

We would like to thank the referee for their very helpful and constructive feedback. They have identified some areas where we are able to greatly improve the review.

We have responded to the referee's comments in blue font below.

Anonymous Referee #1

The authors provide a thorough overview of the implementation of the MEGAN module into the SURFEX land model, and compare the model results in terms of isoprene emissions against reported inventories from the literature. The authors obtain mostly similar emission totals and distributions, compared to other MEGAN-based emission estimates, and clearly discuss the impact of model assumptions and input datasets which drive the parameterization. The impact of changes in driving meteorology is relatively modest, and mostly explained by the PPF. Changes in emission potential can have a larger impact, while the introduction of a sensitivity to drought, through the actual soil moisture relative to the wilting point, were shown to lead to very large differences in modeled emissions. Based on this information the authors rightly address this issue that further studies are necessary to reduce the uncertainties to soil moisture assumptions.

We thank referee 1 for the concise summary of the paper.

This raises the question whether the authors have any thoughts on how they intend to validate the assumed BVOC emissions. It would be useful if they could spend some words on this. It also relates to a concern I have whether there is evidence if some of the emission estimates (esp. the MEGAN-MACC) can be disregarded from this study, as they may appear beyond the range of reasonable values.

While we think that the validation of the modelled BVOC emissions against flux measurements is of great value, it is not the primary focus of our paper. The paper seeks to validate the implementation of MEGAN in SURFEX by comparing the coupled model SURFEX-MEGAN isoprene emissions with other MEGAN-based isoprene inventories. Furthermore, the validation of global isoprene emissions is of extreme difficulty due the lack of isoprene observations. The sensitivity to the emission-driving variables and the uncertainties related to the MEGAN model was thoroughly discussed in other papers aiming to compare the MEGAN model estimations to local isoprene flux measurements ((Sindelarova et al.2014) - (Situ et al.2014) – (Kota et al.2015) - (Seco et al.2022)).

References:

Sindelarova, K., Granier, C., Bouarar, I., Guenther, A., Tilmes, S., Stavrou, T., ... & Knorr, W. (2014). Global data set of biogenic VOC emissions calculated by the MEGAN model over the last 30 years. *Atmospheric Chemistry and Physics*, *14*(17), 9317-9341.

Situ, S., Wang, X., Guenther, A., Zhang, Y., Wang, X., Huang, M., ... & Xiong, Z. (2014). Uncertainties of isoprene emissions in the MEGAN model estimated for a coniferous and broad-leaved mixed forest in Southern China. *Atmospheric environment*, *98*, 105-110.

Seco, R., Holst, T., Davie-Martin, C. L., Simin, T., Guenther, A., Pirk, N., ... & Rinnan, R. (2022). Strong isoprene emission response to temperature in tundra vegetation. *Proceedings of the National Academy of Sciences*, *119*(38), e2118014119.

Kota, S. H., Schade, G., Estes, M., Boyer, D., & Ying, Q. (2015). Evaluation of MEGAN predicted biogenic isoprene emissions at urban locations in Southeast Texas. *Atmospheric Environment*, *110*, 54-64.

Minor comments:

line 8: "more precise": more precise than what?

"This scheme provides to MEGAN vegetation-dependent parameters allowing a more precise estimation of biogenic fluxes (e.g., leaf area index, soil moisture, wilting point data)."

Will be replaced with:

"This scheme provides to MEGAN vegetation-dependent parameters such as leaf area index, soil moisture, wilting point data. This approach enables a more accurate estimation of biogenic fluxes compared to the stand-alone MEGAN model, which relies on average input values for all vegetation types."

line 42 "emission of ozone" -> "production of ozone"?

Changed as suggested.

Figure 1 / line 95 / line 96 / line 97: Please align the definition of different tiles, esp choose between 'Town' / Urban area / city, but not these three different names.

We have used "Town".

line 183 "its corresponding defined" please check wording

"For most CLM4 PFTs, existing similar vegetation types are defined in ECOCLIMAP-II."

