Submission to the Net Zero Advisory Body

Ken Gregory, P.Eng. **December 22, 2021**

The Federal Minister of the Environment and Climate Change commissioned the "Net-Zero Advisory Body" (NZAB) to provide advice on how the federal government can reach its 2030 and 2050 climate targets. The NZAB had requested comments on how to cut greenhouse gas (GHG) emissions from the petroleum industry, due December 22, 2021. The NZAB's website is soliciting comments by asking "How should the NZAB implement or refine its existing 10 values and principles to help ensure 2030 puts Canada on the mostly likely pathways to net-zero by 2050?" The 'values and principles' document states that we must act urgently and to prioritize early and deep reduction in GHG emissions.

IPCC

There is no justification for making any GHG emissions reduction given on the NZAB website, no climate science and no economic cost-benefit analysis. I assume that the NZAB believes that GHG emissions are harmful because of the unscientific rhetoric from the U.N.'s Intergovernmental Panel on Climate Change (IPCC) and U.N. officials and environmental non-government organizations.

The IPCC is a disgraced, political organization, not a scientific one. A large archive of emails and files were release in 2009 that proved IPCC associated scientists

- Manipulated, hid or misrepresented data and evidence in official reports.
- Blocked the publication of scientific results that contradicted the IPCC theory.
- Expressed greater doubt in the emails about the science than they wrote in official reports.
- Manipulated the peer-review process to get friends to review their papers.
- Blocked access to data and methodologies to prevent other scientists from evaluating their work.
- Pressured scientific journals to reject papers showing evidence contrary to their theory.
- Intimidated or discredited scientific journals that publish evidence contrary to their theory.

- Conspired to destroy data and emails subject to Freedom of Information Act (FOIA) laws.

See Climategate and the Inquiries

Climate gate was followed by several other scandals that left the IPCC's reputation in tatters. The IPCC claim that Himalayan glaciers would melt by the year 2035. This claim originated as an off-hand speculation by a scientist that about India's glaciers. The World Wildlife Fund then cited this speculation in a fundraising and advocacy brochure. The IPCC knew the claim was false but put it in its report to put political pressure on politicians. There were several other scandals where the IPCC made false claims based on NGO fundraising claims meant to scare the public.

The IPCC fabricated false evidence to discredit research that shows the surface temperature record is contaminated by the effects of urban warming, badly sited surface stations and other defects. It ignores huge bodies of evidence of urban warming and natural causes of climate change. The IPCC doesn't evaluate the peer-reviewed science on climate change; they only consider human causes of climate change and falsely attributed natural causes to GHG warming. Politicians and journalist foolishly believe the IPCC is credible when in fact their reports a full of misrepresentation, deceit and omissions.

Consensus

There is a mantra promoted by the media that 97% of climate scientists agree with the IPCC position on climate change, that most of the warming since 1900 was caused by greenhouse gases. A review of several papers that make a near 97% consensus claim easily shows that claim is false. A summary table is here. In particular, a frequently cited paper by Cook et al 2013 falsely claimed a 97% consensus by reviewing the abstracts of 11,944 climate papers. It found that only 64, or 0.54% of the papers explicitly endorsed the view that more than 50% of the 20th century warming was caused by humans. Humans cause warming by urban warming, land use changes, black soot on snow, as well as by GHG. The 97% comes from implicit and explicit endorsement that humans have caused some warming, regardless how tiny, from any cause, not just GHG. There is no mention that warming is harmful. If fact, as shown later, warming is quite beneficial.

There are several major groups of climate scientists who strongly disagree with the IPCC position. These include the Friends of Science Society, Clintel, the Nongovernmental Panel on Climate Change, the CO2 Coalition and more. Unlike the IPCC, they are not limited to consider only human causes of climate change. They all provide evidence of strong natural causes of climate change.

The Clintel Climate Declaration, signed by over 925 experts says in part;

There is no climate emergency. Climate science should be less political, while climate policies should be more scientific. Natural as well as anthropogenic factors cause warming. The geological archive reveals that Earth's climate has varied as long as the planet has existed, with natural cold and warm phases. The Little Ice Age ended as recently as 1850. Therefore, it is no surprise that we now are experiencing a period of warming. The world has warmed significantly less than predicted by IPCC on the basis of modeled anthropogenic forcing. Climate models have many shortcomings and are not remotely plausible as policy tools. They do not only exaggerate the effect of greenhouse gases, they also ignore the fact that enriching the atmosphere with CO_2 is beneficial.

The Global Warming Petition Project was signed by 31, 487 American scientists including 9,092 with PhDs. The petition states in part;

There is no convincing scientific evidence that human release of carbon dioxide, methane, or other greenhouse gases is causing or will, in the foreseeable future, cause catastrophic heating of the Earth's atmosphere and disruption of the Earth's climate. Moreover, there is substantial scientific evidence that increases in atmospheric carbon dioxide produce many beneficial effects upon the natural plant and animal environments of the Earth.

IPCC AR6 SPM

The recent IPCC sixth assessment report (AR6) summary for policy markers (SPM) doesn't indicate that emissions are or will be a crisis. However, it is much more alarmist than the main report. The SPM is edited by government bureaucrats to create alarmism to promote the UN's agenda of transferring wealth from rich to poorer nations and increasing the UN's political power. The Irish Climate Science Forum and CLINTEL, a group of 925 climate scientists and experts, have produced a 17 page catalog of "misrepresentations" in the 40 page IPCC AR6 SPM. The SPM presents a fake graph of proxy temperatures that grossly misrepresents the underlying proxy temperature series and fails to show the large historical temperature variations between the Roman Warm Period (RWP), the Dark Ages Cold Period, the Medieval Warm Period (MWP) and the Little Ice Age (LIA). The RWP and the MWP were likely warmer than or as warm as current global temperature. The LIA was likely the coldest period of the last eight thousand years. About 50% of the warming from 1950 was due to natural climate change according to this study. Recent warming was caused by a combination of anthropogenic and natural influences, not human influence alone. History shows the civilization flourished during the warm periods and suffered during the cold periods.

The incidence of so-called "extreme weather" events is misrepresented in the SPM. The main report identifies no statistically-significant trends in most categories of extreme weather.

Hail Storms

Hail storms have declined significantly in recent decades. Non-tropical storms are caused by a difference in temperatures of colliding air masses. To the extent that climate change from GHG

emissions warms the Polar Regions more than temperate and tropical regions there will be a smaller temperature gradient, and less severe storms. All other things being equal, a warmer world should have fewer, not more, severe storms. Figure 1 shows the decline is hailstorms.

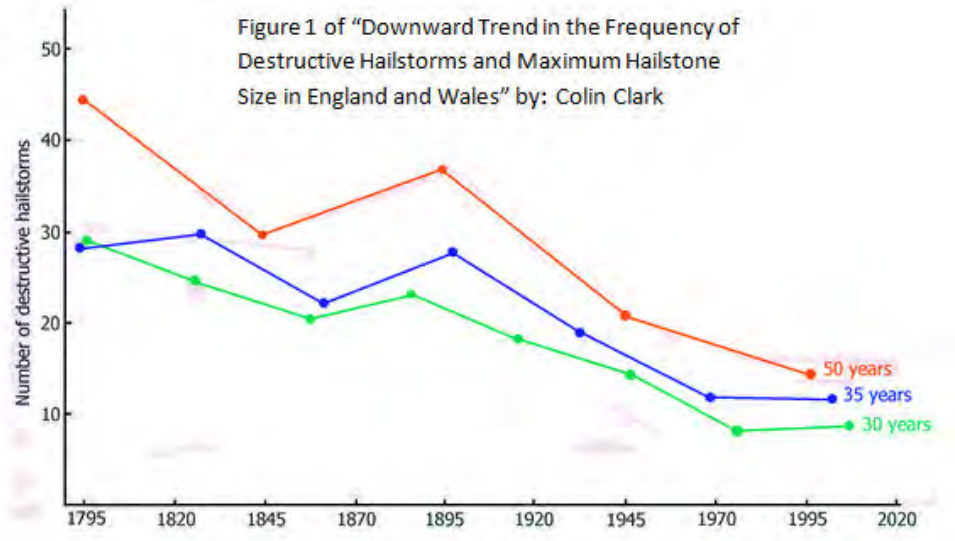

Figure 1.

Tornadoes

A graph of strong to severe tornadoes in the USA from 1955 to 2019 is shown as figure 2.

