

Global Warming Has Begun, Expert Tells Senate

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- June 24, 1988



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The earth has been warmer in the first five months of this year than in any comparable period since measurements began 130 years ago, and the higher

temperatures can now be attributed to a long-expected global warming trend linked to pollution, a space agency scientist reported today.

Until now, scientists have been cautious about attributing rising global temperatures of recent years to the predicted global warming caused by pollutants in the atmosphere, known as the "greenhouse effect." But today Dr. James E. Hansen of the National Aeronautics and Space Administration told a Congressional committee that it was 99 percent certain that the warming trend was not a natural variation but was caused by a buildup of carbon dioxide and other artificial gases in the atmosphere.

Dr. Hansen, a leading expert on climate change, said in an interview that there was no "magic number" that showed when the greenhouse effect was actually starting to cause changes in climate and weather. But he added, "It is time to stop waffling so much and say that the evidence is pretty strong that the greenhouse effect is here." An Impact Lasting Centuries

If Dr. Hansen and other scientists are correct, then humans, by burning of fossil fuels and other activities, have altered the global climate in a manner that will affect life on earth for centuries to come.

Dr. Hansen, director of NASA's Institute for Space Studies in Manhattan, testified before the Senate Energy and Natural Resources Committee.

He and other scientists testifying before the Senate panel today said that projections of the climate change that is now apparently occurring mean that the Southeastern and Midwestern sections of the United States will be subject to frequent episodes of very high temperatures and drought in the next decade and beyond. But they cautioned that it was not possible to attribute a specific heat wave to the greenhouse effect, given the still limited state of knowledge on the subject. Some Dispute Link

Some scientists still argue that warmer temperatures in recent years may be a result of natural fluctuations rather than human-induced changes.

Several Senators on the Committee joined witnesses in calling for action now on a broad national and international program to slow the pace of global warming.

Senator Timothy E. Wirth, the Colorado Democrat who presided at hearing today, said: "As I read it, the scientific evidence is compelling: the global climate is changing as the earth's atmosphere gets warmer. Now, the Congress must begin to consider how we are going to slow or halt that warming trend and how we are going to cope with the changes that may already be inevitable." Trapping of Solar Radiation

Mathematical models have predicted for some years now that a buildup of carbon dioxide from the burning of fossil fuels such as coal and oil and other gases emitted by human activities into the atmosphere would cause the earth's surface to warm by trapping infrared radiation from the sun, turning the entire earth into a kind of greenhouse.

If the current pace of the buildup of these gases continues, the effect is likely to be a warming of 3 to 9 degrees Fahrenheit from the year 2025 to 2050, according to these projections. This rise in temperature is not expected to be uniform around the globe but to be greater in the higher latitudes, reaching as much as 20 degrees, and lower at the Equator.

The rise in global temperature is predicted to cause a thermal expansion of the oceans and to melt glaciers and polar ice, thus causing sea levels to rise by one to four feet by the middle of the next century. Scientists have already detected a slight rise in sea levels. At the same time, heat would cause inland waters to evaporate more rapidly, thus lowering the level of bodies of water such as the Great Lakes.

Dr. Hansen, who records temperatures from readings at monitoring stations around the world, had previously reported that four of the hottest years on record occurred in the 1980's. Compared with a 30-year base period from 1950 to 1980, when the global temperature averaged 59 degrees Fahrenheit, the temperature was one-third of a degree higher last year. In the entire century before 1880, global temperature had risen by half a degree, rising in the late 1800's and early 20th century, then roughly stabilizing for unknown reasons for several decades in the middle of the century. **Warmest Year Expected**

In the first five months of this year, the temperature averaged about four-tenths of a degree above the base period, Dr. Hansen reported today. "The first five months of 1988 are so warm globally that we conclude that 1988 will be the warmest year on record unless there is a remarkable, improbable cooling in the remainder of the year," he told the Senate committee.

He also said that current climate patterns were consistent with the projections of the greenhouse effect in several respects in addition to the rise in temperature. For example, he said, the rise in temperature is greater in high latitudes than in low, is greater over continents than oceans, and there is cooling in the upper atmosphere as the lower atmosphere warms up.

"Global warming has reached a level such that we can ascribe with a high degree of confidence a cause and effect relationship between the greenhouse effect and observed warming," Dr. Hansen said at the hearing today, adding, "It is already happening now."

Dr. Syukuro Manabe of the Geophysical Fluid Dynamics Laboratory of the National Oceanic and Atmospheric Administration testified today that a number of factors, including an earlier snowmelt each year because of higher temperatures and a rain belt that moves farther north in the summer means that "it is likely that severe mid-continental summer dryness will occur more frequently with increasing atmospheric temperature." *A Taste of the Future*

While natural climate variability is the most likely chief cause of the current drought, Dr. Manabe said, the global warming trend is probably "aggravating the current dry condition." He added that the current drought was a foretaste of what the country would be facing in the years ahead.

Dr. George Woodwell, director of the Woods Hole Research Center in Woods Hole, Mass., said that while a slow warming trend would give human society time to respond, the rate of warming is uncertain. One factor that could speed up global warming is the widescale destruction of forests that are unable to adjust rapidly enough to rising temperatures. The dying forests would release the carbon dioxide they store in their organic matter, and thus greatly speed up the greenhouse effect.

Sharp Cut in Fuel Use Urged

Dr. Woodwell, and other members of the panel, said that planning must begin now for a sharp reduction in the burning of coal, oil and other fossil fuels that release carbon dioxide. Because trees absorb and store carbon dioxide, he also proposed an end to the current rapid clearing of forests in many parts of the world and "a vigorous program of reforestation."

Some experts also believe that concern over global warming caused by the burning of fossil fuels warrants a renewed effort to develop safe nuclear power. Others stress the need for more efficient use of energy through conservation and other measures to curb fuel-burning.

Dr. Michael Oppenheimer, an atmospheric physicist with the Environmental Defense Fund, a national environmental group, said a number of steps can be taken immediately around the world, including the ratification and then strengthening of the treaty to reduce use of chlorofluorocarbons, which are widely used industrial chemicals that are said to contribute to the greenhouse effect. These chemicals have also been found to destroy ozone in the upper atmosphere that protects the earth's surface from harmful ultraviolet radiation from the sun.

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