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RESEARCH ARTICLE

"Never has there been a flood greater than this": Climate Memories and the Awareness of a Changeable Climate in 17th-century Jiangnan

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From the perspective of collective climate memories, this paper examines how people in the 17th century (1600–1700) in the Jiangnan region of East China related to climate history. This was a century of political and climatic upheavals, affected by a worldwide gradual turn to colder and more unstable weather which included memorable events. Did people have any awareness that the climate was changing around them? I demonstrate that there existed a well-developed tradition of climate history stretching back at least several hundred years. But to speak of a concept of changing climates in Late Imperial China is trickier. A basically stable climate subject only to short-term changes (often linked to the moral actions of rulers and others) was generally assumed in Chinese culture and found various expressions in local customs. Nevertheless, through examining not only the long-standing cultural perceptions of whether it was possible for the climate to change, but also such topics as observed changes in the landscape and fauna, perennial disasters and unprecedented calamities, disasters in ancient history (with all the preceding being possibly expressions of a changeable climate) and individual perceptions, we can attain a more nuanced image of how changeable the climate was in the thoughts of the 17th-century Chinese. In these years we can find those who thought a changing climate impossible, while the Kangxi emperor provides a counter-example of someone who was finely attuned to changes in weather patterns.

十七世紀，全球變冷和天氣不穩定引發過極端氣候事件。本文通過研究對氣候的群體記憶，探討十七世紀中國江南地區的人民對氣候環境的感知。研究顯示，對氣候的探索在明清時期已沉澱了豐富的歷程，但對現代語境中「氣候變化」的認知卻與目下有所不同。根據中國傳統觀念和風俗，氣候總體上比較穩定，若有異象也是暫時的，通常是天子德行所致。然而，通過查閱有關天災人禍的記載、考察自然景觀和生態的變遷、追蹤人們在文化和個體層面的感知，我們更為細緻地探察到十七世紀中國人對「氣候可變性」的理解。儘管當時普遍認為氣候是穩定不變的，但也有人對天氣變化表現出高度敏感，例如康熙皇帝。歷史上的治亂興衰與氣候之間是否也存在一定關聯呢？

Keywords: Natural calamities, climate history, Jiangnan, collective memory, Ming-Qing China

關鍵詞： 自然災害，氣候史，江南地區，集體記憶，明清中國

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When observing a cold spell on Yutai 玉臺 Mountain in 1609, the noted painter, cultural connoisseur, and official Li Rihua 李日華 (1565–1635) from Jiaxing, Zhejiang, wrote in his diary, the *Weishuixuan riji* 味水軒日記 (Diary from the Water-Tasting Gallery), of a great cold spell that it was a frost seen but once in "ten thousand years 萬年" (*Weishuixuan*, 1:1b). In Chinese terms this is to say all eternity. Some three decades later, Niu Ruolin 牛若麟 (*jinshi* 1637), an efficient administrator hailing from Huanggang, Huguang (now in Hebei), was in 1637–1642 the County Magistrate of Wu county, part of Suzhou. This was a time of climatic crisis throughout China and beyond. Contrary to Li, Niu claimed, in the county gazetteer he edited, that, "Since ancient times, the winds and rains have only come in [their] proper order. 自古惟風雨順序。" (*Wuxian zhi*, 11.1a).

Where Li highlights an event known communally as a climate extreme – a possible sign of a change in weather patterns – Niu puts his emphasis on the weather being basically stable. Both men expressed attitudes towards their weather and climate typical of the Late Ming 明 Dynasty (1368–1644) Chinese. But these men with seemingly contrasting attitudes did not live in a time of typical climate. The 17th century formed part of the latter period of the Little Ice Age (c. 1300–1850), when cold and unstable weather affected much of China and the Northern Hemisphere (see e.g. Brook 2017; Li 1999). Many weather events in these harsh years had been unprecedented for generations, while temperatures were the lowest in several hundred years (see e.g. Elvin 2006, 16; Li 1991, 16; Marks 2012, 187; Parker 2013, 125–26). The people alive in these years were thus living through a time of significant climate change. It is therefore an appropriate period to study the communal memories of environmental hazards and trends and whether people at the time were able to perceive and conceptualise a changing climate in China.

This paper will study the collective memories of environmental hazards and disasters related to climate change in the 17th century (1600–1700) in the Jiangnan region of East China. The article's source material is a selection of primarily local gazetteers 方志 (*fangzhi*) supplemented by diaries and historiography. Gazetteers are local histories or descriptions which primarily present the consensual viewpoint of the local elites and administrators; diaries help balance this perception by providing less processed personal opinions. I ultimately have difficulty in arriving at what the common people thought. A hazard is here defined as an environmental threat with the potential to do harm; a disaster is a hazard that ends up actually damaging local society. This distinction is found also in the sources through the concept *zai* 災 (calamity): for example, winds in Haining in 1669 "became a calamity 為災 (*wei zai*)" (*Haining xianzhi*, 12 *shang*:48a). Hazards and disasters are together also termed "climate events". Jiangnan is here defined as the ten Ming- and Qing-era prefectures Yingtian/Jiangning (Nanjing), Changzhou, Suzhou, Zhenjiang, Songjiang, Huzhou, Hangzhou, Jiaxing, Ningbo, and Shaoxing. Collective memory will be considered to be memories shared by a group of people, handed down through generations and influencing their sense of identity (see e.g. Barash 2016; Corning and Schuman 2015; Fuller 2022, 215–38 et al.; Halbwachs and Coser 1992). Collective or communal memory here refers to the localised narratives of the shared memories of specific communities (Fuller 2020, 14).

Following an introduction to how the 17th century Jiangnanese related to their natural environment and its climate, I discuss how they understood climate history through their climatic memory. In particular, I examine possible indications of beliefs that the local climate could change – in this case become colder and more unstable – using a concept roughly analogous to what we today call climate change. The analysis considers the concept of a stable climate; changes in landscape and fauna; events considered abnormal or unprecedented; calamities in ancient history; and individual perspectives. I argue that having lived through generations of calamities, the late-imperial Chinese had developed a sophisticated tradition of climate history, which found expression in a variety of cultural factors. This tradition surely helped people deal with further climatic challenges. Even so, linking it to an awareness of a permanently changed climate quickly becomes problematic, though I find strong individual differences in how changeable the climate was seen to be.

Remembering past floods and droughts

To understand how 17th-century people collectively remembered past environmental hazards and calamities that formed their climate history, I need to understand how their experiences of these differ from our own. Here, I will consider some of the conditions that shaped perceptions of climate, or, more specifically, how environmental hazards were experienced and remembered. Ultimately, this was often through the effects of these climate events on agriculture or people's encounters with natural calamities. Long-term environmental transformations had enabled Jiangnan's inhabitants to attain a rich economy based on agriculture and handicrafts, but they had also made them vulnerable to climatic challenges. Most people experienced weather changes through their engagement in grain farming, cotton growing or silkworm raising, directly or through their tenants. They thus risked suffering from environmental hazards, which thereby shaped life in pre-modern Jiangnan and influenced how its people perceived the climate.

