Sci Top 11-12-24

# CliSciPol

## Climate Science and Policy for Nonscientists

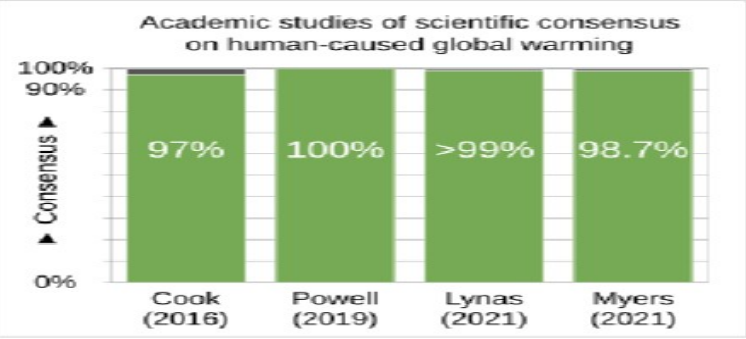
One picture is worth a thousand words.

## 97% Agree - But About What?

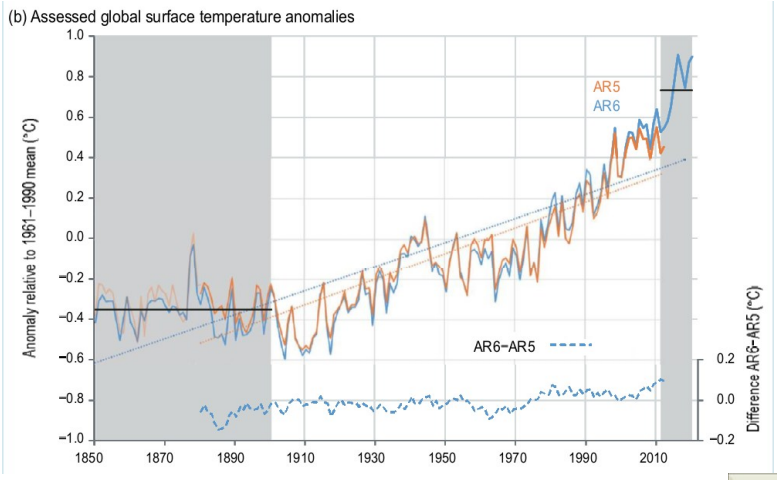
The Assessment Reports of the Intergovernmental Panel on Climate Change are written by climate scientists and are the best comprehensive summaries of the issues on which climate scientists agree. In the ARs the scientists' agreed opinions are set out with supporting data and discussion. But in recent years, to supplement the AR opinions, various people have conducted independent surveys to ascertain scientists' opinions. These surveys have generally surveyed opinions on only two issues: (1) is the world getting warmer? And (2) has human activity contributed to the warming? All of these surveys have been attacked as inaccurate on a variety of technical grounds, but this post will not evaluate such attacks. Rather this post will set out the actual results of these surveys and evaluate those results.

In general, there is virtual unanimity: (1) the world is getting warmer, and (2) that human activity has contributed *something* to that warming. But the amount of the human contribution has not been determined with any degree of accuracy. The surveys go back at least as far as a 2004 essay by Naomi Oreskes that concluded that 75% of scientists agreed that human activities were responsible for *most* of the observed warming over the prior 50 years. The commonly cited 97% figure appears to go back to a 2009 paper claiming that 97% of scientists believed that humans were a *significant* contributing factor in the warming since the 1800s.

The 97% figure also appeared in a 2016 publication by Cook, and there have been other similar surveys performed more recently, such as the Myers study, referenced in the adjoining image, which concluded that climate experts agree that the earth is getting warmer *mostly* because of human activity." Wikipedia concludes that modern warming has been *primarily* caused by humans burning fossil fuels.

