NEWS IN FOCUS

AP PHOTO/A. GALVAN III

Just moments after the launch of the Glory probe, NASA realized that the satellite was doomed.

EARTH SCIENCE

Mourning Glory

NASA satellite crash will hamper solar monitoring and aerosol measurements vital to improving climate models.

BY JEFF TOLLEFSON

The parallels are spooky. The Glory probe was meant to collect crucial climate data as part of NASA's 'A-Train' constellation of Earth-observing satellites, just like the doomed Orbiting Carbon Observatory (OCO) that launched two years ago. Like OCO, Glory took off from Vandenberg Air Force Base in California. And it rode the same model of rocket, the Taurus XL.

Gregory Kopp, a physicist from the University of Colorado in Boulder, who was in charge of a solar-irradiance-monitoring instrument on Glory, couldn't help but feel "apprehensive" as the probe prepared for countdown on 4 March. Then his worst fears came true.

Minutes after Glory's launch at 2:09 a.m. local time, NASA officials declared the US$424-million mission a failure. Like OCO, Glory had failed to reach orbit, apparently plunging into the icy southern reaches of the Pacific Ocean. An initial analysis suggests that, just as with the previous mission, the clamshell fairing that protected the satellite during launch had failed to detach, weighing it down.

Glory's failure is another serious blow for NASA's Earth-observation programme. It also raises tough questions for the company that made the Taurus rocket: Orbital Sciences Corporation, based in Dulles, Virginia. "I understand these things happen with the difficult tasks NASA attempts," Kopp wrote to *Nature* in a remarkably calm e-mail from the Vandenberg base, where he witnessed the failed launch. "I'm of course surprised that after two years of scrutiny, Orbital evidently does not understand what is causing their Taurus launch vehicles to fail — they've now lost three of the last four."

Scientists are also grieving for data that might have been. The loss of Glory's solar monitor increases the risk of a lapse in the continuous 32-year record of the Sun's total energy output, data that are fundamental to climate-change models. It also complicates efforts to compare solar-irradiance data from different instruments.

Kopp had calibrated Glory's Total Irradiance Monitor (TIM) using a ground-based facility at the University of Colorado. The same system had been used to test the Precision Monitoring Sensor (PREMOS) — a Swiss-built instrument launched last June aboard the French satellite PICARD — and to validate the measurements taken by an older version of TIM now flying on NASA's Solar Radiation and Climate Experiment (SORCE) satellite. The system is designed to avoid mismatches of data sets in the solar record, an issue that has been addressed by using different instruments to take overlapping measurements. Glory represented the biggest test yet of this calibration system (see *Nature* **469,** 457–458; 2011).

"It's really sad," says Werner Schmutz, director of the World Radiation Center in Davos, Switzerland, and principal investigator for PREMOS. But Schmutz is fairly confident that one of the existing solar-monitoring satellites will survive until the next sensor goes up; NASA is already planning to launch another instrument designed by Kopp's team in 2015. Even if there is a monitoring hiatus, adds Schmutz, the calibration system should still be able to link future satellite data with previous records.

Glory also carried the Aerosol Polarimetry Sensor, which would have provided climate modellers with important data about dust, sulphate haze, black carbon and other ▶

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particulates in the atmosphere. By analysing the polarization of light bouncing off the particles, scientists would have been able to discern their size, shape and chemical make-up — key information for understanding their effect on clouds and global climate. These effects collectively represent the greatest area of uncertainty in current climate models, so scientists have been talking about putting a sensor like this in space for more than a decade.

"The magnitude of the aerosol forcing is a big determinant of where we are going to go in the future," says Gavin Schmidt, a climate modeller at NASA's Goddard Institute for Space Studies in New York. "We have the technology to pin this down more than it is being pinned down, and yet that technology is sitting at the bottom of the ocean."

Glory's failure puts NASA in a quandary. OCO, which would have mapped atmospheric carbon dioxide levels with unprecedented accuracy, enabling scientists to improve definitions of carbon sinks and sources, was deemed so important that the agency planned a rapid-replacement mission. OCO-2 is now scheduled to launch in February 2013 — once again aboard a Taurus XL rocket built by Orbital Sciences. Michael Luther, deputy associate administrator for science programmes at NASA, says the agency will complete the investigation into Glory's failure and then "adjust our plans [for OCO-2] appropriately".

