

IN THIS ISSUE:

News: Landsat 5 to Be Decommissioned, Fire Activity Increases, and More, p. 19
 Meeting: Capacity Building for Sustainable Marine Research, p. 21
 Meeting: Hydrological Properties and Processes, p. 21
 Meeting: The Evolution of the Lunar Highlands Crust, p. 21
 Meeting: What Do We Know About Calderas?, p. 22
 About AGU: Member Engagement Is Key, p. 22
 Research Spotlight: Heliosheath Fluctuations, Snowfall Shifts, and More, p. 28

Detailed Data Available for Recent Costa Rica Earthquake

On 5 September 2012 a magnitude 7.6 earthquake occurred beneath the Nicoya Peninsula of northwestern Costa Rica, rupturing the subduction zone between the Cocos and Caribbean plates. In most subduction zones the locus of seismic slip lies far offshore, making it difficult to infer interface seismogenic processes from on-shore observations. In contrast, the Nicoya Peninsula lies close to the trench (within 70 kilometers), allowing observations directly over the earthquake rupture zone.

Because of its favorable location, the frequency and apparent regularity of large earthquakes, and timing (late in the earthquake cycle), the Nicoya Peninsula was a focus site for the Seismogenic Zone Experiment (SEIZE) beginning in 1997. This project was funded by the U.S. National Science Foundation's (NSF) MARGINS program, which investigated the geological evolution

of continental margins. Since then, the region has seen numerous studies of seismicity, velocity structure, heat and fluid flux, bathymetry, geodesy, coastal geomorphology, and paleoseismology, addressing fundamental questions about subduction zone processes.

The September 2012 Nicoya earthquake is a fitting capstone for the SEIZE initiative and also presents an important opportunity to address new science objectives central to the MARGINS successor program, Geodynamic Processes at Rifting and Subducting Margins (GeoPRISMS). These objectives span a spectrum of fault slip behavior from seconds (earthquakes) to months (slow slip events) to decades or longer (seismic cycle strain and net crustal deformation).

Costa Rica Earthquake cont. on page 18

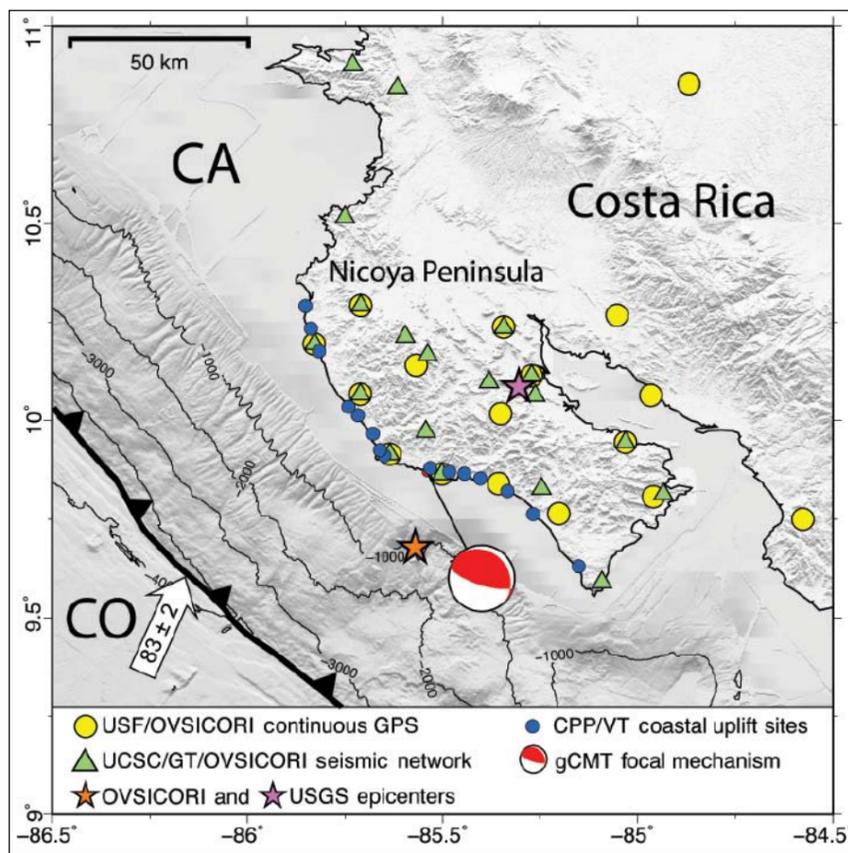


Fig. 1. Scientific observation stations at the Nicoya Peninsula in Costa Rica, where the Cocos plate (CO) is subducting under the Caribbean plate (CA). Institutions involved with study are the University of South Florida (USF); University of California, Santa Cruz; Georgia Institute of Technology (GT); Observatorio Vulcanológico y Sismológico de Costa Rica, Universidad Nacional (OVSICORI-UNA); California State Polytechnic Institute, Pomona (Cal Poly Pomona, CPP); and the Virginia Polytechnic Institute and State University (Virginia Tech, VT). Global Centroid Moment Tensor solution (gCMT) for the 5 September 2012 earthquake is shown along with epicenter estimates from the U.S. Geological Survey (USGS) and OVSICORI-UNA. Arrow shows rate (in millimeters per year) and direction of convergence of CO relative to CA. Depth contours are in meters.

Canada's Cabled Ocean Networks Humming Along

Canada recently reconfirmed commitment to supporting cabled ocean observations by awarding Ocean Networks Canada (ONC) 5 years of operations and maintenance funding. ONC supports the Victoria Experimental Network Under the Sea (VENUS) and Northeast Pacific Timeseries Underwater Networked Experiments (NEPTUNE Canada), both located offshore Canada's west coast (Figure 1). Results from both efforts demonstrate the wealth of information that can be gained through continuous in situ monitoring of the sea.

VENUS Network and NEPTUNE Canada

The VENUS network (Figure 1) began operations in 2006. It has sensors in Saanich Inlet, the Strait of Georgia, and the Fraser River delta, locations ideal for studying hypoxia and acidification, as well as underwater landslides [Lintern and Hill, 2010]. VENUS is continuing to build its infrastructure with subsurface gliders, sensors on ferries, and coastal radar.

The NEPTUNE (Figure 1) 800-kilometer fiber-optic cable with five active nodes was completed in late 2009. Since then, installation of scientific instruments on the nodes—seismometers, current meters, cameras, gas sensors, pressure recorders, accelerometers, biological sensors, acoustic imaging systems, and robots—has taken place. The cable runs from Vancouver Island across the continental shelf into the deep sea and back, forming a loop. The 5 nodes are located inshore at Folger Passage, on the continental slope at Ocean Drilling Program (ODP) site 889 and Barkley Canyon, at the middle of the Juan de Fuca plate at ODP site 1027, and on the Endeavour segment of the Juan de Fuca ridge.

Seismic and Geophysical Studies

NEPTUNE hosts seismographs for observing earthquake activity and crustal stresses on the Juan de Fuca plate. Broadband seismometers detect events on the ridge, midplate region, Cascadia subduction zone, and offshore fracture zones. Researchers

expect that the subduction zone will eventually experience a strong megathrust earthquake—the last such event occurred on 26 January 1700 [Ludwin et al., 2005], and paleoseismicity studies suggest recurrence periods of approximately 500 years [Goldfinger et al., 2012, and references therein].

Further, at ODP 889, changes in electrical conductivity indicate high gas hydrate concentrations in the seafloor [Edwards, 1997]. These data are also used with seafloor movement measurements to estimate changes in hydrate volume. In less than 1 year, hydrate concentrations have risen almost 50% [Edwards et al., 2010]. If sea temperatures warm, hydrates sublimate, moving methane—a greenhouse gas—from the seafloor into the water column and potentially into the atmosphere.

Wally, a seafloor crawler connected at Barkley Canyon, regularly surveys the seafloor where hydrate outcrops. Thomsen et al. [2012] showed that methane release increased when bottom currents strengthened, seen through combining data from Wally and current meters. Inverted echo sounders simultaneously detected surface waves; during times of known storms, bottom currents were stronger, suggesting that storm events disturb the stability of hydrate.

Studies of Tsunamis

NEPTUNE's sensitive bottom pressure recorders serve as tsunami sensors that span different depths, from 2700 meters deep and 400 kilometers offshore at Endeavour Ridge to the inner continental shelf. Hundreds of earthquakes and numerous tsunamis have been detected since 2009; rapid, real-time calculations have allowed precise determination of tsunami wave speed, direction, and amplitude.

The high-precision real-time tsunami monitoring systems of ONC have captured the February 2010 Chilean earthquake and tsunami, as well as the April 2011 Great Tohoku earthquake and tsunami, helping to improve

Ocean Networks cont. on page 18

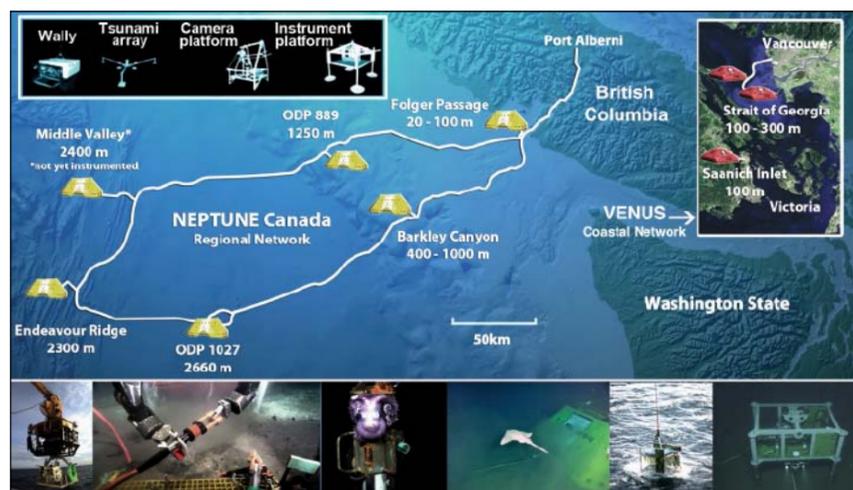


Fig. 1. Location map of Northeast Pacific Timeseries Underwater Networked Experiments (NEPTUNE) and Victoria Experimental Network Under the Sea (VENUS) primary infrastructure of cables and nodes. The upper left inset illustrates some of the instruments and infrastructure located along NEPTUNE's 800-kilometer cabled seafloor network. The bottom inset shows photographs of instruments: from left to right, Remotely Operated Platform for Ocean Science (ROPOS) carrying TEMPO-mini for installation at Endeavour, ROPOS's arm being used to remove a cap from a wet-mateable connector to connect an instrument to the primary infrastructure, an octopus on top of a Circulation Obviating Refit Kit (CORK) at Site 889, a deep-sea skate beside the NEPTUNE node at Ocean Drilling Program (ODP) site 1027, recovery of the Remote Access Sampler (RAS), and an instrument platform installed at ODP 889. (All images are courtesy of Ocean Networks Canada.)

EOS

TRANSACTIONS
AMERICAN GEOPHYSICAL UNION
The Newspaper of the Earth and Space Sciences

Editors

Christina M. S. Cohen: California Institute of Technology, Pasadena, Calif., USA; cohen@srl.caltech.edu

José D. Fuentes: Department of Meteorology, Pennsylvania State University, University Park, Pa., USA; juf15@meteo.psu.edu

Wendy S. Gordon: University of Texas at Austin, Austin, Tex., USA; wgordon@mail.utexas.edu

David Halpern: Jet Propulsion Laboratory, Pasadena, Calif., USA; davidhalpern29@gmail.com

Carol A. Stein: Department of Earth and Environmental Sciences, University of Illinois at Chicago, Chicago, Ill., USA; cstein@uic.edu

Editor in Chief

Barbara T. Richman: AGU, Washington, D.C., USA; eos_brichman@agu.org

Editorial Advisory Board

M. Lee Allison Earth and Space Science Informatics

Nathan T. Bridges Planetary Sciences

Roland Bürgmann Tectonophysics

Michael A. Ellis Earth and Planetary Surface Processes

Arlene M. Fiore Atmospheric Sciences

Nicola J. Fox Space Physics and Aeronomy

Michael N. Gooseff Hydrology

Seth S. Haines Near-Surface Geophysics

Kristine C. Harper History of Geophysics

Keith D. Koper Seismology

Xin-Zhong Liang Global Environmental Change

Stephen Macko Education

Stefan Maus Geomagnetism and Paleomagnetism

Jerry L. Miller Ocean Sciences

Peter Olson Study of the Earth's Deep Interior

Thomas H. Painter Cryosphere Sciences

Roger A. Pielke Sr. Natural Hazards

Len Pietrafesa Societal Impacts and Policy Sciences

Michael Poland Geodesy

Paul R. Renne Volcanology, Geochemistry, and Petrology

Sarah L. Shafer Paleoclimatology and Paleogeography

Adrian Tuck Nonlinear Geophysics

Sergio Vinciguerra Mineral and Rock Physics

Jeffrey M. Welker Biogeosciences

Earle Williams Atmospheric and Space Electricity

Staff

Editorial and Production: Randy Showstack, Senior Writer; Mohi Kumar, Science Writer/Editor; Ernie Balcerak, Writer/Editor; Faith A. Ishii, Program Manager; Tricia McCarter-Joseph, Production Assistant; Liz Castenson, Editor's Assistant; Valerie Bassett, Electronic Graphics Specialist

Advertising: Tel: +1-202-777-7536; E-mail: advertising@agu.org; Christy Hanson, Manager; Robyn Bassett, Classified and Display Ad Sales

©2013, American Geophysical Union. All Rights Reserved. Material in this issue may be photocopied by individual scientists for research or classroom use. Permission is also granted to use short quotes, figures, and tables for publication in scientific books and journals. For permission for any other uses, contact the AGU Publications Office.

