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## **METEOROLOGICAL AND HYDROLOGICAL EXTREMES IN THE DIETRICHSTEIN DOMAINS OF DOLNÍ KOUNICE AND MIKULOV BETWEEN 1650 AND 1849 ACCORDING TO OFFICIAL ECONOMIC RECORDS OF NATURAL DISASTERS**

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The paper shows the possibilities of obtaining data about hydrological and meteorological extremes from official economic evidence about natural disasters recorded at the level of domain, region and land management. It is a new source of information for creating the series of extremes before the beginning of systematic observations. The recording of this data was connected with the applications of the subjects for tax abatement due to damage caused by natural disasters or with the information of the domain managers to their owners about important events at the domain. Records about damage in the Dietrichstein domains of Dolní Kounice and Mikulov in southern Moravia between 1650 and 1849 are analysed. From them it is possible to obtain information about floods, convectional storms, strong winds, early and late frosts. Series of these extremes are presented, further completed by known sources from the area studied. An important increase in extremes took place after the 1760s, which must be related partly to a higher number of

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preserved records, including the increased bureaucratisation of the state management, partly to the increased climate variability in the final stage of the so-called Little Ice Age.

**Key words:** historical climatology, economic records about damage, floods, convective storms, strong winds, frosts, domains of Dolní Kounice and Mikulov

## INTRODUCTION

Meteorological and hydrological extremes caused in the past, the same as nowadays, losses of human lives and great material damage. The present process of global warming conditioned by anthropogenic intensification of the greenhouse effect calls for the reasonable fears that increased frequency and severity of extreme phenomena might accompany it (Houghton et al. 2001). For the study of the possible anthropogenic conditioning of meteorological and hydrological extremes it is, of course, necessary to use the longest possible observation series. In the case of systematic observations in the Czech Republic (further CR), they are limited in time by the establishment of the networks of meteorological and hydrological stations. With few exceptions their beginning falls into the latter half of the 19th century. These observation series can, however, be extended to the preceding period by means of the so-called documentary data, which contain direct and indirect information about the weather and related phenomena. The traditional sources of such data include above all chronicles, annals, memoirs, early visual weather observations, personal correspondence, occasional prints and newspapers, economic sources, etc. (Brázdil 2000, Brázdil and Kotyza 2002).

The most frequently used economic sources for historical climatology were continuous series of dates of the beginnings of vintage, from which were subsequently reconstructed air temperatures of the preceding period (e.g. Pejml 1974, Le Roy Ladurie and Baulant 1980, Burkhardt and Hense 1985, Pfister 1988b, Glaser 1991). More recently Souriau and Yiou (2001) used data about vintage for checking the reconstructed series of the so-called North Atlantic Oscillation (NAO). Data about the beginning of the harvest and the size of the harvest of cereals are used in a similar way (e.g. Pejml 1968, Stauffer and Lüthi 1975, Pfister 1979, 1988a, Fliri 1991, Tarand and Kuiv 1994). Brázdil and Kotyza (2000) on the basis of the book of accounts of the town of Louny, analysed wages paid regularly on Saturday for municipal work performed in the preceding week connected with the course of the weather (e.g. cutting ice at the mills on the Ohře, clearing snow in the town, haymaking, harvest) between 1450 and 1632. Then they used these data for the reconstruction of air temperatures. Analogously Nordli (2001) started from phenological data obtained from diaries of Norwegian farmers in the reconstruction of summer temperatures and their comparisons with instrumental observations in the 19th century. The series of spring and summer temperatures in western Norway compiled for the period 1734-2002 was then based, besides instrumental measurements, also on data about the beginning of harvest and about changes in terminal glacial moraines (Nordli et al. 2002).

Grove and Battagel (1983) used data from general tax commissions to characterise climatic impacts on the economy in the 17th and 18th centuries in the region of Sunnfjord in western Norway. A detailed analysis of records of 1667-

1723 with enormous numbers of petitions for tax abatement showed a deterioration of conditions for the economy as a result of the onset of glaciers, when higher situated farms were affected above all by landslides and avalanches, in lower positions by floods. García et al. (2003) on the basis of data about tax payments compiled series of wheat and barley yields in the Canary Isles in 1595-1836, which they then used for the reconstruction of precipitation.

From the above list it follows that in the CR, despite the variety of economic sources, only some types of information have so far been utilised from the climatological point of view. There is also a great potential of meteorological and hydrological data in official economic documents concerning damage due to natural disasters on individual domains. They are on the one hand reports of damage by the administrators of the domains to their owners, on the other hand the statements of the damage suffered in connection with the petitions for tax abatement. In the CR many such records have been preserved in archive collections, covering the period of the 17th to 20th centuries. Their study has so far had a rather random character (e.g. Matušíková 1996). Most recently the importance and possibilities of the climatological utilisation has been hinted at in the papers by Brázdil and Valášek (2003) and Brázdil et al. (2003c).

The present paper deals with the utilisation of official economic records of natural disasters for the analysis of meteorological and hydrological extremes from the mid-17th to the mid-19th centuries at two Dietrichstein domains in southern Moravia, at Dolní Kounice and Mikulov.

#### OFFICIAL ECONOMIC RECORDS AS A SOURCE OF INFORMATION ABOUT METEOROLOGICAL AND HYDROLOGICAL EXTREMES

Damage due to natural disasters, including meteorological and hydrological, was the reason for the abatement of the tax duty. It is thus a part of the written record connected with tax collection and preserved at different levels of the management of the domain, the region or the land. The actual procedure of tax collection was, however, different at different times. For example, in the 16th century the suzerain handed tax declaration documents (so-called "přiznávací berní listy"), in which the domain owner himself stated the subjects affected by fire or weather, by whose number he reduced the delivered sum of money (see e.g. MZA Brno, fond A 7 Přiznávací berní listy 1528-1623).

In the latter half of the 17th century the Moravian tax system was built on newly introduced hide taxation. The taxation concerned only the rustical (i.e. the land of the subjects), whereas the dominical (i.e. the land of the lords) was exempt from the tax duty. In the so-called First Moravian Land-Registry of 1655 it was already agreed that "who in the future will suffer damage due to fire or otherwise, shall, for the purpose of reduction of tax hides affected by the damage, report it to the regional administrator who will evaluate it with the neighbours", which concerned also natural disasters. Already 10 years later it was, however, decided to bring about its general revision and in 1675 a new registry was established, denoted as the so-called Second Moravian Land-Registry (Novotný 1934).

The mechanism of tax reductions was checked by the state management so that commissioners appointed by the regional administrator had to come to each

damage event to see the affected places with their own eyes and make a record of them. For the owner of the domain it meant a claim to bonification that he could assert as a reduction from the tax duty. However, the originally demonstrated damage was not always acknowledged. Thus, after a spate rain and a flash flood on 2 June 1710 in 8 villages of the domain of Pernštejn the damage stated by the reeves to winter and summer sowings were reduced by the commission to less than two-thirds (605 “měřices” 5 “achtls” – i.e. 133.2 ha). The acknowledged bonification concerned, however, only 382 “měřices” 7 “achtls” (i.e. 84.2 ha) of damaged fields and was figured out to 100 gulden and 45 kreuzer (Brázdil and Valášek 2003).

The tax system of the Second Moravian Land-Registry became the basis of tax determinations until the introduction of the so-called Land-Registry of Maria Theresa in 1760, on which work began during the reign of Maria Theresa as early as 1748. The Land-Registry of Maria Theresa represented a new list of holdings and all other revenues subject to land taxes and dues. On the basis of the list determination of the tax basis from the net profit of the serf homesteads started. For the first time a list of seigniorial land was also added for the reimbursement of general state expenses and the incomes of feudal lords from industrial undertaking, serf payments and manorial labours, including the possessions of the Church and the towns.

In a short time interval from 1 November 1789 until 1 May 1790 the Land-Registry of Joseph II was valid in Moravia. Its fundamental tax unit was the community. For taxation the dimensions of the individual pieces of land were newly determined. The main purpose of the whole reform was to abate the difference of taxation between the rustical and the dominical. After this period the Land-Registry of Maria Theresa was again valid, with the tax delivery of the suzerain and the serfs was adapted to a uniform amount. Taxes were raised according to it until 1 November 1820, when a tax provisional arrangement became valid in the whole of Moravia and continued until the introduction of the so-called Stable Land-Registry in 1851. In the case of the land tax this provisional tax arrangement linked up with a slightly adapted Land-Registry of Joseph II, with respect to the change in the landholders, the extent of land and the agricultural crops grown. The new evaluation of the yields also became the subject of taxation (Kocman et al. 1954).

The information obtained at the level of domain management can be confronted with data based on the summary processing of taxes within the land. The respective institutions were the regional offices and particularly the land book-keeping department, where the taxes were summarised and where also actual sums were directed. Unfortunately the materials from these institutions were preserved in Moravia only accidentally (regional offices) (Macek and Žáček 1958) or an extensive shredding of documents was performed (Kocman et al. 1954), so that actual data can be obtained only sporadically.

