

# NEWS

## Earth and Space Science Community Assesses Impacts of U.S. Government Shutdown

The recent 16-day shutdown of the U.S. federal government cost the U.S. economy an estimated \$24 billion. Federal science agencies are also tallying significant negative effects, including interruptions, delays, and, in some cases, cancellation of critical research projects in the Earth and space sciences.

Among the biggest concerns is the impact of the 1–16 October shutdown on Antarctic research during the start of the continent's austral summer field season. Without an appropriation from Congress, the U.S. Antarctic Program (USAP), managed by the National Science Foundation (NSF), "was forced to begin a transition to caretaker status, jeopardizing a full season of research," NSF acting director Cora Marrett said at a 21 October briefing. She said the agency is digging through its backlog and working "feverishly right now to determine what priorities, what things can be done, during what is always a very constrained season."

With the shutdown over, NSF is "working hard to restore as much of the planned activities as safely possible," noted Scott Borg, head of the agency's Antarctic Sciences Section, in an 18 October posting on the NSF website. "Unfortunately, because we plan activities to take full advantage of the

limited austral summer season, the 16-day interruption has already resulted in deferral of some projects, and additional projects will be impacted." (See "Antarctic projects stymied by the shutdown," page 399.)

"The timing of the government shutdown was terrible: It's spring in Antarctica, and the most active field season is ramping up," NSF Geosciences Advisory Committee chair Louise Kellogg told *Eos*. "Many scientists who were preparing to travel to Antarctica faced cancellation of critically important research projects after years of preparation. There is a lot of concern about long-term research involving ice sheets, seismic and geodetic measurements, climate studies, cosmology, and more," said Kellogg, a professor in the geology department at the University of California, Davis. "The instruments operate in an extremely challenging environment and require regular, ongoing maintenance."

Marrett said the shutdown in general "severely limited [NSF's] ability to conduct our mission." During the shutdown, 99% of NSF employees were furloughed, no proposals were received or distributed for peer review, none of 98 planned NSF review panels were convened, no new awards were made, and no existing awards received

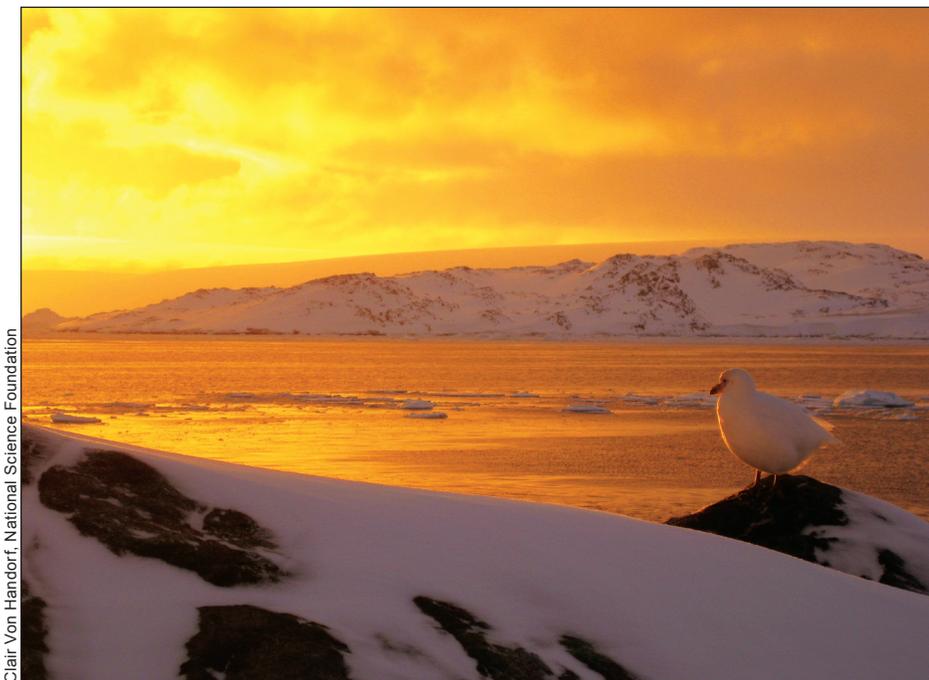
payment, she said. "It is difficult for researchers and educators to do any long-range planning when you don't know exactly what the funding is going to look like. So, yes, it has its consequences," Marrett added.

