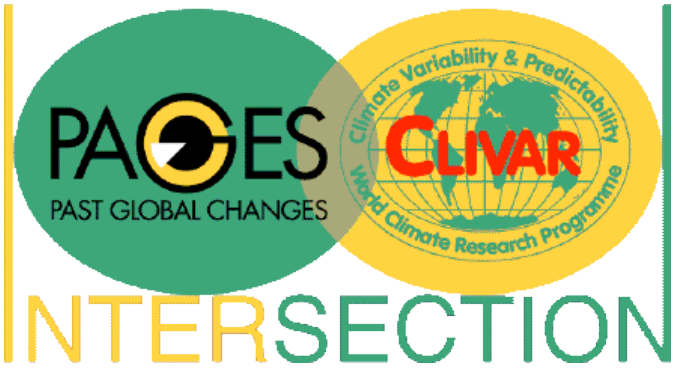

The PAGES/CLIVAR Intersection

Vision Document

2009

PAGES/CLIVAR Intersection Panel

Vision Document - revised 2009

Current Panel members

Co-Chairs

Gavin Schmidt; NASA GISS & Center for Climate System Research, Columbia University
Valerie Masson-Delmotte; LSCE, Gif-sur-Yvette, France

Regular Members

Caspar Ammann; NCAR, Boulder, USA
Juerg Beer; Institute for Aquatic Science and Technology (EAWAG), Switzerland
Keith Briffa; Climatic Research Unit, University of East Anglia, UK
Kim Cobb; Georgia Institute of Technology, Atlanta, USA
Elsa Cortijo; LSCE, Gif-sur-Yvette, France
Michael Mann; Pennsylvania State University, USA
Andreas Schmittner; COAS, Oregon State University, USA
Paul Valdes; School of Geographical Sciences, University of Bristol, UK
Peter Clark; Department of Geosciences, Oregon State University, USA
Eystein Jansen; Department of Geology, University of Bergen, Norway
Johann Jungclaus; Max Planck Institute for Meteorology, Hamburg, Germany

Proposed members

The Panel will be seeking representation from China, potentially an Instrumental/documentary researcher.

Contacts at the International Project Offices

Anna Pirani; CLIVAR
Thorsten Kiefer; PAGES

Introduction

The PAGES/CLIVAR Intersection Working Group is jointly sponsored by the Past Global Changes (PAGES) project of the International Geosphere-Biosphere Programme (IGBP) and the Climate Variability and Predictability (CLIVAR) project of the World Climate Research Programme (WCRP). It plays an important role in developing and implementing the research programs of both CLIVAR and PAGES. The group was first established in the middle of the 1990s. Details of its history are recorded in previous meeting reports and relevant publications archived at: http://www.clivar.org/organization/pages/pages.php. The group was reconstituted in 2004 under the following Terms of Reference, which still underlie the objectives of the Intersection Panel today:

- To promote improved high resolution (seasonal to interannual), well-dated, quantitative paleoclimate records in regions that are of direct relevance to IGBP and WCRP.

- To formulate and promote analysis and synthesis of paleoclimatic data in order to reveal patterns of variability within the climate system over seasonal to millennial timescales.

• To promote improved quantitative methods of model-data comparison and evaluation in order to understand the variability present in both the paleoclimatic record and the models.

• To promote the use of paleoclimate data in examining issues of climate predictability.

• To coordinate with other modeling activities of relevance to IGBP and WCRP.

The vision document at hand outlines the focus and plans of the PAGES/CLIVAR Intersection Panel for the coming years. It is still based on the first version of this document from 2004, which was revised at a meeting of the Panel in Trieste, Italy June 11-12, 2008, with new key scientific issues identified and existing ones updated.

Since 2004, the Panel has organized a number of workshops on paleoclimate reconstructions and the relevance of past climate data for future predictability. The first was a workshop in Wengen, Switzerland (2005) on proxy-based reconstructions, modeling and methodology for climate variability over recent millennia. This was followed by the Trieste (2008) meeting on reducing uncertainties in those reconstructions. Additionally, a one-day workshop on the 8.2 ka event was held in conjunction with the RAPID annual meeting in Birmingham (2006). Further, a special joint issue (January 2006) of CLIVAR Exchanges and the PAGES Newsletter was dedicated to climate forcings.

Over the next few years, the Panel plans to continue facilitating improvements in proxy-based reconstructions, links and calibrations with the modern instrumental record and model-data comparison, with particular focus on the role of paleoclimate data in reducing uncertainties in climate projections that were highlighted by the IPCC Fourth Assessment Report (2007).

Key scientific issues

1) Overarching and cross-cutting issues

The formation of the PAGES/CLIVAR Intersection Committee was predicated on the idea that paleoclimate studies can provide a useful adjunct to studies of present day climate variability and likely future change. Paleoclimate studies can extend short instrumental records and help provide longer and richer data than previously available. Studying the association between changes in potential climate forcings and reconstructed climate variability, using a combination of empirical and simulation approaches, offers real prospects for an enhanced understanding of the mechanisms and likely course of climate change. Thus there are a number of cross-cutting themes that are specific to this panel and areas in which there is substantial room for interaction with other WCRP panels.

