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**The Little Ice Age and the Hungarian Kingdom? Sources and Research Perspectives**

**Abstract:** The paper surveys the possibilities and limitations of identifying the impacts of the Little Ice Age (LIA) in the Kingdom of Hungary in the late medieval period. Using a variety of written sources, scholars working on western and other parts of central Europe have documented weather events and environmental processes associated with the LIA. Despite the scarcity of some of these genres of written evidence – notably narrative sources – for historians working in the Hungarian region, there are indications of similar, if less pronounced, contemporary phenomena in the Kingdom of Hungary, which covered most of the Carpathian Basin in the late medieval period. This paper discusses two case studies, beginning with the problem of the appearance of the so-called “Great Famine” of 1310s in this area. Despite the lack of contemporary domestic narrative accounts of the events, legal evidence and other sources suggest that some aspects of this weather-related crisis had a similar effect on the Hungarian kingdom as on other parts of central Europe (Bohemia, Poland, and the German lands). These sources, however, mention virtually nothing on the extent of the famines – they may have been only local or regional problems. The second part of the paper discusses the research potential into the long-term impacts of the Little Ice Age; while information on the climatic processes is limited, a clear shift in the water table resulted in changes in the suitability of certain altitudes and areas for settlement in the late medieval period.

**Keywords:** Little Ice Age, climate history, environmental history, famines, Kingdom of Hungary

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1 Introduction

The paper explores to what extent the climatic processes scholars have documented for western Europe can be confirmed using similar research methods in the Hungarian kingdom, which covered most of the Carpathian Basin in the Middle Ages. The title asks a legitimate question, for the sources to which medieval historians working on this area of east central Europe have access are somewhat different from those to which historians working on France or Switzerland are accustomed. While it is not yet clear which, if any, consequences the Little Ice Age (LIA) had in Hungary, there is preliminary evidence of weather patterns and climatic processes similar to those which have been demonstrated for western and central Europe in the late medieval period, even if a scarcity of source material for the study of the Carpathian Basin is more of a problem than in other regions of Europe.

This study begins with a consideration of the 1310s, a decade usually considered the first uncharacteristically cold and wet decade of the fourteenth century and the beginning of the LIA. The aim in this case is to argue that, despite the very scarce written evidence, some elements of the environmental crisis that were unfolding in other regions of the continent and on the British Isles or other parts of northwestern Europe reached the Hungarian kingdom as well. The study also asks to what extent long-term processes, such as changes in the hydrological regimes of various bodies of water throughout central Europe, were characteristic of the Carpathian Basin.

2 Sources and Research Situation in Hungary

Data gathered from historical sources now permits medium- and long-term climate reconstructions for the past millennium (and even longer in some places) for some parts of western and central Europe.1 Nothing similar is possible for the medieval climate of the Carpathian Basin. After the Roman era, literacy only reappears in the region during the period of Hungarian state formation around the turn of the tenth century; the scarce legal evidence produced at that time is insufficient for climate history research. The number of legal documents produced grew significantly only from the late thirteenth century onwards, and, even then, these documents rarely mention weather-related phenomena and do not provide enough data for continuous climatic reconstruction. Whereas scholars working on western European climate

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reconstructions have access to an abundance of chronicles and annals dating back into the Middle Ages, such sources are rather scarce for the Kingdom of Hungary until the sixteenth century. The narrative texts, as well as other written evidence mostly tell of extreme weather events and crisis periods which generated richer narrative sources.²

Although the 1310s are not particularly rich in contemporary domestic narratives, a critical evaluation of the domestic and foreign chronicles and annals – both contemporary and later accounts – along with legal sources (charters) allow some insight into the environmental circumstances of this period in the Carpathian Basin, as well.

