

graphical sequence, although the smallest sampling interval is only 13 cm, and they reveal a ~4,000-year continuous depositional history (Fig. 1). The results indicate that the deposition rate varied in the range of 0.8 and 24.6 mm/yr, with an average of 3.85 mm/yr. Two fast deposition periods, one from 103 to 305 AD and the other for the last 1,000 years, are identified. Episodes of elevated depositions within the last 1,000 years correlate well in timing with strong storm events identified from U-series dates of storm-relocated coral blocks in the area (Yu et al., 2004b). Therefore, coral reef lagoon profiles provide great potential for high-resolution (4-10 years) and continu-

ous climate and environmental reconstruction in the tropical oceans.

Apart from the above outlined research topics, we are also undertaking research on U-series dating of recent coral mortality history, sea-level fluctuation on millennial-to-century scales, and radiocarbon reservoir age change in the SCS since the mid-Holocene.

REFERENCES

- Zhang, Q.M., Yu, K.F., Shi, Q. and Zhao, M.X., 2005: The Outcome of Global Coral Reef Monitoring and the New Strategy for Global Coral reef Conservation and Management, (in Chinese with English abstract).
- Yu, K.F., Zhao, Y.X., Wei, G.J., Cheng, X.R., Chen, T.G., Wang, P.X. and Liu, T.S., 2005a: $\delta^{18}\text{O}$, Sr/Ca and Mg/Ca records of *Porites lutea* corals from Leizhou Peninsula, northern South China Sea and their

applicability as paleothermometers, *Palaeogeography Palaeoclimatology Palaeoecology*, **218**: 57-73.

Yu, K.F., Zhao, J.X., Wei, G.J., Cheng, X.R. and Wang, P.X., 2005b: Mid-late Holocene monsoon climate retrieved from seasonal Sr/Ca and $\delta^{18}\text{O}$ records of *Porites lutea* corals at Leizhou Peninsula, northern coast of the South China Sea, *Global and Planetary Change* (in press).

Yu, K.F., Zhao, J.X., Liu, T.S., Wei, G.H., Wang, P.X. and Collerson, K.D., 2004a: High-frequency winter cooling and reef coral mortality during the Holocene climatic optimum, *Earth and Planetary Science Letters*, **224**(1-2): 143-155.

Yu, K.F., Zhao, J.X., Collerson, K.D., Shi, Q., Chen, T.G., Wang P.X. and Liu, T.S., 2004b: Storm cycles in the last millennium recorded in Yongshu Reef, southern South China Sea, *Palaeogeography Palaeoclimatology Palaeoecology*, **210**(1): 89-100.



Sorting Chinese Climate Records from the 13th Century BC to 1911 AD and their Latest Applications

DE'ER ZHANG

National Climate Center, Beijing 100081, China; derzhang@cma.gov.cn

A myriad of historical documentary records in China preserves one of the paramount sources of paleoclimate data marked by definite description of place and time of climate events over thousands of years, and is thus of particular importance to chronologically calibrating such proxy data as tree rings, ice cores and sediments, not to mention their strong humanism inference. Chinese researchers began in 1985 to assemble and sort systematically the meteorological records from historical documents, and have recently finished a book entitled "A Compendium of Chinese Meteorological Records of the Last 3000 Years" (Zhang, 2004).

Compiled on a chronological basis, this collection represents a splendid archive of ancient Chinese cultural heritage and scientific contributions, covering various weather/climatic conditions, atmospheric physical phenomena, and other written records related to meteorological conditions over 3,000 years, from the 13th century BC to 1911 AD (Fig. 1).

This compendium is composed of four volumes. Each volume contains the following records: (1) descriptions of weather, climate, and atmospheric physical phenomena, including flood, drought, rain, snow,

