Human Caused Climate Change? A Skeptical Look at the Narrative

Global Climate Models and Their Predictions

(sixth PDF of 12)

Roger Golden Brown
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Note: Please read the first PDF, *Introduction to Human Caused Climate Change? A Skeptical Look at the Narrative* first, where the intent and scope of this project are explained.

Note: Text that is indented both from the right and left (like this paragraph) is quoted from the noted source.

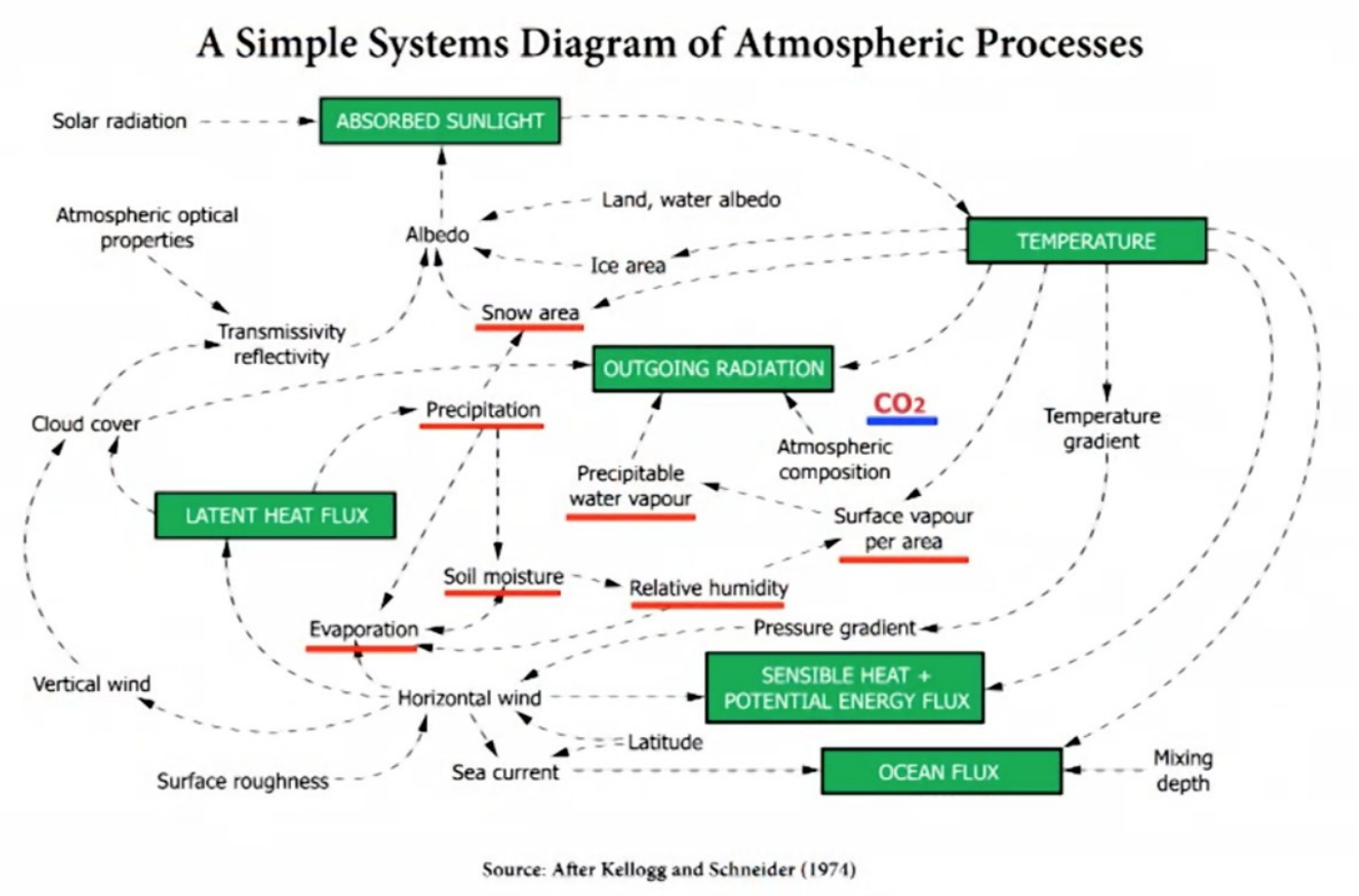
Sections

Global Climate Models

Computers are not smart. Get that idea out of your head. They can only use the information programmed into them and then only draw conclusions based on that.

