

HYDRO-CLIMATIC EVENTS DURING THE LITTLE CLIMATIC OPTIMUM IN ROMANIA

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Key-words: historical climatology, Little Climatic Optimum, extreme events, Romania.

Hydro-climatic events during the Little Climatic Optimum in Romania. Our knowledge of the climate during the Little Climatic Optimum (8th–14th centuries) in this country comes from some historical studies of climatic events occurring in countries around or near Romania (Hungary, the Italian Peninsula, Ukraine, the Balkan Peninsula and the region around Constantinople), found in foreign chronicles, French, German, and Russian, as well as in some notes of foreign travellers in that territory. The records speak mostly of harsh winters, especially early in the interval considered, with rivers and the Black Sea frozen, or rainy summers, with floods, but also of some very warm winters, with tree in blossoms in January, and long, hot and dry summers. Some of these extreme events led to famine, pestilence, and high morbidity.

1. INTRODUCTION

After the last glaciation, the climate on Earth began gradually to warm up.

Historical climatology reveals periods of heating across Europe alternating with periods of cooling, outstanding being the Mediaeval Warm Period (Little Climatic Optimum) (between AD 750 or 800–900 and 1100–1200 or 1300) followed by the Little Ice Age (between 1300 or 1350 and 1850).

Researchers consider a difference of 0.5–1°C average temperature between the cold and the warm periods. However, within a few hundred years of warm period, numerous harsh winters or rainy and cold summers set in, just like in a cold period mild winters and hot, dry summers can be recorded.

2. SOURCES OF INFORMATION ON THE CLIMATE OF PAST CENTURIES

All information about prehistorical and historical climate use data from “the archives of nature”: glaciers, terrestrial and marine sediments, tree rings and sporopollenin analyses.

Data from the “archives of society” are also used: archaeological remains, data on different vegetation phases, remarks about hydro-climatic phenomena: floods, frozen rivers and seas, snow data (early, late, and snow depth), drought and others. Local archives speak about the value and price of crops, found in parish and monastic registers, royal and harbour registers, religious or secular books, calendars, and in chronicles, letters, travel journals, reports by officials, etc. (Pfister 1999).

According to sources, the limit of hot or cold periods is different (Table 1).

Some past hydro-climatic events in Central Europe and the areas around the Black Sea, recorded by different historians, can be referred also to regions around the Carpathians. Researchers such as Arago, Angot, Hann, and Hennig used ancient sources: Latin historians: Titus Livius, Strabo, Tacitus, Zosimus, Teofanus and German, French, and Russian mediaeval and other chronicles.

Romania’s past historical conditions were not favourable to the building of a stable society until the 13th and 14th centuries, when the Romanian Countries were founded. Therefore, our knowledge on the climate of past centuries in this territory is virtually absent until the 13th century. So, we could not exactly reconstruct the climate of the Middle Ages, but we may infer it.

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To get an image of the Little Climatic Optimum in Romania we used climate data about Europe recorded by Ch. Easton (1928) for Western Europe and C. Mihăilescu (2004), who offers additional data provided by Russian researchers, based on mediaeval Russian chronicles; Ch. Lebeau's work (1831) on the Byzantine Empire; N. Topor (1964), recorded by Western sources; P. Cernovodeanu and P. Binder (2003), who resorted to German and Hungarian sources, especially for Transylvania.

Table 1

The climate of the past two millennia

After Blytt (1876), Sernander (1908), based on studies of palynology in Danish peat bogs (Agostini and others 2005) :	After Emm. Le Roy Ladurie (2008), based on historical studies:
– AD 100 BC – 400 – warm and dry – AD 400–750 – cold – 750–1200 – warm – 1200–1350 – cold – 1350–1550 – cool – 1550–1850 – very cold – 1850–1950 – warm – 1950–1975 – cold (from 1975 – warm episode)	– AD 400 BC–200 Little Climatic Optimum, (<i>“the beautiful centuries” of the Roman Republic</i>) – AD 270–600 little Ice Age, (<i>the decay of the Roman Empire and ruinous invasions of Germanic tribes.</i>) – 800–900 – 1100–1200 or 1300 – the medieval warm (Little Climatic Optimum) 1300 or 1350 – 1850 – Little Ice Age – 1850 – to date – warm period (1950 – 1970. – short cooling period)

3. SOME HYDRO-CLIMATIC EVENTS BETWEEN the 8th – 10th CENTURIES

We have no historical climatic information on this interval connected strictly to the southern territories that would later become the Romanian Countries. There are some foreign historians who recorded events in neighbouring regions around the Carpathians (the Balkan Peninsula, Constantinople region, the Italian Peninsula, areas around the Black Sea or in Central Europe and the plains of Ukraine), which might suggest similar climatic conditions.

