2 February 2015

Dr. Ian Candy
Department of Geography
Royal Holloway
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Egham, Surry, TW20 0EX, UK

Dear Dr. Candy,

Please find the manuscript, "On the reliability of global air temperature projections in light of propagated error: A critical review," for submission to Earth Science Reviews.

This manuscript critically reviews the reliability global surface air temperature climate model projections. It is a standard of science to evaluate the predictive reliability of a physical model by propagation of error. However general circulation models (GCMs) of climate have never been so evaluated.

A method is developed to propagate systematic error through GCM surface air temperature projections. The review then assesses the reliability of historically important GCM air temperature projections spanning 25 years.

New critical results include:

1. A simple expression that accurately emulates any GCM global surface air temperature projection.
2. A demonstration that projections of increasing surface air temperature are just linear extrapolations of greenhouse gas forcing.
3. The consequential linear propagation of projection uncertainty as the root-sum-square of systematic physical error.
4. The total cloud fraction (TCF) error of twelve CMIP5 GCMs is shown to be pair-wise correlated, implying a common systematic theory-bias.
5. CMIP5 TCF error (±4 Wm^{-2}) propagates to yield an uncertainty of ±15 C in centennial global averaged surface air temperature projections.

The error propagation methodology is extensively documented to the literature.

Also assessed are the unrecognized problems in purported removal of GCM simulation error by differencing against a base-state, and why taking anomalies always increases uncertainty (Section 2.4.3).

Discussion Section 3 includes why model tuning does not increase projection reliability and why ensemble averages do not improve physical uncertainty even though they may improve statistical conformance.

While the error analysis is very straight-forward, these results are clearly controversial. Therefore an Auxiliary Material (AM) document provides confirmatory data and analysis, especially of items 1 and 2 above.

Transparency requires informing you that prior versions of this manuscript were twice submitted each to the Journal of Geophysical Research – Atmospheres and to the International Journal of Climatology, and twice rejected.

Nine of ten prior review were provided by climate modelers, and their rejections chiefly followed from three objections. First, that an 1850 base-state climate simulation already includes all model error. Therefore differencing against subsequent simulations produces error-free anomalies.

Second, that a ±T (C) propagated confidence interval is unphysical because it implies that models rapidly oscillate between ice-house and hot-house climate states.

Third, that model variance about a model mean is identical to physical error, rendering propagation an incorrect method of model error analysis.

These three ideas are badly mistaken, and are addressed in review sections 2.4.3 and 3. Auxiliary Material Sections 7 and 10 present further detailed examination of these and other peculiar misconceptions found persistent among the climate modeler reviewers.

The AM should fully defray any criticism of the review on these and other grounds. Interestingly, the one reviewer obviously not a climate modeler (IJC round 1, reviewer 2) did not make any of these mistakes and recommended publication.

To provide full transparency, all prior journal review and response documents are offered for your consideration. These can be provided as zip files scanned and verified virus-free.

Please feel entirely welcome to share these documents with any of your reviewers or associate editors. I am confident they fully and completely resolve the reviewers' concerns.

The prior reviews clearly indicated that propagation of error and physical confidence intervals are entirely foreign notions to climate modelers. Likewise is the distinction between precision and accuracy.

Given this situation, it is respectfully suggested that scientific reviewers be physicists or physical meteorologists, rather than climate modelers.

Meteorological and physicist reviewers might include:
Prof. Carl Wunsch; MIT: cwunsch@mit.edu
Prof. Yong-Sang Choi, EW University, Seoul: ysc@ewha.ac.kr
Prof. Roberto Rondanelli, U Chile: ronda@dgf.uchile.cl
Prof. William Happer, Princeton University: happer@Princeton.EDU

Dr. Hyo-Jong Song, SUNY, Albany: hsong2@albany.edu
Prof. Anastasios Tsonis, University of Wisconsin: aatsonis@uwm.edu

Experts in validation and error assessment of numerical models include:
Prof. Victor Vasquez, U Nevada, Reno: victor.vasquez@unr.edu
Prof. Christopher Roy, Virginia Tech: cjroy@vt.edu
Dr. William Oberkampf, Sandia Labs: wloberk@sandia.gov

The manuscript Figures are in color to assist review. Black-and-white versions can be provided should the need arise.

This work has been carried out on my own time and was not funded by any external agency or third-party donor.

Finally, thank-you very much for your consideration, and I await your reply.

Yours sincerely,
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