Climate and migration in historical perspective

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ABSTRACT Migration is an inherent part of human history. It has been linked to socioeconomic, political, demographic, and environmental factors, and increasingly to past climate variability, climate change, and natural hazards, including extreme weather events. This paper discusses migration as both a cascading effect of climate change impacts and an adaptive response to climate-related risks. It distills key patterns in regional and global studies of past climate-migration links; provides a topical overview of existing studies dealing with climate-induced migration during historical times in Europe, North America, and Asia; and summarizes key perspectives of climate and migration research on the historical past.

KEY WORDS migration – mobility – climate variability and change – natural disaster – weather-related hazard

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1. Introduction

Migration is here defined as "the movement of people from one place to another, to settle in a new location" (European Parliament 2024). Migration may be classified in several ways. Studies often distinguish between internal, international, and forced migration (Weinstein, Pillai 2015; Bhende, Kanitkar 2024). Studies also classify migration based on direction of movement, spatial dimensions, reasons for migration, and duration (Massey et al. 1993). Population movements may be caused by demographic, economic, environmental or climate-related factors (European Parliament 2024). Kwilinski et al. (2022) consider net migration in relation to economic, social, political and ecological determinants. The Internal Displacement Monitoring Centre (2025) assesses internal population displacements as a consequence of conflicts, violence, or disasters (both geophysical and weather-related).

Environmental conditions and climate have long been considered among the factors influencing past and present human migration. As early as 1990, the Intergovernmental Panel on Climate Change (IPCC) identified human migration as an important impact of climate change. Accelerating anthropogenic global warming and its impacts have also popularised the concepts of "environmental refugees" (Brown 2008), "climate refugees", and "climate migration" – i.e., movements as a potential adaptation strategy to adverse climatic conditions (e.g., Fang, Liu 1992; Reuveny 2007; Piguet, Pécoud, de Guchteneire 2011; Li et al. 2017; McLeman 2018; Abel et al. 2019; Cattaneo et al. 2019; Richter 2019; Kaczan, Orgill-Meyer 2020; Grau-Satorras et al. 2021; Burzyński et al. 2022; Liang et al. 2023; Almulhim et al. 2024; Hauer, Jacobs, Kulp 2024; Ivanova et al. 2024). Nevertheless, effects of climate variability on internal and international migration are complex and country-specific. For example, Gray and Wise (2016) examined climate-migration links in five African countries during 2004–2009. Temperature anomalies tended to increase migration in Uganda and decrease migration in Kenya and Burkina Faso, but no such relationship was found for Nigeria or Senegal, and precipitation had only weak and inconsistent relationships with migration in any of the five countries.

Despite recent popular and academic interest in current global warming and migration, the history of climate-migration links during past centuries has received comparatively little scholarly attention (Ljungqvist, Seim, Huhtamaa 2021). Histories of migration written during the late 20th century rarely considered climate. This avoidance was partly a reaction to the climate determinism of the 19th and early 20th centuries (Piguet 2013). Climate history and historical climatology have focused primarily on high-resolution climate reconstructions, as well as biophysical and economic impacts of climate variability and extreme weather (Brázdil et al. 2005, 2010; Pfister, White, Mauelshagen 2018), but less often on migration.

Nevertheless, migration has always been a feature of human history and has often associated with weather-related hazards, climate variability, and climate change. Historically, people migrated primarily in search for better living conditions, including leaving from regions experiencing deteriorating climatic conditions or agricultural crisis (Collet, Schuh 2018). Ancient and early modern states planned territorial expansion and colonies so that populations could exploit new resources in different climates (Yunusbayev et al. 2015; White 2017; Vidal-Cordasco, Nuevo-López 2021). Various studies have concluded that harsh weather conditions, failed harvests (Hoerder 2022) and even volcanic eruptions (Büntgen, Eggertsson, Oppenheimer 2024) triggered migrations during past centuries. Hsu (1998) attributed the largest demographic movements in history to crop failures and starvation. Büntgen et al. (2011) developed tree ring-based summer precipitation and temperature reconstructions for Europe for the past 2,500 years; they associated increased climate variability *c.* 250–600 CE with the demise of the Western Roman Empire and the turmoil of the Migration Period. Drake (2017) distinguished four shifts in the North Atlantic Oscillation that led to increased droughts on the periphery of the Roman Empire and contributed to migration, including population movements during the 6^{th} century CE.

Mauelshagen (2018) provided a global review of studies on past climate and migration, from migrations of *H. sapiens* 130,000 years ago through the early modern Little Ice Age (LIA) to recent times. This review discussed concepts of "primitive migration" and "environmental" or "climate migration" in greater detail. Overall, studies on the influence of weather-related hazards, climate variability, and climate change on historical migration have focused particularly on three regions: Europe (e.g., Engler et al. 2013; Jennings, Gray 2015; Glaser, Himmelsbach, Bösmeier 2017; Collet 2019; Jakus 2019; Ingimarsson 2024), North America (e.g., McLeman, Smit 2006; White 2014, 2017; Rohland 2015; Bird et al. 2017; Murray-Tortarolo, Salgado 2021; Zhu et al. 2024), and Asia (e.g., Fang, Liu 1992; Ye, Fang, Khan 2012; Xiao, Fang, Ye 2013; Pei, Zhang 2014; Pei, Zhang, Lee 2016; Pei, Lee, Zhang 2018; Damette, Goutte, Pei 2020; Pei et al. 2024). Developing this body of research, the aim of our paper is to present an overview of the relationship between climate and migration primarily during the past millennium, with particular attention to Europe, North America, and Asia, emphasizing recent trends, progress, and key perspectives of climate and migration research on the historical past.

2. Climatic effects on migration

As with recent studies of climate-conflict links (White et al. 2025), the comparison between present and past climate-migration links may inform both contemporary and historical research. During the late 20^{th} century, rising concern over global warming spurred a growing number of climate impact studies projecting hundreds of millions of future climate migrants. Around 2008, the research focus shifted to quantitative and qualitative analysis of contemporary climate-migration links by economists, sociologists, demographers, and anthropologists (Perch-Nielsen, Bättig, Imboden 2008; Piguet, Kaenzig, Guélat 2018; Maretti, Tontodimamma, Biermann 2019; İçduygu, Gören 2023).

This new body of studies has refuted projections of inevitable, massive increases in long-distance climate-driven migration. It has instead found complex and variable but significant influences of climate on the timing, geography, composition, and conditions of population movements. Some key findings, discussed particularly in Piguet, Pécoud and de Guchteneire (2011) and in Kaczan and Orgill-Meyer (2020) may be briefly formulated as follows:

(i) weather-related hazards, climate variability, and climate change do not automatically lead to displacements, due to the complexity of the relationship between environmental change and migration;
(ii) migration flows reflect, among other factors, the severity of the climatic events and the ability of individuals and households to migrate;
(iii) climate-induced migration is not necessarily more prevalent among poorer households;
(iv) climate-induced migration may be more prevalent for long-distance domestic moves than local or international moves;
(v) long-term and medium-term climate changes or slow-onset disasters (e.g., desertification, increase in sea level) are more likely to induce increases in long-distance migration than are short-term extremes or rapid-onset disasters (e.g., floods);
(vi) the severity of climate shocks impacts migration in a nonlinear fashion, with impacts influenced by the relative capability or vulnerability of affected communities;
(vii) climate change is experienced very differently around the world and across countries, since vulnerabilities are ultimately a product of the socio-economic forces that shape all societies.

Figure 1 provides a simplified schema of climate-migration links. It illustrates how effects of weather-related hazards, climate variability, and climate change affect the living conditions of populations, and consequently their mobility and migration. Climate may influence populations through long-term climatic processes on scales of years or decades (warming, cooling, desertification, sea level rise); medium-term phenomena (droughts); or short-term extremes such as tropical cyclones, torrential rains, floods or heatwaves. People may be affected immediately (fatality, injuries, property damage, etc.) or with some delay (lack of water, harvest failure, high

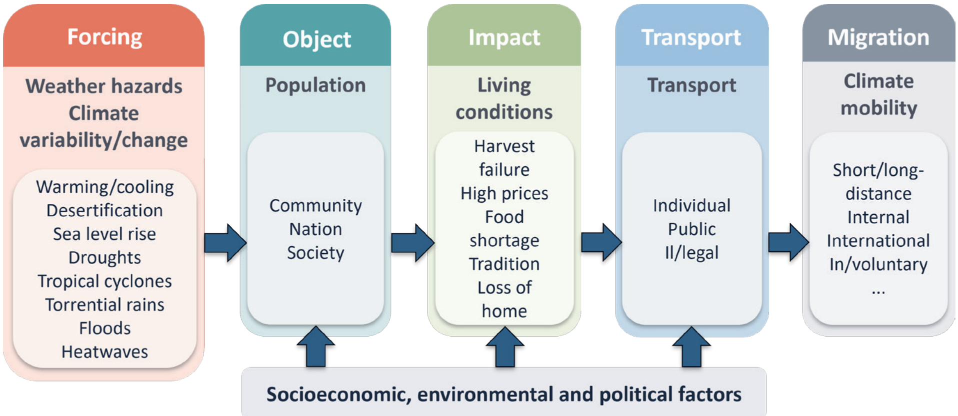

Fig. 1 – Simplified schema illustrating effects of weather-related hazards, climate variability, and climate change on migration, expressed as a chain of impacts and responses.

prices, etc.). Mobility may begin with short-distance displacement, particularly from sudden-onset disasters. Possibilities for further migration – rural-to-urban, inter-regional, or international – will depend on available funds and transportation, physical and legal infrastructures, and networks of information and support. The plurality of migration experiences – short- and long-distance, temporary and permanent, involuntary and voluntary – is reflected in the term "climate mobility". This denotes the full range of human responses without suggestions of permanent long-distance migration or security and conflict issues often associated with "climate refugees" or "climate migrants". While past climatic change was mainly influenced by natural forcings (orbital, solar, volcanic, etc.), anthropogenic forcing has dominated changes in the climate system in recent decades (IPCC 2021).

3. Climate and migration in historical times

The influence of past weather-related hazards, climate variability, and climate change on human societies typically began with impacts on agriculture, including loss of crops and animals. In addition to displacement from hazards such as floods, migration could be a short-term response to food shortages or a planned response to deteriorating food availability or food entitlement. Moreover, migration could result from cascading effects of food shortages, including epidemic diseases, economic and political turmoil and violent conflict, which sent populations in search of food and safety. The following sections discuss these and other patterns in historical climate-migration links over the past millennium in the three continents that have received the most research: Europe, North America, and Asia.

3.1. Europe

Within the last millennium, several migration waves induced by weather-related hazards, climate variability, and climate change can be detected in Europe. However, unlike North America (see Section 3.2.), it is relatively difficult to distinguish clearly the main migration periods in Europe in the past. Despite that, following main migration phases and their triggers can be revealed: periods of volcanic eruptions in 13th and subsequently in the late 16th, 18th and 19th centuries during the LIA (*c*. 1300–1860 CE), accompanied by a series of various-length phenomena, and migration to North America since c. 1700. However, all these phases slightly overlapped each other, and they are not as uniform as other migration phases in North America or Asia (see Sections 3.2. and 3.3.).

