

Faux Pause?¹ A new study says that global warming is still going strong

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A new paper in the journal *Science* casts doubt on the existence of the global warming “pause” that has received widespread media attention in recent years.² After correcting one global temperature dataset for several time-dependent biases in collection methodology, a team of NOAA scientists show that the rate of warming in the 21st century (0.116 °C/decade) is nearly the same as the rate observed over the latter half of the 20th century (0.113 °C/decade).

The global warming pause was originally reported by the IPCC and other researchers based on temperature data that showed an apparent slowdown in the rate of global warming since 1998. According to the IPCC’s Fifth Assessment Report from 2013, “[The temperature] trend over 1998–2012 is estimated to be around one third to one half of the trend over 1951–2012. For example, [in one model] the trend is 0.04°C per decade over 1998–2012, compared to 0.11°C per decade over 1951–2012.”³ The exact cause had not been definitively determined, but some studies showed that a decadal change in Pacific ocean circulation was causing the oceans to take up more heat from the atmosphere.⁴

While climate skeptics latched on to the pause as evidence that global warming was a farce, scientists argued that a global warming pause, if it existed, did not change either long-term climate projections or our understanding of the climate system. Many pointed out that the pause was merely a temporary slowdown in warming, during which record high temperature years in 2005, 2010 and 2014 continued to occur. And as I discussed in my previous memo, natural climate variability on the scale of years to decades is common in the observed temperature record. Still, the scientific uncertainty about the cause of the slowdown fueled public skepticism about the existence of global warming and the reliability of global climate models.⁵

The new paper claims that the pause is merely an artefact of biases in NOAA’s ocean and land temperature datasets that make recent years appear cooler than they really were. Specifically, the authors claim that changes in the way that land and especially sea surface temperatures are measured create biases in the data that change over time. The study addresses three particular biases: 1) an increasing reliance on sea surface temperatures collected from ships rather than buoys, 2) a change in the way sea surface temperatures have been collected by ships over time, 3) a sparsity of land temperature data in Arctic regions, where warming is the fastest. These biases highlight the difficulty that scientists face in measuring mean temperature across the entire globe using only sparse networks of sensors and historical data that is less robust than modern data.

¹ I thought I was being so very clever with this title, but it turns out The Guardian beat me to it.

² T. R. Karl et al., “Possible Artifacts of Data Biases in the Recent Global Surface Warming Hiatus,” *Science*, June 4, 2015, doi:10.1126/science.aaa5632.

³ IPCC Fifth Assessment Report Technical Summary. (2013)

⁴ Byron A. Steinman, Michael E. Mann, and Sonya K. Miller, “Atlantic and Pacific Multidecadal Oscillations and Northern Hemisphere Temperatures,” *Science* 347, no. 6225 (February 27, 2015): 988–91, doi:10.1126/science.1257856.

⁵ “Ted Cruz’s world’s on fire, but not for the last 17 years”. Politifact, March 20, 2015.

<http://www.politifact.com/truth-o-meter/statements/2015/mar/20/ted-cruz/ted-cruzs-worlds-fire-not-last-17-years/>

In addition to the biases in the data, the authors point out that the rate of warming during the supposed pause is sensitive to the date at which the pause is assumed to start (an issue which I raised in my previous memo). The IPCC had somewhat arbitrarily selected 1998 as the beginning of the pause, despite the fact that 1998 was a record-setting El Niño year, which biased the calculated warming trend downward. Finally, the authors show that including the most recent years of 2013 and 2014 in the analysis also contributes to a faster rate of warming, which is consistent with 2014 being the warmest year on record.

After correcting the dataset for the biases and shifting the starting and ending dates forward two years, the authors show that the warming during the period 2000–2014 (0.116 °C/decade) is identical, within error, to that during 1950–1999 (0.113 °C/decade).

