VOL. 96 • NO. 10 • 1 JUN 2015

EOS

Earth & Space Science News

Humans Greatly Increase Mercury in the Ocean

AGU Editors' Citations to Excellent Reviewers

Learning from the Nepal Quake

AGU
American Geophysical Union

AGU CHAPMAN CONFERENCE

Which Chapman Will You Be Attending in 2015?

Evolution of the Asian Monsoon and its Impact on Landscape, Environment and Society: Using the Past as the Key to the Future
Hong Kong SAR, China
14–18 June

The Width of the Tropics: Climate Variations and Their Impacts
Santa Fe, New Mexico, USA
27–31 July

Magnetospheric Dynamics
Fairbanks, Alaska, USA
27 September–2 October

The MADE Challenge for Groundwater Transport in Highly Heterogeneous Aquifers: Insights from 30 Years of Modeling and Characterization at the Field Scale and Promising Future Directions
Valencia, Spain
5–8 October

chapman.agu.org

1 JUNE 2015
VOLUME 96, ISSUE 10

COVER

What Can We Learn About Disaster Preparedness from Nepal's Quake?

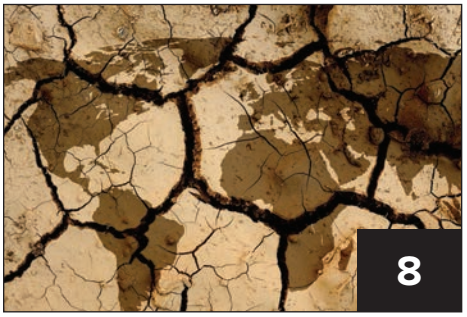
In an interview with *Eos*, hazard mitigation expert Brian Tucker discusses how researchers and the public can help minimize death and damage from strong earthquakes.

NEWS

5 Initiative Aims to End Routine Flaring of Natural Gas

A new initiative to curtail the wasteful burning of natural gas associated with oil production could lead to significant environmental and public health benefits.

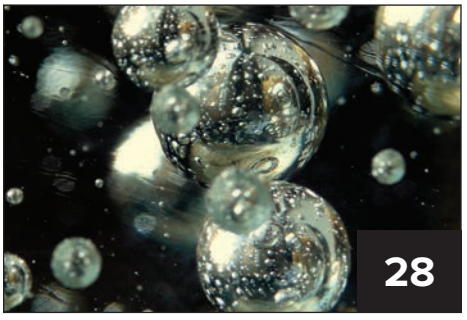
OPINION



Spreading the Word About Climate Change

It has been 1 year since the release of the third U.S. National Climate Assessment. What has been learned over this year, and how can you help to inform the public about these important results?

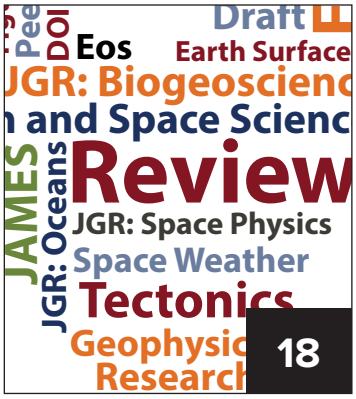
RESEARCH SPOTLIGHT



Humans Greatly Increase Mercury in the Ocean

A study of the natural cycle of mercury reveals that humans are to blame for a five- to sixfold increase in the oceanic concentrations of the potentially toxic element.

DEPARTMENTS



Eos

Editor in Chief

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

Editors

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

Wendy S. Gordon
Ecologia Consulting, Austin, Texas, USA; wendy@ecologiaconsulting.com

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

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

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

Editorial Advisory Board

M. Lee Allison, Earth and Space Science Informatics
Lora S. Armstrong, Volcanology, Geochemistry, and Petrology
Michael A. Ellis, Earth and Planetary Surface Processes
Arlene M. Fiore, Atmospheric Sciences
Nicola J. Fox, Space Physics and Aeronomy
Steve Frolking, Biogeosciences
Edward J. Garnero, Study of the Earth's Deep Interior
Michael N. Gooseff, Hydrology
Kristine C. Harper, History of Geophysics
Keith D. Koper, Seismology
Robert E. Kopp, Geomagnetism and Paleomagnetism
John W. Lane, Near-Surface Geophysics
Xin-Zhong Liang, Global Environmental Change
Jian Lin, Tectonophysics
Figen Mekik, Paleoceanography and Paleoclimatology
Jerry L. Miller, Ocean Sciences
Michael A. Mischna, Planetary Sciences
Thomas H. Painter, Cryosphere Sciences
Roger A. Pielke Sr., Natural Hazards
Michael Poland, Geodesy
Eric M. Riggs, Education
Adrian Tuck, Nonlinear Geophysics
Sergio Vinciguerra, Mineral and Rock Physics
Earle Williams, Atmospheric and Space Electricity
Mary Lou Zoback, Societal Impacts and Policy Sciences

Staff

Production: Faith A. Ishii, Production Manager; Melissa A. Tribur, Senior Production Specialist; Liz Castenson, Editor's Assistant; Yael Fitzpatrick, Manager, Design and Branding; Valerie Bassett and Travis Frazier, Electronic Graphics Specialists

Editorial: Randy Showstack, Senior Writer; Mohi Kumar, Science Writer/Editor; JoAnna Wendel, Writer

Marketing: Angelo Bouselli and Mirelle Moscovitch, Marketing Analysts

Advertising: Christy Hanson, Manager; Tel: +1-202-777-7536; Email: advertising@agu.org

Eos (ISSN 0096-3941) is published semi-monthly, on the 1st and 15th of the month except the 1st of January 2015 by the American Geophysical Union, 2000 Florida Ave., NW, Washington, DC 20009, USA. Periodical Class postage paid at Washington, D. C., and at additional mailing offices. POSTMASTER: Send address changes to Member Service Center, 2000 Florida Ave., NW, Washington, DC 20009, USA.

Member Service Center: 8:00 a.m.–6:00 p.m. Eastern time; Tel: +1-202-462-6900; Fax: +1-202-328-0566; Tel. orders in U.S.: 1-800-966-2481; Email: service@agu.org.

Use AGU's Geophysical Electronic Manuscript Submissions system to submit a manuscript: http://eos-submit.agu.org.

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

Christine W. McEntee, Executive Director/CEO

AGU
American Geophysical Union

What Will Become of Sweet Briar's Atmospheric Research Station?

While faculty members and students of Sweet Briar College scramble to secure their futures elsewhere or fight to keep the institution open, environmental science professor Thomas O'Halloran worries about what will become of the college's atmospheric research station, which includes an observation tower standing 2 kilometers away from campus within a sprawling loblolly pine forest.

O'Halloran was just minutes away from installing a new instrument on the tower on the morning of 3 March when officials at Sweet Briar College, a liberal arts college in Virginia, announced that the school would close at the end of the semester.

"I was [in the lab] soldering a connector, one of the last things I had to do before putting it on the tower," O'Halloran said. "If you go into my lab right now, the thing is sitting there with the soldering iron."

Now the instrument, which would have measured carbon dioxide fluxes of the forest, rests unattended while O'Halloran searches not only for a new job but also for some way to save the research tower and its accompanying laboratory. Because the tower was purchased partly using a private gift bestowed on the college itself, O'Halloran cannot simply take it with him to his next position.

"What the school is telling me is 'If you want to take it somewhere, someone's going to have to buy it,'" O'Halloran said.

Research Dreams

Less than a year ago, in the summer of 2014, O'Halloran and a small team erected the 37-meter-tall tower, which stretches 17 meters above the canopy. They also built a research shed at its base, complete with equipment, electricity, Internet access, and air conditioning. Together, these components form Sweet Briar's Land-Atmosphere Research Station.

The tower itself hosts a myriad of instruments, most dedicated to studying the gases that contribute to aerosol formation above the canopy. The rest include devices that measure meteorological features such as air temperature, humidity, incoming and reflected solar radiation, and wind speed and direction. Instruments on the tower also measure precipitation amount, rate, and intensity.

O'Halloran planned to focus on studying air quality and the formation of aerosols, specifically those responsible for a well-known phenomenon that annually blankets the Appalachian Mountains: the Blue Ridge haze.

Scientists know that the haze forms when hydrocarbons released by the canopy are oxidized in the air, which turns them into tiny particles that scatter blue light. The effect can be strengthened by chemicals emitted by upwind coal-burning power plants but occurs naturally even without air pollution. With the research tower and facility, O'Halloran intended to investigate how this haze relates to a documented cooling effect seen in the southeastern United States.

The newest device would have made the tower an AmeriFlux site—one of more than a hundred dotted across the country, making up a network of atmospheric research stations that study energy fluxes, carbon dioxide storage, and water vapor around North and South America. The tower also holds a PhenoCam, a camera designed to observe the greenness of the canopy, part of a national phenology research network studying the timing of ecological changes.

O'Halloran also had collaborations planned within and outside the Sweet Briar community, including allowing the biology department to install sticky traps on the tower to collect insect specimens, working with forestry scientists to study the surrounding pine forest, and collaborating with scientists at nearby schools to provide data for other studies.

"His site was such a great opportunity because the infrastructure was already established," said Quinn Thomas, an ecology professor at Virginia Polytechnic Institute and State University who was going to use the research tower to study carbon cycling.

Other research towers exist in the region—one at the University of Virginia in Charlottesville and a set at Duke University in North Carolina—but these facilities are farther away and do not typically offer the same kinds of opportunities to undergraduate students as the facility at Sweet Briar, which is a much smaller institution, O'Halloran said.

Women in Science

Sweet Briar, a women's college, allows undergraduates opportunities to do serious research in atmospheric and environmental sciences at a time when women are famously underrepresented in many scientific fields. So the loss of the research tower and facility would also mean a lost opportunity for Sweet Briar's current students who want to pursue scientific

Rob Alexander

Verena Joerger, a senior at Sweet Briar College, and environmental sciences professor Thomas O'Halloran check instruments at the top of the atmospheric research tower.

Meridith De Avila Khan/Sweet Briar College

Looking up the 37-meter-tall atmospheric research tower.

careers but need research experience, O'Halloran said.

Verena Joerger, who used the tower to conduct research for her senior thesis, is among the last students to study at the tower. Throughout the summer of 2014, Joerger helped O'Halloran build the tower and the laboratory, which included learning to climb the tower, installing instruments, and outfitting the wooden research shed with equipment.

"I might not have felt as comfortable volunteering for those types of activities if I were in a co-ed environment," Joerger said. "At a women's college you don't have that feeling that maybe you're not as qualified as your male peers."

Using the data collected at the tower, Joerger created a research project and presented a poster (see http://bit.ly/JoergerAGUPoster) at AGU's 2014 Fall Meeting in San Francisco, Calif. Next fall, she will be starting graduate school in atmospheric sciences at Cornell University in Ithaca, N.Y.

However, for students who have yet to graduate, prospects are more grim. Emily Dallas, a current junior at Sweet Briar, was going to conduct a summer research project studying solar radiation, but now those plans must be put on hold. In fact, the day the school announced it would close, Dallas and O'Halloran had planned to meet and discuss in depth what her research project would be, Dallas said. Now she must search for a new summer research opportunity to build her scientific resume before transferring to a new school in the fall.

Opportunities Lost

If research can no longer continue at the facility, future students will "miss out on being a part of something that is a lot bigger than Sweet Briar," said Joerger, because it is "an opportunity that most students at small liberal arts colleges wouldn't have."

The tower was "going to be part of two international research networks. We could do it with undergraduates and we could do it with women," O'Halloran said. "Right now, it has no future."

By **JoAnna Wendel,** Staff Writer

Initiative Aims to End Routine Flaring of Natural Gas

Faith Nwadishi has heard it all before when it comes to promises to end the routine flaring of natural gas that is associated with oil production. Nwadishi, a resident of Nigeria's oil-rich Delta State, said that although her country approved a law in 1979 to end gas flaring, the routine flaring continues.

Communities near the flaring sites "don't know the difference between day and night because they go to bed with active gas flare sites," said Nwadishi. She is the national coordinator in Nigeria for Publish What You Pay, a nongovernmental organization focusing on transparency in extractive industries. "Women go to gas flare sites to dry their fish and sell to the people without knowing the implications of what they are doing," she said. She added that "gas flaring is a threat to my fundamental right to life because gas flaring hampers my right to a clean environment and gas flaring is evil."