In the case of a climate model they can only draw conclusions based on the relative interaction of all the elements of that particular system. And, of course, the computers can only use the data that is fed into them, which is at the whim of the programmer, who must decide which data to use or if conflicting data is used, must somehow program the computer to parse the information. Finally, the information that makes up the many aspects of the system has to be weighted and prioritized by the programmer.

The diagram below is of the system the programmer has to work with. I leave it up to the reader to decide whether they want to trust a computer model to determine policy.



Referenced below are three articles about computer climate models. The first is a detailed explanation of how modeling works by Judith Curry followed by her appraisal of climate models. The second is about how the bias of the programmer, which is unavoidable considering the dynamics of the system, influences the models. And the third is about how modelers "tune" their models to make up for incomplete data for phenomena that can't be programmed.

Judith Curry on the Mechanics of Global Climate Models

A 2017 paper by Judith Curry and published by the Global Warming Policy Foundation, Climate Models for the layman, looks at many aspects of computer climate modeling and appraises the results. First her bio:

> About the author: Professor Judith A. Curry is the author of over 180 scientific papers on weather and climate and is a recipient of the Henry G. Houghton Research Award from the American Meteorological Society in 1992. She recently retired from the Georgia Institute of Technology, where

she held the positions of Professor and Chair of the School of Earth and Atmospheric Sciences. She is currently President of Climate Forecast Applications Network.

Curry goes into all aspects of modeling but first, I will just provide an excerpt that is the first four paragraphs, explaining the mind boggling complexity:

> What is a global climate model?
>
> Global climate models (GCMs) attempt to create a coarse-grained simulation of the Earth's climate system using computers. GCMs have modules that model the atmosphere, ocean, land surface, sea ice and glaciers. The atmospheric module simulates the evolution of the winds, temperature, humidity and atmospheric pressure using complex mathematical equations that can only be solved using computers. GCMs also include mathematical equations describing the oceanic circulation, how it transports heat, and how the ocean exchanges heat and moisture with the atmosphere. Climate models include a land surface submodel that describes how vegetation, soil, and snow or ice cover exchange energy and moisture with the atmosphere. GCMs also include submodels of sea ice and glacier ice. While some of the equations in climate models are based on the laws of physics such as Newton's laws of motion and the first law of thermodynamics, there are key processes in the model that are approximated and not based on physical laws.
>
> To solve these equations on a computer, GCMs divide the atmosphere, oceans, and land into a three-dimensional grid system (see Figure 1 below). The equations are then calculated for each cell in the grid – repeatedly for each of the time steps that make up the simulation period.
>
> The number of cells in the grid system determines the model 'resolution' (or granularity), whereby each grid cell effectively has a uniform temperature, and so on. Common resolutions for GCMs are about 100–200 km in the horizontal direction, 1 km vertically, and a time-stepping resolution typically of 30 min. While at higher resolutions, GCMs represent processes somewhat more realistically, the computing time required to do the calculations increases substantially – a doubling of resolution requires about 10 times more computing power, which is currently infeasible at many climate modelling centers. The coarseness of the model resolution is driven by the available computer resources, with tradeoffs made between model resolution, model complexity, and the length and number of simulations to be conducted. Because of the relatively coarse spatial and temporal resolutions of the models, there are many important processes

that occur on scales that are smaller than the model resolution (such as clouds and rainfall; see inset in Figure 1). These subgrid-scale processes are represented using 'parameterisations', which are simple formulas that attempt to approximate the actual processes, based on observations or derivations from more detailed process models. These parameterisations are 'calibrated' or 'tuned' to improve the comparison of the climate model outputs against historical observations.

The actual equations used in the GCM computer codes are only approximations of the physical processes that occur in the climate system. While some of these approximations are highly accurate, others are unavoidably crude. This is because the real processes they represent are either poorly understood or too complex to include in the model given the constraints of the computer system. Of the processes that are most important for climate change, parameterisations related to clouds and precipitation remain the most challenging, and are responsible for the biggest differences between the outputs of different GCMs.

