Introduction

INTEGRATING, CONNECTING AND NARRATING NORDIC CLIMATE HISTORIES

Dominik Collet, Ingar Mørkestøl Gundersen, Heli Huhtamaa, Fredrik Charpentier Ljungqvist, A.E.J. Ogilvie and Sam White

Rediscovering Climate History

The rapidly accelerating global warming of our time has reawakened interest in past periods of climatic change. While the scale and speed of twenty-first-century anthropogenic warming are unprecedented, historical experiences hold important information to situate the present. The past does not just provide the indispensable baselines for forecasting the future; it holds the available inventory of human responses to 'socialise climate'. Crucially, it also helps us connect the abstract forecasts of global computer models to 'lived' regional experiences.

The Nordic countries, specifically, have long been imagined in relation to their climatic setting. From the sixteenth-century descriptions of Olaus Magnus of the icy North and the idealisations of nineteenth-century romantic nationalism, their cold, harsh, snowy climate has been employed to set the Nordic countries apart (Sörlin 2024). Yet, just as elsewhere, interest in climate history has waxed and waned over time in accordance with perceived risks. The traditional entanglement of climate and society that characterised earlier natural histories fragmented during the nineteenth century with the proliferation of specialised academic disciplines. Attempts in the early twentieth century to enlist climate for the legitimation of colonialism and racism discredited the field for decades. Only during the 1970s did an integrated study of 'historical climatology' start to reemerge, building on the availability of new datasets. However, it was not until the current climate change became pressingly obvious, that the dispersed research communities of geographers, historians, archaeologists and other social and natural scientists once again galvanised into a coherent field.

Today, climate history is characterised by its ambitious 'big interdisciplinarity'. This connects the natural sciences and the humanities. Research in this

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area explores both 'archives of nature' (tree-rings, ice cores, etc.) and 'archives of societies' (historical records, early observations, material culture). The collaboration among natural scientists, historians and climate communicators remains both challenging and constitutive. These communities bring their own methods, vocabulary and work routines (Haldon et al. 2018). As a result, climate history is characterised by plurality, heterogeneity and occasionally eclecticism. Quantitative and qualitative approaches coexist alongside local, regional and global perspectives. Different areas of research emphasise different 'proxies' – indirect sources of information – ranging from tree-ring data and sediment cores to agricultural records, poetry and songs (Pfister et al. 2018). Some climate histories explore single climatic periods or anomalies in detail, while others follow regional trajectories across centuries or even millennia. What unites this diverse field is the ambition to answer similar questions: What can the reconstruction of climatic trends and shocks add to our understanding of the past? What can these earlier climate–society interactions tell us about future scenarios, both biophysical and societal? What lessons can be learned from earlier failures and successes in climate change adaptation?

Nordic environments offer exceptional opportunities for climate histories. They are both particularly sensitive to changes in climate and richly documented. Nordic countries offer a consummate range of climate proxies, some unique to the region. Trees in high latitudes provide exceptionally accurate reconstructions of summer temperatures. Other proxies, such as sea- or lake-ice break-up dates, are much richer across Fennoscandia than elsewhere. In addition, the natural archives of Nordic countries, such as glaciers and freezing lakes and rivers, are located close to human populations, reducing the need to interpolate societal impacts over large distances. Societies in many parts of the Nordic countries also persisted in rather marginal ecological environments, where small changes in climate could have disproportionate impacts. They cultivated a broad repertoire of responses to climatic stress, including specific foodways, housing and heating practices as well as cultural and communal adaptations. As a result, climatic changes are often visible in the history of the North before they are seen to have affected warmer regions.

Paradoxically, this abundance of information has reduced the need for interdisciplinary collaboration. Scholars in Nordic countries have felt less pressure to reach across academic and national borders to supplement sparse data. Research into past climate has often been compartmentalised, with a lack of integration across natural and societal archives. Attempts to (re-)connect these data through a combined socio-natural approach remain rare. Compared to Central Europe and East Asia, climate history in the Nordic countries commands little institutional structure and support. Integrative research is often pursued by individual researchers or temporary research projects. As a result, the visibility of these approaches and their impact on public debate have been limited.

This collection aims to present climate histories from across the Nordic countries in a single volume. It was conceived during an international conference at the University of Oslo in May 2024. The meeting connected leading and emerging scholars in the field with practitioners in climate communication and governance. The papers in this volume have been selected to represent the whole scope of recent developments in the vibrant field of climate history. The collection is deliberately interdisciplinary in format, connecting climatologists, geographers, archaeologists, historians and museologists. It presents historiographical and methodological research, as well as histories from every Nordic country, from prehistory to the present. It includes in-depth case studies as well as reflexive meta-histories of longer pathways. These cover the period from the mid-Holocene to the twentieth century. The papers also draw on the whole range of available records from glaciology to material culture and poetry. Crucially, the collection also includes several texts that debate how these climate histories can be communicated. These investigate how museums and literature can bring these histories into conversation with a current audience looking for lived experiences of climate adaptation. Inevitably, some gaps remain. Denmark is covered only peripherally, and research with a strong (palaeo)climatological focus has not been included. However, the selected texts make extensive use of the available palaeoclimatic data and results.

The resulting volume is intended to provide an overview of the rich and rapidly growing scholarship in Nordic climate history and its connection to public debate in the Nordic countries and beyond. Its essays speak to various academic communities (climatology, archaeology, history, literature) and stakeholders (museum, climate communication and advocacy practitioners) as well as a wider public interested in the vibrant debate on climate adaptation and experience. Taken together, they explore timely questions: How did Nordic societies cope with climate variability in the past? What responses did the Medieval Climate Anomaly or the Little Ice Age trigger in the different societies they affected? Can these past experiences help to identify current shortcomings and reductions?

Variations in Climate in the Nordic Countries

The Nordic countries share a range of climatic characteristics. However, they also exhibit substantial internal variation in climatic conditions, not just over time, but also geographically. Norway is mountainous as opposed to Denmark and most of Sweden and Finland. Coastal Norway is also exceptionally mild for its latitude in winter – and wet year-round – as a consequence of prevailing westerly winds and the relatively warm North Atlantic currents. Southwestern Sweden and Denmark also have mild winters, but with far less precipitation than in Norway, and much warmer growing seasons. Conversely, interior northern Sweden and Finland have the coldest and longest winters. The Lake Mälaren region of east-central Sweden (around Stockholm), southeastern Sweden, and southeastern Finland enjoy the warmest – and also driest – summers, shorter in length but with temperatures temperatures resembling continental climate. Summers along the Norwegian west coast are cool and precipitation-rich due to a strong oceanic influence. The annual mean precipitation reaches 2,500–3,000 millimetres in parts of coastal Norway, with rainfall averages across the Nordic agricultural areas decreasing strongly from west to east. In the drier regions, mainly located in southeastern Sweden, late spring and early summer drought is a major challenge. Here spring precipitation is particularly low and irregular (Wastenson et al. 1995; Tveit et al. 2001).

