PMIP2 Workshop

Estes Park, USA, 15-19 September 2008

Bette L. Otto-Bliesner[1], S. Joussaume[2], S.P. Harrison[3], A. Abe-Ouchi[4] and P. Braconnot[2]

[1]Climate and Global Dynamics Division, National Center for Atmospheric Research, Boulder, USA; ottobli@ucar.edu
[2]Laboratory for Climate and Environment Sciences, Gif-sur-Yvette, France; [3]School of Geographical Sciences, University of Bristol, UK; [4]Center for Climate System Research, University of Tokyo, Japan

The Palaeoclimate Modelling Intercomparison Project (PMIP) is a long-standing initiative endorsed by both WCRP/CLIVAR/WGCM and PAGES. It has provided an efficient mechanism for coordinating paleoclimate modeling activities. These activities provide valuable information on the mechanisms of climate change, the identification of key feedbacks operating in the climate system and, through model evaluation, the capability of climate models to reproduce climates different from today. Thanks to the production of data syntheses and to rigorous model-data comparisons, the mid-Holocene climate (ca. 6 kyr BP) and the Last Glacial Maximum (LGM; ca. 21 kyr BP) are now recognized as benchmark periods for climate models.

Drawing on its past experience, PMIP will continue to combine simulations made with climate models and paleoenvironmental data syntheses. At its recent workshop in Estes Park, USA, over 70 scientists, including atmospheric scientists, oceanographers, and paleoclimatologists from the data and modeling communities, met to review past successes and discuss future efforts. The first day of the workshop focused on the analyses by PMIP2 subprojects of the coupled atmosphere-ocean and atmosphere-ocean-vegetation model simulations for the LGM and mid-Holocene, and the evaluation of these results using new and existing data syntheses (Fig. 1).

The workshop participants then concentrated on the science and implementation plans for the four new priority themes of PMIP Phase 3: 1) Evaluation of Earth System Models for mid-Holocene and LGM, 2) Interglacials and warm periods, with emphasis on the last interglacial, the mid-Pliocene, and last millennium, 3) Abrupt climate changes, particularly the last deglaciation and thresholds in the hydrologic cycle, and 4) Characterization and understanding of uncertainties. An outcome of the workshop was the identification of key climate targets for model simulations and data synthesis that could help reduce uncertainties in future climate projections. The workshop participants adopted a set of coordinated climate model experiments of past time periods that will become the basis for future internationally mandated assessments of climate science (e.g., the IPCC's AR5, scheduled to be published in early 2013).

It was proposed that a high priority for international modeling groups participating in the Coupled Model Intercomparison Project CMIP5 of the WCRP's Working Group on Coupled Modelling (WGCM) was to perform mid-Holocene and LGM simulations with the same model components and at the same resolution as the preindustrial and future projection simulations. The mid-Holocene experiment evaluates responses of the monsoons to vegetation feedbacks and patterns of ocean warming, as well as high latitude to poleward expansion of boreal forests. The LGM experiment considers the sensitivity of tropical oceans and continents to lowered CO_2, and improves our understanding of feedbacks between sea ice and ocean thermohaline circulation.

The workshop participants identified several additional coordinated experiments of priority, though it was recognized that these might be run with different model components and resolutions than CMIP5. The experiments proposed are the last millennium, for detection and attribution studies of decadal to centennial climate variability; the mid-Pliocene, an equilibrium world of 400 ppm CO_2 and reduced Greenland and Antarctic ice sheets; and the last interglacial, with Arctic summer warmth comparable to projections at the end of this century. The last interglacial experiment is also relevant for coupled climate-ice sheet models, to assess the stability of the polar ice sheets and sea level rise. PMIP3 will continue to provide a forum for modelers and observationalists to discuss experiments for other past time periods. Working groups have been established to study the transient behavior of the Earth System during deglaciation and the 8.2-kyr event.

