providing an excellent follow-on to the Satellite Image Atlas series. GLIMS objectives are to measure changes in the extent of the Earth's glaciers. The international GLIMS team uses high-resolution satellite images from ASTER and the Landsat 7 ETM+ to track the size and movement of glaciers. The Landsat 7 (http://landsat.gsfc.nasa.gov/) data acquisition plan for Greenland and Antarctica is key to the GLIMS project and other glacier work. Landsat 7 data are useful not only for studying small glaciers, but have also proven useful for studying flow patterns and other parameters over ice sheets.

### *Product Availability*

Most EOS products relevant to snow and ice research are available free of charge from the National Snow and Ice Data Center (NSIDC) (http://nsidc.org). These products include the MODIS snow and sea ice products from both the Terra and Aqua platforms, all AMSR-E products from Aqua, and GLAS products from ICESat.

The products are available through various approaches such as the EOS Data Gateway (EDG), data pool Search 'N Order Web Interface (SNOWI), user subscriptions, and Machine-to-Machine Gateway (MTMGW). The data pool is a short-term data cache that provides FTP access to MODIS, AMSR-E, and GLAS products (http://nsidc.org/data/data_pool/). Many other EOS precursor and ancillary products can also be obtained from NSIDC.

At the workshop, representatives from the NSIDC and Goddard Distributed Active Archive Centers (DAACs) provided hands-on demonstrations to answer users' questions and to instruct prospective users about the product details and ordering. Demonstrations of new data analysis tools were also conducted, showing users the broad utility of the products.

### *Panel Discussions*

Discussions resulted from the three panels and from oral presentations. A modeling panel was chaired by R. Dickinson, Georgia Institute of Technology; a data-fusion panel was chaired by D. Robinson, Rutgers University; and a sea ice panel was chaired by M. Van Woert, NOAA National Ice Center. Discussions highlighted concerns about differing requirements of operational monitoring and modeling organizations, as compared with those of the scientific research community. Common among those concerns was the need for timely, quality data products that could be used alone or blended with other products to help achieve the operational or research goals of the user.

One of the biggest issues in GCM modeling is the fact that many subgrid-scale processes must still be averaged in GCM grid cells. Also, models need to improve their parameterization of snow albedo, including analysis of the effect of desert dust and other contaminants on the albedo of snow. EOS products have enabled improvements in data-assimilation models since early 2000.

Also discussed was the future availability of passive-microwave (Cross-Track Microwave Imaging Sensor (CMIS)) and visible (Visible Infrared Imaging Radiometer Suite (VIIRS)) data for blending of data sets, provided in part by the launch of the National Polar-orbiting Operational Environmental Satellite System (NPOESS) in 2010.

### *Workshop Recommendations*

Significant recommendations emerged from the workshop concerning validation, the importance of estimating errors, and the creation of Climate Data Records (CDRs). Optimally, validation should be undertaken (and funding provided) when data-product funding is awarded by NASA. While it is recognized that there is a trade-off between science and validation in terms of funding, the discussions concluded that validation should be an integral part of algorithm and product development, and validation activities should be a component of product monitoring. Including error estimates associated with a derived geophysical parameter (with the product) is necessary for evaluating the product, especially those products that are used to construct CDRs. Scientific stewardship should be applied in constructing and maintaining CDRs so that they possess the consistent quality necessary for study of decade-scale change in a geophysical parameter. EOS products will be useful in the creation of CDRs.

The EOS Snow and Ice Products Workshop was held on 16–17 November 2004, in Upper Marlboro, Maryland. The agenda and presentations from the workshop are available at http://nsidc.org/events/eos_workshop04/.

### *Acknowledgments*

The workshop was sponsored jointly by NASA Goddard Space Flight Center, Greenbelt, Maryland, and the National Snow and Ice Data Center, Boulder, Colorado. Meeting support for the workshop was furnished by Raytheon, Upper Marlboro, Maryland; the Cryospheric Processes Program at NASA Headquarters; and the Moderate-Resolution Imaging Spectroradiometer (MODIS) Project at NASA/GSFC.

