Reviewer #1

This is an innovative paper that obtains quantitative measures of the geometric properties of frozen droplet aggregates, demonstrated to dominate some cloud cases. The work will be useful in future studies of radiative properties and fall speeds of such particles. The paper is well presented and I only have some relatively minor comments, with the exception of the suggestion to publish it in AMT instead of ACP.

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

The circle Hough transform is an interesting new approach in this context, and it is worth publicising. However, the authors noted that the two sub-methods used (twostage and phase-coding) performed differently for different aggregates, yet do not give any statistics, or suggest why they perform differently. Since the methods may lead to different bias, this should be elaborated on.

"Two different techniques are used because the performance of each technique varies depending on the CPI image being classified. The technique used for the subsequent analysis is chosen as that for which the projected area of the FDAs determined for the element frozen droplets identified by CHT technique (i.e., area determined by red lines in Fig. 5) best matches that for the original CPI image (i.e., area enclosed by green line in Fig. 5). For example, the phase-coding technique shows closer agreement to the imaged area for the FDAs shown in the top row of Fig. 5, while the two-stage CHT does for the FDAs shown in the bottom row."

Since both techniques showed similar performance we used both methods. Following original sentences (italic) shown above we added sentences as the reviewer suggested.

"But, the performance of both techniques is quite similar."……"Although the phase-coding method provided marginally better results for ~54% cases, the differences in projected area determined by two techniques were within 9.7% for all FDAs. Thus, since the performance of both methods in replicating the determined area of the CPI images is similar, there should be minimal bias in the determined results."

The authors say repeatedly that the relative frequency of occurrence of single frozen droplets and FDAs depended on temperature and position within the anvil cloud. The same may be the case for the retrieved properties, like the AI or fractal dimension. Yet no quantitative data, even a simple as scatter plots or correlations are given. Why is this valuable information withheld? Without it, the paper is essentially a method paper, and appears to be more suitable for Atmospheric Measurement Techniques, not ACP.

Thank you for pointing this out. We did further microphysical analysis and a new figure (Fig. 9 in revised manuscript) has been added. Figure 9 shows the dependence of AI on temperature. It shows that the AI of FDAs decreases with increasing temperature. This indicates that larger and more compact-shape FDAs exist in lower regions (i.e., higher temperature) of upper anvils.

We feel that this manuscript is more suitable for ACP than AMT for 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 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.

It is not correct to assume idealised spheres as basic elements of the aggregates. This is because frozen droplets are not smooth spheres, and the scattering properties of chain aggregates tend towards the scattering properties of individual elements as the the chain straightens (due to diminishing interactions - this effect is seen e.g. in Um et al, 2009). Thus the scattering may become dominated by the low asymmetry parameter of rough spheres for some aggregate types. So for the future study that the authors propose in the Summary and Conclusions microscopic detail of the particle surface must be taken into account, determining the selection of the single-scattering modelling method, e.g. superposition T-matrix would not be appropriate.

We agree with the reviewer's point of view. Frozen droplets do not have spherical shapes, but rather quasi-spherical shapes that are important for the radiative property calculations. However, since this study identified the number, size, and relative position of element frozen droplets within FDAs the assumption of spherical shape is still valid. For example, an identifying number, size, and relative position of element frozen droplets within FDAs does not depend on an assumption of spherical or spheroidal shape element.

Minor correction: p.1, line 28: this sentence needs rewriting.

The sentence has been revised.