



# Epidemic and Environmental Change in China's Early Modern Maritime World During the 'Little Ice Age' (ca. 1500–1680)

*Angela Schottenhammer*

*Lipotidae*

Large ones get more than 6 m long; on their back they have like a sharp blade.

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A. Schottenhammer (✉)  
KU Leuven, Leuven, Belgium  
e-mail: [angela.schottenhammer@kuleuven.be](mailto:angela.schottenhammer@kuleuven.be)

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When they come in front of the South Seas God Temple, this is called ‘the arrival’.

Sometimes [this occurs] several times a year, sometimes once every few decades.

When they come frequently, then the people have diseases.

鱗魚

大者長二丈餘脊若鋒刃

嘗至南海廟前謂之來朝

或一年數至或數十年一至

若來數，則人有疫疾。

[*Guangdong xinyu* 廣東新語, j.22 (*linyu* 鱗語)]

The environment and climate have become ever more prominent components of recent research into China’s history.<sup>1</sup> A great deal of this scholarship has focused on recurring floods and droughts, which have constituted a perpetual problem in China’s past. Such catastrophes were not seldom accompanied by severe outbreaks of disease, often of epidemic proportions. Debates still prevail about the linkages between these phenomena. If, for example, significant climatic changes, such as the rise or drop of temperatures, decisively influenced typhoons, floods, or droughts, how did these broader climatic anomalies contribute to the spread of epidemics and related phenomena? This chapter analyses potential answers to this question through an analysis of the linkages between El Niño Southern Oscillation (ENSO) anomalies, typhoons, and

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UGent, Gent, Belgium

<sup>1</sup> Mark Elvin was certainly one of the first sinologists to be mentioned in this context. See: Mark Elvin, *The Retreat of the Elephant: An Environmental History of China* (New Haven: Stanford University Press, 2004); Mark Elvin and Liu Ts’ui-jung, eds., *Sediments of Time: Environment and Society in Chinese History* (Cambridge: Cambridge University Press, 1998). Subsequently, I will particularly refer to the research of Timothy Brook. See, for example: Timothy Brook, ‘Nine Sloughs: Profiling the Climate History of the Yuan and Ming Dynasties, 1260–1644,’ *Journal of Chinese History*, 1 (2017), 27–58; Timothy Brook, ‘Differential Effects of Global and Local Climate Data in Assessing Environmental Drivers of Epidemic Outbreaks,’ *PNAS*, 114, 49 (2017). See also the results of collaborative work between Chinese historians and climate scientists, such as: Quansheng Ge, Jingyun Zheng, Yanyu Tian, Wenxiang Wu, Xiuqi Fang, and Wei-Chyung Wang, ‘Coherence of Climatic Reconstruction from Historical Documents in China by Different Studies,’ *International Journal of Climatology*, 28 (2008), 1007–24. Several more examples are referred to below.

epidemics during a protracted period of global cooling, known as the Little Ice Age (LIA), focusing on the period c.1500–1680.<sup>2</sup> It builds upon the knowledge of climate historians but restricts itself to social historic analysis.

Recent climatological analyses suggest that ENSO, an anomaly of sea surface temperatures (SSTs) in the eastern equatorial Pacific Ocean, has significant teleconnections with the frequency, origin points, tracks, and strength of tropical cyclones. During La Niña years, when SSTs in the east-central equatorial Pacific are anomalously low, the chance of typhoons making landfall on much of the Chinese coastline is increased.<sup>3</sup> Similarly, colder temperatures in northern and central China have been reported to increase the intensification of westerlies, thereby further increasing typhoons' chances of making landfall.<sup>4</sup>

It is in this context that the period c.1560–1650—a core period within that which is under review—represents a particularly interesting case study. Widely recognized as a period of global cooling, recent climatic reconstructions using proxy data have suggested prevailing La Niña-like conditions. According to Joëlle Gergis and Anthony Fowler, 47 of these 90 years were La Niña years. Moreover, consecutive years of La Niña anomalies occurred in 1571–1573, 1576–1584 (all but one), 1600–1605, 1622–1632, and 1637–1639.<sup>5</sup> Thus, based on recent models connecting these phenomena, historians looking in the archive might expect to find frequent reports of typhoons making landfall in this period. This is further supported by research by Kam-biu Liu, Caiming Shen, and Kin-sheun Louie, who suggested that the years 1660–1680—a particularly cool and dry period in Chinese history—represent one of the most active periods of local typhoon landfalls in Guangdong.<sup>6</sup>

<sup>2</sup> For more on the LIA, see: Chapter by Chaudhuri, this volume.

<sup>3</sup> James B. Elsner and Kam-biu Liu, 'Examining the ENSO-Typhoon Hypothesis,' *Climate Research*, 25, 1 (2003), 43–54. See also: César Caviedes, *El Niño in History: Storming Through the Ages* (Gainesville: University Press of Florida, 2001).

<sup>4</sup> Kam-biu Liu, Caiming Shen, and Kin-sheun Louie, 'A 1,000-Year History of Typhoon Landfalls in Guangdong, Southern China, Reconstructed from Chinese Historical Documentary Records,' *Annals of the Association of American Geographers*, 91, 3 (2001), 460–61.

<sup>5</sup> Joëlle L. Gergis and Anthony M. Fowler, 'A History of ENSO Events Since A.D. 1525: Implications for Future Climate Change,' *Climatic Change*, 92 (2009), 371.

<sup>6</sup> Kam-biu Liu, Caiming Shen, and Kin-sheun Louie, 'A 1,000-Year History of Typhoon Landfalls,' 460.

Building on such work, this chapter examines the frequency of typhoon landfalls in China, especially Fujian, Guangdong, and Zhejiang, in c.1500–1680, and explores their potential connections to flood events and epidemics. Further correlations are of interest in this context. Recent work by Kong Dongyan, Li Gang, and Wang Huijuan has also suggested a close relationship between increased frequency of La Niña events, solar activity, and locust attacks. The authors also argue that La Niña conditions increase the chances of tidal inundations.<sup>7</sup> Similarly, scholars have elsewhere argued that ‘successive natural disasters caused by the climate of the LIA were the main natural factors of the plague epidemic during the late Ming dynasty.’<sup>8</sup> Thus, the current scholarship, although only in a formative stage, suggests cautious correlations between global cooling, negative ENSO anomalies, increased frequency of flood events in China, and the outbreak of epidemics. This chapter seeks to explore these possible correlations further, incorporating the existing research, and providing a wider geographic research area (Fig. 3.1).

Writing as a historian, I have to emphasize that this research necessarily remains speculative in various aspects. The data is often incomplete, fragmentary, or too general. Sometimes the sources provide descriptions in some detail; sometimes they just record that a disaster occurred. Records for many parameters that we use today for weather prediction, temperature measurements, and reconstruction of ocean currents, do not exist for most historical periods. In addition, we have yet to gather more data and information from all Chinese coastal provinces, other East Asian coastal

<sup>7</sup> Kong Dongyan 孔冬艳, Li Gang 李钢, Wang Huijuan 王会娟, ‘Ming Qing shiqi Zhongguo yanhai diqu haichao zaihai yanjiu 明清时期中国沿海地区海潮灾害研究,’ *Journal of Natural Disasters / Ziran zaihai yanjiu* 自然灾害学报, 25, 5 (2016), 93. The article explains that typhoons need strong convective movements, absorbing lots of heat, to develop. Because in El Niño years, the equatorial water surface temperature in the Eastern Pacific is high, while they are relatively low in the Western Pacific, heat and water vapours decrease so that the tendency of increasing atmospheric energy, of strong convective movements in other words, also decreases. When the surface temperatures in the Western Pacific are relatively low, the atmospheric energy to develop typhoons also decreases.

<sup>8</sup> Qiu-Hua Li, Yue-Hai Ma, Ning Wang, Ying Hu, and Zhao-Zhe Liu, ‘Overview of the Plague in the Late Ming Dynasty and Its Prevention and Control Measures,’ *TMR Journals*, 5, 3 (2020), 138–39.



**Fig. 3.1** Map of coastal China, including locations of places and features mentioned in-text. Drawn by Philip Gooding

regions, and island archipelagos.<sup>9</sup> Consulting other studies by Chinese historians and environmental and climate specialists, and by analysing data I have been collecting on this topic in cooperation with colleagues, I am unable to provide any generalized tendencies. Being confronted with the restrictions mentioned above and analysing here only a fraction of the body of sources available to us on this topic, I can simply provide some snapshots of micro-environmental events and some particular stories of crisis management. The reader should consequently take this chapter as another small contribution to the question of to what extent climatic and other natural phenomena fostered the outbreak of epidemics.

