Title

Global Warming Revisited

Abstract

Only a few single point estimates of the rate of warming of the earth have been reported. Using a new method to determine warming rates, this study estimates over 2000 global monthly warming and cooling rates over the past 170 years. These results show the average rate of warming of the surface of the earth may be near zero degrees C per decade. Such a low average rate of warming is not correlative with the steady increase of CO_2 in the atmosphere observed since 1940 and is too small to measure. The perceived threat of excessive future global temperatures may stem from misinterpretation of 40 years of increasing intensities of the largest transient climate event ever recorded in the eastern Pacific Ocean.

The intensity of that climate event has been diminishing for 13 years.

Introduction

The inherent premise of most climate scientists is that earth temperatures are precipitously rising, and human intervention is necessary to save humanity. If this premise were wrong, then current studies on how to address this perceived threat are misdirected. This study investigates how much the earth has warmed over the past 170 years.

The author declares that there are no competing interests.

Methods

This study is a mathematical analysis of two time-temperature series of measurements of surface temperatures of the earth.

1. The Met Office Hadley Centre mean monthly surface temperature dataset; a blending of the CRUTEM4 near surface mean monthly air temperature dataset and the HadSST3 mean monthly sea-surface temperature dataset *(1)*. The measurements cover a time-period from 1850-2020.
2. The NASA Goddard Institute for Space Studies (GISS) mean annual temperature dataset combined with NOAA GHCN v4 (meteorological stations) and ERSST v5 (ocean areas) *(2,3)*. The measurements cover a time-period from 1880-2020.

The objective of this study is to estimate the warming and cooling rate of the surface of the earth from 1850 to the present. The warming or cooling rate in this study is expressed in degrees Celsius per decade.

The methodology used in this study consists of two steps.

1. Construct a best fit trendline through a time-temperature series scatterplot of measured earth temperatures using Excel's 6^{th} degree polynomial least squares regression tool. The process of fitting a trendline removes data errors and transient weather events that do not contribute to the long-term temperature trend of interest.
2. Mathematically, calculate the first derivative of the trendline, dy/dx, and convert to degrees per decade. This value is the estimated average rate of heating or cooling of the surface of the earth.

The results are remarkable. The values are comparable to earth warming values calculated by others from global energy balance studies for a few isolated points. This method estimates values for every month over a period of 170 years.

Discussion

Data Availability

All the temperature data used in the study can be downloaded from the HadCRUT4 *(1)* and NASA *(2,3)* websites, highly cited land and sea temperature data sets. The CO2 data can be downloaded from the Oak Ridge National Laboratory website *(4)*.

HadCRUT4 Monthly Temperature Anomalies

The HadCRUT.4.6.0.0 database of global monthly surface temperature anomalies from 1850 to the present is used for first section of this analysis.

Analysis of Temperature Anomalies-Case 1

All temperature measurements used in this study are calculated temperature anomalies and not measured surface temperatures. A temperature anomaly is the difference between a measured temperature and a baseline average temperature; in this case, the average annual temperature from 1961 to 1990. This conversion process is intended to minimize the effects on temperatures related to the locations of the measurement stations, 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 global monthly average surface temperature anomalies. The jagged character of the curve is data noise (inaccuracies in measurements and natural, short-term weather events that do not contribute to long-term temperature trends). The red curve is an Excel sixth-degree polynomial best fit trendline of the temperature anomalies. The curve-fitting process enhances the measured temperature data by removing much of the noise. The blue curve, mathematically the first derivative *(5)* of the trendline, is the single most important curve derived from global monthly averaged temperature anomalies. The curve is a time-series of the month-to-month differences in average surface temperatures in units of degrees Celsius change per month. (Simply stated, the first derivative is the rate of change of the variable, temperature, and the direction of change, increasing or decreasing.) The very small monthly changes are commonly multiplied by 120 to convert the units to the more manageable number of degrees per decade (left vertical axis of the graph). If noise-free, the derivative of the temperature trendline is an estimate of the instantaneous rate at which the earth's surface is cooling or warming; sometimes referred to as the warming or cooling curve of the surface of the earth. Use of the derivative is a new method for estimating the degree of warming or cooling of the earth.

In a recent talk, Dr. 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 *(6)*. These values were estimated from global energy balance studies of the troposphere from 15 years of newly acquired global satellite data in 1994 *(7)* and, a repeat of the 1994 study in 2017 with nearly 40 years of satellite data *(8)*. From this work, Dr. Christy concluded the earth warming in the troposphere for the past 40 years is approximately a straight line that slopes 0.095 degrees per decade.

