**Atmospheric
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Comment

Interactive comment on "Continuous monitoring of the boundary-layer top with lidar" *by* H. Baars et al.

H. Baars et al.

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Please find below our reply (in italic) to the comments of the reviewer (in bold):

1. The main part of the paper deals with the discussion of the potential of different approaches how to find the BLH from the lidar data. This implies that the truth (or "something similar") must be known to be able to select the best solution. It is not very clear how this is done: it seems that the decision is based on visual inspections of the wind lidar data and/or the time-height cross sections of the attenuated backscatter, i.e., more or less on plausibility.

As mentioned in the reply to reviewer 1, we assume that lidar can provide accurate PBL tops. This is demonstrated in many papers before (partly cited in the introduction). We will not repeat this work. We concentrate on a new aspect, that is the comparison

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of different lidar methods that are most frequently used. This aspect is new, with the clear result that the WCT method works best from the point of view of a robust, routine, automated Bl top detection from lidar data. The height-time display (color plots) of the range-corrected signal profiles can easily be used to identify PBL top by eye. But the algorithms just analyze the several-minute profiles, one after the other.

2. A detailed discussion of the potential of the different lidar approaches would be desirable; the authors present two cases studies and then only state (Sec. 5.2) that in the majority of cases the WCT was the best (which criterion, see above).

The DEMONSTRATION CASES (Figures 7,9,10,11) summarize our main impressions, our key results (see discussion in the reply to reviewer 1). We improved the plots (Figures 9 and 10) by adding further BL times series obtained with the 5-min variance method (Figure 9), and by adding the gradient method (Figure 10). The case studies now clearly show that the WCT technique provides good results and is more robust than the other two (variance method, gradient method). Regarding 'criterion', strong or moderate variability is the best indication of uncertainty, variability in the BL time series is weakest in the case of WCT and strongest in the case of 5-min variance method.
We also used the variance, gradient and the WCT methods in the analysis of the one-year data set, and we found again that the WCT method is the most robust one.

3. The authors should also comment in more detail why they omit nighttime measurements. For the reader this is surprising as one assumes that lidars work better during night than during daytime. An extension to nighttime would considerably improve the value of the data set.

As mentioned above, we explain what is necessary to make successful lidar BL top observations during nighttime: lower laser beam receiver field overlap, higher signal resolution. It is not our goal to develop a nighttime BL detector. One of the 'indirect' goals is to convince the non-lidar community that lidar is a powerful BL detector that

allows us to resolve BL developments up to more than 2-3 km height with sufficiently high vertical and temporal resolution even during bright daytime hours. On the other hand, why not use a simple ceilometer at nighttime for the description of the stable nighttime boundary layer?

4. A final point, that remains open to a certain extent is the problem of layered aerosol structures and smooth transitions of the BL to the FT. From my experience (at my site) I expect that in 30-50 percent of the cases such "difficult" situations occur; so I would expect a much lower number of successful identifications of BLH as indicated in Fig. 12 (including nighttime!)

We believe (after the improvement of Figures 9 and 10,) that it is more clear now, that WCT is the most robust one. Problems with aerosol layering was the main argument to select the WCT for further use and to do the next steps, i.e, introduction of the modifications in order to detect even weak changes from the BL to the free troposphere.

5. The minimum ranges of Polly and WiLi are not consistent throughout the text and the figures (200/250m) or (400/500m).

This is now clarified, complete overlap at 500-700m, minimum height at 200m, minimum WCT technique height at 500 m.

6. Polly is stated to be "small and compact"! From Fig. 1 I find a height of 1.8 m; is this correct? What is the mass? What about the required infrastructure? Please comment on this.

Compared to a container lidar, POLLY is rather compact. It is about 2m high, and the weight is 300 kg. It has wheels to move it. It can easily be shipped by aircraft to remote areas, and transported to the field site by renting a pick up. It needs normal eclectic power, and can be operated via internet. Presently we run one POLLY at the tropical rain forest (Manaus, Brazil), and get the data via satellite. But as usual, laser damages cannot be repaired via internet and satellite.

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We leave out to comment on this in the text.

7. Page 10754, line 20 ff: This paragraph sounds like a "commercial" and should be omitted (it is neither relevant in this context nor the statements are proved in the paper).

We leave out the last sentence, but we want to cite Althausen et al.(2008) to indicate that there is new version. It took us (multiwavelength and Raman lidar experts) about two years to develop this new Polly, and because our institute is not a company that sells lidars, it should be allowed to cite own scientific work.

8. Page 10756: the forth method is not illustrated in one of the panels but all the other methods are. If possible (with not too much effort), this should be added.

The fourth method is more or less just modeling (a fitting procedure), which again assumes a gradient in the lidar backscatter signal. The method is very good illustrated in Steyn et al., 1999. Therefore we see no need for a more detailed description of this method.

9. Page 10758: This section starts with the outcome of the following; maybe it is better to shift it to the end of the section.

We would like to leave it as it is. It is the motivation for the discussion afterwards.

10. Page 10763: When discussing the COSMO-retrieval, it would be nice to mention (again), that it is based on the Ri-Number (isn't it?)

Yes, we add this information

11. Page 10765, line11: Is this comparison not a little bit unfair. If the authors do it on a 2-hour basis, the agreement is better.

Of course it would give a perfect agreement if we would do the comparison on a 2 hours basis, but it would also conceal that at 11 UTC there is a big difference between the

model and the lidar PBL depth which is caused by a wrong modeled growth behavior. For that reason we would like to leave it as it is.

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