In the gazetteers that are the main sources for this research we often find chapters or sections called "*xiangyi* 祥異 (auspicious omens and strange events)" or "*zaixiang* 災祥 (natural calamities and auspicious omens)"; here I call them "omen lists." These lists recount numerous environmental hazards, in many cases all notable events in the relevant administrative locality, sometimes in great detail; they mirror similar catalogues of disasters in the "treatises on the Five Phases 五行志 (*wuxing zhi*)" that had been part of Chinese historiography since the 1st century AD *Han Shu* 漢書 (Book of Han) (*Han shu*, 1315–1522). Introductory texts or end-commentaries are typically appended to many such lists to explain their purpose and compilation; I term them "essays". These texts make it clear that a key reason for recording environmental hazards was to learn from past climate events so as to better handle future ones (e.g. *Haiyan xian tujing*, 16.1a). Next, diaries often contain records of daily weather conditions and how they affected individuals and families (e.g. *Jiaxing rizhu*).

The omen lists and diaries enable us to reconstruct the sequence of environmental hazards and disasters of various kinds that happened every few years in most localities. We have reason to believe that

the contents of the omen lists in many cases formed part of the history and memory of local communities. While many calamities have not been allowed to play a major role in national historiography, in China or elsewhere (Fuller 2022, 294), the way they were recorded, sometimes in detail, by individuals and societies underlines their importance for local collective and individual memories. The diaries and omen lists often include the extent and destructive effects of particular calamities, relief efforts, and grain yields and prices. These things were vital for the people's survival and local revenue while most state funds came from agricultural taxes. Though lacking instruments to quantify weather conditions, we also see that people often compared different historical floods, such as the ones in 1573 and 1629 (*Shanyin xianzhi*, 9.7b-8a). They sometimes measured water levels in feet 尺 (*chi*) and inches 寸 (*cun*) or with flood markers sometimes said to date back hundreds of years – in the case of a 1690 flood, to the Song 宋 (960–1279) and Yuan 元 (1271–1368) dynasties (*Yuyao zhi*, 11.7b).

The question was not if a hazard would strike, but when and how frequent and severe it would be; even so, climate fears were culturally contingent (Hulme 2017, 81–91). Flood and droughts were the most common and most severe hazards that threatened the people's livelihood. They were claimed to amount together to a majority of all hazards and were sometimes used in general terms to represent all environmental challenges (e.g. *Renhe xianzhi*, 25.1a-1b; *Zhenyang xianzhi*, 14.5b). On the low-lying Jiangnan plains, the threat from the sea and the great rivers was especially great. Both kinds of hazard frequently became calamities that threatened the lives and livelihoods of the people – as expressed in the frequent losses of homes, grain, and lives. Extreme heat and dangerous cold also imperilled the people's livelihoods. Severe cold appears to have been more dramatic than scorching heat, being recorded more frequently, but both were dangerous to people in their own way. This was the case, for example, for a 1624 heatwave and a 1650 snowfall (*Dantu xianzhi*, 10.109b; *Zhili Taicang zhouzhi*, 58.5b). Like drought and floods, temperature is closely connected to crop yields, with lower temperatures causing lean years, as happened, for example, with a cold spell and a flood in 1651 (*Wujiang xianzhi*, 40.23a). The essays in the 1671 Sheng county gazetteer, when claiming that floods were more dangerous and droughts easier to handle, and in the 1721 Qiantang county gazetteer, when stressing droughts as more serious than rains, furthermore make it clear that the danger of a particular hazard depended on the local geography (1671 *Shengxian zhi*, 3.52b; 1721 *Qiantang xianzhi*, 12: *zaixiang* 1b).

Moreover, hazards were often seen as interrelated by the gazetteer writers. Thus, for instance, crop failures were linked with foreign attacks (1671 *Shengxian zhi*, 3.52b). Failed harvests are in turn most often caused by natural hazards, which therefore here are seen as the natural cause of wars and unrest. Still, many disasters were also caused by human agency or mismanagement or were otherwise exacerbated by these factors. The 17th-century Jiangnanese, then, mostly experienced climate change through a series of environmental hazards. Their perception of these events was rooted in traditional views of nature. Especially important were the concepts of "correlative thinking" and (following Mark Elvin) "moral meteorology" (see e.g. Bodde 1991, 97–122; Elvin 1998; Elvin 2006, 413–53; Graham 1986). Following these ideas, environmental hazards were conceptualised as omens for events in human society (see e.g. Eberhard 1957; Lippiello 2011; Raphals 2013; Smith 2008). They were not always interpreted as such, however; previous research has shown that the great number of calamities during the late Ming was in fact rarely seen in correlation with the dynastic transition (see e.g. Agøy 2021,

167–184; Brook 2010, 52–53; 47; Elman 2015, 69; Swope 2014, 213–214). Thus, the relevance of the otherwise key concepts here appears lessened.

Did unstable 17th-century weather influence beliefs about whether the climate was changeable or stable? I will explore this through the following discussion on whether living through numerous hazards enabled 17th-century people to be aware that their climate was getting colder and more unstable and whether some 17th-century events were seen as unprecedented. To do this, I need to seek out various indirect indications of a concept of a changeable climate in the source material. I will first see which references to a view of a constant climate are found in the texts before I go through the different aspects that potentially indicate an alternative view. Finally, I address whether there existed an awareness that the climate could change.

Constancy and change

Based on the fundamental view of a stable and "constant 常 (*chang*)" climate in Chinese thinking, I assume that the remembered environmental hazards referred to above were seen as exceptions from which the weather would revert once the event had passed. Indeed, the stability of the natural world was even opposed to the high irregularity of human affairs (Bodde 1991, 338; Henderson 2010, 185–86). There must have been an unstated concept of a "normal" condition with which unusual events were contrasted, even if this condition itself was typically left out of gazetteers (Zhang, ed. 1996, 201). The perceived "normalcy" of the climate is reflected in various ways in traditional Chinese culture. Firstly, China had a weather prognostication tradition, often called "*nongzhan* 農占 (farmers' prognostications)", consisting of long series of localised weather-sayings. These prognostications are sometimes included in the gazetteer chapters on "*fengsu* 風俗 (local customs)" (e.g. 1609 *Qiantang xianzhi, jishi*.1a-6b). Such weather-rules rely on a predictable climate, though with room for the divinations to fail at times.[1] Secondly, there is the prominence of the twenty-four solar terms 節氣 (*jieqi*) into which the solar year was divided and which hint at how a typical year's weather conditions should unfold (Hong and Liu 2006, 162–63). They are sometimes highlighted along with more detailed descriptions of local "climates 氣候 (*qihou*)" in gazetteers, typically presented through the unfolding of the year's weather conditions (e.g. 1751 *Xincheng xianzhi*, 7.3b-5a). Solar term names like *dashu* 大暑 (in July), "great heat", and *shuangjiang* 霜降 (in October), "frost descends", refer to what supposedly happens at these times. Their use in different climatic zones across China probably diminished this aspect, though the basic thinking remained.