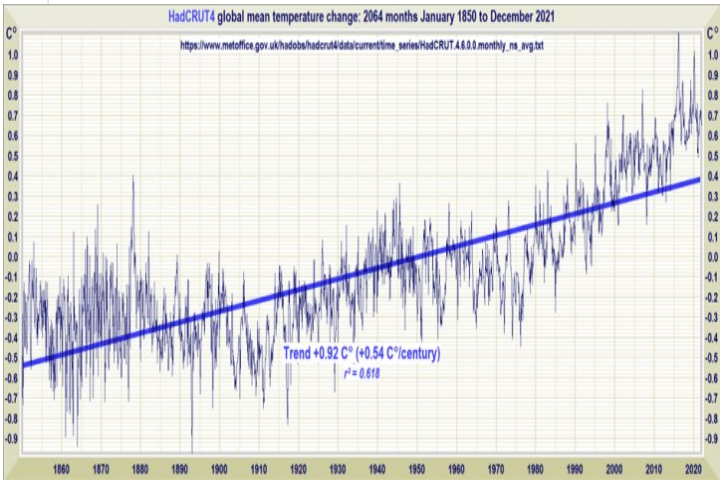



*Scientific consensus on causation:* Academic studies of scientific agreement on human-caused global warming among climate experts (2010–2015) reflect that the level of consensus correlates with expertise in climate science.[98] A 2019 study found scientific consensus to be at 100%,[99] and a 2021 study concluded that consensus exceeded 99%.[100] Another 2021 study found that 98.7% of climate experts indicated that the Earth is getting warmer mostly because of human activity.[101]




# THE TEMPERATURE ISSUE

Virtually 100% of scientists agree that the world has warmed since 1900. Reliable data, summarized in this graph from AR6 WGI p.322 (2021), clearly shows the warming trend. According to AR6 WGI p.5, the warming from the preindustrial period through 2010-2020 has been about 1.1 C, and the world has probably warmed another 0.1-0.2 C or so since then.




But scientists disagree significantly about the details of the warming. There are over ten datasets that follow world temperatures, and they differ in a number of respects. For example, this graph shows temperatures rising at a linear rate since 1850. AR6 says that there is a *near-linear* dependence of temperature on cumulative greenhouse gas emissions. (AR6 WG1 p.202).

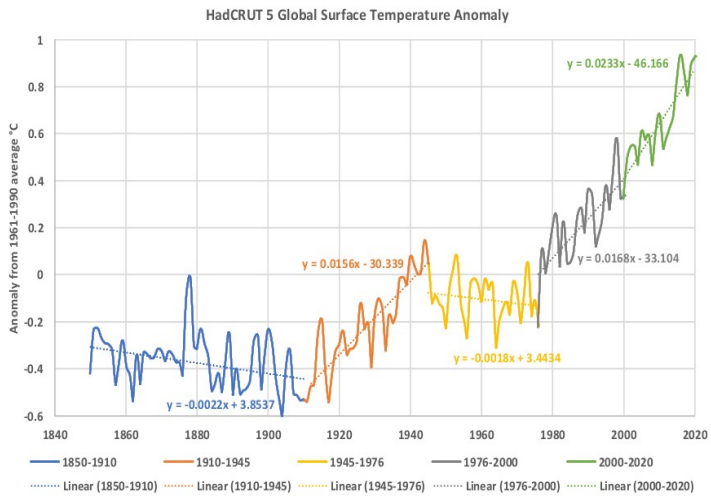
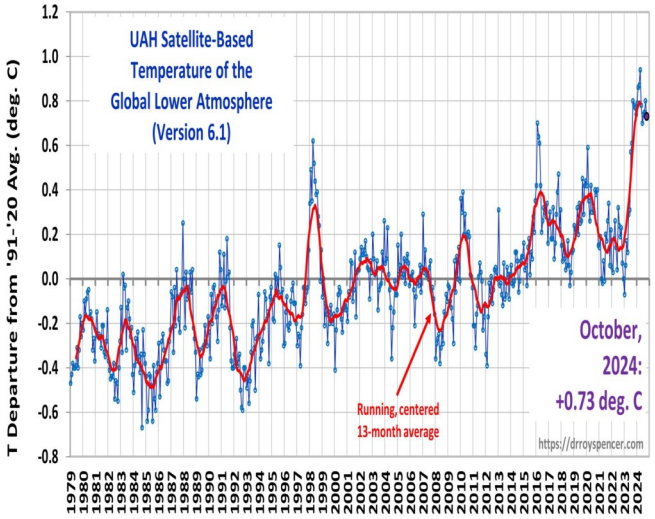
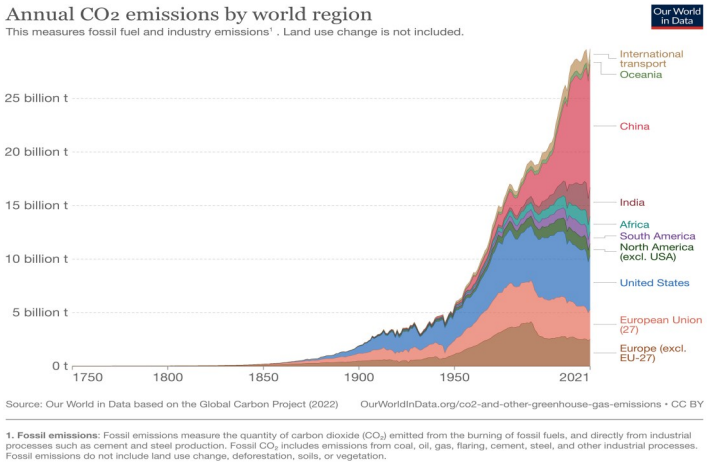