Most of the weather-related events on which these written sources report are of hydrometeorological nature: floods, waterlogged lands, droughts, etc. Though research into historic floods has greater potential for the early modern period,³ it is nonetheless possible to determine to some extent the nature and frequency of late medieval flooding of major rivers, too, especially the Danube and the Tisza.⁴ In addition, studies of some bodies of standing water are promising for determining weather conditions in certain periods. The shallowness of lakes in the Carpathian Basin (especially that of Lake Fertő) means that even smaller changes in water levels caused some areas to dry out or, conversely, to become inundated. It is possible to deduce primary trends in the water levels – or changes in the extremes – in some rivers and bodies of water, but these only allow for indirect extrapolation of changes in precipitation

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² For the most recent overview of the role of written evidence in historical climatology, see: Andrea Kiss, Historical Climatology in Hungary: Role of Documentary Evidence in the Study of Past Climates and Hydrometeorological Extremes, in: Időjárás 113 (2009), pp. 315–339. For the possibilities of research into medieval weather events, see: Ead., Weather and Weather-Related Environmental Phenomena Including Natural Hazards in Medieval Hungary I: Documentary Evidence on the 11th and 12th Centuries, in: Medium Aevum Quotidianum 66 (2013), pp. 5–37; Ead., Weather and Weather-Related Natural Hazards in Medieval Hungary II: Documentary evidence from the 13th Century, in: Medium Aevum Quotidianum 68 (2014), pp. 5–46.


within the catchment areas.\textsuperscript{5} Such research, however, always incurs the constant methodological problem of how to account for the human impacts on the different water bodies. Nonetheless, the study of areas with a dense network of waterways has considerable, as yet partly untapped, potential for the study of medieval and early modern environmental (and climatic) conditions. Despite the relatively wide scope of written sources from the fourteenth century, it is not possible to determine short- or long-term climatic tendencies in the Middle Ages; this only changes with the source situation of the sixteenth or rather seventeenth century, when the number of written sources increased and, even more importantly, new types of sources appeared or became more widespread, including private correspondence, diaries, town books, account books.\textsuperscript{6}

Over the past two decades or so, scientists have made significant advances in our understanding of medieval climate fluctuations. Dendroclimatological, paleobotanical, and complex environmental methods (e.g., pollen, macrofossil, and sediment analysis) now make it possible to reconstruct historical temperature (and precipitation) fluctuations in the Carpathian Basin.\textsuperscript{7} However the territorial validity of the this research is relatively limited, and the high resolution studies either do not go


\textsuperscript{7} For an overview of the research results up to 2012, see: András VADAS/ Lajos RÁCZ, Climatic Changes in the Carpathian Basin during the Middle Ages: The State of Research, in: Global Environment 6/12 (2013), pp. 199–227.
back into the Middle Ages or only cover the fringes of the Carpathian Basin (mostly mountainous areas).  

The recent emergence of the discipline of environmental archeology has also furthered understanding of medieval environmental (and climatic) changes, such as variations in the long-term hydrological conditions of the Carpathian Basin. It has proven particularly valuable in determining average fluctuations in the levels of lakes and rivers, dating floods and other hydrometeorological events, and – by incorporating research into settlement patterns – in tracing environmental changes within small areas. While there are relatively few excavations addressing the physical environment and the links between settlement location, settlement structure, and environmental change at the present, environmental archeology will surely become a more important factor in future environmental and climate history research. Even given the current state of the research, combining the written historical record with scientific research and these preliminary environmental archeological findings sheds some light on the changes in the late medieval period usually understood in the context of western and central Europe as the initial period of the LIA.

3  The “Great Famine” and Hungary – Problems with and Interpretation of the Sources

According to the timeline established in Hubert H. Lamb’s foundational monograph, a period of milder winters, warm summers, and higher precipitation throughout western Europe ended in the late thirteenth century, and a slow cooling period set in that lasted until the sixteenth century, which marks the beginning of the LIA.  

8 See the dendroclimatological reconstructions from the Carpathians, most importantly: Ionel POPA/ Zoltán KERN, Long-Term Summer Temperature Reconstruction Inferred from Tree-Ring Records from the Eastern Carpathians, in: Climate Dynamics 32 (2009), pp. 1107–1117.
In the 1990s, however, scholars started to classify this earlier transitional period as part of the LIA itself, not primarily because of average temperatures or precipitation levels but due to the growing frequency of weather anomalies and weather-related environmental crises (famines and floods). Recent scholarship suggests a rapid transition to the LIA in the first decades of the fourteenth century.