I will first introduce examples of typhoons, tide disasters, and storm surges, and contemporary outbreaks of epidemics relying on data collected by climate historians and on data we have been gathering as part of two ongoing projects entitled ‘TRANSPACIFIC’ and ‘Appraising Risk.’<sup>10</sup> Before coming to a tentative conclusion, I will introduce forms of Ming-period (1368–1644) crisis management, incorporating the views of some contemporary scholars in China on the relationships between nature, environmental changes, and the outbreak of certain diseases and epidemics.<sup>11</sup>

## TIDE DISASTERS, TSUNAMIS, AND STORM SURGES

The famous Song scholar, Su Shi 蘇軾 (1036–1101), who established the first pharmacy in 1089 in Hangzhou, was convinced that the dense networks of waterways in Hangzhou made the city particularly vulnerable to epidemics: ‘Hangzhou is a place where water and land meet; therefore

<sup>9</sup> As part of my TRANSPACIFIC project and the ‘Appraising Risk’ project, my colleagues and I have started to collect and organize such data. We already possess year-for-year proxy data for various Chinese coastal provinces for the years 1500–1700. But we need to collect data from many more regions. In addition, our geoinformatician is currently still developing our spatial–temporal database that will enable visualisation and systematic analysis of relationships and correlations between data-points.

<sup>10</sup> See credentials.

<sup>11</sup> The selection of the scholars was partly arbitrary. However, the fact that a scholar like Su Jun dedicated a special chapter to the question of ‘climate’ attracted my attention. He also directly addressed the question of local climate, environmental change, and epidemics, in this case various forms of malaria. Qu Dajun has been chosen because he speaks especially about the causes and development of typhoons, a major periodic calamity in his home province Guangdong.

there are more illnesses than elsewhere.<sup>12</sup> He believed in a correlation between plenty of water and the outbreak of disease. In the early centuries CE, most floods occurred in north and northwest China, but from sometime during the Song (960–1279) onwards, the frequency of these catastrophes shifted to the southeastern regions, especially Zhejiang and Jiangsu.<sup>13</sup> This shift may be associated with a process of general cooling in East Asia dating from the twelfth century.<sup>14</sup> As the famous maritime historian Lo Jung-pang has noted:

The southeast coastal lands of China are a region that feels the greatest effect of the continental cyclonic storms. It was therefore a region that suffered more from floods than any other region of China. Estimated in terms of the number of floods per thousand square kilometres per century, Zhejiang ranked the highest in the nation.<sup>15</sup>

Jiangsu came second. While Lo Jung-pang described the situation during the Song and Yuan (1271–1368), the figures presented in this chapter on the Ming and early Qing (1644–1912) generally confirm the picture.

Based on the statistical data on tropical cyclones gathered by Yen-Chu Liu, Hwei-Fen Chen, Xingqi Liu, and Yuan-Pin Chang, it is evident that the number of typhoons increased remarkably after 1400 CE.<sup>16</sup> Referring

<sup>12</sup> Angela Ki Che Leung, 'Organized Medicine in Ming-Qing China: State and Private Medical Institutions in the Lower Yangzi Region,' *Late Imperial China*, 8, 1 (1987), 136: With reference to: *Xu zizhi tongjian changbian* 續資治通鑑長編, by Li Dao 李燾 [1115–1184] (Taipei: Shijie shuju, 1965), 435.20b.

<sup>13</sup> Lo Jung-pang stated that in Yuan times, Zhejiang and Jiangsu provinces had 33.7% of the floods per 1000 square kilometers per century, and 27.5% of all the droughts per 1000 square kilometers per century from 206 BCE to 1911 CE. See: Lo Jung-pang, *China as a Sea Power, 1127–1368: A Preliminary Survey of the Maritime Expansion and Naval Exploits of the Chinese People During the Southern Song and Yuan Periods*, ed. Bruce A. Elleman (Singapore: National University of Singapore Press, 2011), 76: With reference to: Yao Shan-yu, 'The Chronological and Seasonal Distribution of Floods and Droughts in Chinese History, 206 B.C.–A.D. 1911,' *Harvard Journal of Asiatic Studies*, 6, 3–4 (1942), 363.

<sup>14</sup> See also: Chapter by Ebner von Eschenbach, this volume.

<sup>15</sup> Lo Jung-pang, *China as a Sea Power*, 89.

<sup>16</sup> Yen-Chu Liu, Hwei-Fen Chen, Xingqi Liu, and Yuan-Pin Chang, 'Insight into Tropical Cyclone Behaviour Through Examining Maritime Disasters Over the Past 1000 Years Based on the Dynastic Histories of China—A Dedication to Ocean Researcher V,' *Quaternary International*, 440, A (2017), 72–81.

to the Ming Period in this context, Zhou Zhiyuan 周致元 has identified the following characteristics<sup>17</sup>: First, most tidal inundations were caused by typhoons and cyclones. Second, the occurrence of these inundations followed certain rules: They primarily occurred during summer and fall, with a peak during the months July to September, and most of the typhoons developed east or southeast of Taiwan and the Philippine Archipelago. Third, whereas floods caused by river inundations were mostly preceded by heavy rainfall, so that people were alarmed in advance and could take precautionary measures, tidal disasters mainly occurred ad hoc, leaving the local population without much time to prepare. The human catastrophes were, consequently, sometimes more drastic in the latter instances.

These patterns are also reflected in the sources investigated for this chapter, which frequently report of thousands, or even tens of thousands, of people drowning, and of water approaching rapidly and rising 'like a mountain.' Often, the water mass arrived with such violence that all dikes or protecting walls were smashed and washed away. The violence of the floods was often significant: Descriptions speak of huge waves flooding rice fields over large areas, and of enormous winds and rains causing additional damages.

To give some examples roughly corresponding to the period under review: In 1472, more than 28,400 people drowned after a severe storm in Zhejiang (浙江大風雨, 海水暴溢,.....溺死者二萬八千四百餘人).<sup>18</sup> In 1539, a storm surge had the water rise to more than 6.66 m and more than 29,000 people drowned (海溢, 高二丈餘, 溺死民灶男婦二萬九千餘口).<sup>19</sup> 1568, a severe typhoon hit Taizhou, Zhejiang, and an enormous flood surge covered all districts and towns in Taizhou, only retreating after three days. More than 30,000 people drowned (浙江台州府颶風大作, 海潮汛漲, 天台諸山水驟合, 沖入台州府城三日乃退, 溺死人民三萬餘口).<sup>20</sup> In Guangdong, in 1618, lightning, thunder, and a typhoon raged,

<sup>17</sup> Zhou Zhiyuan 周致元, 'Mingdai Dongnan diqu de haichao zaihai 明代东南地区的海潮灾害,' *Shikue jikan 史学集刊/Collected Papers of History Studies*, 2 (2005), 83–93.

<sup>18</sup> Zhou Zhiyuan, 'Mingdai Dongnan diqu de haichao zaihai,' 89: With reference to *Ming Xianzong shilu 明憲宗實錄*, *juan*, 106.

<sup>19</sup> *Ibid.*, with reference to the Wanli edition of *Tongzhou zhi 通州志*.

<sup>20</sup> *Ibid.*, with reference to *Ming Muzong shilu 明穆宗實錄*, *juan* 22.



causing 12,530 men and women to drown.<sup>21</sup> In 1628, in Hangzhou 杭州, Jiaxing 嘉興, Huzhou 湖州, and Shaoxing 紹興, Zhejiang, a severe storm caused a tidal surge that drifted away uncountable fields and grain, destroying homes and killing several tens of thousands of people (大風雨, 海溢, 漂沒田禾無算, 壞民居數萬間, 殺傷居民數萬人).<sup>22</sup> In 1631, a flood surge in Zhejiang was so high that it buried 70,000 people under the mass of water (海潮狂溢, 漂溺人民七萬).<sup>23</sup> These descriptions provide an insight into the extent of damage caused by such flood surges. The sources are sometimes detailed enough that we do not need to look at the damage of hurricanes and typhoons in more recent times to be able to get an idea of the destruction.