Simon Stephenson, NSF section head for Arctic sciences, told *Eos* that no funded Arctic field science projects were canceled. "NSF, working with the various support organizations, was able to prioritize the limited number of science projects still in the field at the 'end' of the 2013 season so that they could all continue using funds provided toward the end of [fiscal year] 2013. If the hiatus in funding had continued into November, that would not have been the case. Planning for next season, which began in September, was severely curtailed," he noted. "NSF, the research community, and the support organizations will have to catch up over the next few months. Despite the delay, we have a high degree of confidence that the plans for 2014 will support research in an efficient and effective manner."

David Conover, director of NSF's Division of Ocean Sciences, told *Eos* that during the shutdown, the academic research fleet operated by the University-National Oceanographic Laboratory System (UNOLS) continued with scheduled activities by using previously allocated funds. Construction activities related to the Ocean Observatories Initiative and the R/V *Sikuliaq* research vessel continued without interruption, as did operations of the *JOIDES Resolution* drillship, he said. However, several key meetings were canceled, including one of the NSF Geosciences Advisory Committee. In addition, NSF employees were unable to attend the initial meeting of a U.S. National Research Council (NRC) committee that is providing guidance to the agency on national ocean science research priorities.

The shutdown also affected atmospheric research, said Tom Bogdan, president of the University Corporation for Atmospheric Research, a consortium of 104 member universities that also manages the National Center for Atmospheric Research under the sponsorship of NSF. "The atmosphere doesn't stop; weather doesn't stop. But a lot of important science in our community was stopped. Interrupting research due to uncertain funding results in critical lapses in our observations and data collection. This ultimately affects our ability to gain an adequate picture of the ever-changing atmosphere," he told *Eos*.

Linda Rowan, external affairs director of the nonprofit UNAVCO consortium, said that the organization lost more than 90% of its authorized income to cover essential expenses during the shutdown, and there was a concern that the consortium would need to close all of its infrastructure and data services. The university-governed consortium, which facilitates geoscience



A Snowy Sheathbill at sunset near Palmer Station, Antarctica.

Clair Von Handorf, National Science Foundation

research and education using geodesy, receives core sponsorship from NSF and NASA. Rowan noted that 18 of 22 UNAVCO Antarctic research projects were likely to advance, though some may not complete all of the planned work. She said the shutdown also delayed borehole research efforts in Turkey and a terrestrial laser scanning project at NASA's Kennedy Space Center.

### Significant Effects at NOAA

The shutdown had significant impacts in several divisions within the National Oceanic and Atmospheric Administration (NOAA), an agency official told *Eos*. While some critical National Weather Service (NWS) functions continued, NWS stopped all preventative maintenance and calibration on systems and radar and postponed its assessment of the September Colorado flash flooding event. At the National Ocean Service, there was a delay in defining, maintaining, and providing access to the National Spatial Reference System, the coordinate system that defines latitude, longitude, and height for the nation. The development of Integrated Ocean and Coastal Mapping procedures and prototype data products also halted, as did research and testing of hydrographic sensors and the development of storm surge and other hydrodynamic models to support weather forecasting, marine transportation, and coastal planning.

Within Oceanic and Atmospheric Research, research and development to improve predictions of high-impact weather events ceased, as did all internal projects funded by Hurricane Sandy supplemental funds, including projects to develop improved weather models and to identify new observing approaches, according to the NOAA official. In addition, research with models and observational data on decadal-scale drought, water availability, and air pollution in western U.S. states was put on hold. The shutdown also delayed all fiscal year (FY) 2014 activities involving NOAA ships and aircraft, as well as FY 2014 NOAA Fleet Council resources that are used for chartering external partner and private sector vessels. The halt in ship and aircraft operations and funding caused immediate project-level disruptions, which will become more severe as time passes, the NOAA official told *Eos*.