As a result of these changes in the climate, the conditions for practicing agriculture changed significantly in most parts of western Europe and probably also in east central Europe. The most dramatic changes, however, occurred in northern and northwestern Europe and in mountainous regions (especially the Alps), where the possible zone in which certain grains and grapes could be cultivated shifted to lower altitudes and lower latitudes causing significant economic crises in a number of areas. The situation in the Carpathian Basin during this period was somewhat different: a deep political struggles at the turn of the thirteenth century was followed by the consolidation of the Angevin rule in the early 1320s, which introduced a period of more or less constant economic growth.

Contemporary narrative and legal sources do not mention country-wide famines during this period, and there is little documentation from the Hungarian kingdom on the great plague epidemics of the 1340s. Taken together, this has been read as


14 On the political struggles of the late Árpádian age, see: Jenő Szűcs, Az utolsó Árpádok [The Last Árpádians], Budapest 1993. On the political consolidation in the 1310s and early-1320s, see: Pál Engel, Az ország újraegyesítése. I. Károly közdelmei az oligarcháknak ellen (1310–1323) [The re-unification of the country against King Charles I], in: Századok 122 (1988), pp. 89–147; Gyula KRISTÓ, I. Károly király harcai a tartományurak ellen (1310–1323) [King Charles I’s Struggles with the Oligarchs], in: Századok 137 (2003), pp. 297–347. For the economic processes in Hungary, see the recent overview: József LASZLOVSKY et al. (ed.), The Economy of Medieval Hungary (East Central and Eastern Europe in the Middle Ages, 450–1450 49) Leiden – Boston 2018.

15 Andrea Kiss/Ferenc Pti/ Ferenc Sebők, Rossz termések, élelmiszerhiány, drágaság, (éh)inség – és feltételezhető okaik a 14. századi Magyarországon [Bad Harvests, High prices, and Famines – and
evidence that the so-called crisis of the fourteenth century did not affect the Carpathian Basin. Scholars have explained the lack of references in the historical record to these crises in different ways; some attribute it to the more favorable climatic conditions, while others see it as an effect of the Mongol invasion, low population density, or the abundance of rich, arable land.16

For nearly a century now, historians have regarded the second half of the 1310s as a period of serious, widespread food shortages in western and moreover northwestern Europe.17 Research on eastern and central Europe, however, has largely neglected the existence of famines in the period,18 but in recent years a growing body of scholarship has begun systematically analyzing the regional sources relating to famines from the 1310s. Finnish, Czech, Hungarian, Polish, and German scholars have also re-evaluated earlier known sources and discovered new evidence on the problem.19 Not only have

the 1310s received more attention in recent scholarship, but researchers have also begun re-evaluating the question of famines in the Carpathian Basin. Though references to them are missing from the domestic narratives of the period, a number of fourteenth-century legal documents do refer to food shortages. The next few paragraphs survey the available written sources which provide evidence of food shortages in the 1310s in the Hungarian kingdom.

The first such document is a charter from 1343, a transcription of another document from 1312, which highlights the food supply in the 1310s. The charter is a seemingly straightforward documentation of the sale of an estate called Pethunye, but it specifies that anticipation of shortages in the near future was the reason for the sale of one sixth of this estate. The charter was issued on June 25, 1312, shortly before the grain was typically harvested, which indicates that there may have been expectations of a poor harvest. This does not mean that there was a widespread crop failure; the charter does not specify the reason for the supposed shortage in the coming year, but it is possible that it was due to weather conditions.

While there is no other legal source referring to food shortage or related events from the first half of the 1310s, foreign narratives and non-contemporary chronicles provide another source of information on problems in the 1310s. Although there is no contemporary domestic evidence which expressly mention a wide-spread famine in the first half of the 1310s, a later chronicle of the Spiš region (northernmost area of present-day Slovakia) is interesting. Compiled in the seventeenth century by Caspar Hain, this account draws partly on local archival evidence and reports that there was a famine around 1312 that lasted three years. Hain even mentions cannibalism among the population, though, under the circumstances, this might reflect the vivid imagination of a seventeenth-century author, despite the fact that scholars, including

20 See Andrea Kiss’s contribution to this volume. See also the works of Andrea Fara, esp. Production of and Trade in Food Between the Kingdom of Hungary and Europe in the Late Middle Ages and Early Modern Era (Thirteenth to Sixteenth Centuries): The Roles of Markets in Crises and Famines, in: Hungarian Historical Review 6 (2017), pp. 138–179. See also: Myśliwski (note 18).

