One Engineer's perspective on global warming

[Note: All hyperlinks to Internet sources have been verified to be functional on July 26, 2020, as things change over time, some of the links (eventually all of the links) will become inoperative. I am sorry for this, but cannot see an alternative.]

Many scientists and non-scientists are discussing "Global Warming" (or as it is increasingly being called "Climate Crises", "Climate Disruption", "Anthropogenic Climate Change", or ACC) on any number of discussion pages. ACC would simply be an interesting topic for discussion if it were not for the politicization, polarization, and sensationalism that have accompanied the "science".

Most scientific concepts start with a hypothesis followed by experimentation, data collection, analysis, theory modification to fit the data, and then further testing of the revised hypothesis. This is healthy scientific inquiry. When the UN forms an Intergovernmental Panel on Climate Change (IPCC) that regularly issues dire predictions of imminent catastrophe and a headline says in January, 2007, Snowdon will be snow-free in 13 years, scientists warn we have moved past limiting the discussion to its scientific merits.

Figure 1--"Snowfalls [in Britain] are now just a thing of the past, March 2000." Article published in The Independent, but since removed from their web page. Photo taken in London, 2014#

The hypothesis

[Note: Many of the people who feel that ACC is real and that human activity is the driving force (I'll call them "warmists") would strongly question my ability to describe ACC objectively. They may be right, but the following is an honest attempt to be objective. These supporters of the ACC Hypothesis have claimed that the hypothesis does not require a positive feedback loop—this requires some mechanism that would break the cycle once started and no one has identified that mechanism. I stand by my description.]

The fundamental hypothesis is that certain "greenhouse gases" accumulate in the atmosphere and prevent heat from radiating into space. Nearly all of the mass of greenhouse gas in the atmosphere is water vapor. The next largest contributors by mass are carbon dioxide (CO_2) and methane (CH_4). The theory expects that these gases in the atmosphere at today's levels (e.g., CO_2 just above 400 ppm, CH_4 approaching 2 ppm) will create a positive feedback loop in the atmosphere (i.e., the famous "Mann Hockey Stick" graph (Figure 2) of global temperature variation vs. time) and make life on Earth untenable due to extreme temperatures.

An example of a natural positive feedback loop is an avalanche. As mass falls down a hillside, it disrupts the equilibrium of mass lower on the hill, adding mass to the avalanche, which causes more mass to be dislodged, etc. An avalanche continues until it reaches a location where there is

a physical barrier or inadequate slope to allow it to continue on. When you look at ACC theory you see that it imputes that the accumulation of "greenhouse gases" in the atmosphere will raise the global temperature, higher temperatures increase the rate that water evaporates from the oceans, lakes, ponds, and rivers, putting more greenhouse gases into the atmosphere, increasing temperatures, etc. On this scenario, there is no way to break the cycle until you run out of water to evaporate, life on earth would be extinguished long before that could happen.

Greenhouse Effect

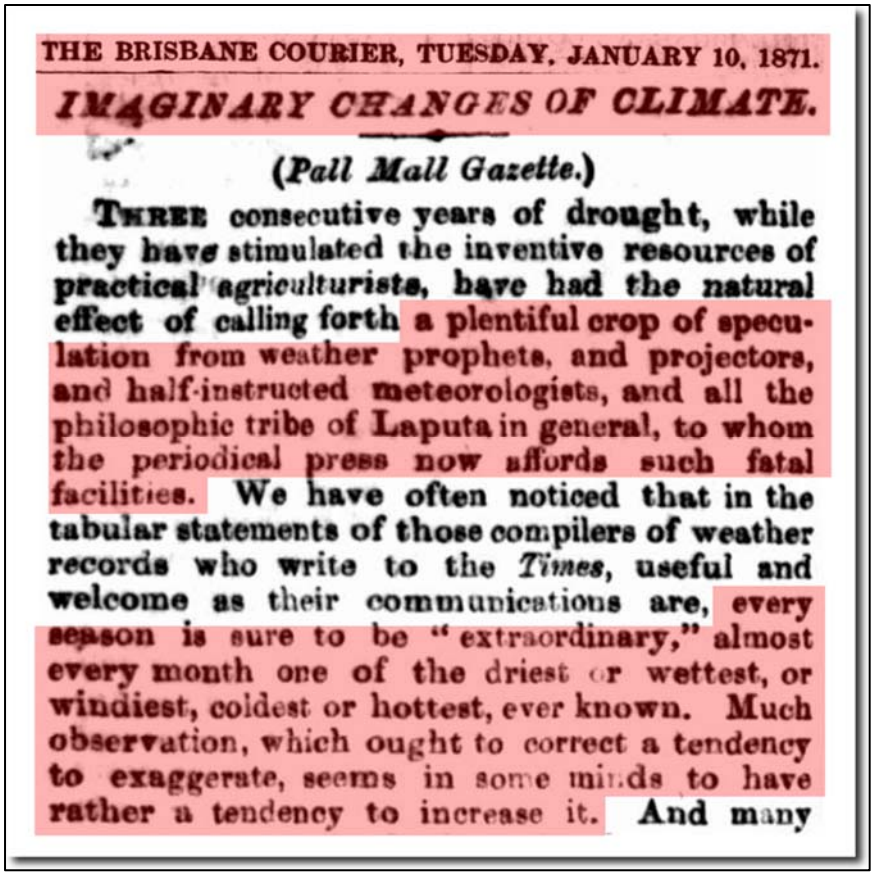
The Concise Oxford English Dictionary (11th Edition) defines

> **Greenhouse Effect** (noun) the trapping of the sun's warmth in the planet's lower atmosphere, due to the greater transparency of the atmosphere to visible radiation from the sun than to infrared radiation emitted from the planet's surface.

This "transparency difference" is due to the presence of so called "greenhouse gases" which can absorb certain wavelengths of light/heat and re-radiate them in a different frequency (e.g., as heat). This radiation of heat from the greenhouse gases tends to be in every direction, so only a portion of the heat radiation is towards the earth. Warmists claim that the portion of the radiation that is directed towards the earth upsets the "energy balance" and heats the atmosphere. The "balance of nature" includes a system with near-infinite heat sinks which makes the requirement for energy in to equal energy out (i.e., the "energy balance") only exists on a very long time scale—if you look at all the solar energy that fell on the earth in the 20th Century, minus all the uses of that energy (e.g., photosynthesis, evaporating ocean water, melting glacier ice, etc.), minus energy radiated into space for the entire 20th century it would be very close to an exact balance. Doing the same calculation for yesterday afternoon would not be close to "in balance" due to energy storage. Oxygen, Nitrogen and Argon do not have the atomic structure to accomplish this selective absorption/radiation. The culprits of ACC are water vapor, carbon dioxide (CO_2), and methane (CH_4). Water vapor is condensable. As temperature changes, water vapor content will go up or down dramatically (either increased evaporation or increased precipitation). Most often the water vapor content (specific humidity) at the ocean's surface is between 30,000 and 40,000 ppm. At 5 miles [8 km] elevation that number drops to about 2,000 to 6,000 ppm. CO_2 and CH_4 are not condensable, so their concentrations are much less variable with altitude and CO_2 concentration is currently (as of June, 2020) about 416 ppm and CH_4 concentration is currently approaching 2 ppm.

The concept of a "Greenhouse effect" can be traced to an 1896 misinterpretation by Arrhenius of the 1827 work of Fourier. A physical greenhouse works by means of mass transfer (not differential radiation as Arrhenius claimed Fourier had asserted). Air is trapped in the building, sunlight shines through the glass and heats the air which is trapped and cannot mix with ambient air. To cool a greenhouse, you open a window and let some of the heated air out. The atmospheric Greenhouse Effect does not accept mass transfer as a component, just radiation (light and heat). According to what Fourier actually postulated, the atmosphere can only function like a "hothouse" (his term) if definite layers of the atmosphere were to solidify, any other interpretation requires that more heat be radiated from the greenhouse gases back to the earth than the sun provides.

All current versions of the Greenhouse Effect (and there are many) disallow the fact that warm gases will tend to rise (i.e., move) or that their contact with cooler molecules will result in the warm molecules cooling off. In the actual atmosphere, there are no physical limits to how far a heated gas can rise, but access to cooler gas above its starting point will tend to homogenize the temperature and slow the rate of mass transfer into space.



THE BRISBANE COURIER, TUESDAY, JANUARY 10, 1871.

IMAGINARY CHANGES OF CLIMATE.

