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## Global Data Products Help Assess Changes to Ocean Carbon Sink

Net oceanic uptake of the greenhouse gas carbon dioxide ( $\text{CO}_2$ ) reduces global warming but also leads to ocean acidification [Intergovernmental Panel on Climate Change (IPCC), 2007]. Understanding and predicting changes in the ocean carbon sink are critical to assessments of future climate change. Surface water  $\text{CO}_2$  measurements suggest large year-to-year variations in oceanic  $\text{CO}_2$  uptake for several regions [Doney *et al.*, 2009]. However, there is much debate on whether these changes are cyclical or indicative of long-term trends. Sustained, globally coordinated observations of the surface ocean carbon cycle and systematic handling of such data are essential for assessing variation and trends in regional and global ocean carbon uptake, information necessary for accurate estimates of global and national carbon budgets.

The Carbon Dioxide Information Analysis Center (CDIAC) has been assembling ocean carbon data from international contributors since 1993. A large amount of relevant data, however, cannot be found at CDIAC, having been archived at other data centers or kept private. Furthermore, the data are in varied formats and often have insufficient documentation. All these factors have been effective barriers to generating global  $\text{CO}_2$  synthesis products essential for assessing changes in the ocean carbon sink.

In response to this, the international ocean carbon research community initiated the Surface Ocean  $\text{CO}_2$  Atlas (SOCAT; <http://www.socat.info/>) in April 2007

[International Ocean Carbon Coordination Project (IOCCP), 2007]. This project aims to improve access to surface water fugacity of  $\text{CO}_2$  ( $f\text{CO}_2$ , similar to partial pressure) data from all ocean areas, to optimize their documentation and quality control (QC), and to ensure their long-term storage.

### SOCAT Framework, Quality Control, and Products

Approximately 50 international seagoing marine carbon scientists and data managers have generously donated their time and expertise to SOCAT. These participants were organized into seven regional groups and a global coordination group. Six international workshops were held to resolve data integration and QC issues. The scientists developed protocols, software, and an interactive Web-based tool for data QC. SOCAT procedures were designed to be transparent and fully documented. Many additional data not yet in CDIAC were retrieved from data originators, public Web sites, and other data centers. Regional group members checked the documentation accompanying the data and carried out data QC. Whenever the QC process highlighted problems, data were suspended for revision by the data provider. A quality flag was assigned to each data set, and only good-quality data were included in SOCAT products.

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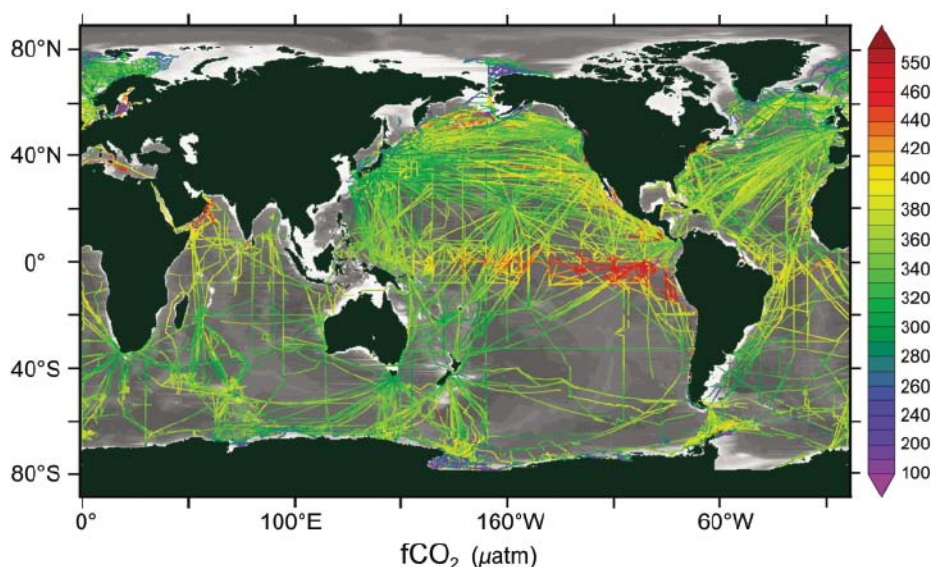


Fig. 1. Surface water  $f\text{CO}_2$  (similar to partial pressure) measured in microatmospheres ( $\mu\text{atm}$ ) in the global oceans and coastal seas from 1968 to 2007. Data are from Surface Ocean  $\text{CO}_2$  Atlas (SOCAT) version 1.5. Note the uneven data distribution across the oceans and coastal seas.

## Fine-Scale Venusian Topography From Magellan Stereo Data

Of all the solar system bodies, Venus is the most like Earth in terms of average surface age, size, distance from the Sun, and diversity of volcanic and deformational features. Despite these similarities, Venus does not currently have plate tectonics and is uninhabitable, and it is not known whether these two conditions are related. As technology advances and such missions as NASA's Kepler begin to detect Earth-sized planets in the habitable zone around other stars, understanding the evolution of Venus will be critical in assessing the odds that "Earth-sized" equates to "Earth-like." Unfortunately, there has not been a geology-oriented spacecraft mission to Venus since the Magellan mission (1989–1994), and no missions are currently planned.

In light of this observation, scientists at the University of Alaska Fairbanks have sought ways to use modern data processing capabilities to enhance the value of data from Magellan, an unmanned NASA spacecraft sent to Venus in 1989. Researchers have undertaken a project to process stereo synthetic aperture radar (SAR) images collected by Magellan to produce topography data for 20% of the Venusian surface with a horizontal resolution of 1–2 kilometers, an order-of-magnitude improvement over Magellan altimetry data. The result effectively represents a new data set for Venus. The data should be particularly useful for regional studies of volcanic features and crustal deformation.

### Extracting Topography From Magellan SAR Stereo Images

The Magellan mission collected radar altimetry and SAR images for Venus with near-global coverage. SAR is an imaging methodology that involves sending and receiving radar pulses from a moving antenna, in this case Magellan's orbiting radar dish. A two-dimensional (2-D) image of the surface is constructed from the time delay and frequency shift of the returned signal. The movement of the spacecraft, with its small antenna, "synthesizes" having a large fixed receiving antenna (hence the term "synthetic aperture").

Magellan SAR image resolution is 100–200 meters [Saunders *et al.*, 1992], while the gridded altimetry has 10- to 20-kilometer horizontal resolution and vertical resolution of 50–100 meters [Ford and Pettengill,

1992]. The 2-order-of-magnitude difference in horizontal resolution means that the SAR images can resolve kilometer-scale features that the altimetry cannot. In SAR images, slopes facing the radar are foreshortened, and slopes facing away are elongated (opposite to obliquely imaged photographs), with the magnitude of foreshortening and elongation increased (also opposite to photographs) for more vertical imaging angles. Thus, SAR images taken from different viewing angles will show relative movement of features between images if there are elevation changes within the scene.

Imaging was accomplished over three Venusian days, or "cycles," with the spacecraft flying over a surface location once each cycle. Data from cycles 1 and 3 were collected with east looking incidence angles separated by about  $20^\circ$  at the surface in the plane perpendicular to the orbital path, so image pairs from these two cycles are stereo anaglyphs. Variations in the relative positions of features in the two images, the parallax, can be converted into elevation changes. Because topography is being derived from the images, it can theoretically be determined with a horizontal resolution that matches image resolution. In practice, however, achievable horizontal resolutions are 5–10 times worse than image resolution [Leberl *et al.*, 1992]. Additionally, spacecraft problems limited cycle 3 coverage to only about 20% of the planet, predominantly in an equatorial band from  $40^\circ\text{N}$  to  $40^\circ\text{S}$  and longitudes of  $60^\circ$ – $180^\circ\text{E}$  (Figure 1).

At the time of the Magellan mission, the data volume (tens of gigabytes of images) made processing all of the stereo data prohibitive. Also, obtaining accurate solutions with stereo radargrammetry has traditionally involved substantial manual editing of match points (points identifying the same feature in both images). Thus, past use of the Magellan stereo data to generate topography has been limited to such small geographic features as impact craters [Herrick and Rumpf, 2011] and modest-sized volcanoes [Gleason *et al.*, 2010]. However, advances in automated matching and computer processing capability have now enabled researchers to process all of the Magellan cycle 1–3 stereo data.

Mosaicked Magellan stereo data were chosen for processing rather than performing a full bundle adjustment (simultaneously

**Venusian Topography** cont. on page 126

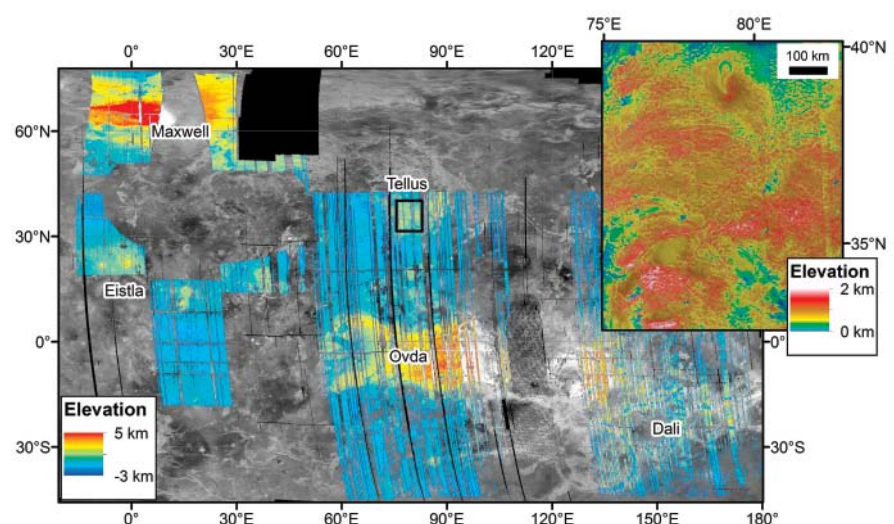


Fig. 1. Stereo-derived topography laid on a background of a Magellan cycle 1 synthetic aperture radar (SAR) mosaic. Elevations are relative to average planetary radius. Inset shows a portion of Tellus Regio, a Venusian highland, outlined in the main image by the black box. Amplitude and wavelength of kilometers-scale folding can now be estimated in this heavily deformed "tessera" terrain.