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# Eighth International Conference on Paleoceanography

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Every three years since 1983, the paleoceanographic community has come together at a different venue to share new data and discoveries at the International Conference on Paleoceanography (ICP). For the recent ICP-8, France was the host country for a conference focused on the theme of "An Ocean View of Global Change." The Environnements et Paléoenvironnement Océanique (EPOC) paleoceanography group of the University Bordeaux I acted as the local organizing committee.

Scientific presentations at ICP-8 addressed the latest discoveries in paleoceanography, and highlighted both emerging and as-yet-unsolved questions on global climate change. Thirty-five speakers, invited by the ICP-8 Science Committee, gave overview talks during morning sessions organized around five major scientific themes. These themes were Cenozoic-Mesozoic Oceans; Carbonate and Silica Systems of the Pleistocene Ocean; Biogeochemical Cycles of the Past; High-Frequency Climate Variability; and Interhemispheric Ocean-Continent-Climate Linkages.

Approximately 550 scientific posters were displayed during afternoon poster sessions centered on the same themes, providing attendees the opportunity to browse and discuss the latest results with their colleagues. Each day concluded with an invited keynote address, delivered this year by Nick Shackleton, Robbie Toggweiler, André Berger, and Jean Jouzel. A copy of the complete conference agenda and the full abstracts of all invited speakers and poster presenters can be found on the ICP-8 Web site: www.epoc.u-bordeaux.fr/icp8.html.

Some of the scientific highlights and outcomes of the wide-ranging presentations and discussions include the following:

1. A growing recognition that marine records need to be studied using ultra high-resolution sampling and analytical strategies, and that age models for paleo time series need to be substantially improved. It has become increasingly clear that high-frequency variability of past climates can only be accurately identified with paleoclimatic records (ice cores and marine cores) sampled and studied at decadal to centennial resolution.

2. A general consensus that past periods of extremely warm climate, such as the Cretaceous, must be more rigorously investigated. Evidence that the traditional view of the Cretaceous as an ice-free "greenhouse" world may be inaccurate or at least oversimplified, and that both long- and short-term climatic variability occurred

during this time interval, is forcing new thinking about the nature of Mesozoic climates.

3. In order to assist modelers trying to simulate future Earth climate, there is a need to better document the best recent analog of the present Holocene, the period of marine isotope stage 11 (~400 kyr ago). Stage 11 is the most recent interglacial period with an astronomical configuration governing the distribution and seasonality of insolation that is comparable to that of the Holocene. Moreover, study of the recently recovered EPICA (European Project for Ice Coring in Antarctica) ice core (South Pole) reveals that marine isotope stage 11 lasted more than 20,000 years, indicating that our interglacial Holocene period is not close to its natural end, a fact sure to influence the potential impacts of global warming in the future.

4. A growing array of innovative geochemical tracers in the paleoceanographic toolbox—such as Mg/Ca ratios in foraminifera and Th, Pa, and Nd isotopes—offers exciting new research opportunities and the potential for new paleoenvironmental understanding. As one measure of the enthusiasm for these new techniques, 120 participants attended a Mg/Ca temperature proxy workshop that immediately preceded the conference.

5. Modelers are developing new concepts that could potentially trigger major improvements in ocean general circulation models. For example, some modelers now argue that buoyancy forcing is largely responsible for the changes imprinted on the global ocean circulation (the so-called conveyor belt). There is also emerging thought that the role of salinity in deep waters may have been underestimated and needs to be better weighted in these models.

6. There is a clear need to amplify efforts to compare and link records from different archives (ice cores, oceanic cores, and continental records). This will not only allow the paleo community to improve and refine age models, but it will also lead to a better understanding of the interhemispheric leads and lags essential to assessing potential climate forcing mechanisms. The reconstruction of pollen assemblages in marine cores, for example, provides a direct and important link to terrestrial changes: By linking the evidence for vegetation changes directly to marine indicators in the same core, the problem of synchronization is elegantly solved. Linked observations from different parts of the climate system will also help us to better evaluate the impact of climate change on human populations during the last climatic cycle.

