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The 2009–2010 El Niño: Hydrologic Relief to U.S. Regions?

Current forecasts by the U.S. National Oceanic and Atmospheric Administration (NOAA) are that the Pacific Ocean will experience El Niño conditions in late 2009 and into 2010. These forecasts are similar to past El Niño events in 1972–1973, 1982–1983, 1986–1987, and 2002–2003.

Evaluating the hydrologic conditions for these past El Niño events reveals that during these times, surface water supply conditions improved in many parts of the United States, including the Southeast, Midwest, and Southwest. At the same time, the Pacific Northwest and other specific regions of the United States experienced below-average water supply conditions. This is consistent with the long-established linkages between oceanic-atmospheric phenomena, El Niño, and streamflow [e.g., *Kahya and Dracup,* 1993; *Tootle et al.,* 2005].

Predicting El Niño responses is challenging. For example, in the upper Colorado River basin, mixed signals in streamflow and snowpack can be seen for past El Niño events. It is projected that Lake Powell and Lake Mead storage could increase between 9% and 48% in the next months if inflows are similar to those observed during three of the past similar El Niño events (1972–1973, 1982–1983, and 1986–1987) and could decrease by 21% if flows are similar to 2002–2003.

Accurately predicting the behavior involves statistical calculations, and once correlations are found, changes to hydrologic characteristics in different regions of the United States can be forecasted. Using the Colorado River basin as an example, forecasted patterns and their implications can be evaluated.

Current and Past El Niño Years

Data for the current forecast and past El Niño years were obtained from the NOAA Climate Prediction Center (http://www.cpc.ncep.noaa.gov/). A region of the Pacific Ocean called the Niño 3.4 (5°N–5°S, 120°–170°W) sea surface temperature (SST) region was used as the indicator of El Niño conditions because it is heavily studied and used by NOAA in its forecasts (Figure 1).

To determine historic El Niño events similar to the forecasted 2009–2010 El Niño, two statistical tests were performed. A similar El Niño event was defined when the monthly historic Niño 3.4 conditions and forecasted 2009–2010 Niño 3.4 conditions had a coefficient of determination (R^2) exceeding 90% and the *t* test of the difference of the means did not exceed 90%. By using these tests, four historic El Niño events (1972–1973, 1982–1983, 1986–1987, and 2002–2003) were found to be similar to the forecasted 2009–2010 El Niño event.

Hydrologic Responses

Figure 2 presents the hydrologic response to the four historic El Niño events that look similar to the current El Niño. Through using six continental U.S. unimpaired streamflow stations (water years 1951–2002), and 323 western U.S. snowpack stations (1 April snow water equivalent (the measure of the amount of water contained in snowpack) for the years 1961–2004 [see *Tootle et al.,* 2005; *Hunter et al.,* 2006]), scientists found that the Southeast, Midwest, and Southwest regions of the United States had increased yearly streamflow and the Pacific Northwest had decreased yearly streamflow (Figure 2a) during El Niño years. Decreased snowpack was also observed in Idaho, western Montana, northwestern Wyoming, and central Colorado during El Niño events (Figure 2b). The streamflow and snowpack were mixed in the Colorado and Utah portions of the upper Colorado River basin.

Case Study: Reservoirs in the Colorado River Basin

To evaluate what the 2009–2010 El Niño might mean on regional scales, it is helpful to examine one example. For Colorado River basin water supply, simulations were performed using the Bureau of Reclamation's long-term planning model Colorado River Simulation System (CRSS), which incorporates the major reservoirs and produces monthly projections of Lake Powell and Lake Mead elevations. CRSS was run for 2 years starting in January 2010 by updating the reservoir initial conditions to reflect the Bureau of Reclamation's most recent forecast for reservoir levels at the end of 2009, along with monthly natural streamflow (the gauged streamflow that had been corrected for the upstream effects of humans) from eight historic El Niño events.

Currently, the combined storage of Lake Powell and Lake Mead is approximately 60% of full, a result of the prolonged drought of the past 10 years. Figure 3a summarizes natural flows at Lees Ferry, Ariz., that represent the contributions from the upper Colorado River basin. Average flows during the 1972–1973, 1982–1983, 1986–1987, and 2002–2003 El Niño events were 106%, 135%, 129%, and 56%, respectively, of the average. Using CRSS with these flows indicates that the combined storage at Lake Powell and Lake Mead at the end of 2011 could increase between 4.0 cubic kilometers (9%, equivalent to 3.2 million acre-feet) under 1972–1973

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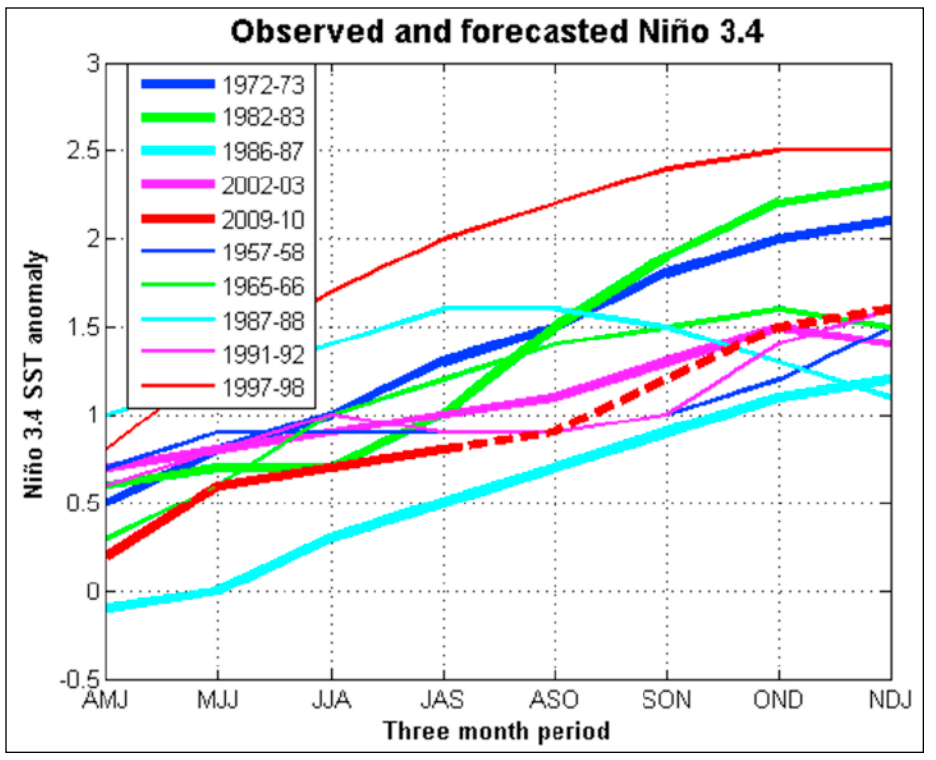

Fig. 1. Historic and forecasted El Niño events, based on Niño 3.4 sea surface temperature (SST) anomalies, during the period 1950–2010. The x-axis shows three month periods (e.g. AMJ is April-May-June). Bold curves represent the four similar El Niño events and the projected 2009–2010 event (observed data are continuous curves, and the forecasted scenario is a dashed curve).

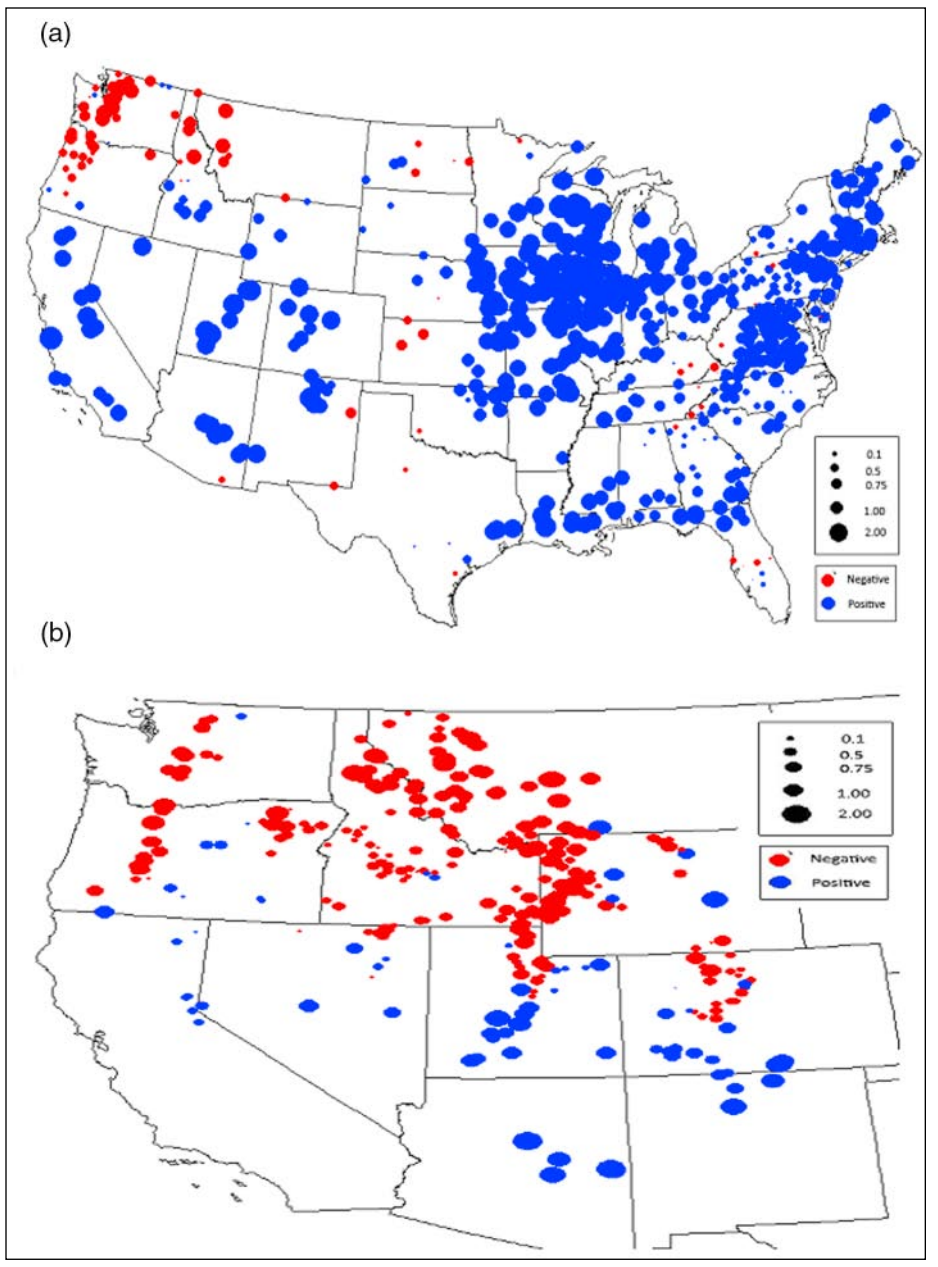

Fig. 2. (a) Continental United States unimpaired water year (October–September) streamflow and (b) western United States 1 April snow water equivalent. For each station, yearly standardized anomalies were determined, and the averages for the four similar El Niño years are displayed. Blue dots represent increased streamflow or snowpack and red dots represent decreased streamflow or snowpack; both are scaled based on the magnitude of the anomaly.

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conditions and 16.2 cubic kilometers (48%, equivalent to 13.1 million acre-feet) under 1982–1983 conditions (Figure 3b). If 2002–2003 conditions are used in CRSS, the combined storage could decrease by 10.3 cubic kilometers (21%, equivalent to 3.2 million acre-feet).

These water elevation changes are not due solely to inflow hydrology. Lake Powell and Lake Mead are operated according to prescribed operational guidelines that include the coordinated operation of the reservoirs [*Bureau of Reclamation,* 2007]. The presence of these guidelines, along with the differences in streamflow response above and below Lake Powell, are partial explanations as to why Lake Mead has a larger increase in water elevation.

