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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Upper Tropospheric Cloud Systems Derived from IR Sounders: Properties of Cirrus Anvils in the Tropics" *by* Sofia E. Protopapadaki et al.

Anonymous Referee #1

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The authors use AIRS data and analyzes the horizontal extent of convective and cirrus clouds. The authors grid Level 2 AIRS data in 0.5 by 0.5 degree grids. Cloud type is determined based on the cloud top pressure and emissivity derived from 8 AIRS channels from 11 to 14 microns. Three cloud types, isolated cirrus, and single- and multi-core convective clouds are analyzed in this study. Isolated cirrus and convective systems cover 5% and 15% of the tropical band between 30N to 30S. For convective systems, the areal fraction of the convective core decreases and thin cirrus increases as the system size increase. Earlier studies show that the size of convective systems depend on their life cycle stage. While assuming the areal fraction of convective core relative to the total area of the system, the authors separate single-core convective

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systems into eleven intervals of the fraction. The size of core matures and decreases when the stage moves toward dissipation, but thin cirrus area continues increasing throughout the life time. The authors also analyze precipitation derived from precipitation data from microwave sounder AMSR-E. The rain rate averaged over the core area decreases as the systems become more mature. The paper is well written and easy to understand. I only have minor comments and questions to clarify the consistency of their results shown in figures.

Minor comments Page 6 line 29 to 30 Instead of saying "we explore the core fraction follows the evolution of convection life cycle", the authors might want to say that the life cycle state is defined using the core areal fraction. Once the life cycle stage is defined by the fraction, the authors do not need to prove that the fraction follows the evolution of convection, which they really haven't done in Section 3.2, although Figure 7 indicates that it might be the case.

Figures 7a and 7e Generally, the core temperature over land is much colder than that over ocean. But the system size over ocean and land is similar for land and ocean. In addition, the order of the core size at the mature stage step less than 6 is not inverse order of the core temperature. Do you have any explanations of this?

Figures 7b, 7e and 7f The rain rate averaged over the core area almost monotonically decreases with mature stage but the convective core size and minimum temperature within convective core do not. I would expect that the rain rate peaks around a middle stage (perhaps 3 to 5?). Do you have any explanations why the rain rate does not follow the size and minimum temperature of core and it monotonically decreases with maturity steps? Also, is this consistent with Figure 9 showing that the average core rain rate increases with decreasing minimum core temperature?

Page 8 line 18 to 20 This is probably because for a same minimum cloud top temperature, the convective system over ocean is more mature than that over land, hence with a large size and less rain rate, according to figure 7. Is this correct?

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