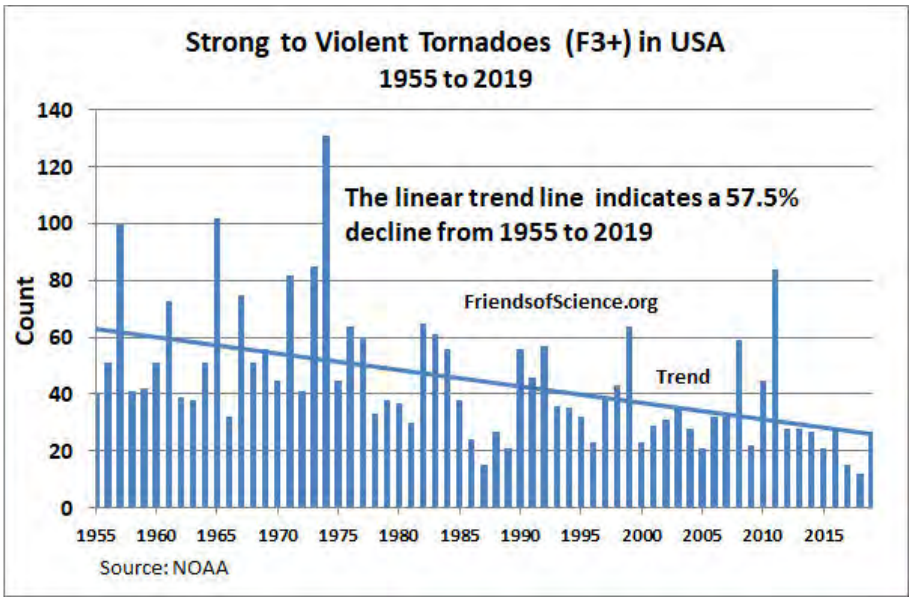

Figure 2.

The graph shows that the trend of strong to violet EF3+ tornadoes from 1955 to 2019 is an amazing 57.5% decline. The decline is primarily due to the reduction of the temperature gradient due to global warming.

Hurricanes

Hurricanes are caused by difference in temperatures between the sea surface and the storm top. The Accumulated Cyclone Energy (ACE) is the 2-year running sum of the combination of hurricanes' intensity and longevity as shown as figure 3. During the past 50 years, global and Northern Hemisphere ACE undergoes significant variability but exhibits no significant statistical trend. Hurricane ACE has no long-term trend, but is currently lower than average.

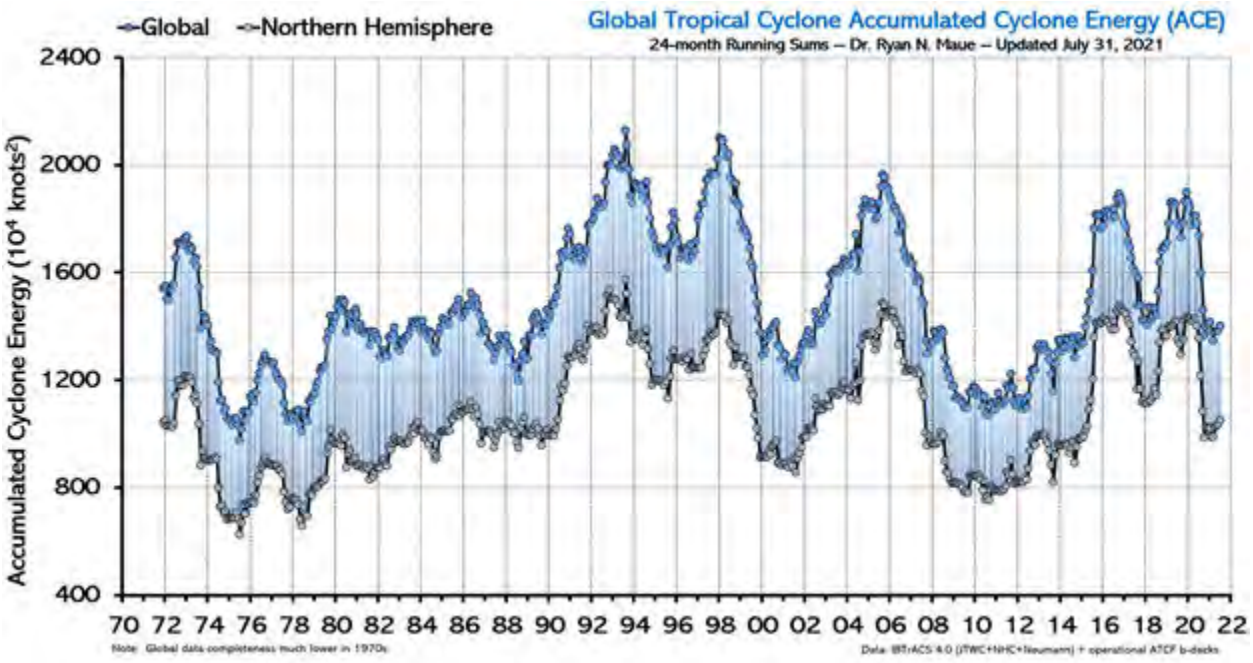

Figure 3

Figure 4 shows the last 4-decades of global hurricane and global major hurricane frequency 12-month running sums through July, 2021. The top time series is the number of all hurricanes (maximum wind speed exceeds 64-knots). The bottom time series is the number of major hurricane strength (96-knots). The global frequency trend of all hurricanes indicates a small decline. Major hurricanes are categories 3 – 5 on the Saffir-Simpson hurricane wind scale.

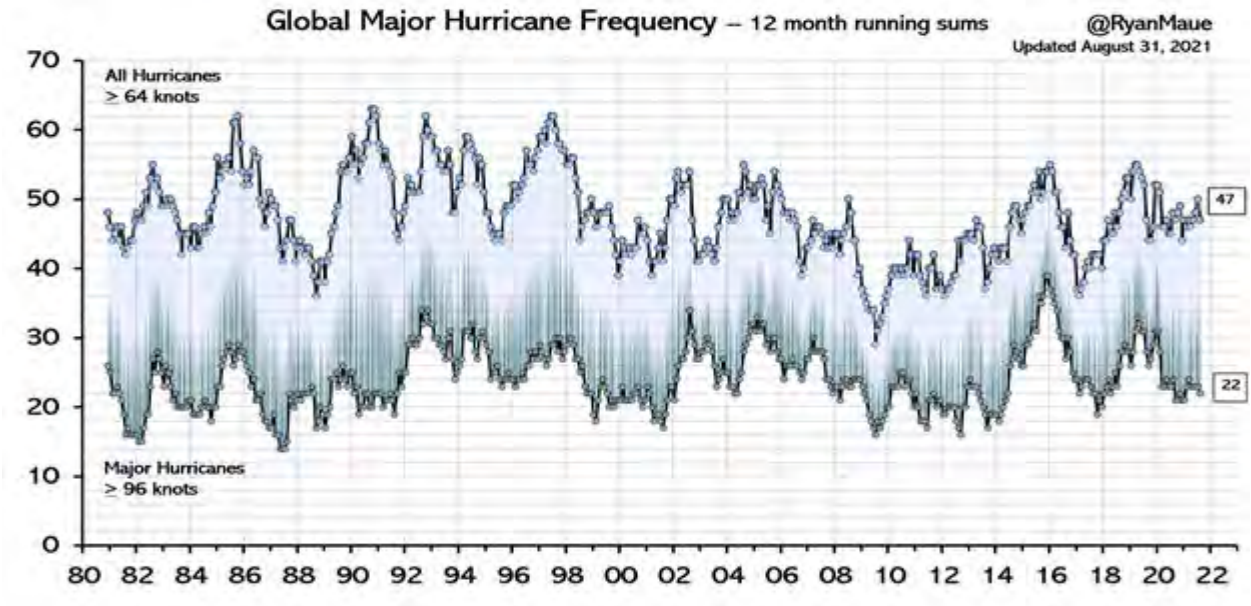

Figure 4

Despite the 1°C global warming seen since the mid-18th century, hurricane intensity and frequency remained well with the range of natural variability and have not trended upwards.

Droughts

AR5 chapter 2 p. 215 says “In summary, the current assessment concludes that there is not enough evidence at present to suggest more than low confidence in a global-scale observed trend in drought or dryness (lack of rainfall) since the middle of the 20th century.”

