How to Write and Think about Political, Social, and Economic History in Dialogue with Climatic and Environmental Data: A Case Study in the Age of Charlemagne, 740-820

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Over the past two decades, the growing availability of paleoclimatic data has opened new opportunities for cross-fertilisation and comparison between natural and social sciences. The parallel history of climate and the environment is often undertaken in a holistic manner, assuming simple and direct causalities between the climate and social change before the onset of anthropogenic global warming. In agrarian societies, natural climate change would have mechanically caused subsistence crises and occasionally, civilisational collapses in human societies. A recent review article published in *Nature*, calls for a more rigorous understanding of environmental and societal responses to climate change in the emerging field of multidisciplinary studies in HCES (History of climate, environment, and societies)[1].

Faced with the finding of research into historic climate, the historian must question the nature of the data and their specific conditions of gathering, validity, and context, as well as the methods and objectives of modelling. Comparing paleoclimatic data and primary sources requires considering their specific limitations and finding a common scale of observation. It also requires careful contextualisation of historical data[2], whether direct evidence of climatic events, or indirect evidence, such as famines[3].

I have recently published in French an in-depth historical case study on the interactions between climate, environment, power, and society in the age of Charlemagne (740-820 AD), a time interval of 80 years that is compatible with the heuristic requirements of both disciplines[4]. Obviously, I do not plan to give a summary of this almost 600-page book, but rather to draw from it a broad methodological reflection on the interactions between climate system, natural and social ecosystems. The objectives are to analyse a geopolitical space, Carolingian Francia, as "a social-ecological system that includes human societies and ecosystems, in which humans are part of nature. The functions of such a system arise from the interactions and interdependence of the social and ecological sub-systems. The system's structure is characterised by reciprocal feedbacks, emphasising that humans must be seen as a part of, not apart from, nature"[5].

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1 DEGROOT D. et al., « Towards a Rigorous Understanding of Societal Responses to Climate Change », in *Nature*, 591, 2021, p. 539-550.

2 SLAVIN Ph., « Climate and famines: a historical reassessment », in *Wiley Interdisciplinary Reviews: Climate Change* 7 (3), 2016, p. 433-447. https://doi.org/10.1002/wcc.395; WOZNIAK Th., *Naturereignisse im Frühen Mittelalter. Das Zeugnis der Geschichtsschreibung vom 6. bis 11. Jahrhundert*, Berlin, Walter de Gruyter, 2020.

3 NEWFIELD T., « The contours of disease and hunger in Carolingian and early Ottonian Europe (c.750-c.950 CE) », Ph.D. Thesis, Montréal, McGill University, 2011.

4 DEVROEY J.-P., *La nature et le roi. Environnement, pouvoir et société à l'âge de Charlemagne (740-820)*. L'évolution de l'humanité, Paris, Albin Michel, 2019. Except for quotations from written sources, we do not systematically refer to the book in the body of the text.

5 VAN DIEMEN R., « Glossary », in *Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems*, Geneva, IPCC, 2019.

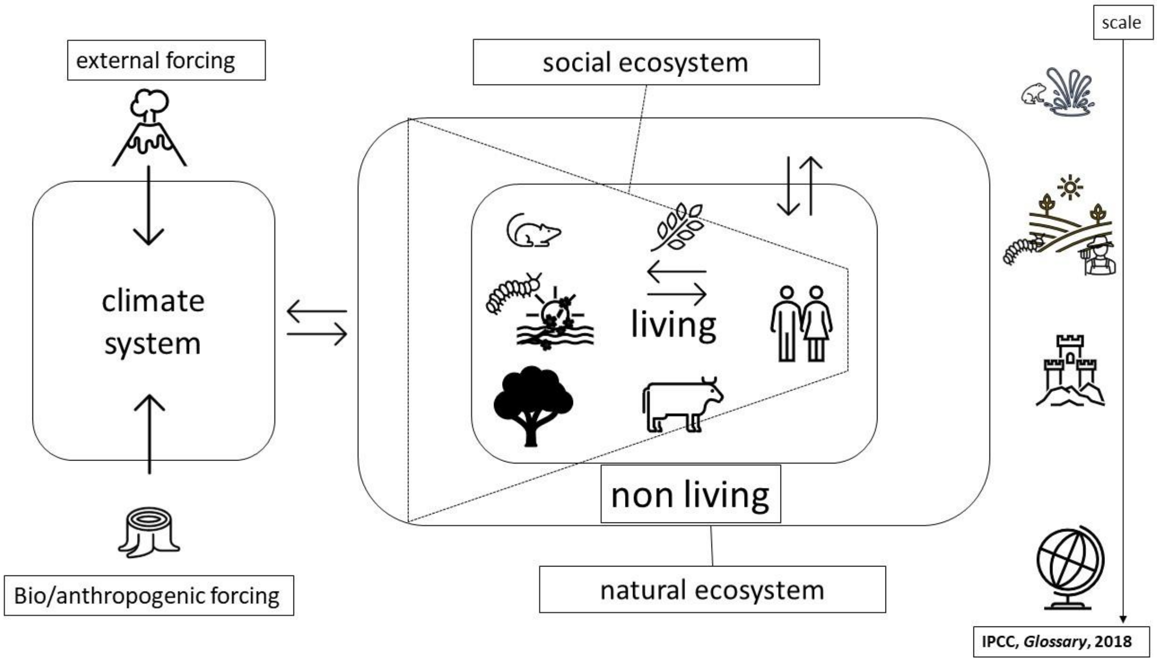


Table 1: Climate, natural, and social ecosystems[6]

Within these constraints of time and space, the most reliable paleoclimatic source for measuring climate change are tree ring records. The seminal study by Büntgen et alii proposed a seasonal reconstruction of rainfall (spring/western Central Europe) and temperature (summer/northern and southern Alpine slopes) during the first two millennia AD[7].

The reconstruction is not downscalable: Results should be considered as a global model of climate variability in three climatic regions of the northern hemisphere: Northern Europe (NEU), Central Europe (CEU) and less directly, the Mediterranean (MED).

The validity of this model has not been checked at the level of regional (or geo) climates. While the core regions of Francia were in western central Europe, this political entity also included North Sea and Atlantic littoral societies, Northern Italy, and more marginally the Mediterranean. Winter is outside the scope of tree records, which are also less sensitive to extreme weather or extreme climate events related to anomalies in precipitation (e.g., the quality of winter rainfall recharge in Mediterranean ecosystems) or external forcing such as modulations of solar activity or volcanic forcing, which can lead to cooling of average temperatures over several years, even a decade or more.

[6] The figures included in this article are from DEVROEY J.-P., *La nature et le roi. Environnement, pouvoir et société à l'âge de Charlemagne (740-820). L'évolution de l'humanité*, Paris, Albin Michel, 2019.

[7] BÜNTGEN U. et al., « 2500 Years of European Climate Variability and Human Susceptibility », in *Science*, 331 (6017), 2011, p. 578-582.

