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# The Dantean Anomaly (1309-1321): Rapid Climate Change in Late Medieval Europe with a Global Perspective

by Martin Bauch

**Project presentation:** *Junior Research Group, financed by a Freigeist Fellowship (Volkswagen Foundation), based at the Leibniz Institute for the History and Culture of Eastern Europe (GWZO), Leipzig.*



**Figure 1:**

*I am in the third circle, filled with cold, / unending, heavy, and accursed rain; / its measure and its kind are never changed. / Gross hailstones, water gray with filth, and snow come streaking down across the shadowed air; the earth, as it receives that shower, stinks. - Dante, Inferno, Canto VI.*

*Picture: Dante Alighieri, Divina Commedia, Inferno, Canto VI: The Gluttons (Northern Italy, end of the 14<sup>th</sup> century). (Source: Oxford, Bodleian Library, MS. Holkham misc. 48, p. 9.*

*Source: Public Domain, [Wikimedia Commons](https://commons.wikimedia.org/wiki/File:Dante_Commedia_Inferno_Canto6.jpg):*

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In the last years of his life, Dante Alighieri (1265-1321) was an unsuspecting witness to a rapid shift in climatic conditions that led to cooler and wetter weather all over the continent. He most probably experienced a series of terrifying meteorological events that hit European agriculture in the 1310s, causing harvest failures, floods, famine, and mass deaths across the continent. Dante completed his most famous work, the *Inferno*, in 1314. Perhaps it was not by chance that Dante punishes the gluttonous sinners in the third circle of hell with incessant rain, hail, and snow; they writhe about in mud that reeks of crops rotting in the fields. His description coincides with the weather conditions that contributed to widespread famine in Italy between the years 1310–12; it may be the most prominent allusion to the onset of the Little Ice Age preserved in the European cultural heritage. Other traces of the event can be found in the written record, as well: inscriptions from Central Europe recall the thousands of who died of starvation and were buried outside the city walls, and countless chronicles report on dearth, famine, corpses in the streets, and riots linked to rising food prices during this period. The hostile weather conditions and massive soil erosion can also be reconstructed using scientific methods including the analysis of ice cores from Alpine glaciers and sediment cores from lakes. Tree rings likewise reveal the rainy years that oaks all over Europe enjoyed, as these trees thrive on chilly, humid weather. How seriously these conditions affected individuals depended very much on social status and on the ability of societies to take preventative measures. Although Italy was hit hard by extreme meteorological events, considerably fewer people died there than in England because food management was taken seriously by the efficient bureaucracies of wealthy city-states which imported grain and stored it in granaries. The nobility north of the Alps, however, was less concerned with their subjects' welfare, which led in some cases to starvation and perhaps even cannibalism. Similarly, reports from Asia provide credible evidence that the period of climatic instability called the “Dantean Anomaly” was not limited to Europe. The Middle East, on the other hand, presents us with quite a contrast: it witnessed a period of abundant harvests and stable weather from 1310 on, while China saw a wet period, and Vietnam suffered from droughts when the monsoon failed to appear. These examples underline that there are always winners and losers of climatic change—not only in the twenty-first century, but also in the Late Middle Ages.

The “Dantean Anomaly” Junior Research Group, funded by a Freigeist fellowship from the Volkswagen Foundation and based at the Leibniz Institute for the History and Culture of East

