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EOS

Earth & Space Science News

Unraveling the Mysteries of Writing Research Proposals

Monitoring Glaciers in the Tropical Andes

Predicting Landslides

Carbon Sequestration in Forests

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Christine W. McEntee, Executive Director/CEO

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Woody Vines Limit How Much Carbon Tropical Forests Sequester

Smithsonian Tropical Research Institute. Photographer: Sean Mattson

Liana vines crisscross a patch of tropical forest in Panama.

Tropical forests, sometimes referred to as the Earth's lungs, are having trouble breathing.

Woody vines, known as lianas, are slowly outcompeting trees in tropical forests, making it harder for those forests to inhale the vast quantities of carbon dioxide that humans pump into the atmosphere every year. In a study published 12 October in the *Proceedings of the National Academy of Sciences of the United States of America* (http://bit.ly/VineCarbon), scientists estimate that without the lianas, tropical forests could soak up 4 times as much carbon dioxide as they do now.

The vines have grown more widespread in recent decades—increasing in some forests by as much as 75%, said Geertje van der Heijden, the study's lead author and a tropical ecologist at the University of Nottingham in the United Kingdom. No one knows for certain why lianas are proliferating, she noted, but one explanation could be that they thrive under higher concentrations of carbon dioxide or drier conditions. Another theory is that because trees are dying faster, lianas can quickly move into the resulting gaps in the canopy, she said.

Forest Competition

The Amazon forest—which is the largest tropical forest in the world—absorbs more carbon than it releases, making it a significant global carbon sink. It sequesters just under 1 billion metric tons of carbon every year through photosynthesis and stores it in the woody tissues of trees.

However, climate change and other human influences are taking their toll on the Earth's forests, especially the tropical ones. Since 1990, the world has lost 129 million hectares to deforestation, predominately in tropical South America and Africa, according to a recent report from the Food and Agriculture Organization of the United Nations (http://bit.ly/DeforestFAO). A study in *Nature* published in March (http://bit.ly/Amazon-Carbon) reported that Amazon trees have been dying at higher rates in the past few decades—possibly because of the atmosphere's increasing carbon dioxide concentrations.

The increasingly abundant lianas are also outcompeting tropical forests' trees, van der Heijden said. Their extensive root systems more efficiently take up water, and their leaves blanket the canopy, blocking out sunlight. The more lianas there are, the faster trees die, allowing the lianas to spread further.

Most important, compared to trees, lianas produce less woody tissue—where carbon is stored in the long term—and more leaves. In other words, what lianas make up for in total biomass, they lack in carbon storage.

"Lianas, on the forest level, make sure that the carbon taken up from the atmosphere is less and that the carbon released back to the atmosphere is higher," said van der Heijden.

Carbon Impact

Previous studies have shown that lianas diminish tropical forests' carbon sequestration, but van der Heijden said this new study quantifies that impact for the first time on a whole-forest level. Researchers cordoned off 16 plots in a 60-year-old forest on the Gigante Peninsula in Panama in 2008 and measured total biomass and the amount of carbon taken up by each plot. Three years later, the researchers removed lianas from eight of the plots and again measured biomass and carbon uptake over another 3 years, comparing the result to plots where lianas remained. The researchers found that the lianas reduced carbon uptake by about 76% in the third year, which translates to 2.43 metric tons of carbon per hectare per year.

Given that the Amazon rain forest, for example, sprawls across 550 million hectares, the loss of carbon-storage capability "is quite a lot," said van der Heijden.

Limit Lianas?

"The cost to the planet of liana-laden trees is decreased rates of carbon uptake and storage by forests. This research shows that liana control makes sense as a global climate change mitigation strategy," said Francis Putz, a professor of biology at the University of Florida, Gainesville, who was not involved in the research.

However, despite their negative impact on carbon storage, lianas provide food and shelter to many organisms and biodiversity to the forest as a whole and shouldn't be blindly chopped down, van der Heijden said. Rather, the lianas' impact should be incorporated into climate models to better understand how tropical forests' carbon intake abilities may change over time, she said.

"The importance of this [study] is that increasing lianas and lianas themselves are really not taken into account in any of the models that try to predict what the climate and tropical forests will look like," she continued. "Lianas are increasing in tropical forests, [and] that needs to be taken into account if we want to make more accurate predictions of what's going to happen with these forests and with climate change in the future."

By **JoAnna Wendel,** Staff Writer

NASA Selects Launch Vehicles for Small Satellites

NASA/Kim Shiflett

NASA official Garrett Skrobot holds up a model at a 14 October briefing to demonstrate the small size of satellites that will launch aboard new rockets to be built under contracts announced by NASA at the briefing.

NASA has selected three companies to provide demonstration commercial launch vehicles to deploy small satellites into low-Earth orbit, the agency announced in mid-October. The result: A class of satellites known as CubeSats, microsats, or nanosatellites will soon fly on small rockets dedicated to their own missions rather than hitch a ride with larger NASA payloads to orbits that can limit the scientific effectiveness of the hitchhikers.

Correction

The article "Gulf of Mexico Dead Zone Largest Since 2002," published in the 15 September 2015 issue of *Eos*, stated that nutrients enter the Mississippi River through runoff. Nutrients enter the river through other ways as well. The online version of the article (http://bit.ly/GulfDZ) has been updated to reflect this.

> The vehicle selection is good news for more than 50 priority CubeSats awaiting launch during the next 3 years.

This is good news for more than 50 priority CubeSats awaiting launch during the next 3 years, said NASA officials at a 14 October briefing at the Kennedy Space Center in Florida. It will also lead to the development of many more small satellites and promote the commercialization and democratization of space, the officials said.

NASA's Launch Services Program (LSP) awarded contracts to Firefly Space Systems, Inc. ($5.5 million); Rocket Lab USA, Inc. ($6.9 million); and Virgin Galactic, LLC. ($4.7 million), following a request for proposals the agency issued in June. The companies are required to launch demonstration flights by 15 April 2018; NASA will track rocket design and technology milestones (see http://bit.ly/Rocket-Contracts).

The launch vehicles will support low-cost and innovative payloads and provide space research opportunities for nonprofits, schools, NASA missions, and commercial enterprises, according to the agency. The miniature satellites offer a low-cost means to conduct Earth and space science research, Earth observation, technology development, and student experiments.

Flying First Class Instead of Coach

With small satellites piggybacking onto primary missions, they have had to fly "coach class" into space, said Garrett Skrobot, lead for NASA's Educational Launch of Nanosatellites mission for LSP. "We had to build our science around those particular orbits or sacrifice some of the science," he said. "CubeSats will now be the primary payloads on these vehicles. We can basically say we are now riding first class."

Mark Wiese, LSP flight projects office chief at Kennedy, said the launch vehicle selection "is a huge step for the commercialization of space." He added that the price tag for the microsat launches would be considerably lower than the $100 million-plus cost for larger missions.

Healthy Competition

Maureen Gannon, Firefly's vice president for business development, said the company plans to eventually ramp up to offer weekly scheduled microsat launches, "allowing customers such as NASA to pick and choose flights that work best for them, that fit their mission and their schedule."

Rocket Lab USA CEO Peter Beck said the average mass of small satellites has decreased by about 75% in recent years, and dedicated launch vehicles will be able to take more of these small satellites into space without compromising their scientific missions.

"You're seeing companies that are coming out to solve problems in very different ways, and that's healthy," Steve Isakowitz, president of Virgin Galactic, said. "I view that as a great opportunity to see the market grow."

By **Randy Showstack,** Staff Writer

Climate Woes Real, Say Most in U.S., Canada, but Differ on Cause

Eighty-two percent of Canadians and 70% of Americans say there is solid evidence of global warming, according to two recent surveys. However, those numbers do not constitute a consensus on the human influence on climate. Just 49% of Canadians and 27% of Americans believe both that there is solid evidence of global warming and that humans are its primary cause, say researchers who conducted the paired surveys.

The National Survey of Canadian Public Opinion on Climate Change and the National Survey on Energy and the Environment posed similar questions to Canadians and Americans in September 2015. The surveys were released on 13 October as part of a report, "Mind the Gap: Climate Change Opinions in Canada and the United States" (see http://bit.ly/climate_change_opinions), during a presentation at the Woodrow Wilson International Center for Scholars in Washington, D. C.

Policy Implications

Although many people think climate change is happening, the fact that not as many think it is caused primarily by humans "has enormous implications" for policy support to take action about global warming, said Christopher Borick with the Institute of Public Opinion at Muhlenberg College in Pennsylvania, who was involved with the U.S. survey.

The U.S. survey found that 56% of Republicans now believe there is evidence of global warming compared with 47% in fall 2014, whereas Republican climate skeptics fell to 26% from 41%. Among Democrats, 79% say there is evidence of global warming, compared with 71% in 2014; among Independents, the number increased to 69% from 57%, according the survey.

The surveys also found that less than 30% of Canadian and American respondents claim to have much knowledge about global warming.

"Nothing in our data to this day suggests that public opinion actually constitutes a pressure for government to act," said Erick Lachapelle, a professor at the University of Montreal involved with the Canadian survey and earlier similar polls. "When you look beyond the 80% perception that there is solid evidence of global warming, you find actually quite a lot of skepticism even in Canada."

Levels of Skepticism

Lachapelle said the skepticism falls into four categories: pure denial; "causal skepticism," where people question the cause of global warming; "consequential skepticism," where people don't see a direct threat from global warming and thus are not motivated to take action; and "response skepticism," where people doubt that anything can be done about global warming.

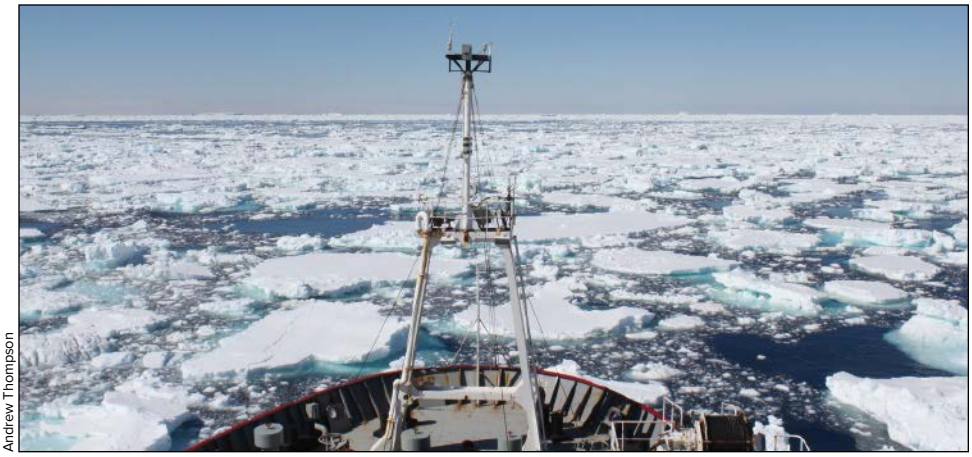
People who acknowledge global warming but attribute it to natural causes align more with climate-change skeptics than with individuals who consider it anthropogenically driven, Lachapelle added. "To lump them together, I think, is a major problem for those that want to claim consensus. They are different creatures."

By **Randy Showstack,** Staff Writer

Adobe Stock

Physical–Biogeochemical Coupling in the Southern Ocean

Southern Ocean Dynamics and Biogeochemistry Workshop
Pasadena, California, 2–5 February 2015



Andrew Thompson

A view from the RRS James Clark Ross *in the northern Weddell Sea. Surface buoyancy fluxes and gas exchange in the lead-filled, marginal ice zone around Antarctica remain poorly constrained because of a lack of observations.*

Over the past 15 years, physical and biogeochemical studies have established that the Southern Ocean, the region surrounding Antarctica, plays a disproportionately large role in modulating Earth's climate. Dense water masses that reside near the ocean bottom throughout mid- and low-latitude basins reach the surface in the Southern Ocean through a combination of wind- and eddy-induced transport. These waters are exposed to heat, freshwater fluxes, and atmospheric gases, which ventilate the deep-ocean reservoirs of heat and carbon.

This region is also critical for the biogeochemical conditioning of nutrients that will be available for primary production (synthesis of organic compounds from carbon dioxide) at lower latitudes. These processes are typically linked to the large-scale depth–latitude structure of the Southern Ocean's density and other property fields, such as temperature, dissolved oxygen, and nutrients.

Research during the past 5 years has increasingly shown that a two-dimensional (2-D), cross-sectional view of the Southern Ocean is too simplistic. Energy content peaks at mesoscales, 10–20 kilometers in the Southern Ocean, but the amplitude and organization of these mesoscale features are not uniform. Distributions of temperature, salinity, nutrients, and dissolved gases typically exhibit even greater structure and patchiness.

The functioning and evolution of Southern Ocean ecosystems and the ventilation of the ocean's deep carbon reservoir depend on the transport of these tracers, which involves an interplay between the underlying circulation and the temporally and spatially varying tracers. The coupled variability of these fields is only beginning to be explored.

To identify gaps in our understanding of Southern Ocean circulation, air-sea fluxes, and tracer fluxes, a workshop on Southern Ocean dynamics and biogeochemistry was held at the California Institute of Technology in Pasadena this past February.

The meeting opened with overview lectures by Michael Meredith, Andy Hogg, Ric Williams, and Danny Sigman on sustained observations, the meridional overturning circulation, air-sea partitioning of carbon, and nutrient fluxes, respectively. The meeting continued over a 3-day period with shorter presentations and significant time for group discussions. Planning future observational strategies that integrate the physical and biogeochemical oceanographic communities was a key goal.

Three major research themes emerged from the meeting discussions:

- 3-D pathways influencing heat uptake, carbon sequestration, and preformed nutrients in the upper ocean. Zonal variations in mass and tracer fluxes extend throughout the water column and localize transport across the Antarctic Circumpolar Current (ACC). It remains unclear how this localization and the 3-D structure of ACC transport properties will respond to a changing climate. Meeting participants also emphasized the need to explore the coupling between physics and biogeochemistry at submesoscales (10 kilometers and smaller) and its impact on setting preformed nutrient values.
- Buoyancy forcing and gas exchange in the marginal sea ice zone. Observations needed to resolve surface processes in the region spanning the winter sea ice extent to coastal polynyas (open water surrounded by sea ice) remain sparse. Specifically, measurements are needed to determine the strength of surface buoyancy forcing and the efficiency of gas equilibration in a divergent, spatially nonuniform (e.g., lead- or gap-filled) sea ice field. These processes significantly influence the lowermost overturning cell dynamics, as well as water mass properties and carbon dioxide concentrations.
- Shelf and slope controls on mass and tracer fluxes. Discussion focused on the need for high-resolution process modeling and better parameterizations of eddy processes over the continental shelf and slope, including localization of transport due to topographic features and the injection of nutrients, such as iron, into the water column due to flow-topography interactions.

Participants discussed observational strategies needed to provide insight into these research priorities. The group highlighted the use of heterogeneous autonomous platforms to acquire persistent (continuous) measurements that resolve seasonal variability in the dynamical processes highlighted above. As sensor development for these platforms continues, an intelligent blend of autonomous and ship-based measurements is needed to advance the science.

Sustained observations, both oceanic and atmospheric, that lead to continuous time series will remain critical for detecting changes in the Southern Ocean. Achievement of these goals in such a challenging environment requires a coordinated, international effort.

Meeting participants and their presentations can be found at http://workshop.caltech.edu/socean/. The workshop was supported by the Linde Center for Global Environmental Science.

By **Andrew F. Thompson,** Environmental Science and Engineering, California Institute of Technology, Pasadena; email: andrewt@caltech.edu; and **Nicolas Cassar,** Division of Earth and Ocean Sciences, Duke University, Durham, N.C.

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Climate Closure

Shaun Lovejoy

A straightforward line of reasoning demonstrates that the only viable explanation of postindustrial warming is an anthropogenic source. This explanation is compatible with the "pause" in the warming since 1998, and it demonstrates that, in a statistical sense, such a pause is extremely likely.

Global warming science has concentrated on proving the theory that the postindustrial warming is largely caused by human activities. Yet no scientific theory can be proved beyond all doubt, and our attempts to convince people of the science are entering a period of diminishing returns.

For example, the Fifth Assessment Report (AR5, 2013) of the International Panel on Climate Change (IPCC) reiterated its 2007 statement "that human influence has been the dominant cause of the observed warming since the mid-20th century," only upgrading it from "likely" to "extremely likely." Meanwhile, those who reject this anthropogenic hypothesis have continued to push their theory that the warming is a giant fluctuation of solar, nonlinear dynamics that are internal to the atmosphere or other natural origin. For brevity we will call this group the "denialists," following the suggestion of *Gillis* [2015].

To end the scientific part of the debate—to reach "climate closure"—it is therefore necessary to demonstrate that the giant fluctuation theory has such a low probability that we can confidently dismiss it. To do this, we can use a fundamental asymmetry in scientific methodology: Although no scientific theory can ever be proved in a mathematically rigorous sense, even elegant theories can be disproved by a single decisive experiment.

> Although no scientific theory can ever be proved in a mathematically rigorous sense, even elegant theories can be disproved by a single decisive experiment.

Below, we summarize a straightforward disproof that achieves this closure so that the only viable explanation of the warming is anthropogenic [*Lovejoy,* 2014a, 2014b, 2015; hereinafter L1, L2, L3]. The same methodology also shows how the anthropogenic theory is compatible with the "pause" in the warming since 1998 and, indeed, in a statistical sense, that such a pause is extremely likely. As a bonus, denialist arguments based on the uncertainties of complex numerical models are rendered irrelevant because this demonstration does not require these models [*Lemos and Rood,* 2010; *Norton and Suppe,* 2001]. Finally, the basic argument can be understood by the lay public.

A Simple Approach to Determine Human Effects

The effects of climate forcings are difficult to quantify and contribute to the large model uncertainties. However, since 1880, the forcings have been linked to economics. To a good approximation, if you double the world economy, double the carbon dioxide (CO_2), double the methane and aerosol outputs, and double the land use changes, you get double the warming. This justifies using the global CO_2 forcing since 1880 as a linear surrogate for all the anthropogenic forcings (L1; using CO_2 equivalent yields nearly identical results).

Figure 1a shows the global annual temperature plotted not as a function of the date but, rather, as a function of the CO_2 forcing. Even without fancy statistics or special knowledge, it is easy to see that the temperature (plotted in green) increases very nearly linearly with some additional fluctuations; these represent the natural variability. The slope (black), 2.33°C per CO_2 doubling, is the actual historical increase in temperature due to the observed increase in CO_2: the "effective climate sensitivity." As a check on our assumptions, this figure sits comfortably in the IPCC range of 1.5°C–4.5°C per CO_2 doubling for the (slightly different) "equilibrium climate sensitivity."