#### METEOROLOGICAL AND HYDROLOGICAL EXTREMES IN OFFICIAL ECONOMIC RECORDS OF NATURAL DISASTERS

As the earlier papers showed (Brázdil and Valášek 2003, Brázdil et al. 2003c), the official economic records concerning damage can be divided into two groups:

a) reports of damage for the reduction of the tax duty

It is information about damage due to natural disasters processed by village reeves, which contain the nominal list of damage for the individual serfs of the given communities. The list recorded in the reports of the damage commissions, whose task it was to revise the information obtained from the reeves is similarly detailed.

b) reports of damage to the domain owners

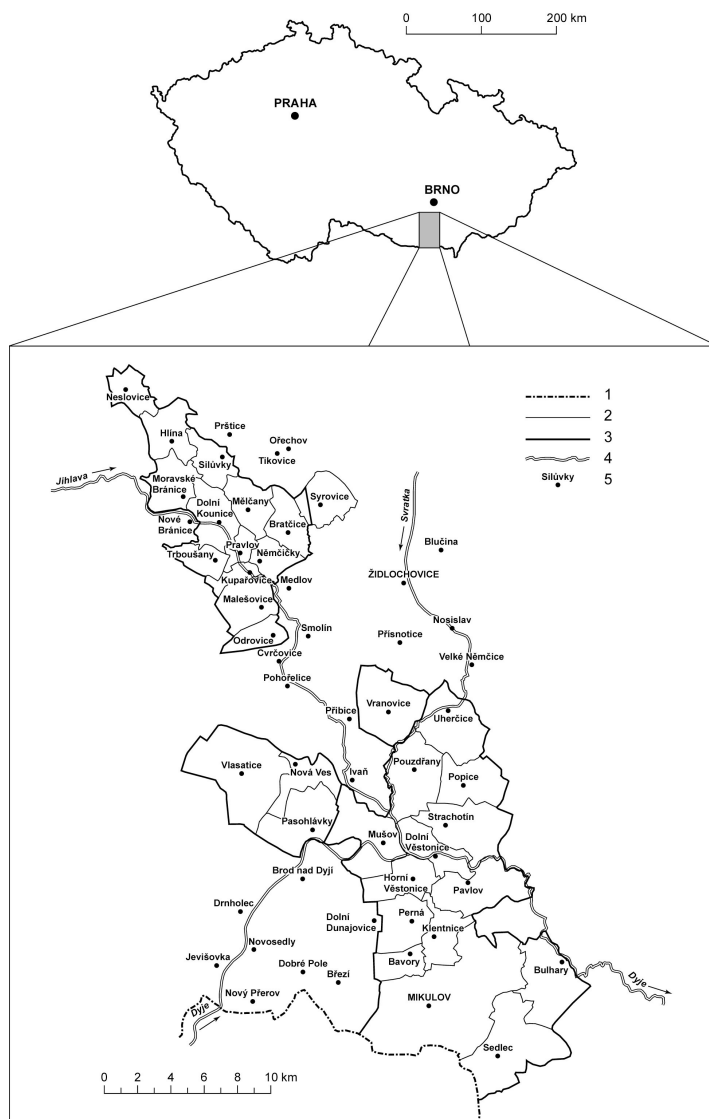
It concerns the reports of damage due to natural disasters, which the administrators of the economic management handed in to the domain owners. In some cases a rich correspondence was preserved between the domain, the central management of the domain and its owners about the damage to the suzerain property (e.g. water structures, suzerain farmsteads and mills), many times with the sigh of the administrator concerning the damage to the serfs. Sometimes the administrator could not yet determine the extent of damage (e.g. when the water from the flood had not yet fallen back). The central management of the estate usually appealed to handing in a more detailed report, so that in some cases even the second report of the same event is available with a detailed list of damage to the suzerain property.

## THE DOMAINS OF DOLNÍ KOUNICE AND MIKULOV

The two studied places were included by the Dietrichstein family in their holdings after 1575, when Adam of Dietrichstein settled in Moravia and chose Mikulov as his seat. However, his son František (1570-1636), a duke, cardinal and the supreme Moravian administrator became the founder of the family property and the most significant member of the Mikulov family branch. He collected under his direct management in Moravia the domains of Dolní Kounice (with the community of Vlasatice), Hranice, Lipník, Mikulov, Nové Město na Moravě and Žďár nad Sázavou, in Bohemia the domains of Horní Studenec, Polná and Přibyslav and in Lower Austria the domain of Steinbrunn with Eibesthal and Thiergarten (Voldán et al. 1964, Válka 1995).

The domain of Dolní Kounice with Vlasatice was in the Brno region and it belonged to the Dietrichsteins from the beginning of the Post-White Mountain period. It consisted of two units not neighbouring on each other's territories. The first of them, the Dolní Kounice domain proper, was situated in a broad and fertile valley on both banks of the river Jihlava, roughly between Ivančice and Pohořelice, the second part consisted of the farmstead of Vlasatice, south of Pohořelice. The domain included the villages of Bratčice, Dolní Kounice, Hlína, Kupařovice, Malešovice, Mělčany, Moravské Bránice, Němčíčky, Neslovice, Odřovice (part of a community), Pasohlávky, Pravlov, Silůvky, Syrovice (part of a community), Trboušany, Vlasatice (small town) and Vranovice (Fig. 1). At the beginning of the 18th century, the new community of Nová Ves was established in the domain, and it was further extended by the villages of Cvrčovice and Nové Bránice. The communities of Cvrčovice, Dolní Kounice, Kupařovice, Nové Bránice and Pravlov were directly on the river. The other settlements were situated further from the river at higher positions.

The domain of Mikulov situated further to the south-east included from the beginning the communities of Bavory, Horní Věstonice, Klentnice, Pavlov,



In the figure there are marked the streams of the rivers Jihlava, Svratka and Dyje (before the construction of the Nové Mlýny reservoirs) as well as communities of the surrounding domains quoted in connection with the reported meteorological and hydrological extremes. Explanations: 1 – state boundaries, 2 – community boundaries, 3 – domain boundaries, 4 – rivers, 5 – communi-

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[illegible]

Fig. 2. The expression of the Regional office in Brno of 30 June 1843 in the matter of examination of the consequences of the flood at Uherčice that took place in the night from 14 to 15 June, sent to the Economic office at Mikulov

The main Mikulov registry and partial archive units of the Dietrichstein farmsteads contain among other things also numerous written documents showing the effect of natural disasters (fires, floods, hailstorms, frosts, etc.) on the fluctuation of the economic life of the domains and on the everyday life of the inhabitants there. The archive material includes in the chapter “natural disas-

ters” in small part records of the damage commissions. In general they describe cases of damage to the suzerain property as well as losses to the serf land and houses. They also mention impacts on other communities, which are not part of the domain, but are situated in its immediate proximity. Mostly reports are available from the administrators of the economic management to the domain owner, the ruling duke from Dietrichstein to Vienna or the central office at Mikulov (Fig. 2).

No. 9575.

## Cirkular

## Cirkulár

Von dem k. k. mähr. Od Cíj. Král. Moravst.  
schles. Landesgubernum. Slezského Gubernum.

Vorschriften über die Grund-  
steuer (Kontributions)  
Nachlässe bei Elementar-  
Unfällen.

Předpisové z ohledu gruntov-  
nj daně (Kontribuce) po-  
pustění při nastalých živeln-  
ních nehodách (Elementar  
Unfälle.

Seine Majestät haben zur  
möglichsten Erleichterung der-  
jenigen Kontribuenten, wel-  
che durch Elementarunfälle in  
den Stand einer ganzen oder  
theilweisen Zahlungsunvermö-  
genheit versetzt werden, zu ge-  
statten geruhet, daß bis auf  
weitere Anordnung, Nachlässe  
an der Grundsteuer (Kontri-  
bution) nach folgenden Grund-  
sätzen gewährt werden dürfen:

Ersten s. Auf Steuer-  
nachlässe haben sowohl die Do-  
minikal: als auch die unter-  
thänigen Grundbesitzer in den

Sich Gasnost k neymo-  
žnému vlehčení onych  
Kontribuentů, kteříž škrze  
živelnj nehody do stavu  
celistvé neb gen podjlné  
nemožnosti k placení kon-  
trybuce postavení bývají,  
pozwolití ráčila: aby až  
na dálejší v tom zřelost,  
popustění na gruntovnj  
dani neb kontribuce se  
popřiti smělo: A syce

Předně. Na takové  
gruntovnj daně popustění  
gaf Dominikálnjch tak Pod-  
daných gruntů Majetnjcy,

Fig. 3. The title page of the printed circular No. 9575 of the Moravian-Silesian Gubernium of 23 April 1819 about the payment of the land tax in natural disasters

Above all the correspondence between the leading officials of the dominion and the state administration is voluminous. These documents form the most valuable part of this unit. They concerned payment of taxes, and therefore it is possible to find in them both the detailed description of every extraordinary event, and also the opinion of the invited official commission stating the exact extent of the damage and the height of the tax abatement. Similarly valuable is the part of official correspondence concerning the collection to those affected



by fires, floods, hailstorms and other disasters. The collected amounts did not concern only the surrounding Moravian domains, but they also yield partial data of natural disasters in Bohemia, Hungary and the Austrian provinces. The great interest of the state administration about the given problems is also documented by the enclosed printed circulars and decrees exactly stating the procedure for granting tax abatement. An example can be the regulation about the payment of the land tax during natural disasters, published as a circular of the Moravian-Silesian Gubernium of 23 April 1819 (Fig. 3).

