WARMING INTERRUPTUS
Causes for the Pause

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GWPF Note 8

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About the author

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Warming Interruptus

What is the reason for the lack of warming observed at the surface of the Earth since about 1997? Many causes have been proposed, and with increasing frequency, but most only represent partial explanations. There are clearly more putative causes than can possibly be the case.

The pause has given climate science several things. It has provided a reassessment of the importance of natural climatic variability and its relationship to human influences on the climate. It has also shed light on the role of so-called sceptics as well as the successes and failures of climate communication.

Here are the current explanations for what has been called the biggest problem in climate science.

There is no pause

Some argue that the pause does not exist and that the warming trend seen to commence around 1980 has continued linearly with predictable variance around the mean. Of course it is possible to draw a straight line through most sets of data and attempt to justify it. However the length of the pause – 17 years – means that it cannot reasonably be regarded as part of a linear trend since 1980, so this explanation no longer works.[1]

Low solar activity

Placing the role of solar activity in recent climate has been problematical. It is obvious that that periods of low solar activity in the past have coincided with cooler climatic conditions. Examples include the Dalton solar minimum around 1800 and the Maunder minimum in the 17th century (now shown to undoubtedly be a global event). Prior to about 1960 solar activity played a major role in the Earth's climate, but in recent decades the IPCC has declared that it plays only a minor part, being dwarfed by human influences on the climate. So what is to be made of the recent decline in solar activity from the relatively high levels in the late 20th century? Some believe that the sun is entering a lengthy period of low activity as it has done in the past. Curiously, the commencement of that low activity coincides with the pause in global surface temperature. There are indications that almost all climate models underplay the effect of solar activity. Some have asked how, if the slight increase in total solar irradiance over the past 30 years cannot cause the warming, it can have contributed to the pause. This effect is likely to be relatively short lived.[2]

As one paper on the subject put it:

> The purpose of this communication is to demonstrate that the reduced rate in the global temperature rise complies with expectations related to the decaying level of solar activity according to the relation published in an earlier analysis Without the reduction in the solar activity-related contributions the global temperatures would have increased steadily from 1980 to present.

The IPCC Fifth Assessment report estimates that despite the decline in solar output since 2000, total warming influences have increased faster since 1998 than over 1951–1998 or 1971–1998.

The heat is in the oceans

The most cited explanation for the pause is that the warming has gone into the oceans, and indeed the oceans are expected to absorb far more energy from the greenhouse effect than the land. But while the oceans have warmed in the past few decades, the extent to which this is due to mankind is debateable and the ocean heat content data is not behaving as some expected.

The best data we have is from the ARGO project. It goes back ten years and shows no warming in the uppermost layers of the oceans, and only modest warming down to 1800 m. If more heat is there it must be at deeper levels, where it is far harder to detect, and where it may well be locked out of the way for a thousand years.[3]

Pacific decadal oscillation/Atlantic multidecadal oscillation

The Pacific decadal oscillation (PDO) switches from warm to cool every 30 years or so. It went positive in 1976–98 and has been mostly negative since about 2000. Given the Pacific's postulated influence on global climate this might indicate that the pause will continue until the PDO changes again, which will be in 15–20 years. A similar effect has also been suggested for the 60–70-year Atlantic multidecadal oscillation.[4]

Stratospheric water vapour

A very interesting paper suggests that natural variations in stratospheric water vapour could be responsible for about a third of the 1980–98 warming phase. Lead author Susan Solomon, of the US National Oceanic and Atmospheric Administration, said:

> Current climate models do a remarkable job on water vapour near the surface. But this is different – it's a thin wedge of the upper atmosphere that packs a wallop from one decade to the next in a way we didn't expect.

Solomon and her co-authors concluded that decreases in stratospheric water vapor concentrations acted to slow the rate of increase in global surface temperature over 2000–9 by about 25% compared to the warming that would have occurred due only to carbon dioxide and other greenhouse gases.

More limited data suggest that stratospheric water vapour probably increased between 1980 and 2000, which would have enhanced the decadal rate of surface warming during the 1990s by about 30% compared to estimates neglecting this change.[5] However, the IPCC Fifth Assessment report shows very little warming from stratospheric water vapour over 1980–2000 and no cooling from it over 2000–2010.

Chinese coal

Kaufman et al. (2012) suggest that the increased burning of coal in China is producing aerosols that are cooling the world. Others suggest this conclusion uses computer model data that has been cherrypicked to give the required result. It also does not include the latest solar data.[6,7] Moreover, the IPCC Fifth Assessment report does not support this finding.

