

Submission to the Alberta Climate Change Advisory Panel

The Alberta Climate Change Advisory Panel has requested input from Albertans on the issue of climate change. This submission by Ken Gregory is organized in 5 parts:

1. Executive Summary
2. Climate change: Natural versus Man-made
3. Climate Model Failures
4. Estimate of Climate Sensitivity
5. The Benefits and Costs of Carbon Dioxide Emissions

1. Executive Summary

The climate has always changed and will continue to change regardless of any action taken by Albertans or the world to reduce greenhouse gas emissions. Natural forces have caused dramatic climate change in the past. There is nothing unusual about recent warming rates. The historic data shows both a millennium scale cycle and a 60-year cycle. These cycles are linked to changes in solar activity. Surface station measurements are badly corrupted by urban warming. According to satellite data, there has been no warming for over 17 years. Numerous studies show that solar changes affect climate. The sun affects climate primarily by changes in the magnetic field. The sun has become less active, which may lead to cooling.

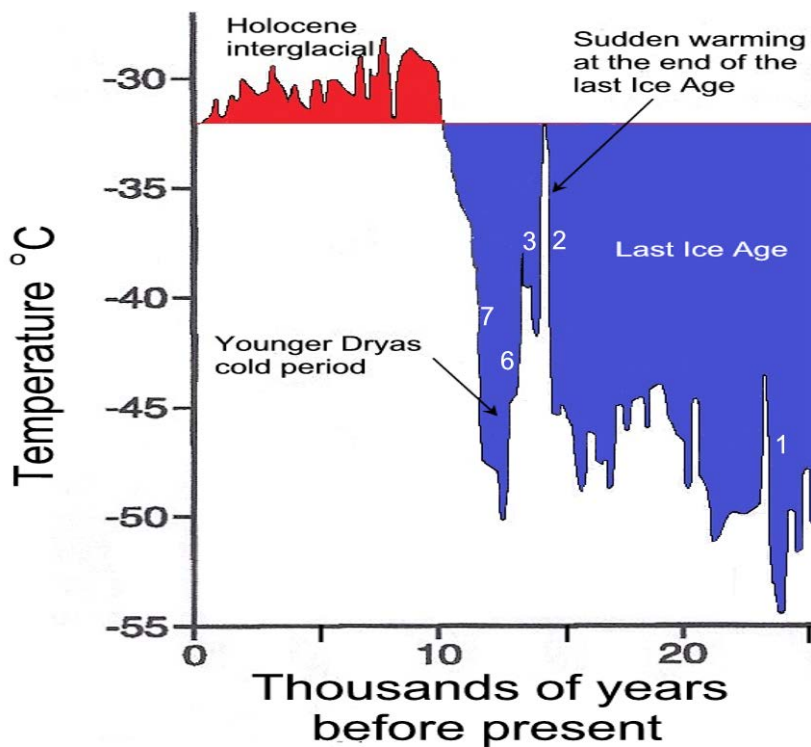
Climate model simulation of temperature do not match the observations indicating that the models are not suitable for making policy decisions. The Canadian climate model surface warming from 1979 is 225% of the actual measured warming rate. The large discrepancies between models and observations is larger in the atmosphere at about 9 km altitude, especially in the tropics. The problem is the models fail to account for negative feedbacks from clouds and declining upper atmosphere water vapour. Natural climate warming was misinterpreted as warming by greenhouse gas emissions.

The climate is relatively insensitive to carbon dioxide (CO₂) emissions. Recent estimates of climate sensitivity to CO₂ are lower than estimates by the Intergovernmental Panel on Climate change (IPCC). The effects of ocean cycles and indirect solar changes are difficult to quantify, so these natural causes of climate change are often ignored, despite the evidence that they are real. If CO₂ continues to increase in the atmosphere at the current rate the CO₂ effect on global temperature is expected to be about 0.4 degrees Celsius by the year 2100. However, CO₂ - caused climate change may be overwhelmed by natural climate change, which may cause cooling.

Models used to calculate the social costs of greenhouse gas emissions ignore many benefits and exaggerates the costs. CO₂ is plant food, and increasing CO₂ caused to date about at 16% increase in crop yields while reducing the crop's water requirements. The warming attributed to

CO₂ emissions also increases plant yields and increases the arable land area in northern countries. Warming increases mental and physical health outside the tropics. Cold temperatures cause 20 times more deaths than warmer temperatures. The intensity and duration of hurricanes show no correlation to temperature. On a global basis, there has been no increase in either droughts nor floods despite the observed warming. In total, the social cost of CO₂ is probably negative, meaning that the social benefits likely exceeds the costs. Climate change is not a serious problem for the world. In Canada, an increase in temperature would be entirely beneficial.

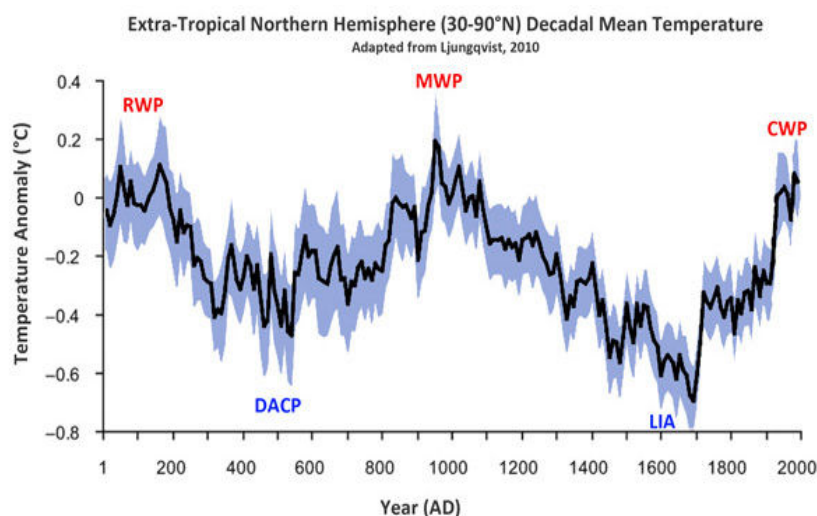
2. Climate Change: Natural versus Man-made



The Earth's history shows that the climate has always been changing, over both short-term and long-term time scales. These changes have sometimes been abrupt and severe, without any help from humans.

According to analysis of the Greenland ice cores, over the past 25,000 years, at least three warming events were 20 to 24 times the magnitude of warming over the past century and four were 6 to 9 times the magnitude of warming over the past century, see figure 1.

Figure 1: Greenland ice core temperatures over 25,000 years.



A temperature reconstruction with decadal resolution, covering the last two millennia, for the extra-tropical Northern Hemisphere (30°-90° N), utilizing many palaeo-temperature proxy records is shown as figure 2. The record shows an obvious millennium scale cycle of temperature change. The temperature fell after the Roman Warm Period to the Dark Age Cold Period,

Figure 2: Exo-tropic northern temperatures over 2000 years.

then rose again to the Medieval War Warm Period, then declined into the Little Ice Age. Civilization and culture flourished during the warm periods, and the cold periods were times of crop failures, starvation, plagues, and much human misery.

None of these dramatic climatic changes before 1950 were caused by human-caused emissions of greenhouse gases as emissions were too low. They were caused by natural climate change, primarily by changes in solar activity.

The instrument temperature record HadCRUT4 produced by the Hadley Centre and the Climate Research Unit in the UK is shown as Figure 3.

