



EGUsphere, referee comment RC2
<https://doi.org/10.5194/egusphere-2022-397-RC2>, 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on egusphere-2022-397

Anonymous Referee #2

Referee comment on "A method for transporting cloud-resolving model variance in a multiscale modeling framework" by Walter Hannah and Kyle Pressel, EGU sphere, <https://doi.org/10.5194/egusphere-2022-397-RC2>, 2022

Review of "Transporting CRM variance in a Multiscale Modeling Framework" by Hannah and Pressel, submitted to GMD.

This manuscript reports development of a technique that helps removal of what the authors refer to the "checkboard pattern". Overall, I find the paper suitable for GMD. I have two general comments and several specific points that should lead to an improved presentation. The paper can be published after some revisions and clarifications in response to my general and specific comments below. I do not need to see the revised manuscript.

My first general comment concerns the stand-alone aspect of the submission. The presentation follows already published manuscripts concerning E3SM-MMF and reports developments motivated by those publications, up to the point of repeating some of the figures. I feel the authors assume that readers are familiar with the past work, and thus they use terms and concepts that are unclear unless you are familiar with those past manuscripts. Since I was not familiar, I had to go back to those previous manuscripts. I feel this needs to change to make the paper more stand-alone. I have several specific questions and suggestions below that should improve that aspect of the manuscript.

My second comment concerns conservative properties of the model with variance transport. The original GCM-CRM coupling conserves energy (in its simplified representation) and water substance by design. Is that true for the system with variance transport? I think it is by design as well, but perhaps worth commenting on it and maybe even illustrating by some additional analysis.

Specific comments:

- Title: I suggest replacing "CRM" with "cloud-scale" or "convective-scale" to avoid the acronym that might be unclear to some readers.

- A general comment on the introduction: I do not think the key problem with MMF is the presence of the spectral gap between scales resolved by GCM and those in CRM. The key is that CRM domain is periodic and the cloud-scale signal cannot propagate from one GCM box (i.e., one CRM) to the CRM in the next GCM box. In other words, small-scale perturbations are trapped in a GCM. This is why transporting variance helps, correct? One way to stress that in the discussion would be to emphasize that CRMs feature periodic lateral boundaries. For instance, adding cyclic or periodic in line 11 would help. Periodicity is important from the energy conservation point of view. Making CRMs open brings essential problems with keeping track of what comes in and comes out. The sentence in line 24, "Another consequence..." is simply incorrect. Lack of advection has little to do with the scale gap; it comes from periodicity of CRM domains. Another comment is that it would help if the checkboard pattern is already documented in the introduction to set the readers on the right pass. This is only mentioned now (line 19-23), but adding a figure from a previous paper would help. And, again, I do not agree that the key is the scale gap, the lack of large-scale advection is the culprit.

- Section 2.2. I think it would help if the technique is illustrated by a figure. If I understand the approach, you simply “scale up” the variance in each CRM based on GCM advection from the neighboring columns, correct? The key is that alpha is advected by the GCM, correct? If the CRM field (at a given height?) is q , you make it alpha q , correct? Can this be shown in a figure? Also, alpha is height-dependent, correct? It would help to state this clearly.

- What is F in (11)?

- Section 3.1. I feel a figure describing the detection would help. This is not clear unless one goes back to Hannah et al (2022). A figure or two from that paper would help.

- Section 4.1. Several statements in this section are hardly evident in the figures. Line 234: perhaps a hint of a double ITCZ? L. 235: I do not see the checkboard pattern. My suggestion is to improve the figure, maybe with a small insert, so the features mentioned are better documented. I think Fig 2 does show that pattern, correct?

- Section 4.2. How is “fractional occurrence” defined? It is unclear to me what Fig. 3 shows. How the “extremum in the local neighborhood” is defined (in IMERG and in the model results)? Figure 4 shows clear differences, but if I do not know what the fractional occurrence is how can I gauge the significance of those differences? Fig. 5 provides a clear impact of the improvement and good comparison with observations. I do not understand what Fig. 6 shows, please explain.

- Please clearly define what each panel of Fig. 7 is showing. Also, do the numbers shown have some relevance to the real world? For instance, the maximum temperature variance (temperature or potential temperature?) is around 0.6 K^2 . Does this mean that the CRM variance is less than 1 K? How this compares to either observations or cloud-scale simulations of tropical convection? Can you explain why GCM and CRM transport panels seem to have the same pattern but the opposite sign? What is the reason for that? Some physical interpretation would be good. This is briefly discussed, but I would like to see more physical interpretation. Similar comments apply to Fig. 8 (please define all panels in the figure caption).