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Reply on RC2

Jinlong Ma et al.

Author comment on "Modeled changes in source contributions of particulate matter during the COVID-19 pandemic in the Yangtze River Delta, China" by Jinlong Ma et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-953-AC2, 2021

Responses to interactive comments
Journal: Atmospheric Chemistry and Physics
Manuscript ID: acp-2020-953
Title: "Changes in source contributions of particulate matter during COVID-19 pandemic in the Yangtze River Delta, China"

Dear Referee #2,
We gratefully thank you for the constructive suggestions to help improve the manuscript. We tried our best to address your comments and detailed responses and related changes are shown below. Our responses are in blue and the modifications in the manuscript are in red. All related figures are included in the attached PDF file.

General Comments:
Ma et al. present a model analysis of changes in PM2.5 during the lockdown period associated with the COVID-19 pandemic in the Yangtze River Delta, China. The model is compared to observations of total PM2.5 in the region, and to a more limited set of speciated PM2.5 data from a specific site. The topic is timely and of interest to the air quality and atmospheric chemistry communities, and warrants publication in ACP.
The paper is mainly a modelling study, with relatively little reference to observations. The authors can do more to make the effects of the lockdown on PM2.5 clear from their model based analysis. Recommendations are below in the specific comments. The word "model" should appear in the title, as it is not clear to the reader until well into the paper that all of the analysis and attributed changes are based on the model rather than any analysis of the observations. A more appropriate title would be something like "Modelled changes in source contributions of particulate matter …. "
The authors should pay attention to the specific comments and technical corrections below. They may wish to have a native English speaker proofread the paper for grammatical corrections, although the writing itself is certainly clear.
Response: Thanks for the recognition of our study and the good suggestion. We are sorry for the unclear expression in the title. Therefore, the title was modified in the manuscript as recommended. Below is the response to each specific comment and technical corrections.
Changes in manuscript:
(Lines 1-2 in the revision): "Modelled changes in source contributions of particulate matter during the COVID-19 pandemic in the Yangtze River Delta, China.".

Specific Comments:
1. Line 41-42: Why do statistical methods only address primary PM?
Response:
Statistical methods such as PMF (Positive Matrix Factor) and CMB (Chemical Mass Balance) use the profiles of primary emissions from different sources and assume the composition remains unchanged in the atmosphere, thus they only resolve contributions of different source sectors to PPM, leaving secondary components as a whole (Tao et al., 2014;Gao et al., 2016;Yao et al., 2016;Zhang et al., 2013). The sentence was modified to be clear.
Changes in manuscript:
Introduction (Lines 41-44 in the revision): "Statistical methods based on observed PM2.5 composition information using source profiles of different emission sources and assuming that composition remains unchanged in the atmosphere can only resolved contributions of different source sectors to PPM, leaving secondary components as a whole (Tao et al., 2014;Gao et al., 2016;Yao et al., 2016;Zhang et al., 2013;Zhu et al., 2018).".

2. Line 67: The term "PM" is used with primary sources (PPM), but the term aerosol is used with secondary sources (SIA). Suggest choosing either PM or aerosol, but not mixing the two.
Response:
The term PPM and SIA are abbreviations of primary particulate matters and secondary inorganic aerosols, which have been widely used in previous studies (Banzhaf et al., 2013;Du et al., 2020;Guo et al., 2020;Guth et al., 2016;Hu et al., 2016;Huang et al., 2014a;Sun et al., 2016;Wang et al., 2019;Yu et al., 2018;Zhang et al., 2014). Although looked confusing, they are commonly used in numerous publications. We hope the academic field have a discussion soon to select unified usages. Therefore, we keep the abbreviation of PPM and SIA.