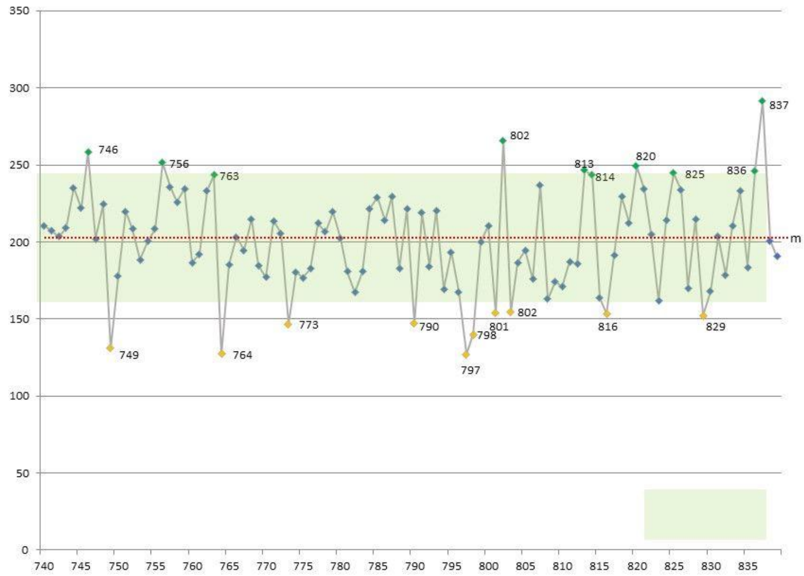
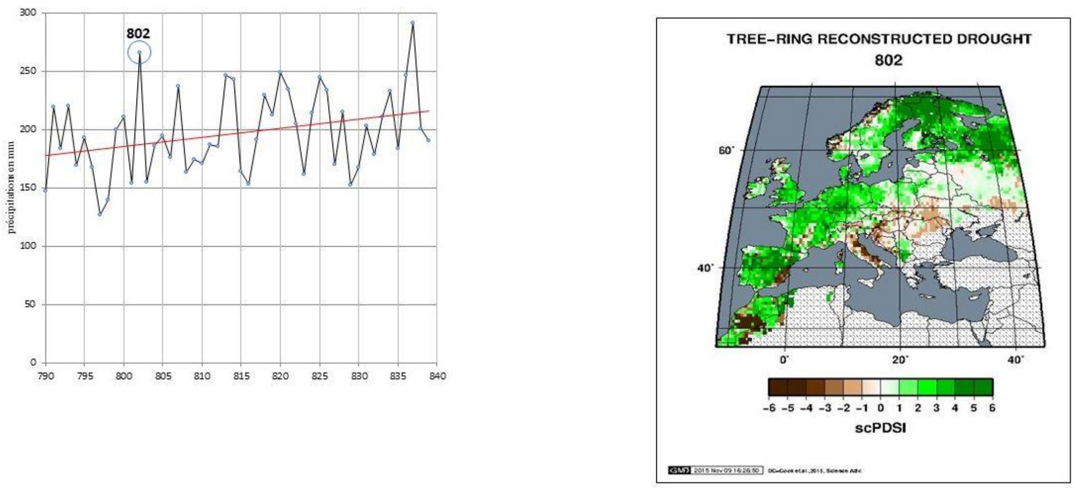


Table 2: Spring rainfall (April, May, June) in north-western Francia[8]

For volcanic activity measured by ice records, several eruptions close together may have triggered a climate change of several decades, as is now being considered for the Late Antique Little Ice Age (LALIA) in the mid-6th century AD[9]. For this study, checking regional climate diversity was also facilitated by invaluable studies on the Lake Bourget sedimentation and the hydrology of the Rhone basin, surveying the annual precipitation regime on the north-eastern slopes of the Alps in the longue durée[10].



Cook, et al., *OWDA*. 2011

Table 3: Growing spring rainfall in north-western Francia[11]

8 Data in Table 2, 3, 4 (BÜNTGEN, U. et al., « 2500 Years of European Climate Variability and Human Susceptibility », in *Science*, 331 (6017), 2011, p. 578-582).

9 BÜNTGEN U. et al., « Cooling and Societal Change during the Late Antique Little Ice Age from 536 to around 660 AD », in *Nature Geoscience*, 9 (3), 2016, p. 231-236.

10 ARNAUD F. et al., « 7200 years of Rhône River flooding activity in Lake Le Bourget, France: a high-resolution sediment record of NW Alps hydrology », in *The Holocene*, 15 (3), 2005, p. 420-428.

11 Supplementary data (COOK E. R., SEAGER R., KUSHNIR Y., BRIFFA K. R., BÜNTGEN U., FRANK D., KRUSIC P. J. et al., « Old World Megadroughts and Pluvials during the Common Era », in *Science Advances*, 1 (10), 2015, e1500561).

Statistical analysis of the dataset places the years between 740 and 840 in western central Europe in a grey zone with slight fluctuations in spring precipitation, and a contrasting geographical climate change in summer temperatures. The average stability of rainfall is misleading. From 790 to 840, the gradient of the regression line is clearly positive, indicating an increase of 39 mm of rainfall over half a century. Northwest Francia would therefore have experienced a significant shift towards progressively wetter conditions during the second half of Charlemagne's reign, as well as the reign of his son, Emperor Louis the Pious. Over a 100-year period, patterns in summer temperatures illustrate asynchronous climatic conditions in northern and southern part of Francia. In the Bavarian Alps, tree records show that the summer season in the northern part of the empire progressively cooled by about 1.4° Celsius over a century. In the Swiss Alps, summers have gradually warmed up by about 0.7° Celsius in a century, reflecting the regional climate in southern France and northern Italy.

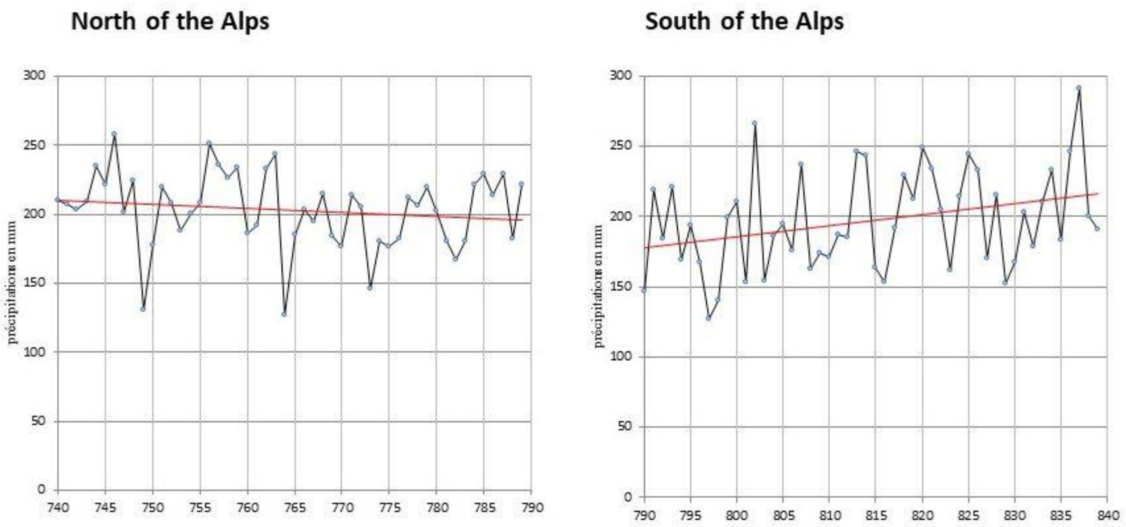


Table 4: regional variability in summer temperature (June, July, August), north and south of the Alps

Written records collected and compared with paleoclimate datasets register mostly extreme events. When writing about the weather, few medieval witnesses referred to normal or exceptionally favourable weather for their surroundings. Their cognitive lenses in interpreting climatic events or ecological crises such as famines or diseases are simultaneously shaped by distance, by their own culture and cosmology, and by collective or individual features of political, religious, community or familial background[12].

The track record for the 80 years of Charlemagne's age relies on a traditional analytical grid combining mentions of climate, famine, and disease in historical sources. Historical records identify extreme weather events, such as the terrible winter of 763-764, which is documented by a very wide range of Byzantine, Frankish, Irish, and early English sources. The paleoclimate proxies make it possible to compare historical mentions of food access decline with indices of seasonal rainfall and temperature, in a crucial period for the growth of the main crops.

12 WORSTER D., « Nature and the Disorder of History », in *Environmental History Review*, 18 (1994), p. 1-15; CRONON W., « The Uses of Environmental History », in *Environmental History Review*, 17 (1993), p. 1-22; CRONON W., *Nature et récits. Essais d'histoire environnementale*, translated by Mathias Lefèvre, Bellevaux, Éditions Dehors, 2016.

Carolingian sources reveal four periods marked by subsistence crises between the years 740' and 820'. Under the conditions of productivity in agrarian societies, before the first globalisation and the chemisation of agriculture, famine is often seen as the result of crop failure, and thus as a good proxy for climate change. The famine/disease association is also an indicator of the intensity of the ecological shock. What is methodologically new in our survey of Frankish sources is to record the entire yearly record in annals, which makes it possible to compare the climatic or ecological background with the socio-political and religious context. The survey includes positive and negative mentions in all active historical sources (Carolingian annals or chronicles mentioning at least one event).