21 For an earlier collection of the weather events of the period, see: Vadas (note 19). I will not refer here to data that is not related to food shortages or famine. For floods and other weather events, consult the article quoted above, and Kiss (note 4), pp. 238–239.


Henry Lucas, have argued that this phenomenon was not unique in times of famine.\textsuperscript{24} In spite of its probable exaggerations and the fact that it is not an contemporary evidence, this chronicle is an important source, as the author was the town judge in Levoča with ready access to the town archives. Some of his references suggest that he was familiar with medieval chronicles or annals which have since been lost, so his descriptions of the medieval period in the town should be considered as well.\textsuperscript{25} Of course there are general methodological problems with the use of early modern chronicles such as the lack of references and the creative license of the chroniclers of the period that make it difficult to separate historical fact from fiction. However, Hain seems to have been aware of the need to cite the earlier sources on which he based his work. For the period after 1516, he specifies which sources he used when compiling the chronicle, including Konrád Sperfogel, Dániel Türk, Márton Frőlich, and others. They were all local office-holders and prominent members of the bourgeoisie of Levoča in the sixteenth and seventeenth centuries.\textsuperscript{26} A recent study significantly suggests that Hain probably used medieval annals on the history of the region, perhaps the work he referred to as the Annals of Levoča.\textsuperscript{27} These annals have a secular background but they may also have contained some transcriptions of religious annals, as well, for Hain’s work contains a large number of references to the foundations of monasteries and religious events, especially in present-day Slovakia.\textsuperscript{28} He dates the foundation of the Cistercian monastery of Spišský Štiavni (Slovakia) to 1216, which is indeed the generally accepted date for this monastery’s foundation, but he misdated, for instance, the foundations of the monasteries of Gelnica and Prešov.\textsuperscript{29} There are a number of mistakes in the Hain chronicle, but, apart from an entirely made up part

\begin{flushleft}
\textit{Hunger, das die Menschen einander geschlachtet und gessen auch die Diebe von Galgen sind vor Hunger abgeriszen worden. Desgleichen war auch unterm dem Viehe.}
\end{flushleft}

\textsuperscript{24} On the question of the cannibalism from 1315 to 1317, see: Lucas (note 17), pp. 343–377, and on cannibalism as a trope in the High Middle Ages, and even more so in the early modern era, see: Cătălin Avramescu, An Intellectual History of Cannibalism, Princeton / NJ 2009.


\textsuperscript{26} On the period of their activity in Levoča, see: Kálmán Demkó, A Szepes-szombati krónika [The Chronicle of Spišská Sobota], Lőcse 1891, pp. 15–16. Hain himself also refers to early modern humanist chronicles such as Ortelius’s and Istvánffy’s chronicles (Bal/ Förster/ Kauffmann [eds.] [note 23], p. 3), however these latter ones are sometimes more unreliable than the later works of the dignitaries.

\textsuperscript{27} Szabó (note 25), p. 198.

\textsuperscript{28} Bal/ Förster/ Kauffmann (eds.) (note 23), p. VI.

\textsuperscript{29} For the correct foundation dates, see: Beatrix F. Romhányi, Kolostorok és társaskáptalanok a középkori Magyarországon. Katalógus [Monasteries and Collegiate Chapters in Medieval Hungary. Catalogue], Budapest 2000.
on the prehistory of the Spiš region, these are probably not intentional. Therefore, it is quite likely that a famine did affect the northern part of the Hungarian kingdom sometime in the early or mid-1310s. Although Hain dates this event to three years around and after 1312, he also added that the exact date was uncertain. Whether or not the famine was linked to the weather or other factors is an open question, but it is worth noting that, as in the aforementioned case of Pethunye, the environmental conditions of the Spiš region were quite unfavorable for agriculture.