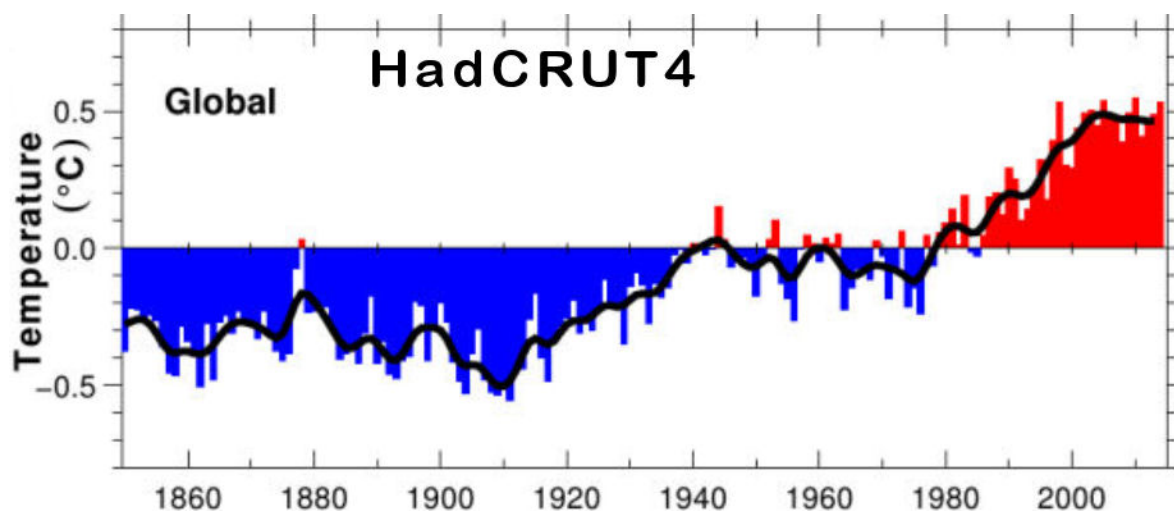
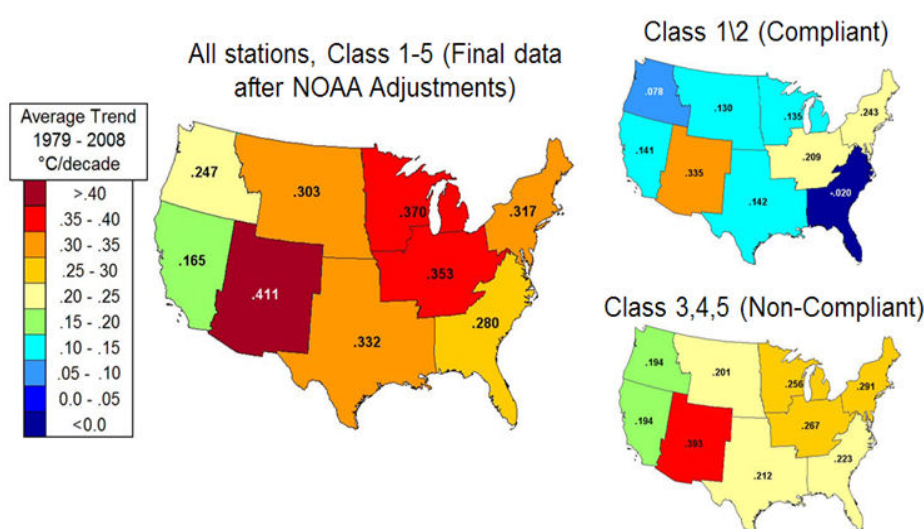


Figure 3: Global surface temperature from HadCRUT4.

Note that the global temperatures cooled slightly from 1850 to 1910, then warmed by 0.5 °C to about 1942 due to natural causes. The warming rate from 1910 to 1942 was almost as great and the late 20th century warming from 1976 to 2002. The data shows a roughly 60-year cycle superimposed on the millennium scale cycle. The 60-year cycle corresponds to ocean cycles. The sun is the only power source that can drive these cycles.



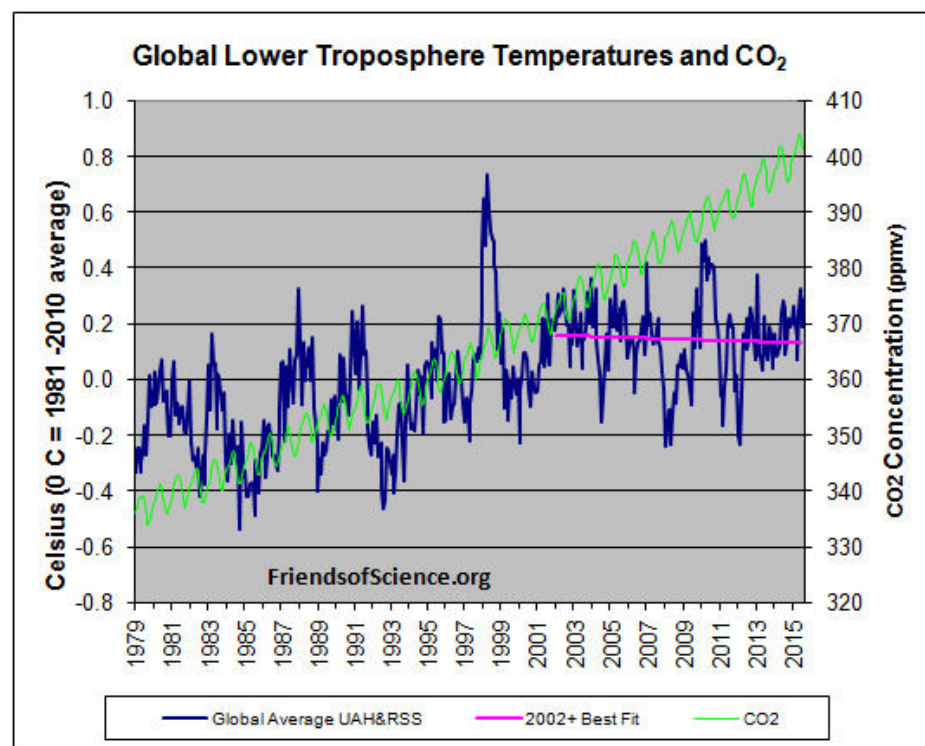
Unfortunately, HadCRUT4 and most other government surface temperature datasets are badly contaminated by the effects of urban development, known as the "urban heat Island" (UHI) effect, as most surface stations are located at or near urban centers that have grown over time. They are not corrected for the UHI effect.

Figure 4: Watt et al 2012 Temperature trends of rated stations in the continental US.

A study by Anthony Watts evaluated the warming trends of NOAA compliant and non-compliant temperature monitoring stations using the recently WMO-approved Siting Classification System. The analysis demonstrates that reported 1979-2008 U.S. temperature trends are spuriously doubled. The improved assessment, for the years 1979 to 2008, yields a trend of +0.155 °C per decade from the high quality sites, a +0.248 °C per decade trend for poorly sited locations, and a trend of +0.309 °C per decade after NOAA adjusts the data, as shown in the Figure 4.

Ross McKittrick and Patrick Michaels published papers in 2004 and 2007 in which they analyzed the pattern of warming over the Earth's land surface compared to local economic conditions. They showed that the spatial pattern of warming trends is tightly correlated with indicators of economic activity. They conclude "The average trend at the surface in the post-1980 interval would fall from about 0.30 degrees [Celsius] per decade to about 0.17 degrees." Removing the net warming bias due to urban heat effects in surface temperature data could explain as much as half the recent warming over land.

An audit by researcher Steve McIntyre reveals that NASA has made urban adjustments of temperature data in its GISS temperature record in the wrong direction. NASA has applied a "negative urban adjustment" to 45% of the urban station measurements (where adjustments are made), meaning that the adjustments make the warming trends steeper. The urban adjustment is supposed to remove the effects of urbanization, but the NASA negative adjustments increases the urbanization effects. The result is that the surface temperature trend is exaggerated. See [here](#) for a summary of this study.



Microwave sounding units on satellites have been measuring the global temperatures with unprecedented accuracy since 1978 over 99% of the earth's surface. These measurements are not affected by urban warming bias as urban areas represent a very small fraction of the earth's surface. Figure 5 shows the temperature changes of the lower troposphere from the surface up to about 8 km as determined from the average of two analyses of satellite data.

Figure 5: Global lower troposphere temperatures from satellites, and CO₂ concentrations

The best fit line from January 2002 to August 2015 indicates a small declining trend of -0.02 °C /decade. There has been no global warming in over 17 years.

The IPCC Technical Assessment section 7.4.6 says **"Many studies have reported observations that link solar activity to particular aspects of the climate system. Various mechanisms have been proposed that could amplify relatively small variations in total solar irradiance, such as changes in stratospheric and tropospheric circulation induced**

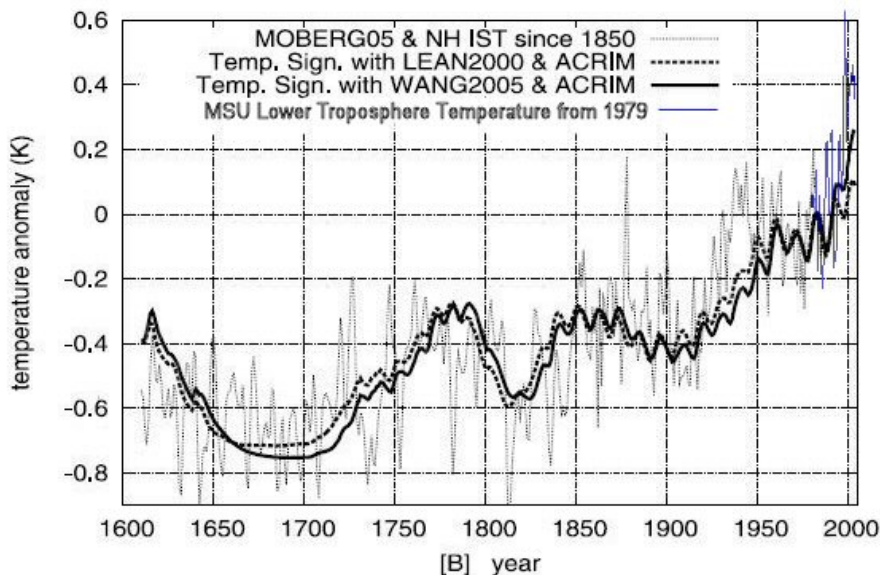


Figure 6: Northern hemisphere temperature and solar irradiance.

by changes in the spectral solar irradiance or an effect of the flux of cosmic rays on clouds.” This acknowledges that there is much empirical evidence that the sun strongly affects climate. The IPCC ignored 123 peer-reviewed articles published 2008 – 2012 "that provide evidence of a significant impact on climate by the sun and natural factors), see [here](#). The IPCC ignored all this evidence because it did not believe the theory linking solar activity to climate was strong. The scientific method demands that empirical evidence is paramount, and theory must yield or be modified to agree with the evidence. The IPCC's action to reject the evidence because they were not satisfied with the theory is the exact opposite of the scientific method. From 2013 to September 2015, there were a further 153 published peer-reviewed articles showing significant solar effects on climate, see [here](#).

