

## ***Interactive comment on “Land cover change dominates decadal trends of biogenic volatile organic compound (BVOC) emission in China” by Hui Wang et al.***

### **Anonymous Referee #2**

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The study by Wang and co-workers investigates the impact of satellite-based land use changes on biogenic VOC emissions in China over 16 years (2001-2016). They report positive emission trends of 1-1.5% per year over the whole country, which are attributed, for a major part, to changes in vegetation. The strongest BVOC trends are reported in Qianling mountains and in south China, where the BVOC emissions increased by more than ~60% in 2016 relative to 2001. Further comparison of BVOC interannual variability with HCHO columns from the OMI instrument over the studied period in summertime exhibited positive temporal correlation over forested regions.

This study addresses an interesting subject for Atmospheric Chemistry and Physics

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journal. However, there are weaknesses and limitations in the present study, which raise doubts regarding the validity of the conclusions. Furthermore, the presentation is often difficult to follow, mostly due to insufficient mastery of the English language. To my view, the manuscript will need a major revision before it becomes suitable for publication. My main concerns are listed below:

(i) Important input datasets required for calculating BVOC emissions using MEGAN model (e.g. PFTs) are not shown. Annual maps of the MODIS PFTs and LAI should be provided, as well as their trends. Without such information, it is impossible to assess the driving factors for the changes and therefore for the validity of the claims. Furthermore, it is not clearly mentioned whether a unique emission factor per PFT has been used (Table 2 of Guenther et al. 2012) or if a map of standard emission factors has been used.

(ii) I have my doubts regarding the almost negligible isoprene trends due to meteorology suggested by Figure 3 (simulations S3 and S4). The scale in this figure does not allow to see any changes elsewhere than in the Tibetan Plateau. Elsewhere, the color (grey) corresponds to no value. In order to explain the emission trend in S3 and S4, trends of the main drivers of the BVOC emission trends, namely, air temperature, solar radiation and leaf area index should be analysed. In addition, the simulated trend in surface temperature and radiation should be compared to the corresponding trends of the in situ temperature and solar radiation data used for the evaluation of the WRF model simulation in Section 2.3.

(iii) There is not convincing evidence for the very low monoterpene emission derived in this study compared to previous work (Table 3). The invoked reasons, e.g. interannual variations, horizontal resolution, etc. (page 7, lines 81-20) are not convincing. The reasons of the discrepancy should be investigated through detailed comparisons e.g. with the MEGAN inventory and similar studies e.g. Sindelarova et al. (2014). These datasets are accessible via the ECCAD database (<https://eccad.aeris-data.fr>).

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(iv) The strong trends inferred over the Qinling mountains and over Southern China need further discussion. Can you put compare this result to past studies? What is the respective roles played by LAI and PFT cover trends?

Specific comments/Language corrections

p.2, l.3-7: The sentence is too long, considering splitting into two and rephrasing

p.2, l.5: add space between '2014' and 'Chen'

p.2, l.12: 'a corresponding impact', replace by 'changes'

p.3, l.10: remove 'observed'

p.3, l.10: 'regional ecosystem isoprene emission', change to 'isoprene emission at regional to global scales'

p.3, l.11: 'reported the', change to 'reported an'

p.3, l.12: read 'detected by the Ozone'

p.3, l.14-15: rephrases as follows: 'Here we used the long-term OMI 2005-2016 record to estimate the interannual isoprene variability in China'

p.3, l.19: add reference Guenther et al.(2012)

p.3, l.20: add more references, e.g. Bauwens et al.(2018) and Messina et al.(2016)

p.3, l.23: read 'uses the fundamental'

p.4, l.1: read 'the standard emisisions factor, and the emission activity factor for the chemical species i'

p.4, l.3: '(PFT) distribution from the Community Land...'

p.4, l.5: replace 'expresses it as' by 'can be written as'

p.4, l.8: 'equal to 1 at standard conditions (Guenther et al. (2006)'

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p.4, l.9: please specify the source of the LAI dataset

p.4, l.9: replace 'and the leaf age in MEGAN' by a new sentence : 'It is used to define the leaf age response function as described in Guenther et al.(2012).'

p.4, l.10: the text should read 'Guenther et al. (1991, 1993, 2012)'

p.4, l.14: remove 'factor'

p.4, l.18: 'adopted', change to 'used'

p.4, l.18: 'in this study', missing reference for the LAI datasets used

p.4, l.20: missing reference for the dataset

p.4, l.22: change 'data' to 'dataset'

p.4, l.22: 'land cover product' missing reference.

p.4, l.24: 'described in'

p.4, l.24: 'using the climatology of ERA-interim dataset', change to 'using the ERA-Interim climatology'

p.5, l.1: 'during 2001-2016', change to 'over 2001-2016'

p.5, l.5: 'The meteorological simulation is', change to 'The model was'

p.5, l.10: 'using the in-situ', change to 'using in-situ'

p.5, l.13: 'monthly averaged'

p.5, l.15: -2 in  $W_m^{-2}$  should be superscript

p.5, l.15: 'among 98 sites, and the overestimations', change to 'for 98 studied sites. The overestimation'

p.5, l.17: 'the lack of aerosol radiation effect and cloud simulation', not clear what is meant here