For centuries, these climatological and ecological frameworks have influenced the livelihoods that supported European pre-industrial societies. During the 1961–1990 reference period, the average length of the growing season (daily mean temperature exceeding 5 degrees Celsius) exceeded 200 days in almost all of Denmark and in southernmost Sweden and surpassed 175 days in the major agricultural regions of Sweden and Norway. In almost all of Finland, the growing season was shorter. At the northern edge of agriculture in the Nordic countries, this is reduced to only 120 days and even today a warm summer is necessary for good harvests. This crucial variable not only shows large inter-annual and inter-decadal fluctuation – it has also varied over time with climatic change. During the climax of the Little Ice Age in the late sixteenth and early seventeenth centuries (Wanner et al. 2022) it was approximately six weeks shorter due to late and cold springs. In addition, in inland regions – due to a large day-to-night temperature range – the nominal growing season is often considerably shorter because of the occurrence of frost (Tveit et al. 2001). In these environments climatic shifts could have disproportionate agricultural effects.

Climate histories have identified some major trends in the past climate of the Nordic regions (Figure 1). Tree-ring based summer (growing season) temperature reconstructions reveal sharp and very strong volcanically-induced cooling, following the large AD 536 and AD 540 eruptions, lasting from 536 to at least c. 545, commonly called the Late Antique Little Ice Age (LALIA) (Büntgen et al. 2016). Summers were mainly warm, slightly exceeding mean 1961–1990 conditions, between c. 850 and 1050 and again, but less so, between c. 1150 and 1250. These warm periods are commonly collectively named the Medieval Warm Period (MWP) or Medieval Climate Anomaly (MCA) (Ljungqvist et al. 2016; Wang et al. 2023). Summers became generally colder, and possibly more variable,

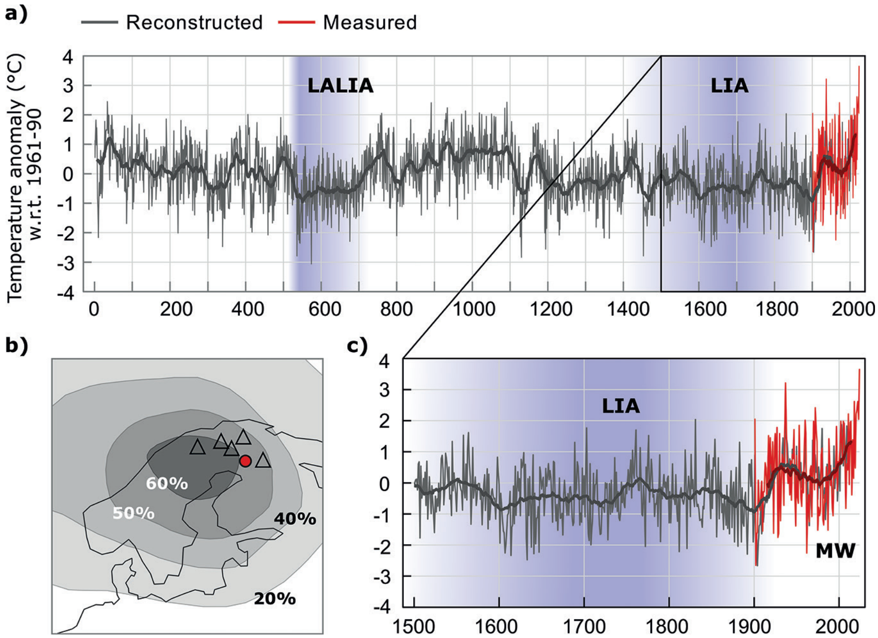

Figure 1. Temperatures past and present. (a) Tree-ring based reconstruction of summer (June, July, August) temperature anomalies (with respect to 1961–90 mean) over northern Fennoscandia in grey, and Sodankylä weather station recordings over the same months in red. (b) Locations of the tree-ring sites (triangles) used for the reconstruction and Sodankylä weather station (red dot). The percentages indicates how well the reconstruction explains the observed temperature variability over the Nordic regions. (c) Close up over the periods of the Little Ice Age (LIA) and Modern Warming (MW). Data sources: Matskovsky and Helama 2014; Morice et al. 2021; Finnish Meteorological Institute (Accessed 11 Nov. 2024 via https://www.ilmatieteenlaitos.fi/havaintojen-lataus).

after the mid-thirteenth century, marking an early onset of the Little Ice Age (LIA) (Wanner et al. 2022). The longest period of very cold summers occurred in the decades around 1600 and during parts of the nineteenth century. Little is known about the temperature conditions in the Nordic countries for other seasons prior to the sixteenth century. The longest period of very cold and long winters occurred in the second half of the sixteenth century and first half of the seventeenth century. In the mid-eighteenth century, winter temperatures, on the other hand, were as mild as in the late twentieth century (Leijonhufvud et al. 2010). Post-2000 winters and springs have most likely been the warmest for at least one, possibly over two, millennia in the Nordic countries. It is less certain whether recent summer warming has also been unprecedented. Importantly, the amplitude of temperature variability, across all timescales, appears to have been about three times larger in winter and early spring than during summer and autumn. Regarding hydroclimate, very dry summers seem to have prevailed during much of the twelfth century, the second half of the fifteenth century and early nineteenth century (Seftigen et al. 2017).

Because of its island location in the North Atlantic, the climate of Iceland is very different to that of the other Nordic countries. A key feature is its variability, due to its proximity to both warm and cold ocean and air currents. In the past, Iceland's climate was much affected by the sea ice that drifted southward to its shores on the East Greenland Current. There is considerable evidence that the climate was relatively mild around the time of the Viking Age settlement at the end of the ninth century, but the picture is complex. Historical records of climate change appear in the late twelfth century. Iceland is known for its excellent historical records of climate information. However, although they first appear in the late twelfth century, they do not become prolific until the beginning of the seventeenth century. From that time onwards the variability of the climate is evident. Yet frequent sea-ice incidence added to the severity of the climate. A warming trend began in the early twentieth century that has for the most part continued to the present day (Ogilvie and Miles, this volume).