What Will This El Niño Be Like?

El Niño is one of the more pronounced climate drivers for the United States. As the current El Niño event progresses, water managers are encouraged to consider these projected changes in water supply and impacts to reservoir operations. It appears that regions will experience some drought relief; however, one El Niño event similar to those historically observed will not be enough to fully replenish large reservoirs such as Lake Powell and Lake Mead.

Acknowledgments

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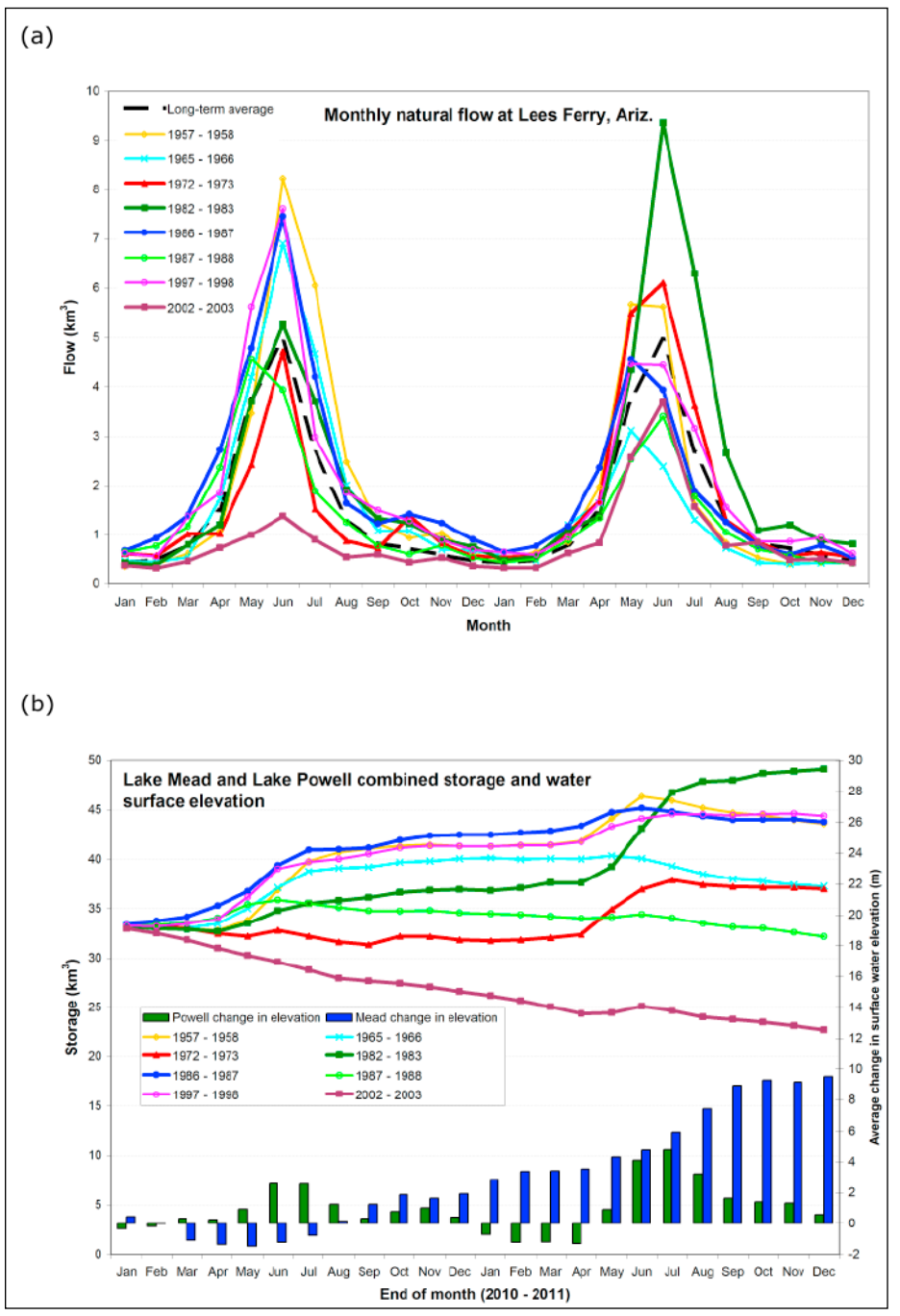

Fig. 3. (a) Eight projections of combined storage levels in Lake Mead and Lake Powell for January 2010 to December 2011 based on historic 24-month natural flows at Lees Ferry, Ariz., during El Niño years. Natural flows represent the flows from the upper Colorado River basin. (b) The projected monthly (January 2010 to December 2011) changes in reservoir storages as represented by Lake Mead and Lake Powell using the four most similar years. The total combined storage (in cubic kilometers, where 1 cubic kilometer is about 0.8 million acre-feet) of the reservoirs is shown for all El Niño years, with the four bold curves representing the most similar years. The 24-month average changes in reservoir elevations (in meters) for the four most similar years are shown as bars.

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Active-Source Seismic Experiment Confirms the Magma Pathway of Mount Asama, Japan

Large volcanic eruptions result from the ejection of magma transported from depth. How the magma is transported to the surface is one of the fundamental questions in understanding how a volcano works. A way to address this question is to explore the seismic structures of volcanoes.

One volcano that is well surveyed and instrumented through a variety of global positioning system and seismic networks is Japan's Mount Asama. Because of this, scientists were able to conduct an active-source seismic experiment on this volcano with the goal of mapping volcanic conduits (see Figure 1).

Asama's Eruptive History

Asama is known to have erupted explosively in 1108 and 1783, both with a Volcano Explosivity Index (VEI) of about 5 according to models of tephra output based on stratigraphic studies. Recent eruptions of Asama include moderately sized events with VEI of 2 in 1973, 1982, 1983, and 2004 and minor events with VEI of 1 in 2008 and 2009. Trace ashfall in Tokyo, about 140 kilometers from the volcano, due to the minor 2009 eruption suggests that at least 20 million people are at risk of volcanic hazards from Asama during future larger eruptions.

Because Asama is a well-instrumented volcano, scientists have already gained some insights into its magma pathways from geophysical observations [*Takeo et al.,* 2006]. These data show that during the 2004 eruptions, magma branched from the main conduit and traveled 4 kilometers west to a depth of 1.5 meters below sea level. The intruded magma then migrated horizontally to just beneath the summit and migrated upward to the surface. Such data suggest that a complex network of dikes and vents supports Asama's volcanic activity.

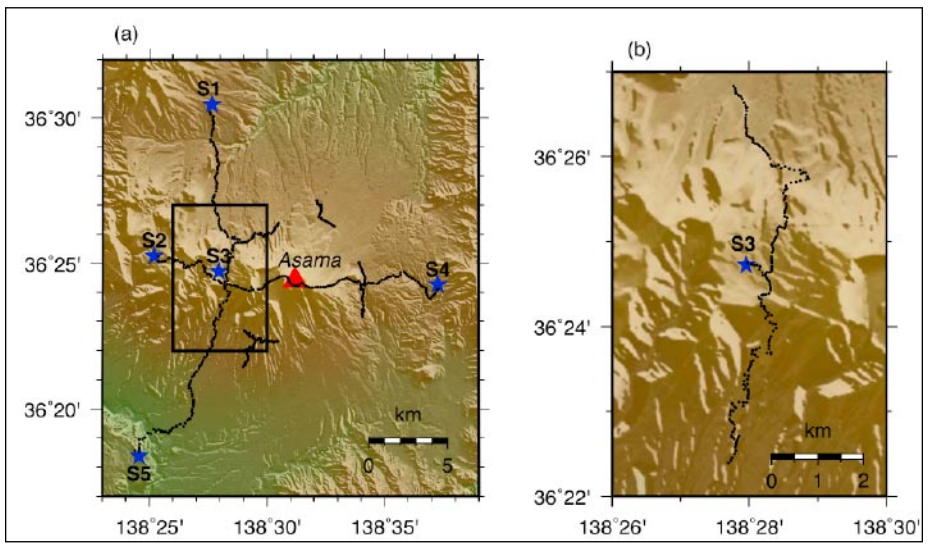

Fig. 1. (a) Location of active sources (blue stars) and temporarily deployed L22-D seismometers with a natural frequency of 2 hertz (black dots). The red triangle represents the location of the summit of Asama. The black rectangle represents the area shown in Figure 1b. (b) Location of densely deployed GS-11D seismometers with a natural frequency of 4.5 hertz (black dots).

Active-Source Seismic Experiment

The activity observed in 2004 raises several questions: Why was the diking offset from the summit? What controls the magma pathway beneath Asama? To address these questions, an active-source seismic experiment was conducted on Asama in October 2006 [*Aoki et al.,* 2009]. Using active seismic sources means that scientists can "engineer" locations and origin times of seismic bursts. Successful active seismic studies have revealed the subsurface structures of several volcanoes, such as Italy's Vesuvius [*Zollo et al.,* 1996, 1998] and Japan's Usu [*Onizawa et al.,* 2007].

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During Asama's active seismic experiment, scientists deployed temporary seismometers to obtain detailed data on the subsurface structure around the volcano's magma pathway (Figure 1). Most of the seismometers were aligned along north-south and east-west profiles, allowing researchers to derive two-dimensional subsurface structures both perpendicular and parallel to the inferred diking area. Five shots were located at the ends of the north-south and east-west profiles and the intersection of the two profiles (Figure 1). This experiment deployed Mark Products L22-D (natural frequency of 2 hertz) and GeoSpace GS-11D (natural frequency of 4.5 hertz) seismometers with an average spacing of 100–150 meters (Figure 1a). A closer spacing of seismometers, placed only 50 meters apart on a section of the north-south profile around the diking area, was used to obtain a finer image (Figure 1b).

P *Wave Velocity Structure*

The obtained velocity structure clearly shows a high-velocity zone around the area of inferred diking during the 2004 eruptions (Figures 2b and 2d), leading researchers to interpret that the high-velocity zone is formed by the solidification of magma resulting from repeating dike intrusions at that location. Note that the high-velocity zone is not formed by a single intrusion; rather, repeating intrusions must have occurred in this zone, because the thickness of a dike formed by a single intrusion is at most 1 meter [*Takeo et al.,* 2006], much thinner than the spatial resolution of the dike observed in the present analysis, which is about 1 kilometer. This implies that the magma pathway beneath Asama has likely been the same during different eruptive episodes. Also note that Figure 2 depicts the *P* wave velocity structure for the north-south and east-west profiles, obtained from interpolations from first-arrival travel times. These interpolations fit well with observations (Figures 2a and 2c), endorsing the idea that the velocity structure is reliable.

Combining these results with natural earthquake locations and the electromagnetic structure measured through resistivity tests of Asama suggests that the intruded magma is blocked by a cap of stiff rocks but then finds a way to reach the surface at the present location of the volcano's summit (Figure 2d).

Data from this active-source seismic experiment are available at http://www.eri.u-tokyo.ac.jp/yaoki/asama2006/ or upon e-mail request to Yosuke Aoki (yaoki@eri.u-tokyo.ac.jp).