	763-764	779	792-794	804-807
mentions in annals	26	9	7	0
number of active sources	32	37	36	35

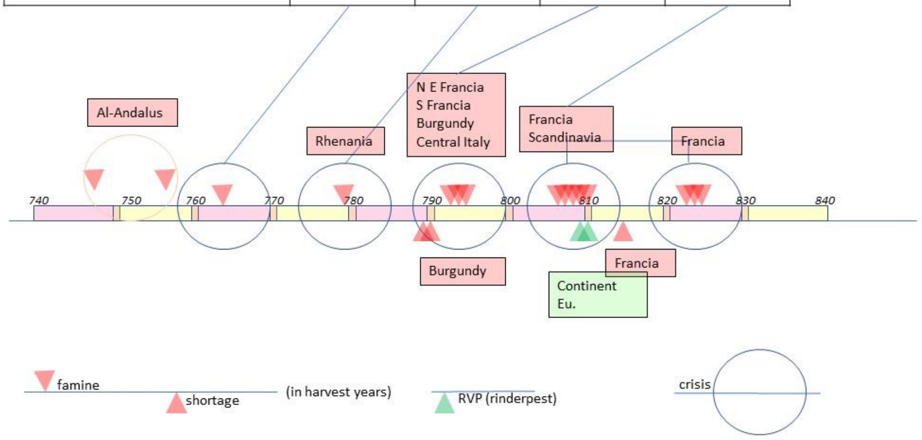


Table 5: Mentions of natural crisis in Frankish sources

The matching of the Paleoclimate proxies and the Carolingian source record yields very poor results. This can be explained, not only in Francia, but also in all cultural areas, by the losses between the phenomena and the perceptions by the authors, and by the filter of their representations.

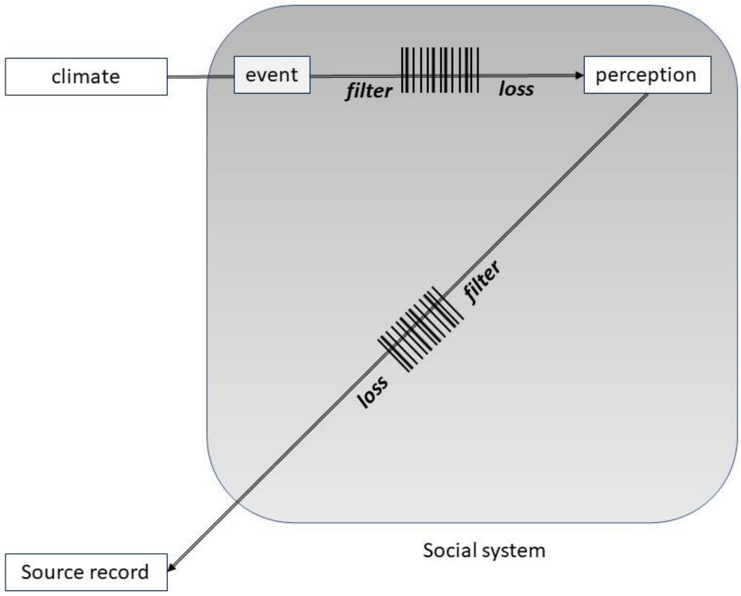


Table 6: Climate, perception, and source records

The approach to meteorological events by magnitude makes it possible to analyse the conditions under which the weather was observed. The witnesses are influenced by the political context and by religious cosmologies, but also by environmental conditions and regional geoclimates. There was a significant discrepancy in the way authors perceived and reported on hot, cold, dry, and wet according to the seasons. This discrepancy between climate and human testimony was explained by cultural perceptions of what was unusual during a season: In north-western Francia, spring was considered a wet season; witnesses were more sensitive to severe droughts that were perceived as anomalies, regardless of the growing conditions of the crops. The belief in winter as the season of God's tribulation, repeatedly expressed by St. Augustine and St. Jerome, probably contributed to the over-representation of wintry weather in Western Central Europe and the British Isles. This grid, which I would describe as phenomenological, makes it possible to carefully articulate the 'given' Nature, deriving from the Paleoclimate data, and the 'constructed' Nature of the witnesses[13].

[13] DESCOLA Ph., *Par-delà nature et culture*, Folio essais 607, Paris, Gallimard, 2015 ; DESCOLA Ph., INGOLD T., LUSSAULT, M., *Être au monde. Quelle expérience commune ? Débat présenté par Michel Lussault*, Lyon, Presses universitaires de Lyon, 2014.

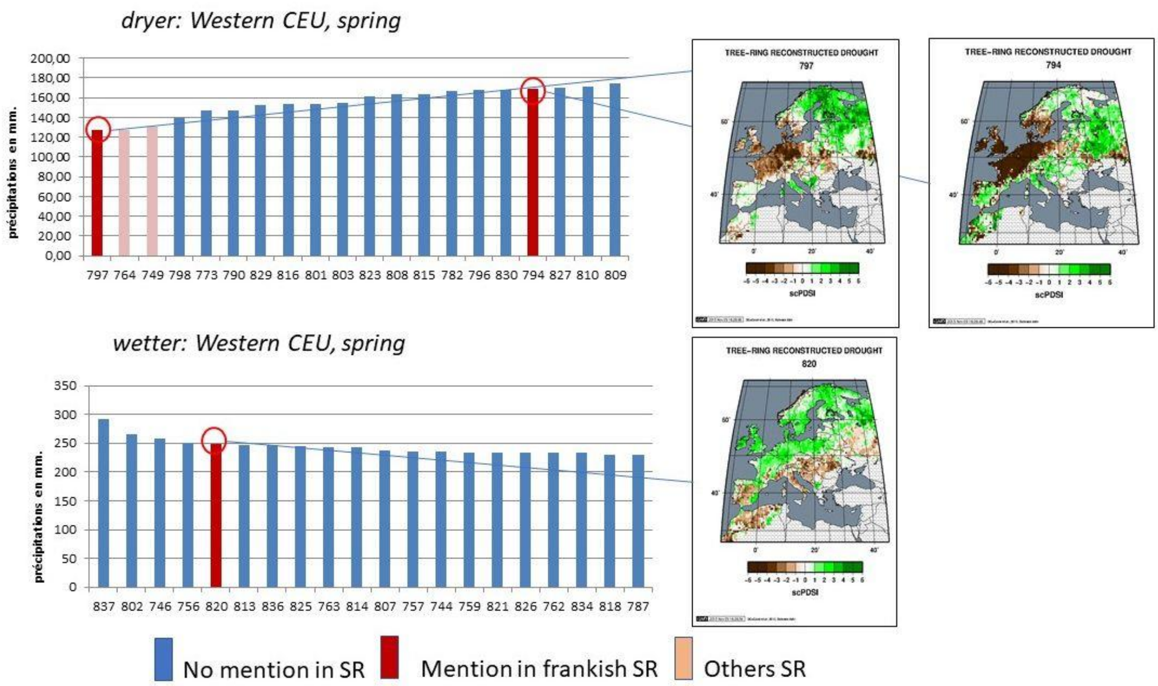


Table 7: Climate anomalies and source records

Comparativism is therefore a powerful tool for interpreting these losses and filtering according to cultural and religious differences. We chose to consider the historical records from sources produced in the three climatic regions bordering on Francia, adding to Western Central Europe, Northern Europe with the Irish and early English annals, and the Mediterranean with the Arab-Muslim sources from Spain and North Africa, the Byzantine, and the Syriac Christian Chronicles. Nevertheless, this survey includes only 'positive' mentions of events, whether climatic or ecological. Arab-islamic sources indicate a decade-long mega-drought between 744 and 755 AD in the southern part of the Iberian Peninsula. This very specific regional phenomenon, which would deserve much more detailed research, was left aside, given that it did not seem to have any equivalent in Southern Francia and in the Pyrenean foothills, and in the absence of sufficient paleoclimatic data.

Comprehensive historical surveys reveal under what circumstances and for what reasons witnesses speak or remain silent, and which meteorological or ecological phenomena have the most meaning and significance for them: astronomical or geological phenomena interpreted as signs and portents; natural hazards interpreted as God's tribulations.