What are the implications of this study? First, getting the global temperature record right is important from both a scientific and a policy standpoint. Global mean surface temperatures (GMST) provide some of the strongest scientific evidence for anthropogenic climate change. Composed of both a land and an ocean component, GMSTs are a measure of the average temperature of the Earth's entire surface, which is one reliable indicator of global warming (though not, as I discuss below, a *complete* indicator of warming). Thanks to the work of agencies like NOAA, we have good data on global surface temperatures reaching back to 1880. The data show that temperatures began to increase in the early 1900s, coinciding with the beginning of worldwide greenhouse gas emissions, ultimately rising 0.8 °C from 1880 to 2014 (Figure 1). They also show strong interannual variability, due to periodic events like El Niño and volcanic eruptions, as well as decadal-scale pauses that may have to do with slower changes in oceanic circulation. Despite the variability, the long-term increasing trend is clear.

The NOAA study will not immediately change the previous scientific consensus that warming has slowed. NOAA is only one of four government agencies that release global temperature data, and the ERSST and NCEI datasets that they use are not the only datasets used to calculate GMST; other agencies like the UK's Hadley Centre will want to weigh in by applying corrections to their own datasets.

As discussed in the previous memo, even if warming *has* slowed slightly in recent years, long-term climate model projections are still accurate. There are many reasons why this should be so. As mentioned above, internal climate variability is common and expected. Furthermore, surface temperatures alone do not give a complete picture of global warming. Oceans, due to their size and heat storing capacity, suck up much of the earth's heat imbalance caused by greenhouse gas emissions. 90% of the earth's warming accumulates in the oceans, which transfer heat from the surface layers to deeper waters over decades to centuries (Figure 2).⁶ Therefore, global surface temperatures alone record only a small portion of total global warming because they do not include heat absorbed by the deep ocean. Small changes in the heat uptake at the surface, as reflected by variability in the surface temperature trend, are therefore dwarfed by heat uptake in the oceans.

The new temperature results do give us greater confidence in the accuracy of our climate models, which have not predicted a slowdown in warming. The IPCC noted this apparent discrepancy in its

⁶ Dana Nuccitelli et al., "Comment on 'Ocean Heat Content and Earth's Radiation Imbalance. II. Relation to Climate Shifts,'" *Physics Letters A* 376, no. 45 (October 1, 2012): 3466–68, doi:10.1016/j.physleta.2012.10.010.

Fifth Assessment Report when it stated that “almost all CMIP5 historical simulations do not reproduce the observed recent warming hiatus.”⁷ A figure from that report shows that 111 out of 114 climate models predicted higher-than-observed temperatures for the 1998 – 2012 period (Figure 3). The IPCC concluded that the difference was probably caused by cooling due to internal climate variability (which is difficult to model) and possibly incorrect radiative forcings in the models (due to uncertainty about the effect of aerosols). While this discrepancy never called into question the accuracy of the models’ long-term predictions or our understanding of the climate system’s behavior, it did produce an element of doubt about model output that was picked up by climate-skeptical media.⁸ With NOAA’s corrected temperature data, the observed temperature trend is now in line with the model outputs.

We will have to wait for further studies using other GMST datasets before concluding with certainty that the global warming pause was merely a data artefact, but the results thus far suggest several conclusions: 1) If there is a statistically significant pause, it is likely to be smaller in magnitude than previously thought. 2) Such a pause is likely to be temporary, as we know from the historical record, and as record high temperatures from 2010, 2014, and (thus far) 2015 suggest. 3) Despite uncertainties surrounding the climate’s sensitivity to greenhouse gas emissions and the magnitude of aerosol forcings, global climate models continue to produce predictions which match the observed historical temperature record. 4) The oceans play a major role in the climate system, producing short-term temperature variability on the order of years to decades. 5) Whether or not the pause exists, there is no scientific basis for questioning the existence of global warming driven by anthropogenic greenhouse gas emissions.

