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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Observational analysis of the daily cycle of the planetary boundary layer in the central amazon during a typical year and under the influence of the ENSO (GoAmazon project 2014/5)" *by* Rayonil G. Carneiro and Gilberto Fisch

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Only today I became aware of this manuscript dealing with the retrieval of the MLH/PBL by means of ceilometer measurements. A large number of researchers has provided studies on diurnal and annual cycles of the MLH, on the potential of different measurement techniques, or on intercomparisons of methodologies (consequently more references should be given in the manuscript). To my knowledge a study on a statistically significant temporal development of the MLH in the Amazon region is indeed missing and I agree with the first anonymous reviewer that the study could be quite

useful. I also agree that a discussion of the accuracy of the retrievals and the variability of the MLH during the different IOPs should be included.

As I am (also) interested in the benefit of ceilometers for aerosol remote sensing including the derivation of the mixing layer height (MLH), I briefly want to comment on the manuscript. I restrict myself mainly to the "ceilometer part". Note, that below I have mainly mentioned my own papers. This has been done for the reason of simplicity (today is the last day of the ACPD-discussion) – of course there are many other papers useful to look at! An overview over potentially useful papers can be found, e.g., in the reference lists of my papers.

Comments on the ceilometer part:

- Sections 2.4 and 2.6: as far as the same methodology is used (exploitation of a backscatter signal) the explanations can be combined: a ceilometer is a backscatter lidar, i.e., they follow the same physical principles.
- line 120: what is meant with "high frequency instrument"? As this could be misleading I suggest to write that the "temporal resolution is high" or something similar.
- lines 121ff: "powerful tool ... high level of detail": This is quite a general statement that neglects the problems of retrieving the MLH, in particular when a low power ceilometer (CL31 compared to CL51 or Lufft ceilometers) is used. A brief overview of the inherent pitfalls should be given: Signal artefacts (Kotthaus et al., 2016, AMT), overlap problems [relevant in particular for the NBL] and water vapor absorption (Wiegner et al., 2019, AMT), or wrong attribution of detected layers (Geiß et al., 2017, AMT).
- Section 2.4: The description how the MLH is determined from the CL31 signals is missing. Is the proprietary software BL-VIEW used? How is it applied (com-

pare Geiß et al., 2017)? A brief outline is strongly recommended as it help to understand the accuracy of the retrieval.

- line 123: What is meant by "reflexive properties"? Do the authors mean the refractive index? It could indeed be dependent on the relative humidity but I doubt that this effect has a significant influence on the MLH-retrieval. Or is the relative humidity mentioned because of potential water vapor absorption? Again, it is unlikely that this effect is relevant for the MLH-retrieval (Wiegner et al., 2014, AMT).
- line 124: "creating a tridimensional map": What does "tridimensional" mean? I assume that the ceilometer provides MLH as a function of time, or the particle backscatter coefficient as a function of time and height. Moreover, mentioning "aerosols, air pollutants, and industrial and natural emissions" might be misleading if it is interpreted as the potential to discriminate between different types of aerosol particles; this is impossible by a simple single-wavelength backscatter lidar (ceilometer).
- line 125: what is a "retrodiffusion" laser? Just skip this word. The expressions "coefficient of the attenuated portion" and "coefficients for aerosols" are not clear/known: do you mean "attenuated backscatter" or "particle backscatter coefficient"?
- line 126: "subsequently the heights of ... the PBL are calculated". See my previous comment. Please outline how this has been done.
- line 145: Similar to the ceilometer-section: What is a "retro-diffused signal"?
- Section 2.6: The authors mention "attenuated backscattering" (this means they use the lidar as an "elastic backscatter lidar") but do not use this quantity for the MLH-retrieval (why?)? Do I understand this correctly?

General comments:

- The authors should explain in detail how they determine the diurnal cycles of the MLH (for each instrument): which days are considered (only if full diurnal cycles can be determined)? Are the sample of days the same/similar for the different approaches? If not, is a bias expected? Did any instrument failures occur? What are the reasons for the gaps of some curves?
- The authors emphasize that the precipitation is quite high at the site. When it is raining the retrieval of the MLH by a ceilometer is not possible. How do these meteorological conditions influence the number of MLH-retrievals? How many full diurnal cycles could be determined during the IOPs? In this context the "sporadic rainfall" (e.g., line 220) could be discussed in more detail.
- The authors consider the MLH derived from radiosondes as truth. This is a frequently made assumption. However, the authors should explicitly mention that the methodologies (radiosonde vs. ceilometer/lidar) are based on different physical concepts.
- According to the shaded areas (not explained!) in Fig. 4 the variation/uncertainty (or whatever it indicates) is so large that the rapid growth/decrease of the MLH as discussed in lines 221ff is not significant.
- MLHs of $50 - 150$ m (line 234, Acevedo's results) can hardly be retrieved by a ceilometer (in particular when the overlap correction function is not very accurate). So it might be possible that the NBL is at 50 m at the authors' site but not detectable by the ceilometer. This fact is not covered by the discussion.
- Mentioning growth rates of e.g. 22.8 m/h (line 243) pretends an accuracy that is unrealistic. How is it determined: from the average over an IOP or from the mean of all individual diurnal cycles during the IOP (in the latter case the uncertainty

can be estimated)? How is such a "precision" justified in view of the vertical resolution of the ceilometer? Please explain.

- The limited temporal coverage of the lidar (compared to the ceilometer) retrievals should be explained.
- A comment on the availability of the different methodologies should be given: How many retrievals (obviously hourly averages) from the ceilometer, the lidar, and so on, are used for Figs. 4 and 6, (see also my first comment).

Minor/technical comments:

- Table 1: The vertical resolution of the ceilometer is given as "X". Please change.
- Figs. 4 and 6: Explain in the caption what the dashed line means? Instead of (A) and (B) one might also use "left" and "right".
- Fig. 6: panel B refers to IOP4 not IOP3.

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