Nwadishi was one of the featured speakers at a 17 April event at the World Bank in Washington, D. C., to launch a new initiative to end the routine flaring of natural gas by 2030 (see http://bit.ly/EndFlaring2030). Flaring is a widely used practice to dispose of natural gas, particularly when there is a lack of infrastructure to use the gas productively.

Nwadishi said she was pleased that 25 countries, companies, and development institutions, which together are responsible for more than 40% of global gas flaring, already have committed to the initiative. However, she said, the commitment needs to be translated into action to help communities affected by pollution from gas flaring.

Health and Environmental Issues Related to Gas Flaring

Gas flaring can emit a number of hazardous substances that can affect public health, including carbon monoxide, which can cause respiratory problems; benzene, which is carcinogenic; and volatile organic compounds, which help to create ground level ozone and can induce nausea and breathing difficulties. According to the World Bank, "There is, however, little definitive data as to how proximity to flares, duration of exposure, etc. are linked to actual health problems as few studies of the health impact of flaring have been carried out."

In addition to health threats posed by the approximately 140 billion cubic meters of natural gas routinely flared each year from thousands of oil fields around the world, the flaring also pumps about 350 million tons of carbon dioxide (CO_2)—nearly 1% of total CO_2 emissions in 2013—into the atmosphere and contributes to black carbon, which affects the radiation balance in the Arctic, according to the World Bank.

That flared gas adds emissions equivalent to that of about 77 million cars, according to bank spokespeople. Moreover, if the gas were used for power generation it could provide 750 billion kilowatt hours of electricity, more than what is currently used in all of Africa, the bank noted.

Randy Showstack

Faith Nwadishi, national coordinator in Nigeria for the nonprofit Publish What You Pay.

The initiative, Zero Routine Flaring by 2030, calls for endorsers to commit to no routine gas flaring at new oil fields and to work as quickly as possible—no later than 2030—and to identify solutions to end routine flaring at existing oil production sites. Initial endorsers of the initiative include 9 countries, 10 oil companies, and 6 development institutions.

Of the countries endorsing the initiative, two, Russia and Kazakhstan, are among the eight largest flaring countries; together, those two account for more than 65% of total flaring, according to satellite data estimates from 2012 cited by the World Bank. The other six large emitters are Nigeria, Iran, Iraq, the United States, Algeria, and Venezuela. The initiative recognizes the distinction between routine flaring and flaring that may need to be done for safety or production protocols.

Routine Flaring "Must Come to an End"

Jim Yong Kim, president of the World Bank Group, said the wasteful, routine flaring of natural gas "must come to an end." He said, "These flares represent inaction, and a stark reality that millions of people go to sleep each night lacking basic energy resources, while a valuable resource that could provide the energy goes up in flames, often just a short distance from their homes."

Kim added, "This is unsustainable and unacceptable, particularly because we know we can build the infrastructure and apply existing new technical and regulatory frameworks and sound energy policies to harness this resource and put it to productive use."

> The flaring initiative "will stand as a tangible contribution to reducing global CO_2 emissions."

He said that with the United Nations (UN) climate summit in Paris later this year, the flaring initiative "will stand as a tangible contribution to reducing global CO_2 emissions."

Ban Ki-moon, secretary-general of the United Nations, said that gas flaring "seems to be a symbol of prosperity and wealth" but that the wasted gas could be used more beneficially. Ban said he is looking to the business community and to scientists to help find ways to reduce wasteful flaring and enhance energy efficiency.

Flaring and Black Carbon

Børge Brende, Norway's minister of foreign affairs, said that his country banned gas flaring from the outset. "Since routine flaring is not an option, industry has had to work creatively. The associated gas is being used, and it increases our productivity."

Brende added that gas flaring causes 40% of the black carbon in the Arctic. "We know that gas flaring in the Arctic is especially harmful. Black carbon from gas flaring settles on Arctic snow and sea ice, darkens the

surface, and accelerates the melting of the ice," he said.

Menahi Al-Anzi, deputy CEO for the exploration and gas directorate of the Kuwait Oil Company, said that since the country's gas flaring reduction program began in 2005–2006, flaring has been reduced from about 17% of total gas production to 1.1%. Al-Anzi told *Eos* that his message to others who have not yet endorsed the World Bank's initiative is that the initiative "is really about human beings' lives, their health, their power generation. It is really humanity more than just economics, so people need to look at this from this side."

©iStock.com/HHakim

A new initiative aims to end the routine flaring of natural gas at oil wells by 2030.

Hurdles to Overcome

Several oil company executives also attended the World Bank's launch of the initiative. They included Jorma Ollila, chairman of Royal Dutch Shell, which has endorsed the initiative. Ollila said that for the initiative to be a success, more parties must sign on, particularly more countries where flaring takes place. He added that stakeholders have to stick together in the campaign to end routine flaring.

"You need alternate ways to use natural gas produced with oil," Ollila said. "You need facilities to capture gas, pipelines to support it, and customers to sell it to. Infrastructure and markets can't be built by governments, companies, or development organizations alone. It requires partnerships."

Eldar Sætre, CEO of Statoil, added that his company believes that meeting the target of zero routine flaring by 2030 "is one of the most important contributions that our industry can make toward mitigating climate change."

Solomon Asamoah, vice president for infrastructure, private sector, and regional integration at the African Development Bank, told *Eos* the hurdles to involve more companies in the initiative include publicity and pressure. "I am a firm believer that lecturing and trying to get companies to do 'the right thing' on [their] own is not powerful enough. You have to have legislation or you have to have financial incentives or financial disincentives for them to adopt these kinds of behaviors. So it's a joint thing between the governments and the private sector. But I think the regulatory issues, the legal issues that govern investment in oil and gas, are where the issue needs to be addressed."

A Complicated Mix

Kandeh Yumkella, CEO of the UN's Sustainable Energy for All Initiative, said that Africa should be the leader on the issue of ending routine gas flaring. Yumkella, who has been instrumental in pushing the initiative, said the wasted gas could provide energy for the 620 million Africans who currently lack access to electricity.

He added that in the past 5 years, 30% of new oil and gas discoveries have been in Africa. "We have no business being energy poor," Yumkella said. "Our dream is the following: We go to Paris and everybody has signed" the initiative.

He told *Eos* that the initiative is doable and that technology is not the limiting factor. "First of all, you need markets," he said, noting that there need to be enabling conditions to provide incentives for investment in infrastructure, including gas pipelines, power plants, and transmission lines. Another key issue is pricing. "So it's a complicated mix of public policy and also incentives to get the investments in."

Anita Marangoly George, senior director of the World Bank Group's energy and extractives global practice, told *Eos* that there are already indications that other parties will sign on to the initiative. However, she noted that investments toward reducing flaring are not cheap.

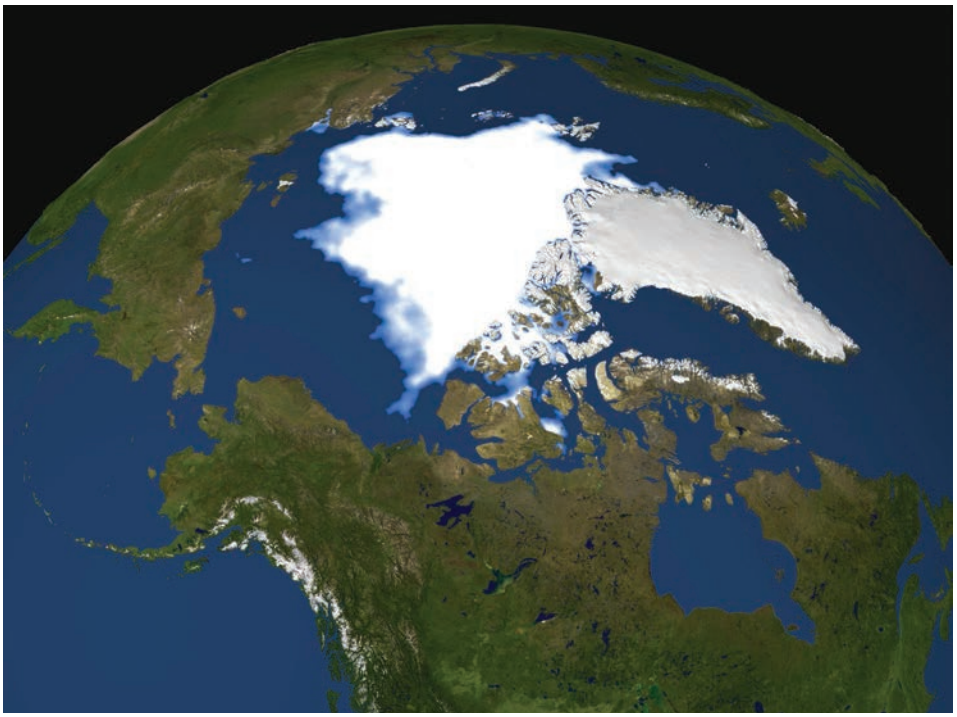
"These companies who are signing up are therefore committing that wherever in the world they are where they have oil fields—both existing as well as green fields—they are going to live up to this commitment," she said. "That's an incremental investment for which, of course, we believe there are huge environmental, social, and economic returns."

However, "On an individual company basis, they are a little bit in the dark, because once they capture this gas they have to figure out [if they can] use it economically so they get the return of the investments." George said. "So that's why [the issue] has been more difficult."

By **Randy Showstack,** Staff Writer

Connecting the Tropics to Polar Regions

Workshop on Connecting the Tropics to the Polar Regions
New York, New York, 2–3 June 2014



DMSP/SSMI via NASA/GSFC Scientific Visualization Studio

Visualization of Arctic sea ice minimum that occurred the week of 12 September 2008, based on satellite data.

In the face of a rapidly warming world, it is becoming increasingly important to climate science to understand the dynamics of the polar atmosphere–ocean–sea ice system and the mechanisms that connect the tropics with polar regions. Scientists met in June 2014 at the Lamont-Doherty Earth Observatory (LDEO) in New York to discuss the connections between the high and low latitudes in both hemispheres, along with outstanding problems. The workshop brought together 25 experts on tropical climate variability, polar climate variability, atmospheric dynamics, polar oceanography, climate and sea ice modeling, and paleoclimatology, as well as about 30 scientists from LDEO and the surrounding region.

The workshop featured sessions on the tropics–pole connection in the Northern Hemisphere, in the Southern Hemisphere, and in paleorecords, as well as how the polar regions feed back to lower latitudes. Discussions centered on the degree of influence of the tropics on the higher latitudes and vice versa. Specific attention was paid to the roles of the atmosphere and ocean, depending on the timescale and time period, in both instrumental and paleoclimate records.

Participants also considered processes and patterns, such as the role of atmospheric jets, the Hadley and Ferrel cells, the Antarctic Dipole, the North Atlantic Oscillation, the Southern Annular Mode, the polar vortex, and chaos. The workshop showcased a mix of oral and poster presentations, with a focus on both observations and modeling.

A key aim of the workshop was to provide a setting to foster discussion and share advancements in tropical climate studies and polar processes. Direct communications among climate modelers, oceanographers, and atmospheric researchers will improve understanding of what the next generation of models can offer and their limitations in terms of investigating the tropical–polar connections.

The workshop also promoted interactions between senior and junior scientists and students, including undergraduates, on timely and critical climate topics. The mid-latitude setting in the New York Palisades recalled the recognition by the Lenape Indians that the Hudson River flows both north and south (thanks to tidal forces), echoing the connection between the tropics and the poles.

Discussions centered on the degree of influence of the tropics on the higher latitudes and vice versa.

The final program, the participant list, abstracts, and some presentations can be found on the workshop website (http://bit.ly/TropicsPoles). An expanded version of this meeting report also can be found on the website. Follow-up activities to this workshop included sessions at the AGU 2014 Fall Meeting titled *Extratropical and High-Latitude Storms, Teleconnections, and the Changing Polar Climate* and an approved special issue in *Journal of Climate*, which will be published in 2015. Although the deadline for submitting a manuscript was around 1 March, interested parties should still contact Professor David Bromwich at Ohio State University (bromwich@polarmet1.mps.ohio-state.edu) for details.

