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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The influence of internal variability on Earth's energy balance framework and implications for estimating climate sensitivity" *by* Andrew E. Dessler et al.

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We thank the reviewer for their comments. In this document, we detail our responses.

64-65. As a single number to quantify the spread, the standard deviation would also be helpful.

A: We have added 5-95% confidence intervals throughout the paper.

66. Why do you use only a single decade, rather than all the data, for instance by dividing the dataset into two or using regression (cf Barnes and Barnes, 2015, 10.1175/JCLI-D-15-0032.1)? A single decade would be less precise. You could es-

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timate the statistical uncertainty incurred from the control run.

A: We calculate ECS using this approach because this is the way most ECS calculations based on the 20th-century observational record are done. Thus, our results can therefore directly provide insight into the impact of variability in the observational estimates of ECS.

The reviewer is correct that using more than a decade might affect the results. If one used the difference between the averages of the first and last 20 years, the range in lambda declines from 0.87 W/m2/K to 0.48 W/m2/K. Using longer averaging periods does not further decrease the range. We now mention this in the paper.

118. It would be useful to remark here that 16 years is chosen to match the CERES dataset, because that was mentioned some lines above (103-104), where it appears actually to be 17 years and 5 months long.

A: We have added a statement that the segmentation of the data is done to match the CERES record. We have also updated the paper to segment the data into 17-year segments to more closely match CERES.

119, 196. Why are monthly anomalies used here, rather than annual? Does it make a difference?

A: We do this to facilitate the comparison with the CERES regressions, which also uses monthly data. The reason most analyses with CERES data are done with monthly data is because using annual data means there's only 17 data points, and the uncertainties end up being very large. Issues involved in annual vs. monthly regressions are discussed in some detail in Forster (2016, 10.1146/annurev-earth-060614-105156).

167. Again, the standard deviation would be helpful, and could be compared with lines 64-65.

A: Added.

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173, 175. You could give standard errors of the mean for each of these two numbers, and judge the significance of their difference.

A: We have added the 5-95% confidence intervals to all of these numbers.

174, 175. "analysis" and "calculated" - by what method? From the slope of R against Delta T?

A: We have clarified the text that we use the method of Gregory et al. (2004), where annual average R is regressed against T, and the slope of the curve is an estimate of lambda or theta.

204. "agrees" in what sense?

A: We have changed the sentence to read: “We find that the 15 models whose short-term theta falls within the uncertainty of theta estimated from CERES observations have ECS values ranging from 2.0-3.9 K, with an average of 2.9 K.”

218. I would say that this is "one source" of the spread, which is not eliminated, but only reduced, by using Theta instead.

A: We would argue that this sentence is phrased correctly. The spread in our estimate from the ensemble is due to the construction of the energy-balance equation. Unlike observational analyses, we know everything else perfectly. Using our revised energy balance equation does not completely solve the problem, but it is an improvement.

233. Why is this material an appendix, rather than being incorporated in the main text?

A: We felt that this material would not be interesting to most readers, so we put it in the appendix. In retrospect, perhaps that was a bad decision. At this stage in the paper’s review cycle, we hesitate to move material around. We can, however, if the reviewer or editor insists.

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