Europe's medieval history includes several cases of population movements related to climate variability or extreme weather events. For example, prolonged cooling after the Samalas eruption (Lombok Island, Indonesia) in 1257 CE caused grain crop failure in Norway and Iceland and led, in some areas, to desertion of the peasants from farmland and desolation of the land itself. The dismal situation in the Trøndelag region (central Norway) even resulted in the amendment of "Frostatingsloven", one of Norway's oldest legal codes, by King Hákon in 1260. He blamed migration for a shortage of labour and tried to limit mobility via the prohibition of merchant voyages for certain subjects (Ingimarsson 2024). According to Rüther (2018), climate-induced harvest failures during the 12th–13th centuries in Germany might have been one of the (less important) factors in German eastward expansion.

In addition to these permanent displacements, environmental shocks often resulted in local and temporary mobility. Storm surge with a subsequent flood known as the St. Lucia's flood on 13–14 December 1287 CE, provides an example of a short-term extreme event. It killed approximately 50,000–80,000 people in the Netherlands and northern Germany alone. Many survivors from East Frisia (northwest Germany) moved to higher ground far from the North Sea. Similarly, the Saint Elizabeth's Day Flood on the night of 19 November 1421 CE permanently submerged several villages in South Holland (Netherlands), caused the death of about 2,000 people, and displaced survivors to nearby towns such as Dordrecht (Buisman 1995, Brown 2023). Kiss and Laszlovszky (in press) find that the abandonment of a monastery in Veröce (northern Hungary) by Pauline monks in the late 1430s or early 1440s coincided with a flood-prone period on the Danube.

Probably the most widespread and severe climate- and weather-related migration events occurred during the LIA. Gradual cooling, worsening weather conditions, and more frequent harvest failures in England led to the "Great Famine" of 1315–1322 CE. This crisis resulted in the abandonment of marginalised farmland and large-scale migration (Campbell 2016, Brown 2023). Decreasing temperatures brought deteriorating weather conditions, expanding ice sheets and rising sea levels, which probably contributed to the abandonment of Viking settlements in southwest Greenland during the mid-15th century (Borreggine et al. 2023). Slowly advancing Alpine glaciers shrank pastures, demolished farms, and crushed entire villages. The glaciers' expansion led to the forced abandonment of some mountain villages in the Swiss Alps and the movement of their inhabitants to the lowlands during the mid-17th century (Fagan 2001).

Exceptional hunger in 1453–1454 CE, triggered by severe weather conditions and exacerbated by political tensions and violent conflicts, initiated migration from the Dalmatian hinterland to towns on the eastern Adriatic coast (Jakus 2019). According to Gaceu et al. (2025), hot summer weather, heatwaves, and droughts in 16th-century Transylvania – particularly during 1511–1520, 1527–1532, 1534–1544, and 1556–1577 – could have affected agricultural production, leading to food shortages, social instability, and forced migration. On the other hand, a series of volcanic eruptions from 1589–1600 brought exceptionally cold years across Europe associated with internal displacement and epidemic outbreaks, particularly in Spain and Turkey, as well as colonial emigration from England (White 2011, 2017). Similarly, exceptional cold further contributed to population displacement during Europe's frequent conflicts of the 17th century, particularly the Thirty Years' War in Central Europe (Brázdil et al. 2023).

The main modern historical migration streams from Europe were directed to North America from *c.* 1700 onwards. One of the earliest and most dramatic events occurred in response to the "Great Frost" of 1709 CE, likely the coldest winter of the last 500 years (Luterbacher et al. 2004). Ice covered the lagoon of Venice, and snow blocked the provisioning of major cities including Paris for months, leading to malnourishment, death from exposure, and epidemic disease (Mauelshagen 2010). In this situation, nearly 10,000 people departed today's southwestern Germany and neighbouring regions in a desperate attempt to reach America. Their well-publicised trek through Europe saw them camping in large tent cities outside London, many succumbing to disease, outstaying their welcome in England, some settling in Ireland, more returning home, and only a minority ever reaching the New World. Their fate not only illustrates the harsh social realities of environmental migration. It also hints at the complex motivations of migrants during the LIA, including religious struggles, economic hardship, and the effects of conflicts such as the War of the Spanish Succession (1701–1714) and the Great Northern War (1700–1721). The so-called Palatine refugees of 1709 alternately gave climatic, religious and security justifications for their migration to secure help, charity and permission to pass through different states and communities (Otterness 2004, Schulte Beerbühl 2004, Sánchez Arreseigor 2017).

The Irish migration of 1740–1741 presents similar patterns. Engler et al. (2013) used a multi-indicator model to analyse the interplay of famine, high prices for staple foods, and excess mortality that followed the severe winter of 1739/40 in Europe. During and after this disaster, many Irish people moved within Ireland or left the country. Engler and Werner (2015) conclude that migration flows of 1727–1728 and 1740–1741 famines laid the foundation for subsequent migration patterns during the "Great Irish Famine" of 1845–1852 (*cf*. Póirtéir 2023). Similarly, a wave of emigration due to famine and high prices was reported in the Swiss canton of Appenzell Ausserrhoden in 1740 and again in 1771. In both cases, famines with subsequent migration led to a slowdown in population growth (Vieli 2020).

The Central European "hunger years" of 1770–1772 witnessed a third major wave of 18th-century emigration (Collet 2019). Three consecutive years of adverse winter and summer weather patterns, followed by harvest failures, tipped already vulnerable societies into widespread poverty and economic depression, resulting in increased epidemic activity and excess mortality (Pfister, Brázdil 2006). Migration became a preferred response where other adaptive strategies, such as market intervention, welfare reform, or increased political participation, had failed. In localities where absent sovereigns or impoverished administrations were unwilling or unable to help, people moved to secure aid. Most migration was rural-to-urban and took place at a local or regional level, leaving many towns crowded by refugees. In 1771, for example, Regensburg hosted some 6,000 refugees in addition to its 20,000 inhabitants. The extent and duration of the crisis later encouraged permanent, long-distance migration. Depending on available travel routes, religious affiliation or political expediency, people either headed for America (along the Rhine), to Hungary (along the Danube), or towards the newly reclaimed marshlands of Prussia. The emigration along the 'dry' Eastern route was so numerous that it became known as the "second Swabian trek". Several tens of thousands of Germans settled in Hungary leaving a legacy that endures to the present (Diemer 2009).

While the famine triggered an increase in mobility, some emigrants also used the weather strategically to legitimise long-held plans to leave. Since the Holy Roman Empire's so-called cameralist states of the 18th century aimed to retain or increase their populations of taxpayers, emigrants appealed to adverse climate or famines to put pressure on overstretched administrations to let them depart. They capitalised on governmental recruitment schemes or patterns of chain migration established long before the disasters. The experience of emigration in this period initiated policy shifts and gave birth to "overpopulation" as a novel political concept (Collet 2019).

Glaser, Himmelsbach, and Bösmeier (2017) analysed the continuing influence of climate on migration from southwestern Germany to North America during the 19th century. Comparing climatic, price, and population data, the authors of the study proposed a chain of effects starting from adverse weather patterns and decreases in crop yields followed by rising cereal prices and finally emigration.

Linear models confirm significant and enduring associations at each link in this chain, with cereal prices explaining 38% of interannual variability in emigration. The most prominent waves of emigration took place in 1816–1817 and 1850–1855.

The first of these waves (i.e. 1816–1817) followed the Tambora eruption on Sumbawa, Indonesia in April 1815 CE. The following year (1816) has been called a "year without a summer" (Luterbacher, Pfister 2015). Many papers have analysed post-eruption climatic conditions and harvest failures with dramatic increases in grain prices (e.g., Oppenheimer 2003; Trigo et al. 2009; Auchmann et al. 2012; Brugnara et al. 2015; Brázdil et al. 2016; Brönnimann, Krämer 2016) and even famine in countries such as Germany (Bayer 1966) and Switzerland (Krämer 2015). Post (1977) described this time as "the last great subsistence crisis in the Western world". In addition to volcanic forcing, an ensemble of demographic, social, and economic factors played an important role in a wave of migration during 1816–1817. These include population growth at the end of the 18th century and a risk of food shortages as well as the end of Napoleonic wars (1803–1815) and a flooding of the labour market by demobilised soldiers (Oppenheimer 2003). New possibilities for intra-European and particularly transatlantic travel attracted long-distance migration as did burgeoning economic opportunities in the "New World" (Cohn 2009, Mauelshagen 2018).

Jennings and Gray (2015) analysed internal and international human migrations in connection with climate variability in the Netherlands during the 1865–1937 CE period using event history models. As their results show, low temperatures in the three years preceding the population movement had a significant effect, especially on short moves in the 1901–1937 period. On the other hand, extreme rainfall mainly affected international migration. The combination of high temperatures and low rainfall increased more likely long-distance moves in the 1865–1900 period but decreased long-distance moves in 1901–1937. In both cases, negative climate conditions influenced only certain social groups, particularly individuals over age 25, citizens, and the non-Western Dutch population. Low precipitation resulted in episodes of droughts and subsequent lower harvests were among the many factors leading to the depopulation of rural areas in southern Italy since the late 19th century. Moreover, the depopulation was exacerbated further by the decline of traditional agriculture during the 1950s and 1960s (Piccarreta, Capolongo, Boenzi 2004; Buliga 2016).

Historical climate-migration links in the Czech Lands remain poorly understood, especially for the period before 1800 CE. A principal difficulty is the lack of reliable data on the number of migrants. As in the rest of Central and Western Europe, there is evidence of population movements during the 1816–1817 wave of migration (Brázdil et al. 2016), but the exact numbers of migrants heading to the Balkan peninsula and Western Europe are not known. Reliable data generally appeared only after 1851, when bigger waves of migration to Vienna and the

United States began, and emigration was on the rise (Nešpor 2005). The influence of climate variability stands out only in the wave of emigration from southern and southwestern Bohemia during 1853–1857. Climatic factors included droughts in 1852 and 1856 (Brázdil et al. 2012, 2015) and crop failures in 1854 or 1856; moreover, the 30-year period between 1829 and 1858 was detected as the coldest period in the Czech Lands since 1501 CE (Brázdil et al. 2022). However, climate was only one of the factors influencing migration at that time.

3.2. North America

Scholars have examined past climate-migration links in North America from diverse disciplines, as discussed in previous reviews (McLeman 2014; White 2018). The history of climate and migration in North America may be roughly divided into three periods: the era before European colonisation; the period of colonisation, plantation slavery, and settlement expansion from the 16th to 19th centuries; and the modern period since the 20th century. In each of these periods, weather-related hazards, climate variability, and climate change influenced migration through sudden disasters and displacement, slow-onset disasters and planned migration, and indirect effects such as economic disruption and conflict. In the modern period, climates perceived as favourable increasingly attracted migration from climates perceived as less favourable.