The *fengsu* sections contain further indications of the notion of a stable climate. An example is found in the 1641 Jiangyin gazetteer, when recounting the characteristics of the "nine nines 九九 (*jiu jiu*)", the eighty-one days after the solstice (1641 *Jiangyin xianzhi, jingyezhi.fengsu* 10a). In the third of these nine-day periods, "the frozen water is sweet like honey 冰水甜如蜜", while in the sixth, "[one] enjoys

[1] For weather prognostication, see e.g. Agøy 2023; Robinson 2021; Hong and Liu 2006, 98–100. For a now dated Chinese study including a comprehensive list of weather sayings, identified by province (not county or prefecture), see Xiong, ed., 1991.

the cool entering Buddhist temples 乘涼入佛寺" (1641 *Jiangyin xianzhi*, *jingyezhi.fengsu* 10a; see also Hong and Liu 2006, 165–66). Another could be the groups of three flowers supposed to bloom after each solar term: "The three [flowers] after the *dahan* 大寒 day (January 20) are 'auspicious apricots 瑞杏 (*ruixing*, *Prunus armeniaca*)', orchids 蘭花 (*lanhua*, *Orchidaceae*), and 'mountain alum 山礬 (*shanfan*, *Symplocaceae*)' 大寒三後，瑞杏、蘭花、山礬" (1641 *Jiangyin xianzhi*, *jingyezhi.fengsu* 10a; see also Hong and Liu 2006, 164). The exact plant names are hard to identify. We remember how the "Great Plan 洪範 (*Hongfan*)" chapter in the *Shangshu* 尚書 (*Book of Documents*) stresses the need for a balance of the basic climatic factors in order for crops to mature properly (Legge, *Shoo King*, 2:339–40).

Such a belief is also seen on a conceptual level in the essays. Here in the essay commentary in the Jiaxing county gazetteer: "Following the canons [all] is normal and [things] cannot be strange. 由典常無可異者。" (*Jiaxing xianzhi*, 16.45a). Or again in reference to the "regular behaviour of Heaven and human affairs 天時、人事" in the 1744 Zhenyang county gazetteer, which here would include the weather (*Zhenyang xianzhi*, 14.1a). However, these essays often refer not only to constants, but also to changes: here unambiguously in the 1742 Sheng county gazetteer: "If they, the Way of Heaven and human affairs, have constants then they must have changes. 天道人事，有其常必有其變。" (1742 *Shengxian zhi*, 14.1a). "Changes in Heaven" can refer to climate-related changes in nature, and we can find more references to this. Similarly, we have this quote from the Jingjiang county gazetteer: "Not esteeming the [astronomical] prognostications, [one] thus [needs] help to crucially examine and retrieve the changes of the *qi*. 非尚占候，所以用助修省、挽回氣化也。" (*Jingjiang xianzhi*, 5.1a). The changing *qi* 氣 (literally "breath" or "air", the "cosmic energy" that characterises everything and flows through humans and nature) here includes the changeable weather; we know that changes in *qi*, through a changing balance of its *yin* 陰 and *yang* 陽 aspects, were thought to impact the weather (Elvin 1998, 213). *Qi* can also have other meanings, however.

There existed moreover a concept of an ideal, stable climate that would appear once human morality was in order. This was a climatic, social, and political ideal, related to Elvin's moral meteorology (e.g. *Wuxi-Jinkui xianzhi*, 31.12a). Moral meteorology itself was widely accepted in gazetteer essays, though much more rarely preferred to in concrete cases (Agøy 2021, 161, 374–384). Richard Smith attributes this concept, which he claims was contested at the time, in regard to the emperor's morality and its ability to stop disasters, to the influential philosopher Zhu Xi 朱熹 (1130–1200) (Smith 1991, 66). The descriptions of the year found in gazetteers, as seen above, refer to the basically harmonious climatic conditions thought to exist. We also see this idea, for example, in the 1683 Dantu county gazetteer, when it tells us about "the *qilin* 麟鳳 and phoenixes roving by daytime in the grassy fields outside the cities 麟鳳日遊郊藪" (*Dantu xianzhi*, 10.99a); see also the Wu county gazetteer editor's belief that "winds and rains have only come in [their] proper order", as quoted in the first paragraph. These mythical creatures were among the good omens that would manifest themselves once things were in proper order.

The harmony of *qi* and *yin-yang* is often referred to as what will cause this ideal state, with prosperous agriculture and husbandry (e.g. *Zhenjiang fuzhi*, 43.1a). A pleasant climate was thus also implied in a poem on the occasion of County Magistrate of Haining Xu Sanli's 許三禮 (1625–1691) prayers for rain in 1675 when it concludes by saying: "[And so] the world returns to benevolence. 天下歸仁。" (*Haining xianzhi*, 12 *shang*.52a). This ideal I assume to have been more or less present in local society at any time during the 17th century. Before the 17th-century climate worsened, moreover, the magistrate of Jiading county, Han Jun 韓浚 (*jinshi* 1598), in a 1605 gazetteer stressed the timeliness of the "winds and rain 風雨 (*fengyu*)" in Jiading in recent years (1605 *Jiading xianzhi*, 17.19a). This we can relate to the relative affluence of the late Wanli 萬曆 period (1573–1620). Some people also insisted on seeing good signs during politically sensitive years in the late 1600s, after the establishment of the Qing dynasty. We have, for example, records of an excellent wheat harvest right after Kangxi's 康熙 (1654–1722, ruled from 1661) accession in 1662 (1744 *Jiangyin xianzhi*, 24.12a). But as hazards were still recorded every few years there are few indicators that anyone thought they were living under these idealised conditions. On the other hand, the co-occurrence during the last years of the Ming of poor climate conditions with one of China's most dramatic political crises was perceived well enough by people at the time.

We find further indications in certain essays of a belief that through proper virtue, understanding, or preparations, disasters could be brought fully to an end. This again relates to moral meteorology. An example found in the Xiangshan county gazetteer reads: "When the rules and regulations to exhort the generations to come are cautiously ordered [there can be] the good fortune of having no floods here. 謹次規制，以詔來者，幸無濫焉。" (*Xiangshan xianzhi*, 10.10b). This would mean an end to calamities, but perhaps not hazards, in Xiangshan. In a similar case, the Gui'an county gazetteer claims that the ancient sage kings "had a way of turning disasters into auspicious omens 有反災為祥之法 (*Gui'an xianzhi*, 12.1a)," thus indicating that proper government would prevent calamities from occurring.

In summary, we can discern a belief in a basically stable climate – though it often appears next to formalised phrases about the "changes" in the factors determining the climate. However, it is not implied that these changes would be permanent or long-lasting – something unlikely, unless the basic relationship between Heaven and humanity somehow changed. The references to them therefore do not by themselves make an argument for a concept of a changeable climate, particularly when keeping in mind the belief in a basically stable climate. An exception is the notion that disasters can be put to an end, if only the people's moral character is proper. This was maybe an unattainable ideal, though it implies a clearly changed climate. But this may have more to do with disaster preparations than with improving the weather through moral rectification.

Changing landscapes and fauna

Within the fundamentally constant climate referred to above, the idea of a changing climate could potentially originate from keen observations of changing landscapes or from the appearance or disappearance of species. There are some references to this, such as when the Xiangshan gazetteer mentions in the introduction to its omen list how the "changes in the hills and valleys 陵穀之變遷" are observed and corrected in omen records (*Xiangshan xianzhi*, 10.1a; see also: *Xiaofeng xianzhi*, 8.10a). Little of this in fact follows in the chapter, however. The 1609 Qiantang county gazetteer is clearer when it reads: "When Hang[zhou] became a region [prefecture] the mountains and swamps each [amounted to] one half. 杭之為郡，山澤相半。" (1609 *Qiantang xianzhi*, 12. *zaixiang* 1b). Here, the contrast with the present mostly cultivated or urban landscape must have been obvious to the book's readers.

