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Atmospheric Measurement Techniques Discussions

Interactive comment on "Mixing layer height retrieval with ceilometer and Doppler lidar: from case studies to long-term assessment" *by* J. H. Schween

Anonymous Referee #1

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The paper deals with the retrieval of the mixing layer height (MLH) from a one-year data set of co-located wind lidar and ceilometer measurements. The authors present one case study for which they discuss the advantages and potentials of the different instruments concerning ML detection. Finally, a bunch of statistics concerning the differences, the cloud-bases, and the MLH itself is presented.

In my opinion the authors missed the chance to fully exploit their unique data set concerning the ML retrieval potentials. The focus of the paper is to show the limitations of the ceilometer concerning MLH retrieval even if the findings just confirm previous work. The presented results are rather descriptive without a intensive discussion and

conclusion for the scientific community. However, the authors present a lot of interesting data/statistics on the MLH behavior at Jülich, Germany, which are new and also of interest for the scientific community. Thus, in my opinion the authors should change the focus of their paper in order to fully exploit their unique data set. Therefore I can recommend the paper for publication only after some major changes.

General comments:

1. There are already many papers around reporting on the detection of the ML-top with backscatter lidar/ceilometer and their limitations. Thus, the finding presented here are neither new nor really front-breaking but they confirm previous findings. The authors use the STRAT 2d algorithm as premade software and black box to get their ML heights from ceilometer. It is already well known that aerosol based ML retrieval is limited to highly convective situations and that the ML cannot be properly captured in the morning and in the afternoon. The authors confirm this finding with their long term statistic, but in my opinion it makes no sense to quantify the general "overestimation" of the ceilometer retrieved ML since this is a methodological problem when the retrievals simply detect the wrong aerosol layer boundary. Therefore, I recommend to leave out some of the statistics purely comparing the differences of the ML height of the two instruments with known limitations. The focus of the paper should be changed, as the "potential performance of a low cost ceilometer network for MLH estimation" is already known.

2. The really new and interesting issue of this paper is the use of a continuous measuring wind lidar for the ML detection. The authors use one method (threshold of wind standard deviation) for the detection of the ML with this lidar type and also discuss the chosen threshold. However, I miss clear statements on the potential of a wind lidar to monitor the ML for 24/7. Is this possible? Was there a possibility to compare to radio soundings as well? Are there limitations to certain weather situations? What errors can occur? What other methods might be more appropriate or not? All these questions remain unanswered but would be really interesting for the reader. And finally, if the authors could come to the conclusion that with wind lidar it is possible to detect

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the ML under most synoptic situations at day and night time (above overlap) while with ceilometer it is not, this would be a clear statement for the scientific community and the pollution monitoring authorities.

3. The conclusion of the limitations by using STRAT-2d to detect the ML should be more stressed for users which want to use this algorithm on ceilometers only sites.

4. The meteorological statistics of the one-year data set are very interesting but have much more potential. Therefore it would be more useful to do some further investigation on the MLH behavior in the region of Jülich based on the existing data set (e.g. see some other publications in the reference list analysing ML data sets) instead of focusing on the difference between the two instruments.

5. Fig. 8 and 9. and the concerning text can easily be left out as it gives no new information to the reader.

6. 4292: I do not really get the idea why one should exclude cloudy cases. Is it possible to derive the MLH with wind lidar during cloudy cases while it is not possible for the ceilometer? What is your definition of the ML during cloud occurrence? Why should this cases be excluded? I anyway do not see significant difference between Fig. 6 and 7.

Specific comments:

Unfortunately following technical correction were propose already in the pre-discussion phase but were not at all considered:

Page 4281, line 17: Sentence not clear: What variable is provided by the software?

Fig 3: An additional panel with the vertical wind speed only would be great for understanding and discussion.

Specific comments (other than previously proposed):

4281, line 6: STRAT-2D is first time introduced without citation

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4281, 18ff: I cannot believe that valid data is available at the range gate of 0 m as stated. Even if the full overlap is already at 0 m, there is still the problem of receiver efficiency and imaging on the detector etc. What is the authors' experience? Down to which height level the retrieved backscatter signal can be used, i.e. what is the real minimum height for the data analysis?

4283, 18. What is meant by relative vertical backscatter difference? Please explain more exactly. With my interpretation, I do not understand how the chosen threshold avoids the misinterpretation in clouds.

4283, 21: This statement is very critical: If no candidate is found, the lowest valid range-gate is returned as MLH: Do you use this values? These values should be clearly flagged and not used for the statistics (as later mentioned), since they are completely arbitrary.

Fig. 1 : In my opinion the statistic would be much more valuable if it would show absolute values and not relative ones. 5% could be 5 m or 500 m.

Fig. 2 same as Fig. 1. Please absolute values.

4286: A conclusion is missing for the threshold sensitivity test.

4228, 9: Are you referring to Figure 4? Please do so!

4289,7-9: Advection could also be one reason for the observed features. . .

4289: It would be good to describe the general climatological characteristics of the observed year. Was it a usual year? Was there an exceptional hot summer? Lot of westerly winds or high-pressure dominance etc.? This would be very helpful for the interpretation of the presented data.

4290, 12-13: Can you explain, why in wintertime often a nighttime ML is detected above the minimum height while during the other season it is not? I.e. come up with an interpretation.

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4290,13-14: I cannot see the switch between night time and day time mode. Can you describe in more detail?

4290, 15-17: This topic is really interesting! Do you have one case study which could be shown and discussed? This would be of high interest for me (and possible other readers). And it would also increase the scientific value of the paper.

4291, 512: Please come up with a conclusion concerning the threshold selection and/or other methods for the wind lidar.

4292, 7: I guess you mean Fig. 6 instead of Fig. 5?

4292, 25: I think concerning this analysis one cannot apply the word “hysteresis” with respect to its physical meaning.

Section 3.4.: The first sentence is confusing, because I guess you are not always detecting cumulus clouds. You should motivate a little bit more that you do this analysis to show that in some seasons the detected clouds are strongly linked to MLH.

4295:4-6: This statement is too strong. You only can use it as a proxy if you know that it is a convectively driven cloud. Usually you do not know this without any ancillary parameter/measurements.

4295, 23: You should also report here that you confirm previous findings that a ceilometer cannot follow the ML evolution in the morning and afternoon instead of solo referring to sec 3.2.

4295: 26ff: I do not understand! How do you conclude that the differences are connected to convective situation?

4297, 23: Conclusion needed. It depends strongly on threshold, ok, but what can we conclude from that finding?

4298, 11ff: Make a strong statement: Ceilometers can only be used for ML detection at daytime under certain conditions.

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Caption Table 2: More explanation needed, caption must be self-explaining. E.g.: On what did you apply the linear regression? How can I interpret the slope?

Caption Figure 1: What does it mean: During times when less than 20% of data was available? Synoptic situations, instrument failures, what time interval did you use for your selection?

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 4275, 2014.