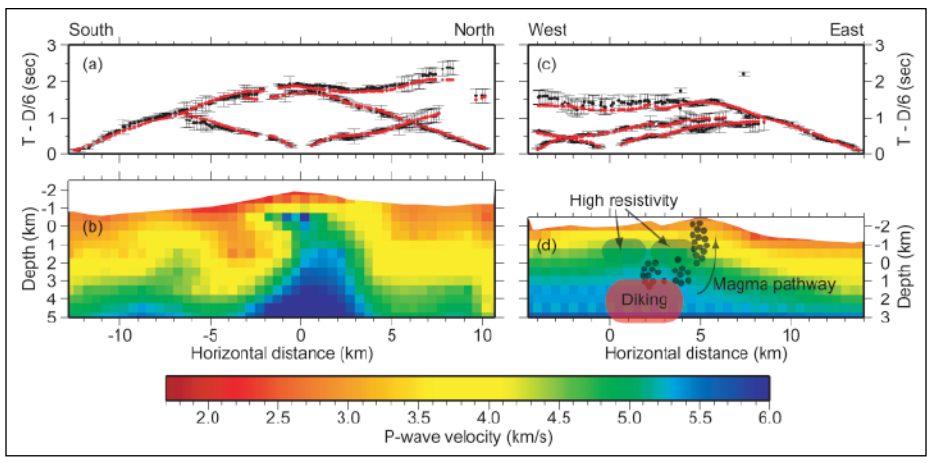

Fig. 2. P *wave velocity structure obtained by travel time inversion. (a) Comparison of observed (black) and calculated (red) travel times for the north-south profile. (b)* P *wave velocity structure along the north-south profile. The blue tongue is a high-velocity body that is formed perhaps by the solidification of magma after repeated intrusions. (c) Comparison of observed (black) and calculated (red) travel times for the east-west profile. (d)* P *wave velocity structure along the east-west profile. A schematic view of the magma pathway is also shown. Black dots represent hypocenters of natural seismic sources; areas of high resistivity and dike intrusion are also shown. Errors in earthquake locations are approximately 100 meters for both horizontal and vertical directions.*

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NEWS

New User Facility for Environmental Sensing

Hydrologic instrumentation is undergoing a transformative shift in its ability to concurrently measure scales from centimeters to kilometers [e.g., *Selker et al.,* 2006]. To rapidly distribute and incorporate these advances in the Earth and hydrologic sciences, the U.S. National Science Foundation's Earth Sciences Instrumentation and Facilities Program launched in September 2009 a community-accessible instrument facility for distributed temperature sensing (DTS) and wireless networked environmental sensing.

DTS systems for the facility use laser-induced Raman backscatter (spectrally shifted scattered light whose intensity can be related to the thermal state of the optical fiber) to measure the distribution of temperatures along fiber-optic cables up to 30 kilometers long. The DTS systems can measure temperatures along fiber-optic cable with spatial resolution of less than 1 meter and with temperature resolution of ±0.01°C. In contrast to "single point in space" measurements of environmental temperatures or "single point in time" remote sensing of temperatures, DTS provides the opportunity to continuously monitor temperatures of air, water, soil, or snow at high spatial and temporal frequency without the need for a large network of measurement systems. The DTS techniques, first widely deployed in the past decade by the oil and electric power industries, have been applied to a wide variety of near-surface Earth observations, including stream and groundwater interaction, snowpack evolution and melting, mixing and energy budgets of lakes and streams, soil moisture sensing, atmospheric processes, and dam seepage.

The Center for Transformative Environmental Monitoring Programs (CTEMPs), jointly operated by Oregon State University and the University of Nevada, Reno, provides short- and intermediate-term project access to five field-deployable DTS systems that can be shipped directly to project sites. CTEMPs is operating as an instrumentation node of the Hydrologic Measurement Facility of the Consortium of Universities for the Advancement of Hydrologic Science, Inc. These DTS systems are available to the Earth science community and can be configured for a wide variety of environmental measurements, data storage/data transmission protocols, and operating conditions. CTEMPs also will provide—as part of the field-deployable systems—wireless autonomous meteorological stations to augment the thermal data collection, as well as advice, guidance, and logistical services to the user community. CTEMPs users will have access to instrumentation as well as technical support for experiment design, field deployment, and data interpretation.

CTEMPs, working with industry, also will make extended-resolution (spatial and temporal) DTS systems available to address the most demanding applications of this technology. CTEMPs anticipates that in early 2010 it will make available to the research community a DTS with 0.25-meter spatial-scale and 1-second temporal-scale capability, which will be 4 times better spatial resolution and 10 times better temporal resolution than currently available instruments. Additionally, CTEMPs is testing a suite of other sensing systems, including fiber-optic distributed strain and acoustic sensing, and a spectrum of low-cost and high-precision point sensors suitable for traditional and wireless networked sensing systems.

CTEMPs also is offering a series of 1-day introductory short courses and 4-day hands-on workshops to train researchers and students on the leading edge of distributed sensing.

For more information about the center and its short courses, and to apply to use the field-deployable DTS systems, visit http://www.ctemps.org or contact Susan Atkisson at susan.atkisson@oregonstate.edu.

Reference

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FORUM

A New Approach to Data Publication in Ocean Sciences

Data are collected from ocean sciences activities that range from a single investigator working in a laboratory to large teams of scientists cooperating on big, multinational, global ocean research projects. What these activities have in common is that all result in data, some of which are used as the basis for publications in peer-reviewed journals.

However, two major problems regarding data remain. First, many data valuable for understanding ocean physics, chemistry, geology, biology, and how the oceans operate in the Earth system are never archived or made accessible to other scientists. Data underlying traditional journal articles are often difficult to obtain. Second, when scientists do contribute data to databases, their data become freely available, with little acknowledgment and no contribution to their career advancement. To address these problems, stronger ties must be made between data repositories and academic journals, and a "digital backbone" needs to be created for data related to journal publications.

Links Between Data Repositories and Academic Journals

The Scientific Committee on Oceanic Research (SCOR) and the International Oceanographic Data and Information Exchange (IODE) of the United Nations Educational, Scientific and Cultural Organization's Intergovernmental Oceanographic Commission (IOC) are discussing how to provide better access to ocean data through increased submission to approved, open, online resources. Such new infrastructure and new approaches to data publication could help scientists who observe the ocean and model its processes. Most important, it is now timely to

- increase the availability of data used to create figures, tables, and statistical analyses in traditional journal articles;
- reinforce linkages between data lodged in data centers and science publications, particularly "data briefs"; and
- encourage the publishing of journals that specialize in "data publications" or "data briefs."

Data publications are short descriptions (as short as a few paragraphs of text), not interpretations, of data sets. They provide persistent pointers to the data in an approved data repository as well as references citable in papers that use the data, and in authors' curricula vitae.

Getting Journals on Board

Several journals in the ocean sciences already welcome the publication of data briefs. They include *Marine Micropaleontology*; *Geochemistry, Geophysics, Geosystems; Ecological Archives;* and *Earth System Science Data.*

Other journals also acknowledge the benefits of submitting the data underlying traditional publications to approved databases. In 1993, AGU first established its "Policy on Referencing Data in and Archiving Data for AGU Publications" (see http://www.agu.org/pubs/policies/data_policy.shtml). The policy emphasizes the importance for authors to submit data that are the basis for their papers to a recognized data archive. It also states AGU's commitment to ensuring the long-term archiving and protection of data. Data sets associated with articles are available at http://www.agu.org/pubs/esupp_browse.html, and access to these data does not require membership in AGU or subscription to an AGU journal.

Submission of data associated with journal publications is a standard practice in other domains, such as molecular biology, in which the gene sequences that are described in peer-reviewed publications must be submitted to GenBank or related archives. To help make such submissions standard in the ocean sciences, SCOR and IODE are working with editors and publishers of journals to discuss how to implement greater use of data publication.

Building a Digital Backbone

To archive and administer data related to journal publications, additional infrastructure in data management systems is required. Such infrastructure must be implemented with minimal costs to avoid impeding the publication process (see Figure 1). The "eRepository" technology developed by the digital library community delivers some of the functionality needed for this infrastructure. However, it does not provide added value—in terms of harmonization with other data in the system, quality control, and metadata enhancement—associated with the IODE network of national data centers.

A workable compromise would be to use eRepository technology as "front-end" processes of data centers that serve ingested data sets "as is" in the short term, as well as providing added value to data sets through existing data management infrastructure in the medium and long terms. This new infrastructure should improve the data publication review process through closer collaboration between data centers and journal editors.

SCOR and IODE are working with existing data centers, libraries, and journals to promote the development of the infrastructure required to provide ocean sciences publications with an effective "digital backbone." Other groups are also spearheading efforts to link academic journals to data repositories. Ongoing cooperative activities are along three lines:

1. SCOR and IODE are continuing to work with editors of ocean science journals to establish pilot projects along the lines described in Figure 1.
2. The Marine Biological Laboratory/Woods Hole Oceanographic Institution (WHOI) library is working with the U.S. Biological and Chemical Oceanography Data Management Office (BCO/DMO) at WHOI on a pilot project on how libraries and data centers could work together to provide the digital backbone for traditional journal publications, ensuring that data sets have appropriate associated metadata and are easily accessible.
3. The British Oceanographic Data Centre is working on a pilot project to repackage existing data holdings into data sets appropriate for assignment of persistent identifiers to provide a mechanism for concrete links to scientific publications.

The work flow diagram in Figure 1 will be revised as scientists, data managers, and journal editors gain experience from the pilot projects. Important questions raised by the ocean science community include the following:

- What should be the details of quality control in data centers? A simple action would be to ensure that submitted data are machine readable. Other actions might be to ensure that data sets include a minimal set of metadata.
- What happens to data associated with articles that are not published? Such data may still be valuable to other scientists, and archiving should ensure that the data originator receives appropriate credit.
- What processes will be needed to ensure that data are archived, assigned a persistent identifier, and accessible before the associated paper is published? The timing surrounding the implementation of this process is especially important as publication times become faster and review drafts of papers become available through electronic publishing.
- What are the rights and responsibilities of data archives during the review process, in terms of data release, data protection, timing, etc.?
- What existing persistent identifier should be assigned to data referenced in journal articles? Digital object identifiers (DOIs) have become an almost de facto standard in journal publishing, but other options exist. Whichever identifier is used, the issue of the "least publishable unit" for assignment of an identifier must be tackled.

More details about the SCOR/IODE activity are available at http://www.iode.org/datapublishing. The authors welcome input on this topic from the geosciences community.

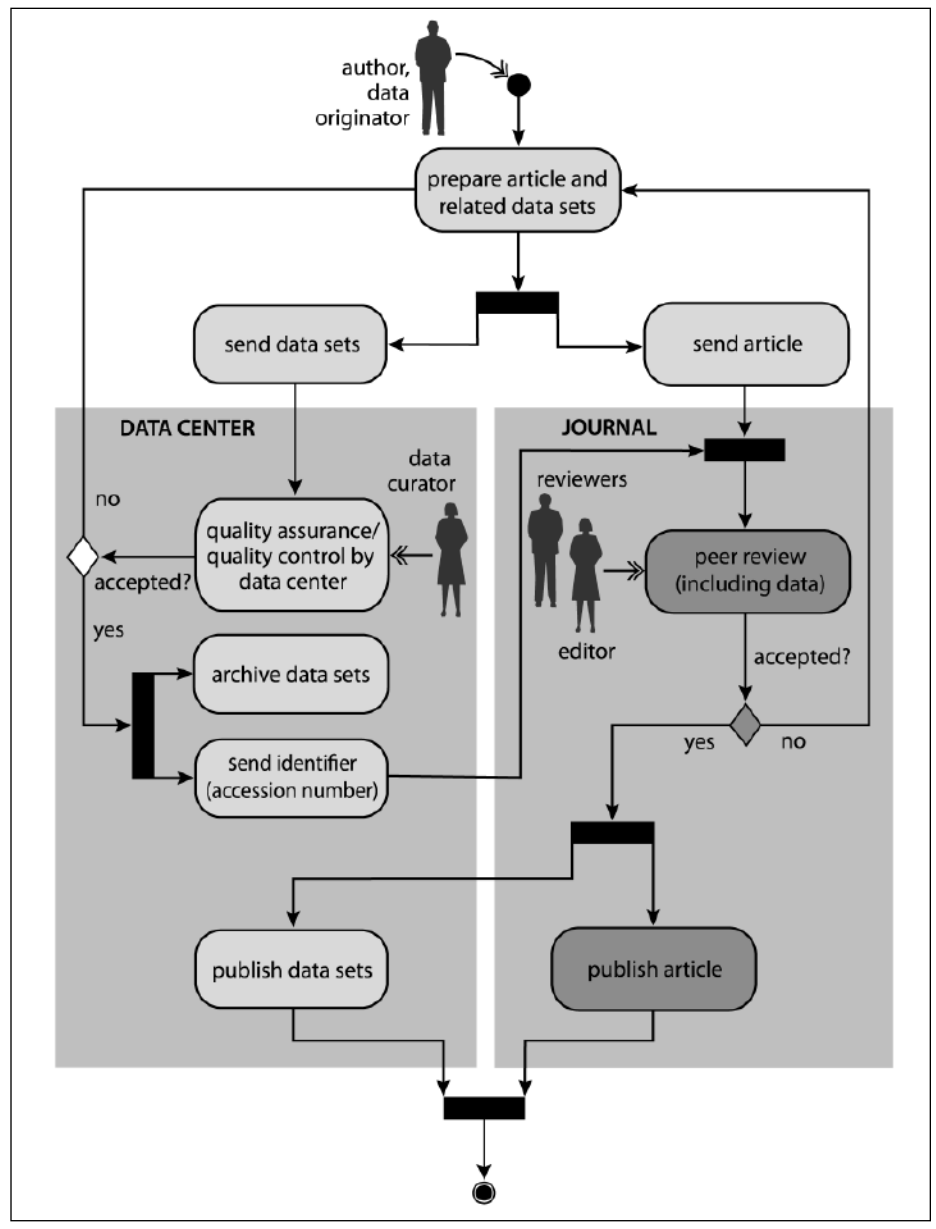

Fig. 1. Suggested work flow for peer-reviewed data publications in the ocean sciences. Image modified from Scientific Committee on Oceanic Research/International Oceanographic Data and Information Exchange *[2008]. At the end point of this flowchart are freely available peer-reviewed papers and data sets.*

