



Pacific Institute
for Climate Solutions
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Issues Brief #1: Clarity over the Global Warming “Hiatus”

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Issue

The past decade has been the warmest on record globally since modern meteorological records began around the year 1850. In fact, each of the last three decades has been warmer than its predecessor. This comes despite the **rate of increase in global average surface temperature** since the late 1990's being less than that of previous decades, resulting in use of the term “hiatus” to describe this recent trend.

It is important to note that surface temperature is not the only parameter that responds to heat-trapping greenhouse gases (GHG's) and that there are aspects of human-induced climate change have been proceeding without pause - for example, melting glaciers, Arctic sea-ice area decreasing and sea levels rising. A substantial portion of the trapped heat (about 90 per cent) is being absorbed by the ocean. As demonstrated by climate models, the [long-term trend of global warming](#) is unequivocal.

What does affect short-term variability is the natural climate. The sun's radiation output and volcanoes have predominantly been in phases that would cause cooling since the late 1990's, as has the dominant La Niña. Climate scientists warn that a return to warmer El Niño conditions could reverse heat penetration into the ocean. When this happens, the global average surface temperature may likely rise at an unprecedented rate.

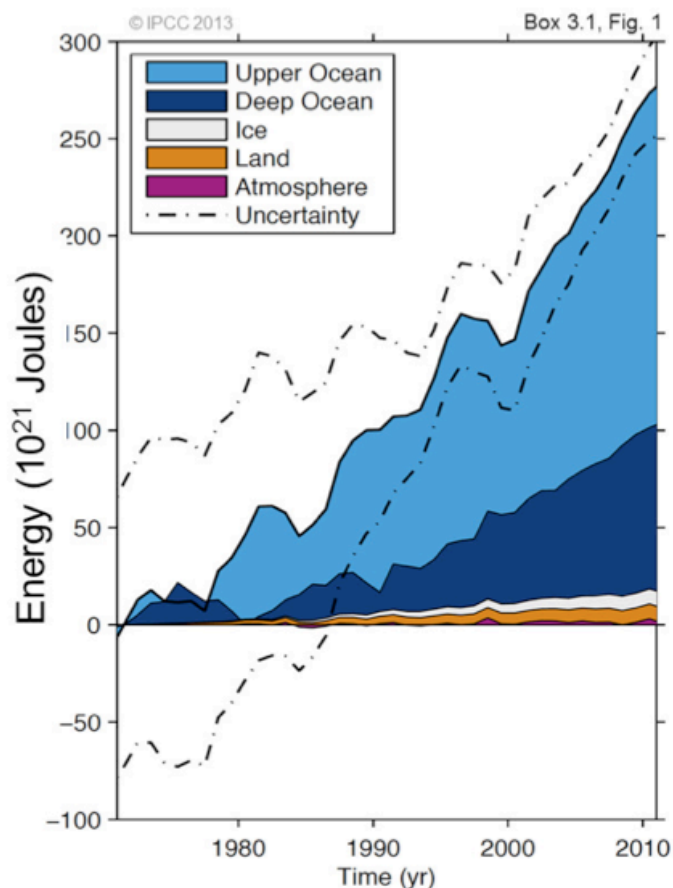
Background

Earlier this year researchers announced that observed global warming over the past 20 years had been significantly less than projected by sophisticated climate models. However, those same models produced simulations that were quite accurate over the longer 1900-2012 period. So why was the long-term projection accurate, while the short-term picture appeared to “miss” the hiatus? The answer is straightforward: Despite taking natural climate variation into consideration, climate models are not capable of reproducing or anticipating the precise timing of random events, such as the following, all of which were at play during this period:

First, the influence of a [predominantly cooling](#) La Niña phase. Major El Niño events, which bathe the eastern tropical Pacific with a widespread, thin layer of very warm water that radiates heat to the atmosphere and drives up global temperature, have been largely absent since the then-record warm year associated with the 1997-98 El Niño.

Second, [solar output](#) has slightly declined. From 2005 to 2010 the sun went into a quiet phase, reducing by a very small but measureable amount the solar energy reaching Earth. Another small contributor to surface cooling is volcanic aerosol increases from small tropical volcano eruptions over the past 15 years, which reflect sunlight and modify clouds.

An important third factor has been the uptake of heat by the ocean. A growing number of recent analyses show that more than 90 percent of warming in the past 50 years has gone into the sea. And in the past decade about 30% of the heat has been driven down to depths below 700 m, largely due to surface wind variability changing ocean heat vertical distribution.



The accumulation of heat in the world's oceans over the last 40 years is shown in this figure, which has been compiled predominantly from thermometer measurements made from ships in the 20th Century and more recently from an array of self-propelled "ARGO floats", now 3600 in number, that since the year 2000 have made temperature measurements from the surface to 2000 m water depth, and relayed the millions of such measurements via satellites to land stations. The ARGO data clearly show the rate at which heat has been accumulating in the upper (top 700 m) and "deep" (700-2000 m) ocean globally. The figure is taken from the IPCC 5th Assessment Report (Box 3.1, Figure 1), released on September 30, 2013. Heat energy is reported in the figure in units of ZetaJoules (1 ZJ = 10²¹ Joules) where 1 Joule is equivalent to the amount of work required to produce one watt of power for one second.

Recommendations

Planners and policy-makers should be aware that there will almost certainly be a renewed increase in the rate of warming in coming years. Some of the heat that has penetrated into the upper ocean will be re-radiated back into the atmosphere during the next El Niño. But in addition, a lot of the heat being stored in the sea will stay there and contribute to the overall warming of the deep sea. While this can mean less warming at the surface in the short term, it will lead to greater warming over the long-term. Moreover, water expands when it warms, so the progressive penetration of heat into the sea will drive sea level inexorably upward.

The Secretary-General of the World Meteorological Organization, Michel Jarraud, recently captured the essence of the 'hiatus issue' well, noting that, "The last decade was the warmest, by a significant margin. If anything we should not talk about the plateau, we should talk about the [coming] acceleration."

Conclusion

While natural climate variability will continue to impact both year-to-year surface temperatures and deliver episodic severe weather events, the overall long-term trend is rising temperatures over land and sea and at depth in the ocean. This year saw the atmospheric carbon dioxide concentration exceed 400 parts per million for the first time in at least 800,000 years, a direct consequence of the burning of fossil fuels and deforestation. During the recent UN Climate talks in Warsaw the World Meteorological Organization announced that [2013 is tracking to be the 7th warmest year](#) since records began in 1850. Ongoing global warming is both unequivocal and a reflection of large-scale human influence on the planetary climate system.

References

- IPCC Fifth Assessment Report ([AR5](#))
- World Meteorological Organization - [The Global Climate 2001-2010, A Decade of Climate Extremes](#), July 2013
- Skeptical Science: Senior scientist [Kevin Trenberth](#), National Center for Atmospheric Research, May 2013
- [Pacific Climate Impacts Consortium](#), August 2013
- Nature Climate Change 3 – [Overestimated global warming over the past 20 years](#), Aug. 2013
- National Aeronautics and Space Administration ([NASA](#))

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