Reply letter to Reviewer 2.

The manuscript presented a case study combining remote sensing and in situ data to investigate the potential enhancement of precipitation associated with seeder-feeder mechanism and further compare observations against the model. It is a study with lots of potential. If well-established, it can be applied to more extensive datasets to provide insightful constraints for models. However, there are major issues to be addressed at this point.
You presented multiple seeding profiles during 3-5 UTC in Fig. 4, 6 and 8, but the precipitation rates are very low for this period in Fig. 11. You stated that no seeding occurs between 3 to 5 UTC in your discussion of Fig. 11. These are conflicting. The observations and conclusions are not reconciled.

We kindly refer to the replies provided to the specific comments. (Side note: The line numbers that are being referred to in the responses are according to the revised version without tracked-changes.)

It is also puzzling that you have 11 profiles selected and shown in Fig. 4, while you picked completely different profiles while you discuss doppler spectrum and polarization ratio etc. in Fig. 6 and 8. A synergetic view means all the coincident observations and available retrievals (reflectivity profile, DWR, retrieved rimed mass, doppler spectrum, etc.) are analyzed and discussed for the identical profiles.

See answer in the specific comments.

The structure of the paper would be more reasonable, if you presented figures summarizing the entire case (e.g., Fig. 5) for both remote sensing and in situ measurements and then zoom in on representative strong, weak and no seeding vertical profiles and dive into further details.

As reviewer #2 suggested, we moved the general in-situ part to the general overview and then go into the details afterwards.

In addition, the performance of fall streak tracking appears questionable. Related retrievals following the trajectories should be reevaluated. It could have a significant impact on your results. See more in the detailed comments.

See answer in the specific comments.

The contrast between with and without seeding is evident, but not for the comparison between your strong and weak seeding cases. I expect to see a more in-depth discussion after careful reanalysis of data.

We thank reviewer #2 for this comment. We added the following paragraph to the discussion of Fig. 11 from line 604: “There is quite a strong contrast not only between seeding and no seeding but also between weak seeding and strong seeding. While the reflectivity in the feeder cloud is very similar for strong seeding and weak seeding (as discussed in Fig. 4) the precipitation shows much lower values for weak seeding than for strong seeding. It seems that a specific amount of seeding mass must fall through the feeder cloud in order to significantly get rimed.” For this reason, we think that the differentiation between strong and weak seeding is useful.

Detailed comments:

Add basic technical details for radars, such as range resolution, minimum detectable sensitivity. Size ranges that 2DVD and VISSS can detect should be provided.

In Sect. 3.1 we added the following parameters within the text at the respective places:
“The RPG94 minimum detectable sensitivity is -60 dBz down to 50m altitude and the range resolution is 15-30m and 1-3s which can be adjusted by the user.”
“The Mira35 minimum detectable sensitivity goes down to -50 dBz at 5km height and range resolution is 30m and 3s. The radar can detect targets down to 150m above ground, with full sensitivity above 450m.”
“The resolution of the 2DVD is 0.17mm which corresponds to the smallest detectable particle size.”
“The resolution of the VISSS is 0.06mm which corresponds to the smallest detectable particle size.”

L59: Please add reference for ICON-D2.

We added Zängl et al.,2015 and Omanovic et al., 2024.

L99: reference for peakTree

Reference is added: Radenz et al., 2019

L122: categorize (verb) categorized. The same applies to the rest of the manuscript.

Categorize is the specific name of the files in Cloudnet. It is concretized in the manuscript from line 129.

L125-126: what is the purpose to obtain PSD and ICNC from both 2DVD and VISSS? Is the information from the 2 instruments complementary or it is for quality control? Also, there is no need to define PSD and ICNC twice.

Both instruments (or at least their application to snowfall in the case of the 2DVD) are relatively new and retrievals are not heavily tested, so we used it as a chance to see if both methods agree well with each other. Also, the instrument setup and resolution are different. VISSS shows a higher ICNC which is the result of its sensitivity to lower particle sizes. It underlines the importance to be able to measure down to very small particle sizes. The Cloudlab campaign provided a unique chance to set bot measurements into relation.
But true, we removed the redefinition of PSD and ICNC.

L153: how large are the uncertainties?

According to the request by reviewer #1 the section was removed from the manuscript. The corresponding Fig. 3d was left out as well.

L171: please provide more description in term of how the data is harmonized.

We added the following paragraph: “For this, the raw data is harmonized, for example into netCDF formats. Then calibration and quality control are done. The Level-2 cloud products generation is performed, including vertical profiles, cloud classification, and liquid/ice water content. Finally, harmonization steps like bias correction, inter-site instrument matching, and consistency checks are done. All processing steps are traceable and reproducible and the datasets get an individual DOI.”

L216: comma should be removed.

Comma is removed now.

L234-235 and L239-240: redundant.

Right, the sentence in L239-240 was removed.

L247-248: How do you define “liquid droplets”? I consider drizzle and rain are part of them.

Thanks to reviewer #2. There is a need to be more precise here. We actually meant “liquid cloud droplets”. It is corrected in the manuscript.

L254: cloud, drizzle and rain are all liquid water droplets. Raindrops do not fall slowly.

