Climate Change: Is It Real? If So, How Much and How Fast? And, What Then?

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The climate change debate should be a scientific discussion, but it has become more of a political one. The political discourse, along with the money it can bring to grant funding, has infected the scientific community and its objectivity. This makes what is already a complex scientific problem a difficult sociological one.

If science seeks to advise politicians, it must be objective; but objectivity has been to an extent lost, especially among scientific leadership. We must be able to sort out the politics and misinformation from the truth and correct information if we are to make good decisions as a society going forward.

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The camps. The basic debate is between two polarized advocacy camps: the "human-made global warming" camp and the "skeptics" camp. The human-made global warming camp asserts our climate is warming due to excessive pollution of our atmosphere with greenhouse gases like carbon dioxide (CO2) from our dependence upon fossil fuels. And warming is producing sea-level rise and changes in weather patterns that will yield negative, damaging results.

The "skeptics" claim that while there may be warming, it is most likely caused by natural cycles. A key difference is the human-made global warming camp insists on action such as global taxation (e.g., carbon credits) to control greenhouse gas emissions, while the skeptics say our actions are not only ineffective in changing nature, but unfair, as it is poor nations who want cheap energy (e.g., coal burning) to gain wealth and prosperity and advance into the league of advanced industrialized nations.

The increasing polarization of the camps into extreme views -- "alarmist" claims of cascading catastrophes (such as offered by a recent U.S. government report) vs. outright "denial" of the human-made global warming hypothesis some skeptics hold to (like radio host Michael Savage) -- is unhelpful. So are false assertions that conflate weather with climate, or that justify any unusual event as due to "climate change;" these attitudes inevitably lead to irresponsible governance.

Just look at California governor Jerry Brown, who laid blame for the recent terrible forest fires in California to "climate change" while many others saw such fires coming due to the buildup of pine and other natural fuels (e.g., the former fire chief of Paradise, who quit a year before the "Camp Fire" because of these dangers that local and state authorities refused to address).

Pine forest densities have increased by a factor of ten since Clinton-era policies bowed to environmentalist demands that eliminated clear-cutting of forests. This leads to skeptics' counter-arguments due to their fear of being played by those who use human-made global warming arguments as a means (e.g., big money taxation) to an end (power over sovereignties through global governance).

Some basic facts. There is merit to both the human-made global warming and skeptics side of the debate. On the human-made global warming side, climate is clearly warming, but not much -- only by 0.9 degree Centigrade (degC) (about 1.5 degrees Fahrenheit) over the last 140 years (see Fig. 1a). The figure also shows the CO2 concentration over the same time period and its remarkable correlation with temperature. But, during this time, sea-levels have risen only about 10 inches -- really not as much as one might expect from such a small temperature rise. This undermines the alarmism of human-made global warming advocates and favors the skeptics.

Actually, CO2 accounts for only 60% of the greenhouse gas effect. There are other key greenhouse gases: methane, nitrous oxide, and chlorofluorocarbons among them. We can see in Fig.1b that methane and nitrous oxides are also rising dramatically upward along with change in CO2 levels.