The workshop was funded by The Climate Center of LDEO and Goddard Institute for Space Studies (NASA) and the Director's Office of LDEO. We thank Rob Gerston (NASA Goddard Space Flight Center) for providing the image's data. This is Lamont-Doherty Earth Observatory contribution 7856.

By **X. Yuan,** Division of Ocean and Climate Physics, Lamont-Doherty Earth Observatory (LDEO), Palisades, N.Y.; **M. A. Cane,** Department of Earth and Environmental Sciences, Columbia University, New York, N.Y., and Division of Ocean and Climate Physics, LDEO; and **M. R. Kaplan,** Division of Geochemistry, LDEO, Palisades, N.Y.; email: mkaplan@ldeo.columbia.edu

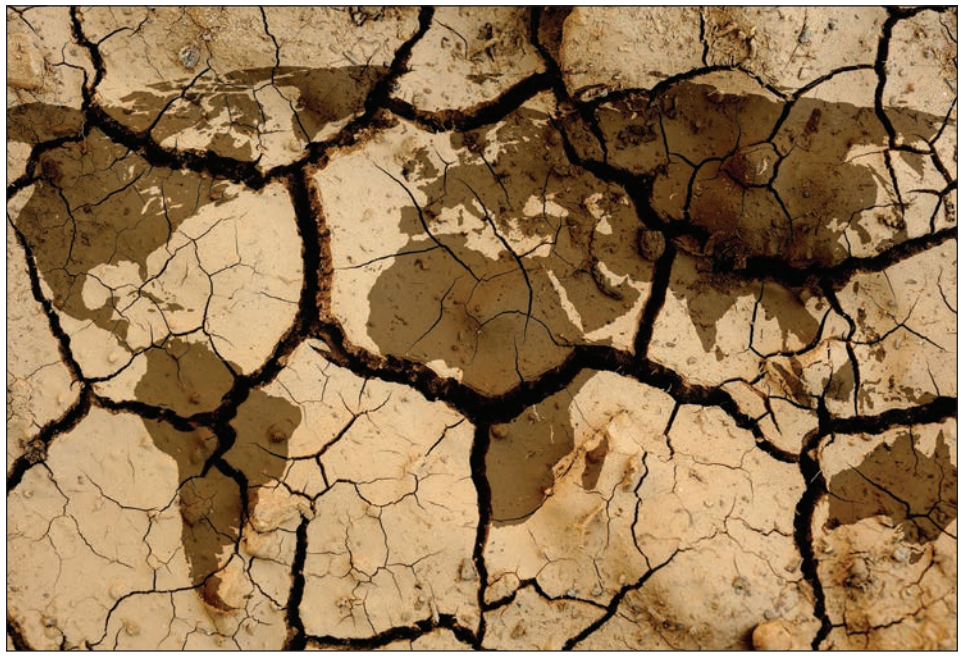
Spreading the Word About Climate Change

Last year, the U.S. Global Change Research Program released the third U.S. National Climate Assessment, which summarizes the impacts of climate change in the United States, both now and in the future. A team of more than 300 experts produced the report, with extensive input from a 60-member Federal Advisory Committee, the public, and the broader scientific community.

One of the exciting things about last year's report was its new emphasis on the user community. Not only is the report more detailed than previous iterations in summarizing impacts relevant to different states and regions around the country, as well as to different industries, but its format is a highly interactive and visual website (http://nca2014.globalchange.gov/). At the same time, all the data that went into the analysis is available on the website for scientists who want to better understand the analysis.

The point, of course, is that it is important for the public to understand some of the very serious implications of climate change, and it is equally important for the scientific community to help explain the issue in a way the public can both grasp and use to make decisions.

Two of the lead authors of the National Climate Assessment recently took up the challenge by writing about the report—and what has changed over the last year—in an editorial in a community newspaper.



©iStock.com/gmutlu

Their article appears on the next page. We hope this encourages other scientists to follow their example!

By **Alexandra Shultz,** Director of Public Affairs, AGU; email: ashultz@agu.org

Climate Change and Our Nation

Republished by permission of The News-Gazette *(see http://bit.ly/NGClimateChange). Permission does not imply endorsement. For links to the papers discussed below, see http://bit.ly/Eos_NCAreview.*

One year ago marked the release of the National Climate Assessment, the most comprehensive analysis to date of how climate change is affecting every corner of our nation—our health, water, food and more. The assessment made clear that climate change is not just a problem for the future, but is happening now across the United States. Americans are already being affected by increases in heat waves and heavy downpours, rising sea level, and other impacts of climate disruption.

Recent changes are occurring more than 10 times faster than past natural changes, and many lines of evidence make clear that emissions from the burning of coal, oil and natural gas are the primary cause of the last half-century's warming.

The assessment also showed that large reductions in global emissions of heat-trapping gases could reduce future climate change and avoid some of its most damaging impacts.

In the year since the assessment's release, new scientific developments have told a consistent and compelling story that points to the need for urgent action to address this great challenge.

NASA and NOAA analyses show that 2014 was the warmest year on record. Nine of the 10 hottest years have taken place since 2000. Over the last five decades, each decade has been warmer than the previous one, and this decade looks like it will be warmer still. So far in 2015, January through March was the warmest first quarter on record globally.

And we understand why. Atmospheric carbon dioxide traps heat, and its level in early 2015 eclipsed a long-standing prehistoric high, as it reached a concentration of 400 parts per million, a level that has not occurred in millions of years.

For the last 200,000 years, the period of human habitation on Earth, the atmosphere's carbon dioxide level has fluctuated between 170 and 280 parts per million, as shown by records preserved in air bubbles trapped in polar ice.

Through the burning of fossil fuels and the clearing of forests, we have pushed carbon dioxide levels about 43 percent above the high end of this range. Human activities have also increased the atmospheric amounts of other important heat trapping gases such as methane and nitrous oxide.

The warming resulting from these increases is leading to massive melting of ice at the poles, and the past year has revealed several disturbing new developments.

> The assessment made clear that climate change is not just a problem for the future, but is happening now across the United States.

In February 2015, the cap of winter sea ice in the Arctic covered far less area than in any previous late winter period. And satellites have now more extensively than ever mapped Earth's two large polar ice sheets on Greenland and Antarctica, and found that the ice on both is declining at unprecedented rates, adding to global sea level rise (which surged in the latter half of 2014).

A new study of a rapidly melting section of the West Antarctic Ice Sheet reveals this sector to be in an irreversible state of decline. This sector alone contains enough ice to raise global sea level by 4 feet, and it is melting faster than expected.

Researchers say these new findings require an upward revision to current sea level rise projections.

New studies have also ftound evidence of increasing societal impacts occurring due to climate change. A new assessment of human health effects developed by leading health experts is now available for public and expert review. Recent research also suggests potentially much larger effects on agriculture than prior studies.

That's the bad news. But good news can be found in recent studies that show the value of reducing emissions. Not only will such emissions cuts reduce future climate change, they will also improve our health in other ways, and save us money.

For example, a new study examining the true costs to society of continuing to burn fossil fuels finds that when the effects of air quality on human health from energy production are included, the actual costs of burning coal, oil and natural gas are far higher than the use of solar and wind power. This is important information that can inform our energy choices.

Other good news can be found in the rapidly-growing capacity and declining prices of solar and wind power.

We report the latest science, hoping that it will help us make better decisions.

After all, as our late colleague F. Sherwood Rowland, a Nobel Laureate, said, "What's the use of having developed a science well enough to make predictions if, in the end, all we're willing to do is stand around and wait for them to come true?"

By **Don Wuebbles** and **Jerry Melillo**

Don Wuebbles works in the Department of Atmospheric Sciences at the University of Illinois, Urbana. Jerry Melillo works in the Marine Biological Laboratory, Woods Hole, Mass.

What Can We Learn About Disaster Nepal's

Hazard mitigation expert Brian Tucker discusses how researchers and the public

Preparedness from Quake?

By Randy Showstack

can help minimize death and damage from strong earthquakes.

David Ramos/Getty Images

The magnitude 7.8 earthquake that shook Nepal on 25 April caused more than 7200 fatalities and more than 14,000 injuries. It displaced about 2.8 million people and damaged more than 190,000 buildings in Kathmandu and other parts of the country.

Eos interviewed Brian Tucker, MacArthur Fellow and founder and president of the nonprofit GeoHazards International (GHI), for his perspectives about this earthquake and about hazard mitigation efforts in general. GHI helps vulnerable communities across the world to better prepare for natural hazards such as earthquakes by emphasizing mitigation strategies, guiding communities through retrofits, and building local capacity to manage risk (see http://geohaz.org).

Here, Tucker focuses on the lessons that he thinks geoscientists, decision makers, politicians, and the general public can learn from this earthquake. He also discusses his own reactions to the recent earthquake and GHI's specific efforts to reduce risk in Nepal.

Eos: *Geoscientists can look at disasters such as the Nepal earthquake and feel that their efforts—to better understand earthquakes and their consequences, to warn people of risks—are futile. What message do you have for geoscientists?*

BT: The need for geoscientists to provide information about seismic risk and risk reduction options is critically important but, most curiously, is underrated by disaster risk professionals and, I suspect, also by geoscientists. Few disaster risk professionals have information about the human and economic losses their communities can expect as a result of probable earthquakes, or information about how to reduce these losses.

Having this information would help them acquire needed resources and design appropriate programs. The geoscientists' and engineers' responsibility in this process is to translate scientific and engineering advances into language the risk managers and the public can use.

A few years ago, GHI's Justin Moresco, with sociology professor Lori Peek of Colorado State University, conducted a survey of more than 100 disaster risk professionals, from government, business, health care, education, and grassroots organizations, in 11 cities—rich and poor, big and small—around the world. We wanted to learn about the barriers they faced when trying to improve earthquake safety in their cities.

The barrier ranked number 1 was "lack of funding." "Lack of earthquake information" came in a distant num-

Sunil Pradhan/Anadolu Agency/Getty Images

Soldiers and residents inspect debris of destroyed buildings in Kathmandu, Nepal, following the 25 April earthquake.

ber 6. When we asked these people, however, if they had information about, for example, the human and economic losses their community could expect from a likely earthquake, they said they did not but they would very much like such information.

How could they possibly expect to get the funding needed to reduce earthquake risk if they didn't know—and make known—what losses their communities could expect? How could earthquake risk reduction compete successfully against other challenges facing these communities if the consequences of earthquakes were not known?

I suspect that most geoscientists don't realize the importance of providing basic risk information; we may think we're communicating if we publish in our professional journals.

Eos: *What would you suggest are some of the key understandings that Earth scientists can gain from this earthquake and its aftershocks?*

BT: I'll give you my answer, which is undoubtedly different from that of card-carrying research scientists: We learned that we already know enough about seismic risk in the Himalayas. What happened in Nepal is just what we expected. Earth scientists and earthquake engineers can see perfectly what will happen to multistory, unreinforced masonry buildings with soft first stories when they are subjected to the ground motions that any city in the Himalayas can expect.

This is not obvious to the normal government official or the lay public. Given this, geoscientists and engineers are obliged, in my opinion, to tell the government officials and the residents of those buildings of their risk and their options.

Eos: *Likewise, is there an opportunity for structural engineers and others—including psychologists and social scientists—to also gain key understandings from this earthquake? If yes, how so?*

BT: We geoscientists and earthquake engineers need help accelerating the application of current Earth science and earthquake engineering research into practice. The problem is not primarily a scientific or engineering one: A great local NGO [nongovernmental organization] and even an effective government of a developing country, facing all their other challenges, cannot by themselves reduce risk faster than today's rapid rural-to-urban migration is increasing the risk.

We need the help of psychologists, social scientists, and advertising gurus to use the techniques they've developed in successful public health campaigns, like those to stop smoking, drunk driving, and unsafe sex.

In addition, I'd like to see that the international development organizations that will fund the reconstruction of Nepal insist that construction employ modern building codes, that funds are allocated for inspection, and that all buildings thus constructed have some kind of plaque that designates them as "earthquake resistant." (One would need a Plaque Police to guard against counterfeits.) These plaques would raise awareness of and demand for earthquake-resistant construction in future buildings. That's what's missing now.