#### METEOROLOGICAL AND HYDROLOGICAL EXTREMES ON THE DOMAINS OF DOLNÍ KOUNICE AND MIKULOV BETWEEN THE YEARS 1650 AND 1849

In the further text individual meteorological and hydrological extremes found on the domains of Dolní Kounice and Mikulov are analysed. They are divided into floods, convectional storms, extremely strong winds and frosts. When no source is mentioned for the given event, they are data excerpted from the sources of the Moravian Land Archives in Brno (MZA Brno, fond F 18, inv. č. 7840, karton 1296; MZA Brno, fond F 72, inv. č. 1683, karton 390; MZA Brno, fond F 119, inv. č. 537, kartony 537, 538). The conversions of the units of that time are made according to Moravian and from 1758 according to Viennese measures (see Chvojka and Skála 1982, Hofmann 1984).

#### Floods

From the point of view of flood regime the rivers Jihlava, Svratka and Dyje affected the territories of the two domains. Markedly meandering rivers (Fig. 4), they not only often flooded their floodplains with floodplain forests, meadows, pastures and fields, but frequently threatened the protective dams, bridges, mills, human dwellings and farm. In the prevalent majority of cases they were spring floods connected with sudden warming after a hard winter, accompanied by the movement of ice, melting of the snow cover and/or precipitation. Another type was floods from heavy rains.

The first report of great damage due to the movement of ice and a flood on the river Jihlava dates back to 4 March 1677 at Pravlov. At Dolní Kounice this flood damaged a mill and at Vlasatice the ponds were ruptured. Another high water affected Pravlov in the spring of 1679. The report about the flooding of an unspecified farmstead near Pohorelice before 20 February 1689 is relatively vague. Another destructive flood raged on the two domains studied after a sudden snow melting accompanied by rain on 24-26 March 1698. In the Dolní Kounice region 103 houses were demolished (stated without the specification of communities) and a bridge was pulled down at Pravlov. In the Mikulov region Mušov was particularly badly affected. Six houses were demolished and another 9 were heavily damaged and 10 were drenched.

After an extremely hard winter of 1708/09 (see e.g. Lenke 1964, Pfister 1988a) the movement of ice with damage to bridges and dams, carried away fuel lumber and damage due to emptying of ponds were mentioned before 3 April 1709 at the Mikulov domain. The communities of Dolní Věstonice, Mušov and Strachotín, as well as Laa an der Thaya in Austria, were isolated by

water. As was, however, stated further in the report, “the waters of the Dyje and the Svratka are falling every hour”.



Fig. 4. The studied region of the domains of Dolní Kounice and Mikulov in Müller's map of the Brno region, published by J. B. Homann at Nürnberg (Marchionatus Moraviae Circulus 1720)

The Dyje was in flood again after downpours before 28 May 1713. The road between Mušov and Dolní Věstonice was impassable and communities on the domain of Drnholec were also cut off by water. The flooding of many meadows ended the hopes of a good hay harvest. Evidently this concerned the second flood of that year, because the report says that during the preceding flooding of the meadows the grass was still small and recovered, but now it would remain covered with mud. Similar damage was to occur also around Znojmo, where the grain was flooded with water and knocked down by a hailstorm. During another flood on 12-14 February 1715, 26 houses were completely destroyed at Pravlov,

9 houses were three-quarters destroyed and 25 were half destroyed. The damage was 8661 gulden and 40 kreuzer.

On 22 June 1734 the rivers Jihlava, Svratka and Dyje were in flood. Meadows and fields were flooded at Kupařovice, Malešovice, Němčičky, Odrovice, Pasohlávky, Pravlov and Vranovice. The figured damage reached the value of 3735 gulden.

The district administrator estimated the damage during the flood on 16 January 1749 at 1000 gulden. After rain lasting whole day and the snow melting the flood damaged the mill at Dolní Kounice, demolished houses and flooded fields at Kupařovice.

Kupařovice was under water again on 10 March 1751. The movement of ice on the Jihlava this time left damage only to the two mills of Dolní Kounice. An analogous situation was also repeated on 14 February 1753, but with greater damage. At Němčičky several houses were demolished and in the lord's farmstead the steward and his family saved their life in the garret, while the livestock stood in the cowshed in water. In the flooded Kupařovice only a few houses remained undamaged.

On 22 February 1761 high water on the Jihlava came suddenly from the snow melting and flooded only a part of the fields through the ruptured dam near Smolín. In the following year, on 16 February ice was lifted on this river and the following day there came a flood from melted snow, so that the whole valley was flooded. Especially Kupařovice and Němčičky were endangered, major floods occurred near Cvrčovice and the weir near Smolín was damaged. Another flood on 24 February 1767 follows from the hint in the report about the flood two years later. In between, another flood raged around Dolní Kounice on 25 February 1768, connected with the movement of ice. Damage was caused to mills at Dolní Kounice and Kupařovice, above Pravlov a dam was ruptured, at Němčičky the sovereign farmstead was flooded and near Cvrčovice the weirs were damaged. Two days later, at 0300 hours an earthquake was recorded in the whole surroundings, documented also in a number of places in the Czech Lands. It did not cause any damage on the two domains. Before 27 August 1768, fields and meadows were flooded and the aftermath was destroyed at Bulhary, Dolní Věstonice, Mušov, Pavlov, Pouzdřany, Strachotín and Uherčice. The administrator of Dolní Kounice considered in his report the flood that came after 17 December 1769 a peculiarity. After rains ice of the thickness of one-quarter ell (i.e. about 19 cm) on the Jihlava broke to pieces, forming an ice barrier which caused the rise in water and a flood, but only with minor damage.

A great flood affected the two domains on 15-20 March 1771. During the ice movement and the subsequent flood the communities of Pravlov, Kupařovice, part of Němčičky (4 demolished houses) and adjacent fields were flooded. Further damage was demonstrated to the mill of Dolní Kounice, ice guards of the bridge and the dam near Pravlov. At Mušov 71 peasants were affected by floods, while 9 houses, 10 barns and 76 "sáhs" (i.e. about 144 m) of a wall, were destroyed or damaged, as were 98 "měřices" and 3 "achtls" (i.e. about 18.9 ha) of cereals after sowing. In the flooded Sedlec all houses built of clay brick (i.e. of unburned brick) fell down or had to be pulled down. The region between Mušov and Dolní Věstonice was under water, the road to Strachotín

was completely destroyed, one had to rescue livestock from flooded cowsheds, and the mills of Mušov and Věstonice were covered with mud. For the removal of damage the corvée duties were increased. As is stated in the report, nobody remembered such a great flood. The years 1770-1771 generally were very wet in the Czech Lands, when due to frequent precipitation in many places the fields and meadows were soaked with water and there were landslides (Brázdil et al. 2001). Similarly also in southern Moravia due to wet weather before 22 October 1771 the stream of the Svratka was blocked by a landslide between Nosislav and Židlochovice, and the adjacent surroundings were under water. On 14 April 1772 a petition was handed for the remission of taxes for Jakub Schulz of Pavlov, whose house collapsed due to extremely wet weather.

Another destructive flood followed the sudden thaw on 3-5 February 1775. At Dolní Kounice a bridge, the mill and 80 houses were damaged, at Pravlov many houses with barns, at Němčičky the houses were either damaged or collapsed and cows stood for two days in the water up to their bellies. A part of Malešovice was completely ruined and also Cvrčovice with surrounding meadows was under water. Near Mušov 200 sheep drowned. In the flooded community itself people were rescued by boat and in the report of 9 February it is written that the flood was still continuing. Dolní Věstonice was also under water. On 12 February, according to Kratochvíl (1904) a weir at Dolní Kounice was reported to be pulled down by high water. On 18 February the expected second wave of floods came, which, however, did not increase the damage. Around Dolní Kounice the above mentioned communities were again affected.

After the movement of ice on 13-14 February 1776 an ice barrier was formed at the Pravlov bridge and in the community itself the water flooded 50 houses, 10 barns and 15 gardens, in which all the fruit trees were damaged. Pravlov is also mentioned in a report of 17 June about damage to houses due to the flood, in which 21 neighbours suffered great privation and asked for tax abatement. From the report it is not clear, whether it concerned the February event. A similar situation to that in February was repeated in the same year on 22-23 December, when ice accumulated near Němčičky and Kupařovice. Mills at Dolní Kounice and Kupařovice were flooded, the dam near Pravlov was damaged, the wall at the lord's farmstead was pulled down and meadows at Němčičky were flooded. At the beginning of March 1777 ice floes accumulated at the Pravlov bridge and the water that broke the dams flooded the meadows, the same as in the surroundings of Němčičky. The weir at Smolín was damaged.