Besides landscapes, changes in the fauna can also reflect new climatic conditions. While no major species is known to have gone extinct during this period, we have for example an invasion of a previously unknown crab species in 1674, as recorded in the Zhenyang gazetteer (*Zhenyang xianzhi*, 14.7a). Robert Marks previously examined pre-modern Chinese concepts of extinction (Marks 1998, 309–32). The surges and falls in the rat population come into the same category, and we would today connect these with changes in the rats' living conditions due to climate. A favourite among gazetteer editors was the image in which "a crowd of rats crossed the [Yangzi] River. [They] crossed [the river] each with the tails of another [rat] in [its] mouth 有羣鼠渡江，相續啣尾而渡," that is, in close succession (this happened in 1614: *Gaochun xianzhi*, 12 *xia*:4b; in 1616: *Guangxu Wujin-Yanghu xianzhi*, 29.6b; in 1617: *Luhe xianzhi*, 8.4b; in 1619: *Jiangning fuzhi*, 29:24a; in 1644: *Dantu xianzhi*, 10:111a). Moreover, the 1673 Changxing county gazetteer includes a long discussion of the "rice rat 稻鼠 (*daoshu*) calamity" in the year 1659 (1673 *Changxing xianzhi*, 4.63b–64a). Rats were usually recorded as having come to Jiangnan from north of the Yangzi, though once, in 1609, they also came all the way from Huguang (Hubei and Hunan), upriver to the west, in search of food (*Jiangning fuzhi*, 29.23b). We can note a Confucian tendency in the texts to refer to ancient classical books to explain strange animals. When it comes to the rats in 1659, we are referred to the 4th century BC *Guoyu* 國語 (*Discourses of the States*) (1673, *Changxing xianzhi*, 4.63b). In another case, when a strange tiger-eating animal appeared in 1653, the gazetteer editors quoted the ancient dictionary *Erya* 爾雅 to explain it (1688 *Hangzhou fuzhi*, 1.39b).

Tiger attacks also found their way into omen lists, such as the attacks by a group of tigers in 1673 mentioned in the Gaochun county gazetteer (*Gaochun xianzhi*, 20.8a). Marks has argued that tiger attacks reflect cooling climate conditions which forced humans to retreat and thereby enabled forests – the tigers' natural habitat – to advance (see Marks 1998, 161 et al.). But the cases of this are not as frequent in 17th-century East China as they are in Marks' study on Lingnan 嶺南 (Guangdong and Guangxi). Ultimately, there is no comment in these gazetteer records connecting changing landscapes or unfamiliar animals appearing to a changing climate. Instead, humans seem to have been held to account for changing environments (e.g. 1778 *Hangzhou fuzhi*, 55.1a). Thus, the changing landscapes

and faunas in the records are not by themselves proof of a 17th-century perception of changing climatic conditions.

Years of disasters and unprecedented calamities

Beyond changing landscapes and new species, was there any awareness of disasters happening over consecutive years, which implies rare climatic conditions? On this point, we can find a number of comments in the sources, such as the following entry from January 7, 1655, in the draft gazetteer for Jiangsu, where major climate events are included in the general telling of history: "Weaving was suspended for two years due to the successive years of floods and droughts in [Jiang]ning, Su[zhou], and other places and the extreme misery of the common people. 以寧、蘇等處，連年水旱，小民困苦已極，暫停織造二年。" (*Jiangsu sheng tongzhi gao*, 39.627). An entry from 1673 in the veritable records similarly implies that the area suffered to an unusual extent at that time: "[There] have been successive years of calamities and dearth in the six prefectures Su[zhou], Song[jiang], Chang[zhou], Zhen[jiang], Huai[an], and Yang[zhou] in Jiangnan. The people live in misery, which is different from other places. 江南蘇、松、常、鎮、淮、揚六府，連年災荒，民生困苦，與他處不同。" (*Shengxu Ren huangdi shilu*, 42.3160).

The unusual frequency of hazards, an indication of a changing climate, is sometimes also referred to.[2] In the Dinghai county gazetteer, we thus find reference to continuing typhoon disasters from 1628 to 1633 (*Dinghai xianzhi*, 1. 6a). Many of the challenges met by people in the 17th century had in fact been unequalled in their severity for centuries. Something similar – in an otherwise cold period – was recorded in the Wu gazetteer, when four years without snow (itself implying cold conditions) was considered a strange, but auspicious, phenomenon (*Wuxian zhi*, 11.49b). Regarding a longer timespan, the Renhe county gazetteer commented, following a great river tide in 1646, that tides were great through the next 40 years (*Renhe xianzhi*, 25.31a). The local Qiantang River is famous for its tidal bores (Needham and Wang 1956, 363).

Most omen lists in gazetteers date back to antiquity, covering 1500 years or more. But they become more detailed around the more recent centuries, often starting with the Ming; some have no pre-Ming records in these chapters. The earliest gazetteers generally also date back to this era (see also Dennis 2015, 22–48, 120). Thus, the Tongxiang county gazetteer and the Xiangshan gazetteer record respectively 20 and three years with hazards pre-1500, but 74 and 32 years with events in the 16th and 17th centuries (*Tongxiang xianzhi, renmin bu*.59a–64b; *Xiangshan xianzhi*, 10.1a–8a). We can thereby assume that the omen lists encompassed generally mostly accurate records of the previous several hundred years, from about the middle Ming period, growing increasingly thorough over time. From the omen lists in gazetteers and historiography, then, both the court and local scholars often had at their disposal detailed historical weather reports. It therefore should have been possible for them, had

[2] See however Ju 2011, where it is claimed that the Late Ming saw fewer disasters than the early and middle periods of the dynasty. I was made aware of this research in Swope 2014, 214.

they been interested in doing so, to analyse the main trends and find that the rate and extent of calamities, as well as average harvests, as expressions of climate, had differed in various periods. Modern scholars reconstructing historical climate conditions have done just this, one of the first being Zhu Kezhen 竺可楨 in the early 20th century (e.g. Zhang, ed., 1996, 3). Excluding moralistic accounts of dynastic transitions and poor rulers, it seems that, as we saw above, such analyses were done infrequently and covered shorter timespans, mostly only several years (as opposed to decades or centuries) for recurring crises. They were often undertaken in order to make policy decisions rather than for the sake of studying the climate itself.

Next to the frequency of environmental challenges, the severity of individual hazards is often highlighted, not only through frequent vivid descriptions (or through measures of floods), but also in more abstract comparative terms. Across 17th-century Jiangnan, there were certain climate events in particular that impressed a great many people as being extraordinary or even unprecedented. One example is a case of great snowfalls found in the Shaoxing prefectural gazetteer, which claimed that, "[This] had never been heard of since ancient times in the lands of Yue. 越地古未之聞。" (*Shaoxing fuzhi*, 7.43b). Yue 越 is an old name for the Zhejiang region. In the commentary to the entry on the heavy snowfalls the same year in the 1749 Changxing gazetteer's omen list, we find a poem by Zhu Sheng 朱升 (1299–1370), where the scholar considered how the environmental hazards he had witnessed "will form part of national history 占國史" (1749 *Changxing xianzhi*, 10.33b). While the poem's initial context was different from that of the 17th century, its presence implies the editors' sense that the extreme climate events one lived through could eventually be recorded as "omens" – that they were great, even era-defining events in the greater span of history. In this regard, we also remember Li Rihua's comment on a "once-in-ten-thousand-years frost" from the introduction to this article.