Even more ambitious, given the enormity of the reconstruction needs: I would like to involve Nepal's reconstruction architects, engineers, and masons from nearby regions, like Assam and Bhutan. They should see firsthand what happened and learn how to prevent this in their own communities.

A community will reduce its risk of earthquakes when a trusted peer shows that the community's risk is unacceptably large and demonstrates an affordable, socially acceptable, and verifiable method to reduce that risk.

Eos: *What is your overall approach to earthquake risk reduction, and what concrete ways to prevent disaster serve as your guiding principles when starting a new project?*

BT: Our approach is based on the work of Everett Rogers's *Diffusion of Innovations* and resulted in our "Theory of Change":

A community will reduce its risk of earthquakes when a trusted peer shows that the community's risk is unacceptably large—e.g., its children are at significant risk of dying—and demonstrates an affordable, socially acceptable, and verifiable method to reduce that risk. The concrete ways we do this are to raise awareness of risk and risk mitigation options, build local capacity, develop public policies and strengthen critical infrastructure, and promote preparedness and prevention.

Eos: *GHI has a long history of working in Nepal. Can you briefly describe your current and past projects there?*

BT: In the mid-1990s we started working with the National Society for Earthquake Technology – Nepal (NSET), which was at that time an organization on paper only. With NSET and funding from the U.S. Agency for International Development, we developed an earthquake scenario that described the expected consequences on modern day Kathmandu of a repeat of the 1934 magnitude 8.0 Bihar earthquake.

Then, working with a collection of about 60 local stakeholders and international earthquake professionals, we developed an action plan of how to reduce those consequences, assuming that we had 20 years to prepare before the next damaging earthquake. As it turned out, we had only 17 years. This action plan became the first strategic plan for NSET, which has grown into a thriving organization.

To accomplish something tangible, we also launched some demonstration projects, including the inauguration of an annual Nepal Earthquake Safety Day, held each year on 15 January. We also conducted a seismic retrofit of one school—simultaneously training local masons.

My daughter returned to this village 10 years later, with an NSET engineer, and surveyed construction undertaken in the village since our retrofit project. The vast majority, about four-fifths, of all this construction employed at least one of the earthquake-resistant construction features introduced in the retrofitted school.

In recent years, we've conducted some evaluations of Kathmandu hospitals.

Basically, NSET is doing a great job and hasn't needed our help.

Eos: *What were your initial reactions—your thoughts and feelings, personally and professionally—to this earthquake?*

BT: A swirling flood of complex, even contradictory, emotions: validation because our warnings of great damage were proven warranted; sickness, bordering on nausea, seeing our loss estimates on paper become flesh and blood; satis-

faction that our work—and that of our Nepali partners—probably saved lives; and some hint of guilt that we could have pushed harder.

Eos: *Do you know how retrofitted buildings, including the hospitals your organization reinforced, were affected by the earthquake?*

BT: We've heard that the schools NSET retrofitted performed well, but we don't yet know what ground motion they were subjected to or if nearby schools that were not retrofitted performed poorly. I read one report that up to 5000 schools nationwide collapsed, which would have been a real tragedy if the earthquake hadn't been on a Saturday. We'll have to investigate, but only after relief operations are over.

Eos: *Have you faced any obstacles from local governments through your work? Do you have any tips or lessons learned in dealing with local governments?*

BT: I remember one Nepali high official who became angry at me when he realized, as a result of our study, how vulnerable Kathmandu was: "What do you expect me to do? Rebuild our entire city?"

In general, however, local government officials have appreciated our work. I particularly remember and am grateful for the support of Jamil Mahuad, who was the mayor of Quito, Ecuador, in our first project. He made available his staff to help us assess the vulnerability of his city and make recommendations on how to reduce the risk. He chaired the Social and Economic Advisory Committee of our project and thereby lent us his political clout.

I learned from him that we must discover political incentives to implement our recommendations. Mayor Mahuad took a risk by trusting us to behave responsibly (no news leaks), and he showed his courage to publicize the risk faced by his city, once it was known. Subsequently he was elected president of Ecuador.

Eos: *GHI has put a great deal of emphasis on the need to retrofit schools and develop ways that communities can address earthquake safety in schools. Why this emphasis on schools?*

BT: As one friend of ours puts it, school earthquake safety is the entry drug to earthquake risk reduction. Strengthening schools is politically popular.

Also, we try to leverage the fact that since most governments compel children to sit in schools that were designed and constructed by the government, governments have the responsibility to make these schools safe. Schools can also provide community shelters following disasters. Plus, if you educate kids in school about the nature of earthquakes and how their consequences can be reduced, they'll take these lessons home and into their adult lives.

In 2008, I went back to the village where NSET and GHI worked in 1998 and asked the 8th grade students what caused earthquakes and what we can do to reduce their effects. The improvement in understanding was tremendous: They know about plate tectonics! Some of the kids we taught back in 1998 are now 30 years old, perhaps wondering about the seismic safety of their kids' schools.

Eos: *A strong piece of your efforts involves community engagement. What specific methods for community engagement have you found to work best?*

BT: We try to identify a local champion who truly wants our help. We find someone who was fired up about reducing risk in her community before we arrived, and then we figure out how we can help her do a better job. Our backing lends some kind of credibility locally.

Brian Tucker, GHI

The annual National Earthquake Safety Day in Nepal is held each year on 15 January to mark the anniversary of the 1934 M8.0 Bihar earthquake. The photo shows the start of a march in Kathmandu to mark the day in 1999.

Eos: *Are there any issues—cultural, political, economic, etc.—specific to Nepal that have made your efforts to help ensure earthquake preparedness easy or difficult?*

BT: The political instability since the assassination of King Birendra in 2001 slowed work. The culture that "the future is written" makes it difficult to convince people that they can and should change their fate. I've even been accused of blasphemy by proposing to change when and how God plans to end our lives.

Eos: *What dilemmas do you face in your work?*

BT: For me, by far the toughest questions are, How can GeoHazards International, with its limited human and financial resources, do the most good in response to the Nepal earthquake? Should we use our knowledge of Kathmandu and the funding that is materializing to join the efforts of others to help Nepal respond and reconstruct, or should we try to raise support from other sources and to go to, for example, Assam and Bhutan, "the next Nepals," and help them prepare for what is coming?

Eos: *What are the lessons from the Nepal earthquake for politicians and decision makers, whether they are in rich or poor countries?*

BT: Nepali politicians and decision makers will learn that the earthquake's human and economic costs are huge and recovery will be long—probably much larger and longer than they expected. I suspect that these losses will be in line with those estimated in the earthquake scenario we developed for Kathmandu in 1999.

I would hope that these politicians and decision makers will also realize that those costs would have been greater were it not for the preparedness and mitigation efforts of the local NGO NSET. We need to wait, however, for a careful evaluation of the actual savings as a result of NSET's work; this can take place only after the relief activities are complete.

Nepalese leaders should know by now that larger earthquakes do and will occur in the region. I hope that Indian and Bhutanese politicians and decision makers are now asking themselves, "How will our communities fare when *our* earthquake strikes, and what can we do now to reduce the costs?"

Author Information

Randy Showstack, Staff Writer

NASA, ESA, the Hubble Heritage Team (STScI/AURA), A. Nota (ESA/STScI), and the Westerlund 2 Science Team

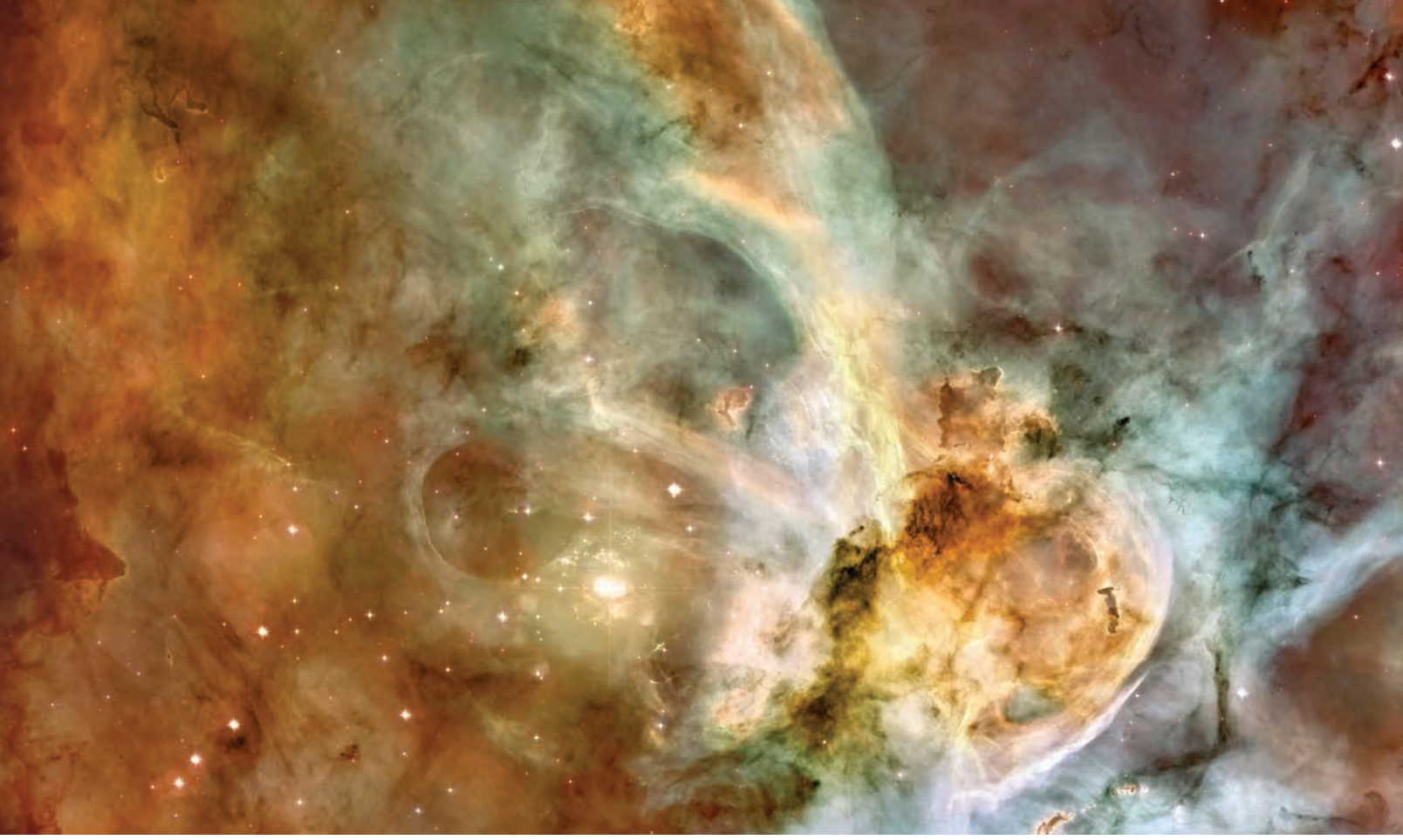
The Art and Science of Hubble's Images

By Ron Cowen

How do Hubble images get their vivid colors and subtle shading?

The two desktop-sized computer screens in Zolt Levay's office at the Space Telescope Science Institute in Baltimore, Md., are often ablaze with images of exploding stars, distant galaxies, and ghostly gas clouds. Earlier this year, he was hard at work, putting the finishing touches on a new image (above) of Westerlund 2, a giant Milky Way star cluster, chosen to celebrate Hubble's 25th anniversary.

For 22 years, ever since corrective optics fixed the Hubble Space Telescope's blurry vision, Levay has been the observatory's image maven, assembling color portraits of the heavens that have riveted the public. Gray-haired, soft-spoken, and sporting a prominent mustache, Levay begins his work with the raw black-and-white images,



In picking the palette for a heavenly scene, you have to sort of suspend your ideas of what's natural.

each taken through a different filter, that Hubble transmits to Earth.

Narrow filters allow one specific wavelength—like the red light emitted by hydrogen atoms or the cyan emitted by oxygen atoms—to reach Hubble's cameras. Broad filters allow a range of wavelengths to pass through, which is more akin to the way the eye perceives color. Many of Hubble's filters are tuned to colors in the infrared and ultraviolet that the eye cannot see.

