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170 Years of Earth Surface Temperature Data Show No Evidence of Significant Warming

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April 2020

Key Points

1. From 1850 to the present, the noise-corrected, average warming of the surface of the earth is less than 0.07 degrees C per decade, possibly as low as 0.038 degrees C per decade.

2. The rate of warming of the surface of the earth does not correlate with the rate of increase of fossil fuel emissions of CO_2 into the atmosphere.

3. Recent increases in surface temperatures reflect 40 years of increasing intensities of the El Nino Southern Oscillation climate pattern.

Abstract

This study investigates relationships between surface temperatures from 1850 to the present and reported long-range temperature predictions of global warming. A crucial component of this analysis is the calculation of an estimate of the warming curve of the surface of the earth. The calculation removes errors in temperature measurements and fluctuations due to short-duration weather events from the recorded data. The results show the average rate of warming of the surface of the earth for the past 170 years is less than 0.07 degrees C per decade, possibly as low as 0.038 degrees C per decade. The rate of warming of the surface of the earth does not correlate with the rate of increase of CO_2 in the atmosphere. The perceived threat of excessive future global temperatures may stem from misinterpretation of 40 years of increasing intensities of the El Nino Southern Oscillation (ENSO) climate pattern in the eastern Pacific Ocean. ENSO activity culminated in 2016 with the highest surface temperature anomaly ever recorded. The rate of warming of the earth's surface has declined 45 percent since 2006.

Introduction

The results of this study suggest the present movement to curtail global warming may by premature. Both the highest ever recorded warming currents in the Pacific Ocean and technologically advanced methods to collect ocean temperature data from earth orbiting satellites coincidently began in the late 1970s. This study describes how the newly acquired high-resolution temperature data and Pacific Ocean transient warming events may have convolved to result in long-range temperature predictions that are too high.

HadCRUT4 Monthly Temperature Anomalies

The HadCRUT.4.6.0.0 monthly medians of the global time series of temperature anomalies, Column 2, 1850/01 to 2019/08 (Morice, C. P., et. al. 2012) was used for this report together with later monthly data to 2020/02. Only since 1979 have high-resolution satellites provided simultaneously observed data on properties of the land, ocean and atmosphere (Palmer, P.I., 2018). NOAA-6 was launched in December 1979 and NOAA-7 was launched in 1981. Both were equipped with microwave radiometry devices (Microwave Sounding Unit-MSU) to precisely monitor sea-surface temperature anomalies over the eastern Pacific Ocean and the areas of ENSO activity (Spencer, et al., 1990). These satellites were among the first to use this technology.

The initial analyses of the high-resolution satellite data yielded a remarkable result. Spencer, et al. (1990), concluded the following: “The period of analysis (1979–84) reveals that Northern and Southern hemispheric tropospheric temperature anomalies (from the six-year mean) are positively correlated on multi-seasonal time scales but negatively correlated on shorter time scales. The 1983 ENSO dominates the record, with early 1983 zonally averaged tropical temperatures up to 0.6 degrees C warmer than the average of the remaining years. These natural variations are much larger than that expected of greenhouse enhancements and so it is likely that a considerably longer period of satellite record must accumulate for any longer-term trends to be revealed”.

Karl, et al. (2015) claim that the past 18 years of stable global temperatures is due to the use of biased ocean buoy-based data. Karl, et al. state that a “bias correction involved 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.” This analysis is not consistent with the interpretation of the past 18-year pause in global warming. The discussion below of the first derivative of a temperature anomaly trendline shows the rate of increase of relatively stable and nearly noise-free temperatures peaked in 2006 and has since declined in rate of increase to the present.

The following is a summary of conclusions by Karl, et al. (2015) (called K15 below) by Mckitrick (2015): “All the underlying data (NMAT, ship, buoy, etc.) have inherent problems and many teams have struggled with how to work with them over the years. The HadNMAT2 data are sparse and incomplete. K15 take the position that forcing the ship data to line up with this dataset makes them more reliable. This is not a position other teams have adopted, including the group that developed the HadNMAT2 data itself. It is very odd that a cooling adjustment to SST records in 1998-2000 should have such a big effect on the global trend, namely wiping out a hiatus that is seen in so many other data sets, especially since other teams have not found reason to make such an adjustment. The outlier results in the K15 data might mean everyone else is missing something, or it might simply mean that the new K15 adjustments are invalid."

