# Climate PMP Report, August 2012

by Prof. Christopher Essex

## Introduction

Climate modeling has been among my many research pursuits as a professor of applied mathematics. I began working on it in the 1970's, including being part of the Canadian General Circulation Model (GCM) group of the Canadian Climate Centre. I was not satisfied with models on physical grounds thirty years ago, so I returned to more fundamental work that was needed before they could be made better. The very best of them were then, and are still now, not good enough for what has become expected of them. It's a little-known fact that all climate models are inherently didactic and not prognostic. This is obscured by the unusual usage of the term "model" in climate research. A friend in astrophysics asked me about this. After he develops a model for what goes on with some star or some nebula he, or an opponent, looks for observations that contradict his model; that is, his model could be shown to be wrong. But climate models are not falsifiable in the sense of Karl Popper.

Many of my skeptical friends attempt to catch climate models in false predictions. But this is a romantic notion. There is no observation or experiment that can be performed that will invalidate a climate model. Any deviation between observations and model behaviour can be simply fixed by tuning the empirical parameterizations without necessarily gaining any deeper understanding, assuming such deviations are not just dismissed outright. The models don't even agree with each other in many important features, such as clouds for example.

But even if you can get them to agree, one empirical treatment may do as well as another, since none of them need to fully respect the actual physics. Moreover, without future climate data, how do you know whether they are all agreeing on the wrong thing or not? One has no data to check against future climates because we have not experienced them. But it is a modern conceit that the same climate dependent empiricism of today will work as well in a different future climate. With that thought in mind it makes no sense to look at the average across models, although, perhaps out of desperation, that has been and is being done.

If we reject empiricism and we use the basic physics to do proper computing, as we teach it to our students with all structure above the grid scale, then the computation time becomes much longer than the age of the Universe! So empirical models are the only possibility for anyone, no matter how clever. This does not mean that climate models have no value. It does not mean that they cannot provide useful insights into the science of climate. It does not mean that climate models are not the best we have or the state-of-the-art—they are the state-of-the-art! But the state-of-the-art can't tell us what the future is going to be. I note here that there are many people who have made full careers making specific predictions about climate, ostensibly backed up by what climate models actually cannot do. This is a warning sign that something is wrong.

In case you think I am the only one saying this, here is the consensus position from the full scientific component of the third assessment report of the IPCC.

> In climate research and modelling, we should recognize that we are dealing with a coupled non-linear chaotic system, and therefore that long-term prediction of future climate states is not possible.[1]

You may not have heard this extremely important quote from the so called consensus position of the IPCC. If that is so, why.

**Climate, Complexity, and Culture**

There is indeed something wrong both with climate science and how our culture deals with it. The IPCC is part of the problem certainly, but in spite of its problems (as Dick Lindzen rightly points out) the worst of what we have to deal with is not the IPCC scientific reports themselves. Many aspects of them are not too bad, and even the most egregious parts of them (and there are some) are small transgressions compared to the crazy cultural and political reactions to them (a 2012 example: melted streetlights in Oklahoma were attributed to global warming). There is a relentless torrent of this kind of nonsense.

Climate dynamics viewed from a meteorological standpoint is governed by a mathematical complex system. Loosely speaking, such complexity refers to mathematics, or properties of the natural world, that defy all of our best tricks to make them simple. Is there always a simple rule that can get you a particular value of a solution of a differential equation without integrating to it from an initial condition? The answer is probably no, and the solutions of chaotic dynamics are among the best known examples. If you can prove that the answer is indeed no, by the way, this is the famous P--NP problem, which is one of the Clay Millennium problems of fundamental mathematics. There is a million dollar prize for a solution.

Simple chaotic dynamics is child's play compared to the climate problem. So then why has such a fiendishly complex, unsolved problem of physics and computation become regarded as solved with such certainty? Some reasons are political for sure. Certainty as a slogan is a byproduct of the "orchestration" of scientists for policymakers. But the real reason why is that people do not understand what "complexity" means to modern science. Everyone prefers a simple world to comprehend, but for complex systems you can't have it. This was a stunning discovery that the scientific community grappled with throughout the 1980's and 1990's. It was a scientific revolution, which we are not quite over. The significance of complexity and nonlinearity of the climate system is an even more challenging idea for the public at large.

No matter how good the explanation of complexity is, it is hard to find a forum to explain it in, and even if you do, there is considerable resistance because of false intuition. The "shoe box" model for climate, illustrated in the cartoon, provides this intuition. The scene is in a school yard because plastic wrap over a shoe box is actually used widely in schools to explain the climate problem itself to children.

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[1] The Intergovernmental Panel on Climate Change (IPCC), third Assessment Report (2001), Section 14.2.2.2, page 774.

But the shoe box is not how climate works. The shoe box delivers simplicity instead of complexity, in addition to other infectious misunderstandings. The powerful subtext for the children, and the grown-ups they become, is one of anti-complexity. The real-world complexity has been swept away by making the problem purely radiative, which it most assuredly is not. This is a metaphor that has replaced the thing itself. While such things are not unheard of, the enormity of it, in connection with the climate problem, is unprecedented.


If this is the secret picture in the back of your mind for how climate works, juxtapose it with the IPCC quotation. That is another warning sign that something is very wrong.

**Broken Science and Politics**

You may know that some scientists have been distancing themselves from their former positions on the climate change canon. Consider the 2012 remarks of James Lovelock, a guru of the environmental movement, and the originator of the Gaia idea. This is from an interview with the american MSNBC channel:

> The problem is we don't know what the climate is doing. We thought we knew 20 years ago. That led to some alarmist books – mine included – because it looked clear-cut, but it hasn't happened...We were supposed to be halfway toward a frying world now..

