

Questionnaire

Summary of the main activities of a research institute of the Slovak Academy of Sciences

Period: January 1, 2016 - December 31, 2021



June, 2022

1. Basic information on the institute:

1.1. Legal name and address

Institute of Hydrology SAS
Dúbravská cesta 9, Bratislava, Slovakia

1.2. URL of the institute web site

<http://www.uh.sav.sk/en-gb/>

1.3. Executive body of the institute and its composition

Directoriat	Name	Year of birth	Years in the position, from - to
Director	Ing. Velísková Yvetta, PhD.	1964	1.9. 2016 - present
Director	RNDr. Pekárová Pavla, DrSc.	1957	1.6. 2012 - 31.8. 2016
Deputy director	Ing. Šurda Peter, PhD.	1982	1.9. 2016 - present
Deputy director	RNDr. Miklánek Pavol, CSc.	1954	1.6. 2012 - 31.8. 2016
Scientific secretary	Ing. Dulovičová Renáta	1963	1.9. 2016 - present
Scientific secretary	Ing. Šurda Peter, PhD.	1982	1.11. 2012 - 31.8. 2016

Add more rows for any changes during the evaluation period

1.4. Head of the Scientific Board

Pavla Pekárová from 2016 to 7.12. 2017
Pavol Miklánek from 8.12. 2017 to 27.11. 2018
Pavla Pekárová from 28.11.2018 to 8.3. 2021
Sokáč Marek from 9.3. 2021 - continues

1.4.1 Composition of the International Advisory Board

IAB- members:

Prof. Márton Jólankai, DrSc., Szent István University, Gödöllő, Hungary

Prof. Juraj Parajka, PhD., Institute of Hydraulic Engineering and Water Resources
Management – TU Wien, Austria

doc. Ing. Zdeněk Chára, CSc., Institute of Hydrodynamics, Czech Academy of Sciences,
Prague, Czech Republic

1.5. Basic information on the research personnel

1.5.1. Fulltime equivalent work capacity of all employees (FTE all), FTE of employees with university degrees engaged in research projects (FTE researchers)

2016		2017		2018		2019		2020		2021		2016-2021	
FTE all	FTE researchers	average FTE all per year	average FTE researchers per year										
37,35	25,10	37,95	25,99	35,22	23,89	34,75	22,43	36,19	24,27	38,40	27,02	36,64	24,78

1.5.2. If applicable, add also a short information on the merger of the institute in the evaluation period. You can also add rows in the above table corresponding to the founding institutes

1.6. Basic information on the funding of the institute

1.6.1. Institutional salary budget, other salary budget¹, non-salary budget²

Salary budget	2016	2017	2018	2019	2020	2021	average
Institutional salary budget <i>[millions of EUR]</i>	0,555	0,581	0,624	0,722	0,796	0,799	0,680
Other salary budget <i>[millions of EUR]</i>	0,047	0,034	0,040	0,059	0,044	0,051	0,046
Total salary budget <i>[millions of EUR]</i>	0,602	0,615	0,664	0,781	0,840	0,850	0,725
Non-salary budget <i>[millions of EUR]</i>	0,235	0,199	0,200	0,198	0,188	0,179	0,200

1.7. Mission Statement of the Institute as presented in the Foundation Charter indicating the years when it was adopted and revised

The Institute of Hydrology Slovak Academy of Sciences (IH SAS) is a scientific research institution that conducts comprehensive research and teaching in environmental science and water management to improve and disseminate knowledge on the circulation and quality of water in nature. The activity of the Institute is focused on:

- water balance components and their changes in catchments;
- transport processes of water and dissolved matters in the atmosphere–plant canopy–soil water–groundwater system with particular focus on the subsurface water formation and its quality;
- the flow of surface water, groundwater, and transported substances;
- the impact of human activities on hydrological processes, including processes of surface and subsurface water pollution;
- changes in the hydrological regime of surface and subsurface waters caused by expected climatic changes;

¹ Salary budget originating outside the regular budgetary resources of the organization, e.g. from the project funding.

² Includes Goods and Services and PhD fellowships

- solving problems connected with environmental management, ecology, utilization and protection of the environment, hydrogeology, pedology
- solving problems connected with water constructions and their impact on the environment, hydromeliorations, hydrotechnical applications, water modifications, flood protection, water morphology, integrated water management, water planning, and water resources protection;
- solving problems connected with landscape engineering, plants, and soil protection and securing water supply during drought seasons.

IH SAS provides consultancy and expert services related to its' primary activity.

IH SAS performs PhD studies following valid legal regulations.

Results of the research conducted at the Institute are published in periodic and other publications such as monographs, proceedings of scientific conferences, and other meetings to disseminate the obtained knowledge and provide the information to specialists and other interested bodies.

IH SAS publishes two journals – Journal of Hydrology and Hydromechanics, which has an international scope (WOS, Q1), and Acta Hydrologica Slovaca, which was nationally recognized in the previous issue. However, from the last accreditation, it has expanded its scope, and since 2020 it has been included in SCOPUS.

IH SAS has built

CENTRE OF EXCELLENCE FOR INTEGRATED RIVER BASIN MANAGEMENT IN CHANGING ENVIRONMENTAL CONDITIONS,

which was completed by another project

COMPLETION OF INFRASTRUCTURE OF HYDROLOGICAL RESEARCH STATIONS.

IH SAS cooperates with the scientific communities of scientific institutes and universities at home and abroad. In this way, IH SAS was also involved in two centers of excellence:

CENTER OF EXCELLENCE FOR PROTECTION AND USE OF LAND AND BIODIVERSITY,

CENTRE OF EXCELLENCE INTEGRATED FLOOD PROTECTION AREA. (for more information see also 2.5.7).

The Foundation Charter valid for assessment period was adopted in 2008. It was revised three times during the assessment period (twice in 2016 and in 2019), however, these changes were not related to changes in the focus of IH SAS, but to legislative changes (change of the organization's address and change of the names of detached workplaces – research bases).

Link to the Foundation Charter (in Slovak and free translation into English)

<https://bit.ly/3yekgVR>

<https://bit.ly/3yfG9UZ>

Appendix 1-3 (1- change of address of the organization, 2- addition of seats and addresses of detached workplaces, 3- change of detached workplaces names:

<https://bit.ly/3A0iNnx>

1.8. Summary of R&D activity pursued by the institute during the evaluation period in both national and international contexts. Describe the scientific importance and societal impact of each important result/discovery. Explain on general level – the information should be understandable for a non-specialist (recommended 5 pages, max. 10 pages for larger institutes with more than 50 average FTE researchers per year as per Table 1.5.1.)

Water is a strategic resource for today, but mainly for the future

The mission of IH SAS is the acquirement and transfer of new scientific knowledge in the fields of hydrology and surface / sub-surface water hydrodynamics to water management practises in Slovakia. Our international activities in the evaluation period have been expressed in collaborative projects, publications, organization and presentations at international conferences, congresses, workshops, etc. expanded as well. It has been reflected in a substantial improvement of the structure of publication outputs. Several foreign experts and interns visited our Institute, one intern even remained working at the Institute as an employee. The PhD programs conducted by the Institute have begun to be more international in that each PhD student must complete an internship abroad and we now accept foreign students for our PhD programs.

The work of IH SAS researchers is based on theoretical, laboratory and field research, and utilizes also the unique field data and results obtained in our experimental research areas in the Tatra Mountains and in the East Slovakian lowland. The Institute obtained modern equipment already in the previous period as the parts of Center of excellence for protection and use of land and biodiversity and Centre of Excellence integrated flood protection area. In the evaluated period the “Centre of Excellence for Integrated River Basin Management in Changing Environmental Conditions” was established at the Institute and supported from the Structural Funds of the European Union (SF). The infrastructure modernization was completed by another SF project “Completion of Infrastructure of Hydrological Research Stations”. Both projects focused on the experimental bases. The modern infrastructure improves the availability of conducting the up-to-date experimental work and attracts foreign young researchers and experts to visit our institute for short or long-term trainings and research.

The R&D activity of the IH SAS has been focused on elaboration of methodologies and manuals to provide the society with powerful tools to solve urgent and perspective water-related problems using the contemporary scientific knowledge. Simulation models are designed and used in analyses and predictions of water dynamics and quality. Special attention is paid to updating of databases characterizing the regions of Slovakia. These activities are permanent.

Throughout the evaluation period, the IH SAS became better acquainted with professional organizations, the public, and in decisive spheres. Employees of the Institute have been working as members of expert and working groups for advisory bodies of various ministries. IH SAS participated in the creation of the Water Plan of Slovakia for period 2022-2027, the Water Policy Concepts until 2030 with a view to 2050, the Action plan addressing the consequences of drought and water scarcity, evaluation of the safety of water structures during floods, etc. At an international level, the employees of IH SAS work as experts evaluating publications and projects as well as, participate in organization of international activities like conferences (e.g. Euromediterranean Network of Experimental and Representative Basins) or COST actions (e.g. WATSON). It is also important to mention the representation of Slovakia in the Sub-Group on Mission “Healthy Oceans, Seas, Coastal and Inland Waters” of the Strategic Configuration of the Horizon Europe Shadow Programme Committee.

Monograph “Applied Soil Hydrology”(Springer International Publishing, 2019. 342 p. <https://doi.org/10.1007/978-3-030-01806-1>. ISBN 978-3-030-01806-1) authored by the IH SAS researchers (Novák, V. - Hlaváčiková, H.) is definitely worth mentioning. The monograph summarizes current knowledge regarding water in the unsaturated zone, and can serve as a textbook or reference guide for anyone dealing with water in the soil. We consider it as a contribution to the world science - it has had more than 33,000 accesses on the Internet to date. It was also awarded as the top publication of SAS.

Education of PhD students is one of the priorities of the Institute. Since the institutes of the Slovak Academy of Sciences are not universities, they are not eligible to provide an independent PhD education. Yet, we managed to contribute to education of PhD students during the entire evaluation period as an external institution affiliated with the PhD programs of the Slovak University of Technology in Bratislava and from the 2019 also with the PhD programs of the Slovak University of Agriculture in Nitra.

The evaluation period (from 2016 to 2021) can be characterized by a number of other important changes or events:

- A new executive body of the Institute was formed in September 2016.
- The seat of the IH SAS in Bratislava changed in April 2016, The Institute moved from Račianská street 75 to its current place. Our employees had to assemble and put into operation laboratories, a server room, workroom and a library. All these activities adversely affected the intensity of scientific work and in part the publishing activity of the IH SAS in 2016, but gradual intensification of publishing activities was stimulated by the new management.
- Recommendations of the previous evaluation were carefully considered in January 2017 and implemented into the Action plan.
- Restrictions during the COVID-19 pandemic situation also adversely affected the intensity of scientific work, especially the performance of experiments and measurements and, in part, the publishing activities of the staff of the Institute.
- Journal of Hydrology and Hydromechanics published by the Institute was included into the CCC database in 2016 that has successfully completed the four-year long effort of the editorial board.
- Acta Hydrologica Slovaca, another journal published by the Institute, was included into the SCOPUS database in 2020 and is ranked in the Q3 (SCOPUS) from 2021
- Since 2017, the IH SAS has been gradually creating jobs for successful PhD graduates
- In 2018, several changes related to the substantial transformation of SAS were implemented. Due to the unsuccessful completion of the transformation, the Institute returned to the previous form of existence (since September 26, 2018). However, this process involved a lot of administration and brought a great deal of uncertainty about the future. As a result, several talented young researchers left the Institute.
- On the other hand, the arrival of a younger generation of researchers, especially in the second half of the evaluation period, occurred.
- Eight staff members acquired higher qualification degrees during the evaluation period and two post-docs were awarded by grants from the Štefan Schwarz Support Funding.
- A new head of the Research base for Mountain Hydrology was appointed in 2018.
- A new web page for the Institute was constructed. Younger colleagues built and handled the Facebook page for promotion of the Institute to general public.
- Extension of research results dissemination to general public by other media (public discussions, newspapers, radio, and TV sessions) remains an important activity for the future. Expertise and advisory activities will be extended, too.
- Our own resources were used to reconstruct the buildings at the experimental bases in Liptovský Mikuláš and Michalovce.
- Our experimental research is based on field measurements and experiments. The institute self-financed the purchase of two new cars suitable for challenging terrain driving (one in 2020, the second in 2021). Our effort to finance a mobile laboratory vehicle was not successful. Despite the necessity of transporting people and equipment to the field, funding rules of our projects considered such vehicles as ineligible costs.

Our research has been supported by various international and national agencies and funding schemes including the H2020, COST, ERA-NET projects, Slovak Aids projects, Structural funds of the EU (ERDF), UNESCO, IAEA, EUREKA, Slovak Research and Development Agency (APVV) and Scientific grant agency of the Ministry of Education of the Slovak Republic and Slovak Academy of Sciences (VEGA).

IH SAS has two scientific departments:

1. *Department of SubSurface Water Hydrology (DSSWH)*, including the Research base for Lowland Hydrology in Michalovce (the East Slovakian Lowland), and
2. *Department of Surface Water Hydrology (DSWH)*, including the Research Base for Mountain Hydrology in Liptovský Mikuláš (the Tatra Mountains).

Short summary of the R&D activities of Department of SubSurface Water Hydrology (DSSWH)

Department of Subsurface Water Hydrology focuses on the research of soil-plant-atmosphere relationships that affect the soil water movement, monitoring and modelling of soil water flow under the climate and land use changes and on interactions between the soil water and groundwater. Researchers of the Department worked on two main themes that were studied in several international projects and projects of national granting schemes:

Theme 1 - mutual interactions between biological factors and soil hydrology

Vegetation and its **succession** can change soil hydrophysical parameters (water sorptivity and hydraulic conductivity) and parameters of **soil water repellency** (SWR) in both the surface layer and the root zone of soils that results in changes in infiltration and water flow in a soil. SWR is caused by hydrophobic compounds that occur in soils of varying textural composition from clay to sand. In collaboration with German colleagues we have found that a continuous increase in soil organic carbon (SOC) content during primary succession in sandy soils caused a continuous increase in the SWR parameters and a continuous decrease in the hydrophysical parameters. In contrast, no continuous trend of the SWR parameters of a sandy soil was observed in the course of secondary succession at abandoned fields in Hungary and Slovakia in the project carried out with Hungarian colleagues. Persistence of SWR and repellency index increased with SOC content during the primary succession and the influence of **microtopography** on the occurrence of the preferential flow in a sandy soil was observed. A new method of the modified water repellency index computation was developed. pH at the abandoned agricultural fields decreased monotonously and the course of other parameters depended on the course of the SOC content. The research also investigated the influence of pines that are widely planted at the Záhorská Lowland (Slovakia) to stabilize the sand dunes. Pines cultivation changes the soil properties and consequently the soil hydrological processes. The results show that sand fraction, pH and hydrophysical properties of the soils tend to decrease with increasing age of planted pine forests, while the SOC content and SWR show a negative trend. Differences in soil hydrophysical properties were attributed to SOC content and SWR caused by vegetation (pine needles at the 30-year-old site and grass cover/pine needles at the 100-year-old site). The higher age of the stand that represents a more advanced stage of succession, is accompanied by increased accumulation of soil organic matter.

Theme 2 - research of soil hydrophysical properties modifications with emphasis on their improvement and elimination of the climate change effects

Soils play an important role in influencing the natural water cycle owing to their water retention capability. **Biochar** can be used to improve the hydrophysical characteristics of soils and increase their water retention. It is a solid, carbon-rich material obtained from various biomasses by a pyrolysis. IH SAS started to research biochar in 2014, it was one of only two institutions in Slovakia to do so. Our research provided unique information about the short-term and long-term effects of biochar in Slovak conditions. Short-term results confirmed only a minimum positive effect of biochar on soil moisture in first two years after its application. At the same time, the relationship between the type of cultivated crop and the magnitude of the effect of biochar application was demonstrated. It was found out that biochar **significantly reduced N₂O emissions** at different doses of nitrogen industrial fertilizers (0, 40, 80 kg N/ha). An **increase in porosity** after biochar application was observed as well. The reason is that biochar creates new pores between the biochar and the soil aggregates. Positive effect of biochar on soil structure and improvement of the water-air regime of soil and infiltration into the soil was manifested in the field three years after the biochar application. The long-term effect of biochar was manifested in higher soil moisture during days without precipitation in the vegetation period. Our research is now focused on different soil types, different feedstock material of biochar and its different particle sizes. The first results showed that biochar applied into the sandy soil reduced the hydraulic conductivity.

Research Base of Lowland Hydrology in Michalovce (RBLH)

Research at the RBLH established in 1986, is focused on the water regime of heavy soils in the East Slovakian Lowland (ESL) which is one of only two greater lowlands of Slovakia. A lysimetric station that is unique in Central Europe was built in the Petrovce Water Node near RBLH. Monitoring, laboratory measurements, lysimetric and numerical experiments were used to achieve the objectives of several national and international projects for basic and applied research as well as, the Schwarz's Fund project.

Due to the high content of clay minerals, **heavy soils** change volume when their water content (soil moisture) changes. Volume changes are manifested by cracks and the two-domain soil structure forms. Neglecting of this physical phenomenon distorts the shape of the soil water retention curves and can result in incorrect calculation of volumetric soil moisture. Spectral analysis of electrical impedance in different soil environments at different humidity conditions conducted within the EUREKA project identified the usability interval of electrical impedance for soil volume moisture measurement. Our research also quantified and analysed individual components of the water balance by using a **lysimeter** at Petrovce Water Node. Unique, measured values of actual evapotranspiration (ET_a) were obtained in Slovakia directly from the lysimeter data. Measured ET_a was compared with calculated reference evapotranspiration. Obtained data represent the first results from a renewed lysimetric research after two decades in Slovakia. Based on the measurements, 10 mathematical models were created to calculate the change in soil volume depending on soil moisture and texture. An optimal "Vis-NIR" model of diffuse reflection spectroscopy for COLE (coefficient of linear expansion) estimation on the basis of direct measurements of COLE was developed using *samples from Slovakia (ESL) and the USA (Texas)*. Research has shown that a good estimate of COLE from Vis-NIR can be attributed to a high correlation of the COLE parameter with the clay content (spectrally active clay minerals).

The main goal of the Schwarz Fund project solved at RBLH was focused on the potential of magnetoferritin application in water management practice. Based on the nano-dimension, high reaction surface and redox activity, magnetic nanoparticles can be applied to water purification, separation or removal of heavy metals, carcinogens and radionuclides from the water. Project results confirmed predicted detoxification ability of magnetoferritin by tests showing the elimination of toxic substances, such as persistent polychlorinated biphenyls, which represent a serious hazard in the ESL territory, but not only there.

Short summary of the R&D activities of Department of Surface Water hydrology (DSWH)

Research at the Department of Surface Water Hydrology is focused on hydrological processes in mountains and big river basins, eco-hydrological problems - particularly the issues of stream water quality, study of surface water flow, and the surface water-groundwater interactions. Monitoring, field and laboratory experiments, mathematical and numerical modelling were employed to reach the research objectives.

The following main themes were studied under the umbrella of both national and international projects:

Theme 1 - comprised analyses of changes in river flow regimes and water balance components under the global climate change and increasing effects of anthropogenic activities.

In years 2007–2019, researchers of the DSWH coordinated an international project on **Flood regime of rivers in the Danube River basin** under the auspices of the National Committees of IHP UNESCO of the Regional cooperation of the countries in the Danube River Basin. Thirty scientists from eleven countries of the Danube river basin participated in the work. In 2019, the IH SAS published the follow-up volume 9 of the Danube Hydrological Monograph "Flood regime of rivers in the Danube River basin" (215 p. + 527 p. app.) We have contributed to the monograph by preparation of five chapters.

Within the framework of the MAD projects, researchers of the Department led a bilateral project „Impacts of global climate changes on water resources in Ukraine estimated by variability of river discharges and hydrograph components“ (2017–2019). The project consisted of two work-packages. In the first one the analysis of river discharge changes from selected rivers in Ukraine was conducted. The second package was focused on stable isotopes and hydrograph components separation.

Mitigation of the effects of hydrological extremes (floods and droughts) needs a better evaluation of their **occurrence**. In order to harmonize the estimation of design discharge values we investigated their regionalization using an appropriate mathematical approach. Synchronization of methodologies and procedures is important in large transboundary river basins in the Carpathian region. Such a uniform approach would provide the possibility of estimating design values in rivers without direct observation, only on the basis of the long-term average of maximum and minimum annual discharges and regional parameters from the neighbouring stations.

Research Base for Mountain Hydrology in Liptovský Mikuláš (RBMH)

The research at RBMH, established in 1986, is focused on water balance components and hydrological processes in mountains including snow cover, runoff formation and water sources interactions.

IH SAS is the only institution in Slovakia conducting the long-term research of the water balance in mountains that substantially affect the hydrological regime of Slovak rivers.

Field measurements using rainfall simulator and electrical resistivity tomography conducted in the evaluation period showed that only a small part of water flows on the soil surface even after an intensive rain and that the flow mostly occurs in only a shallow layer under the soil surface.

The RBHM team has contributed to intercomparison of methods of **snow water equivalent** measurements used in Europe and northern America (COST action HARMOSNOW). It also participated in discussions of the international hydrological community on the **land-use change impacts on floods** and **major unsolved scientific problems** in hydrology and in using stable isotopes of oxygen and hydrogen in water in the critical zone research (COST project WATSON).

More than *three decades of hydrological research in the catchment* allowed the **evaluation of variability in** obtained **hydrological data** series. The data shows that although the regional air temperature has been increasing since 1990 and the hydrological cycle in the catchment has become more dynamic since 2014, significant trends or changes in measured data series did not occur. However, the modelling indicated greater decrease in snow water equivalent at the lowest catchment elevations after 2010 and hourly discharge data showed cessation of typical diurnal runoff oscillations related to June.

Forest dieback became an important phenomenon affecting the hydrology of Slovak mountain catchments in the last decade. Therefore, experimental measurements of the overland flow (quantity, timing) at runoff plots in the dead, regenerating and alive forest started.

Theme 2 - hydrodynamics of flow in natural stream conditions taking into account the impacts of anthropogenic activity in a basin on stream water quality and the interaction with the surrounding groundwater

Within research of **dispersion processes and pollution spreading in surface** water, we have developed the knowledge base of pollution spreading processes and *methodology of pollution spreading rate determination*, for a simple stream branch as well as for a system of watercourses and sewer networks. Utilization of knowledge of hydrodynamics of pollution transport in flowing waters and skills with tracers allowed us to contribute to the *H2020 project – 787128 – SYSTEM* in which we designed and developed the **software tool for pollution source localization**. We have also acted as consultants in topics related to flow hydraulics in sewer system during a pilot implementation (six urban areas in Italy, Germany, Slovakia).

Mutual interactions between surface water (SW) and groundwater (GW) represent an important aspect of water management, especially in a **lowland territory**, where channel systems were constructed for the *intensification of agricultural production and discharge of inland waters*. Large **channel networks** exist in the Danube Lowland (Rye Island) and in the ESL territory and it was necessary to reevaluate their construction parameters. The obtained data and developed models also allowed evaluation of the **degree of interaction between SW and GW**, especially **with regard to the actual rate of the channel network silting**. The **proposal of their multifunctional use** was elaborated *in cooperation with other leading national research institutions and administrators of channel networks*. New possibilities of drainage channel utilization are important for landscape use and protection, namely the development and stability of biodiversity.

The research was also focused on **quantification of aquatic vegetation influence on discharge** conditions and impacts of nutrient content and water temperature on the degree of stream overgrowing.

Provision of safe drinking water during periods of short-term degradations of surface water quality caused e.g. by storms or intensive snowmelt was another research topic. In cooperation with the Slovak University of Technology and the Water Research Institute, we started monitoring of changes in the spatial distribution of basic **water quality indicators** in drinking water supply reservoirs. The research also includes simulation of impacts of critical weather situations on water quality in reservoirs.

2. Partial indicators of main activities:

2.1. Research output

2.1.1. Principal types of research output of the institute: basic research/applied research, international/regional (in percentage)

basic research/applied research: 80/20

international/regional (in percentage): 50/50

2.1.2 List of selected publications documenting the most important results of basic research. The total number of publications should not exceed the number of average FTE researchers per year. The principal research outputs (max. 10% of the total number of selected publications, including Digital Object Identifier – DOI if available) should be underlined. Authors from the evaluated organizations should be underlined.