Eos, Transactions, American Geophysical Union (ISSN 0096-3941) is published weekly except the last week of December by the American Geophysical Union, 2000 Florida Ave., NW, Washington, DC 20009, USA. Periodical Class postage paid at Washington, D.C., and at additional mailing offices. POSTMASTER: Send address changes to Member Service Center, 2000 Florida Ave., NW, Washington, DC 20009, USA. Member Service Center: 8:00 A.M.–6:00 P.M. Eastern time; Tel: +1-202-462-6900; Fax: +1-202-328-0566; Tel. orders in U.S.: 1-800-966-2481; E-mail: service@agu.org. Information on institutional subscriptions is available from the Wiley institutional sales team (onlinelibrarysales@wiley.com). Use AGU's Geophysical Electronic Manuscript Submissions system to submit a manuscript: <http://eos-submit.agu.org>.

Views expressed in this publication do not necessarily reflect official positions of the American Geophysical Union unless expressly stated.

Christine W. McEntee, Executive Director/CEO

<http://www.agu.org/pubs/eos>



Costa Rica Earthquake

cont. from page 17

Seismic Setting and Observation Campaigns

The Nicoya region produces frequent large ($M > 7$) earthquakes, including similar events in 1853, 1900, and 1950 ($M 7.7$) [Protti *et al.*, 1995]. Prior geodetic studies mapped the Nicoya segment as a locked zone, with parts of the subduction interface accumulating strain at essentially the rate of motion between the plates, about 8 centimeters per year [Dixon, 1993; Lundgren *et al.*, 1999; Norabuena *et al.*, 2004; Feng *et al.*, 2012]. Geomorphic data are also consistent with these rates of strain accumulation [Marshall and Anderson, 1995]. The history of frequent large earthquakes, combined with geodetic and geomorphic data consistent with locking on the plate interface and accumulating seismic strain, meant that the 2012 event was expected [Nishenko, 1989; Protti *et al.*, 1995].

Smaller ($M \sim 7$) events in 1978 and 1990 also occurred in the region, and at least five slow slip and tremor events have been recognized here in the last decade [Outerbridge *et al.*, 2010; Walter *et al.*, 2011; Jiang *et al.*, 2012]. Nonetheless, prior to the earthquake on 5 September 2012, significant seismic strain had accumulated.

The University of South Florida; University of California, Santa Cruz; Georgia Institute of Technology; and Observatorio Vulcanológico y Sismológico de Costa Rica, Universidad Nacional (OVSICORI-UNA), one of Costa Rica's main institutes for earthquake and volcano research, operate a network of high-precision, continuously recording GPS receivers and broadband seismometers on the Nicoya Peninsula (Figure 1). The network started in 2002 through a collaboration between OVSICORI-UNA, Tokyo University, and the Japan International Cooperation Agency. Since 2005, support has come from NSF's Instrumentation and Facilities,

MARGINS, and CAREER programs, the latter of which is designed to support early-career development for young scientists. Installation, maintenance, and data archiving are facilitated by UNAVCO and the Incorporated Research Institutions for Seismology (IRIS). This network recorded data several years before, during, and after the 2012 earthquake. MARGINS-funded geomorphic and paleoseismic studies by the California State Polytechnic Institute, Pomona (Cal Poly Pomona), and the Virginia Polytechnic Institute and State University (Virginia Tech) provide additional constraints on seismic cycle deformation along the Nicoya coast.

Data Freely Available

In the wake of the 2012 earthquake the NSF Geophysics and GeoPRISMS programs funded rapid response fieldwork to collect real-time geophysical and geomorphic data from the Nicoya Peninsula. These data provide an unprecedented image of the temporal and spatial distribution of slip during and after the earthquake, along with a significant community research opportunity.

Geodetic data from the continuous GPS network (including 5-hertz GPS data for selected stations) are archived and publicly available on the UNAVCO Web site (<http://www.unavco.org/voce/viewforum.php?f=56>). The seismic and geomorphic data from the recent surveys are being processed and will be archived and available through IRIS and UNAVCO in early 2013. Anyone with an interest in seismic processes and hazards is encouraged to exploit these new data.

References

Dixon, T. H. (1993), GPS measurement of relative motion of the Cocos and Caribbean plates and strain accumulation across the Middle America Trench, *Geophys. Res. Lett.*, **20**, 2167–2170.

Ocean Networks

cont. from page 17

scientists' ability to hindcast the heights of waves that impact the coast.

Sediment and Benthic Dynamics

Acoustic sensors on VENUS and NEPTUNE quantify suspended sediment concentration and size, seasonal river discharge variations, slope stability, and bed form evolution during storms, among other events. Sonars are complemented with cameras that observe benthic organisms.

From January to October 2010, images from these cameras showed a field of pits on the upper slope in 400-meter water. Analyses suggest that the seafloor pits were formed by benthic fish—currents were not strong enough to generate them, and fish regularly

revisited them [Robert and Juniper, 2012]. In the same area, flatfishes and sea urchins can churn up the surface sediment completely within 93–125 days [Robert and Juniper, 2012]. This shows the importance of animals for mixing sediment, which liberates nutrients, suggesting that long-term monitoring of bioturbation will help researchers understand the response of seafloor ecosystems to changes in primary productivity.

Ecosystem Function

Marine sediment ecosystems cover more of Earth than all other habitats combined, contributing significantly to global nutrient cycles, carbon and oxygen budgets, fisheries production, and pollutant dynamics.

Feng, L., A. V. Newman, M. Protti, V. Gonzalez, Y. Jiang, and T. H. Dixon (2012), Active deformation near the Nicoya Peninsula, northwestern Costa Rica, between 1996 and 2010: Interseismic megathrust coupling, *J. Geophys. Res.*, **117**, B06407, doi:10.1029/2012JB009230.

Jiang, Y., S. Wdowinski, T. H. Dixon, M. Hackl, M. Protti, and V. Gonzalez (2012), Slow slip events in Costa Rica detected by continuous GPS observations, 2002–2011, *Geochem. Geophys. Geophys.*, **13**, Q04006, doi:10.1029/2012GC004058.

Lundgren, P., M. Protti, A. Donnellan, M. Hefflin, E. Hernandez, and D. Jefferson (1999), Seismic cycle and plate margin deformation in Costa Rica: GPS observations from 1994 to 1997, *J. Geophys. Res.*, **104**, 28,915–28,928.

Marshall, J. S., and R. S. Anderson (1995), Quaternary uplift and seismic cycle deformation, Península de Nicoya, Costa Rica, *Geol. Soc. Am. Bull.*, **107**, 463–473.

Nishenko, S. P. (1989), Circum-Pacific seismic potential, 1989–1999, *U.S. Geol. Surv. Open File Rep.*, 89-86.

Norabuena, E., *et al.* (2004), Geodetic and seismic constraints on some seismogenic zone processes in Costa Rica, *J. Geophys. Res.*, **109**, B11403, doi:10.1029/2003JB002931.

Outerbridge, K., *et al.* (2010), A slow slip and tremor event in May 2007, Costa Rica margin, *J. Geophys. Res.*, **115**, B10408, doi:10.1029/2009JB006845.

Protti, M., *et al.* (1995), The March 25, 1990 ($M_w = 7.0$, $M_L = 6.8$), earthquake at the entrance of the Nicoya Gulf, Costa Rica: Its prior activity, foreshocks, aftershocks, and triggered seismicity, *J. Geophys. Res.*, **100**, 20,345–20,358, doi:10.1029/94JB03099.

Walter, J. L., S. Y. Schwartz, M. Protti, and V. Gonzalez (2011), Persistent tremor within the northern Costa Rica seismogenic zone, *Geophys. Res. Lett.*, **38**, L01307, doi:10.1029/2010GL045586.

—TIMOTHY H. DIXON, University of South Florida, Tampa; E-mail: thd@usf.edu; SUSAN SCHWARTZ, University of California, Santa Cruz; MARINO PROTTI and VÍCTOR GONZÁLEZ, Observatorio Vulcanológico y Sismológico de Costa Rica, Universidad Nacional (OVSICORI), Heredia, Costa Rica; ANDREW NEWMAN, Georgia Institute of Technology, Atlanta; JEFF MARSHALL, California State Polytechnic Institute, Pomona; and JIM SPOTILA, Virginia Polytechnic Institute and State University, Blacksburg

ONC benthic ecology research combines camera observations and interactive sampling with sediment traps, while multiple sensors provide uninterrupted measurements of temperature, oxygen, and nitrate.

Results from VENUS show that taxon richness negatively correlates with low oxygen concentration—cameras showed high abundances of juvenile squat lobsters when oxygen levels were lowest, possibly reflecting exclusion of larger predators by hypoxia in Saanich Inlet. Adult crustaceans, in contrast, increased biological activity within 2 hours after a high-oxygen intrusion [Matabos *et al.*, 2012].

Although sensors to directly measure acidity are not yet stable enough for long-term deployment, prototype acidity sensors were installed for testing in Saanich in October. Knowledge of local acidity variations will help scientists better understand where to concentrate mitigation efforts as acidic conditions rise.

Marine Mammals

Anthropogenic underwater sound affects the physiology and behavior of marine fauna. VENUS uses hydrophones to assess the large-scale acoustic ecology. Every 5 minutes, data are processed to identify ships and marine mammals. Several whale species have been detected, including an interpreted acoustic signal with no visual confirmation from an endangered North Pacific right whale. The last visual sighting of a right whale in these waters was in 1951.

Real-Time Vertical Profiling

A vertical water column profiling system was successfully installed in summer 2012 after three previous deployments encountered technical problems. This installation demonstrates that these types of sensor packages, which require significant power, are feasible for cabled observatories. The vertical profiler, capable of profiling the entire water column from the seafloor to the surface, is fixed to the seafloor at 400 meters at Barkley.

Along with depth, temperature, and salinity, the profiler measures quantities such as chlorophyll concentrations, turbidity, nutrient concentrations, irradiance and light attenuation, currents, and bioacoustic properties. A complete profile is

Ocean Networks cont. on next page

SAVE THE DATE

2013 NOMINATIONS OPENS 15 JANUARY

Nominate your colleagues for one of AGU's prestigious
Union Awards, Fellows, Prize, or Medals.

www.agu.org/honorsprogram

AMERICAN GEOPHYSICAL UNION HONORS PROGRAM

NEWS

In brief

Landsat 5 to be decommissioned After orbiting the planet more than 150,000 times since its launch in 1984, the Landsat 5 Earth observing satellite is being decommissioned due to the recent failure of a gyroscope, the U.S. Geological Survey (USGS) announced on 21 December. The 29-year-old satellite originally had an expected design life of 3 years.

USGS director Marcia McNutt said, "Any major event since 1984 that left a mark on this Earth larger than a football field was likely recorded by Landsat 5, whether it was a hurricane, a tsunami, a wildfire, deforestation, or an oil spill. We look forward to a long and productive continuation of the Landsat program, but it is unlikely there will ever be another satellite that matches the outstanding longevity of Landsat 5."

The more than 2.5 million images that Landsat 5 has transmitted include photographs of the 1980 Mount Saint Helens eruption site in Washington state, the 1986 Chernobyl nuclear power plant disaster in the Soviet Union, the Kuwaiti oil fires of 1991, urban growth around the world, Antarctica, and global crop production.

Landsat 7, launched in 1999 with an expected 5-year design life, will be the only operational satellite in the series until the liftoff of Landsat 8—called the Landsat Data Continuity Mission (LDCM)—which is scheduled for 11 February 2013. In preparation for the launch, LDCM arrived at its launch site at Vandenberg Air Force Base, Calif., on 26 December.

LDCM carries the Operational Land Imager and the Thermal Infrared Sensor. "Both of these instruments have evolutionary advances that make them the most advanced Landsat instruments to date and are designed to improve performance and reliability to improve observations of the global land surface," said Ken Schwer, LDCM project manager at NASA's Goddard Space Flight Center in Greenbelt, Md.

NASA and the U.S. Department of the Interior, through USGS, jointly manage the Landsat program. For more information, see <http://landsat.usgs.gov> and <http://www.nasa.gov/Landsat>. —RS

Call for tighter coal ash disposal standards More than 200 million tons of coal ash and scrubber sludge were deposited from coal plants into ponds or landfills between 2009 and 2011, according to a 21 December report by the Environmental Integrity Project (EIP), a nonprofit organization based in Washington, D. C. EIP issued the report to mark the fourth anniversary of the dike rupture at the Tennessee Valley Authority's Kingston Fossil Plant, which spilled an estimated 1.1 billion gallons of coal fly ash slurry into the Tennessee River system on 22 December 2008. EIP called for the U.S. Environmental Protection Agency (EPA) to issue ash disposal standards.

The report, which the group notes is based on industry figures submitted to EPA's Toxics Release Inventory database, identifies 44 U.S. facilities that reported disposing of significant amounts of arsenic and other toxic metals from 2009–2011. For more information, see <http://www>

environmentalintegrity.org/news_reports/12_21_2012.php. —RS

EPA releases progress report on hydraulic fracturing study The U.S. Environmental Protection Agency (EPA) provided a 21 December progress report on its ongoing national study about the potential impacts of hydraulic fracturing on drinking water resources. The agency said that a draft of the congressionally requested study will be released in 2014 for public and peer review and that its progress report does not draw conclusions about the potential impacts of hydraulic fracturing, often referred to as fracking.

"Responsible development of America's oil and gas resources offers important economic, energy, security, and environmental benefits. However, as the use of hydraulic fracturing has increased, so have concerns about its potential human health and environmental impacts, especially for drinking water," the progress report states.

As part of this report, the agency released updates on 18 research projects underway to help answer a number of questions related to fracking.