He words it like a recent discovery, but 20 years ago we did know that we didn't know. It was never clear cut! But those of us who tried to point this out then had a great deal of trouble getting anyone to listen. Why.

A century from now, historians may still be arguing about this. But what we do know is that there has been a sustained assault on simple basic principles of science and it originates from the world of politics. Some of it, but not all of it, may even have been unintentional collateral damage from other political actions because politicians don't understand or care about scientific ideals. But both scientists and the general public have become extremely confused about where science ends and politics begins as a result.

There is a popular, but naive, idea that science has no internal controversies of its own. But disagreements are inevitable, because if there is no room for doubts or questions, then what starts as science degenerates into dogma and ceases to be science at all. Skepticism is

among the most basic components of a scientific mindset. Where skepticism is under attack there is no science.

But for climate work, skepticism itself has become depicted as wrong. This is political thinking, which leads to all manner of thoughtless actions, dirty tricks and even actual threats. I won't dwell on such things here. But the Climategate emails proved what many of us already knew. This political thinking had grown into a large scale phenomenon, even penetrating into the scientific world with many participants cooperating to manipulate, intimidate, bully, and conceal undesirable results.

Erice was not insulated from this. I am proud to say that there is an email that complains about Skeptics, with a capital "S," at Erice, as if Skeptics were a political party. The author makes himself sound like a political lobbyist. I am proud of this because, while a skeptic is a person, skepticism is a trait that all scientists need to do their work. It is not an ideology. It is a virtue and a talent, not something to be railed and struggled against. All scientists should be skeptical. Only fortunetellers and scoundrels rail against "skeptics."

It is only necessary here that you understand that we have a significant problem and that we have a chance to fix it before it is too late.

**The PMP Meeting**

The climate PMP meeting was set against this background, including ten presentations and discussion sessions. We were most honored to have Dr. Vaclav Klaus in attendance, present as a private citizen, for much of the meeting.

Three special themes where put forward.

1. Disentangling politics and science.
2. Developing a better alternative to the precautionary principle.
3. Fostering good science hurt by current policies

Points arising from the meeting:

Climatology is in the unusual position that a politically-appointed organization, the UN Intergovernmental Panel on Climate Change (IPCC), has been given the authority to review ongoing work and, at regular intervals, issue judgements about the credibility of published scientific findings, decide among rival hypotheses and declare a consensus of experts. There was extensive discussion about problems arising from the existence and institutional dominance of the IPCC, its questionable review procedures and its role in polarizing the field of climatology. The following suggestions arose:

1. Criticisms of the IPCC were made by the InterAcademy Council in a 2010 report. These focused on potentially serious problems of lack of transparency, especially in author selection, and deficiencies in the peer review process, among other things. Even though the IAC was itself compromised as not being truly independent of the IPCC and not taking sufficient evidence from IPCC critics, its report nevertheless identified some genuine flaws and made important recommendations for reform. Regrettably the IPCC has dismissed

most of the recommendations out of hand, and indeed has enacted new procedures that decrease transparency further.

2. There is no compelling rationale for the existence of Working Groups II and III within the IPCC. They focus on issues of policy and politics, making it more likely that the entire organization will subordinate science to policy advocacy. Support was expressed for abolishing both Working Groups and bringing the IPCC's focus back specifically to objective questions in physical science.

3. Increasing polarization of the scientific community is exacerbated by academic societies issuing position statements on behalf of their members, without giving members the right to sign or not as individuals. This phenomenon stifles free inquiry and is antithetical to the principle that scientists should think and speak for themselves, and not be forced to conform their opinion to an administratively-imposed dogma. This principle is already formally adopted by, for example, the American Economic Association. It also ought to be the logical consequence of the motto, *Nullius in Verba*, of the Royal Society. But such enlightened policy has not been realized by that organization.

Scientific issues discussed included climate sensitivity, which included a very interesting discussion on sensitivity from Dick Lindzen suggesting an unexpected dynamical consequence to the magnitude of climate sensitivity. Also notable was Henrick Svensmark's latest results on cosmic ray induced aerosol formation. He has been able to close one of the most crucial gaps in the aerosol idea---a very exciting scientific result involving the radiation induced catalysis by sulphuric acid.

**Concrete Project Suggestions Discussed in the PMP**

1. Robustness and Resilience.

You may recall that this topic escaped embargo with some enthusiasm in Monday's session.

This project suggestion followed from theme 2 (a replacement for the precautionary principle). The heart of the notion is that uncertainty and nescience are qualitatively different (recall the sheep farmer who went to the Falkland islands to avoid war--that's nescience). These two things imply different policy responses. The goal would be to use expertise with, for example, modern dynamical systems theory, and the theory of risk, to formulate simple (not complicated) principles or guidelines for formulating policy.

2. The Climate Forecasting Prize

Ross McKitrick noted in his Monday presentation that climate modelling is not "incentivized" for forecasting. He proposed a taxation approach that might affect modelling positively. But the presumption that good forecasting already exists is inherent in the very premiss of the climate change issue. Such underserved confidence has even induced calls for offices of climate forecasting to be instituted!

However, in the PMP meeting, data from individual climate models showed, as we would expect, that they are far from being able to do what many people believe they can do or

would wish them to do. They really are more focussed on the needs of policymakers instead of how well they can actually forecast with money at stake.  But rather than argue endlessly over whether such forecasts are even possible or not, there is a clever way to push the discussion to a more pragmatic level: give a prize for actually doing successfully what is in doubt. But is it possible to define an intelligent criterion for what an accurate long-term forecast would be? Perhaps it would involve some climate version of meteorological skill. A substantial prize would be offered to the first person or team able to achieve it.

We are thinking in terms of more than $1 million over, say, 10 years. But it would take some time to elaborate and  the idea needs some development to confirm that the prize plan is possible to do and to do well.