Atmos. Chem. Phys. Discuss., 13, C10308–C10310, 2013
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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Role of the residual layer and large-scale subsidence on the development and evolution of the convective boundary layer" *by* E. Blay-Carreras et al.

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Received and published: 21 December 2013

This discussion paper is about the behavior of the convective boundary layer in the morning, and in particular about the roles of the residual layer and subsidence in that behavior. It is generally interesting, thoughtful, and well-written. Some of the interpretation could be clarified, as I suggest below.

General comments: 1. The heart of the paper is the comparison of simulations intialized with two different profiles, with (RL) and without (nRL) a residual layer. The profile without a residual layer has considerably less total heat than the residual layer profile.

After the BL grows to nearly its final height, the nRL simulation must necessarily have a lower temperature. This is not really a flaw in the design, but it must be taken into account when interpreting the results. For example, the first paragraph of section 3.3 should be reconsidered with this in mind.

2. p.31536 line 20ff: It would be helpful to show profiles just before and just after the residual layer is incorporated. These are shown in figure 4, but not called out as such, and forward referencing is generally not allowed.

3. p.31538 line 8: The roughly constant BL depth in the afternoon may be partly due to subsidence, but since the mean BL temperature also is roughly constant, advection cannot be ruled out.

4. last paragraph of section 3.3: The interpretation is unclear here. The incorporation of the residual layer and the increase in magnitude of heat flux are not (cannot be) simultaneous. While the residual layer in being incorporated, the BL is in a "free encroachment" regime and the entrainment heat flux must be nearly zero because the temperature jump is zero. After the BL reaches the RL top, the jump is re-established and the flux takes on a new value. This could be shown by including the BL top trace on figure 5.

5. Related to the previous comment, the authors rely on eq. 2 for much of their interpretation. They should keep in mind that the two terms interact and compensate. A large jump should lead to a small growth rate, for example.

6. A note on language: I prefer that authors express themselves in their own voice as much as possible. While some of the English in this paper is imperfect, I found it clearly understandable throughout.

Specific comments: 1. p.31537 line 15: The main reason that the effect of subsidence can only be appreciated at the end of the afternoon is that its effect is cumulative.

2. Figure 3: It should be noted that the determination of z from the first sounding is

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probably erroneous, the analyst or algorithm has mistaken the residual layer top for the BL top.

3. p.31546, line 19: The winds are mentioned here for the first time. Because shear is important to entrainment, wind profiles (initial and at other important times) should be included in table 1 and added to the appropriate figures.

Technical corrections: 1. Abstract, line 19: "buoyancy heat flux" should be either buoyancy flux or heat flux.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 31527, 2013.