January-February 2024

CliSciPol

Climate Science and Policy for Nonscientists

One picture is worth a thousand words.

Temperature Evaluation

2023 was the warmest year on record. What caused the warming? What is the significance? The effect of warming (good or bad) depends on where and when the warming occurs. The world has many different climate regions, and so the effects of warming and other climate change must be evaluated region by region.

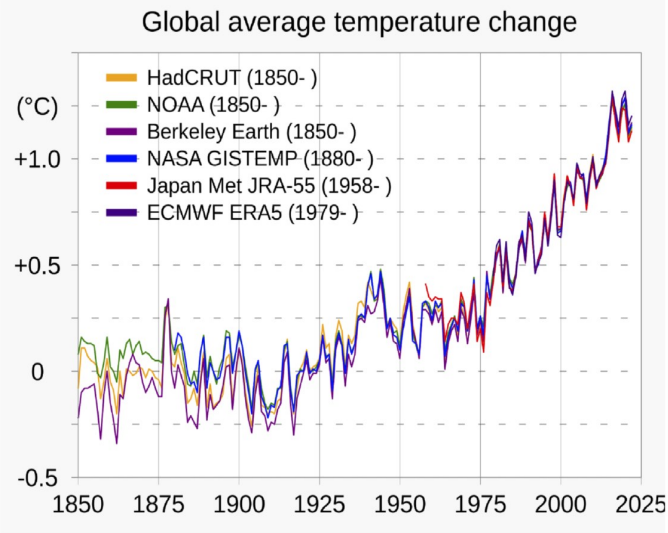
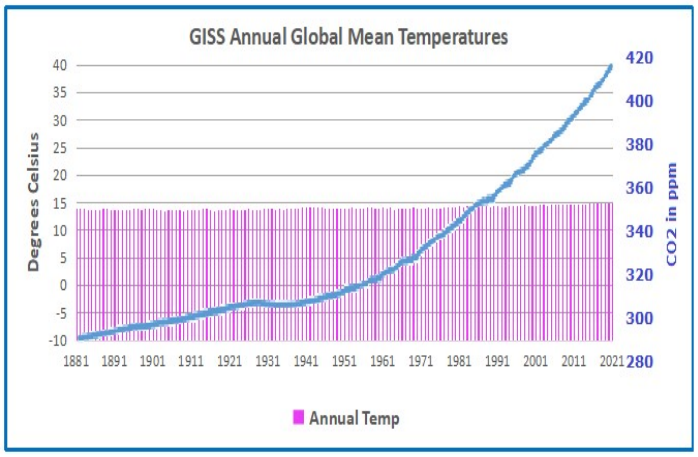
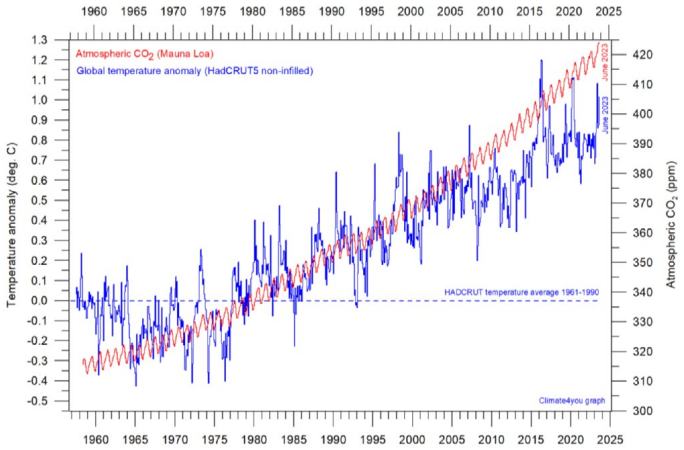


Figure 1 Global average temperature anomaly.

Six major surface temperature datasets confirm that 2023 was the warmest year "of record," which means, roughly, since 1850. The IPCC concludes that temperatures have risen 1.1 C from the preindustrial period to 2010-2020 (AR6, WGI p.5), and the world may have warmed an additional 0.1 C since then. The rate of actual measured warming since the late 1800s, ,when warming began, is fairly linear and slightly less than 1 C per century.

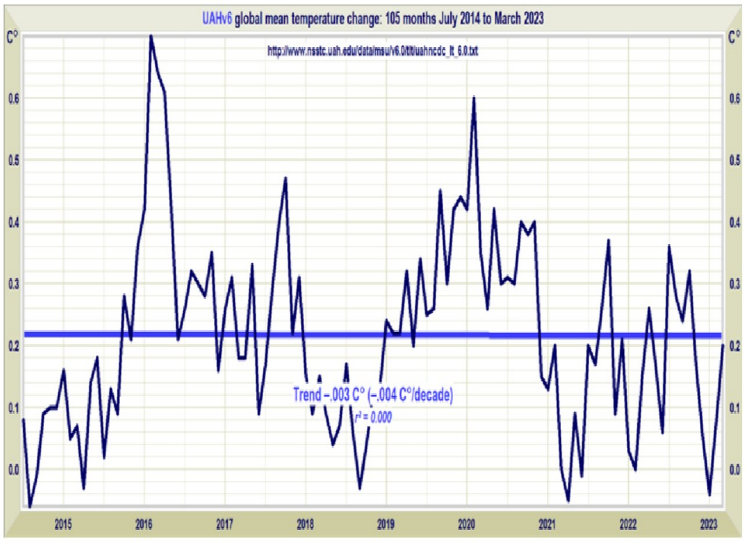
The graph above shows temperature "anomalies," which are the changes of temperatures from some arbitrarily chosen baseline. Such a presentation emphasizes the change. The graph on the right shows actual temperatures with the world warming from 57 F to 59 F (1 C = 1.8 F) from 1880 to 2020, an increase of less than 4% over 140 years. Such a presentation suggests that the temperature change has been minimal.

