NEWS

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Developing marine protected areas
A draft framework for the development of a national system of marine protected areas (MPA) has been released for public comment by the U.S. National Oceanic and Atmospheric Administration and the U.S. Department of the Interior. Under the proposed framework, an MPA is any area of the marine environment that has been reserved by U.S. federal, state, local, or other government regulations "to provide lasting protection for part or all of the natural and cultural resources therein." About 1500 marine conservation areas initially would qualify as MPAs. The national system is intended to guide cooperative efforts among various parties and thus increase protection of these areas. The framework goals for a national system include: advancing conservation and management of marine resources through ecosystem-based approaches, and enhancing effective coordination and integration among MPAs in the national system and within the broader context of ecosystem-based management.

The draft framework is available for public comment until 14 February 2007. Further information is available at http://www.mpa.gov/national_system/framework_sup.html

Cassini images Saturn storm The Cassini spacecraft has spotted an 8000-kilometer-wide, hurricane-like storm around Saturn's South Pole, NASA announced on 9 November. The storm has a dark 'eye' at the South Pole along with eye-wall clouds and spiral arms, but it is not known if moist convection—the driver of hurricanes on Earth—drives the Saturn storm. A movie taken by Cassini's camera indicates that the winds are blowing clockwise at about 560 kilometers per hour. Although large storms have been observed on other planets in the past—most notably, Jupiter's Great Red Spot—this is the first storm found to have eye-wall clouds and a relatively calm center. Andrew Ingersoll, a member of Cassini's imaging team at the California Institute of Technology, Pasadena, said the storm looks like a hurricane but is not behaving like one. "Whatever it is, we are going to focus on the eye of this storm and find out why it is there."

A new flood monitoring system
A system of 'intelligent' sensors linked in a grid could provide rapid, low-cost flood forecasts. The system's designers, scientists from the University of Lancaster (U.K.), recently installed the sensors at 13 locations across a Yorkshire (U.K.) flood plain. At each location, researchers placed a depth sensor and digital camera that can measure the speed of flotsam in the water. Computers incorporated into the sensors link them together wirelessly in a grid that allows the system to adapt as flood waters rise or if some sensors cease working or wash away. In addition, the sensors can adjust their power management so that, for example, they use less power during dry times. Flood forecasting models are run on the computer grid and adjust their predictions as the information from the sensors changes. Keith Beven of Lancaster University said that this type of local system could provide advance warning even in situations of fast rainfall that typically make flood forecasting difficult.

—SARAH ZIELINSKI, Staff Writer

MEETINGS

Past Millennia Climate Variability

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Human influences on climate operate against a background of long-term natural climate variability. Our ability to characterize this long-term variability and to distinguish it from climate change due to human activities is limited by the relative shortness of the instrumental record. Thus, investigators turn to a combination of indirect paleoclimate proxy evidence and theoretical climate models to ascertain the nature and causes of climate changes on centennial and longer timescales.

Particularly relevant in this context is the time frame of the last few millennia, which is termed the 'Late Holocene.' During this period, the fundamental external boundary conditions on the climate, such as the configuration of the continents, the size and locations of the major ice sheets, and the mean radiative forcing due to changes in Earth-orbital geometry, are similar to those today. Study of this interval thus allows insights into the natural variability that might be expected today in the absence of human influences.

Highly resolved proxy data (i.e., representing decadal, annual, and sometimes seasonal variability), such as data derived from tree rings, corals, ice cores, and lake sediments among others, are relatively abundant over this time interval. Also available are indirect estimates of the natural 'forcing' factors; these include, for example, explosive volcanic activity and changes in solar output, which are believed to be important over this time frame. These sources of evidence provide an opportunity to reconstruct and characterize recent natural climate variations well before instrumental climate records are available.

Recognizing the importance of a better understanding of the climate variability over past few millennia, a group of paleoclimate researchers recently convened a workshop in Wengen, Switzerland to review the currently available evidence and its uncertainties, and to discuss the priorities for future research.

This workshop, entitled "Past Millennia Climate Variability: Proxy Based Reconstructions, Modeling and Methodology—Synthesis and Outlook," was organized by the international joint Past Global Changes/Climate Variability and Predictability (PAGES/CLIVAR) intersection working group in concert with the PAGES office in Bern, Switzerland. The workshop, funded by the Electric Power Research Institute (EPRI), PAGES, the Swiss National Centers of Competence in Research (NCCR), and CLIVAR, represented the continued efforts of the international PAGES/CLIVAR intersection to identify the key priority areas for future international collaborative research to advance understanding of the nature of natural climate variability and the extent to which human activities are causing changes.

Key Findings and Conclusions

Twenty-four international scientific researchers participated in the workshop, representing different climate data and modeling subdisciplines. All participants were invited to discuss the state-of-the-art and future needs in the study of late Holocene climate variability. Two days were devoted to short presentations and extended discussions on timely topics and issues, covering the areas of proxy data, climate reconstructions, and paleoclimate modeling.

Particular attention was paid to the issue of how to deal with uncertainties in assessing climate variability over the past one to two millennia, and how to reduce current uncertainties. Questions posed and addressed included, What do current uncertainty estimates take into account? How relevant are current uncertainties for the general findings regarding past climate variability over the past few millennia?

Workshop participants reached the following primary conclusions:

- Late twentieth century warming appears to be anomalous in the context of the past 1000 years at hemispheric scales. There is evidence for periods of cooling and warming that occur on all timescales and on all spatial scales.