The Historiography of Climate History in the Nordic Region

Writings on the impacts of climate change and variability in the Nordic countries may be found as early as the mid-sixteenth century. In his great opus of 1555, *Historia de Gentibus Septentrionalibus* (Description of the Northern Peoples) the Swedish writer and cartographer Olaus Magnus (1490–1557) refers to topics that include climatology, meteorology and hydrology. Icelanders were particularly precocious in their interest in the topic. In the late-sixteenth century, the scholars Arngrímur Jónsson and Oddur Einarsson wrote treatises on sea ice and climate that were followed in the seventeenth century onwards by similar accounts (Ogilvie 2005; 2022). One of the earliest works anywhere on what would now be termed climate-impact studies must be that by the Icelandic Bishop, Hannes Finnsson (1739–1796) *Mannfækkun af Hallærum* (Loss of Life as a Result of Dearth Years) first published in 1796 (and in Danish translation, 1831; Ogilvie 2005).

As regards early instrumental observations, scientists from mainland Scandinavia were among the pioneers in this field. A notable example is Anders Celsius (1701–1744) an astronomer, physicist and mathematician from Uppsala in Sweden. The temperature scale he invented is the principal one in use in the world today (Lundstad et al., this volume). The Enlightenment movement and the attendant 'Age of Reason' of the seventeenth and eighteenth centuries brought an increase in knowledge in all spheres and provided a basis for an increasing interest in climate and its effects (Gundersen, this volume). To some extent, the study of climate was the province primarily of practitioners of medicine who were interested in the influence of climate on diseases and epidemics. Related to this, and in parallel with the development of early meteorological observations, came an interest in gathering historical documentary information on climate. Such information was assembled in compilations which later on were much used by the pioneers of historical climatology. Some fifteen such compilations were published in different countries, with three of them relating to Nordic regions.[1] Generally, as no attempt was made at historical source analysis, the compilations contain a mixture of reliable and unreliable information (Bell and Ogilvie 1978).

Discussions on historical climate change in the North Atlantic and Nordic regions had begun by the early nineteenth century. An example is the account entitled *Om Climaternas rörlighet* ('On Climatic Variations') published in 1824 by the Swedish scholar and diplomat, F.V. von Ehrenheim (discussed in Ogilvie and Jónsson 2021). In the early years of the twentieth century, a discussion among academics in Iceland, Norway and Sweden focused on the climate of Scandinavia in medieval times. In 1913, the Swedish oceanographer Otto Pettersson published a paper entitled 'Climatic Variations in Historic and Prehistoric time' (Pettersson 1913, 1914). He asserted not only that climates vary but also that climate was an important causal factor in Scandinavia's economic and demographic decline in late medieval times. In spite of his pioneering work on the past climate of Iceland, Thorvaldur Thoroddsen did not agree (Thoroddsen 1914; Ogilvie and Miles this volume). The Norwegian historian, Edvard Bull, then entered the debate, calling for a more comprehensive analysis. Bull showed himself to be ahead of his time by making a plea for accurate and reliable sources in historical climate analyses (Bull 1915). The debate continued with, among others, Speerschneider, in his compilation on ice conditions, and Arnold Norlind, who in 1915 published *Till frågan om det historiske klimatet,*

1. Amongst these are *Einige Bemerkungen über das Klima der historischen Zeit nebst einem Verzeichnis mittelatlerlicher Witterungserscheinungen* ('Some Remarks on the Climate of Historical Times, together with a List of Medieval Weather Phenomena') by the Swedish historical geographer Arnold Norlind (1783–1929) published in 1914 and *Om Isforholdende i Danske Farvande i aeldre og nyere tid, aarene 690–1860* ('On Ice Conditions in Danish Waters in Early and Recent times, the Years 690–1860') by the Danish meteorologist C.I.H. Speerschneider (1915). For Iceland, the compilation *Árferði á Íslandi í þúsund ár* ('The Seasons in Iceland in One Thousand Years') was published in 1916–17 by the geologist and geographer Thorvaldur Thoroddsen (1855–1921) (Ogilvie and Miles, this volume).

särskilt i Nord- och Mellaneuropa ('With Regard to the Question on Historical Climate, especially in northern and central Europe'). In the early 1920s, the Norwegian humanitarian, scientist and explorer Fridtjof Nansen (1861–1930) took up the debate. Nansen believed that sea ice had been extensive in medieval times and remained sceptical of warm conditions in the centuries around AD 1000. What ended this discussion, however, was the growing realisation that the climate was actually changing. This point was brought home by another Scandinavian scientist, the Danish geologist, Lauge Koch, in his major work on Arctic sea ice, *The East Greenland Ice* (1945).[2]

In spite of this early pioneering scholarship on historical climates in the North Atlantic, the possible role of the effects of climate variability fell out of favour in mainstream Scandinavian discourse from around the 1930s. For example, the Norwegian agrarian historian Sigvald Hasund suggested that the Black Death pandemic alone was responsible for the late medieval crisis (Hasund 1934). This became the prevailing view for decades.

A new era may be said to have begun in the early 1970s with a renewed international interest in what was then becoming known as 'historical climatology' (see, e.g., Ingram et al. 1978). A pioneering contribution to this field was made by the British climatologist Hubert Lamb (1913–1997), the first Director and founder of the Climatic Research Unit (CRU) at the University of East Anglia in the UK. Lamb coined the term the 'Medieval Warm Period' and began to use the 'Little Ice Age' to refer to a period from around AD 1400 to 1800. Lamb spoke Norwegian and had a high regard for his Scandinavian colleagues, whom he encouraged and collaborated with. These included Erik Wishman from Norway who, together with colleagues at the Stavanger Museum of Archaeology, established a 'national historical-climatological database' supported by the Norwegian Research Council.[3] Knud Frydendahl of the Danish Meteorological Institute established a project to search for documentary climate information and collaborated closely with Lamb, including on a compendium of historical North Sea storms (Lamb and Frydendahl 1991). A student of Lamb's, Astrid Ogilvie, decided instead to focus on Iceland because of the wealth of historical information on climate and climate impacts (Ogilvie 1982 et seq., Ogilvie and Miles, this volume). She continued the collaboration established by Lamb with Scandinavian colleagues such as with the meteorologist Øyvind Nordli (see, e.g., Nordli et al.) but in particular with Icelanders, including the meteorologist Trausti Jónsson who has undertaken pioneering work in early instrumental data (Jónsson and Garðarson 2001).

