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Holocene abrupt climatic events and the environmental effects

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This workshop was organized by the Institute of Earth Environment at the Chinese Academy of Sciences and attracted speakers from across China, as well as Australia, India, Japan, and USA. A total of 35 talks were presented, covering diverse topics from identifying abrupt events and their impact on past societies; interdecadal variability; modeling and dynamical forcing from the Atlantic, Indian and Pacific Oceans; the Sun; and aerosols. A large number of new high-resolution datasets were presented. A key feature of the meeting was the large number of presentations by young scientists, a sure sign of a healthy future for Holocene science.

In the past there have been conflicts arising from climate changes and even possibly dynastic collapses. Understanding how humans coped with changes in the past, evident in high-resolution time series, provides a template relevant for policy and planning issues. The role of humans as drivers of abrupt changes in the Holocene in various parts of the world was discussed, as well as the expression of abrupt changes such as the 9.2, 8.2 and 4.2 ka BP cooling and drying events, which are represented to varying degrees in different regions. Several analyses focused on modern process studies and on how these can help improve precision in interpretation of paleoseries. The recent international cooperative ocean monitoring program (led by the Ocean University of China, Qingdao) is an outstanding example of this, and despite its yet still short time series, it is already yielding new insights into ocean dynamics.

ENSO events now show evidence of enhancement by volcanic forcing, and appear to be stronger in the 20th century than any other period in the Holocene. The future expression of ENSO is of vital concern for many parts of the world. While no two ENSO events are the same, Figure 1 shows how a modeled future configuration will lead to increasing numbers of extreme events. New evidence is emerging on the frequency of droughts in eastern Asia and on how these are related to variability and intensity of the Asian Summer Monsoons, especially in the later Holocene. There is now a strong case emerging for the forcing of climate change in eastern Asia modulated by both the Atlantic Meridional Ocean Oscillation and the Pacific Decadal Oscillation. It was noted that much good science emerges from international cooperation, and at present this is taking place in good spirit and above regional geopolitical considerations.

Some time was spent identifying areas that are particularly vulnerable to future change in Asia. These include Central Asia, the Indian Monsoon region and North East China, and are likely to provide challenges for the people who live there and from a geopolitical aspect.

Young scientists were challenged to think beyond simple series comparisons when considering their own data, and to keep in mind that while some series do in fact show similarities, these sometimes break down due to phase shifts and altered forcing conditions. Systems become better understood when the full range of variability is revealed and studied.

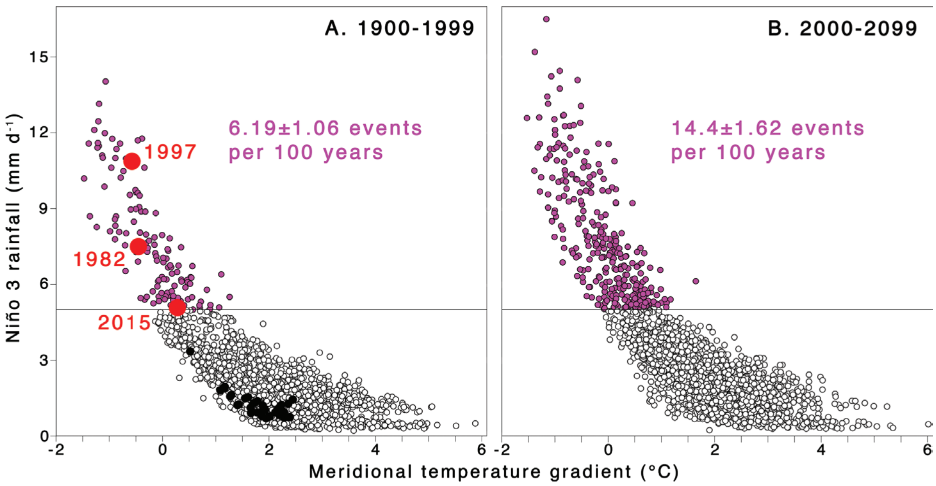

Figure 1: Relationship of meridional SST gradient (5-10°N, 150-90°W minus 2.5°S-2.5°N, 150-90°W) with December-January-February (DJF) mean Niño 3 (5°S-5°N, 150-90°W) rainfall, for **(A)**, Control Climate (1900-1999 CE) and **(B)**, Climate Change (2000-2099 CE) periods, respectively, aggregated over 21 selected CMIP5 models. Purple dots indicate modeled extreme El Niño events with a Niño 3 DJF rainfall greater than 5 mm per day and black circles indicate other modeled events. The corresponding average frequency of modeled extreme El Niño over the Control Climate period and Climate Change period is labelled in each panel, with the 95% confidence intervals based on a Poisson distribution. Red dots in (A) indicate observed 1982/83, 1997/98 and 2015/16 CE extreme El Niño events and black dots indicate other observed events since 1979. For more details see Cai et al. (2014).

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