Solar Activity and Climate (as seen by proxies)

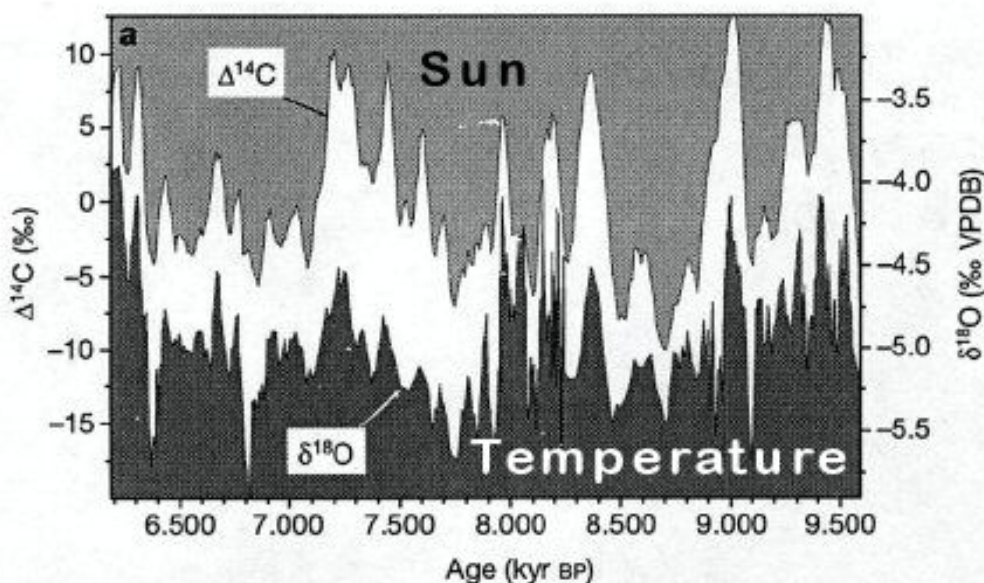
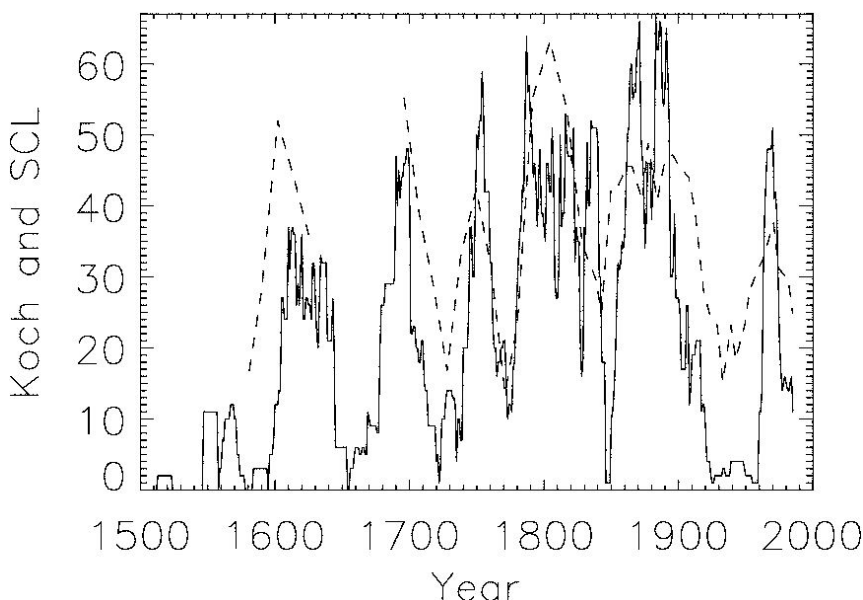


Figure 7: A solar proxy ^{14}C correlates with a temperature proxy ^{18}O from a cave in Oman.

Here I review only 4 studies showing strong correlations between solar activity and climate. A study of 400 years of Northern Hemisphere temperatures and solar irradiance by N. Scafetta

and B. West shows a strong correlation. The correlation as shown in figure 6 suggests that the sun may have caused up to 70% of the 20th century warming.

Longer term, a study by U. Neff et al. used data obtained from a stalagmite in a cave in Oman to show a correlation of a solar proxy to a temperature proxy for a period of 3000 years. Values of carbon-14 (produced by cosmic rays hence a proxy for solar activity) correlate extremely well with oxygen-18, a temperature proxy.



A study by the Danish Meteorological Institute compares the Koch ice index which describes the amount of ice sighted from Iceland, in the period 1150 to 1983 AD, to the solar cycle length, which is a measure of solar activity. The study finds "A close correlation ($R=0.67$) of high significance is found between the two patterns, suggesting a link from solar activity to the Arctic Ocean climate."

Figure 8: Koch ice index and the solar cycle length.

A paper Soon et al 2015 presents a new estimate of exo-tropic Northern Hemisphere (NH) surface air temperature trends since 1881 based on mostly rural stations to eliminate most of the effects of urbanization that contaminates government datasets. The authors compares the new NH temperature dataset to the solar variability dataset by Scafetta & Willson, 2014 as shown in Figure 9 and finds a strong correlation of $R^2=0.48$, implying that solar variability has been the dominant influence on Northern Hemisphere temperature trends since at least 1881.

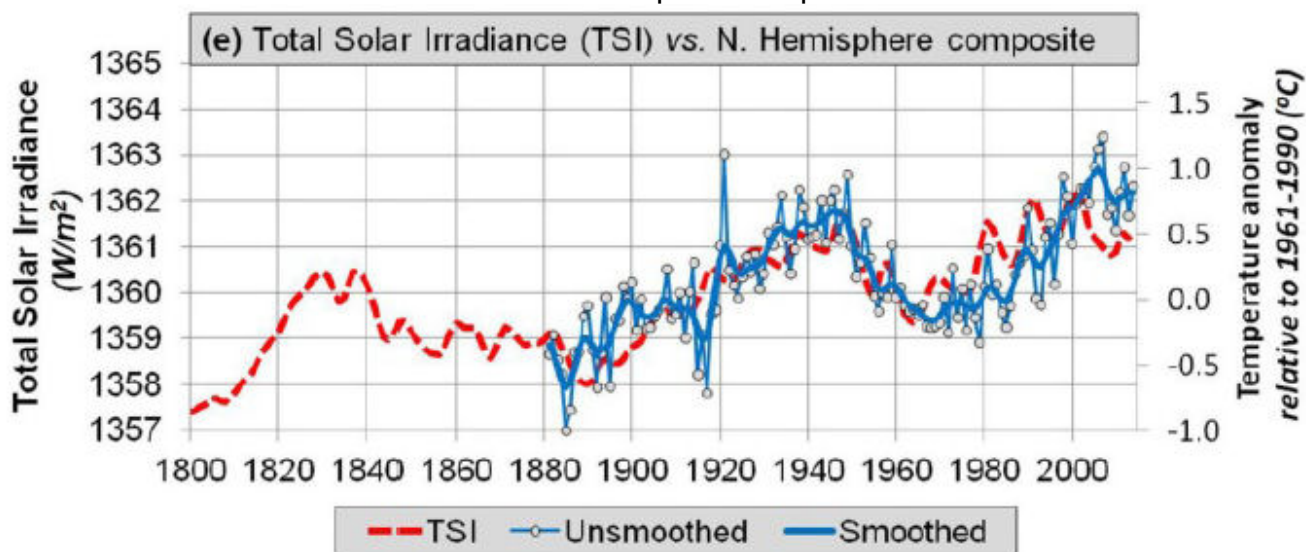


Figure 9: Total solar irradiance by Scafetta & Willson, 2014, and exo-tropic Northern hemisphere from mostly rural stations.