The study, dubbed a Highly Influential Scientific Assessment, will receive EPA's highest level of peer review, according to the agency. EPA also said that its science advisory board is forming a panel of independent experts to review and provide input about the study to the agency. For more information, see <http://www.epa.gov/hfstudy> and <http://yosemite.epa.gov/sab/sabpeople.nsf/WebCommittees/BOARD>. —RS

Fire activity increasing as climate changes Analysis of images from NASA's Moderate Resolution Imaging Spectroradiometer (MODIS) satellites shows that more than 2.5 million hectares were burned in 2012 from January through August in the United States. The amount is less than a record

3.2 million hectares in 2011 but greater than the area burned in 12 of 15 years since satellite monitoring began, scientists reported at the AGU Fall Meeting. With satellites "we can detect fires as they're actively burning," said Louis Giglio of the University of Maryland, College Park, at a press conference on 4 December. "We can also map the cumulative area burned on the landscape after the fire's over." He noted that "2012 has been a particularly big fire year" in the United States.

The rising fire activity has increased carbon dioxide emissions in recent years. Chris Williams of Clark University in Worcester, Mass., and his colleagues used satellite data on a charred area to calculate the amount of biomass burned and thereby estimate how much carbon was emitted into the atmosphere as a result. He reported that carbon dioxide emissions from wildfires in the western United States have increased from an average of 8 teragrams per year during 1984–1995 to an average of 20 teragrams per year during 1996–2008. "There's been more than a doubling of the carbon impacts of these fires," said Williams.

Models also predict an increase in fire activity in the next several decades. Doug Morton of NASA's Goddard Space Flight Center noted that dryness during fire season and the total burned area both increased between 1980 and 2010. "Climate has made the U.S. more susceptible to fires," he said. In the future that is likely to continue. Under both a high-emissions scenario and a low-emissions scenario, model projections show an increase by 2050 in both the length of the fire season and the frequency of extreme events, though that increase would happen more rapidly in the high-emissions scenario, Morton said. —EB

—ERNE BALCERAK and RANDY SHOWSTACK, Staff Writers

Ocean Networks

cont. from page 18

measured every 6 hours. Because of the profiler's location, onboard sensors track transitions from downwelling to upwelling conditions, the supply of inorganic nutrients to the surface, and variability of nutrient-rich undercurrents.

Hydrothermal Vent Turbulence

Because flux studies require measurement of time series, little is known about heat, chemical, and biological fluxes from the crust into the ocean via hydrothermal vents. An unprecedented time series of plumes imaged in three dimensions as they rose above black smokers was captured from diffuse vents at NEPTUNE's Endeavour field area using the new Cabled Observatory Vent Imaging System (COVIS) [Rona and Light, 2011]. These data measured suspended sediment backscatter intensity and black smoker temperature fluctuations, which describe the buoyant plume's size and shape. Their Doppler phase shift defined flow rise velocity, and their scintillation helped to image diffuse flow from the seafloor. These observations suggest the ratio of flow from black smokers compared with diffuse flow is about 20 times larger than previous estimates [Di Iorio et al., 2012].

Expanding to Other Disciplines: Forensics

The underwater cameras of VENUS are being used to study the decomposition of pig carcasses, lowered to the seafloor within a protective cage and unprotected in 95-meter-deep water in Saanich Inlet. A pig carcass is commonly used as proxy for human remains in forensic research. Results revealed strong effects of ocean chemistry on carcass degradation and microbial colonization [Anderson, 2010].

Citizen Science

Digital Fishers (<http://digitalfishers.net/>) is a citizen science portal for video interpretation. Because software cannot yet automatically identify marine life forms and seafloor features, ONC's large video data set requires human eyes to view and annotate videos for identification of marine life and seafloor features. Digital Fishers allows anyone in the world to explore and document the ocean videos. NEPTUNE's *Marine Life Field Guide*, an e-book available from Apple, provides an identification list of species observed on the network's underwater

cameras for use by scientists and citizen scientists. Using such data, two NEPTUNE campaigns recently showed how species distributions and occurrences change over time for sablefish and thornyhead rockfish (see campaign results at <http://digitalfishers.net/?p=427>).

Acknowledgements

Operations of NEPTUNE Canada and VENUS are supported by major funding from the Canada Foundation for Innovation and the province of British Columbia and support from the University of Victoria, Natural Resources Canada, Fisheries and Oceans Canada, Natural Sciences and Engineering Research Council, and Canada's Advanced Research and Innovation Network.

References

- Anderson, G. (2010), Decomposition and invertebrate colonization of cadavers in coastal marine environments, *Current Concepts in Forensic Entomology*, edited by J. Amendt et al., pp. 223–271, Springer, Dordrecht, Netherlands.
- Di Iorio, D., J. W. Lavelle, P. A. Rona, K. Bemis, G. Xu, L. N. Germanovich, R. P. Lowell, and G. Genc (2012), Measurements and models of heat flux and plumes from hydrothermal discharges near the deep seafloor, *Oceanography*, 25(1), 168–179, doi:10.5670/oceanog.2012.14.
- Edwards, R. N. (1997), On the resource evaluation of marine gas hydrate deposits using seafloor transient electric dipole-dipole method, *Geophysics*, 62(1), 63–74.
- Edwards, R. M., K. Schwalenberg, E. C. Willoughby, R. Mir, and C. Scholl (2010), Marine controlled-source electromagnetics and the assessment of seafloor gas hydrate, in *Geophysical Characterization of Gas Hydrate*, edited by M. Riedel, E. C. Willoughby, and S. Chopra, pp. 149–160, Soc. of Explor. Geophys., Tulsa, Okla.
- Lintern, D. G., and P. R. Hill (2010), An underwater laboratory at the Fraser River delta, *Eos Trans. AGU*, 91(38), 333.
- Ludwin, R. S., C. P. Thrush, K. James, D. Buerge, C. Jonientz-Trisler, J. Rasmussen, K. Troost, and A. de los Angeles (2005), Serpent spirit-power stories along the Seattle fault, *Seismol. Res. Lett.*, 76(4), 426–431.
- Matabos, M., V. Tunnicliffe, S. K. Juniper, and C. Dean (2012), A year in hypoxia: Epibenthic community responses to severe oxygen deficit at a subsea observatory in a coastal inlet, *PLoS ONE*, 7(9), e45626, doi:10.1371/journal.pone.0045626.
- Robert, K., and S. K. Juniper (2012), Quantifying megafaunal surface bioturbation using cameras on the NEPTUNE Canada cabled observatory: Observational protocol development and Bayesian modeling, *Mar. Ecol. Prog. Ser.*, 453, 137–149.

Rona, P., and R. Light (2011), Sonar images of hydrothermal vents in seafloor observatory, *Eos Trans. AGU*, 92(20), 169.

Thomsen, L., C. Barnes, M. Best, R. Chapman, B. Pirene, R. Thomson, and J. Vogt (2012), Ocean circulation promotes methane release from gas hydrate outcrops at the NEPTUNE Canada

Barkley Canyon node, *Geophys. Res. Lett.*, 39, L16605, doi:10.1029/2012GL052462.

—KATE MORAN, Ocean Networks Canada, University of Victoria, Victoria, Canada; E-mail: kmoran@uvic.ca

Call for Participation in



CHIKYU+10

International Workshop
21-23 April, 2013, Tokyo

The Japan Agency for Marine-Earth Science and Technology (JAMSTEC) announces a decadal planning workshop for the deep-sea drilling vessel *Chikyu* (www.jamstec.go.jp/index.html). Beginning in October 2013, *D/V Chikyu* (www.jamstec.go.jp/chikyu/eng/CHIKYU), a unique resource for ocean and Earth science, will continue deep drilling, logging, and observatory deployment beneath the world's oceans for the new International Ocean Discovery Program, IODP (www.iodp.org/new-program).

The international workshop CHIKYU+10 invites researchers to discuss priority projects for *D/V Chikyu*'s next decade of exploration. The workshop will be held 21-23 April 2013 in Tokyo with assistance from IODP Management International. Thematic discussions will highlight *D/V Chikyu*'s accomplishments within the current IODP framework, current science proposals to use *D/V Chikyu*'s deep riser capability, new ideas to be submitted as white papers, and inspiring keynote talks. CHIKYU+10 will emphasize participation by early career researchers.

The Steering Committee has identified five workshop themes (Active Faults, Earth's Mantle, Deep Life, Continent Formation, Sediment Secrets) as well as a "Blue Sky" area for new ideas. Short white papers related to these themes will be accepted until 31 January 2013. Participant travel support is under discussion by JAMSTEC and other national and consortium IODP sponsors. Registration, application for travel support, and submission of white papers will open on 7 January 2013. The final agenda will be published by 1 March 2013.

Please visit the workshop website for explanation of themes and more details:

<http://www.jamstec.go.jp/chikyu+10/index.html>



Recognizing Innovation

Winners for the 5th Award (2012)

The **Creativity Prize** is awarded to the team led by Dr. Ashok Gadgil (University of California, Berkeley) for developing an innovative and effective method to treat the arsenic contamination of groundwater using electrocoagulation. Team members include: Dr. Susan Addy, Dr. Robert Kostecki, Dr. Joyashree Roy, and Case van Genuchten.



The **Surface Water Prize** is awarded to the team led by Dr. Kevin Trenberth (National Center for Atmospheric Research, USA), which includes Dr. Aiguo Dai, for groundbreaking work that provides a powerful estimate of the effects of climate change on the global hydrological cycle, with a clear explanation of the global water budget.



The **Groundwater Prize** is awarded to the team lead by Dr. Charles Franklin Harvey (Massachusetts Institute of Technology), which includes Dr. Abu Borhan Mohammad Badruzzaman, for developing a complete diagnostic and conceptual model for understanding and preventing the arsenic contamination of groundwater.



The **Alternative Water Resources Prize** is awarded to Dr. Mohamed Khayet Souhaimi (University Complutense of Madrid, Spain) for his work in pioneering and promoting membrane distillation for water recovery using alternative renewable energy sources.



The **Water Management & Protection Prize** is awarded to Dr. Damià Barceló (Catalan Institute for Water Research, Spain) for work at the leading edge of water science in understanding the effect of pharmaceuticals in the water environment and developing new methods for future risk assessment and management of emerging contaminants.



The awards ceremony for the 5th Award was held in Riyadh on 6 January 2013, concurrently with the 5th International Conference on Water Resources and Arid Environments (ICWRAE 5), which was held from 7-9 January 2013.

Nominations are open for the 6th Award.

Nominations can be made online until 31 December 2013.

www.psipw.org email: **info@psipw.org**

MEETINGS

Capacity Building for Sustainable Marine Research in the Asia-Pacific Region

Needs Assessment for Capacity Development for Integrated Marine Biogeochemistry and Ecosystem Research in the Asia-Pacific Region; Shanghai, China, 31 July to 4 August 2012

An international workshop on capacity building (CB) for marine research in the Asia-Pacific region (<http://www.imber.info/index.php/Science/Working-Groups/Capacity-Building/2012-CB-Workshop>) was held at the East China Normal University (ECNU), in Shanghai, China. The workshop brought together about 20 marine researchers and CB experts from 14 countries to discuss CB experiences, assess regional CB needs, and consider recommendations to improve regional CB, which would be of interest to other groups and other geographical regions.

Innovative marine research requires the integration of disciplinary skills, advanced observational techniques, and state-of-the-art infrastructure. This workshop aimed to facilitate such integration and the access to existing global marine research resources and to support marine researchers in the Asia-Pacific region in their contributions to the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) project for both regional and international success.

Participants presented their past experiences with CB activities and identified regional CB gaps and opportunities. Breakout groups focused on three topics: (1) marine CB needs and challenges identified in the region with relevance to global context, (2) how marine CB could be improved in the region, and (3) what the IMBER project could do to advance its CB globally.

The synthesis prepared during the workshop demonstrated that current regional CB efforts (e.g. <http://westpac.unescobkk.org>) do not cater to the tremendous marine research needs (matrix 2 on the workshop Web page). Three marine research topics require top CB priority: climate change impacts, ecosystem health, and food security. Capacity development for integrated (e.g., sustainable fisheries management) and transdisciplinary (e.g., predictions of ecosystem response to climate change) marine research needs much attention at national and regional levels. The major challenges of the regional CB activities include (1) sustained funding support for research and equipment in national and regional programs; (2) infrastructural and policy-relevant support in key marine research areas; and (3) attracting postgraduate students and early-career researchers into marine science-related careers,

providing opportunities for the development of young professionals and mitigating regional brain drain (i.e., migration of intellectual resources from developing countries to developed countries) through development policies.

The following recommendations were proposed to help enhance the regional marine research capacity:

1. **Building Platform.** IMBER was invited to help build a regional CB platform, targeting the aforementioned regional research priorities in collaboration with relevant institutions, e.g., Scientific Committee on Oceanic Research, Intergovernmental Oceanographic Commission Subcommission for the Western Pacific, and Partnership for Observation of the Global Oceans.

2. **Promoting Globalization.** Shifting the locations of CB activities from region to region with particular skew to developing countries will help promote regional research contributions and regional CB efforts.

3. **Sustaining Network.** Building a community of practice with senior researchers and educators and facilitating the emergence of new research generation focusing on marine research in this region are essential. An IMBER-related mentoring program and alumni network for early-career researchers would help strengthen the regional marine research community.

Examples of existing international and regional CB resources were listed (see workshop Web site). Potential incentives (e.g., career advancement, network development, and facilitated resources sharing) and dedicated financial resources for CB activities targeting the regional needs were also discussed and should be explored by IMBER and the relevant marine research communities.

The workshop was initiated by the IMBER Capacity Building Task Team and financially supported by IMBER, Asia-Pacific Network for Global Change Research, and ECNU.

—LIUMING HU, Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) Regional Project Office, Shanghai, China; E-mail: liumingh@sklec.ecnu.edu.cn; BERNARD AVRIL, IMBER International Project Office, Bergen, Norway; and JING ZHANG, East China Normal University (ECNU), Shanghai, China

Studying Hydrological Properties and Processes at Scales From Centimeters to Watersheds

SEG-AGU Hydrogeophysics Workshop; Boise, Idaho, 8–11 July 2012

The Hydrogeophysics Workshop, jointly sponsored by the Society of Exploration Geophysicists and the American Geophysical Union (AGU), was held in Boise, Idaho. The workshop was organized to bring together the international hydrogeophysics community to discuss current approaches for determining, predicting, and studying hydrological properties and processes in both the saturated and unsaturated zones, at scales ranging from centimeters to watersheds.

