

We thank for the constructive comments and suggestions. We revised our manuscript according to the comments and suggestions. The following list the point-to-point response to the comments.

Comment #3

The manuscript titled "Surprisingly high levels and activity contributions of oxygenated volatile organic compounds on the southeast of the Tibetan Plateau" by Guo et al. reports findings from the @Tibet field campaigns 2021. The study focuses on oxygenated volatile organic compounds (OVOCs), which are significant for tropospheric chemistry due to their roles as precursors to free radicals. The research found high levels of OVOCs in Lulang, a region on the southeast of the Tibetan Plateau characterized by high vegetation cover and intense solar ultraviolet radiation. The study detected 13 OVOCs accounting for 49% of the total VOCs, with notable diurnal variation peaking at noon. These compounds contributed significantly to VOC reactivity and ozone formation potential. Source apportionment using positive matrix factorization and photochemical age parameterization methods indicated that biogenic sources, particularly plant emissions influenced by sunlight, were the primary contributors to the OVOC levels, with biomass burning also being a significant source.

The dataset may benefit the broad research community from the geographical uniqueness of the field site. However, the manuscript should clarify the key analyses of the manuscript to evaluate the scientific merit of the manuscript.

1. I am not convinced the level of OVOC observed in this manuscript should be considered 'surprising.' surprising is an ill-defined term for scientific literature. Using the term would be more acceptable if the presented results clearly contrasted with conventional wisdom, which is not the case for the presented dataset. I think OVOCs should be high in the studied area as it is far away from the major emission sources. I would recommend either the authors **drop the term 'surprising**, or make a scientific argument if the observed OVOC levels are 'surprising'

Response: Accepted. We delete the term 'surprising' in the revised manuscript.

2. Equation 3 appears too simplistic to account for real-world source distributions. **Many other anthropogenic VOCs produce OVOCs other than benzene.** The study should **discuss how dominant benzene is as an OVOC source** for justification. I understand **isoprene** is the most dominant BVOC on the global scale, but locally, it may not be the case. Without a proper justification, the underlying assumption cannot be prudently established.

Response: CO, acetylene, and benzene are commonly used as tracers for primary emissions from anthropogenic sources. De Gouw et al. (2005) firstly described the photochemical age-based parameterization method, using acetylene as a tracer for primary anthropogenic emissions. Subsequent studies employing this method for OVOC source apportionment have predominantly used benzene as the tracer for primary anthropogenic emissions (Zhu et al., 2019; Huang et al., 2019; Zhu et al., 2021). In our data analysis, we found that the peak response of benzene was better than that of acetylene, resulting in more accurate quantification. Therefore,

we chose benzene as the tracer for primary anthropogenic emissions in my calculations. Both concentration contribution and the contribution to the rate constant of OH reaction (k_{OH}) from benzene to total anthropogenic VOCs suggest benzene is also a major anthropogenic VOC and source of OVOCs.

Isoprene is mainly emitted from plants, although some studies have reported its emission from vehicle exhaust as well. However, in the vicinity of Lulang, where the vegetation cover is dense and anthropogenic emissions such as vehicle exhaust are relatively low, isoprene was selected as a tracer compound for biogenic emissions. Furthermore, based on the diurnal variation of isoprene and the results of PMF source apportionment, it is evident that local isoprene emissions are predominantly biogenic in nature.

3. In the past decade, a substantial progress has made in the atmospheric isoprene oxidation processes, which illustrates the first-generation oxidation product yield (e.g. MVK and MACR) substantially varies **as a function of the NO levels**. The Equation (2) should be reconsidered to reflect the development.

Response: We appreciate the reviewer's comment on the progress in atmospheric isoprene oxidation processes and the potential impact on our Equation (2). We have discussed in more details our method and uncertainties.

The approach adopted in our manuscript assumes that biogenic source of OVOCs and isoprene emission should be proportional under specific conditions, such as solar radiation intensity, temperature and oxidant concentrations and NO concentrations. We have indeed measured similar diel profiles of solar radiation intensity, temperature and oxidant concentrations and NO concentrations from day to day, which supports our assumption. The measured results are reasonable within the monthly measurement period and at a site far from anthropogenic emissions.

Utilizing the measured relationship between typical OVOCs such as MVK and MACR, and their parent VOC isoprene, we estimate the hydroxyl radical exposure $[OH]\Delta t$ and back-calculate the initial isoprene concentrations. However, we acknowledge that this calculation method has inherent errors and uncertainties. For instance, the calculation primarily considers the chemical conversion of isoprene, neglecting dilution effects. Consequently, the initial concentration of isoprene may be underestimated. Nevertheless, OVOCs and isoprene undergo similar dilution in the atmosphere, suggesting that the OVOC/isoprene ratio is less affected by dilution. In addition, simplified chemical conversion assumption by OH radicals might be another source of uncertainties. The VOC-oxidation reactions initialized by ozone and NO_3 radical during nighttime, as well as Cl radicals at daytime, are not negligible. Furthermore, the reaction pathways and OVOC yields from isoprene can vary under different NO levels, further contributes to the uncertainties in determining OVOCs/isoprene ratio and the initial concentration of isoprene. Nevertheless, the oxidation reactions of VOCs initiated by various oxidants under various NO conditions may already be reflected in our measured relationship between MVK and MACR and their parent VOC isoprene. Overall, this method should provide a reasonable deduction result on initial concentration of biogenic VOCs.

Nonetheless, we will expand our discussion on the limitations of our approach in the revised manuscript, addressing potential sources of uncertainty and highlighting the need for further research in this area.

References:

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