A particularly notable case was the great flood in the summer of 1608, which affected dozens of counties (Agøy 2021, 357). Numerous gazetteers describe this flood in great detail. The long memory of it is seen also in later floods being described as similar to it (as in Jiading in 1670: 1673 *Jiading xianzhi*, 3. *xiangyi* 14a) or even greater (as in Shangyuan in 1663: *Shangyuan xianzhi*, 13.4b). Not only were other floods compared to the 1608 flood, but the 1721 Qiantang county gazetteer highlighted the extreme severity of the 1641 drought by stating that, "Compared to the calamity in the *wushen* year of the Wanli era [1608], [this calamity] was even more extreme here. 較萬曆戊申之災，為尤甚焉。" (1721 *Qiantang xianzhi*, 12. *zaixiang* 9a). Even more, according to the 1609 Qiantang gazetteer, the 1611 Chongde gazetteer, and the veritable records: "This disaster was [of a kind] not seen for a full two hundred years." (*Chongde xianzhi*, 11.6a and *Shenzong Xian huangdi shilu*, *juan* 447, 5a: "蓋二百年來，未有之災;" 1609 *Qiantang xianzhi*, *jishi*.6b: "蓋二百年來，未見此災。"). The same claim was made in Grand Secretary Wen Tiren's 溫體仁 (1573–1633) report on the 1628 Zhejiang floods (*Mingji beilüe*, 4.97). In the Qiantang source, discussing the 1608 flood in more detail, the experience of local fishermen is appealed to as proof that for several centuries there had been no comparable flood (1609 *Qiantang xianzhi*, *jishi*.6b).

In a similar vein, according to the 1751 gazetteer for Kunshan and Xinyang, in the case of the famine that followed the great flood: "This famine was [the kind of which one] does not have in a hundred

years. 災荒為百年所無。" (*Kunshan-Xinyang hezhi*, 37.4a). Two centuries would take us back to about the end of the Yuan 元 era (1271–1368), which in later ages was seen as a time of frequent natural disasters (Bodde 1991, 245, 247). The editors of the Qiantang (and surely also the Chongde) gazetteers themselves experienced the calamity (1609 *Qiantang xianzhi*, *jishi*.6b). The comment similarly placed at the end of the record of the 1608 calamity in the 1778 Hangzhou prefectural gazetteer was even more daring in its statement that, "Never has [there] been a flood calamity greater than this. 水災莫甚於此。" (1778 *Hangzhou fuzhi*, 56.20a). The use of flood markers, as seen above, gives credibility to such claims. This and other 17th-century climatic hazards were clearly understood by people at the time as being very unusual. We can find similar claims about the unprecedented scale of the 1641–42 drought and crisis in gazetteers and diaries (e.g. the 1641 entry in *Wuxian zhi*, 11.53a, and a 1642 comment in *Yiyou biji*, 8).

The records of these calamities highlight the shared memories of unusual hardships and a wish to pass them on to future generations. Doubts were expressed as to whether posterity would truly comprehend these events – and thereby also a belief that future generations would not experience the climate in an equally dramatic way. Moreover, as shown by Timothy Brook, the frequent references to grain prices (leaving aside the issue of obvious inflation) suggest an awareness of which hazards had the most dramatic consequences for the people (Brook 2017, 35, 45–46).[3] For example, following the Jingjiang gazetteer, in 1652 "a bushel (*dan*) of rice [cost] four [silver] taels (*liang*) 米石錢四兩," (*Jingjiang xianzhi*, 9.3b) which was many times the average price at the time, and certainly a price too high for many to afford.

Examples of such unusual disasters were naturally also present on the timescales of individuals. The Shanghai writer Ye Mengzhu 葉夢珠 thus wrote: "Of the extremity of damage from natural calamities that I have seen, none could compare to the drought of the fourteenth year of the Chongzhen 崇禎 era [1641], the *xinsi* year. 以予所見災害之甚者，莫如崇禎十四年辛巳之旱。" (*Yueshi bian*, 1.14). In Yao Tinglin's 姚廷遴 (1628–after 1697) writings, also from Shanghai, we hear of how before 1641: "[There] have all along never been locusts on our lands, but this year [there] were very many [of them]. When flying [they] covered the sky, when [they] stopped [from their flight] [they] filled the fields.我地向來無蝗，其年甚多，飛則蔽天，止則盈野" (*Linian ji*, 50). Again in 1671: "All along the winds and tide have never been this great. 從來風潮未有如此之大者。" (*Linian ji*, 100). Moreover, Yao wrote in 1690 that he had experienced the kind of great cold felt that year only three times before in his life – in 1655, 1681, and 1683 (*Linian ji*, 138).

These passages referring to the unusually frequent and great calamities that can be tied to climate change formed a historical tradition of extreme climate events that stretched back several generations. But while unusual to the people who recorded them, the recounting of these environmental hazards does not imply any belief in a permanently changed climate, or that stable conditions would not return. They also did not lead to further studies on the past climate trends visible from these materials.

[3] See also Timothy Brook's research on grain prices: Brook 2023. . For grain prices, see also Agøy 2021, 250-253; Wang 1989; Wang 1992.

Disasters in ancient history

The perspective in the last section was of climate memories dating back for centuries, or roughly to the earliest period for which the Jiangnanese gazetteers have detailed climate event records. While going beyond this period thus means leaving reliable climate history behind, it does not mean an end to climatic memory. Though more infrequent than Ming-Qing events, numerous gazetteers record disasters from practically all of imperial Chinese history (e.g. from 73 BC onwards in 1693 *Xincheng xianzhi*, 10.1a). Moreover, the dramatic climate disasters that supposedly took place in ancient history and legend were seen as relevant. Appearing first in the 1670s and then in several subsequent essays, nine references are found in gazetteer essays to the legendary ruler Yao 堯 (traditional dates c. 2356–2255 BC) and to Tang 湯 (ruled c. 1658–1629 BC), founder of the ancient Shang 商 Dynasty (c. 17th century-1046 BC) (*Chongxiu Chongming xianzhi*, 7.1a; *Jiangning xianzhi*, 12:1a; 1744 *Jiangyin xianzhi*, 24:25b; *Lin'an xianzhi*, 4:*xiangyi* 1a; *Pinghu xianzhi*, 10:*zaixiang* 9b; *Shangyuan xianzhi*, 13:17a; *Tongxiang xianzhi*, *renmin bu*.59a; *Xiaofeng xianzhi*, 8.1a; 1693 *Xincheng xianzhi*, 10.1a). Yao was famous for handling a flood, Tang a drought, here neatly summarised: "Yao had nine years of flood and Tang had seven years of drought. 堯有九年之水，湯有七年之旱。" (*Lin'an xianzhi*, 4: *xiangyi* 1a; *Shangyuan xianzhi*, 13:17a).

