekologické hodnotenie vplyvu diaľnice na krajinu. In *„Metódy krajinne-ekologických analýz a syntéz“. Zborník z konferencie*. Česká Budějovice (ÚKE ČSAV), pp 207-217.
OŤAHEĽ, J., FERANEC, J. (1997). Rural landscape assessment in environmental planning: case study – part of the Záhorie Lowland. In Munzar, J., Vaishar, A., eds. *Rural geography and environment, CONGEO'97*. Brno (GEOKONFIN), pp. 89-96.
OŤAHEĽ, J., LEHOTSKÝ, M., IRA, V. (1997). Environmental planning: proposal of procedures (case studies*). Ekológia, (Bratislava)*, 16, 403-420.
OŤAHEĽ, J., POLÁČIK, Š. (1987). *Krajinná syntéza Liptovskej kotliny.* Bratislava (Veda).

OŤAHEĽ, J., ŽIGRAI, F., DRGOŇA, V. (1993). Landscape use as a basis for environmental planning (case studies Bratislava and Nitra hinterlands). *Geografické štúdie*, 2, 7-15.

PAINE, J. (1988-1989). *Environmental geography (book one – three).* Melbourne (South Melbourne Macmillan).

REGIONÁLNE ENVIRONMENTÁLNE CENTRUM (2000). *Regionálna Agenda 21 pre Stredné Pohronie.* Bratislava (REC Slovensko).

SOLÍN, Ľ. (2008). Analýza výskytu povodňových situácii na Slovensku v období 1996-2006. *Journal of Hydrology and Hydromechanics*, 56, 95-115.

SHU, T, XUEJUN, W., JIANYING, H., FULIU, X., WENXIN, L., BENGANG, L., JUN, C. (2004). Environmental geography of China: retrospect and prospect. *Journal of Geographical Sciences*, 14, 4-78.

SPIŠIAK, P., BARTKOVÁ, M. (1998). Hospodárske aktivity regiónu Turčianske Teplice a ich vplyv na životné prostredie. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 40, 17-28.

STANKOVIANSKY, M. (2003). *Geomorfologická odozva environmentálnych zmien na území Myjavskej pahorkatiny*. Bratislava (UK).

SZŐLLŐS, J. (1998). Geografická analýza energie a energetiky: teoretická báza a aplikácia na energetický systém Slovenska. *Geographia Slovaca*, 14, Bratislava (Geografický ústav SAV).

SZŐLLŐS, J. (2001). *Kresťanstvo a ekológia. Globálne (ekologické) problémy z aspektu kresťanstva a ekológie*. Bratislava (STUŽ/SR).

SZŐLLŐS, J., HUBA, M., DAHLSTROM, T. (1997). Environmental protection and capacity building in Slovakia. In. *Environmental policy and the role of foreign assistance in Central and Eastern Europe*. Copenhagen (KPMG, CESAM), pp. 83-124.

TŘEBICKÝ, V., NOVÁK, J., IRA, V., HUBA, M., STODULSKI, W., ERI, V. (2003). *Road to sustainability – economic, social and environmental dimension of sustainability in Visegrad countries.* Praha (Institute for Environmental Policy).

TREMBOŠ, P. (1992). Environmental limits – their forms and importance in the process of ecological landscape carrying capacity evaluation. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 33, 223-232.

TREMBOŠ, P. (2003). Environmentálne kritériá optimalizácie cestnej siete na Slovensku. In Izakovičová, Z., ed. *Slovensko rok po Johannesburgu*. Bratislava (UKE SAV), pp. 64-68.

TRIZNA, M. (1998). Hodnotenie zraniteľnosti územia pri identifikácii povodňového rizika. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 41, 13-34.

TRIZNA, M. et al. (1997). Diaľnica D61 Bratislava: Mierová ulica – Senecká cesta. Zámer. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica, Supplementum 1*. Bratislava (Univerzita Komenského).

URBÁNEK, J. (1977). Logická štruktúra problematiky životného prostredia. *Životné prostredie*, 11, 123-126.

VILČEK, J. (2006). Regionálne aspekty hodnotenia a využívania poľnohospodárskych pôd. *Folia Geographica*, 10, 540-545.

ŽIGRAI, F., HUBA, M. (2004). Some metascientific remarks concerning the sustainable development of the society and the environment. *Ekológia (Bratislava)*, *Supplement*, 23, 403-413.

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LAND COVER/LAND USE CHANGE RESEARCH AND MAPPING IN SLOVAKIA

*Ján Feranec, Ján Oťahel'**

Výskum a mapovanie zmien krajinnej pokrývky a využitia krajiny na Slovensku
Príspevok prináša prehľad prác o výskume a mapovaní zmien krajinnej pokrývky a využitia krajiny na Slovensku so zvláštnym zreteľom na výsledky Geografického ústavu SAV. Obsahuje aj krátku charakteristiku metódy aplikovanej v projektoch CORINE Land Cover (CLC) na získanie údajov o krajinnej pokrývke Slovenska z rokov 1970 (CLC1970), 1990 (CLC1990), 2000 (CLC2000) a 2006 (CLC2006) a jej zmien v troch časových horizontoch – CLC1970/1990, CLC1990/2000 a CLC2000/2006 prostredníctvom vizuálnej interpretácie a počítačom podporovanej vizuálnej interpretácie satelitných snímok Landsat, SPOT a IRS. Analýza výsledkov ukazuje, že v období 1970-1990 boli najintenzívnejšie zmeny na Slovensku v poľnohospodárstve, s dominanciou zmien heterogénnych poľnohospodárskych areálov v prospech ornej pôdy (37 150 ha) a lúk (41 710 ha), ako aj lúk v prospech ornej pôdy (15 750 ha) a heterogénnych poľnohospodárskych areálov (43 190 ha). V období 1990-2000 boli najvýznamnejšie zmeny v lesnej krajine, ktoré sa prejavili znížením rozlohy lesa (58 032 ha) v prospech prechodných lesokrovín (areálov po výruboch a poškodeniach lesov), zväčšením rozlohy ďalších prechodných lesokrovín o18 600 ha, predstavujúcich zarastajúce (opustené) poľnohospodárske lúky, najmä v horských a podhorských oblastiach, prirodzené lúky a heterogénne poľnohospodárske areály. Zmeny v lesnej krajine boli najvýznamnejšie aj počas šesťročného obdobia 2000-2006, v ktorom sa rozloha prechodných lesokrovín zvýšila o 54 842 ha na úkor lesov a pasienkov (prirodzeným vývojom).

Kľúčové slová: CORINE land cover projekt, satelitné údaje, zmeny krajinnej pokrývky, Slovensko

INTRODUCTION

Research and mapping of land use (LU) and land cover (LC) is an important geographical issue. It often becomes the conclusion of the physical geographical or geoecological research above all in the context of comparisons of the potential natural conditions with their real exploitation. On the other side, the regional or human geographical research, LU and LC mapping is rather an introduction to the analysis of a territory of interest. LU research has been traditionally connected with registration of parcels and land as the basic landscape resource, which is also associated with securing the nutrition and needs of society. LU research has developed above all in geography of agriculture and applied statistical data about the acreage of agriculture crops or about production per administrative unit.

At present, LU research and mapping have been distinctly determined by aerial and satellite images which provide temporally and spatially accurate records of the condition of land cover and its changes. Aerial photography spread in the years 1920-1930 (Philipson, ed. 1997) and the obtained photographs immediately an in-

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valuable information source about changes of landscape objects formerly only secured by field surveys (Feranec et al. 2004). Regular aerial and satellite imaging represents an appropriate tool for the analysis of LC and LU changes. Numerous examples of application of satellite imagery prove the efficiency of landscape mapping data in different regions of the world. A drawback of several programmes and their results was the heterogeneous or incompatible methodologies and classification systems. Since 1992, the International Geosphere Biosphere Programme introduced the data and information system DISCover, the aim of which is acquisition and evaluation of LC data for the entire Earth surface. A significant milestone in homologization of the methodology was the CORINE Land Cover (CLC) Project, part of the CORINE (Coordination Information on the Environment) Programme from 1985. It is today respected and accepted by all European countries including Slovakia. By the CLC method (Heymann et al. 1994, Feranec and Oťaheľ 2001), CLC data layers have been derived for the territory of Slovakia and the years 1990 (CLC90), 2000 (CLC2000) and 2006 (CLC2006) at scale 1:100 000, which represent a regional and all-European compatible database about LC changes.

LU and LC changes are considered the central theme of research on environmental changes (cf. Verburg and Veldkamp 2005), solution of which should contribute to prediction of the possible future of our planet. This is the reason, why the aim of this study is to offer an overview of LC change research and mapping in Slovakia and specifically the role of the Institute of Geography of the SAS in it. Fulfilment of this aim is documented by the studies of Oťaheľ and Feranec (2006) Feranec and Oťaheľ (2008) published in *Geografický časopis* and complemented by the most recent results achieved in the field in Slovakia in the years 2007-2009.

LC AND ITS CHANGES: OVERVIEW OF APPROACHES

The issue of LC change identification by application of remote sensing data was and still is addressed by various international projects and programmes some of which will be mentioned here. The aim of the *LACOAST* (LAnd cover changes in COASTal zones) Project was to identify LC changes in the 10 km wide coastal zone of Europe for the period 1975-1990 using the CORINE land cover (CLC) 90 database and Landsat MSS satellite images from the 1970s (Perdigao and Christensen 2000). Part of the *Phare Topic Link on Land Cover* Project was to identify LC changes in Czechia, Hungary, Romania and Slovakia like in the preceding projects for the 1970s-90s also using the CLC90 database and images of the Landsat MSS from the 1970s (Feranec et al. 2000). Details concerning the derivation of the CLC2000 data layers in a greater part of Europe are quoted in the study of Feranec et al. (2007a, 2007b).

In 2003-2005, the Pan-European project of BIOPRESS was worked on. Its aim was to analyse the effects of LC changes on biodiversity in experimental plots (73 squares 30×30 km and 59 transects 15×2 km) in different biogeographical regions of Europe and protected *Natura 2000* territories for the years 1950, 1990 and 2000. In this project too, the information about LC changes was drawn from aerial black&white photographs and the CLC90 database by computer aided visual interpretation (Gerard et al. in print).

In addition there was also the *Earth Observation for Sustainable Development of Forest (EOSD)* Project involved with compilation of LC map representing the forested part of Canada based on automated processing of satellite images. Nine of 23

classes of the appurtenant nomenclature characterized the forest landscape (Wulder 2002). The *National Land Cover Database – NLCD 2001* of the USA contains 28 land cover classes identified by interpretation of Landsat 5 and 7 satellite images and additional data mostly obtained from thematic maps (Homer et al. 2004).

Monitoring of Land Use/Cover Dynamics (MOLAND) is the research project accomplished by the Environment and Sustainability Joint Research Centre (JRC) in Ispra, Italy. The project was initiated in 1998 under the title *Monitoring Urban Dynamics (MURBANDY).* The project focuses on acquisition of data necessary in spatial planning and modelling of territorial development for selected areas in the all-European context and urbanized landscape on regional and local scales.

In 2005, the pilot project of *GMES Service Element Land (GSELand)* was started as a component of the *Global Monitoring for Environment and Security (GMES* programme for all-European monitoring activities with the aim of preparing land use and land cover mapping by application of satellite images on the European level with the minimum surface of the area unit 0.25 ha–5 ha (www.gmes.info). Generation of the all-European data layer CLC2006 is part of these monitoring activities

LC/LU MAPPING IN SLOVAKIA

Systematic interest in landscape with emphasis on its component, the land, the way it is used, who owns and who uses it, is connected with the foundation of the cadastre and compilation of cadastre maps at a scale of 1:2 880. The first surveys for the cadastre in the Kingdom of Hungary started in 1856 (Prikryl 1977) and compilation of cadastre maps lasted until 1885 (Pravda 2003). In 1897, the cadastre of the Kingdom of Hungary was revised and adapted recalculating the archaic measure of "siaha" (1.8288 metre) into the metric system (Prikryl 1977). Plots, their owners, their users and the way of use were entered into the cadastre books.

In the territory of the former Czechoslovakia the first cadastres contained the original maps and indication sketches, parcel protocols, plot sheets, lists of holders and lists of houses. In terms of spatial cognition, cadastre maps were important because they contained the boundaries of all plots, parcels by numbers quoting the owner, the user, class of the plot and its use.

However, after the Second World War the agrarian reforms followed later by the socialist collectivization of agriculture made the estate register redundant. The Ministry of Agriculture introduced a registration of its own regardless the original parcels and owners. From 1964, what is referred to as *Jednotná evidencia pôdy* (Single Land Register) was used. The basic material consisted of written documents and maps of the cadastre complemented by legal changes, maps at scales 1:5 000 and 1:2 880 fashioned by aerial photogrammetry. A dichotomy in registration was a typical phenomenon in this period. It meant that the real situation differed from the legal one. A supplement entered in the *Evidencia nehnuteľností* (Register of Estates) was meant to solve it, but only the *Kataster nehnuteľností* (Estate Cadastre) enacted in 1993 meant the return to the correct registration of parcels and land in the territory of Slovakia (Feranec and Oťaheľ 2001).

Topographic maps are an other source of information about land use. Military topographic maps from 1782-1784 and 1819-1858 at the scale of 1:28 880 (1st and 2nd military mapping) and from 1875-1883 at scales 1:25 000 (3rd military mapping) deposited in the Military Archives of Vienna are worth mentioning. The same infor-

mation was also contained in later made map derivations at scale 1:75 000 (cf. Götz ed. 1966).

The most topical series in this group is represented by the last editions of topographic maps of the Czechoslovak Army at scales from 1:10 000 to 1:200 000 compiled with data from the 1950s to 1980s.

Land registering, cadastre and topographic maps were the basic source for the derived land use maps prevailingly made by the agricultural firms or for individual regions.

One of the first synthesized pictures of spatial differentiation of land use in Slovakia is the work of Kubijovyč (1932). It contains maps at a scale of 1:1 000 000, which document the distribution of cultures (forests, vineyards, arable land, meadows and pastures and non used land) by natural regions. Statistical data about land use in Czechoslovakia from 1934 are presented on maps included in the *Atlas of the Czechoslovak Republic* by Pantoflíček, ed. (1935), by the share of arable land, meadows, pastures, vineyards and forest in the total area of individual districts. Hromádka (1943) presented maps of the statistical evaluation of farming cultures (fields, meadows, gardens, vineyards, pastures and barren land) and forest by orographic units (in %) and the share of sown crops in total arable land (in %) in his *General Geography of Slovakia*. In the *Land Use Map* at a scale of 1:1 000 000 (Götz, ed. 1966) the author delimited six land use classes (arable land, meadows and pastures, devastated land and barren land). Mazúr (1974 and 1980) authored maps where he presented landscape maps of Slovakia showing use of the existing land pool in the years 1895-1961, and 1895-1970. Mazúr and Krippel (1980) integrated data on land use, settlement and composition of wood species with basic natural landscape units in the map *Types of the present landscape* at a scale of 1:500 000. Zelenský (1980) also emphasized agricultural landscape use in his *Land use map* at a scale of 1:500 000. He distinguished on this map five basic classes: forests, agricultural and technicized landscape, waters and non used land. The *Land use map of the SSR* at a scale of 1:250 000 (Ivanička 1981 and 1982) is based on Polish works in the field of land use with a distinct stress on agriculture (Kostrowicki 1962 and Kostrowicki, ed. 1965). Drdoš (1991) presented an assessment of land use in Slovakia at a scale of 1:1 000 000 regarding the topical environmental problems.

Polish authors and their methodological procedures of traditional research in the area of land use have positively inspired the Slovak authors working on regional or local scales. Papers of Paulov (1964), Ivanička (1964, 1971 and 1972), Biegajlo and Paulov (1966), Mocko (1968), Ivaničková (1971), Žigrai (1981, 1983 and 1995), Spišiak (1989 and 1999), Ofúkaný (1999 and 2000) are especially worth mentioning in this context.

Analysis of land use as part of integrated landscape research (landscape synthesis and landscape ecology) is one of the basic information sources for the diagnosis of the contemporary landscape (cf. Žigrai 1973 and 1995, Lukniš 1977, Michaeli and Kandráčová 1982, Mazúr et. al. 1985, Kandráčová and Michaeli 1987, Oťaheľ and Poláčik 1987). Land use research possesses a distinct geographical context whether it is independent analysis of how the areas are used followed by assessments (Kusendová and Lauko 1992, Korec and Husárová 1994, Lauko and Rajčáková 1994, Machová 1994, Mládek 1994) or the issue of land use and natural conditions assessments (Žigrai 1973, Oťaheľ et. al. 1993, 2000a, Žigrai and Drgoňa 1995).

RESULTS IN THE AREA OF LU AND LC RESEARCH AND MAPPING ACHIEVED AT THE INSTITUTE OF GEOGRAPHY OF THE SAS

The Institute of Geography of the SAS (IG SAS) holds an important place in the national and international activities connected with LU and LC research and mapping by application of remote sensing data. Use of remote sensing data is valuable because these data provide information about spatial and physiognomic characteristics of landscape structures and objects. Aerial panchromatic and multispectral photographs taken by different cameras were used in experimental LU and LC mapping (Feranec and Oťaheľ 2001).

Activities of the Institute of Geography of the SAS in the context of international projects such as *Phare Topic Link on Land Cover* (Feranec et al. 2000a), *CORINE Land Cover 1990 (CLC90), Image and CORINE Land Cover 2000 (I&CLC2000)* (Feranec et al. 2005b, Feranec et al. 2007a) and *CLC2006* (Feranec and Nováček, in print) have contributed to derivation of data layers that characterized frequency and surface of land cover areas in Slovakia in the 1970s, 1990s and in v 2000 (+/– one year) and in 2006 (+/–one year) at a scale of 1:100 000 by application of Landsat MSS, TM, ETM+, Spot and IRS satellite images. Existence of data layers CLC70, CLC90, CLC2000 and CLC2006 was the basis for the regular monitoring and assessment of LC changes in Slovakia using remote sensing data. At present, information about LC changes that have taken place in 1970-1990, 1990-2000 and 2000-2006 are available. This is perhaps, a clear proof that satellite images are crucial for such regular monitoring of landscape changes induced by human society and also on a national level.

The results are obvious from the following examples of land use/cover on the local, regional and national scales. Local scale: Feranec and Oťaheľ (1987): *Land use map for cadastre of Cejkov* at a scale of 1:10 000 Oťaheľ and Feranec (1993): *Land cover type map of the Morava floodplain* at scale 1:10 000.

Regional scale: Feranec et al. (1983): *Land use map of environs of Trebišov* at a scale of 1:50 000, Oťaheľ and Poláčik (1987): *Land use forms in of the Liptovská Basin* at a scale of 1:50 000, Feranec et al. (1994): *Map of land cover forms, sheet Šurany M-34-133-C* at scale 1:50 000, Cebecauerová and Cebecauer (1997): *Land cover in the southern part of the Záhorská Lowland* at a scale of 1:50 000, Feranec et al. (1997a): *Land cover in central part of the Trnavská Hill Land* at scale 1:50 000, Pravda et al. (1998): *Land cover of Zvolen – Detva – Krupina* at scale 1:100 000, Feranec et al. (1988): *Land use in the administrative region of Western Slovakia* at a scale of 1:200 000, first of its kind in Slovakia, Feranec and Oťaheľ (1989): *Interpretation scheme of land use in the Eastern Slovakian Lowland* at a scale of 1:200 000.

National scale: Feranec and Oťaheľ (1992): *Interpretation scheme of land use of land use forms in Slovakia* at a scale of 1:50 000, Feranec et al. (1996): *Slovakia – CORINE – landscape and tourist map* at a scale of 1:500 000, Feranec and Oťaheľ (1996): *Slovakia – CORINE – land cover map* at a scale of 1:500 000. Information about the land use/cover of Slovakia was applied in compilation of the following maps: *Ecology of Land Use in Central Europe* at a scale of 1:1 500 000 (Richling et al. 1996) and *CSFR – land use* at a scale of 1:1 000 000 (Viturka ed. 1992).

On the map *Natural landscape and land cover of Slovakia* at a scale of 1:500 000 (Oťaheľ et al. 2000a) the authors presented the integrated view of the state in land use pursuing land cover in 1990 (CLC90) and natural landscape types. By

overlaying natural landscape and landscape cover layers (CLC90), information about the real land use derived by means of the GIS and interpreted in the form of graphs and tables was obtained. The *Land cover map* at a scale of 1:500 000 published in *Landscape Atlas of the Slovak Republic was derived from CLC90 data* (Feranec and Oťaheľ 1996). The Maps *Slovakia Land Cover 1990* and *Slovakia Land Cover 2000* published in the atlas *Land use/cover changes in selected regions in the world* (Feranec et al. 2005c) present the status in land use in the years 1990 and 2000 along with its changes by regions of Slovakia.

Identification and assessment of land use changes are important subjects of the geographical research of the landscape sphere of Earth on the national and global scales as proved by the ongoing activities of the Study Group Land Use/Land cover Change working under the International Geographical Union, the members of which also include our IG SAS. The Institute participated in preparation and publication of the atlas *Land use changes in selected regions of the world* (Feranec et al. 2001a, Oťaheľ et al. 2002b). Several other works deal with changes applying the CLC layers: Feranec et al. (1997a, 1997b, 2000a, 2000b, 2000c, 2001b, 2002a, 2002b, 2003, 2004, 2005a, 2005b, 2006a, 2006b), Šúri (1997), Oťaheľ et al. (2000b, 2002a, 2002b, 2003, 2004, 2008a, 2008b, 2008c), Cebecauerová and Cebecauer (2004a and 2004b), Kopecká (2005), Cebecauerová (2007), Feranec and Oťaheľ (2008), Kopecká et al. (2008), Spišiak et al. (2008). A study by Feranec and Pravda (2009) in turn, is devoted to the aesthetic evaluation of CLC maps.

The results of land cover mapping achieved at the IGU SAS by participation in the national (VEGA Grant Agency) and international projects (CORINE Land Cover 1990, Image and CORINE Land Cover 2000 and CLC2006/GMES FTSP Land Monitoring Slovakia) also found reflection in the international acceptance of the methodological procedures proper to land cover at a scale of 1:50 000 and the proposed nomenclature for the countries of the Phare Programme (Feranec and Oťaheľ 1999, Bossard et al. 2000).

LANDSCAPE-ECOLOGICAL RESEARCH OF LAND COVER/LAND USE

Geographical approaches to land cover mapping also inspired other authors interested in landscape ecological research (Falťan 2000a, 2000b, 2005, Boltižiar 2002 and 2003, Boltižiar and Petrovič 2004, Falťan and Saksa 2007).

The stress upon the analysis of vegetation forms (Kalivodová et al. 2002, Hrnčiarová et al. 2002a, 2002b) or functions of settlements (Štefunková et al. 2002) in LU mapping is evident in the landscape ecological studies published in the *Atlas krajiny Slovenskej republiky* (2002). Historic topographical maps were the source material used for the analysis of land use changes by Olah (2001, 2003a, 2003b), Špulerová (2002), Petrovič (2004 and 2005), Boltižiar (2005) and Drgoňa (2004). Chrastina (2004 and 2005), Chrastina and Boltižiar (2006) and Boltižiar and Chrastina (2006) are especially involved with the development of LU in the historical context.

Remote sensing data brought about new chances for landscape research mainly with regard to temporally and spatially correct LC/LU change analyses. Boltižiar et al. (2007) comments on the importance of historic maps and aerial photographs for landscape change assessment using the example of the High Tatras. Historic maps and aerial photographs are normally used for the long-interval analyses of LU

changes above all in Biosphere Reserves of Slovakia (Boltižiar and Petrovič 2005, Boltižiar et al. 2006, Olah et al. 2006a, 2006b).

Aerial photographs from the archives of the Topographic Institute in Banská Bystrica from the 1950s represent a relevant tool for LU/LC change analysis. The images were mainly used for the analysis of the high-mountain landscape structure impacted by geomorphological processes along with the economic activity of humans (Boltižiar 2003, 2004a, 2004b, 2006, 2007 and Boltižiar et al. 2006).

The LC data layers of Slovakia (CLC90 and CLC2000) are also used for evaluation of landscape on the national scale in cases like the issue of soil erosion (Cebebecauer and Hofierka 2008), use of the principal natural landscape types (Zaušková and Midriak 2007), or introduction of the cultural landscape types by land cover (Hofierka 2008).

The methodology applied to research on the development and changes of land use published in the landscape-ecological university textbook (Olah 2008) also deserves acknowledgement.

LAND COVER CHANGES IN SLOVAKIA IN THE PERIOD OF 1970-1990-2000-2006

Studies by Feranec et al. (2000a, 2000b), Feranec and Oťaheľ (2001), Feranec et al. (2005c) and Feranec and Nováček (in print) http://atlas.sazp.sk contain the analysis of LC changes in Slovakia in the quoted period and their results. The overall volume of LC changes that took place between the 1970s and 1990s in the territory of Slovakia was 315,640 ha (6.4% of the total area of the country), in the 1990s and in 2000 (+/– one year) it was 207,006 ha (4.2%) and in 2000-2006 the area of LC changes amounted to 76,924.6 ha (1.5%).

LC changes in the period 1970-1990

In terms of area, what changed most in the period of the 1970s and the 1990s was heterogenous agricultural areas (24, Tab. 1 explains the codes of CLC classes, only LC classes of the second level of the CLC nomenclature were identified for; see tab. 1) in favour of arable land (21) that is 37,150 ha and meadows (23) – 41,710 ha and vice versa: 15,750 ha of pastures changed in favour of arable land, while 43,190 ha of pasture became heterogeneous agricultural areas (see Tab. 2). The trend is the result of the agrarian policy promoted by the State. Changes of this type were identified in the southern part of the Podunajská and Eastern Slovakia Lowlands but also in central and northern regions of Slovakia. The second most conspicuous change in terms of area was the dimintion of forests (31) in favour of transitional woodland/shrubs (32) by 87,160 ha. It is presumably the result of logging and various calamities that occurred above all in the regions of Záhorie, Slovenské rudohorie, Levočské vrchy, Čergov, Ondavská vrchovina and Laborecká vrchovina. Changes of agricultural and forest landscape in favour of urbanized areas (11, 12 and 13) with a in total area of 14,990 ha were identified above all along the urbanization axes that run down the valleys of the Váh, Nitra and Hron Rivers. Construction of the Gabčíkovo Dam also contributed to an increased area of changes in urbanized landscape.

Tab. 1. CLC nomenclature (Heymann et al. 1994, Bossard et al. 2000)

1 Artificial surfaces	**3 Forest and semi-natural areas**
11 Urban fabric	*31 Forests*
111 Continuous urban fabric	311 Broad-leaved forests
112 Discontinuous urban fabric	312 Coniferous forests
12 Industrial, commercial and transport units	313 Mixed forests
121 Industrial or commercial units	*32 Scrub and/or herbaceous vegetation associations*
122 Road and rail networks and associated land	321 Natural grasslands
123 Port areas	322 Moors and heathland
124 Airports	323 Sclerophyllous vegetation
13 Mine, dump and constructions sites	324 Transitional woodland-scrub
131 Mineral extraction sites	*33 Open spaces with little or no vegetation*
132 Dump sites	331 Beaches, dunes, sands
133 Construction sites	332 Bare rocks
14 Artificial, non-agricultural vegetated areas	333 Sparsely vegetated areas
141 Green urban areas	334 Burnt areas
142 Sport and leisure facilities	335 Glaciers and perpetual snow
2 Agricultural areas	**4 Wetlands**
21 Arable land	*41 Inland wetlands*
211 Non-irrigated arable land	411 Inland marshes
212 Permanently irrigated land	412 Peat bogs
213 Rice fields	*42 Maritime wetlands*
22 Permanent crops	421 Salt marshes
221 Vineyards	422 Salines
222 Fruit trees and berry plantations	423 Intertidal flats
223 Olive groves	**5 Water bodies**
23 Pastures	*51 Inland waters*
231 Pastures	511 Water courses
24 Heterogeneous agricultural areas	512 Water bodies
241 Annual crops associated with permanent crops	52 Marine waters
242 Complex cultivation patterns	521 Coastal lagoons
243 Land principally occupied by agriculture, with significant areas of natural vegetation	522 Estuaries
244 Agro-forestry areas	523 Sea and ocean

LC changes in the period 1990-2000

The results published in the studies by Feranec et al. (2005a) and Feranec et al. (2005b) allow for identification of basic trends in LC changes for the decade of 1990-2000. The most important area changes took place in forest landscape, with To 58,032 ha (see Tab. 3) changing in favour of transitional woodland/shrubs (324, areas after clear cuts and damage or calamities for instance in the Levočské vrchy, Hnilecké vrchy, Veporské vrchy, Považský Inovec Mountain Ranges), additional transitional wood/scrub in the form of overgrown (abandoned) farming meadows accounts for 18,600 ha (231 above all in mountain and submountain regions), of natural meadows (321) and heterogeneous agricultural areas (243). Transitional woodland/scrubs naturally matured into 52,974 ha of forest. In total, however, the area of forest increased by 2,590 ha (minus class 324, see Tab. 3). Privatization of forests and market mechanism are the determining factors of the demonstrated changes in forest landscape.

Tab. 2. LC changes in Slovakia in the period 1970-1990 (Feranec et al. 2000b)

1970s classes	1990s classes													Total 1970s (in ha)
	11	12	13	14	21	22	23	24	31	32	33	41	51	
11	-	130	30	-	10	-	-	130	-	-	-	-	50	120
12	10	-	70	-	10	-	-	10	-	20	-	-	10	120
13	1,260	310	-	0	190	0	90	340	30	140	-	50	630	3040
14	10	-	-	-	-	-	-	10	-	-	-	10	40	70
21	3,890	1,820	2,550	50	-	6,540	12,770	18,300	360	150	-	40	640	47,110
22	20	-	-	-	1,530	-	20	430	-	-	-	-	-	2,000
23	150	20	20	-	15,750	110	-	43,190	270	2,510	-	-	340	62,550
24	2,070	420	410	120	37,150	2,240	41,710	-	1,470	1,140	-	120	870	87,720
31	60	180	3,120	140	1,410	10	1,010	4,130	-	87,160	10	210	350	97,780
32	-	70	130	50	340	-	280	2,220	5,480	-	990	10	100	9,660
33	-	-	10	-	-	-	-	10	-	660	-	-	90	770
41	20	20	60	-	180	-	140	190	230	330	-	-	350	1,530
51	-	10	390	40	10	-	20	310	380	130	0	1,640	-	2,950
Total 1990s (in ha)	7,480	2,980	6,960	400	56,580	8,900	56,050	69,270	8,210	92,240	1,010	2,080	3,480	315,640

Tab. 3. LC changes in Slovakia in the period of 1990-2000 (Feranec et al. 2005b)

		2000's classes																							
	CLC class	112	121	122	131	132	133	142	211	221	222	231	242	243	311	312	313	321	324	331	333	411	511	512	Total 1990's (in ha)
1990s classes	112						25							16										28	69
	131		6						6							10			65					93	180
	132											70							244						314
	133	221	214	63					34				12	26					1,524				1,563	2,365	6,022
	141	7	23																						30
	142																							34	34
	211	1,850	544	99	68	56	356	7		882	254	4,623	13,205	1,409	23	10	25		201					134	23 746
	221	81	11						2,872			123	10	245											3,342
	222	58							2,412	44			132	208											2,854
	231	74	28		19	47	159	49	8,051				3,737	6,624	413	136	189		10,269					229	30, 024
	242	14	7				51		264			179		314											829
	243	738	101		34		175	81	4,360		40	4,574	282		1,808	180	684		4,860					392	18, 309
	311	27	5		68	28	16	53	6			14		207		61	2,053		13,686				6	20	16, 250
	312				86	73	26	39	14			64		14	62		522		37,252					72	38, 224
	313	22			26	36	69	41				16		18	1,013	693			7,094						9,074
	321																		1,345						1,345
	324	22			6		5	40	34			146		141	35,428	4,719	12,827						6	92	53, 466
	331																		35		121		102		258
	333											61						482							543
	334																		30						30
	411													119					25					1,450	1,594
	511		11																	26	6			308	351
	512	7																				112			119
	Total 2000's (in ha)	3,121	996	162	307	240	882	310	18,053	926	294	9,870	17,378	9,340	38,747	5,809	16,300	482	76,630	26	127	112	1,677	5,217	207,006

Increased area of the field, meadow and permanent culture mosaic by 16,564 ha, mostly at the expense of arable land is the most frequent change identified in the agricultural landscape (especially in districts Námestovo, Tvrdošín, Liptovský Mikuláš, Detva, and Nitra). This change is the consequence of privatization and leasing of agricultural land and the return to the management of small fields, meadow and permanent cultures. Nevertheless, land management in large blocs by cooperatives prevailed in Slovakia during the evaluated period.

Identified changes in urbanized landscape manifested by increase of settlement, industrial and recreation areas along with communications by 4,500 ha (above all in the hinterland of Bratislava and Košice, and in the districts of Komárno, Dunajská Streda, Galanta, Levice, and Michalovce). Changes in rural settlements were not so pronounced (it must be born in mind that only changes with the minimum area of 5 ha and larger were identified).

Changes in the period 2000-2006

The Size of LC changes in the period 2000-2006 is documented in Tab. 4.

It is evident from Tab. 4 that during six years, 76,925 ha of LC equalling 1.5% of the total country area changed (for comparison in the ten years between 1990 and 2000 as much as 207,006 ha LC (or 4.2% of the total country area) changed. The most distinct change is the increase of the area of class 324 (by 54,842 ha), above all at the expense of classes 231 (3,714 ha), 311 (13,106 ha), 312 (32,556 ha) and 313 (4,970 ha) (see Tab. 4). The size of changes above all in classes 312 and 324 was mostly determined, apart from logging, by the windstorm that struck the areas of the High and Low Tatra Mountain Ranges on 19 and 20 November 2004. Enlargement of class 324 at the expense of class 231 is attributed to the abandonment of what were originally agriculturally exploited meadows as a results of economic conditions imposed in the EU. An important feature of the forest landscape and its development are changes of class 324 in favour of classes 311 (4021 ha), 312 (1193 ha) and 313 (4134 ha) (see Tab. 4). Changes in forest dominated in the districts of Poprad, Kežmarok, Brezno and Čadca. Their scope is smaller in districts of Žarnovica, Poltár, Revúca, Rožňava, Gelnica, Humenné, Námestovo, etc.

Changes in agricultural landscape are manifested by diminution of class 211 in favour of classes 133 (1,373 ha), 221 (843 ha), 231 (1,336 ha) and 242 (2,731 ha). A reverse process is also evident: enlargement of the area of class 211 at the expense of 221 (1,067 ha), 222 (495 ha), 231 (1,262 ha) and class 243 (116 ha) (see Tab. 4). Dynamics in the agricultural landscape are the consequence of newly formulated conditions of the agrarian policy both on the national and EU levels. Enlargement of the area of class 242 at the cost of class 211 in districts Galanta, Šaľa, Dunajská Streda, Nové Zámky and Komárno is probably associated with leasing of land to new lessees who change the large-scale management for that on a smaller scale. Enlargement of class 221 in the district of Trebišov is obvious.

Among the identified changes in the context of urbanized landscape enlargement of class 133 (by 1,853 ha) at the expense of class 211 (see Tab. 4) is most evident. It is due to construction of commercial and industrial areas (for instance the car manufacturing plants PSA Pegueot Citroën and KIA) and of motorways in the districts of

Tab. 4. Land cover changes in Slovakia in 2000-2006 (Feranec and Nováček, in print)

Area in ha										CLC00								
CLC06	131	132	133	142	211	221	222	231	242	243	311	312	313	321	324	331	333	Total area
112			195.42	7.38	92.38					16.66		15.14						326.97
121			7.92		916.76				15.91	20.34		20.97			14.75			996.64
122			214.43															214.43
131					280.10				6.37	16.82	16.48	12.23	10.43					342.44
132			26.45												7.90			34.35
133					1372.74	65.20		157.87	15.38	146.51	22.05	9.57	58.26		5.86			1853.43
142					74.76				33.36				5.75					113.88
211			94.70			1066.50	494.78	1262.00	95.83	116.44								3130.25
221					843.09													843.09
222					129.99													129.99
231		27.11			1336.28	100.03	15.99			348.02								1827.43
242					2731.18													2731.18
243			31.84															31.84
311															4020.94			4020.94
312															1193.23			1193.23
313															4133.58			4133.58
324	37.81						10.50	3713.78			13,105.67	32,555.63	4969.77	50.58		65.54	333.18	54,842.45
512					109.54			7.04		20.40	6.41				15.06			158.45
Total area	37.81	27.11	570.75	7.38	7886.82	1231.72	521.28	5140.69	166.84	685.19	13,150.61	32,613.53	5044.21	50.58	9391.33	65.54	333.18	76,924.56

Trnava, Bytča, Žilina, and Poprad. The developmental trend in urbanized landscape was also recognized in enlargement of the areas of classes 112, 121, 122 and 131, mostly at the expense of agricultural landscape (for instance in the districts of Bratislava, Pezinok, Senec, Kežmarok and Košice).

CONCLUSION

The characteristics of LC in Slovakia revealed here are results of a successful cooperation of the IG SAS with the Slovak Environmental Agency in several pan-European CLC projects in the last 15 years. Derivation of these characteristics represents a significant contribution to the analysis and assessment of different aspects of landscape dynamics on the one side and presentation of novel spatial information on the other.

In the period of the 1970s to the 1990s, 315,640 ha of LC changed in Slovakia. In this total, changes of heterogeneous agricultural areas (24) in favour of arable land (37,150 ha) and pastures (41,710 ha), those of meadows in favour of arable land (15,750 ha) and heterogeneous agricultural areas (43,190 ha) dominate. Decline of forest areas in the same period in favour of transitional wood/shrubs (87,160 ha) was also conspicuous.

In the decade 1990-2000, a total of 207,006 ha of land cover changed. Both, the change of forest into transitional woodland/shrubs (58,032 ha) and the opposite, change of transitional woodland/shrubs into forest (52,174 ha) dominated. In agricultural landscape, enlargement of the class covering the mosaic of fields, meadows and permanent cultures at the expense of arable land (by 16,564 ha) dominated.

In the last analysed period of 2000-2006, the size of LC changes in Slovakia reached 76,924.6 ha. The most conspicuous change is that of an increased area of transitional wood/shrubs (by 54,842 ha) at the expense of classes 231, 311, 312 and 313. Change of transitional woodland/shrubs in favour of forest amounted to 9,348 ha. Changes of class arable land mainly in favour of classes 133 (1,373 ha) and 242 (2,731) ha dominated in the agricultural landscape. In turn what dominated in the urbanized landscape was areas of construction (by 1,853 ha).

The Land cover data and the corresponding changes in Slovakia identified by the CLC projects besides spatial correctness also bring the advantage of international compatibility and the option of efficient comparison of landscape changes in almost all Europe.

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REFERENCES

Atlas krajiny Slovenskej republiky. (2002). Bratislava, Banská Bystrica (Ministerstvo životného prostredia, Slovenská agentúra životného prostredia).

BIEGAJLO, W., PAULOV, J. (1966). Štúdium využitia zeme na príklade obce Veľké Blahovo na Žitnom ostrove. *Acta Geologica et Geographica Universitatis Comenianae, Geographica*, 6, 225-247.

BOLTIŽIAR, M. (2002). Analýza krajinnej štruktúry vysokohorskej krajiny Tatier vo veľkých mierkach v prostredí GIS. *Geografické informácie*, 7, 278-297.

BOLTIŽIAR, M. (2003). Mapovanie a analýza vzťahu krajinnej štruktúry a reliéfu vysokohorskej krajiny Tatier s využitím údajov DPZ a GIS. *Kartografické listy*, 11, 5-15.

BOLTIŽIAR, M. (2004a). Batizovská dolina vo Vysokých Tatrách – mapovanie a vzťah krajinnej štruktúry k vybraným vlastnostiam reliéfu s využitím výsledkov DPZ a GIS. In Baláž, I., ed. *Teória a prax krajinno-ekologického plánovania*. Nitra (Fakulta prírodných vied UKF), pp. 14-22.

