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Geoscientific Model Development Discussions

Interactive comment on "The Importance of Considering Sub-grid Cloud Variability When Using Satellite Observations to Evaluate the Cloud and Precipitation Simulations in Climate Models" *by* Hua Song et al.

Anonymous Referee #1

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The authors explore the sub-grid variability assumed in COSP, which many studies use to compare observations to models. Use of SPCAM at 4km resolution allows the authors to examine the impact of resolving sub-grid variability on COSP.

I really like this paper and think it is very important to get it out there to allow people to better understand the abilities of COSP and that it shouldn't be applied fecklessly to any given model. Frequently COSP is used in studies as some sort of magical talisman that

bridges models and observations. This is rarely questioned as far as I can tell. As the authors point out in line 91 page 4, there are some basic resolution issues in coupling a GCM to COSP and trying to pull out something like a satellite pixel. I would almost suggest that the authors move their comments on line 91-98 into the abstract somehow so that people who just skim it will have this brought to their attention as it is critically important. However, this change is not required scientifically and may be disregarded by the authors. This paper will be a very useful reference in the COSP documentation for people trying to set their model up to run with COSP.

Line 126- convectional=convective

Line 129- it is worth noting that this is still in the so-called convective grey zone, for example: Field et al. (2017). Do you think your results would change much if you doubled your grid size?

Line 186 'sub-columns are'

Line 262- Although not required, the authors might consider how this might contextualize results such as Nam et al. (2012).

Line 374- The authors have focused on the warm rain process representation. This may be a very ignorant comment on my part, but I would be interested in how the evaluation of the first indirect effect in GCMs might be affected by the assumptions in homogeneous COSP. For example, most empirical studies of the first indirect effect utilize level 3 gridded data (McCoy et al., 2017a;Gryspeerdt et al., 2017;Bellouin et al., 2013;Quaas et al., 2008;Quaas et al., 2009), either using observed AOD/AI (Gryspeerdt et al., 2017) or reanalysis aerosol mass (McCoy et al., 2017a;McCoy et al., 2017b). These studies compare to level 3 aggregated cloud and aerosol from models and make statements regarding the ability of models to represent the first indirect effect. If the authors could comment on whether this is a valid approach that would be highly informative.

Figure 2 c-d are somewhat hard to parse.

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