

75, indicating that C108 is contributing but not crucial for catalysis. In contrast, mutating cysteine 265 to alanine resulted in complete loss of activity (Fig. 4C). These findings are in agreement with β -elimination demanding only one proton abstraction (as opposed to isomerization) and with C265 acting as the catalytic base.

The *E. huxleyi* genome has 7 *Alma* paralogs (see the SM) (Fig. 4A) (16). However, the transcriptome analysis indicates that *Alma1* is by far the most highly expressed *Alma* gene in HL373 (≥ 40 times as much as all other paralogs) (Fig. 3). There appear to be four clades of *Alma* paralogs, with *Alma3/6* and *Alma7* (Clade A) being most closely related to *Alma* genes from *Phaeocystis antarctica*, another bloom-forming algal species that possesses high DMSP lyase activity and large DMS emissions (20, 22). Clade A (Fig. 4A) also includes key algal species that are known to possess high DMSP lyase activity, dinoflagellates (e.g., *Symbiodinium* sp., a coral symbiont), other haptophytes (e.g., *Prymnesium parvum*) (20, 30), and coral orthologs (*Acropora millepora*). Although DMSP can also be produced by corals (31), DMSP lyase activity is thought to be associated with symbiotic algae and/or associated bacteria and not with the coral itself (32). Within clade B (Fig. 4A), several *Alma* genes were found to have two *Alma1*-like domains fused in tandem, including *E. huxleyi Alma4/5* and the *Chrysochromulina polylepis* gene. Clade C (Fig. 4A) includes *E. huxleyi Alma1* and *Alma2* that also appear in the closely related *Isochrysis*. The more distant clade D comprises bacterial genes with $\sim 30\%$ identity to *Alma1*, but its relevance is yet to be determined. We synthesized five genes from across the phylogenetic tree and expressed them in *E. coli* (see the SM). Two genes, *E. huxleyi Alma2* (clade C) and *Symbiodinium-A1* (clade A) were expressed at low levels, yet exhibited lyase activity upon feeding DMSP to *E. coli* culture (fig. S10). However, these two enzymes were not sufficiently stable to be purified.

The identification of the family members of the newly identified algal DMSP lyase in a wide range of marine organisms would enable better understanding of the physiological and signaling roles of DMS in algal resistance to viral infection, predation (5), and commensal (14) and symbiotic interaction (31). Although it is clear that DMS production by bacteria DMSP lyases has a fundamental role in the oceanic sulfur and carbon cycles, the newly revealed algal enzyme may allow quantification of the relative biogeochemical contribution of algae and bacteria to the global DMS production.

REFERENCES AND NOTES

- W. Sunda, D. J. Kieber, R. P. Kiene, S. Huntsman, *Nature* **418**, 317–320 (2002).
- E. Garcés, E. Alacá, A. Refiñ, K. Petrou, R. Simó, *ISME J.* **7**, 1065–1068 (2013).
- M. Garren *et al.*, *ISME J.* **8**, 999–1007 (2014).
- J. Decelle *et al.*, *Proc. Natl. Acad. Sci. U.S.A.* **109**, 18000–18005 (2012).
- G. V. Wolfe, M. Steinke, G. O. Kirst, *Nature* **387**, 894–897 (1997).
- A. J. Kettle, M. O. Andreae, *J. Geophys. Res. Atmos.* **105** (D22), 26793–26808 (2000).
- R. J. Charlson, J. E. Lovelock, M. O. Andreae, S. G. Warren, *Nature* **326**, 655–661 (1987).
- P. K. Quinn, T. S. Bates, *Nature* **480**, 51–56 (2011).
- J. R. Seymour, R. Simó, T. Ahmed, R. Stocker, *Science* **329**, 342–345 (2010).
- M. S. Savoca, G. A. Nevitt, *Proc. Natl. Acad. Sci. U.S.A.* **111**, 4157–4161 (2014).
- A. R. Curson, J. D. Todd, M. J. Sullivan, A. W. Johnston, *Nat. Rev. Microbiol.* **9**, 849–859 (2011).
- C. R. Reisch, M. A. Moran, W. B. Whitman, *Front Microbiol.* **2**, 172 (2011).
- M. A. Moran, C. R. Reisch, R. P. Kiene, W. B. Whitman, *Annu. Rev. Mar. Sci.* **4**, 523–542 (2012).
- R. Simó, *Trends Ecol. Evol.* **16**, 287–294 (2001).
- W. M. Balch, P. M. Holligan, S. G. Ackleson, K. J. Voss, *Limnol. Oceanogr.* **36**, 629–643 (1991).
- B. A. Read *et al.*, *Nature* **499**, 209–213 (2013).
- M. Steinke, G. V. Wolfe, G. O. Kirst, *Mar. Ecol. Prog. Ser.* **175**, 215–225 (1998).
- G. L. Cantoni, D. G. Anderson, *J. Biol. Chem.* **222**, 171–177 (1956).
- M. P. de Souza, Y. P. Chen, D. C. Yoch, *Planta* **199**, 433–438 (1996).
- J. Stefels, L. Dijkhuizen, *Mar. Ecol. Prog. Ser.* **131**, 307–313 (1996).
- M. Nishiguchi, L. J. Goff, *J. Phycol.* **31**, 567–574 (1995).
- B. R. Mohapatra, A. N. Rellinger, D. J. Kieber, R. P. Kiene, *Aquat. Biol.* **18**, 185–195 (2013).
- J. Stefels, *J. Sea Res.* **43**, 183–197 (2000).
- B. R. Lyon, P. A. Lee, J. M. Bennett, G. R. DiTullio, M. G. Janech, *Plant Physiol.* **157**, 1926–1941 (2011).
- U. Alcolombri, P. Laurino, P. Lara-Astiaso, A. Vardi, D. S. Tawfik, *Biochemistry* **53**, 5473–5475 (2014).
- J. D. Todd *et al.*, *Science* **315**, 666–669 (2007).
- P. von Dassow *et al.*, *Genome Biol.* **10**, R114 (2009).
- S. D. Rokitta *et al.*, *J. Phycol.* **47**, 829–838 (2011).
- U. Alcolombri, M. Elias, A. Vardi, D. S. Tawfik, *Proc. Natl. Acad. Sci. U.S.A.* **111**, E2078–E2079 (2014).
- A. M. N. Caruana, G. Malin, *Prog. Oceanogr.* **120**, 410–424 (2014).
- J. B. Raina *et al.*, *Nature* **502**, 677–680 (2013).
- J. B. Raina, E. A. Dinsdale, B. L. Willis, D. G. Bourne, *Trends Microbiol.* **18**, 101–108 (2010).

ACKNOWLEDGMENTS

We thank S. Albeck for assistance with the gel filtration analysis, S. Rosenwasser for important insights regarding the transcriptome de novo construction, U. Sheyn for assistance with the experimental setup for the transcriptome, A. Admon for mass spectrometry, P. Laurino for the nuclear magnetic resonance analysis, R. Hashayev for technical assistance with fractionation, and S. Graff for the graphic design. We gratefully acknowledge financial support from the Sasson and Marjorie Peress Philanthropic Fund to D.S.T. and from the European Research Council (ERC) StG (INFOTROPIC grant 280991) to A.V. All data are available in the supplementary materials. Transcriptome sequences are deposited in NCBI's Sequence Read Archive, BioProjectID PRJNA283462. Author contributions: U.A., D.S.T., and A.V. conceived the project, designed the experiments, analyzed the data, and wrote the paper. U.A. performed the experiments. S.B.-D. and E.F. performed the transcriptome analyses. Y.L. performed the shotgun proteomics.

SUPPLEMENTARY MATERIALS

www.sciencemag.org/content/348/6242/1466/suppl/DC1
Materials and Methods
Figs. S1 to S10
Tables S1 to S3
References (33–41)

19 March 2015; accepted 15 May 2015
10.1126/science.aab1586

CLIMATE CHANGE

Possible artifacts of data biases in the recent global surface warming hiatus

Thomas R. Karl,^{1*} Anthony Arguez,¹ Boyin Huang,¹ Jay H. Lawrimore,¹ James R. McMahon,² Matthew J. Menne,¹ Thomas C. Peterson,¹ Russell S. Vose,¹ Huai-Min Zhang¹

Much study has been devoted to the possible causes of an apparent decrease in the upward trend of global surface temperatures since 1998, a phenomenon that has been dubbed the global warming “hiatus.” Here, we present an updated global surface temperature analysis that reveals that global trends are higher than those reported by the Intergovernmental Panel on Climate Change, especially in recent decades, and that the central estimate for the rate of warming during the first 15 years of the 21st century is at least as great as the last half of the 20th century. These results do not support the notion of a “slowdown” in the increase of global surface temperature.

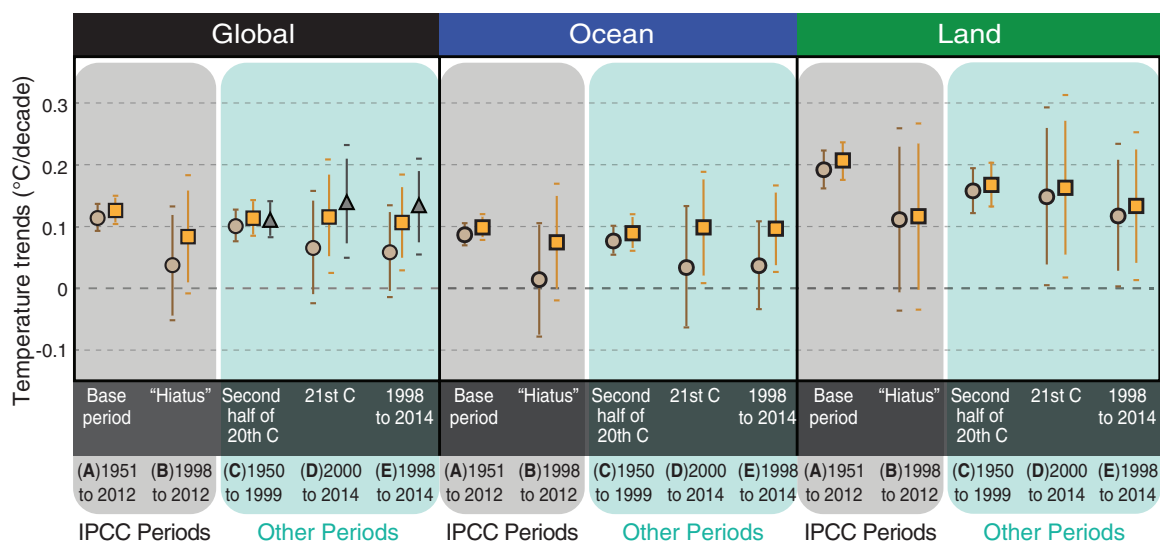
The Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (1) concluded that the global surface temperature “has shown a much smaller increasing linear trend over the past 15 years [1998–2012] than over the past 30 to 60 years.” The more recent trend was “estimated to be around one-third to one-half of the trend over 1951–2012.” The apparent slowdown was termed

a “hiatus” and inspired a suite of physical explanations for its cause, including changes in radiative forcing, deep ocean heat uptake, and atmospheric circulation changes (2–12). Although these analyses and theories have considerable merit in helping to understand the global climate system, other important aspects of the “hiatus” related to observational biases in global surface temperature data have not received similar attention. In particular, residual data biases in the modern era could well have muted recent warming, and as stated by IPCC, the trend period itself was short and commenced with a strong El Niño

¹National Oceanographic and Atmospheric Administration (NOAA), National Centers for Environmental Information (NCEI), Asheville, NC 28801, USA. ²LMI, McLean, VA, USA.
*Corresponding author. E-mail: thomas.r.karl@noaa.gov

Fig. 1. Effect of new analysis on global surface temperature trends for several periods.

Temperature trends are shown for data with the “new” analysis (squares) and “old” analysis (circles) for several periods of interest. Also indicated are global values calculated with the new corrections and the polar interpolation method (triangles). Consistent with the IPCC report (1), the error bars represent the 90% confidence intervals (CIs). The additional error associated with uncertainty of our corrections extends the 90% CI and is depicted with a horizontal dash. (A and B) The base period (1951–2012) and “hiatus” period used in IPCC (1). (C) An alternate base period, the second half of the 20th century. (D) The 21st century through 2014. (E) 1998 (a strong El Niño year) through the 21st century. Source data are provided in table S1.



The additional error associated with uncertainty of our corrections extends the 90% CI and is depicted with a horizontal dash. (A and B) The base period (1951–2012) and “hiatus” period used in IPCC (1). (C) An alternate base period, the second half of the 20th century. (D) The 21st century through 2014. (E) 1998 (a strong El Niño year) through the 21st century. Source data are provided in table S1.

in 1998. Given recent improvements in the observed record (13, 14) and additional years of global data (including a record-warm 2014), we reexamine the observational evidence related to a “hiatus” in recent global surface warming.

The data used in our long-term global temperature analysis primarily involve surface air temperature observations taken at thousands of weather-observing stations over land, and for coverage across oceans, the data are sea surface temperature (SST) observations taken primarily by thousands of commercial ships and drifting surface buoys. These networks of observations are always undergoing change. Changes of particular importance include (i) an increasing amount of ocean data from buoys, which are slightly different than data from ships; (ii) an increasing amount of ship data from engine intake thermometers, which are slightly different than data from bucket seawater temperatures; and (iii) a large increase in land-station data, which enables better analysis of key regions that may be warming faster or slower than the global average. We address all three of these, none of which were included in our previous analysis used in the IPCC report (1).

First, several studies have examined the differences between buoy- and ship-based data, noting that the ship data are systematically warmer than the buoy data (15–17). This is particularly important because much of the sea surface is now sampled by both observing systems, and surface-drifting and moored buoys have increased the overall global coverage by up to 15% (supplementary materials). These changes have resulted in a time-dependent bias in the global SST record, and various corrections have been developed to account for the bias (18). Recently, a new correction (13) was developed and applied in the Extended Reconstructed Sea Surface Temperature (ERSST) data set version 4, which we used in our analysis. In essence, the bias correction involved

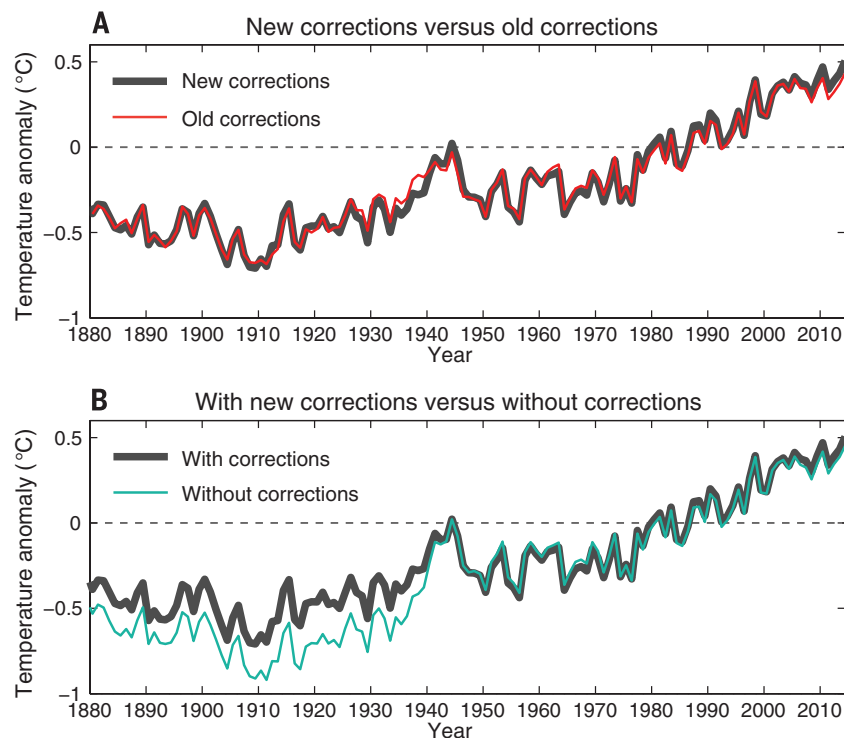


Fig. 2. Global (land and ocean) surface temperature anomaly time series with new analysis, old analysis, and with and without time-dependent bias corrections. (A) The new analysis (solid black) compared with the old analysis (red). (B) The new analysis (solid black) versus no corrections for time-dependent biases (blue).

calculating the average difference between collocated buoy and ship SSTs. The average difference globally was -0.12°C , a correction that is applied to the buoy SSTs at every grid cell in ERSST version 4. [IPCC (1) used a global analysis from the UK Met Office that found the same average ship-buoy difference globally, although the corrections applied in that analysis were equal to differences observed within each ocean basin (18).] More

generally, buoy data have been proven to be more accurate and reliable than ship data, with better-known instrument characteristics and automated sampling (16). Therefore, ERSST version 4 also considers this smaller buoy uncertainty in the reconstruction (13).