BOLTIŽIAR, M. (2004b). Zmeny krajinnej štruktúry vysokohorskej krajiny na príklade lokality„Spálenisko pod Slavkovským štítom“ v rokoch 1949-2003 s využitím výsledkov DPZ a GIS. In Zaušková, Ľ., ed. *Horská a vysokohorská krajina*. Zvolen (Technická univerzita), pp. 167-176.

BOLTIŽIAR, M. (2005). Tvorba historických máp krajinnej štruktúry Tatier na základe leteckých snímok a ich aplikácia pri hodnotení zmien krajiny. In Pravda, J., ed. *Historické mapy*. Bratislava (Kartografická spoločnosť SR a Geografický ústav SAV), pp. 19-26.

BOLTIŽIAR, M. (2006). Changes of high mountain landscape structure in the selected area of Predné Meďodoly valley (Belianske Tatry Mts.) in 1949-1998. *Ekológia* (Bratislava), 25, Supplement, 1, 16-25.

BOLTIŽIAR, M. (2007). *Štruktúra vysokohorskej krajiny Tatier (veľkomierkové mapovanie, analýza a hodnotenie zmien aplikáciou údajov diaľkového prieskumu Zeme).* Nitra (Fakulta prírodných vied Univerzity Konštantína Filozofa, Ústav krajinnej ekológie SAV Bratislava, pobočka Nitra, Slovenský národný komitét pre program UNESCO Človek a biosféra).

BOLTIŽIAR, M., PETROVIČ, F. (2004). Zmeny krajiny v kontexte spoločensko-ekonomických zmien (1949-2003) na príklade Ulíčskej doliny (NP Poloniny). In Baláž, I., ed. *Teória a prax krajinno-ekologického plánovania.* Nitra (Fakulta prírodných vied UKF), pp. 23-28.

BOLTIŽIAR, M., PETROVIČ, F. (2005). Zmeny krajiny v Národnom Parku Poloniny v rokoch 1949-2003. *Acta Facultatis Rerum Naturalium Universitatis Comenianae. Geographica,* Supplementum, 3, 68-79.

BOLTIŽIAR, M., CHRASTINA, F. (2006). Využitie krajiny SV okraja Bakoňského lesa v Maďarsku. *Geografická revue*, 2(2), 49-61.

BOLTIŽIAR, M., OLAH, B., PETROVIČ, F. (2006). Zmeny využitia krajiny vybranej časti Biosférickej rezervácie Tatry v rokoch 1772-2003. *Geografické informácie*, 9, 239-256.

BOLTIŽIAR, M, BRŮNA, V. KŘOVÁKOVÁ, K. (2007). Potential of antique maps and aerial photographs for landscape changes assessment – an example of High Tatras. *Ekológia (Bratislava)*, 26, 421-436.

BOSSARD, M., FERANEC, J., OŤAHEĽ, J. (2000). *CORINE land cover technical guide – Addendum 2000. Technical report,* 40. Copenhagen (European Environment Agency). http://terrestrial.eionet.eea.int

CEBECAUER, T., HOFIERKA, J. (2008). The consequences of land cover changes on soil erosion distribution in Slovakia. *Geomorfology*, 98, 187-197.

CEBECAUEROVÁ, M., CEBECAUER, T. (1997). Krajinná pokrývka v južnej časti Záhorskej nížiny. In Feranec, J. et al. Analýza zmien krajiny aplikáciou údajov diaľkového prieskumu Zeme. *Geographia Slovaca*, 13, Bratislava (Geografický ústav SAV).

CEBECAUEROVÁ, M., CEBECAUER, T. (2004a). Analysis of the land cover changes in the years 1954-1979 in the southern part of Zahorska Lowland. In Kirchner, K.,.Wojtanovicz, J., eds. *Cultural landscapes.* Brno (REGIOGRAPH), pp. 99-108.

CEBECAUEROVÁ, M., CEBECAUER, T. (2004b). Vývoj krajinnej pokrývky v južnej časti Záhorskej nížiny a Malých Karpát v období 1954-1992. *Geografické informácie*, 8, 60-67.

CEBECAUEROVÁ, M. (2007). Analýza a hodnotenie zmien štruktúry krajiny (na príklade časti Borskej nížiny a Malých Karpát). *Geographia Slovaca*, 24, Bratislava (Geografický ústav SAV).

DRDOŠ, J. (1991). Landnutzung und Umweltprobleme in der Slowakischen Republik. *Österreichische Osthefte*, 33, 697-716.

DRGOŇA, V. (2004). Assessment of the landscape use changes in the city of Nitra. *Ekológia (Bratislava)*, 23, 385-392.

FALŤAN, V. (2000a). Krajinná pokrývka okolia Kysuckého Nového Mesta identifikovaná metódou CORINE. *Geografický časopis*, 52, 363-376.

FALŤAN, V. (2000b). Krajinná pokrývka okolia Borinky identifikovaná metódou CORINE. *Geografické spektrum*, 2, 101-106.

FALŤAN, V. (2005). *Veľkomierkové mapovanie vegetácie a krajinnej pokrývky.* Bratislava (Univerzita Komenského).

FALŤAN, V., SAKSA, M. (2007). Zmeny krajinnej pokrývky okolia Štrbského plesa po veternej kalamite v novembri 2004. *Geografický časopis*, 59, 359-372.

FERANEC, J., OŤAHEĽ, J., SLOBODA, Š. (1983). Niektoré možnosti aplikácie údajov získaných interpretáciou multispektrálnych leteckých snímok pri mapovaní využitia Zeme. In Hájek, M. ed. *Matematické modelovanie v kartografii*. Bratislava (ČSVTS), pp. 87-94.

FERANEC., OŤAHEĽ, J. (1987). Tvorba mapy využitia krajiny veľkej mierky aplikáciou multispektrálnych leteckých snímok. *Geografický časopis,* 39, 411-426.

FERANEC, J., HÁJEK, M., OŤAHEĽ, J., SLOBODA, Š., ŠAFÁR, J. (1988). The use of multispectral space photographs to draw up a map of land use in Western Slovakia. *Photogrammetria (PRS),* 42, 157-162.

FERANEC, J., OŤAHEĽ, J. (1989). Súčasné využitie krajiny Východoslovenskej nížiny. *Geografický časopis,* 41, 158-170.

FERANEC, J., OŤAHEĽ, J. (1992). Land cover forms in Slovakia identified by application of colour infrared space photographs at scale 1:500 000. *Geografický časopis*, 44, 120-126.

FERANEC, J., OŤAHEĽ, J., PRAVDA, J., HUSÁR, K. (1994). Formy krajinného krytu identifikované v rámci projektu CORINE Land Cover. *Geografický časopis*, 46, 35-46.

FERANEC, J., OŤAHEĽ, J. (1996). *Slovensko – CORINE – mapa krajinnej pokrývky. 1:500 000.* Bratislava (Geografický ústav SAV).

FERANEC, J., OŤAHEĽ, J., DVORSKÁ, H., KONDÁŠOVÁ, M. (1996). *Slovensko – CORINE – krajinno-turistická mapa*. Bratislava (Geodetický a kartografický ústav, Geografický ústav SAV).

FERANEC, J., CEBECAUEROVÁ, M., CEBECAUER, T., HUSÁR, K., OŤAHEĽ, J., PRAVDA, J., ŠÚRI, M. (1997a). Analýza zmien krajiny aplikáciou údajov diaľkového prieskumu Zeme. *Geographia Slovaca*, 13. Bratislava (Geografický ústav SAV).

FERANEC, J., OŤAHEĽ, J., HUSÁR, K. (1997b). Landscape changes mapping by application of aerial photographs. In Ottoson, L., ed. *Proceedings of the 18th International Cartographic Conference*. Gävle (Swedish Cartographic Society), pp. 306-313.

FERANEC, J., OŤAHEĽ, J. (1999). Mapovanie krajinnej pokrývky metódou CORINE v mierke 1:50 000: návrh legendy pre krajiny programu Phare. *Geografický časopis*, 51, 19-44.

FERANEC, J., SURI, M., OTAHEL, J., CEBECAUER, T., KOLAR, J., SOUKUP, T., ZDENKOVA, D., WASZMUTH, J., VAJDEA, V., VIJDEA, A., NITICA, C. (2000a). Inventory of major landscape changes in the Czech Republic, Hungary, Romania and Slovak Republic. *International Journal of Applied Earth Observation and Geoinformation*, 2, 129-139.

FERANEC, J., ŠÚRI, M., OŤAHEĽ, J., CEBECAUER, T. (2000b). Landscape Changes in Slovak Republic 1970's-1990's. *International Archives of Photogrammetry and Remote Sensing*, 32, 7C2, 64-70.

FERANEC, J., ŠÚRI, M., OŤAHEĽ, J., CEBECAUER, T., KOLÁŘ, J., SOUKUP, T., ZDEŇKOVÁ, D., WASZMUTH, J., VAJDEA, V., VIJDEA, A. M., NITICA, C. (2000c). Landscape changes detection, analysis and assessment in the Phare countries – the Czech Republic, Hungary, Romania and Slovak Republic. *Journal of Geography Education*, 43, 95-106.

FERANEC, J., OŤAHEĽ, J. (2001). *Land cover of Slovakia*. Bratislava (Veda).

FERANEC, J., ŠÚRI, M., OŤAHEĽ, J., CEBECAUER, T., PRAVDA, J., KOLÁŘ, J., SOUKUP, T., ZDEŇKOVÁ, D., WASZMUTH, J., VAJDEA, V., VIJDEA, A. M., NITICA, C. (2001a). Landscape change detection, analysis and assessment in the Phare countries – the Czech Republic, Hungary, Romania and Slovak Republic. In Himiyama, Y., Mather, A., Bičík, I., Milanova, E. V., eds. *Land Use/Cover Changes in Selected Regions in the World,* 1. Asahikawa (Institute of Geography, Hokkaido University of Education, IGU-LUCC), pp. 51-58.

FERANEC, J., ŠÚRI, M., OŤAHEĽ, J., CEBECAUER, T., SOUKUP, T. (2001b). Výsledky porovnania národných štatistík Česka, Maďarska, Rumunska a Slovenska s údajmi CORINE land cover. *Geodetický a kartografický obzor*, 47, 208-213.

FERANEC, J., CEBECAUER, T., OŤAHEĽ, J., ŠÚRI, M. (2002a). Methodological aspects of landscape changes detection and analysis in Slovakia applying the CORINE land cover database. *Geografický časopis*, 54, 271-288.

FERANEC, J., ŠÚRI, M., CEBECAUER, T., OŤAHEĽ, J. (2002b). Zmeny krajinnej pokrývky Ponitria a Požitavia v období 1970-1990. *Geographia Slovaca*, 18, 31-37.

FERANEC, J., CEBECAUER, T., OŤAHEĽ, J., ŠÚRI, M. (2003). Assessment of the selected landscape change types of Slovakia in the 1970' and 1990'. *Ekológia, 22, Supplement*, 2, 161-167.

FERANEC, J., OŤAHEĽ, J., CEBECAUER, T. (2004). Zmeny krajinnej pokrývky – zdroj informácií o dynamike krajiny. *Geografický časopis*, 56, 33-47.

FERANEC, J., PRAVDA, J., CEBECAUER, T., OŤAHEĽ, J., HUSÁR, K., MACHKOVÁ, N. (2005a). Mapové vyjadrenie zmien krajinnej pokrývky Slovenska za roky 1990-2000. *Geodetický a kartografický obzor*, 51(6-7), 157-164.

FERANEC, J., OŤAHEĽ, J., CEBECAUER, T., MACHKOVÁ, N., NOVÁČEK, J. (2005b). Land cover changes of Slovakia in the period 1990-2000. In Kleinn, Ch., Nieschulze, J., Sloboda, B., eds. *Schriften aus der Forstlichen Fakultät der Universität Gottingen und der Niedersächsichschen Forstlichen Versuchsanstalt*, 138. Frankfurt am Main (J. D. Sauerländers Verlag), pp. 139-147.

FERANEC, J., OŤAHEĽ, J., MACHKOVÁ, N., NOVÁČEK, J., PRAVDA, J., CEBECAUER, T., HUSÁR, K. (2005c). Land cover changes in administrative regions

of Slovakia in 1990-2000. In Himiyama, Y., Mather, A., Bičík, I., Milanova, E. V., eds. *Land use/cover changes in selected regiosn in the world*, 4. Asahikawa (IGU-LUCC, Hokkaido University of Education), pp. 25-31.

FERANEC, J., OŤAHEĽ, J., CEBECAUER, T. (2006a). Krajinná pokrývka Slovenska a jej zmeny za obdobie 1990 - 2000 (identifikované aplikáciou databáz CORINE land cover). *Acta Geographica Universitatis Comenianae*, 47, 141-150.

FERANEC, J., OŤAHEĽ, J., ORLITOVÁ, E., SOUKUP, T. (2006b). Data layers of CORINE land cover – contribution to cognition of land cover changes of Europe. *Acta Geographica Universitatis Comenianae*, 49, 19-26.

FERANEC, J., HAZEU, G., CHRISTENSEN, S., JAFFRAIN, G. (2007a). CORINE land cover change detection in Europe (case studies of the Netherlands and Slovakia). *Land Use Policy*, 24, 234-247.

FERANEC, J., CEBECAUER, T., HAZEU, G., JAFFRAIN, G. (2007b). Cartographic aspects of land cover changes detection (over- and underestimation in the I&CORINE Land Cover 2000 Project. *The Cartographic Journal*, 44, 44-54.

FERANEC, J., OŤAHEĽ, J. (2008). Land cover changes in Slovakia in the period 1970-2000. *Geografický časopis*, 60, 113-128.

FERANEC, J., PRAVDA, J. (2009). Aesthetics of the CORINE land cover maps. In Cartwright, W., Gartner, G., Lehn, A., eds. *Cartography and art*. Berlin (Springer), pp. 69-79.

FERANEC, J., NOVÁČEK, J. The CLC2006 database of land cover in Slovakia and its changes in the period of 2000-2006. *Moravian Geographical Report*, (in print).

GERARD, F., BUGAR, G., GREGOR, M., HALADA, L., HAZEU, G., HUITU, H., KÖHLER, R., KOLAR, J., LUQUE, S., MÜCHER, C. A., OLSCHOFSKY, K., PETIT, S., PINO, J., SMITH, G., THOMSON, A., WACHOWICZ, M., BEZAK, P., BROWN, N., BOLTIZIAR, M., DE BADTS, E., FERANEC, J., HALABUK, A., MANCHESTER, S., MOJSE, M., PETROVIC, F., PONS, X., RODA, F., ROSCHER, M., SUSTERA, J., TUOMINEN, S., WADSWORTH, R., ZIESE, H. Determining Europe's land cover changes over the past 50 years using aerial photographs. *Journal of Land Use Science* (in print).

GÖTZ, A. ed. (1966). *Atlas Československé socialistické republiky*. Praha (ČSAV a ÚSGK).

HEYMANN, Y., STEENMANS, CH., CROISSILLE, G., BOSSARD, M. (1994). *CORINE land cover. Technical guide.* Luxembourg (Office for Official Publications of the European Communities).

HOFIERKA, J. (2008). Kultúrna krajina na Slovensku. *Geografické práce*, 13. Prešov (FHPV, Prešovská univerzita).

HOMER, C., HUANG, CH., YANG, L., WYLIE, B., COAN, M. (2004). Development of a 2001 National Land-Cover Database for the United States. *Photogrammetric Engineering & Remote Sensing*, 70, 829-840.

HRNČIAROVÁ, T., KUBÍČEK, F., RUŽIČKOVÁ, H., RAČKO, J. (2002a). Charakteristická štruktúra využitia kotlinovej krajiny – časť Žiarskej kotliny. 1:25 000. In *Atlas krajiny Slovenskej republiky*. Bratislava (Ministerstvo životného prostredia SR).

HRNČIAROVÁ, T., KUBÍČEK, F., RUŽIČKOVÁ, H., BERKOVÁ, A. ŠIMONOVIČ, V. (2002b). Charakteristická štruktúra využitia horskej krajiny – časť Vysokých Tatier a Podtatranskej kotliny. In *Atlas krajiny Slovenskej republiky*. Bratislava (Ministerstvo životného prostredia SR).

HROMÁDKA, J. (1943). Všeobecný zemepis Slovenska. In Novák, L., ed. *Slovenská vlastiveda,* 1. Bratislava (SAVU), pp. 83-332.

CHRASTINA, P. (2004). *Vývoj krajiny Trenčianskej kotliny a jej horskej obruby*. Dizertačná práca, Prešovská univerzita, Prešov.

CHRASTINA, P. (2005). Vývoj krajiny ako fenomén environmentálnych dejín (na príklade Trenčianskej kotliny a jej horskej obruby). *Historická geografie*, 33, 9-19.

CHRASTINA, P., BOLTIŽIAR, M. (2006). Kultúrna krajina SV okraja Bakoňského lesa v Maďarsku (súčasnosť v kontexte minulosti). *Historická geografie*, 34, Suplement, 1, 175-188.

IVANIČKA, K. (1964). Mapa využitia zeme rajónu Východoslovenských železiarní. Prílohová mapa. *Acta Geologica et Geographica Universitatis Comenianae, Geographica*, 4. Bratislava (SPN).

IVANIČKA, K. (1971). Systémové analýzy poľnohospodárstva v zázemí Bratislavy. *Acta Geographica Universitatis Comenianae, Economico-geographica*, 10, 9-49.

IVANIČKA, K. (1972). *Mapa využitia zeme areálu Bratislavy*. Bratislava (Slovenská kartografia).

IVANIČKA, K. (1981). *Mapa využitia zeme SSR v mierke 1:250 000.* Banská Bystrica (Učebné pomôcky, n. p.).

IVANIČKA, K. (1982). *Mapa využitia zeme SSR. Metodický návod.* Banská Bystrica (Učebné pomôcky, n. p.).

IVANIČKOVÁ, A. (1971). Problems of transformation of the use of soil fund in West-Slovakia as exemplified on the village of Horné Orešany. *Acta Geographica Universitatis Comenianae, Economico-Geographica*, 10, 175-189.

KALIVODOVÁ, E., DOBROVODSKÁ, M., RUŽIČKOVÁ, H., ŠTEFUNKOVÁ, D. (2002). Charakteristická štruktúra využitia nížinnej krajiny – časť nivy rieky Morava. 1:20 000 In *Atlas krajiny Slovenskej republiky*. Bratislava (Ministerstvo životného prostredia SR).

KANDRÁČOVÁ, V., MICHAELI, E. (1987). Priestorová štruktúra krajiny katastra Drienovskej Novej Vsi a jej hospodárske využitie. *Zborník Pedagogickej fakulty v Prešove Univerzity P. J. Šafárika v Košiciach. Prírodné vedy*, 22(1) 167-203.

KOPECKÁ, M. (2005). Hodnotenie hemeróbie s využitím mapy krajinnej pokrývky. In: Svatoňová, H., ed. *Geografické aspekty středoevropského prostoru. Geografie*, 16. Brno (Masarykova univerzita v Brně, Pedagogická fakulta), pp. 30-39.

KOPECKÁ, M., FERANEC, J., OŤAHEĽ, J., BETÁK, J., VATSEVA, R., STOIMENOV, A. (2008). Driving forces of the most important landscape changes in selected regions of Slovakia and Bulgaria in the period between 1990 and 2000. In Kabrda, J., Bičík, I., eds., *Man in the Landscape across frontiers: Landscape and land use change in Central European border regions: CD Proceedings of the IGU/LUCC Central Europe Conference*. Prague (Charles University, Faculty of Science), pp. 100-111.

KOREC, P., HUSÁROVÁ, K. (1994). Územie Bratislavy z hľadiska perspektívy jeho využitia. *Geographia Slovaca*, 7, 61-73.

KOSTROWICKI, J. (1962). Le survey polonais de l´utilisation du sol. *Geographical Studies*, 31, 31-58.

KOSTROWICKI, J. ed. (1965). Land utilization in East-Central Europe. Case studies. *Geographia Polonica*, 5. Warszawa (Wydawnictwa Geologiczne).

KUBIJOVYČ, V. (1932). *Rozšíření kultur a obyvatelstva v Severních Karpatech*. Sborník Filosofické fakulty UK v Bratislave, 8. Bratislava (Filosofická fakulta UK).

KUSENDOVÁ, D., LAUKO, V. (1992). Mapa využitia plôch a tvorba databázy kartografického modelu územia mesta. In Drdoš, J., ed. *Zborník referátov z 10. zjazdu Slovenskej geografickej spoločnosti pri SAV*. Bratislava (SGS), pp. 104-115.

LAUKO, V., RAJČÁKOVÁ, E. (1994). Aplikácia mapy využitia zeme v ochranárskom výskume. In Machová, Z., ed. *Prírodná časť krajiny, jej výskum a návrhy na využitie*. Bratislava (Prírodovedecká fakulta Univerzity Komenského), pp. 95-98.

LUKNIŠ, M. (1977). *Geografia krajiny Jura pri Bratislave.* Bratislava (Univerzita Komenského).

MACHOVÁ, Z. (1994). Mapa využitia Zeme v okolí Rudna (Turčianska kotlina) ako podklad pre aplikovaný výskum. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica,* 35, 121-127.

MAZÚR, E. (1974). Využitie zeme. In Plesník, P. et al. *Slovensko. Ľud – 1. časť.* Bratislava (Obzor), pp. 75-100.

MAZÚR, E. (1980). Typy krajiny podľa využitia pôdneho fondu. 1:1 000 000. In Mazúr, E., ed. *Atlas Slovenskej socialistickej republiky.* Bratislava (SAV a SÚGK), pp. 292.

MAZÚR, E., KRIPPEL, E. (1980). Typy súčasnej krajiny. In Mazúr, E., ed. *Atlas Slovenskej socialistickej republiky*. Bratislava (SAV a SÚGK), pp. 102-103.

MAZÚR, E., DRDOŠ, J., BUČKO, Š., HUBA, M., OŤAHEĽ, J., OČOVSKÝ, Š., TARÁBEK, K. (1985). *Krajinná syntéza oblasti Tatranskej Lomnice. Edícia vedy o Zemi a vesmíre.* Bratislava (Veda).

MICHAELI, E., KANDRÁČOVÁ, V. (1982). Príspevok ku geografii obce Medzany. In Drdoš, J., ed. *Geografia a životné prostredie.* Bratislava (SGS), pp. 94-102.

MLÁDEK, J. (1994). Petržalka – development and transformation of urban structure. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 34, 3-12.

MOCKO, Z. (1968). Vplyv intenzifikácie poľnohospodárstva na formovanie regiónov na príklade vinohradníctva Slovenska. *Acta Geographica Universitatis Comenianae*, *Economico-geographica*, 8, 241-267.

OFÚKANÝ, M. (1999). Využitie zeme v urbanistických obvodoch Bratislavy. In Kusendová, D., Pravda, J., eds. *Mapa produkt geoinformačných technológií*. Bratislava (Kartografická spoločnosť SR), pp. 43-53.

OFÚKANÝ, M. (2000). Zmeny využitia lesných a zastavaných plôch v Bratislavskom kraji. In Feranec, J., Pravda J., eds. *Aktivity v kartografii 2000*. Bratislava (Kartografická spoločnosť SR a Geografický ústav SAV), pp. 77-90.

OLAH, B. (2001). Zmeny využitia zeme v prechodnej zóne BR Poľana – porovnanie stavu pri 1. a 2. vojenskom mapovaní. *Acta Facultatis Ecologiae (Zvolen)*, 8, 39-47.

OLAH, B. (2003a). Potential for the sustainable land use of the cultural landscape based on its historical use (a model study of the transition zone of the Poľana Biosphere Reserve). *Ekológia (Bratislava)*, 22, Supplement, 2, 79-91.

OLAH, B. (2003b). *Vývoj využitia krajiny Podpoľania – starostlivosť o kultúrnu krajinu prechodnej zóny Biosférickej rezervácie Poľana.* Vedecké štúdie, 1/B. Zvolen (Technická univerzita).

OLAH, B. (2008). Vývoj využitia krajiny v krajinnoekologickom kontexte. In Šteffek, J. et al. *Krajinnoekologický výskum. Vybrané teoretické a metodické aspekty*. Zvolen (Fakulta ekológie a environmentalistiky, Technická univerzita vo Zvolene), pp. 149-182.

OLAH, B., BOLTIŽIAR, M., PETROVIČ, F. (2006a). Land use changes ´relation to georelief and distance in the East Carpathians Biosphere Reserve. *Ekológia (Bratislava)*, 25, 68-81.

OLAH, B., BOLTIŽIAR, M, PETROVIČ, F., GALLAY, I. (2006b). *Vývoj využitia krajiny slovenských biosférických rezervácií UNESCO.* Vedecké štúdie, 10/B. Zvolen (Technická univerzita).

OŤAHEĽ, J., POLÁČIK, Š. (1987). *Krajinná syntéza Liptovskej kotliny*. Bratislava (Veda).
OŤAHEĽ, J., ŽIGRAI, F., DRGOŇA, V. (1993). Landscape use as a basis for environmental planning (case studies Bratislava and Nitra hinterlands). *Geographical Studies*, 2, 7-83.
OŤAHEĽ, J. FERANEC, J. (1993). Land cover (habitat types) map based on the colour infrared aerial photographs as a tool for vegetation analysis. In *Proceedings of the Ninth Thematic Conference on Geologic Remote Sensing*. Ann Arbor (ERIM), pp. 535-544
OŤAHEĽ, J., FERANEC, J., PRAVDA, J., HUSÁR, K., CEBECAUER, T., ŠÚRI, M. (2000a). *Prírodná krajina a krajinná pokrývka. Mapa Slovenska v mierke 1:500 000*. Bratislava (Geografický ústav SAV).
OŤAHEĽ, J., FERANEC, J., PRAVDA, J., HUSÁR, K., CEBECAUER, T., ŠÚRI, M (2000b). Prírodná (rekonštruovaná) a súčasná krajinná štruktúra Slovenska hodnotená využitím bázy údajov CORINE land cover. *Geographia Slovaca*, 16. Bratislava (Geografický ústav SAV).
OŤAHEĽ, J., FERANEC, J., HUSÁR, K. (2002a). Prírodná krajina a krajinná pokrývka Ponitria a Požitavia: hodnotenie zmien a heterogenity. *Geographia Slovaca*, 18, 133-142.
OŤAHEĽ, J., FERANEC, J., CEBECAUER, T., PRAVDA, J., HUSÁR, K., ŠÚRI, M. (2002b). Changes of natural (reconstructed) landscape of Slovakia. In Himiyama, Y., Mather, A., Bičík, I., Milanova, E. V., eds. *Land use/cover changes in selected regions in the world*, 2. Asahikawa (IGU-LUCC, Hokkaido University of Education), pp. 1-9.
OŤAHEĽ, J., FERANEC, J., CEBECAUER, T., HUSÁR, K. (2003). Mapovanie zmien krajinnej pokrývky aplikáciou databázy CORINE Land Cover (na príklade okresu Skalica). *Kartografické listy*, 11, 61-73
OŤAHEĽ, J., FERANEC, J., CEBECAUER, T., PRAVDA, J., HUSÁR, K. (2004). *Krajinná štruktúra okresu Skalica: hodnotenie zmien, diverzity a stability. Geographia Slovaca*, 19, Bratislava (Geografický ústav SAV).
OŤAHEĽ, J., FERANEC, J. (2006). Výskum a mapovanie využitia krajiny: minulosť a súčasnosť v kontexte Slovenska. *Geografický časopis*, 58, 105-123.
OŤAHEĽ, J., FERANEC, J., KOPECKÁ, M., BETÁK, J., HUSÁR, K. (2008a). Landscape development (long-term changes) assessment: case study of the Tatra region. In Kabrda, J., Bičík, I., eds., *Man in the landscape across frontiers: Landscape and land use change in Central European border regions. CD Proceedings of the IGU/LUCC Central Europe Conference*. Prague (Charles University, Faculty of Science), pp. 31-33.
OŤAHEĽ, J., FERANEC, J., BETÁK, J., HUSÁR, K., KOPECKÁ, M. (2008b). Landscape changes: analysis and classification. In Lechnio, J. et al., eds. *Klasyfikacja krajobrazu: teoria i praktyka. Problemy Ekologii Krajobrazu*, 20. Warszawa (Polska Asocjacja Ekologii Krajobrazu, Wydzial Geografii i Studiów Regionalnych Uniwersytetu Warszawskiego), pp. 45-56.
OŤAHEĽ, J., FERANEC, J., BETÁK, J., HUSÁR, K., KOPECKÁ, M. (2008c). Rural landscape development and landscape changes in 1990-2000: case study of Trnava region. In Boltižiar, M., ed. *Implementation of Landscape Ecology in New and Changing Conditions.* Nitra (Institute of Landscape Ecology, SAS), pp. 313-322.
PANTOFLÍČEK, J. ed. (1935). *Atlas Republiky Československé.* Praha (Česká akademie věd a umění).
PAULOV, J. (1964). Prímestská agrozóna Košíc. *Acta Geologica et Geographica Universitatis Comenianae*, *Geographica*, 4, 231-255.
PERDIGAO, V., CHRISTENSEN, S. (2000). *The LACOAST atlas: land cover changes in European coastal zones*. Milan (Joint Research Centre).

PETROVIČ, F. (2004). Zmeny využitia krajiny s rozptýleným osídlením. *Životné prostredie*, 38, 103-106.
PETROVIČ, F. (2005). *Vývoj krajiny v oblasti štálového osídlenia Pohronského Inovca a Tribeča*. Nitra (Ústav krajinnej ekológie SAV).
PHILIPSON, R. W, ed. (1997). *Manual of photographic interpretation*. Bethesda. (American Society for Photogrammetry and Remote Sensing).
PRAVDA, J., FERANEC, J., OŤAHEĽ, J., HUSÁR, K. (1998). Kartografická aplikácia bázy údajov CORINE land cover v mierke 1:100 000. *Geografický časopis*, 50, 21-33.
PRAVDA, J. (2003). *Stručný lexikón kartografie*. Bratislava (Veda).
PRIKRYL, Ľ. V. (1977). *Vývoj mapového zobrazenia Slovenska*. Bratislava (Veda).
RICHLING, A., CSORBA, P., FERANEC, J., KOLEJKA, J., KOŽELUH, M., LEWANDOWSKI, W., MILLER, G. P., NATEK, K., NOVÁČEK, V., OŤAHEĽ, J., SEGER, M., STIPERSKI, Z., STOJKO, S. (1996). Ecology of land use in Central Europe. Accompanying text, 2 maps. In Jordan, P., ed. *Atlas of Eastern and Southeastern Europe. Up-to-date ecological, demographic and economic maps*. Wien (Österreichisches Ost- und Südosteuropa Institut).
SPIŠIAK, P. (1989). Poľnohospodárske využitie Horehronia a možnosti jeho intenzifikácie. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographia,* 28, 81-97.
SPIŠIAK, P. (1999). Využitie zeme Bratislavy v rôznych regionálnych dimenziách. In Minár, J., Trizna, M., eds. *Teoreticko-metodologické problémy geografie, príbuzných disciplín a ich aplikácie*. Bratislava (Univerzita Komenského), pp. 256-262.
SPIŠIAK, P., FERANEC, J., OŤAHEĽ, J., NOVÁČEK, J. (2008). Transition in the agricultural and rural systems in Slovakia after 1989. In Bański, J., Bednarek M. eds. *Contemporary changes of agriculture in East-Central Europe. Rural Studies*,15. Warsaw (Polish Geographical Society and Stanislav Leszczynski Institute of Geography and Spatial Organization PAS), pp. 121-146.
ŠPULEROVÁ, V. (2002). Charakteristická štruktúra využitia vrchovinnej krajiny – časť hornej Oravy, 1:35 000. In *Atlas krajiny Slovenskej republiky*. Bratislava (Ministerstvo životného prostredia SR).
ŠTEFUNKOVÁ, D., PAUDITŠOVÁ, E., POPOVIČOVÁ, J. V. (2002). Charakteristická štruktúra využitia urbanizovanej krajiny – hlavné mesto SR Bratislava. 1:25 000. In *Atlas krajiny Slovenskej republiky*. Bratislava (Ministerstvo životného prostredia SR).
ŠÚRI, M. (1997). Mapovanie krajinnej pokrývky 1:50 000 v prostredí GIS s využitím satelitných údajov Landsat a SPOT. *Geodetický a kartografický obzor*, 43, 181-186.
VERBURG, H. P., VELDKAMP, A. (2005). Introduction to the spatial issue on spatial modelling to explore land use dynamics. *International Journal of Geographical Information Science*, 19, 99-102.
VITURKA, M., ed. (1992). *Atlas životního prostředí a zdraví obyvatelstva ČSFR*. Brno (Geografický ústav ČSAV, Federální výbor pro životní prostředí).
WULDER, M. (2002). *Mapping the land cover of the forest area of Canada with Landsat data*. Proceedings of International Geoscience and Remote Sensing Symposium, June 24-28, Toronto, Canada. http://www.pfc.forestry.ca/eosd/cover/index_e.html
ZAUŠKOVÁ, Ľ. MIDRIAK, R. (2007). *Únosnosť a využívanie krajiny*. Multimediálne CD. Banská Bystrica (Fakulta prírodných vied Univerzity Mateja Bela).
ZELENSKÝ, K.(1980). Mapa využívania zeme. In Mazúr, E., ed. *Atlas Slovenskej socialistickej republiky*. Bratislava (SAV a SÚGK).

ŽIGRAI, F. (1973). Die Beziehung zwischen den ökologischen Eigenschaften der Landschaft und ihren landwirtschaftlichen Nutzung (Sarstedt bei Hannover, BRD). *Questiones Geobiologicae*, 11, 259-268.
ŽIGRAI, F. (1981). Štúdium využitia zeme v Liptovskej kotline. *Questiones Geobiologicae*, 26, 1-131.
ŽIGRAI, F. (1983). *Krajina a jej využívanie.* Brno (Univezita J. E. Purkyně, Přírodovědecká fakulta).
ŽIGRAI, F. (1995). Integračný význam štúdia využitia zeme v geografii a krajinnej ekológii na príklade modelového územia Lúčky v Liptove. *Geographical Studies,* 4. Nitra (University of Education).
ŽIGRAI, F., DRGOŇA, V. (1995). Landscape-ecological analysis of the land use development for environmnetal planning (case study Nitra). *Ekológia (Bratislava), Supplement,* 1, 97-112.
www.gmes.info (05-05-2009)
http://atlas.sazp.sk (05-05-2009)

GEOGRAPHIA SLOVACA, 26, 2009

GEOGRAPHICAL APPROACHES TO THE ASSESSMENT OF SOLAR RESOURCES IN SLOVAKIA (ACCORDING TO THE EXAMPLE OF A CASE STUDY IN THE CITY OF PREŠOV)

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Geografické prístupy vo výskume solárnych zdrojov na Slovensku (prípadová štúdia Prešov)
Slnečná energia má veľký význam pre krajinu a jej výskum, ale aj pre energetické aplikácie. Značnú priestorovú a časovú variabilitu slnečného žiarenia na zemskom povrchu však ovplyvňujú mnohé prírodné faktory, pričom využívanie slnečnej energie závisí aj do faktorov socio-ekonomických a technických. Súčasný výskum dostupnosti slnečnej energie na zemskom povrchu je zameraný najmä na vývoj slnečných databáz s vyšším priestorovým a časovým rozlíšením a na výskum zdrojov slnečnej energie v lokálnej mierke v urbánnych oblastiach. Tento príspevok tiež obsahuje prehľad výskumu slnečnej energie na Slovensku a prezentuje príklad výskumu fotovoltického potenciálu v lokálnej mierke na území mesta Prešov.

Kľúčové slová: slnečná energia, obnoviteľné zdroje energie, geografický informačný systém, Prešov, Slovensko

INTRODUCTION

Solar energy is one of the renewable energies (RE) with a rapidly growing importance. In these times, this fact is even more boosted by the environmental costs and limited supply of fossil fuels, progress in solar technology and the increasing efficiency of solar energy conversion (Jäger-Waldau 2005). Solar energy is currently used in a number of applications that can be grouped in three major areas: heat production (hot water, building heat, cooking), electricity production (photovoltaics) and desalination of seawater.

It is assumed that future massive thermal and photovoltaic (PV) applications will involve mainly urban areas. More than 80% of inhabitants of the most developed countries live in the urban environment. In urban areas, the energy is being consumed and, at the same time, a large portion of green-house gases is being produced. Some authors (for example, Šúri et al. 2007a) point out that, in theory, the electricity consumption in many countries could be completely covered by utilization of solar radiation from a relatively small area (e.g., using only 1% of the territory in some countries). Among the key problems affecting the wider use of solar energy are strong spatial and temporal variations in solar radiation patterns influenced by many factors.

For example, the basic patterns of seasonal and daily variations given by astronomical factors are strongly modified by changing atmospheric conditions (e.g., clouds, aerosols, water vapour, and ozone). At local scales, the patterns are modified even more due to varying local conditions (for example, sky-view obstructions, temperatures, etc.). While the amount of solar radiation on the Earth's upper atmos-

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phere is almost constant (1,366 W/m^2), the availability of solar irradiation on the Earth's surface is extremely variable in relation to space and time. The key factor is latitude with the greatest available irradiation in tropics and the lowest values around the poles. The seasonal dynamics of irradiation is given by astronomic factors. The atmosphere absorbs and reflects a large part of the radiation, so the irradiation in desert areas near tropics is about 7 to 9 kWh/m²/day. (Hofierka and Cebecauer 2008).

Solar systems (photovoltaics, heating and cooling systems) are experiencing a rapid growth (Jäger-Waldau 2005), and more detailed knowledge of the primary solar energy resource is needed. Clearly, the analysis of the available solar energy resource is part of the efforts to integrate solar energy into energy systems in many countries. For example, Šúri et al. (2006) present a complex database of solar irradiation maps and other climatic parameters for Europe. New web-based tools were developed to provide access to the solar database and make assessments of the photovoltaic systems performance (Šúri et al. 2005). The increasing share of renewable energies in the national energy mix transforms a current model of energy production and consumption from concentrated production – distributed consumption to distributed production – distributed consumption. Spatial and temporal variability of energy sources also requires better prediction models and system monitoring. Distributed model of production provides new possibilities for on-site energy consumption and different demands for energy transmission. Hence, it is clear that solar resource assessments require complex, geographic approaches taking into account various factors including natural, socio-economic and technical aspects of solar resource utilization.

In this paper, we bring an overview of recent solar research in Slovakia, especially for environmental and energy applications. We present a methodology for photovoltaic assessments of solar resource in urban areas and provide an application example for the city of Prešov. This approach is based on the analysis of urban zones, 3- dimensional (3-D) city model implemented in a GIS database and specific open-source solar radiation tools that include the r.sun solar radiation model and the PVGIS estimation utility.

SOLAR RESEARCH IN SLOVAKIA

Despite a relatively weak position of Slovakia in the use of RE including solar radiation, Slovak research of solar radiation is not below the average. As the solar radiation is one of important factors for various landscape-ecological processes, this research area has attracted attention of climatologists, landscape ecologists, foresters and agriculture scientists. Among the most important papers are works by Hrvoľ and Tomlain (1992), Krcho (1990), Jenčo (1992), Mészároš (1998). Especially Krcho (1990) and Jenčo (1992) have contributed to the exact mathematical solution of solar radiation computation on georelief (taking into account terrain features).

The second important scientific branch dealing with solar radiation is civil engineering and architecture. Solar radiation influences thermal and light conditions in buildings (residential, industrial or offices) (Littlefair 2001, Pereira et al. 2001). The most important Slovak authors in this area are Kittler and Mikler (1986), Kittler and Pulpitlová (1988) and others, whose works have also been frequently cited abroad. Specific issues of solar collector field configuration has been studied by Rybar and Kudelas (2005).

The solar cell technology and material issues are investigated by several Slovak researchers, including (Müllerová et al. 2006, Šály and Ružinský 2005), Gmucová et al. 2006).

