Abstract: The introductory comment revisits older discussions in medieval studies about the “Crisis of the Fourteenth Century,” connecting it – as recent studies suggest – to a general increase in the intensity and frequency of natural extreme events between the turn of the century and the ravages of the Black Death in mid-century. New approaches to this period of transition examine how societal phenomena coincided with rapid or gradual environmental changes and attempt to establish the relationship between causality and correlation; these methods challenge – albeit without reverting to climatic or environmental determinism – established historiographical paradigms that have tended to explain social facts via other social facts (Durkheim). Hence, the introduction discusses new theoretical tools in environmental history like consilience, resilience, vulnerability, and man-nature-interaction models, such as, for example, those developed by the Vienna School (Winiwarter), but also approaches which have received less attention, like Luhmann’s ecological communication, the Panarchy model (Gunderson/Holling), and Lovelock’s Gaia hypothesis. In the interest of promoting a pragmatic heuristic perspective, the editors expand on the idea of societal teleconnections of meteorological extreme events (Moser/Finzi Hart), as this concept integrates delayed effects and feedback loops, acknowledges spatial crosslinks, and avoids hierarchical impact-levels. Applying the meteorological term “teleconnection” in social historical studies allows for the discovery of “strange parallels” (Lieberman) in the socio-economic development of otherwise unconnected areas of the world, and these synchronicities, in turn, open avenues for the further development of a global pre-modern environmental history.

Keywords: crisis, societal teleconnection, correlation, coincidence, causality, consilience, climate determinism, resilience, vulnerability, Gaia hypothesis, socio-natural site, great transition
During the fourteenth century, many Europeans felt they were living in an era of crisis *avant la lettre* in which frightening events seemed increasingly frequent. For instance, the Franciscan Alvarus Pelagius, who studied the Black Death and may have been influenced by medical theories, declared his age to be a time of serious trouble, a *tempus fermentatum*, or “time of fermentation.”

There has been extensive historical research on the crises, wars, and disasters that fourteenth century people faced. In the following we name only a few well known events: the famine in northern and central Europe from 1315 to 1321; the first phase of the Hundred Years’ War between France and England (1337–1386); the so-called Babylonian Captivity of the Papacy in Avignon (1309–1377) and the Western Schism (1378–1417); the waves of plague after 1347, including the agrarian crisis, the economic and demographic depression, flagellant campaigns, increasing murders of Jews, peasant revolts, upheavals in the cities and locust plagues. Many contemporaries were also frightened by short-term or geographically limited events such as a recurrent cattle plague in England between 1318 and 1350, the disastrous flooding of Florence in 1333, St. Mary Magdalene’s flood that affected half

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of central Europe in 1342, the earthquake in Basel in 1356, and St. Marcellus’ flood in 1362 along the coast of the North Sea.\(^5\) The list could go on and on.

Historians must ask, however, whether the frequency and intensity of these events was in fact atypical? Or does modern research rather pay too much attention to the interpretations of contemporary witnesses, perhaps even constructing a crisis where there was none at all? The central question of this volume is whether a correlation between these events can be established. Or more precisely: is there a correlation between these sociocultural phenomena and scientific evidence? We must phrase this question carefully, because there are at least three constraints regarding the assumption of such correlations: First of all, humanists and social scientists are generally reticent to explain “social facts” by means of facts taken from the physical world like environmental conditions and climatic change, genetics, lack of resources, etc. Most historians ascribe such crises to the sphere of social facts and prefer, at least since Émile DURKHEIM, to explain them with \textit{faits sociaux antécédents}.\(^6\) It is most probably due to this tradition that there are strong reservations with regard to the so-called “climate determinism,” which reduces the extremely complex interdependencies between mankind and climate to an assumed unilateral effect of climate on mankind.\(^7\) Thirdly, the social-constructivist research trend of recent decades supports the certainly justified negation of any determinism, including that based on climate.\(^8\) However, we would be ill advised to characterize all factors that play a role in the living environment of humans as mere social constructs. An earthquake or a cold snap in summer is, of course, a social construct (all the more so if historians know of it only from the written historical record), but it is first and foremost a natural event with social consequences.

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\(^6\) Émile DURKHEIM, Les règles de la méthode sociologique, Paris 1895, p. 135.

\(^7\) See Franz MAUELSHAGEN, Klimageschichte der Neuzeit 1500–1900, Darmstadt 2010, pp. 21–23.

