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Interactive comment on "Isoprene emissions track the seasonal cycle of canopy temperature, not primary production: evidence from remote sensing" *by* P. N. Foster et al.

Anonymous Referee #4

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General comments

The presented manuscript aims to identify environmental parameter(s), which is (are) the main driving factor(s) of seasonal cycle of the terrestrial isoprene emissions independently on the region of the globe or biome type. Authors use the satellite retrievals of formaldehyde concentration as a proxy for the isoprene emissions since formaldehyde is the principal isoprene oxidation product. By means of correlation coefficients the study investigates relationships between seasonal variation of formaldehyde concentration and a set of modeled and observed parameters including air and canopy temperatures, GPP and modeled isoprene emissions. The correlations are calculated over divers regions of different geographical location and biome

composition. The study adopts an up-to-date approach of using remotely sensed data. The satellite-based observations provide extensive temporal and spatial coverage and thus have an advantage over regional measurements, which are still limited in space and time.

The manuscript concludes that according to the obtained results the isoprene emissions are best correlated to canopy temperature and do not depend on GPP. This conclusion applies to all studied regions.

Authors show better correlation of formaldehyde with canopy temperature when compared to correlation with air temperature and suggest using canopy temperature in the models. In fact this finding has already been adopted. Emission models simulate canopy temperature using the dynamic vegetation or canopy environment model (e.g. Arneth et al., 2007; Guenther et al, 2006; Guenther et al., 2012). This study is a valuable support to this model approach. Authors may want to rephrase and include this fact in the manuscript.

However, the conclusion regarding the relationship between isoprene emissions and GPP (fPAR) is not that clear. As shown in the Table S1, the p-values are often higher than 0.05, which leads to doubts about statistical significance of obtained results. E.g. discussion of negative correlation of GPP in Australia supporting the authors' conclusion of isoprene emissions following temperature rather than GPP in temperate region corresponds to p-values equal 1. Similarly, high p-values are found for correlations between formaldehyde and modeled isoprene emissions, GPP and fPAR in many of the listed tropical regions. Nevertheless, these correlations are used to prove that there is no relationship between isoprene emissions and GPP in the tropics. To my opinion, high p-values for these results are not sufficiently discussed in the manuscript.

The study also shows similar dependence of formaldehyde concentration on canopy temperature and on precipitation (only opposite) in the tropical region. This is an interesting result that, to my knowledge, has not yet been presented.

Specific comments

1) The authors may want to specify which isoprene emissions were used and how were they calculated in the chemical transport model TM5 when conducting the test of the seasonal cycle of the net chemical modulation of formaldehyde (results presented in Figure S1). The modeled formaldehyde production depends not only on the applied chem. mechanism, but certainly on the input emissions as well.

2) Since the p-values are important part of the results, I'd suggest moving Fig. 4 to the Supplement and replace it by Table S1.

3) There is no reference to and no discussion of the Table S2 and Figures S3-4 in the manuscript. Without a discussion, it is not very clear to me what is the added value of the results in Table S2. Why were the sigma values in Table S2 calculated only for the modeled variables and not for the observed ones?

4) The statement *"Our results however suggest that current models are unlikely to capture the over-riding dominance of canopy temperature as a predictor of the seasonal cycle of isoprene emission, especially in the tropics"* (P19587-25) is maybe too strong considering the fact that the study is using only one emission model and the statistical significance of the results is questionable.

5) In the discussion authors state that the *"remotely sensed observations provide a bridge between the global scale of interest in the relationship between atmospheric chemistry and climate, and the more local scale of direct emissions measurements"* (P19587-27). Can the presented results based on relatively large areas (240 km) be representative also on smaller scales?

Technical comments

1) Please unify abbreviations of region names (boreal, temperate, tropical forest, tropical savannas) in Table S1 and Table S2.

2) Background of the Fig.4 and color for boreal region are quite similar. I'd suggest changing the background color to white.

References

Arneth, A., Niinemets, Ü ., Pressley, S., Bäck, J., Hari, P., Karl, T., Noe, S., Prentice, I. C., SercÂÿa, D., Hickler, T., Wolf, A., and Smith, B.: Process-based estimates of terrestrial ecosystem isoprene emissions: incorporating the effects of a direct CO2-isoprene interaction, Atmospheric Chemistry and Physics, 7, 31–53, 2007.

Guenther, A., Karl, T., Harley, P., Wiedinmyer, C., Palmer, P. I., and Geron, C.: Estimates of global terrestrial isoprene emisisons using MEGAN (Model od Emissions of Gases and Aerosols from Nature, Atmospheric Chemistry and Physics, 6, 3181–3210, 2006.

Guenther, A., Jiang, X., Heald, C. L., Sakulyanontvittaya, T., Duhl, T., Emmons, L., 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, Geoscientific Model Development, 5, 1471–1492, 2012.

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