The blue curve temperature values shown in Figure 1 are close to the values of noise-free troposphere temperature estimates determined at UAH. The 2017 average monthly value for the blue curve is 0.184, compared to a value of 0.095 determined at UAH for 2017. The mean value of earth warming over 2,032 months since 1850 is -0.084 degrees C per decade. These numbers are not evidence of out-of-control earth warming.

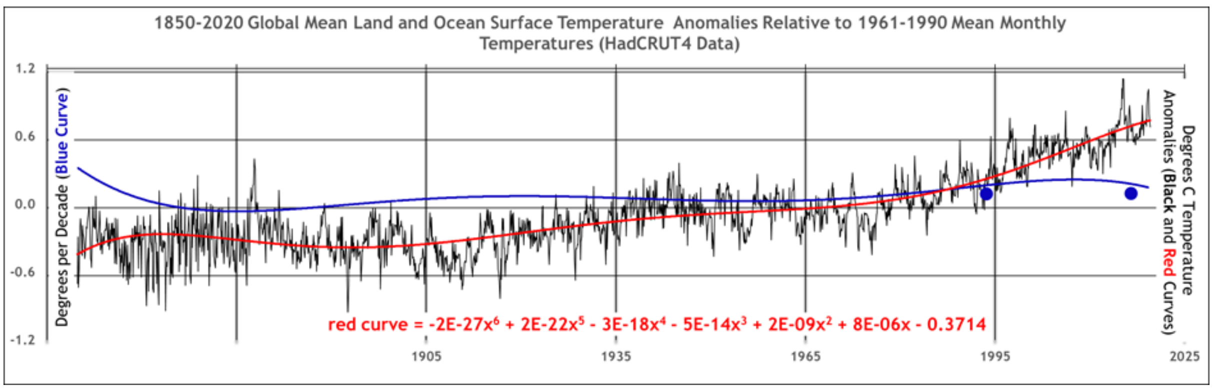

Fig. 1. HadCRUT4 Time-series of global temperature anomalies. The black curve is the time series of the monthly global land and sea surface temperature anomalies, 1850-present. Anomalies are deviations from the 1961-1990 annual average temperature in degrees Celsius. The red curve is the trendline of the HadCRUT4 data set, an Excel sixth-degree polynomial best fit of the temperature anomalies. The blue curve, mathematically the first derivative of the trendline (5), is converted from units of degrees C per month to degrees C per decade, the slope of the trendline curve. The blue curve approximates 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 *(8)*.

Recent statistical analyses conclude that 95% uncertainties of global annual mean surface temperatures range from 0.05 degrees C to 0.15 degrees C over the past 140 years; 95 measurements out of 100 are expected to be within the range of uncertainty estimates. "The resulting 95% uncertainties are near 0.05 °C in the global annual mean for the last 50 years and increase going back further in time reaching 0.15 °C in 1880" *(7)*. The rate of warming of the earth is too small to measure.

In Figure 2, the blue curve is the warming curve; a time series of the rate of change of the temperature of the surface of the earth in degrees per decade. The green curve is a time series of the concentration of fossil fuel emissions of CO2 in units of million metric tons of carbon in the atmosphere. The blue curve is nearly level from 1900 to 1979 and then rises slightly due to lower frequency noise remaining in the temperature anomalies produced by 40 years of intense ENSO (El Nino Southern Oscillation activity *(9)*. The rate of increase of warming has declined since 2008 to the present. The concentration of carbon increased steadily from 1943 to 2019. Dr. Pieter Tans, senior scientist with NOAA's Global Monitoring Division stated in May 2019: "There is abundant and conclusive evidence that the acceleration" (rise of CO2 in the atmosphere from 1.6 ppm to 2,2 ppm over the last decade) "is caused by increased emissions" (of anthropogenic CO2) *(10)*. This conclusion is not supported by the graphs of temperature and carbon emissions shown in Figure 2. There is no apparent relationship between a rising carbon concentration in the atmosphere and a relatively stable, low rate of warming of the surface of the earth.

