Answers to reviewers, 2nd revision

We would like to thank the reviewers again for their time and effort reviewing this manuscript and providing helpful comments and suggestions. The comments from the reviewers are marked in black, our answers in red and new text added to the manuscript in blue. In the revised document, all new text is marked in blue, and deleted text is crossed out in red.

Report #1:

1. L292: The addition of this section is helpful to assess the accuracy of these Cloudnet profiles. However, computing the mean temperature difference between the radiosondes and Cloudnet can be misleading if Cloudnet exhibits a cool bias in one layer and a warm bias in another. Wouldn't RMSD or some other metric better account for these differences?

A: In Dias-Neto 2021, also the RMSD was calculated for the comparison between the Cloudnet temperature information and the temperature measured by the radiosondes. Dias-Neto 2021 found that the RMSD=1.1°C. Further, the error is distributed around 0°C for temperatures between -20 and 20°C; for colder temperatures Cloudnet overestimates the temperature. We added the following sentence to Line 293: Further, the root-mean square difference was found to be RMSD=1.1°C.

2. L637–L650: Although it is true that SIP may augment the concentration of ice crystals, are the authors suggesting that mechanisms such as ice fragmentation were so prevalent for this study that it exceeds any impact that aggregation typically has at reducing the concentration of KDP-producing crystals (L628)? Couldn't horizontal/vertical winds, some sort of lifting mechanism, instability, etc. also play a role?

A: Our main goal in this paragraph is to provide a possible explanation for our finding that the increase of KDP towards the bottom of the DGL is correlated with DWR class. At first, this appears to be counter intuitive as aggregation should reduce the number of particles. However, as aggregation is connected to collision of particles, it would be in our opinion quite logical that more collisions could also lead to more fragments. We absolutely agree with the reviewer that other mechanism might be also very relevant for the vertical evolution of number concentration but we somehow doubt that for example lifting or instability would show such a systematic temperature dependence as we find it in our statistics.

Report #2:

Line 630-631: I still think that mentioning this factor of three ratio of dendritic to aggregate KDP requires more qualifications regarding the variability in dendritic and aggregate shapes. This shape variability produces a range of KDP values for each particle type, increasing uncertainty in the value of the ratio.

In order to address the reviewer’s concern about our example calculation, we repeated the experiment using the scattering properties of the other aggregate types available in the Lu database (see Figure 1). As expected, there is a significant difference, depending on the density and type of monomer assumed. The aggregates with the lowest density (LDt-P1d) produce the smallest Ze, ZDR and KDP. Assuming these low-density particles, in order to match the DWR of 4.2dB, Λ was estimated to be 1.3*10^-3. For this Λ, N0 of 65*10^5 has to be assumed to match Ze of 10.2dB. For this PSD and particle type LDt-P1d, a KDP of 1.9 was estimated. So with this extreme, low-density particle type, we would obtain a KDP which even exceeds the observed KDP. In fact, by changing our particle type to low density aggregates the KDP contribution by aggregates would even be more important to be taken into account. However, we would like to stress again that this calculation experiment was not meant to provide final conclusions on the KDP contribution of aggregates. It rather is intended to demonstrate that the KDP contribution can not be simply neglected and that previously calculated low KDP of aggregates might be mainly caused by the used unrealistic scattering model (low density and refractive index connected to effective medium approximation and spheroidal shape approximation).

