General comments:

Ma et al. presented the OH and HO_2 radical measurement conducted at a rural site in Yangtze River Delta, China. A box model based on RACM2-LIM1 was used to simulate the radicals concentrations, which was underestimated the OH at low NO (<1ppb) conditions. The influence of monoterpene oxidation and heterogenous loss of HO_2 on aerosol surface were tested. The authors also summarized the HOx measurement in (sub)urban environments all over the world, which gave a very nice overview of the HOx studies. Overall, the manuscript is well-written, and the investigation is scientifically sound. I strongly recommend the publication with some minor modification.

Answer:

We would like to thank the reviewer for comments and questions which helped us to improve the manuscript. The reviewer comments are given below together with our responses and changes made to the manuscript. The technical comments were changed accordingly and not listed below for simplify.

Major comments:

1. *Line 189, Information on back trajectory analysis of air masses is better added in the SI for the demonstration.*

Answer:

We added the back trajectory analysis of air masses during this campaign in SI (Fig. S3).

2. *Figure 2: Oxidation product of HCHO and Gly diurnal pattern show peaks in morning, which is not the common sense of their formation pathway in summertime. Even for the urban site in YRD, these two species also show comparable abundances but higher levels around noontime (Guo et al., 2021). Could the authors explain more about the anthropogenic emission-related origin?*

Answer:

HCHO and glyoxal are not only photochemical product of VOC oxidation, but also from primary biogenic and anthropogenic emissions, including vegetation, biomass burning, fossil fuel combustion, and biofuel consumption. Since the EXPLORE-YRD campaign was conducted during a harvest season, biomass burning events occurred frequently. The elevated concentration might be due to the biomass burning activity.

We added some sentences to explain this in Sect. 3.1 as 'Since this campaign was conducted during a harvest season, agriculture biomass burning might be responsible for the elevated HCHO and glyoxal in the early morning (Guo et al., 2021;Liu et al., 2020;Wang et al., 2017;Silva et al., 2018).'

3. *The investigation of possible influence of monoterpene on radical chemistry and*

ozone production is interesting and of importance. I agree with Reviewer#1 that additional discussion on the monoterpene oxidation (most probably using alpha-pinene as a representative) would benefit the manuscript. However, lacking the simultaneous measurement of RO_2 concentration and OH reactivity, one could not really draw solid conclusion from this comparison. It's unlikely to test the chemical mechanism with the current dataset. Therefore, I suggest to minimize the discussion on monoterpene and only show the potential impact. The same applies to the closure of OH reactivity.

Answer:

We agree with the reviewer that lacking of the simultaneous measurement of RO_2 concentration and OH reactivity, we could not draw solid conclusion. Nevertheless, we performed a series of sensitivity tests to investigate the impact of the applied monoterpene oxidation mechanism and the potential missing OH reactivity on the modelled radical concentrations and ozone production rates in this study. Detailed discussion can be found in the response to Reviewer#1.

4. *I would like to suggest the authors can review other literatures reporting the precursors related species, e.g. HONO, HCHO etc to the ROx production in YRD areas to strengthen the discussion, and destruction also.*

Answer:

We added some discussions of the radical sources and destructions in YRD region in Section 4.1. as 'Two recent winter campaign in the same region also found HONO photolysis dominated radical primary source, contributing 38% to 53% of the total radical sources, despite the overall radical production rates were several times lower than that in summertime (Lou et al., 2022;Zhang et al., 2022). The photolysis of HONO is one of the most important radical primary sources in worldwide urban and suburban areas for both summer (Ren et al., 2003;Dusanter et al., 2009;Michoud et al., 2012;Whalley et al., 2018;Tan et al., 2017) and winter time (Ren et al., 2006;Kanaya et al., 2007;Kim et al., 2014;Tan et al., 2018;Ma et al., 2019).'

5. *In addition, comparison with wintertime OH and HOx in YRD may benefit the discussion on measurements and simulation throughout the manuscript, which can help to give the full view of the year for YRD region, e.g. Zhang et al., 2022.*

Answer:

We added some sentences about the wintertime HOx in YRD in Section 3.2. 'A recent winter observation in Shanghai in YRD region reported an averaged noontime OH concentration of 2.7×106 cm-3 (Zhang et al., 2022), which was comparable to or even higher than that was observed in winter Beijing (1.7~3.1×106 cm-3) (Tan et al., 2018;Ma et al., 2019;Slater et al., 2020). It demonstrated the strong atmospheric oxidation capacity in this region among the three megapolitan areas (NCP, PRD, and

YRD) in China from the perspective of OH concentration.’

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