

## ***Interactive comment on “In situ characterization of mixed phase clouds using the Small Ice Detector and the Particle Phase Discriminator” by P. Vochezer et al.***

**Anonymous Referee #1**

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This paper discusses data from the SID-3 and PPD-2K instruments, collected in three different environments, as a means of assessing the mixed phase state of a cloud. The work presented in this manuscript shows promise for expanding our understanding of cloud probes that rely on the information obtained from forward scattering patterns, but there are some issues with the work as presented here.

First, the authors fail to properly acknowledge false ice detection with the SID-3 instrument. Yes probability of coincident particles within the trigger volume is low (as discussed on Page 6, Line 13) but there is an extended sensing volume in which you can still have coincident particles leading to falsely identified ice. This needs to be

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considered by the authors in the context of the observations.

Second, the authors promise to present data on the shape and roughness of ice particles. The shape of observed ice was touched on in the Jungfraujoch data and FFT particle classification scheme but overall lacking. Additionally, data on particle roughness and what this tells us about the observed ice particles is non-existent.

Third, the authors also promised an algorithm that can discriminate the phase of cloud particles. An FFT method is mentioned but no in-depth details on the method were provided. Without such information, or citing where their algorithm came from, it is hard for the reader to determine how well the transform is performing and subsequent particle classification can be trusted.

Page 2, Line 23 – The Wegener-Bergeron-Findeisen process is really only applicable to water vapor limited cases. If this process is relevant for the observations presented here it should be stated as such.

Page 3, Line 2 – It is also challenging to distinguish observe and classify small ice particles due to instrument resolution and sample volume.

Page 5, Line 6 – It was also my understanding that using a droplet generator to map out the sensing volume of a SID type instrument was not so straightforward due to the imaging optics and the extended sensing volume. Can you tell us more about the process? Also, were any coincidence studies done with this set-up? Such work would be of great use to the community. If so, specific questions are as follows - If the SID-3 is triggered by a particle, what are the effects of another particle in the extended sensing volume at various locations along the beam? Where, if at all, along the beam can a second particle pass and it's effects on the scattering pattern are negligible?

Page 7 (and page 11) – You promise an algorithm that uses roughness to discriminate particles but it falls through. Nowhere in the context of your observations is roughness or GLCM mentioned. Please add this information if you wish to mention roughness.

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If you do add particle roughness information to the studies presented here, further definition of the gray levels used would be of great use to the community.

Page 7, line 9 – Can the  $q$  and  $I$  thresholds used here be related to saturation of the azimuthal segments used for scattered light detection of the earlier SID models?

Page 7, Eqn 2 – Do you have a feel from this work whether Vaz or asymmetry threshold, used in Cotton et al. and Johnson et al., is better at discriminating between ice and liquid? What value of  $N$  do you use here? How does this compare with SID-2 and its 28 segment detector? Additionally, Cotton et al. noted that the asymmetry threshold for discrimination was dependent on cloud type. Does Vaz suffer from the same issue? Can you correlate what you've found with Vaz back to SID-2 data?

Section 2.3.3 – The authors go through the trouble of defining ice particle classification, but they don't fully utilize this instrument ability. For instance, during the AIDA expansion what types of particles were observed based on scattering patterns?

Page 18, line 21 – It is a shame SID-3 was not operational for run 46 and because of this I don't feel that the observations of PPD-2K alone are enough to demonstrate your conclusion, "the presented technique enables the discrimination between liquid water droplets and cloud ice particles at the same optical sizes in a range of  $5\mu\text{m} < D_p < 50\mu\text{m}$ ."

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Interactive comment on Atmos. Meas. Tech. Discuss., 8, 6511, 2015.