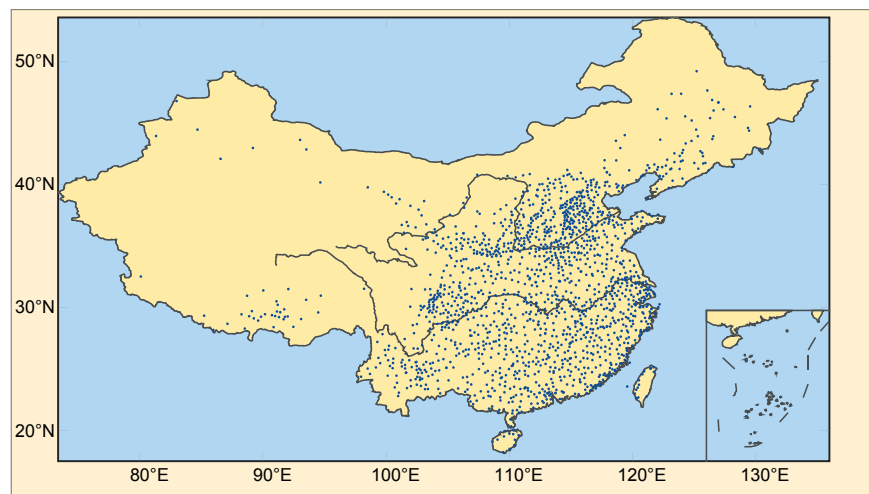


Fig. 1: Distribution of places of the historical climate records in the Compendium.

cold, heat, icing, freezing, frost, hail, wind, dust and haze, storm, thunder and lightning, atmospheric optical phenomena, and the time and location of these phenomena; (2) spatial coverage and degree of damage caused by meteorological disasters and the relief and tax waiver afterwards, and; (3) phonological, crop yield, insect damage, plague and famine records that are related to meteorological conditions. Because of the very large quantity of records starting from the Ming Dynasty, records of the same year in the Ming and Qing Dynasties (1368-1911 AD) are further sorted according to their

provincial locality. Modern names for the recorded localities are also given for convenience.

The original data came from 65 libraries and archives in 37 cities of the country, and they were collected according to different categories prepared in advance. We have read through all the books and records for seeking and selecting, with the materials made into various duplications (photocopies, microfilms and hand-written copies). The books and records selected amount to 8,228, of which 7,835 were chosen, including 7,713 local chronicles, 28 kinds of chronicles and many official docu-

