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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Thermodynamics of climate change: generalized sensitivities" *by* V. Lucarini et al.

Anonymous Referee #2

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This paper is a very interesting effort to develop measures of climate model fidelity to data that characterize the efficiency with which the climate system converts potential energy to kinetic energy, or equivalently. A single climate model (PRISIM) is analyzed, and it is found that as with temperature, the measures of climate system efficiency vary nearly linearly with the log of CO2 concentration, when the model is allowed to fully equilibrate. The authors do not explicitly address how these measures of climate model fidelity are to be compared with the same measures applied to the earth, which is not in equilibrium- it would be good to see some discussion of how well these measures averaged over, say, thirty years in a simulation with monotonically increasing CO2 correlate to measures made at equilibrium with the same mean CO2 level. Agreement would make the measures much more promising as tests of climate model fidelity.

There are few areas where the paper could be improved:

It be very helpful to have a figure showing where the Θ^+ and Θ^- regions are located in the atmosphere, to give the reader some intuition about the nature of the warm and cold pools discussed in the introduction.

It may be that the authors are planning an additional paper with more climate sensitivity indices (Λ's), but this paper would definitely be improved by the addition of a few additional measures. The most obvious would be: the sensitivity of Hadley Cell over-turning, the sensitivity of convective precipitation and large scale precipitation.

I assume there is some fixed meridional ocean heat flux applied within the slab ocean. I would be very good to investigate the sensitivity of a few of the climate sensitivity measures to the strength of this heat flux.

Finally, I concur with the recommendation of the first reviewer that the prediction of reduced surface wind speeds winds be confirmed. Reduced dissipation could also, after all, result from a redistribution of winds from high roughness areas to low roughness areas, and a reduction in total dissipation certainly doesn't imply that dissipation is reduced in over most areas.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 3699, 2010.