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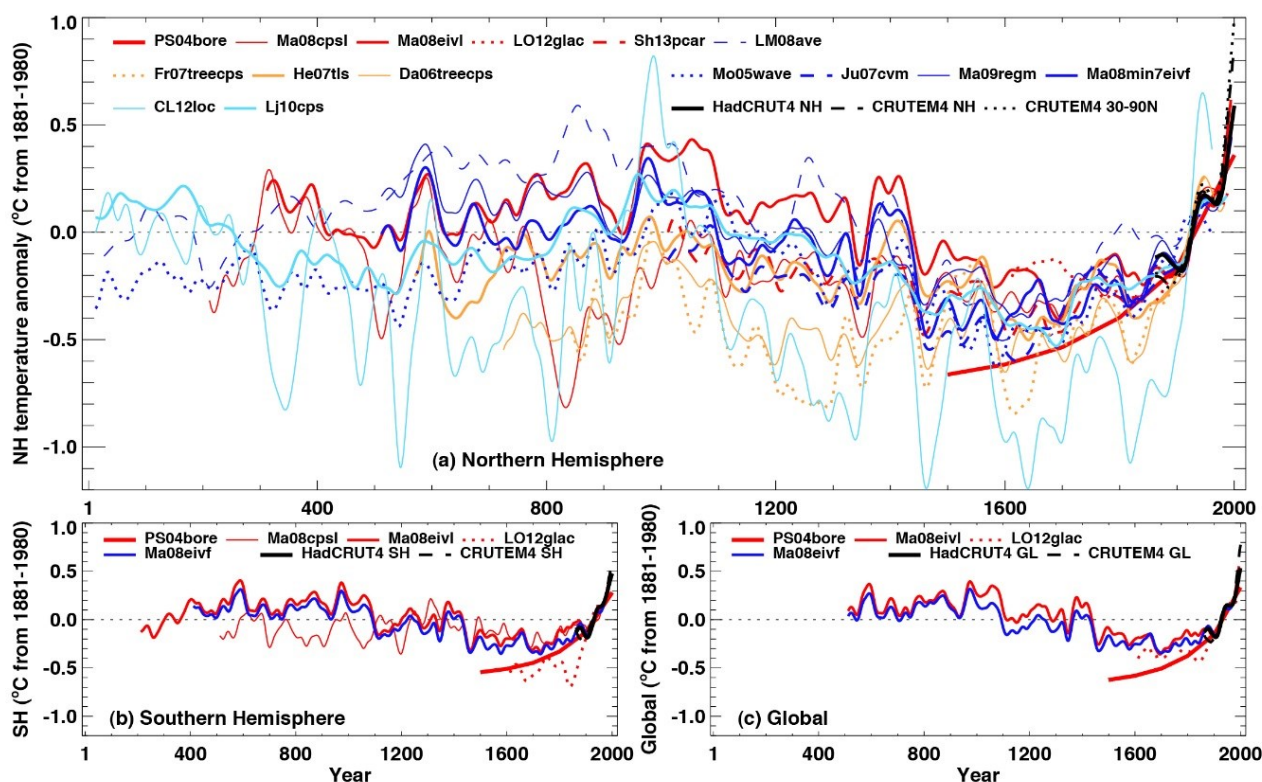
Central Europe (GWZO) in Leipzig, will address all these aspects and shed new light on the environmental history of the Middle Ages. The following synopsis of the project's proposal outlines the four central objectives of the project, its methodological approach, and the current state of research to illustrate the benefits of better understanding the dire weather conditions from 700 years ago and their implications for these societies.

### OBJECTIVES OF THE JUNIOR RESEARCH GROUP

**1. RECONSTRUCTION:** *The project will reconstruct in detail the only well documented onset of a rapid climate change in historical time, the so-called Dantean Anomaly (1309–21), while focusing on three late medieval European societies. This project focuses on three regions that have not been researched in detail before, although they can provide written sources or scientific data not sufficiently taken into account in climate history.*

Most scientists and climate historians agree that climatic conditions changed seriously at the beginning of the fourteenth century, as the milder conditions of the Medieval Climatic Anomaly ended and the Little Ice Age began. When referring to the extreme wet and cool conditions in northwestern Europe that led to the Great Famine (1315–21), written sources and dendrochronological data agree that the 1310s were a decade of climatic stress. This period has been called the “Dantean Anomaly” in reference to Dante’s death in 1321, despite the commonly accepted assumption that the meteorological deterioration spared the Mediterranean and was limited to the British Isles, Northern France, the Benelux countries, and northern Germany. Recent research from Scandinavia and Hungary, however, has begun questioning these geographical limitations, while case studies from Central Europe, Italy, and eastern France also concur that the Dantean Anomaly was probably a transcontinental event.

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**Figure 1:** The reconstruction of annual temperatures of the Northern Hemisphere in the last 2000 years, representing anomalies (°C) from the 1881–1980 mean (horizontally dashed line). Source: *IPCC Assessment Report 5 (2013), Chapter 5, Fig. 5.7:* <http://www.ipcc.ch/report/graphics/index.php?t=Assessment%20Reports&r=AR5%20-%20WG1&f=Chapter%2005>.