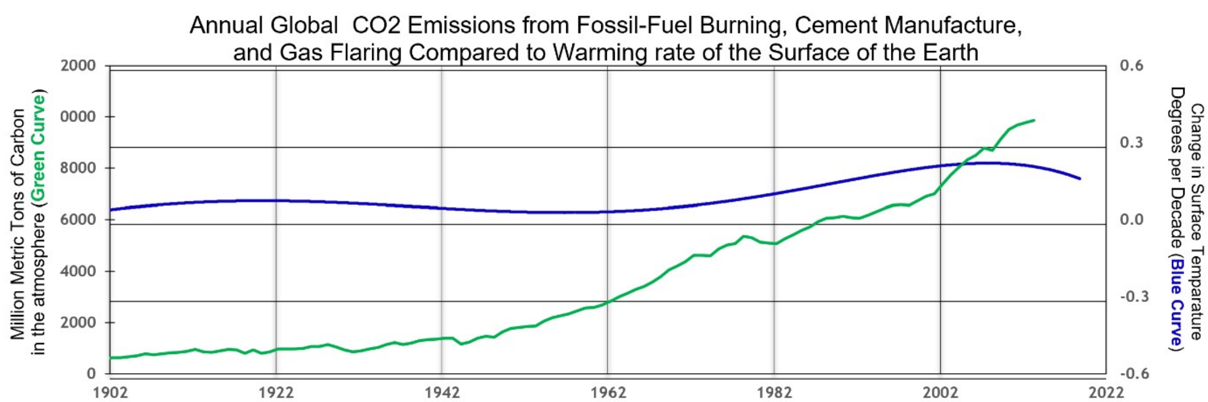

Fig. 2. Comparison of rate of warming of the earth and the amount of CO2 in atmosphere. The units of the blue curve are degrees C per decade, the rate of change of the surface temperature of the earth. See Figure 1 for the blue curve with the temperature anomalies curve and the trendline curve. The green curve showing total carbon emissions from fossil fuels in the atmosphere is from an Oak Ridge National Laboratory study *(4)*. There is no relationship 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 40 years, several strong to very strong intensity El Nino events (temperature spikes in the curve) are recorded. The highest ever recorded global monthly temperature anomaly of 1.111 degrees C occurred in 2016 *(1)*.

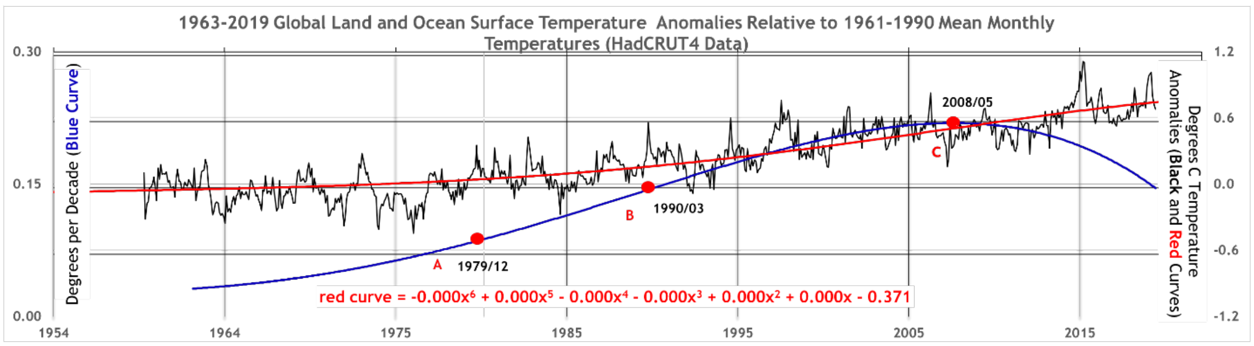

Fig 3. Use of the first derivative to analyze the curvature of the red trendline. An enlarged portion of Figure 1 from 1963 to 2020 with vertical scale enlarged to emphasize very significant changes in the shape of the blue warming curve.

The blue curve values (left vertical axis) increase from Point A to Point B, a 67 percent increase in rate of warming in nearly 10 years. The warming curve is concave upward**.** Point A marks a weak El Nino and the beginning of 40 years of increasing ENSO intensities. Point B is an inflexion point at which the warming curve becomes concave downward; temperatures are still increasing, but at a slower rate. The blue curve values (rate of change of the temperature anomaly trend curve) decrease from Point B to Point C, a 52 percent decrease in rate of warming in 18 years, Point C is an inflexion point with a rate of warming of 0.219 degrees per decade. This is the maximum warming rate since 1850. The rate of warming decreased to a rate of 0.149 degrees per decade in July 2020, a 32 percent decrease in nearly 13 years. These observations do not support the declaration by some of a clear and present danger of out-of-control global warming.

