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To  
Dr. Nicolas Dittert  
Ass. Director of IMAGES  
MARUM / University of Bremen

Dear Dr. Dittert,

Below you will find a short preliminary summary report on the output of the Trins Workshop in early June, linked to the request to the IMAGES Scicom for initiating an IMAGES – PAGES working group that will deepen the discussion on the main issues of this workshop, a working group that also had been requested by the IMAGES executive committee in December 2006.

With sincere thanks for the previous generous support of IMAGES,

Michael Sarnthein      Ralph Schneider Lowell Stott

Ref.: Report on the PAGES-IMAGES-NSF WORKSHOP on  
**“Intra- and interhemispheric variability of SST and the hydrological cycle over the last 4 Myr“**, held at Trins, Austria, 30 May – 2 June 2007

Thirty three scientists participated with orals and posters in the lively discussions of this workshop. It gathered climate modellers, paleoceanographers, terrestrial paleoclimatologists including speleothem, paleolimnology, ice core, and sea level expertise, and data managers, with colleagues coming from many European, American, Asian, and African countries. During the second half of the workshop scientists split up into four theme groups (with a system enabling everybody to contribute to each theme group) writing up in short the present state of the art, main hypotheses, recommendations, and best strategies to study four major (paleo-) climatic issues:

**A) Hadley vs Walker Circulation, Atlantic-Pacific Zonal vs Meridional ITF Shifts**

Andre Paul and Lowell Stott (chair)

**B) Phasing of Monsoon Precipitation in Africa, India, and East Asia and West Pacific**

Dominik Fleitmann and Ralph Schneider (chair)

**C) Hemispheric and Interhemispheric Teleconnections**

Mark Maslin and Larry Peterson (chair)

**D) Human-scale events in Hydrological Cycle over the last 20 kyr**

Ashish Sinha and David Anderson (chair)

**GROUP A** summarized questions of water vapor transport, jets, and northern and southern Intertropic Convergence Front (ITF) boundaries. The group recommended to critically assess the short- and long-term variability range of the interocean exchange of water vapor, particularly in view of competing ideas on its potential effect on overall salt balance calculations (including analyses of all meteorological observations available and re-evaluation of oceanographic observations, e.g., World Ocean Circulation Experiment – WOCE – data).

These data need to be tested by data-model comparison, whether (1) the atmospheric moisture transport across Central America is instrumental in maintaining and/or establishing the salinity contrast between the Pacific and Atlantic Oceans and the modern THC; (2) whether the amplitude of glacial/interglacial and stadial/interstadial changes reconstructed on either side of the Central American Isthmus can be reconciled with changes in zonal moisture transport; (3) whether changes in monsoon may be related to changes in atmospheric  $p\text{CO}_2$ .

Group A proposed that “key study regions” (1) need to be critical for atmospheric dynamics either as source (such as the tropical ocean), as sink, or specific trajectory (such as the Panama Isthmus) of atmospheric water; (2) should produce large-scale signals, more sensitive to climate change than other regions and representative for large areas and (3) should be relevant to large human populations.

**GROUP B** discussed time-transgressive shifts in rainfall and SSS and various links of precipitation maxima during the last climate optimum such as the role of tropical Indian SST, the Atlantic Dipole, and tropical zonal seesaw. For future studies they recommended tree-ring and speleothem chronologies as less problematic than age models deduced

from marine records, both in terms of Milankovitch and millennial-to-decadal-scale variability.

Regional master chronologies need be identified, where marine and terrestrial records can be tied by means of local precipitation and temperature records from both archives. Joint age control points in lake and marine cores should be based on speleothem ages and tree rings and established at key nearshore sites and/or near major river mouths for the hierarchy of chronologies. Simple tuning to Greenland and Antarctic ice core chronologies should be avoided prior to identification of analogous trends in land and ocean-borne records of SST and precipitation change. Comparison of  $^{18}\text{O}$  records of fluid inclusions in speleothems with nearby planktic  $^{18}\text{O}$  records may serve as novel correlation tool.

Future strategies should include the initiation of new research networks to establish (1) regionally integrated information on monsoon changes such as tropical ice core records, and (2) include East Pacific regions where influences of monsoon and westerlies do interfere.

**GROUP C** proposed five hypotheses to be tested:

- 1) Do tropical hydrology and ITCZ shifts simply respond to changes in northern and/or southern high-latitude temperatures and meridional temperature gradients?
- 2) Do tropical warm-pool temperatures control the export of water vapor from low to higher latitudes and what are the climatic feedbacks between warm-pool regions and higher latitudes?
- 3) Are methane concentrations in ice cores indicative of methane release in either tropical or high-latitude wetlands, which provide an important amplifier of hydrological changes?

4) Past ENSO changes were only recorded in varved sediments (off Pakistan) as forcing mechanism of monsoonal intensity. Can a clear ENSO signal also be identified in proxy records from other monsoon regions?

5) High-latitude climate responds to enhanced dust transport due to hydrologic changes in the tropics that control aridification. However, the effects of high dust supply on mid- and high latitude climate still need to be identified.

**GROUP D** focussed on abrupt vs gradual climate shifts, magnitudes of change that compare to historical records. Two periods appeared especially important, (1) the last 2000 years and (2) the 8.2-ka cooling and Younger Dryas event, implying closer studies of the following objectives:

1) To what extent are changes over the last 2000 yr, termed in Europe the Little Ice Age, the Medieval Warm period and the Roman warm period, connected to large-scale patterns of climate variability? Are these evident as changes in sea surface temperature, droughts, and floods throughout the world? To what extent are coeval variations in tropical monsoon connected to other tropical processes such as the ITCZ, Walker, and Hadley circulations?

2) The role of tropical sea surface temperature in driving hydrologic variability throughout the extratropics is evidenced in model-based studies and the instrumental record. Yet long-term trends in this ocean-climate linkage are poorly known. New records of the past 1000 years may provide proper means to assess the long-term influence of ocean SST patterns on hydrologic changes in remote regions.

**A complete version of this report (including refs. and 4-6 figures) is presently edited and will be submitted to EOS for publication.**

On the basis of this report we ask IMAGES to support a future Working Group that can help to implement the envisaged studies to reach a better understanding of global and regional hydrological cycles within the next two to three years.

*We propose that **this working group** may comprise all eight chair people responsible for the report, including the three main organizers of the Trins workshop signed below.*

Sincerely,

Michael Sarnthein

Ralph Schneider

Lowell Stott