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p.5, l.23: 'Our', change to 'The'

p.6, l.1: 'Observations'

p.6, l.3: 'and was retrieved'

p.6, l.4-5: 'The detailed...De Smedt et al. (2015)'. Please remove sentence (repetition)

p.6, l.6: 'temporally stable', what about the row anomaly? This effect should be mentioned.

p.6, l.9: change 'anthropogenic source' to 'anthropogenic VOC'

p.6, l.10: 'in the forest regions without obvious anthropogenic impact', replace by 'over forests in summertime'

p.6, l.21: 'between 2001 to 2016', change to 'between 2001 and 2016'

p.6, l.25: This has been already mentioned, please avoid repetitions

p.6, l.26-27: sentence not clear

p.7, l.6-8: what do you mean by 'results' and corresponding results'? State clearly what you did

p.7, l.15: 'S1...conditions', repetition

p.7, l.18: 'other estimations', missing references

p.7, l.24: 'increasing rates of these species', replace by 'trends'

p.7, l.25: 'despite the direct impact of meteorological conditions', not clear

p.8, l.11: Rewrite as 'The average annual total BVOC emission over 2009-2016 is by 50% higher than over 2001-2008.' Is that what you mean?

p.8, l.13: 'are by 11.3%'

p.8, l.21: 'S4 is 23.5%', change to 'S4 is by 23.5%'

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p.8, l.23: 'by 29.9%'

p.8, l.25-26: poor language

p.9, l.15: 'landcover', change to 'land cover'

p.9, l.15: read 'contribute up to 20%, and taken together more than 30% to the estimated...'

p.10, l.6: 'driven', change to 'driven'

p.10, l.10-12: Sentence could be removed

p.10, l.15: superscripts for  $m^{-2} y^{-1}$

p.10, l.20: read 'broadleaf trees, needleleaf trees and other vegetation'

p.10, l.25: 'percent', replace by 'percentage'

p.10, l.13-24: too many numbers in this paragraph make the reading difficult, consider removing some of the numbers and rewriting

p.11, l.4-7: too many numbers in the text, consider introducing them in a table

p.11, l.11: 'in (Figure 3)', change to 'in Figure 3'

p.11, l.23: 'dominate factor', read 'dominant factor'

p.12, l.2: 'suffering from poor air quality'

p.12, l.2: add space between 'years' and 'Yang'

p.12, l.13: 'in rural regions with minimal anthropogenic influence', change to 'over forests'

p.12, l.18: 'summer-average isoprene emission estimated in our study to evaluate our estimation of interannual variability of isoprene emission', poor wording

p.13, l.1: 'anthropogenic sources', missing reference

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p.13, l.5: 'correlation can be found', change to 'correlation is found'  
p.13, l.10: 'anthropogenic sources', missing reference  
p.13, l.20: 'greatest increasing trend', change to 'strongest positive trend'  
p.14, l.4: 'the mega-city areas', read 'in megacities'  
p.15, l.1: read 'from 2001 to 2016'  
p.15, l.1: read 'as inputs in the MEGAN'  
p.15, l.1: 'the long-term', remove 'the'  
p.15, l.11: here and elsewhere in the manuscript, use one instead of two decimals  
p.15, l.18: 'there'?  
p.15, l.21: 'during 200-2010', missing reference  
p.15, l.22: 'there has been in a increasing trend', do you mean 'showed an increasing trend'?  
p.15, l.24: read 'assess'  
p.16, l.6: remove the references (they are already mentioned before)  
p.16, l.6-10: repetition of l.20-25 of page 14, not necessary  
p.23: Table 3, the estimates reported in Li et al. are in TgC, not in Tg, please correct  
p.26: Difficult to read, I suggest splitting into a figure with 4 panels (a, f, k, p) and another figure with the trends. The regions in panel (r) are barely visible. Please improve.  
p.27: It is very difficult to distinguish the colors corresponding to broadleaf and needle-leaf trees, please adapt. In the caption, please correct typos for the names of provinces.  
References:

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Bauwens, M., Stavrou, T., Müller, J.-F., Van Schaeybroeck, B., De Cruz, L., De Troch, R., Giot, O., Hamdi, R., Termonia, P., Laffineur, Q., Amelynck, C., Schoon, N., Heinesch, B., Holst, T., Arneth, A., Ceulemans, R., Sanchez-Lorenzo, A., and Guenther, A.: Recent past (1979-2014) and future (2070-2099) isoprene fluxes over Europe simulated with the MEGAN-MOHYCAN model, *Biogeosciences*, 15, 3673-3690, <https://doi.org/10.5194/bg-15-3673-2018>, 2018.

Messina, P., Lathièrre, J., Sindelarova, K., Vuichard, N., Granier, C., Ghattas, J., Cozic, A., and Hauglustaine, D. A.: Global biogenic volatile organic compound emissions in the ORCHIDEE and MEGAN models and sensitivity to key parameters, *Atmos. Chem. Phys.*, 16, 14169-14202, <https://doi.org/10.5194/acp-16-14169-2016>, 2016.

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