Dear Editor, Prof. Xiaohong Liu,

Thank you for your careful review and helpful suggestions.

1. We have reorganized and condensed the Abstract, and revised the "Summary and Conclusions" section, following ACP guidelines. The revised Abstract and the "Summary and Conclusion" section are shown as below:

"**Abstract.** Marine aerosol affects the global energy budget and regional weather. The production of marine aerosol is primarily driven by wind at the sea-air interface. Previous studies have explored the effects of wind on marine aerosol, mostly by examining the relationships between aerosol optical depth (AOD) and surface wind speed. In this paper, utilizing the synergy of aerosol and wind observations from Aeolus, the relationships between the marine aerosol optical properties at 355 nm and the instantaneous co-located wind speeds of remote ocean are investigated at two vertical layers (within and above the marine atmospheric boundary layer, MABL). The results show that the enhancements of the extinction and backscatter coefficients caused by wind are larger within the MABL than above it. The correlation models between extinction/backscatter and wind were established with power-law functions. The slope variation points occur during extinction and backscatter coefficients increasing with wind speed, indicating that the wind-driven enhancement of marine aerosol involves two phases: a rapid growth phase with high wind dependence, followed by a slower growth phase after the slope variation points. We also compared the AOD-wind relationship acquired from Aeolus with CALIPSO-derived result from previous research. The variation of the lidar ratio with wind speed is examined, suggesting a possible "increasing-decreasing-increasing" trend of marine aerosol particle size as wind speed increases. This study enhances the comprehension of the correlation between marine aerosol optical properties and wind speed, by providing vertical information and demonstrating that their relationships are more complex than a linear or exponential relation."

"**5 Summary and conclusion**

By utilizing particle optical properties data (Level 2A products) and wind vector data (Level 2C products) provided by ALADIN onboard the Aeolus satellite, the correlations between marine aerosol optical properties at 355 nm and the instantaneous co-located wind speed over remote ocean areas are investigated at two separate vertical atmospheric layers (0-1 km and 1-2 km, corresponding to the heights within and above marine atmospheric boundary layer, MABL), revealing the effect of wind speed on the marine aerosol within and above the MABL over the remote oceans.

Several data processing procedures were conducted to obtain pure marine aerosol data from Aeolus observations. Firstly, three study areas located in the remote ocean were selected, which were named the North Pacific (NP) area, the South Pacific (SP) area and the South Indian (SI) area, respectively. The dominances of marine aerosol in these areas was then examined using the aerosol classification data provided by the VFM products of CALIOP. The proportions of marine aerosol in these areas are all larger than 79%, while the percentage sums of marine aerosol and dusty marine aerosol are all above 90%. Following quality control, cloud screening was performed using specific criteria (relative humidity and backscatter ratio). 9%, 35%, 40% of the data were identified as cloud-contaminated in the altitude range of 0-2 km and were subsequently eliminated for the NP area, the SP area and the SI area, respectively. Finally, the backscatter correction is applied to the Aeolus L2A products. These procedures allow us to obtain reliable, cloud-free marine aerosol optical properties and the corresponding wind speed.