For that reason, the “Dantean Anomaly” research group will focus on three geographically and climatically different case studies or subprojects (SPs), which scholars have largely neglected thus far: SP1 will examine the impact of extreme meteorological events in Siena and Bologna and the direct surroundings of these two Italian cities; SP2 will focus on Central Europe, i.e. the Holy Roman Empire, from east of the Rhine to Poland, Moravia, and Austria, with its continental climate; finally, SP3 will take a specifically rural perspective for regions at the edge of the Atlantic maritime climate zone in southeastern France, namely Bresse, Pays de Gex, and Savoy.

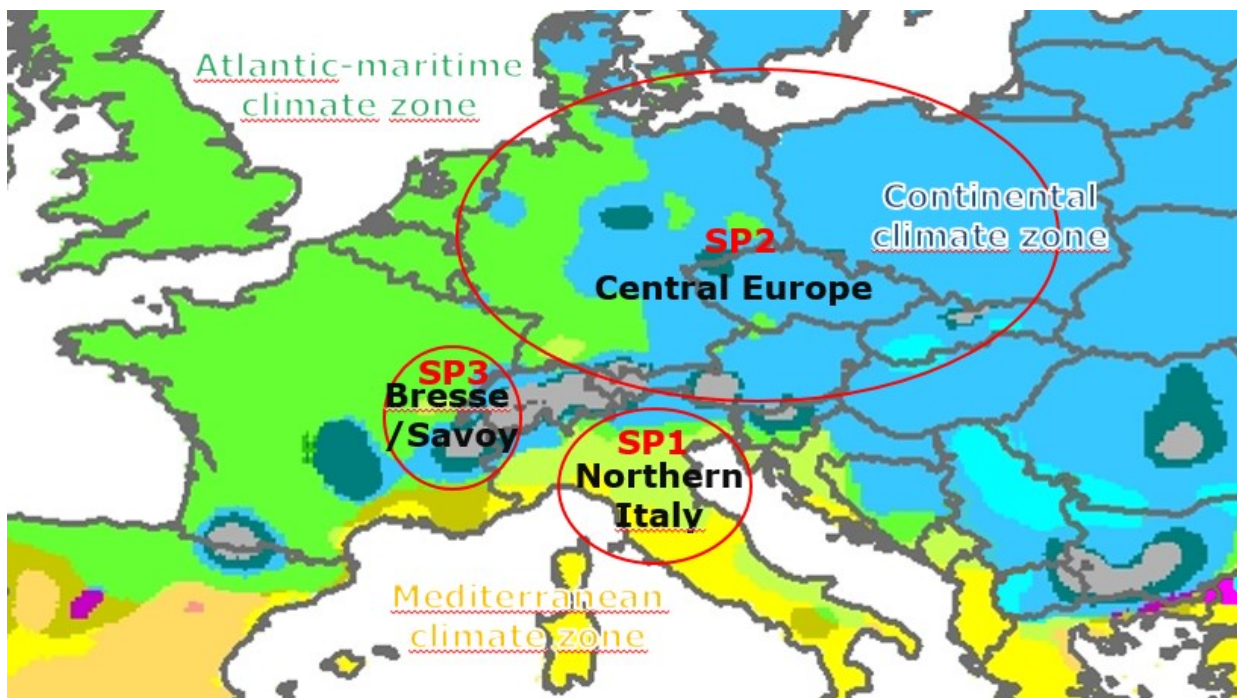
These case studies differ not only in terms of climate and geography, but also in the types of written sources to be studied: whereas SP1 (urban) and SP3 (rural) will incorporate administrative reports and fiscal accounts, SP2 relies on charters for a larger region that cannot provide dense archival sources of the kind we find in France and Italy. In some instances, inscriptions on buildings and archeological artifacts provide further information. Narrative sources, the traditional database for

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climate historians, will, of course, be taken into account, as well. Abundant for all three regions, they provide a larger general background for the years 1200–1400. Additionally, the specific administrative records under examination for the 1310s yield a more detailed and reliable picture than any chronicle. This bigger picture is necessary to place the results for the 1310s in their proper context, as will be explained later. A reconstruction of climatic conditions should not limit itself to data from written sources only. This project aims to incorporate scientific research which provides information on meteorological conditions in a high temporal resolution (dendrochronology; ice core research, warve chronology, geomorphology) to enhance and, in some cases, correct the written sources. At the same time, scientific data that is less specific or does not cover certain regions may profit from comparison with the historical record. With the cooperation of several scientific partners or interdisciplinary research groups, an integrated and reliable study of climatic conditions in the 1310s in large parts of Europe will be provided for the first time. However, it is not the reconstruction of a gradual decrease in mean temperatures or an increase in precipitation that will define the Dantean Anomaly project but rather the frequency and magnitude of extreme events that are ultimately responsible for the societal impact of a climatic crisis.



