Climate History of Asia (excluding China)

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Introduction

As the largest landmass on Earth, the climatic history of Asia is of paramount importance. However, with the exception of China {see Hao, this volume}, research on the historical climatology of the continent remains in its infancy. Instrumental observation of weather in Asia began earlier than in many other parts of the world. In Siberia, observations date back to the formation of the Russian Central Physical Observatory in 1849 (Fleming 1988), while the genesis of the Japanese Meteorological Agency began with the founding of the Tokyo Meteorological Observatory in 1875. Systematic meteorological observation in India and Indonesia began shortly after the establishment in 1854 of national meteorological services in the UK and Netherlands, the colonial countries who then governed these regions. The *Magnetisch en Meteorologisch Observatorium* in Batavia (Jakarta) was established in 1866, and the Indian Meteorological Department in 1875.

Reconstruction of climate for periods prior to the mid-19th century using documentary sources is only just commencing, although it is further advanced in Japan than in other regions of the continent (excluding China). Reconstructions using tree rings are common in the Himalayas, the Mongolian Steppes, northern Japan, and parts of Siberia. Coverage in tropical regions is much weaker due to the general absence of trees producing annual growth rings, although researchers have begun to derive climatic data from teak species (*Tectona grandis*) (e.g., Cook et al. 2010).

As the climate of Asia is extremely diverse—ranging from subarctic in Siberia (Df in the Köppen classification) to tropical rainforest in Indonesia (Af) —the continent will be divided into five regions for the purposes of this chapter. These are Arabia and West Asia; the Indian Subcontinent; Japan and Korea; Southeast Asia and Indonesia; and Siberia and Central Asia.

Arabia and West Asia

The documentary record of the Islamic world has been identified as a potentially fruitful source of historical climate information. Arabic (and other) language documents have been used substantially for information on historical astronomical occurrences (see Domínguez-Castro et al. 2012 and references therein). However, climate reconstruction has as yet been either preliminary (Grotzfeld 1991, 1995, Bulliet 2009, Weintritt 2009, Vogt et al. 2011, Domínguez-Castro et al. 2012) or focused on the Iberian peninsula (de Miguel 1988, Domínguez-Castro et al. 2014). The documents available for climate reconstruction are predominantly *ta'rikh* (history) chronicles, which require careful interpretation for climatic information. Moreover, many have been lost, existing now only in copy or abridged format (Domínguez-Castro et al. 2014). (On North Africa and Nile Valley, see also {Nicholson} and {Damodaran et al.} in this volume.)

Nevertheless, some reconstruction has been undertaken for the period 800-1500 AD, notably for Iraq, Syria and Palestine. Using references to freezing conditions, Ricardo Domínguez-Castro and colleagues identified that the 10th century AD in Iraq witnessed a greater frequency of cold winters than the 20th. Steffen Vogt and colleagues have further demonstrated that winters from 900-950 and 1020-1070 AD were particularly wet. At a more coarse resolution, using documents from the late Roman Empire, McCormick (2012) identified droughts in Palestine from 210-220 and 311-313 AD, a return to wetter conditions around 400 AD, and further droughts from 523-538 AD. Available information on the Arab world becomes more limited after 1500 AD, a reversal of the situation in most other part of the world. This is likely related to a shift in the focus of the chronicles from accounts of events to biographical data and anecdotes at the turn of the 16th century (Grotzfeld 1995).

The climate history of Anatolia has received somewhat more attention than that of the Arab world. Several scholars have undertaken studies assembling and mapping historical references to climatic and meteorological events during Hellenistic and Roman times.[1] Byzantine historians have compiled more extensive descriptions of climate (particularly extremes such as drought and freezing winters) from the 4th-15th centuries AD. Some researchers have recently begun to integrate those descriptions with archaeological finds as well as paleoenvironmental reconstructions, with the goal of formulating a more comprehensive interdisciplinary climate history of Byzantine Anatolia. So far this research has identified probable periods of colder drier climate during the 4th-5th and late 8th-9th centuries, and possibly warmer wetter climate during the 10th-early 11th centuries (Telelis 2008; Haldon et al. 2014). The Ottoman period (ca.1300-1923AD) offers further potential for detailed documentary-based climate reconstruction, including, among other sources, numerous chronicles, travel narratives, records from the imperial archives in Istanbul, and European diplomatic dispatches. So far only a handful of studies have analyzed particular episodes in Ottoman climate history, including Sam White's (2011) study of drought, rebellion, and crisis during the late 16th-17th centuries.