The strong correlations are due to changes in the solar magnetic field, not total solar irradiance. The solar magnetic field has doubled from 1900 to 1992 causing warming. The maximum

temperature response is delayed about 10 years to 2001 due to the large heat capacity of the oceans. The solar magnetic field strength has declined since 1992 as shown in the Figure 10. A low period corresponds to the 1970's global cooling scare. The low solar activity since 2005 has contributed to the current hiatus of global warming.

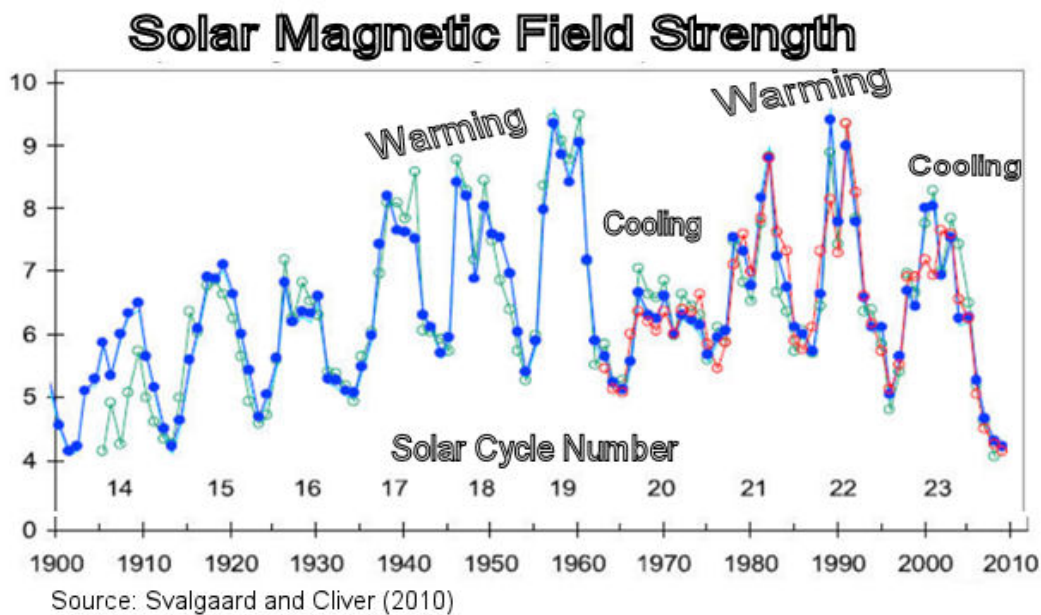


Figure 10: Solar magnetic field strength and solar cycle number.

The sun has entered a less active phase with declining sunspot counts as shown in this [graph](#) from NASA. This may lead to natural cooling as discussed [here](#).

3. Climate Model Failures

The IPCC projections are based on climate models that fail to match the historical record of air temperatures and ocean temperatures, globally and regionally. Figure 11 shows the 7-year average of model runs used for the IPCC fifth assessment report (AR5) of global surface temperatures compared to observation of surface stations and satellite data adjusted to surface conditions.

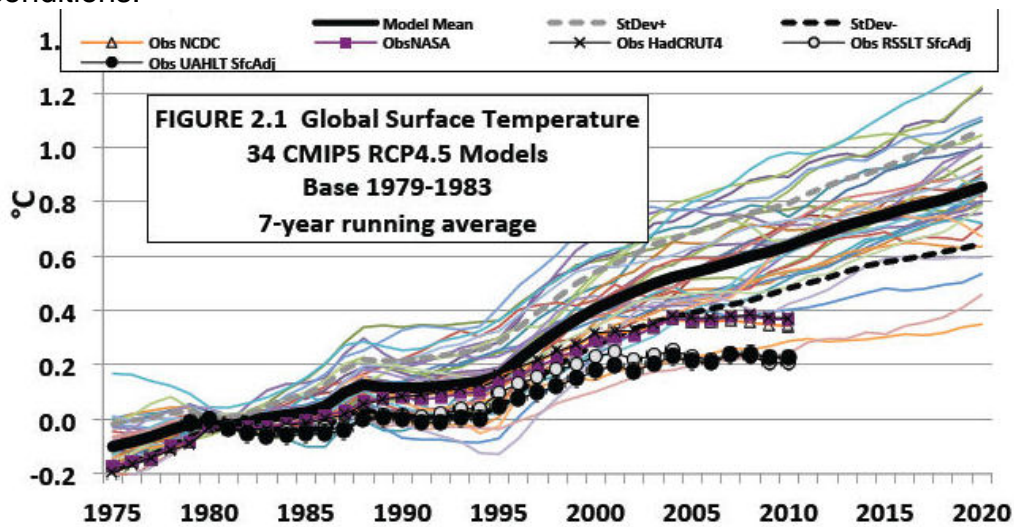
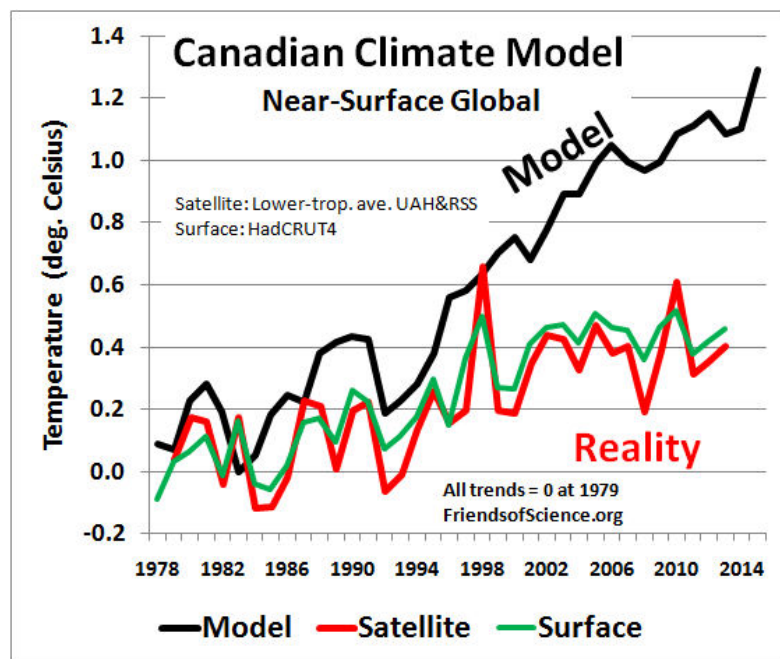


Figure 11: Global surface computer model simulation and compared to observations.

The observations are significantly below model mean and the standard deviation of the model runs, indicating that the models are much running too hot.

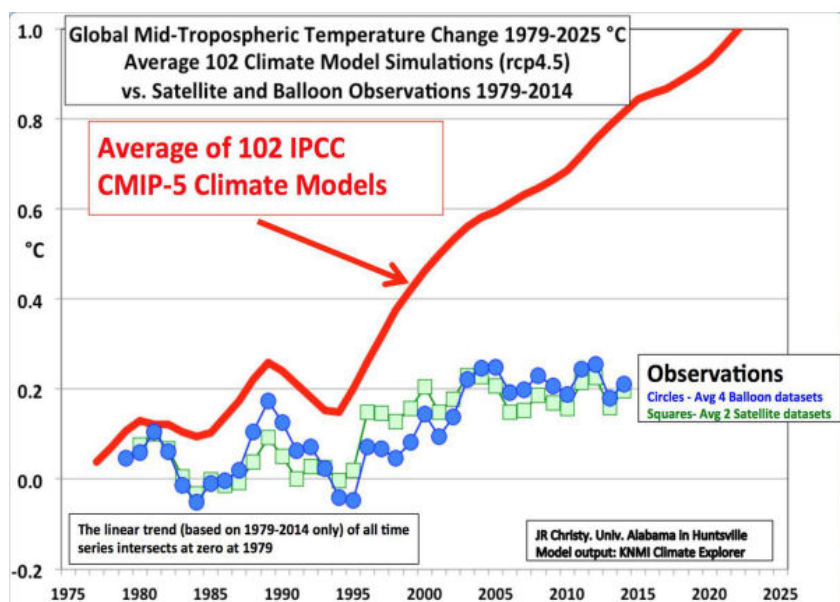
The Canadian climate model produces one of the most extreme warming projections of all the 30 models evaluated by the IPCC. The discrepancy between the model and the observation



increase dramatically after 1998 as there has been no global near-surface warming during the last 16 years as shown in figure 12. The model temperature warming trend as determined by the best fit linear line from 1979 to 2013 is 0.337 °C/decade, and the average trend of the two observational datasets is 0.149 °C/decade. The model temperature warming rate is 225% of the observations.

Figure 12: Canadian climate model global surface temperature.