Written records of North America are scarce before the colonial period. Nevertheless, a combination of archaeological evidence, high-resolution paleoclimatology, and cultural memory among Indigenous nations demonstrates connections between climatic variability or change and migrations during previous centuries (see reviews in Foster 2012 and Wickman 2018). For example, tree-ring evidence indicates exceptional drought conditions in the US Southwest during the abandonment of Ancestral Puebloan settlements in the mid-13th century CE. Some archaeological evidence indicates conflict and displacement at sites such as Chaco Canyon, and this episode has even been interpreted as a violent collapse (Diamond 2005). However, oral histories carry a narrative of adaptive migration to later Puebloan settlements (Zappia 2014); moreover, archaeological studies have also found that "people with access to the most water in this arid landscape were also the most likely to migrate when confronted with dry conditions" since they had more resources to relocate (Ingram, Schollmeyer 2021).

Periods of cold, drought, and flooding during the LIA have also been linked to migration, particularly in eastern North America. Relatively favourable conditions during the so-called Medieval Climate Anomaly (c. 950–1300 CE) may have supported the spread of agriculture and the rise of larger, more complex communities such as Cahokia as well as chiefdoms of the early Mississippian period. Numerous studies have associated the break-up of, and outmigration from, these communities with weather-related hazards, climate variability, and climate change (Benson, Pauketat, Cook 2009; Meeks, Anderson 2013; Bird et al. 2017; White et al. 2019). Circumstantial evidence also suggests that some communities, such as Iroquois villages on the St. Lawrence, retreated from LIA cooling, either as an adaptive strategy or as the result of conflicts over resources (Micon, Birch 2024).

As described in the previous section, cold periods of the LIA accelerated European emigration to North America, where settlers expected to find seasons similar to those of Mediterranean Europe. This confusion about North American climate – as well as exceptional cold, droughts, and storms that ruined many early settlements – significantly delayed European colonisation of today's US and Canada during the 16th and early 17th centuries, and subsequently discouraged migration to the colder climates of New England and Quebec (Kupperman 1982, Zilberstein 2016, White 2017). Climatic conditions of the LIA exacerbated conflicts between colonists and Indigenous communities, slowing colonial expansion while accelerating destruction and displacement of Indigenous populations (Grandjean 2011; Hodge 2012; White 2014; Wickman 2015). Meanwhile, colonists used theories about climate, health, and race to justify the import of millions of enslaved Africans – the largest transatlantic migration of the period. Droughts and cold shocks appear to have influenced the geography and timing of the slave trade (Behrendt 2009; Fenske, Kala 2015; Mauelshagen 2018).

Disaster-induced displacement was a recurrent factor in the westward expansion of American populations. For example, exceptionally cold weather in the 1810s was associated with mass migration from the Northeast to the Midwest (Wood 2014). As Rohland (2018) has explored in a history of hurricanes in French and Spanish Louisiana, limited understanding of climate and weather, political expediencies, and the institution of slavery in the South all limited effective adaptation to hazards. Confusion about North American climates, including hopes that cultivation would ameliorate extreme temperatures and drought, continued draw migrants westward into unfamiliar environments. As late as the turn of the 20th century, boosters continued to attract farmers to the Great Plains with the myth that "rain follows the plow" (Culver 2012).

Urbanisation, industrialisation, and greater prosperity in the 20th century reshaped exposure and vulnerabilities to weather-related hazards and consequently the influence of climate on migration, particularly in the United States. Communication infrastructure such as telegraph and telephone lines were exposed to storms and ice, while snow disrupted driving in increasingly automobile-dependent cities (Meyer 2014). Meanwhile, the spread of air conditioning into public spaces, homes, and cars reduced the inconvenience and danger of heat, especially in the southern and southwestern US (Arsenault 1984, Ackermann 2002). Warmer climates helped attract residents from the Midwest and Northeast to growing towns, cities, and especially suburbs in the newly branded "Sunbelt". Expansion of irrigation and agribusiness, particularly in California, also attracted permanent migrants and seasonal labour, particularly from Mexico. New residential developments emphasized the amenities of warmer climates while often ignoring or downplaying disaster risks, including drought and fire in the Southwest and hurricanes in the South (Steinberg 2006; Culver 2012).

Thus, despite technological improvements and economic growth, the attraction of hazard-prone regions and persistent racial and economic inequalities in the United States ensured that disaster-induced displacement remained an issue into the 21st century (Boustan, Kahn, Rhode 2012; Lübken 2019). The 1930s "Dust Bowl" migration from the southern plains to California remains the iconic example in American cultural memory. However, subsequent studies have found that this was often a case of planned migration rather than sudden displacement; that migrants responded to effects on rural wages and employment; that the migration combined multiple short- and long-distance movements; and that most long-distance migrants relied on existing networks of kinship and information to resettle (Gutmann et al. 2005, McLeman 2006, Hornbeck 2012). More typical were the many Americans displaced by river flooding and tropical storms throughout the past century, most notably following the Hurricane Katrina in 2005. In the case of Katrina, as in other past examples, households without means to escape from the disaster itself were more likely to make permanent long-distance moves in its aftermath (Colten 2012).

A growing body of research has also linked the geography and timing of migration from Mexico and the Caribbean to the US with hazards related to recent climate change. While sudden-onset disasters may have reduced long-distance movements in the short term, it appears disaster risk has increased migration to the US in the long term, particularly where previous migrants from a region have already established networks of information and support (e.g., Hunter, Murray, Riosmena 2013; Mahajan, Yang 2020; Murray-Tortarolo, Salgado 2021; Zhu et al. 2024).

3.3. Asia

Research on historical climate-migration links in Asia may be reviewed according to the identity of the migrants in question, the geographical and chronological scale of the studies, and the analytical methods they employ. The majority of these studies have focused on historical China, which will be the primary focus of this section, supplemented by findings from other regions in Asia. "Migration" in these studies is broadly defined to include most human movement, regardless of point of departure, destination, or migrant identity (Ge, Wu, Cao 1997), which is consistent with the definition by European Parliament (2024). Therefore, the use of the term here may differ from that found in contemporary climate and migration research.

Regarding the identity of migrants, most Chinese historical studies have focused on either pastoral nomads or farmers. Nomadic peoples mainly originated in the steppes of Central Asia or Mongolia (Sodnompilova, Nanzatov 2019). Migration of nomads is here defined to mean that they not only moved annually or seasonally but also changed their location as an adaptive approach to climate change, because their livelihoods required them to follow the "water and grass" (Di Cosmo 1994). For nomads, climate-related disaster usually involved cooling or drought (Parker 2013), both of which could push nomads to shift their summer and winter pastures to new areas. Even short-term climate extremes could drive nomads to shift their pastures into new areas in the past (Bai, Kung 2011; Di Cosmo et al. 2018). Current studies show stronger historical associations between decreased precipitation and nomadic migration than between cooler temperatures and nomadic migration (Pei, Zhang 2014; Zhang et al. 2015; Damette, Goutte, Pei 2020), because drought can reduce bioproductivity with serious effects on grazing stock in the semiarid zones of Asia (Huq et al. 2004, Dong et al. 2021). Under the ecological stress generated by climate change, nomads usually had a southward direction in their migrations (Zou et al. 2017, Pei et al. 2020) or preferred to migrate into agricultural regions (Shaheen 2011, Rogers 2012), where they could generally find enough warmth and water. The migration of nomads toward southern or agricultural zones unavoidably threatened the security of agricultural states in eastern and southern China (Ludden 1994, Zhang et al. 2007, Pei et al. 2024).

The linkage between climate change and farmer migrations seems more complicated, because farmers were traditionally reluctant to leave their ancestral homes (Lee 1978). However, many studies indicate that migrations of farmers were usually associated with cascading effects of disasters, such as epidemics (Tian et al. 2017), famines (Hang et al. 2025), and wars (Chen, Kung 2022), which were triggered by climate change in imperial China (Xiao, Fang, Ye 2013; Xiao et al. 2015; Fang et al. 2018). Historical studies of other regions in Asia also reveal a similar pattern of farmers' migrations driven by cascading effects of climate-related disasters (Damodaran et al. 2018, Shen 2019). For example, during the 1770s climate anomaly in Bengal, entire villages disappeared and were relocated. Just like their counterparts in Europe at the time, numerous peasants moved strategically. They responded not just to repeated monsoon failures but also to evade the governmental takeover of the East India Company and diminishing welfare entitlements (Chowdhury-Zilly 1982, Damodaran 2007). From 1780 to 1812 CE, following several famines in India, many farmers repeated this pattern of climate mobility and fled their homes in search of food and rights, triggering intense scrutiny of the colonial administration (Danvers 1877); and in the 1860s, due to the infertile farmland and low productivity in South Korea, farmers were forced to migrate for potential opportunities of agricultural development (Damodaran et al. 2018). Although there are some studies interpreting farmer migration as a direct effect of climate change (Fang, Ye, Zeng 2006; Ye, Fang, Khan 2012), such as that described for pastoral nomadic migrations, the climate-migration linkage for farmers usually presents a less direct pattern (Pei, Lee, Zhang 2018; Zhang et al. 2019; Zhang et al. 2022).

The mass migration of farmers mainly from the Yellow River valley into northeastern China from the late 18th to early 20th centuries was similar in timing and scale to the emigration from Central and Western Europe to North America during the same period, and it reveals similar patterns of sensitivity to climate variability (Ye, Fang, Khan 2012). Studies elsewhere in Asia associate migrations with individual disasters. For example, severe cold accompanied by shortage and famines during the late LIA led to several migrations in around Cappadocia (southern central Anatolia, Turkey). During harsh winters, especially in 1845–1874 CE, some mountain roads had to be closed, causing increased cereal prices and subsequent famine (Erler 2012). In several cases, affected communities were forced to migrate to areas that did not suffer from such severe shortages of grain (Tekin 2015). Population displacement in central Anatolia was also triggered by droughts and food shortages, for instance, in the summer of 1887, when migrants were sent back to their homes (Bayer Altın, Kaya 2020). Amrith (2013) explored the movement of labour between South and Southeast Asia during and after the region's 19th-century natural disasters, demonstrating influences of colonial markets as well as racial and climatic theories on patterns of migration.

In terms of their scale and analytical methods, most studies have employed case-based qualitative or mixed analysis or else macro-scale quantitative analysis. Case-based analyses have usually been conducted for limited periods and areas – for example, nomadic and agricultural migration due to famine in the Ming Dynasty (1368–1644 CE) during the LIA (Zheng et al. 2014) or migration in the northeastern Tibetan Plateau (1368–1911 CE) driven by climate pressure and local policies (Jia et al. 2016). Besides weighing the "push" effect of climate change, case-based analyses have focused on migration as adaptation to climate change. Examples include the migration in the eastern Central Asia from 1600 to 1800 CE due to the wars between nomads and farmers (Fang, Liu 1992) or a peak in migration from China's Shaanxi and Gansu provinces to North Xinjiang following droughts and floods during 1760–1820 CE (Li et al. 2017).