Mears and Wentz (2016) discuss adjustments to satellite data and their new dataset, which "shows substantially increased global-scale warming relative to the previous version of the dataset, particularly after 1998. The new dataset shows more warming than most other middle tropospheric data records constructed from the same set of satellites." The discussion below shows the warming curve of the earth has been decreasing in rate of increase of slope since July 1988; that is, the curve is concave downward. Based on this observation alone, their new dataset should not show "substantially increased global-scale warming."

Analysis of Temperature Anomalies-Case 1

All temperature measurements used in this study are calculated temperature anomalies and not absolute temperatures. A temperature anomaly is the difference of the absolute measured temperature from a baseline average temperature; in this case, the average annual mean temperature from 1961 to 1990. This conversion process is intended to minimize the effects on temperatures related to the location of the measurement station (e.g., in a valley or on a mountain top) and result in better recognition of regional temperature trends.

In Figure 1, the black curve is a plot of monthly mean surface temperature anomalies. The jagged character of the black temperature anomaly curve is data noise (inaccuracies in measurements and random, short term weather events). The red curve is an Excel sixth-degree polynomial best fit trendline of the temperature anomalies. The curve-fitting process removes high-frequency noise. The green curve, a first derivative of the trendline, is the single most important curve derived from the global monthly mean temperature anomalies. The curve is a time-series of the month-to-month differences in mean surface temperatures in units of degrees Celsius change per month. These very small numbers are multiplied by 120 to convert the units to degrees per decade (left vertical axis of the graph). Degrees per decade is a measure of the rate at which the earth's surface is cooling or warming; it is sometimes referred to as the warming (or cooling) curve of the surface of the earth. The green curve temperature values are close to the values of noise-free troposphere temperature estimates determined at the University of Alabama in Huntsville for single points (Christy, J. R. May 8, 2019). The green curve has not previously been reported and adds a new perspective to analyzes of long-term temperature trends.

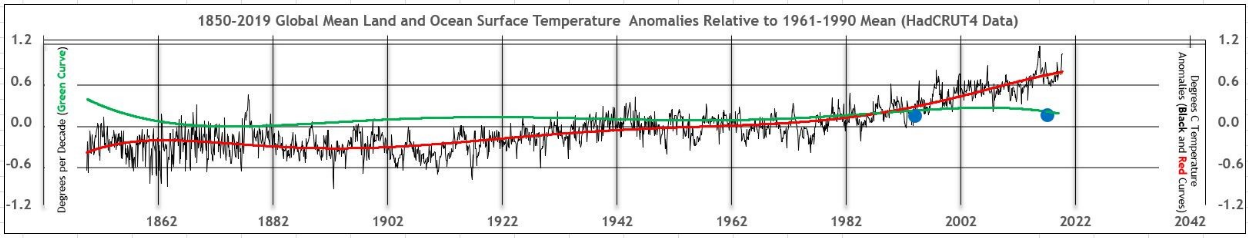

Figure 1. The black curve is the HadCRUT4 time series of the mean monthly global land and sea surface temperature anomalies, 1850-present. Anomalies are deviations from the 1961-1990 annual mean temperatures in degrees Celsius. The red curve is the trendline of the HadCRUT4 data set, an Excel sixth-degree polynomial best fit of the temperature anomalies. The green curve is the first derivative of the trendline converted from units of degrees C per month to degrees C per decade, that is; the slope of the trendline curve. The green curve is the warming curve of the surface of the earth. The two solid blue circles are warming values of the troposphere calculated at the University of Alabama in Huntsville from global energy balance studies.

