**Atmospheric
Measurement
Techniques**
Discussions

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Interactive comment on "Lidar-based remote sensing of atmospheric boundary layer height over land and ocean" *by* T. Luo et al.

Anonymous Referee #1

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The paper is of scientific relevance. It is clearly structured and the scientific methods are well described. It is mostly good to understand even if some sentences/paragraphs would need some rephrasing to fit English languages standards. Some scientific issues however must be discussed more intensively. I therefore recommend the paper for publication after some minor revisions.

General comments:

The authors investigate lidar measurements at two stations: one continental in the US and one marine in the Southern Pacific. However, the location of the stations are not really described as well as it is not discuss if these stations are representative for the whole globe as the authors also developed a global boundary layer top height data

base. Especially the results from Nauru concerning the decoupling of the marine BL may not be representative for all marine locations world wide.Thus, the authors should discuss a little bit more on this issue (see also minor comments). Beside that, for a certain reason the locations are named as SGP_C1 and TWP_C2. I personally felt a little bit disturbed by these names as one has always to think which is which. Therefore, I would prefer (just a recommendation) to name the stations to there name (Nauru and . . ..) or just to marine and continental.

Please clearly define once in your manuscript how you use the term mixing layer and atmospheric boundary layer and what the are the differences in terms of properties.

Could you please state the vertical resolution and maximum height of the MPL?

Specific comments:

8312, line 10: cite->site (also found somewhere else in the manuscript)

8313 different definitions by Seidel – which one do you use? (see general comment)

8313, 23ff. Please improve these lines, it is not made clear which message the authors want to give with their statements about the other publications.

8314, line 13: There are certainly some more publications concerning ABL top measurements with backscatter lidar/ceilometer - also from long-term measurements. Some of them should be cited here as well. E.g.: a recent review of Haeffelin, 2012, Boundary-Layer Meteorology

8314, line 18: The fact that ABL aerosol during night time is hard to distinguish by means of lidar has been found out long tome before Ferrare 2013. So you may give a real citation here and not only a conference one. E.g. Martucci, 2007, JAOT, and Baars, 2008, ACP, already informed, that with backscatter lidar only the daytime convective ABL can be distinguished reliably.

8314, line 20. A careful evaluation is needed, and even more important, a clear def-

inition which top height is detected with the lidar and what it stands for. The authors should state that and may write the definition they will use already down here.

8314, Line 21ff. Here the authors write that they evaluate their lidar-based BLH to radio soundings. However at 8313, line 27ff they somehow criticize that previous work relay on in-situ measurements to evaluate global BLH climatology, but the authors do exactly the same in their paper. This should be rephrased.

8315, line 8. Please give coordinates of the two sites and a description. I.e. discuss why Nauru is perfect to study tropical marine conditions.

8315, line 13: First sentence is confusing, because you speak of cloud-free signals and in the next sentence you state how "the cloud" is detected. This should be rephrased, e.g.: Because only cloud-free ABL shall be studied, clouds need to be screened out of the long-term MPL set. This is done the following way...:

8315, Line 23: What happens in the rare case of aerosol between 5 and 6 km, can you automatically sort out these cases?

8317, line 21: What is a no-negative BLH. How is this possible?

8318, line 1-6: Either refer Emeis, 2008 for all methods, because all are described there or refer for each method the original one. E.g., the variance method was much earlier introduced, than by Jordan, 2010 (by Hooper and Eloranta, JCAM,1985 or Piironen and Eloranta, JGR, 1995).

8318, line 10: Earlier you write that you would like to define the BLH in such a way that it fits to the thermodynamic structure of the atmosphere and therefore fit to radio soundings. However, this is in contrast to the definition you made here, i.e. up to which height surface influence concerning aerosol is detectable. You nicely demonstrate this by yourself in Fig.1. So please adapt this paragraph.

8318,15: What is shown in Fig. 2, that's not clear? Is this one land, one shallow and one deep ocean case, or are these mean values plus standard deviation? Please

clarify and state how you have selected the profiles, how many, which period etc.) Please also state explicitly that the y-Axis is the normalized (by BLH) height!!!!!

8318, 25 ff. I do not see any sharp gradient at the top of the ABL for shallow ocean. What do you mean?

8319, line 5: two times ocean Line 8: rephrase: the aerosol content has more concentration. Line 16-22. Please improve English.

Fig. 4 and Fig. 5. What is shown? Is this one characteristic profile or a mean of many cases? Please clarify! This is essential because of these figures you justify why you use the different methods, but these methods may fail for a different case...so please give evidence that the methods you have chosen are appropriate for "all" oceanic and "land" cases.

8320, 5ff:It is still unclear how you remove elevated layers. Please use a better formulation of the paragraph. I could not understand when a layer will be identified as BLH and when it is identified as elevated layer.

8321, 11: What does it mean: "assuming layer top at 8 km". You set the calibration interval to this height? And what happens if there are lofted aerosol layers at this height?

8321, 16: 3 points of what? 3 range bins?

8321,18: Please rephrase with improved English. I do not understand. Do you set it to 1 if one of the channels detect aerosol or must both channels detect aerosol?

8321, 24: screen or remove, decide for one!

8322, 1: Strong peak of what? Please write scientific correctly!

8322, 9:. Please state period for the recorded profiles!

8322,16: Why can you detect a MPL BLH much lower than SONDE due to the overlap

issue? Can you explain?

8322, last line: I think that the positive bias in the cold season is due to the overlap effect. Especially at very continental places under stable conditions in winter time almost no convective ABL development can be expected. Possibly very shallow ABL are not "seen" and thus lofted layer tops are detected as BLH, which are higher than the SONDE BLH. Is this possible? Can you discuss this? Thus, it can be the same reason as for night time measurements and thus not be further improved.

8323, 13: Why do you only consider cases with cloud fractions of 0.1 and 0.7. Please explain!

8324, line 12: Figure 8d not 9d. Line 18: It is not evident for me why these results show that decoupling frequently occurs under cloud free conditions. Can you give evidence for this statement and explain more detailed?

8324, line 24: Not only temperature profiles, I thought the thermodynamic state of the atmosphere is considered with the RI method.

8325, 3: Over the specific Ocean site of Nauru the decoupled structure was found, please discuss if this is valid for all maritime sites-> see comment before – same for the continental station.

8325, 5-10. The aerosol structure "can" be complicated not "is"

8325, 22: "was" instead of "were"

Fig.2, Caption: Please state explicitly which profiles are shown (mean profiles or a case study etc.) see comment before.

Fig 3, Caption: It's not a black dot but a black cross.

Fig. 4 and 5: Are these illustrations one specific case study? If yes, please write down date.

Fig 8a: White circles would be better; I hardly can see the black circles in my printed version. Caption: "site" instead of "cite"

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