EARTH OBSERVATION

# Tracking $CO_2$'s Comings and Goings From Space

Climate scientists trying to better understand Earth's carbon cycles have long been hampered by tunnel vision. Ground-based carbon dioxide ($CO_2$) monitoring is precise, but the 100-odd stations across the globe provide insufficient coverage, particularly in developing countries and over the oceans. Soon, however, there will be two eyes in the sky with all-encompassing views of this worrisome greenhouse gas. In the next few weeks, Japan and the United States plan to launch satellites to observe $CO_2$ from space.

**Parallel views.** Japan's GOSAT (*left*) and NASA's OCO will provide the first global views of $CO_2$.

The view from on high should lead to more accurate predictions of how rising $CO_2$ levels might affect global temperatures and climate change. "This will also contribute to political decisions on [acceptable levels] of $CO_2$ emissions," says Tatsuya Yokota, who heads the satellite observation office of Japan's National Institute for Environmental Studies (NIES) in Tsukuba. In addition, patchy data have been a "barrier to coloring in the maps of $CO_2$ sources and sinks," says Peter Reyner, a climate modeler at the Laboratoire des Sciences du Climat et de l'Environnement near Paris. "There are large parts of the globe where this will be our first look [at $CO_2$ data]."

Japan will launch its Greenhouse Gases Observing Satellite (GOSAT) on 21 January. NASA's Orbiting Carbon Observatory (OCO) will follow on 23 February. Both intend to answer a fundamental question: Where is $CO_2$ generated by human activities coming from and going to? Each year, humans dump about 9 billion tons of carbon into the atmosphere, but only half stays there, says David Crisp, principal investigator for the $270 million OCO at NASA's Jet Propulsion Laboratory in Pasadena, California. Of $CO_2$ recycled from the atmosphere, about one-quarter is absorbed by land vegetation and another quarter is somehow drawn into the oceans. "We don't know where the other half is going," Crisp says.

How these carbon sinks might evolve as climate shifts in response to rising $CO_2$ levels is also unclear. And scientists can't begin to fathom the missing sinks until they've been located.

There are other mysteries, such as large variations in atmospheric $CO_2$ concentrations from year to year. In 1973, virtually all of the 5 billion tons of carbon put into the atmosphere stayed there; but the following year, 4 billion out of 5 billion tons that were emitted got absorbed by sinks, Crisp says. In another riddle, in 1993, a major El Niño coincided with high rates of $CO_2$ absorption; the link and mechanism are unclear. GOSAT, a $500 million joint effort of Japan's space and environment agencies and NIES, has a mission lifetime of 5 years (versus OCO's 2 years) because scientists want "to detect annual variations in $CO_2$ [resulting from] El Niño, La Niña, and other weather phenomena," Yokota says.

GOSAT will also measure methane, a greenhouse gas for which there is even less data. Both missions might also contribute to understanding localized problems by helping pinpoint pollution sources.

The satellites grew out of ongoing Earth-observation programs. Crisp says that the $CO_2$ data gap was long recognized but that improved detection was beyond standard remote-sensing techniques. Previous satellite sensors for ozone worked at thermal or ultraviolet wavelengths, but thermal wavelengths don't work well for $CO_2$. The new satellites will observe in near-infrared. "The measurement technique is one of the real innovations that OCO and GOSAT have had to make in order to move forward," says Crisp.

The two satellites will observe in different patterns; OCO will be more sensitive to fortnightly or monthly rhythms, whereas GOSAT will be better able to correlate $CO_2$ levels with changing weather patterns. "The data will be highly complementary," says Yokota. That kind of stereovision might be just what it takes to spot those missing carbon sinks.

–DENNIS NORMILE



**Saying goodbye.** Julie Gerberding is leaving CDC to make way for an Obama appointment.

CDC have made statements that meant nothing [to us]. Julie really tried to connect CDC with the average person," says Michael Osterholm, director of the Center for Infectious Disease Research and Policy at the University of Minnesota, Minneapolis, and a longtime supporter of Gerberding— and, he hastens to note, of Barack Obama.

But Gerberding's leadership of CDC was also marked by tension and sharp criticism, especially after she launched an extensive reorganization of the agency. Morale among CDC scientists reportedly plunged, and five former CDC directors wrote Gerberding a letter 3 years ago expressing "great concern" about the departure of top scientists from the agency. In a sometimes testy interview with *Science* in late 2006, Gerberding defended the changes and expressed confidence that they were needed to help CDC tackle large-scale health threats (*Science*, 13 October 2006, p. 246).

The agency is "clearly at a crossroads" now, says James LeDuc, who spent 14 years at CDC before leaving at the end of 2006 to join the University of Texas Medical Branch at Galveston. Whoever takes over next will have to ensure that young, talented scientists come and stay. And, adds Curran, they must prove adept at another critical task—communicating with Congress and the White House.

–JENNIFER COUZIN

CREDITS: (LEFT TO RIGHT) JAXA; NASA; (BOTTOM) JAMES GATHANY/CDC



Published by AAAS