Review of "Albedo susceptibility of Northeastern Pacific stratocumulus: the role of covarying meteorological conditions" by J. Zhang et al.

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Zhang et al. use satellite observations to study relationships between cloud droplet number concentration and cloud albedo in subtropical stratocumulus clouds. The observed relationships are interpreted in the context of several proposed mechanisms of cloud susceptibility to aerosol perturbations. Overall the topic and findings of the paper are important, and the paper is clearly written and fits within the scope of ACP. However, I have a few concerns about how the data are filtered and how uncertainty is quantified. For this reason, I recommend *major revision* for the manuscript. Please see my comments below.

General Comments

1. Line 105-100, 140. I understand the need to filter the data to get reliable retrievals of cloud-droplet number concentration (Nd), but I would have liked to see more discussion about potential sampling biases that could result from the filtering. First of all, what fraction of the data are you excluding by applying the filters? Do you believe that the inferred relationships approximately represent the entire cloud population in the study region or only a subset of the population? If the relationships only represent a subset of the population, then are the stated Nd-albedo relationships likely to underestimate or overestimate the true Nd-albedo relationship for the entire cloud population? Also, is it possible to have a cloud field that satisfies the filter criteria, then becomes exposed to an aerosol perturbation and no longer meets the filter criteria? One possible example is a cloud field that transitions between open and closed cellular convection regimes when exposed to an aerosol perturbation. Could such cases be an important component of the overall cloud-albedo susceptibility to aerosol perturbations? If so, then could the Nd-albedo relationships stated in the paper be biased, and in what direction?

2. Line 160. Do you account for spatial and temporal autocorrelation when estimating confidence intervals? If autocorrelation is not accounted for, then every observation is implicitly assumed to be an independent realization, which is not accurate. I would guess based on the published literature that neglecting autocorrelation in the uncertainty analysis would lead to confidence intervals that are a factor of 5-10 too narrow. I recommend estimating the spatial and temporal degrees of freedom following Bretherton et al. 1999 and then scaling the confidence intervals accordingly. For an example, see Myers et al. 2021.

3. Line 190. I believe that the dependence of cloud-droplet asymmetry parameter on droplet effective radius can make a non-negligible contribution to the total cloud-albedo dependence on effective radius when the droplets are relatively small (<12 um). I wonder if the assumption of constant asymmetry parameter could affect the Nd-albedo relationship in Fig. 1 for the high-Nd cases. Could you do a sensitivity test that defines asymmetry parameter as a function of mean droplet effective radius? The parameterization of Slingo 1989, or some approximation of it, is probably easier to implement than that of Hu and Stamnes 1993.

Specific Comments

- Line 5: “Aqua satellite, to …” remove comma
- Line 6: “low-cloud brightening potential of …” It would help to clarify that the stated value represents the albedo susceptibility for overcast scenes, not the area-average value.
- Line 41: “increase in LWP, that …” remove comma
- Line 125, 126: “casual” -> “causal”
- Line 177: “This means …” I suggest rephrasing this so that it does not use the word “means”. This will avoid potential confusion with the alternate definition of “means” that relates to averages. This will be helpful since the word “average” is used later in the sentence.
- Line 230: “positive S0 reflects …” I suggest using a word other than “reflects” here to avoid potential confusion with the alternate meaning of “reflects” that is associated with radiation.
- Line 371: Please report uncertainties. This is very important information because it facilitates comparison with other work, among other things.

References

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