First of all we sincerely thank the reviewers for their work in reviewing the manuscript. These reviews were helpul to improve the manuscript and we hope that their justified concerns will be answered here. The reviewer's comment is in normal color, while the answer is in blue.

Reviewer 1

This is a thorough and important study demonstrating how the CloudNet radar network can be leveraged to provide intercalibration between ground-based and spaceborne cloud radars; it expands and improves upon the previous work by Protat et al. and Kollias et al using similar methods, and will provide an important means of monitoring and calibrating ground-based radars and EarthCARE during its lifetime. The manuscript is well-structured and clearly written, and the figures are well-presented; however, there are some methodological issues which need addressing to make the treatment of EarthCARE data consistent with the ground-based and CloudSat data. I recommend this paper for publication subject to major revisions.

1. For the selection of ice clouds from the ground-based and CloudSat datasets, the CloudNet and DARDAR-MASK target classification products are used to identify liquid cloud layers. Both of these products are synergistic radar-lidar target classifications, wherein the lidar provides the bulk of the detections of liquid cloud. For the current analysis of EarthCARE CPR data, however, it appears that the CPR L2a product (C-TC) is being used. While C-TC contains a classification of liquid cloud (alongside many detections of rain and melting layers, as described in Section 4.3), it will miss the vast majority of non-precipitating liquid cloud—and especially supercooled liquid cloud. This was shown in Irbah et al. (2023). In fact, the C-TC product is not capable of diagnosing supercooled liquid at all: all hydrometeors detected at temperatures below the freezing level will be classed as ice or snow. It may be that the existing criteria for selection of data are screening these cases out to some extent, but there's a good chance that mixed-phase clouds are not entirely removed from the EarthCARE data at present.

We understand this concern as it was also one of ours during this study. The AC-TC classification was not used for several reasons. The first one being known issues in the classification for the BA baseline. An issue corrected in BC baseline was the missclasification of liquid clouds to aerosols (https://earth.esa.int/eogateway/documents/d/earthcare-data-handbook/earthcare-ac-tc-level-2b-processor-disclaimer). We therefore prioritize the removal of liquid clouds over the attenuation from supercooled water. Looking at our final closure, this tradeoff does not seem detrimental as we have a very good agreement between EarthCARE and the ground stations.

Another concern we have is that as supercooled water is detected through the lidar, the geometry of the observation could be a problem. As EarthCARE observes from the top of the cloud, a supercooled water layer embedded in the cloud could be invisible if the lidar is attenuated before it. The same inverted phenomena could happen from the ground. An instrument seeing supercooled water could therefore lead to not removing it for the other, thus keeping an observation of a cloud in the dataset that is not in the other. This would need to be investigated if we want to precisely filter the profiles with supercooled water.

Figure R1 is the equivalent of figure B1 from the manuscript, with supercooled water filtered using AC-TC for the satellite and CloudNet classification for the ground. Removing the supercooled water with AC-TC divides by 2 the number of available satellite profiles and the infered bias is larger. Taking account of the uncertainties, the results with and without supercooled water are coherent one with another. Looking at R1, we also see that between 8 and 10 km, the ground and satellite center profiles are similar, but this similarity fades at heights lower than 8km.