The destruction was sometimes so extensive that it took years, or even decades, for infrastructure to be repaired. Sources repeatedly speak of ‘uncountable’ (*wusuan* 無算) homes being washed or blown away. Sometimes even concrete figures are mentioned: In 1619, during a tide disaster in Chaozhou 潮州, Guangdong, 31,867 houses were destroyed. In an event during the reign of Emperor Yingzong 英宗 (r. 1435–1449 and 1457–1464), more than 3000 *zhang* of protective dikes were destroyed (that is approximately 10 km) in one district. Sometimes, the entire dike construction, including the base layers, were washed away.<sup>24</sup>

The consequences for agriculture were also often disastrous. Salty water and brine destroyed plants, grain, and the soil.<sup>25</sup> Entire harvests, grain stocks, and fields could be destroyed, as a consequence of which famines followed. In 1422, a flood surge in Guangdong destroyed 1200 homes and more than 25,300 *dan* of grain (i.e. more than approx. 1315 tons).<sup>26</sup> With the shortage of grain and rice, prices increased, and the distress of the people was consequently further exacerbated. Frequently, the number of people who died following such natural disasters still exceeded the quantity of those who drowned or died directly in the disaster. Famine and epidemics were among the most serious of such

<sup>21</sup> Ibid., with reference to *Ming Shen-zong shilu* 明神宗實錄, *juan* 583.

<sup>22</sup> Ibid., with reference to Bo Sen 伯森 et al., *Ming shilu leizuan* 明實錄類纂, *juan Ziran zaiyi* 自然災異卷 (Wuhan: Wuhan chubanshe, 1993), *juan* 11.

<sup>23</sup> Ibid., with reference to Bo Sen, *Ming shilu leizuan*, *juan* 45.

<sup>24</sup> Ibid., 90.

<sup>25</sup> See also: Chapter by Ebner von Eschenbach, this volume.

<sup>26</sup> Zhou Zhiyuan, ‘Mingdai Dongnan diqu de haichao zaihai,’ 90.

consequences. Because of the immediate impacts of climate changes and environmental disasters on agriculture, the basis of the early modern Ming and Qing economies, rulers have been sensitive to such problems ever since.<sup>27</sup>

## OUTBREAKS OF DISEASES AND EPIDEMICS

Corresponding with the climatic effects of the core of the LIA, epidemics were frequent during the late Ming dynasty. Nevertheless, we have to be cautious in drawing simple correlations here. Social, hygienic, and economic factors significantly affected the likelihood that typhoon-related floods would contribute to an epidemic. We also have to take into account that the mid-seventeenth century was a time of war and unrest, characterized by the military conquest of China by the Manchus. Contemporary life was thus also negatively influenced by wars and man-made destruction. Even so, Timothy Brook has stressed that disasters, droughts, and famines were omnipresent in the last years of the Ming. In Shanghai, the corpses of the dead lay in the streets: ‘Epidemics followed in the wake of drought and famine.’<sup>28</sup>

China was struck by various infectious diseases and epidemics (*dayi* 大疫; *wenyi* 瘟疫; literally: ‘febrile pestilence’) from early Ming times. For example, in 1408, more than 78,400 people passed away in Jiangxi and Fujian; in 1411, more than 6000 people died in Dengzhou 鄧州 and Ninghai 寧海; in 1435–1436, 30,000 deaths occurred in Shaoxing 紹興, Ningbo 寧波 and Taizhou 台州; in 1455 more than 20,000 died in Guizhou 貴州; and in 1475, there were innumerable deaths in Fujian and Jiangxi.<sup>29</sup> Bubonic plague and smallpox were likely the most common epidemics in these contexts. In the south, malaria constituted a big

<sup>27</sup> See, for example: Robert B. Marks, “‘It Never Used to Snow’”. Climate Variability and Harvest Yields in Late-Imperial South China, 1650–1850,’ in *Sediments of Time*, eds. Elvin and Ts’ui-jung, 411–12.

<sup>28</sup> Timothy Brook, *The Troubled Empire: China in the Yuan and Ming Dynasties* (Cambridge, MA: Belknap Press of Harvard University Press, 2010), 250.

<sup>29</sup> *Mingshi* 明史 [1739], by Zhang Tingyu 張廷玉 [1672–1755] et al. (Beijing: Zhonghua shuju, 1974), 28.442–442 includes a paragraph on epidemics during Ming times.

problem. Malarial intermittent fevers (*zhangnüe* 瘴虐) are mentioned as early as in an early fourth-century Chinese source.<sup>30</sup>

The frequency of widespread disease outbreaks then reached a peak in the late fifteenth and early sixteenth centuries, and again in the late sixteenth and early seventeenth centuries. During the Ming dynasty, at least 22 major outbreaks of contagious diseases occurred in Zhejiang, 22 in Fujian, 5 in Guangxi, 2 in Guangdong, and 11 in Shandong—in comparison to Huguang with 26, Jiangxi with 16, Shanxi with 24, the metropolitan area with 20, and Shaanxi with 12.<sup>31</sup> Additionally, 137 cases of epidemics have elsewhere been counted for all of Southeast China during the Ming period; 197 cases for the Qing period.<sup>32</sup> Typhoons, unhygienic circumstances, and an extensive river system with frequent floods provided positive conditions for a spreading of contagious diseases in these contexts. Many epidemics, with over 28% of all catastrophes recorded, occurred at the same time as inundations.<sup>33</sup>

Wang Shuanghui 王雙懷 has already investigated the nature and frequency of natural disasters alongside the outbreak of epidemics (*yizai* 疫災) in Southeast China during the Ming Dynasty. He argues that Fujian ‘suffered most,’ especially Fuzhou, Quanzhou, and Zhangzhou. Next was Guangdong, with mainly Guangzhou, Chaozhou, Zhaoqing and Qiongzhou being affected.<sup>34</sup> But he does not include Zhejiang or Jiangsu provinces. At least as far as inundations and epidemics are concerned, our research shows that among the Southeast coastal regions, Zhejiang province ‘suffered most,’ and in terms of floods and ‘water calamities’ (*shuizai* 水災), Jiangsu was still more heavily affected than Zhejiang (see Fig. 3.2). Temporally speaking, the period between 1522 and 1619, especially the last third of the sixteenth century and the second decade of the seventeenth century, was particularly severe. In terms of epidemics,

<sup>30</sup> *Bao Puzi neipian* 抱朴子內篇 (ca. 320), by Ge Hong 葛洪 (283–363). See: Erhard Rosner, *Miasmen. Studien zur Geschichte der Malaria in Südchina* [Veröffentlichungen des Ostasien-Instituts der Ruhr-Universität Bochum 69] (Wiesbaden: Harrassowitz Verlag 2019), 21.

<sup>31</sup> Mei Li 梅莉 and Yan Changgui 晏昌贵, ‘Guanyu Mingdai chuanranbing chubu kao 關於明代傳染病的初步考察,’ *Hubei daxue xuebao* 湖北大學學報, 5 (1996), 85.

<sup>32</sup> Wen Zongdian 閔宗殿, ‘MingQing shiqi Dongnan diqi yiqing yanjiu 明清時期東南地區疫情研究,’ *Xueshu yanjiu* 學術研究, 10 (2003), 109.

<sup>33</sup> *Ibid.*, 159.

<sup>34</sup> Wang Shuanghui, ‘Mingdai Hua’nan de ziran zaihai,’ *Dili yanjiu*, 18 (1999), 160.



**Fig. 3.2** Graphs showing numbers of inundations and epidemics in coastal Chinese provinces in the period c.1500–1680, according to the data collected as part of the ongoing TRANSPACIFIC and ‘Appraising Risk’ projects

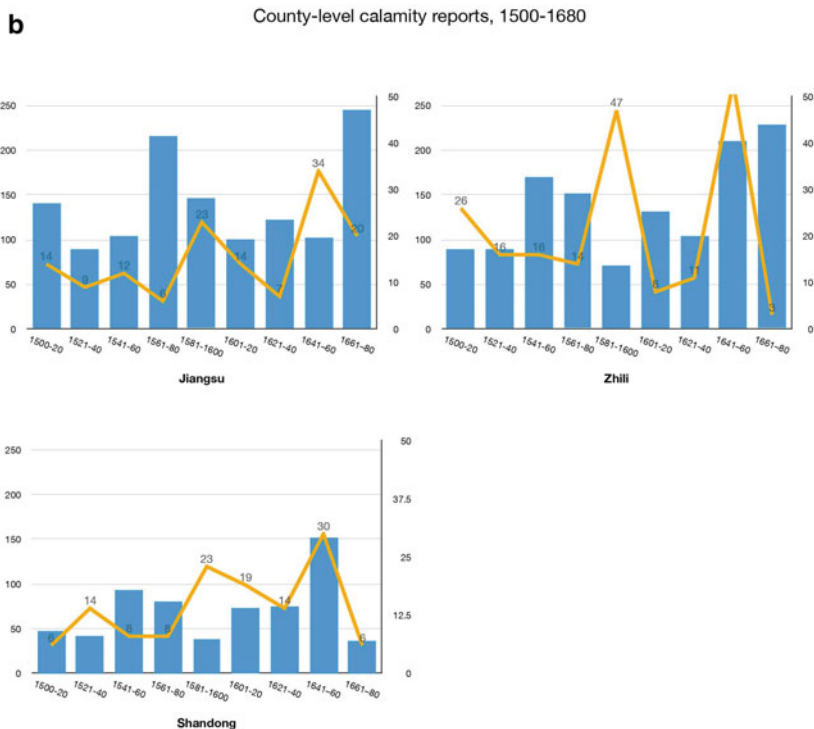


Fig. 3.2 (continued)

most occurred during the Jiajing (1521–1567) and Wanli (1573–1620) periods.<sup>35</sup> The early seventeenth century, especially around 1602, saw an extreme frequency of large epidemics, as Helen Dunstan has also shown—although her study looks at the Ming as a whole and does not specifically focus on China’s coastal regions.<sup>36</sup>