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Global Data Products

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SOCAT version 1.5, public since September 2011, contains 6.3 million surface water CO<sub>2</sub> measurements from the global oceans and coastal seas. The data originate from 1851 voyages by research vessels, commercial ships, and moored as well as drifting platforms. Two SOCAT products have been created: (1) a global data set of surface ocean fCO<sub>2</sub> from 1968 to 2007 (Figure 1) recalculated using a uniform procedure and subject to QC checks and (2) a global, gridded, monthly mean surface water fCO<sub>2</sub> data product with minimal temporal and spatial interpolation. The SOCAT data products and individual cruise files can be downloaded from PANGAEA (http://www.pangaea.de/), an International Council for Science World Data System, and CDIAC (http://cdiac.ornl.gov/oceans/). The data products can also be accessed via an interactive data visualization and analysis tool, the Live Access Server, and Ocean Data View (links available at http://www.socat.info/).

Applications of Products and Future SOCAT

Currently, two types of global surface ocean CO<sub>2</sub> synthesis products are publicly available: the SOCAT products and the Lamont-Doherty Earth Observatory (LDEO) climatologies [Takahashi *et al.*, 2009]. Although the SOCAT and LDEO products share many original data sources, QC and extrapolation procedures used for creating the gridded products are very different. Nonetheless, both sources of information can help researchers evaluate CO<sub>2</sub> air-sea fluxes for constraining global carbon budgets. Potential applications of the SOCAT products include studies of seasonal, year-to-year, and decadal variations in the ocean carbon sink at regional and global

scales. Global data products provide much-needed initialization and validation fields for ocean carbon cycle models, as used by IPCC [2007]. The SOCAT project has revealed major room for improvement in the way that scientists report and document data. The SOCAT community, together with IOCCP, hopes to address this by developing a largely automated data submission and QC system. Work on the second SOCAT release has started. The inclusion of additional parameters, e.g., those relevant for ocean acidification research, is under consideration. Marine carbon scientists are strongly encouraged to promptly submit their surface water CO<sub>2</sub> data with accompanying documentation for inclusion in global synthesis products. Data submissions should follow the recommended formats (see http://cdiac.ornl.gov/oceans/submit.html).

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Venusian Topography

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solving for elevation and revising the estimated position of the spacecraft) with the original Magellan SAR swaths. This significantly reduced the effort required, with a minor effect on output quality. First, match points between images (points on different images that show the same physical feature) were identified using a windowed, weighted cross-correlation procedure [Frankot *et al.*, 1994; Hensley and Shafer, 1994]. Then, a series of filtration steps were implemented to remove invalid match points. The remaining match points define parallax values, which were converted into relative elevations using knowledge of the angles at which the spacecraft’s antenna were pointing. These stereo-derived relative elevation values were then combined with the Magellan altimetry data using complementary high-pass/low-pass filters to establish geodetic linkage (the absolute elevation relative to some planetary reference frame).

Coverage and Example

After processing, the final product is a topographic data set with a nominal horizontal resolution of 1–2 kilometers for an area that covers a variety of interesting geologic regions on Venus (Figure 1). The new topography data allow examination of topographic details for extensive regions; these include large shield volcanoes, Venusian rift systems, and the heavily deformed “tessera” terrain (see Figure 1 inset) of complex crustal folding within Venusian plateaus. The new data make geomorphic units easier to distinguish [Gilmore *et al.*, 2010], and the amplitudes and wavelengths of regional folding can now be estimated, modeled, and interpreted [Gilmore *et al.*, 2011]. The data also resolve the rifts that cross many of the planet’s shield volcanoes and show them to be deeper than anticipated; the strain on these rifts can now be evaluated and modeled [Verner *et al.*, 2011].

Data Availability

The final data and a variety of related products (match points, intermediate

processing products, maps in PDF format, etc.) are currently available at <http://www.gi.alaska.edu/~rherrick/stereotopo.html>.

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# NEWS

## Congressional Hearing Reviews NSF Major Research and Facilities Projects

An 8 March congressional hearing about the U.S. National Science Foundation's Major Research Equipment and Facilities Construction (NSF MREFC) account focused on fiscal management and accountability of projects in that account and reviewed concerns raised by NSF's Office of Inspector General (OIG).

NSF established the MREFC account in 1995 to better plan and manage investments in major equipment and facilities projects, which can cost from tens of millions to hundreds of millions of dollars, and the foundation has funded 17 MREFC projects since then. The Obama administration's proposed fiscal year (FY) 2013 budget includes funding for four MREFC projects: Advanced Laser Gravitational-Wave Observatory (AdvLIGO), Advanced Technology Solar Telescope (ATST), National Ecological Observatory (NEON), and Ocean Observatories Initiative (OOI).

The hearing, held by a subcommittee of the House of Representatives' Committee on Science, Space, and Technology, reviewed management oversight throughout the life cycles of MREFC projects and concerns raised in recent OIG reports about the use of budget contingency funds. NSF's February 2012 manual called "Risk management guide for large facilities" states that cost contingency is "that portion of the project budget required to cover 'known unknowns,'" such as planning and estimating errors and omissions, minor labor or material price fluctuations, and design developments and changes within the project scope. Committee members acknowledged measures that NSF has made to improve the MREFC oversight process, but they also urged the agency to continue to take steps to ensure better project management.

Committee chair Rep. Mo Brooks (R-Ala.) said that over the past 10 years, NSF has worked to establish and refine the practices for launching new MREFC projects, for overseeing construction, and for the transition to managing the operations and maintenance of the equipment and facilities. "These practices have led to greater involvement by the National Science Board and a clear understanding of how MREFC projects are prioritized in difficult economic times," Brooks said. He added that while MREFCs support NSF's larger goal of helping the United States maintain its competitive edge in science, "it is imperative that appropriate oversight be executed to guarantee the greatest return on taxpayer investments."

The OIG's September 2011 semiannual report to Congress noted that NSF "has made steady progress towards improving its project management capability since 2003, when NSF first appointed a Deputy Director for Large Facilities. However, according to three recent audits conducted by DCAA [Defense Contract Audit Agency] for the OIG, costs for contingency provisions contained in each of the contracts are unallowable."

In the September report, OIG stated that it had found "unallowable contingency funds" for three MREFC projects: \$76 million for NEON, \$62 million for ATST, and \$88 million for OOI. "Auditors recommended the

removal of the unallowable contingency provisions from the proposed budgets and advised NSF to implement policies that require the agency rather than the awardee to control the contingency funds until a need for them is demonstrated. Without adequate controls on the establishment and utilization of contingencies, the agency cannot be certain that funds are not being used to hide poor project planning, management, or other deficiencies in administration."

The report also noted, "During the past year, the agency has participated in ongoing discussions with OIG regarding the resolution of audit findings and recommendations related to contingencies. Once agreement is reached, NSF has indicated that it will update the Contingency Policy and Procedures module of its Large Facilities Manual."

At the hearing, representatives from NSF and several MREFC project directors said contingency funds are a key element in helping to manage project construction. NSF deputy director Cora Marrett responded to the OIG concern about unallowable contingency funds by stating that contingency funds help to keep projects within budget and prevent cost overruns. "There's a question about whether there are problems," she said. "Those audits were of the proposals from the particular projects, not from the actual expenditures once construction had begun. I believe the inspector general's office is prepared now to do its audits not of the proposals but of the actual expenditures. Those are likely to result in very different consequences."

NSF management is working to clear up the understanding that the processes the agency uses for contingency funds are consistent with practices used by other agencies and industry, Marrett said. She added, "We are convinced that we will be able to resolve what seemingly are differences that we're not quite sure are as deep as might be implied in the semiannual report."

Committee ranking member Rep. Dan Lipinski (D-Ill.) stated that he is "comfortable" with the definition NSF is using for contingency funds and that it appears to be consistent with practices in the private sector and at other federal agencies. Calculating a contingency total "based on the ensemble mean of all foreseeable risks across all aspects of a project and incorporating that into the total project cost is the right approach," he said. "But the IG has raised important questions regarding whether there are sufficient controls over drawdowns from the contingency fund and whether the fund should be held at the agency or with the project. I think there are good arguments on both sides of this issue, and I worry also that the projects currently under way are caught in this dispute between the IG and NSF management."

Lipinski added that overall, he is "very pleased with how far the agency has come in the last few years in strengthening management and oversight of its large facilities."

—RANDY SHOWSTACK, Staff Writer

## G E O P H Y S I C I S T S

### Soren W. Henriksen (1916–2011)

Soren Werner Henriksen, a pioneer in applying space technology to geodesy and mapping, died on 5 September 2011 at the age of 95. His expertise spanned the fields of applied mathematics, astronomy, surveying, and photogrammetry as well as geodesy and cartography.

Soren was born in New York City on 5 August 1916 but grew up in Chicago. He joined the Illinois National Guard in 1938 and 3 years later transferred to the U.S. Army, where he served until August 1945. During that summer he had been severely wounded in the Philippines. The following year he entered the Illinois Institute of Technology, graduating in 1949 with a bachelor's degree in mathematics. In 1950 he obtained a master's degree from the University of Illinois at Urbana-Champaign, also in math.

At that point in time, navigation across the oceans was still done with sextants, compasses, and dead reckoning. Precise geodetic datums had been created in many places, and sometimes of continental scale, but the connections among them were scarcely any better than in previous centuries. There were various commercial, scientific, and military needs for a high-precision global geodetic network, and the technologies to make this possible became available after World War II. The U.S. Department of Defense took a leading role, but NASA and other federal and foreign agencies were in on the game, with academics and contractors providing vital support.

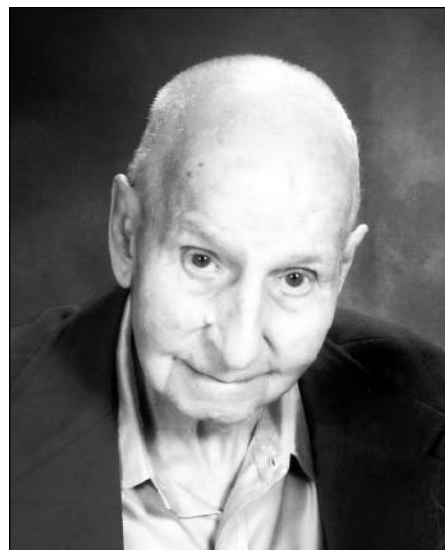
Thus, it came to be that in 1951 Soren was hired by the Army Map Service (AMS), a component of the U.S. Army Corps of Engineers, which was recruiting mathematicians to support this global geodetic mission. He started in the Occultation Section of the Research and Analysis Branch of the Geodetic Division, where he applied his mathematical skills to analyzing lunar occultations and solar eclipses. In 1955 he was promoted to chief of the section and completed the definitive manual, AMS Technical Report 46, "The application of occultations to geodesy," in 1962.