As the German medievalist Peter SCHUSTER pointed out twenty years ago, a culture-critical tendency to characterize the late Middle Ages as an era of deterioration and crisis has been evident in many studies since the 1920s.9 Ironically, the Italian Renaissance is simultaneously celebrated as the cradle of modernity and florescence of art and culture.10 In fact, older theories have increased their persuasive power only since 1929, against the background of the Great Depression. They draw connections between the Black Death, decreasing populations, deserted settlements, and an agrarian crisis which has mostly been characterized as an economic crisis or depression. The incomplete statistical foundations have contributed to disputes between different theoretical schools to explain economic cycles and depressions even today:11

The neo-Malthusians and the neo-Ricardian school (Wilhelm ABEL, Michael POSTAN, George DUBY) try to analyze the price-wage-spiral with the aid of a real economic perspective. The monetarists base their quantitative argumentation on decreasing silver production. Marxist researchers highlight a structural crisis within feudalism. Market economists point to a commercial revolution in the late Middle Ages, a market failure, or the influences of regulatory institutions. The American historian Barbara TUCHMAN compared the 1970s with the Vietnam War to the social unrest of the fourteenth century; the reflection in this “distant mirror” (as TUCHMAN titled her bestseller) showed that humanity had already coped with worse.12 A very influential work on the fourteenth century as an era of crisis was published in 1987 by the Bohemian-German historian of Jewish origin František GRAUS (1921–1989),13 who had survived three concentration camps and escaped in 1969 as an originally Marxist historian from the communists in the Czech Republic to West Germany. GRAUS believed that several sub-crises culminated in the fourteenth century, causing severe social disruption. In his view, which may well have been influenced by his own

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biography, this tension resulted among other things in the flagellant movement and in anti-Semitic murders in the years following 1348.\textsuperscript{14}

Ultimately, against the background of current climate change, natural factors are also discussed as a basic condition or deeper cause of the “crises” of the Middle Ages.\textsuperscript{15} Most recent interdisciplinary research on global climate suggests an instable transition period between the different climate regimes of the Medieval Warm Period (about 950–1250) and the Little Ice Age (about 1450–1850).\textsuperscript{16} In spite of existing uncertainties about the dynamics of the process and significant regional differences, this period seems to have been characterized by climatic variations with increasingly frequent and dramatic extreme events.

The interdependencies between natural environment and human activity need to be discussed in addition to weather and climate. Thus, the colonization period of the High Middle Ages, which led to enormous clearances, an expansion of farmland, and population growth, could have had long-term negative effects on the water balance and soil erosion, which in turn could result in decreased harvests and diminished resistance to epidemics and insects.\textsuperscript{17} It is an unanswered question as to whether and to what extent we can talk about anthropogene effects on weather patterns or even climatic development at the regional or continental level as soon as the late Middle Ages or even earlier. The famine crisis from 1315 to 1322, which was obviously not limited to northwestern Europe, the cattle fever starting in 1318, and, last but not least, the bad harvests and years of scarcity in the 1340s in Central Italy seem to correlate with a worsening climate (wet and cold summers); these agrarian crises were accompanied by epidemics.

\textsuperscript{14} Graus (note 2), p. 387 suggests that anti-Semitic violence served as “Ventil” (an outlet) for all kinds of retained emotional tension.


\textsuperscript{17} Compare Harry Kitsikopoulos’s introductory comments in Id. (ed.), Agrarian Change and Crisis in Europe, 1200–1500 (Routledge Research in Medieval Studies 1), New York, London 2012, pp. 8–9.
and had weakened the population prior to the arrival of the Black Death in 1347. The intensifying meteorological extreme events hit an increasingly vulnerable society.  

We could retain the old juxtaposition of Charles P. Snow’s “two cultures”19 in which humanists deconstruct the “Crisis of the Late Middle Ages” while scientists point to an ever-growing amount of evidence on climatic instability and meteorological extreme events even as their assumptions about the consequences remain all too often characterized by determinism. Instead of playing off different types of evidence from disciplines that seem to have nothing in common, however, one could take advantage of at least the shared interest in the same objects of research, be it periods, processes, or single events. It was the nineteenth-century philosopher William Whewell (1794–1866) who first described the “unexpected coincidences of results drawn from distant parts of a subject”20; in 1998, the evolutionary biologist Edmund O. Wilson named this concept “consilience”, literally a kind of “jumping together” and defined it as an agreement of inductions based on at least two epistemologically different sources of data.21 His work, despite its popularity and the fact that this approach is implicitly
familiar to any researcher, was only reluctantly received in the humanities. It was the American medievalist Michael McCormick who introduced it, in a decisively positive interpretation in 2011, as it seemed particularly fit to embrace a confluence of scientific and historical studies with regard to the interplay of paleoclimate and history. Finally, in 2016, interdisciplinary cooperation with the declared goal of consilience resulted in a volume on the climate of the Mediterranean during the Holocene in which the Byzantinist Adam Izdebski and others argue that the methodological gaps between historical scholarship, archeology, and paleoclimatic sciences are not as difficult to bridge as one might think: interdisciplinary research does require that the scholars within these disciplines find a common language and fairly distribute influence on the design of research agendas and the evaluation of research impacts.

Scholars welcomed this approach as “the next phase in the evolution of premodern environmental history – interdisciplinary historians working in multidisciplinary teams.” The present volume – while not yet fulfilling all the requirements of a consilient “archeoscience of the human past” – tries to make an interesting contribution: Tim Newfield and Inga Labuhn argue for a focus on epochs for which both data for the natural and cultural sciences is dense. This allows for a more balanced evaluation of single factors, and cross-disciplinary research should prove particularly effective in countering the danger of environmental determinism. In the case of the crisis of the fourteenth century, consilience should encourage historians to transcend the internal discourses of their disciplines without forgetting these. Intradisciplinary conversations may still prove useful to curb the sometimes effervescent enthusiasm about the new possibilities of this interdisciplinary research.