The difference (residues) between the actual temperature and the anthropogenic part is the natural variability, which is plotted in Figure 1b. We can confirm that this is reasonable because the average amplitude of the residues (±0.109°C) winds up being virtually the same as the *errors* in 1-year global climate model hindcasts (±0.105°C and ±0.106°C from *Smith et al.* [2007] and *Laepple et al.* [2008], respectively). So knowing only the slope of Figure 1a and the global annual CO_2, we could *predict* the global temperature for the next year to this accuracy (L3). Clearly, this residue must be close to the true natural variability.

Disproving Natural Causes

The range of the straight line in Figure 1a is an estimate of the total anthropogenic warming since 1880—about 1°C. What is the probability that the denialists are right and that this is

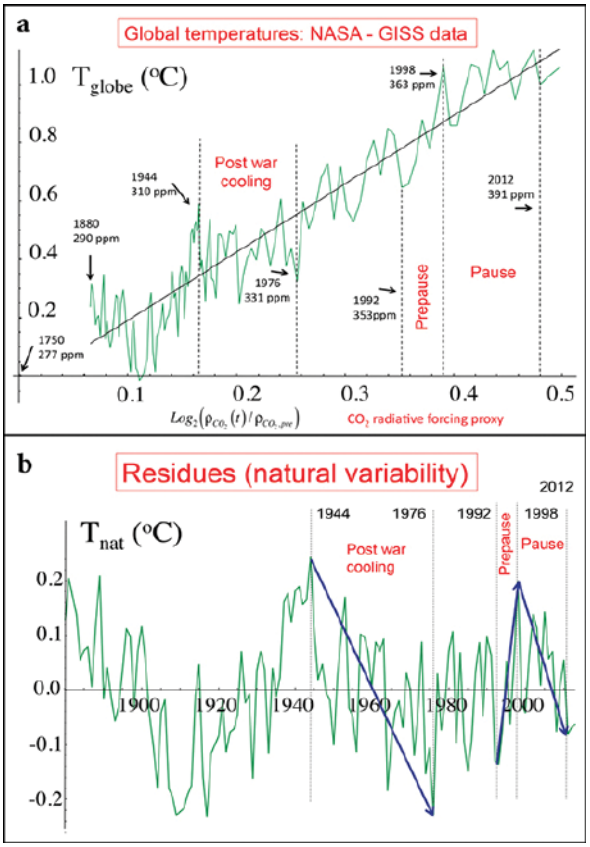

Fig. 1. (a) Global temperature anomalies (NASA, 1880–2013) as functions of radiative forcing using the carbon dioxide (CO_2) forcing as a linear surrogate. The line has a slope of 2.33°C per CO_2 doubling. Some dates and corresponding annually, globally averaged CO_2 concentrations are indicated for reference. GISS, Goddard Institute for Space Studies; ppm, parts per million. Adapted from Lovejoy *[2014b, Figure 1a]. (b) The residuals from the straight line in Figure 1a; these are the estimates of the natural variability. The vertical dashed lines are the same as in Figure 1a. The arrows indicate notable events. Adapted from* Lovejoy *[2014b, Figure 1c].*

simply a giant natural fluctuation? This would be a rare event but how rare?

To check that comparisons of the current period against the historical record are valid, L1 reconstructed records of volcanic and solar activity. That study concluded that the statistics of the industrial epoch variations are no different from the preindustrial ones. Volcanic activity was highly intermittent but no more so than usual; solar activity, which denialists often blame for the observed warming, has, if anything, diminished over the past 50 years [*Foukal et al.*, 2006].

Then L1 used preindustrial temperature series drawing on several sources to estimate the likelihood of a given amount of natural temperature change. Applying the usual statistical approach—the bell curve—to these data leads to the conclusion that the chance of a 1°C fluctuation over 125 years being natural is in the range of 1 in 100,000 to 1 in 3,000,000. This is a rough estimation: For long periods, the standard deviation of temperature *differences* is twice the 0.1°C value. Hence a 1°C fluctuation is about five standard deviations, or a 1 in 3,000,000 chance.

However, nonlinear geophysics tells us that the extremes should be far stronger than the usual bell curve allows. L1 shows that 1°C, century-long global-scale fluctuations are more than 100 times more likely than the bell curve would predict. This gives a probability of at most 1 in 1000, which is still small enough to confidently reject this possibility.

A Necessary "Pause"

One can apply the same type of analysis to the hiatus in the warming (the relatively flat part of the fluctuating line in Figure 1a after 1998), also referred to as the pause. Figure 1b shows that it is actually a natural cooling event sufficiently large (≈0.3°C) that it has masked the more or less equal anthropogenic warming over the period.

Although this cooling is somewhat unusual, it is not rare: Statistical analysis shows that similar 15-year coolings have a natural return period of 20–50 years (L2). Additionally, in this case, the cooling immediately follows the even larger prepause warming event (1992–1998; Figure 1b). That is, the pause is no more than a return to the mean; it can be accurately hindcast (L3).

Alternatively, *Karl et al.* [2015] have recently produced a temperature series with new ocean and other bias corrections. In this warmer series, the amplitude of the corresponding natural cooling is 0.09°C less than that shown in Figure 1b. Because the return period for this smaller natural cooling is only about 10 years (L2, Figure 2), decadal trends cannot (and did not) detect any statistically significant pause at all.

In any case, far from supporting denialist claims that the warming is over, this return is a necessary consequence of the theory of anthropogenic warming that predicts that the natural variability will cause fluctuations to stay near the long-term anthropogenic trend in Figure 1: Without it, the warming would have soon become unrealistically strong.

Although this cooling is somewhat unusual, it is not rare: Similar 15-year coolings have a natural return period of 20–50 years.

Quod Erat Demonstrandum

The scientific method is much more effective at rejecting false hypotheses than at proving true ones. By estimating the probabilities of centennial-scale preindustrial temperature changes, with 99.9% confidence we are able to reject the denialist hypothesis that the industrial age warming was from solar, volcanic, or other natural causes, leaving anthropogenic origin as the only alternative.

The scientific debate is now over; the moment of closure has arrived. Although climate scientists must move on to pressing scientific questions such as regional climate projections and the space–time variability, our species must tackle the urgent issue of reducing emissions and mitigating the consequences of the warming.

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Teaching the Art and Science of Getting Research Funding

By Elisha M. Wood-Charlson and Barbara C. Bruno

The National Science Foundation–funded EDventures program delivers successful training in proposal writing to graduate students and postdocs.

All scientists, no matter how talented, need to know how to secure funds to support their research. But many scientists make it all the way to faculty positions without any substantial training in how to write successful grant proposals. This shortfall can imperil otherwise promising careers.

If your institution does not offer proposal writing training to graduate students and postdocs, we encourage you to fill this critical gap. To help, we present an innovative program, EDventures (http://bit.ly/C-MORE_Edventures), as a model of real-time proposal-writing training with a built-in reward: the possibility of receiving funding for the proposed activities.

Any research group or department can create an EDventures program; the only costs involved are the pot of money made available to proposers and a bit of faculty time.

Learning by Doing

Created by the National Science Foundation (NSF)-sponsored Center for Microbial Oceanography: Research and Education (C-MORE), a multi-institutional center based at the University of Hawai'i at Mānoa, EDventures awards seed funding for educational activities. Graduate students and postdocs build skills by both writing proposals and executing funded projects.

Rather than providing training before participants start writing, the EDventures model encourages students and postdocs to write proposals based on guidelines provided in the request for proposals. Proposers receive training during the review stage, when they receive feedback specific to their proposal.

An EDventures researcher from the University of Hawai'i at Mānoa collecting viral RNA samples along the Antarctic Peninsula.

EDventures also encourages graduate students and postdocs to serve as reviewers. This adds a third layer of training: Students build skills not only through writing proposals and executing the project but also through reviewing their peers' proposals.

A Friendly Review Process

As at many funding agencies, EDventures panelists first review proposals independently and then convene to reach a consensus. What happens between these two stages, however, is not at all typical: Reviewer comments, criticisms, and requests for clarification are shared with proposal authors, who are invited to revise and resubmit their proposals before the panel convenes.

Since its creation in 2007, EDventures has awarded funding for 40 of 51 (~78%) proposal submissions. By contrast, most funding agencies fund only a minority of proposals. As EDventures funds only high-quality proposals, we attribute our anomalously high success rate to the user-friendly review process. Like manuscript peer reviews, proposal peer reviews can dramatically increase quality.

Any organization that creates an EDventures program can freely establish its own guidelines. Our program employs NSF merit review criteria and accepts three proposal types: research proposals focusing on "high-risk, high-reward" studies, training proposals geared toward developing new skills, and outreach proposals. Any C-MORE personnel (including faculty and staff) can submit outreach proposals, but only students and postdocs can submit research or training proposals.

Logistical Considerations

When creating an EDventures-like program, it is important to establish a management team to review the panel's funding recommendations, make a final decision, ensure that proposal budgets follow institutional and funding agency guidelines, and administer the transfer of awards.

The management team should include principal investigators with broad knowledge of your organization's research and outreach missions. In cases where the management team does not follow the panel's recommendation, they should communicate their reasons to the review panel, thereby providing an opportunity for additional training.

We highly recommend appointing a senior graduate student or postdoc to serve as program manager. She or he will advertise the program, coordinate proposal submission and review, recruit panelists, and serve on the management team. We also recommend that the program manager create a website or Facebook page to share the request for proposals, submission dates, and abstracts of previous awards.

This role will train an early-career scientist in project management while reducing faculty workload. This experience can be a valuable contribution to the CV of an early-career researcher because it builds skills in project management, tracking budgets, grantsmanship, interacting with senior personnel, and social media. Depending on the number of proposal cycles per year and the number of submissions per proposal cycle, acting as program manager may require a fair amount of work. If possible, consider factoring these extra responsibilities into the program manager's normal working hours as a graduate student or postdoc to ensure that she or he is not stretched too thin.

Students build skills not only through writing proposals and executing the project but also through reviewing their peers' proposals.

Delivering Success

What imprint has EDventures made on students' and postdocs' careers? To find out, we administered an anonymous online survey (see http://bit.ly/Edventures_survey) to 187 C-MORE personnel and alumni, regardless of their participation in EDventures.

We received 61 nonblank responses, including 35 from students and postdocs. Of these respondents, 22 (63%) were proposal authors and/or reviewers; the remaining 13 (37%) did not participate in EDventures in any way. A total of 34 EDventures awards was granted to students and postdocs over the program's 9-year history; thus, the 22 participant respondents represent a 65% return rate. Although selection bias is always possible, this high return rate suggests a representative sample.

We evaluated program success in three ways: (1) subjectively, on the basis of participant self-reporting, (2) objectively, on the basis of subsequent proposal success rates, and (3) anecdotally, through success stories.

Participant Self-Reporting

The survey included six Likert scale questions, which asked respondents to report their self-confidence at various aspects of the proposal process on a scale of 1 (very low) to 5 (very high) before and after participating in EDventures. Nonparticipants simply answered each self-confidence question once.

Four questions concerned the proposal process: developing ideas, writing, reviewing, and submitting. Two questions focused on fostering collaborations and engaging in outreach. We used a two-tailed *t* test to evaluate mean "before" versus "after" differences.

For each question, mean confidence increased significantly from before to after program participation (paired *t* test; all $p < 0.001$; Figure 1). Mean "before" values ranged from 2.82 to 3.27 (which we termed medium confidence), and mean "after" values ranged from 3.64 to 3.82 (high confidence). It is not surprising that the responses of nonparticipants and those of participants before they took part in the program were not significantly different (unpaired *t* test, all $p > 0.16$).

Subsequent Funding Success

Subsequent to receiving EDventures awards, 22 program alumni reported that they had submitted 36 proposals (~1.64 proposals per alumnus) to outside agencies. It is impressive that 13 of the proposals were funded. Because five are still pending, alumni currently have a 42% success rate.

Of the 31 proposals on which a decision has been made, 12 were submitted to NSF, including 10 to NSF directorates

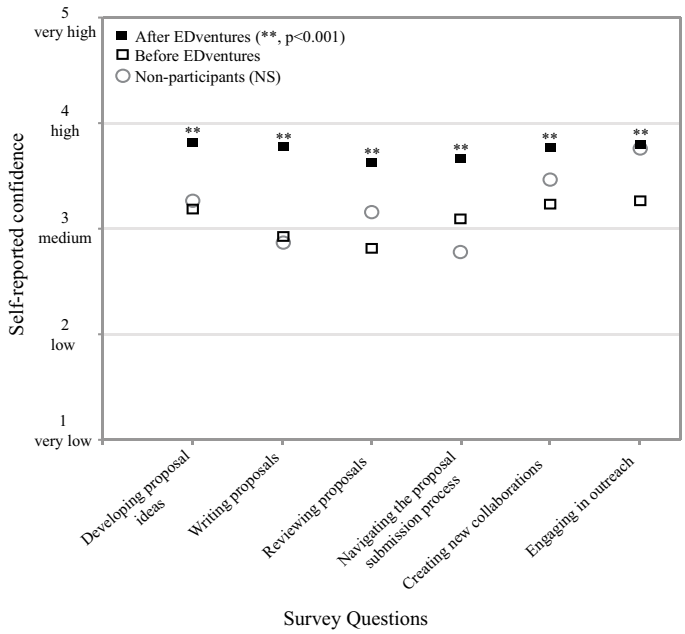
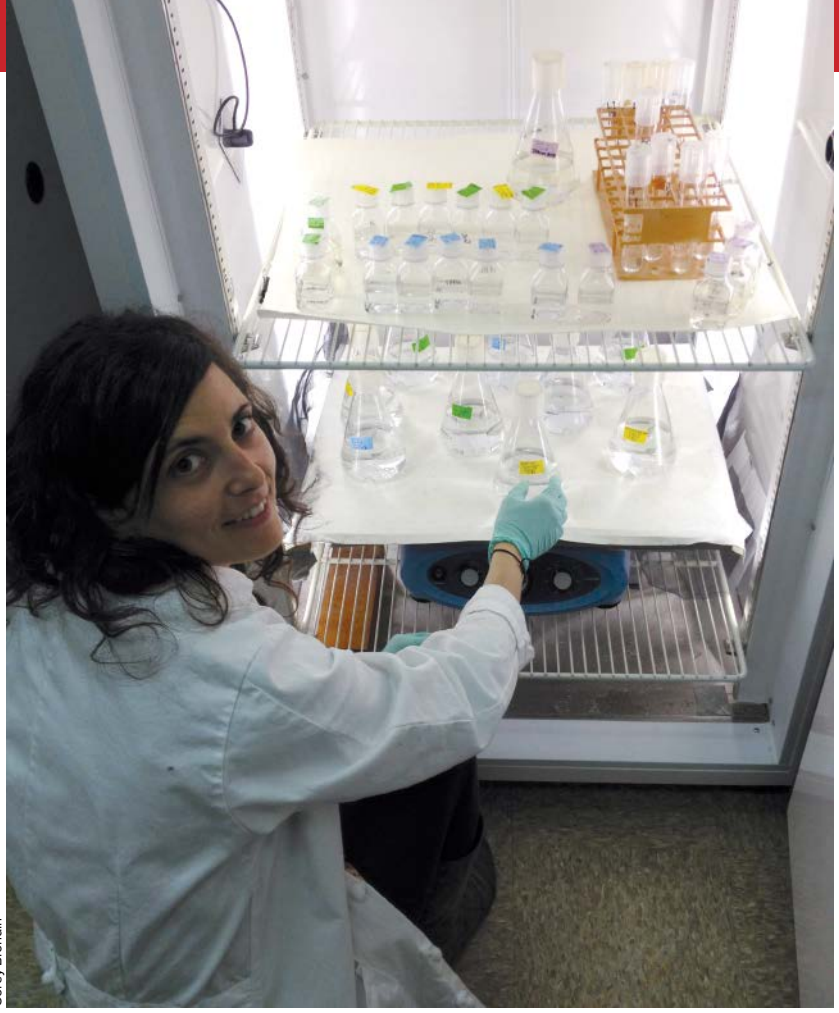


*Fig. 1. Self-reported confidence level of graduate students and postdocs in six key areas before (open squares) and after (solid squares) participating in EDventures (n = 22) and that of nonparticipants (circles, n = 13). For participants, mean confidence increased for each question after participating in EDventures, and all increases were significant (all p < 0.001, represented by **). Comparing nonparticipants to participants before EDventures, there were no significant differences (p = 0.16–0.85, NS).*



Corey Blondin

Fig. 2. EDventures awardee Mónica Rouco Molina (Columbia University), tending to her Trichodesmium *colonies.*

and 2 to the Graduate Research Fellowship Program (GRFP). The NSF proposals had an astonishing 50% funding rate: 5 directorate proposals and 1 GRFP proposal were funded. This compares extremely favorably to the 22% cross-directorate funding rate for early-career scientists [*NSF,* 2014]. Clearly, EDventures participants are well positioned for professional success.

Success Stories

Anecdotally, EDventures alumni have had several notable successes over the years. Here we highlight two examples.

Graduate student Christopher Schvarcz's proposal began with training at a Joint Genome Institute genomics workshop, followed by research to sequence genomes from previously undescribed marine viruses. Schvarcz discovered that some of these viral genomes encoded for carbon utilization pathways previously thought to exist only in cellular life. Unexpected discoveries such as these challenge our perception of viruses as simply packets of viral code. Schvarcz presented this research at the 2014 Ocean Sciences Meeting [*Schvarcz and Steward,* 2014].

Regarding outreach, former postdoc Angelicque White developed an interactive website (see http://bit.ly/C-More_microscopy) to illustrate how marine microbes transfer energy and matter in the ocean. This highly visual project inspired the art show *The Art of Plankton, Form Follows Function,* which featured work from 35 Oregon artists based on White's plankton images [*Houtman,* 2012]. White is now an associate professor at Oregon State University.

Participants' proposal-writing skills, particularly for NSF proposals, improved through program participation.

Positive Feedback

Feedback received from proposal authors and reviewers on the C-MORE EDventures program has been overwhelmingly positive. We acknowledge that EDventures participants are self-selecting; they came to the program with a desire to develop projects, improve their proposal skills, and make progress in their professional development. Nevertheless, the EDventures program rarely received negative reviews.

Students and postdocs have reported that developing projects based on their own ideas rewarded them with a sense of professional independence and helped them progress toward careers as principal investigators. They reported enjoyment and satisfaction in completing projects and sharing results, often in presentations or publications. Many found the proposal-specific feedback received through the two-stage peer review process to be highly useful—considerably more so than the generic proposal-writing training typically received in a workshop.

EDventures award recipient Mónica Rouco Molina (Figure 2) recounted, "The constructive criticisms and suggestions from the EDventures review panel helped me improve certain aspects of the proposal, such as the level of detail to use when describing data analysis tools, contributing to a better quality of the final project." Rouco was a C-MORE postdoc and is now a lecturer at the Lamont-Doherty Earth Observatory at Columbia University.