Second, there was a large change in ship observations (from buckets to engine intake thermometers) that peaked around World War II. The

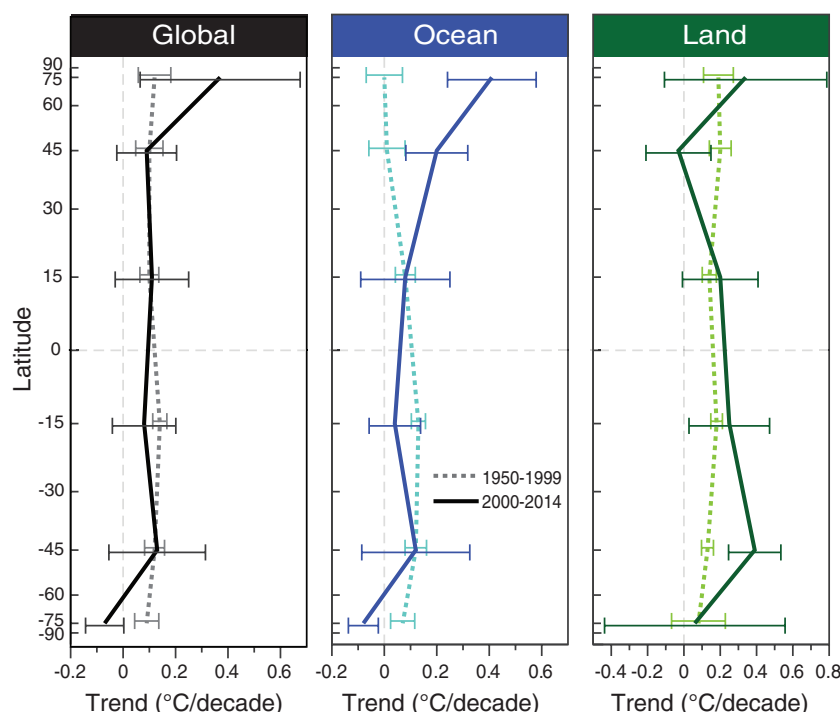


Fig. 3. Latitudinal profiles of surface temperature trends. Zonal mean trends and statistical uncertainty of the trend estimates for global, ocean, and land surface temperature, averaged in 30° latitudinal belts, for the second half of the 20th century (dashed) compared with the past 15 years (solid). Trends are cosine-weighted within latitude belts, and the vertical axis is on a sine scale so as to reflect the proportional surface area of the latitude bands. Only the uncertainty related to the trend estimates is provided because zonal standard errors of estimate are not available in contrast to the global averages.

previous version of ERSST assumed that no ship corrections were necessary after this time, but recently improved metadata (18) reveal that some ships continued to take bucket observations even up to the present day. Therefore, one of the improvements to ERSST version 4 is extending the ship-bias correction to the present, based on information derived from comparisons with night marine air temperatures. Of the 11 improvements in ERSST version 4 (13), the continuation of the ship correction had the largest impact on trends for the 2000–2014 time period, accounting for 0.030°C of the 0.064°C trend difference with version 3b. [The buoy offset correction contributed 0.014°C decade⁻¹ to the difference, and the additional weight given to the buoys because of their greater accuracy contributed 0.012°C decade⁻¹ (supplementary materials).]

Third, there have also been advancements in the calculation of land surface air temperatures (LSTs). The most important is the release of the International Surface Temperature Initiative (ISTI) databank (14, 19), which forms the basis of the LST component of our new analysis. The ISTI databank integrates the Global Historical Climatology Network (GHCN)–Daily data set (20) with more than 40 other historical data sources, more than doubling the number of stations available. The resulting integration improves spatial coverage over many areas, including the Arctic, where temperatures have increased rapidly in recent decades (1). We applied the same methods used in our old analysis for quality control, time-

dependent bias corrections, and other data processing steps (21) to the ISTI databank in order to address artificial shifts in the data caused by changes in, for example, station location, temperature instrumentation, observing practice, urbanization, and siting conditions. These corrections are essentially the same as those used in the GHCN–Monthly version 3 data set (22, 23), which is updated operationally by the National Oceanographic and Atmospheric Administration's (NOAA's) National Centers for Environmental Information (NCEI). To obtain our new global analysis, the corrected ISTI land data (14) were systematically merged with ERSST version 4 (13), as described in the supplementary materials.

In addition to the three improvements just discussed, since the IPCC report (1) new analyses (24) have revealed that incomplete coverage over the Arctic has led to an underestimate of recent (since 1997) warming in the Hadley Centre/Climate Research Unit data used in the IPCC report (1). These analyses have surmised that incomplete Arctic coverage also affects the trends from our analysis as reported by IPCC (1). We address this issue as well.

Temperature trends in our old analysis and our new analysis are depicted in Fig. 1, supplemented with polar interpolation. (In this discussion, “old” refers to the analysis based on ERSST version 3b for ocean areas and GHCN–Monthly version 3 for land areas). For the most recent IPCC period (1998–2012), the new analysis ex-

hibits more than twice as much warming as did the old analysis at the global scale (0.086° versus 0.039°C decade⁻¹) (table S1). This is clearly attributable to the new SST analysis, which itself has much higher trends (0.075° versus 0.014°C decade⁻¹). In contrast, trends in the new LST analysis are only slightly higher (0.117° versus 0.112°C decade⁻¹).

IPCC (1) acknowledged that trends since 1998 were tenuous because the period was short and commenced with a strong El Niño. Two additional years of data are now available to revisit this point, including a record-warm 2014, and trends computed through 2014 confirm the IPCC supposition. Specifically, the central trend estimate in our new analysis for 1998–2014 is 0.020°C decade⁻¹ higher as compared with 1998–2012. Likewise, global trends for 2000–2014 are 0.030°C decade⁻¹ higher than for 1998–2012. In other words, changing the start and end date by 2 years does in fact have a notable impact on the assessment of the rate of warming, but less compared with the impact of new time-dependent bias corrections.

Our analysis also suggests that short- and long-term warming rates are far more similar than previously estimated in IPCC's report (1). The difference between the trends in two periods used in IPCC's report (1998–2012 and 1951–2012) (1) is an illustrative metric: The trends for these two periods in the new analysis differ by 0.043°C decade⁻¹ compared with 0.078°C decade⁻¹ in the old analysis reported by IPCC (1). The smaller difference results from more warming in the new ocean analysis since 1998, reflecting the improved bias corrections in ERSST version 4. The new corrections show that the 90% confidence interval for 1998–2012 encompasses the best estimate of the trend for 1951–2012.

Also, the new global trends are statistically significant and positive at the 0.10 significance level for 1998–2012 (Fig. 1 and table S1) by using the approach described in (25) for determining trend uncertainty. In contrast, the IPCC report (1), which also used the approach in (25), reported no statistically significant trends for 1998–2012 in any of the three primary global surface temperature data sets. Moreover, for 1998–2014 our new global trend is $0.106^{\circ} \pm 0.058^{\circ}\text{C decade}^{-1}$, and for 2000–2014, it is $0.116^{\circ} \pm 0.067^{\circ}\text{C decade}^{-1}$ (table S1). This is similar to the warming of the last half of the 20th century (Fig. 1). A more comprehensive approach for determining the 0.10 significance level (supplementary materials), which also accounts for the impact of annual errors of estimate on the trend, shows that the 1998–2014 and 2000–2014 trends (but not 1998–2012) were positive at the 0.10 significance level.

For the full period of record (1880–present) (Fig. 2), the new global analysis has essentially the same rate of warming as that of the previous analysis (0.068°C decade⁻¹ and 0.065°C decade⁻¹, respectively) (table S1), reinforcing the point that the new corrections mainly have an impact in recent decades. However, it is also clear that the long-term trend would be significantly higher (0.085°C decade⁻¹) (Fig. 2B) without corrections for other historical biases, as described in (26).

There are important differences between the latitudinal structure of trends for the second half of the 20th century and for the 21st century (2000–2014) (Fig. 3). For example, the Arctic latitudes have shown strong warming trends both over the land and ocean since 2000, but during the latter half of the 20th century, the ocean trends in this area are near zero. The longer-term 50-year trend has more consistency in the rates of warming across all latitudes, and this is even more evident over the full period of record back to 1880 (fig. S1). There is a distinct Northern Hemisphere mid-latitude cooling in LST during the 21st century, which is also showing up in cooling of the cold extremes, as reported for the extreme minimum temperatures in this zone in (27). Atmospheric teleconnections and regional forcings could be relevant in understanding these short time-scale zonal trends. It is evident that in most latitude bands, the global trends in the past 15 years are comparable with trends in the preceding 50 years.

Last, we considered the impact of larger warming rates in high latitudes (24) on the overall global trend. To estimate the magnitude of the additional warming, we applied large-area interpolation over the poles using the limited observational data available. Results indicate that, indeed, additional global warming of a few hundredths of a degree Celsius per decade over the 21st century is evident (Fig. 1), providing further evidence against the notion of a recent warming “hiatus” (supplementary materials).

Newly corrected and updated global surface temperature data from NOAA’s NCEI do not support the notion of a global warming “hiatus.” As shown in Fig. 1, there is no discernable (statistical or otherwise) decrease in the rate of warming between the second half of the 20th century and the first 15 years of the 21st century. Our new analysis now shows that the trend over the period 1950–1999, a time widely agreed as having significant anthropogenic global warming (1), is $0.113^{\circ}\text{C decade}^{-1}$, which is virtually indistinguishable from the trend over the period 2000–2014 ($0.116^{\circ}\text{C decade}^{-1}$). Even starting a trend calculation with 1998, the extremely warm El Niño year that is often used as the beginning of the “hiatus,” our global temperature trend (1998–2014) is $0.106^{\circ}\text{C decade}^{-1}$ —and we know that is an underestimate because of incomplete coverage over the Arctic. Indeed, according to our new analysis, the IPCC’s (1) statement of 2 years ago—that the global surface temperature “has shown a much smaller increasing linear trend over the past 15 years than over the past 30 to 60 years”—is no longer valid.

REFERENCES AND NOTES

- IPCC, *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, T. F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, P.M. Midgley, Eds. (Cambridge Univ. Press, Cambridge, 2013).
- G. A. Meehl, H. Teng, J. M. Arblaster, *Nature Clim. Change* **4**, 898–902 (2014).
- G. A. Meehl, A. Hu, J. M. Arblaster, J. Fasullo, K. E. Trenberth, *J. Clim.* **26**, 7298–7310 (2013).
- Y. Kosaka, S.-P. Xie, *Nature* **501**, 403–407 (2013).
- M. H. England et al., *Nature Clim. Change* **4**, 222–227 (2014).
- B. D. Santer et al., *Nat. Geosci.* **7**, 185–189 (2014).
- G. A. Schmidt, D. T. Shindell, K. Tsigaridis, *Nat. Geosci.* **7**, 158–160 (2014).
- J. Tollefson, *Nature* **505**, 276–278 (2014).
- M. Watanabe et al., *Geophys. Res. Lett.* **40**, 3175–3179 (2013).
- J. C. Fyfe, N. P. Gillett, *Nature Clim. Change* **4**, 150–151 (2014).
- K. E. Trenberth, J. T. Fasullo, M. A. Balmaseda, *J. Clim.* **27**, 3129–3144 (2014).
- H. Ding, R. J. Greatbatch, M. Latif, W. Park, R. Gerdes, *J. Clim.* **26**, 7650–7661 (2013).
- B. Huang et al., *J. Clim.* **28**, 911–930 (2015).
- J. J. Rennie et al., *Geosci. Data J.* **1**, 75–102 (2014).
- E. C. Kent, J. J. Kennedy, D. I. Berry, R. O. Smith, *Clim. Change* **1**, 718–728 (2010).
- R. W. Reynolds, N. A. Rayner, T. M. Smith, D. C. Stokes, W. Wang, *J. Clim.* **15**, 1609–1625 (2002).
- R. W. Reynolds, D. B. Chelton, *J. Clim.* **23**, 3545–3562 (2010).
- J. J. Kennedy, N. A. Rayner, R. O. Smith, D. E. Parker, M. Saunby, *J. Geophys. Res. Atmos.* **116** (D14), D14104 (2011).
- J. H. Lawrimore, J. J. Rennie, P. W. Thorne, *Eos* **94**, 61 (2014).
- M. J. Menne, I. Durre, R. S. Vose, B. E. Gleason, T. G. Houston, *J. Atmos. Ocean. Technol.* **29**, 897–910 (2012).
- M. J. Menne, C. N. Williams Jr., *J. Clim.* **22**, 1700–1717 (2009).
- J. H. Lawrimore et al., *J. Geophys. Res.* **116** (D19), D19121 (2011).
- C. N. Williams, M. J. Menne, P. W. Thorne, *J. Geophys. Res.* **117** (D5), D05116 (2012).
- K. Cowtan, R. G. Way, *Q. J. Roy. Met. Soc.* **140**, 1935–1944 (2014).
- B. Santer et al., *Int. J. Climatol.* **28**, 1703–1722 (2008).
- T. M. Smith, R. W. Reynolds, *J. Clim.* **16**, 1495–1510 (2003).
- J. Sillman, M. G. Donat, J. C. Fyfe, F. W. Zwiers, *Environ. Res. Lett.* **9**, 064023 (2014).

ACKNOWLEDGMENTS

We thank the many scientists at NCEI and at other institutions who routinely collect, archive, quality control, and provide access to the many complex data streams that go into the computation of the global surface temperature. In particular, we thank T. Boyer, B. Gleason, J. Matthews, J. Rennie, and C. Williams for their contributions to this analysis. We also thank J. Meehl and P. Duffy for constructive comments on an early version of this manuscript.

SUPPLEMENTARY MATERIALS

www.sciencemag.org/content/348/6242/1469/suppl/DC1
Materials and Methods
Fig. S1
Table S1
References (28–38)

23 December 2014; accepted 21 May 2015
Published online 4 June 2015;
10.1126/science.aaa5632

BRAIN CIRCUITS

A parvalbumin-positive excitatory visual pathway to trigger fear responses in mice

Congping Shang,^{1,2} Zhihui Liu,¹ Zijun Chen,^{1,2} Yingchao Shi,^{1,2} Qian Wang,¹ Su Liu,¹ Dapeng Li,¹ Peng Cao^{1*}

The fear responses to environmental threats play a fundamental role in survival. Little is known about the neural circuits specifically processing threat-relevant sensory information in the mammalian brain. We identified parvalbumin-positive (PV⁺) excitatory projection neurons in mouse superior colliculus (SC) as a key neuronal subtype for detecting looming objects and triggering fear responses. These neurons, distributed predominantly in the superficial SC, divergently projected to different brain areas, including the parabrachial nucleus (PBN), an intermediate station leading to the amygdala. Activation of the PV⁺ SC-PBN pathway triggered fear responses, induced conditioned aversion, and caused depression-related behaviors. Approximately 20% of mice subjected to the fear-conditioning paradigm developed a generalized fear memory.

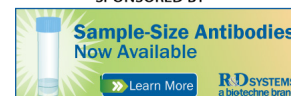
Environmental threats are detected by different sensory organs projecting to central brain areas to trigger fear responses (1, 2). The superior colliculus (SC) is a retinal recipient structure (3, 4) composed of different neuronal subtypes (5, 6), including parvalbumin-positive (PV⁺), somatostatin-positive (SST⁺), and vasoactive intestinal peptide-positive (VIP⁺) neurons (Fig. 1A and fig. S1). In addition to mediating orienting responses (7), the SC contributes to avoidance and defense-like behaviors (8–11).

With an optogenetic approach (12–14), we found that activation of neurons expressing channelrhodopsin-2 (ChR2) in mouse SC triggered freezing that lasted 52.8 ± 5.3 s ($n = 5$ mice) (movie S1). This prompted us to systematically identify the key neuronal subtypes underlying this behavior.

By crossing Ai32 (15) with different Cre lines (Fig. 1B) (16, 17), we expressed ChR2-enhanced yellow fluorescent protein (EYFP) in specific neuronal subtypes in the SC (Fig. 1C and fig. S1) and optogenetically elicited spikes in acute slices (Fig. 1D and fig. S1). Activation of SC PV⁺ neurons, but not SST⁺ or VIP⁺ neurons, triggered impulsive escaping (1.18 ± 0.09 s) followed by long-lasting freezing (46.4 ± 2.8 s) (Fig. 1, E to G; fig. S1; and movie S2). To avoid activation of PV⁺ retinal

¹State Key Laboratory of Brain and Cognitive Sciences, Institute of Biophysics, Chinese Academy of Sciences, Beijing 100101, China. ²University of Chinese Academy of Sciences, Beijing 100049, China.

*Corresponding author. E-mail: pcao@ibp.ac.cn



Possible artifacts of data biases in the recent global surface warming hiatus

Thomas R. Karl *et al.*
Science **348**, 1469 (2015);
DOI: 10.1126/science.aaa5632

This copy is for your personal, non-commercial use only.

If you wish to distribute this article to others, you can order high-quality copies for your colleagues, clients, or customers by [clicking here](#).

Permission to republish or repurpose articles or portions of articles can be obtained by following the guidelines [here](#).

The following resources related to this article are available online at www.sciencemag.org (this information is current as of November 26, 2015):

Updated information and services, including high-resolution figures, can be found in the online version of this article at:

<http://www.sciencemag.org/content/348/6242/1469.full.html>

Supporting Online Material can be found at:

<http://www.sciencemag.org/content/suppl/2015/06/03/science.aaa5632.DC1.html>

A list of selected additional articles on the Science Web sites **related to this article** can be found at:

<http://www.sciencemag.org/content/348/6242/1469.full.html#related>

This article has been **cited by** 3 articles hosted by HighWire Press; see:

<http://www.sciencemag.org/content/348/6242/1469.full.html#related-urls>

This article appears in the following **subject collections**:

Geochemistry, Geophysics

http://www.sciencemag.org/cgi/collection/geochem_phys

The beyond-two-degree inferno

In the history of humankind, there is a dearth of examples of global threats so far-reaching in their impact, so dire in their consequences, and considered so likely to occur that they have engaged all nations in risk mitigation. But now with climate change, we face a slowly escalating but long-enduring global threat to food supplies, health, ecosystem services, and the general viability of the planet to support a population of more than 7 billion people. The projected costs of addressing the problem grow with every year that we delay confronting it. In recognition of the shared risks we face and the collective action that will be necessary, an international meeting of stakeholders will convene in Paris next week (www.commonfuture-paris2015.org), ahead of the United Nations Climate Change Conference (COP21) in December, to discuss solutions for both climate mitigation and adaptation.