Soren was fortunate in having his branch chief, John O'Keefe, as a mentor. O'Keefe had anticipated the enormous value of artificial satellite observations for geodesy and prepared AMS to utilize them. Soren directed his section to support this effort and worked to develop and deploy Minitrack II and Sequential Collation of Ranges (SECOR), mobile satellite tracking systems.

O'Keefe and several other experienced senior scientists left AMS for NASA's then new Goddard Space Flight Center. Soren replaced O'Keefe as branch chief in 1960, but recent college graduates, including myself, were recruited to fill in for the others.

Despite the many things going on at AMS, Soren developed the wanderlust of O'Keefe and the others and departed for Raytheon Autometric early in 1965. During his 7 years there, he generated reports typified by "Modes of satellite triangulation adjustment." Twice he received the firm's Outstanding Author Award.

I again encountered Soren as one of the organizers of the Third International Symposium on the Use of Artificial Satellites for Geodesy, held in Washington, D. C., on 15–17 April 1971. He also was among the three editors of its proceedings, *The Use of Artificial Satellites for Geodesy* (AGU Geophysical Monograph Series, vol. 15, Washington, D. C., 1972). Then, in 1972, AGU hired him to edit two volumes (1030 pages) of articles on NASA's National Geodetic Satellite Project, which required 2 years.



Soren W. Henriksen

The next stop for Soren was to join me in 1974 at the Geodetic Research and Development Laboratory in the National Oceanic and Atmospheric Administration (NOAA). There he worked on polar motion, geocenter observations, and photogrammetric applications among other things. He also helped to revise the *Manual of Photogrammetry* for a 1980 edition and wrote the entry on field surveys. But his major effort at NOAA was to update Hugh Mitchell's 1948 publication *Definition of Terms Used in Geodetic and Other Surveys*. Soren sought to expand the scope of this work, but the resulting *Geodetic Glossary*, published by NOAA in 1986, was less comprehensive than he had wished.

Soren retired in 1984 but, not surprisingly, worked harder than ever. In 1988 he submitted his manuscript for the *Glossary of the Mapping Sciences* to a joint committee of the American Society for Photogrammetry and Remote Sensing (ASPRS), the American Congress on Surveying and Mapping, and the American Society of Civil Engineers (ASCE). It finally was published in 1994 by ASCE. This, perhaps, is his most notable publication.

During his long career, Soren was active in several scientific societies. He was a member of not only AGU but also ASPRS, the Institute of Electrical and Electronics Engineers, the Royal Astronomical Society, and the American Astronomical Society. For relaxation he enjoyed competitive games, such as duplicate bridge and the ancient Chinese game of Go. In his later years he played computer games such as Myst. One of Soren's little eccentricities was not wanting to be photographed, so the accompanying picture of him was the only one available. It was cropped from a photo taken of him and his wife in February 2011 for a church directory.

Soren had permanently acquired two things at AMS: Pamela, his wife of 59 years, and the nickname "Walt." He has left a daughter, Kirsten, and two grandchildren. His son, Donn, predeceased him.

A paperback edition of the *Glossary of the Mapping Sciences* may be purchased at the ASPRS online bookstore (<http://www.asprs.org/Publications-Other/Bookstore.html>). The National Geodetic Survey of NOAA has placed the *Geodetic Glossary* online at [http://www.ngs.noaa.gov/CORS-Proxy/Glossary/xml/NGS\\_Glossary.xml](http://www.ngs.noaa.gov/CORS-Proxy/Glossary/xml/NGS_Glossary.xml).

—FOSTER MORRISON, Turtle Hollow Associates, Inc., Gaithersburg, Md.; E-mail: [turtle\\_hollow@sigmaxi.net](mailto:turtle_hollow@sigmaxi.net)

**Geophysicists** cont. on page 128

### Workshop Announcement



#### Observatories in Scientific Ocean Drilling

September 10–11, 2012 - Houston, Texas, USA

The International Ocean Discovery Program's science plan identifies observatories as an important platform to push forward scientific boundaries in Earth science. Time-series data from observatories help us address dynamics of physical, chemical, geophysical, and biological systems and foster cross-disciplinary science. We are convening a workshop to educate scientists on the state of the art in observatory science, to explore possible applications of new technologies, to discuss sensor and data needs for addressing fundamental problems, and to discuss strategies for proposing and maintaining long-term observatory experiments.

Full and partial travel support is available for a limited number of scientists. Early-career researchers and graduate students are encouraged to apply. To apply, please send a short statement of interest and CV by May 15, 2012. US applicants should contact Brandon Dugan ([dugan@rice.edu](mailto:dugan@rice.edu)). International applicants from IODP member countries should contact Heinrich Villinger ([vill@uni-bremen.de](mailto:vill@uni-bremen.de)).

<http://iodp-usssp.org/workshop/observatories/>



**Application Deadline: May 15, 2012**

### From the AGU Blogosphere

- The Martian Chronicles: "Why explore Mars?" <http://bit.ly/xzSVJt>
- Mountain Beltway: "Poleta plume paradise" <http://bit.ly/zYuLJB>
- Dan's Wild Wild Science Journal: "This time NASA really is making chemtrails" <http://bit.ly/zm85Yg>
- Georneys: "Monday geology picture: Fossil seashells at Barr Al-Hikman, Oman" <http://bit.ly/z6mGU6>
- The Landslide Blog: "Analysing the pre-landslide image from Tumby Quarry" <http://bit.ly/wsWUh8>



- Magma Cum Laude: "Survival geology for the space traveler" <http://bit.ly/wlksjG>
- GeoSpace: "Space weather explosions detected on Venus" <http://bit.ly/wircZE>



## Geophysicists

cont. from page 127

### Honors

**Elizabeth Ambos** is the new executive officer of the Council on Undergraduate Research, an international not-for-profit organization focused on increasing undergraduate research opportunities. Most recently, Ambos has served as Assistant Vice Chancellor for Research Initiatives and Partnerships for the California State University Chancellor's Office.

**Anthony Beasley** has been appointed as the next director of the National Radio Astronomy Observatory, a facility of the National Science Foundation (NSF), operated under cooperative agreement by Associated Universities, Inc. Beasley has served as chief operating officer and project manager of the National Ecological Observatory Network, an NSF-funded continental-scale observatory designed to detect ecological change and enable forecasting of its impacts.

*Chasing Ice*, a feature documentary film that follows photographer **James Balog** and his team deploying time-lapse cameras to film melting glaciers in the Arctic, won the Boulder International Film Festival's best adventure film award.

**Jane Lubchenco**, under secretary of commerce for oceans and atmosphere and administrator of the National Oceanic and Atmospheric Administration, is the recipient

of the Women's Council on Energy and the Environment (WCEE) Woman of the Year Award. WCEE recognized Lubchenco for "her outstanding accomplishments as a world-renowned scientist and skilled policy maker" and also said that "her science-based approach has earned respect within a broad spectrum of constituencies, including leaders in the scientific, business, NGO, and government communities."

**Judy Scotchmoor**, assistant director for education and public programs at the University of California Museum of Paleontology (UCMP), is a recipient of the National Center for Science Education's (NCSE) Friend of Darwin Award for 2012. NCSE noted Scotchmoor's efforts in building the UCMP evolution program from scratch and her involvement with the Understanding Evolution and Understanding Science Web sites.

### In Memoriam

**Talbot Chubb**, 88, 10 December 2011, Fellow, Space Physics and Aeronomy, 1959

**Claudia Lewis**, 56, 23 February 2012, Tectonophysics, 1988

**Susan Niebur**, 39, 1 February 2012, Planetary Sciences, 2010

**Carolyn Purvis**, 64, 8 November 2011, Magnetospheric Physics, 1986

**F. Sherwood Rowland**, 84, 10 March 2012, Fellow, Atmospheric Sciences, 1974



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## HOUSING AND REGISTRATION NOW OPEN!

Monday, 30 April – Thursday, 3 May 2012  
Washington, DC

This inaugural conference will focus on key Earth and space science issues relevant to challenges facing today's public policy environment.

Take advantage of AGU special  
reduced hotel rate (\$224 USD/night)

Register to be a part of the conference!  
[www.agu.org/spconference](http://www.agu.org/spconference)

Deadline: 30 March, 23:59h EDT

EOS\_12035



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EOS\_061001



# MEETINGS

## Developing Plans and Priorities for Climate Science in Service to Society

**World Climate Research Programme (WCRP) Open Science Conference; Denver, Colorado, 24–28 October 2011**

The WCRP Open Science Conference (OSC), which had the theme "Climate Research in Service to Society," was held to consult with the international community of experts on future plans and priorities for the WCRP. More than 1900 participants, including 541 young scholars from 86 nations and 300 scientists from developing nations, made the conference a success.

Several major scientific priorities emerged from OSC. These include (1) the need for prediction of the Earth system, bridging the physical climate system with biogeochemistry and the socioeconomic and humanity sciences, in a program such as the "Future Earth-Research for Global Sustainability" initiative of the International Council for Science; (2) capitalizing on the opportunity, provided by new satellite observations, to make a major leap in understanding of clouds and aerosols and their contributions to climate sensitivity; (3) the need for skillful climate information on regional scales for Global Framework for Climate Services; (4) the importance of quantifying true uncertainty in climate predictions; (5) defining the challenges and opportunities involved in predicting how the forced anthropogenic component of climate change will modify the natural modes of climate variability over the coming decades; (6) the increasing importance of establishing the predictability of polar climate, with possible opening of the Arctic, and the importance of international policy for commercial shipping and extraction of natural resources; (7) the need to better understand the causes of extreme events and to conduct attribution studies in near real time; (8) tackling the challenges to providing improved predictions of future regional sea level change; and (9) the need to train and empower the next generation of climate scientists.

Dialogue with young scholars on future education and research opportunities and

how to effectively communicate climate science was a significant component of OSC. A major emerging theme was the need for actionable science. Decision makers need climate and other scientific information to guide decisions. Future water availability in a region, for example, may guide the siting of a new water treatment plant that will be operational for decades. The demand for and importance of understandable information about climate is increasing, especially as extreme weather and climate events and their adverse impacts on natural ecosystems and global economic development increase in frequency and severity.

