Title: Simultaneous observations of peroxyacetyl nitrate and ozone in central China during static management of COVID-19: Regional transport and thermal decomposition.

Authors: Bowen Zhang[1,3], Dong Zhang[2,3], Zhe Dong[2,3], Xinshuai Song[1,3], Ruiqin Zhang[1,3], Xiao Li[1,3,*]

Manuscript number: egusphere-2024-575

Dear Editor

Thank you for recognizing our work and encouraging us to resubmit the above manuscript. We would also like to thank the reviewers for reading our manuscript and again providing valuable comments and suggestions to improve the quality of our manuscript. We believe that all of the reviewers' comments have been addressed and we respond to each comment individually below. In order to incorporate the reviewers' comments into the revised manuscript, we will definitely revise the manuscript completely and analyze the data in more depth. We have also made changes to the abstract to highlight the substantive and novel contributions of the paper. Changes made in response to these responses are highlighted in yellow in the highlighted copy of the revised version. Our own minor changes are highlighted in red.

The following is a point-by-point response to each reviewer's comments.

Reviewer #1:

The authors have made significant efforts to address the comments and suggestions from the previous review. The revisions have improved the manuscript, but there are still some issues that need to be addressed before it can be considered for publication.

We do appreciate your recognition of our work. We would like to thank you again for your valuable suggestions. Your comments will still receive point-by-point responses.

Detailed comments:

Line 42: The current list of keywords is quite limited. I recommend including additional relevant terms that reflect the core topics and methodologies discussed in the manuscript.

Response: We are very grateful for the positive comments and suggestions. We have added 'Positive Matrix Factorization model' and 'Secondary organic aerosol formation potential' as new keywords to the manuscript.

Section 3.1 Overview of variation in pollutants and meteorological parameters

While the correlations between $PM_{2.5}$, TVOCs, NO_x, and relative humidity are mentioned, a more detailed analysis of these correlations is needed.

Explain the nature of these relationships and their impact on understanding pollution formation, and compare these correlations with previous research results. Although the influence of meteorological conditions on pollution formation is noted, further elaboration on how specific meteorological factors (such as low wind speed and temperature) affect pollutant concentrations is necessary. Discuss why these conditions might lead to higher or lower pollutant levels. Additionally, while the comparison of pollutant concentrations between different periods is addressed, a detailed analysis of the observed trends, such as the increase in $PM_{2.5}$ and TVOCs during the recovery period, should be provided. Analyze the possible reasons for these trends and their relationship with the resumption of production activities.

Response: We are very grateful for the positive comments and suggestions.

Emissions of pollutants from different sources are the main cause of pollution. It is true that meteorological conditions play an important role in the level of pollution. However, we know that emissions from pollutant sources usually change very little over a period of time, while meteorological conditions play a very important role in the formation of pollution. And previous studies have shown that meteorological factors such as low wind speed, high relative humidity, and low precipitation are responsible for the increase in particulate matter pollution in Zhengzhou in winter (Duan et al., 2019). The meteorological conditions of the two time periods are basically similar, and Case 2 during the recovery period is slightly more prone to meteorological conditions unfavorable to pollutant dispersion, such as atmospheric stability and high relative humidity, than Case 1 during the infection period. However, this minor meteorological difference does not directly lead to significant changes in the pollution levels we observe. It is clear that pollution levels over time are primarily the result of anthropogenic activities and, to a lesser extent, regional transport (see responses below), rather than meteorological conditions. The reason for providing meteorological data is to add supplementary information to these events.

Our correlation analysis of different pollutants with meteorological conditions during pollution revealed that $PM_{2.5}$, TVOCs, and NO_x were all positively correlated with relative humidity, which is consistent with the results of some previous studies (Wang et al., 2019). The high humidity environment favors the conversion of gaseous pollutants such as sulfur dioxide, nitrogen oxides, and ammonia into particulate matter, and the formation of static weather under meteorological conditions such as low wind speed, high humidity, and temperature inversion is the main factor for the occurrence of heavy pollution days.