There is at least one further reference to the famine in legal evidence from the 1310s: in 1318 a group of nobles from the village of Zeuleus (Szőlős, present-day Balatonszőlős) took an oath to the convent of Tihany, a significant Benedictine abbey in Transdanubia (western Hungary). According to the document, the abbey cared for its tenant peasants by protecting and nourishing them during hardships and famine. The reference to famine is a valuable hint as the event described may have taken place precisely in the years of the documented “great famine.” The question of protection also raises a very important point already mentioned above: when the rule of the Árpádian dynasty ended, the Hungarian throne was left unoccupied, and the subsequent period was one of the most anarchic eras in the history of the kingdom. A number of powerful oligarchs and dynasties tried to seize the Hungarian throne. The consolidation of the rule of Charles I and the Angevins was a long process of which his third, and lawful, coronation, on August 27, 1310, was the starting point rather than the end. The scholarship generally considers the period between 1310 and 1323 as a decisive phase in the reunification of the country and in the cementing of Angevin rule. Under such political circumstances, the protection by an ecclesiastical institution may have been crucial.

Military campaigns had a great impact on the communities affected; armies caused considerable crop damage when they marched through a given region, especially around harvest time. In the years addressed in this study, such campaigns were frequent. On May 19, 1317 the king issued a charter granting estates to János, 30 For the low historical value of the prehistoric section, see: BAL/ FÖRSTER/ KAUFFMANN (eds.) (note 23), p. VI and its introduction.
32 See the most recent overview of the period, the special issue of Hungarian Historical Review 2 (2013), pp. 211–386 (ed. Tamás PÁLOSFALVI); Enikő CSUKOVITS (ed.) L’Ungheria angioina (Bibliotheca Academiae Hungariae – Roma. Studia 3), Roma 2013.
son of Péter Popdi, as compensation for the damage the royal armies had done to his other estates. Although not documented during this decade, there are cases in other periods when the lack of food in a certain region was connected to ongoing military campaigns; this might have been the case in the 1310s, as well. Although significantly fewer soldiers were involved in these military expeditions than in later campaigns in the early modern era, the armies could still have serious consequences in smaller areas, especially if they passed through during a crucial phase of the agricultural cycle: i.e., in late spring, early summer, or at harvest time. This could easily explain why protection was a key issue both for noble families and peasants.

Medieval narrative sources offer very little information on the famines in the early fourteenth century or, more precisely, the 1310s in the Hungarian kingdom. The period’s most extensive source, the so-called “Fourteenth-Century Chronicle Composition” does not list any major famines in this period. While some traces of the elements of the “Dantean Anomaly” posited recently by Martin Bauch may have occurred in the Hungarian kingdom just as they did in other parts of central Europe (Bohemia, Poland, or the German empire), there is virtually no information on the extent of the famines mentioned. It is impossible to deduce whether these were limited local or regional problems.

4 The Long-Term Impacts of the LIA in the Carpathian Basin – Where to Look?

As noted above, a second, no less relevant problem is the possibility of tracing long-term changes in the fluctuation of the hydrological conditions in the Carpathian Basin going back to the medieval period. To date, there are no relevant reconstructions based on written evidence for the medieval period, and, even up to the eighteenth century, a number of uncertainties complicate the reconstructions, making them either impossible or unreliable. The same is true for temperatures and precipitation, but historical,

archaeological, and scientific research in the last few decades have highlighted some medium- or long-term trends of medieval water levels. A number of factors influence such fluctuations: changes in riverbeds, changes in vegetations, the felling of forests, etc. Such processes are evident in a few sites that allow some conclusions regarding the changes in hydrological conditions of the Carpathian Basin during the medieval period.

Drawing on a variety of sources, scholars have deduced that the water level in a number of rivers was significantly lower in the Árpádian period (ca. 1000–1300) than in the late Middle Ages, and that a major flood peak occurred in the late fifteenth or early sixteenth century. Much of this data comes from the Danube valley. Individual case studies in the vicinity of the Danube Bend (some 25 kms north of Budapest) have generally found a significant rise in the average level of the Danube in the late medieval period and a corresponding elevation of the groundwater tables along the banks of the river. Soil science research in connection with a never-realized dam project (part of the Gabčíkovo–Nagymaros Dams) at Nagymaros revealed that there had been a catastrophic flood in the late Middle Ages or the first phase of the early modern era. Data from Visegrád, both from the royal palace and from the so-called “New Town” (“Újváros” in Hungarian) as well as from the left bank of the Danube (Vác), suggests that the shift in the hydrological regime of the Danube took place at some point around the end of the Middle Ages.

