Strážnické Pomoraví—Holocene Evolution of a Unique Floodplain and Aeolian Landforms

28

Zdeněk Máčka and Jaroslav Kadlec

Abstract

The Morava River drainage basin is the largest fluvial system of the eastern part of the Czech Republic. The Morava enters the Dolnomoravský úval Basin (northern tip of the Vienna Basin) at its lower course, where a 3.5 km wide floodplain is developed. The most interesting section of floodplain may be found between the towns Veselí nad Moravou and Hodonín, where Pleistocene and Holocene sediments of the Morava River are accompanied by the unique complex of lacustrine sediments remodelled by the wind action to the shape of up to 10 m high sand dunes. The Morava river was branching into many large as well as small arms in its floodplain, creating an anastomosed channel pattern. Diverse mosaic of aquatic and (semi)terrestrial habitats were present as it is displayed on old maps of the floodplain. The majority of small anastomosed channels vanished due to the river regulation works started in the nineteenth century and most of the river flow was concentrated into one dominant channel. This channel was affected by substantial deepening, widening and lateral migration in the second half of the twentieth century triggered by river regulation in 1930s. The aerial extent of floodplain inundation was reduced to approximately one-fourth of its original extent due to the construction of flood defence dykes. The Strážnické Pomoraví region is one of last remaining examples of a lowland meandering river with more or less preserved natural dynamics of fluvial processes in the Czech Republic.

Keywords

The Morava River • Anastomosing • Meandering • Sedimentary archive • Floods • Aeolian landforms • Human impact

28.1 Introduction

The section of the Morava River floodplain in Strážnické Pomoraví (named after the town of Strážnice) is one of last remaining regions where a large lowland river freely meanders in its several kilometres wide floodplain (Fig. 28.1). Sustained quasi-natural dynamics of fluvial processes of a lowland river is rather a unique phenomenon in Middle Europe due to the long tradition of river engineering spanning back to the nineteenth century. The rarity of the Strážnické Pomoraví landscape lies also in the connection of rich fluvial sedimentary archives with aeolian sands of “Moravian Sahara”. In a small area, two different worlds are intimately interlinked—a flat alluvial plain of meandering river covered by arable land and managed forests meeting the rolling topography of sand dunes overgrown by pine forests. Though, Strážnické Pomoraví is also

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Z. Máčka (✉)
Department of Geography, Faculty of Science, Masaryk University, Brno, Czech Republic
e-mail: macka@sci.muni.cz

J. Kadlec
Laboratory of Geomagnetism, Institute of Geophysics AS CR, v.v.i, Prague, Czech Republic
e-mail: kadlec@ig.cas.cz

T. Pánek and J. Hradecký (eds.), *Landscapes and Landforms of the Czech Republic*,
World Geomorphological Landscapes, DOI 10.1007/978-3-319-27537-6_28