Will be replaced with:

"Each vegetation type from ECOCLIMAP-II was mapped to its corresponding type defined in CLM4."

line 195 "is similar for most vegetation types": Actually, apart from shrubs I also see relatively large discrepancies for grassland and needle-leaf trees - but maybe it's a colorscale issue (and/or not so relevant in eventual emissions.) - can't the authors comment?

Indeed, there is a disparity in needleleaf tree coverage between ECOCLIMAP and CLM4, however, the impact on global isoprene emissions is expected to be minor. This is attributed to the fact that this specific plant functional type represents only 1.4% of the total annual emitted isoprene. (Guenther et al.2012).

References:

Guenther, A. B., Jiang, X., Heald, C. L., Sakulyanontvittaya, T., Duhl, T. A., Emmons, L. K., & Wang, X. (2012). The Model of Emissions of Gases and Aerosols from Nature version 2.1 (MEGAN2. 1): an extended and updated framework for modeling biogenic emissions. *Geoscientific Model Development*, 5(6), 1471-1492.

line 200: "LAI value of the past 10 days" change to "LAI value of 10 days in the past"?

Changed as suggested.

Figure 3 shows that also the T24 and PPF24 (previous day mean temperature and PPF24) are required as input to the ISBA-MEGAN processor. Out of curiosity, how are these parameters computed? Simply keeping track of temporal variations in PPF24 and Temperature over all (24) hours for the last day, or is there a more intricate procedure for this?

T24 and PPF24 are calculated by storing the 24h historical values of temperature and light, the averaged values are updated at 00:00 of each day.

line 217 “simulation of isoprene emissions”

Changed as suggested.

line 224: The authors write: “As there are no available inputs for surface incident diffuse shortwave radiation ... a value of 0 Wm^{-2} is assigned”. Maybe I do not understand this well, but wouldn't it make more sense to assign a higher default value than 0 Wm^{-2} for this quantity?

We agree that using a higher value for shortwave diffused radiation would be more reasonable. The decision to assign a value of 0 to the diffused component of radiation was driven by the challenge of identifying a default value that accurately represents the spatial and temporal variations of diffused shortwave radiation.

line 275: “PAR calculated from incoming shortwave radiation” from which product is this PAR here derived? From ERA5 / ERA-Interim? please clarify

This paragraph shows the impact of using different PAR inputs on isoprene emissions. Sindelarova et al. (2014) performed a sensitivity study using two approaches. The first derives PAR from incoming shortwave radiation (SR) obtained from the MERRA reanalysis data ($\text{PAR} = 0.5 * \text{SR}$) and the second uses the PAR provided on hourly basis by the MERRA Land model.

“Sindelarova et al. (2014) found that using PAR calculated from incoming shortwave radiation instead of PAR from the MERRA reanalysis led to a 17.5% increase in total isoprene emissions. »

Will be replaced with

“Sindelarova et al. (2014) found that using PAR derived from the MERRA incoming shortwave radiation, obtained by multiplying with a factor of $\frac{1}{2}$ instead of using PAR provided by the MERRA Land model led to a 17.5% increase in total isoprene emissions.”

References:

Sindelarova, K., Granier, C., Bouarar, I., Guenther, A., Tilmes, S., Stavrakou, T., ... & Knorr, W. (2014). Global data set of biogenic VOC emissions calculated by the MEGAN model over the last 30 years. *Atmospheric Chemistry and Physics*, 14(17), 9317-9341.

Figure 6: It would help if the authors re-organize the grouping such that one panel is given for each region, with bars for each emission product, to more easily intercompare the various estimates per region and month.

Changed as suggested (see Figure below).