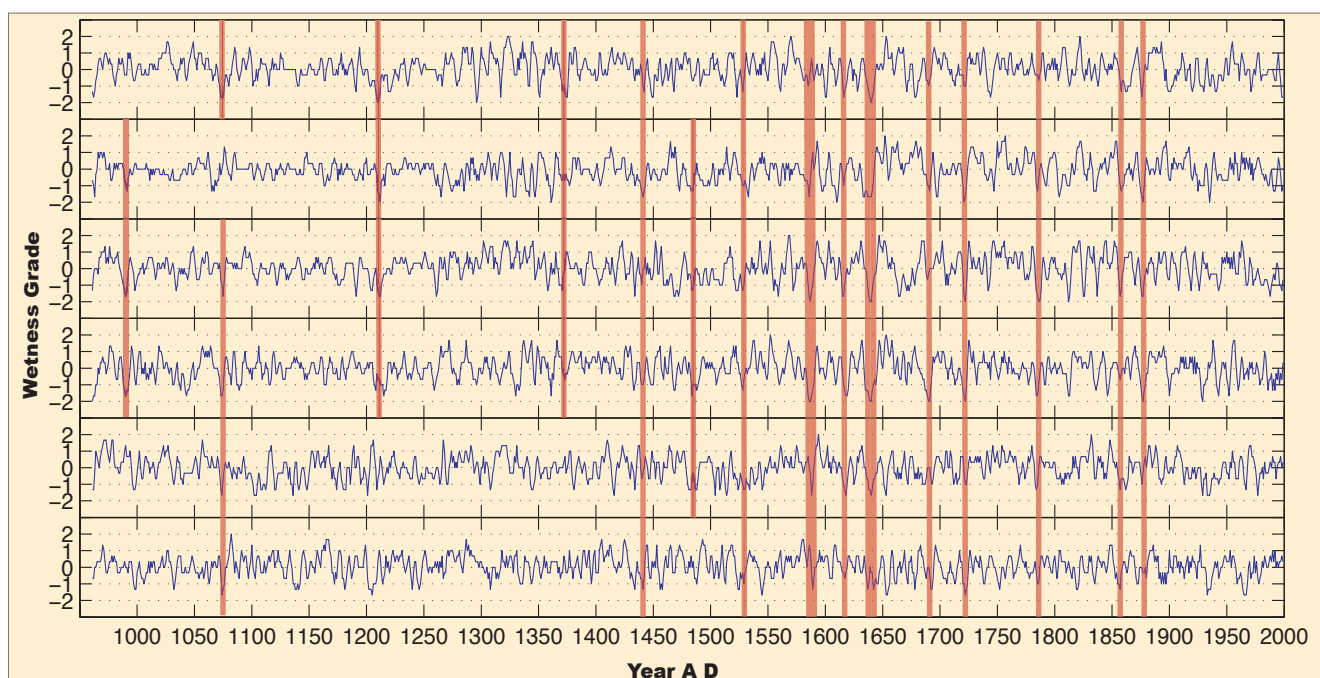


Fig. 3: Yearly wetness grade series (with 3-year running mean) for the 6 regions I-VI in eastern China for 960-2000 AD and 15 severe droughts marked by brown stripes (Zhang, 2005).

ments, scholars' prose volumes and tablet inscriptions over a very long period. It is worth mentioning that the duplications comprise more than 10,000 volumes, forming an unprecedented centralized collection of Chinese historical climatic data, and they will serve as a reference database of historical climate records for researchers undertaking various studies in the country. Records of personal diaries and from the Royal Archives of the Qing Dynasty are not included because of their different style. The materials included in the more than 200,000 records collected initially underwent careful checking and correction against other data, with the source of each piece investigated, and verbal errors arising from multiple sources of

publications and/or quotations being corrected. During compilation, if an event appeared more than once in the records, the earliest source was generally taken. An event found in a number of books was selected only from a reliable source after careful examination. Each event is given with its source, with errors in time, place and verbal description corrected as much as possible.

At the front of the text, oracles inscribed on animal's bones and tortoise shells during the 13th-11th centuries BC (later Shang Dynasty) are given. Recorded 3,000 years ago, these represent the earliest Chinese characters on meteorological phenomena. A total of 358 oracle bone meteorological records are sorted into 12 meteorological categories: wind, cloud, rain, snow, hail, frost, thunder, drought, clear, haze, daily weather and multiple day weather. Each record is given in Mandarin and explained in modern Chinese (Fig. 2).

Now, a compendia-based historical climate data recall system has been established for the purposes of reconstructing historical climate sequences and restoring real conditions of climate events, e.g., severe droughts, excessive precipitation, extreme cold season and heat wave. A study on large-scale drought events indicates that 15 cases lasting in ex-

cess of 3 years and affecting more than 4 provinces have occurred in the past 1,000 years, in relatively warm or cold climate backgrounds, and 5 of them covering both east and west China are supported by tree-ring records (Fig. 3). Inference from the restored events as regarding their domains, duration and rainfall reveals that these persistent drought events were more severe than those that occurred in the past 50 and even 100 years (Zhang, 2005). In addition, the historical records are used to construct a chronicle of events both for dust-fall and locust disaster, and particularly, the recorded volcanic ash events discovered in the collection are a useful supplement to the chronology of volcanic eruptions of the world (Stimkin & Siebert 1994).

REFERENCES

- Zhang, De'er (Ed.), 2004: A Compendium of Chinese Meteorological Records of the Last 3000 Years. Nanjing: Jiangsu Education Press, pp.1-3666 (in Chinese with English introduction).
- Zhang, De'er, 2005: Severe drought events as revealed in the climate records of China over the past thousand years. *Acta Meteorologica Sinica* (English edition, accepted).
- Simkin, T. Siebert, L. (Eds.), 1994: Volcanoes of the world. Geoscience Press, Tucson, Arizona, pp.1-349.

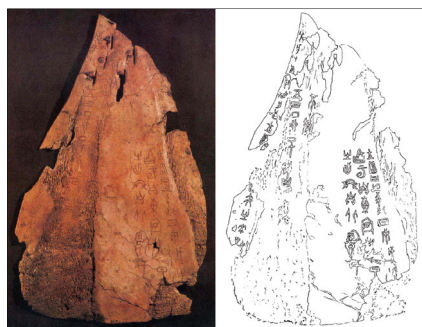


Fig. 2: The earliest meteorological record (photo, left; hand-craft, right) inscribed on a bone with "cloud" and "rainbow" characters in the 13th century BC. It is explained to the effect that clouds are moving from the east ... and a rainbow appears in the north at sunset of day eight.

