

Heat Waves of the 21st Century: More Intense, More Frequent and Longer Lasting

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Heat waves in Chicago, Paris, and elsewhere in North America and Europe will become more intense, more frequent and longer lasting in the 21st century, according to a new modeling study by two scientists at the National Center for Atmospheric Research (NCAR) in Boulder, Colo. In the United States, heat waves will become most severe in the West and South. The findings appear in the August 13 issue of the journal *Science*.

Gerald Meehl and Claudia Tebaldi, both of NCAR, examined Earth's future climate using the Parallel Climate Model, developed by NCAR and the U.S. Department of Energy (DOE). NCAR's primary sponsor, the National Science Foundation (NSF), and DOE funded the study.

"This study provides significant insight into the complex response of global climate to possible future worldwide economic and regulatory policies," said Cliff Jacobs, program director in NSF's division of atmospheric sciences, which funded the research. "The societal implications of this study need to be further explored."

Model results show that an increase in heat-absorbing greenhouse gases intensifies an unusual atmospheric circulation pattern already observed during heat waves in Europe and North America. As the pattern becomes more pronounced, severe heat waves occur in the Mediterranean region and the southern and western United States. Other parts of France, Germany and the Balkans also become more susceptible to severe heat waves.

"Extreme weather events will have some of the most severe impacts on human society as climate changes," says Meehl.

Heat waves can kill more people in a shorter time than almost any other climate event. According to records, 739 people died as a result of Chicago's July, 1995, heat wave. Fifteen thousand Parisians are estimated to have died from heat in August, 2003, along with thousands of farm animals.

For the study, Meehl and Tebaldi compared present (1961-1990) and future (2080-2099) decades to determine how greenhouse gases and sulfate aerosols might affect future climate in Europe and the United States, focusing on Paris and Chicago. They assumed little policy intervention to slow the buildup of greenhouse gases.

During the Paris and Chicago heat waves, atmospheric pressure rose to values higher than usual over Lake Michigan and Paris, producing clear skies and prolonged heat. In the model, atmospheric pressure increases even more during heat waves in both regions as carbon dioxide accumulates in the atmosphere.

Model Results:

Heat waves will become more severe

During the 1995 Chicago heat wave, the most severe health impacts resulted from the lack of cooling relief several nights in a row, according to health experts. In the model, the western and southern United States and the Mediterranean region of Europe experience a rise in nighttime minimum temperatures of more than 3 degrees Celsius (5.4 degrees Fahrenheit) three nights in a row.

They will occur more often:

The average number of heat waves in the Chicago area increases in the coming century by 25 percent, from 1.66 per year to 2.08. In Paris, the average number increases 31 percent, from 1.64 per year to 2.15.

They will last longer:

Chicago's present heat waves last from 5.39 to 8.85 days; future events increase to between 8.5 and 9.24 days. In Paris, present-day heat waves persist from 8.33 to 12.69 days; they stretch to between 11.39 and 17.04 days in future decades.

Source: National Science Foundation

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