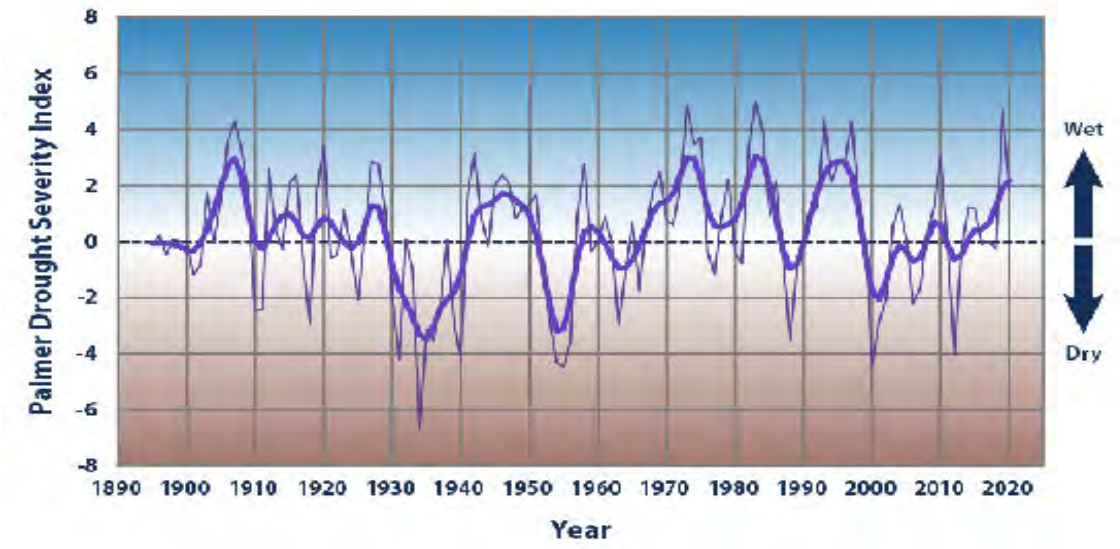

Figure 5

In North America, the greatest droughts in recent history were in the 1930s and 1950s. Figure 5 shows the average drought conditions in the contiguous 48 states according to the Palmer Index, 1895–2020. The thicker line is a nine-year weighted average. Currently very little of the USA is in drought conditions. There is no apparent correlation to temperatures.

Figure 6 shows the proportion of the planet in drought, by intensity, 1982-2012. The graph is from the Global Integrated Drought Monitoring and Prediction System (GIDMaPS), which provides drought information based on multiple drought indicators. The system provides meteorological and agricultural drought information based on multiple satellites, and model-based precipitation and soil moisture data sets. The Do is mild drought, D1 through D3 are increasing severity, D4 is extreme drought. There is a slight declining trend of total droughts throughout the period.

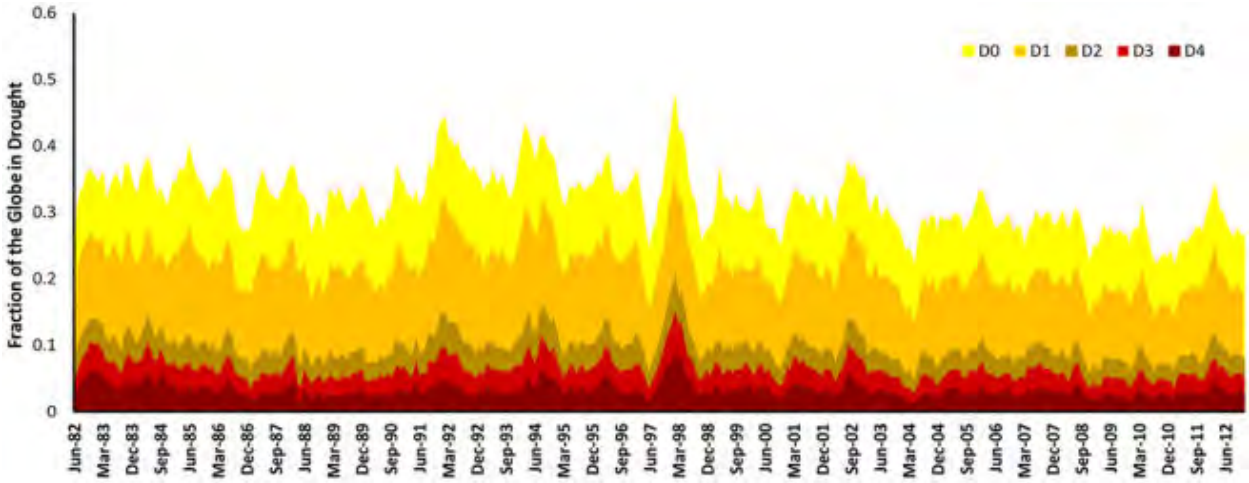

Figure 6

Floods

Dr. Roger Peilke Jr. prepared a chart of US flood damages as a fraction of gross domestic product (GDP) below from here. He presented a similar chart to the US Congress in 2013. He wrote “The US is prone to very large flood events, resulting in tens of billions of dollars in losses. However, the trend since 1940 is striking. As the nation has seen its economic activity expand by a factor of almost 13, flood losses as a proportion of that activity have dropped by about 75%.”

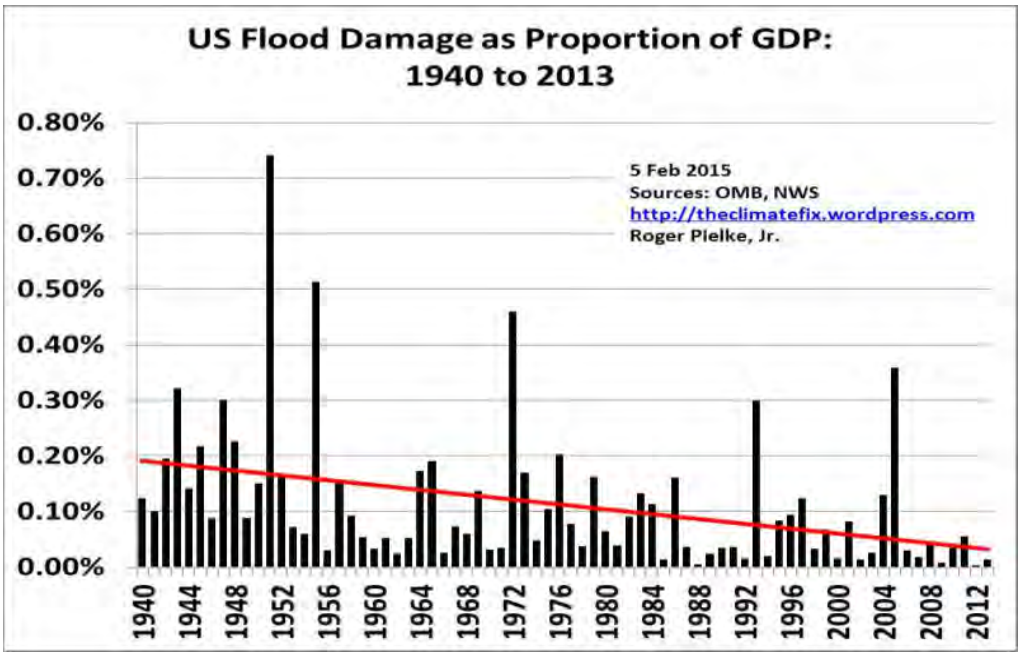

Figure 7

Figure 7 shows that US floods threaten assets worth about 0.03% of US GDP.

The AR5 WG1 p.8-39 states "For changes in the magnitude of peak flow, recent studies show strong spatial heterogeneity in the sign, size and significance of trends. … In summary, the assessment of observed trends in the magnitude of runoff, streamflow, and flooding remains challenging, due to the spatial heterogeneity of the signal and to multiple drivers." There is no indication in the report that floods threaten a significant portion of global GDP.

Sea Level Rise

The rise of sea levels is measured by tide gauges and by satellites. Sea level rise (SLR) is influenced by ocean cycles, ocean eddies, glacial isostatic land level changes, local land level changes as well was warming. Land levels can change due to water and petroleum extraction and plate tectonics. Long-term tide gauges are required to evaluate the SLR and acceleration. Sea levels have been rising since the Little Ice Age (LIA) to 1950 when the rise can't be caused by greenhouse gases because their concentrations were too low to have a significant effect. Therefore a portion of the current SLR is a natural recovery from the LIA and the last glaciation.

Figure 8 shows the average of 65 of the world's longest-operating tide gauges. Using a quadratic fit, the 2020 global average SLR is 2.0 mm/yr with an acceleration of just 0.013 mm/yr^2. An analysis by Church and White (data link) shows an acceleration of 0.0078 mm/yr^2 from 1900. The best fit curve extrapolates to 3.0 mm/yr SLR rate at 2020. 3.0 mm/yr is 11.8 inches per century, far from the disaster claims published in the news media.

