General comments:

This study conducted a four-season field campaign at an urban site in the Yangtze River Delta, revealing a distinctive seasonal pattern of measured IVOCs, with a maximum in summer and a minimum in winter. The authors provide robust observational evidence that temperature-dependent evaporative emissions and gas/particle partitioning are the key drivers, and these findings have important implications for SOA modelling and the refinement of emission inventories. Overall, the manuscript is logically structured, and the dataset quality and analytical methodology adopted throughout the study are reliable. I suggest the paper be accepted for publication in ACP pending minor revisions.

Reply: We sincerely appreciate your valuable comments and suggestions. We have carefully revised the manuscript accordingly, and a point-by-point response is provided below:

Specific comments:

1. This study listed the sample numbers but did not mention how to store the samples, and whether any IVOCs were detected in field blanks.

Reply: Thank you for carefully reviewing our manuscript. Based on your comments, we have revised our manuscript accordingly. Specifically, we have added the sample storage procedure and included some sentences on the IVOCs detected in field blanks, as detailed below:

"*Upon sampling, the tube samples were promptly placed into a cool box (4 °C), transported to the laboratory, and stored at −18 °C until analysis. All samples were analyzed within one week.*" (Lines 141−143)

"The IVOCs in field blanks were either not detected or below the method detection limits (MDLs), indicating negligible background contamination." (Lines 113−115)

2. The PMF model identified a factor associated with "gas/particle partitioning". As PMF is predominantly a source apportionment tool, the authors should state in the Methods or Results section that this factor does not correspond to a primary emission source, but reflected the net effect of temperature-dependent phase transfer processes. This clarification will prevent potential misinterpretation by readers.

Reply: We thank the reviewer for carefully reviewing our manuscript. We had previously included a brief note in the Results and Discussion section, but we agree that a more explicit clarification is necessary to prevent any potential misinterpretation. To address this, we have revised the manuscript accordingly, and the relevant sentences are provided below:

"It should be pointed out that the PMF factors resolved in this study included primary emission sources and an atmospheric process. Specifically, three of the factors represent direct emissions including vehicle exhaust, evaporative emissions, and industrial emissions,

while the remaining one, gas/particle partitioning, represents a critical atmospheric process that controls the phase distribution of measured IVOCs, particularly the low-volatility species." (Lines 382−387)

"Hence, Factor 3 was interpreted as reflecting gas/particle partitioning processes, rather than a conventional primary source." (Lines 411−412)

3. A key question arises: how do the authors differentiate evaporative emissions from gas/particle partitioning, as both processes exhibit temperature dependence?

Reply: Thank you for raising this crucial issue. Although both evaporative emission and gas/particle partitioning are temperature-dependent, there are some differences existing between these two factors. The gas/particle partitioning factor (Factor 3) is dominated by the low-volatility species (nC_{19}–nC_{22}), which are most susceptible to phase transfer. This factor exhibits a pronounced exponential decay with increasing $PM_{2.5}$ concentrations, reflecting the condensation sink effect under high aerosol loading. In contrast, the evaporative emission factor (Factor 2) is dominated by lighter alkanes (nC_{12}–nC_{16}), correlates with isopentane (a gaseous tracer of fuel evaporation), and shows no significant $PM_{2.5}$ dependence. These distinct chemical fingerprints and response patterns collectively demonstrate that our PMF model effectively differentiated evaporative emissions (a primary source) from gas/particle partitioning (an atmospheric process), even though both are temperature-sensitive.

Based on your comments, we have revised the manuscript and added following sentences to Results and Discussion section:

"*Notably, this factor was dominated by low-volatility nC_{19} – nC_{22}, which are susceptible to phase transfer. Furthermore, the IVOCs attributed to Factor 3 exhibited a strong positive correlation with temperature ($r = 0.79$, $p < 0.01$, Figure S9), consistent with the temperature-driven repartitioning of low-volatility organics from the particle phase to the gas phase (Zhou et al., 2024). This factor also showed a pronounced exponential decay with increasing $PM_{2.5}$ concentrations, reflecting the condensation sink effect under high aerosol loading. Hence, Factor 3 was interpreted as reflecting gas/particle partitioning processes, rather than a conventional primary source.*" (Lines 405−412)

References

Zhou, Z.Y., Wang, Z.S., Feng, W., Qin, C., Liao, H., Wang, Y.H., and Xie, M.J.: Simulation of gas-particle partitioning of semi-volatile n-alkanes and PAHs in Nanjing, China, and Denver, United States: effects of vapor pressure and surface adsorption estimation. J. Geophys. Res. Atmos., 129, e2024JD041368, https://doi.org/10.1029/2024JD041368, 2024.

4. In Section 3.4, asphalt and VCPs were proposed as potential evaporative sources. However,

tracers for these sources were not directly measured in this study. The authors are advised to soften relevant statements by using cautious wording such as "may" and "requires further investigation". Additionally, the authors should explicitly clarify that the evaporative factor resolved by PMF in this work is mainly ascribed to bulk evaporative emissions, while other individual evaporative sub-sources remain to be verified.