The need for actionable science was also explored with a panel of experts from the private sector: British Petroleum, Northrop Grumman, Zurich Financial Services, Computer Sciences Corporation, and the Weather Channel. They discussed how scientists and private enterprise can better work together toward actionable information, concluding that while gaps exist today between information needs and availability, those gaps are rich with opportunity.

The general consensus among the participants was that WCRP and its affiliate network of scientists and projects must move beyond understanding and predicting the Earth's climate system to providing the resulting knowledge and information in ways that yield practical solutions to the complex and interrelated challenges required of a sustainable Earth for future generations. More information on the conference is available at <http://conference2011.wcrp-climate.org>.

—GHASSEM ASRAR, World Meteorological Organization, Geneva, Switzerland; E-mail: [gasrar@wmo.int](mailto:gasrar@wmo.int); ANTONIO BUSALACCHI, University of Maryland, College Park; and JAMES HURRELL, National Center for Atmospheric Research, Boulder, Colo.

## International Coordination to Improve Studies of Changes in Arctic Sea Ice Cover

**Climate and Cryosphere Arctic Sea Ice Workshop; Boulder, Colorado, 31 October to 2 November 2011**

The Arctic sea ice cover is undergoing tremendous changes. The end-of-summer ice extent is decreasing, the ice is thinning, and there is a fundamental shift from perennial to seasonal ice. These changes have important implications for both the Arctic and the global climate system. This importance creates a need to observe and understand the ongoing changes and to predict future changes in the Arctic sea ice cover.

The Arctic Sea Ice Working Group of the Climate and Cryosphere Project of the World Climate Research Programme held a workshop at the National Snow and Ice Data Center to discuss ways to improve our ability to observe, understand, and predict changes in Arctic sea ice through internationally coordinated activities. More than 40 researchers from 10 countries attended the workshop. The group included field experimentalists, remote sensing specialists, and sea ice and climate modelers. The workshop featured presentations on sea ice observations and models plus ample time for group discussions. A common theme was the need for collaboration and coordination and an ongoing dialogue among experimentalists, remote sensing scientists, and modelers. Specific recommendations and proposed actions are described below.

Participants recommended developing and implementing a standardized, computerized ship-based ice observation protocol and creating an online center for summarizing ongoing field activities and collecting, disseminating, and archiving ice observations. This should be coordinated with the International Ice Charting Working Group and other relevant bodies.

The group also agreed that a long-duration field campaign studying first-year ice is needed. The campaign should integrate observations of the atmosphere, ice, and ocean, examining physical and biogeochemical properties and processes. The experimental design

should be developed jointly by observationists and modelers. The Arctic Sea Ice Working Group should coordinate with other working groups involved in similar planning.

In addition, participants pointed to a need to integrate surface-based and airborne observations with modeling activities and remote sensing. Team members with modeling backgrounds will help identify priorities and types of observations of greatest utility in understanding and predicting changes in the Arctic sea ice cover. Guidance from models will help inform strategies for observing campaigns and the design of observing networks. The overall goal is to improve sea ice predictions on seasonal to interannual time scales.

Finally, the working group agreed to build on the Arctic Sea Ice Outlook (<http://www.arcus.org/search/seaiceoutlook/>) to integrate all of the above activities. The Sea Ice Outlook will be used as a central clearinghouse for highlights from surface-based and remotely sensed observations. These observations can be assimilated into models. Predictions from different models will be intercompared and assessed.

Small teams have been assembled to undertake each of these tasks. The goal is to make significant progress within 1–3 years. Results from these efforts will be published in reports and journal articles. Those interested in participating in any of these activities should contact any of the authors of this meeting report.

Ralf Doescher, Sebastian Gerland, Alexander Makhstas, Jinping Zhao, and the meeting attendees contributed to this report.

—DONALD K. PEROVICH, Cold Regions Research and Engineering Laboratory, U.S. Army Corps of Engineers, Engineer Research and Development Center, Hanover, N. H.; E-mail: [donald.k.perovich@erdc.usace.army.mil](mailto:donald.k.perovich@erdc.usace.army.mil); HAJO EICKEN, Geophysical Institute, University of Alaska Fairbanks; and WALTER MEIER, National Snow and Ice Data Center, Boulder, Colo.



# ABOUT AGU

## Guenther Receives 2011 Yoram J. Kaufman Unselfish Cooperation in Research Award

*Alex B. Guenther received the Yoram J. Kaufman Unselfish Cooperation in Research Award at the 2011 AGU Fall Meeting, held 5–9 December in San Francisco, Calif. The award recognizes “broad influence in atmospheric science through exceptional creativity, inspiration of younger scientists, mentoring, international collaborations, and unselfish cooperation in research.”*

### Citation

The Atmospheric Sciences section of AGU awards the 2011 Yoram J. Kaufman Unselfish Cooperation in Research Award to Alex B. Guenther of the National Center for Atmospheric Research (NCAR). His qualifications for this award can best be expressed by quoting from those who know him best, as expressed in his nomination letters: “Despite his formidable research reputation—he is without question the world’s leading expert [on the subject of] emissions of volatile organic compounds from the biosphere to the atmosphere—Alex has always remained extremely approachable and friendly and encourages interactions with early career scientists.” “I can say without reservation that he is the most unselfish scientist I have ever had dealings with. Alex has always been incredibly generous with his time and has always gone out of his way to help students and others starting out.” “Alex Guenther has been the catalyst for much of the cohesiveness that has developed within the

community of scientists and students conducting research on the topics of biogenic emissions of volatile organic compounds to the atmosphere and their effects on atmospheric chemistry.” “As you can see from the publications produced from the EXPRESSO campaigns, African colleagues were a central component of the study. More recently, Alex has organized studies in Brazil as part of the NASA LBA [Large-scale Biosphere-Atmosphere Experiment in Amazonia] effort. Once again, in that study, he has organized research teams around collaborations of both North American and South American scientists to conduct the research. Thus, in all of his recent research activities, Alex Guenther has applied the normal operating paradigm of bringing together scientists from around the globe to converge on common topics involving vegetation-atmosphere interactions.”

Alex B. Guenther clearly merits the Yoram J. Kaufman Award for broad influence in atmospheric science through exceptional creativity, inspiration of younger scientists,

mentoring, international collaborations, and unselfish cooperation in research.

—ALAN ROBOCK, Rutgers University, New Brunswick, N.J.

### Response

I am honored by this award and the kind words from my colleagues. It is both rewarding and humbling to be recognized for “exceptional creativity, inspiration of younger scientists, mentoring, international collaborations, and unselfish cooperation in research.” I have been incredibly blessed by opportunities to accomplish this while simply doing what I enjoy.

Although there are still examples of science being advanced by individuals working in solitude, the collaborative approach in the manner of Yoram Kaufman is increasingly necessary. I learned this as a graduate student with Brian Lamb and others in the Laboratory for Atmospheric Research (LAR) at Washington State University, in Pullman. The LAR team is one of the best examples of unselfish and effective cooperation that I have experienced. My career at NCAR, with an institutional emphasis on serving the community, provided an exceptional opportunity to tackle scientific challenges associated with understanding the role of reactive trace gases in the coupling between the physical, chemical, and biological processes operating across the relevant scales of the Earth system. This undertaking requires collaborative efforts of a multidisciplinary and global community of scientists sharing the reward of exciting discoveries and the steady advancement of knowledge. I am especially indebted to the teamwork and excellence of the NCAR



Alex B. Guenther

Biosphere-Atmosphere Interactions group members including students, postdoctoral scientists, and visitors with whom it has been my pleasure to work. My enjoyment of this research was greatly enhanced by the overwhelming hospitality of field study hosts in Asia, Africa, Europe, Australia, and South and North America.

Above all, I am thankful for the support, guidance, and encouragement of my family. My parents and brothers provided my first and most important examples of unselfish cooperation and community building. My wife and children graciously endured my absences while I was traveling around the world. I could not have accomplished anything without them.

—ALEX B. GUENTHER, National Center for Atmospheric Research, Boulder, Colo.

## Shaw Receives 2011 James R. Holton Junior Scientist Award

*Tiffany A. Shaw received the James R. Holton Junior Scientist Award at the 2011 AGU Fall Meeting, held 5–9 December in San Francisco, Calif. The award recognizes outstanding research contributions by a junior atmospheric scientist within 3 years of his or her Ph.D.*

### Citation

The Atmospheric Sciences section of AGU awards the 2011 James R. Holton Junior Scientist Award to Tiffany A. Shaw, an assistant professor at Columbia University. As one of her nominators said, “Tiffany is an exceptionally promising young scientist. She combines a deep understanding of the theoretical foundation of atmospheric sciences with a keen desire to apply it to tackle complex applied issues, such as modeling of gravity waves, study of monsoonal flows, or analysis of moist processes in the storm-tracks.” Another pointed out that “Tiffany

is an outstandingly talented young scientist who has first-rate mathematical skills and the ingenuity needed to crack tough problems, but also has the physical intuition and motivation to carry her theory through to applications.” She has already published 14 journal articles in major journals, and another letter summarized, “there is no doubt in my mind that she is the best atmospheric scientist of her generation.”

—ALAN ROBOCK, Rutgers University, New Brunswick, N.J.

### Response

I would like to thank AGU and the members of the James R. Holton Junior Scientist Award Committee for this award. As an atmospheric dynamicist, I am humbled to be the recipient of an award named after Jim Holton, a dynamicist who had such a profound impact on the field. It is also a privilege to be put in the company of the previous recipients of the award. Given the increasing complexity of climate and Earth system models, it is more important than ever to have a solid foundation in geophysical fluid dynamics and to use that foundation to elucidate the fundamental aspects of the system and its response to external forcing.

I have many people to thank: First, Ted Shepherd, my thesis supervisor, for his support and guidance over the years and for helping to shape me into the scientist I am today; my postdoctoral advisors, Olivier Pauluis and Judith Perlwitz, who have helped me to grow as a scientist; Lorenzo Polvani and Adam Sobel for their support and mentorship; and, finally, all my



Tiffany A. Shaw

collaborators, my family, and my friends, who have enriched my research and my life.

—TIFFANY A. SHAW, Columbia University, Palisades, N.Y.