3. Line 79-81: The authors probably mean "due to considerable uncertainties". Beyond the grammar, however, it is difficult to believe that SOA is <10% of PM2.5. Huang et al. 2014 (given below, also in the reference section) show that organic matter accounts for 48% of PM in Shanghai. Is there a more recent reference showing a much smaller contribution of SOA?
Huang, R.J., et al., High secondary aerosol contribution to particulate pollution during haze events in China. Nature, 2014. 514(7521): p. 218-222.
Response:
Thanks for understanding, we intend to express the reason for not considering SOA is due to considerable uncertainties in SOA modelling. In current models, SOA is mostly underestimated due to inadequate knowledge of its precursors, incomprehensive formation mechanisms, and limited observations (Zhao et al., 2016a;Yang et al., 2019;Heald et al., 2005;Carlton et al., 2008). Although we have the technique to resolve its sources, we have no confidence on the simulated results and leave it for future studies. In widely used models like CMAQ and WRF-Chem, simulated SOA accounts for less than 10% of total PM2.5. Observations in recent years show that in Shanghai and the YRD, SOA accounts for 8.6%-22.2% to total PM2.5 (as shown in below Table R1). It indicates that more efforts are needed to improve SOA modelling in future. By the way, in Huang et al. (2014b), organic matter contributed to 48% of PM2.5, but organic matter includes both primary organic matter and SOA. The two things can not be compared directly.
Table R1 Detailed information of references about contributions of SOA to PM2.5
Year SOA contribution to PM2.5 Site Reference
2020 16.8% at Pudong Environmental Monitoring Station Shanghai (Li et al., 2020)
2020 12.6% at Pudong Supersite; 8.6% at Dianshan Lake Supersite Shanghai (Jia et al., 2020)
2020 22.0% at Fengxian campus of East China University of Science and Technology (ECUST) located at the southern edge of Shanghai Shanghai (Sun et al., 2020)
2016 15.7% at East China University of Science and Technology (ECUST) Shanghai (Zhao

et al., 2016b)
2016 22.2% at Dian Shan Lake (DSL) air quality monitoring supersite Shanghai (Wang et al., 2016)
This sentence was modified to express more exact information.
Changes in manuscript:
Methodology (Lines 84-86 in the revision): "The SOA simulation has considerable uncertainties, which were caused by the inadequate knowledge of its precursors, incomprehensive formation mechanisms in the model, and limited observations (Zhao et al., 2016a;Yang et al., 2019;Heald et al., 2005;Carlton et al., 2008). Therefore, the SOA sources are not tracked in this study.".

4. Line 115: It's not clear what acceptable means here, but the quantitative measures are given above, so suggest simply omitting the last sentence of this paragraph.
Response:
We are sorry for the unclear expression here. The sentence was modified and shown below.
Changes in manuscript:
Result and discussion (Lines 121-122 in the revision): "Generally, the WRF model in this study showed a good performance, which were comparable to previous study (Shen et al., 2020;Wang et al., 2021).".

5. Line 121-122: The sentence is somewhat misleading in that it implies that the figure compares observations of speciated PM2.5 to the model output. The comparison is between observed and predicted total PM2.5 mass.
Response:
We appreciate your comment. We are sorry for misleading expression. This sentence was modified to express the exact information.
Changes in manuscript:
Results and discussion (Lines 128-129 in the revision): "Figure 1 shows predicted and observed daily PM2.5 averaged over the YRD and at three major cities based on Case 2 and Case 1.".

6. Figure 1 would be far more convincing if it showed the time series of predicted total PM2.5 mass for case 1 (business as usual) and case 2 (lockdown), as well as the difference between the two cases. It is not obvious from looking at this figure alone that the lockdowns had any influence on PM2.5.
Response:
Thanks for your suggestion. Figure R1 (named as Figure 1 in the revision) was modified to show the time-series differences between Case 1 and Case 2. As shown in Figure R1, Case 1 had higher PM2.5 emission than Case 2 during the lockdown period, indicating the lockdown policies was notable in decreasing the PM2.5 concentrations.
Changes in manuscript:
(Lines 400-404 in the revision)

Figure R1. Predicted daily PM2.5 with observed daily PM2.5 in the YRD and three major cities in Case 2 (orange histogram) before (shaded area) and during the lockdown period (white area), the green histogram (Diff.) represents concentration difference of PM2.5, which is calculated by Case 1 - Case 2. Units are μg m^{-3}. Pred. is the predicted PM2.5 concentration, Obs. is the observed PM2.5 concentration.