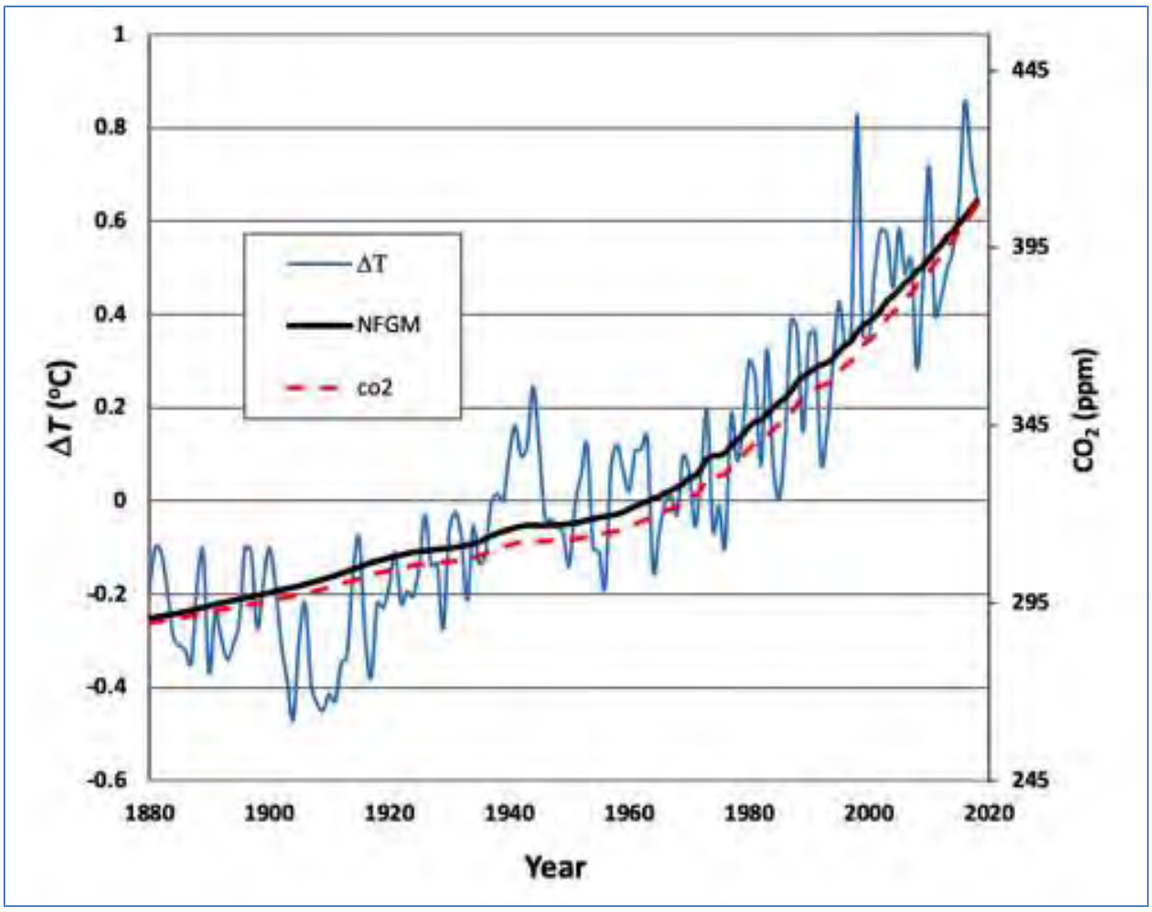
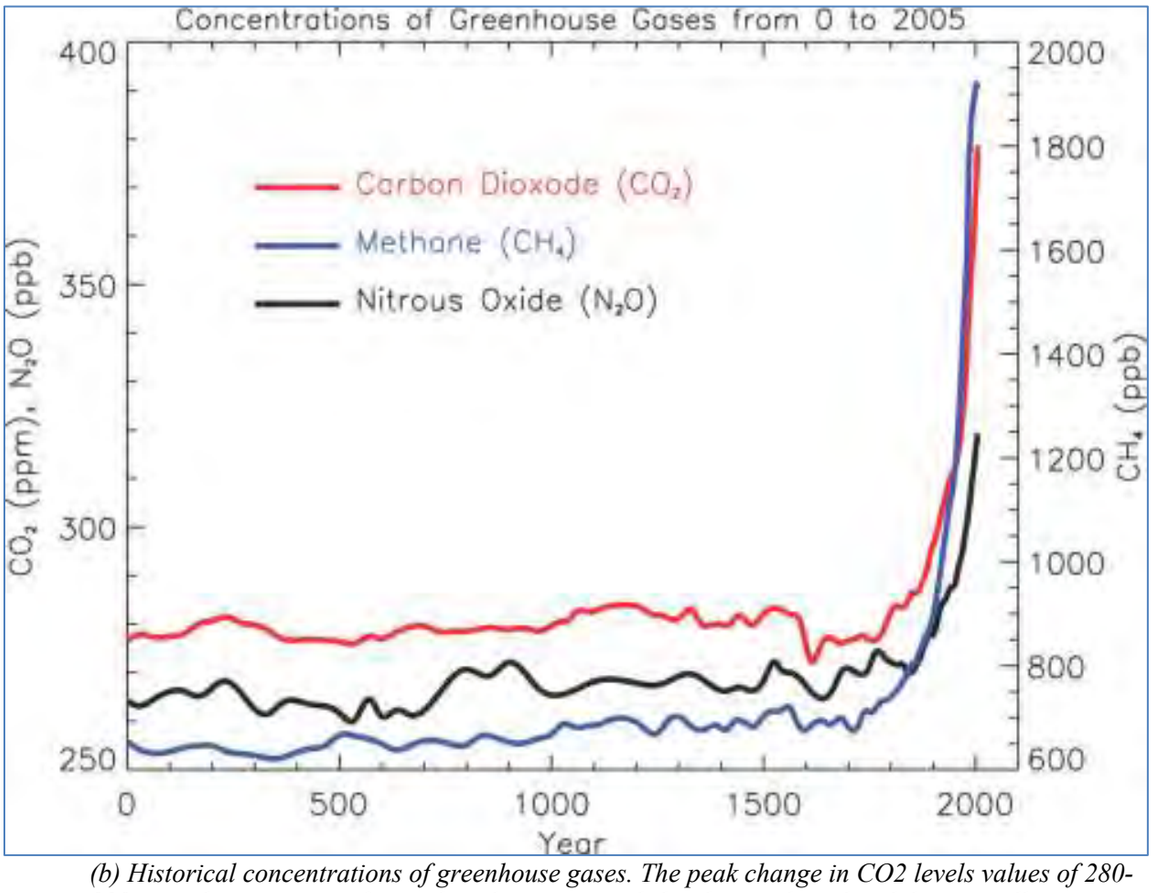


