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# *Interactive comment on* "TRAPPIST-1 Habitable Atmosphere Intercomparison (THAI). Motivations and protocol" *by* Thomas Fauchez et al.

**Anonymous Referee #2**

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This brief paper describes a protocol for inter comparing GCMs for TRAPPIST-1e in anticipation of future observations. The goal is to determine the differences in climate states when the models are run under similar configurations. These states can be related to spectra or thermal phase curves anticipated from future observations such as JWST. Four GCMs have signed on so far but only preliminary results are available; more detailed analysis will follow. This is a good idea and should be a useful effort.

The biggest uncertainty is the mass and composition of the atmosphere. The only constraint seems to be that HST observations do not favor an extended H2 atmosphere for TRAPPIST-1e. Thus, heavier atmospheres consisting mainly of N2 and CO2 are considered. The models are configured to sort out the effects of the dynamical core, physical packages, and moist processes. This is achieved by comparing four different



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Discussion paper

runs for each model with different surface and atmospheric conditions. The approach seems reasonable and should give the authors a good start on what will surely be a challenging but stimulating research project.

The authors might consider a few things.

1. If the goal is to determine the differences in model climate states with similar run configurations, it is not clear how model numerics will be separated from model physics. Different dynamical cores running at different resolutions with different numerical schemes will produce different climates. How does one distinguish these differences from those due to real physical processes? I think BEN1/BEN2 should get at some of this but not all of it. Perhaps one way is to run with simple Newtonian cooling using a common relaxation field and time constant. 2. Once that is clarified then an even more daunting task is to isolate changes due to different physics prescriptions. Is the intent to go to that level of detail or to describe what the differences are without analyzing the reasons? Some brief discussion about this would be helpful. 3. With suppressed CO2 condensation nightside surface temperatures are likely to be much warmer than when condensation is included. Without latent heat release atmospheric temperatures will cool and the surface must warm to maintain energy balance. Feedbacks related to moist processes may be affected and this may complicate the interpretation. 4. The radiative effects of clouds, both CO2 and H2O, can be very different between models. Runs with passive clouds might help isolate those effects. Of course, this adds to the analysis work (as does running with Newtonian cooling), but it is a point worth considering. 5. The authors hope to add more models into the mix which will increase the workload. Recognizing that this is not a proposal, it still begs the question of having adequate support and manpower to do the work. Is there?

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