

On behalf of all co-authors, we thank Referee #3 for the insightful and extensive comments which certainly contribute to the substantial improvement of the manuscript (MS). Below we respond to each of the specific comments which are copied below (in black). After each comment we provide our response, in red, together with changes in the revised MS. Line numbers (indicated by L) mentioned by Referee #3 refer to the original MS as published in the ACP discussion Section and revisions are quoted with line numbers (indicated by LR) referring to the revised MS.

The manuscript carefully assessed and determined the contributions of meteorological and anthropogenic effects on aerosol variations on monthly and inter-annual scales of China by taking five key areas and representations based on time series analysis of MODIS/MAIAC C6.1 AOD product and CESM model. It highlighted the complex interplay between meteorological and anthropogenic factors in shaping AOD variations across China and confirmed the increasing significance of meteorological effects in shaping China's AOD. Overall, the paper is well-written and presents novel findings. However, this manuscript needs some revisions before publication.

Thank you for these kind comments.

Specific comments:

1. The evolution of aerosol optical depth over China or East China or typical region, should be clearly indicated in title and abstract of the manuscript.

Thank you for this comment. This information is included in the title and abstract: The title starts with "Evolution of aerosol optical depth over China" (L 1-2) and the abstract starts with "Time series of MODIS/MAIAC C6.1 aerosol optical depth (AOD) over China were used together with model simulations of AOD to determine contributions of meteorological and anthropogenic effects on aerosol variations on monthly and interannual scales" (lines 26-28).

2. Line 47, "NCP, YRD, PRD, HNB and SCB", Abbreviations should be given their full names when they first appear.

Thank you for this comment. However, the word limit for the abstract is 250 words, which does not leave much room for more detailed information. We preferred to provide more information on the content of the MS, and therefore chose to provide the full names in the MS, Sect. 1 (lines 126-129).

3. Line 47, "An aerosol" may be modified as "Aerosol".

Thank you for this comment. We have checked and "An Aerosol" (L 48; LR 48) is correct use of English language.

4. Line 50, Pay attention to the font size of the word "atmosphere".

Thank you for this comment. We have corrected the font size (L 51; LR 51).

5. Figure 1 (line 190-191) shows mainly south-east China, is it suitable to use Southeast Asia other than south-east China for Figure 1's title? Please confirm.

Thank you for this comment. As advised by the Editorial staff, we have changed the Figure but this was not included in the MS as we were advised to do that later, after first revision.

6. Please provide the full name at abbreviations' first appearance to ensure clarity for readers who may not be familiar with these terms, such as MODIS (line 96), ENSO (line 732), etc.

Thank you for this comment. We have added the full names at first occurrences (LR 99), (LR 715), etc.

7. Line 201, MODIS sensor also has two channels with a pixel size of 250 m at nadir.

Thank you for this comment. We have changed the sentence to “a nominal pixel resolution at nadir of 250m (2 bands), 500m (5 bands) and 1000m (29 bands),” (LR 226).

8. Line 227-232, some studies show MAIAC AOD have a good validation accuracy in East China (the study area), which can be added in the description.

Thank you for this comment. We have modified the text in Section 2.3 and added more information on the validation of MAIAC C6.1: “MAIAC C6.1 has been validated over China by Ji et al. (2024) and Huang et al. (2024). Both studies report that the overall accuracy of the MAIAC AOD products over China is good. The validation by Ji et al. (2024) over bright surfaces, using publicly available reference data from AERONET and CARSNET until 2014, shows a significant underestimation and negative bias of the MAIAC C6.1 product, which however performs slightly better than DB and C6. The comparison with collocated AERONET AOD data, for the period from 2001 to 2021, by Huang et al. (2024) shows good consistency, with correlation coefficients (R) of 0.933/0.939, root mean square error (RMSE) of 0.152/0.146, bias of 0.005/0.015, mean absolute error (MAE) of 0.094/0.092, relative mean bias (RMB) of 1.221/1.301 and percentage of data points within expected error (EE) of 71.02/68.36. These statistical metrics refer to comparison at the overpass times of the Aqua (13:30 LT) and Terra (10:30 satellites, respectively (Huang et al., 2024, Fig. 2). The comparison shows a slight overestimation of C6.1 at low AOD (<0.5) and a small underestimation at higher AOD.” (LR 252-263).

9. The line color of SCB in Figure 2 (line 272), Figure 3 (line 303) is not quite clear, use a darker color?

Thank you for this comment. We have used the color scheme recommended by ACP.

10. Line 296, Pay attention to the font size of the word “tendencies”, “in different regions” should be modified as “in all/each regions”.

Thank you for this comment. We have changed the font size of “tendencies”. As regards the second comment, we have changed the words to “AOD reduction in the five regions”.

11. Line 597, what does “These authors” referring to?

Thank you for this comment. We have provided a number of references in the previous sentence (613-614). “These authors” referred to the first authors and their co-authors of these papers. However, this was written in Section 4 and Section 4 has been re-written and re-organized for better and more clear presentation of the results. Now this text appears in Section 4.1 (LR 675-676).

12. Line 614-615, cite the reference “MEE & General Administration of Quality Supervision Inspection and Quarantine, 2011”, and use the correct citation format of Yan et al. (2023).

Thank you for this comment. We have added the citation for this reference and provide the correct citation format for Yan et al. (2023) in the text and the list of references (LR 699-700).