7. Line 122-123: The authors should plot predicted vs. observed PM2.5 during each period rather than just providing the time series for the comparison. A slope of a linear fit to this scatter plot would provide a quantitative measure of model performance. Similarly, a slope of the case 1 prediction against the observations would show how well this case performed prior to the lockdowns, as well as how much is overpredicted the observations during the lockdown.

Response:
Thanks for your suggestion. The linear fit of PM2.5 predictions vs. observations in each period of Case 1 and Case 2 was drawn in Figure R2 (add as Figure S3 in the revision) in the supplementary material as shown below. The general agreement was found between the predicted and observed PM2.5, with more than 90% of data points falling into the 1:2 and 2:1 dash lines in the YRD. Although the overprediction was occurred both in Case 1 and Case 2, the slope of Case 2 was closer to the 1:1 line with a higher correction coefficient compared to Case 1.
Changes in manuscript:
(Lines 39-41 in the revised supplementary material)

Figure R2. Comparisons of observed and predicted daily concentration of PM2.5 in the YRD and three major cities of Case 1 and Case 2 in each period. R is the correction coefficient. The dash lines in the plot are 1:2, 1:1, 2:1, respectively. Unit is μg m-3.

Changes in manuscript:
Results and discussion (Lines 131-136 in the revision): "Although the overprediction was occurred both in Case 1 and Case 2, the slope of Case 2 was closer to the 1:1 line with a higher correction coefficient compared to Case 1 (Fig. S3). It indicated that the model performance was better after adjusting the emission. This discrepancy could be caused by the uncertainties in the emissions (Ying et al., 2014). The model simulation of the WRF was the same in two cases.".

8. Figure 3: The labeling is not quite clear. It appears the authors mean "percent concentration change" rather than "relative concentration" for the circles that are plotted against the right axis.
Response:
Thank you for your valuable suggestion. The label "relative concentration" in Figure R3 (named as Figure 3 in the revision) was modified to "relative change", which was calculated by (Case 2- Case 1)/ Case1, and was mentioned in the caption. The modifications were also taken in Figure 5, Figure 7, Figure S9 and Figure S10 in the revision.

Figure R3. Predicted PM2.5 and its major components of Case 2 (red histogram corresponding to left Y-axis) and the relative change (circle corresponding to right Y-axis) from January 23 to February 28, 2020 in the YRD and Shanghai, Hangzhou, and Nanjing. Here the relative change means the relative change of concentration between Case 1 and Case 2, which is calculated by (Case 2 – Case 1) / Case 1.

Changes in manuscript:
(Lines 410-413 in the revision): "Figure 3: Predicted PM2.5 and its major components of Case 2 (red histogram corresponding to left Y-axis) and the relative change (circle corresponding to right Y-axis) from January 23 to February 28, 2020 in the YRD and Shanghai, Hangzhou, and Nanjing. Here the relative change means the relative change of concentration between Case 1 and Case 2, which is calculated by (Case 2 – Case 1) / Case 1.".