We added the meteorological parameters of clean days in Table 1, and after comparing the polluted days with the clean days, it can be seen that the wind speed is lower than that of the clean days, and the humidity is higher than that of the clean days, which is in line with the meteorological conditions characterized by the emergence of polluted days. However, when comparing the meteorological conditions of the two pollution processes, none of the processes showed a tendency to be more prone to pollution. However, the pollution parameters were significantly higher in Case 2 than in Case 1, a trend that is most likely related to the resumption of production activities and the increase in emissions during the Case 2 period.

Reference:

Duan, S., Jiang, N., Yang, L., Zhang, R.: Transport Pathways and Potential Sources of $PM_{2.5}$ During the Winter in Zhengzhou, Environmental Science, Jan 8;40(1):86-93, https://doi.org/10.13227/j.hjkx.201805187, 2019.

Wang, H., Li, J., Peng, Y., Zhang, M., Che, H., Zhang, X.: The impacts of the meteorology features on PM2.5 levels during a severe haze episode in central-east China, Atmospheric Environment, Volume 197, Pages 177-189, ISSN 1352-2310, https://doi.org/10.1016/j.atmosenv.2018.10.001, 2019.

Section 3.2 SOAFP

The analysis of SOAP contributions across different pollution processes provides an overview but lacks in-depth explanations. It would be beneficial to include more detailed analysis on why the industrial source is dominant in Case 1 and why solvent usage and fuel evaporation sources are more evenly distributed in Case 2. Additionally, analyze whether the observed trends in SOAP values and source contributions are related to other environmental factors or changes over time. Explain how these trends impact air quality and $PM_{2.5}$ pollution.

Response: We are very grateful for the positive comments and suggestions. Case 1 was during the infection period, when social activities had not yet returned to normal. In Case 2, when society had basically returned to normal, the increase in emissions from various sources resulted in a more balanced distribution of SOAP contributions and caused more severe $PM_{2.5}$ pollution. In addition, a few days before Case 2, the Zhengzhou Municipal People's Government initiated the Heavy Pollution Weather Level II response (https://sthjj.zhengzhou.gov.cn/tzgg/7037130.jhtml) and introduced control measures for emissions from industrial and mobile sources, which resulted in a significant reduction of SOAP levels from industrial and motorized sources in Case 2.

Section 4 Conclusions

The conclusions provided primarily summarize the results without offering detailed explanations for the observed changes or the influence of different sources on VOCs and $PM_{2.5}$ pollution. To strengthen the conclusions, it would be beneficial to include more in-depth analysis and discussion regarding why certain changes were observed and how they relate to the influence of specific sources on VOCs and $PM_{2.5}$ formation, how different sources contribute to changes in TVOCs and $PM_{2.5}$ levels across different periods, and potential driving factors behind the presence and variation of these sources during different pollution episodes. Incorporating such explanations will provide a clearer understanding of the underlying mechanisms driving the observed results and enhance the overall impact of the conclusions.

Response: We are grateful for your insightful feedback and have revised the abstract in accordance with your recommendations. The revised conclusion is presented below:

From December 1, 2022, to January 31, 2023, continuous observations of VOCs were conducted in a heavily polluted urban area of Zhengzhou during the Omicron epidemic infection. During the aforementioned period, the daily mean concentrations of $PM_{2.5}$ exhibited a range of 53.5 to 239.4 $\mu g/m^3$, with a mean value of 111.5 ± 45.1 $\mu g/m^3$. The concentrations of TVOCs ranged from 15.6 to 57.1 ppbv, with a mean value of 36.1 ± 21.0 ppbv, which was higher than that observed during the same period in the previous year (27.9 ± 12.7 ppbv, as reported by Lai et al., 2024). Two representative pollution processes were identified during the observation period: Case 1, which occurred during the infection period, and Case 2, which occurred during the recovery period. The TVOC concentrations in Case 1 and Case 2 were 48.4 ± 20.4 and 67.6 ± 19.6 ppbv, respectively, which represented a 63% and 188% increase compared to the concentrations observed on clean days. The mean $PM_{2.5}$ and TVOC concentrations in Case 2 were 1.3 and 1.8 times higher, respectively, than those in Case 1. This is consistent with the observed increase in pollutant emissions following the return to normal social life from the period of Omicron infection. The volume contribution of alkanes is the highest in Case 1 (48%) and Case 2 (44%). Despite aromatic hydrocarbons exhibiting the lowest volumetric contribution (6% in Case 1 and 7% in Case 2), the greatest rate of increase in the volumetric contribution of aromatic hydrocarbons was observed from the clean day to the contaminated day. Low wind speed and high humidity were the main meteorological reasons for the occurrence of pollution. Analyzing the sources of VOCs revealed that VOCs were found to be affected by a combination of local emissions and regional transport. The primary sources of atmospheric VOCs in Zhengzhou were identified as industrial emissions (32%), vehicle emissions (27%), and combustion (21%). Significant discrepancies were observed in the sources of VOCs between the two pollution processes. In Case 1, industrial emissions constituted the primary source of VOCs, accounting for 32% of the total VOC concentration. In contrast, in Case 2, the proportion of vehicle emissions increased to 33%, representing the primary source of VOCs.

A further analysis of the effect of VOCs on SOA generation reveals that aromatic compounds are the primary contributors to SOAP, with BTEX being the predominant contributor throughout the period. The SOAP values reached 37.6 and 65.6 μg/m³ in Case 1 and Case 2, respectively. In Case 1, the greatest contribution to SOAP was made by industrial sources (63%, 23.8 μg/m³), while vehicular sources, which constituted the second most important source, accounted for only 18%. In Case 2, the contribution of each VOC source was more evenly distributed, with solvent use sources and fuel evaporation sources representing the primary contributors to SOAP, accounting for 32% (20.9 μg/m³) and 26% (16.8 μg/m³), respectively. The SOAP result for the clean day was 8.8 μg/m³, with industrial sources and solvent use still being the primary contributors. Therefore, the industrial and solvent use sectors are the predominant sources of pollutants during this observation. The aforementioned results substantiate the considerable impact of elevated emissions from all sources on the exacerbation of pollution following the conclusion of the Omicron infection.

Reviewer #2:

I would like to thank the authors for submitting the review of your manuscript. However, I regret to recommend not publishing the manuscript in its current form as it still lacks clarity and scientific significance on how the results have been presented. Below, I have outlined only some of my specific concerns.

I am grateful for your time and effort in reviewing our paper and for your numerous valuable suggestions. We regret any shortcomings in the manuscript that did not meet your expectations and are committed to further revisions. We will provide a point-by-point response to your suggestions below.

Abstract:

1. Line 16: The abrupt mention of Case 2 is confusing. How many cases were analyzed, and based on what factors were these cases chosen?

Response:

1. We extend our sincerest apologies for any confusion that may have arisen from the reading material. In light of your invaluable suggestions, we have made the necessary additions to the summary.

2. Lines 23-25: The significance of this section is unclear. Please clarify what you mean and what you are trying to signify.

3. The abstract needs a more cohesive approach to presenting the results.

2 & 3. In accordance with your recommendations, we have implemented comprehensive revisions to the summary. The following revisions have been made:

Line10-39: Online volatile organic compounds (VOCs) were monitored before and after the Omicron policy change at an urban site in polluted Zhengzhou from December 1, 2022, to January 31, 2023. The characteristics and sources of VOCs were investigated. The daily mean concentrations of $PM_{2.5}$ and total VOCs (TVOCs) ranged from 53.5 to 239.4 μg/m³ and 15.6 to 57.1 ppbv, respectively, with mean values of 111.5 ± 45.1 μg/m³ and 36.1 ± 21.0 ppbv, respectively, throughout the period. Two severe pollution events (designated as Case 1 and Case 2) were identified in accordance with the National Ambient Air Quality Standards (NAAQS) (China's National Ambient Air Quality Standards (NAAQS) from 2012). Case 1 (December 5 to December 10, $PM_{2.5}$ daily mean = 142.5 μg/m³) and Case 2 (January 1 to January 8, $PM_{2.5}$ daily mean = 181.5 μg/m³) occurred during the infection period (when the policy of "full nucleic acid screening measures" was in effect) and the recovery period (after the policy was cancelled), respectively. The $PM_{2.5}$ and TVOCs values for Case 2 are, respectively, 1.3 and 1.8 times higher than those for Case 1. The results of the positive matrix factor modeling demonstrated that the primary source of volatile organic compounds (VOCs) during the observation period was industrial emissions, which constituted 32% of the total VOCs, followed by vehicle emissions (27%) and combustion (21%). In Case 1, industrial emissions constituted the primary source of VOCs, accounting for 32% of the total VOCs. In contrast, in Case 2, the contribution of vehicular emission sources increased to 33% and became the primary source of VOCs. The secondary organic aerosol formation potential for Case 1 and Case 2 were found to be 37.6 μg/m³ and 65.6 μg/m³, respectively. In Case 1, the largest contribution of SOAP from industrial sources accounted for the majority (63%, 23.8 μg/m³), followed by vehicular sources (18%). After the end of the epidemic and the resumption of productive activities in the society, the difference in the proportion of SOA generated from various sources decreased. Most of the SOAP came from solvent use and fuel evaporation sources, accounting for 32% (20.9 μg/m³) and 26% (16.8 μg/m³), respectively. On days with minimal pollution, industrial sources and solvent use remain the main contributors to SOA formation. Therefore, regulation of emissions from industry, solvent-using industries and motor vehicles need to be prioritized to control the $PM_{2.5}$ pollution problem.

Introduction:

1. Line 97: The term "human factor" is vague and hard to understand. Please specify what you mean.

Response:

1. Thank you for your suggestion. We have revised the sentence to "Furthermore, some studies have discussed the impact of changes in human production activities on air pollution during and after the outbreak of the coronavirus disease."

2. Lines 120-125: The phrase "See what results show later on..." is unclear. What results are you referring to, and how do they relate to the study's objectives?

2. We appreciate your input and regret that we are unable to provide a satisfactory response. A thorough examination of the section in question revealed no evidence of the suggested sentence in the manuscript. Should you believe that a problem persists, we kindly request that you contact us at your earliest convenience so that we may undertake a careful revision in accordance with your suggestions.

3. Line 110: The rationale for choosing this sampling duration is unclear. Was the Omicron lockdown a significant interruption compared to earlier variants? Providing a timeline of Omicron detection, lockdown periods, and sampling coverage would help clarify this. Additionally, what is meant by "nuclei acid screening measure for all staff," and how does it relate to your study? Clarify whether "all staff" refers to government staff or the general population.

3. Zhengzhou Municipal Government in Henan Provincial People's Government Portal (www.henan.gov.cn) on October 5, 2022 issued Circular No. 139, the content of the circular is due to Zhengzhou during this period Omicron infection cases frequently, in order to prevent the spread of the epidemic hidden, and therefore to carry out the city's new coronavirus nucleic acid screening, screening scope for all residents in the city area, at the same time, closed public places Suspension of business, and to advise residents to reduce activities outside, and the content of the above notice similar to the notice continued to be issued until the Circular No. 162. The epidemic prevention and control measures in Zhengzhou changed to tin Circular No. 163 issued on December 4, 2022, restoring the opening of closed public places; Circular No. 164 issued on December 8 announced that it was no longer necessary to present health codes and nucleic acid negative certificates for the movement of people, and that centralized isolation would no longer be adopted for those who were positive for the infection. Since then, the number of people moving around Zhengzhou has increased and social production has resumed.

After the quarantine policy was lifted, people basically rested at home due to infection or fear of infection with Omicron. The resumption of normal production and life depends on herd immunization. This outbreak event is the longest in duration and the largest in number of infections since the 2020 outbreak of the novel coronavirus in Zhengzhou. It would be beneficial to investigate the impact of this event on emissions related to transportation and industrial production.

4. The introduction should clearly explain Cases 1 and 2, as well as the clean period, to clarify the study's objectives. Although some of this information will appear in the methods section, the introduction and abstract should provide a clear understanding of the study's purpose.