**Figure 4:** The HadCRUT5 temperature record.

But this graph from a different dataset shows 5 different periods from 1850 with different rates of temperature change. In particular the graph shows: (1) a a period of significant warming 1910-1945, (2) a period of cooling 1945-1975, and (3) another period of significant warming since 1975.

This graph of temperature rise since 1979 is from the satellite dataset maintained by the University of Alabama Huntsville. It suggests that, while temperatures have been rising, there is significant variability from year to year. Since this graph provides temperatures through October 2024, it shows the dramatic and unprecedented temperature spike that started in the spring of 2023 (the "2023 Temperature Spike").






## THE CAUSATION ISSUE

CO2 is indisputably a greenhouse gas, and rising levels of CO2 in the atmosphere indisputably cause some warming. Scientists agree: (1) that since the 1950s human emissions of CO2 have increased dramatically at a very linear rate, and (2) that therefore, to some extent, human activity has caused some warming.

The CO2 warming effect depends on the concentration of CO2 in the atmosphere. There is high quality data showing that, since 1958, this concentration was been rising at a very steady rate with a slight increase over the last decade or two.

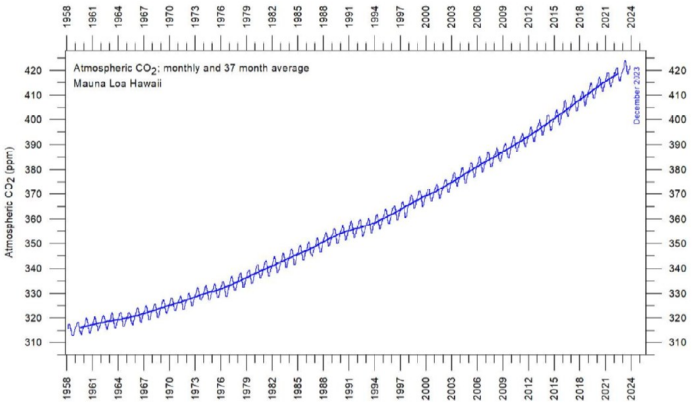


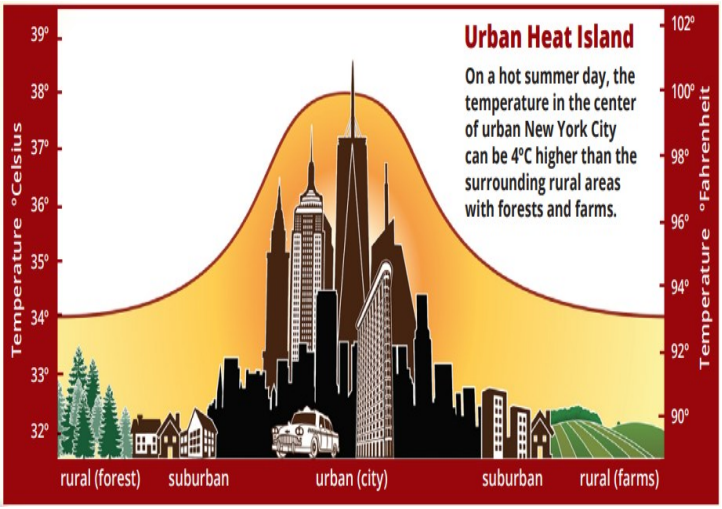

*FIGURE 25: Monthly amount of atmospheric $CO_2$ since March 1958, measured at the Mauna Loa Observatory, Hawaii. The thin line shows the monthly values, while the thick line is the simple running 37-month average, nearly corresponding to a running 3-year average.*

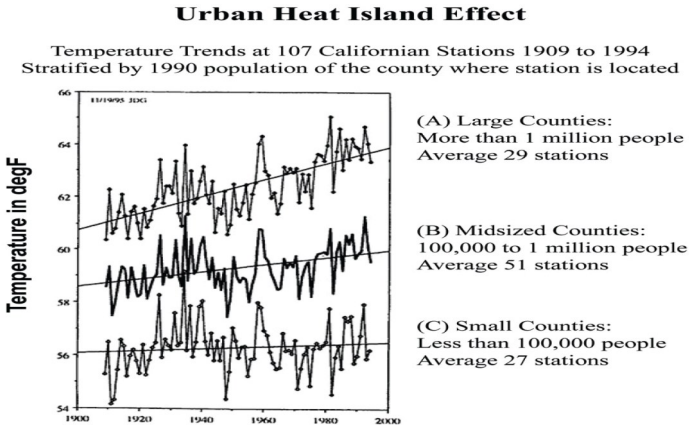
## WORLD POPULATION – URBAN POPULATION

| | 1960 | 2022 |
|---|---|---|
| World Population (billions) | 3.019 | 7.956 |
| % Urban | 34% | 57% |
| Urban Population (billions) | 1.026 | 4.535 |

But scientists disagree as to the percentage of warming since 1900 that has been caused by human CO2 emissions. Humans cause warming in other ways, in particular by changes in land use, and, most significantly, by urbanization. Since 1960 there has been a massive increase in urbanization around the world, which indisputably is a significant cause of warming.

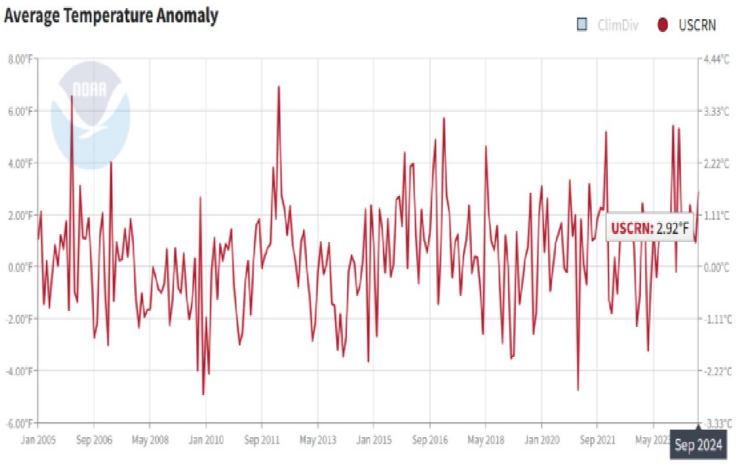
The temperature differential between an urban area and the surrounding rural areas can readily be measured and is large.

