Slowdown of global warming fleeting

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The recent slowdown in the warming rate of the Northern Hemisphere may be a result of internal variability of the Atlantic Multidecadal Oscillation—a natural phenomenon related to sea surface temperatures, according to Penn State researchers.

"Some researchers have in the past attributed a portion of Northern Hemispheric warming to a warm phase of the AMO," said Michael E. Mann, Distinguished Professor of Meteorology. "The true AMO signal, instead, appears likely to have been in a cooling phase in recent decades, offsetting some of the anthropogenic warming temporarily."

According to Mann, the problem with the earlier estimates stems from having defined the AMO as the low frequency component that is left after statistically accounting for the long-term temperature trends, referred to as detrending.

"Initial investigations into the multidecadal climate oscillation in the North Atlantic were hampered by the short length of the instrumental climate record which was only about a century long," said Mann. "And some of the calculations were contaminated by long-term climate trends driven or forced by human factors such as greenhouse gases as well as pollutants known as sulfate aerosols. These trends masqueraded as an apparent oscillation."

Mann and his colleagues took a different approach in defining the AMO, which they report online in a special "Frontier" paper in *Geophysical Research Letters*. They compared observed temperature variation with a variety of historic model simulations to create a model for internal variability of the AMO that minimizes the influence of external forcing—including greenhouse gases and aerosols. They call this the differenced-AMO because the internal variability comes from the difference between observations and the models' estimates of the forced component of North Atlantic temperature change. They found that their results for the most recent decade fall within expected multidecadal variability.

They also constructed plausible synthetic Northern Hemispheric mean temperature histories against which to test the differenced-AMO approaches. Because the researchers know the true AMO signal for their synthetic data from the beginning, they could demonstrate that the differenced-AMO approach yielded the correct signal. They also tested the detrended-AMO approach and found that it did not come up with the known internal variability.

The detrended approach produced an AMO signal with increased amplitude—both high and low peaks were larger than in the differenced-

AMO signal and in the synthetic data. They also found that the peaks and troughs of the oscillation were skewed using the detrending approach, causing the maximums and minimums to occur at different times than in the differenced-AMO results. While the detrended-AMO approach produces a spurious temperature increase in recent decades, the differenced approach instead shows a warm peak in the 1990s and a steady cooling since.

Past researchers have consequently attributed too much of the recent North Atlantic warming to the AMO and too little to the forced hemispheric warming, according to the researchers.

Mann and his team also looked at supposed "stadium waves" suggested by some researchers to explain recent climate trends. The putative climate stadium wave is likened to the waves that go through a sports stadium with whole sections of fans rising and sitting together, propagating a wave around the oval. Random motion of individuals suddenly becomes unified action.

The climate stadium wave supposedly occurs when the AMO and other related climate indicators synchronize, peaking and waning together. Mann and his team show that this apparent synchronicity is likely a statistical artifact of using the problematic detrended-AMO approach.

"We conclude that the AMO played at least a modest role in the apparent slowing of warming during the past decade," said Mann. "As the AMO is an oscillation, this cooling effect is likely fleeting, and when it reverses, the rate of warming increases." Others working on this project were Byron A. Steinman, postdoctoral fellow in meteorology, and Sonya K. Miller, programmer/analyst, meteorology, Penn State.

Provided by Pennsylvania State University

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