## Integrated Ocean Drilling Program

Call for Applications  
Application deadline: 30 April 2012

### Baltic Sea Paleoenvironment (Spring-Summer 2013) Expedition 347

Based on IODP Proposal 672 “Paleoenvironmental evolution of the Baltic Sea Basin through the last glacial cycle”, this expedition will investigate the sediments in the Baltic Sea Basin, one of the world’s largest intra-continental basins. The sediments comprise a unique high-resolution archive of the paleoenvironmental history of the huge drainage area, the basin itself and neighboring sea areas. The high sedimentation rates of the Baltic Sea Basin provide an excellent opportunity to reconstruct climatic variability of global importance at a unique resolution from a marine-brackish setting controlled by e.g. changes in Meridional Overturning Circulation, the North Atlantic Oscillation and the Arctic Oscillation.

Scientific objectives include (1) Climate and sea level dynamics of MIS 5, including onsets and terminations; (2) The complexities of the last glacial, MIS 4 – MIS 2; (3) Deglacial and Holocene (MIS 2 – MIS 1) climate forcing; (4) Deep biosphere responses to glacial-interglacial cycles.

It is anticipated that the offshore portion of the expedition will take place during Spring-Summer 2013 and last for 60 days, with only a limited proportion of the Science Party participating. See <http://www.eso.ecord.org/expeditions/msp.php>.

The Onshore Science Party (OSP) is expected to be several weeks long at Bremen University, probably in Autumn of 2013. All members of the Science Party must attend for the whole duration of the Onshore Science Party. See <http://www.eso.ecord.org/expeditions/osp.php>.

Specialists in the following fields are particularly required: sedimentology, microbiology, organic geochemistry, inorganic geochemistry, benthic foraminifera, planktonic foraminifera, diatoms, ostracodes, dinoflagellates, terrestrial palynology, petrophysics/logging, stratigraphic correlation, and paleomagnetism.

Applications must be submitted to the appropriate IODP Program Member Office. Please see <http://www.iodp.org/program-member-offices/>.

Applications will be considered by ESO in June 2012. Please see further details under <http://www.iodp.org/apply-to-sail/>.

### For more details, please contact:

David McInroy, ESO Science Manager, [dbm@bgs.ac.uk](mailto:dbm@bgs.ac.uk) / Carol Cotterill, Expedition Project Manager, [cjcott@bgs.ac.uk](mailto:cjcott@bgs.ac.uk) (<http://www.eso.ecord.org/>)

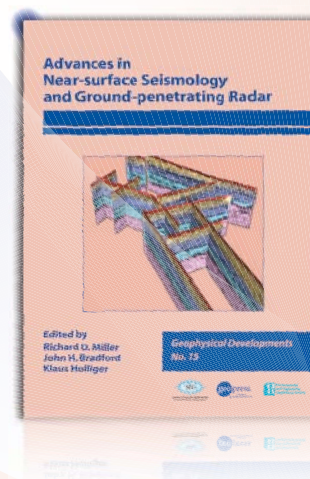


## Advances in Near-surface Seismology and Ground-penetrating Radar

Richard D. Miller, John H. Bradford, and Klaus Holliger, Editors

The most cutting-edge issues with regard to near-surface seismology and ground-penetrating radar are unraveled in this collection of original papers written by internationally renowned and respected authors. Divided into sections based on reviews, methodology, integrative approaches, and case studies, the compilation showcases seismologists’ significant insights into subsurface properties by exploring full wavefields and the new, innovative ways ground-penetrating radar (GPR) researchers have utilized electromagnetic waves to measure electrical properties, relating those to hydrologic and geologic properties. These forward-looking papers also depict the incorporation of advanced modeling and inversion methods as tools for more accurate and complete characterizations of the subsurface.

As a first cooperative publication effort by AGU, the Society of Exploration Geophysicists (SEG), and the Environmental and Engineering Geophysical Society (EEGS), the volume serves as both a reference for researchers and practitioners and a valuable supplement for students studying near-surface seismology, GPR, or general near-surface geophysics.



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POSITIONS AVAILABLE

Atmospheric Sciences

Postdoctoral Position in Regional Paleoclimate Modeling.

A postdoctoral position is available in the Department of Earth and Planetary Sciences at the University of New Mexico. The postdoc will perform regional paleoclimate modeling of tropical cyclones during the Last Glacial Maximum and mid-Holocene to investigate the effects of climate change on tropical cyclone climatology. The research will be conducted as part of a joint project between the University of New Mexico, Texas A&M University, and Lamont-Doherty Earth Observatory.

Demonstrated experience with the WRF or similar model is required, and preference will be given to applicants with expertise in numerical modeling of tropical cyclones. A PhD in atmospheric sciences or a related field is required at the time of the appointment. The position is available immediately, and will remain open until filled.

For further details, or to apply, please contact Dr. Joseph Galewsky (galewsky@unm.edu). To apply, please include a CV, a brief statement of research experience and interests, and the names and email addresses of three references. The initial appointment is for one year, with renewal in future years subject to satisfactory performance.

Ball Aerospace is hiring for a Staff Consultant-Weather and Environment Domain Expert.

Ball Aerospace leads the way in designing, developing and manufacturing innovative aerospace systems. We take on some of the most complex and exciting challenges in the universe--from space and Earth science to national security and intelligence programs. Our success is built on more than products or systems. Our team of more than 3,000 engineers, scientists, technicians and support staff drives all the achievements at Ball Aerospace.

The Weather and Environment Domain Expert is a recognized authority in the external market/community. They are responsible for providing in-depth analysis of the weather and environment market to support strategic decisions. The position supports the weather community by leading and managing a variety of knowledge and analysis projects, including the design and delivery of products and services in response to customer needs. Working in conjunction with the company leadership and leadership in the customer community, the W&E domain Expert helps drive and contribute to the creation of white papers and thought leadership pieces to differentiate Ball in the marketplace.

Our ideal candidate will possess a BS in Engineering or a related technical field, plus 16 or more years of related experience.

Experience areas include:  
- Skilled at identifying trends that translate into key market facing - Proven ability to succeed

working at a senior level in a fast-moving, customer driven environment.  
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Interested applicants should please contact  
Toya Speckman, 303-939-4000.

Geochemistry

Geoscientist - 74278.

The Earth Sciences Division at the Lawrence Berkeley National Laboratory is seeking an early-career scientist with expertise in hydrogeology or petroleum engineering and a strong interest in modeling of groundwater/multiphase flow and transport.

Requires Ph.D. in hydrogeology, petroleum engineering, civil engineering, geology, or a related field.

For additional information and to apply online, please visit:  
http://bit.ly/lbl74278EOS  
LBNL is an AA/EEO employer.

Hydrology

Postdoctoral positions in Hydrology.

The University of Washington's Department of Civil and Environmental Engineering invites applications for two postdoctoral research associate positions. The first will conduct research on the impact of changing climate extremes on water quality. The candidate will be expected to have hydrology and water quality model development and applications experience, and will be responsible for integrating a spatially distributed hydrologic model with water quality modules from EPA's BASIN modeling platform. The second position will assess implications of IPCC AR5 climate scenarios for the hydrology of the western U.S., and will require knowledge of statistical climate downscaling methods and macroscale land surface models. Both positions require proficiency in C/C++ and scripting languages in Linux/Unix environments, as well as handling of large data sets. Email vitae and a short statement of relevant experience to Dennis P. Lettenmaier, dennisl@uw.edu with cc to yearsley@hydro.washington.edu. AA/EOE.

Ocean Sciences

VACANCY INTERNATIONAL SEABED AUTHORITY KINGSTON, JAMAICA TITLE: Head, Office of Resources and Environment Monitoring (OREM), D-1

MINIMUM SALARY: \$129,047 per annum.  
The Office of Resources and Environment Monitoring (OREM) is responsible for providing scientific and technical advice to the organs of the Authority (principally the Council and the Legal and Technical Commission) and for implementing the scientific and technical programmes of the Authority. These programmes include organizing workshops and seminars on scientific and technical matters, developing and maintaining databases, monitoring the activities of exploration contractors with the Authority and promoting and encouraging marine scientific research in the International Seabed Area.

The Head of OREM is responsible for providing strategic direction, leading and managing the staff of OREM.

For detailed information on the position, please visit our website: www.isa.org.jm

Applications should be forwarded by 6 April 2012 to the attention of the Human Resources Officer  
International Seabed Authority by email to postmaster@isa.org.jm or by fax : 1-876-922-0195.

Position Title: Post-Doctoral Research Scientist

Position Location: Texas A&M-Corpus Christi.

Qualifications: PhD in Oceanography or a related field such as Physics, Fluid Dynamics, or Atmospheric Sciences is required. Experience in measurements of turbulence and ability to program in Matlab is required.

Texas A&M University - Corpus Christi (Department of Physical & Environmental Sciences) seeks applications for a competitively awarded postdoctoral fellowship from highly qualified candidates interested in any aspect of: oceanic turbulence measurements, small-scale air-sea interactions, mixing and dispersion under wavy interface or oceanic boundary layer dynamics.

The successful candidate will join a multi-institutional team of researchers working on the dispersion and turbulence in the Gulf of Mexico. The position is renewable every year depending on performance -initial appointment is for three years.

The research will involve a combination of techniques, including in-situ observations, lab studies, remote sensing and/or modeling. The position comes with expectation of publication in refereed journals. The candidates are expected to participate in a few multi-institutional cruises, design and carry out oceanic microstructure measurements, be responsible for processing of acquired data. Fieldwork will begin in summer 2012 and applicants must be able to participate at that time.

Applicants should include a statement of past research experience and future interests, a current CV, and the names and email addresses of three references.

To apply: ONLY on-line applications are accepted at  
http://islanderjobs.tamucc.edu/applicants/Central?quickFind=69724

Search will stay open for 30 days after the ad appears and will continue until the position is filled. If necessary, contact Dr. Darek Bogucki (darek.bogucki@tamucc.edu) for more information about the project.

Solid Earth Geophysics

The Missouri University of Science and Technology Department of Geological Sciences and Engineering invites applications for a full-time tenure-track position at the assistant professor level in Geology and Geophysics in the area of Neotectonics, Remote-Sensing, and Geodynamics to begin September, 2012.

