Ghost of '82 El Niño Haunts Climate

More than a decade after it came and went, the century's largest El Niño warming continues to reverberate in the Pacific, according to scientists who have detected what is – by the standards of oceanography – an ancient wave rippling through the northwest part of that ocean.

Because this 11-year-old wave has shifted the position of large ocean currents, it could have altered weather patterns over the United States, says the team of researchers from NASA's Stennis Space Center in Mississippi and the University of Colorado at Boulder.

"This is a major new discovery – that there are very large perturbations of the upper ocean that can live for very long times," comments oceanographer James J. O'Brien of Florida State University in Tallahassee. "It's a whole new paradigm for change in the ocean."

Gregg A. Jacobs of the Stennis Space Center and his colleagues made their discovery while examining measurements of the ocean's height taken by satellites in the 1980s and the 1990s. The data revealed an unusual pattern east of Japan: Part of a major current called the Kuroshio Extension had shifted noticeably northward, bringing with it warm water. They report the finding in the Aug. 4 NATURE.

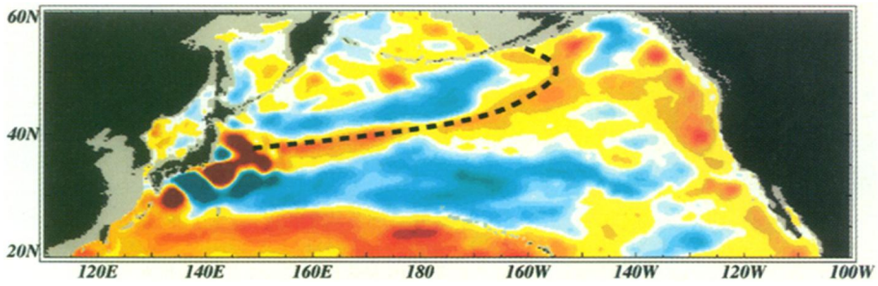
To ascertain why the Kuroshio Extension had moved, the researchers turned to a computer model of the Pacific, which tested how winds since 1981 have affected the upper ocean. The simulations unexpectedly linked the present changes off Japan with the El Niño of 1982-1983.

El Niños occur when trade winds slacken along the equator, causing warmth to shift from the west to the east – a rearrangement that upsets weather in North America, South America, Australia, and even Africa (SN: 7/23/94, p.52). At the same time, the drop-off in the winds generates a fast-moving Kelvin wave that crosses the Pacific in 1 to 2 months.

After hitting South America, this wave reflects westward as a so-called Rossby wave – a broad feature imperceptible to ships. Along the equator, Rossby waves can reach Asia in 6 months. But parts of the wave that head north move much more slowly. Scientists therefore expected these waves to die out before reaching far into the midlatitudes.

"They never thought that ones from the American coast would go much beyond Hawaii, if they got to Hawaii at all," says Jacobs.

But the computer model suggests that such waves could survive to reach Asia. Furthermore, the simulated Rossby wave generated by the 1982-1983 El Niño displaced the Kuroshio Extension at approximately the same time that the current actually shifted position.



Jacobs/NATURE

Computer simulation shows how Rossby wave (dashed line) has reached North Pacific 10 years after 1982-1983 El Niño. Red and orange indicate above-average sea height.

According to Jacobs' team, the wave will keep going. "The 1982-83 El Niño is not over. Its effects have moved from South America to the northwest across the Pacific basin. This Rossby wave should continue to propagate across the far northwest corner of the North Pacific basin for at least another decade."

Because models can predict the waves' paths, scientists could forecast 10 years in advance of changing ocean conditions in the midlatitudes and northern Pacific, Jacobs suggests. If they can establish a connection between such conditions and North American weather, then meteorologists could make general forecasts years in advance, he adds.

Nicholas Graham at the Scripps Institution of Oceanography in La Jolla, Calif., discounts that possibility, saying that sea changes outside the tropical Pacific do not strongly affect U.S. weather.

But Mojib Latif of the Max Planck Institute for Meteorology in Hamburg, Germany, says his research with sophisticated ocean-atmosphere models does show a link between conditions in the Pacific midlatitudes and the United States. Yet he disagrees with Jacobs' primary theory connecting the 1982-1983 El Niño to present changes in the North Pacific. Latif believes that decade-long cycles in the midlatitudes control the position of the Kuroshio Extension, which is independent of tropical El Niños. Both theories, however, raise the possibility of extremely long range weather forecasting. *– R. Monastersky*

Forming electric crystals in a dusty plasma

Industrial researchers have long studied the behavior of dust particles suspended in the electrically charged gases, or plasmas, often used in microelectronics fabrication. These tiny particles become charged readily and can contaminate surfaces, adversely affecting product quality.

Dusty plasmas have also been of interest to astrophysicists studying such processes as planet formation and the evolution of interstellar clouds.

Two teams of researchers have now observed that dust particles immersed in a plasma can arrange themselves into orderly patterns characteristic of a crystal. When illuminated, such an array is even visible to the naked eye.

Hubertus Thomas of the Max Planck Institute for Extraterrestrial Physics in Garching, Germany, and his coworkers report their observation of "plasma crystals" in the Aug. 1 PHYSICAL REVIEW LETTERS. J.H. Chu and Lin I of the National Central University in Chungli, Taiwan, describe their results in the journal's June 20 issue.

Thomas and his colleagues used a high voltage to strip electrons from argon atoms and create a weakly ionized plasma similar to that inside a fluorescent light. Plastic spheres, 7 micrometers in diameter, sprinkled into the plasma quickly picked up electrons and ions, becoming highly charged. These "dust" particles formed a thin, disk-shaped cloud with a nearly uniform spacing between the particles.

Using a slightly different technique, the Taiwan group worked with silicon dioxide particles in an argon plasma, obtaining similar results.

"We're using a plasma to make an experimental model of a solid-state crystal," says John A. Goree of the University of Iowa in Iowa City, who worked with Thomas. Such a model may make it possible to study, in a readily accessible fashion, the formation, growth, and melting of crystalline structures.

Because Earth's gravity restricts the formation of a plasma crystal to a small number of ordered layers, Thomas and his colleagues are now looking into the possibility of doing their experiment aboard a spacecraft. *– I. Peterson*