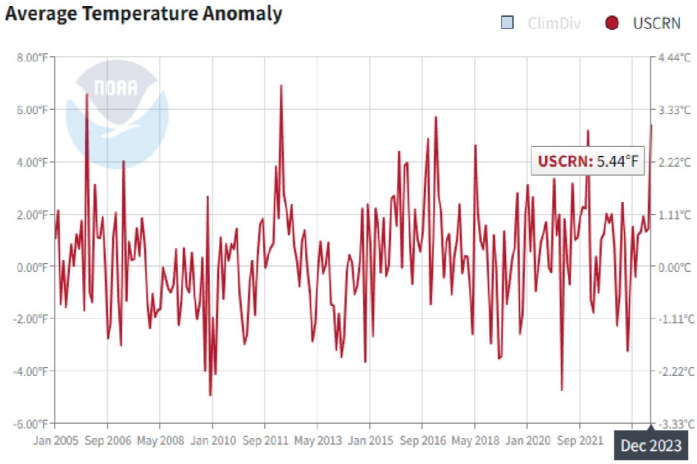




Since 1960 atmospheric CO2 levels have been rising at a significant, mostly linear rate with some recent increase. But the rate of world temperature increase has slightly slowed since 2005. Comparing the CO2 data and the temperature data since 1960 suggests that CO2 is a significantly less powerful greenhouse gas than claimed by the IPCC.

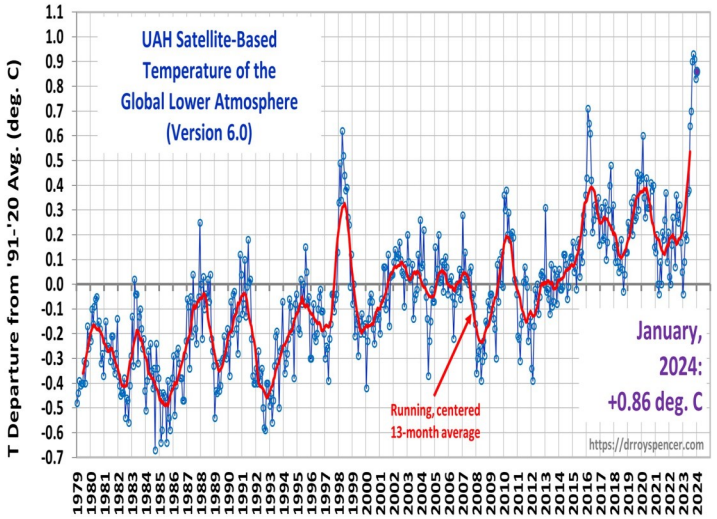
Despite the continued rising atmospheric CO2 levels, the UAH (University of Alabama Huntsville) satellite dataset shows world temperatures flat from July 2015 to March 2023. Since the UAH dataset reports temperatures by month, it shows the month-to-variations that other datasets do not generally show, and that can not be explained by CO2 theory.

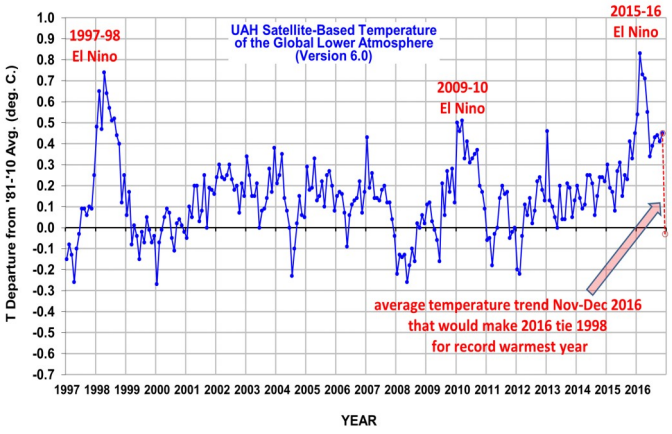




The US government's most accurate dataset (NOAA's Climate Reference Network) shows US temperatures flat from 2005 (when the dataset began) through early 2023 when a temperature spike occurred.

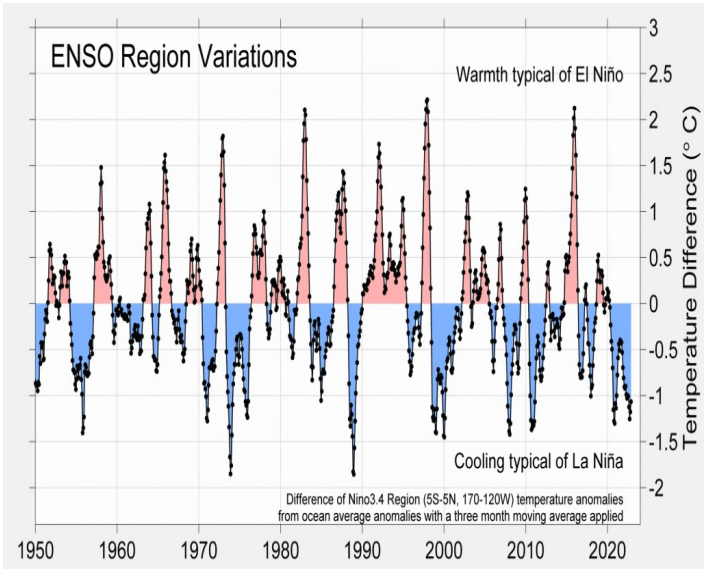
The most recent UAH monthly report shows a dramatic increase in the rate of world warming starting in May 2023. A high was reached in October and then a slight decline began. Scientists agree that a significant cause is the current strong El Nino, but other contributing factors have been suggested, and, at present, there is no agreement on the extent of their contributions. But there has been no recent changes with respect to CO2 or other greenhouse gases that could possibly cause this rapid temperature rise and then decline.

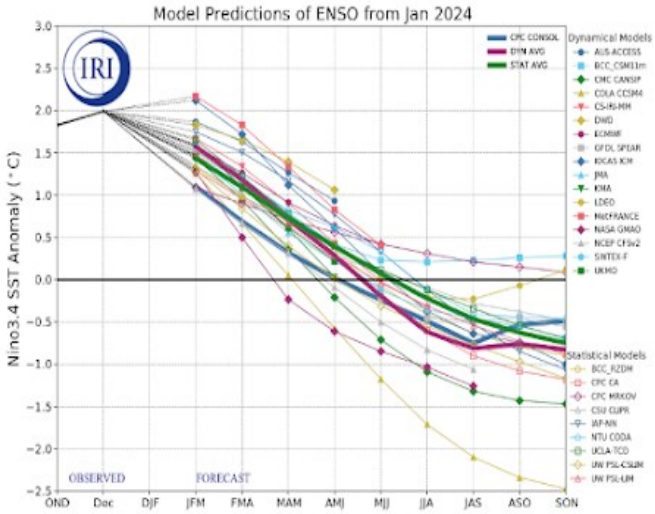




This UAH graph identifies prior strong El Ninos, which cause a characteristic, short term temperature spike. Referring back to the prior UAH graph, the 1997-8 spike drove up temperatures from -0.2 to +0.6, an increase of 0.8 C. The present spike is from +0.2 to +0.9, an increase of 0.7 C.