The Indian Subcontinent

Substantial written information on the climate of the Indian subcontinent becomes available from around 1700 AD onwards. This is predominantly due to the knowledge-production project of various European colonial and missionary groups, particularly the British East India Company (Grove 1998). In recent years, scholars have begun to explore the documentary record of the East India Company to reconstruct the historical intensity of the monsoon and extreme meteorological events. The earliest reconstructions derive from records of the Royal Danish Lutheran-Protestant Mission in Tranquebar, which date from 1710 (Walsh et al. 1999). In western India, the records of the East India Company have been used to reconstruct monsoon duration and intensity from 1780 to 1860 (Adamson and Nash 2013, 2014). These reconstructions have demonstrated a long-term change in the average date of monsoon onset (Figure XX.1),

[1] e.g., M. McCormick et al., "Geodatabase of Historical Evidence on Roman and Post-Roman Climate" (2012), https://docs.google.com/spreadsheets/d/1meoPMwiiVZ_buAYgasx5NBt7Gz3Ar9LJysco6npzEgY/edit

and have been used to explore the long-term relationship between the Indian monsoon and the El Niño Southern Oscillation. Using a selection of personal diaries from early 19th-century Bombay, George Adamson (2014) has also demonstrated that monthly maximum temperatures were then around 5°C lower than today, likely a result of the urban heat-island effect.

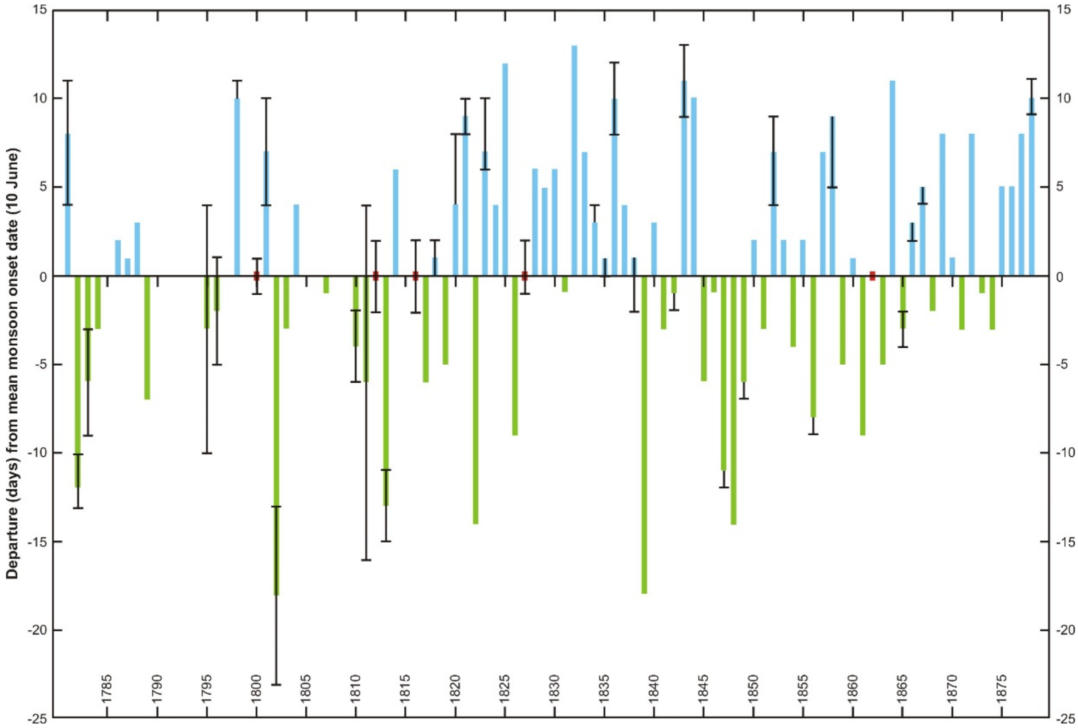

Figure XX.1: Reconstructed date of monsoon onset over Bombay for 1781–1878 (with error bars). Positive values indicate a later date of monsoon onset. From Adamson and Nash (2013).

For the pre-colonial period, G.B. Pant and colleagues (1993) reviewed a number of different types of written source material to uncover broad-scale monsoon variability for the past ~1000 years. This work revealed a 12-year drought between 1397 and 1408 and a random distribution of drought from 1600 AD onwards. Recorded drought before this date was relatively low, likely due to a lack of preserved documentary evidence.

