Climate Models versus Reality: Part II

Ross McKitrick

First, a bit of arcane background: In a recent Climate Audit blog discussion,[1] UK climate modeler Myles Allen commented that the Muir Russell inquiry into climategate had found no evidence of contamination of the so-called "instrumental record", or surface temperature data. He explained the importance of this by pointing out that "we all use the instrumental temperature record all the time…If there had been anything wrong with the instrumental record, I would have to retract or redo a huge number of papers. It turned out there wasn't."

In our subsequent exchange, Allen conceded that a statistical argument relied upon by the Russell inquiry was not one he would recommend his students use, but nevertheless, he still gave them the benefit of the doubt on their conclusion that evidence of contamination of the surface temperature record can be safely ignored.

The statistical evidence in question can be thought of as a rival explanation of climate change over land since 1979. It contrasts to the approach Allen and his many colleagues have pursued for several decades. They have built about two dozen large computer systems called General Circulation Models (GCMs) which represent the behavior of the global climate largely on the assumption that greenhouse gases play the dominant role in climate change. These models underpin the conclusions of the Intergovernmental Panel on Climate Change (IPCC) about the role of greenhouse gases in 20th century warming, and its forecasts for much more warming in the future.

The rival model explains patterns of warming over land as a result of urbanization and the varying patterns of socioeconomic and industrial development. A series of studies over the past decade have shown this hypothesis to have significant explanatory power, even though it has nothing to do with greenhouse gases.

Of course both models might be partly right. But the IPCC has taken an extreme position, that the socioeconomic patterns have no effect[2] and any temperature changes must be due to global "forcings" like carbon dioxide (CO_2) emissions. Studies that claim to detect the effects of CO_2 emissions on the climate make this assumption, as do those that estimate the rate of greenhouse gas-induced warming. As Allen says, if this assumption isn't true, there are a lot of papers that would have to be retracted or redone.

Yikes.

In a new paper[3] with my colleague Lise Tole of Strathclyde University, just published in the journal *Climate Dynamics*, we took the socioeconomic data and evaluated it alongside the 22 GCMs used by

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[1] http://climateaudit.org/2012/05/26/myles-allen-and-hide-the-decline/

[2] IPCC (2007) Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.).. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. See pages 237, 242.

[3] McKitrick, Ross R. and Lise Tole (2012) Evaluating Explanatory Models of the Spatial Pattern of Surface Climate Trends using Model Selection and Bayesian Averaging Methods. *Climate Dynamics* In Press, DOI 10.1007/s00382-012-1418-9.

the IPCC in its last assessment report whose data were available online. We examined which approach best explains the spatial pattern of temperature trends over the past few decades: climate models or socioeconomic data. The answer is you need both, especially the latter.

We used two types of methods (classical and Bayesian) to study the issue. In the classical testing framework, 10 of the 22 climate models predicted a pattern that was negatively correlated with observations and had to be removed from most of the analysis to avoid biasing the results. In 10 other cases we found the climate models predicted a pattern that was loosely correlated with observations, but not significantly so—in other words not significantly better than random numbers. In only 2 cases was there statistically significant evidence of explanatory power.

We then tried a so-called "encompassing" test, which asks if each of the 22 GCMs does such a good job explaining the climate data that the socioeconomic data can be ignored, or vice versa. In all 22 cases the probability you could leave out the socioeconomic data was computed as zero. But only in 3 of 22 cases did the data say you should keep the GCM, and in one of those cases the fit was negative (opposite to the observed patterns) so it didn't count. So, again, only 2 of 22 climate models demonstrated enough explanatory power to be worth retaining, but in all 22 cases the data gave primary support to the socioeconomic measures the IPCC insists should not be used.

Then we estimated a weighted combination of the two types of models and asked if the socioeconomic data should be given all the weight, some, or none at all. The data never rejected the option of giving all the weight to the socioeconomic model, and always rejected giving it none.

Finally, we used Bayesian methods to check if the climate models might work better in some new super-model consisting of an unknown linear combination of some or all of the 22 GCMs, with a linear combination of some or all of the socioeconomic variables. Our data set yields 537 million such combinations, so we employed a computational method that searched over the entire model space and estimated the probability that each of our variables belongs in the overall, best model.

This approach identified the optimal combination as consisting of 3 of the 7 socioeconomic variables and 3 of the 22 GCMs. The rest, it said, could be ignored. Re-doing the encompassing tests confirmed that these variables contained all the relevant information in the data set. So we conclude that a valid model of the pattern of temperature changes at the earth's surface requires both measures of data contamination induced by regional socioeconomic variations and some climate model processes.

The three climate models consistently identified as having explanatory power were from China, Russia and a US lab called NCAR. Climate models from Norway, Canada, Australia, Germany, France, Japan and the UK, as well as American models from Princeton and two US government labs (NASA and NOAA), failed to exhibit any explanatory power for the spatial pattern of surface temperature trends in any test, alone or in any combination.

Why does this matter? First, the fact that the socioeconomic model has significant explanatory power means, as Myles Allen put it, there is something "wrong" with the surface temperature data, or at least with the assumption that the data processing has removed all the socioeconomic contamination. Second, since most models are basically useless at regional climate predictions, policy makers need to realize that policy plans based on those predictions will be equally useless. Finally, climate models embody the dominant current theory about the behavior of the climate. If they keep making wrong predictions, it probably means the theory still needs work.

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