We would like to thank the editor again for handling the review process for our manuscript. We also thank Reviewer 1 for the careful review of the revised manuscript. We believe that the remaining minor concern of Reviewer 1 is simply due to semantics (basically, what is meant by "3-D effects"). We have re-worded the parts in question and addressed all comments. Our responses are listed below in blue italics. Comments from the reviewers are in upright black plain texts. The line numbers in our responses are referring to the line numbers in the revised manuscript.

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?

Response:
We agree. Following the suggestion, we have now added discussion in Section 4.2.1 and the conclusion section as followed:

Line 656 to Line 675: "It has been pointed out by several studies that the bi-spectral Re retrieval has a sensitivity to instrument resolution due to a) the nonlinear relationship between VNIR and SWIR reflectances and the COT and Re and b) the presence of variability in cloudy reflectances at all scales (e.g., Marshak et al. 2006; Zhang et al. 2012; Zhang et al. 2016; Werner et al. 2018a). An important example of this effect is clear sky contamination, in which cloudy radiances and clear sky radiances are both present within the field of view (FOV) of the sensor. The presence of this sub-pixel clear sky can cause Re overestimates of up to 41% when decreasing instrument resolution from 30 m to 1 km (Werner et al. 2018b). The bias in the bi-spectral retrieval due to clear sky contamination decreases monotonically as instrument resolution increases. This is due to the applicability of an independent column approximation as a model of the variability within the FOV due to the negligible atmospheric and surface scattering contributions over ocean surfaces to VNIR and SWIR radiance. Other reflectance variations within cloudy portions of an instrument FOV also cause a sensitivity of the bi-spectral retrieval to instrument resolution, though this is typically smaller, being 1 - 3 μm (Zhang et al. 2016; Werner et al. 2018a). In this case, increasing instrument resolution does not necessarily cause a monotonic reduction in retrieval bias (e.g., Davis et al. 1997; Zhang et al. 2012). That is because the relationship between the heterogeneity of the optical and microphysical properties (e.g., Re) within the cloud and the radiance field is governed by 3-D radiative transfer, not an independent column approximation. Note that polarimetric retrievals are only weakly sensitive to instrument resolution as they are largely unaffected by clear sky contamination (e.g., Miller et al. 2018; Shang et al. 2015). Based on these considerations, we assess the sensitivity of our bias estimate in the bi-spectral Re due to the relative coarse resolution of RSP by investigating the impact of clear sky contamination using the higher resolution HSRL-2 lidar. We may then attribute the remaining bias in Re to the expression of cloud heterogeneity and 3-D radiative transfer, whether this occurs at resolved or unresolved (i.e., sub-pixel to HSRL-2) scales."

And:

Line 856 to Line 859: "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 bi-spectral Re observed during CAMP2Ex is due to 3-D radiative transfer and cloud heterogeneity (both resolved and unresolved by RSP) effects that lead to large positive biases in bi-spectral retrievals of

Re compared to polarimetric retrievals."

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.

Response:
We experimented with both density plot and scatter plot when we first made the figures. The density plot is attached here, we have replaced Fig. 8(a) with this density plot in the main text.

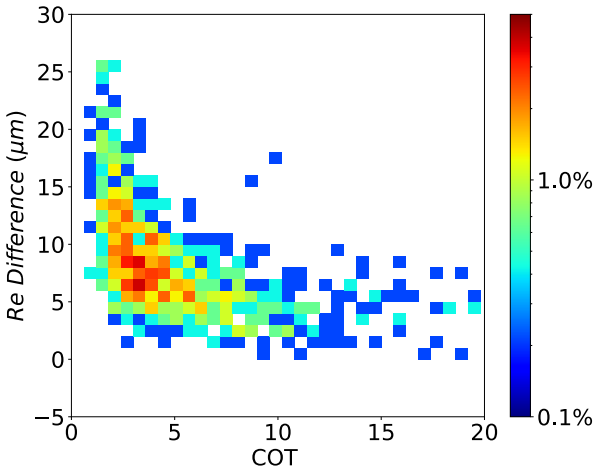

Figure 8(a). Density plot of cloud element mean Re difference ((bi-spectral – polarimetric Re) vs. mean COT.

Original review comment :- *(the original reviewer comment in R1 is in red, the original response in light blue)*

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.

Response:
We agree. We believe that the concern here deals with semantics – basically our use of "3-D radiative pathways" includes pathways involving sub-pixel cloud heterogeneity. For clarity, we changed "3-D radiative pathways" to "3-D radiative transfer and cloud heterogeneity" in both the abstract and the conclusion. By calling it "3-D radiative transfer and cloud heterogeneity", we include all effects of 3-D radiative transfer that are both "external" (such as cloud shape) and "internal" (i.e., microphysical variability) cloud heterogeneity, whether they are resolvable or not by the measurement. The paragraph added to Section 4.2 in response to the reviewer's first question also clarifies this.

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

Response:
We have removed all "cloud bow" and they are now "COT" as suggested.

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.

Response:
We have gone through the entire text and found several grammatical errors/typos and we have now corrected them.