Climate Science Continued

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The December 2014 issue of *Perspectives on Science and Christian Faith* carried two articles on current climate science. The present author challenged some of the basic assumptions and the conclusions following from them,[1] while Thomas Ackerman presented the familiar consensus position of the reports of the Intergovernmental Panel on Climate Change (IPCC).[2] Now I would like to respond to Ackerman and further emphasize why we should not depend on the predictions of climate models used in the 2013 Report, which I will refer to as IPCC2013.[3]

There is no doubt that our climate is changing, as it always has. Also, I am sure that adding CO_2 and the other minor absorbing gases (CH_4, N_2O, and CFC's) to our atmosphere increases the earth's temperature and that temperature has risen during the last 250 years. The central issue is how much of the temperature rise from 1970 to 1998 is due to natural causes. The abrupt slope changes in the global surface temperature curve in figure 1 of my previous article[4] show that these effects must be important and most of the hypotheses to explain the present plateau in the temperature attribute it to various natural phenomena absent from the models. The IPCC statements that human activity is the dominant cause of the temperature rise are based on comparing models with and without the anthropogenic gases, but now we know that the models omitted many possible natural causes. In any case, this wide range is not very useful. If the fraction is 95% anthropogenic, we have a serious problem, but if it is close to 50%, we very likely can adapt without major economic disruption.

We are told that the predictions of disastrous global warming caused by human activity are based solidly on science, so it is appropriate to review that science. Central to the scientific method is the development of a theory to explain some aspect of the natural world, and then testing it by predicting new results of experiments or observations not used in the formulation of the theory. In the case of the climate models used by the IPCC, simply reproducing past observations is not a test because these models depend on hundreds of parameters to represent phenomena too complicated to put into the computer codes. These parameters are calibrated by comparisons with past observations.

A high-priority goal of climate models is to predict how the mean global surface temperature anomaly changes with the rising concentrations of CO_2 and similar gases, but the lack of any temperature increase since 1998 continues to challenge the models. Ackerman explains the divergence by the stochastic nature of climate

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and recognizes that these processes are not occurring in the models in the same way as in the observations. In models tested with perturbations, the perturbations seem to average out after a decade or more, but it remains a hypothesis that our climate will do the same because it depends on many stochastic phenomena omitted from the models. The proposed time scale necessary to see the global climate average keeps increasing with the duration of the temperature plateau. Furthermore, the wiggles in the IPCC plots for individual models have a pattern rather different from the almost constant temperature of the twenty-first century.

Besides being stochastic, climate is expected to be chaotic in that it jumps from one approximately stable state to another, rather like the observed temperature. IPCC2013 recognizes the problem by the statement, "There are fundamental limits to just how precisely annual temperatures can be projected, because of the chaotic nature of the climate system" (FAQ 1.1, p. 140). However, there is no indication of how long the models are valid even though predictions often are shown to the year 2100.

As we continue to add CO_2 to our atmosphere, global temperatures eventually could start to rise again, or they could fall if the present weak solar activity continues. Until we understand the cause of the plateau we will not know how much of the rise is due to human activity. Whatever happens to future temperatures, there remain serious difficulties with the present climate models. The physics of climate requires a multitude of nonlinear differential equations, yet the models assume without justification that linear approximations are valid for predicting the future.

Ackerman described climate models "as straightforward applications of the laws of physics and chemistry."[5] This is true in a broad sense, but the physics quickly is overwhelmed by the adjustment (tuning) of hundreds of parameters to match a model to the real world. According to IPCC2013,

> Model tuning aims to match observed climate system behavior and so is connected to judgments as to what constitutes a skillful representation of the Earth's climate. For instance, maintaining the global-mean top-of-the-atmosphere energy balance in a simulation of pre-industrial climate is essential to prevent the climate system from drifting to an unrealistic state. The models used in this report almost universally contain adjustments to parameters in their treatment of clouds to fulfill this important constraint of the climate system. (Box 9.1, p. 749)

Clouds are a fundamental component of any climate system because they influence how much sunlight is scattered back to space, but they enter simply as parameters.