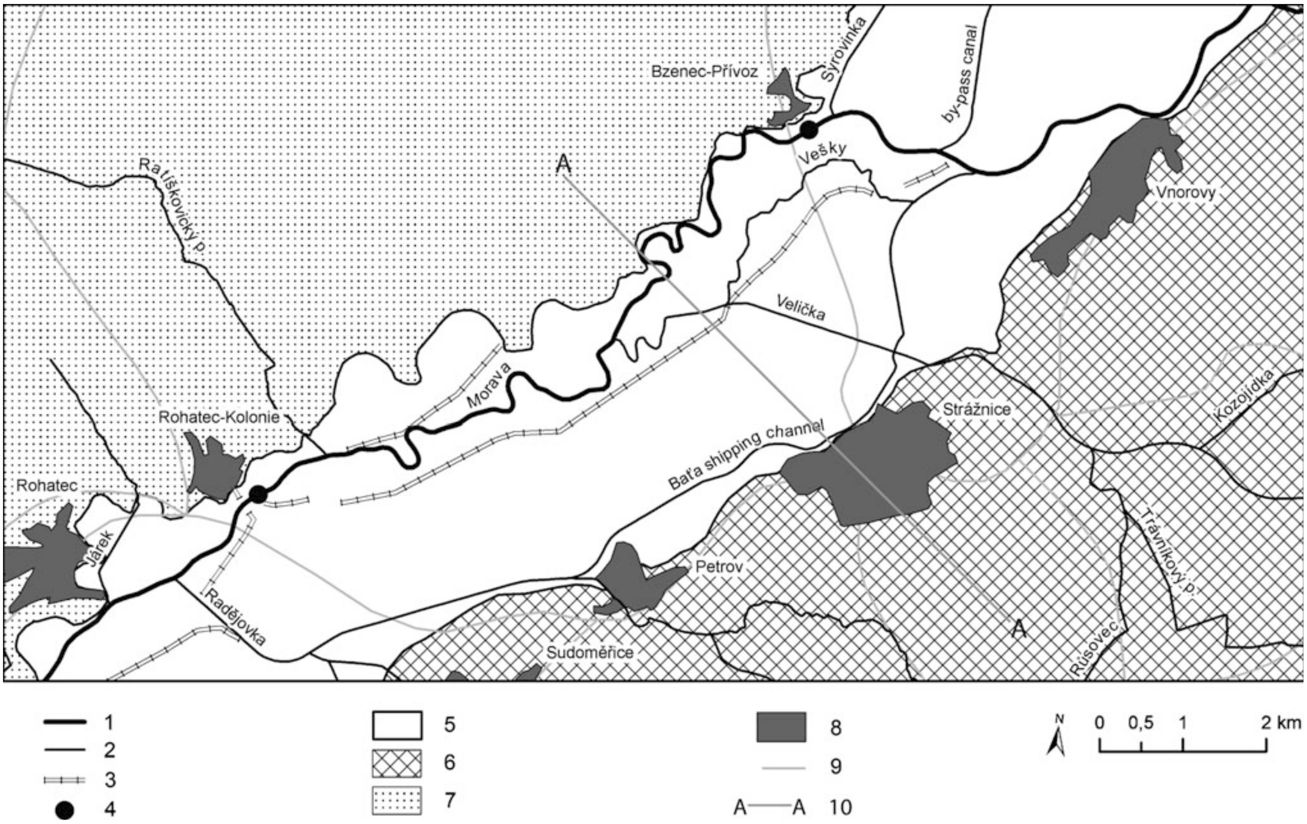


Fig. 28.1 The Morava River floodplain within the Strážnické Pomoraví region. Legend: *1* modern river bed; *2* side river branches and tributaries; *3* flood defence dyke; *4* hydrological station; *5* floodplain; *6* Mesozoic and Tertiary flysch rocks; *7* Upper Pleistocene (aeolian) sands; *8* settlement; *9* road; *10* line of geological section (see Fig. 28.3)

a landscape bearing the stigmas of human impact, a landscape profoundly moulded by humans since the early medieval times. The folk traditions of the past are still alive in the Strážnice region and the town hosts annually thousands of visitors of the International folklore festival. The slopes of flysch hills in the wider surrounding of Strážnice are covered with vineyards and wine production has given its unmistakable imprint into the local folk architecture (Fig. 28.2).

28.2 The Setting

28.2.1 The Morava River: Natural Backbone of the Strážnické Pomoraví Cultural Landscape

The Morava River drainage basin is the largest fluvial system in the eastern part of the Czech Republic. Above its confluence with the Danube, the Morava has a length of 353.1 km with a catchment area of 26,578 km^2. The Morava rises in the Králický Sněžník Mts. close to the Polish border at an altitude of 1,371 m and leaves the territory of the Czech Republic in the lowlands of southeastern Moravia, at an altitude of 148 m. The lower course of the river is located in the Dolnomoravský úval Basin (northern tip of the Vienna Basin, altitude between 150–200 m), where its floodplain is 3.5 km wide on average (Kirchner and Nováček 1991). Anastomosed channel pattern with meandering as well as straight branches was typical for the lower course of the Morava as long as to the first half of the twentieth century. As a result of river regulation, the flow in many anastomosed channels was reduced and discharge has concentrated primarily into a single channel. The area described in this chapter is, in fact, a small segment of the riverscape stretched along the 12.5 km long section of the Morava River between the settlements of Strážnice, Bzenec-Přívoz and Rohatec in the Czech historical land of Moravia. Mean annual discharge at the gauging station Strážnice is 59.6 m^3 s^{-1}. The Morava River is intimately woven into the history of western Slavic tribes that established their first empire “Great Moravia” (Moravia Magna) along its lower course in the ninth century.

Fig. 28.2 Painted facades of wine cellars in Petrov, the settlement placed at the margin of the Morava River floodplain (*Photo* V. Kubík)

28.2.2 Geological Setting

Geologically, Strážnické Pomoraví belongs to the Moravian part of the Vienna Basin. Sedimentary strata of the basin consist of Neogene claystones, siltstones and sandstones of Miocene age. Quaternary sediments on the right flank of the floodplain are represented by Upper Pleistocene aeolian sands of "Moravian Sahara". Aeolian sands cover the older Quaternary fluvial and Neogene marine sediments (Fig. 28.3). Aeolian sediments are undercut by lateral erosion of the river and locally the sprinkling sand banks up to 10 m high are developed (Fig. 28.4). (Hence the local name Osypané břehy, i.e. Sprinkling banks, comes) Aeolian sands are fine to coarse grained, yellow-brown in colour, with prevailing quartz (80–90 %), forming rolling topography of sand dunes up to 10 m high. Deposition of sand had not been continual, but interrupted by hiatuses of variable duration (Havlíček et al. 2008). Higher terrain in the wider