On the international level, solar resource research for energy applications is permanently developing. The focus is shifting from global and regional views to detailed studies, such as the studies at urbanized areas by (Scharmer and Greif 2000, Barker et al. 2001, Compagnon 2004, Robinson and Stone 2004). The development of geographical information system (GIS) technology has also been mirrored in the solar radiation modeling in general (Dubayah and Rich 1995, Kumar et al. 1997, Hofierka 1997 and 2004) or in the analysis of the potential for utilization (Šúri et al. 2002, Gadsden et al. 2003, Šúri and Hofierka 2004). Recent works done by Slovak researchers include Šúri et al. (2007b), Hofierka et al. (2007), Hofierka and Cebecauer (2008), Šúri et al. (2008) and Hofierka and Kaňuk (2009). Part of this research was done in close cooperation with the Joint Research Centre of the European Commission in Ispra, Italy.

Recent developments in Slovak solar research include improvements of national solar databases to cover the whole territory of Slovakia, provide data with higher spatial and temporal resolution (Hofierka and Cebecauer 2008), better access to these data via the Internet and Google Maps technology (Šúri et al. 2005). New studies are also focused on small-scale modelling of spatial distribution and temporal variability of available solar radiation in urban areas using a GIS (Hofierka and Kaňuk 2009). Šúri (2004 and 2006) also provided general views on the use of solar energy for photovoltaic applications in Slovakia.

The dynamics of solar radiation and complexity of urban areas require sophisticated modelling approaches and tools. Šúri et al. (2007a) suggest that geographical information systems (GIS) could contribute to the effective assessment of solar resource at supra-national, national or regional levels. The interaction of solar radiation with natural and human environments requires the use of complex spatial database with relevant factors as well as GIS tools for processing spatial information. While the solar radiation models implemented in GIS have been extensively used in environmental applications, only a few studies have focused on coupling GIS technology and solar radiation models in urban areas. Šúri and Hofierka (2004) have developed the r.sun solar radiation model included in the open-source GRASS GIS (Neteler and Mitasova 2004) and proposed its application to regional PV assessments. Šúri et al. (2005 and 2007) have developed a web-based PV estimation utility (PVGIS) that can be effectively used for an on-site evaluation of PV installations. Estimation of PV potential in urban areas requires sophisticated modelling tools and spatial data representing the complexity of the urban environment (Hofierka and Kaňuk 2009).

ASSESSMENT OF THE PHOTOVOLTAIC ELECTRICITY PRODUCTION IN URBAN AREAS

To assess the PV potential of urban areas using a standard GIS technology, the following three groups of tasks need to be performed (Hofierka and Kaňuk 2009):

– Digital model of the city implemented in a GIS database. It contains a 3-D city model containing digital terrain model and buildings with a set of attributes influencing the solar panel installation.

– Spatially and temporally variable solar radiation modelling. This modelling can be applied specifically for the considered surfaces buildings, or, alternatively, for all surfaces available in the area.
– Estimation of PV electricity production.

Digital model of the city

Current GIS technologies provide plenty of methods and tools to prepare realistic 3-D city models that can be employed in the PV potential modelling. In this study open-source GRASS GIS and proprietary ArcView GIS technologies have been used to prepare a digital model of an urban area. To prepare a GIS database for PV modelling, the following steps have been performed:

– selection of the study area,
– collection of GIS data,
– classification of urban areas.

Our study area is Prešov, a city situated in eastern Slovakia. Prešov is the 3rd largest city in Slovakia, with approximately 91,000 inhabitants. This city has a rich intra-urban structure with different urban zones that are a result of long-term development with several stages (Matlovič 1998 and 2004). In similar research for the city of Bardejov, Hofierka and Kaňuk (2009) have proposed to distinguish four major urban zones with basic morphological and functional characteristics of the buildings related to solar energy utilization (Fig. 1):

– Residential houses,
– Blocks of flats,
– Industrial areas,
– Other facilities (schools, garages, sport and entertainment halls, etc.).

These four main urban zones can be found in all major cities in Slovakia with little variation in the morphology and urban density. This is partly due to the uniform architectural design of buildings constructed during the socialist era in the second half of the 20th century. The basic characteristics of these zones can be found in Tab. 1.

The primary GIS database consists of a digital orthophotomap and a digital elevation model created from digitized contours of topographic maps at a scale of 1:10,000. Both data layers are in a raster format with a spatial resolution of 1 m. The footprints of all buildings have been vectorized from the orthophotomap using ArcView GIS software creating polygon objects in the ArcView GIS database. Building attributes relevant for creation of a 3-D city model and installation of PV system such as building height, roof type, inclination, exposition and available roof area have been mapped using a laser distance device. Values of mapped attributes for each building have been stored in a GIS database and used in further analysis.

The r.sun solar radiation model

Hofierka (1997), Hofierka and Šúri (2002) and Šúri and Hofierka (2004) have developed the r.sun solar radiation model based on open-source GRASS GIS technology (Neteler and Mitasova 2004) that can be used for any geographical region and time to assess solar irradiance and irradiation. The model works in two modes. In *mode 1* for the instant of time (second), it calculates grid maps of solar irradiance

($W.m^{-2}$) and solar incident angle (degrees). In *mode 2*, the grid maps of daily sum of solar irradiation ($Wh.m^{-2}$) and duration of the beam irradiation (minutes) are computed from the integration of irradiance values that are calculated at a user-selected time step from sunrise to sunset. If selected, for each time step the computation can account for sky obstruction (shadowing) by local terrain features. This model can also be used in local-scale analysis of surfaces and shadows, however the current version of the model is not able to handle 3-D data representing features in a 3-D city model (e.g., façades, trees, etc.). A full 3-D version of the *r.sun* model is currently under development.

Tab. 1. Characteristics of urban zones in Prešov

Urban zone	Total area (ha)	Number of buildings	Buildings footprint area (ha)
Residential houses	408.8	2,625	41.1
Blocks of flats	317.2	720	40.5
Industrial areas	441.6	735	84.8
Other facilities	613.9	1,085	69.8
Total	1,781.6	5,165	236.2

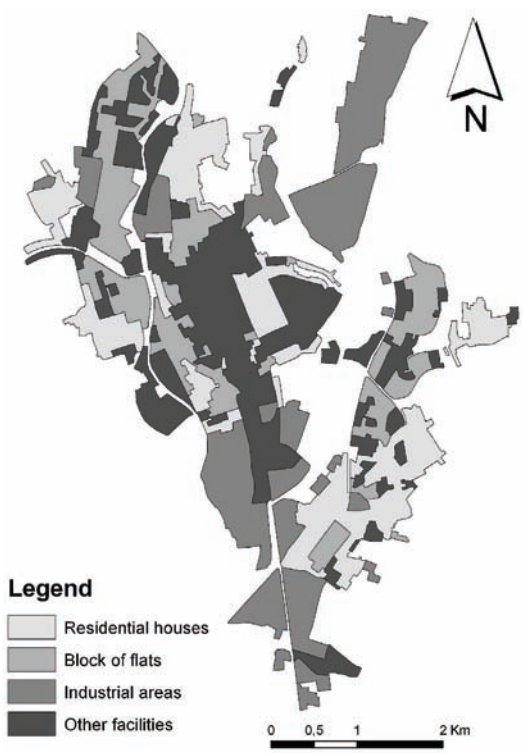

Fig. 1. Urban zones of Prešov for solar resource applications

The *r.sun* model was used to develop solar resource maps (solar database) with 100-m spatial resolution for Slovakia (Hofierka and Cebecauer 2008). These maps can be used to assess regional availability of solar resource. The similar methodology was also used in the European PhotoVoltaic Geographic Information System (PVGIS) solar database, however with 1-km spatial resolution (Šúri et al. 2005). The PVGIS database is part of the Web-based PVGIS utility that was used in this study to assess the PV potential of buildings represented by a 3-D city model.

Assessment of the photovoltaic electricity production using PVGIS

The PVGIS utility with a web-based interface provides access to solar irradiation and PV performance assessments, in the form of maps and graphs/tables for any location that can be chosen by browsing on a map, by choosing a country and a city from a list, or by setting latitude/longitude. All the information can be accessed from http://re.jrc.ec.europa.eu/pvgis/.

This web-based photovoltaic assessment utility also contains a database of interpolated climatic data and solar radiation maps covering the European continent. The horizontal resolution of grid maps is 1 km and in many cases it reflects terrain features (e.g. elevation and shadowing).

The PV potential was calculated for the global irradiation incident to horizontal, vertical and optimally inclined surfaces. As further assumptions we considered the most widespread grid-connected PV technology, installed within the existing building infrastructure. To compute the annual total electricity output from a PV system, E [kWh], the following simple equation was used (Hofierka and Kaňuk 2009):

$$E = 365 P_k r_p G,$$

where (in kW) is the peak power installed, is the system efficiency (analogous to the performance ratio, typical value for a roof mounted system with modules from mono- or polycrystalline silicon is 0.75) and is the annual mean of daily global irradiation on a horizontal or inclined surface of the PV module.

To assess the PV potential of the roof, the utility requires only a few basic parameters (e.g,. inclination and exposition of the solar panels/roof area). A location is selected using geographical coordinates set manually or by clicking on the map. The assessment was done manually using the PVGIS utility and attributes of each building taken from the GIS database.

The assessment results using the PVGIS utility show (Fig. 2, Tab. 2) that the highest PV potential can be found in industrial zones and zones with other facilities that have a mixed character (including schools, and shopping malls). The roofs in these zones are usually large and flat and can be effectively used for on-site consumption or fed to the electricity grid. Another interesting zone is the zone of blocks of flats that has the highest efficiency per footprint area. Again, these buildings have good conditions for an effective electricity consumption or supplies to the grid.

One of main constraints for a wider use and higher share of PV applications is the great temporal variability of PV production. In case of Prešov it can be seen that a PV production during the summer months is almost three times higher than during winter (Fig. 3). This is positive for countries with a wider use of air-conditioning during summer, however, in Slovakia winter months require more energy for hea-

ting than summer for cooling. This dicrepancy must be compensated by other energy sources. Still, solar energy may present a large part of sustainable and reliable energy. For example, Hofierka and Kaňuk (2009) assessed in a similar study for Bardejov that potential PV installations extrapolated to all urban areas in Slovakia can provide up to 59% of the recent electricity consumption in the country.

Fig. 2. 3-D city model with greyscale colour indicating photovoltaic potential of the building (annual production of electricity produced from photovoltaic systems)

Tab. 2. Photovoltaic potential of urban zones in Prešov

Urban zone	Total area (m^2)	Total area (ha)	Buildings footprint area (ha)	Roof area for PV systems [ha]	Estimated PV electricity Production [MWh/year]	Annual PV electricity Production per footprint area [kWh/m^2]
Residential houses	4,088,100	408.8	41.1	24.3	19,351.774	47.0
Blocks of flats	3,171,709	317.2	40.5	30.8	25,075.971	61.9
Industrial areas	4,416,405	441.6	84.8	57.9	47,610,525	56.2
Other facilities	6,139,663	613.9	69.8	41.9	34,300.827	49.1
Total	17,815,877	1,781.6	236.2	154.9	126,339.097	53.5

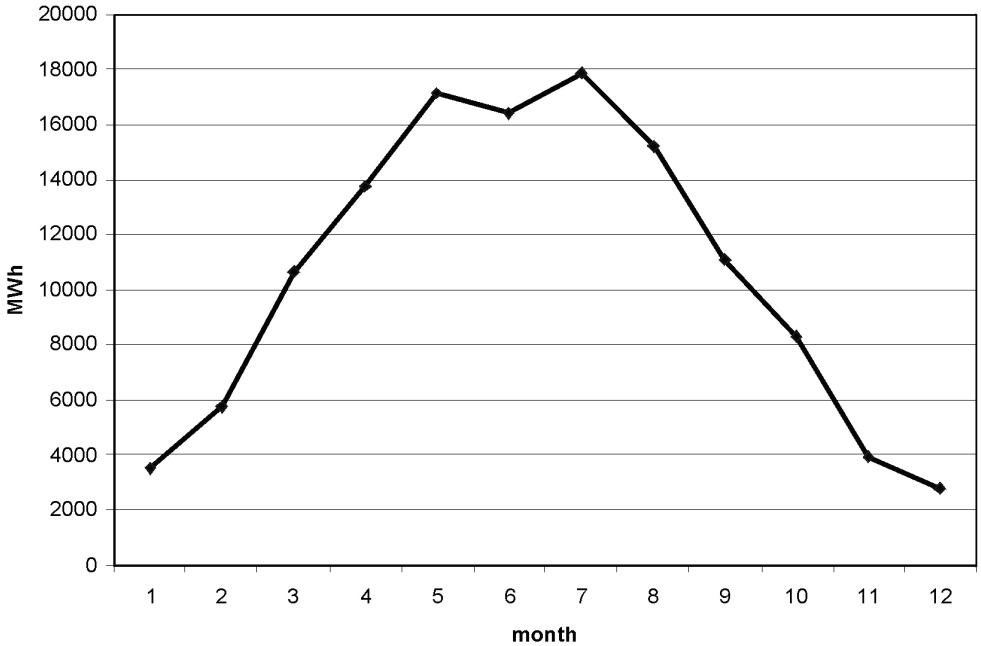

Fig. 3. Seasonal changes in potential photovoltaic electricity production in Prešov

CONCLUSIONS

In this paper we have presented an overview of recent developments in the geographical solar research with special attention to the contribution of Slovak geographers. We have pointed out that spatial and temporal distribution of solar energy on the Earth's surface is influenced by many factors and its utilization also depends on socio-economic and technical factors. Therefore geographical approaches can help us to better understand the availability of solar resources and provide tools and methodology for better utilization of the renewable energy especially in urban environments. The presented case study for the city of Prešov showed great potential, however with a substantial spatial and temporal variability. To increase accuracy of these assessments, new 3-D GIS tools are needed to couple existing 3-D city models with models simulating the availability of solar energy and urban processes.

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REFERENCES

BARKER, M., BLEWETT-SILCOCK, T., EISING, K., GUTSCHNER, M., KJELLSSON, E., LUTTER, E., NOWAK, S., STEEMERS, K., TONDI, G. (2001). *Solar ElectriCity Guide*. Institut Cerda, EU Energie Publication.

COMPAGNON, R. (2004). Solar and daylight availability in the urban fabric. *Energy and Buildings*, 36, 321-328.

DUBAYAH, R., RICH, P. M. (1995). Topographic solar radiation models for GIS. *International Journal of Geographical Information Systems*, 9, 405-19.

GADSDEN, S., RYLATT, M., LOMAS, K. (2003). Putting solar energy on the urban map: a new GIS-based approach for dwellings. *Solar Energy*, 74, 397-407.

GMUCOVÁ, K., NÁDAŽDY, V., DUNÝ, R. (2006). The nature of mobile hydrogenin a-Si:H–electrochemical studies. *Solar Energy*, 80, 649-700.

HOFIERKA, J. (1997). Direct solar radiation modeling within an open GIS environment. In *Proceedings of the Joint European GI Conference 1997*, pp. 575-584.

HOFIERKA, J. (2004). Modelovanie priestorovej distribúcie slnečného žiarenia na georeliéfe pomocou modelu r.sun a geografického informačného systému. *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis. Folia Geographica*, 7, 157-166.

HOFIERKA, J., CEBECAUER, T. (2008). Spatially distributed assessment of solar resources for energy applications in Slovakia. *Acta Facultatis Studiorum Humanitatis et Naturae Universitatis Prešoviensis. Folia Geographica*, 12, 97-114.

HOFIERKA, J., CEBECAUER, T., ŠÚRI, M. (2007). Optimisation of interpolation parameters using a cross-validation. In Peckham, R. J., Jordan, G., eds. *Digital terrain modeling, development and applications in a policy support environment. Series: lecture notes in geoinformation and cartography*. Berlín (Springer), pp. 67-82.

HOFIERKA, J., KAŇUK, J. (2009). Assessment of photovoltaic potential in urban areas using open-source solar radiation tools. *Renewable Energy*, 34, 2206-2214.

HOFIERKA, J., ŠÚRI, M. (2002). The solar radiation model for open source GIS: implementation and applications. In. Ciolli, M., Zatelli, P., eds. *Proceedings of the "Open Source Free Software GIS - GRASS users conference 2002"*, CD-ROM.

HRVOĽ, J., TOMLAIN, J. (1992). *Globálne žiarenie na rôzne orientované sklonené plochy na území Slovenskej republiky*. Bratislava (Slovenská bioklimatologická spoločnosť pri SAV).

JÄGER-WALDAU, A. (2005). *PV Status Report 2005. Research, Solar Cell Production and Market Implementation of Photovoltaics.* European Commission, DG JRC, Institute for Environment and Sustainability, Renewable Energies Unit, EUR 21836 EN.

JENČO, M. (1992). Distribúcia priameho slnečného žiarenia na georeliéfe a jej modelovanie pomocou komplexného digitálneho modelu reliéfu. *Geografický časopis*, 44, 342-355.

KITTLER, R., MIKLER, J. (1986). *Základy využívania slnečného žiarenia.* Bratislava (Veda).

KITTLER, R., PULPITLOVÁ, J. (1988). *Základy využívania prírodného svetla*. Bratislava (Veda).

KRCHO, J. (1990). *Morfometrická analýza a digitálne modely georeliéfu*. Bratislava (Veda).

KUMAR, L., SKIDMORE, A. K., KNOWLES, E. (1997). Modelling topographic variation in solar radiation in a GIS environment. *International Journal of Geographical Information Science,* 11, 475-97.

LITTLEFAIR, P. (2001). Daylight, sunlight, and solar gain in the urban environment. *Solar Energy*, 70, 177-185.

MATLOVIČ, R. (1998). *Geografia priestorovej štruktúry mesta Prešov*. Geografické práce, VIII, 1. Prešov (KGaG FHPV PU).

MATLOVIČ, R. (2004). Tranzitívna podoba mesta a jeho intraurbánnych štruktúr v ére postkomunistickej transformácie a globalizácie. *Sociológia*, 36, 137-158.

MESZÁROŠ, I. (1998). Modelovanie príkonu slnečnej energie na horské povodie. *Acta Hydrologica Slovaca*, 1, 68-75.

MÜLLEROVÁ, J., JUREČKA, S., ŠUTTA, P. (2006). Optical characterization of polysilicon thin films for solar applications. *Solar Energy*, 80, 667-674.

NETELER, M., MITASOVA, H. (2004). *Open Source GIS: a GRASS GIS approach*. Boston (Kluwer Academic Publishers).

PEREIRA, F. O. R., SILVA, C. A. N., TURKIENIKZ, B. (2001). A methodology for sunlight urban planning: a computer-based solar and sky vault obstruction analysis. *Solar Energy*, 70, 217-226.

ROBINSON, D., STONE, A. (2004). Solar radiation modelling in the urban context. *Solar Energy*, 77, 295-309.

RYBÁR, R., KUDELAS, D. (2005). Posudzovanie konfigurácie kolektorového poľa z pohľadu insolácie. *Časopis pre elektrotechniku a energetiku*, 2, 20-23.

SCHARMER, K., GREIF, J., eds. (2000). *The european solar radiation atlas. 2: Database and exploitation software*. Paris (Les Presses de l'École des Mines).

ŠÁLY, V., RUŽINSKÝ, M. (2005). Fotovoltika v kontexte vývoja na začiatku tretieho tisícročia a SR. *Časopis pre elektrotechniku a energetiku*, 2, 17-20.

ŠÚRI, M. (2004). Výroba elektriny z hľadiska obnoviteľných zdrojov energie. *Životné prostredie*, 38, 242-249.

ŠÚRI, M. (2006). Slnečná elektrina a perspektívy jej výroby na Slovensku. *Životné prostredie*, 40, 127-132.

ŠÚRI, M., DUNLOP, E. D., HULD, T. A., OSSENBRINK, H. A. (2006). Geographical aspects of solar electricity generation in Europe. In Dunlop E. D., Wald, L., Šúri, M., eds. *Solar energy resource management for electricity generation from local to global scale.* New York (Nova Science Publishers).

ŠÚRI, M., HOFIERKA, J. (2004). A new GIS-based solar radiation model and its application to photovoltaic assessments. *Transactions in GIS*, 8, 175-190.

ŠÚRI M., HULD, T., CEBECAUER, T., DUNLOP, E. D. (2008). Geographic aspects of photovoltaics in Europe: contribution of the PVGIS web site. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, 1, 34-41.

ŠÚRI, M., HULD, T. A., DUNLOP, E. D. (2005). PV-GIS: a web-based solar radiation database for the calculation of PV potential in Europe. *International Journal of Sustainable Energy*, 24, 55-67.

ŠÚRI, M., HULD, T. A., DUNLOP, E. D., OSSENBRINK, H. A. (2007a). Potential of solar electricity generation in the European Union member states and candidate countries. *Solar Energy*, 81, 1295-1305.

ŠÚRI, M., HULD, T., HOFIERKA, J., DUNLOP, E. D. (2007b). Solar resource modeling for energy applications. In Peckham, R. J., Jordan, G., eds. *Digital terrain modeling, development and applications in a policy support environment.* Series: Lecture Notes in Geoinformation and Cartography. Berlín (Springer), pp. 259-273.

ŠÚRI, M., JONES, A. R., DUNLOP, E. D. (2002). Mapping the potential of photovoltaic systems in urban areas of Slovakia. In Brebbia, C. A., Martin-Duque, J. F., Wadhwa, L. C., eds. *The sustainable city II, urban regeneration and sustainability*. Southampton (WIT press), pp. 1007-1016.

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NATURAL GEOMORPHOLOGICAL HAZARDS IN SLOVAKIA

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Prírodné geomorfologické hazardy na Slovensku
Tento príspevok sa zameriava na hodnotenie priestorovej distribúcie a vzájomných vzťahov najvýraznejších prírodných geomorfologických hazardov na Slovensku. Autori definujú oblasti ohrozené parciálnymi hazardami, a to zemetraseniami, zosuvmi a príbuznými javmi, poklesmi a prepadmi stropov krasových a banských suterénov, snehovými lavínami, veternou a vodnou eróziou, regionálnymi a lokálnymi povodňami, ako aj bahennými povodňami. Následne analyzujú priestorovú štruktúru kombinácií extrémnych hodnôt rôznych typov hazardov z hľadiska ich možného synergického pôsobenia a multiplikačného efektu. Nakoniec prezentujú syntetické charakteristiky hazardov a delimitujú základné hazardné regióny. Typizácia územia Slovenska z hľadiska rôznych typov prírodných geomorfologických hazardov predstavuje výsledok využiteľný v procese krajinného plánovania na regionálnej úrovni.
Kľúčové slová: prírodné geomorfologické hazardy, totálna hazardná hodnota, kumulatívny efekt hazardov, hazardné regióny, Slovensko

INTRODUCTION

Problems of natural geomorphological hazard evaluation have started to appear in the literature more frequently since the 1990s (see Cooke and Doornkamp 1990, Panizza 1996, Kalvoda and Rosenfeld 1998). As for Slovakia, though a lot of partial hazard assessments have been published so far (cf. the representative maps of some hazards in the Landscape Atlas of the Slovak Republic [Atlas krajiny Slovenskej republiky] 2002), a comprehensive, synthetic evaluation of the most important natural hazards has not been done until recently. The first attempt to fill this gap was the work by Minár et al. (2006). This paper represents an upgraded version of that work.

The Slovak territory includes the majority of the West Carpathians, a small part of the East Carpathians and adjacent parts of the Pannonian Basin. Morphostructural effect of young tectonic movements, miscellaneous natural conditions and human interventions into the landscape result in a relatively high degree of numerous partial natural hazards. These are earthquakes, landslides and related phenomena, karst and mining subsidence and collapsing, snow avalanches, water and wind ero-

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sion as well as floods, with many of them showing mutual relations. The spatial distribution of natural hazards is largely in accordance with the geomorphological division of the country, however some specific exclusions exist, as explained in detail below.

Although the territory of Slovakia is not ranked among the most hazardous regions of the world, natural hazards represent a serious issue for the economy and development of the country. The average annual loss of some tens of human lives and financial damage of tens of millions of euros results from geomorphological processes. Regional analysis of the problem is therefore essential for the public administration and insurance business, as well as for the decision-making of investors and private individuals.

MATERIAL AND METHODS

Natural hazards are understood here as the probability of occurrence of geomorphological processes endangering human interests in the affected area. The probability of frequency and magnitude of these processes defines a value of partial hazards. The geomorphic effect of a partial process (per time unit) also depends on its magnitude and frequency and it can be considered as an estimation of the hazard value.

The maps evaluating either geomorphic effect or magnitude and frequency of the main hazardous geomorphological processes in Slovakia represented the basis for our analysis. We have unified these various source materials into a homogeneous database based on elementary geomorphological units (on the original scale of 1:500 000) that were delimited by an overlay of the map of the individual geomorphological regions (Mazúr and Lukniš 1980) and the map of the morphometrical-morphological types (Tremboš and Minár 2002). It enabled us to achieve the necessary degree of generalization of unequal sources while the relative homogeneity of hazard-forming natural conditions in the units is ensured by the high correlation of georelief characteristics with properties of rocks, soils, climate and hydrological conditions as well as with the basic character of land cover.

The majority of maps of partial hazards (namely seismic, landslide, wind and water erosion hazards) were made by an overlay of source maps and a map of elementary geomorphological units, computation of the average value of hazard in these units (using map algebra) and then its subsequent visualization. Naturally, the use of geomorphological units for the expression of partial hazards in these maps leads to loss of some spatial details. Only one value of hazard was estimated for the whole unit regardless of land cover differentiation. However, this differentiation is reflected in partial hazard values. The remaining maps, namely of karst/mining subsidence and collapse, snow avalanche and flood hazards were constructed using geomorphological units as a basis for a unified database from the beginning of their compilation. A consistent 3-degree scale (i.e. low, medium, high) was used for the estimation of all values of partial hazard.

ArcView 3.3 was used as the main tool for the geoinformatic processing. The DVD-version of the above mentioned Landscape Atlas of the Slovak Republic was used as the source of borrowed analytical information. The resultant synthetic map representing synthetic characteristics of hazards and basic hazardous regions was created using just this database. Genetic types of hazardous geosystems, total values

of hazards and probabilities of creating cumulative effects were taken into account as the three classification criteria. The first of these criteria, namely genetic types of hazardous geosystems, was defined according to dominance of hazards determined either litho-structurally (earthquakes, landslides, karst/mining subsidence and collapse) or climatically (snow avalanches, wind and water erosion, floods, muddy floods). The algorithm for estimation of the last two of these criteria was based on system analysis of natural hazards (Fig. 1). The weighted sum of values of partial hazards was used for the estimation of total hazard (Tab. 1) and the estimation of the probability to create a cumulative effect (Tab. 2).

Finally, an alternative use of some partial hazard maps (in comparison with Minár et al. 2006) was tested. Results obtained using different seismic hazard map or autonomous integration of the muddy floods hazard layer were compared and evaluated.

Tab. 1. Weight of partial hazard's values in the estimation of the total hazard value

Hazard: value/name	Earthquakes	Landslides	Karst/mining subsidence	Snow avalanches	Water erosion	Wind erosion	Floods
low	0	1	1	0	1	0	1
medium	1	3	2	3	2	1	3
high	2	5	3	5	3	2	5

Tab. 2. Weight of partial hazard's values in the estimation of probability to create a cumulative effect

Hazard: value/name	Earthquakes	Landslides	Karst/mining subsidence	Snow avalanches	Water erosion	Wind erosion	Floods
low	0	0	0	0	0	0	1
medium	3	2	1	1	0	0	2
high	6	4	2	3	0	1	3

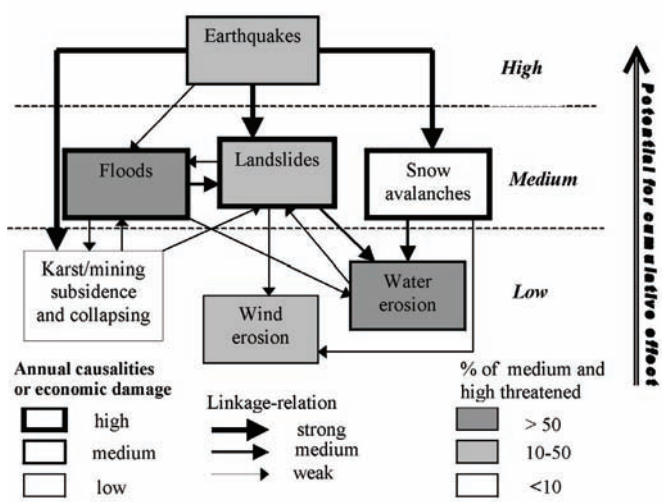

Fig. 1. System scheme of main natural geomorphological hazards in Slovakia

PARTIAL HAZARD ASSESSMENT

Hazards determined litho-structurally

The seismic hazard has a specific position among natural hazards in Slovakia. In fact, it represents the only threat connected with endogenous processes. The country is characterized by weak to medium seismic hazard in comparison with worldwide conditions (2-3 weak earthquakes per year, once every 5-10 years earthquake accompanied by little damage and once every 50-100 years an earthquake causing bigger damage). However, some strong earthquakes (to 9° MSK-64) were recorded in the past, for example Komárno in 1763: seven churches and 297 houses were destroyed completely and 63 people were killed. The supposed frequency of such events is some hundreds of years.

Seismic hazards have been studied from the detailed level (e.g. Viskup and Janotka 1996, Labák et al. 1998, Hrašna 2002) to regional generalization (e.g. Brouček 1980, Šefara et al. 1998, Schenk et al. 2002, Kováč et al. 2003). Until 2004, the studies were based on the network of six fixed seismic stations and four specific stations that were rather outmoded and not fully spatially representative. Estimation of differentiation of actual seismicity was facilitated with the help of macroseismic observations. The historical records are also not sufficiently homogeneous and thus represent the weakest link in seismic hazard assessments relating to the occurrence of long-frequency disastrous earthquakes. In 2004 the new National Network of Seismic Stations was established. It consists of 12 modern stations and makes the more accurate location of future active epicentral zones possible.

The map of seismic hazard (Fig. 2a) was produced by adaptation of a layer of maximum expected seismic intensity from the map "Selected geodynamic phenomena" (Klukanová et al. 2002) based on the Slovak Technical Standard concerning seismic actions on structures (Slovenská technická norma 73 0036, 1996). An alternative expression of the seismic hazard is introduced on Fig. 2b. It is derived from the map of peak ground acceleration on rock sites for the 90% probability of non-exceedance in 50 years (Schenk et al. 2002). The less distinguishable level of both maps is reflected in a smaller territorial differentiation of this hazard than is probable in reality. Seismic activity is concentrated along main active fault structures mainly on the boundary between the Carpathians and the Pannonian Basin and between the Outer and Inner West Carpathians. Epicentres of earthquakes are as a rule situated on the fault junctions (surroundings of the Malé Karpaty Mts., towns of Komárno, Žilina, Zvolen, Humenné etc.). Although Slovakia was not affected by a serious earthquake within the last hundred years, the probability of its occurrence is rising every year. As the earthquake also acts as a trigger for some other geomorphological processes, the approaching seismic event not only increases the hazard of the earthquake as such but also of accompanying phenomena, or in other words it raises the probability of creating the cumulative effect.

The hazard of landslides and related phenomena (creeping, flowing, falling) is relatively high in connection with the predominantly mountainous character of Slovakia. Landsliding is represented by rotational, planar and combined landslides, flowing is represented by earth flows (as well as by debris flows in the highest mountains), falling is represented by rock topples and planar rock falls (cf. Malgot and Baliak 1994) but probably also by rock avalanches. A deep-seated creep can also be transformed into a dangerous phenomenon under special circumstances. The

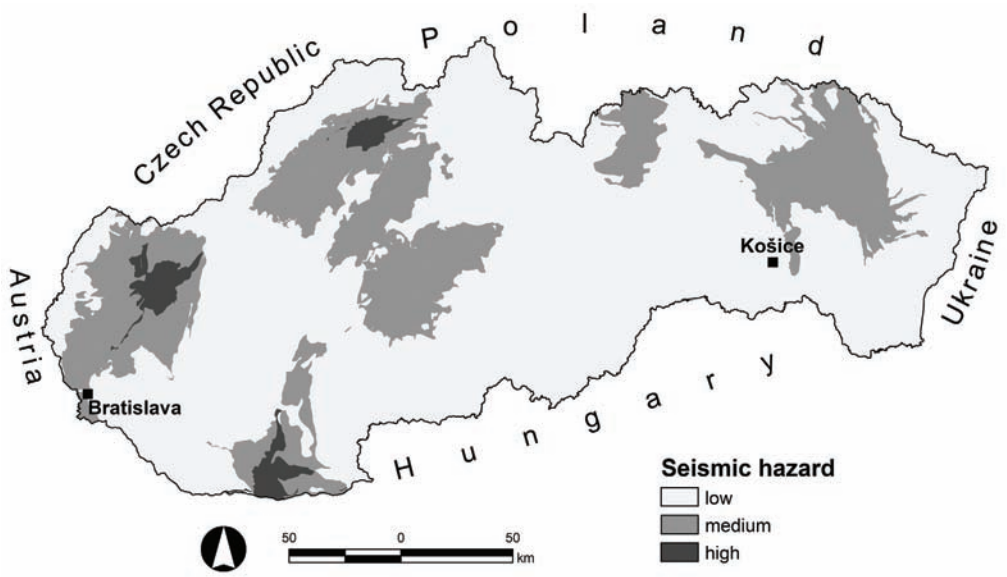

Fig. 2a. Seismic hazard

The modification of one layer of the map by Klukanová et al. 2002.

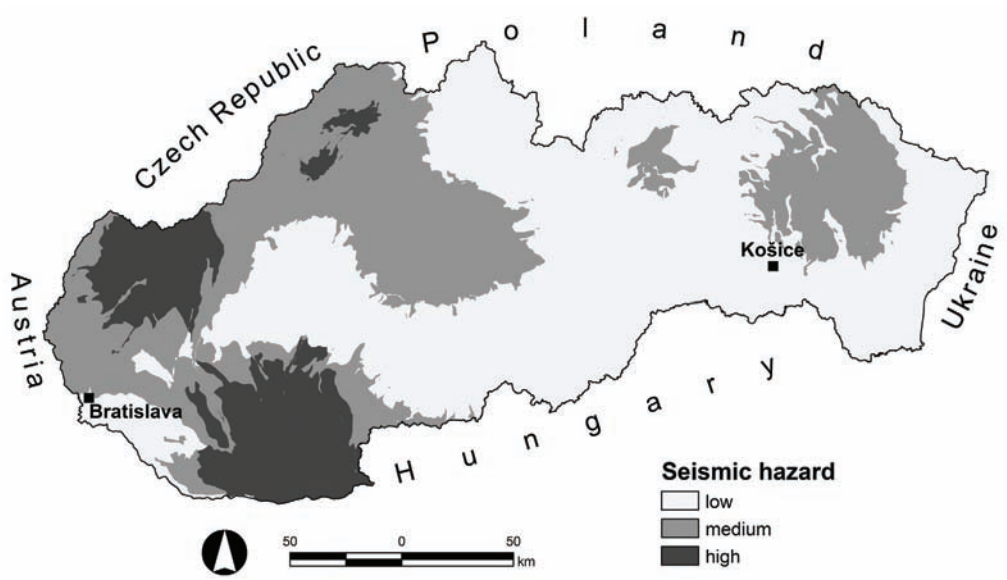

Fig. 2b. Seismic hazard

The modification of the map by Schenk et al. 2002.

regional extent of the above slope failures depends on the geological structure and rock type, geomorphic, hydrogeological and climatic conditions. The most affected areas are flysch uplands, the intra-mountain basins and marginal parts of young volcanic mountains. Specific types of slope failures were formed in the so-called core mountains.

Naturally, up to now special attention was devoted mostly to present slope failures, especially to landslides. Wagner et al. (2002) provide information on the monitoring of gravitational deformations. The best known slope failures include the landslides at Handlová and Ľubietová activated in 1960 and 1977 respectively. To date, more than 21,000 slope failures have been recorded. The spatial distribution of landslides and related phenomena is introduced on the map with the scale of 1: 500 000 by Klukanová et al. (2002) and in the atlas of slope stability maps with the scale of 1:50 000 by Šimeková and Martinčeková et al. (2006). About 90% of new landslides are influenced by human activity (Malgot and Baliak 2002).

Besides the maps assessing the spatial distribution of existing slope failures the maps dealing with landslide hazard were also created, some of them for the whole of Slovakia. Urbánek (1980) produced a map of potential landslide areas and recently Liščák (2002) worked out a map of susceptibility to landslides. The latter author delimited areas with three different degrees of susceptibility, namely high, moderate and low. His map was used as a source material for our map of landslide hazard (Fig. 3). In fact, the areas with a high degree of susceptibility to landslides correspond well to the areas of the highest concentration of existing landslides.

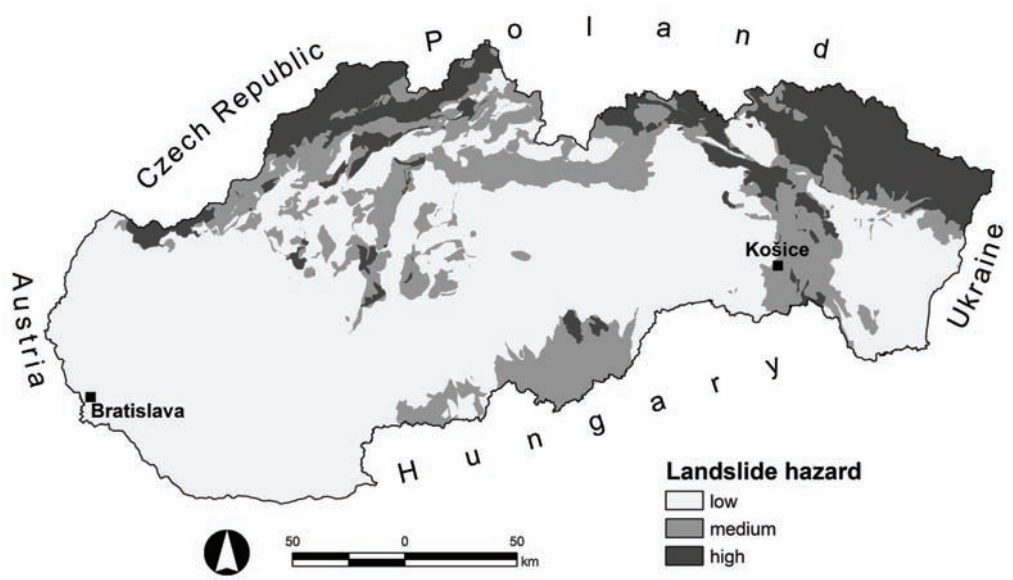

Fig. 3. Landslide hazard (the modification of the map by Liščák 2002)

The third partial natural hazard of this type represents the hazard of both *karst and mining subsidence and collapse* (Fig. 4). According to Jakál (2000), a significant predisposition to this hazard in the karst landscape is a high degree of subterra-

nean karstification in the near-surface part of karst massifs. This is characterized by the occurrence of extensive subterranean cave systems in a senile stage of evolution with existence of domed spaces threatened by sudden collapses of cave ceilings. The hazard of collapsing increases in areas where carbonate massifs are strongly affected by tectonics and also where the genetically oldest cave levels lie close to the terrain surface. Block sinking or cave ceiling collapse are caused by corrosive broadening of fissures, by congelifraction acting along these fissures and by the consequent free circulation of precipitation water in the vadose zone. The most frequent occurrence of these phenomena is in the Silicicum tectonic unit, mostly in the central parts of the Silická and Plešivecká planina Plateaus, where their surface is deformed more markedly by sinking of big blocks often accompanied by collapsed chasms of the "light hole" or "aven" types. Gravitational sinking of karstified blocks and the origin of fissure caves and chasms is linked to the high-mountain karst in the Červené vrchy Mts. and Belianske Tatry Mts.

