Oceanography's New Catch: Roving Blobs

The latest beasts discovered in the Atlantic won't munch unwary swimmers or swallow luxury liners, but they may wreak havoc on French farmers and other landlubbers across Europe. The newfound creatures are an oceanographic phenomenon—giant patches of warm or cold water that drift slowly around the North Atlantic and may alter European weather.

Two Florida researchers identified these climatic critters by studying sea surface temperature records from 1948 through 1992. During that period, 14 of these temperature anomalies developed and roved the ocean basin, report Donald V. Hansen of the University of Miami and Hugo F. Bezdek of the National Oceanic and Atmospheric Administration in Miami. They describe their work in the April 15 JOURNAL OF GEOPHYSICAL RESEARCH.

"I think this is a seminal paper," comments oceanographer James J. O'Brien of Florida State University in Tallahassee. "They have identified a very important mode of ocean variability."

Hansen and Bezdek found that the large warm and cold blobs measured hundreds or thousands of kilometers across and typically had a lifetime of 3 to 10 years. Although the vertical thickness of these patches remains unknown, measurements made by ships passing through them suggest that they may reach depths of 400 meters.

As they drifted, the temperature anomalies followed the path of prevailing ocean currents, but they moved at only one-third to one-half the speed of the actual currents—an observation that scientists cannot yet explain.

The newly described phenomenon lasts much longer than the well-known El Niño warmings in the tropical Pacific Ocean, which usually persist for a year or two. Although Hansen and Bezdek focused on the North Atlantic, they suspect that long-lived temperature anomalies are also drifting around other ocean basins.

Previously, oceanographers believed that temperature anomalies were stationary. In the 1960s, the late Norwegian meteorologist Jacob Bjerknes found hints of traveling temperature anomalies in the Atlantic, and other researchers later detected similar isolated examples. But oceanographers did not pursue these sporadic sightings, says Yochanan Kushnir, a meteorologist at the Lamont-Doherty Earth Observatory in Palisades, N.Y.

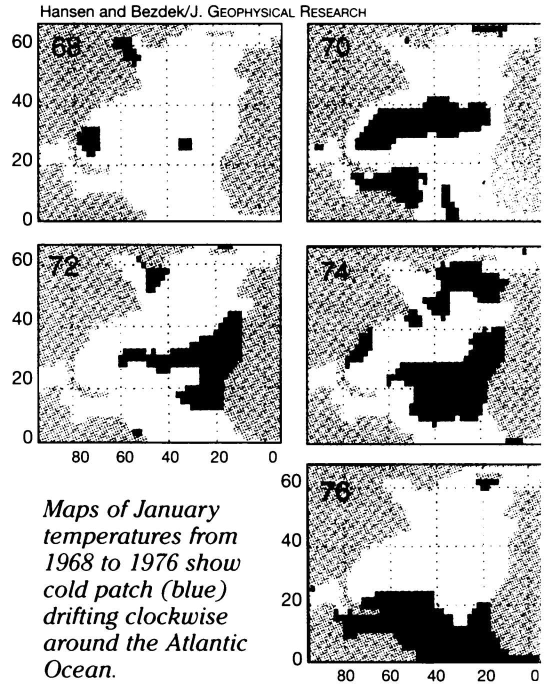
Hansen and Bezdek identified five cold and nine warm patches moving around the Atlantic by making maps of January ocean temperatures that strayed furthest from average conditions. Their maps show blobs slinking across the ocean like amoebas on a microscope slide.

In one example, a cold patch developed off the coast of Florida in 1968 and started drifting eastward. By 1971, the anomaly had greatly elongated and hit the coast of Africa. It then turned south and traveled westward across the tropical Atlantic until it reached the coast of South America in 1975. Over the next 2 years, the cold region withered and finally disappeared.

Because sea surface temperatures strongly influence weather and climate, the researchers suspect that these long-lived Atlantic anomalies affect conditions in Europe and perhaps elsewhere. For instance, the researchers suggest that a warm patch in the late 1950s helped cause a prolonged Scandinavian drought.

Oceanographers cannot explain how these anomalies form or what drives them, but similar features appear in some computer simulations of ocean temperatures. By dissecting the computer versions, researchers hope to learn more about these wandering weather makers of the Atlantic. — *R. Monastersky*

Hansen and Bezdek/J. GEOPHYSICAL RESEARCH



Maps of January temperatures from 1968 to 1976 show cold patch (blue) drifting clockwise around the Atlantic Ocean.

