Geosci. Model Dev. Discuss.,
https://doi.org/10.5194/gmd-2017-213-RC4, 2017

Geoscientific Model Development Discussions

Interactive comment on "Radiative-Convective Equilibrium Model Intercomparison Project" *by* Allison A. Wing et al.

Anonymous Referee #4

Received and published: 19 October 2017

The authors suggest an intercomparison project for various types of models run in radiative-convective equilibrium (RCE). While previous studies have differed in details of their setup the aim of this paper is to provide a common baseline. First, the setup of the intercomparison is detailed, then some sample results are provided.

Overall, I think that this is a great initiative and the suggested setup useful. There are a few suggestions to consider:

1. As e.g. detailed in Wing et al. (2017), the resulting equilibrium state and the clustering may look very different in the different CRMs. It will thus be very difficult to compare the different models and to identify the root for the differences (radiation scheme, microphysics parametrizations, . . .). An even simpler setup for the models could therefore be useful to identify, which schemes are responsible for the differences. As suggested

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by the authors and brought forward by Jeevanjee et al. (2017) a simplified microphysics scheme could be one option. A further option could be to simplify the longwave radiative cooling, as e.g. described in Muller and Bony (2015). Such a simplified simulation should be run as number 0 at one SST to assess science objective 3. If this simulation already showed large differences between the individual CRMs running simulations 1-3 should be reconsidered.

2. A number that is hardly discussed in the aggregation literature is the heating/cooling rate at which the equilibrium is reached. Which longwave cooling rate is balanced by convection? How much latent heat is released? This will again be reflected in the surface precipitation rate. How strongly does this number differ between simulations and what is its value in observations? The output from multiple models would give an indication of how much this value varies, and how GCMs with parametrized convection compare with CRMs/observations. A value of $\sim$100 W/m2 for precipitation is found, but how much variation around this value is there between the participating models? On page 4, last paragraph it is mentioned that radiative flux divergence is nearly a universal function of temperature, which in turn is a function of temperature only. Before investigating the response of RCE to warming it is important to first focus on the robustness of these fundamental quantities across models. 3. A strong focus of the project will lie on the coupling between convection and circulation. At the same time it is stressed that the proposed framework will be suitable for SCMs, that are unable to resolve circulations by design. Moreover, aggregation can not occur. Please specify more clearly which aspects from the SCMs will be analyzed and how they can contribute to a deeper understanding of aggregation in RCE.

Specific comments:

page 2, line 14: correct “explict” page 3, line 4: remove “in” before “between” page 3, line 9: add “to” before “those” page 10, last paragraph: a grid spacing of 60 or even 220 km very likely not produce reasonable convection, which makes the acquired RCE state questionnable. page 10, line 33: remove “to” page 13, line 21: replace “estimate”

with “estimates” page 20, line 4: please list the unanswered questions laid out by Wing et al., (2017) for those readers who are not very familiar with the paper. Figures 9 and 10: please give the point in time

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