Reply: Thank you for the constructive suggestions. Accordingly, we have carefully revised the relevant text in the Results and Discussion section, which are also provided as below:

"Moreover, evaporative IVOCs are also from asphalt (itself petroleum-derived) and volatile chemical products (VCPs) (McDonald et al., 2018; Khare et al., 2020; Wan et al., 2026). PMF model cannot further sub-partition this factor to separate contributions from fuel evaporation, asphalt, and VCPs. Therefore, Factor 2 resolved by PMF was primarily attributed to bulk evaporative emissions, with fuel evaporation as the important constrained contributor, based on its significant correlations with isopentane, Pr, and Ph" (Lines 399−404)

*"Given China's substantial annual asphalt consumption (e.g., 21.5 million tons in 2024, with over 90% used for road paving and roofing, https://www.yunliqing.com/public//static/uploads /files/pdf/2024/12/19/17345905736763c06debf64.pdf), this **may** represent a significant and sustained contributor to evaporative IVOCs in urban areas."* (Lines 440−445)

References

Khare, P., Machesky, J., Soto, R., He, M., Presto, A.A., and Gentner, D.R.: Asphalt-related emissions are a major missing nontraditional source of secondary organic aerosol precursors, Sci. Adv., 6, eabb9785, https://doi.org/10.1126/sciadv.abb9785, 2020.

McDonald, B.C., de Gouw, J.A., Gilman, J.B., Jathar, S.H., Akherati, A., Cappa, C.D., Jimenez, J.L., Lee-Taylor, J., Hayes, P.L., McKeen, S.A., Cui, Y.Y., Kim, S.W., Gentner, D.R., Isaacman-VanWertz, G., Goldstein, A.H., Harley, R.A., Frost, G.J., Roberts, J.M., Ryerson, T.B., and Trainer, M.: Volatile chemical products emerging as largest petrochemical source of urban organic emissions. Science, 359, 760–764, https://doi.org/10.1126/science.aaq0524, 2018.

Wan, Z.C., Guo, S., Ni, X.S., Zhou, Q.Q., Hu, K., Chen, S.Y., Yao, M.S., and Donahue, N.M.: Urban activity shifts reshape S/IVOC composition and SOA formation: insights from wintertime observations in Beijing, Environ. Sci. Technol., 60, 17927-17937, https://doi.org/10.1021/acs.est.5c17863, 2026.

5. The total IVOC concentration measured here (1228.2 ± 132.7 ng m^{-3}) is lower than wintertime values in Shanghai (~5265 ng m^{-3}), and the seasonal trends are opposite: summer maxima in this study versus winter maxima in Shanghai. The authors attributed the observed

seasonal pattern to temperature-driven evaporative emissions. However, it remains unclear why Shanghai, also situated in the YRD, showed higher winter concentrations. Are these gaps caused by different site characteristics or varying meteorological conditions during observation periods? I suggest including some sentence to interpret the considerable disparities in concentration levels and seasonal cycles across sites within the YRD.

Reply: Thank you for the thoughtful comments. We fully acknowledge the apparent discrepancy between our results and the previous observations in Shanghai. Although both sites are located within the YRD region, the seasonal pattern of measured IVOCs in this study is opposite to that reported by Li et al. (2019), with a summer maximum in our work versus a winter maximum in Shanghai. Two factors may contribute to these disparities. First, differences in the range of measured species may play a role. Our study focused on gas-phase IVOCs, whereas Li et al. (2019) collected both gas- and particle-phase IVOCs, which may have led to higher reported concentrations due to the inclusion of particle-bound species. Second, differences in sampling timing and meteorological conditions may also be important. Li et al. (2019) conducted their IVOC sampling during **winter haze episodes**, during which atmospheric pollution levels and meteorological conditions were considerably different from those in our study. This could further amplify the observed variations between the two studies. Nevertheless, despite these differences, our finding of a summer-maximum and winter-minimum pattern provides a complementary perspective on IVOC seasonality within the YRD, highlighting the critical role of evaporative sources that may have been less emphasized in previous winter-focused studies. Based on your suggestion, we have added relevant sentences in Section 3.1 to address this issue, and the revised text is provided below:

"*The seasonal pattern of measured IVOCs in this study was opposite to that reported in the Shanghai (Li et al., 2019), despite both sites being located within the YRD region. This could be attributed to differences in the range of measured species. Only gas- phase IVOCs were measured here, whereas both gas- and particle-phase IVOCs were collected during Shanghai observation. Furthermore, Li et al. (2019) conducted their IVOC sampling during winter haze episodes, where atmospheric pollution levels and meteorological conditions differed substantially from those encountered in our study. This could further amplify the observed variations of IVOCs between the two studies.*" (Lines 240−248)

References:

Li, Y.J., Ren, B.N., Qiao, Z., Zhu, J., Wang, H., Zhou, M., Qiao, L.P., Lou, S.R., Jing, S.G., Huang, C., Tao, S.K., Rao, P.H., and Li, J.: Characteristics of atmospheric intermediate volatility organic compounds (IVOCs) in winter and summer under different air pollution levels. Atmos. Environ., 210, 58–65, https://doi.org/10.1016/j.atmosenv.2019.04.041, 2019.

6. There is a citation error: “Donahue et al., 20212”. Please thoroughly verify the citation format and reference list across the manuscript.

Reply: Following your suggestion, we have thoroughly checked the citation format and reference list and made corresponding revisions.

7. Some long sentences (e.g., Lines 410−413) should be split to improve readability.

Reply: Thank you for the valuable suggestions. In response to your comments, we have revised the manuscript, and broken down some lengthy sentences into shorter ones to improve readability.

8. Table S2: The unit of atmospheric pressure should be “hPa”.

Reply: Revised as suggested.