Although researchers dealing with climate variations place the beginnings of the Little Climatic Optimum around AD 750–900 (Le Roy Ladurie 2004; Agostini and others 2005), information on cold winters in that period are more numerous than about warmer winters. This might be due to the high frequency of cold winters after the last major glaciation, or to people bearing harsh winters with greater difficulty, and therefore they are better remembered by society. Consequences in these cases (famine, epidemics, and high mortality) generally last much longer in the memory. If the winter is mild, short, with little snow, it usually has fewer consequences and is easily forgotten.

Before AD 800 most information relate to harsh winters: 717, 768, 786, 791, 794–795 and especially to “one of the major winters ever known” (Easton 1928), i.e. 763–764, when “all wars, even all civil affairs were suspended by excessive cold which made one think of the total disappearance of people and animals” (Lebeau 1831). Numerous German, French, Dutch, and English sources mention it in greater detail or in brief. That winter was exceptionally severe throughout Europe; in Constantinople, the Black Sea was frozen from October to March, and in spring floes reached the Aegean Sea. In Romania warm winters were few: in 739, 767 and 776.

After AD 800 cold periods were still numerous. The Black Sea froze in 800, 801, 858–859, the Adriatic in 850, 859 and 864 (the Venice lagoon froze and carriages could be driven on ice), in 821 all the rivers of Europe, the Rhine and the Danube in 822. Some of these extreme events brought famine

(very rainy spring in 801, and all the year was barren) with high mortality among people and animals because of hunger and cold (in 859–860, frost lasted from November to April, even in Italy, so that all seeds died, vines dried and wine froze in pots).

There is a lot of information about harsh winters *in the next century*, too. Thus, in 932–933 a frosty winter froze the Black Sea, in 943 and 981 harsh winters throughout Central Europe; in 992, a long and frosty winter in Southern Europe. Some records are questionable, for example, on July 15, 993, lakes froze and all fish were dead in Germany.

The terrible storm of 906 in Constantinople, with south-west winds that uprooted trees, destroyed houses and churches. In 907 and 979 major droughts in Ukraine, 981, a summer drought in Russia, 945 large spring floods in Kiev (the oldest evocation of a flood on the Dnieper River).

The year 994 was exceptionally hot and almost all rivers in Europe dried up in summer. Some of these phenomena produced disastrous epidemics, death and famine.

The above information suggests that in Eastern Europe the Little Climatic Optimum did not begin in the 9th and 10th centuries, but 100–200 years later than in Western Europe. In the West there had been some warmer periods, such as the 800–801 warm winter, followed by the plague; 807–808 and 838 were rainy winters (from January to March it thundered and “a scorching sun perched the earth”, Easton, 1928); 843–844 mild winter; 863, warm, rainy, windy winter; 872 hot and very dry summer; 999 and 1000 two very hot summers, with unheard of droughts, waters and springs dried up.

4. HYDRO-CLIMATIC INFORMATION IN THE 11th CENTURY

The regions around Romania experienced harsh winters in 1008, 1010, 1020, and 1035; 1060, a hard winter in the Lower Danube; 1077, frosty winter in Eastern and Central Europe. A frozen Black Sea in 1008, 1011 and 1076; in 1011 the Bosphorus was in the same situation.

Dry years (especially dry summers) were 1008, 1017, 1024, and 1035 (in the East it did not rain for 6 months), 1037 (over 6 months of drought in Thrace and Macedonia), and 1067.

Rainy summers: 1009, 1012, 1015, 1016, and 1020, with floods: 1012 (the Danube), 1093 (the Dnieper), 1096 (around Constantinople). Many of these events resulted in compromised crops, invasion of locusts, famine, pestilence and high mortality.

5. HYDRO-CLIMATIC INFORMATION IN THE 12th CENTURY. THE APEX OF THE LITTLE CLIMATIC OPTIMUM?

Most information generally speak of cold winters, which usually make peoples' life difficult. Cold periods: 1100, hard winter in Thrace; 1133, cold winter in Italy and Hungary; 1044, snowy winter in Kiev; 1167–1168 frozen Black Sea.