<sup>35</sup> Chen Xu 陈旭, *Mingdai yiwu yu Mingdai shehui* 明代瘟疫与明代社会. Chengdu: Xinan caijing daxue chubanshe, 2016, Ch. 2, *Mingdai wenyi de tedian* 明代瘟疫的特点, 25.

<sup>36</sup> Helen Dunstan, ‘The Late Ming Epidemics: A Preliminary Survey,’ *Ch’ing-shih wen-t’i*, 3, 3 (1975), 1–59.

The data we have so far collected for our TRANSPACIFIC project suggests that Guangdong experienced significantly more typhoon disasters than other coastal provinces, though Zhejiang province was most affected by epidemics. In the latter case, severe outbreaks occurred in 1534, 1545–1546, 1554–1555, 1588–1589, 1601–1603/1604, 1639, and 1640–1641. Meanwhile, they occurred in Fujian in 1522–1523, 1544–1545, 1561, 1601–1603, 1608, 1617–1618, 1640, and 1642; and in Guangdong, they occurred in 1533, 1547–1548, 1629–1630, and 1632. This suggests that the frequency of typhoon disasters alone, even if they contributed to severe inundations, may not hastily be taken as a marker for a higher rate of epidemic outbreaks. This is a clear indication that we need to consider a broader variety of environmental factors. Most investigations, however, agree that water, floods, and inundations, coupled with high temperatures, played a major role in the outbreak of epidemics and constituted ideal circumstances for the breeding of pathogenic microorganisms.<sup>37</sup>

In this context, research on the regional distribution of natural disasters in Ming period Fujian has shown that those prefectures that were located close to water, that is the Min River and its tributaries, namely Jianning, Shaowu, Yanping and Fuzhou, suffered most frequently from natural disasters, especially flooding, typhoons, but also droughts.<sup>38</sup> Moreover, as Xu Zhixin has emphasized, among the recorded natural disasters, water-related hazards played the most direct role in causing widespread diseases, as 79.41% of the epidemic diseases that broke out in Ming Fujian were related to floods and typhoons.<sup>39</sup>

These linkages are borne out by some written records, in which gazetteers discussed epidemics in the context of inundations. For example,

<sup>37</sup> See, for example: Gong Shengsheng 龚胜生, Wang Xiaowei 王晓伟, and Zhang Chou 张涛, 'Mingdai Jiangnan diqu de yizaidili 明代江南地区的疫灾地理,' *Dili yanjiu* 地理研究 *Geographical Research*, 33, 8 (2014), 1569–78.

<sup>38</sup> Wang Shuanghuai 王雙懷, 'Mingdai Huanan de ziran zaihai jiqi shikong tezheng,' 明代華南的自然災害及其時空特征, *Dili yanjiu* 地理研究 18 (1999), 158.

<sup>39</sup> Xu Zhixin, 'The Environment, Perceptions, and Publication of Medical Texts in Fujian During the Ming Period (1368 to 1644), in *Seafaring, Trade, and Knowledge Transfer: Maritime Politics and Commerce in Middle Period and Early Modern China*, eds., Wim De Winter, Angela Schottenhammer, and Mathieu Torck [Crossroads—History of Interactions across the Silk Routes] (Leiden: Brill Publishers, in print, paper held at Ghent University, Ghent in 2017): With reference to: Wang Shuanghuai, 'Mingdai Hua'nan de ziran zaihai jiqi shikong tezheng,' 158.

1544 was a year of various catastrophes in Fujian. Droughts alternated with inundations, and a typhoon struck the coast. Epidemics then followed during the winter. They broke out in Jianning 建寧 (大疫) and Shaxian 沙縣 (癘疫), as well as in various other districts. In Jianning, the District Magistrate, He Menglun 何孟倫, prohibited private transportation of goods and leaving the district.<sup>40</sup> In addition, medicines were purchased and doctors dispatched to each village to prepare them accordingly (市藥發醫分遣各鄉調製).<sup>41</sup> Similarly, for the 7th month of 1579, a major epidemic (大疫) is mentioned in relation to a typhoon, and many districts suffered from severe inundations.<sup>42</sup>

Meanwhile, 1587–1589 were very bad years for most of Zhejiang and for Guangdong. Floods, storms, and typhoons occurred at the same time as epidemics, low temperatures, famines, and locusts, especially in Zhejiang, although Fujian seems to have been less affected. Timothy Brook has written in this context of an ‘environmental collapse on a scale that stunned the regime and established a new benchmark for social disaster.’<sup>43</sup> Furthermore, in Tiantai 天台, Zhejiang, ‘another’ major epidemic (復大疫) broke out in the 7th month of 1587, accompanied by storms and heavy rains. People consequently ate the bark of trees and the roots of grass and weeds.<sup>44</sup> In 1588, the Regional Inspector (*xun'an yushi* 巡按御史), Cai Xizhou 蔡系周, went through the prefectures and provided medicinals, and so he was able to save tens of thousands of lives. The upright scholars (義士) Du Tan 杜潭 and Ye Shiyuan 葉世源 also provided medicine for help.<sup>45</sup>

Epidemics continued to rage during the years 1588–9, for example in various districts of Shanghai (1588 Fengxian 奉賢: 疫; Baoshan 寶

<sup>40</sup> In addition to controlling the price of rice and securing the local provisions therein, this measure might also have been considered necessary to control the further spread of the epidemics.

<sup>41</sup> Zhang De'er 張德二, *Zhongguo sanqian nian qixiang jilu zongji* 中國三千年氣象紀錄總集, vol. 2 (Nanjing: Jiangsu jiaoyu chubanshe, 2013), 1163. Further source descriptions from Zhang De'er, vol. 2, are abbreviated as ‘Description,’ followed by the relevant page number.

<sup>42</sup> Description, 1339.

<sup>43</sup> Timothy Brook, *The Troubled Empire*, 242.

<sup>44</sup> Description, 1387.

<sup>45</sup> Description, 1397.

山: 大疫; 1588–89 Qingpu 青浦: 大疫).<sup>46</sup> Most entries for this year in Shanghai speak of terrible droughts and famines. For Baoshan, the records tell us that many people died. A great epidemic is also mentioned for Nanjing and districts of Jiangxi Province. In Hangzhou 杭州, for example, from the 3rd to the 5th month, the rain did not stop, and inundations were widespread. Also, febrile epidemics (*wenyi* 瘟疫) broke out while many places were buried by water.<sup>47</sup> For Xiaoshan 蕭山, Zhejiang, the sources speak of a major epidemic pestilence (大疫癘) raging in both years. Large numbers of dead were left on the street, and the Xiaoshan District Magistrate, Liu Hui 劉會, from Quanzhou, Fujian, was ordered to select physicians to provide medicines to cure the sick. People and monks were hired to cover the skeletons. Meanwhile, a typhoon hit on the 9th day of the 6th month, 1589, overflowing large parts of the region. In Jiashan district one heard the sound of crying people all over the streets.<sup>48</sup>

Moving to examples from the seventeenth century, in early summer 1609, a major epidemic broke out in Fenxian 奉賢, Jiading 嘉定, and Baoshan 寶山 districts in Shanghai, and they occurred at the same time as inundations. Also, many districts in Fujian, for example, Shaowu, were struck by epidemics and severe floods.<sup>49</sup> Tens of thousands of people drowned all over the region. A record for Shaowu explicitly states that ‘when the water was gone, the epidemic came’ (水過疫作).<sup>50</sup>

In 1639 and 1641, two severe epidemics struck the Yangzi valley. Also, in the years 1641–1643, Zhejiang, Shandong, and almost the entire eastern coast was once again affected by plague and epidemics. Droughts, locust plagues, and epidemics frequently alternated.<sup>51</sup> Timothy Brook speaks of this series of disasters as the ‘Chongzhen slough,’ the Chongzhen emperor’s reign period lasting from 1627 to 1643.<sup>52</sup> No emperor of the Yuan or Ming dynasty before him faced as abnormal and severe climatic conditions as the Chongzhen Emperor. Tempera-

<sup>46</sup> Description, 1396–1398.