Similar processes were identified at sites in present-day Budapest. A number of ecclesiastical institutions in the Middle Ages were situated on Margaret Island, in the Danube between Pest and Buda, including one of the wealthiest such institutions in the medieval Hungarian kingdom, a Dominican nunnery founded by King Béla IV, who had been the Hungarian monarch in the during and the aftermath of the Mongol invasion. The whole island was, however, more or less a lower floodplain and thus endangered by flooding; a thirteenth-century miracle narrative refers to the problem of floods reaching the Dominican convent. In the sixteenth century, the high water of the Danube seems to have been more serious and, more importantly, a recurrent problem: for one thing, archeological excavations suggest that the floors were raised

38 Kiss/ Laszlóvsky (note 5).
41 Kiss (note 4), pp. 228–232; Vadas (note 5).
in a number of parts of the nunnery friary, and legal evidence also provides additional proof that flooding reached higher levels than used to be typical.42

Although there is a relative abundance of charters relating to the institution in the late medieval period, most of these do not concern Margaret Island itself but rather more distant estates which belonged to the nunnery. One extremely important charter from the early sixteenth century, however, demonstrates very well what kind of sources may help reconstruct climatic phenomena in areas where narrative sources are relatively scarce. Thommaso de Vio, a papal legate and cardinal, issued a charter on September 5, 1523, granting the nunnery of Margaret Island permission to move the remains of “Blessed Margaret.” Margaret, the daughter of the aforementioned Béla IV, had spent her entire adult life in the nunnery in the mid-thirteenth century; after her death and burial somewhere in the church of the nunnery, she became the subject of a growing cult. According to an early sixteenth-century member of the convent, Lea Ráskai, renovations of the church’s sanctuary began in 1510. Circumstantial evidence suggests that Margaret’s grave was opened at some point between 1510 and 1512, probably due to this restoration work. The princess’s remains were consequently transferred to some point outside the church but within the cloistered area of the nunnery.43

Because the cloister was not open to pilgrims, however, Margaret’s earthly remains were no longer accessible to the public. The primary reason for the nuns to show Thommaso de Vio the place where Margaret’s bones were kept was to procure permission from the cardinal to move the relics to a location where pilgrims could view them – donations from these visitors were an important source of income to the nuns. One of the possible locations for Margaret’s body was the church, of course, which by the early 1520s had certainly been restored. Because Margaret was not actually canonized at that point (and not until 1943), however, it was not clear whether her bones should be put on display for veneration. The church would have been an obvious choice, as it was open to pilgrims for the majority of the year. In 1499, in fact, the nuns had been granted permission to visit Margaret’s remains in the church for only ten (!) days per year. This implies that the burial place of Margaret (and that of his brother King Stephen V) was open to the wider public for the rest of the year.44

According to the charter the legate issued, he had visited the place where Margaret’s relics were kept in 1523. For the purposes of the present study, the charter’s reasoning regarding the act of relocation is of primary importance: the nuns ask for permission to move Margaret’s bones because their present location is subject to

42 See VADAS (note 5), pp. 77–79.
43 Lajos NÉMETHY, Adatok Árpádházi Boldog Margitereklyéinek történetéhez [Data on the History of the Relics of Blessed Margaret], Budapest 1884, pp. 26–34; Ilona KIRÁLY, Árpádházi Szent Margit és a sziget [Saint Margaret and the Island], Budapest 1979, pp. 143–144.
44 András HARSÁNYI, A domonkos rend Magyarországon a reformáció előtt [The History of the Dominican Order in Hungary before the Reformation], Debrecen 1938, p. 105.
According to the nuns, the problem was not that one disastrous flood had reached the nunnery but rather that the nunnery was exposed to flooding on a regular basis. Unfortunately, the petition does not specify the location of the relics at that time, but it is highly unlikely that the nuns had placed their most precious object at a place where it was exposed to destruction in the early 1510s, meaning that the situation had changed since then. Of course, the nuns’ mention of the flood danger in this case could have been a ploy to convince the legate that it was necessary to bring Margaret’s relics back into the church where her remains would be available for veneration despite the fact that her canonization was still pending. Nevertheless, it is probable that their argument was not entirely fallacious and that parts of the enclosed area of the nunnery were flooded from time to time around 1520.