9. Figure 4: Why is Case 1 (base case, no reductions) not also shown? It would seem the business as usual case is as important to show as the reduced emissions case. Also, all of the relative differences are negative. Why? Shouldn't the residential sector increase while transportation and industry decrease?
Perhaps what would make the above clearer is the apportionment among sources for case 1 and case 2 – i.e., what fraction of PM2.5 is attributable to each source in each case. This measure would likely show that residential was a larger overall contributor for case 2.
Response:
Thanks for your comment. For the first question, we think Case 2 with the relative

difference between Case 1 and Case 2 in Figure 4 of in the manuscript can also express the information of Case 1, so Case 1 is not shown. For the second question, the adjustment of emission was based on Huang et al. (2020), also as shown in Table 1. Huang et al. (2020) explained that the residential sector includes the commercial use of boilers and stoves and residential heating and cooking. During the lockdown period, the commercial use of boilers and stoves was closed, but the uses of residential heating and cooking remained the same. Therefore, the residential sector was also affected by the lockdown measures. In addition, Figure 5 in the manuscript shows the contribution from the residential sector were the major contributor to the YRD in Case 2.

10. Figure 5 is also difficult to read. The authors should consider using a pie chart format in which the contribution from each sector is shown as a wedge in a pie for case 1 and case 2. This would make clear how the sources changed between business as usual and lockdown policies.
Response:
We have considered using the pie chart to express the source contribution information of Case 1 and Case 2 as shown in Figure R4, but it was more difficult to visualize the change in source contribution. Thus, we keep Figure 5 in the manuscript.

Figure R4. The source contribution of PM2.5 in the YRD and three major cities in Case 1 and Case 2.

Technical Corrections:
1. Title: Should read "the COVID-19 pandemic".
Response:
Gratefully thanks for your comment. Revised as below.
Changes in manuscript:
Title (Lines 1-2 in the revision): "Modelled changes in source contributions of particulate matter during the COVID-19 pandemic in the Yangtze River Delta, China".

2. Line 35: "In the Yangtze River Delta …"
Response:
Thanks for your comment. Revised accordingly.
Changes in manuscript:
Introduction (Line 35 in the revision): "In the Yangtze River Delta (YRD) …".

3. Line 41: "… is based …"
Response:
We show a grateful appreciation for your comment. Revised as below.
Changes in manuscript:
Introduction (Lines 40-41 in the revision): "… its source apportionment is based on quantifying …".

4. Line 50-51: Therefore, updated source apportionment information is needed to support further reduction policy.
Response:
We show a grateful appreciation for your comment. Revised as below.
Changes in manuscript:
Introduction (Lines 52-53 in the revision): "Therefore, updated source appointment information is needed to support the formulation of further reduction policy.".

5. Line 57-58: "changes, and these studies cannot be used …".
Response:
Thanks for your comment. This sentence was modified and shown below.
Changes in manuscript:
Introduction (Lines 59-60 in the revision): "and the conclusions reported in the mentioned

literature cannot be used to design control strategies.”.

6. Line 110: replace “were met” with “met”.
Response:
We are grateful for your comment. Revised accordingly.
Changes in manuscript:
Results and discussion (Line 116 in the revision): “… RMSE (1.7 and 2.0) met the benchmarks …”.

7. Line 121: “Figure 1 shows predicted …”
Response:
Thanks for your comment. Revised as suggested.
Changes in manuscript:
Results and discussion (Line 128 in the revision): “Figure 1 shows predicted …”.

8. Line 146: Replace “decreasing ratios” with “decreases”
Response:
Thanks for the comment. Revised as below.
Changes in manuscript:
Results and discussion (Line 154 in the revision): “… with decreases of 40-50% …”.

9. Line 148: Replace “reduced more” with “more reduced”.
Response:
We appreciate your rigorous comment. This sentence was modified.
Changes in manuscript:
Results and discussion (Lines 155-156 in the revision): “… mainly due to a greater reduction of SO2 from …”.

10. Line 153, 155: Replace “decrease” and “decrease ratio” with “percent decrease”
Response:
We appreciate your rigorous comment. We revised the sentences.
Changes in manuscript:
Results and discussion (Line 159 in the revision): “The most significant percent decrease was found … the largest percent decrease of 27% …”.

11. Line 163: Replace “Below” with “The next section”
Response:
We appreciate your rigorous comment. Revised as below.
Changes in manuscript:
Results and discussion (Line 172 in the revision): “And the next section showed the source appointment and regional transport of PM2.5.”.