Region	events (all)	signs & portents %	climate %	famine %	disease %
All	**763**	**48**	**30**	**11**	**11**
NEU	**126**	**33**	**33**	**13**	**21**
irish	95	27	36	13	24
anglo-saxon	31	52	26	13	9
CEU	**389**	**52**	**29**	**8**	**11**
MED	**248**	**50**	**30**	**15**	**5**
arabo-islamic	44	9	43	41	7
byzantine	119	66	32	1	1
christian syriac	85	48	21	21	10

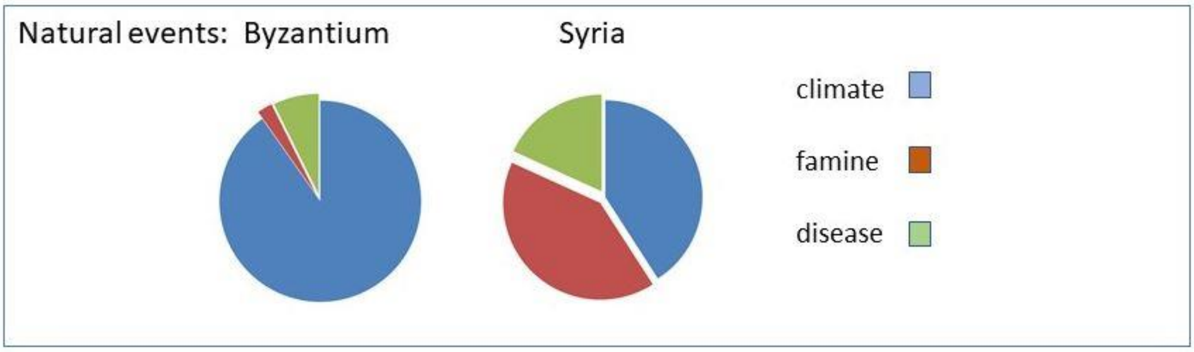


Table 8: Religious, and cultural perceptions

This analytical grid, which reveals the different sensibilities of witnesses to natural phenomena, opens new research questions. During the eighth century, according to historical sources, Byzantine Anatolia did not suffer from any famine after 730, whereas neighbouring Syria was confronted with eleven subsistence crises between the years 730 and 800. This contrast can also be related to other natural hazards, epidemics after 740, and pests throughout the eighth century. Should this contrast between the two regions be interpreted positively as a real difference in climate or other natural factors[14]? I personally doubt it. The hypothesis that the two cultural areas had different perceptions of natural hazards should be seriously tested. Despite the rule of iconoclastic emperors, iconodule chroniclers, whose writings are the only ones that have come down to us, seem to have hesitated to use natural crises as an argument against their enemies, preferring to point to the protective interventions of Mary, Mother of God, in support of the Greeks, or to interpret natural signs and portents as evidence of God's hostility to iconoclastic rule.

The perception of the weather depended on meteorological knowledge inherited from antiquity through Isidore of Seville and Bede the Venerable. Early in the ninth century, the redactor of the Annales Regni Francorum makes a causal link between climate anomaly – the winter is very mild (where the order of nature would dictate that it should be cold) – and the

[14] STATHAKOPOULOS D., « Reconstructing the Climate of the Byzantine World: State of the Problem and Case Studies », in *People and Nature in Historical Perspective*, by Jozsef Laszlovszki and Peter Szabo, Budapest, Central European University Press, 2003, p. 247-261.

outbreak of a pestilence: in 801, "a pestilence occurred because of the mildness of the winter weather"; in 808, "There was at that time a very mild and pestilential winter"[15]. To interpret these two references correctly, the underlying logic must be reconstructed: the mild winter is a sign of air pollution, which, according to bioclimatic theory, is the source of epidemics. If thoroughly examined, meteorological records can also yield valuable evidence. During the second half of the eighth and early ninth centuries climate in Ireland was mainly characterised as stormy/windy (37%) and snowy (34%), to be compared with two features of the oceanic climate in north-western Europe: typically windy weather, and mild winters. These two anomalies suggest the hypothesis of an extreme climatic event linked to one of the important factors determining the Irish climate, the North Atlantic Oscillation (NAO), which would have reached a cold and wet peak, also reported locally by pollens in late 8th. During the years 777-781, Ireland also saw violent outbreaks of disease in humans and livestock. This may well have been triggered, as in 809-810 on the Continent, by a zoonotic disease caused by a common ancestor of present-day rinderpest and measles[16]. Palaeozoological evidence suggests a decline in cattle breeding, while archaeology has revealed an extraordinary flourishing of watermills. All these clues allow us to build a historical narrative to be tested in the future with fresh paleoclimate reconstructions. An exceptional conjunction of biological and climate factors may have triggered a systemic adaptation of the domestic agrarian system, moving from an ecosystem mainly focused on livestock farming to an agropastoral economy that developed cereal cultivation to an unprecedented degree. Environmental constraints may have launched a process of creative destruction, according to Schumpeter's economic terminology, by structurally modifying the Irish economic and social environment. Social stratification has shifted to the elite, as illustrated by the marked preference of high-status sites for the best farmland in the North of Ireland. Through complex interactions and technological innovations such as the spread of the watermill and the adoption of the plough in the 10th century, these phenomena led to agricultural and population growth and significant changes in Irish society. The above case study shows that climate change should not be interpreted in past societies according to a monocausal and deterministic deductive logic, but by simultaneously considering the conjunction of exogenous (a possible negative phase of the North Atlantic Oscillation) and endogenous factors, through complex interactions and feedbacks within the natural and social ecosystems. The best ecological scenario in the Irish case is not collapsive but adaptive[17].

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[15] *Annales regni Francorum*, MGH SS rer. Germ., 6, 114, 125.

[16] NEWFIELD T., « A great carolingian panzootic: the probable extent, diagnosis and impact of an early ninth-century pestilence », in *Argos*, 46, 2012, p. 200-210.

[17] MCCORMICK, F., KERR T. R., O'SULLIVAN A. 2013. *The economy of Early Medieval Ireland*, EMAP report, 7.1., Dublin, 2013.

cycle	Nb.	cold	rainy	stormy	snowy	dry	length	hot	good	Indet.
Year	65	5	23	10	8	14	1		1	3
spring	9			4	2			1	1	1
summer	16	6	3	3				3		1
fall	4	1		3						
winter	77	52	1	5	3		11	5		
Total	171	64	27	13	10	14	12	9	2	5

Irish and early English source records (NEU)	%
stormy/windy	**37,0**
snowy	**34,0**
cold	11,5
rainy	11,5
dry	6;0
hot	0,0

Frankish source records (CEU)	%
cold	**54,0**
rainy	20,0
dry	11,0
stormy/windy	8,0
hot	7,0
snowy	8,0

Table 9: Weather conditions in Francia and the British Isles

Turning now to Francia in the age of Charlemagne, I will briefly outline the parallel history of climate and environment across four crises: an extreme climate event, the winter 763-764, and three periods described by Carolingian sources as severe famines ("great hungers"): a regional crisis in the Rhine Valley (779), multi-annual and multi-regional crisis phenomena between 791 and 794 in Francia and Italy, and a prolonged period of climatic degradation between 800 and 824 in western Central Europe, accompanied by a rinderpest pandemic in 810-811. A multifactorial approach shows that the climatic parameter never acted alone in the perception and in the economic and social repercussions of environmental parameters. Witnesses were influenced in their assessment of the critical nature of a crisis by elements of a religious, political, military nature, etc.

The Terrible Winter of 763-764

According to written sources, the three major climatic regions, the Mediterranean, western central Europe, and western northern Europe, experienced simultaneously a severe winter in 763/4. This type of global climatic phenomenon is often associated with a significant volcanic forcing. This was the hypothesis underlying the seminal 2007 paper by McCormick, Dutton, and Mayewski. Using one of the first ice cores in Greenland, GISP2, they found that eight of the nine extreme winters mentioned in the written sources from 750 to 950 AD corresponded to the signing of volcanic eruptions, a sulphate peak in GISP2[18]. The 2012 model published by Gao et alii using 54 ice cores from the two hemispheres now challenges these findings Between 765 and 770, Japan had a volcanic event, with no peak in the ice cores[19]. A close reading of the written evidence suggests the conjunction of three different extreme climatic events: in the

[18] McCormick M., Dutton P. E., Mayewski P. A., 2007, « Volcanoes and the Climate Forcing of Carolingian Europe, A.D. 750-950 », in *Speculum*, 82 (4), 2007, p. 865-894.

[19] Gao Ch., Robock A., Ammann C., « Volcanic forcing of climate over the past 1500 years: An improved ice core-based index for climate models », in *Journal of Geophysical Research: Atmospheres*, 113 (D23), 2008, p. 1-15; Sigl M.et al., « Timing and Climate Forcing of Volcanic Eruptions for the Past 2,500 Years », in *Nature*, 523 (7562), 2015, p. 543-549.

Black Sea and eastern Mediterranean, an exceptionally cold winter from October to February 764, probably caused by an abnormal position of the Siberian High, driving dry and cold continental polar air masses to the southwest; in southern Gaul and Illyria, an extreme winter, resembling the meteorological conditions observed in Western Europe in February 1956 (the winter of Fellini's Amarcord), which caused the destruction of olive trees in Provence and the freezing of wheat seeds in Belgium. In west-central Europe, the third extreme event was probably the result of disturbances in polar air masses. In Ireland and England, the extreme winter conditions may correspond to the same phenomenon, but they are also part of the North Atlantic Oscillation disturbance that characterised the Irish climate in the second half of the 8th century.

