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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Statistical analysis of a LES shallow cumulus cloud ensemble using a cloud tracking algorithm" *by* J. T. Dawe and P. H. Austin

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As described in the title, the paper uses LES and a tracking algorithm to analyse various statistics of shallow clouds. The paper's main conclusions are: 1. the eventual height of a cloud does not depend on the humidity of the environment through which it travels, 2. the amount of entrainment plays a larger role in a cloud's thermodynamic development than its cloud-base thermodynamic properties, and 3. the cloud-base horizontal area of a cloud influences eventual cloud height.

This paper uses a novel diagnostic approach to the study of LES of clouds, and it comes up with some interesting results. My main recommendations are to simplify and clarify the description of the cloud-tracking algorithm, to compare the results to

previous work, and to redo the cloud-top analysis to make it more robust to numerical noise. Below are my comments.

Section 3.1. This description of the cloud-tracking algorithm is difficult to follow. What distinguishes the different yellow areas that are otherwise adjacent in Figure 1? How is cloud that is connected to more than one core associated with only one core?

p. 23243, lines 5-7. Are these inter-cloud or intra-cloud correlations? Does this include clouds of all heights?

p. 23243, line 14. If a and M have near-unity correlations, this implies that variations in w can be neglected. Should this sentence read "characterized by two variables: theta-rho and a"?

p. 23243, lines 26-28. Please elaborate on how this can be seen or quantified from Figure 8. Also, how negative is the anticorrelation between theta-l and theta-rho at 500 meters in the cutoff portion of Figure 7?

p. 23244, line 4. Here and some other places, should this be Romps and Kuang?

Figure 9. This figure is described inadequately. Since the dots in b are the same as in a, but connected by lines differently, why are they shown twice? In c, should these lines be labeled by the level? What correlation is being shown in d?

Section 4.1. How do these results compare to the results in the "Nature and Nurture" paper by Romps and Kuang?

Section 4.2. This method for calculating the cloud-top properties relies on collecting statistics on the grid cell(s) that first contains liquid water at a given height. Is this not prone to large numerical error? How can we be sure that the results from this method can be trusted to give meaningful statistics? A more robust method would be to average properties some distance (say, 100 m) below the cloud top and the same distance above the cloud top.

p. 23251, line 7. "but not buoyancy"? Why would the upward velocity of parcels in a convective boundary layer not be controlled by buoyancy?

p. 23251, lines 17-18. These lines state: "the fate of clouds... is determined by a race btw. the rate the cloud moves upward and rate the cloud is mixed away." This is reminiscent of Neggers et al, "A multiparcel model..." Is there support for the Neggers et al theory in this paper? Please elaborate. The discussion on p. 23245 lines 24-28 seems to suggest the opposite.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 23231, 2011.