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PANASH

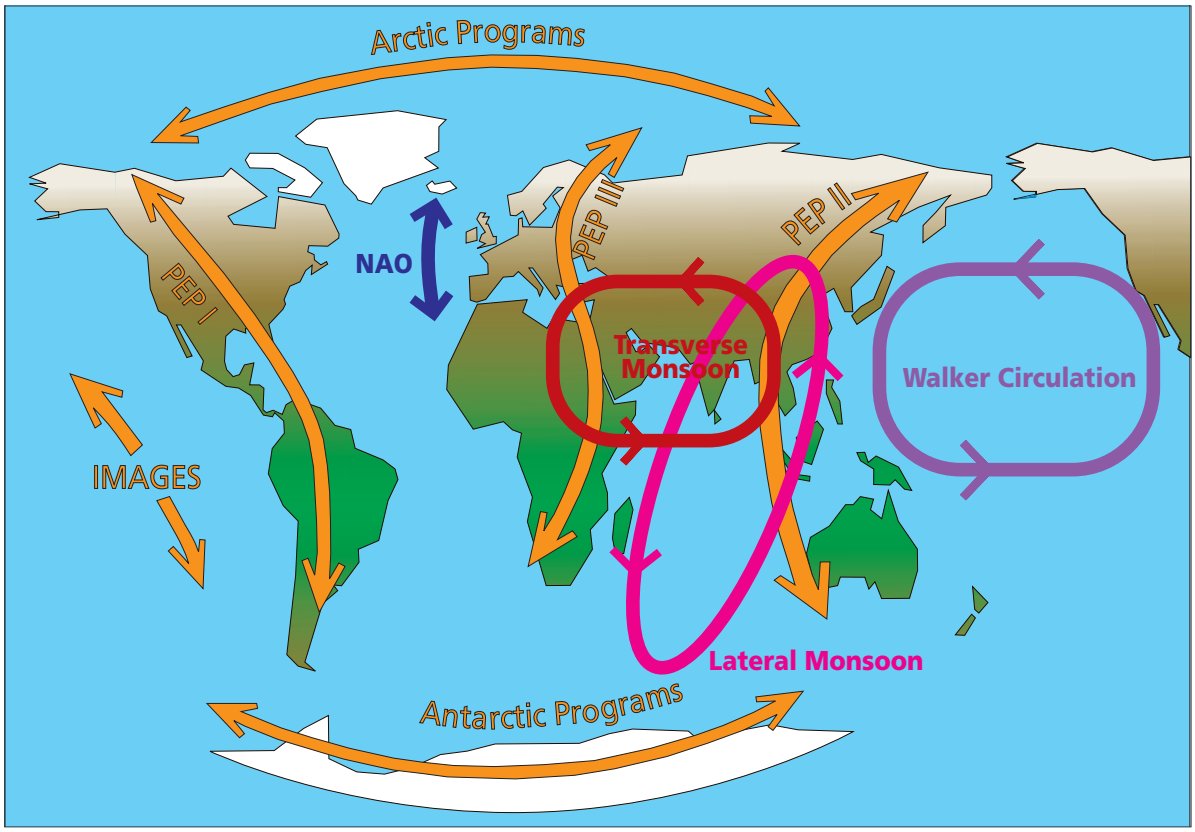

Figure 1: Schematic representation of the North Atlantic Oscillation, the Asian-Australian summer monsoon system and the Walker circulation (adapted from Webster et al.1998: J.Geophys. Res., 103:14464) alongside the PEP/IMAGES transects.

Editorial

PANASH – Paleoclimates of the Northern and Southern Hemispheres – was initially coined to describe PAGES' task to produce a coherent and quantitative record of the Earth's environmental history. As such, PANASH specifically addresses questions of interhemispheric mechanisms and coupling of climate and climate change. Research activities that will ultimately enhance our understanding of global change are defined within the framework of three terrestrial Pole-Equator-Pole (PEP) transects, complemented by the International Marine Global Change Study (IMAGES) program.

The primary tasks of the PANASH project are to:

- Document the amplitude, phase and geographic extent of the inter-relation of records between the two hemispheres;
- Determine potentially important forcing factors that affect either one, or both hemispheres;

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Editorial, continued from front page

- Identify the important feedbacks which operate to amplify, or reduce the influence of changes occurring in a specific part of the climate system;
- Identify mechanisms of climatic coupling between hemipheres.