**Figure 2:** Geographical location of the three subprojects, integrated into a Köppen-Geiger map of climatic zones in Europe. Source: Public Domain: [Wikimedia Commons: https://commons.wikimedia.org/wiki/File:Europe\\_K%C3%B6ppen\\_Map.png](https://commons.wikimedia.org/wiki/File:Europe_K%C3%B6ppen_Map.png), adapted by Martin Bauch.

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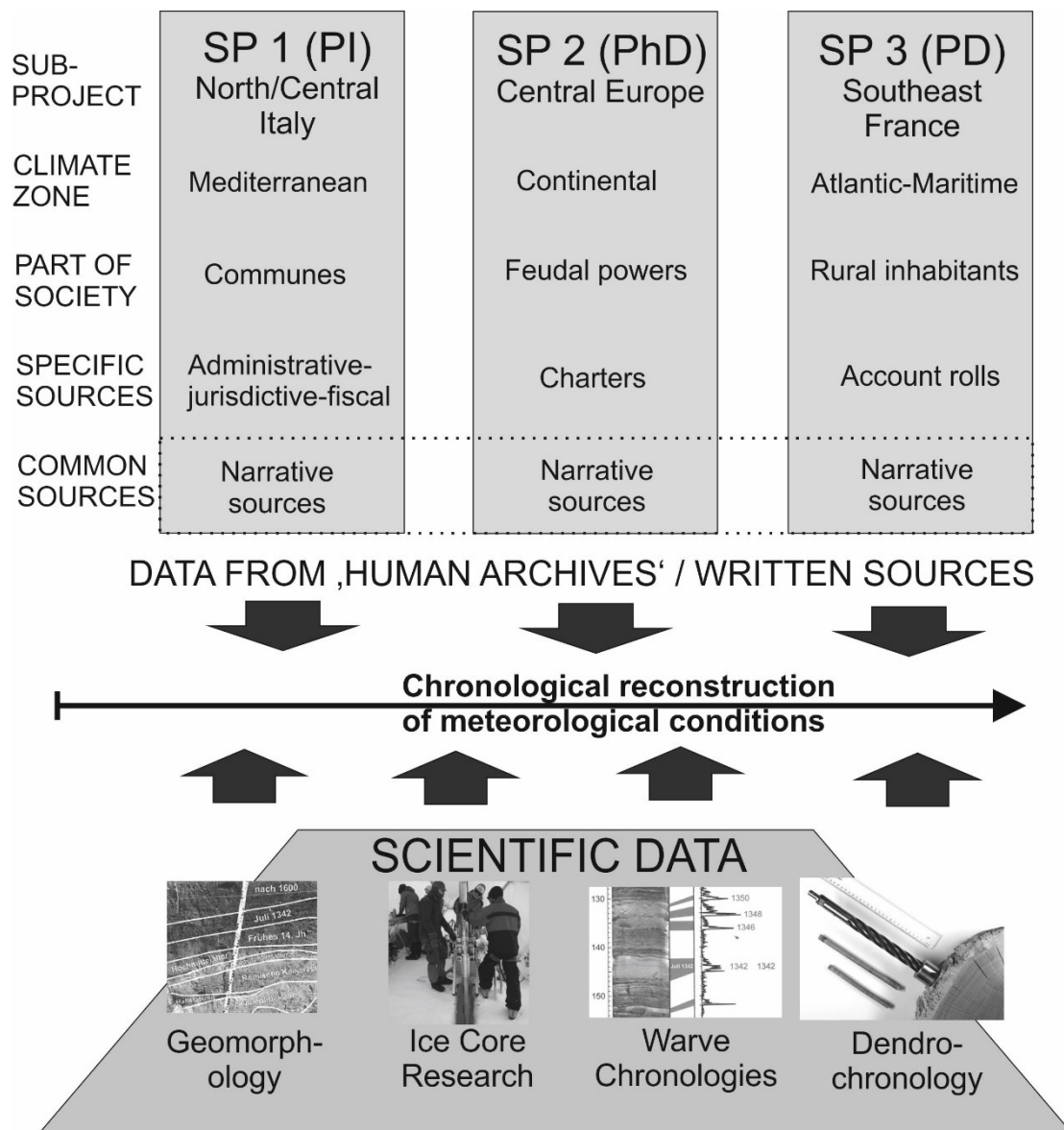
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**2. IMPACT:** *By highlighting correlations between periods of dramatic climate change and periods of dearth, famine, and disease, this project will clarify the significance of natural factors in economic crises. Such connections have long been ignored or even denied in the historical scholarship.*