In a recent talk, John Christy, director of the Earth System Science Center at the University of Alabama in Huntsville, reported estimates of noise-free warming of the troposphere in 1994 and 2017 of 0.09 and 0.095 degrees C per decade, respectively (Christy, J. R., May 8, 2019). These values were estimated from global energy balance studies of the troposphere by Christy and McNider using 15 years of newly acquired global satellite data in 1994 (Christy, J. R., and R. T. McNider, 1994) and, a repeat of the 1994 study in 2017 with nearly 40 years of satellite data (Christy, J. R., 2017). From this work, using two points derived from the 1994 data and the 2017 data they concluded the earth warming in the troposphere for the last 40 years was approximately a straight line that sloped 0.095 degrees per decade. They call this curve the “tropospheric transient climate response”, that is, “how much temperature actually changes due to extra greenhouse gas forcing.”

The green curve in Figures 1 and 3 could be called the earth surface transient climate response after Christy, although some longer wave-length noise from 40 years of intense ENSO activity remains in the data. The 2017 average value for the green curve is 0.154: this value is 0.059 degrees per decade higher than the UAH estimate for the troposphere. The latest value in February 2020 for the green curve is 0.117 degrees C per decade. The average degrees C per decade value of earth warming based on the green curve over 2,032 months since 1850 is 0.068 degrees C per decade. The average from 1850 through 1979, the beginning of the most recent ENSO, is 0.038 degrees C per decade, a value too small to measure.

A warming rate of 0.038 degrees C per decade would need to significantly increase or decrease to support a prediction of a long-term change in the earth’s surface temperature. If the earth’s surface temperature increased continuously starting today at a rate of 0.038 degrees C per decade, in 100 years the increase in the earth’s temperature would be only 0.4 degrees C., which is not indicative of a global warming threat to humankind.

The 0.038 degrees C per decade estimate is likely beyond the accuracy of the temperature measurements. Recent statistical analyses conclude that 95% uncertainties of global annual mean surface temperatures range between 0.05 degrees C to 0.15 degrees C over the past 140 years; that is, 95 measurements out 100 are expected to be within the range of uncertainty estimates (Lenssen, N. J. L., et al. 2019). Very little measurable warming of the surface of the earth has occurred from 1850 to 1979.

In Figure 2, the green curve is the warming curve; that is, a time series of the rate of change of the temperature of the surface of the earth in degrees per decade. The blue curve is a time series of the concentration of fossil fuel emissions of CO_2 in units of million metric tons of carbon in the atmosphere. The green curve is generally level from 1900 to 1979 and then rises slightly due to lower frequency noise remaining in the temperature anomalies from 40 years of ENSO activity. The warming curve declined since early 2000 to the present. The concentration of CO_2 increased steadily from 1943 to 2019. There is no correlation between a rising CO_2 concentration in the atmosphere and a relatively stable, low rate of warming of the surface of the earth from 1943 to 2019.

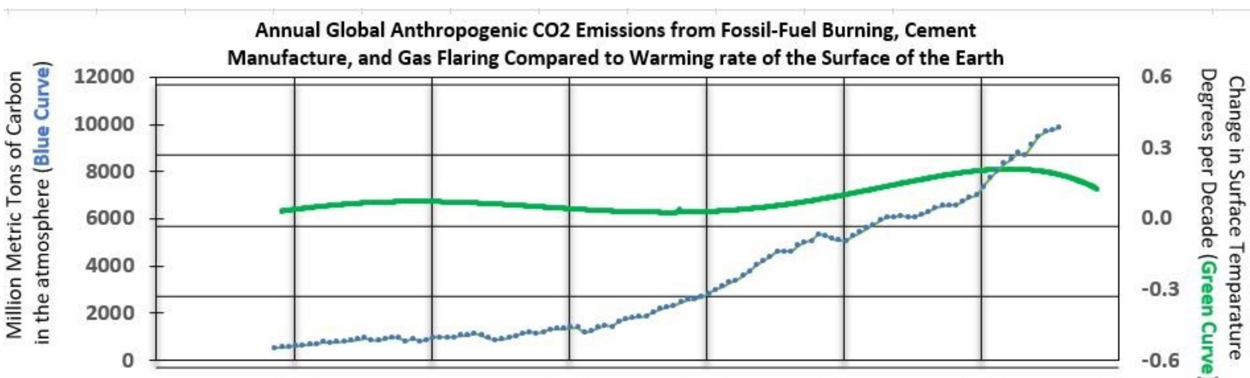

Figure 2. The green curve is the first derivative of the trendline converted to units of degrees C per decade, that is, the rate of change of the surface temperature of the earth. See Figure 1 for the same curve along with the temperature anomalies curve and the trendline curve. The blue dotted curve showing total carbon emissions from fossil fuels in the atmosphere is modified from Boden, T. A., et al. (2017); the time frame shows only emissions since 1900. There is no correlation between increase in the concentration of carbon in the atmosphere and the surface temperature of the earth.

