We greatly thank the reviewers for the careful review of the manuscript. The comments greatly improved our manuscript. We revised our manuscript according to the reviewers' comments and suggestions. Here are our point-to-point responses to the comments.

Response to Referee #1:

This study provides a detailed characterization of VOC-IVOC-SVOC emissions from incense burning, estimates the OFP, SOA formation, and the toxicity risks. Furfural is proposed as the molecular marker of incense burning due to its stable emission among different types of incense materials. The intensive domestic usage of incense imposes significant health risks for a large number of Chinese residence and this works gives a valuable set of data to assess the epidemiological influences of incense burning for future work. I recommend publication in ACP before a few comments to be addressed as below.

Response: We greatly appreciate the careful review of this manuscript. We have addressed the comments and revised the manuscript accordingly.

It is well known that TA tubes are designed for sampling gaseous organics in a given volatility range. The common way is to collect samples in I/SVOCs range using TA tubes and VOCs using summa tanks. There indeed are commercially available tubes for VOC collections. In this regard, further information on the methodology section and quality assurance is needed, either in the main text or SI. How did you choose the sampling materials, and what are their adsorption efficiencies for VOCs and IVOCs. The authors also mentioned that VOCs contributed to the majority of total EFs, i.e., over 80% as shown in Figure 1. Are these numbers arising from sampling biases that tubes don't trap IVOCs efficiently?

Response: Thank you for your comment. A detailed comparison of summa tank-based GC-MS and TD-GC×GC-MS is in preparation in another manuscript, which could be regarded as a validation of the adsorption efficiency of VOC-IVOCs by Tenax TA tubes. A comprehensive tunnel experiment was conducted and the performance of GC-MS and TD-GC×GC-MS was compared in detail. We could provide some simple results as follows to illustrate the accuracy of TD-GC×GC-MS in quantifying VOC-IVOC species. Figures A1 and A2 display the correlation analysis of benzene-C3 and chlorobenzene. Good agreements were obtained showing the reliability of TD-GC×GC-MS. The sampling materials (Tenax-TA) could be validated by cross-instrument comparisons as follows.

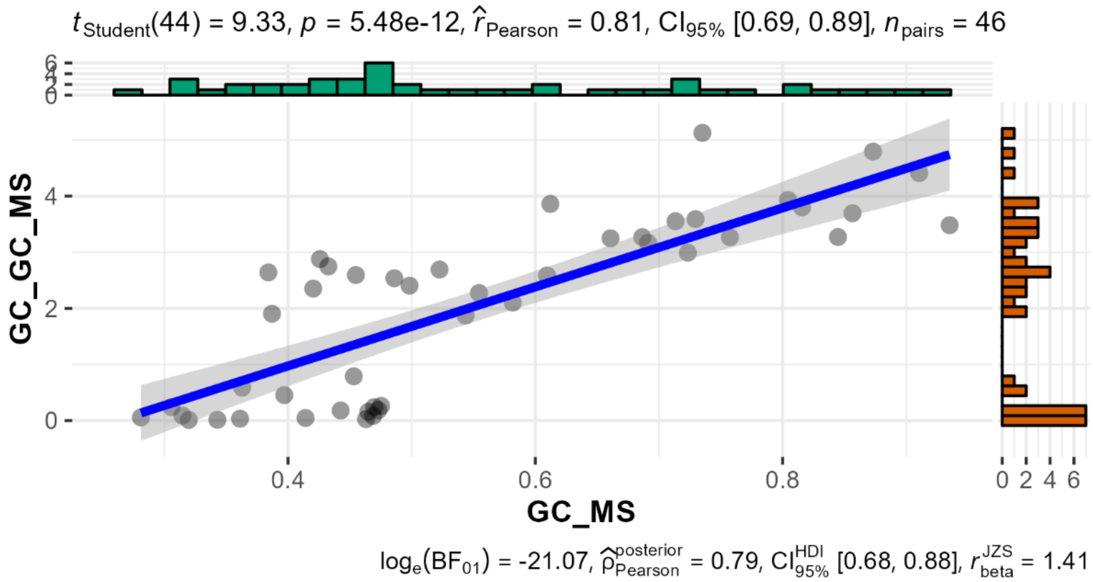

Figure A1. Correlation analysis of emission factors (EFs) of benzene-C3 obtained by SUMMA-GC-MS (*x*-axis) and TD-GC×GC-MS (*y*-axis). The slope is not equal to 1 as we summarised the EFs of all benzene-C3 isomers ($p < 0.001$).

