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Interactive comment on “First correlated measurements of the shape and scattering properties of cloud particles using the new Particle Habit Imaging and Polar Scattering (PHIPS) probe” by A. Abdelmonem et al.

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The Referee #1 Wrote:

“The end of section 5.1 is not clear about the comments on comparisons on measurements with theoretical results. The observations should be reported on Fig. 13 to show differences between the two approaches.” and “Please re-write the legend with more concise details. What are the instruments shown on panels c, d, e and f respectively?”

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Authors' response:

This part was re-considered and the following interpretation will replace the end of section 5.1 in the final version:

“We found a relatively low linear depolarization ratio of $\delta_{||}=0.14$ for the thin columns observed in the blue and yellow experiment periods of Figs. 11 and 12. Subsequent periods with thicker and larger columns are nicely correlated with the increase observed in the depolarization ratio up to a value of 0.35. A wide range of aspect ratios between about 0.02 and 1 was deduced from the HOLIMO and PHIPS images throughout the experiment (see panel d of (the new version of) Fig. 10). Figure 13 shows theoretical δ_{\perp} and $\delta_{||}$ values calculated for a scattering angle of 178° and for an aspect ratio range of $0.0002 \text{ (needles)} < \chi < 200 \text{ (thin plates)}$. We used the same geometric optics ray-tracing program by Macke et al. (1996) that has been applied in the previous study for plate-like ice crystals (Amsler et al., 2009). For the observed aspect ratio range the geometric optics model gives a flat χ -dependence of the depolarization ratio $\delta_{||}$, and δ_{\perp} values that are always larger than $\delta_{||}$. These findings are in a qualitative agreement with the flat temporal evolution of $\delta_{||}$ and a larger δ_{\perp} value measured in the blue and yellow periods where the sizes of the ice particles are comparable, yet the modeled linear depolarization ratios are in general higher than the measured ones. This discrepancy might partly be due to the small width of the investigated columnar ice crystals, which brings geometric optics to the margin of its applicability. A similar observation, i.e. a low depolarization ratio for thin particles, has been made in case of plate like ice crystals investigated in the IN11 2 experiment by Amsler et al. (2009). From these results we can conclude that the observed low depolarization ratios of thin plates and thin columns are rather a consequence of the extreme shape of the hydrometeors than being provoked from their actual hexagonal geometry since we probed two extremes of internal prismatic reflections where we have almost no influence of basal or prism facets in one or the other case.”

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Updated Figure and captions:

Fig. 10. Temporal evolution of the AIDA mixed phase cloud experiment HALO02_18. Panel (a): wall and gas temperatures and pressure of the AIDA chamber. Panel (b): ice saturation ratio of the total and interstitial water contents s_i in the AIDA volume. Panel (c): optical particle diameter as measured by WELAS. Panel (d): geometric particle diameters as measured by the HOLIMO and PHIPS imagers together with the aspect ratio solely deduced for the PHIPS columns. Panel (e): near-forward (2°) and near-backward (178°) light scattering intensities measured by SIMONE. Panel (f): backscattering linear depolarization ratio measured by SIMONE. See text for details.

Fig. 13. Linear depolarization ratios vs. χ of randomly oriented hexagonal prisms calculated using geometric optics. The shaded area represents the wide range of aspect ratios which was deduced from the HOLIMO and PHIPS images throughout HALO02_18 experiment.

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 2883, 2011.