The time for debate has ended. Action is urgently needed. The Paris-based International Energy Agency recently announced that current commitments to cut CO₂ emissions [known as Intended Nationally Determined Contributions (INDCs)] from the world's nations are insufficient to avoid warming the entire planet by an average of more than 2°C above the preindustrial level. This is a target viewed as the boundary between climate warming to which we can perhaps adapt and more extreme warming that will be very disruptive to society and the ecosystems on which we depend (see Gattuso *et al.* on p. 45). To set more aggressive targets, developed nations need to reduce their per-capita fossil fuel emissions even further, and by doing so, create roadmaps for developing nations to leapfrog technologies by installing low-CO₂-emitting energy infrastructure rather than coal-fired power plants as they expand their energy capacity.

The European Union (EU) is leading the way with the most aggressive INDC target for reduction: a cut of 40% below 1990 levels of CO₂ emissions by 2030. The United

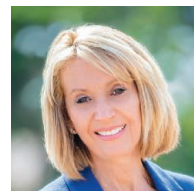
States has pledged reductions of 26 to 28% below 2005 levels by 2025, with California independently choosing to match the EU's more ambitious goal. All eyes are on China and India, two of the largest total emitters of CO₂, both of which have yet to submit their proposed INDCs in advance of COP21. Unfortunately, Piyush Goyal, India's Minister of State for Power, Coal, and New and Renewable Energy, intends to double his nation's coal production by the year 2019 to meet domestic energy requirements. China appears to be taking the opposite track, recognizing its vulnerability to climate change and investing heavily in renewable energy.* Like California, China is betting that good environmental policy will make for good fiscal policy by being in the vanguard of the clean energy economy.

I applaud the forthright climate statement of Pope Francis, currently our most visible champion for mitigating climate change, and lament the vacuum in political leadership in the United States. This is not the time to wait for political champions to emerge. Just as California has decided to go it alone, every sector (transportation, manufacturing, agriculture, construction, etc.) and every

person need to do whatever is possible to reduce carbon pollution by conserving energy, adopting alternative energy technologies, investing in research, and capturing CO₂ at the source.

In Dante's *Inferno*, he describes the nine circles of Hell, each dedicated to different sorts of sinners, with the outermost being occupied by those who didn't know any better, and the innermost reserved for the most treacherous offenders. I wonder where in the nine circles Dante would place all of us who are borrowing against this Earth in the name of economic growth, accumulating an environmental debt by burning fossil fuels, the consequences of which will be left for our children and grandchildren to bear? Let's act now, to save the next generations from the consequences of the beyond-two-degree inferno.

— Marcia McNutt



Marcia McNutt
Editor-in-Chief
Science Journals



*“where [would]...Dante...place
all of us who are borrowing
against this Earth...?”*

*www.bbc.com/news/science-environment-33040965.

Breaking news and analysis from the world of science policy



AAAS

Marcia McNutt

McNutt nomination for U.S. academy will benefit women, climate debate, researchers say

Tweet 114 Share 64 G+1 1

By [Marianne Lavelle \(/author/marianne-lavelle\)](#) 8 July 2015 12:15 pm 6 Comments ([/people-events/2015/07/mcnutt-nomination-u-s-academy-will-benefit-women-climate-debate-researchers#disqus_thread](#))

The naming of *Science* Editor-in-Chief Marcia McNutt as the likely next president of the U.S. National Academy of Sciences (NAS) has won praise as a move that will bolster women in the profession while providing knowledgeable leadership in the policy challenges ahead on climate change.

If McNutt is elected, as expected, she would be the first woman to lead the U.S. government's premier science advisory organization in its 152-year history. And because she is a geophysicist, her rise next year would mark a break for NAS, which by tradition would have selected a new leader from the biological sciences after the two-term presidency of atmospheric scientist Ralph J. Cicerone.

The choice of a second consecutive earth scientist as NAS president marks "a recognition that geoscience is as integral to advancing humanity as physics, chemistry, math, and the other sciences," Christine McEntee, executive director of the American Geophysical Union (AGU) in Washington, D.C., told *ScienceInsider*.

McNutt underscored that importance in offering her own thoughts on the challenge ahead for NAS. "I worry that if society does not take action on the problem of climate change within the next few years, it will be too late to make a meaningful difference in emissions before unacceptable consequences are a foregone conclusion," she wrote in an email. "My goal as NAS president would be to spur serious action on mitigation and adaptation, showing U.S. leadership in technology choices and policy solutions that can be widely adopted."

McNutt said that initially she was a member of the nominating committee to vet candidates for the NAS presidency, but she missed the first meeting due to a conflict. After that session, the group's chair, Barbara Schaal, dean of the

faculty of arts and sciences and a biologist at Washington University in St. Louis in Missouri, asked McNutt if she would be willing to step down from the committee so that she could be considered as a candidate instead.

"I thought it was very much a long shot that I would ever be asked to ever do the job, if for no other reason than the academy's long-standing tradition of alternating the presidency between the physical and biological sciences," McNutt wrote. "It was biology's 'turn.' But I said yes just because I was honored simply to have my name discussed in the same association with so many distinguished scientific leaders."

The NAS Council said that it approved McNutt's nomination after a 6-month search. Her name will be presented to the full NAS membership for formal ratification on 15 December, the council said. Under the academy's bylaws, other candidates could be nominated for the presidency by NAS members, but that has never happened since the advisory organization was established by Congress in 1863.

Environmental microbiologist Rita Colwell, the former head of the National Science Foundation who chairs the National Academies of Sciences' Engineering, and Medicine's Committee on Women in Science, Engineering, and Medicine, said that she and fellow committee members are "ecstatic" about McNutt's nomination.

"It's historic, in that a very conservative organization is bursting into the 21st century," Colwell said. Citing McNutt's long record, including teaching at the Massachusetts Institute of Technology, serving as chief executive of the Monterey Bay Aquarium Research Institute in California and, later, as director of the U.S. Geological Survey (USGS), Colwell said, "Marcia has the credentials that will alleviate the unease that will occur among some of the more staid and arch-conservative members."

Colwell, a former president of AAAS, publisher of *Science*, praised the leadership of Cicerone and said that it is significant that the NAS Council selected another expert on Earth systems to follow his tenure. "I would say it points to a need for leadership in addressing the most difficult issues we face on a global basis," said Colwell, who holds joint professorships at the University of Maryland and Johns Hopkins University in Baltimore, Maryland. "Climate change, energy, distribution and supply of water, and agriculture—these are the major challenges of the 21st century, and we'll have a leader at the national academy who understands these."

McEntee, of AGU, recalled that when McNutt served as president of AGU, from 2000 to 2002, she began a President's Club to bring together former and current AGU leaders to share knowledge and ideas to help the organization, McEntee recalled. About 4 years ago, McEntee said that McNutt teamed up with marine ecologist Jane Lubchenco to co-host the first women's networking session at the AGU annual meeting. About 100 women attended that first session organized by McNutt, who was then head of USGS; Lubchenco was then head of the National Oceanic and Atmospheric Administration. McEntee said the women's networking session at AGU now has become an annual event with more than 500 attendees.

"For her to become president of NAS at this time, when there is a lot of talk about getting more women and minorities into STEM (science, technology, engineering, and math) fields, here is an exemplary role model to those who might see themselves in those realms," McEntee said.

McNutt noted that NAS has had women in top leadership roles, such as home secretary, and has many women on the council. She said she's not sure why it has taken so long for a woman to be nominated for the president's role. "But the larger significance will possibly be one less reason for any person, male or female, to argue that women are not as capable as men in the role of scientist," she said.

McNutt plans to remain at the helm of the *Science* journals, where she has served since 2013, until she is elected and sworn in to her new post, likely in July 2016. The AAAS Board of Directors will soon launch an effort to recruit McNutt's successor, said Rush Holt, AAAS CEO and executive publisher of *Science*.

Posted in [People & Events \(/category/people-events/\)](/category/people-events/), [Scientific Community \(/category/scientific-community/\)](/category/scientific-community/)

 **Tweet**  **114**  **Share**  **64**  **1**

Science | DOI: 10.1126/science.aac8817

Climate warning, 50 years later

Long before geophysicist Michael Mann's hockey-stick graph became the icon for anthropogenic global warming, the U.S. President's Science Advisory Committee [now known as the President's Council of Advisors on Science and Technology (PCAST)] cautioned President Lyndon B. Johnson that the continued release of CO₂ to the atmosphere from burning fossil fuels would "almost certainly cause significant changes" and "could be deleterious from the point of view of human beings." The committee's report concluded that there could be "marked changes in climate, not controllable through local or even national efforts." In recognition of the 50th anniversary of that first official warning from scientists to policy-makers, the American Association for the Advancement of Science (AAAS), the Carnegie Institution for Science, the American Meteorological Society, and the Linden Trust for Conservation sponsored a 1-day climate symposium on 29 October.

Fifty years ago, the problems of global warming seemed distant and highly uncertain. Today, we are already experiencing impacts from climate change. In the face of mounting urgency, there are signs of hope, though. Within the past few weeks, 10 oil producers, representing 20% of global production, have pledged to reduce greenhouse gas emissions by curbing the flaring of natural gas and investing in carbon capture and storage. The best part of this announcement is the acknowledgment by energy giants BP, Pemex, Statoil, Saudi Aramco, Total, Royal Dutch Shell, BG Group, Eni, Reliance Industries, and Repsol that climate change is a serious problem and that energy companies need to be part of the solution. Unfortunately, the proposed steps are inadequate contributions toward meeting the goal of keeping the increase in average global temperature to below 2°C, a target that would avoid the worst impacts from warming.

Another beacon of hope is the leadership being taken by faith-based groups. Pope Francis has done perhaps the most to raise world awareness of the moral impera-

tive to take action on climate change for the sake of the most disadvantaged members of society, who have done the least to cause the problem. His message resonates far beyond those of Catholic faith. *Laudato Si* joins statements from many other religious leaders, including those of Buddhist, Muslim, Jewish, and other Christian faiths.*

The private sector is also stepping up its responsibility. This past summer, in the ramp-up to the Paris Conference of the Parties to the United Nations Framework Convention on Climate Change, 12 major corporations, including General Motors, Apple, Google, Alcoa, and Bank of America, pledged to invest more than \$140 billion in efforts to curtail CO₂ emissions in the next 5 to 10 years.

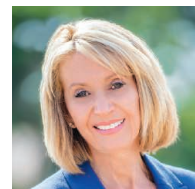
Although these announcements from diverse sectors are all hopeful signs of a growing awareness of climate-change risk and the need to take action, some leaders are instead distracting scientists from the important work at hand. Last month, the U.S. National Oceanic and Atmospheric Administration (NOAA) received a subpoena from

Lamar Smith (R-TX), chairman of the Committee on Science, Space, and Technology in the House of Representatives, for all documents and communications among and between NOAA employees that refer to various global temperature data sets. Ranking member Eddie Bernice Johnson (D-TX) labeled the subpoena "a fishing expedition"† triggered by a NOAA paper published earlier this year in *Science*, "Possible artifacts of data biases in the recent global surface warming hiatus."‡ Senator Edward Markey (D-MA) summed up his opinion at the 50th anniversary event when he suggested that policy-makers should be sending thank-you notes—not subpoenas—to express their gratitude to scientists for sounding the alarm on the perils of greenhouse gas emissions. The senator's remarks remind us that we scientists should thank the many leaders who promote action on climate change.

— Marcia McNutt



"...policy-makers should be sending thank-you notes—not subpoenas—to express their gratitude to scientists..."



Marcia McNutt
Editor-in-Chief
Science Journals

*www.interfaithpowerandlight.org/resources/religious-statements-on-climate-change/. †<http://democrats.science.house.gov/sites/democrats.science.house.gov/files/Ranking%20Member%20Johnson%20Letter%20to%20Chairman%20Smith%20on%20NOAA%20Subpoena.pdf>. ‡T. R. Karl et al., *Science* **348**, 1469 (2015).



ADVANCING SCIENCE, SERVING SOCIETY

[NEWS \(/NEWS\)](#)

[JOURNALS \(/SCIENCE-JOURNALS\)](#)

[FOR MEMBERS \(HTTP://MEMBERCENTRAL.AAAS.ORG/\)](http://membercentral.aaas.org/)

[CAREERS \(/CAREERS\)](#)

[PROGRAMS \(/PROGRAMS\)](#)

[GIVING \(/GIVING\)](#)

[EVENTS \(/EVENTS\)](#)

[ABOUT \(/ABOUT-AAAS\)](#)

[Read More News Stories \(/news\)](#)

[SEARCH](#)

AAAS Leads Coalition to Protest Climate Science Inquiry

24 November 2015 Ginger Pinholster *Updated* 25 November 2015 - 11:00am

[Like](#) [Share](#) 657

[Tweet](#) [reddit this!](#) (<http://www.reddit.com/submit>)

[Email \(http://www.aaas.org/printmail/9059\)](http://www.aaas.org/printmail/9059)

[Print \(http://www.aaas.org/print/9059\)](http://www.aaas.org/print/9059)

[AAAS NEWS \(/TOPICS/AAAS-NEWS\)](#)

[Intersociety NOAA Letter to Chairman Lamar Smith \(/sites/default/files/Intersociety_NOAA_letter_11-25-2015.pdf\)](/sites/default/files/Intersociety_NOAA_letter_11-25-2015.pdf)

AAAS and seven other leading scientific organizations on Tuesday expressed "grave concern" about a Congressional inquiry that has unfoundedly called into question the integrity of federal scientists whose research, published in *Science*, seemed to debunk claims of a global-warming slowdown or "hiatus."

In a letter to Rep. Lamar Smith (R-Texas), chairman of the U.S. House Committee on Science, Space, and Technology, the group acknowledged the importance of appropriate congressional oversight of federally funded research, but emphasized that "scientists should not be subjected to fraud investigations or harassment simply for providing scientific results that some may see as politically controversial."

AAAS CEO Rush Holt, executive publisher of the *Science* family of journals, said that AAAS and other scientific organizations have a responsibility to speak out against excessively intrusive inquiries that go beyond the need for due diligence by policymakers. "This kind of political interference in the scientific process ultimately retards the ability of science to provide understanding and to improve people's lives," Holt said. "To arrive at the greatest benefit for people's lives, the scientific process must be free from politicization."

Research completed by Thomas Karl and colleagues at the National Oceanic and Atmospheric Administration (NOAA) used updated and corrected global surface temperature data to dispute the existence of a recent slowdown in the rate of in global warming. In his 4 June *Science* article (<http://www.sciencemag.org/content/348/6242/1469.full.pdf>), Karl's team suggested no discernable decrease in the rate of warming between the second half of the 20th century, a period marked by human-caused warming, and the first fifteen years of the 21st century, which some have described as a warming hiatus.

Since the article's publication, the House Committee on Science, Space, and Technology has sent letters and subpoenas to NOAA,

requesting "all documents and communications" related to Karl's paper in *Science*. NOAA Administrator Kathryn D. Sullivan, Under Secretary of Commerce for Oceans and Atmosphere, sent a letter to Smith (<https://s3.amazonaws.com/ucs-documents/science-and-democracy/2015-11-20-commerce-noaa-response-to-chairman-smith-climate-hiatus-study.pdf>) on 20 November, noting that "NOAA has made a concerted and significant effort to answer the Committee's questions and provide relevant and responsive information." The committee has nonetheless threatened "the use of a compulsory process" if NOAA does not surrender additional records, including e-mails among individual scientists.

AAAS and other science societies emphasized that needlessly intrusive Congressional inquiries can inhibit scientific discovery, particularly if scientists are threatened with legal action. "Science cannot thrive when policymakers — regardless of party affiliation (http://www.geosociety.org/geopolicy/letters/2015/1503_Grijalva.pdf) — use policy disagreements as a pretext to attack scientific conclusions without public evidence," the coalition's letter said. "We are concerned that establishing a practice of inquests directed at federal scientists whose findings may bear on policy in ways that some find unpalatable could well have a chilling effect on the willingness of government scientists to conduct research that intersects with policy-relevant scientific questions."

The group noted further that "NOAA's National Centers for Environmental Information (NCEI) manages one of the world's most significant archives of oceanic, atmospheric, and geophysical data."

Independent assessment of scientific results is of course a crucial part of the scientific process, and the coalition encouraged the House committee to use other established mechanisms for assessing technical information, such as advisory reports of the National Academies of Sciences, Engineering, and Medicine.

The AAAS intersociety letter was signed also by the American Chemical Society, the American Geophysical Union, the American Meteorological Society, the American Statistical Association, the Ecological Society of America, the Geological Society of America, and the Society for Conservation Biology.

AAAS has protested other cases of scientists being targeted for seemingly ideological reasons. In 2011, for example, the AAAS Board of Directors expressed deep concern over reports of personal attacks on climate scientists (http://www.aaas.org/sites/default/files/migrate/uploads/0518board_statement_cuccinelli1.pdf). In 2010, the AAAS Board also decried the Virginia Attorney General's investigation of climate researcher Michael Mann.

Resources for Reporters and Online Communications

PRESS ROOM (/NEWSROOM)

EUREKALERT!
([HTTP://WWW.EUREKALERT.ORG](http://www.eurekalert.org))

LAST UPDATED 25 NOV 2015

READ OUR PRIVACY POLICY (/PRIVACY-POLICY) AND TERMS OF USE (/TERMS-OF-USE)

© 2015 AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

1200 NEW YORK AVE NW, WASHINGTON, DC 20005

202 326 6400 | CONTACT US
([HTTP://WWW.AAAS.ORG/CONTACT-AAAS](http://www.aaas.org/contact-aaas))

(<https://www.google.com/maps/place/1200+New+York+Ave+NW,+Washington,+DC+20005/@38.9083333,-77.0355556,17z/data=!3m1!1e3!3m2!1s1200+New+York+Ave+NW,+Washington,+DC+20005!1sAAAS+Science+Center>)
(<https://www.aaas.org>) /user/www.aaas.org/397260907623014)

November 24, 2015

The Honorable Lamar Smith
Chairman
House Committee on Science, Space, and Technology
2321 Rayburn House Office Building
Washington, DC 20515

Dear Chairman Smith,

As representatives of the major U.S. science organizations and the hundreds of thousands of scientists and engineers who make up our collective membership, we are writing to express our grave concern regarding the committee's inquiry into a scientific paper prepared by National Oceanic and Atmospheric Administration (NOAA) researchers.

