**Reviewer #2**

**1 Main Comments**

The paper analyses 22k+ images of ice crystals within the upper anvil region of two storms over Colorado. They apply a circle Hough transform technique to identify the positions of element-frozen droplets, which appears to be a new and useful technique in this context.

We thank the reviewers for their careful reviews and constructive suggestions.

In the abstract they talk about the relative frequency of occurrence of different habits depending on temperature and position within the anvil cloud. While this may be expected I did not see any results that supported this statement.

Different habits indicate single frozen droplet, frozen droplet aggregates, and other habits in this study. Comparing against the frequency of occurrence of single frozen droplet and frozen droplet aggregates, the frequency of occurrence of all other habits are very low (~7% by number, Table 1 and Figs. 2 and 3) as shown in Section 4.1.

A statement that the CPI error in sizes is +/- 4.6 microns is given on page 9, line 15. I think this may underestimate the errors when particles are positioned away from best focus. What value of the focus parameter from the CPI processing software was used? Particles around 30 microns diameter can be oversized by a factor of 1.6 due to these effects.

We used the focus > 20 following McFarquhar et al. (2013). The CPI used during the DC3 is 3V-CPI that has improved optical characteristics compared with those in Conolly et al. (2007) and McFarquhar et al. (2013). Based on the reviewer's suggestion, we added following sentence and corresponding reference.

"The CPI errors in sizing particle vary with focus (Connolly et al., 2007) and can be larger than those considered in this study."

Conolly, P. J., Flynn, M. J., Ulanowski, Z., Choularton, T. W., Gallagher, M. W., and Bower, K. N.: Calibration of cloud particle imager probes using calibration beads and ice crystal analogs: The depth of field, J. Atmos. Ocean. Tech., 24, 1860-1879, 2007.

McFarquhar, G. M., Um, J., and Jackson, R.: Small cloud particle shapes in mixed-phase clouds, J. Appl. Meteorol. Clim., 52, 1277–93, 2013.

Overall the techniques used and results presented are of a high quality; however, if the paper is to be published in ACP I feel more should be made of the relative abundance of single frozen and FDAs in these anvil clouds – this is the main scientific finding of the paper. Why is it important to know these, and how can the measurements / findings be used by modellers, etc. Could the aggregation indices in figure 5 help modellers understand the nature of the aggregation process for instance? i.e. whether electric fields are important, or whether it is more random. I think this may be the case. It may be worth presenting a discussion about the electric field-aggregation hypothesis, and then presenting these statistics as a way of testing it? The methodology is innovative and very useful; however, when presented alone it would warrant publication in a techniques paper like AMT.

The results of this study (i.e., derived AI) have important implication to improve the calculations of the microphysical (e.g., fall velocity) and radiative (e.g., asymmetry parameter) properties of ice crystals in upper anvil clouds, especially continental convective clouds. It may take time to implement the results of this study in numerical models and remote sensing algorithm, but it worthwhile to do as stated in the Summary and Conclusion section. We also added following sentences at the end of manuscript:

"To implement the results of this study for numerical models and satellite-retrieval algorithms, the role of electric fields within clouds should be identified and quantified systemically. Recent laboratory experiment (Pedernera and Ávila, 2018) showed that the collision and adhesion process was highly related to electrical forces that stimulated aggregation process of frozen droplet aggregates."

Pedernera, D. A. and Ávila, E. E.: Frozen-droplets aggregation at temperature below –40 °C. J. Geophys. Res., 123, 1244-1252, 2018.

We feel that this manuscript is more suitable for ACP and still want this manuscript to be published in ACP because of several reasons. First, only Section 3.2 is about the newly developed technique and other sections (more than 90% of this manuscript) are about analysis of microphysical properties of frozen droplet and their aggregates in upper anvil clouds. Second, more microphysical analysis (Figure 9 and the corresponding explanation) has been added in the revised manuscript as the reviewer suggested. Third, all similar previous studies (Baran et al., 2012; Gayet et al., 2012; Stith et al., 2014; Stith et al., 2016) on this subject (i.e., observations of FDAs) were published in ACP.

**2 Specific comments**

• BC not defined in the abstract. Assume you mean Black Carbon.

"Black carbon" has been added in the abstract.

• Woodely should be Woodley page 3, line 18.

It has been revised.

• Figure 2: a complicated habit recognition scheme is described in the figure caption, but the acronyms do not appear in the figure

Unnecessary acronyms in Fig. 2 have been removed as the reviewer indicated.