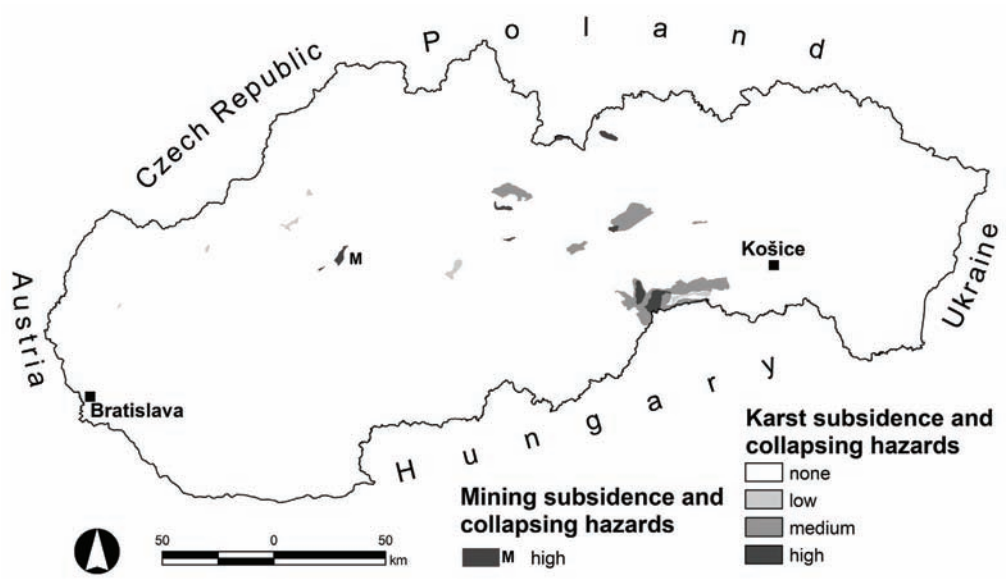

Fig. 4. Karst / mining subsidence and collapsing hazards

The active collapse of the karst surface, disturbing the stability of buildings and roads, occurred within the basin karst type in the area of the Bystriansko-valaský kras Karst in the 1960s (cf. Kubíny 1974). The Rissian terrace of the Hron River is penetrated by a system of subterranean cavities (up to 30 m long), culminating in narrowed openings into overlying terrace gravels. Collapses were triggered by erosion due to underground water during a sudden rise of the water resulting from heavy rains.

Subsidence and collapse are also phenomena typical for mining areas. Of course, the process is similar but its cause is different. The most marked manifestations of these processes due to mining occur in the contact zone of the Hornonitrianska kotlina Basin and the Vtáčnik Mts. Underground and also partially surface mining of

brown coal and lignite has distinctly changed the relief configuration due to sinking ground. The occurrence of large, shallow, closed sinking depressions and deep depressions of a shaft-like form disturb the original appearance of the landscape. The surface consequences of underground mining resulted in the need for the gradual partial evacuation of some villages in the area (Jakál 1998).

Hazards determined climatically

Snow avalanches represent a serious natural hazard in the high mountains of the West Carpathians. Avalanches cause several deaths annually in Slovakia. 27 people were killed and 33 injured by avalanches from 2000 to 2007. Skiers, mountain climbers and hikers are the most endangered groups. Up to 300 avalanches are registered each winter season in the Slovak Carpathians.

Snow avalanches occur in the Tatras, Low Tatras, Malá and Veľká Fatra Mts., and Chočské vrchy Mts. Their occurrence in other mountains is very rare and is linked only with periods with very thick snow cover (e. g. Súľovské vrchy Mts., Oravská Magura Mts.). The most avalanche-prone areas are mountain slopes with inclination of 30-45° and a smooth surface (grass, fine gravels, etc.), especially above the upper timberline. However, avalanches were also reported in broadleaf forests, as in the winter 2004-2005, when some of them temporarily blocked highway transport (in Strečnianska úžina Valley, Malý Šturec Saddle, etc.).

The main avalanche season is from January till March, but the first avalanches start to fall at the end of November, and the last occur in May. In the Tatras smaller avalanches can also fall exceptionally in summer, namely during unexpected drops of temperature with snowfall, as it happened, for example, in August 2005. An extraordinarily huge snow avalanche (probable return period one hundred years) occurred in the Žiarska dolina Valley in the Western Tatras on March 20, 2009.

The map of snow avalanche hazard (Fig. 5) was worked out on the basis of maps from the "Atlas of avalanche paths in Slovakia" (Kňazovický 1979) and "Avalanche register" that is kept by the Mountain Rescue Service – Avalanche Prevention Centre. Assessment of avalanche hazard in the Slovak Carpathians during the last decade also utilizes the computer determination of avalanche prone areas (e. g. Hreško 1998, 2000, Hreško and Bugár 2001, Barka and Rybár 2003, Milan 2006).

In contrast to snow avalanches, the spatial distribution of *the wind erosion hazard* is associated mostly with the lowland landscape. Though it is not one of the most marked hazards, this process can cause, under favourable circumstances, considerable environmental peoblems.

Some works were devoted to an assessment of the spatial distribution of wind erosion so far, namely from the viewpoint of its present occurrence or of its prospective hazard. Jůva and Cablík (1954) distinguished the areas threatened by dry or cold winds and especially delimited areas prone to deflation. Bučko and Mazúrová (1958), Bučko et al. (1966) and Jakál (1980) delimited only the affected or threatened areas but did not categorize them. Pasák (1978) was the first to categorize the hazard of wind erosion; he distinguished five categories, namely slight, moderate, moderate to severe, severe and very severe. Klukanová et al. (2002) distinguished three categories (namely moderate, high and extreme) in the up to now most detailed map of wind erosion hazard (1:500 000).

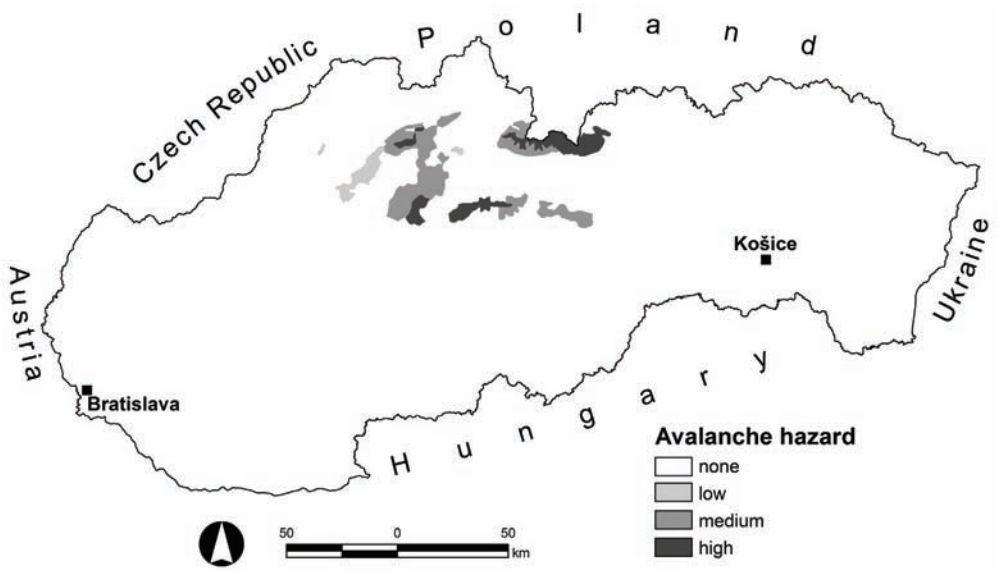

Fig. 5. Snow avalanche hazard

Wind erosion occurs mostly in all three Slovak lowlands, namely the Záhorská nížina Lowland (together with the adjacent part of the Dolnomoravský úval Valley), the Danube Lowland and the Východoslovenská nížina Lowland. Less threatened areas are represented by parts of the Juhoslovenská kotlina Basin, the Cerová vrchovina Upland, the Košická kotlina Basin and the lower Váh Valley. In these areas, wind erosion threatens both, flat and sloping positions, but in fact during only a small part of the year. From the temporal viewpoint it is concentrated into the period of the winter and early spring months when the most favourable conditions for deflation (frozen, dusty and vegetation-free surface of soil) occur. After the winter transition the dry soil is easily detachable and under a strong, gusty wind large quantities of the most fertile surface layer are often blown out which could result in sandy or dusty storms (according to texture of affected soils). Larger parcels with texturally lighter sandy soils are particularly vulnerable, but deflation is not rare on loamy soils either (Jambor 2002). Unfortunately, the map of the wind erosion hazard (Fig. 6), worked out on the basis of the above-mentioned map by Klukanová et al. (2002), introduces almost exclusively endangered areas with sandy soils.

Water erosion presents a serious natural hazard with severe consequences for soil cover, agriculture production and the overall landscape degradation. It is a complex process determined by mutual interaction of numerous factors. At present, inter-rill and rill erosion represent the dominant hazards of water erosion in Slovakia (Stankoviansky et al. 2006). However, also concentrated flow erosion resulting in the formation of ephemeral gullies is also a hazard of great importance. On the other side, a dense network of large, permanent gullies, depicted on the map of Slovakia with the scale of 1:400 000 by Bučko and Mazúrová (1958), was formed by disastrous gullying in the past while gully erosion was conditioned both by the land use and climate changes (Stankoviansky 2009a).

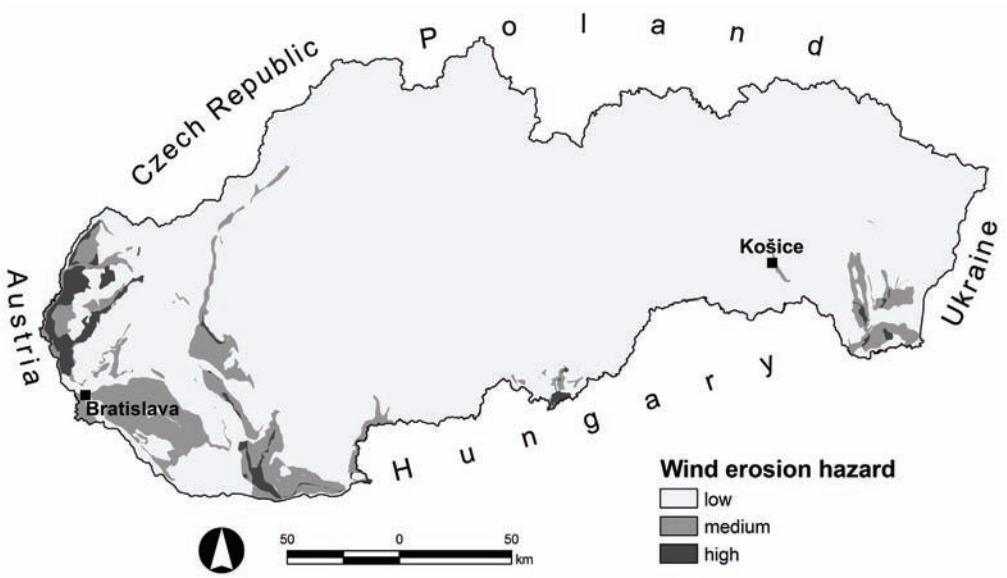

Fig. 6. Wind erosion hazard (the modification of one layer of the map by Klukanová et al. 2002)

The water erosion hazard is affected by the amount and intensity of rainfall, soil erodibility, topography and land cover. Land cover is the most variable factor with a strong protective function and therefore some researchers also publish potential water erosion maps that exclude the effect of land cover (e.g. Midriak 2002, Šúri et al. 2002a, both at the scale of 1:1 000 000). The first map of actual water erosion hazard taking into consideration the protective function of land cover was published by Bučko et al. (1966, 1:1 000 000). The most realistic attempt to assess the actual hazard of water erosion is the map by Šúri et al. (2002b), taking into account the contemporary land cover derived from the CORINE Land Cover database (Feranec and Oťaheľ 2001). The map shows that in total about 55% of Slovak territory is endangered by water erosion, while about 17% of the area is threatened by erosion at moderate to very high rates (Šúri et al. 2002c). This map served as the source material for our map of water erosion hazard (Fig. 7).

The highest actual hazard of water erosion occurs mostly in agricultural areas within wide contact zones between lowlands or intra-mountain basins with mountains, as well as in the intra-mountain erosion depressions. These are remarkable for a relatively high share of medium to low resistant rocks (especially flysch and volcanic) with a thick cover of easily erodible regolith. The most harmful manifestations of water erosion are linked with extreme events such as heavy rainfalls and snowmelts in spring periods with weak land cover.

The analysis of land cover changes during the 1990-2000 period and effects on water erosion distribution in Slovakia showed that the land cover and crop rotation changes had a significant influence on water erosion pattern predominately in the hilly and mountainous parts of Slovakia with overall slightly decreased water erosion hazard. The mixed character of these changes is associated with ongoing land

ownership changes, changing structure of crops, deforestation and afforestation (Cebecauer and Hofierka 2008).

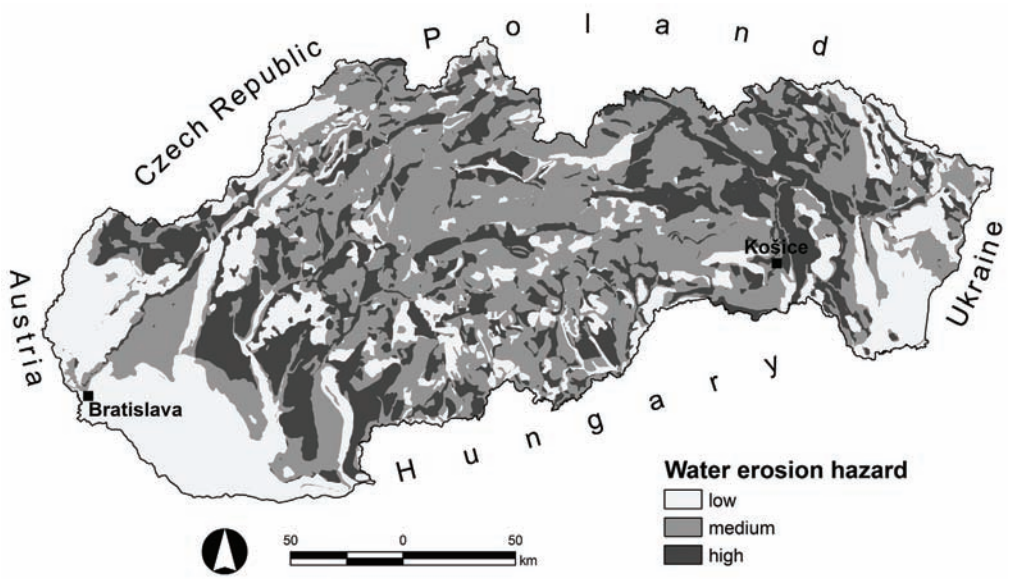

Fig. 7. Water erosion hazard (the modification of the map by Šúri et al. 2002b)

The flood hazard is one of the most dangerous partial hazards in Slovakia as is confirmed by the long list of flood events on the Slovak rivers from the period of the second half of the last millennium (cf. Minár et al. 2005). The best known regional, area-wide flood within the last decades occurred on the Danube River in 1965 and on the Hron River in 1974. In the period of the last 10-15 years floods of this type occurred on a smaller scale in comparison with neighbouring or other European countries. Slovak territory has not been affected by precipitation that would cover a major part of it and would exceed its extreme rate values (as it was in the Moravian part of the Czech Republic in 1997 or in the Czech Republic, Poland, Germany, and other countries in 2002). However, in Slovakia the local floods (so-called flash floods) occur regularly. A flash flood on the Malá Svinka Brook killed 50 people on July 20, 1998 in the village of Jarovnice in Eastern Slovakia. We can state an increase in the number of extreme runoff events associated with an increase in intensity of extreme rainfall events of local character.

Flood hazard problems are discussed in works devoted to the evaluation of existing flood situations, which are both of regional (Škoda et al. 1997) and local (Pacl 1959, Svoboda and Pekárová 1998) character. Studies dealing with flood hazard and flood risk management problems (e.g. Gilard 1996) appeared only a few years ago (Minár and Tremboš 1994, Trizna and Minár 1996, Trizna 1998, Solín 2005, 2007, Solín and Martinčeková 2007). The work by Minár et al. (2005) deals with the landscape potential for flooding in Slovakia (taking into account the system of current flood protection). The generalised results of this work are introduced in Fig. 8.

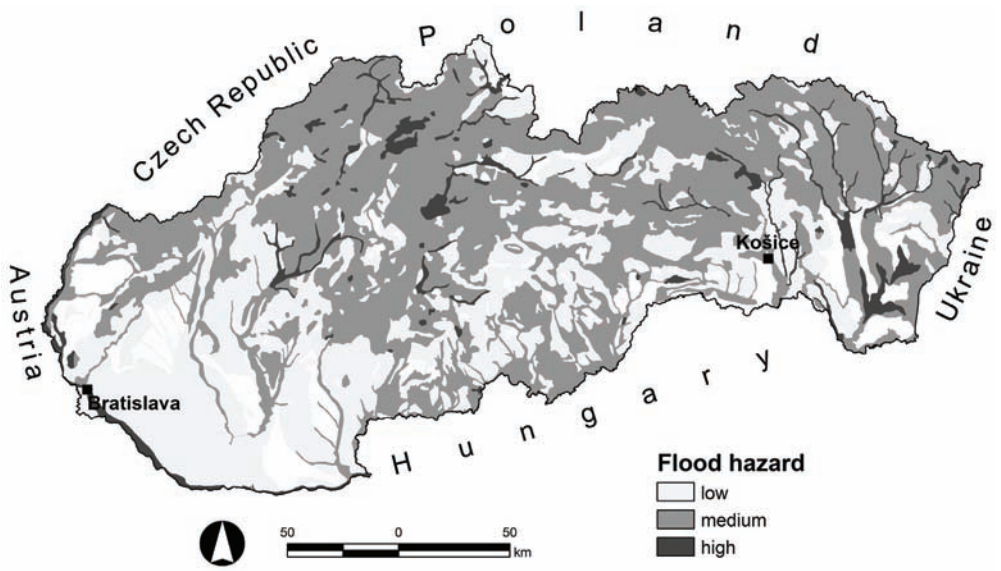

Fig. 8. Flood hazard (the generalisation of the map by Minár et al. 2006a)

Territorial differences in the flood hazard in Slovakia can be defined on two levels. On the first level, it is the flood hazard caused by regional floods from cyclonal precipitation or from the snowmelt. Principally the Východoslovenská nížina Lowland is one of the most endangered regions besides the floodplains of the larger rivers (the Danube, Hron, and Ipeľ Rivers). It is induced by the georelief morphology that determines the occurrence of internal waters (i.e. waters that accumulate in closed depressions under increased water levels in rivers or during sudden snowmelts). On the second level, it is the measure of the local flash flood hazard. From the point of view of conditions for the formation of extreme runoff, the territory of the flysch belt is the most endangered area besides the highest mountains (the High Tatras, Low Tatras, Malá Fatra Mts.).

The present systematic observation of flood events in Slovakia together with geoecological research of flood hazard of the landscape gives a good basis for the development of research in this sphere.

Beside the environmental impact of floods, the flood hazard also includes the geomorphic response to fluvial processes.

Within the last decade an increased attention is dedicated to *muddy floods* representing significant environmental issue and natural hazard. Muddy floods signify water flowing from agricultural fields carrying large quantities of soil as suspended sediment or bedload (Boardman et al. 2006). They occur mostly during extreme rainfall events at times when the soil is not protected by vegetation, above all in the spring months. Thus, this phenomenon is not connected with permanent watercourses, but exclusively with arable land on slopes; the more intense the water erosion processes, the more extreme the manifestations of muddy floods. Muddy floods are conditioned mostly by concentrated flow erosion and resultant formation of ephemeral gullies, developing in thalwegs of dry valleys. The ideal conditions for muddy flood generation are provided by landscapes with dense networks of dry

valleys (Boardman et al. 1994). Dry valleys, dells, as well as other slope hollows of various origin concentrate runoff what multiplies its erosion force. Muddy deposits cause damage to farmers due to burial of crops in fields at footslope positions, damage to citizens, firms and local authorities associated with a necessity to remove the mud from houses, yards, public open spaces, roads, railways, etc. Delivery of eroded material (carried by muddy floods) to valley bottoms and water courses causes damage to water management in association with water pollution, silting of adjusted channels, canals and finally reservoirs. These consequences of muddy floods belong to the so-called off-farm (also off-site) effects of water erosion that manifest themselves out of agricultural fields.

The contemporary farmland in Slovakia provides very good conditions for muddy flood generation as a result of large blocks of fields with monocultures. The research on muddy floods up to now was focused mostly on three topics, namely: a) the documentation of direct geomorphic effect and environmental impact of particular muddy floods, b) the assessment of the total geomorphic effect of a series of anonymous, consecutive events in the second part of the 20th century that occurred repeatedly at the same site and c) reconstruction of the effects of known events that happened in the recent past in various places (cf. Stankoviansky 2009b). The last of the documented muddy flood events occurred in Budmerice (September 11, 2005) and in Kunov and Prietrž (June 6, 2009). The latter muddy flood killed one man in Prietrž.

The last step in the study of muddy floods was the assessment of the hazard of this phenomenon in the Slovakia-wide scale (Stankoviansky et al. 2009). An algorithm for muddy flood hazard assessment was created using the map of water erosion hazard (Fig. 7) and the map of flood hazard (Fig. 8). The resultant map (Fig. 9) shows a territorial differentiation of various classes of muddy flood hazard. The most threatened areas are the flysch uplands and furrows, intra-Carpathian depressions and the higher parts of the Pannonian Basin.

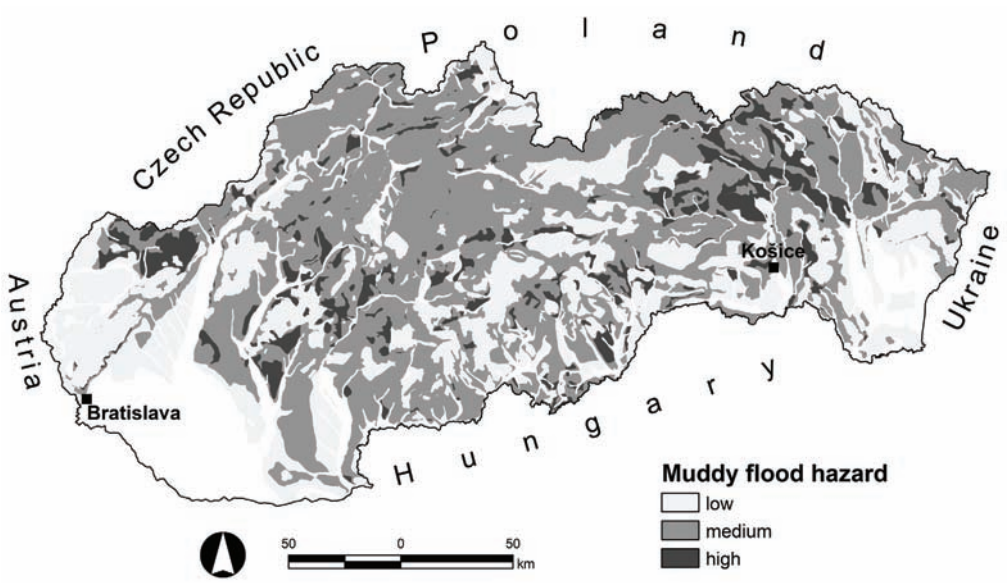

Fig. 9. Muddy flood hazard (the generalisation of the map by Stankoviansky et al. 2009)

SYNTHETIC CHARACTERISTICS OF HAZARDS AND BASIC HAZARDOUS REGIONS

The structure of the created database on partial hazards gives us various synthetic views on natural hazards in Slovakia, both of the lower and higher orders. The authors introduce three selected syntheses of a lower order, namely territorial differentiation of three basic genetic types of hazardous geosystems (determined litho-structurally, climatically or mixed), total hazard value as a weighted sum of a partial hazard's value (Tab. 1) and probability of the cumulative effect of the hazards (Tab. 2) that are presented on the synthetic maps (Fig. 10a and 10b). Even though undoubted linkage exists between total hazard value and cumulative effect, their interpretation value is variable. This is why three different, independent synthetic indicators are used for delimitation of the synthetic hazardous regions: 1) main controlling factor (litho-structural or climatic conditions) depictured in Fig. 10a, 2) probability of occurrence of any hazardous process and 3) probability of a chain reaction of hazardous processes depicted in Fig. 10b. Their combinations in situ and the spatial structure of these combinations represents the synthesis of a higher order. A typical feature of synthetic hazardous characteristics in Slovak territory is heterogeneity (see Figs. and 10 a 10b). However, a similar pattern (similarity in heterogeneity) represented a basis for the identification of four basic hazardous regions that are characterized below.

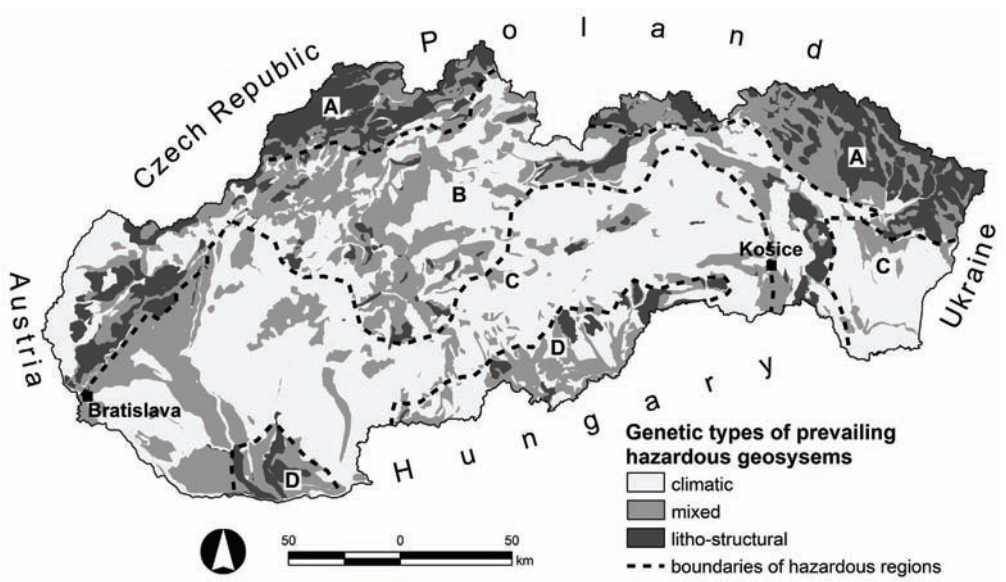

Fig. 10a. Synthetic characteristics of hazards and basic hazardous regions: Dominant genetic types of hazards

Synthetic hazardous regions: A – Extremely hazardous flysch region, B – North contrast hazardous region, C – Central low hazardous region, D – South contrast hazardous region.

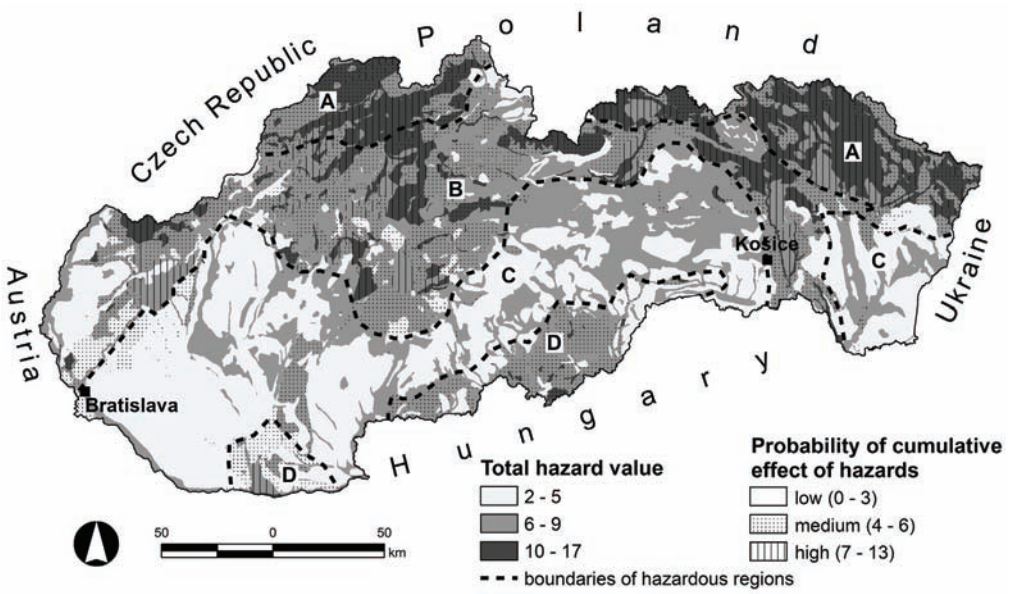

Fig. 10b. Synthetic characteristics of hazards and basic hazardous regions: Total hazard value and probability of cumulative effect of hazards

Synthetic hazardous regions: A – Extremely hazardous flysch region, B – North contrast hazardous region, C – Central low hazardous region, D – South contrast hazardous region.

The extremely hazardous flysch region is characterized by a high total hazard value as well as by a cumulative effect (more than 50% of its area is in the highest degree and almost all the area in the medium degree in both cases, but their territorial distribution is different) and by the dominance of litho-structural and the near absence of purely climatically hazardous geosystems. The region represents the majority of the Outer Carpathians and the landslide-prone flysch lithology is a determining factor in its formation. However, a high total hazard value is also determined by intensive agricultural land use (water erosion and flooding) and by increased tectonic activity. A mosaic of three depicted synthetic characteristics in Fig. 10 is formed by their values that differ from each other only slightly. An area-wide representation of a high degree of synthetic hazard indicators suggests a necessity to pay the maximum attention to hazard management.

The northern contrasting hazardous region is characterized by high variation in all synthetic characteristics, but the most frequent are medium values. In contrast to the previous region, the northern region is markedly heterogeneous also from a morphostructural point of view and includes all the main geomorphological units of Slovakia. The mosaic of hazards that it unifies is determined by various local factors, which makes the delimitation of more distinct subregions possible. The southern spurs of this region at the border with neighbouring lowlands near Bratislava and Košice represent two of the most notable subregions. The seismic activity (delimiting the whole region from the neighbouring central low hazardous region and connecting with young differential tectonic activity) may be the integrating fac-

tor of the region's formation. Due to the character of the region, it is necessary to study hazard issues carefully and in more detail for hazard management purposes.

The central low hazardous region represents the most stable part of Slovakia from the point of view of natural hazards. The general absence of litho-structural hazards (except small areas of karst/mining subsidence and collapse) and lower values of other hazards (except water erosion) are a precondition for this stability. Mostly, a low total hazard value is thus connected with minimal possible cumulative effect and absolute dominance of climatic hazardous geosystems. In spite of the maximum hazardous homogeneity of the region, some differences between lowlands (west and east parts) and mountains (central part) exist. A medium value of flood and water erosion hazard is characteristic for the very homogeneous mountainous area consisting mainly of the oldest and most stable parts of the West Carpathians. The lowlands are more differentiated in detail, with areas of extreme flooding, wind and water erosion, but without their overlapping. Research on the differential hazards of these areas should be sufficient for effective hazard management.

The southern contrasting hazardous region, despite its resemblance to the north region, has several differences. The main difference is the lower degree of total heterogeneity. However, a generally lower total hazard value as well as a lower cumulative effect and a higher abundance of mixed and litho-structural geosystems are close to the character of the Košice and Bratislava spurs (subregions) of the northern contrasting hazardous region. Their spatial configuration also indicates an alternative to accept both southern and northern contrasting hazardous regions as parts of a joint belt encircling the stable central part of the West Carpathians and adjacent parts of the Pannonian Basin. The southern region shows two distinctive parts. The smaller western subregion is linked to the seismically "hotest spot" in Slovakia in the surroundings of Komárno. A larger, more easterly situated subregion is characterized by minimal seismicity which also differentiates it from the majority of the northern contrasting region. As for the study of hazards, a similar level is necessary as in the case of the northern contrasting hazardous region.

DISCUSSION AND CONCLUSIONS

The possibility of synthetic study of the natural geomorphological hazards of Slovakia was outlined in the chapter. The method used is based on the creation of a geomorphologically unified database in the GIS that enables transparency of analysis, operative actualization, modification and input of data as well as modification and improvement of evaluation algorithms. In the future, other natural hazards will be added in analysis, for example, the strong wind hazard resulting in wind calamites in forested mountainous regions (expressed by broken and uprooted trees), as well as other non-geomorphological hazards without adequate present research in Slovakia. Characterizing interactions of partial hazards in more detail and looking for mechanisms of the creation of their territorial structure are other possibilities.

Of course, the delimited hazardous regions of the Slovakia reflect the character and quality of the used database. However, our experiments with the use of an alternative dataset (namely taking the different seismic hazard layer into consideration – Fig. 2b or incorporation of an additional layer for muddy flood hazard – Fig. 9) did not lead to substantial differences. Depending on the dataset some regions were

enlarged or reduced (e.g. part of the southern contrasting hazardous region in the surroundings of the town of Komárno expanded nearly doubly using the new seismic hazard layer) but the basic distribution and character of the four regions remained stable. This indicates the basic natural character of the delimitated regions. A low influence of the muddy floods hazard complement on the synthetic hazardous region can be a consequence of a lower weight of this hazard but also of the fact that muddy floods represent a synthesis of the water erosion and local floods already contained in the model.

The limitation of the presented analysis by the state boundary seems to be unfortunate in principle. Territorial spreading of the database could enable more comprehensive and more valuable interpretation of reasons and characteristics of regional differences. Necessary international cooperation on the given topic is the challenge for geomorphologists of the Carpathian region.

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REFERENCES

Atlas krajiny Slovenskej republiky (2002). Bratislava, Banská Bystrica (Ministerstvo životného prostredia SR, Slovenská agentúra životného prostredia).

BARKA, I., RYBÁR, R. (2003). Identification of snow avalanche trigger areas using GIS. *Ekológia (Bratislava)*, 22, 182-194.

BOARDMAN, J., LIGNEAU, L., DE ROO, A., VANDAELE, K. (1994). Flooding of property by runoff from agricultural land in northwestern Europe. *Geomorphology*, 10, 183-196.

BOARDMAN, J., VERSTRAETEN, G., BIELDERS, Ch. (2006). Muddy floods. In Boardman, J., Poesen, J., eds. *Soil erosion in Europe*. Chichester (Wiley), pp. 743-755.

BROUČEK, I. (1980). Zemetrasná činnosť 1 : 2 000 000. In *Atlas Slovenskej socialistickej republiky*. Bratislava (SAV, SÚGK), pp. 32.

BUČKO, Š., HOLÝ, M., PRETTL, J., STEHLÍK, O. (1966). Eroze půdy a sesuvná území 1 : 1 000 000. In *Atlas Československé socialistické republiky*. Praha (ÚSGK). 12/1.

BUČKO, Š., MAZÚROVÁ, V. (1958). Výmoľová erózia na Slovensku. In *Vodná erózia na Slovensku*. Bratislava (Vydavateľstvo Slovenskej akadémie vied), pp. 68-101.

CEBECAUER, T., HOFIERKA, J. (2008). The consequences of land cover changes on soil erosion distribution in Slovakia. *Geomorphology*, 98, 187-198.

COOKE, R. U., DOORNKAMP, J. C. (1990). *Geomorphology in environmental management*. Oxford (Clarendon Press).

FERANEC, J., OŤAHEĽ, J. (2001). *Land Cover of Slovakia*. Bratislava (Veda).

GILARD, O. (1996). Flood risk management: risk cartography for objective negotiations. In *Third IHP/IAHS George Kovacs Colloquium, UNESCO, Paris, (19-21 Sept. 1996)*. Manusricpt.

HRAŠNA, M. (2002). Monitorovanie tektonickej a seizmickej aktivity územia. *Geologické práce, Správy*, 106, 103-114.

HREŠKO, J. (1998). Lavínová ohrozenosť vysokohorskej krajiny v oblasti Tatier. *Acta Facultatis Stud. Hum. et Naturae Univ. Prešoviensis*, *Folia geographica,* 2, 348-351.

HREŠKO, J., BUGÁR, G. (2001). Problems of natural hazard assesment and monitoring in the Tatra Mts. *Ekológia (Bratislava)*, 20, *Supplement*, 4, 96-100.

JAKÁL, J. (1980). Súčasné reliéfotvorné procesy 1:1 000 000. In *Atlas Slovenskej socialistickej republiky*. Bratislava (SAV, SÚGK), pp. 45.

JAKÁL, J. (1998). Antropická transformácia reliéfu a jej odraz v krajine Hornej Nitry. *Geografický časopis*, 50, 4-20.

JAKÁL, J. (2000). Extrémne geomorfologické procesy v krase. *Geografický časopis*, 52, 211-219.

JAMBOR, P. (2002). Water and wind erosion upon Slovakian soils. *SSCRI Proceedings*, 25, 41-46.

JŮVA, K., CABLÍK, J. (1954). *Protierosní ochrana půdy*. Praha (Státní zemědělské nakladatelství).

KALVODA, J., ROSENFELD, C. L., eds. (1998). *Geomorphological hazards in high mountain areas.* Dordrecht (Kluwer Academic Publishers).

KLUKANOVÁ, A., LIŠČÁK, P., HRAŠNA, M., STREĎANSKÝ, J. (2002). Vybrané geodynamické javy 1 : 500 000. In *Atlas krajiny Slovenskej republiky.* Bratislava (MŽP SR), Banská Bystrica (SAŽP), pp. 282-283, 341.

KŇAZOVICKÝ, L. (1979). *Atlas lavínových dráh SSR.* Bratislava (HS SÚV ČSZTV, SŠP).

KOVÁČ, M., BIELIK, M., HÓK, J., KOVÁČ, P., KRONOME, B., LABÁK, P., MOCZO, P., PLAŠIENKA, D., ŠEFARA, J., ŠUJAN, M. (2003). Seismic activity and neotectonic evolution of the Western Carpathians. In Cloeting, D., Horváth, F., Bala, G., Lankreijer, A. C., eds. *Neotectonics and surface processes: the Pannonian Basin and Alpine/Carpathian System*. S. *EGU Stephan Mueller Special Publication Series*, 3, pp. 1-18.

KUBÍNY, D. (1974). Správa o geologických a speleologických pomeroch prepadového územia vo Valaskej pri Brezne. *Slovenský kras*, 12, 135-156.

LABÁK, P., BYSTRICKÁ, A., MOCZO, P., CAMPBELL, K. W., ROSENBERG, L. (1998). Preliminary probabilistic seismic hazard assessment for the Nuclear Power Plant Bohunice (Slovakia) site. In Bisch P., et al. *Proceedings of the 11th ECEE*. Rotterdam (Balkema), CD-ROM.

LIŠČÁK, P. (2002). Náchylnosť územia na zosúvanie 1:2 000 000. In *Atlas krajiny Slovenskej republiky.* Bratislava, Banská Bystrica (MŽP SR, SAŽP), pp. 283, 341.

MALGOT, J., BALIAK, F. (1994). Slope deformation research in Slovakia. In *7th International IAEG Congress (5-9 Sept. 1994, Lisboa, Portugal): Proceedings*. Rotterdam (Balkema), pp. 2195-2204.

MALGOT, J. BALIAK, F. (2002). The influence of human activity on the development of landslides in Slovakia. *Geografický časopis*, 54, 21-38.

MAZÚR, E., LUKNIŠ, M. (1980). Geomorfologické jednotky 1:500 000. In *Atlas Slovenskej socialistickej republiky*. Bratislava (SAV, SÚGK), pp. 54-55.

MIDRIAK, R. (2002). *Potenciálna vodná erózia pôdy (podľa R. K. Frewerta, K. Zdražila a O. Stehlíka)* 1 : 1 000 000. Bratislava, Banská Bystrica (MŽP SR, SAŽP), pp. 288, 341.

MILAN, L. (2006). *Lavíny v horstvách Slovenska*. Bratislava (Veda).

MINÁR, J., TREMBOŠ, P. (1994). Prírodné hazardy – hrozby, niektoré postupy ich hodnotenia. *Acta Facultatis rerum naturalium Universitatis Comenianae, Geographica*, 35, 173-194.

MINÁR, J., TRIZNA, M., BARKA, I., BONK, R. (2005). *Povodňový potenciál na území Slovenskej republiky*. Bratislava (Geo-grafika).

