Geophysical Research Abstracts
Vol. 19, EGU2017-5323-2, 2017
EGU General Assembly 2017

The implications of rebasing global mean temperature timeseries for GCM based climate projections

David Stainforth (1,2,3), Sandra Chapman (3), Nicholas Watkins (2,3,4)

(1) Grantham Research Institute, London School of Economics, London, United Kingdom, (2) Centre for the Analysis of Timeseries, London School of Economics, London, United Kingdom, (3) Department of Physics, University of Warwick, Warwick, United Kingdom, (4) Open University, Milton Keynes, United Kingdom

Global climate and earth system models are assessed by comparison with observations through a number of metrics. The InterGovernmental Panel on Climate Change (IPCC) highlights in particular their ability to reproduce “general features of the global and annual mean surface temperature changes over the historical period” [1,2] and to simulate “a trend in global-mean surface temperature from 1951 to 2012 that agrees with the observed trend” [3]. This focus on annual mean global mean temperature (hereafter GMT) change is presented as an important element in demonstrating the relevance of these models for climate projections. Any new model or new model version whose historic simulations fail to reproduce the “general features “ and 20th century trends is likely therefore to undergo further tuning. Thus this focus could have implications for model development.

Here we consider a formal interpretation of “general features” and discuss the implications of this approach to model assessment and intercomparison, for the interpretation of GCM projections. Following the IPCC, we interpret a major element of “general features” as being the slow timescale response to external forcings. (Shorter timescale behaviour such as the response to volcanic eruptions are also elements of “general features” but are not considered here.) Also following the IPCC, we consider only GMT anomalies i.e. changes with respect to some period. Since the models have absolute temperatures which range over about 3K (roughly observed GMT +/- 1.5K) this means their timeseries (and the observations) are rebased. We present timeseries of the slow timescale response of the CMIP5 models rebased to late-20th century temperatures and to mid-19th century temperatures.

We provide a mathematical interpretation of this approach to model assessment and discuss two consequences. First is a separation of scales which limits the degree to which sub-global behaviour can feedback on the global response. Second, is an implication of linearity in the GMT response (to the extent that the slow-timescale response of the historic simulations is consistent with observations, and given their uncertainties). For each individual model these consequences only apply over the range of absolute temperatures simulated by the model in historic simulations. Taken together, however, they imply consequences over a much wider range of GMTs. The analysis suggests that this aspect of model evaluation risks providing a model development pressure which acts against a wide exploration of physically plausible responses; in particular against an exploration of potentially globally significant nonlinear responses and feedbacks.

[1] IPCC, Fifth Assessment Report, Working Group 1, Technical Summary: Stocker et al. 2013.
[2] IPCC, Fifth Assessment Report, Working Group 1, Chapter 9 – “Evaluation of Climate Models”: Flato et al. 2013.
[3] IPCC, Fifth Assessment Report, Working Group 1, Summary for Policy Makers: IPCC, 2013.