

More Extremes Found in Weather, Pointing to Greenhouse Gas Effect: An ...

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CLIMATE scientists have long predicted that an intensifying greenhouse effect would make for a more extreme climate, and the especially turbulent weather of recent years has suggested that the predictions might be coming true.

Now, in the first systematic study of its kind, researchers at the National Climatic Data Center in Asheville, N.C., have found that the climate of the United States has indeed become more extreme in the last decade and a half. Furthermore, they have calculated that there is a 90 to 95 percent chance that the nation's climate is being affected by increasing concentrations of heat-trapping industrial waste gases like carbon dioxide.

On the basis of the new study, which analyzed United States weather data collected since 1910, "I would say the climate is responding to increases in greenhouse gases," said Thomas R. Karl, the senior scientist of the climatic data center, a Federal agency. But he said a 90 to 95 percent probability that the greenhouse effect is being felt "is not as high as we'd like to see," adding, "You'd like to come up with a 1 in 100 chance that you're wrong" rather than a 1 in 20 chance.

And in any case, he said, the findings do not say anything about how large and disruptive the effect of the rising concentrations of heat-trapping gases might eventually be. Scientists say that a doubling of the gases, expected some time in the next century at present emission rates, would cause widespread and serious climatic disruptions.

Mr. Karl, who has been agnostic on the question of whether greenhouse gases emitted by the burning of fossil fuels are changing the climate, was joined in conducting the study by three other researchers at the data center: Richard W. Knight, Dr. David R. Easterling and Robert G. Quayle. Their report appears in the initial issue of *Consequences*, a new federally supported, peer-reviewed journal on environmental change published by Saginaw Valley State University in Michigan.

Discussion of the greenhouse effect has usually focused on the question of whether the earth will warm and by how much; scientists believe

An increase in extreme weather appeared abruptly.

a doubling of greenhouse gas concentrations would raise the average global temperature by 3 to 8 degrees Fahrenheit. But climatologists have said all along that the most obvious effects, and those that will have the largest impact on people, would be extremes of temperature, precipitation and storminess.

The Federal scientists set out to measure changes in temperature and precipitation patterns: The researchers reasoned that the United States provides an especially clear window on the global situation because its long-term data are so abundant and clear. The scientists also wanted to look at possible effects of global climate change that would be noticed in people's everyday lives.

There were two aspects to the study. In the first, the researchers identified the years in which extremes of heat, cold, drought and wetness occurred. Extremes were defined as the top and bottom 10 percent of the long-term climate record. These indicators were combined into a single index of extremity. The researchers found that since the late 1970's, the index has been about 1.5 percent higher than the average of the previous 65 years. Expressed another way, they said,

the parts of the country affected by "a persistent increase of extreme events," when added together, equal somewhat more than the area of the state of Indiana.

Similar peaks of extreme weather occurred in the 1930's and 1950's, but the present one has lasted longer, said Mr. Quayle. These recent changes are not large enough and have not persisted long enough for anyone "to conclude that the climate has systematically changed to a more extreme state," the researchers wrote.

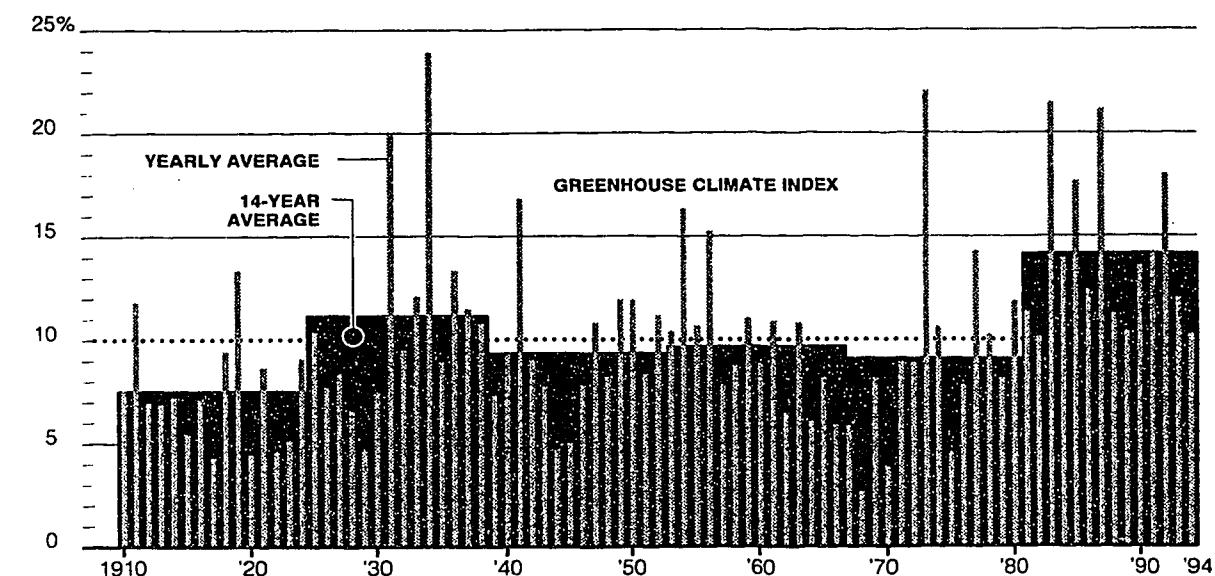
By itself, this phase of the analysis revealed little about whether the changes can be tied to the greenhouse effect. In the second phase, the researchers examined the climate record to see whether telltale climatic changes that scientists expect to result from the greenhouse effect were occurring.

Four indicators were examined: minimum temperatures much above normal; much-above-normal precipitation from October through April; extreme or severe drought from May through September; and a much-greater-than-normal proportion of precipitation derived from extreme one-day precipitation events.

The results were averaged and combined into what the researchers call a "greenhouse climate response index." They found that from 1976 on, the index was 2.8 percent above the average of previous years in the century. This apparent greenhouse impact was felt over parts of the

A Warmer Climate? Looking for Long-Term Patterns

The Greenhouse Climate Index is the percentage of the area of the contiguous states experiencing conditions consistent with projections of an enhanced greenhouse effect. The index value that would be expected if random chance alone is at work is 10 percent.



Source: National Climatic Data Center

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country whose combined area equaled somewhat more than the combined area of Indiana and Illinois.

For the period from 1980 through 1994, the greenhouse response index was 4 percent higher than in earlier parts of the century. The rise for 1980 through 1994 affected areas of the country equal to the combined area of Illinois, Indiana and Ohio.

These findings, they wrote, are "suggestive of a climate driven by greenhouse warming." But they cautioned that the rate of change is not large enough to rule out unequivocal

ly the possibility that the changes might result from other factors, including the climate's natural variability — although statistically, "this is but a 5 to 10 percent chance."

Both the increase in extreme weather and the apparent greenhouse impact appeared rather abruptly at a time when major changes in atmospheric circulation took place over the Pacific Ocean and North America. The researchers wrote that there is "little doubt" that these changes are at least partially related to their findings. The role played by the greenhouse effect in

causing the circulation changes is "poorly known," they said.

Some climatologists predict that greenhouse warming will lead to an increase in the number and severity of hurricanes and other tropical storms. The researchers at the climatic data center studied hurricane trends in this century and said that it was "difficult" to detect any trend. But they cited other studies that say that even if significant greenhouse warming were to occur, it is "doubtful" whether increases in tropical storms could be detected amid natural climatic variability.