2. An expanded discussion on these early debates may be found in Ogilvie and Jónsson 2001; Huhtamaa and Ljungqvist 2021.

3. https://uis.brage.unit.no/uis-xmlui/handle/11250/216733?locale-attribute=en

A key development within the Nordic region during the 1970s included the Scandinavian Research Project on Deserted Farms and Villages (*Det nordiske ødegårdsprosjekt*). As early as 1951 the archaeologist Axel Steenberg had suggested that climate could have played a part in the abandonment of farms in Denmark during the fourteenth century. The 1970s project on Deserted Farms and Villages, however, represented a larger collaborative project among Nordic historians to systematically map the desertion and abandonment of farms (*gårdsbruk*) in the Nordic countries during the late Middle Ages. Although the possibility of effects from climate variability was a significant part of the project, no firm conclusions were made as to the possible role of climate for the late medieval crises in any Nordic country (Holmsen 1978; Sandnes 1978; Sandnes and Salvesen 1978). Other scholars later revisited the issue. For example, the Norwegian historian Audun Dybdahl wrote on climate, dearth years and crises in Norway during the past 1,000 years (Dybdahl 2016) and suggested that historians since Hasund's days had probably underestimated the role of climatic cooling in Norway's late medieval crises. The Danish historian Nils Hybel also implicated climate variability in Denmark's famines during the medieval period (Hybel 1997, 2002).

An important theme in the study of climate impacts in Nordic history studies has been the effects of climate on agriculture. In the 1950s, Swedish economic historian Gustaf Utterström undertook pioneering studies focused on the early modern period. Utterström (1954, 1955) tentatively linked changing climatic conditions to harvest variations and demographic fluctuations, emphasising that the coldest years and decades generally coincided with large-scale harvest failures in early modern Sweden. As in Sweden, early studies on climate history in Finland focused primarily on the early modern period. In 1975, Finnish historian Eino Jutikkala undertook one of the first studies of the adverse effects of colder climatic periods for Finnish agriculture and society. His study highlighted the use of data from the natural sciences to understand past climate, as well as the impact of hunger-related infectious diseases on mortality following harvest shortfalls (Jutikkala 1975; see also Jutikkala 1994, 2003). In the 1980s and 1990s, quantitative examination was established as one of the main approaches within climate history research, as well as a closer following of the state-of-the-art research in palaeoclimatology. Subsequently, concepts such as the Little Ice Age were introduced in historical research (Seland, this volume; Tornberg 1989, 1992).

More recently, historian Sven Lilja reassessed links between early modern Swedish climate, harvests and demography (Lilja 2006, 2012), but his conclusions were tentative due to a lack of quantitative approaches and interdisciplinary collaboration. A study by Edvinsson et al. (2009) presented quantitative estimates of climate–harvest relationships in 1724–1955, concluding that summer temperatures were of major importance only in the sparsely populated northern two-thirds of Sweden. In the main population areas of Sweden, drought would have been the major hazard for agriculture instead. This was confirmed by Skoglund (2022, 2023, 2024), although Ljungqvist et al. (2023) showed that cold conditions, in addition to drought, had an adverse effect on grain yields in most major agricultural areas in Sweden.

The past decade has brought a growing number of interdisciplinary investigations of climate history, with emphasis on identifying societal vulnerabilities, resilience and adaptation strategies to climate. Heli Huhtamaa has studied the effects of climatic variability on crop yields in pre-modern Finland, from medieval times to the nineteenth century, as well as socio-economic and demographic consequences of harvest failures (Huhtamaa et al. 2015, Huhtamaa 2018). Her research has uncovered important differences in resilience to harvest failures among different social groups in Little Ice Age Finland (Huhtamaa and Helama 2017; Huhtamaa et al. 2022). Furthermore, Skoglund showed that eighteenth- and nineteenth-century agriculture in southern-most Sweden could be notably resilient to climate shocks, as even severe drought years had relatively modest impacts on grain agriculture in this fertile area (Skoglund et al. 2022, 2024). However, for environmentally marginal locations, such as Iceland, it is easily demonstrable that variations in climate had a substantial impact on vegetation growth, famines and related issues; and considerable research has been undertaken for this location (see, e.g., Bergthórsson 1985; Ogilvie 2001, 2020; Júlíusson 2021; Jónsson, G. 2023; Ogilvie and Sigurðardóttir, forthcoming).

More scholars have come to recognise the potential benefits of interdisciplinary research into the human dimensions of past climate change, and the value of local Indigenous knowledge has become more apparent. Although beyond the scope of this introduction, there are now numerous examples of how the use of palaeoclimatic data from the natural sciences can be used together with historical documentary data and archaeological data in order to assess climate impacts in the past. A current venture in the discipline of historical climatology and related studies is the NORLIA project.[4] Furthermore, recent advances in the disciplines of both history, archaeology and palaeoclimatic studies offer new opportunities to bring such investigations to fruition. This volume is a contribution to current debates on climate changes and adaptation through a connected, socio-natural, approach.

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4. Center for Advanced Study Oslo, The Nordic Little Ice Age (1300–1900): Lessons from Past Climate Change: https://cas-nor.no/intranet/project/nordic-little-ice-age-1300-1900-norlia.

Methods and Approaches

Beyond well-established short-run impacts of climate and weather on agriculture and prices lie difficult questions about the long-term influence of climatic variability and change in Nordic history more generally. How should climate figure (if it figures at all) in the stories of economic and demographic developments, military victories and defeats, political crises and revolutions, or cultural and religious movements that fill the pages of conventional national history books (see Seland, this volume)? This question raises challenging issues that frame the contributions of this volume.

Scholars often broach the question of the long-run influences of climate in the context of powerful global climate events, usually in the wake of large volcanic eruptions, which historians have associated with episodes of crisis and transformation in world history. These include the 'Late Antique Little Ice Age' (LALIA) and crisis of the sixth century (Büntgen et al. 2016); famine, plague, and the 'Great Transformation' of the fourteenth century (Campbell 2016); Europe's crisis of the 1590s (Clark 1985) and the following 'General Crisis' of the seventeenth century (Parker 2013); as well as social and cultural turmoil, such as witchcraft trials and famine catastrophes during the Little Ice Age (Ljungqvist et al. 2021, 2024).