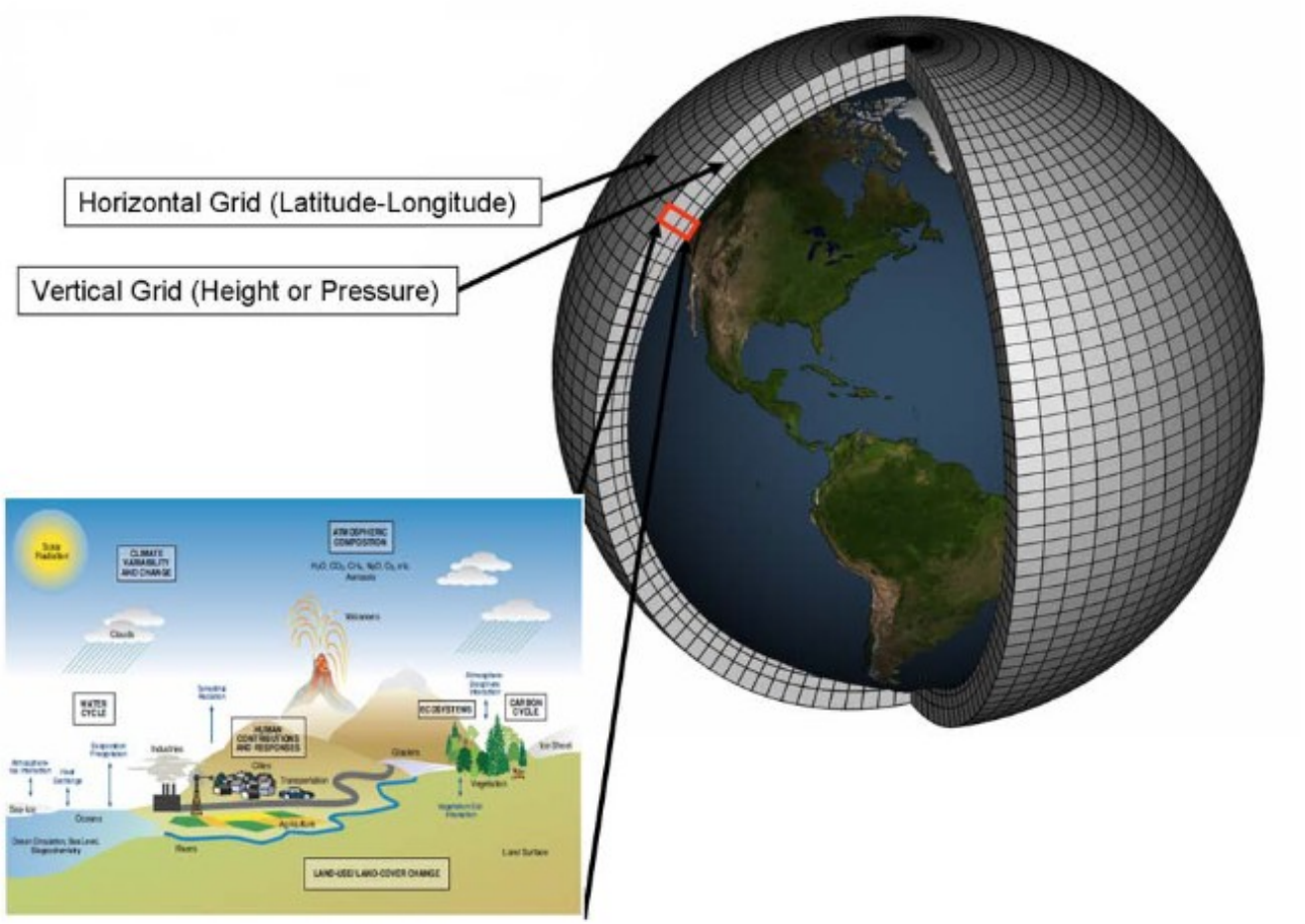


Figure 1: Schematic of a global climate model.

