Referee #1

** General comments **

The authors use CAM6-Chem to explore regional trends in organic aerosol concentrations over China. In addition to quantifying the trends, they discuss reasons for the trends.

Following minor revisions, the paper could be a useful contribution to the scientific literature.

** Specific comments **

1. In the data availability statement, I have been unable to identify where the authors' CAM6-Chem model data can be accessed. Should the relevant model data not be published to comply with ACP's data policy and support reproducibility? Would it also be possible to publish the analysis code used to produce the figures?

Response: Thanks for the comment. The long-term CAM6-Chem model data is too large to be published through public FTP or cloud drives. The code and data used to generate the figures will be made available upon reasonable request.

2. The clarity of some of the figures could be improved. Ideally, each figure should be understandable without referring to the caption. To improve readability, I offer the following suggestions:

(i) give each subfigure panel a short title (as has been done in e.g. Fig. 2, but not Figs. 1 & 7);

(ii) label colorbars with units;

(iii) explain the difference between the solid and dashed lines in the Fig. 1e legend (not just the caption);

(iv) share colorbars across subfigure panels where possible (as has been done in e.g. Fig. 3a–c, but not Fig. 2a–c);

(v) use the same y-axis limits in Fig. 9a and 9b.

Response: Thank you for your helpful suggestions on improving the clarity and readability of the figures. We have carefully considered each of your points and made the following revisions to the manuscript:

(i) We have added short titles to each subfigure panel in Figs. 1 and 7, similar to what was done in Fig. 2, to enhance the overall clarity and make each panel easier to interpret without referring to the caption.

(ii) We have labeled the colorbars with appropriate units in Figs. 1,2,3 and 7 to improve clarity and ensure that the data presentation is fully self-explanatory.

(iii) We have revised the legend in Fig. 1e to explicitly explain the difference between the solid and dashed lines, so that the distinction is clear without needing to refer to the caption.

(iv) We have shared colorbars across subfigure panels in Fig 2, in line with the approach used in Fig. 3a–c, to enhance consistency and make the figures easier to interpret.

(v) We have adjusted the y-axis limits in Figs. 9a and 9b to ensure consistency between the two figures, as per your suggestion.

We believe these changes significantly improve the readability of the figures, and we appreciate your careful review.

3. The precision of the numbers in the Fig. 1c colorbar (-1.80 to 1.80) differs from that in Fig. 1f (-1.8 to 1.8). Should they not be consistent?

Response: Thank you for pointing out the inconsistency in the precision of the numbers in the colorbars of Fig. 1c and Fig. 1f. We have revised the colorbar labels in both figures to ensure that the precision is consistent.
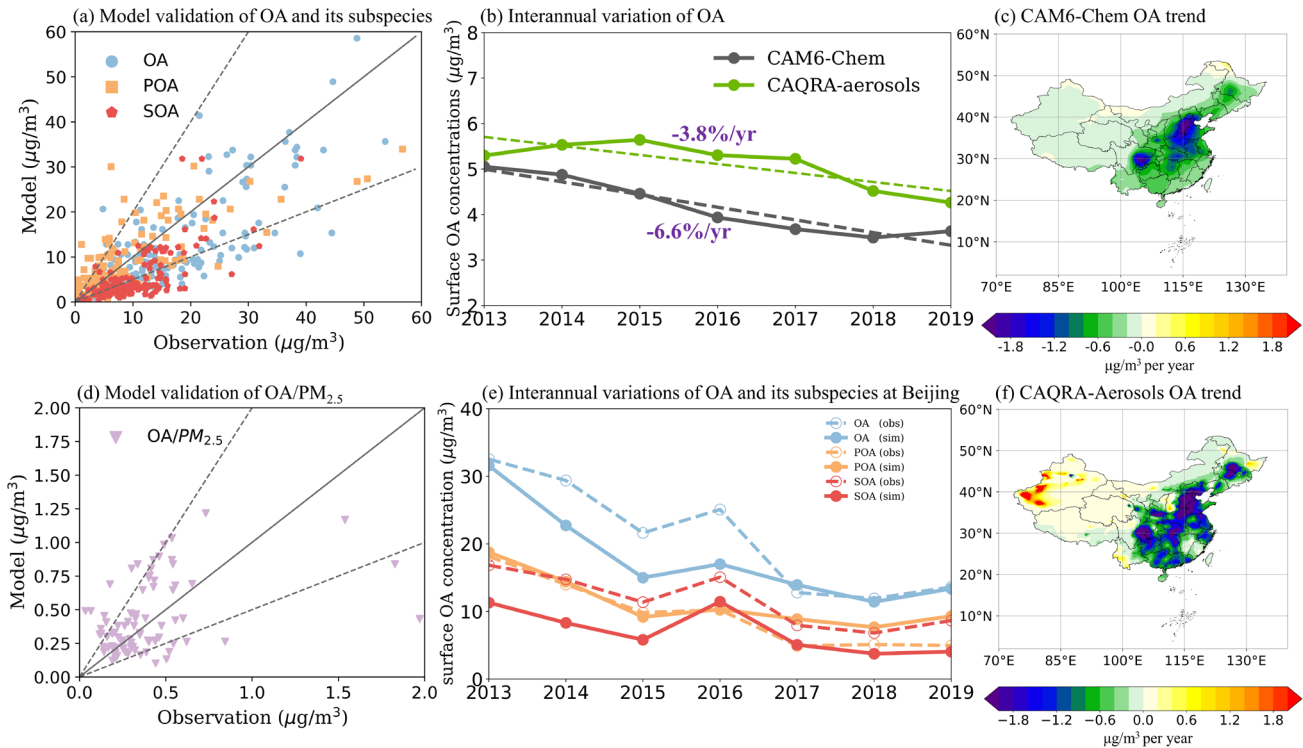
Figure 1: (a) Validation of modelled organic aerosols (OA), primary organic aerosols (POA), and secondary organic aerosols (SOA) based on ground-based measurements compiled by Miao et al. (2021) and Chen et al. (2024) (unit: μg m⁻³). (b) 2013 to 2019 interannual variation of average surface organic aerosol (OA) concentrations in CAM6-Chem (dark grey) and the CAQRA-aerosols dataset (green) (unit: μg m⁻³). The trend lines (dotted line) are based on linear regression fitting. (c) 2013 to 2019 CAM6-Chem modelled annual long-term trend of surface OA concentrations (unit: μg m⁻³ per year). The trend is calculated by linear regression on an annual scale over 1990-2019. (d) Validation of modelled OA/PM2.5 based on OA measurements compiled by Miao et al. (2021) and Chen et al. (2024) and PM2.5 observations from the National Urban Air Quality Real-time Release Platform of China Environmental Monitoring Station. (e) Interannual variation of average surface OA, POA and SOA concentrations (μg m⁻³) at Beijing site from 2013 to 2019 in CAM6-Chem (solid line; sim) and ground-based measurements compiled by Miao et al. (2021) and Chen et al. (2024) (dashed line; obs). (f) 2013 to 2019 annual long-term trend of surface OA concentrations (unit: μg m⁻³ per year) in the CAQRA-aerosols dataset. The trend is calculated by linear regression on an annual scale over 1990-2019.