The successful candidate will be expected to develop an externally-funded research program integrated with excellence in teaching at both the graduate and undergraduate levels. Teaching responsibilities will include courses in Tectonics and Remote Sensing as well as others in the individual's area of expertise. Specific research subfields of the successful applicant could include active deformation/geodesy/InSAR, morphotectonics/dynamic-topography, and crustal/mantle dynamics that can build on departmental strengths in Mechanical Earth Modeling, Tectonics, Geophysics/Seismology, and Natural Hazard Mitigation. For a full position

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Head, John and Willie Leone Family Department of Energy and Mineral Engineering

The John and Willie Leone Family Department of Energy and Mineral Engineering (EME) at The Pennsylvania State University invites applications or nominations for Department Head. EME is a unique and innovative department within the College of Earth and Mineral Sciences that is nationally recognized for its research in the areas of energy engineering; mineral resources; environmental science and engineering; and energy economics. EME is one of the few places in the United States that houses integrated engineering and business programs related to energy and mineral resources under one academic roof. The Department seeks a dynamic and innovative leader who is dedicated to excellence in research and education across multiple disciplines. The successful candidate will articulate a poised and ambitious vision for maintaining strength and cohesiveness in all of the Department's programmatic areas; develop new initiatives and fund vehicles to enhance research and scholarship opportunities for undergraduate and graduate students; and promote strategic initiatives within the College of Earth and Mineral Sciences, including enhancement of diversity and increasing engagement with external stakeholders, and is expected to start as early as August 1, 2012. The candidate should demonstrate an exceptional record of scholarship and be qualified for appointment with tenure at the rank of Professor, with an earned doctorate in a field relevant to the Department. The EME Department has 32 faculty members, almost 200 graduate students and 1200 undergraduate students. Undergraduate Engineering programs offered by the Department include Energy Engineering; Environmental Systems Engineering (including Industrial, Health and Safety); Mining Engineering; and Petroleum and Natural Gas Engineering. Undergraduate programs related to business and public policy include BS in Energy Business and Finance; and the online BA program in Energy Sustainability and Policy. EME's graduate program also integrates students from a wide variety of technical and economic disciplines, with options in Energy Management and Policy; Environmental Health and Safety; Fuel Science; Mining and Mineral Process Engineering; and Petroleum and Natural Gas Engineering. EME's active research faculty are closely associated with the EMS Energy Institute (www.energy.psu.edu) and the Earth and Environmental Systems Institute (www.eesi.psu.edu). The Department is also actively involved in teaching general science education courses on energy, resources and environment to non-science majors. Additional information about the Department can be found at www.eme.psu.edu. Review of applications will begin April 1, 2012 and continue until suitable candidates are identified. Applications from individuals of diverse backgrounds are encouraged. Application materials should include a cover letter; curriculum vitae; vision statement; representative research papers; and the names and contact information of at least three references. Applications should be submitted to: Professor Turgay Ertekin, Chair, Department Head Search Committee, The Pennsylvania State University, 101 Hosler, University Park, PA 16802, (E-mail: eur@psu.edu).

Penn State is committed to affirmative action, equal opportunity and the diversity of its workforce.

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Stockholm University

The International Meteorological Institute at Stockholm University

announces the annual

Rossby Visiting Fellowship

for 2013. Join the research community at Stockholm University, Sweden, to work with colleagues in Climate and Earth System Sciences in fields such as atmospheric sciences, oceanography, global water cycle, cryosphere, global and regional climate variability and change, paleoclimatology and climate modeling. For more information about IMI and the visitor program, go to our web-page (<http://www.misu.su.se/>) or contact the IMI Director (Professor Michael Tjernström, email: [michaelt@misu.su.se](mailto:michaelt@misu.su.se)).

Those interested should send a CV, including a publication list, along with a cover letter presenting themselves and how they think they can contribute to the research environment, in particular considering the graduate programs.

Applications must be received before 30 April by mail to International Meteorological Institute, Department of Meteorology, attn: Michael Tjernström, Stockholm University, SE-10691 Stockholm, Sweden, or by email to [michaelt@misu.su.se](mailto:michaelt@misu.su.se).



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description including application procedures visit:  
<http://hraadi.mst.edu/hr/employment/geologygeophysics/>

Interdisciplinary/Other

**Geophysical Sciences, The University of Chicago.**  
The Department of the Geophysical Sciences at the University of Chicago invites applications for faculty positions from outstanding scientists studying Global Sedimentary Geology, including the evolution of Earth's surface and the formation of stratigraphic records. We are interested in candidates who use any combination of field-based, experimental, theoretical, or analytical approaches, and who will complement and interact with our existing research groups in solid-earth geology and geophysics, planetary science, geochemistry, geobiology, paleobiology, atmospheric and oceanic science, glaciology, and climate.  
Candidates must have completed a Ph.D. prior to appointment. Applicants must apply through the University's Academic Careers website and upload a cover letter; a curriculum vitae; statements of research and teaching interests; and names and contact information for at least three referees. Consideration of applications will begin April 1, 2012. For a position at the rank of Assistant Professor, please apply at [academiccareers.uchicago.edu/applicants/Central?quickFind=52110](http://academiccareers.uchicago.edu/applicants/Central?quickFind=52110). To be considered for a tenured rank, please apply at [academiccareers.uchicago.edu/applicants/Central?quickFind=52115](http://academiccareers.uchicago.edu/applicants/Central?quickFind=52115).  
The University of Chicago is an Affirmative Action/Equal Opportunity Employer.  
For more information on the Department, please visit <http://geosci.uchicago.edu>.

**STATE UNIVERSITY OF NEW YORK ONEONTA DEPARTMENT OF EARTH AND ATMOSPHERIC SCIENCES HISTORICALLY UNDERREPRESENTED DISSERTATION FELLOW (VISITING ASSISTANT PROFESSOR).**  
The Department of Earth and Atmospheric Sciences at SUNY Oneonta invites applications for a non-tenure track position as a Historically Underrepresented Dissertation Fellow (Visiting Assistant Professor) beginning in August 2012. This is a temporary, two year appointment. SUNY Oneonta is a comprehensive, public, liberal arts and sciences college with 6,000 students and 500 faculty. The College is ranked ninth among the best regional universities by U.S. News and World Report. The College offers over 60 undergraduate majors and nine graduate programs. The student to faculty ratio is approximately 17:1. The nine-member Earth Sciences Department is multi-disciplinary with undergraduate programs in geology, water resources, earth science, earth science education, environmental earth science, and meteorology. There is also a small master's degree program. The department has a strong history of excellence in teaching, faculty-student mentoring, and continued contact with alumni. The department strongly encourages its faculty to conduct/supervise research projects that involve undergraduates. To learn more about the College or the Department please visit [www.oneonta.edu](http://www.oneonta.edu) or [www.oneonta.edu/academics/earths](http://www.oneonta.edu/academics/earths).  
For a complete description of this position go to: <http://www.oneonta.edu/employment>  
To apply online go to: <https://www.interviewexchange.com/jobofferdetails.jsp?JOBID=30816> Upload cover letter that specifically addresses historical underrepresentation and ability to complete your degree requirements in addition to teaching

duties within the two year time frame (two page max), curriculum vitae, statements of teaching philosophy (two page max) and research interests (two page max), and scanned copies of graduate transcripts (official transcripts required at time of appointment). Please have three professional references send or e-mail letters to: Dr. Martha L. Growdon, Chair, Search Committee, Earth Sciences Department, SUNY Oneonta, Oneonta, NY 13820-4015, [martha.growdon@oneonta.edu](mailto:martha.growdon@oneonta.edu). Applications will be accepted until the position is filled. Review of applications will begin immediately.  
For other employment and regional opportunities, please visit our website at: <http://www.oneonta.edu/employment>.  
SUNY Oneonta values a diverse college community. Please visit our website on diversity at: [www.oneonta.edu/admin/oei/](http://www.oneonta.edu/admin/oei/). Moreover, the College is an EEO/AA/ADA employer. Women, persons of color, and persons with disabilities are encouraged to apply.

**Research Positions Available.**  
Estuarine and Coastal Morphodynamics and Sedimentary Dynamics  
in State Key Laboratory of Estuarine and Coastal Research  
East China Normal University  
Shanghai, China  
The State Key Laboratory of Estuarine and Coastal Research (SKLEC) at East China Normal University (ECNU), Shanghai, China, is seeking six senior level researchers in the fields of estuarine and coastal morphodynamics and sedimentary dynamics. Three of the positions are at the Professor level and three at the Associate Professor level.  
SKLEC, established in 1989, is co-sponsored by the Ministry of Science and Technology of China and ECNU. It is the only state key laboratory in China that specializes in estuarine and coastal studies. More information about SKLEC can be found at <http://www.sklec.ecnu.edu.cn/>.  
SKLEC is a multi-disciplinary research organization. Aiming at the interactions of atmosphere, land and sea and their effects on coastal and estuarine areas and connected basins and continental shelves, SKLEC focuses mainly on the following fields: (1) Estuarine and coastal hydrodynamics, morphodynamics, and sedimentary dynamics; (2) Estuarine and coastal biogeochemical processes; (3) Estuarine and coastal wetland eco-systems and water quality; (4) Sustainable utilization of estuarine and coastal resources; (5) Impacts of global climate change and human development on estuaries and coasts. Additionally, SKELC is expanding its research capacity in the area of ocean sciences.  
Applicants should have a Ph.D. and research experience in any of the following fields: coastal geomorphology, coastal sedimentology, marine geology, or related scientific sub-disciplines.  
Interested candidates should send a PDF file including a CV, a cover letter, and the names and addresses of three references as an email attachment to: [pwang@sklec.ecnu.edu.cn](mailto:pwang@sklec.ecnu.edu.cn) and [zhouyx@sklec.ecnu.edu.cn](mailto:zhouyx@sklec.ecnu.edu.cn).  
For additional information regarding the positions, please contact:  
Ms. Ping Wang ([pwang@sklec.ecnu.edu.cn](mailto:pwang@sklec.ecnu.edu.cn))  
or  
Dr. Yunxuan Zhou ([zhouyx@sklec.ecnu.edu.cn](mailto:zhouyx@sklec.ecnu.edu.cn))  
State Key Laboratory of Estuarine and Coastal Research  
East China Normal University, Shanghai 200062, China  
Tel: +86-21-62232892  
Fax:+86-21-62546441  
Salaries and benefits are negotiable based on qualifications and experience. The search

committee will begin considering applications on March 1, 2012 and will accept applications until the positions are filled.