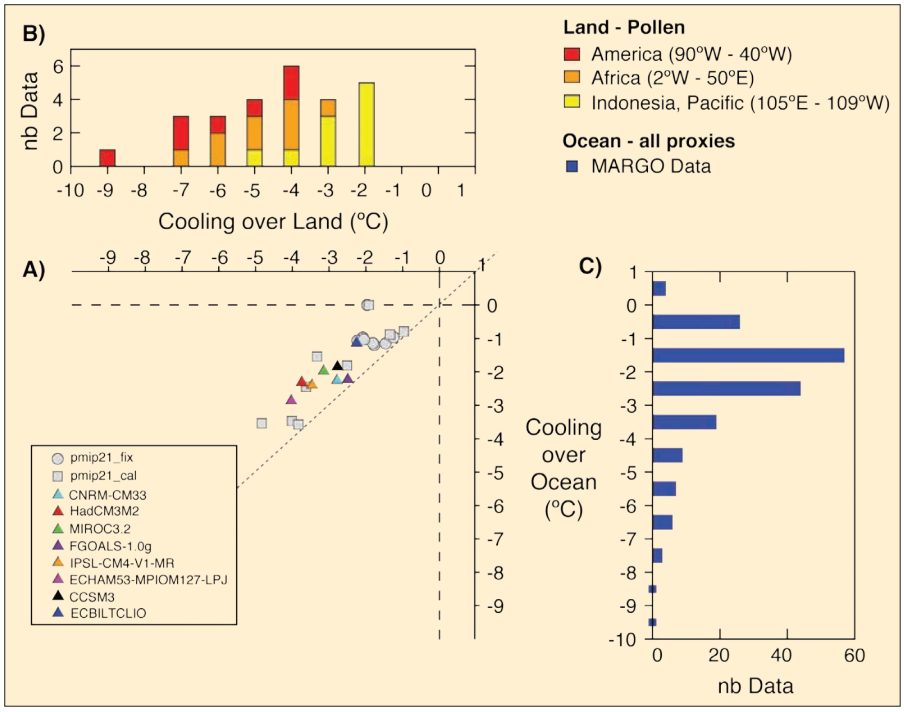

*Figure 1: Comparison between model results and paleodata of annual mean tropical cooling (°C) at the LGM. **A**) Simulated surface air temperature changes over land, displayed as a function of surface air temperature changes over the oceans, both averaged in the 30°S to 30°N latitudinal band, for the PMIP1 simulations (gray) and all the PMIP2 OA simulations (color). In comparison to the PMIP1 models, the PMIP2 models include a fully predictive 3D ocean (for details on model abbreviations used see Braconnot et al., 2007). The comparison with paleodata uses two reconstructions: **B**) Distribution of temperature change over land, estimated from various pollen data (Farrera et al., 1999); **C**) Distribution of sea surface temperature change estimated from Multiproxy Approach for the Reconstruction of the Glacial Ocean surface (MARGO; http://margo.pangaea.de/). Note, "nb data" is the number of data points for each temperature change. Figure courtesy of M. Kageyama.*

Subgroups have been organized to provide the model simulation design and identify the relevant datasets for the PMIP3 coordinated experiments. For further information, see http://pmip2.lsce.ipsl.fr/

Acknowledgements

The workshop was sponsored by PAGES and the U.S. National Science Foundation and National Oceanic and Atmospheric Administration.

References

Braconnot, P., et al., 2007: Results of PMIP2 Coupled Simulations of the Mid-Holocene and Last Glacial Maximum – Part 1: Experiments and Large-Scale Features, *Climate of the Past*, **3**: 261-277.

Farrera, I., et al., 1999: Tropical climates at the Last Glacial Maximum: a new synthesis of terrestrial palaeoclimate data. I. Vegetation, lake-levels and geochemistry, *Climate Dynamics*, **15**: 823-856.

Oxygen isotopes as tracers of Mediterranean climate variability: Linking past, present and future

ESF MedCLIVAR Workshop, Pisa, Italy, 11-13 June 2008

Neil Roberts[1], G. Zanchetta[2] and M. Jones[3]

[1]School of Geography, University of Plymouth, UK; cnroberts@plymouth.ac.uk
[2]Department of Earth Sciences, University of Pisa, Italy; 3School of Geography, University of Nottingham, UK

Given predictions of future climate, changes in rainfall and water resources seem certain to have important socio-economic and political impacts in the Mediterranean region (Giorgi, 2006). Understanding the variability of hydro-climate over different timescales is therefore essential for predicting future climate change and its possible impact on society. Because they vary directly with the physical processes of the hydrological cycle, oxygen isotope ratios provide an important hydro-climatic tracer on all timescales—instrumental, historical and geological. This workshop provided a timely opportunity to bring together members of the scientific community engaged in different aspects of stable isotope research around the Mediterranean basin. The meeting was held over three days in the University of Pisa's Botanical Gardens, with oral and poster presentations by 56 participants.

