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RESEARCH

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THE SCIENTIFIC METHOD IN CONTEMPORARY (CLIMATE) RESEARCH

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ABSTRACT

In this work contemporary climate ideas are analyzed in the light of the Scientific Method developed through the ages. The conclusion is that science was not used in this subject.

For about 25 years now, we have been living with the fear that the climate of the planet is changing in a catastrophic way, and we ourselves are to blame for it, the so-called Anthropogenic Global Warming (AGW) syndrome. The carbon-dioxide, liberated into the atmosphere from burning of fossil fuels for our industries and heating of our houses, it is argued, is rapidly accumulating in the atmosphere and this causes severe and irreversible changes in our climate system. The needed response measures are even more severe. For one, it would require large reductions in energy consumption, and until now, the level of civilization and the number of people living in the world have been directly related to energy consumption. Much effort is spent on mitigating the climate change problem. Yet it has long been argued that such problems do not have technical solutions [8]. In order to avoid disastrous unwanted side-effects, extreme care has to be taken before drastic measures are adopted. We have to be sure beyond reasonable doubt that the problem is real and not a mere figment of our imagination. For that we have science. But was science used in this case? Indeed, what is science? We will analyze here whether scientific care was taken in identifying the threat and conclude that has not been so. Far from it. We are here not to prove the models wrong, but to show that climate research is wrongly organized; is not geared towards answering the core questions.

The major source of the information on climate changes and the role of CO₂ is the IPCC (Intergovernmental Panel on Climate Change), a child of the United Nations and the 'think-tank' of so-called Alarmists.

The contemporary idea of the destructive effects of CO₂ derives from a paper by Roger Revelle who warned us in his trend-setting article in the Scientific American in 1982 [15]. He had recycled the ideas of Arrhenius of the end of the 19th century in order to justify his research program. Without going into the dynamics of the

associated politics, six years after Revelle wrote his paper, the IPCC was set up with a single mission: to determine the (magnitude) of the climate change caused by CO₂. Theoretically, it *could* have happened that they would conclude after some time that there *is* no (man-made) climate change and would have closed down. However, that is naive thinking, for the simple reason of organizational behaviour. In management we have The Law of Angus, also called Angus' First Law: All human organizations tend to be self-amplifying. There is an effect which hampers all corporations, even the most effective ones. It is the natural tendency of any organization to become ever more like what it already is. This is called the "self-amplifying" tendency. "The longer an organization has spent becoming more as it is already, the stronger is the force to pushing it in the same direction – like matter being sucked into a black hole. Eventually it will lose the ability to change at all, without recognizing how it happened".[3] The IPCC suffers from this phenomenon. It is an ever-growing political body of fanatics devoted to the one idea: "The climate is changing and humans are the cause". This is also called an *idée-fixe*, when people no longer want to listen to reason. Or, as Churchill formulated it, "A fanatic is a person that cannot change his mind and does not want to change the subject".

The main problem is that IPCC scientists look for *proof* of their ideas. This is quite common in research. We all have an idea of how our subject under study should work, and start measuring until we produce graphs that prove our ideas. That is why the scientists involved found nothing wrong in the e-mails of IPCC researchers, now labelled ClimateGate, which showed that they demanded from each other the production of nicer data to convince the public at large that Anthropogenic Global Warming was real. Yet, the question remains: is such research morally acceptable? Can it still be called 'science'? Does it follow the scientific ethics? This brings us to the main point. What is 'science'? In our Faculty of Sciences and Technology we ask our colleagues, what is 'science' and what is 'technology'? There are no easy or useful answers.

We should go back to the heroes of science. Heroes from times when science was still science and there were 'universities' and 'technical college' – a distinction that also has disappeared – and when a graduate in sciences had a PhD (a philosophical degree) and a graduate in engineering was an engineer, the two clearly distinguishable professions without one being classified superior to the other.

One of these heroes, and our personal favorite, is Richard Feynman. He summarized some essential elements of science (basically Karl Popper's empirical falsification definition of the Scientific Method [14]), see for instance his inaugural speech at Cal-Tech in 1974 or his book *The Character of Physical Law* [5,6]:

1. Once developed a 'hypothesis', an idea or model of how nature works, effort should be spent on finding out where and how the model *fails*. Moreover, Feynman added: It has to be mentioned by the designer of the model not only whether the model is correct, but also where it is on thin ice. "In other words, we are trying to prove ourselves wrong as quickly as possible, because this is the only way to make progress"[6].
2. The creators of the model should convince the readers that it is the *only* model that can explain reality, the data.

3. The model should include a verifiable prediction of an event happening in the future, for instance an experiment that can be done and the outcome of it. “Science is only useful if it tells you about some experiment that has not been done; it is no good if it only tells you what just went on”[6].