Figure 13 shows the global mid-troposphere average of the climate model runs used in the IPCC AR5 report compared to the weather balloon and satellite observations. All data points are 5-year averages. The mid-troposphere is at about 9 km altitude. Notice the enormous and



growing discrepancy between the climate model simulated temperatures and the observations.

The large errors are primarily due to incorrect assumptions about water vapour and cloud changes. The climate model assumes that water vapour, the most important greenhouse gas, would increase in the upper atmosphere in response to the small warming effect from CO₂ emissions.

Figure 13: Global mid-troposphere temperature climate model simulation compared to satellite and weather balloon observations.

Scientist generally agree that the direct warming effect of CO₂ is about 1 °C per doubling, but the climate models falsely increases this by assuming positive feedbacks from water vapour and clouds. The evidence shows the water vapour and cloud changes cause a negative feedback, reducing the direct. Contrary to the model assumptions, radiosonde humidity data show declining water vapour in the upper atmosphere as shown in [this graph](#). Radiative code calculations show that a water vapor change in the mid-troposphere at about 7 km altitude (air pressure is about 400 mbar) has 29 times the effect on outgoing radiation to space of the same change in the near-surface layer, so the largest positive feedback in the models occurs in the mid-troposphere, especially in the tropics.

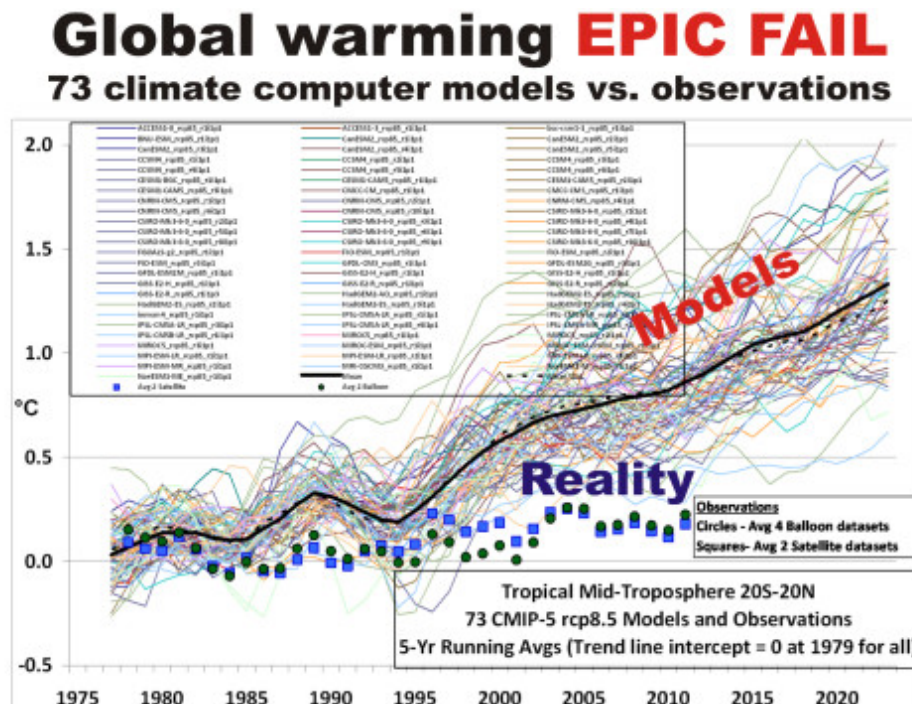


Figure 14: Tropical mid-troposphere temperature climate model simulations compared to satellite and weather balloon observations.

About half of the incoming solar radiation occurs in the tropics, so it is critical that climate models simulate the tropical mid-troposphere correctly. Figure 14 shows the large discrepancy between the model runs and the weather balloon and satellite observations.

Dr. Roy Spencer writes "Now, in what universe do the above results not represent an epic failure for the models? I frankly don't see how the IPCC can keep claiming that the models are "not inconsistent with" the observations. Any sane person can see otherwise."

One of the most important parameters in determining climate sensitivity to greenhouse gas emissions in climate models is the amount of heat they transfer to the oceans. Figure 15 compares the Levitus observations of ocean warming trends during 1955-1999 to 15 IPCC AR4 climate model runs. The models exhibit wildly different behaviours, with deep-ocean cooling just as likely as warming. Three of the models actually produced average cooling of the full depth of the oceans while the surface warmed, which seems physically implausible to say the least. Most of the models produce too much warming in the layer to 700 m. Many models produce unexpected ocean cooling below 100 m while the surface warms. None of the models even remotely match the observations. The observed rate of warming of the ocean has been too weak to be consistent with a sensitive climate system.

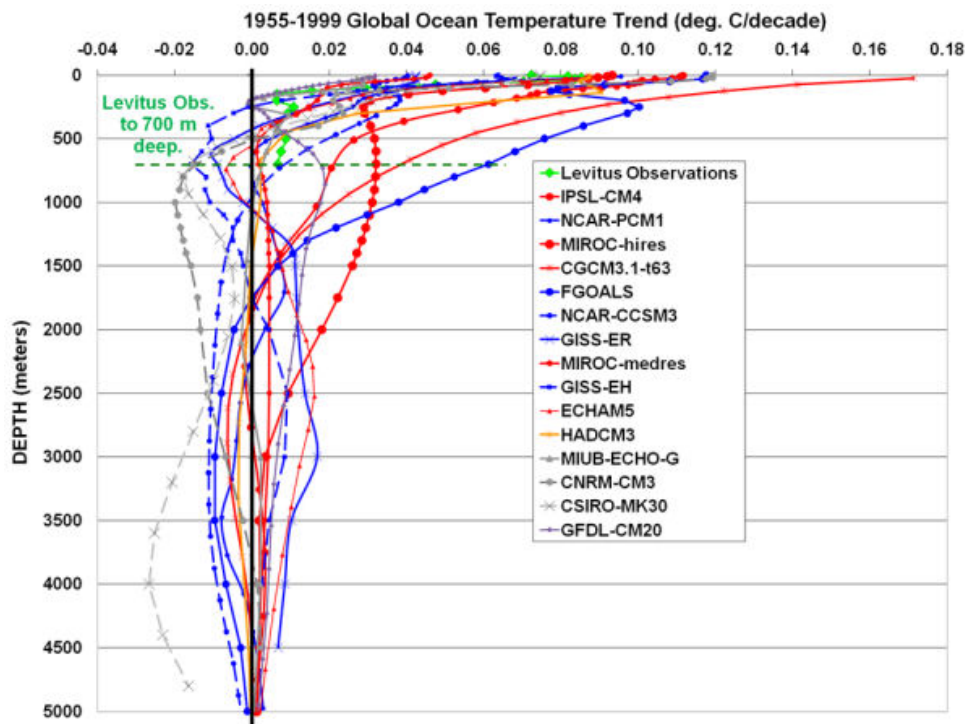


Figure 15: Global ocean temperature trends of models and observations.

Model results with large history match errors should not be used for formulating public policy. A model without a good history match is useless and there can be no confidence in its projections.

4. Recent Estimates of Climate Sensitivity

The enormous and growing discrepancy between climate model projections and real temperature measurements has resulted many new and lower estimates of climate sensitivity. It is becoming apparent to climate scientists that natural climate change is much more important than previously thought. The Equilibrium Climate Sensitivity (**ECS**) estimate is the temperature rise due to a doubling of CO_2 and waiting for the deep oceans to reach equilibrium, which takes thousands of years, which is not useful for policy makers. The more policy relevant parameter is the Transient Climate Response (**TCR**) which is the temperature rise due to a doubling of CO_2 at the time which the CO_2 reaches the doubling. A doubling from the current 2015 value of 400 ppm will take 120 years according to IPCC estimates. Estimates of climate sensitivity from estimates of total forcings are likely to be much too high because there are no direct measures of natural climate forcings, so they are not included.

A paper by Nic Lewis and Judith Curry (Lewis & Curry 2014, [here](#)) published an estimate of ECS of 1.64 °C [likely range 1.25 - 2.45 °C] based on ocean heat content and IPCC estimates of forcing parameters.

Subsequent to this paper, Lewis writes, "... a compelling new [paper](#) by Bjorn Stevens estimating aerosol forcing using multiple physically-based, observationally-constrained approaches is a game changer. Using the new aerosol forcing estimates, the ECS drops to 1.45 °C [likely range 1.20 - 1.80 °C], and TCR drops to 1.21 [likely range 1.05 - 1.45 °C] as shown [here](#). The TRC best estimate was only 67% of the IPCC climate model estimate of 1.80 °C. However, these estimates does not take into account of the millennium scale climate cycles that are so obvious in the climate records as shown in figure 2 above.

