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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The time-space exchangeability of satellite retrieved relations between cloud top temperature and particle effective radius" *by* I. M. Lensky and D. Rosenfeld

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The authors would like to thank the referee for his constructive criticism of this paper.

Before answering the referees' comments, we want to note that we improved the retrieval algorithm of the effective radius. In the first version we used an empirical correction for the CO2 absorption, (documented in EUMETSAT's MSG interpretation guide in the following url: http://oiswww.eumetsat.org/WEBOPS/msg_interpretation/PowerPoints/Channels/conversion.ppt), in the revised version we improved the CO2 correction (will be soon published in a separate paper) and added H2O absorption (after Rosenfeld and Lensky 1998). We went over the whole analysis and plotted all the figures again.

1) The authors need to show much stronger evidence that the ergodocity assumption is verified. At the very least the authors should plot on a same diagram the T-re relationships obtained for each area from the snapshots and from the convective cell tracking methods. The comparison needs to quantitative (e.g. compare the slopes of the relationships).

We changed figure 6 (now figure 7) according to the reviewers' recommendations. Figure 7 now shows a scatter plot of the T-re of the coldest pixel in some of the convective cells in areas 2, 3 and 4 that are shown in figure 6. An overlay of the median, the 15th and the 85th percentiles of 11:01 (red) and 14:01 (blue) are added. A comparison of slopes is warranted only when the T-re relations were linear or at least could be approximated to a simple function. However, this is not the case here.

2) The discussion should raise and answer the following question: Is the ergodicity assumption verified at any time of the day (given the diurnal cycle of convection)?

We added a discussion where we expect the ergodicity to break down:

Strictly speaking, the ergodiciy assumption is valid only for stationary conditions, i.e., not allowing systematic changes in the cloud field properties with time. However, the ergodicity approximation would be still valid if the time scale of the growing phase of convective elements is short with respect to the time scale of the changes in the cloud population properties. The time scale for growth of individual convective elements is 20 to 40 minutes. For example, an air parcels would ascend at the modest updraft velocity of 5 ms-1 through a 10-km deep cloud within 33 minutes. This time scale is much shorter than the diurnal time scale which affects the general properties of the cloud field. Therefore, the ergodiciy assumption remains generally valid, except for areas of strong gradients in the properties such as coast lines, strong aerosol gradients or over sharp transitions between different air masses.

3) It is not clear to me why the relationships obtained from the convective cell tracking should correspond to the 15th percentile of the snapshot relationship. More discussion

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of this aspect is needed.

We added the following text to clear this point and the meaning of the 15th, 50th and 85th percentiles that are usually presented on the T-re plots. In addition to avoid confusion from the readers, we changed the re of figure 4 (figure 5 in the ACP) from 15th percentile to the median as is in the other figures.

The T-re plots are formed by calculating the median and other percentiles of the re for each 1žC interval of T. If we will examine in a certain cloud cluster (where the dynamic and thermodynamic conditions are nearly uniform) two pixels with the same T but with different re, than we can assume that the pixel with the smaller re represents a more vigorous cloud. In the supercooled water and mixed phase clouds a smaller re can represent also a younger cloud that developed less ice than the cloud of the second pixel. With this consideration in mind we can assume that the lower/higher percentiles represent the younger/older elements at that height. In figure 3, the 15th percentile will represent the younger elements, and the 85th percentile will represent the older elements in a given height (temperature).

Small corrections:

page 11912, line 22: delete full stop Corrected

page 11919, line 3: dependence or dependency Corrected

page 11924, figure 3: microphysicaly should read microphysically Corrected

page 11926, figure 5: specify which pixel is in each area The area is labeled in the title, for example: A2C123 is cell number 123 in area number 2. An explanation is added to the figure caption.

page 11918, line 23: its' should be its Corrected

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 11911, 2005.