Reply to Anonymous Reviewer #2.

Basically, we agree with all of the points raised by the reviewer, and wherever possible we will modify the manuscript as recommended.

1. Title: Will be changed to "Effects of ice particle shattering on the 2D-S (Stereo) probe". We prefer to use the terminology 2D-S instead of two-dimensional because that is how the probe is most commonly recognized.

2. Probe tip modification: In a revised manuscript we will show schematics and photographs of the two sets of probe tips used in the SPARTICUS experiment and try to place them in the timeline of the Korolev tip evolution.

3. Number of small particles that are not artifacts: We concur emphatically that there is no way to know the actual number of small particles in the precipitation of large aggregates below and anvil cloud. Perhaps we did not make this point clear enough. What we do show, based on the images in Fig. 4, is that there are a lot of shattered particles generated from both standard and modified probe tips. Given that this is a region of cloud where particles are sublimating and one would expect there to be few real small ice particles, it is reasonable to conclude that a large majority of the small ice particles are artifacts. We go on to state that the remaining number of small ice particles after removal of suspected shatterers, about 350 per gram of ice mass, can be used as an upper limit for the uncertainty in the measurement. i.e., regardless if there are zero or 350 ice particles per gram of ice mass, 350 ice particles per gram is the upper limit of the measurement. In a revised manuscript we will make these points more emphatic.

4. Supporting bulk measurements: Unfortunately, bulk measurements on the Learjet (i.e., Nevzorov probes) were not deemed sufficiently accurate to be used as an independent measurement. Raman lidar measurements are available for some of the SPARTICUS flights over the ARM site in Oklahoma, and preliminary analysis of one flight is available from Jennifer Comstock at PNNL. The data were also presented at an ARM science team meeting. The agreement in Raman Lidar and 2D-S extinction measurements after shattering was removed was good, but this case and other possible cases have not been analyzed in sufficient detail to provide validation. This analysis may be conducted by PNNL in the future, but publication is at least a year or two down the road. The remainder of the reviewer's concern in item 4. are addressed above in item 3.

5. Provide better statistics: Again, we agree that this would be beneficial. A larger dataset would be extremely valuable. However, this was not possible. Unfortunately, we do not have a comprehensive dataset of measurements with two 2D-S instruments. We were only able to install both 2D-S probes for a few flights during the SPARTICUS field campaign. Again, unfortunately, we could not find regions where both probes were working properly in clouds without large ice

that would produce shattering, and it was necessary to do this to confirm that the probes were responding similarly in regions without shattering. The only flight we could find where the two probes agreed in a region without large ice was in a cumulus cloud with small cloud drops, where shattering was not a factor. This flight (on 23 July) took place after the official close of the SPARTICUS field season and the cumulus cloud was intentionally penetrated, something that was outside the normal SPARTICUS flight profile. The figure below shows the comparison in the region with small cloud drops and will be added to a revised manuscript, if requested. While we do not have a large statistical dataset, we do have measurements taken approximately one hour previous to the anvil penetration showing that the two probes were in reasonably good agreement measuring high concentrations of cloud drops in a cumulus cloud.

6. Last Section: We agree to divide the last section into two sections, discussion and conclusions, and to add bullet points.

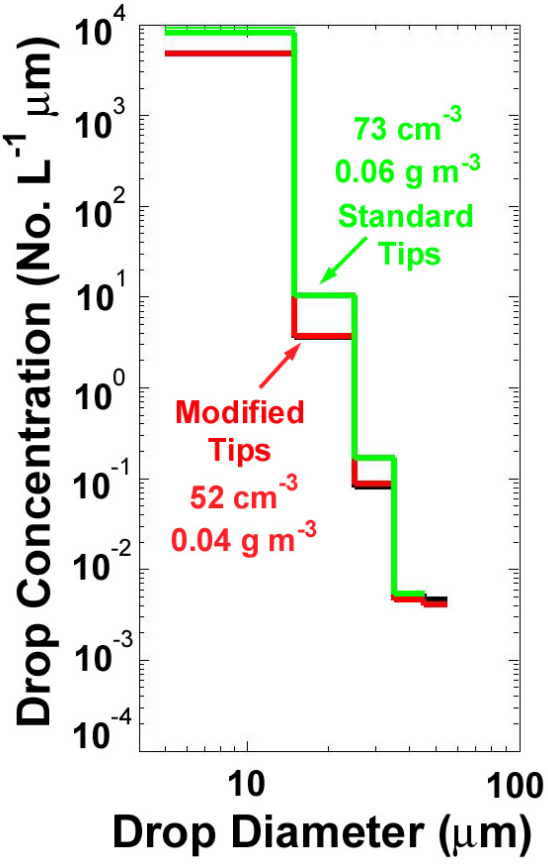

Figure 3. 2D-S drop size distributions from penetration of a small cumulus containing only water drops. The light green trace is from the probe with standard tips and includes shattered particles. A dark green trace is from the probe with standard tips after applying the shattering algorithm, but is not visible behind the light green trace. The red trace is from the probe with modified tips and includes shattered particles. A blue trace is from the probe with modified tips after applying the shattering algorithm is barely visible near the red trace.