An introduction of Three-Dimensional Precipitation Particles Imager (3D-PPI)

Response to the reviewers

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Original Referee comments are in italic

manuscript text is indented, with added text underlined and ~~removed text crossed out.~~

Our responses are in regular font.

Thank you very much for your thorough review and insightful comments on our manuscript. We appreciate the time and effort you have dedicated to evaluating our work and your constructive feedback. Your suggestions have been invaluable in helping us improve the quality and clarity of our manuscript. Below, you will find our point-by-point responses to your comments, along with the revisions made to the manuscript.

1. In subsection 4.1 Image processing, all has improved and is fine with the exception of how you seem to do normal arithmetic means of relative errors that are positive and negative. I find it odd to do that, since you could have cases where half of the errors are +5% and half -5%, in which the average would be 0% (could lead to think that on average there is no error). For Dmax the average is, you say +2.2%. If I would determine the average of the absolute values of all Dmax errors it would be close to 5%.

Thank you for your recognition. We have revised the text to clarify that while the arithmetic mean of D_{max} relative errors is +2.2%, the average absolute relative error is 5.0%, indicating a systematic overestimation tendency. This distinction ensures readers understand both the net bias and the overall error spread.

2. Still in subsection 4.1 and still discussing errors in Fig 7, you say that "the measurement errors of Deq for all spheres are lower than the true values …". Did you want to compare measurements (rather than "measurement errors") to true values? In that case, it would be almost all (rather than "all", there is one exception). Maybe there is something else here I didn't understand.

Thank you for your advice. We apologize for our mistake. The expression "all" is wrong, and there is indeed an exception here. The revised text now states: "nearly all estimates are below the true values, with a single exception at 10 mm (+0.8%)", which aligns with the data in Fig. 7d.

What follows is lines 233-239 in the revised manuscript, which should address your first two comments:

> Regarding the D_{max} measurement results (Fig. 7c, e), smaller spheres (≤9 mm) exhibit slight overestimations of the true values, while larger particles show underestimations. The maximum relative error is approximately 14%. The arithmetic mean of relative errors across all diameters is +2.2%, though the average absolute relative error (i.e., magnitude regardless of sign) is 5.0%, reflecting a systematic overestimation tendency. For D_{eq} measurements (Fig. 7d, f), nearly all estimates are below the true values, with a single exception at 10 mm (+0.8%). The worst relative error is -7%, and the arithmetic mean of relative errors is -2.7%. The consistent underestimation of D_{eq} (except for the 10 mm case) suggests its utility for systematic error correction. Overall, the image processing methods demonstrate effectiveness, with errors remaining minimal in practical terms.

3. In Section 5, you have introduced DVmax to denominate the distance between the two farthest points on the surface of the particle. I cannot guess why you called it DVmax. It is also fine that you use something different from Dmax here, even if I don't see the motivation. Regardeless, If you want to keep this DVmax, then update the Figure that follows with examples listing particle properties (I guess Dmax in that figure should now be DVmax).

Thank you for your advice. We apologize for the lack of clarity. The DV_{max} (short for "Dimensional Maximum in Volume") is defined as the maximum distance between any two surface points of the 3D-reconstructed particle. This terminology distinguishes it from the 2D D_{max} (smallest enclosing circle diameter). To clarify, in the manuscript, "DV_{max}" is only used in Section 5.2, while "D_{max}" is used in all other parts of the manuscript. We have checked and confirmed that "DV_{max}" is consistently used in all examples in Figure 13. The specific revisions are as follows:

> To characterize the 3D shape of each snowflake, four parameters are calculated: volume V, dimensional maximum ~~dimension~~ in volume DV_{max} (distance between the two farthest points on the surface of the 3D-reconstructed particle).