

Interactive comment on “Retrieval of the vertical profile of the cloud effective radius from the Chinese FY-4 next-generation geostationary satellite” by Yilun Chen et al.

Anonymous Referee #1

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Review of “retrieval of the vertical profile of the cloud effective radius from the Chinese FY-4 next-generation geostationary satellite” by Chen et al.

This manuscript studies the vertical profiles of R_e in a convective cluster using the Chinese FY-4 satellite data. An objective method is used to identify the cloud cluster. Then the temperature- R_e relationship is obtained for the identified cloud cluster. The temperature- R_e relationship is very useful for understanding the cloud microphysical processes that produce precipitation. The method and the results are well presented in this manuscript. But it needs some revision in order to be accepted in ACP.

Major points:

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(1) I strongly suggest that the manuscript present a figure to show how the bi-spectral reflectance vary with cloud optical depth and effective radius. The bi-spectral reflectance algorithm has been widely used (for example, in the cloud retrieval of MODIS). It would be very helpful for the readers to see how sensitive the bi-spectral reflectance is to the cloud optical depth and effective radius for the FY-4 bands. Especially this study shows that the effective radius retrieved from FY-4 is generally smaller than that retrieved from MODIS. I'm curious if this could be caused by some errors in the measurement of the near-infrared reflectance. Of course, the discrepancy between the FY-4 and MODIS retrievals may be caused by other reasons, such as different resolution, different view angles, etc.. I can understand there is discrepancy between instruments. But a figure showing the bi-spectral reflectance as a function of optical depth and effective radius for the FY-4 would be very helpful. The readers could even compare this figure with MODIS.

(2) In Figure 8, I guess it's the median radius that is shown in the figure? I suggest other percentiles, such as the 25 and 75 percentiles, should also be shown in the figure. It seems that the manuscript focuses on some subtle details in Figure 8. For example, it is said in the manuscript that 15-22 microns (03:30-05:30 UTC), correspond to a significantly accelerated growth. But this profile is only the median effective radius. I would like to see if this accelerated growth is still seen in the 25 and 75 percentiles. Similarly, 25 and 75 percentiles should also be plotted in Figure 3.

(3) The discussions related to the microphysical processes on page 8 are not very clear. I don't understand why the cloud in an earlier stage (00:30 UTC) is totally glaciated. The manuscript should at least provide some description of the convection at this stage. For temperature lower than 273 K, the cloud starts to become mixed-phase, so ice-related processes could be very important. But the manuscript seems to emphasize on the collision-coalescence process to explain the accelerated growth for the 15-22 microns (03:30-05:30 UTC). In addition, in lines 250-251, "the rate of increase in Re slows down". Why? I would expect that, in the mixed-phase, the cloud

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particles are easier to get larger. Line 239-240, “did not exhibit the characteristics of the earlier zones”, what does this mean?

Minor points:

(1) In the abstract, lines 13-15: I think these two sentences should be reorganized. Identifying cloud cluster is one task of this study. Obtaining the Re profiles is the other task of this study. The two sentences in the manuscript seem to mix the two tasks together.

(2) In the introduction: because the Re profile is very useful for studying precipitation formation, the first paragraph of the introduction should have some writings on precipitation. In the first sentence, only the radiation budget is mentioned. I think it should also be pointed out that clouds control precipitation, and therefore the water cycle.

(3) Line 31: the coalescence of cloud droplets is proportional to Re^5 . What does this mean? What property of coalescence is proportional to Re^5 ?

(4) Line 76: the aim of this study was to automatically identify and ... Therefore I think section 2.2 should be reorganized. The method of identifying the cloud cluster should first be presented, and then the method for obtaining profiles of effective radius is presented. But I'll leave it to the authors to decide on this.

(5) In section 2.1: it's better to show the total 14 band wavelength. How many bands are in the visible? How many in the near-infrared? And how many in the infrared?

(6) Figure 2: Figure 2 should only plots the north hemisphere. There's no need to plot the southern hemisphere in the figure. The domain shown in Figure 3 should also be indicated in Figure 2. The angles are shown in Figure 2. But I don't see any discussion of the angles in the text.

(7) Line 150-152: why is the most extreme precipitation event selected for this study? Please provide some motivation. Intuitively I would expect that this study could start with a normal precipitation case.

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