

Interactive comment on “Lidar measurement of planetary boundary layer height and comparison with microwave profiling radiometer observation” by Z. Wang et al.

Z. Wang et al.

zhiting@iup.physik.uni-bremen.de

Received and published: 25 April 2012

Response to Referee 2

We thank the reviewer for carefully reading the manuscript and for providing constructive comments. We address the comments below.

- The description of the methodology is not as clear as required to understand the different steps (“... are some empirical parameters...”). Maybe a sketch will help: a realistic lidar signal with the different heights H1, H2, H3 as found by the wavelet algorithm, the illustration of the thresholds, the meaning of oldblh and so on. With this sketch it should also be possible to describe the different pitfalls and the corresponding

C813

solutions.

We have add a sketch with a realistic lidar signal, wavelet transform coefficients CWT1 and CWT2 and different heights H1, H2 and H3. The illustration of the thresholds and the meaning of oldblh have also been added.

- The discussion of the results is poor and not convincing, i.e., several figures are not explained at all or not in a sufficient way (Fig. 2, right panel: no comments in the text; Fig. 5: no discussion at all; Fig. 6: the “lidar part” is not explained). Often, just statements are given, but the interpretation is missing (e.g. Sect. 4.4).

A new part on the introduction of the results is added, and discussion for Sect. 4.3 and Sect. 4.4. is also expanded. Fig. 5 is deleted. For Fig. 6 the entrainment zone thickness is derived from MPL-4, and the corresponding explained have been done in Sect. 3.3, the BLH used there is from lidar (MPL-4) data using the method described in this manuscript.

- The reason of the comparison with the model results is not obvious; one would expect sort of a consistency check or validation. It is however not clear how a lidar can measure the entrainment zone (EZ) in a quantitative way. If the thickness of the EZ is an independent information, available from further instruments (microwave radiometer) and with the lidar retrieved BLH, the influence of errors of the BLH on the retrieved thickness of the EZ must be quantified.

The entrainment zone thickness is related to the BL and surface properties, such relationship is described by so-called parameterization theory on it, which is used here to check the consistency between derived quantity and these theories. The entrainment zone thickness is derived from the variability of the BLH, the method is described in Sect. 3.2 and also has been described by Cohn et al. (2000). EZ is originally defined as the region with negative buoyancy flux, but lidar measurement aerosol distribution which is indirectly related to the thermal structure of the BL. In the strong convective condition the aerosol distribution is mainly determined by transport of thermal convec-

C814

tion, the aerosol can trace rising thermal, which has been verified by observation of scanning lidar (Bores and Eloranta, 1986). Bores and Eloranta (1986) derived the entrainment zone thickness using a scanning lidar, which means it is calculated based on variations of the BL top over horizontal distance, but here over time. If the variability of BL top over space is equivalent to that over time, maybe the method used here works, but we are not sure. So the EZ thickness derived from lidar may be not very quantitative, only the relative value is meaningful.

- Parts of the conclusions do not meet scientific standards (“...reveals that some consistency exists in them but the difference is also obvious”.) This is not a quantitative description of a result!

The part of conclusion has been rewrite completely.

- Some relevant parts are missing, e.g., details on the instruments (what is the difference between the lidars), the location of the sites (coordinates, distance from each other), or the introduction of Section 4 and 4.1.

The details on the instruments and the locations of the sites have been added. A new part of the introduction of Section 4 have been added also.

- In Sect. 6 the authors state that there is a disagreement between the BLH derived by the lidar and the microwave radiometer, respectively. What is the conclusion: which one is correct or are both incorrect? In Fig. 4 the authors show some examples of the agreement but do not explain why the differences occur and what could be learnt from them.

The BLH from microwave radiometer represents the equilibrium level of a hypothetical rising parcel of air representing a thermal. In the case of lidar, the BLH is derived from the vertical distribution of aerosol that is indirectly related to the thermal condition in boundary layer (Emeis et al., 2004), represents aerosol mixing layer height. This is two different definitions, for research of air pollution the BLH from lidar may be more suit-

C815

able, and the BLH from microwave radiometer can trace the development of convective boundary layer in the morning. In the afternoon the convective BL departs into residual layer and stable layer, the BLH from lidar likely represent the height of residual layer, and BLH from radiometer decline rapidly. What can be learnt is that aerosols do not drop immediately even if the upper limit height that the rising thermal air-masses can reach decreases.

- No information on errors or uncertainties is given; this should be added. -It is not possible to measure “vapor” by a micro-pulse lidar. What is meant?

This is our misunderstand. When there is water vapor the scatter signal of aerosol will be enhanced, this is the effect of water to lidar signal. But about this we are not sure so the sentence has been deleted.

- What is meant by: “...larger than 0.15H1...” in line 15 of page 1240? I don't see H2 and H3 in Fig. 2 (line 23, page 1240).

These illustrations are for Fig. 1, and Fig. 2 shows the evolution of the BLH only.

- What does “...represents the relative concentration profiles of atmospheric aerosols” mean (line 20, page 1234)? This is not a correct statement.

It should be ‘Lidar backscattering profile represents the vertical distribution of aerosol concentration’, this sentence has been changed.

- The reference list includes a lot of papers not included in the text! E.g., four papers of Emeis are listed but forgotten in the text. If Emeis et al. (2004) is referenced, Wiegner, Emeis et al. (J. Geophys. Res., 111, D13201, doi:10.1029/2005JD006593, 2006) should be added as well (or instead) as it includes a more comprehensive set of instruments and methodologies. - The authors should discuss the relevance of the residual layer for their study. The corresponding change has been done for the reference.

About the residual layer, we thanks for referee's suggestion, the residual layer may help explain the difference between the BLH from lidar and that from microwave radiometer

C816

in the afternoon. This has been shortly discussed in Sect. 4.3. About the reference we agree with this comment, corresponding changes have been done in the revised manuscript.

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 1233, 2012.