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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 #1

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The manuscript presents a novel approach to climate sensitivity focusing on the thermodynamics and shows some evidence of its potential utility by using a simplified circulation model. While this approach seems to be very promising I think the authors should provide more evidence of the success of the predictions of this approach. I think this is actually one of the major advantages of using simplified models that one is able to thoroughly check new ideas and discuss there strengths and weaknesses. Before the manuscript can be accepted for publication the authors should provide more evidence of the validity of their predictions. I recommend a publication of the manuscript after a major revision and the authors provide more evidence for the utility of their approach and all my below comments are satisfied.

Detailed comments:

1) The authors claim that their approach predicts weaker surface winds in a warmer climate. Is this indeed the model response? The authors should provide some evidence for their claim like figures of the surface wind fields. Does the wind strength also changes almost linearly with CO2 concentration? The authors should also provide some evidence for the predicted changes in vertical temperature gradient.

2) The surface temperature response in Fig. 1 does not seem to be very linear to me. While the generalised sensitivities seem to be well approximated by straight lines the quantity of main interest for many scientists, policy and decision makers, the global mean surface temperature, is not. This should be more clearly stated in the manuscript. The different responses of the temperatures makes it also questionable if a simple linear relationship is sufficient to re-parameterize the different thermodynamic quantities.

3) Does the statement that the system becomes less efficient with increasing temperatures mean that the storms/storm tracks become weaker? Does this in turn imply that more heat is transported as latent heat? Some more evidence for these predictions would be very much appreciated; e.g. figures of the storm tracks and heat fluxes.

4) What is the difference between S and s in Eq. 2? s is nowhere defined.

5) In section 4 you refer to the appendix which is missing in the manuscript.

6) In the last paragraph of section 5 the authors mention changes of the solar constant which seems to be a misnomer. The 'solar constant' is a constant, however, what it describes, the solar irradiance, can chance and is one of the main causes of paleoclimate variation.

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