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 2008 (Figure 3), the rate of increase in surface temperatures has decreased as the intensity of the ENSO has decreased. The first derivative of the red temperature trendline, the blue curve, is not yet completely free of transient noise from some 40 years of ENSO activity. Nevertheless, the continuous slowing of the rates of increase in surface temperatures in recent years indicates lessening of ENSO activity.

Analysis of Temperature Anomalies-Case 2

To validate the methodology used to analyze the HadCRUT4 temperature data, a similar analysis was carried out using NASA's Goddard Institute for Space Studies Surface Temperature Analysis (GISTEMP v4) and temperature trendline *(2,3)* using annual data.

Figure 4 is comparable to Figure 1 but derived from the NASA earth temperature dataset. The NASA land-ocean temperature anomaly data extend from 1880 to the present with a 30-year base period from 1951-1980.

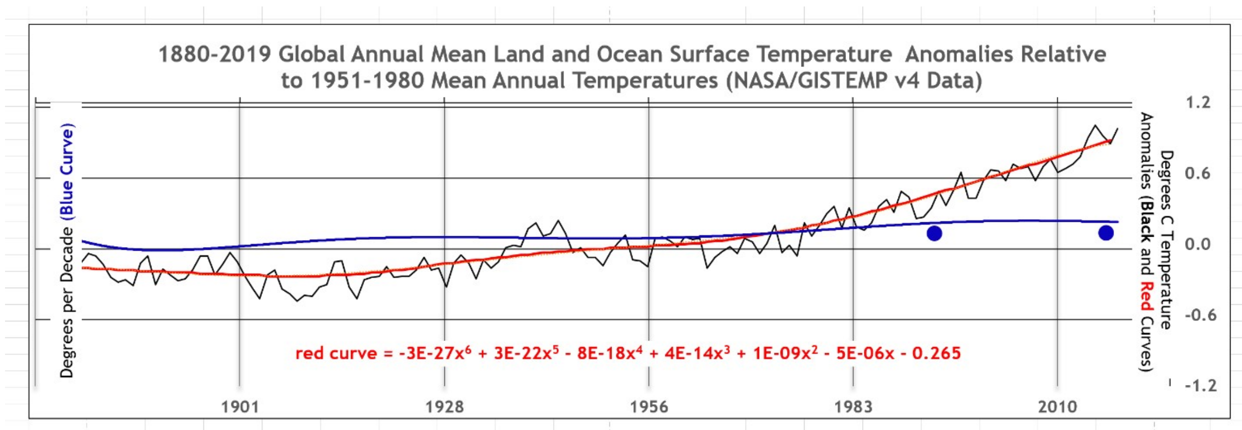

Fig. 4. NASA GISTEMPv4 time-series of global temperature anomalies. The black curve is the time series of the average annual global land and sea surface temperature anomalies, 1880-present. Anomalies are deviations from the 1951-1980 mean annual temperatures in degrees C. The red curve is the five-year lowess smooth (11) best fit of the temperature anomalies. The blue curve is the first derivative of the red curve converted from units of degrees C per year to degrees C per decade, the slope of the red curve or warming curve of the surface of the earth. The two solid blue circles are single point warming values of the troposphere calculated at the University of Alabama in Huntsville from global energy balance studies *(8)*.

Results

The perceived threat of excessive future temperatures may stem from an underestimation of the unusually large effects of ENSO warming events on natural global temperature increases. Nearly 50 years of transient warming from several large ENSO events, including the largest El Nino ever recorded may have been misinterpreted to include significant warming due to anthropogenic emissions of CO2. The warming effects of emissions are theoretical and too small to measure. These facts are compelling evidence global warming is not a likely threat to the planet.

The scientific goal must be to narrow the range of uncertainty of predictions with better data and better models. 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. This is not the time to embark on grandiose projects to save humanity, when no credible threat to humanity has yet been identified. Justice Oliver Wendel Holmes eloquently addressed a similar situation in a famous opinion he wrote in the Schenck case in 1919: "The most stringent protection of free speech would not protect a man in falsely shouting "fire" in a theatre and causing a panic" (12). We have the time to get the science of climate change right before shouting “global warming” and causing a global panic before such a threat has been shown to exist.

References and Notes:

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