**Scientific Assistant, American Museum of Natural History.**  
The Dept.of Earth and Planetary Sciences (<http://research.amnh.org/eps/>) seeks a scientific assistant to manage, maintain and research the meteorite collection. Position offers research opportunities. Applicants must have a minimum BA/BS in geology, and interest in and knowledge of planetary science and geochemistry. Experience with electron microprobe/SEM desirable. The AMNH is an Equal Opportunity/Affirmative Action employer. Submit cover letter, resume, & contact info. of 3 professional references by 27-April-2012 to:  
Dr. D. S. Ebel  
Department of Earth and Planetary Sciences  
American Museum of Natural History  
Central Park West at 79th St.  
New York, NY 10024-5192  
[debel@amnh.org](mailto:debel@amnh.org)

**Visiting Young Scientist: A visiting appointment for a recent PhD scientist is available at Dartmouth College.** The appointment would be for up to 6 months during academic year 2012-2013. The position includes teaching in the departments of Physics and Astronomy, Engineering, or Earth Sciences. Extension of appointment may be possible using appropriate sponsored research projects. To qualify, candidates must be U.S. citizens engaged in research related to space science, planetary science, astrophysics, remote sensing, aerospace technology, or technology dependent on space-based platforms. To apply, send a 1-2 page summary of teaching and research goals, curriculum vitae, and the names of three references to: Visiting Young Scientist, c/o James LaBelle, Department of Physics and Astronomy, Dartmouth College, 6127 Wilder Hall, Hanover, NH 03755. For more information, e-mail [james.labelle@dartmouth.edu](mailto:james.labelle@dartmouth.edu). Applications will be reviewed starting April 23, 2012. The position is funded by NASA NH Space Grant. Dartmouth College is committed to diversity in hiring, and members of under-represented groups are encouraged to apply.

STUDENT OPPORTUNITIES

**Chemical Oceanography PhD position.** The Ocean Acidification Research Center (OARC) at the University of Alaska Fairbanks (UAF) is seeking a graduate student to conduct a fully funded project in the western Arctic Ocean to better understand the controls on carbonate mineral saturation states and ocean acidification in the region. Funding includes full stipend, tuition, health insurance and


travel support for one annual meeting. The ideal applicant will have a background (either undergraduate or preferably M.S.) in marine chemistry or a closely related field. The project will require extensive fieldwork in the Arctic Ocean and the applicant must be able to start by June 1st, 2012. For more information please visit [www.sfos.uaf.edu/oarc](http://www.sfos.uaf.edu/oarc) or contact Professor Jeremy Mathis ([jmathis@sfos.uaf.edu](mailto:jmathis@sfos.uaf.edu)). Applications can be submitted at <http://www.sfos.uaf.edu/>.

**Graduate Student Opportunity in Atmosphere-Ocean Interaction.**  
The Atmospheric Sciences Research Center at the State University of New York at Albany has an opening for a motivated PhD student to make state-of-the-art measurements of air-sea CO2 exchange in the Southern Ocean. Qualifications include a BS or MS degree in physical sciences (atmospheric sciences, oceanography, engineering or a related discipline). Anticipated start date April 1, 2012 or when position filled. Contact Dr. Scott Miller ([smiller@albany.edu](mailto:smiller@albany.edu)) or <http://asrc.albany.edu/people/faculty/miller>.

**PhD Graduate Assistantships.**  
The Department of Physical & Environmental Sciences at Texas A&M University-Corpus Christi awards graduate assistantships for incoming Ph.D. students in the Coastal and Marine System Science doctoral program.  
The funding is available in the areas of oceanography, physics or related disciplines see - <http://pens.tamucc.edu/boguckilab/> or <http://www.facebook.com/Bogucki.lab>  
Applications for Fall 2012 are due on 1 February 2012 for priority consideration.  
More information about the CMSS program can be found at:  
<http://cmss.tamucc.edu/>

**Post-Docs For Cloud, Boundary Layer, and Scale-Aware Parameterization Development.**  
Pacific Northwest National Laboratory seeks multiple post-docs in the areas of cloud parameterization, boundary layer parameterization, and numerics of scale-aware physics parameterizations for climate models. Focus will be on development of parameterizations that function well on multi-resolution grids. For more information and to apply, see <http://jobs.pnnl.gov> for job IDs 301465, 301466, & 301467.

**SERVICES, SUPPLIES, COURSES, & ANNOUNCEMENTS**  
**United States Polar Rock Repository.** Rock samples are available as no-cost loans for research, teaching & museum use.  
<http://bprc.osu.edu/emuwebuspr>.



THE NORTHERNMOST UNIVERSITY  
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# Chaired Professor

## in Exploration Geophysics


The chair in Exploration Geophysics is of great importance for fulfilling the strategic goals of the priority area “Mining technology and Metallurgy” of LTU. Sweden is the leading mining nation in Europe and the country where exploration is most strongly supported. We are looking for a research leader conducting research with focus on development of geophysical methods for exploration of mineral deposits.


For more information: **[www.ltu.se](http://www.ltu.se)**

Deadline for application: May 15, 2012, ref no 1501-11

Contact: Professor Sten-Åke Elming +46 (0)72 543 11 60, [sten-ake.elming@ltu.se](mailto:sten-ake.elming@ltu.se)

LULEÅ UNIVERSITY OF TECHNOLOGY has an annual turnover of more than EUR 160 million. Today the University has 1,600 employees and 17,000 students. Research is carried out in close cooperation with companies such as Shell, Ericsson, Scania, LKAB, Airbus, Volvo Aero, IBM and international universities. Research conducted within Luleå University of Technology has a turnover of more than EUR 90 million.





OAK RIDGE NATIONAL LABORATORY

MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

## DEPUTY DIRECTOR, ENVIRONMENTAL SCIENCES DIVISION

**Purpose** The Oak Ridge National Laboratory (ORNL) is seeking applicants for Deputy Director of the Environmental Sciences Division (ESD). This position has primary responsibility to support the ESD Director in scientific leadership, strategic planning, and communications to the scientific community and policy leaders. The Deputy Director will be part of the ESD management team helping to lead environmental sciences at ORNL by expanding scientific knowledge and by developing innovative strategies and technologies in the environmental dimensions of energy, global and regional change, and sustainability. In addition to maintaining an active personal research agenda, the Deputy Director will be responsible for providing scientific leadership of large complex research programs with a focus on successful implementation and execution of scientific strategy for the division and ORNL. ESD is part of the Energy and Environmental Sciences Directorate. For more information on the divisions and directorate, go to <http://www.ornl.gov/sci/ees/>.

**Major Duties/Responsibilities**

- Lead environmental research programs through both a personal research agenda and the development and implementation of scientific strategies to sustain and enhance national and international prominence of the institution.
- Develop strategic partnerships, in collaboration with program managers at ORNL, with other national laboratories, with colleges and universities, with other research institutions, and with public and private corporations.
- Work with the ESD Director, program managers, and group leaders to strengthen existing research programs, to develop new programs, and to drive strategic initiatives for the division in bioenergy, climate change, global environmental monitoring and simulation, sustainability, remediation, and environmental stewardship.
- Represent the division on selected directorate or ORNL committees, task forces, and working groups with a shared responsibility for the overall science and technology strategy for the directorate.
- Identify staffing and other resource requirements. Support recruiting initiatives in diversity, in fellowships, and in university relations.

**Qualifications Required**  
The successful candidate shall have a Ph.D. in environmental or biological research fields such as biogeochemistry, bioenergy, computational environmental science, ecology, ecosystem genomics, earth science, hydrology, or environmental informatics. The successful candidate should be regarded as a leading expert and visionary in the field of environmental sciences. Candidates should have at least 5 years of demonstrated management experience, including leading complex and multidisciplinary research programs. Candidates must have outstanding oral and written communication skills, experience interacting with key stakeholders, clients, and program sponsors, and a demonstrated ability to successfully engage internal staff on new initiatives. Candidates must demonstrate experience in successfully developing, implementing, and executing scientific strategy with engagement from critical stakeholders.

For further consideration, please visit <http://jobs.ornl.gov/> and reference posting NB50292922 or type "Deputy Division Director" in the keyword search field. For additional details, contact Doug Cross at [crossdr@ornl.gov](mailto:crossdr@ornl.gov). Oak Ridge National Laboratory is an equal opportunity employer.

*Oak Ridge National Laboratory has spent the last decade investing billions in scientific infrastructure mapped to the most exciting and urgent science in the world. The unmatched caliber of the Lab's facilities gives our researchers and the user community the opportunity to conduct the most important science of their careers. Feel free to find out more about the Science and Life at Oak Ridge, meet our incredible staff, and while you're here—find the career you have been waiting for at [jobs.ornl.gov](http://jobs.ornl.gov). UT–Battelle is recognized by our employees and the community as an inclusive environment where diversity is valued and individuals and teams are inspired to contribute fully to the organization's success. ORNL is an equal opportunity employer.*



# RESEARCH SPOTLIGHT

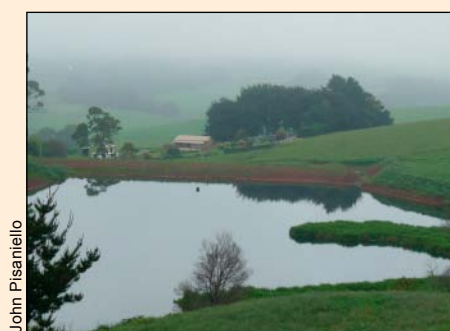
Highlighting exciting new research from AGU journals

## Small dams need better management

Many small dams around the world are poorly maintained and represent a safety hazard, according to *Pisaniello et al.* Better oversight of small dams is needed, the authors argue. The researchers reviewed literature, conducted case studies in four states in Australia, and developed policy benchmarks and best practices for small-dam management.

Small dams, often just several meters high and typically privately owned by individual farmers, have historically caused major damage when they fail. For instance, in China in 1975, 230,000 people died when two large dams failed because of the cumulative failure of 60 smaller upstream dams. In the United States, in 1977 the 8-meter-high Kelly Barnes Lake dam failed, killing 39 people. Many other small-dam failures around the world have resulted in casualties and severe ecological and economic damage.