MINÁR, J., BARKA, I., JAKÁL, J., STANKOVIANSKY, M., TRIZNA, M., URBÁNEK, J. (2006). Geomorphological hazards in Slovakia. *Studia Geomorphologica Carpatho-Balcanica*, 40, 61-78.

PACL, J. (1959). Katastrofálna povodeň v oblasti Tatier v júni 1958. *Zborník prác o TANAPe*, 3, 17-56.

PANIZZA, M. (1996). *Environmental Geomorphology*. Amsterdam (Elsevier).

PASÁK, V. (1978). *Větrná eroze půdy*. PhD. Thesis, Výskumní ústav meliorací, Praha .

SCHENK, V., SCHENKOVÁ, Z., KOTTNAUER, P., GUTERCH, B., LABÁK, P. (2002). Seizmické ohrozenie v hodnotách makroseizmickej intenzity 1 : 1 500 000. In *Atlas krajiny Slovenskej republiky*. Bratislava, Banská Bystrica (MŽP SR, SAŽP), pp. 276, 340.

Slovenská technická norma 73 0036. *Seizmické zaťaženie stavieb*. Bratislava (Úrad pre normalizáciu, metrológiu a skúšobníctvo SR).

SOLÍN, Ľ. (2005). Identification of homogenous regional classes for flood frequency analysis in the light of regional taxonomy. *Hydrological Sciences Journal*, 50, 1105-1118.

SOLÍN, Ľ. (2007). Single scale flood risk of small basins in Slovakia. *Ecohydrology and Hydrobiology*, 7, 165-177.

SOLÍN, Ľ., MARTINČEKOVÁ, M. (2007). Niekoľko poznámok k metodológii tvorby povodňových máp Slovenska. *Geografický časopis*, 59, 131-158.

STANKOVIANSKY, M. (2009a). Vývoj výmoľovej siete na Slovensku. *Disputationes Scientificae Universitatis Catholicae in Ružomberok* (in press).

STANKOVIANSKY, M. (2009b). Geomorphic effect and environmental impact of current and historical muddy floods in Slovakia. *Zeitschrift für Geomorphologie, Suppl.-Band* (in press).

STANKOVIANSKY, M., FULAJTÁR, E., JAMBOR, P. (2006). Slovakia. In Boardman, J., Poesen, J., eds. *Soil erosion in Europe*. Chichester (Wiley), pp. 117-138.

STANKOVIANSKY, M., MINÁR, J., BARKA, I., BONK, R., TRIZNA, M. (2009). Muddy floods in Slovakia. *Land Degradation and Development* (in press).

SVOBODA, A., PEKÁROVÁ, P. (1998). Katastrofálna povodeň z júla 1998 v povodí Malej Svinky – simulácia jej priebehu. *Vodohospodársky časopis*, 46, 356-372.

ŠEFARA, J., KOVÁČ, M., PLAŠIENKA, D., ŠUJAN, M. (1998). Seismogenic zones in the Eastern Alpine-Western Carpathian-Pannonian junction area. *Geologica Carpathica*, 49, 247-260.

ŠIMEKOVÁ, J., MARTINČEKOVÁ, T., ABRAHÁM, P., GEJDOŠ, T., GRENČÍKOVÁ, A., GRMAN, D., HRAŠNA, M., JADROŇ, D., ZÁTHURECKÝ, A., KOTRČOVÁ, E., LIŠČÁK, P., MALGOT, J., MASNÝ, M., MOKRÁ, M., PETRO, Ľ., POLAŠČINOVÁ, E., SOLČIANSKY, R., KOPECKÝ, M., ŽABKOVÁ, E., WANIEKOVÁ, D. (2006). *Atlas máp stability svahov Slovenskej republiky (1: 50 000)*. Žilina (Ingeo).

ŠKODA, P., BLAŠKOVIČOVÁ, L., DEÁKOVÁ, K. (1997). Hydrologické zhodnotenie júlovej povodne 1997. *Vodohospodársky spravodajca*, 40, 9.

ŠÚRI, M., CEBECAUER, T., FULAJTÁR, E., HOFIERKA, J. (2002a). Potenciálna vodná erózia pôdy (podľa W. H. Wischmeiera a D. D. Smitha) 1:1 000 000. In *Atlas krajiny Slovenskej republiky*. Bratislava, Banská Bystrica (MŽP SR, SAŽP), pp. 288, 341.

ŠÚRI, M., CEBECAUER, T., FULAJTÁR, E., HOFIERKA, J. (2002b). Aktuálna vodná erózia pôdy 1:500 000. In *Atlas krajiny Slovenskej republiky*. Bratislava, Banská Bystrica (MŽP SR, SAŽP), pp. 286-287.

ŠÚRI, M., CEBECAUER, T., HOFIERKA, J., FULAJTÁR, E. (2002C). Soil erosion assessment of Slovakia at a regional scale using GIS. *Ekológia*, 21, 404-422.

TREMBOŠ, P., MINÁR, J. (2002). Morfologicko-morfometrické typy reliéfu 1:500 000. In *Atlas krajiny Slovenskej republiky*. Bratislava, Banská Bystrica(MŽP SR, SAŽP), pp. 90-91.

TRIZNA, M., MINÁR, J. (1996). Niektoré nové metodické aspekty hodnotenia povodňovej hrozby. *Acta Facultatis Rerum Naturalium Universitatis Comenianae*, *Geographica*, 39, 89-98.

TRIZNA, M. (1998). Hodnotenie zraniteľnosti územia pri identifikácii povodňového rizika. *Acta Facultatis Rerum Naturalium Universitatis Comenianae*, *Geographica*, 41, 13-34.

URBÁNEK, J. (1980). Potenciálne zosuvné územia 1:1 000 000. In *Atlas Slovenskej socialistickej republiky*. Bratislava (SAV, SÚGK), pp. 53.

VISKUP, J., JANOTKA, V. (1996). Engineering geological zoning and seismic microzoning. *Acta Geologica Universitatis Comenianae*, 51, 23-56.

WAGNER, P., IGLÁROVÁ, Ľ., PETRO, Ľ., SCHERER, S. (2002). Monitorovanie zosunov a iných svahových deformácií. *Geologické práce*, *Správy*, 106, 21-42.

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FLUVIAL-GEOMORPHOLOGICAL RESEARCH IN SLOVAKIA: STATE OF THE ART AND OUTLOOK

*Anna Grešková, Milan Lehotský**

Fluviálno-geomorfologický výskum na Slovensku – súčasný stav a perspektívy
Fluviálna geomorfológia predstavuje veľmi dynamickú a vo svete rozvinutú vednú disciplínu s priamymi dopadmi jej výsledkov na prax. Poznávanie riek, korytovo-nivných a dolinových systémov má dlhodobú tradíciu a je charakteristické kontinuálnym vývojom. Situácia na Slovensku bola iná ako vo svete a dokonca aj ako v okolitých krajinách. Fluviálnej geomorfológii, ako špeciálnej subdisciplíne geomorfológie, nebola v minulosti venovaná primeraná pozornosť v rámci geografického výskumu na Slovensku. Nebola rozpracovaná základná metodologická báza poznávania morfológie korytovo-nivných geosystémov, ani metódy a techniky ich výskumu.
Preto považujeme za potrebné venovať pozornosť tejto problematike a priblížiť rozvoj fluviálnej geomorfológie na Slovensku. Cieľom tohoto príspevku je prezentovať oblasti výskumu, ktorým bola venovaná pozornosť v geograficky orientovaných prácach zameraných na výskum morfológie fluviálnych geosystémov a riečnej krajiny, publikovaných za ostatných 10 rokov. V závere sú načrtnuté perspektívne oblasti smerovania výskumu a uplatňovania jeho výsledkov v praxi.

Kľúčové slová: fluviálna geomorfológia, korytovo-nivné a dolinové systémy, terminológia, metódy a nástroje výskumu, aplikácie, perspektívy smerovania výskumu

INTRODUCTION

Fluvial geomorphology represents a very dynamic and developed science with results that have a direct impact in the practical sphere. Research and studies of rivers, channel-flood plain and valley systems enjoy quite a long tradition and continuous development is its characteristic feature. Moreover, recently it progressed dramatically thanks to new tools, method, procedures, improved analytical tools and the data technology providing new and more accurate quantitative data concerning the processes and forms in river systems and their interactions with slope systems. The large-scale research, above all, brought new and more accurate methodology and sophisticated fieldwork procedures that yield more precise input data. This trend was determined by an increasing interest in improvement of the condition of streams and other water bodies suffering from the global deterioration of their quality as a result of increasing anthropogenic impact and the global environmental and/or climate change. River systems worldwide, the most complicated, most dynamic but also most vulnerable landscape elements, have been altered and destabilized. This is manifested in changed parameters of their longitudinal and transversal profiles, runoff-sedimentation regimes and modification of the riverine corridors. In advanced countries, this situation, new legislation and practical needs have called for greater attention to rivers and their environs.

The situation in Slovakia is different to that in the world and even in the neighbouring countries. This is the reason, why it is necessary to deal with the issue and explain the development of fluvial geomorphology in Slovakia in the last dec-

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ade. The aim of the paper is to present clusters of issues, which were dealt with in published studies in the last ten years.

RESEARCH BACKGROUND AND THE STATE OF THE ART

Fluvial geomorphology as a special subscience of the geographical research was not given sufficient attention in Slovakia. Basic methodology and techniques for research into the morphology of the channel-floodplain geosystems were missing.

In the approximate period of 1955 to 1980, research carried out in the environs of rivers concentrated on general knowledge of geomorphology, paleogeography and sedimentology of the Quaternary lowlands in Slovakia (Kvitkovič, Lukniš and Mazúr), or on knowledge about the development of valleys. It was above all representatives of a strong generation of Slovak geomorphologists who researched, for instance, the development of the middle and upper reaches of the Váh River and its valley (Droppa, Mazúr and Mazúrová), the Žitava River (Harčár), the upper Hron River (Škvarček), the valleys of the western part of the Little Carpathians valleys (Urbánek), valleys of the High Tatras and their forefront (Lukniš), as well as the terrace system of the Danube, Váh and Žitava Rivers (Mazúrová, Mazúr, Harčár and Činčura). The first geomorphological regionalizations of the lowland floodplain areas of the Holocene and Pleistocene age that relied on field research and mapping were made at that time (Mazúr and Lukniš, Kvitkovič). Although the merits of these studies lie now above all in their cognitive aspect, they meant a great contribution because of the detailed fieldwork (which was unfortunately abandoned in the next phase of 1980-2000), collection of the proper data and their analysis (analysis of sediments, degree of disruption of heavy minerals, $CaCO_3$ content and the like) involved. In spite of the fact that technologies and tools now used by science were not available, these studies brought the first detailed information not only about the development of the selected river valleys and lowlands in Slovakia but also about of morphological manifestations of river activities such as terraces, aggradation ramparts and alluvial cones.

It must be noted though, that hydrological and hydraulic research on streams in Slovakia enjoys a long tradition. The engineering approach covered the area of water management regulation of water channels, construction of navigation tracks, flood control, etc. Important results were achieved in the area of natural development of the river channel research and their application in control of streams (Raplík and Szolgay 1986, Macura 1987a, Macura et al. 2002). Macura (1990), Macura et al. (2002) and Jakubis (2002, 2004 and 2005) were involved with the issue of river channels adjustment including the relationships of the hydraulic geometry in naturally stabilized channel and the application of regional and regime equations (curves) in the assessment of channel development. There were some isolated studies involved with identification of river sediment granulometry (e.g. Macura 1987b, Holubová 2000). Hydromorphological atlases of the Slovak rivers and the results of projects realized at Water Research Institute (VÚVH) that dealt with suspended load and bed-load of selected streams of Slovakia (Holubová et al. 2004) and revitalization of the Morava River (Holubová and Lisický 2001 and 2005, Holubová and Lukáč 2000, Holubová et al. 2005) were also important contributions. Since 2004, monitoring of the morphology of the natural streams under the EU Water Framework Directive started at the Slovak Hydrometeorological Institute (Blaškovičová et al.) and heavily modified water bodies started at the Water Research Institute (Lukáč et al.).

Only recently (around 2000), the first geographically oriented studies focused on the morphology of fluvial geosystems as well as on the riverine landscape appeared in Slovakia due to a more liberal access to the world scientific literature, including the electronic versions of journals. Another developmental impulse was the result of the natural and gradual profiling of the personal scientific orientation of those who are now the main protagonists of fluvial geomorphology at the Institute of Geography of the SAS (Slovak Academy of Sciences). Thus Slovak geography and geomorphology discovered again a vast and topical scientific theme with considerable applied potential. The increasing interest in integrated research into the complexes of river channels, floodplains and valley slopes confirms the fact that the group of fluvial geomorphologists in Slovakia has widened recently. The great number of papers dedicated to fluvial/geomorphological themes, which now dominate at conferences and congresses, only confirms the above-outlined trend.

CLUSTERS OF INQUIRY

Theoretical & methodological basis. Terminology of fluvial geomorphology

The first studies were theoretical and involved with the basic methodology and terminology of the fluvial geomorphology. They were the studies dealing with the basic problems of learning and research of fluvial geosystems and the riverine landscape (e.g. Lehotský 2001, 2002, 2003 and 2004b, Lehotský and Grešková 2003a). These studies showed that the present fluvial systems are historically determined and their further development is characterized by non-linearity, dynamic instability and a determinist chaos.

The basic principle of the behaviour and changing morphology of river systems was the subject of Lehotský (2005e and 2006a) and Lehotský and Novotný (2006). Authors bring reviews of the developments and tools applied to the study of river morphology changes and behaviour where the general tendency of the river channel is towards adjustment to a certain water discharge and sediment load.

The basic attributes of the channel morphology in a certain section of stream are formed above all in the moment of what is referred to as the bankfull status. In Grešková and Lehotský (2006b), the authors explain the concept of bankfull, its hydrological and morphological meaning and the characteristics of profile geometry for the status described as bankfull and the significance of such condition for this cognition and management of stream morphology.

Compilation of the Slovak-English hydromorphological terms (Lehotský and Grešková 2004d), was a considerable contribution and the first attempt to publish such dictionary. The origin of an important part of hydromorphological terminology lies in the English specialized literature and as many terms lacked Slovak equivalents until recently, the dictionary is perhaps a piece of pioneer work in this sense.

Several studies by Lehotský and Grešková (e.g. Lehotský and Grešková 2003a, 2004a, 2004b, 2004c and 2005a, Lehotský 2004a, 2005a and 2006b, Grešková and Lehotský 2004a) explain the basic concepts connected with the fluvial geosystem research and that of its morphology. They are concepts like: the hierarchy, three natural zones, river continuum, serial discontinuity and extended serial discontinuity, connectivity, flood-pulse, “telescoping”, river channel sensitivity and thresholds, coarse sediment connectivity, lateral gradient, channel equilibrium (regime),

natural capital value, channel evolution, expansion-contraction cycles and the hyporeic corridor.

A model of hierarchical composition of spatial units (River Morphology Hierarchical Classification) was developed for the holistic understanding of the behaviour proper to the morphological base of the river system. This model represents the fluvial geosystems as hierarchized structures which makes it possible to explain processes running on the lower hierarchical levels by processes that occur on higher hierarchical levels and vice versa. The River Morphology Hierarchical Classification (RMHC) model presented in the works of Lehotský and Grešková (e.g. Lehotský and Grešková 2003a, 2004a and 2004b, Lehotský 2004a, Grešková and Lehotský 2004a) with seven taxonomic levels: catchment, zone, segment, channel-floodplain unit, river reach, geomorphic unit and morphohydraulic unit, presents a good research tool for survey and assessment as well as for river management applications. The RMHC framework is catchment-based, process-based, structured hierarchically and directly linked to the assessment of the trajectory of the future river condition and to restoration measures. Bottom-up and top-down trans-taxon (trans-scale) linkages provide a foundation for understanding the geomorphological dynamics of riverine geosystems.

Methods, tools and fieldwork

The morphology of a river is the reflection of the dynamic balance existing between the discharge of water and sediments in basins controlled by erosion, transport and accumulation processes. The result of these processes is the morphological formation of the channel bottom, banks and the floodplain but also formation of the transversal profile, meandering (sinuosidy), braiding and the river channel pattern. Regarding their specific features, a wide scale of techniques, tools and methods is applied in morphological research. Some of them are known in our geomorphology and physical geography such as the analyses of the river and basin networks, analysis of longitudinal valley profiles, processing of hydrological data, analysis and modelling of sediment transport and balance, isotope methods, dendrochronology, methods applied in analysis of historic data and artefacts.The establishment of fluvial geomorphology as a modern discipline with application potential also requires, apart from the above mentioned data, work with other types of data that can be obtained only by application of specific techniques and tools.

Several studies explaining the methods and procedures for acquisition of the proper data and those applied in the fluvial geosystem morphology research have recently been published. A key study in this area is that of Lehotský and Grešková (2005b) about the basic classification systems and morphometric characteristics of the channel-floodplain geosystems. Basic research tools, according to these authors are: 1. Classification systems as products of many-years of field surveys of stream morphology in different parts of the Earth; 2. Basic classification systems of fluvial sediments; 3. Water movement classification and 4. Basic morphometric characteristics concerning the planform, transversal and longitudinal profile of channel or of the channel/floodplain unit.

In the cited work of Lehotský and Grešková (2005b), authors not only explained comprehensive classification schemes corresponding to morphological types of stream properties such as the planform, slope of longitudinal profile, channel cross section and dominant bed material (Rosgen 1994, Montgomery and Baffington

1997), which had not been known and used in Sovakia before, but they also presented other classification systems of rivers. These include classification of morphological zones of streams (Lehotský and Novotný 2004), classification of valley-river systems (Lehotský and Lacika 2007), classification of river reaches (Grešková and Lehotský 2004a), of banks (Lehotský 2005d), floodplains (Lehotský and Grešková 2005b), and woody debris accumulations (Grešková 2005a and 2005b), classification of sediments (Lehotský and Grešková 2005b) and of water movement (Grešková and Lehotský 2004a, Lehotský 2005b).

Fluvial-morphological research can be carried out in different spatial scales and time dimensions and it can focus on solution of a wide spectrum of basic research problems and those connected with application of geomorphologists' knowledge in practice. Recently, research concerned with morphology of fluvial geosystems started to concentrate on very detailed scales and the study of relationships between physical processes and landforms became more intensive. This was accompanied by deviation from description of forms to explanation of their development and mechanisms along with the dynamics and behaviour that contributed to it. During the last decade, due to holistic interpretation of the geomorphological reality and abundant exact field measuring, thorough laboratory analysis in various places of the world (mainly in USA, Canada, Australia, South African Republic and Great Britain), compilation of databases in the GIS and development of software that processed them, the applied potential of fluvial geomorphology has enormously increased.

The increasing interest and care for streams in many countries, including Slovakia, has resulted in working out of field survey methodologies. It requires first of all a sufficient theoretical knowledge, familiarity with fluvial-geomorphological terminology and a clearly formulated scientific problem. An important part of the field survey is protocol. It must facilitate recording of a phenomenon, its characteristics or its value. Acquisition of basic information about the morphology of the channel/ floodplain geosystem and its field survey is described in Lehotský and Grešková (2004b and 2005c).

The key step in the field survey is identification of geomorphological units which means the basic forms of the channel and floodplain relief. These represent the specific manifestations of the linkage between forms and processes. These linkages represent the basis on which the geosystems are analysed and classified by causal relationships between the fluvial and sedimentation processes. The abovementioned classifications are applied during the survey of the channel bottom or the banks and their dissection, that of flow types, sediments, woody debris in the channel, bank vegetation but also to the description of hydraulic characteristics of the channel.

Assessment of hydromorphological conditions

Morphological assessment and monitoring of streams and their environs genetically determined by them, have become not only subjects of interest for experts in various sciences and a platform for their cooperation but recently also a commitment ensuing from the new legislation. The geomorphological and physical-geographical approach along with the biological and hydrological ones are jointly used in the process of assessment of streams and of the river landscape complex which requires an integrated and comprehensive study. New methods were developed in the world and several manuals were prepared in specialized applied and sci-

entific centres for the purpose of estimating and evaluating the status of streams. While proposing the particular methods for assessment of stream morphology it must be born in mind that no assessment can encompass the whole complexity of the matter. Moreover, the existing relationships, processes and responses must be considered in the context of human impact. In spite of this, some assessments that try to get over this difficulty by searching for simpler causal relationship and an adequate set of indicators that would sufficiently enlighten the natural scope of variability and mechanisms of behaviour proper to the rivers were developed. A survey of such manuals and individual procedures is to be found in, for instance, Grešková (2004b), Lehotský (2004c and 2005c), Lehotský and Grešková (2005c).

Among the first comprehensive attempts to assess river system status in this country were the papers by Grešková et al. (2000) and Lehotský et al. (2001) where the authors outline the methodological procedure used for the load assessment of water as the landscape component and define the landscape hydroecological types (HET) by the relevant landscape properties.

In the EU, the activities focused on the improvement of the condition of all surface waters in basins are concentrated into the 2000/60/EU Water Framework Directive, where the basic concepts and procedures associated with the set aim (good ecological condition defined by the hydromorphological, biological and physical/chemical parameters) are set. The least developed area of this document proposes the an establishment of indicative parameters for the hydromorphological quality and monitoring of streams.

Grešková (2004b), Grešková and Lehotský (2003), Lehotský (2004c), Lehotský and Grešková (2003b, 2006, 2007a and 2007c) and Pedersen et al. (2004) worked out the conceptual framework of hydromorphological assessment with the aim of monitoring the condition of streams in Slovakia. The quoted studies explain the basic aspects of assessment including the principles for the selection of river reaches to be surveyed, evaluated parameters and description of basic steps in field survey and assessment. The fundamental premise of the assessment is that the status of the stream is evaluated against the referential locality and the target status (healthy ecological condition) is reached if the conditions of the evaluated river reach are close to referential ones. The obligatory methodological procedures of survey and assessment for the hydrological parameters of streams in the Slovak Republic is based on the manual and the field protocol worked out by the mentioned authors (Lehotský and Grešková 2003b).

Adamková et al. (2003), Lehotský and Grešková (2003b) and Pedersen et al. (2004) present the fundamental methodology for the assessment of the hydrological status of rivers consisting of five steps: 1. Data collection; 2. Definition of survey units in river reach; 3. Assessment of parameters from map and digital sources; 4. Field survey; 5. Presentation and evaluation of results. The assessment is materialized in form of a field protocol which consists of groups of parameters related to the river channel pattern, character of the channel bottom, banks and riverine zone, floodplain and hydrological regime.

In spite of the fact that monitoring in the EU requires a single methodology for the hydromorphological assessment of water bodies, scientific approaches to the assessment of the stream status must respect the circumstance that types of river reaches in Slovakia are several (Lehotský and Grešková 2004b and 2005c), their features are specific and composition of their morphological units is characteristic.

Every such type can be characterized and consequently assessed by means of a specific set of attributes that does not have to be necessarily suitable for other types of river reach. This means that a correct assessment can only be accomplished by comparison of the values of attributes corresponding to a referential reach of a certain type to values of attributes of an other reach of the same type. Otherwise it is not possible to compare, assess or monitor river reaches (Lehotský 2004c). Assessment procedures used in practice are based on the basic premise that the good status is reached when the hydromorphological conditions in the reach are close to referential ones and when the spatial diversity is the greatest possible, which is not always true. Some types of river reach boast low diversity in spite of being quasi natural. This especially goes for assessment of bottom forms, substrates, flow types and woody debris in the channel (Lehotský 2004c). This is the reason why the selection of the parameter set must be done with care, as it does not have to be necessarily the same for different morphological types of stream and different types of reach.

Applications: case studies

Parallel to the development of the theory, the fluvial/geomorphological research on selected river reaches or river systems was carried out in the form of case studies.

The first case studies were linked with two important Slovak rivers, the Morava and the Danube. In the lower reach of the Morava River, basic floodplain morphological units were identified from black and white aerial photographs taken in time of floods and a digital map of the morphology of the flooded part of the Morava floodplain was compiled (Grešková 2000, 2002a, 2002b and 2003). Several important results were reached during assessment of the geomorphic response of the Danube River channel and floodplain to flood events (Grešková and Lehotský 2003-2004 and 2004b). Synoptic analysis and evolutionary analysis of Bratislava´s suburban riverine landscape (Lehotský et al. 2008) were applied. Novotný et al. (2007 and 2008) and Szmańda et al. (2008a and 2008b) described the present sedimentological and morphological development of the interdike area of the Danube in the territory of Bratislava.

The model of hierarchical structure of morphology for the rivers Vydrica (Grešková 2005c), Studený potok (Jančuška 2005 and 2006, Lehotský and Grešková 2007d, Lehotský and Lacika 2007) and Smrečianka (Tomčíková 2005a, 2005b, 2007 and 2008) was applied in the framework of the basic hydromorphological survey. Several studies such as those of Grešková (2004a and 2005c), Barabas (2008), Medveďová et al. (2007), Tomčíková (2006) and Halaj et al. (2005) are devoted to identification and mapping of spatial variability concerning morphological units of the channel/floodplain systems and their dynamics. Research on the effects of bank vegetation and big woody debris on the behaviour and morphology of a river channel using the model reach of the Vydrica by Grešková and Lehotský (2007) resulted in the new knowledge about the behaviour and morphology of a river channel in a forested area.

Several authors took up the theme of the response of the river system and ecological implications in the basin of the Studený potok (Jančuška 2006, Lehotský and Grešková 2007b, Lehotský 2007, Lehotský and Lacika 2007) after the 2004 windstorm in the High Tatras. Classification of river reaches, where the morphological response of the river landscape was identified, was carried out by means of field in-

dicators in order to obtain a comprehensive spatial picture of the situation the after natural disaster.

Cooperation of fluvial geomorphologists and hydrobiologists brought about some original results. They include the results obtained in research on two reaches of the Drietomica brook (Grešková and Lehotský 2005and 2006a, Pastuchová et al. 2007 and 2008, Grešková et al. 2007) describing the effects of the morphohydraulic structure of a small stream channel bed on macroinvertebrate communities.

There is another group of papers, which bring knowledge obtained by use of historic maps at large scales for reconstruction of the development of the Danube in the case of works by Pišút (1995, 2002, 2005 and 2008, Pišút et al. 2004), the Morava River (Grešková 2002b, Pišút 2006) or the Sacramento River (Michalková 2006 and 2009) and others (Hronček 2007, Pišút and Tomčíková 2008). These studies clarify the channel evolution and forms existing in floodplains and specify the older ideas about the evolution of meandering of the lower Morava River and about the development of the Danube beyond Bratislava.

Opportunities to apply the results of the fluvial/morphological research to the revitalization and management of streams were pointed out in works of Šíbl et al. (1999), Halaj (2004), Lehotský and Grešková (2005d), Grešková (2007), Anstead and Barabas (2009).

CONCLUSION

Lehotský, Grešková, Michalková, Macura, Jakubis, Halaj, are the authors who point to the modern applied and highly topical environmental character of fluvial geomorphology in a time of global changes as it promotes the idea that the morphological research on riverine landscape represents the basic building and locational fundations of the knowledge, assessment and management of rivers. In contrast to Slovakia, advanced countries routinely work on projects, the aim of which is to conserve the good (sound) morphological and biotic status of rivers. Such projects are mainly focused on: restoring of the natural river channel pattern (meandering) along with provision for an appropriate structure of inner-channel morphological units, wider corridors with subsequent "loosening" of the river channel in favour of lateral migration, projects focused on stabilization of bank zones, some of which address the silting and environmentally friendly operation of dams, and the like. Consequently, future research and application of its results will certainly have to concentrate on the following:

- Identification, classification and mapping of spatial structures in the morphology of river systems,
- Research on erosion processes on river banks in connection with bank vegetation and identification of erosion corridors of river channels,
- Research on morphological/sedimentological risks and responses to floods,
- Research on sediment sources, their movement and accumulation in water basins and weirs,
- Developmental models of individual types of reaches and rives systems in order to predict their behaviour in the changing global conditions (natural and anthropogenic),
- Assessment of eco-hydro-morphological status of rivers;

– Cooperation with hydrobiologists and ecologists in research of fish and invertebrate associations, and vegetation,
– Participation in integrated research on riverine landscape,
– Participation in projects of revitalization and management.

Education of young fluvial geomorphologists is equally important for further development of this research. The principal protagonists of such education are the departments of geography, environmental science and ecology, in Slovakia it is also the Department of Water Management of the Construction Faculty at the Slovak University of Technology, the Department of Forest Improvement of the Technical University in Zvolen and the Department of Landscape Engineering of the Horticulture and Landscape Engineering Faculty, University of Agriculture Nitra.

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REFERENCES

ADAMKOVÁ, J., HENSEL, K., GREŠKOVÁ, A., KLOZÍK, M., LEHOTSKÝ, M., OŤAHEĽOVÁ, H., ŠPORKA, F., ŠTEFKOVÁ, E., VALACHOVIČ, M. (2003). *Príprava databázy hydromorfologických a biologických ukazovateľov pre proces výberu a charakterizácie referenčných miest podľa Smernice 2000/60/EC*. Bratislava (Slovenský hydrometeorologický ústav).

ANSTEAD, L., BARABAS, D. (2009). Hydromorfologický prieskum Váhu ako nástroj pre manažment vodných tokov na Slovensku. *Geomorphologia Slovaca et Bohemica*, 9, in press.

BARABAS, D. (2008). Analýza priestorového rozšírenia akumulačných foriem v korytových úsekoch Bodvy. *Geomorphologia Slovaca et Bohemica*, 8, 7-15.

GREŠKOVÁ, A. (2000). Mapovanie zaplavených a zamokrených území aplikáciou leteckých čiernobielych snímok (na príklade inundačného územia rieky Moravy). *Geografický časopis*, 52, 353-361.

GREŠKOVÁ, A. (2002a). The application of the geographic information system and remote sensing in identification of the flooded and waterlogged areas. *Landform Analysis*, 3, 41-45.

GREŠKOVÁ, A. (2002b). Dynamika a transformácia nivy rieky Moravy študovaná pomocou historických máp a leteckých snímok. *Geomorphologia Slovaca*, 2, 40-44.

GREŠKOVÁ, A. (2003). Geographic information system and aerial photographs as a tool for identification of standing water bodies and landforms in flooded areas. *Geomorphologia Slovaca*, 3, 19-21.

GREŠKOVÁ, A. (2004a). Priestorová variabilita korytovo-nivného geosystému Vydrice. *Geomorphologia Slovaca*, 4, 54-61.

GREŠKOVÁ, A. (2004b). Hydromorfologický prieskum a hodnotenie vodných tokov. In Herber, V., ed. *Fyzickogeografický sborník 2 : Kulturní krajina*. Brno (Masarykova univerzita, Přírodovědecká fakulta), pp. 191-195.

GREŠKOVÁ, A. (2005a). Zvyšky dreva v korytách riek: interakcie s korytovou morfológiou a fluviálnymi procesmi. *Geomorphologia Slovaca*, 5, 21-33.

GREŠKOVÁ, A. (2005b). Geomorfologické účinky dreva v korytách riek – úvod do problematiky. In Ryp, J., ed. *Geomorfologický sborník 4 : Stav geomorfologických výzkumů v roce 2005.* České Budějovice (Jihočeská universita), pp. 59-62.

GREŠKOVÁ, A. (2005c). Hierarchická štruktúra morfológie riek – na príklade malého vodného toku (Vydrica). In Herber, V., ed. *Fyzickogeografický sborník 3 : fyzická geografie teorie - krajinná ekologie - trvalá udržitelnost*. Brno (Masarykova univerzita), pp. 161-166.

GREŠKOVÁ, A. (2007). Využitie akumulácií zvyškov dreva /Large Woody Debris/ pri revitalizácii riečnych korýt. In Herber, V., ed. *Fyzickogeografický sborník 4 : fyzická geografie teorie a aplikace*. Brno (Masarykova univerzita), pp. 105-110.

GREŠKOVÁ, A., HANUŠIN, J., LEHOTSKÝ, M. (2000). Hydroecological aspects of load assessment of water component of landscape (example Slovakia). *Ekológia, 19, Supplement*, 2, 82-91.

GREŠKOVÁ, A., LEHOTSKÝ, M. (2003). Ekologické aspekty hodnotenia riečneho systému (výzva pre fluviálnu geomorfológiu). In Mentlík, P., ed. *Geomorfologický sbor-ník 2 : stav geomorfologických výzkumů*. Plzeň (Západočeská univerzita, Česká asociace geomorfologů), pp. 75-79.

GREŠKOVÁ, A., LEHOTSKÝ, M. (2003-2004). Hydrogeomorphic response of urban landscape to flooding (case study of the Danube river beach in Bratislava). *Revue Roumaine de Géographie*, 47-48, pp. 205-216.

GREŠKOVÁ, A., LEHOTSKÝ, M. (2004a). Priestorové štruktúry riečnej krajiny. In Měkotová, J, Štěrba, O., eds. *Říční krajina 4 : sborník příspěvků z konference*. Olomouc (Palackého univerzita), pp. 44-51.

GREŠKOVÁ, A., LEHOTSKÝ, M. (2004b). Hydrogeomorphic response assessment of the Danube river channel and floodplain to the 2002 flood events. In *XXIInd Conference of the Danubian Countries on Hydrological Forecasting and Hydrological Bases of Water Management : conference proceedings*. Praha (Český hydrometeorologický ústav), CD ROM, p. 9.

GREŠKOVÁ, A., LEHOTSKÝ, M. (2005). Morfohydraulická (habitatová) štruktúra dna koryta (príkladová štúdia z Drietomice). In Měkotová, J., Štěrba, O., eds. *Říční krajina 3.* Olomouc (Palackého univerzita), pp. 81-90.

GREŠKOVÁ, A., LEHOTSKÝ, M. (2006a). Stav plného koryta a jeho význam pre poznávanie a manažment morfológie vodných tokov. *Geografický časopis*, 58, 317-328.

GREŠKOVÁ, A., LEHOTSKÝ, M. (2006b). Geomorfologický výskum korytových habitatov. In Smolová, I., ed. *Geomorfologické výzkumy v roce 2006*. Olomouc (Palackého univerzita), pp. 38-42.

GREŠKOVÁ, A., LEHOTSKÝ, M. (2007). Vplyv lesných brehových porastov na správanie a morfológiu riečnych korýt. *Geomorphologia Slovaca et Bohemica*, 7, 36-42.

GREŠKOVÁ, A., LEHOTSKÝ, M., PASTUCHOVÁ, Z. (2007). Morfohydraulická štruktúra dna koryta malého vodného toku a spoločenstvá makrozoobentosu. *Geografický časopis*, 59, 25-48.

GREŠKOVÁ, A., LEHOTSKÝ, M., PASTUCHOVÁ, Z. (2008). Riverbed geodiversity and macroinvertebrate communities. In Boltižiar, M., ed. *Implementation of landscape ecology in new and changing conditions: Proceedings of the 14th International Symposium on Problems of Landscape Ecology Research 4-7 October 2006, Stara Lesná, Slovakia*. Nitra (Institute of Landscape Ecology SAS), pp. 87-92.

HALAJ, P. (2004). *Revitalizácia vodných tokov. Vysokoškolské skriptá*. Nitra (SPU).

HALAJ, P., BÁREK, V., ĎURIŠ, J., IGAZ, D., ŠIŠKA, B., JURÍK, Ľ. (2005). Morfologické zmeny vybraných malých vodných tokov a ich vplyv na priebeh povodní počas povodňových prietokov. In Rožnovský, J., Litschmann, T., eds. *Bioklimatologie současnosti a budoucnosti, Křtiny 12.-14.9.2005.* Praha (Česká bioklimatická společnost), CD-ROM.

HOLUBOVÁ, K. (2000). Some aspects of the bedload transport regime in the Slovak section of the Danube River. *Conference of the Danubian Countries on Hydrological Forecasting and Hydrological bases of Water management, Bratislava, 4.-8.9.2000.*

HOLUBOVÁ, K., CAPEKOVÁ, Z., SZOLGAY, J. (2004). Impact of hydropower schemes at betload regime and channel morphology of the Danube River. In Greco, M., Carravetta, A., Della Morte, R., eds. *River Flow 2004. Proceeding of 2nd International Conference on Fluvial Hydraulics.* Napoli (Balkema Publisher), pp. 135-142.

HOLUBOVÁ, K., HEY, R. D., LISICKÝ, M. J. (2005). Middle Danube tributaries: constrains and opportunities in lowland river restoration. *Large Rivers*, 15, 507-519.

HOLUBOVÁ, K., LISICKÝ, M. J. (2001). River environmental processes in wetland restoration of the Morava river. In *River Basin Management*. Cardiff (Cardiff University), pp. 179-188.

HOLUBOVÁ, K., LISICKÝ, M. J. (2005). *Ochrana revitalizáciou: Stratégia a manažment riečneho systému dolnej Moravy. Záverečná správa o riešení projektu APVT*. Bratislava (VÚVH).

HOLUBOVÁ, K., LUKÁČ, M. (2000). Numerical modelling as a tool for optimal design of Morava river wetland restoration. In *4th Internation Conference Hydroinformatics, Iowa City, 23 – 27 July 2000.*

HRONČEK, P. (2007). Transformácie vodných tokov v okolí Slovenskej Lupče. *Geografická revue*, 3, 67-94.

JAKUBIS, M. (2002). Analýza vzájomných závislostí geometrických charakteristík prirodzene ustálených korýt bystrín na neovulkanitoch. *Acta Facultatis Forestalis*, 44, 281-295.

JAKUBIS, M. (2003). Vzťahy hydraulickej geometrie v prirodzene ustálených úsekoch bystrín. *Acta Facultatis Forestalis*, 45, 113-126.

JAKUBIS, M. (2004). K zákonitostiam morfogenézy bystrinného koryta. *Acta Facultatis Forestalis*, 45, 305-314.

JAKUBIS, M. (2005). Analýza vývoja koryta bystriny metódou regionálnych rovníc. *Acta Facultatis Forestalis*, 47, 377-386.

JANČUŠKA, D. (2005). Morfologické zóny vysokogradiendového toku (príklad Studeného potoka vo Vysokých Tatrách). In Měkotová, J., Štěrba, O., eds. *Říční krajina 3., 5. – 6. 10. 2005.* Olomouc (Palackého univerzita), pp. 128-134.

JANČUŠKA, D. (2006). Štruktúry a procesy riečneho systému Studeného potoka (Vysoké Tatry). In Smolová, I., ed. *Geomorfologické výzkumy v roce 2006.* Olomouc (Palackého univerzita), pp. 77-82.

LEHOTSKÝ, M. (2001). Fluviálna geomorfológia – úvod do metodológie a terminológie. In Prášek, J., ed. *Současný stav geomorfologických výzkumů*. Ostrava (Ostravská univerzita), pp. 79-86.

LEHOTSKÝ, M. (2002). Korytovo-nivný geosystém – terra incognita v slovenskej geomorfológii. *Geomorphologia Slovaca*, 2, 23-30.

LEHOTSKÝ, M. (2003). Postmoderna a epistemológia krajinného priestoru s akcentom na fluviálne geosystémy. In Herber, V., ed. *Fyzickogeografický sborník, 1: fyzická geografie - vzdělávání, výzkum, aplikace*. Brno (Masarykova univerzita), pp. 146-151.