The Dantean Anomaly group's research aims to examine the causal relationship between rain, frost, and flooding, on the one hand, and dearth, famine, and human and animal diseases, on the other. The project will make a fundamental contribution to the economic and environmental history of the Middle Ages which is also relevant to the ongoing discussion of climate change as related to the accelerating frequency of extreme events in the past and present. There is a long tradition of research on the so-called agrarian crisis of the fourteenth century, but the historiographies of Italy, France, and Germany have mostly interpreted this event from a neo-Marxist or neo-Malthusian perspective of economic history, neglecting the role of natural factors in the outbreak of famines. Only recently have dearth, famine, and animal diseases on the British Isles been convincingly connected with extreme precipitation in the second half of the 1310s. One important explanation of the economic crisis in pre-modern times, the "*crise d'ancien type*" (E. Labrousse), allows for the consideration of natural factors, because it underlines the annual fluctuations of harvest as its central argument. The research conducted in SP1 and SP3 will contribute to enhancing the economic models with natural factors: the feudal administration in rural southeastern France kept detailed accounts which record the prices of grain, wine and various other foods, as well as information on harvests, floods, migration, mortality, repairs to infrastructure, and the suspension of tithes due to inclement weather. With the exception of prices, this is also true for the data from communal Italy in SP1. This body of continuous information allows for a reconstruction of the frequency of extreme events in general. An attentive reading of charters also reveals hints about these events in Central Europe. Scientific data on rainfall in specific years (from dendrochronology) and on historical erosion will be indispensable: geomorphological research on historical erosion in Central Europe has proven that 40% of fertile soil loss for the entirety of the second millennium occurred in the first half of the fourteenth century alone. The agricultural and economic consequences are obvious and yet vastly underestimated in the economic and agricultural historiography of Continental Europe, which is characterized by a kind of social determinism.

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**Figure 3:** A scheme of the proposed subprojects, their characteristics in regard to climate zones, sources, and the segments of medieval society that they represent, and the integration of scientific data into the study of historical records. Image: Martin Bauch.

**3. REACTIONS:** *The project will therefore highlight the vulnerability of the societies addressed to these manifold impacts by focusing on their reactions to the events described. The short time span examined here, in combination with the broad geographical scope, is especially promising in terms of understanding the cultural, political, and economic factors which contribute to the vulnerability or resilience of societies under climatic pressure.*

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The societies involved in this study reacted to these climatic anomalies in myriad ways ranging from inactiveness to mere ad-hoc actions (SP2, SP3). More sophisticated responses included the creation of institutions, technological countermeasures, and adaptations of agricultural and economic structures (S1), as well as religious ceremonies (S1, S2). The cultural and institutional circumstances of specific societies are crucial to understanding the impact of climate change; therefore, the causal relationship between weather, dearth, and famine must be investigated in relation to the economic, cultural, social, and political preconditions. Existing *longue durée* studies on the resilience and vulnerability of pre-modern societies to ecological stress cannot definitively confirm a close connection between extreme events and social change, since the pace of change and the occurrence of natural events cannot be synchronized. Chronologically limited case studies, however, can provide insight into reactions in the short term to natural extreme events—an approach that has hardly been employed until now. To prove that a natural event is actually causing social change, it is necessary to compare several geographically removed case studies and arrive at parallel results. All three case studies examined here provide sufficient source material to achieve the stated goal. For the period under investigation, Siena and Bologna (SP1) have preserved rich archives documenting political processes and institutional reactions. Furthermore, in Siena very detailed fiscal accounts are extant, and in Bologna an abundance of notes on law enforcement and jurisdiction have survived. In both cities, the management of the food supply (grain, salt) was a central task of the communal government, while the maintenance and reconstruction of water infrastructure (canals, dams) both within and beyond the city walls was more of a topic in Bologna. In the 1310s, both cities faced precipitation-related food supply crises which resulted in the expansion of existing institutions or the foundation of new ones. Food-related unrest even shook the established order: documentation from Bologna suggests that food scarcity contributed to criminal behavior and rising social tensions. Yet it seems as if Italian cities were better prepared for the climatic stress of the 1310s than societies north of the Alps: by examining a large number of charters, SP2 will consciously adapt the perspective of feudal overlords on the destiny of their subjects and the estates during this natural crisis. Although the project will in all probability reveal short-term profits earned by those institutions which sold grain during shortages and punctual charity provided by monasteries, it is unlikely to find coherent, systematic, or enduring relief measures. The vulnerability and resistance of inhabitants of Central Europe to climatic phenomena may well have depended on their social status. It can be safely assumed that the situation in



