Reviewer 1

In this paper, the authors extended the OSAT of CAMx model to include the function of tracking the lifetime of ozone precursors which then can quantified the temporal contributions of ozone. With the implementation of the method, they analyze the spatial and temporal contributions of difference geographical sources to ozone in GBA in summer in 2016. The research is interesting, but I have some questions which the authors should answer before this paper be published in this journal.

[Response]: We thank the reviewer for the positive and encouraging comments. In the revised manuscript, we have added more elaboration of the TSA method and model setting in the main text. More discussion of the TSA method application has also been added. Please see our point-by-point response below. The additional content in the revised manuscript is marked with italics in the response. Thank you!

1. In section 2.1, it introduced that the temporal tagging method set a-five-day range. Please show us the reason why you set a-five-range to tracking the air pollutants. Because we can see the contribution of day-4(all the contribution from the days earlier than 3 days ago) to ozone is not small (sometime can reach up to 20%), maybe increase the range can show us more information about the ozone contributions from the four days ago or even earlier.

[Response]: Thanks for your comment. The primary objective of this study is to examine the collective spatial-temporal impact of different sources on O_3 levels in the GBA region. By utilizing the TSA method, the tracers employed will be N times greater than those used in the OSAT method when set to a-N-range. In this study, we have chosen to set it to a-five-range to assess the influence of a broader range of source areas, taking into account computational resources. In addition, Figure 5 shows the time series of contributions from different source areas and emitting periods to the O_3 concentrations in the GBA. It shows that the influence of pollutants emitted earlier than 3 days ago was much smaller in July. Usually, the pollutants emitted earlier than 3 days ago originate from the ocean and other countries. However, we agree with the reviewer that it's necessary to investigate further the contribution of pollutants emitted from earlier periods, which will provide more information, such as O_3 concentration in late August. The preliminary result of this study could provide a reference for a more comprehensive and targeted investigation in future work. We have clarified it in the discussion section. Please refer to Line 554-558 in the revised manuscript.

"Meanwhile, our preliminary findings indicate that pollutants emitted more than three days prior can still have a considerable impact on the O_3 levels in the GBA. As a result, it would be valuable to conduct source apportionment analyses with finer source areas and earlier source periods for O_3 pollution in different cities within the GBA. This further investigation would provide deeper insights into the unique O_3 pollution characteristics of each city."

2. The model outputs are generated by a continuously run simulation. I am curious that what the temporal contribution results will be like if your simulation is segmented run.

[Response]: Thanks for your comment. The model results were generated by the segmented simulation. We conducted one day simulation each time. The simulation result of the last hour in the current day's simulation will be used as the initial conditions for the next day's simulation. Hence, in theory, the model results obtained from the segmented run are identical to those obtained from the continuous run.

3. Also, about the temporal tagging method, the chemical production of ozone should both consider the NOx and VOCs. How do you deal with the ozone precursors when they are emitted in different days.

[Response]: Thanks for your comment. In the OSAT method, the sensitivity of O_3 formation is determined by the photochemical indicator, the ratio of the production rate of hydrogen peroxide (H_2O_2) and nitric acid (HNO_3) (denoted as $P(H_2O_2)/P(HNO_3)$). When the $P(H_2O_2)/P(HNO_3) > 0.35$, the O_3 formation is classified as NOx-limited. In this case, the contributions to ozone formation are attributed to different NOx sources based on the proportion of their emissions to the total NOx emissions. Conversely, when the O_3 formation is classified as VOC-limited, the contributions are proportionally attributed to the sources of VOCs. Hence, the TSA method follows the same rule to determine the sensitivity of O_3 formation. When it is NOx-limited, the contributions are proportionally distributed to the NOx sources emitted on specific days. Same method is applied to VOCs sources when it is VOC-limited. We have added more description of the O_3 formation sensitivity in the TSA method in Line 138-142 in the revised manuscript.

"*Same as the OSAT method, the TSA method also utilizes the photochemical indicator, namely, the ratio of the production rate of hydrogen peroxide (H_2O_2) and nitric acid (HNO_3), to determine the sensitivity of O_3 formation. When the O_3 formation is classified as NOx-limited (VOC-limited), the contributions are distributed to the NOx (VOCs) sources emitted at different periods, based on the proportion of their emissions to the total NOx (VOCs) emissions."*

4. Please pay attention to your presentation, the language needs to be more carefully polished.

[Response]: Thanks for your comment and suggestion. We have thoroughly reviewed and checked the English writing of the manuscript. For example, in the discussion section,

" *Previous studies mainly focused on exploring the contribution and control of various source areas and categories on O_3 over the GBA. The analysis in this study illustrated that there could be a larger difference between the temporal contribution of emissions to the O_3 pollution over the GBA under different weather patterns. This finding emphasizes the importance of*

understanding the contribution of pollutants from different emission periods and identifying the major periods, particularly in episodic cases, for effective policymaking in pollution control. In contrast to the zero-out method, which requires multiple simulations, our approach provides a comprehensive overview of source contributions within a single simulation. This method is suited for applications involving more potential sources as it saves computation costs. "

"*In the context of climate change, the occurrence of extreme weather, such as extreme heatwaves (Coffel et al., 2018; Dong et al.,2023), is expected to become more frequent. These events will significantly impact the sources and sinks of pollutants through various physical and chemical processes. At the same time, governments in different countries will implement various emission control strategies in response to climate change, such as carbon neutrality (Liu et al., 2021; Zhang et al., 2021), which will also alter the emission structure. How these extreme weather events and control measures influence the temporal characterization of sources, the formation of air pollution, and the spatial-temporal contribution of emissions from different countries, as well as their interactions, are also worth further investigation in the future. Such investigations can foster mutual cooperation among nations to collectively address environmental challenges.* "