On 9 March 1780 Mušov was affected by flood, and damage to the buildings of 25 peasants was documented. Consequently this list was limited to only 8 persons, in the remaining 17 it was stated that the water did not damage houses, but only carried away the plaster and in the barns it damaged the corners built of clay brick.

The spread of the waters of the rivers Dyje, Jihlava and Svratka at the end of May 1783 meant for the communities at the Mikulov domain the end of hopes of a good haymaking. The flood on 28 February 1784 was connected with the thaw and the movement of ice after the hard winter of 1783/84 (see Brázdil et al. 2003b). The ice accumulated first at the bridge of Pravlov which was damaged the same as the bridge at Dolní Kounice. The Jihlava was in flood in the

night from 29 February to 1 March, and then so was the Dyje. The sovereign farmstead at Němčíčky was cut off by water. Mušov was also under water, including the road. Buildings, barns, farm objects, bridges and dams were damaged. From Věstonice to Strachotín one single lake was formed. It is further stated that at the Mikulov domain the flooded waters did not do any further damage to the lord's property after the movement of ice, even though water went across dams and bridges.

In the spring of 1785 a rise in the water level of the Jihlava was observed on 17 April. The flood affected the mill at Dolní Kounice, near Kupařovice the banks were heavily eroded, the bridge and weir damaged the same as the stone weir near Cvrčovice, the mill race and the dams of the ponds at Vlasatice. On the Mikulov domain the report of 22 April states that after the snow melting in forests and valleys three small ponds overflowed, although the sluices were lifted for 6 days and the water let out. After the downpours before 27 August 1786 and the probable flooding of the rivers the meadows of the serfs were under water at Bulhary, Dolní Věstonice, Mušov, Pavlov, Pouzdřany, Strachotín and Uherčice.

Adverse weather affected the Mikulov region on 20 July–3 August 1793. After the heats lasting several days, a thunderstorm with heavy rain came in the evening of 20 July. The subsequent heavy rains lasting three days and three nights caused the spread of the rivers and the flooding of meadows, and soaked the grain in the fields. Another strong thunderstorm with downpours came on 27 July and again on 1-2 August. As stated in the report, the downpours still continued (i.e. up to 3 August). Meadows were flooded, roads became impassable and people lost the hope of a good harvest. In the report of 7 September, in connection with the communities of Dolní Věstonice, Mušov, Pavlov, Pouzdřany, Strachotín and Uherčice it is stated that due to flooded meadows there would be no aftermath.

On 2-3 March 1799 the river Jihlava was in flood and broke the bank near the bridge of Pravlov. Near Vlasatice the mill race and the pond dams were damaged. Another water spate came a month later, on 8-12 April. The water level exceeded, according to the memorial plaque on the mill at Dolní Kounice, the flood of 1771 by 6 inches (i.e. by about 16 cm). The monastery there stood 6 feet (i.e. about 190 cm) in water and some people had to leave their homes. Near Kupařovice meadows were flooded due to a ruptured dam. The water cut off the mill near Medlov.

The snow melting was the cause of the flood of 2 April 1800. That caused damage to water structures (Cvrčovice, Dolní Kounice, Kupařovice, Malešovice, Pravlov) and flooded the meadows, covering them with mud (e.g. Němčíčky). On the following day the flood was mentioned in the area between Mušov and Dolní Věstonice, where the water reached 2 feet (i.e. about 63 cm) higher than in 1799. In the two communities several serf houses and stables were flooded, and houses built of clay brick collapsed in many places. On 1 January 1804, on the river Jihlava between Dolní Kounice and Pravlov ice accumulated and the water flooded houses near the river. In the preserved reports of the domain officers the information about the flood of 21 February 1806, mentioned for Dolní Kounice by Kratochvíl (1904) is missing.

On 2 March 1810 the flood ruptured the protective dam near Kupařovice and flooded the forest and the surrounding meadows. The water could not flow away, because the protective dam held it from the other side. After the serfs dug through the dam without a permit, the water retreated. At Cvrčovice the same water damaged the weirs and the mill race. At Dolní Kounice part of the ground near the mill was carried away. In the region of Mikulov the weir between Dolní Věstonice and Strachotín suffered minor damage, and in some places river banks were soaked, but only on 4 April. At Malešovice damage due to the spread of water to meadows and pastures on 13 August of the same year was estimated at 4000-5000 gulden.

The damage mentioned on the domain of Dolní Kounice before 8 June 1812, was evidently also connected with the flood. According to the report of the commissioner 196 wagon loads of hay were destroyed in the meadows. Kratochvíl (1904) mentions a flood that brought a lot of lumber only to 10 July of the same year. Before 22 July 1816 after rains lasting several days and floods on the rivers Jihlava, Svatka and Dyje, damage was reported to field crops at Pouzdřany, Strachotín and Popice, the same as to meadows near those rivers. Downpours on 31 July-2 August 1817 were the cause of the flood on the Jihlava, which flooded the gardens at Medlov and a great part of meadows at Němčice. Damage to grain and gardens was intensified by hail which reached the size of one-half of a hen egg in the surrounding of Mělčany. Similarly the flooding of the suzerain and serf meadows is described in the Mikulov region. In this connection a petition was handed to the Brno regional office, referring to the unfinished water structure on the Dyje in the Lednice domain, when due to rising waters there are floods at Dolní Věstonice, Strachotín and Pavlov. Spates of water after sudden snow melting in the Bohemian-Moravian Highlands before 18 January 1818 caused the rupture of the dam on the Jihlava near Kupařovice. At that time only one house was saved. Also Pravlov, the suzerain farmstead at Němčičky and the suzerain meadows were flooded.

Another flood arrived at Dolní Kounice shortly before 23 May 1820. According to Kratochvíl (1904) it destroyed 108 houses and the bridge. On the Mikulov domain this event was mentioned after the downpours on 21-22 and 24 May, when the rivers flooded meadows and floodplain forests. Game and pheasant nests with eggs were afflicted. The list of afflicted communities includes Bulhary, Dolní Věstonice, Mušov, Pavlov, Pouzdřany, Strachotín and Uherčice. A similar situation was repeated after the rains before 17 August 1821, when in the preceding list of affected communities includes Horní Věstonice instead of Bulhary and Dolní Věstonice. A document from the regional office in Brno of 4 December 1824 includes a note of flooded plots at Pavlov, so that no yield is expected from them. But a detailed specification of the event is not evident.

After the March flooding of the rivers Jihlava, Svatka and Dyje in 1826, they flooded repeatedly in May and June of the same year due to rains lasting several days. Fields, gardens, meadows and pastures were under water at Bulhary, Dolní Věstonice (the community was flooded for the fourth time, 267 serfs suffered damage), Pavlov (flooded 3 times, on 5 May, 3 and 24 June), Pouzdřany (three times the Svatka in flood), Strachotín and Uherčice (97

serfs). Floods in the above communities afflicted altogether 1594 acres 802 5/6 square "sáhs" (i.e. about 917.6 ha) of agriculturally utilised areas. Before 25 June 1827 after rainy weather the rivers Dyje, Jihlava and Svratka were in flood and their waters flooded meadows, forests, pastures, destroyed hay and covered the aftermath with mud. The affected communities included Bulhary, Dolní Věstonice, Mušov, Pavlov, Pouzdřany, Strachotín and Uherčice. About mid-January 1828 the flood affected above all Kupařovice. The description of this event was brought even in the press of the time (see *Brünner Zeitung* of 24 March 1828). In June 1829 the floods caused damage to the dominical and rustic in the same communities as in 1827. On 5 October 1829 the Dyje in flood caused damage to the aftermath on the Drnholec domain (Brod nad Dyjí, Dobré Pole, Dolní Dunajovice, Drnholec, Jevišovka, Novosedly, Nový Přerov).

Before 6 April 1830 the Dyje at Pavlov flooded. The flooding of communities and meadows was caused by the flood on the Dyje and the Jihlava on 11-12 June of the same year (stated communities Dolní Věstonice, Mušov and Strachotín). It is not quite evident which of the two floods is drawn attention to in the communication of the regional office to the manager at Dolní Kounice of 7 August 1830. A short spread of the waters of the Dyje and the Svratka before 18 August 1831 meant the destruction of aftermath for the peasants of Buhary, Dolní Věstonice, Mušov, Pavlov, Pouzdřany, Strachotín and Uherčice. On 1 March 1833 a flood started on the river Jihlava at Pravlov and caused great damage to houses, farm buildings, gardens and meadows. Before 9 June 1834 the Dyje in flood spread and covered with mud meadows and pastures near Nový Přerov on the Drnholec domain. Considerable damage was caused by the flood of 26-29 December 1837. The report speaks of damage to the mills of Dolní Kounice and Medlov, the ponds at Vlasatice, demolished houses at Němčičky and Pohořelice, and flooding at Kupařovice and Pravlov, where the parson asked the administrator at Dolní Kounice for help in removing the ice floes remaining on the ground after the flood. Pravlov suffered again by the movement of ice and high water of the Jihlava on 7-10 March 1838, when 40 houses collapsed in the community and another 30 were half damaged. Another source says that hardly one-sixth of the 115 houses and farm buildings remained undamaged. In this event the inhabitants of Pravlov complained that the community had been affected by water already in the years 1828, 1830 and 1832. The regional office in Brno proclaimed a collection to help the affected. For the work of releasing ice at the Mušov bridge during the March flood wages were paid to three men. Before 20 June 1838 the waters of the Svratka flooded meadows near Dolní Věstonice, Mušov, Pouzdřany, Strachotín and Uherčice and gave a check to good haymaking.