In addition to the primary conference agenda, a series of successful and well-attended workshops was organized before and after the meeting to complement the ICP program. A general outcome of the five separate workshops (Mg/Ca Temperature Proxy, Southern Hemisphere Climate Modes, Stable Isotope Laboratory Intercalibrations, Marine Isotope Stage 11, and LINKS (Linking Present Oceanic Processes and Paleo Records) Working Group was the recognition by participants that major future advances in paleoceanography will require work of a more collaborative nature, using a more interdisciplinary approach, and with final results assembled for publication in dedicated special journal issues or in collaborative review papers.

In particular, the Mg/Ca Temperature Proxy workshop attendees made plans to organize in the months ahead a worldwide intercalibration exercise in order to better constrain methodology and the transfer functions used to calculate paleotemperatures. A total of 30 laboratories to date have expressed a willingness to participate, and more are welcome. Interested parties can contact N. Caillon (Nicolas.Caillon@lsce.cnrs-gif.fr) or M. Greaves (mg109@esc.cam.ac.uk) for more details.

ICP-8 attracted a total of 700 scientists from 34 different countries. This number includes 250 students, which attests to the dramatic growth and future vitality of the field. Prizes consisting of subscriptions to scientific journals (e.g., *Paleoceanography*, *Nature*, and *Marine Micropaleontology*) were offered to the authors of the 13 best student posters.

On a final note, the traditional ICP Paleomusicology Concert once again showcased the musical talents of many colleagues. This well-attended event teamed up conference attendees and local musicians for an enjoyable evening concert of classical and popular works.

The ICP-8 was held 5–10 September 2004, in Biarritz, France.

*Acknowledgments*

ICP-8 was a great success thanks to generous support and funding from a number of sources, including the French Centre Nationale de la Recherche Scientifique (CNRS-INSU), the French Research Ministry, Région Aquitaine, CG 64, and Université Bordeaux I. The International Marine Global Change Study (IMAGES) and the Scientific Committee on Ocean Research (SCOR) provided travel grants to students and scientists from developing countries to help underwrite their participation at this meeting. The next ICP (ICP-9, in 2007) will be organized in Shanghai by Chinese colleagues.

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# EarthScope Science for Mid-America

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In mid-America (roughly the region between the Rocky and Appalachian mountains, and between the U.S./Canadian border and the Gulf of Mexico), the National Science Foundation's (NSF) EarthScope program presents important opportunities to advance the understanding of the evolution, composition, and hazards of the North American heartland. EarthScope (http://www.earthscope.org) will help to image the geological roots of North America at unprecedented resolution with a variety of geophysical techniques.

The program challenges the solid Earth science community to define multidisciplinary science objectives that further both the technical knowledge and the societal impact of our work.

Last summer, 50 Earth scientists gathered in Memphis, Tennessee, to define and discuss fundamental scientific issues central to the success of EarthScope. A diverse group of participants representing academic institutions, state agencies, and seismic engineering professionals attended.

Five keynote speakers highlighted overlapping themes: the geologic evolution of mid-America, lithospheric composition, seismic hazards, multidisciplinary geodatabases, and education and outreach. Issues raised by the keynoters and presented in posters by attendees were discussed in open forum and in discussions organized and moderated by a panel. NSF funded the meeting, with supplemental support from the U.S. Geological Survey (USGS) and the Mid-America Earthquake Center.

## *The Evolution of (Mid) North America*

Geologic assessments of the assembling of North America apply rules derived largely from plate tectonics to fragmentary observations, including the correlation of physical properties of rocks, fabrics, and boundaries of blocks. William Thomas of the University of Kentucky posed the fundamental question of how to relate the post-Proterozoic-aged (< 2.6 Ga) geological structures in mid-America to plate tectonic theory, or, alternatively, must the idea of plate tectonics be modified to account for the observations?

For a start, plate tectonics in the strict sense of involving rigid plates fails to explain the current deformation (as evidenced by regional seismicity). Northernmost mid-America crust was the southern edge of the Archean-aged (>2.6 Ga) Superior province, one of six probable microcontinents that form the core craton of the continent.

Much of mid-America's crust is Proterozoic in age and composed of accreted oceanic terranes and magmatic arcs of the Yavapai or Central Plains province and the Granite-Rhyolite province, which is magmatically augmented but not clearly related to known plate boundary interactions. In eastern mid-America, the Precambrian crust is associated with the Grenville orogeny, the last act in the formation of the supercontinent Rodinia (~1.1 Ga).