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southeastern France was not extremely different, but, in SP3, the particularly interesting comparison is the development of lowlands and mountains. Hence, the “Dantean Anomaly” project has great potential to advance our knowledge of medieval societies’ vulnerability (and maybe resilience) in regard to environmental stress, and this potential stems mainly from this unique transregional approach.

**4. TRANSREGIONAL & GLOBAL PERSPECTIVE:** *This project strives to contribute to an emerging field of comparative climate history on a transregional and even global scale by appraising the reactions of pre-modern societies to the challenges presented by rapid climatic change. A truly global history of the Middle Ages could consider climate change and social reactions throughout Europe, Asia, and the Muslim world.*

To understand the Dantean Anomaly as a phenomenon of at least continental dimensions, the results of all three SPs must be compared with the research already completed on the Great Famine in Britain, Ireland, Scandinavia, and the Carpathian basin. Meteorological and climatological expertise can help explain both written documents and natural data, and European climatic patterns between 1309–21 will also be established in a thorough scientific reconstruction. Beyond that, the final aim of the project is to understand these case studies within a global context, which will help to shape a global environmental history before 1500. This subsequent phase of the project, based on the results of the three SPs, will take on a global perspective by including research on the Muslim world and Southeast Asia between the years 1309–21. Both of these non-European regions have experienced periods of rapid change in climatic conditions which have been partially studied by comparable projects of climate history at Princeton, Harvard, and Canberra. The decline of the monsoon in Southeast Asia led to massive droughts in Vietnam during this this time. In China, however, the time between 1308–25 seems to have been particularly wet and cool. The situation in the Mid-East was also marked by drought, sandstorms, and torrential precipitation in this decade.

The concept of teleconnection, taken from meteorology to describe societal reactions to climatic changes, will help to shape an emerging global environmental history of the Middle Ages. The possibility of parallels or differences in climatic conditions in distant regions could also contribute to the discussion and understanding of past and present climate change. The DANTEAN project hence has the potential not only to prove the importance of the history of the Middle Ages for

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present-day issues, but it could also significantly enhance the geographical and thematic radius of medieval studies.

## METHODS

Our initial objective will be to reconstruct historical climate change. The Dantean Anomaly group will apply the established approaches of climate history, meaning that extreme meteorological events and all available meteorological information will be extracted from the extant narrative sources for each of the SPs. These will be both placed in their larger geographical area and chronologically clustered to determine which points in time and regions were particularly affected by extreme meteorological events in the thirteenth and fourteenth century. As gaps in documentary sources are inevitable, dendrochronological data, warve chronologies, and ice core analysis will provide additional information on precipitation and temperatures on an annual basis. The scientific data will constitute the necessary foil to countercheck historical accounts and fill any gaps. The established method of (Pfister-) indices for temperature and precipitation will serve to quantify the narrative sources.