This giant star cluster, known as Westerlund 2, contains some of the Milky Way's brightest and most massive stars. Credit: NASA, ESA, the Hubble Heritage Team (STScI/AURA), A. Nota (ESA/STScI), and the Westerlund 2 Science Team

Each wavelength or wavelength range is assigned a color: red, green, or blue. In picking the palette for a heavenly scene, "you have to sort of suspend your ideas of what's natural," said Levay.

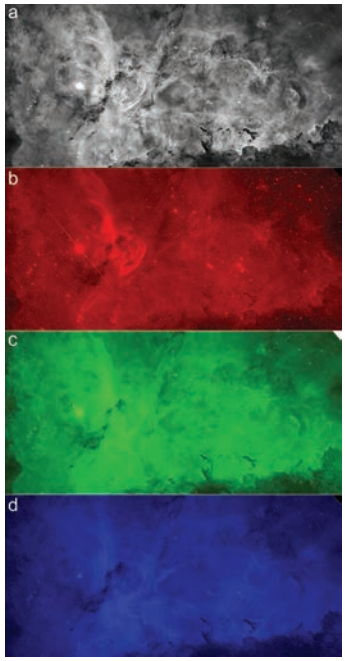
Picking a Palette

Consider, for instance, the light emitted by a gas cloud set aglow by the ionizing radiation from a hot nearby star. The cloud will emit light from hydrogen, oxygen, and sulfur atoms. Both oxygen and sulfur atoms give off a reddish light, but the two emissions come from completely different parts of the gas cloud and highlight completely different structures.

If both the hydrogen and sulfur emissions were portrayed in red, as might seem natural, the image would appear monochromatic, and information about the structure of the gas cloud would be lost. So Levay picks a reddish hue for the emission from hydrogen atoms and chooses green for the light radiated by sulfur, which has a slightly shorter wavelength.

For the new image of Westerlund 2 above, which contains some 3000 stars in a region 6 to 13 light-years across, Levay blended visible and near-infrared light recorded from two of Hubble's cameras. What results relays important information: Red dots are tiny, faint stars, only 1–2 million years old—so young they have not yet ignited the nuclear furnace at their core. Bright blue stars are mostly foreground stars, not members of the cluster. Shock waves generated when winds from the

This composite image of the Carina Nebula, a Milky Way star-forming region about 7500 light-years from Earth, combines high-resolution Hubble observations taken at a single wavelength with a color palette derived from multiwavelength images recorded at CTIO in Chile. The image shows at least 12 bright stars that are 50 to 100 times as massive as the Sun. The image was released to celebrate Hubble's 17th birthday. Credit for Hubble data: NASA, ESA, N. Smith (University of California, Berkeley), and the Hubble Heritage Team (STScI/AURA). Credit for CTIO images: N. Smith (University of California, Berkeley) and NOAO/AURA/NSF



Raw images from Hubble and the Cerro Tololo Inter-American Observatory (CTIO) in Chile, which were later combined to generate a final image of the Carina Nebula. (a) High-resolution Hubble image, taken in the light emitted by hydrogen atoms. (b) Ground-based image taken in the light emitted by sulfur atoms, assigned a reddish hue. (c) Ground-based image taken with a filter tuned to the light emitted by hydrogen atoms, given a greenish hue. (d) Ground-based image taken through a filter sensitive to light emitted by oxygen atoms, colored blue. Credit: (a) NASA, ESA, N. Smith (University of California, Berkeley), and the Hubble Heritage Team (STScI/AURA). (b–d) CTIO/N. Smith (University of California, Berkeley), NOAO/AURA/NSF

bright stars slam into dense walls of gas may hasten the birth of new stars, scientists speculate.

In creating any final image, Levay and his assistant, Lisa Frattare, walk a fine line between making the images pleasing to the public and scientifically accurate. In terms of true color, the final image is not what the eye would see. However, the picture preserves the information on structure and composition recorded by Hubble. "These are not scientific images," Levay explained. "Yet we do want them to be scientifically valid."

He must also contend with the huge range of brightness, from the most luminous stars to the darkest shadows, in each raw image. If too much emphasis is given to the overwhelming brilliance of the brightest stars, "you won't see any of the faint detail, even though it's sitting there in the data," he noted.

Stellar Evolution, in Subtle Coloring

One of Levay's favorite Hubble images—and one of the most challenging he's had to assemble—depicts a Milky Way star-forming region known as the Carina Nebula.

Taken in 2007 to commemorate the telescope's 17th anniversary, the picture shows the life cycle of stars, from birth to death. Newborn clusters of stars are eroding the birthplaces of stars within dusty pillars while the same clusters are also pushing gas together to make new stars. "You see this whole range of stellar evolution displayed in front of you," Levay said.

Because Hubble imaged the nebula at just one wavelength, the observatory could provide only the sharp detail, not the color. The hues, derived from multiwavelength observations with a ground-based telescope, are more subdued because the instrument on the ground has lower resolution. Levay used ground-based data along with 32 separate pointings of the Hubble observatory to stitch the image together.

For a detailed look at Hubble's 25 years of breathtaking images and groundbreaking science, read the Eos.org feature story (http://bit.ly/eos_Hubble).

Author Information

Ron Cowen, Freelance Writer

Thanks to AGU Reviewers

AGU Publications again recognizes outstanding reviewers for their work in 2014, as selected by the editors of each journal.

Peer-reviewed literature plays an important role in advancing science. Less well known is the growing use of peer-reviewed literature in our legal systems and governments as a basis for regulations, policies, and laws. This literature also provides reliable scientific information for advisory groups such as the Intergovernmental Panel on Climate Change and the National Academies.

Quality peer review is thus a critical part of the social contract between science and society. As the uses for this literature have grown, so has the complexity of papers, which now typically include more authors bringing more techniques, data, simulations, and results.

This increase in complexity, in turn, has increased the challenge and role of reviewing. The outstanding reviewers listed here have all provided in-depth evaluations, often over more than one round of revisions that greatly improved the final published papers.

Many Reviewers: A Key Part of AGU Journals

While we note these few outstanding reviewers here, we also acknowledge the broad efforts by the many AGU reviewers in helping ensure the quality, timeliness, and reputation of AGU journals. Overall, AGU received nearly 12,000 submissions and published nearly 6000 manuscripts in 2014. Many of these submissions were reviewed multiple times—in all, representing more than 26,000 reviews in 2014. More than 800 reviewers completed 5 or more reviews, and 87 completed 10 or more.

This has happened in the past year while every AGU journal worked to shorten the time from submission to first decision and publication or maintained already industry-leading standards. Several AGU journals regularly return first decisions within 1 month of submission, and most others do so now within 2 months. Reviewers represent a key part of this improvement.

Editorials (some already published, some upcoming), along with recognition lists, express our appreciation. Our thanks are a small recognition of the large responsibility that reviewers shoulder in improving our science and its role in society.

Additional Thanks

In addition, we are working to highlight the valuable role of reviewers through events at the Fall Meeting and other meetings (for example, at this year's European Geophysical Union meeting in Vienna and the Joint Assembly in Montreal).

We are extending subscription benefits to those reviewers who repeatedly provide quality reviews. Each reviewer also receives a discount on AGU and Wiley books. We will work with the Open Researcher and Contributor Identification network (ORCID) to provide official recognition of reviewers' efforts as soon as this service is up and running, so that reviewers receive formal credit there.

Getting Your Feedback

We are working to improve the peer review process itself, using new online tools. We have designed a short questionnaire for reviewers to provide feedback and will send a link after each review is completed.

We value your feedback, including ideas about how we can recognize your efforts even more, help improve your experience, and increase your input on the science.

We look forward to hearing from you. If you'd like to respond directly, feel free to take our survey (see https://www.surveymonkey.com/r/AGUreviewers).

Once again: Thanks!

By **Brooks Hanson,** Director, Publications, AGU; email: bhanson@agu.org; and **Rob van der Hilst,** Chair, AGU Publications Committee

2014 Editors' Citations for Excellence in Refereeing

One of the most important services performed for AGU is the conscientious reviewing of submitted papers. Because of the nature of the reviewing process, this service is also one of the least recognized. Every year, editors are asked to select the outstanding reviewers from the previous year. The reviewers listed below have been cited by editors of AGU journals and* Eos *for excellence in refereeing. These individuals are to be commended for consistently providing constructive and thoughtful reviews.

Stephen Ackley
Cited by Julienne Stroeve
Geophysical Research Letters

Hidenori Aiki
Cited by Lie-Yauw Oey
JGR: Oceans

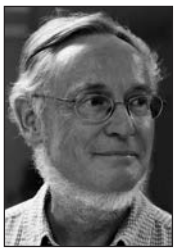
Magdalena Andres
Cited by Lisa Beal
Geophysical Research Letters

Stacey A. Archfield
Cited by Alberto Montanari
Water Resources Research

Donald F. Argus
Cited by Eric Calais
Geophysical Research Letters

Elizabeth Barnes
Cited by Noah Diffenbaugh
Geophysical Research Letters

Jaime Barnes
Cited by Thorsten Becker
Geochemistry, Geophysics, Geosystems



Alan K. Betts
Cited by José Fuentes
Eos

Scott A. Boardsen
Cited by William Peterson
Geophysical Research Letters

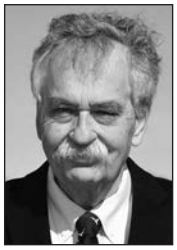
William Boicourt
Cited by Lie-Yauw Oey
JGR: Oceans

Tami C. Bond
Cited by Alan Robock
Reviews of Geophysics

Pierre Boué
Cited by Robert Nowack
JGR: Solid Earth

Jean Braun
Cited by Thorsten Becker
Geochemistry, Geophysics, Geosystems

Christopher Bretherton
Cited by Robert Pincus
Journal of Advances in Modeling Earth Systems (JAMES)



Kenneth H. Brink
Cited by Lie-Yauw Oey
JGR: Oceans

Harold Brooks
Cited by Paul Williams
Geophysical Research Letters

Grégoire Broquet
Cited by Geoffrey Tyndall
Geophysical Research Letters

Amy Hawes Butler
Cited by Paul Williams
Geophysical Research Letters

Karen L. Casciotti
Cited by Susan Trumbore
Global Biogeochemical Cycles

Robert Chant
Cited by Alejandro Souza
JGR: Oceans

Seth G. Claudepierre
Cited by Benoit Lavraud
Geophysical Research Letters

Anthony Colaprete
Cited by Andrew J. Dombard
Geophysical Research Letters

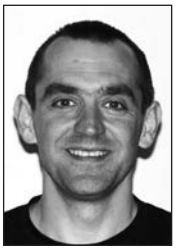
Owen R. Cooper
Cited by James Crawford
JGR: Atmospheres

Chris E. Crabtree
Cited by ***JGR: Space Physics*** editors
JGR: Space Physics

John T. Crawford
Cited by Miguel Goni
JGR: Biogeosciences

Nirvikar Dashora
Cited by ***JGR: Space Physics*** editors
JGR: Space Physics

Victoria A. Davis
Cited by Louis Lanzerotti
Space Weather



Michael H. Denton
Cited by ***JGR: Space Physics*** editors
JGR: Space Physics

Timothy F. Duda
Cited by Thomas Herbers
JGR: Oceans

Timothy J. Dunkerton
Cited by Paul Williams
Geophysical Research Letters

Mark J. Engebretson
Cited by *JGR: Space Physics* editors
JGR: Space Physics

Manfred Ern
Cited by Ulrike Langematz
JGR: Atmospheres

Mark Flanner
Cited by Steven Ghan
JGR: Atmospheres

Sergey V. Fridman
Cited by Philip Wilkinson
Radio Science

Patrick M. Fulton
Cited by Andrew Newman
Geophysical Research Letters

Olivier Galland
Cited by Michael Walter
JGR: Solid Earth

Eric Gilleland
Cited by Ruby Leung
JGR: Atmospheres

Timothy R. Ginn
Cited by Alberto Montanari
Water Resources Research

Paul A. Ginoux
Cited by Zhanqing Li
JGR: Atmospheres

Oleg A. Godin
Cited by Mark Moldwin
Reviews of Geophysics

Wendy D. Graham
Cited by Alberto Montanari
Water Resources Research

Jean-Pierre Gratier
Cited by André Revil
JGR: Solid Earth

Agust Gudmundsson
Cited by André Revil
JGR: Solid Earth

Sebastian Hainzl
Cited by Robert Nowack
JGR: Solid Earth

Ed Hawkins
Cited by Noah Diffenbaugh
Geophysical Research Letters

Ton Hoitink
Cited by Alberto Montanari
Water Resources Research

Qiuqiong Huang
Cited by Alberto Montanari
Water Resources Research

Yoshihiro Ito
Cited by Andrew Newman
Geophysical Research Letters

Brian Jicha
Cited by Thorsten Becker
Geochemistry, Geophysics, Geosystems

Timothy D. Jickells
Cited by Susan Trumbore and Sara Mikaloff-Fletcher
Global Biogeochemical Cycles