4. Thanks for your suggestion, we have added this section of the introduction to the narrative.

Line 105-109: The focus of this study was on pollution events in which the daily average $PM_{2.5}$ concentration exceeded 75 μg/m^3 (China's Class II standard) for more than three consecutive days, and any day in which the $PM_{2.5}$ concentration was less than 35 μg/m^3 (China's Class I standard) was considered a clean day.

Methods:

1. Line 140: The claim that the sampling period covered the entire infection period of Omicron is questionable. According to your introduction, Omicron started on October 8th and lasted until early December, while your sampling is from December 1st to January 31st. Your sampling period appears to coincide with the post-Omicron period.

Response:

1. The Zhengzhou Municipal Government issued Circular No. 139 on the Henan Provincial People's Government Portal (www.henan.gov. cn) on October 5, 2022, which stated that due to the frequent occurrence of omicron infections in Zhengzhou during this period, in order to prevent the spread of the epidemic from becoming invisible, and thus carry out the city's new coronavirus nucleic acid screening, which was conducted within the scope of the city's territory for all residents, and at the same time, closed public places were suspended, and residents were advised to reduce their outings. At the same time, closed public places suspended business, and advise residents to reduce outdoor activities, and the content of the circular similar to the above notice continued to be issued until the 162nd notice, during this period of Zhengzhou population Omicron infection rate is extremely low. On December 4, 2022, Zhengzhou City issued Circular No. 163, which made adjustments to the epidemic prevention and control measures, and resumed the opening of closed public places. On December 8, Circular No. 164 announced that it was no longer necessary for people to show their health codes and nucleic acid negative certificates when moving around, and that centralized quarantine would no longer be applied to positively infected people. Since then, the number of people moving around Zhengzhou has increased and social production has resumed. However, the proportion of people infected with omicron has increased dramatically, with a large number of uninfected residents becoming

infected for the first time, leading to a situation where the majority of people in Zhengzhou were actually still at home in December. This infection trend only slows down after January 2023 due to the herd immunization situation; after mid-January, when the herd immunization covers almost the entire population, the number of new infections decreases to a level that does not affect the normal production of society. Thus, our sampling period covers virtually the entire period of Omicron infection.

2. Line 145: Please provide references to other literature discussing the TH-PKU 300b instrument and its methodology.

2. Ambient VOCs were collected and plumed into refrigeration and pre-concentration system. Programmed increased temperature method was used to separate each VOC species. We have added this to the revised version of the manuscript, details of which can be found in Line 175-176

Line175-176: A detailed description of the instrumentation can be found in our previous study (Zhang et al., 2021; Shi et al., 2024; Zhang et al., 2024).

Reference:

Shi, Y., Liu, C., Zhang, B., Simayi, M., Xi, Z., Ren, J., and Xie, S.: Accurate identification of key VOCs sources contributing to O_3 formation along the Liaodong Bay based on emission inventories and ambient observations, Science of the Total Environment, 844, 156998, 10.1016/j.scitotenv.2022.156998, 2022.

Zhang, D., He, B., Yuan, M., Yu, S., Yin, S., Zhang, R.: Characteristics, sources and health risks assessment of VOCs in Zhengzhou, China during haze pollution season, Journal of Environmental Sciences, 108. 44-57, 1001-0742, https://doi.org/10.1016/j.jes.2021.01.035, 2021.

Zhang, D., Li, X., Yuan, M., Xu, Y., Xu, Q., Su, F., Wang, S., Zhang, R.: Characteristics and sources of nonmethane volatile organic compounds (NMVOCs) and O_3–NO_x–NMVOC relationships in Zhengzhou, China, Atmosphere Chemistry and Physics, 24, 8549-8567, https://doi.org/10.5194/acp-24-8549-2024, 2024.

3. Line 160: Was the instrument calibrated for all 160 compounds?

3. Thank you for your suggestion. After a comprehensive selection process, 106 VOCs were ultimately included in this study. To ensure the accuracy of the VOCs, all 106 substances were injected into the standard gas through a five-point standard curve. This methodology has been added to the manuscript. Should you have further suggestions, we kindly request that you contact us so that we can carefully revise the manuscript according to your suggestions.