Judith Curry Summarizes the Usage of Global Climate Models

From Judith Curry's paper (linked to above) I will include the Executive Summary in full and leave it to the reader to explore the article to follow up on the items detailed:

> Executive Summary: There is considerable debate over the fidelity and utility of global climate models (GCMs). This debate occurs within the community of climate scientists, who disagree about the amount of weight to give to climate models relative to observational analyses. GCM outputs are also used by economists, regulatory agencies and policy makers, so GCMs have received considerable scrutiny from a broader community of scientists, engineers, software experts, and philosophers of science. This report attempts to describe the debate surrounding GCMs to an educated but nontechnical audience.
>
> Key summary points:
>
> - GCMs have not been subject to the rigorous verification and validation that is the norm for engineering and regulatory science.
> - There are valid concerns about a fundamental lack of predictability in the complex nonlinear climate system.
> - There are numerous arguments supporting the conclusion that climate models are not fit for the purpose of identifying with high confidence the proportion of the 20th century warming that was human-caused as opposed to natural.
> - There is growing evidence that climate models predict too much warming from increased atmospheric carbon dioxide.
> - The climate model simulation results for the 21st century reported by the Intergovernmental Panel on Climate Change (IPCC) do not include key elements of climate variability, and hence are not useful as projections for how the 21st century climate will actually evolve.
>
> Climate models are useful tools for conducting scientific research to understand the climate system. However, the above points support the conclusion that current GCMs are not fit for the purpose of attributing the causes of 20th century warming or for predicting global or regional climate change on timescales of decades to centuries, with any high level of confidence. By extension, GCMs are not fit for the purpose of justifying political policies to fundamentally alter world social, economic and energy systems. It is this application of climate model results that fuels the vociferousness of the debate surrounding climate models.

Computer Models and the Real World - Digital vs Analog

On the Climate4you website, Ole Humlum's website, he includes a section on computer modeling. He repeats much of what Judith Curry explained about what the programming takes into account and how it works, then expands on that. In this excerpt, from the section titled, Computer models and the real world, he explains the bias that is built in because of the complexity of the system and limitations of modeling in general:

> Global climate is in a continuous dynamic state of flux, representing an analogue system, where everything is happening simultaneously. In contrast to this, computer models are digital, attempting to solve a problem by repetitive calculations (iterations), before moving on to solving the next problem, etc. This represents a drawback for computer-based modelling of climate.
>
> While the laws of physics may be beyond discussion, it is not always equally clear or predictable which concept or process will predominate over which when a huge number of competing processes are acting simultaneously as is the case for climate. The description of the individual concepts in a model may well be correctly defined in the mathematical formulations, but the dominance or subservience of one process to others is defined by the modeller, not by the model itself. The modeller decides that issue in the way the program code is written.
>
> In the end, the computer model therefore simply mirrors the intellectual choices of the modeller and only puts numbers to them. If those choices are based on flawed reasoning or insufficient observational evidence, it is naive to believe that the model will somehow remove this fundamental problem through sheer number crunching power. That would be to attribute qualities of judgment to models which they simply do not have. In essence, a mathematical model does not relieve the intellectual burden of determining which variable or process is dominant over which. The modellers have to make a decision on this when writing the code and this choice then becomes an integral part of the model.

“It's Like Reshaping an Instrument to Compensate for Bad Sound”

An October 28, 2016 article on the Science website, Climate scientists open up their black boxes to scrutiny, has the subtitle: Modelers becoming less hush-hush about tuning, the “secret sauce” that controls fine-scale processes.

The article is not critical of modeling but in talking about the process reveals the limitations and how modelers "tune" to make up for shortcomings of the process:

In 2010, Erich Roeckner, a longtime guru behind the global climate model at the Max Planck Institute for Meteorology (MPIM) in Hamburg, Germany, was unable to work. The timing was inopportune: Deadlines loomed for an international project that would compare the major climate models with one another, and MPIM's had a bug.

Roeckner's skill was handling details like the effects of rough terrain or the formation of clouds—processes too fine-grained for models to render within the imaginary boxes, tens of kilometers on a side, into which they divide the atmosphere and ocean. Instead, modelers “parameterize” such details, coming up with equations meant to approximate their effects. When the equations miss the mark and the model strays from the known climate, scientists like Roeckner bring it back into harmony by adjusting them. Other disciplines might call this calibration. In climate science, it's called tuning.

For example, modelers tune for cloud formation based on temperature, atmospheric stability, humidity, and the presence of mountains. Parameters are also used to describe the spread of heat into the deep ocean, the reflectivity of Arctic sea ice, and the way that aerosols, small particles in the atmosphere, reflect or trap sunlight.