Engineers had determined that the most likely culprit for OCO's failure to reach orbit in 2009 was the system for separating the fairing from the rocket body, which relied on explosives to push the fairing's halves away. After OCO failed, the system was redesigned to use pressurized cold nitrogen gas instead. "We really felt like we had the problem nailed," said Richard Straka, deputy manager of Orbital Science's launch-system group, at a NASA press conference shortly after Glory's launch.

Jonathan McDowell, an astrophysicist at the Harvard–Smithsonian Center for Astrophysics in Cambridge, Massachusetts, who follows rocket launches closely, suggests that Glory's failure might come down to a wiring error. He points out that Orbital Science's Pegasus and Minotaur rockets, which between them have made almost 20 successful launches, use fairings and fairing-release systems similar to those on its Taurus rockets. And because the Taurus had five successful launches between 1994 and 2000 before the string of failures began, McDowell sees no evidence of a fundamental design problem. "So it's either sloppiness … or really bad luck." ■

Additional reporting by Geoff Brumfiel.

POLICY

US scientists in budget limbo

Researchers face anxious wait as negotiations continue in Congress over 2011 budget.

BY EUGENIE SAMUEL REICH

The US Congress narrowly avoided a government shutdown last week by passing a continuing resolution to fund federal activities until 18 March. But the two-week reprieve is prolonging scientists' anxiety over the final 2011 budget that may emerge from negotiations between the Republican-majority House and the Democrat-majority Senate. The delay is also raising fears about how drastic the cuts to science might be.

"It's a time of great uncertainty and the [scientific] community is very concerned," says John Marburger, vice-president for research at the State University of New York at Stony Brook. At his university, researchers continue to put in proposals for federal funding, but they worry that a tighter budget will reduce success rates. Marburger, who was science adviser to former president George W. Bush, has spoken out against the cuts proposed by House Republicans. Postdocs and graduate students, who, he estimates, make up 80% of researchers supported by federal grants, will be hit hardest. "It will put people out on the streets."

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The latest continuing resolution cuts US$4 billion from federal budgets, although it largely spares science. And if a 2011 budget is eventually agreed, it is unlikely to contain the full $61 billion in cuts passed by the House on 19 February, which are not expected to pass the Senate (see 'Budget ping pong'). But House Republicans have said that these proposals will form the basis for future negotiations. Judging by an alternative bill put forward by Senate Democrats on 4 March, the final budget will undoubtedly be lower than 2010 levels.

The uncertainty can be paralysing, says Jennifer Zeitzer, director of legislative affairs for the Federation of American Societies for Experimental Biology (FASEB) in Bethesda, Maryland. "The longer the National Institutes of Health (NIH) is under a continuing resolution, the more people may have questions about their grants," she says. The latest continuing resolution "just kicks the can down the road". Neurobiologist Darcy Kelley of Columbia University in New York agrees that the mere threat of cuts may be enough to hamper scientists' careers. "With funding levels certain to drop quite drastically, I think people would be even more cautious about hiring somebody new in the lab," she says.

If Congress can't reach agreement in the next two weeks, it will again risk a government shutdown. William Talman, president of FASEB and a neuroscientist at both the University of Iowa and the Veterans Affairs Medical Center in Iowa City, vividly remembers the last government shutdown that began in December 1995. As a physician, Talman was considered to be 'essential personnel' and was funded to care for patients. But his research — a study of neural regulation of blood pressure in rats,

BUDGET PING PONG

House Republicans and Senate Democrats are battling over federal agencies' 2011 budgets.

Agency	House proposed cut (US$ million)	% change from 2010	Senate proposed cut (US$ million)	% change from 2010
Environmental Protection Agency	2,859	−28%	398	−4%
Centers for Disease Control and Prevention	1,397	−22%	173 increase	+3%
Department of Energy's Office of Science	893.2	−18%	162	−3%
National Institute of Standards and Technology	160	−19%	108	−13%
NASA	303	−2%	224	−1%
National Institutes of Health	1,629	−5%	86	−0.3%
National Science Foundation	360	−5%	73	−1%

SOURCE: US HOUSE AND SENATE APPROPRIATIONS COMMITTEES