Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-825-RC1, 2018

Atmospheric Chemistry and Physics
Discussions
Open Access

Interactive comment on "Subsiding shells and vertical mass flux in warm cumulus clouds over land" *by* Christian Mallaun et al.

Anonymous Referee #1

Received and published: 14 November 2018

acp-2018-825 SUBSIDING SHELLS AND VERTICAL MASS FLUX IN WARM CUMULUS CLOUDS OVER LAND by Christian Mallaun, Andreas Giez, Georg J. Mayr, and Mathias W. Rotach

Recommendation: Reject.

This observational study examines the dynamical properties at the boundaries of shallow cumulus clouds over land. In particular, it provides evidences of the existence of a thin shell just outside of the cloud that is characterized by subsiding vertical motion and downward mass flux. The results are consistent with other published observational and modeling works, and the topic fits the scope of ACP. However, in general, this manuscript lacks novelty and originality and does not provide new contributions to the studies of cumulus clouds. My specific comments are listed below.

When the authors explained the motivation of this study, they have claimed that they "investigate the mean distribution as well as individual cloud transects" (L18-19, P2). But looking at individual transects are not meaningful because of the turbulent nature of the environment. That's why composite analysis of cumulus transects have been conducted in previous works: Wang et al. (2009) over both trade wind and continental Cu, and Katzwinkel et al. (2014) over trade wind ones. Both of those observational studies have performed a more detailed analysis and provided evidence of a subsiding shell at cloud edge based on a large sample of Cu clouds. In my opinion, Section 3 of this manuscript is more like a case study that explains how the clouds and their boundaries are defined.

In addition, the definition of cloud is not consistent in the text. It's mentioned in the text that the criterion of 100% relative humidity has been used to identify the edges of clouds (Section 2.3). But the cases shown in Figures 5 and 6 are clearly associated with unsaturated air close to at least one identified cloud edge. Apparently, this criterion has not been objectively applied to every sampled cloud and this would significantly impact the results. Take the case shown in Figure 6c as an example. RH does not reach 100% until the x-axis is larger than 0.3. Therefore, I doubt the part of transect (x = [0-0.3]) should be considered as in-cloud region as the authors have done. And the inclusion of clouds incorrectly identified like this would have changed the mean distribution of vertical velocity, buoyancy, and mass flux across the cloud edges.

The major portion of the manuscript is based on statistical analysis over 191 identified cloud transects. However, throughout the text, I did not find any texts that have discussed the statistical uncertainty of the shown results. The mean distributions are important. But are they statistically important based on the sample size? In particular, the sample size of the inactive and bottom cases is only 3 in Figure 8, which creates a significant uncertainty when they are compared with other cases.

I also have some other comments that I think are important. (1) The authors mentioned that the observed downdraft in the subsiding shell compensates the upward mass flux

Printer-friendly version

Discussion paper

within the cloud. This conclusion cannot be drawn based on what's shown. The authors could have tested the validation of the statement by investigating if the updraft in cloud is correlated with the sinking motion around cloud. (2) The authors should give specific panel numbers to each panel in Figures 6 and 8, and more importantly, refer to figure numbers when discussing relevant findings. I have found the text hard to follow in many places. Examples include but not limited to these paragraphs: L18-27, P6; L17-27, P8. (3) How are the cloud samples stratified to active and inactive subgroups? It's not clear in the manuscript. (4) It's better to change the right axis (RH) to blue colors for easy reading in Figure 6. (5) Use consistent units.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-825, 2018.