12. Line 199: Replace “traffics” with “traffic”
Response:
We appreciate your rigorous comment. Revised accordingly.
Changes in manuscript:
Results and discussion (Line 209 in the revision): “… commercial activities and traffic …”.

Reference
Banzhaf, S., Schaap, M., Kruit, R. J. W., van der Gon, H. A. C. D., Stern, R., and Builtjes, P. J. H.: Impact of emission changes on secondary inorganic aerosol episodes across Germany, Atmospheric Chemistry and Physics, 13, 11675-11693, 10.5194/acp-13-11675-2013, 2013.
Carlton, A. G., Turpin, B. J., Altieri, K. E., Seitzinger, S. P., Mathur, R., Roselle, S. J., and Weber, R. J.: CMAQ Model Performance Enhanced When In-Cloud Secondary Organic Aerosol is Included: Comparisons of Organic Carbon Predictions with Measurements,

Environmental Science & Technology, 42, 8798-8802, 10.1021/es801192n, 2008.
Du, H., Li, J., Wang, Z., Dao, X., Guo, S., Wang, L., Ma, S., Wu, J., Yang, W., Chen, X., and Sun, Y.: Effects of Regional Transport on Haze in the North China Plain: Transport of Precursors or Secondary Inorganic Aerosols, Geophysical Research Letters, 47, 10.1029/2020gl087461, 2020.
Gao, J., Peng, X., Chen, G., Xu, J., Shi, G.-L., Zhang, Y.-C., and Feng, Y.-C.: Insights into the chemical characterization and sources of PM2.5 in Beijing at a 1-h time resolution, Science of the Total Environment, 542, 162-171, 10.1016/j.scitotenv.2015.10.082, 2016.
Guo, J., Zhou, S., Cai, M., Zhao, J., Song, W., Zhao, W., Hu, W., Sun, Y., He, Y., Yang, C., Xu, X., Zhang, Z., Cheng, P., Fan, Q., Hang, J., Fan, S., Wang, X., and Wang, X.: Characterization of submicron particles by time-of-flight aerosol chemical speciation monitor (ToF-ACSM) during wintertime: aerosol composition, sources, and chemical processes in Guangzhou, China, Atmospheric Chemistry and Physics, 20, 7595-7615, 10.5194/acp-20-7595-2020, 2020.
Guth, J., Josse, B., Marecal, V., Joly, M., and Hamer, P.: First implementation of secondary inorganic aerosols in the MOCAGE version R2.15.0 chemistry transport model, Geoscientific Model Development, 9, 137-160, 10.5194/gmd-9-137-2016, 2016.
Heald, C. L., Jacob, D. J., Park, R. J., Russell, L. M., Huebert, B. J., Seinfeld, J. H., Liao, H., and Weber, R. J.: A large organic aerosol source in the free troposphere missing from current models, Geophysical Research Letters, 32, n/a-n/a, 10.1029/2005gl023831, 2005.
Hu, W., Hu, M., Hu, W., Jimenez, J. L., Yuan, B., Chen, W., Wang, M., Wu, Y., Chen, C., Wang, Z., Peng, J., Zeng, L., and Shao, M.: Chemical composition, sources, and aging process of submicron aerosols in Beijing: Contrast between summer and winter, Journal of Geophysical Research-Atmospheres, 121, 1955-1977, 10.1002/2015jd024020, 2016.