The historical record suggest that about 0.14 °C/100 year temperature rise is due to a recovery from the little ice age. Making this adjustment to the Lewis & Curry results bring the best estimate ECS and TCR down to 1.07 °C and 0.98 °C, respectively. Compare these to the climate model mean for ECS and TCR or 3.2 °C and 1.8 °C, respectively. These adjusted estimates of ECS and TCR are only 33% and 54% of the climate models. However, these estimates are still likely too high because the beginning time period of the analysis was not at the peak of the ~60 year ocean cycle oscillation but the final time period was at the peak.

A paper by Roy Spencer and William Braswell (2014) incorporated the effects of El Nino, and determined a ECS of 1.3 °C, abstract [here](#) and explained [here](#). The authors use a time-dependent forcing-feedback model of global average ocean temperature as a function of depth to explain the Levitus record ocean temperature variations and trends since 1955. The paper shows that part of the late 20th century warming was caused by more frequent El Ninos that are radiatively forced by less clouds, allowing more solar energy to warm the earth.

A study by Roy Spencer (2015) using 15 years of CERES satellite data and HadCRUT4 temperature estimates shows that ECS is at most 1.3 °C, as shown [here](#). The CERES satellite measures the top-of-atmosphere net radiative flux. However, Spencer says, "Again, the remaining radiative forcing in the 15 years of data causes decorrelation and (almost always) an underestimate of the feedback parameter (and overestimate of climate sensitivity). So, the real sensitivity might be well below 1.3 deg. C, as Lindzen believes. The inherent problem in diagnosing feedbacks from observational data is one which I am absolutely sure exists — and it is one which is largely ignored. Most of the “experts” who are part of the scientific consensus aren’t even aware of it ...”.

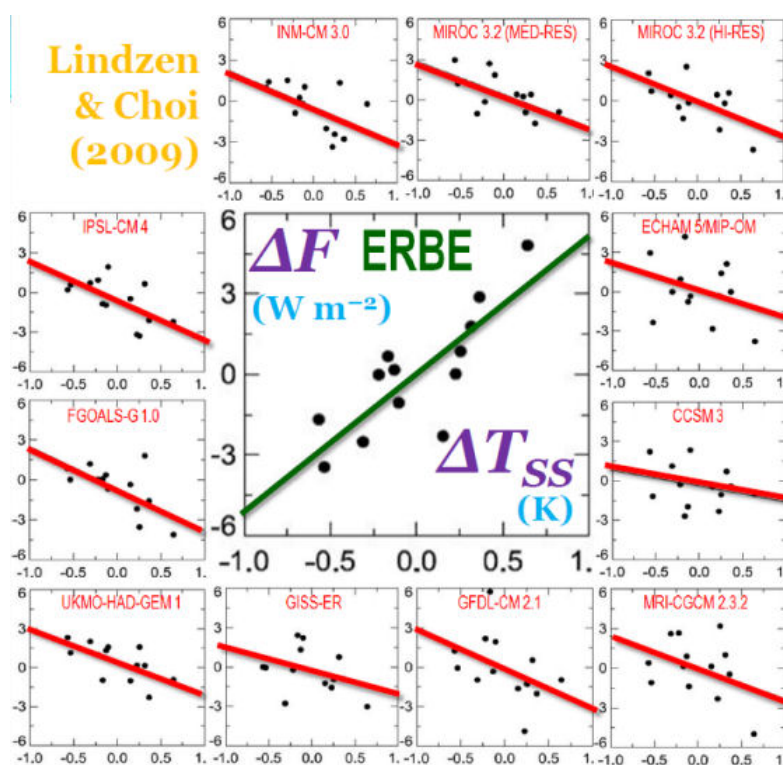


Figure 16: Lindzen & Choi the climate model versus the ERBE satellite observation.

A paper [here](#), published by Richard Lindzen and Choi 2011 using the fluctuations in sea surface temperatures and the concurrent fluctuations in the top-of-atmosphere outgoing radiation from the ERBE and CERES satellite instruments during the period 1985 - 2008. The authors write, "We demonstrate that our new method does moderately well in distinguishing positive from negative feedbacks and in quantifying negative feedbacks. In contrast, we show that simple regression methods used by several existing papers generally exaggerate positive feedbacks and even show positive feedbacks when actual feedbacks are negative." They find the ECS is 0.7 °C [extremely likely range 0.5 - 1.3 °C]. This result is only 22% of the climate model mean.

Figure 16 is from a previous paper by Lindzen and Choi which was limited to only the tropics. The centre part of the figure shows that results of the ERBE satellite measurements. When sea surface temperatures increase, outgoing radiation increases as indicated by the green line. However, the response of 11 climate models when forced by the same sea surface temperature

changes shows the opposite response because the climate models falsely assume that there are positive feedback, restricting the loss of energy to space.

I calculated the TCR by comparing the changes in the greenhouse effect to the changes in greenhouse gas concentrations. The greenhouse effect is the difference between the earth's surface temperature and the effective radiating temperature of the earth at the top of the atmosphere as seen from space. The temperature trend of the HadCrut4 dataset was compared to the CERES satellite data for the during March 2003 to June 2013. During this period there was no surface temperature trend so that there was no net feedback. This method doesn't require an estimate of climate forcing parameters and is only applicable during a period where there is no surface temperature trend. Using HadCRUT4 data, the TCR was estimated at 0.74 °C [very likely range 0.20 - 1.29 °C]. This corresponds to a temperature change of 0.4 °C from now to 2100 if CO₂ continues to increase at a linear rate. To the extent that the HadCRUT4 dataset is contaminated by the UHI effect, this estimate may also be too large. If the HadCRUT3 dataset is more correct, than the TCR falls to 0.38 °C [0.0 to 0.92 °C] as shown [here](#).

Climate Sensitivity Best Estimates			
Study	ECS °C	TCR °C	Comment
Adj. Lewis & Curry 2014	1.45	1.21	Adj. for aerosol forcing
Adj.2 Lewis & Curry 2014	1.07	0.98	Adj. for millennium warming
Spencer & Braswell 2014	1.3		Includes ENSO warming
Spencer 2015	1.5		Using CERES, upper limit
Gregory 2014		0.74	Using HadCRUT4
IPCC climate model mean	3.2	1.8	

Table 1: Climate sensitivity estimates of recent studies and the Climate model mean.

A summary of ECS and TCR climate sensitivity estimates of recent estimates and the climate model mean as reported in the IPCC AR5 report is given in Table 1. There are many other estimates of climate sensitivity but most are based only on the forcings recognized by the IPCC, which do not include most natural climate forcings, which are hard to quantify. The climate record before 1900, when humans could not have affected climate, shows natural climate changes as fast as during the last century, sometimes faster. This must not be ignored.

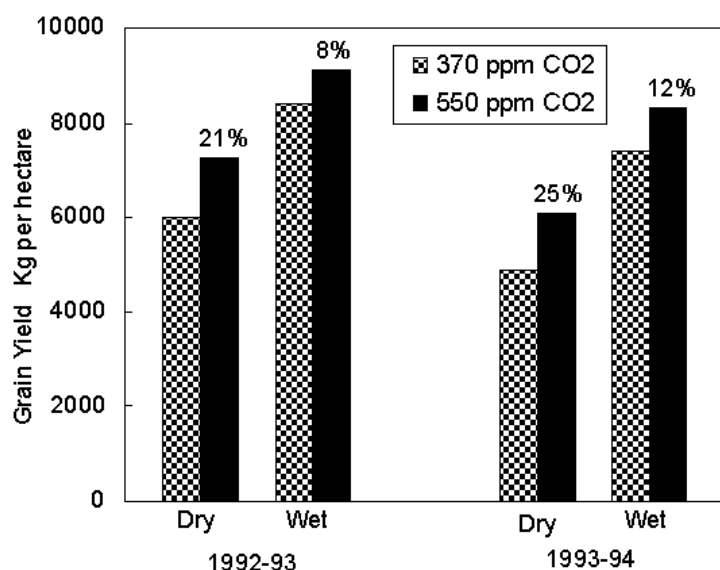
5. The Benefits and Costs of Carbon Dioxide Emissions

Integrated Assessment Models (IAM) are supposed to estimate the social benefits and costs of carbon dioxide and other minor greenhouse gas emissions to determine a Social Cost of Carbon (SCC). These models have the following faults:

- They ignore most of the social benefits,
- they grossly exaggerate the social costs, and
- they use climate model projections, not reality.

Ignored Benefits

CO₂ is plant food! Emissions of CO₂ has increased the crop yield by at least 16%, helping to



feed the world, with further benefits in the future, yet most IAM ignore this benefit. CO₂ concentration has increased from about 280 parts per million (ppm) in pre-industrial times to 400 ppm now. This increase has helped preserved or returned enormous tracts of marginal land as wildlife habitat that would otherwise have had to be put under the plow in an attempt to feed the growing global population. Commercial growers deliberately generate CO₂ and increase its levels in agricultural greenhouses to between 700 ppm and 1,000 ppm to increase productivity and improve the water efficiency of food crops far beyond those in the somewhat CO₂ starved atmosphere.