By contrast, macro-scale investigations cover long periods and/or large areas (Bai, Kung 2011; Pei, Zhang 2014; Pei, Zhang, Lee 2016; Damette, Goutte, Pei 2020; Pei et al. 2020). They aim to test whether climate variability or change, especially cooling and drought, influenced migration trends, even though these trends may not be applicable to every migration event of the period. Especially abundant and consistent records for Ming and Qing (1644–1912 CE) China underpin these quantitative analyses of past climate-migration links, helping to explain the popularity of this approach in Chinese historical research.

The scale of inquiry largely determines the most appropriate mode of explanation, but different historical investigations may yield to different approaches. At a macro scale with an abundance of data and records, rigorous statistical methods have been usually adopted; while narrative approaches are mainly applied to micro-scale studies and historical case studies (White, Pei 2020; White et al. 2023). However, this does not mean that qualitative case studies and macro-scale quantitative studies contradict one another, nor that they cannot be applied at the same time. Narrative and quantitative methods may be mutually reinforcing, as revealed in a study on climate-migration links in China by Pei et al. (2019). Therefore, the findings from case-based analysis and macro-scale investigation should build upon each other.

4. The latest progress in the study of climate and migration

The latest progress in the study of climate-migration links was discussed at the workshop "Climate and Migration: Historical and Present Perspectives", organised by the CRIAS (Climate Reconstruction and Impacts from the Archives of Societies) working group of the PAGES (Past Global Changes) programme on 3–4 June 2024 in Brno, Czechia (Dolák et al. 2024). Some studies presented at the workshop became a part of this special issue of *Geografie*, as described below.

Concerning Europe, Damm (2025) analysed the colonisation of Iceland by Norwegian settlers during the late ninth century. The colonisation was accompanied by several disasters, including soil erosion resulting from deforestation, famines following from overgrazing and depletion of fisheries, as well as conflicts over the utilisation of agricultural land and natural resources. Using palaeoecological proxies, including pollen, tephra, and stable isotopes, as well as written accounts from the North such as sagas, annals, and law codes, the paper investigates how medieval Icelanders adapted to environmental and socio-economic challenges. The paper also tried to answer questions about changes in the Icelandic landscape and ecosystems caused by Norse settlers and the impacts of social and political structures on environmental management.

The study of historical climate-migration links requires high-resolution climate information obtained and analysed through time-consuming methods of historical climatology. To facilitate this process, Kahle and Glaser (2025) explore new methods to extract and classify information about weather extremes, such as thunderstorms and heavy rainfall, drawn from the large tambora.org database (Tambora 2012). Their study tests different methodological approaches ranging from manual hermeneutics and keyword searches to machine learning, including

Bayesian methods, as well as advanced artificial intelligence techniques such as Large Language Models.

Four papers in this special issue are devoted to migration in Asia. Bu et al. (2025) analysed migration across the Great Wall in China during the LIA c. 1500–1850 CE, considering data on precipitation, temperature, population size, and migration events. They found that more migration events occurred during cool periods, while during dry periods more migrants came across the wall from farther north. The study shows the general ineffectiveness of the Great Wall as a tool for blocking migration.

Fei and Pei (2025) investigated the mass migration from mainland China to Taiwan that followed a drought in 1628 CE. Though moderate, the drought in Fujian province (southeastern China) was followed by a great famine. To reduce piracy, the late Ming Dynasty (1368–1644 CE) prohibited maritime fisheries and trade, which left populations in southeastern China especially vulnerable to crop failure and famine, with no relief available from local authorities. A leading warlord of the Taiwan Strait, Zheng Zhilong, took advantage of the drought and famine to carry thousands of refugees from Fujian to Taiwan, where a quasi-military settlement had already been founded in 1624.

Zhang et al. (2025) investigated the extreme droughts of 1743, 1877, and 1920 CE in northern China, comparing multiple sources of documentary evidence with characteristics of climate-induced migration at different stages of Chinese sociocultural transformation between the mid-18th and early 20th centuries. They find that precipitation deficits and flight from hunger triggered climate-related migrations, following the following pathway: precipitation deficit – harvest failure – famine – migration. Changes in administration and transportation influenced both the possibility and necessity of moving, and these factors are thus reflected in the size and distance of migrations.

Ichino, Kurosu, and Masuda (2025) employ data from eastern Fukushima (northeastern Japan) to examine relationships among solar radiation reconstructed from standardised weather descriptions in historical diaries, agricultural productivity, economic conditions, and demographic movements, including migration and mortality during famines in the period 1729–1870 CE. Significant reduction in solar radiation was associated with severe famines of the 1780s and 1830s, which also witnessed increases in migration. For the Tenpo famine (1833–1838 CE) in particular, they find significant correlations between solar radiation and rice prices, on the one hand, and between rice prices and migration, on the other.

5. Research prospects

Both this review and the perspectives offered in the research articles of this special issue highlight several important conclusions and promising avenues for future research on climate-migration links:

(i) Human migration represents a complicated process, influenced both in the past and in the present by socio-economic, political, and cultural as well as environmental factors. The focus of research is no longer *whether* migration responds to weather-related hazards, climate variability, and climate change – but *which migrants, when, where*, and *how*. Recent global warming has elevated the frequency and severity of some weather-related disasters and drawn public and scholarly attention to contemporary climate-migration links. The resulting growth in research on this topic has yielded valuable insights, particularly on short- and medium-term effects of climate change and disasters since the late 20th century. Historical scholarship should build on this contemporary research and aim to provide insights into long-term patterns and consequences of climate-migration links, which are hard to discern in the brief contemporary record.

(ii) New databases utilising natural proxies and historical written evidence provide high-resolution information on past climate and weather that can be combined with historical economic and social data (e.g., Wang et al. 2018, Burgdorf et al. 2023, Valler et al. 2024). These databases hold promising potential for application in historical migration studies. Cooperation between climatologists, historians, and social scientists may lead to deeper understanding of relationships between human mobility and weather-related hazards, climate variability, and climate change.

(iii) Although the study of contemporary climate-migration links has focused on the Global South (Piguet, Kaenzig, Guélat 2018), historical climate migration research has focused on Europe, North America, and (East) Asia, leaving gaps, particularly for Africa and Latin America. Historical research would benefit from more varied geographical and disciplinary perspectives, including more attention to women's history. Regional studies could also benefit from balance and communication between macro-scale quantitative research and in-depth case studies and narratives.

(iv) As with contemporary research on climate-migration links, historical research may aim for greater policy relevance to help address challenges related to global warming. The study of past migration flows, integration policies, and institutional responses enables a deeper understanding of long-term trends and their societal impacts. Reflecting on historical experiences contributes to the identification of both effective and ineffective approaches, thereby supporting the development of evidence-based policymaking. A historical perspective thus allows recent policymakers to avoid repeating past failures and provides not only a warning but also inspiration for innovative approaches to managing migration in a globalised world.

(v) The policy significance of historical research extends beyond analogies between past and present climate, disasters, and migrations. As with other areas of climate history, scholarship in this field may also contribute to histories of scientific knowledge; histories of policies, politics, and institutions; conceptual history; and above all the construction of social and cultural memory to help build local resilience (Adamson, Hannaford, Rohland 2018).

References

ABEL, G.J., BROTTRAGER, M., CUARESMA, J.C., MUTTARAK, R. (2019): Climate, conflict and forced migration. Global Environmental Change, 54, 239–249. https://doi.org/10.1016/j.gloenvcha.2018.12.003

ACKERMANN, M.E. (2002): Cool Comfort: America's Romance with Air-Conditioning. Smithsonian Institution Press, Washington.

ADAMSON, G.C.D., HANNAFORD, M.J., ROHLAND, E.J. (2018): Re-thinking the present: The role of a historical focus in climate change adaptation research. Global Environmental Change, 48, 195–205. https://doi.org/10.1016/j.gloenvcha.2017.12.003

ALMULHIM, A.I., ALVERIO, G.N., SHARIFI, A., SHAW, R., HUQ, S., MAHMUD, M.J., AHMAD, S., ABUBAKAR, I.R. (2024): Climate-induced migration in the Global South: an in depth analysis. npj Climate Action, 3, 47. https://doi.org/10.1038/s44168-024-00133-1

AMRITH, S.S. (2013): Crossing the Bay of Bengal: The Furies of Nature and the Fortunes of Migrants. Harvard University Press, Cambridge, Massachusetts. https://doi.org/10.2307/j.ctt6wpmb1

ARSENAULT, R. (1984): The end of the long hot summer: The air conditioner and southern culture. The Journal of Southern History, 50, 597–628. https://doi.org/10.2307/2208474

AUCHMANN, R., BRÖNNIMANN, S., BREDA, L., BÜHLER, M., SPADIN, R., STICKLER, A. (2012): Extreme climate, not extreme weather: the summer of 1816 in Geneva, Switzerland. Climate of the Past, 8, 325–335. https://doi.org/10.5194/cp-8-325-2012

BAI, Y., KUNG, J.K-S. (2011): Climate shocks and Sino-nomadic conflict. The Review of Economics and Statistics, 93, 3, 970–981. https://doi.org/10.1162/REST_a_00106

BAYER, D. (1966): O gib mir Brot. Die Hungerjahre 1816 und 1817 in Württemberg und Baden. Deutsches Brotmuseum e.V., Ulm/Donau.