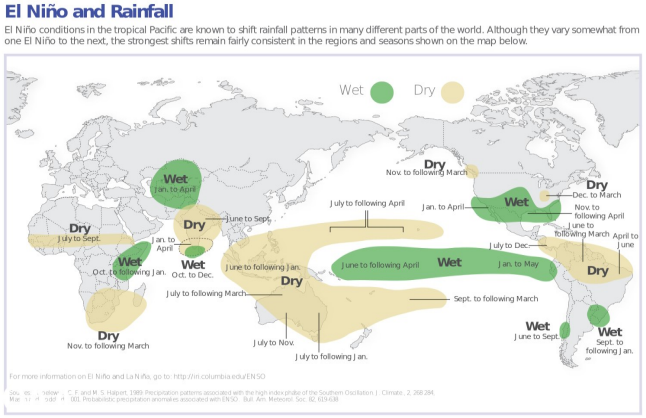
The El Nino/La Nina, or ENSO (El Nino Southern Oscillation), cycle has a profound effect on Pacific Ocean temperatures and world atmospheric temperatures. ENSO is just one of the ocean climate cycles that affect world climate by transferring heat back and forth between the oceans and the atmosphere without any change in total world heat content. This is not climate change. It is an example of natural variability.

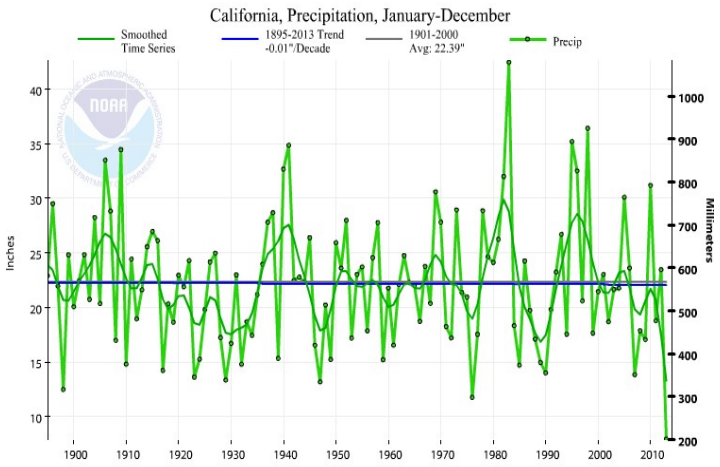




The models agree that the current El Nino is in decline and will vanish by summer. When a stable, post-El Nino temperature is established, that will show whether or not there has been any real global warming, or whether this spike has just been a temporary transfer of heat energy from the oceans to the atmosphere. Usually the oceans (average temperature 39 F) are absorbing heat energy from the atmosphere (average temperature 59 F).

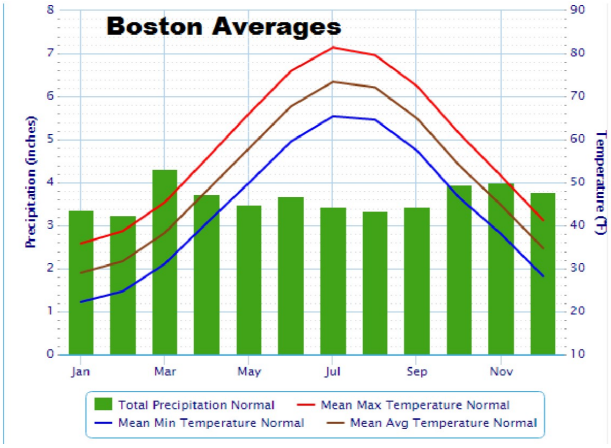
The El Nino has a profound effect on regional climates, as shown. In particular it brings torrential rains to California, which are currently being reported and blamed on climate change by politicians and by the media. When ENSO switches to its cold El Nino phase, it brings drought to California.



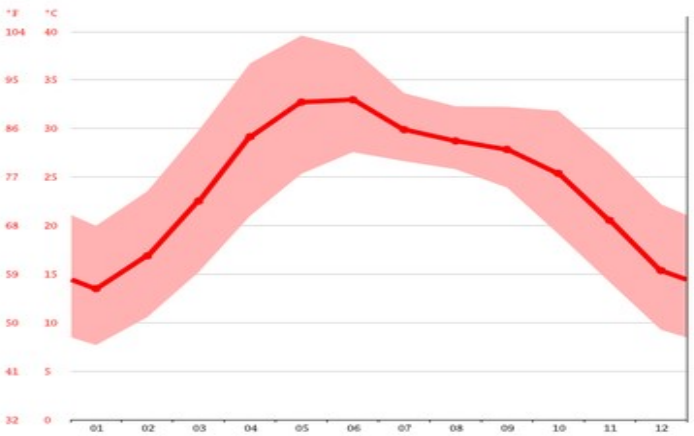


California suffers from a high degree of weather variability due to the ENSO cycle, which has nothing to do with climate change. There is no significant upward or downward trend in long term California precipitation.

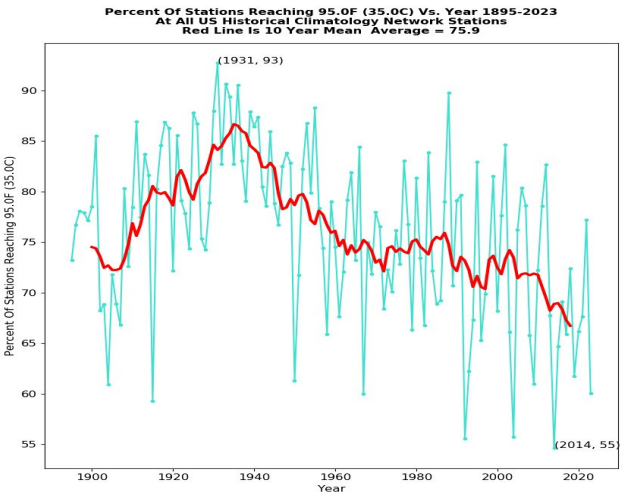
Boston's hottest month is July, averaging 74 F. The coldest month is January, averaging 29 F. The world has warmed 2 F over the last century from 57 to 59 F. So 100 years ago those Boston monthly highs and lows were 72 and 27 F, and 100 years in the future those numbers will be 76 and 31. This assumes global warming has equal geographical and seasonal distribution, and assumes the rate of warming remains the same. The maximum average temperature in July 100 years in the future will have increased from 82 to 84. World temperature change of less than 2 F per century is insignificant in relation to the present Boston seasonal temperature swing, which is 45 F (January 29 F to July 74 F).