Many advances in the field of hydrogeophysics are closely tied to the availability of instrumentation capable of making field measurements at the appropriate levels of spatial and temporal resolution. Considerable interest was generated at the meeting by recent advancements in both surface-based and logging nuclear magnetic resonance (NMR), which offer new ways of obtaining estimates of water content and hydraulic conductivity.

Substantial improvements in geophysical data analysis and inversion techniques have occurred over the past 5 years. Full waveform inversion of ground-penetrating radar data, for example, can now provide images of decimeter-scale subsurface structural heterogeneity. For spectral induced polarization and NMR, methods are now established that allow the estimation of hydraulic conductivity at the sample/core scale within one order of magnitude.

Integration of hydrological and geophysical data, at various stages of data analysis and inversion, can significantly improve scientists' ability to both conceptualize and parameterize hydrological models. Airborne electromagnetic surveys were highlighted as representing an important recent advance for improving conceptual models of the structure of aquifer systems. Another area of research that has seen considerable recent progress is coupled inversion, whereby time-lapse geophysical data are inverted directly for hydrological properties through the linking of geophysical and hydrological process models.

The assessment and communication of uncertainty remains a critical challenge in all forms of hydrogeophysics research.

Recent computational and algorithmic advancements mean that stochastic methods such as Markov chain Monte Carlo are now feasible for low-dimensional hydrogeophysical problems. In higher dimensions, parameter reduction strategies, improved prior information, and mixed deterministic-stochastic approaches may offer solutions.

Notable to all at the workshop was the growing focus in hydrogeophysics on characterizing structure and properties at the watershed scale. An emerging area of current research is thus the challenge of moving between various scales of measurement.

As participants discussed the future of hydrogeophysics, there was general agreement that the ongoing success and advancement of the field requires continued engagement and communication with the rest of the hydrogeological community. There are also educational challenges and opportunities in mentoring the next generation of hydrogeophysicists. As evidenced at the workshop, the continuously increasing complexity of hydrogeophysical concepts and approaches intertwines various disciplines/subjects including geophysics, hydrology, petrophysics, geostatistics, inverse theory, etc. Reflecting on all that is involved in hydrogeophysics was an ideal way to end the meeting, with a commitment to continue working together across disciplinary and international boundaries in this important field of Earth sciences.

Funding for the workshop was received from the Hydrology Program of the National Science Foundation (grant EAR 1239074), Geometrics, GeoTomo, Mt. Sopris, Zonge International, Vista Clara, Geotomographie, Sensors and Software, Advanced Geosciences Inc., and Geonics. We thank the numerous other workshop participants who contributed to the preparation of this meeting summary.

—ROSEMARY KNIGHT, Geophysics Department, Stanford University, Stanford, Calif.; E-mail: rknight@stanford.edu; JAMES IRVING, Faculty of Geosciences and Environment, University of Lausanne, Switzerland; and JAN VAN DER KRUK, Forschungszentrum Juelich, Germany

The Evolution of the Lunar Highlands Crust: A Complicated History

Second Conference on the Lunar Highlands Crust; Bozeman, Montana, 13–15 July 2012

More than 30 years after the first Lunar Highlands Crust conference, lunar petrology and remote sensing experts from around the world gathered to discuss and debate the formation and evolution of the lunar highlands crust. Huge strides in orbital remote sensing have enabled researchers to put the samples gathered during the Apollo missions into a larger, global context, yet many of the original, key questions remain. What was the extent and fate of the lunar magma ocean (LMO)? What is the nature of the lower lunar crust? Do lunar sample ages still suggest that the inner solar system was subject to an increase in impact flux around 3.9 billion years ago? At the heart of these questions is the desire to understand not only the formation and evolution of the Moon but of Earth, the terrestrial planets, and the inner solar system as a whole.

A field trip to the Stillwater layered mafic intrusion set the stage for the conference, fostering discussions in an informal setting and providing a reminder of the complexities and heterogeneity of a much smaller analog to the lunar highlands crust. Over the next 3 days, lunar researchers worked to integrate petrological research, empowered by advances in analytical technologies, with newly gathered remote sensing data of the Moon. The meeting opened with a discussion of cratering and the lunar megaregolith, including a sneak peek at new gravity results from the most recent mission to the Moon, the Gravity Recovery and Interior Laboratory (GRAIL).

The geophysical discussion was followed by an extensive review of the character of the composition of the anorthositic crust and the small amounts of iron-bearing minerals associated with it. In the LMO model,

anorthosite began to form after 70–80% of the ocean had crystallized, and being less dense than the remaining iron-rich liquid, it would have floated to form the primitive lunar crust. Apollo samples, as well as models, suggest that the small amounts of mafic minerals trapped at this stage would be iron rich. However, new research based on near-infrared spectral data from Japan's Kaguya mission indicate that the mafic minerals associated with anorthosites become increasingly magnesian toward the lunar far side. Feldspathic lunar meteorites have also been discovered that are also significantly more magnesian than the ferroan anorthosites returned by the Apollo missions. A further wrinkle presented by both the Moon Mineralogy Mapper and Kaguya teams is that the purest anorthosite was excavated in the peak rings of lunar basins rather than the more mafic lower crust that was anticipated.

Despite these discoveries, which might seem counter to the global magma ocean model, the overall evidence for the LMO remains strong. But, as might be expected, post-LMO magmatism coupled with 4.5 billion years of impact gardening has produced a complex and intriguing lunar rock record. It is critical that the interdisciplinary discussions promoted by this workshop-style meeting continue. Evidence from sample studies and orbital data must be integrated and reconciled if scientists are to build a cohesive and comprehensive understanding of lunar formation and evolution.

—RACHEL KLIMA, Planetary Exploration Group, Johns Hopkins University Applied Physics Laboratory, Laurel, Md.; E-mail: Rachel.Klima@jhuapl.edu

Meetings cont. on page 22

AGU MEETING OF THE AMERICAS

Cancun, Mexico | 14–17 May 2013

ABSTRACT SUBMISSION SITE NOW OPEN!

Deadline:

6 February, 11:59 p.m. EST

Abstract submission policies and guidelines posted at moa.agu.org

AGU galvanizes a community of Earth and space scientists that collaboratively advances and communicates science and its power to ensure a sustainable future.

012-1009



Meetings

cont. from page 21

What Do We Know About Calderas?

4th International Workshop on Collapse Calderas; Bolsena, Italy, 23–29 September 2012

The International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI) Commission on Collapse Calderas organized its fourth workshop in the Vulsini Calderas District, Italy (<http://www.gvb-csic.es/CCC.htm>). Vulsini includes the Bolsena and Latera calderas, formed in the past 0.6 million years. It is a famous type locality where fundamental concepts concerning caldera collapse and eruptive dynamics have been proposed.

Calderas are subcircular depressions in volcanic areas resulting from magma chamber roof collapse when magma is withdrawn. They are usually associated with significant and long-lasting magmatic systems responsible for major eruptions. These areas often undergo unrest, accompanied by surface deformation, seismicity, and gas emission. Because of the hazards they may pose, calderas are among the most studied volcanic features. The aims of the workshop were to (1) provide an overview of the state of the art of different aspects related to calderas, (2) encourage interaction among researchers with different backgrounds, and (3) present appropriate field cases to test and compare models and ideas. The workshop consisted of 2 days of oral and poster presentations, 3 days of field excursions, and a final discussion.

The outcome of the workshop was summarized in its final discussion. Scientists know the most about the depositional features of the products of caldera-forming eruptions and recently have learned more about structural and evolutionary features of calderas and their relationships to eruptions. However, other aspects are less constrained, and it is expected that future research will be devoted to their further development.

A major limitation is the fragmented and incomplete knowledge of the relationships

between magma chambers, eruptions, and caldera collapses, including postcaldera resurgence. For example, under which conditions does a magma chamber initiate a caldera? What drives resurgence? Scientists need to improve understanding of the geology and dynamics of reservoirs and magmatic intrusions in general.

Another major limitation concerns the poor understanding of the state of unrest of calderas; here a pressurized hydrothermal system, usually hosted within the caldera infill and heated by the magma below, may mask any magmatic signature of the unrest, amplifying surface deformation, seismicity, and degassing. Better understanding of the dynamics of magmatic and hydrothermal systems, including interpretation of monitoring data during unrest episodes at calderas, is crucial to assess whether the unrest will culminate in an eruption or not; this understanding would improve forecasting approaches. Finally, the investigation and exploitation of the geothermal resources offered by many calderas should be stimulated, both for economic purposes and to better image the subsurface structure and dynamics of calderas.

Improvement in these research lines may be provided by collaboration between experts in magmatic intrusions and hydrothermal and caldera monitoring systems as well as from the development of an updated and complete database, particularly focused on unrest episodes at calderas.

—VALERIO ACOCELLA, Dipartimento Scienze Geologiche Roma Tre, Rome, Italy; E-mail: acocella@uniroma3.it; ADELINA GEYER, Institute of Earth Sciences, Consejo Superior de Investigaciones Científicas (CSIC), Barcelona, Spain; and NOBUO GESHI, Geological Survey of Japan, Tsukuba Ibaraki, Japan

ABOUT AGU

Member Engagement Is Key to Our Success: A Note From AGU's New President, Carol Finn

Carol Finn has been a member of AGU since 1980. She currently serves as a senior research geophysicist with the U.S. Geological Survey, and her major research interests include geological interpretation of potential field data, volcano hazards, and tectonics. Finn received her B.A. in geology from Wellesley College, her M.S. in geophysics from the University of Colorado, and her Ph.D. in geophysics from the University of Colorado. She is a member of the Department of Geological Sciences Advisory Board for the University of Colorado and a fellow of the Geological Society of America, and she has written 54 refereed publications—half in AGU journals. Below are a few words from Finn as she starts her new position as AGU president.

I joined the AGU Earth and space science community as a 22-year-old green-haired graduate student eager to experience excellent, societally relevant science, to network, and to find role models. At my first Fall Meeting, I was inspired by the community of scientists, ranging from fellow graduate students to luminaries, who were engrossed, excited, and motivated by their science. Imagine my surprise when I was singled out not just for my green hair but also to join the Budget and Finance Committee!

This was the beginning of my volunteer service at AGU. My time on the Budget and Finance Committee was followed by assignments on the Statutes and Bylaws Committee. I served as General Secretary from 2006–2010, at which time I worked with many members on strategic planning, forming our new governance model and hiring our new chief executive Chris McEntee.

Three years ago, when I was asked to run for president of AGU, I saw an opportunity to continue to give back to the community that had supported and inspired me professionally and personally. Being elected president was a huge honor—a gift and the chance of a lifetime—and I was thrilled to continue working on the plans that had been made to shape AGU's path forward.

During my time as president-elect/chair of AGU's Council, we forged a new way of working, advancing AGU's science in the areas of publishing, meetings, outreach, and honors and recognition. We developed an effective way to work together as a large and diverse group of scientists and to elicit new ideas, such as the interdisciplinary SWIRL sessions at the 2012 Fall Meeting. We also provided scientific input on critical decisions, such as our new publishing partnership with Wiley, and we enabled AGU to be more nimble and to act quickly and clearly on behalf of you, our members.

The next few years will be a thrilling time for AGU as we work toward our vision of galvanizing the Earth and space science community to collaboratively advance and communicate science and its power to ensure a sustainable future. I see us continuing our scientific excellence through robust strategic planning



(left) Incoming AGU President Carol Finn receives her presidential gavel, inscribed with her name and term, from (right) outgoing AGU President Mike McPhaden.

processes that support and foster innovation in our journals and meetings. I also see us expanding our efforts to encourage member engagement and, through training opportunities, mentoring programs, and other resources, to facilitate members' efforts to communicate their science to broad audiences.

AGU is a broad and complex organization, and our leadership should represent and celebrate that diversity. I am fully committed to ensuring that our volunteer leadership is representative of the diversity of career stages, job types, areas of science, geography, gender, and ethnicity that compose our membership. One of my proudest moments as president-elect was when we added six new positions to the Council specifically for student and early-career scientists.

In the same way that we are committed to ensuring broad diversity with the AGU governance structure, we are also committed to better weaving it into our honors program. As I was reminded by a group of students at the 2012 Fall Meeting, it is essential that

About AGU cont. on next page

What's on the Web?

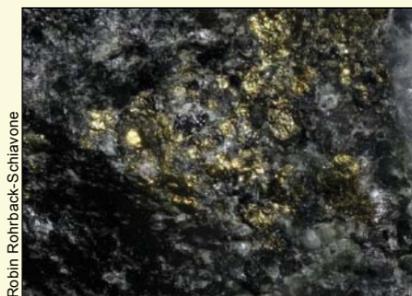
Read the latest offerings from the AGU Blogosphere:

The Landslide Blog: "Four landslide videos for Christmas" (<http://goo.gl/NBRky>)

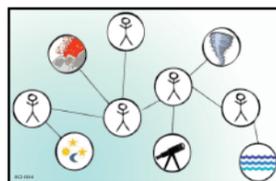
Mountain Beltway: "More GigaPans from the M.A.G.I.C. project" (<http://goo.gl/axPV2>)

Magma Cum Laude: "5 years already?!" (<http://goo.gl/RmB3H>)

Dan's Wild Wild Science Journal: "Images of the big Christmas storm" (<http://goo.gl/OLya0>)



A small section of a GigaPan photo of an Archean conglomerate with detrital pyrite, posted on the Mountain Beltway blog.



SHARE YOUR SCIENCE

sharingscience.agu.org



AGU CHAPMAN CONFERENCE

Snow Mountain Ranch, Colorado, USA | 8–13 June 2013

COMMUNICATING CLIMATE SCIENCE: A HISTORIC LOOK TO THE FUTURE

The conference will bring together scientists, social scientists, and journalists to discuss both the history and recent advances in the understanding of climate science and how to communicate that science to policy makers, the media, and society.

