This manuscript combines Aeolus and CALIPSO data along with ECMWF wind products that assimilate Aeolus to understand the relationship between wind speed and marine aerosol optical properties in 3 remote oceanic basins. The manuscript is well written and results are clearly presented. I recommend publication with minor revision:

1) The authors have a hard cut-off at 1 km to mark the MABL top throughough the manuscript. I would suspect this would vary somewhat with region. Can the authors comment on any ramifications of this? Would using ECMWF MABL help?

AR:

a. That the MABL height of the remote ocean areas is around 1 km was summarized from several references (Luo et al., 2014; Luo et al., 2016; Alexander et al., 2019).

b. Thank you for your advice, and we have calculated the mean values of ECMWF provided boundary layer heights at the three study areas for the time period of 20 April 2020 to 26 May 2021, which are $787.47 \pm 231.77$ m at the NP area, $939.39 \pm 360.20$ m at the SP area and $1005.29 \pm 366.60$ m at the SI area.

c. Moreover, the height resolution (0.25 km below 0.5 km, 0.5 km in the range of 0.5 km to 2 km) of Aeolus is relatively low. Using 1 km as the boundary to split Aeolus data vertically is feasible while more precise MABL height won't make more sense. Therefore, it is considered that the consequent lower layer (0-1 km) is capable to generally represent the MABL.

As you advised, the discussion about MABL heights are revised in the manuscript as:

"Referring the results of Luo et al. (2014), Luo et al. (2016) and Alexander et al. (2019), the MABL height of the remote ocean is summarized as around 1 km. Moreover, calculated with ECMWF provided boundary layer heights at the three study areas for the time period of 20 April 2020 to 26 May 2021, the mean values and the standard deviations are $787.47 \pm 231.77$ m at the NP area, $939.39 \pm 360.20$ m at the SP area and $1005.29 \pm 366.60$ m at the SI area. Hence, the boundary height of the two vertical layers is set as 1 km, approximately corresponding to the mean MABL height of remote ocean. Though the

MABL heights are variable and thus set as 1 km will lead to the potential inaccuracies, restricted by the relatively low height resolution of Aeolus (0.25 km below 0.5 km, 0.5 km in the range of 0.5 km to 2 km), utilizing more precise height boundaries won't make more sense. It is considered that the statistical results of the 0-1 km layers and the 1-2 km layers are capable to generally represent the atmospheric conditions within the MABL and above the MABL."

***Reference:***

*Alexander, S. P. and Protat, A.: Vertical profiling of aerosols with a combined Raman-elastic backscatter lidar in the remote Southern Ocean marine boundary layer (43–66°S, 132–150°E), J. Geophys. Res.-Atmos., 124, 12107–12125, https://doi.org/10.1029/2019JD030628, 2019.*

*Luo, T., Yuan, R., and Wang, Z.: Lidar-based remote sensing of atmospheric boundary layer height over land and ocean, Atmos. Meas. Tech., 7, 173–182, https://doi.org/10.5194/amt-7-173-2014, 2014.*

*Luo, T., Wang, Z., Zhang, D., and Chen, B.: Marine boundary layer structure as observed by A-train satellites, Atmos. Chem. Phys., 16, 5891–5903, https://doi.org/10.5194/acp-16-5891-2016, 2016.*

2) Line 41. Please specify - by area, by mass.

AR: The first sentence of Section 1 has been revised as "According to the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report, the total emission of marine aerosol (including marine primary organic aerosol) produced from ocean is 1400 to 6800 $\mathrm{Tg \cdot yr^{-1}}$, which is considered the largest natural aerosol input to the atmosphere globally (Boucher et al., 2013)." to make it more logical.

***Reference:***

*Boucher, O., D. Randall, P. Artaxo, C. Bretherton, G. Feingold, P. Forster, V.-M. Kerminen, Y. Kondo, H. Liao, U. Lohmann, P. Rasch, S.K. Satheesh, S. Sherwood, B. Stevens and X.Y. Zhang, 2013: Clouds and Aerosols. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin,*

*G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.*

3) Line 95. Change from "is" to "was" as ALADIN stopped science operations at the end of April 2023.

AR: Thanks, revised.

4) Line 174. Why was version 3.41 used for January 2022- July 2022? Was version 4 data not available? This has implications for continuity of the VFM algorithm.

AR: Only version 3.41 of CALIOP VFM product is available for January 2022- July 2022, while version 4 data was not available in this period.