The average daily maximum temperature in May in New Delhi, India, now approaches 104 F. Yet the population of New Delhi has grown from less than 16 million in the year 2000 to now over 32 million. People adjust to hot temperatures. People like hot temperatures. In the US the net movement is from cold states to hot states, such as Texas, Florida, Arizona, and Nevada. When New Englanders move, they move to warmer climates, not colder.

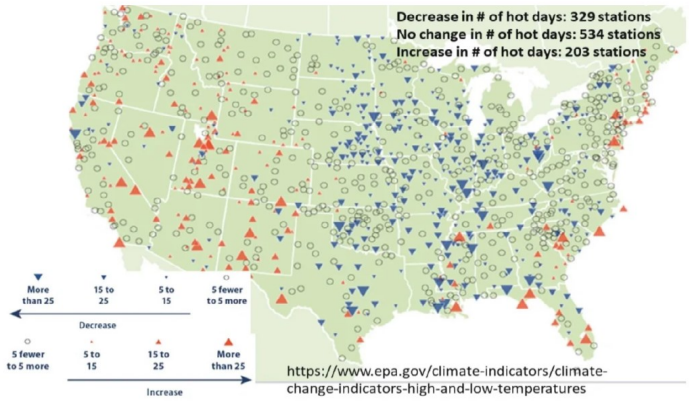


In the US we tend to think of a 95 degree day as a heat wave. The percentage of US stations reporting even a single such day is declining.

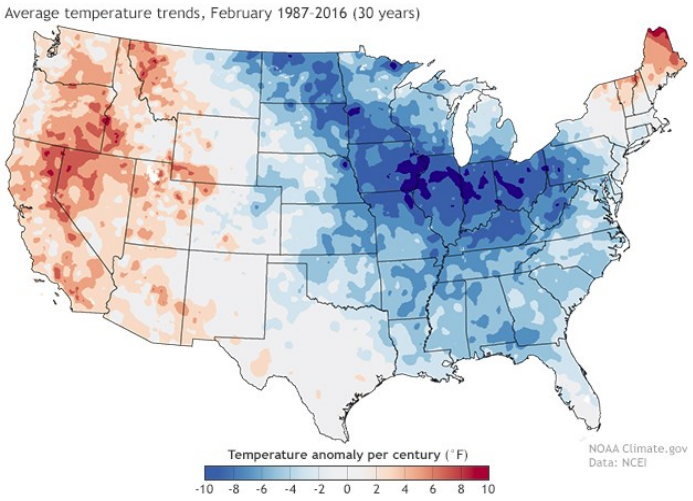


EPA: Few Stations Show Increase in Hot Days

September 9, 2023



In the US more stations are reporting a decrease in the number of "hot" days than an increase, and there is a clear geographical pattern.



Warming in the US is not evenly distributed geographically. In the East and Central parts of the country there has been cooling, while the Western parts and Maine have been warming.

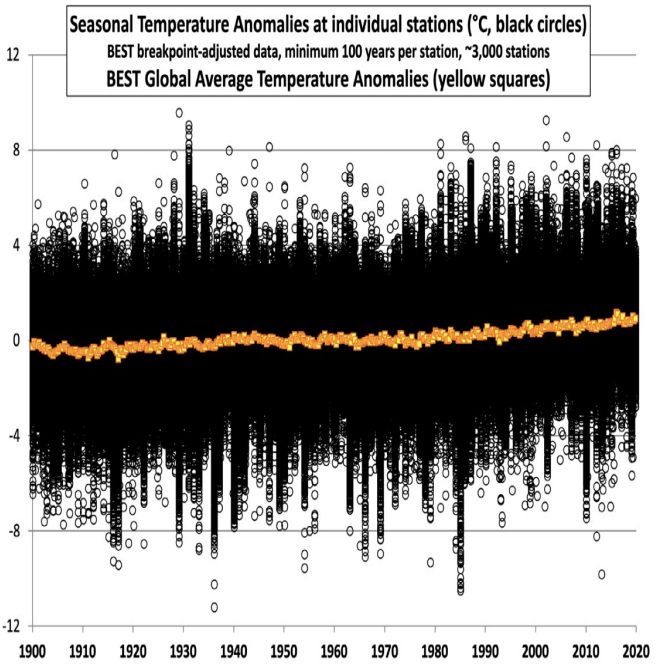
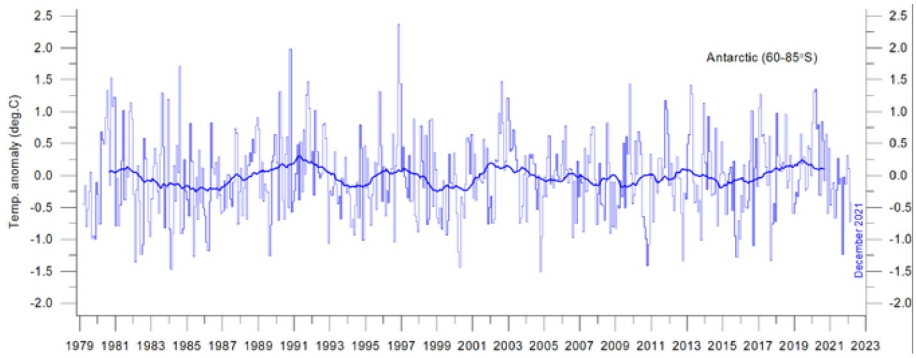


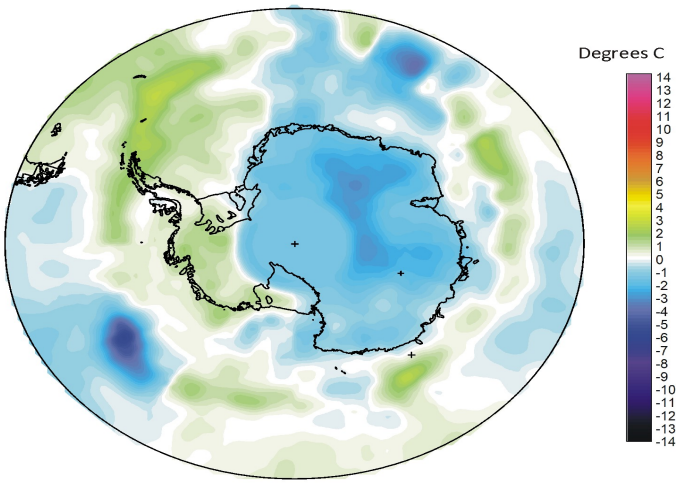
Figure 2 Temperature anomalies at individual stations as well as the mean.