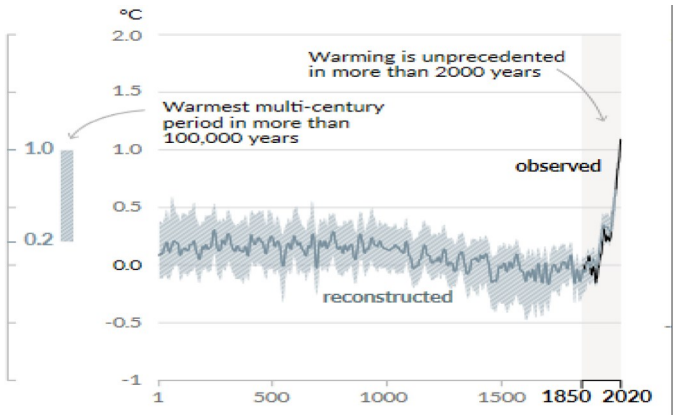





And there are studies showing that the rate of temperature rise in particular counties varies with the population of the counties. Counties with larger populations warm more rapidly than counties with smaller populations

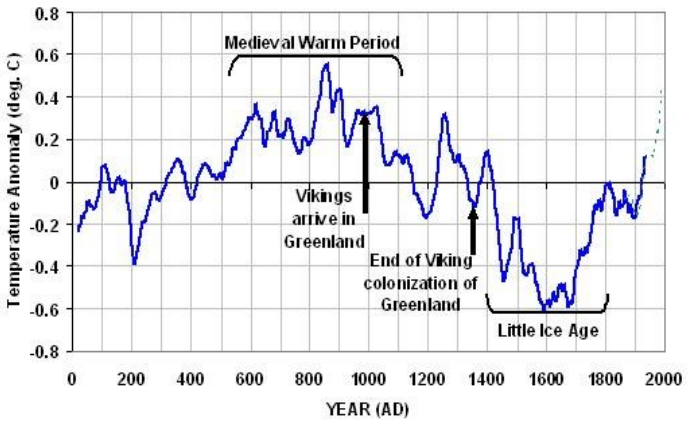
The US government's most accurate temperature dataset (NOAA's Climate Reference Network) uses temperature measurement stations located to screen out the urbanization effect. It shows virtually no warming since 2005 when the dataset was initiated. But, overall, there is significant disagreement as to the contribution of urbanization and other changes in human land use (such as deforestation) to the global warming that has occurred since 1900. Obviously, to the extent urbanization or deforestation have caused global warming, that warming was not caused by rising atmospheric CO2 levels

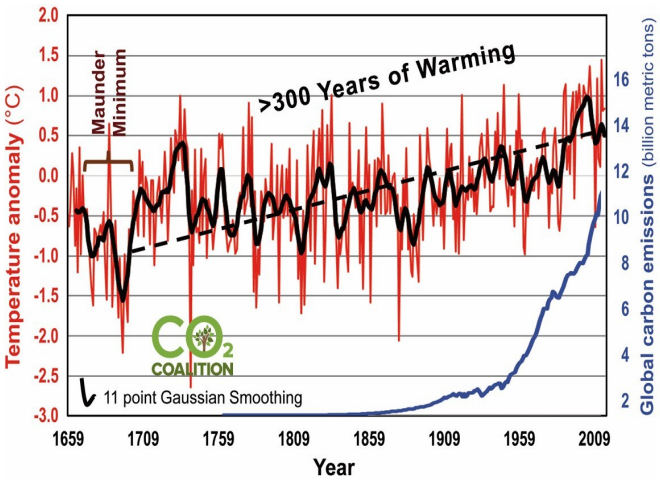



There is also disagreement as to the contribution of natural variability to the global warming since 1900. A controversial conclusion of AR6 is that world temperatures have been relatively flat for nearly 2,000 years prior to the preindustrial period, as shown on this graph. (AR6 SPM p.6). This suggests no natural temperature variability.