BAYER ALTIN, T., KAYA, M. (2020): Climatic and social change during the Little Ice Age in Cappadocia vicinity, southern central Anatolia, Turkey. Regional Environmental Change, 20, 1, 16. https://doi.org/10.1007/s10113-020-01604-x

BEHRENDT, S.D. (2009): Ecology, seasonality, and the Atlantic slave trade. In: Bailyn, B., Denault, P.L., eds.: Soundings in Atlantic History. Harvard University Press, Cambridge, MA, 44–85. https://doi.org/10.4159/9780674053533-002

BENSON, L.V., PAUKETAT, T.R., COOK, E.R. (2009): Cahokia's boom and bust in the context of climate change. American Antiquity, 74, 3, 467–483. https://doi.org/10.1017/S000273160004871X

BHENDE, A., KANITKAR, T. (2024): Principles of Population Studies. Himalaya Publishing House, New Delhi.
BIRD, B., WILSON, J., GILHOOLY III, W., STEINMAN, B.A., STAMPS, L. (2017): Midcontinental native American population dynamics and late Holocene hydroclimate extremes. Scientific Reports, 7, 41628. https://doi.org/10.1038/srep41628
BORREGGINE, M., LATYCHEV, K., COULSON, S., POWELL, E.M., MITROVICA, J.X., MILNE, G.A., ALLEY, R.B. (2023): Sea-level rise in southwest Greenland as a contributor to Viking abandonment. Proceedings of the National Academy of Sciences, 120, 17, e2209615120. https://doi.org/10.1073/pnas.2209615120
BOUSTAN, L.P., KAHN, M.E., RHODE, P.W. (2012): Moving to higher ground: Migration response to natural disasters in the early twentieth century. American Economic Review, 102, 238–244. https://doi.org/10.1257/aer.102.3.238
BRÁZDIL, R., DOBROVOLNÝ, P., LUTERBACHER, J., MOBERG, A., PFISTER, C., WHEELER, D., ZORITA, E. (2010): European climate of the past 500 years: New challenges for historical climatology. Climatic Change, 101, 1–2, 7–40. https://doi.org/10.1007/s10584-009-9783-z
BRÁZDIL, R., DOBROVOLNÝ, P., MIKŠOVSKÝ, J., PIŠOFT, P., TRNKA, M., MOŽNÝ, M., BALEK, J. (2022): Documentary-based climate reconstructions in the Czech Lands 1501–2020 CE and their European context. Climate of the Past, 18, 4, 935–959. https://doi.org/10.5194/cp-18-935-2022
BRÁZDIL, R., DOBROVOLNÝ, P., PFISTER, C., KLEEMANN, K., CHROMÁ, K., SZABÓ, P., OLINSKI, P. (2023): Weather and climate and their human impacts and responses during the Thirty Years' War in Central Europe. Climate of the Past, 19, 9, 1863–1890. https://doi.org/10.5194/cp-19-1863-2023
BRÁZDIL, R., CHROMÁ, K., VALÁŠEK, H., DOLÁK, L. (2012): Hydrometeorological extremes derived from taxation records for south-eastern Moravia, Czech Republic, 1751–1900 AD. Climate of the Past, 8, 2, 467–481. https://doi.org/10.5194/cp-8-467-2012
BRÁZDIL, R., PFISTER, C., WANNER, H., VON STORCH, H., LUTERBACHER, J. (2005): Historical climatology in Europe – the state of the art. Climatic Change, 70, 3, 363–430. https://doi.org/10.1007/s10584-005-5924-1
BRÁZDIL, R., ŘEZNÍČKOVÁ, L., VALÁŠEK, H., DOLÁK, L., KOTYZA, O. (2016): Climatic effects and impacts of the 1815 eruption of Mount Tambora in the Czech Lands. Climate of the Past, 12, 1361–1374. https://doi.org/10.5194/cp-12-1361-2016
BRÁZDIL, R., TRNKA, M., MIKŠOVSKÝ, J., ŘEZNÍČKOVÁ, L., DOBROVOLNÝ, P. (2015): Spring-summer droughts in the Czech Land in 1805–2012 and their forcings. International Journal of Climatology, 35, 7, 1405–1421. https://doi.org/10.1002/joc.4065
BROWN, O. (2008): Migration and Climate Change. IOM Migration Research Series No. 31. International Organization for Migration, Geneva. https://doi.org/10.18356/5ab20a38-en
BROWN, P.J. (2023): Meteorological disasters in Medieval Britain (AD 1000–1500): Archaeological, Historical and Climatological Perspectives within a Wider European Context. De Gruyter, Berlin, Boston. https://doi.org/10.1515/9783110719628
BRÖNNIMANN, S., KRÄMER, D. (2016): Tambora and the "Year Without a Summer" of 1816. A perspective on Earth and human systems science. Geographica Bernensia G90, 48 pp.
BRUGNARA, Y., AUCHMANN, R., BRÖNNIMANN, S., ALLAN, R.J., AUER, I., BARRIENDOS, M., BERGSTRÖM, H., BHEND, J., BRÁZDIL, R., COMPO, G.P., CORNES, R.C., DOMINGUEZ-CASTRO, F., VAN ENGELEN, A.F.V., FILIPIAK, J., HOLOPAINEN, J., JOURDAIN, S., KUNZ, M., LUTERBACHER, J., MAUGERI, M., MERCALLI, L., MOBERG, A., MOCK, C.J., PICHARD, G., ŘEZNÍČKOVÁ, L., VAN DER SCHRIER, G., SLONOSKY,

V., USTRNUL, Z., VALENTE, M.A., WYPYCH, A., YIN, X. (2015): A collection of sub-daily pressure and temperature observations for the early instrumental period with a focus on the "year without a summer" 1816. Climate of the Past, 11, 1027–1047. https://doi.org/10.5194/cp-11-1027-2015

BU, X., SU, Y., FAN, L., PEI, Q., PAI, P.-L., JIANG, D. (2025): Climate change and migration across the Great Wall of China during the Little Ice Age. Geografie, 130, 3, 299–320. https://doi.org/10.37040/geografie.2025.009

BUISMAN, J. (1995): Duizend jaar weer, wind en water in de Lage Landen 1 tot 1300. Uitgeverij Van Wijnen, Franeker.

BULIGA, A.L. (2016): Causes and effects of the migratory Italian waves in the 19th–20th centuries. Bulletin of the Transilvania University of Braşov, Series VII: Social Sciences, 58, 2, 53–60.

BURGDORF, A.-M., BRÖNNIMANN, S., ADAMSON, G., AMANO, T., AONO, Y., BARRIOPEDRO, D., BULLÓN, T., CAMENISCH, C., CAMUFFO, D., DAUX, V., PRIETO, M. DEL R., DOBROVOLNÝ, P., GALLEGO, D., GARCÍA-HERRERA, R., GERGIS, J., GRAB, S., HANNAFORD, M.J., HOLOPAINEN, J., KELSO, C., KERN, Z., KISS, A., KUAN-HUI LIN, E., LOADER, N.J., MOŽNÝ, M., NASH, D., NICHOLSON, S.E., PFISTER, C., RODRIGO, F.S., RUTISHAUSER, T., SHARMA, S., TAKÁCS, K., VARGAS, E.T., VEGA, I. (2023): DOCU-CLIM: A global documentary climate dataset for climate reconstructions. Scientific Data, 10, 402. https://doi.org/10.1038/s41597-023-02303-y

BURZYŃSKI, M., DEUSTER, C., DOCQUIER, F., DE MELO, J. (2022): Climate change, inequality, and human migration. Journal of the European Economic Association, 20, 1145–1197. https://doi.org/10.1093/jeea/jvab054

BÜNTGEN, U., EGGERTSSON, O., OPPENHEIMER, C. (2024): Braided motivations for Iceland's first wave of mass emigration to North America after the 1875 Askja eruption. Regional Environmental Change, 24, 2, 48. https://doi.org/10.1007/s10113-024-02215-6

BÜNTGEN, U., TEGEL, W., NICOLUSSI, K., MCCORMICK, M., FRANK, D., TROUET, V., KAPLAN, J.O., HERZIG, F., HEUSSNER, K.-U., WANNER, H., LUTERBACHER, J., ESPER, J. (2011): 2500 years of European climate variability and human susceptibility. Science, 331, 568–572. https://doi.org/10.1126/science.1197175

CAMPBELL, B.M.S. (2016): The Great Transition: Climate, Disease and Society in the Late-Medieval World. Cambridge University Press, Cambridge. https://doi.org/10.1017/CBO9781139031110

CATTANEO, C., BEINE, M., FRÖHLICH, C.J., KNIVETON, D., MARTINEZ-ZARZOSO, I., MASTRORILLO, M., MILLOCK, K., PIGUET, E. (2019): Human Migration in the Era of Climate Change. Working Paper 19–13. European Institute on Economics and the Environment, Milano. https://doi.org/10.1093/reep/rez008

CHEN, T., KUNG, J.K-S. (2022): War shocks, migration, and historical spatial development in China. Regional Science and Urban Economics, 94, 3, 103718. https://doi.org/10.1016/j.regsciurbeco.2021.103718

CHOWDHURRY-ZILLY, A.N. (1982): The Vagrant Peasant. Agrarian Distress and Desertion in Bengal 1770 to 1830. Steiner, Wiesbaden.

COHN, R.L. (2009): Mass Migration under Sail: European Immigration to the Antebellum United States. Cambridge University Press, Cambridge, New York. https://doi.org/10.1017/CBO9780511575211

COLLET, D. (2019): Die doppelte Katastrophe. Klima und Kultur in der europäischen Hungerkrise 1770–1772. Vandenhoeck&Ruprecht, Göttingen. https://doi.org/10.13109/9783666355929

COLLET, D., SCHUH, M. (2018): Famines: At the interface of nature and society. In: Collet, D., Schuh, M., eds.: Famines During the 'Little Ice Age' (1300–1800): Socionatural Entanglements in Premodern Societies. Springer International Publishing, Cham, 3–16. https://doi.org/10.1007/978-3-319-54337-6_1

COLTEN, C.E. (2012): Forgetting the unforgettable: Losing resilience in New Orleans. In: Mauch, C., Mayer, S., eds.: American Environments: Climate Cultures Catastrophe. Universitätsverlag Winter, Heidelberg, 159–176.

CULVER, L. (2012): Manifest destiny and manifest disaster: Climate perceptions and realities in United States territorial expansion. In: Mauch, C., Mayer, S., eds.: American Environments: Climate Cultures Catastrophe. Universitätsverlag Winter, Heidelberg, 7–30.

DAMETTE, O., GOUTTE, S., PEI, Q. (2020): Climate and nomadic migration in a nonlinear world: evidence of the historical China. Climatic Change, 163, 2055–2071. https://doi.org/10.1007/s10584-020-02901-4

DAMM, C. (2025): (Im)mobile Vikings? Environmental stress, adaptation, and the decision not to leave. Geografie, 130, 3, 251–269. https://doi.org/10.37040/geografie.2025.015

DAMODARAN, V. (2007): Famine in Bengal. A comparison of the 1770 famine in Bengal and the 1897 famine in Chotanagpur. The Medieval History Journal, 10, 1–2, 143–181. https://doi.org/10.1177/097194580701000206

DAMODARAN, V., ALLAN, R., OGILVIE, A.E.J., DEMARÉE, G.R., GERGIS, J., MIKAMI, T., MIKHAIL, A., NICHOLSON, S.E., NORRGÅRD, S., HAMILTON, J. (2018): The 1780s: Global climate anomalies, floods, droughts, and famines. In: White, S., Pfister, C., Mauelshagen, F., eds.: The Palgrave Handbook of Climate History. Palgrave Macmillan, London, 517–550. https://doi.org/10.1057/978-1-137-43020-5_34

DANVERS, F.C. (1877): A Century of Famines: Being Particulars of All the Famines that Have Visited India Since the Year 1770, and an Inquiry as to the Best Means of Providing Against Them. India Office, Calcutta.