These world events may contextualise historical developments in Nordic countries and provide a framework for investigating possible long-term roles of climate variability and change in the region. At the same time, Nordic history may well present distinct features that test and refine theories and narratives developed in other parts of the world. For example, 'maximalist' interpretations of catastrophic impacts during the LALIA and the crisis of the sixth century have become hotly contested among scholars of the eastern Mediterranean, where much of the original research has focused. These debates may caution Nordic scholars against *a priori* assumptions of climate-driven catastrophe, but they hardly invalidate evidence of settlement abandonment, migration and social reorganisation in Nordic regions (Anagnostou et al. 2024). Moreover, these debates highlight the value of further local and comparative studies that help explain why some societies survived the sixth century intact and others faced crises (such as Ystgaard and Sauvage, this volume). A number of recent studies on the sixth century in Scandinavia clearly demonstrate how climate change, although a global phenomenon, can have very different local consequences, depending on both environmental and social factors, such as topography and food strategies (see Gundersen and van Dijk, forthcoming).

This raises the question of why some communities, even within the same climate zone, were more susceptible to climate shocks than others. It also contests the idea of past climate crises as something uniform and highlights the need to integrate both environmental and social data in analyses when trying to understand the wider societal ramifications of climate change in the past. Abandonment of Nordic farms, both before and after the Black Death, has been an important piece of evidence for the role of climate change in the Late Medieval Crisis in Europe, centred around the fourteenth century. Yet local tree-ring evidence indicates that northeastern Europe did not experience the same cold, wet summers that characterised the 'Great Famine' in Western Europe during the 1310s (Huhtamaa 2020). Utterström's classic (1955) study on climatic cooling and harvest failures in early modern Nordic countries helped draw attention to the 'European crisis of the 1590s'. Yet recent studies have emphasised that the crisis during this period – in the sense of a turning point in political and economic fortunes – focused on the Spanish and Ottoman Empires rather than parts of northern or western Europe usually considered more vulnerable to climatic cooling (Parker 2018; White 2017).

Within a longer perspective, the consequences of climatic impacts also varied among and within the Nordic countries. Health and prosperity in all Northern Europe depended to some degree on the seasons well into the industrial era; nevertheless, the continuing vulnerability of Iceland and Finland to weather-related famines as late as the nineteenth century constitutes a significant element in those countries' economic and demographic development compared to Sweden and Denmark (Huhtamaa 2018; Ponzi 1995; Ogilvie and Miles, this volume). Within these divergent national climate histories are also diverse local stories: sites of higher or lower mortality from hunger or disease as they related to diverse systems of taxation and landholding or different strategies of land use and migration (e.g., Huhtamaa et al. 2022; Starlander, this volume).

These problems of scale highlight the need for clear causal analysis when assessing the roles of climate in Nordic history. Climate alone did not 'make history' in Nordic countries or anywhere else. Yet some *distinctions* about past climate and weather made significant *differences* in Nordic history. For example, climate alone does not explain why there were famines and witch hunts in the early modern Nordic countries. However, the timing and severity of the worst cold spells during the Little Ice Age can help explain the timing and severity of the worst famines and some Nordic witch hunts, as well as why those witch trials focused on accusations of weather magic. Rather than offering arguments that climate did (or did not) determine Nordic history, studies in this volume relate features of variability and change in past climate to differences in demographic, economic or cultural developments across diverse scales, from the local to the regional and from years to centuries.

As new studies emphasise, causation in climate history also calls for consideration of historical context, structures and agency. Climate and weather

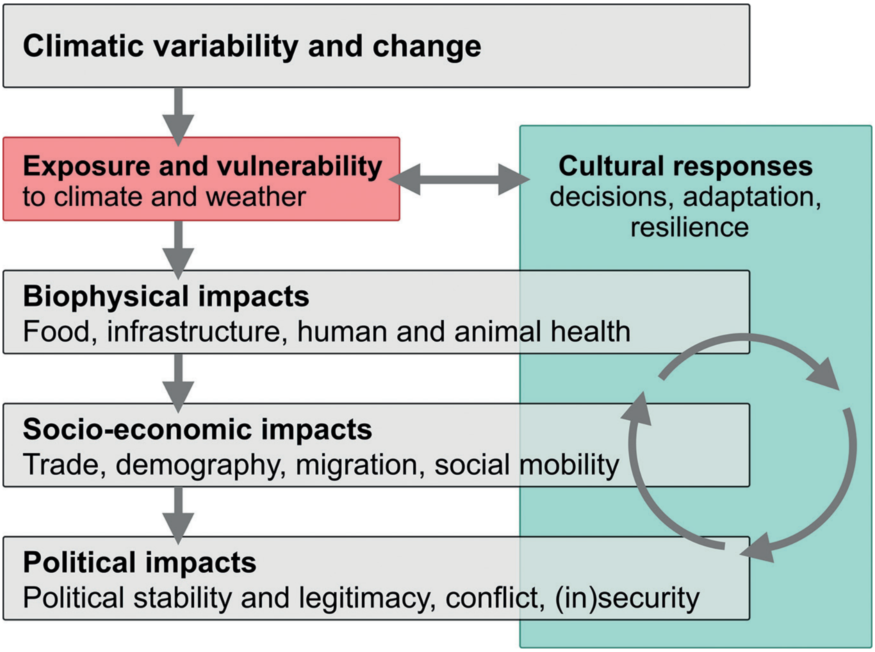

Figure 2. A simplified model of climate-society interactions often used in climate history. It conceptualises climate impacts cascading through the various societal levels mediated through pre-existing vulnerabilities, mitigated by cultural arrangements on all levels.

could be unpredictable yet consequential contingencies at critical moments in history: for example, Denmark's stunning military defeat and political transformation following the invasion of Swedish soldiers into Zeeland across the frozen North Sea straits in the winter of 1657–58. Nevertheless, the frequency and severity of most climate and weather impacts – historically, as in the present day – were a function of exposure and vulnerability to weather and to meteorological hazards such as frosts and floods. In short, they were not just about the weather itself. Cultural responses, including individual and political decisions and the adaptability and resilience of institutions, also mediated the scope and consequences of climate- and weather-related disasters and the risks of cascading effects such as migration or conflict (Figure 2). Studies in this volume highlight context and cultural responses associated with the influence of climate in Nordic history – as well as possibilities and challenges in using historical examples to explain current issues of climate, causation and agency to a wider public (Melo et al. and Riede, this volume).

