# Article AMT-2020-78 – Response of Referee 3's comments

# Iteration #3

## General comment

**The authors revised significantly the manuscript based on the previous comments and suggestions. To ensure the paper quality to be high, the reviewer advised the authors if the manuscript can be checked once more in term of English grammar and presentation.**

The authors made a series of little modifications in order to improve the language which are highlighted in the marked-up version. They thank the referee for the time spent on the review.

# Article AMT-2020-78 – Response of Referee 4's comments

# Iteration #3

*Note:* every response is followed by corresponding changes (CC) in the manuscript. Changes are referenced with lines numbers from the marked-up version to make them easier to identify. Changes visible in marked-up version that are not referenced as referee's response are for English language improvement.

## General comments

**The manuscript presents a comparison of two machine learning algorithms for boundary layer height detection using MicroMPL measurements. The optimal configurations for the algorithms have been determined using a sensitivity analysis. The performances of both methods have been studied for a 2-year database and for a case study, comparing them with independent radiosonde estimates as well as with the estimates given by the instrument manufacturer. The manuscript presents high scientific level, significance and potential for application of the work. In my opinion, the manuscript is well written, the different parts are clearly presented, and the approach is technically well justified and validated. The abstract is accurate and concise, the introduction is accessible, presents the topic background in a proper form and is followed by a clear presentation of the work done. Previous works on the subject are properly cited and the new points are clearly indicated. The methodology is properly explained, as it is expected in this kind of studies. The results and discussion sections are well structured and their content is relevant to properly analyze the proposed algorithms. Therefore, I propose that this article is accepted for publication, after improving some minor aspects that, to my view, will make the work more robust.**

The authors are pleased to read such positive opinion about their work and they are thankful to the reviewer for the time spent on a careful reading.

## Main aspects

**1. The concept of "mixing height" only appears in the title and in the conclusions. However, this concept is not properly discussed or explained, and the term "Boundary layer height (BLH)" is the one that is mentioned throughout the manuscript. I agree to use this more general name (BLH) in the present work, as I understand that the aim is not to separate or detect different phenomena within BL (e.g. mixing, stable nocturnal layers, etc.). Therefore, I think the term "mixing" should be avoided, in special for the title.**

The title and the conclusions were changed accordingly.

***Corresponding changes (CC)***: title and line 547 (marked-up version) "mixing height" changed for "boundary layer height".

**2. To my opinion, the training of the manuscript using estimation "by hand" (as it is stated in line 170 of latest manuscript version, "On days where the boundary layer is easily visible to a human expert, the top of the boundary layer can be drawn by hand") is well justified in the view of the explanations given in the following paragraph (lines 173-183). However, in order to avoid any doubt on the justification of this estimation, I recommend: 1) to include in the introduction some brief explanation with references on the relevant aspects of BL structure that are later mentioned in lines 173-183 (i.e. stable layer, etc) and 2) to give more quantitative information in such description (e.g. "a stable boundary layer is present near the ground during the night, as it is observed by the higher signal intensity due to higher aerosol concentration…" in line 175). These corrections will also help justifying other statements given in the manuscript, e.g. "The boundary layer was clearly visible and had nearly all the features of the conceptual image" in lines 413-414.**

The authors understand from this comment that the manuscript would be clearer with additional details about the terms "mixed layers" and "stable layers". However, the question of defining these terms is deep –especially seen from a measurement point of view– and is out of the manuscript's purpose. For example, the stable layer will be seen very differently with an aerosol lidar than with a radiometer, and it will be very different in a narrow valley than in large plains. Any description of the stable layer not mentioning these aspects would be incomplete and would raise legitimate critics. The authors believe that the given descriptions are understandable for AMT's readers. This choice is coherent with the newly changed title that no longer mention "mixing layer".

***CC:*** none.

**3. Nighttime retrievals have been sometimes removed from the study, in particular for the overall comparison with RS (as it is stated in line 362) and for the monthly average (line 386). However, this is not well justified in any of the cases, and actually in section 2.2 it is said that the BLH was calculated using bulk Richardson number method for nighttime because it is a good method according to literature.**

The boundary layer at night is much more complex than during the day. Therefore we judged that nighttime estimates were not "well-defined cases" (line 482). This choice is debatable but it has the two following advantages.

- If a method do not work with well-defined cases, it cannot provide continuous estimation of the BLH. Therefore, assessing the new algorithms in well-defined cases appeared to the authors as a good first step.
- The overall comparison results are intended to be compared with previous studies, therefore we better reproduce similar conditions.

However, BLH-RS estimates at night were used elsewhere (e.g. in the Figure 10 b and d). For monthly average, the nighttime estimates were drawn, but not shown in the manuscript because they did not bring enough new information compare to the other figures.

***CC:*** none.

## Other corrections

**4. Lines 180-181: "The mixed layer started to develop at 09:00 UTC...". In the view of Figure 4 (right), this development seems to start around 8 UTC actually.**

Yes, the hour is corrected.

**5. Both in Figure 4 and Figure 11, an indication on sunrise and sunset times would be helpful.**

Sunrise and sunset times were not used by the human experts nor by machine learning algorithms, therefore the authors did not think this would be relevant in Figure 4. However, we do agree that this is helpful in Figure 11 in order to correctly criticize the results.

***CC:*** Figure 11 and caption.

**6. Lines 190-192: lower case letters should be used after semicolon.**

Yes, it is corrected.

**7. Line 339: "optimal" instead of "most optimal". This word already includes the superlative meaning.**

Yes, "most" is removed.

**8. Caption of Figure 9: an indication of what INDUS means should be given.**

An additional sentence is accordingly added in the caption.