<sup>47</sup> Description, 1407.

<sup>48</sup> Ibid.

<sup>49</sup> Description, 1518–1519.

<sup>50</sup> Description, 1519.

<sup>51</sup> Description, 1730–1731.

<sup>52</sup> Brook, *The Troubled Empire*, 429.



tures reached a cold minimum between approximately 1629 and the 1640s.<sup>53</sup> Peak periods of LIA cooling coincided with erratic rainfall, typhoon-related inundations, and epidemics in the sixteenth–seventeenth centuries.

### SOME REMARKS ON MING-QING CHINA'S CRISIS MANAGEMENT

An eighteenth-century scholar, Liu Kui 劉奎 (fl. late eighteenth century) listed over seventy types of epidemic diseases, and integrated a discussion of religious and other healing practices in a work entitled *Songfeng shuoyi* 松峰說疫 (Speaking of Epidemics, 1786).<sup>54</sup> Like in most societies all over the world, religion played a major role in crisis management in Ming China. To sacrifice and pray to the gods and spirits of the ocean was an essential part of official ceremonies seeking to prevent damage and disaster. In Haiyan xian 海鹽縣, a 'Temple to the Sea God,' *Haishen ci* 海神祠, was established in 1405, and the local population called it 'Dragon King Temple,' *Longwang miao* 龍王廟. Every year 'in fall on the 18<sup>th</sup> day of the 8<sup>th</sup> month officials proceeded there to pray' (秋及八月十八日有司致祭).<sup>55</sup> In 1569, however, during a disaster, this temple was washed away.

Direct crisis management during floods included burying the dead, except not, of course, the many that drifted out to sea. Official subsidies and subventions, as well as private donations, were also essential. When too many corpses lay around, people and monks were hired to cover them. Government funds were used to reconstruct buildings and dikes, and to provide food, clothes, and medication. Tax exemptions were essential to encourage peasants to resume work, and so the sources repeatedly discuss tax exemptions after serious disasters.<sup>56</sup> Dams and dikes were built

<sup>53</sup> Ibid.

<sup>54</sup> Marta E. Hanson, *Speaking of Epidemics in Chinese Medicine: Disease and the Geographic Imagination in Late Imperial China* (New York: Routledge, 2013), 118. *Songfeng shuoyi* 松峰說疫, by Liu Kui 劉奎, in XXSKQS, 子部-醫家類.

<sup>55</sup> Zhou Zhiyuan, 'Mingdai Dongnan diqu de haichao zaihai,' 91: With reference to: Haiyanxian tujing 海鹽縣圖經 (1624), by Hu Zhenheng 胡震亨 and Fan Weicheng 樊維城, *juan* 2.

<sup>56</sup> Parallels can be drawn here with specific cases in Song China. See: Chapter by Ebner von Eschenbach, this volume.

for prevention purposes and had to be repaired and reconstructed expensively when destroyed after disasters. Such dikes and the reclamation of shorelands were also responsible for the growth of cities in Zhejiang and Jiangsu, as early as the Five Dynasties and the Song period (tenth through thirteenth centuries). Shanghai is one of the many cities originally built on reclaimed land.<sup>57</sup>

In 1587, the seawalls in Jiaxing were destroyed after a storm flood and had to be rebuilt. The local military governor (*xunfu* 巡撫), Teng Bolun 滕伯輪 (1528–1589), who had formerly worked in Panyu, Guangdong, where he had been involved both in the construction of the new town of Guangzhou and in repelling pirates, managed the repair of 571 *zhang* (approximately 1.9 km) and the reconstruction of 600 *zhang* (approximately 2 km) of sea dikes. He also added more than 2000 *zhang* (approximately 6.7 km) of a new dike section, in total spending more than 6800 *liang* of silver (roughly 212 kg). The construction works were not completed when he passed away by exhaustion, but he left his ‘Ten Point Discussion’ (*Shiyi* 十議), a summarized description of requirements when constructing dike and embankments to ward off storm surges.

The ten points were included in the Qing edition of the *Local Gazetteer of Zhejiang* (*Zhejiang tongzhi*). Here we only introduce his first discussion point, which provides insight into the share of responsibilities:

For the construction works, obligatory *corvée* labour should be used, organized in large transportation units, under the supervision of the Irrigation Circuit (*shuili dao* 水利道). Your humble servant’s responsibility lies in going from district to district to supervise the works, (*corvée* labour and the craftsmen), and one associate administrator from the local prefecture has to particularly take care of retracting funds and food supplies. As for the gathering of stones in the two prefectures Su(zhou) and Hu(zhou), two prefecture assistants are to be put in charge to jointly control the works; and for the dyke construction, sixteen officials should be appointed. Four officials shared control of the collecting of stones. Collectively, they commissioned guards to pass through the districts; horse recorders and other officials went through the province to select and recruit staff, so that there are enough people to be sent and to fill the positions.<sup>58</sup>

<sup>57</sup> H. von Heidenstam, ‘The Growth the Yangtze Delta,’ *Journal of the Royal Asiatic Society, North China Branch*, LIII (1922), 30–31.

<sup>58</sup> *Zhejiang tongzhi* 浙江通志, by Ji Zengjun 嵇曾筠 (1670–1738) and Shen Yiji 沈翼機 (Jinshi 1706), 63.62–13b (海塘二), Siku quanshu-edition, fasc. 519–526: <https://www.kanripo.org/text/KR2k0044/062> [Accessed: 7 July 2021]. The original text is as

The (re-)construction of dike was consequently a task that required well-organized supervisory structures and close cooperation between local and central authorities. The sources indicate that it seems to have remained primarily a government task, even if local authorities received private donations.

Private donations played a larger role when we look at the distribution of food, clothes, and medication after a local catastrophe had happened. Local authorities or officials often remained involved in crisis management though. As we have seen above, sometimes local officials were ordered to travel to the various districts and prefectures of a province to distribute medicinals, rice, and clothing. The case of Liu Hui from Quanzhou, Fujian, demonstrates that they sometimes also selected physicians to provide medicines and to cure the sick. Studying such phenomena, Angela Ki Che Leung has argued that healthcare became increasingly commercialized in the Ming and Qing periods, suggesting a gradual retreat of government.<sup>59</sup> But given these examples of governmental roles in crisis management, more research may be needed to discuss general tendencies or trends.

It is nevertheless clear that the failure to effectively control epidemics was not necessarily only the result of a lack of knowledge. Already in the early Ming period, infectious and non-infectious diseases were identified, and the symptoms were described in detail—as were treatments. Besides plague, smallpox was one of the great pestilences in this time. The Ming Chinese were already practising variolation (a simple form of inoculation), while the Manchus were not—definitely a major reason why the Manchus paid so much attention to quarantine and segregating people.<sup>60</sup> We possess good documentation of the widespread use of anti-smallpox

follows: 議委官塘工大役總大綱者水利道臣之責移駐該縣督理其董率官役工匠收放錢糧本府同知一員專理之次/則蘇湖二府採石合委府佐二員分管塘工應用官十六員分管採石應用官四員俱合委衛總縣丞簿等職於通省選取庶足充任使。

<sup>59</sup> Angela Ki Che Leung, 'Organized Medicine,' 134–66.

