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Interactive comment on "An evaluation of clouds and radiation in a Large-Scale Atmospheric Model using a Cloud Vertical Structure classification" *by* Dongmin Lee et al.

Anonymous Referee #2

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The simulated cloud radiative effects (CRE) are commonly biased in most climate models. This study, with the aid of both CloudSat/CAPLIPSO retrievals and the implemented subcolumn cloud generator in NASA's GEOS-5, explores the CRE biases in association with cloud vertical structure classification. Results show that while the simulation of global CRE is in much agreement with observation, the CRE due to different cloud classification is not. Moreover, by decomposing model's CRE errors into components stemming from biases in RFO and cloudy-column CRE, the relatively good simulations of global grid-mean CRE largely benefit from compensating errors in these two terms. The method introduced in this paper can be used in other models to explore their CRE behavior, thus beneficial for the modeling community.

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Discussion paper

While I generally find the manuscript suitable for publication in GMD, further improvements are needed before the manuscript is accepted. Below I have included a list of the major comments that I think should be addressed, followed by a list of more specific comments.

Major comments:

1. The study uses 2B-FLXHR-LIDAR âĂĺproduct as a guiding reference for CRE, which was obtained by invoking radiative transfer algorithm operating on thermodynamical fields from re-analysis and cloud properties from CloudSat/CAPLIPSO retrievals. As the authors mentioned, the SW CREs in 2B-FLXHR-LIDAR is strongly time dependent. It is worth to add CERES data as a reference as well, since a great many models are commonly tuned to resemble CERES observations.

2. Besides cloud overlap assumptions, the cloudiness vertical profile per se is important for the determination of CVS classification. The authors are suggested to replenish the role of layer cloud fraction when revising the paper. The CVS classification may suffer from poor representation of subgrid cloud condensation and/or overlap assumption. In addition, the vertical resolution in GCMs is typically coarser than that in CloudSat/CALIPSO retrievals, which to some extent plays an important role in calculating RFO. The authors need point out this in the paper.

3. When comparing the two overlap assumptions, the GN assumption yields more clouds than MR in almost all cloud regimes except for isolated low clouds in extratropics. Why does this occur? Is this because clouds in this region are nonadjacent separated by clear skies that have a vertical distance smaller than specified decorrelation length in GN?

Specific comments:

1. The abbreviation “RFO” is not fully spelled at the first place in the main text.

2. P9L1 regions pronounced orography -> regions with pronounced orographyâĂĺ 3.

P9L17 exceeds -> exceed 4. P27 As Fig. 3-> As Fig. 4.

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