(*Pall Mall Gazette.*)

THREE consecutive years of drought, while they have stimulated the inventive resources of practical agriculturists, have had the natural effect of calling forth a plentiful crop of speculation from weather prophets, and projectors, and half-instructed meteorologists, and all the philosophic tribe of Laputa in general, to whom the periodical press now affords such fatal facilities. We have often noticed that in the tabular statements of those compilers of weather records who write to the *Times*, useful and welcome as their communications are, every season is sure to be "extraordinary," almost every month one of the driest or wettest, or windiest, coldest or hottest, ever known. Much observation, which ought to correct a tendency to exaggerate, seems in some minds to have rather a tendency to increase it. And many

Figure 2: 1871 Newspaper Article

Data Storage

There are a number of data stores. For U.S. data, all of them start with the U.S. Historical Climate Network (USHCN) database which contains the daily data from over 1200 automated weather stations in the U.S. This data is far from pristine, in that it is scrubbed for repeated data, null data, missing data, etc. and assigns values for this bad data, but at least it flags the made-up data as "estimates". The databases that are used to generate the Penn State, NOAA and NASA climate data bases are populated from the USHCN (not a simple update procedure, the "raw" data is subjected to several user-specific destructive edits on top of data that is already far from raw). When a weather station goes off line or starts sending obviously invalid data it is marked with an "E" (for "estimated") in USHCN. In 1990, something on the order of 10% of the USHCN data was marked as estimated . The number has been increasing, until today nearly 70 percent of the new data coming in is marked with an "E", meaning that it was made up (Dr. Tim Ball, The Deliberate Corruption of Climate Science, Stairway Press, 2014 and "Evaluating The Integrity of

Official Climate records", video by Dr Tony Heller on Principia Scientific International). The most common method is to average the data from the surrounding stations, which is sensible until you realize that most of the off-line stations are rural and most of the on-line stations are urban. Urban stations get adjustments for something called the "heat island effects" to correct for the hard surfaces around the recording instruments. The exact criteria for adjustments, the magnitude of the adjustments, and the algorithm for performing the adjustments are all proprietary and tend to change when the custodian of a given data store changes. The net result of the process is that many stations which are clearly in a rural location have the heat-island adjustment made on them.

It is little wonder that with 70 percent of the data made up, that any organization with an agenda to further the cause of Anthropogenic Climate Change has no problem proclaiming any given day, month, year, decade as the "hottest on record". Figure 2 shows that this sort of charlatanism is anything but new, even though it should be reprehensible in any epoch.

The issue with the Hockey Stick

Nature is replete with examples of negative feedback. For example, when local ocean surface temperatures increase, water evaporates and the latent heat of vaporization leads to local cooling. When air temperature drops, some amount of the water vapor will condense leading to local warming. This portion of the water cycle is "negative feedback"—evaporation leads to cooling, cooling leads to condensation, and the system moves toward equilibrium.

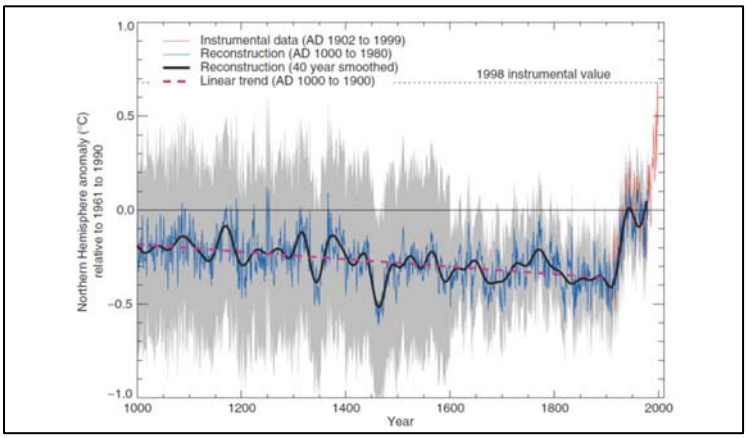


Figure 3--Mann Hockey Stick graph from IPPC Third Assessment Report (1995) Chapter 2#

It is difficult to find an example of sustained positive feedback in nature other than the hypothesis of ACC. Even something like an avalanche where the force of the falling material leads to other material breaking free (the snowball effect) can only exist until the moving mass reaches an unsurmountable barrier or runs out of incline, a matter of minutes. A visual extrapolation of the Mann Hockey Stick graph (Figure 3) has led many people to the conclusion that greenhouse gases will trap heat in the low-Earth atmosphere, temperature will increase, evaporation will put more greenhouse gas into the atmosphere which will trap more heat—a run away positive feedback loop that does not have a dampening mechanism. Without a dampening mechanism, the graph supports the interpretation that within a few years (definitely less than a decade from when the graph was created in 1999) the temperature of the earth will be universally untenable.

Political ramifications

The focus of the political portion of the climate-change discussion is the reduction of the anthropogenic (i.e., "man-made") portion of the total atmospheric CO_2 and CH_4. The IPCC has published several reports all concluding that imminent efforts are required to save the world from man's activities. The major milestones of this discussion have been:

- 1990—IPCC published First Assessment Report (1AR)
- 1992—UN Conference on the Environment and Development in Rio de Janeiro, Brazil developed (among other results) the Framework Convention on Climate Change (UNFCCC)
- 1995—1st Conference of Parties (COP) in Berlin to outline specific targets. IPCC 2nd Assessment Report (2AR) published
- 1997—Kyoto Protocol completed in Kyoto, Japan
- 2001—IPCC Third Assessment Report (3AR)
- 2002—Russia and Canada sign the Kyoto Protocol
- 2006—AB32, California Global Warming Solutions Act of 2006
- 2007—IPCC Fourth Assessment Report (4AR)
- 2008-2012—37 industrial countries plus the European Union (EU) sign Kyoto and accept base emissions reductions
- 2011—Canada, Japan, and Russia withdraw their signature on Kyoto
- 2012—Australia imposees taxes on carbon emissions
- 2012—California imposes Cap & Trade program ($13 Billion USD transferred from the private sector to the State of California 2013-2020 as of June, 2020)
- 2013—IPCC Fifth Assessment Report (5AR)
- 2014—Australia repeals taxes on carbon emissions
- 2019—IPCC Sixth Assessment Report Working Group II Contribution to 6AR (2021)

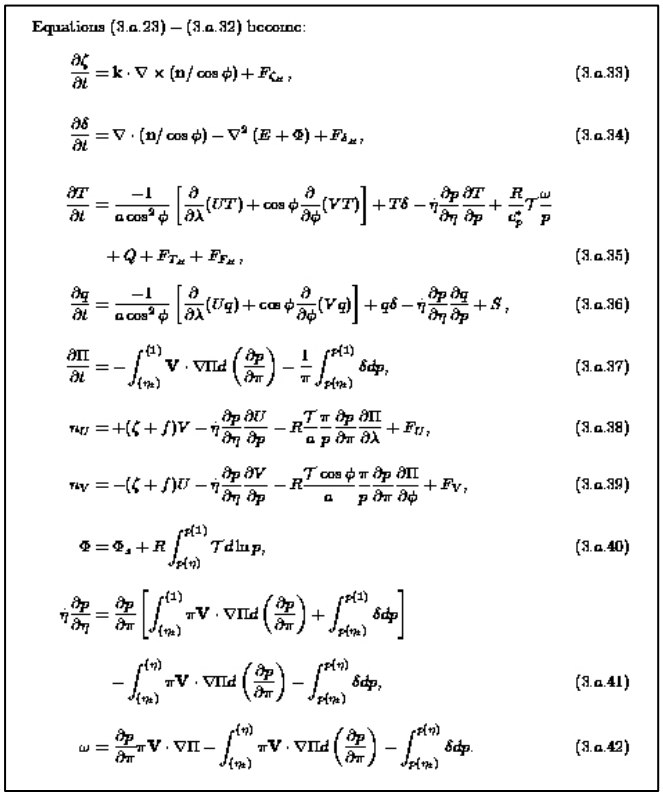
Since the IPPC First Assessment Report (1990) , governments have been progressively increasing their presence in this scientific discussion. The EU implemented a "cap and trade" program that allowed companies to increase (or even maintain) their carbon emissions only by finding another company that was emitting less than its allotted share of carbon and purchasing the excess. Several countries and subdivisions of countries have implemented similar programs.

The U.S. Environmental Protection Agency (EPA) was thwarted by the courts in 2013 in their attempt to regulate CO_2 emissions, but has implemented an extensive "inventory" system and has put severe de facto (if not de jure) limits on CO_2 and CH_4 emissions. The Executive Branch of the U.S. government continued extensive efforts to implement greenhouse-gas controls on many fronts including regulations proposed by the Department of the Interior, Department of Energy, and the Department of Commerce in addition to the Environmental Protection Agency. Thus far they have been largely unsuccessful in classifying carbon as a "pollutant". Their efforts are continuing even though the current administration is trying to curb the regulatory agency's overreach.

Scientific support for anthropogenic climate change

The "climate" is big. Very big. Full-system experiments have proven impossible to perform to date. In the absence of a full-system experiment, scientists are limited to physical models and mathematical models.