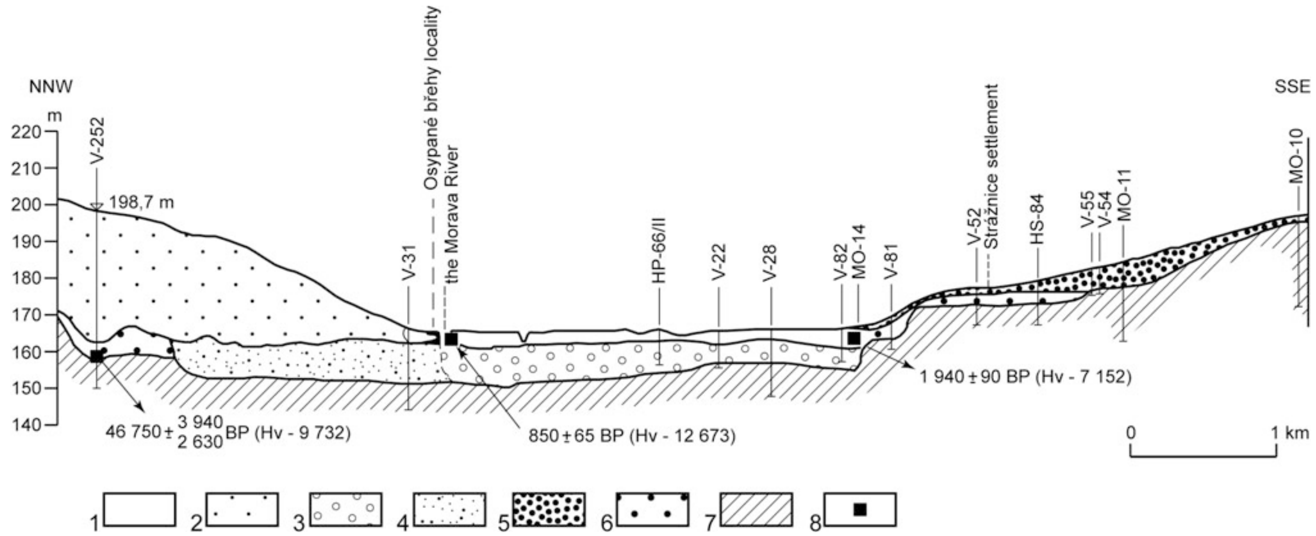


Fig. 28.3 Geological section across the Morava River floodplain between Bzenec-Přívoz and Strážnice. *1* flood loams; *2* aeolian sands; *3* fluvial sandy gravels (Holocene to Upper Pleistocene); *4* fluvial sandy gravels (Upper Pleistocene); *5* coarse grained sandy gravels of alluvial fans, locally with intensive cryoturbations; *6* loamy fluvial sandy gravels (Middle Pleistocene, two height levels); *7* Neogene sands and clays; *8* radiocarbon sample points with laboratory codes (Hv = Hannover). © Havlíček et al. (2008), Vydavatelství ČGS

Fig. 28.4 Eroded bank of the Morava River in the downstream part of the meander loop in the Osypané břehy locality. Bank erosion has exposed sediments of the sand dune of “Moravian Sahara” (*Photo* L. Krejčí)

surroundings is built by flysch sediments of Magura group of nappes of the Outer Western Carpathians (Bílé Karpaty and Rača units), that were thrust from SE to NW.