### Assessing Impacts at USGS

Suzette Kimball, acting director of the U.S. Geological Survey (USGS), told *Eos* that it will be days, perhaps weeks, before the agency has a full understanding of the impact of the shutdown. "We do know that important scientific research was interrupted and delayed," she said.

USGS officials will assess whether important gaps have occurred in monitoring data

## Antarctic Projects Stymied by the Shutdown

The U.S. federal government shutdown coincided with the beginning of the Antarctic austral summer research window, and many scientists told *Eos* they are deeply concerned about the impacts on research there. John Priscu, a lead principal investigator with the Whillans Ice Stream Subglacial Access Research Drilling (WISSARD) project in West Antarctica, said the government shutdown "threw us a curve that I did not anticipate or plan for." Priscu, who has spent 30 seasons working in Antarctica under federal funding, said that a hole in the project's long-term data set "will have a major impact on the models we are developing to examine climate-induced changes" in Antarctic ecosystems.

Because of the shutdown, more than 15 graduate students in the WISSARD program will not deploy to Antarctica this year, said Priscu, a professor of ecology at Montana State University, Bozeman. "The graduate students were hurt the most by the shutdown," he said. "In my case, two excellent Ph.D. students joined my laboratory because they trusted me and trusted that the federal funding I had would allow them to conduct novel research addressing important polar questions. These students are now searching for ways to complete their Ph.D. programs and move forward with their lives." Priscu added, "I am afraid that the government shutdown has been a huge setback in educating the next generation of U.S. polar scientists."

Anne Gambrel, a third-year Ph.D. student at Princeton University, in N. J., who has been working on the SPIDER balloon-borne polarimeter experiment to measure the temperature and polarization of the cosmic microwave background, was to have flown to Antarctica for the launch of the polarization sensitive telescope near McMurdo Station. She said that the shutdown delayed the schedule and it now appears logistically impossible to launch the payload this year. She said that seven senior graduate students involved with the project will need to find alternate data sets for their research.

"We were incredibly proud of the experiment we had collectively put so

much into, and we felt so excited to take the final step and see it launched," Gambrel told *Eos*. "Two weeks before we were scheduled to depart [for Antarctica], at the height of our excitement, the rug was pulled out from under us. It was like a punch in the stomach, and we are still trying to wrap our heads around how much we have lost."

Kendra Daly, a co-principal investigator on an ecosystem study of the influence of top predators on their prey in McMurdo Sound in the Ross Sea, told *Eos* that her group heard on 18 October that the project was canceled and will be rescheduled for 2014. "Our greatest concern is for the students and postdoctoral fellows who lose the opportunity to complete their research in a timely manner," said Daly, an associate professor in the College of Marine Science at the University of South Florida. "As far as our project is concerned, the government shutdown resulted in wasted time, effort, and taxpayer funding to plan and equip our project for this field season. Additional costs will be incurred as we will have to recalibrate and ship instruments again for next year and pay for personnel for an extra year."

Douglas Wiens, a professor in the Department of Earth and Planetary Sciences at Washington University in St. Louis, Mo., said members of his group were scheduled to go to Antarctica as part of the Polar Earth Observing Network team to install and service seismographs and GPS receivers. Wiens said it is not yet clear whether any of their planned work will go forward this year. If the group is not able to carry out its work, many of the seismic stations needing battery replacements will shut down, with the possibility that they will be damaged by prolonged exposure to  $-60^{\circ}\text{C}$  temperatures, he said. Wiens added that stations scheduled to be installed this year might not be deployed until next year, and a year's worth of data could be lost.

—RANDY SHOWSTACK, Staff Writer

due to equipment failure or the inability to capture data or conduct tests that are seasonally based, delays in the delivery of scientific analyses and products, and whether opportunities for science coordination were missed, she said. The agency also will conduct quality assurance and quality control measures for data captured by sensors during the shutdown. "It is too early to determine whether we can recover missed

data-collection opportunities or whether rescheduling field or experimental activities will be sufficient to make up for lost opportunities and canceled fieldwork," Kimball said.

