

Response to Reviewer 2:

Thanks for the corrections and comments, we implemented all of them in our final version of the paper. We also went through the text carefully and proofread the article.

1. Why the authors use the term *scan* to indicate a lidar profile? I am used to refer to a scan strictly as for a scanning device, e.g., a scanning wind lidar will give a profile of wind strength and direction. The recording in time of the photon- counting signal when transformed into altitude is better called a profile.

We agree with you and we changed the term scan to profile throughout the paper.

2. When the authors use the relative pronoun “which”, this shall come after comma otherwise “that” has to be used instead.

Thanks for the comment. We corrected the paper accordingly.

3. Plenty of punctuation, articles and auxiliary verbs are missing through the text. I have tried to highlight a part of them, but the authors should perform a thorough re-reading of the manuscript and correct these typos and errors.

Sect.1, Pg 2, In 20: the PCL acronym has already been defined. *done*

Sect.2, Pg 3, In. 8: you can remove “which are as follows”. *done*

Sect.2, Pg 3, In. 23: “minimizes” *done*

Figure 1, caption: I’d say the line color in the left panel is Cyan rather than blue. Sect. 2.2, Pg 4, In 5: “we have tested” (remove “been”) *done*

Sect. 2.4, pg6, In 3: As it is mentioned here for the first time, it could be useful to add the extended name of bagging in brackets “bagging (bootstrap aggregating)” . *done*

Sect. 2.5, pg 6, In 28-29: the definition of overfitting should be provided in Sect. 2.4 when it is first introduced. *done*

Sect. 3.1, pg 9, In 4: “. . .different years AND represent different. . .” *done*

Sect. 3.1, pg 9, In 21: change “True negatives (FN)” to “False negative (FN)” *done*

Sect. 3.1, pg 9, last paragraph: first you define precision and recall and then you present results of accuracy in Table 1. I would show Table 2 before Table 1, right below equations 9.

We changed the structure so that we presented the accuracy score and then we defined precision and recall.

Sect. 3.1, pg 10, ln 5: “clear scans” *done*

Sect. 3.3, pg 13, ln 9: replace “smoke does not present” with “smoke is not present”. Sect. 3.3., pg 13, ln 12: replace “during late June and early June 2002” with “during early June and late June 2002”. *done*

Sect. 3.3., pg 13, ln 13: “As, the smoke” without a comma *done*

Sect. 3.3., pg 13, ln 16: “1961 lidar scans” *done*

Sect. 3.3, pg 14, ln 2: replace “To investigate if scans with layers are clustered together the particle extinction . . .” with “To investigate if scans with layers are clustered together, the particle, extinction. . .”.

Sect. 3.3, pg 14, ln 10-11: please consider rephrasing and correcting the English. Sect. 3.3, pg 14, ln 11: “no anomalies WERE detected” *done*

“We are planning to expand our unsupervised learning method to both Rayleigh and Nitrogen channels to be able to correctly identify and distinguish cirrus clouds from smoke traces in the UTLS.”. Does the PCL have a depolarization channel, or is in the forthcoming plans to implement one to discriminate between different particles based on their asphericity?

The PCL does not have a depolarization channel, which is the best way to distinguish smoke particles from ice. However, we have shown (Gamage et al, 2019) that is possible in our processing algorithms to use the multiple color measurements of the lidar to estimate the lidar ratio, which allows ice and smoke particles to be distinguished.

References:

Mahagammulla Gamage, S., Sica, R. J., Martucci, G., and Haeefe, A.: Retrieval of temperature from a multiple channel pure rotational Raman backscatter lidar using an optimal estimation method, Atmos. Meas. Tech., 12, 5801–5816, <https://doi.org/10.5194/amt-12-5801-2019>, 2019.