The Pacific and the La Niñas

Some scientists suggest that recent cooling in the eastern equatorial Pacific reconciles climate simulations and observations. Although they consider only 8.2% of the global surface they maintain that their computer model reproduces the annual-mean global temperature remarkably well for 1970–2012, a period that includes the current hiatus and a period of accelerated global warming. They postulate that the pause is part of natural climate variability, tied to a La-Niña-like decadal cooling. Although similar decadal hiatus events may occur in the future, they say, the multidecadal warming trend is very likely to continue due to man's influence on the climate. [8]

Stadium waves

In this idea the extent of sea ice in the Eurasian Arctic enhances or dampens the long-term trend in rising temperature. Such changes introduce a low-frequency climate signal, which propagates across the Northern Hemisphere through a network of synchronised climate indices. The tempo of its propagation is rationalised in terms of the multidecadal component of Atlantic Ocean variability – the Atlantic multidecadal oscillation. The authors of the stadium wave paper say, 'the Eurasian Arctic Shelf-Sea Region, where sea ice is uniquely exposed to open ocean in the Northern Hemisphere, emerges as a strong contender for generating and sustaining propagation of the hemispheric signal'. This explanation suggests that the pause should end in the 2030s.[9]

Arctic stations

Could it be that the pause is an artefact of poor spatial sampling? This is the suggestion from Cowtan and Way (2013). They compare different ways of accounting for the lack of weather-station data in various regions of the globe, principally the Arctic. They maintain that when the data are infilled the pause goes away and that the warming rate is similar to that seen in the 1990s.

The problem with this approach is that it involves creating a hybrid dataset using different infilling techniques for different regions, leaving it open to suggestions of cherrypicking. [10,11]

Pacific trade winds

According to some scientists a key component of the pause has been identified as the cool eastern-Pacific sea-surface temperature, even though it is not clear how this ocean has remained cool despite the long-term warming effect on the climate due to human activity. It is contended that there has been a strengthening in Pacific trade winds over the past two decades that has not been factored into climate models and that when these changes are made the effect is sufficient to account for the cooling of the tropical Pacific and a substantial slowdown in surface warming through increased subsurface ocean heat uptake. The scientists who suggest this have used model-based ocean temperature 'reanalyses', not measurements, and the mechanism involved implies the heat uptake in the top few hundred metres of the ocean should have increased during the pause, but measurements suggest otherwise.[12]

Note also that a few years ago other scientists were suggesting the opposite: that weak trade winds were responsible for the pause.[13]

Volcanoes

Since Mt Pinatubo in 1991 there have been no volcanic eruptions sufficiently large to obviously reduce global temperatures. However, it has been argued that there has been a number of smaller eruptions, the cumulative effect of which might partly account for the pause. This is the argument of Santer et al. (2014). However, these authors estimate this is likely to have caused only a 15% reduction in the temperature trend since 1998, only a fraction of the actual reduction.[14,15]

A coincidence!

It has been suggested that the computer climate predictions are running too warm because they are not properly accounting for volcanic aerosols, aerosols in general, solar activity and the effects of El Niños. In a recent *Nature* commentary, Schmidt et al. suggest that, taking these climatic influences together, they can completely explain the pause. The problem with this approach is that other influences are ignored and a non-unique combination of factors has been cherrypicked to provide the explanation.[16]

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Notes

[1] http://www.lse.ac.uk/GranthamInstitute/Media/Commentary/2012/october/myth-that-global-warming-stopped-in-mid-1990s.aspx.

[2] http://www.scirp.org/journal/PaperInformation.aspx?PaperID=41752.

[3] http://onlinelibrary.wiley.com/store/10.1002/2013EF000165/asset/eft24.pdf.

[4] http://www.pnas.org/content/110/6/2058.full.pdf.

[5] http://www.thegwpf.org/water-vapour-and-the-recent-global-temperature-hiatus/.

[6] http://wattsupwiththat.files.wordpress.com/2011/07/pnas-201102467.pdf.

[7] http://www.cawcr.gov.au/staff/jma/Decadal.trends.Meehl.JClim.2013.pdf.

[8] http://www.nature.com/nature/journal/vaop/ncurrent/full/nature12534.html.

[9] http://judithcurry.com/2013/10/10/the-stadium-wave/.

[10] http://www.thegwpf.org/pause/.

[11] http://onlinelibrary.wiley.com/doi/10.1002/qj.2297/abstract.

[12] http://www.thegwpf.org/pacific-pause/.

[13] http://www.nature.com/nature/journal/v441/n7089/abs/nature04744.html.

[14] http://www.thegwpf.org/volcanoes-20-year-pause/.

[15] http://www.nature.com/ngeo/journal/v7/n3/full/ngeo2098.html.

[16] http://www.nature.com/ngeo/journal/v7/n3/full/ngeo2105.html.

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