LEHOTSKÝ, M. (2004a). River morphology hierarchical classification (RMHC). *Acta Universitatis Carolinae, Geographica.* Praha (Univerzita Karlova), 39, 33-45.
LEHOTSKÝ, M. (2004b). Riečna krajina – staro-nový objekt fyzickogeografického výskumu. In Herber, V., ed. *Fyzickogeografický sborník, 2: Kulturní krajina*. Brno (Masarykova univerzita, Přírodovědecká fakulta), pp. 185-190.
LEHOTSKÝ, M. (2004c). Hodnotenie morfológie vodných tokov. *Geomorphologia Slovaca*, 4, 36-47.
LEHOTSKÝ, M. (2005a). Riečna krajina – základné koncepty. *Alfa Spectra: Urbanistické listy FA STU*, 9, 38-47.
LEHOTSKÝ, M. (2005b). Morfohydraulická jednotka ako báza habitatu. In Rypl, J., ed. *Geomorfologický sborník 4: Stav geomorfologických výzkumů v roce 2005.* České Budějovice (Jihočeská universita), pp. 67-70.
LEHOTSKÝ, M. (2005c). Vodné toky, ich hodnotenie a fluviálna geomorfológia. In Herber, V., ed. *Fyzickogeografický sborník 3: fyzická geografie teorie - krajinná ekologie - trvalá udržitelnost*. Brno (Masarykova univerzita), pp. 154-157.
LEHOTSKÝ, M. (2005d). Morfológia brehu. In Měkotová, J., Štěrba, O., eds. *Říční krajina 3.* Olomouc (Palackého univerzita), pp. 200-207.
LEHOTSKÝ, M. (2005e). Metodologické aspekty správania a zmien korytovo-nivných geosystémov. *Geomorphologia Slovaca*, 5, 34-50.
LEHOTSKÝ, M. (2006a). Morfológia rieky – princípy a nástroje výskumu jej prispôsobovania. In Smolová, I., ed. *Geomorfologické výzkumy v roce 2006*. Olomouc (Palackého univerzita), pp. 147-153.
LEHOTSKÝ, M. (2006b). Riečna krajina a jej udržateľný rozvoj – nová oblasť aplikácie integrovaného prístupu. In Izakovičová, Z., ed. *Smolenická výzva III. Integrovaný manažment krajiny - základný nástroj implementácie trvalo udržateľného rozvoja : Zborník príspevkov z konferencie. Smolenice 18. - 19. apríl 2006*. Bratislava (Ústav krajinnej ekológie SAV), pp. 155-159.
LEHOTSKÝ, M. (2007). Výskum morfológie riečnych systémov Tatier. In Švajda, J., Vološčuk, I., Vančura, T., eds. *Veda a výskum pre potreby ochrany prírody v Tatranskom národnom parku : zborník referátov z medzinárodnej konferencie*. Zvolen (Štátna ochrana prírody, Správa TANAP, Slovenská ekologická spoločnosť pri SAV, SNK programu UNESCO Človek Biosféra – MAB), pp. 23-24.
LEHOTSKÝ, M., GREŠKOVÁ, A. (2003a). Geomorphology, fluvial geosystems and riverine landscape (methodological aspects). *Geomorphologia Slovaca*, 3, 46-59.
LEHOTSKÝ, M., GREŠKOVÁ, A. (2003b). *Hydromorfologický prieskum a hodnotenie vodných tokov Slovenska*. *Návrh manuálu*. Bratislava (SHMÚ).
LEHOTSKÝ, M., GREŠKOVÁ, A. (2004a). Riverine landscape and geomorphology: ecological implications and river management strategy. *Ekológia (Bratislava), 23, Supplement*, 1, 197-190.
LEHOTSKÝ, M., GREŠKOVÁ, A. (2004b). Korytovo-nivné geosystémy riečna krajina: prieskum a hodnotenie. *Geografie, Sborník České geografické společnosti*, 109, 277-288.
LEHOTSKÝ, M., GREŠKOVÁ, A. (2004c). Hydromorphology, riverine landscape and river management strategy. In *XXIInd Conference of the Danubian Countries on Hydrological Forecasting and Hydrological Bases of Water Management: conference proceedings*. Praha (Český hydrometeorologický ústav), CD ROM, p. 8.
LEHOTSKÝ, M., GREŠKOVÁ, A. (2004d). *Hydromorfologický slovník: (Slovensko-anglický výkladový slovník hydromorfologických termínov)*. Bratislava (Slovenský hy-

drometeorologický ústav). Accessed <http://www.shmu.sk/File/implementacia_rsv/slovnik/slovnfinal.pdf> (cit:02-09-2004).
LEHOTSKÝ, M., GREŠKOVÁ, A. (2005a). Methodology, concepts and hierarchy of riverine landscape. In *Border-Free River Basins Flusslandschaften ohne Grenzen : Mitteleuropäische Ansätze zur Entwicklung vom Flusslandschaften und Forderung landschaftsbezogener Identität*. Bratislava (ROAD), pp. 18-36.
LEHOTSKÝ, M., GREŠKOVÁ, A. (2005b). Základné klasifikačné systémy a morfometrické charakteristiky korytovo-nivných geosystémov. *Geomorphologia Slovaca*, 5, 5-20.
LEHOTSKÝ, M., GREŠKOVÁ, A. (2005c). Prieskum a hodnotenie morfológie vodných tokov ako súčasť integrovaného manažmentu povodia. In *Hydrologické dni 2005: Hydrológia pre integrovaný manažment vodných zdrojov.* Bratislava (Slovenský výbor pre hydrológiu, Český výbor pre hydrológiu), CD-ROM, pp. 718-729.
LEHOTSKÝ, M., GREŠKOVÁ, A. (2005d). Morfológia riečnych systémov ako základ revitalizačných projektov. In *Revitalizácia mokradí a riečnych systémov v Slovenskej republike : seminár v Bratislave, 23. - 24. november 2005*. Bratislava (Ministerstvo životného prostredia SR), CD-ROM, p. 52.
LEHOTSKÝ, M., GREŠKOVÁ, A. (2006). Riečna krajina – integrovaný výskum a environmentálné plánovanie. *Acta Geographica Universitatis Comenianae*, 47, 187-195.
LEHOTSKÝ, M., GREŠKOVÁ, A. (2007a). Fluvial geomorphological approach to river assessment - methodology and procedure. *Geografický časopis*, 59, 107-129.
LEHOTSKÝ, M., GREŠKOVÁ, A. (2007b). Odozva morfológie vysokogradientového vodného toku na veternú kalamitu – ekologický aspekt. *Geomorphologia Slovaca et Bohemica*, 7, 79-84.
LEHOTSKÝ, M., GREŠKOVÁ, A. (2007c). Hydrogeomorphic assessment of riverine landscape. In Kozová, M., Oťaheľ, J. et al., eds. *Landscape ecology in Slovakia: development, current state, and perspectives*. Bratislava (Ministry of the Environment of the Slovak Republic, Slovak Association for Landscape Ecology), pp. 248-258.
LEHOTSKÝ, M., GREŠKOVÁ, A. (2007d). Veterná kalamita a morfológia riečneho systému Studeného potoka – ekologické implikácie. In Fleischer, P., Matejka, F., eds. *Zbornik prispevkov zo seminara Pokalamitny vyskum v TANAP-e 2007.* Bratislava (Geofyzikálny ústav SAV), CD-ROM.
LEHOTSKÝ M., GREŠKOVÁ A., HANUŠIN J. (2001). Hydro-ecological evaluation of load of water component in main Slovak river basins. In Starosolszky, O., ed. *International conference on water and nature conservation in the Danube-Tisza river basins.* Debrecen (Pro aqua), pp. 244-250.
LEHOTSKÝ, M., LACIKA, J. (2007). Typy segmentov vysokogradientových dolinovoriečnych systémov. *Geomorphologia Slovaca et Bohemica*, 7, 27-35.
LEHOTSKÝ, M., NOVOTNÝ, J. (2004). Morfologické zóny vodných tokov Slovenska. *Geomorphologia Slovaca*, 4, 48-53.
LEHOTSKÝ, M., NOVOTNÝ, J. (2006). Metodológia konceptuálneho modelu vývoja morfológie rieky. In Smolová, I., ed. *Geomorfologické výzkumy v roce 2006*. Olomouc (Palackého univerzita), pp. 154-159.
LEHOTSKÝ, M., NOVOTNÝ, J., GREŠKOVÁ, A.(2008). Complexity and Landscape. *Geografický časopis*, 60, 95-112.
MACURA, V. (1987a). Príspevok k určeniu a využitiu parametrov stabilného režimu korýt tokov. *Vodní hospodářství*, A, 152-154.
MACURA, V. (1987b). Určenie granulometrie štrkopieskového materiálu korýt tokov fotografickou metódou. *Vodní hospodářství*, A, 296-300

MACURA, V. (1990). Určenie hydraulických a geometrických parametrov stabilných úsekov tokov. In *Obnova vegetačního doprovodu toků a revitalizace povodí.* Ostrava (SVK), pp. 39-43.

MACURA, V., SZOLGAY, J, KOHNOVÁ, S. (2002). *Úprava tokov*. Bratislava (ES STU).

MEDVEĎOVÁ, A., PROKEŠOVÁ, R., KRÁTKA, E. (2007). Morfológia bystrinného toku – príklad potoka Vôdka. *Geomorphologia Slovaca et Bohemica*, 7, 25-36.

MICHALKOVÁ, M. (2006). Mapovanie a časovo-prietorová analýza mŕtvych ramien Sacramenta (Kalifornia). *Aktivity v kartografii*, 151-158.

MICHALKOVÁ, M. (2009). Analysis of lateral channel activity of Sacramento river from aerial photos. *Geografický časopis*, in press.

MONTGOMERY, D., BUFFINGTON, J. (1997). Channel-reach Morphology in Mountain Drainage Basins. *Geological Society of America Bulletin*, 109, 596-611.

NOVOTNÝ, J., LEHOTSKÝ, M. (2005). Pozdĺžny profil rieky – nástroj geomorfologického výskumu. In Rypl, J., ed. *Geomorfologický sborník 4: Stav geomorfologických výzkumů v roce 2005.* České Budějovice (Jihočeská universita), pp. 63-66.

NOVOTNÝ, J., LEHOTSKÝ, M., GREŠKOVÁ, A. (2007). Súčasný morfologický vývoj medzihrádzového priestoru (Dunaj, Bratislava). *Geomorphologia Slovaca et Bohemica*, 7, 72-78.

NOVOTNÝ, J., LEHOTSKÝ, M., GREŠKOVÁ, A., SZMAŃDA, J. B. (2008). Geomorfologický výskum nivy Dunaja (Bratislava – Petržalka). In Kalábová, E., Smolová, I., Ira, V., eds. *Změny regionálních struktur České republiky a Slovenské republiky*. Brno, Olomouc (Ústav geoniky AV ČR, Palackého univerzita), pp. 18-23.

PASTUCHOVÁ, Z., GREŠKOVÁ, A., LEHOTSKÝ, M. (2006). Vplyv morfohydraulických charakteristík na štruktúru a distribúciu vybraných skupín makrozoobentosu toku Drietomica (Biele Karpaty). In Sacherová, V., ed. *Sborník příspevků 14. konference České limnologické společnosti a Slovenskej limnologickej spoločnosti*. Praha (Česká limnologická společnost), pp. 118-119.

PASTUCHOVÁ, Z., LEHOTSKÝ, M., GREŠKOVÁ, A. (2008). Influence of morphohydraulic habitat structure on invertebrate communities (Ephemeroptera, Plecoptera and Trichoptera). *Biologia*, 63, 720-729.

PEDERSEN, M. L., OVESEN, N. B., FRIBER, G. N., CLAUSEN, B., LEHOTSKÝ, M., GREŠKOVÁ, A. (2004). *Hydromorphological assessment protokol for the Slovak Republic. ANNEX 1.* Accessed <http://www.shmu.sk/File/implementacia_rsv/twinning/a1_Protocol_final.pdf> (02-02-2005).

PIŠÚT, P. (1995). Meandrovanie Dunaja pri Bodíkoch pred zmenou charakteru riečiska v 18. storočí. *Geografický časopis*, 47, 285-298.

PIŠÚT, P. (2002). Channel evolution of the pre-channelized Danube River in Bratislava, Slovakia (1712-1886). *Earth Surface Processes and Landforms*, 27, 369-390.

PIŠÚT, P. (2005). Príspevok historických máp k rekonštrukcii vývoja koryta Dunaja na uhorsko-rakúskej hranici (16.-19. storočie). In Pravda, J., ed. *Historické mapy: Zborník z vedeckej konferencie Bratislava 17. 3. 2005*. Bratislava (Kartografická spoločnosť SR a GgÚ SAV), pp. 167-181.

PIŠÚT, P. (2006). Evolution of meandering lower Morava river (W Slovakia) during the first half of 20th century. *Geomorphologia Slovaca*, 6, 55-68.

PIŠÚT, P. (2008). Endangerment of the village Čunovo (Slovakia) by lateral erosion of the Danube River in the 18th century. *Moravian Geographical Reports*, 16, 33-44.

PIŠÚT, P., KUBALOVÁ, S., HAJNALOVÁ, M., SLAMKOVÁ, M. (2004). Study of the Danube River palaeochannel, Slovakia (preliminary results). *Geomorphologia Slovaca*, 4, 12-21.

PIŠÚT, P., TOMČÍKOVÁ, I. (2008). Rekonštrukcia zmien vodného toku Smrečianka v jej odozvovej zóne podľa historických máp. *Geographia Cassoviensis II*, 1, pp. 122-127.

RAPLÍK, M., SZOLGAY, J. (1986). *Kvantitatívna hydromorfológia*. Bratislava (SVŠT, Stavebná fakulta).

ROSGEN, D. L. (1994). A classification of natural rivers. *Catena*, 22, 169-199.

SZMAŃDA, J. B., LEHOTSKÝ, M., NOVOTNÝ, J. (2008a). Zapis sedymentologiczny powodzi z 2002 i 2007 r. w aluwiach pozakorytowych Dunaju w Bratyslawie. *Landform Analysis*, 8, 83-87.

SZMAŃDA, J. B., LEHOTSKÝ, M., NOVOTNÝ, J. (2008b). Sedimentological record of flood events from year 2002 and 2007 in the Danube River overbank deposits in Bratislava (Slovakia). *Moravian Geographical Reports*, 16(4), 25-32.

ŠÍBL, J., DERKA, T., HOLČÍK, J., MACURA, V. (1999). *Revitalizácia vodných tokov*. Nitra (Slovenská poľnohospodárska univerzita v Nitre a Prírodovedecká fakulta Univerzity Komenského v Bratislave).

TOMČÍKOVÁ, I. (2005a). Štruktúry riečnej krajiny na príklade rieky Smrečianka. In Měkotová, J., Štěrba, O., eds. *Říční krajina 3., Olomouc 5. – 6. 10. 2005*. Olomouc (Palackého univerzita), pp. 336-343.

TOMČÍKOVÁ, I. (2005b). Štruktúry riečnej krajiny okresu Liptovský Mikuláš. In *Zborník z medzinárodnej konferencie. Transformační procesy v přihraničí, Ostrava 10.-11. 10. 2005*. Ostrava (Ostravská univerzita), pp. 239-247.

TOMČÍKOVÁ I. (2006). Morfológia riečnej krajiny vysokogradientového vodného toku (príklad Smrečianky). In Měkotová, J., Štěrba, O., eds. *Říční krajina 4, Olomouc, 18. 10. 2006*. Olomouc (Univerzita Palackého), pp. 320-326.

TOMČÍKOVÁ, I. (2007). Hierarchická klasifikácia riečnej krajiny na príklade rieky Smrečianka. *Geographia Cassoviensis, I*, pp. 193-196.

TOMČÍKOVÁ, I (2008). River landscape, the morphological zones of the Smrečianka river. In Svatoňová, H., et al., eds. *Geography in Czechia and Slovakia Theory and practice at the onset of 21st century*. Brno (Masaryk University), pp. 148-152.

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REGIONAL GEOMORPHOLOGICAL DIVISION OF SLOVAKIA: OLD PROBLEM IN NEW PERSPECTIVES

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Regionálne geomorfologické členenie Slovenska: starý problém v nových perspektívach
Problém geomorfologického členenia Slovenska treba neustále aktualizovať. Autormi posledného členenia sú E. Mazúr a M. Lukniš. Ich mapa „Regionálne geomorfologické členenie v mierke l:500 000 vyšla v roku 1980. V tom čase vyjadrovala stav geomorfologického poznania a zodpovedala aj požiadavkám praxe. Po tridsiatich rokoch je však potrebné ju aktualizovať. V rámci projektu VEGA „Regionálne geomorfologické členenie Slovenska 1:50 000“ bola preto spomínaná mapa premietnutá do topografickej mapy mierky 1:50 000 (180 mapových listov) a následne digitalizovaná. Táto transformácia nastolila celý rad nových problémov spätých s podrobným geomorfologickým členením a jeho kartografickým vyjadrením.

Kľúčové slová: geomorfologické členenie, geomorfologické hranice, sústava, podsústava, provincia, subprovincia, oblasť, celok, podcelok, časť

INTRODUCTION

The problem of regional geomorphological division is a classic one. It is both new and old. The old problem is continuously updated in the context of newly acquired knowledge. The Authors of the most recent geomorphological division of Slovakia are E. Mazúr and M. Lukniš. Their map *Regional geomorphological division* (1:500 000) was published in l980 at the Institute of Geography, SAS as part of the map series *Regional geographical syntheses of the SSR. Series of diagnostic and prognostic maps of landscape and the environment*. The territory of Slovakia on these map is divided into eight hierarchical levels: system, subsystem, province, subprovince, region, unit, subunit and part. The same map under the title *Geomorphological Wholes* was also published in the *Atlas of the SSR in l980*.

The map *Regional geomorphological division* updated the preceding geomorphological divisions of Slovakia and simultaneously satisfied the then existing requests of the practical sphere (Mazúr and Lukniš l978). Today, after thirty years, the updating of the regional geomorphological divisions (RGD) is topical again. The map of *Regional geomorphological division* at the scale of 1:500 000 is too general. It does not adequately reflect the present status of the geomorphological knowledge and does not correspond to the needs of the practical sphere, particularly the need to include the geomorphological division of Slovakia as a layer into the Fundamental Base of the Geographical Information System. This need was responded by the project *Geomorphological division of Slovakia at scale 1:50 000* of the VEGA Grant Agency.

The aim of the Project was to convert the map *Regional geomorphological division* (RGD) from 1:500 000 to 1:50 000 scale and preserve to the greatest possible

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degree the whole hierarchy of the original regional division. It meant not altering the original network of boundaries, not creating new wholes or altering the hierarchy of the division. Consequently, the map *Regional geomorphological division* was projected on l80 map sheets at the scale of 1:50 000 and digitized. During the Project work though, it was found that updating of the original map is a far more complicated task. The updating cannot be limited to simple application of a more detailed scale because this operation involves varied changes precisely such as the changes of the boundary network, those in the hierarchical system of the geomorphological division, creation of new wholes, and so on. Such changes were avoided under the Project because it was not possible to accomplish them in a desirably thorough and systemic way. This is a task, which is far beyond the possibilities of the Project. On the other side, the scope and nature of such changes can be quite easily anticipated. The authors of this study concentrate on the problems that have appeared during the transformation of the RGD map at the scale of 1:500 000 into the one at the scale of 1:50 000.

METHODOLOGY

A simplifying illusion has accompanied the production of the analogue map. It was the idea that the RGD map at a scale of 1:500 000 can be simply projected on to the topographic map at a scale of 1:50 000. The clear fact that between the space depicted on the topographic maps at smaller and bigger scales is a huge qualitative difference was simply ignored. Meanwhile, the projection of the RGD map from a smaller onto a bigger scale represents a fundamental transformation. This illusion is the result of certain methodological vacuum that existed in the process of geomorphological regionalization.

Fortunately, a very good map of *Regional geomorphological division* at a scale of 1:500 000 (Fig. 1 brings its simplified form) is available. However, the method which was applied to the production of this map is not altogether known as it was not explicitly and adequately described although the authors of this map wrote the study *Regional geomorphological division* (Mazúr and Lukniš l978), the primary function of which was that of an introductory commentary to the eponymous map. However, they only suggested the principal features of the method of the regional geomorphological division. The authors did realize this fact. They were preparing an extensive study with a detailed explanation of the methodology but the intention was never realized. The *methodological vacuum* in the form of missing explanatory notes became permanent. The method used for the production of the *Regional geomorphological division* map remained uncertain.

The authors of the above mentioned study assert that the geomorphological regionalization is a logical link to typification of relief, it means the map of *Relief Types* (Atlas SSR l980). The criterion for the delimitation of geomorphological wholes is the contact lines or boundaries between the different relief types such as foothill lines, terrain edges, saddles, morphostructural and morphosculptural lines, etc. This criterion is in no way questionable. However, in terms of methodology, it is a very uncertain criterion, because it was not specified how to work with this large set of boundaries in the concrete space of the detailed topographic map. Particularly, when the boundary line is to be drawn over a valley; when it crosses a ridge or foothills, when to give preference to the boundary on an active to that on a passive morphostructural line, etc. This albeit correct but vague criterion in the

concrete space of the topographic map at the scale of 1:50 000 is an inefficient tool. The problem will be addressed in more detail later on. The study also reports that geomorphological regionalization is a top-bottom process. It is the logical division after Grigg (l965). The method is acceptable but it is not specified. Logical division is the method that can acquire many different forms. It depends on the applied criterion of division. The logical division, according to which the map *Regional geomorphological division* was made, was not exactly defined or supported by arguments. This methodological uncertainty causes numerous inconsistencies, which will be analysed later.

In the situation caused by the methodological vacuum, the gap between the maps at scales 1:500 000 and 1:50 000 can be filled in only one way. It is the method that proceeds in a way contrary to the usual method of *generalization*, which means from a detailed map to a general one. It is the method that can be called concretization as it proceeds from the general map to a detailed and particular map. It means the return to the *empirical basis*, the aim of which is to restore the *precise reference* of the whole hierarchic system of geomorphological wholes (parts subunits, units, etc.) to the topographic situation depicted on the map at the scale of 1:50 000, in other words, to identify the boundaries of the geomorphological wholes depicted on the map at the scale of l:500 000 on the map with the scale of 1:50 000. The problem was dealt with on a general level (Urbánek l997). Only after this first step of the geomorphological analysis, the analysis of relationships composed of two linked steps i.e. *differentiation and systemization* can follow (Urbánek 2000). This geomorphological analysis took place in the above mentioned methodological vacuum when its rules were only hinted at. It gained clearer contours only in the process of mapping of the concrete geomorphological units on the map at the scale of 1:50 000. Hence, the methodological vacuum can be eliminated progressively to disappear definitely at the end of the path.

IDENTIFICATION OF BOUNDARIES

The inevitable step is identification. Its aim is to establish contact with the empirical basis in order to secure the reference for the geomorphological division of Slovakia with a particular situation represented on the topographic map at scale 1:50 000. Fig. 2 illustrates the difference and the relationship between the borders of geomorphological wholes represented on the map at the scale of 1:500 000 and the borders of the same units on the map at the scale of 1:50 000. The boundary on the map at the small scale was identified on the map at the large scale, which means that its course, shape and situation were established. Identification of the boundary network was made on l80 map sheets at the scale of 1:50 000.

The map of *Regional geomorphological division* was verified in the process of identification. The overwhelming majority of boundaries of the geomorphological wholes represented on this map could be identified in its shape on the topographic map at the scale of 1:50 000. Verification is not only related to this map but logically also to other maps at the scale of 1:500 000. They are the maps *Relief types* and *geomorphology* included in the *Atlas SSR* from 1980. All these maps possess a very similar boundary network and a *similar pattern*. This pattern represents a common synopsis, the basic spatial differentiation of the relief in Slovakia. It is even possible to say that this synopsis was verified on the 180 map sheets at the scale of 1:50 000.

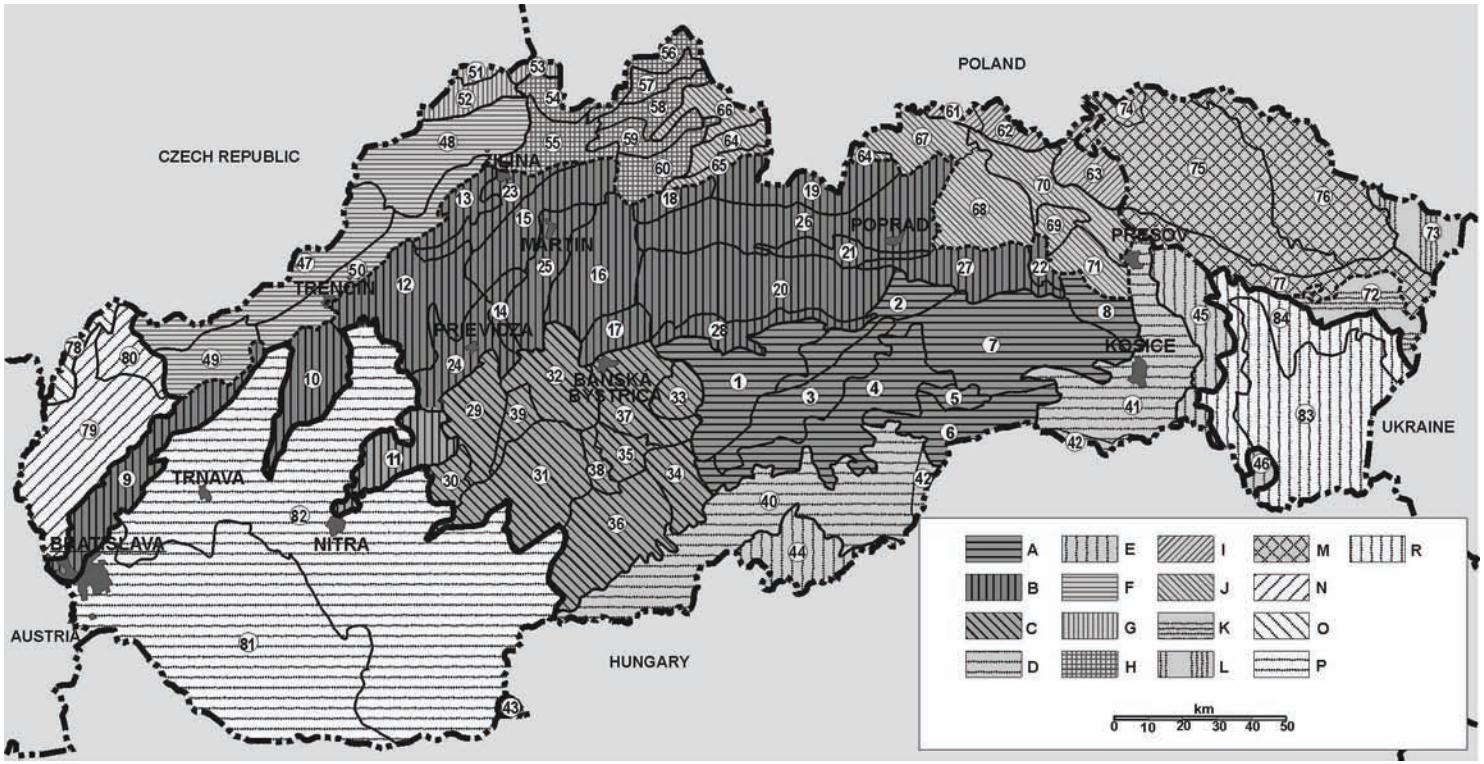

Fig. 1. Geomorphological division of Slovakia (Lukniš and Mazúr 1978)

A Slovenské rudohorie Mts.

1 – Veporské vrchy, 2 – Spišsko-gemerský kras, 3 – Stolické vrchy, 4 – Revúcka vrchovina, 5 – Rožňavská kotlina, 6 – Slovenský kras, 7 – Veporské vrchy, 8 – Čierna hora

B Fatra – Tatry region

9 – Malé Karpaty, 10 – Považský Inovec, 11 – Tribeč, 12 – Strážovské vrchy, 13 – Súľovské skaly, 14 – Žiar, 15 – Malá Fatra, 16 – Veľká Fatra, 17 – Starohorské vrchy, 18 – Chočské vrchy, 19 – Tatry, 20 – Nízke Tatry, 21 – Kozie chrbty, 22 – Branisko, 23 – Žilinská kotlina, 24 – Hornonitrianska kotlina, 25 – Turčianska kotlina, 26 – Podtatranská kotlina, 27 – Hornádska kotlina, 28 – Horehronské podolie

C Slovenské stredohorie Mts.

29 – Vtáčnik, 30 – Pohronský Inovec, 31 – Štiavnické vrchy, 32 – Kremnické vrchy, 33 – Poľana, 34 – Ostrôžky , 35 – Javorie, 36 – Krupinská planina, 37 – Zvolenská kotlina, 38 – Pliešovská kotlina, 39 – Žiarska kotlina

D Lučenec – Košice Lowland

40 – Juhoslovenská kotlina, 41 – Košická kotlina, 42 – Bodvianska pahorkatina

E Matra – Slaná region

43 – Burda, 44 – Cerová vrchovina, 45 – Slanské vrchy, 46 – Zemplínske vrchy

F Slovensko-moravské Karpaty Mts.

47 – Biele Karpaty, 48 – Javorníky, 49 – Myjavská pahorkatina, 50 – Považské podolie

G West Beskids

51 – Moravsko-sliezske Beskydy, 52 – Turzovská vrchovina, 53 – Jablunkovské medzihorie

H Middle Beskids

54 – Kysucké Beskydy, 55 – Kysucká vrchovina, 56 – Oravské Beskydy, 57 – Podbeskydská brázda, 58 – Podbeskydská vrchovina, 59 – Oravská Magura, 60 – Oravská vrchovina

I East Beskids

61 – Pieniny, 62 – Ľubovnianska vrchovina, 63 – Čergov

J Subalpine – Magura region

64 – Skorušinské vrchy, 65 – Podtatranská brázda, 66 – Oravská kotlina, 67 – Spišská Magura, 68 – Levočské vrchy 69 – Bachureň, 70 – Spišsko-šarišské medzihorie, 71 – Šarišská vrchovina

K Vihorlat – Gutin region

72 – Vihorlatské vrchy

L Poloniny Mts.

73 – Bukovské vrchy

M Low Beskids

74 – Busov, 75 – Ondavská vrchovina, 76 – Laborecká vrchovina, 77 – Beskydské predhorie

N South Moravian Basin

78 – Dolnomoravský uval

O Záhorie Lowland

79 – Borská nížina, 80 – Chvojnícka pahorkatina

P Danubian Lowland

81 – Podunajská rovina, 82 – Podunajská pahorkatina

R East Slowakian Lowland

83 – Východoslovenská rovina, 84 – Východoslovenská pahorkatina

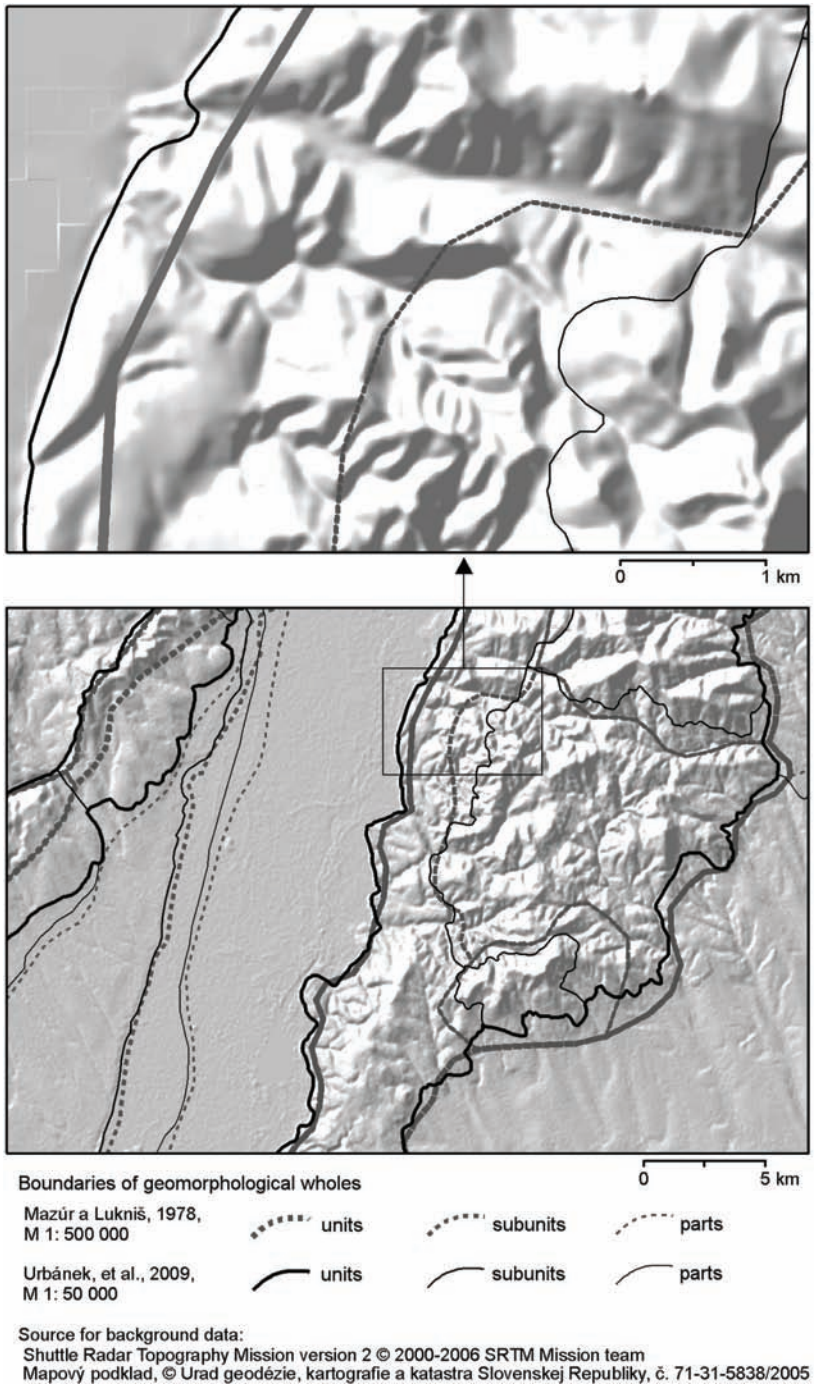

Fig. 2. Boundaries of geomorphological wholes in differnet scales

In the process of identification, the whole boundary network represented on the map at the scale of 1:500 000 was verified as an objective one. However, simultaneously this network in the specific space of the map at the scale of 1:50 000 appeared as a relatively inadequate one. But it is not fault of the map *Regional geomorphological division.* It is only the logical consequence of its transformation into a more detailed scale. The space of the map at scale 1:50 000 is qualitatively different hence it requires a more precise and more concrete boundary network. A more complicated spatial structure of the boundaries becomes clearly evident in this space and that opens a number of new problems.

Many boundaries on the map at the scale of 1:50 000 are not continuous. Boundaries are distinct in some sections and get lost in other. Drawing of such boundaries required numerous *interpolations.* It was necessary to do so above all on the foothills of mountain ranges with basins and lowlands because numerous narrow or wider valleys often interrupt these boundaries. Considerable distances had to be often bridged by interpolation. Similar, as a rule even stronger interpolation, had to be done on the boundary between the higher and lower parts of mountain ranges and boundaries between basins and lowlands. Boundaries *doubled* in many places. Where it was possible to draw the boundary as a single line on the map at the scale of 1:500 000, a double boundary or even bundles of boundaries appeared in the concrete space of the map at the scale of 1:50 000. It was mainly in cases when the boundary on the map at the scale of 1:500 000 ran in the centre of the valley. This boundary acquired a shape of a double one in the specific space of the map at the scale of 1:50 000. Such doubling was distinct above all in wider valleys. Even more complicated was the situation in valleys where apart from the present bottom, remnants of an older and taller bottom were recognizable. As far as it was possible, these more complicated geomorphological situations were not represented on the map at the scale of 1:50 000. It would lead to the origin of numerous new geomorphological units requiring a considerable transformation of the whole established and codified hierarchical system of the regional geomorphological division. It was not possible to accomplish such transformation under the Project.

The complex boundary structure represented in the specific space of 180 map sheets at the scale of 1:50 000 opens a series of problems that did not exist or were not so evident on the map at the scale of 1:500 000. They are the problems associated with differentiation followed by systemization of boundaries.

DIFFERENTIATION OF BOUNDARIES

Identification of the entire network of boundaries of geomorphological wholes represented on l80 map sheets at the scale of 1:50 000 revealed a serious and chronically disregarded question. As a rule, the boundary is never given a systematic and deserved attention. This important geomorphological phenomenon is still disregarded; it is not systematically analysed (Urbánek 1997, 2000 and 2003). Boundaries on the map *Regional geomorphological division* are differentiated only in terms of hierarchy; it means, boundaries of the system, those of the subsystem, province, etc. They are not differentiated within any hierarchical level and remain *analytically not identified*. They are drawn as a homogenous line. But in the concrete space of the map at the scale of 1:50 000 they appear differentiated to such an extent that this phenomenon cannot be overlooked. Qualitatively different sections compose them.

Every boundary represents a *spatial relationship* or a *difference*. Two different terrains meet on any boundary. A boundary is *qualitatively determinated* by the difference between two such contiguous terrains. In this way, a very wide spectrum of spatial differences albeit qualitatively not identified or analysed is encoded in the boundary network represented on the sheets of the map at the scale of 1:50 000. The boundary of a certain whole, for instance, that of a basin, is qualitatively not the same a round the whole course of the basin girth. Various types of relief corresponding to a basin with different types of relief that belong to the contiguous ranges or other whole are in contact on individual sections of the boundary. The boundaries of the majority of the geomorphological wholes are highly differentiated. Some of them run alternatively over saddles and mountains between saddles. Some follow water sheds and some run in the valley bottom or on the foothills. In some places the boundary follows the tectonic line or the dividing lines between passive morpho-structures but it can also separate different generations of forms etc.

The boundary network represented on the l80 map sheets at the scale of 1:50 000 represents a wide *empirical basis* for the above outlined analysis of relationships, which would not be possible without previous identification. This analysis consists of two basis steps. First of all, the nature of individual spatial differences represented in entire boundary network must be *determined analytically* and then this wide spectrum must be *classified*. This is the case of the "bottom-up" type of classification, which is ased on the set of particular and analytically identified boundaries (spatial differences) grouped into glasses based on similarities. It is the *typification of the geomorphological boundaries* that removes a considerable part of the above mentioned me-thodological vacuum. It is a task that far exceeds the framework of the above-mentioned Project. The boundary network identified on map sheets at the scale of 1:50 000 of course, does not solve but anticipates the problem in a distinct form.

The problem of boundary differentiation of the geomorphological wholes cannot yet be displayed in the context of the whole of Slovakia. It will be only demonstrated on a specific example of foothill lines between ranges and basins. The course of some of them is not unambiguous. It was the reason why the basic and auxiliary criteria were opted for in their differentiation.

Mazúr and Lukniš (1978 and 1980) already relied on the basic morphostructural plan of Slovakia when they delimited the geomorphological wholes on the level of units. They took the mosaics of mountain ranges (horst) and basins (grabens) for the basis. There is a comparatively distinct boundary between these geomorphological wholes predestined by the fault lines of the uplifting of individual ranges against basins. These boundaries characterized by steep slopes are more evident in big inter-range basins while they are less conspicuous in the case of lesser basins and erosion furrows within ranges or they are places changed by different properties of rocks (resistance, for example) or under the effects of linear or lateral erosion.

As the point is the geomorphological division the most elementary trait that controls the course of the boundaries is the foothill line as emphasized already by Hromádka (1956a and 1956b). Mazúr and Lukniš also made use of it. However, there are morphological transitions between basins and ranges where the course of the foothill line is ambiguous due to several morphological differences. This was the reason why: 1. Basic criteria and 2. Auxiliary criteria were established for the

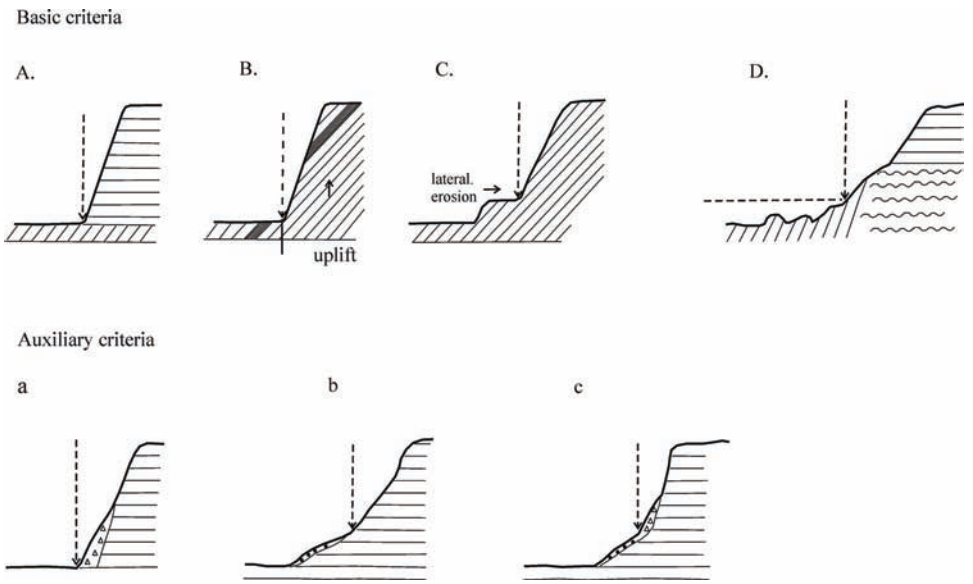

Fig. 3. Boundaries of geomorphological units (mountains – basins)

Basic criteria: A – Geological boundary, B – Tectonic boundary, C – Erosional boundary (pediment), D – Erosional boundary (hillyland – upland)

Auxiliary criteria: a – Boundary at the foot of talus cone (occurrence in A, B, C), b – Boundary in top of deluvium (occurrence in C, D), c– Boundary between deluvium and talus cone (occurrence in C, D)

delimitation of boundaries between individual units and for making of boundaries between geomorphological wholes at a lower hierarchical level (Fig. 3). Combination of the quoted criteria can be applied to individual geomorphological units.