Figure 1 (a and b): Some basic facts about temperature and greenhouse gas concentrations:
(a) Historical temperature anomaly ΔT and change in CO2 levels in the last 140 years. The temperature curve is an average of GISS, JMS data prior to 1979, and satellite data sets after 1979. The dashed change in CO2 levels curve is scaled and plotted so its endpoints in 1880 and 2018 match multi-year temperature averages. The "climate signal" is represented by the solid line that results from a simple "no-feedback greenhouse model" (NFGM) which generates the temperature change from change in CO2 (Courtesy J. Andrew Combs, World Research Institute for Science and Technology Summer Conference, Gifu, Japan, 2018)



(b) Historical concentrations of greenhouse gases. The peak change in CO2 levels values of 280-310 ppm characteristic of interglacial warm periods has been eclipsed and dramatically

surpassed; its 120 ppm rise since 1750 is larger than the 100 ppm rises from glacial troughs to interglacial peaks during the ice ages. (Source: IPCC 4th Assessment Report, Ch. 2)

So, how do the temperature and greenhouse gas rise fit in with historical values? A picture is worth a thousand words (see Fig. 2). Temperatures, change in CO2 levels and sea levels have risen and fallen in 100-kyr cycles (1-kyr is 1,000 years) over the last half-million years. The cycles represent 20-kyr interglacial warm periods alternating with roughly 80-kyr ice ages.