28.3 The Morava River Floodplain as a Unique Natural Archive of Fluvial Sedimentation

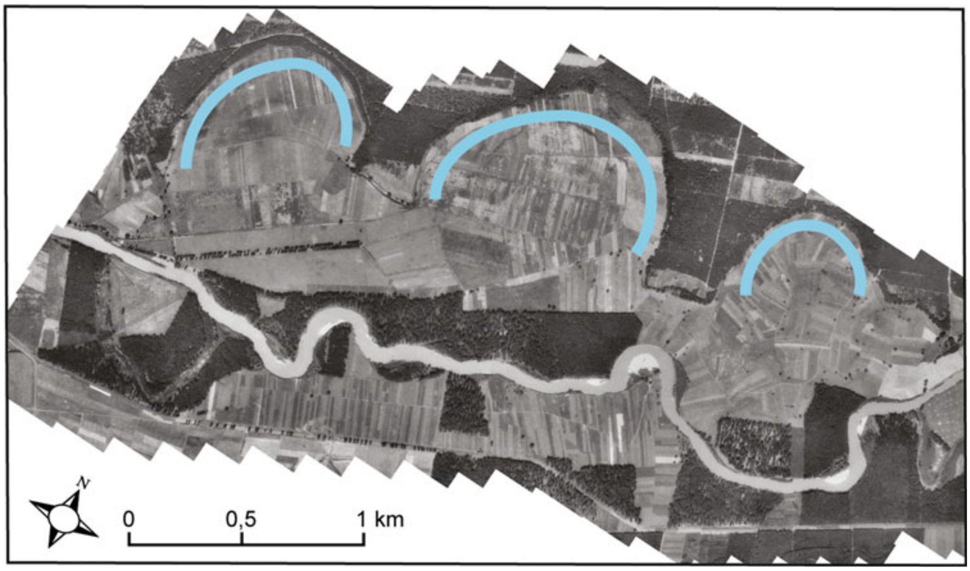
Alluvial fine-grained Holocene sediments of the Strážnické Pomoraví floodplain (overlying Upper Pleistocene sandy gravels) may serve as a natural archive. Overall thickness of fluvial sediments of Last Glacial and Holocene age, overlying the Tertiary clays, is up to 17 m (Fig. 28.3). Stehlík and Kadlec (2012) discriminated three distinct erosional phases separated by aggradation periods dating from the Late Glacial to the present.

The first erosional phase is dated to the transition from Allerød to Younger Dryas within the Late Glacial. The Morava created excessive channel with meander belt much wider than today and rapidly incised by 15 m into the neighbouring sandy sediments. River channels from that period (13.5 ky old) are still preserved at the NW margin of the floodplain in the form of large meander bends cut into the adjacent slopes built of aeolian sands (Fig. 28.5).

The second erosional phase was triggered by climatic changes at the glacial/interglacial transition, from Younger Dryas to Preboreal. An active meander belt shifted from NW margin of the floodplain to the present-day position and an early Holocene river incised deeply into its own deposits and locally even into underlying Tertiary clays. The incised valley of early Holocene was gradually filled with clayey sediments during the warm and wet Atlantic stage between 9 and 5.5 ky BP. The higher flanks of the floodplain were not affected by the Atlantic sedimentation and this type of deposits is lacking there. ^{14}C ages of sediments suggest that the sedimentation within the whole width of the floodplain was reactivated at the beginning of the Subboreal stage (approximately around 5 ky BP). At that time, the Morava formed an anastomosed channel pattern characteristic by interwoven channel branches, the winding relics of which are still noticeable in the arable fields far from the present-day river channel.

At the end of the Subboreal stage, a further climatically controlled change in the river regime resulted in a new erosional phase dated between 2500 and 0 BC. It is evident

Fig. 28.5 Late Glacial paleomeanders cut into the sands of Moravian Sahara. The course of paleomeaders is accentuated by the boundary of arable land (alluvial deposits) and forest (sands reworked by wind). Note the markedly different size of present-day meanders and paleomeanders. Background image from 1954 © Vojenský geografický a hydrometeorologický úřad



that the river deepened its channel at least by 5 m below the present floodplain surface, incising into fine-grained deposits of the Atlantic and Subboreal age. The erosion trough that originated was filled with the deposits of meandering river in the following 1500 years. These sediments consist mainly of fine-grained flood loams deposited outside the channel (vertical accretion sediments) that buried the older river branches and point-bars deposits. The majority (70 %) of radiocarbon ages comes from this approximately 4 m thick sedimentary sequence, where the largest number of dates fall into period between the eleventh and seventeenth centuries. Stehlík and Kadlec (2012) infer that the dynamics of the Morava River increased at the turn of the second millennium. The reason was probably the combination of climatic influences (e.g. ending of Medieval Climatic Optimum and beginning of Little Ice Age) and rise in human activities in the drainage basin.

Most research attention was paid to the flood sediments of the youngest accumulation phase, from approximately the last millennium. Kadlec et al. (2009) refer to substantial change of the character of the flood sediments from more clayey to more sandy and silty at about AD 1550 on the basis of the study of five sections (thickness up to 5 m) exposed in erosional river banks. They assign the coarsening of floodplain fines to the onset of Little Ice Age. Despite the detected changes in river activity (reflected in coarsening of sediments), estimated mean sedimentation rates stayed rather uniform throughout the last millennium (around 0.2 cm year^{-1}).

The anthropogenic pollution has clearly affected the topmost 50 cm of flood sediments deposited over the last 50 years. The mean sedimentation rate based on this “industrial layer” is estimated at 0.8 cm year^{-1}. At a depth of 12 cm, a peak in ^{137}Cs activity is attributed to the Chernobyl nuclear power plant accident in April 1986. Kadlec et al. (2009) attribute the higher sedimentation rate in the topmost part of the floodplain sequence to increased erosion in response to land-use changes linked with the period of socialist collectivization of agriculture after the World War II.

