

Separating signal and noise in climate warming

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A National Oceanic and Atmospheric Administration (NOAA) weather satellite. Image courtesy of NASA.

(PhysOrg.com) -- In order to separate human-caused global warming from the "noise" of purely natural climate fluctuations, temperature records must be at least 17 years long, according to climate scientists.

To address criticism of the reliability of thermometer records of surface warming, Lawrence Livermore National Laboratory scientists analyzed [satellite measurements](#) of the temperature of the lower troposphere (the region of the atmosphere from the surface to roughly five miles above) and saw a clear signal of human-induced warming of the planet.

Satellite measurements of [atmospheric temperature](#) are made with microwave radiometers, and are completely independent of surface thermometer measurements. The satellite data indicate that the lower troposphere has warmed by roughly 0.9 degrees Fahrenheit since the beginning of satellite temperature records in 1979. This increase is entirely consistent with the warming of Earth's surface estimated from thermometer records.

Recently, a number of global warming critics have

focused attention on the behavior of Earth's temperature since 1998. They have argued that there has been little or no warming over the last 10 to 12 years, and that computer models of the [climate system](#) are not capable of simulating such short "hiatus periods" when models are run with human-caused changes in greenhouse gases.

"Looking at a single, noisy 10-year period is cherry picking, and does not provide reliable information about the presence or absence of human effects on climate said Benjamin Santer, a climate scientist and lead author on an article in the Nov. 17 online edition of the *Journal of Geophysical Research* (Atmospheres).

Many scientific studies have identified a human "fingerprint" in observations of surface and lower tropospheric temperature changes. These detection and attribution studies look at long, multi-decade observational temperature records. Shorter periods generally have small signal to noise ratios, making it difficult to identify an anthropogenic signal with high statistical confidence, Santer said.

"In fingerprinting, we analyze longer, multi-decadal temperature records, and we beat down the large year-to-year temperature variability caused by purely natural phenomena (like El Niños and La Niñas). This makes it easier to identify a slowly-emerging signal arising from gradual, human-caused changes in atmospheric levels of greenhouse gases," Santer said.

The LLNL-led research shows that climate models can and do simulate short, 10- to 12-year "hiatus periods" with minimal warming, even when the models are run with historical increases in [greenhouse gases](#) and sulfate aerosol particles. They find that tropospheric temperature records must be at least 17 years long to discriminate between internal climate noise and the signal of human-caused changes in the chemical composition of the atmosphere.

"One individual short-term trend doesn't tell you much about long-term climate change," Santer said. "A single decade of observational temperature data is inadequate for identifying a slowly evolving human-caused warming signal. In both the satellite observations and in computer models, short, 10-year tropospheric temperature trends are strongly influenced by the large noise of year-to-year [climate](#) variability."

Provided by Lawrence Livermore National Laboratory

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