The world average temperature conceals how much variation there is among the over 3,000 reporting stations around the world. Nearly as many stations report declining temperatures as report increasing temperatures. Some stations report as much as 4 C (7 F) less warming than average, and some stations report as much as 4 C more warming than average. The world average temperature, for example, says nothing about the changes actually occurring in particular places, such as Antarctica or Brazil or Canada. The effect of climate change is predominantly regional and must be evaluated on a regional basis.

The average temperature of Antarctica has not changed at all over at least the last 40 years. The interior averages minus 71 F. The coasts average 14 F. Ice melts at 32 F. How much ice is melting?



Surface air temperature December 2022 versus December last 10 yr



But the Western edge of Antarctica as a subregion has been warming while the rest of Antarctica has been cooling.

The Northern Hemisphere is significantly warmer than the Southern Hemisphere. As shown for the period 1961-1990, the Northern Hemisphere high in July was 21 C or 70 F . But the Southern Hemisphere high in January was only 16 C or 61 F.

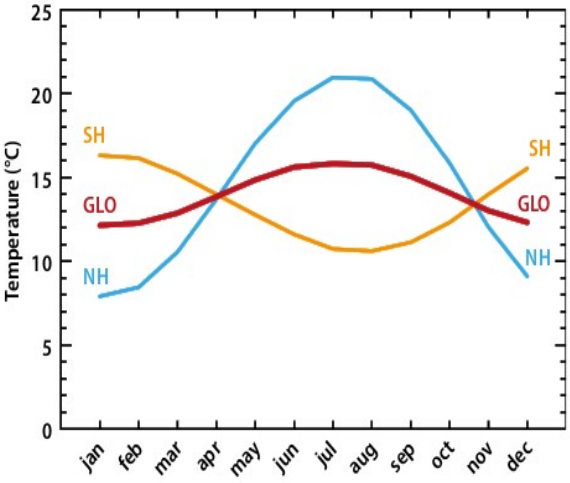


Figure 2: Average global surface temperatures from 1961-1990 for the globe (GLO), sphere (SH) by month. After: (Jones, New, Parker, Martin, & Rigor, 1999).[20]

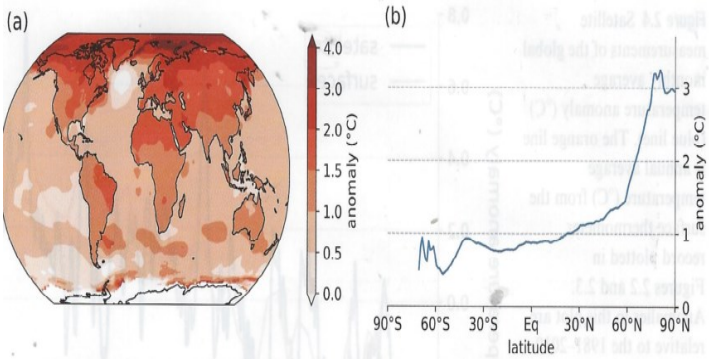
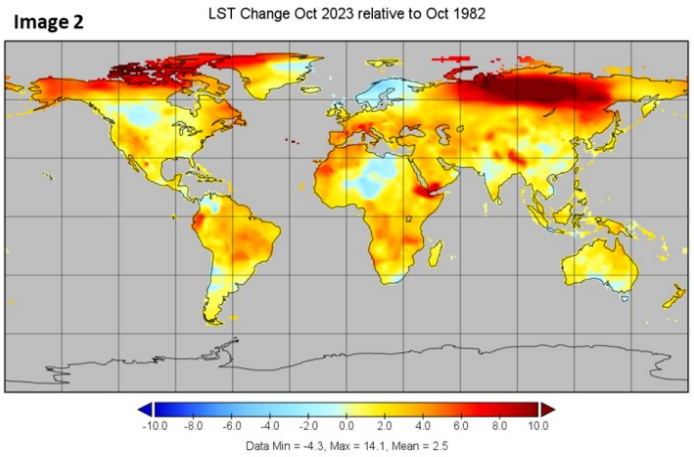


Figure 2.3 The distribution of modern warming (in °C). (a) Spatial distribution of the warming; (b) the warming as a function of latitude. Warming is calculated as the difference between the 1850–1900 average and 2009–2018 average. Data are from Berkeley Earth (http://berkeleyearth.org/data/, retrieved October 14, 2020).

Most of the world's warming is concentrated at latitudes between 60 North and the North Pole.

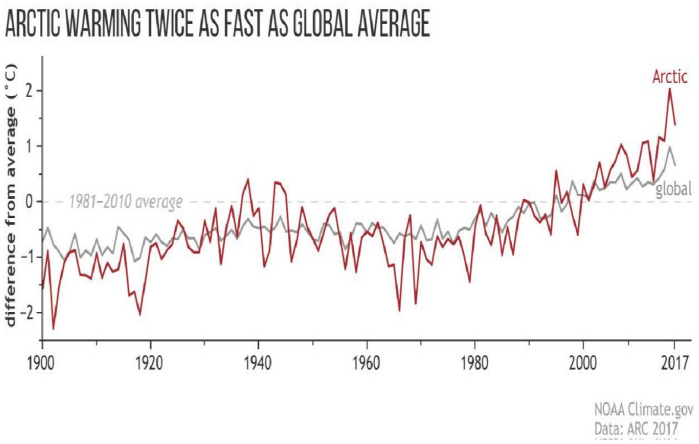
None of the continental US even reaches 50 North latitude, so most of the modern global warming is occurring North of the US.