Reference

Scientific Committee on Oceanic Research/International Oceanographic Data and Information Exchange (SCOR/IODE) (2008), SCOR/IODE workshop on data publishing: IOC Project Office for IODE, Oostende, Belgium, 17–18 June 2008, *Workshop Rep. 207*, 23 pp., United Nations Educ., Sci., and Cult. Organ., Paris.

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MEETINGS

Earth Sciences Push Radiative Transfer Theory

2009 International Conference on Advances in Mathematics, Computational Methods, and Reactor Physics; Saratoga Springs, New York, 4–7 May 2009

The theories of radiative transfer and particle—particularly neutron—transport are grounded in distinctive microscale physics that deals with either optics or particle dynamics. However, it is not practical to track every wave or particle in macroscopic systems, nor do all of these details matter. That is why Newton's laws, which describe individual particles, are replaced by those of Euler, Navier-Stokes, Maxwell, Boltzmann, Gibbs, and others, which describe the collective behavior of vast numbers of particles. And that is why the radiative transfer (RT) equation is used to describe the flow of radiation through geophysical-scale systems, leaving to Maxwell's wave equations only the task of providing the optical properties of the medium, be it air, water, snow, ice, or biomass. Interestingly, particle transport is determined by the linear transport equation, which is mathematically identical to the RT equation, so geophysicists and nuclear scientists are interested in the same mathematics and computational techniques.

In nuclear science and engineering, transport theory holds a very high profile. Clearly, it is important to know that reactor criticality or radiation medicine dosage is computed to as many decimal places as possible. Accordingly, particle transport theoreticians regroup every 2 years at the American Nuclear Society's Mathematics and Computation (M&C) Conference series. At M&C 2009, there were two cross-disciplinary sessions of immediate interest to the geophysics community: "Radiation transport in the Earth sciences" and "Transport in stochastic media."

The former session was composed almost entirely of invited papers by RT experts in various aspects of geophysics, especially the cloudy atmosphere. The speakers showcased progress, often at the fundamental level, capitalizing on the common mathematical language. Extensions from steady state to time-dependent problems, from intensity/scalar-RT to polarized/vector-RT, and from one- to three-dimensional geometries were covered, as was the modeling of intricate RT processes in vegetated surfaces and at interfaces between distinct media. The results presented were timely and important for remote sensing of the environment, as well as for radiation energy budget estimation in global climate models, using innovative deterministic and Monte Carlo numerical methods.

The latter session is a regular feature at M&C events, but this year it was almost half populated by speakers originally invited for the special Earth science session. These speakers reported on large-scale RT effects from unresolved random spatial variability. This merged scheduling demonstrates the ease with which transport theoreticians can cross huge disciplinary divides.

By all accounts, these sessions were a very successful outreach effort by the American Nuclear Society. Several of the "Earth science" invitees attended the full meeting, running from session to session to hear the latest on the daunting technicalities of the RT equation, with its six or seven independent variables. A special issue of the *Journal of Quantitative Spectroscopy and Radiative Transfer* will be dedicated to the breadth of topics covered at these sessions.

In summary, Earth science challenges RT at its core, thus justifying deep dives into the foundations of the theory. The meeting highlighted the possibility that new ideas—and maybe collaborations from the world of nuclear science and engineering—will enable scientists to resurface from those dives with the potential for breakthrough in the applications.

—ANTHONY DAVIS, Jet Propulsion Laboratory, California Institute of Technology, Pasadena; E-mail: Anthony.b.davis@jpl.nasa.gov; and MICHAEL MISHCHENKO, NASA Goddard Instituted for Space Studies, New York

Improving Environmental Projections in the High Mountains of Northern Eurasia

International Workshop on the Northern Eurasia High Mountain Ecosystems; Bishkek, Kyrgyzstan, 9–13 September 2009

The northern Eurasia high mountains, particularly in dry regions of Central Asia, are critically important because they are the source of the water supply for the densely populated lowlands. These regions are highly vulnerable to climatic and environmental changes. Global warming, current and future expected retreat of seasonal snow cover and glaciers, and changes in precipitation pattern and type significantly affect river runoff, permafrost, and groundwater. Moreover, the majority of mountain regions in northern Eurasia are characterized by growing anthropogenic pressure that causes harmful feedback, including desertification of lowlands; wind erosion; contamination of the atmosphere, surface waters, and groundwaters; reduction in crop yield; and increasing human mortality rates.

Compounding these problems are socioeconomic hardships resulting from recent and still unsettled political changes and a lack of local research funds. The latter has limited the amount of observational data collected in this part of the world, leaving climate and hydrological modelers unable to validate regional climate and water resources projections.

The Northern Eurasia Earth Science Partnership Initiative (NEESPI), an interdisciplinary program of internationally supported Earth system research in northern Eurasia, addresses the question of how the science community can develop and utilize predictive capability on dynamics of the regional terrestrial ecosystems. Within the sequence of NEESPI regional workshops (http://neespi.org/meetings/), a workshop held in Kyrgyzstan focused on the high-mountain regions of northern Eurasia. The workshop was convened jointly with the High Elevations Coordinated Energy and Water Cycle Observation Project (CEOP; http://www.ceop-he.org and hosted by the Central Asian Institute for Applied Geosciences.

Since 2004, about 30 projects have been funded through and/or have joined NEESPI to study mountainous regions of northern Eurasia, from the Khibiny Mountains in the north to the Pamir Mountains in the south. The ongoing projects study potential consequences of human activity, climate variability, and global change on high-elevation ecosystems, water resources, and land cover. The purposes of the workshop were to synthesize and disseminate information about the current state of knowledge of regional changes, foster collaboration among researchers addressing environmental problems, and identify new research topics critical for achievement of NEESPI objectives in high-elevation regions.

Workshop participants outlined missing links and deficiencies in data and knowledge of processes in the mountains and developed recommendations for further advancing this knowledge in the form of a "message to decision makers." The message states that mountain regions are particularly susceptible to observed and projected changes. Therefore, actions are urgently required to prevent hazardous impacts on ecosystems and societies and to develop viable adaptation strategies. The workshop stressed the need for much better environmental data exchange and integration among the countries within the region. Its major strategic recommendations for decision makers within regional governments, national and international agencies, and institutions that invest in regional development are to (1) promote a culture of evidence-based policy making, (2) promote capacity building and public awareness, (3) develop a high-elevation meteorological observational network and intensify the complex studies of high-elevation processes, and (4) invest more to improve the academic education system in Central Asian countries.

The workshop was preceded by a summer school for early-career scientists of the region. The workshop presentations and statements can be found at http://neespi.org/meetings/Bishkek_2009.htm.

—PAVEL GROISMAN, University Corporation for Atmospheric Research/National Climatic Data Center, Asheville, N. C.; E-mail: pgroisma@ucar.edu; and VLADIMIR AIZEN, University of Idaho, Moscow

ABOUT AGU

A Crash Course in Science Radio Reporting

This past summer, 5 weeks after defending my doctoral dissertation, I traded my lab bench and field sampling gear for a radio reporter's recorder and a microphone, and I headed west. As a graduate student at Yale University in New Haven, Conn., I had seen great science going on all around me, but the public was unaware of most of it. Having dabbled in science writing while finishing my Ph.D. in ecology and evolutionary biology, I was looking for ways to gain more experience in science communication and even had been considering pursuing a career in science reporting.

Then a remarkable opportunity opened up that took me to Greeley, Colo., covering science stories at KUNC, a National Public Radio affiliate, for 10 weeks this past summer.

I had been accepted into a special program that offered me everything I was hoping for: With AGU's sponsorship, I participated in the American Association for the Advancement of Science's (AAAS) Mass Media Science and Engineering Fellows Program.

The program offers science graduate students the opportunity to work as science reporters at media outlets including magazines, newspapers, and radio stations such as KUNC. The goal is not to lure us away from research and teaching careers (although some fellows have gone that route) but to give scientists the tools to explain science to the public.

The fellowship was indeed a crash course in journalism. During a 3-day orientation for fellows at AAAS headquarters in Washington, D. C., I got some grounding in basic journalism (how to write a catchy introduction, how to find story ideas, and so forth).

When I showed up at KUNC, I had no idea how to use a recorder, a microphone, or the editing software to piece together a radio story, but I learned quickly. On my first day, I started writing, and I produced a "tape and copy" news spot (audio clip from an interview plus text) for the news program host to read on air. A few days later, I produced my own "wrap" during which I read text and melded it with an audio clip. It was exciting to hear myself on the radio for the first time. After that, I moved on to reporting feature stories and daily news spots.

Despite my inexperience, the news director treated me pretty much like any other reporter. I was able to do daily spots, super spots (1.5 minutes instead of typical minute-long dailies), and features (4 minutes).

The most exciting aspect of reporting was the breadth of stories I covered on topics ranging from alternative energy to genetic testing. That aspect of my fellowship, along with talking to many different researchers about their latest findings—which, even prior to the fellowship, had been one of my favorite parts of science—made me better informed and more up to date regarding advances across the sciences than I was when working on my dissertation.

As a result of those 10 rewarding weeks in Greeley, I now have a much clearer understanding of how to communicate complex stories to the public. The biggest lesson I learned was that I cannot provide all of the details in a story. Sometimes I cannot even hit all of the main points. Rather, it is essential to find one or two key ideas and present them clearly and concisely.

I also learned that even serious science stories can have an element of fun. For a story about genetic testing and sports, for example, I revealed some of my less-than-successful childhood sports endeavors and included an interview with my parents. By poking some lighthearted fun at myself, I drew readers into that story about complex issues of genetic variation and the ethics of genetic testing of children. Positive feedback on that story confirmed the value of drawing in the listener with an entertaining anecdote and showing that scientific issues can have personal relevance.

Erika Schielke

I came to this fellowship believing that communicating science to the public is incredibly important—science touches most aspects of our daily lives, from climate change to health. I returned home with a strong understanding of how to do that type of reporting.

I got exactly what I had hoped for from my summer at KUNC: the chance to see what the daily life of a reporter is like. I discovered that I love the fast-paced exposure to many different areas of research, and I have begun producing a biweekly science radio series at Adirondack Community College in Queensbury, N. Y., where I am currently teaching. I plan to pursue other freelance opportunities in science communications, and I am even keeping an eye open for a full-time position as a science reporter.