Specifically, the panel believes that the forward modeling of proxy data, whereby the proxy data is explicitly modeled directly by the Earth System Model, is of fundamental importance for improving model-paleodata comparisons. Given the

diverse range of available proxies and local climatic influences upon them, it is essential that the researchers most closely involved with proxy development play a major role in the development of suitable forward models that can be either incorporated within climate models directly, or used, in conjunction with downscaling techniques, to translate climate model output.

Secondly, reducing uncertainties in proxy reconstructions (and in data synthesis in general) is very important for improving targets for climate modeling and understanding of the intrinsic variability and forced response of the climate system.

Finally, paleoclimate proxies need to be calibrated against variability and changes seen in the instrumental period, thus a greater interaction between paleoclimatologists and modern observationalists is a prerequisite for improved synthesis of the two approaches.

Additional areas of overlap within the broader WCRP themes and PAGES Science Plan are in the areas of atmospheric chemistry and climate, anthropogenic climate change, decadal prediction, monsoons, extreme events and sea level rise. In all these areas, paleo-data can potentially illuminate the past behavior of these systems and provide a test bed for model predictability.

2) Climate variability over the last few millennia

Well-dated, high-resolution proxy reconstructions and model simulations incorporating estimates of natural and anthropogenic forcings for the last two thousand years offer multiple opportunities for assessing the background of natural decadal- to centennial-variability and forced responses in conditions very like the present. In addition to hemispheric-mean or continental-scale estimates of warming or cooling, spatial patterns of temperature or precipitation associated with particular modes of climate variability (ENSO, NAO, AMO etc.) provide excellent targets for state-of-the-art models. Forced changes in large-scale atmospheric circulation such as the NAO, and internal dynamics related to El Niño, may play an important role in explaining regional patterns of variability and change in past centuries. Despite progress in recent years however, important uncertainties and caveats exist with regard to both empirical reconstructions and model estimates.

Our focus in coming activities and workshops will be on advancing process-based comparisons of models and data through an enhanced appreciation of forward modeling of specific proxies and at specific sites, including an appreciation of the role of downscaling from large-scale model simulations. Uncertainties in reconstruction methodology and in our understanding of what climate parameters are, or climate information is, recorded within the proxies will continue to be addressed through the Paleoclimate Reconstruction Challenge (PR Challenge) (http://www.pages.unibe.ch/science/prchallenge/index.html), where double-blind tests of pseudo-proxy networks and simulations of climate change during the last few millennia will be used to validate reconstruction methods. A necessary pre-requisite for these activities is a greater emphasis on the role of data synthesis at the appropriate data centers and through the activities of the regional PAGES 2k Network (http://www.pages-igbp.org/science/last2millennia.html).

3) North Atlantic circulation changes

Interactions between the ocean, atmosphere, and sea ice are the likely cause of decadal-multi-decadal and centennial variability in the Atlantic meridional overturning circulation (MOC), with attendant impacts on spatial patterns of temperature and precipitation. Impacts of Atlantic multi-decadal variability (e.g., AMO) have been seen in drought records in the Sahel and the Americas. Thus improved understanding of MOC variability may serve to improve climate projections in these regions. Uncertainties in model parameterizations and in the response of the climate system to anthropogenic forcings make projections of future MOC behavior unclear. Due to the possible persistence of multi-decadal MOC activity, there is potential for improved climate predictions on decadal timescales. With improved data syntheses of multi-decadal MOC activity in recent millennia and the prominent example of abrupt change at 8.2 ka, more sophisticated model-data comparisons should now be possible.

Since multiple proxy records from ice cores, speleothems, lake and ocean sediments, etc., reflect MOC changes and their climatic impact, MOC variability is an excellent showcase for the value of using forward models of paleo-proxies, specifically ocean proxies, water, carbon and nitrogen isotopes, atmospheric chemistry, dust and sea salt aerosols.

The Panel will support synthesis activities and workshops focused on data-model integration particular where the work seeks to improve the mechanistic understanding of multidecadal variability and its impacts, especially on hydrology.

4) Hydrological changes and interactions with the land surface

Recent observations indicate that the tropical realm is expanding with the effect of increasing occurrence of drought in the sub-tropics. This trend towards increased sub-tropical aridity is projected to continue under IPCC AR4 scenarios. There is also considerable evidence to suggest that terrestrial climate variability is strongly influenced by hydrological and biospheric interactions and feedbacks. This is particularly relevant to high-latitude regions and the tropics, where it has been shown that feedbacks between the monsoon and land surface conditions have significantly influenced climate variability on all timescales.

Studies of the mid-Holocene (as part of the Paleoclimate Model Intercomparison Project, PMIP) have also suggested that vegetation and soil moisture feedbacks are central to understanding observed changes throughout the Holocene.