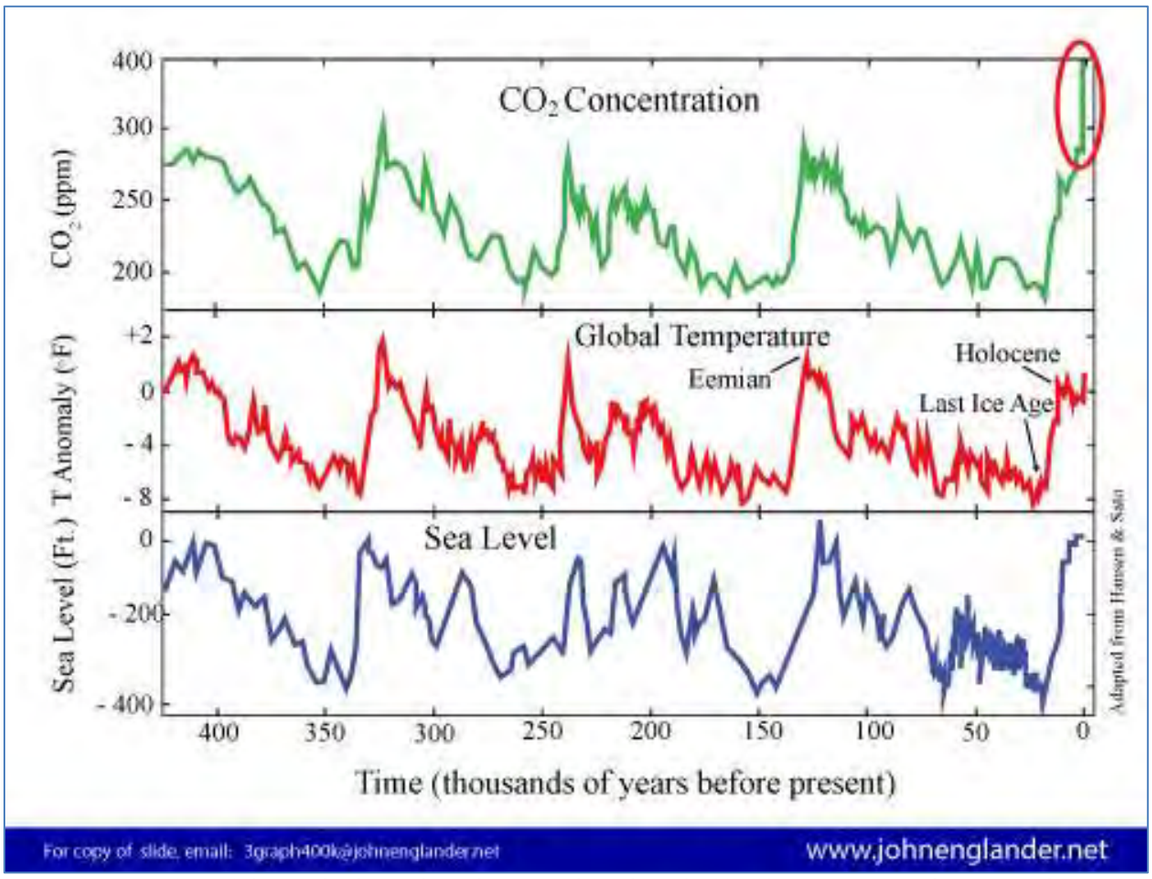


Figure 2: 100-kyr Milankovitch cycles in carbon dioxide (CO2), temperature from Vostok ice-core samples along with sea-levels. Note that while CO2 typically follows temperature over time, step for step, recent CO2 levels (circled in red) diverge from this pattern, leaving temperature behind. (Courtesy JohnEnglander.net; click chart to enlarge)

Temperatures have a range of about 8-10 degC change in CO2 levels, from lows of 180 parts-per-million (ppm) to highs from 280 to 310 ppm, and sea levels rise by about 100 meters from ice age to warming period. It is believed these 100-kyr cycles are due to an interplay of earth's orbital dynamics (Milankovitch cycles) with drying and consequent vanishing of vegetation taking place at higher altitudes due to the low change in CO2 levels at cycle bottoms since change in CO2 levels is retained by colder oceans. This enables dust storms that dirty the ice sheets, increasing their absorption of sunlight, and causing melting.

This mechanism drives to completion when ice sheets have retreated to places like Greenland and Antarctic enclaves, and cooling slowly resumes as the ice becomes increasingly pristine due to greater vegetation coverage at high altitudes in the higher change-in-CO2-levels environment, and the precession of the orbital axis begins to favor sunlight in the lower percentage land area of the southern hemisphere. This can be called an "albedo-dust-orbital" coupling mechanism. It drives warming of about 10 degC over 100 centuries from ice sheet maxima into interglacial warm eras. That is about 0.1 degC per century (degC/century).

But we are currently warming at a rate more than *ten times* that -- at about 1.5 degC/century (according to satellite data). A few tenths of a degC may be due to the upswing in the Atlantic Multi-decadal Oscillation (an ocean-atmosphere heat exchange mechanism), but most of it is something else. This definitely argues against the skeptic's claims for natural mechanisms. Furthermore, from the mid-1700s, change in CO2 levels has taken off from 280 ppm to exponentially higher.

We've just recently breached the 400 ppm level in the last few years; that is 120 ppm above the last interglacial peak -- matching trough to peak changes in change in CO2 levels in the 100-kyr cycle. This rise in change in CO2 levels is clearly not part of a "natural cycle," and again argues against the skeptics view. Also, such a rapid increase can't be good for the environment. At the same time, while recent temperatures in Fig. 2 have not followed CO2's meteoric rise, they are still rising at an unprecedented rate

-- three to ten times the maximum rates during 1-kyr cycles that gave rise to the Minoan, Roman and Medieval warm peaks of the last 3,300 years, and the respective cold periods that followed them including the little ice age that bottomed around 1700 AD from which we've been warming ever since. This again would argue against the "natural cycles" argument.