—ERIKA SCHIELKE, Adjunct Instructor, Adirondack Community College, Queensbury, N. Y.; E-mail: Erika.schielke@gmail.com

NEW BOOKS

This column lists recently published books that have been received by Eos.

Death of an Ocean: A Geological Borders Ballad, Euan Clarkson and Brian Upton, Dunedin, 2010, 978-1-9067-1602-8, $39.95

Deformation and Gravity Change: Indicators of Isostasy, Tectonics, Volcanism, and Climate Change, Volume II, Detlef Wolf et al. (Eds.), Birkhäuser, 2009, 978-3-0346-0147-4, $79.95

Excursion Guide to the Geology of East Sutherland and Caithness, Nigel Trewin and Andrew Hurst (Eds.), Dunedin, 2009, 978-1-906716-01-1, $25.50

Global Geodetic Observing System: Meeting the Requirements of a Global Society on a Changing Planet in 2020, H.-P. Plag and M. Pearlman (Eds.), Springer, 2009, 978-3-642-02686-7, $169.

High-Redshift Galaxies: Light From the Early Universe, Immo Appenzeller, Springer, 2009, 978-3-540-75823-5, $99.

Interstellar Boundary Explorer (IBEX), D. J. McComas et al. (Eds.), Springer, 2010, 978-1-4419-1447-7, $159.

Metastable Systems Under Pressure, Sylwester Rzoska et al. (Eds.), Springer, 2010, 978-90-481-3406-9, $229.

Paleoclimates: Understanding Climate Change Past and Present, Thomas M. Cronin, Columbia University Press, 2009, 978-0-231-14494-0, $95.

Recent Directions in Astrophysical Quantitative Spectroscopy and Radiation Hydrodynamics: Proceedings of the International Conference in Honor of Dimitri Mihalas for His Lifetime Scientific Contributions on the Occasion of His 70th Birthday, Ivan Hubeny et al. (Eds.), American Institute of Physics, 2009, 978-0-7354-0710-7, $159.

Sources and Detection of Dark Matter and Dark Energy in the Universe: Proceedings of the 8th UCLA Symposium, David B. Cline (Ed.), American Institute of Physics, 2009, ISBN 978-0-7354-0703-9, $145.

Space Astronomy: The UV Window to the Universe, A. I. Gómez de Castro and Noah Brosch (Eds.), Springer, 2010, 978-90-481-3005-4, $189.

The Astronaut's Cookbook: Tales, Recipes, and More, Charles T. Bourland and Gregory L. Vogt, Springer, 2009, 978-1-4419-0623-6, $29.95

The Dark Side of the Universe: 5th International Workshop on the Dark Side of the Universe, Csaba Balázs and Fei Wang (Eds.), American Institute of Physics, 2009, 978-0-7354-0719-0, $89.

The Earth's Plasmasphere: A Cluster and Image Perspective, F. Darrouzet et al. (Eds.), Springer, 2009, 978-1-4419-1322-7, $129.

The Hydrogen Economy: Opportunities and Challenges, Michael Ball and Martin Wietschel (Eds.), Cambridge University Press, 2009, 978-0-521-88216-3, $135.

Water Circulation in Rocks, Laura Scesi and Paola Gattinoni, Springer, 2009, 978-90-481-2416-9, $129.

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ADVERTISING INFORMATION

Eos is published every Tuesday. For a classified or display advertisement to be published in a future issue of *Eos*, electronic copy must reach us by 7:00 P.M., Eastern Time, 9 days prior (Sunday) to publication. No cancellations accepted after deadline.

Ads with "Reply by" deadlines that are less than 14 days from the publication date will not be accepted.

Display and in-column advertising specs, pricing, and submission guidelines can be found online at www.agu.org/pubs/eosadinfo.html.

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"Positions Available" and "Student Opportunities" are updated every Tuesday and listed on our Web site, accessible to AGU members.

www.agu.org

POSITIONS AVAILABLE

Atmospheric Sciences

Assistant, Associate or Full Professor, Tenure-Track Faculty Position. The Department of Geological and Mining Engineering and Sciences (GMES) at Michigan Technological University invites applications for a tenure-track faculty position (appointment as Assistant, Associate or Full Professor is possible) in atmospheric sciences, with a preference for those with research interests/programs that include field measurements. We are particularly interested in candidates with a strong background in atmospheric chemistry. The successful applicant will contribute to Michigan Tech's interdepartmental research and teaching program in Atmospheric Science (www.atmos-sci.mtu.edu).

Atmospheric science activities within the GMES department and Michigan Tech are undergoing major growth, with recent hires in the fields of chemical-transport modeling, remote sensing, aerosol chemistry and climate modeling, complementing existing strengths in volcanology and cloud physics. For more information on the GMES department, see www.geo.mtu.edu. Michigan Tech has a total student population of about 7000 and is located in Michigan's Upper Peninsula, a pristine area on the south shore of Lake Superior.

Only electronic applications will be accepted, preferably as a single PDF file that includes a detailed CV and statements of research and teaching interests along with a cover letter. Applications should be emailed to atmosearch@mtu.edu. In addition, candidates should arrange for three letters of reference to be sent to the same address. Review of applications will begin on January 15, 2010 and will continue until the position is filled.

Informal inquiries may be directed to Dr. Simon Carn (scarn@mtu.edu).

Combined Position of Dean, College of Atmospheric and Geographic Sciences and Director, National Weather Center. Announcing a national search for senior leadership position. The University of Oklahoma, Norman, Oklahoma, is seeking applications for the combined position of Dean, College of Atmospheric and Geographic Sciences and Director, National Weather Center.

The Dean and Director guides and oversees the OU Geography Department, the School of Meteorology and the Geoinformatics Program, plus ten associated research and service units and integrates the OU and NOAA programs of the National Weather Center to facilitate synergistic opportunities and discoveries.

The University is seeking a dynamic visionary and proven professional. They must provide academic, intellectual and administrative leadership for an interactive and collaborative community of educational, governmental and private sector organizations. This weather and environmental enterprise is comprised of well over 700 weather-related professionals and 350 students.

Applications and Nominations: Review of applications will begin December 1, 2009 and continue until the position is filled. Preferred start date is July 1, 2010. Formal candidates will be requested to submit a letter of interest demonstrating how the candidate fulfills the qualifications for this position, a detailed resume, and names of at least five references (including mail and email addresses and telephone/fax numbers). Electronic submission in PDF format preferred.

Direct nominations and applications to: Rich Taylor, Atmospheric and Geographic Sciences Dean Search Committee Chair, Dean of the Weitzenhoffer Family College of Fine Arts, Carpenter Hall, Suite 104, Norman, OK 73019. Email: rich.taylor@ou.edu; Phone: (405) 325-7370; FAX: (405) 325-1667.

For complete job description and application process: http://ags.ou.edu/deansearch/. The University of Oklahoma is an Affirmative Action/Equal Opportunity employer and encourages diversity in the workplace.

Faculty Position in Atmospheric Sciences. The Department of Atmospheric Sciences, National Central University (NCU) in Taiwan is seeking 1-2 tenure-track faculty members.

Depending on the candidate's experience and accomplishments, the appointment can be at the assistant, associate or full professor levels, beginning from August 1, 2010. A Ph.D. degree from an accredited institution is required, and independent research experience is preferred.

Qualified applicants with the following specialties are welcomed: satellite meteorology, data assimilation, weather analysis and dynamics, tropical meteorology, environmental sciences, climate study. Particular consideration will be given to candidates working in areas that complement existing research programs. The successful candidates will be required to teach undergraduate and graduate courses in Mandarin or English, maintaining strong research programs, and publications, supervising students, and participating in departmental services/ activities.

Applicants should submit a detailed resume including curriculum vitae, a complete list of publications, a statement of teaching and research interests and three recommendation letters. These materials must be sent before 31 January, 2010 to Chair Pay-Liam Lin, Department of Atmospheric Sciences, National Central University, Jhongli City, Taiwan, (Phone: +886-3-422-0270, Fax: +886-3-425-6841, e-mail: tliam@atm.ncu.edu.tw).

Postdoctoral Fellow in Wind Energy. Desert Research Institute-The Division of Atmospheric Sciences in Reno, NV seeks a postdoctoral researcher in the rapidly growing area of Renewable Energies-Wind Energy to participate in wind assessment studies using data from meteorological towers and by conducting mesoscale and microscale meteorological modeling. Candidates must have a Ph.D. in atmospheric, environmental or earth sciences, or engineering with experience required in one of the following areas: wind energy studies, wind analysis/modeling/forecasting, acquisition and analysis of large data sets, mesoscale and/or microscale modeling, climate data analysis and modeling. A strong background in meteorological modeling is highly desired. For full details and to apply online, visit http://www.dri.edu/employment. AA/EEO employer.

Biogeosciences

Biogeochemistry Student and Post-doc Opportunities. The Biogeochemistry Group at Washington University in St. Louis has funding for several graduate and post-doctoral fellowships in the general area of microbial geochemistry. Particular topics include:

- Using high spatial resolution geochemical and isotopic data to constrain the distribution and functioning of microbial metabolisms.
- Combining culture-dependent and culture-independent microbiology with analytical geochemistry and energy modeling in shallow-sea hydrothermal systems.
- Developing numerical models that link fluid geochemistry and microbial communities in mid-ocean ridge hydrothermal systems.

Interested parties should contact Associate Professor Jan Amend (amend@levee.wustl.edu) or Assistant Professor David Fike (dfike@levee.wustl.edu). Graduate applications are due by Jan 15th for the Fall 2010 class. Consideration of post-doc applications will begin immediately and continue until the posts are filled.

Postdoctoral Position. Harvard University invites applications for a postdoctoral position in terrestrial ecosystem and biosphere modeling in the laboratory of Professor Paul R. Moorcroft. The successful candidate will be involved in collaborative research projects relating to the effects of anthropogenic climate change on the composition, structure and functioning of temperate and tropical ecosystems, and resulting biophysical and biogeochemical feedbacks onto the atmosphere.

Candidates should have a strong background in ecosystem ecology, terrestrial biosphere modeling, or a related field. Applicants with previous experience with terrestrial ecosystem or land surface models are strongly preferred. Candidates should email their CV, a summary of research interests, and the names of three references to Carla Barger (cbarger@oeb.harvard.edu). Harvard University is an equal opportunity/affirmative action employer.

Hydrology

Post-Doctoral Positions in Pore-Scale Processes. The University of Texas-Austin Jackson School of Geosciences invites applications for a post-

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doctoral scientist to pursue research in the areas of numerical modeling of coupled hydrodynamic, biogeochemical and microbiological processes at the intra-pore to multi-pore scales for porous and fractured media. The goal of the project is to understand how coupled physical-biologic deep subsurface environments respond to injection of fluids such as supercritical CO_2.

The post-docs will join the UT/Sandia National Lab-Center for Frontiers in Subsurface Energy Security supported by the US DOE. The initial appointment will be for 1 year but can be renewed for up to 3 years. Candidates should send CVs, statement of research interests, and contact information for 3 professional references to Dr. Bayani Cardenas (cardenas@jsg.utexas.edu) or Dr. Philip Bennett (pbennett@mail.utexas.edu).

Senior Science Advisor for Water Quality, Full-Time Position. The U.S. Geological Survey (USGS) seeks candidates for the full-time position of Senior Science Advisor for Water Quality. This is a SL position with a salary range of $117,787-$162,900 per annum.

As the Senior Science Advisor for Water Quality, you will serve as the senior USGS water quality specialist with fundamental responsibility for providing policy-level advice to the Director and the Associate Director for Water and their staffs, and consultation to all elements of the organization to ensure its scientific, technical, and operational preparedness for assessment of the water quality of the Nation, its territories and possessions, and to assist with the solution of highly critical and often controversial water-related problems of congressional, Federal, non-Federal, and local concern. You will develop and propose objectives, policies, and procedures for long-range programs of the USGS in the field of water quality and work closely with the leadership of the Water Resources and other disciplines to develop a comprehensive, interdisciplinary program of water-resource investigations. You can learn more about USGS at www.usgs.gov/aboutusgs.