Review panelists also reported receiving valuable training. Beyond discussing the proposed science, the panel review and discussion often provided insights that improved their own proposal writing skills. They also learned about the more technical aspects of proposal writing, such as federal per diem limits and subcontracts.

Former panelist Jessica Fitzsimmons noted, "Not only did [reviewing EDventures proposals] improve my own proposal writing, especially for the shorter proposal length required by EDventures, but it also helped me identify the most common proposal writing pitfalls for students I men-

tor, which improves their proposal writing as well." A former C-MORE graduate student, Fitzsimmons is now an assistant professor at Texas A&M University.

Management team member Paul Kemp concurred with the self-assessments of Rouco, Fitzsimmons, and others that participants' proposal-writing skills, particularly for NSF proposals, improved through program participation. Kemp, who is associate director of C-MORE and former NSF deputy division director, noted, "C-MORE graduate students and postdocs were able to improve their NSF proposal writing skills because the C-MORE management team decided to model EDventures after the NSF proposal process."

An Adaptable Program

EDventures has been shown to increase participants' self-confidence in the proposal process, and it has the potential to increase the number and quality of subsequent proposals produced by early-career scientists. The program, which is nearing the end of its grant period, has received very positive reviews from participants.

The EDventures model can easily be adapted to fit any research program or budget. Program project funding amounts can be modest (e.g., $10,000–$30,000 per year), and proposal categories (e.g., research, training, and outreach) can be readily adapted to fit your program's goals and objectives.

If your organization is looking for ways to help early-career scientists become better grant writers, we hope you will consider EDventures as a model. For more information, please visit the EDventures website or contact the lead author.

Acknowledgments

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GREAT ICE Monitors Glaciers in the Tropical Andes

By Jean Emmanuel Sicart, Marcos Villacis, Thomas Condom, and Antoine Rabatel

An international program strengthens glaciological studies in the tropical Andes, promotes collaborative projects, and develops educational programs with local universities.

Tropical glaciers in the central Andes cover about 1920 square kilometers in Bolivia (20%), Peru (71%), Ecuador (4%), and Colombia-Venezuela (4%). They play a significant role in freshwater availability in highly populated regions and are key indicators of recent climate changes in poorly documented mountainous regions [*Rabatel et al.*, 2013].

To study them, the French Institut de Recherche pour le Développement (IRD) partnered with local universities and research institutions, founding glaciological programs in Bolivia in 1991 and in Peru and Ecuador in 1994. This grew into a permanent monitoring program, which was incorporated into the global glacier-monitoring network GLACIOCLIM (Glaciers, a Climate Observatory; see http://bit.ly/glacioclim) in 2002. Two of the glaciers that are being monitored—Zongo in Bolivia and Antisana 15 in Ecuador—are now the longest-monitored glaciers in the tropics and are considered benchmark glaciers by the World Glacier Monitoring Service.

The IRD funded the international GREAT ICE (Glacier and Water Resources in the Tropical Andes: Indicators of Changes in the Environment; see http://www.great-ice.ird.fr/) program in 2011 to strengthen glaciological studies in the tropical Andes; promote collaborative projects between Andean institutions in glaciology, climatology, and hydrology; and develop education and student training programs with local universities.

The GREAT ICE Program

The initiative in Bolivia in 1991 has grown into a network of permanent glacier monitoring with sites in four nations

The view from the glacier on the slopes of Antisana, the fourth-highest volcano in Ecuador.

Glaciers in the tropical Andes have been retreating since the late 1970s at a rate that appears to be unprecedented since the Little Ice Age maximum.

(Figure 1). It includes institutions in France (Laboratoire d'Étude des Transferts en Hydrologie et Environnement, Laboratoire de Glaciologie Geophysique de l'Environnement, University of Grenoble, Maison des Sciences de l'Eau, and Laboratoire de Géographie Physique), Bolivia (Universidad Mayor de San Andrés), Ecuador (Escuela Politécnica Nacional and Instituto Nacional de Meteorología e Hidrología), Peru (Unidad de Glaciología y Recursos Hídricos de la Agencia Nacional de Agua, Servicio Nacional de Meteorología e Hidrología, and Instituto Geofísico del Perú), and Colombia (Instituto de Hidrología, Meteorología y Estudios Ambientales and University of Colombia).

Three main research areas are addressed:

- evolution of the ice masses from the Little Ice Age (13th–19th centuries) to the present
- analysis of glacier ablation and accumulation processes and their relationships with the local to large-scale climate
- impacts of glacier changes on water resources

Research questions include whether the glacier retreat observed in recent decades is unprecedented since the Little Ice Age and how it is related to changes in precipitation and temperature.

Permanent glacier-monitoring networks have been functioning in the central Andes since 1991 in collaboration with local partners (Figure 1). The observation system includes glaciological, hydrological, and meteorological measurements.

Remote sensing studies have used aerial photographs and satellite images to reconstruct the evolution of the surface area, volume, and length of the glaciers since the mid-20th century. Moraines were used to reconstruct glacier fluctuations since the Little Ice Age maximum in the second half of the 17th century. Analysis of ice cores from summits in Ecuador, Peru, and Bolivia revealed information about climate variations on a multidecadal time scale over the past millennium. A comprehensive overview of the GREAT ICE investigations can be found in *Rabatel et al.* [2013].

Glaciers in Retreat

Like most mountain glaciers worldwide, glaciers in the tropical Andes have been rapidly retreating since the late 1970s. The rate of current retreat appears to be unprecedented since the Little Ice Age maximum [*Rabatel et al.*, 2013]. The magnitude of mass loss seems to be related to the size and elevation of the glacier. Glaciers with a maximum altitude higher than 5400 meters above sea level (i.e., glaciers that still have a permanent accumulation zone) have typically lost the equivalent in water of 0.6 meter in thickness every year over the past 3.5 decades, whereas glaciers with a maximum altitude lower than 5400 meters have shrunk at an average rate of 1.2 meters water equivalent per year, i.e., at twice the rate of the higher glaciers. Although sporadic positive annual mass balances have been observed on some glaciers, the average mass balance has been mostly negative over the past 50 years.

GREAT ICE has extensively studied the link between glaciers and climate. In the outer tropics of Bolivia and Peru, which are characterized by marked seasonality in cloud cover and precipitation, process-based energy balance studies investigated the atmospheric forcing that controls seasonal and interannual variations in the glacier mass balance [e.g., *Sicart et al.*, 2011]. In the inner tropics of Ecuador and Colombia, studies focused on the relationship between mass balance and climate variability linked to El Niño–Southern Oscillation, which exerts a greater influence there than it does in the outer tropics [*Francou et al.*, 2004].

Solar radiation is the main source of energy, but seasonal changes in melting energy are mainly driven by long-wave radiation—infrared radiation emitted by clouds and moisture in the atmosphere. This radiation is closely linked to clouds and humidity, which are the main seasonal variables of low-latitude climates. Long-wave radiation plays a key role in the energy balance of tropical glaciers. During the melt season, light snowfalls are frequent, and the glacier surface continuously alternates between ice and thin layers of snow that rapidly melt, so that the melt rate strongly depends on the frequent changes in surface albedo.

Tropical glaciers are characterized by large vertical mass balance gradients due to the frequent changes in snow cover throughout the long ablation season. Ablation and accumulation processes are closely related, and the mass balance strongly depends on the timing and length of the wet season, which arrives during the summer months, interrupting the period of highest melt rates caused by solar radiation [*Sicart et al.*, 2011]. GREAT ICE is currently studying the properties of the wet season in terms of precipitation frequency, intensity, and phase.

Glaciers: A Key Water Resource, Under Threat

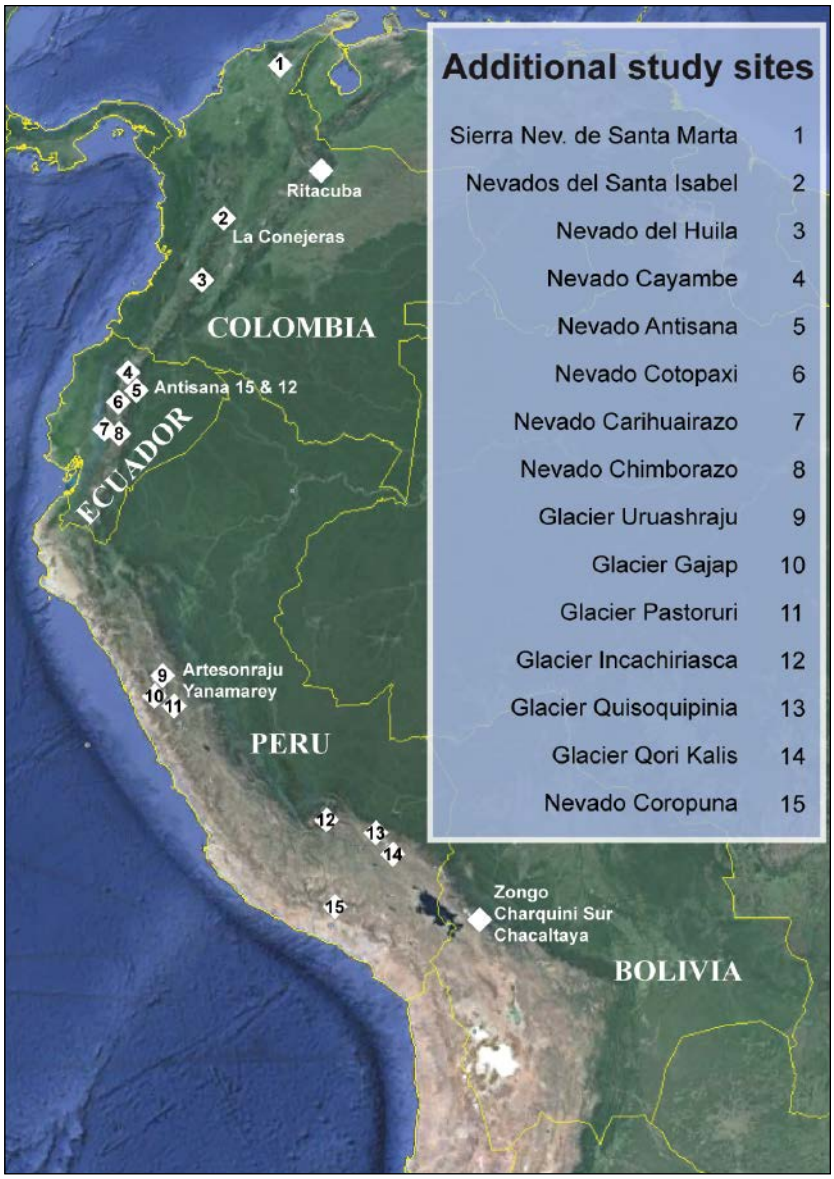
The supply of water from glacierized mountain chains is critical for agricultural and domestic water consumption as well as for hydropower generation. Glacier runoff will initially increase as the climate warms and glaciers melt at a faster rate, probably resulting in a deceptive increase in water to downstream reaches. However, this increase will then be followed by a sobering reduction in runoff as the glaciers dwindle, affecting water resource availability and reducing the glacier's capacity to act as a buffer, adding water to the stream flow during periods of low seasonal precipitation.

GREAT ICE has studied the hydrology of glaciers in several regions, including the Peruvian Rio Santa basin, which

drains the Cordillera Blanca, the most glacierized tropical mountain range in the world. There glaciers shrank by 36% to 528 square kilometers between 1930 and 2003 and contribute up to 20% of annual Rio Santa runoff. In the dry season, around two thirds of runoff comes from glaciers [*Condom et al.*, 2012].

In Bolivia, *Soruco et al.* [2015] studied the supply of glacier water to the city of La Paz between 1963 and 2006 and showed that glaciers contributed roughly 15% of the water resources at an annual scale—14% in the wet season and 27% in the dry season. In the future, assuming complete disappearance of glaciers and no change in precipitation, they calculated that runoff should diminish by about 12% at an annual scale, 9% during the wet season and 24% during the dry season. This demonstrates the important buffer effects of glacier melt in seasonal changes of runoff.

Glacier melt contribution to runoff is also significant in Ecuador, reaching 35% during the dry season in populated areas around Cayambe, Antisana, Cotopaxi, and Chimborazo mountains [*Nolivos et al.*, 2015].



Modified from *Rabatel et al.* [2013]; CC BY 3.0 (http://bit.ly/ccby3-0)

Fig. 1. A 1991 glacier-monitoring initiative in Bolivia has grown into a permanent network in the tropical Andes, with sites in four nations. The main study sites are marked on the map, and additional study sites are numbered and listed in the inset.

Training the Next Generation of Glacial Hydrologists

GREAT ICE has a strong commitment to education and student training, in particular through funding and supervising South American students. The IRD has funded roughly 10 Ph.D. positions in French universities through GREAT ICE programs, which include the opportunity to spend several months in France and to attend international scientific conferences.

These programs connect the students with national and international collaborators, allowing them to broaden their experience and build a professional network. The students also receive chances to disseminate their work via presentations to scientific and nonscientific audiences, popular science publications, and interviews with media and by participating in the making of documentary films.

Next Steps: Biodiversity and Water Management

In the second phase of the GREAT ICE program planned for 2016, a new theme will be proposed: the impacts of glacier changes on terrestrial and aquatic biodiversity. Although plants may be able to colonize new terrain opened up by the glaciers' retreat, we hypothesize this upward migration to be much slower than glacier retreat itself, at least for a number of key organisms. We expect that this lag will negatively affect the biodiversity and functioning of mountain ecosystems.

Moreover, reduction in glacial meltwater contribution to river flow may potentially affect the specialized aquatic fauna in glacier-fed rivers. The decrease in water availability should also reduce the high Andean wetlands and associated biodiversity and vegetation biomass.

Further efforts in glacier-hydrological modeling are crucial to inform policy makers about how to manage water resources in regions whose glaciers are rapidly shrinking. So far, most studies have been limited to small drainage

The mass balance strongly depends on the timing and length of the summer wet season, which interrupts the period of highest melt rates.

basins, but we now urgently need to investigate the effect of glacier shrinkage on water resources and availability for human use on the scale of mountain ranges. Hydrologists will need to collaborate closely with climatologists, especially in tropical mountains where the impact of climate change is still uncertain.

Acknowledgments

The Laboratoire Mixte International program GREAT ICE is supported by the IRD. The glaciological monitoring network is sponsored by the French SO/SOERE GLACIOCLIM (Service d'Observation/Système d'Observation et d'Expérimentation pour la Recherche en Environnement) and Labex OSUG@2020 (Investissements d'Avenir ANR10 LABX56). The co–principal investigators of the GREAT ICE project are Alvaro Soruco (Universidad Mayor de San Andrés, La Paz, Bolivia), Bolivar Caceres and Luis Maisincho (Instituto Nacional de Meteorología e Hidrología, Quito, Ecuador), Wilson Suarez (Servicio Nacional de Meteorología e Hidrología, Lima, Peru), and Jorge Luis Ceballos (Instituto de Hidrología, Meteorología y Estudios Ambientales, Bogota, Colombia). We thank Benjamin Lehmann for providing the photograph of the Huayna Potosí massif.

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AGU Sections and Focus Groups Announce 2015 Awardees

Garrick-Bethell Receives 2015 Ronald Greeley Early Career Award in Planetary Science

Ian Garrick-Bethell will receive the 2015 Ronald Greeley Early Career Award in Planetary Science at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif. The award recognizes significant early-career contributions to planetary science.

Ian Garrick-Bethell

Citation

The Greeley Early Career Award is named for pioneering planetary scientist Ronald Greeley. Ron was involved in nearly every major planetary mission from the 1970s until his death and was extraordinarily active in service to the planetary science community. Ron's greatest legacies, however, are those he mentored through the decades, and it is young scientists whose work and promise we seek to recognize.

This year's Greeley Award winner is Ian Garrick-Bethell, an assistant professor at the University of California, Santa Cruz. Ian received his Ph.D. from the Massachusetts Institute of Technology in 2009, working with Maria Zuber and doing a second project with Ben Weiss, and moved afterward to a postdoc at Brown University.

Ian began by studying the long-wavelength topography and the inertial moments of the Moon. Ian first suggested that the Moon might not have spent its orbital evolution in a circular, synchronous orbit but may have moved through other orbital configurations, including a 3:2 spin orbit resonance. Ian went on to show that the Moon's fossil shape is consistent with being a tidal-rotational bulge that formed when the Moon was at 32 Earth radii. Ian's first lunar work was published in *Science*.

Ian then worked with Ben Weiss to use modern techniques to investigate the source of remanent magnetism in some lunar rocks. The resulting paper, also published in *Science*, provided the first convincing evidence of an ancient core dynamo on the Moon. Now Ian is the principal investigator on a Discovery mission proposal to investigate the high-albedo swirls visible on the Moon's surface, which he suggests are caused by locally strong crustal magnetic fields.

It's often said that the difficult part of science is not finding answers but asking the right questions. Ian has the gift of asking the big questions. Congratulations to Ian Garrick-Bethell, the 2015 recipient of the Ronald Greeley Early Career Award in Planetary Science.

—Linda T. Elkins-Tanton, *Arizona State University, Tempe*

Response

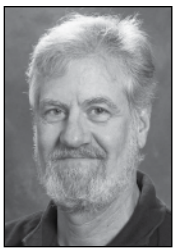
I am deeply honored to receive the Ronald Greeley Award this year. Ron's interest in the Moon at the start of his career is particularly inspiring to me, as I have also started my career studying the Moon. Ron eventually contributed to the study of many solar system objects, and I hope my research may eventually have the same reach.

I would like to acknowledge the tremendous support I've had from my Ph.D. advisers, Maria Zuber and Benjamin Weiss. I am very grateful for their roles in my career. I'd also like to acknowledge and thank my outstanding postdoc advisers, Carle Pieters and Jim Head. Many thanks to the support from NASA Ames Research Center in developing mission concepts with me, especially with the assistance of Pete Worden and Belgacem Jaroux. I'd like to thank Bob Lin for his early enthusiasm for many of these concepts. I'd also like to acknowledge my Korean collaborators, whom I have enjoyed working with enormously, particularly Ho Jin and Dong-Hun Lee. Also, I am deeply indebted to the work of my graduate and undergraduate students. Finally, I'd also like to acknowledge the essential support from my friends and family.

—Ian Garrick-Bethell, *University of California, Santa Cruz*

McEwen Receives 2015 Whipple Award

Alfred S. McEwen will receive the 2015 Whipple Award at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif. The award recognizes an individual who has made an outstanding contribution in the field of planetary science.



Alfred S. McEwen

Citation

The Whipple Award, the highest honor given by the AGU Planetary Sciences section, is named for Fred Whipple, a famed space scientist most noted for his work on comets.