Damage to the domain of Dolní Kounice was also recorded in the winter of 1839/40. First, due to the movement of ice at the end of 1839 parts of the weirs at Dolní Kounice and Medlov were carried away and then, on 22 January 1840 another movement of ice damaged the bridge at Pravlov. Further damage around the river was perceptible at Kupařovice and Vlasatice. On the other hand, the movement of ice did not cause damage to weirs and the bridge at Vranovice. On 20 March 1842 the administrator of the domain of Dolní Kounice reported that the movement of ice this time did not cause damage to mills, weirs, dams and bridges. Repeated flooding of water occurred after in-

tense rains in 1843. Thus, the waters of the Svratka flooded meadows at Uherčice in the night from 14 to 15 June. At Dolní Věstonice, Mušov and Pouzdřany meadows were flooded and grass covered with mud due to the spread of the waters of the rivers Dyje, Jihlava and Svratka on 27 June, while “the flood still persists”. Near Pavlov and Strachotín meadows and pastures were flooded on 12-15 July and the flood there was larger than that in spring. Another report speaks of floods at Strachotín already before 3 July. In May 1844 the spread of waters of the rivers Dyje, Jihlava and Svratka caused above all the flooding of meadows and loss of hopes of a good hay harvest. Besides the communities on the Mikulov domain (Dolní Věstonice, Mušov, Pavlov, Perná, Pouzdřany, Strachotín, Uherčice) also 5 communities of the Židlochovice domain are mentioned (Blučina, Ivaň, Přibice, Přisnotice, Velké Němčice). On 25-28 March 1845 the Jihlava in flood carried away the bridge at Pravlov, and, besides this community, it also flooded Kupařovice, Neslovice, Vlasatice and Nová Ves. A source from Pouzdřany documents a great flood on 24 March (Polický 1936). However, the most severe affected was Mušov, where with the exception of the school, the council house, the parsonage and the hunters’ lodge all houses were under water on 29-30 March. The situation was complicated by a windstorm, which drove the waves of the high water to the houses. At the time of handing the report already one-quarter of the 84 numbers had been demolished and it was not clear how many more would still collapse (to the event at Mušov see also the daily Moravia of 8 April 1845).

### Convectional storms

A convectional storm represents a set of atmospheric phenomena generated by the convection accompanying the rise of the thunderstorm cloud (cumulonimbus), that is, mostly a thunderstorm (lightning), precipitation (downpours or hails) and short-time intensified wind (such as tornado, downburst, squall) (Šálek et al. 2002). Intense downpours can cause destructive flash floods or floods. These extreme weather events could cause direct damage to property (strikes of lightning) or in a short time the whole harvest of field crops in the area affected might be damaged or destroyed. Considerable damage could also be caused to vineyards, because the production of wine in the southern Moravian region has always been one of the most significant activities. For the two domains, belonging thanks to soils of highest quality to places with extensive agricultural production, losses due to the above phenomena could be very sensitive.

On 1 May 1658 Pavlov was affected by a hailstorm. Before 15 July of the same year the vineyards at Mělníky were damaged. Mělníky was affected by hail again on 15 July of the following year. Before 15 September 1659 damage is mentioned due to wind and water (evidently by a downpour and a hailstorm) at Hlína, Moravské Bránice and Silůvky. It is not excluded that it concerns the same event as at Mělníky.

The vineyards of Mušov and Pouzdřany were heavily damaged by a hailstorm on 21 July 1664.

On 25 July 1677 a cloudburst caused great damage to houses, vineyards and fields of grain at Hlína, Mělníky, Moravské Bránice and Silůvky. At Mělníky



streams of running water pulled down 16 houses. The afflicted house owners asked the suzerain for help in the form of lumber for building the demolished homes.

At Mikulov lightning during a thunderstorm on 22 May 1688 set a house on fire and 52 buildings burned out (Vaňáček 1968). On 4 June of the same year a hailstorm affected Odrovice and Vlasatice, where it knocked down 380 “měřices” 7 “achtls” (i.e. 83.8 ha) and/or 726 “měřices” 3 “achtls” (i.e. 159.8 ha) of the fields.

In the night from 11 to 12 August 1691 in the Mikulov region a two-hour thunderstorm with a gale raged. At Mikulov itself roofs were carried away, windows in the castle and the wind mill were damaged. Trees in gardens and forests were uprooted. At Bulhary half a roof of the sheep-cote was pulled down. At Sedlec, the specification of damage due to the hailstorm states: 735 buckets of wine (i.e. about 416 hl), 77 “měřices” of wheat (i.e. about 16.9 ha), 363 “měřices” of rye (i.e. about 79.9 ha), 70 “měřices” of barley (i.e. 15.4 ha) and 569 “měřices” of oats (i.e. 125.2 ha), but also injury to livestock. Damage amounting to 4871 gulden and 26 kreuzer was required by a cloudburst, which on 30 August 1692, afflicted the community of Bratčice (15 damaged peasants), Hlína (16), Kupařovice (19), Mělčany (31), Moravské Bránice (36), Němčičky (28), Syrovice (8) and Trboušany (26). On 12 May 1693 a cloudburst with a subsequent flood came to the domain of Mikulov. Besides the damage to mills, of which those of Věstonice, Mušov and Uherčice “will be unable to grind for 8 weeks”, meadows were flooded and winter crops destroyed in the fields. Further damage was caused by a thunderstorm with a downpour and a flood on 19 May of the same year at Bulhary, Klentnice and Mikulov. Liedermann (1873) mentions the hit of a lightning in 1696 at Mikulov, probably to the church spire at Sv. kopeček Hill.

On 15 May 1712 vineyards and fields with grain were hit by a hailstorm and a downpour at Klentnice, Pavlov, Perná and at the Drnholec domain. The hails reached the size of hens’ eggs. According to the report of 15 August 1718 the manor house at Dolní Kounice was hit six times by lightning and at Odrovice the wind carried away the mown spring corn.

On 30 May 1727 damage is mentioned due to “horrible weather” to the serfs at Hlína, Moravské Bránice, Neslovice and Trboušany. No doubt it was also a hailstorm in this case.

On 16-17 August 1736 a thunderstorm with a hailstorm caused damage at Bavory, Dolní Věstonice and Pavlov, in which three-quarters of the 119 “měřices” 5 “achtls” of summer crops (i.e. 26.3 ha) were destroyed and in the case of vineyards completely 20 “čtvrťces” 2 “achtls” (i.e. 0.6 ha), three-quarters of 13 “čtvrťces” 1 “achtl” (i.e. 0.4 ha) and a half of 98 “čtvrťces” 2.5 “achtls” and 100 “měřices” 1 “achtl” (i.e. altogether 24.8 ha).

On 13 August 1741 the domain of Dolní Kounice was afflicted by a downpour with a hailstorm that knocked the grain and completely destroyed the vineyards at Kupařovice and Trboušany. This hailstorm is also mentioned in the chronicle of the Hodonín burgess Jakub Klein and the list of affected communities also includes Popice and Pouzdřany (Treixler 1932). On 17 July 1748 the reeve of Pavlov writes to the duke at Mikulov about the spates of water by

which half of the field crops and the fodder for livestock were destroyed. In July of the same year damage due to weather to houses and fields at Pasohlávky is spoken about. Probably it was a spate rain with damage due to running water.

On 5 June 1753 a hailstorm knocked the grain and vineyards in the surroundings of Dolní Kounice, Kupařovice, Malešovice, Pravlov and Trboušany. A downpour with a hailstorm also raged on 24 July 1756 in the surroundings of Vlasatice and Nová Ves. As stated in the report, fields with grains changed into desert, vineyards were heavily damaged as well as ponds in the surroundings due to spates of water.

On 22 June 1760 in the afternoon during a thunderstorm at Cvrčovice a lightning struck and two houses burned out. In the field near Smolín a lightning killed a man. A heavy downpour in 1761 at Pavlov is mentioned in the report of 29 December, according to which the running water exceeded the height of an adult man. Eleven houses were in danger, a stable was demolished and the water caused great damage to field crops. As follows from another report, the water also carried a stream of mud and stones, which directly endangered three houses. Some gardens fell down; the water also eroded deep ditches and damaged the community road that wagons could not go on it. On 4 July 1767 a lightning struck and set afire the church at Sv. kopeček Hill near Mikulov (Liedermann 1873).