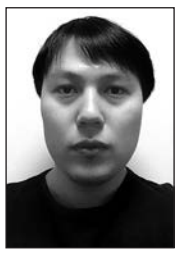
Christopher D. Jones
Cited by Wolfgang Knorr
Geophysical Research Letters

Ian Joughin
Cited by Julienne Stroeve
Geophysical Research Letters

Jennifer Kay
Cited by Noah Diffenbaugh
Geophysical Research Letters

Jan Kazil
Cited by Geoffrey Tyndall
Geophysical Research Letters

Alexander Khain
Cited by Steven Ghan
JGR: Atmospheres



Jongho Kim
Cited by Alberto Montanari
Water Resources Research

Andrew Kiss
Cited by Lisa Beal
Geophysical Research Letters

Lynn M. Kistler
Cited by *JGR: Space Physics* editors
JGR: Space Physics

Stephen A. Klein
Cited by Geoffrey Tyndall
Geophysical Research Letters

Jasper Konter
Cited by Thorsten Becker
Geochemistry, Geophysics, Geosystems

Robert E. Kopp
Cited by Ben van der Pluijm
Earth's Future

Oliver Korup
Cited by Bryn Hubbard
JGR: Earth Surface

Mikhail A. Kreslavsky
Cited by Steven Hauck
JGR: Planets

Yvette D. Kuiper
Cited by Nathan Niemi
Tectonics

Nathan T. Kurtz
Cited by Julienne Stroeve
Geophysical Research Letters

Michael P. Lamb
Cited by Gregory Okin
Reviews of Geophysics

W. Richard Leaitch
Cited by Lynn Russell
JGR: Atmospheres

Rene Lefebvre
Cited by Alberto Montanari
Water Resources Research

Jianjun Liu
Cited by Chidong Zhang
JGR: Atmospheres

Di Long
Cited by M. Bayani Cardenas
Geophysical Research Letters

Ralph D. Lorenz
Cited by Steven Hauck
JGR: Planets

Jack Loveless
Cited by Paul Tregoning
JGR: Solid Earth

Andrew R. Mahoney
Cited by Andrey Proshutinsky
JGR: Oceans

Robin S. Matoza
Cited by Andrew Newman
Geophysical Research Letters

Jerry F. McManus
Cited by Eric Calais
Geophysical Research Letters

James P. McNamara
Cited by Alberto Montanari
Water Resources Research

Nadine McQuarrie
Cited by John Geissman
Tectonics

Jason Milbrandt
Cited by Robert Pincus
Journal of Advances in Modeling Earth Systems (JAMES)

Phoolendra K. Mishra
Cited by Alberto Montanari
Water Resources Research

Didier Mourenas
Cited by *JGR: Space Physics* editors
JGR: Space Physics

Paul Myers
Cited by Andrey Proshutinsky
JGR: Oceans

Peter A. Nelson
Cited by Bryn Hubbard
JGR: Earth Surface

Michael Notaro
Cited by Allison Steiner
JGR: Atmospheres

David Nunn
Cited by *JGR: Space Physics* editors
JGR: Space Physics

Travis O'Brien
Cited by Noah Diffenbaugh
Geophysical Research Letters

Zaitao Pan
Cited by Ruby Leung
JGR: Atmospheres

Rui A. P. Perdigão
Cited by Alberto Montanari
Water Resources Research

Michael S. Petronis
Cited by Michael Walter
JGR: Solid Earth

Leonhard Pfister
Cited by Jonathan Jiang
Earth and Space Science

Risto Pirjola
Cited by Delores Knipp
Space Weather

Robert Porritt
Cited by Thorsten Becker
Geochemistry, Geophysics, Geosystems

Derek J. Posselt
Cited by Allison Steiner
JGR: Atmospheres

Ian G. Richardson
Cited by *JGR: Space Physics* editors
JGR: Space Physics

Charles L. Rino
Cited by Philip Wilkinson
Radio Science

Craig J. Rodger
Cited by *JGR: Space Physics* editors
JGR: Space Physics

Michelle Santee
Cited by James Crawford
JGR: Atmospheres

Audrey H. Sawyer
Cited by Alberto Montanari
Water Resources Research

Wayne A. Scales
Cited by William Peterson
Geophysical Research Letters

Brandon Schmandt
Cited by Robert Nowack
JGR: Solid Earth

Isla Simpson
Cited by Noah Diffenbaugh
Geophysical Research Letters

Victoria A. Sinclair
Cited by Chidong Zhang
JGR: Atmospheres

Daniel J. Sobota
Cited by Eric Davidson
Global Biogeochemical Cycles

Andrew John Sole
Cited by Bryn Hubbard
JGR: Earth Surface

Y. Tony Song
Cited by Chunzai Wang
JGR: Oceans

Kenneth R. Sperber
Cited by Chidong Zhang
JGR: Atmospheres

Scott St. George
Cited by Kim Cobb
Geophysical Research Letters

Susan E. Strahan
Cited by Ulrike Langematz
JGR: Atmospheres

Anatoly V. Streltsov
Cited by *JGR: Space Physics* editors
JGR: Space Physics

Nicholas L. Swanson-Hysell
Cited by Eric Calais
Geophysical Research Letters

Stefania Tamea
Cited by Alberto Montanari
Water Resources Research

Mark E. Tamisiea
Cited by Eric Calais
Geophysical Research Letters

Suzanne Tank
Cited by Miguel Goni
JGR: Biogeosciences

Mary-Louise Timmermans
Cited by Andrey Proshutinsky
JGR: Oceans

Tara J. Troy
Cited by Alberto Montanari
Water Resources Research

Bruce T. Tsurutani
Cited by *JGR: Space Physics* editors
JGR: Space Physics

Jens Martin Turowski
Cited by Alberto Montanari
Water Resources Research

Rodrigo Vargas
Cited by Miguel Goni
JGR: Biogeosciences

Bart Vleminckx
Cited by Carol Stein
Eos

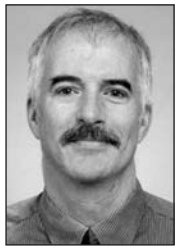
Dingbao Wang
Cited by M. Bayani Cardenas
Geophysical Research Letters

David Watkins
Cited by Alberto Montanari
Water Resources Research

Christopher Watson
Cited by Paul Tregoning
JGR: Solid Earth

Seth J. Wenger
Cited by Alberto Montanari
Water Resources Research

Donald J. Wuebbles
Cited by José Fuentes
Eos



Robert Zimmerman
Cited by André Revil
JGR: Solid Earth

2014 Cited Referees Not Pictured

Xiaopei Lin
Cited by Chunzai Wang
JGR: Oceans

Binbin Ni
Cited by Benoit Lavraud
Geophysical Research Letters

Jens Oldeland
Cited by Benoit Pirenne
Earth and Space Science

Particle Accelerator in Space Could Help Scientists Study Auroras

A picture of an aurora caused by electrons colliding with molecules in Earth's atmosphere.

High above the Earth's surface, high-energy electrons and ions rain down on the atmosphere, spiraling along the planet's magnetic field lines. When they strike the upper atmosphere, they can excite or ionize nitrogen and oxygen molecules and produce glowing displays of auroras. One way to study this behavior in even greater detail is to inject the electrons artificially with a spaceborne particle accelerator.

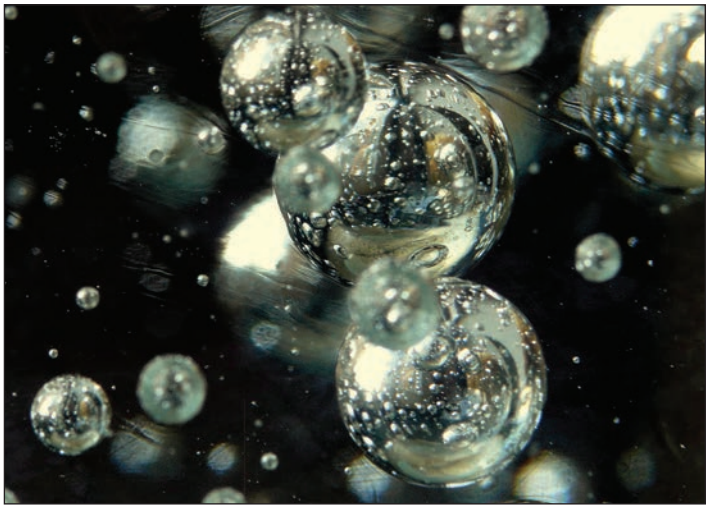
Marshall et al. consider this in a new study that uses computer simulations to explore the capabilities of a small but powerful particle accelerator positioned at an altitude of 300 kilometers, aimed at the atmosphere.

NASA has previously flown devices that fired beams with energies of a few to tens of kiloelectron volts, but the authors explore the effects of an accelerator 3 orders of magnitude stronger. The device would be capable of producing a beam with particles in the 0.5–10 million electron volt range in pulses lasting 0.1 microsecond and carrying 0.1 amp of current. These simulated specs are based on the Compact Particle Accelerator for Space Science (COMPASS), an instrument currently being designed by the SLAC National Accelerator Laboratory and the nonprofit research institute SRI International, both in Menlo Park, Calif.

The authors say that employing such instrumentation would offer many scientific opportunities to study the behavior of particles in the upper atmosphere. The paths of the electrons would trace out the arcing field lines of Earth's magnetic field, illustrating how they bend and snap during the intense geomagnetic activity caused by solar storms. As they descend into Earth's atmosphere, some of the electrons would strike atmospheric molecules, producing visible aurora-like emission. Furthermore, a particle accelerator might even be capable of triggering lightning in the upper atmosphere, including some of its more exotic forms such as red sprites and blue jets.

The team's modeling finds that the beam would leave a visible glowing trail that could be measured from the ground, with the peak emission occurring at an altitude of 44 kilometers. As the incoming electrons are jerked around by the atmosphere's molecules, they would also emit X-rays that could be seen from high-altitude balloons operating around 44 kilometers. The authors say that demonstrating the feasibility of detecting these signatures is a step toward the construction and deployment of such an instrument. (*Journal of Geophysical Research: Space Physics*, doi:10.1002/2014JA020427, 2014) **—Mark Zastrow, Freelance Writer**

Humans Greatly Increase Mercury in the Ocean



Mercury, pictured here, becomes monomethylmercury in the ocean. Monomethylmercury is a potent neurotoxin that can build up in food chains that end at our kitchen tables.

Since 1850, the amount of mercury humans have released into the atmosphere by burning coal and mining precious metals has, by conservative estimates, increased threefold. The atmosphere is a major source of mercury in the ocean, and as the element makes its way from the air to the sea, it infiltrates marine food webs. Ultimately, fish containing mercury—a known neurotoxin—can wind up on our plates.

Despite the health implications, the role of human activities in rising oceanic mercury levels has not yet been quantified. *Zhang et al.* wanted to know how much of the mercury deposited in the oceans came from human activity and how much was just part of the element's natural biogeochemical cycle. Put another way, to what extent are we poisoning ourselves?

To find out, the researchers had to determine the natural cycle of mercury—how the chemical circulated in oceans in preindustrial times, say before the mid-15th century. They combined three-dimensional simulations of mercury in the atmosphere, rivers, and oceans before the year 1450 to explore how the element travels from the surface of the seas to the sediment.

