Ms. Ref. No.: egusphere-2022-1522
Title: Assessment of isoprene and near surface ozone sensitivities to water stress over the Euro-Mediterranean region
Authors: Strada et al.
Journal: Atmospheric Chemistry and Physics

Response to Reviewer #1

GENERAL COMMENT:

This is a detailed study of how emission of isoprene are impacted by the newer MEGAN v3 soil moisture activity parameterisation compared to the previous v2.1 parameterisation. Comparisons are also made using satellite formaldehyde columns and surface ozone measurements. Results were compared over a number of summer seasons from 1992 to 2015, when isoprene is expected to be at peak concentrations in Europe.

One of the interesting parts of this paper was the demonstration of how 'smooth' the soil moisture activity function is using the MEGANv2.1 parameterisation compared to MEGANv3. The latter parameterisation allowed for more spatially varying reductions in isoprene, which were often less than those calculated using MEGANv2.1 and more localised. By contrast, a soil moisture activity function of ~0.4-0.5 covers most of Europe in summer using MEGANv2.1 which causes a very even, but perhaps too high a reduction in isoprene emissions.

I thought the methods, model and observations section was very well detailed, with all datasets well documented and described.

I only have a few comments before publication is recommended. They mainly relate to difficulties reading the figures.

Authors' response: We thank Reviewer #1 for this positive evaluation of our article and these insightful comments. Below, we separately reply to each comment and, when necessary, we precise where and how the manuscript has been modified. While reviewing the manuscript, we found an error in the conversion of ozone and formaldehyde mixing ratios that has been corrected in the revised manuscript.

SPECIFIC COMMENTS

Line 139: Would be good to have these values tabulated somewhere, or even refer to Oleson et al (2013) table 8.1 which is where I finally found them. Would be useful if others wanted to implement the new scheme.

Authors' response: Thanks to this comment, we have added the reference to Oleson et al. (2013) in Table 8.3 in which the plant functional type (PFT) root distribution parameters are listed (Table 8.1 has PFT photosynthetic parameters). The text has changed, now reading:

"The root fraction distribution *r* decreases exponentially with depth based on PFT-dependent parameters (see Table 8.3 in Oleson et al., 2013)."

Line 343: 76 mg/m2/day is a huge reduction. I wondered where about this was located, and what was the underlying vegetation type?

Authors' response: Thanks to this insightful suggestion, we found that isoprene emissions have decreased by -76 mg/m^2/day in July 2010 over a grid-cell located in south-western Russia (latitude: 60.24°N; longitude: 39.88°E). Over this grid cell, based on the CLM4.5 land cover, the boreal needleaf evergreen (49%) and the temperate broadleaf deciduous (47%) trees dominate, with the remaining 4% covered by crop (C3 unmanaged rainfed crop). Based on this information, we modified the manuscript accordingly:

"In the summer 2010, the RegCM4chem-CLM4.5-MEGAN2.1 model also reproduces the largest decrease in isoprene emissions, with a maximum reduction of -76 mg m^{-2} day^{-1} simulated in July and located over south-western Russia (latitude: 60.24°N; longitude: 39.88°E) where needleaf evergreen and broadleaf deciduous trees dominate in the CLM4.5 land cover. Between July and August 2010, south-western Russia was hit by an extreme heat wave and drought (Barriopedro et al., 2011). Such a substantial reduction in isoprene emissions corresponds to -3 mg m^{-2} hour^{-1} (not shown)."

Line 481: there looks to be a co-author comment (?) still in the text.

Authors' response: The question marks is actually a reference that did not work during the compilation of the Latex source. We have now correctly inserted the reference to the study by Massad et al. (2019). The correct text is :

"Moreover, the modelling of ozone chemistry strongly depends on the spatial resolution that influences the model ability in adequately distinguish chemical regimes (i.e., VOC- or NOx- limited) that, in turn, depend on the emission pattern of natural and anthropogenic sources (Massad et al., 2019)."

Conclusions section. There are a lot of new references introduced here which isn't usual – they're more suited to the introduction where previous literature is more commonly reviewed.

Authors' response: Based on this suggestion, we have restructured the Introduction and the Conclusion sections. Now, previous literature is mainly reviewed in Sect. 1, while Sect. 4 contains references related to recommendations for future studies.

Figures: Most were too small to see properly.

Authors' response: We improved all figures and made them bigger. We also implemented colorblind-friendly colormaps in Figures 6 (now Figure 7) and 11 (now Figure 12), as requested by the EGU journals.

Figure 1 the axis text is too feint to read.

Authors' response: We increased the size of Fig. 1, and as well of colorbar labels and ticks.

Figure 4 needs the units putting on the y-axis. The orange line is also too feint to see.

Authors' response: In Fig. 4, we added the units on the Y-axis, while in Fig. 5 we thickened the orange line.

Figure 5: I was confused by the legend which has pointers indicating the scale goes below 0 and above 1. There is a lot of white areas in the 12 maps which look to be above 1 and suggests that gamma2018 is higher than the default (which it can't be)?

Authors' response: The Reviewer is correct: the soil moisture activity factor γ_{SM} ranges between 0 (water stress shuts down isoprene emissions) and 1 (there is no water stress). To produce all figures, we use Python which does not include the upper limit value of each color bin. For this reason, grid-cells where γ_{SM} equals 1 appear as white areas in Figure 6 (now Figure 7, while Figure 5 shows the model evaluation for formaldehyde column concentrations). To solve this issue, we forced Python to include grid-cells where γ_{SM} equals 1 in the last colored bin (dark blue). Using the same method, we also modified Figure 11 (now Figure 12), which compares the two soil moisture activity factors. In the new figures, there are no grid-cells colored in white. In addition, we implemented colorblind-friendly colormaps, as requested by the EGU journals.

Figure 9a: numbers on y-axis are bunched together and overlap

Authors' response: To ease the reading, we modified the angle rotation of the Y-axis labels.