The dilemma of the single witness is equally acute in interpreting historical (the famine recorded in the Aniane's chronicle[20]) and climate proxies (the peak in the Greenland ice core). Climate models become increasingly rich, which means that comparisons with written sources and archaeological finds must be made again and again. Defining the spatial dimension is a key element. It is here that written sources and environmental proxies can provide invaluable insights.

In Francia, the memorable winter was interpreted by King Pepin III and his entourage as divine punishment for the common sins of the Franks. Once the abundant harvests of 764 had demonstrated divine mercy, the king launched an array of actions that remained unchanged during subsequent natural shocks. The replies were liturgical (litanies) and moral (alms to the poor). The tithe, which originally represented a voluntary gift from the Christian in return for the goodness of providence, became compulsory[21]. Charlemagne reiterated this requirement twice in times of bad weather and famine, in 779, and 794. The new tax had economic externalities: the revenue from the parish tithe was theoretically to be spent on specific local needs: the maintenance of church buildings, the care of the minister, and food relief for the poor. However, like other Ancien Régime taxes, the tithe was not universal. Lords' landed property was no longer subject to tithes from the 9th century onwards, and it is likely that the income from tithes was taken over by secular lords at an early stage. Already in the 820s, Louis the Pious had to impose a minimal endowment to provide for the needs of the parish cult. Tithing did not become widespread in the Western Latin Church as a church tax until the 11th and 12th centuries, in line with Gregorian reform. The parish tax was confronted with the usual array of peasant resistance: fraud, hiding, partial or deferred payment. However, its implementation shows how medieval social ecosystems shape and implement reactions to climatic shocks. By keeping ten per cent of the harvest, kingship created local collective food stocks to draw on in the event of shortage[22].

779, the rightfulness of the king

In 779, three Rhenish annals mention a great famine and mortality in Francia. No proxies can link this subsistence crisis to a climatic shock. The political context allows us to answer two questions: why was this tribulation recorded by the Rhenish sources? What were the causes of the famine? In addition to the famine, the contemporary annals provide three additional pieces of information: 1) the victory of Charlemagne's armies in Spain against the Saracens in

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[20] *Chronicon Moissiacense*, MGH SS, 1, p. 294.

[21] DEVROEY J.-P., « La « mauvaise année » 779: Accès à la nourriture et bon gouvernement en période d'échec des récoltes céréalières », in *Les Carolingiens dans le bassin mosan. Actes de la Journée d'étude carolingienne, 25 février 2014: Herstal*, Les Dossiers de l'IPW, Namur, Institut du Patrimoine Wallon, 2016.

[22] DEVROEY J.-P., « Dîme et économie des campagnes à l'époque carolingienne », in *La dîme dans l'Europe médiévale et moderne*, edited by Roland Viader, Toulouse, Presses universitaires du Mirail, 2010, p. 37-62.

778; 2) at the same time, the breach of Saxon oaths of obedience and their attack on the right bank of the Rhine, from the region of Cologne to the Main Valley; and 3) the return of the king and the victory over the rebelling Saxons.

Defeat at Roncesvalles was only mentioned after Charlemagne's death. Nevertheless, according to François-Louis Ganshof, the young king's failures led to doubts about his fortune[23]. After returning from the unsuccessful Spanish expedition, he had to thoroughly reorganise the administration of Aquitaine. The rebellion, and the destruction of the new eastern capital of Karlsburg, where the Saxons had been baptised 'en masse' in 777, was also a serious political and symbolic setback. By leading their raid into the core of old Francia, some sixty kilometres from Aachen, Widukind's troops temporarily achieved a significant success. The "great famine and mortality" of 779 and the defeats of 778 can be interpreted cautiously, subjectively as a revenge of Providence for the sin of the Franks, and objectively as the aftermath of the Saxon expedition in the spring and summer of 778, resulting in plundering, crop destruction, death of men and enslavement of women and children, and migration of distress. On the basis of the information available today, the famine and mortality of 779 thus appears to be a regional or even local subsistence crisis, caused by Saxon fear and panic in the central Rhine valley, without any causal linking to a climatic event[24].

Charlemagne's response was articulated in sophisticated measures set out in two capitularies promulgated at the annual assembly in Herstal. After reiterating the compulsory tithe, and decreeing reconciliatory liturgies, Charlemagne had a scale established for the redemption of fasting (a religious response that would become customary in times of famine) and for welfare to the poor required from the religious and political elites. The king appears to be the guarantor and the main person responsible for the religious economy of exchange with God, based on the ideology of kingship in Early Christianity and the dispensing function of the Roman emperor. However, the written sources also make it possible to identify a cosmic dimension of the ruler. In an ideological tradition that took root in Ireland from the 7th century onwards, and reached the Continent in the 770s, the fertility of nature and the balance of the cosmos were symbolically linked to the king's achievement. A just king brings blessing to his own, his family and his subjects. In return for his injustice, writes the monk Cathwulf of Saint-Denis to Charlemagne[25], God adds to his own misfortunes, 'famine for the people, pestilence, sterility of the land and seas, a host of storms destroying the fruits of the earth, and the king defeated by his enemies and thrown out of his kingdom'[26].

The homology between king and Nature predominates in the conception of royal power in the 9th century. This cosmological theme, departing somewhat from Foucault's model of the 'pastorate' in relation to absolute monarchy, moved out of the political arena with the gradual dissolution of Carolingian power[27]. However, the idea of the ruler's responsibility for the care of his subordinates, and the idea of a politics of hunger to mitigate starvation, did not disappear. The former is a key feature of paternalism. The latter lived on in the efforts of the Germanic bishops in the 10th-12th centuries, as well as in the conception of secular princely power, for example during the Flemish famine of 1126-1127 under Charles the Good. Without direct continuity to Charlemagne's moral and political economy, Louis XIV's policy of relief and

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23 GANSHOF Fr.-L., « Une crise dans le règne de Charlemagne, les années 778 et 779 », in *Mélanges d'histoire et de littérature offerts à Charles Gilliard à l'occasion de son soixante-cinquième anniversaire*, Lausanne, 1944, p. 133-145.

24 EBERT St. F., *Der Umwelt begegnen. Extremereignisse und dir Verflechtung von Natur und Kultur im Frankrich vom 8. bis 10. Jahrhundert*, Vierteljahrschrift für Sozial- und Wirtschaftsgeschichte, Beihefte, 254, Stuttgart, Franz Steiner Verlag, 2021, p. 78-119.

25 STORY J., « Cathwulf, kingship, and the royal abbey of Saint-Denis », in *Speculum* 74, 1999, p. 1-24.

26 *Cathwulf's letter to Charlemagne*, c. 775, MGH Epistolae 4, 501-505.

27 FOUCAULT M., *Sécurité, territoire, population: cours au Collège de France, 1977-1978*, edited by Michel Senellart, Paris, Seuil, 2004.

market regulation, and the definition of royal power in the 17th century, or Montesquieu's statement on the Welfare State in late 18th, were enriched by several references to the Carolingian precedent.

While the fear of hazards and their cosmological significance haunted early medieval European societies, they did not remain passive and demonstrated political creativity and social resilience in dealing with the challenges of the climate. The Carolingian moral and political economy reached its highest level of sophistication in two capitularies promulgated in Frankfurt in June 794 and in Nijmegen in March 806 amidst multi-annual food shortages. After reforming the silver denarius, the previous year by making it strong, stable, and uniform, Charlemagne set a maximum price for wheat in 794 and 806. The silver denarius served to set the legal weight of bread, and the tariff included a provision for selling crown grain at one-third to one-half the normal price. Both capitularies also intended to set the rules for a Christian ethic of exchange, which stigmatised avarice and greed and prized hospitality[28]. His scope was made more precise in 806: fighting beggary through forced labour, defining usury in the lending of money or grain, praising fairness, defining shameful (*turpe lucrum*) and fair profit (*iustum foenus*), and commerce (*negotium*). The mechanisms of speculation in grain and wine, through cornering and hiding, were explained. Finally, the law determined a general duty of care to their dependents from the lords and followers of the emperor. Given the emergency, a ban on grain exports across the border was imposed in the previous winter of 806. Since the 18th century, the ordinances of 794 and 806 have been considered as laws of circumstances, taken in an emergency, and left without posterity. This is in line with Adriaan Verhulst's argument that Charlemagne's policy was merely idealistic, ineffective, and hardly implemented[29]. This minimalism is contradicted by a broad overview of royal and conciliar legislation from Pepin III to Charles the Bald. They used the regal definition of the market to regulate staple prices, seeking to fix their level according to the quantity of the harvest. Throughout the Middle Ages, many of the ideas concerning the formation of food prices became part of the instruments that the market authority had at its disposal to guarantee access to food for city dwellers[30]. However, one should not fall into the trap of Western exceptionalism. Similar measures were taken in Byzantium during the great drought of 767 by Constantine V Copronymus[31]. The emperor restored the aqueduct that supplied Constantinople with water and built new cisterns. At the same time, he adopted a monetary policy that favoured low grain prices to the detriment of monasteries and farmers. These broad political ideas correspond to the notion of moral economy used by Edward P. Thompson to designate a set of economic and social values put forward by the power elites to justify their domination in the pre-Smith era, which were brandished at the end of the 18th century by the English crowd to demand grain regulation, denouncing the unfairness of the free trade, and the State's withdrawal from regulating the circulation of basic foods[32]. In October 1789, the people of Paris were still convinced that the king should act like

