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

Anonymous Referee #2

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General comments

This study attempts to answer, given inversion strength, why weaker subsidence promotes thicker stratocumulus cloud layer and larger liquid water path (LWP), which has been suggested both modeling and observational studies. The authors utilize a recently developed LWP-budget analysis method for ASTEX large eddy simulations. Their LWP budget analysis shows that (1) magnitude of drying due to subsidence is small, (2) weaker subsidence dries less cloud, (3) weaker subsidence reduces radiative cooling for daytime, (4) drying due to entrainment and moistening due to cloud base flux almost cancel each other for any subsidence rate. Thus, subsidence effect stands out even though its magnitude is much smaller than other processes. Overall, I think that the study improves our understanding for the subject, and the manuscript is

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generally well written. After clarifying some questions below, the manuscript is ready for publication.

Specific comments / technical corrections

- I think that the authors should add something like "for the same inversion properties (e.g., inversion strength and thickness)" when they introduce past studies that suggest increase of LWP and increase of cloud amount as subsidence is weakened. If the inversion properties are different, weaker subsidence may not result in larger LWP.
- Equation (4): Is there a problem if the authors use actual lapse rate of q_l from their LES data? How is z_i measured?
- Equation (5): How is entrainment velocity measured?
- Typo at line 16, page 17234: "Eqs. (4)-8)" should be "Eqs. (4)-(8)".
- What is the authors definition of cloud fraction?
- Add more description for DALES in 3.2. Too short.
- "thinning contribution", "thinning tendency", and "cloud thinning": When these are used for LWP tendency, they should be replaced by "drying". Cloud layer thins, but not LWP.
- Fig. 1a: add vertical line to indicate sun rise and sun set. The discussion in page 17238 is hard to follow.
- "Surprisingly" in line 24, page 17238: Show time series of precipitation. Is large precipitation expected?
- What is the authors definition of cloud cover?
- Second paragraph in page 17239: I think that this is very hand wavy argument. Any evidence?
- Line 28 in page 17239 "the entrainment rate is found to increase...": Does the in-

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version strength become weaker for the weak subsidence case? Provide figure for inversion strength for all cases. Climatologically, subsidence and inversion strength are positively correlated. Is it also true for these simulations?

- Line 2 in page 17240 "...most likely the result of the larger stratocumulus thickness h,...": Show the time series of cloud thickness for all cases.

- Line 18 in page 17241 "...for the lowest subsidence case...": Show the time series of three terms for the entrainment contribution term.

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

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