<sup>60</sup> 'Interestingly, the Manchu idea of segregation was to quarantine and protect those royalty who had not had smallpox rather than to isolate the sufferers. In case of any smallpox alert, the Manchu emperor and royal family members immediately escaped to their respective shelters,' called *bidou suo* 逼痘所 (shelters for avoiding smallpox). See: Chia-Feng Chang, 'Aspects of Smallpox and Its Significance in Chinese History' (Unpublished PhD diss., SOAS, 1996), 181. But they also banished infected individuals outside the city walls.

inoculation in the seventeenth century. A Ming dynasty physician, Leng Kaitai 冷開泰, wrote a treatise on smallpox during the Wanli period, entitled *Tianhua pushi* 天花譜史, *tianhua* or ‘heavenly flowers’ being another name for smallpox.<sup>61</sup>

Joseph Needham and Nathan Sivin additionally have drawn our attention to a certain Zhang Lu 張璐 (1695), whose work provides us with further information on how such an inoculation was practically carried out:

If you are unable to take [literally: ‘steal’] lymph from the pustules, you can use scabs to culture the inoculum. If there are no scabs to be taken, you can obtain clothing from a child who has just developed smallpox and give it to another child to wear; it too will develop smallpox. The point is to employ a similar pneuma (*chbi*); inchoate though it be, it can serve to guide out the womb poison.<sup>62</sup>

On the other hand, as Angela Ki Che Leung has observed, the Ming government did at no time ‘attempt to follow the example of Cai Jing or Su Shi of the Song, and segregate the ill from the well. ... The only important effort at quarantine undertaken in late imperial China occurred not during the late Ming epidemics but in seventeenth-century Peking under the Manchus, and its circumstances underscore that this was an alien tactic.’<sup>63</sup> She concluded that, while quarantine measures were more common in early modern Europe, the Ming state actually at no time took serious measures to impose a strict quarantine or otherwise try to segregate the infected people. We are, to use her words, rather confronted with ‘a slackening of bureaucratic intervention, and a democratization of medical knowledge.’<sup>64</sup>

Nevertheless, ‘social distancing’ in times of epidemics was not unknown to the Ming. The Ming scholar, Gao Cheng 高澄 (1494–1552),

<sup>61</sup> Available online under: <https://www.loc.gov/resource/lcnclscd.2012402208.1A001/?st=gallery> [Accessed: 7 July 2021].

<sup>62</sup> Joseph Needham, *Science and Civilisation in China*, vol. 6, *Biology and Biological Technology*, Part 6, *Medicine*, ed. Nathan Sivin (Cambridge: Cambridge University Press, 2000), 123.

<sup>63</sup> Angela Ki Che Leung, ‘Organized Medicine,’ 142.

<sup>64</sup> *Ibid.*, 154.

described the untenable circumstances on board many ships. He accompanied Chen Kan 陳侃 (1489–1538), who was sent to the Ryūkyū Islands as head of a mission to officially install Shang Qing 尚清 (Jap. Shō Sei, r. 1526–1555) as the new ruler of the Chūzan 中山 kingdom.<sup>65</sup> Gao Cheng was clearly aware of the fact that missing space greatly enhanced the transmission of germs and diseases, which had particularly negative effects on board ships, where hygienic conditions were invariably unsanitary.<sup>66</sup>

### CONTEMPORARY THEORIES ABOUT ENVIRONMENT, STORMS, AND DISEASES

Chinese thinkers and officials have been concerned about the relationship between Heaven, earth, and mankind since ancient times. The order of the world was supposed, according to traditional Chinese thinking, to depend on a harmonious balance of these three powers. Since the Han Dynasty (206 BCE–220 CE), disasters, including earthquakes, inundations, and locust plagues, were recorded in the chapter ‘Records on the Five Elements’ (*Wuxing zhi* 五行志) of the official dynastic histories. Correct behaviour of the rulers was believed to be responsible for harmony on earth or for disasters.<sup>67</sup> If an emperor wanted to rule well, he was supposed to correctly consider the so-called ‘five elements’ (*wuxing* 五行)—wood, fire, earth, metal, and water—and their relation to Heaven, earth, and mankind.<sup>68</sup> This ‘moral meteorology’ placed a heavy burden

<sup>65</sup> *Shi Liuqiu lu* 使琉球錄, by Chen Kan 陳侃, in ed., Guoli Beiping tushuguan shanben congshu 國立北平圖書館善本 (Shanghai: Commercial Press, 1937).

<sup>66</sup> *Shi Liuqiu lu* 使琉球錄 (1579), by Xiao Chongye 蕭崇業 (*jinsbi* 1571) and Xie Jie 謝杰 (*jinsbi* 1574), in *Shi Liuqiu lu sanzong* 使琉球錄三種 [Taiwan wenxian shiliao congkan 台灣文獻史料叢刊, 287] (Taipei: Taiwan datong shuju, 1970), 91 (使琉球錄卷上, 造船): With reference to: Gao Cheng’s *Caozhou ji* 操舟記. For a translation, see: Angela Schottenhammer, ‘Maritime Disasters and Risk Appraisals in the East Asian Waters,’ *Études thématiques* (2022).

<sup>67</sup> See, for example: Angela Schottenhammer, ‘Erdbeben in China: Entzug des “Himmlichen Mandats” oder Verlust des Yin-Yang-Equilibriums,’ in *Naturkatastrophen. Dramatische Naturereignisse aus kulturwissenschaftlicher Perspektive*, eds. Ilja Steffelbauer and Christa Hammerl (Wien: Mandelbaum Verlag, 2014), 90–129.

<sup>68</sup> The power and force of the five elements corresponded in Heaven to the celestial bodies of Jupiter, Mars, Saturn, Venus, and Mercury; and to virtue, integrity, justice, rationality, and reliability (or trustworthiness) as far as mankind is concerned.

on all emperors,<sup>69</sup> especially during years or periods in which many disasters occurred.<sup>70</sup> These cosmological linkages are exemplified by the works of contemporary scholars, two of whose works are discussed below, with special reference to climate, typhoons, and epidemics.

*Yuxi wenzai* 粵西文載 (Compendium of documents on the region west of Yue, i.e. Guangxi) includes an interesting discussion by Su Jun 蘇濬 (1541–1599) on the climate (*qihou lun* 氣候論).<sup>71</sup> Su Jun was employed in the southwestern province of Guangxi after 1590, and carefully observed there the relationship between climatic phenomena, the natural environment, and their impacts on the local population:

Chao Cuo 晁錯 (200–154 BCE)<sup>72</sup> says: “The territory that spreads across Yue [= Guangdong] has little *Yin* and much *Yang*.” Li Daizhi 李待制 says: “The earth in the south is inferior and the soil thin; when the soil is thin, then the *Yang* vapours frequently leak out. When the earth is inferior, the *Yin* vapours flow abundantly. When *Yang* vapours leak out, flowers frequently bloom in the four seasons. In three winters there is no snow, and in one year the hot summer time lasts longer than half a year. When people live there, the vapours rise and are obstructed, the skin produces lots of sweat, the pores do not close; this is caused by the *Yang* that cannot return properly. When *Yin* vapours are abundant, there is a lot of dew during dawns and dusks, in spring and summer, there is excessive rain; within one year, more than half of the time, [the weather of steaming vapours] dominates; in midsummer there is continuous rain, and when it gets extremely cold, the clothes are covered with white mould. The people then frequently [suffer from] dampness, their limbs get heavy and tired, and they frequently get diseases such as *beriberi* (脚氣). It is generally so because the *Yin* is constantly abundant. When *Yin* and *Yang* vapours are extreme and mutually shifting, then, within a day, the climate is constantly

<sup>69</sup> Brook, *The Troubled Empire*, 73.

<sup>70</sup> Paolo Santangelo discusses ecologism versus moralism in Ming-Qing times, while Helen Dunstan has provided an overview of official thinking on environmental issues in the eighteenth century. See: Paolo Santangelo, ‘Ecologism Versus Moralism: Conceptions of Nature in Some Literary Texts of Ming-Qing Times,’ in *Sediments of Time*, eds. Elvin and Ts’iu-jung, 617–56; Helen Dunstan, ‘Official Thinking on Environmental Issues and the State’s Environmental Roles in Eighteenth-Century China,’ in *Sediments of Time*, eds. Elvin and Ts’iu-jung, 585–614.

<sup>71</sup> *Yuxi wenzai* 粵西文載, by Wang Sen 汪森 (1653–1726), in SKQS, fasc. 1465–1467.

