La Niña's Big Chill Replaces El Niño

The cooling of El Niño's unusually warm waters in the Pacific will alter weather and probably cool the "greenhouse," at least temporarily

IF IT ISN'T ONE THING with the world's weather it's another. The capacity of El Niño's warm Pacific waters to alter weather patterns—from the Indian monsoon and Winnipeg's winter cold to the temperature of the globe—has been well known for years. Now it seems that El Niño's mirror image, a pool of colder than normal water in the tropical Pacific called La Niña, has the opposite effects of El Niño. Among those effects in the coming year could be a dry winter for the southeastern United States and a reversal of the putative greenhouse warming. By this fall La Niña could also chill enough of the globe to lower its mean temperature, raising further doubts about the recently popularized notion that the greenhouse is behind the current global warming.

The present situation in the tropical Pacific is an unusual one in the recent history of El Niño. A year ago the temperature of surface waters in the central tropical Pacific was about 1.6°C above normal for that time of year, a clear sign that the exceptionally long-running El Niño that had started a year earlier was still going strong. This was the first El Niño since one of the strongest of the century struck in 1982–83. Before that there was the El Niño of 1976–77.

By December of last year El Niño's fate seemed to be sealed. Both human and computer model forecasts were calling for an end to the warm event by summer. But some of the models, and that of Tim P. Barnett of Scripps Institution of Oceanography in particular, were calling for a temperature drop to distinctly cool waters. Modest temperature anomalies persisted into March, but they were followed by a precipitous drop to 2°C below normal by June. That is about as cold as the tropical Pacific can get as strong winds draw cold water up from several hundred meters beneath the surface.

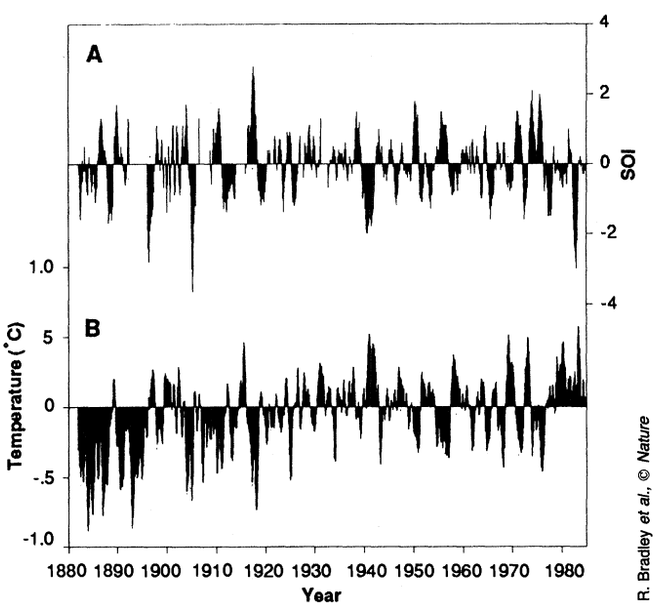
A relatively cold (24°C) equatorial Pacific has not been seen for some time. Raymond Bradley of the University of Massachusetts in Amherst, Henry Diaz of the National Oceanic and Atmospheric Administration in Boulder, and George Kiladis and John Eischeid of the University of Colorado have found that, by their definition, there were no cold events between 1975 and 1988, a unique hiatus in a record that goes back to 1881. Cold events had recurred about 4 years apart on average. Recurrence intervals were as long as 10 years.

The chilling of the tropical Pacific had always been seen as a part of the El Niño cycle, but it was a neglected phenomenon. It did not have a catchy name. It did not seem to have socially significant effects, such as the collapse of the anchovy fishery off Peru or the failure of the Indian monsoon. It seemed more difficult to define. And, unlike El Niño, it seemed to lack a practical mechanism for influencing the atmosphere outside the tropical Pacific.