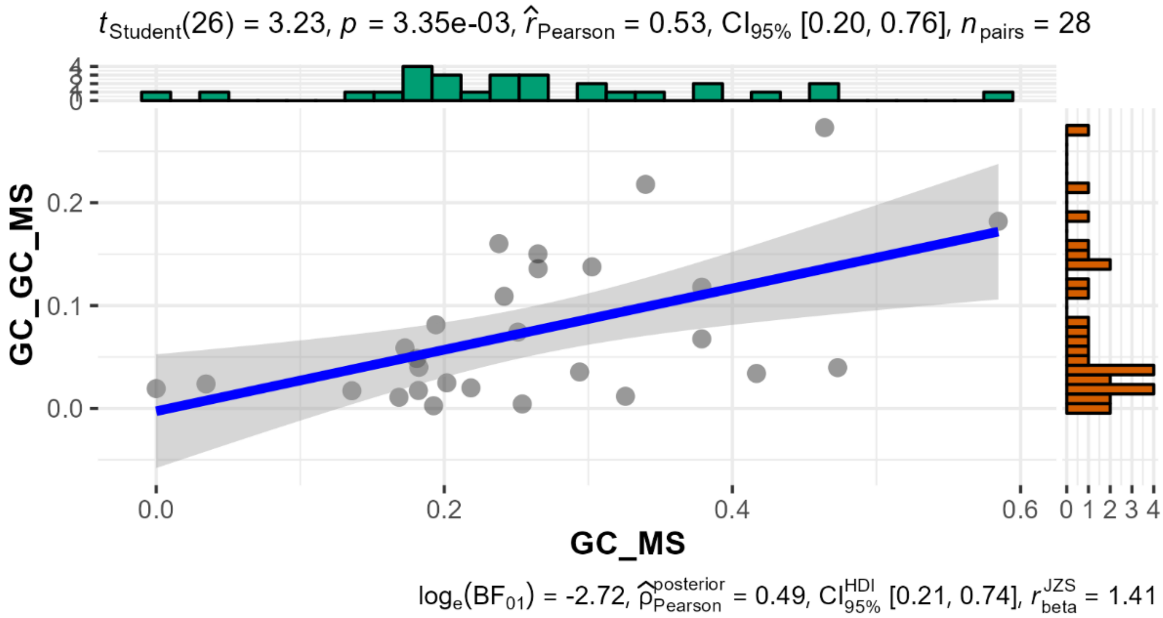

Figure A2. Correlation analysis of emission factors of chlorobenzene obtained by SUMMA-GC-MS (*x*-axis) and TD-GC×GC-MS (*y*-axis). The slope is near equal to 1 with $p < 0.001$.

Due to the discussion above, uncertainty mainly occurs as TD-GC×GC-MS fails to detect certain chemicals with higher volatility (mainly VOC compounds) as discussed in the implication part of this manuscript. We notice that reliable comparison of IVOC capture efficiency among different materials is still not available in most studies.

Modifications in the manuscript:

Further investigation should be carried on to elucidate emission characteristics of short-chain compounds that are lacking in our research, such as alkanes (<C7), alkenes (<C7), and aldehydes (<C5). By combining data obtained from gas-chromatography-flame ionization detector (GC-FID) and proton transfer mass spectrometer (PTR-MS), the emission pattern of incense burning could be well demonstrated. Comparisons of IVOC capture efficiency on different sampling materials should also be taken into account to obtain a reliable quantification result of IVOC species. High-time resolution measurement should also be carried on to understand the time-resolved pattern of incense burning.

Line 146 a space missing before Table S3.

Response:

Thank you for your comment. We added a space and the revised sentence is displayed as follows:

Where $k_{OH,i}$ and $Y_i$represent the OH reaction rate and SOA yield of precursor *i*, respectively (Table S3).

Modifications in the manuscript:

Where $k_{OH,i}$ and $Y_i$represent the OH reaction rate and SOA yield of precursor *i*, respectively (Table S3).