Figure 1 shows the Fig. 1 from Kim et al. (2018), which is the flowchart of the CALIPSO aerosol subtype selection scheme for tropospheric aerosols. In this flowchart, the blue-shaded region and blue-dotted arrows are used in V3 but removed in V4 while the red-shaded region and solid red arrows are newly added in V4. It can be learnt from the flowchart that the main framework of the aerosol subtype discrimination algorithm is the same between V3 and V4. Nevertheless, considering that the new-added procedure of version 4 in the red-shaded region identifies part of “polluted dust” aerosol subtype as “dusty marine”, partly using version 3 VFM data will lead to the underestimate of “dusty marine” aerosol and the “marine” subtype discrimination will not be influenced. As describe above, using the version 3.41 of the CALIOP VFM data for January 2022- July 2022 in this study led to the underestimate of total marine aerosol portion, which means the real total marine aerosol percentage is larger than the statistic. To conclude, though there are several upgrades between version 4 and version 3, the statistical results of aerosol subtype are acceptable and the “marine aerosol dominating areas” conclusion is not affected.

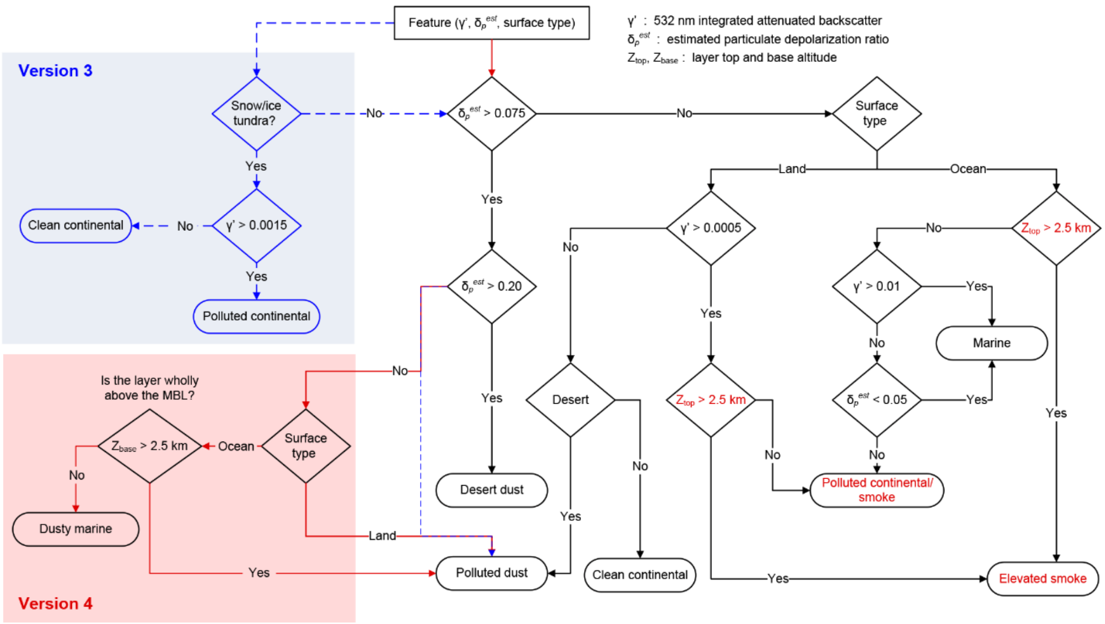


Figure 1: Flowchart of the CALIPSO aerosol subtype selection scheme for tropospheric aerosols (Fig. 1 from Kim et al. (2018)).

To briefly clarify this fact, the relevant description has been added to the Section 4.1 as "It should be illustrated that "dusty marine" was a new aerosol subtype raised for the first time in the version 4.10 of the CALIOP VFM product and was absent in the version 3.41, which was identified from part of version 3.41's "polluted dust" with the criteria of "surface type" and "layer base altitude". Using the version 3.41 of the CALIOP VFM data for the period of 19 January 2022 to 4 July 2022 led to the underestimate of "dusty marine" portion and the total marine aerosol portion. Even though under the condition of underestimate, the percentage of total marine aerosol are larger than 90%, which means the real proportion of total marine aerosol is higher, and hence the conclusion that the marine aerosol dominates in the altitude range of 0-2 km above these three areas is still valid."

***Reference:***


*Kim, M.-H., Omar, A. H., Tackett, J. L., Vaughan, M. A., Winker, D. M., Trepte, C. R., Hu, Y., Liu, Z., Poole, L. R., Pitts, M. C., Kar, J., and Magill, B. E.: The CALIPSO version 4 automated aerosol classification and lidar ratio selection algorithm, Atmos. Meas. Tech., 11, 6107–6135, https://doi.org/10.5194/amt-11-6107-2018, 2018.*

5) The authors have not discussed the implication for the time offset of CALIPSO and Aeolus. While I don't think this is a major impact, the aerosol typing by CALIPSO will be after Aeolus observed winds and would be seeing the aftermath. Please consider discussing this point in the manuscript.

