Reviewer(s)' Comments to Author:

Reviewer: 1

General comments

This work presents a very detailed and thorough technology-based global NMVOC emission evolution inventory 1970-2020, which is also compared to other widely used inventories. Overall, the quality of the presented work is very high.

Response: We thank the Referee for the positive view on the manuscript and the thoughtful suggestions below. We've made a number of revisions in response, and believe the manuscript has been improved. A point to point response is presented below.

Specific comments

Introduction: The authors should add at least a paragraph discussing in some detail the representation of the speciation of NMVOC and differences in lumping in different inventories, including the presented one.

Response: We thank the Referee for the thoughtful comment. As suggested by the Referee, we have added a paragraph in the Introduction to describe NMVOC speciation and lumping for different chemical mechanisms, as well as their relationship with total NMVOC emission estimates. Relevant references are also cited.

"NMVOC emission estimates also provide the basis for emission data used in chemical transport models (CTMs) by further developing chemically-resolved NMVOC speciation and subsequent lumped emissions with different chemical mechanisms (Li et al., 2019; Huang et al., 2017). Therefore, the biases and uncertainties in total NMVOC emission estimates can be compounded by those in speciation profiles and mechanism-specific mapping tables (Huang et al., 2017; von Schneidemesser et al. 2023), affecting accurate emission estimates of key species such as HAPs (Pye et al., 2023; Li et al., 2019) and modeling performance of O_3 and SOA in CTMs (von Schneidemesser et al., 2016; Rowlinson et al., 2024; Oliveira et al., 2025)."

However, it should be noted that this study focuses on the estimates and evaluation of total NMVOC emissions and does not include speciation or lumping methodology/analyses. This allows us to present a detailed description of the methodology and a comprehensive analysis for total NMVOC emission estimates without making the manuscript overly lengthy and complex.

We are currently working on NMVOC speciation and lumping to chemical mechanisms in the MEIC-global-NMVOC emission inventory, with preliminary results prepared for a separate manuscript. We first collect speciation profiles by integrating existing profile datasets and new measurements (e.g., Simon et al., 2010; Theloke and Friedrich, 2007; Li et al., 2014). These profiles are then mapped to each emission source, and uncertainties are reduced by developing

composite profiles with corrections for OVOC fractions (Li et al., 2014). NMVOC emissions are speciated to derive chemically-resolved emissions using the source-specific emission estimates presented in this work and the developed profiles. Finally, we apply the mapping tables developed by Carter (2023) to lump the chemically-resolved emissions into chemical-mechanism-specific emissions that can be used directly by different chemical transport models.

We are committed to presenting the detailed methodology and results of NMVOC speciation and lumping in a separate manuscript. We hope the Referee understands our considerations for addressing these efforts separately. We also acknowledge that the lack of speciation and lumping analysis is a limitation of the current study and have added a brief discussion in Section 4.1 of the revised manuscript as below.

"Finally, NMVOC emission speciation is not included in this study, but will be addressed in future work to provide species-resolved emissions and model-ready emissions for different chemical mechanisms."

References:

Simon, H., Beck, L., Bhave, P. V., Divita, F., Hsu, Y., Luecken, D., Mobley, J. D., Pouliot, G., Reff, A., Sarwar, G., and Strum, M.: The development and uses of EPA's Speciate database, Atmos. Pollut. Res., 1(4), 196-206, 2010.

Theloke, J., and Friedrich, R.: Compilation of a database on the composition of anthropogenic VOC emissions for atmospheric modeling in Europe, Atmos. Environ., 41(19): 4148-4160, 2007.

Li, M., Zhang, Q., Streets, D. G., He, K. B., Cheng, Y. F., Emmons, L. K., Huo, H., Kang, S. C., Lu, Z., Shao, M., Su, H., Yu, X., and Zhang, Y.: Mapping Asian anthropogenic emissions of non-methane volatile organic compounds to multiple chemical mechanisms, Atmos. Chem. Phys., 14, 5617–5638, 2014.

Carter, W. P. L.: Development of an improved chemical speciation database for processing emissions of volatile organic compounds for air quality models, https://intra.engr.ucr.edu/~carter/emitdb/, 2023.

Section 4.2 comparison with other inventories: Do all the compared inventories use the same speciation/lumping for NMVOC? If not, the authors should discuss also what this might imply for the comparison.