4. In Fig. 4, why are normal distributions fitted? The normal distribution does not provide a good approximation to the underlying empirical distributions. The exponential distribution may be more appropriate.

Response: Thanks for your suggestion. The original curve fitting was intended to provide a more intuitive representation of the concentration differences between the two time periods for each species, in addition to the bar chart. Compared to the normal distribution, the exponential distribution does indeed better approximate the basic empirical distribution. However, the results from the exponential distribution fitting did not show significant differences between the two periods, and the normal distribution did not closely match the bar chart distribution. Therefore, we switched to using a logarithmic scale for the bar chart, and it is now unnecessary to use fitting curve. The results (Fig. 4) more clearly illustrate the differences between the two time periods.
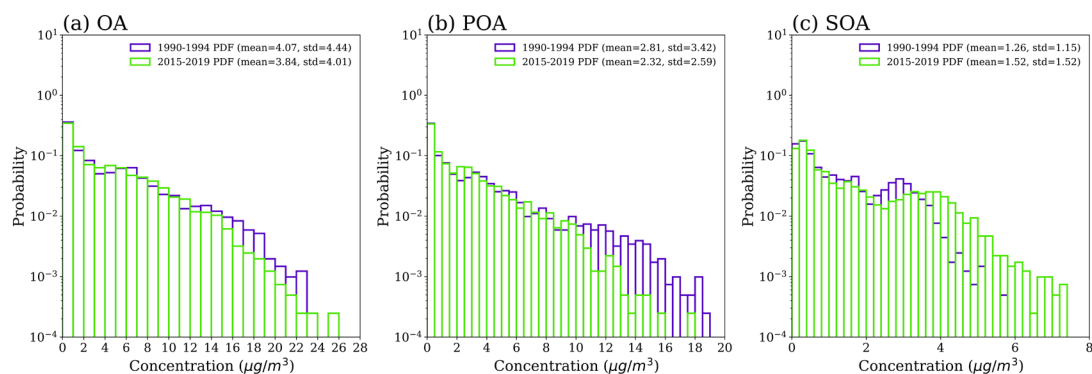
Figure 4: Probability density function (PDF) distributions of simulated five-year average concentrations of surface organic aerosols (OA; a), primary organic aerosols (POA; b), and secondary organic aerosols (SOA; c) for the periods 1990-1994 (purple) and 2015-2019 (green), along with the annual mean values and standard deviations for each species in different time periods.

5. The number of acronymns may be overwhelming to many readers. Is it possible to use fewer acronyms? For example, could "PRD" be replaced by "Pearl River Delta" throughout the paper?

Response: Thank you for your valuable suggestion regarding the use of acronyms. To improve the readability of the paper and reduce the potential for confusion, we have replaced all region-related acronyms with their full names throughout the manuscript. For example, "PRD," "NCP," "SBA," and "YRD" have been replaced by "Pearl River Delta," "North China Plain," "Sichuan Basin Area," and "Yangtze River Delta," respectively.