NOAA's National Centers for Environmental Information (NCEI) manages one of the world's most significant archives of oceanic, atmospheric, and geophysical data. Businesses, governments, and academics rely heavily on NCEI data to make informed decisions to help grow the economy and protect public safety and the environment.

The integrity of federal scientists' research [published](#) in the journal *Science* is being questioned despite a lack of public evidence of scientific misconduct. The progress and integrity of science depend on transparency about the details of scientific methodology and the ability to follow the pursuit of scientific knowledge. The data and methodology of the paper in question have been publicly shared and discussed directly with the committee staff. While we recognize the oversight responsibility of Congress with respect to the work of government scientists, the committee has continued to suggest that the updates that NOAA scientists made to its dataset constitute scientific misconduct.

Science is a self-correcting process and part of the purpose of placing research into the scholarly record is so other scientists can attempt to replicate, confirm, or refute it. This paper is subject to these same norms. In fact, over the past year there have been other peer-reviewed research papers published by university scientists and derived from other independent data sources that have also analyzed the climate hiatus. This is the way in which science advances.

Scientists and policymakers may disagree over the implications of scientific conclusions on climate change and other policy-relevant topics. Disagreements about the interpretation of data, the methodology, and findings are part of daily scientific discourse. Scientists should not be subjected to fraud investigations or harassment simply for providing scientific results that some may see as politically controversial. Science cannot thrive when policymakers—[regardless of party affiliation](#)—use policy disagreements as a pretext to attack scientific conclusions without public evidence.

These broad inquiries threaten to inhibit the free exchange of ideas across scientific disciplines not only for NOAA, but for other government experts and the academic and industry scientists with whom they collaborate.

We are concerned that establishing a practice of inquests directed at federal scientists whose findings may bear on policy in ways that some find unpalatable could well have a chilling effect on the willingness of government scientists to conduct research that intersects with policy-relevant scientific questions. The repercussions of the committee's actions could go well beyond climate science, setting a precedent to question other topics such as genetically modified organisms and vaccines that have controversial regulatory and policy implications.

As we stated previously, we recognize the oversight responsibility of Congress, however, the inquiry should not be used as a tool to inhibit the ability of federal scientists to fulfill their agencies' science missions and of agencies to attract world-class scientific talent. We encourage the committee to utilize other avenues, such as the National Academies, for assessing the science and distilling technical matters to assist policymakers.

Sincerely,

American Association for the Advancement of Science
American Chemical Society
American Geophysical Union
American Meteorological Society
American Statistical Association
Ecological Society of America
Geological Society of America
Society for Conservation Biology

cc: Rep. Eddie Bernice Johnson

<http://wattsupwiththat.com/2015/06/04/noaancdcs-new-pause-buster-paper-a-laughable-attempt-to-create-warming-by-adjusting-past-data/>

WUWT What's Up With That? June 4, 2015

NOAA/NCDC's new 'pause-buster' paper: a laughable attempt to create warming by adjusting past data

[Guest Blogger](#) / [June 4, 2015](#)

Did SNL's Tommy Flanagan Oversee the New Surface Temperature Data?

By Bob Tisdale and Anthony Watts, commentary from Dr. Judith Curry follows

There is a new paper published in the journal *Science* about the recent slowdown in global surface warming (released from embargo today at 2PM eastern). It is from Tom Karl and others at NOAA's newly formed NCEI, [National Centers for Environmental Information](#) (a merger of three NOAA data centers: NCDC, NODC and NGDC) and from [the government-consulting firm LMI](#). The lead author is [Tom Karl, Director of NCEI](#) and [Chair of the Subcommittee on Global Change Research \(SGCR\)](#) of the [U.S. Global Change Research Program \(USGCRP\)](#). The paper is Karl et al (2015) *Possible artifacts of data biases in the recent global surface warming hiatus*. "Possible" is obviously the key word in the title.

There is a big push by the American Association for the advancement of Science (AAAS) to promote this paper. Here is what they sent out to press contacts days in advance:

Science Press Package

This information is embargoed until:

2:00 PM U.S. Eastern Time, Thursday, 4 June 2015

Check timezone conversions [here](#).

Please cite the journal *Science* and the publisher, AAAS, the science society, as the source of this information. Please hyperlink to www.sciencemag.org when publishing online.

Summaries of Articles in the 5 June *Science*

Evidence Against a Global Warming Hiatus?

An analysis using updated global surface temperature data disputes the existence of a 21st century global warming slowdown described in studies including the latest Intergovernmental Panel on Climate Change (IPCC) assessment. The new analysis suggests no discernable decrease in the rate of warming between the second half of the 20th century, a period marked by manmade warming, and the first fifteen years of the 21st century, a period dubbed a global warming “hiatus.” Numerous studies have been done to explain the possible causes of the apparent hiatus. Here, Karl and colleagues focused on aspects of the hiatus influenced by biases from temperature observation networks, which are always changing. Using updated and corrected temperature observations taken at thousands of weather observing stations over land and as many commercial ships and buoys at sea, the researchers show that temperatures in the 21st century did not plateau, as thought. Instead, the rate of warming during the first fifteen years of the 21st century is at least as great as that in the last half of the 20th century, suggesting warming is continuing apace. According to these and other results, the authors suggest the warming slowdown was an illusion, an artifact of earlier analyses.

Article #16: “Possible artifacts of data biases in the recent global surface warming hiatus,” by T.R. Karl; A. Arguez; B. Huang; J.H. Lawrimore; M.J. Menne; T.C. Peterson; R.S. Vose; H.-M. Zhang at National Oceanographic and Atmospheric Administration (NOAA) in Asheville, NC; J.R. McMahon at LMI in McLean, VA.

The abstract of Karl et al (2015) reads (our boldface):

Much study has been devoted to the possible causes of an apparent decrease in the upward trend of global surface temperatures since 1998, a phenomenon that has been dubbed the global warming “hiatus.” Here we present an updated global surface temperature analysis that reveals that global trends are higher than reported by the IPCC, especially in recent decades, and **that the central estimate for the rate of warming during the first 15 years of the 21st century is at least as great as the last half of the 20th century.** These results do not support the notion of a “slowdown” in the increase of global surface temperature.

Karl et al expand on that highlighted discussion in the text of the paper (our boldface):

It is also noteworthy that the new global trends are statistically significant and positive at the 0.10 significance level for 1998–2012 (Fig. 1 and table S1) using the approach described in (25) for determining trend uncertainty. In contrast, IPCC (1), which also utilized the approach in (25), re-reported no statistically significant trends for 1998–2012 in any of the three primary global surface temperature datasets. **Moreover, for 1998–2014, our new global trend is $0.106 \pm 0.058^\circ\text{C dec}^{-1}$, and for 2000–2014 it is $0.116 \pm 0.067^\circ\text{C dec}^{-1}$ (see table S1 for details). This is similar to the warming of the last half of the 20th century (Fig. 1).** A more comprehensive approach for determining the 0.10 significance level (see supplement) that also accounts for the impact of annual errors of estimate on the trend, also shows that the 1998–2014 and 2000–2014 trends (but not 1998–2012) were positive at the 0.10 significance level.

THE MISDIRECTION

As shown in their Figure 1 (also our Figure 1), Karl et al. (2015) used the periods of 1951 to 2012 and 1950 to 1999 as references for the recent slowdown in surface warming. The IPCC's 5th Assessment Report serves as the justification for the early-1950s start point for their reference periods. See [Chapter 2](#) and [Chapter 9](#) of AR5 for the IPCC's brief mention of the slowdown in global surface warming.

Figure 1 from Karl et al. (2015)

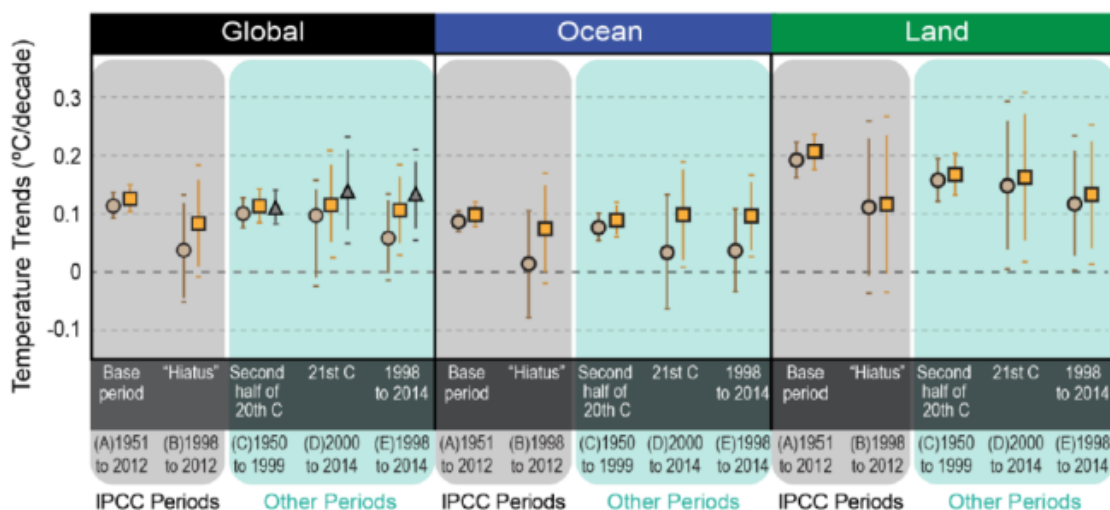


Fig. 1. Effect of new analysis on global surface temperature trends for several periods. Temperature trends are shown for data with the “new” analysis (squares) and “old” analysis (circles) for several periods of interest. Also indicated are global values calculated with the new corrections and the polar interpolation method (triangles). Consistent with IPCC (1), the error bars represent the 90% confidence intervals (CIs). The additional error associated with uncertainty of our corrections extends the 90% CI and is depicted with a horizontal dash. (A) and (B) show the base period (1951–2012) and “hiatus” period used in IPCC (1). (C) An alternate base period—the second half of the 20th century. (D) The 21st century through 2014. (E) 1998 (a strong El Niño year) through the 21st century. See Table S1 for source data.

Figure 1

Yet the climate model-based projections of a disaster-filled future global surface warming better align with the warming rate of the recent warming period, which began in the mid-1970s, not 1950. See Figure 2, which uses the GISS Land-Ocean Temperature Index data, because the new NCDC data have not yet been released. Keep in mind there was an earlier hiatus that lasted from the early-to-mid 1940s to the mid-1970s.

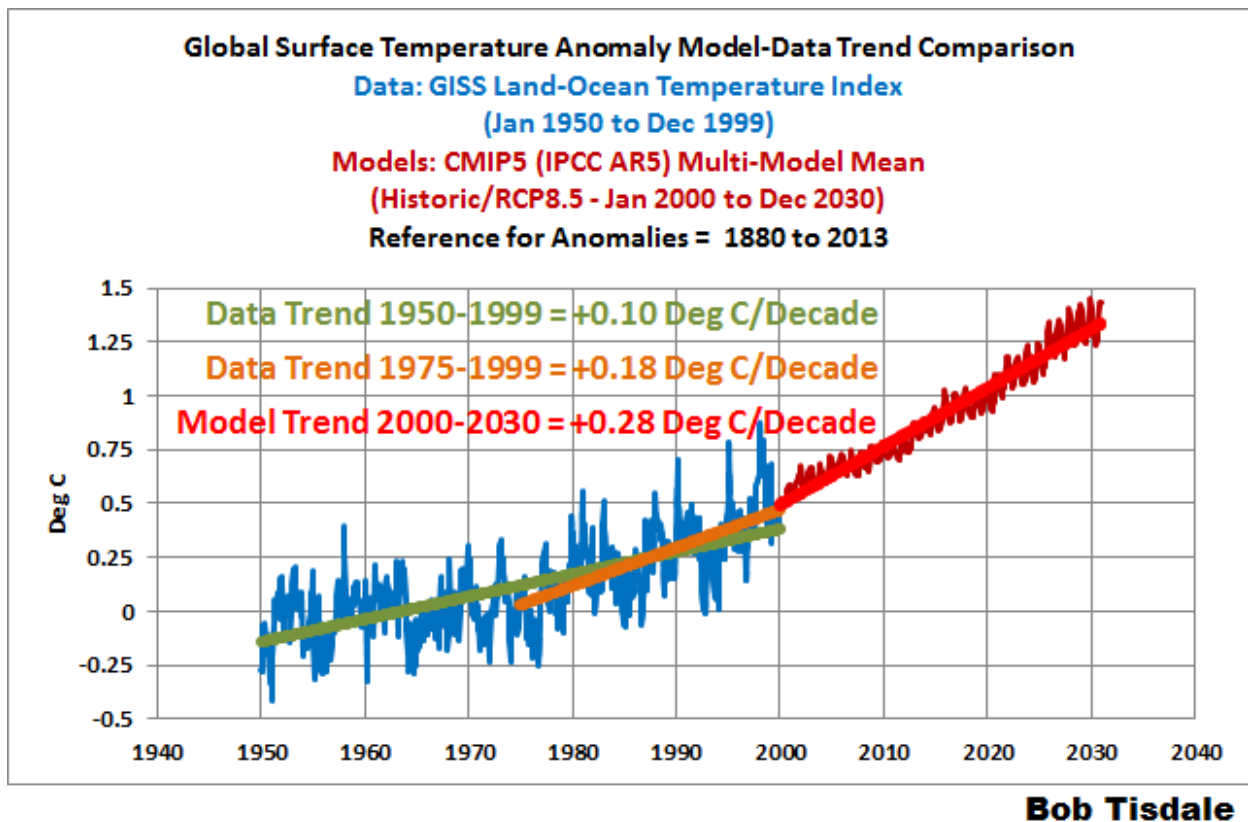


Figure 2

If NOAA would like to revise their estimates of future global warming to reflect the more benign warming rate of 0.1 deg C/decade from 1950 to 1999, it would be a big step toward their coming to terms with reality.

We illustrate the ever-growing differences between models and data in the monthly global surface temperature (and lower troposphere temperature) update posts. Figure 3 is the model-data comparison from the [April 2015 update](#).

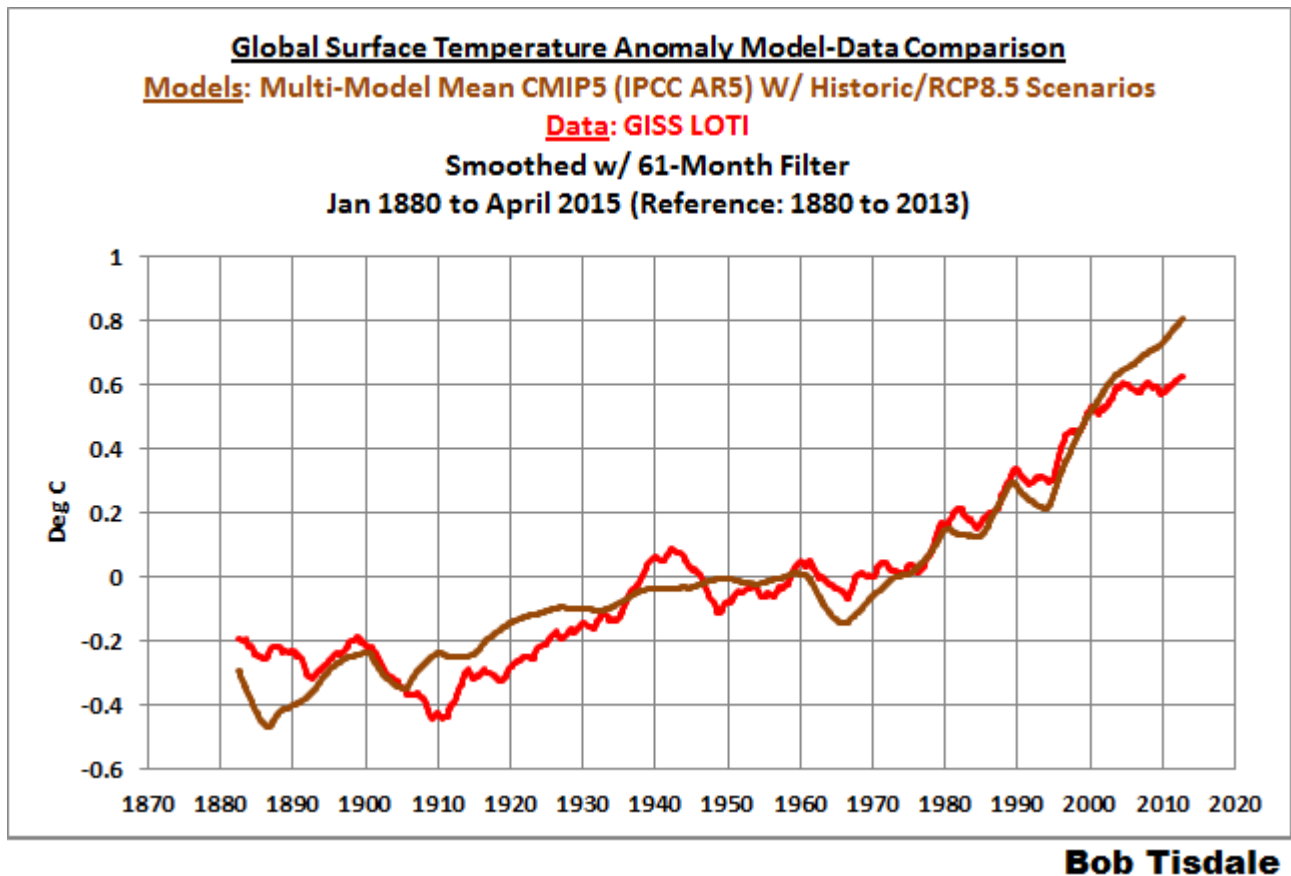


Figure 3

NEW DATA USED

In many respects, the paper is an introduction to a revised global surface temperature dataset from NOAA. For the oceans, it includes their new ERSST.v4 sea surface temperature data. We discussed that new NOAA sea surface temperature data in the post [Has NOAA Once Again Tried to Adjust Data to Match Climate Models?](#) (The WattsUpWithThat cross post is [here](#).)