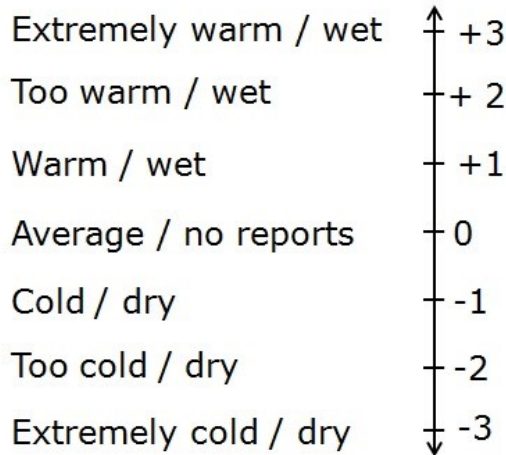
We will probably apply different indices for the thirteenth and the fourteenth centuries, as the density of narrative sources and the level of detail they report about extreme events differs considerably for the earlier and later period under study. Furthermore, seasonal indices will be prepared for the fourteenth century only, while for the thirteenth century we plan to create indices only for the “growing season” (April–September) and the “non-growing season” (October–March). An innovative color-system will indicate at first glance our confidence in the results. The reliability of such analysis depends very much on the number and quality of available independent, contemporary sources and the proxy information they may contain about meteorological extreme events. This color scheme aims to make these variables more transparent.

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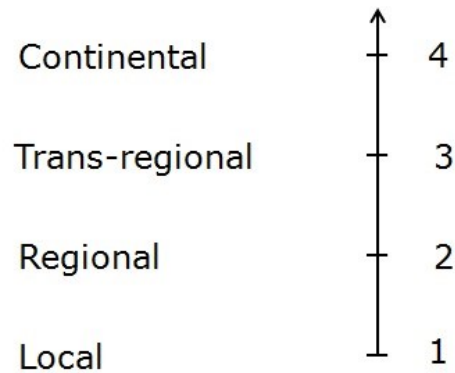
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Indices of temperature/precipitation for single seasons (Dec-Feb/Mar-May/Jun-Aug/Sep-Nov)



Indices defined by geographical extension of the event to scale the intensity of floods, epidemics, dearths and famines



**Figure 4:** Scale to the left: (Pfister-) Indices that will be used to quantify the findings of temperatures and precipitation from narrative sources and from scientific data in order to create a comparison. Scale to the right: Indices to quantify reports on natural disasters, diseases, and social disasters. Image: Martin Bauch

Reports on dearth, famines, epidemics, and epizootics, which are important for assessing the impacts of natural climate phenomena, will thus be quantified with indices (based on geographical extension and, where possible, qualitative aspects), although the results will probably be somewhat fragmentary. Reconstructing temperatures is not an aim of this project: it is more important to the Dantean Anomaly project to highlight the instability of meteorological conditions and their chronological and spatial distribution. In this way, the acceleration of extreme events can be demonstrated. Beyond that, the accumulated data from written sources can serve to balance and calibrate the results of natural scientists. This is especially true in the case of the ‘historical ice core’ analysis from the Alps.

The region-specific sources of the SPs are critical in addressing the ways these societies reacted to climate events, as each of these source types will highlight different impacts and reactions to these: the working hypothesis is that massive precipitation, flooding, harvest failure, erosion, dearth, famine, and disease affected all of the regions examined in the period between 1309–21. We can also assume that either systematic (SP1) or ad-hoc (SP2, SP3) reactions, such as charity, food management, and protection measures, were employed and that these reactions depended very much on political circumstances (communal/feudal government), economic factors (access to and funds

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for grain imports), and geomorphological preconditions (vulnerability of fields to erosion). There are three interconnected research questions which conceptualize the social impact and reactions oriented around Richard C. Hoffmann's interactive and reciprocal model of the relationship between nature and culture:

- 1. What is the relationship between natural and cultural factors in regards to the extreme events?*
- 2. What cultural mechanisms exist to interpret and handle the extreme events?*
- 3. How successfully do societies actually cope with the natural extreme events? Are the measures taken new or traditional?*

These questions will be answered for all three SPs via a detailed evaluation of the administrative and fiscal sources, as well as knowledge from chronicles and existing research about the societies involved.

Finally, the project will focus on questions of reconstruction, impact, and societal resilience and vulnerability at a transregional or even global level. The results of all three SPs will be contextualized with research on other parts of Europe to determine the characteristics and similarities of the Dantean Anomaly across the continent. Beyond that, cooperation with climate historical initiatives on Southeast Asia and the Byzantine world will provide further data to reconstruct the impact in these areas. In addition, studies on Muslim and Chinese environmental history will provide information. Taken together, this could represent a possible starting point for a comparative global environmental history of the Middle Ages within the emerging field of climate history.