Huang, R.-J., Zhang, Y., Bozzetti, C., Ho, K.-F., Cao, J.-J., Han, Y., Daellenbach, K. R., Slowik, J. G., Platt, S. M., Canonaco, F., Zotter, P., Wolf, R., Pieber, S. M., Bruns, E. A., Crippa, M., Ciarelli, G., Piazzalunga, A., Schwikowski, M., Abbaszade, G., Schnelle-Kreis, J., Zimmermann, R., An, Z., Szidat, S., Baltensperger, U., El Haddad, I., and Prevot, A. S. H.: High secondary aerosol contribution to particulate pollution during haze events in China, Nature, 514, 218-222, 10.1038/nature13774, 2014a.
Huang, R. J., Zhang, Y., Bozzetti, C., Ho, K. F., Cao, J. J., Han, Y., Daellenbach, K. R., Slowik, J. G., Platt, S. M., Canonaco, F., Zotter, P., Wolf, R., Pieber, S. M., Bruns, E. A., Crippa, M., Ciarelli, G., Piazzalunga, A., Schwikowski, M., Abbaszade, G., Schnelle-Kreis, J., Zimmermann, R., An, Z., Szidat, S., Baltensperger, U., El Haddad, I., and Prevot, A. S.: High secondary aerosol contribution to particulate pollution during haze events in China, Nature, 514, 218-222, 10.1038/nature13774, 2014b.
Jia, H., Huo, J., Fu, Q., Duan, Y., Lin, Y., Jin, X., Hu, X., and Cheng, J.: Insights into chemical composition, abatement mechanisms and regional transport of atmospheric pollutants in the Yangtze River Delta region, China during the COVID-19 outbreak control period, Environ Pollut, 267, 115612, 10.1016/j.envpol.2020.115612, 2020.
Li, R., Wang, Q., He, X., Zhu, S., Zhang, K., Duan, Y., Fu, Q., Qiao, L., Wang, Y., Huang, L., Li, L., and Yu, J. Z.: Source apportionment of PM_{2.5} in Shanghai based on hourly organic molecular markers and other source tracers, Atmospheric Chemistry and Physics, 20, 12047-12061, 10.5194/acp-20-12047-2020, 2020.
Shen, J., Zhao, Q., Cheng, Z., Wang, P., Ying, Q., Liu, J., Duan, Y., and Fu, Q.: Insights into source origins and formation mechanisms of nitrate during winter haze episodes in the Yangtze River Delta, Sci Total Environ, 741, 140187, 10.1016/j.scitotenv.2020.140187, 2020.
Sun, P., Nie, W., Wang, T., Chi, X., Huang, X., Xu, Z., Zhu, C., Wang, L., Qi, X., Zhang, Q., and Ding, A.: Impact of air transport and secondary formation on haze pollution in the Yangtze River Delta: In situ online observations in Shanghai and Nanjing, Atmospheric Environment, 225, 10.1016/j.atmosenv.2020.117350, 2020.
Sun, Y., Wang, Z., Wild, O., Xu, W., Chen, C., Fu, P., Du, W., Zhou, L., Zhang, Q., Han, T., Wang, Q., Pan, X., Zheng, H., Li, J., Guo, X., Liu, J., and Worsnop, D. R.: "APEC Blue": Secondary Aerosol Reductions from Emission Controls in Beijing, Scientific Reports, 6,