Basic criteria

A. *Geological boundary* defined by different hardness and resistance of rocks: examples are less resistant Lower Triassic marled limestone rocks compared to resistant Middle Triassic limestone and dolomite (Rožňavská Basin) rocks. Different weathering process of such rocks also plays an important role. The Paleogene or Neogene filling of basins against the Mesozoic or resistant crystalline rocks (Liptovská Basin) is more frequent,

B. *Tectonic boundary* is identifiably from the steep slopes of the surrounding mountain ranges; facets on spurs support its legibility. Coincidence of a fault with the geological boundary is also frequent (Turčianska Basin),

C. *Erosion boundary with generation of foothill pediments* accompanied by the process of lateral erosion. This pediment though, is not always present, it does not proceed uninterruptedly on the contact of the basin and range. We classify pediment under a basin. Its importance is greater in deep depressed forms than in shallow ones. Examples are the Horehronské Valley or Hornádska Basin,

D. *Morphographic boundary:* transition between hill land and upland. The bottom acquires the character of hill land in larger basins (altitudinal dissection is 3-

100 m). The boundary between the hill land, which is part of a basin, and the up-land, which is part of a range, is not always discernible so it is necessary to apply the morphographic criterion (example: some parts of the Zvolenská Basin).

The level of altitude of the hill land and the pediment is approximately the same. In the case of large inter-mountain basins they are aligned to basin bottoms as their parts.

Hill lands in smaller inner-mountain basins and erosion furrows in places dissemble into an upland. Additional criteria must be used for the delimitation of the basin boundary.

Auxiliary criteria

The clearness of a boundary, hence the course of the foothill line, is in places erased by slope material, result of weathering and gravitational processes. They are the *debris cones* that form on the foothills of very resistant rocks like granite but more often limestone. Slopes of the corresponding material are very steep (inclination > 45°), even perpendicular. Debris cones are also steep. This is the reason why the foothill line runs between the bottom of the depression and the lower edge of cones. In terms of morphology and geology they are parts of the convex form. *Slope diluvia* represent the deposits of weathering process, which were deposited on the slope as effects of slope modelling. They are loam or loam-sand deposits on moderately inclined slopes that are parts of the basin bottom or of erosion furrow. Diluvia are also formed on slightly inclined slopes below the debris cones.

Differentiation of boundaries of geomorphological units is only the first of the indispensable steps proper to relationship analysis. The second step is systemization. Its purpose is to find the group of relationships that play the decisive role in the *regional geomorphological division*.

SYSTEMIZATION OF BOUNDARIES: REGIONALIZATION

The functions of the geomorphological boundary that is as a rule left analytically un-identified are numerous. First of all, it discerns two contiguous forms, geomorphological types, etc. This function was discussed above. Apart from it, the geomorphological boundary can also *systemize different geomorphological types* into geomorphological wholes on different hierarchical levels. It also facilitates the regional geomorphological division. This function of the geomorphological boundary is ambivalent. It both, unites and separates the contiguous geomorphological wholes. At a certain hierarchic level, the boundary separates two geomorphological wholes, for instance two mountain ranges. At a lower level, however, this same boundary unites different parts of each range into independent units. This ambivalent function of the geomorphological boundary is the indispensable requisite of the logical division namely the regional geomorphological division of a certain territory. The method of geomorphological regionalization lies in this *ambivalent* function of the geomorphological boundary.

The above-mentioned methodological vacuum concerns above all the geomorphological regionalization. The method how to create geomorphological wholes on different hierarchical levels is still very vague. The boundary network represented on the map *Regional geomorphological division* was verified by the fact that it was

also identified in the concrete space of map sheets at the scale of 1:50 000. However, only the location of these boundaries, their course, shape and structure were verified. What is the function of these objective geomorphological boundaries in terms of geomorphological regionalization? When and on which hierarchical level do they represent the dividing and when the uniting boundary? How and by what method should this problem be solved?

The map *Regional geomorphological division* was compiled by the up-bottom method and that of the logical division. The biggest and top whole of the hierarchy was gradually divided into smaller ones situated at a lower level of the hierarchy. This operation was accomplished on eight hierarchical levels. Formally, this procedure cannot be reproached. The problem lies somewhere else. It depends on what *keys or criteria* were applied to the logical division. The answer is a surprising *paradox,* which could not be removed in the course of the Project. However, exposition of its nature can help its removal.

Mazúr (1979) defined the Západné Karpaty mountain range as a megamorphostructure with an ellipsoid ground plan and culmination in the area of the Tatry, which differentiates into the mosaic of inter-mountain basins and ranges. Mazúr also expressed this idea on a map. But the idea was not paradoxically used as the principle for the logical division in the regional geomorphological division. The map *Regional geomorphological division* was constructed pursuing other principles and other logical divisions. This has caused numerous incongruities that are manifested in different ways and on different hierarchical levels.

No serious problems occur on the three top levels (system, subsystem and province). Nevertheless, a problem with the klippen belt emerges. What is the function of this belt in the regional geomorphological division? It is the problem of the above-mentioned systemization. Is the klippen belt a line, which divides the geomorphological whole on the level of subprovince, or should an other dividing line be given preference on this level? Geologists (Vass et al. 1988) consider the narrow klippen belt a boundary between the Outer and the Inner Western (and Eastern) Carpathians. The situation is different in the geomorphological regionalization. Authors of the geomorphological division drew the boundary in an other way. Their geomorphological boundary follows the passive geological boundary between what is referred to as the core and the flysch structures. They also included the wholes formed by the Inner Carpathian flysch (Skorušinské vrchy, Spišská Magura, Levočské vrchy, Ba-chureň, Šarišská vrchovina) into the Outer Western Carpathians. Regarding the present knowledge of the active morphostructure of Slovakia this boundary should be changed. The boundary between the Inner and Outer Carpathians should be the klippen belt not only in the geological, but also in the geomorphological division. This morphostructural phenomenon is not only passive but also active; it is a zone of active faults and seismic phenomena. It also fits well into the ellipsoid arch of the Western Carpathians. Geomorphological wholes where the klippen belt lies were aligned to the Outer Carpathians. It is the case of the Biele Karpaty, Javorníky, Kysucká vrchovina, Oravská vrchovina, Pieniny, Ľubovnianska vrchovina and Spišsko-šarišské medzihorie Systemization of the Myjavská pahorkatina and Súľovské vrchy is problematic. As the klippen belt runs on the outer side of these wholes, they should be included as the Inner Carpathian wholes. The Skorušinské vrchy, Spišská Magura, Levočské vrchy, Bachureň, Šarišská vrchovina should be included in the Inner Western Carpathians although they are composed of flysch rocks.

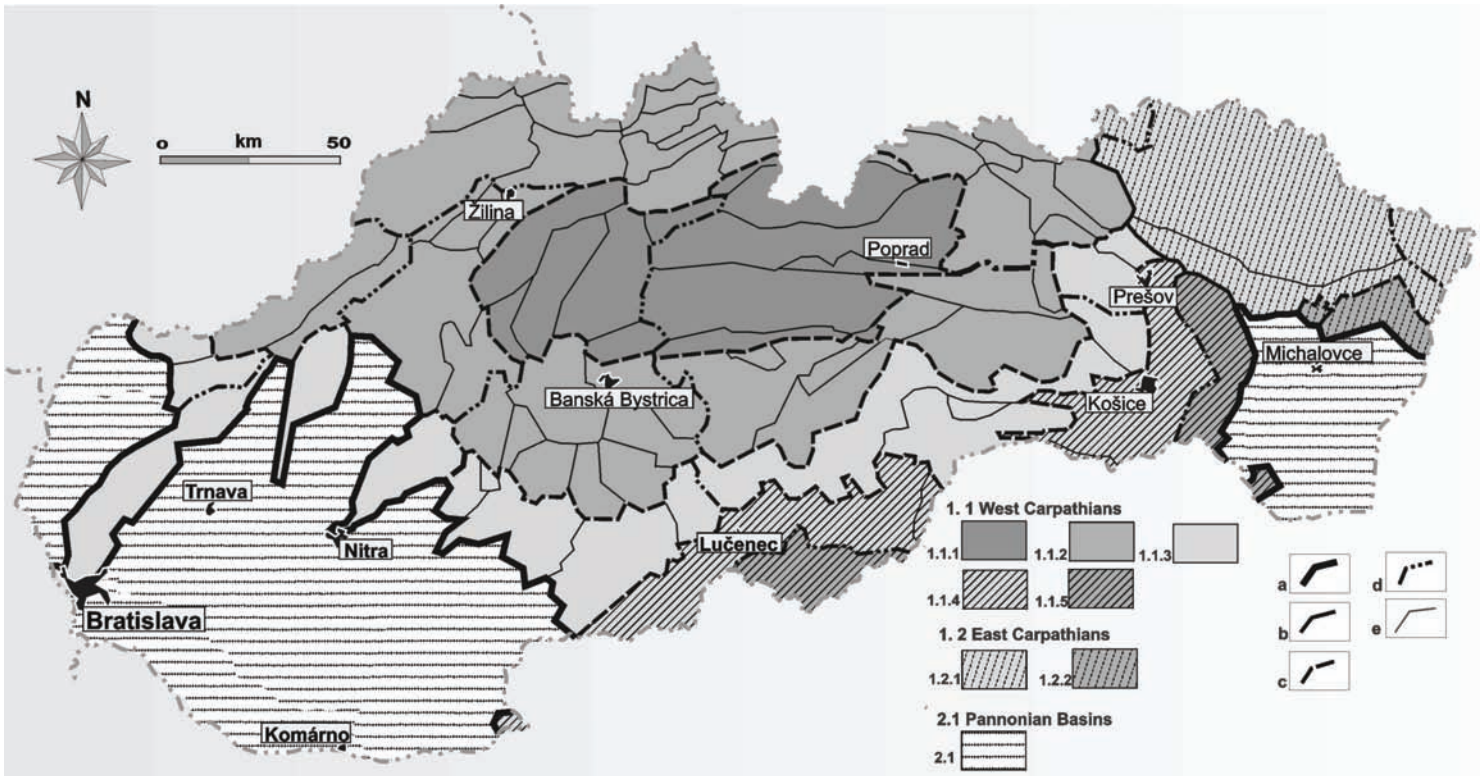

Fig. 4. Morphostructural division of Slovakia (Lacika and Urbánek 1998)

1. Carpathians
1.1 West Carpathians
1.1.1 Central morphostructures of the West-Carpathians dome
1.1.2 Transitive morphostructures of the West-Carpathians dome
1.1.3 Marginal morphostructures of the West-Carpathians dome
1.1.4 Southern depressional morphostructures
1.1.5 Southern elevation morphostructures
1.2 East Carpathians
1.2.1 Outher zone morphostructures of the East Carpathians
1.2.2 Inner zone morphostructures of the East Carpathians

2. The Panonnian Basin
2.1 Pannonian Basins

Borders of morphostructures
a. Broders of morphostructures of the 1st order
b. Broders of morphostructures of the 2nd order
c. Broders of morphostructures of the 3rd order
d. Broders of morphostructures of the 4th order
e. Broders of morphostructures of the 5th order

The greatest number of problems have been found on the level of regions. The disagreement between the real West Carpathian Arch and the boundaries on the map Regional g*eomorphological division* is the most conspicuous. The boundary on this map runs along the passive morphostructures. The active morphostructure represented by the West Carpathian Arch was not taken into consideration on this hierarchical level. The result of such division is, for instance the Fatra-Tatry region. The only thing common to the territory that is so heterogeneous in terms of geomorphology is its geological structure consisting of the crystalline Mesozoic rocks. On the other side, as far as morphostructure of this area is concerned there are very different wholes. Geomorphological incongruities are evident between the Malé Karpaty and the Tatry and that should be taken into account in their systemization into higher geomorphological wholes.

A similar incongruity is obvious in the case of the Slovenské stredohorie and Slovenské rudohorie regions. A distinct boundary dividing the taller parts from shorter ones runs over the two areas. It does not respect the boundary between the volcanic and crystalline-Mesozoic mountain ranges. It rather reflects differentiation of these mountain ranges within the West Carpathian Arch.

Drawbacks of the regional geomorphological division at the level of subprovinces are described in a way that also suggests the method of their possible revision. They were pointed to but not removed on the map at the scale of 1:50 000 because it is only possible via a systematic geomorphological analysis of the relief of Slovakia on all its hierarchical levels.

The way to avoid the mentioned discrepancies was outlined in several consecutive studies. First of all there was an attempt at a closer characterization of the West Carpathian Arch (Urbánek and Lacika l998). Then the basic features of the regional geomorphological division trying to respect the morphostructural nature of the West Carpathian Arch were proposed (Lacika and Urbánek l998 and Lacika l999). Fig. 4 shows a simplified form of the division.

The proposed geomorphological division is a draft, which tries to remove the described paradox in the logic of the regional geomorphological division. This draft has to be further specified and supported by additional arguments.

Numerous discrepancies were also found on the hierarchical level of units on the map of the *Regional geomorphological division*. Geomorphological units are divided unevenly and in different ways (Fig. 5). A formal and logical division is the one that divides the units in to subunits without residues and does not leave over any territory not assigned to any subunits. This is also true on a lower hierarchical level. Each subunit should be divided into parts without residues. Many units have been divided in such a correct way. However, there are still many that were divided in a different way and some have not been divided at all. The division ends at the level of unit. Some units have been divided into subunits but not into parts. Other units are divided directly into parts and the level of subunit has been skipped. The division of many units has been done in a way the left "forgotten territories". The unit is divided into subunits and there are territories, which do not belong to any of them. Similar forgotten territories were formed in the division of subunits in to parts. The division that is subject to strict criteria of the logical division cannot be applied to the geomorphological division as a universal standard. Particularly, the geomorphological units are objectively differentiated in different ways. A certain degree of imbalance of the formal-logical error is tolerable in some cases. However, imbalanced division of units must be ascribed to the errors in the proper process of the geomorphological division. Only a geomorphological analysis prepared for the scale of 1:50 000 and for the entire territory of Slovakia can remove such drawbacks. The contours of such analysis were only hinted at in the Project. The habitual division of units in to subunits and parts in the 1:50 000 map was then accepted in the overwhelming majority of cases. Corrections were only made in indispensable cases.

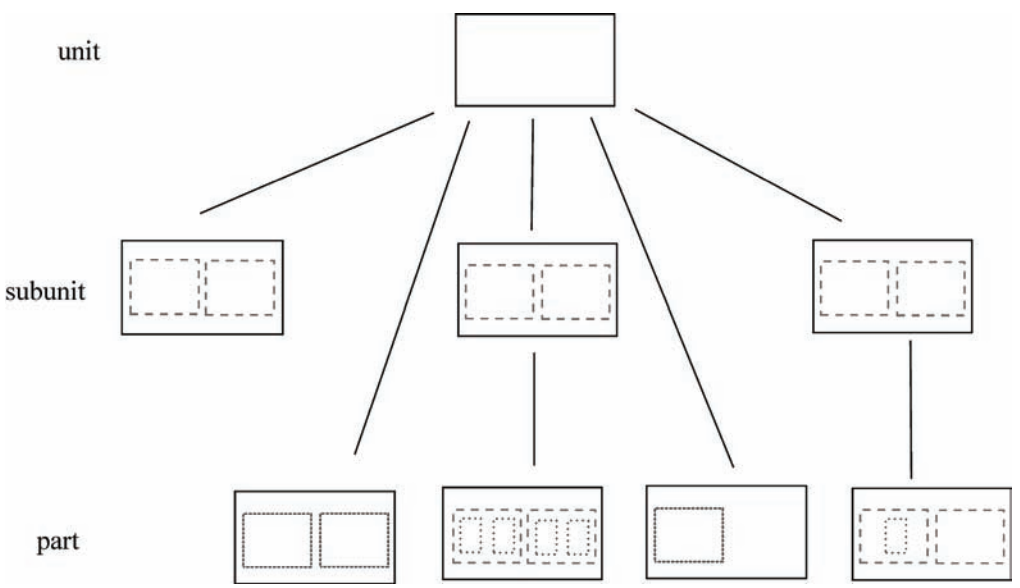

Fig. 5. Different ways of the geomorphological division

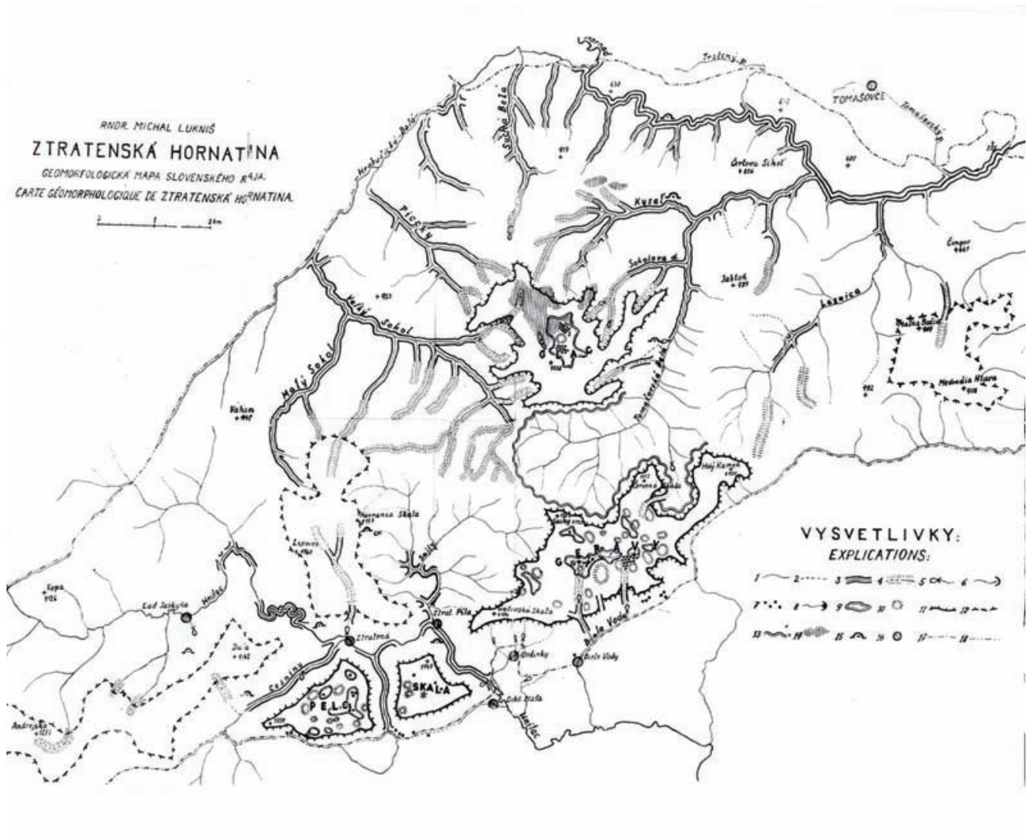

Fig. 6. Geomorphological map of Slovenský raj (Lukniš 1945)

1 – River, 2 – Dry valley, 3 – Canyon, 4 – Old pliocene valley, 5 – Karst resurgence, 6 – Ponor, 7 – Doline, 8 – Ponor in doline, 9 – Uvala, 10 – Hum, 11 – Boundary of good preserved plateau karst, 12 – Boundary odf partly preserved plateau karst, 13 – Upper margine of sack-line valley, 14 – Disintegratedd paleogene conglomerate (gravels), 15 – Cave, 16 – Settlement, 17 – Boundary of Ztratenská hornatina after J. Hromádka, 18 – Boundary between Poludnica nappe and Muráň series after R. Kittner

The karstic territories of the *Slovenský kras and Spišsko-gemerský kras* have been delimited in the current system as geomorphological units. However, the incongruity in their hierarchy appears already on the level of geomorphological subunits. Individual plateaus of the unit *Slovenský kras* are delimited as subunits with the proper names of plateaus (Koniarska Plateau, Plešivská Plateau, etc.). These subunits can also be cartographically represented on the 1:500 000 map.

The problems appear when the *Spišsko-gemerský* karstic area is divided as a unit into two subunits Slovenský raj and Muránska planina. The authors of such division (Mazúr and Lukniš 1978), were obviously inspired by the fact that it was not possible to represent smaller plateaus such as Pelc and Skala on the map at the quoted scale. On the other side, it should be noted that the area of the Geravy and Duča Plateaus correspond to the medium size plateaus of the Slovenský kras. However, it is possible to represent cartographically even smaller plateaus on a map at the scale of 1:50 000. For this reason, it is more practical to divide the *Spišsko-gemerský kras* into two geomorphological units *Slovenský raj* and *Muránska planina*. This may facilitate classification of the individual karstic plateaus as subunits. It would simplify the delimitation of karstic regions like in Slovenský kras. The name Spišsko-gemerský kras will have to be discarded. Such step is also supported by the fact that the geomorphological units are not numbered in the actual division like in the case of geomorphological subunits and parts. Lukniš (1945) already delimited seven karstic plateaus: Geravy, Glac, Matka Božia, Pelc, Skala, Duča and Havrania skala in the Stratenská hornatina and Slovenský raj (Fig. 6). Mazúr and Lukniš (1978) and Mazúr et al. (1986) also added the dolomitic karst of Tri kopce to Slovenský raj. Our task will be to align the contiguous more dissected parts of karstic ridges and valleys protruding from the edge of the plateaus to the individual plateaus. Lukniš' names can be maintained.

The name Spišsko-gemerský kras did not take root among geographers. The reason of the division is that two National Parks, those of Slovenský raj and Muránska planina, are involved.

Tab. 1. Geomorphological division of selected geomorphological wholes (by Mazúr and Lukniš 1980 and Mazúr et al. 1986)

Units	Slovenský kras	**Spišsko-gemerský kras**
Subunits	1. Jelšavský kras	1. **Muránska planina**
	2. Koniarska planina	2. **Slovenský raj**
	3. Plešivská planina	
	4. Silická planina	
	5. Horný vrch	
	6. Zádielska planina	
	7. Jasovská planina	
	8. Dolný vrch planina	
	9. Turnianska kotlina	
Parts	4.1. Silické úbočie	
	5.1. Borčianska brázda	

Entries in bold indicate the problematic classification on the hierarchical level

Tab. 2. New division of the geomorphological wholes of selected territories

Units	Slovenský kras	Slovenský raj	**Muránska planina**
Subunits	1. Jelšavský kras	1. **Glac**	1. **Muránsky kras**
	2. Koniarska planina	2. **Geravy**	2. **Tisovský kras**
	3. Plešivská planina	3. **Matka Božia**	
	4. Silická planina	4. **Pelc**	
	5. Horný vrch	5. **Skala**	
	6. Zádielska planina	6. **Duča**	
	7. Jasovská planina	**7. Havrania skala**	
	8. Dolný vrch	8. **Tri kopce**	
	9. Turnianska kotlina		
	10. **Borčianska planina**		
	11. **Štítnický kaňon**		
	12. **Slánsky kaňon**		
Parts	4.1. Silické úbočie		
	5.1. Borčianska brázda		

Entries in bold indicate the problematic classification on the hierarchical level

Note: New wholes (in bold) were added to the unit of the *Slovenský kras*. The Spišsko-gemerský kras is divided into two new units with delimited subunits, which are morphologically appropriate and similar in size to those of the Slovenský kras.

The boundary between some plateaus in Slovenský kras on the map at the scale of 1:500 000 was drawn through canyons and narrows. But canyons at the scale of 1:50 000 appear as a distinct and extensive geomorphological wholes. The canyons of the Slaná and Štítnik have a 750 m wide floodplain and constitute in fact a continuation of the above-situated geomorphological wholes (Fig. 7). The bottom of the canyon of the Slaná and its floodplain lie on the gravel of the Poltár formation and also represent an extension of the Rožňavská Basin. But it is not a basin in terms of morphology so it should be classified as a subunit of the Slovenský kras at the level of karstic plateaus. Canyons as fluviokarstic forms are rather attributable to karst than to basin landforms. This was the reason why an independent subunit of *Štítnický and Slánsky kaňon* was created.

The exposed example suggests that in some cases it is not enough to carry over the boundaries from the map at 1:500 000 to an other with a scale of 1:50 000. It is mostly necessary to delimit new subunits or parts with new boundaries and names.

The original division of the Slovenský kras will be extended by the *Borčianska planina* as a subunit comparable to the neighbouring karstic plateaus. In the so far existing division, it was interpreted as a part of the geomorphological subunit Horný vrch Plateau. It is separated from the Horný vrch Plateau by the distinct *Borčianska brázda* (geomorphological part) linked to soft Verfen rocks as far as the saddle above the Zádielská dolina Valley. The northern and eastern limits are in contact

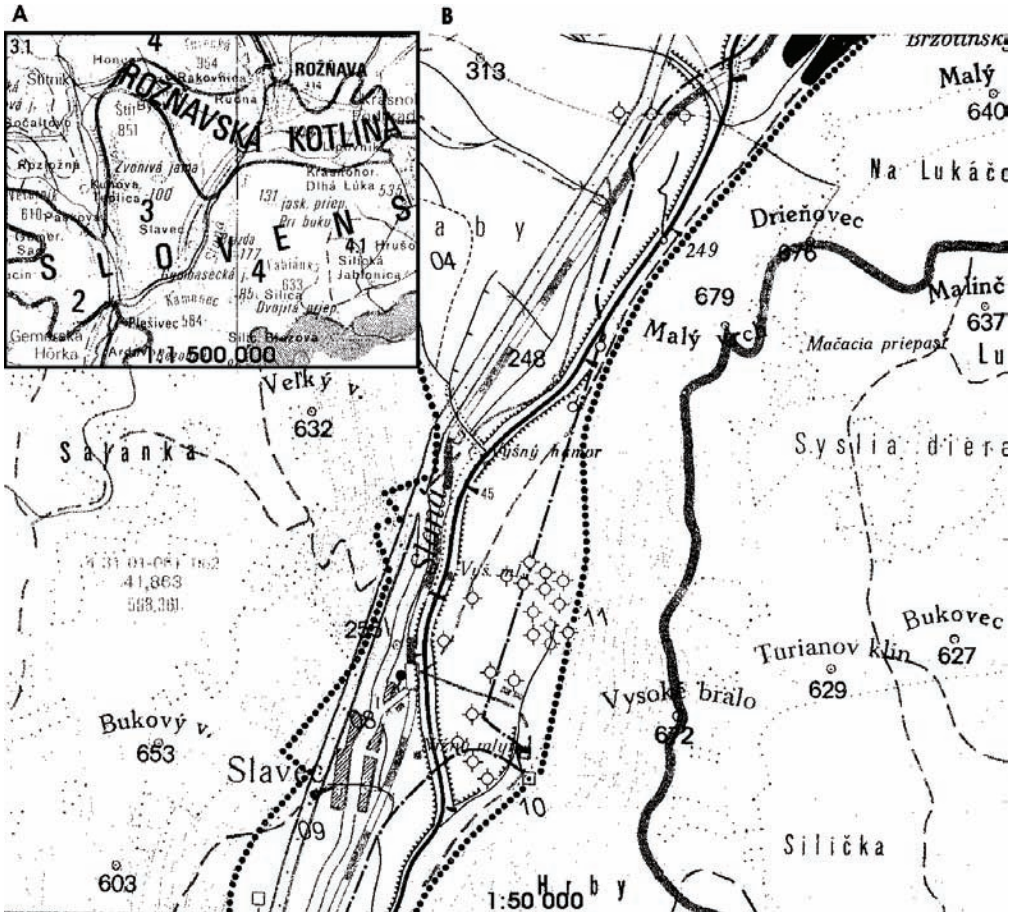

Fig. 7. The geomorphological boundary between Silická planina and Plešivecká planina (Slovak karst)

The boundary is depicted as a simple line on the map at scale 1:500 000 (map A)

The same boundary on the map at scale 1:500 000 (map B) is in form of a double line. This is the reason why a new subunit should be delimited (Canyons of the Štítnik and of the Slaná)

with the narrow-like valley of the Blatnický potok Brook. In terms of geology, it is composed of Middle Triassic limestone and dolomite rocks. Its morphology and the degree of karstification of the high plain are those of a karstic plateau to which the adjacent smaller massif of Žleb is also aligned.

MAP DIGITIZATION

The regional and geomorphological division of Slovakia in the Project represented on 180 sheets of the topographic map at a scale of 1:50 000 was digitized. Such technical processing of the map presented problems we have experienced for the first time.

During the Project work we have often run into the methodological question whether it was necessary to draw the boundaries of the geomorphological wholes first onto the classical topographical map and then compile a digitized map. Was it not possible to accomplish this operation directly on the computer screen? It was not, because there is a difference between the computer screen and the set of map sheets at the scale of 1:50 000. A map at any scale can be projected on a computer screen. However, only a small territory in a detailed scale such as 1:50 000 can be represented on a computer screen. As a rule, it is a territory, which corresponds to the lower hierarchical levels of the regional geomorphological division, namely parts and subunits. A bigger territorial unit such as a basin, lowland or mountain range can be represented on a screen only in a very generalized form. The particular geomorphological context of larger hierarchically higher wholes is not captured. The classical analogue map is free from such handicap. A particular geomorphological situation of a small territory can be represented on one map sheet at scale 1:50 000. A large and hierarchically high situated territory, unit, group of units, region, etc. is represented in a series consisting of several map sheets at scale 1:50 000. All geomorphological wholes of the regional geomorphological division can be represented in their concrete forms avoiding the generalization typical for the computer representation. The geomorphological situation is represented in its concrete form in the entire hierarchical scale from detail to the top unit. The computer screen does not present such a particular and overall view.

This is the reason why the authors believe that first of all it is necessary to draw the analogue map, which represents the particular empirical basis. The process, which removes the analytical indefiniton of the boundary network that is to say the process of boundary differentiation and systemization and the digital map must always refer to this empirical basis.

Regarding the scope of the project, first it was necessary to choose the appropriate methods of digitization and database generation. After several experiments with different approaches, manual digitization of the analogue source material into the digital from on the screen appeared to be the best method. The basic digital source material consisted of ZM[1] 1:50 000 layers in TIFF format and some supplementing materials.

(DTM derived from SRTM3 data, source orthophotomaps, etc.). Digitization was carried out in the ArcView GIS software, which provides the ideal support for vector data. Boundaries of geomorphological units were vectorized as *polylines*, as in this format it was possible to change, complement, and revise the generated data more efficiently than in the polygon layer. By applying the method of manual digitization, a full control over the output and multiple control of the overall result was secured. Digitization of source material took place approximately on scales from 1:20 000 (in dissected relief such as mountain ranges) up to 1:50 000 (in scarcely dissected relief such as plains and hill land). This was one of the most time consuming tasks.

After the construction of the line layer of geomorphological wholes on the level of parts, construction of polygons was started by means of several scripts of the software. In case of the whole consisting of two independent polygons (for instance

[1] ZM stands for the Basic Map of the CSSR

Bus), the polygons were united through the *multipart polygon* procedure. Each polygon was assigned one numerical identifier as an attribute which expresses the position of the given whole in the overall hierarchy of the geomorphological division of the SR. Hierarchically higher situated units were then simply constructed by clustering of polygons classified in lower hierarchical levels.

Independently of spatial data, a table of names with the corresponding codes was made. This made it possible to link the table with names with the attribute table corresponding to the given polygon layer.

The resulting database consists of 7 polygon layers in *shapefile* format with the corresponding attribute table where each line contains a code and a name of the geomorphological whole as well as its geometrical parameters (area and circumference).

The basic problem in the development of the map was to establish the resulting scale of the map. Digital layers were generated on the referential scale of 1: 50 000. The map in analogue form was processed to M 1:375 000 (A1 format) which meant an efficiency compromise between the editing possibilities and the legibility of information the map carries. The SRTM data processed by us in *3 arcsec* resolution into the DEM *(Digital Elevation Model*) form in combination with the shaded relief with standard parameters of its irradiation (i.e. 315 azimuth and 45° inclination) were used as an appropriate source for visualization of boundaries corresponding to the geomorphological wholes and for the assessment of their reference to the real relief. The second layer consists of selected settlements digitized on the ZM 1:50 000 in the TIFF format. The boundaries of the geomorphological wholes are visually discerned based on their hierarchy.

BASIC GEOMETRICAL AND STATISTICAL CHARACTERISTICS OF THE GEOMORPHOLOGICAL WHOLES

By means of the ArcView GIS tools, basic characteristics were computed for the individual geomorphological wholes. Characteristics are quoted in Tab. 3 starting at the top level. Reading of statistical characteristics is justified from the level of regions.

The overall length of the boundaries of geomorphological wholes exceeds 15 000 km (Tab. 4). The boundary lines consist of almost 90 000 vertices with

Tab. 3. Basic geometrical and statistical characteristics of the geomorphological wholes on different hierarchical levels

Number		Area (km^2)				Mean circumference (km)
		Average	Maximum	Minimum	Standard error	
Regions	18	2,724	9,867	87	2,897	454
Units	85	577	6,360	24	821	169
Subunits	271	158	3,507	3	276	74
Parts	239	76	588	2	96	52

a mean density of almost 6 vertices/km. Their number is higher in dissected relief as it exceeds the average (7 vertices /km), and lower in less dissected relief (on average almost 3.5 vertices/km in lowlands and hill lands) – see Tab. 5. Hence, the dissection of relief boundaries represents an objective factor for the level of specification in the process of boundary delimitation. There is also a subjective factor, involving the capacity of the interpreter to interpret the boundary from the analogue to the digital form. Three interpreters participated in the output (*a, b, c*). Although each of them processed a different territory, the available sufficient statistical set allows for certain comparison. The perception of a relief detail from the topographic sources by each of them was different as tab. 4 approximately demonstrates. This subjective factor is felt as a weakness of the manual digitization against the automated or semiautomated methods, which behave practically identically according to rules set in advance.

However, these rules set in advance, can only be defined on the basis of the above-mentioned geomorphological analysis consisting of identification, differentiation and systemization of the geomorphological boundaries. Only after the objective nature of the boundary network is known from such analysis, can appropriate rules for the objective automatic digitization be set. In terms of methodology, it is a cyclic process where the compilers step by step draw closer to the adequate regional geomorphological division of Slovakia. Only then can the methodological vacuum be eliminated.

Tab. 4. Boundaries interpreted by different researchers

Interpreter	Overall length of interpreted boundaries (km)
A (Urbánek)	10,969
B (Lacika)	2,081
C (Jákal)	1,954
Total	15,004

Tab. 5. Indicator of the specification level for segments of the geomorphological boundaries based on vertices

Interpreter	Relief type	Length of digitized boundaries (km)	Number of vertices/km
A	Upland, highland	1,221	13.95
B	Upland, highland	8,913	6.77
	Plain, hill land	2,751	3.38
C	Upland, highland	2,081	4.13

CONCLUSION

Relief is an important criterion for classification of landscape. The map of geomorphological division provides the basic information about the given country and is projected into the map of administrative division. Hence, its specification is not only significant for geomorphologists but also for public at large. Results of the regional geomorphological division project presented in this article do not bring a definite solution to this task. On the contrary, the project work has revealed that the now used division should be further updated and deepened. Slovak geomorphology faces the task to produce a new map in a more detailed scale, which will take into account all recent knowledge. This obviously is not the matter of a small team of authors but a challenge for the whole community of Slovak geomorphologists.

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REFERENCES

Atlas SSR (1980). Bratislava (SAV a SÚGK).

GRIGG, D. (1965). The Logic of Regional Systems. *Annals of the Association of American Geographers*, 55, 465-491.

HROMÁDKA, J. (1956a). Orografické třídení Československé republiky. *Sborník Československé společnosti zeměpisné*, 61, 161-180.

HROMÁDKA, J. (1956b). Orografické třídení Československé republiky. Dokončení. *Sborník Československé společnosti zeměpisné*, 61, 265-299.

HUSÁR, K. (2002). Štruktúra dát regionálneho geomorfologického členenia Slovenska. In Bezák, A., ed. *Luknišov zborník*, *3*. Bratislava (Geografický ústav SAV), pp. 79-84.

JAKÁL, J. (1993). *Karst geomorphology of Slovakia. Typology, map on the scale 1:500 000*. Geographia Slovaca, 4. Bratislava (Geografický ústav SAV).

LACIKA, J. (1999). The principles of morphostructural division of Slovakia. *Moravian geographical reports*, 1, 2-12.

LACIKA, J., URBÁNEK, J. (1998). New morphostructural division of Slovakia. *Slovak Geological Magazine*, 4, 17-28.

LUKNIŠ, M. (1945). Príspevok ku geomorfológii povrchového krasu Ztratenskej hornatiny (Slovenský raj). *Zborník prác Prírodovedeckej fakulty Slovenskej univerzity v Bratislave*, p. 46.

MAZÚR, E. (1965). Major feautures of the West Carpathians in Slovakia as a result of zoung tectonic movements. In Mazúr, E., Stehlík, O., eds. *Geomorphological problems of Carpathians*. Bratislava (SAV), pp. 9-54.

MAZÚR, E. (1979). Morfoštruktúry Západných Karpát. *Acta Fakultatis Rerum Naturalium Universitatis Comenianae, Geographica*, 17, 21-34.

MAZÚR, E. (1980). Morfoštruktúry 1:1 000 000. In Mazúr, E., Jakál, J., ed. *Atlas SSR*. Bratislava (Veda).

MAZÚR, E., LUKNIŠ, M. (1978). Regionálne geomorfologické členenie Slovenskej socialistickej republiky. *Geografický časopis*, 30, 101-125.

MAZÚR, E., LUKNIŠ, M. (1980). Geomorfologické jednotky. Mapa 1:500 000. In Mazúr, E., Jakál, J., ed. *Atlas SSR*. Bratislava (Veda).

MAZÚR, E., LUKNIŠ, M., BALATKA, B., LOUČKOVÁ, J., SLÁDEK, J. (1986). *Geomorfologické členenie SSR a ČSSR. Mapa 1:500 000*. Bratislava (Slovenská kartografia).

URBÁNEK, J. (1992). Typy reliéfu. *Geografický časopis*, 44, 374-387.

URBÁNEK, J. (1997). Geomorfologická mapa: niektoré problémy geomorfologického mapovania na Slovensku. *Geografický časopis*, 49, 175-186.

URBÁNEK, J. (2000). Geomorfologická analýza: hľadanie systému. *Geografický časopis*, 52, 197-210.

URBÁNEK, J. (2003). Geomorfologická mapa ako systém. *Geografický časopis*, 55, 235-247.

URBÁNEK, J., LACIKA, J. (1998). Morphostructures of the West Carpathians of Slovakia. *Studia Geomorphologica Carpatho-balcanica*, 32, 60-67.

VASS, D., BEGAN, A., GROSS, P., KAHAN, Š., KOHLER, E., KRYSTEK, I., LEXA, J., NEMČOK, J. (1988). *Regionálne geomorfologické členenie Západných Karpát a severných výbežkov panónskej panvy na území ČSSR. Mapa 1:500 000*. Bratislava (Geologický ústav Dionýza Štúra).