For the land portion, Karl et al. (2015) state:

Third, there have also been advancements in the calculation of land surface air temperatures (LSTs). The most important is the release of the International Surface Temperature Initiative (ISTI) databank (14, 19), which forms the basis of the LST component of our new analysis. The ISTI databank integrates the Global Historical Climatology Network (GHCN)–Daily dataset (20) with over 40 other historical data sources, more than doubling the number of stations available.

ADJUSTMENTS MAKE MOST OF THE WARMING

NCDC has been in the business of adjusting the surface temperature record for quite some time. The modus operandi so far has been to get a new paper published describing what NCDC considers to be a new and improved dataset, and since NCDC's articles are often peer reviewed by other government employed scientists at NOAA, they often don't get a critical peer review. Certainly, based on the reports I've received over the years, few if any skeptic scientists have ever been asked to review an NCDC paper on a new global temperature dataset and the techniques involved.

Fortunately, it is very easy to divine such adjustments by comparing the raw data and the final adjusted data, as shown in the graph below. Note how the past gets cooler, centered around 1915 and the present gets warmer.

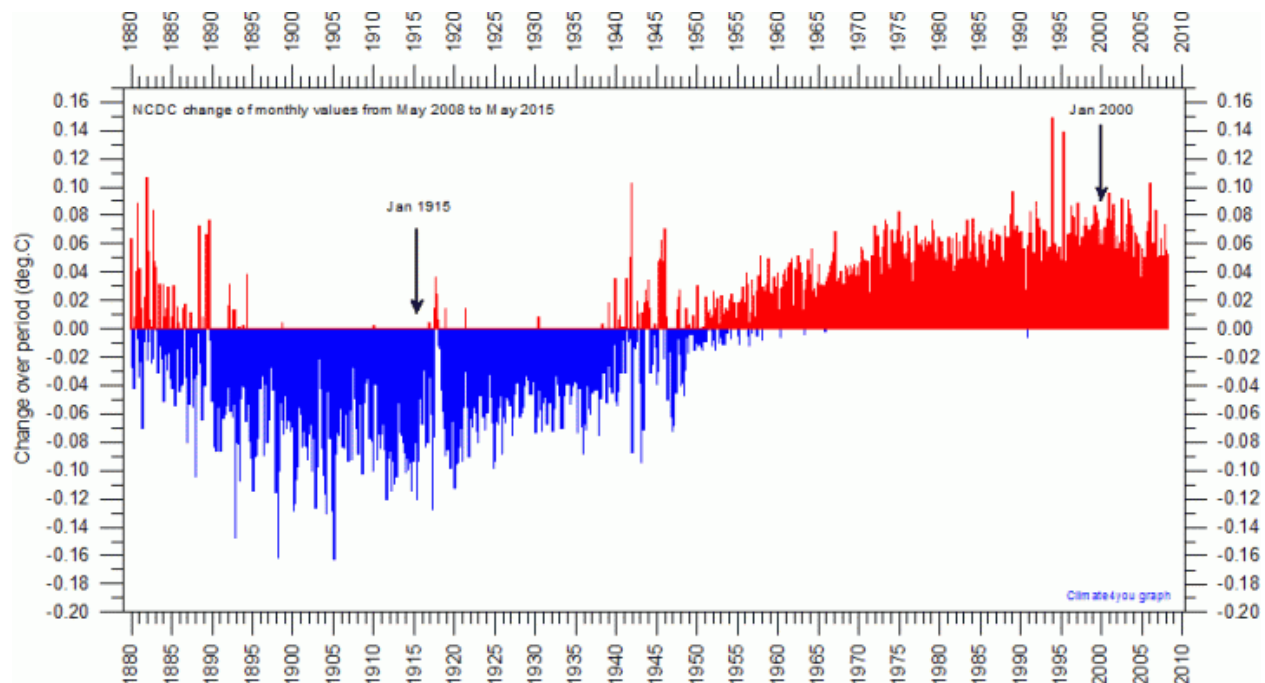


Figure 4 Maturity diagram showing net change since 17 May 2008 in the global monthly surface air temperature record prepared by the National Climatic Data Center (NCDC), USA. The net result of the adjustments made are becoming substantial, and adjustments since May 2006 occasionally exceeds 0.1oC. Before 1945 global temperatures are generally changed toward lower values, and toward higher values after 1945, resulting in a more pronounced 20th century warming (about 0.15oC) compared to the NCDC temperature record published in May 2008. Arrows indicate two months where the adjustments over time are illustrated in the figure below. Last diagram update: 19 May 2015. Source: Professor Ole Humlum

Figure 4

On May 2, 2011, NCDC transitioned to GHCN-M version 3 as the official land component of its global temperature monitoring efforts. In November 2011, the GHCN-M version 3.1.0 replaced

the GHCN-M version 3. The overall net effect of the transition from GHCN-M version 2 to version 3 is to increase global temperatures before 1900, to decrease them between 1900 and 1950, and to increase temperatures after 1950.

The diagram below exemplify adjustments made by NCDC since May 2008 for two single months (see arrows in diagram above); January 1915 and January 2000.

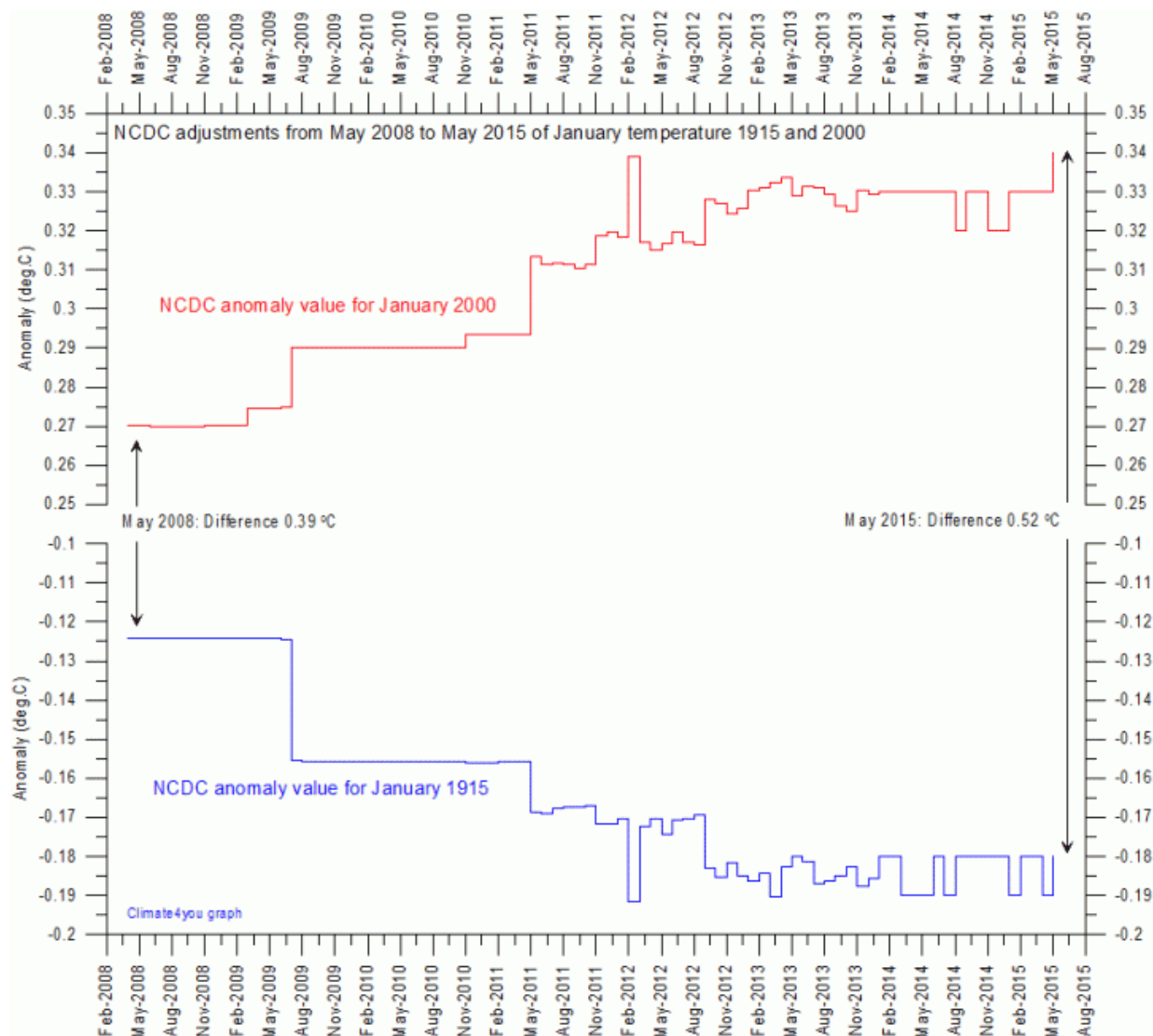


Figure 5 Diagram showing the adjustment made since May 2008 by the National Climatic Data Center (NCDC) in the anomaly values for the two months January 1915 and January 2000. Last diagram update 19 May 2015. Source: Professor Ole Humlum

Figure 5

Clearly, with each revision of data, NCDC is making the past cooler and the near present warmer through their adjustment process of the original data. To revisit something said in regards to a previous [news story about NCDC's tendency to adjust data as time goes on](#), so much so that they can't even tell us with certainty anymore which month in the past century was the warmest on record, this is still applicable:

“Is history malleable? Can temperature data of the past be molded to fit a purpose? It certainly seems to be the case here, where the temperature for July 1936 reported ... changes with the moment,” Watts told FoxNews.com.

“In the business and trading world, people go to jail for such manipulations of data.”

Hold that thought, because NCDC is at it again.

THE IMPACT OF NOAA'S SHIP-BUOY BIAS ADJUSTMENTS DURING THE SLOWDOWN HAVE MADE THEIR NEW SEA SURFACE TEMPERATURE DATASET AN OUTLIER

You'll note in Figure 1 that the biggest changes between the new and old NOAA data during the global-warming-slowdown periods are in the sea surface temperature data, not the land surface air temperature data. Those adjustments are supposed to be justified by ship-buoy biases. See the quotes in the post [Quick Look at the DATA for the New NOAA Sea Surface Temperature Dataset](#), under the heading of SHIP-BUOY BIAS CORRECTIONS IN ERSST.v4.

(Note 1: the buoys being discussed are NOT ARGO floats. The buoys used for sea surface temperature measurements are [Surface Drifting Buoys](#) and fixed buoys like the [TAO Project](#) buoys. Note 2: the latitudes of 60S-60N were used for the following graphs to avoid any differences in how sea ice is accounted for between the datasets and to be consistent with the two papers that introduced the new ERSST.v4 data. Note 3: the trends shown are for sea surface temperatures. They are not directly comparable to the trends discussed by Karl et al. in the second quote, which were for combined land-plus-ocean data.)

THE UKMO HASST3 data have also been adjusted for ship-buoy biases. For the two slowdown periods presented by Karl et al., Figures 6 and 7 compare the HADSST3 and the new NOAA ERSST.v4 data, both of which have been “corrected” for ship-buoys biases, to the older NOAA ERSST.v3b which had not been adjusted for those biases. During both periods, the bias-adjusted HADSST3 data have a much lower trend than the bias-adjusted NOAA ERSST.v4 data. In fact, the bias-corrected HADSST3 data in both cases is more in line with the older NOAA data than the new.

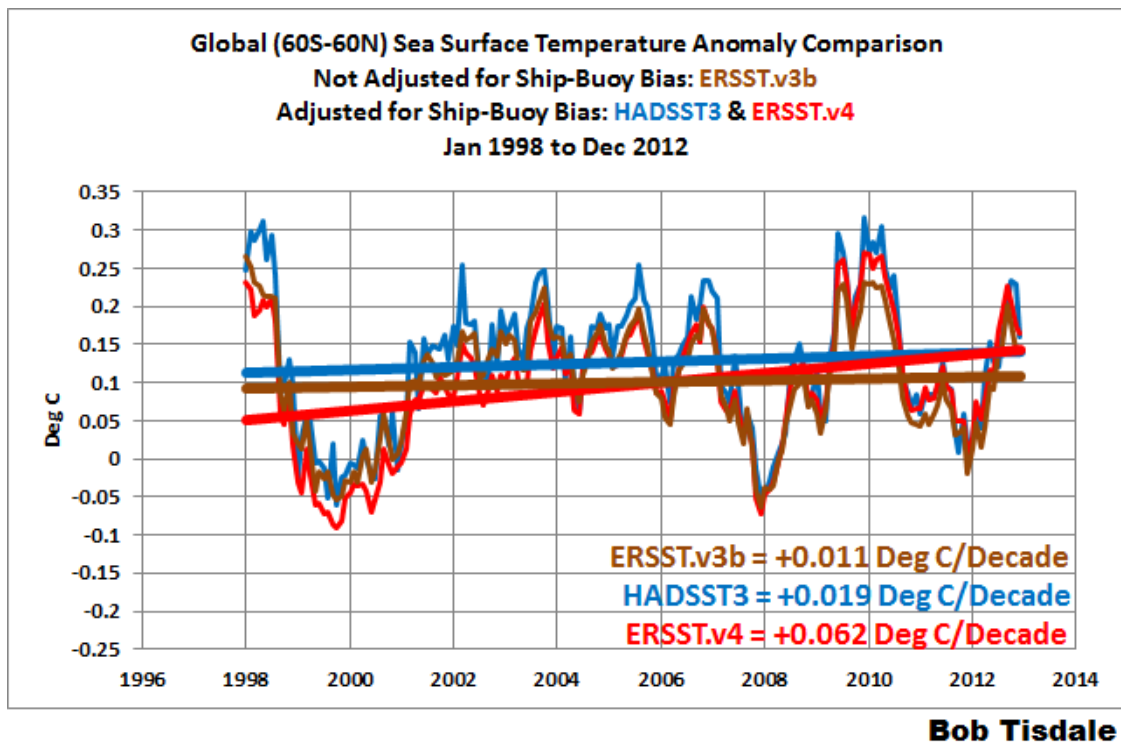


Figure 6

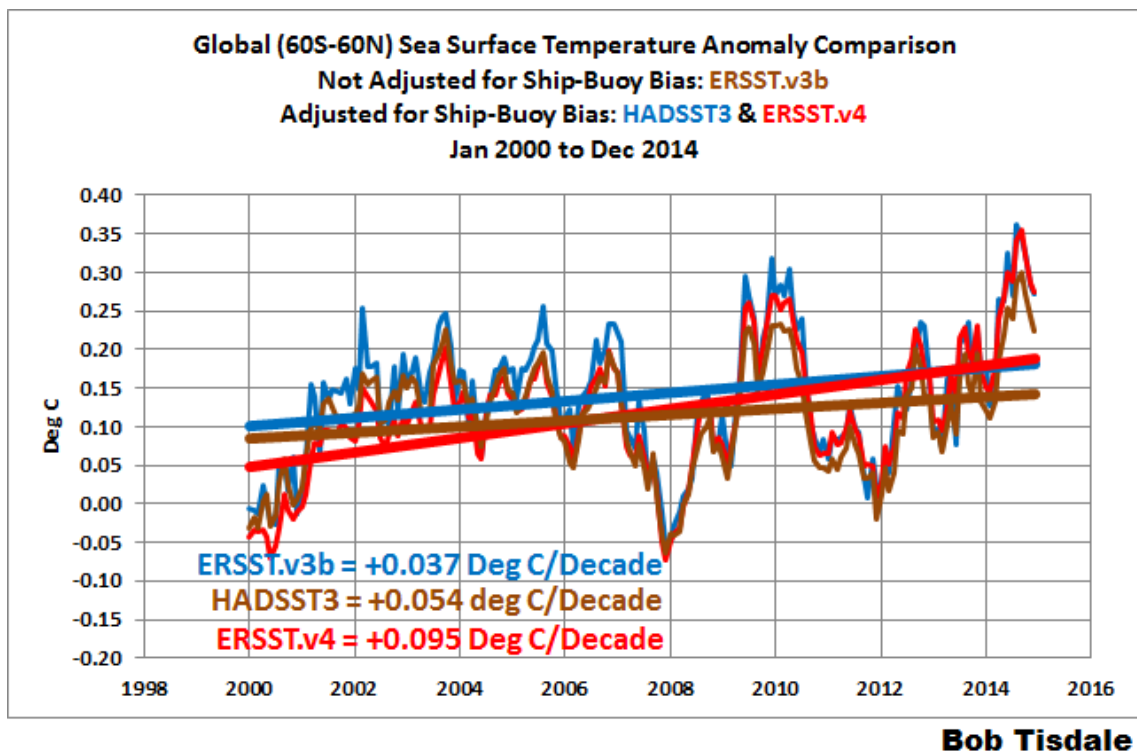


Figure 7

Some might think that NOAA under the direction of Tom Karl designed their ship-buoy bias adjustments with the sole intent of minimizing the impacts of natural slowdown in surface warming. (Those would be some interesting emails and meeting minutes to read.)