Physical models rely on "similitude" to ensure that the model is representative of the full system. Similitude is a technique that attempts to scale a natural phenomenon of an inconvenient size to a convenient size. This scaling in fluids problems is based on matching several dimensionless parameters such as Reynolds Number, Weber Number, Nusselt Number, or any one of a dozen other dimensionless parameters. The theory is that if you can build a physical model that results in more than two dimensionless parameters being equal between the model and the full system then the data from the model has a high potential to reflect the full system. Matching the incomprehensively complex interactions on a global scale to a manageable physical model has not been successful.



Equations (3.a.23) – (3.a.32) become:

$$\frac{\partial \zeta}{\partial t} = \mathbf{k} \cdot \nabla \times (\mathbf{n} f / \cos\phi) + F_{\zeta_M}, \tag{3.a.33}$$

$$\frac{\partial \delta}{\partial t} = \nabla \cdot (\mathbf{n} f / \cos\phi) - \nabla^2 (E + \Phi) + F_{\delta_M}, \tag{3.a.34}$$

$$\frac{\partial T}{\partial t} = \frac{-1}{a\cos^2\phi}\left[\frac{\partial}{\partial\lambda}(UT) + \cos\phi\frac{\partial}{\partial\phi}(VT)\right] + T\delta - \eta\frac{\partial p}{\partial\eta}\frac{\partial T}{\partial p} + \frac{R}{c_p^*}\mathcal{T}\frac{\omega}{p} + Q + F_{T_M} + F_{F_M}, \tag{3.a.35}$$

$$\frac{\partial q}{\partial t} = \frac{-1}{a\cos^2\phi}\left[\frac{\partial}{\partial\lambda}(Uq) + \cos\phi\frac{\partial}{\partial\phi}(Vq)\right] + q\delta - \eta\frac{\partial p}{\partial\eta}\frac{\partial q}{\partial p} + S, \tag{3.a.36}$$

$$\frac{\partial \Pi}{\partial t} = -\int_{(\eta_s)}^{(1)} \mathbf{V}\cdot\nabla\Pi d\left(\frac{\partial p}{\partial\pi}\right) - \frac{1}{\pi}\int_{p(\eta_s)}^{p(1)} \delta d p, \tag{3.a.37}$$

$$\eta_{dU} = +(\zeta + f)V - \eta\frac{\partial p}{\partial\eta}\frac{\partial U}{\partial p} - R\frac{\mathcal{T}}{a}\frac{\pi}{p}\frac{\partial p}{\partial\pi}\frac{\partial\Pi}{\partial\lambda} + F_U, \tag{3.a.38}$$

$$\eta_{dV} = -(\zeta + f)U - \eta\frac{\partial p}{\partial\eta}\frac{\partial V}{\partial p} - R\frac{\mathcal{T}\cos\phi}{a}\frac{\pi}{p}\frac{\partial p}{\partial\pi}\frac{\partial\Pi}{\partial\phi} + F_V, \tag{3.a.39}$$

$$\Phi = \Phi_s + R\int_{p(\eta)}^{p(1)} \mathcal{T} d\ln p, \tag{3.a.40}$$

$$\eta\frac{\partial p}{\partial\eta} = \frac{\partial p}{\partial\pi}\left[\int_{(\eta_s)}^{(1)} \pi\mathbf{V}\cdot\nabla\Pi d\left(\frac{\partial p}{\partial\pi}\right) + \int_{p(\eta_s)}^{p(1)} \delta d p\right] - \int_{(\eta_s)}^{(\eta)} \pi\mathbf{V}\cdot\nabla\Pi d\left(\frac{\partial p}{\partial\pi}\right) - \int_{p(\eta_s)}^{p(\eta)} \delta d p, \tag{3.a.41}$$

$$\omega = \frac{\partial p}{\partial\pi}\pi\mathbf{V}\cdot\nabla\Pi - \int_{(\eta_s)}^{(\eta)} \pi\mathbf{V}\cdot\nabla\Pi d\left(\frac{\partial p}{\partial\pi}\right) - \int_{p(\eta_s)}^{p(\eta)} \delta d p. \tag{3.a.42}$$

Figure 4--Sample of the equations that control the behavior of the atmosphere (University of Arizona)#

Mathematical models are the other tool (Figure 4). If an interaction involving mass and/or energy transport can be described by an equation or a system of equations, then insights can be gained into the functioning of that physical event. When the system of equations moves beyond rudimentary relationships (e.g., the Bernoulli Equation can describe why a sub-sonic airplane can fly, but completely breaks down when the plane accelerates to a significant fraction of the speed of sound), you must assemble the variables and equations, along with boundary conditions and environmental variables into a computer model to be able to begin to assess the viability of the system of equations based on observed data verses modeled data, let alone assessing how things might change with time.

The primary tool of climate science is the computer model. Computational fluid dynamics (CFD) and finite element analysis (FEA) tools are used to try to reflect the climate of the earth and determine the drivers of climate change.

The set up for the computer modeling software requires selecting a grid size (Figure 5). In most modeling software, the most important thing about a grid cell is the information that is transferred from one cell to the next. In other words, the model considers all energy, force, and reactions

within each grid to be homogenous. The model enters a grid cell with a very large number of parameters (e.g., temperature, atmospheric pressure, surface wind velocity, atmospheric gas composition, humidity, cloud cover, solar irradiance, albedo, jet stream velocity, and hundreds more) and uses mathematical functions to predict the state of each of the variables on exiting the cell and entering the next cell. Some of the important parameters (such as cloud cover) and greenhouse gas concentrations are inputs to the model instead of outputs. This series of calculations is then adjusted for hysteresis (i.e., the amount that a previous state impacts a future state) and run for the next time step.

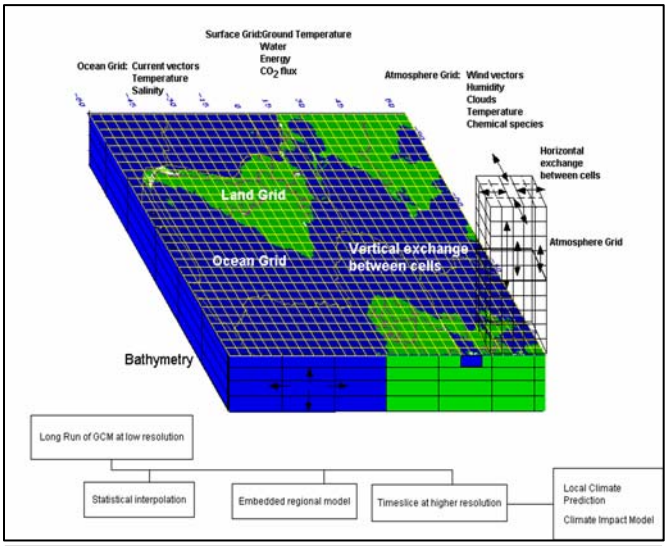


Figure 5--Computer model grid layout (University of Arizona)#

Once the model is built, it must be "calibrated" or "trained" to verify that it can reflect past time periods before it can be allowed to attempt to predict future states. The calibration takes the data from a known past point in time and tries to match other more recent time periods. The modeler has a number of "levers" that he can "pull" to adjust the influence of the various parameters in the model and to change the magnitude of the fixed variables.

Major cyclical events like el Niño, la Niña, sunspots, Pacific Decadal Oscillation, or Atlantic Multi-Decadal Oscillation are put into a supervisory file that drop their impact into the model on the frequency that these events have occurred in the past.

When the model is built and calibrated, it is turned loose to predict future outcomes with a temporal granularity ranging from a few hours to 10,000 years (i.e., it averages every single climate or weather event within the time step into one set of numbers). The model output parameters that are reported in the press with the highest frequency are seal level and global average temperature variation from base. The scientific community tries very hard to present this data as factually as possible with little reference to social impacts.

Extrapolations from the scientific literature are made in the press and in political discussions about what this increasing global average temperature will do (e.g., increased tropical hurricanes and typhoons, increased frequency and duration of droughts, more tornadoes, etc.) and the dislocation effects of rising sea level to assess the risks of inaction. These potential effects are pure politics and are not a part of the scientific assessment.

Scientific consensus

Much has been made in the press about the report that "97% of climate scientists agree" that "Global warming is a real threat, and that mankind's activities are the cause—the science is settled".

One of the sources frequently cited for the consensus is Affiliated Professor of Earth and Planetary Sciences Naomi Oreskes from Harvard. Professor Oreskes examined the abstracts from 928 articles (no disclosure as to how the 928 articles were selected from a body of peer-reviewed literature in the tens of thousands) and found that 75% supported the view that human activities are "responsible for most of the observed warming over the previous 50 years."

An article published by Doran and Zimmerman in *Eos: Transactions of the American Geophysical Union* in 2007 reported the results of a two-question online survey of selected scientists that claimed "97% of climate scientists agree." The questions were:

1. Have global mean temperatures risen since the pre-1800s?
2. Do humans significantly influence the global temperature?

It is difficult, even for a skeptic, to answer those questions in the negative—this is much like the question "have you stopped beating your children?", a "yes" answer means you did beat your children but have stopped while a "no" says you are still beating your children. It is a strong skeptic position that climate changes, climate has always changed, climate will always change. It is also difficult to say that the biomass of 7 billion people would not have some impact on a heat sink.

