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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Large-eddy simulation of organized precipitating trade wind cumulus clouds" *by* A. Seifert and T. Heus

Anonymous Referee #2

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This paper studies the organization of precipitating trade cumulus clouds. The organization of cumulus clouds has been observed for a few decades, but the formation mechanisms are not well known. There is also lack of simulation for this phenomenon in the literature. This paper demonstrates the ability of LES to simulate organized cumulus clouds with high resolution and relatively large domain size. It also provides an objective analysis of the organization of cumulus clouds. The content of this paper is very important for the understanding of cloud formation and cloud morphology over trade wind regime. However, the paper needs some revision before it can be published in ACP. Below are my suggestions:

1.This paper showed many sensitivity tests to demonstrate that cloud organization is caused by precipitation evaporation in the sub-cloud layer. I think the authors should

make it clear that precipitation evaporation in the sub-cloud layer has two direct effects: (1) temperature perturbation, i.e., cold pool; (2) moisture perturbation, i.e., moistening due to the evaporation of liquid phase. The cold pool can be clearly seen in the figures in the paper. However, the paper has demonstrated that precipitating regions often has less moisture (drying effect) in the sub-cloud layer, which seems conflicting with the moistening effect of precipitation evaporation. Therefore, the paper should add more discussion to explain the dry core in the cold pool region. I think the paper has mentioned that dryer air from higher levels are transported to the cold pool region and make a dry core. It just needs more clarification and explanation. I also think that the paper should not try to answer "whether the cooling or the moistening of the sub-cloud layer is triggering the organization (page 1866, lines 4-5)". Statements and analysis related to this could be misleading because the core region is indeed not moistened, as the authors have recognized (page 1872, line 16).

2.The authors have shown that new clouds tend to form at the boundary of cold pool. At the boundary, temperature is often warmer and air is often moister, compared to the cold pool core region. But sometimes I found statements in the paper are inconsistent with this picture. For example, page 1868, lines 6-8: "clouds usually occur over the moister patches of the sub-cloud layer and even prefer colder rather than warmer areas."

3.In the Fourier analysis, have the authors also looked at spectra of liquid water mixing ratio at 1000m or LWP? Especially in the following section (section 3.3), the authors identify and track clouds based on LWP and cloud cores, I think it would be interesting to look at the 2D Fourier analysis of liquid water mixing ratio at some height or simply just the 2D Fourier analysis of LWP.

4.The introduction of the paper is too short. It does not provide enough background on the previous studies of cumulus cloud organization.

5.The paper should provide more detailed description of the microphysics in the model.

For example, how the cloud water is converted to rain water. This is very important because different microphysical schemes could result in different behavior of the cloud field.

6.Fonts in all the figures are too small.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 1855, 2013.