Generally speaking, the Scientific Method includes the possibility of proving ideas wrong. Note that a single piece of evidence can prove a theory wrong, while a million pieces of evidence cannot prove a theory correct. Where Taleb describes it as “There is no such animal as corroborative evidence”[17], Einstein states “No amount of experimentation can ever prove me right; a single experiment can prove me wrong.” (Remember this, next time you hear somebody use consensus as an argument. The word ‘consensus’ cannot be used in combination with a scientific statement). Or, to put it in another way, a theory is correct until proven wrong; Newton was entirely right until Einstein came along with his theories of relativity. In another famous work of Einstein, concerning the photoelectric effect, his theories were under heavy scrutiny by ‘skeptical’ Millikan who did not believe them. “American physicist Robert Millikan set out to disprove Einstein’s model, and wound up confirming it in every detail. Einstein and Millikan each got Nobel Prizes out of the deal”[12]. Note that in the old days, you could apparently also get a Nobel Prize for being wrong, as long as you applied the scientific method in your research.

The above may be complemented by the ideas of William of Ockham and Saint Exupéry who both stated that a model describing reality should not be more complex than necessary. This, in a way, is another form of restating the second part of the Scientific Method outlined above. If a model has spurious, unnecessary elements, it is undoubtedly not the only model that can explain reality, because at least two models may exist: one with and one without the decoration. In that case, the simpler one is taken to be the correct one, even though both may explain the data.

One more essential of sound science, which should not be ignored is:

4. Other scientists are able to repeat the work presented, so-called ‘replication’. Science should not be a matter of believing or trusting that our colleagues did a good job. Scientists have the obligation to present their case in such a way that we can repeat their experiments and trains of thought. It is not sufficient to say “Here are the results of our simulations and analysis”. Remember Feynman: “You cannot prove a vague theory wrong”[6].

Finally, it is important to note that, contrary to technology and engineering, science is not aimed at making the world a better place, other than in a philosophical sense of assuming that the world is better if we understand it more. In Einstein’s words “Anyone who thinks science is trying to make human life easier or more pleasant is utterly mistaken.” The question therefore arises is: Do members of the IPCC have an urge to make the world a better place? If so, they have the profile of an engineer, not of a scientist; they are more like Da Vincis than Galileos.

This definition of science can be applied to climate research. In our study of the literature, we have never found a single member of the IPCC (or any Alarmist) guilty of applying the Scientific Method. Nowhere did we see signals of trying to find evidence that points against the idea of AGW. Everywhere we note publications (in journals and on blogs) that present corroborating data, or where non-corroborating

data are either explained away – that is interestingly by somehow applying the Scientific Method to the *opposite* hypothesis – or factually altered. One example is the CO₂ summary by Beck (a skeptic) and the reply by the Alarmist RealClimate blog[1]), but the most flagrant example is the famous ‘Hockey Stick’ that was constructed in 2001 to prove global warming. The Hockey Stick is the Millennial Northern Hemisphere temperature reconstruction showing no warming until the beginning of the 20th century and sharply rising temperatures since. (see Figure 5 of Ref. 9) The proponents of this graph forgot to tell the readers where the model fails. These failures are not tiny details but impact the core of the AGW model. For instance, the correlation found between CO₂ and temperature, upon scrutiny, reveals that the CO₂ is *lagging behind* the temperature by some hundreds of years.

Communications that try to critically analyze the AGW hypothesis come from people who are called ‘skeptics’. That is not surprising, because skepticism is as close to the definition of the Scientific Method as one can get; a scientist is an auto-skeptic. For every idea that is postulated, a skeptic looks at it and tries to find where the reasoning (might) fail. Or, as Descartes wrote: “Doubt everything, until that which cannot be doubted is left”. Woods, in his History of Philosophy describes it as: “The very process of scientific controversy, discussion, constant re-examination of positions, backed up by observation and experiment, leads to a deepening of our understanding and a closer approximation to the truth”[18]. In other words, doubt, discussion and skepticism are the sound elements of science.

There are some excellent skeptics who deserve, in our opinion, the next Nobel Prizes for being the ‘Last of the Mohicans’ defending the scientific method, while many others are just data engineers in search for proofs of given ideas. Examples include Steve McIntyre, Anthony Watts and Dr. Roy Spencer. We recommend visits to their blogs. Even if they are not always going to be correct, they are scientific in their approach.

In contrast, the IPCC reports often contain parts labeled ‘The Scientific Basis’[9], which always turn out to be the ‘engineering basis’, or at best the ‘research basis’ - research and science are often confused - where the data collection, processing and modeling are presented. Whatever you want to call it, this is not science. Thus, we conclude that the IPCC is not applying the major first component of the scientific method, the search for proof *against* its own ideas. What about the other parts? What about the uniqueness of their predictions and their verification?