- 01 BAČOVÁ MITKOVÁ, Veronika - PEKÁROVÁ, Pavla - MIKLÁNEK, Pavol - PEKÁR, Ján. Hydrological simulation of flood transformations in the upper Danube River: Case study of large flood events. In Journal of Hydrology and Hydromechanics, 2016, Vol. 64, No. 4, pp. 337–348. (1.469 - IF2015). ISSN 0042-790X. (ADNA)
- 02 ORFÁNUS, Tomáš - STOJKOVOVÁ, Dagmar - NAGY, V. - NEMETH, T. Variability of soilwater content controlled by evapotranspiration and groundwater-root zone interaction. Archives of Agronomy and Soil Science, 2016, Vol. 62, No. 11 pp: 1602–1613. (ADCA)
- 03 VELÍSKOVÁ, Yveta - DULOVIČOVÁ, Renáta - SCHÜGERL, Radoslav. Impact of vegetation on flow in a lowland stream during the growing season. In Biologia, 2017, vol. 72, no. 8, p. 840-846. (0.759 - IF2016). ISSN 0006-3088. (ADDA)
- 04 RODNÝ, M., NOLZ, R., NOVÁK, V., HLAVÁČIKOVÁ, H., LOISKANDL, W., HIMMELBAUER, M.: Modified method of aerodynamic resistance calculation and its application to potential evapotranspiration estimation. In International Agrophysics, 2016, Vol. 30, No. 2, pp. 231–235. (1.067 - IF2015). ISSN 0236-8722. (ADMA)
- 05 Tomáš ORFÁNUS, Abdel-Monem Mohamed AMER, Grzegorz JOZEFACIUK, Emil FULAJTAR, Anežka ČELKOVÁ. Water vapour adsorption on water repellent sandy soils. In Journal of Hydrology and Hydromechanics, 2017, vol. 65, no. 4, p. 395-401. (2016: 1.654 - IF, Q2 - JCR, 0.481 - SJR, Q2 - SJR, CCC). (2017 - Current Contents, WOS, SCOPUS, CCC). ISSN 1338-4333. (ADDA)
- 06 BAČOVÁ MITKOVÁ, Veronika - PEKÁROVÁ, Pavla - HALMOVÁ, Dana - MIKLÁNEK, Pavol. Reconstruction and post-event analysis of a flash flood in a small ungauged basin: a case study in Slovak territory. In Natural Hazards, 2018,

- vol. 92, iss. 2, p. 741-760. (2017: 1.901 - IF, Q2 - JCR, 0.767 - SJR, Q1 - SJR, CCC). (2018 - Current Contents). ISSN 0921-030X. <https://doi.org/DOI> <https://doi.org/10.1007/s11069-018-3222-2> (ADCA)
- 07 VITKOVÁ, Justína - KONDRLOVÁ, Elena - RODNÝ, Marek - ŠURDA, Peter - HORÁK, J. Analysis of soil water content and crop yield after biochar application in field conditions. In *Plant, Soil and Environment*, 2017, vol. 63, no. 12, p. 569-573. (2016: 1.225 - IF, Q2 - JCR, 0.631 - SJR, Q2 - SJR). (2017 - Current Contents). ISSN 1214-1178. <https://doi.org/10.17221/564/2017-PSE> (ADCA)
- 08 HOLKO, Ladislav - BIČÁROVÁ, Svetlana - HLAVČO, Jozef - DANKO, Michal - KOSTKA, Zdeňek. Isotopic hydrograph separation in two small mountain catchments during multiple events. In *Cuadernos de Investigación Geográfica Geographical Research Letters*, 2018, vol. 44, no. 2, p. 453-473. (2017: 0.865 - SJR, Q1 - SJR). (2018 - SCOPUS). ISSN 0211-6820.ADMB)
- 09 SOKÁČ, Marek - VELÍSKOVÁ, Yvetta - GUALTIERI, Carlo. An approximate method for 1-D simulation of pollution transport in streams with dead zones, In *Journal of Hydrology and Hydromechanics*, 2018, vol. 66, no. 4, p. 437-447. (2017: 1.714 - IF, Q3 - JCR, 0.599 - SJR, Q1 - SJR, CCC). (2018 - Current Contents, WOS, SCOPUS, CCC). ISSN 1338-4333. (ADDA)
- 10 PEKÁROVÁ, Pavla - BAČOVÁ MITKOVÁ, Veronika - PEKÁR, Ján - MIKLÁNEK, Pavol - HALMOVÁ, Dana - LIOVÁ, Soňa. Historical floods on the territory of Slovakia and their importance in hydrology. Bratislava: Veda, 2018. 135 p. ISBN 978-80-224-1684-9. (AAB) – in Slovak
- 11 LICHNER, Ľubomír - FELDE, Vincent J.M.N.L. - BÜDEL, Burkhard - LEUE, Martin - GERKE, Horst H. - ELLERBROCK, Ruth H. - KOLLÁR, Jozef - RODNÝ, Marek - ŠURDA, Peter - FODOR, Nándor - SÁNDOR, Renáta. Effect of vegetation and its succession on water repellency in sandy soils. In *Ecohydrology*, 11, 2018, 6, Article Number: UNSP e1991 (2.755 - IF2017). ISSN 1936-0584. (ADCA)
- 12 HLAVÁČIKOVÁ, Hana - HOLKO, Ladislav - DANKO, Michal - NOVÁK, Viliam. Estimation of macropore flow characteristics in stony soils of a small mountain catchment. In *Journal of hydrology*, 2019, vol. 574, p. 1176-1187. (4.405 - IF2018). <https://doi.org/10.1016/j.jhydrol.2019.05.009> (ADCA)
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2.1.3 List of monographs/books published abroad

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- AAA02 ANTAL, László - BABINSZKY, László - BÁCSI, István - BAI, Attila - BALLÁNÉ KOVÁCS, Andrea - NAGY, Viliam - ORFÁNUS, Tomáš. *VÍZZEL KAPCSOLATOS KUTATÁSOK: precíziós mezőgazdaság*. [Research related the water: accurate agriculture]. Prof. dr. Nagy János (ed.). Debrecén : University Debrecen, 2020. 277 p. ISBN 978-615-5938-01-6

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- ABC10 VELÍSKOVÁ, Yvetta - SOKÁČ, Marek - SIMAN, Cyril. Assessment of Water Pollutant Sources and Hydrodynamics of Pollution Spreading in Rivers. In *Water Resources in Slovakia: Part I Assessment and Development : The Handbook of Environmental Chemistry*. - Berlin ; Heidelberg : Springer International Publishing, 2019, p. 185-212. ISBN 978-3-319-92853-1. ISSN 1867-979X. https://doi.org/10.1007/698_2017_199

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- AAB02 LICHNER, Ľubomír - ŠURDA, Peter - NAGY, Viliam. Vplyv vegetácie a jej sukcesie na hydrologické procesy v pôde [Impact of vegetation and its succession on soil hydrological processes]. Bratislava : Veda, 2020. 93 s. ISBN 978-80-224-1812-6
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ABB01 DANÁČOVÁ, Zuzana - BLAŠKOVIČOVÁ, L. - POÓROVÁ, Jana - ŠIMOR, V. - FENDEK, Marián - HORVÁT, Oliver - FENDEKOVÁ, Miriam - PEKÁROVÁ, Pavla - PEKÁR, Ján. Vývoj a prognóza výskytu hydrologického sucha v prietokoch [Development and prognosis of hydrologic drought in discharges]. In Hydrologické sucho na Slovensku a prognóza jeho vývoja. Bratislava: Univerzita Komenského (Comenius University in Bratislava), 2017, s. 101-218. ISBN 978-80-223-4398-5.

2.1.5. List of other scientific outputs specifically important for the institute, max. 10 items for institute with less than 50 average FTE researchers per year, 20 for institutes with 50 – 100 average FTE researchers per year and so on

01 The monograph NOVÁK, Viliam - HLAVÁČIKOVÁ, Hana. *Applied Soil Hydrology*. Vol. 32. Series Title: Theory and Applications of Transport in Porous Media. Cham : Springer International Publishing, 2019. 342 p. <https://doi.org/10.1007/978-3-030-01806-1>. ISBN 978-3-030-01806-1 has more than 33 000 accesses and was awarded as a top publication of SAS in that year.

02 The monograph entitled “FLOOD REGIME OF RIVERS IN THE DANUBE RIVER BASIN, the Danube and its Basin – Hydrological Monograph Follow-up Volume IX“ was published at IH SAS in 2019 as a final output of the IHP UNESCO project No. 9 “Flood regime of rivers in the Danube River basin”. The monograph is the result of a 12-year long-term cooperation of a number of hydrologists from 11 countries in the Danube basin. It has 215 pages of printed text plus 527 pages of attachments on the attached CD. It consists of 9 chapters prepared by 29 authors. IH SAS contributed 4 chapters. (PEKÁROVÁ, Pavla - MIKLÁNEK, Pavol - PEKÁR, Ján. History and downstream propagation of the Danube floods. In Flood regime of rivers in the Danube River basin: The Danube and its Basin – Hydrological Monograph Follow-up Volume IX. - Bratislava: Regional Co-operation of the Danube Countries within the Frame of the International Hydrological Programme of UNESCO: Slovak Academy of Sciences, Institute of Hydrology, 2019, p. 44-65. ISBN 978-80-89139-46-0; PEKÁROVÁ, Pavla - PEKÁR, Ján - MIKLÁNEK, Pavol. Analysis of cyclicity and long-term trends of annual series, and Qmax series. In Flood regime of rivers in the Danube River basin: The Danube and its Basin – Hydrological Monograph Follow-up Volume IX. - Bratislava: Regional Co-operation of the Danube Countries within the Frame of the International Hydrological Programme of UNESCO: Slovak Academy of Sciences, Institute of Hydrology, 2019, p. 78-101. ISBN 978-80-89139-46-0; RÖSSLER, Ole - MÜRLEBACH, Michael - LARINA-POOTH, Maria - HALMOVÁ, Dana - GARAJ, Marcel - PEKÁROVÁ, Pavla. Analysis of the intra-annual regime of flood flow and its changes in the Danube basin. In Flood regime of rivers in the Danube River basin: The Danube and its Basin – Hydrological Monograph Follow-up Volume IX. - Bratislava: Regional Co-operation of the Danube Countries within the Frame of the International Hydrological Programme of UNESCO: Slovak Academy of Sciences, Institute of Hydrology, 2019, p. 102-123. ISBN 978-80-89139-46-0; PEKÁROVÁ, Pavla - DROBOT, Radu - BAČOVÁ MITKOVÁ, Veronika - MÉSZÁROS, Jakub - DRAGHIA, Aurelian Florentin. Statistical analysis of extreme discharges. In Flood regime of rivers in the Danube River basin: The Danube and its Basin – Hydrological Monograph Follow-up Volume IX. - Bratislava: Regional Co-operation of the Danube Countries within the Frame of the International Hydrological Programme of UNESCO: Slovak Academy of Sciences, Institute of Hydrology, 2019, p. 124-150. ISBN 978-80-89139-46-0)

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- 07 Lichner, Ľ., Šurda, P., Nagy, V.: Vplyv vegetácie a jej sukcesie na hydrologické procesy v pôde. Impact of vegetation and its succession on soil hydrological processes. Veda, Bratislava 2020, 96 p. (AAB)
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2.1.6. List of patents, patent applications, and other intellectual property rights registered abroad

2.1.7. List of patents, patent applications, and other intellectual property rights registered in Slovakia

2.1.8. Narrative on the most important research outputs of the institute – especially focused on their importance for society (3-5 pages)

The most important research outputs of the R&D activities summarised in the section 1.8. could fall into several groups:

1. Development of databases, approaches and methods contributing to mitigation of extreme hydrological events (floods, droughts)

The territory of the Danube River basin, shared by 19 countries, is one of the most flood-endangered regions of Europe. Assessment of the design discharge values along the Danube channel is complicated due to application of different estimation methods in particular countries. Therefore, it is necessary to commence the harmonization of the flood design values assessment methods.

In 2007, the "XXIst Working Meeting of Regional Cooperation of the Danube countries" within the framework of the UNESCO International Hydrological Program agreed on the project No. 9 "Flood regime of rivers in the Danube River basin". Slovakia - Institute of Hydrology of the Slovak Academy of Sciences was approved as the international coordinator of the project. The project solution was originally planned for 7 years. However, due to the difficulties with compilation of the database containing historical input data (daily data from some countries from 1930-1960 had to be digitized), the project was extended to 12 years.

1. In the first phase of the project (2008–2010), individual National Committees of the Danube Countries nominated their experts and specialists to the working groups. The internet Web page was created (<http://www.ih.savba.sk/danubeflood>), where all the details about the project were given. A methodology for solving individual project topics was developed and a list of stations with high-quality long-term observations of daily flows was created.

2. In the second phase (2011–2016), individual countries prepared the input data and teams of experts processed daily, monthly, and annual characteristics.

3. In the third phase (2017–2019), the chapters of the final monograph presenting the results of the project were processed.

At the end of 2019, final output of the project - the monograph entitled "FLOOD REGIME OF RIVERS IN THE DANUBE RIVER BASIN, the Danube and its Basin – Hydrological Monograph Follow-up Volume IX" was published at IH SAS. The monograph is the result of a long-term 12-year cooperation with a number of hydrologists from 11 countries in the Danube basin and has an extraordinary practical importance for the flood risk management in the Danube river basin. At the same time, it is an excellent example of a scientific approach to hydrological flood risk analysis. It is the basis for further work and transboundary co-operation between the national services responsible for the flood protection and implementation of the European Floods Directive. The monograph has 215 pages of printed text plus 527 pages of attachments on the attached CD. It consists of 9 chapters prepared by 29 authors from 11 Danube countries.

The main achievements of the project are:

1. the establishment of a single database of average daily discharge series and maximum annual discharge series from over 80 Danube basin stations; and
2. uniform methodology for processing of all collected data.

The database built in the project has been provided to a UNESCO project "Low Flows and Hydrological Drought in the Danube Basin" that is part of the activities of the International Hydrological Programme VIII: WATER SECURITY.

Increasing global air temperature can have adverse impacts on the soils that are essential not just in food production, but also in redistribution of water from precipitation and thus formation of runoff and water storage (eventually leading to floods, droughts, decrease in agricultural production, etc.). A monograph "APPLIED SOIL HYDROLOGY" (2019) published by the authors from IH SAS presenting and quantifying the role of soil in the hydrological cycle is an important international contribution to dissemination of current knowledge among hydrologists, agronomists, foresters, environmental protectionists, meteorologists and other people who are interested in soil hydrology. It is also suitable for students, it includes a comprehensive view of the processes and phenomena taking place in soils and also the measurement methods of individual characteristics.

Application of the approaches developed in research needs data. IH SAS has participated (as one of 94 institutions from 54 countries and the only institution from Slovakia) in the development of the Soil Water Infiltration Global database, containing 5023 infiltration curves collected across all continents in the period from 1976 to late 2017. In addition to infiltration data, basic information on measurement location and method, soil properties, and land use was gathered. That made the database valuable for the development of pedotransfer functions to estimate soil hydraulic properties, for the evaluation of water infiltration measurement methods, and for the development and validation of mathematical models of water infiltration to soils. The database will also allow a better parametrization of the infiltration process in land surface models. All collected data and related soil characteristics are provided online and can be copied freely by referencing it.

Drought is a consequence of climate anomalies, as well as of incorrect human water use practices. Agricultural drought is commonly related to the deficit in soil moisture, which affects plant production and crop yield. Especially in the southern areas of Slovakia, where longer non-precipitation periods are regularly repeated in summer months, is this problem visible in last decade. Our research indicates that biochar can represent a relatively cheap and naturally acceptable material that could retain more water in the soil during longer drought periods. More water also means more water-soluble nutrients, which are accessible for agricultural plants. This in turn affects the quantity of the crop. Our results about biochar application in field conditions are useable for small and large farmers, as well as ordinary citizens who want to grow their own vegetables and fruits. Results also showed the reduction of N₂O emissions which is the most important result for environment and society.

Prolonged dry periods across Europe, predicted with regard to climate change, would most likely increase the extent of areas affected by soil water repellency. Our research conducted in grassland ecosystems in collaboration with colleagues from Italy, Hungary and United Kingdom showed that sites with finer texture soil under humid climate are unlikely to be water repellent. Regions with coarser texture soils with high or, conversely, low organic matter content and regions in drier climate having longer dry periods have a greater likelihood of containing water repellent soils. It was found that climatic factors can override or suppress the impact of vegetation on the soil water repellency.

Scientists from IH SAS doing the soil water repellency research also contribute to international collaboration related to the effects of forest fires (often triggered by high air temperatures and causing soil water repellency) and coordinate the activities of a group focused on soil hydrophobicity with participants from ten institutions in Europe and Japan.

Underpinning research

APVV-15-0160 Elimination of degradation processes in soil by biodiversity restoring

VEGA 2/0013/15 Biochar impact on transport and retention of water in agricultural soil

VEGA 2/0053/18 Strengthening Agroecosystem Resilience: Hydropedological and Biohydrological Aspects

VEGA 2/0155/21 Impact of biochar application on hydro-physical characteristics of different soil types

VEGA 2/0020/20 Effect of vegetation and its secondary succession on soil hydrological processes

COST Action CA18135 Fire in the Earth System: Science & Society

project EIG JC2019-074 Soil Eco-Technology to Recover Water Storage in disturbed Forests

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<https://www.mdpi.com/1996-1944/14/6/1335>

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https://www.agriculturejournals.cz/web/swr.htm?type=article&id=15_2018-SWR

<https://link.springer.com/article/10.2478/s11756-020-00471-5>

<https://www.sciencedirect.com/science/article/pii/S0016706120325350>

<https://journals.sagepub.com/doi/full/10.1177/11786221211028185>

<https://www.sciendo.com/article/10.2478/johh-2021-0012>

2. Detection and mitigation of the effects of environmental pollution caused by human activities

Urban dwellers are increasingly threatened by illegal (criminal) activities. Systems for detecting such activities are different - they focus on the detection and monitoring of air, water, respectively waste. Because the threats are urgent and approaches are different, it was decided to include theme "Integration of detection capabilities and data fusion with utility providers' network" (SEC-10-FCT-2017) into the 2016-2017 Work Programme "Secure societies – Protecting freedom and security of Europe and its citizens" of Horizon 2020. The challenge is addressed by consortium "SYnergy of integrated Sensors and Technologies for urban sEcured environMent" (SYSTEM) that is aimed at developing and testing a customised sensing system for hazardous substances detection in

complementary utility networks and public spaces. Proposed innovative monitoring of fused data sources was tested and adapted in six urban areas.

IH SAS contributed to the project by development of the method of pollution sources localization in sewer systems based on the continuous monitoring of a substance of interest. The source of a substance can be localized according to concentration time courses by solving the so-called inverse task that is based on the solution of a partial differential advection-dispersion equation (ADE). The inverse solution is characterized by the high degree of uncertainty and the computing time is very long even with modern computers. Therefore, it was necessary to find, design or create an alternate solution and develop 1-D analytical solutions for the dispersion of pollutants in flows. We have developed the approach that significantly accelerated the solution of the inverse task and made it more accurate. Numerical models of pollution distribution in watercourses (rivers, sewer systems) based on various analytical solutions of ADE coupled with optimization methods for the pollution source localization were used.

Precision of the pollution source localisation depends highly on the numerical modelling precision. Therefore, an extensive research has been carried out about the spread of pollution in watercourses. The research focused on real conditions in rivers and sewer networks. Numerous field and laboratory experiments were performed. Based on the results, a specific software was created, tested and validated. The developed software allows the solution of the inverse task, i.e. to localise the pollution source under various conditions (scenarios).

The research has a direct impact on detection and reduction of hazardous (illegal/criminal) activities, but also on the environment, because it allows to detect and localize such activities as industrial accidents, illegal waste discharges, production of illegal substances, etc. It has also important societal impacts, because it enhances the fight against criminal, terrorist and drug trafficking, and contributes to internal security of the EU citizens, and thus to environment and water quality as well. The stakeholders and participants the project were also the police and Law Enforcement Authorities (LEA) of the Slovak Republic, as well as water companies.

Underpinning research

project Horizon 2020 – SYnergy of integrated Sensors and Technologies for urban sEcured environMents”, Acronym: SYSTEM, Grant agreement No. 787128

7th FP Detection of Watercourse Contamination in Developing Countries using Sensor Networks, Acronym: Goldfish, FP7-ICT-2009-6, Grant agreement no: 269985

VEGA 2/0085/20 Prediction of a point pollution source position in a watercourse network – a hydrodynamic approach

VEGA 1/0805/16 Localisation of accidental point sources of pollution in watercourses based on-line monitoring data

References to the research

<https://www.mdpi.com/2073-4441/13/22/3168>

<https://www.mdpi.com/2073-4441/11/10/2145>

<https://www.sciendo.com/article/10.2478/johh-2018-0035>

<https://iopscience.iop.org/article/10.1088/1755-1315/612/1/012037>

<https://www.systemproject.eu/>

Polychlorinated biphenyls (PCBs) are synthetic organic substances that were introduced to nature by a man. They are used in many products (electrical devices, dyes, inks, adhesives, etc.). Although many countries banned or seriously restricted the PCBs production, about 10% of all PCBs produced by mankind since 1929 remains in the environment. They can accumulate in human bodies, probably cause cancer, contribute to ecological risks and economic damage. PCBs were produced in eastern Slovakia where they still represent a serious environmental problem. Recently, hundreds of tons of contaminated waste were for the first time officially confirmed there, and an emergency situation was announced. The Ministry of Environment and the Ministry of Agriculture initiated activities that could help to mitigate the effects of this long-term burden. Our recent research addressed the highly topical issue of the removal of PCBs from the environment. Many previous studies showed the potential of magnetic nanoparticles with high effective surface and reactivity for hydrological or medical treatments. We have tested magnetoferritin, the synthetic derivate of natural iron storage protein of living systems -

ferritin, for interaction with PCB congener 28 (2,4,4'-trichlorobiphenyl). Iron-based magnetic nanoparticles and redox activity in magnetoferritin solution allowed the (bio)remediation ability study. The obtained results were acknowledged among the most significant results of the Slovak Academy of Sciences in 2020 and proved that magnetoferritin can be used to address the water quality problems. Knowledge of the iron phases cycles enables understanding of the transformations of iron-containing minerals, which are found in soil and water.

Underpinning research

VEGA 2/0044/20 Quantification of Interaction Processes in Hydrological Cycle in Lowland area conditions

References to the research

<https://www.sciencedirect.com/science/article/pii/S0045653520318245?via%3Dihub>

3. Long-term monitoring and research as a tool in analyses of changes in hydrological cycle, collaboration with other institutions and education of the public

Slovakia is a mountainous country. Mountain environments are fragile and susceptible to changes in climate or landuse. IH SAS is the only institution in Slovakia conducting the long-term research of the water balance and hydrological processes in the high mountains which substantially affect the hydrological regime of Slovak rivers, but are sparsely covered by measured data.

More than three decades of hydrological research in the high mountain Jalovecký Creek catchment (the Western Tatra Mountains, area 22 km², elevation range 820-2178 m a.s.l., mean elevation 1500 m a.s.l.) enabled evaluation of variability in the obtained hydrological data series and collaboration with several institutions providing services to the society. Our results show that although the regional air temperature has been increasing since the 1990' and the hydrological cycle in the catchment has become more dynamic since 2014, significant trends or changes in the measured data series have not yet occurred. Even the snow water equivalent characterizing the amount of water in snow (hydrologically the most important characteristic of the snow cover) did not exhibit significant changes over the last three decades. However, mathematical modelling and time shifts between the air temperature and discharge maxima indicated a greater decrease in the snow water equivalent at the lowest catchment elevations after 2010. A clear increase in the percentage of precipitation leaving the catchment as runoff started in 2014. The flashiness index representing day to day flow fluctuations became higher as well. These characteristics could point at the influence of forest dieback that has recently become serious in the densely forested high mountains of Slovakia. Forest dieback started in our study catchment at the beginning of the 2010' and has become more significant since 2017. However, the attribution analysis aimed at finding the probable reasons of variability in our hydrological data indicated that various characteristics of precipitation regime such as number of wet periods, precipitation total during the late winter and spring months, etc., were best correlated with the investigated data series. Other characteristics (flow in March and June, annual versus summer runoff coefficients) suggest that something happened in the cold period of the year. Isotopic composition of water documented increased concentrations of heavier isotopes in precipitation and runoff that might be related to an increased global evapotranspiration. Evaluation of the isotopic composition of local tap waters in the downstream part of the catchment inspired the discussion about water sources with local water supply company.

Part of our meteorological data measured at high altitudes is shared with the Mountain rescue service and contributes to avalanche forecasting. We also collaborate with Slovak Hydrometeorological Institute on the evaluation of radar-based precipitation that is employed in flood forecasting. Our measured data showed that precipitation estimates used in the flood forecasting are often seriously underestimated. The underestimation inevitably results in problems with correct flood forecasting in some mountain areas.