10.1038/srep20668, 2016.
Tao, J., Gao, J., Zhang, L., Zhang, R., Che, H., Zhang, Z., Lin, Z., Jing, J., Cao, J., and Hsu, S. C.: PM_{2.5} pollution in a megacity of southwest China: source apportionment and implication, Atmos. Chem. Phys., 14, 8679-8699, 10.5194/acp-14-8679-2014, 2014.
Wang, D., Zhou, B., Fu, Q., Zhao, Q., Zhang, Q., Chen, J., Yang, X., Duan, Y., and Li, J.: Intense secondary aerosol formation due to strong atmospheric photochemical reactions in summer: observations at a rural site in eastern Yangtze River Delta of China, Sci Total Environ, 571, 1454-1466, 10.1016/j.scitotenv.2016.06.212, 2016.
Wang, H., Ding, J., Xu, J., Wen, J., Han, J., Wang, K., Shi, G., Feng, Y., Ivey, C. E., Wang, Y., Nenes, A., Zhao, Q., and Russell, A. G.: Aerosols in an arid environment: The role of aerosol water content, particulate acidity, precursors, and relative humidity on secondary inorganic aerosols, Science of the Total Environment, 646, 564-572, 10.1016/j.scitotenv.2018.07.321, 2019.
Wang, X., Li, L., Gong, K., Mao, J., Hu, J., Li, J., Liu, Z., Liao, H., Qiu, W., Yu, Y., Dong, H., Guo, S., Hu, M., Zeng, L., and Zhang, Y.: Modelling air quality during the EXPLORE-YRD campaign – Part I. Model performance evaluation and impacts of meteorological inputs and grid resolutions, Atmospheric Environment, 246, 10.1016/j.atmosenv.2020.118131, 2021.
Yang, W., Li, J., Wang, W., Li, J., Ge, M., Sun, Y., Chen, X., Ge, B., Tong, S., Wang, Q., and Wang, Z.: Investigating secondary organic aerosol formation pathways in China during 2014, Atmospheric Environment, 213, 133-147, 10.1016/j.atmosenv.2019.05.057, 2019.
Yao, L., Yang, L., Yuan, Q., Yan, C., Dong, C., Meng, C., Sui, X., Yang, F., Lu, Y., and Wang, W.: Sources apportionment of PM2.5 in a background site in the North China Plain, Science of the Total Environment, 541, 590-598, 10.1016/j.scitotenv.2015.09.123, 2016.
Ying, Q., Wu, L., and Zhang, H.: Local and inter-regional contributions to PM2.5 nitrate and sulfate in China, Atmospheric Environment, 94, 582-592, 10.1016/j.atmosenv.2014.05.078, 2014.
Yu, J., Jihan, S., Song, J., Lee, D., Yu, M., and Kim, J.: A Study on the Change of Condensable Particulate Matter by the SO2 Concentration among Combustion Gases, Journal of Korean Society for Atmospheric Environment, 34, 651-658, 10.5572/kosae.2018.34.5.651, 2018.
Zhang, R., Jing, J., Tao, J., Hsu, S. C., Wang, G., Cao, J., Lee, C. S. L., Zhu, L., Chen, Z., Zhao, Y., and Shen, Z.: Chemical characterization and source apportionment of PM2.5 in Beijing: seasonal perspective, Atmospheric Chemistry and Physics, 13, 7053-7074, 10.5194/acp-13-7053-2013, 2013.
Zhang, Y., Wang, W., Wu, S.-Y., Wang, K., Minoura, H., and Wang, Z.: Impacts of updated emission inventories on source apportionment of fine particle and ozone over the southeastern US, Atmospheric Environment, 88, 133-154, 10.1016/j.atmosenv.2014.01.035, 2014.
Zhao, B., Wang, S., Donahue, N. M., Jathar, S. H., Huang, X., Wu, W., Hao, J., and Robinson, A. L.: Quantifying the effect of organic aerosol aging and intermediate-volatility emissions on regional-scale aerosol pollution in China, Sci Rep, 6, 28815, 10.1038/srep28815, 2016a.
Zhao, M., Xiu, G., Qiao, T., Li, Y., and Yu, J.: Characteristics of Haze Pollution Episodes and Analysis of a Typical Winter Haze Process in Shanghai, Aerosol and Air Quality Research, 16, 1625-1637, 10.4209/aaqr.2016.01.0049, 2016b.
Zhu, Y., Huang, L., Li, J., Ying, Q., Zhang, H., Liu, X., Liao, H., Li, N., Liu, Z., Mao, Y., Fang, H., and Hu, J.: Sources of particulate matter in China: Insights from source apportionment studies published in 1987-2017, Environ Int, 115, 343-357, 10.1016/j.envint.2018.03.037, 2018.

Please also note the supplement to this comment:
https://acp.copernicus.org/preprints/acp-2020-953/acp-2020-953-AC2-supplement.pdf