Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC2
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Comment on amt-2021-292

Anonymous Referee #2

Referee comment on "Comparison of planetary boundary layer height from ceilometer with ARM radiosonde data" by Damao Zhang et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-292-RC2, 2021

Main comment:

This is an interesting paper that has an element of novelty: it presents a comparison between ceilometer and radiosonde data for a range of PBL sites and regimes. I generally think that the paper is worth publishing although it needs major improvements.

Specific comments:

You show correlation coefficients, but I don't see any calculations of and the discussion on the biases between the tested methods. Can you please add it (if not to the paper, then to the Supplement)? This is an important part that should complement the whole picture.

What is the significance of your correlation coefficients? You calculate those values but don't seem to comment on their significance. To me it looks like only convective PBL can be relatively well probed with the two instruments but I couldn't find anything about the overall accuracy/differences between the two ways of calculating it.

You could shorten your PBLHT acronym to PBLH and still be well understood.

Abstract:

L7: How can a parameter influence atmospheric processes? Processes are controlled by the physics, not by PBLHT. Maybe you meant that their representation in climate models depends on PBLHT?

You mention PBL types (stable vs unstable, cloud free and cloudy conditions. More information is needed on latitudes (mid-lat vs tropics?) and types of the surface (maritime vs continental).

"Under unstable boundary conditions" – you can simply say "For convective boundary layers"

Introduction:

L24: and moisture

L27-30: Unclear: is the depth a parameter that determines the structure of the lowest few km? The depth is the result rather than a cause of the PBL processes.

L33-35: I think a different classification is more common: stable, unstable, neutral PBLs, depending on their mean stratification. This is however not what Liu-Liang method is based on.

Generally, that classification is somewhat simplified and may not be appropriate for transient cases, which should be mentioned.

It may be helpful to clarify that Liu-Liang method is simply a temperature gradient method.

L36: for CBL it is both convection and turbulence that cause strong mixing across the PBL

L37: for shallow CBLs there should be some temperature inversion at the top, but for deeper CBLs (e.g. in the tropics) it is more difficult to determine the top of the PBL

Mention briefly about different definitions of PBLHT used in atmospheric models and observational studies: maximum Richardson number, temperature inversion, moisture gradient, minimum refractivity gradient.

L127: what does theta with two dots above mean?

What is the vertical resolution of the soundings? What is the accuracy of wind and temperature measurements and thus the overall accuracy of the methods used?

L136: Explain why Ri dramatically increase at the top of SBL.

Eq. 1: That equation is different from a typical one for bulk Richardson number including temperature and velocity gradients. I think this is because you calculate mean properties in the entire layer between z=0 and PBLH, which should be clarified in the text. I am skeptical about using such a bulk method for determining PBL height. The thicker the layer, the more risk that you omit important turbulence activity between 0 and z. That is why maximum Richardson number method can be more beneficial: instead of looking at one thick layer we can look at a number of thin layers for which Ri is calculated.

Does your Richardson number method really use Eq. 1 or looks into different layers within PBL?

3.1 LLC-free unstable boundary layer conditions – I suggest to make those section titles more self-descriptive, for instance:

LLC-free unstable boundary layer conditions -> Cloud-free unstable PBL (or similar)

LLC-free stable boundary layer condition -> Cloud-free stable PBL (or similar)

L315: typo: Richardons -> Richardson

L361: You claim that "machine learning techniques have the potential to greatly improve PBLHT estimates" – but you didn't prove it in this paper, so this claim has no foundation and should be removed. The same sentence is present in the abstract, and it is totally unjustified as far as I can see.

Figures;
Fig 3: What are the units of backscatter?

Fig 4: Is it a climatology or just a selected time period? I don't understand it.

Explain what fraction means here (fractional occurrence?).

Fig 11: explain the range of the boxes and whiskers in the caption.

You could cite this paper:

- Fritz, A. M., Lapo, K., Freundorfer, A., Linhardt, T., & Thomas, C. K. (2021). Revealing the morning transition in the mountain boundary layer using fiber-optic distributed temperature sensing. *Geophysical Research Letters*, 48, e2020GL092238. https://doi.org/10.1029/2020GL092238

  (they show how important it is to measure PBL transitions with high spatio-temporal resolutions and suggest using a temperature gradient method)