AR:

a. Generally, as for the closest orbits of Aeolus and CALIPSO, CALIPSO scanning tracks are about 4 h ahead of Aeolus (Dai et al., 2022). The lifetime of marine aerosol is usually with in the range of 1 day to 1 week, depending on its size (Boucher et al., 2013). Compared to the lifetime of marine aerosol, the 4 h time offset between CALIPSO and Aeolus observations is much shorter, and hence the same marine aerosol layer will be observed by two spaceborne lidars with very high probability.

b. The aerosol type analyses is a statistical result using more than two years CALIPSO aerosol typing data, which represent the background aerosol type conditions in the 0-2 km height atmospheric layers of the three study areas, and is considered to be independent of wind speed.

To conclude, the implication for the time offset of CALIPSO and Aeolus is intended to be ignored resulting from the much shorter time offset compared to the marine aerosol lifetime and the long-term statistical analyses of CALIPSO aerosol typing data.

***Reference:***

*Boucher, O., D. Randall, P. Artaxo, C. Bretherton, G. Feingold, P. Forster, V.-M. Kerminen, Y. Kondo, H. Liao, U. Lohmann, P. Rasch, S.K. Satheesh, S. Sherwood, B. Stevens and X.Y. Zhang, 2013: Clouds and Aerosols. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA*

*Dai, G., Sun, K., Wang, X., Wu, S., E, X., Liu, Q., and Liu, B.: Dust transport and advection measurement with spaceborne lidars ALADIN and CALIOP and model reanalysis data, Atmos. Chem. Phys., 22, 7975–7993, https://doi.org/10.5194/acp-22-7975-2022, 2022.*

6) Equation 1. Consider labeling Bmar, Aeolus as Bmar, Aeolus co or Bmar, Aeolus II to indicate it is the co polarized return.

AR: Thanks for the advice. Equation 1 has been revised as $\beta_{mar} = (1+\delta_{mar,355nm}) \cdot \beta_{mar,Aeolus-co}$.

7) Line 555. The "upward" trend in the middle of the plot seems very faint.(DIFF) Is it statistically significant?

AR: The revised Fig. 13 (Fig. 16 in the old version), shown as below, presents the $\mathrm{LR}_{mar}$ variation with wind speed at $\mathrm{Layer}_{L}$ and $\mathrm{Layer}_{H}$, in (a) the NP area, (b) the SP area and (c) the SI area, respectively.

From this figure, the upward trends can be found at the middle wind speed range, 13 $\mathrm{m \cdot s^{-1}}$-17 $\mathrm{m \cdot s^{-1}}$ of the NP area, 9 $\mathrm{m \cdot s^{-1}}$-16 $\mathrm{m \cdot s^{-1}}$ of the SP area, 10 $\mathrm{m \cdot s^{-1}}$-20 $\mathrm{m \cdot s^{-1}}$ of the SI area, which are especially significant for $\mathrm{Layer}_{H}$. Therefore, it is considered statistically significant.

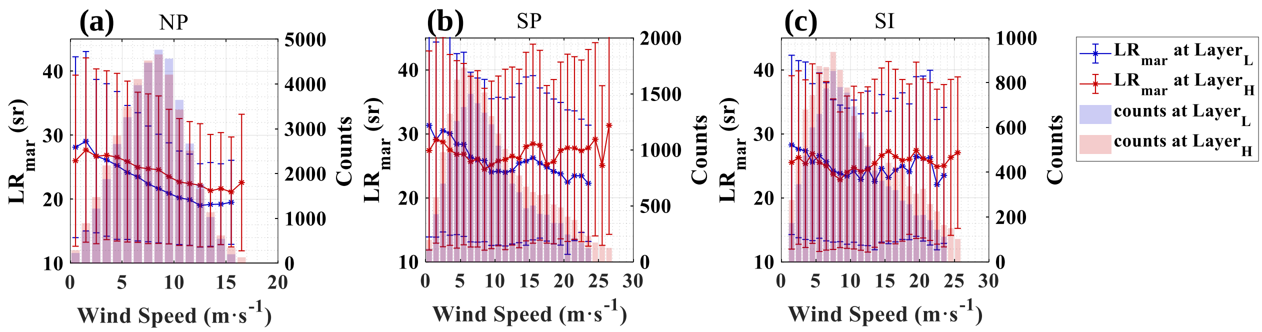


**Figure 13: Averaged $\mathrm{LR}_{mar}$ versus wind speed at $\mathrm{Layer}_{L}$ and $\mathrm{Layer}_{H}$, in (a) the NP area, (b) the SP area and (c) the SI area, respectively.**