The correlations between the marine aerosol extinction coefficient (α_{mar}) and backscatter coefficient (β_{mar}) at 355 nm and the wind speed (ws) are analyzed at two separate layers, for three study areas respectively. It is found that the Aeolus observations can provide evidence of the fact that both the layers within and above the MABL receive marine aerosol input produced and transported from the sea-air interface. Moreover, the marine aerosol load in the MABL is stronger than that in at the higher layer. The enhancement of α_{mar} and β_{mar} caused by wind is more intense at the MABL. This may be due to the proximity of the MABL to the sea-air interface, making it more susceptible to such effects. Besides, the slope variation points (15 $\mathrm{m \cdot s^{-1}}$ for α_{mar} and 10 $\mathrm{m \cdot s^{-1}}$ for β_{mar}) were found during α_{mar} and β_{mar} increasing with the wind speed. Above these slope variation points, the growth rates become lower. This phenomenon implies that the wind-driven enhancement of marine aerosol includes two phases, among which one is a rapid growth phase with a high dependence on wind, and another is a slower growth phase with higher fluctuations after the slope variation points. The α_{mar}-ws curves and the β_{mar}-ws curves were fitted by power-law functions and the corresponding R^2 are all higher than 0.9 for both layers and for all study areas. In addition, the relationship between the $\mathrm{AOD_{mar}}$ at 355 nm and the wind speed shows quite consistent tendency with the regression function found in a previous study that compared CALIOP-retrieved $\mathrm{AOD_{mar}}$ and 10 m surface wind speed. The marine aerosol lidar ratio ($\mathrm{LR_{mar}}$) and its particle size have a negative relationship. From the examination of the correlation between the $\mathrm{LR_{mar}}$ and the wind speed, it can be inferred that as the wind speed increases, the particle size of marine aerosol appears to becomes larger in the relative low wind speed range, then could be broken up into smaller particles by wind at higher wind speeds, and ultimately turns out a larger state again at very high wind speeds. As α_{mar} and β_{mar} are affected by both particle concentration and size, this reminds us that the increase in α_{mar} and β_{mar} with wind speed may not only be due to the enhancement of particulate quantity produced from the sea-air interface, but may also be impacted by the variation in size.

The regression models of α_{mar}-ws and β_{mar}-ws at two vertical layers above three study areas are inconsistent, while the meteorological and environmental parameters, apart from the wind, differ across various regions. The production, entrainment, transport and removal of marine aerosol above the ocean are not only dominated by the wind, but also impacted by other meteorological and environmental factors, e.g., atmospheric stability, sea and air temperature, RH, etc. This implies that in order to obtain more precise α_{mar} and β_{mar} models, in addition to wind speed, above factors should also be included in the establishment of the models.

This study demonstrates the ability of Aeolus to quantify interactions between aerosols and wind speeds in poorly observed ocean regions through a synergy of aerosol and wind observations based on its unique setup. The analyses of these interactions deepen our understanding of the effect of wind speed on marine aerosol optical properties over remote oceans, by providing vertical information and demonstrating that their relationships are more complex than a linear or exponential relation."

2. As for the citation of IPCC report, we actually referred to the **Summary for Policymakers** provided by IPCC. The citation information for the Summary for Policymakers is "IPCC: Summary for Policymakers, in: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, edited by: Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S. L., Péan, C., Berger, S., Caud, N., Chen, Y., Goldfarb, L., Gomis, M. I., Huang, M., Leitzell, K., Lonnoy, E., Matthews, J. B. R., Maycock, T. K., Waterfield, T., Yelekçi, O., Yu. R., and Zhou, B., Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 3-32, https://doi.org/10.1017/9781009157896.001, 2021." Feurdean et al. (2022), Callewaert et al. (2022), and Terhaar et al. (2022) also cited the same reference. Their citation formats of the Summary for Policymakers in the text are "(IPCC, 2021)". So we decided to retain the citation formats "(IPCC, 2021)" in the text.

References:

Callewaert, S., Brioude, J., Langerock, B., Duflot, V., Fonteyn, D., Müller, J.-F., Metzger, J.-M., Hermans, C., Kumps, N., Ramonet, M., Lopez, M., Mahieu, E., and De Mazière, M.: Analysis of CO2, CH4, and CO surface and column concentrations observed at Réunion Island by assessing WRF-Chem simulations, Atmos. Chem. Phys., 22, 7763–7792, https://doi.org/10.5194/acp-22-7763-2022, 2022.

Feurdean, A., Diaconu, A.-C., Pfeiffer, M., Gałka, M., Hutchinson, S. M., Butiseaca, G., Gorina, N., Tonkov, S., Niamir, A., Tantau, I., Zhang, H., and Kirpotin, S.: Holocene wildfire regimes in western Siberia: interaction between peatland moisture conditions and the composition of plant functional types, Clim. Past, 18, 1255–1274, https://doi.org/10.5194/cp-18-1255-2022, 2022.

Terhaar, J., Frölicher, T. L., and Joos, F.: Observation-constrained estimates of the global ocean carbon sink from Earth system models, Biogeosciences, 19, 4431–4457, https://doi.org/10.5194/bg-19-4431-2022, 2022.