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25 Adam Izdebski et al., Realizing consilience: How better communication between archeologists, historians and natural scientists can transform the study of past climate change in the Mediterranean, in: Gogou/ Izdebski/ Holmgren (note 24), pp. 5–22.
27 McCormick (note 23), p. 256.
Recent research applies not only the term “vulnerability” but also the complementary concept of “resilience” as an analytical key difference. The “vulnerability” of societies was established as a concept in the discourse of development policy and disaster research. This approach, which involves measuring the systemic (i.e. material, social and cognitive) vulnerability of societies against threats in a causal and gradual manner, has in the meantime also been applied to analyze infrastructure systems, despite some criticism. “Vulnerability” as a concept examines, for example, social conditions and processes and how these influenced whole societies – or segments thereof – and their ability to respond to dangers and catastrophes. From a historical point of view, the concept builds a methodological bridge between natural sciences, engineering, social sciences, and cultural studies.

As a counter term, the concept of “resilience” – drawn originally from ecology and psychology – describes how well a system tolerates disturbance. "Resilient"
means that in times of crisis, the system remains functional, reacting dynamically and flexibly in terms of time and space. In other words, it has a certain ability to resist and adapt. There are three types of resilience: 1) resistance: the precautions a system takes to withstand shocks or creeping changes; 2) recovery: the capacity of a system to recover and bounce back to the original condition relatively quickly, to react appropriately to disturbances and to absorb them; 3) creativity: the ability of a system to achieve the highest possible level of functionality and protection by adapting to the changing conditions. Although the concept is marked by modern political and cultural assumptions, is at times conceptually imprecise, and is difficult to apply directly to historical societies and their infrastructures, the key difference between “vulnerability” and “resilience” allows for a more precise analysis of historical societies and their reactions to dangers, threats and catastrophes.

From this perspective, the following simple questions arise and reoccur in this volume: What strategies did societies develop to protect themselves? Did they prepare themselves in the face of inevitable dangers or even make catastrophic cuts in the interest of disaster preparedness? Or did they try to avoid disturbances and threats in the first place by taking steps in the sense of disaster prevention? There are many examples of societies across time and space that anticipated disturbances and dangers and prepared themselves accordingly.

The question of how societies dealt with very gradual changes, such as large-scale environmental and climate change and even more so the meteorological effects of changing ocean currents or major volcanic eruptions on the other side of the world,
which can extend over several years, has been addressed only to a limited extent.\(^{41}\) In most cases, it is not clear whether contemporaries were aware of these processes of change, and, even if they were, they probably did not detect or understand their actual cause. Nevertheless, the changes, especially whenever these were of an eventful character (e.g., natural extreme events such as storms, drought, floods), challenged people to find explanations, as changes in nature have often been understood as “God’s book” and interpreted as the Creator’s signs to the faithful.\(^{42}\) Whether their origin was known or not, these “natural” factors had dynamic effects on the “societal relationship with nature”\(^ {43}\) and are therefore historically relevant elements which scholars should address in their research.

There are two contrasting approaches to this historical source material: on the one hand, scholars employ an emic approach when they analyze contemporary accounts with particular attention given to the respective time horizon.\(^ {44}\) In this case, researchers are especially mindful of the specific world view of contemporaries and their respective social reactions. These source-critical methods make it possible to glean information from other, non-narrative forms of documentation, such as invoices and inventories, by considering their communicative purposes (Maximilian Schuh, Peter Brown). On the other hand, scientists sometimes adopt an etical approach in which they rely on sources to describe past events and processes such as large-scale weather conditions and climatic fluctuations. These follow patterns that can be explained and based on rules using natural scientific methods.\(^ {45}\) Ideally, scholarship combines these


\(^{44}\) Recent research on historical catastrophes has not limited itself, but prefers this emic perspective, cf. the latest research review of Schenk, Historical Disaster Experiences (note 43), p. 4–15, 23–35.

\(^{45}\) For more information on this epistemically different methodological approach, see Gerrit Jasper Schenk, “Learning from History”? Chances, problems and limits of learning from historical natural disasters, in: Fred Krüger et al. (eds.), Cultures and Disasters. Understanding Cultural Framings in Disaster Risk Reduction, London, New York 2015, pp. 72–87, here pp. 78–82; and more in Id.,
two methodological approaches: the emic perspective is essential to appraise the value and validity of first-hand accounts when reconstructing such weather events, for example. A more straight-forward etic reading of chronicles and calculations, however, lends itself to statistical analysis of precipitation and temperatures, crop yields, and prices, which can be evaluated and combined with dendrochronological data, for example, to reconstruct past weather patterns (Thomas Labbé, Heli Huhtamaa). It is only against this background that contemporary reactions, with their numerous interactions between “nature” and “society,” become recognizable and interpretable.

In understanding the dynamic relationship between societies and their natural environment, a heuristic method has proven to be a fruitful approach in ecological and environmental history research for decades. Researchers have based their ideal-typical models on considerations in the sense of systems theory; a few examples here are intended to provide a basic outline of these models as a basis for the concept of both natural and social teleconnections developed in this volume. We begin with those models that have less heuristic potential. While all models are abstractions and thus intrinsically interpret a “reality,” based on source analysis, observations, calculations and considerations, they can be tested using concrete case studies.