To be considered for this position, you must meet the education requirements for the hydrologist job series. Our on-line vacancy announcement contains additional information regarding these and other qualifications requirements.

Applications (Resumes and Questionnaire responses) must be received on-line via the USGS Online Automated Recruitment System (OARS) BEFORE midnight Eastern Time on the closing date of the announcement (January 8, 2010). It is important that candidates view the Vacancy Announcement in its entirety to be sure that all required documents are submitted. Incomplete application packages cannot be considered.

The vacancy announcement can be found on the Office of Personnel Managements USAJOBS website at www.usajobs.opm.gov or you may directly link to the vacancy announcement on USAJOBS using one of the links below.

For candidates who have never worked for the Federal Government: http://jobsearch.usajobs.opm.gov/ftva.asp?OpmControl=1749941.

For current status employees or reinstatement eligibles: http://jobsearch.usajobs.opm.gov/ftva.asp?OpmControl=1749958.

For more information, contact Cindy Lonergan at clonergan@usgs.gov or (703) 648-7472. The U.S. Geological Survey is an Equal Opportunity Employer U.S. Citizenship is required.

Water Institute Fellow at the University of Florida. The University of Florida seeks a Water Institute Fellow to begin a two-year post-doctoral program. The successful candidate will join an interdisciplinary group of faculty and students from the University of Florida and the Colorado School of Mines who seek to understand and predict the dynamics of surface-groundwater mixing, and the transport and transformation of ecologically relevant solutes, in karst river basins. The Fellow will be responsible for developing coupled surface-subsurface flow and transport models for the Santa Fe River basin in Florida; using these models to test hypotheses and gain insights about the system; and developing data assimilation algorithms to ingest data into the model to improve its predictions. A recent Ph.D. Civil or Environmental Engineering, Fluid Mechanics or related field is required.

For more details on desired qualifications and a complete position description see http://waterinstitute.ufl.edu/index.html. To apply send CV and contact information for 3 references to Dr. Wendy Graham at wgraham@ufl.edu. Applications are due by January 15, 2010.

Ocean Sciences

Term Research Faculty Position Available. The Alaska Center for Climate Assessment and Policy (ACCAP) at the University of Alaska, Fairbanks, seeks a research faculty with strong outreach, research and interpersonal skills. Applicants must have completed a M.S., although a Ph.D. is preferred, in the sciences or social sciences by the time of hire. Possible areas of expertise include, but are not limited to, climate science, geography, biological sciences, ocean or marine sciences, public health, interdisciplinary degrees.

ACCAP works closely with stakeholders in Alaska to deliver information about climate change that is scientifically accurate and relevant to real-time decision-making in policy, land and resource management, public health, planning, and community well-being. ACCAP is funded by the NOAA Climate Program Office and is one of nine Regional Integrated Sciences and Assessment (RISA) programs nation-wide.

Responsibilities for this position include:

- Conducting 'Climate Change 101' trainings for a diversity of stakeholders, including state and federal agency personnel.
- Working with the ACCAP team to develop decision-support tools and effective outreach mechanisms.
- Writing competitive grants and conducting research.
- Collaborating with NOAA affiliates.

This position holds the opportunity to develop research and outreach in a range of specific fields relevant to climate change science and information involving a diversity of Alaskan stakeholders including state, tribal, and local government, federal and state agencies, industry, and non-profit organizations.

Please apply at: www.uakjobs.com/applicants/Central?quickFind=67541. Review of candidates is ongoing, on an as needed basis. For further information contact: Dan White, 907-474-6222, dmwhite@alaska.edu.

Solid Earth Geophysics

Assistant/Associate Professor of Seismology/Seismic Exploration. The Department of Geology and Geophysics at the University of Utah seeks applicants for a tenure track position at the Associate or Assistant Professor level in Seismology/Seismic Exploration.

Priority will be given to candidates whose research has a focus on seismic imaging, including but not limited to processing and interpretation of seismic array data, reflection seismology, inversion and integrated interpretation with other geophysical data. Preference will be given to a candidate with a strong background in quantitative sciences and with experience in solving practical geological and geophysical problems. The successful candidate should have a proven ability or potential to attract external funds and to build a vibrant research program involving graduate students and post docs. Applicants must hold a Ph.D. in geophysics, or a closely related discipline.

Applicants should e-mail an application letter describing research, teaching, and career interests, a curriculum vitae, and the names and contact information for three referees, all in PDF format to: searchcommitee-seism-expl@lists.utah.edu. Review of applicants will begin January 1, 2010, and continue until the position is filled.

The University of Utah is an Equal Opportunity/Affirmative Action Employer, encourages applications from women and minorities, and provides reasonable accommodation to the known disabilities of applicants and employees. The University of Utah values candidates who have experience working in settings with students from diverse backgrounds, and possesses a strong commitment to improving access to higher education for historically underrepresented students.

Postdoctoral Positions in Seismology, Geodesy, and Geodynamics of the Yellowstone Hotspot at the University of Utah. The University of Utah invites applications for one or more Postdoctoral Fellows in seismology, geodesy (GPS, InSAR, etc.) focused on understanding the geodynamics of the Yellowstone hotspot. We are especially interested in scientists to conduct research on this active volcanic-tectonic system including earthquake sources, wave propagation and tomography studies; processing and modeling of GPS and borehole strainmeter data; geodynamics of the crust and mantle magma systems; synthesis and joint modeling of seismic and geodetic data, etc. A rich source of information is available from the University of Utah and EarthScope Yellowstone seismic and GPS networks including a 31-station seismograph network and

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new borehole strainmeters and down-hole seismographs (see www.uusatrg.utah.edu, www.seis.utah.edu and pboweb.unavco.org). An upgrade of the Yellowstone seismic network to full broadband and accelerometer network coverage will begin in 2010 from USGS Stimulus funds.

Interaction with students and faculty of the University of Utah, Department of Geology and Geophysics and the Yellowstone Volcano Observatory is expected. The associates will be expected to participate in earthquake and volcano response and interpretation activities. Computing experience with the Linux/Unix operating system is essential. The expected starting salary is competitive, depending on qualifications and experience. Applicants must have a Ph.D. in Geophysics or closely related field. Appointments will be for one year with continuation based upon performance and on funding.

Applicants should email Robert B. Smith, (robert.b.smith@utah.edu): 1) a letter of application including a statement of how the applicant is qualified to participate in one or more of the above specific research areas; 2) a curriculum vitae; and 3) names and email addresses of three persons who can provide recommendations for the candidate. The University of Utah is an Equal Opportunity/Affirmative Action employer, encourages applications from women and minorities, and provides reasonable accommodation to the known disabilities of applicants and employees. Applications will be accepted until the positions are filled.

Professor Practice in Geology, Tulane University. The Department of Earth & Environmental Sciences seeks to fill a non-tenure track, Professor of Practice position to teach introductory courses in geology, to supervise introductory geology laboratory courses, and to teach other courses related to their field of expertise. We seek an individual possessing an enthusiastic dedication to teaching who is willing to make a long-term commitment to the department and the University. The initial appointment will be for three years with the possibility of renewal after a performance review at the end of the second year. The deadline for applications is January 10, 2010, but the position will remain open until filled. Applications should include a curriculum vitae, a statement of teaching interests and goals, and the names and contact information of at least three referees to Dr. Stephen Nelson, Department of Earth & Environmental Sciences, Tulane University, 6823 St. Charles Ave., New Orleans, LA 70118-5698. (snelson@tulane.edu) (email preferred). Further information about the department and University can be obtained at http://tulane.edu/sse/eens. Tulane University is an affirmative action/equal opportunity employer. Women and minorities are encouraged to apply.

Space Physics

Assistant Professor. The Colorado Center for Lunar Dust and Atmospheric Studies of the Laboratory for Atmospheric and Space Physics at the University of Colorado at Boulder invites applications for a tenure-track faculty position at the Assistant Professor level to start in August 2010.

Candidates with experience in one or more of the following are especially encouraged to apply: plasma laboratory experiments; space hardware development for electromagnetic fields; plasma and dust measurements. The successful candidate is expected to develop an independent research program using or supporting our planned and existing research facilities, including a 3MV electrostatic accelerator. The successful candidate will have teaching responsibilities in the Department of Physics or in the Department of Aerospace Engineering Sciences.

Please visit our web site: http://lasp.colorado.edu/ccldas, for a description of our research program. Applications must be submitted on-line at www.jobsatcu.com and reference job posting #808580. For full consideration, all application materials, including 4 names of references, should be received by January 5, 2010.

Interdisciplinary/Other

Assistant or Associate Professor, Physicochemical Processes of Soils, Soil Processes and Climate Change. The Idaho State University Departments of Biological Sciences and Geosciences seek applicants for a new tenure-track faculty position at the rank of Assistant or Associate Professor focused on physicochemical processes of soils, in the context of ecosystem responses to climate change. The position is initially funded by NSF EPSCoR, in support of climate and water research in Idaho. We seek applicants with expertise in topics such as biogeochemistry, soil hydrology, soil crust development, or other aspects of pedogenesis and contemporary surficial processes of semi-natural or wildlands.

Applicants should be able to complement existing institutional strengths including geomorphology, dryland plant and ecosystem ecology, aeolian transport, remote sensing, microbiology, stable isotopes, and watershed and stream ecology.

Applications must demonstrate scholarly accomplishments and skills that indicate potential for collaboration, instruction, supervision of undergraduate and graduate students, and development of an externally funded research program. The position begins August 2010. A Ph.D. is required, postdoctoral experience is preferred, salary will be commensurate with experience. Women and minorities are encouraged to apply.

Applicants should email a cover letter stating research and teaching interests, a CV, contact information of three references, and one reprint as a single pdf file to Pam Christensen (chripame@isu.edu). Review of applications will begin January 8, 2010, and proceed until a suitable candidate is identified.

Assistant Professor, Geosciences. The University of Nevada, Reno, Department of Geological Sciences and Engineering is searching for a full-time, tenure-track Assistant Professor in the Geosciences. The areas of research expertise for the position are intentionally broad. We seek an outstanding geoscientist whose research and teaching strengths complement the existing department faculty. A willingness and experience to be involved with interdisciplinary earth science research is highly desirable. Experience in field-based research and ability to teach field classes is also desirable. Applicants must have been awarded a doctorate degree in a geoscience field by the time of hire (July 1, 2010) and demonstrate the potential to establish a teaching and research program with international recognition.

Established record of publication commensurate with the applicant's career stage, commitment to teaching, and ability to attract external funding are essential.

Applications should be submitted using the Faculty Jobs page at http://jobs.unr.edu/. Applications will close on January 15, 2010.

Assistant Professor, Tenure-Track Appointment. The Department of Geological and Mining Engineering and Sciences at Michigan Tech invites applications for a tenure-track appointment at the Assistant Professor level to support our Geological Engineering Program. Candidates with demonstrated achievements commensurate with appointment at Associate or Full Professor will also be considered. A Ph.D. is required at the time of appointment. While candidates need not have engineering degrees, they must possess experience and training that would permit licensure as a professional engineer. The candidate must demonstrate a strong commitment to excellence in teaching and research, with the desire to strike a balance between undergraduate and graduate teaching and advising, funded research, scholarly activity, and service. We are particularly interested in candidates who can enhance our research and educational activities in natural hazards and natural resources (mineral, hydrocarbon, and water resources) and who possess technical strengths in geological engineering, hydrology, mining engineering, remote sensing, or related areas.

Michigan Tech has a total student population of about 7000 and is located in Michigan's Upper Peninsula, a pristine area on the south shore of Lake Superior. The department is committed to a strong educational focus and values basic and applied interdisciplinary research. Undergraduate and graduate programs are offered in Geology, Geological Engineering and Geophysics. Interested candidates can learn more about the department faculty, research, and educational programs at www.geo.mtu.edu.