It's impossible to get parameters right on the first try. And so scientists adjust these equations to make sure certain constraints are met, like the total energy entering and leaving the planet, the path of the jet stream, or the formation of low marine clouds off the California coast. Modelers try to restrict their tuning to as few knobs as possible, but it's never as few as they'd like. It's an art and a science. “It's like reshaping an instrument to compensate for bad sound,” Stevens says.

Indeed, whether climate scientists like to admit it or not, nearly every model has been calibrated precisely to the 20th century climate records—otherwise it would have ended up in the trash.

Models and Forecasting

Methodology for Climate Forecasting

A report, Global warming: Forecasts by scientists versus scientific forecasts by Kesten C. Green and J. Scott Armstrong, published August 3, 2007, gives a cynical but probably accurate appraisal of computer modeling:

> The methodology for climate forecasting used in the past few decades has shifted from surveys of experts’ opinions to the use of computer

models. However, based on the explanations that we have seen, such models are, in effect, mathematical ways for the experts to express their opinions. To our knowledge, there is no empirical evidence to suggest that presenting opinions in mathematical terms rather than in words will contribute to forecast accuracy.

(Find more from this report in PDF 8, *ClimateGate, the IPCC, and Cheating Scientists*.)

New Satellite Data Only Show Half the Warming That Climate Models Do

A 2023 article by Jo Nova on her website, 40 years of expert failure: New NOAA STAR satellite temperatures only show half the warming that climate models do, explains how new data has exposed the failings of the climate models:

> An all new reanalysis of the STAR satellite data finds markedly lower temperature trends for the last 40 years. The big deal about this is that this third dataset suddenly supports the original UAH satellite data, not the other RSS system, and not the "surface thermometers" sitting near hot tarmacs and absolutely not the climate models.
>
> The warming trend in the troposphere was *only half* of what the expert models predicted. From the paper (Zou et al.):
>
> "Santer et al. (2021) reported that the multi-model averages for the TTT (Temperature Total Troposphere) trends from CMIP5 and CMIP6 (Coupled Model Intercomparison Project) were 0.28–0.29 K/decade during 1979–2019. The total TTT trend found in this study was only one-half of the climate model simulations during the same period. This is consistent with conclusions in McKitrick and Christy (2020) for a slightly shorter period (1979–2014)."
>
> Skeptics have long favoured the original UAH satellite data set that consistently showed far less warming than climate models and for good reasons (see below) — especially because UAH agreed with 28 million weather balloons. A second satellite set called RSS gradually showed warmer trends than UAH did. A third satellite set was collected by NOAA and called STAR and it agreed with RSS — at least until a few weeks ago. Now suddenly it's been re-worked thoroughly and the trend is almost identical to the UAH one.

Five Reasons UAH is Different to RSS

The following is not about models directly but is relevant to the previous article (where it was referred to) and an explanation of why the models might be wrong depending on which data they use. It is from another article by Jo Nova, Satellite battle: Five reasons UAH is different (better) to the RSS global temperature estimates:

> And so the adjustments war ramps up a notch.
>
> There are two main groups that use essentially the same NASA and NOAA satellites to estimate global temperatures. In the last year, they've both made adjustments, one down, and one up, getting further apart in their estimates. In ClimateWorld this is a big deal. Believers are excited that now a satellite set agrees a bit better with the maligned "hot" surface thermometers. But UAH still agrees more with millions of weather balloons. The debate continues.
>
> Five reasons UAH is different to RSS
>
> 1. UAH agrees with millions of calibrated weather balloons released around the world. RSS now agrees more with surface data from equipment placed near airports, concrete, airconditioners and which is itself wildly adjusted.
> 2. In the latest adjustments UAH uses empirical comparisons from satellites that aren't affected by diurnal drift to estimate the errors of those that are. RSS starts with model estimates instead.
> 3. Two particular satellites disagree with each other (NOAA-14 and 15). The UAH team remove the one they think is incorrect. RSS keeps both inconsistent measurements.
> 4. Diurnal drift probably created artificial warming in the RSS set prior to 2002, but created artificial cooling after that. The new version of RSS keeps the warming error before 2002, but fixes the error after then. The upshot is a warmer overall trend.
> 5. UAH uses a more advanced method with three channels. RSS is still using the original method Roy Spencer and John Christy developed with only one channel (which is viewed from three angles).