An extraordinary downpour and the subsequent flash flood afflicted Neslovce on 14 May 1770. In some houses the water reached quite high and the report speaks about great damage. A stream of water also carried away eight wagons from the Drnholec domain which had been there to buy lumber.

On 6 September 1771 during a heavy thunderstorm the lightning struck six times in the surroundings of Dolní Kounice. During the last strike the house of the local butcher started burning, but fortunately the heavy rain extinguished the fire. Kratochvíl (1904) mentions in the same place a thunderstorm and fire already for 1 September.

At Moravské Bránice a hailstorm of 29 June 1772 caused much damage to the fields and the vineyards. A gale connected with it carried away roofs of the wine vaults; it destroyed walls and uprooted trees.

On 16 June 1774 a cloudburst destroyed grass and hay in the meadows at Cvrčovice and in the surroundings. In the same place in the evening on 20 June a lightning set afire to a house, but the downpour extinguished it. On the following day, 21 June, the flooding of fields after a downpour at Cvrčovice, Medlov and Odrovice caused damage. On 4 July 1775 a lightning during a thunderstorm set fire to a house at Nová Ves. At Bavory on 22 July 1776 vineyards, fruit trees, vegetables, wheat and further summer crops were knocked by hail. At the near Klentnice the hailstorm knocked completely everything, whereas at Sedlec only "some damage" is mentioned. On 1 July 1777 12 houses with stables burned from the lightning at Pasohlávky. Fortunately the wind was not too strong, so that the fire did not spread further.

Three years later, on 12 May 1780, a hailstorm destroyed grain on suzerain fields at Cvrčovice. On 30 June 1781 the regional office in Brno refused to grant tax abatement to Uherčice for the stated damage to vineyards and rye due to the hailstorm and water. At Mikulov, on 28 May 1784, during a heavy thun-

derstorm with a downpour lasting from 1230 to 1900 hours, deep grooves were eroded, in places fields were covered with mud, a water canal was damaged, and so on. Damage to the suzerain property was not so significant. The same event may have been meant in the communities of Březí and Brod nad Dyjí on the domain of Drnholec, where damage is mentioned due to water spates to field crops and vineyards. On 13 May 1786 the region of Dolní Kounice was afflicted by a destructive hailstorm with a gale. The grain and vineyards were knocked down, roofs carried away, trees broken and uprooted. At Dolní Kounice many windows of the manor house were broken. Among further damaged communities Moravské Bránice, Nové Bránice, Mělčany and Silůvky are mentioned. Some people were also injured by the hailstorm at Prštice, Tikovice and Ořechov.

Vineyards at Dolní Kounice were half or completely destroyed by a hailstorm in the night from 25 to 26 May 1796. Mělčany, Syrovice and somewhat less Bratčice were also afflicted. In the night from 19 to 20 August 1797 lightning struck the roof of the mill at Mušov during a thunderstorm, thus causing much damage. On 18 June 1798 lightning set fire to a house and killed one person at Dolní Věstonice. Weak rain did not prevent the fire, although everywhere else there was heavy rain. In the afternoon of 6 July of the same year much damage was caused to vineyards and summer crops at Sedlec by a hailstorm, a downpour and mainly by running water.

On 7 August 1800 three houses and a barn burned at Vlasatice, after being struck by lightning. Intense rain prevented further spreading of the fire. At Bavory there was such a hailstorm in 1804 that pieces of ice killed young lambs (Drössler 1933a). Before 3 May 1808 a spate rain afflicted Nové Bránice and did great damage to fields. On 14 August 1809 a cloudburst was recorded at Mělčany which caused damage to 42 peasants in gardens, vineyards, fields and meadows.

A terrible weather, probably with a hailstorm at Mělčany and Němčičky is mentioned in the afternoon of 15 May 1811. Whereas the damage to suzerain farmsteads was 30 and 20 “měřice”, respectively, (i.e. 5.8 and 3.8 ha, respectively), the subjects suffered more. In 1812, without specified date, a hailstorm is mentioned at Silůvky (Kratochvíl 1904). Before 13 July 1814, damage due to weather (“Wetterschaden”), probably connected with a thunderstorm was reported on the domain of Dolní Kounice. On 30 July of the same year a hailstorm caused damage to suzerain farmsteads at Dolní Kounice and Mělčany. Vineyards were particularly damaged. At the manor houses at Dolní Kounice and Kupařovice hails broke windows. The manor house at Prštice was also struck by lightning, but it did not set the building on fire. On 22 July 1815 a heavy thunderstorm with a cloudburst and a hailstorm arrived and it lasted from 7 p.m. until midnight. Damage to houses and field crops was caused at Bavory, Bulhary, Dolní Věstonice, Horní Věstonice, Klentnice, Mikulov, Pavlov and Sedlec. The duke road was damaged and losses were mentioned in fish farming (rupture and overflowing of ponds). In 1816 a great part of the harvest was destroyed by a hailstorm at Vlasatice. Particularly intense was the hailstorm on 5 July 1817 in the region of Mikulov, which caused damage particularly at the foot of the Pavlovské vrchy Hills between Mikulov and Pavlov. Most afflicted was Klentnice, where nothing at all remained from the vineyards and only one-

third of the fruit and field crops. At the castle of Mikulov 144 window panes were damaged and in 87 of them the glass was broken. Damage due to the hailstorm was recorded in belts also at Bavory, Dolní Věstonice, Horní Věstonice, Mušov, Popice, Pouzdřany, Strachotín and Uherčice. On 17 July 1818 the hailstorm knocked down one-half of vineyards between the duke lane and Sv. kopeček Hill near Mikulov. The hail lay one foot high (i.e. about 32 cm).

A thunderstorm, a hailstorm and a stormy wind caused damage to fields and vineyards on 2 May 1821 at the communities of Popice and Pouzdřany. In the afternoon on 24 June 1822 lightning set fire to a barn at Malešovice. Due to a strong wind the fire spread to further buildings and altogether 15 houses and 7 barns burned out. A flash flood, during which houses at Bratčice were damaged, was recorded on 6 August 1823. In the evening of 23 June 1828 two men were killed by lightning at Bavory while ringing the bells against the thunderstorm (Drössler 1933b). In the summer of the same year a hailstorm is also mentioned there (Drössler 1933a).

On 2 May 1830 a thunderstorm and a hailstorm afflicted Strachotín with damage to grains. In the afternoon on 19 May 1833 a thunderstorm, a hailstorm, a downpour and a gale caused great damage to fields at Pouzdřany and between Strachotín and Popice, where, according to the report, "it will be impossible to cultivate the fields in the future".

On 10 and 12 June 1840, after a hailstorm and downpours, meadows around the ponds were flooded, particularly near Vlasatice. A similar situation was repeated there after a thunderstorm and a downpour on 6 June 1844. In the evening on 31 May 1842 a hailstorm, a cloudburst and spates of waters destroyed vineyards and heavily damaged gardens, meadows and pastures at Klentnice, Pavlov and Perná. In the report of Pavlov it is even stated that meadows, fields and pastures were so much covered with mud by running water that it would be impossible to cultivate them in the next and in the following years. In 1843 Neslovice suffered from a hailstorm (Kratochvíl 1904). On 4 June 1844 damage due to downpours is mentioned to field crops at Perná.

### Strong winds

Some information about strong winds has already been mentioned in connection with convectional storms, and thus their list is somewhat limited.

On 15 August 1762 a gale caused damage at Bulhary and Pouzdřany.

In the evening on 13 March 1773 a fire broke out at Mělčany. Fortunately a strong wind blew from the village to the vineyards, so that it did not spread.

On 27-29 September 1798, at the Mikulov domain, a strong wind was mentioned blowing for three days and two nights, accompanied by boisterous gusts. The wind gusts damaged vineyards.

In the morning of 15 June 1822 a stormy wind caused great damage to roofs and trees on the domain of Dolní Kounice. At Vlasatice it carried away a damaged shingle roof from a stable.

On 14 April 1834 a strong wind that had been blowing for several days spread a fire at Pouzdřany, so that 103 houses and many barns were burned out (Polický 1936).

On 22 January 1840 after midday a stormy wind was observed during a fire at Vranovice.

### Early and late frosts

Besides heavy winter frosts considerable damage to the field crops, fruit trees in blossom and vineyards was also caused by late spring frosts. On the other hand, early autumn frosts endangered above all the vintage of vine grapes. An important factor for the action of frosts was the location of vineyards or gardens, because in valley positions during night outgoing radiation the temperature dropped even lower than in slope or top positions.

According to a report of 1659 from the studied region almost all the vineyards froze at Pouzdřany, Strachotín and their surroundings (Polický 1936).

