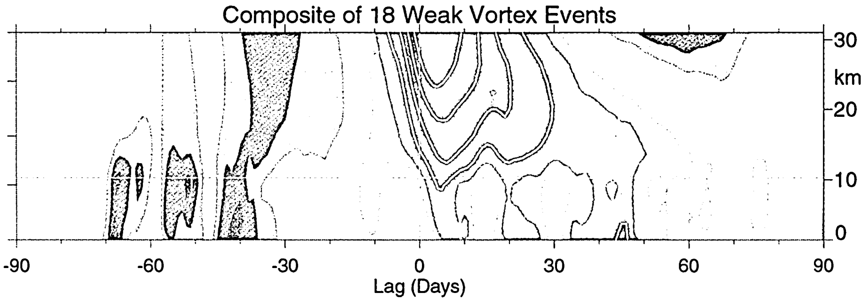


Weather from above. A weakening stratospheric vortex (red) can alter circulation down to the surface, bringing storms and cold weather farther south than usual.

SOURCE: M. BALDWIN AND T. DUNKERTON/NWRA

sphere and reaching the surface as a weakening and diversion of the AO's westerly winds. Because it took a few weeks for a switch to get from the vortex to the AO, predicting a switch a week or two ahead looked possible.

Baldwin and Dunkerton have now taken a more detailed look at 42 years of vortex and AO wintertime behavior and found that the connection can be a persistent one. Once a major switch reaches the lower stratosphere, the vortex remains unusually weak or strong for an average of 60 days, which should let forecasters predict extremes in the underlying AO and the accompanying likelihood of weather extremes out as far as a month or two. Forecasters might, for example, warn that cold air outbreaks from the Arctic into midlatitudes would be three to four times more likely across Europe, Asia, and North America.

In separate, as-yet-unpublished analyses, Thompson, Baldwin, and Wallace find that major vortex and AO shifts affect surface temperatures about as much as El Niño does. In central Europe and most of North America, surface temperatures average 0.5° to 2°C cooler in the 60 days following the onset of an extremely weak vortex than in the same period following the onset of a strong vortex. The difference is 1.5° to 4°C for the high Eurasian Arctic. That compares with temperature differences between El Niño and its opposite, La Niña, of 1° to 3.5°C in higher latitudes. "The El Niño analogy is a good one," says Baldwin. "The magnitude of these [switches] could be very useful."

Researchers are generally impressed. The Baldwin and Dunkerton "analysis is very careful and very complete," says stratosphere meteorologist Karin Labitzke of the Free University Berlin. Predicting weather based on the work will be harder, as Baldwin and Dunkerton point out, because switches in the stratosphere and the AO sometimes occur independently, and no one understands the mechanics of the stratosphere-troposphere linkage when it does happen. Forecasters' computer models "must be able to predict where and when the effects of this interaction [between stratosphere and troposphere] will be manifested," says Edward O'Lenic, a long-range forecaster at the National Weather Service's Climate Prediction Center in Camp Springs, Maryland. "This is a tall order and a challenge for modelers, but the payoff could be great."

Modelers are already trying to sort out how the stratosphere can influence the weather. The stratosphere might gain leverage on the troposphere through great globe-girdling atmospheric waves that rise into the stratosphere during winter. How the stratosphere and troposphere communicate will be of interest not only to long-range forecasters, but to climatologists as well. The same linkage may well be operating when volcanic debris, an inconstant sun, ozone depletion, or greenhouse gases alter stratospheric climate. Perhaps more than one forecasting nightmare could be eased by understanding stratospheric harbingers.

–RICHARD A. KERR

VOLCANOLOGY

Vesuvius: A Threat Subsiding?

NAPLES, ITALY—People living in the shadow of Vesuvius, the volcano that so famously buried the Roman town of Pompeii, may be able to sleep a bit easier. New satellite data, some experts say, suggest that the small earthquakes that shake the region almost daily are not harbingers of an imminent eruption. Rather, they occur because the central part of the volcano's crater is sinking at a rate of several millimeters per year.

About 1 million Neapolitans might have to be evacuated if Vesuvius awakes from its 57-year-long slumber. Scientists and civil defense experts are bitterly divided over the adequacy of evacuation plans. There is no way of knowing when Vesuvius might erupt again, but rising magma beneath active volcanoes can produce tremors before an eruption.