Rainy summers and floods: 1108, floods in Russia (around Kiev), 1150 (the Danube), 1156, floods in all European countries, 1162 and 1164, floods (the Dniester), 1193, floods in the upper Danube region. In 1177, warm winter in Russia.

Some exceptional hydro-climatic events were being recorded in the Romanian Countries which justifies listing this century in the Mediaeval Warm Age. For example, the hot summer of 1136 in the West Plain dried up the rivers; a hot dry summer also in 1142, many people died of hunger.

In 1186, trees flourished in January, birds laid eggs and at the end of the month apples were no bigger than nuts, and the warm weather made all crops develop quickly. Some of these exceptional events brought again famine, epidemics, and high mortality rates.

6. SPECIAL EVENTS IN THE 13th CENTURY

Some remarkable events were recorded on the territory of the Romanian Countries and associating them with information on the surrounding countries gives a clearer profile of the climate at that time.

- 1209–1210, a terrible winter throughout the Balkans, the Black Sea was frozen.
- 1216 a rough winter in Italy, the Po River froze, so did the wine in cellars; the weather was frosty also in the east, followed by a rainy summer with epidemics, poor harvests, and famine.
- 1223–1224, Russia experienced an unprecedented drought, forests and swamps burned “we all went across a dried Dnieper” (Russian Chronicle, quoted by Mihăilescu 2004). After two years of droughty weather, rainfall made all crops rot in the fields and famine raged throughout Russia.
- 1225–1226, on December 6, pastures flourished in Transylvania.
- 1232, the Bosphorus froze, and the summer was rainy: in July–August, the Danube overflowed. A hard winter, the wine froze in cellars; a frozen Black Sea and Adriatic Sea in 1234.
- 1234–1235, rainy summer with floods in the Danube basin; 1236, harsh winter across Western and Central Europe, frozen rivers, “Our old Danube River froze to the bottom” (Hepites quoted by Topor 1964), there followed five months of drought in the warm season.
- Winter 1241–1242, much snowfall, terribly cold at Christmas time, the Danube was frozen, and cold spread to southern Europe, in Italy the Po froze. Famine caused by poor harvest and augmented by terrible Tatar plunder was followed by a great epidemic, probably the plague, which made many victims. Famine and plague lasted until 1245, with repercussions in Transylvania and south of the Carpathians, “Cumania” (Wallachia) “remained almost depopulated” (Cernovodeanu, Binder 1993).
- 1246, frosty winter in Central Europe and in Ukraine, “... many horses perished because the snow was so deep that they could not get the food under it”; in his journey to the Mongolian Empire, the papal legate Plano Caprini (1182–1252) was forced to cross the Dnieper on ice (Mihăilescu 2004). The Black Sea was frozen more than three miles off shore. In 1247, there was much snow in Kiev Principality. In 1254, the Danubian Countries experienced severe frost in January. In 1267–1268, between Christmas and Epiphany, the middle Danube sector was flooded in winter; 1270, cold winter in Central Europe (Bohemia, and Hungary), in Novgorod, the snowfall of March 25 covered many courtyards and people; 1280, big Danube floods.
- 1288–1289, trees were blooming at Christmas time, and vines blossomed in April. In that exceptional winter, children bathed in the rivers and harvesting took place two months earlier than usual (Zolnay, cited by Cernovodeanu, Binder 1993). 1298 was a very droughty year, with forest fires in southern and central Russia. In 1299 there was little rain in summer, poor yields over a vast territory in the east.

7. THE 14th CENTURY. THE LITTLE CLIMATIC OPTIMUM AT THE END

Since some researchers have extended the Mediaeval Warm Period beyond 1300, we also have recorded some special events of that century.

In 1300, 1301, 1302, and 1304 winters were generally mild and short, no snow; in 1301 trees were blooming in January, summers were hot, and dry; in 1304, the Danube could be crossed on foot.

A very cold winter in 1304–1305, the Black Sea was frozen. In 1312, flooding on the Danube. Major floods in 1317 followed by a big epidemic, probably the plague, in Transylvania and Wallachia, with a steep demographic decline; the epidemic spread across Europe (“the Black Plague” from 1348 to 1350) (Cernovodeanu, Binder 1993). In 1322–1323, the Black Sea shores were frozen. 1327 was a

mild winter year; in the West Plain trees were in flower in May, in the first August days harvesting began.