School excursions continue to attend the research base in Liptovský Mikuláš to learn about the hydrological cycle and its measurement in mountains. Other popularization and education activities of IH SAS are also expanding.

Underpinning research

VEGA 2/0065/19 Variability of the water balance and hydrological processes in a mountain catchment under the global change conditions

APVV 19-0340 Connectivity and flood runoff dynamics in headwater catchments of Slovakia

References to the research

<https://sciendo.com/article/10.2478/johh-2020-0010>

<https://sciendo.com/article/10.2478/johh-2020-0011>

<https://onlinelibrary.wiley.com/doi/abs/10.1002/hyp.14128>

https://www.sav.sk/index.php?lang=sk&doc=journal-list&part=article_response_page&journal_article_no=26181

2.1.9. Table of research outputs

Papers from international collaborations in large-scale scientific projects (Dwarf team, ALICE Collaboration, ATLAS collaboration, CD Collaboration, H1 Collaboration, HADES Collaboration, and STAR Collaboration) have to be listed separately

Scientific publications	2016			2017			2018			2019			2020			2021			total			
	number	No. / FTE researches	No. / one million total salary budget	number	No. / FTE researches	No. / one million total salary budget	number	No. / FTE researches	No. / one million total salary budget	number	No. / FTE researches	No. / one million total salary budget	number	No. / FTE researches	No. / one million total salary budget	number	No. / FTE researches	No. / one million total salary budget	number	averaged number per year	av. No. / FTE researches	av. No. / one million total salary budget
Scientific monographs and monographic studies in journals and proceedings published abroad (AAA, ABA)	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	1	0,045	1,280	1	0,041	1,190	0	0,000	0,000	2	0,333	0,013	0,460
Scientific monographs and monographic studies in journals and proceedings published in Slovakia (AAB, ABB)	1	0,040	1,661	1	0,038	1,626	2	0,084	3,012	0	0,000	0,000	1	0,041	1,190	0	0,000	0,000	5	0,833	0,034	1,149
Chapters in scientific monographs published abroad (ABC)	0	0,000	0,000	1	0,038	1,626	2	0,084	3,012	4	0,178	5,122	1	0,041	1,190	2	0,074	2,353	10	1,667	0,067	2,298
Chapters in scientific monographs published in Slovakia (ABD)	1	0,040	1,661	0	0,000	0,000	22	0,921	33,133	5	0,223	6,402	0	0,000	0,000	0	0,000	0,000	28	4,667	0,188	6,434
Scientific papers published in journals registered in Current Contents Connect (ADCA, ADCB, ADDA, AADB)	7	0,279	11,628	11	0,423	17,886	18	0,753	27,108	15	0,669	19,206	23	0,948	27,381	18	0,666	21,176	92	15,333	0,619	21,140
Scientific papers published in journals registered in Web of Science Core Collection and SCOPUS not listed above (ADMA, ADMB, ADNA, ADNBN)	12	0,478	19,934	8	0,308	13,008	3	0,126	4,518	16	0,713	20,487	25	1,030	29,762	22	0,814	25,882	86	14,333	0,578	19,761
Scientific papers published in other foreign journals (not listed above) (ADEA, ADEB)	1	0,040	1,661	1	0,038	1,626	2	0,084	3,012	1	0,045	1,280	2	0,082	2,381	0	0,000	0,000	7	1,167	0,047	1,608
Scientific papers published in other domestic journals (not listed above) (ADFA, ADFB)	30	1,195	49,834	17	0,654	27,642	21	0,879	31,627	19	0,847	24,328	3	0,124	3,571	9	0,333	10,588	99	16,500	0,666	22,748
Scientific papers published in foreign peer-reviewed proceedings (AECA)	8	0,319	13,289	0	0,000	0,000	0	0,000	0,000	2	0,089	2,561	1	0,041	1,190	0	0,000	0,000	11	1,833	0,074	2,528
Scientific papers published in domestic peer-reviewed proceedings (AEDA)	6	0,239	9,967	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	9	0,371	10,714	14	0,518	16,471	29	4,833	0,195	6,664
Published papers (full text) from foreign scientific conferences (AFA, AFC)	9	0,359	14,950	12	0,462	19,512	2	0,084	3,012	6	0,267	7,682	1	0,041	1,190	2	0,074	2,353	32	5,333	0,215	7,353
Published papers (full text) from domestic scientific conferences (AFB, AFD)	9	0,359	14,950	14	0,539	22,764	20	0,837	30,120	14	0,624	17,926	0	0,000	0,000	1	0	1	58	10	0	13

2.2. Measures of research outputs (citations, etc.)

2.2.1. Table with citations per annum (without self-citations)

Citations of papers from international collaborations in large-scale scientific projects (Dwarf team, ALICE Collaboration, ATLAS collaboration, CD Collaboration, H1 Collaboration, HADES Collaboration, and STAR Collaboration) are listed separately

Citations, reviews	2015		2016		2017		2018		2019		2020		total		
	number	No. / FTE researchers	number	averaged number per year	av. No. / FTE researchers										
Citations in Web of Science Core Collection (1.1, 2.1)	223	8,88	259	9,97	240	10,05	255	11,37	420	17,31	464	17,17	1 861	310,17	12,52
Citations in SCOPUS (1.2, 2.2) if not listed above	16	0,64	58	2,23	56	2,34	44	1,96	75	3,09	122	4,52	371	61,83	2,49
Citations in other citation indexes and databases (not listed above) (3.2,4.2)	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00	0,00
Other citations (not listed above) (3.1, 4.1)	139	5,54	109	4,19	70	2,93	217	9,67	111	4,57	16	0,59	662	110,33	4,45
Reviews (5,6)	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00	0,00

2.2.2. List of 10 most-cited publications published any time with the address of the institute, with number of citations in the assessment period (2015 – 2020)

- ADCA02 ROGGER, M. - AGNOLETTI, Mauro - ALAOUI, A. - BATHURST, James C. - BODNER, G. - HOLKO, Ladislav. Land use change impacts on floods at the catchment scale: Challenges and opportunities for future research. In *Water Resources Research*, 2017, vol. 53, iss. 7, p. 5209-5219. (2016: 4.397 - IF, Q1 - JCR, 2.615 - SJR, Q1 - SJR, CCC). (2017 - Current Contents). ISSN 0043-1397. <https://doi.org/10.1002/2017WR020723>, **82 cit.**
- ADCA06 BLÖSCHL, G. - BIERKENS, Marc F. P. - HOLKO, Ladislav. Twenty-three Unsolved Problems in Hydrology (UPH) – a community perspective. In *Hydrological Sciences Journal : international association of hydrological Sciences.Association Internationale des Sciences Hydrologiques*, 2019, vol. 64, iss. 10, p. 1141-1158. (2018: 2.180 - IF, Q2 - JCR, 0.913 - SJR, Q1 - SJR, CCC). (2019 - Current Contents). ISSN 0262-6667. <https://doi.org/10.1080/02626667.2019.1620507>, **57 cit.**
- ADCA07 ONDERKA, Milan - WREDE, S. - RODNÝ, Marek - PFISTER, L. - HOFFMANN, L. - KREIN, A. Hydrogeologic and landscape controls of dissolved inorganic nitrogen (DIN) and dissolved silica (DSi) fluxes in heterogeneous catchments. In *Journal of hydrology*, 2012, vol. 450-451, no. 1, p. 36-47. (2011: 2.656 - IF, Q1 - JCR, 1.742 - SJR, Q1 - SJR, CCC). (2012 - Current Contents). ISSN 0022-1694. <https://doi.org/10.1016/j.jhydrol.2012.05.035>, **48 cit.**
- ADCA08 FODOR, N. - SÁNDOR, R. - ORFÁNUS, Tomáš - LICHNER, Ľubomír - RAJKAI, Kálman. Evaluation method dependency of measured saturated hydraulic conductivity. In *Geoderma*, 2011, vol. 165, no. 1, pp. 60-68. (2010: 2.178 - IF, Q1 - JCR, 1.454 - SJR, Q1 - SJR, CCC). (2011 - Current Contents). ISSN 0016-7061. <https://doi.org/10.1016/j.geoderma.2011.07.004>, **40 cit.**
- ADCA09 LICHNER, Ľubomír - HALLETT, P.D. - DRONGOVÁ, Z. - CZACHOR, H. - KOVÁČIK, Ľubomír - MATAIX-SOLERA, Jorge - HOMOLÁK, Marián. Algae influence the hydrophysical parameters of a sandy soil. In *CATENA*, 2013, vol. 108, p. 58-68. (2012: 1.881 - IF, Q2 - JCR, 0.955 - SJR, Q1 - SJR, CCC). (2013 - Current Contents). ISSN 0341-8162. <https://doi.org/10.1016/j.catena.2012.02.016>, **40 cit.**
- ADCA10 PARAJKA, Juraj - HOLKO, Ladislav - KOSTKA, Zdeňek - BLÖSCHL, G. MODIS snow cover mapping accuracy in a small mountain catchment – comparison between open and forest sites. In *Hydrology and Earth System Sciences*, 2012, vol. 16, pp. 2365-2377. (2011: 3.148 - IF, Q1 - JCR, 1.490 - SJR, Q1 - SJR, CCC). (2012 - Current Contents). ISSN 1027-5606. <https://doi.org/10.5194/hess-16-2365-2012>, **37 cit.**
- ADCA11 NOVÁK, Viliam - ŠIMUNEK, J. - GENUCHTEN, Martinis Th. van. Infiltration of water into soil with cracks. In *Journal of Irrigation and Drainage Engineering*, 2000, vol. 126, no.1, pp. 41-47. ISSN 0733-9437. [https://doi.org/10.1061/\(ASCE\)0733-9437\(2000\)126:1\(41\)](https://doi.org/10.1061/(ASCE)0733-9437(2000)126:1(41)), **35 cit.**
- ADCA12 BAČA, Peter. Hysteresis effect in suspended sediment concentration in the Rybarik basin. In *Hydrological Sciences Journal : International Association of Hydrological Sciences.Association Internationale des Sciences Hydrologiques*, 2008, vol. 53, no. 1, p. 224-235. (2007: 1.604 - IF, Q1 - JCR, 1.224 - SJR, Q1 - SJR, CCC). (2008 - Current Contents). ISSN 0262-6667. <https://doi.org/10.1623/hysj.53.1.224>, **35 cit.**
- ADCA13 ONDERKA, Milan - PEKÁROVÁ, Pavla. Retrieval of suspended particulate matter concentrations in the Danube River from Landsat ETM data. In *Science of the Total Environment*, 2008, vol. 397, no. 1-3, p. 238-243. (2007: 2.182 - IF, Q1 - JCR, 1.393 - SJR, Q1 - SJR, CCC). (2008 - Current Contents). ISSN 0048-9697. <https://doi.org/10.1016/j.scitotenv.2008.02.044>, **35 cit.**

ADCA14 PEKÁROVÁ, Pavla - MIKLÁNEK, Pavol - PEKÁR, Ján. Spatial and temporal runoff oscillation analysis of the main rivers of the world during the 19th-20th centuries. In *Journal of Hydrology*, 2003, vol. 274, no. 1, p. 62-79. ISSN 0022-1694. [https://doi.org/10.1016/S0022-1694\(02\)00397-9](https://doi.org/10.1016/S0022-1694(02)00397-9), **33 cit.**

2.2.3. List of 10 most-cited publications published any time with the address of the institute, with number of citations obtained until 2020

ADCA05 PEKÁROVÁ, Pavla - MIKLÁNEK, Pavol - PEKÁR, Ján. Spatial and temporal runoff oscillation analysis of the main rivers of the world during the 19th-20th centuries. In *Journal of Hydrology*, 2003, vol. 274, no. 1, p. 62-79. ISSN 0022-1694. [https://doi.org/10.1016/S0022-1694\(02\)00397-9](https://doi.org/10.1016/S0022-1694(02)00397-9), **89 cit.**

AAB01 MAJERČÁK, Juraj - NOVÁK, Viliam. *GLOBAL, one-dimensional variable saturated flow model, including root water uptake, evapotranspiration structure, corn yield, interception of precipitations and winter regime calculation*. Bratislava : Institute of Hydrology, 1994. 75 s. **85 cit.**

ADCA01 ROGGER, M. - AGNOLETTI, Mauro - ALAOUI, A. - BATHURST, James C. - BODNER, G. - HOLKO, Ladislav. Land use change impacts on floods at the catchment scale: Challenges and opportunities for future research. In *Water Resources Research*, 2017, vol. 53, iss. 7, p. 5209-5219. (2016: 4.397 - IF, Q1 - JCR, 2.615 - SJR, Q1 - SJR, CCC). (2017 - Current Contents). ISSN 0043-1397. <https://doi.org/10.1002/2017WR020723>, **82 cit.**

ADCA01 NOVÁK, Viliam - ŠIMUNEK, J. - GENUCHTEN, Martinis Th. van. Infiltration of water into soil with cracks. In *Journal of Irrigation and Drainage Engineering*, 2000, vol. 126, no.1, pp. 41-47. ISSN 0733-9437. [https://doi.org/10.1061/\(ASCE\)0733-9437\(2000\)126:1\(41\)](https://doi.org/10.1061/(ASCE)0733-9437(2000)126:1(41)), **68 cit.**

AAB01 ŠÚTOR, Július - ŠTEKAUEROVÁ, Vlasta. *Hydrofyzikálne charakteristiky pôd Žitného ostrova. [Hydrophysical characteristics of soils at Rye Island – in Slovak]*. 170 p., Bratislava: UH SAV, 2000. ISBN 80 - 968480 - 1 – 1, **67 cit.**

ADCA01 ONDERKA, Milan - PEKÁROVÁ, Pavla. Retrieval of suspended particulate matter concentrations in the Danube River from Landsat ETM data. In *Science of the Total Environment*, 2008, vol. 397, no. 1-3, p. 238-243. (2007: 2.182 - IF, Q1 - JCR, 1.393 - SJR, Q1 - SJR, karentované - CCC). (2008 - Current Contents). ISSN 0048-9697. Dostupné na: <https://doi.org/10.1016/j.scitotenv.2008.02.044>, **60 cit.**

ADDA01 LICHNER, Ľubomír - HALLETT, P.D. - FEENEY, D.S - ĎUGOVÁ, Olívia - ŠÍR, Miloslav - TESAŘ, Miroslav. Field measurement of soil water repellency and its impact on water flow under different vegetation. In *Biologia : journal of the Slovak Academy of Science*, 2007, vol. 62, no. 5, p. 537-541. (2006: 0.213 - IF, Q4 - JCR, 0.154 - SJR, Q3 - SJR, CCC). (2007 - Current Contents). ISSN 0006-3088. <https://doi.org/10.2478/s11756-007-0106-4>, **58 cit.**

ADCA01 BLÖSCHL, G. - BIERKENS, Marc F. P. - HOLKO, Ladislav. Twenty-three Unsolved Problems in Hydrology (UPH) – a community perspective. In *Hydrological Sciences Journal : international association of hydrological Sciences. Association Internationale des Sciences Hydrologiques*, 2019, vol. 64, iss. 10, p. 1141-1158. (2018: 2.180 - IF, Q2 - JCR, 0.913 - SJR, Q1 - SJR, CCC). (2019 - Current Contents). ISSN 0262-6667. <https://doi.org/10.1080/02626667.2019.1620507>, **57 cit.**

ADCA02 ONDERKA, Milan - WREDE, S. - RODNÝ, Marek - PFISTER, L. - HOFFMANN, L. - KREIN, A. Hydrogeologic and landscape controls of dissolved inorganic nitrogen (DIN) and dissolved silica (DSi) fluxes in heterogeneous catchments. In *Journal of hydrology*, 2012, vol. 450-451, no. 1, p. 36-47. (2011: 2.656 - IF, Q1 - JCR, 1.742 - SJR, Q1 - SJR, CCC). (2012 - Current Contents). ISSN 0022-1694. <https://doi.org/10.1016/j.jhydrol.2012.05.035>, **56 cit.**

AAB01 ŠÚTOR, Július - MATI, Rastislav - IVANČO, Jozef - GOMBOŠ, Milan - KUPČO, M. - ŠTASTNÝ, Pavel. *Hydrologia Východoslovenskej nížiny*. [Hydrology of the East Slovakian Lowland - in Slovak]. Michalovce : Media Group, v.o.s., 1995. **55 cit.**

2.2.4. List of 10 most-cited publications published during the evaluation period (2016-2021) with the address of the Institute, with number of citations obtained until 2021

ADCA01 ROGGER, M.** - AGNOLETTI, Mauro - ALAOUI, A. - BATHURST, James C. - BODNER, G. - HOLKO, Ladislav. Land use change impacts on floods at the catchment scale: Challenges and opportunities for future research. In *Water Resources Research*, 2017, vol. 53, iss. 7, p. 5209-5219. (2016: 4.397 - IF, Q1 - JCR, 2.615 - SJR, Q1 - SJR, CCC). (2017 - Current Contents). ISSN 0043-1397. <https://doi.org/10.1002/2017WR020723>, **122 cit.**

ADCA02 BLÖSCHL, G.** - BIERKENS, Marc F. P. - HOLKO, Ladislav. Twenty-three Unsolved Problems in Hydrology (UPH) – a community perspective. In *Hydrological Sciences Journal : international association of hydrological Sciences.Association Internationale des Sciences Hydrologiques*, 2019, vol. 64, iss. 10, p. 1141-1158. (2018: 2.180 - IF, Q2 - JCR, 0.913 - SJR, Q1 - SJR, CCC). (2019 - Current Contents). ISSN 0262-6667. <https://doi.org/10.1080/02626667.2019.1620507>, **106 cit.**

ADCA03 RAHMATI, Mehdi** - WEIHERMUELLER, Lutz - VANDERBORGHT, Jan - PACHEPSKY, Ya. - LICHNER, Ľubomír. Development and analysis of the Soil Water Infiltration Global database. L. Weihermueller., J. Vanderborght., Ya. Pachepsky, Ľ. Lichner. In *Earth System Science Data*, 2018, vol. 10, iss. 3, p. 1237-1263. (2017: 8.792 - IF, Q1 - JCR, 4.885 - SJR, Q1 - SJR, CCC). (2018 - Current Contents). ISSN 1866-3508. <https://doi.org/10.5194/essd-10-1237-2018>, **26 cit.**

ADCA04 HLAVÁČIKOVÁ, Hana** - NOVÁK, Viliam - ŠIMŮNEK, J. The effects of rock fragment shapes and positions on modeled hydraulic conductivities of stony soils. In *Geoderma*, 2016, vol. 281, p. 39-48. (2015: 2.855 - IF, Q1 - JCR, 1.518 - SJR, Q1 - SJR, CCC). (2016 - Current Contents). ISSN 0016-7061. <https://doi.org/10.1016/j.geoderma.2016.06.034>, **24 cit.**

ADCA05 FLEISCHER, P. - PICHLER, Viliam - FLEISCHER, Peter jr. - HOLKO, Ladislav - MÁLIŠ, František - GÖMÖRYOVÁ, Anna** - CUDLIN, P. - HOLEKSA, Jan - MICHALOVÁ, Zuzana - HOMOLOVÁ, Zuzana. Forest ecosystem services affected by natural disturbances, climate and land-use changes in the Tatra Mountains. In *Climate Research*, 2017, vol. 73, iss. 1-2, pp. 57-71. (2016: 1.578 - IF, Q3 - JCR, 0.881 - SJR, Q1 - SJR, CCC). (2017 - Current Contents). ISSN 0936-577X. <https://doi.org/10.3354/cr01461>, **23 cit.**

ADCA06 VITKOVÁ, Justína** - KONDRLOVÁ, Elena - RODNÝ, Marek - ŠURDA, Peter - HORÁK, J. Analysis of soil water content and crop yield after biochar application in field conditions. In *Plant, Soil and Environment*, 2017, vol. 63, no. 12, p. 569-573. (2016: 1.225 - IF, Q2 - JCR, 0.631 - SJR, Q2 - SJR, CCC). (2017 - Current Contents). ISSN 1214-1178. <https://doi.org/10.17221/564/2017-PSE>, **23 cit.**

ADNA01 KRAJČÍ, Pavel** - HOLKO, Ladislav - PARAJKA, Juraj. Variability of snow line elevation, snow cover area and depletion in the main Slovak basins in winters 2001-2014. Ladislav Holko, Juraj Parajka. In *Journal of Hydrology and Hydromechanics*, 2016, vol. 64, no. 1, p. 12-22. (2015: 1.469 - IF, Q2 - JCR, 0.524 - SJR, Q2 - SJR). (2016 - WOS, SCOPUS). ISSN 1338-4333. <https://doi.org/10.1515/johh-2016-0011>, **19 cit.**

- ADDA01 IOVINO, Massimo** - PEKÁROVÁ, Pavla - HALLETT, P.D. - PEKÁR, Ján - LICHNER, Ľubomír - MATAIX-SOLERA, Jorge - ALAGNA, V. - VALSH, Richard - RAFFAN, Annette - SCHACHT, K. - RODNÝ, Marek. Extent and persistence of soil water repellency induced by pines in different geographic regions. Pavla Pekárová, P.D. Hallett, J. Pekár, Ľ. Lichner, J. Mataix-Solera, V. Alagna, R. Valsh, A. Raffan, K. Schacht, M. Rodný. In *Journal of Hydrology and Hydromechanics*, 2018, vol. 66, no. 4, p. 360 - 368. (2017: 1.714 - IF, Q3 - JCR, 0.599 - SJR, Q1 - SJR, CCC). (2018 - Current Contents, WOS, SCOPUS, CCC). ISSN 1338-4333. <https://doi.org/10.2478/johh-2018-0024>, **17 cit.**
- ADCA01 LICHNER, Ľubomír** - FELDE, Vincent J.M.N.L. - BÜDEL, Burkhard - LEUE, Martin - GERKE, Horst H. - ELLERBROCK, Ruth H. - KOLLÁR, Jozef - RODNÝ, Marek - ŠURDA, Peter - FODOR, Nándor - SÁNDOR, Renáta. Effect of vegetation and its succession on water repellency in sandy soils. In *Ecohydrology*, 2018, vol. 11, iss. 6, art. no. UNSP e1991. (2017: 2.755 - IF, Q1 - JCR, 1.152 - SJR, Q1 - SJR, CCC). (2018 - Current Contents). ISSN 1936-0584. <https://doi.org/10.1002/eco.1991>, **16 cit.**
- ADDA01 ALAGNA, V. - IOVINO, Massimo** - BAGARELLO, V. J. - MATAIX-SOLERA, J. - LICHNER, Ľubomír. Application of minidisk infiltrometer to estimate water repellency in Mediterranean pine forest soils. In *Journal of Hydrology and Hydromechanics*, 2017, vol. 65, no. 3, p. 254-263. (2016: 1.654 - IF, Q2 - JCR, 0.481 - SJR, Q2 - SJR, CCC). (2017 - Current Contents, WOS, SCOPUS, CCC). ISSN 1338-4333. <https://doi.org/10.1515/johh-2017-0009>, **14 cit.**

2.2.5. List of most-cited authors from the Institute (at most 10 % of average FTE researchers per year) and their number of citations in the assessment period (2015– 2020). The cited papers must bear the address of the institute

Ladislav Holko – 564 cit
 Ľubomír Lichner – 463 cit
 Viliam Novák – 350 cit

2.2.6. List of most-cited authors from the Institute (at most 10 % of average FTE researchers per year) and their number of citations obtained until 2020. The cited papers must bear the address of the Institute

Ladislav Holko – 920 cit
 Pavla Pekárová – 905 cit
 Viliam Novák – 836 cit

2.2.7. List of most-cited authors from the Institute (at most 10 % of average FTE researchers per year) and their number of citations obtained until 2021 of their papers published during the evaluation period (2016– 2021). The cited papers must bear the address of the Institute

Ladislav Holko – 672 cit
 Ľubomír Lichner – 532 cit
 Viliam Novák – 368 cit

2.3. Research status of the institute in international and national context

- **International/European position of the institute**

- 2.3.1. List of the most important research activities demonstrating the international relevance of the research performed by the institute, incl. major projects (details of projects should be supplied under Indicator 2.4). Max. 10 items for institute with less than 50 average FTE researchers per year, max. 20 for institutes with 50 – 100 average FTE researchers per year and so on**

The international collaboration of the IH SAS is based on both multilateral and bilateral collaborations. The multilateral collaborations were realized within the programme HORIZON 2020, EUREKA, COST, EIG CONCERT-Japan and International Hydrological Programme of UNESCO (IHP UNESCO).