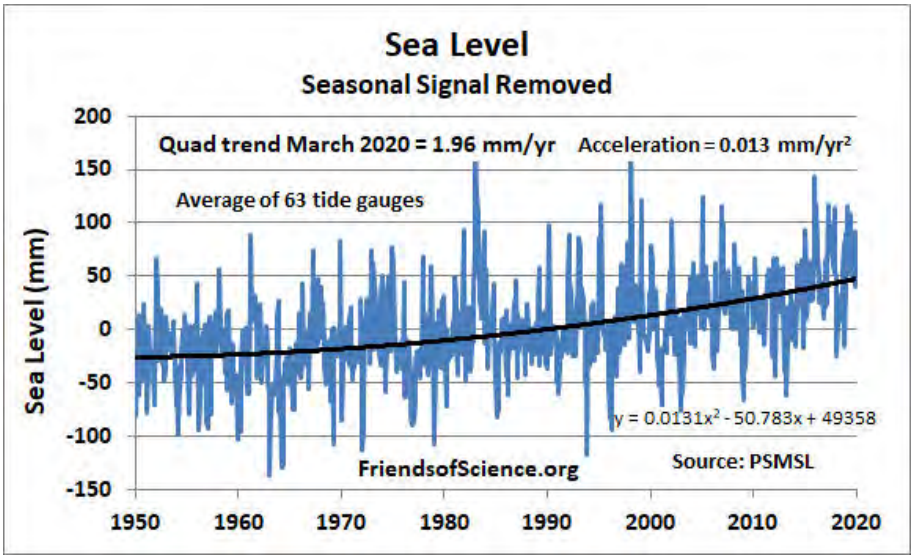

Figure 8

Satellite data analysis by the University of Colorado found an acceleration of 0.098 mm/yr and an average SLR rate of 3.2 mm/yr over 1993-2021. The satellite data includes data from four separate satellites with overlapping periods. Once in orbit, the satellites are calibrated to a set a tide gauges. The satellite data covers the entire ocean surface; not only near the oceans, and the calibration procedure is not disclosed. If the satellites were calibrated correctly the linear trends of the satellite data during the periods of their overlaps should be the same. This article compares the satellite trends during the overlap periods and reports that the differences between the latter and the earlier satellite trends over the first two overlap periods are 1.47 mm/yr and 0.33 mm/yr. The increase in trends over the two overlay periods sum to 1.8 mm/yr. This suggests that most of the sea level acceleration of the reported satellite data is bogus and is due to the failure to properly calibrate the satellite data.

Sea level rise doesn't pose a serious threat because the land deposition on the shores may offset much of the SRL. This study of tropical island and atoll area changes assesses their vulnerability to sea level rise. Atolls are ring shaped coral reefs in the mid-ocean, including a coral rim that encircles a lagoon. The authors reanalyzed the available photo and satellite imagery of 30 Pacific and Indian Ocean atolls including 709 islands over several decades to a century. The study found that "no atoll lost land area and that 88.6% of the islands were either stable or increased in area, while only 11.4% contracted." Islands that changed less than 3% in area were categorized as stable. The paper reports that "no island larger than 10 ha decreased in size".

This paper examined the historical shoreline change trends using satellite images since 1984. The paper reports that 31% of the world's ice-free shoreline are sandy or gavel. The study says that 24% of the world's sandy and gravel beaches are eroding at rates exceeding 0.5 m/yr, while 28% are accreting more than 0.5 m/yr and 48% are stable. On a global scale, the world's beaches have accreted on average 0.33 m/yr over the past three decades, i.e. a total gain of 3,663 km^2 despite SLR. This new study (2021) reports "Since 2000, land area on 221 atolls examined had increased by 61.74 km^2 (6.1 %)".

Wild Fires

The US National Interagency Fire Center keeps track of US forest fires since 1926. The dataset shows the area burned by wildfires had declined by a factor of 5.7 from the 1930s to the 2010s, which undermined claims that climate change was making wildfires more frequent and severe. Figure 9 shows the number of forest fires and the acres burned per year in the USA.

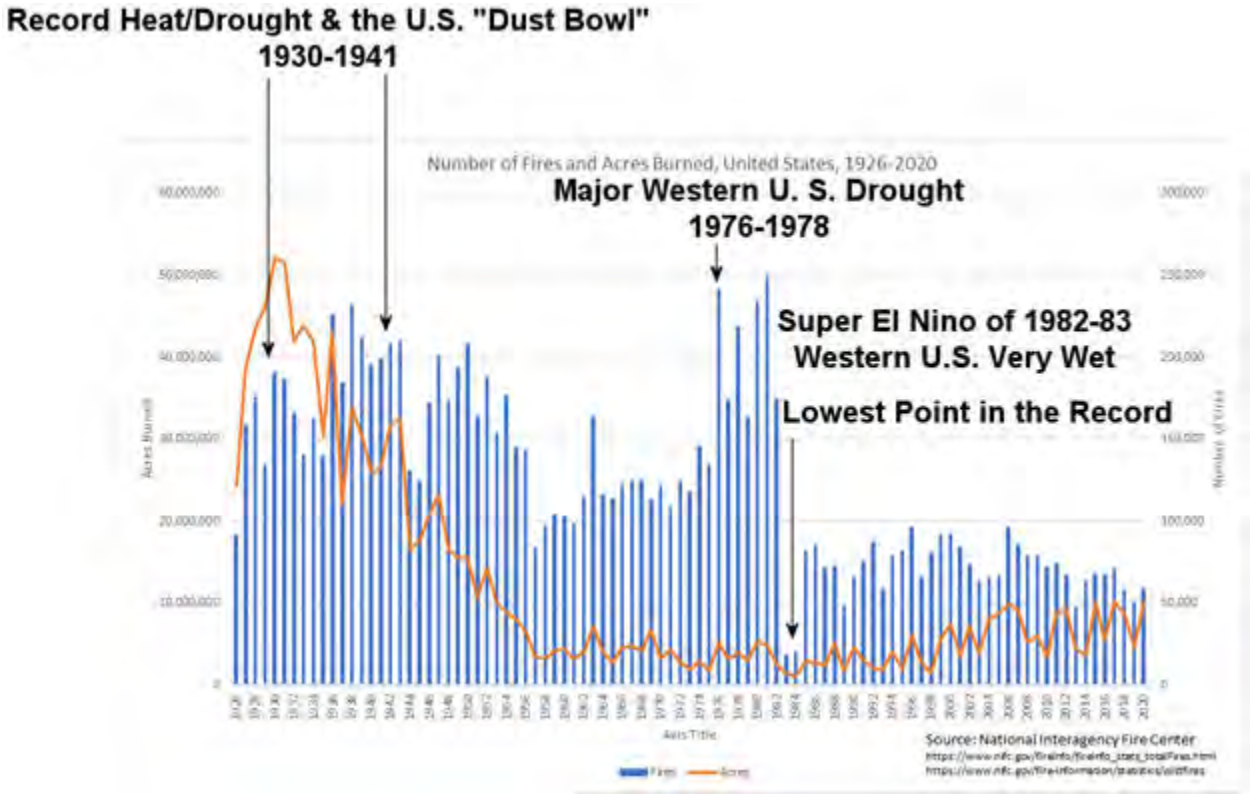

Figure 9

Global warming is expected to cause greater precipitation and evaporation. However, since evaporation changes over the oceans are much greater than over land, the precipitation increases over land is measured and projected to be greater than evaporation increases, resulting in increasing soil moisture. Soil moisture to 10 cm depth has been measured world-

wide. Figure 10 shows the trends of soil moisture from 1985 on a global basis and for Australia. The increase in soil moisture is due to the increase in temperatures. A warmer world is a wetter world. The higher soil moisture helps to inhibit forest fires.

