



PAGES Section

Reconstructing Climatic Variability from Historical Sources and Other Proxy Records

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An international conference titled, “Reconstructing Climatic Variability from Historical Sources and Other Proxy Records” was held in Manzanillo, Mexico, on 1–3 December, 1999. The meeting attracted 21 participants from 9 countries. The goal of the conference was to highlight historical research directed at reconstructing climatic variations prior to the modern era of instrumental records. A special focus was on historical climate research in the Americas, although a number of papers also focused on new results from other parts of the globe. In addition, some papers specifically addressed this topic from the perspective of epidemiological history and the possible role that climatic variations may have had in initiating and/or exacerbating communicable diseases, especially vector borne illnesses.

Papers were presented covering three major themes: 1) Reconstructing major drought and flood episodes, primarily in the region of the Americas for the past four centuries; 2) Documenting multiscale teleconnections and their association with El Niño/Southern Oscillation (ENSO) events and other decadal climate variability, such as the North Atlantic Oscillation (NAO); and 3) Emerging studies on the connections between climate and human health. A central goal of the meeting was to advance the study of historical analysis for the purposes of emphasizing those times where significant historical events and periods may have been affected by major climatic events—prolonged cold episodes or extended drought, perhaps associated with the occurrence of extreme events such as ENSO, or large volcanic eruptions. Another goal of the conference was to promote the exchange of views and information among the participants, and to foster new ideas for collaborative research.

The papers presented at the conference underscore the wide depth and breadth of ongoing research, and illustrate the potential of this type of analysis within the study of long term climate change. There exists in the Americas, as well as in many other parts of the world, rich sources of archived information that can be used to infer climatic changes in the past, on annual, interannual, and decadal timescales. Below, a few of the more promising studies and their possible use in climatic reconstruction are highlighted.

In the United States, large amounts of weather and climate information were recorded, mostly in diaries during the 19th century by pioneers moving west across the continent, primarily from the 1840s onward. In the earlier-settled eastern United States, useful climate information can be extracted from diaries and other such documentary records back to the start of the 19th century, and earlier in a few in-



Exterior and interior (next page) views of the historical archive in Seville, Spain in which records of voyage duration of the Manila Galleons, dating as far back as the late 1500's, are stored.

stances. The beginnings of organized weather and climate services in other parts of the Americas generally parallel those in the U.S. and Europe, because many of the major figures that played important roles in that development were from Europe or the U.S.A. High-resolution climate proxies can be extracted in places where the daily state of the weather was important for commercial reasons. For instance, high mountain passes in the Andes of South America, which were an important transportation artery between major settlements, recorded daily snow conditions for much of the year. Normalized time series of snowfall quantity have been developed from the mid-1700s for an area in the central Andes along the Argentinean–Chilean border.

Other presentations focused on continuing efforts to improve and refine the chronology of El Niño events prior to the modern instrumental records, which go back to about the mid-1800s. These efforts include the mining of information about weather phenomena usually associated with ENSO events from a variety of sources, as well as the use of coral records from the tropical Pacific. New information useful for the analysis of long term variations in the NAO has been developed from the Canary Islands, using agricultural time series as proxies for precipitation. Another interesting set of proxy records is the voyage durations of the Manila Galleons, whose yearly trips from Acapulco, Mexico to Manila, The Phillippines, starting in the late 1500s, and continuing for more than two centuries, may be able to provide a record of decadal scale variability in the strength of the North Pacific trade winds. The utility of comparative analysis among different proxy records was illustrated by the fact that a period of apparently weaker trades in the western tropical Pacific, inferred from the presence of significantly longer voyage durations of the Manila Galleons from about 1630–1680, coincides with a large increase in the incidence of typhoon landfalls in southeastern China during the same period. The typhoon landfall data for southeastern China was compiled from documentary historical sources in China. Additional research to establish the validity of these decadal



Modelling Extreme Climates of the Past : What we have learned from PMIP and related Experiments

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climate changes and their context within large-scale circulation patterns during that time appears warranted.

Innovative new research is being carried out to utilize tree-ring proxy records together with historical information to infer the occurrence of a major drought episode in the late 1500s, that affected areas stretching from northern Mexico to the eastern United States. Early indications are that this drought equals or exceeds any drought episode in the 20th century, but its spatial extent and duration – twenty years or more in some areas – appears to be unprecedented in the context of the last half-millennium.

Finally, more information is becoming available relating the outbreak of vector-borne diseases, such as malaria and yellow fever, and outbreaks of cholera in past centuries to the occurrence of major climatic events, such as major El Niño episodes. It was the goal of this conference to explore connections among information extracted from historical documentary records and proxy climate records of various sorts. The goal was also to try to use the inferred climatic events in order to provide some degree of context to understand and to develop hypotheses about the impacts of these salient climatic events on human society. We will have succeeded in our goals to the extent that new ideas, scientific partnerships, and renewed interest in pursuing these endeavors come to fruition as a result of this conference.

Acknowledgments

The conference on “Reconstructing Climatic Variability from Historical Sources and Other Proxy Records” was supported by the Earth System History Program of the U.S. National Science Foundation and the Paleoclimatology Program of the Office of Global Programs of the U.S. National Oceanic and Atmospheric Administration. Local support was provided by the University of Colima, Colima, Mexico, and the Museo Universitario de Arqueología de Manzanillo, Mexico. The organizers gratefully acknowledge their support.

The Paleoclimate Modeling Intercomparison Project (PMIP), endorsed by both CLIVAR and PAGES, was established in 1991 for the purpose of improving our understanding of past climatic changes and assessing how well models can simulate such changes. If climate models can demonstrate skill in simulating conditions much different from today, this will build confidence in their predictions of future climate changes.

The initial PMIP experiments focused on two periods of the relatively recent past: the last glacial maximum, 21,000 years before present (BP), and the mid-Holocene climate, 6000 year BP (Joussaume and Taylor, 1995). These periods were selected in part because of the relatively plentiful data available for comparison with model output. In addition, the last glacial maximum was a period of relatively extreme cold, and this provides a challenge to climate models, forcing them to simulate a state much different from the present one, which they are to some extent “tuned” to reproduce. The mid-Holocene, on the other hand, provides an opportunity to test whether models can realistically respond to a significant change in the seasonal insolation pattern forced by well-known small perturbations in Earth’s orbital configuration (i.e., Milankovitch forcing).

The third PMIP Workshop was held in Québec (Canada), 4–8 October 1999, hosted by the Canadian Climate System History and Dynamics (CSHD) Research Network and funded by CSHD, UQAM, and PAGES. The purpose of the workshop was to report on PMIP results and PMIP related work and to reach some agreement about the future of PMIP, based on a synthesis of the results. Here we summarize results of PMIP and its future direction as discussed at the workshop. A full report on the PMIP Workshop will be published soon by the WCRP.

Simulations for the mid-Holocene with eighteen different climate models all simulate an increase in the summer monsoon over Africa and Asia as a result of increased summer insolation, but, when compared quantitatively to biome reconstructions over Africa (Jolly *et al.*, 1998), all the models underestimate the northward displacement of the desert-steppe transition (Joussaume *et al.*, 1999; Harrison *et al.*, 1998). Comparisons with proxy data over Europe (Masson *et al.*, 1999; Guiot *et al.*, 2000) and high northern latitudes (Harrison *et al.*, 1998) also show an underestimation of the model response. It should be noted, however, that the PMIP simulations were purposefully simplified in order to isolate differences in the atmospheric component of climate models. In particular, both ocean and land surface feedbacks were suppressed in these experiments, which obviously strongly