In 1985 George Philander of the Geophysical Fluid Dynamics Laboratory in Princeton, New Jersey, attempted to emphasize the complementary natures of the warm and cold phases of the irregular oscillation of the Pacific's water and atmosphere by naming the cold phase La Niña, or The Girl. That seemed to have more character than cold event or cold phase and to be preferred over anti–El Niño, which in Spanish would be read as anti–Christ Child.

The name La Niña has been slow to catch on, but that could change as studies point up its coequality with El Niño. By last year Chester Ropelewski of the National Meteorological Center in Camp Springs, Maryland, had already shown in a study with colleague Michael Halpert that El Niño is associated with drier than normal conditions in southeastern Africa, India, the western Pacific including Australia, and northern South America and with wetter conditions in the central Pacific and southeastern United States. They had not looked at La Niña, but Ropelewski was beginning to think that some people were making too much of La Niña and its power to change the weather. "I was doing a study to show that it wasn't that simple," says Ropelewski. "It turns out that it is."

From Ropelewski's current work on precipitation and published and ongoing work by Bradley and his colleagues on temperature and precipitation, it seems that La Niña generally has the opposite effect of El Niño in a given area. An El Niño Indian monsoon is usually drier than normal, as in 1986 and 1987, and a La Niña monsoon is wetter than normal, as is the case this year. In North America, the coming fall-winter-spring period in the southeastern United States will most likely be drier and warmer than normal, which would be no help at all for drought-stricken areas there. And, too late to help the Winter Olympics in Edmonton, this winter should be colder than nor-



A correlation *between the swings from El Niño (expressed as a negative Southern Oscillation Index or SOI in (A) to La Niña (positive SOI) and land temperatures in the tropics (B) has been found. Note the absence of La Niñas since 1975 and the corresponding abnormal warmth of the tropics, which cover almost half the globe.*

mal in western and south-central Canada and perhaps the U.S. northern tier states.

La Niña may affect such matters of narrow interest as the Olympics, but it also may play a role in the trendiest climate topic of the moment, detecting the global greenhouse warming. James Hansen of the Goddard Institute for Space Research touched off the biggest climatological hullabaloo since the bitter winters of the 1970s when he testified on Capitol Hill in the midst of a searing drought that the greenhouse warming is here. He said the global warming since 1965 is statistically significant, which no researcher would argue with. He said the warming is consistent with models predicting the greenhouse warming, another undisputed fact. Then he concluded that "the global warming is now sufficiently large that we can ascribe with a high degree of confidence a cause and effect relationship to the greenhouse effect."

That is where most every climate researcher in the country draws the line. The size of the present warming is not a unique indicator of its cause at this point, they argue. Any number of climate-changing mechanisms could be at work, alone or in combination. Clearly, El Niño was behind the record warm years of 1987 and 1983 (*Science*, 13 May, p. 883). The first half of 1988 has been running at a record warm pace too, but then, as Kiladis notes, there is about a 6-month lag between a temperature switch in the tropical Pacific, and its effect on the global atmosphere. "It's almost certain," he says, "that in late 1988 and early 1989, the mean temperature of the tropics equatorward of a latitude of about 30° will be below normal." That area constitutes half the area of the globe. "Unless the tropics are offset by higher latitudes," says Kiladis, "the globe will be colder" this winter.

This La Niña, which is likely to continue into next spring, could at least temporarily return the globe to temperatures typical of the 1950s or even the 1920s. The last La Niña before the present one began in 1975. The last year the average global temperature was below the mean for the period 1940 to 1960 was 1976. The abrupt jump to the warmth of the 1980s came shortly thereafter. Whether La Niña's absence contributed to the global warming is unknown, but that is the sort of point that many climate researchers would like to make. It is too early, they say, to be so certain about such a poorly understood phenomenon as global climate.

■ **RICHARD A. KERR**

ADDITIONAL READING

R. Bradley, H. Diaz, G. Kiladis, J. Eischeid, "ENSO signal in continental temperature and precipitation records," *Nature* **327**, 497 (1987).