Japan and Korea

Japan is one of the best-served regions for documentary climate reconstruction in Asia. Written evidence of climatic phenomena extends back to 55 AD (Ingram et al. 1981). Historical sources for climate reconstruction are reviewed in Takehiko Mikami's 2008 paper "Climatic Variations in Japan Reconstructed from Historical Documents" (Mikami 2008). The longest and possibly most robust record available is that of the "cherry blossom festivals," which coincided with the date of spring flowering of cherry trees at Kyoto, recorded regularly in diaries and chronicles. Flowering was found to correlate closely with average February-March temperatures, allowing springtime temperature to be reconstructed back to 801 AD (Aono and Omoto 1994, Aono and Kazui 2008, Aono and Saito 2010). Similar studies have been undertaken for Tokyo (Aono 2015). Likewise, the dates of ceremonies for the *Omiwatari* on Lake Suwa (a crack in the ice running the full length of the lake, caused by diurnal temperature variations) reach back to the 15th century. The date of freezing was found to be highly correlated with mean December-January temperatures, allowing reconstruction of these temperatures back to 1444 AD (Mikami 2008). A large number of weather diaries from the 18th century onwards have been digitised in the Historical Weather Database of Japan (see Mikami 2008, for further details), also enabling reconstruction of summer temperatures. These show a general increase in temperatures from around 1800 onwards, although this increase is not uniform (Mikami 2008). Other studies have used references to typhoons in documentary materials to reconstruct northwest Pacific typhoon frequency and tracks during the 19th century (e.g. Grossman and Zaiki 2009).

Woo-Seok Kong and David Watts have undertaken a coarse-grained reconstruction of precipitation, frost, droughts and floods for Korea using documentary evidence (Kong and Watts 1992). This reconstruction demonstrates major cold phases from 1001 to 1400 AD, dry phases during 201-600, 701-900 and 1001-1300 AD, and humid phases from 400 to 500 and 1000 AD to the present. Famine seems to have been associated with the cold phases. Gyo-Ho Lim and Tae-Hyeon Shim additionally used the Annal of the Chosun-Dynasty to reconstruct extreme weather events from around 1400 AD, indicating extreme droughts around 1440, 1600 and 1680, and wet periods around 1410, 1520 and 1660 (Lim and Shim 2002). The authors are unaware of any other such studies in Korea, although some may be available in the Korean language.

Southeast Asia and Indonesia

Southeast Asia and Indonesia have generally been understudied with regards to documentary climate analysis, although tree-ring reconstruction has been undertaken in parts of Java and Thailand. The authors are aware of no precipitation or temperature reconstructions, despite a wealth of documentary materials available from the records of the Dutch East India Company (VOC) and Dutch colonial government, as well as in local languages. More work has been done on cyclones (typhoons), particularly in the Philippines. Ricardo García-Herrera and colleagues (Ribera et al. 2005, García-Herrera et al. 2007, Ribera et al. 2008) reconstructed landfalling typhoons over the Philippines from 1566 to 1900, particularly using records compiled by the Spanish Jesuit Miguel Selga in 1935.

Research by historians not specifically designed to reconstruct climatic variability has uncovered evidence of extreme events, particularly drought. Victor Liberman has outlined evidence for drought in Burma, Cambodia and Vietnam during the 14th century (Liberman 2011), a period that saw the concurrent decline of Pagan, Angkor and Dai Viet. Brendan Buckley and colleagues reviewed evidence for climate extremes in central Vietnam from the 13th-18th centuries using historical chronicles (Buckley et al. 2014). They note in particular a period of heavy climate-related mortality associated with the 17th-century “crisis” (also discussed by Reid (1990) and Boomgaard (2001)). In general such analysis has been only descriptive, and systematic climate reconstruction from documentary sources in the region remains elusive.

Siberia and Central Asia

Despite the availability of a number of sources of documentary evidence, most notably historical chronicles and Russian governmental documents and grade books, documentary-based climate reconstructions in Siberia and Central Asia also remain very limited. Much of the early work on the historical climatology of the former Soviet Union east of the Urals is reviewed by Borisenkov (1992, and references therein). Of particular note are the relatively mild climate conditions reconstructed in Siberia during the early-mid 17th century—at the heart of the Little Ice Age—when conditions were sufficiently favourable to allow Russian vessels to sail from the Kola Peninsula to Chukotka in northeast Siberia and through the Bering Straits, opening up a trade route to the Pacific. The authors are aware, though, of no other significant studies.

Conclusion

Despite its size, the climate history of Asia (outside China) remains far less studied than Europe or North America. The chief source for historical climate patterns in much of the continent is the Monsoon Asia Drought Atlas, deriving predominatly from tree-rings (Cook et al. 2010). However, this work is contrained by the geographical spread of the growth-ring producing trees (mostly located in the Himalaya) and has been found to be unreliable in places (see Adamson and Nash 2014). Documentary climate reconstruction that has been undertaken has shown the importance of such approaches for understanding long-term climate variability, and the influence of climate on social change. Other work not specifically designed for climate reconstruction has demonstrated the potential of the written record in the region, and it is hoped that the climate history of the continent will continue to be revealed in the future.

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