

Response to comments

Note: All line numbers refer to the revised manuscript (with track changes hidden).

5 Comment 1 (CC1)

The subject of how mean albedo relates to mean cloud properties has been the focus of decades of investigative effort, but these works and their insight are not represented or cited in this article. I have listed a few references below as a starting point (e.g., Cahalan et al., 1994; Oreopoulos & Davies; 1998; 10 Rossow et al. 2002), including some about how the issue of cloud heterogeneity is represented in the radiative transfer schemes of climate models. I recommend the authors read them and other associated works (far more relevant works exist than I have listed) and revise this article to place their results within the context of our existing knowledge about radiative transfer through cloudy atmospheres.

15 **Reply:** Thank you for the reference suggestions. We have reviewed the listed papers and have now incorporated several of these works into the introduction to better contextualize our study within the existing literature on cloud heterogeneity and radiative transfer. Specifically, we have added citations to Cahalan et al. (1994), Oreopoulos and Davies (1998), Rossow et al. (2002), and Barker and Räisänen (2005) (lines 56–60).

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References

Barker, H. W. and Räisänen, P.: Radiative sensitivities for cloud structural properties that are unresolved by conventional GCMs, *Quarterly Journal of the Royal Meteorological Society*, 131, 3103–3122, 25 <https://doi.org/10.1256/qj.04.174>, 2005.

Barker, H. W., Wiellicki, B. A., and Parker, L.: A Parameterization for Computing Grid-Averaged Solar Fluxes for Inhomogeneous Marine Boundary Layer Clouds. Part II: Validation Using Satellite Data, *Journal of the Atmospheric Sciences*, 53, 2304–2316, [https://doi.org/10.1175/1520-0469\(1996\)053%253C2304:APFCGA%253E2.0.CO;2](https://doi.org/10.1175/1520-0469(1996)053%253C2304:APFCGA%253E2.0.CO;2), 1996.

30 Boutle, I. A., Abel, S. J., Hill, P. G., and Morcrette, C. J.: Spatial variability of liquid cloud and rain: observations and microphysical effects, *Quarterly Journal of the Royal Meteorological Society*, 140, 583–594, <https://doi.org/10.1002/qj.2140>, 2014.

Cahalan, R. F., Ridgway, W., Wiscombe, W. J., Bell, T. L., and Snider, J. B.: The Albedo of Fractal Stratocumulus Clouds, *Journal of the Atmospheric Sciences*, 51, 2434–2455, 35 [https://doi.org/10.1175/1520-0469\(1994\)051%253C2434:TAOFSC%253E2.0.CO;2](https://doi.org/10.1175/1520-0469(1994)051%253C2434:TAOFSC%253E2.0.CO;2), 1994.

Hill, P. G., Morcrette, C. J., and Boutle, I. A.: A regime-dependent parametrization of subgrid-scale cloud water content variability, *Quarterly Journal of the Royal Meteorological Society*, 141, 1975–1986, <https://doi.org/10.1002/qj.2506>, 2015.

40 Kawai, H. and Teixeira, J.: Probability Density Functions of Liquid Water Path and Total Water Content of Marine Boundary Layer Clouds: Implications for Cloud Parameterization, *Journal of Climate*, 25, 2162–2177, <https://doi.org/10.1175/JCLI-D-11-00117.1>, 2012.

Oreopoulos, L. and Cahalan, R. F.: Cloud Inhomogeneity from MODIS, *Journal of Climate*, 18, 5110–5124, <https://doi.org/10.1175/JCLI3591.1>, 2005.

45 Oreopoulos, L. and Davies, R.: Plane Parallel Albedo Biases from Satellite Observations. Part I: Dependence on Resolution and Other Factors, *Journal of Climate*, 11, 919–932, [https://doi.org/10.1175/1520-0442\(1998\)011%253C0919:PPABFS%253E2.0.CO;2](https://doi.org/10.1175/1520-0442(1998)011%253C0919:PPABFS%253E2.0.CO;2), 1998.

Rossow, W. B., Delo, C., and Cairns, B.: Implications of the Observed Mesoscale Variations of Clouds for the Earth's Radiation Budget, *Journal of Climate*, 15, 557–585, [https://doi.org/10.1175/1520-0442\(2002\)015%253C0557:IOTOMV%253E2.0.CO;2](https://doi.org/10.1175/1520-0442(2002)015%253C0557:IOTOMV%253E2.0.CO;2), 2002.

- 50 Zhang, F., Liang, X.-Z., Li, J., and Zeng, Q.: Dominant roles of subgrid-scale cloud structures in model diversity of cloud radiative effects, *Journal of Geophysical Research: Atmospheres*, 118, 7733–7749, <https://doi.org/10.1002/jgrd.50604>, 2013.