Reconstructing Late Holocene Climate

Studying the past few millennia, the Late Holocene, can help us better understand modern-day natural climate variability. With this in mind, a group of paleoclimate researchers and climate modelers recently convened at a workshop to discuss three distinct approaches to reconstructing Late Holocene climate history.

The first approach involves calibrating long-term proxy climate indicators against modern instrumental records to estimate past patterns [e.g., *Mann et al.*, 1998; *Luterbacher et al.*, 1999]. The second employs numerical modeling of the forced component of climate change using estimates of past climate forcings to drive climate model integrations [e.g., *Crowley*, 2000]. The [redacted]

taken into account. Since half the surface area of the globe lies within the tropics and sub-tropics, the relative paucity of tropical and Southern Hemisphere proxy records was identified as a primary remaining source of uncertainty. Methodological issues regarding proxy-based climate reconstructions were also addressed. Results from forced and control-coupled model integrations demonstrated that calibration of paleoclimate indicators against a non-stationary twentieth-century climate is unlikely to introduce any significant bias. A new "Age Band Decomposition" standardization method demonstrated prospects for obtaining enhanced, low-frequency vari- [redacted]

tury scale variations in reconstructed Northern Hemisphere temperature over the past millennium. In the EBM, however, discrepancies are observed during the 19th century; the modeled hemispheric temperature increases while proxy and instrumental records show slight cooling. Borehole temperature reconstructions portray a colder past few centuries than do proxy estimates, but considerable uncertainty surrounds the interpretation of the borehole data. A high, prescribed EBM sensitivity to radiative forcing is more consistent with the large past cooling inferred from borehole data; a moderate sensitivity agrees more closely with proxy temperature reconstructions. The GCM results presented support higher temperature sensitivity.

Process-based models were used to gener- [redacted] are especially needed in low-latitude regions such as Africa, much of the Southern Hemisphere, and ENSO-sensitive regions. An internationally coordinated effort to update key proxy networks is required. Extension of climate reconstructions back in time will require the use of lower-resolution proxies such as lake and ocean sediments, speleothems, and sclerosponges that provide sufficient resolution to resolve decade-century scale variability over several millennia. The stability of climate/proxy relationships needs to be more fully investigated. The sources of differences between temperature reconstructions from different data sources must be resolved, and histories of radiative forcings in past centuries better constrained, for more confident assessments of climate sensitivity. Finally, forward proxy models should be further developed and validated.

Participants supported a coordinated international paleoclimate proxy re-analysis of the 19th and 20th centuries. Such an interdisciplinary project would focus on issues in forward modeling, data assimilation, proxy calibration, and the identification of significant gaps in information. The results could feasibly provide a framework for prioritizing the collection of new proxy data.

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