• Model-predicted and reconstructed climate variations over past centuries are generally compatible, taking into account uncertainties in the currently available paleoclimate and forcing data and possible limitations in the models.

• It is essential in interpreting past paleoclimate proxy evidence to consider the spatial extent, seasonality, and duration of regional climate anomalies.

• In seeking to explain the proxy climate record, the role of large-scale dynamics as well as changes in the external forcings that might cause past changes must be considered.

• Natural radiative forcing changes appear to play an important role on the relevant timescales. Solar forcing may account for some climate variability on decadal through millennial timescales, though current estimates of the magnitude of past solar forcing are quite uncertain. Individual volcanic eruptions affect climate generally for only a few years, but longer-term episodes of closely spaced large eruptions (e.g., as in the early nineteenth century) can lead to multidecadal-scale effects.

• Usefully constraining estimates of global climate sensitivity from paleoclimate data will require a better knowledge of past radiative forcing and the amplitude of internal as well as forced natural variability.

The discussions emphasized the importance of distinguishing past hemispheric or global-scale variability from regional variations. It was shown that the widely used term 'Medieval Warm Period' simply is not an appropriate description of medieval climate in many regions of the world. Coral data for the tropical Pacific, for example, suggest a 'Medieval Cool Period.'

Such considerations reinforce the principle that a better regional documentation of past climate is necessary to better understand the past. The group also noted the importance of focusing not simply on the often emphasized hemispheric mean temperature variations of past centuries, but also on the spatial patterns of various key climatic fields, including surface temperature, atmospheric circulation, precipitation, and drought.

Additionally, the group stressed the importance of obtaining, where possible, seasonally resolved records so that the seasonality of past climate changes can be better investigated. The importance of considering dynamical mechanisms such as the El Niño–Southern Oscillation (ENSO) and the North Atlantic Oscillation (NAO) in interpreting past climate changes was also discussed. Such considerations are consistent with recent PAGES and CLIVAR initiatives aimed at the study of past regional variability in South America and the Mediterranean region.

Launch of a Paleoclimate Reconstructing Challenge

The participants agreed that progress in climate modeling is crucial not only to the assessment of current and future anthropogenic impacts on climate, but also to a better understanding of past climate variability. The importance of using general circulation models (GCMs) to test the performance of paleoclimate reconstruction approaches and the sensitivities of those methods to assumptions regarding proxy data was emphasized in the group's discussions. To this end, the workshop participants agreed that an international community-wide Paleoclimate Reconstruction Challenge (PR Challenge) should be held in the near future.

Accepting this recommendation, the PAGES/CLIVAR working group is currently planning such a project, and the details will be announced in the near future. The PR Challenge will build on the theme of past model intercomparison projects, coordinating the use of synthetically derived proxy (pseudoproxy) networks produced from climate model simulations to provide a test bed for examining the performance of paleoclimate reconstruction methods. The challenge will closely follow the model provided by last year's successful 'EPICA (European Project for Ice Coring in Antarctica) Challenge' initiative (see, e.g., *Eos, 85*(38), 363, 2004).

The PR Challenge will follow a double-blind protocol in which various international climate modeling centers will provide long-term climate model simulation results for use in the project; a subset (network) will be provided to an independent group of scientists who will produce synthetic proxy data networks with varying statistical characteristics that reflect the behavior of real-world proxy data, with their potential strengths, limitations, and biases. Climate scientists involved in paleoclimate reconstruction will be challenged to apply their methods, using the synthetic proxy networks and the 'modern instrumental record' (i.e., actual model climate fields of the nineteenth to twentieth centuries, appropriately degraded to simulate actual instrumental data), to estimate the true past behavior of the model as measured by various data (hemispheric mean temperatures, surface temperature fields, sea level pressure fields, etc.). Further information is available at http://www.pagesigbp.org/science/initiatives/challenge

A synthesis publication on the state of the art regarding late Holocene climate variability will be published by the workshop participants. Follow-up future activities are currently being planned.

Future Priorities

The group recognized that additional effort is needed in the archiving of paleoclimate data and associated metadata. Such efforts, which logically should be coordinated by the international world data centers (such as the World Data Center for Paleoclimatology, http://www.ncdc.noaa.gov/paleo), will require international cooperation. Additionally, the group agreed on the importance of encouraging scientists to provide not just the proxy data and climate reconstructions, but as much information as possible about random and systematic error associated with them, to allow a better quantification of inescapable uncertainty. Such information is crucial, for example, in comparisons of paleoclimate evidence with model simulation results.

The participants also identified the need for a second project in the area of proxy data uncertainties. In association with this project, an additional workshop is being planned to establish a coherent approach to identifying uncertainties in climate proxies, and to develop strategies for future collection and integration of proxy data from key regions. That workshop will focus on climate proxies that have decadal or better temporal resolution and will involve the world data centers.

The four-day workshop in the unique setting of the snow-covered Bernese Alps provided a good setting for informal discussions, setting the stage for productive activities in the months and years ahead.

The workshop "Past Millennia Climate Variability: Proxy Based Reconstructions, Modeling and Methodology—Synthesis and Outlook," was held 7–10 June 2006 in Wengen, Switzerland. The authors of this report constitute the PAGES/CLIVAR Intersection Working Group.

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