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Comment on hess-2020-652

Anonymous Referee #1

Referee comment on "Evaluation of Asian summer precipitation in different configurations of a high-resolution general circulation model in a range of decision-relevant spatial scales" by Mark R. Muetzelfeldt et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2020-652-RC1, 2021

Muetzelfeldt et al's manuscript evaluates high-resolution (grid-spacing ca. 14 km) GCM simulations with parameterized convection, with only shallow and mid-level convection parameterized, and explicit convection (i.e. without any convection parameterization) over a South and East Asian area in the months June, July, August. The results are interesting as the challenge of simulating the diurnal cycle of precipitation and its characteristics with parameterized convection is well known. Therefore, the models are pushed to higher and higher resolutions into the convection-permitting regime where deep-convection parameterization can safely, and also shallow and mid-level convection are often switched off. The convection-permitting regime is usually assumed to be at grid-spacing below about 4 km. But, as the authors discuss, this has been relaxed recently (e.g. as in Vergara-Temprado et al. 2020). It might be interesting for the potential reader to note that already Bougeault and Geleyn (1989) did experiments with and without deep convection paramaterization using grid spacing of 10 km in the, as they call it, resolvable domain.

What I missed are figures for the entire investigation domain showing frequency and intensity for all three variants (explicit, hybrid, and parameterized). As Figs. S3 and S4 show for south-eastern China in comparison with Figs. 9 and 10, the hybrid did the diurnal cycles as good as the explicit, and the frequencies and intensities look comparably better. This is what I expected, given the applied grid-spacing very far from resolving shallow convection. Thus, I am not sure that the explicit variant performs better overall than the hybrid one, as the authors imply.

Sec. 2.3: Given the definition, the amount A is a rate. This wording is a bit confusing given the usually different units of precipitation amount and precipitation intensity. It is also a bit confusing that some of the figs. show precipitation and some show amount, which is almost the same, but the reader might have to think twice.

Why the special section 4 on precipitation over China and no special section for the other areas?

The discussion Sec. 5 misses a discussion on the simulation variants and their representation of the different processes and process scales. This discussion might help the reader to understand better the shown results.

The conclusions lack a conclusion on how to proceed in very high-resolution GCMs. What was learnt? Shall GCMs at O(10km) run without any convection parameterization? Should consistent PBL, shallow convection models be further developed?

Fig S3 refers to Fig. 9 not 10.

Line 440: of convection -> of precipitation?

Line 444: "Fig. ??"

Figure 7: Amount of precipitation -> The diurnal cycle of .... ?

Bougeault, P., & Geleyn, J. F. (1989). Some problems of closure assumption and scale dependency in the parameterization of moist deep convection for numerical weather prediction. *Meteorology and Atmospheric Physics*, *40*(1–3), 123–135. https://doi.org/10.1007/BF01027471

Vergara-Temprado, J., Ban, N., Panosetti, D., Schlemmer, L., & Schär, C. (2020). Climate Models Permit Convection at Much Coarser Resolutions Than Previously Considered. *Journal of Climate*, *33*(5), 1915–1933. https://doi.org/10.1175/JCLI-D-19-0286.1