Applicants should send a single PDF document containing a detailed curriculum vitae, a statement of research capabilities and interests, a statement of teaching experience and interests, and the names and complete contact information for at least three professional references to geoengsearch@mtu.edu. Applications received by February 15, 2010 will receive the fullest attention.

Associate Dean, Academic Affairs (Physical Sciences & Wellness), Broward College. Apply on-line through https://jobs.broward.edu.

Associate Professor, the University of North Carolina at Chapel Hill. The Curriculum for the Environment and Ecology invites applications for a position of Associate Professor. Under very special circumstances where a candidate also satisfies criteria for endowment funds from an associated department, consideration will be given to the rank of Full Professor.

The Curriculum seeks outstanding candidates who have a demonstrated excellence in both teaching and research and who have the potential to provide leadership in the Curriculum. Priority will be given to candidates with strong interdisciplinary backgrounds with demonstrated interests and record of building programs. Candidates must have a Ph.D. in a field related to the environment, including but not restricted to Anthropology, Biology, Economics, Geography, Geology, Marine Science, and Public Policy. Some areas of special interest are environment and social sciences, energy, hydrology, and atmospheric sciences. The successful candidate will have his or her primary appointment in an appropriate department within the College of Arts and Sciences, but a major portion of their time and energy will be devoted to the Curriculum.

The Curriculum is a unit of the College of Arts and Sciences. It offers graduate degrees in Ecology, a Bachelor of Arts in Environmental Studies, and a Bachelor of Science in Environmental Science. Approximately 25 full-time students are enrolled in the graduate program, and there are approximately 200 majors at the undergraduate level.

Students in the program benefit from a close working relationship with the UNC Institute for the Environment which offers a number of opportunities for experiential education, including operation of field study sites. More detail about the Curricu-

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lum and the Institute may be found at www.cee.unc.edu and www.ie.unc.edu.

Students pursuing undergraduate degrees may select from several concentrations, including Environment and Health, Ecology, Land Use and Transportation Planning, Environmental Decision-making, Environmental Communication, Environment and Culture, and Environment and Natural Resources.

The University of North Carolina is an equal opportunity employer, and the Curriculum is committed to increasing diversity of its faculty. Women and minorities are encouraged to apply. Candidates should submit application through UNC's Human Resources jobseekers website at jobs.unc.edu/1002014. Include at least three references from whom letters may be sought for candidates who are placed on a short list. The Search Committee will begin review of candidates immediately.

Faculty Position. The Department of Chemical Engineering and Applied Chemistry invites applications for a faculty position in the tenure-stream at the rank of Assistant Professor, effective on or after July 1, 2010. The successful candidate will show leadership and innovation in research and teaching.

Applicants are expected to have a Ph.D. or equivalent, demonstrated excellence in research and excellent teaching skills. Postdoctoral or industrial experience is an asset.

The successful candidate will be expected to initiate and lead an independent research program of international caliber, and teach in the chemical engineering curriculum at the undergraduate and post-graduate level. Collaborative and interdisciplinary research and collegial interaction will be important elements in success. Eligibility to register as a Professional Engineer in Ontario is a desirable qualification. Salary will be commensurate with qualifications and experience.

Applicants should send curriculum vitae, a statement of research vision with a five to ten year horizon (three to five pages), and a statement of teaching philosophy and interests. Applicants should arrange for three letters of reference to be sent directly to:

Doug Reeve,
Professor and Chair
Department of Chemical Engineering and Applied Chemistry
University of Toronto
200 College Street
Toronto, Ontario, Canada M5S 3E5

The search will continue until the position is filled. To ensure consideration, interested individuals should deliver complete application materials before January 15, 2010.

Inquiries: chair.chemeng@utoronto.ca
Information: www.chem-eng.utoronto.ca

All qualified candidates are encouraged to apply; however, Canadians and permanent residents will be given priority. The University of Toronto is strongly committed to diversity within its community and especially welcomes applications from visible minority group members, women, Aboriginal persons, persons with disabilities, members of sexual minority groups, and others who may contribute to the further diversification of ideas.

Faculty Positions in Global Environment, Health and Sustainability. The State University of New York College of Environmental Science and Forestry (SUNY ESF) invites applications for faculty positions in the following representative areas: Biomimicry and design of sustainable systems; climate change drivers and responses of natural and urban systems; urban sustainability: built environments, ecological engineering and sustainable communities; quantitative analysis of fate and transport of environmental contaminants, pathogens and/or invasive species; biomolecular engineering for sustainable products and processes; and renewable energy engineering. Additional information on these areas is provided at http://www.esf.edu/positions.

These tenure-track positions will be at the Associate or Assistant Professor level, depending on qualifications; candidates will have a Ph.D. in one of the areas described or closely related field, a strong record of publication and external funding, and evidence of collaborative skill and effective college teaching.

The academic home of these faculty will lie in one of several Departments in SUNY ESF, including Chemistry; Environmental and Forest Biology; Environmental Studies; Environmental Resources and Forest Engineering; Forest and Natural Resources Management; Landscape Architecture; Paper and Bioprocess Engineering; and Construction Management and Wood Products Engineering. SUNY ESF (http://www.esf.edu/) is one of eight doctoral-granting institutions of the State University of New York. These new faculty, to start August 15th, 2010 will join 127 research-oriented faculty with active graduate and undergraduate teaching/research programs. ESF faculty lead the SUNY system in per-capita extramural support, with extensive collaborations that include Syracuse University, other SUNY institutions, and Brookhaven National Laboratory.

Availability and Application Deadline: To ensure optimal consideration, all application materials must be received by January 11, 2010; these positions will remain open until filled.

Application Procedure: Application is online only. Applications should include a letter summarizing qualifications and research interests, curriculum vitae, a separate statement of teaching experience and philosophy, and the names and contact information for three references and be submitted on-line at http://www.esf.edu/hr/search/.

For More Information: Contact the Search Committee Chair, Dr. Neil H. Ringler, Dean of Research and Distinguished Teaching Professor, SUNY-ESF; e-mail: neilringler@esf.edu; telephone: (315) 470-6682. SUNY-ESF is an Equal Opportunity/Affirmative Action employer.

Geological & Environmental Science & Engineering Positions. The National Energy Technology Laboratory (NETL) is a science, technology, and energy laboratory owned and operated by the U.S. Department of Energy. NETL's mission is to implement national research, development, and demonstration programs to help resolve environmental, supply, and reliability issues and constraints associated with the production and use of fossil energy resources.

NETL is currently recruiting for various engineers/scientists to perform research as part of NETL's Geological and Environmental Systems Focus Area. Positions include research in geological sequestration of carbon dioxide; geochemistry/geomaterials science based problems in engineered geological systems used in energy technologies such as carbon dioxide sequestration; exploration, production, and development of ultra deep and/or unconventional oil, gas, and other fossil fuel resources; and development of geothermal energy systems.

The positions are located in Pittsburgh, PA or Morgantown, WV, depending on the position.

For complete information about these positions, including all major duties and responsibilities, qualification requirements, and application procedures, please visit our career opportunities page on the NETL website at www.netl.doe.gov and look for vacancy announcement numbers NETL-09-152, 153, and 154. U.S. citizenship is required for all positions.

The Department of Energy is an equal opportunity employer.

Post-Doctoral Fellowships. From time to time the Department of Earth and Planetary Sciences at Harvard University seeks to fill Post-Doctoral Fellowships in the broadly defined areas of atmospheric and climate studies, biogeochemistry, geochemistry, geophysics, and planetary science. Please forward a letter of interest and CV to C. Marsh at 20 Oxford Street, Cambridge, MA 02138 or by email to marsh@eps.harvard.edu. Harvard University is an affirmative action/equal opportunity employer and applications from women and minorities are encouraged.

Postdoctoral Opportunity, Environmental Geochemistry. Wofford College, a private Phi Beta Kappa liberal arts college founded in 1854, has launched a new program in Environmental Studies. We seek a postdoctoral scholar with strong interest in undergraduate education for an 18-month position with both program and research responsibilities, preferably starting January 2010. Candidates should ideally have expertise in two or more of the following areas: uranium geochemistry, geochemical and/or transport modeling, X-ray absorption spectroscopy, pore-scale imaging, environmental mineralogy. See http://www.wofford.edu/environmentalstudies, for further information.

It is the policy of Wofford College to provide equal opportunities and reasonable accommodation to all persons regardless of race, color, creed, religion, sex, age, national origin, disability, veteran status, or other legally protected status in accordance with applicable federal and state laws.

Applicants should email a cover letter, curriculum vitae, statement describing career goals, teaching and research interests, and contact information for three references to Prof. Kaye Savage, Director of Environmental Studies: savageks@wofford.edu.

Postdoctoral Position in Geothermal Reservoir Simulation. The Department of Petroleum Engineering at the Colorado School of Mines is seeking a postdoctoral researcher to work on a research project, funded by US Department of Energy, on modeling studies of Enhanced Geothermal Systems (EGS). This work is to develop a comprehensive and efficient reservoir simulator for modeling multiphase fluid and heat flow, coupled with effects of rock deformation and chemical reaction, in geothermal reservoirs. The tasks for the postdoctoral researcher include: simulation of multiphase fluid and heat flow processes in porous and fractured media; implementation of a computational module for handling coupled effects of pressure and temperature variation induced rock deformation and a chemical reaction module to include important chemical species and their reactions in EGS geothermal systems; and model verification/validation efforts using laboratory and field data of geothermal reservoirs. Qualifications: Experience in numerical reservoir simulation and scientific computing (Fortran/C/C++). Good understanding of multiphase fluid and heat flows in porous media and related transport processes and fundamental continuum mechanics (rock mechanics).

Excellent interpersonal, communication (oral and written), and presentation skills. Experience with the TOUGH2 family of codes and commercial reservoir simulators is desired, but not required. Compensation: An initial annual salary of $50,000 is offered. Mines also provides an attractive benefits package. For a complete job announcement, more information about the position and the university, and instructions on how to apply, please visit: http://www.mines.edu/Academic_Faculty. Application review begins immediately and will continue until the position is filled. Mines is an EEO/AA Employer.

Postdoctoral Research Position. The Department of Earth Sciences at the University of Western Ontario invites applications for a postdoctoral research position. The successful applicant will work on various problems related to the simulation and modeling of seismic data for the study of earthquake rupture processes and seismic hazard. A Ph.D. in geophysics or a related field is required at the time of appointment, and successful applicants are anticipated to have a background in geophysics, physics, or engineering and demonstrated scientific achievement, as well as some computational programming experience. Applicants should have fluent written and oral communication skills in English.

The initial appointment will be for one year, with the possibility of renewal for a second year. The position is open upon availability. Information about the department and surrounding area can be found at www.uwo.ca/earth.

Please submit a curriculum vitae, a letter describing your research experience and interests, and a list of three references complete with contact information, to Dr. Kristy F. Tiampo at ktiampo@uwo.ca (+1-519-661-3188).

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All qualified candidates are encouraged to apply; however, Canadians and permanent residents will be given priority. The University of Western Ontario is committed to employment equity and welcomes applications from all qualified women and men, including visible minorities, aboriginal people and persons with disabilities.

Postdoctoral Researcher, University at Buffalo. This 2-year position (beginning in July, 2010) will have a major role in the VHub project, which is developing a virtual organization and cyberinfrastructure for volcanology research and risk mitigation (see http://geohazards.buffalo.edu/VHub/). The successful candidate will work with the investigator team, international collaborators, and volcano observatories to implement VHub architecture and on one or more of the following topics: (1) integration of complex datasets (e.g., volcano topography, time-varying meteorological data, volcanic deposit distributions and characteristics) with predictive modeling tools; (2) development of multimodel forecasting and/or hazard assessment tools for eruptive phenomena; and (3) development and implementation of formal methods and standards for verification, validation, and benchmarking of volcano process models. More detail is available at https://www.ubjobs.buffalo.edu (posting #0900395) and applicants must apply online to be considered. Interested candidates should contact Greg Valentine (gav4@buffalo.edu).

