

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/>

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

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

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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 paleo-hydrology (see Roberts and Jones, 2002). M. Leng examined the isotopic record preserved in lake carbonates and silicates,



Figure 1: Map showing mean-weighted  $\delta^{18}\text{O}$  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  $\delta^{18}\text{O}$  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).

- Improved monitoring of modern hydro-climatic conditions in the same systems (e.g., individual caves or lakes) that preserve longer isotope-climate records in carbonate deposits.
  - Harmonizing methods for numerically calibrating paleo-isotope data to derive quantitative values for past temperature, precipitation and relative humidity.
  - Data-model comparisons, both for individual systems and at a Mediterranean-wide scale.
- Reconstruction of Mediterranean isotope gradients at important time periods in the past.

Abstracts and a longer version of this report are available at: [www.geog.plymouth.ac.uk/research/groups/MedCLIVAR\\_isotope\\_workshop.html](http://www.geog.plymouth.ac.uk/research/groups/MedCLIVAR_isotope_workshop.html)

A selection of the papers will be published in a special issue of *Global and Planetary Change*.

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## Past climate variability in the Altai

**Barnaul, Russia, 1-6 June 2008**

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The Altai mountain range in Central Asia has a NW to SE extension of about 2100 km and is located on the boundary between Russia, Kazakhstan, China, and Mongolia. It forms a climate divide between vast Siberian forests in the north and arid regions of Central Asia in the south (Fig. 1). The region has the highest degree of continentality in the world (Lydolph, 1977), resulting in cold winters and warm summers. In winter, due to the prevailing stable Siberian High, cold and dry arctic air masses predominate. In summer, humid air masses from the Atlantic Ocean and recycled moisture are the main sources of precipitation. The Altai mountain range has great potential for high-resolution, well-dated multiproxy reconstructions of past climate, since high-elevation glaciers, lakes with laminated sediments, and living trees and relict wood material can be found in close proximity to each other. Long meteorological records from Barnaul (1840-present) and glacier mass balance data from Malii Aktru (1961-present) are also available. These facts, together with the geographical setting, make the Altai particularly attractive for climate change research.

A Russian-Swiss workshop was held at the Institute for Water and Environmental Problems, Siberian Branch of the Russian Academy of Sciences, in Barnaul, Russia to discuss the status of paleoclimate research on the Altai, and the prospects and limitations of obtaining more high-resolution millennial-scale paleo-records from this region. The meeting brought together 12 Russian and 8 Swiss scientists working with the different kinds of natural archives (ice cores, lake sediments, peat bogs, tree

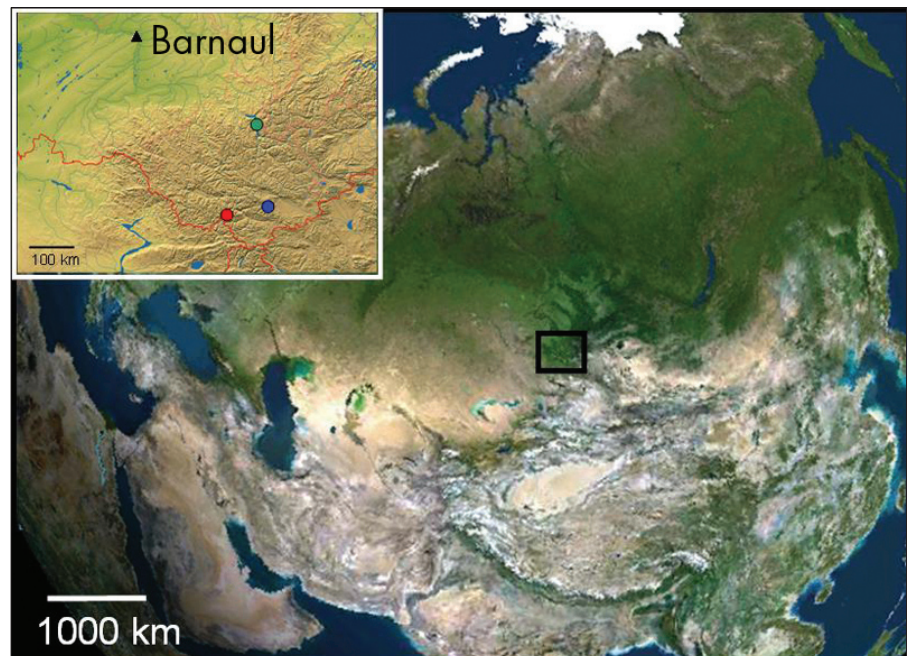


Figure 1: Satellite image showing the location of the Altai mountain range on the boundary between vast Siberian forests and arid regions of Central Asia. Insert gives locations of the different natural archives (green: Lake Teletskoye, red: Belukha glacier, blue: tree ring sites) and the city of Barnaul with an instrumental data set covering the period 1840-present (black triangle). Satellite images from DVD-ROM "Der Große 3D-Globus 4.0 Premium", © 2008 United Soft Media Verlag GmbH, Munich.

rings) in Siberia. The main objective was to discuss the strengths and weaknesses of existing paleo-records and to identify gaps in spatial/temporal data coverage.

One outcome of the workshop was a compilation of three annually resolved, millennial-scale temperature records—Belukha ice core, Teletskoye Lake sediments, and tree ring width chronologies for Larix Sibirica from the SE Altai (Fig. 2). Although the common proxy is temperature, the three archives represent different seasons (ice core = March–November (Eichler et al., 1008); lake sediment = annual (Kalugin et al., 2007); tree ring width = June–July (Ovtchinnikov et al., 2000)). This most

likely explains the observed differences between each of the reconstructions. Nevertheless, a general feature of the three reconstructions is the pronounced long-term variation, along with a strong temperature increase of 2–3°C from the Little Ice Age minimum to the present. This is consistent with instrumental data and model simulations suggesting that warming is strongest at highly continental sites (e.g., Bradley et al., 2003). Furthermore, it is in agreement with reconstructions of the recent mass-balance history of the Sofiykiy glacier (Altai Mountains; De Smedt and Pattyn, 2003). As indicated in Fig. 2, there is a strong correlation between ice core