And just in case you're wondering, the new NOAA ERSST.v4 data are compared to the NOAA and UKMO satellite-enhanced sea surface temperature data in Figures 8 and 9.

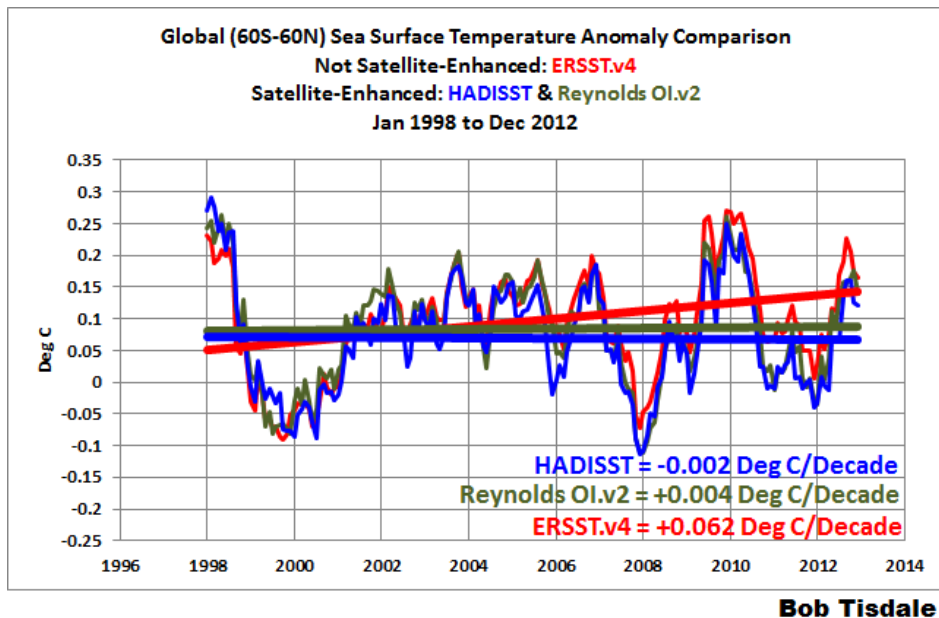


Figure 8

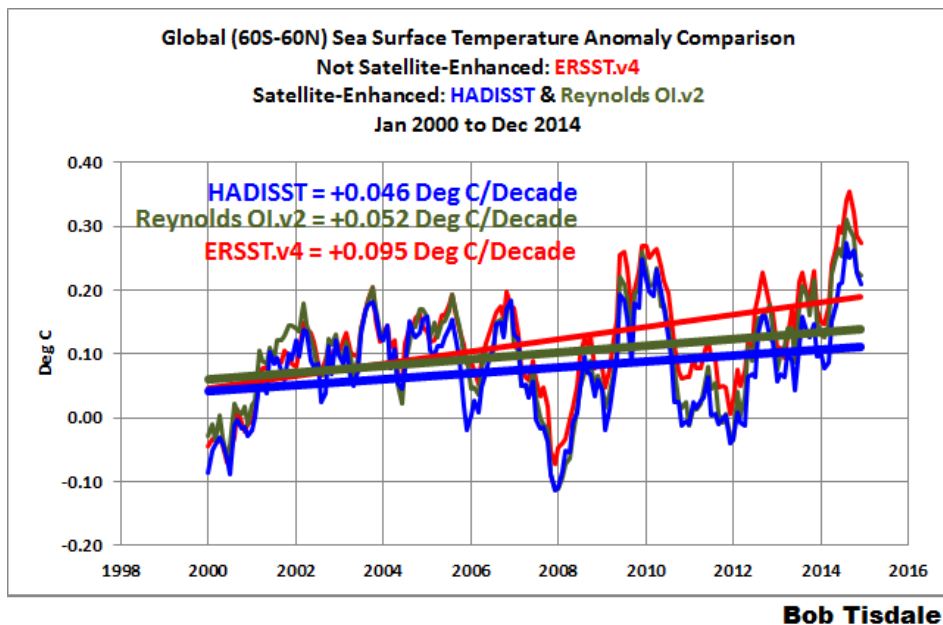


Figure 9

As noted in the heading, with their new adjustments, NOAA has created an outlier in their new sea surface temperature dataset. Add that to the [curious spike in the late-1930s and 1940s](#) that [can't be explained by climate models](#), which were presented in the post [here](#).

BUT THE WARMING RATES OF NOAA'S OLD AND NEW SEA SURFACE TEMPERATURE DATA ARE THE SAME OVER THE PAST 3+ DECADES

The satellite era of sea surface temperature data started in November 1981. Neither of the NOAA sea surface temperature reconstructions (new or old) utilize the satellite-enhanced data. The original version of the NOAA ERSST.v3 data included satellite data when they were first released in 2008, but the satellite data were removed before the dataset became “official” because they did not meet political agenda of the dataset users, which were only NOAA at that time. The revised dataset was renamed ERSST.v3b. It is ERSST.v3b that Karl et al. are calling the “old” data.

But we can learn something very interesting if we compare NOAA's ERSST.v4 (new) and ERSST.v3b (old) data during the satellite era. See Figure 10.

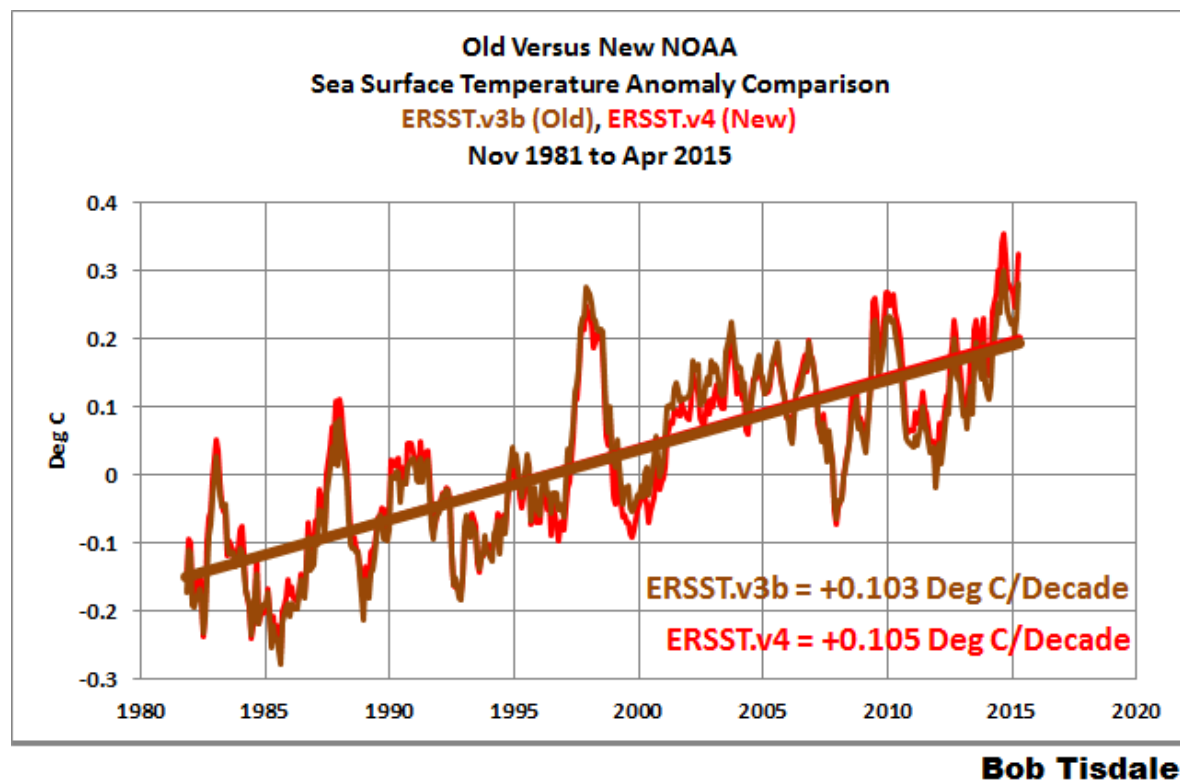


Figure 10

The warming rates are the same.

But the new data show a much higher warming rate during the “hiatus” periods, and that means...

TO MANUFACTURE WARMING DURING THE HIATUS, NOAA ADJUSTED THE PRE-HIATUS DATA DOWNWARD

If we subtract the ERSST.v3b (old) data from the new ERSST.v4 data, Figure 11, we can see that that is exactly what NOAA did.

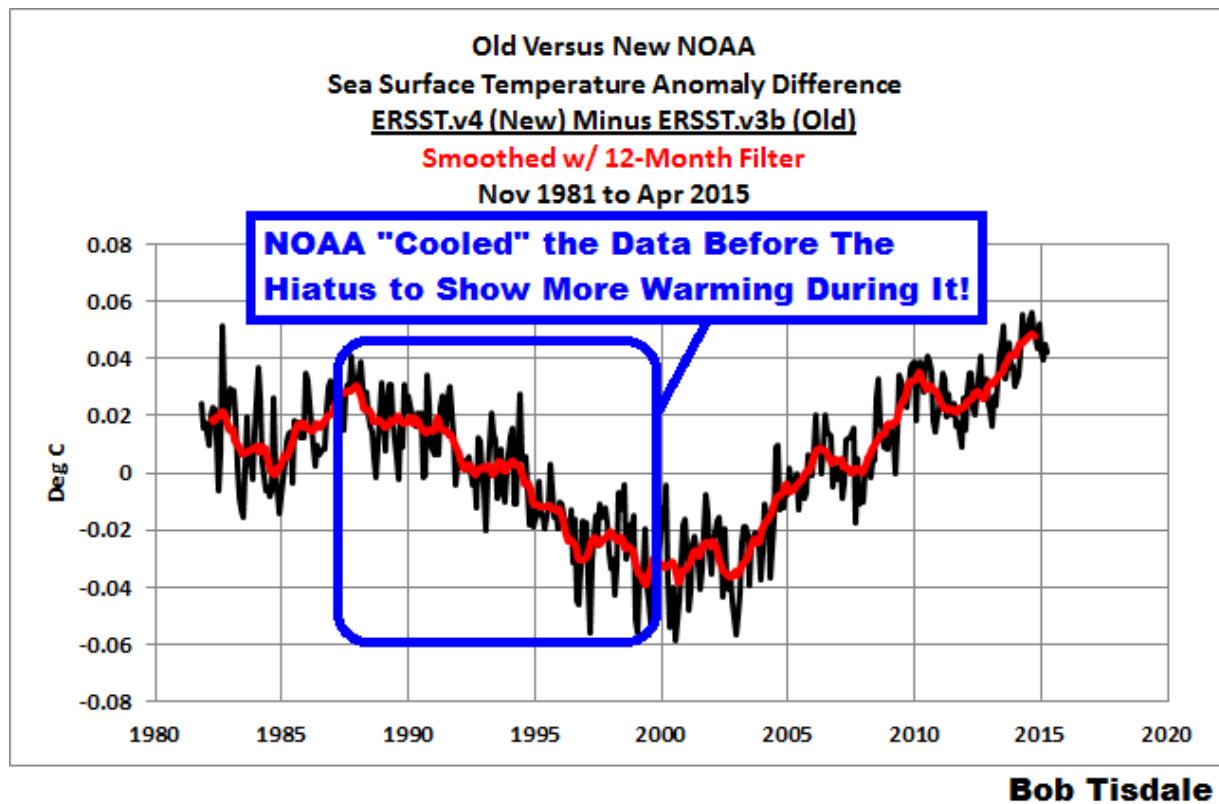


Figure 11

Remember the adjusted data from figures 4 and 5 above? Figure 11 uses the same data subtraction method to determine the difference between the original measured data, and the “new and improved” adjusted data courtesy of government-funded science. It’s the same story all over again; the adjustments go towards cooling the past and thus increasing the slope of temperature rise.

Their intent and methods are so obvious they’re laughable.

It’s like John Lovitz *Saturday Night Live* character “Pathological liar”, Tommy Flanagan was in charge.

Gee, we need to show more sea surface warming during the hiatus, but we don't want to increase the trend since about 1982.



**We'll Cool the Data Before The Hiatus So We
Can Show More Warming During It.
Yeah. That's The Ticket.**

It's hard to imagine how anyone could take the new NOAA global surface temperature data seriously.

SEA SURFACE TEMPERATURE DATA SOURCE

The sea surface temperature data presented in this post are available from the [KNMI Climate Explorer](#).

Comments from Georgia Tech Climatologist Dr. Judith Curry:

The greatest changes in the new NOAA surface temperature analysis is to the ocean temperatures since 1998. This seems rather ironic, since this is the period where there is the greatest coverage of data with the highest quality of measurements – ARGO buoys and satellites don't show a warming trend. Nevertheless, the NOAA team finds a substantial increase in the ocean surface temperature anomaly trend since 1998.

In my opinion, the gold standard dataset for global ocean surface temperatures is the UK dataset, HadSST3. A review of the uncertainties is given in this paper by John Kennedy <http://www.metoffice.gov.uk/hadobs/hadsst3/uncertainty.html>. Note, the UK group has dealt with the same issues raised by the NOAA team. I personally see no reason to the use the NOAA ERSST dataset, I do not see any evidence that the NOAA group has done anywhere near as careful a job as the UK group in processing the ocean temperatures.

I am also unconvinced by NOAA's gap filling in the Arctic, and in my opinion this introduces substantial error into their analysis. I addressed the issue of gap filling in the Arctic in this recent publication: Curry JA, 2014: Climate science: Uncertain temperature trends. *Nature Geoscience*, 7, 83-84.

Relevant text:

Gap filling in the Arctic is complicated by the presence of land, open water and temporally varying sea ice extent, because each surface type has a distinctly different amplitude and phasing of the annual cycle of surface temperature. Notably, the surface temperature of sea ice remains flat during the sea ice melt period roughly between June and September, whereas land surface warming peaks around July 1. Hence using land temperatures to infer ocean or sea ice temperatures can incur significant biases.

With regards to uncertainty, in their 'warmest year' announcement last January, NOAA cited an error margin in the global average surface temperature anomaly of 0.09°C. The adjustments to the global average surface temperature anomaly is within the error margin, but the large magnitude of the adjustments further support a larger error margin. But they now cite a substantially greater trend for the period 1998-2014, that is now statistically greater than zero at the 90% confidence level.

My bottom line assessment is this. I think that uncertainties in global surface temperature anomalies is substantially understated. The surface temperature data sets that I have confidence in are the UK group and also Berkeley Earth. This short paper in Science is not adequate to explain and explore the very large changes that have been made to the NOAA data set. The global surface temperature datasets are clearly a moving target. So while I'm sure this latest analysis from NOAA will be regarded as politically useful for the Obama administration, I don't regard it as a particularly useful contribution to our scientific understanding of what is going on.



American Thinker

June 4, 2015

The climate warming pause goes AWOL (or not)

By [S. Fred Singer](#)

Science mag is publishing a blockbuster paper today, on June 4. Oh boy! Get ready to watch yet another big fight about climate change – this time mainly among different groups of climate alarmists. Is there a “pause”? Did global climate really stop warming during the last dozen years, 18 years, or even 40 years – in spite of rising levels of the greenhouse (GH) gas carbon dioxide?

The renowned National Climate Data Center (NCDC), a division of NOAA located in Asheville, NC, claims that the widely reported (and accepted) temperature hiatus (i.e., near-zero trend) is an illusion – just an artifact of data analysis – and that the global climate never really stopped warming. If true, what a blessing that would be for the UN-IPCC – and for climate alarmists generally, who have been under siege to explain the cause of the pause.

This paper is turning out to be a “big deal.” The publisher of *Science* has even issued a special press release, promoting the NCDC claim of continued slow but steady warming.

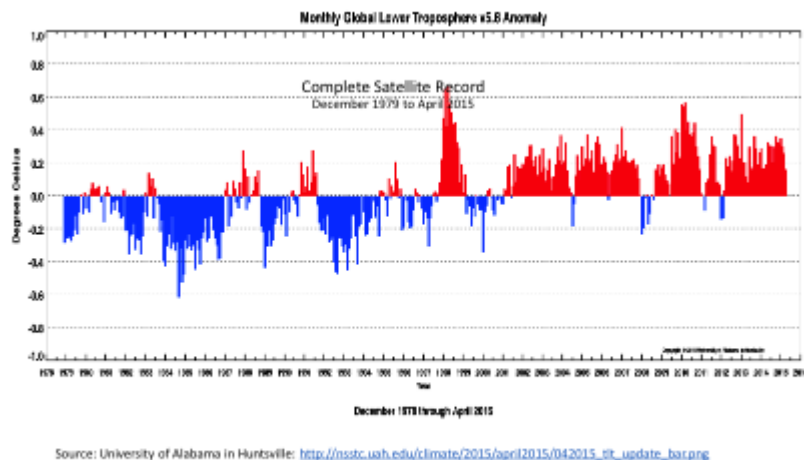
Of course, NCDC-NOAA and *Science* may end up with egg on their collective faces. It does look a little suspicious that NCDC arrived at this earth-shaking “discovery” after all these years, after “massaging” its own weather-station data, just before the big policy conference in December in Paris that is supposed to slow the rise of CO₂ from the burning of energy fuels, coal, oil, and gas.

Now watch the sparks fly -- as there are two major constituencies that have a vested interest in the pause:

There are at least two rival data centers that may dispute the NCDC analysis: the Hadley Centre in England and the NASA-Goddard Institute for Space Studies (GISS). In fact, Hadley’s partner, the Climate Research Unit at the University of East Anglia, was the first to announce, on the BBC, the existence of a pause in global warming.

