Atmospheric
Chemistry
and Physics
Discussions

Interactive comment on "Mixing layer height and the implications for air pollution over Beijing, China" *by* G. Tang et al.

Anonymous Referee #1

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The paper deals with the determination of the MLH over Beijing during more than 3 years from ceilometer measurements and its correlation with pollution classes (clear days, slight, light, medium and heavy haze). Most of the paper is devoted to a meteorologically based discussion why the correlations are as they are. This is certainly a positive feature of the paper as often just statements are given without any critical scrutiny. The authors consider a variety of parameters derived from different measurements (e.g., meteorological tower), so the discussion is quite elaborated. However, the readability is often very difficult because a separation of very long sections into different paragraphs is missing, information is only put into words where a table would be helpful, and often it is difficult to follow because the expressions are not clear but unnecessarily complex or in bad English. Consequently, it is sometimes hard to check

the validity of the authors' conclusions.

Thus, I strongly recommend to make the text more concise, to clarify statements, to delete redundancies and to improve its consistency. And ask a native speaker or a professional office for improving the language. If this is provided (implying major revisions) the paper can be foreseen for publication. A few suggestions and technical comments (in chronological order, not ordered in terms of importance) for improvements are made below, but it is not possible to review/amend every single expression or sentence.

- (28251,7):

  "The height to which the atmospheric mixing layer extends is the mixing layer height (MLH)". This sentence is more or less trivial and does not help to explain

- (28251,11):

  "gradients" → "concentration"

- (28251,22):

  "1000 m": is this really true, this value seems to be extremely large

- (28251,23):

  "...even the hourly observations...": which data set is meant here? Or should it be something like "even if hourly observations would be available they would not provide a sufficient temporal resolution"? Please clarify.

- (28251,24):

  I would not mention airborne measurements because they cannot provide routine measurements. They can only be used for case studies.

- (28252,4):

  "light intensity detection and ranging": delete "intensity"

- (28252,5):

  for consistency reasons replace "Doppler radar" by "radar" and explain the acronym. Or do not explain all acronyms (sodar, lidar and radar are well known)!

- (28252,7):

  delete "variations in"

- (28252,14):

  "visible light band": many lidars operate in the UV and NIR, i.e. not visible.

- (28252,17):

  "Wind radar is easily interfered by clouds, and the observational height is limited under cloudy conditions." This sentence does not fit here (previous and next sentence is on lidar). By the way: the lidar range is also limited in the presence of clouds.

- (28252,24):

  "...the eye-safe ceilometers..." This is a feature of all ceilometers, not only of Vaisala-ceilometers. This sentence must be more general, you can cite the AMT paper (Earlinet special issue) on the benefit of ceilometers.

- (28253,11):

  "...and the atmospheric stratification is stable..." Is this in contrast to the findings on (28255,24) where the authors find "only" 540 out of 800 cases to be stable?

- (28253,22):

  The citations "He and Mao, 2005; Yang et al., 2005;..." should be moved to line 20: after "during heavy pollution periods". At the present position it might be confusing.

- (28254,1):

  "variation characteristics" → "temporal development"

- (28254,1):

  "3 years"? In the previous sentence it was "3 years and 5 months" (whereas "July of 2009 to December of 2012" is 3 years and 6 months)

- (28254,19):

  39.97: Give all geographical coordinates with 3 or 4 decimal places

- (28254,22):

  "...attenuated backscatter coefficient profile of atmospheric aerosols..." This is not exactly true as water vapor absorption occurs (there are similar expressions elsewhere in the paper).

- (28255,5):

  How is radiation measured by "ultrasonic anemometers"? Use clear descriptions!

- (28255,8):

  PM2.5 and PM10 were measured at the ground?

- (28255,26):

  "...visibility at station..." How is this measured? How accurate are these numbers? It would help to have this information as it is of importance for subsequent sections of the paper.

- (28255,27):

  "...of Wyoming Engineering University (http://weather.uwyo.edu)." Give a more precise URL and name of the institution. Maybe it can be added to the acknowledgements.

- (28256,3):

  "is relatively long and" can be deleted.

- (28256,7):

  "...backscatter coefficient profile of atmospheric particles". delete: "of atmospheric particles"

- (28256,9):

  "...we use the gradient method": It should be outlined whether the Vaisala-firmware is used or own retrievals have been developed. Especially in the latter case the retrieval should be explained in 2–3 sentences. What is the lowermost level, where the MLH can be detected? Is an overlap correction applied?

- (28256,13):

  "...spatial and temporal averaging...": give typical values.

- (28256,19):

  "convective state": delete "state"

- (28256,21):

  "variations" → "profiles"

- (28257,8):

  "and the results were evaluated." I believe that can be deleted too.

- (28257,11):

  delete "of atmospheric particles"

- (28257,3): Section 3.1

  If a "verification" shall be provided it must be defined what is considered as "truth". It seems that the radio soundings are used as reference. This should be clearly stated. Another important aspect is that it is not clear what the "error" of the ceilometer data is (backscatter profile? MLH-determination?, relative error? absolute error?...). This must be clarified at different places of the manuscript.