Earth System Models that incorporate these feedbacks are now being used for future climate change prediction and it is essential that they are thoroughly and rigorously tested against the paleoclimate record. As mentioned above, this testing of models requires improvement in forward modeling tools, such as isotopes, hydrological and biome sub-components. This requires synthesis of high quality proxy records for key time periods. High temporal resolution data is required to test the models' capability to simulate variability during different time periods.

Paleoclimate model simulations increasingly involve long timescale integrations using spatially resolved climate models, as well as regional modeling with dynamical downscaling from simulations with global Earth System Models. Testing of such simulations will require the development of extensive new syntheses of proxy data to

provide accurate reconstructions of the spatial and temporal evolution of climate and how this variability is associated with specific forcings, particularly solar and volcanic.

The emphasis of the Panel will be primarily on initiating and supporting data syntheses and workshop activities concerned with data-model interaction. Particular emphasis lies on forward modeling of climate proxy data with relevance for low latitude changes in hydrology. These activities will seek to identify possible changes in ENSO and monsoon related drought patterns and how these may be related to potential climate forcings.

5) Tropical Cyclones, Extreme Precipitation Events

For some extreme events, such as tropical cyclones, intense precipitation, droughts and floods, there is some theoretical basis for expecting changes in their occurrence, associated with changes in background climate state. For some, changes may already be underway. However, it is the nature of extreme events that they are rare, and so the observational record is often sparse. By targeting specific proxies (paleo-tempestology) or by increasing the appreciation of long documentary records available in Europe, US East Coast, Japan, China and Korea, an improved basis for the characterization of some extreme events could be developed.

3. Key implementation issues

3.1 Workshops:

One of the main responsibilities of the panel is to organize workshops that promote the study of the issues raised above. The proposed schedule for these workshops is as follows:

Workshop 1. Forward Modeling and regional downscaling – (organizer: Nick Graham, Caspar Ammann)

Workshop 2. AMO: Mechanisms and Impacts - 3-day workshop, which we will seek to organize jointly with CLIVAR Atlantic Panel. Tentatively attached to ICP 2010. (organizers Mike Mann and Eystein Jansen)

Workshop 3. ENSO: Past and future variability - small workshop attached to a more general meeting on the Tropical Pacific – potentially in association with the CLIVAR Pacific Panel and the PAGES Global Monsoon WG (potential organizers: Julien Emile-Geay, Mike Mann, Axel Timmerman).

Workshop 4. Paleo-data/Model fusion – Data assimilation. Potential organizers Hugues Goosse, Andreas Schmittner, possibly as a special session at an EGU/AGU conference.

Workshop 5. Extreme events (Tropical cyclones, extreme precipitation events, flooding).

2nd PAGES Global Monsoon Symposium: Global Monsoon and Low-Latitude Processes (Shanghai, China, 13 – 15 Sep 2010**)** – this will be a potential candidate for a third joint PAGES/CLIVAR Newsletter (see 3.3 below).

3.2 Other Initiatives

The PAGES/CLIVAR Intersection Panel believes that the proxy record over the last two millennia provides a valuable means of evaluating coupled atmosphere-ocean general circulation models and their internal parameterizations. Through coordination with the WCRP WGCM, the PAGES/CLIVAR Intersection Panel will encourage international modeling groups to undertake multi-model ensembles of integrations of the last 2 ka and 6 ka BP, employing a consistent set of forcings and agreed protocols. These simulation experiments should be produced using the same Earth System Models that will be used for AR5 of the IPCC, preferably as an option in the set of experiments planned for AR5. The PAGES/CLIVAR Panel will also promote mechanisms to facilitate the storage and routine distribution of the model output arising from such efforts, which should be made available in the same formats and data bases used for IPCC model experiments, e.g., the IPCC AR4 model experiments at PCMDI or at the PMIP-servers.

To this end the Panel would like to open discussions with the PMIP group to encourage greater community involvement and to support a stronger integration of their efforts to co-ordinate with the WGCM preparations for IPCC AR5.

The Panel would also like to encourage the establishment of a database of natural climate forcings of the last 2 ka – in a format ready for model implementation – on the PAGES Focus 1 ("Climate Forcings") website in preparation for the PR challenge (discussed above).

More generally, the Panel is keen to foster development of more active data repositories that would facilitate the work of data synthesis. Towards this goal, the Panel will work as an advisory partner with NOAA, and hopefully other agencies, to encourage the development of more useful archives – either through the addition of more metadata, or the creation of new access tools.

3.3 Newsletter

Following the success of the first two Joint PAGES-CLIVAR Newsletters (March 2000 and January 2006 – see http://www.clivar.org/publications/exchanges/exchanges.php), the Panel would like to maintain the tradition with the production of a third joint newsletter, possibly with contributions associated with each of the above workshops, in 2011.

3.4 Panel views on Post-CLIVAR

The CLIVAR program is due to be retired in 2013. Discussions concerning how the post-CLIVAR committees and panels should be organized are needed before February 2009. The Panel submitted a short document to the joint SSC outlining the case for the inclusion of a paleo component wherever useful.