There are also three references to other ancient sage rulers in such essays (*Gui'an xianzhi*, 3.30a; *Shimen xianzhi*, 53.54a; *Zhenjiang fuzhi*, 43.1a–1b). The effect of these references is to create parallels between ancient history and current events. Originally such ancient legends, including those of the legendary hero Hou Yi 後羿 and the ruler Yu the Great 大禹 (*Da Yu*, traditional dates c. 2123–2025 BC), may have been memories of dramatic flood and drought conditions in early history (Hong and Liu 2006, 119). As a part of this ancient tradition, managing climatic challenges to imperial rule proved one's fitness as a ruler (Dodgen 2011, 1), a principle which could here be applied to the local magistrates who sponsored the gazetteer compilers. Yu's claim to kingship thus was his management of hydraulic systems (see e.g. Wittfogel 1967, 27). According to Benjamin Elman, the appeals to these ancient rulers were meant to discourage resignation in the face of calamity as unacceptable for orthodox scholars (Elman 2015, 68). What mattered was not the supernatural origins of disasters, but the concrete policies taken to deal with them (ibid.). This link between ancient and contemporary events is clearly seen in the Tongxiang gazetteer: "[Natural calamities] not only descend [now], but so [it] was that the drought and flood of Yao and Tang also came during the Age of Sages. 不徒降，然堯湯旱潦，亦來聖世。" (*Tongxiang xianzhi*, *renmin bu*.59a).

The references to these ancient rulers indicate, beyond their moralistic role, that late-imperial people could conceive of gigantic calamities that supposedly had taken place in the remote past, signifying different climate conditions. This indicates a climate memory stretching through known history, as we also see reflected in gazetteer omen lists and in historiography. But again, this did not necessarily imply a belief that these calamities could occur in their own time or would be permanent. The point was rather that the handling of disasters depended on human agency.

Honouring past heroes.
Left: Emperor Yao by the 13th-century painter Ma Lin 馬麟 (Wikimedia Commons).
Right: Yu the Great's tomb on Mount Kuaiji (photo by author).

From the Kangxi emperor to Magistrate Chen

So far, the references to an awareness of a changeable climate have been vague at best. The most direct references are found not in gazetteers and their shared communal climate history but in the great span of individuals' awareness of climatic variations. Marks draws our attention to certain passages from none other than the Kangxi emperor (Marks 1998, 195, 206–207). Kangxi was born in what was likely the coldest year in Jiangnan in the 17th century and played a key role in China's recovery from the crisis (Agøy 2021, 150). An example relating to Jiangnan is when the emperor, in a 1670 edict, from the period when the weather had begun to turn cold again after a more benign decade in the 1650s (Parker 2013, 73; see also Agøy 2021, 347–350), stated that, "This year's floods in Jiangnan are especially large, and are different from [those of] former years. 今年江南水災甚大，比往年不同。" (*Shengzu Ren huangdi shilu*, 30.3067). On another occasion in 1717, he was more direct when writing that, in the translation used by Marks, "The climate has changed" (Marks 1998, 195; in the original, *Shengzu Ren huangdi shilu*, 5613 (*juan* 272): "天時地氣，亦有轉移。"). Reference is made in the original context to Jiangnan, but also to Shandong, Henan, and many other places. Unusual rainfall patterns, the spread of snowfalls, and the retreat of miasmas causing disease (malaria) are all referred to. This finding was borrowed and given a wider audience by Geoffrey Parker in his great

work on the 17th-century General Crisis, when discussing the topic of climate change awareness in history (Parker 2008, 1063–64; Parker 2013, 8).

Marks takes such references as an indication of the emperor's awareness that the climate was changing (Marks 1998, 195). But that may not be the only possible explanation for Kangxi's remarks. Kangxi was exceptional in that he took a personal interest in climate matters (Parker 2013, 8). He reached his conclusion only after having closely studied the regional weather reports he ordered from all over China (Marks 1998, 195; Parker 2013, 8; see also Smith 1991, 66). Kangxi considered such systematic reports from each administrative locality essential in promoting political stability in China, keeping in mind the role of harvest failures in the Ming's fall (Parker 2013, 627–628).[4] While during the Ming provincial officials had also included "rain reports" in their regular communications with the capital, the government had paid little attention to them (Parker 2013, 62). Contrary to this, Kangxi made even his bannermen and bondservants submit reports on weather conditions – especially from the economically important Jiangnan – to supplement the official weather reports (Parker 2013, 62). But due to the extreme scarcity of these comments, which did not extend much beyond Kangxi's own unique circumstances, and a lack of more detailed discussions, we can hardly take them as an indicator of a widespread awareness of a changing climate in 17th-century China.

Opposed to this, there were also those who denied, sometimes vehemently, that anything was off-kilter with the weather, exhibiting a particularly strong belief in an unchanging climate. Climates change gradually and it is possible for people to live their whole lives during a period of change, such as a cold or unstable cycle (Brook 2017, 58); in such cases people may not have been able to notice it. One example is found in Yao Tinglin's diary, during a deadly 1696 flood that he describes in dramatic terms (*Linian ji*, 153). The County Magistrate of Shanghai, Chen Shan 陳善 (in office 1693–97), did not take the disaster seriously – with Yao's judgement attached at the end: "County Magistrate Chen said, '[This] is nothing more than winds and rain.' [One] could see [from this] the harsh side of County Magistrate Chen. 陳知縣雲：「不過風雨罷了。」可見陳知縣殘忍處。" (*Linian ji*, 153). This shows us how in 17th-century China people held widely different beliefs on how changeable and dangerous the climate could be. On this note, with those seemingly aware of a changeable climate next to those who denied calamities, I am ready for my conclusion.

Conclusion

In what terms can we phrase the historical memories of the long and dramatic series of climate-change-related environmental hazards and calamities in 17th-century Jiangnan? They certainly made climatic challenges part of local history, doing so also in order to prepare for future climatic challenges. I went through a range of different factors that could indicate an awareness of a changeable climate. Ultimately, none of these can be used to present a strong argument that people thought it was possible for the climate to change permanently. Still, they tell us much about how people related to climate

[4] For weather recording during the Qing, see Hong and Liu 2006, 81, 137, 140; Zhang and Wang 1988, 755. See also *Shengzu Ren huangdi shilu*, 5568 (*juan* 267), for the 1716 edict.–

history as part of their collective memory. It is clear that for most people, seeing the climate as fundamentally stable (if not always harmonious) was a key part of their world-view. Even so, people also cultivated and transmitted concrete climate memories stretching back hundreds of years and eventually into mythical prehistory, taking note of unprecedented calamities and of disasters that happened over consecutive years. In doing this, they surely hoped to learn from past experiences of handling the climate to counter future calamities. Moreover, they also acutely observed changes in local landscapes, including the inroads of invasive species.

Ultimately, people differed in their attitudes to past climates and climatic happenings. It is likely that this depended largely on which weather events they had personally experienced, though no doubt personality also played a role. Only a few individuals attained an awareness that the climate could change over time, and probably more fully denied any such idea. The Kangxi emperor may have been one of these few, however, as he approached an awareness of a changing climate through his systematic study of weather reports from across the country. He also personally lived through much of the cold century. On the other hand, the way some gazetteer writers insisted on explaining things using ancient books shows that they were caught firmly in the nets of Confucian orthodoxy. It is my hope that through the above survey of how people related to their climate history, we have attained a better understanding of a key aspect of how the inhabitants of Jiangnan historically experienced climate change.