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[28] CÂNDIDO M., « L'économie morale carolingienne (fin VIII^e^-début IX^e^ siècle) », in *Médiévales*, n^o^ 66 (2014), p. 159-178 ; DEVROEY J.-P., « La politique annonaire des Carolingiens comme question économique, religieuse et morale », dans *L'Alimentazione nell'Alto Medioevo: Pratiche, simboli, ideologie. Spoleto, 9-14 aprile 2015*, 2016, p. 299-354 (= Atti delle Settimane di Studio del Centro italiano di studi sull'alto medioevo 63, Spoleto, Fondazione Centro italiano di studi sull'alto Medioevo).

[29] VERHULST A., *The Carolingian Economy*, Cambridge, Cambridge University Press, 2002.

[30] WILKIN A., « Time constraints on market activity and the balance of power in medieval Liège », in *Continuity and Change*, 30, 2015, p. 315-340.

[31] THEOPHANES, *The Chronicle of Theophanes Confessor: Byzantine and Near Eastern History, A.D. 284-813*, translated by Cyril A. Mango et Roger Scott, Oxford, Clarendon press, 1997, p. 611; NICEPHORUS, *Short history*, translated by Cyril A. Mango, Dumbarton Oaks Texts 10, Washington, D.C, Dumbarton Oaks, Research Library and Collection, 1990, p. 161.

[32] THOMPSON E. P., « The moral economy of the English crowd in the eighteenth century », in *Past & Present*, 50, 1971, p. 76-136.

an honest baker and a good father, and that by bringing the royal family back to the capital, bread would be good, plentiful, and fairly priced[33].

Which shocks led to the failure of harvests and the violent decline in food supply in 792-794 (2 successive harvest years), in 805-809 (3 or 4 harvest years in 5 years) and in 820-824 (3 or 4 harvest years in 5 years)[34]? A comparison of climate records with a close reading of the written sources helps to rule out any reductive determinism.

In the early 9th century, a deteriorating climate in northwestern Europe was the main driver of crop failures. After 790, the effects of repeated long, cold winters and the secular cooling of summer temperatures took their toll on farming productivity. According to the most recent models, part of the cold waves mentioned in the written sources between 800 and 840 could be attributed to the decrease in sunlight caused by volcanic ash pollution. Another factor of variability is the significant increase in spring rainfall between 790 and 840. These different triggers may explain the cascading effect of the recurring agrarian crises between 805 and 809 and 820 and 824. However, the average rainfall pattern varied regionally, as the frequency of floods in northern Francia coincides with a significant decrease in Rhône discharge in the first half of the 9th century. Therefore, mid-term weather patterns had a strong regional dimension. Biological accidents could also disrupt European agrosystems, such as the continental rinderpest of 809-810, which resulted in loss of energy and food in agriculture in the mid-term. We must strongly stress the relevance of cascading processes in low-productivity agrarian systems that can rely little on their annual stocks.

In 792, famine set in immediately after the harvest in the region of Metz. Famine seems to have peaked the following year in several regions: northern and eastern France, the Rhine valley, southern France, and central Italy. The eastern part of the Frankish Empire, in the Danube regions where Charlemagne was campaigning against the Avars, appears unaffected. Several sources indicate dramatic circumstances, cannibalism in Metz, the obligation to eat meat instead of bread during Lent in Italy, and in Septimania, in many places, empty grain instead of normal crops. The summer and autumn were marked by heavy rains in Bavaria. This bad weather caused the abandonment of the canal project, the Fossa Caroli, which was to link up the Rhine and Danube basins by ship. In the Metz region, despite the dryness, the harvest of 794 was bountiful. The timing of events and their geographical distribution therefore remain unclear. The spring ten-year tree-record series points to the decades 790 and 800 as the driest in western central Europe on a century-long scale. To provide relevant answers on the climate/crop interaction, it would be necessary to separately deal with northern Francia, where summer drought can be easily tolerated by cereals, and the south, where it can lead to dramatic yield losses. However, the precipitation regime was not uniform: while northern Francia experienced extreme climatic events in the first third of the 9th century, with colder and wetter weather, sedimentological data on the activity of the Rhône shows that the upper valley and neighbouring regions experienced below-average rainfalls, with intense droughts after 820. None of the paleoclimate records directly substantiate the extent of the crop losses in Francia and central Italy from 792 to 794.

The theme of empty grain was the starting point for a wide-ranging and meticulous historical investigation that is presented at length in the book, from early medieval Frankish and Syriac sources to the discovery of insect pests in the first scientific revolution, and to the ecological

33 DEVROEY J.-P., « Il re fornaio: Economia morale e polittica del cibo nell'età di Luigi XIV (con un sguardo a Carlo Magno », in *Cucina politica, Il linguaggio del cibo fra pratiche sociali e rappresentazione ideologiche*, edited by Massimo Montanari, Bari-Roma, Editori Laterza, 2021.

34 EBERT St. F., 2021. *Der Umwelt begegnen. Extremereignisse und dir Verflechtung von Natur und Kultur im Frankrich vom 8. bis 10. Jahrhundert*, Vierteljahrschrift für Sozial- und Wirtschaftsgeschichte, Beihefte 254, Stuttgart, Franz Steiner Verlag, 2021, p. 119-161.

crisis caused by the hessian fly in north-western America during the Revolutionary War and in the decades that followed[35].

The crop failure of the 790s was not a direct outcome of the climate system. The causes, potentially multiple, lay within the natural ecosystems. By combining medieval sources with current biological knowledge, the empty grain pattern can be interpreted in terms of three ecological scenarios: 1) abortion of the cereal flower because of spring frost. This is one plausible explanation for the crop failure in northern Syria described in the Zuqnin's Chronicle[36]; 2) cryptogamic diseases colonising the grain. The medieval bioclimatic theory attributing wheat rust to fogs, provides a narrative that allowed medieval people to naturalise fungal attacks; 3) the discrete action of a worm nematode or of gall-midges implanting their larvae and colonising the grain. Because of their tiny size, and in the absence of any theological framework, they remained invisible and therefore unthinkable until the 18th or even mid-19th century. Crop pests and their companion species are full partners in ecosystems, likely to proliferate due to favourable weather conditions, changes in the balance within agrosystems, or social factors of co-existence between predators and humans. In Britain, populations of granary pests do not exist in wildlife. They are not found in Iron Age archaeological sites. The procession of post-harvest pests, led by the weevil (*Sitophilus granarius*), first arrived with Roman troops during the reign of Claudius (43 AD). These pests lived in synanthropy, in military and urban sites and in the great aristocratic *villae* of the Roman period, before disappearing completely from the archaeological horizons of the early Middle Ages, and then reappearing with feudal granaries in the Norman period[37]. Looking at all the living beings in an ecosystem allows us to change our perspective in terms of time and space. One of the hallmarks of the large Carolingian estates is the contrast between the open landscape of the manorial fields and the smaller, more enclosed grounds of the peasant farms. In the former, the lack of plant barriers, the use of the heavy plough and the monoculture of winter cereals favoured specific soil developments, ecological niches adapted to pests or parasites, and climate-related risks. On the contrary, the latter favoured narrow plots and mixed crops partitioning the living environments of plants and animals. Typical agricultural practices of peasant farmers, such as the sowing of several plants on the same plot of land (a mixture of cereals sown in autumn and spring, or cereals and legumes), made crops more resilient to pests or climatic conditions, while at the same time mixed yields were more difficult to control and collect for lords' agents. Various social forms of agricultural production thus interact differently with the natural environment. Slower-paced waves also stirred up plant oceans. In the Western European loess belt, late antiquity saw the spread of a new bread grain, rye, and to a lesser extent, and for other purposes, of oats[38]. Often referred to as pioneer plants, these new cereals were less demanding and more resistant than wheat in the colder, wetter or more unstable climate that characterised the long Middle Ages from 8th to 14th century. In terms of resistance and adaptation, the alternative to rye was not wheat-corn, which was grown for its higher market value and to satisfy the tastes of the elite, but spelt, which also yielded a white and light bread, and was more robust, but required costly and sophisticated post-harvest treatments. In northern France and

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35 CRONON W., *Changes in the Land. Indians, Colonists, and the Ecology of New England*, 1st revised edition, New York, Hill and Wang, 2003.