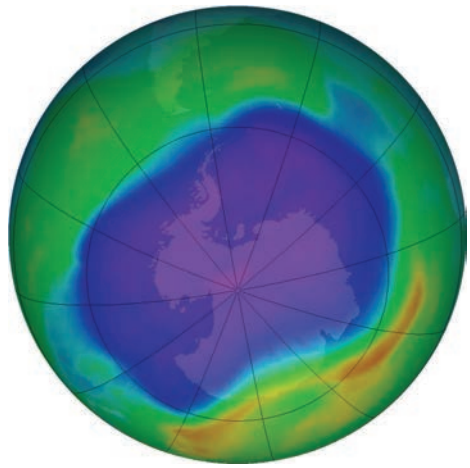
The model allowed the team to recreate how mercury moves and varies both vertically and horizontally throughout the water, which allows for more accurate comparisons between the model's predictions and observed mercury distributions. The authors calculated that mercury stays in the water for an average of 2000 years before embedding in sediment. They created maps of the average concentrations of mercury in the ocean at several depths.

The researchers compared the results to real samples from the Southern Ocean, the Atlantic Ocean, and the North Pacific Ocean and found that the amount of mercury actually present far exceeded what the model of natural mercury distributions predicted. They attribute the excess to human activities, which have increased the amount of mercury in the oceans by a factor of 5 to 6, the authors say. (*Global Biogeochemical Cycles,* doi:10.1002/2014GB004814, 2014) **—Shannon Palus, Freelance Writer**

Ozone Hole to Remain Large During Cold Years

Since it was first reported in 1985, scientists have watched the ozone hole form over Antarctica every spring in the Southern Hemisphere. The hole's size is determined by both temperature and the amount of chlorine in the atmosphere. Chlorine atoms hitch a ride to the stratosphere on chlorofluorocarbons (CFCs) that humans pumped into the air via aerosols, solvents, and refrigerants. When CFCs reach the stratosphere, their chlorine atoms are freed by the Sun's ultraviolet light and eat up ozone—a molecule with three oxygen atoms that shields Earth from harmful radiation.

In 1987, the nations of the world negotiated the Montreal Protocol to stop the harmful emissions of CFCs. The hole quit growing by the mid-1990s, but recovery of the protective shield has been slow because many ozone-depleting substances can last in the atmosphere for 50 and even 100 years. Scientists project that the hole will not vanish until around 2070. However, conclusively tying the international regulations to ozone recovery is not straightforward.



The 2006 Antarctic ozone hole, shown here in purple and blue, was the largest yet observed, with an average area of 27.3 million square kilometers.

Although CFCs are no longer emitted, scientists calculate that the slow destruction of CFCs already in the atmosphere causes chlorine to decline each year by roughly 20 parts per trillion (ppt), or about 0.5%. However, Earth-orbiting satellites indicate that the natural variability of chlorine levels over Antarctica is up to 10 times larger than the expected annual decline. In some years the chlorine level declined by as much as 200 ppt, but in other years measurements indicate it increased by as much as 150 ppt. According to *Strahan et al.,* it will take a decade of chlorine declines to be certain the Montreal Protocol has caused the ozone hole to shrink.

Low temperatures in the Antarctic stratosphere currently play the largest role in determining the size of the ozone hole. In 2006, the combination of very low temperatures and high chlorine levels produced the largest ozone hole ever. By 2040, the authors expect that chlorine levels will have fallen enough that the ozone hole will be smaller than it is today even during a very cold year. The authors say it is unlikely any future ozone hole will grow to 2006 levels.

Still, the team cautions that natural fluctuations mean it will take years of watching both temperature and chlorine levels before ozone trends can be attributed to the Montreal Protocol. (*Journal of Geophysical Research: Atmospheres,* doi:10.1002/2014JD022295, 2014) **—Eric Betz, Freelance Writer**

AGU's Career Center is the main resource for recruitment advertising.

All Positions Available and additional job postings can be viewed at Eos.org at **https://eos.org/jobs-support.**

AGU offers printed recruitment advertising in Eos to reinforce your online job visibility and your brand.

Contact **advertising@agu.org** for more information about reserving an online job posting with a printed Eos recruitment advertisement.

LINE LISTING RATES:

- $0.32 per character for first issue of publication
- $0.26 per character for each additional issue of publication

STUDENT OPPORTUNITY RATES:

- No Cost up to 500 characters
- $0.16 per character over 500 characters for first issue of publication
- $0.16 per character for each additional issue of publication

EMPLOYMENT DISPLAY ADVERTISING RATES (OPEN RATE, BLACK AND WHITE):

- Full Page : $5,500.00 net
- Half Page: $2,160.00 net
- Third Page: $1,450.00 net
- Quarter Page: $1,090.00 net
- Sixth Page: $730.00 net
- Eighth Page: $590.00 net
- To view all employment display ad sizes, visit **http://sites.agu.org/media-kits/files/2014/12/Eos-Employment-Advertising.pdf**

COLOR RATES:

- One Color: $315.00 net
- Full Color: $980.00 net

- *Eos* is published semi-monthly on the 1st and 15th of every month. Deadlines for ads in each issue are published at **http://sites.agu.org/media-kits/eos-advertising- deadlines/.**
- *Eos* accepts employment and open position advertisements from governments, individuals, organizations, and academic institutions. We reserve the right to accept or reject ads at our discretion.
- *Eos* is not responsible for typographical errors.
- Print only recruitment ads will only be allowed for those whose requirements include that positions must be advertised in a printed/paper medium.

Atmospheric Sciences

HPC Application & Workflow Positions

Princeton University's Cooperative Institute for Climate Science has a number of openings in the general area of high-performance computing, algorithms and workflows. The positions will support an exciting new initiative to adapt GFDL/CICS Earth System models to novel architectures and systems.

Our effort will take place in the context of an integrated effort to target NOAA Earth system models to these novel architectures, where we will contribute to the overall NOAA effort, as well as specifically target models and model components used in GFDL Earth System Modeling and based on the Flexible Modeling System (FMS). (http://www.gfdl.noaa.gov/fms).

The scope of the work is broad: it includes

- redesigning the architecture of the Earth system model for greater concurrency
- the optimization of codes for fine-grained parallel architecture, requiring knowledge of compilers (including layers like LLVM) and languages for expressing parallelism (MPI, OpenMP, OpenACC, CUDA, PGAS)
- the redesign and substitution of existing algorithms with others better suited for novel architectures.
- the redesign of the complete workflow systems for maximizing system throughput

Candidates will join a dynamic team of computational experts attached to one of the foremost research institutions in Earth system science, will collaborate with top scientists and algorithm developers in the field, and will have access to an extraordinary range of computational and data resources. This is a growth area for the lab and the lab's group leading this effort, and candidates will have considerable leeway to develop their own ideas within the context of the lab's mission. Candidates must be able to work in a team environment that combines the collegiality of an academic setting with the focus of a mission agency, and be able to deliver rigorously tested results to meet deliverables for international collaborative science missions. Occasional travel to project meetings, site visits, and national and international conferences and workshops is to be expected.

Candidates must possess an MS in a relevant field (computer science, or physical sciences) and at least two years experience working with weather or climate codes and runtime environments in an HPC context. At least one senior hire (PhD, and/or 10 years relevant experience) is envisioned. Knowledge of one or more parallel programming methods is desirable. Appointments will be made at either the Associate Professional Specialist or Professional Specialist rank, depending on the candidate's credentials.

Applicants must apply online to http://jobs.princeton.edu, Requisition #1500296 and submit a CV, publication list and contact information for at least 3 references.

Princeton University is an equal opportunity employer and all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, disability status, protected veteran status, or any other characteristic protected by law. This position is subject to the University's background check policy.

Ocean Sciences

Postdoctoral Research Associate Position at the Applied Physics Laboratory of the University of Washington, Seattle, WA.

The Applied Physics Laboratory (APL) at the University of Washington is seeking Post-doctoral Research Associates with research interests in Oceanography, Polar Science, Remote

Ocean Dynamics and Prediction Research
Naval Research Laboratory

The Naval Research Laboratory is seeking postdoctoral and senior researchers to push forward the frontiers of ocean forecasting. Problems that must be addressed cover a wide scope of physics including surface waves, thermohaline circulation, ice, nearshore circulation, and ocean/atmosphere coupling from global to nearshore scales. This challenging work includes processing and analysis of satellite and in water observations, construction of numerical model systems and assimilation for predicting the ocean environment. This work is long term, with the goal to provide new technology for systems moving to operational forecast centers.

This is an excellent opportunity to work with some of the best modelers and data analysts in the ocean community. The Naval Research Laboratory has access to the major supercomputer sites as well as excellent local computer resources. The laboratory is collocated with the Naval Oceanographic Office, which is the largest national operational forecast center for oceanography.

For a quick overview of some of the research projects within the NRL Oceanography Division at Stennis Space Center, visit the web site:

http://www7320.nrlssc.navy.mil/projects.php

Applicants must be a US citizen or permanent resident at time of application. Applications will be accepted until positions are filled. Please mail or e-mail a resume and description of research interests, or phone:

Gregg Jacobs
NRL Code 7320
Stennis Space Center, MS 39529

via e-mail: jacobs@nrlssc.navy.mil
Phone: 228-688-4720

Sensing, Environmental Acoustics and Ocean Engineering.

APL is a unit of the University of Washington and a University Affiliates Research Center of the Navy. Expected terms are two years. Positions are not project specific; a specific applicant is expected to define his/her research goals within the broad program areas of the participating APL departments (Air-Sea Interaction & Remote Sensing (AIRS), Acoustics Department (AD), Ocean Engineering (OE), Ocean Physics Department (OPD), Polar Science Center (PSC). Successful applicants must hold a recent (no more than 4-years) PhD or foreign equivalent in order to assume a post-doctoral position.

A transition to permanent staff following the completion of the post-doc appointment is possible subject to availability of funds and the demonstration of an interest in developing independent research initiatives during the course of the post-doc appointment. Opportunities to collaborate with scientists across the UW campus provide access to a broad range of expertise both during the post-doctoral research and as a permanent member of the staff.

University of Washington faculty engage in teaching, research and service. University of Washington is an affirmative action and equal opportunity employer. All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, age, protected veteran or disabled status, or genetic information.

The position offers salary commensurate with experience and excellent benefits.

Screening of applicants will begin June 16, 2015 and applications should be received prior to June 13, 2015. Finalists will be contacted in July. Travel expenses will be covered to allow finalists to present their recent work in an APL seminar.

Job offers be will made in September 2015 with start dates negotiable between October 2015 and March 2016.

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,

(4) The names of four individuals who can provide a letter of reference.

In addition, a letter of support from a mentor in one of the participating departments (AIRS, AD, OE, OPD, PSC) is strongly encouraged. Further information on current research at APL, by department and principal investigator, can be found at: http://www.apl.washington.edu/departments/departments.php

Applications should be submitted preferably via email to:

Dr. Kevin Williams
Sr. Principal Physicist, Acoustics Department Chair, and Liaison of Science and Engineering Group of APL
Applied Physics Laboratory - University of Washington
1013 NE 40th Street
Box 355640
Seattle, WA 98105-6698
williams@apl.washington.edu

Assistant Professor (Coastal Physical Oceanography) Tenure Track

Department of Oceanography Graduate School of Engineering and Applied Sciences Naval Postgraduate School, Monterey, CA

The Oceanography (OC) Department in the Graduate School of Engineering and Applied Sciences at the Naval Postgraduate School (NPS) invites applications for the position of tenure track Assistant Professor in the field of coastal physical oceanography. We are seeking candidates with core strengths in areas such as: coastal and nearshore processes; field experimentation; and coastal modeling and data assimilation. The successful candidate is expected to develop an externally funded research program that spans basic to applied research areas and involves graduate students. The candidate must have a strong commitment to graduate teaching.

We are seeking a colleague to join our vibrant OC Department, which has a long history of excellence in physical oceanography, ocean acoustics, ocean dynamics, nearshore processes, ocean waves and turbulence, ocean analysis and prediction, and high latitude ocean dynamics. The OC Department has a strong research infrastructure, such as facilities and vessels located in close proximity to Monterey Bay, CA, an experienced group of technical staff, and computational resources. The OC department promotes interdisciplinary research and encourages research collaborations with the number of oceanographic institutions located around

icdp

The International Continental Scientific Drilling Program, ICDP invites scientists from upcoming scientific drilling projects for lacustrine sediments to apply for the

ICDP Training Course on Lacustrine Sediment Drilling

to be held from September 14-16, 2015 at Lake Ohrid (Macedonia). This training course will touch upon relevant aspects of scientific drilling in lakes, including project planning and management, pre-site studies, drilling engineering, drill core handling and storage, on-site core analysis, downhole logging, data management, and post-drilling activities. The training course is recommended for master students, doctorate students and post-docs involved in scientific drilling.

