Response to Short Comment by Nadir Jeevanjee (author response in blue)

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

**N. Jeevanjee**

nadir.jeevanjee@noaa.gov  
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Apologies for the late post.... About a half dozen GFDL scientists, along with two GFDL post-docs, met to discuss the RCEMIP proposal and GFDL’s potential participation using the FV3 dynamical core. This note outlines some of the thoughts and responses that came up.

There is a common interest here in developing a doubly-periodic, cloud-resolving RCE configuration of FV3 which uses our current (‘AM4’) comprehensive physics package and which would be suitable for RCEMIP. Motivations for this are diverse, however. Probably the most common motivation is to use RCE as an idealized testing ground, for use in (say) comparing microphysics schemes, or benchmarking low-resolution parameterized-convection simulations against high-resolution explicit convection simulations on the same domain. Note that these activities have little to do with RCEMIP as currently presented, though there is some mention (but little emphasis) in the manuscript on planar GCM configurations.

A second motivation for our development of FV3 RCE would be to assess how idiosyncratic our simulated, unaggregated RCE state is relative to other models. This falls nicely in line with the ‘robustness’ objective of RCEMIP (science objective #3), though (as other reviewers have pointed out) this objective seems to get de-emphasized in the paper. The authors may want to consider increasing their emphasis on it.

Convective self-aggregation seems to be a major focus of RCEMIP, and while there is some interest in aggregation here at GFDL, overall it is probably only a secondary concern. Thus, while interest in a suite of kilometer (or even sub-kilometer) small- domain RCE simulations is strong, interest in aggregated simulations (and especially the computation of secondary, aggregation-focused diagnostics) seems to be weaker.

As advocated for by Isaac and other reviewers, there is also interest here in using simplified (Kessler) microphysics in our RCE setup. Such a scheme already exists in development branches of our code.

We thank Dr. Jeevanjee for his comments and are pleased that GFDL scientists are interested in RCEMIP, and we sincerely hope that GFDL will contribute one or several configurations of the FV3 model to RCEMIP.

We hope that the revised manuscript (see especially Section 6) better conveys our goal with regards to the simulation design: to keep it as simple as possible in order to maximize participation, establish a baseline, and inform subsequent experimentation. We envision that RCEMIP will eventually extend far beyond the simulations laid out in this paper, as we recognize that the baseline we propose will not be a definitive representation of the RCE climate for many of the reasons raised by the reviewers. While it is clear that certain physical parameterizations (or lack thereof) may lead to biases that require further investigation, we see the simulations proposed as a way to bring the community together to get us to that next point. We believe one of the strengths of RCEMIP is the sheer number of scientific questions that can be investigated within this framework, and while we have described the motivations as we see them, there is certainly room for other interests, and we in fact encourage groups to use this framework and the intercomparison as a tool to explore their individual interests. We do mention in both the introduction and conclusions that RCEMIP will serve as a useful framework for model development and evaluation, and in Sections 3.1 and 3.3 encourage modeling groups to simulate both RCE on the sphere and plane. We now also explicitly encourage LES simulations in Section 3.3.5. We have also clarified what the proposed simulations are in Section 3.1, describing them as a set of small domain simulations and a set of large domain simulations.

We absolutely agree about the importance of assessing the robustness of the RCE state, and have tried to emphasize this point a bit more in the revised manuscript. We have revised the abstract to more strongly state the importance of the robustness theme (Lines 7-9, Page 1), added that the difference in set up between past studies makes it difficult to determine which aspects of the simulations are robust (Lines 23-25, Page 2), note that an intercomparison can establish which features of the RCE state are consistent across models and which vary (Lines 30-31, Page 2), state that using a wider range of models is important for evaluating the generality of previous work on RCE (Line 3, Page 3), and reworded some of the description of the robustness theme in Section 2 (Lines 29-35, Page 4).

We also recognize that post-processing requests should be kept to a minimum but think what we have asked for is reasonable. Only the cloud fraction and moist static energy budget terms need to be computed online. We have removed the mention of the autocorrelation length, but retain a shortened description of the two aggregation metrics, since we show plots of one of these quantities in the paper. We have rephrased the text to indicate that code to compute those metrics will be available on the website to make it easy for everyone to compute them.

Regarding the simplified microphysics scheme, we are very supportive of applying such a scheme in the second phase of RCEMIP. We agree that large differences could result from differences in microphysics, and that it might be correct that the diversity of simulations will be dominated by the diversity of microphysical assumptions. However, we think that it is useful to first determine the full range of RCE simulations and *then* proceed to test the microphysics sensitivity by imposing a simple microphysics scheme on all models in the second phase of RCEMIP. In the past, groups have found large sensitivities to microphysics, but that might also reflect that the behavior of microphysical parameterizations are easiest to change (i.e., it is easy to modify a fall speed, but harder to change an underlying assumption in a boundary layer representation, for instance). In addition, it might not make sense to specify the microphysics without specifying the treatment of cloud optical properties (radiation), representation of partial cloudiness, etc…, and this would be too much to accomplish with our first set of simulations. Importantly, our goal with the first phase of RCEMIP is to keep the required simulations to a minimum and as close as possible to a models “standard” configuration so as to encourage maximum possible participation and limit the possibility of new physics introducing bugs that are not characteristics of a specific model. We believe that it is worth first providing a framework and taking stock of where things stand. We think that determining, for example, how many of the models have a decrease in high cloud fraction with warming, with the “standard” configuration is valuable (if hard to disentangle), because presumably all the different schemes used are individually reasonable and justified choices and we don’t want to immediately bias the results in the direction of one scheme over another.