36 Zuqnin's Chronicle (HARRAK A., *The Chronicle of Zuqnin, Parts III and IV*, Toronto, Pontifical Institute of Medieval Studies, 1999, p. 181-189).

37 SMITH D., KENWARD H., « Roman Grain Pests in Britain: Implications for Grain Supply and Agricultural Production », in *Britannia*, 42, 2011, p. 243-262.

38 MITTERAUER M., *Warum Europa?: Mittelalterliche Grundlagen eines Sonderwegs*, München, Beck, 2004; BAKELS C. C., *The Western European Loess Belt. Agrarian History, 5300 BC-AD 1000*, Dordrecht-Heidelberg-London-New York, Springer. 2009; DEVROEY J.-P., « La céréaliculture au haut Moyen Âge (IIIe-XIe siècles AD) : Apports archéologiques et problèmes historiques récents », in *VA, vie archéologique*, nº 72, 2013, p. 59-66.

southern Belgium, palaeobotanical analyses show that the choice of spelt, cultivated extensively on seigneurial fields, was guided by the imperatives of the large royal or monastic estate, in terms of robustness and durability. In non-elite sites, a wide variety of crops are found, covering the whole range of winter and spring wheats and pulses. The switchover from spelt to rye occurred in the 10th century. The progression of rye is marked at the end of the 10th century by the first description of ergotism, a serious intoxication caused by the consumption of rye grains colonised by a fungus that produces a gall containing deadly alkaloids, which are ingested along with the porridge, or are mixed with the flour, in the absence of careful sorting of the crops.

Diversity of human social formations is thus directly reflected in the natural environment. Contrary to Fernand Braudel's ideas and more recently to the climate determinism, environmental history must not leave ancient societies "to the dictatorship of the physical world". The historical approach thus makes it possible to stress the spatial and temporal complexity of the interactions between climate, environment, and social ecosystems, all of which argue against a holistic approach that tends to confuse coincidences, correlations, and causalities, underestimates social and agroecological feedbacks, and makes climate an absolute instance of determinism. At a time when contemporary societies are plagued by environmental anxiety, environmental history offers a lesson in caution and optimism[39].

Bibliography

ARNAUD F., REVEL M., CHAPRON E., DESMET M., TRIBOVILLARD N., « 7200 years of Rhône River flooding activity in Lake Le Bourget, France: a high-resolution sediment record of NW Alps hydrology », in *The Holocene*, 15 (3), 2005, p. 420-428.

BAKELS C. C., *The Western European Loess Belt. Agrarian History, 5300 BC- AD 1000*, Dordrecht-Heidelberg-London-New York, Springer, 2009.

BÜNTGEN U., MYGLAN V. S., LJUNGQVIST Fr. C., MCCORMICK M., COSMO N. D., SIGL M., JUNGCLAUS J. et al., « Cooling and Societal Change during the Late Antique Little Ice Age from 536 to around 660 AD », in *Nature Geoscience*, 9 (3), 2016, p. 231-236.

BÜNTGEN U., TEGEL W., NICOLUSSI K., MCCORMICK M., FRANK D., TROUET V., KAPLAN J. O. et al., « 2500 Years of European Climate Variability and Human Susceptibility », in *Science*, 331 (6017), 2011, p. 578-582.

CÂNDIDO M., « L'économie morale carolingienne (fin VIII[e]-début IX[e] siècle) », in *Médiévales*, n[o] 66, 2014, p. 159-178.

COOK E. R., SEAGER R., KUSHNIR Y., BRIFFA K. R., BÜNTGEN U., FRANK D., KRUSIC P. J. et al., « Old World Megadroughts and Pluvials during the Common Era », in *Science Advances*, 1 (10), 2015, e1500561.

CRONON W., « The Uses of Environmental History. » *Environmental History Review*, 17, 1993, p. 1-22.

CRONON W., *Changes in the Land. Indians, Colonists, and the Ecology of New England*, 1st revised edition, New York, Hill and Wang, 2003.

CRONON W., *Nature et récits. Essais d'histoire environnementale*, translated by Mathias Lefèvre, Bellevaux, Éditions Dehors, 2016.

DEGROOT D., ANCHUKAITIS K., BAUCH M., BURNHAM J., « Towards a Rigorous Understanding of Societal Responses to Climate Change », in *Nature*, 591, 2021, p. 539-550.

DESCOLA Ph., *Par-delà nature et culture*, Folio essais 607, Paris, Gallimard, 2015.

[39] This paper was presented as inaugural lecture at the Leeds International Medieval Congress, *Climate*, 5-9 July 2021.

DESCOLA Ph., INGOLD T., LUSSAULT M., *Être au monde. Quelle expérience commune ? Débat présenté par Michel Lussault*, Lyon, Presses universitaires de Lyon, 2014.

DEVROEY J.-P., « Dîme et économie des campagnes à l'époque carolingienne », in *La dîme dans l'Europe médiévale et moderne*, edited by Roland Viader, Toulouse, Presses universitaires du Mirail, 2010, p. 37-62.

DEVROEY J.-P., « La céréaliculture au haut Moyen Âge (III^e^-XI^e^ siècles AD): Apports archéologiques et problèmes historiques récents », in *VA, vie archéologique*, n^o^ 72, 2013, p. 59-66.

DEVROEY J.-P., « La « mauvaise année » 779: Accès à la nourriture et bon gouvernement en période d'échec des récoltes céréalières », in *Les Carolingiens dans le bassin mosan. Actes de la Journée d'étude carolingienne, 25 février 2014: Herstal*, Les Dossiers de l'IPW, Namur, Institut du Patrimoine Wallon, 2016.

DEVROEY J.-P., « La politique annonaire des Carolingiens comme question économique, religieuse et morale », in *L'Alimentazione nell'Alto Medioevo: Pratiche, simboli, ideologie. Spoleto, 9-14 aprile 2015*, 2016, p. 299-354 (= Atti delle Settimane di Studio del Centro italiano di studi sull'alto medioevo 63, Spoleto, Fondazione Centro italiano di studi sull'alto Medioevo).

DEVROEY J.-P., *La nature et le roi. Environnement, pouvoir et société à l'âge de Charlemagne (740-820)*. L'évolution de l'humanité, Paris, Albin Michel, 2019.

DEVROEY J.-P., « Il re fornaio: Economia morale e polittica del cibo nell'età di Luigi XIV (con un sguardo a Carlo Magno », in *Cucina politica, Il linguaggio del cibo fra pratiche sociali e rappresentazione ideologiche*, edited by Massimo Montanari, Bari-Roma, Editori Laterza, 2021.

EBERT St. F., *Der Umwelt begegnen. Extremereignisse und dir Verflechtung von Natur und Kultur im Frankrich vom 8. bis 10. Jahrhundert*, Vierteljahrschrift für Sozial- und Wirtschaftsgeschichte, Beihefte 254, Stuttgart, Franz Steiner Verlag, 2021.

FOUCAULT M., *Sécurité, territoire, population: cours au Collège de France, 1977-1978*, edited by Michel Senellart, Paris, Seuil, 2004.

GANSHOF Fr.-L., « Une crise dans le règne de Charlemagne, les années 778 et 779 », in *Mélanges d'histoire et de littérature offerts à Charles Gilliard à l'occasion de son soixante-cinquième anniversaire*, Lausanne, 1944, p. 133-145.

GAO Ch., ROBOCK A., AMMANN C., « Volcanic forcing of climate over the past 1500 years: An improved ice core-based index for climate models », in *Journal of Geophysical Research: Atmospheres*, 113 (D23), 2008, p. 1-15.