This year, we have selected Alfred McEwen, professor at the Lunar and Planetary Laboratory, University of Arizona, as the 2015 Whipple Award winner. Before, during, and after his Ph.D. at Arizona State University, Dr. McEwen worked at the U.S. Geological Survey branch of astrogeology in Flagstaff, moving to the University of Arizona in 1996.

Dr. McEwen is interested in how planets evolve. His mission involvement began in 1989 as a guest investigator with the Voyager imaging team for Neptune encounter. Since then, he has been involved with Galileo, Cassini, Clementine, the Mars Global Surveyor, Mars Odyssey, the Mars Reconnaissance Orbiter (MRO), the Lunar Reconnaissance Orbiter, and the ExoMars Trace Gas Orbiter, as well as current proposals for future missions. He is deputy principal investigator (PI) of the new Europa Imaging System.

Perhaps his first revolutionary work was the discovery of especially high temperature volcanism on Io. He has published ~200 papers with a who's who of planetary scientists as collaborators. He has served as an indispensable reminder that better mission data produce better understanding of planets and provide the surprises that we don't anticipate.

Alfred is the principal investigator of the incredibly successful High-Resolution Imaging Science Experiment (HiRISE) on MRO. Along with critical data about the planet's past, HiRISE has provided conclusive evidence that Mars remains a dynamic planet. Dr. McEwen's most important contribution to our field may be the linear features that darken and lengthen during the warmest periods, only to fade away as surface temperatures drop—these recurring slope lineae are most probably seasonal flows of brine on Mars today.

That inquisitive nature, the openness to new ideas and people, and—most of all—his ability to produce results have marked his career and are worthy of the Whipple Award. Many congratulations to Alfred S. McEwen for outstanding contributions to planetary science.

—Linda T. Elkins-Tanton, *Arizona State University, Tempe*

Response

I truly appreciate this unanticipated recognition. I've had awesome role models in past Whipple recipients Larry Soderblom, who hired me off the street and changed my life, and Gene Shoemaker, whose enthusiasm and generosity are legendary. The success of HiRISE is due to many people, including Alan Delamere (instrument design), Rich Zurek (project scientist), Candice Hansen (deputy PI), and the munificent science and operations teams. Those 200 papers Lindy mentioned are due to my past and present students and postdocs, who have been fruitful collaborators. For the Whipple lecture I hope to leave a few takeaway messages:
(1) high-resolution repeat imaging is key to understanding active, "ground-breaking" geologic processes, (2) NASA

needs more PI-led missions, and (3) planetary scientists should pay close attention to what's happening on Earth, which, to exoscientists, has to be one of the most interesting exoplanets in the galaxy.

My personal scientific bucket list includes understanding (1) how the recurring slope lineae (RSL) form on Mars, (2) the very high temperature volcanism on Io, and (3) the active geologic processes on Europa. The RSL have a suite of characteristics consistent with seasonal seeps of water in equatorial and midlatitude regions of Mars, but where does that water come from? If humans are really going to live on Mars at any future time, we must understand the RSL. Galileo spacecraft and Earth-based telescopic observations suggest that very high temperature volcanism occurs on Io, consistent with ultramafic lavas. A dedicated mission to Io could be the best way to understand komatiite volcanism and other processes in the early evolution of terrestrial planets. Finally, there is controversy about whether Europa is currently active, but we have almost no appropriate observations to address this question. The new NASA Europa mission will have the capability to definitively answer this question.

—Alfred S. McEwen, *Lunar and Planetary Laboratory, University of Arizona, Tucson*

Paytan Receives 2015 Paleoceanography and Paleoclimatology Dansgaard Award

Adina Paytan will receive the inaugural Dansgaard Award at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif., as selected by a Dansgaard Award selection committee. The award is given in recognition of the awardee's research impact, innovative interdisciplinary work, educational accomplishments (mentoring), societal impact, and other relevant contributions and to acknowledge that the awardee shows exceptional promise for continued leadership in paleoceanography or paleoclimatology.

Adina Paytan

Citation

It is my great pleasure to announce that Dr. Adina Paytan is the recipient of the 2015 AGU Dansgaard Award for an outstanding midcareer scientist.

Dr. Paytan is a biogeochemist in the broadest sense. Her work encompasses both marine and terrestrial ecosystems and has wide breadth ranging from groundwater discharge into coastal systems, nutrient cycling, ocean acidification, and, in particular, paleoclimatology/paleoceanography. Highlights of her work include key advances on (1) present and past phosphate cycling in the ocean and coastal environments, (2) the use of marine barite in paleoproxy records of various oceanic processes, (3) isotopes as indicators of the interaction between weathering and ocean chemistry, and (4) the first continuous record of sulfur isotopes of seawater sulfate for the last 130 million years.

Dr. Paytan has over 160 scientific publications in prestigious journals such as *Science, Nature, Proceedings of the National Academy of Sciences of the United States of America, Paleoceanography, Global Biogeochemical Cycles,* and *Geophysical Research Letters.* She is the lead author in only 20% of her publications in order to promote her students and postdocs as first authors.

Dr. Paytan devotes time to mentor students and early-career scientists. She has supervised over 20 advisees receiving graduate degrees and 12 postdocs between 2001 and 2015, and she currently advises 10 graduate students, 3 postdocs, and several undergraduate students. She has initiated innovative interdisciplinary collaborations and contributed to projects with scientists from a number of institutes throughout the world.

In addition to being a leading scientific figure in our discipline, Dr. Paytan also finds time to contribute to substantial outreach, education, and professional service. She has served as editor or associate editor for several scientific journals, as well as on organizing committees for several scientific meetings. All in all, Dr. Paytan is a well-respected, prolific scientist and mentor who tirelessly promotes the professional growth and success of her students and colleagues and contributes to the leadership in paleoceanography and paleoclimatology.

—Figen Mekik, *Grand Valley State University, Grand Rapids, Mich.*

Response

I would like to thank Bob Thunell, Tim Bralower, and Miriam Kastner for the nomination and support letters and Figen Mekik, Bill Anderson, and the AGU Paleoceanography and Paleoclimatology focus group award committee for selecting me for this prestigious award. I also want to thank my many students and collaborators over the years, who through their hard work, enthusiasm, and sharing of ideas and knowledge were instrumental to my productivity and scientific accomplishments. They contributed greatly to my work and, most important, made it a fun and rewarding journey.

Paleoceanography is a fascinating field of research; it is a humbling endeavor to try and read the pages of Earth's history from indirect clues preserved in rocks, mud, and fossils. The "print" is not always clear and at times requires creative imagination and bold assumptions to be made. However, keeping true to the data and realizing the limitations of the records are key for moving forward toward gaining a better understanding of one of the most fascinating questions of all times: How does our planet work?

This is a formidable task, and hence, it is a great honor to be a participant, along with the broader paleoceanographic community, in this grand challenge of understanding the processes and feedbacks operating in the Earth system and how they relate to global changes in climate and tectonics.

—Adina Paytan, *University of California, Santa Cruz*

Cottaar Receives 2015 Keiiti Aki Young Scientist Award

Sanne Cottaar will receive the 2015 Keiiti Aki Young Scientist Award at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif. The award recognizes the scientific accomplishments of a young scientist who makes outstanding contributions to the advancement of seismology.

Sanne Cottaar

Citation

Dr. Sanne Cottaar received her bachelor's and master's degrees with distinction from the University of Utrecht, Netherlands, and her Ph.D. from the University of California, Berkeley, in 2013. As a graduate student, she was awarded the Tocher Fellowship, and as a research fellow of Pembroke College and a research associate at the University of Cambridge, she was awarded the Drapers' Company Research Fellowship.

Sanne has worked, and published, on a wide range of topics concerning the structure and dynamics of Earth's deep interior. She used full-waveform modeling to document a very large ultralow-velocity zone at the base of the mantle near Hawaii. She has used thermochemical convection modeling to argue for convective stability of the inner core. She has used *S* diff waves to study the strength and extent of the Perm anomaly. She has studied seismic anisotropy at the base of the mantle and identified an asymmetry of azimuthal anisotropy with respect to the edge of the African superplume. She also carried out multidisciplinary work that explored a model of a subducted slab interacting with the core-mantle boundary. More recently, she has turned her attention to constraining the structure of upper mantle discontinuities.

In addition to these topics, Sanne cocreated the publicly available BurnMan code with a group of junior scientists, which allows investigation of elastic properties for different mineral compositions under different pressures and temperature conditions deep in the Earth (Cottaar et al., *Geochemistry, Geophysics, Geosystems,* 2014, doi:10.1002/2013GC005122).

Sanne Cottaar is a creative scientist who has contributed significantly to understanding the deep Earth. Her approach is primarily seismological but is well informed by information and modeling from allied disciplines. The Aki Award recog-

nizes the significance of these accomplishments and anticipates further outstanding contributions in the future.

—Gregory C. Beroza, *Stanford University, Stanford, Calif.*

Response

It is with great gratitude and joy that I receive the 2015 Keiiti Aki Award. This has only been possible because of many supportive and generous scientists, of whom I can name only a few here. I thank Barbara Romanowicz, Arwen Deuss, and Bruce Buffett for the many inspiring years of mentoring, teaching, and supporting the development of my research style and drive. Hanneke Paulssen and Jeannot Trampert introduced me to seismology and research; thank you.

I have benefited greatly from being in many stimulating and welcoming environments, the broader communities at the University of California, Berkeley; University of Cambridge; Pembroke College; and the Cooperative Institute for Dynamic Earth Research (CIDER). I also thank their staffs, who keep these institutes up and running. With the research labs, my science siblings, I have enjoyed a lot of pleasurable time in and out of the office; by naming Vedran Lekic and Elizabeth Day, I thank you all.

I feel very fortunate to be part of the seismology and deep Earth communities. I regard so many of you as collaborators, mentors, and friends. This is also a place to recognize those countless involved in collecting and distributing seismic data, without whom my work on the deeper Earth is not possible.

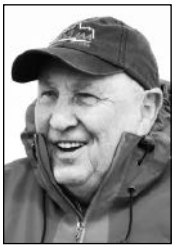
I thank my parents for my initial conditions and their ever-continued support, my siblings for always challenging me, and now my "niblings" for reminding me to play. I thank my friends across continents for their continual support and welcome distraction.

It remains a privilege to continue learning, being part of a research family, and studying an amazing planet—Earth.

—Sanne Cottaar, *University of Cambridge, Cambridge, U.K.*

Smith Receives 2015 Paul G. Silver Award for Outstanding Scientific Service

Robert B. Smith will receive the 2015 Paul G. Silver Award for Outstanding Scientific Service at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif. The award recognizes outstanding contributions to the fields of geodesy, seismology, or tectonophysics through mentoring of junior colleagues, leadership of community research initiatives, or other forms of unselfish collaboration in research.



Robert B. Smith

Citation

Bob received his bachelor's degree from Utah State University in 1960 and his Ph.D. from the University of Utah in 1967. Soon thereafter, he joined the University of Utah faculty. He is a talented geophysicist whose scientific work focused on Yellowstone and the tectonics of the Basin and Range. To a remarkable degree, he has made outstanding contributions to each of the areas of the AGU sections sponsoring the Silver Award.

Bob played an important role in the development of multiple major initiatives over the last 30 years. He helped form the Incorporated Research Institutions for Seismology (IRIS) in 1984. His contributions as an early developer of scientific GPS geodetic networks helped lead to the creation of the University Navstar Consortium (UNAVCO) in its early days in the 1980s, and he helped guide it through its eventual incorporation. He served many years on the Advisory Council for the Southern California Earthquake Center (SCEC), including as its first chair. He was a cofounder of the National Science Foundation (NSF) EarthScope program focused on understanding the structure, evolution, and active tectonics of North America. He was the founding scientist of the Yellowstone Volcano Observatory in 1990 and continues as coordinating scientist.

Bob represents the best in unselfish collaboration in scientific research and in scientific organization and infrastructure development. In addition to the many students he trained in his own group at Utah, his influence extends internationally through collaborations he fostered with younger scientists around the world. He is also known for the exceptional time and energy he devotes to educating the public, civil and emergency response authorities, and politicians on earthquake and volcano hazards. The Paul G. Silver Award recognizes Robert Smith's outstanding, multifaceted, and sustained record of service to the AGU community.

—Gregory C. Beroza, *Stanford University, Stanford, Calif.*

Response

It is most rewarding to receive the Silver Award in the name of Paul G. Silver, a long-time scientific collaborator, and I thank the Seismology, Geodesy, and Tectonophysics sections, with whom I have been affiliated for than 45 years.

I formulated much of my philosophy when I experienced the 1959 *M* 7.3 Hebgen Lake, Mont., earthquake that was closely followed when I learned how to fly a jet in the U.S. Air Force in 1963 and in only 1 year learned how to drive a dog team exploring Antarctica as the U.S. exchange scientist to the British Antarctic Survey. My early academic efforts involved, with associates, forming the Program for Array Seismic Studies of the Continental Lithosphere (PASSCAL) consortium for seismic instrumentation that later merged into IRIS.

On the basis of my using GPS and leveling work in Yellowstone, colleagues and I formed a geodetic instrument consortium, UNAVCO. Again, associates and I formed a consortium to study the evolution of North America, treating it as a natural geologic laboratory, forming the EarthScope program. Moreover, my interests in understanding earthquake physics through integrating multiple geologic data led me to become a member of SCEC, where integration of methods and tools is practiced so well. And I have always viewed Yellowstone as "a window into Earth processes" that led me along with National Park Service and the U.S. Geological Survey (USGS) scientists to form the Yellowstone Volcano Observatory.

Critically, I have always involved and mentored young faculty, successfully supervising 70 graduate students, and tried to set an example of how to organize their own science programs. In closing, I am grateful to the NSF and the USGS for their support and to the University of Utah, which has always supported my academic interests.

—Robert B. Smith, *University of Utah, Salt Lake City*

Jiang Receives 2015 Basu Early Career Award in Sun–Earth Systems Science

Chaowei Jiang will receive the Sunanda and Santimay Basu Early Career Award in Sun-Earth Systems Science. He will present a talk and will be formally presented with the award at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif.

Chaowei Jiang has been awarded the Sunanda and Santimay Basu Early Career Award in Sun-Earth Systems Science. The award recognizes an individual scientist from a developing nation for making outstanding contributions to research in Sun-Earth systems science that further the understanding of both plasma physical processes and their applications for the benefit of society.

Chaowei Jiang

Chaowei Jiang received his B.S. in astronomy from Beijing Normal University in 2006 and a Ph.D. in space physics from the Graduate College of the Chinese Academy of Sciences (CAS) in 2011 under the supervision of Xueshang Feng and Fengsi Wei. He is currently working as an associate research scientist within the SIGMA Weather group at the State Key Laboratory for Space Weather, National Space Science Center of CAS. His research interests include reconstruction and analysis of the solar magnetic field, data-driven models of solar flares and coronal mass ejections, and advanced numerical techniques for space weather–related modeling.

Chappell Receives 2015 Space Physics and Aeronomy Richard Carrington Award

Charles "Rick" Chappell will receive the 2015 Space Physics and Aeronomy Richard Carrington Award at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif. The award is given in recognition of significant and outstanding impact on students' and the public's understanding of our science through education and/or outreach activities.

Charles "Rick" Chappell

While being a leading researcher in the area of space physics, Rick Chappell has always recognized the importance of public understanding of science in general and in the research field of solar terrestrial research in particular.

Early in his NASA career he worked with the U.S. Space and Rocket Center to create a major exhibit for the museum about the solar-terrestrial system. Later, as mission scientist and active public spokesperson for the international Spacelab 1 mission, which conducted multiple space physics and aeronomy experiments, he led daily press conferences about the science results during the mission and subsequently did science commentary for CNN on other Spacelab missions.

Rick later became a visiting scholar at Vanderbilt University in 1996 in order to conduct a study on the interaction between the science community and the media. Together with science journalist Jim Hartz, he coauthored the book *Worlds Apart,* which made recommendations to improve the science-media interaction and effectiveness. The results were presented at multiple panel discussions at many universities, on C-SPAN, and in interviews on NPR's *Science Fridays* show.

He joined Vanderbilt as a research professor of physics and worked with multiple departments to create an interdisciplinary major in the communication of science and technology that for more than 10 years has been producing graduates who work at the interface between science and the public.

Chappell became the director of the Vanderbilt Dyer Observatory in 2003, and he led a renovation of the observatory to make it an outreach facility for science and exploration for K–12 students and the public. He created summer space camps for middle school students where students learned about space science and built satellite mock-ups.

Rick also developed a partnership between Vanderbilt and Nashville Public Television in 2010 to create television shows about science, technology, engineering, and mathematics (STEM) explorers. These programs were designed for middle school and high school students as well as adults.

In summary, Rick Chappell has worked diligently and effectively in space physics and aeronomy education and public outreach for 4 decades and is most deserving of the 2015 Richard Carrington Award.

—Edgar A. Bering, *University of Houston, Houston, Texas*

Response

I want to give my sincere thanks to the Space Physics and Aeronomy section of AGU for selecting me for the Richard Carrington Award. Through its recognition, this award reminds all of us about one of our important roles as explorers—the role of communicating to the public what we have learned and the adventures that we have lived. Our intense curiosity about the space environment around us drives us continuously to learn new things. In so doing, our interest in learning can cause us to forget about "reporting to our stockholders," whose support has enabled us to explore.

We are all explorers, although many of us do not think of ourselves in this way. As young students, we remember reading about explorers in history class, not in science class. Explorers were people who went to places where others had never been before. In reality, explorers are people who learn things that have never been known before, such as understanding the solar-terrestrial environment. We have been given the privilege of spending our lives as explorers.

We all must take the time to tell our stories of exploration and to communicate our discoveries effectively to the public. We must work with the wonderful teachers who inspire the explorers of tomorrow. We must be accessible mentors for students of all ages so that they can feel our enthusiasm and begin to think that they can and they will become explorers. We must share the thrill of discovery and the great adventure of exploration in order to give back to those who have given to us.

The programs that I have worked to create have all been directed toward communicating our stories of exploration and the knowledge of discovery to our stockholders and to the student explorers of tomorrow.

In accepting this award, I want to thank all of the people whom I have been so fortunate to work with during my life in space exploration. They all follow the NASA mindset that there is nothing we cannot do; we just have to figure out how to do it.

—Rick Chappell, *Vanderbilt University, Nashville, Tenn.*

Correction

In the 1 November issue of *Eos,* Robert Anderson was cited incorrectly for winning the 2015 G. K. Gilbert Award. The correct name of the award is the 2015 G. K. Gilbert Award in Surface Processes. AGU congratulates Robert Anderson on winning this prestigious award.

Mayyasi-Matta Receives the 2015 Fred L. Scarf Award

Majd Mayyasi-Matta will receive the Fred L. Scarf Award. She will be formally presented with the award at the 2015 American Geophysical Union Fall Meeting, to be held 14–18 December in San Francisco, Calif.