Matys Grygar et al. (2011) refer that apart from past land-use changes and climatic forcing, sedimentation rates were also affected by building of flood defence dykes and downstream/upstream river channelization most recently. For proximal floodplain sediments, the mean deposition rate increased from 0.23 cm year^{-1} in 700 AD to about 0.31 cm year^{-1} at the end of the twentieth century. For distal floodplain sediments, the corresponding increase would be from 0.14 to 0.23 cm year^{-1}. In their previous paper, Grygar et al. (2010) reported higher depositional rates in the interval 0.2–0.6 cm year^{-1}, however, this data refer only to the faster deposited proximal floodplain sediments.

28.4 The Late Glacial Lacustrine, Fluvial and Aeolian Processes

The NW edge of the Morava River floodplain is bounded with a large sand body which is exposed in an extensive sand quarry and in the modern Morava River meander cut (Fig. 28.6). The sediments show laterally continuous beds ranging in thickness from 3 to 20 cm. The dominant feature of the beds is normal grading, in which sandy gravel to gravelly sand base fines upward to medium or fine sand. Grains are rounded, frosted and there is an absence of mud. The upper portion of the sections consists of ripple-to-dune scale cross-stratified sand with intercalated sandy gravel beds, and cross-stratified, fine-grained sand dominated by wind-ripple laminae. The dominant presence of graded beds and the paucity of sedimentary structures such as planar lamination or cross-strata argue that sedimentary-gravity flows within a quiet water setting were the primary depositional processes, and the stacked graded beds are interpreted as representing repeated deposition by turbidity currents. The frosted and rounded grains, and the absence of mud suggest an aeolian history to the sediment, and the turbidity currents are plausibly the result of dune slumping into a standing water body. The cross-stratified and sandy gravel beds overlying the turbidites, however, argue for a resumption of braided stream conditions followed by aeolian sand dune formation.

Incision of the modern meander bend of the Morava River gives rise to a natural outcrop in the Bzenec sand body. The outcrop called “Osypané břehy” is dramatically truncated by Holocene floodplains at both the upstream and downstream reaches of the meander bend. Bedding is similar to that observed in the sand quarries, showing laterally continuous beds, with normal grading in which sandy gravel or gravelly sand yields upward to medium sand, with an iron-stained fine-grained sand cap.

In terms of origin, this sedimentary sequence was interpreted as the wind-blown sediment body (e.g. Havlíček et al. 1996, 2007). However, recently conducted research has provided evidence allowing for a new interpretation and reconstruction of sedimentary processes controlled by the Late Glacial climatic oscillations (Kadlec et al. 2015). The Last Glacial stage was dominated by the braided river sediments which formed a terminal fan downstream from the Morava and Dyje river confluence during the MIS 3 and early MIS 2 periods. The subsequent MIS 2 stadial climatic

Fig. 28.6 The horizontally stratified lacustrine sand deposited by turbidity currents exposed in the Bzenec-Přívoz Sand Quarry (*Photo* J. Kadlec)

deterioration triggered an increase in aridity and freezing accompanied by fluvial activity decrease. The flow disappeared downstream, giving rise to aeolian dunes at the terminal fan top. Fluvial conditions withdrew to the area upstream, giving rise to a lake in the Dolnomoravský úval Basin. The OSL ages of the lacustrine sediments indicate the existence of the lake between 20 and 18 ka BP. Dam erosion and a subsequent lake cessation were driven by Late Glacial climatic amelioration, which increased the Morava River discharge. Fluvial systems changed from braided to meandering (Vanderberghe et al. 1994; Mol et al. 2000). The Morava River meandering channel incised into the lake deposits and formed an area for the Holocene floodplain processes.

The aeolian sand dunes have been formed on the surface of the Bzenec sand body after the lake cessation. These relic features trend roughly N–S and the forms are rounded and subdued, but most show asymmetry with a gentler W flank and a steeper E flank and range in height from 6 to 8 m. The internal stratal architecture, surveyed by a ground penetrating radar, shows steeply strata dipping to the east in agreement with the surface morphology. Overall dune migration was toward the east, but the poor quality of the exposures did not allow for a more detailed reconstruction of the constructive winds (e.g. Eastwood et al. 2012). The historic evidence of the sand dune reactivation is a reason why this area is called Moravian Sahara.

