We sincerely thank both reviewers for their time and effort to review the current manuscript and for their helpful comments! Please find below a detailed answer to your comments. The reviewers' comments are highlighted in *italic*, while our response is in normal font.

Reviewer 1:

*(*general *comments)*

This paper is the first well-organized study on the validation of ATLID using ground-based lidar, and it serves as an extremely valuable report for both ATLID users and algorithm developers. It evaluates ATLID products using reliable ground-based lidar systems at locations scattered around the world for various types of aerosols. The text is clear and easy to read, and the figures are of high quality. While I believe this paper is nearly ready for publication, some technical corrections and few additional explanations are needed, so I consider minor revisions to be necessary.

Thanks for your evaluation and your positive words!

(specific comments)

- *Please clarify whether, for all selected cases, the profile closest to the ground site was used, or whether, in some cases, the profiles were averaged. For example, line 89 states "all but one within 20 km," which I interpreted to mean that all profiles within 20 km were used; however, as noted in line 357, Fig. 9 states that the closest product was used.*

Thanks for this hint. The closest profile of ATLID has always been used. We describe this now explicitly in the manuscript.

„We screened the co-located observations for overpasses in close vicinity (shortest distance between ground-site and EarthCARE ground track < 20 km for all except one case study) and appropriate atmospheric conditions to select seven case studies for a detailed discussion on the potentials and limitations of ATLID profiling products of Baselines B. The closest available profile from the respective ATLID product was then used for comparison."

- *Regarding lines 416–417, it states, "Dedicated investigations have shown..."; if there is a reference, please include it.*

Unfortunately, there is no reference, as the investigation was done by some of the co-authors. However, we added some more information to this

„Dedicated investigations performed for this study in the framework of DISC (EarthCARE Data Innovation & Science Cluster) have shown that…"

(technical corrections)

- *Line 254: It says 14.4 N, but based on Fig. 3, isn't 14.1 N correct?*
  - you are right, corrected – thanks!
- *Line 278: Regarding "100 km vertical smoothing," isn't this a typo for "horizontal"?*
  - Of course, thanks!
- *Line 399: Since "ore" is a proper noun, it should be written as "Ore."*

- Corrected!
- *Line 573: ")" is missing in "(see Fig. 19".*
  - Thanks!

Reviewer 2:

This paper provides a detailed discussion of the results of ground-based/ship-borne validation of the ESA aerosol product derived from EarthCARE satellite-borne lidar data. The validation process demonstrates meticulous and sophisticated planning, including the selection of datasets that account for the horizontal heterogeneity of the target aerosols and the incorporation of various aerosol scenarios. Furthermore, the paper not only demonstrates the validity of the product but also discusses remaining challenges, providing valuable information and insights for aerosol science using EarthCARE data. The writing is extremely thorough and clear, the figures and tables are appropriate, and it is a well-written paper. For the reasons stated above, this reviewer recommends the publication of this paper in AMT. While no major revisions are required, I would like the authors to revise the paper taking into account the points listed below.

We thank reviewer two for his/her/their thorough and positive review and the useful comments.

1. *Although the text is written in a clear manner, I feel that the key points of this paper—such as its findings—become less clear as I read on. This paper selects seven aerosol cases. For each case, it describes the atmospheric and aerosol conditions, the differences in optical properties between satellite and ground-based data, findings, suggestions, and conclusion. The underlying issue may be not only the large number of cases—seven in total—but also the substantial amount of information provided for each one (and the writing may be somewhat redundant). Furthermore, it may be difficult to recall the details of a previous case while reading about a new one. Therefore, it would be very helpful to have a table summarizing the key points (observation area and period, what type of aerosol case it is, whether the optical properties between satellite and ground observations are consistent, what findings were identified—e.g., edge effects) corresponding to Section 3 for the seven cases.*

   Thanks for your comments. We realize this issue, but also find it difficult to leave out certain information which is needed or add information instead of referring to a previous case. Therefore, we think adding a table to guide the reader is an excellent idea. We now provide such a table (Tab. 2) at the beginning of the Case study section and hope that it gives enough information to guide the reader properly.

2. *Conclusion: It would be very helpful if you could emphasize the description of the findings. For example, you could elaborate on the findings, stating something like, "The findings of this paper are as follows."*

   Thanks for the advice. We included respective statements now in the conclusion.

3. *While many descriptions of the differences in optical properties between satellites and ground-based measurements tend to "overestimate" or "underestimate" these differences, it would be helpful if the actual magnitude of the difference (relative or absolute error) were specified in specific instances.*

Thanks for your advice. Indeed, in the very first versions of the manuscript we quantified the deviations in certain regions for each case study. However, we decided to not provide these results, as they may not be representative in a general sense and may confuse the reader. For this reason, we would like to leave it as is and let the reader interpret the results by analysing the comparison plots. A quantitative assessment, however, is planned for a statistical analysis using long-term ground-based data which is currently under preparation.

4. *P6 L163: AM-COL (Haarig et al., 2023), ACM-CAP (Mason et al., 2023) : A brief explanation of the synergy with which sensor (MSI?, CPR?, both?) would aid the reader's understanding.*

   Thanks for this hint. We added a respective explanation.

5. *P10 L279: 100 km vertical smoothing => 100km horizontal smoothing?*

   You are right, of course, thanks!

6. *P13 Fig5: No description on NR*

   Thanks for notifying, we added the respective information.

7. P23 L443: *Above the aerosol layers, ice clouds were observed at around 7.5 and 11.5 km: Is the 11.5 km layer a cloud? It appears to have a very high lider ratio (~80sr ?). Could it be an aerosol in some areas?*

   Thank you very much for your proper analysis and spotting this. Indeed, given the high depol values (>0.2), we were a bit quick in judging. After re-checking the values, we conclude that the high lidar ratio together with the moderate depol are a unique feature of stratospheric smoke instead of Cirrus. This is also confirmed by our Fluorescence lidar measurement at Leipzig. They clearly reveal smoke at this altitude on the same day. We clarified this now in the manuscript! Interestingly, it seems to be that ice formation is triggered at the bottom of the smoke layer in some regions indicated by the very low lidar ratio. We will not discuss this in the paper as it would be out of scope, but it shows nicely the potential of EarthCARE to investigate aerosol-cloud interaction …

   Added text: “Above the tropospheric aerosol layers, stratospheric smoke was observed by ATLID at around 11 km indicated by enhanced depolarization values and high lidar ratio values (>60 sr). The presence of smoke at this altitude was also confirmed by observations with the fluorescence lidar MARTHA (Gast et al., 2025) at Leipzig showing clearly enhanced fluorescence capacity values as typically for smoke (Gast et al., 2026). Interestingly, it seems to be that ice formation is triggered at the bottom of the smoke layer in some regions indicated by the very low lidar ratio. Nevertheless, to not lose focus, we concentrate on the tropospheric features below 6 km in the following.”

8. *P33 L565: hardly revealing the horizontally heterogeneous atmospheric state.: At this point, I think a bit more explanation is needed as to why this is stated in this way.*

Some persons may suggest that while high-resolution products (right figure) are indeed noisier than low-resolution products (left figure), their horizontal structure appears to be similar to that of low-resolution products.

You are right, this was misleading. We formulated now as follows:

"The medium-resolution products (left panels) show a consistent but horizontally heterogeneous structure. While the high-resolution products (right panels) seem to be dominated by noise, the general atmospheric state is still identifiable. "