Responses to the Reviewers' Comments

We would like to thank the editor and two anonymous reviewers for their helpful comments and suggestions. All authors have read the revised manuscript and agreed with the submission in its revised form.
Reviewers' comments are in black color, our responses are in blue color, and our corresponding revisions in the manuscript are in red color.

Response to the Reviewer #1

General Comments:

BVOCs are important precursors to ozone and secondary organic aerosols in the atmosphere. In this manuscript, the authors focused on a comprehensive analysis of trends in BVOC emissions from 2001-2020 on a regional to global scales and identified the contribution of various driving factors to these trends. The manuscript is well written, and I suggested the acceptance after addressing the comments below.

Response: We thank the reviewer for the encouraging comments. We have revised the manuscript following your comments.

1. The authors used a newer version of MEGAN. Could the authors elaborate the major advancement compared to previous versions such as MEGAN 2.1?

Response: Thank you. Following your comment, we have added the following text for the major advancement in the new MEGANv3.2 compared to MEGANv2.1:

in Section 2.1 "MEGANv3.2":

"Specifically, while MEGANv2.1 uses a look-up table of emission factors for the 15 PFTs corresponding to the biological emission classes (see Table 2 in Guenther et al. (2012)), MEGANv3.2 uses the so-called Emission Factor Processor, to estimate the landscape average emission factors, which are based on the following three databases: (1) Growth form datasets for four PFTs: tree, shrub, grass, and crops; (2) Ecotype datasets: composed of a mix of emission-specific tree species/grass associated with specific emission capacities; and (3) Updated tree species/grass datasets corresponding to the biogenic emission classes. These updates can distinguish the differences in vegetation emission factors in regions with the same PFT but with varying plant species. The new version also considers the additional stress factors of emissions by using the simple threshold function, including high/low temperature, strong wind, and heavy O_3 pollution."

2. Are the observations only in 2013? The seasonal variations of isoprene flux in MEGAN appears to be very small, which seems to be quite different from the observations. Any explanations?

Response: Yes, the observations are only in 2013. The magnitude of seasonal variations of the modeled isoprene flux is small compared to the observations. We have added the explanations for the small seasonal variations in simulated isoprene flux in Section 3.1.1 "Spatial distribution of BVOC emissions":

"The large bias in the seasonal variation of isoprene fluxes in MEGANv3.2 may be due to a lack of representation of the isoprene emission capacity of tree species at different leaf ages (Alves et al., 2018). Additionally, the model bias arises from a lack of realistic representations of leaf phenology, canopy structure, soil moisture feedbacks, and variation in isoprene emissions due to the complex biodiversity in the Amazon region."

3. Line 274: These discrepancies are mainly ascribed to the differences in vegetation emission factors between the two versions of MEGAN. Could the authors add some explanations the emission factors from which vegetation are more accurate?

Response: Thank you for the comment. We have added some explanation and discussion of the accuracy of the vegetation emission factors for MEGANv3.2 and MEGANv2.1 in Section 3.1.1 "Spatial distribution of BVOC emissions":

"Note that MEGANv2.1 only utilizes fixed emission factors corresponding to the PFTs, but the PFT is insufficient to characterize the emission factors, e.g., tree species with the same PFT may have very different BVOC emission rates. MEGANv3.2 further considers differences in emission factors for tree species with the same PFTs. Thus, the vegetation emission factors in MEGANv3.2 are more accurately represented. However, we note that the uncertainties associated with emission factors are still large due to the limited observational data (Guenther et al., 2020)."

4. Line 367: Could the authors explain why for monoterpene emissions, only the effects of vegetation and meteorological factors are considered?

Response: Thank for your comment. We have added the reasons why for monoterpene emissions in the model only the effects of vegetation and meteorological factors are considered in Section 3.2 "Trends of BVOC emissions":

"Different from isoprene emissions, there is no statistically significant effect of CO_2 concentration on monoterpene emissions as suggested by previous studies (Malik et al., 2019, 2023). Therefore, monoterpene emissions in MEGANv3.2 only consider the effects of vegetation and meteorological factors and show a significantly positive trend of 0.34% yr^{-1} globally (Fig. S2)."

References

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