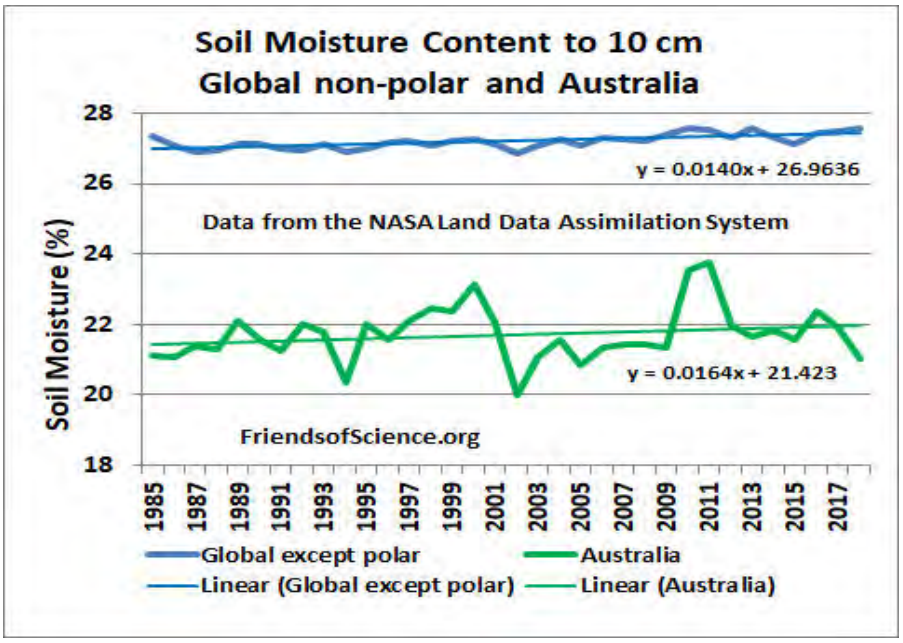

Figure 10

And after nearly 100 years of fire suppression across the United States, western states are susceptible to fires. Forest management experts say that fire suppression has led to the large buildup of bush, dead trees and dense forests. "What people don't know is that these ecosystems are fire-adapted," said Stephen Creech, who teaches firefighting certification courses at Purdue University. "Fire is a natural part of the system out here. Fuel feeds the flames," he said.

Chris Dynon produced a video showing the build-up of dead fuel on the ground and light shrubs in Australia. This is catastrophic for wildfire risk. A Canadian forestry expert said “Heat is proportional to the fourth power of weight of fuel. Doubling even a sparse fuel loading has a huge consequence for fire intensity.” He said about the video “It is worse than just the biomass increase. Fuel bed bulk density is very low, and the resinous vegetation and debris makes for extreme combustibility. Think gasoline-soaked vegetation. What makes this so dangerous is, like British Columbia, the worst stand structure is most likely closest to and in communities – like Paradise, CA.”

Alberta Environment statistics (2011) show there is an increase in human causation in the 5-year trend as more people become active in the woods or move to acreages. The number of forest fire ignited by humans increased from 62% in 2007 to 81% in 2011.

Figure 11 from Zoe Phin here shows the global count of wild fires from 2000 to 2020. Contrary to media hype, the global wildfires trend is downward. Zoe wrote “NASA has collected daily data on Active Fires since 2000. Climate scammers need to cherrypick locations and seasons in order to distract from the empirical truth that global fires have been decreasing.”

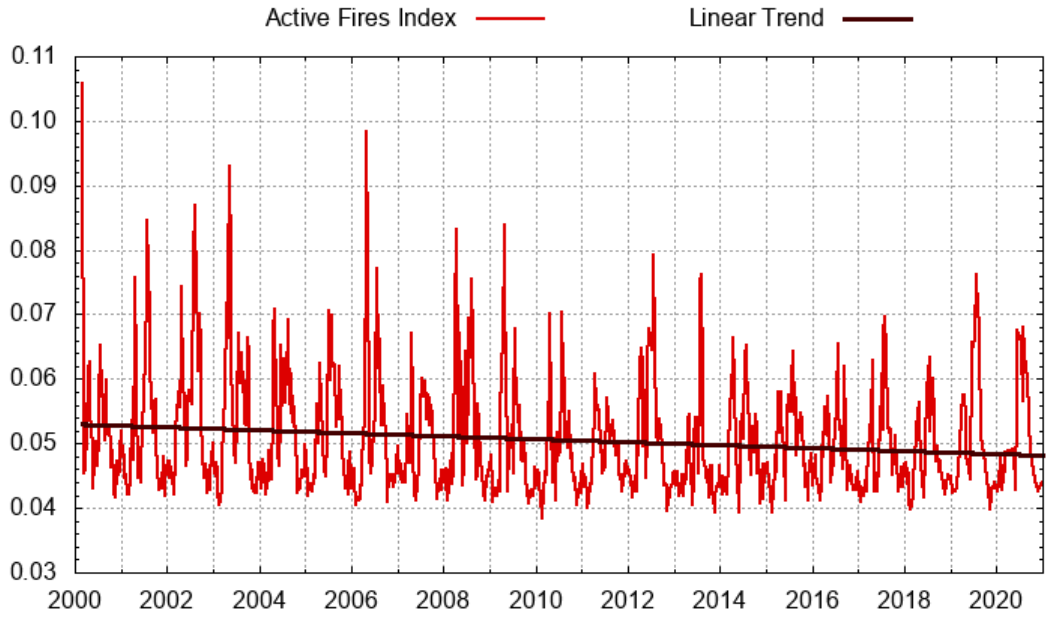

Figure 11

Health and Deaths

This article reviews three papers on the health effects of warming. A study published in 2015 examined 74 million deaths worldwide from 1985 to 2012 and found that the ratio of cold-related to heat-related deaths was a whopping 17 to 1. A study of heat-related deaths in the USA shows that as heat waves become more frequent, heat-related deaths decrease because of adaptation. There were 41 heat-related deaths/year/million population is the 1960s and 1970s dropping to 17 in the 1980s and to only 10 in the 1990s. A 2017 study of temperature-related hospital emergency visits in China over the period 2011–2014 shows that the risk is far greater for cold temperatures than for hot temperatures. When temperatures fall the risk of an emergency visit increased by 80% but when temperatures rise the risk increases by only 15%. The lengths of hospital stays due to cold temperatures are ten times greater than that due to hot temperatures.

The Canadian death rate in January is more than 100 deaths/day greater than in August, for the years 2007 to 2011 as shown in figure 12. A million Canadian snowbirds fly to the USA in the winter annually to benefit from warmer temperatures.

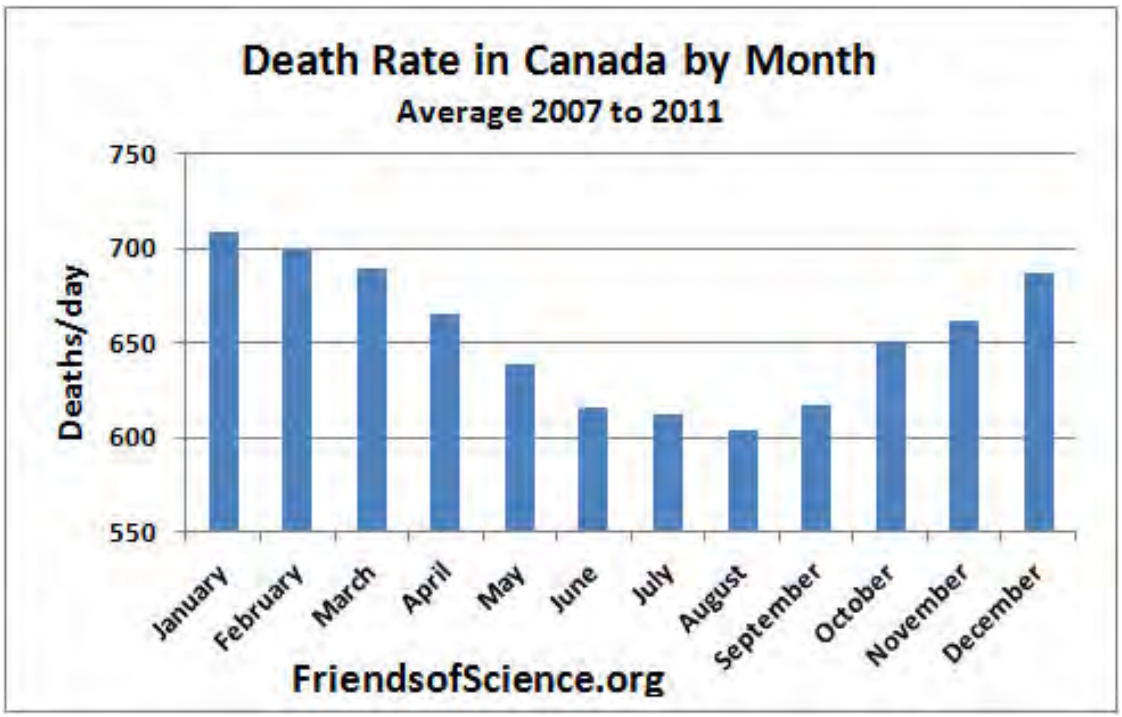

Figure 12

IPCC SR1.5

The U.N. published a special report on keeping global temperature below 1.5 °C from pre-industrial temperature (SR1.5). I published a report "The Economics of the IPCC's Special Report on Limiting Temperatures to 1.5 °C" that states "The report says the cost of mitigating CO_2 emissions in 2030 to prevent temperatures from exceeding 1.5 °C above pre-industrial levels is about 880 US$2010 per tonne of CO_2 ($/tCO_2). The benefit of doing so, according to the report, is 15 $/t$CO_2$." Therefore, according to the report, the cost of reducing CO_2 emissions is about 60 times ($880/$15) the social net benefit. In other words, the path to net zero emissions requires a cost to the economy of 60 times the alleged benefit of avoiding a net social cost. The solution costs 60 times more than the cost of the problem being eliminated. That is a very bad deal!