One of the dominating roles in Institute`s bilateral international cooperation has been the long-term co-operations, covered by Memorandum of Understanding with institutions in Austria, Italy, Georgia, Switzerland, Hungary, Poland, and Czech Republic. Bilateral cooperation with the Polish Academy of Sciences, the National Academy of Sciences of Ukraine, Georgian Environment Agency and the Austrian University of Natural Resources and Life Sciences was realized on the basis of bilateral mobility projects.

Contact point for researchers in the field of hydrology of the Central European research area is International Poster Day organized annually by the Institute. The IH SAS was also a co-organizer of the annual conference, which traditionally deals with current problems of the soil and their agricultural use “Alps-Adria Scientific Workshop” and also “International Conference on Biohydrology”, proposing an interdisciplinary approach to the biohydrology world. The regular Czech - Slovak conference “Small River Basin Hydrology” is organized with The Czech Academy of Sciences, Czech Hydrometeorological Institute and other Czech institutions. The institute has an important role in the field of Central European snow research and participates in the organization of regular Czech-Slovak meetings of snow researchers. The Institute as the seat of the secretariat of the Slovak National Committee for the UNESCO International Hydrological Program has organised meetings of representatives of the National Committee IHP UNESCO of the Danube countries.

1. The Institute has built a relatively strong position in the research of monitoring and prediction of pollution spreading in flowing water, which has been a base for participation in the H2020 project. The previous project of the 7th Framework Program is thematically followed by the project H2020 called “Synergy of integrated sensors and technologies for urban secured environment” (H2020-SEC-2016-2017-2). The institute is part of the project consortium, which consists of scientific institutions from Belgium, Germany, Great Britain, Italy, Poland and Sweden. IH SAS team designed an evaluation method of threats associated to the manufacturing of explosives and to the production and handling of synthetic drugs based on data from the sewage wastewater networks. The specific task of the IH SAS in this project was to develop, calibrate and verify a methodology and software tool algorithm for the dangerous illegal substances sources localisation in sewer network systems.
2. Representation of Slovakia in the Sub-Group on Mission “Healthy Oceans, Seas, Coastal and Inland Waters” of the Strategic Configuration of the Horizon Europe Shadow Programme Committee. (Mission Board - EC DG Research & Innovation) (The Ministry of Education of the Slovak Republic nominated Dr. Velísková as a representative of Slovakia)
3. The National Committee of the International Hydrological Programme of UNESCO (IHP UNESCO) is affiliated to the Institute. Historically, from the establishment of the programme, the Institute of Hydrology SAS was designated as a key point (National Committee) of the programme. Participation in the programme helps to develop international collaborations and the international position of the Institute. In addition to the administrative coordination of the whole programme in Slovakia, several other projects of the Programme are running at the Institute.

The Institute was the national representative for the IHP UNESCO Programme Component “Flow Regimes from International Experimental and Network Data” (FRIEND). FRIEND is a worldwide project operated on large scale regions. Practically all European countries participate in the EUROFRIEND group and the Institute is an active member of the Steering Committee.

The Institute was the national representative for the European Network of Experimental and Representative Basins. Small experimental catchments offer invaluable opportunities to observe and study hydrological and ecohydrological processes. Despite being time-, energy- and money-consuming, experimental studies carried out in representative catchments are fundamental to advance our understanding of hydrological and ecohydrological processes and how they may be impacted by human activities. Twenty European countries collaborate in the network and the Institute is an active member of the Steering Committee.

The Institute acts as a national representative for the IHP UNESCO Regional cooperation of the Danube Countries. The cooperation between 18 participating countries (from Germany downstream the Danube to Moldova and Ukraine) formulates basin-wide research projects of common interest and organizes regular bi-annual scientific conferences. During the assessment period, the co-operation was developed under the following themes, Managing water as a shared responsibility across geographical & social boundaries (Regional cooperation of Danube Countries, IHP UNESCO FA 2.4, 2008–2013), and Improve scientific basis for hydrology and water sciences for preparation and response to extreme hydrological events (Regional cooperation of Danube Countries, IHP UNESCO FA 1.5, 2014–2021). The Regional co-operation is a very important tool for understanding the hydrological regimes and processes of our region. The Institute represents Slovakia in the steering committee of the co-operation. The Institute was the international coordinator of the the project No. 9 Flood Regimes of the Rivers in the Danube Basin and the Follow-up Volume IX of The Danube and its Basin – Hydrological Monograph was edited and published by the Institute in 2019 (<https://doi.org/10.31577/2019.9788089139460>).

Since 2020 the Institute continues to collaborate on the ongoing project Water Temperature simulation during summer low flow conditions in the Danube Basin.

4. Senior researchers of the Institute are/were members of management committees of three COST projects, which serve as a mobility base for researchers from the institute within the activities of COST projects, including workshops, study stays and meetings of working groups. Project CA19120 – “WATER isotopeS in the critical zONE: from groundwater recharge to plant transpiration” aims to be a synthesis of scientific knowledge on water partition in the Earth’s critical zone based on water isotope data to support water resources management in Europe. The goal of the project CA18135 – “Fire in the Earth system: science and society” is to allow the discussion of different experiences and the emergence of new approaches to fire research.
5. Project of the EIG CONCERT-Japan programme “Soil Eco-Technology to Recover Water Storage in disturbed Forests” aims to develop scientific cooperation and exchange of current methods between institutions in Europe and Japan in the field of sustainable water management. The institute is part of the project consortium, which consists of scientific institutions from Czech Republic, Germany and Japan.
6. Consortium of Institute and scientific institutions from Belgium, Italy, Switzerland, and Czech Republic cooperate on development and realization of the system for monitoring selected parameters of porous organic and inorganic substances within the project EUREKA E!7614 “A System of Monitoring of Selected Parameters of Porous Substances Using the EIS Method in a Wide Range of Applications”.
7. Bilateral cooperation of the institute is realized through flexible mobility projects, which enable the preparation of more complex projects of multilateral grant schemes. Within the evaluated period Institute realized mobility projects with University of Natural Resources and Life Sciences (BOKU) in Vienna through the project "The Impact of biophysical and environmental factors on the differences between measured and calculated evapotranspiration totals"; with Institute of Agrophysics of Polish Academy of Sciences in

Lublin through the projects “Effect of biochar and dairy sewage sludge application on hydrophysical and mechanical properties of agricultural soils” and “Evaluation of surface soil moisture from satellite and ground-based measurements”; with Ukrainian Hydrometeorological Institute of the National Academy of Sciences through project “Impacts of global climate changes on water resources in Ukraine estimated by variability of river discharges and hydrograph components”; with Georgian Environment Agency through project “Prediction of changes in soil moisture under changed land use and climate conditions”.

8. The Institute implements relatively extensive bilateral cooperation through Memoranda of Understanding (MoU) that IH SAS has concluded with foreign institutions with a related research focus. Currently active are MoU:
 - with the Polish Academy of Sciences, specifically with the Institute of Agrophysics in Lublin and also with the European Regional Center for Ecohydrology in Łódź. Cooperation currently includes the creation of joint research projects and publications, the implementation of research and the sharing of data databases.
 - with the University of Natural Resources (BOKU) in Vienna and also with the Technical University of Vienna. The cooperation mainly includes doctoral student stays, research and data sharing.
 - with the Institute of Environmental Engineering - ETH in Zurich, exchange stays of doctoral students of cooperating institutions are carried out and the achieved results are published in joint publications.
 - the Hungarian Institute of Soil and Agricultural Chemistry in Budapest, which is part of the Agricultural Research Center of the Hungarian Academy of Sciences in Mártonvásár; the Institute of Plant Production of St. Stephen's University in Gödöllő; the Faculty of Agriculture and Food of István Széchenyi University in Mosonmagyaróvár; as well as with the Faculty of Agriculture and Food of the István Széchenyi University in Mosonmagyaróvár; the Faculty of Agriculture, Food and Environmental Management of the University of Debrecen and the Eötvös Loránd University in Budapest. The cooperation currently includes the creation of joint research projects and publications, the implementation of research and the sharing of instrumentation.
 - with the Department of Agricultural and Forestry Sciences, University of Palermo. Within the framework of inter-academic and inter-constitutional co-operation, regular exchange stays of employees of co-operating institutions are carried out and the achieved results are published in joint publications.
 - with the Georgian Environment Agency (NEA) in Tbilisi. Cooperation in the field of science and research includes the creation of joint publications and international projects and study stays of employees.
9. Our traditional partners are the Czech University of Life Sciences in Prague (Department of Water Resources and Department of Soil Science and Soil Protection), and the Institute of Hydrodynamics of the Academy of Sciences of the Czech Republic (IH ASCR). This cooperation enables the participation of our institute's staff in measurements in the hydrodynamic laboratory of the IH ASCR. IH SAS published well established Journal of Hydrology and Hydrodynamics together with the Institute of Hydrodynamics till 2019.
10. Researchers of the Institute are active reviewers of international journals (Dr. Lichner was awarded as “Outstanding Reviewer 2016-2020” by Journal of Arid Land) and international projects.

2.3.2. List of international conferences (co)organised by the institute

2016:

23rd Poster Day, IH SAS Bratislava, Slovakia, 150 participants, 10.11. 2016

15th Alps-adria scientific workshop, Mali Losinj, Croatia, 85 participants, 25.04.-30.04.2016

4th International Conference on Biohydrology, Almería, Spain, 110 participants, 13.09.-16.09.2016

2017:

XXIInd Meeting of snow researchers 2017, Bobrovec, Slovakia, 25 participants, 07.03.-09.03. 2017

16th Alps - adria scientific workshop 2017, Opatija, Croatia, 200 participants, 03.04.-08.04.2017

6th International conference "Hydrology of small basins 2017", Praha, Czech republik, 80 participants, 18.04.-20.04.2017

VIIth workshop of project UNESCO "Flood regime of rivers in the Danube River Basin" 2017, Zlaté Piesky, Bulgaria, 14 participants, 13.09.2017

27th International conference of Danube countries 2017, Zlaté Piesky, Bulgaria, 110 participants, 26.09.-28.09.2017

International scientific conference "Catchment management and extreme hydrological phenomenon 2017", Vyhne, hotel Sitno, Slovakia, 300 participants, 10.10.-11.10.2017

24th Poster Day IH SAS Bratislava, Slovakia, 72 participants, 08.11.2017

2018:

17th Alps-Adria Scientific workshop 2018, Hnanice, Czech republik, 09.04.-14.04.2018

VIIIth workshop of project UNESCO "Flood regime of rivers in the Danube River" 2018, KC SAV, Smolenice, Slovakia, 15 participants, 29.10.-31.10.2018

28th meeting of delegates NC IHP UNESCO of Danube countries 2018, KC SAV, Smolenice, Slovakia, 10 participants, 30.10.2018

25th Poster Day IH SAS 2018, Bratislava, Slovakia, 65 participants, 07/11/2018

2019:

18th Alps-Adria Scientific workshop 2019, Cattolica – Rimini, Italy, 150 participants, 01.04.-06.04.2019

XXVIIIth Conference of Danube countries on the hydrological forecasting and hydrological bases of water management, Kijev, Ukraine, 75 participants, 06.11.-08.11.2019

Meeting of representants NC IHP UNESCO and experts of Danube countries 2019, Kijev, the Ukraine, 17 participants, 05.11.2019

26th Poster Day IH SAS 2019, Bratislava, Slovakia, 50 participants, 06.11.2019

International scientific conference "Catchment management and extreme hydrological phenomenon 2019", Vyhne, hotel Sitno, Slovakia, 08. – 09. 10. 2019,

2020:

19th Alps-Adria Scientific workshop 2020, Wisła, Poland, 26.04.-01.05.2020 – for pandemic situation postponed to 2021

27th Poster Day 2020, iCloude, 96 participants, 11.11.-13.11.2020

2021:

19th Alps-Adria Scientific workshop 2021, Wisła, Poland – cancelled for pandemic situation

28th International Poster day 2021, online, IH SAS, Bratislava, Slovakia, 10.11.2021

2.3.3. List of edited proceedings from international scientific conferences**2016:**

23rd International Poster Day and Institute of Hydrology Open Day: Proceedings of peer-reviewed contributions - Transport of water, chemicals and energy in the soil-plant-atmosphere system. Editor: Anežka Čelková, Reviewers: Bačová-Mitková Veronika, Gomboš Milan, Holko Ladislav, Nejedlík Pavol, Orfánus Tomáš, Podhorský

Dušan, Skalová Jana, Šurda Peter, Tall Andrej. Bratislava: IH SAS, 2016, 352 pp. ISBN 978-80-89139-38-5.

2017:

FAI09 *24th International Poster Day and Institute of Hydrology Open Day : Proceedings of peer-reviewed contributions - Transport of Water, Chemicals and Energy in the Soil-Plant-Atmosphere System.* Editor: Anežka Čelková, Reviewers: Veronika Bačová Mitková, Milan Gomboš, Ladislav Holko, Branislav Kandra, Radka Kodešová, Pavol Nejedlík, Tomáš Orfánus, Kálmán Rajkai, Jana Skalová, Peter Šurda, Andrej Tall. Bratislava : IH SAS, 2017. 1 CD-ROM (354 p.). ISBN 978-80-89139-40-8

2018:

FAI10 *25th International Poster Day and Institute of Hydrology Open Day : Proceedings of peer-reviewed contributions - Transport of Water, Chemicals and Energy in the Soil-Plant-Atmosphere System.* Editor Anežka Čelková. Bratislava : Institute of Hydrology SAS, 2018. 265 pp. ISBN 978 - 80 - 89139 - 42 - 2

2019:

FAI11 *26th International Poster Day and Institute of Hydrology Open Day: Proceedings of peer-reviewed contributions - Transport of Water, Chemicals and Energy in the Soil-Plant-Atmosphere System.* Editor Anežka Čelková. Bratislava : Institute of Hydrology SAS, 2019. 1 CD-ROM (296 p.). ISBN 978-80-89139-44-6

2020:

FAI02 *27th International Poster Day and Institute of Hydrology Open Day - Transport of water, chemicals and energy in the soil – plant –atmosphere system in conditions of the climate variability: Book of Abstracts and Posters from the 27th Poster Day 2020.* [elektronick source]. Editors: Pavla Pekárová, Justína Vitková, Pavol Miklánek. Bratislava: Institute of Hydrology of the Slovak Academy of Sciences, 2020. 1 CD-ROM (91 p.). ISBN 978-80-89139-48-4

2021:

FAI05 *28th International Poster Day and Institute of Hydrology Open Day Transport of water, chemicals and energy in the soil – plant –atmosphere system in conditions of the climate variability: book of Abstracts from the 28th POSTER DAY 2021.* Editors: Peter Rončák, Lenka Botyanszká. Bratislava : Institute of Hydrology of the Slovak Academy of Sciences, 2021. 64 p. ISBN 978-80-89139-51-4

2.3.4. List of journals edited/published by the institute and information on their indexing in WOS, SCOPUS, other database or no database, incl. impact factor and other metrics of journals in each year of the assessment period

1. ***Journal of Hydrology and Hydromechanics***: is an international open access journal for the basic disciplines of water sciences, journal is published four times per year, on the present by the IH SAS (to 2019 jointly with Institute for Hydrodynamics, Czech Academy of Sciences, Prague)

2016 – indexing in **WOS** from Vol. 64, No. 4, IF 1,654, Q2, CiteScore 3,1

2017 – indexing in WOS, IF 1,714, Q1, CiteScore 2,9

2018 – indexing in WOS, IF 2,023, Q1, CiteScore 3,1

2019 – indexing in WOS, IF 2,011, Q1, CiteScore 3,4

2020 – indexing in WOS, IF 2,512, Q1, CiteScore 4,2

2021 – indexing in WOS, IF 2,329, Q1, CiteScore 5,1

Indexing in other databases: from 2016 - on the present:

AGRICOLA (National Agricultural Library), Baidu Scholar, Celdes, Chemical Abstracts Service (CAS) – Caplus, Chemical Abstracts Service (CAS) – SciFinder, Clarivate Analytics (formerly Thomson Reuters) - Current Contents/Agriculture, Biology, and Environmental Sciences, Clarivate Analytics (formerly Thomson Reuters) - Current Contents/Engineering, Computing, and Technology, Clarivate Analytics (formerly Thomson Reuters) - Journal Citation Reports/Science Edition, Clarivate Analytics (formerly Thomson Reuters) - Science Citation Index Expanded, CNKI Scholar (China National Knowledge Infrastructure), CNPIEC, DOAJ (Directory of Open Access Journals), EBSCO (relevant databases), EBSCO Discovery Service, Elsevier – Compendex, Elsevier - Engineering Village, Elsevier – Geobase, Elsevier – Reaxys, Elsevier – SCOPUS, Genamics JournalSeek, GeoRef, Google Scholar, J-Gate, JournalGuide, JournalTOCs, KESLI-NDSL (Korean National Discovery for Science Leaders), Microsoft Academic, Naviga (Softweco), Primo Central (ExLibris), ProQuest (relevant databases), ReadCube, ResearchGate, SCImago (SJR), Sherpa/RoMEO, Summon (Serials Solutions/ProQuest), TDNet, TEMA Technik und Management, Ulrich's Periodicals Directory/ulrichsweb, WanFang Data, WorldCat (OCLC)

2. ***Acta Hydrologica Slovaca***: journal publishes original research papers from the field of hydrology of surface and subsurface water in natural catchments and urbanized areas, journal is published two times per year by the IH SAS

2016 – indexing in other databases: Electronic Journals Library – Social Science Research Center Berlin, Bibliothekssystem Universität Hamburg, Universitäts bibliothek Leipzig, EIJASR New Frontiers in Research, ISSN 1335-6291 (printed)

2017 – indexing in other databases: Electronic Journals Library – Social Science Research Center Berlin, Bibliothekssystem Universität Hamburg, Universitäts bibliothek Leipzig, EIJASR New Frontiers in Research, ISSN 1335-6291 (printed)

2018 – indexing in other databases: Electronic Journals Library – Social Science Research Center Berlin, Bibliothekssystem Universität Hamburg, Universitäts bibliothek Leipzig, • EIJASR New Frontiers in Research, ISSN 1335-6291 (printed)

2019 – indexing in other databases: Electronic Journals Library – Social Science Research Center Berlin, Bibliothekssystem Universität Hamburg, Universitäts bibliothek Leipzig, EIJASR New Frontiers in Research, ISSN 2644-4690 (online)

2020 – *Indexing in SCOPUS*, ISSN 2644-4690 (online), indexing in other databases: Electronic Journals Library – Social Science Research Center Berlin, Bibliothekssystem Universität Hamburg, Universitäts bibliothek Leipzig, EIJASR New Frontiers in Research

2021 – *Indexing in SCOPUS*, ISSN 2644-4690 (online), indexing in other databases: Electronic Journals Library – Social Science Research Center Berlin, Bibliothekssystem Universität Hamburg, Universitäts bibliothek Leipzig, EIJASR New Frontiers in Research

- **National position of the institute**

- **2.3.5. List of selected activities of national importance**

The Institute provides information that can help (Slovak) decision makers better understand the nature of the current hydrological problems. Researchers of the Institute are members of advisory boards of Government of SR, local governments, ministries of the Slovak Republic and other institutions:

- The National Committee of the International Hydrological Programme of UNESCO within the Slovak Commission for UNESCO at the Ministry of Foreign and European Affairs of SR
- Advisory Committee for the Danube Strategy of the Slovak Government Office

- Consultative Group of the Government of the Slovak Republic for the Danube Strategy
- Working group of Ministry of Environment (MoE) for solving the issue of safety of water constructions during floods
- Expert groups of the MoE of the Slovak Republic for the preparation of the Water Policy Concept (Water pollution, Water management, Landscape management and adaptation to climate change)
- Working Group of the Slovak National Center for Human Rights on Climate Change Impact Indicators
- Blue Team of Bratislava local government - a forum of experts in the field of water resources protection in the Bratislava region

The expertise and competence of researchers at the national level is confirmed by their membership in the commissions for doctoral studies, university scientific councils, administrative boards of universities and faculties:

- Commissions for doctoral studies of Slovak University of Agriculture in Nitra
- Scientific council and administrative board of Slovak University of Technology in Bratislava

Research activities at the national level have included projects of the scientific grant agency VEGA and the Slovak Research and Development Agency (APVV). The solved national projects were both bilateral and multilateral. The most important project partners were:

- Slovak University of Technology, The Faculty of Civil Engineering
- Comenius University Bratislava, Faculty of Mathematics, Physics and Informatics
- Slovak University of Agriculture, Faculty of Horticulture and Landscape Engineering
- Technical University of Zvolen, Faculty of Forestry
- Slovak Hydrometeorological Institute
- Water Research Institute
- Research Institute of Plant Production of The National Agricultural and Food Centre
- Soil Science and Conservation Research Institute of The National Agricultural and Food Centre
- Comenius University, Faculty of Natural Sciences

Very close bilateral cooperation activities at national level are covered by:

i) Memorandum of Understanding:

- with Institute of Earth Sciences SAS

ii) Framework agreement on cooperation with EEI (External Educational Institution) on the implementation of PhD studies:

- with Slovak University of Agriculture, Faculty of Horticulture and Landscape Engineering
- with Slovak University of Technology, The Faculty of Civil Engineering

iii) Agreement of joint research with:

- Comenius University Bratislava, Faculty of Mathematics, Physics and Informatics
- Slovak University of Technology, The Faculty of Civil Engineering
- Slovak Museum of Nature Protection and Speleology Liptovský Mikuláš
- Slovak Hydrometeorological Institute

Joint publication activity is successful with:

- Institute of Geography of SAS,
- Institute of Earth Sciences of SAS,
- Institute of Landscape Ecology of SAS,
- Institute of Experimental Physics of SAS
- Archaeological Institute of SAS

2.3.6. List of journals (published only in the Slovak language) edited/published by the institute and information on their indexing in WOS, SCOPUS, other database or no database, incl. impact factor and other metrics of journals in each year of the assessment period

none

• **Position of individual researchers in the international context**

2.3.7. List of invited/keynote presentations at international conferences, as documented by programme or invitation letter

2016:

- RNDr. Tomáš ORFÁNUS, PhD. and RNDr. Pavol Miklánek, PhD. participated as nominants of GWP CEE and IHP UNESCO at prestige international event "Budapest Water Summit 2016", 28. - 30. 11. 2016. Dr. Orfánus participated at Civil Forum with presentation "The effects of forest roads on stormflow generation - Case study from South-western Slovakia". Both researchers also participated at the workshop discussion "Science-Technology Forum".

- International conference "Alps-Adria 2016", 25.-30. 4 2016, Mali Losinj, Croatia, invited/keynote presentation "Anthropization of soils in rural agricultural land", authors Mgr. Anton Zvala, RNDr. Dagmar Stojkovicová, PhD., RNDr. Tomáš Orfánus, PhD.

- RNDr. Tomáš Orfánus, PhD. presented at international conference "Effective utilization of water resources in the conditions of climate change (drought and water scarcity)", Danube region strategy, 17.-18. 5 2016, hotel Falkensteiner, Bratislava, section Drought in Practice, keynote presentation "New trends in the research of drought indicators" - author RNDr. Tomáš Orfánus, PhD.

2017:

- RNDr. Pavol Miklánek, PhD. on demand of Dr. Plamen Ninov (Bulgaria) - invited presentation "Flood regime of rivers in the Danube river basin" authors: Pavol Miklánek, Pavla Pekárová, during inauguration of conference of Danube countries "XXVII. Danube conference 2017", Bulgaria.

- RNDr. Pavol Miklánek - invited presentation "Flood regime of rivers in the Danube River basin", author Dr. Pavol Miklánek, PhD. at 24. Poster Day IH SAS Bratislava (Transport of water, chemicals and energy in the soil-plant-atmosphere system) - 8.11. 2017

2018:

- RNDr. Tomáš Orfánus, PhD. on demand of Prof. Dr. István Komlósi, DSc., dean of Faculty of Agricultural and Food Sciences and Environmental Management, University Debrecen presented at international conference "Agriculture challenges in Hungary 2018 – Agriculture Days in Trans-Tisza region", 5. - 6. 9. 2018 in Debrecen, invited presentation "Water infiltration into the soil - what do measurements indicate?" authors: Tomáš Orfánus, Viliam Nagy

- RNDr. Pavol Miklánek, PhD. (on demand of Dr. Miklós Domokos and Dr. Jovan Despotovic) presented at "Conference of the veteran meeting of the co-operation of the hydrologists of the Danubian Countries", 24.4.2018 in Baja, Hungary, 3 invited presentations: "Thermal and ice conditions", "Danube River channel training" and "Update of the water balance of the River Danube" and at "International Conference on Flood management education", 25.-26. 6. 2018 in Baja invited presentation "On Historical Floods in the Danube Basin".