DI COSMO, N. (1994): Ancient Inner Asian nomads: Their economic basis and its significance in Chinese history. The Journal of Asian Studies, 53, 4, 1092–1126. https://doi.org/10.2307/2059235

DI COSMO, N., HESSL, A., LELAND, C., BYAMBASUREN, O., TIAN, H., NACHIN, B., PEDERSON, N., ANDREU-HAYLES, L., COOK, E.R. (2018): Environmental stress and steppe nomads: Rethinking the history of the Uyghur Empire (744–840) with paleoclimate data. The Journal of Interdisciplinary History, 48, 4, 439–463. https://doi.org/10.1162/JINH_a_01194

DIAMOND, J.M. (2005): Collapse: How Societies Choose to Fail or Succeed. Viking, New York.

DIEMER, K. (2009): Ursachen und Verlauf der Auswanderung aus Oberschwaben im 18. Jahrhundert. In: Fata, M., ed.: „Die Schiff stehn schon bereit". Ulm und die Auswanderung nach Ungarn im 18. Jahrhundert. Kohlhammer, Stuttgart, 37–58.

DOLÁK, L., WHITE, S., HUHTAMAA, H., PEI, Q., ZHANG, D. (2024): Climate and migration: Historical and present perspectives. Past Global Changes Magazine, 32, 139. https://doi.org/10.22498/pages.32.2.139

DONG, G., WANG, L., ZHANG, D.D., LIU, F., CUI, Y., LI, G., SHI, Z., CHEN, F. (2021): Climate-driven desertification and its implications for the ancient Silk Road trade. Climate of the Past, 17, 3, 1395–1407. https://doi.org/10.5194/cp-17-1395-2021

DRAKE, B.L. (2017): Changes in North Atlantic Oscillation drove population migrations and the collapse of the Western Roman Empire. Scientific Reports, 7, 1227. https://doi.org/10.1038/s41598-017-01289-z

ENGLER, S., MAUELSHAGEN, F., WERNER, J., LUTERBACHER, J. (2013): The Irish famine of 1740–1741: Famine vulnerability and "climate migration". Climate of the Past, 9, 1161–1179. https://doi.org/10.5194/cp-9-1161-2013

ENGLER, S., WERNER, J. (2015): Processes prior and during the early 18th century Irish famines – weather extremes and migration. Climate, 3, 1035–1056. https://doi.org/10.3390/cli3041035

ERLER, M.Y. (2012): Osmanlı Devleti'nde Kuraklık ve Kıtlık Olayları (1800–1880). Libra Kitap, İstanbul.

EUROPEAN PARLIAMENT (2024): Exploring migration causes: Why people migrate. Available at: https://www.europarl.europa.eu/topics/en/article/20200624STO81906/exploring-migration-causes-why-people-migrate.

FAGAN, M.B. (2001): The Little Ice Age: How Climate Made History 1300–1850. Basic Books, New York.

FANG, J., LIU, G. (1992): Relationship between climatic change and the nomadic southward migrations in Eastern Asia during historical times. Climatic Change, 22, 151–168. https://doi.org/10.1007/BF00142964

FANG, X., SU, Y., ZHENG, J., XIAO, L., WEI, Z., YIN, J. (2018): The Social Impacts of Climate Change in China over the Past 2000 Years. China Science Publishing & Media, Beijing.

FANG, X., YE, Y., ZENG, Z. (2006): The interaction among extreme climatic events, farming of migrants and political management. Science in China (Series D: Earth Sciences), 36, 7, 680–688.

FEI, J., PEI, Q. (2025): Drought in 1628 AD and beginning of massive migration from Chinese mainland to Taiwan Island. Geografie, 130, 3, 321–337. https://doi.org/10.37040/geografie.2025.010

FENSKE, J., KALA, N. (2015): Climate and the slave trade. Journal of Development Economics, 112, 19–32. https://doi.org/10.1016/j.jdeveco.2014.10.001

FOSTER, W.C. (2012): Climate and Culture Change in North America AD 900–1600. University of Texas Press, Austin.

GACEU, O.R., CACIORA, T., BAIAS, Ș., MORAR, C., DUDAȘ, M., STUPARIU, M., MAXIM, M. (2025): Reconstruction of climatic events from the 16th century in Transylvania: interdisciplinary analysis based on historical sources. Frontiers in Climate, 6, 1507143. https://doi.org/10.3389/fclim.2024.1507143

GE, J., WU, S., CAO, S. (1997): Chinese Migration History. Fujian People's Publishing House, Fu Jian.

GLASER, R., HIMMELSBACH, I., BÖSMEIER, A. (2017): Climate of migration? How climate triggered migration from southwest Germany to North America during the 19th century. Climate of the Past, 13, 1573–1592. https://doi.org/10.5194/cp-13-1573-2017

GRANDJEAN, K.A. (2011): New world tempests: Environment, scarcity, and the coming of the Pequot War. The William and Mary Quarterly, 68, 75–100. https://doi.org/10.5309/willmaryquar.68.1.0075

GRAU-SATORRAS, M., OTERO, I., GÓMEZ-BAGGETHUN, E., REYES-GARCÍA, V. (2021): Prudent peasantries: Multilevel adaptation to drought in Early Modern Spain (1600–1715). Environment and History, 27, 1, 3–36. https://doi.org/10.3197/096734019X15463432086964

GRAY, C., WISE, E. (2016): Country-specific effects of climate variability on human migration. Climatic Change, 135, 555–568. https://doi.org/10.1007/s10584-015-1592-y

GUTMANN, M.P., DEANE, G.D., LAUSTER, N., PERI, A. (2005): Two population-environment regimes in the Great Plains of the United States, 1930–1990. Population and Environment, 27, 2, 191–225. https://doi.org/10.1007/s11111-006-0016-3

HANG, X., SUN, Z., HE, J., XIN, J., ZHANG, S., ZHAO, Y., TAN, Z., HAN, L., HAO, Y. (2025): Temporal and spatial effects of extreme drought events on human epidemics over Ancient China in 1784–1787 CE. Environmental Health, 24, 1, 8. https://doi.org/10.1186/s12940-025-01163-w

HAUER, M.E., JACOBS, S.A., KULP, S.A. (2024): Climate migration amplifies demographic change and population aging. Proceedings of the National Academy of Sciences, 121, e2206192119. https://doi.org/10.1073/pnas.2206192119

HODGE, A.R. (2012): 'In want of nourishment for to keep them alive': Climate fluctuations, bison scarcity, and the smallpox epidemic of 1780–82 on the Northern Great Plains. Environmental History, 17, 365–403. https://doi.org/10.1093/envhis/emr153

HOERDER, D. (2022): Cultures in Contact: World Migrations in the Second Millennium. Duke University Press, Durham, NC.

HORNBECK, R. (2012): The enduring impact of the American Dust Bowl: Short- and long-run adjustments to environmental catastrophe. American Economic Review, 102, 1477–1507. https://doi.org/10.1257/aer.102.4.1477

HSU, K.J. (1998): Sun, climate, hunger and mass migration. Science in China Series D: Earth Sciences, 41, 449–472. https://doi.org/10.1007/BF02877737

HUNTER, L.M., MURRAY, S., RIOSMENA, F. (2013): Rainfall patterns and U.S. migration from rural Mexico. International Migration Review, 47, 874–909. https://doi.org/10.1111/imre.12051

HUQ, S., REID, H., KONATE, M., RAHMAN, A., SOKONA, Y., CRICK, F. (2004): Mainstreaming adaptation to climate change in Least Developed Countries (LDCs). Climate Policy, 4, 1, 25–43. https://doi.org/10.1080/14693062.2004.9685508

İÇDUYGU, A., GÖREN, H. (2023): Exploring temporal and topical dynamics of research on climate/environment–migration nexus: A critical comparative perspective. Migration Studies, 11, 4, 572–597. https://doi.org/10.1093/migration/mnad021

ICHINO, M., KUROSU, S., MASUDA, K. (2025): Solar radiation, rice prices, and migration in Northeastern Japan during the 18th and 19th centuries. Geografie, 130, 3, 369–388. https://doi.org/10.37040/geografie.2025.013

INGIMARSSON, S. (2024): "What a winter it was": The 1257 Samalas eruption and the fall of the Icelandic Commonwealth. Scandinavian Journal of History, 50, 1, 26–51. https://doi.org/10.1080/03468755.2024.2424243

INGRAM, S.E., SCHOLLMEYER, K.G. (2021): Understanding past climate-related migration for our warming world. The Kiva, 87, 2, 220–252. https://doi.org/10.1080/00231940.2021.1880170

INTERNAL DISPLACEMENT MONITORING CENTRE (2025): 2024 Global Report on Internal Displacement, Geneva.

IPCC (2021): Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, New York.

IVANOVA, A., SINGH, D., RAI, P., RICHARDS, C., VASCONCELOS, H., GOLDSBY, M. (2024): Climate hazards and human migration: Literature review. Environmental Research: Climate, 3, 042002. https://doi.org/10.1088/2752-5295/ad6fc4

JAKUS, Z.N. (2019): Migration patterns from the Dalmatian hinterland during and after the great hunger of 1453–1454 as a consequence of environmental and political crisis. In: Kiss, A., Pribyl, K., eds.: The Dance of Death in Late Medieval and Renaissance Europe: Environmental Stress, Mortality and Social Response. Routledge, London, 159–174. https://doi.org/10.4324/9780429491085-10

JENNINGS, J.A., GRAY, C.L. (2015): Climate variability and human migration in the Netherlands, 1865–1937. Population and Environment, 36, 255–278. https://doi.org/10.1007/s11111-014-0218-z

JIA, X., DONG, G., WANG, L., MA, M., LEE, H.F., ZHANG, Z., CHEN, F. (2016): How humans inhabited the northeastern Tibetan plateau during the Little Ice Age: A case study at Hualong County, Qinghai Province, China. Journal of Archaeological Science: Reports, 7, 27–36. https://doi.org/10.1016/j.jasrep.2016.03.036

KACZAN, D.J., ORGILL-MEYER, J. (2020): The impact of climate change on migration: a synthesis of recent empirical insights. Climatic Change, 158, 281–300. https://doi.org/10.1007/s10584-019-02560-0

KAHLE, M., GLASER, R. (2025): Digital innovations in historical climatology: classifying weather and climatic extremes and their impacts on societies using machine learning on written documents. Geografie, 130, 3, 271–297. https://doi.org/10.37040/geografie.2025.014

KISS, A., LASZLOVSZKY, J. (in press): Medieval Danube island monasteries: flood resilience, mitigation, prevention and adaption in the Middle Danube region (in print). In: Hüglin, S., Mehler, N. Petts, D., eds.: Islands, Monasteries and Water – Liquid Life on Liminal Land. Tübinger Forschungen zur Historischen Archäologie. Leiden, Sidestone.

