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Atmospheric Chemistry and Physics Discussions

Interactive comment on "How large-scale subsidence affects stratocumulus transitions" *by* van der Dussen et al.

Anonymous Referee #1

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General comments

This paper presents some new LES sensitivity studies of the response of a Sc-Cu transition to changes in the mean subsidence. The results corroborate several past studies that the cloud-top inversion height and liquid water path (LWP) increase as mean subsidence decreases. Essentially, mean subsidence starts to thicken the cloud layer until turbulent, radiative and microphysical feedbacks kick in.

The authors use a LWP tendency budget equation to analyze the differences between their simulations. This seems like a logical strategy, but I did not find the results particularly helpful for understanding the differences between the sensitivity studies (comment G1 below). It might help to combine the 'Entr' and 'Base' terms in the budget (comment

G2). Idealizing the case to neglect the diurnal cycle and precipitation in the sensitivity studies appears to be a more effective tool than the LWP budget for understanding the LWP response to subsidence.

G1: The LWP tendency is made up of five terms which compensate to yield a small residual, both in the original simulation and in the differences between the sensitivity simulations. As the authors note, the budget in Fig. 1b might lead the reader to believe that the subsidence is a negligible contributor to the LWP tendency budget, but the whole point of the paper is to show how LWP does depend on subsidence. If the authors can make a more persuasive case for the quantitative utility of the budget in explaining their results, that would strengthen the paper. In particular, the statements in the conclusions, e. g. 17242 L24-17425 L2, are well known and don't require justification with an LWP tendency equation.

G2: In interpreting their results, the authors should note that the 'Base' term in the LWP tendency partitioning (Eq. 3) is inseparably linked to entrainment, since there can be no entrainment drying and warming without corresponding turbulent fluxes below the inversion. Thus, except perhaps for one illustrative example, only the sum of these strongly compensating terms ('Turb'?) should be plotted. This has the conceptual advantage of isolating all the turbulent contributions to LWP tendency into one term. At the end of section 5, the authors finally reach this conclusion themselves in noting the cloud base and entrainment sensitivities of LWP tendency to subsidence rate nearly add to zero.

Specific comments

17233 Eq. 5: Should there be a factor 'h' in front of the parenthesis to give the right hand side units of LWP tendency?

17242 L10-11: Are the authors implying that there is a fundamental reason that the entrainment and cloud base contributions to LWP tendency should add to zero? If not, one could argue that this conclusion is just due to a coincidental cancellation between

two other terms and is therefore not particularly meaningful. If so, please explain why the combined entrainment/base contribution should be negligibly small.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 17229, 2015.