

## ***Comments from Reviewer #2***

### ***General comments***

The manuscript by Cheng et al. investigated the optical properties of carbonaceous aerosols under changeable conditions of haze pollution in Northeast China. For this purpose, the authors combined on-line data (from a PAX, an AE33 and analyzers for several gaseous pollutants) and off-line results (from a high-volume PM<sub>2.5</sub> sampler) measured during April, 2023, when different types of haze episodes were encountered. They first explained the discrepancies between the light absorption results from different methods, and then discussed the influences of agricultural fire emissions and secondary aerosol formation on the optical properties of carbonaceous aerosols. In general, the results and discussions were scientifically sound. Given that the studied region is distinct (especially regarding the agricultural fires) but largely overlooked by previous studies, the manuscript is suitable for a measurement-report paper in ACP. My overall assessment is that it could be considered for publication after the following concerns were properly addressed.

### ***Major points***

(1) Lines 22-25. The two sentences were not well connected. It is completely unclear why the dust episodes need to be excluded.

**Our responses:** A new sentence was added to explain the exclusion of the dust episodes: “*BC concentrations were also overestimated for the dust episodes*” (see lines 24-25).

(2) Lines 56-62. The new standard has been released. The statements need to be revised correspondingly.

**Our responses:** The statements were updated as suggested: “*More recently, the Ministry of Ecology and Environment (MEE) of China released stricter Ambient Air Quality Standards for PM<sub>2.5</sub> (MEE, 2026), e.g., starting from 2031, the Class 2 standards will be reduced to 25 from 35  $\mu\text{g}/\text{m}^3$  for annual average (with an interim limit of 30  $\mu\text{g}/\text{m}^3$  for 2026–2030) and to 50 from 75  $\mu\text{g}/\text{m}^3$  for 24-hour average (with an interim limit of 60  $\mu\text{g}/\text{m}^3$ ). The new standards provide additional impetus for air quality improvement...*” (see lines 61-70).

(3) Table 1. Fractions in total data points should also be given for the SSA bins.

**Our responses:** The fractions were added as suggested (see Table 1 in Page 12 of the

revised manuscript):

**Table 1.** SSA-dependent  $C^*$  results determined during the spring campaign.

| SSA range                         | 0.50–<br>0.60 | 0.60–<br>0.65 | 0.65–<br>0.70 | 0.70–<br>0.75 | 0.75–<br>0.80 | 0.80–<br>0.85 | 0.85–<br>0.90 | 0.90–<br>0.95 | 0.95–<br>1.00 |
|-----------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Median $C^*$                      | 1.24          | 1.65          | 2.06          | 2.24          | 2.26          | 2.46          | 2.76          | 3.06          | 3.27          |
| Lower quartile of $C^*$           | 0.90          | 1.34          | 1.66          | 1.78          | 1.89          | 2.17          | 2.46          | 2.72          | 2.91          |
| Upper quartile of $C^*$           | 1.35          | 2.07          | 2.40          | 2.53          | 2.62          | 2.77          | 3.07          | 3.40          | 3.92          |
| Fraction in total data points (%) | 0.03          | 0.12          | 1.37          | 4.40          | 11.89         | 24.73         | 30.30         | 26.53         | 0.64          |

**Minor points**

(1) Lines 12-13. Suggest replacing “Northeast China” by a more specific term, e.g., the site type (urban, suburban, rural, etc.) would be more useful.

**Our responses:** The change was made as suggested: “*a field campaign was conducted in a Chinese megacity during a spring season*” (see lines 12-13).

(2) Lines 37-41. The sentence is difficult to follow. Revise it.

**Our responses:** The sentence was revised to: “*as indicated by the difficulties in proper predictions of several key fractions including primary OA emitted by open burning...*” (see lines 38-40).

(3) Line 70. I guess the average temperature was for winter. Clarify it.

**Our responses:** This point was clarified as suggested: “*with a seasonal average of  $-15^{\circ}\text{C}$  in Harbin’s winter*” (see line 79).

(4) Line 75. It is better to use “emission system”.

**Our responses:** The change was made as suggested (see line 84).

(5) Line 84. It should be “secondary”.

**Our responses:** The mistake was corrected (see line 93).

(6) Line 119. Suggest using “over” instead of “in”.

**Our responses:** The change was made as suggested (see line 129).

(7) Line 169. It should be “obtained”.

**Our responses:** The mistake was corrected (see line 179).

(8) Line 217. Suggest using “different types of filters”.

**Our responses:** The change was made as suggested (see lines 229-230).

(9) Line 219. Move “heavily loaded” to the next sentence, as the detailed carbon loadings had been given here.

**Our responses:** The change was made as suggested (see lines 231 and 234).

(10) Lines 220-221. I think PM<sub>2.5</sub> concentrations were not highly relevant to the statement here, i.e., in addition to PM<sub>2.5</sub> concentration, filter loading also depends on the sampling volume or, more precisely, face velocity.

**Our responses:** Thanks for the suggestion. ATN levels, which are independent of face velocity, were presented instead of PM<sub>2.5</sub> concentrations in the revised version: “...showed the highest carbon loadings (above 115 µgC/cm<sup>2</sup> for the sum of OC and EC) and ATN levels (exceeding ~2.5) throughout the campaign” (see lines 232-234).

(11) Lines 444-445. It is better to explain  $(b_{\text{abs}})_{@370}$  first, which is the basis for the calculation of  $(b_{\text{abs}})_{\text{BrC}@370}$ .

**Our responses:** The change was made as suggested (see lines 459-461).

(12) Line 453. Change “used” to “considered as”.

**Our responses:** The change was made as suggested (see line 469).

(13) Line 462. It is unnecessary to define the ratio again.

**Our responses:** The duplicated definition was removed as suggested (see line 478).

(14) Lines 545-546. “ $E_{\text{abs}}$ ” should be introduced, as it was mentioned in the abstract. Accordingly, it is unnecessary to define it again in Line 596.

**Our responses:**  $E_{\text{abs}}$  was introduced as suggested: “the light absorption enhancement ( $E_{\text{abs}}$ ) factors were estimated to be...” (see lines 561-562). Correspondingly, the duplicated definition for  $E_{\text{abs}}$  in the Conclusions section was removed (see line 613).

(15) Line 561. To my understanding, the  $C^*$  factor was used to correct for the overall effect of the multiple scattering by the filter media and the scattering by the collected

particles. Clarify it.

**Our responses:** Yes,  $C^*$  was used to account for the overall effect of the multiple scattering by the filter media and the scattering by the collected particles. The sentence was changed to: “*PAX was used as the reference method to constrain the scattering-associated artifacts in the AE33-based absorption measurement*” (see lines 577-578).

(16) Line 600. Remove the comma before “and effectively”.

**Our responses:** The change was made as suggested (see line 617).