- IH SAS and SNC IHP UNESCO prepared VIII. workgroup meeting of project „Flood regime of rivers in the Danube River Basin“, 29. – 31. 10. 2018, KC Smolenice, Slovakia.

The workshop was organized as an activity of national delegates meeting of IHP-VIII Regional cooperation of the Danube countries under UNESCO.

2019:

- RNDr. Pavol Miklánek, PhD. presented invited presentation "Development of the Danube co-operation in the field of hydrology" at the international event WMO Hydrology Forum for Region Europe, Bratislava, 2-4. April 2019.

- RNDr. Ladislav Holko was invited by Dr. M. Źelazny from Jagiellonian University Krakow, to present invited presentation "Sustainable water resources management in high mountains in the Baltic Sea Region" at opening ceremonial of 2nd Tatra international Hydrological Workshop, 10. - 13. 6. 2019 Zakopané, Poland. Additionally, Mgr. Jakub Mészáros, PhD., a student at IH SAS, as the final workshop exam, (with other students) developed the design of hydrological monitoring network for sustainable water resources in part of Poland's Tatra mountains.

2020:

- doc. Ing. Marek SOKÁČ, PhD. presented invited presentation „Current state of stormwater management in Slovakia“ at international conference „STORMWATER POLAND 2020“ which was organized in March 2020, Gdansk, Poland.

- RNDr. Ladislav HOLKO, PhD. was invited by project "Evaluating Groundwater Resources and Groundwater-Surface-Water Interactions in the Context of Adapting to Climate Change" on virtual international course of isotope hydrology IAEA in Russian language which was organized online 2. - 6. 11. 2020. He presented online presentation about isotope spectroscopy - 3. 11. 2020.

2021:

- RNDr. Ladislav HOLKO, PhD., COST WATSON – invited presentation about period of transit in Jalovecký potok catchment by work group WG3, Luxembourg https://www.dropbox.com/s/dxf3xqvbtiikb2u/Uncertainties_streamflow_MTT_mountain_catchment_Holko_20210415.pdf?dl=0

- RNDr. Ladislav HOLKO, PhD., CUAHSI (Consortium of Universities for the Advancement of Hydrologic Science) – invited presentation about hydrological research in Jalovecký potok catchment by cycle Research and Observatory Catchments: The Legacy and the Future, USA-Germany: <https://www.cuahsi.org/education/cyberseminars/research-and-observatory-catchments-the-legacy-and-the-future>; https://www.youtube.com/watch?v=r13bTLNZ7RQ&list=PLPG5Ed5L1SY7T_1cb15fD-oQV6nvZsQTW&index=3

- RNDr. Pavol MIKLÁNEK, PhD., invited presentation Programme and Projects of the Danube Countries Cooperation within the Intergovernmental Hydrological Programme of UNESCO. 11th Danube Academies Conference, 22. 10. 2021, Bulgaria

2.3.8. List of researchers who served as members of the organising and/or programme committees

2016:

15th Alps-Adria scientific workshop, international conference, Mali Losinj, Croatia, 25.04.-30.04.2016, 85 participants:

Pekárová - member of programme committee, Nagy - member of organising committee

4th International Conference of Biohydrology, Almería, Spain, 13.09.-16.09.2016, 110 participants:

Lichner - chairman of programme committee

23rd International Poster Day "Transport of water, chemicals and energy in the soil – plant – atmosphere system 2016, IH SAS Bratislava, 150 participants, 10.11. 2016:

Bačová, Gomboš, Holko, Nagy, Šurda, Tall, Orfánus – members of programme committee, Nagy, Šurda, Vitková, Čelková, Orfánus – members of organising committee

28th Conference of Young Hydrologists, international event, SHMI Bratislava, 09.11. 2016:

Halmová - member of programme and organising committee, Miklánek – gestor of scientific committee,

International event "Catchment processes in regional hydrology: from plot to regional scales – monitoring catchment processes and hydrological modelling", Wien, Austria, 2016, 40 participants:

Miklánek – member of programme scientific committee

2017:

International conference XXIth meeting of snow researchers 2017, Bobrovec, Slovakia, 07.03.-09.03.2017, 25 participants:

Holko– member of programme committee

16th Alps – Adria scientific workshop 2017, Opatija, Croatia, 03.04.-08.04.2017, 200 participants:

Nagy, Velísková – member of programme committee

6th international conference Hydrology of small basins 2017, Prag, Czech Republik, 18.04.-20.04.2017, 80 participants:

Lichner, Pekárová, Holko, Miklánek – members of programme committee

7th workshop of international project UNESCO "Flood regime of rivers in the Danube River Basin" 2017, Zlaté Piesky, Bulgaria, 13.09.-13.09.2017, 14 participants:

Miklánek - member of programme scientific committee

International scientific conference "Catchment management and extreme hydrological phenomenon 2017", Vyhne, hotel Sitno, Slovakia, 10.10.-11.10.2017, 300 participants:

Miklánek, Velísková – members of programme committee

24th International Poster Day "Transport of water, chemicals and energy in the soil – plant – atmosphere system 2017, IH SAS Bratislava, 08.11. 2017, 72 participants:

Bačová, Gomboš, Tall, Holko, Šurda, Orfánus - members of programme committee, Vitková, Nagy, Šurda, Čelková, Orfánus – member of organizing committee

29th Conference of Young Hydrologists, international event, SHMI Bratislava, 09.11. 2017, 65 participants:

Halmová - member of programme and organising committee, Miklánek – gestor of scientific committee,

XXVIIth conference of the Danubian Countries on Hydrological forecasting and hydrological bases of Water Management, Zlaté piesky, Bulgaria, 26.09.-28.09. 2017, 110 participants:

Miklánek – member of programme committee

2018:

17th Alps-Adria Scientific workshop 2018, Hnanice, Czech republik, 09.04.-14.04.2018:

Velísková – member of programme committee, Nagy - member of organising committee

VIIIth workshop of the IHP UNESCO Regional cooperation of the Danube countries project No. 9. " Flood Regimes of Rivers in the Danube Basin", Congresse centrum of SAS, Smolenice, Slovakia, 15 participants, 29.10.-31.10.2018:

Miklánek, Bačová, Halmová, Pekárová - members of programme and organising committee

28th Meeting of representants NC IHP UNESCO of Danube countries, 2018, KC SAV, Smolenice, Slovakia, 10 participants, 30.10.2018:

Miklánek - member of programme and organising committee

25th International Poster Day "Transport of water, chemicals and energy in the soil – plant – atmosphere system 2018, IH SAS Bratislava, 65 participants, 07.11.-07.11.2018:

Bačová, Šurda, Tall – members of programme committee, Šurda, Čelková, Vitková - members of organizing committee

10th International Scientific Conference "Influence of anthropogenic activities on water regime of lowland territory" - 22.04.-24.04. 2018 and 10th Slovak-Czech-Polish Scientific Seminar "Physics of Soil Water" conference with international participation, 23.4.2018, Zemplínska Šírava, Slovakia, 65 participants:

Velísková – member of programme committee, Gomboš, Tall, Kandra, Balejčíková – members of programme and organising committee, Pavelková - chairman of organising committee

6th International Conference "Catchment and river processes in regional hydrology: field experiments and modelling in carpathians basins", Wien, Austria, 2018:

Miklánek - member of programme and organising committee

30th Conference of Young Hydrologists, international event, SHMI Bratislava, 08.11. 2018, 70 participants:

Halmová - member of programme committee, Miklánek – gestor of scientific committee

2019:

18th Alps-Adria Scientific workshop 2019, Cattolica – Rimini, Italy, 01.04.-06.04.2019, 150 participants:

Velísková, Nagy - members of programme committee, Nagy - member of organising committee

Meeting of representants NC IHP UNESCO and experts of Danube countries, Kijev, the Ukraine, 05.11.2019, 17 participants:

Miklánek - member of programme and organising committee

26th International Poster Day "Transport of water, chemicals and energy in the soil – plant – atmosphere system 2019, IH SAS Bratislava, 06.11.2019, 50 participants:

Bačová, Šurda, Tall - members of programme committee, Šurda, Vitková- members of organizing committee

XXVIIIth conference of the Danubian Countries on Hydrological forecasting and hydrological bases of Water Management, Kijev, Ukraine, 06.11.-08.11.2019, 75 participants:

Miklánek – member of programme committee

5th International Conference on Biohydrology 2019, Valencia, Spain, 24.07.-27.07.2019, 60 participants:

Lichner - member of programme scientific committee

31st Conference of Young Hydrologists, international event, SHMI Bratislava, 14. 11. 2019, 68 participants:

Miklánek – gestor of scientific committee

7th International Conference Catchment and river processes in regional hydrology: field experiments and modelling in carpathians basins, Wien, Austria, 2019, 40 participants:

Miklánek - member of programme committee

International scientific conference "Catchment management and extreme hydrological phenomenon 2019", Vyhne, hotel Sitno, Slovakia, 08. – 09. 10. 2019, 100 participants:

Velísková - member of programme committee

2020:

32nd Conference of Young Hydrologists, international event, online, SHMI Bratislava, 12.11.2020:

Miklánek – member of programme scientific and organizing committee

19th Alps-Adria Scientific workshop 2020, Wisła, Poland, 26.04.-01.05.2020, for pandemic situation postponed to 2021

Velísková, Nagy - members of programme committee, Nagy - member of organising committee

27th International Poster Day "Transport of water, chemicals and energy in the soil – plant – atmosphere system 2020, iCloude IH SAS Bratislava, 11. – 13.11.2020, 96 participants:

Holko, Bačová Mitková, Sokáč, Šurda, Gomboš, Tall - members of programme committee, Pekárová, Miklánek, Pavelková, Halmová, Vitková, Mészáros - members of organizing committee

18th Biennial Conference ERB 2020, New perspectives on hydrological and ecohydrological processes in small natural and human-impacted catchments Portoferraio, Elba Island, Italy, for pandemic situation postponed to 2021 and again and again to 2022 - 07-10 June 2022, 90 participants:

Holko – member of programme committee

7th international conference Hydrology of small basins 2020, Prag, Czech Republik, for pandemic situation postponed to 2021, 0 participants:

Holko, Miklánek, Lichner, Pekárová – members of programme committee

9th international Conference Hydrocarpath 2020 “Processes, patterns and regimes in the hydrology of the carpathians: coupling experiments, remote sensing, citizen science and modelling”, Wien, Austria, online form:

Miklánek – member of programme committee

2021:

33rd Conference of Young Hydrologists, international event, online, SHMI Bratislava, 12.11.2021

Miklánek – member of programme scientific and organizing committee

20th Alps-Adria Scientific workshop 2020, Wisła, Poland, 29.08.-03.09.2021, for pandemic situation cancelled

Nagy - member of programme and organising committee

28th International Poster Day “Transport of water, chemicals and energy in the soil – plant – atmosphere system 2020, IH SAS Bratislava, 10.11.2021, 45 participants

Pekárová, Holko, Gomboš, Sokáč - members of programme committee, Botyanszká, Rončák, Šurda, Čelková, Vitková - members of organizing committee

XXIXth conference of the Danubian Countries on Hydrological forecasting and hydrological bases of Water Management 2021, Brno, Czech republik, on site 24 participants and online 72 participants

Miklánek – member of programme committee

10th international Conference Hydrocarpath 2021 “Catchment and River Processes in Regional Hydrology: Coupling Field Experiments and Data Assimilation into Process Understanding and Modelling in Carpathian Basins”, Wien, Austria, online form:

Miklánek – member of programme committee

International Scientific Conference ENVIRO 2021, online by platform MS Teams, 3. - 4. 6. 2021:

Velísková – member of programme committee

2.3.9. List of researchers who received an international scientific award

2016:

non dedit

2017:

non dedit

2018:

RNDr. Balejčíková Lucia, PhD.: international competition L'Oréal-UNESCO for Women in Science 2018 – "Certificate of merit" prize given for project "Physicochemical characterization of magnetoferritin as a potential magnetopharmaceutical nanomaterial and as a decontamination system in hydrology"

2019:

Ing. Velísková Yvetta, PhD., Mgr. Siman Cyril: "Prize for the authors for the high scientific quality of their presentation, Award of the Scientific board of the 18th Alps-Adria Scientific Workshop, 5. 4. 2019, Cattolica, Italy

2020:

non dedit

2021:

Ing. Lichner Ľubomír, DrSc.: "Outstanding Reviewer Award 2016-2020" was 21. 1. 2021 awarded as the excellent reviewer by Editorial board of Journal of Arid Land (IF = 1.899, Springer)

- **Position of individual researchers in the national context**

- 2.3.10. List of invited/keynote presentations at national conferences, as documented by programme or invitation letter**

2016:

- Invited presentation of authors: RNDr. Pavla Pekárová, DrSc., Mgr. Branislav Pramuk, RNDr. Pavol Miklánek, CSc. "Are the floods bigger and droughts longer than the past in Slovakia?" – at national conference „XX. District water days 2016“, Michalovce, 14.-15. 4. 2016, Vinianske jazero

- Invited presentation of authors: RNDr. Andrej Tall, PhD., Ing. Danka Pavelková, PhD., "Lyzimeter station in village Petrovce nad Laborcom" – at national conference „XX. District water days 2016“, Michalovce, 14.-15. 4. 2016, Vinianske jazero

- Invited presentation of author: RNDr. Pavla Pekárová, DrSc. "Historical floods on Danube River – are the floods on Danube more frequently than ever?" - at national conference "Towns and water, Bratislava and water" - 24. 10. 2016, Primate's palace Bratislava, section Towns and rivers

2017:

- Invited/keynote presentation of authors: Ing. Yvetta Velísková, PhD., Ing. Valentín Sočuvka „Possibilities of monitoring of reservoirs and polders clogging" – national conference "XXI. District water days 2017", Zemplínska Šírava, hotel Glamour, 20. - 21. 4. 2017

- Invited/keynote presentation of author RNDr. Tomáš Orfánus, PhD. "History of the drought-phenomenon theme in Slovakia" - seminar, organized by SHMI, GWP CEE a GWP Slovakia, "DriDanube National Briefing Seminar" in scope of project Interreg, June 2017, SHMI Bratislava

- Invited/keynote presentation of author RNDr. Tomáš Orfánus, PhD. Which was invited by Prof. RNDr. L. Miklós, DrSc., garant of V. international conference "Selected aspects of integrated management of environment" to present a presentation on conference theme, 23.- 24.10. 2017, TU Zvolen

2018:

- none

2019:

- none

2020:

- none

2021:

- doc. Ing. Sokáč Marek, PhD. – invited presentation at The lecture SAVinci – „Good water, bad water“, 30.6.2021, Bratislava

- Ing. Gomboš Milan, CSc. Online lecture „Monitoring of soil - moisture regime“, presented on webinar „Earth Day“, 23.4.2021, Košice

2.3.11. List of researchers who served as members of organising and programme committees of national conferences

2016:

XX. District water days, domestic conference, Vinianske Lake, 14.04.-15.04.2016, 116 participants:

Gomboš – member of programme committee, Pavelková - chairman of organising committee

2017:

XXI. District water days, domestic conference, Zemplínska Šírava, 20.04. 2017, 100 participants:

Gomboš, Tall, Kandra – members of programme and organising committee, Pavelková - chairman of organising committee

2018:

Conference “Waste waters”, domestic conference, Štrbské Pleso, 17. - 19. October 2018, 250 participants:

Sokáč – member of programme comitee

2019:

none

2020:

none

2021:

none

2.3.12. List of researchers who received a national scientific award

2016:

Danko Michal - the winner of competition at "Conference of Young Hydrologists 2016" appraised by NC IHP UNESCO in section Hydrology and water management

Gomboš Milan - "Prize for scientific and professional literature for year 2015" in category Sciences and technical sciences, appreciator - Foundation of literature in Section of scientific and professional literature and computer programmes for collective authorship of creation "Regionalization of pedotransfer functions of moisture retention curves of Slovak soils". The prize was awarded in 2016.

Holko Ladislav - The Liptov library of G. F. Belopotocký in Liptovský Mikuláš published "The book of Liptov 2015" and the 2nd printing of book "Wilderness below Salatín (Divočina pod Salatínom)" which fit in 2nd place in category of professional literature. Dr. Holko worked as co-compiler and author of two chapters of this book. The prize was awarded in 2016.

Krajčí Pavel - the winner of competition at "Conference of Young Hydrologists 2016" appraised by NC IHP UNESCO in section Hydrology and water management.

Sočuvka Valentín - the winner of competition at "Conference of Young Hydrologists 2016" appraised by NC IHP UNESCO in section Hydrology and water management.

2017:

Danko Michal - "The prize of SAS for building of science infrastructure" awarded by Presidium of SAS to workteam of IH SAS (*Pavelková, Tall, Kostka, Holko, Velísková, Gomboš, Kandra, Danko, Hlavčo, Rusina*) for implementation of project "Infrastructure completion of hydrological research stations"

Pekárová Pavla - "Medal of Dionýz Štúr", awarded by SAS

Hlaváčiková Hana - the "Award for scientific and professional literature for year 2016" in category Sciences and technical sciences, awarded by Foundation of literature in Section of scientific and professional literature for co-authorship of monography "Soil Hydrology". The prize was awarded on 21.9.2017 at a ceremony in Bratislava.

Novák Viliam - the "Award for scientific and professional literature for year 2016" in category Sciences and technical sciences, awarded by Foundation of literature in Section of scientific and professional literature for co-authorship of monography *NOVÁK, Viliam - HLAVÁČIKOVÁ, Hana. Hydrológia pôdy [Soil Hydrology]. Bratislava: Veda, 2016. 347 s. ISBN 978-80-224-1529-3*. The prize was awarded on 21.9.2017 at a ceremony in Bratislava.

Pekárová Pavla - "The Plaque of Faculty of Civil Engineering Slovak University of Technology Bratislava" awarded by dean of FCE SUT which Dr. Pekárová was granted for eminent life-long addition in development of engineering hydrology and education of engineers and researchers in hydrological domain.

2018:

Vitková Justína - Honorable mention in "Competition of young scientists of SAS to 35 age" awarded by Presidium of SAS

Sokáč Marek - The memorable medal of Department of Sanitary and Environmental Engineering of Faculty of Civil Engineering, Slovak University of Technology Bratislava (FZEI SvF STU) awarded to Doc. Sokáč on ceremonial of occasion of 70th jubilee of FZEI establishment

Velísková Yvetta - "The memorable letter and medal" awarded by Faculty of Civil Engineering, Slovak University of Technology Bratislava (FCE SUT) awarded on

ceremonial of occasion of 80th jubilee of FCE SUT establishment as the prizegiving of addition and support of education at FCE SUT

Velísková Yvetta - "The Plaque of academician Dub" awarded by Faculty of Civil Engineering, Slovak University of Technology Bratislava on seminar of ceremonial occasion of 65th jubilee of IH SAS establishment as the prizegiving of longstanding mutual cooperation.

2019:

Lichner Ľubomír - the prize "Prominent personhood of SAS 2019" awarded by Presidium of SAS

2020:

Novák Viliam - the "Prize of SAS for top-level publication", awarded by President of SAS in category Scientific monographs, to co-author of this publication: *Novák, V., Hlaváčiková, H. Applied Soil Hydrology, Springer International Publishing, Cham, Switzerland, 2019, pp.342, ISBN 978-3-030-01806-1*

Sleziač Patrik - 2nd place in "Competition of young scientists of SAS to 35 age", awarded by SAS for the best publications, awarded by 1st scientific department - Earth and Space Sciences SAS, Committee SAS No.15.1.2., references in <http://www.uh.sav.sk/en-gb/News/Latest-News/aid/204>

Mészáros Jakub - the prizegiving at "Conference of Young Hydrologists 2016" apprised by NC IHP UNESCO in section Hydrology and water management as co-author of contribution "Average annual atmospheric precipitation depth in the Slovak river basins during cyclonic situations with different air flow directions"

Siman Cyril - the prizegiving at "Conference of Young Hydrologists 2016" apprised by NC IHP UNESCO in section Hydrology and water management as author of contribution "Use of the MONERIS model for identification of sources of surface streams pollution by total nitrogen"

2021:

Balejčíková Lucia - 1st place in "Competition of young scientists of SAS to 35 age", awarded by SAS, 1st scientific department - Earth and Space Sciences, Committee SAS No.16.1.2.

Jančo Martin -: Diploma for the best scientific work of year 2020 in competition of young scientific researchers of resort "Soil management and country development" in Section of water management which was awarded by Slovak Academy of Soil Sciences. He got this prize as co-author of publication "Mikloš, M., Škvarenina, J., Jančo, M., Škvareninová, J. 2020. Density of Seasonal Snow in the Mountainous Environment of Five Slovak Ski Centers. In *Water*, 2020, vol. 12, iss. 12, art. No. 3563"

2.4. Research grants and other funding resources

(List type of project, title, grant number, duration, total funding and funding for the institute, responsible person in the institute and his/her status in the project, e.g. coordinator "C", work package leader "W", investigator "I". Add information on the projects which are **interdisciplinary**, and also on the joint projects with several participating SAS institutes)

- **International projects**

- 2.4.1. **List of major projects of Framework Programmes of the EU (which pillar), NATO, COST, etc.**

- 1. *Synergy of integrated sensors and technologies for urban secured environment*

- (**Horizon 2020**, Proj.registr.No. 787128, Duration - 2018-2022, total funding: 7 926 171, - EUR, funding for the institute: 251 875,- EUR, Coordinator: FONDAZIONE PER LA RICERCA SULLA MIGRAZIONE E SULLA INTEGRAZIONE DELLE TECNOLOGIE, Italia, Work package leader: Yveta Velísková
2. *Water isotopes in the critical zone: from groundwater recharge to plant transpiration*
(**COST**, Proj.registr.No. CA19120, Duration - 2020-2024, total funding: 67 000,- EUR, funding for the institute: 2 870,- EUR, Coordinator: University of Florence, Italia, Work package leader: Ladislav Holko
3. *Fire in the Earth System: Science & Society*
(**COST**, Proj.registr.No. CA18135, Duration - 2019-2023, funding for the institute: 9 158,- EUR, Coordinator: prof. Artemi Cerda, Spain, Work package leader: Lubomír Lichner
4. *A European network for a harmonized monitoring of snow for the benefit of climate change scenarios, hydrology and numerical weather prediction*
(**COST**, Proj.registr.No. COST Action ES1404, Duration - 2014-2018, funding for the institute: 2 617,- EUR, Coordinator: Earth Science Institute SAS – RNDr. Nejedlík, Work package leader: Ladislav Holko
5. *Water temperature simulation during summer low flow conditions in the Danube basin*
(**UNESCO**, Proj.registr.No. 4.1.2, Duration - 2020-2023, funding for the institute: 6 310,- EUR, Coordinator: Pavla Pekárová
6. *Flood regime of rivers in the Danube River basin, Phase III. Final monograph preparation*
(**UNESCO**, Proj.registr.No. FA UNESCO 2.4/9, Duration - 2017-2019, funding for the institute: 11 427,- EUR, Coordinator: Pavla Pekárová
7. *European Network of Experimental and Representative Basins – ERB*
(**UNESCO**, Proj.registr.No. ERB, Duration - 2013-2021, funding for the institute: 2 578,- EUR, Coordinator: Universität für Bodenkultur, Wien, Austria, Work package leader: Ladislav Holko
8. *IHP-VIII Regional cooperation of the Danube countries*
(**UNESCO**, Proj.registr.No. IHP-VIII Danube, Duration - 2014-2021, funding for the institute: 5 949,- EUR, Coordinator: Prof. Dr. Mitja BRILLY, University of Ljubljana, Slovenia, Work package leader : Pavol Miklánek
9. *EUROFRIEND - Flow Regimes from International Experimental and Network Data*
(**UNESCO**, Proj.registr.No. IHP-VIII AP, Duration - 2014-2021, funding for the institute: 460,- EUR, Coordinator: Prof. Dr.ir. Henny A.J. van Lanen; Wageningen University, Netherlands, Work package leader: Pavol Miklánek
10. *A System of Monitoring of Selected Parameters of Porous Substances Using the EIS Method in a Wide Range of Applications*
(**EUREKA**, Proj.registr.No. E!7614, Duration - 2012-2016, funding for the institute: 0,- EUR, Coordinator: GEOtest a.s., Brno, CZ, Czech Republik, Work package leader: Milan Gomboš
11. *Prediction of changes in soil moisture under changed land use and climate conditions*
(**Mobility**, Proj.registr.No. Mob-Open-20-03, Duration - 2021-2022, total funding: 6 000,- EUR, funding for the institute: 6 000,- EUR, Coordinator: Peter Rončák
12. *Evaluation of surface soil moisture from satellite and ground-based measurements*
(**MAD**, empty of Proj.registr.No., Duration - 2016-2018, total funding: 0,- EUR, funding for the institute: 0,- EUR, Coordinator: Justína Vitková
13. *Impacts of global climate changes on water resources in Ukraine estimated by variability of river discharges and hydrograph components*

