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 #2

General Comments:

This is a study of great relevance to the atmospheric pollution modeling community. The trends presented and the sensitivity of MEGAN 3.2 to various parameters and its geographical distribution are of great interest to all of us who model both emissions and air quality. It provides interesting insights into how BVOC emissions can change at specific regions and highlights the significant impact of land-use changes and global warming.

Response: We thank the reviewer for the encouraging comments.

I would like to ask the authors if they have reviewed or analyzed the uncertainty associated with the new emission factors used in MEGAN. Have they utilized those with the highest confidence index (denoted as 'J' in the code)? Or do they consider it worthwhile to address these factors or their spatial distribution in the future? Are these emission factors the default values in MEGAN for tree, shrub, grass, and crop categories?

Response: Thank you for your comments and questions. In fact, MEGANv3.2 provides an open-source and expandable database of species-specific emission factors. The model code uses these emission factors by default, and there is no option to set a confidence index (denoted as 'J' in the code). Therefore, in this study, we did not carry out sensitivity analyses directly for the uncertainty associated with the new emission factors, but instead used ground- and satellite-based observations, and previous simulation results to evaluate our modeled BVOC emission fluxes.

Currently, most of the tree emission factors provided by MEGANv3.2 come from observations in the United States as well as from numerous literature data. Therefore, there is an urgent need to conduct observations in other hotspot regions around the globe in the future. This point has been emphasized in the Discussion section.

These emission factors are not the default values in MEGAN for tree, shrub, grass, and crop categories. Compared to MEGANv2.1, MEGANv3.2 can distinguish the differences in vegetation emission factors in regions with the same PFTs but with varying plant species. We have added a detailed explanation of the MEGANv3.2 emission factor methodology in the model introduction section.

Text about the MEGANv3.2 emission factor calculation methodology has been added 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 O3 pollution."

Was there any anomaly in the reference year of 2001 that could potentially bias the study in specific regions? Did the authors find any unexpected anomalies that they did not anticipate?

Response: Thank you for your comments. Since there are significant inter-annual variations in the drivers (vegetation, meteorology, and CO_2) affecting BVOC emissions in some specific regions. The selection of the reference year may lead to differences in the modeled BVOC emissions, primarily affecting the magnitude rather than the sign of the absolute trends. However, this study focuses on the relative trends in BVOC emissions. Differences in the reference year have little effect on the magnitude and sign of our estimation results.

We have added the following discussion of the impact of the reference year selection on our results in Section 4 "Discussion":

"Note that the selection of the reference year (i.e., year 2001 in Table 1) may cause variations in simulated BVOC emissions, mostly affecting the magnitude rather than the sign of the absolute trends. Since this study focuses on the relative trends in BVOC emissions (i.e., ratio of absolute trend to multi-year means), differences in the reference year have little effect on the magnitude and sign of our estimation results."

Possible issues I have detected:

- In line 70, based on my reading of the rest of the manuscript, shouldn't the range '0.04-0.33% yr^{-1}' be negative?

Response: Sorry for the ambiguity of this sentence, we've corrected it.

"… and pointed out that land cover changes from 2001 to 2016 mitigate the isoprene emissions ranging from -0.33% to -0.04% yr^{-1}"

- Please review the use of capitalization for the acronyms 'LAI' and 'VCF' in both the text and figure captions.

Response: Thank you for your comment. We have reviewed and corrected the use of capitalization for the acronyms 'LAI' and 'VCF' in both the text and figure captions.

- In line 545, it should be corrected with “activity factors”.

Response: Done. Thank you.

References

Guenther, A. B., Jiang, X., Heald, C. L., Sakulyanontvittaya, T., Duhl, T., Emmons, L. K., and Wang, X.: The Model of Emissions of Gases and Aerosols from Nature version 2.1 (MEGAN2.1): an extended and updated framework for modeling biogenic emissions, Geosci. Model Dev., 5, 1471-1492, 10.5194/gmd-5-1471-2012, 2012.