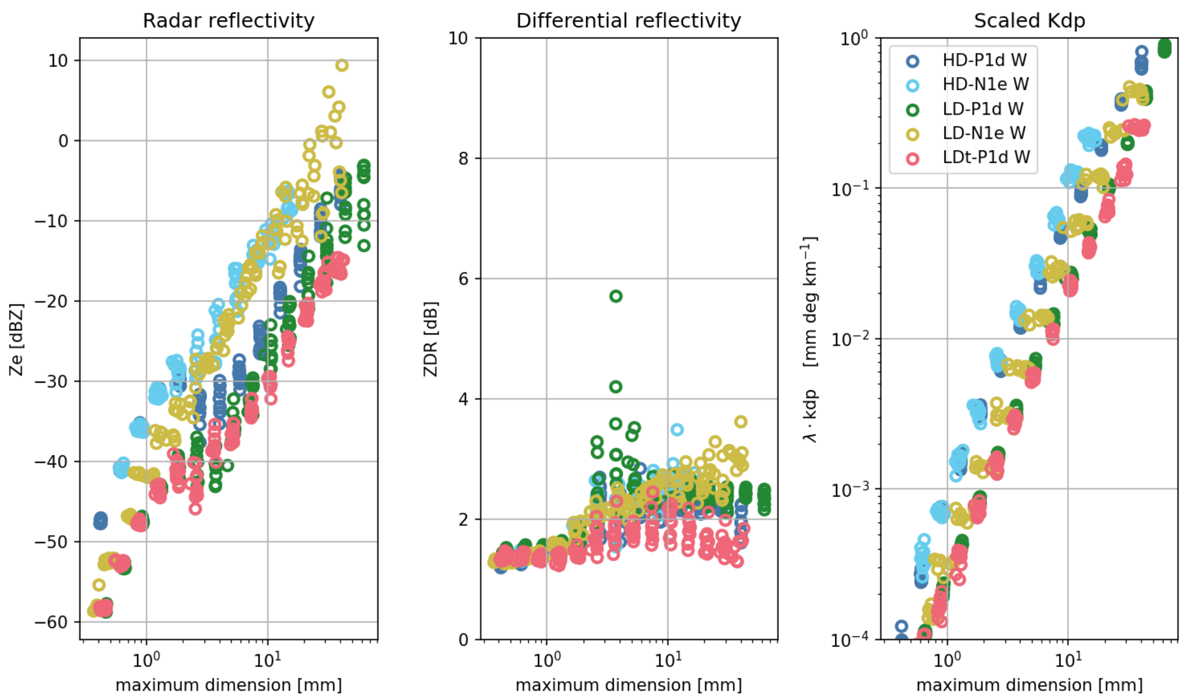

Figure 1: scattering properties of all aggregate types available in the Lu et al. (2016) database.

Addressing the remark from the precedent review file validation:

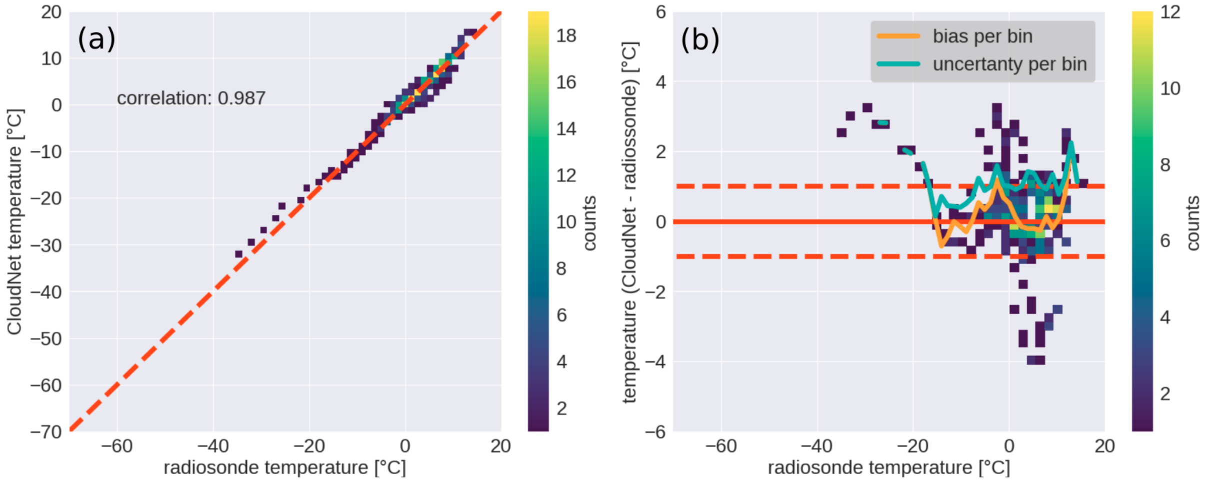

Figure 1: comparison of cloudnet and radiosonde temperatures during the TRIPEx-pol campaign. (a) scatterplot between cloudnet and radiosonde temperatures, (b) radiosonde temperature against the difference in cloudnet and radiosonde temperature. This figure was taken from Dias Neto, J (2021). “Investigating aggregation in ice and snow clouds using novel combination of triple-frequency cloud radars and radar Doppler spectra.” PhD Thesis. Cologne: Universität zu Köln, and reproduced here with permission from Jose Dias-Neto.