Majd Mayyasi-Matta

Citation

Majd Mayyasi-Matta produced a hallmark for a Ph.D. dissertation's goal. She pushed the envelope of knowledge outward to explain how the ionosphere of Mars responds to hydrogen in its atmosphere, plasma temperatures far warmer than its neutral gas conditions, and dynamical adjustments due to crustal magnetic fields. These were not merely newer and faster simulations of past single-point observations, but fundamental advances in our understanding of the full diurnal and spatial contexts of driving mechanisms.

—John Clarke, Michael Mendillo, *and* **Paul Withers,** *Boston University, Boston, Mass.*

Response

I have taken a nontraditional path toward a career in science. I started off as a computer engineer and worked in industry for a few years. I started a family and decided life was too short to not be doing what one is most passionate about. For me, it was astronomy. Over 9 years, I pursued the appropriate background: a B.S. in physics, minor in mathematics, a master's and Ph.D. in astronomy. I am currently settled in academic research trying to improve our understanding of water escape at Mars.

I grew up in a society where women typically did not go into technical fields and, as such, had very few role models to look up to. The resulting social and time management challenges overshadowed any technical or academic ones. This has cultivated a deep respect and appreciation for my accomplishments and for the mentors who helped me achieve them, namely, my advisers, Michael Mendillo, Paul Withers, and John Clarke. I could not have picked a more personally rewarding career. I am mindful of my potential and as such have been participating in initiatives that provide underrepresented minority women with mentors and accessible role models in science, technology, engineering, and mathematics (STEM) fields.

I am grateful for the Scarf Award honors recognition that my colleagues and the AGU have provided me with. I look forward to the opportunities it will provide.

—Majd Mayyasi-Matta, *Boston University, Boston, Mass.*

Duly Receives 2015 Basu United States Early Career Award for Research Excellence in Sun–Earth Systems Science

Timothy Duly will receive the 2015 Basu United States Early Career Award for Research Excellence in Sun-Earth Systems Science at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif. This award is given annually to one early-career scientist (no more than 3 years postdegree) from the United States in recognition of significant work that shows the focus and promise of making outstanding contributions to research in Sun-Earth systems science that further the understanding of both plasma physical processes and their applications for the benefit of society.

Timothy Duly

Timothy received his B.S. in electrical engineering from the Ohio State University in 2009 and a M.S. and Ph.D. in electrical and computer engineering from the University of Illinois at Urbana-Champaign in 2011 and 2014, respectively, under the supervision of Jonathan Makela. He is currently a research engineer at Atmospheric & Space Technology Research Associates (ASTRA) in Boulder, Colo. His research interests include measuring and modeling traveling ionospheric disturbances and understanding their impact on radio frequency systems.

Weller Receives 2015 Study of the Earth's Deep Interior Focus Group Graduate Research Award

Matthew Weller will receive the 2015 Study of the Earth's Deep Interior Focus Group Graduate Research Award at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif.

Matthew Weller

Matthew Weller received a dual B.Sc. in geology and astrophysics from the University of Toledo in 2007 and a M.Sc. in remote sensing from the University of Nevada, Reno, in 2010. He is currently finishing a Ph.D. in planetary science and geodynamics under the principal supervision of Adrian Lenardic at Rice University in Houston, Texas. His research focuses on the evolution and dynamics of planetary bodies, deformation through the crust and mantle, and the coupling of global-scale endogenic and exogenic cycles.

Liu Receives 2015 Jason Morgan Early Career Award

Lijun Liu will receive the 2015 Jason Morgan Early Career Award at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif. The award is for significant early-career contributions in tectonophysics.

Lijun Liu

Citation

It's with great pleasure I received the news that Lijun Liu is the recipient of the 2015 Jason Morgan Early Career Award, which recognizes the impact that his work has already made toward understanding the dynamical processes within the deep Earth. In his career thus far, he has produced an impressive array of scientific contributions based upon his holistic approach of integrating diverse suites of geological and geophysical observations with quite advanced numerical methods that model the dynamics of the deep Earth. The successes of using that approach are not easily achieved. Where typical models of the day might be simplified in some way, perhaps generic, Cartesian, or instantaneous, or might avoid the many challenges of Earth's complicated rheology, Lijun has pushed forward to generate geographically referenced, three-dimensional spherical dynamic models that evolve through tens of millions of years and yield appropriate deformations from the scales of mineral grains to tectonic plates. Yet the real pioneering aspect of this effort is that the models can evolve either forward from a time in history or backward from the present day.

Lijun is working at the leading edge of his discipline and, more importantly, using geodynamic models as a framework for data assimilation. This type of synthesis can help transform tectonophysics into a more integrative science with more predictive capability. It takes both talent and assiduousness, which reflect the qualities that make Lijun deserving of this award. But he's also the kind of scientist you want to see recognized because of his other virtues such as integrity, objectiveness, and his generosity to those he works with. He inspires those around him with his tremendous work ethic and dedication, which I can assure you is driven by his natural curiosity and determination to figure out how Earth works.

—Dave Stegman, *Scripps Institution of Oceanography, La Jolla, Calif.*

Response

Thanks, Dave, for the kind citation. It is a great honor to receive this prestigious award. Among the many young talents within the broad field of tectonophysics, I feel very fortunate to be recognized by AGU during the early stage of my career. With modern Earth science emphasizing multidisciplinary research and community effort more than ever before, it becomes challenging for individuals to build independent career records. As a result, recognitions from the AGU Honors Program are important for encouraging young researchers to carry on.

Upon receiving this award, I owe many thanks to my former mentors and colleagues. I am indebted to my Ph.D. adviser, Michael Gurnis, and former group members, Eh Tan and Eunseo Choi, from whom I learned a great amount on geodynamic modeling with supercomputers. I am deeply grateful to my postdoc adviser, Dave Stegman, who helped me with not only building realistic subduction models but also the many things that allow me to smoothly transition into a faculty member. I also want to thank colleagues and friends Dietmar Müller, Don Helmberger, Peter Olson, Jason Saleeby, and Shijie Zhong for their strong support and encouragement throughout the years.

My thanks also go to the University of Illinois, where I spent the past 3 years. I sincerely appreciate warmhearted colleagues Stephen Marshak, Xiaodong Song, Bruce Fouke, Tom Johnson, and many other people in the Department of Geology for their unreserved support during the establishment of my geodynamics group. I have enjoyed and benefited from the numerous lovely scientific discussions with students and faculty during our weekly donuts and dynamics seminar.

Finally, I want to thank my families for their persistent support, without which I couldn't have walked this long.

—Lijun Liu, *Department of Geology, University of Illinois at Urbana-Champaign, Urbana*

Sisson Receives 2015 N. L. Bowen Award

Thomas Sisson will receive the 2015 N. L. Bowen Award at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif. The award recognizes "outstanding contributions to volcanology, geochemistry, or petrology."

Thomas Sisson

Citation

Tom Sisson's breadth of inquiry and approaches span volcanology, geochemistry, and petrology in a way that is truly rare. Tom is at once a creative and meticulous experimental petrologist, having done landmark work on the effect of water on the compositional evolution of magmas. He also is an innovative geochemical analyst, widely known for ground-breaking measurements on the preeruptive volatile contents of arc basalts. And he's a prominent volcanologist, having made key discoveries in the study of Hawaiian and Cascades volcanoes while informing the public on their hazards.

Tom is also a field geologist of exceptional talent, befitting the challenges of geologic mapping in the Sierra Nevada and at volcanoes such as Mount Rainier, arguably the volcano that poses the highest risk to communities in the conterminous United States. This background has guided his keen insights into magmatic processes from laboratory experi-

ments and measurements anchored in ground truth from the field. Moreover, Tom's Rainier papers serve as real-world examples of quantitative geoscience with societal relevance through application to volcano hazard evaluations. Tom's work on the formation of granites, specifically how many steps are involved to create crustal distillates from primary mantle-derived basalt, will shape research and thinking into the next decade.

Tom's knowledge, gravitas, and generosity are also legendary. He is a caring mentor to young scientists, commonly at their side at meetings, listening patiently and then generously working through their problems, with considerable seriousness and substance though not without a sense of humor, helping to inform and inspire their science. When Tom speaks, it is with unusual clarity and confidence, and everyone listens. It is difficult to think of a modern scientist more deserving of Bowen's legacy than Tom Sisson, in his foundational, high-impact, and diverse contributions to our understanding of magmas, from their origin to eruption.

—Terry Plank, *Lamont Doherty Earth Observatory, Palisades, N.Y.*

Response

Dear Terry, thanks for your considerate words and thanks to the anonymous colleagues who championed my nomination and to the Volcanology, Geochemistry, and Petrology awards committee. When I was a Stanford undergrad, Bob Compton assigned us Bowen's *The Evolution of the Igneous Rocks.* I was convinced, and shortly after graduating, I bought a copy in New Zealand, where I was climbing in the Southern Alps. That copy accompanied me during my "living out of a VW bus and climbing" period, and I was slow to unlearn the few areas where Bowen was wrong.

I've benefited from numerous inspiring mentors and colleagues, but Jim Moore and Tim Grove stand out. Jim gave me the precious opportunity to collaborate with him mapping a swath of U.S. Geological Survey (USGS) geologic quadrangles across the Sierra Nevada batholith, as well as studying the Mount St. Helens directed blast. Jim never worried too much if he was working on petrology, volcanology, glacial geology, or …, and I found this a good model to follow.

Fieldwork only goes so far, so I went to work with Tim at the Massachusetts Institute of Technology because he addresses major scientific issues using the highest-quality experiments guided and tested insofar as possible by field observations. Having mapped numerous mafic intrusions in the Sierra, it seemed obvious and inescapable to me that basaltic arc magmas are wet (yes, this was once not known). We showed experimentally how this explains many aspects of arc magmas, shortly confirmed by my early ion probe measurements on basaltic melt inclusions. The USGS called me back, where I've continued mostly studying arc petrogenesis and hazards. The in-depth, place-based studies fostered by the USGS reveal how magmatic systems are at the same time complex and simple. Understanding controls on magmatic volumes, locations, and timing are some of the challenging and fascinating issues that I look forward to seeing addressed.

—Thomas Sisson, *California Water Science Center, U.S. Geological Survey, Menlo Park*

Huber Receives 2015 Hisashi Kuno Award

Christian Huber will receive the Hisashi Kuno Award at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif. The award recognizes "accomplishments of junior scientists who make outstanding contributions to the fields of volcanology, geochemistry, and petrology."

Christian Huber

Citation

It gives me great pleasure to introduce the 2015 Hisashi Kuno Award recipient, Christian Huber. It is truly fitting that Chris should receive an award celebrating the activities of a young scientist in the Volcanology, Geochemistry, and Petrology (VGP) section as his research touches on a range of themes covered by this section. The research Chris has conducted spans diverse topics from volcano seismology to deciphering magmatic time scales from diffusion profiles. He already has written several influential papers on rejuvenation and pore-scale processes in magmatic systems, and he continues to broaden his research portfolio examining reactive porous flows and bubble coalescence and interacting with diverse data sets from crystal diffusion profiles to ground deformation.

Throughout his career Chris has blended Earth science and physics and has pursued rigor even when it has taken him on paths traveled by few. After receiving his geology undergraduate degree from the University of Geneva, he continued to do a master's in volcano seismology, including a stint at the U.S. Geological Survey in Menlo Park working with Bernard Chouet. He then received a second B.S. in physics from Geneva, before applying to work on his Ph.D. in Berkeley, with Michael Manga. Chris is a valuable faculty member at Georgia Tech, where he is an engaging presence. Chris is quick to incorporate new ideas and to distill the crux of many physical arguments. He is also a very collegial individual, and this has contributed to his ability to work with many students and faculty at Berkeley, Georgia Tech, and elsewhere.

Chris has a great mix of curiosity, creativity, and quantitative skill that makes him a real pleasure to interact with. Fellow VGP members, it is my privilege to present Christian Huber, this year's recipient of the Kuno Award.

—Josef Dufek, *Georgia Institute of Technology, Atlanta*

Response

Thank you, Joe. I want to thank the committee, the VGP section of AGU, and my nominators for this honor.

During my studies in Earth sciences in Geneva, Mike Dungan offered a field experience in the San Juan Islands to assist Pete Lipman (former postdoc of H. Kuno) and a second-year Ph.D. student, Olivier Bachmann. This experience ignited my passion for volcanology and initiated a friendship with Olivier that has lasted now for 18 years. Later, Bernard Chouet and Phil Dawson set the standard for patience while mentoring graciously the inept master student that I was. My struggles prompted the decision to step back from Earth sciences for 4 years and study physics.

After physics, I moved to Berkeley for a Ph.D. with Michael Manga. Michael has always been a kind and patient adviser as he tried to show me the Jedi way to science. Don DePaolo also played an important role advising me about science and academia. Jim Watkins was my partner in crime; we remain close friends and collaborators to this day. As Joe Dufek joined Berkeley for his postdoc, it started a friendship and collaboration that has led me to Georgia Tech. There, I am blessed with great colleagues such as Andy Newman, Carol Paty, Ken Ferrier, Yuanzhi Tang, Martial Taillefert, and Chris Reinhardt.

Since I started at Georgia Tech, I learned about my role of researcher and adviser from Olivier Bachmann, Dave Bercovici, Mark Jellinek, and Helge Gonnermann. I am extremely proud of my talented Ph.D. students, Yanqing Su, Salah Faroughi, and Hamid Karani. My good fortune has allowed me to lure in gifted postdocs, and I owe a lot to all of them. Andrea Parmigiani has been a special friend and collaborator for close to 10 years now, and I started exciting collaborations with Wim Degruyter, Caroline Bouvet de Maisonneuve, Babak Shafei, and, more recently, Tarsilo Girona.

Finally, I would like to dedicate this award to my family, my wife, Olga, and daughter, Benedicte, and to my mother and late father. Thank you!

—Christian Huber, *Georgia Institute of Technology, Atlanta*

Visit **eos.org/agu-news** to read more announcements of AGU section and focus group awards.

Magnetized Collisionless Shock Waves Measured in the Lab

NASA, J. J. Hester Arizona State University

A small portion of the Cygnus Loop supernova remnant, which marks the edge of a bubble-like, expanding blast wave from a colossal stellar explosion about 15,000 years ago. Collisionless shock waves occur in the debris clouds of supernovae.

Collisionless shock waves are observed throughout the universe, including in the heliosphere and the expanding debris clouds of supernovae. These types of shocks are unique because of the low density of the plasma in which they occur.

Scientists have numerically modeled shock formation in the past but have not confirmed these predictions through in situ measurements or through experiments. *Niemann et al.* have now made measurements of collisionless shock waves in the lab.

In a normal shock wave, as the gas compresses, the particles "collide"—that is, they get so close that their electric fields cause them to change direction, and they pile up like a traffic jam. However, in a collisionless shock wave, the gas density is too low for the particles to interact in this way; instead, they are pushed around by turbulent waves in the plasma that act on much smaller scales.

Creating collisionless shock waves in a controlled laboratory setting allows scientists to make measurements at the microscale that would otherwise be impossible in space. Previous laboratory experiments used pistons to generate shock waves in plasma, but these were limited to perpendicular motion and did not propagate away from the pistons. Later experiments created shocks in laser or photoionized plasma but encountered problems with magnetizing or ionizing the background.

The authors created an experiment at the Large Plasma Device at the University of California in Los Angeles that used a high-power laser to blow up a piece of plastic, creating a cloud of debris exploding into a stationary magnetized plasma. Collisionless interactions transfer momentum from the debris cloud to the ambient ions, creating a shock that travels away from the piston. The team plotted the shock waves and compared them to numerical simulations.

The measurements collected by the team validate the models that predicted that collisionless interactions accelerate the ambient ions to the debris velocity. The data also indicated that microinstabilities play a minor role in shock dissipation. These results will be useful in future studies of the microphysics of magnetized shocks. (*Geophysical Research Letters*, doi:10.1002/2014GL061820, 2014)

—Catherine Minnehan, Freelance Writer

Near-Surface Aquifer Discovered on Svalbard Glacier

Near the surface of glaciers, firn—partially compacted snow left from previous years—has the potential to store significant amounts of meltwater. Year-round reservoirs of liquid water trapped in the firn, called perennial firn aquifers (PFAs), are commonly observed on mountain glaciers and were discovered on the southeastern edge of the Greenland ice sheet in 2011.

Now a team of researchers has identified a PFA similar to the ones in Greenland in the Holtedalfonna ice field in northwestern Svalbard (a Norwegian archipelago in the Arctic Ocean). Using GPS and ground-penetrating radar observations, *Christianson et al.* found that the PFA has a dynamic water table that can fluctuate by several meters from year to year. Their data show that the downward percolation of meltwater recharges this aquifer during the summer, and downhill flow partially drains the aquifer during the winter. Using a mixing model, the authors also inferred that the aquifer's bulk liquid water content decreases substantially with depth, from about 40% to about 2%, as densification reduces available firn pore space. However, the percentage of this decreasing available pore space that is filled by liquid water increases with depth, and the lower half of the aquifer is likely water saturated.

Although this discovery extends the diversity of settings where PFAs have been found, the authors emphasize that the implications for glacier and ice sheet dynamics remain unclear. The storage of summer meltwater could potentially affect ice flow by warming the ice below it. PFAs may also increase drainage to the bed, a process that has been linked to rapid basal thawing. Drainage to the bed may also enhance the formation of deep fractures, potentially accelerating ice shelf breakup and ice sheet shrinkage.

Knut Christianson

Kronebreen, Svalbard, a large outlet glacier that drains the Holtedalfonna ice field.

Because PFAs on Arctic glaciers like Holtedalfonna may respond more rapidly to climate change and can be more easily characterized than the larger PFAs on the Greenland ice sheet, the authors assert that additional detailed observations will ultimately allow better quantification of PFA processes and their effect on ice sheets. (*Geophysical Research Letters*, doi:10.1002/2014GL062806, 2015) **—Terri Cook, Freelance Writer**

"Fingers" of Plasma Invade Saturn's Magnetic Field

Saturn is surrounded by a sphere of plasma that rotates in lockstep with the planet, held rigidly in place by its magnetic field. As a result, centrifugal forces tend to fling dense, heavy plasma parcels into deep space. At the same time, less dense material rushes inward to fill their place, forming fingers of hot plasma that penetrate deep inside Saturn's magnetic field. This shot of plasma is called an interchange injection, and the exact physics of how it occurs remain unknown.

But NASA's Cassini probe sometimes flies directly through interchange injections as it orbits Saturn, which allowed *Thomsen et al.* to measure just how far these injections can travel. They identified 13 interchange events in the mission's archives from 2005 to 2010 for which observing conditions were suitable and analyzed the data to determine how many of what particles were there, including hydrogen and water.