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Bibliography

Primary sources

Changxing xianzhi 長興縣志 (Gazetteer of Changxing county). 1673.

Changxing xianzhi 長興縣志 (Gazetteer of Changxing county). 1749.

Chongde xianzhi 崇德縣志 (Gazetteer of Chongde county). 1611.

Chongxiu Chongming xianzhi 重修崇明縣志 (Revised gazetteer of Chongming county). 1681.

Dantu xianzhi 丹徒縣志 (Gazetteer of Dantu county). 1683.

Dinghai xianzhi 定海縣志 (Gazetteer of Dinghai county). 1715.

Gaochun xianzhi 高淳縣志 (Gazetteer of Gaochun county). 1683.

Gui'an xianzhi 歸安縣志 (Gazetteer of Gui'an county). 1673.

Haining xianzhi 海寧縣志 (Gazetteer of Haining county). 1683.

Haiyan xian tujing 海鹽縣圖經 (Illustrated gazetteer of Haiyan county). 1624.

Han shu 漢書 (Book of Han). 1997. Ban Gu 班固 et al. Beijing: Zhonghua shuju.

Hangzhou fuzhi 杭州府志 (Gazetteer of Hangzhou prefecture). 1688.

Hangzhou fuzhi 杭州府志 (Gazetteer of Hangzhou prefecture). 1778.

Mingji beilüe 明季北略 (Northern outline of the last years of the Ming). [1673] 1984. Ji Liuqi 計六奇. 2 vols. Beijing: Zhonghua shuju.

Jiading xianzhi 嘉定縣志 (Gazetteer of Jiading county). 1605.

Jiading xianzhi 嘉定縣志 (Gazetteer of Jiading county). 1673.

Jiangning xianzhi 江寧縣志 (Gazetteer of Jiangning county). 1683.

Jiangyin xianzhi 江陰縣志 (Gazetteer of Jiangyin county). 1641.

Jiangyin xianzhi 江陰縣志 (Gazetteer of Jiangyin county). 1744.

Jiaxing rizhu 甲行日注 (Daily notes beginning on a *jia* day). [1648] 2016. Ye Shaoyuan 葉紹袁 and Bi Min 畢敏 (ed.). Changsha: Yuelu shushe.

Jiaxing xianzhi 嘉興縣志 (Gazetteer of Jiaxing county). 1637.

Jingjiang xianzhi 靖江縣志 (Gazetteer of Jingjiang county). 1669.

Kunshan-Xinyang hezhi 崑山新陽合志 (Combined gazetteer of Kunshan and Xinyang). 1751.

Lin'an xianzhi 臨安縣志 (Gazetteer of Lin'an county). 1759.

Linian ji (gao ben) 歷年記(稿本) (Record of successive years, draft). 1982. Yao Tinglin 姚廷遴. Pages 39–168 in *Qingchao riji huichao* 清代日記匯抄 (Transcribed collection of Qing-era diaries). Liu Pinggang 劉平崗, Hu Wensui 胡文遂 and Zou Jihua 鄒紀華(eds.). Shanghai: Shanghai renmin chubanshe.

Luhe xianzhi 六合縣志 (Gazetteer of Luhe county). 1646.

Pinghu xianzhi 平湖縣志 (Gazetteer of Pinghu county). 1745.

Qiantang xianzhi 錢塘縣志 (Gazetteer of Qiantang county). [1609] 1893.

Qiantang xianzhi 錢塘縣志 (Gazetteer of Qiantang county). 1721.

Renhe xianzhi 仁和縣志 (Gazetteer of Renhe county). 1687.

Shangyuan xianzhi 上元縣志 (Gazetteer of Shangyuan county). 1721.

Shanyin xianzhi 山陰縣志 (Gazetteer of Shanyin county). 1701.

Shaoxing fuzhi 紹興府志 (Gazetteer of Shaoxing prefecture). 1683,

Shengxian zhi 嵊縣志 (Gazetteer of Sheng county). 1671.

Shengxian zhi 嵊縣志 (Gazetteer of Sheng county). 1742.

Shengzu Ren huangdi shilu 聖祖仁皇帝實錄 (Veritable records of the Shengzu Ren Emperor). [1731] 1985. Volume 4–6 of *Qing shilu* 清實錄 (Veritable records of the Qing). 60 vols. Beijing: Zhonghua shuju.

Shenzong Xian huangdi shilu 神宗顯皇帝實錄 (Veritable records of the Shenzong Xian Emperor). 1966. Volume 96 to 123 of *Ming shilu* 明實錄 (Veritable records of the Ming). 133 vols. Taibei: Zhongyang yanjiusuo lishi-yuyan yanjiusuo.

Shimen xianzhi 石門縣志 (Gazetteer of Shimen county). 1818.

Shoo King, or the Book of Historical Documents. 1960. Legge, James, trans. Vol. 3 of The Chinese Classics, with a Translation, Critical and Exegetical Notes, Prolegomena, and Copious Indexes. 2 vols. Hong Kong: Hong Kong University Press.

Tongxiang xianzhi 桐鄉縣志 (Gazetteer of Tongxiang county). 1678.

Weishuixuan riji 味水軒日記 (Diary from the Water-Tasting Gallery). 1616. Li Rihua 李日華.

Wujiang xianzhi 吳江縣志 (Gazetteer of Wujiang county). 1747.

Wuxi-Jinkui xianzhi 無錫金匱縣志 (Gazetteer of Wuxi and Jinkui counties). 1813.

Wuxian zhi 吳縣志 (Gazetteer of Wu county). 1642.

Xiaofeng xianzhi 孝豐縣志 (Gazetteer of Xiaofeng county). 1879.

Xiangshan xianzhi 象山縣志 (Gazetteer of Xiangshan county). 1698.

Xincheng xianzhi 新城縣志 (Gazetteer of Xincheng county). 1693.

Xincheng xianzhi 新城縣志 (Gazetteer of Xincheng county). 1751.

Yuyao zhi 餘姚志 (Gazetteer of Yuyao). 1781.

Yiyou biji 乙酉筆記(舊舊抄本) (Notes from the Yiyou year, old transcribed edition). 1982. Zeng Yuwang 曾羽王. Pages 3–36 in *Qingdai riji huichao* 清代日記匯抄 (Transcribed collection of Qing-era diaries). Liu Pinggang 劉平崗, Hu Wensui 胡文遂 and Zou Jihua 鄒紀華(eds.). Shanghai: Shanghai renmin chubanshe.

Yueshi bian 閱世編 (Writing on reading the world). 1981. Ye Mengzhu 葉夢珠 and Lai Xinxia 來新夏 (ed.). Shanghai: Shanghai guji chubanshe.

Zhenjiang fuzhi 鎮江府志 (Gazetteer of Zhenjiang prefecture). 1685.

Zhenyang xianzhi 鎮洋縣志 (Gazetteer of Zhenyang county). 1744.

Secondary sources

Agøy, Erling. 2021. Historical Climate Change in the Jiangnan Region in the Late Ming and Early Qing periods (1600–1700): Perceptions, Effects and Adaptation. Unpublished PhD dissertation, University of Oslo.