Following introductory papers by R. García Herrera, N. Roberts and A. Longinelli, the meeting was structured around 5 themes: Session 1 examined how water isotopes have been used as tracers in the monitoring and modeling of contemporary precipitation patterns over the Mediterranean (Fig. 1). L. Araguas outlined the IAEA water-isotope monitoring program, while S. Lykoudis described spatial interpolations of precipitation isotope data for the eastern Mediterranean region. Oxygen isotopes are one of few outputs of Global Circulation Models (GCMs) that can be measured directly by natural climate archives, and G. Hofmann discussed nested meso-scale GCM simulation experiments and their application to isotopes from tree ring cellulose.

Session 2 focused on surface waters, involving both contemporary and paleohydrology (see Roberts and Jones, 2002). M. Leng examined the isotopic record preserved in lake carbonates and silicates,

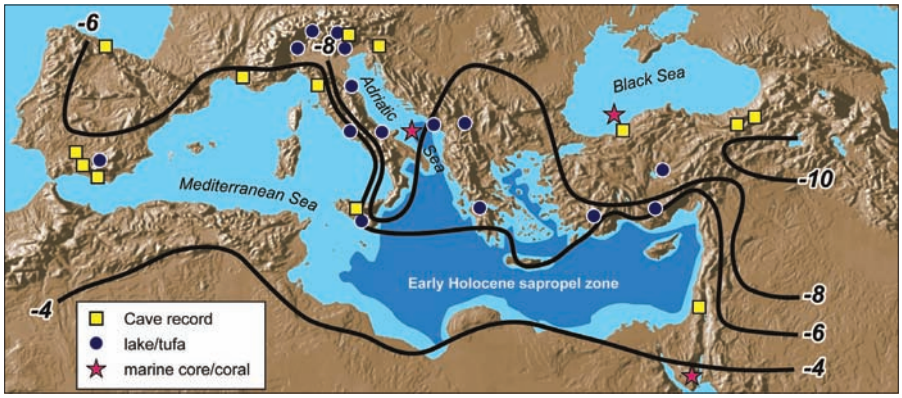

Figure 1: Map showing mean-weighted $\delta^{18}O$ composition of Mediterranean precipitation and paleo-isotope records presented at the workshop

and U. von Grafenstein provided examples from northern Italy and the ancient Lake Ohrid. M. Jones presented a mass balance model of isotope response to climatic forcing for different lake types, while J. Andrews showed how laminated tufa deposits from Greece can potentially provide a signal of past climate seasonality.

Session 3 was devoted to karst hydrology and cave carbonates. A. Baker focused on the calibration of carbonate isotope records against instrumental climate data, and F. McDermott compared $\delta^{18}O$ against other proxy-climate parameters from speleothems to highlight how no single proxy provides a "magic bullet" solution to climate reconstruction. D. Fleitmann used speleothem isotopes to show paleoclimatic gradients from south (Oman) to north (Turkey). H. Affek closed the session by outlining the new technique of clumped-isotope paleothermometry and its application to the well-known Soreq Cave record from Israel.

In session 4, the focus shifted to marine isotopes. E. Rohling provided an analysis of paleoceanographic conditions during sapropel formation when the eastern Mediterranean Sea became anoxic. This occurred most recently during the early Holocene when, as M. Fontugne showed, runoff from the Nile and North African wadi systems contributed to the creation of a freshwater lid. T. Felis presented high-resolution isotopic analyses of northern Red Sea corals during different time windows of the late Holocene, with teleconnections to "centers of action" under climate modes such as the North Atlantic Oscillation.

In session 5 on intercomparison of isotope archives, G. Zanchetta evaluated data from lakes, caves and land snails in a review of Holocene isotope changes in Italy. The integrated multi-archive OLOAMBIENT project provided the basis of two linked papers; M. Letizia Filippi described the results of seasonal monitoring of Lake Lavarone, and A. Borsato outlined analyses of speleothems from three cave systems in northern Italy. The final presentation by A. Delgado-Huertas compared lake carbonate isotopes with those of bone phosphate from archaeological sites in Iberia.

The final session was a panel discussion of key issues relevant to different time periods and archives. Participants identified the following future objectives:

- Synthetic stable isotope databases for speleothem, coral and lake records for the last 2 kyr, of at least decadal-scale resolution, for comparison against data from historical observational records (e.g., Luterbacher et al., 2006).