ABSTRACT SUBMISSION DEADLINE: 5 February, 11:59 p.m. EST

For more information on submission policies and guidelines, the program, conveners, registration, and housing details, visit:

chapman.agu.org/climatescience/



Student Travel Grants

AGU MEETING OF THE AMERICAS

Cancun, Mexico | 14–17 May 2013

Want to go to the Meeting of the Americas in Cancun this May?

Apply for a Student Travel Grant to get you there!

Application Due: February 15

To apply, visit education.agu.org/grants



About AGU

cont. from page 22

every member—and every potential member—have a role model in the organization with whom to identify and connect.

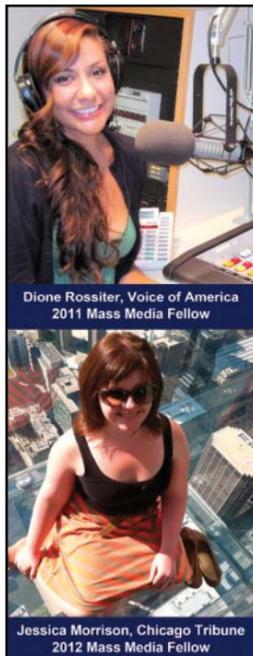
I want to see us focus on ensuring diversity in the types of awards we give and the nominations we receive, as well as in the committees and task forces charged with selecting the winners. By doing this, we will not only improve our ability to adequately recognize the amazing work being done by AGU members, from luminaries to up-and-comers around the world, but we will also create a more inclusive pool of role models to inspire the next generation of Earth and space scientists.

I am also really excited about the Thriving Earth Exchange, which promises to be a vehicle to apply our excellent science to critical problems facing society. Through the Thriving Earth Exchange, AGU will become a driving force toward allowing scientists to more easily apply their expertise for specific and lasting societal benefit. It will do this by connecting communities seeking solutions to societal challenges with AGU members

ready to design solutions and sponsors willing to provide the funds to achieve those solutions. You will be hearing much more about this project in the coming months.

A focus of my presidency for the next 2 years is to engage the members with AGU programs, with one another to improve networking and collaboration, and with members of the community, policy leaders, and society at large to communicate the excitement, importance, and benefit of our science. I invite you to step forward and participate not only in the scientific enterprise of your specialty but also with other disciplines and the public. Only together, as a community of dedicated volunteer leaders, talented staff, and an engaged and energized membership, can we achieve our vision for AGU as an authoritative source for Earth and space science and a source of solutions for society's pressing issues.

—CAROL FINN, President, AGU, E-mail: president@agu.org

**JOURNALISM FELLOWSHIP OPPORTUNITY**

Are you a student or post-doc interested in working as a science reporter? Each summer, AGU sponsors one Earth or space scientist's fellowship in a newspaper, radio or TV newsroom as part of the AAAS Mass Media Fellows program. Past fellows have worked at the National Public Radio, CNN, U.S. News & World Report, and more.

Application Deadline: January 15

To apply now, visit www.aaas.org and search for keywords "mass media fellowship application."

012_1029

**AGU CONGRESSIONAL SCIENCE FELLOWSHIP****Application Now Open**

As an AGU Congressional Science Fellow you will be assigned to the staff of a member of Congress or a congressional committee with duties that may include drafting legislation, organizing congressional hearings, meeting with lobbyists or constituents, and writing speeches.

Applications due 1 February 2013

For more information and to apply visit www.agu.org and search keywords - **Science Policy Fellowship**.

012_919



Key Largo, Florida, USA | 8–12 April 2013

Causes and Consequences of the Extended Solar Minimum Between Solar Cycles 23 and 24 (4CESM)

The most recent solar minimum provided the scientific community with an exceptional opportunity to assess the nature and structure of a very quiet Sun, a weak solar wind, and an upper atmosphere relatively devoid of solar influences.

The conference will provide a platform for an interdisciplinary discussion to determine the current state of our understanding of the Sun during a protracted minimum and the associated terrestrial effects.

ABSTRACT SUBMISSION DEADLINE: 8 JANUARY, 11:59 p.m. EST

For more information on submission policies and guidelines, conveners, registration, and housing details, visit:

chapman.agu.org/solarminimum/



012-767

**CLASSIFIED****ADVERTISING INFORMATION**

Eos is published every Tuesday, except the last week of December. For a classified or display advertisement to be published in a future issue of *Eos*, electronic copy must reach us by 23:59 eastern time, 9 days prior (Sunday) to publication, except around certain holidays, which have earlier deadlines. No cancellations accepted after deadline.

For inquiries on advertising pricing and availability:

E-mail: advertising@agu.org

Phone: +1-202-777-7536

Facsimile: +1-202-777-7478

POSITIONS AVAILABLE**Atmospheric Sciences****Regional to Global-Scale Earth-System Dynamics.**

In support of its unique program in climate and extreme weather, Purdue University's Department of Earth, Atmospheric, and Planetary

Sciences (EAPS) invites applications for a tenure track faculty position, at the rank of Assistant Professor, in large-scale, Earth-system dynamics. We are particularly interested in candidates who investigate the spatial and/or temporal links between large-scale atmospheric processes and phenomena occurring at local scales. The expectation is that the successful candidate will work across scales, using novel integrative

approaches that range from theoretical to statistical to numerical modeling.

The appointee must have completed a Ph.D. in, or a field related to, the Earth, Atmospheric, or Planetary Sciences at the time of employment. The appointee is expected to develop and maintain a vigorous, externally funded, internationally recognized research program and to teach and mentor students at the undergraduate and graduate levels. Applications will be accepted until March 1, 2013, with applicant screening beginning on January 1, 2013. Additional information on EAPS can be found at <http://www.eaps.purdue.edu>. To apply, submit: (1) a cover letter, including names of three people who may be asked to send letters of reference; (2) a curriculum vita; and (3) statements of research and teaching experience and interests, to thompson@purdue.edu with the subject line "Regional to Global-Scale Earth System Dynamics". A background check is required for employment in this position.

Purdue University is an Equal Opportunity/Equal Access/Affirmative Action employer fully committed to achieving a diverse workforce.

Geochemistry**Analytical Instrumentation Specialist.**

We seek an analytical instrumentation specialist to support research and teaching in the

Department of Earth and Environmental Studies at Montclair State University. The specialist will assist students, faculty, and visitors with sample preparation and analysis using our ICP-OES, ICP-MS, GC/MS, AA, XRD, HPLC, IC, CHNS analyzer, and ancillary equipment. The successful applicant will have experience working with a wide range of geologic and environmental materials, experience with operation and maintenance of ICP instruments and one or more of the instruments listed above, experience overseeing chemical hygiene and safety, and possess excellent communication and interpersonal skills. A Masters degree in a STEM discipline and at least 3 years of experience is required. Strong knowledge of computers and electronics is highly desirable. Electronic applications are preferred, and should consist of one single PDF or .doc file that includes a CV, statement of technical skills, description of research and laboratory management experience, and the names and contact information for at least three references. Send electronic applications to brachfelds@mail.montclair.edu. Hardcopies can be sent to Dr. Stefanie Brachfeld, Department of Earth and Environmental Studies, Montclair State University, Montclair, NJ 07043. Review of applications will begin on January 28, 2013.

Classified cont. on page 24



University of Victoria

School of Earth and Ocean Sciences

TENURE-TRACK ASSISTANT PROFESSOR POSITION IN GEOLOGY

The School of Earth and Ocean Sciences at the University of Victoria invites applications for a Tenure Track Assistant Professor position in Geology to begin July 1st 2013. We seek applicants who work with the stratigraphic/sedimentary record. This could include sedimentary geochemistry, paleoclimate studies, surface/lithosphere structure, tectonics and geodynamics, and basin analysis. The successful candidate will develop a vigorous, independent, externally funded research program that complements our existing strengths by integrating fieldwork, laboratory analyses, and/or experiments and numerical modeling. It is also expected that the candidate will mentor graduate students and teach undergraduate and graduate courses, including geological field schools. A Ph.D. is required at the time of appointment and post-doctoral experience is desirable.

Applicants should submit a letter of application, CV, contact information (name, address, fax, e-mail) for three references, a two-page statement describing their teaching experience and philosophy, and a two page statement describing their current and future research direction. Applications should be sent to Dr. Stephen T. Johnston, Director, School of Earth and Ocean Sciences, University of Victoria, P.O. Box 1700, STN CSC, Victoria, B.C. V8W 2Y2, Canada; fax: 250-721-6200; email: seos@uvic.ca. Review of applications will begin on March 1, 2013, and continue until a suitable candidate is identified. Information about the department can be found at <http://www.seos.uvic.ca/>

The University of Victoria is an equity employer and encourages applications from women, persons with disabilities, visible minorities, Aboriginal Peoples, people of all sexual orientations and genders, and others who may contribute to the further diversification of the University. All qualified candidates are encouraged to apply; however, in accordance with Canadian Immigration requirements, Canadians and permanent residents will be given priority.

**Senior Arctic Marine Scientist
Senior Lecturer/Reader**

Salary up to £55k depending on experience



We seek to appoint a senior Arctic marine scientist in any discipline to join our active Arctic research group and contribute to furthering SAMS' capability and reputation as a leading UK centre for Arctic marine research and expertise. You will be a high-calibre scientist with a record of high-impact research publications, have a history of successful grant capture, and be engaged in national and international networks. You will have a commitment to excellence in undergraduate and postgraduate education and a track record of successful postgraduate training and supervision. Exceptional candidates may be considered for a Chair. The position is permanent and is based at the Scottish Association for Marine Science near Oban, on the west coast of Scotland.

For further information and to apply for this position online, go to: www.sams.ac.uk. Alternatively, please write to: Human Resources, Senior Arctic Marine Scientist (Job Ref.D25/12.RL), The Scottish Association for Marine Science, Scottish Marine Institute, Oban, Argyll, PA37 1QA or e-mail recruitment@sams.ac.uk

The closing date for receipt of applications is Friday 25th January 2013

SAMS is a registered Scottish charity (SC 009206), has an equal opportunities policy and welcomes applications from all sections of the community.



FACULTY POSITIONS: EARTH SCIENCES AND ENGINEERING

The Earth Sciences and Engineering (ErSE) program at King Abdullah University of Science and Technology (KAUST) invites applications for a faculty position at all ranks. Preference will be given to applicants with expertise in subsurface reservoir modeling with a focus on petroleum reservoir modeling, mechanics, structural geology, and the physical behavior of subsurface reservoirs for CO₂ sequestration and enhanced oil recovery; interest in subsurface hydrological modeling is an advantage. Successful candidates should have the ability to lead a high impact research program and have a commitment to teaching at the graduate level. Applicants should apply at the <http://pse.kaust.edu.sa> employment site. Applications received by January 31, 2013 will receive full consideration and the position will remain open until filled.

KAUST is an international, graduate research university dedicated to advancing science and technology through interdisciplinary research, education, and innovation. Located on the shores of the Red Sea in Saudi Arabia, KAUST offers superb research facilities, generous assured research funding, and internationally competitive salaries. The university attracts top international faculty, scientists, engineers, and students to conduct fundamental and goal-oriented research to address the world's pressing scientific and technological challenges related to the sustainability of water, food, energy, and the environment.

The ErSE program, within the Division of Physical Sciences and Engineering <http://pse.kaust.edu.sa>, currently has eight full-time faculty members, over 20 postdocs and research scientists and more than 50 graduate students. Research areas include: applications of modern computational methods to study geophysical problems associated with the atmosphere and/or ocean circulation, earthquakes, oil exploration, reservoir modeling, and subsurface phenomena.

These areas are enhanced through close collaboration with some of the best geophysical and meteorological centers in the world and advanced central research facilities including supercomputing and scientific visualization. More information about the ErSE program and research activities is available at: <http://ese.kaust.edu.sa>.

www.kaust.edu.sa

Classified

cont. from page 24

Montclair State University is an Equal Opportunity/Affirmative Action institution. Additional information can be found on the MSU website at www.montclair.edu. Please go to https://oit-app2.montclair.edu/xfl/hr_jobpostings/details.php?id=278 to view the full job announcement

Assistant Professor Position in Paleoclimatology, Biogeochemistry, Environmental Geochemistry and Carbon Sequestration, Institute of Surficial Geochemistry (ISG), Nanjing University.

The ISG, a Ministry of Education Key Laboratory at Nanjing University, China, is seeking qualified candidates worldwide to fill multiple positions in geology/low temperature geochemistry/atmospheric sciences/marine sciences/environmental sciences/hydrology or any closely related fields. ISG provides a cutting-edge, multi-disciplinary research platform aiming at exploring and developing new approaches and theories, as well as methodologies and their applications to the research of earth's surface system. For assistant professor position, a salary package of 200 thousands RMB annual salary, startup funds and housing bonus is offered.

Applications include a letter of application, curriculum vitae, publication list, summary of academic achievements (within 500 words), statement of future work plans (within 1 page), and two references. For further information and submission of applications, please contact: Dr. Yang Chen (phone: 8625-83686042, email: chenyang@nju.edu.cn).

Petroleum Geochemist - Houston.

ExxonMobil Upstream Research Company has an immediate opening for a Petroleum Geochemist at its Upstream Research Laboratory located in Houston, Texas.

The successful candidate will conduct research and research applications in organic geochemistry. Our investigations focus on developing broad understanding and predictive models of geological processes involved in hydrocarbon systems ranging from deposition and evolution of source rocks, generation, expulsion and retention of oil and gas, and migration, accumulation, and alteration of hydrocarbons. Our research goals are tied to addressing both immediate concerns and emerging trends in exploration, development, and production. Candidates should have the following qualifications:

- A Ph.D. in petroleum geochemistry, analytical chemistry, organic geochemistry or related field.
- Experience in one or more areas pertinent to petroleum geochemistry including but not limited to molecular geochemistry, stable isotope

geochemistry, fluid inclusion analysis, and/or organic petrography.