Agøy, Erling. 2023. "Weather prognostication in Late Imperial China as presented in Local Gazetteers (1644–1722)." *International Journal of Divination and Prognostication* 4, no. 2: 104–141.

Barash, Jeffrey Andrew. 2016. *Collective Memory and the Historical Past*. Chicago and London: University of Chicago Press.

Bodde, Derk. 1991. Chinese Thought, Society, and Science, The Intellectual and Social Background of Science and Technology in Pre-modern China. Honolulu: University of Hawai'i Press.

Brook, Timothy. 2010. *The Troubled Empire: China in the Yuan and Ming Dynasties*. Cambridge, Mass., and London: Belknap Press of Harvard University Press.

Brook, Timothy. 2017. "Nine Sloughs: Profiling the Climate History of the Yuan and Ming Dynasties, 1260–1644." *Journal of Chinese History* 1: 27–58.

Brook, Timothy. 2023. *The Price of Collapse: The Little Ice Age and the Fall of Ming China*. Princeton: Princeton University Press. (Forthcoming.)

Corning, Amy and Schuman, Howard. 2015. *Generations and Collective Memory*. Chicago: University of Chicago Press.

Dennis, Joseph R. 2015. *Writing, Publishing, and Reading Local Gazetteers in Imperial China, 1100–1700*. Harvard East Asian Monographs 379. Cambridge, Mass.: Harvard University Asia Center.

Dodgen, Randall A. 2011. Controlling the Dragon: Confucian Engineers and the Yellow River in Late Imperial China. Honolulu: University of Hawai'i Press.

Eberhard, Wolfram. 1957. "The Political Function of Astronomers and Astronomy in Han China." In *Chinese Thought and Institutions*, edited by John K. Fairbank, 33–70. Chicago: University of Chicago Press.

Elman, Benjamin A. 2015. "Some Comparative Issues – Ming-Qing Border Defense and Jesuit Learning in Late Imperial China." In *Science in China 1600–1900, Essays by Benjamin A. Elman*, edited by Ho Yi Kai, 39–76. Hackensack: World Century Publishing Corp.

Elvin, Mark. 1998. "Who Was Responsible for the Weather? Moral Meteorology in Late Imperial China." *Osiris* 13: 213–237.

Elvin, Mark. 2006. The Retreat of the Elephants, An Environmental History of China. New Haven: Yale University Press.

Fuller, Pierre. 2022. Modern Erasures, Revolution, the Civilizing Mission, and the Shaping of China's Past. Cambridge: Cambridge University Press.

Graham, A.C. 1986. Yin-Yang and the Nature of Correlative Thinking. Occasional paper and monograph series No. 6. Singapore: Institute of East Asian Philosophies.

Halbwachs, Maurice and Coser, Lewis A., trans. 1992. *On Collective Memory*. Chicago: University of Chicago Press.

Henderson, John B. 2010. "Cosmology and Conceptions of Nature in Traditional China." In *Concepts of Nature, A Chinese-European Cross-Cultural Perspective*, edited by Hans Ulrich Vogel and Günter Dax, 181–197. Leiden: Brill.

Hong Shinian 洪世年 and Liu Zhaomin 劉昭民. 2006. *Zhongguo qixiang shi, Jindai qian* 中國氣象史 – 近代前 (History of meteorological phenomena in China, before the modern era). Beijing: Zhongguo kexue jishu chubanshe, 2006.

Hulme, Mike. *Weathered: A Cultural Geography of Climate*. London: Sage Publications, 2017.

Ju Mingku 鞠明庫. 2011. *Zaihai yu Mingdai zhengzhi* 災災害與明代政治 (Natural calamities and Ming-era politics). Beijing: Zhongguo shehui kexue chubanshe.

Li Bozhong 李伯重. 1991. "*Qihou bianhua yu Zhongguo lishishang renkou de jici daqi daluo* 氣候變化與中國歷史人口紀次大起大落 (Climate change and the several great rises and falls of China's historical population)." *Renkou yanjiu* 人口研究 23, no. 1: 15–19.

Lippiello, Tiziana. 2001. Auspicious Omens and Miracles in Ancient China, Han, Three Kingdoms and Six Dynasties. Monumenta Serica Series XXXIX. Sankt Augustin: Institut Monumenta Serica.

Marks, Robert B. 1998. Tigers, Rice, Silk, and Silt, Environment and Economy in Late Imperial South China. Cambridge: Cambridge University Press.

Marks, Robert B. 2012. *China. Its Environment and History*. Lanham, Md.: Rowan and Littlefield Publishers.

Needham, Joseph, and Wang Ling. 1956. *Science and Civilisation in China.* Vol. 2, *History of Scientific Thought*. Cambridge: Cambridge University Press.

Parker, Geoffrey. 2008. "Crisis and Catastrophe: The Global Crisis of the Seventeenth Century Reconsidered." *The American Historical Review* 113, no. 4: 1053–1079.

Parker, Geoffrey. 2013. Global Crisis: War, Climatic Change, and Catastrophe in the Seventeenth Century. New Haven: Yale University Press.

Raphals, Lisa. 2013. *Divination and Prediction in Early China and Ancient Greece*. Cambridge: Cambridge University Press.

Robinson, Rebecca. 2021. "The *Document on Rain* (*Yushu* 雨書): Weather and Prognostication in Early China." *International Journal of Divination and Prognostication* 2, no. 2: 191–223.

Smith, Richard J. 1991. Fortune-tellers and Philosophers, Divination in Traditional Chinese Society. Boulder: Westview Press.

Smith, Richard J. 2008. "Divination in Late Imperial China: New Light on Some Old Problems." In *The Imperative of Reading: Chinese Philosophy, Comparative Philosophy, and Onto-Hermeneutics*, edited by Ng On-cho., 273–315. New York: Global Scholarly Publications.

Swope, Kenneth M. 2014. The Military Collapse of China's Ming Dynasty, 1618–44. London: Routledge.

Wang Yeh-chien. 1989. "Food Supply and Grain Prices in the Yangzi Delta in the Eighteenth Century." In *Proceedings of the Second Conference on Modern Chinese Economic History*, edited by the Institute of Economics, 424–29. Taipei: Academia Sinica.

Wang Yeh-chien. 1992. "Secular Trends of Rice Prices in the Yangzi Delta, 1638–1935." In *Chinese History in Economic Perspective*, edited by Thomas G. Rawski and Lillian Li, 35–68. Berkeley: University of California Press.

Wittfogel, Karl August. 1967. *Oriental Despotism: A Comparative Study of Total Power*. New Haven and London: Yale University Press.

Xiong Dishu 熊第恕, ed. 1991. *Zhongguo qixiang yanyu* 中國氣象諺語 (Climate sayings of China). Beijing: Qixiang chubanshe.

Zhang De'er and Wang Pao-kuan. 1988. "An Introduction to Some Historical Governmental Weather Records of China." *Bulletin of the American Meteorological Society* 69, no. 7: 753–758.

Zhang Peiyuan 張丕遠 et al., eds. 1996. *Zhongguo lishi qihou bianhua* 中國歷史氣候不安華 (Historical climate change in China). Jinan: Shandong kexue jishu chubanshe.