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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Isoprene emissions over Asia 1979–2012: impact of climate and land use changes" *by* T. Stavrakou et al.

Anonymous Referee #3

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Stavrakou et al. improve upon earlier studies of biogenic isoprene emissions from Asia, a region undergoing dramatic land-use and climate changes in recent decades, by applying the MEGAN emissions model coupled to a canopy vegetation model. Applying base conditions (meteorology, static vegetation map, and emission factors), they calculate the spatial and temporal changes in isoprene emissions over the period 1979-2012. Starting from their base simulation, the authors perform four additional simulations to correct for previously identified biases using observation-derived emission factors, and the observed trends in land-use and solar radiation. They find that their best bottom-up isoprene emission trends and distributions are consistent with those derived using GOME-2 formaldehyde (HCHO) columns.

The information provided in this paper is valuable to both the emissions and air qual-

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ity communities as it clearly highlights that biogenic isoprene emissions in Asia are changing significantly in response to environmental changes and this will have important consequences for regional air quality. The study highlights the improvement in modeled estimates of biogenic emission in Asia when constraints from limited ground-based observations are included –enhanced observational network in that region will lead to better-informed emission models. Overall the paper is well-written with valuable information for emission and air pollution modeling. There is some choppy organization (see general comments below) which can be easily addressed. The paper is appropriate for publication in ACP after minor corrections have been made.

General Comment:

1. Before discussing the trends in Asian isoprene emissions, the authors should evaluate the isoprene fluxes from their base simulation against observations in Asia, preferably ground-based. This will convince the readers that the current model setup suffers from similar biases as noted by Langford et al. (2010) and that the corrections applied in subsequent simulations indeed improve upon the base simulation. Thus, it would be helpful to evaluate the base isoprene fluxes for a particular time period (e.g. 2005 following the discussion in section 4/figure 7) against measurements from OP3 and measurements from other regions wherever available. For example, observational estimates of isoprene fluxes from other parts of Asia are available (Bai et al., 2004; Geron et al., 2006; Varshney and Singh, 2003; Singh et al., 2007; Singh et al., 2008).

2. In terms of the organization, section 4 should be moved before section 3. Section 6.1 belongs as a sub-section in Section 2.

Specific Comments:

1. Abstract, line 8-13: The authors should mention that they incorporated these factors (changes in land-use, solar radiation etc.) to correct for the biases identified in previous studies and also to account for deficiencies in meteorological inputs that have important implications for simulating trends and variability in isoprene emissions in this region.

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Line 18-19: The authors attribute the variability and trends in emissions to changes in temperature and solar radiation here while including soil moisture as one of the main drivers in the conclusions (page 29572, line 1). I would suggest being consistent in the abstract and the main text. Also see comment #14 below.

Line 19-22: Remind the readers that the trend discussed here is from the base simulation that does not include the additional factors considered in sensitivity simulations.

2. Page 29554, Line 10: A reference is needed for "...since crops are known to be weaker isoprene emitters than the forests they substitute."

3. Page 29554, Line 15: For better clarity, the sentence should be revised to: "Crops in China are being converted to tree plantations (e.g....) for economic reasons, resulting in..."

4. Page 29555, Line 16: The sentence "Their estimation is uncertain, as it relies..." needs to be rephrased for clarity.

5. Page 29556, Line 19: Remove "literature"

6. Page 29558, Line 13: The word "realized" reads awkward here. Replace with perhaps "accomplished"

7. Page 29559, Lines 9-10: What level of uncertainty is introduced in the calculated emission trends with the use of climatological mean MODIS LAIs prior to 2002, particularly, since emission flux rate is a function of LAI (equation 2)? Are the same LAIs used for all simulations S0 through S4?

8. Page 29560, 2nd paragraph: It would be helpful to provide the basal emission factors for oil palm trees.

9. Page 29561-29562: Discussion of Figure 4 should be presented before the discussion of Figure 5. Further, in relation to Figure 5, it would be helpful to provide a quantitative estimate of the dominant drivers of fluxes either in the Asian domain or

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in China by performing statistical correlation of fluxes with temperature, radiation, and soil moisture (since emissions are dependent on these time-varying factors). Similarly, a pattern correlation of the trends in Figure 4 is needed to quantitatively substantiate statements like "the increasing trend in emission is due to increases in the soil moisture activity factor, most likely reflecting positive trends in soil moisture. . .."

10. Page 29563, Lines 8-21: As the other reviewers note, the discussion of the relationship between emissions and ONI is abrupt and needs a preface in Section 1. Also, it is not clear how the "isoprene flux anomaly" is calculated? Is this anomaly with respect to the mean of 1979-2012?

11. Page 29564, Line 25: Although the authors discuss S3 results for 2005, Figure 7 does not show fluxes for S3. This oversight should be corrected.

12. Page 29566, Section 5: To me, this section is an extension of the discussion of variability and trends in isoprene emission in the S0 simulation (section 2). Perhaps the authors could combine the two to make the text and figures more concise. As an example, the black line in Figure 9 for China is the same as in Figure 5 (second panel from the top), although it appears that the calculated trends are different (why is it 0.42%/yr in Fig 9 versus 0.52%/yr in Fig 5). Additionally, all panels in Figure 9 do not show fluxes for the 5 simulations (S0 – S4). Is there a reason for showing selective simulations for each country? If so, it should be stated clearly, although I would recommend showing all simulations to be consistent as otherwise this would be akin to cherry-picking to support conclusions.

13. Page 29571, line 24: replace "builts" with "builds"

14. Page 29572, line 1: I suggest that the authors perform a quantitative analysis of the role of soil moisture in driving variability and trend in Asian isoprene emissions to support their conclusion statement – "Temperature, solar radiation, and soil moisture are the main drivers of interannual variability."

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15. Page 29572, line 15: The statement "...in better agreement with ground-based observations." needs to be supported by comparing the fluxes simulated in S4 (and S0) with ground-based observations.

16. Figures 1, 2, 4, 7, 8, and 10: The labels on the label bar are too small to read. Please use bigger and darker font.

17. Figures: Please consider labeling panels as (a), (b), (c) and so on for figures that have greater than one panel.

References: Bai, J., Baker, B., Johnson, C., Li, Q., Wang, Y., Zhao, C., Klinger, L., Guenther, A., and Greenberg, J.: Observational studies on volatile organic compounds of the tropical forest in Xishuangbanna, China Environmental Science, 24, 142-146, 2004.

Geron, C., Owen, S., Guenther, A., Greenberg, J., Rasmussen, R., Bai, J. H., Li, Q. J., and Baker, B.: Volatile organic compounds from vegetation in southern Yunnan Province, China: Emission rates and some potential regional implications, Atmos Environ, 40, 1759-1773, DOI 10.1016/j.atmosenv2005.11.022, 2006.

Singh et al., Seasonal variations in isoprene emission from tropical deciduous tree species, Environ. Monit. Assess., 131, 231-235, 2007.

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Interactive comment on Atmos. Chem. Phys. Discuss., 13, 29551, 2013.