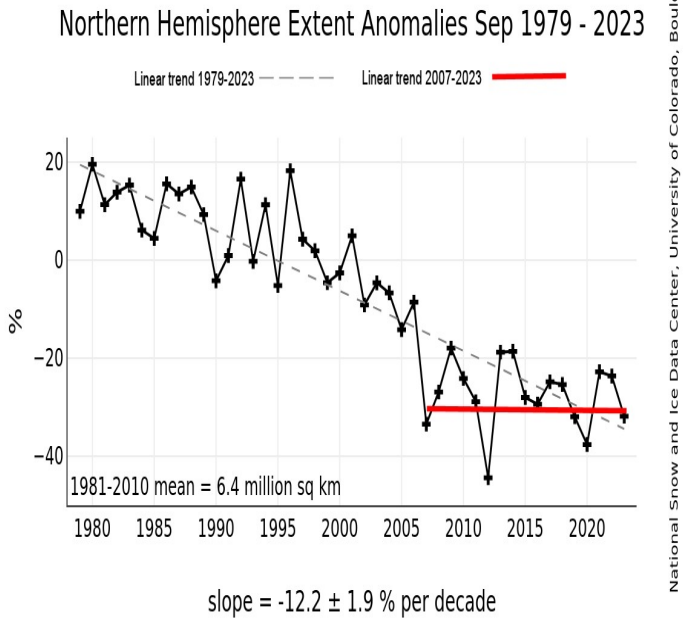
Image 2



This image shows temperature changes from 1982 to 2023, a 41 year period. It shows regions where the world has been cooling over this period as well as where it has been warming.. For example, some parts of India have been cooling. Greenland appears to have three different regional climates., each experiencing different degrees of warming or cooling. Siberia benefits from warming.

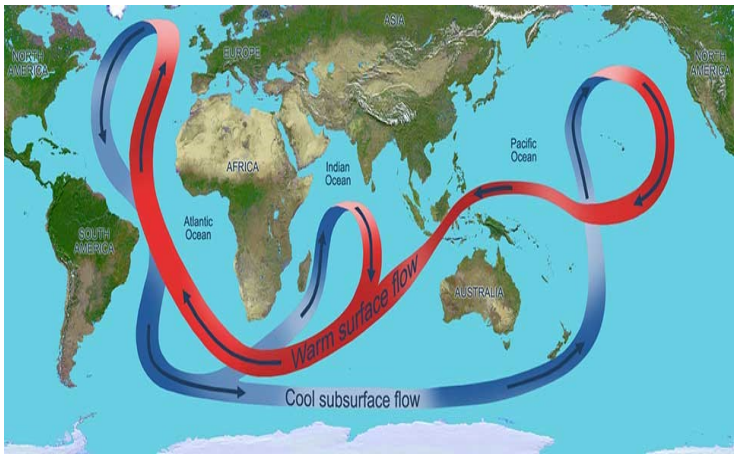
Some studies show the Arctic warming twice as fast, or even faster, than the rest of the world.





But temperature is not the only factor affecting the Arctic climate. Summer sea ice declined significantly 1980-2006, but over the last 17 years (including the annual low point in September 2023) it has shown no downward trend. Sea ice extent is determined not only by temperatures but also by ocean currents, wind patterns, and storms.

The earth's unequal warming is caused primarily by the effect of ocean currents, particularly in the Atlantic Ocean. Well known is the role in warming Europe of what is colloquially known as the Gulf Stream, which moves massive amounts of heat energy from tropical regions Northward, eventually into the Arctic Ocean.



The Keeling Curve is the standard expression used to describe the rise of atmospheric CO2 concentrations since the 1950's. This behaviour can be seen by comparing the measured values to a straight line fit. This is shown in Figure 1 with a least squares fit to the South Pole measurements.

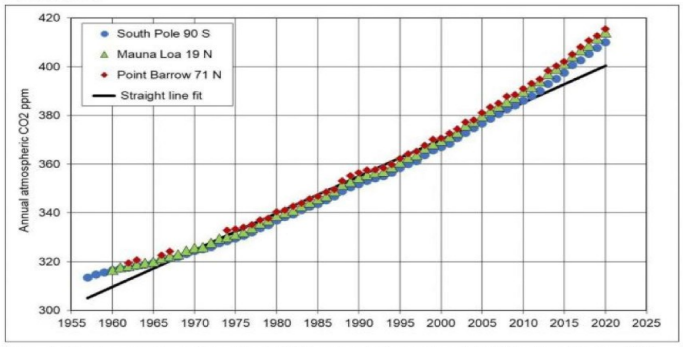
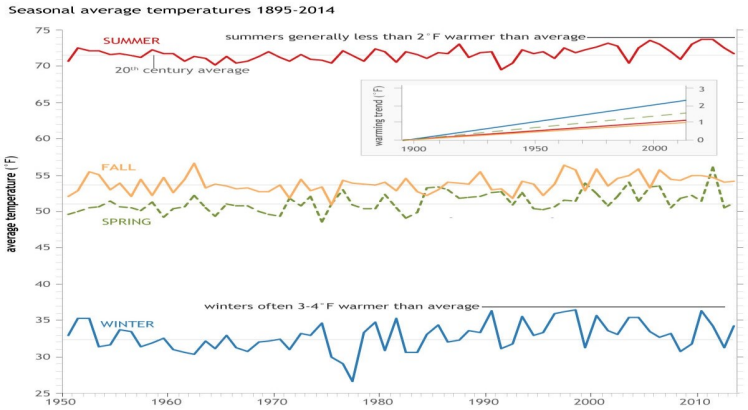
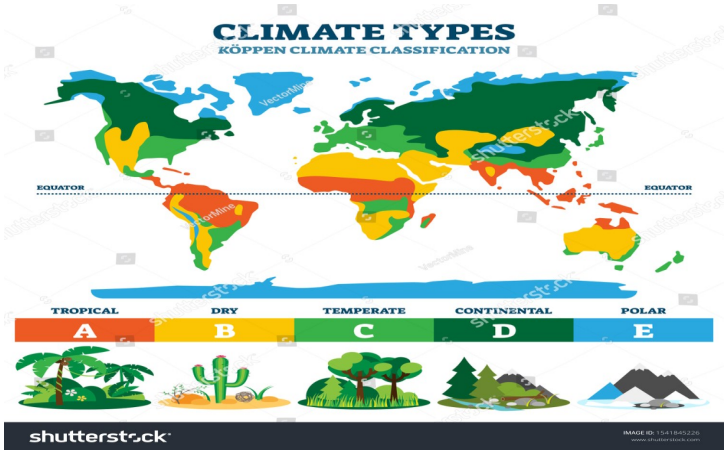


Figure 1: *Measured annual atmospheric CO2 concentrations. The straight line is a fit to the CO2 concentrations at the South Pole.*

Co2 is a "well-mixed" greenhouse gas (AR6 WGI p.4), which means it is evenly distributed in the atmosphere around the world. Therefore, if CO2 was the cause of global warming, the observed warming should be roughly even around the world. But it is not. Among other things, the IPCC's computer models fail to account for the lack of warming in the Antarctic and the extra warming in the Arctic.

