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Atmospheric Chemistry and Physics
Discussions

# *Interactive comment on* "Turbulent structure and scaling of the inertial subrange in a stratocumulus-topped boundary layer observed by a Doppler lidar" *by* J. Tonttila et al.

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This discussion paper presents data from lidar observations of a coastal stratocumulus episode. The lidar data are of sufficient quality and resolution to allow analysis of turbulent quantities including variance and skewness. Such observations are sufficiently rare that their analysis and publication should be encouraged. The paper makes use of the skewness to decide whether the boundary layer at specific times is primarily driven by radiative cooling at the cloud top, by surface heating, or some combination. I have a basic concern about the conceptual model implied by much of the text, and a number of other general and specific comments, which should be addressed before



final publication.

General comments:

1. The authors seem to have a conceptual model in mind, which should be made more explicit in the Introduction. This would make the paper more accessible to a wider audience, rather than just measurement specialists. Their model is first referred to in section 4, and seems to be based on the idea of "competition" between surface- and top-driven convection. In fact, both surface and top driving may be present, and cooperate (rather than competing) to produce turbulence. When thinking purely of skewness, the two drivers do have opposing effects. The questions that should be addressed by the analysis are: What are the depths of influence of surface and top driving? When do the two depths merge to create a single turbulent layer, and when do they remain decoupled? What is the degree of coupling, since coupling is a continuum between fully coupled and fully decoupled? The last question can be addressed by emphasizing variance profiles. Another issue is what processes are reducing coupling (or increasing stability), since turbulence always acts to reduce stability?

2. In addition to the figures already included, some line plots of vertical profiles of variance and skewness during the different regimes (appropriately time-averaged) should be shown. This will allow the reader to understand better the data presented in the time-height plots.

3. Throughout the paper, the vertical coordinate is scaled by the cloud-top height, which is defined as the boundary layer height. This is not treated completely consistently, since it is acknowledged later that the expectation is that each sublayer should scale with its own depth.

Specific comments:

1. In the last paragraph of section 4.1, the attribution of the measured effects on the boundary layer is unclear. Is there really an influence of the land, even though the flow

is still onshore? Advection of cooler air aloft would also reduce stability and increase mixing, can this be ruled in or out?

2. In section 4.2, it is indicated that the spectra have various structures. It might be helpful to include some representative spectra in a supplement.

3. page 24133, paragraph beginning with line 19: Does L0 scale with the horizontal size of the clouds or breaks, rather than the layer depth?

4. page 24133, line 27: Here is a particular example of the conceptual model issue. In what sense do the surface and top driving compete to prevent formation of a mixed layer? Don't they in fact cooperate, but with possibly differing strengths?

5. page 24134, line 11: Is the supression of L0 during this time real, or an artifact due to very weak turbulence?

6. page 24134, line 17: Wind shear at the cloud top influences entrainment, not wind in general.

7. page 24136, line 13: It should be expected that decoupling reduces L0 as it is defined here, since in a decoupled structure scales should go with their own layer depth, not the depth of the whole structure. This is consistent with the statement of previous expectation in lines 25-26.

8. Figure 6 and text discussing it: It should be acknowledged that surface-driven layers without cloud have negative skewness near their tops.

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