<sup>72</sup> Chao Cuo was a political advisor and official of the Western Han Dynasty (206 BCE–9 CE).

changing. A proverb says that ‘when the four seasons are like summer, once there is rain, it easily converts into fall.’ Another proverb says ‘to undress and dress again [when the climate is changing], is equal to taking medicine.’ When the weather conditions are like this, the vapours of human bodies are circulating between Heaven and Earth. The vapours of Heaven, in the farthest north, are extremely cold; in the farthest south, heat is extreme. [The region] south of the Five-Mountain-Passes, is called the ‘hot weather zone’ (*yanfang*). The high hills there are a range of peaks, left and right enclosed by water; the vapours are damp and steamy, so that the vapours from mountains are accumulated and become misty (鬱而為嵐). Only in Quanzhou 全州, close to Huxiang 湖湘 (= Hunan), in mid-winter, there is lots of snow, and the climate resembles the districts in the central plains (中州). This stops at Guilin 桂林全州 Zimei 子美 [Du Fu 杜甫 (712–770)?] said: ‘In the Five-Mountain-Ranges [the climate] is very hot and only Guilin has pleasant weather.’ He was telling the truth. Left and right there are two rivers (Li and Yijiang River), bordering Zhao and Wu 昭梧 Prefectures. Places in the distant wilderness have barely acceptable [weather condition]; but in cities located close to gorges or to low-lying and damp [places] with rough mountain passes, there are (places) where one can see the colour of the sun only close to noon. In the creeks and the uncivilized highlands where the southern barbarians live, with luxuriant vegetation, where large, poisonous snakes come and go, the water of the river contains poison, and the pestilential (malaria) vapours (瘴氣) turn infectious. In the 3<sup>rd</sup> month (i.e. in spring) this is called ‘green-grass miasma’ (青草瘴), in the 4<sup>th</sup> and 5<sup>th</sup> month (i.e. in the rainy summer season called *mei*) this is called ‘yellow-*mei* miasma’ (黃梅瘴), in the 6<sup>th</sup> and 7<sup>th</sup> month (i.e. in late summer, early fall) this is called ‘ripening-crops miasma’ (新禾瘴), and in the 8<sup>th</sup> and 9<sup>th</sup> month (i.e. fall) it is called ‘yellow-reeds miasma’ (黃茅瘴); it is also called ‘sweet osmanthus miasma’ (桂花瘴) or ‘chrysanthemums miasma’ (菊花瘴).”

This quotation clearly demonstrates the climate consciousness of the author and shows how closely he connected malaria outbreaks to local environment and climate. ‘Miasmas’ have been discussed in Chinese literature, medicinal, local administrative and statecraft sources for centuries. ‘*Zhang*,’ a pathogenic, atmospheric agent related to ‘water caused’ diseases in a broader sense, the most important of which is malaria. Although Su Jun did not understand the real causes of malaria, he, like many before him, comprehended that local conditions, a wet and humid

climate, that was feared by most Chinese from the north, were very conducive to its spread.<sup>73</sup>

Another author, who lived approximately 100 years later, also discussed the environment and natural phenomena. The Cantonese literati, Qu Dajun 屈大均 (1630–1696), left a collection of notes in his home province Guangdong. In his *Guangdong xinyu* 廣東新語 (New Discourse on Guangdong; around 1680), he wrote not only about miasmas,<sup>74</sup> but also, for example, about the ‘typhoon spirit’ (*jufeng shen* 颶風神):

Yue 粵 (= South China Yue region, including Guangdong) is located in the south (離方). As far as typhoons are concerned, the grief of the southern head-winds cannot be escaped there, the fire vapours (火氣) burst out and turn into dangerous calamities. In Yue, typhoons occur every year. Mostly they rise from (the direction of) Qiong[zhou] 瓊 and Lei[zhou] 雷 [i.e. from Hainan and the Leizhou Peninsula], that is, from the utmost point in the south [of China]. This is why Qiong and Lei both have a typhoon temple (颶風祠). Its god is the mother of the typhoons. The local authorities offer sacrifices during the Dragon Boat Festival (端午日). During their procession they offer gifts; they truly fear it. If there is a typhoon, then all the winds [of the four directions] are being possessive (颶者具也). Once a typhoon rises, the winds from the east, west, south, and north all unite into one single wind. This is why it is called *ju* 颶 (that means, a wind that possessively unites all winds together). As far as the term ‘mother (of the typhoons)’ is concerned, it is so called, because a typhoon can produce winds of four directions, and it thus becomes the mother of the winds of the four directions; separating the wind of any one single direction, can develop into a storm (大風). This is why it is called the mother. Also *xun* 巽 [i.e. one of the eight diagrams, representing wood and wind] produces wind; the eldest daughter of *qian* 乾 [i.e. the diagrams representing Heaven] rules it. Thunder (雷) is meant to restore the nature (性) of the ten thousand things; it has the way (道) of the father. This is why it is called lord (or father). The wind is meant to restore the fate (命) of the ten thousand things; it has the way of the mother. This is why it is called mother. When a storm (大風) is the mother, then a little breeze (微風) is consequently either a little boy or a little girl. What rises from the marshes (澤) is called “little girls’ wind”, what rises from the mountains (山) is called “little boys’ wind”; and they all have the typhoon as mother. And as ruler of the wind, *Xun* is the root and origin of moon and water.

<sup>73</sup> An excellent overview has recently been provided in: Erhard Rosner, *Miasmen*.

<sup>74</sup> See, for example: *Ibid.*, 29.



Moon and water both are born from wind; this is why it is called mother. There is a saying that the typhoon mother is the goddess of the winds (*mengpo* 孟婆). In spring and summer there are vapours that resemble the halo [or aura] around the moon, [and that is Mengpo]! This saying probably takes a halo as the typhoon mother, but Po [婆; from Mengpo] is in fact Mu 母, namely the mother.

Of the gods of the earth, there are no more powerful (大) than thunder and wind. Thunder and wind give birth to sun and moon. To serve the god of the thunder means, thus, to serve the sun. To serve the god of the winds means, thus, to serve the moon. And the god of thunder resides in Leizhou 雷州 [lit. “Thunder district”], and the god of the winds resides in Qiongzhou. These two districts are, thus, the utmost south. The utmost south, this is the lowest point of the earth (其地最下). Thunder is born at the lowest point of the earth and the winds follow it. This is why the gods of thunder and wind are located there!<sup>75</sup>

Qu Dajun sought to understand the origins of and causes of typhoons, which brought so much damage and sorrow to the people, including epidemics. In the passage quoted at the beginning of this chapter, we read further that the historical annals claim that there were annual disasters of ‘wind fish’ (*fengyu* 風魚) in the Southern Seas. The winds in this context were typhoons, and the fish was possibly some kind of river dolphin, Lipotidae (*ji* 鯨), of which dark and white ones exist.<sup>76</sup> Because they came suddenly with the wind, they are also called ‘wind fish.’<sup>77</sup> Interesting in this quotation is also the statement about the frequency of the coming of these fish. This statement attests to shifting cycles of typhoons, and to a direct relation between frequent typhoon disasters and the outbreak of epidemics.

<sup>75</sup> *Guangdong xinyu* 廣東新語, by Qu Dajun 屈大均 (1630–1696) [Lidai shiliao biji congkan 歷代史料筆記叢刊] (Beijing: Zhonghua shuju, 2006), 6.201–202.

<sup>76</sup> The *Hanyu da cidian* 漢語大字典 states for the entry of “*ji*”: is the same as 鯨; and the entry explains that the character “*zhu*” 鯨 is identical with the character “*ji*” 鯨, and these are “*baiji*” 白鯨 (white fish). *Hanyu da cidian* also provides Qu Dajun’s text on 鯨魚 as an example; Qu Dajun namely continues saying that the character is also written as (暨一作) and he states that there are white and dark ones. These white lipotidae (dolphins) actually only lived in the Yangzi River. The observation from *Guangdong xinyu* may thus be interpreted as that, depending on the typhoon cycles and possibly directions, these dolphins (or fish?) actually occurred along the Guangdong coast.

<sup>77</sup> *Guangdong xinyu*, 22.550.

Scholars were also conscious of and sensitive to the impacts of environmental and climatic factors on the health and daily lives of ordinary people. This is, for example, reflected in significant changes in the thinking and theories of contemporary medical theorists and scholars, as Marta H. Hanson has elsewhere shown. Hanson has in detail investigated diseases and geographic imaginations as a core theme in Chinese medicine, and has shown how medicinal doctrines and perceptions changed in the late Ming. She argued, that it was not before 1642 (towards the very end of the Ming dynasty) that ‘warm diseases’ came to be considered as a separate disease category worthy of analysis: ‘Wu Youxing 吳有性 (c. 1582–1652; also Wu Youke 吳又可) argued that a specific pestilential or deviant *qi* (pneuma or vapour) rather than the usual unseasonable *qi* caused ‘warm epidemics’ (*wenyi* 溫疫). His *Treatise on Warm Epidemics* (*Wenyi lun* 溫疫論, 1642), gave *wenbing* a contagionist tenor.’ As a result of his critique, *wenyi* 瘟疫 (febrile epidemics), defined as the most severe form of *wenbing*, became a new topic of medical analysis. The term itself was already used earlier, and we encounter several records on *wenyi* in the sixteenth century.<sup>78</sup> The fact that the water radical is added to the character ‘*wen*’ may indicate that many epidemics and diseases were in one or the other way related to water, such as from inundations or heavy rainfall. Wu Youxing also discussed the role of poison, pathogenic local *qi*, and person-to-person transmissions. The contagionist view understood epidemics to be caused by human-to-human transmission via some kind of pathogen.<sup>79</sup> This ‘contagious turn’ in the conception of Chinese, relating the outbreak of diseases rather to pathogenic factors instead of just the environment, only occurred in the late Ming through early Qing dynasties. Hanson also observed that medical essays on the Guangdong region ‘reveal a conceptual shift from climate-consciousness to a poison-consciousness.’<sup>80</sup> Chen Sicheng’s discussion of ‘Cantonese sores,’ the *Secret Account of Rotting Sores* (*Meichuang milu* 霉瘡祕錄, 1632) may be taken as a case in point.