In areas beyond the Danube valley, there is also evidence that water levels and flood danger rose after the Árpádian era, but most of this evidence is the result of scientific analysis and archeological excavation rather than analyses of written sources. In Transdanubia, a research project which studied the environmental changes in the area along the River Dráva (the modern Hungarian-Croatian border) found that excavation sites belonging to the Árpádian period were at lower elevations than late medieval sites, which suggests rising water levels in the later Middle Ages. In addition, the existence of a number of small lakes in the alluvial plain around the river during the early modern period provides additional evidence of increased water levels.

Not only the rivers but also the lakes show similar patterns in Transdanubia. As for the early medieval period (i.e., before the Hungarian Conquest in the late ninth century), archeological data is the most important source for historical hydrological investigations. In the area around Lake Balaton, numerous cemeteries and the settlement complex at Zalavár (Mosaburg) – situated on the shores of the Kis-(’Small’) Balaton, a huge wetland area southwest of Lake Balaton – have received considerable attention in the scholarship. Most studies conclude that low water levels prevailed in the Conquest period. In addition to these archeological investigations, a charter

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45 Cum nuper apud monasterium vestrum diverteremur, ostensa nobis per vos fuerunt ossa beatę Margaretę virginis monialis vestre filę quonadam clarię memorię Belę quarti regis hungarię in loco ut asserebatis exposito aquarum inundationibus. Et quoniam illam vitę sanctimonia non minus quam prosapia clarisse asserebatis nobis humiliter supplicasti ut illa inde transferri et in loco decentiori in quo inundationes huiusmodi non officerent poni permitteremus – MNL OL DL 25 312, for the most recent edition of the charter, see: Antonín Kalous, Plenitudo potestatis in partibus? Papežští legáti a nunciové ve střední Evropě na konci středověku (1450–1526) [Papal Legates and Nuncios in Late Medieval Central Europe], Brno 2010, p. 379.

46 For the final report on the project, see: Kovács/ZATYKÓ (eds.) (note 9).


48 Károly SÁGI, A Balaton szerepe Fenékpuszta, Keszthely és Zalavár IV–IX. századi történetének alakulásában [The Role of Lake Balaton in the 4th–9th-Century History of Fenékpuszta, Keszthely,
from 1335 allows for the reconstruction of the water level here with relative accuracy. This research suggests that the water levels were rising but still below modern (but pre-systematically regulated) average in the period between ca. 900 and 1335.\footnote{MNL OL DF 253 832. Published in: Nagy/ Véghely/ Nagy (note 31), pp. 294–307 (No 206.)} Scientific data for this period also confirms rising water levels in Lake Balaton, but varied reconstructions show considerable differences in the extent of the area affected by this process.\footnote{Vajda (note 5).} Highway constructions in the last twenty years along the southern shoreline of Lake Balaton unearthed archeological evidence of settlements proving that many of the Árpádian sites disappeared by the late medieval period because they were situated at lower elevations and were likely endangered by water rising in the plains around the lake.\footnote{Mészáros/ Serlegi (note 5).} As has been demonstrated for the western (and partly for the northern) shore of Lake Balaton,\footnote{Most recently, see: Tamás Pusztai, A tapolcai bencés apátság építéstörténete [Building History of the Benedictine Abbey of Tapolca], in: A Hermann Ottó Múzeum Évkönyve 52 (2013), pp. 149–170., esp. p. 161.} the water table also changed, which could have affected large areas that had previously been inhabited or suitable for cultivation. Some authors, however, point out that local populations regulated or at least influenced the water level of the lake. Though there may not yet have been a flood gate constructed primarily for regulating water levels in the Middle Ages, the huge mill complex not far from the present-day flood gate at Siófok may have functioned partly as such.\footnote{For the mills there, see: Andrea Kiss, “Rivulus namque, qui dicitur Fuk, fluens de prefato lacu” – Fok, Sár, Foksár, in: Bertalan Andrásfalvy/ Gábor Vargyas (eds.), Antropogén ökológiai változások a Kárpát-medencében [Anthropogenic Ecological Changes in the Carpathian Basin], Pécs 2009, pp. 49–63.} Despite doubts concerning the correlation between the fluctuation of water levels of Lake Balaton and precipitation in its catchment area, rising water levels have also been demonstrated along the shores of other lakes, such as Lake Fertő (northwestern Hungary/eastern Austria).\footnote{Kiss (note 5).}