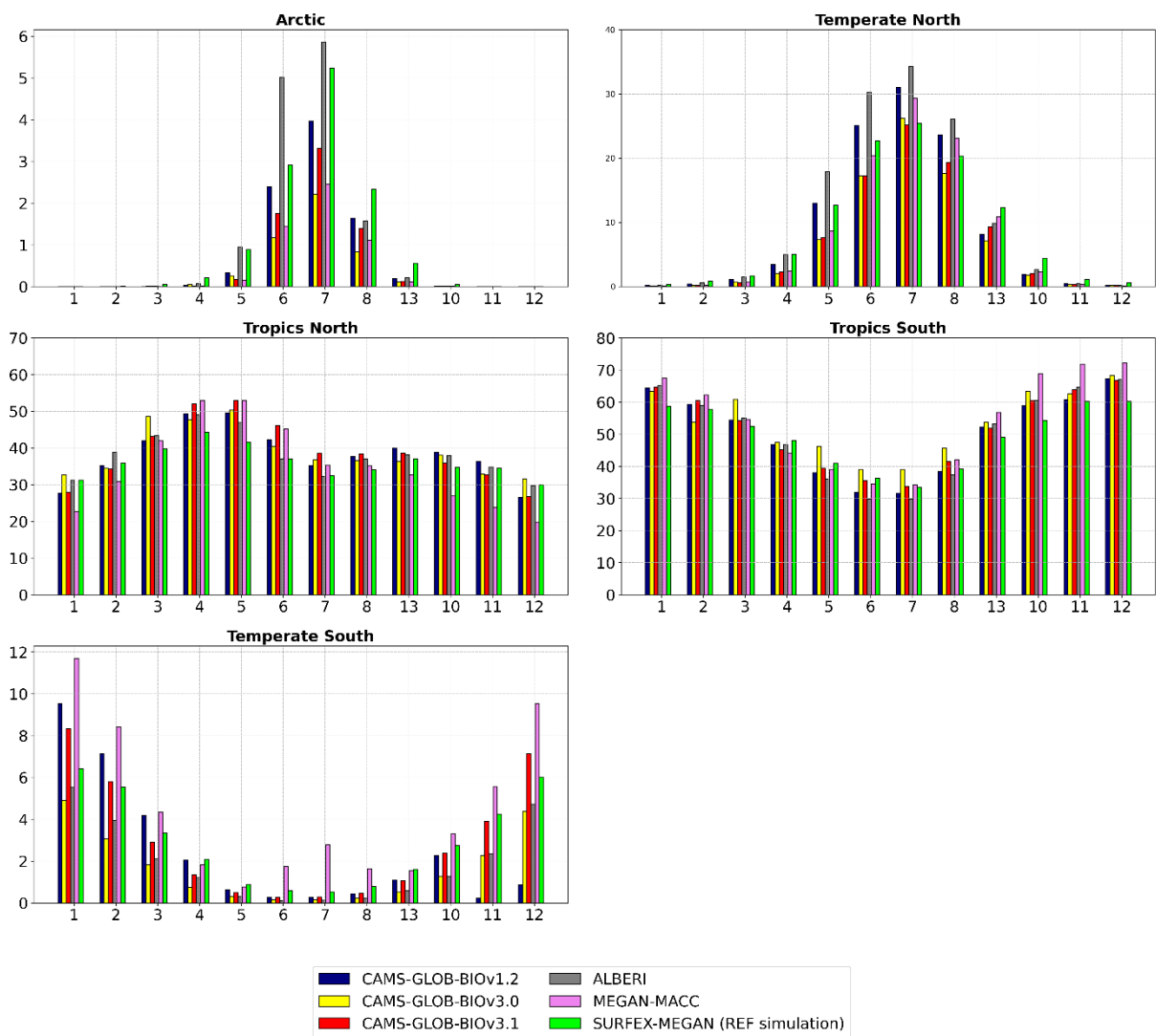


Figure 5: Contribution of zonal regions to monthly isoprene in CAMS-GLOB-BIOv1.2, CAMS-GLOB-BIOv3.0, CAMS-GLOB-BIOv3.1, MEGAN-MACC, ALBERI and SURFEX-MEGAN reference simulation in 2019 (2018 for CAMS-GLOB-BIOv1.2 and ALBERI).