- Experience in one or more analytical techniques including but not limited to chromatography, mass spectrometry, isotopic analysis, solid-state characterization, and/or organic petrography.
- Creative, adept at team work, and able to drive projects to completion.
- Strong communication, organization, and interpersonal skills.

-Industry or post-graduate experience in petroleum geochemistry and/or experience in integrated hydrocarbon systems analysis including basin modeling would be a plus.

The candidate filling this position will be expected to immediately contribute to on-going projects as well as formulate and direct future endeavors. Collaboration is required with corporation geoscientists and engineers with a broad range of disciplines, including organic geochemistry, stratigraphy, structural and regional geology, hydrocarbon-system integration, analytical chemistry, reservoir engineering, and production engineering.

Please submit your application and resume to our website: www.exxonmobil.com. Please apply to Job No. 16211.

ExxonMobil is an Equal Opportunity Employer

TENURE-TRACK Position Environmental (low temperature) Geochemist Department of Geological Sciences, California State University Long Beach.

Assistant or Associate Professor: Rank and salary depend upon qualifications and experiences. Start date: August 23, 2013.

QUALIFICATIONS: Ph.D. in the Geological Sciences or closely related field and record of successful, grant-supported research in environmental geochemistry with focus on low-temperature fluid-solid earth material interaction. Candidate must be able to communicate effectively with an ethnically and culturally diverse campus community and demonstrate potential for excellence in teaching and for developing and sustaining an independent, externally funded research program involving students. Demonstrated excellence in teaching and a record of published research in environmental geochemistry are desired. The successful candidate will utilize the broad range of analytic instrumentation in the Signal Hill Environmental Geochemistry laboratory and the CSULB Institute for Integrated Research in Materials, Environment, and Society.

For further information, see <http://www.csulb.edu/divisions/aa/personnel/jobs/cnsm/>.

APPLICATION: Review of applications begins January 14, 2013; position open until filled. Send letter of application, CV, statement of teaching/research goals, and three letters of recommendation directly from referees to: Geological Sciences Search Committee, Dept. of Geological Sciences, California State University, Long Beach, 1250 Bellflower Blvd. Long Beach, CA 90840-3902; Telephone: (562) 985-4809; Email: envgeochem@csulb.edu. CSULB is an Equal Opportunity Employer

Hydrology

Visiting Assistant Professor of Hydrology/Hydrogeology at Oberlin College. Full-time non-continuing beginning Fall 2013 for a term of one year to teach five courses in the area of hydrology or hydrogeology with secondary interest in sedimentology or geochemistry. Ph.D. required in hand or by Fall 2013. Send all documents to: Karla Parsons-Hubbard, Geology, Oberlin College, 52 West Lorain Street, Carnegie 403, Oberlin, OH 44074 by 2/08/13. See: <http://new.oberlin.edu/>

Ocean Sciences

ASSISTANT PROFESSOR, CHEMICAL OCEANOGRAPHY The Florida State University.

The Department of Earth, Ocean and Atmospheric Science at Florida State University is seeking applications for a Ph.D.-level chemical oceanographer to fill a nine-month, tenure-earning appointment at the Assistant Professor level to begin as soon as August 2013.

The position involves research, teaching (at the graduate and undergraduate level), and service. The successful candidate will have completed a Ph.D. degree (or equivalent) in chemical oceanography, marine biogeochemistry, environmental chemistry, or a closely related field and will have had post-doctoral research experience. A well-qualified candidate will have a record that reflects their high level of research productivity.

We are particularly interested in a person who will complement our existing strengths in light stable isotopes, microbial biogeochemistry, and trace element cycling (see faculty research at <http://ocean.fsu.edu/Faculty.php>) and who will expand our curriculum by teaching in our Environmental Sciences undergraduate major and in our Chemical Oceanography and Biogeochemistry graduate programs, as described on these web sites:

<http://www.eoas.fsu.edu/Earth-Ocean-and-Atmospheric-Science/Undergraduate-Education/Environmental-Science-Undergraduate-Degrees>
<http://www.eoas.fsu.edu/Earth-Ocean-and-Atmospheric-Science/Graduate-Education>

<http://biogeochem.fsu.edu/>

Women and members of minority groups are especially encouraged to apply. The review of applications will begin immediately and continue until the closing date of January 18, 2013. Please send a pdf of your cover letter, curriculum vitae, research statement, teaching philosophy and contact information for three references to:

Prof. William Landing, Department of Earth, Ocean and Atmospheric Science, Florida State University, Tallahassee, FL 32306-4320; www.eoas.fsu.edu, wlanding@fsu.edu.

Florida State University is a Public Records Agency and an Equal Opportunity-Equal Access-Affirmative Action Employer.

Ocean-climate Modeling PhD Fellowship.

We are seeking PhD applicants to join the Ocean and Climate modeling group in the Department of Earth and Environmental Science of the University of Pennsylvania. Topics of interest include: variability of the global physical climate on various time scales and links with ocean biogeochemistry and ecology; large scale controls of the oceanic sink for atmospheric CO₂; including evolutionary concepts into ecological models and coupling them to global climate models. Please contact Prof. Irina Marinov at imarinov@sas.upenn.edu if interested. Additional information is available on our website at <https://climate.sas.upenn.edu>

Postdoctoral Associates.

The Institute of Marine and Coastal Sciences at Rutgers University is seeking Postdoctoral Associates in the areas of biological, chemical, geological and physical oceanography. Prospective candidates should foster creative research avenues and interactions among existing research programs and faculty expertise. These fellowships are one year renewable appointments. Applications are presently being accepted and evaluated on an ongoing basis. However, applications received by February 15, 2013 will receive the fullest attention. To apply, please email a curriculum vitae, statement of research interest, and names of 3 references to Dr. Richard A. Lutz (Director, Institute of Marine and Coastal Sciences): postdocsearch@marine.rutgers.edu (please include "Postdoc" in the subject line). Rutgers is an Equal Opportunity/Affirmative Action Employer.

Solid Earth Geophysics

Texas A&M University-Kingsville Assistant Professor of Geosciences.

The Department of Physics & Geosciences at Texas A&M University-Kingsville invites applications for a tenure-track, field-oriented Assistant Professor of Geosciences with primary expertise in mineralogy/petrology, and supporting interests in at least one of the following: ore

Classified cont. on page 26



NICHOLAS SCHOOL OF THE ENVIRONMENT
Faculty of Excellence Initiative

The Nicholas School of the Environment at Duke University seeks outstanding scholars with exceptional records or promise of interdisciplinary research, productivity, creativity, vision, and leadership.

The mission of the Nicholas School of the Environment is to create knowledge and leaders of consequence for a sustainable future. Our focus is on leadership in education, research, and service to understand environmental processes, to understand human behavior related to the environment, and to inform society about the conservation and enhancement of our environment and natural resources for future generations. In keeping with our interdisciplinary culture, we seek individuals with exceptional promise or demonstrated leadership whose work spans disciplinary boundaries (earth system science, environmental life sciences, environmental social sciences) on the general themes of **marine science and governance, environmental health, biodiversity and ecosystem services, and energy and the environment.** Applications are strongly encouraged from members of under-represented populations.

Appointments may be made at the Assistant, Associate, or Full Professor level, and may be based at either Duke's Durham NC campus or at the Duke Marine Laboratory in Beaufort NC. We seek candidates with a demonstrated record or exceptional promise of achievement, and leadership in their fields of expertise. Candidates will be expected to teach and mentor students at the undergraduate level, professional master and/or doctoral levels, and to support a vigorous, extramurally funded research program.

Please send a statement of interest, including a summary of research and teaching, a curriculum vitae, and contact information for three referees as a single PDF file to:

Laura Turcotte
ljturco@duke.edu

Applications will be considered as they are received and the search will remain open until positions are filled.

Duke University is an Affirmative Action/ Equal Opportunity Employer.



UNIVERSITÉ DE
NEUCHÂTEL

The University of Neuchâtel, Switzerland, invites applications for a position of

Full or Assistant Professor in Geothermics

Job description: the successful candidate will establish a dynamic research program in fundamental and applied geothermics as part of a competence center for hydrogeology and geothermics. Experts in geological and geophysical exploration, characterization of aquifers and stimulated systems at intermediate/large depth, and hydrothermal/geochemical processes in such systems are particularly encouraged to apply. The successful candidate will foster synergies with focal, national and international partners, contribute to teaching in the BSc and MSc curricula in English and in French after an adaptation period, and participate in administrative tasks.

Starting date: August 1st, 2013 or upon agreement.

Requirements: background in geology/Earth sciences with a PhD degree, as well as an internationally recognized research record in geothermics.

Application file: to be sent by regular mail to the Dean of the Faculty of Science, Prof. Peter Kropf, rue Emile Argand 11, 2000 Neuchâtel, Switzerland, as well as by email (one single pdf file) to doyen.sciences@unine.ch. The applications will include a signed letter of motivation, a curriculum vitae covering the applicant's teaching and research experience, a list of research funds obtained, a list of publications and copies of academic degrees. Applicants will also provide a brief teaching statement (max. 1 page), and a description of the research projects he/she would develop at the University of Neuchâtel (max. 2 pages). The candidate will request three experts to send a signed letter of reference via email directly to the head of the Hiring Committee, Prof. D. Hunkeler daniel.hunkeler@unine.ch.

Application deadline: March 1st, 2013.

The University of Neuchâtel encourages women to apply.

Additional information: Prof. D. Hunkeler daniel.hunkeler@unine.ch or Dean of the Faculty doyen.sciences@unine.ch and www.unine.ch/sciences.

Director of Science and Technology

British Geological Survey

Ref: IRC78650

We are looking to make a senior appointment as Director of Science and Technology to join the BGS Executive team. You will optimise the delivery of BGS science underpinning a science strategy that is tuned to the needs of the Natural Environment Research Council (NERC) the UK government and international collaborators. You will refine and develop the BGS science programme and working in partnerships with numerous stakeholders, ensure BGS delivers national capability in the geosciences and innovative research. You will develop collaborative programmes with universities, research agencies industry and other geological surveys in developing earth and environmental science leading to scientific results that will influence decision making.

You will be an international leader of science and research and have a good general knowledge of areas of geoscience in the present and emerging core mission for BGS. You will have experience of delivering scientific results at the highest level and running complex scientific research programmes. You will be able to provide evidence of high-level communication and negotiation with stakeholders in your area.

If you are interested in the role, please contact Marion Squires – Head of Human Resources – for an informal discussion; she can be contacted on 0115 9363512; e-mail: masq@bgs.ac.uk.

Applications are handled by the RCUK Shared Services Centre; to apply please visit our job board at <http://www.topcareer.jobs/> and up-load your up-to-date c.v. and a covering letter. Applicants who would like to receive this advert in an alternative format (e.g. large print, Braille, audio or hard copy), or who are unable to apply online should contact us by telephone on 01793 867003. Please quote reference number IRC78650.

Closing date for applications will be 31 January 2013.

Interviews will be held in February 2013 at our Headquarters in Keyworth, Nottingham.

The Natural Environment Research Council is an equal opportunities employer and welcomes applications from all sections of the community. People with disabilities and those from ethnic minorities are currently under-represented and their applications are particularly welcome.

The Survey has a no-smoking policy in all of its buildings. The British Geological Survey is an Investors in People organisation. There is a guaranteed Interview Scheme for suitable candidates with disabilities.



British Geological Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL



WE HELP KEEP THE WORLD MOVING

Classified

cont. from page 25

deposits, petroleum geology, regional tectonics, hydrogeology, geochemistry or geospatial analysis, beginning August 2013. Review of applications will begin January 15, 2013, and continue until the position is filled. Primary responsibilities of the faculty member will be to: 1) offer undergraduate courses in mineralogy, petrology (igneous and metamorphic), physical geology and/or earth science, and other courses relevant to his/her research interests; 2) help coordinate a rapidly growing field camp program; 3) help sustain a successful recruiting program for undergraduates in all areas of the geosciences; and 4) develop and maintain a robust, widely recognized research agenda. Candidates must be comfortable working across disciplines, teaching introductory and advanced courses to a diverse student body, and mentoring undergraduate research projects. The ability to obtain external funding for faculty and student research is vital, as is an overall commitment to excellence in teaching, research, and service. A Ph.D. in Geology is preferred, although applicants with a doctoral degree in a related area and significant expertise in the relevant fields of expertise will be considered. Following a period of release from at least one course per semester, the faculty member normally will teach one or two upper division courses as well as two courses in introductory physical geology or earth science each semester. Salary and benefits are competitive.

The full advertisement of this position is on <https://javjobs.tamuk.edu/>.

The University of Alabama Department of Geological Sciences-Geophysics.

The Department of Geological Sciences at The University of Alabama invites applications for a three-year, non-tenure track visiting faculty position in geophysics beginning August 16, 2013. The position will be filled at the Assistant Professor level. Though open to all geophysical sub-disciplines, preference will be given to candidates who will enhance our existing geophysics research programs in earthquake seismology and exploration geophysics. This position will also complement existing programs in tectonics, petrology, petroleum systems and hydrogeology. Candidates must have a strong record of research and a Ph.D. in geophysics, geology, or a related field by the time of appointment. The successful candidate will be

expected to teach introductory geology courses and undergraduate and graduate courses in geophysics, advise graduate students and enhance the department's externally funded research program in geophysics. The department has a broad range of resources and existing facilities that the candidate can utilize including modern terrestrial reflection and refraction seismology hardware, high-resolution marine seismic equipment, broadband seismometers, a gravimeter, magnetic gradiometer, terrestrial lidar imaging system and ground penetrating radar. Modern computer equipment and software includes a Cray High Performance Cluster and industry standard seismic processing and interpretation software. Details regarding existing research programs, related department equipment and facilities are found at <http://www.geo.ua.edu>. Questions should be directed to Andrew Goodliffe, amg@ua.edu. A complete application includes a CV, research statement, teaching statement and names and contact information for at least three referees. Applications must be submitted electronically at facultyjobs.ua.edu. Applications will be reviewed beginning February 4, 2013 and will continue until the position is filled.