Several services widely used by the general public were affected by the shutdown. For instance, Kimball pointed to "an inability to provide imagery from Landsat 8, lack of maintenance of much of the streamgage

network and portions of the earthquake warning networks, and interrupting studies supporting Hurricane Sandy recovery. In a sense, we and the nation were lucky that we did not experience multiple extreme events during this period, and we were able to provide science support for the flooding in Colorado," Kimball said.

"I myself woke up each day concerned about the possibility of an extreme event occurring during the shutdown," Kimball said. "Other agencies, local communities, and the public rely on USGS data and analyses to help them respond to natural disasters, and I was concerned that our ability to fully assist in such circumstances might be compromised."

Kimball added that the USGS earthquake monitoring network experienced some outages, limiting the availability of data from some strong-motion sensors deployed in the San Francisco Bay area, Hawaii, and the Pacific Northwest. "We experienced increasing network degradation as the lapse in appropriations continued. The accuracy and timeliness of hazard information products was affected, as well as interactions with media (e.g., an earthquake that occurred in the Bay Area)," Kimball noted.

She said another specific impact from the shutdown was that scientists missed the window of opportunity to field-test an acoustic barrier deterrent to Asian carp that could help protect the Great Lakes Fishery from the invasive species.

Robert Gropp, chair of the nongovernmental USGS Coalition, said some water and ecosystem sciences may have suffered most from the shutdown. "Living organisms don't stop doing what they do simply because our political leaders can't come to terms and fund the government on time. So we'll have to see how much data was lost because scientists could not get into the field." Gropp said the shutdown "is a further hit to the morale of the federal scientists and contractors who work so hard to advance science and provide the American public with accurate and important information. I certainly hope that lawmakers will now do their job so that we aren't back in a couple of months with another shutdown."

### *Concerns About Space Science*

Scientists also worried about the effect of the shutdown on space science. "The loss of productivity [due to the shutdown] only makes it all the more difficult to sustain U.S. leadership in space and Earth science, which was hard enough already, given the ongoing effects of flat budgets and [budget] sequestration," said Charles Kennel, director and distinguished professor emeritus of Scripps Institution of Oceanography at the University of California, San Diego, and chair of NRC's Space Studies Board.

Kennel, whose views are his own and not necessarily those of his institutions, told *Eos*,

"Even before the present paralysis took hold, NASA was slowly being deprived of oxygen as the conflict over basic political principles reached down to enervate the government's lower levels. Now, it has always been important for NASA leadership to respond to the goals of the administration and Congress. But at the end of the day, people on both sides of the aisle believed that science—space science—ought to be nonpolitical, an attitude that led to some restraint. I wonder whether this is true anymore." He added, "There seem to be two different political visions of what science NASA should be pursuing. If this continues, there could be real problems. This is not good for an agency whose projects take years to bring to fruition. Politicization of science could be one of the more serious fall-outs of today's governmental crisis."

**"Precious time was wasted dealing with the shutdown rather than doing the scientific, engineering, and management work that should have been the focus of attention."**

"The real story in my mind is that scientific programs already greatly impacted by the sequester and other budget hits may now be challenged further by fallout from the government shutdown," Art Charo, senior program officer with NRC's Space Studies Board, told *Eos*. "The next shoe that could drop would be if the existing sequester cuts were to remain in place or, worse, if additional cuts occur as scheduled—remember the original idea was for [sequester] cuts each fiscal year for a decade." Charo said, for instance, that the NASA heliophysics program can try to absorb an 8% cut—on the order of what has occurred this fiscal year—and maintain the possibility of executing the recently completed NRC heliophysics decadal strategy. If the sequester cuts were to continue unabated against a backdrop of level funding that does not rise to account for inflation, the program would be "shredded," he said.

Dan Baker, director of the Laboratory for Atmospheric and Space Physics (LASP) at the University of Colorado, Boulder, told *Eos* that key milestones were missed on NASA and NOAA programs "and precious time was wasted dealing with the shutdown rather than doing the scientific, engineering, and management work that should have been the focus of attention." Baker said the shutdown "sends a message to present practitioners of science, as well as the next generation of potential scientists and engineers, that their work, no matter how time critical, no matter how important to the nation's

future, no matter what the work may mean to our country's image in the world, still can be thrown away because of differences between political factions."