Leaked IPCC 5th Assessment Report Admits Failings of the Models

The IPCC publishes "Assessment" reports every few years as, ostensibly, comprehensive assessments of the state of the climate. Their first was in 1990 followed by reports in 1995, 2001, 2007, 2013/2014, and AR6 in 2021/2022/2023.

In late 2013 the IPCC leaked the Final Draft Summary for Policy Makers to some "friendly" media, that was to be officially published later that month.

Judith Curry wrote an article about it that gives a good critique of it, then refers to an article by David Rose. I will start with Judith Curry's critique of the report, then follow with excerpts from David Rose's article.

Judith Curry

From Judith Curry's September 15, 2013 article on her Climate etc. website, Leaked IPCC report discussed in the MSM:

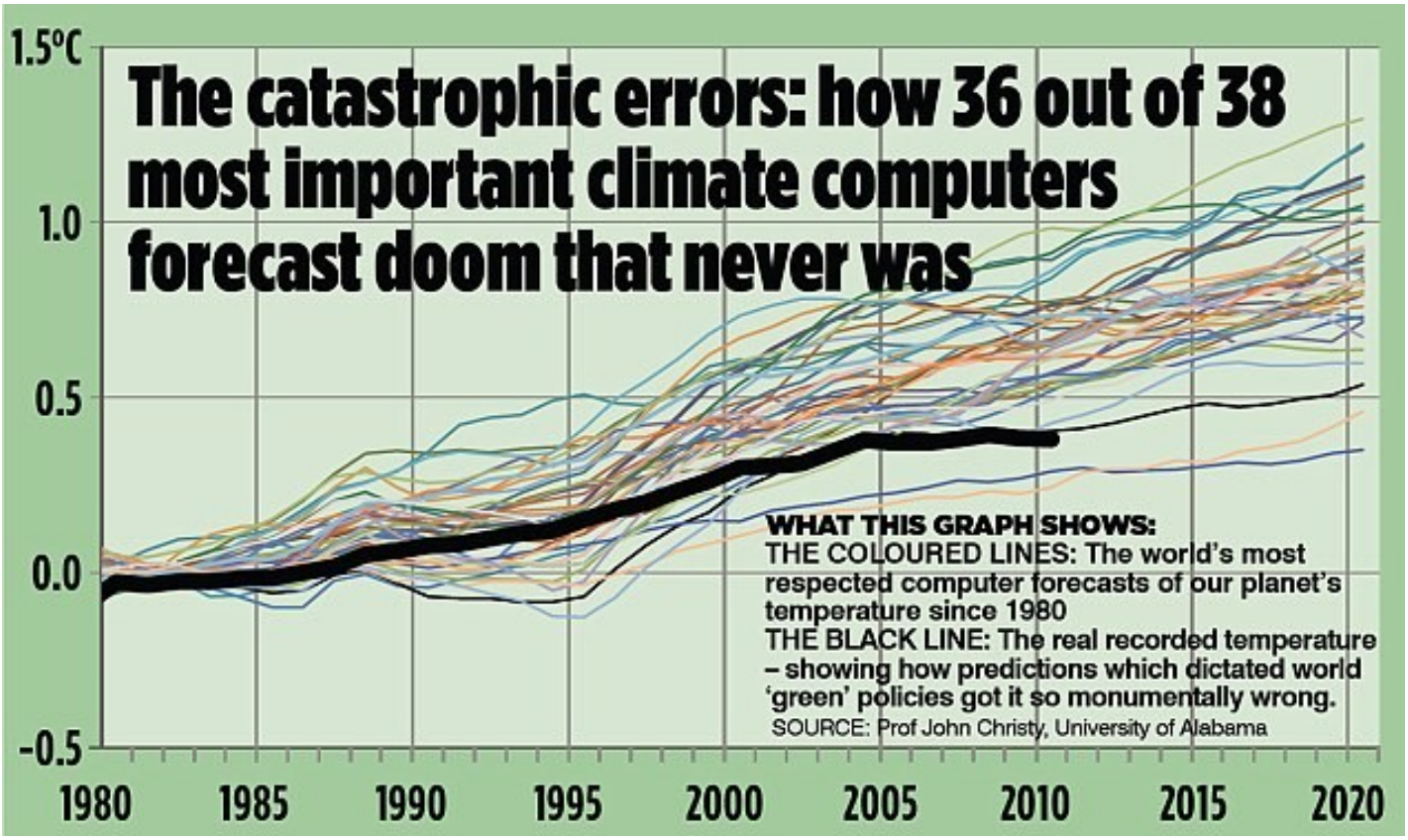
> What interests me the most about the AR5 report is how the IPCC is changing its positions and statements relative to the previous AR4 report. It is particularly interesting to see how the different drafts of the AR5 Summary for Policy Makers are changing. I am very grateful that these drafts have been leaked, as these drafts provide important insights into the reasoning behind the IPCC conclusions and confidence levels. The IPCC should of course change its conclusions and confidence levels in response to new scientific evidence and analyses. Because of the rapid pace of publication of papers over the past year that challenge aspects of the AR4 conclusions, the slow ponderous assessment process of IPCC has been apparently having difficulty in responding to and assessing all this, as evidenced by the substantial changes in the drafts.
>
> My main point is this. If there are substantial changes in a conclusion in the AR5 relative to a confident conclusion in the AR4, then the confidence level should not increase and should probably drop, since the science clearly is not settled and is in a state of flux. While there has been a reduction in either the magnitude of the change or in a confidence level in some of the supporting findings, these changes do not seem to have influenced the main conclusion on climate change attribution:
>
> *"It is extremely likely that human influence on climate caused more than half of the increase in global average surface temperature from 1951-2010."*
>
> The 'extremely likely' represents an increase in confidence from the 'very likely' of the AR4. An increase in confidence in the attribution statement, in view of the recent pause and the lower confidence level in some of the supporting findings, is incomprehensible to me. Further, the projections of 21st century changes remain overconfident. These inconsistencies seems to me to reflect a failure in meta-reasoning by the IPCC. I hope that these inconsistencies are pointed out at the forthcoming meeting in Stockholm.