The University of Alabama is an Equal Opportunity Affirmative Action Employer and actively seeks diversity in its employees.

Visiting Assistant Professor in Sedimentary Geology University of Nevada Las Vegas.

The Department of Geoscience at UNLV invites applications for a full time, 9-month, non-tenure track faculty position for the 2013-2014 academic year with the possibility of extension of funding for up to three years. Primary responsibilities are teaching of upper division and graduate courses in Sedimentary Geology. Additional responsibilities include introductory level courses for non-science majors, and participation in teaching field geology. Preferences will be given to applicants with expertise in field-based sedimentology/stratigraphy. The Department seeks a dynamic and enthusiastic individual with a commitment to undergraduate and graduate education. A minimum requirement is a Ph.D. degree in geoscience or sub-discipline of geoscience from a regionally accredited College or University. Salary is commensurate with qualifications and experience.

Classified cont. on next page



STANFORD UNIVERSITY

Managing Director Computational Earth and Environmental Sciences – School of Earth Sciences

The Stanford Center for Computational Earth and Environmental Science (CEES) was established to maintain and grow the School of Earth Sciences leadership in computational Earth science research and education.

The managing director will be responsible for: managing CEES personnel and relations with the University's IT organization, partnering with SES faculty to develop proposals and courses related to computational earth science, and building relationships with vendors.

The applicant must have a master's degree (Ph.D. preferred) in engineering or science, experience in research computing, 5 years of personal management experience, and excellent communication skills.

Candidates can apply and see a full list of responsibilities and qualifications at <http://stanfordcareers.stanford.edu/job-search> (keyword CEES). Applications received by February 28, 2013 will receive full consideration, though the position will remain open until the appropriate applicant is identified.

Stanford University is an equal opportunity employer and is committed to increasing to the diversity among its students, staff, and faculty. It welcomes nominations of and applications from minority groups and women, as well as others who would bring additional dimensions to the university's research, teaching and service missions.

Classified

cont. from page 26

The department (<http://geoscience.unlv.edu/>) has an enthusiastic faculty of 21, undergraduate and M.S./Ph.D. degree programs, and state of the art laboratory facilities including stable isotope, argon geochronology, XRF/XRD, soils, and electron microprobe/SEM labs.

Application materials must include a cover letter, curriculum vitae, statement of teaching philosophy and interests, and contact information for five referees. To receive full consideration, application materials should be received by February 25, 2013. Materials should be addressed to Dr. Michael Wells (Michael.wells@unlv.edu), and are to be submitted via on-line application at <https://hrsearch.unlv.edu>. For assistance with UNLV's on-line applicant portal, contact UNLV Employment Services at (702) 895-2894 or hrsearch@unlv.edu.

Salary competitive with those at similarly situated institutions. Position is contingent upon funding. UNLV is an Equal Opportunity/Affirmative Action educator and employer committed to achieving excellence through diversity.

Space Physics

VACANCY ANNOUNCEMENT National Aeronautics and Space Administration Science Mission Directorate Heliophysics Division Washington, DC Director, Heliophysics Division Pay Plan-Series: ES-1301 Salary Range: \$119,554-\$165,300 Area of Consideration: Open to all qualified individuals Open: December 14, 2012 Closes: February 14, 2013

The Director, Heliophysics, reports directly to the Associate Administrator (AA) Science Mission Directorate (SMD) and supports the AA in directing, determining and presenting the Heliophysics Program to NASA senior management, the Office of Management and Budget, the Office of Science and Technology Policy, Congress and the science community.

Major Duties
In partnership with other SMD Division Directors, the Director, Heliophysics Division, will support the AA in providing the overall guidance, strategy, advocacy and budget formulation for NASA's Science Program and is responsible for the following:

- Establish policy and objectives as a basis for the planning and formulation of a national program in Heliophysics science; direct the planning and implementation of a national Heliophysics program which is compatible with the priorities of the scientific community and with a balanced NASA program; implement and manage a program for scientific flight investigations; and plan and formulate recommendations for future flight programs.

- Develop budgets, policies and priorities for the programs under his/her cognizance,

- Including providing scientific and technical leadership required to guide implementation of relevant programs at NASA Field Centers, other Government research laboratories, academia and private industry.

- Ensure an effective program of research and analysis of Heliophysics science data and dissemination of results of the studies to the general public and to the scientific community through scientific publications, symposia, colloquia, press releases and press conferences.

- Responsible for liaison with the scientific community through advisory committees and other entities such as the National Academy of Sciences; coordinates the requirements of Heliophysics studies with the international community and other Federal Agencies.

How to Apply

To access the full announcement that contains additional qualification and application procedures, visit the USAJobs website, Announcement HQ13S0003.

For additional questions, contact Dan Shen at 202-358-4760 or daniel.k.shen@nasa.gov.

Interdisciplinary/Other

Postdoctoral position in Phosphorus Biogeochemistry University of Delaware.

Plant and Soil Science Department at the University of Delaware is seeking an energetic and enthusiastic applicant for a postdoctoral position in the area of phosphorus biogeochemistry. Particular experience in phosphorus cycling in agricultural or coastal environments, simulated laboratory experiments at biotic and abiotic interfaces, and/or phosphate oxygen stable isotopes is required. Initial appointment is for one year and can be renewed for following years based on the satisfactory performance.

Apply online at www.udel.edu/udjobs by January 31, with anticipated start date of March 1, 2013. Job ID: 101098

The UNIVERSITY OF DELAWARE is an Equal Opportunity Employer.

Postdoctoral Research Opportunity at San Diego Supercomputer Center.

San Diego Supercomputer Center at UCSD invites applications for a postdoctoral research position to support our team in software development for computational solid Earth sciences. The postdoctoral position will offer research opportunities in development of petascale modeling package for dynamic rupture and wave propagation simulations, with access to world-class HPC facilities for frontier research in seismic modeling. The immediate projects involve extending GPU functionality of the GPU-based AWP-ODC, a finite difference wave propagation code, and development of a community IO library supporting SCEC petascale applications. The successful candidate will be a graduate majoring in Earth Sciences, Computer/Computational Science, Computer Engineering, Electric Engineering, or Applied Mathematics. Experience of MPI, Fortran, C or C++ languages and UNIX operating systems are required; hands-on experience with the software development, MPI-IO, and/or parallel file systems will be a plus. The ideal candidate will also have a background in computational seismology. Excellent oral/written communication skills are required for working in a diverse, multidisciplinary environment. The position is initially for 12 months with possibility of extension to three years. More info about the position can be found at http://hpgeoc.sdsc.edu/Yifeng_Postdoc_posting_SDSC_2.2012.pdf. Direct questions to Dr. Yifeng Cui, yfcui@sdsc.edu.

Turner Postdoctoral Fellowship University of Michigan.

The Department of Earth and Environmental Sciences at the University of Michigan invites applications for the Turner Postdoctoral Fellowship. This highly competitive fellowship is open to all fields within Earth Sciences.

The Department is interested in innovative research proposals that can be pursued in collaboration with a faculty member. Interested applicants are encouraged to contact prospective hosts ahead of the application deadline to discuss areas of common interest and potential collaborations (<http://www.lsa.umich.edu/earth/people/faculty>).

Turner Postdoctoral Fellows receive an annual salary of \$55,000, discretionary research funds totaling \$10,000, and a generous benefits package. The fellowship is awarded for a one-year period, with an anticipated extension for a second year.

Interested applicants should send a single pdf file with the following: a curriculum vitae,

research proposal (5 pages maximum), and the names and addresses of at least three references no later than January 15, 2013. Applications should be sent to turnerpdf@umich.edu.

The University of Michigan is an affirmative action/equal opportunity employer. Women and minorities are encouraged to apply.

University of Michigan Water Center Postdoctoral Fellowships.

Deadline: Application review will begin on February 1, 2013

The University of Michigan Water Center (<http://graham.umich.edu/centers/water.php>), the Cooperative Institute for Limnology & Ecosystems Research (CILER) (<http://ciler.snre.umich.edu/>), and affiliated UM faculty are seeking EIGHT postdoctoral scholars to explore ecosystem approaches to understanding the world's greatest lakes through a variety of qualitative and quantitative methods that address management needs for the Great Lakes and their watersheds.

Fellowship start dates are negotiable through December 2013. Positions will be for a two-year period, with extensions possible pending performance and funding availability. The University of Michigan is an equal opportunity/affirmative action employer.

View the RFP for additional information, including application instructions: <http://graham.umich.edu/pdf/water-postdoc-rfp.pdf>

Student Opportunities

Graduate Assistantship (M.S and Ph.D) opportunities available for Fall 2013 in the Department of Geosciences, Western Michigan University.

Teaching and Research Assistantships are available for the Fall semester (September, 2013) in the M.S. and Ph.D. programs. Financial support includes stipend and tuition for two or more years (M.S.) or three or more years (Ph.D.). The Department of Geosciences consists of 11 faculty who maintain active research programs in aqueous geochemistry, biogeochemistry, stable isotope studies, paleo-basin analysis, hydrogeology, contaminant and reservoir hydrology, stratigraphy and petroleum reservoir studies, carbon sequestration, remote sensing/GIS, geoinformatics, shallow earth geophysics, glacial geology, Rocky Mountain and Argentina tectonics, slope stability analysis, and geosciences education. Effective October 11, 2011 the Michigan Geological Survey became part of the Department of Geosciences providing opportunities for student participation in the Survey's mapping, assessment and research activities. The Department of Geosciences affiliated Michigan Geological Repository for Research and Education (MGRRE) maintains an extensive collection of drill cores that provide excellent opportunities for creative subsurface studies. Dedicated research laboratories are also maintained for mass spectrometry, contaminant hydrology, aqueous geochemistry, remote sensing/GIS/informatics, geotechnical studies, near-surface geophysics, and basin subsidence analysis. One of the leading hydrogeology field camps in the country. Our graduates have an excellent record of employment in academia and industry. Please submit application by February 15, 2013. Application materials can be obtained by downloading the forms from <http://www.wmich.edu/geology>. For additional information contact Amy Stonerock (amy.stonerock@wmich.edu or 269-387-5485). Western Michigan University is an affirmative action/equal opportunity employer consistent with applicable federal and state law. All qualified applicants are encouraged to apply.

Graduate Assistantships and Fellowships, University of Kentucky. The Department of Earth and Environmental Sciences at the University of Kentucky has assistantships and fellowships available for the 2013-14 academic year for MS and PhD students. All awards include

tuition and health insurance. The department has 10 tenured/tenure-track faculty, 3 lecturers, and 11 adjuncts at the Kentucky Geological Survey and the UK Center for Applied Energy Research. Research specializations include geochemistry, geophysics, hydrogeology, igneous/metamorphic petrology, sedimentary geology, and tectonics. Facilities include the Sedimental, Environmental and Radiochemical Research Laboratory; a state-of-the-art stable isotope laboratory; the Kentucky Seismic and Strong-Motion Network; instruments for potential field geophysics; electron microprobe and X-ray diffraction laboratories; and extensive library holdings. UK is located in Lexington, a vibrant community of nearly 300,000. The surrounding area offers a wealth of outdoor and cultural opportunities. For more information, visit <http://ees.as.uky.edu> or contact Dr. Alan Fryar, Director of Graduate Studies (859-257-4392 or alan.fryar@uky.edu).

Graduate student opportunities with the Multidisciplinary Applied Geochemistry Network (MAGNET) in analytical, environmental and exploration geochemistry (Canada).

MAGNET seeks highly motivated students to join our unique network of leading scientists, industry partners and state-of-the-art analytical laboratories across Canada. Numerous MSc and PhD positions (with salary and travel stipends) available. Canadian and international applicants welcome. Visit www.magnet.eos.ubc.ca or contact ghanano@eos.ubc.ca for more information.

PhD positions: Cross-scale Biogeochemistry and Climate. Predicting future climate requires an improved understanding of atmospheric greenhouse gas concentrations which are directly emitted by human activities, as well as having important natural sources and sinks. Cornell, the Cary Institute of Ecosystem Studies, and the National Center for Atmospheric Research are partners in a new NSF-IGERT program designed to train graduate students in microbial, ecosystem, and global-scale approaches for advancing understanding of biogeochemical controls on greenhouse gas concentrations and global climate.

Students will apply to work with individual faculty, but participate in cross-disciplinary, cross-scale research in a collaborative environment across multiple departments and institutions. Minority and female students are especially encouraged to apply. Deadlines vary by field from December 1 to February 1. Multiple Ph.D. positions are available across many departments at Cornell, conducting innovative lab, field and modeling work. See www.biogeo.cornell.edu or email biogeo@cornell.edu for more details.

Undergrad Research Internships in Seismology and Geophysics.

Seeking physics, geoscience and math majors for seismology related-research projects. Projects may involve the deployment of seismic instruments in the field and/or analyses of seismic data in the lab. The goal of each project is to produce results for presentation at a national scientific meeting. Participants receive high-quality mentoring, integration into a rich peer community, opportunities to explore career paths in seismology, and financial compensation.

Apply your knowledge. Explore your future. Contribute to science.

Deadline: February 1, 2013 www.iris.edu/hq/internship

University of Florida Water Institute Interdisciplinary PhD Fellowships. Impacts of Sea Level Change on Coastal Aquifers, Water Resources, and Ecosystems. This program will provide 4 years of support for PhD Fellows to work collaboratively addressing issues related to sea level changes including: ecology, geochemistry, aquifer dynamics, potable water supplies or other topics related to students' interests Link: <http://waterinstitute.ufl.edu/WIGF/>

Postdoctoral Investigator Marine Chemistry and Geochemistry Department

The Marine Chemistry and Geochemistry Department is searching for a Postdoctoral Investigator to join their team. This position will be full-time for the first year with the possibility of an extension for a second year. This position is eligible for benefits.