In Figure 3, the December 1979 temperature spike (Point A) is associated with a weak El Nino event. During the following 39 years, several strong to very strong intensity El Nino events (single temperature spikes in the curve) are recorded; the last one, in February 2016, the highest ever recorded mean global monthly temperature anomaly of 1.111 degrees C (Goldengate Weather Services (2019). Since then, monthly global temperature anomalies declined over 23 percent to a temperature of 0.990 degrees C in February 2020 as the ENSO decreased in intensity.

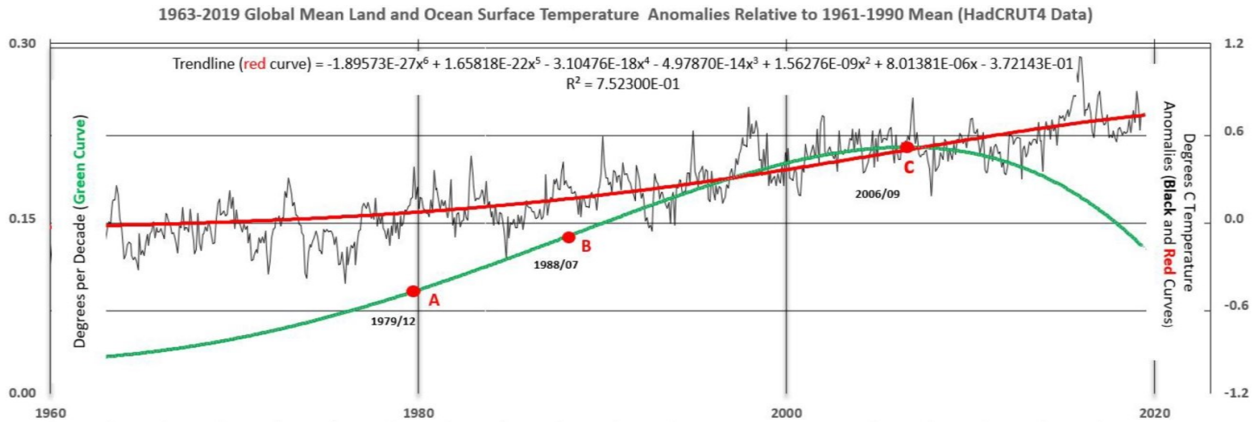

Figure 3. An enlarged portion of Figure 1 from 1963 to 2019 with vertical scale enlarged more than the horizontal scale to emphasize important changes in the shape of the green curve.

Points A, B and C mark very significant changes in the shape of the green warming curve (left vertical axis).

1. The green curve values increased each month from 0.088 degrees C per decade in December 1979 (Point A) to 0.136 degrees C per decade in July 1988 (Point B); this is a 60 percent increase in rate of warming in nearly 9 years. The warming curve is concave upward**.** Point A marks a weak El Nino and the beginning of increasing ENSO intensities.

2. From July 1988 to September 2006, the rate of warming increased from 0.136 degrees C per decade to 0.211 degrees per decade (Point C); this is a 55 percent increase in 18 years but about one-half the total rate of the previous 9 years because of a decrease in the rate of increase each month. The July 1988 point on the x-axis is an inflexion point at which the warming curve becomes concave downward.

3. September 2006 (Point C) marks a very strong El Nino and the peak of the nearly 40-year ENSO transient warming trend, imparting a lazy S shape to the green curve. The rate of warming has declined every month since peaking at 0.211 degrees per decade in September 2006 to 0.117 in February 2020; this is nearly a 45 percent decrease in 14 years. When the green curve reaches a value of zero on the left vertical axis, the absolute temperature of the surface of the earth will begin to decline, and the derivative of the red curve will be negative. The earth will be cooling. That point could be reached within the next decade.