Figure 17: Wheat yield response to CO₂.

Figure 17 shows the response of wheat grown under wet conditions and when the wheat was stressed by lack of water. Wheat was grown in open fields, but the atmospheric CO₂ concentrations of circular sections of the fields were increased by means of arrays of computer-controlled equipment that released CO₂ into the air to hold the levels as specified. Average CO₂-induced increases for the two years were 10% for wet and 23% for dry conditions.

For a 300 ppm increase in the atmosphere's CO₂ concentration above the current 400 ppm, the productivity of earth's herbaceous plants rises by roughly 30%, while the productivity of its woody plants rises by roughly of 50%.

A paper by Donohue et al published May 2013 [here](#) finds that "satellite observations, analyzed to remove the effect of variations in precipitation, show that cover across [warm and arid] environments has increased by 11% from 1982 to 2010. Our results confirm that the anticipated CO₂ fertilization effect is occurring alongside ongoing anthropogenic perturbations to the carbon cycle and that the fertilization effect is now a significant land surface process." A map showing these changes is presented a figure 18.

A major study [here](#) found that the annual total monetary value of CO₂ fertilization on crops grew from \$22.1 billion in 1961 to over \$167 billion by 2011, amounting to a total sum of \$3.8 trillion over the 50-year period 1961-2011. Projecting the monetary value of this positive externality forward in time reveals it will likely bestow an additional **\$11.7 trillion** on crop production between now and 2050 (all values in \$US 2014).

Dr. Patrick Michaels found that only one of the three IAMs ... has any substantial impact from carbon dioxide fertilization, and the one that does, underestimates the effect by approximately 2-3 times, as shown [here](#).

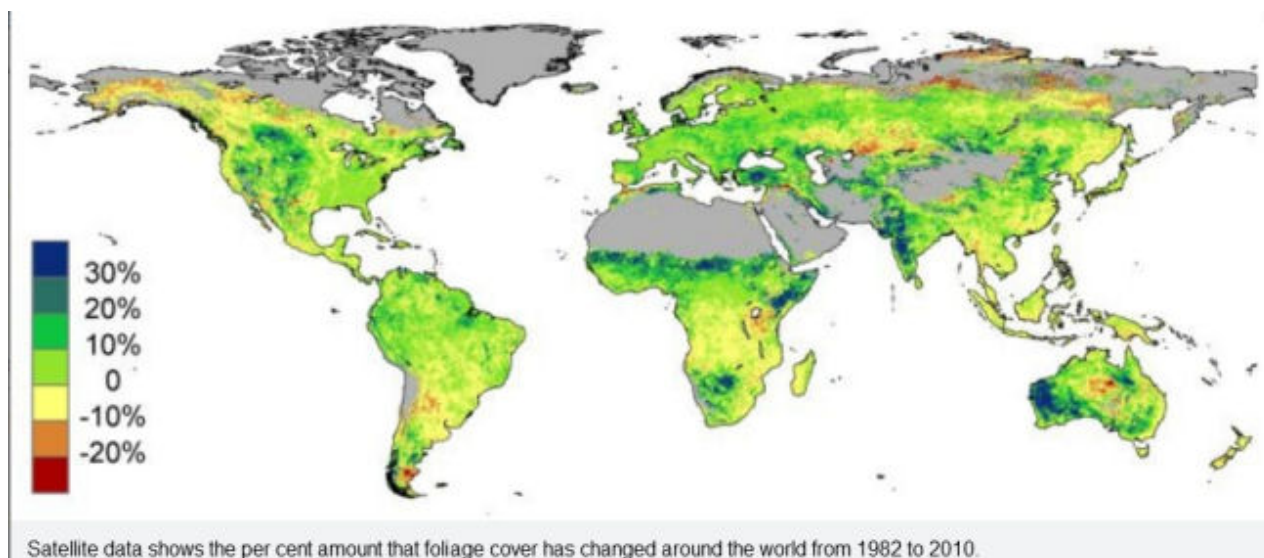


Figure 18: Donohue et al (2013) world effect of CO₂ fertilization.

CO₂ also causes warming benefits, including greater crop yields and larger arable area, including lower fuel costs for heating, lower costs for outdoor commercial activities, and substantial health benefits.

The graph [here](#) shows that surface temperatures in the tropics (-10 to 10 latitude) increased by only a tiny 0.05 °C/decade, but the climate models incorrectly show 0.2 °C/decade warming rate, or four times greater than reality!

Every Albertan knows that warmer temperatures increases crop yields. My garden in Brooks grew better than my garden in Calgary because Brooks is at a lower altitude so is warmer. Most studies relied on by the IPCC do not take into account farmers adapting to climate change. Farmers choose the crop strain most appropriate for the climate, and if the climate changes, warmer or cooler, they will select another strain best suited for that climate.

Dr. Richard Tol, an expert in climate economic, was an author for the IPCC, but resigned because the most other IPCC authors were too alarmist. The IPCC is infected by green activists. Reuters reported [here](#) "Tol said the IPCC emphasized the risks of climate change far more than the opportunities to adapt." Tol also said farmers, for instance, could grow new crops if the climate in their region became hotter, wetter or drier. "They will adapt. Farmers are not stupid". He says, "It is pretty damn obvious that there are positive impacts of climate change, even though we are not always allowed to talk about them."

An article by D'Aleo and MacRae [here](#) reports "Economic actively slows down in cold weather. Alec Phillips, an economist at Goldman Sachs, noticed that from 2010 through 2014, growth in the first three months of the year has averaged 0.6 percent, while it has averaged 2.9 percent in the other three quarters. And Macroeconomic Advisers, a forecasting firm, has found that the pattern goes back further: Since 1995, outside of recessions, the first quarter has grown at half the pace of the other three." This implies that a warmer climate would creates more wealth.

The authors also report that there are on average 1,100 more deaths per day in the USA than in cold months. A study of 13 countries found that "Cold weather kills **20 times** as many people as hot weather".

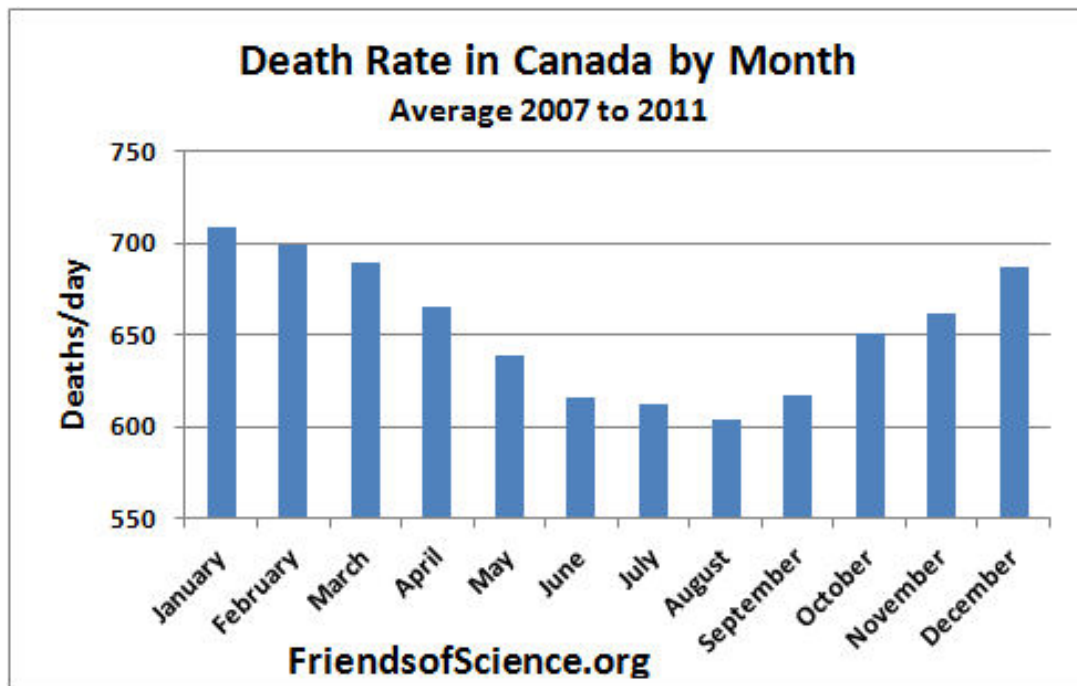


Figure 19: Death rate in Canada by month. There are fewer deaths when it is warmer.

Michaels and Knappenberger reports [here](#) "Americans have actively been moving to warmer climates. And there is every indication that they are continuing to do so". Why? Because a warm climate is very beneficial, yet IAMs assume the opposite.