Response: We thank the Referee for the thoughtful comment. As mentioned above, this study primarily focuses on the estimates and analysis of total NMVOC emissions. Therefore, speciation and lumping processes do not influence the comparative results of total NMVOC emissions presented in this manuscript. Nevertheless, as the Referee points out, the differences in total NMVOC emissions can be further compounded by the differences in speciation profiles and chemical-mechanism-specific mapping tables in the subsequent steps of NMVOC speciation and lumping. To reflect this important point, we have added a paragraph in Section

4.2 discussing the differences in total NMVOC emissions, speciation, and lumping, as well as their implications.

"Importantly, the discrepancies in NMVOC emission estimates among the emission inventories can propagate through subsequent steps of chemical speciation and chemical-mechanism-specific lumping, ultimately affecting emission estimates of key chemical species and the performance of CTMs in simulating secondary air pollutants (Pye et al., 2023; von Schneidemesser et al., 2016). Therefore, it is crucial for developers of NMVOC emission inventories to collaboratively identify and diagnose the underlying causes of these discrepancies and to better constrain source-specific total NMVOC emission estimates before the differences are further amplified by the application of different speciation profiles and mapping tables for chemical-mechanism-specific lumping (Huang et al., 2017; von Schneidemesser et al. 2023)."

As mentioned above, the detailed comparison and evaluation related to speciation and lumping will be presented in a separate manuscript. We hope the Referee understands our considerations for addressing these efforts separately.

Line 235, "as higher temperatures lead to more NMVOC evaporation": here the authors might e.g. cite Kourtidis K.A., I.C. Ziomas, B. Rappenglueck, A. Proyou, D. Balis, Evaporative traffic hydrocarbon emissions, traffic CO and speciated HC traffic emissions from the city of Athens, Atmospheric Environment 33(23), 3831-3842, 1999, https://doi.org/10.1016/S1352-2310(98)00395-1

Response: We thank the Referee for the constructive suggestion. The references have been supplemented as shown below.

"For start and evaporation modes, the effects of ambient temperature were considered in the calculation, as higher temperatures lead to more NMVOC evaporation (Kourtidis et al., 1999; Rubin et al., 2006), …"

References:

Kourtidis, K. A., Ziomas, I. C., Rappenglueck, B., Proyou, A., and Balis, D.: Evaporative traffic hydrocarbon emissions, traffic CO and speciated HC traffic emissions from the city of Athens, Atmos. Environ., 33(23), 3831-3842, 1999.

Rubin, J. I., Kean, A. J., Harley, R. A., Millet, D. B., and Goldstein, A. H.: Temperature dependence of volatile organic compound evaporative emissions from motor vehicles, J. Geophys. Res. Atmos., 111(D3), 2006.

Fig. 2 in page 9: This appears more like a Table than a Figure.

Response: We thank the Referee for the constructive comment. As the Referee suggested, Figure 1 could be presented as a table. However, we believe that using different colors and shading in the figure helps to distinguish regions and policy stages, thereby improving the

readers' understanding of policy timelines. Since ACP tables are required to be black and white, we have retained the figure format.

Technical corrections

Line 26: Change "growths were" to "growth was".

Line 55: We feel that the authors by "are generally not presented in detail" mean "are generally not detailed enough"

Line 58: Change "should be concerned" to "should be addressed" and "First" to "Firstly".

Line 60: Change "chemical" to "the chemical".

Line 61: Change "Second" to "Secondly".

Line 76, 158, 279, and elsewhere in the text: It is not clear what the authors mean by the plural "literatures".

Line 141and footnote of Table 1: Change "synchronously" to "simultaneously".

Lines 158-159: "market surveys for available years" means "market surveys for the years such surveys were available"?.

Line 192: Change "stove type proportion" to "stove type percentages".

Line 194: Change "the besting performing" to "the best performing".

Line 209: Change "penetration of advanced stove" to "penetration of advanced stoves".

Line 255: Change "scatters" to "circles".

In Fig. 3, a legend with the different line colors would help.

Line 401: Change "maintained stable" to "remained stable".

Response: We thank the Referee for the helpful and detailed suggestions. The technical errors have all been corrected in the revised manuscript.