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THE CONTEMPORARY PHASE AND COMING VISION OF OPEN GEOSPATIAL INTELLIGENCE IN SLOVAKIA

*Eva Mičietová, Juraj Vališ**

Súčasná fáza a vízia otvorenej geopriestorovej inteligencia na Slovensku
Tvorba, využívanie a analýza geopriestorových informácií na opis, hodnotenie a vizuálne zobrazenie fyzikálnych vlastností a geograficky referencovaných aktivít na Zemi v súlade s konceptom interoperability predstavuje otvorenú geopriestorovú inteligenciu. Prostredím pre tieto operácie je infraštruktúra priestorových údajov. Cieľom referátu je poskytnúť prehľad o informačných nástrojoch a službách, ktoré súvisia so zosúladením, distribúciou a integráciou geopriestorových údajov ako zložiek národnej infraštruktúry priestorových údajov. Opisuje sa metainformačný katalóg, katalógové služby, aplikačné servery s distribuovanými spoločnými topografickými údajmi a miestopisným zoznamom, bežný katalóg a rôzni mapoví klienti na integráciu metaúdajov a geopriestorových údajov. Popísaná je integrovaná technická platforma slovenskej národnej infraštruktúry priestorových údajov. Uvedené príklady sú výsledkami aplikačného výskumného projektu „Integračné nástroje a distribuované využívanie geopriestorových informácií“, ktorý prebieha od roku 2004. (Projekt je podporovaný Ministerstvom školstva Slovenskej republiky).

Kľúčové slová: otvorená geopriestorová inteligencia, infraštruktúra priestorových údajov, mapové servery, mapoví klienti, klienti katalógov, geografické informácie, mapové služby, katalógové služby, (OpenGIS, WMS, WFS, CS-W, WCS)

INTRODUCTION

The fusion of remote sensing data, geographical information system (GIS) technology, and precise geographical information from the Global Positioning System (GPS) constellation, coupled with the increasing power and decreasing cost of computing over a network has enabled an explosion of geospatial data on local, national and global regional levels. Common geospatial standards and Service-Oriented-Architecture (SOA) enhance interoperability across related communities. Several benefits will derive from the interoperable landscape management with the addition of knowledge to geospatial understanding. Interoperable discovery, exploitation and analysis of geospatial information to describe, assess, and visually depic physical features and geographically referenced activities on the Earth represent open geospatial intelligence. The fusion of spatial data immediately relates spatial data and knowledge discovery methods Discovery and integration precede in the spatial data infrastructure (SDI) environment.

Geographical information sources[1] (geographical information, geographical information systems and geographical information services) along with rules of access, use, sharing and co-ordination activities represent the basic elements of SDI. Their implementation represents a coordinated environment where information service (integration, publication, enquiry, access, visualization and processing of the integrated information) flows between providers of geo-spatial data and their users.

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The above mentioned information services generate specific tools implemented in the open environment of the Internet.

Building of spatial information infrastructures has now reached the stage when geographical information sources are harmonized. It means harmonization of the present geographical information sources with standards in force and standards of geographical information. The process includes fulfillments of the following particular tasks: harmonization of the geographical information (GI) description, quality, data models, and harmonization of tools applied to discovering, processing, distribution, integration and portrayal of the GI.

The article presents the common specifications of SDI as a basis for interoperable geospatial intelligence at the national level, its implementation forms related to OpenGIS (open geodata interoperability specifications) standards and the contemporary phase of Slovak national spatial infrastructure (NSDI) solution. It is focused on data harmonization, distribution and integration in compliance with standards. According to this fact, the INSPIRE (Infrastructure of Spatial Information in Europe) implementation rules had high priority within the SDI solution's development. There was an endeavour to implement the INSPIRE rules from the beginning of the SDI development. The different time frames of the INSPIRE and the NSDI development forced the solution to implementation the draft version of the metadata implementing rules (DT METADATA 2007). The solution had already implemented the INSPIRE metadata rules according to the first version of the implementation rules. The accordance of the implemented metadata and the ISO 19115, ISO 19116 and ISO19139 was tested and the results were published on the webpage http://www.geonet.sk. Tools, for the discovery, distribution and integration of geospatial data inside NSDI, implementing OpenGIS services standards (WMS, WFS, WFS/T, WCS, CS-W), are presented.

The presented outputs of NSDI solution in Slovakia were created on the basis of results of the research and development project "Tools for the integration and distributed use of geospatial information" (collaborating institutions: Comenius University in Bratislava, Research Institute of Geodesy and Cartography, Slovak Environmental Agency, National Forest Centre, ESPACE Morava, Intergraph CZ, CORAGeo) with reference to publication (Mičietová et al. 2008).

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[1] Geoinformation systems in the Slovak Republic have been conceived and developed since the 1970s. The basis of geoinformatization in studies concerning the specification of the geographical sphere as a spatial dynamic system with the proper spatial organization and structure (Krcho 1968) that yielded the basic definition of the GIS in the 1980s (Krcho and Mičietová 1989). After an ample introduction of the GI systems in the 1990s, principles and the related practice were published (Tuček 1998).
In the sphere of tools for the collection and the primary processing in the GIS, methods of remote sensing (Feranec et al. 1996, Feranec and Oťaheľ 2001) and those of digital photogrammetry (Čerňanský and Kožuch 2003, Kožuch and Čerňanský 2006, Žihľavník et al. 2005) have been successfully and abundantly applied since the 1990s. The methodology of landscape modelling in geographical databases has been presented by Adamiák and Michalík (2004), Koreň (2007), Mičietová et al. (2004), Mičietová and Boroš (2004), Mičietová (2008) and Solín et al. (2000). In the sphere of the development of analytical tools of the GIS, the theory of complex morphometric georelief analysis was developed by Krcho (1973, 1990 and 2001); methods of georelief modelling are developed by Feciskanin (2007), Hofierka et al. (2002), Koreň (2006), Šúri et al. (2002 and 2007) and others; Hofierka and Šúri (1996) worked on the dynamic methods of modelling the geographical phenomena. The theoretical basis of cartography for the GIS in the SR is represented by studies of Pravda (1990), Benová and Pravda (2009). Digital cartography as part of the GIS is the subject Kusendová (2000) works with. Important outputs of applied digital cartography in the GIS are the *Population Atlas of Slovakia* (Atlas obyvateľstva Slovanska 2006) and the *Landscape Atlas of the SR* (Atlas krajiny Slovenskej republiky 2002).

VISION FOR THE NSDI

The NSDI assures that spatial data from multiple sources (state, local, academia, and the private sector) are available and easily integrated to enhance the understanding of our physical and cultural world. The NSDI honours several key public values:

- Privacy and security of citizens' personal data and accuracy of statistical information on people, both in raw form and in derived information products,
- Access for all citizens to spatial data, information, and interpretative products,
- Protection of proprietary interests related to licensed information and data,
- Interoperability of geographic information systems to enable the portrayal of spatial information from multiple national resources.

The NSDI supports and advances the building of an Infrastructure of spatial information in Europe and Global Spatial Data Infrastructure, consistent with national spatial data security, interoperability and international trade requirements. International compatibility is an important aspect of the NSDI. Specifications of NSDI visions and implementations relate to OGC specifications

(http://www.opengeospatial.org), INSPIRE implementation process (http://inspire.jrc.ec.europa.eu/workprogrammeDocs.cfm) and coordinating procedures presented by US Federal Geographic Data Committee (http://www.whitehouse.gov/omb/circulars/a016/print/a016_rev.html).

Components of the NSDI

The components of the NSDI are data themes, metadata, the National Spatial Data Clearinghouse, standards, and partnerships.

Data themes are electronic records and coordinates for a topic or subject. Common rules for the creation of NSDI data sets are specified by the national object catalogue. Themes providing the core, most commonly used set of base data are known as framework data, specifically geodetic control, orthoimagery, elevation and bathymetry, transportation, hydrography, cadastral, and governmental units. Other themes of national significance are also an important part of the NSDI, and must be available to share with others. Additional data themes may be added. NSDI data themes are developed with appropriate metadata, using national standards and served through the Clearinghouse. The facilitate interoperability and information exchange across administrative boundaries.

Metadata can also information about data and/or geospatial services, such as content, source, vintage, spatial scale, accuracy, projection, responsible party, contact phone number, method of collection, and other descriptions. Metadata are critical to document, preserve and protect agencies' spatial data assets. Reliable metadata, structured in a standardized manner, are essential to ensuring that geospatial data are used appropriately, and that any resulting analysis is credible. Metadata also can be used to facilitate the search and access of data sets or geospatial services within a Clearinghouse or data library. All spatial data collected or derived directly or indirectly will have metadata.

The National Spatial Data Clearinghouse is an electronic service providing access to documented spatial data and metadata from distributed data sources. These sources include a network of data producers, managers, and users, linked through

the Internet and other communications means, and accessible through a common interface. All collected spatial data will be made available through the Clearinghouse. Spatial data users will have access to the NSDI through the National Spatial Data Clearinghouse.

Standards are common and repeated rules, conditions, guidelines or characteristics for data, and related processes, technology and organization. To broaden the global use of common spatial data and services, international standards and protocols must be used. NSDI is made possible by the universal use of standards and protocols for data development, documentation, exchange, and geospatial services. NSDI standards propose OGC (Open GIS Consortium). They are adopted at international and national levels in the form of technical specifications of the ISO (International Standardization Organization).

Collaborative partnerships are well-coordinated efforts among state, local, and academic institutions, as well as a broad array of private sector geographic, statistical, demographic, and other business information providers and users. Involving these stakeholders in the development of the NSDI will aid in meeting the needs of end-users.

Coordinating authority

The coordinating authority will establish the procedures and committees necessary and sufficient to carry out interagency coordination and implement the NSDI, in accordance with existing law, statute, and policy related to spatial data quality, content, description, discovery, sharing and integration.

Benefits of the NSDI

Spatial data is a national capital asset. The NSDI facilitates efficient collection, sharing, and dissemination of spatial data among all levels of government institutions, as well as the public and private sectors, to address issues affecting the Nation's physical, economic, and social well-being. A coordinated approach for developing spatial data standards that apply to collecting, maintaining, distributing, using, and preserving data will improve the quality of spatial data and reduce the cost of derivative products created by users. Applications using spatial data that adhere to adopted standards enable cost effective public and private policy development, management, and operations. Many applications are dependent upon accurate spatial data: utility infrastructures, transportation, energy, emergency management and response, natural resource management, weather and climate analysis, disaster recovery, homeland defense, law enforcement, protection planning, public health and other civilian or military strategic issues. The seamless spatial information needed for these applications can range from highly detailed local data, such as the nature of specific hazardous material stored in a particular room of a single building, to the various data needed for real-time projection of the probable effects of natural disasters.

SDI 1.0 BASELINE

In 2007 SDI 1.0 Baseline 11. was issued (Harrisson 2007a, Nebert et al. 2007). It proposes a suite of geospatial standards /SDI standards suite version 1.0/ to facilitate the description and acquisition of compatible technology for SDIs worldwide.

Core suite of standards for interoperable operation of geospatial data contains[2]:

– OGC Web Map Service 1.1.1;

– OGC Web Feature Service 1.0;

– OGC Filter Encoding 1.1;

– OGC Web Coverage Service 1.0;

– OGC Geography Markup Language 2.1.2;

– OGC Catalogue Service 2.0 Z39.50 protocol binding;

– Content Standard for Digital Geospatial Metadata (ISO199115, ISO19139).

Supplemental *suite* of standards contains:

– ISO metadata standard 19115:2003 and ISO DTS 19139:2006;

– OGC Geography Markup Language 3.1.1;

– OGC Styled Layer Descriptor 1.0;

– OGC Web Map Context 1.1;

– OGC Catalogue Service 2.0 HTTP protocol binding, CS-W.

The above concept of standards suite was considered by the proposal and implementation of the Slovak NSDI.

SLOVAK NSDI ARCHITECTURE

The NSDI architecture is proposed as a software and technology independent environment. There are basic interoperable elements contained in infrastructure: NSDI portal, data servers, metadata catalogue, application servers eventually combined servers. These elements are accessible to several clients (Fig. 1).

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[2] *Web Features Service (WFS)*: allows retrieving and updating of geospatial data encoded in Geography Markup Language (GML) from multiple WFSs. It defines interfaces for data access and manipulation of geographic features and through these interfaces, a web user or service can combine, use, and manage geo-data.

Web Map Service (WMS): supports the creation and display of registered and super-imposed maplink views (graphical images, such as GIF, JPEG, TIFF, and NITFS.

Web Map Context (WMC): describes how to save a map view composed of many different layers from different Web Map Services.

Web Coverage Service (WCS): allows access to geospatial "coverage's" (raster datasets) that represent values or properties of geographical locations rather than WMS-generated maps (pictures).

Geography Markup Language (GML): GML is extensible Markup Language (XML) encoding for the transport and storage of geographical information, including both the spatial and non-spatial properties of geographical features.

Styled Layer Descriptor (SLD): defines the structure of an XML file that applies rendering or symbolization rules to features. An SLD requests a WMS to present a map according to submitted style rules.

Catalog Services (CS-W): provides an abstract model and protocol-specific solutions for the discovery of geospatial resources. Through catalog metadata and query interfaces, metadata properties are returned to the requestor often embedded with links to actual data or services that allow the catalog to act as a referral service to other information resources.

Filter Encoding Specification (FE): FE is used to express a query or filter using a predicate language, or terms and operators, stored in XML elements. FE is used in requests to WFS and queries to CS-W.

ISO IS19115/DTS 19139 metadata standard: Metadata standard ISO 19115:2003 contains an abstract model represented in UML depicting the content and relationships of descriptions of geographical data and services. The 19115 standard does not provide guidance on the encoding or exchange of metadata but serves as a guide for what information should be documented for data and services. ISO Draft Technical Specification 19139 was scheduled for release in late 2006. The primary content of interest in this specification is a set of XML schema documents that can be used in the validation and structuring of compliant ISO metadata, derived from the 19115 metadata model.

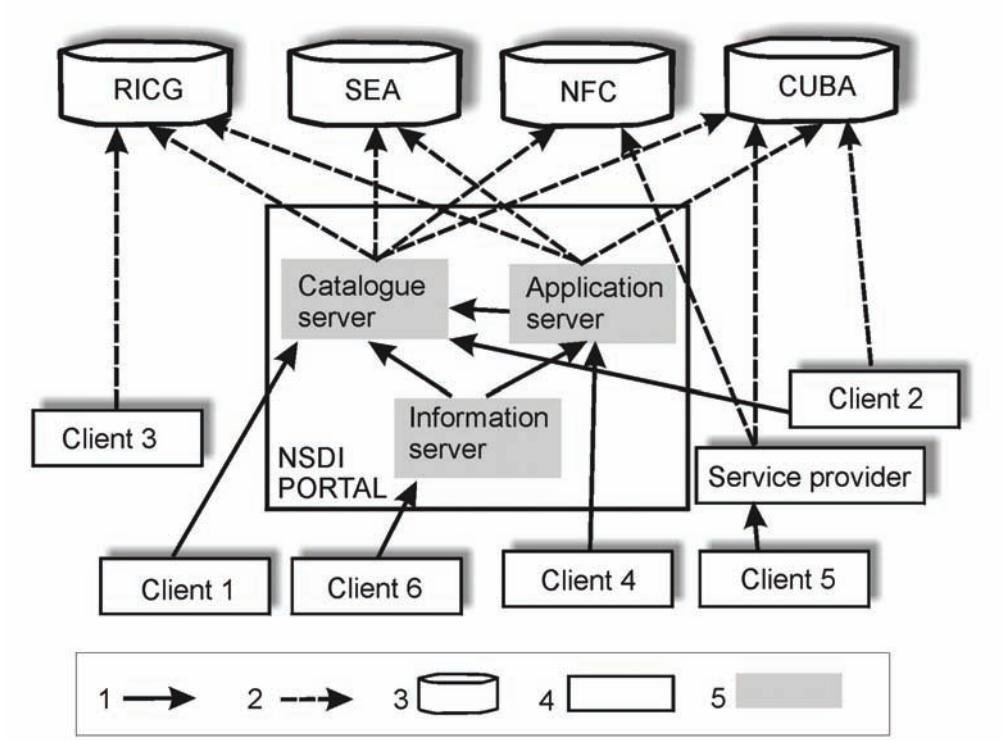

Fig. 1. Interrelations between elements of NSDI architecture

The information server contains documentation and the NSDI terminological dictionary. It manages open access to the catalogue and application servers, user controlled access to private sites of consortium members and open access to the NSDI portal client applications. The catalogue server manages query and spatial access to metadata, XML import and export of metadata, interactive editing of metadata records, user controlled access for metadata update and distribution of metadata in form of CS-W services. NSDI application server distributes core map sources in the form of WMS services, manages WMS, WFS, CS-W, and WCS clients, and realizes coordinate transformation services and spatial data portrayal (Panagiotis 2002 and 2005, Nebert et al. 2007a, Beaujardière 2002).

The integrated technological architecture is interoperable through the NSDI GEONET domain (Slovak language interface mainly):

– Portal and the Geonet webpage – http://www.geonet.sk;

– Integrated metadata catalogue NIPI – http://metakatalog.geonet.sk;

– Map server with applications –

http://mapserver.geonet.sk/wmsklient,

http://mapserver.geonet.sk/wfsclient,

http://mapserver.geonet.sk/CS-Wklient;

– NSDI information server – http://geonet.fns.uniba.sk;

– NSDI terminological glossary – http://gis.fns.uniba.sk/wiki/index.php;
– List of distributed geodata – data structures available on map servers of collaborating institutions (http://geonet.fns.uniba.sk/freeser.htm).

DESCRIPTION AND DISCOVERY OF GEOGRAPHICAL INFORMATION

The common rules for geographical information specification and tools for metadata, collection, distribution and integration are most important elements of the Slovak NSDI. Conceptual description of the content and structure of metadata – specification rules - were proposed in the form of Common national metadata profile on the basis of ISO 19115, INSPIRE directive (Directive 2007/2/EC 2007) and its implementation rules (Dufourmont 2004, Commission Regulation (EC) No 1205/2008 2008, Inspire road map 2008, Nowak and Graglia 2006). Specification of XSD metadata template for national profile was proposed according to ISO 19116 and ISO19139 and (Nebert 2007b, Voges and Senklaer2006 and 2007, European Commission DG Joint research centre 2005, Craglia and Smits 2005, Nowak and Craglia 2006). A test of the XSD metadata profile was executed and it confirmed the conformity of the proposed profile with the ISO 19115 standard. Table 1 presents the content of the national metadata profile. Full documentation of the national metadata profile specification (shortnames.xsd, longname.xsd and examples) is included in (Mičietová, Vališ et al. 2008). Description of the data model for Slovak metadata profile is accessible on http://www.geonet.sk/narodnyprofil/nipi_meta_profil_01_v_03.pdf.

The metainformational catalogue (MIC), catalogue server and catalogue client are tools for interoperable operation of NSDI metadata. The MIC application provides an overview of the spatial data descriptions created by registered users of the metacatalogue. The MIC is implemented in the Slovak language at web location http://metakatalog.geonet.sk/ (Fig. 2).

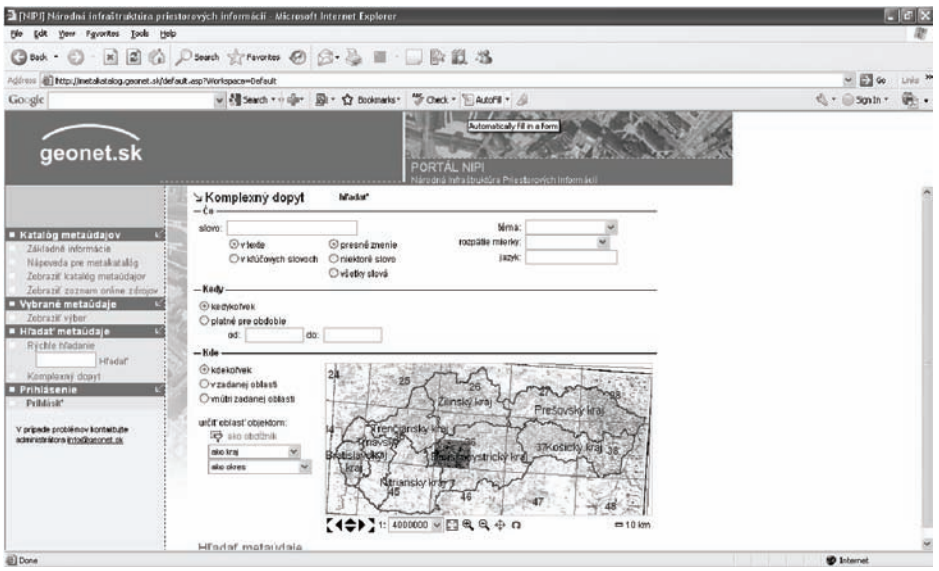

Fig. 2. User interface of the Metainformation catalogue application: Complex search

Tab. 1. Metadata profile of the NSDI in Slovakia

Object class of metadata	Description
MD_DataIdentification	Identification of data set
MD_Keywords	Key words
MD_Constraints	Condition for access to data
MD_LegalConstraints	Legal needs for access to data
MD_SecurityConstraints	Constraints according to state security
DQ_DataQuality	Quality and origin of data
LI_Lineage	Lineage of data
LI_ProcessStep	Description of data transformation process
LI_Source	Information about Source data
DQ_Scope	Data quality scope
MD_CRS	Metadata about coordination system
MD_Distribution	Data distribution and possibility to obtain
MD_DigitalTransferOptions	Technical tools for data distribution
MD_Distributor	Data about distributor
MD_Format	Description of digital format of data representation
MD_StandardOrderProcess	Description of Standard order process
EX_Extent	Spatial extent of data
EX_BoundingPolygon	Boundary of spatial area
EX_GeographicBoundingBox	Specification of geographical Bounding box
EX_GeographicDescription	Geographical identification
EX_TemporalExtent	Temporal validity of data set
EX_VerticalExtent	Vertical extent of data set

The MIC provides several operations: recording of metadata in form of national profile template, search for metadata records (what, where, when) in three form of detail (brief, summary, full), search by metadata owner, quick search by key words, search by territory, search of on line resources, approximate calculation of price, import of metadata in form XML, export of metadata in form of XML, interactive editing of metadata, automatic user registration.

The catalogue service is introduced as an independent component of the MIC application. It uses the same data and data model used for the WEB interface of the MIC application. Basic functions of CWS service are GetCapabilities, GetRecords, GetRecordById, and GetDomain.

The localization of the CS-W service is at URL http://metakatalog.geonet.sk/service.asp. A Catalogue client is necessary for access and integration with other catalogue services. A national CS-W client was developed at URL (http://mapserver.geonet.sk/CS-Wklient) for the NSDI solution.

COMMON NSDI OBJECT CATALOGUE

The construction of spatial data infrastructure requires semantic integration of geographical, topographic and hypsometric information and property unit entities on the state, regional and local levels. The presented NSDI solution proposed a common object catalogue with hierarchical specification of spatial objects (category, subcategory, object classes, attributes and code values). The hierarchical levels of spatial entities specification derive from the contextual concept of the base map, related national strategies (Concept of GCCA automated information system 2005, Object catalogue of FBGIS 2004), FACC (Feature attribute and coding catalogue) catalogue of DIGEST (Digital Geographic Exchange Standard, http://www.digest.org) and INSPIRE Consolidated UML Model (https://inspire-twg.jrc.it/inspire-model/).

The common Slovak NSDI object catalogue is accessible on http://www.geodesy.gov.sk/gis/standards/kozbgis/KO_10_2004.pdf in text and language dependent form. Present visions related to the NSDI object catalog with respect to the data model harmonization process on the basis of (INSPIRE Consolidated UML Model 2008, Portele 2005) is the creation of its FACC catalogue in a MS access database, its exporting into the UML application schema repository and conversion of UML application schema into the GML application schema.

DISTRIBUTION AND INTEGRATION OF GEOSPATIAL INFORMATION

The Slovak NSDI tools for distribution contain: 1) several platform dependent map servers of data providers, 2) Geomedia WebMap server implemented on the GEONET NSDI portal – mapserver for distribution of core data (Administrative units, gazetteer, raster base map 1:100 000) and 3) Integrated Framework (IF) map server – new free configurable tool for common use for all data providers with the support of the ADO, ShapeFile, XML, GeoMedia, Oracle formats and the possibility to develop special proprietary data provider. IF is easy to use, and contains a proper web (HTTP) server. WMS and WFS services are operable after its installation.

Key data providers from the territorial point of view, distributing their data in the form of OGC WMS map services in the Slovak NSDI are:

- SEA (Slovak Environmental Agency) (http://isu.enviroportal.sk)[3].
- GCCA (Geodesy, Cartography and Cadastre Authority of the SR) (www.geoportal.sk/gp/wms.html).
- Ministry of Defence, Topographic institute, http://topu.army.sk/
- National Forestry Centre (http://158.195.46.74:84/default.asp).
- Soil Science and Conservation Research institute (www.vupop.sk) prefers interactive web map services (www.podnemapy.sk).
- CUBA (Comenius University in Bratislava) distributes 1) WMS layers of digital ortophotomap (http://158.195.46.74/NIPI_PRIFUK/wms3.asp) – which is password protected (see Fig. 3), 2) hydrological water framework directive layers (http://158.195.46.74/wfd) – interactive web application, 3), the WEB

[3] http://isu.enviroportal.sk/media/File/documents/ISU_zav_sprava_2006_prilohy_final.pdf, page Nr. 15.

Geonames service (http://mapserver.geonet.sk/nipi.geonames/request.aspx) – implemens the Eurogeographics specifications and is distributed as a modified WFS service and is localized an application server of the GEONET portal.

The NSDI tools for integration of geospatial data are presented by several types of map clients. A special NSDI portal application was developed – to integrate the WMS and WCS client (http://mapserver.geonet.sk/wmsklient). Coordinate transformations needed for several national WMS resources integration, displaying of locations by Geonames query and integration of WCS layers are executed by this application (Fig. 3).

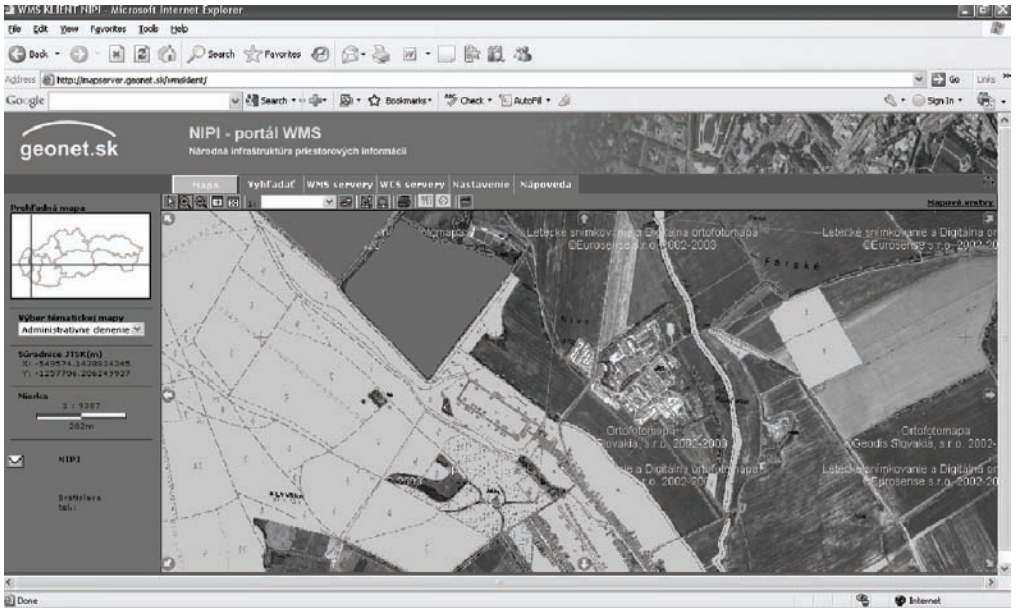

Fig. 3. WMS client application (http://metakatalog.geonet.sk/wmsklient): Integration of the digital orthophotomap of SR (http://158.195.46.74/NIPI_PRIFUK/wms3.asp) and Base map of SR 1:10000 (http://atlas.sazp.sk/wmsconnector/com.esri.wms.Esrimap?ServiceName=archiv_sazp&).

LEGAL FRAMEWORK AND COORDINATION ON THE NSDI IN SLOVAKIA

Awareness of the need for an NSDI is growing and the main promoter is the GCCA SR, which leads the Working Group for GIS in the Public Sector (WG GIS) us committee of the Informatics Council of the SR Government /established in the year 2000/. The WG GIS takes over the coordination of the NSDI development and consists of the representatives of the GCCA as well as representatives of the Ministry of Defence, Ministry of the Environment, Ministry of Agriculture, Ministry of the Interior, Ministry of Transport, Post and Telecommunications, the Statistical Office and others. It is a high-level co-operation between ministry departments and national institutions and members belong to the key stakeholders in the area of GI.

The legal framework for the on NSDI in Slovakia is mainly determined by the Act No. 215/1995 on Geodesy and Cartography, as amended by the Act No. 423/2003 and the PD GIS is considered to be the core geo-referenced data set for building up the State Information System by the public authorities. In this legislation the following issues are dealt with: maintenance, liability, funding and the obligations imposed on users and producers. The category of the core data sets is rather static and no fundamental changes are being planned.

Informatics tools for discovery, distribution and integration of geospatial information developed in the application research phase are completely implemented inside the collaborating institutions of the research project. They are full accessible for testing and ready to use for implementation in all governmental, public, research and private NSDI subjects in Slovakia. The Coordinating authority for dissemination of the introduced tools is the donor of the research project – the Slovak Ministry of Education.

CONCLUSION

The presented NSDI solutions meet OpenGIS standards and the INSPIRE implementation process. Future research activities will proceed in several fields:

- Proposal and implementation of a common spatial data model and building up of interoperable repositories of GML application schema for common NSDI object catalogue;
- Development and implementation of tools for the distribution and integration of geospatial information with WFS transactional service with respect to e-government, crisis management and local (municipality) level spatial management;
- Proposal of consolidation methods for national core spatial data (administrative units, transport network, hydrography, and elevation) with respect to European harmonization rules according to common spatial data datasets (http://www.gis4eu.com).

The establishment of technical tools of an NSDI is not, however, an end in itself. The NSDI is not primarily about technology, but about developing a clear framework of agreements among government agencies, and between government, the private sector and citizens on terms through which the use of public sector information can be maximized for the benefit of all. The government, therefore, plays an absolutely crucial role in the development of an NSDI because it is at the same time a data producer, user, policy setter, and regulator which provides policy and guidance to major public sector organizations. The most important step in the coordinating process on the governmental level is to build up an NSDI clearing house with the possibility of catalogue services discovery and integration of distributed metadata.

REFERENCES

ADAMIÁK, M., MICHALÍK, Ľ. et al. (2004). *Katalóg objektov ZBGIS*. Verzia 10/2004. http://www.geodesy.gov.sk/gis/standards/kozbgis/KO_10_2004.pdf

Atlas krajiny Slovenskej republiky. (2002). Bratislava, Banská Bystrica (MŽP SR, SAŽP). http://enviroportal.sk/atlas/online/

Atlas obyvateľstva Slovenska (2006). Bratislava (Univerzita Komenského, Prírodovedecká fakulta).

BEAUJARDIÈRE, J. (2002). *Web Map Service Implementation Specification*. OGC01-068r3. http://portal.opengeospatial.org/files/?artifact_id=1081&version=1&format=pdf

BENOVÁ, A., PRAVDA, J. (2009). Map style. *Cartography and Art. Springer*, 145-154.

ČERŇANSKÝ, J., KOŽUCH, M. (2003). Automated digital aerotriangulation – its application in geoinformatics and in cartography. *Geodetický a kartografický obzor*, 49(91), 157-165.

COMISSION REGULATION (EC) No 1205/2008. (2008). Implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata. *Official Journal of the European Union*. http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32008R1205:EN:NOT

CONCEPT OF GCCA AUTOMATED INFORMATION SYSTEM. (2005). http://www.geodesy.gov.sk/ulohy/priority/ciele2005.htm

CRAGLIA, M., SMITS, P. C. (2005). Requirements for the definition of the INSPIRE implementing rules for metadata. http://www.sdic.it/ftp/ir_dev_process_metadata.pdf

DIRECTIVE 2007/2/EC (2007). Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE) L 108. ISSN 1725-2555. http://eur lex.europa.eu/JOHtml.do?uri=OJ:L:2007:108:SOM:EN:HTML"

DT METADATA. (2007). Draft implementing rules for metadata: http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/draftINSPIREMetadataIRv2_20070202.pdf

EUROPEAN COMMISSION DG JOINT RESEARCH CENTRE, INSTITUTE FOR ENVIRONMENT AND SUSTAINABILITY, LAND MANAGEMENT UNIT, ESDI ACTION. (2005). Draft Guidelines for the Development of the INSPIRE Implementing Rules. http://www.eurogeogra-phics.org/eng/documents/ir_draft_guidelines.pdf

FECISKANIN, R. (2007). Optimization of triangular irregular networks for modeling of geometrical structure of georelief. 23. *International Cartographic Conference - Cartography for everyone and for you*. Moscow (Roskartografija), pp. 1-9, CD-ROM.

FERANEC, J., OŤAHEĽ, J., PRAVDA, J. (1996). *Krajinná pokrývka Slovenska identifikovaná metódou CORINE land cover.* Geographia Slovaca, 11. Bratislava (Geografický ústav SAV).

FERANEC, J., OŤAHEĽ, J. (2001). *Krajinná pokrývka Slovenska.* Bratislava (Veda).

DUFOURMONT, H., ANNONI, A., DE GROOF, H. (2004). Work programme preparatory phase 2005-2006. http://www.gmes.info/library/files/1.%20GMES%20Reference%20Documents/INSPIRE_WorkProgramme2005-2006.pdf

HARRISSON, J, MORRIS-JONES, D. (2007). *SDI 1.0: GEOINT revolution.* http://www.thecarbonproject.com/pdfs/mgt5.4reprintwhite.pdf

HOFIERKA J., PARAJKA J., MITASOVA H., MITAS, L. (2002). Multivariate interpolation of precipitation using regularized spline with tension. *Transactions in GIS*, 6, 135-150.

HOFIERKA, J., ŠÚRI, M. (1996). Modelling spatial and temporal changes in soil water erosion. *Geografický časopis*, 48, 255-269.

INSPIRE CONSOLIDATED UML MODEL (2008). https://inspire-twg.jrc.it/inspire-model/

INSPIRE ROADMAP. (2008). http://inspire.jrc.ec.europa.eu/inspire_roadmap.cfm

KOREŇ, M. (2006). Modelovanie krajiny prostredníctvom polí. *Geografický časopis*, 58, 45-60.
KOREŇ, M. (2007). Geografické databázy. In *Aplikácie GIS v lesníctve*. Zvolen (Technická univerzita vo Zvolene), pp. 163-1981.
KOŽUCH, M., ČERŇANSKÝ, J. (2006). The use of digital orthophotomaps in geography. *Acta Geographica Universitatis Comenianae*, 47, 177-185.
KRCHO, J., MIČIETOVÁ, E. (1989). Geograficky informačný system – struktura a urovne integrity. *Geografický časopis*, 4, 249-273.
KRCHO, J. (1968). Prírodná časť geosféry ako kybernetický systém a jeho vyjadrenie v mape. *Geografický časopis*, 20, 115-139.
KRCHO, J. (1973). Morphometric analysis of relief on the basis of geometric aspect of field theory. *Acta Geographica Universitatis Comenianae, Geographica Physica*, 1, 11-233.
KRCHO, J.(1990). *Morfometrická analýza a digitálne modely georeliéfu*. Bratislava (Veda).
KRCHO, J. (2001). *Modelling of georelief using DTM: positional and numerical accuracy*. Bratislava (Q111).
KUSENDOVÁ, D. (2000). Digitálna legenda pre geomorfologické mapy. *Kartografické listy*, 8, 45-54.
MIČIETOVÁ, E., BOROŠ, R. (2004). Integrity and interoperability of GIS data model for water protedtion accordings to water framework directive, *Meteorological Journal*, 1, 25-37.
MIČIETOVÁ, E., ZAHN, O., VALIŠ, J., IVANIČ, I. (2004). Štruktúra, intergrita, interoperabilita a implementácia ZB GIS, *Geodetický a kartografický obzor*, 4, 113-125.
MIČIETOVÁ, E. (2008). Geografický informačný systém a jeho báza údajov. In Mičietová, E., Kožuch, M., eds. *Špecializovanéinformačné technológie v prírodovednom výskume:Geoinformačné technológie*. Bratislava (Elita), pp. 57-101.
MIČIETOVÁ, E., VALIŠ, J. et al. (2008). *Tools for integration and distributed use of geospatial information*. Bratislava (Elita).
NEBERT, D., REED, C., WAGNER, R. M. (2007a). Proposal for a Spatial Data Infrastructure Standards Suite: SDI 1.0, Research and Theory in Advancing Spatial Data Infrastructure Concepts (ed. Harlan Onsrud; Redlands, CA: ESRI Press), http://gsdidocs.org/gsdiconf/GSDI-9/papers/TS19.1paper.pdf
NEBERT, D., WHITESIDE, A., VRETANOS, P., eds. (2007b) OpenGIS® Catalogue Services Specification. OGC 07-006r1. http://www.opengeospatial.org/standards/cat
NOWAK, J., CRAGLIA, M. (2006). INSPIRE metadata survey results. EUR 22488 EN. ISSN 1018-5593 http://www.ec-gis.org/inspire/reports/INSPIRE_Metadata_Survey_2006_final.pdf
Object catalogue of FBGIS (2004). http://www.geodesy.gov.sk/gis/standards/kozbgis/KO_10_2004.pdf
PANAGIOTIS, A. V. (2002). *Web Feature Service Implementation Specification., Version 1.0.0, OGC 01-065*. https://portal.opengeospatial.org/files/?artifact_id=7176
PANAGIOTIS, A. V. (2005). Web *Feature Service Implementation Specification, Version 1.1.0, OGC 04-094*. https://portal.opengeospatial.org/files/?artifact_id=8339
PORTELE, C (2005). *Mapping UML to GML application schemas. Guidelines and encoding rules*. http://www.interactive-instruments.de/ugas/UGAS-Guidelines-and-Encoding-Rules.pdf
PRAVDA, J. (1990). *Základy koncepcie mapového jazyka*. Bratislava (Geografický ústav SAV).

SOLÍN, Ľ., CEBECAUER, T., GREŠKOVÁ, A., ŠÚRI, M. (2000). *Small basins of Slovakia and their physical characteristics*. Bratislava (Slovak Comittee for Hydrology, Institute of Geography of the SAS).

ŠÚRI, M., CEBECAUER, T., HOFIERKA, J., FULAJTÁR, E. (2002). Soil erosion assessment of Slovakia at a regional scale using GIS. *Ekológia (Bratislava)*, 21, 404-422.

ŠÚRI M., HULD, T., HOFIERKA, J., DUNLOP, E. D. (2007). Solar resource modelling for energy applications. In Peckham, R. J., Jordan, G., eds. *Digital terrain modelling, development and applications in a policy support environment*, *Series: Lecture Notes in Geoinformation and Cartography*. Berlín (Springer), pp. 259-273.

TUČEK, J. (1998). *GIS – Geografické informační systémy (Principy a praxe)*. Praha (Computer Press).

VOGES, U., SENKLAER, K. (2006). *OpenGIS® Catalogue Services Specification 2.0.1 (with Corrigendum) – ISO Metadata Application Profile.OGC 04-038r4*. http://www.opengeospatial.org/standards/requests/35"

VOGES, U., SENKLAER, K. (2007). ISO *Metadata Application Profile (1.0.0)CS-W2 AP ISO, ISO Metadata Application Profile of CS-W, Version 1.0, OGC, 2005*. http://www.opengeospatial.org/standards/cat

ŽÍHLAVNÍK, Š., CHUDÝ, F., KARDOŠ, M. (2005). *Digitálna fotogrametria v lesníckom mapovaní. Vedecké štúdie*. Zvolen (TU).

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