Then there are also dozens of scientists who have published research papers, purporting to provide an explanation for the reported pause. Yours truly turns out to be amongst these. They will all be mightily disappointed if their intellectual efforts turn out to be for naught.

But hold on. NCDC may turn out to be quite wrong. Not surprisingly, they used the surface temperature record, with its well-known problems. Not only that, but a look at the detailed NCDC evidence shows that much depends on polar temperatures -- which are mostly guessed at, for lack of good observations. If one uses the (truly global) satellite data, analyzed either by UAH or by RSS, the pause is still there, starting around 2003 [see Figure; it shows a *sudden* step increase around 2001, not caused by GH gases].



Not only that, but the same satellite data show no warming trend from 1979 to 2000 – ignoring, of course, the exceptional super-El-Nino year of 1998. This finding is confirmed by other, independent instrumental data -- and also by (non-instrumental) proxy records (from tree rings, ice cores, lake sediments). This leads to important far-reaching consequences that are more fully discussed and referenced in the reports of NIPCC (Non-governmental International Panel on Climate Change) [search NIPCCreport.org, esp. the CCR-II report of 2013].

UN-IPCC claims for AGW undermined

IPCC-4 [2007] and IPCC-5 [2013] both present claims for anthropogenic global warming (AGW) that are based mainly on reported surface warming from 1979 to 2000. In the absence of such a warming trend, the IPCC claims become invalid; there would be no human-caused greenhouse warming in the 20th century – and certainly not earlier.

It is worthwhile, therefore, to re-examine carefully the absence of warming in the last two decades of the 20th century.

The satellite results of near-zero warming trend are fully backed by radiosonde data from balloon flights -- notwithstanding spurious claims by Santer et al [in *Int'l J of Climatology*

2008; see full discussion by Singer in *Energy&Envir* 2013]. The absence of a tropical “Hotspot” (a once-controversial upper-troposphere warming trend) “makes the cheese more binding.”

Sea-surface temperatures (SST) show only a slight warming – as do night-time marine air temperatures (NMAT), assembled by the Hadley group. Data on ocean heat content before 2000 are spotty and not very useful. In any case, the interpretation of vertical temperature profiles would require factoring in ocean circulation at different levels.

Proxy data of various types, assembled by Fredrik Ljungqvist in Sweden, and independently by NOAA scientist David Anderson, generally show no warming; Michael Mann never released his post-1979 proxy data, and has even denied their existence (in a personal 1990 email); one suspects that the reason is they show no warming.

A quick word about the observed (and genuine) warming interval 1910-40. It can be seen not only in surface thermometers at weather stations, temperature records from ships, but in all published proxy records. Alas, I could not find any atmospheric temperature data for that period. It is generally agreed, however – including by IPCC --that this warming is of natural origin and not from GH gases.

Thus there is no evidence whatsoever of any warming from human-released CO₂ during the whole of the 20th century or earlier.

The bottom line

One can certainly argue about whether the NCDC results are correct –and I expect many months of back-and-forth. So, has global warming really stopped? We will know for sure in just a few years.

There will certainly be debate also about my proposition of no evidence at all for AGW. We will need a persuasive answer to the puzzle -- why do land thermometers show a warming before 2000, but not after 2000? I may have an answer, but must first try to convince my colleagues.

One thing is quite certain, however: Current IPCC climate models cannot explain what the observations clearly show. This makes the models unsuitable for climate prediction – and for policy purposes generally.

S. Fred Singer is professor emeritus at the University of Virginia and a founding director of the Science & Environmental Policy Project; in 2014, after 25 years, he stepped down as president of SEPP. His specialty is atmospheric and space physics. An expert in remote sensing and satellites, he served as the founding director of the US Weather Satellite Service and, more recently, as vice chair of the US National Advisory Committee on Oceans & Atmosphere. He is a Senior Fellow of the Heartland Institute and the Independent Institute. He co-authored the NY Times best-seller Unstoppable Global Warming: Every 1500 years. In 2007, he founded and has chaired the NIPCC (Nongovernmental International Panel on Climate Change), which has released several scientific reports [See [NIPCCreport.org](http://www.nipccreport.org)]. For recent writings see http://www.americanthinker.com/s_fred_singer/ and also Google Scholar. revised 06:41 EDT

http://www.americanthinker.com/blog/2015/07/commenters_excoriate_a_emscienceem_paper_that_denies_global_warming_pause.html



American Thinker

July 1, 2015

Commenters excoriate a *Science* paper that denies global warming 'pause'

By [S. Fred Singer](#)

Perhaps the most inconvenient truth for global warming theorists has been the absence of any statistically significant warming trend in the past 18 years – in spite of rapidly rising atmospheric levels of the greenhouse gas carbon dioxide. Many are simply ignoring this unanticipated result – for example, the encyclical letter issued by Pope Francis on June 18. Conventional climate science, as employed in IPCC models, has been unable to explain these observations.

Coming to the rescue, Dr. Tom Karl, head of NOAA's National Climate Data center (NCDC), asserts that the temperature plateau (aka "pause" or "hiatus") is simply an artifact of the data. After he and colleagues adjust some recent SST (sea-surface temp) readings, they claim an uninterrupted warming trend in the 21st century. Their paper appeared in *Science-Express* on June 4 and in *Science* mag on June 26 (<http://www.sciencemag.org/content/348/6242/1469.full>)..

The Karl claims gave rise to many published comments, mostly negative. *There was not a single comment in support of the Karl paper.* Some simply addressed technical details – the fact that atmospheric temperature data, from satellites as well as from balloon-borne radiosondes, have shown no warming trend. But many other comments questioned the good faith of the authors and implied political motives.

Here is a selection of the latter type of comments (excluding my own), as [published in Science](#):

Megalith Megalith

So, you found a way to fudge the data that proved anthropogenic global warming was a hoax. I'm sure Obama and the Democrat party will reward you with more of my stolen taxes to support your continuing charade.

It doesn't add up

This study has already been debunked by Richard Lindzen: <http://www.cato.org/blog/there-no-hiatus-global-warming-after-all> Tisdale and

Watts: <http://www.powerlineblog.com/archives/2015/06/new-paper-on-the-pause-is-...> Judith

Curry: <http://judithcurry.com/2015/06/04/has-noaa-busted-the-pause-in-global-wa...> Ross

McKittrick: <http://wattsupwiththat.com/2015/06/04/a-first-look-at-possible-artifacts...>

Larry Evans

"Adjusted" = Fake. Pathetic.

William Adams

There are a lot of genuine criticisms of the methodology used here. One such article is here: <http://dailycaller.com/2015/06/04/noaa-fiddles-with-climate-data-to-eras...> Even after reading all the texts and looking at the data, many data scientists as well as climate scientists are questioning if this is a case of adjusting the data to meet the desired conclusion.

Ted King

This article seems to do nothing more than demonstrate the sheer malleability of these data to fit a politically-driven narrative.

Danley Wolfe

The so called "hiatus" in warming of global mean temperature since the 1990s is a fact. Whether it is temporary or permanent is not known; however, it smells a lot like meddling. If you did it with your PhD dissertation data you would deserve scrutiny or even being dismissed. FACT: if you prepare a simple cross plot of NASA-GISS global mean temperature vs. Mauna Loa - Keeling CO2 from 1997 to-date there is essentially zero correlation which says that all the variability in global mean temperature is due to "not CO2" - other variables. How do you reconcile this with the supposition that "the increase in global temperature" is "predominately due to anthropogenic causes namely CO2." If you look at the entire data set from 1959 (limited by the MLK CO2 data): a) CO2 levels rise monotonically throughout the extended period, b) you find two distinct periods in which temperatures are flat and/or even falling - mid 1940s to mid 1970s and late 1980s to present - representing around two-thirds of the time; and one period (middle) in which global mean temperature increased with CO2. The first period is normally left out of the analysis by consensus / advocacy groups and most emphasis given to the second / middle period but claims made that the third period should be discounted as an anomaly. This is reminiscent of the end of the 1972 Olympics Men's basketball gold medal game in which the Russians were given 3 tries to score the winning goal and take the gold.

Scott Martell

"In all this they are not seeking for theories and causes to account for observed facts, but rather forcing their observations and trying to accommodate them to certain theories and opinions of their own." - Aristotle, On the Heavens II.13.293a

Tom D

Wow! The same thing happened with my GPA. Somehow the university showed a lower GPA than my projection model had predicted. I easily solved this problem by hacking into my school's computer system and made my grades 'more accurately' reflect my projections. Global Warming data works the same way. See, isn't life easy when you get to adjust the data points.

Gregory Girard

I think we can feel reassured that they were able to catch this error when they did rather than years ago, or in the future at some time. The IPCC is the global leadership of a political movement, and the "climate scientists" are partisans will do or say anything to advance the interests of the party. If it was not so menacing to our way of life, pretending this is science would just be laughable on account of how manifestly politically expedient it is.

Dr. Robert Oppenheimer

The preceding comments were brought to you by combined worldwide oil and coal industries, and by The Heartland Institute (a wholly owned subsidiary of Koch Industries INC).

Danley Wolfe

I am sorry to see this kind of crude disfiguration of well meaning people just because they may find reason to question - smears, innuendos and name calling is a primary propaganda as promoted by Herr Dr Jos Goebbels and Willi Minzenberg. I know that the real Dr J Robert Oppenheimer (if he were alive) would not stoop so low. (Note, Michael Oppenheimer, son of Frank, is the nephew of the real J Robert Oppenheimer; J Robert and Michael both are/were Princeton faculty). At this stage in the climate discussion the issues need to be discussed in an adult manner allowing different points of view and in the end data will decide the winner. According to Norman Davies' Five Basic Rules of Propaganda, in "Europe, a History," Oxford University Press, 1996, pp 500-501:

Theorists of propaganda have identified five basic rules:

1. The rule of simplification: reducing all data to a simple confrontation between 'Good and Bad', 'Friend and Foe'.
2. The rule of disfiguration: discrediting the opposition by crude smears and parodies.
3. The rule of transfusion: manipulating the consensus values of the target audience for one's own ends.
4. The rule of unanimity: presenting one's viewpoint as if it is the unanimous opinion of all right-thinking people; including drawing doubting individuals into agreement by the appeal of star-performers, social pressure and by 'psychological contagion, aka psy-ops.

5. The rule of orchestration: endlessly repeating the same message; in different variations and combinations."

albert parker

The new paper published by Science that negate the "hiatus" in global warming prompts serious questions about the political bias of high impact factor journals. The claim by the authors that "global trends are higher than reported by the IPCC, especially in recent decades, and that the central estimate for the rate of warming during the first 15 years of the 21st century is at least as great as the last half of the 20th century" is a dubious statement motivated with a flawed analysis that should not have passed unobserved by the reviewers. There exist multiple measures of lower atmosphere temperature which indicate the existence of a "hiatus" that should have been used to question a biased reconstruction of global temperatures with unidirectional corrections always in the direction of magnifying the warming. There is no scientific value in these arbitrary corrections always in one sole direction to create similarity with flawed model predictions. Genuine artifacts do not only work for the cause of a new world order originated from the climate alarmism.

Thomas [Reynolds](#)

Just Kudos and push forward. Forward, never straight.

Ken Towe

The adjustments to the sea surface temperatures do not seem to have affected the LAND temperatures of the contiguous US 48 states. According to NCDC's data the "hiatus" in the US remains intact. Indeed their latest 2015 data show clearly that since 1998 the annual, winter and fall trends are all down. 2014 was only the 34th warmest year on record for the US.

Paul Axford

Do I understand correctly that the sea surface temperature data was normalized to the ship data even though the buoy data is considered more accurate? If so, what was the rationale for this?

David Simpson

Who can we trust anymore, ever since I witnessed Nixon outright lying , I became a confirmed sceptic, as more people should.

Daniel Villanova

However, the 1998-2012 rate is still non-significant ($p > .10$). Whoa, what does that mean? That means the corrected or uncorrected rate for that time period STILL (even WITH the corrected upwards estimates) exhibits the pause. The results showing no pause are being driven by 2013 or 2014, or both. In fact, the new corrections show no statistically significant 1998-2012 warming

in any breakdown

(<http://www.sciencemag.org/content/early/2015/06/05/science.aaa5632/F1.la...>). The lack of pause is due completely to the additional 2 years of data. Conclusion: need more data.

Patrick Michaels

The senior author was the chief climate scientist on the first (2000) National Assessment. In my review, I discovered that the two models they relied upon were literally worse than applying a table of random numbers to the 20th century data. In other words, they were using models that had the dubious ability to produce negative knowledge. Tom replied that they had in fact done a similar test and found what I did. They went ahead anyway. Enough said?

CJ Orach

How to erase the Global Warming Pause bit.ly/1cBX6LY

1. Don't use any data that shows the 18 + year pause in global warming or does not agree with your findings including Satellite Temperature Data or Argo Sea Surface Temperature Data
 2. Instead use measurements from buoys that were never intended to be used to measure temperatures accurately.
 3. Then adjust any data that still may not agree with your premise by claiming the data was inaccurate and needs to be adjusted.
 4. To further adjust the data cherry pick the time intervals so the pause is just seem to disappear.
- Abra Kadabra OUT Damn Pause

J Peden

Pile up a bunch of hokey, "just so" adjustments, top them off with a $p=0.10$ just for good measure, and...does anyone at "Science" Mag. still do any real science at all?

Alexander Carpenter

If you torture the data long enough, it will confess to anything.

Flame CCT

I'm curious how the editor allowed such a paper to be published. It is easy to see how the only change made was manipulation to the data, downward for the previous years and upward for the more recent years. Makes one wonder what else has NOAA manipulated.

Richard [Fletcher](#)

Wouldn't you know it, throw enough money at the problem, and it will take care of itself. What hiatus?

Dan Peyton

Witness the death of Science at the altar of Politics.

Robert Matthews

The authors state: "It is also noteworthy that the new global trends are statistically significant and positive at the 0.10 significance level for 1998–2012". It's certainly noteworthy for sceptics, as so high a p-value is usually interpreted as meaning the null hypothesis (here, that there is no temp trend) has not been ruled out. Perhaps the authors could explain why this interpretation does not apply here ?

John Torres

So basically, if you don't like the "pause" in global warming all you have to do is fiddle with the numbers until you get the result you want. Guess the "debate" is finally over. Thank you, *Science*.

Adolf Stips

Satellite SST has global coverage (including the mentioned undersampled arctic regions) but as these data do not fit with message given by the authors, they with just one sentence of justification exclude 30 years of satellite observations from their analysis. I cannot believe this to be true. Is this serious science?

|  [263 Comments](#)

S. Fred Singer is professor emeritus at the University of Virginia and a founding director of the Science & Environmental Policy Project; in 2014, after 25 years, he stepped down as president of SEPP. His specialty is atmospheric and space physics. An expert in remote sensing and satellites, he served as the founding director of the US Weather Satellite Service and, more recently, as vice chair of the US National Advisory Committee on Oceans & Atmosphere. He is a Senior Fellow of the Heartland Institute and the Independent Institute. He co-authored the NY Times best-seller Unstoppable Global Warming: Every 1500 years. In 2007, he founded and has chaired the NIPCC (Nongovernmental International Panel on Climate Change), which has released several scientific reports [See NIPCCreport.org]. For recent writings see http://www.americanthinker.com/s_fred_singer/ and also Google Scholar.

http://www.americanthinker.com/articles/2015/07/editor_of_emscienceem_magazine_should_resign.html



American Thinker

July 28, 2015

Editor of *Science* Magazine Should Resign!

By [S. Fred Singer](#)

The 3 July 2015 issue of *Science* features a remarkable editorial by Editor Marcia McNutt. Titled “[The beyond-two-degree inferno](#),” it suggests that an anthropogenic greenhouse (GH) warming of more than 2 degrees C (global average) will literally cause hell on earth, unless we can all agree to reduce emissions of the “infernal” GH-gas carbon dioxide – preferably before or at a [UN-sponsored mega-confab](#) in Paris in December. This much-hyped event, to be attended by nearly 200 national delegations and thousands of hangers-on, has even been endorsed in a [papal encyclical](#), referred to, somewhat irreverently, as a “Pope-sicle” by my Virginia colleague Dr Charles Battig.

McNutt’s editorial claims a “*global threat to food supplies, health, ecosystem services, and the general viability of the planet.*” Yet none of these threats are supported by any scientific evidence -- even from the usually alarmist UN-IPCC. She fails to remind us that atmospheric CO₂ is the essential ingredient for sustaining carbon-based life on Earth. The low CO₂ levels during the recent ice age severely limited the rate of photosynthesis; at slightly lower levels, we and almost all living things on the Earth’s surface would just starve and die. And she takes for granted that rising CO₂ will cause significant Global Warming (GW), with all the usual calamities that are recited by climate alarmists -- in spite of overwhelming evidence for absence of 21st-century warming.

As geologist Dudley Hughes wrote in May 2007 in [Environment & Climate News](#), “[L]ittle publicity is given to the large number of qualified scientists who...contend that if CO₂ plays any part in global warming, it is so insignificant that it can barely be measured, let alone be the major cause.” And: “[T]he claim that increased carbon dioxide is causing ‘global warming’ ...has no more scientific foundation than the bloodletting of past generations.”

His words are backed by the five reports (in English) of the independent NIPCC (Nongovernmental International Panel on Climate Change), issued since 2008 and based on many thousands of references collected from peer-reviewed journals by nearly 100 well-qualified climate scientists; they included many papers ignored by the IPCC. The brief Overview-NIPCC volume of 2008 was translated into several European languages; the Chinese Academy of Sciences translated and published a substantial NIPCC summary volume in 2013.