Climatic variability and change affect societies mainly through their exposure and vulnerability to extreme weather and meteorological hazards, such as droughts, floods, frosts and heatwaves. Experience of extremes and hazards also generates cultural responses: individual and collective decisions and adaptation measures, including improvements to infrastructure and public or private disaster relief. These cultural responses, in turn, influence future exposure and vulnerabilities. The most direct impacts of extreme weather and hazards were usually biophysical, affecting food production, physical infrastructure, and health (Ljungqvist et al. 2021). Biophysical impacts could, in turn, affect economies (e.g., prices and employment) and populations (e.g., mortality and migration); and socioeconomic disruption could, in its turn, produce political effects, including disruptions to political stability and legitimacy or crime and violent conflict. The worst crises of the Little Ice Age (e.g., White 2011) involved feedback loops among biophysical, socioeconomic, and political impacts, which brought recurring disasters, population loss and displacement, and long-term conflict and political instability. However, these 'cascading effects' from one type of impact to another are mediated through cultural responses. Timely and effective decision-making, as well as resilient political, economic and cultural institutions could prevent disasters from spiralling into crises.

Ways of Knowing Nordic Climate

The contents of this book can be read in the chronological order they are presented, an arrangement chosen for the sake of convenience. Such a deep dive reveals long pathways and the continuity of exposure that characterises the Nordic world. Yet the collected papers also disclose an array of common themes. They contain the persistent dynamic of hazards and adaptation in response to ice, cold, floods, fires and storms. Instead of fixed responses, the studies unveil plural and creative choices that might not usually be associated with pre-industrial societies. They also highlight how these entanglements over time condensed into 'ways' (Richter 2020) of knowing climate. The papers illustrate how these experiences were expressed through building techniques, trading networks and settlement patterns, but also through lifestyles, poetry, and stories.

Opening the volume, Lundstad et al. provide the first major overview of early Nordic meteorology and discuss how prevailing theories on climate and weather influenced how weather data were observed and analysed. In the second section, they introduce the data available and analyse how it can be used to reconstruct the temperature increase in the Nordic capitals up to this day. Similarly, Ogilvie and Miles compile evidence for sea-ice occurrence off the coast of Iceland in the early modern period by using contemporary historical records.

They stress that Iceland is characterised by distinct climate conditions separate from those in continental Europe – a key finding of Lundstad et al. as well.

Two papers focus on architectural adaptations in response to Little Ice Age climate conditions – a topic that is receiving renewed attention in the light of current challenges. Both focus on late medieval high-status residences. Kerr draws our attention to the severe storm surges that ravaged coastal Denmark during a key period of the Little Ice Age and the evidence for estate relocation. According to Kerr, the moving manors demonstrate resilience among the ruling elite to climate extremes. Reinfjord focuses on the buildings themselves and explores how they were modified to accommodate colder and wetter weather. He focuses on prominent alterations in late medieval buildings in Norway, such as drains, tile stoves, stone cellars and building materials, and argues that these improvements were entangled with climatic stress.

The dynamic 'socialisation' of climate hazards is explored in three more papers. Norrgård investigates historical ice jams in the Aura River, Turku, Finland. He compiles an ice-jam index from historical records and newspapers. This tool helps him to analyse not just the severity of the incidents. He can also show how the anthropogenic built environment contributed to their development. Starlander explores the impact of wildfires and climate on early modern Finnish peasant communities. He highlights that building resilience among the Finnish rural population against these hazards depended on dynamic cooperation, between the peasants, communities and authorities. Damm traces similar interactions in response to volcanism in medieval Iceland. Using 'vulnerability' as an analytical lens, she situates her study at the intersection of external shocks and communal responses. Her research unveils the careful balance between practical measures and religious interpretations. All three studies illustrate how societal vulnerability to hazards depends not just on environmental stress, such as the climate, but also on human practices and responses.

Foodways and agricultural responses permeate many papers. The contribution by Nielsen is a strong reminder that the impact of Little Ice Age type events depended on the coexistence of risk drivers across the natural and human domains. His reflexive paper hypothesises that a mid-Holocene cold event should have had a negative impact on human demography in southern Norway. However, the reconstructed population trajectory shows little influence, prompting him to explore alternative pathways and explanations. Ystgaard and Sauvage use 'vulnerability' and 'resilience' to unlock these dynamics in two Iron Age farming settlements in mid-Norway. Both settlements seem to have experienced a profound crisis during the mid-sixth century LALIA climate anomaly. Yet, their analysis also explores the long-term impacts beyond the immediate disaster. Their research stresses plurality, revealing how different social and environmental conditions resulted in one settlement becoming permanently abandoned, while the other seems to have been able to reorganise and reoccupy farming lands after the climate shock. While recognising the sixth century as a time of crisis, their interpretations support the recent challenge to a maximalist approach by highlighting diversity in disaster impact and human responses (see Anagnostou et al. 2024; Gundersen and van Dijk, forthcoming). A similar approach can be found in Gundersen's socio-natural study of harvest failures in eighteenth-century Norway. He deploys a growing degree days (GDD) model to critically investigate the entanglements of meteorological and agricultural data. His study flags that local farmers were locked into a narrow farming strategy that made them highly vulnerable to climatic shocks. In such a built ecology, the development of a crisis depended not just on local climatic but also on regional societal factors. Conversely, due to this linkage, climatic stress could (and did) result in socio-political reform and rupture in late-eighteenth-century Norway.

Two more papers investigate how these persistent shocks and their influence on Nordic lifeworlds have often been marginalised. Kleveland revisits a long-neglected part of Norwegian literature, glacier poetry. As a motif, a symbol and even an agent, glaciers have a long tradition in Norwegian poetry that has not been previously acknowledged. This is reminiscent of how the climate was discussed in public histories as late as the twentieth century. Seland's historiographic examination of multi-volume popular histories of Norway shows that climate was recognised early on by archaeologists and medieval historians, but often as a stage for human action rather than an active element in human and environmental history. Modern-era historians devoted even less attention to climate. Many treated it as a static backdrop. The growing awareness of past climate change among scientists, historians, and archaeologists alike, failed to surface even in the latest editions. Only in the twenty-first century did climate find a reluctant place (again) in historical narratives.