28.5 Fluvial Dynamics of the Morava River in the Nineteenth and Twentieth Centuries: Metamorphosis of Channel Pattern

The rate of geomorphological change of the Morava River may be studied not only from its sedimentary archive, but also from historical documents such as old maps and written records. For the most recent times, the evidence of old maps, photographs and chronicles may be combined with direct field measurements of fluvial processes.

28.5.1 The Testimony of Old Maps

Maps available for the studied area cover the period from the second half of the sixteenth century up to the present day (Fig. 28.7). The scale of maps varies from 1:530,000 (Comenius Map of Moravia, 1624) to 1:10,000 (present-day topographical maps). The planimetric accuracy of maps from the sixteenth to eighteenth century is not comparable to modern standards but they can be used for evaluation of the overall river pattern and its evolutionary tendencies over 100 years. It is evident that the Morava River had an anastomosed pattern through its middle and lower course as it flowed through the Outer Carpathian Depressions and the

Fig. 28.7 An example of an old map showing the anastomosed channel pattern of the Morava River. Müller´s map of Moravia from 1730, original scale ca. 1:168,000 (Map collection of the Department of Geography, Masaryk University in Brno)

Vienna Basin. Taking a transect across the floodplain from Strážnice to Rohatec settlements, all the historical maps portray a channel pattern consisting of several parallel branches; from two to five parallel channels are shown depending on the map scale and cartographic generalisation.

Historical maps indicate that individual river branches varied in their width, course and sinuosity. Two large channels were located along the opposite margins of the floodplain and formed lateral boundaries of the channel network. From the second half of the eighteenth century, these two main channels were intensively meandering and were laterally active. The overall pattern of the channel network included numerous smaller meandering or straight river branches that diverted and re-joined the main channels, or in some cases crossing the floodplain and connecting the two main channels. The Morava River thus had an anastomosed character with meandering and straight individual channels. The sinuosity of the individual channels reflected the stream power; large branches (trunk channels) with a higher discharge had a meandering pattern and small branches (minor channels) were rather straight. Some of the minor channels are occasionally exposed in the cut banks of the present-day channel of the Morava River.

It can be inferred from historical maps that the arrangement of the channel network has not been affected by any dramatic changes at least since the first half of the seventeenth century. The overall pattern with two dominant channels can be traced back to the Comenius Map of Moravia which dates from 1624. The most valuable information on the dynamics and development of the channel network is provided by the maps of the First, Second and Third Austrian Military Surveys, which were conducted from the second half of the eighteenth to the second half of the nineteenth centuries. These maps provide the indirect and direct evidence of channel avulsions as well as the lateral shifts by gradual bank erosion. The relatively dense network of degrading, ephemeral watercourses, either still connected to the active channel network or preserved as isolated fragments within the floodplain, provides the indirect evidence of historical reorganisations of the channel network. Véšky and Medvídka channels are the current remnants of such abandoned channels (see Fig. 28.1). The direct evidence of channel relocation is depicted on maps from the first half of the nineteenth century, when the southernmost of the two trunk channels split into two branches. Old and new branches coexisted for several decades until the entire discharge eventually diverted into the new channel.

Cessation of natural avulsions, the abandonment of many smaller channels, and the concentration of discharge into one of two main channels are the main trends in channel network development during the second half of the nineteenth and the whole of the twentieth century. The transformation of the anastomosed system into a single channel meandering system was completed during the 1930s by the erection of flood defence dykes and local straightening of the dominant channel. Fluvial processes have been inhibited in the side channels but, on the other hand, the dominant meandering channel experienced profound morphological changes. Increased discharge has caused channel incision and widening and fast lateral migration has occured. Thus, the Morava River between Strážnice and Rohatec documents the transformation from a multichannel system with both sinuous and straight branches to a single channel meandering system with high lateral activity (Fig. 28.8).

28.5.2 Evolution of a Cut-off Meander: Case Study of the Osypané Břehy Locality

The spring flood of 2006 caused the meander cut-off upstream of the Osypané břehy locality, and the oxbow lake originated (Fig. 28.9). Many geomorphological and ecological changes may be observed at the oxbow lake since the cut-off. Meander cut-off occurred at the turn of April 2006 during a flood that culminated at the gauging station Strážnice on 29 March with the discharge of 733 $m^3\ s^{-1}$ (Q_{50}).