(MAD, empty of Proj.registr.No., Duration - 2017-2019, total funding: 0,- EUR, funding for the institute: 0,- EUR, Coordinator: Pavla Pekárová

14. Effect of biochar and dairy sewage sludge application on hydrophysical and mechanical properties of agricultural soils

(Proj.registr.No. SK-PL-2015-0023, Duration - 2016-2017, total funding: 3 000,- EUR, funding for the institute: 0,- EUR, Coordinator: Peter Šurda

15. Influence of biophysical and environmental factors on deviations between measured and calculated evapotranspiration

(Proj.registr.No. SK-AT-2015-0018, Duration - 2016-2017, total funding: 4 000,- EUR, funding for the institute: 0,- EUR, Coordinator: Marek Rodný

Add information on your activities in international networks

- **National projects, incl. international projects with only national funding**

2.4.2. List of ERA-NET projects funded from SAS budget

1. Soil Eco-Technology to Recover Water Storage in disturbed Forests

(ERA-NET, Proj.registr.No. EIG JC2019-074, Duration – 01/04/2020-31/03/2023, funding for the institute: 26 334,- EUR, Coordinator: Biology Centre CAS, České Budějovice, Work package leader: Peter Šurda

2.4.3. List of projects of the Slovak Research and Development Agency, APVV

APVV

- 1. Connectivity and flood runoff dynamics in headwater catchments of Slovakia*
(grant No. APVV-19-0340, Duration 2020-2024, total funding 249 808,- EUR, funding for the institute: 70 995,- EUR, work package leader “W”: Ladislav Holko
- 2. Regional detection, attribution and projection of impacts of climate variability and climate change on runoff regimes in Slovakia*
(grant No. APVV-20-0374, Duration 2021-2025, total funding 180 000,- EUR, funding for the institute: 60 977,- EUR, coordinator “C”: Pavla Pekárová
- 3. Management of crisis situations in water supply with respect to climate change*
(grant No. APVV - 18 - 0205, Duration 2019-2023, total funding 239 800,- EUR, funding for the institute: 66 400,- EUR, work package leader “W”: Yveta Velísková
- 4. Analysis of nitrous oxide emissions from agricultural used soils and proposal of measures for their reduction*
(grant No. APVV-0512-12, Duration 2013-2017, total funding 246 447,- EUR, funding for the institute: 66 042,- EUR, work package leader “W”: Peter Šurda
- 5. Sensitivity of surface runoff generation in headwater catchments to intensive precipitation and landuse*
(grant No. APVV-15-0497, Duration 2016-2020, total funding 249 657,- EUR, funding for the institute: 64 000,- EUR, work package leader “W”: Ladislav Holko
- 6. Elimination of degradation processes in soil by biodiversity restoring*
(grant No. APVV-15-0160, Duration 2016-2020, total funding 239 296,- EUR, funding for the institute: 65 240,- EUR, coordinator “C”: Ľubomír Lichner
- 7. New possibilities of use of drainage canal systems with taking into account the protection and use of a landscape*
(grant No. APVV-14-0735, Duration 2015-2019, total funding 230 919,- EUR, funding for the institute: 59 142,- EUR, work package leader “W”: Yveta Velísková; the joint project with participating of the Institute of Landscape Ecology SAS)

2.4.4. List of projects of the Scientific Grant Agency of the Slovak Academy of Sciences and the Ministry of Education, VEGA (for funding specify only total sum obtained from all VEGA grants in particular year)

1. *Analysis of changes in surface water balance and harmonization of design discharge calculations for estimation of flood and drought risks in the Carpathian region*
(grant No. 2/0004/19, Duration 2019-2022, coordinator "C": Veronika Bačová Mitková)
2. *Fytoindication of changes of soil hydrological regime*
(grant No. 2/0096/19, Duration 2019-2022, coordinator "C": Anton Zvala)
3. *Quantification of Interaction Processes in Hydrological Cycle in Lowland area conditions*
(grant No. 2/0044/20, Duration 2020-2023, coordinator "C": Milan Gomboš)
4. *Prediction of a point pollution source position in a watercourse network – a hydrodynamic approach*
(grant No. 2/0085/20, Duration 2020-2023, coordinator "C": Yvetta Velísková)
5. *Variability of the water balance and hydrological processes in a mountain catchment under the global change conditions*
(grant No. 2/0065/19, Duration 2019-2022, coordinator "C": Ladislav Holko)
6. *Impact of biochar application on hydro-physical characteristics of different soil types*
(grant No. 2/0155/21, Duration 2021-2023, coordinator "C": Justína Vitková)
7. *Impact of climate change on rainfall–runoff relationships*
(grant No. 2/0150/20, Duration 2020-2023, coordinator "C": Peter Šurda)
8. *Effect of vegetation and its secondary succession on soil hydrological processes*
(grant No. 2/0020/20, Duration 2020-2023, coordinator "C": Ľubomír Lichner)
9. *Influence of aquatic vegetations on quantitative and qualitative parameters of lowland streams*
(grant No. 2/0025/19, Duration 2019-2022, coordinator "C": Radoslav Schügerl)
10. *Analysis of sediment impact rate on interaction between surface water and groundwater with implementation of progressive measurement methods*
(grant No. 2/0058/15, Duration 2015-2018, coordinator "C": Yvetta Velísková)
11. *Experimental research of overland flow generation in small catchments*
(grant No. 2/0055/15, Duration 2015-2018, coordinator "C": Ladislav Holko)
12. *Strengthening Agroecosystem Resilience: Hydropedological and Biohydrological Aspects*
(grant No. 2/0053/18, Duration 2018-2020, coordinator "C": Justína Vitková)
13. *Identification of changes in hydrological regime of streams and mutual relation of extreme hydrologic events in complex river system of the Danube basin*
(grant No. 2/0009/15, Duration 2015-2018, coordinator "C": Veronika Bačová Mitková)
14. *Forest soils, their degradation and hydrological consequences*
(grant No. 2/0152/15, Duration 2015-2018, total funding 30 000,- EUR, funding for the institute: 30 000,- EUR, coordinator "C": Tomáš Orfánus)
15. *Localisation of accidental point sources of pollution in watercourses based on-line monitoring data*
(grant No. 1/0805/16, Duration 2016-2019, work package leader "W": Yvetta Velísková)
16. *Soil water repellency as an indicator of soil drought*
(grant No. 2/0189/17, Duration 2017-2019, coordinator "C": Peter Šurda)
17. *The impact of biological soil crust and microtopography on infiltration and flow of water in sandy soil*

- (grant No. 2/0054/14, Duration 2014-2017, coordinator "C": Ľubomír Lichner
18. *Biochar impact on transport and retention of water in agricultural soil*
(grant No. 2/0013/15, Duration 2015-2017, coordinator "C": Marek Rodný
19. *Influence of soil texture on water regime in unsaturated soil profile*
(grant No. 2/0062/16, Duration 2016-2019, coordinator "C": Milan Gomboš

Total sum obtained from all VEGA grants in particular year:

2016: 61 611 Eur

2017: 63 681 Eur

2018: 65 769 Eur

2019: 60 345 Eur

2020: 58 970 Eur

2021: 64 717 Eur

2.4.5. List of projects supported by EU Structural Funds

2.4.6. List of other projects funded from national resources

2.4.7. List of projects funded from private funds

2.4.8. List of projects funded from other competitive funds

2.5. PhD studies and educational activities

2.5.1. List of accredited programmes of doctoral studies, period of validity, source of funding

Programme "Water Resources Engineering – field of study Water constructions" valid by 8/2019, source of funding – SAS

Programme "Water Resources Engineering – field of study Building valid from 9/2019 to present, source of funding - SAS

Programme "Landscape Engineering – field of study Landscape" - valid from 2/2019 to 8/2019, source of funding - SAS

Programme "Landscape Engineering – field of study Agriculture and Landscape" from 9/2019 to present, source of funding - SAS

2.5.2. Summary table on doctoral studies (number of internal/external PhD students at the end of the year; number of foreign PhD students, number of students who successfully completed their theses during the year, number of PhD students who quit the programme during the year)

PhD study	2016			2017			2018			2019			2020			2021		
Number of potential PhD supervisors	3			5			5			5			7			9		
PhD students	number, end of year	defended thesis	students quitted	number, end of year	defended thesis	students quitted	number, end of year	defended thesis	students quitted	number, end of year	defended thesis	students quitted	number, end of year	defended thesis	students quitted	number, end of year	defended thesis	students quitted
Internal total	6	1	0	4	3	0	4	1	0	4	0	0	4	2	0	6	0	1
from which foreign citizens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
External	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Other supervised by the research employees of the institute	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Research stay:

2019:

Our PhD. student Cyril Siman participated on scholarship of Ernst Mach - by Slovak Academic Information Agency - SAIA, n.o., during period from January, 15th 2019 to July, 15th 2019, at Vienna University of Technology, Institute of Water Quality and Resources Management at Assoc. Prof. Dr. M Zessner-Spitzenberg.

Our PhD. student Marcel Garaj participated on scholarship of Ernst Mach - by Slovak Academic Information Agency - SAIA, n.o., during period from January, 15 2019 to July, 15 2019, at Vienna University of Technology, Institute of Hydraulic Engineering and Water Resources Management at Assoc. Prof. Dr. J. Parajka.

2020-2021

Our PhD. student Jakub Meszaros – participated on research felowship at Vienna University of Technology, Institute of Hydraulic Engineering and Water Resources Management, during period from September, 01, 2020 to Februar, 28, 2021, at Assoc. Prof. Dr. J. Parajka.

Scholarship Programs realized at our Institute:

2018:

PhD. student Babar Mujtaba from Pakistan, graduate of Faculty of Science and Technology, Department of Civil Engineering, University of Coimbra, Portugal participated on research trainee-internship at IH SAS during 2 months (from 1 March to 30 April 2018) within the frame of Project ERASMUS 2017/2018. Visit objectives - Analysis of the flow of water in stony soils and links between the hydrological response the soil and catchment runoff in a small mountain catchment.

MSc. student Yanik Fuchs from Institute of Environmental Engineering Swiss Federal Institute of Technology (ETH) Zurich participated on research trainee-internship at IH SAS - Research Base for Mountain Hydrology in Liptovský Mikuláš during 3 month (from October to December 2018) within the frame of preparing his graduation theses - Dr. Holko as his consultant supervisor together with whole research team of the experimental Jalovecky Creek catchment introduced him their work, provided data and helpful ideas and scientific inputs and help him set up his thesis.

2020:

Dr. Temur Avaliani from National Environmental Agency Tbilisi, Georgia participated on research trainee-internship at Department of subsurface water hydrology of IH SAS during 3 months period (agreement MAD)

2021:

Dr. Saeid Okhravi, PhD. - postdoc from Iran participated on research trainee-ship at Department of surface water hydrology of IH SAS during 10 months period. His scholarship was funded by The National Scholarship Programme of the Slovak Republic (NSP) (funded by the Ministry of Education, Science, Research and Sport of the Slovak Republic and roofed by Slovak Academic Information Agency - SAIA, n.o.). On 01/10/2021 he started to work at the Department of surface water hydrology of IH SAS as a research worker at research position II.b.

2.5.3. PhD carrier path – Information on the next career steps of the PhD graduates who received their degree from the institute

Pramuk Branislav – after the PhD. degree at IH SAS in **2016** he was employed at Directorate for Geology and Natural Resources, Ministry of Environment of the Slovak Republic

Dušek Petr – after the PhD. degree at IH SAS in **2017** he was on the establishment, full time (100 %) at the Department of Surface Water Hydrology IH SAS as scientific worker with degree IIb. - from 01/09/2017 to 28/02/2018, then he was employed at Water management construction - technical supervision

Sočuvka Valentín - after the PhD. degree at IH SAS in **2017** he was on the establishment, full time (100 %) at the Department of Surface Water Hydrology IH SAS as scientific worker with degree IIb. - from 01/01/2020 to present

Krajčí Pavel - after the PhD. degree at IH SAS in **2017** he was employed at Mountain rescue service of the High Tatras Mountains

Zvala Anton - after the PhD. degree at IH SAS in **2018** he was on the establishment, full time (100 %) at the Department of SubSurface Water Hydrology IH SAS as research worker - from 01/09/2018 to 31/12/2019 and then as a scientific worker with degree IIb - from 01/01/2020 to present

Siman Cyril - after the PhD. degree at IH SAS in **2020** he was employed on half time work (50 %) at the Department of Surface Water Hydrology IH SAS as a scientific worker with degree IIb - from 01/09/2020 to 30/04/2021, then he was employed at the Slovak Hydrometeorological Institute in Bratislava

Garaj Marcel - after the PhD. degree at IH SAS in **2020** he was employed in the Slovak Hydrometeorological Institute in Bratislava

2.5.4. Summary table on educational activities

Teaching	2016	2017	2018	2019	2020	2021
Lectures (hours/year)*	0	0	1	2	23	8
Practicum courses (hours/year)*	8	0	3	1	6	0
Supervised diploma and bachelor thesis (in total)	1	2	4	2	3	4
Members in PhD committees (in total)	5	6	5	3	7	4
Members in DrSc. committees (in total)	0	0	0	0	1	0
Members in university/faculty councils (in total)	1	1	2	2	1	1
Members in habilitation/inauguration committees (in total)	1	1	1	1	1	2

2.5.5. List of published university textbooks

None

2.5.6. Number of published academic course books

None

2.5.7. List of joint research laboratories/facilities with universities

Centre of Excellence of Integrated Flood Protection Systems – the institute as a partner with Slovak University of Technology Bratislava - Faculty of Civil Engineering and Faculty of Chemical and Food Technology, and Comenius University Bratislava - Faculty of Natural Sciences

Centre of Excellence for Protection and Use of Landscape and for Biodiversity – the institute as a partner with Institute of Landscape Ecology SAS, Institute of Botanic SAS, Institute of Zoology SAS, Institute of molecular biology SAS, Chemical Institute SAS and Comenius University Bratislava - Faculty of Natural Sciences

Centre of Excellence for the Integrated River Basin Management in the Changing Environmental Conditions – the institute as an applicant with partners Slovak University of Agriculture in Nitra and Technical University in Zvolen

2.5.8. Supplementary information and/or comments on doctoral studies and educational activities – focused on what changes have occurred since the last evaluation in 2016

Doctoral studies are among the priorities of the Institute that can offer multidisciplinary research themes and modern equipment. Quality control is achieved by regular doctoral seminars, consultations of doctoral students with Guarantors of the programs and evaluations at the Scientific Council. The doctoral students are selected based on their motivation, result of their university study and McS theses. Selection of the supervisors takes into account their publication and project activities as well as experience with previous doctoral education.

The long-term collaboration with Faculty of Civil Engineering of the Slovak University of Technology (SvF STU) in Bratislava in the PhD study program “Water Management Engineering” (field of study 35. Civil Engineering) successfully continued. Seven students defended their PhD theses in 2016–2021. An important new fact is that owing to collaboration with the Austrian colleagues, five of them could do part of their study abroad and spent one semester of their study at Technical University in Vienna. One student was repeatedly awarded by the doctoral students’ grant of Slovak Academy of Sciences. It is worth mentioning that all of the students who defended their theses, work in the water and environment sector.

In addition to the traditional long-standing cooperation in doctoral studies with the SvF STU, in February 2019 a framework agreement was signed with the Faculty of Horticulture and Landscape Engineering of the Slovak University of Agriculture in Nitra (FZKI SPU) in the study programme "Landscape Engineering" (field of study 27. Agriculture and Landscape Engineering). This year we are training 4 PhD students in this study programme. Their research deals with several current topics - the impact of fires and vegetation succession on soil water infiltration and surface runoff generation, water quality in water reservoirs, the impact of biochar on soil hydrophysical properties and the impact of green architecture on runoff from urbanised areas.

Decrease in the number of educated specialists – hydrologists, water managers, meteorologists – at the universities in Slovakia represents a serious problem. The number of students enrolled in hydrology and water management programs decreases every year as a result of higher requirements on students (mathematics, statistics, modelling, GIS) and low appraisal of the employees in the water sector. Currently, there is no PhD study program

in hydrology accredited at any university in Slovakia. According to Slovak legislation, the institutes of SAS are not allowed to educate PhD students if they are not affiliated with PhD programs accredited at the universities. Thus, a new generation of hydrologists capable of solving challenging tasks is missing.

The institute also hosted students from abroad who did part of their research at the institute (an MSc. student from ETH Zurich and PhD student Babar Mujtaba from University of Coimbra; and also researchers MSc. Saied Okhravi, PhD. from Iran and Dr. Temur Avaliani from National Environmental Agency Tbilisi, Georgia participated on research study stay at Department of surface water hydrology and Department of subsurface water hydrology). Institute organized for students from Slovak University of Technology, Bratislava the experimental snow measurements at Research Base for Mountain Hydrology, IH SAS in Liptovský Mikuláš.

The students of Bachelor's programme Soil, Water, Atmosphere from Wageningen University & Research, Netherlands participated at Research Base for Mountain Hydrology, IH SAS in Liptovský Mikuláš (2017).

The students of the last year of study from Faculty of architecture and design, Slovak University of Technology Bratislava participated at 6 presentations of basic hydrogeologic research application to engineering practice in laboratory of Department of subsurface water hydrology IH SAS (2017).

Scholarships and excursion within the frame of PhD. Study

2016:

Dušek, Sočuvka, Siman, Garaj – international conference Hydrocarpath 2016, Wien, Austria, 1 day

Krajčí – international conference EGU 2016 (European Geosciences Union General Assembly), Wien, Austria, 5 days

Dušek - 12th International conference - International PhD and DLA symposium, Pécs, Hungary

2017:

Garaj – MAD Ukraine, 10 days

Dušek, Sočuvka - 5th International Symposium on Water Management and Hydraulic Engineering, Croatia, 5 days

Siman, Kimličková - international conference Hydrocarpath 2017, Wien, Austria, 1 day

Garaj, Siman – international conference EGU 2017, Wien, Austria, 3 days

Garaj, Siman - 11th International Summer School 2017 - Water in the sustainable development – challenges and opportunities, Global Water Partnership Central and Eastern Europe Summer School, Warsava, Poland, 8 days

2018:

Garaj – seminar of Adolf Patera, workplace of Česká vědeckotechnická vodohospodářská společnost, Czech Republic, 1 day

Garaj, Siman, Kimličková, Mészáros Jakub - international conference Hydrocarpath 2018, Wien, Austria, 1 day

Garaj, Siman - 17th Alps Adria Scientific Workshop, Hungary, 5 days

2019:

Siman - 18th Alps Adria Scientific Workshop 2019, Cattolica, Italy, 5 days

Mészáros Jakub - Workshop "Sustainable water resources management in high mountains in the Baltic Sea Region", Poland, 4 days

Garaj - WMESS 2019 - World Multidisciplinary Earth Sciences Symposium, Prague, Czech republic, 5 days

2020:

Mészáros Jakub - international conference Hydrocarpath 2020 - Processes, patterns and regimes in the hydrology of the Carpathians: coupling experiments, remote sensing, citizen science and modelling, ONLINE, 2020-12-03 from 9:00 to 12:00 h., Vienna, Austria; Bratislava, Slovakia; Sopron, Hungary

2021:

Botková, Varga – international conference Hydrocarpath 2021 - Catchment and river processes in regional hydrology: coupling field experiments and data assimilation into process understanding and modelling in Carpathian basins, ONLINE, 2021-11-26 from 8:30 to 14:30 h., Vienna, Austria; Bratislava, Slovakia; Sopron, Hungary

Botková –5th international conference on Agricultural, environment and food security ICAEFS 2021, 18/11/2021

- 13th international conference on Agrophysics ICA - „Agriculture in changing climate“, Lublin, Poland, online 15 – 16/11/2021
- 1st International Congress on Fire in the Earth System: Humans and Nature, Valencia, 2.-6. November 2021, in 04/11/2021
- online workshop “V4 Biochar Conference“, 17/09/2021
- online workshop EUSDR “Thematic event on climate change & water management“, 27/09/2021
- online workshop “7th session of the seminar - Urban Green infrastructure and Urban Agriculture for Sustainable Cities“, 05/10/2021

2.6. Societal impact

2.6.1. The most important case studies of the research with direct societal impact, max. 4 for institute with up to 50 average FTE researchers per year, 8 for institutes with 50 – 100 average FTE researchers per year and so on. Structure: Summary of the impact; Underpinning research; References to the research; Details of the impact; Sources to corroborate the impact. One page per one case study

1.

Summary of the impact

Humac s.r.o. company turned to us to find out how their humic acid products behave in the soil and whether they change the soil's retention capacity positively or negatively. Our research has shown that the impact of supplied materials on soil water retention is significant. Depending on the individual materials, the water retention volume increased by 50-75%. Additionally, based on our analyzes, the company offers these products for the purpose of improving soil retention properties.

Underpinning research

Project VEGA 2/0013/15 Biochar impact on transport and retention of water in agricultural soil

Project VEGA 2/0053/18 Strengthening Agroecosystem Resilience: Hydrological and Biohydrological Aspects

Project APVV-15-0160 Elimination of degradation processes in soil by biodiversity restoring

References to the research

- <https://link.springer.com/article/10.2478/s11756-020-00415-z>
- <https://www.scopus.com/record/display.uri?eid=2-s2.0-85077366613&origin=resultslist&sort=plf-f&src=s&st1=Evaluation+of+Biochar+Amendment+Impact+on+Soil+Water+Content+Changes+in+Field+Conditions+according+to+the+Soil+Hydrological+Limits.&sid=e7acbf4919f894b6f7073f212303b06d&sot=b&sdt=b&sl=138&s=TITLE-ABS-KEY%28Evaluation+of+Biochar+Amendment+Impact+on+Soil+Water+Content+Changes>

[+in+Field+Conditions+according+to+the+Soil+Hydrolimits.%29&relpos=0&citeCnt=0&searchTerm=&featureToggles=FEATURE_NEW_DOC_DETAILS_EXPORT:1](#)

- https://www.sav.sk/index.php?lang=sk&doc=journal-list&part=article_response_page&journal_article_no=25039
- https://www.sav.sk/index.php?lang=sk&doc=journal-list&part=article_response_page&journal_article_no=17829

Details of the impact

Improving water retention capacity in soils is a major challenge for both the private and public sectors, because climate change causes more frequent drought periods. Application of mentioned products is possible retain a larger amount of water in the soil and its mineralogical composition is improved by humic acids. This also results in higher crops of vegetables and fruits

Sources to corroborate the impact

<https://www.humac.sk/poda-a-rastliny-shop>

2.

Summary of the impact

Knowledge of temporal and spatial changes in soil water supplies can be obtained by measurement or numerical simulation on mathematical models. Numerical simulation, despite all its advantages, can be applied only after calibration and verification of the results on the measured values in the field. Soil moisture measuring by conventional methods (gravimetrically) is lengthy and expensive. For this reason, efforts are being made to design instruments that allow easy, inexpensive and fast measurement of soil water content. Emphasis is also placed on the possibility of automated data collection and their remote transmission. For measuring the water content in a porous medium with the possibility of automated data collection and their remote transmission, it is possible to use the Z-meter, based on the method of electrical impedance spectrometry. Electrical impedance is a basic property that characterizes alternating electrical circuits. It is most often considered to be a generalized electrical resistance. Calibration of this device was carried out in the East Slovakian Lowland during the vegetation periods 2016 - 2021. The aim was to convert the measured electrical parameters of soil depending on soil moisture to soil moisture. In a broader sense, it is the conversion of measured electrical parameters to the volumetric water content of the porous medium.

Underpinning research

Project EUREKA E!7614 APPL-EIS - A System of Monitoring of Selected Parameters of Porous Substances Using the EIS Method in a Wide Range of Applications. Research teams from 9 countries (Czech Republic, Slovakia, Switzerland, Italy, Belgium, Bulgaria, Lithuania, the Philippines and Poland) participated in the project.