However, it is actually much worse than that! The reported social cost of carbon dioxide (SCC) of 15 $/t$CO_2$ is from an economic model called DICE which utilized a sensitivity of global average temperatures to CO_2 emission that is far in excess of empirical estimates. It grossly overestimates sea level rise compared to IPCC estimates and fails to include the large benefits of CO_2 fertilization of plants and crops. When DICE is run with empirically constrained climate sensitivity, the SCC from DICE drops to only 8.7 $/t$CO_2$, according to the paper "Empirically Constrained Climate Sensitivity and the Social Cost of Carbon Dioxide", Dayaratna et al 2017. But the DICE model fails to include benefits of warming and CO_2 fertilization so even that SCC is

far too high. The FUND model, which does include CO_2 fertilization, calculates a SCC of -0.19 $/tCO_2$, where the negative sign means that the benefits of emissions are greater than the social costs! It is preposterous to use an economic model the fails to include known beneficial processes such as CO_2 fertilization. Note that "empirically constrained" means that the climate sensitivity match the Earth's temperature history, but falsely assumes that all of the warming was due to GHE, and attributes warming due to nature and urban warming to GHG caused warming.

If the SR1.5 report used the empirically constrained FUND SCC of -0.19 $/tCO_2$ instead of the faulty DICE value of 15 $/tCO_2$, then SR1.5 would show a 2030 cost of CO_2 mitigation of 880 $/tCO_2$ to avoid a net benefit, which would be an insane thing to do!

Climate Models

The IPCC put far too much faith is climate models that are shown to be running far too hot. A study published October 2020 by Mitchell et al found that the average climate model's warming trend from 1979 in the tropical upper troposphere (at 200 hPa level) is 4 to 5 times the observed trend as shown in figure 13.

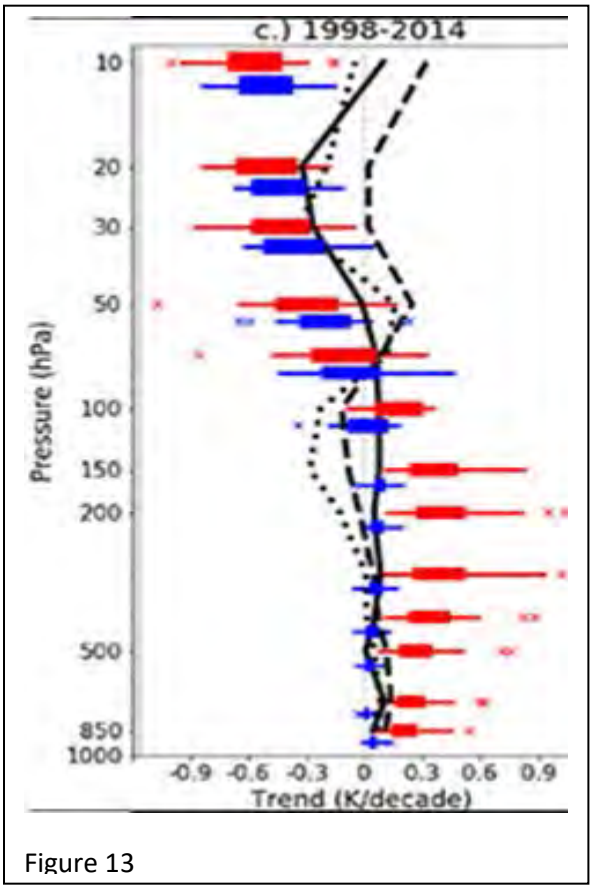

Figure 13

The Canadian model's trend there is 7 times the observed trend. That is outrageous!

The McKitrick & Christy 2020 paper examined the first 38 models of CMIP6 over 1979 - 2014. The paper reports that every model overshoots the observed trend in both the lower and mid troposphere, globally and in the tropics. The models as a group warm too much throughout the global atmosphere. "The models with low ECS values tend to have lower tropospheric trends, thus closer to observed values. The paper's conclusions state "An ensemble of models with warming rates consistent with observations would likely have to have ECS values at or below the bottom of the CMIP6 range." The models average global warming trends of the lower and mid troposphere are 1.86 and 2.40 times the observations. The models tropical trends of the lower and mid troposphere are 2.40 and 3.24 times the observations, respectively. The reason for noting the

large discrepancies between the measurements by weather balloons and the climate models in the upper troposphere is that this identifies the reason that the models are running too hot near the surface. The models falsely assume that the amount of water vapour in the upper troposphere increases with warming, but weather balloons show that this hypothesis is false. The modelers falsely assume that the relative humidity stays constant with warming in the upper troposphere, so the absolute humidity increases. The NOAA weather balloon data shows the relative humidity declining from 1970 to 2012, allowing excess heat to escape to space, as water vapour is the most important GHG.

The average model global lower troposphere temperature trend from 1979 is 200% of the measured trends as shown in figure 14. The troposphere is the lowest part of the atmosphere where we live.

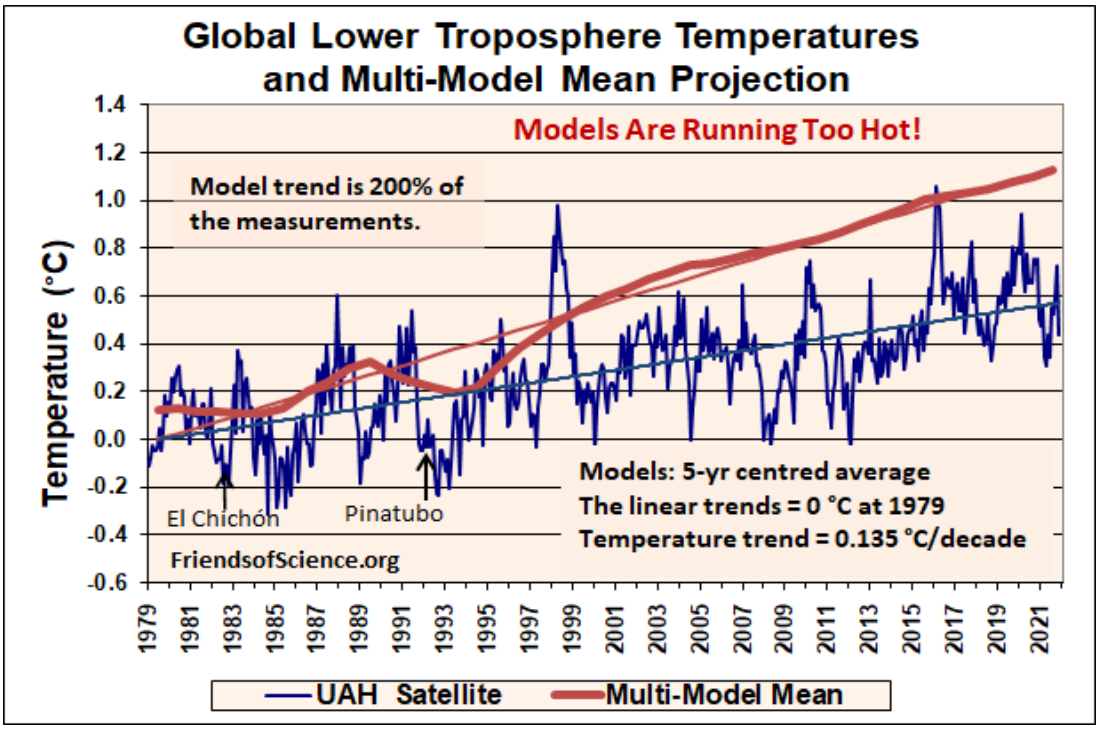

Figure 14

CO_2 is Greening the Earth

The website CO_2 Science contains a huge database of studies that show the dramatic increases of crop yields with higher CO_2 concentration.

