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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Lifted Temperature Minimum during the atmospheric evening transition" *by* E. Blay-Carreras et al.

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First of all, we would like to acknowledge the positive review. Below we comment/answer to the comments made by the referee.

General:

This article describes careful tower observations of small-scale Lifted Temperature Minima (LTM) during BLLAST. These occurred at about 10 cm height above the ground during the evening transition in rather calm conditions. There is however some wind (1-2 m/s at 2m, Figure 4) and weak turbulence (Figure 6). The article is well-written and quite useful in presenting observations around this interesting but rare phenomenon.

- What I missed was the presentation of the observed moisture profiles. These are important input for radiation codes, e.g. for modellers who would like to try and simulate the observed cases.

We agree with the referee. Unfortunately, during BLLAST campaign, around the two towers used to define LTM, moisture at lower heights was not monitored.

Specific comments:

- When looking at the potential temperature profiles, especially those of Tower 2 of Figure 2, one gets the impression that above the LTM at about 10 cm there is actually a temperature maximum in every case at about 20-30 cm height, and that the LTM could here be in fact the side-result of this sharp maximum being temporarily created into the otherwise normal evolution toward an inversion caused by the rapid cooling of the ground (Figure 8). The maximum could be driven e.g. by the strong radiative warming from 0 to about 50-70 cm above a rapidly cooling surface (Edwards 2009a,b, Savijarvi 2006, 2014) being temporally dominating at 20-30 cm over turbulent cooling, which gets strong and dominating only in the lowest 10-15 cm or so under fairly calm conditions (see the references above). This is open to discussion, of course.

This is a really interesting comment, and we basically agree with the referee. However, with the instrumentation deployed at the BLLAST campaign we are not able to check it. Moreover, it would difficult to prove its validity with observations. While small Kajo-Denkji sonics could be used 15 cm and 30 cm to measure cooling via sensible heat flux divergence, radiation measurements would be much more difficult at those heights close to the surface, and not possible with commercial pyranometers.

On the other hand, the proposed hypothesis could be valid when analyzing stable boundary layers, as Edwards (2009a, b) and Savijarvi (2014) did. Moreover, as Hoch (2009) showed, the radiative cooling/heating during day or night has also clear dependence to surface conditions.

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However, in our case we deal with the afternoon/evening transition when the heat budget (the competition between turbulent fluxes and radiation divergence) at the different levels close to the surface, to our knowledge, has not been studied. In fact, the currently MATERHORN observational campaign (http://mech.utah.edu/∼pardyjak/MATERHORN_PR_2013.php), where some of the authors are involved, was partially designed to study this point.

We will include some sentences regarding this point in the new version of the manuscript.

Details:

- The referee is right about including references in the abstract. We would modify it if the journal edition rules don't allow them.

We will modify it the other mistakes in the new version of the manuscript.

References:

Hoch, S. W.: Radiative flux divergence in the surface boundary layer from observational and model perspectives. EMS2009-306. http://www.emetsoc.org/fileadmin/ems/dokumente/annual_meetings/2009/AW3_EMS2009-306.pdf European Meteorological Society. Toulouse (France). 2009.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 27769, 2014.