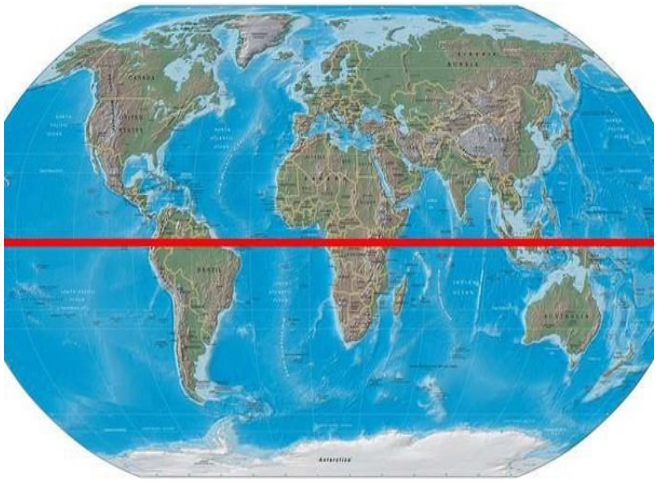
Also global warming is not evenly distributed by season. More warming occurs in the winter than in other seasons. In general, warming in the winter is beneficial. Warming in spring, summer, and fall can be either good or bad depending on the particular region. In some regions warming in the summer is extending the length of the growing season and increasing crop production, as acknowledged by the IPCC. (AR6 WGI p.6)

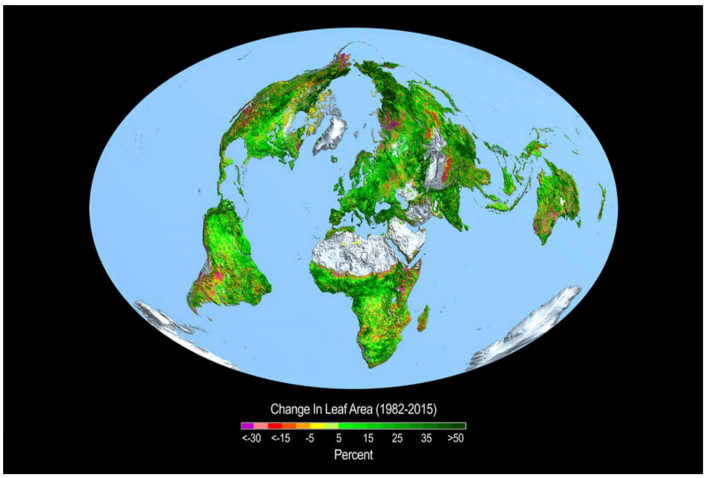




Scientists identify five basic types of climate. The US Eastern half and the US West coast are Temperate (forests are dominated by deciduous trees). The Great Plains and the Rocky Mountains are Dry. Canada, parts of Europe, and huge areas of Asia are Continental (forests are dominated by conifers).

68% of the world's land is in the Northern Hemisphere. Large areas as classified as having a "Continental" climate. This is where most of the world's warming is occurring. Countries and regions like Canada, Scandinavia, Northern Europe, and Russia will all benefit from warming. In general, any region that has a winter will benefit from warming at the present rate of increase. This includes many areas with a "Temperate" climate. Much of the Northen half of the US (including New England) will benefit from global warming.





In general the world is greening due to rising CO2 levels (CO2 being plant food) and rising temperatures. (See the Science Topic post on the CLISCIPOL website "Greening World" with citations to IPCC findings in agreement).

Using satellite images, Venter et al. 2018 found an eight percent increase in woody vegetation in sub-Saharan Africa over the last three decades, underscoring the global "greening trend".

Recent study by Venter et al finds that the Sahara has shrunk by 8% over the past three decades. NASA image, public domain.

The Sahara is greening. The desert has shrunk by 8% over 30 years.

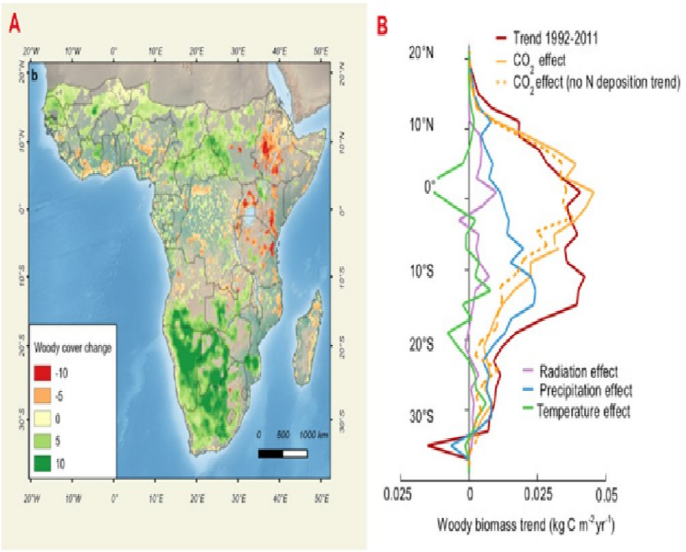
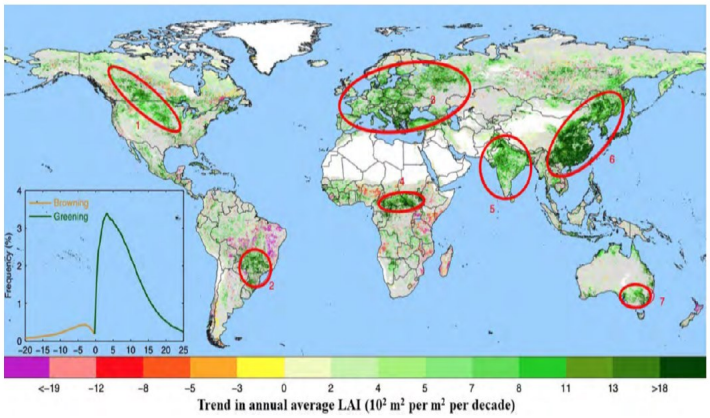