He said that science and technology programs should be taken as far from the political arena as possible. He said the government "needs to reassert in word and deed that scientific research is not, and will not be, a pawn in such [political] battles. Young people just contemplating coming into science disciplines need to be confident that their work will be valued and will be shielded from political fallout to the greatest degree possible."

The shutdown nearly delayed the November launch of NASA's Mars Atmosphere and Volatile Evolution Mission (MAVEN). According to Bruce Jakosky, MAVEN principal investigator and LASP associate director for science, NASA found that the mission met requirements allowing an emergency exception from the federal Anti-Deficiency Act that shuts down non-exempt activities. Jakosky told *Eos* that although the mission was shut down along with the rest of the government, it is back on schedule to be ready at the start of its launch period on 18 November.

### *Lack of Confidence in Government*

Bob Gagorian, president and CEO of the Consortium for Ocean Leadership, said that although the shutdown brought the science community to a grinding halt, the good news was that it didn't last 2 months, which would have been "a disaster." Gagorian told *Eos* that the long-term issue is the lack of confidence with the government as a whole, not with specific agencies. "Is this going to happen again and again and again?" he asked. He said that if politicians don't care about shutting down the government and if concerns about the country defaulting on its debt don't get their attention, "science isn't going to get their attention."

Corale Brierley, principal with Brierley Consultancy LLC, told *Eos* that in addition to the possible loss of data and information streams, her main concerns about the shutdown include the likely backlog in processing applications, permits, and leases and the loss of morale among federal workers. "It seems to me the agencies have not been given a sound sense of their budget futures through this fiscal year or beyond. Consequently, this would seem to make planning very difficult, particularly in those areas that require a long-term vision, such as research and development, land use/land management, hazard mitigation, water use and management, and resource use and development," said Brierley, who is also chair of the NRC Board on Earth Sciences and Resources. Brierley's views are her own and not necessarily those of her institutions.

*"A Messy, Unplanned Experiment"*

"We saw the shutdown as a messy, unplanned experiment in what happens when the federal government greatly reduces support for the nation's science enterprise," said Andrew Rosenberg, director of the Center for Science and Democracy at the Union of Concerned Scientists (UCS). "The signal was sent that much of the scientific work done around the country is not valued by policy makers," he told *Eos*. Rosenberg said that members of the UCS Science Network reported a number of specific impacts to the Earth and space sciences, including interruptions of fieldwork and scientific testing. In addition, he said that "many scientists, early or late in careers, told us they were demoralized. Some questioned whether they should work for the federal labs that are so important to their fields because of the morale issue."

Matt Hourihan, director of the R&D Budget and Policy Program for the American Association for the Advancement of Science, told *Eos* that the shutdown only added to concerns about the funding for federal research and development, which is on a "long-term slide" as a share of the budget. "Lurching from crisis to crisis is not an effective means of governing," he said. Kasey White, director for geoscience policy at the Geological Society of America, added that "agencies are still operating in constrained budget environments due to the sequester and will continue to make difficult choices."

Ralph Cicerone, president of the National Academy of Sciences and NRC chair, expressed specific concern about the impacts of the shutdown on the U.S. Antarctic Program and on gaps in data collecting. He suggested measures to increase future support for science among elected

officials. He told *Eos* that scientists should invite members of Congress to their labs to show them what scientists and students do. Cicerone said that members of Congress have told him that such lab visits would be received enthusiastically but that they are too rare. "Getting to know scientists and their students can be a very enriching experience for elected leaders," Cicerone said, adding that it can take some time and that scientists should get started.

—RANDY SHOWSTACK, Staff Writer

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*Editor's Note: AGU issued a statement in response to the end of the government shutdown and its impacts on scientists and research and development. See <http://news.agu.org/press-release/government-reopens-science-struggles-to-recover/>.*