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4, C996–C1000, 2011

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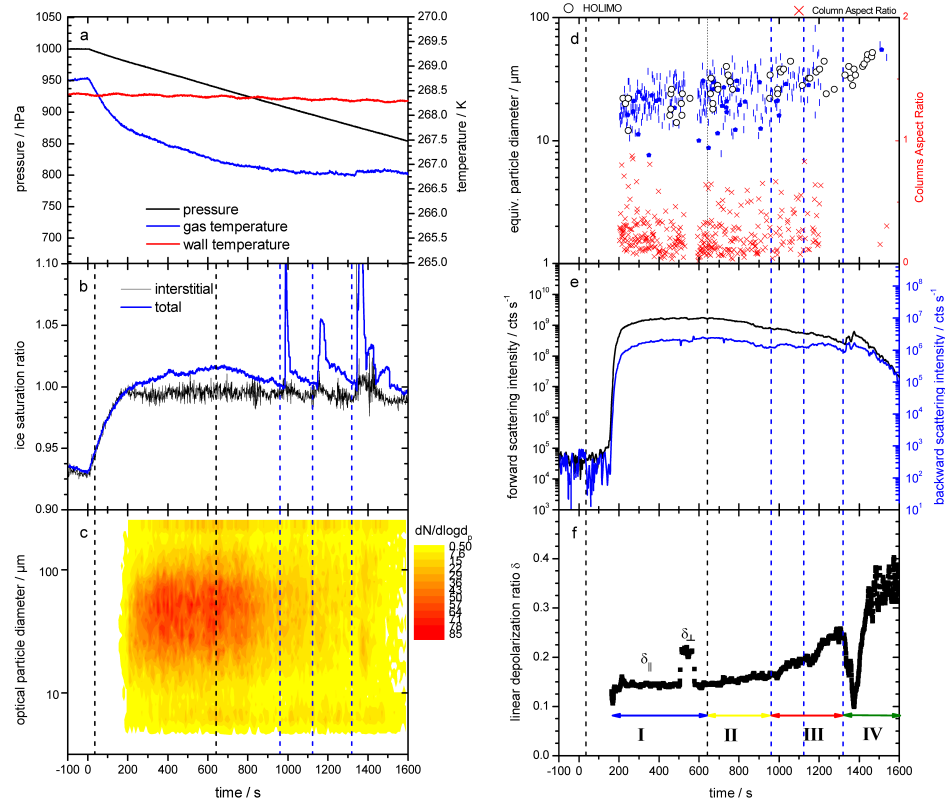
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Fig. 1.

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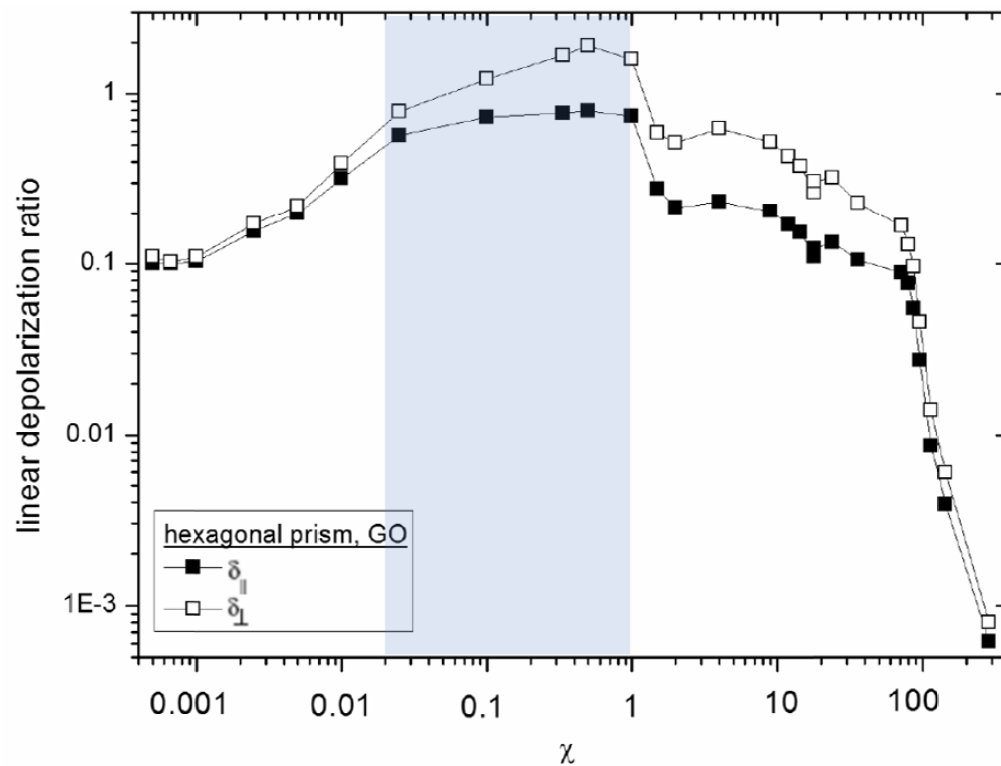
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Fig. 2.

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