Review of “Evaluation of polarimetric ice microphysical retrievals with OLYMPEX campaign data”, by Armin Blanke, Andrew J. Heymsfield, Manuel Moser, and Silke Trömel, egusphere-2022-1488.

Response to reviewer 2

Dear reviewer,
We are very grateful for your valuable feedback and suggestions to improve the manuscript. The manuscript has been thoroughly revised and point-by-point responses have been prepared. Please find below our replies highlighted in blue along with your suggestions. The revised manuscript is also provided with tracked-changes for clarity.

General comments:

The manuscript “Evaluation of polarimetric ice microphysical retrievals with OLYMPEX campaign data” is satisfactorily written, and the content is within the journal's scope. The authors introduce a new way of radar data processing, RSVP. They compare polarimetric and standard X-band radar retrievals with in situ aircraft measurements of IWC, Dm, and Nt, suggesting that dual-pol information improves the microphysical retrievals. Minor revision is the recommendation.

Specific comments:

Lines 140-145: Brown and Francis (1995) (BF) relation derived for cirrus clouds may not represent IWC properly in different cloud types and environmental temperatures. Authors may want to comment a bit more on the BF usage (there is only a short comment in section 5 beginning about the uncertainty of the assumed mass-dimension relation – line 285).

Thank you for this suggestion. An extended explanation on the usage of BF is given in Lines 148-153:
‘Even though parameters a and b of the mass-dimension relationship vary with the environmental conditions and particle shapes (Baker and Lawson, 2006), constant standard parameters are used in this study which reasonably represent the mean ice water content, especially for ice crystal aggregates. Tridon et al. (2019) confirmed that the aggregates observed during OLYMPEX can mostly be described by a quite narrow range of mass-size relations. In single situations with large aggregates or intense riming processes, however, the fixed parametrization may underestimate the ice water content (see also Heymsfield et al., 2023).‘ We included Baker and Lawson (2006; doi: 10.1175/jam2398.1) and Heymsfield et al. (2023 ; doi: 10.1175/JAMC-D-22-0057.1) as references and also referred to Moser et al. (2023; doi: 10.5194/acp-2023-44) with respect to the operating principles, uncertainties and limitations of the 2D-S and HVPS. Please see Lines 111 - 112.

Line 167: Reword the part about the “confusion among the experts”; it is probably a typo in Murphy et al. (2020) – their multiplier is reciprocal to multiplier in (8).

Yes, it is likely a typo in Murphy et al. (2020). We rephrased as follows: ‘ This equation differs from Eq. (5) in Murphy et al. (2020) showing, due to a typo, the reciprocal multiplier when converting D_{mm} to D_m.‘ Please see Lines 175 - 176.

Lines 224-229: The factor α_0 does not vary with the degree of riming frim; it is constant. The authors probably wanted to emphasize that the prefactor α in the snow density relation, $\rho s = \alpha D^{-1} = \alpha_0 f_{rim} D^{-1}$, varies with the degree of riming.

Indeed, thanks for pointing it out. We clarified Eq. (20): '… where ρ_s is expressed in g cm^{-3}, α_0 is a constant, and the prefactor α_p varies with the degree of riming f_{rim}, which ranges from 1 for unrimed ice to 5 for heavily rimed ice.' Please see Lines 235-237.

Line 231: There is no reference to Table 2 in the body text.

Thanks, we are now referring to Table 2 in Lines 242 - 243.

Line 311: Provide a reference for the temperatures - the text is difficult to follow this way.

Thanks for raising this point. With colder temperatures we refer to the range T≲ -27°C and with warmer temperatures we refer to T≳ -14°C. We included this information in brackets. Please see Lines 320 - 321.

Line 318: The same comment as for Line 311.

We indicated again the according temperature ranges. Please see Lines 328 – 329.

Line 320: Did the authors mean Kdp<0.01 deg/km here?

No, we are not referring here to the filtering criterion mentioned in Line 274, in fact we mean that the data point exhibit a low Kdp value below 0.1 deg/km (exact value: 0.08 deg/km).

Line 388: Remove "as" from the sentence.

Thanks, removed in Line 398.