On 5-6 September 1664 grapes in vineyards were affected by a heavy frost around Mikulov. In the report damage is mentioned according to the individual tracts in the whole volume of 1880 buckets (i.e. about 1064 hl) and it is stated that the duke's vineyards were afflicted less than those of the subjects. Similarly, vineyards, but also fruit trees were damaged by a late frost on 7 May 1666. The list of the individual communities includes Horní Věstonice, Mikulov, Popice, Pouzdřany (62 "achtls" of suzerain vineyards, i.e. 1.7 ha) and Sedlec. The frost raged there also a year later before 19 May. At Uherčice around 50 buckets of wine froze (i.e. about 28 hl) at suzerain vineyards. The vineyards at Pouzdřany and Popice were also seriously damaged. Vineyards around Mikulov were again affected by frost on 2 May 1668. Again there was smaller damage to suzerain than to subject vineyards, perhaps due to their more favourable slope position. The list of damaged communities includes Dolní Věstonice, Horní Věstonice, Mikulov, Popice, Pouzdřany ("only a few plants were not touched by the frost"), Sedlec and Strachotín ("everything froze").

Also in 1675, due to frosts, few grapes ripened around Mikulov and the wine was, besides, sour (Dostál et al. 1968).

Before 22 May 1768 two night frosts damaged vineyards at Horní Věstonice and in other communities of the Mikulov domain.

In 1781 the vineyards at Pouzdřany froze, so that there was no wine (Polický 1936).

On 31 May 1818 a frost destroyed all rye and a great part of the wheat at Vlasatice.

Thanks to late frosts on 14-15 May 1825 no wine was made at Bavory in that year. In the same place on 3 and 10 May 1828 frosts destroyed one-half of the vineyards (Drössler 1933a).

Heavy frosts on 10-15 May 1831 damaged vineyards at Bavory, Dolní Věstonice and Pouzdřany. Although in the reports it is stated that damage due to frost does not constitute the right to tax abatement, the petitions stress the fundamental importance of viticulture for the prosperity of communities in the Mikulov region. In 1832 late frosts afflicted vineyards at Pouzdřany (Polický 1936). On 29 May 1834 frost caused damage to vineyards at Bavory (Drössler 1933a).

## DISCUSSION OF RESULTS

As follows from the above voluminous description, the obtained information about meteorological and hydrological extremes represents altogether quite new and original knowledge for the region of southern Moravia. The first preserved records of the late 1650s are no doubt connected with the possibility of asserting tax abatements after the introduction of the First Moravian Land-Registry in 1655. The subjects of the study so far have not been extremes after 1850, when gradually systematic meteorological observations start appearing. A total of 68 floods and the same number of cases of convectional storms, including 34 hailstorms have been documented on the two domains in the period 1650-1849. The number of strong winds (15) and frosts (14) is substantially lower. Concordant extremes exhibited at the two domains concerned mostly floods, whereas the impacts of convectional storms were, as a rule, limited to a smaller region.

The preserved records include above all events that can be considered extreme from the point of view of their impacts, that is, they were worth mentioning in the reports of administrators or they may have been directly the reason for the petition for the reduction of the tax duty. That is evident with floods, with reports often stating that the spring spread of the waters of the rivers Jihlava, Svratka and Dyje is almost a phenomenon of every year. Even though some communities appear almost regularly in the reports, it is difficult to compile a chronology of the extremes for the individual communities. They would be considerably incomplete and it would be necessary to complement them from a number of further sources.

That is why Fig. 5 shows the frequencies of occurrence of the studied extremes for the two studied domains as a unit. It seems that, both in the case of floods and of convectional storms after 1760, a considerable part of the significant extremes is expressed. Their higher concentration in this period can be partly explained by the increased climatic variability, corresponding in the classical understanding of the development of climate to the last phase of the so-called Little Ice Age (ending in 1850-1860 – see e.g. Brázdil and Kotyza 2002). In the Czech Lands this period includes, for example the disastrous floods of February 1784 and March 1845 (Brázdil 2002) or the destructive hurricanes of January 1801, December 1833 and January 1834. The increase in strong winds between 1770 and 1870 is documented for the Czech Lands, for example by Brázdil et al. (2003a). The discussed increased number of extremes must also be attributed to the character of the information processed. Its increase is also connected with a higher number of preserved official economic documents and with the approach to the present, the same as to the increasing bureaucratisation of the state administration after the succession of Maria Theresa. To judge critically the weight of the individual factors will only be possible after the excerpting of further sources from other regions of southern Moravia.

The most destructive extremes on the two domains were above all the floods due to the snow melting and movement of ice, the same as from substantial precipitation, which flooded not only gardens, fields, meadows and pastures, but also damaged houses, farm buildings and structures on water streams. On the domain of Dolní Kounice their almost regular target were above all Kupařovice and Pravlov, on the domain of Mikulov above all Mušov, Pavlov and Dolní

Věstonice, but also Pouzdrány, Strachotín and Bulhary. Out of 68 reported floods almost one-half (48.5 %) fell in the period 1810-1849. Another accumulation of them is evident in the years 1760-1789 (25 %). The most disastrous on the two domains were no doubt the floods of 1698, 1771, 1775, 1799, 1800, 1826 and 1838. A similar accumulation of floods into only a certain time space

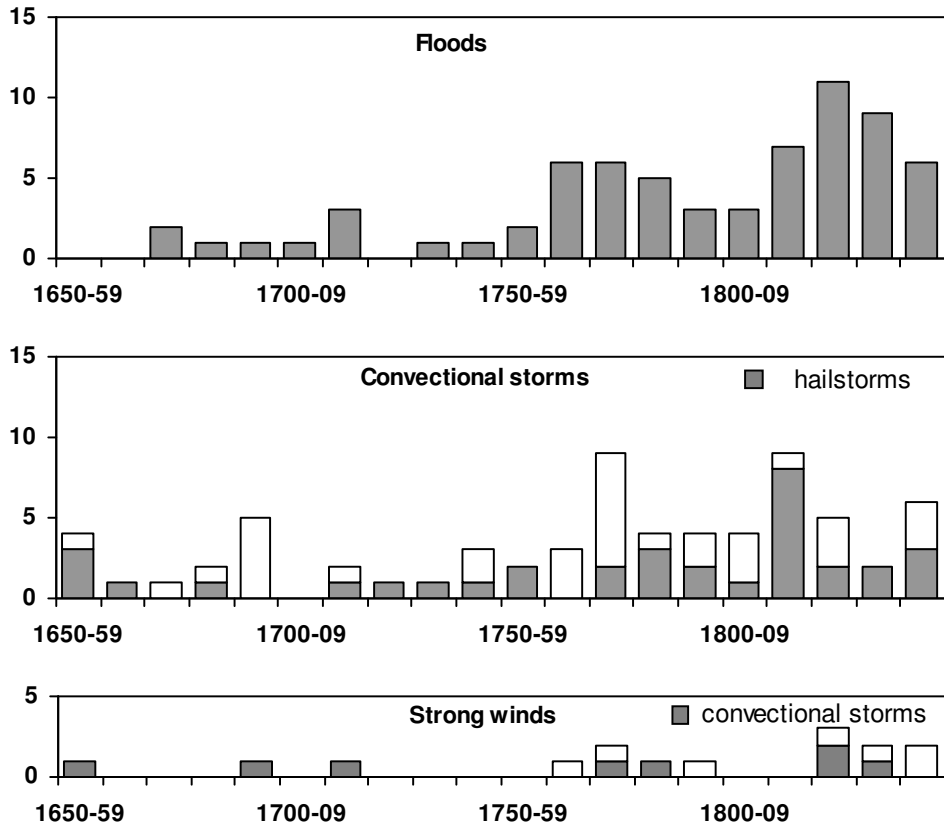


Fig. 5. Fluctuation of the frequency of occurrence of selected meteorological and hydrological extremes in a part of southern Moravia in 1650-1849 according to the records about natural disasters at the domains of Dolní Kounice and Mikulov and complemented with further sources

as in the series processed is evident also in the 20th century, as documented by the data about floods for the stations at Ivančice (the Jihlava), Židlochovice (the Svatka) and Trávní Dvůr (the Dyje). In all three places a conspicuous concentration of floods is evident with a higher  $n$ -year peak discharge rate before 1950, whereas in the latter half of the 20th century floods on those streams were both less frequent and less intense (Fig. 6). A certain role in the reduction of the number of floods and their intensity can also be played by water reservoirs,

their moderating effect by holding back the water being evident particularly in lesser floods (the Dyje – the water reservoir Vranov nad Dyjí has been in operation since 1934; the Svatka – Brno-Kníničky since 1941 and Vír since 1958; the Jihlava – Dalešice since 1979).

As for the occurrence of convectional storms, only the decade 1700-1709 is not represented in the damage records from the two domains. Their most conspicuous concentration is, on the contrary, evident in 1770-1779 and 1810-1819, to which more than one-quarter (26.5 %) of the mentioned extremes fell.