The water molecules come mostly from Saturn's moon Enceladus, which has a subterranean ocean that spews out into space through cracks in its icy surface. Enceladus orbits close to Saturn, at a distance just over 4 times greater than the radius of Saturn itself. It steadily fills the inner regions of Saturn's magnetic field with water ice molecules that eventually migrate out of the system. This means that water concentrations are highest near Enceladus's orbit and decrease farther away from Saturn. Thus, by measuring the ratio of water to hydrogen inside the interchange injections, the team could determine where the intruding jets of plasma were from. The drier the plasma was, the farther out it originated.

The team found that interchange injections were carrying plasma from regions as distant as 14 times the radius of Saturn, bringing them inward by over six Saturn radii, or roughly 360,000 kilometers. The team says this could provide clues to what triggers these events. One possibility is a process scientists already know about in Saturn's magnetic field—the pulses of energy that ripple from the nightside of the magnetic field, where the Sun's wind of particles blows the field back into a converging tail. But another possibility is that the events arise spontaneously from turbulence in the magnetosphere. (*Journal of Geophysical Research: Space Physics*, doi:10.1002/2014JA020489, 2014) **—Mark Zastrow, Freelance Writer**

Efficiently Predicting Shallow Landslide Size and Location

Landslides from recently logged steep slopes dumped millions of tons of mud and debris into Stillman Creek, near Curtis, Wash., in December 2007. Landslides like these may be easier to predict thanks to a new search algorithm derived from quantitative slope stability models.

Because landslides can destroy property and reshape landscapes, scientists seek to predict when they will strike and to model their behavior. Previous work revealed that location and size are the most important characteristics that determine the impacts of shallow landslides less than a few meters deep. However, modeling these parameters presents unique challenges to researchers.

One common strategy involves digitally representing the landscape as a grid of adjacent cells or blocks with different physical properties, such as elevation, slope, soil depth, and pore pressure. This approach allows researchers to simulate the landscape in three dimensions, incorporate variation between cells, and account for the lateral effects of friction and plant root reinforcement.

However, the spatial arrangement of groups of unstable grid cells is not known. To overcome this issue, the computer could try to test every possible arrangement of blocks, but this strategy becomes computationally demanding or even impossible as the number of blocks increases. The authors point out that testing a 1-square-kilometer area composed of 1 million blocks generates $2^{1,000,000}$ possible arrangements—a computational task beyond even our best computers.

To help reduce this burden, *Bellugi et al.* developed a search algorithm—a sequence of computer operations—that analyzes hillslope properties and outputs clusters of unstable blocks, allowing larger swaths of land to be analyzed using the gridded cell method. The team tested their new model on a virtual hillside as well as on data obtained from a landslide in Coos Bay, Ore. The algorithm performed well in both cases, allowing scientists to predict the location and approximate size of landslides with useful accuracy.

The results should allow future teams to better understand how shallow landslides develop in three dimensions without the need for such arduous computation. They should also give scientists the ability to scout for hazardous conditions that might cause loss of human life or property. (*Journal of Geophysical Research: Earth Surface*, doi:10.1002/2014JF003137, 2015) **—David Shultz, Freelance Writer**

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Atmospheric Sciences

Assistant Professor at Texas A&M University

The Department of Atmospheric Sciences at Texas A&M University is seeking applications for a tenure-track position at the assistant professor level in the field of physical meteorology, with an emphasis on radiative transfer and atmospheric remote sensing. Candidates are sought with research expertise in one or more of the following areas: radiative transfer, atmospheric remote sensing, and applications of remote sensing observations to broader areas such as climate study, physical meteorology, and atmospheric chemistry. A Ph.D. in atmospheric sciences or a related field is required at the time of appointment. Postdoctoral experience is desirable but is not required. The successful candidate will be expected to maintain a prominent research program and to teach courses at the undergradu ate and graduate levels.

The Department of Atmospheric Sciences is one of the largest such departments in the U.S., offering degree programs at all levels and research activities across the full spectrum of the atmospheric sciences. Resources available for teaching and research include the Texas A&M Supercomputing Center; the Center for Geospatial Sciences, Applications, and Technology; the Texas Center for Climate Studies; and the Center for Atmospheric Chemistry and the Environ ment.

The Department of Atmospheric Sciences is part of the College of Geosciences, which also includes the Departments of Geology and Geophysics, Geography, and Oceanography. Texas Sea Grant, the Geochemical and Environmental Research Group, and the International Ocean Discovery Program are also part of the College of Geosciences. Texas A&M University, a land, sea, and space-grant university, is located in a metropolitan area with a dynamic and international community of over 250,000 people. Texas A&M University is an affirmative action/ equal opportunity employer committed to excellence through the recruitment and retention of a diverse faculty and student body and compliance with the Americans with Disabilities Act. We encourage applications from minorities, women, veterans, and individuals with disabilities. Texas A&M University also has a policy of being responsive to the needs of dual-career partners.

To apply, please send a CV, statement of research and teaching interests, and names and contact information for at least three references to:

Prof. Kenneth P. Bowman
Chair, Faculty Search Committee
Department of Atmospheric Sciences
Texas A&M University
College Station, TX 77843-3.150
Email: k-bowman @tamu.edu

The position will remain open until a suitable candidate is found. Initial review of applications will begin on December 1, 2015.

Post-Doc in atmosphere-land interactions at the University of California, Los Angeles

The UCLA Department of Geography seeks applicants for a Post-Doc position. A Ph.D. in atmospheric sciences, or a related discipline and experience in utilizing a GCM and/or a RCM are required. Background knowledge on land surface processes and climate-land interaction is desirable. The Post-Doc will conduct numerical experiments to understand land surface processes and their interactions with climate. This position is initially for one year but is renewable based on satisfactory performance. Please send an application with a statement of research interests, CV, and contact information for two references to Dr. Yongkang Xue (yxue@geog.ucla.edu). The UCLA is an equal opportunity action employer.

Postdoctoral Research Associate

The Shepson Tropospheric Chemistry Research Group at Purdue University has an opening for a Postdoctoral Research Associate. The position involves work aimed at developing and improving methods for quantification of sources and sinks of greenhouse gases, focusing on aircraft-based methods. This work is part of the Indianapolis Flux Experiment (INFLUX). Depending on interests, there may also be an opportunity to lead, and to work on a number of other problems in atmospheric chemistry, including:

1. Nitrogen cycling in forest environments
2. Aerosol phase photochemistry
3. Arctic halogen chemistry and analytical mass spectrometry

Expertise in atmospheric analytical chemistry and laboratory methods is essential. The position is for one year, but potentially renewable annually. The position will be open until filled. Interested candidates should send a CV with a list of 3 references to:

Prof. Paul B. Shepson
Purdue University
560 Oval Dr.
West Lafayette, IN 47907
765-494-7441
pshepson@purdue.edu

Purdue University is an ADVANCE Institution. Purdue University is an EEO/AA employer fully committed to achieving a diverse work force. A background check will be required for employment in this position.

Postdoctoral Research Associate Position University of Washington, Seattle, WA

The Joint Institute for the Study of the Atmosphere and Ocean (JISAO) at the University of Washington is seeking Post-doctoral Research Associates with research interests in atmospheric science, oceanography, climate science, and fisheries science and management. JISAO encompasses a broad range of scientific interests including large-scale atmospheric-ocean interaction, ocean and atmospheric dynamics, biogeochemical cycles, ocean acidification, marine ecosystems, climate impacts on ocean and land ecosystems, high-latitude climate, paleoclimate studies, ocean and atmospheric model development and evaluation, and climate forcing and feedbacks, including both aerosol and clouds. JISAO operates jointly between the University of Washington and the NOAA research laboratories in Seattle, particularly the Pacific Marine Environmental Laboratory (PMEL).

We anticipate that two positions will be filled. Terms of appointment are for one (1) year, renewable for a second year, subject to approval and availability of funding. Positions are not project specific; a successful applicant is expected to define his/her research goals within the broad program areas of JISAO and are strongly encouraged to collaborate with University of Washington and NOAA PMEL scientists. Applicants who can demonstrate research relevance to both JISAO and PMEL programs are preferred. Successful applicants must hold a recent Ph.D. in order to assume a post-doctoral position.

Applicants are asked to submit electronically: (1) a curriculum vitae, (2) a publication list, (3) a brief research proposal (no more than 5 pages, double-spaced, excluding bibliography and figures) describing research to be pursued during a two-year tenure at the University of Washington, and (4) the names of four individuals who can provide a letter of reference. In addition, a letter of support from a mentor at the UW or PMEL is strongly encouraged. Research mentors may be JISAO research scientists, PMEL research scientists, and/or UW faculty members in relevant departments. (A list of possible mentors and their research interests can be found on the JISAO web page [http://jisao.washington.edu/research/postdocs]. This list is not inclusive; mentors at PMEL or the UW not on this list may also be considered.)

Applications should be received prior to January 1, 2016. Applications received after that date are not likely to be considered. Applications should be sent to: Collen Marquist, Administrative Specialist, at marquist@uw.edu. Inquiries may be directed to Collen electronically by Fax at 206-685-3397; or by mail to the Director, Joint Institute for Study of Atmosphere and Ocean, Attn: Collen Marquist, Box 355672, University of Washington, Seattle, WA 98195.

University of Washington is an affirmative action and equal opportunity employer. All qualified applicants will receive consideration for employ-

ment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, age, protected veteran or disabled status, or genetic information. To request disability accommodation in the application process, contact the Disability Services Office at 206.543.6450 / 206.543.6452 (tty) or dso@u.washington.edu

The Department of Meteorology and Climate Science at SJSU invites applications for a tenure-track faculty position at the Assistant Professor level, to begin August 22 2016.

We seek applicants with specialization in Western US weather as it relates to precipitation events, together with impacts of climate change. The successful candidate will teach classes in the areas of synoptic and mesoscale meteorology as they relate to precipitation in the western US, as well as classes in the broad area of impacts of climate change on western precipitation patterns. Teaching responsibilities may over time include General Education, majors (BS) and graduate (MS) courses. The successful candidate will also be expected to develop a research program involving both graduate and undergraduate students, and also participate in advising, committee, and departmental outreach activities.

Applicants must have a completed PhD in Atmospheric Science or a closely related field by the start of the appointment. Applications will only be accepted online via apply.interfolio.com/31100. For full consideration, send/upload: (i) a letter of application; (ii) CV; (iii) undergraduate and graduate transcripts (copies now, originals later); (iv) a statement of teaching interests/philosophy; (v) a statement of research plans; and (vi) three original letters of reference with contact information by January 19, 2016. This is JOID 23434.

Dr. Alison Bridger
Chair, Department of Meteorology & Climate Science
San Jose State University
One Washington Square
San Jose CA 95192-0104
Tel: (408) 924-5200
Fax: (408) 924-5191
Email: Alison.Bridger@sjsu.edu

A complete announcement is located on our web page. SJSU is an Affirmative Action/Equal Opportunity employer and is committed to increasing the diversity of its faculty.

UNIVERSITY OF CALIFORNIA, RIVERSIDE Open-Rank Faculty Position CLIMATE CHANGE AND SUSTAINABILITY

The Department of Environmental Sciences at UCR is recruiting a faculty member in the broadly defined area of Climate Change and Sustainability. This is a 9-month, open rank position and appointment can be made at the Assistant, Associate, or Full Professor level. The position is composed of 50% Instruction and Research and 50% Organized Research in the Agricultural Experiment Station (https://cnas.ucr.edu/about/aes/), and will be located in the Department of Environmental Sciences. The successful candidate will investigate climate change and sustainability within the context of two or more of the following fields of inquiry: atmospheric science, climate modeling, earth system science, oceanography, biogeochemistry, sustainability science and/or ecosystem science. The candidate is expected to use state-of-the art measurements or models as the foundation of his/her research and to work at regional to global scales. Examples of research foci can include, but are not limited to: i) interactions among emissions of greenhouse gases and aerosols ii) in-situ measurements or remote sensing of greenhouse gas emissions from agricultural activities, iii) field-measurements or modeling of the aerosol indirect effect, iv) modeling of feedbacks between natural anthropogenic emissions of aerosols and dust and climate, v) development of sustainable energy, agricultural or water infrastructure and vi) research on ocean-atmosphere interactions. It is desirable that the candidate's research generate results that can be used by policy makers to enhance sustainable development of resources. The incumbent will participate in both the undergraduate and graduate programs in Environmental

Sciences and offer courses on climate change and sustainability within their field of expertise. A Ph.D. in atmospheric sciences, environmental sciences, oceanography, ecosystem science, sustainability science or a related discipline is required. Applicants must include a vita, statements of research and teaching interests, and provide the names and addresses of at least 3 references. For appointment at the Assistant Professor level, application materials must be submitted through http://aprecruit.ucr.edu/apply/JPF00396. For appointment at the Associate or Full Professor level, application materials must be submitted through http://aprecruit.ucr.edu/apply/JPF00397. Advancement through the faculty ranks at the University of California is through a series of structured, merit-based evaluations, occurring every 2-3 years, each of which includes substantial peer input. Evaluation of applications will begin on January 11, 2016, but the position will remain open until filled. For more information about the position, please contact Dr. Roya Bahreini, Department of Environmental Sciences, University of California, Riverside; roya.bahreini@ucr.edu. For questions on application procedures and requirements, please contact Margi Burnett, Academic Personnel Coordinator, at margi.burnett@ucr.edu. UCR is a world-class research university with an exceptionally diverse undergraduate student body. Its mission is explicitly linked to providing routes to educational success for underrepresented and first-generation college students. A commitment to this mission is a preferred qualification. The University of California is an Equal Opportunity/Affirmative Action/ADA/Veterans Employer.

Biogeosciences

Multiple Positions in the Department of Environmental Earth and Atmospheric Science

UMass Lowell

Department Chair - Environmental, Earth and Atmospheric Sciences

Applicants are invited to apply for the position of Chair, Department of Environmental, Earth and Atmospheric Sciences (EEAS) at the University of Massachusetts Lowell. EEAS is a small interdisciplinary department within a Carnegie Doctoral/Research-Extensive university. We offer BS degrees in Atmospheric Science, Environmental Geoscience, and Environmental Studies and MS and PSM degrees in Atmospheric Science and Environmental Geoscience. We are planning to develop an interdisciplinary Environmental Science PhD program in the next couple of years. Current faculty research is in the areas of paleoclimatology, geochemistry, and environmental change. Ample opportunities exist for collaborative research with colleagues in the other science departments. The University is committed to increasing the size and research activity of the department with additional faculty hires over the next several years.

Preferred areas of expertise for the department chair are geochemistry and/or geohydrology, but other areas of expertise which contribute to the overall growth of the research enterprise of the department will be considered. The applicant should have an outstanding record of publication and funded research which meets the requirements for appointment as a tenured Full Professor at the University of Massachusetts Lowell. The successful applicant is expected to develop and maintain externally funded research programs and to contribute to the overall growth of department programs. The successful applicant should also demonstrate interpersonal skills that will foster the development of department faculty and students and enhance the visibility of EEAS both internally and externally.

To apply please submit a cover letter, curriculum vitae, research interest, research statement, names and contact information of three references, teaching philosophy, and publication list at: https://jobs.uml.edu/applicants/Central?quickFind=54657

Initial review of applications will begin January 6, 2016, and will continue until the position is filled. However, the position may close when an adequate number of qualified applications is received.

Assistant/Associate Professor - Geochemistry/Hydrogeology

The Department of Environmental, Earth, and Atmospheric Sciences at the University of Massachusetts Lowell is seeking to fill a tenure track position (at the rank of Assistant or Associate Professor) in the area of Geochemistry or Hydrogeology. This is a permanent, full-time, 9-month faculty position starting September 2016. The position is the first hire in a multi-year cycle of new hires intended to contribute to the growth of the Environmental Geoscience and related programs at UML. We currently offer BS and MS degrees in Environmental Geoscience (and Atmospheric Science) and plan to develop an interdisciplinary Ph.D. program within the next few years. The new hire will be expected to teach courses at both the undergraduate and graduate levels and develop funded research programs in his/her area of expertise. While we are a small department, we are embedded in a large research-oriented university and there are numerous opportunities for collaborative research with colleagues in the College of Sciences and the College of Engineering. For the geochemistry specialty area we seek an individual who is conversant with modern analytical techniques, particularly ICP-MS, and who can contribute to the development of new analytical facilities. Applicants with expertise in low temperature and/or high temperature geochemistry are invited to apply.

Minimum requirements are an earned doctorate, at the time of appointment, in a discipline related to geochemistry or hydrogeology and a record of research and scholarly achievements as evidenced by peer reviewed publications and/or funded research. For appointment at the rank of Associate Professor the candidate must have 6 years of teaching (or equivalent) experience, and a record of scholarly publication and funded research that would merit promotion to the rank of Associate Professor at UML.

To apply please submit a cover letter, curriculum vitae, teaching philosophy, research statement, and the names and contact information of three reference at: jobs.uml.edu/applicants/Central?quickFind=54741

Initial review of applications will begin January 6, 2016, and continue until the position is filled. However, the position may close when an adequate number of qualified applications is received.

The University of Massachusetts Lowell is an Equal Opportunity/Affirmative Action, Title IX employer. All qualified applicants will receive consideration for employment without regard to race, sex, color, religion, national origin, ancestry, age over 40, protected veteran status, disability, sexual orientation, gender identity/expression, marital status, or other protected class.

Geochemistry

Geochemistry Lab Manager

The Department of Geology and Environmental Earth Science at Miami University invites applications for a Geochemistry Lab Manager. The Lab Manager will be expected to manage new trace metal geochemistry and ICP-OES labs, and to share responsibility for ICP-MS, HPLC and powder XRD labs. Duties will include training and supervision of lab users, laboratory maintenance, data quality assurance, assistance in teaching laboratory-based courses, oversight of radiation and environmental health and safety compliance, and laboratory financial management. Laboratory technique development and adaptation for analysis of diverse geologic and environmental materials expected, with opportunities to pursue research and external funding.

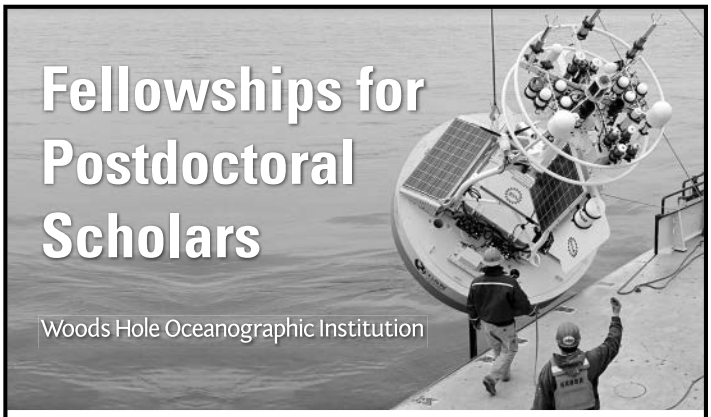
Required: M.S. or Ph.D. in geology or related field, at least 4 years of experience in major and trace element analysis of geologic materials by plasma techniques at the time of the appointment, and proven experience in successful training and supervision of geochemistry lab users. Desired: experience in powder XRD and HPLC analysis; expertise in laboratory technique development, computer programming and electrical and mechanical abilities.