In 2001, the Third IPCC Report spoke of an accelerated heating up of our planet. The media reported then that the conclusion was that the warming of our planet occurs at a rate faster than predicted before. This came three years after the warmest year in recent history, the year 1998. In 2001, the data point 1998 was considered a normal point, part of a series, a trend of accelerated temperature rises. A fit to the data up to 1998, in their model, resulted in a temperature rise of 2 to 4.5 degrees until the end of the 21st century. All temperature variations were caused by human activity. The natural fluctuations were deemed tiny and insignificant, see Figure 4 of the 2001 IPCC Work Group 1 Summary for Policymakers [9] or Fig. 2.5 of the 2007 IPCC Synthesis Report [10]. The conclusion in 2001 was that 1998 was a warm year and, without any margin of doubt, the world would continue warming up. The Hockey Stick (Fig. 1 of

2001 IPCC-WG1) also left no room for doubt or the possibility of a near-future cooling of our planet, as the reader can easily verify.

In the meantime, Earth has not been warming since 1998, for the past decade-and-a-half which actually makes the period of ‘post-industrial’ non-warming about equal to the period of warming. The IPCC now faces a huge problem. Their predictions have failed miserably and their models and ideas should be rejected without remorse. IPCC research does not meet the third criterion of the scientific method, namely containing a verified prediction. That is, it *did* include a verifiable prediction that can act as a judge, but the outcome was that the prediction – and thus the model with it – failed.

However, it is difficult to stop a running train and considering Angus’ First Law, the IPCC must continue giving itself a justification for its existence by adjusting the predictions by way of retrodiction. IPCC researchers can now easily ‘predict’ data retroactively. This is a pseudo-scientific method called Bayesian inference, named after the mathematician Bayes. In this approach, parameters (and models) are constantly updated to change the predictions retroactively; thus ‘predicting’ the historical data correctly, but continuing to fail to predict the future.

The conclusion must be that the IPCC never managed to convince a scientific audience that its models are the *only* ones that can predict the climate, since there now exist an apparently wide and diverging range of models that can all retrodict the existing data up to a certain point. They never even bothered to convince us that the existing alternative non-AGW models were wrong. Many alternatives exist to model climate: cosmic radiation, solar sunspot cycles and magnetic fields, and even (believe it or not) divine intervention (which we can scientifically interpret as ‘the universe is rolling dice’).

The Bayesian approach is not only applied to the models and the data. Even further, it is now applied to the rules of science itself. An example is given by Stott, *et al.*, who analyzed weather events. They write: “Currently, attribution of single extreme events to anthropogenic climate change remains challenging. In the past it was often stated that it simply was not possible to make an attribution statement about an individual weather or climate event. However, scientific thinking on this issue has moved on and now it is widely accepted that attribution statements about individual weather or climate events are possible provided proper account is taken of the probabilistic nature of attribution [citation of a *Nature* editorial]”[13]. This text of Stott *et al.*, apart from being quite insulting to earlier (more stupid, or just more careful?) scientists of the past, finishes with a mis-citation of a *Nature* article [11]. Actually, the article referred to does not mention that “attribution statements ... are possible ...”, but only that the public would like to *hear* such statements from scientists. There is a market for them (and this gives Stott and coworkers a *raison d’être*).

This abandonment of the scientific method in general – not only for the climate – was also studied by Hansson in an analysis of 70 papers in the *Nature* journal in 2000[7]. Hansson argues that not all science can be done in a null-hypothesizing way. He concludes that the majority of papers in *Nature* is not of this type. All swans are white, let’s try to find a single black swan that would falsify the hypothesis, where a million white swans would not prove it. He claims there is also a science of the type asking ‘what is the color of swans’? (In fact, he classifies science by four parameters,

apart from the yes/no aspect). However, such research is not science, but is a work of tallying as for example done by a statistical (governmental) agency. A scientist would divide his dataset in two distinct sets, a ‘learning set’, to define a model, a null-hypothesis (e.g., all swans are white), and a ‘test set’, to check if the model (null-hypothesis) is correct, or at least if it cannot be rejected. Remarkably, apparently very few ‘science’ papers, even in one of the most renowned journals, are scientific.

The IPCC has cleverly converted the scientific binary testing hypothesis – “Does AGW exist?” – into a non-testable question “How many degrees does it warm up?”. Probably without knowing it, they have abandoned the scientific path. Can the idea that the planet will not warm with doubling of CO₂ in the atmosphere be excluded? Was this tested? Actually, the null-hypotheses ‘no warming’ and ‘continuous linear warming’ (in the last century) have both not been rejected, yet, even while these models are simpler [2].