4. Line 252: Jan 1 as an absolute cutoff of "infection period" and "recovery period" needs proper debate.

4. Since the lifting of the containment policy in early December 2022, there has been a notable increase in the number of Omicron infections in Zhengzhou City. The peak number of infections occurred in mid- to late-December, after which the rate of infections declined rapidly. Since January, the number of new infections has remained relatively stable. Clinical observations indicated that individuals without a history of other illnesses typically required approximately one week of rest following their initial Omicron infection. Additionally, the majority of residents had recovered

from their first infection and resumed their normal work activities by January. It seems reasonable to posit that January 1 marks the transition between the infection period and the recovery period.

Results and Discussion:

1. Figure 2: The composition pie chart does not show a discernible difference between the two cases. Surprisingly, the recovery period had even lower NO_x and aromatics than the infection period. Please clarify.

Response:

1. Thank you for your suggestion. The decrease in the percentage of aromatic hydrocarbons is mainly caused by the increase in the percentage of OVOCs and halogenated hydrocarbons. From Table 2, we can see that the concentration of aromatic hydrocarbons is increased in the recovery period compared to the infection period, which is increased by 28%.

2. Line 286: What do you mean by "highest increase ratio"?

2. We apologize for any confusion caused by our presentation. It has been revised to read: Although aromatic hydrocarbons have the lowest volumetric contribution (6% in Case 1 and 7% in Case 2), they show the largest increase from clean days to pollution.

3. Tables 1 and 2: The criteria for dividing the infection period vs. the

recovery period are unclear. In several instances, the terms Cases 1 and 2 are used interchangeably with infection and recovery periods, which is confusing.

3. We apologize for the confusion in your reading. We have labeled the infection and recovery periods in the chart. The reason for the division can be found in the answer to the previous question. Here we have compared the pollution during the infection period with the recovery period, Case 1 and Case 2. This is to highlight the increase in air pollution after the end of the epidemic infection.

4. Line 303: The use of VOC ratios possesses uncertainty. If you reference values of 0.13-0.7 for combustion, how does an average value of 1 align with combustion? Similarly, how do you reconcile the isopentane/n-pentane ratio with liquid petrol if the average does not fall within the referenced range? The same question applies to the isobutane/n-butane ratio for natural gas. The current explanation suggests a limited understanding of VOC ratios.

4. We acknowledge that this method has limitations. This method is only a preliminary determination of the emission sources of VOCs, and this method has been used in several studies (Yu et al., 2021; Wang et al., 2023; Xu et al., 2023). The mean value of T/B in our case is 1, which is between combustion and transport emissions (1.3-3.0), and thus receives the

combined effect of combustion and transport emissions. This phenomenon is also found in previous studies (Wang et al., 2023).

Reference:

Wang, B., Liu, Z., Li, Z., Sun, Y., Wang, C., Zhu, C., Sun, L., Yang, N.: Characteristics, chemical transformation and source apportionment of volatile organic compounds (VOCs) during wintertime at a suburban site in a provincial capital city, east China, Atmospheric Environment, Volume 298, 119621, ISSN 1352-2310, https://doi.org/10.1016/j.atmosenv.2023.119621, 2023.

Xu, Z., Zou, Q., Jin, L., Shen, Y., Shen, J., Xu, B., Qu, F.: Characteristics and sources of ambient Volatile Organic Compounds (VOCs) at a regional background site, YRD region, China: Significant influence of solvent evaporation during hot months, Science of The Total Environment, Volume 857, Part 3, 159674, ISSN 0048-9697, https://doi.org/10.1016/j.scitotenv.2022.159674, 2023.

Yu, S., Su, F., Yin, S., Wang, S., Xu, R., He, B., Fan, X., Yuan, M., Zhang, R.: Characterization of ambient volatile organic compounds, source apportionment, and the ozone–NOx–VOC sensitivities in a heavily polluted megacity of central China: effect of sporting events and emission reductions, Atmosphere Chemistry and Physics, Volume 21, 15239-15257, ISSN 1680-7324, https://doi.org/10.5194/acp-21-15239-2021, 2021.