The Doran and Zimmerman survey was sent to 3,146 scientists who were identified by having had a paper published which mentioned climate change. Of this subset, only 79 responded. So this evidence of a consensus actually had 77 people respond positively to inane and general questions.

In 2013, a paper by Cook et al. published in *Environmental Research Letters* claimed that their review of the abstracts of peer-reviewed papers from 1991 to 2011 (11,944 papers, of which 4,014 explicitly expressed an opinion about the impact on global temperature of man's activities) found 97 percent of those that stated a position explicitly or implicitly suggesting that human activity is responsible for some warming. The Cook paper was reviewed by Legates, et al. in *Science and Education* who found that "just 0.03 percent endorsement … that most warming since 1950 is anthropogenic." They found "only 41 papers – 0.03 percent of all 11,944 abstracts or 1.0 percent of the 4,014 abstracts expressing an opinion … had been found to endorse the quantitative hypothesis."

Many of the authors of abstracts that were included in Cook, et al. analysis have since come forward to refute that their position was properly categorized.

A thorough review of the topic of consensus on Anthropogenic Climate Change (ACC) can be found at The Heartland Institute. A discussion of the Social Psychology of the consensus is at José

Duarte's blog site. In his June 3, 2014 blog entitled "Ignore climate consensus studies based on random people rating journal article abstracts" he says (emphasis is his):

> Ignore them completely – that's your safest bet right now. Most of these studies **use political activists as the raters**, activists who **desired a specific outcome for the studies** (to report the highest consensus figure possible), and who sometimes collaborated with each other in their rating decisions. All of this makes these studies completely invalid and untrustworthy (and by customary scientific standards, completely unpublishable.) I had no idea this was happening. This is a scam and a crisis. It needs to stop, and those papers need to be retracted immediately, especially Cook, et al (2013), given that we now have evidence of explicit bias and corruption on the part of the raters. (It's crazy that people think the consensus needs to be artificially inflated to absurd heights – do they think 84% or 90% isn't good enough?)

As an engineer, I find the very concept that a scientific consensus could constrain alternative research to be objectionable. At one time the "scientific consensus" was that the sun revolved around the earth, and Galileo Galilei suffered mightily at the hands of the Inquisition for putting forth an alternate hypothesis. "Scientific consensus" is a powerful thing to entrench a particular concept and stifle contrary opinions.

The other side of the discussion

People who do not accept this science as "settled" are frequently called "deniers" and "skeptics". Skeptics call the people who feel that the science as settled "warmists" and claim that the warmist position is much closer to a religion (i.e., you must take certain things on faith, and you must "believe") than to free, scientific inquiry. The discussion is very polarized.

Everyone who is skeptical about ACC has their own reasons for this skepticism, but mostly the basis fits into one or more of the following categories:

- The climate has always changed; the climate will always change; live with it. Since mankind began walking the Earth we've have ice ages, droughts that extended over decades, brief periods of clement weather, and everything in between. It has been warmer than today by a considerable margin. It has been colder than today by an equally large margin. We have adapted. Regardless of the cause, magnitude, or direction of the next set of changes, we will adapt if allowed to. No action by the governments of the world will prevent changes in climate. Even if the current trend is actually one of increasing temperatures, and even if that trend is due to human activity, successfully changing that human activity will only remove a single factor in an impossibly complex group of factors and some other factor will cause warming or cooling that we will have to deal with. Mankind has survived five "ice ages" and the subsequent "global warming" that followed; there is a good chance that if the politicians don't muck it up we'll survive the next one too.

  In engineering activities the fact of climate changing would be treated as an "environmental variable" that can be measured, assessed, and factored into activity, but that cannot be

successfully modified. In other words, “The ant really should not try of move the rubber tree plant,” even with “high hopes.”

- Data. The more information that is released about historical climate data, the less valid it seems.
    - *Heat island effects*. It seems to make sense to most people that urban locations will be warmer for a given solar flux, cloud cover, and wind conditions than a rural location would be. Over time cities have encroached on monitoring sites that had been rural. The warmists claim that the data can be mathematically adjusted to account for this fact to allow the station to show a consistent set of conditions over time. The magnitude and basis of the adjustment for a given station is different in different data sets, destructive (i.e., the raw data is replaced by “adjusted data”), and undisclosed. There have been examples of a given data store imposing a different adjustment to the data simply because the person responsible for populating a data store changed jobs and their replacement had a different theory as to the magnitude of “required” adjustments.

      In all other science and engineering activities this kind of systemic modification of data would be done based on explicitly divulged algorithms and would be reversible. Not in “Climate Science”.
    - *Station location*. Souleyman Fall, et al. did a peer-reviewed study published in *Journal of Geophysical Research*, Vol 116, D14120 in 2011, where they found that only 7.9 percent of U.S. climate monitoring stations provided data that was within ±1°C. They also found that 70.6 percent of the stations were worse than ±2°C. When you realize that the worst projections of ACC were on the order of 0.5°C/decade temperature increase, it is hard to have much faith in data that was incapable of demonstrating that precision. These results are from the richest country on earth. It should not be assumed that overall integrity of the global data set is nearly this “good”.
    - *Original data*. The climate dataset is very large. Many station’s data is appropriately edited (e.g., a site with a temperature instrument stuck at 999°C for several months needs to be excluded from calculations), other stations have edits that are more subtle (e.g., edits for the heat island effect mentioned above). Regardless of whether the edits are done to correct errors or to adjust reality, the original data is not retained. There is no way for future researchers to evaluate different heat-island adjustments for example because the owners of the data do destructive edits in the claim that the datasets are simply too big to allow non-destructive edits.

      In engineering activities destroying part of a data set or replacing measured data with “judgmental data” is done all of the time—with the ability to roll the changes back out to be able to demonstrate the magnitude, reason, and technique for the opinion that you have a “better number”. Without this ability to reassess a raw data

set there is no way to prove that the edits were unbiased towards any specific conclusion.

- *Pre-industrial data*. The 20th Century data before the 1990s was all taken from manual reads of analog instruments that rarely had calibrated steps tighter than ±5°C. The person making the record had to interpolate between marks that were physically very close together. Even worse is the tree-ring, sea floor, and ice core data used for pre-20th Century. Tree rings are thicker when the tree sees adequate moisture and considerable sunshine. They are thinner if either moisture or sunshine is lacking. Scientists can make some reasonable guesses about temperature from an analysis of tree rings, but at the end of the day they are just guesses.

  Sea temperatures are another topic that needs consideration. A ship sailing from San Diego to Hong Kong encounters several dozen coherent currents whose temperature can vary from surrounding water by 5°F to 25°F. Much of the pre-industrial data on both sea temperature and atmospheric temperature was taken at the changing of the watch on sailing ships. The data retrieved from those logs are so spotty and sparse that it is only useful as anecdotes. Today's ocean temperatures are not much better.

  In engineering activities, it is important to honor the uncertainty of the data. If an instrument provides data that has an uncertainty of ±2.5°C, then it is irresponsible to report a calculation done with the data to more significant digits than ±1.25°C. The data from before the 20th Century has a temporal granularity of seasons, years, decades, and even centuries. Ice core data does not contain a direct read of temperature, but allows the creation of a temperature proxy from isotopes of various gases. A computer model is used to try to typify whether the isotope mix came from the Pacific, Atlantic, or Indian Oceans, and then the model uses the magnitude of the count of the relevant isotopes to estimate the temperature required to evaporate that much water. Many papers have been written about this. An article in AstroBiology Magazine in 2012 said:

  > "We ran an oxygen isotope-enabled atmosphere model, so we could simulate what these ice cores are actually recording, and it can match the actual oxygen isotopes in the ice core even though the temperature doesn't cool as much," Carlson says. "That, to us, means the source of precipitation has changed in Greenland across the last deglatiation. And therefore that the strict interpretation of this iconic record as purely temperature of snowfall above this ice sheet is wrong."

  The divergence problem has brought any use of tree-ring data into question, further a computer model is used to convert the limited data available from a tree ring into a temperature; some claim that this step is fraught with potential for bias.

Even with all of this temporal and magnitude uncertainty, the data from these proxies is regularly posted on a -1°C to +1°C, with conclusions in the ±0.1°C range. In engineering this is referred to as "making stuff up".

- *"Granularity."* There are parts of the world where monitoring stations are within a few miles of each other. Other parts of the world might have one station every few hundred miles. Some stations have been off line for years while wars were waged around them—in some cases the last data point recorded is simply reported forward, in other cases the date data is honored (i.e., data from 21 Nov 1999, is copied to that date in 2000, 2001, 2002, etc.), and in other cases the date data is honored but "adjusted" for global warming. Again, very creative efforts that have nothing to do with "science".