In his study on “ecological communication,” Niklas Luhmann describes society as a “system of communication” in which “nature” is perceived as an impulse of the “environment” (i.e., the surroundings) of the system only if this impulse can be incorporated into the internal communication within the system and creates “resonance”


46 On the ecological modeling, which tried to explain the development of mankind and his cultural evolution, see as early as 1978, Kenneth E. Boulding, Ecodynamics. A New Theory of Societal Evolution, Beverly Hills, London 1978; an overview in Antoinette M. Mannion, Global Environmental Change, New York 1997, pp. 1–11; from the perspective of environmental history, see Verena Winiwarter/Martin Knoll, Umweltgeschichte. Eine Einführung, Köln, Weimar, Wien 2007, pp. 117–143. This is to point out once again that the terms “nature” and “society” are only applied in an ideal-typical context, and that they are so closely related to each other that an ideal-typical separation only makes sense for analytical reasons.

there.\textsuperscript{48} If, however, one considers the system-environment (i.e. in this case “nature”) to be connected to and co-evolving with the system of society,\textsuperscript{49} these historical relationships may be analyzed even in cases where there is no record of overt communication in society concerning environmental changes; these occurred nevertheless and altered in turn the society’s relationship to nature. Rigorously demarcating the boundaries between “system” (i.e. “society”) and “system-environment” (i.e. “nature”) in LUHMANN’s sense therefore blocks a heuristic approach that seeks to identify and investigate interdependencies and feedback loops between the (communication) system and the system-environment in the past.

The so-called “Gaia hypothesis” – formulated by the physician and biophysicist James LOVELOCK and biologist Lynn MARGULIS and sold in bestsellers that include an esoteric element – takes an extreme approach in the opposite direction.\textsuperscript{50} LOVELOCK and MARGULIS suggest that the whole earth be regarded as a self-regulatory living being (superorganism). Unfortunately, the authors apply this image not to actual superorganisms that could be investigated but to the totality of the earth as such and thereby impede any scientific usefulness of the metaphor. As a result, a number of biologists and ecologists have rejected the Gaia hypothesis.\textsuperscript{51} However, the controversy surrounding the Gaia hypothesis (which cannot be included in this discussion) has recently led to a systems theory understanding of the earth as a slowly developing totality of biotic and abiotic elements which interact with each other in a sort of self-regulation; scientists remain divided on the question of whether these elements actually co-evolve and whether the process strives for homeostatic states.\textsuperscript{52} Within the context of Bruno LATOUR’s actor-network theory, which similarly ascribes agency to abiotic elements, the French sociologist of science has recently made some affirm-
ative comments about LOVELOCK’S Gaia hypothesis. While we recognize the importance of addressing socio-ecological systems in a way which includes abiotic factors (such as weather, volcanism, etc.) as part of these processes, we reject the organic implications of the Gaia hypothesis.

Socio-ecological system theories, which fall between the two extremes outlined above, have been developed and used, for example, in the “Vienna and Klagenfurt School” around Marina Fischer-Kowalski and Verena Winiwarter, the prominent ecologists whose widely received scholarship has influenced, for example, the Canadian medievalist Richard C. Hoffmann. The starting point here, too, is the assumption of a complex systemic relationship between the inanimate and animate world, of which human societies are only one element. By analyzing the interactions within this system, the exchange relationships and material flows, it is possible, for example, to reach conclusions about the energy regime of societies (the so-called “social metabolism”). This model can be related to very different “socio-natural sites” and is therefore scalable and specific (Theodore R. Schatzki, Martin Knoll). An interdisciplinary working group around the environmental biologists Lance H. Gunderson and Crawford S. Holling has developed an even more complex system theory in its Panarchy model. This all-encompassing heterarchical network model facilitates the mapping of transformations within socio-ecological systems. This model is scalable and can incorporate both adaptive processes as well as non-linear developments (e.g. disruptive events like disasters).

None of these concepts and models are the focus of the present volume, but they do provide the conceptual and hypothetical framework for examining the questions posed here. Analyzing the interaction between the ideal types “nature” and “society” in space and time raises methodological problems beyond the abstract models, mainly concerning the verifiability and the type of interaction or form of the interrelationships between the ideal types “nature” and “society.” Are observable environmental phenomena like cool, wet weather during the growth period and (possibly remote) supply crises merely coincidental or are they causally related? What is the epistemic status of correlations and the legitimacy of connecting temporal and spatially removed events? Is there a point at which quantitative arguments and correlations of more or less connected events have to be interpreted as causal connections? On the one hand a succession of bad summers certainly does not explain the visions of someone like Dante Alighieri sufficiently, but, on the other hand, Giovanni Boccaccio’s entertaining novelettes are more than an escapist diversion in the period of the Black Death – the entertaining diversion is intended to be medicine against bad humors (in the sense of humoral pathology). The complex interdependencies between environment and society defy easy explanations; we have to assume that the products of high culture also possessed a great deal of Welthaltigkeit; in other words, they contain parts of their creators’ physical realities. To summarize the results of this overview of approaches for the study of environmental history, a pragmatic heuristical approach should display the following traits:

