

4 June 2016

Response to Reviewer #3

The author thanks this reviewer for the constructive comments.

The manuscript has been revised throughout, following this reviewer's concerns and suggestions.

The following steps through the reviewer's points.

Zero-order point: An alphabetically ordered "Table of Terms and Acronyms" has been added at the head of the manuscript.

In addition, the Introduction has been expanded with several new paragraphs that describe the logical structure of the analysis, including the rationale for Section 2.1, the mean-free-path and radiative transfer analysis.

p. 2: "Theory-bias" now is hyphenated throughout. This term is now also defined in the Table of Terms and Acronyms.

p. 5: "futures" is now removed and the phrase has been modified to "... X_N is a prediction of a future state..."

p. 7 (first point): "lower limit of resolution"; this term has now been defined with the added sentence, "That is, a GCM cannot resolve the effect of a tropospheric thermal flux perturbation that is smaller than its LWCF error."

This sentence now introduces the concept of a resolution lower limit, in addition to the discussion under Section 2.4.1.

p. 7 (second point): The rationale for the analysis in Section 2.1 is now given in paragraphs 11 and 12 of the Introduction.

To summarize, one wants to know where zero forcing occurs in the extrapolation of the Manabe temperature vs. CO₂ (ppm) plot (Figure 1b). Therefore, one must first know the ppm of CO₂ at which CO₂ forcing is zero. As it turns out, CO₂ ≤ 1 ppm has zero net forcing.

p. 14: "PWM" is now defined where it first appears. The definition is also in the Table of Acronyms.

p. 16: i) Figure 2 is now in color. The author hopes this makes the Figure easier to interpret. All the other Figures are now in color, as well.

ii) The GISS model is now readily identifiable in Figure 2a. The relevant text has been revised for clarity.

iii) All the relevant figures now have the same "Anomaly Temperature (ΔC)" ordinate label.

pp. 18, 19: Figure 3 and Figure 4 have been remade and are now in color. The author hopes the reviewer finds them acceptable.

p. 22: i) Lag-1 is now defined in the Table of Terms and Acronyms. The meaning of a lag-1 plot is now included in paragraph 1 of Section 2.3.1.

ii) Figure 6 and legend have been revised for clarity. Much of the legend from prior Figure 6 has been revised and moved into the text.

iii) The opening paragraphs of Section 2.3.1 have been revised to clarify the method and meaning of the inter-correlation of model total cloud fraction (TCF) error.

iv) I am not sure what the reviewer means by "uncontrolled experiments." The TCF data are part of the 25-year (1980-2004) CMIP5 GCM hindcast experiment. In this experiment, the simulated cloud cover was compared with the cloud cover observed by satellite.

Figure 5 shows the error residual, namely the difference between the 25-year average of observed and simulated global cloud cover.

The reviewer is certainly correct that the terrestrial climate does not possess an averaged cloud cover. Nevertheless, construction of averages from observations can produce a very useful understanding of the compliance of a simulated climate with the physically real climate.

The experiment and the GCM outputs are described in Section 6 and Figure 10 of the Supplemental Information (SI). Reference to the SI is made in Section 2.3 paragraph 2 and Figure 5 legend.

Discussion of the meaning of Figure 6 has also been revised for clarity.

p. 23-24: The reviewer is thanked for this warning. Table 1 has been modified to remove the error. Originally, Table 1 was rotated 90° to allow for more space and a larger font. However, doing so interfered with conversion of the document into a pdf. One hopes this can be rectified in any final production.

Minor points:

p. 37: this paragraph has been revised in light of the reviewer's recommendation.

p. 41: Reference 30 is fixed, thank-you.

p. 43: Reference 63 is fixed, thank-you

p. 43: Reference 64 is fixed, thank-you