Editorial

Interaction between IGBP-PAGES and WCRP-CLIVAR is driven by the overlapping interests of the past climate reconstruction and future climate prediction research communities. Paleoscientists rely on modern instrumental records in order to calibrate and validate their proxy climate reconstructions while climate prediction relies on the information about decadal and century scale variability which long, high resolution, multi-proxy paleorecords provide.

Following on from the initial success of the first PAGES/CLIVAR Intersection meeting (PAGES Report, 1996), and riding the momentum from the CLIVAR international meeting (WCRP Report 108), a series of PAGES/CLIVAR workshops, open meetings and short courses, with equal representation from the paleoclimate and climate dynamics communities, is underway. The most recent workshop, held in Venice, Italy from Nov. 8–12, 1999 concentrated on the theme "Climate of the Last Millennium." Many of the results and recommendations which grew out of this meeting are collected here in a special newsletter, produced as a joint effort and sent to the entire PAGES and CLIVAR communities.

In the first piece in this newsletter "Climate Paradigms for the Last Millennium" Ray Bradley provides a scientific editorial along the theme of the Venice workshop itself. This is followed by several scientific highlights authored primarily by participants in the Venice workshops on the topics of:

- ENSO Variability in the Pacific (Cane *et al.*)
- Abrupt Climate Change (Alverson and Oldfield)
- Regional Hydrological Change (Cook and Evans, Trenberth)
- North Atlantic Variability (Jansen and Koç, Sarachik and Alverson)

These same four themes are encapsulated in an series of PAGES/CLIVAR meetings and short courses, planned over the coming years, which will build on the recommendations agreed on at the Venice workshop, and highlighted in this newsletter. The entire series will provide continuity and momentum to this interdisciplinary effort, and culminate in an open synthesis meeting and publication.

- *Early 2001, TBA* : **ENSO and Monsoon Variability in the Pacific**
- **Nov. 10–15, 2001*, "Il Ciocco", Italy*:* **Abrupt Climate Change Dynamics**
- *2002, USA, TBA:* **Regional Hydrological Variability**
- **Oct. 11–16, 2003, Granada, Spain:* **North Atlantic Variability**
- *2004, Switzerland, TBA:* **PAGES/CLIVAR Synthesis Meeting**

* co-sponsored by EURESCO

The second and third part of this newsletter cover items related to PAGES and CLIVAR individually in order to provide the respective communities with information of their own programs. This newsletter concludes with a (joint) conference calendar covering the most important meetings in the near future. More comprehensive meeting information can be obtained through our websites.

Please note that the references in this issue are only avaible in an abbreviated form to save space.

K. Alverson and A. Villwock

Climate Paradigms for the Last Millennium

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Conventional wisdom has it that the climate of the last millennium followed a simple sequence – a "Medieval Warm Epoch" (MWE), a "Little Ice Age" (LIA) and then globally extensive warming. This view has its roots in the early work of H.H. Lamb (1963, 1965) but more recent research has reassessed this paradigm. Lamb defined the MWE as a period of unusual warmth in the 11th–13th centuries A.D., based almost exclusively on evidence from western Europe and the North Atlantic region. His studies pre-dated modern quantitative paleoclimatology so the values of temperature change that he attributed to this period are essentially anecdotal, and based largely on his own estimates and personal perspective. In revisiting the concept of a MWE, Hughes and Diaz (1996) reviewed a wide range of paleoclimatic data, much of it reported since Lamb's classic work (Lamb 1965). They concluded that "*it is impossible at present to conclude from the evidence gathered here that there is anything more significant than the fact that in some areas of the globe, for some part of the year, relatively warm conditions may have prevailed.*" Thus, they found no clear support for there having been a globally extensive warm epoch in the MWE or indeed within a longer interval stretching from the 9th to the early 15th century. Certainly, there is no evidence that global or hemispheric mean temperatures were higher during the MWE than in the 20th century (Crowley and Lowery, 2000) yet this notion has somehow become entrenched as common lore. This is unfortunate as it does not help our understanding of natural climate variability and its causes. Perhaps of greater significance is that there were significant precipitation anomalies during the period of the "MWE"; in particular, many areas experienced protracted drought episodes and these were far beyond the range of anything recorded within the period of instrumental records. For example, Stine (1994) describes compelling evidence that prolonged drought affected many parts of the western United States (especially eastern California and the western Great Basin) from (at least) A.D.910 to ~A.D.1110, and from (at least) A.D.1210 to ~A.D.1350. There is also strong evidence that prolonged drought affected Patagonia during the earlier of these episodes. This led Stine to argue that a better term for the overall period was the "Medieval Climatic Anomaly" (MCA) which removes the emphasis on temperature as its defining characteristic (Stine, 1998). The widespread nature of hydrological anomalies during the MCA suggests that changes in the frequency or persistence of circulation regimes may account for the unusual nature of the period, and naturally this may have led to anomalous warmth in some (but not all) regions.