HARRAK A., *The Chronicle of Zuqnin, Parts III and IV*, Toronto, Pontifical Institute of Medieval Studies, 1999.

MCCORMICK F., KERR T. R., O'SULLIVAN A., *The economy of Early Medieval Ireland*, EMAP report, 7.1., Dublin, 2013.

MCCORMICK M., DUTTON P. E., MAYEWSKI P. A, « Volcanoes and the Climate Forcing of Carolingian Europe, A.D. 750-950 », in *Speculum*, 82 (4), 2007, p. 865-894.

MITTERAUER M., *Warum Europa?: Mittelalterliche Grundlagen eines Sonderwegs*, München, Beck, 2004.

NEWFIELD T., « The contours of disease and hunger in Carolingian and early Ottonian Europe (c.750-c.950 CE) », Ph.D. Thesis, Montréal, McGill University, 2011.

NEWFIELD T., « A great carolingian panzootic: the probable extent, diagnosis and impact of an early ninth-century pestilence », in *Argos*, 46, 2012, p. 200-210.

NICEPHORUS, *Short history*, translated by Cyril A. Mango, Dumbarton Oaks Texts 10, Washington, D.C, Dumbarton Oaks, Research Library and Collection, 1990.

SIGL M., WINSTRUP M., MCCONNELL J. R., WELTEN K. C., PLUNKETT G., LUDLOW F., BÜNTGEN U. et al., « Timing and Climate Forcing of Volcanic Eruptions for the Past 2,500 Years », in *Nature*, 523 (7562), 2015, p. 543-549.

SLAVIN Ph., « Climate and famines: a historical reassessment », in *Wiley Interdisciplinary Reviews: Climate Change*, 7 (3), 2016, p. 433-447. https://doi.org/10.1002/wcc.395.

SMITH D., KENWARD H., « Roman Grain Pests in Britain: Implications for Grain Supply and Agricultural Production », in *Britannia*, 42, 2011, p. 243-262.

STATHAKOPOULOS D., « Reconstructing the Climate of the Byzantine World: State of the Problem and Case Studies », in *People and Nature in Historical Perspective*, by Jozsef Laszlovszki and Peter Szabo, p. 247-261, Budapest, Central European University Press, 2003.

STORY J., « Cathwulf, kingship, and the royal abbey of Saint-Denis », in *Speculum*, 74, 1999, p. 1-24.

THEOPHANES, *The Chronicle of Theophanes Confessor: Byzantine and Near Eastern History, A.D. 284-813*, translated by Cyril A. Mango and Roger Scott, Oxford, Clarendon press, 1997.

THOMPSON E. P., « The moral economy of the English crowd in the eighteenth century », in *Past & Present*, 50, 1971, p. 76-136.

VAN DIEMEN R., « Glossary », in *Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems*, Geneva, IPCC, 2019.

VERHULST A., *The Carolingian Economy*, Cambridge, Cambridge University Press, 2002.

WILKIN A., « Time constraints on market activity and the balance of power in medieval Liège », in *Continuity and Change*, 30, 2015, p. 315-340.

WORSTER D., « Nature and the Disorder of History. », in *Environmental History Review*, 18, 1994, p. 1-15.

WOZNIAK Th., *Naturereignisse im Frühen Mittelalter. Das Zeugnis der Geschichtsschreibung vom 6. bis 11. Jahrhundert*, Berlin, Walter de Gruyter, 2020.

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Résumé

Depuis deux décennies, l’afflux des données paléoclimatiques offre de nouvelles opportunités de croisement et de comparaison entre sciences de la nature et sciences sociales. L’histoire parallèle du climat et de l’environnement est souvent menée de manière holistique dans l’hypothèse de causalités simples et directes entre changement climatique et changement social. Face aux séries climatiques, l’historien doit s’interroger sur la nature des données et sur leurs conditions spécifiques de collecte, de validité et d’environnement, ainsi que sur les méthodes et les objectifs de modélisation. Comparer données paléoclimatiques et sources primaires demandent de prendre en compte leurs limitations spécifiques et de trouver une échelle commune d’observation. Une étude de cas historique vient d’être conduite à partir des séries climatiques et des sources de l’âge de Charlemagne (740-820, un intervalle de temps de 80 ans qui est compatible avec les exigences heuristiques des deux disciplines. L’approche des événements météorologiques par magnitude permet d’analyser les conditions d’observation du temps. Les témoins sont influencés par le contexte politique et les cosmologies religieuses, mais également par des conditions environnementales et les géo-climats régionaux, comme le montre un corpus constitué à partir des sources franques, irlandaises et anglosaxonnes, arabes d'Espagne, byzantines et syriaques chrétiennes. Des relevés exhaustifs révèlent dans quelles circonstances et pour quelles motifs les témoins parlent ou se taisent, et quels phénomènes météorologiques ou écologiques ont le plus de sens et de signification pour eux. Les séries climatiques ont été ensuite confrontées à quatre périodes de crise : un hiver marqué par des températures extrêmes (763-764), et trois périodes décrites par les sources carolingiennes comme des famines graves (des « grandes faims ») : une crise régionale dans la vallée du Rhin (779), des phénomènes de crise pluriannuels et multirégionaux entre 791 et 794 et une période prolongée de dégradation climatique entre 800 et 824. Une approche multifactorielle montre que le paramètre climatique n'a jamais agi seul dans la perception et dans les répercussions économiques et sociales. Les témoins étaient influencés dans leur évaluation du caractère critique d'une crise par des éléments de nature religieuse, politique, militaire, etc. Si la peur des aléas et de leur signification cosmologiques ont hanté les sociétés européennes du haut Moyen Âge, elles ne sont pas restées passives et ont fait preuve face aux défis du climat de créativité politique et de résilience sociale. L'approche historique permet ainsi d'insister sur la complexité spatiale et temporelle des interactions entre climat, milieu et écosystèmes sociaux, tous éléments qui plaident contre une approche holistique qui tend à confondre coïncidences, corrélations et causalités et sous-estime les rétroactions sociales et agroécologiques, et fait du climat une instance absolue de déterminisme. À l'heure où les sociétés contemporaines sont en proie à l'inquiétude environnementale, l'histoire environnementale offre une leçon de prudence et d'optimisme.

Abstract

Over the past two decades, the growing availability of paleoclimatic data has opened new opportunities for cross-fertilisation and comparison between natural and social sciences. The parallel history of climate and the environment is often undertaken in a holistic manner, assuming simple and direct causalities between the climate and social change. Faced with the findings of research into historic climates, the historian must question the nature of the data and their specific conditions of gathering, validity, and environment, as well as the methods and objectives of modelling. Comparing paleoclimatic data and primary sources requires considering their specific limitations and finding a common scale of observation.

This paper will discuss a historical case study conducted using climate data and documentary sources from the age of Charlemagne (740-820 AD), a time interval of 80 years that is compatible with the heuristic requirements of both disciplines. Approaching meteorological events by magnitude makes it possible to analyse the conditions under which the weather was observed. Textual witnesses are influenced by the political context and by religious cosmologies, but also by environmental conditions and regional geo-climates, as shown by a corpus constituted from Frankish, Irish, Early English, Spanish Arab, Byzantine, and Syriac Christian sources.

What emerges is a rich picture of under what circumstances and for what reasons witnesses speak or remain silent, and which meteorological or ecological phenomena have the most meaning and significance for them. There were, in these years, four periods of crisis: a winter marked by extreme temperatures (763-764), and three periods described by Carolingian sources as severe famines ("great hungers"): a regional crisis in the Rhine Valley (779), multi-annual and multi-regional crisis phenomena between 791 and 794 in Francia and Italy, and a prolonged

period of difficult climatic conditions between 800 and 824 in northwestern Europe, accompanied by a rinderpest pandemic in 810-811.

This multifactorial approach shows that the climatic parameter never acted alone in the perception and in the economic and social repercussions of environmental parameters. Witnesses were influenced in their assessment of the critical nature of a crisis by other elements of a religious, political, military nature. While the fear of hazards and their cosmological significance haunted early medieval European societies, they did not remain passive and demonstrated political creativity and social resilience in dealing with the challenges of the climate. The historical approach thus makes it possible to stress the spatial and temporal complexity of the interactions between climate, environment, and social ecosystems, all of which argue against a holistic approach that tends to confuse coincidences, correlations and causalities, underestimates social and agroecological feedbacks, and makes climate an absolute instance of determinism. At a time when contemporary societies are plagued by environmental anxiety, environmental history offers a lesson both in caution and optimism.