Yes, same as above; we meant liquid cloud droplets. It is corrected in the manuscript in line 260.

L270: add a table listing the criteria for each classification and providing the percentage of each group – “ice”, “ice and liquid”, “unclassified”, etc. Evaluate how well the classification technique works for your dataset.

We added a Tbl. 2 in Sect. 3.9 listing the thresholds for the different categories. Also, we added the percentage of occurrence of the different categories in the hydrometeor classification in the discussion of the respective figure. There, we also discussed how well the results of the peakTree hydrometeor classification agreed with the in-situ observations.

L296-297: why not put M in the far left of Eq.2, if that is what to derive?

The suggestion of reviewer #2 does make sense and we adjusted the equation in the way that M is on the left side of the equation.

L304: what is VISSS resolution?

We changed the formulation to:” resolution of VISSS which is 0.06mm”.

L305: *M* for individual particles and population should have different symbols.

Alright, we included the index “i" for the individual particles.

Eq. 3: is FR for one particle or a population?

The equation can be used for both. Here, in the end, it is used for a particle population.

L317: VISSS data is not mentioned in section 3.14.

We thank reviewer #2 for the remark. We removed VISSS data in the subsection title.

Fig. 4: a panel should be added under panel b to show the time series of liquid water path with error bars indicating retrieval uncertainties.

On the one hand, it a good idea of the reviewer #2 to show the evolution of the LWP early. On the other hand, the LWP should be shown together with the precipitation later in the manuscript. If we would include the LWP into Fig. 4, we would show the same LWP curve twice in the manuscript. We think, it is not appropriate to show a figure twice. As a compromise, in the discussion of Fig. 4, we now refer to Fig. 11a containing the LWP measurements (see line 412).

In Fig. 4b, the first 3 profiles from the left (between 2 and 5 UTC) appear to be under the impact of shear between 1.75 and 2 km by eyeballing the structure of reflectivity. The trajectories are likely slanted. I doubt the particles are falling straight down as indicated. Despite the uncertainties of fall streak tracking, I am not convinced that it works as expected here. I suggest that authors experiment with different time windows when looking for local maximum reflectivity.

Sometimes, the visual expectation of fall streaks in scenes and the algorithm do not seem to be equivalent, especially if there is strong wind shear like in this case around the border between the PBL and the free troposphere. However, we put a lot of effort into the fall streak tracking algorithm. The code was independently programmed by two different co-authors following the description in the methods section. This yielded the same results. Due to 3-dimensional effects, limitations remain in fall streak tracking, however, it is still a more suitable approach than just vertical profiles. This is already stated in the manuscript from line 195. The difference in visually expected and calculated fall streak may also be a result of the logarithmic color scale.

L409: what does white color indicate in fig. 5f? It is not part of your colorbar. The high spectral width between 2 and 3 km in fig. 5a mostly collocate with the white colors in fig. 5f. If white indicates missing value, you cannot conclude the high spectral width is not related to turbulence.

The white color is related to data points where no EDR could be retrieved. A fit is calculated to the power-spectrum. If the slope is close to -5/3 (specifically, in between -2 and -1.33, which is 20% uncertainty according to Borque et al. 2016) then the EDR is calculated. Otherwise, no EDR can be calculated. In the presented scenario, this is the case for some of the points in this layer with enhanced spectral width and, by definition, for the entire background. Therefore, it is the same white color (meaning that no EDR could be retrieved). In any way, Reviewer #2 is right, there might be a slightly enhanced EDR. Also, reviewer #1 commented on this, so we removed the concluding part of the sentence “however, here, Fig. 5f indicates that these were not enhanced.”

L410: remove e.g. in this line.

Okay, it is removed.

L459: you state it is a “strong seeding event” here, but your description in Fig. 6 is a “a case with weak seeding”.

Reviewer #2 is right! The figure caption was not updated after we included another case for the Doppler spectrum. It is corrected now.

L460: why not present a case where fall streaks are available and add that profile in Fig. 4?

In our revised manuscript we now changed the times of the fall streaks in Fig. 4, so that they are equivalent with the times discussed in Fig. 6 and 8.
Just as a side-note: The analysis in Fig. 8 can anyway not be done along fall streak as this technique requires a scan of the radar. While scanning, tracking along fall streak is not possible. However, we decided to use the same initial times in Fig. 4.

Fig. 8 caption: the panel letters for weak (c, d) and no seeding (e, f) events are not correct.

It is corrected now.

L574: are total ICNC from 2 instruments comparable if very small particles below 0.5 mm are excluded?

Yes, the results of the ICNC from both instruments should be equivalent. However, so far there are no extensive comparison studies that show agreement/disagreement, strengths, and limitations of both instruments, so we chose to show both measurements. Due to the optical setup, VISSS is more sensitive to smaller ice particles than 2DVD. This information is important when dealing with the dataset. It underlines the importance to be able to measure down to very small particle sizes.

L583: why is there no seeding between 3 to 5 UTC? You have multiple seeding profiles during this period presented in Fig. 4, 6 and 8.

Thanks for carefully reading the manuscript. It is correct that it was formulated inconsistently. We changed the sentence in the discussion of Fig. 11 to what we actually meant: “These periods are coinciding with times where no or only weak seeding occurs.”