Submit cover letter, vita and unofficial copy of transcripts to: https://miamioh.hiretouch.com/jobdetails?jobID=1868. Arrange to have three (3) letters of recommendation sent to GeochemistrySearch@miamioh.edu. Screening of applications will begin January 15, 2016 and continue until the position is filled. Miami University, an EO/AA employer encourages applications from minorities, women, protected veterans and individuals with disabilities. Miami does not permit, and takes action to prevent, harassment, discrimination and retaliation. Requests for reasonable accommodations for disabilities should be directed to Ms. Mary Jane Leveline at (513) 529-2027. Annual Security and Fire Safety Report may be found at: http://www.MiamiOH.edu/campus-safety/annual-report/index.html. Criminal background check required. All campuses are smoke- and tobacco-free.

Hydrology

ASSISTANT PROFESSOR Groundwater Hydrology University of California, Riverside

The College of Natural and Agricultural Sciences at the University of California, Riverside invites applications for a tenure track position in groundwater hydrology at the rank of Assistant Professor. The position has 50% Instruction and Research and 50% Organized Research in the Agricultural Experiment Station (http://cnas.ucr.edu/about/aes/), and will be located in the Department of Environmental Sci-



Fellowships for Postdoctoral Scholars

Woods Hole Oceanographic Institution

Scholarships are available to new or recent doctoral graduates in diverse areas of research. Applications will be accepted from doctoral recipients with research interests associated with the following:

Departments - Applicants who wish to conduct research on topics of general interest to one or more of the departments are encouraged to apply. The Departments are:

- **Applied Ocean Physics & Engineering**
- **Biology**
- **Geology & Geophysics**
- **Marine Chemistry & Geochemistry**
- **Physical Oceanography**

Institutes - With the aim of fostering interdisciplinary research addressing critical issues, WHOI has established four institutes. We anticipate that we will award a scholarship to support research within the Institutes. The Institutes are:

- **Ocean and Climate Change Institute**
- **Ocean Exploration Institute**
- **Coastal Ocean Institute**
- **Ocean Life Institute**

A joint USGS/WHOI award will be given to a postdoc whose research is in an area of common interest between USGS and WHOI Scientific Staff. The individual will interact with both USGS and WHOI based advisors on their research.

The National Ocean Sciences Accelerator Mass Spectrometer Facility (NOSAMS) will award a fellowship in the development and implementation of new techniques in marine science radiocarbon studies.

Recipients of awards are selected competitively, with primary emphasis placed on research promise. Scholarships are awarded for 18-month appointments with a stipend of $58,000 per year, a modest research budget and eligibility for group health and dental insurance. Recipients are encouraged to pursue their own research interest in association with resident Scientific and Senior Technical Staff. Communication with potential WHOI advisors prior to submitting an application is encouraged. Completed applications must be received by January 5, 2016 for the 2016/2017 appointments. Awards will be announced by March 1.

Further information about the Scholarships and application forms as well as links to the individual Departments and Institutes and their research themes may be obtained through the Academic Programs section of the WHOI web pages at:

www.whoi.edu/postdoctoral

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WOODS HOLE OCEANOGRAPHIC INSTITUTION 1930

ences. Appointees in this series are expected to conduct mission oriented, translational research that has an ultimate goal of solving societal problems relevant to the mission of the Agricultural Experiment Station. The successful candidate will develop a nationally recognized program in groundwater hydrology. The incumbent is expected to have expertise in subsurface hydrology, including measurement and modeling of groundwater flow, reactive transport modeling, and/or remote sensing of groundwater. Research areas may include, but are not limited to, local and regional-scale groundwater dynamics and groundwater quality; surface water-groundwater interactions; the impact of climate change on groundwater recharge, storage and use; or groundwater transport of contaminants. The successful candidate is expected to be fully engaged in the teaching mission of the department and university, including formal classroom instruction in undergraduate and graduate degree programs in Environmental Sciences and mentoring of M.S. and Ph.D. students. Teaching responsibilities will include undergraduate courses in groundwater hydrology and graduate courses in the candidate's area of specialty. A Ph.D. in groundwater hydrology, hydrogeology, or related field and a proven ability to conduct innovative hydrologic research are required. Evaluation of applications will begin on January 6, 2016, but the position will remain open until filled. Applications must include a vita, statements of research and teaching interests, and contact information for at least 3 letters of recommendation. All application materials, must be submitted through AP Recruit at: https://aprecruit.ucr.edu/apply/JPF00442.

Advancement through the faculty ranks at the University of California is through a series of structured, merit-based evaluations, occurring every 2-3 years, each of which includes substantial peer input.

For more information about the position, please contact Dr. Jirka Simunek, Department of Environmental Sciences, University of California, Riverside; Jiri.Simunek@ucr.edu. For questions on application procedures and requirements, please contact Margi Burnett; margi.burnett@ucr.edu. Additional information about the Department of Environmental Sciences can be found at: http://envisci.ucr.edu/.

UCR is a world-class research university with an exceptionally diverse undergraduate student body. Its mission is explicitly linked to providing routes to educational success for underrepresented and first-generation college students. A commitment to this mission is a preferred qualification.

The University of California is an Equal Opportunity / Affirmative Action Employer with a strong institutional commitment to the achievement of excellence and diversity amount its fac-

THE UNIVERSITY OF RHODE ISLAND

GRADUATE SCHOOL OF OCEANOGRAPHY

TWO FACULTY POSITIONS IN OCEANOGRAPHY

The Graduate School of Oceanography at the University of Rhode Island (http://www.gso.uri.edu) invites applications for 2 tenure track faculty members:

1) Assistant Professor specializing in the chemistry or biogeochemistry of seafloor vent and/or seep systems (posting number SF00162)

2) Assistant Professor specializing in autonomous systems and data processing for ocean observation (posting number SF00165)

Located on the water's edge at URI's Narragansett Bay Campus, GSO is the state's center for marine studies, research and outreach. The new hires will have the unique opportunity to participate in the active sea-going community of GSO and the Ocean Exploration Trust utilizing platforms such as the R/V Endeavor and E/V Nautilus. The new faculty members will be expected to develop strong externally funded research programs, advise graduate students, and teach undergraduate and graduate courses.

Application review will begin January 7, 2016 and continue until the positions are filled. Visit https://jobs.uri.edu and search individual posting number (#SF00162 & #SF00165) to read full position descriptions, required and preferred qualifications, and application instructions. Applications must be submitted online only. The University of Rhode Island is an AA/EEOD employer. Women, persons of color, protected veterans, individuals with disabilities, and members of other protected groups are encouraged to apply.

ulty and staff. All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, age, disability, protected veteran status, or any other characteristic protected by law.

Tenure-Track Faculty Position, Civil and Environmental Engineering, Utah State University

The Department of Civil and Environmental Engineering at Utah State University is searching to fill a tenure-track faculty position in water management of irrigated systems (complete description go to https://usu.hiretouch.com/job-details?jobid=937) as part of a water-focused cluster hire involving multiple colleges within the University (https://caas.usu.edu/cwi/). All ranks (Assistant/Associate/Full Professor level) will be considered for this position. Applications will begin being reviewed on 12/2/15, but the position will remain open until filled

The Department of Civil, Environmental, and Geo- Engineering at the University of Minnesota seeks applications for a tenure-track faculty position in the area of water resources.

We are particularly interested in applicants with strong core fundamentals in environmental fluid mechanics that allow them to easily move across disciplinary boundaries and become involved in department, university, and national interdisciplinary research opportunities. The position is expected to be at the rank of assistant professor, although exceptional candidates at all ranks will be considered.

Areas of interest include hydrology, physical limnology, stream hydraulics, computational fluid dynamics, atmospheric boundary layer, and environmental management and sensing. Candidates will be expected to initiate and maintain a strong externally-funded research program. Teaching responsibilities include core undergraduate and graduate courses in water resources engineering, as well as the opportunity to develop new courses in specialty areas. An earned doctorate is required at the time of appointment.

Applications must be completed online at http://z.umn.edu/cegeasstprof (assistant professor) or http://z.umn.edu/cegeprof (professor). Include a letter of intent, CV with a list of publications, complete contact information for three references, and a statement of teaching and research interests. The review of applications will begin December 30, 2015. Applications will continue to be accepted until the position is filled. Expected appointment is Fall 2016.

The Department of Civil, Environmental, and Geo- Engineering at the University of Minnesota is affiliated with St. Anthony Falls Laboratory (SAFL) and the faculty member will have access to the excellent facilities at SAFL. Other major research centers include the National Center for Earth Surface Dynamics 2, EOLOS Wind Energy Research Consortium, Multi-Axial Subassemblage Testing Laboratory, and the Center for Engineered Fracturing of Rock. The University of Minnesota is an equal opportunity educator and employer. Candidates from underrepresented groups are encouraged to apply.

Solid Earth Geophysics

Colorado School of Mines Department of Geophysics Assistant/Associate Professor - Computational Seismology

Colorado School of Mines invites applications for a regular academic faculty position in Geophysics, which is anticipated to be filled at the rank of Assistant or Associate Professor.

The successful candidate will conduct a vigorous research program that includes (a) building strong collaborative relationships with industry, academic, research, and/or government institutions; (b) generating research funding; (c) supervising graduate students; and (d) maintaining a strong record of scholarly publishing. The successful candidate will teach at both the undergraduate and graduate levels, and participate actively in the international geophysics community.

Candidates must possess a doctoral degree in geophysics or a related field. Candidates must also possess superb interpersonal and communication skills and a collaborative style of research and teaching, and must have experience in collaboration with industry.

For the complete job announcement, full statement of qualifications and directions on how to apply, visit: http://inside.mines.edu/HR-Academic-Faculty

Mines is an EEO/AA employer.

PETROLOGIST (OPEN-RANK POSITION) UNIVERSITY OF CALIFORNIA, RIVERSIDE

The Department of Earth Sciences invites applications at the Assistant, Associate and Full Professor levels for a faculty position in the field of petrology, broadly defined. The successful candidate will lead an innovative research program in Earth system dynamics with an interest in the shallow crust, deep Earth processes, elemental cycling, and/or interactions among the surface, oceans, and atmosphere. Appropriate areas of expertise include but are not limited to: petrochemical, petrophysical or novel isotope approaches to Earth history, large-scale tectonics, geodynamics, crustal evolution, fault dynamics, and geochemical cycles.

The successful candidate will be expected to engage fully in formal instruction at the undergraduate and graduate levels and mentor BS, MS, and PhD students. Teaching responsibilities will include undergraduate courses in igneous and metamorphic petrology. We prefer candidates with petrologic expertise suited to graduate course offerings that would support our internationally recognized studies in large-scale Earth cycles, paleoenvironmental change, and/or earthquake science. The successful candidate should possess a PhD in Earth Sciences or related field by the time of appointment.

Information about Earth Sciences at UCR is available on the Web at http://earthsciences.ucr.edu/. Applications must include a curriculum vitae, cover letter, and statements of research and teaching interests. A statement addressing potential contributions of the applicant to diversity is encouraged.

Applicants for appointment as Assistant Professor must submit materials through http://aprecruit.ucr.edu/apply/JPF00419 and should arrange for at least three letters of reference to be provided. Applicants for appointment as Associate or Full Professor must submit materials through http://aprecruit.ucr.edu/apply/JPF00420 and provide the names and addresses of at least three references. Questions about the position should be directed to the search chair, Prof. Pete Sadler: peter.sadler@ucr.edu. For questions on application procedures and requirements, please contact Margi Burnett, at margi.burnett@ucr.edu . Review of applications will begin Dec. 15, 2015, and will continue until the position is filled. Advancement through the faculty ranks at the University of Califor-

nia is through a series of structured, merit-based evaluations, occurring every 2-3 years, each of which includes substantial peer input.

UCR is a world-class research university with an exceptionally diverse undergraduate student body. Its mission is explicitly linked to providing routes to educational success for underrepresented and first-generation college students. A commitment to this mission is a preferred qualification.

The University of California is an Equal Opportunity / Affirmative Action Employer with a strong institutional commitment to the achievement of excellence and diversity amount its faculty and staff. All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, age, disability, protected veteran status, or any other characteristic protected by law.

Position Announcement
Department of Marine,Earth, and Atmospheric Sciences
Assistant/Associate Professor- Sedimentary Basin Analysis

The Department of Marine, Earth, and Atmospheric Sciences (MEAS) at North Carolina State University (NC State) intends to fill a junior (Assistant I Associate Professor) tenure-track faculty position in sedimentary basin analysis. Possible research areas include,but are not limited to, the relationship of basin evolution to mantle processes,linkages of stratigraphy to landscape evolution as a function of tectonics, climate, and sea-level change, the prediction of sub-surface porosity and permeability to model the movement of water and hydrocarbons, and the use of stratigraphy in paleo-environmental and paleo-biological studies. The starting date for this position is 15 August 2016. Candidates that combine surface and/or subsurface observations with numerical simulations, analogue models, or laboratory experiments to investigate the geologic history of sedimentary basins are preferred, and applicants should have a strong interest in interdisciplinary collaborations across and beyond the geosciences.

Applicants must hold a Ph.D. degree in the geosciences or a related field. Postdoctoral experience is preferred, but not required. The successful candidate must demonstrate strong potential for outstanding accomplishments in research, research supervision, and teaching. The successful applicant will be expected to teach an undergraduate-level course in stratigraphy, as well as other undergraduate and graduate classes commensurate with the candidate's interest and expertise. An interest in participating in the Department's capstone undergraduate geology field course also is desirable. MEAS places a high value on excellent instruction and the use of innovative teaching methods.

Affiliated with the College of Sciences at NC State, MEAS is one of the largest interdisciplinary geoscience departments in the nation. Opportunities exist for disciplinary and interdisciplinary interactions with more than 30 marine,earth, and atmospheric scientists. Additional information about the department and its facilities can be found on the web page: http://www.meas.ncsu.edu.

Review of applications will begin on 15 November 2015; the position will remain open until filled. Applications, including cover letters, curriculum vitae, teaching and research statements, and contact information for three references must be submitted online at http://jobs.ncsu.edu/postings/57829

Founded in 1887, NC State is a land-grant institution distinguished by its exceptional quality of research, teaching, extension, and public service. Located in Raleigh, North Carolina, NC State is the largest university in North Carolina, with more than 34,000 students and 8,000 faculty and staff. National rankings consistently rate Raleigh and its surrounding region among the five best places in the country to live and work, with a highly educated workforce, moderate weather, reasonable cost of living,and a welcoming environment. A collaborative, supportive environment for business and innovation and research collaborations with area universities and the Research Triangle Park are compelling reasons for relocation to the area. NC State is an equal opportunity and affirmative action employer. All qualified applicants will receive consideration for employment without regard to race, color, national origin, religion, sex, sexual orientation, age, veteran status, or disability. Applications from women, minorities, and persons with disabilities are encouraged.

Tenure-track Assistant or Associate Professor in Economic Geology at the University of Nevada Las Vegas.

The successful applicant will have an active research program that includes a field component that complements existing departmental strengths, and will have a strong commitment to teaching at both graduate and undergraduate levels. The candidate is expected to investigate scientific questions related to economic geology, mineral resources, and/or fluid-rock interaction; to develop new experimental or analytical techniques for ore deposit exploration and genesis; and to communicate results internationally. The candidate is also expected to develop (Assistant), or show evidence for (Associate) a rigorous externally-funded research program and to supervise MS and PhD students. Preference will be given to applicants with research interests in one or more subdisciplines including high temperature and/or isotope geochemistry, geochemical modeling, experimental petrology, and/or geochronology as they relate to ore deposit genesis. The UNLV Geoscience department has 21 Faculty, more than 50 MS/PhD students, and hosts laboratory facilities including stable isotope, argon geochronology, fluid inclusions, XRF/XRD, ICP-MS, soils, and electron microprobe/SEM labs. Materials should be addressed to Dr. Matthew Lachniet, Search Committee Chair, and are to be submitted via on-line application at https://hrsearch.unlv.edu . Review of application materials will begin on 12/11/15 and continue until filled. UNLV is an Affirmative Action / Equal Opportunity educator and employer committed to excellence through diversity.

Interdisciplinary/Other

Lecturer Faculty Position Geoscience

The Department of Geology and Environmental Earth Science at Miami University invites applications for a full-time Lecturer faculty position on the Oxford campus, beginning August 2016. The Lecturer will teach undergraduate courses, including foundation courses in physical and environmental geology, as well as intermediate level courses; advise undergraduate students; provide professional service to the department and university. Required: M.S. in geoscience by date of appointment and documented teaching experience. Desired: Ph.D. in geo-

science with interest in contributing to supervision of undergraduate student research and field-based experiences. Submit cover letter, vitae, statement of teaching philosophy and experience, unofficial copy of transcripts, and names of three (3) referees to https://miamioh.hiretouch.com/job-details?-jobID=1874. Letters of reference will be requested upon receipt of application. Inquiries can be directed to Cathy Edwards at edwardca@miamioh.edu. Review of applications will begin on January 15, 2016 and continue until position is filled. Miami University, an EO/AA employer encourages applications from minorities, women, protected veterans and individuals with disabilities. Miami does not permit, and takes action to prevent, harassment, discrimination and retaliation. Requests for reasonable accommodations for disabilities should be directed to Ms. Mary Jane Leveline at (513) 529-2027. Annual Security and Fire Safety Report may be found at: http://www.MiamiOH.edu/campus-safety/annual-report/index.html. Criminal background check required. All campuses are smoke- and tobacco-free.

Professor - Civil & Environmental Engineering The University of Delaware

Newark, Delaware

The Department of Civil and Environmental Engineering (www.ce.udel.edu/) at the University of Delaware invites applications for a tenured faculty position at the rank of Full Professor.

We seek a creative and ambitious individual who has a strong record of excellence in research and teaching and an established reputation as a leader in the field. While applicants in the broad field of environmental engineering and science will be considered, candidates specializing in physical-chemical processes, emerging contaminants, and novel investigative tools are of particular interest. The successful candidate will have a Ph.D. in environmental engineering or a closely related discipline and will mount an innovative and productive program of fundamental research with clear impacts on our societal challenges. In addition, she/he is expected to develop and direct a new university-wide doctoral program in Environmental Engineering and Science that willforge collaboration among researchers across campus and produce students equipped to tackle the complex environmental problems of the future.

