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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Application of holography and automated image processing for laboratory experiments on mass and fall speed of small cloud ice crystals" *by* Maximilian Weitzel et al.

Anonymous Referee #3

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This manuscript presents the results of a series of experiments designed to measure the size, mass, and fall velocity of small ice crystals. Focusing on particles smaller than 150um in diameter, this study fills a large gap in the literature where detailed measurements of the physical properties of small ice are rare, and has important follow-up implications in cloud lifetimes, radiative properties, and cloud dynamics. Overall I think this manuscript is well written, with clearly described techniques, methods, and results. More discussion of the results in a few areas of the manuscript would be valuable, as well as some points of clarification as noted below. Otherwise, I have no

major reservations with the work presented, and recommend publication in ACP with minor revisions.

Line 85: Were particles measured in the fall chamber individually matched to the particles collected on the glass slides? It was not clear if the experiment supported this.

Line 100: What is the estimated positional accuracy in all three directions for particles in the hologram?

Line 132: How many particles are in a typical hologram? Was the ice concentration so high that linking particles from one frame to another is difficult?

Line 180: Were the same edge detection methods used for the holographic images as for the slide-captured images?

Line 242 and Figure 5: Were the other power law relationships converted to use a consistent size definition (Deq or Dsec)? This can sometimes make a large difference.

Line 243: What are the power law coefficients from this study (a and b), for both Deq and Dsec?

Line 245: It is mentioned in the abstract that the other power laws were generally developed on larger particles and have been extrapolated down to the sizes in this study. I think this point needs to be reemphasized here. Some discussion behind the observed differences would also be valuable, such as the types of particles (habit, degree of riming, etc.) that were collected in the other studies. Also, is there a functional form that could bridge the gap between various small/large mass-size parameterizations?

Line 255: Related to the first comment, is the mass of each particle known, i.e. were the velocity measurements (either by hologram or fallstreak) directly linked to the mass measurement for each individual particle? If not, is m estimated from the power law in Section 4.2 to get Dhyd?

Line 260: What is happening physically when Dhyd > Dmax, and do you have any

speculations or measurements to indicate why that transition occurs around 100um?

Line 278: The 3-D holographic track information is highlighted in the abstract and in a few places in the body of the manuscript, but I don't see any data on the lateral movement of the particles presented in this manuscript. Is there significant lateral movement of the particles? Were any tumbling motions observed? I think it would be valuable to add a figure or two to highlight any lateral movement (or lack thereof).

Line 295: Was there any attempt to measure the size of the particles in the fallstreak analysis, and how does the distribution compare with the holographic method?

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