- Openness to data from human-made sources as well as proxy data of scientific origin, and consideration of possible contradictions
- Attentive to the sensitivity/liability of social groups to external shocks without underscoring potential tolerance to these shocks or an ability to resist that some segments of a society may have
- Consideration of the temporal dimension of these external shocks, be they rapid or slow, singular or repeated events
- No blind dependence on communication about nature within a given society (although this might be an aspect) but rather an understanding that some changes take place although contemporaries remain unaware of them (e.g., climate change and shifting baselines)
- Focus on the interactions, exchanges, and material flows between the living and the non-living world following the Vienna School’s model (scalable both geographically – i.e., applicable to local, regional, continental and global phenomena – and chronologically – i.e., covering periods from several days to decades, if not centuries)

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Because most of the contributions in this volume focus on phenomena more or less associated with historical climate change, it seems reasonable to introduce the pragmatic impact-reaction model that Daniel Krämer and Christian Pfister proposed to conceptualize the interactions of meteorological extreme events and societal change.61

While this model (Figure 1) seems to include a number of the traits discussed above, it focuses nearly exclusively on the idea of an “impact” of natural events: these impacts are implicitly understood as short-term, immediate, and locally bound, and the cascading effects from one level to another can explain quite a lot in most of the thinkable case studies.

But this model has its flaws, as well: there are at least three aspects in which this scheme of impact/reaction cannot sufficiently explain what can be empirically found:

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1. **Impacts can skip the logical order of levels**: from biophysical effects to economy/health to demography/society to, finally, culture. For example, the mere anticipation of extreme weather sometimes impacts food prices even if no serious damage actually occurs.

2. **Delayed effects and feedback loops**: Impacts repeat on one level (mainly biophysical/economic), but the consequences at other levels emerge only after a – sometimes considerable – time lag, often long after the original extreme event has ended. For example, societies might introduce delayed institutional or infrastructural adaptations in the areas of flood protection or food security.

3. **Spatial crosslinks**: The impact of extreme events on different levels can also happen in differing geographic regions: it gets projected from one area to another, as long as they are somehow connected. This might be a physical connection, like the flooding along the lower stretch of a stream while the flood wave originated in the headwaters of the river, where extreme precipitation took place. Also social connections are thinkable: for example, inclement weather in a grain-producing area impacts the harvest and causes dearth or even famine in a far away city or region that depends on imports from that very area of grain production.

A combination of all three aspects is also feasible. For example, the cult of a protective saint against the plague spreads in a European region hardly affected by the Black Death, even as the pandemic itself was sparked in part by changing precipitation patterns in Central Asia.

Perhaps it is more useful to think of the multi-level impacts of a meteorological extreme event on a society (as the sole or contributory factors) as a social equivalent to what climatologists define as an oscillation: atmospheric phenomena that tend to vary above or below a mean value, in most of the cases in a periodic way.⁶² There is a variety of oscillation types⁶³ as it might seem useful to re-categorize impacts based on their frequency and strength. The methodological approach proposed in more detail below, especially when it applied to the longue durée or at least multi-annual analysis, is comparable to what climatologists do.⁶⁴

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⁶² A perfect periodicity would be described as a cycle, but this applies only to few atmospheric oscillations, see Howard A. Bridgman/ John E. Oliver, The Global Climate System. Patterns, Processes, and Teleconnections, Cambridge 2006, pp. 25–26.

⁶³ There is a multitude of different categories, e.g. a damped oscillation with constantly decreasing amplitude; a persistant oscillation that maintains its amplitude; an unstable oscillation with an amplitude that grows and then breaks down. A forced oscillation is set up periodically by an external force, while a free oscillation receives only initial external energy to set in place a certain motion, see Rhodes W. Fairbridge, Oscillations, in: John E. Oliver/ Rhodes W. Fairbridge (eds.), The Encyclopedia of Climatology, New York 1987, pp. 643–644.

⁶⁴ “The character of the identified oscillations is mostly derived statistically from long-term pressure observation series” (Bridgman/ Oliver [note 62], p. 26).
And yet is it not enough to add the idea of oscillation to our often fairly unnu-
anced notion of “impact.” If we want to describe the “long arm of climate change” in
historical research, it is useful to adopt the term of “societal teleconnection”, broadly
defined as “mechanisms that produce inter-dependence in the vulnerabilities of eco-
systems, people, and places”.65 Originally, the term “teleconnection” described the
tendency for atmospheric circulation patterns to be related over large, not necessar-
ily connected, areas.66 Significantly, the origins of meteorological theories on long-
distance connections between meteorological events were caused by observations of
the social impact of weather events. The first scholars to develop such hypotheses have
been English meteorologists in the service of the Indian Meteorological Department in
the second half of the nineteenth century; they noted that snowfall in the Himalayas
correlated to droughts in India, which repeatedly caused threatening famines.67 In
the early twentieth century, systematic statistical analysis verified global correlations
and weather patterns (“Yule-Walker equations”).68 As such, teleconnections became
strongly associated with atmospheric oscillations.69 Teleconnections “often provide
the missing piece in the understanding of climate patterns, both spatial and tempo-
ral, that occur across the world.”70