KRÄMER, D. (2015): "Menschen grasten mit dem Vieh". Die letzte grosse Hungerkrise der Schweiz 1816/1817. Wirtschafts-, Sozial- und Umweltgeschichte (WSU), 4. Schwabe Verlag, Basel. https://doi.org/10.24894/978-3-7965-3447-8

KUPPERMAN, K. (1982): The puzzle of the American climate in the early colonial period. American Historical Review, 87, 1262–1289. https://doi.org/10.1086/ahr/87.5.1262

KWILINSKI, A., LYULYOV, O., PIMONENKO, T., DZWIGOL, H., ABAZOV, R., PUDRYK, D. (2022): International migration drivers: Economic, environmental, social, and political effects. Sustainability, 14, 11, 6413. https://doi.org/10.3390/su14116413

LEE, J. (1978): Migration and expansion in Chinese history. In: McNeill, W.H., Adams, R.S., eds.: Human Migration: Patterns and Policies. Indiana University Press, Bloomington, Ind., 20–47.

LI, Y., GE, Q., WANG, H., TAO, Z. (2017): Climate change, migration, and regional administrative reform: A case study of Xinjiang in the middle Qing Dynasty (1760–1884). Science China Earth Sciences, 60, 1328–1337. https://doi.org/10.1007/s11430-016-9034-9

LIANG, B., SHI, G., SUN, Z., BABUL, H., ZHOU, M. (2023): Evolution trend and hot topic measurement of climate migration research under the influence of climate change. Frontiers in Ecology and Evolution, 11, 1118037. https://doi.org/10.3389/fevo.2023.1118037

LJUNGQVIST, F. C., SEIM, A., HUHTAMAA, H. (2021): Climate and society in European history. WIREs Climate Change, 12, 2, e691. https://doi.org/10.1002/wcc.691

LUDDEN, D. (1994): History outside civilisation and the mobility of South Asia. South Asia: Journal of South Asian Studies, 17, 1, 1–23. https://doi.org/10.1080/00856407808722954

LUTERBACHER, J., PFISTER, C. (2015): The year without a summer. Nature Geoscience, 8, 246–248. https://doi.org/10.1038/ngeo2404

LUTERBACHER, J., DIETRICH, D., XOPLAKI, E., GROSJEAN, M., WANNER, H. (2004): European seasonal and annual temperature variability, trends, and extremes since 1500. Science, 303, 5663, 1499–1503. https://doi.org/10.1126/science.1093877

LÜBKEN, U. (2019): Histories of the unprecedented: Climate change, environmental transformations, and displacement in the United States. Open Library of Humanities, 5, 1–25. https://doi.org/10.16995/olh.347

MAHAJAN, P., YANG, D. (2020): Taken by storm: Hurricanes, migrant networks, and US immigration. American Economic Journal: Applied Economics, 12, 250–277. https://doi.org/10.1257/app.20180438

MARETTI, M., TONTODIMAMMA, A., BIERMANN, P. (2019): Environmental and climate migrations: An overview of scientific literature using a bibliometric analysis. International Review of Sociology, 29, 1–17. https://doi.org/10.1080/03906701.2019.1641270

MASSEY, D. S., ARANGO, J., HUGO, G., KOUAOUCI, A., PELLEGRINO, A., TAYLOR, J. E. (1993): Theories of international migration: A review and appraisal. Population & Development Review, 19, 3, 431–466. https://doi.org/10.2307/2938462

MAUELSHAGEN, F. (2010): Klimageschichte der Neuzeit. WBG, Darmstadt.

MAUELSHAGEN, F. (2018): Migration and climate in world history. In: White, S., Pfister, C., Mauelshagen, F., eds.: The Palgrave Handbook of Climate History. Palgrave Macmillan, London, 413–444. https://doi.org/10.1057/978-1-137-43020-5_31

MCLEMAN, R.A. (2006): Migration out of 1930s rural eastern Oklahoma. Great Plains Quarterly, 26, 27–40.

MCLEMAN, R.A. (2014): Climate and Human Migration: Past Experiences, Future Challenges. Cambridge University Press, New York. https://doi.org/10.1017/CBO9781139136938

MCLEMAN, R.A. (2018): Thresholds in climate migration. Population and Environment, 39, 319–338. https://doi.org/10.1007/s11111-017-0290-2

MCLEMAN, R.A., SMIT, B. (2006): Migration as an adaptation to climate change. Climatic Change, 76, 31–53. https://doi.org/10.1007/s10584-005-9000-7

MEEKS, S.C., ANDERSON, D.G. (2013): Drought, subsistence stress, and population dynamics: Assessing Mississippian abandonment of the Vacant Quarter. In: Wingard, J.D., Hayes, S.E., eds.: Soils, Climate, and Society: Archaeological Investigations in Ancient America. University Press of Colorado, Boulder, 61–83.

MEYER, W. (2014): Americans and Their Weather. Oxford University Press, New York.

MICON, J., BIRCH, J. (2024): The materiality and temporality of St. Lawrence Iroquoian incorporation in late precolonial northern Iroquoia. Journal of Anthropological Archaeology, 75, 101600. https://doi.org/10.1016/j.jaa.2024.101600

MURRAY-TORTAROLO, G.N., SALGADO, M.M. (2021): Drought as a driver of Mexico-US migration. Climatic Change, 164, 3, 48. https://doi.org/10.1007/s10584-021-03030-2

NEŠPOR, Z.R. (2005): České migrace 19. a 20. století a jejich dosavadní studium. Soudobé dějiny, 12, 2, 245–284. https://doi.org/10.51134/sod.2005.017

OPPENHEIMER, C. (2003): Climatic, environmental and human consequences of the largest known historic eruption: Tambora volcano (Indonesia) 1815. Progress in Physical Geography, 27, 230–259. https://doi.org/10.1191/0309133303pp379ra

OTTERNESS, P. (2004): Becoming German. The 1709 Palatine Migration to New York. Cornell University Press, Ithaca.

PARKER, G. (2013): Global Crisis: War, Climate Change and Catastrophe in the Seventeenth Century. Yale University Press, New Haven. https://doi.org/10.2307/j.ctt32bksk

PEI, Q., LEE, H.F., ZHANG, D.D. (2018): Long-term association between climate change and agriculturalists' migration in historical China. The Holocene, 28, 2, 208–216. https://doi.org/10.1177/0959683617721325

PEI, Q., LI, G., WINTERHALDER, B.P., LOWMAN, M. (2020): Regional patterns of pastoralist migrations under the push of reduced precipitation in imperial China. Global Ecology and Biogeography, 29, 3, 433–443. https://doi.org/10.1111/geb.13040

PEI, Q., NOWAK, Z., LI, G., XU, C., CHAN, W.K. (2019): The strange flight of the peacock: Farmers' atypical northwesterly migration from central China, 200 BC–1400 AD. Annals of the Association of American Geographers, 109, 5, 1583–1596. https://doi.org/10.1080/24694452.2019.1570837

PEI, Q., QIU, M., LI, G., WU, K.M., MORDECHAI, L., LIU, W., ZHANG, H. (2024): Cost of resilience to climate change: Migration, conflicts, and epidemics in imperial China. Environmental Research Letters, 19, 11, 114025. https://doi.org/10.1088/1748-9326/ad7a8e

PEI, Q., ZHANG, D. (2014): Long-term relationship between climate change and nomadic migration in historical China. Ecology and Society, 19, 2, 68–76. https://doi.org/10.5751/ES-06528-190268

PEI, Q., ZHANG, D.D., LEE, H.F. (2016): Contextualizing human migration in different agro-ecological zones in Ancient China. Quaternary International, 426, 65–74. https://doi.org/10.1016/j.quaint.2015.12.007

PERCH-NIELSEN, L.S., BÄTTIG, M.B., IMBODEN, D. (2008): Exploring the link between climate change and migration. Climatic Change, 91, 375–393. https://doi.org/10.1007/s10584-008-9416-y

PFISTER, C., BRÁZDIL, R. (2006): Social vulnerability to climate in the "Little Ice Age": an example from Central Europe in the early 1770s. Climate of the Past, 2, 2, 115–129. https://doi.org/10.5194/cp-2-115-2006

PFISTER, C., WHITE, S., MAUELSHAGEN, F. (2018): General introduction: Weather, climate, and human history. In: White, S., Pfister, C., Mauelshagen, F. (eds.): The Palgrave Handbook of Climate History. Palgrave Macmillan, London, 1–17. https://doi.org/10.1057/978-1-137-43020-5_1

PICCARRETA, M., CAPOLONGO, D., BOENZI, F. (2004): Trend analysis of precipitation and drought in Basilicata from 1923 to 2000 within a southern Italy context. International Journal of Climatology, 24, 7, 907–922. https://doi.org/10.1002/joc.1038

PIGUET, E. (2013): From "primitive migration" to "climate refugees": The curious fate of the natural environment in migration studies. Annals of the Association of American Geographers, 103, 1, 148–162. https://doi.org/10.1080/00045608.2012.696233

PIGUET, E., KAENZIG, R., GUÉLAT, J. (2018): The uneven geography of research on 'environmental migration'. Population and Environment, 39, 357–383. https://doi.org/10.1007/s11111-018-0296-4

PIGUET, E., PÉCOUD, A., DE GUCHTENEIRE, P. (2011): Migration and climate change: An overview. Refugee Survey Quarterly, 30, 1–23. https://doi.org/10.1093/rsq/hdr006

PÓIRTÉIR, C., ed. (2023): The Great Irish Famine. Mercier Press Ltd, Cork.

POST, J.D. (1977): The Last Great Subsistence Crisis in the Western World. The John Hopkins University Press, Baltimore, London.

REUVENY, R. (2007): Climate change-induced migration and violent conflict. Political Geography, 26, 656–673. https://doi.org/10.1016/j.polgeo.2007.05.001

RICHTER, L. (2019): Semiotik, Physik, Organik: Eine Geschichte des Wissens vom Wetter (1750–1850). Campus Verlag, Frankfurt am Main.

