Authors' reply to the reviewer's comments:

Dear Anonymous Referees,

Thank you for your careful review of the manuscript. We read the reviewer's comments carefully, and have responded to and taken all of the comments into consideration and revised the manuscript accordingly. My detailed responses are as follows:

Comments from Anonymous Referee #1:

This work tried to compare the atmospheric equivalent refractive index structure parameter measured by two different methods and then compare the aerosol mass vertical transport fluxes obtained by different methods. The paper is interesting and generally well-written. However, there are several questions need to be answered before its acceptance.

Major concerns:

In Section 3.3, in Fig.7, the correlation coefficient of the real part of the AERISP is smaller, and the reason is that the difference in the real part of the AERISP obtained by the two methods at night is larger. I wonder this reason can also explain the big discrepancy of the absolute value of aerosol flux obtained by the LAS and EC during nighttime in Fig.9(a)? And also in Fig.9(a), why the absolute value of aerosol flux obtained by the LAS is larger than EC at noontime on 10-11,12 Jan, 2022?

Answer: This can also explain the large discrepancy in the absolute values of aerosol fluxes obtained by the LAS and EC at night in Fig.9(a) because the calculation of aerosol flux needs the value of the real part of the AERISP, which is given in Eq. (16).

We thank the reviewers for their careful observation. The reason why the absolute value of the aerosol flux obtained by the LAS was greater than that obtained by the EC at noontime on 10-11 Jan, 2022, was that the imaginary parts of the AERISP obtained by the LAS were greater than that obtained by the EC, shown in Fig. 6a. A further possible explanation is that both days 10th and 11th were cloudy, there was a weak rainfall process on the 10th at 16:00, and the winds on the 10th and 11th were lighter and had a greater change in direction. The turbulence during noontime on 10-11 is weaker, resulting in an inhomogeneous horizontal distribution and a large difference in measurements between the two methods. On the 12th, sunny, and at midday on the 12th, the measurements taken by the two methods were relatively close to each other.

Please see Lines 519-526.

"As shown in Fig. 9(a), the absolute value of the aerosol flux obtained by the LAS is greater than that obtained by the EC at noontime on 10-11 Jan, 2022. This is because the imaginary parts of the AERISP obtained by the LAS are larger than those obtained by the EC, as shown in Fig. 6a. Another possible reason is that it was a cloudy day during both the 10th and 11th days, there was a weak rainfall process on the 10th day at 16:00, and the winds on the 10th and 11th days were lighter and had a greater change in direction. The turbulence during noontime on 10-11 is weaker, resulting in an inhomogeneous horizontal distribution and a large difference in measurements between the two methods." (Paragraphs in blue are copied from the revised manuscript)

In Section 3.5, how can you get the values of $C\,2n$, and , $C\,2n$,$I\,m$?

Answer: When a light beam propagates in the atmosphere, irradiance fluctuations at the end of an LAS can be attributed to two causes. One is the inhomogeneous distribution of the atmospheric gas refractive index due to temperature fluctuations, which refracts and diffracts the beam, and the other is the existence of aerosol particles in the atmosphere, which scatter and absorb the beam. The first causes high-frequency fluctuations in light intensity, and the second causes low-frequency fluctuations in light intensity. By analyzing the light intensity fluctuation spectrum, it is possible to separate high-frequency fluctuations from low-frequency fluctuations.

The calculation steps for the real and imaginary parts of the AERISP are as follows: first, power spectrum analysis or correlation analysis of the irradiance fluctuation data are performed; then, the irradiance fluctuation data are decomposed into high-frequency and low-frequency parts; the high-frequency part corresponds to the contribution of the real part of the AERI, and the low-frequency part of the fluctuation corresponds to the contribution of imaginary part of the AERI; finally, the real part of the AERISP $C_{n,Re}^2$ can be obtained from the high-frequency part of the irradiance fluctuation, and the imaginary of the AERISP $C_{n,Im}^2$ can be obtained from the low-frequency part of the irradiance fluctuation.

Please see Lines 226-232.

"The calculation steps for the real and imaginary parts of AERISP are as follows: first, power spectrum analysis or correlation analysis of the irradiance fluctuation data are performed; then, the irradiance fluctuation data are decomposed into high-frequency and low-frequency parts; the high-frequency part corresponds to the contribution of the real part of the AERI; and the low-frequency part of the fluctuation corresponds to the contribution of the imaginary part of the AERI; finally, the real part of the AERISP $C_{n,Re}^2$ can be obtained from Eq. (10); and the imaginary part of the AERISP $C_{n,Im}^2$ can be obtained from the low-frequency part of the irradiance fluctuation. "

Specific comments:

Page 3, line 95-96, the meaning of "However, the direct and rapid measurement of the atmospheric extinction coefficient is difficult to realize" is not very clear

At present, the existing online instruments for measuring atmospheric extinction coefficient include visibility meters, LIDAR devices and nephelometers, etc. The sampling period of these instruments is 1 minute at the shortest, which makes it difficult to perform rapid measurements of the atmospheric extinction coefficient.

This paragraph has been deleted in the revised version.

Line 279, “wind direction radiation”?

Thank you, we modified this text.

Line 645: Figure 8 (a,) -> Figure 8

Thank you, we modified this text.

Line 649: “and (b) the imaginary part and (b) aerosol flux”?

Thank you, we modified this text.

We also modified some typo errors.

Finally, the authors thank the two referees for their constructive comments,which helped us to improve the clarity and quality of the manuscript greatly. All the comments are answered and the modifications are provided in the revised manuscript. We sincerely hope our answers can relieve doubts and provide a better description of our work.