A paper published in 2016 shows a widespread increase of growing-season leaf area over 25% to 50% of the global vegetated area, with the CO_2 fertilization effect explaining 70% of the

observed greening trend. Climate change explains 8% of the greening trend, predominantly in the high latitudes and the Tibetan Plateau. The study used three satellite leaf area index records to determine the greening and used ecosystem models to allocate the greening trends during 1982 - 2009 among four key drivers. The greening is equivalent to 18 million km2, or 12.4% over the 33 years.

Figure 15 shows the change in leaf area from 1982 through 2015.

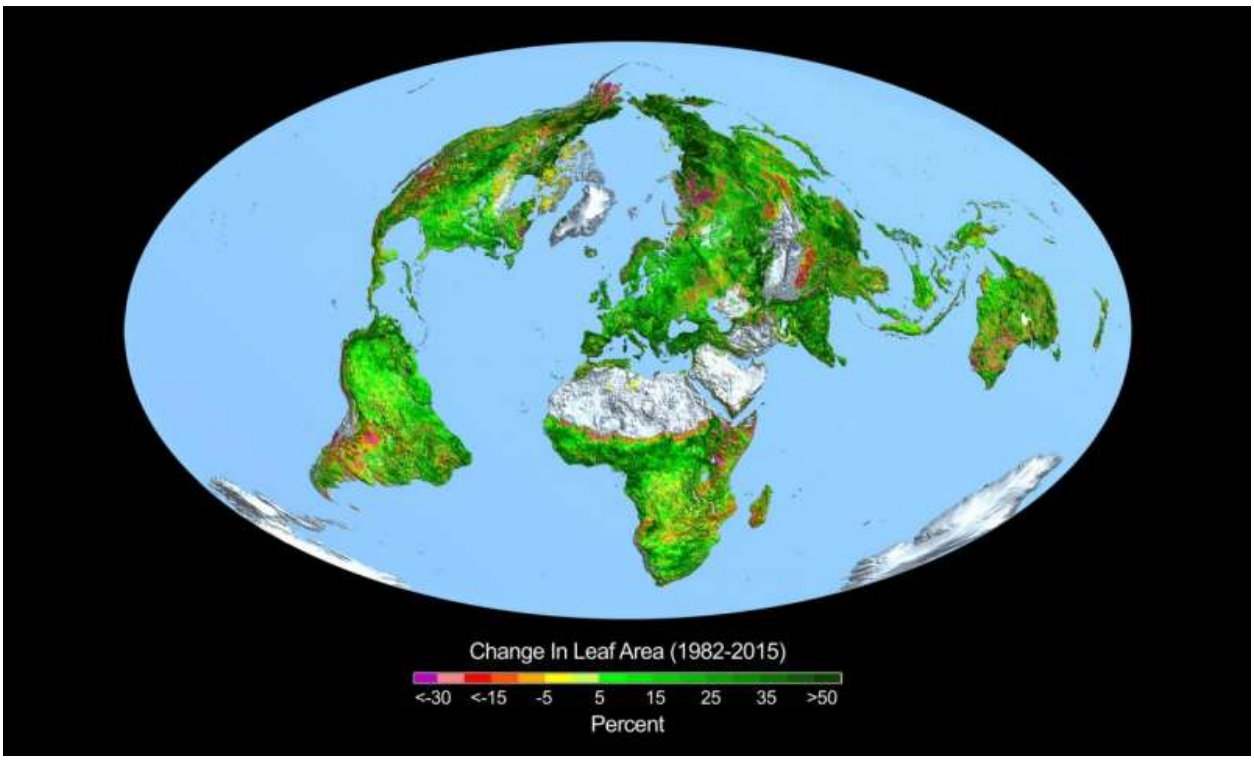

Figure 15

This 2018 study used satellite leaf area index (LAI) data and advanced analytical techniques to quantify changes in the vegetation dynamics over nine main vegetation types, including broadleaf, coniferous and evergreen forests as well as summer and winter crops, and grasslands that may co-exist in a grid pixel (about 1 km^2) of satellite data. A trend analysis is performed for each vegetation type over the 1999-2015 period. The results are validated against ground observations at 83 sites. The largest global trend is for coniferous forests at 4.2%/yr followed by summer crops at 3.9%/yr. The global trend for winter crops and grasslands are 2.6%/yr and 2.8%/yr, respectively.

Urban Heat Island Effect

There are hundreds of studies describing the urban heat island effects (UHIE). This effect is not removed from government datasets of surface temperatures. Most long-term temperature

records are recorded in or near cities which have gotten warmer as they grow. Trees and shrubs are replaced by buildings, road, parking lots and airports. Poor countries have few monitoring stations and limited resources to provide maintenance and quality control. The number of operating stations dropped from 6000 in the 1970s to 2600 by 1997. Taller buildings cause turbulence which mixes warmer upper nighttime air down to the surface. All of process cause surface warming.

The Friends of Science website shows several UHIE studies. All of these studies are ignored or dismissed by the IPCC.

NASA applies an urban correction of its GISS temperature index in the wrong direction in 45% of the adjustments. Instead of eliminating the urbanization effects, these "wrong-way corrections" makes the urban warming trends steeper. This article discusses Steve McIntyre's audit of the GISS corrections.

A study by McKitrick and Michaels showed that about half of the warming over land since 1980 in instrument data sets is due to the UHIE. The authors compared the pattern of warming over the Earth's land surface to local economic conditions. A paper by De Latt and Maurellis gives evidence of strong influences of urban activity and other surface processes on measured temperature trends in both the surface dataset by the Climate Research Unit and the satellite lower troposphere datasets. Both papers show that the UHIE contaminates the surface record over land by about 0.14 °C/decade. The global land area is 29.2%, so the UHIE on a global basis is 0.041 °C/decade.

Millennium Cycle

The temperature history shows an obvious millennium scale temperature oscillation, indicating that natural climate change accounts for a significant portion of the temperature recovery since 1900. Figure 16 shows a proxy temperature reconstruction of the Extra-Tropical Northern Hemisphere during the last two millennia.