Figure 1. *Panel A: Percent absolute change in woody cover estimated from satellite observations for the period 1992-2011. Panel B: The total trends of woody biomass in sub-Saharan Africa, from north to south, along with the estimated contribution to this trend from the relative effects of CO2, precipitation, radiation, and temperature. Source: Brandt et al. (2017, supplementary information).*

A study of Sub-Sahara Africa over the period 1992 -2011 found that 36% of the land area showed an increase in woody cover while 11% showed a decrease. Overall the area of woody cover increased 2%. The main reason for the decreases was habitat destruction (agricultural expansion, urbanization, and wood fuel harvesting), not unfavorable climate change.

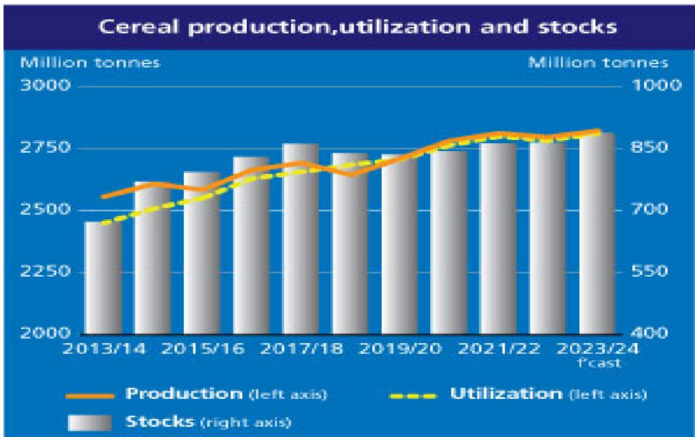
Figure 20: Trend in annual average leaf area



Source: Chen (2019)

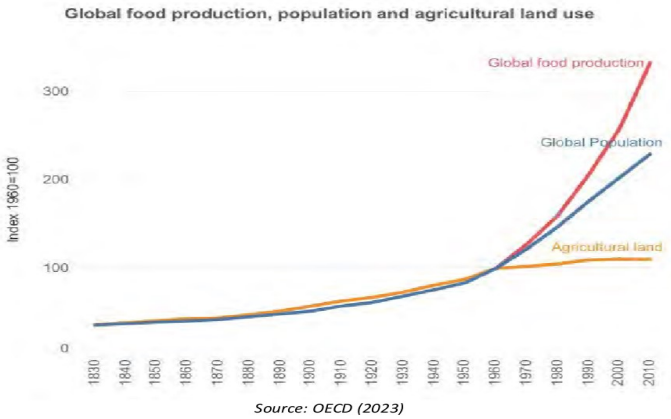
Chen (2024) reports that greening 2000-2017 is accelerating across 55% of the world, and only 14% of the world is browning, both with significant regional variation. Approximately 75% of the greening is due to rising CO2 levels (increasing amounts of plant food availability). It is correct to say that in some regions climate change is causing droughts, but the droughts affect a much smaller area than the greening. This emphasizes the importance of analyzing the effects of climate change on a regional basis.

More good news from the UN suggests that cereal output hit another record high in 2023:



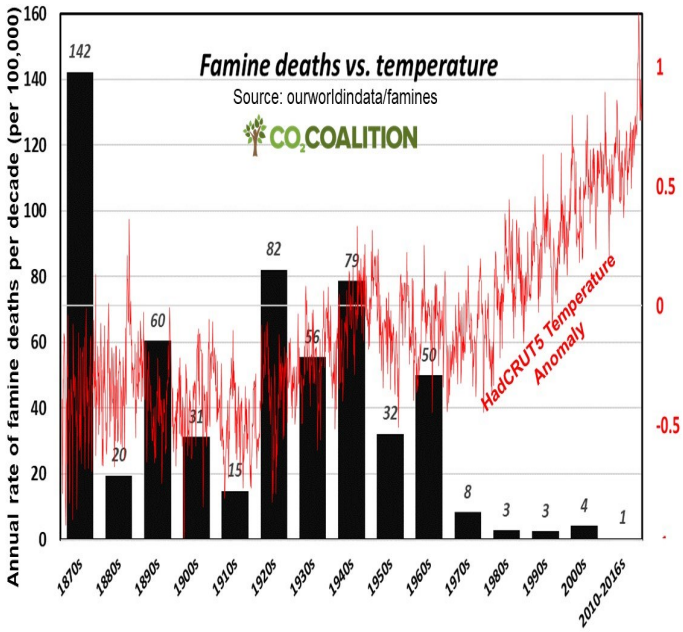
UN IPCC staff and various environmental advocates claim that climate change is jeopardizing the world's food supply. But the UN Food and Agricultural Organization ("FAO") keeps publishing statistics showing increasing, and record high, food production.

Figure 16: Global food production index, population and land use for agriculture



Source: OECD (2023)

Food production is growing faster than the world population.



While atmospheric CO2 levels and temperatures have been rising, deaths by famine have been reduced to unprecedented low levels.

CONCLUSION

Climate change is real, but the change differs from region to region. The effects (good or bad) need to be evaluated in the particular regions where the climate is changing.

The IPCC and the media tends to assume that the climate in the 1800s (the preindustrial period) was optimal, and that therefore any change from the 1800s climate must be bad. But in the 1800s the world was emerging from the Little Ice Age, a period of unusual cold. One study has concluded that more than 50 million people died in the 1870s alone due to extreme weather and climate.

Most of us would rather not remember incidents like the Great Famine of 1876-1878 in India and Pakistan.

The world has many different regional climates, and the climate change is different in different regions. Therefore whether climate change is good or bad needs to be evaluated on a regional basis, comparing the present regional climate and the predicted future regional climate with the actual regional climate that prevailed in the 1800s.

Work Cited

Intergovernmental Panel on Climate Change Assessment Report 6, Working Group I, The Physical Science Basis (2021) (AR6 WGI)