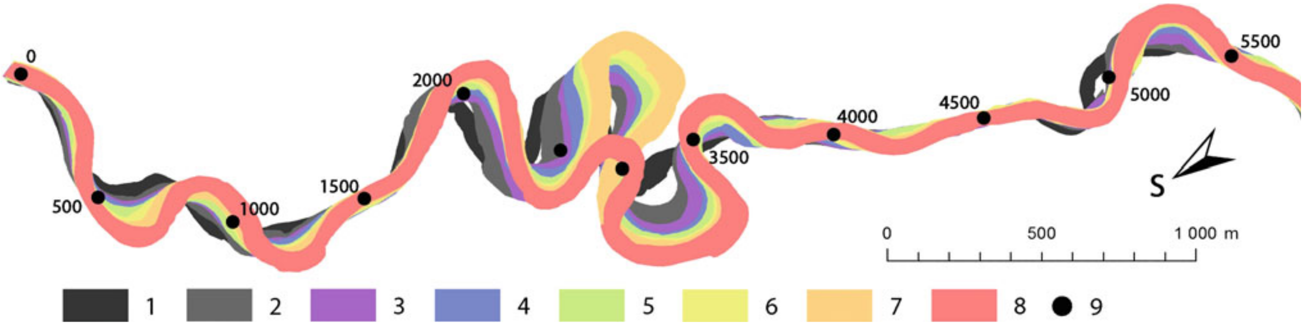


Fig. 28.8 Lateral shifts of the Morava River in the surroundings of the Osypané břehy locality in the period 1938–2012. The route of the channel in respective years: *1* 1938; *2* 1953; *3* 1963; *4* 1973; *5* 1982; *6* 1993; *7* 2003; *8* 2012; *9* distance from the beginning of analysed river reach (m). © Ondruch (2014), Masaryk University

Fig. 28.9 Oblique aerial image of the cut-off meander upstream to the Osypané břehy locality, photo taken in summer 2006. At the inflow and outflow parts of the oxbow lake are visible newly formed alluvial plugs (*Photo* J. Wenzel)

Cut-off was accomplished through bank erosion of opposite banks of the meander neck (neck cut-off type). The local sinuosity of the Morava channel dropped from 3.05 to 2.27 after the cut-off. The resulting oxbow lake had a length of 826 m.

The evolution (mainly infilling) of the oxbow lake was very dynamic in several years following the cut-off (Máčka et al. 2011; Ondruch 2014). One of the reasons was the low angle between the line of active and cut-off channel; thus, the suspended load from the active channel was easily transported into the oxbow lake. It resulted in the fast formation of alluvial plugs at inflow and outflow ends of the oxbow lake. Most marked was the growth of the inflow plug in first 6 months after the cut-off, when the area of the plug reached 10,000 m^2 (that is 22.5 % of the whole oxbow lake area), while the outflow plug reached the area of only 4,200 m^2. In the following period, the rate of oxbow filling decreased, but acceleration occurred again between 2009 and 2012. Faster infilling in this period may be attributed to hydrological situation, when a few larger floods brought larger quantities of sediment into the oxbow lake. The maximum thickness of deposited sediments reached 4–6 m until the year 2012. After 6 years of development the hydraulic connectivity between the active channel and the oxbow lake substantially decreased, with only higher flows penetrating into the lake.

Profound geomorphological changes affected close surrounding of the oxbow lake too. Due to the channel shortening by cut-off, a knickpoint originated in the active channel, and localised, accelerated channel erosion began. Around 2,000 m^2 of floodplain were eroded during 1 month after the cut-off and newly formed river bank retreated by 15 m. The destruction of further 9,600 m^2 of floodplains took place until 2012; the rate of bank erosion gradually declined from 7.92 m $year^{-1}$ (2006–2009) to 5.74 m $year^{-1}$ (2010–2012).

28.6 People and Floods

An inseparable feature of the Strážnické Pomoraví landscape were always the annual floods (floodplain inundations). Temporal changes in frequency and intensity of floods may be traced back to the end of the seventeenth century, thanks to archival sources and records of instrumental measurements. Among the most important documentary sources for flood data are monastery diaries, claims for tax relief, river channel engineering documentations and chronicles of settlements (Brázdil et al. 2005). Oldest instrumental hydrological measurements come from a water stages gauging station located at the mill weir in the settlement of Rohatec (since 1886) (Brázdil et al. 2011a). A sudden melting of accumulated snow reserves, mainly in the mountainous parts of the catchment, often accompanied by rainfall, is important for the generation of winter floods between November and April. Heavy rains, lasting for several days, cause summer floods between May and October.