Lines 267&269, delete the "_".

Response: Thank you for your comment. We deleted the "_" and went through the manuscript for double-checking. The revised sentences are displayed as follows.

Phenols only account for 11.0% of SOA estimation in this work. Alcohols (7.3%) and furans (7.6%) are much more important SOA precursors in incense burning compared to biomass burning and cooking emissions. Compared with other sources, we stress the importance of incense-burning benzenes, furfural, alcohols, and phenols in OFP formation and alcohols and furans in SOA formation. The secondary formation potential of mosquito coils is the lowest, while OFP and SOA of burning smokeless sandalwood sticks are the highest. Compared to other incense, the higher aromatic contents of smokeless sandalwood sticks burning fumes result in much more ozone and SOA formation.

Modifications in the manuscript:

Phenols only account for 11.0% of SOA estimation in this work. Alcohols (7.3%) and furans (7.6%) are much more important SOA precursors in incense burning compared to biomass burning and cooking emissions. Compared with other sources, we stress the importance of incense-burning benzenes, furfural, alcohols, and phenols in OFP formation and alcohols and furans in SOA formation. The secondary formation potential of mosquito coils is the lowest, while OFP and SOA of burning smokeless sandalwood sticks are the highest. Compared to other incense, the higher aromatic contents of smokeless sandalwood sticks burning fumes result in much more ozone and SOA formation.

Lines 138&139. The sentence “Where EFi is ….” is grammatically incorrect. Please re-write it.

Thank you for your comment. The revised sentences are displayed as follows:

The ozone formation potential (OFP, μg g^{-1}) was calculated using equation (2). EF_i is the emission factor of precursor *i* (μg g^{-1}) with maximum incremental reactivity (MIR) of MIR_i.

Modifications in the manuscript:

The ozone formation potential (OFP, μg g^{-1}) was calculated using equation (2). EF_i is the emission factor of precursor *i* (μg g^{-1}) with maximum incremental reactivity (MIR) of MIR_i.

Response to Referee #2:

OVERALL COMMENTS:

This paper gives us a full glimpse of incense smoke by the non-target approach of GC×GC-MS which 371 compounds are identified. Incense and I/SVOCs emissions are neglected as part of burning studies before. The emission of incense burning is an important source of contribution to ozone and SOA formation. The MIR, OFP, SOA yields, EF factors, and tracers of incense burning are also listed which can give scientific support to other studies. The potential risks of these compounds evaluated in this paper can also give an important effect to reveal and assess the epidemiological influences of incense burning in future work.

Response: We greatly appreciate the careful review of this manuscript. We have addressed the comments and revised the manuscript accordingly.

INDIVIDUAL COMMENTS:

Line 119-120: What is the quantification rule, as shown in lines 119-120? Usually, the data was calculated as 1/2 LOQ when it matched the IDL.

Response: IDLs for organics semi-quantified (without standards) are unknown, as a result, chemicals with negative values calculated by calibration curves were quantified by the volume-to-mass (ng) ratio of the lowest quantification point of standards. The manuscript was revised accordingly.

Modifications in the manuscript:

Instrument detection limits (IDLs) for organics semi-quantified were unknown, as a result, chemicals with negative values calculated by calibration curves were quantified by the volume-to-mass (ng) ratio of the lowest quantification point of standards (Table S2).

Lines 190-197: The Tenax-TA method is not a very efficient sorbent for VOCs as the authors showed in lines 185-188. So the result from lines 190 to 197 should be clarified the VOCs here are the part of compounds captured by Tenax-TA, not the common VOCs detected by SUMMA-GC/MS.

Response: Thank you for your comments. The manuscript was revised accordingly.

Modifications in the manuscript:

The top 10 compounds are all VOC compounds (Figure S4), accounting for 35.3% of the total EFs. Toluene (70.8 ± 35.7 μg g^{-1}) is the most abundant compound in incensing-burning smoke, followed by benzene, furfural, phenol, styrene, 2-oxo-propanoic acid methyl ester, 3-methyl-2-butanone, ethylbenzene, 1-hydroxy-2-propanone, and benzyl alcohol. Note that VOC compounds discussed here are part of volatile organics captured by Tenax-TA, not the common VOCs detected by SUMMA-GC-MS.