Most scientists believe modern warming is due to greenhouse gas accumulation. The effect of increasing CO2 levels on climate has been a growing focus of research since the Nobel laureate in chemistry, Svante Arrhenius, proposed a model of global warming in 1896. While this belief may be a "trivial" one, as Richard Lindzen of MIT -- a famously self-proclaimed "climate denier" -- once said, million dollar global circulation models (GCM) run on supercomputers include greenhouse gas effects yet their predictions are falsified by temperature data. To wit, if CO2 levels are doubled, GCMs generate a temperature shift of 3.0±0.2 degC for a 100-run average, whereas only 1.6±0.3 degC is observed by satellite (the oft-quoted 1.5 degC uncertainty of GCMs in the Charney MIT report of 1979 is reduced when computed using a standard-error).

On the other hand, the no-feedback greenhouse model calculation of Fig. 1a, presented at the summer conference of the World Institute for Science and Technology (WRIST) at Gifu, Japan, in 2018, is simply an extension of the Arrhenius formulation to include the main greenhouse gas components and can generate results using just an Excel spreadsheet (WRIST was founded in 1984 by Rev. Sun Myung Moon for the advancement of science and engineering for the benefit of humankind). It is therefore quite surprising that the no-feedback greenhouse model temperature prediction falls within about *two percent* of the best fit for Arrhenius-type forcing models. As such it should be considered superior to GCM models for the purpose of forecasts upon which policy recommendations are made.

In light of that, it is difficult *not* to conclude that the current warming is due primarily to greenhouse gas warming. That is, the no-feedback greenhouse model clearly and unambiguously identifies the exponential greenhouse gas increase shown in Fig. 1b as the causal mechanism of a roughly exponential increase in temperature shown in Fig. 1a.

Warming effects are currently subtle. To this point, effects of warming are observable, but remain small. Glaciers are receding or disappearing, there is decreasing Arctic sea ice, and some changes in local climates and growing seasons. Jet stream patterns in the northern hemisphere have become less "zonal" (east-west) and more meridional (north-south) due to warmer north polar temperatures which lowers the north-south temperature gradient that drives the jet stream. Weaker jet streams are in turn more vulnerable to creating more stationary regional "heat domes" or "cold sinks" that last longer, creating more serious health risks to populations.

While there are claims that hurricanes and typhoons are more extreme, and ocean temperatures are higher to justify such claims, actual statistics on hurricane strength do not clearly show that -- at least not yet. Most of the damage that hurricanes inflict are largely due to unwise districting (e.g., having below sea-level communities in New Orleans), including the buildup of densely populated coastal communities. Catastrophes such as caused by superstorm Sandy, and hurricanes Katrina or Michael, have been warned of for years by former National Hurricane Center directors, and well before the climate warming argument became fashionable.

Sea levels have risen, but not even a foot over the last 200 years. Fantastic predictions of warming disasters have come and passed without realization. There are no "climate refugees" of coastal inundation. And wild claims have been an embarrassment for human-made global warming leaders. For example, in the mid-1980s, and before a congressional committee, James Hansen of NASA's Goddard Institute for Space Studies apparently blundered into an awful prediction of a global temperature rise of 2 degC by 2010, yet it later turned out temperatures rose only about 0.3 degC during that period.

How could scientists be so wrong? Maybe it was this very the lack of temperature change that drove leaders and researchers in the Hadley Climate Research Unit to apparently try and "adjust temperatures" in their datasets downward in the past to make it appear more warming was taking place, and to seemingly conspire to remove board members from peer review publications who weren't sufficiently on board with the human-made global warming viewpoint (cf. "climate-gate emails"). This was alarmism and confirmation bias working against people who had been transformed from scientists into true believers. At least Hansen had the integrity to resign his post recently as a scientist and become a full-time human-made warming lobbyist and advocate.

