Wojciechowska and Gryspeerdt present a simplified framework for estimating marine liquid cloud albedo using cloud fraction (CF), liquid water path (LWP), and cloud droplet number concentration (Nd). Their approach combines climatological, collocated MODIS cloud properties with CERES albedo to construct a reduced cloud albedo kernel. The authors show that this formulation yields robust albedo estimates, with more than 80 percent of samples differing from CERES by less than 0.05. The results also exhibit a clear spatial structure in regions where albedo is systematically underestimated or overestimated.

The manuscript is clearly written, and I find no major issues with the methodology or the interpretation of results. My comments concern a few missing details and clarifications. I also suggest a straightforward way to incorporate cloud morphology into the algorithm, which may further enhance the albedo estimates. I recommend acceptance of the manuscript after the following minor comments are addressed:

Line 57: One of the key factors that controls the relationship between albedo and CF and/or LWP and/or Nd/CER is the cloud morphology or sub-grid cloud heterogeneity (Goren et al., 2023; McCoy et al., 2023; Choudhury and Goren, 2024).

It is still unclear to me what the main motivation is for assessing how accurately cloud albedo can be estimated from cloud microphysical and macrophysical properties. Is the aim to evaluate these relationships because they are used to quantify changes in cloud albedo driven by changes in cloud properties, as in Zhang et al. (2021) or Wall et al. (2022)? If so, then this study seems to assess whether kernel-based decompositions of cloud albedo are justified. Could the authors clarify this point in the introduction?

Line 73: Which cloud fraction is used? Is it the cloud fraction derived only from pixels with successful cloud property retrievals, as is common in many aerosol–cloud interaction studies, or the total cloud fraction including partially cloudy pixels and those with failed retrievals?

Line 79: Were CERES Aqua and Terra products considered separately and paired with their respective MODIS-cloud retrievals, or were the datasets averaged across the two platforms?

Section 3.1: I recommend including an additional global map showing the geographical distribution of albedo bias (potentially as an extension of Figure 4). This figure should be supported by a short description summarizing the mean bias and its spatial pattern, noting regions where the discrepancies are especially pronounced.

Section 3.1: Does the bias decrease when the data are resampled to the monthly scale, which is the temporal resolution typically used in studies that construct such kernels?

Figure 6b: How does the solar zenith angle extend beyond 65 degrees when this threshold was used in the G18 sampling strategy for estimating Nd?

Line 213: "… more restricted to location …" Perhaps "cloud morphology" is intended here?

Line 224: What explains the seasonal variability? Did you construct the kernel at each grid point as well as for all days of the year separately? If not, this might help reduce the bias further.

I also suggest adding thin cloud fraction (F_thin, a proxy for cloud morphology) to the kernel. F_thin can be computed from the MODIS Level-3 "Cloud_Optical_Thickness_Liquid_Histogram_Counts" dataset by using COT < 3 or < 5. Including F_thin alongside CF, LWP and Nd/CER may improve the albedo estimation (McCoy et al., 2023).

Could the authors speculate on why albedo is underestimated in stratocumulus regions and overestimated in the tropics?

Language edits:

Line 55: "more bins in …"?

Line 55: "sub-pixel" or "sub-gridbox"

Line 101: By "pixel," do you mean the 100 km gridbox?

Line 123: Do you mean "left-skewed"?

Line 270: Please rephrase. The current wording is unclear.

References:

Choudhury, G., & Goren, T. (2024). Thin clouds control the cloud radiative effect along the Sc-Cu transition. *Journal of Geophysical Research: Atmospheres*, 129, e2023JD040406. https://doi.org/10.1029/2023JD040406

Goren, T., Sourdeval, O., Kretzschmar, J., & Quaas, J. (2023). Spatial aggregation of satellite observations leads to an overestimation of the radiative forcing due to aerosol-cloud interactions. *Geophysical Research Letters*, 50, e2023GL105282. https://doi.org/10.1029/2023GL105282

McCoy, I. L., McCoy, D. T., Wood, R., Zuidema, P., & Bender, F. A.-M. (2023). The role of mesoscale cloud morphology in the shortwave cloud feedback. *Geophysical Research Letters*, 50, e2022GL101042. https://doi.org/10.1029/2022GL101042

Wall, C. J., Norris, J. R., Possner, A., McCoy, D. T., McCoy, I. L., and Lutsko, N. J.: Assessing effective radiative forcing from aerosol-cloud interactions over the global ocean, Proc. Natl. Acad. Sci. U. S. A., 119, 1–9, 2022.

Zhang, Y., Jin, Z., and Sikand, M.: The Top-of-Atmosphere, Surface and Atmospheric Cloud Radiative Kernels Based on ISCCP-H Datasets: Method and Evaluation, J. Geophys. Res. Atmos., 126, e2021JD035053, https://doi.org/https://doi.org/10.1029/2021JD035053, 2021.