Anonymous Referee #1:

This study is too simple and may be well-suited as a measurement report. Undoubtedly, the aerosols in that location are very important to study, but the paper lacks enough depth to it.

However, I have some minor comments

Respond:

Thanks for your comments, we have changed the type of this manuscript to "measurement report", we hope to use the current measurement data to increase the understanding of the characteristics of aerosol optical depth at Zhongshan Station.

The following are our responds to your comments, with black text for your comments and blue text for our responds. We hope our responds will address your concerns.

"The increase in AOD during spring and winter correlates with a reduction in the fine mode fraction, whereas the increase observed in summer and autumn may be attributed to the growth and aging of fine particles." How can both increase? Please correct

Respond:

Thanks for your questions. In Section 3.2, we use the aerosol classification method proposed by Gobbi to obtain the contribution of fine mode particles to AOD and the size of fine mode particles, and can also separate whether the increase of AOD is caused by the hygroscopicity growth of fine mode particles or by the increase of coarse mode particles. In Fig. 4, we discussed the different seasons. For example, in spring (Fig.4a), when AOD<0.03, aerosol is mainly composed of fine mode particles ($\alpha_{440-870\,nm} > 1.0$), the contribution of fine mode particles to AOD is less than 70% ($\eta < 70\%$); when AOD>0.03, aerosol is dominated by coarse mode particles ($\alpha_{440-870\,nm} < 1.0$), and the contribution of fine mode particles to AOD is less than 30% ($\eta < 30\%$). Moreover, since the particles during spring are mainly concentrated in the $\delta\alpha > 0$, this indicates that the increase of coarse mode particles is main reason for the increase of AOD in spring. In summer (Fig.4b), when AOD>0.03, aerosols mainly concentrated in the region of fine mode particle growth ($\delta\alpha < 0$), and the contribution of fine mode particles to AOD is 50% to 99% ($50\% < \eta < 99\%$), indicating a significant influence of fine mode particle

growth on AOD increase. Therefore, we believe that the main reason for the higher AOD values is different during different seasons.

We apologize for this unclear statement, which may lead to confusion for readers. The following is our change:

In winter and spring, high AOD values are related to increase of coarse mode particles, while in summer and autumn, high AOD values may be related to the growth of fine mode particles.

"Increases in AOD during spring and winter correlated with decreases in fine mode fraction, while increases during summer and winter related to fine mode particle growth and aging." This line is very confusing with the usage of 'increase''

Respond:

Thanks for your comment, it is helpful to improve the quality of our manuscript. The following is our change:

The high AOD values during winter and spring were associated with increased contribution of coarse mode particles, while high AOD values during summer and autumn are associated with the growth of fine mode particles.

The last line in abstract only talks about the origins of particles in the summer. Why specifically summer? Why not other seasons?

Respond:

Thank you for pointing out the problem. In the discussion part, we used the air mass backward trajectory to discuss the sources of aerosol on high AOD days and low AOD days respectively. Although most of the high AOD days occur in summer, it is inaccurate to mention only summer in the abstract. The following is our change:

Backward trajectory analysis revealed that coarse particles from the ocean predominantly contributed to high AOD daily mean values, while fine particles on low AOD days originated mainly from the air mass over the Antarctic Plateau.

The abstract is incomplete. I suggest you to add a conclusion line to your abstract as to why this study is important or how it can help others?

Respond:

Thanks for your suggestion, it is very important for our manuscript! The following is what we added in abstract:

This study analyzed the variation characteristics of AOD on different time scales at Zhongshan Starion in Antarctica, and the observation during the polar night is helpful for us to understand the variation of AOD in winter. In addition, we provide important insights into regional AOD levels affected by meteorological conditions and aerosol sources in Antarctica.

How is DMS found in the plateau? Does it come from transportation from ocean? But you have mentioned about katabatic winds that drive from interior to coastal

Respond:

Thank you for your comments. In fact, we did not observe DMS particles in the Antarctic plateau. In Section 3.2, the increased concentration and growth of fine mode particles in summer and autumn are similar to the increased concentration and oxidation process of DMS observed in previous studies. Therefore, we believe that the particles observed at Zhongshan Station may be related to DMS. In the discussion section, some air masses on low AOD days originated from the Antarctic plateau and may be associated with katabatic winds. Given the small particle sizes observed and referencing other literature on aerosol components from the Antarctic plateau, we infer that these particles may be non-sea-salt sulfates.

"AOD675 nm is associated with the declining η"..... introduce η before using it

Respond:

Thank you for your careful review of our manuscript, which is helpful to improve the rigor of this manuscript! The following is our change in Section 3.2:

The solid black line represents the size of fine mode particles (R_{eff}), and the dashed blue line represents the proportion of the contribution of fine mode particles to AOD (η).

Finally, thank you again for your review of our manuscript and your valuable comments, which are of great help to our manuscript.