Global warming progressing at moderate rate, empirical data suggest

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A composite image of the Western hemisphere of the Earth. Credit: NASA

A new study based on 1,000 years of temperature records suggests global warming is not progressing as fast as it would under the most severe emissions scenarios outlined by the Intergovernmental Panel on Climate Change (IPCC).

"Based on our analysis, a middle-of-the-road warming scenario is more likely, at least for now," said Patrick T. Brown, a doctoral student in climatology at Duke University's Nicholas School of the Environment. "But this could change."

The Duke-led study shows that natural variability in surface temperatures—caused by interactions between the ocean and atmosphere, and other natural factors—can account for observed changes in the recent rates of warming from decade to decade.

The researchers say these "climate wiggles" can slow or speed the rate of warming from decade to decade, and accentuate or offset the effects of increases in greenhouse gas concentrations. If not properly explained and accounted for, they may skew the reliability of climate models and lead to over-interpretation of short-term temperature trends.

The research, published today in the peer-reviewed journal *Scientific Reports*, uses empirical data, rather than the more commonly used climate models, to estimate decade-to-decade variability.

"At any given time, we could start warming at a faster rate if greenhouse gas concentrations in the atmosphere increase without any offsetting changes in aerosol concentrations or natural variability," said Wenhong Li, assistant professor of climate at Duke, who conducted the study with Brown.

The team examined whether climate models, such as those used by the IPCC, accurately account for natural chaotic variability that can occur in

the rate of global warming as a result of interactions between the ocean and atmosphere, and other natural factors.

To test how accurate climate models are at accounting for variations in the rate of warming, Brown and Li, along with colleagues from San Jose State University and the USDA, created a new statistical model based on reconstructed empirical records of surface temperatures over the last 1,000 years.

"By comparing our model against theirs, we found that climate models largely get the 'big picture' right but seem to underestimate the magnitude of natural decade-to-decade climate wiggles," Brown said. "Our model shows these wiggles can be big enough that they could have accounted for a reasonable portion of the accelerated warming we experienced from 1975 to 2000, as well as the reduced rate in warming that occurred from 2002 to 2013."

Further comparative analysis of the models revealed another intriguing insight.

"Statistically, it's pretty unlikely that an 11-year hiatus in warming, like the one we saw at the start of this century, would occur if the underlying human-caused warming was progressing at a rate as fast as the most severe IPCC projections," Brown said. "Hiatus periods of 11 years or longer are more likely to occur under a middle-of-the-road scenario."

Under the IPCC's middle-of-the-road scenario, there was a 70 percent likelihood that at least one hiatus lasting 11 years or longer would occur between 1993 and 2050, Brown said. "That matches up well with what we're seeing."

There's no guarantee, however, that this rate of warming will remain steady in coming years, Li stressed. "Our analysis clearly shows that we

shouldn't expect the observed rates of warming to be constant. They can and do change."

More information: "Comparing the Model-Simulated Global Warming Signal to Observations Using Empirical Estimates of Unforced Noise," Patrick T. Brown, Wenhong Li, Eugene C. Cordero and Steven A. Mauget; *Scientific Reports*, April 21, 2015. DOI: 10.1038/srep09957

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