References to the research

All publication in proceedings from 4th to 9th colloquium and working session (ISSN 2464-4595) and e.g.:

- https://link.springer.com/chapter/10.1007/978-3-030-18359-2_13
- <https://www.proquest.com/openview/62f66a944e6f86dcbf15fcfa8285b91e/1?cbl=1056436&pg-origsite=gscholar&parentSessionId=7RvmG4%2FT2UfplQefsm%2BVanfT12Q2AgxeyribLNDL%2BhE%3D>
- <https://eds.p.ebscohost.com/abstract?site=eds&scope=site&jrnl=18446116&AN=146183979&h=jFs3ZLZuiLrZppe13VrVJH7s9l0NiJz7p7t9cnnpT1U7AgzKjABZxBn0l%2fVi4i%2bvV MdfVC%2b5OZQLSOD3r75AHQ%3d%3d&crl=c&resultLocal=ErrCrlNoResults&resultNs=Ehost&crlhashurl=login.aspx%3fdirect%3dtrue%26profile%3dehost%26scope%3dsite%26authtype%3dcrawler%26jrnl%3d18446116%26AN%3d146183979>

- <http://www.uh.sav.sk/ah/Find-Issues/All-Issues?kod=18.2>

Details of the impact

The Z-meter has integrated simplicity, speed and sensitivity of measurements with the possibility of remote data transmission. The application of the Z-meter device in hydropedological research and its use in different regime monitoring measurements has been proven. The device is also suitable as part of lysimetric stations. Its limitation (in the case of monitoring) is the formation of a two-domain soil structure in heavy clay soils. On the other hand, it is possible to sensitively determine the time process of this soil structure formation in which the dynamics of water movement in a porous medium changes fundamentally.

Sources to corroborate the impact

<http://www.eureka3838.com>

3.

Summary of the impact

The experts of IH SAS participated in the year 2021 in the preparation of the General masterplan of the Nitra region. Such masterplan contains various chapters (e.g. demography, transport, energy) and the IH SAS participated (together with the Ing. Peter Slezák, HydroCoop company, Ltd.) on the elaboration of the chapter "Water management". This chapter comprises complex water management, i. a. regional hydrology, pedology, irrigation, drainage, water balance, water quality, water use in industry, agriculture, use of water energy, water supply, sewerage, flood protection, bathing water. Such Masterplan is a basic and binding plan for all development activities in the Nitra region, lower territorial unit plans are derived from this plan (district, city masterplans).

Underpinning research

This masterplan was underpinned by a wide spectrum of IH SAS research projects, like:

- APVV 18-0205 Management of crisis situations in water supply with respect to climate change
- APVV 14-0735 New possibilities of use of drainage canal systems taking into account the protection and use of a landscape
- UNESCO Project Nr. 9 - Flood regime of rivers in the Danube river basin
- VEGA 2-0155-21 Impact of biochar application on hydro-physical characteristics of different soil types
- VEGA 2-0096-19 FYTOINDICATION OF CHANGES OF SOIL HYDROLOGICAL REGIME
- VEGA 2-0025-19 Influence of aquatic vegetations on quantitative and qualitative parameters of lowland streams
- VEGA 20053-18 Strengthening Agroecosystem Resilience: Hydropedological and Biohydrological Aspects
- VEGA 2-0058-15 Analysis of sediment impact rate on interaction between surface water and groundwater with implementation of progressive measurement methods
- VEGA 2-0142-12 Water regime of heavy soils in depression areas of lowlands

References to the research

https://link.springer.com/chapter/10.1007/698_2017_199

http://www.uh.sav.sk/Portals/16/vc_articles/2009_57_1_Pekarova_3.pdf

http://www.uh.sav.sk/Portals/16/vc_articles/2016_64_4_Pekarova_393.pdf

http://www.uh.sav.sk/Portals/16/vc_articles/2014_62_3_KoczkaBara_177.pdf

https://www.sav.sk/index.php?lang=sk&doc=journal-list&part=article_response_page&journal_article_no=17208

<https://www.sgem.org/index.php/elibrary?view=publication&task=show&id=5667>

[Acta Hydrologica Slovaca, Vol. 19, No. 2, 2018, p. 179 - 184, Justína Vítková, Andrej Tall: Changes in soil temperature regime and soil water regime at Danubian Lowland and East Slovak Lowland during 2017](#)

Details of the impact

Various outputs from the research activities of IH SAS were embedded in the General masterplan of the Nitra region. Incorporating the results of research and development in this case has implications for the efficiency and effectiveness of the use of funds, as well as for long-term conceptual planning in the field of water management. The use of the latest research and development results represents in this case a direct transfer of technology to management practice.

Sources to corroborate the impact

<https://www.enviroportal.sk/sk/eia/detail/uzemny-plan-regionu-nitrianskeho-kraja-1>

4.

Summary of the impact

The construction of the water system Gabčíkovo-Nagymaros is a huge intervention to the water regime of the floodplain forests and the neighboring area. The impacts of the water construction on the environment is permanently monitored and evaluated. The companies responsible for the monitoring of the impacts under the Ministry of transport and construction of the SR and the Ministry of environment of SR contracted the IH SAS to monitor the impacts of the water system on the soil water regime of the floodplain forests of the area impacted by the Gabčíkovo water plant and the Hrušov water reservoir.

Underpinning research

Project VEGA 0009/15 Identification of the changes of the hydrological regime of rivers and mutual relation of the extreme hydrologic events in the complex river system of the Danube basin

Project VEGA 2/0004/19 Analysis of changes in surface water balance and harmonization of design discharge calculations for estimation of flood and drought risks in the Carpathian region

References to the research

Joint Annual Report on Environment Monitoring in 2016

www.gabcikovo.gov.sk/uploads/monitorovacie_spravy/spolocne_vyrocne/JointReport2016.pdf

Joint Annual Report on Environment Monitoring in 2017

www.gabcikovo.gov.sk/uploads/monitorovacie_spravy/spolocne_vyrocne/JR2017-a.pdf

Joint Annual Report on Environment Monitoring in 2018

http://www.gabcikovo.gov.sk/uploads/monitorovacie_spravy/spolocne_vyrocne/Joint-18.pdf

Joint Annual Report on Environment Monitoring in 2019

<http://www.gabcikovo.gov.sk/uploads/Joint19.pdf>

Details of the impact

According to the requirements of the contractor a set of 10-14 measuring sites were monitored through the whole period 2016-2019 including groundwater table depths and soil moisture in different depths with the step of 10 cm. The monitoring was performed in the time step of 14 days during the vegetation season and 1 month during the rest of the year. Research reports were prepared each year for the contractor who joined individual topical reports into the Joint Annual Report on Environment Monitoring for the Government of SR requested by the "Agreement between the Government of the Slovak Republic and the Government of the Republic of Hungary concerning Certain Temporary Technical Measures and Discharges in the Danube and Mosoni branch of the Danube", signed on April 19, 1995.

Sources to corroborate the impact

2.6.2. List of the most important studies and/or other activities commissioned for the decision-making authorities, the government and NGOs, international and foreign institutes (title, name of institution, contract value, purpose (max 20 words))

Contract title: Soil moisture monitoring on forest plots in the area of influence of the Gabčíkovo Waterworks in the years 2016–2020

Name of institution (customer): Ministry of Environment SR / Consultation Group Podzemná voda, s.r.o.

Contract value (€): 13 080 (year 2016); 18 312 (year 2017); 20 312 (year 2018); 22 143 (year 2019); 24 143 (year 2020).

Purpose: monitoring the environmental impacts of the Gabčíkovo water works construction to pursue the intergovernmental Treaty of April 19, 1995.

Contract title: Support for the project "Integrated Drought Management in Central and Eastern Europe" in the form of expert services

Name of institution (customer): Global Water Partnership - Central and Eastern Europe (NGO)

Contract value (€): 9 000.

Purpose: IH SAS developed a methodological framework for evaluating the synergistic cumulative effectiveness of small water retention measures in the country and the river basin evaluation.

Contract title: Preparation of the publication "Flood Regime of Rivers in the Danube Basin" within the UNESCO International Hydrological Program.

Name of institution (customer): Ministry of Foreign Affairs and European Affairs of the Slovak Republic

Contract value (€): 1500.

Purpose: For the needs of the customer's representational purposes.

2.6.3. List of contracts and research projects with industrial and other commercial partners, incl. revenues (study title, name of institution, contract value, country of partner, purpose (max 20 words))

Contract title: Assessment of the impact of discharged wastewater on the Slatina watercourse

Name of institution (customer): JT-Partner, s.r.o.

Contract value (€): 1500.

Purpose: For the needs of the commercial institution.

Contract title: Analysis of basic hydrophysical characteristics of commercial amelioration substrates

Name of institution (customer): HUMAC s.r.o.

Contract value (€): 650.

Purpose: For the needs of the commercial institution.

Contract title: Spatial plan of the Nitra region - part water management

Name of institution (customer): Hydrocoop, s.r.o.

Contract value (€): 1000.

Purpose: For the needs of the commercial institution.

2.6.4.1 List of intangible fixed assets (internally registered IP (confidential know-how), patent applications, patents granted, trademarks registered) denoting background IPR

2.6.4.2 List of licences sold abroad and in Slovakia, incl. revenues (background IPR identification, name of institution, contract value, country of partner, purpose (max 20 words))

2.6.5. Summary of relevant activities, max. 300 words (describe the pipeline of valorization in terms of Number of disclosure, Number of registered IP internally, number of CCR/LIC contracts and their respective summary values, the support you are receiving in specific points internally at the institute, at SAS, externally – also the limitations and drawbacks.

The Institute's long-term efforts to increase the share of private resources in financing its research activities are limited by stagnating conditions for science in the Slovak Republic and the nature of hydrological research. The volume of funds that the Institute obtained through contracts for the evaluated period definitely helped its management and enabled not only financial contribution to salaries, but also to the development of its infrastructure. The potential of the Institute for the implementation of contracts of various kinds is not low - during the reviewed period, both human resources and instrumentation improved. Unfortunately, our possibilities and efforts were not as successful as we would have liked and were able to cover. Environment and water resources protection resonates in society especially recently very emphatically, but there is still little money for research and to protect them.

In addition to expertises and contracts, the societal impact of our research is undeniable, because water is de facto a strategic raw material and the importance of sufficient quantity of clear water will only grow. Having qualified staff able to understand the components of the hydrologic cycle, to conduct training courses for various levels of education, to adjust the measurement methodology – it is essential for the future of society. Modern instrumentation (often unique in the conditions of the Slovak Republic, sometimes in Central Europe) allows to us performing measurements of various parameters at a professional level (subchapter 2.6.1-2.6.3). Presentation of research activities and offered expert services (determination of hydrophysical and other soil parameters, monitoring and modelling of soil water supplies and transport of solutes, assessment of storage space change of water reservoirs, determination of water flow velocity profiles, analysis of stable isotopes of oxygen and hydrogen in water) is realized several times a year at scientific festivals (Researchers' Night), agricultural exhibition (Agrokomplex) but also through social networks ([\(1\) Ústav hydrológie SAV | Facebook](#)) and the institute's website.

2.7. Popularisation of Science (outreach activities)

2.7.1. List of the most important popularisation activities, max. 20 items

2016:

Presentation of IH SAS at international exposition CONECO/ RACIOENERGY/ Water - CONECO 2016, Incheba Bratislava, 06/04/2016

Danko, Sleziač- IH SAS popularisation on the social network - administrator of facebook page - 2016 to present, <https://www.facebook.com/ustavhydrologie/>

Exposition „Historic flood marks on the Upper Danube River“, 24/10/2016 to 25/10/2016 – Hall of mirrors of Primaciálny palace, Bratislava

Velísková – the guest of Night pyramid Radio Slovakia, RTVS, 14.3.2016

Velísková – lecture in “Scientific patisserie”, National center for popularization of science and technics in society, CVTI SR, http://ncpvat.cvtisr.sk/buxus/images/VedCukraren/BA/ba_2016/cukraren_letak_f, 16.2.2016

2017:

Presentation of IH SAS at 11th festival of Slovak science “European Researchers' Night 2017”, <http://www.uh.sav.sk/en-gb/News/Latest-News/aid/137>, <https://www.facebook.com/ustavhydrologie/>, 29.9.2017

Nagy - online discussion in morning broadcast of Radio Slovakia on Theme “Groundwater at Žitný ostrov and atrazine contamination, RTVS, 22.12.2017

2018:

Danko – press paper in magazine QUARK 2018 with title “Chladno, chladnejšie, sneh” (Cold, colder, snow)

Pekárová – press paper in magazine Quark, No. 4, 2018 with title “Máme vody dosť?”, <http://www.uh.sav.sk/en-gb/News/Latest-News/aid/153>, 10.4.2018

Pekárová, Miklánek – discussion in broadcast “Veda SK” in Radio Slovakia, RTVS <http://www.rtvs.sk/radio/archiv/11373/879785>, 24.2.2018

Velísková – press paper with title “Viete, čo pijete? (Do you know what you drink?)”, weekly newspaper Téma 19/2018

2019:

Velísková, Vitková – discussion in broadcast “Veda SK” in Radio Slovakia, RTVS on theme „Voda čo nás drží nad vodou“ (Water that keeps us above water), <https://www.rtvs.sk/radio/archiv/11373/1238741>, 30.11.2019

Event “Weekend with SAS”, Bratislava, 21. – 22. June 2019, <http://www.uh.sav.sk/>

Presentation and popularization of IH SAS at event “European Researchers' Night 2019”, <http://www.uh.sav.sk/>, 27/09/2019

2020:

Danko – reportage in TV JOJ with title “Ešte to nie je katastrofa” (It is not yet a catastrophe), Daily news of TV JOJ +

<https://www.facebook.com/ustavhydrologie/videos/2398064410411379/>, 30.1.2020

Sočuvka – online discussion in Radio Slovakia RTVS to programme “Rádiožurnál - K veci – Odborník na telefóne” and discussion in daily news TV RTVS about measurements by SONAR Lowrance in common project with Institute of Archaeology SAS

2021:

Gomboš, Tall, Kandra – press article in daily paper Denník N – “The East Slovak Lowland is natural laboratory for scientists. Will we be able to produce the vegetables or cactuses from it?”, 14.7.2021

Pekárová – video on canal youtube “Historical floods” <https://zmenaklimy.sk/aktivita/historicke-povodne/2021>

Sokáč – Internet scientific cafe SAVinci – article “What influenced the water quality and where the residents of Bratislava can take the safe bath?” <https://spojenaba.sk/savinci-co-vplyva-na-kvalitu-vody-a-kde-sa-bratislavcania-bezpecne-okupu/>, 30.6.2021

Velísková – discussion for RTVS on theme “Contamination of oceans influences also Slovakia”, <https://slovensko.rtvs.sk/clanky/spolocnost/255020/znecistenie-oceanov-vplyva-aj-na-slovensko>, 28.4.2

2.7.2. Table of outreach activities according to institute annual reports

Outreach activities	2016	2017	2018	2019	2020	2021	total
Articles in press media/internet popularising results of science, in particular those achieved by the Organization	5	0	8	2	2	28	45
Appearances in telecommunication media popularising results of science, in particular those achieved by the Organization	11	1	8	3	9	6	38
Public popularisation lectures	6	4	2	4	5	6	27

2.8. Background and management. Infrastructure and human resources, incl. support and incentives for young researchers

2.8.1. Summary table of personnel

2.8.1.1. Professional qualification structure (as of 31 December 2021)

	Degree/rank				Research position		
	DrSc./DSc	CSc./PhD.	professor	docent/ assoc. prof.	I.	II.a.	II.b.
Male	1	16	0	1	1	8	8
Female	1	9	0	0	1	5	4

I. – director of research with a degree of doctor of science/DrSc.

II.a – Senior researcher

II.b – PhD holder/Postdoc

2.8.1.2. Age and gender structure of researchers (as of 31 December 2021)

Age structure of researchers	< 31		31-35		36-40		41-45		46-50		51-55		56-60		61-65		> 65	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Male	0,0	0,0	5,0	5,0	2,0	2,0	4,0	4,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	1,5	4,0	3,3
Female	3,0	3,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	0,5	4,0	4,0	5,0	4,5	3,0	2,5	0,0	0,0

A – number

B – FTE

2.8.2. Postdoctoral fellowships (list of positions with holder name, starting date, duration. Add brief information about each fellow's career path before and after receiving PhD degree, etc.)

2.8.2.1. MoRePro and SASPRO fellowships

2.8.2.2. Stefan Schwarz fellowships

RNDr. Lucia Balejíčková, PhD. (born Melníková)

Štefan Schwarz Supporting Fund, Slovak Academy of Sciences, duration of Stefan Schwarz post-doctoral project (2016 – 2020), project title: „*Magnetoferritin as decontamination system in hydrology*”.

Additional brief information about each fellow's career path before and after receiving PhD degree:

RNDr. Lucia Balejčíková, PhD. (born Melníková) graduated in Chemistry (Bachelor level) with a specialization in Biochemistry (Master level) at the Pavel Jozef Šafárik University (PJŠU) in Košice, Slovakia, in 2011. She earned a PhD. in the condensed matter physics field in 2015 with a dissertation entitled: „Physical characterization of magnetic nanoparticles in magnetoferritin” at PJŠU. Financial support approval for the theme continuation obtained in 2016 within the post-doctoral Štefan Schwarz project named „Magnetoferritin as decontamination system in hydrology” was evidence of the research quality and impact on science. In 2016 she participated in a fellowship for DESY in Hamburg, Germany and under the international DESY project „Effect of artificial ferritins on the lysozyme amyloid fibrils structure” as its leader produced publication: Balejčíková, L. - Petrenko, V. I. - Baťková, M. - Šipošová, K. - Garamus, V. M. - Bulavin, L. A. - Avdeev, M. V. - Almasy, L. - Kopčanský, P. Disruption of amyloid aggregates by artificial ferritins. In *Journal of Magnetism and Magnetic Materials*, 2019, vol. 473, p. 215-220. In 2018 the shift to the Institute of Hydrology of SAS allowed the expansion of current problematics of magnetic nanoparticles for environmental and hydrological practice, especially in destruction of polychlorinated biphenyls. Part of her PhD. and post-doctoral work was on the chemical preparation of different nanomaterials related to bio-applications. Physicochemical properties were studied using the following methods: ultraviolet and visible spectroscopy, infrared spectroscopy, dynamic light scattering, zeta potential measurement, magnetic properties measurements using SQUID magnetometry and small-angle X-ray and neutron scattering. She completed several working stays in Russian Federation (Joint Institute for Nuclear Research), Poland (Adam Mickiewicz University), Germany (Deutsches Elektronen-Synchrotron), Hungary (Budapest Neutron Centre) and France (Institut Laue-Langevin and Jean Monnet University). Obtained results published in more than 35 Current Content papers with more than 280 citations resulted in an H-index of 10 and awarded in several Slovak Academy of Sciences competitions for young scientists and allowed advancement to the finals of the prestigious competition L'Oréal UNESCO for Women in Science in 2018 with project: „Physicochemical characterization of magnetoferritin as a potential magnetopharmaceutical nanomaterial and as a decontamination system in hydrology”.

Ing., Ing. Patrik Sleziak, PhD.

Štefan Schwarz Supporting Fund, Slovak Academy of Sciences, project duration: 2 years (01.06.2019 - 31.05.2021), project title: *New concept of hydrological modelling of mountain catchments in changed climatic conditions*. After the end of the project solution period extended by 1 year. The project focused on the use of new satellite data in mathematical modelling of the hydrological cycle in the mountains.

Additional brief information about each fellow's career path before and after receiving PhD degree:

Ing., Ing. Patrik Sleziak, PhD. is a young scientist (under 35) at the experimental base in Liptovský Mikuláš. His research is oriented towards the study and development of the physically-based and conceptual schemes of the hydrological processes parameterization in rainfall-runoff models, which allow the simulation of anthropogenic impacts on extreme runoff from precipitation in small basins and improve the simulations in changing climatic conditions. In 2015, he received the Ernst Mach Scholarship for PhD. Students at the Vienna University of Technology. In 2016, he received a scholarship from the National Scholarship Program for PhD. students at the Vienna University of Technology. In 2019, he was supported by the Stefan Schwarz fond of the Slovak Academy of Sciences for young researchers. In 2020, his work “The effect of the snow weighting on the temporal stability of hydrologic model efficiency and parameters” was awarded in the competition of young scientists of the Slovak Academy of Sciences. He joined the Department of Land and Water

Resources Management at STU in Bratislava in 2013 as an internal doctoral student in the field of water engineering. Since 2019 he has been an employee of the Institute of Hydrology of the Slovak Academy of Sciences. In 2012, he completed his university studies (Ing.) in the field of landscaping at the Slovak University of Agriculture in Nitra. In 2019, he graduated from the 2nd degree of university studies (Ing.) In the field of geoinformatics at the VŠB-Technical University in Ostrava. He completed both university studies with honors. He successfully completed his doctoral studies (PhD.) in 2017 at the Department of Land and Water Resources Management, STU in Bratislava. The topic of his dissertation was " Modeling of rainfall-runoff processes under changing climate".The work examined in detail the uncertainties associated with the use of hydrological models in changing climatic conditions.

2.8.2.3. Postdoctoral positions from other resources (specify)

2.8.3. Important research infrastructure introduced during the evaluation period with the information about the sources of funding (max. 2 pages)

During the evaluated period IH SAS provided maintenance, necessary repairs and the purchase of updates to the instrumentation of:

- Joint research facility/laboratory within the Centre of Excellence of Integrated Flood Protection Systems:
Common infrastructure for systematic monitoring of the amount and environmental quality of waters and introduction of new methods for water planning and catchment areas' management
Instrumentation of IH SAS: Disc Permeameter, Set for pF Curve Measurement, Guelph Permeameter, Double Ring Infiltrometer, ArcGIS, FlowTracker Handheld-ADV (Acoustic Doppler Velocity meter)-3D, Electromagnetic Open Channel Flow Meter - model 801, GRS-1-Handheld GNSS REC, MIKE SHE – software – groundwater flow modelling, Sonar Lowrance HDS 10 + accessories
- Joint research facility/laboratory within the Centre of Excellence for Protection and Use of Landscape and for Biodiversity:
Common facility for collecting of the landscape abiotic components data. Part of it is a hydrological laboratory for the study of the effect of hydrological regime on land and changes in land use and biodiversity.
Instrumentation of IH SAS: Limnigraph, Portable Spectrophotometer VIS DR 2088, Flow Tracker 2D, Hydrometric Wing Valeport 801C, Visual MODFLOW software, Vector map of SR
- Joint research facility/laboratory within the Centre of Excellence for the Integrated River Basin Management in the Changing Environmental Conditions:
Common facility for continual monitoring of soil water storage together with flow measuring and measuring of meteorological and climatic Instrumentation of IH SAS: automatic monitoring kit for moisture and soil temperature, rainfall and groundwater level measurement, laser particle size analyzer, set for soil water retention determination, calcimeter, air pycnometer, soil water permeameter, system for field measurement of electrical conductivity and induced polarization of soil profile, device for accurate measurement of the concentration of oxygen isotope and deuterium in water samples (PICARRO), instrument assembly for measuring the speed of water flow in natural river channels, system for measuring leaf area index (LAI) of forest cover, multispectral camera
- Project infrastructure of hydrological research stations:

The infrastructure and technical equipment serve in complex monitoring of hydrological processes in the lowland and mountain areas.

Instrumentation of IH SAS: sonar with accessories, lysimeters, field kit for pH determination in liquids and soils, with an apparatus for taking intact samples of bottom sediments with accessories, an apparatus for automatic mapping of quality and morphology of streams and reservoirs, groundwater flow modeling software, surface runoff modeling software, simulation model for modeling the flow and transport of pollution in surface flows, multispectral camera with accessories, neutron probe, infrared camera, spectrophotometer, system for field tomography of electrical resistance and induced polarization of the rock environment, georadar, laser measurement system for stable isotopes of oxygen and hydrogen, system for remote survey of river basin characteristics, stationary precipitation monitoring system, field multiparametric device with accessories, complete set for measuring soil retention curves, rainfall simulator, disdrometer

In addition, IH SAS invested in the purchase of cars, which are a prerequisite for field research; to ensure the maintenance and reconstruction of buildings of research bases; replaced obsolete and broken laboratory fixtures. These infrastructure investments were financed mainly from own financial resources.

2.9. Supplementary information and/or comments on all items 2.1 – 2.8 (max. 2 pages in total for the whole section)

Over the years, the institute has cooperated with several NGOs, non-profit organizations, and associations.

The International Geosphere-Biosphere Programme (*IGBP*) was a research programme that ran from 1987 to 2015 dedicated to studying the phenomenon of global change. Its primary focus was coordinating "international research on global-scale and regional-scale interactions between Earth's biological, chemical and physical processes and their interactions with human systems. In 2015, the IGBP was incorporated into the *Future Earth Alliance International Initiative*. The vision of this initiative is to provide scientific knowledge to improve the sustainability of life on Earth. The research objectives are

- to analyze the interactive physical, chemical and biological processes;
- to analyze the changes that occurred;
- to analyze the impact of human activity on these changes.