Since the publication of the PANASH-PEP science plan (PAGES 95–1, 1995) the international paleoscience community has made immense progress in coordinating regional research activities and linking regional paleoenvironmental and paleoclimate information along these transects. Several publications testify to the success of these coordinated interhemispheric paleoclimate activities (PEP I: Markgraf, 1998 in press; PEP II: Mikami *et al.* 1995; Dodson & Guo, 1998; PEP III: Gasse *et al.*, 1997). The time scales considered by these activities range from seasonal to decadal and millennial, using instrumental, historical, and multi-proxy paleoenvironmental records. Much effort has been spent to develop records that cover the last 250,000 years to document glacial-interglacial variations during two complete climatic cycles, which appear to have had very different characteristics. Another major effort addresses the need for high temporal resolution of records that cover the more recent past, the last 20,000 years (i.e. since the last glacial maximum), and the last 2000 years (times when human impact became a global feature).

While addressing interhemispheric paleoclimate questions separately for each transect, it became aparent that several of the major atmospheric circulation features that operate zonally, linking the transects, were not dealt with in a holistic fashion. Although to some degree this aspect has been addressed by the PAGES initiatives specifically focusing on past variability in the tropics (ARTS), of ENSO and the monsoons, it seemed timely to consider the whole Earth system and its linkages. For this reason the Inter-PEP meeting was convened in September 1999, supported by PAGES and the US NSF. The major goals of the meeting were to

- Illustrate the present and past character of climate linkages between the interhemispheric transects, and
- Identify questions that can only be addressed by further enhancing scientific collaboration between the interhemispheric transects.

The report of this meeting represents a summary of some of the major points raised. It will be up to the scientific community to take up the challenges and incorporate them into already ongoing activities.

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WORKSHOP REPORT

Inter-PEP

Appenberg, Switzerland, 1–2 September, 1999

To further strengthen the inter-hemispheric (N–S) paleoclimate research activities represented by the PEP (Pole-Equator-Pole) and IMAGES (International Marine Global Change Study) transects, a meeting was convened in September 1999, that focused on zonal (E–W) paleoclimate linkages. The aim of the meeting was to enhance those aspects of climate dynamics that are optimally addressed by comparison of paleoclimate records between the PEP and IMAGES transects. In terms of present and past climate variability, several themes clearly link paleoclimate patterns zonally. The most prominent and probably best studied global zonal climate links are related to El Niño/Southern Oscillation (ENSO) anomalies (Diaz & Markgraf, 1992). Mechanisms that link the different monsoon systems of East Asia, India, Africa, and perhaps even the Americas, and further link them to ENSO anomalies, are still the subject of debate (Sirocko, 1996). There are also clear links between these tropical climate systems and circulation in extra-tropical latitudes, such as the westerlies (Ganeshram & Pedersen, 1998; Markgraf *et al.*, 1992) whereas the influence on tropical climates by extra-tropical phenomena is less clear. When discussing intra- and interhemispheric linkages in the paleoclimatic context, it is important to remember that climate systems operate at different time scales, reflecting climate variability at inter-annual, decadal and centennial scales. The different temporal scales reflect the different processes and interactions between the atmosphere, ocean and land.

Combined with the inter-hemispheric PEP and IMAGES programs, the zonal Inter-PEP approach will ultimately lead to a more holistic view of global climate change by allowing an assessment of changes in global latitudinal gradients in surface and land-sea temperatures. These gradients act as the principal driver behind all large-scale atmospheric and oceanic motions as well as latitudinal heat and moisture fluxes. For example, modeling experiments (Rind 1998) indicate that atmospheric dynamics primarily respond to gradient changes, both latitudinal and longitudinal, and not to changes in mean annual temperature.

To address the Inter-PEP concept the meeting dealt with tropical circulation systems, including ENSO, monsoons and their interaction, and with mid- and high-latitude circulation systems, including the westerlies and their linkages with the polar systems, especially the Arctic. The following review of the discussions provides a framework for an increasingly global view of paleoclimate research.

Tropical Systems

As an example of the linkages of the tropical systems the cover figure shows schematically the flow of the Asian-Australian monsoon system and the Walker circulation in the context of the interhemispheric transects. Trying to understand the coupling between these circulation systems and its causes has been the subject of climate and paleoclimate research for many years (Barnett *et al.*, 1991; Clemens *et al.*, 1996; Charles *et al.*, 1997; Webster *et al.*, 1998). Although it has been shown by modeling experiments and spectral analysis of records that changes in insolation and solar activity affect the strength of either monsoons (e.g. Prell & Kutzbach, 1992) or ENSO (Anderson, 1992), the relationship between the variability of these climate systems is not straightforward. Only recently, Kumar *et al.* (1999) documented that the inverse relationship between ENSO and Indian summer monsoon that existed for the last 140 years