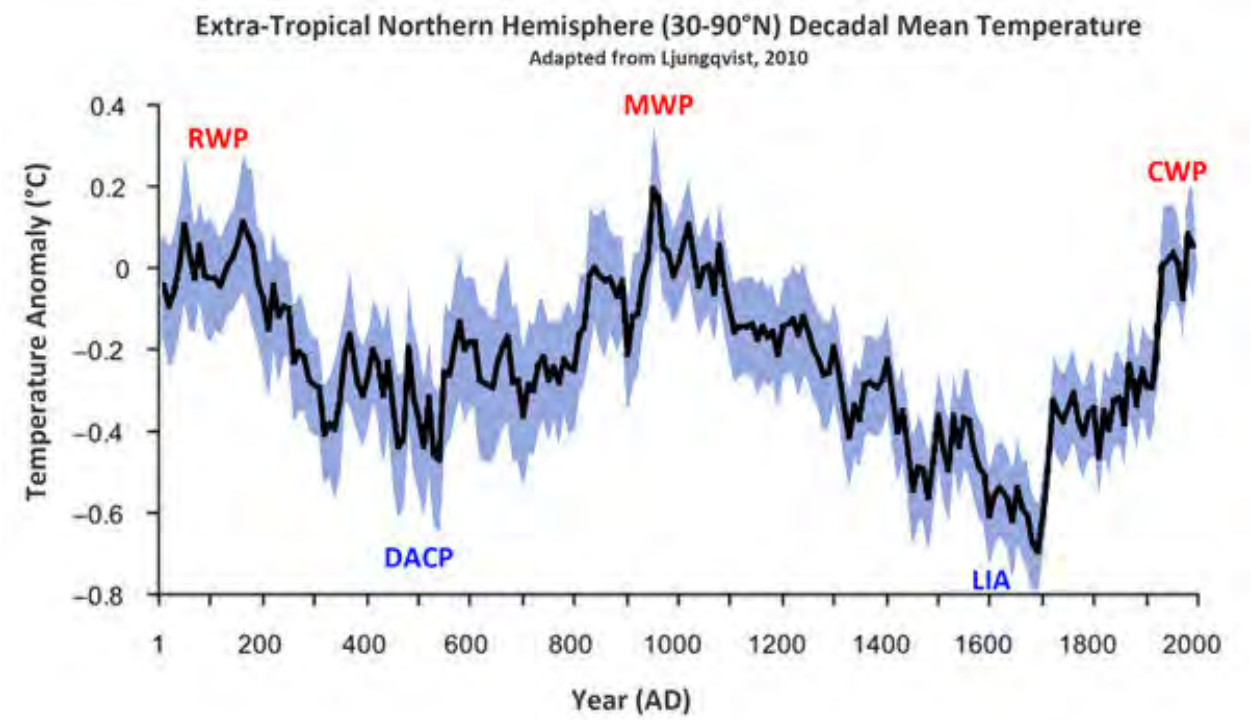

Figure 16

Climate Sensitivity

The transient climate sensitivity as determined by measurements of the actual Earth's warming, when allowing for natural and urban warming, from this study is about 0.95 °C (with a probabilistic likely range of 0.74 – 1.21 °C) at the time of a doubling of CO_2 concentrations, which takes about 125 years. This value is near half of the 1.8 °C transient climate sensitivity estimated in the AR6 report. The corresponding equilibrium climate sensitivity (ECS) is 1.2 °C. The ECS is the temperature rise caused by a doubling of the CO2 concentration, then held constant to allow the oceans to reach temperature equilibrium, which my take up to 1500 years.

I use the FUND economic model to determine the social net benefit of CO_2 emissions. The model includes adaptation and benefits, but also has some shortcomings. A study found that the energy impact from temperature rise is flawed as it doesn't agree with empirical evidence from USA data. On a global basis, FUND projects a 3 °C temperature rise would reduce wealth by 1.59% considering only the space heating and cooling energy use, but the empirical evidence show it would instead increase wealth by 0.05%. A new paper recommends that the CO_2 fertilization effect in FUND be increased by 30% due to recent studies of the effect. The temperature response in FUND needs to be adjusted so that it matches that of the climate models for a given ECS and emissions scenario.

This important study adjusts an energy balance climate sensitivity estimate by Lewis and Curry by incorporating the UHIE and an adjustment to account for natural warming from the millennium cycle. The study uses the new, globally infilled HadCRUT temperature dataset.

With the above adjustments and using the probabilistic climate sensitivity estimate and a 5% discount rate, the social cost (benefit) of carbon dioxide (SCC) emissions in 2020 is estimated at US$-6 per tonne CO_2. The SCC becomes US$-11/tCO2 using a 3% discount rate. The negative sign indicates that the benefits of emissions are greater than the costs. The impacts are dominated by agriculture impacts. Both warming and the CO_2 fertilization effect contribute to the positive agriculture impacts (the beneficial effects of increased carbon dioxide levels on plant growth). The media is obsessed with impacts of storms and sea level rise, but the detailed evaluation shows the positive agriculture impacts are 95 times the sum of the storms and sea level rise negative impacts. Climate change from 2000 with continued increases in CO_2 in the atmosphere will likely increase economic growth by 1.2% by 2100. The beneficial impacts continue to increase until 2150 as shown in figure 17. The black line is the total impact of GHG emissions on global world product.

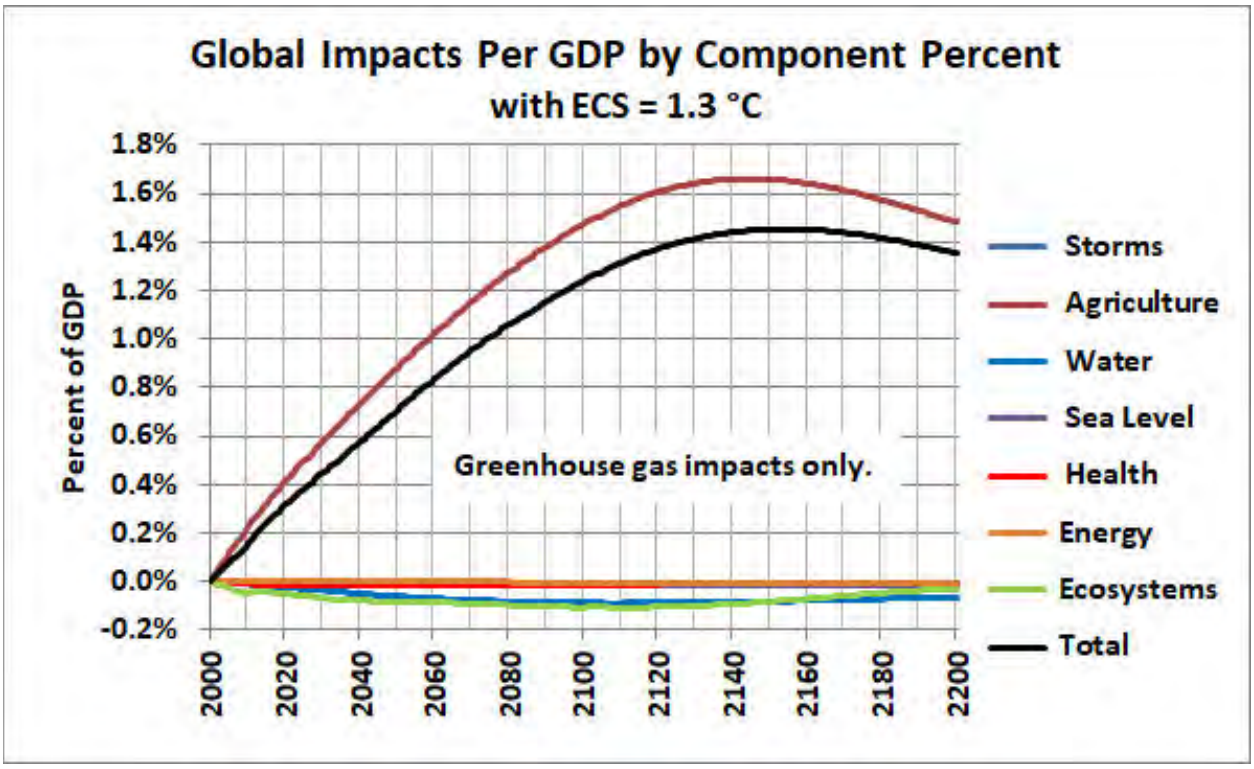

Figure 17

Cost of Net Zero USA

A new Friends of Science (FoS) report provides capital cost estimates to electrify the USA economy by replacing all or part of fossil fuel use with wind and solar energy. The FoS report identifies errors in an influential study, the Tanton report, and provides new capital cost estimates using 2019 and 2020 hourly electricity generation data rather than using annual average conditions as was done in the Tanton report. The FoS study finds that the battery costs for replacing all current fossil fuel fired electricity with wind and solar generated electricity, using 2020 electricity data, is 109 times that estimated by the Tanton report. The total capital cost of electrification is estimated, using 2020 data, at US$433 trillion, or 20 times the U.S.A. 2019 gross domestic product. It would cost every adult (18 year and over) a total of US$1.7 million!

Allowing fossil fuels with carbon capture and storage to provide 50% of the electricity demand dramatically reduces the total costs from US$433 trillion to US$24 trillion, which is a reduction of 94.6%. Battery storage costs are highly dependent on the year's weather and the seasonal shape of electricity demand.

The Tanton report estimates the annual energy expenses in the USA will likely increase by at least $5,000 per household, corresponding to US$640 billion per year.

If we assume electrification of the USA economy is achieved using 50% fossil fuels and 50% solar and wind energy, then the net zero plan will cost the USA economy US$24 trillion in capital costs to avoid a net benefit of US$0.69 trillion per year while paying an extra US$0.64 trillion per year in energy costs. The net zero plan is truly insane.

Cost of Net Zero Canada

By reviewing the energy use of Canada and the USA, we estimates that the electrification costs for Canada would be about 15% of that in the USA. Therefore, If solar and wind energy with battery backup were substituted for fossil fuels, the cost to achieve net zero in Canada is estimated at Can$82.3 trillion. US costs are

converted to costs in Canadian dollars using an exchange rate of 0.79 US$/Can$. However, if fossil fuels provide 50% of required electrical power with carbon and capture and storage with solar and wind providing 50% of the electricity, the capital cost to achieve net zero would be Can$4.5 trillion. Note that these costs may by less accurate than the USA costs.

Net zero without fossil fuels would result in stranded asset costs. The net value of Canada's proven oil, gas and coal reserves after operating costs are estimated at Can$6.3 trillion, equivalent to Can$660,000 per family of four.

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