In 1330–1331 (or 1333–1334), the Arab traveller and geographer Ibn Battutah (1304–1377 ?), accompanying a Byzantine princess to Constantinople, passed through Dobrogea and described that winter as follows: “It was then in the midst of winter. I put on three coats and three pairs of pants, ... had woollen footwear, a double lined hamp pair over it and ... a third, fur-lined pair ... When I was washing my face, the water ... turned into ice and if I was shaking my beard, white frost fell from it ... I could not get on horse because of my many clothes, so my companions had to push me on horsedback” (Brătescu 1923).

1338–1340, locusts caused havoc from Bârsa Land to Lipova Land, summer rains drove them away, but still there was famine. 1341, a mild winter in Central Europe, but drought, famine and epidemics in the east. It seems that the winter of 1343 was warm, and very droughty.

1346, 1347, 1348, 1349, and 1350 maximum rainfall in summer, very cold winters, poor harvests, famine, and plague in the east.

1363, droughty, poor crops, and famine. In the West Plain, the Hungarian King Louis I of Anjou ordered his governors to go from house to house, to record the inhabitants’ grain reserves and sell the surplus in the market (Cernovodeanu, Binder 1993); 1367 was a mild winter.

1370 was a rainy year, with big floods. In 1371, Russia had a mild winter, the hot and dry, droughty summer dried up rivers, lakes, and swamps; forests and peat bogs were burning.

1387 was a very hot and dry summer, in Switzerland and Central Europe it rained only 6 times from February 28 to September 19. Heat was so great that even after several hundred years, that summer is remembered as “the old hot summer” (Easton 1928). In contrast, Russia experienced big summer flooding.

In September 1396, Peter von Rez (? – 1396), a German knight participating in the battle of Nicopolis alongside King Sigismund of Hungary, wrote: “The wind was blowing and it rained heavily, and we had to cross a big water (probably the Olt) and many people drowned then. They (the local Vlachs) pulled down the bridges in front of us, we had to run all crazy through high mountains and along some bad paths, through large forests and among fierce people ... People were dying of hunger and cold... It took over seven days” (*Călători străini*, 1968).

In 1399 severe winter throughout the Danube basin. Did the Little Ice Age begin?

8. CONCLUSIONS

The period spanning the 8th–9th and 13th–14th centuries, called the Medieval Warm Period or the Little Climatic Optimum, started probably earlier in Western Europe than in Eastern Europe. Besides, the expansion of the Vikings to Greenland and farther on to the American continent is explained in part by climate warming in North-Western Europe at that time.

Presumably, the Little Climatic Optimum in Eastern Europe had lasted for some 100 years.

Information on that period is limited and does not enable a general climatic characterization or tendency to heating or cooling either. Also, some information are too general, both in time and space: hard winter, but where? or dry year, but we do not know whether in summer or in winter? (Teodoreanu 2007, 2012)

There were numerous harsh long winters and much snow in many years, when sea and rivers would freeze; also cold or rainy summers and floods, especially in the first part of the period. However, some winters were very warm, e.g. 1186, 1288–1289, 1327, 1341, 1343, 1367, 1371 and 1387, as were summers hot and dry: 1008, 1017, 1024, 1035, 1037, 1067, 1136, 1142, 1223, 1298–1304, 1363, and 1387.

It should be mentioned that weather in Eastern Europe was not always similar to that in Western Europe. For example, in 801, the Black Sea froze, but in the West the winter was warm; in 1116, at Christmas time, they would gather fresh strawberries, as a chronicle of Liège tells us (Jouzel, Debroise 2004), but no information about Eastern Europe; in 1387, it was hot and dry in Central Europe, but big floods in Russia, etc.

However, some periods were similar throughout Europe, for example the harsh winter of 1020, or a warm year 1300–1301–1302.

Generally, normal times were not mentioned, except in rare cases, because anyway they had been easily forgotten.

We can appreciate temperature and precipitation values only very approximately, as found in written sources (flowering trees in winter, which indicates long positive temperatures), or flood water level on the city walls, as known in some French cities.

Perhaps further research will provide more information and clarifications of the climate of Europe during the mediaeval warm of the 8th–14th centuries.

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Received March 4, 2013