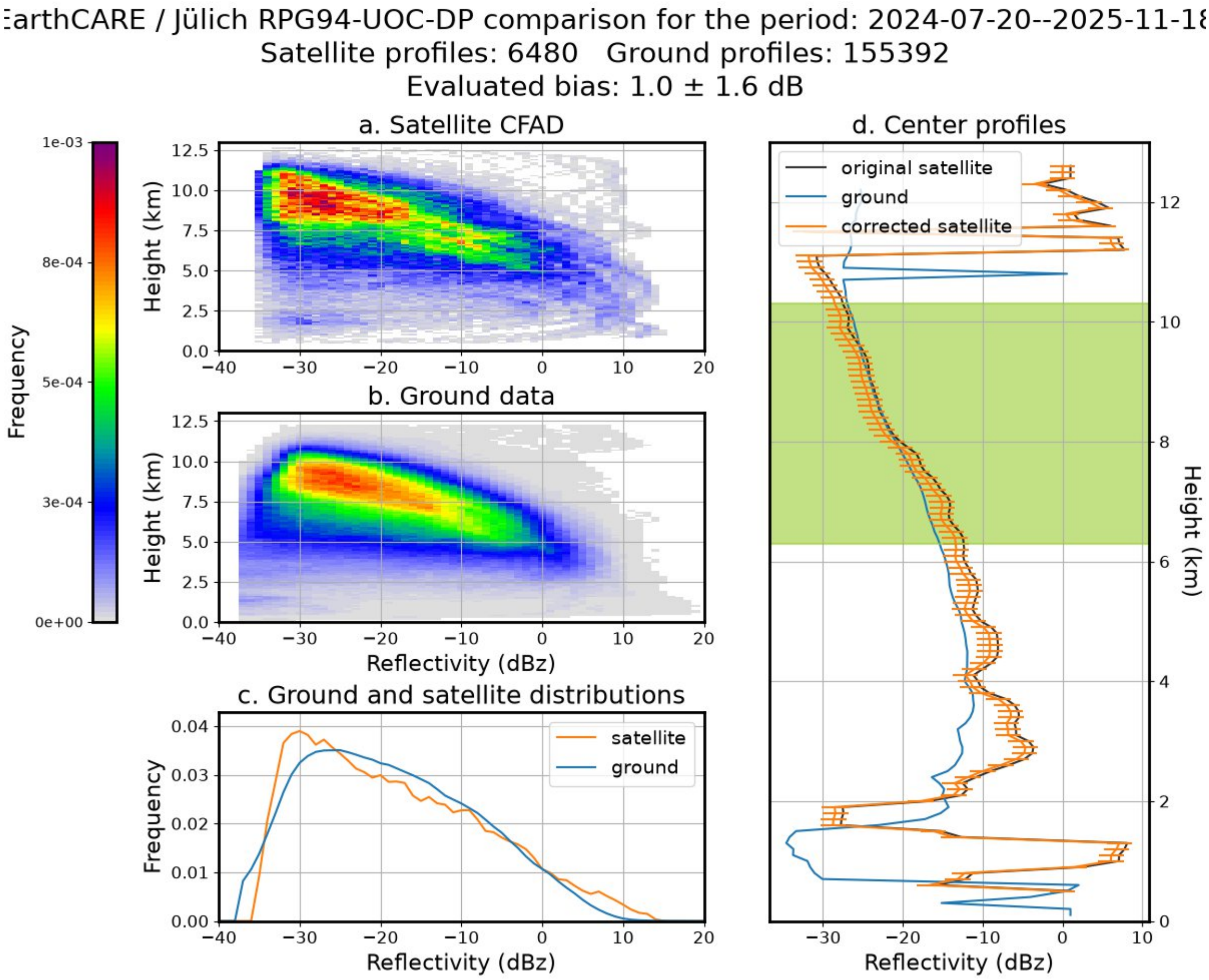

Figure R1: Same figure than figure B1 from the manuscript but with supercooled water filtered using AC-TC. a., b. Satellite and ground CFADs. b. Satellite (orange) and ground (blue) reflectivity distributions. d. Center profiles of the ground (blue), satellite (black) and satellite corrected for the bias (orange).

To summarize, the removal of supercooled water should be possible and could be beneficial when the classifications products have undergone more validation. We think that this filtering would need further investigations and should be done carefully. For our methodology, this could also require to refine our height selection parameters.

Changes to the manuscript: Added a discussion on why we did not used AC-TC, lines 128-130. Added a discussion on the future use of the AC-TC product to filter supercooled water, lines 474-476 .

2. Another apparent issue in the data screening is indicated by the presence of a local maximum in the EarthCARE CFAD (e.g. Figure 3) around -30 dBZ and 2.5km above ground level. Although I see that there is a (smaller & shallower) maximum in the

ground-based data near here, I suspect there's a contribution to the EarthCARE CPR detections from a measurement artefact. This feature is highly characteristic of a known second-trip echo effect that occurs over highly reflective surfaces (including rivers, lakes, ponds, flooded fields, as well as salt-flats and the open ocean in light wind conditions). It was not yet removed from the L2a CPR products at the time of the BA baseline, but will be identified & removed in later versions. These second-trip echoes will occur only in profiles where the surface return (sigma0) in the CPR data exceeds around 30 dBZ, so could be screened for using this criterion.

In the case of our study, these second trip echoes are not a problem and can even be considered as a proof of concept. These heights are indeed rejected for the comparisons by all 3 of out selection criterias, confirming our capability to discard non comparable heights.

Changes to the manuscript: The presence of these scond trip echoes is mentionned in the description of fig3. The confirmation that the algorithm is capable of discarding different physical observations such as scond trip echoes is also mentionned lines 319-322.

3. The only other comment I have is very minor: In the CFAD plot introduced in Fig 3., the "discarded data" section of the ground-based CFAD corresponds to the minimum detectable signal of the EarthCARE CPR. But in some of the plots in the appendix, the lower thresholds of the CFADs and PDFs of reflectivity (panel c) are not consistent between the ground and satellite: Figs. A1, B4, B5 & B6.

Answer: The windowing of the data is made dynamicaly, based on the reflectivity target observed by both instruments. This is done to avoid errors in the calibration bias estimation that could arise when removing data using fixed reflectivity thresholds. A fixed threshold would be quantitatively incorrect if the 2 radars are not calibrated the same way. The window is infered from the satellite PDF then applied on the ground data. The reference to apply the window is the 20% of data from the maximum of the pdf. This 20% might differ between the gound and the satellite, leading to a different minimum reflectivity, thus explaining the difference of lower threshold between EarthCARE and the ground.

Changes to the manuscript: A mention of this potential non coincidence of the minimum of the distributions was added lines 244-245.