In the eastern part of the Carpathian Basin, a number of studies have reached a similar conclusion. Settlements along rivers and mort-lakes in the Danube-Tisza Interfluve area follow a comparable pattern. Szabolcs Rosta’s recent study of medieval routes which passed through the Kiskunság region made some important contributions concerning the late medieval topography of the village of Akasztó. As Rosta explains, the environmental situation of the area surrounding the settlement is quite problematic; the roads leading to the closest market town, Kiskunhalas, would have had to cross the so-called “Nagy-Sár” (“big mud”), which was, at least in the late medieval and early modern period, true to its name, a marshy area. The presence of trade

routes through the area in the earlier Middle Ages at least calls into question whether it was marshland at that stage.\textsuperscript{55} Not far from the area, in the valley of the Tisza at Szer (Öpusztaszser), research has highlighted how the settlement “moved” towards higher elevations in the late medieval period, probably to escape the flooding of the Tisza which affected the area. Archeological topographies indicate clearly that many settlements on the Great Hungarian Plain from the Árpádian era were not rebuilt after the Mongol invasion (1241/42), and new dwellings were often built in the vicinity of old villages, on higher terraces protected from potential floods.\textsuperscript{56} In the eastern part of the Great Hungarian Plain, a recent study has documented this process not only at sporadic sites, but at a general regional level,\textsuperscript{57} by comparing average elevations of high Árpádian and late medieval (fourteenth to early sixteenth century) archeological sites – including settlements, churches, and cemeteries situated in the heartland of the wetlands that covered a huge part of the Great Hungarian Plain. The area studied covered roughly four thousand square kilometers (nearly five percent of the territory of present-day Hungary). The average elevation of the late medieval archeological site group was significantly higher than that of the Árpádian period. On the other hand, the paper pointed out that the desertion of specific areas and settlements could have been partly due to their direct vulnerability to flooding, but also, to some extent, to the potential inundation of roads that would have resulted in the settlements’ being isolated and cut-off from existing networks.

Despite the lack of precise information on long-term changes in the climatic conditions of late medieval Hungary, the abundance of circumstantial evidence gathered above does permit at least some conclusions. In at least more than dozen individual study areas in the Carpathian Basin, research has found that water levels rose from the late Árpádian period up to the late sixteenth or early seventeenth century. Such changes can be attributed to a number of factors: changes in the agricultural techniques, the felling of forests, and, of course, changes in the climate, to name just a few. While some scholars attribute the whole process to the LIA and increasing precipitation during this period, they would do well to resist this temptation. Recent


\textsuperscript{57} PINKE/ FERENCZI/ GÁBRIS/ NAGY (note 5).
research, for example, has not demonstrated a clear increase in regional precipitation sufficient to explain the clear shift in the water table. While climatic change may have influenced settlement patterns in the Carpathian Basin, changes in agricultural techniques, like the shift towards herding cattle, may also have been as influential in some areas as changes in precipitation.

5 Conclusions

This paper aimed to highlight possibilities for research on short- and long-term climatic and environmental processes in an area usually considered poor with regard to written evidence. Despite the scarcity of narrative sources and the limits this scarcity places on the research possibilities in the study of events related to weather in the medieval Hungarian kingdom, other genres of evidence – e.g., legal documents – have considerable potential for climate history research as Andrea Kiss and others have recently demonstrated. The two aspects this short article addresses do certainly not reveal much about either the Hungarian research potential for the whole of the Middle Ages or the climatic processes of the same area, but they do (hopefully) show that historical evidence can be combined with scientific and archeological data to significantly advance the understanding of some environmental processes if not climate itself.

The title of the article asks to what extent historians and scientists can provide evidence of the LIA using the sources available for the region. The answer very much depends on how the data presented here is interpreted, i.e., to what extent the presence of food scarcity or famine in distant regions of Hungary during a period of constant warfare can be attributed to the same factors as famines in northern France or Scandinavia. The situation is equally ambiguous regarding potential connections between the LIA and rising water levels in the Carpathian Basin. What is nevertheless quite clear is that a major transformation in the environmental conditions in the region occurred from the late thirteenth century onwards. Perhaps the more important task facing scholars is to understand the different factors contributing to this transformation in more detail understanding rather than pursuing a search for traces of the LIA.