To aid the debate, Riccardo Lanari and his colleagues at the Research Institute for Electromagnetism and Electronic Components in

ScienceScope

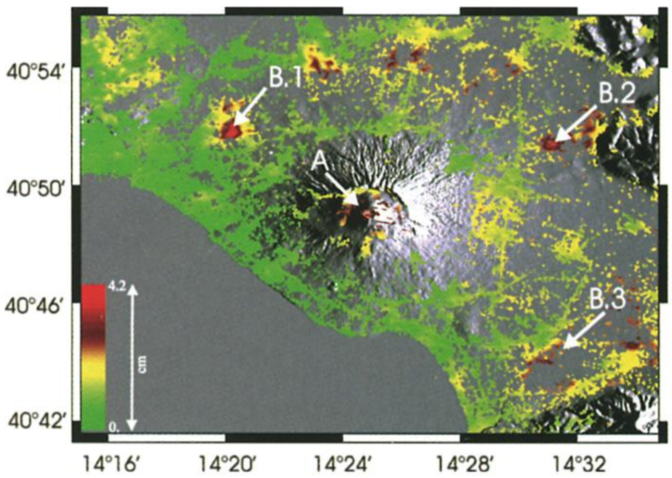
Special Breed A Japanese government committee charged with either privatizing or abolishing some 163 special public corporations (*Science*, 7 September, p. 1743) has let those doing research off the hook. Many of the public works agencies have drawn criticism from economic reformers because they are seen as inefficient. But in a 5 October report, the committee says that it is "impossible" to alter the status of research organs such as the Institute of Physical and Chemical Research (RIKEN), the Japan Marine Science and Technology Center, and the Japan Atomic Energy Research Institute because they fulfill national policy objectives and are too dependent on government funding. "Unlike many of the other special corporations, the research labs have no sources of income," says Shun-ichi Kobayashi, RIKEN's president.

Even so, there may be changes afoot. The committee wants to consolidate seven research funders, including the Japan Society for the Promotion of Science and the New Energy and Industrial Technology Development Organization, into one entity. Researchers strongly prefer to have multiple funding sources. And Kobayashi says he's heard that RIKEN's accelerator physics group, which operates its own particle accelerators, could be merged into the High Energy Accelerator Research Organization (KEK) in Tsukuba. The report gives few details on such changes, however, and Kobayashi laments that "we only know what we read in the newspapers."

Technology Czar? The White House is rumored to have chosen one of two top deputies to science adviser John Marburger as part of a reorganization of his office. Richard Russell, a longtime congressional aide who has been serving as staff director of the White House Office of Science and Technology Policy since last spring, will become OSTP's head of technology, Washington insiders say. Russell, who earned a bachelor's degree in biology from Yale University in 1988, worked for the Republican-led House Science Committee from 1996 to 2000. He is closely linked to efforts to kill the Department of Commerce's Advanced Technology Program, which funnels R&D funds to tech companies.

Russell may be part of a slimmed-down senior staff split between science and technology. Sources say that White House planners may eliminate two existing senior posts, overseeing the environment and national security–international affairs.

Contributors: Michael Balter, Jocelyn Kaiser, Dennis Normile, David Malakoff



Sinking feeling. Areas of greatest subsidence are marked red.

Naples used radar interferometry to look for tiny ground deformations around the volcano. The European Space Agency's ERS-1 and ERS-2 satellites took radar images of the Vesuvius region repeatedly between 1992 and 2000. The images recorded microwaves that were emitted by the satellite and bounced back from the ground below. By comparing images taken at different times, researchers can spot small deformations in the level of the terrain.

For the current study, Lanari's team used newly developed software to detect minuscule deformations over shorter periods than previously possible. The team identified two key areas of subsidence, both of which are slumping by 3 to 8 millimeters per year. One is a ring circling the base of the volcano, whereas the other is within the central crater. "This is quite a spectacular image," says Steve Sparks of the University of Bristol, U.K.

Local researchers believe that the ring-shaped deformation is caused by the weight of the volcano on the underlying rock, the so-called carbonatic basement. The radar observations confirm earlier suggestions of this slumping using seismic tomography—bouncing sound waves off underlying rock. "We were able to see the spectacular effects of the volcano loading," says Giuseppe De Natale of the Vesuvius Observatory.

More intriguing is the subsidence in the central crater. Researchers had thought that the frequent minor tremors in the area—which seemed to come from directly below the crater—were due to molten magma welling up. But according to De Natale, the central subsidence confirms that a giant magma plug—a "high-rigidity anomaly" about 5 kilometers long—is sinking. The tremors are caused by the plug grinding against surrounding rock. Sparks thinks this makes sense. "It is sort of consistent with what people have been deducing from model experiments and theory," he says.

