# Review of Fu, et al., 2022. (v3)

Section 4.2 discusses the effects of 3D radiative effects, clear-sky contamination and drizzle, but not for sub-pixel heterogeneity (as in Zhang, 2016 – now referenced in the new manuscript). In the authour's response you say that some attempts to do this were tried, but appropriate sub-pixel variability data was not available. Perhaps this could be explained as an extra section in Section 4.2.1 with some discussion that sub-pixel variability therefore remains as a candidate for the cause of the Re overestimate from the bi-spectral approach?

Fig. 8a – this would be better as a density plot rather than a scatter plot (i.e., with colours showing the frequency within each x-y bin) since the points become cluttered at low COT.

Original review comment :-

I don't really see any evidence for this statement in the abstract (line 44): "3D radiative pathways appear to be the leading cause for the large positive biases in bi-spectral retrievals.". Where was this shown?

Response: As noted in our response to the reviewer's first question, it came from a synthesis of analyses presented throughout the manuscript and summarized in our conclusion, part of which, for example, as:
Line 839 to Line 850: "Our analysis in Sect. 3.1 showed that most samples observed by the P-3 remote sensors came from small, optically thin, shallow clouds. The samples exhibit a large difference (~factor of 2) between RSP bi-spectral and polarimetric Re retrievals. For non-drizzling shallow clouds, in situ observations compare well against the RSP polarimetric retrievals, and show variability of within ~2 µm. For these non-drizzling shallow clouds, no in situ Re samples are as large as the RSP bi-spectral Re. Therefore, for the shallow clouds observed by RSP during CAMP2Ex, the long-held hypothesis of the presence of drizzle or vertical variations as major contributing factors to Re differences between bi-spectral and polarimetric retrievals could be rejected with near certainty. Also, as revealed by the HSRL-2 derived RSP cloud element cloud fraction, clear sky contamination only has very limited contribution (~1 µm) to the observed RSP Re differences. Thus, for the shallow, non-drizzling clouds, the evidence presented herein is strongly suggestive that the dominant cause for the differences between RSP polarimetric and bispectral
Re observed during CAMP2Ex lies within 3-D radiative pathways that lead to large positive biases in bi-spectral retrievals of Re compared to polarimetric retrievals."

I'm afraid that I don't agree with this conclusion. The main evidence presented seems to be that the highest Re biases are at low COD. I agree that this does look similar to the effects of 3D radiative biases as presented in Fig. 5 of Marshak (2006). However, it is not hard evidence and the possibility of other explanations (e.g., sub-pixel variability - see above) should be acknowledged unless more substantial evidence can be presented. Also, as noted by the other reviewer, at the high resolution of the aircraft 3D radiative effects are more likely to be resolved than sub-pixel and hence 3D radiative effects may be larger than for MODIS - it would be good to discuss this in this section too.

There are still a few references to "cloud bow" COT, etc. in Section 3.2 - as discussed earlier it would be good to remove these to avoid confusion.

The newly added text contains a few grammatical errors that hopefully the type editors will pick up - or it might be useful to get it checked over if not.