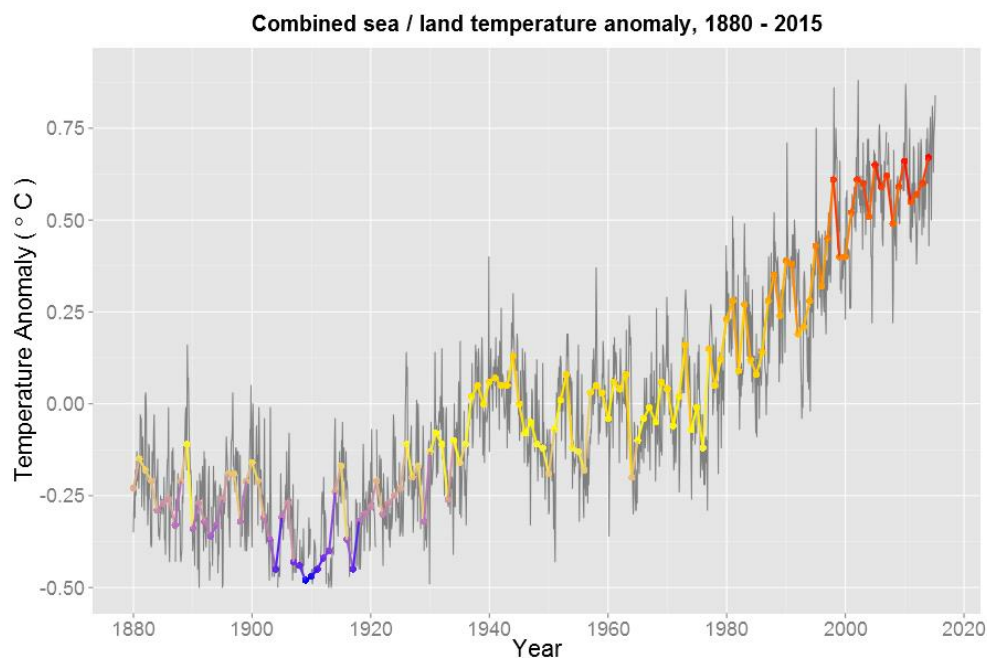


Figure 1. Global warming pauses have occurred at least three times over the past century. The yellow/red line shows the increase in average annual global temperature from 1880 to 2015. Zero on the y-axis represents the average baseline temperature between 1951 and 1980. The gray line shows more detailed monthly temperatures. Data from NASA-GISS.

⁷ IPCC Fifth Assessment Report Technical Summary. (2013)

⁸ For example, “Warming Pause Threatens Climate Science And Green Energy Funding”, The Global Warming Policy Forum. <http://www.thegwpcf.com/warming-pause-threatens-climate-science-green-energy-funding/>