Bright X rays to illuminate a new frontier

Much of what is known about the atomic structures of proteins and other biological molecules comes from studies of how crystals of these materials deflect X rays. Growing the protein crystals large enough to use with conventional X-ray sources, however, can be a difficult and frustrating task.

This week, researchers expect to get their first chance to use a new, intense source of X rays to begin probing tiny crystals of various proteins. "We've designed our [equipment] to work with extremely small crystals so that even when you don't get the world's best crystals, you can still study them [or parts of them]," says Edwin M. Westbrook, director of the Structural Biology Center at Argonne (Ill.) National Laboratory.

"We're going to test our setup on a variety of crystals over the next month or so," he notes. "By the end of June, we should be reliably on track."

Westbrook heads one of about a dozen collaborations, which include researchers from roughly 100 universities and nearly 50 companies and research institutions, that are gearing up to use Argonne's Advanced Photon Source. Designed as the world's brightest source of high-energy X rays for studying materials and chemical processes, the facility was dedicated last week.

The U.S. Department of Energy provided $812 million for constructing and operating the Advanced Photon Source. Federal agencies, universities, and other bodies contributed an additional $200 million for instruments and equipment.

When electrons and other charged particles traveling at nearly the speed of light are forced to change direction, they emit electromagnetic radiation (called synchrotron radiation), which emerges as a cone resembling the beam from a car's headlight. As the energy of the particles increases, this cone gets narrower and the average wavelength of the radiation decreases.

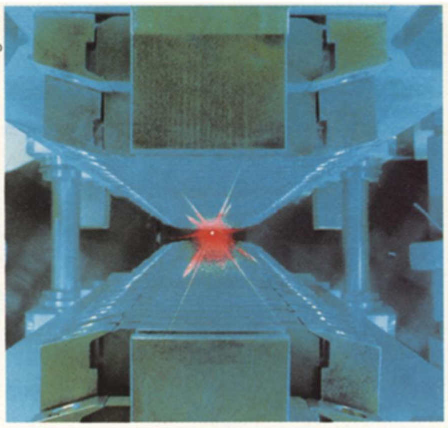
In the Advanced Photon Source, the charged particles are positrons, the antimatter counterparts of electrons. These particles are accelerated in stages to an energy of 7 gigaelectronvolts, then injected into a storage ring about 1 kilometer in circumference—large enough to encircle a baseball stadium. The particles circulate there at nearly the speed of light for about 10 hours.

The storage ring is an 80-sided polygon with alternating short and long sides. At the corners, the bending magnets deflect the circulating positrons and stimulate the emission of X rays with a broad range of wavelengths. Along most of the straight sections, the positrons pass through a gauntlet of magnets that jiggle the particles back and forth in a tight, snaking path. Each change in direction produces an intense burst of high-energy X rays with a well-defined wavelength, which can then be directed to the specific sample.

The Advanced Photon Source allows as many as 35 research teams to conduct experiments simultaneously. Each research group has access to two X-ray beams, one from a corner and the other from the undulator magnets of a straight section of the storage ring. By adjusting the magnets, the researchers can tailor the X-ray beams to a particular experiment.

Groups already preparing experiments plan to take advantage of this unique X-ray source to do highly detailed protein crystallography; obtain new views of enzymes, toxins, viral proteins, and other biological molecules; and produce movies of changes in atomic and molecular arrangements as polymers or semiconductors form. — *I. Peterson*

Argonne



A light beam simulates the passage of charged particles through an array of magnets called an undulator. In the Advanced Photon Source, undulators cause the paths of speeding positrons to zigzag, generating an intense burst of high-energy X rays with each change in direction.

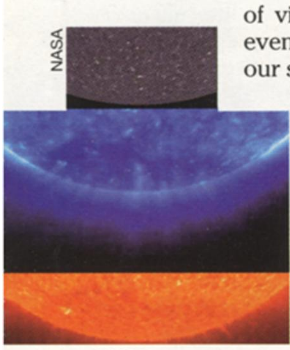
SOHO views the sun in a new dimension

Fiery plumes shoot millions of kilometers above the poles. Streams of charged particles rush into space. Miniflares dot the solar disk like tiny Christmas lights, and gases seethe just beneath its visible surface.

And they call this the quiet sun.

To the surprise of many solar astronomers, a recently launched spacecraft has documented sustained, global acts of violence on the sun—even though the star of our solar system is now at its most quiescent, poised at the minimum of its 11-year activity cycle.

NASA



SOHO images show magnetic fields on the sun's surface near the south pole (top), an ultraviolet image of hot plumes high above the pole (middle), and an ultraviolet image of the atmosphere closer to the surface (bottom).