- "Climategate." In November, 2009, the email accounts and work files of a number of highly regarded climate scientists was posted on the Internet (some say by hackers, some say it was leaked). Extracts from the 3000+ documents were widely published with the intention of showing that the field of ACC research as being rife with fabrications, cronyism, data that is selectively excluded, and data that is modified to fit a narrative.

  A number of investigations of the leaked documents all found that the fraud alleged by the skeptics had not been in evidence. Specific documents still available on the internet (mostly without context) seem to indicate that there actually was a conspiracy in spite of assurances by the Union of Concerned Scientists, several universities, and several governments that it was all a hoax and/or that in context the documents are justifiable.

  Skeptics claim that all of the assessments were done by organizations with a strong vested interest in there not being a problem.

- Lawsuits. There have been a number of lawsuits by warmists against skeptics for defamation of character and other offenses. A good example is Michael Mann v Timothy Ball in British Columbia, Canada. This suit was filed March 25, 2011 alleging that Dr. Ball defamed Dr. Michael Mann. Dr. Ball was purported to have said that Dr. Mann "should be in the State Pen, not Penn State" in a 2011 interview for the Frontier Centre for Public Policy. During the execution of the trial, Dr Mann absolutely refused to provide his computer models and data manipulation algorithms. Dr. Ball's legal team interpreted this refusal to show support for the argument that honest people don't hide their processes. Dr. Mann's legal team claimed that the work was proprietary and that disclosure would have a negative impact on Dr. Mann's ability to continue his research. This issue was left unresolved by the court.

  The case was dismissed August 22, 2019, for the stated reason that there had been inappropriate delays in the execution of the case and Dr. Ball was reimbursed for his costs.

Cases like this have been very common, and the tendency of the warmists to end them prior to trial has been nearly universal, which many in the skeptic community take to mean that the lawsuits are simply an intimidation technique.

- Computer models. Computer modeling is a cornerstone of modern science and engineering. There is one (of very few) points where everyone with real expertise in modeling agrees—computer models cannot **prove** anything. Ever. Computer models are outstanding at pointing out areas that warrant further analysis or that have weaknesses. At best they represent the biases of the author. At worst they can easily be manipulated to tell any story the author wants to tell—with the large number of parameters that are "input" rather than "derived" it doesn't take much effort to "adjust" any of the input parameters to match the desired conclusion. It is nearly impossible for an outsider to conduct a competent audit of someone else's model. If there is intentional bias or even fraud in a model it is highly unlikely that it will ever be discovered. Every single assertion of the community supporting ACC is predicated on the output of a computer model.
    - *Grid size*. The surface area of the earth is 196.9 million square miles [510.1 million $(km)^2$]. The "atmosphere" is generally considered to end at 62 miles [100 km] above sea level so the generally accepted volume of the atmosphere is 9.6E8 mi^3 [4E18 m^3].

      The current generation of computer models divides the earth into 2 to 20 vertical layers, surface blocks ranging from 120 to 600 miles [200 to 1,000 km] on a side, and time scales ranging from hours to 10,000 years. This leads millions of trillions of grid processes for a single model run. IPCC First Assessment Report says it well:

      > **3.7** **Summary**
      > Many aspects of the global climate system can now be simulated by numerical models. The feedback processes associated with these aspects are usually well represented, but there appear to be considerable differences in the strength of the interaction of these processes in simulations using different models.
      >
      > Unfortunately, even though this is crucial for climate change prediction, only a few models linking all the main components of the climate system in a comprehensive way have been developed. This is mainly due to a lack of computer resources, since a coupled system has to take the different timescales of the sub-systems into account, but also the task requires interdisciplinary cooperation.

      In other words, even the IPCC lacks much faith in the ability of the models to faithfully represent reality. The IPPC Fifth Assessment Report (2013) tries to spin these deficiencies with statements about how far the "science" of computer modeling has come since IPPC First Assessment Report (1990) , but the essence of the above quote from IPPC First Assessment Report (1990) still exists in 2020.

- *Cell to cell math.* The climate is strongly influenced by the movement, accumulation, and storage of fluids. This fluid activity is defined by the engineering field called "fluid mechanics." Fluid mechanics relationships are so complex that the only way to solve any problem is to impose a long list of simplifying assumptions (e.g., to develop the well-known Bernoulli equation, Daniel Bernoulli had to assume that there is no fluid friction, fluids were incompressible, there is no heat transfer into or out of the system, there was no rotation, and the fluid does no work).

  Bernoulli's assumptions are the common ones for fluids problems. We do not know how to solve fluids problems with rotating flow. Friction is another area where there is no closed-form solution to (there are a number of empirical approximations, but all have strict boundary conditions). Heat transfer to or from a moving fluid mass require very strict localization assumptions. None of these standard simplifying assumptions applies to the atmosphere as a whole. Not a single one. This results in the models being forced to rely on empirical equations that try to give "good enough" answers in limited cases.

  The physics of the energy transfer in the atmosphere is even more complex than the fluid mechanics. The arithmetic underlying these models is barely competent to describe the fluid reactions to dropping a rock into a still pond and is being used to drive whole economies.
- *Number of iterations.* It is not unusual for a computer model to have to iterate upwards of a million times per time step. Doing a marginal operation on questionable data through a million iterations can result in some pretty random numbers. You can demonstrate this by entering 1.000000000001 in one cell of an Excel spreadsheet and .999999999999 in the next cell. Then in the next row square each of the two numbers. Duplicate that operation a few thousand times down the sheet. Within 20,000 repetitions your answer in the first column will be infinity (actually it will be the overflow value on your computer) and the second will be indistinguishable from zero. That is a long way from a million steps, and your data confidence far exceeds what you can get from a weather station.

  This is an example of an unconstrained experiment. All of the models have very strong artificial constraints to reign in out-of-control data, by forcing a "wrong" answer back into the realm of "right" with no external indication of this having happened. The concepts of "right" and "wrong" can only exist within human biases.
- Source of underlying data. Some of the data in the models comes from terrestrial weather stations that has been "corrected" by computer models. Figure 3 starts at the year 1000. There were no terrestrial weather stations in the Middle Ages, so where does ±0.1°C data from the year 1000 come from?

It is not possible to measure temperature directly, consequently we rely on the reaction of surrogates to a temperature. For example, we have measured the specific volume of Mercury at many distinct and verifiable ambient temperatures with great precision and repeatability. This allows us to put a measured mass of Mercury into a tube with a precisely determined and constant cross-sectional area and then calibrate a linear temperature scale based on the temperature specific volume of the known mass of Mercury—a very reliable indication of temperature, but not a **measurement** of temperature. Other modern instruments rely on other material's response to temperature change, but they all rely on surrogates. This distinction probably seems pedantic to many readers, but it is crucial to understanding what the record contains. This is a reasonably tough problem for modern conditions, but what about the Middle Ages?

To estimate data from the distant past, our surrogates are ice cores, tree rings, and ocean sediment cores. None of these methods include a recording thermometer. In an ice core evaluation, a time reference is obtained from indications of seasonal changes in the ice (assuming that the changing of the seasons is immutable over all time, even centuries long ice ages). Once the time period is determined, the mix of gaseous isotopes trapped in the ice is determined and computer models apply thousands of assumptions to that mix of isotopes to "determine" a temperature for that time period. If any one of those myriad assumptions is incorrect for a given time period, then the temperature is incorrect. In actual practice, evaluation of ice cores cannot be better than ±10 years on temporal scale and ±5°C in temperature assessment. Inadequate for a ±0.1°C presentation. When you are trying to honor the uncertainty of the data, your uncertainty must be consistent with the **least precise** data in your dataset. If you have are merging data from a high-quality digital instrument (e.g., ±0.01°C) with 1 reading per second resolution with ice core data with ±5°C, then your maximum precision is ±5°C. In fact, there is not a single data point on Figure 3 that can legitimately be presented with ±0.1°C uncertainty.

Tree ring data is even worse. Two trees in the same forest can show very different response to environmental conditions, and the computer model that converts tree ring data into a date/temperature pair has even more assumptions than the ice core assumptions.

- Sources of greenhouse gases. There isn't much argument about the source of the largest greenhouse gas—something on the order of 434,000 cubic kilometers (1.1×10^{17} gallons) of liquid water evaporates from the oceans, lakes, rivers, and ponds of the world every day. No one is trying to regulate evaporation. CO_2 and CH_4 are another thing. Atmospheric CO_2 is about 400 ppm. In 1800, it has been estimated to have been around 260 ppm and the current argument is that the ONLY way that it could have increased by over 50 percent was industrialization.