Deadline for applications is June 30, 2015; decisions will be communicated by July 10. Preference will be given to applicants involved in ICDP drilling projects, applicants from ICDP member countries, developing countries, and those from countries considering ICDP membership. For the successful candidates, costs including those for travelling, visa, and accommodation will be covered by the ICDP. Applications should include a letter of interest, CV, and at least two letters of support.

Please send your application to icdp-outreach@gfz-potsdam.de
More information on ICDP training measures can be found at
http://www.icdp-online.org/support/training

OAK RIDGE National Laboratory

The **Chemical Sciences Division** (CSD) at Oak Ridge National Laboratory (ORNL) is seeking a **Computational Chemist**. We are seeking either an early to midcareer Research Associate or a Senior R&D Staff Scientist. Only one position will be filled and applicants should apply based on relevant experience and job requirements.

Research will focus on modeling the interplay of chemical reactions at fluid-solid interfaces and transport in porous media, in chemical, materials and geologic sciences. Due to the inherently multi-scale nature of these processes, the successful candidate should be comfortable addressing processes at atomic to macroscopic scales. The diverse fundamental research program in the CSD and the unique capabilities at ORNL including world class computing, Spallation Neutron Source and High Flux Isotope Reactor, and the Center for Nanophase Materials Sciences will prove beneficial to the selected candidate.

MAJOR DUTIES/RESPONSIBILITIES:

◆Model the interplay of chemical reactions at fluid-solid interfaces and transport in porous media ◆Work independently and with experimentalists to develop validated, predictive models that move beyond the current length and time scale limitations ◆Publish results in high-quality, peer-reviewed journals in a timely manner and make presentations at professional and all-hands meetings ◆Contribute to peer-reviewed proposal development utilizing new computational methods to understand mesoscale processes and participate in major initiatives across the laboratory

QUALIFICATIONS:

◆PhD in Physical Sciences, Mathematics, Computational Science or a closely related field ◆ Expertise in computational modeling, simulations and code development pertaining to the hydrodynamic flow regime, modeling realistic chemical reactions, such as sorption, precipitation/dissolution and heterogeneous catalysis ◆ Experience in high performance computing and flexibility and understanding of experimental and computational methods and theories

For more information and to apply, please visit http://www.ornl.gov/ornl/careers and search the following:
NB50483895 for the Research & Development Staff Member or **NB50483878** for the Senior Research & Development Staff Member
ORNL is an equal opportunity employer. All qualified applicants, including individuals with disabilities and protected veterans, are encouraged to apply.

the bay. Additional information can be found online at http://nps.edu/Academics/Schools/GSEAS/Departments/Oceanography/index.html

Minimum qualifications:

– Requires an earned doctoral degree in coastal physical oceanography or related field that supports the OC Department's instructional needs

– Evidence of teaching aptitude

– Evidence of potential to advise student theses and dissertations

– Evidence of strong potential for scholarship leading to scholarly publications

– Must currently hold or be eligible for a Secret clearance

– U.S. citizenship preferred

A letter of application including CV, statement of teaching and research interests and philosophy, and the names of three referees should be sent by July 31, 2015 to:

Dr. Jamie MacMahan, Faculty Search Committee Chair
Department of Oceanography
Naval Postgraduate School
Monterey, CA 93943
831-656-2379
jhmacmah@nps.edu

Salary is commensurate with qualifications and experience. Relocation package, including recruitment/relocation incentive may be authorized. The position will remain open until filled.

The Naval Postgraduate School is an equal opportunity employer. For additional information about NPS, please refer to the website at http://www.nps.edu

Ocean Sciences Faculty positions in the Department of Oceanography, National Sun Yat-sen University, Kaohsiung, Taiwan, ROC.

The Department of Oceanography at the National Sun Yat-sen University is looking to fill three tenure-track faculty positions in the areas of satellite oceanography/remote sensing, atmosphere-ocean interaction, general oceanography or one of the specialty fields in oceanography (physical, biological, chemical or geological oceanography) beginning February 2016. The applicant must hold a Ph.D. degree in disciplines mentioned above, demonstrate his/her capability to conduct research, and preference will be given to applicants with extensive experience in sea-going field work. The rank (from assistant, associate, to full professor) of the appointment will commensurate with experience and accomplishment. This position carries a 12-month salary plus a 1.5-month bonus at the Chinese New Year. The successful candidate is expected to teach both undergraduate and graduate (master and doctorate levels) courses and to establish his/her own research through outside funding. Applications will remain open until the positions are filled, but preferential consideration will be given to applicants submitting before August 31, 2015.

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

FACULTY OF PHYSICS

DLR Deutsches Zentrum für Luft- und Raumfahrt
German Aerospace Center

As one of Europe's leading research universities, Ludwig-Maximilians-Universität (LMU) in Munich is committed to the highest international standards of excellence in research and teaching. Building on its more than 500-year-long tradition, it offers a broad spectrum that covers all areas of knowledge within its 18 Faculties, ranging from the humanities, law, economics and social sciences, to medicine and the natural sciences.

DLR is the national aeronautics and space research centre of the Federal Republic of Germany. Its extensive research and development work in aeronautics, space, energy, transport and security is integrated into national and international cooperative ventures. The Institute of Atmospheric Physics of DLR investigates the physics and chemistry of the atmosphere from the surface up to the mesosphere. The knowledge of dynamical, cloud physical, and chemical processes constitute the basis for many aerospace applications. On both regional and global scales the relevant processes and changes of the state of the atmosphere are quantified and systematically investigated using remote sensing, research aircraft, and computational models.

The **Faculty of Physics of LMU** and the **Institute of Atmospheric Physics of DLR** invite applications for a

Head of Department for Atmospheric Remote Sensing
at the Institute of Atmospheric Physics of DLR and
Professorship (W2) (6 years/tenure track) of Atmospheric Remote Sensing
at the Faculty of Physics of LMU Munich

commencing as soon as possible.

The department of Atmospheric Remote Sensing is one of five departments at the Institute of Atmospheric Physics of DLR. It has a long tradition in passive satellite remote sensing and ground-based radar remote sensing of water and ice clouds, having developed a number of well-known algorithms for cloud detection and microphysics retrieval, with a special emphasis on natural ice clouds and aircraft contrails. Close collaboration is established with the chair of Experimental Meteorology at the faculty of physics at LMU where radiative transfer models are developed specifically targeted at the quantitative analysis of remote sensing observations. Preparing for and exploiting the EarthCARE mission is a major research aim of the Institute. We are looking for a scientist, with particularly outstanding achievements in active and/or passive cloud remote sensing, capable of leading a research group with 10 to 20 people. The candidate should be skilled in project management, teaching and team leadership, and take a keen interest in further promoting the research activities of the department and initiate new projects at the national and international level. The institute generates about 30% of its budget via external projects. The candidate is expected to contribute two hours per week (during semester) to the teaching activities in atmospheric physics at LMU Munich.

LMU Munich and DLR seeks to appoint a highly qualified junior academic to this professorship and, therefore, especially encourages early-career scholars to apply. Prerequisites for this position are a university and a doctoral degree. With an excellent record in research and teaching to date, prospective candidates will have demonstrated the potential for an outstanding academic career.

The future holder of this position will be appointed to LMU Munich as a university professor (pay grade W2) under the terms of a private-law contract and will be granted leave of absence in order to be employed at DLR as head of Department for Atmospheric Remote Sensing at the Institute of Atmospheric Physics based on an employment agreement under private law.

The initial appointment will be for six years. After a minimum of three years, it can be converted into a permanent position pending a positive evaluation of the candidate's performance in research and teaching as well as his or her personal aptitude and if all legal conditions are met.

LMU Munich and DLR make a point of providing newly appointed professors with various types of support, such as welcoming services and assistance for dual career couples.

LMU Munich and DLR are equal opportunity employer. The University continues to be very successful in increasing the number of female faculty members and strongly encourages applications from female candidates. LMU Munich intends to enhance the diversity of its faculty members. Furthermore, disabled candidates with essentially equal qualifications will be given preference.

Please submit your application comprising a curriculum vitae, documentation of academic degrees, certificates and a list of publications to the **Dean of the Faculty of Physics, Schellingstrasse 4, 80799 Munich, Germany**, as well as to **Prof. Dr. Markus Rapp, at the Institute of Atmospheric Physics (IPA) of Deutsches Zentrum für Luft- und Raumfahrt (DLR), Oberpfaffenhofen, 82234 Wessling, Germany**, no later than **June 30, 2015**.

Applicants should send their curriculum vitae, three recommendation letters, statement of research and teaching interests through electronic mails to:

Prof. Li-Lian Liu
Department of Oceanography
National Sun Yat-sen University
Kaohisung, Taiwan 80424
Tel: +886-7-5252000*5108
Fax: +886-7-5255130
E-mail: lilian@mail.nsysu.edu.tw
http://ocean.nsysu.edu.tw/bin/home.php

Solid Earth Geophysics

RESEARCH FELLOW/ FELLOW / SENIOR FELLOW Research School of Earth Sciences, Australian National University

The Research School of Earth Sciences seeks to appoint a Seismologist to strengthen and complement current activities that exploit Australia's unique position in relation to regional and world seismicity with the goal of understanding Earth structure and dynamics. Applicants will be expected to have established a strong research profile in the analysis of seismological observations, or the development of interpretational techniques for determining Earth structure. The successful applicant will be expected to develop an internationally distinguished research program and demonstrate leadership in seismological research.

The level of appointment will depend on the experience of the applicant. An appointment as Fellow and above will be continuing (tenured) subject to satisfactory completion of a probationary period.

The school has 65 portable broadband systems, and 200 new solid state recorders with 3 component sensors, and access to a fleet of 20 Ocean bottom seismometers. Advanced computational facilities are available within the group and through the national supercomputing NCI) peak facility.

The successful applicant will be expected to take a major role in the development of the program in seismology, supervise graduate students and contribute to the School's graduate and undergraduate teaching program. An active program of external fund raising is expected.

ANU values diversity and inclusion and believes employment opportunities must not be limited by socio-economic background, race, religion or gender. Interest in this position from women and minorities is strongly encouraged. Information on the Research School of Earth Sciences can be found at http://rses.anu.edu.au.

Further particulars, including how to apply can be found at http://jobs.anu.edu.au/cw/en/job/493896/research-fellow-fellow-senior-fellow

Postcards from the Field

Dear Everyone,

Our deserts get a bad rap! "Barren," you say? Ridiculous! "Wasteland?" Absolutely the opposite. The diversity and complexity of Earth processes here in Organ Pipe Cactus National Monument in southern Arizona are ever-present. As I trace the origins of the invasive Sahara mustard across North America, I am reminded of these complexities while gazing across this diverse landscape of flora and volcanic secrets.

Wish you were here.
Daniel E. Winkler
Ph.D. student at the University of California, Irvine

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

AGU FALL MEETING

San Francisco | 14 – 18 December 2015

Share Your Science With More Than 20,000 Worldwide

Five Reasons to Attend

The Best Value

Registration for the 2015 Fall Meeting includes all **general and breakout sessions; communication, educational outreach, and career workshops**; and access to all presentations.

Visibility for Your Science

Fall Meeting **draws both luminaries in their fields and up-and-coming talent.** More than 200 members of the press attended the 2014 Fall Meeting, resulting in more than 4,500 news stories about the research showcased during the week.

Learn about Cutting-edge Research

Gain insights about the latest science and enhance your knowledge beyond your scientific field of interest. Fall Meeting has a robust scientific program, with more than **23,000 presentations** spanning the geophysical sciences.

Connect With Your Colleagues

Network with your peers at the **opening ice breaker reception** and during **AGU section and focus group events** and **daily networking breaks (free refreshments included!).**

Advance Your Career

Boasting **more than 25 career-related events**, the Fall Meeting can help advance your career and increase your worth to potential employers.

ABSTRACT SUBMISSION OPENS:

10 JUNE

ABSTRACT SUBMISSION DEADLINE:

5 AUGUST

fallmeeting.agu.org