Superconductivity Result Unconfirmed

Several American laboratories are trying to reproduce the work of a group of Taiwanese researchers who say they have made a material that becomes superconducting at a record 162 K, but so far no one has announced a confirmation.

Scientists at the Materials Research Laboratory in Taiwan say they have produced a thallium-calcium-barium-copper-oxygen compound that loses all resistance to electricity at 162 K. If true, that would be 37 K warmer than the previous best superconductor, which contains the same elements but apparently with a different composition. It has been at least a month, however, since word of the Taiwanese result began to spread through the superconductivity community, and so far no second group has announced it has seen the same phenomenon, even though the Taiwanese scientists have made their synthesizing process available to other labs.

Paul Grant at the IBM Almaden Research Center said researchers at IBM have known about the result for about a month and have tried without success to reproduce it. His group has talked with the Taiwanese scientists and has followed their recipe for the material, he said, but they have only gotten superconductivity at 110 to 120 K. This is no better than has already been done with thallium-based superconductors, which have the highest critical temperature to date, at 125 K.

The Taiwanese scientists speculate they may have found the predicted "four-layer phase" of the thallium system of superconductors. The crystalline structures of these superconductors depend sensitively on the proportions of different elements in the starting composition as well as on the processing conditions, and various thallium-based superconductors have been discovered with different structures. So far, these thallium-based superconductors have all had certain features in common, including having layers of CuO_2 lying between layers of thallium. (All of the materials discovered so far that become superconducting at higher than 77 K, not just the thallium materials, have layered crystalline structures. Scientists speculate that these layers play a major—although still undetermined—role in high-temperature superconductivity.)

The critical temperatures of the different thallium superconductors seem to depend on the number of CuO_2 layers. For instance, the materials with 125 K critical temperature have three CuO_2 layers interspersed between their thallium layers; compounds with two layers have critical temperatures of about 110 K; and compounds with only one layer become superconducting at no higher than 80 K. Some scientists have suggested that the critical temperature could be increased by fabricating a thallium-based compound with four, five, or more CuO_2 layers.

The Taiwan group said its 162 K material seems to have chemical composition $TlCa_2Ba_3Cu_4O_x$ and to have four CuO_2 layers between the thallium layers. The researchers cannot be completely sure of this composition, though, because their samples contain a number of different materials that have not been separated. The tentative identification of the structure is based on circumstantial evidence—in each sample over 140 K that the group examined with an electron microscope, they found this four-layer structure.

Results from other labs, however, raise doubts about this reported four-layer structure, as well as about whether it could produce 162 K superconductivity. "When we follow their synthetic procedure, we don't get a four-layer compound," Grant said. Two groups that have recently reported synthesizing four-layer thallium compounds say they found the critical temperature to be less than 125 K. One of the groups reports preparing the same $TlCa_2Ba_3Cu_4O_x$ composition as the Taiwan team, but that group measured only a 122 K critical temperature.

Although Grant said his team still takes the Taiwan result seriously, the inability so far to reproduce those results does raise questions. Early this year, when two new classes of superconductors were discovered, laboratories all over the world reproduced the results in a matter of days—or hours in some cases. For instance, after Allen Hermann at the University of Arkansas discovered the first thallium-based superconductors in February, researchers at IBM reproduced the results within 24 hours of receiving information on the structure of the new material. "A real result is instantly reproducible at a number of locations, even if that result is very transitory," Grant said. "A month is a long time [to go without reproducing a result]."

■ **ROBERT POOL**

ADDITIONAL READING

H. Ihara, R. Sugise, M. Hirabayashi, N. Terada, M. Jo, K. Hayashi, A. Negishi, M. Tokumoto, Y. Kimura, T. Shimomura, *Nature* **334**, 510 (1988).

P. Haldar, K. Chen, B. Maheswaran, A. Roig-Janicki, N. Jaggi, R. Markiewicz, B. C. Giessen, *Science*, in press.