In the year 2020, it has become difficult to find historical (and pre-historical) data that isn't simply a model projection—and all of the models that get published coincidentally show peak CO_2 less than 300 ppm. A review by Dr. C.R. Scotese (*Analysis of the Temperature Oscillations in Geological Eras, 2002*, W.H. Freeman and Sons, New York) shows that since the early Tertiary Period (about 40 million years ago) the earth has been experiencing a period of severe shortages of CO_2 in the atmosphere (which has resulted in less drought tolerance and insect resistance in plants)—"normal" levels have historically been over 2,000 ppm. If the only possible way for the CO2 levels to have risen from 260 ppm to 400 ppm is industrial activity, then it is very difficult to understand why CO_2 levels rose from about 210 ppm to 1000 ppm during the Triassic Era. Remember that commercial greenhouse operators regularly maintain the atmosphere in physical greenhouses at around 1500 ppm to improve their profitability (increased CO_2 has been reported to reduce the required quantity of water, pesticide, and fertilizer).

Internet searches in 2020 for the sources of atmospheric CO_2 yield millions of hits that break down man's contribution to the "problem". I could not find the impact of ocean krill, plankton, algae, termites, volcanos, or rotting vegetation. Nothing about the methane clathrates released when the permafrost melts from global warming. These non-human sources account for about 98 percent of the total CO_2 and CH_4 in the atmosphere (that leaves 2 percent of the 2 percent that is not water vapor or 0.04 percent of the total greenhouse gases). That number was easy to find in 2014 when this paper was originally published, but in 2020 the "change culture" has eradicated all quantitative references to non-human sources of greenhouse gases.

One seemingly strong argument for ACC is carbon dating the atmospheric CO_2. The idea of carbon dating is the result of very creative work in 1946 by Willard Libby at the University of Chicago. His concept is that Nitrogen-14 in the atmosphere is bombarded by solar radiation and that some proportion of the impacts will cause the stable nitrogen to lose a neutron and become radioactive Carbon-14 (radiocarbon). He further postulated that the number of collisions is relatively constant and that as animals breathe the C14 a portion of it would be absorbed into their systems and decay to Carbon 12 over time. This means that as long as the animal is breathing, they will be ingesting C14. When the animal stops breathing, they will stop ingesting C14 and the inventory of radiocarbon in their bodies will decay with a half-life of 5730 years. So, if you find a sample with 1/4 as much C14 as you expect then it is something like 11,460 years old. There are a large number of assumptions that go into this calculation, and many of them are invalid for any given biological sample, and the uncertainty in dating can be ±millennia. Applying this to ACC, fossil fuels tend to be somewhere between 67 and 550 million years old—no C14 would last that long. This means that if the portions of C14 in the atmosphere are less than would be predicted by this theory then the extra C14-free CO_2 must have come from the combustion of fossil fuels since the theory recognizes no other source of CO_2 is C14-free. Other sources of C14-free gas that have been identified are seeps of various gases from

deep in the earth, the methane clathrates that lie under the permafrost in incomprehensible volumes, the debris from plants and animals that have been frozen under the permafrost for tens of thousands of years, and CO_2 from volcanic activity.

The earth has warmed since the last ice age. Skeptics do not refute this. As the earth warms, the Arctic permafrost limit retreats and uncovers what has been kept from the atmosphere for thousands or millions of years. The organic material being uncovered does not have the same mix of isotopes as contemporary organic material and will tend to skew the value of the radio-isotope analysis.

- Methane. In the IPCC Third Assessment Report (2003) (Table 3), the impact on the climate of methane is 11 times the impact of CO_2. The reasons for the multiplier are reasonably well documented in the IPCC First Assessment Report (1990) and seem to be sound. In 2011, the EPA guidance for Subpart OOOO of the Clean Air Act specified (without explanation) that methane emissions were 37 times as strong a greenhouse gas as CO_2. The current web site for the Climate and Clean Air Coalition shows that the impact is 84 times that of CO_2 as a bald fact without explanation. This impact-creep is quite disturbing and the lack of explanation of the basis since the IPCC First Assessment Report (1990) reeks of manipulation.

  The Climate and Clean Air Coalitions claims that 60 percent of atmospheric methane comes from industrial sources. Specifically, they claim that 40 percent of the industrial sources is from agriculture, including "manure management", "enteric fermentation", open burning of agriculture waste, and paddy rice. Another 40 percent of industrial sources is fossil fuels, including coal mines, gas distribution systems, oil and gas production including flaring, and long-distance gas transmission. It is interesting to note that the two largest industrial sources are manure management and coal mines. If you think about it there are many, many species of animal that produce significant quantities of manure. Think of a heard of gnu numbering over 1 million animals. Snow geese in their millions. Insects in their trillions. In fact, something like 4 trillion tonnes of biological material is converted to waste in one form or another each year. A significant portion of this vast mass of material will eventually be converted to either CO_2 or methane. It has been estimated that natural biological processes produce 5 TSCF/day of methane (world industrial natural gas production is on the order of 0.332 TSCF/day), and about 75 TSCF/day of CO_2, nearly all of which are unrelated to man's activities and enter the atmosphere every day. Also, there are tens of millions of natural methane seeps around the world. No one has any estimate of the amount of gas that enters the atmosphere from these seeps, but the few that have been quantified have constituted significant volumes.

  When more sensitive methane-detecting equipment was launched into space in 2012, a methane hot spot was detected in the Four Corners Region of the U.S. (supposedly representing $1/10^{th}$ of the total industrial sources of released methane). This area where Utah, Colorado, New Mexico, and Arizona all touch at one point is the home of the San

Juan Basin gas field which was the largest natural gas field in the U.S. for nearly 30 years. At least 5 universities were contracted by the EPA to find the leaks. All failed, because there were no leaks of significant magnitude. The formations (known as Dakota, Mesaverde, Pictured Cliffs, and Fruitland Coal) that make up the San Juan Basin all have surface outcrops in an arc that is 3 miles wide and 100 miles long in southern Colorado—the center of the hotspot. Several of the EPA studies identified the outcrop as the source, but those reports were buried and cannot be located today. A minority of the studies claimed that there was an unknown leak that their sensitive (and very expensive) equipment was unable to localize. Had the very sensitive equipment been deployed in 1900 it would have likely shown a much larger methane source at the outcrops since Oil & Gas activity has significantly lowered the reservoir pressure in all of the formations since 1950.

When the "science" outright lies about the source and the impact of one of the greenhouse gases it becomes very difficult to take it seriously.

- Is warming bad? As we come out of the Little Ice Age and move towards temperatures consistent with the Renaissance (the first time in man's history that the general population had enough wealth to support the arts and science) you have to wonder what is bad about "warmer?" The counter argument that warmer will melt the ice in Antarctica and Greenland, flooding low lying regions doesn't carry much weight with the skeptics since both Amsterdam and Venice thrived during the last warming period.
- Is atmospheric CO_2 bad? The current CO_2 concentration at Mauna Loa in Hawaii is approaching 416 ppm. Ice core data indicate that this level has been reached and passed before. Extrapolations into the previous epoch suggest that it was much higher during the time of the dinosaurs. CO_2 is the fundamental building block of all life on earth—if plants don't have it then everything dies. Many commercial growers who operate physical greenhouses dope the atmosphere to 1500 ppm CO_2 to accelerate plant growth. Current levels do not seem to be the pending catastrophe that we've been led to believe. In fact, the CO_2 levels in today's atmosphere seem to be recovering from a multi-million-year period of a CO_2 starved condition and the current shrinking of the world's deserts supports the idea that the environment is much healthier with significantly higher CO_2 than we have today.
- Leading or lagging? Several times in the ice core data, increases in CO_2 can be correlated to increases in temperature. The problem is that the temporal granularity of the data can be as much as ±100 years (it is never better than seasonal)—meaning that all of the information gleaned from a data point was laid down somewhere within two centuries. So in one scenario, temperatures rose, some of the permafrost in Siberia, Alaska, and Canada melted, millions of tons of biological material that had been frozen for centuries began to decay, atmospheric CO_2 increased. The data supports this "lagging" theory precisely as well as it supports a "leading" theory that requires CO_2 to be a cause of warming instead of an effect of warming.

If CO_2 is leading, then it takes a significant leap of faith to come up with a source of CO_2 during a glaciation period that could possibly kick start the warming process. Maybe T-Rex drove a Land Rover?

The inherent uncertainty of the timeline does not preclude either scenario, but a lagging level of CO_2 does not require a positive feedback mechanism or supplying a source of significantly increasing CO_2 levels.

- The earth hasn't warmed since the 20th century. Much has been made of the fact that all of the models from the last century predicted temperatures by 2020 that were markedly warmer than what has been observed. Individuals who extrapolated concrete outcomes from the model's predicted temperature increase, postulated increased severe weather events when in fact we've seen decreased severe weather (2013 had the lowest number of deaths from heat or cold that has been recorded since the mid-20th century). Warmists claim that this is perfectly well explained by the deep oceans warming even though we only have reliable ocean temperature down to about 160 ft [50 m] and no data at all from below 2,300 ft [700 m]. The only data that begins to explore this theory is the ARGO Program which has only been in effect since 2007.