The premise of this analysis is the rate of increase of surface temperatures over most of the past 40 years reflects the effects of the largest ENSO ever recorded, a transient climate event. Since September 2006 (Figure 3), the rate of increase in surface temperatures has slowly decreased as the intensity of the ENSO has decreased. The derivative of the red temperature trendline, that is; the green curve, does not remove all transient noise during the past 40 years of ENSO activity. The curve shows a slight increase and decrease in rates of change of temperatures during that period. Nevertheless, the continuous slowing of the rates of increase in surface temperatures since September 2006 is highly significant and should be accounted for in long-term earth temperature forecasts.

Analysis of Temperature Anomalies-Case 2

Scientists at NASA's Goddard Institute for Space Studies (GISS) updated their Surface Temperature Analysis (GISTEMP v4) on January 14, 2020 (https://www.giss.nasa.gov/). To help validate the methodology of the HadCRUT4 earth temperature data analysis described above, a similar analysis was carried out using NASA earth temperature data and NASA's derivation of the temperature trendline.

Figure 4 is comparable to Figure 1 but derived from a different data set. The NASA land-ocean temperature anomaly data extend from 1880 to the present with a 30-year base period from 1951-1980. The solid black line in Figure 4 is the global annual mean temperature, and the solid red line (trendline through the temperature data) is the five-year Lowess Smooth. Lowess Smooth (https://www.statisticshowto.datasciencecentral.com/lowess-smoothing/) creates a smooth line through a scatter plot to determine a trend as does the Excel sixth-degree polynomial best fit method.

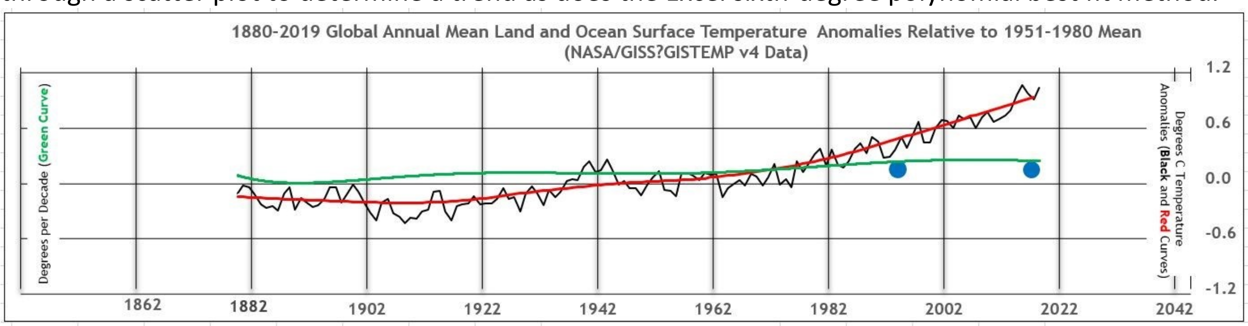

Figure 4. The black curve is the NASA GISTEMP v4 time series of the mean annual global land and sea surface temperature anomalies, 1880-present. Anomalies are deviations from the 1951-1980 annual mean temperatures in degrees C. The red curve is the five-year lowess smooth, best fit of the temperature anomalies. The green curve is the first derivative of the trendline converted from units of degrees C per year to degrees C per decade, that is; the slope of the trendline curve. The green curve is the warming curve of the surface of the earth. The two solid blue circles locate single point warming values of the troposphere calculated at the University of Alabama in Huntsville from global energy balance studies.

The director of the Earth System Science Center at the University of Alabama in Huntsville reported estimates of noise-free warming of the troposphere in 1994 and 2017 of 0.09 and 0.095 degrees C per decade, respectively, located by the solid blue circles on Figure 1 (Christy, J. R., May 8, 2019). The rates of warming of the earth surface estimated from the derivatives of the red temperature trendline shown on Figure 1 and Figure 4 are 0.078 (average of 170 years of data) and 0.068 (average of 138 years of data) degrees C per decade, respectively. These temperature estimates are probably too high because not all noise from several decades of strong ENSO activity has been removed from the raw temperature data. Before the beginning of the current ENSO in 1979, the average rate of warming from 1850 through 1979 estimated from the derivatives of the red temperature trendline is 0.038 degrees C per decade, possibly the best estimate of the long-term rate of warming of the earth.