David Rose

A September14, 2013 article, published on the Daily Mail website by David Rose, World's top climate scientists confess: Global warming is just QUARTER what we thought - and computers got the effects of greenhouse gases wrong, critiques the IPCC after his seeing the leaked draft of their latest report. Below are excerpts from two parts of the extensive article; first his assessment of the report, then an interesting analysis.

David Rose's assessment:

> A leaked copy of the world's most authoritative climate study reveals scientific forecasts of imminent doom were drastically wrong.
>
> The Mail on Sunday has obtained the final draft of a report to be published later this month by the UN Intergovernmental Panel on Climate Change (IPCC), the ultimate watchdog whose massive, six-yearly 'assessments' are accepted by environmentalists, politicians and experts as the gospel of climate science.
>
> Yet the leaked report makes the extraordinary concession that over the past 15 years, recorded world temperatures have increased at only a quarter of the rate of IPCC claimed when it published its last assessment in 2007.



They admit large parts of the world were as warm as they are now for decades at a time between 950 and 1250 AD – centuries before the Industrial Revolution, and when the population and CO2 levels were both much lower.

The IPCC admits that while computer models forecast a decline in Antarctic sea ice, it has actually grown to a new record high. Again, the IPCC cannot say why.

A forecast in the 2007 report that hurricanes would become more intense has simply been dropped, without mention.

This year has been one of the quietest hurricane seasons in history and the US is currently enjoying its longest-ever period – almost eight years – without a single hurricane of Category 3 or above making landfall.

Despite the many scientific uncertainties disclosed by the leaked report, it nonetheless draws familiar, apocalyptic conclusions – insisting that the IPCC is more confident than ever that global warming is mainly humans' fault.

It says the world will continue to warm catastrophically unless there is drastic action to curb greenhouse gases – with big rises in sea level, floods, droughts and the disappearance of the Arctic icecap.

David Rose's analysis, *'A Reflection Of Evidence From New Studies'... The IPCC Changes Its Story*.

What they say: 'The rate of warming over the past 15 years [at 0.05C per decade] is smaller than the trend since 1951.'

What this means: In their last hugely influential report in 2007, the IPCC claimed the world had warmed at a rate of 0.2C per decade 1990-2005, and that this would continue for the following 20 years.