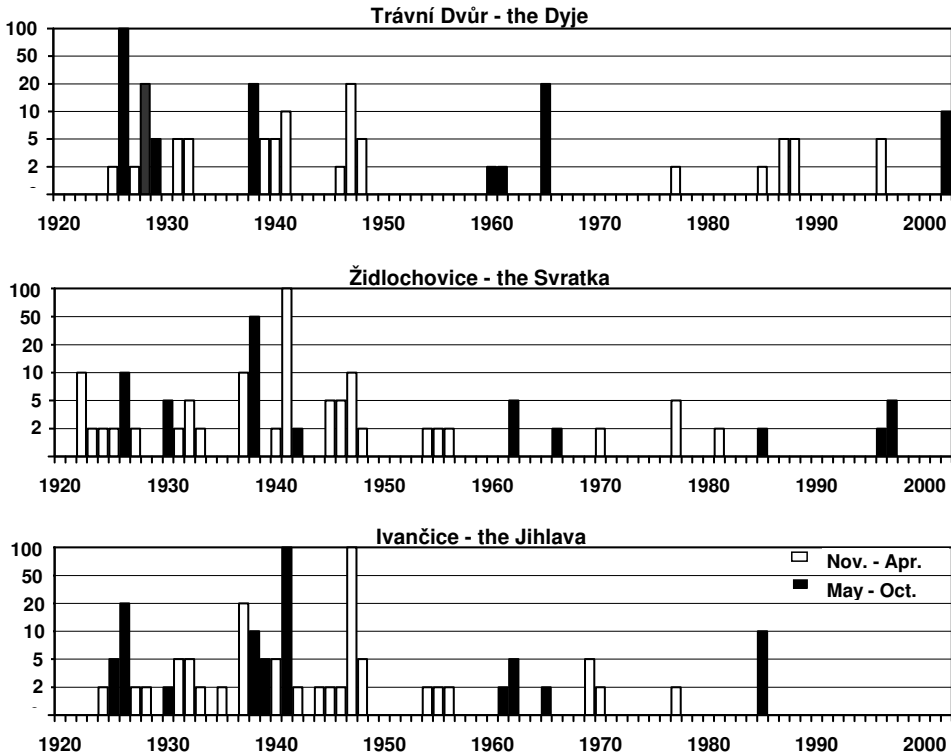


Fig. 6. The variation of the floods according to the  $n$ -annual peak discharge rates ( $n = 2, 5, 10, 20, 50, 100$ ) at the stations Ivančice (1924-2002), Židlochovice (1921-2002) and Trávní Dvůr (1924-2002) (adapted and complemented according to Bukáček 1999). In the case of several floods in one year there was always plotted the case with the highest peak discharge rate

In the last mentioned decade also the highest share of 34 total cases of disastrous hailstorms (23.5 % of recorded hailstorms) was recorded. They were, as a rule, territorially limited to one or a few communities, according to the extent of the thunderstorm clouds. Among the most destructive hailstorms can be counted above all cases of 13 May 1786 on the domain of Dolní Kounice and of 5 July 1817 on the domain of Mikulov. The spate rain during convectional storms



caused in a quarter of cases flash floods or floods during which running water endangered dwellings and farm buildings, the same as the area utilised for agriculture, somewhere eroded by running water and in other places covered with transported material. Among the most disastrous cases the situation at the Dolní Kounice domain of 25 July 1677 or at Pavlov in 1761 can be counted.

Further analysed extremes, however, do not have an analogous statement value to those of floods and convectional storms. Thus, a lower number of the stated late spring or early autumn frosts must be attributed above all to the fact that to that damage since a certain date no tax abatement was applicable, as follows from the statement on frosts in 1831. From a limited number of these cases, we can distinguish above all the destructive frosts of 1664 and 1666-1668 with considerable damage to vineyards. The frequency of strong winds is also relatively low. As far as they occurred during convectional storms, then their impacts could be combined or covered by the disastrous action of further phenomena (such as hailstorm, cloudburst). In the other cases the damage due to strong wind to field crops was essentially lower than during floods or further phenomena connected with convectional storms. On the other hand, houses, farm buildings and trees in gardens and forests could be affected more significantly, but they are mentioned in the official documents processed only very rarely.

## CONCLUSION

The compiled chronologies of meteorological and hydrological extremes for the Dolní Kounice and Mikulov domains for the period 1650-1849 show that data about natural disasters excerpted from official economic records have quite a fundamental importance for the extension of the source base of historical climatology with the utilisation for the study of the fluctuation of meteorological and hydrological extremes and their impacts. The obtained data are quite new for the studied region (i.e. so far unknown from other sources), complement each other and also complement the existing descriptions of extremes known from other reports. Thus, they can also be utilised for cross-checking data. Despite certain limitations it appeared that from the processed reports it is possible to generally reliably state the date and place of the event, its type and with certain probability the extent of its impacts. These sources are thus at least equivalent to other documentary sources of historical climatological information (such as chronicles, memoirs, personal correspondence), but they rather transcend them.

On the other hand, there is no doubt that the presented series of meteorological and hydrological extremes are incomplete in time and space. This drawback will gradually be eliminated with the further analysis of analogous economic documents from the surrounding domains that will contribute to complementing the temporal and spatial mosaic of extremes. There is a hope that the systematic study of existing archive materials will permit us to obtain information about all most significant extremes and their spatial coverage. That should allow a serious evaluation of their long-term trends with respect to the trends observed at present.

Study of the impacts of the individual meteorological and hydrological extremes remains an independent problem. It is evident that these events many times sharply concerned the lives of individual people, the whole community or domain. Therefore the further application of the materials analysed above opens broad possibilities also for the study of the history of everyday life.

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### **HYDROMETEOROLOGICKÉ EXTRÉMY NA DITRICHŠTEJNSKÝCH PANSTVÍCH DOLNÍ KOUNICE A MIKUŠOV MEZI LÉTY 1650-1849 PODLE ÚŘEDNÍCH HOSPODÁŘSKÝCH ZÁZNAMŮ O ŽIVELNÝCH POHROMÁCH**

Pro získání informací o hydrometeorologických extrémech a jejich dopadech na přírodu a člověka před začátkem pravidelných pozorování jsou využívány různé typy dokumentárních údajů. Jedním z možných zdrojů takovýchto dat jsou úřední hospodářské

záznamy o živelných pohromách, vedené na úrovni správy panství, kraje nebo země. Jde o nový zdroj údajů, v historické klimatologii dosud jen zřídka využívaný. Zmíněné hospodářské záznamy souvisely jednak se žádostmi poddaných o snížení daní v důsledku škod způsobených živelnými pohromami, jednak s informacemi správců panství podávaných jejich majitelům o významných událostech na panstvích, stejně jako s posuzováním daňových úlev na úrovni kraje nebo země.

V práci jsou analyzovány záznamy o škodách způsobených hydrometeorologickými extrémami na Ditrichštejnských panstvích Dolní Kounice a Mikulov na jižní Moravě mezi léty 1650 až 1849. Stručně jsou charakterizovány jednotlivé zaznamenané případy povodní, konvektivních bouří (bouřky, blesky, přívalové srážky, krupobití), silných větrů a časných a pozdních mrazů, které díky způsobeným škodám byly důvodem pro snížení daní. Jednalo se zejména o různá poškození obydlí a hospodářských budov, dále zahrad, polí, vinohradů a luk.

Je podána chronologie analyzovaných extrémů, doplněná o události z dalších literárních pramenů z této oblasti. K výraznému nárůstu extrémů došlo od 60. let 18. století, což je třeba přičítat jednak většímu množství dochovaných záznamů, včetně zvýšené byrokratizace státní správy, jednak zvýšené extremitě klimatu ke konci tzv. malé doby ledové. Studovaná panství byla nejničivěji postihována zejména povodněmi řek Jihlavy, Svratky a Dyje, způsobených táním sněhu, chodem ledu a vydatnými srážkami. Téměř polovina z 68 zaznamenaných povodní připadla na období 1810-1849. K nejkatastrofálnějšímu patřily zejména povodně z let 1698, 1771, 1775, 1799, 1800, 1826 a 1838. V 68 případech byly škody způsobeny konvektivními bouřemi (bouřky, blesky, přívalové srážky, krupobití), kumulovanými svým výskytem zejména na léta 1770-1779 a 1810-1819. Na poslední uvedenou dekádu připadla také téměř čtvrtina z 34 zaznamenaných ničivých krupobití. Po přívalových srážkách následovaly ve čtvrtině případů bleskové povodně. Méně frekventované jsou ve studované oblasti údaje o silných větrech a pozdních jarních a časných podzimních mrazech.

Provedená analýza ukázala, že z úředních hospodářských záznamů o škodách lze vcelku spolehlivě stanovit datum a místo události, její typ a intenzitu (se zřetelem na rozsah dopadů). Jde tedy o prameny, které jsou nejméně rovnocenné ostatním dokumentárním zdrojům historicko-klimatologických informací. V případě obou analyzovaných panství jde vesměs o údaje o extrémech, neznámé v této oblasti z jiných pramenů.