A continuous flood chronology for the Morava River at the Rohatec/Strážnice stations over the 1886–2010 period was created based on peak water stages ($H_k \geq H_2$; Rohatec 1886–1920) and peak discharges ($Q_k \geq Q_2$; Rohatec 1921–1939, Strážnice 1940–2010) (Fig. 28.10). So far, the highest peak discharge at Strážnice, a flow of 901 m^3 s^{-1}, was recorded on 10 July 1997, during the "flood of the 20th century" on the Morava River and significantly exceeded the value of Q_{100}. During the 90 years of discharge measurement, the annual peak discharge was $\geq Q_2$ in 39 years (i.e. 43.3 % of all years) with an accumulation of these cases

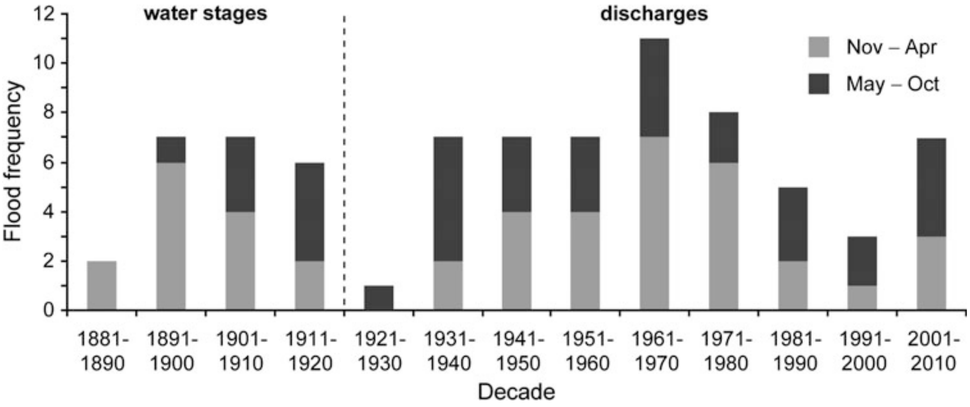


Fig. 28.10 Synthesis series of decadal frequencies of floods of the Morava River at the Rohatec/Strážnice stations in the 1881–2010 period with respect to their occurrence in the winter (November–April) and summer (May–October) hydrological half-years. Flood frequencies were derived from annual peak water stages ($H_k \geq H_2$) of Uherský Brod and Uherské Hradiště (1881–1885), peak water stages ($H_k \geq H_2$) of Rohatec (1886–1920) and peak discharges ($Q_k \geq Q_2$) of Rohatec (1921–1939) and Strážnice (1940–2010). © Brázdil et al. (2011b), Taylor&Francis

evident between 1937 and 1987. In terms of seasons, the occurrence of annual peak discharges exhibits a dominant concentration in March (31.1 %). The highest frequency of floods (seven or more floods per decade) was recorded in the periods 1891–1910, 1931–1980 and 2001–2010, with a clear predominance in the 1961–1970 decade, with 11 floods. In contrast, only one flood was recorded in 1921–1930, two occurred in 1881–1890 and three in 1991–2000. There is a higher proportion of winter floods as compared to summer floods (55.1 % cf. 44.9 %) among the 78 floods in this compiled series, with summer floods prevailing in the years 1911–1940 and 1981–2010.

Although, the dimensions of the Morava channel are not known for the break of nineteenth and twentieth century, it is evident that overbank flows occurred annually, in some years even twice. On the other hand, in the more recent times, the overbank flow of the Morava River at the Strážnice gauging station occurs at the value greater than ~520 $m^3 s^{-1}$, which corresponds to a discharge with a reoccurrence frequency of 5 years. The inundation frequency of the floodplain decreased dramatically since the 1930s, when extensive river engineering works were accomplished. The reason lies in the progressive enlargement of the channel cross-section arising out of accelerated incision and bank instability triggered by river training. In the presently inundated part of the floodplain, i.e. only within flood defence dykes, rather coarser sediments are deposited in comparison to the state before regulation work (Grygar et al. 2010).

28.7 Conclusions

Strážnické Pomoraví is a traditional settlement area intensively moulded by human activities for more than 1000 years, since western Slavs founded their first state of Great Moravia there. Folk traditions of the past are still alive in the Strážnice region with richly decorated costumes, moving songs, “ride of kings” and others that are presented every June at the International folklore festival. Strážnice region is also one of Moravian wine production areas that invites the visitors to rest in wine cellars, to cycle along the Moravian wine trails or to sail along the Baťa shipping channel.

The natural backbone of the region is the River Morava with its floodplain that touches the area of sand dunes called “Moravian Sahara”. River was branching and meandering in its 3.5 km wide floodplain creating anastomosed channel pattern as long as to the beginning of the twentieth century. The period of great river management projects just before the World War II caused the cessation of anastomosed river system functions and the transition towards a single channel meandering pattern. The unique combination of fluvial and lacustrine sediments, the latter reworked by wind action, creates a remarkable natural archive suitable for the investigation of environmental changes since the Late Glacial. Fluvial sediments with thickness up to 17 m conceal the evidence of alternating phases of floodplain erosion and aggradation from Late Glacial and Holocene, but also bear the testimony of industrial and agricultural pollution in the upper 50 cm of floodplain soils (DDT, PCB, lead contamination).

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