Hence, “teleconnection” can be seen as a heuristically sensible term to describe
both direct and indirect causal links between historical phenomena of climatic
and societal change. Susanne C. Moser and Juliette A. Finzi Hart, a geographer
and oceanographer who have long adopted approaches from the social sciences
to study climate change, put the term “societal teleconnections” in a “simple but
systematic framework”71: Man-made linkages add another layer of risk to the vul-

65 W. Neil Adger/ Hallie Eakin/ Alexandra Winkels, Nested and teleconnected vulnerabilities to
66 Most simply they have been defined as linkages between climate anomalies at some distance
from each other, see Michael H. Glantz, Currents of Change: El Nino and La Nina Impacts on Cli-
mate and Society, 2nd edition Cambridge 2001; for a detailed analysis on the example of Africa see
Andreas Philipp, Zirkulationsdynamische Telekonnektivität des Sommerniederschlags im südhem-
osphärischen Afrika, Diss. Würzburg 2003, specially pp. 1–7 (concept), 43–44 (patterns in the northern
hemisphere).
67 Henry F. Blanford, On the Connexion of the Himalaya Snowfall with Dry Winds and Seasons of
Drought in India, in: Proceedings of the Royal Society of London 37 (1884), pp. 3–22; on the roots of
the discussion already in the eighteenth century, see Richard H. Grove, The East India Company, the
Australiens and the El Nino: Colonial Scientists and Ideas about Global Climate Change and Telecon-
nections between 1770 and 1930, in: Id., Ecology, Climate and Empire. The Indian Legacy in Global
Environmental History 1400–1940, Delhi et al. 1998, pp. 124–146.
70 Ibid., p. 27.
71 Susanne C. Moser/ Juliette A. Finzi Hart, The long arm of climate change: societal teleconnections
nerability to climate change, as the interactions of actors, framed by institutions, influence the movement of material substances (money, goods, people, biological agents) through physical transmitter structures (mainly transportation infrastructure) and processes (like commerce, travel, migration). These “societal teleconnections” are created in societal interactions and cause, reinforce, or mitigate vulnerability to climatic change. They are neither innately positive nor negative to a society, as their effects depend very much on the ability of local communities to cope with their effects. Susanne C. MOSER and Juliette A. FINZI HART list a number of societal teleconnections, which apply cum grano salis to modern as well as to medieval societies:

- **Economic teleconnections**: trade of foodstuffs
- **Energy production**: mills, draft animals, danger of city fires
- **Migration**: Movement of population due to disasters or famine
- **Human health**: Famine and vulnerability to epidemics; effect on biological agents

Combined with the physical meaning of teleconnection, this social enhancement of the term should be able to cover the three aspects to which a simpler impact/reaction scheme does not pay attention. Finally, from the perspective of global history, actual physical teleconnections as studied by climatologists and meteorologists might become in certain cases important heuristical tools which link similar events in regions that are otherwise not connected. There are “strange parallels” of historical processes in societies that are not or at least not obviously connected by trade, migration, or other forms of cultural exchange. This seems to be a fundamental difference to the extant global histories of the period 500–1500 AD, for these focus on communication and economic, cultural, and political interaction, as if these were the only possible ways to develop a global perspective on pre-modern history. Climate

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history is either completely missing\textsuperscript{75} or a marginalized factor, with the possible exception of historical disaster research.\textsuperscript{76}

There are, however, encouraging exceptions: Patrick Boucheron\textquotesingle s global history of the fifteenth century starts with a volcanic eruption in mid-century as a teleconnecting moment.\textsuperscript{77} Victor Liebermann demonstrates a more long-term perspective in his two-volume comparative history of Southeast Asia by outlining the synchronicity of geophysical oscillations which resulted in meteorological extreme events. The first volume points to relatively synchronized periods of warming between 950 and 1300 and highlights the less favorable climate in the fourteenth century. Agricultural and maritime cycles possibly both depended on climate as a third factor.\textsuperscript{78} Liebermann refers a lot to climatic changes of solar, volcanic, and oceanic origin and describes in detail their positive impact on Burmese rice cultivation between 900 and 1300, although he does not propose a \textquoteleft climatic interpretation of Burmese or Eurasian history\textquoteright. While climatic conditions might have helped to jump start charter civilization,\textsuperscript{79} he makes this argument with reservations.\textsuperscript{80} In the second volume of his magistral publication, Liebermann names nine different factors that promoted similar developments in Europe and Southeast Asia, climate being just one of them, although it is considered only second in importance after commerce.\textsuperscript{81} He basically argues that the Medieval Warm Period (800/850–1250/1300) extended the growing season in Europe and dried out arable land in Northern Europe, making it accessible, hence contributing to rapid demographic and economic growth. At the same time, higher temperatures promoted stronger monsoons in Southeast Asia, critical for rice