Truth and Consequences

The "hockey stick graph", which had been cited by the media frequently as evidence for out-of-control global warming over the past 20 years, is not supported by the current temperature record (Mann, M., Bradley, R. and Hughes, M. 1998). The graph is no longer seen in the print media.

None of 102 climate models of the mid-troposphere mean temperature comes close enough to predicting future temperatures to warrant drastic changes in environmental policies. The models start in the 1970s at the beginning of a time period that culminated in the strongest ENSO ever recorded and by 2015, less than 40 years, the average predicted temperature of all the models is nearly 2.4 times greater than the observed global tropospheric temperature anomaly in 2015 (Christy, J. R. May 8, 2019). The true story of global climate change has yet to be written.

The peak surface warming during the ENSO was 0.211 degrees C per decade in September 2006. The highest global mean surface temperature ever recorded was 1.111 degrees C in February 2016; these occurrences are possibly related to the increased quality and density of ocean temperature data from the two, earth orbiting MSU satellites described previously rather than indicative of significant long-term increase in the warming of the earth. Earlier large intensity ENSO events may not have been recognized due to the absence of advanced satellite coverage over oceans.

The use of a temperature trendline to remove high frequency noise did not eliminate the transient effects of the longer wavelength components of ENSO warming over the past 40 years; so, estimates of the rate of warming for that period in this study still include background noise from the ENSO. A noise-free signal for the past 40 years probably lies closer to 0.038 degrees C per decade, the average rate of warming from 1850 to the beginning of the ENSO in 1979 than the average rate from 1979 to the present, 0.168 C degrees per decade. The higher number includes uncorrected residual ENSO effects.

Foster and Rahmstorf (2011) used average annual temperatures from five data sets to estimate average earth warming rates from 1979 to 2010. Noise removed from the raw mean annual temperature data is attributed to ENSO activities, volcanic eruptions and solar variations. The result is said to be a noise-adjusted temperature anomaly curve. The average warming rate of the five data sets over 32 years is 0.16 degrees C per decade compared to 0.17 degrees C per decade determined by this study from 384 monthly points derived from the derivative of the temperature trendline. Foster and Rahmstorf (2011) assume the warming trend is linear based on one averaged estimate, and their data cover only 32 years. Thirty years is generally considered to be a minimum period to define one point on a trend. This 32-year time period includes the highest intensity ENSO ever recorded and is not long enough to define a trend. The warming curve in this study is curvilinear over nearly 170 years (green curve on Figures 1 and 3) and is defined by 2,032 monthly points derived from the temperature trendline derivative. From 1979 to 2010, the rate of warming ranges from 0.08 to 0.20 degrees C per decade. That trend is not linear.

Conclusions

The perceived threat of excessive future temperatures may stem from an underestimation of the unusually large effects of the recent ENSO on natural global temperature increases. Nearly 40 years of natural, transient warming from the largest ENSO ever recorded may have been misinterpreted to include significant warming due to anthropogenic activities. All warming estimates are theoretical and too small to measure. These facts are indisputable evidence global warming of the planet is not a future threat to humankind.

The scientific goal must be to narrow the range of uncertainty of predictions with better data and better models before prematurely embarking on massive infrastructure projects. A rational environmental protection program and a vibrant economy can co-exist. The challenge is to allow scientists the time and freedom to work without interference from special interests. We have the time to get the science of climate change right. This is not the time to embark on grandiose projects to save humankind, when no credible threat to humankind has yet been identified.

Acknowledgments and Data

All the raw data used in this study can be downloaded from the HadCRUT4 and NOAA websites.
http://www.metoffice.gov.uk/hadobs/hadcrut4/data/current/series_format.html
https://research.noaa.gov/article/ArtMID/587/ArticleID/2461/Carbon-dioxide-levels-hit-record-peak-in-May

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Journal of Climate, Vol. 3, No. 10 (October) pp. 1111-1128. Published by American Meteorological Society.