Dam management practices vary between and within countries, although in many places, few regulations exist to require farmers to maintain their dams at safe standards, the authors note. In their case studies, the researchers found many dams that were unsafe because they were improperly designed, poorly maintained, or had spillways that were blocked by natural vegetation or deliberately blocked by



A typical high-hazard dam on a farm in Tasmania, Australia. The dam is high hazard because residents are located directly below the dam, placing them at threat should the dam fail. The dam has an unacceptably high risk of flood failure due to an inadequately sized spillway, evidenced by how previous overtopping has eroded a portion of the top of the right-hand side of the dam wall next to the spillway outlet.

farmers to retain extra water. The authors argue that government regulation and education efforts, which can include the use of insurance mechanisms and cost-effective technology, are needed to get individual dam owners to bring dams up to a safe standard. (*Water Resources Research*, doi:10.1029/2011WR011155, 2012) —EB

## Passive margin earthquakes: Reviewing knowledge and challenges

Earthquakes like the August 2011 magnitude 5.8 Mineral, Va., temblor that occur on “passive” continental margins surprise people because they expect earthquakes to occur only on plate boundaries. But, in fact, large and damaging intraplate earthquakes occur fairly regularly on passive margins around the world. For instance, in North America the magnitude ~7 Charleston earthquake shook South Carolina in 1886, causing severe damage and about 60 deaths, and the 1929 magnitude 7.2 earthquake on the Grand Banks of Newfoundland caused a tsunami, a large landslide, and 28 fatalities.

Although they are fairly common, these earthquakes are not well studied, and their specific geologic settings and causes are unclear. *Wolin et al.* review what is known about these earthquakes and describe some of the challenges. They note that these quakes, which occur both onshore and offshore, are thought to be caused by reactivation of ancient faults created by previous continental collision and breakup. Stresses causing passive margin earthquakes could be due to plate-wide forces, glacial isostatic adjustment, local stresses, or other factors, but no comprehensive model explains all of these earthquakes. Aftershocks of passive margin earthquakes can occur for hundreds of years.

One challenge is that because large intraplate events occur infrequently and small events are not well recorded, it has been difficult for scientists to collect enough data on passive margin quakes to form a complete understanding. However, GPS is making it possible to track tiny crustal deformations as small as 1 millimeter per year, enabling scientists to identify areas where

strain is building. The authors conclude that it is important to continue research on these quakes, integrating seismic, geodetic, and geological techniques, to learn more about the mechanisms causing passive margin earthquakes and to improve hazard assessment. (*Geophysical Research Letters*, doi:10.1029/2011GL050310, 2012) —EB

## Magnetospheric source of auroras tracked down by satellite fleet

Prebreakup arcs (PBAs), thin, faint tendrils of glowing gas stretching thousands of kilometers in either direction, are very different from the multicolored lights typically associated with auroras. PBAs develop a few minutes before the onset of the full display, brightening and expanding (“breaking up”) to form the more prominent auroras. Previous research has shown that the PBA breakup can be tied to brief pulses of energetic particles (auroral substorms) flowing into the upper atmosphere from the nightside of Earth’s magnetic field, but the PBA generation mechanism has largely remained a mystery. Understanding the formation of PBAs would be an important step toward answering one of the most longstanding and pressing questions in space physics research: How do substorms form?

Using a network of ground-based fish-eye cameras and roughly a dozen satellites, *Sergeev et al.* analyzed 16 auroral breakups to try to understand how changes in Earth’s magnetic field may be related to the formation and structure of PBAs. The authors measured changes in the flow of energetic particles from various regions in the radiation belt and in the tail of Earth’s magnetic field, magnetosphere dynamics, and the behavior of auroras in the upper atmosphere. For 3 of the 16 auroral breakups, they constructed models of the magnetosphere, finding they could largely reproduce their observations of the magnetic environment.

The authors suggest that the formation of PBAs is closely tied to a flow of high-energy electrons stemming from the fringes of the outer Van Allen radiation belt (7.5–11 Earth radii), whose precipitation to the upper atmosphere is controlled by the changing magnetic field. Prior to substorm onset, this source region moves closer to Earth. During its migration it encounters the bulk of the radiation belt particles, whose precipitation may initiate the PBA. (*Journal of Geophysical Research-Space Physics*, doi:10.1029/2011JA017154, 2012) —CS

## Improving forecasts of volcanic ash concentrations

Volcanic ash can severely damage airplanes, and eruptions such as the 2010 Eyjafjallajökull eruption may result in major disruption to air travel. Improved forecasting

of ash cloud locations and concentrations could benefit the aviation industry and reduce delays, but forecasting is challenging because eruptions and atmospheric transport of volcanic ash are complex processes.

The UK Met Office had improved its modeling procedures prior to the 2010 Eyjafjallajökull eruption, enabling peak ash concentrations to be estimated during that event. *Webster et al.* describe the Met Office’s method of ash concentration forecasting and how it has evolved from simply predicting regions of ash to also estimating peak ash concentrations. They compared the forecasted ash concentrations with ground-based and aircraft-based observations collected during the Eyjafjallajökull eruption and evaluated the sources of errors. Although there were challenges with predicting ash concentrations and the errors were, at times, large, the authors conclude that their ash forecasting method gives useful information on likely ash concentrations. The study provides guidance for further improvements in operational forecasting. (*Journal of Geophysical Research-Atmospheres*, doi:10.1029/2011JD016790, 2012) —EB



The 2010 eruption of Eyjafjallajökull.

## Yellowstone’s diverse hydrothermal activity stems from single source

Within Yellowstone National Park, the water emanating from the park’s famous hot springs and geysers seems to belong to either one of two distinct types. In some areas, subterranean waters rich in chlorine and dissolved silicates burst from the ground to create the park’s iconic geysers. In other areas, highly acidic mud pools form from chlorine-depleted waters rich with sulfate ions. In the 1950s, researchers proposed that these two distinct surface features actually stem from a single type of underground water. Across Yellowstone, geysers and mud pools are often separated by defined geographic boundaries, making a test of their interrelatedness difficult. In northwestern Wyoming, however, acid-rich and silica-rich waters coexist within a roughly 12-square-kilometer watershed that drains into nearby Heart Lake.

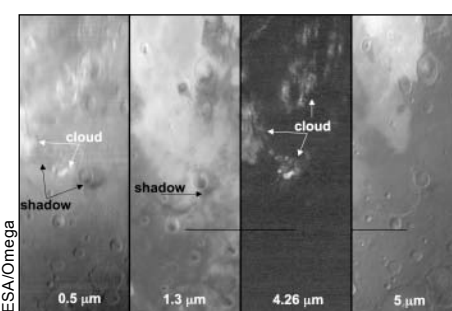
Drawing water and gas samples from pools and steam vents distributed throughout the Heart Lake Geyser Basin, *Lowenstern et al.* found support for the single-water-source hypothesis. On the basis of a wide array of chemical and hydrological analyses, including measurements of the concentrations of various dissolved

minerals, isotope ratios, flow rates, and gas fluxes, the authors found that the diverse features in the Heart Lake Geyser Basin could stem from a single source of 205°C subsurface water. The authors suggest that the chlorine-depleted, acidic mud pools that populate the upper reaches of the basin form as thermophilic bacteria to break down dissolved hydrogen sulfide. That sulfur is carried from the water as it boils below the surface. Farther downstream, after subsurface flow, boiling, and dilution with rainwater, the original source water arrives at the surface as the chlorine- and silica-rich waters typically associated with Yellowstone’s geysers. (*Geochemistry, Geophysics, Geosystems*, doi:10.1029/2011GC003835, 2012) —CS

## Martian carbon dioxide clouds tied to atmospheric gravity waves

On 4 March 1997 the Mars Pathfinder lander fell through the thin Martian atmosphere. During its descent, instrumentation aboard the lander recorded the changing atmospheric temperature, pressure, and density. Within this atmospheric profile, researchers identified anomalous cold air packets within the Martian mesosphere (60- to 90-kilometer altitude). Later orbital measurements confirmed the existence of these cold pockets, adding to the mystery the detection of clouds made from carbon dioxide. Researchers in 1998 suspected that the cold air pockets, and thus conditions favorable for carbon dioxide condensation, were the product of atmospheric gravity waves in the Martian mesosphere. That hypothesis remained largely untested until advances in global- and intermediate-scale atmospheric models allowed *Spiga et al.* to confirm that gravity waves were a potentially viable mechanism to produce the necessary mesospheric conditions.

The authors found that gravity waves, produced in the model when wind rose up and over a mountain, could cause temperature variations in the mesosphere of up to 12 K. They suggest that this amount of cooling, if it happens to coincide with a larger atmospheric temperature shift, could push mesospheric temperatures a few degrees below the ~80°C condensation point of carbon dioxide. Combining the results of their smaller-scale model with those of a Martian general circulation model, the authors found that they could account for carbon dioxide cloud distribution patterns consistent with observational records. (*Geophysical Research Letters*, doi: 10.1029/2011GL050343, 2012) —CS

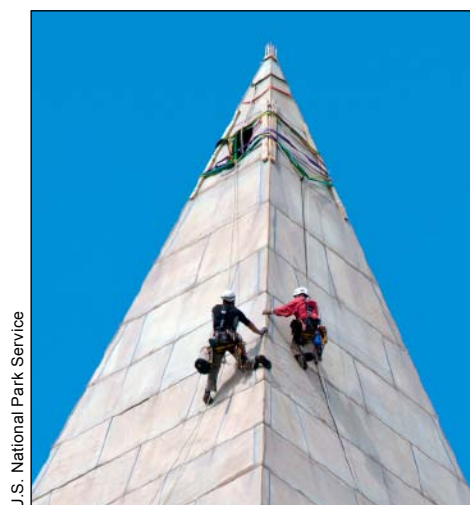


A scene of the Martian surface, taken in multiple wavelengths, shows the presence of mesospheric carbon dioxide clouds and the shadows they cast on the ground below.

## Molecular oxygen ions confirm exosphere at Saturn’s moon Dione

The Cassini spacecraft flew by Dione, one of Saturn’s icy moons, on 7 April 2010. During that flyby, instruments detected molecular oxygen ions around the moon. *Tokar et al.* used those measurements to estimate the density of the molecular oxygen ions to be in the range of 0.01–0.09 ion per cubic centimeter. These molecular oxygen ions are produced when neutral molecules are ionized; the measurements confirm that a neutral exosphere surrounds Dione. (*Geophysical Research Letters*, doi:10.1029/2011GL050452, 2012) —EB

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



Rappellers survey the Washington Monument for possible damage after the 23 August 2011 M5.8 Mineral, Va., earthquake.



Chloride- and silica-rich waters emerge from springs and geysers at the north end of Heart Lake in Yellowstone National Park. More acid sulfurous waters are found higher in the drainage, and both water types are related to a hotter deep fluid found at depth.