But McNutt is not interested in listening to contrary evidence. “*The time for debate has ended. Action is urgently needed.*” What a strange position to take for the editor of a leading and (formerly) respected international science journal! She should resign her job and allow someone else to take her place -- someone who recognizes that debate is essential for scientific progress.

Maybe McNutt really believes that GW has never really paused and that reducing CO2 levels can make a noticeable difference. That could happen only if she reads the evidence selectively and rejects all evidence to the contrary. Or maybe she is cynically playing along with current White House policy, even though it is completely uninformed and misguided, in the hope it will benefit *Science* mag and herself.

Yet another possibility is that she is naïve enough to believe that the world’s nations are actually worried about a small amount of climate warming; in reality, the game is about money and political power. She seems oblivious to the fact that China snookered Obama in their [November 2014 climate agreement](#); but she seems really disturbed about India’s plans, and insensitive to that nation’s desperate need for reliable, secure, and low-cost electric power: “*Unfortunately, [energy minister] Piyush Goyal ... intends to double his nation’s coal production by the year 2019 to meet domestic energy requirements.*” India’s CO2 emissions will soon match China’s and, together, will make irrelevant any emission reductions by the rest of the world; after all, it’s the global CO2 level that counts. Could someone please explain this to McNutt?

As for myself, I have decided to drop my subscription to *Science* and my AAAS membership; *Science* is the flagship journal of the [American Association for the Advancement of Science](#). I guess I will continue as an elected AAAS Fellow; but I am no longer proud of that distinction. I suppose, also, that any future contribution to *Science* – even a Letter or a Technical Comment -- will not be welcome as long as McNutt or someone of her persuasion continues as editor.

Has the global warming pause really ended?

The pernicious influence of Editor McNutt’s ideology-driven science can be easily recognized in the promotion given to a fairly routine scientific paper by NOAA climatologist Thomas Karl and coauthors; however, it has very important policy implications. After making certain controversial adjustments to the surface temperature record, the authors concluded that there had been no GW pause (a.k.a. hiatus or plateau), which many researchers had rather reluctantly accepted, but that there had actually been a continuing warming trend during all of the 21st century. Their paper was published in *Science-Express* on June 4, with a lot of the publicity usually reserved for major discoveries.

It was finally printed in the 26June issue of *Science*; the comments published in *Science* blog were almost uniformly negative, and questioned the authors' motives rather than the technical details of their data adjustment. This is wrong, of course; with the 3July editorial at hand, such comments might have been better addressed to the Editor.

The several NIPCC reports can be accessed free of charge at www.NIPCCreport.org. IPCC reports are available at www.ipcc.de. A critique of the latest IPCC science report was issued as a Policy Brief in Oct 2013 and can be accessed at http://heartland.org/sites/default/files/critique_of_ipcc_spm.pdf

My initial reaction (of 4June) to the Karl paper in *Science-Express* is seen [here](#). Independent comments from the *Science* blog were reprinted [here](#). Technical papers questioning the Karl conclusions are forthcoming -- but may not be published in *Science*; one would want to look at other scientific journals.

To sum up: The GW plateau appears to be ongoing -- and is as yet unexplained. We don't know if or when it will end. Climate sensitivity of CO₂ seems to be much lower than any of the IPCC models predict -- perhaps even close to zero. Thus, any policies based on GH models can be junked; fossil fuels are not the cause of climate change. So much for McNutt's policy prescription that

"...every person need [sic] to ... reduce carbon pollution [sic] by ...adopting alternative energy technologies, ...and capturing CO₂ at the source."

The two-degree limit is a political invention

The 2deg limit has nothing to do with science -- and, in any case, is unlikely to be exceeded, or even reached, as things look now. As recounted in [American Thinker](#), the 2deg limit was invented in Sweden as a pure guess -- without any "evidence" from climate models that there might be some kind of discontinuity when global temperature (however it may be calculated) reaches the 2deg level.

However, the 2deg limit was widely adopted by politicians and became enshrined in folklore, when it was realized that it satisfied the "Goldilocks" principle -- not too little or too large, but just right for political action against CO₂, fossil fuels, low-cost and secure energy -- and the economic growth all this made possible.

Consider: A limit set at 0.5deg will be dismissed with "We've already seen this -- and nothing happened." A limit at, say, 5deg may elicit a different kind of response: "It won't happen soon -- at least, not in my lifetime." In fact, the whole concept of a global average is very vague; GH models tell us that warming will concentrate at high latitudes at night. So, Siberian winter nights might warm from minus 40deg all the way to minus 35deg. Is that bad?

Many economists have concluded that even a 3deg warming might on the whole be beneficial, even at the lower US latitudes, largely because of gains by the agricultural sector: longer

growing seasons and fewer frosts, more rain, but mostly increased fertilization from higher atmospheric CO2 levels.

Ice ages are the real threat to mankind

The most recent glaciation covered much of the northern hemisphere with miles-thick ice and wiped out the Neanderthals; its sudden end about 12,000 years ago led into the present warm interglacial period, which we call the Holocene. According to the Milankovitch astronomical calculations, the next glaciation is “just around the corner” -- or at least a millennium or so away.

But even a “little” ice age, like one that ended only 200 years ago, would be extremely damaging to our civilization. Crop failures worldwide would lead to famines, disease, and many deaths. The December gabfest in Paris should be concerned about near-future cooling -- not warming. And so should Editor McNutt.

She should be soliciting research papers that explore adaptation to an extended cool period, and ways its harmful effects can be [overcome or lessened](#). Time to prepare may be short.

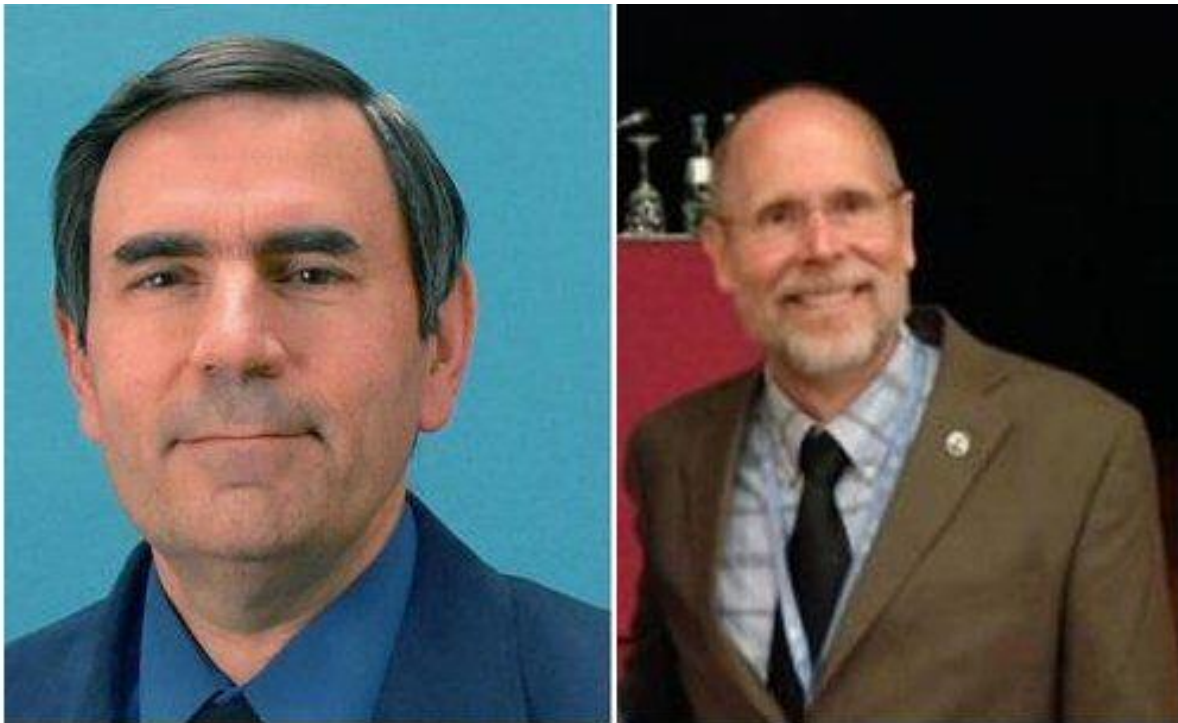
S. Fred Singer is professor emeritus at the University of Virginia and a founding director of the Science & Environmental Policy Project; in 2014, after 25 years, he stepped down as president of SEPP. His specialty is atmospheric and space physics. An expert in remote sensing and satellites, he served as the founding director of the US Weather Satellite Service and, more recently, as vice chair of the US National Advisory Committee on Oceans & Atmosphere. He is a Senior Fellow of the Heartland Institute and the Independent Institute. He co-authored the NY Times best-seller Unstoppable Global Warming: Every 1500 years. In 2007, he founded and has chaired the NIPCC (Nongovernmental International Panel on Climate Change), which has released several scientific reports [See NIPCCreport.org]. For recent writings see http://www.americanthinker.com/s_fred_singer/ and also Google Scholar.

<http://wattsupwiththat.com/2015/10/28/ncdenceis-karl-and-peterson-refuse-congressional-subpoena-on-flawed-pausebuster-paper/>

WUWT What's Up With That? October 28, 2015

NCDC/NCEI's Karl and Peterson refuse congressional subpoena on flawed 'pausebuster' paper

[Anthony Watts](#) / [October 28, 2015](#)



Thomas Karl, Director NCEI/NCDC Thomas Peterson, NCEI/NCDC

Wow, just wow. I told Dr. Tom Peterson in an email this summer that their [highly questionable paper that adjusted SST's of the past to erase the "pause"](#) was going to become "their waterloo", and Peterson's response was to give the email to wackadoodle climate blogger Miriam O'Brien (aka Sou Bundanga) so she could tout it with the usual invective spin that she loves to do. How "professional" of Peterson, who made the issue political payback with that action.

Another reminder of Peterson's "professionalism" is this political cartoon he made portraying climate scientists holding different published opinions as "nutters", while working on the taxpayer's dime, courtesy of the Climategate emails in 2009:



Now, it looks like Karl and Peterson think they are above the law and forget who they actually work for. They've really stepped in it now.

Via The Hill:

Agency won't give GOP internal docs on climate research

The federal government's chief climate research agency is refusing to give House Republicans the detailed information they want on a controversial study on climate change.

Citing confidentiality concerns and the integrity of the scientific process, the National Oceanic and Atmospheric Administration (NOAA) said it won't give Rep. Lamar Smith (R-Texas) the research documents he subpoenaed.

At the center of the controversy is a study that concluded there has not been a 15-year "pause" in global warming. Some NOAA scientists contributed to the report. Skeptics of climate change, including Smith, have cited the pause to insist that increased greenhouse gas emissions, mostly from burning fossil fuels, are not heating up the globe.

Smith, the chairman of the House Science Committee, vehemently disagreed with the study's findings. He issued a subpoena for communications among the scientists and some data, leading to charges from Democrats that he was trying to intimidate the researchers.

Late Tuesday, NOAA provided Smith with some more information about its methods and data but refused to give Smith everything he wanted.

NOAA spokeswoman Ciaran Clayton said the internal communications are confidential and not related to what Smith is trying to find out.

“We have provided data, all of which is publicly available online, supporting scientific research, and multiple in-person briefings,” she said.

“We stand behind our scientists who conduct their work in an objective manner. It is the end product of exchanges between scientists — the detailed publication of scientific work and the data that underpins the authors’ findings — that are key to understanding the conclusions reached.”

Clayton also refuted Smith’s implication that the study was political.

“There is no truth to the claim that the study was politically motivated or conducted to advance an agenda,” she said. “The published findings are the result of scientists simply doing their job, ensuring the best possible representation of historical global temperature trends is available to inform decisionmakers, including the U.S. Congress.”

Smith defended his investigation, saying NOAA’s work is clearly political.

“It was inconvenient for this administration that climate data has clearly showed no warming for the past two decades,” he said in a statement. “The American people have every right to be suspicious when NOAA alters data to get the politically correct results they want and then refuses to reveal how those decisions were made.”

Smith also said NOAA’s assertion of confidentiality is incorrect.

“The agency has yet to identify any legal basis for withholding these documents,” he said, adding that his panel would use “all tools at its disposal” to continue investigating. Smith has been communicating with NOAA about the research since it was published in the summer, and their exchanges have grown increasingly hostile. Rep. Eddie Bernice Johnson (Texas), the committee’s ranking Democrat, has sharply criticized Smith’s requests.”

More here: <http://thehill.com/policy/energy-environment/258375-agency-wont-give-gop-internal-docs-on-climate-research>

h/t to WUWT reader “catcracking”

The purpose of the Karl et al. paper was to *erase the pause*, clearly a political move, and one that is already backfiring in the scientific arena as noted [climatologist Gerald Meehl has made some pushback](#) against their politically based science.

Note: about ten minutes after publication, this story was edited to fix some text formatting errors.

<http://arstechnica.com/science/2015/11/congressman-claims-noaa-whistleblowers-told-him-climate-study-was-rushed/>

ARS TECHNICA November 19, 2015

Scientific Method / [Science & Exploration](#)

Congressman claims NOAA whistleblowers told him climate study was rushed

NOAA denies the study was hurried for political reasons.

by [Scott K. Johnson](#) - Nov 19, 2015 6:09am PST



Aurich Lawson / Thinkstock

Rep. Lamar Smith (R-TX) is back with more accusations against National Oceanic and Atmospheric Administration (NOAA) climate scientists. The new claims came in the form of [another letter](#) sent to Commerce Secretary Penny Pritzker on Wednesday.

The letter alleges for the first time, that “information provided to the [House Committee on Science, Space, and Technology] by whistleblowers appears to show that the Karl study was rushed to publication despite the concerns and objections of a number of NOAA scientists.” The letter states that “Dr. Karl rushed to publish the study before all appropriate reviews of the

underlying science and new methodologies used in the foundational climate datasets were conducted.”

Why would the study be rushed? Rep. Smith writes that “the timing of its release raises concerns that it was expedited to fit the Administration’s aggressive climate agenda.” The [June study](#) in the journal *Science* came out two months before the new EPA “Clean Power Plan” [regulations were finalized](#), and five months before the upcoming international climate negotiations in Paris.

Referring to the scientists' e-mails, which he has subpoenaed, Rep. Smith writes, “If you do not produce the requested material by Friday, November 20, 2015, I will be forced to consider the use of compulsory process.” Rep. Smith is also postponing the closed-door interviews he had requested with several NOAA scientists and staff in the meantime.

An aide for the House Science Committee declined to disclose to Ars whether the whistleblowers were NOAA staff, or any other details about the nature of the information they have provided, citing a desire to protect their identity. The information Rep. Smith refers to has not been shared with House Science Committee Democrats, either.

When asked to comment, NOAA provided Ars with the following statement:

The notion that this paper was rushed to publication is false. In December 2014, the coauthors of the study submitted their findings to *Science*—a leading scientific journal. Following a rigorous peer-review process, which included two rounds of revisions to ensure the credibility of the data and methodologies used, *Science* informed the authors that the paper would be published in June.

The notion that NOAA is “hiding something” is also false. We have been transparent and cooperative with the House Science Committee to help them better understand the research and underlying methodologies. We have provided data (all of which is publicly available online), supporting scientific research, and multiple in person briefings. We have provided all of the information the Committee, or anyone else, needs to understand, verify, or challenge the paper's findings.

We stand behind our scientists who conduct their work in an objective manner. As we've said before, there is no truth to the claim that the study was politically motivated or conducted to advance an agenda.

Ars also reached out to the office of Commerce Secretary Penny Pritzker for comment, but no response was received as of press time.

The NOAA study that was published in *Science* presented the latest version of the agency's global surface temperature dataset and explored changes to the specific warming trend from 1998 to 2014. The update came from folding in a pair of previously published datasets: a new database of terrestrial weather stations, and the most recent version of a [database](#) of sea surface temperatures that included some corrections for non-climatic factors like changes in measurement techniques.

The weather station database was published [in *Geoscience Data Journal*](#) in June 2014, and NOAA processed the raw data using the same methods it had used before; those methods were [published in 2011](#). The sea surface temperature database, which Rep. Smith appears to view with suspicion, was published [in the *Journal of Climate*](#) in February 2015, but started the peer review process in December 2013. (As any researcher can tell you, peer review can drag on for a long time.)

As of press time, an aide for the House Science Committee had not clarified why this series of events was being described as a rush “to publish the study before all the appropriate reviews of the underlying science” were completed. NASA incorporated this same sea surface temperature database into [its own](#) global surface temperature dataset back in July. Ars asked whether Rep. Smith plans to investigate NASA’s decision as well, but a response was not immediately provided.

Meanwhile, the *Washington Post* published a letter to the editor from Rep. Smith [Tuesday](#), in which he wrote, “In June, NOAA employees altered temperature data to get politically correct results and then widely publicized their conclusions as refuting the nearly two-decade pause in climate change we have experienced. The agency refuses to reveal how those decisions were made.”

Setting aside the fact that global temperatures have [increased](#) in all of the major surface temperature [datasets](#) over that [time](#) period, and the oceans (where the vast majority of heat energy added due to our greenhouse gas emissions has gone) have continued [warming apace](#), all of NOAA’s data and methods are publicly available.

Rep. Smith’s letter to the editor closes with a familiar argument: “If NOAA has nothing to hide, why not provide the communications to support the agency’s claims?”

On Wednesday, the House Science Committee, which Rep. Smith chairs, was [holding a hearing](#) in which invited speakers criticized new US greenhouse gas emissions regulations and future pledges as expensive and incapable of having a significant effect on global climate.

Further Reading



[Congressman continues pressuring NOAA for scientists’ e-mails](#)
Rep. Lamar Smith seeks closed-door interviews, in the meantime.