> The simulation of clouds in modern climate models involves several parameterizations that must work in unison. These include parameterization of turbulence, cumulus convection, microphysical processes, radiative transfer, and the resulting cloud amount (including the vertical overlap between different grid levels), as well as subgrid-scale transport of aerosol and chemical species. The system of parameterizations must balance simplicity, realism, computational stability and efficiency. Many cloud processes are unrealistic in current GCMs, and as such their cloud response to climate change remains uncertain. (IPCC2013, Sec. 7.2.3.1, p. 584)

IPCC2013 further elaborates the challenges of parameterization, stating,

> With very few exceptions modeling centres do not routinely describe in detail how they tune their models. Therefore the complete list of observational constraints toward which a particular model is tuned is generally not available … It has been shown for at least one model that the tuning process does not necessarily lead to a single, unique set of parameters for a given model, but that different combinations of parameters can yield equally plausible models. (Box 9.1, pp. 749–50)

Parameters are necessary in complex climate modeling, but they have the risk of producing a false model that happens to fit existing observations but incorrectly predicts future conditions. The parameters for most of the present IPCC models were largely influenced by data from 1961 to 1990 when temperatures were rising faster than the average, so it is not surprising that the response of the models to CO_2 is excessive.

The IPCC reports claim that the averages of models or ensembles of models with small variations in their parameters provide a useful guide to the uncertainty in the predictions, but the samples are not random.

Referring to these multimodel ensembles (MME), IPCC2013 states,

> the sample size of MME's is small, and is confounded because some climate models have been developed by sharing model components leading to shared biases. Thus, MME members cannot be treated as purely independent. (Sec. 9.2.2.1, p. 755)

The IPCC report continues with

> As a result, collections such as the CMIP5 MME cannot be considered a random sample of independent models. This complexity creates challenges for how best to make quantitative inferences of future climate. (Sec. 9.2.2.3, p. 755)

It is regrettable that such important details about the climate models were not included in the Summary for Policy Makers (SPM).

One might ask whether the SPM writers deliberately tried to hide the difficult details of the climate models. I expect that brevity was the primary reason, but in the same way that climatologists expect biased contributions from anyone funded by an oil company, there is always the possibility of some authors choosing words that do not displease government and IPCC sponsors already committed to mitigating anthropogenic global warming. Government and IPCC representatives were involved in the final preparation of the IPCC report.

What should we do now? In my view as Christians and as scientists, we should state the whole truth about the uncertainties in the climate models, including the fraction of warming actually due to human activity. It should not be necessary for everyone trying to evaluate the predictions to have to read a thousand of pages of IPCC reports in order to learn about the fundamental inadequacies of the models described there. Certainly we should respect God's creation and not be wasteful of all the wonderful sources of energy he has provided, but the present evidence of danger is not so compelling that we must stop flying to conferences in distant places. Certainly we should terminate bad policies such as the mandatory use of biofuels, transporting petroleum products by rail where a pipeline is possible, or destroying jungle habitat to grow palm oil.

Also we should take time to thoroughly review proposed policies, particularly questioning their impact on the poor in developed countries and on everyone in poor countries seeking a better life. For example, we ought to reject the claim that climate change is the world's most serious environmental problem, and encourage countries to give priority to reducing real pollution that is affecting people's health. If there were some reduction in the generation of CO_2, that would be a useful byproduct, but not the primary goal. Some people will remain concerned about the more pessimistic predictions, and so will prefer the precautionary principle and advocate a severe reduction in the use of fossil fuels, but they should not claim that their choice is being driven by the science.

Finally, remember that consensus on a scientific issue proves nothing. Ackerman extrapolates from consensus on thermodynamics, electromagnetic wave propagation and fluid mechanics, but each of these have earned their consensus status through more than a century of successful predictions. The climate models are not there yet. Science progresses by questioning everything, and this includes comparing theory with experiment and observation. ◈

Notes

[1]D. C. Morton, "Climate Science and the Dilemma for Christians," *Perspectives on Science and Christian Faith* 66, no. 4 (2014): 236–41.
[2]T. P. Ackerman, "Christian Action in the Face of Climate Change," ibid., 242–47.
[3]IPCC, *Climate Change 2013: The Physical Science Basis*. Contribution of Working Group I to the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (New York: Cambridge University Press, 2013), http://www.ipcc.ch.
[4]Morton, "Climate Science and the Dilemma for Christians," 237.
[5]Ackerman, "Christian Action in the Face of Climate Change," 242.