The complexities of narrating climate are unfolded at the culmination of this volume. The contribution by Melo, Þórsson, Riede and Norrgård studies how climate history is framed and presented in Nordic national museums. Their permanent exhibitions demonstrate the willingness to incorporate climate. Yet its impact is rarely integrated into their storytelling, often appearing as isolated fragments disconnected to overall narratives and storylines. In response, the authors propose six key strategies to guide and inspire critical engagements and collective action. They suggest tools to help museums incorporate climate narratives, including the use of the past to situate future-oriented perspectives. Riede's paper departs in a similar direction. He reflects on his exhibition covering the consequential Lacher See eruption (~13,000 years BP). The museum intervention used the disruption of Paleolithic populations to envision critical vulnerabilities of modern societies experiencing anthropogenic global warming. The exhibition, named 'After the Apocalypse', sought to highlight the potential to learn from past existential risk. Both these papers explore main themes of the volume – the potential of past events to situate, contextualise, challenge and to enrich our debates on human–climate interactions in the present.

The Future of Past Climate

Three critical points lend relevance to climate histories today. First, they help improve and ground our *understanding of past societies*. Studying past communities, particularly pre-industrial ones, without their climatic context ignores a crucial variable shaping their choices and pathways. Marginalising past climatic environments also reinforces the modern fallacy of neglecting ecological context when imagining societal change. Reconnecting climatic and societal development can help to make sense of the timing and regional coherence of historical changes.

Second, climate histories advance the development of *scenarios for the future*. Highly resolved climate histories provide baselines for predictions and planning for both biophysical and societal trends. The combination of natural and societal archives produces more precise climate and weather reconstructions and models. Their integration also allows higher accuracy in calculating societal impacts and the range of human responses (Adamson et al. 2018; Haldon et al. 2024).

Third, they provide a way to *orient ourselves* in regard to current climate change. Technical scenarios expressing climatic change in global degree changes or CO_2 gigatons, can be challenging to process for non-scientists. Climate histories ground these scenarios in human experiences. They connect forecasts with actual events and situate current challenges within collective memories and heritage. Climate histories provide narratives that make abstract models actionable, answering questions such as: What might a 1.5 degrees Celsius change entail? Which type of responses were effective and which failed? Crucially, regional climate histories, such as the ones presented here, reduce planetary abstractions and bring climatic challenges closer to home.

In this way, climate histories have the potential to challenge the persistent gap between what we know and what we do. However, to succeed in these tasks, research into the field of climate history must overcome substantial challenges. We identify six areas where improvement is necessary and desirable:

- **Achieving true interdisciplinarity.** The impacts of climate change cross boundaries and reach every aspect of our lives, while our research infrastructures remain fragmented geographically and institutionally. Collaborating across the entrenched divisions of current universities and research centres requires more than merely reading each other's papers. Understanding the methods, biases, and gaps of other fields demands sustained and intense forms of co-working and co-creation (Haldon et al. 2018; van Bavel et al. 2019; Degroot et al. 2022; Ogilvie et al. 2024). Currently, the Nordic countries offer limited support for 'big interdisciplinarity' across the sciences and the humanities. Few climate-focused centres host such research.[5] The design of Nordic research calls and expected career tracks often remain within disciplinary limits. At the same time, a range of contemporary collaborative projects demonstrates the potential of tightly integrated climate histories.[6] Their experience suggests that successful interdisciplinarity in this field requires the close personal and spatial integration of research and work best when embedded in the research design from the start.

- **Pathways rather than determinisms.** Earlier climate histories often posited direct relationships of cause-and-effect between climatic impacts and societal developments. Current research instead highlights the *interaction* of environment and society. The papers in this volume illustrate how effects of climatic shifts can cascade through the various levels of society from agriculture to the economy, then on to politics and culture, often with decreasing intensity (Figure 2). At the same time, societal constellations and traditions moderate how and if these effects gain influence. In close-up studies, climatic effects often serve as a catalyst rather than a cause. They seem to accelerate change that is already occurring or escalate tensions already in place. Climate histories have developed specific interaction models to safeguard against 'determinism' and 'reductionism'

5. Cf. the Oslo Center for Environmental Humanities (OCEH), the Greenhouse Centre for the Environmental Humanities at the University of Stavanger, the Bolin Centre for Climate Research or the KTH Environmental Humanities Laboratory in Stockholm, the Centre for Environmental Humanities at Aarhus University or The Stefansson Arctic Institute, Akureyri, Iceland.

6. Cf. the ClimateCultures and VIKINGS projects at the University of Oslo (https://www.hf.uio.no/iakh/english/research/projects/climatecultures/; https://www.mn.uio.no/geo/english/research/projects/vikings/), the VICES (Volcanic Impacts on Climate, Environment and Society) team at Bern (https://www.hist.unibe.ch/forschung/forschungsprojekte/forschung_wirtschafts__sozial__und_umwelt_geschichte/vices/index_ger.html), the Nordic ARCPATH (Arctic Climate Predictions: Pathways to Resilient, Sustainable Societies: https://arcpath.nersc.no/) or the Icelandic MYSEAC (The Mývatn District of Iceland: Sustainability, Environment and Change ca. AD 1700 to 1950) projects and the Adaptations to Climate Change in the Northern Baltic Region ca 1500–1900 study at Stockholm University (https://www.su.se/english/research/research-projects/adaptations-to-climate-change-in-the-northern-baltic-region-ca-1500-1900).

(Hulme 2011). This includes the reflexive use of terminology such as 'collapse', 'resilience' or 'sustainability' borrowed and translated from ecological sciences to social settings often without critical evaluation of their conceptual baggage. Future research should be careful to heed these qualifications despite the current demand for single-factor solutionism. Highlighting the ecological guardrails and historical pathways in which climate effects take indirect or delayed action can help to advance current debates.