<sup>78</sup> Human-to-human transmission certainly occurred, for example, in 1562 Jinjiang 晉江 (Fujian). See: Description, 1257. In 1596, a major smallpox pandemic (痘疹) is mentioned for Shaowu 邵武, Fujian that caused uncountable deaths. See: Description, 1450.

<sup>79</sup> Hanson, *Speaking of Epidemics*, 18.

<sup>80</sup> *Ibid.*, 79.

## CONCLUSION

The period between 1550 and 1640 is significant for a high frequency of La Niña years, according to climatologists. Tentative subsequent research by other climatologists suggests that this may have contributed to the heightened frequency of typhoons making landfall in South China and Southeast Asia. This chapter generally, despite often thin source material, supports this hypothesis: We do indeed encounter many more typhoon incidents for South China: Guangdong province was severely affected, in comparison to China's southeastern coastal provinces, such as Fujian and Zhejiang. But it remains near to impossible to establish any direct correlations between specific El Niño or La Niña years and reduced or increased precipitation and inundations.<sup>81</sup> A tentative reconstruction of ENSO years taken from the KNMI Climate Explorer and from NOAA (National Oceanic and Atmospheric Administration)<sup>82</sup> would actually even suggest the opposite, or at least not confirm any direct correlation. Data recording of these kinds of disasters is simply not even enough for this early period. There are too many holes in our records to be able to provide more reliable dates and estimations concerning correlations between El Niño and La Niña years and typhoon landfalls. We will have to include yet more data from China's northern coastal provinces and Northeast Asia in general, as well as from Southeast Asia, southern Japan, the Ryūkyū Islands, Taiwan, the Philippine Archipelago, as well as Guangxi, Hainan, and northern Vietnam. But these will only be able to show us general tendencies, not the kind of climate reconstruction charts we are used to from NOAA for later periods.

Due to the lack of traceable data, not only on precipitation, we can only select years and locations for which significant rainfalls and inundations are reported in our sources and compare these years with other locations, in order to receive some very general insights into which years and where inundations were particularly frequent. We can then check if or not they

<sup>81</sup> Our first comprehensive data analysis for typhoon landfalls in China's northeastern provinces will only be available after further research. For this reason, I have focused this chapter mainly on where we have already collected data, namely, Fujian, Guangdong, and Zhejiang Provinces.

<sup>82</sup> The World Meteorological Institution (Koninklijk Nederlands Meteorologisch Instituut), see: <https://www.knmi.nl/home> [Accessed: 7 July 2021].

were related to, for example, typhoons. The result will be a general picture but nothing like what we are used to for the period after ca. 1850.

Generally speaking, as all analyses show, there are by far more reports on inundations than on any other calamity—a fact that has political and ideological reasons, as severe floods and inundations could pose a serious threat to political rule. The concrete causes for the inundations, flooding rivers, tidal floods, or heavy rainfalls, are, however, often not easy to trace back, as sources do not always specify where the water came from and just speak of ‘water calamities’ (*shuizai*). The fact that Jiangsu province in particular experienced more inundations than, for example, Fujian and Guangdong can certainly be explained by Yangzi River flooding. Both heavy rainfalls and storms have time and again caused catastrophic calamities in the region. The records also demonstrate that nearly all typhoons went along with tidal disasters, which occurred frequently in the coastal regions. Most inundations happened between the late 1530s and the early 1640s, with special peaks during the periods between 1521 and 1540, the 1570s to the early seventeenth century, and the late 1620s to mid-1640s. Jiangsu and Zhejiang province were most affected, followed by Guangdong, where we see a high concentration in and around the Canton River Delta.

As far as epidemics are concerned, Guangdong was, relatively speaking, little affected. Zhejiang in particular was the region experiencing most epidemic outbreaks during the period under investigation. We can observe epidemic peaks across coastal China in the periods 1581–1600 and again 1641–1660. For Zhejiang, the former period was definitely yet more severe than the latter—when, for example, for the northern province of Zhili, the total quantity of reported epidemics was yet higher than in Zhejiang, while we have almost no recorded typhoons.

A relation between some natural catastrophes, such as inundations, and diseases is, however, obvious. As we have seen, in Fujian, for example, almost 80% of the recorded diseases that broke out in Ming Fujian were related to floods and typhoons. Additionally, above we have introduced some snapshots of local typhoon and tide disasters, inundations in general and possible correlations with the outbreak of epidemics and climatic changes. But further research and yet more data are needed to obtain a better picture not only of local micro-histories and crisis management on the ground, but also of possible general tendencies and correlations.

So, how should we proceed in future research? First, as part of our ongoing TRANSPACIFIC and ‘Appraising Risk’ projects, we will

need to expand our research into the larger East Asian maritime space, including Northeast and Southeast Asia, as well as island archipelagos located in the (South-)East Asian area. Second, we will need to cover longer time periods and always thoroughly consider human–environment interactions. Only then will we be able to provide meaningful statements on developments in the spread of diseases in conjunction with changing environments, global travel, and local crisis management. At the same time, due to our uneven and sketchy data for the middle and early modern periods, we need to focus on well-documented cases in varied and multi-lingual sources, apply a historical comparative-analytical approach, examine documents of different contents, provenience, and types (such as diaries, travelogues, local gazetteers, missionary reports, medicinal texts, and administrative and judicial documents), and adopt modern scientific approaches to gain insights into the effectiveness of historically applied ‘medications.’ Early modern treatments and medications, for example, mostly consisted in a decoction or combination of herbs and other medicinal plants, many of which have undergone a thorough clinical investigation and testing in present times. Camphor, for example, is a case in point, as are *Salvia miltiorrhiza* (*danshen* 丹参) and ginseng Taiyi pills (*taiyi dan* 太乙丹).<sup>83</sup> In an article discussing the relationship between climate, environment, and the spread of diseases in early modern coastal China and (South-)East Asian maritime space, I have selected various case studies from the seventeenth to the nineteenth century to demonstrate which directions our research should take, which sources and methodologies we should use, and what we can learn from

<sup>83</sup> For a detailed discussion of camphor, see my: ‘Some Remarks on the Use and Provision of camphor in Early Modern China and in Spanish Asian and American Colonies,’ in *From the Steppe to the Sea: A Festschrift for Paul Buell*, eds. Timothy May (forthcoming). Clinical trials, for example, have been conducted to test the efficiency of camphor in treating asthma. See: Rafie Hamidpour, Soheila Hamidpour, Mohsen Hamidpour, and Roxanna Hamidpour, ‘The Effect of Camphor Discovery for Treating Asthma,’ *Biotechnology Advances*, 1 (2019), 1–4: *Advances in Bioengineering and Biomedical Science Research*, 2019, [www.opastonline.com](http://www.opastonline.com) [Accessed: 4 Jan. 2022]. For ginseng Taiyi pills, see: Xijun Yan, ed., *Dan Shen (Salviamiltiorrhiza) in Medicine*, Vol. 3, *Clinical Research* (Dordrecht: Springer, 2015), 257, table 17.8. These pills could contain a variety of different ingredients, were administered in different preparations, and could have antimicrobial qualities.

them.<sup>84</sup> I hypothesize that there existed a close connection between the increasing global integration of East Asia, environmental problems, and the occurrence of specific diseases, which, in turn significantly influenced risk appraisal and crisis management, including medical treatment.

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<sup>84</sup> Angela Schottenhammer, 'Climate, Environment, and the Spread of Diseases in Early Modern Coastal China and (South-)East Asian Maritime Space,' *Guojia hanghai* 国家航海, 27 (2021), 161–91.

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