Although the technique is impressive, says Paul Lundgren, an earthquake and volcano specialist at NASA's Jet Propulsion Laboratory in Pasadena, California, more work is needed. The result "is not high enough above the noise that you get a really good crystal-clear picture of what is going on," he says. De Natale adds that radar and other geodesic methods may be useful for forecasting eruptions: Significant uplift could indicate that Vesuvius is waking from its sleep.

–ALEXANDER HELLEMANS

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CREDITS: (TOP TO BOTTOM) R. LANARI *ET AL.*; DAVID MALIN/ANGLO-AUSTRALIAN OBSERVATORY

ASTRONOMY

Pulsars Solve Mystery Of Missing Gas

By rights, clusters of stars should be swimming in gas. Stellar winds just like the solar wind blowing from our sun should fill the space between their stars. Yet decades of searches have failed to turn up interstellar gas in globular star clusters, and theorists have bent over backward to explain its absence.

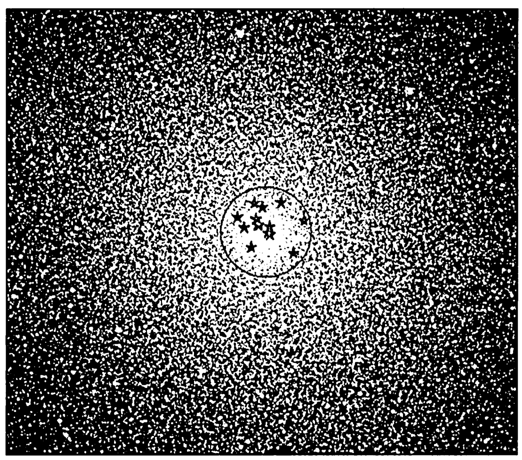
Now they can unbend. Meticulous observations using the 64-meter Parkes radio telescope in Australia have revealed that the globular cluster 47 Tucanae harbors about 100 times as much gas as its immediate surroundings. "It's a very nice discovery," says astrophysicist Frank Verbunt of Utrecht University in the Netherlands.

Globular clusters are spherical clumps of hundreds of thousands of old, low-mass stars, held together by the mutual pull of their gravity. To understand how such clusters evolve, astronomers want to know how much of the stellar wind escapes the cluster and how much remains trapped by gravity. "If the stellar wind velocity is larger than some 50 kilometers per second, the gas will leave the cluster altogether," says Verbunt. Numerous searches for radiation coming from trapped gas, however, revealed nary a whiff, and some astronomers proposed that starlight had blown it all away. "It has been suggested that the energetic radiation of the large number of pulsars in 47 Tucanae would have rendered the cluster devoid of any gas," says Michael Kramer of the Jodrell Bank Observatory at the University of Manchester, U.K.

Kramer and an international team of astronomers led by Paulo Freire, also of Jodrell Bank, detected the gas by carefully observing 15-millisecond pulsars—very compact, rapidly spinning stars that emit bursts of radio waves with clockwork precision. As the pulsars orbit the cluster center, Kramer explains, gravitational acceleration minutely alters the pulse frequency. By monitoring such changes over a couple of years, the team determined whether each pulsar lay on the near side of the cluster center, where its acceleration points away from us, or on the far side, where it points toward us. "We didn't expect the data to be precise enough [to observe this effect]," says Kramer, "but it turned out we could track it."

Next, the astronomers observed the radio pulses at a variety of wavelengths and found that the radiation from the farside pulsars was affected by more interstellar gas than was the radiation from the nearside ones. From these differences, they calculated the density of the intracluster gas. "People have been looking for this gas for over 60 years," says Kramer. "Now we've found it." The team reported its discovery in the 10 October issue of *Astrophysical Journal Letters*.

There's not much gas there, however: about one-tenth of a solar mass, spread out over the central parts of the cluster. The next step for astronomers is to figure out why it is so thin. Did most of it escape as high-velocity solar wind, did pulsars blow it away, or was it stripped out when the cluster made one of its periodic passes through the dense central plane of the Milky Way? Verbunt plans to look for answers in another globular cluster using the Westerbork Synthesis Radio Telescope in the Netherlands.



Starry, starry night. Some of the pulsars used to find gas in 47 Tucanae.

–GOVERT SCHILLING

Govert Schilling is an astronomy writer in Utrecht, the Netherlands.