

Global Climate Stayed Warm in 1996, With Wet, Cold Regional Surprises

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THE world's climate system served up some big regional surprises in 1996, even as this decade's familiar string of warm years continued globally, climatologists have found as they tally their annual data.

On the regional level, all-time record precipitation soaked the Northeastern United States and Pacific Northwest, making last year the seventh wettest in more than a century for the contiguous 48 states, despite a protracted drought in the Southwest. December's devastating storms and floods on the West Coast topped off the soggy performance.

And as not only Americans but also Canadians and Europeans can attest, large expanses of their continents were unusually chilly for much of the year, reversing a three-decade pattern of warming in those areas.

For the earth as a whole, though, 1996 ranked among the 10 warmest years since worldwide records of air temperature at the earth's surface were first kept in the mid-19th century, American and British scientists say, although it was not quite as warm as the peak annual temperature recorded in 1995.

While experts on climate are far from a complete understanding of the world's weather machine, they believe they can account for some of last year's changes. They say, for instance, that the cooling of North America and Europe was caused by naturally occurring shifts in atmospheric circulation that dictate the large-scale movement of hot and cold air.

Even with the continental coolings, however, a report issued last week by the NASA Goddard Institute for Space Studies in New York ranked last year as the fifth warmest ever recorded, just shy of the 1995 peak of slightly more than 58 degrees Fahrenheit. A second report, by the British Meteorological Office and the University of East Anglia, placed it eighth on the basis of preliminary data, also just short of the 1995 record.

Despite the drop, scientists said, the 1990's remain the warmest decade on record, with the 1980's second. "It's still an underlying upward trend," said Dr. Phil Jones of the Climatic Research Unit at East Anglia.

While many scientists agree with that assessment, not all do. The rise over the last two decades is too small to be statistically significant, especially since there are many gaps in the surface data, said Dr. Richard S. Lindzen, an atmospheric scientist at the Massachusetts Institute of Technology who discounts the likelihood of serious global warming.

The surface records show that the earth has warmed by about 1 degree Fahrenheit in the last century, and that the warming has accelerated in the last two decades. Mainstream climatologists say the warming has probably been caused, at least in part, by emissions of heat-trapping waste industrial gases like carbon dioxide, and they estimate that the surface will warm by about another 3.5 degrees over the next century if emissions are not reduced. By comparison, the world is 5 to 9 degrees warmer now than in the depths of the last ice age.

Climatologists do not expect the warming to be smooth and continuous. "One can get cooler years or even cooler decades owing to natural variation" in climate, said David Parker, a climate analyst at the British Meteorological Office.

Temperature measurements taken from balloons above the earth also showed a slight global temperature drop last year, said Dr. James K. Angell of the National Oceanic and Atmospheric Administration's Air Resources Laboratory in Silver Spring, Md. So did measurements of global temperature taken from satellites, said Dr. John R. Christy of the University of Alabama at Huntsville.

The satellite data, which give better global coverage but reflect temperatures throughout the atmosphere rather than at the surface, generally parallel the year-to-year fluctuations revealed by the surface readings. On balance, however, they show a cooling over the satellites' 18-year record. But when influences on climate like volcanic eruptions and the occasional warming of Pacific waters known as El Nino are filtered out, said Dr. Christy, the satellite data reveal a warming rate of 14 one-hundredths of a degree per decade. This compares with about 30 one-hundredths for the surface data obtained by the British Meteorological Office.

While there probably has been a significant rise in global temperature over the last century, Dr. Lindzen said, all the data taken together show that "there hasn't been a profound warming."

One consequence of a warmer earth, scientists say, would be heavier precipitation like that experienced by Americans in the Northeast and Northwest last year; a warmer atmosphere holds more moisture. Government researchers say they have, in fact, linked this century's warming to a 20 percent increase in heavy precipitation in the United States. Even in the cold season, they found, there has been a 10 percent increase in overall precipitation.

No single storm can be attributed to warming. But the heavy rains and snows of 1996 nevertheless contributed to the emerging overall pattern of increasing precipitation, said Thomas R. Karl, senior scientist at the National Climatic Data Center in Asheville, N.C.

Some scientists are skeptical that warming has stimulated precipitation. "It would be remarkable" if the small amount of warming felt so far produced a noticeable increase, said Dr. John M. Wallace, an atmospheric scientist at the University of Washington in Seattle. He said that while he did not question Mr. Karl's statistics, there was no convincing physical mechanism to account for large changes in weather caused by such a small warming.

But Mr. Karl said that in a warming atmosphere, moisture increases at a faster rate than the warming itself, and that recent measurements show an increase in water vapor over North America.

Global warming aside, scientists have identified a number of natural factors affecting last year's unusual weather. One is a naturally occurring, semiperiodic reversal of atmospheric pressure patterns and wind direction in the North Atlantic that is believed responsible for the flip-flop in continental temperatures, especially in Europe. This phenomenon, called the North Atlantic Oscillation, apparently has made Europe and North America relatively warm and Greenland cold for the last three decades. Now the pattern has reversed, and Europe especially is feeling the effects: the New Year brought the continent's worst freeze in more than 10 years, while Greenland luxuriated in springlike warmth.

Another factor in the United States' weather was the persistence for much of the year of large high-pressure systems over the continent's northern tier. These diverted the jet stream southward, along with accompanying storms and colder air. "Whenever you get these blocking patterns, you're going to get persistent, recurring storms," said Fred Gadomski, a meteorologist at Pennsylvania State University. "It will be wet in a region again and again and again." What causes such a persistent pattern? "Your guess is as good as mine," he said.

The diverted jet stream delivered other punches to the Northeast as well. It carried a number of northeasters into the region, including last January's record-setting blizzard. And it helped create a well-defined atmospheric "corridor" that funneled three major hurricanes directly into the Northeast.

Still another factor, experts say, was La Nina, a cooler-than-normal pool of water in the eastern tropical Pacific. It prevailed early in 1996, and a number of scientists say it was responsible for much of the cooling in the Northern United States, as well as exerting a general cooling effect on the globe.

Now La Nina has faded and the tropical Pacific's temperature is about normal. In these neutral conditions, the climate tends to become unusually variable, with no regional climatic pattern lasting longer than about 30 to 60 days, said Vernon Kousky, a meteorologist at the Government's Climate Prediction Center at Camp Springs, Md.

One such pattern, which recently directed storm after storm at the Pacific Coast while warming the East, has ended, he said, bringing cold weather to the East. The Eastern chill is expected to last until about the end of January, he said, after which it "could flip back and go warm again." But, he said, "there are no guarantees."

Last year, until the advent of an unusual December warm spell, the Northeast experienced one of its chilliest years on record -- the 21st coolest in the last 102 years, according to the National Climatic Data Center. The Northeast's year ended as 39th coolest, but other areas of the country were much colder for the 12 months. The biggest exception was the Southwestern quadrant of the country, where heat and drought ruled much of the year.

What does the rest of the decade have in store?

Scientists cannot go much beyond informed speculation, but Dr. James E. Hansen, the director of the Goddard Institute, offers at least two possibilities.

One is that the North Atlantic Oscillation will lock into its new pattern for a few years, producing "a tendency for continued cooling in Europe and North America." Another is that with the fading of La Nina, both continental and global temperatures will rise again.

Dr. Hansen, who predicts that at least one new global temperature record will be set by the decade's end, believes the second possibility more likely. But, citing the atmosphere's natural variability and large measure of chaotic behavior, he said it would not be clear for several years whether the change in regional climates was more than temporary.

It will be "extremely interesting" to watch, he said.

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