Global Water Partnership is focused on water management. IH SAS applied in 2012 for membership in GWP for Central and Eastern Europe (GWP CEE), which is part of the Global Water Partnership Organization (GWPO) based in Stockholm. GWP Slovakia participates in the implementation of GWP CEE programs in multilateral projects and through its specific working program. GWP cooperated in launching the Action Plan of Slovakia against drought. At the national level, GWP functions mainly as a knowledge and expert platform for facilitating dialogue between governmental and non - governmental organizations active in water management and environmental protection.

3. Implementation of the recommendations from the previous evaluation period

The International Evaluation Meta-Panel in 2016 recommended:

- to address the topic "Water, landscape evolution and future climate change and its impact on society"

- *to intensify the connection between surface and subsurface hydrology*
- *to improve the interconnection of research at the Institute with research of related organizations (Institute of Geography SAS, Earth Science Institute of the SAS)*
- *to develop a multidisciplinary and multispectral approach to problem solving (engineers, natural scientists, sociologists)*
- *to increase the number of publications in other (non domestic) international journals*
- *to support and initiate an increase in pedagogical activities - SAS and universities should look for a solution (a way) to strengthen education in the field of hydrology.*

As a response to the results of evaluation, the Action Plan (AP) of the IH SAS with a long-term outlook until 2025 was developed in 2017. Its proposal was based on the above mentioned recommendations as well as on the analysis of the current situation and the measures taken within the SAS.

The AP set out the R&D strategy of the IH SAS and partial objectives in the horizons of individual years. The steps to achieve them were divided into 5 areas:

- Strategic research topics of the Institute of Hydrology of SAS for period 2017–2025
- Improvement of the quality of research outputs
- The position of the Institute in the international and national context
- Doctoral study
- Management, infrastructure, personnel policy.

The objective of the Action Plan is to strengthen the reputation and improve the position of the Institute in the scientific and professional community at both national and international levels, improve and modernize the scientific research process and increase the motivation of the staff and the sense of responsibility for the Institute.

The Action Plan is updated every year. The summary of activities for the near future in tabular form is an annual annex to the Action Plan. It contains a closer and more specific description of all activities. Within the yearly update, the defined tasks are divided into areas: science and research, position of the institute in the international and national context, management and personnel policy, doctoral studies and popularization.

Another step in the reinforcement of the IH SAS reputation and position in the scientific community, and in modernization of the scientific research process, was the establishment of the International Advisory Board (IAB) in 2019. Since then, a short summary of the Institute's Annual Report containing important information about our activities is prepared every year. The IAB can comment on them and formulate recommendation for the next period. Their comments and recommendations are reflected in the update of the Action plan for the next year.

To the implementation of individual recommendations

- *to address the topic "Water, landscape evolution and future climate change and its impact on society"*

Research topics of IH SAS coincide with the focus of the Institute, set out in the valid Charter of IH SAS and at the same time with the requirements of social practice in the field of hydrology and water management in Slovakia, as it was recommended by evaluation Meta-Panel and also by the members of our International Advisory Board. Last but not least, the research is influenced by the topics of the calls announced under the international R&D funding schemes and also with the current world trends in hydrological research. In all these aspects, climate change and its impact on society resonate very strongly. A non-acceptance of this requirement would make it almost impossible to be successful in research funding schemes (research of water balance components under the global climate change and increasing effects of anthropogenic activities: flood prediction / protection, drought / agriculture production, soil water repellence / forest fires, anthropogenic impacts on water resources / pollutant spreading, drinking water supply, etc.). Research topics of new research proposals are discussed in the Scientific Board of the Institute every year.

A comprehensive project called *WATERS* (*W* – water, wild nature and human being, wisdom; *A* – availability, adaptability, agriculture, alimentation, alliance, adventure, arts; *T* – territory, transportation, tourism; *E* – ecology, environment, economy, energy; *R* – resources, research, regulation, reserve, relief, recreation; *S* – source, society, sharing, safety, sports, Slovakia) was being prepared within SAS, in which IH SAS had a relatively substantial presence. This multidisciplinary project synthesized water resources research using a multispectral approach. Unfortunately, it has not yet been possible to implement it, because it has not been possible to convince the decision-making sphere in Slovakia of the need and usefulness of solving problems with water in the country in this extent, or to find other sources of funds for its solution.

A specific act was the Institute's cooperation with the Institute of Archaeology SAS in the research of a settlement location near the Danube river in Roman period.

- *to intensify the connection between surface and subsurface hydrology*

Although the contacts of researchers from the surface and subsurface hydrology are permanent, we have tried to intensify them. The results have come in the form of project proposals and publications. Joint project proposals are represented by proposal "Small catchments as the simple dynamic system" submitted to Slovak Research and Development Agency in 2018, APVV that obtained a very good evaluation, but was not supported, three project proposals in the EIG CONCERT-Japan Joint Call 2019 "Smart Water Management for Sustainable Society" of which one was successful and one project proposal for SlovakAid Call 2021 "Technical assistance for a combat against climate change in water management and agriculture in Georgia" which was not successful. Joint publications include several monograph chapters and journal articles:

HLAVÁČIKOVÁ, Hana - NOVÁK, Viliam - DANKO, Michal - HOLKO, Ladislav. Stony soils in a small mountainous catchment. In Hydrological research in the context of ongoing climate change - Bratislava : Veda, 2018, s. 51-93. ISBN 978-80-224-1691-7 (in Slovak);

HOLKO, Ladislav - KOSTKA, Zdeňek - DANKO, Michal - HLAVÁČIKOVÁ, Hana. Overland flow research in catchments with different geology. In Hydrological research in the context of ongoing climate change - Bratislava : Veda, 2018, s. 129-157. ISBN 978-80-224-1691-7 (in Slovak);

HLAVÁČIKOVÁ, Hana - HOLKO, Ladislav - DANKO, Michal - NOVÁK, Viliam. Estimation of macropore flow characteristics in stony soils of a small mountain catchment. In Journal of hydrology, 2019, vol. 574, p. 1176-1187. ISSN 0022-1694. <https://doi.org/10.1016/j.jhydrol.2019.05.009>;

MUJTABA, Babar- HLAVÁČIKOVÁ, Hana - DANKO, Michal - DE LIMA, Joao L.M.P - HOLKO, Ladislav. The role of stony soils in hillslope and catchment runoff formation. In Journal of Hydrology and Hydromechanics, 2020, vol. 68, iss. 2, p. 144-154. ISSN 1338-4333. <https://doi.org/10.2478/johh-2020-0012>).

Unfortunately, so far only one project proposal has been successful. Although our efforts in this field were not as successful as we would like, we will continue to pursue this effort.

- *to improve the interconnection of research at the Institute with research of related organizations (Institute of Geography SAS, Earth Science Institute of the SAS)*

IH SAS management has supported the activities to respond to this comment. One result was the above mentioned project proposal *WATERS* in which the Institute of Geography SAS and the Earth Science Institute SAS participated and participation of researches and professionals from Slovak universities, other institutions and water resource managers was anticipated.

The effort to improve the collaboration with other organizations continues and the results have started to appear in the form of common publications:

ZVALA, Anton - ŠURDA, Peter - KIDOVÁ, Anna* - VITKOVÁ, Justína. Water retention of the organic soil horizon in a central European deciduous forest. In Geografický časopis, 2021, vol. 73, no. 4, p. 347-358. (2020: 0.263 - SJR, Q3 - SJR). ISSN 0016-7193. <https://doi.org/10.31577/GEOGRCAS.2021.73.4.18>, * Institute of Geography SAS;

HOLKO, L., SLEZIAK, P., DANKO, M., BIČÁROVÁ, S*, POCIASK-KARTECZKA, J. Analysis of changes in hydrological cycle of a pristine mountain catchment. 1. Water balance components and snow cover. Journal of Hydrology and Hydromechanics, 2020, vol. 68, no. 2, p. 180-191. (2019: 2.011 - IF, Q3 - JCR, 0.674 - SJR, Q1 - SJR (2020 - Current Contents, WOS, SCOPUS, CCC). ISSN 1338-4333. <https://doi.org/10.2478/johh-2020-0010> * Earth Science Institute of the SAS).

IH SAS also cooperates with the Earth Science Institute of the SAS in the survey of the High Tatras mountain lakes (tarns).

Mutual cooperation exists also with the Institute of Landscape Ecology SAS:

LICHNER, Ľ., IOVINO, M., ŠURDA, P., NAGY, V., ZVALA, A., KOLLÁR, J.*, PECHO, J., PÍŠ, V., SEPEHRNIA, N., SÁNDOR, R.: Impact of secondary succession in abandoned fields on some properties of acidic sandy soils. *Journal of Hydrology and Hydromechanics*, 68, 2020, 1, 12–18. (2019 IF = 2,011) ISSN 1338-4333. <https://doi.org/10.2478/johh-2019-0028>;

SÁNDOR, R., IOVINO, M., LICHNER, L., ALAGNA, V., FORSTER, D., FRASER, M., KOLLÁR, J.*, ŠURDA, P., NAGY, V., SZABÓ, A., FODOR, N.: Impact of climate, soil properties and grassland cover on soil water repellency. *Geoderma*, 383, 2021, Article Number: 114780. (2019 IF = 4,848) ISSN 0016-7061. <https://doi.org/10.1016/j.geoderma.2020.114780>)

and Institute of Experimental Physics SAS:

BALEJČÍKOVÁ, Lucia - MOLČAN, Matúš* - KOVÁČ, Jozef* - KUBOVČÍKOVÁ, Martina* - SAKSL, Karel - MITRÓOVÁ, Zuzana* - TIMKO, Milan* - KOPČANSKÝ, Peter*. Hyperthermic effect in magnetoferritin aqueous colloidal solution. In *Journal of Molecular Liquids*, 2019, vol. 283, p. 39-44. (2018: 4.561 - IF, Q1 - JCR, 0.862 - SJR, Q1 - SJR, CCC). ISSN 0167-7322. <https://doi.org/10.1016/j.molliq.2019.03.023>; BALEJČÍKOVÁ, Lucia - TOMAŠOVIČOVÁ, Natália* - ZAKUŤANSKÁ, Katarína* - BAŤKOVÁ, Marianna* - KOVÁČ, Jozef* - KOPČANSKÝ, Peter*. Dechlorination of 2,4,40-trichlorobiphenyl by magnetoferritin with different loading factors. In *Chemosphere*, 2020, vol. 260, art. no. 127629. (2019: 5.778 - IF, Q1 - JCR, 1.530 - SJR, Q1 - SJR). ISSN 0045-6535. <https://doi.org/10.1016/j.chemosphere.2020.127629>; BALEJČÍKOVÁ, Lucia - SAKSL, Karel - KOVÁČ, J.* - MARTEL, A. - GARAMUS, Vasil M. - AVDEEV, Mikhail V. - PETRENKO, Viktor I. - ALMÁSY, L. - KOPČANSKÝ, Peter*. The impact of redox, hydrolysis and dehydration chemistry on the structural and magnetic properties of magnetoferritin prepared in variable thermal conditions. In *Molecules*, 2021, vol. 26, no. 22, art. no. 6960. (2020: 4.412 - IF, Q2 - JCR, 0.782 - SJR, Q1 - SJR, CCC). ISSN 1420-3049. <https://doi.org/10.3390/molecules26226960>)

IH SAS participated in the multidisciplinary project “New possibilities of use of drainage canal systems with taking into account the protection and use of a landscape” (grant No. APVV-14-0735, 2015-2019) with the Institute of Landscape Ecology SAS and other research institutions. This project had also a direct impact on water management practice.

IH SAS also coordinated the multidisciplinary and multispectral project proposal “Impact of microplastics on soil properties and crop growth and mitigation of this influence by microbial degradation of microplastics” in the APVV (the Slovak Research and Development Agency) call 2021 with participation of the Institute of Molecular Biology SAS and the Polymer Institute SAS, but this proposal was not successful in this call.

We plan to strengthen all activities regarding this research interconnection in the future.

- *to develop a multidisciplinary and multispectral approach to problem solving (engineers, natural scientists, sociologists)*

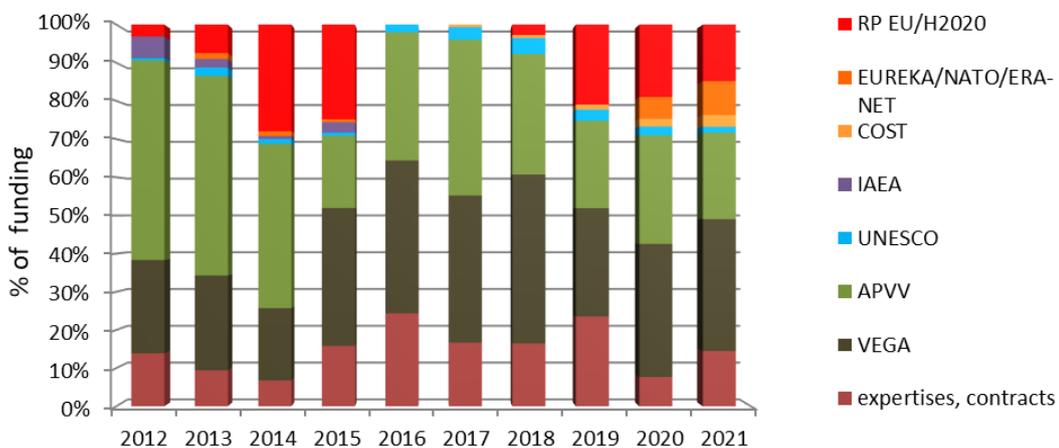
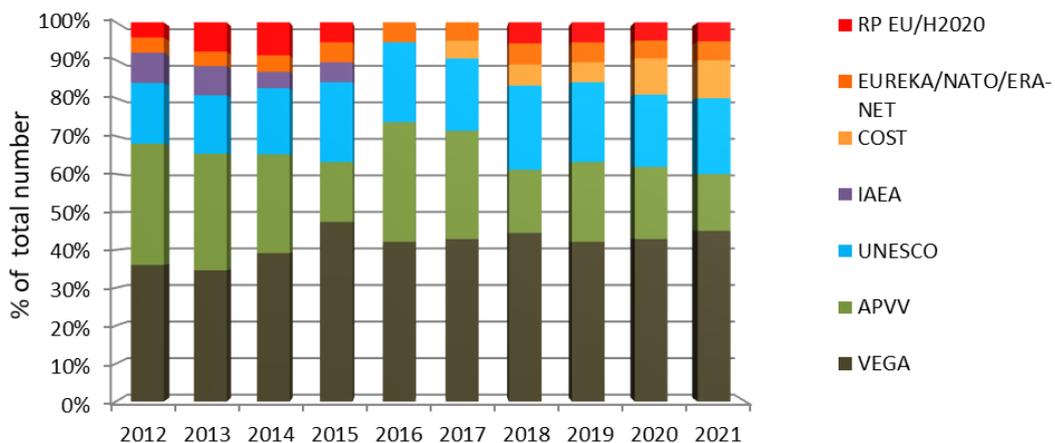
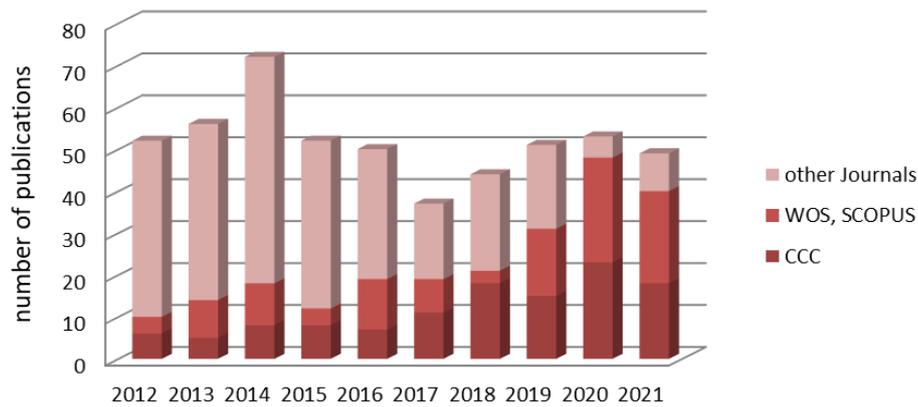
Practice from the previous time shows that a multidisciplinary and multispectral approach to problem solving is very interesting and prosperous, however, evaluation of this kind of project (and also publications) has been problematical. Until recently, the agencies funding the research in Slovakia did not have the methodology for evaluation of such project proposals. The activities connected with this have only recently been started. Publication of results of multidisciplinary/multispectral projects maintain the problem of finding an appropriate journal where the results could have been published.

Regardless, we will not slacken this effort - gained experience will help us to be more successful in the future and it looks like the agencies in the Slovak Republic will be able to better evaluate such projects.

- *to increase the number of publications in other (non domestic) international journals*

The main emphasis in adopting measures and implementing the recommendations has been placed on improving the structure of publication outputs. For this purpose, the criteria for evaluation of our researchers have been adjusted and the remuneration of researchers is determined by the accomplishment of adopted criteria. The criteria stimulate publishing in impact journals with an international impact and the preparation of project proposals for international funding schemes.

The results of our effort showing a significant increase in the number of publications in journals indexed in WOS and SCOPUS on account of publications in other journals can be seen in the graphs below:



Nevertheless, it is necessary continue in the effort, improve the structure of publication outputs with a focus on periodicals ranked in the first quartile and decile, and increase their number per researcher. For this purpose, the criteria for evaluation of our researchers have been modified, and their fulfilment will be subsequently taken into account in the wage evaluation.

- *support and initiate an increase in pedagogical activities - SAS and universities should look for a solution (a way) to strengthen education in the field of hydrology.*

IH SAS as an external educational institution is accredited in the PhD study program "Water Engineering" in cooperation with Faculty of Civil Engineering of the Slovak University of Technology and since February 2019 also in the study program "Landscape Engineering" in cooperation with Faculty of Horticulture and Landscape Engineering of the Slovak University of Agriculture in Nitra.

The quality of the PhD education (the work of our PhD students) is evaluated in cooperation with the Scientific Council of the Institute. The PhD students are motivated in an active involvement in scientific projects, but also in regular activities at the institute, so that during their study at the Institute they become acquainted with all aspects of the work in a scientific organization. The emphasis is also placed on increasing of their mobility.

IH SAS organizes regular internal seminars "Creative discussion forum of scientists" during the year, where the all researchers, including the PhD students, present the results of their current work, discuss them with the colleagues, and improve their presentation skills.

The management of the Institute has supported continued publication of both its journals (Journal of Hydrology and Hydromechanics, Acta Hydrologica Slovaca) as well as scientific monographs. This effort has paid off, both journals have raised their level and are indexed in in recognized databases (WOS, SCOPUS, respectively) and help to disseminate research results.

4. Research strategy and future development of the institute for the next five years (Recommended 3 pages, max. 5 pages)

Research strategy of the institute in the national and international contexts, objectives, and methods (including the information on when the strategy was adopted)

The mission of IH SAS has three key dimensions:

- research aimed at raising the level of knowledge - *the scientific dimension*,
- research, bringing the society an identifiable benefit – *the social dimension*,
- research that contributes to making the Earth an increasingly better place to live – *the environmental dimension*.

R&D strategy of the IH SAS with a long-term outlook to 2025 which was developed in 2017 and has been divided into 5 areas:

- Strategic research topics of the Institute of Hydrology of SAS for the period 2017–2025
- Improving the quality of research output
- Position of the Institute in the international and national context
- Doctoral study
- Management, infrastructure, personnel policy.

We plan to follow basic principles of this strategy, alternatively to modify them after considering the results of the accreditation and recommendation of the panel.

Regardless, the strategy should be based on at least 3 pillars: people, capital, and facilities! Their building and development is a necessary prerequisite for the successful achievement of goals.

The goal is:

Sustainable improvement of the Institute's position in the national and international research area

Considering the positive trend of research outputs and the recent development of IH SAS position, it is necessary to continue the current strategy. But due to the society-wide situation and negative forecasts of public finances in the Slovak Republic and due the mentioned pillars building, it is also appropriate for IH SAS to focus on the following sub-tasks:

- i) to focus on research tasks and funding schemes; from which it is possible to finance the purchase and operation of research infrastructure necessary for the development of the Institute and for solving research tasks,
- ii) to focus on grants that allow reimbursement of staff salaries,

iii) to use funding schemes allowing residence and scientific internships for quality and experienced foreign researchers.

It is necessary to be active in international and national collaborations, cooperate with private sector and strive to increase our impact on decision makers in water management and environment. It is equally important to support research with a direct impact of the results on practice.

We want to continue in playing an active role in international collaboration, i.e. in UNESCO projects and apply for other projects, especially in the European space as well (excellence-based research and innovation projects, mobility projects, ...). The effort will be to increase the share of financial resources from international financial schemes. On the national level we want to remain the leader in experimental hydrological research, application of water isotopes, principal research organization for solution of pollutant transport in flowing water and in research of processes of water, energy and dissolved substances transport in soils. IH SAS management emphasis will be on solving APVV projects (Agentúra na Podporu Výskumu a Vývoja = Slovak Research and Development Agency) and engaging in the new calls of this agency. The goal of IH SAS is to achieve a state that every creative worker is also involved in the solution of the APVV project. A similar idea applies to participation in international projects.

Improving the quality of our instrumentation and infrastructure allows us to apply modern methods and methodologies, more efficiently collect and process data, which is one of the pillars of increasing the quality of outputs. Therefore, it will be necessary to actively seek resources for the sustainability or improvement of instrumentation - for example through EFDR projects.

IH SAS management will continue to support the publication of both journals (Journal of Hydrology and Hydromechanics, Acta Hydrologica Slovaca) as well as scientific monographs. However, publishing outputs in the WOS and SCOPUS database remains a priority activity of the scientific workers, as it is necessary to increase the level of publication outputs of the Institute, with an emphasis on the database indexed journal publications in the first decile or in Q1.

In the field of human resources management, attention should be paid to recruiting young researchers from the ranks of talented PhD graduates and motivating them to seek scholarships and grants to cover the beginning of their work at the Institute, as well as to increase the existing scientific staff qualifications. IH SAS management will continue to support exchange internships of employees, involvement of them in the international scientific and evaluation panels work or in the editorial boards of international scientific periodicals, as well as invite foreign experts and lecturers to the institute.

Within the realization of PhD studies, attention will be paid to its quality and the quality of applicants; not only to motivate their active involvement in scientific projects, but also in regular activities at the Institute, so that during their studies at the Institute they will be familiar with all aspects of work in a scientific organization. The emphasis will also be placed on increasing of their mobility.

IH SAS a scientific research institution, which provides a comprehensive research and education in the field of environmental science and water management in order to disseminate knowledge on the circulation and quality of water in nature. In the future, it will remain important to study the hydrological cycle in the natural environment. However, because the environment is changing, our research will have to respond to this fact. Strategy and objectives of the IH SAS research activities have to reflect the worldwide trends in hydrology and effectively contribute to the international hydrological research with new knowledge from our country and for our country, as well.

Topics of research will be related to the adaptation of society to climate change, especially in connection with the use of water resources and the landscape. In this context, it is the development of databases, approaches and methods contributing to analyses of changes in hydrological cycle and to mitigation of extreme hydrological events (floods, droughts) impact to society

The next topic of research will be related to the detection and mitigation of the effects of environmental pollution caused by human activities (including water and soil pollution by microplastics or other dangerous substances).

Due to the transformation of the Institute from a state institution to a public research institution, it will be necessary in the next five years to redirect part of its research capacity (while continuing basic research) to applied research with expected higher societal use of research results.

In this context, the field of hydrology of urbanized areas seems to be a very promising area of such research. In this research area, elements of basic research overlaps with elements of applied research and at the moment this area of research is very interesting and promising also due to the large number of initiatives and research directions (eg. EU Missions initiative "Adaptation to the climate change ", "Climate-neutral and smart cities", calls in the HEU programmes etc.) as well as practical initiatives of cities and municipalities in the Slovak Republic in the field of adaptation of cities to climate change. In addition, this area of research in the Slovak Republic is not sufficiently covered by specialized research institutes in the field of hydrology, respectively water management. The results of research activities in the area of urban hydrology can be used in the field of planning and concepts of urban drainage (territorial plans of regions, territorial and urban units, cities), design methodologies, methodological guidelines up to practical design of measures; all in the field of state administration and self-government, or in water management practice (owners and operators of urban water infrastructure, water companies).

Education of the public and popularization activities of IH SAS will continue in accordance with the message of the EU missions and also as part of the dimensions of the IH SAS mission mentioned in the introduction of this section of Questionnaire.