Many thousands of Canadian "Snowbird" escape Canada's cold climate to enjoy the mental and physical health benefits of a warmer climate in the USA. Statistics Canada data shows that the death rate in cold months is much greater than in warm months. Figure 19 shows that the death rate in Canada is 100 death per day greater in January than in August.

Exaggerated Costs

The graph [here](#) shows that surface temperatures in the tropics (-10° to 10° latitude) increased by only a tiny $0.05^{\circ}\text{C}/\text{decade}$, but the climate models incorrectly show $0.2^{\circ}\text{C}/\text{decade}$ warming rate, or **four times greater than reality!** Since the IAM use the faulty climate models as their temperature input, they greatly exaggerate the harmful effects of warming in tropics. Most of the warming has been outside of the tropics.

Citing several studies, Michaels and Knappenberger report [here](#) that "...the sensitivity of urban populations to extreme heat events has been on the decline since at least the mid-1960s" and "that these declines have continued." The SCC estimate fail to include the fact that people adapt to changes.

Michaels report that the sea level rise in the DICE model (one of the IAM) "produces future sea level rise values that far exceed mainstream projections and are unsupported by the best available science." They far exceed even the estimates published by the IPCC.

Severe weather is a major component of the IAM estimate of the SCC. However, Dr. Roger Pielke, Jr. reports [here](#) (fig.1), that globally, weather-related losses as a proportion of Gross World Product (GWP) have decreased from 1990 to 2012 by about 25%. In 2012, the losses were only 0.20% of GWP.

Dr. Pielke, Jr. also reports "Tornadoes have not increased in frequency, intensity or normalized damage since 1950, and there is some evidence to suggest that they have actually declined."

Total monetary losses have increased due to the increasing value of property developments in areas susceptible to storm damage because of increasing total wealth, not due to increasing severity of storms.

Concerning hurricanes, the IPCC AR5 states, "Current datasets indicate no significant observed trends in global tropical cyclone frequency over the past century ... No robust trends in annual numbers of tropical storms, hurricanes and major hurricanes counts have been identified over the past 100 years in the North Atlantic basin" .

The Accumulated Cyclone Energy (ACE) is the 2-year running sum of the combination of hurricanes' intensity and longevity. It is the most comprehensive measure of hurricane activity. During the past 43 years, global and Northern Hemisphere ACE undergoes significant variability but exhibits no significant statistical trend. Figure 20 shows the ACE as tracked by Dr. Ryan Maue.

Despite the evidence that there has been no increase in the frequency or intensity of hurricanes over many decades, estimates of SCC includes increasing hurricanes cost from climate change. Increasing temperatures in the past four decades didn't cause more hurricanes, so there is no logical reason to forecast that they will increase in the future.

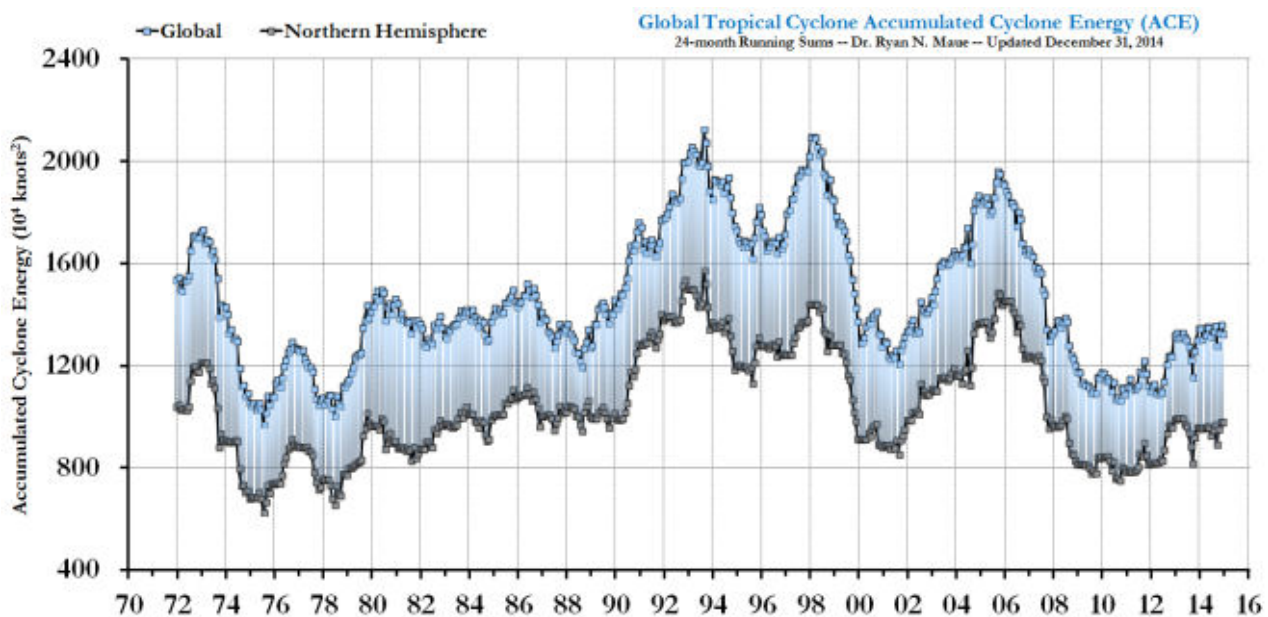


Figure 20: Global and Northern Hemisphere Accumulated Cyclone Energy.

Concerning floods, the IPCC AR5 says, ""In summary, there continues to be a lack of evidence and thus low confidence regarding the sign of trend in the magnitude and/or frequency of floods on a global scale."

Droughts have declined globally. Figure 21 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, D2 and D3 are increasing severity, and D4 is extreme drought. There is a slight declining trend of total droughts throughout the period.

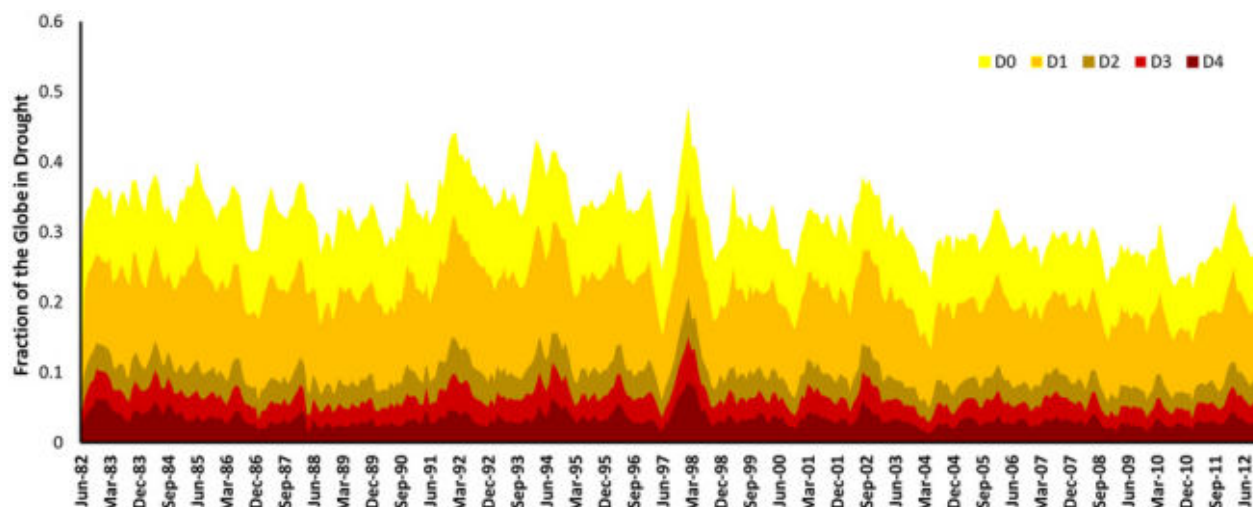


Figure 21: Fraction of the globe in drought from 1982.

Climate Model vs Reality

All of the alleged severe weather damages forecast by IAMs use the climate models as the temperature forecast. However, as shown in sections 3 and 4, those forecasts are greatly exaggerated. Instead of using the climate model mean ECS of 3.2 °C for a doubling of CO₂ concentration, a more likely estimate is in the range of 1.0 to 0.75 °C. This would greatly reduce estimates of the SCC, and free the world of the burden of climate policies.

Final Comments

Economist Robert Pindyck of M.I.T. recently wrote (Pindyck, 2013) about the IAMs **"the models are so deeply flawed as to be close to useless as tools for policy analysis."**

Despite all the exaggerated damages, and omitted benefits, Dr. Richard Tol, says in his book "Climate Economics" that an integrated assessment model calculates that **climate change will have only positive impacts in Canada. He writes, "The impact is positive throughout the 21st century, as are incremental impacts so that there is no incentive to reduce emissions."**

Ken Gregory