- (28257,10):

  The whole sentence starting with "Because the ceilometer determines..." is not clear. What is the measurement error? How is it determined? This has to be explained in Section 2.2.1. Give a reason why the error increases when the concentration is low?

- (28257,14):

  "An analysis...". The sentence is not clear at all, must be re-phrased. If "visibility" is introduced here: where does this information comes from? What is "high" and "low" visibility? How is it measured? What is its accuracy?

- (28257,19):

  "...predict underestimations". See remark to (28257,3). What is the reference?

- (28257,22):

  A bi-level structure (two layers are meant?) could be better seen if the attenuated backscatter profile is added to Fig. 2b.

- (28258,26):

  What is the "variation rate"?

- (28258,28):

  It is not clear to which data points in Fig.2 the PM2.5/PM10 labels belong to. This must be clear, maybe by giving only the numbers without "PM2.5/PM10".

- (28259,5ff):

  Do I understand correctly what has been done? The authors identify cases, where the MLH from the ceilometer strongly differs from the radio sounding (under- and overestimates). These cases (and as a consequence specific meteorological conditions as e.g. cold air masses and dust occurrence) are excluded from the further investigation. An alternative approach would have been to try to correct the MLH from the ceilometer to consider an unbiased data set of meteorological situations. I recommend to revise the whole paragraph to make absolutely clear what have been done.

- (28259,10):

  "sand–dust weather almanac": What is this?

- (28259,15):

  delete "and manipulability" (I don't know, what is meant)

- (28259,22):

  What is meant by "high-quality..."?

- (28259,24 and 26):

  "effectiveness of the data" → "availability..."

- (28259,26 – 28260,5):

  Are these correlations an independent result or a consequence of the filtering process described in the previous section?

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- (28260,8):

  "The monthly average maximum for the daily minimum MLH": is this the "maximum of the monthly average of the daily minimum"?

- (28260,16):

  What are "platform periods"?

- (28260,17):

  Here, MLH are rounded and numbers like 600 m, 700 m are given. This does not fit to numbers like 351 m given previously; later (28264) heights are even given with one decimal place (this is nonsense with respect to any meteorological application). Please give all numbers in a consistent way. It would be worthwhile to add the variability of each height (each number is an average over almost 100 values [3 years, 31 days]). What about the inter-annual change of the monthly means?

- (28260,26):

  The "total radiation flux" should be defined: is total referring to the spectral range?

- (28260,29):

  "has determined seasonal variations in the MLH, because more data were eliminated for winter and spring,...". If this is true, the evaluation is somewhat questionable because the results should not depend on the sampling but on meteorological conditions. Please comment on this.

- (28261,2):

  "... winter and spring seasons are likely underestimated." This conclusion should be explained in a convincing way.

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- (28261,3):

  "To avoid the influence of data elimination on the study, ...". This is certainly a good idea (see comment on 28260,29), but it is not clear how the determination of the correlation with the sensible heat helps. By the way: if the sensible heat is determined at several heights, it should be clarified here, which heights are meant.

- (28261,16)

  Why are only string and summer discussed. What about the other seasons?

- (28261,21)

  "..only reaches 102 m/h..": is the difference to 114 m/h really significant? It seems to be within the error margins. Please discuss briefly.

- (28261,22)

  Here, the findings are discussed in terms of time (hours), previously four stages are introduced. It seems to be more consistent to use these terms here again.

- (28261, 24):

  "...convex variation characteristics...": there should be a better description, the present text is not clear.

- (28263, 5–6):

  ".. the air space from near surface to 300 m...": should be re-phrased, maybe just "troposphere below 300 m".

- (28263, 18):

  "...concave-down curvature...": there should be a better description.

- (28265, Eq. 1):

  Every symbol must be defined.

- (28264-28265):

  All numbers listed here should be summarized in a table for the different visibility classes. This table should also include the definition of the classes (name, v-range). Then, it would be much easier to follow the arguments of the authors because the text is better to read. As a consequence the whole text can be re-phrased to be absolutely concise. Don't use MLH with decimal places! Check if there is no confusion between "slight haze" and "light haze".

- (28266, 25):

  "...exhibit a conflicted state." That is meant?

- (28267, 17):

  "Previous studies..." Give citations!

- (28268, 14):

  "...and the critical threshold is 80 %." Where is this statement coming from? Is it a definition/estimate of the authors?

- (28268, 17):

  "We found that the..." I don't understand this and the next sentence? Is the order of visibilities and names (10 km does not correspond to heavy haze) correct? Please clarify!

- (28269, 16):

  "exhibits the feature": please re-phrase

- (28269, 17):

  "variation in the MLH": please re-phrase

- (28270, 1):

  "slight haze": should be light haze?

- Fig. 1

  A scale would be helpful

- Fig. 10

  "visibility levels": levels can be omitted.

- all Figs.

  whenever possible include a x/y-grid

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 28249, 2015.

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