Geosci. Model Dev. Discuss.,
https://doi.org/10.5194/gmd-2019-193-RC2, 2019

Geoscientific Model Development Discussions

Interactive comment on "Effects of model configuration for superparametrised long-term simulations – Implementation of a cloud resolving model in EMAC (v2.50)" *by* Harald Rybka and Holger Tost

Anonymous Referee #2

Received and published: 22 October 2019

General comments:

This paper systematically presents climatological simulation results of EMAC with super-parameterization with 20 various configurations, including CRMs orientation, cell size and number of cells. It is useful and impressive to see these results as in Table 2. This paper is publishable if clearer messages are provided.

For the current version, the readers only know from the abstract that only some aspects of tropical precipitation are better represented with the super-parameterized EMAC

compared with the CTRL with a convectional convection parameterization. The other aspects depend on the choice of the CRM setup, and the super-parameterized simulations deteriorate in some cases. What the readers want to know are whether and when the super-parameterized EMAC becomes better than CTRL, and what kind of suitable setup should be chosen for CRMs.

One interesting result is that results of the super-parameterized simulations are divided into two groups (sub-ensemble A/B). More analysis is suggested to explain why this separation exists. It seems that the results do not clearly depend on the CRM setup.

It is suggested that effects of momentum transport should be summarized in the abstract.

The authors also should argue about the similarities and the differences of the general behaviors of the effect of the super-parameterization with previous studies of the other groups (Khairoutdinov, W-K Tao, etc.).

Specific comments:

p. 1, L11, "cloud cover": This is ambiguous. Is this high cloud fraction or total cloud fraction? Needs a clear definition.

p. 1, L12, "hydrological overturning is too efficient": This is not clear and may cause confusion. What is the meaning of "efficient circulation"? The authors might want to mention precipitation efficiency. However, in this case, it is not straightforward to related cloud fraction and precipitation efficiency. Even precipitation efficiency is unchanged, cloud cover may decrease if cloud thickness decreases.

p. 1, L15, "diurnal cycle of precipitation": In general, diurnal cycle of precipitation is reasonably captured by CRMs. One may think that if "diurnal cycle of precipitation" is not properly simulated, something wrong in parameter settings of CRMs.

p. 3, L8-9, "To our knowledge this is the first attempt summarizing the effects of different configurations of the super-parameterization onto the model mean climate state."

I think that there exist similar studies on the effects of different cloud microphysics schemes on the model climate.

p. 9, Table 2: precipitable water should be added and discussed.

p. 10, L6, “observed value”: Please add a reference to this value.

p. 10, L19, “All simulations show shortwave and net radiative fluxes at TOA that are in close agreement to observed fields”: This is not clear whether the SP-EMAC runs are better than CTRL.

p. 10, L22-23: Any difference between “cloud cover” and “cloud amount”? Is “cloud cover” of SP-EMAC generally better than CTRL? Why?

p. 10, L35, “The overestimated variability of specific humidity is mainly a cause of too much water vapor transport over tropical continents and too less over tropical oceans”: Is this general behavior of SP-EMAC? Why?

p. 12, L11-15: From this summary paragraph, it is not clear the real advantage of the super-parameterizaion. Is this the correct message of this paper?

p. 13, L5-11: Related to the discussion around this paragraph, the authors should refer to Luo and Stephens (2006), “An enhanced convection-wind-evaporation feedback in a superparameterization GCM (SP-GCM) depiction of the Asian summer monsoon” (Geophys. Res. Lett., 33, L06707, doi:10.1029/2005GL025060).

p. 14 L3-6: The logic of this paragraph is not clear. Why the super-parameterization affects land-ocean contrast?

p. 15, L15-17: It is suggested that Figure 3 should be compared with the zonal mean precipitation of global cloud-resolving models by Stevens et al. (2019, Fig. 5, https://doi.org/10.1186/s40645-019-0304-z).

p. 16, L4: Which product of TRMM is used. Refer to Sato et al. (2009), “Diurnal cycle of precipitation over the tropics simulated by a global cloud resolving model.” (J. Clim.,

22, 4809-4826, doi:10.1175/2009JCLI2890.1).

p. 18, Section 3.3: Please discuss robustness of the difference between the sub-ensemble A and B. It seems that the difference is not systematically depend on the CRM configuration. Can the authors say in which cases the category of the sub-ensemble is determined.

p. 19, L28-29: Why the results are very different from MODIS?

Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2019-193, 2019.