\textsuperscript{75} Ibid.; this applies even for the single chapters which address specific regions, for example, Michael Limberger, Vom Zeitalter der Gotik zur spätmittelalterlichen Krise. Westeuropa, in: Ibid., pp. 29–55.
\textsuperscript{78} Liebermann (note 73), vol. 1, p. 49.
\textsuperscript{79} Ibid., pp. 101–112.
\textsuperscript{80} In his conclusion to the first volume, Lieberman states: “in seeking to explain the more or less coordinated 10th-14th century florescence of charter states, I have called attention to the Medieval Climate Anomaly and improved monsoon flows. But without better information, we cannot easily separate climate from autonomous changes in agricultural technique, religious organization, or foreign commerce” (Ibid., p. 459).
\textsuperscript{81} Liebermann (note 73), vol. 2, pp. 77–92.
production in interior dry zones.\textsuperscript{82} That would be a perfect example for a physical teleconnection with clear societal consequences: Improved climate combines with other factors to increase the demographic and agrarian vitality of medieval Western Europe and Southeast Asia, from Kiev on the one side to Angkor, Pagan, and Dai Viet on the other. At the same time, the crisis that both Europe and Southeast Asia faced from the second half of the thirteenth century to the mid-fifteenth century, was not only the result of epidemics like the Black Death and land degradation (e.g. erosion and political strains) but also of the climatic downturn around 1300.\textsuperscript{83}

The synchronicity of meteorological extreme events\textsuperscript{84} are the common denominator of these “strange parallels” – and not so much the actual impacts or the kind of changes they caused. These might even be quite contradictory.\textsuperscript{85} And yet, the results of dendrochronological research to reconstruct the forty wettest and driest years in Cambodia\textsuperscript{86} are astonishing: six of the driest and wettest forty years of the last 759 years are within the fourteenth century, and the specific years are all too familiar from European climate history.\textsuperscript{87} While some of the strange parallels in the thirteenth and fifteenth century might be attributed to volcanic activity, this does not provide an easy explanation in the fourteenth century.\textsuperscript{88} So it is not at all surprising that we find the same years again and again here in contributions on completely different

\begin{itemize}
  \item \textsuperscript{82} Ibid., p. 80.
  \item \textsuperscript{83} Ibid., p. 83–84.
  \item \textsuperscript{84} As, for example, Bruce CAMPBELL demonstrates for the remarkable year 1342. CAMPBELL (note 15), pp. 208, 283–284.
  \item \textsuperscript{85} See, for example, the seesaw-effects that can be found for the Mediterranean during the eleventh century, outlined in Ronnie ELLENBLUM, The collapse of the eastern Mediterranean. Climate change and the decline of the East, 950–1072, Cambridge 2012.
  \item \textsuperscript{87} The driest years: 1363, 1362, 1346, 1338, 1327, 1326; with 1362/63 well known due to a Central European drought, see Andrea Kiss’s contribution. The wettest years: 1316, 1322, 1335, 1336, 1375, 1376; with 1316 and 1322 as core years of the Dantean Anomaly and the connected Great Famine, see Thomas LABBÉ’s contribution in this volume and also Tana Li’s.
  \item \textsuperscript{88} The two wettest years on record are 1258 and 1453, with the Samalas and possibly the Kuwae eruptions, the two biggest tropical eruptions of the past millenium, as a background; on the first event see Sébastien GUILLET et al., Climate response to the Samalas volcanic eruption in 1257 revealed by proxy records, in: Nature Geoscience 10 (2017), pp. 123–128 and Martin BAUCH, Chronology and Impact of a Global Moment in the Thirteenth Century: The Samalas Eruption Revisited, in: Andrea Kiss/ Kathleen PRIBYL (eds.), The Dance of Death in Late Medieval and Renaissance Europe. Environmental Stress, Mortality and Social Response, Abingdon-on-Thames 2019 [in print]; on the mid-fifteenth century eruptions see Martin BAUCH, The Day the Sun Turned Blue. A Volcanic Eruption in the Early 1460s and its Possible Climatic Impact – a Natural Disaster Perceived Globally in the Late Middle Ages?, in: Gerrit J. SCHENK (ed.), Historical Disaster Experiences. A Comparative and Transcultural Survey between Asia and Europe, Heidelberg 2017, pp. 107–138.
\end{itemize}
parts of Europe (LABBÉ, BROWN, CAMENISCH, PREISER-KAPELLER/ MITSIOU, KISS et al., VADAS, NANNI, HUHTAMAA) or even beyond (LI).

This volume cannot possibly fully develop the potential heuristic value of (societal) teleconnections, specifically when it comes to the new perspective on global history that it may open up. The importance of cultural factors that determine a society’s specific response to meteorological extreme events and climatic oscillations, however, becomes visible if we consider the contributions on regions outside of Europe (LI) or on its margins (PREISER-KAPELLER/ MITSIOU).

Beyond that, recent publications have sketched the potential contributions of climate historical studies to new contextualizations of the European Expansion. Classical studies on this question, like Eric JONES’ “The European Miracle,” have assumed climatical conditions to be stable, with negative consequences especially for Asia, while regarding Europe’s climate as favorable. Older theories like the Wittfogel-hypothesis seem to underlie many of JONES’ assumptions, but he himself admitted at the time that these assumptions lacked a dense reconstruction of the frequency and severity of disasters on which to draw. In the interim, researchers have contributed a great deal of such data. It might be promising, therefore, to reexamine traditional topics within the historiography like the crisis of the fourteenth century or the rise of Europe to include aspects of climate history at the level of global comparisons.