ROGERS, J.D. (2012): Inner Asian states and empires: Theories and synthesis. Journal of Archaeological Research, 20, 3, 205–256. https://doi.org/10.1007/s10814-011-9053-2

ROHLAND, E. (2015): Hurricanes in New Orleans: Disaster migration and adaptation, 1718–1794. In: Sommer, B., ed.: Cultural Dynamics of Climate Change and the Environment in Northern America. Brill, Leiden, 137–158. https://doi.org/10.1163/9789004300712_007
ROHLAND, E. (2018): Adapting to hurricanes. A historical perspective on New Orleans from its foundation to hurricane Katrina, 1718–2005. Wiley Interdisciplinary Reviews: Climate Change, 9, e488. https://doi.org/10.1002/wcc.488
RÜTHER, A. (2018): The role of climate and famine in the medieval Eastern expansion. In: Collet, D., Schuh, M., eds.: Famines During the 'Little Ice Age' (1300–1800): Socionatural Entanglements in Premodern Societies. Springer International Publishing, Cham, 133–147. https://doi.org/10.1007/978-3-319-54337-6_7
SÁNCHEZ ARRESEIGOR, J.J. (2017): Winter is coming: Europe's deep freeze of 1709. National Geographic History January/February, 18–21.
SCHULTE BEERBÜHL, M. (2004): Frühneuzeitliche Flüchtlingshilfe in Großbritannien und das Schicksal der Pfälzer Auswanderer von 1709. In: Beer, M., Dahlmann, eds.: Über die trockene Grenze, über das offene Meer, binneneuropäische und transatlantische Migrationen im 18. und 19. Jahrhundert. Klartext, Essen, 303–328.
SHAHEEN, A. (2011): Living on the margins: A socio-historical profile of the nomads in Pakistan. Pakistan Perspectives, 16, 1, 41–75.
SHEN, S. (2019): Historical and contemporary Korean emigration: A comparative analysis of ten waves of Korean migration. Journal of International Migration and Integration, 20, 1, 31–47. https://doi.org/10.1007/s12134-018-0599-4
SODNOMPILOVA, M.M., NANZATOV, B.Z. (2019): The idea of space among the nomads of Great Steppe. Social Evolution & History, 18, 2, 35–54. https://doi.org/10.30884/seh/2019.02.02
STEINBERG, T. (2006): Acts of God: The Unnatural History of Natural Disaster in America. Oxford University Press, New York.
TAMBORA (2012): The climate and environmental history collaborative research environment, https://tambora.org/ (28. 5. 2025).
TEKIN, S. (2015): Experienced droughts in Western Anatolia between the end of the 19th and the beginning of the 20th centuries. The Journal of Academic Social Science Studies, 33, 329–341. https://doi.org/10.9761/JASSS2841
TIAN, H., YAN, C., XU, L., ZHANG, Z. (2017): Scale-dependent climatic drivers of human epidemics in ancient China. Proceedings of the National Academy of Sciences, 114, 49, 12,970–12,975. https://doi.org/10.1073/pnas.1706470114
TRIGO, R.M., VAQUERO, J.M., ALCOFORADO, M.-J., BARRIENDOS, M., TABORDA, J., GARCÍA-HERRERA, R., LUTERBACHER, J. (2009): Iberia in 1816, the year without a summer. International Journal of Climatology, 29, 99–115. https://doi.org/10.1002/joc.1693
VALLER, V., FRANKE, J., BRUGNARA, Y., SAMAKINWA, E., HAND, R., LUNSTAD, E., BURGDORF, A.-M., LIPFERT, L., FRIEDMAN, A.R., BRÖNNIMANN, S. (2024): ModE-RA: a global monthly paleo-reanalysis of the modern era 1421 to 2008. Scientific Data, 11, 36. https://doi.org/10.1038/s41597-023-02733-8
VIDAL-CORDASCO, M., NUEVO-LÓPEZ, A. (2021): Resilience and vulnerability to climate change in the Greek Dark Ages. Journal of Anthropological Archaeology, 61, 101239. https://doi.org/10.1016/j.jaa.2020.101239
VIELI, I. (2020): Swiss Volkskalender of the 18th and 19th Centuries – A New Source of Climate History? Master Thesis. University of Bern, Bern.
WANG, P.K., LIN, K.-H.E., LIAO, Y.-C., LIAO, H.-M., LIN, Y.-S., HSU, C.-T., HSU, S.-M., WAN, C.-W., LEE, S.-Y., FAN, I.-C., TAN, P.-H., TING., T.-T. (2018): Construction of the REACHES

climate database based on historical documents of China. Scientific Data, 5, 180288. https://doi.org/10.1038/sdata.2018.288

WEINSTEIN, J., PILLAI, V.K. (2015): Demography – The Science of Population. Rowman & Littlefield Publishers, Lanham, MD, London.

WHITE, A.J., STEVENS, L.R., LORENZI, V., MUNOZ, S.E., SCHROEDER, S., CAO, A., BOGDANOVICH, T. (2019): Fecal stanols show simultaneous flooding and seasonal precipitation change correlate with Cahokia's population decline. Proceedings of the National Academy of Sciences, 116, 5461–5466. https://doi.org/10.1073/pnas.1809400116

WHITE, S. (2011): The Climate of Rebellion in the Early Modern Ottoman Empire. Cambridge University Press, New York. https://doi.org/10.1017/CBO9780511844058

WHITE, S. (2014): Cold, drought, and disaster: The Little Ice Age and the Spanish conquest of New Mexico. New Mexico Historical Review, 89, 4, 425–458.

WHITE, S. (2017): A Cold Welcome: The Little Ice Age and Europe's Encounter with North America. Harvard University Press, Cambridge, MA. https://doi.org/10.4159/9780674981331

WHITE, S. (2018): Climate, history, and culture in the United States. WIREs Climate Change, 9, 6, e556. https://doi.org/10.1002/wcc.556

WHITE, S., COLLET, D., ALCOBERRO, A., BARRIENDOS, M., BRÁZDIL, R., CASTELL, P., CHEN, S., DE CONING, C., DEGROOT, D., DOLÁK, L., DÖRING, S., GOROSTIZA, S., KLEEMANN, K., KRAMPE, F., LIN, K.-H., MAUGHAN, N., MELO, N., MOLLOY, B., OGILVIE, A.E.J., PAI, P., PEI, Q., PFISTER, C., SERAFIMOVA, S., ZHANG, D. (2025): Climate, peace, and conflict – past and present: Bridging insights from historical sciences and contemporary research. Ambio, 54, 774–792. https://doi.org/10.1007/s13280-024-02109-1

WHITE, S., PEI, Q. (2020): Attribution of historical societal impacts and adaptations to climate and extreme events: Integrating quantitative and qualitative perspectives. Past Global Changes Magazine, 28, 2, 44–45. https://doi.org/10.22498/pages.28.2.44

WHITE, S., PEI, Q., KLEEMANN, K., DOLÁK, L., HUHTAMAA, H., CAMENISCH, C. (2023): New perspectives on historical climatology. WIREs Climate Change, 14, 1, e808. https://doi.org/10.1002/wcc.808

WICKMAN, T. (2015): "Winters embittered with hardships": Severe cold, Wabanaki power, and English adjustments, 1690–1710. The William and Mary Quarterly, 72, 1, 57–98. https://doi.org/10.5309/willmaryquar.72. 1. 0057

WICKMAN, T. (2018): Narrating Indigenous histories of climate change in the Americas and Pacific. In: White, S., Pfister, C., Mauelshagen, F., eds.: The Palgrave Handbook of Climate History. Palgrave Macmillan, London, 387–411. https://doi.org/10.1057/978-1-137-43020-5_30

WOOD, G.D'A. (2014): Tambora: The Eruption That Changed the World. Princeton University Press, Princeton. https://doi.org/10.2307/j.ctt5vjv5c

XIAO, L.B., FANG, X.Q., YE, Y. (2013): Reclamation and revolt: Social responses in Eastern Inner Mongolia to flood/drought-induced refugees from the North China Plain 1644–1911. Journal of Arid Environments, 88, 9–16. https://doi.org/10.1016/j.jaridenv.2012.07.022

XIAO, L., FANG, X., ZHENG, J., ZHAO, W. (2015): Famine, migration and war: Comparison of climate change impacts and social responses in North China between the late Ming and late Qing dynasties. The Holocene, 25, 6, 900–910. https://doi.org/10.1177/0959683615572851

YE, Y., FANG, X., KHAN, M.A.U. (2012): Migration and reclamation in Northeast China in response to climatic disasters in North China over the past 300 years. Regional Environmental Change, 12, 193–206. https://doi.org/10.1007/s10113-011-0245-6

YUNUSBAYEV, B., METSPALU, M., METSPALU, E., VALEEV, A., LITVINOV, S., VALIEV, R., AKHMETOVA, V., BALANOVSKA, E., BALANOVSKY, O., TURDIKULOVA, S., DALIMOVA, D., NYMADAWA, P., BAHMANIMEHR, A., SAHAKYAN, H., TAMBETS, K., FEDOROVA, S., BARASHKOV, N., KHIDIYATOVA, I., MIHAILOV, E., KHUSAINOVA, R., DAMBA, L., DERENKO, M., MALYARCHUK, B., OSIPOVA, L., VOEVODA, M., YEPISKOPOSYAN, L., KIVISILD, T., KHUSNUTDINOVA, E., VILLEMS, R. (2015): The genetic legacy of the expansion of Turkic-speaking nomads across Eurasia. PLoS Genetics, 11, 4, e1005068. https://doi.org/10.1371/journal.pgen.1005068

ZAPPIA, N.A. (2014): Traders and Raiders: The Indigenous World of the Colorado Basin, 1540–1859. University of North Carolina Press, Chapel Hill. https://doi.org/10.5149/northcarolina/9781469615844.001.0001

ZHANG, D., CHEN, S., GLASER, R., FANG, X. (2025): Drought, hunger, and migration: a retrospect of North China from the mid-18th century to the early 20th century. Geografie, 130, 3, 339–368. https://doi.org/10.37040/geografie.2025.012

ZHANG, D.D., PEI, Q., FRÖHLICH, C., IDE, T. (2019): Does climate change drive violence, conflict and human migration? In: Hulme, M., ed.: Contemporary Climate Change Debates: A Student Primer. Routledge, London, New York, 51–64. https://doi.org/10.4324/9780429446252-5

ZHANG, D.D., PEI, Q., LEE, H.F., ZHANG, J., CHANG, C.Q., LI, B., LI, J., ZHANG, X. (2015): The pulse of imperial China: A quantitative analysis of long-term geopolitical and climatic cycles. Global Ecology and Biogeography, 24, 1, 87–96. https://doi.org/10.1111/geb.12247

ZHANG, D.D., ZHANG, J., LEE, H.F., HE, Y-Q. (2007): Climate change and war frequency in eastern China over the last millennium. Human Ecology, 35, 403–414. https://doi.org/10.1007/s10745-007-9115-8

ZHANG, X., WANG, F., LU, W., LI, S., ZHENG, J. (2022): Gridded reconstruction of the population in the traditional cultivated region of China from 1776 to 1953. Science China Earth Sciences, 65, 365–378. https://doi.org/10.1007/s11430-020-9866-2

ZHENG, J., XIAO, L., FANG, X., HAO, Z., GE, Q., LI, B. (2014): How climate change impacted the collapse of the Ming dynasty. Climatic Change, 127, 2, 169–182. https://doi.org/10.1007/s10584-014-1244-7

ZHU, J.L., CHAU, N., RODEWALD, A.D., GARIP, F. (2024): Weather deviations linked to undocumented migration and return between Mexico and the United States. Proceedings of the National Academy of Sciences, 121, 46, e2400524121. https://doi.org/10.1073/pnas.2400524121

ZILBERSTEIN, A. (2016): A Temperate Empire: Making Climate Change in Early America. Oxford University Press, New York. https://doi.org/10.1093/acprof:oso/9780190206598.001.0001

ZOU, Y., ZHOU, H., CHEN, J., KUANG, Y. (2017): The decline of Pingcheng: Climate change impact, vulnerability and adaptation in the Northern Wei dynasty, China. Journal of Historical Geography, 58, 12–22. https://doi.org/10.1016/j.jhg.2017.08.002

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