Science vs. politics

If this were a pure scientific debate then every engineer "denier" that I've ever talked to would be cheering for the scientists to nail it down. We'd be helping. The problem is that it has become a political debate in the guise of science. A climate scientist who doesn't support the idea of ACC bringing global catastrophe will have a hard time getting published, tenure, or even a job. Few learned papers suggesting that ACC is neither real nor a pending catastrophe get published, and very few pass a peer review.

The politics are particularly insidious. Governments are doing real harm to their economies by mandating that "40 percent of the national power supply will come from renewable sources," or "CO_2 emissions from power plants must be reduced by 30 percent" or "Cap and Trade" or "Carbon Taxes." The tone of many engineers on discussion boards has been "Show me how raising my taxes, utility costs, and fuel costs will impact the climate that my grandchildren will live in." The only response is to trot out yet another computer model running on adulterated data with a potentially biased calibration.

The politicians and press may have convinced some portion of the general public that this proposition is supported in the science, but they are some distance from convincing the preponderance of the engineering community. While I can't find many "skeptics" on the engineering discussion boards who have become "warmists" or "warmists" who have become "skeptics," there have been a large number who have gone from "it's not my field, and I don't have time to think about it" to very skeptical.

This engineer's perspective

It should be very easy for the reader to tell from this document that I have a very strong bias against the actions of government to adapt the planet to the ACC Hypothesis. I'm frequently asked "but what if you are wrong; isn't doing something better than doing nothing?" This is a fair question. I've been wrong before. I'll be wrong again.

It is important to note that the output of the computer models is a deviation from a base temperature value averaged over the planet. It is very common for there to be a 200°F [93°C] variation from the hottest place on earth to the coldest place on earth at any point in time. If the base temperature at a weather station in Antarctica on July 22 is -80.2°F [-62.3°C] and the model says that July 22, 2030 will be -79°F [61.7°C], then that location has a variance of +1.2°F [+0.67°C]. At the same time if the base temperature at Death Valley in the U.S. for July 22 is 118.3°F [47.9°C], if the model predicts that July 22, 2030, will be 119.0°F [48.3°C] then that would go into the calculation as +1.7°F [+0.94°C]. The stations are averaged to come up with a "global temperature variance". The models do not predict clouds, rain, snow, any rotational event (e.g., tornados, typhoons, and hurricanes), forest fires, or volcanic activity. They "predict" a variance from local base temperatures.

Any catastrophe associated with a deviation from the base temperature has been ascribed to the climate by people asking "if the temperature goes up, what could happen?" These assessments are the result of a very non-scientific "What if?" analysis by groups of people at several universities with a vested interest in maintaining the climate hysteria. There is no link from the only "science" that ACC includes (i.e., the computer models) to the widely published "effects". Claims by "scientists" in the field of ACC that wild fires are increasing and that ACC is the cause (Impact of anthropogenic climate change on wildfire across western US forests) always include something like the statement "We use modeled climate projections to estimate the contribution of anthropogenic climate change to observed increases in eight fuel aridity metrics and forest fire area across the western United States." In other words, "we started with an adulterated data set, ran it through the climate models that predicted the highest temperatures, and then took the model temperature projections into yet another model that **proves** that increased wildfire activity is caused by ACC". All of the "scientific proofs" of the consequences of ACC are model output, and a competent modeler with an agenda can always "prove" whatever consequence that their agenda calls for.

Biodiversity reductions are an interesting consequence—no one on earth knows within at least ±500,000 species how many species of plants and animals there are on earth, no one knows how many new species emerge through mutations each year, no one know how many species become extinct each year. No one knows. There are 5 major Polar Bear populations, one of them has been counted twice. Two of them have been counted once. The others have never been counted. In other words, no one has the first idea about whether the polar bear population is increasing, decreasing, or remaining the same, to say nothing of the causes for the changes in the population. But "scientists" have written article after article about the reduction in biodiversity and the "Sixth

Major Species Extinction" (Has the Earth's sixth mass extinction already arrived?) and many skeptics ask "if it has happened 5 times, doesn't that mean that it is supposed to happen?" and "if we don't know how many species there are, how doe we know that extinction is actually accelerating?". Finally, the linked Nature article abstract says "Our results confirm that current extinction rates are higher than would be expected from the fossil record, highlighting the need for effective conservation measures." This skeptic has to ask "what makes species extinction bad or gives humans the right to try to interfere?" If we hadn't interfered with bald eagles would some other species with better survival chances moved into the top predator position since we killed off most of the bears and wolves? Of course it would have. But bald eagles a pretty and the earth would be a worse place without their beauty and majesty. "Conservation measures" are a very slippery slope and human's track record for successfully navigating it are less than stellar.

According to the Union of Concerned Scientists I **am** wrong this time. They say it is already too late to correct the damage done, we have already passed the tipping point, and the climate is falling out of any possibility of control towards catastrophe. As of September, 2013, this group claims we are experiencing: (1) Accelerating sea level rise and increased coastal flooding: (2) Longer and more damaging wildfire seasons; (3) More frequent and intense heat waves; (4) Costly and growing health impacts; (5) An increase in extreme weather events; (6) Heavier precipitation and flooding; (7) More severe droughts; (8) Growing risks to our electricity supply; (9) Changing seasons (spring arrives earlier, fall arrives later); (10) Melting ice; (11) Disruptions to food supplies; (12) Destruction of coral reefs; (13) Plant and animal range shifts. The facts of some of these things are verifiable, others are not.

Sea Level. There is an edited data set (as best I was able to find, there are no raw data sets available) at The Permanent Service for Mean Sea Level that has the data points. Extracting, reformatting, and plotting that data shows that from 1807 to 1860 the sea level at a specific station on the west coast of the U.S. dropped fairly rapidly (about 150 mm decrease over 57 years). It started rising in 1860 until it returned to the 1807 level by 1919 (150 mm increase over 112 years). It continued at about the same trend to the end of the data in 2010 (170 mm over 91 years). A change in sea level of 6.6 inches over 91 years seems like a rate of change we can adapt to. I was unable to find any actual data after 2010 (but plenty of model-output posing as data). United Nations Development Programme (UNDP) predicted in 2007 that a 3°C temperature increase would make 330 million people homeless due to sea level rising. It is now 13 years later and while there have been reports of the "first climate change refugee" looking for a new home every year since 2007; they haven't left their houses yet. Three small South Pacific Islands in the country of Kiribati that were inhabited have been flooded out, but careful analysis of the sea level in the area shows a net decrease in sea level since the 1960s, it also showed that the islands had subsided more than the sea level had risen. A 2018 typhoon (Hurricane Wanda in the revisionist nomenclature) washed away an 11-acre Hawaiian island, but there is no indication of sea level rise in the surrounding islands. Still waiting on the first (of billions apparently) climate refugee—maybe it will a proponent of ACC like Al Gore, Barack Obama, and Bernie Sanders who have all purchased

multi-million-dollar homes that current climate models would list as being in significant risk of being flooded by sea level rise.

Looking at the data for hundreds of sea-level monitoring stations shows that: (1) sea level measurements are taken adjacent to land in bays and harbors; (2) "sea level" is much more a function of the volume of fresh water flowing into the bay or harbor than any general change in