JOB SUMMARY: We are seeking a Postdoctoral Investigator to work on a multi-investigator project in the field of chemical biology, recently funded by the Gordon and Betty Moore Foundation. Specifically, we are seeking someone with a strong skill set in isolation chemistry, microbiology, mass spectrometry and NMR spectroscopy with interests in microbial chemical ecology. This project will focus on elucidating chemical grazing deterrents, and infochemical signals produced by marine phytoplankton and characterizing their ecological influence. The applicant will have opportunities to collaborate with chemical and biological oceanographers at WHOI and other institutions and perform field-based studies.

Competitive applicants should have a strong publication record and a desire to work in a highly collaborative and interdisciplinary environment.

Please upload your CV, Research Statement and publications into one PDF document.

Ph.D is required.

For a complete description and to apply, please visit: <http://jobs.whoi.edu>.

WHOI is an Affirmative Action/
Equal Opportunity
Employer M/F/D/V.
Applications are
reviewed
confidentially



**Woods Hole
Oceanographic
INSTITUTION**



INSTITUTE FOR GEOPHYSICS
JACKSON SCHOOL OF GEOSCIENCES

RESEARCH ASSOCIATE POSITIONS

The University of Texas Institute for Geophysics (UTIG), which is part of the Jackson School of Geosciences, invites applications for several full-time, entry-level research positions (Research Associate). Successful candidates will be expected to develop an externally funded research program and a leadership role within their chosen field.

While all applicants with expertise allied with the research goals of UTIG will be considered, we are especially interested in applicants in the fields of:

Ice Sheet Dynamics — exploiting observational datasets to create three-dimensional, dynamic, predictive models, including those that examine lithosphere-ice, ocean-ice, and atmosphere-ice interactions.

Planetary Geophysics — utilizing existing planetary datasets, and organizing space-borne and surface-deployed geophysical experiments in future mission proposals.

Geofluids Research — investigating geofluids in environments that can range from the deep crust to the atmosphere, using theoretical or experimental methods and/or field applications.

Coastal Processes — understanding the dynamics of coastal water column, seafloor and subsurface, utilizing either observations or numerical modeling.

Review of applicants will begin February 8, 2013, with expected starting dates on or after September 1, 2013. Following an initial year of full research support, Research Associates at UTIG currently receive 6 months of salary support annually, and are expected to raise the rest of their annual salary through externally funded projects. An application should include a cover letter, CV, list of publications, names of at least three references, and a statement of research interests. Application package should be submitted via <http://utdirect.utexas.edu/pnjobs/index.WBX>. Applications should use posting number 12-11-28-01-0708. More information on the hires can be found at <http://www.ig.utexas.edu/jobs/research.htm>.

RESEARCH SPOTLIGHT

Highlighting exciting new research from AGU journals

Global tropical cyclone activity to decrease with climate change

Given its strong dependence on sea surface temperatures and atmospheric conditions, tropical cyclone activity is expected to be strongly affected by climate change. With observational records suggesting that tropical North Atlantic hurricane activity has increased in recent decades, some scientists have suggested that global tropical cyclone activity will increase as the planet warms. Using an ensemble atmosphere general circulation model, however, *Sugi and Yoshimura* found that global tropical cyclone activity has undergone a long-term decline from 1872 to the present—a trend they found should continue throughout the coming century. They found that the rate of global tropical cyclone activity decreased by 12.4 hurricanes per century—8.7 fewer hurricanes per century in the Northern Hemisphere and 3.7 fewer in the Southern Hemisphere.

The authors used a high-resolution model that divided the Earth into 60-square-kilometer boxes with 64 atmospheric levels each. From 1872 to 2003, the authors prescribed sea surface temperatures, greenhouse gas concentrations, and aerosol forcings that aligned with observations. For 2003–2099, they used projected values reflective of a moderate societal push toward renewable energy sources. The researchers found that the drop in global hurricane activity was driven by a reduction in upward mass transport in hurricane formation regions. As the temperature increases, so does atmospheric stability, a shift that limits convective transport and thus tempers the formation of tropical cyclones. (*Geophysical Research Letters*, doi:10.1029/2012GL053360, 2012) —CS

Voyager observes magnetic field fluctuations in heliosheath

For the past several years, as the two Voyager spacecraft near the outer reaches of the solar system, they have been sending back observations that challenge scientists' views of the physics at the edge of the heliosphere, the bubble created by charged particles flowing outward from the Sun. A new study looks at magnetic field fluctuations and cosmic ray intensity observed by Voyager 1.

In 2004, Voyager 1 crossed the termination shock, the region where the solar wind begins to slow as it interacts with the interstellar medium. Just outside the termination shock is the heliosheath, where the solar wind continues to slow, reaching a stagnation region where solar wind speed drops to zero. *Burlaga and Ness* studied the magnetic field observed by Voyager 1 during 2010, when the spacecraft was moving through this stagnation region. Their analysis shows that magnetic field fluctuations outside

the termination shock were primarily compressive fluctuations in field strength along the direction of the motion of the planets around the Sun. The fluctuations were observed on time scales of several hours.

The researchers also observed that the intensity of high-energy cosmic rays (above 70 megaelectron volts per nucleon) tended to rise with increasing magnetic field strength and increasing magnetic fluctuations. This was contrary to expectations, as theories predict that charged cosmic rays would be scattered by fluctuations in the magnetic field. The authors suggest that compressive fluctuations of the magnetic field may play a role in accelerating energetic particles in the heliosheath. (*Journal of Geophysical Research–Space Physics*, doi:10.1029/2012JA017894, 2012) —EB

Regional models do not add much value to climate change projections

Global general circulation models are the dominant tool in the effort to forecast the effects of climate change. Given the expansive scope of these models, some simplifications need to be made when representing smaller-scale processes, such as the effects of regional topography. To compensate, regional climate models are sometimes used to incorporate local influences and, in theory, improve the accuracy of projections of regional climate change. In testing the abilities of a regional model and a global model to represent historically observed climate change for the continental United States, however, *Rachera et al.* found that the regional model provided only a small increase in model accuracy and in some cases actually made the forecasts worse.

The authors used a regional model to dynamically downscale a global model, creating representations of the continental U.S. climate for two periods, 1967 to 1978 and 1994 to 2005. The authors ran the regional model in two modes: as a stand-alone model and with the calculations being nudged, or constrained, by the global model. They also operated the global model in two modes: at its standard resolution and with the results being interpolated to simulate a higher resolution. They then compared the model results against precipitation and temperature observations.

The authors found that when nudged, the regional model outperformed the interpolated global model in representing the climate of the individual decadal periods. The nudged regional model was also more accurate than the global model at representing observed climate changes between the two periods, though the authors suggest neither setup was particularly skilled. When left unnudged, the regional model was less accurate than the interpolated global model on all counts. The authors suggest that future efforts should focus on improving the

ability of global models to accurately represent long-term climate changes. (*Journal of Geophysical Research–Atmospheres*, doi:10.1029/2012JD018091, 2012) —CS

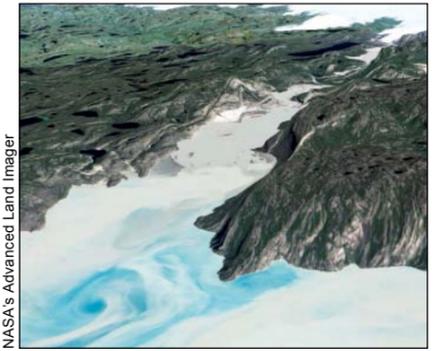
High-frequency flux transfer events detected near Mercury

The physical process that creates connections between the magnetic fields emanating from the Sun and a planet—a process known as magnetic reconnection—creates a portal through which solar plasma can penetrate the planetary magnetic field. The opening of these portals, known as flux transfer events (FTEs), takes place roughly every 8 minutes at Earth and spawns a rope of streaming plasma that is typically about half of the radius of the Earth. As early as 1985, scientists analyzing the Mariner 10 observations, collected during their 1974–1975 flybys, have known that FTEs also occur at Mercury. However, using the measurements returned from the Mercury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) spacecraft now orbiting Mercury, *Slavin et al.* found that Mercurial flux transfer events are proportionally much larger, stronger, and more frequent than those at Earth.

Over a 25-minute period on 11 April 2011, MESSENGER detected 163 FTEs near Mercury's magnetopause. The individual events took 2 to 3 seconds to move past the spacecraft, and the events were separated by 8 to 10 seconds. Using a model of FTE motion, the authors found that the events were likely initiated near the planet's southern magnetic pole before traveling to MESSENGER's location at the nightside magnetopause. Modeling the changes in the observed magnetic field as the flux transfer events passed over MESSENGER, the authors determined that FTEs had elliptical cross sections with a mean semimajor axis of about one sixth of the radius of Mercury. The authors suggest that if MESSENGER had not orbited out of the path of the events emanating from the southern magnetic pole, then FTEs likely would have continued to be detected until the interplanetary magnetic field conditions became unfavorable for reconnection. (*Journal of Geophysical Research–Space Physics*, doi:10.1029/2012JA017926, 2012) —CS

Near-total surface melt detected on the Greenland Ice Sheet

On 12 July 2012, 98.6% of the surface of the Greenland Ice Sheet melted, an event so expansive that a similar episode had not previously been seen in the satellite era. Ice core records indicate that the most recent melting event of this scale was 123 years ago. The one before that occurred another 7 centuries prior, during the Medieval Warm Period. Just 2 weeks following the near-total melt of the surface of the Greenland Ice



NASA's Advanced Land Imager

Extreme flooding in the Watson river in western Greenland following the extreme melt across nearly the entire surface of the Greenland Ice Sheet.

Sheet, after the surface ice had refrozen to seasonal levels, a second episode pushed the melt area back up to 79.2%. Compiling measurements from three different satellite systems and from in-the-field observations, *Nghiem et al.* describe the extent of the melt. The authors suggest that warm air ridges stagnating over Greenland, coincident with the melt episodes, may have underlain the extensive melting.

Given the extreme nature of the event, the authors supported the detection with observations from three satellite-based sensors: a scatterometer aboard the Indian Space Agency's Oceansat-2 satellite, a passive microwave radiometer carried by a U.S. defense satellite, and the Moderate Resolution Imaging Spectroradiometer aboard NASA's Aqua and Terra satellites. The satellite sensors each detected the surface melt in different ways and thus, when taken together, supported the overall finding of the extensive melt. The authors also found melting at field sites around Greenland, including Summit Station, a high-altitude base that does not typically see seasonal melting, and the North Greenland Eemian Ice Drilling site, where it rained on the days surrounding the 12 July melt. The authors note that a series of similar melt events during the Medieval Warm Period were separated from the two contemporary instances by the Little Ice Age. (*Geophysical Research Letters*, doi:10.1029/2012GL053611, 2012) —CS

Soft electron precipitation explains thermosphere mass enhancements

From 2000 to 2010, a German satellite carrying the Challenging Minisatellite Payload (CHAMP) orbited the Earth, tracking the properties of the thermosphere—the atmospheric layer that starts roughly 90 kilometers above the surface and coincides with the lower layers of the ionosphere. In analyzing CHAMP's observations, researchers came across an anomaly: 400 kilometers above the Earth in two different regions in the thermosphere, the density was persistently higher than scientists expected given model calculations. The density enhancements were found in two places: at the dayside cusp—the polar region where terrestrial magnetic field lines create a funnel for the solar wind—and in the auroral region on the planet's nightside. Though researchers had identified these anomalous regions, they have so far been unable to identify a mechanism to explain them.

Using a coupled magnetosphere-ionosphere-thermosphere model, *Zhang et al.* found that the precipitation of low-energy electrons into the F region of the ionosphere could account for the differences between observations and previous modeling work. The authors ran the coupled model both with and without representations for soft electron precipitation. They found that the presence of low-energy electrons flowing into the ionosphere at the two anomalous regions—the dayside cusp and the pre-midnight auroral region—caused the electron density and the electron temperature to increase. These shifts led to an increase in conductivity and in the resistive heating of thermospheric plasma, which, in turn, caused an increase in the modeled mass density. (*Geophysical Research Letters*, doi:10.1029/2012GL053519, 2012) —CS

—ERNIE BALCERAK, Staff Writer, and COLIN SCHULTZ, Writer

Regional shifts in snowfall, melt in the intermountain west

The freshwater supplies of the American West rely, for the most part, on snow. The Colorado River, the Rio Grande, and other rivers in the intermountain west—bounded by the Sierra Nevada and Cascade mountains to the west and the Rockies to the east—are the main sources of water for one of the driest parts of the continent, and their flows are predominantly fed by the springtime melt of snow accumulated over the winter. With winter mean temperatures rising in some places by as much as 2.5°C in the past 2 decades, some scientists are concerned that the current hydrological regime of the region could be overthrown, with snow giving way to rain as the dominant form of precipitation. Decreasing snow accumulation and earlier snowmelt onset have been observed in Colorado. Whether these trends extend to the larger intermountain west region, however, is unknown.

Drawing on daily observations from 202 snowpack telemetry (SNOTEL) stations, *Harpold et al.* found that although there have been changes in snowpack behavior, the effects of rising temperatures on snow properties are regionally variable. They suggest that a regime shift is not underway for the intermountain west.



Christopher Jones

Researchers conduct a snow survey in the Valles Caldera National Preserve, New Mexico.

Using daily observations of snow depth, snow-water equivalent, and the precipitation rate from 1984 to 2009, the authors calculated the length of the snow-covered season, the onset of melt, the date of maximum accumulation, and other parameters. Using a regional analysis the authors

found that trends in these properties were highly variable across the intermountain west but that negative trends were most prominent in the Colorado River basin and in high-elevation regions that were above 2800 meters. (*Water Resources Research*, doi:10.1029/2012WR011949, 2012) —CS