The fireworks are just one of the findings uncovered by the Solar and Heliospheric Observatory (SOHO), a NASA-European Space Agency mission launched last December. For more than 4 months, the craft has stared unblinkingly at the sun, probing its outer atmosphere, its visible surface, and regions several thousand kilometers beneath.

Together, SOHO's images and spectra have begun to paint a more unified portrait of the sun, directly relating the release of high-energy radiation and the expulsion of material in the hot outer atmosphere, or corona, to turbulent motion and changes in magnetic field patterns far below. "We've never had a [craft] that can just sit up there and see what's going on" in so many different regions at the same time, says Harold Zirin of Big Bear (Calif.) Solar Observatory.

Researchers reported the first SOHO findings May 2 at press briefings in Paris and Washington, D.C.

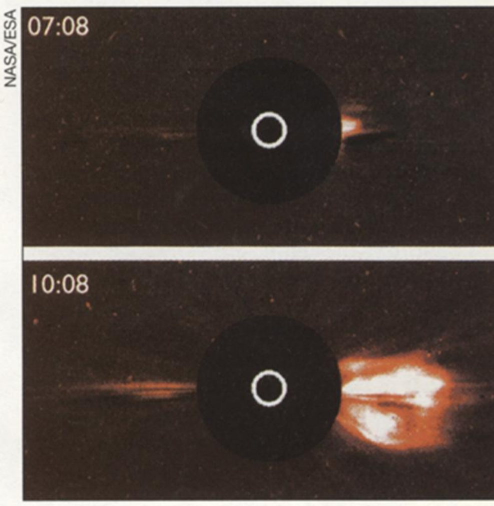
Ultraviolet movies compiled from the craft's images reveal the source of flaming plumes that extend more than 15 million km into interplanetary space from the poles of the sun. Each plume's base, about 1.5 times wider than Earth's diameter, is anchored in turbulent gases and wildly gyrating magnetic fields.

Magnetic fields guide the motion of charged particles in the sun. Rapid changes in these fields "may represent the release of significant amounts of energy on the sun and . . . contribute to the heating of the corona," says SOHO investigator Joseph B. Gurman of NASA's Goddard Space Flight Center in Greenbelt, Md. The magnetic fields often appear as loops, which can sometimes break, forming jets that may propel charged particles upward.

SOHO researchers are attempting to determine whether the plumes contain high-speed outflows of gas. If they do, these plumes could be the source of an unusually fast-moving component of the solar wind—the stream of charged particles blown out by the sun—that the Ulysses spacecraft observed when it passed over the sun's poles in 1994 and 1995.

In another SOHO study, visible-light images of the solar corona depict the sun spewing out billions of tons of gas. Such events, known as coronal mass ejections, can trigger electrical storms on Earth powerful enough to damage power grids. Because the craft's coronagraph can view the atmosphere lying as close as 1.4 million km from the sun's surface and as far away as 15 times that distance, researchers can track the evolution of these violent events.

NASA/ESA



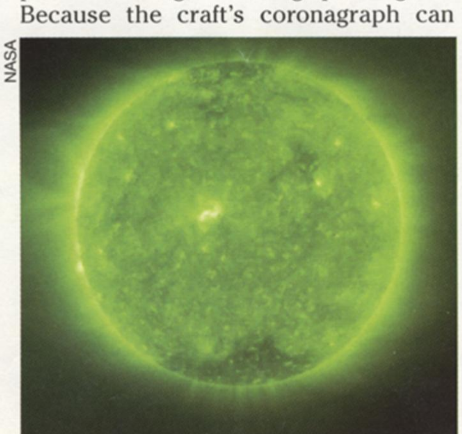
Images taken 3 hours apart show a coronal mass ejection. To reveal the corona, disks were used to blot out the sun.

"I believe that for the first time we can see the sun preparing itself for a mass ejection," says Guenter E. Brueckner of the Naval Research Laboratory in Washington, D.C. In the days preceding an ejection, he told SCIENCE NEWS, SOHO images show that looping magnetic fields in the inner corona expand, transporting material to the outer part of the corona. The bulging fields exert enough pressure to blow the lid off material trapped by existing magnetic fields in the outer corona, hurling tons of gas into space.

Brueckner notes that if further SOHO observations confirm this admittedly sketchy model, scientists would gain advance warning of destructive outbursts from the sun. SOHO has already demonstrated, he adds, that coronal mass ejections are widespread. Their global nature suggests that these events could be the long-sought origin of most components of the solar wind, Brueckner says.

— *R. Cowen*

NASA



SOHO's ultraviolet view of the sun's corona shows gas at 1.5 million kelvins.