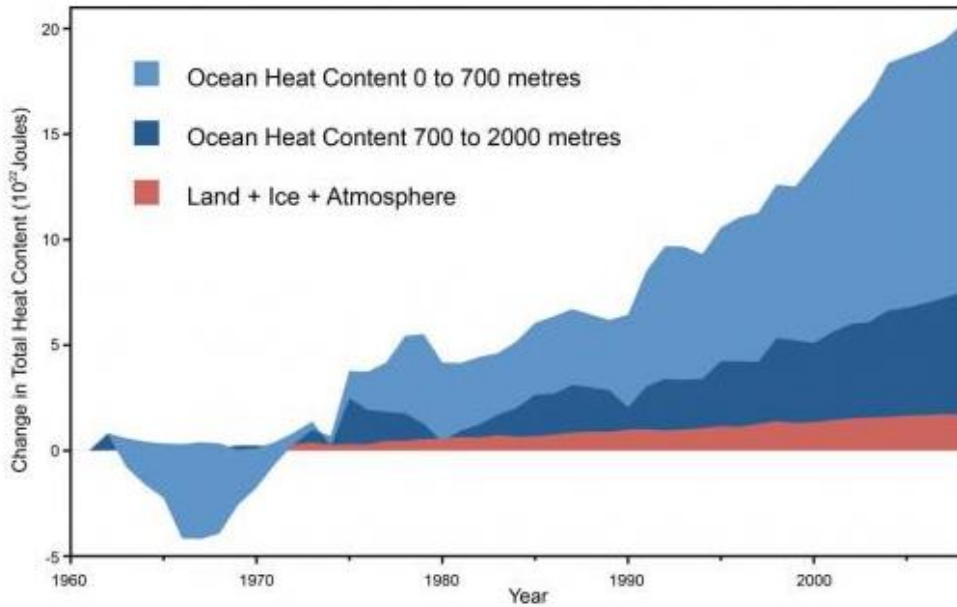


Figure 2. The change in the total heat content of the climate system since 1960, revealing that the oceans absorb 90% of the heat from the Earth's radiative energy imbalance. From Nuccitelli et al., 2012.

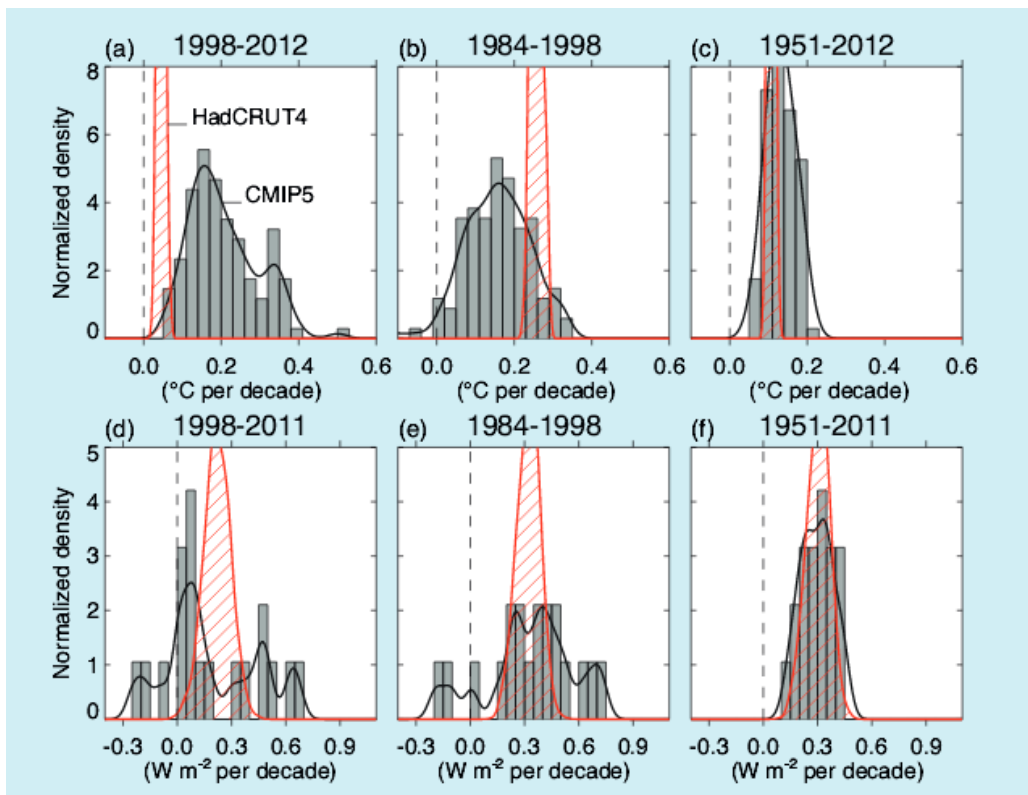


Figure 3. Box (a) reveals that nearly all climate models evaluated by IPCC (grey bars) predict rates of warming that are larger than the observed (but biased and uncorrected) rates (red bar) for the period 1998–2012. Reproduced from Figure 1, BOX TS.3 of the IPCC Fifth Assessment Report Technical Summary.