The Joseph P. Obering Postdoctoral Fellowship. The Department of Earth Sciences seeks outstanding candidates for the Joseph P. Obering Postdoctoral Fellowship in Earth Sciences at Dartmouth College. This competitive fellowship provides two years of full-time salary and a research allowance, with a third year contingent upon performance and funding. In concert with Dartmouth's philosophy that scholarship and teaching are inseparable facets of academic life, this fellowship provides recent Ph.D. recipients the opportunity to pursue independent research as well as to develop a teaching portfolio.

Candidates will be expected to collaborate with one or more Dartmouth Earth Sciences faculty members, taking advantage of existing resources and facilities, and will teach one course (under the quarter system) per year. The starting date is negotiable, but could be as early as July 1, 2010. Details about Dartmouth Earth Sciences may be found at www.dartmouth.edu/~earthsci.

Candidates should submit a CV, statements of research and teaching interests, and selected preprints/reprints by January 8, 2010. Applications should be sent to: Obering Postdoctoral Fellowship Committee, Department of Earth Sciences, Dartmouth College, 6105 Fairchild Hall, Hanover, NH 03755. In addition, applicants should arrange for three letters of recommendation to be sent directly to the above address. Dartmouth College is an EO/AA Employer.

STUDENT OPPORTUNITIES

8 MS and 4 Ph.D. Scholarships. 8 MS and 4 Ph.D. scholarships in oceanography at Texas A&M University through NSF funding. Academically talented, financially needy students (especially from under-represented groups) are encouraged to apply. Research opportunities include studies/models of a range of oceanographic processes from molecular scales to full ocean from the Pacific to Atlantic, Arctic to Antarctic, the Gulf of Mexico, Galapagos Islands, etc. Details at http://ocean.tamu.edu/scholarships.

Graduate Research Assistantship. Graduate Research Assistantship at M.Sc. or Ph.D. level in remote sensing and GIS models of forest inventory for biofuels and bioenergy. Unique opportunity to explore research issues in the context of announced bioethanol facility in Michigan, USA. Background in GIS/RS and forestry with interest in assessing terrestrial vegetation desired. Proficiency in written English necessary. Stipend, tuition & fees included. Start spring semester 2010. Send GRE scores and CV to Robert Froese at froese@mtu.edu.

Graduate Students Summer Program Hydrologic Synthesis Summer Institute. Highly motivated graduate students sought for 7 week intensive summer program (P.I. M. Sivapalan, Univ. of Illinois) at the University of British Columbia in Vancouver. Research topics include solute transport, sediment dynamics, and nutrient cycling at various scales as well as invasion/blooming behavior of Didymosphenia geminate (aka "rock snot"). Application deadline is January 29. For more information, visit http://cwaces.geog.uiuc.edu/synthesis or contact Jennifer Wilson, project coordinator, at jswilson@illinois.edu.

Hydrology Ph.D. Assistantships. Two 4-year Ph.D. research assistantships are available at the University of Texas-Austin to pursue research in numerical modeling and experimental measurement of coupled hydrodynamic, biogeochemical and microbiological processes at the micron to millimeter scales. Summer internships with collaborators at Sandia National Labs are possible. Interested candidates should contact Dr. Bayani Cardenas (cardenas@jsg.utexas.edu) or Dr. Philip Bennett (pbennett@mail.utexas.edu).

MS Students. MS students wanted to study Air-Land-River-Sea interactions. The Department of Marine Sciences at the University of New England has openings for students to pursue a Masters of Science degree studying some part of the interactions among land use change, precipitation, river runoff, climate change, and the chemical and microbiological loading in rivers, and ultimately how all of those changes affect coastal biology and ocean circulation.

Students are sought with expertise or interest in the following fields: biology (and all its subfields, e.g., botany, microbiology, toxicology, genetics, molecular biology, chemical ecology), physical oceanography, hydrology, remote sensing, GIS, numerical modeling, nutrient or chemical dynamics, marine biology (especially fish, invertebrates and algae), or ecology (terrestrial, aquatic or marine).

Students may enroll in either the Department of Marine Sciences (http://www.une.edu/cas/marine/graduate/index.cfm) or Department of Biology (http://www.une.edu/cas/biological/graduate/index.cfm).

Funding is available through: NSF GK-12 grant http://www.une.edu/cas/marine/spartacus.cfm, Departmental Teaching Assistantships.

Other Grant supported activities (NASA, NOAA). The University of New England (www.une.edu) is located on the coast of Southern Maine, approximately 45 minutes from Portland. Learn more about the MS Degree at http://www.une.edu/cas/graduate.cfm.

To apply, fill out the UNE Graduate Admissions form online: http://srm.targetx.com/orgs/00D80000000Lc6PEAS/registration/step_1.

Multi-Year Ph.D. and Postdoctoral Fellowships. Interdisciplinary: The Department of Earth and Environmental Science of the University of Pennsylvania seeks applicants for competitive, multi-year Ph.D. and postdoctoral fellowships to work with the Luquillo Critical Zone Observatory in Puerto Rico. Research areas include soil biogeochemistry and nutrient cycling, fluvial

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geomorphology and hydrology, cosmogenic dating, sea-level rise and coastal evolution. All inquiries should be sent to earth@sas.upenn.edu and should include a CV and brief statement of interests. Ph.D. candidates must apply on line using the Departmental Web page http://www.sas.upenn.edu/earth/.

Ph.D. and M.S. Student Opportunities. Ph.D. and M.S. student opportunities in climate change research at the University at Buffalo Geology Department. Foci include monitoring Greenland and Antarctic ice sheet mass balance changes using laser altimetry and other remote sensing methods as well as reconstruction of ice sheet dynamics from historical photographs. Funding also exists for Holocene climate and glacier reconstructions using lake sediments, including fieldwork. Contact Bea Csatho or Jason Briner (bcsatho/jbriner at buffalo.edu); http://www.geology.buffalo.edu/.

Ph.D. Candidate. We are seeking a Ph.D. candidate that will perform research within the field of hard rock seismology with applications related to deep drilling, both siting of boreholes and geological interpretation on a more regional scale.

Acquisition and processing of seismic data are part of the activities included in the position. Research will focus on (1) interpretation of geological structure based on reflection seismic data; (2) development of novel and innovative processing methods; and (3) integration of reflection seismic results with other geological and geophysical data from the Jamtland area in Sweden in order to plan deep drilling projects there. For full details on how to apply see www.personalavd.uu.se/ledigaplatser/2866dorand_eng.html.

Applications due by 28 January 2010.

Ph.D. **Opportunities in Carbon Sequestration Research.** The Division of Marine Geology and Geophysics (MGG) at the Rosenstiel School of Marine and Atmospheric Science (RSMAS), University of Miami, Florida, has initiated a major research program in carbon sequestration. One aspect of this work involves monitoring the fate of CO_2 pumped into natural reservoirs using a combination of InSAR and GPS, seismology and geochemistry. This project is funded by the Department of Energy (DOE). We invite applications for graduate students leading to the Ph.D. degree. We anticipate up to five openings with specific research areas include Geochemistry, Seismology, and Space Geodesy. For more information on RSMAS and our research activities, please visit http://www.rsmas.miami.edu/ and http://www.geodesy.miami.edu. Starting date is Spring 2010 or Fall 2010.

For formal application procedures please visit the RSMAS Graduate Studies website. International applicants are encouraged to take the GRE and TOEFL tests at their earliest convenience. Applications from students with a MSc. and research interests in both geodesy and seismology are particularly welcome. Review of applications will start in early 2010 and continue until the positions are filled.

For more information please contact Professors Tim Dixon (tdixon@rsmas.miami.edu), Guoqing Lin (glin@rsmas.miami.edu), Falk Amelung (famelung@rsmas.miami.edu), or Peter Swart (pswart@rsmas.miami.edu).

Ph.D. Opportunity in Atmospheric Chemistry. We seek a Ph.D. student in the School of Marine and Atmospheric Sciences at Stony Brook University, Long Island, NY. Candidates should have a BS degree in a related field (MS preferred) and strong experimental and analytical skills. The Ph.D. laboratory project is concerned with the chemical transformation of organic aerosol particles by atmospheric trace gases. For more information, please visit www.somas.stonybrook.edu or contact Dr. Daniel Knopf (Daniel.Knopf@stonybrook.edu).

Ph.D. Position. Ph.D. Position Helmholtz Centre for Environmental Research-UFZ, Leipzig, Germany. Focus of the work is a detailed mechanistic modelling of the water balance of a Mediterranean savannah but the candidate is supposed to spend 3-5 mon/a in Portugal helping with fieldwork. Ideal candidate will have a strong math background and good programming skills. Plant physiology is a plus. Please contact Matthias.Cuntz(at)ufz.de for further information.

Ph.D. Position in Lithospheric Flexure & Seismic Anisotropy. Applicants are sought for a 3-year Ph.D. position at Curtin University in Perth, Western Australia, on the topic of lithospheric flexure and seismic anisotropy. A stipend of $22,500 + fees is available. Applicants should possess a strong mathematical background and some programming experience, and should hold or expect to receive a first-class degree in geophysics, physics, mathematics, engineering or geodesy. Please send a CV to Dr. Jon Kirby, j.kirby@curtin.edu.au, and visit www.cage.curtin.edu.au/~jfk/PhD.html.

Ph.D. Research Assistantship in Land Use and Hydrology. Montana State University is seeking a Ph.D. student to study land use and cover change modeling and the relative influence of climate variability and land use change on hydrologic dynamics in the Gallatin River Watershed, MT. Desired qualifications include M.S. in ecology, hydrology, or related field and expertise in quantitative spatial analysis, remote sensing, and/or modeling. Desired starting date is January to June 2010. Funds for tuition, fees, and a research stipend will be provided. Contact Andrew Hansen (hansen@montana.edu) for more information.

Ph.D. Student. Support for a Ph.D. student is available to conduct research on Lagrangian coherent structures with application to transport and mixing processes in geophysical flows. I am especially seeking a Ph.D. student with a good mathematical background. Application deadline is January 1. Detailed program information can be found at http://www.rsmas.miami.edu/grad-studies. For more information, please contact M. Josefina Olascoaga, RSMAS/Applied Marine Physics (jolascoaga@rsmas.miami.edu).

REU Summer Assistantships. NAIC will conduct a 10-week undergraduate summer program at the Arecibo Observatory in Puerto Rico, which is funded by the NSF's Research Experience for Undergraduates (REU) Program. Areas of research include radio and radar astronomy, and atmospheric sciences, as well as electronic instrumentation and computer science. NAIC will also fund one or two positions for first or second year graduate students from US institutions (non-US citizens may apply). For application forms and details go to http://www.naic.edu/science/summer_set.htm. EOE/AAE.

Stephen F. Taber Fellowship for Ph.D. Research. The Graduate Studies Program of the Department of Earth and Ocean Sciences, University of South Carolina invites applications for the Taber Fellowship. This award is intended to attract and retain exceptional new doctoral students who demonstrate the ability to make a significant contribution in the geosciences. Applications are invited from persons interested in, but not limited to: hydrology, geophysics, seismology, marine science, oceanography, geochemistry, tectonics, surface processes and structural geology. To learn more about the Department please visit our website at www.geol.sc.edu.

Each Taber Fellow will receive a three-year award consisting of a teaching assistantship plus a $12,000/year stipend with full tuition, and fees. Total 3-year award value is over $100,000.

Additional information concerning this fellowship can be obtained at: http://www.geol.sc.edu/gradprog/prospective.htm. SC is an EEO/AA Institution.

Summer 2010 Research Education Undergraduate (REU) Program. The Sevilleta Long Term Ecological Research Site is seeking applicants for the summer 2010 Research Education Undergraduate (REU) program. We are looking for undergraduate students interested in doing independent research working with mentors in Earth & Planetary Science, Ecology & Biology. The program runs 11 week; housing, a $4500 stipend and up to $500 in travel is provided. Applications due 20 February 2010. On-line applications and further details can be found at: http://sev.lternet.edu/REU.

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