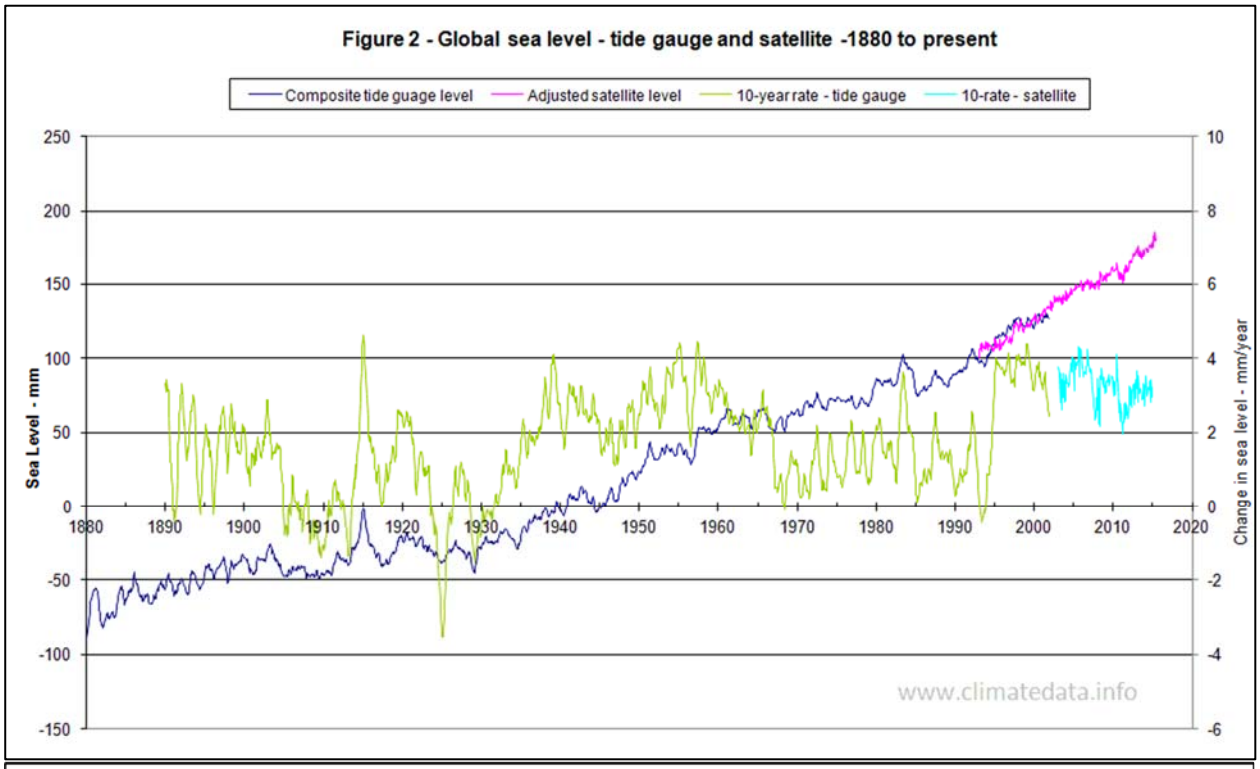


Figure 6: Sea Level Data from Climate Data Information

the volume of the ocean; and (3) there are approximately as many stations showing "sea level" falling as there are stations showing "sea level" rising. But you can do anything you want with the data (Figure 6). The explanation of the "Adjusted satellite level" in Figure 6 is "To harmonise (sic) the two data sets the satellite data were adjusted to give the same average for the period of overlap." While the cyan satellite data appears to be consistent with the tide gauge data, it was "adjusted" to match the "composite tide gauge level". It is not obvious how a dataset with a declining trend can be adjusted to a significantly increasing trend, but it must make sense to someone.

Longer and more damaging fire seasons. Fire statistics are really tough to parse. In 1994, there was a movement in the Northern Hemisphere to stop counting every ignition event as a separate fire (instead count the fires after the fact based on contiguous burned acreage). Some jurisdictions/organizations followed this, others did not. Sifting out real counts from the noise seems to be beyond most researchers, it was certainly beyond me. Most of the peer-reviewed papers I looked at fell back to model predictions after 1994. There was a paper by Marlon, et. al. that looked at historical charcoal records and found the biomass burned in wildfires in the U.S. to be largely unchanged over the last 3,000 years (and slightly down for the last 200 years).

Wildfire is a very interesting discussion. Man's ham-handed attempts to suppress and manage wildfires has led to inventories of unburned fuel in the forests that are so great that when fires start, they burn so hot that they sterilize the forest floor (increasing the time required to replenish

The New York Times

SUNDAY, OCTOBER 9, 1938

Forest Fires, One Every 3 Minutes in 1937, Burned 21,980,500 Acres at $20,668,880 Loss

Special to THE NEW YORK TIMES.

WASHINGTON, Oct. 8.—Every three minutes on the average, during 1937, a forest fire started in the United States, but the year's total of losses was considerably under that of 1936.

The Forest Service of the Department of Agriculture reported today that 185,209 forest fires last year burned 21,980,500 acres of timber and caused damage estimated at $20,668,880.

The number of fires in 1937 was 18 per cent less than in the previous year while the burned acreage was only slightly more than half the acreage burned in 1936.

The Service attributed the reduction to more favorable weather, improved fire-fighting technique, better fire detection, more cooperation by private woodland owners, the work of the Civilian Conservation Corps and less carelessness on the part of forest workers and visitors.

Ninety-four per cent of all the acreage burned consisted of unprotected forest areas and more than 11 per cent of all unprotected forested land was burned over. The 121,449 fires on lands not protected burned approximately 20,637,000 acres, causing damage of more than $18,000,000.

The average number of fires annually on unprotected areas during 138,776,000 acres of Federally owned annual loss was 33,129,000 acres valued at $33,613,000.

Fire protection is now given to 130,776,000 acres of Federally owned forest land needing protection, but only three-fifths of the 423,070,000 acres of private and State forest areas needing protection is protected by organized fire control systems.

Fires on Federal land in 1937 were restricted to an average area of 9.5 acres, as compared with the 1933-37 average of 43.3 acres. Fires on private lands showed a reduction from 48.6 acres to 23.1 acres.

Figure 7: New York Times, October 9, 1938

vegetation), and they become much more difficult to extinguish. So, one might say that man's activities have worsened the risk of wildfire, but it was absolutely through "doing something" instead of "doing nothing".

During the 2019 fire season in the U.S., 50,477 fires burned 4.7 million acres. During the 1937 fire season in the U.S., 185,209 fires burned nearly 22 million acres (Figure 7). Even with the change in reporting fire count, 22 million acres 80 years ago seems to be more than 4.7 million acres in 2019.

The next few consequences described by the Union of Concerned Scientists are all pretty much manifestations of the same thing; it is hard to distinguish between heat waves, severe weather, flooding, and droughts. "Heat wave" doesn't seem to have a generally agreed upon definition, so statistics on heat waves are difficult to acquire and claims that they are increasing are based on something other than data. If we look at environmental-related deaths as a surrogate for heat wave, the CDC Mortality Database can be queried to see that in the period 1997-2002, 16,313 people in the U.S. died from extreme cold, 8,589 died from extreme heat, 2,395 died from flood, 1,512 died from lightning, 1,321 died from tornados, and 460 died from hurricanes. Total weather-related deaths in that period accounted for 0.058 percent of the 2.1 million people who die in the U.S. each year. As a percent of population this relationship is consistent with the pre-1950 data.

When scientists look at tornados, hurricanes, and typhoons as a surrogate for extreme weather they are really grasping at straws. Remember that the models cannot predict (or even include) rotational events due to the scientist's total lack of understanding of how to solve fluids problems that include rotational fluid flow. This means that including rotational events as a consequence takes us back to the concept of "making stuff up". When they look at tornados, the data only goes back to 1954. When they look at hurricanes/typhoons our ability to even count (let alone categorize) the storms that don't make landfall only goes back to the late 1970s. Property damage from hurricanes/typhoons (in terms of dollars paid out by insurance companies) is going up, but that is a function of people building expensive structures in locations that were empty because earlier generations saw those locations as highly vulnerable and elected not to build there. Regardless of the reason, death tolls from rotational weather events has gone down. If you factor in improved early warning and extensive evacuation plans, increased deaths from rotational weather events would be a huge red flag that things are getting worse—but in fact deaths from rotational weather events has dropped to very, very low levels.

The rest of the list is far too amorphous and subjective to try to refute. In short, the risk of "doing nothing" seems to be far less damaging to the world than the proposed actions.

Man's track record at being able to manage nature has been horrible. We want to stabilize a river bank so we bring in foreign species of plant, the new species pushes out the native species and becomes invasive, we bring in a beetle to attack the invasive and it spreads out of control to the native plants, etc. We eradicate the large predators from Yellowstone, and life is so easy for the deer, elk, and moose that they congregate near the rivers, destroying the vegetation that stabilizes the river banks, clogging the pristine mountain streams with mud. We fight fires and create an abundance of fuel that turns "just a fire" into a "fire catastrophe".

If we fail to respond to ACC, and ACC is a real threat, then the result will be environmental change that engineers will be in the forefront of the efforts to adapt to. If ACC is not actually changing the climate, then sunspots, the Yellowstone Caldera, falling stones from space, or space aliens will create change that engineers will have to rally to combat. ACC is simply not the place to get proactive.

Conclusion

Before you say you "believe" in ACC remember that “Belief is the acceptance of a theory in the absence of data”. Nothing wrong with beliefs, just understand that your belief or your opinion is yours, and does not necessarily represent reality.

For every Michael Mann there is a Judith Curry. For every Al Gore there is a Jim Inhofe (U.S. Senator from Oklahoma). For every David Suzuki there is a Lord Monkton. For every Greta Thunberg there is a Naomi Selbt. For every Bill Nye there is a Jack-in-the-Box Clown. For every IPCC report there are contributors who claim their statements were misrepresented. The 97% consensus was made up from whole cloth. Before this subject got so political and began having so much money thrown at it, there were frank and honest discussions among the scientific community and people of varying views could get published or get on the podium at conferences. Not today. There are a large number of scientists who have actually lost tenure for holding opinions that the ACC story does not consider to be consistent with the narrative, and getting published with papers outside the mainstream is nearly impossible. Not the "science" of my youth.

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