5. Figure 5: The figure caption is awkwardly written. Combine the note into the caption itself. Generally, wind speeds below 1 m/s indicate local emissions and are not suitable for CPF analysis. Apply a filter of <1 m/s for CPF. Despite CPF indicating local sources, you also mention long-range transport as the most influential source in another instance, which is contradictory.

5. Thank you for your suggestion. We have merged the notes into the title. We have applied a <1 m/s filter for CPF as per your suggestion and revised

the corresponding description in the text (Fig. 5). We extend our sincerest apologies if our choice of words has caused any confusion or misunderstanding. we have mentioned in other examples that long-range transport also contributes to emission sources, but is not identified as the most significant source, and we have revised this section.

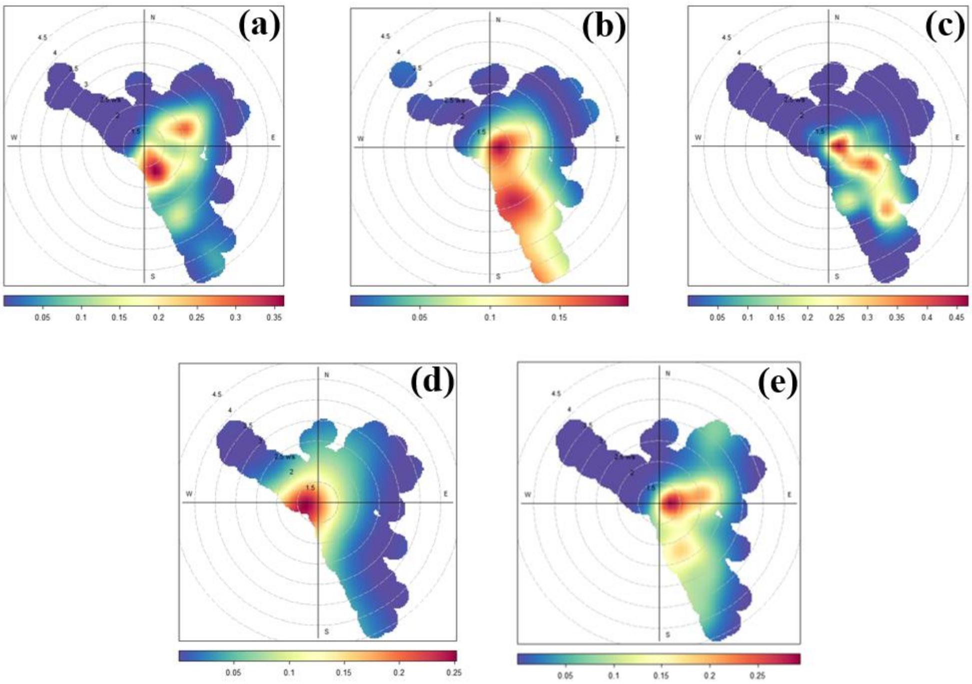

Fig. 5. CPF plots of five VOCs sources obtained using the PMF model. Note: a: Fuel evaporation; b: Solvent usage; c: Industrial source; d: Vehicular emission; e: Combustion.

6. The study's main aim seems to be comparing infection vs. recovery cases and/or pollution Cases 1 and 2 vs clean period, yet the overall PMF for entire sampling is discussed in the main text, while PMFs differences for the periods of interest are in the supplementary section. This does not align with the study's objectives.

6. Thank you for your comments. A discussion of the PMF differences

between the infection and recovery periods and contamination Case 1 and 2 versus the clean period has been added to the manuscript. The PMF factor profiles for the relevant periods are shown in Figure S6 in the supplementary section.

7. Line 374: Clarify what is meant by "peak of Omicron infection period." The terminology used is confusing, making it difficult to follow the results.

7. We apologize for that our description in this section was not clear. We have changed the section to “Figure S6 compares the differences in PMF source profiles between the Omicron infection period and the recovery period, as well as between the pollution day and the clean day.”