

We are grateful to the referees for the encouraging comments and careful reviews which helped to improve our paper. The point-by-point responses and corresponding changes within the manuscript are shown below. The comments are in black, and the responses are in blue. The changes within the manuscript are italicized.

## **Reviewer #2**

This manuscript by She et al. evaluated the model performances in simulating volatile organic compounds (VOCs) in summer in multiple cities in China by using the CMAQ model. The author also investigated the influences of adjusting VOC emissions on O<sub>3</sub> simulations and discussed the sensitivities of O<sub>3</sub> to different VOCs. This study enriches our understanding of model performances in simulating VOCs and provides insights for developing VOC emission inventories in the future. The study is logically designed and the manuscript is well organized. I have some editorial suggestions as follows:

Line 70: substantial underprediction of => a substantial underprediction of

**Response:** Thanks, we have made the correction.

Lines 73-75: “notable effects on air pollutants” vague. What pollutants? “enhance model performance” => “improve model performance”.

**Response:** Thanks for the comment. In the study of Zhu et al. (2019), they analyzed the impact of the augmented VOC emission inventory on O<sub>3</sub> (maximum 8-hr ozone concentrations increase by 17.4 ppb in summer and by 15.6 ppb in winter) and PM<sub>2.5</sub> (24-hr maximum PM<sub>2.5</sub> increase by 7.8 µg/m<sup>3</sup> in winter). We have replaced “air pollutants” with “O<sub>3</sub> and PM<sub>2.5</sub>”, and used “improve” instead of “enhance” in the main text.

Line 97: There have been studies evaluating VOC predictions in China so that “for the first time” may not be appropriate. It is recommended to commence a new paragraph from here and add the key findings of this study.

**Response:** Thanks for the comment. We have removed “for the first time” and revised the paragraph as follows:

Lines 103-109 in the revised manuscript:

*The results of this study indicated that the model performance of VOCs in China still has much room to improve, likely with a focus on updating emission inventories in fast-growing industrial cities. Most sites underpredicted TVOCs, and the biases of alkenes significantly impacted O<sub>3</sub> production. These findings enhanced our understanding of the current VOC modelling in air quality models, which could help to improve VOC emission inventory and O<sub>3</sub> prediction in the future.*

Lines 100-106: Please rephrase this sentence.

**Response:** Thanks for the comment. We have rephrased it as follows:

Lines 100-103 in the revised manuscript:

*This study aimed to assess the disparities between measured VOC concentrations and*

*predictions in various regions of China using the widely used CMAQ model. We quantified the impacts of VOC biases on O<sub>3</sub> predictions through emission adjustments based on observation-prediction differences.*

Line 108: “Observation description” => “Observation data”

**Response:** Revised.

Line 111: “VOC measurement” => “VOC measurements”

**Response:** Revised.

Line 113: “collection devices” => “sampling devices”

**Response:** Revised.

Line 119: “formaldehydes” => “formaldehyde”

**Response:** Revised.

Line 222: “The observed ratios of TVOCs predictions ...” This is confusing. Do you mean “the ratio of observed to predicted TVOCs”?

**Response:** Thanks for the comment. We have revised it as you suggested.

Lines 239-241: Please rephrase this sentence.

**Response:** Thanks for the comment. We have rephrased this sentence as follows:

Lines 252-255 in the revised manuscript:

*The predicted proportions of aromatics (13.1% to 22.8%) and HCHO (15.3% to 28.9%) were higher than in the observations. In addition, alkynes were predicted to have a minor contribution to TVOCs.*

Line 254: Remove “Regarding alkenes”.

**Response:** Revised.

Line 259: “predicted content” => “predicted concentration”

**Response:** Revised.

Line 260: ACYE was lower than what? “predicted HCHO” => “HCHO”

**Response:** Thanks for the comment. In this sentence, the predicted ACYE was lower than the observation, we have clarified it in the main text.

Lines 273-275 in the revised manuscript:

*Furthermore, the predicted concentration of acetylene (ACYE) was lower than observation at all sites ( $0.41 \pm 0.47$  for alkynes), while the HCHO was slightly overpredicted ( $1.21 \pm 1.61$  for HCHO).*

Line 262: Remove “that” before “the majority of emitted VOCs”.

**Response:** Revised.

Line 313: “concentration differences” => “differences”

**Response:** Revised.

Line 316: “NO<sub>2</sub> concentrations was” => “NO<sub>2</sub> concentration was”

**Response:** Revised.

Line 355: “aromatic” => “aromatics”

**Response:** Revised.

Lines 387-389: Does “ratio” mean the fraction of TVOCs? However, in line 211, “ratio” is specifically referred to as the prediction/observation ratio.

**Response:** Thanks for the comment. We have made the correction.

Lines 406-408 in the revised manuscript:

*The predicted ETHE in ZH was higher (50% of alkenes) than the observation (20% of alkenes), while other cities exhibited similar ETHE percentages.*

Line 393: Do you mean “urban and background areas”?

**Response:** Thanks for the comment. We have made the correction.

Line 403: “with a decrease of 6.91 ppbV compared to the observation values” This is confusing. Are the alkanes underpredicted by 6.91 ppbV?

**Response:** Thanks for the comment. We clarified in the main text:

Lines 420-422 in the revised manuscript:

*Each of the five VOCs showed lower predictions, with alkanes exhibiting the most notable disparity, with a negative bias of 6.91 ppbV compared to the observation values*

Line 410: “different regions and urban background areas” => “urban and background areas in different regions”

**Response:** Revised.

Line 421: “a notable monoterpene” => “an important monoterpene”; “including”=>“originating from”

**Response:** Revised.

Line 436: “substantial variation” => “a substantial variation”

**Response:** Revised.

Line 500: “Through considering” => “After considering”; “the MEIC model” => “the MEIC inventory”

**Response:** Revised.

Line 516: “inaccuracies” => “uncertainties”

**Response:** Revised.

Thanks for your careful editing to help us improve the English grammar and quality of our manuscript!