Numerous studies provide strong evidence that cooler conditions characterized the ensuing few centuries, and the term "Little Ice Age" is commonly applied to this period. Since there were regional variations to this climatic deterioration, it is difficult to define a universally applicable date for the "onset" and "end" of this period, but commonly ~A.D.1550–1850 is used (Jones and Bradley, 1992). However, there is evidence that cold episodes were experienced earlier, by A.D. 1450 or even A.D. 1250 in some areas (Grove and Switsur, 1994; Luckman, 1994). This definitional problem is illustrated by the estimates of Northern Hemisphere mean annual temperature for the last 1000 years, reconstructed by Mann *et al.* (1999) which show a gradual decline in temperature over the first half of the last millennium, rather than a sudden "onset" of a "LIA". Furthermore, it is clear that within the period 1550–1850 there was a great deal of temperature variation both in time and space. Some areas were warm at times when others were cold and vice versa, and some seasons may have been relatively warm while other seasons in the same region were anomalously cold. No doubt the complexity, or structure that we see in the climate of the LIA is a reflection of the (relative) wealth of information that paleoclimate archives (tree rings, corals, varved sediments, ice cores, historical records etc.) have provided for this period. Having said that, when viewed over the long term this overall interval was undoubtedly one of the coldest in the entire Holocene. Such is the nature of perspective – there is the danger that on close examination one may not see the woods for the trees, yet a full explanation of the observed changes may require a fairly detailed understanding of the temporal and spatial details. If we had similar data for the last 1000 years, our somewhat simplistic concepts of Medieval climatic conditions would certainly be revised and strong efforts are needed to produced a comprehensive paleoclimatic perspective on this time period. Only with such data will we be able to explain the likely causes for climate variations over the last millennium. At present, it is difficult to unequivocally ascribe the changes to external forcing (solar, orbital, volcanic) or internal ocean-atmosphere interactions, or indeed to a combination of all of these, perhaps varying in importance over time (cf. Mann *et al.*, 1998, 1999; Crowley and Kim, 1999; Broecker *et al.*, 1999). Given that these forcing factors will play a role in future climate variations, getting a better appreciation for both the past record of climate and of forcing factors must be a top priority for both PAGES and CLIVAR.

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ENSO Through the Holocene, Depicted in Corals and a Model Simulation

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In the 1990s El Niño attained global name recognition just short of Michael Jordan's. (Perhaps not coincidentally, the economic impact of the two is estimated to have the same order of magnitude, US$ 10^{10}). ENSO (El Niño and the Southern Oscillation) has also received enormous attention from the scientific community. Both the popular and scientific attention came in recognition of the premier role ENSO plays in modern climate variability, variability with great consequence for human society. A special recent concern, both popular and scientific, is whether the apparently "unusual" ENSO behavior of the past two decades is due to anthropogenic changes in the climate system. Or is it consistent with natural variability? It is hard to say from the instrumental record of ENSO, which is only some 130 years long.

Putting recent ENSO variability in proper context requires the longer view afforded by proxy records. This longer view includes periods with mean conditions and orbital forcings very different from today, providing some idea of the sensitivity of the ENSO system to external forcing. A number of reports on ENSO in the mid-Holocene appeared in the latter half of the 1990s. (McGlone *et al.*, 1995; Shulmeister and Lees, 1995; Sandweiss *et al.*, 1996, 1997; Wells and Noller, 1997; Gagan *et al.*, 1998) culminating in that of Rodbell *et al.* (1999). The interpretations they offered for the paleoproxy evidence are often contradictory, and have been much debated.

Clement *et al.* (2000) suggest a picture of the mid-Holocene (5000–10000 BP) tropical Pacific consistent with all prior paleo-ENSO data. Their view is based on a model simulation in which the intermediate Zebiak and Cane (1987) ENSO model, a model still in use for ENSO prediction, is forced by variations in heating due to orbital variations in seasonal insolation. Some summary statistics from the model run are presented in Figure 1. We see that the model ENSO