Most – though not all – of the papers in this volume were presented at a three-day conference in February 2016 in Rome. The support of many different people and insti-

89 Bruce CAMPBELL tried to connect the origins of the “Great Divergence” (K. POMERANZ) between Asia and Europe to the last phase of consolidation after the Great Transition. Bruce CAMPBELL (note 15), pp. 373–394.
91 “This places the explanation of the difference in Asian and European levels of breeding and income squarely in the fertility response to different risk environments” (Ibid., p. 20).
92 “Underlying the European response pattern was an adjustment to a more favorable risk profile than in the remainder of Eurasia. The options were simply a little broader.” (Ibid., p. 21).
93 Especially when it comes to the dependency of European farmers on rainfall, while their Asian counterparts were busy with irrigation. (Ibid., pp. 8–9)
94 Ibid., pp. 22–29; see already SCHENK, Historical Disaster Experiences (note 43), pp. 31–35.
96 Michael MITTERAUER examines the agrarian system, mining, and water mills, but natural change is of no concern to him. Michael MITTERAUER, Warum Europa? Mittelalterliche Grundlagen eines Sonderwegs, München 2003.
97 The Conference, entitled “The Crisis of the 14th Century: ‘Teleconnections’ between Environmental and Societal Change?,” took place from 24–26 February 2016 at the German Historical Institute in
tutions made this event possible. Our thanks are due first to the German Historical Institute in Rome, especially to its director, Prof. Martin Baumeister, for hosting the event and supporting it financially. Additional funding came from the Max-Weber-Stiftung (Bonn) and the DFG-project “Vulnerable Societies,” led by Prof. Dominik Collet (then Heidelberg University, now Oslo University). The publication of this volume was only possibly by the willingness of the Association of German-Speaking Medievalists (Mediävistenverband) to include it in their series Das Mittelalter. Beihefte. In addition, Dr. Ellen Yutzy Glebe (Kassel) edited most of the texts with great attention to linguistic style and clarity. Without the substantial financial support of the Chair of Medieval History at Darmstadt University of Technology, and the Junior Research Group “The Dantean Anomaly” (Leipzig), funded in turn by a Freigeist-Fellowship of the Volkswagen Foundation, this volume could not have been printed. Generous financial support by the Open Access Fonds of the Leibniz Association allowed us to make this volume openly available online immediately after its publication.

One of the highlights of our conference was an evening lecture delivered by Prof. Bruce M.S. Campbell (Belfast). This thought-provoking and convincing lecture – which drew on material that appeared some months later in his ground-breaking monograph on The Great Transition – is available online. We are particularly grateful that Richard C. Hoffmann, a big fish in the still relatively small pond of Medieval Environmental History, agreed to provide this volume with a comment on the individual contributions and the methodological approach we editors have proposed above. His comment is not the only element which connects the single contributions, however. Although our decision to publish them in alphabetical order of their author’s surnames may seem to suggest otherwise, this introduction has hopefully shown how the common question of “teleconnections” and the attempt to examine natural and social factors in their interactions pervades all the contributions, even if this is at times a geographical teleconnection. Forming thematical blocks would have inherently reduced their value when regarded from various perspectives:

Some of the authors here reconstruct short-term events (Brown) or processes of medium-term length (Labbé, Nanni, Huhtamaa), while other address developments over the long term (Kiss et al., Preiser-Kapeller/ Mitsiou, Li, Schreg). While such reconstructions are quite instructive and still needed, other contributions address


98 Bruce M.S. Campbell, The Environmental Origins of the Black Death (video lecture), https://youtu.be/7x9Oh0-viyM.
very specific written sources, in some cases for the first time in the context of environmental history. These include the Italian and Nordic calendars (HALONEN) or the accounts of comital castellans in Savoy (LABBÉ). Other contributions critically review records long-established in climate history, like the famous Winchester pipe rolls (SCHUH) and Swiss chronicles (CAMENISCH). If written sources are scarce, the particular value of including natural proxies in such studies is highlighted by two papers from eastern (VADAS) and northeastern Europe (HUHTAMAA).

Beyond reconstruction, source criticism, and innovative and established methodologies, many of our papers elaborate on the social consequences of the extreme events in question: While in some cases cultural patterns seem to prevail over the natural impacts (NANNI, HALONEN), other contributions here closely connect socio-economic effects with previous natural events (BROWN, KISS et al., SCHREG). When it finally comes to the value of thinking in terms of geophysical teleconnections, however, the contributions on Byzantium (PREISER-KAPELLE/MITSIOU) and China (LI) – in addition to Bruce CAMPBELL’s video lecture – open both the large chronological perspective and also point to (not completely) coincidental developments over large distances. We sincerely hope that this volume can demonstrate the potential that research on the climate and its extremes has to provide many more insights to medievalists than just what the weather was like in the thirteenth and fourteenth centuries.

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