As a side remark, the correct engineering approach of data simulation and fitting is the following procedure: Include a virtual point for the year 2100 with a large excess of CO₂ in the atmosphere, but without a temperature rise and then try to fit it by adjusting the parameters. As far as we know, nobody has ever tried this approach, which is in itself quite informative.

The atmosphere is a very complex system, perhaps the most complex system studied by man. Nobody can claim to understand it well. The research approach is more trial-and-error than solid reasoning. The procedure is very similar to the way the weather models are developed. In fact, the biggest climate-studying centers are linked to weather-forecasting centers and use the same equipment such as super-computers. An example is the Met Office in London, the seat of an IPCC nucleus, the Met Office Hadley Center. The IPCC is in fact not only the child of the United Nations but also of the World Meteorological Organization. The result is that the climate is studied with non-climate tools such as finite-element simulations. “If you have a hammer as a tool, you see all problems as nails”.

As we have argued, such finite-elements models incorporate a limited set of parameters, parameters that need no physical justification, but are found by adjusting the retrodictions to the historical data until they are consistent with them.

To give an example, it can be calculated that, in a simple model with straightforward physics laws, the climate sensitivity to CO₂ is about 50 mK for a doubling of its concentration in the atmosphere relative to the current level[16]. We can call this the (open loop) ‘gain’ or ‘response’ of the system, $A = (50 \text{ mK})/(400 \text{ ppm})$. This falls way short of the IPCC predictions of several degrees. How did they manage to engineer such high predictions for the temperature changes? The answer is that they include (positive) feedback in their recent models. In feedback, part of the output signal (temperature in this case) is fed back, with a factor β , into the input signal (in this case [CO₂], the square brackets indicating concentration). As feedback theory tells us, the total gain of the system $\Delta T/\Delta[\text{CO}_2]$ with feedback is given by $A/(1-A\beta)$, as the reader can easily verify in Fig. 1. By tuning the parameter β , that has little or no physical basis or justification, *any* overall sensitivity can be simulated. For instance, to get a 5-degree climate-sensitivity of doubling of [CO₂], a β of $(99/5) \times (400 \text{ ppm/degree})$ can be used.

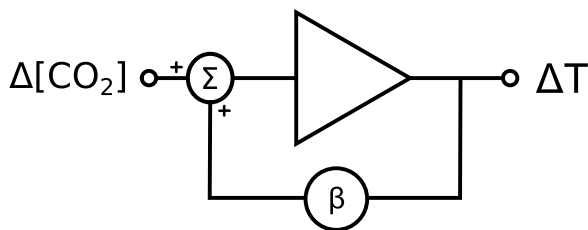


Fig. 1. Feedback, with response A and feedback factor β linking temperature changes ΔT to $[\text{CO}_2]$ changes

The model can thus easily be adjusted to retrodict any temperature variations and ‘predict’ any desired future temperature rise. An additional feature of positive feedback ($\beta > 0$) is that the system is unstable – there where negative feedback ($\beta < 0$) is stable and actually diminishes the overall gain/sensitivity of the system, as the above equation easily shows. That explains why the IPCC uses wording like ‘point of no return’, etc. That while the climate, as any observer can readily understand, is a stable system, since it always recovers from huge temperature (and CO_2) excursions every day and every year and was not even affected much by 25% less radiation input from the Sun in the distant past.

In reality, the finite-element simulations of the IPCC have of course many more parameters – the model is obfuscated and not known or understood even by the researchers themselves, i.e. a vague theory – but the idea is basically the same. With this in mind, we look at the remarkable predictions of the IPCC in another way. Their models include a set of tunable parameters, most without clear physical justification – because the physics of the atmosphere and the climate in general are far from being understood by humans, see for instance the El Niño events that have to be introduced *a posteriori*. This is similar to what is done for weather predictions. There it has taken about 10 thousand iterations (the weather-span is some days) to get a mere 5-day prediction reasonably correct. Using the same approach to the climate, it would take the same number of iterations of 30 years climate predictions – about 3000 centuries – to get a reasonably correct answer. This is therefore a wrong approach and we are not surprised that the predictions of the IPCC have not yet ‘hit the mark’. Not are they likely to do so in the foreseeable future.

Finally, we note that the IPCC and its climate/weather simulators, present their conclusions in a fuzzy way -always presenting the outcome only and never showing the steps that led to their conclusions. An outsider can never repeat the study. In this way, we cannot analyze *where* the reasoning fails, we only see *that* the reasoning fails somewhere by comparing the predictions to reality. It is similar to the case of spiritualists described by Engels in his *Dialectics of Nature* [4]. Today we may find spiritualism ridiculous but willingly accept similarly vague ideas of human-caused climate changes. We conclude that the Alarmist research fails to meet all four fundamental criteria of the Scientific Method and can hence not be called ‘science’.

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