The unexpected 'pause' means that at just 0.05C per decade, the rate 1998-2012 is less than half the long-term trend since 1951, 0.12C per decade, and just a quarter of the 2007-2027 prediction.

Some scientists - such as Oxford's Myles Allen - argue that it is misleading to focus on this 'linear trend', and that one should only compare averages taken from decade-long blocks.

What they say: 'Surface temperature reconstructions show multi-decadal intervals during the Medieval Climate Anomaly (950-1250) that were in some regions as warm as in the late 20th Century.'

What this means: As recently as October 2012, in an earlier draft of this report, the IPCC was adamant that the world is warmer than at any time for at least 1,300 years. Their new inclusion of the 'Medieval Warm

Period' – long before the Industrial Revolution and its associated fossil fuel burning – is a concession that its earlier statement is highly questionable.

What they say: 'Models do not generally reproduce the observed reduction in surface warming trend over the last 10–15 years.'

What this means: The 'models' are computer forecasts, which the IPCC admits failed to 'see... a reduction in the warming trend'. In fact, there has been no statistically significant warming at all for almost 17 years – as first reported by this newspaper last October, when the Met Office tried to deny this 'pause' existed. In its 2012 draft, the IPCC didn't mention it either. Now it not only accepts it is real, it admits that its climate models totally failed to predict it.

What they say: 'There is medium confidence that this difference between models and observations is to a substantial degree caused by unpredictable climate variability, with possible contributions from inadequacies in the solar, volcanic, and aerosol forcings used by the models and, in some models, from too strong a response to increasing greenhouse-gas forcing.'

What this means: The IPCC knows the pause is real, but has no idea what is causing it. It could be natural climate variability, the sun, volcanoes – and crucially, that the computers have been allowed to give too much weight to the effect carbon dioxide emissions (greenhouse gases) have on temperature change.

What they say: 'Climate models now include more cloud and aerosol processes, but there remains low confidence in the representation and quantification of these processes in models.'

What this means: Its models don't accurately forecast the impact of fundamental aspects of the atmosphere – clouds, smoke and dust.

What they say: 'Most models simulate a small decreasing trend in Antarctic sea ice extent, in contrast to the small increasing trend in observations... There is low confidence in the scientific understanding of the small observed increase in Antarctic sea ice extent.'

What this means: The models said Antarctic ice would decrease. It's actually increased, and the IPCC doesn't know why.

What they say: 'ECS is likely in the range 1.5C to 4.5C... The lower limit of the assessed likely range is thus less than the 2C in the [2007 report], reflecting the evidence from new studies.'

What this means: ECS – 'equilibrium climate sensitivity' – is an estimate of how much the world will warm every time carbon dioxide levels double. A high value means we're heading for disaster. Many recent studies say that

previous IPCC claims, derived from the computer models, have been way too high. It looks as if they're starting to take notice, and so are scaling down their estimate for the first time.

The UK Met Office's Wonky Model Predictions

Finally, one more article about the unreliability of computer models. From the BBC website, December 6, 2011, the article, Climate models yield confidence question, looks at the contradictory predictions of the UK Met Office's climate models. (Although the UK Met Office surely has a different computer now than 12 years ago when this article was written, it's worth noting that now they have one of the world's most powerful supercomputers and are a premier place for computing climate models.)

From the article:

> Now, on the fringes of the UN talks, the Met Office - at the government's request - has published a new study, Climate: observations, projections and impacts, plotting likely climate impacts on 24 countries around the world.
>
> Twenty-one computer models of climate were quizzed for answers on issues such as vulnerability to floods, rainfall changes and suitability for growing crops.
>
> When you look at the figures a little more, however, you see distinct differences in the confidence associated with each of those conclusions.
>
> In calculating the proportion of UK farmland likely to become more fertile, the models' answers ranged from 60% to 99% - pretty firm stuff - and only one projected any losses in any parts of the country.
>
> The flooding picture, however, is different, with estimates ranging from a 56% reduction in flood risk to a 180% increase.
>
> Looking into other countries, even bigger discrepancies materialise.
>
> The change in flood risk to Bangladesh - surely one of the most flood-prone countries in the world even without climate impacts - ranged from -59% to 557%
>
> Dry Egypt could be better off by 100%, or worse off by 206%.