Submit required application materials include curriculum vitae, research and teaching statements, and names and contact information of four references online at apply.interfolio.com/31891. Applicants are encouraged to include their perspectives on how they would fit into the Department, the College, and the broader research community on campus. Review of applications will begin November 1, 2015 and will continue until the position is filled. For inquiries, contact Dr. Pei Chiu, Search Committee Chair, 302-831-3104, pei@udel.edu.

Equal Employment Opportunity

The University of Delaware is an Equal Opportunity Employer which encourages applications from minority group members, women, individuals with a disability and veterans. The University's Notice of Non-Discrimination can be found at http://www.udel.edu/aboutus/legalnotices.html. Employment offers will be conditioned upon successful completion of a criminal background check. A conviction will not necessarily exclude you from employment.

The Roy M. Huffington Department of Earth Sciences at SMU announces a search to fill a named tenure-track or tenured professorship (the rank is open) honoring WB Hamilton.

We solicit nominations and applications from earth scientists who maintain vigorous and sustainable research programs and who have a commitment to full participation in the educational mission of the department to provide professional training in a liberal arts environment. As the fourth holder of the chair established in 1921, the successful candidate will extend existing departmental strengths in earth science. The department's focus is on pure research to understand Earth history and geologic processes with applied research on problems in the national interest such as climate and environmental change, earthquake seismology including induced seismicity, natural hazards, nuclear test ban monitoring and resources including geothermal energy. The expected start date is August 1, 2016.

Applications can be submitted electronically to sschwob@smu.edu or in writing to:

Professor John Walther

Search Committee Chair, Department of Earth Sciences,

Southern Methodist University, P.O. Box 0395

Dallas TX 75275

Applicants should include curriculum vitae, statements of research and teaching interests, and contact information for three references. To insure full consideration applications must be received by December 5, 2015, but the committee will continue to accept applications until the position is filled. The committee will notify applicants of its employment decisions after the position is filled.

Southern Methodist University will not discriminate in any program or activity on the basis of race, color, religion, national origin, sex, age, disability, genetic information, veteran status, sexual orientation, or gender identity and expression. The Executive Director for Access and Equity/Title IX Coordinator is designated to handle inquiries regarding nondiscrimination policies and may be reached at the Perkins Administration Building, Room 204, 6425 Boaz Lane, Dallas, TX 75205, 214-768-3601, accessequity@smu.edu.

Hiring is contingent upon the satisfactory completion of a background check.

Two Tenure-Track Assistant Professor Positions in Basin-modeling/Solid Earth Geophysics and Sedimentology

The Department of Geology at Kansas State University invites applications for two tenure-track faculty positions at the assistant professor level beginning in August 2016 in the areas of: (1) sedimentology and/or stratigraphy, (2) basin-scale modeling or solid earth geophysics. A detailed advertisement for both positions is located at www.ksu.edu/geology. Screening of applications begins December 21, 2015 and continues until the position is filled. Full consideration will be given to applications received by December 1, 2015. Kansas State University is an EOE of individuals with disabilities and protected veterans. Kansas State University actively seeks diversity among its employees. Background check required.

Visiting Instructor / Visiting Assistant Professor Hydrogeology

The Department of Geology and Environmental Earth Science at Miami University invites applications for a temporary, full-time faculty position on the Oxford campus, beginning August 2016. This is a nine-month (two academic semester) appointment that may be renewed for up to four years pending funding availability and satisfactory performance. The primary responsibility of this position is teaching, including foundation courses in physical and environmental geology, and intermediate and upper level courses such as Water & Society and Hydrogeology. An M.S. in geology or a related field is required for appointment as Instructor; a Ph.D. is preferred and is required for appointment as a Visiting Assistant Professor. Submit cover letter, vitae, statement of teaching philosophy and experience, unofficial copy of transcripts, and 3 letters to reference to https://miamioh.hiretouch.com/job-details?jobID=1862. Inquiries can be directed to Cathy Edwards at edwardca@miamioh.edu. Review of applications will begin on January 15, 2016 and continue until position is filled. Miami University, an EO/AA employer encourages applications from minorities, women, protected veterans and individuals with disabilities. Miami does not permit, and takes action to prevent, harassment, discrimination and retaliation. Requests for reasonable accommodations for disabilities should be directed to Ms. Mary Jane Leveline at (513) 529-2027. Annual Security and Fire Safety Report may be found at: http://www.MiamiOH.edu/campus-safety/annual-report/index.html. Criminal background check required. All campuses are smoke- and tobacco-free.

West Virginia University, Department of Geology & Geography: Three Assistant Professor Positions

The Department of Geology and Geography at West Virginia University seeks to fill three geology faculty positions. Applicants should have a PhD or equivalent degree in geology, earth science or related field by the start date. Review of applications for all positions will begin January 15, 2016 and continue until each position is filled; start date for all positions is August 15, 2016.

Paleobiology: We seek to hire a full-time (9-month), tenure-track Assistant Professor specializing in Paleobiology, which could include expertise in Invertebrate or Vertebrate Paleontology, Micropaleontology, Paleoecology, Paleobotany/Palynology, Ichnology, or related fields. The successful candidate will be expected to develop a vigorous externally-funded research program, teach core undergraduate classes in paleontology, graduate courses in the area of his/her expertise, and mentor graduate and undergraduate students. Candidates should demonstrate potential to establish a strong externally-funded research program, publish in peer-reviewed journals, and excel

Faculty positions available at the Institute of Oceanography, National Taiwan University

The Institute of Oceanography, National Taiwan University (IONTU), invites applications for one to three faculty position(s), at the level of assistant professor or higher, starting on August 1, 2016. Applicants should hold a doctoral degree in research fields related to marine sciences, including physical oceanography, chemical oceanography, marine geology, marine biology or biological oceanography. Applicants should send (1) curriculum vitae (including publication list), (2) PDF reprints of up to three publications (published after June, 2012), (3) a proposal for future research and teaching preferences, via e-mail before **December 31, 2015** to:

Prof. Sen Jan
Chair, Faculty Search Committee
Institute of Oceanography, National Taiwan University
(senjan@ntu.edu.tw ; please also Cc to chienchung@ntu.edu.tw)

Tel: +886-2-3366-1373
Fax: +886-2-2362-6802
Please visit http://www.oc.ntu.edu.tw for general information of IONTU.
Please also arrange for three recommendation letters to be sent directly to the Chair of the Faculty Search Committee. Upon receipt of the application, an acknowledgement email will be sent to the applicant within a week. Applicants who do not receive the acknowledgement email please contact the Chair of the Faculty Search Committee via fax or telephone for confirmation.

in teaching at the undergraduate and graduate levels. To apply, please visit jobs.wvu.edu and navigate to the position title listed above. Upload (1) a single PDF file containing a curriculum vitae, statement of research interests, statement of teaching philosophy, and names, titles, and full contact information for 3 references; and (2) PDF files of up to 3 publications. In addition, arrange for 3 letters of reference to be sent to Paleobiology@mail.wvu.edu. For additional information, please see pages.geo.wvu.edu/Paleobiology or contact the search chair, Amy Weislogel, at Paleobiology@mail.wvu.edu or (304) 293-6721.

Quantitative Structural Geology or Geomechanics: We seek to hire a full-time (9-month), tenure-track Assistant Professor specializing in quantitative structural geology with interests in the study of fractured reservoirs and geomechanics. The successful candidate will be expected to develop a vigorous externally-funded research program, teach undergraduate classes in structural geology or geomechanics, teach graduate courses in the area of his/her expertise, and mentor graduate and undergraduate students. Candidates should demonstrate potential to establish a strong externally-funded research program, publish in peer-reviewed journals, and excel in teaching at the undergraduate and graduate levels. To apply, please visit jobs.wvu.edu and navigate to the position title listed above. Upload (1) a single PDF file containing a curriculum vitae, statement of research interests, statement of teaching philosophy, and names, titles, and full contact information for 3 references; and (2) PDF files of up to 3 publications. In addition, arrange for 3 letters of reference to be sent to Geomechanics@mail.wvu.edu. For additional information, please see pages.geo.wvu.edu/Geomechanics or contact the search chair, Dengliang Gao, at Geomechanics@mail.wvu.edu or (304) 293-3310.

Teaching Assistant Professor of Geology: We seek to hire a full-time (9-month), non-tenure track Teaching Assistant Professor. The successful candidate will teach a variety of undergraduate courses, including both large introductory and smaller upper-division classes, in the classroom and online, and the field component of the B.S. capstone course, Geology Field Camp (the last with an additional summer stipend). Specialty area is open. Teaching Assistant Professors at WVU are eligible for promotion; however, promotion to senior ranks is not a requirement for institutional commitment and career stability. This position is a nine-month renewable appointment (no maximum number of terms) and includes full benefits. The position carries an 80% teaching (4 courses per semester) and 20% service assignment. The successful candidate will join a faculty that takes great pride in having members recognized at the university, state, and national levels for excellence in teaching. The Department occupies the recently renovated Brooks Hall with state-of-the-art teaching technologies and facilities. To apply for this position, interested candidates should visit jobs.wvu.edu and navigate to the position title listed above. Upload a single PDF file containing a curriculum vitae, statement of teaching interests and philosophy, teaching evaluations as available, and full contact information for 3 references. In addition, please arrange for three letters of reference to be sent directly to GeologyTAP@mail.wvu.edu. For additional information, please see pages.geo.wvu.edu/GeologyTAP or contact the search chair, Thomas Kammer, at GeologyTAP@mail.wvu.edu or (304) 293-9663.

WVU is an EEO/Affirmative Action Employer and welcomes applications from all qualified individuals, including minorities, females, individuals with disabilities, and veterans. For additional information about the department visit www.geo.wvu.edu.

Student Opportunities

EarthCube's Visiting Scientist Program

Offers up to $2000 each to support five graduate students and early career scientists for travel and related expenses incurred while incorporating EarthCube technologies and capabilities in their own research agendas.

For more information or to apply for funding, please go to: http://earthcube.org/info/visiting-scholar-program

Lindahl Ph.D. Scholarships: The University of Alabama, Department of Geological Sciences

Seeks highly qualified Ph.D. students with specializations in topics that complement faculty research interests. Exceptional students will receive Research or Teaching Assistantships and a Lindahl Scholarship totaling $22,000 for a nine month appointment. The University of Alabama covers the cost of non-resident tuition and fee waivers. Funding is renewable for at least 4 years if expectations are met. Other fellowships are available from the Graduate School on a competitive basis. Further details are at http://www.geo.ua.edu/. Applicants should contact Dr. Delores Robinson (dmr@ua.edu) to express interest. Review of applications for Fall 2016 admission will begin January 15, 2016.

NASA Student Research Opportunity - Summer 2016

The NASA Airborne Science Program invites highly motivated advanced undergraduates who will be rising seniors in summer 2016 to apply for participation in the 8th annual NASA Student Airborne Research Program (SARP 2016). The purpose of the Student Airborne Research Program is to provide students with hands-on research experience in all aspects of a major scientific campaign, from detailed planning on how to achieve mission objectives to formal presentation of results and conclusions to peers and others. Students will work in multi-disciplinary teams to study surface, atmospheric, and oceanographic processes. Participants will fly onboard the NASA DC-8 and assist in the operation of instruments to sample and measure atmospheric solar radiation, gases and aerosols. They will also use remote sensing data collected during the program from the NASA ER-2 high-altitude research aircraft to image land and water surfaces in multiple spectral bands. Along with airborne data collection, students will participate in taking measurements at field sites. Each student will complete an individual research project from the data collected.

Outstanding faculty and staff for this program will be drawn from several universities and NASA centers, as well as from NASA flight operations and engineering personnel.

The eight-week program begins June 12, 2016 and concludes August 5, 2016.

Instrument and flight preparations, and the research flights themselves, will take place during the first two weeks of the program at NASA's Armstrong Flight Research Center, in Palmdale, CA. Post-flight data analysis and interpretation will take place during the final six weeks of the program at the University of California, Irvine.

SARP participants will receive a $5,000 stipend. They will also receive a travel allowance as well as free housing and local transportation during the 8-week program.

Applicants must be US citizens attending a US college or university majoring in a STEM discipline.

The application deadline is Wednesday February 2, 2016.

Apply here: www.nserc.und.edu/sarp/sarp-2016/

Email questions to the SARP Project Manager, Dr. Emily Schaller, at: SARP2016@nserc.und.edu

SARP staff will also be present at the NASA booth at the 2015 AGU Fall Meeting in San Francisco.

Follow us on Facebook: facebook.com/nasasarp

PhD Fellowships in Hydrologic Sciences available at the University of Nevada, Reno and Desert Research Institute

The Graduate Program of Hydrologic Sciences at the University of Nevada, Reno and the Desert Research Institute seeks PhD candidates in hydrology and hydrogeology to fill graduate teaching and research assistant positions beginning in Fall 2016. Three year research fellowships are available for a wide range of topics, including effects of halophytic plants on soil quality; climate patterns and tree rings; groundwater residence times and aquatic ecology of springs; snow ecohydrology; and Nevada water resources. Details are available at http://www.hydro.unr.edu/research/research_funding.aspx.

PhD Opportunity in Vadose Zone Hydrology, Univ. of Tennessee - Knoxville, Dept. of Earth & Planetary Sci.

Research will focus on film flow & solute transport on rock fracture surfaces. Further information at: http://web.eps.utk.edu/faculty/perfect.php. Preferred qualifications: MS degree, excellent GPA, strong quantitative & writing skills, familiarity with laboratory techniques in hydrogeology / soil physics, and previous experience with analytical / numerical models. To apply, send a cover letter & CV to Prof. Edmund Perfect (eperfect@utk.edu, 865-974-6017).

PhD Student Opportunity in Hydrology, Washington State University

Four year RA available for student to work with an interdisciplinary team to understand the interactions between drought, forest management, and wildfire on forest ecosystem resilience. Studentsexperienced with Linux/programming and/or ecohydrology will be competitive. The student will be co≠advised by Jennifer Adam (WSU} and Christina Tague {UCSB}. Interested students should contact jcadam@wsu.edu for more information. Fall semester applications to WSU are due on 10 January for priority consideration.

The Jonathan O. Davis Scholarship supports graduate students working on the Quaternary geology of the Great Basin. The national scholarship is $7,500 and the University of Nevada, Reno stipend is $7,500. The national scholarship is open to graduate students enrolled in an M.S. or Ph.D. program at any university in the United States. The Nevada stipend is open to graduate students enrolled in an M.S. or Ph.D. program at the University of Nevada, Reno. Details on application requirements can be found at: http://www.dri.edu/GradPrograms/Opportunities/JonathanDavis. Applications must be post-marked by February 17, 2016. Proposals will not be returned. Applications should be addressed to: Executive Director Division of Earth and Ecosystem Sciences, Attn: Davis Scholarship,Desert Research Institute, 2215 Raggio Parkway, Reno NV 89512

Thursday, 17 December

Support your favorite AGU initiative while earning prizes, creating community, and making a difference!

Find out more or donate at the Donor Fast Lane located at registration in Moscone West or at

giving.agu.org

Postcards from the Field

Greetings from the field!

Graduate students William Wright and Matt McClellan from the Environmental Geophysics Lab in the Department of Geosciences at Florida Atlantic University are measuring methane and carbon dioxide gas distribution and releases from peat soils in the Florida Everglades using near-surface geophysical methods.

We enjoy being in the water when the weather is hot and humid…unfortunately for us, pythons and alligators enjoy that as well!

Wish you were here,
Xavier Comas
Associate Professor, Department of Geosciences, Florida Atlantic University

View more postcards at *http://americangeophysicalunion.tumblr.com/tagged/postcards-from-the-field*.

SHARING SCIENCE

Learn, Engage, Be Inspired!

Learn

Luncheon: How to Become a Congressional Science Fellow or Mass Media Fellow*
Monday, 12:30 P.M.–1:30 P.M.
Moscone North, Rooms 121, 122, 124, 125

Sharing Science in Plain English (Panel & Lunch)*
Tuesday, 12:30 P.M.–2:00 P.M.
Moscone North, Rooms 121, 122, 124, 125

Communicating Your Science: Ask the Experts*
Wednesday and Thursday, 10:00 A.M.–11:00 A.M.
San Francisco Marriott Marquis, Salons 14-15

Science Policy: Moscone West Wing*
Wednesday, 12:30 P.M.–1:30 P.M.
Moscone North, Rooms 121, 122, 124, 125

Not Just the Facts: How to Communicate Opinion*
Wednesday, 12:30 P.M.–2:00 P.M.
Moscone West, Room 3000

Engage

Games Arcade*
Monday, 6:00 P.M.–8:00 P.M.
San Francisco Marriott Marquis, Golden Gate A

Blogging and Social Media Forum 101*
Tuesday, 4:00 P.M.–5:00 P.M.
Moscone West, Room 3000

Blogging and Social Media Forum 201*
Tuesday, 5:00 P.M.–6:00 P.M.
Moscone West, Room 3000

SIPS Focus Group Discussion and Luncheon*
Thursday, 12:30 P.M.–1:30 P.M.
San Francisco Marriott Marquis, Salons 3&4

Games Workshop
Thursday, 1:00 P.M.–4:00 P.M.
San Francisco Marriott Marquis, Golden Gate A

Be Inspired

AGU Cinema: Short Films on Science
Monday–Wednesday, 8:00 A.M.–3:30 P.M.
Thursday, 8:00 A.M.–6:00 P.M.
Friday, 8:00 A.M.–12:00 P.M.
Moscone South, Room 101

Open Mic Night
Tuesday, 7:30 P.M.–9:00 P.M.
Jillian's Restaurant & Bar, 175 Fourth Street

Ignite@AGU
Wednesday, 6:00 P.M.–8:30 P.M.
Infusion Lounge, 124 Ellis Street

Sharing Science Sessions

PA21D The Many Sides of Sharing Science: A How-To I Posters
Tuesday, 8:00 A.M.–12:20 P.M.
Moscone South, Poster Hall

PA24A The Many Sides of Sharing Science: A How-To
Tuesday, 4:00 P.M.–6:00 P.M.
Moscone South, Room 103

ED54B Make It More Simple: The Up-Goer Five Giving-It-a-Try (aka Challenge)
Friday, 4:00 P.M.–6:00 P.M.
Moscone South, Room 310

Earn a button at each starred (*) event, and trade in 3 or more buttons at the AGU Booth for a prize (Wed & Thurs).

AGU's Sharing Science program provides scientists with opportunities, tools, and support to effectively promote widespread awareness of Earth and space science and its value.

sharingscience.agu.org/agu15

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Amazon Web Services and AGU are excited to announce a special Live Granting of Amazon Web Services research grants at the 2015 Fall Meeting.

Applications will be accepted and evaluated 20 October–31 December 2015 with the opportunity for live applications and granting at the AWS booth (#516) during the Fall Meeting. Grants will be awarded during and following the Fall Meeting.

Visit **FallMeeting.agu.org/2015/AWSLiveGranting** for more information and to apply.