- **Regional dynamics to qualify global trends.** Climate science has often focused on global perspectives and planetary averages. While these abstractions helped to identify the large-scale trends of anthropogenic warming and facilitated international political action, they also severed climatic shifts from personal experience and regional heritage (Adamson and Rapson 2024). Climate histories have in part mirrored this trend, with earlier research taking a larger view, often productively challenging the national foci of historical research. However, the proliferation of more highly resolved data has now made it possible to go beyond planetary abstractions and identify regional trends. One example is the intense debate around the Little Ice Age and its uneven regional duration, amplitude, seasonality and societal effects (Pfister and Wanner 2021; Wanner et al. 2022). The focus on more regionally resolved archives such as tree-rings has helped to highlight spatial variations. This trend to regional scopes has not only helped qualify current models, both past and present. It also creates the opportunity to challenge the myth that consequences are limited to distant areas and to reconnect climate histories with local traditions, collective memory and cultural heritage instead. This link has been identified as crucial in translating planetary science into local action (Adamson et al. 2018). We suggest that regional climate histories have an important role to play in establishing these relationships.
- **Identifying risk drivers**. Climate variability can have very different consequences both within and between societies. Local climates, topography, food strategies, networks, foreign relations, socio-economic structures, past experiences, decision-making processes and the complexity of the climate system itself are a few examples of key variables that contribute to different types of impact and human responses. Understanding these variables is particularly important for understanding the spatiotemporal variability present in the archaeological and historical records, but also for our ability to draw lessons from the past to inform future solutions. It is crucial for future research in climate history to address why some

situations developed into crisis, and others did not, and identify the various risk drivers that significantly influenced the course of events.

- **Broadening the repertoire for action.** Current debates on how to cope with a changing climate often stay close to established precedents. In the midst of turbulence, it can be difficult to envision transformation outside familiar trajectories. Climate histories can challenge the technology-centred, top-down debates that dominate our present. Past societies developed a range of responses that could not rely on international accords or techno-fixes (Haldon et al. 2018). The papers in this volume highlight a broad mix of mitigating reactions that range from new foodways, improved legal codes, advanced risk-sharing arrangements, broadened political participation to new forms of cultural memory and communication of hazards. From a modern perspective, these climate histories can highlight that the current focus on technologies might be too restrictive and that adaptations need to be flanked by social transformation to be effective.
- **Narrating climate.** The climate sciences often stop short of providing a narrative for their results. This can be the consequence of disciplinary traditions of evidencing, an abstract systems-oriented perspective or a lack of information-sharing when designing future scenarios (Daniels et al. 2009). Similarly, earlier historical work on past climate often relied on laden tropes and emplotments to provide meaning. Imaginaries of collapse, decline and disaster often served as the silent referents of many older works (Carey 2012). The studies in this volume illustrate that a broader, reflexive approach to narration increases both relevance and impact. This can include creative entanglements of abstract data and individual historical experience or storyline approaches that visualise research in the form of exhibitions or public interventions. They challenge the reductionism of declensionist tropes and include creative, place-based ways of 'socialising climate'. The narration of complex cascades of interaction between climatic stress and societal responses can now draw on a range of recent storytelling and interaction designs (Ljungqvist et al. 2021; Melo 2023; White et al. 2023). Including them has the potential to overcome the fatalism and passivity that the scale and abstraction of planetary models often instill in audiences.

Climate histories that creatively embrace interdisciplinarity, that explore dynamic pathways rather than rigid causalities, that operate on an accessible regional scale, that challenge the limitations of current mitigation discourses, and that reflexively employ narrative strategies can fill important gaps. These include the trajectories of *past* societies, the pathways for the *future* and the communication of climate challenges in the *present*. In this sense, the future of past climate can and should be an integral supplement to our presentist discourses.

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The Authors

Dominik Collet is Professor of Climate and Environmental History at the University of Oslo, Norway. He is the PI of *ClimateCultures – Socionatural entanglement in Little Ice Age Norway (1500–1800)* as well as the thematic research group *Nordic Climate History*. He also leads the project *The Nordic Little Ice Age (1300–1900) Lessons from Past Climate Change (NORLIA)* at the Centre for Advanced Study at the Norwegian Academy of Science and Letters. His research focuses on the historical entanglements of climate and culture both in their material and mental configurations.

Ingar Mørkestøl Gundersen is a Postdoctoral Research Fellow in the Department of Archaeology, Conservation, and History at the University of Oslo. He has published on a range of topics on climate history and the Scandinavian Iron Age. Gundersen received his Ph.D. in 2022 with the thesis 'Iron Age Vulnerability', which investigated the archaeological evidence for a sixth-century climate crisis in eastern Norway. His doctoral research was part of the VIKINGS project (Volcanic Eruptions and their Impacts on Climate, Environment, and Viking Society in 500–1250 CE). Together with Dr Manon Bajard, he received the Inter Circle U. prize 2022 for outstanding examples of cross-disciplinary research. He is currently part of two research projects on the Nordic Little Ice Age (ClimateCultures, University of Oslo and *The Nordic Little Ice Age (1300–1900) Lessons from Past Climate Change (NORLIA)* at the Centre for Advanced Study at the Norwegian Academy of Science and Letters.

Heli Huhtamaa is a climate and environmental historian. Her research interests include human consequences of the Little Ice Age and pre-industrial Nordic history. She focuses on interdisciplinary approaches concerning both historical and climate

sciences. She is an Assistant Professor at the University of Bern, Switzerland, where she leads a research project on volcanic impacts on climate, environment and society.

Fredrik Charpentier Ljungqvist is Professor of History, in particular Historical Geography, at Stockholm University, Sweden. He also holds the title of Associate Professor of Physical Geography at the same university. Ljungqvist was in 2022 by the Royal Swedish Academy of Letters, History and Antiquities awarded the Rettig Prize for "interdisciplinary works concerning climate and diseases in a long-term perspective". He was a Pro Futura Scientia Fellow at the Swedish Collegium for Advanced Study from 2019 to 2024 and has been a visiting researcher at the University of Cambridge, Lanzhou University, University of Bern and the Freiburg Institute for Advanced Studies (FRIAS).

Astrid E.J. Ogilvie is a Research Professor at the Institute of Arctic and Alpine Research at the University of Colorado and a Senior Associate Scientist at the Stefansson Arctic Institute in Akureyri, Iceland. Her research focuses on the broader issues of climatic change and contemporary Arctic issues, as well as the environmental humanities. Her interdisciplinary, international projects have included leadership of the NordForsk Nordic Centre of Excellence project: *Arctic Climate Predictions: Pathways to Resilient, Sustainable Societies (ARCPATH)*; and *The Natural World in Literary and Historical Sources from Iceland ca. AD 800 to 1800 (ICECHANGE)*. She is the author of some 100 scientific papers and has three edited books to her credit.

Sam White is Professor of Political History at the University of Helsinki, author of *A Cold Welcome* (Harvard University Press, 2017) and editor of the *Palgrave Handbook of Climate History* (Palgrave, 2018).

All authors are currently Fellows of the project *The Nordic Little Ice Age (1300–1900) Lessons from Past Climate Change (NORLIA)* at the Centre for Advanced Study at the Norwegian Academy of Science and Letters.