

Greenhouse gases likely drove near-record US warmth in 2006

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Greenhouse gases likely accounted for over half of the widespread warmth across the continental United States in 2006, according to a new study that will be published 5 September in *Geophysical Research Letters*, a publication of the American Geophysical Union. Last year's average temperature was the second highest since recordkeeping began in 1895. The team found that it was very unlikely that the 2006 El Nino played any role, though other natural factors likely contributed to the near-record warmth.

When average annual temperature in the United States broke records in 1998, a powerful El Nino was affecting climate around the globe. Scientists widely attributed the unusual warmth in the United States to the influence of the ongoing El Nino. El Nino is a warming of the surface of the east tropical Pacific Ocean.

The research team, led by Martin Hoerling at the National Oceanic And Atmospheric Administration (NOAA) Earth System Research Lab in Boulder, Colorado, also found that greenhouse gas increases in Earth's atmosphere enhanced the probability of U.S. temperatures breaking a record in 2006 by approximately 15-fold compared to pre-industrial times. The authors also estimate that there is a 16 percent chance that 2007 will bring record-breaking warmth.

"We wanted to find out whether it was pure coincidence that the two warmest years on record both coincided with El Nino events," Hoerling said. "We decided to quantify the impact of El Nino and compare it to

the human influence on temperatures through greenhouse gases."

Preliminary data available in January 2006 led NOAA to place that year as the warmest on record. In May 2007, NOAA revised the 2006 ranking to second warmest after updated statistics showed the year was .08 F cooler than 1998. The annual average temperature in 2006 was 2.1 F above the 20th Century average and marked the ninth consecutive year of above-normal U.S. temperatures. Each of the contiguous 48 states reported above-normal annual temperatures, and for the majority of states, 2006 ranked among the 10 hottest years since 1895.

Using data from 10 past El Nino events observed since 1965, the authors examined the impact of El Nino on average annual U.S. surface temperatures. They found a slight cooling across the country. To overcome uncertainties inherent in the data analysis, the team also studied the El Nino influence using two atmospheric climate models. The scientists conducted two sets of 50-year simulations of U.S. climate, with and without the influence of El Nino sea-surface warming. They again found a slight cooling across the nation when El Nino was present.

To assess the role of greenhouse gases in the 2006 warmth, the researchers analyzed 42 simulations of Earth's climate from 18 climate models provided for the latest assessment by the Intergovernmental Panel on Climate Change (IPCC). The models included greenhouse gas emissions and airborne particles in Earth's atmosphere since the late 19th century and computed their influence on average temperatures through 2006. The results of the analysis showed that greenhouse gases produced warmth over the entire United States in the model projections, much like the warming pattern that was observed last year across the country.

For a final check, the scientists compared the observed 2006 pattern of abnormal surface temperatures to the projected effects of greenhouse-gas warming and El Nino temperature responses. The U.S. temperature

pattern of widespread warming was completely inconsistent with the pattern expected from El Nino, but it closely matched the expected effects of greenhouse warming.

"That attribution was not confirmed at the time," says Hoerling. "Now we have the capability, on the spatial scale of the United States, to better distinguish natural climate variations from climate changes caused by humans."

Source: American Geophysical Union

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