The fact is, warming in one direction will produce effects in the same direction, and if trends of greenhouse gas increase are not reversed, so will the trend in sea level rise. It takes a long time (centuries) to mix a given temperature increase down through an entire ocean column, and the ocean expands more and more as that mixing happens. Every 1 degC is believed to imply six feet of sea level rise over a millennium -- half through thermal expansion, half through melting of land-based ice sheets and glaciers. That six feet takes centuries to develop, but it will happen -- guaranteed. Remember, ocean levels have risen about 400 ft since rising from the depths of the last ice-age. Moreover, beyond a 1.5 degC rise in

global temperature from the 1750s, it is believed by some that the Greenland ice sheet may become unstable to wholesale melting. While that melting may itself take many millennia, it will eventually cause an additional 20 foot sea level rise (at about an extra half-foot per century), which is not good.

On the other hand, we are experiencing long-term cooling since the peak in the current Holocene interglacial maximum about 6,000 years ago. The series of descending 1-kyr cycle warming peaks -- the Minoan, Roman and Medieval maxima -- foretell a colder future and eventual descent into a new ice age. This would be truly catastrophic as it would physically destroy most of the northern cities of Europe and North America. At some point some *controlled* warming will be necessary to avoid this. Maybe the emission of CO2 by humans and knowledgeable stewardship of greenhouse gas concentration is a part of God's plan. This is not normally a skeptic's argument, but it is a reality. If the human-made global warming camp gets its way completely, we are in danger of more severe problems, jumping out of a warming frying pan into an ice age fire.

What is to be done? If we do nothing, change in CO2 levels will continue as burning fossil fuel is cheap. And continuing that will slowly and inevitably create problems. Increasing change in CO2 levels in the oceans is causing acidification, which is impacting shellfish offshore of the western U.S. But, more significantly, we are currently in the midst of a great dying of species -- as fast or faster than the great dying of the Permian era where 90% of existing species vanished. In the last two to three decades, insect biomass has decreased by 75% in many regions of industrialized countries. Some argue that climate change is responsible, but I doubt it. I suspect it is due to chemical pollution and the driving out of species from the physical expansion of civilization. If there is alarm in any current environmental message, this is more likely it.

Regardless, change in CO2 levels and other greenhouse gas increases should be controlled. The most straightforward way may be re-forestation and other greening efforts (e.g., greening of cities including roof-tops, streets, parking lots) as vegetation not only cools through evaporation, but directly absorbs CO2, returning O2, and absorbs less radiation than concrete and asphalt. This could help offset asphalt heat traps our cities have become that give rise to the "heat-island" effect that has now blurred into "heat-regions." And oddly, agriculture -- which seems like a "green business" -- produces 25% of all greenhouse gases (methane from cattle, nitrous oxide from fertilizers). Controlling that will be a challenge.

As per the skeptics argument, simply ridding the world of cheap coal penalizes underdeveloped countries striving for prosperity. But, there can be concerted efforts of industrial countries to install increasingly cheaper solar power in third world countries. That involves sacrifice of the richer on behalf of the poorer nations. And isn't that a principled approach?

Transportation fuels have to re-examined (e.g., using potential fuel cell or existing electric technologies). And electric is not so green if it depends on fossil-fuel power generation; so any advocacy against greenhouse gas emissions that does not include advocacy for new nuclear technologies smacks of hypocrisy and political manipulation. Modern modular passive-cooling nuclear reactor design allows regulation to be fast-tracked as the era of one-off melt-able nuclear fission plant design comes to an end. And recent advances in high-temperature superconductivity offer the hope that magnetically-confined fusion can finally realize its promise within 10-20 years.

If we are to tax carbon use, it must not be simply to enable aggrandizement of power in the hands of global governing authorities and banks. It should be used to help transform fossil fuel-based electrical production and transportation into green alternatives. That takes discipline. And any taxation or restricting solutions must be global. It must not be done only by California, or the U.S., or the U.S. plus Europe. It must be done with the collaboration of the most rapidly advancing economies: India and China. And it needs to be done quickly. Using the no-feedback greenhouse model and "business as usual" rates of greenhouse gas production, the IPCC and Paris target climate levels of 1.5 degC and 2.0 degC will be breached in 2070 and 2110, respectively.

It doesn't help the human-made global warming argument when the GCM results they typically depend on are falsified by temperature data. And evidence persists of confirmation bias in temperature "adjustments" made by NASA data stewards that seem always to "cool the past," thereby generating higher rates of warming today. These issues continue to cloud the debate, causing many political conservatives and climate skeptics to remain unconvinced that something can and should be done.

Hopefully, the truth of the matter can prevail and we can act wisely. Only time will tell.

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