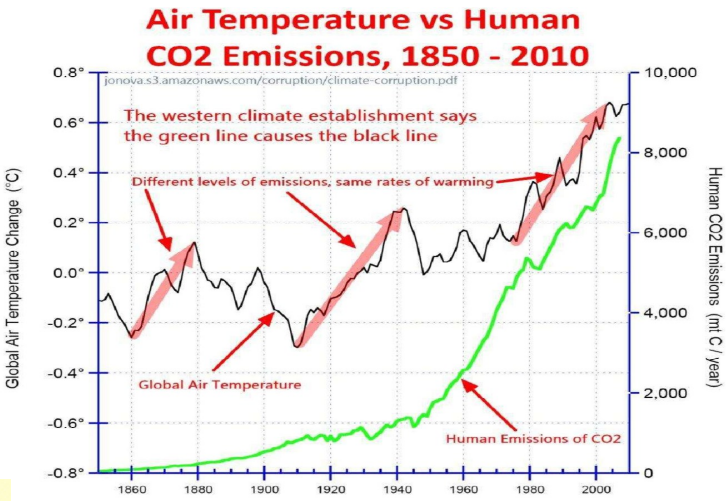
But other temperature reconstructions show a pronounced Medieval Warm Period and Little Ice Age, suggesting large natural temperature varibility.






As shown in this graph (and a prior graph), human CO2 emissions did not become significant until the 1950s, but global warming, according to some reconstructions, began in the 1700s, long before any human activity could have been a factor. Such warming must have been caused by natural variability.

CO2 emissions can not explain: (1) the warming 1910-1945, (2) nor the cooling 1945-1975, (3) nor the 2023 Temperature Spike.




## IPCC #1 1990 REPORT - CONCLUSION ON CAUSATION

- "The size of [the warming over the last 100 years] is broadly consistent…with natural climate variability.
- Thus the observed increase could be largely due to this natural variability."

The IPCC in AR1 (1990) concluded that all the warming from 1910 to 1945 and from 1975 to the date of the report could have been *largely due* to natural variability. (AR1 p.xii). The IPCC also commented that, "the rather rapid changes in global temperature seen around 1920-1940 are very likely to have had a mainly natural origin." (AR1 p.233)

AR 5 in 2013 did not address the 1910-1945 warming, but concluded that *more than half* of the subsequent warming was "caused by the increase in greenhouse gases." (AR5 p.17) The IPCC in effect, conceded that the 1910-1945 warming was due to natural variability.

## IPCC #5 2013 REPORT - CONCLUSION ON CAUSATION

"It is EXTREMELY likely that MORE THAN HALF of the observed increase in global average surface temperature from 1951-2010 was caused by the increase in greenhouse gas."

# CONCLUSION

The most recent IPCC report, AR6 (2021), distinguished between human CO2 emissions and all human activities. Thus human CO2 emissions were identified as *very likely* the *main* driver of warming since 1979 with *very likely* defined as 90-100% odds and *main* defined as "responsible for more than 50% of the change. (AR6 WGI p.5). All human causes (CO2 emissions, urbanization, deforestation, and all other causes) were assessed as *likely* to have caused 1.07 C of the total 1.09 C temperature increase from 1850-1900 to 2010-2020 with *likely* defined as 66-100% odds. (AR6 WGI p.5) But AR6 provided no discussion of how humans could possibly have caused the 1910-1945 warming. This warming occurred before human CO2 emissions were significant enough to have contributed any significant amount of the warming. AR6 admitted that it was unable to attribute the pre-1951 warming to any specific human activities. (AR6 WGI p. 425)

Overall, scientists agree that human activity has caused some significant amount of the post-1900 warming. But there is significant disagreement as to: (1) the % of the post-1979 warming caused by human CO2 emissions, (2) the % of the post-1979 warming caused by urbanization, deforestation and other changes in land use, and other types of human activity, and (3) the causes of the 1910-1945 warming (human versus natural), which occurred before rising CO2 levels could have been a significant factor.

A 2015 survey asked specifically how much of the post-1950 warming could be attributed to human greenhouse gas emissions. Only 64% of those responding answered 51% or more.

For a discussion of the various natural forces and cycles that might have contributed to the post-1900 warming (e.g. sun, ocean currents, and other natural cycles) see CLISCIPOL Science Topic: Climate History II, and also Science Topic: Sun.

## Works Cited


Intergovernmental Panel on Climate Change First Assessment Report (1990) (AR1)

Intergovernmental Panel on Climate Change Assessment Report 5, Working Group I, The Physical Science Basis (2013) (AR5)

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