Atmos. Chem. Phys. Discuss., 14, C2772–C2775, 2014
www.atmos-chem-phys-discuss.net/14/C2772/2014/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Improved model of isoprene emissions in Africa using OMI satellite observations of formaldehyde: implications for oxidants and particulate matter" *by* E. A. Marais et al.

E. A. Marais et al.

emarais@fas.harvard.edu

Received and published: 27 May 2014

We thank the anonymous referee for suggested improvements to our manuscript. Responses to comments are below. Reviewer comments are in italics.

Marais et al. present an analysis of new isoprene emissions over Africa derived from OMI formaldehyde observations in comparison with the MEGAN inventory. They explore the factors (temperature, leaf area index) which control the seasonal and spatial variability of the African emissions. They show that emission factors tend to be overes-

timate in MEGAN inventory especially over equatorial forests. The results are validated using direct leaf measurements from field campaigns taken from literature and using isoprene measured during the AMMA aircraft campaign. The total emission of isoprene in Africa is then estimated and the impact on surface ozone and particular matter quantified The paper is well written in a concise and clear manner. This work is suitable for ACP publication and I recommend it after the following comments are addressed.

General comment on the evaluation with canopy flux measurements
The OMI-derived and MEGAN isoprene emissions are compared to flux measurements reported in literature and corresponding to years outside the 2005-2009 period analyzed with OMI. Is the interannual variability of isoprene emissions sufficiently small compared to the errors to make this comparison valid? The authors should discuss this point.
Addressed.

On the other hand, most of the flux measurements have a small footprint (600m). Is the representativity of these measurements sufficient to be compared the emission derived from OMI (1x1 degree gridsquare average). The authors should address this point in more details in their discussion.
The small footprint of the flux towers (sites 1 and 4) is an issue in our comparison, as these tower sites sampled vegetation with a low proportion of isoprene emitting species, while vegetation beyond the sampling footprint had a high proportion of isoprene emitters. We already acknowledge this and other shortcomings in Section 3.

Moreover, p 6958, lines 22-23, I do not understand the given argumentation for the observed discrepancies at site 2. I would expect that the fact that both flux measurements and OMI have similar footprint would improve the representativity of in situ measurement compared to satellite observation and then improved the comparison
The aircraft REA flux measurement at site 2 has a representative sampling footprint. Unfortunately, REA flux measurements from aircraft are susceptible to a negative bias of at least 25 % due to vertical flux divergence between the altitude of the aircraft and

the surface flux (p. 6958 lines 27-29, p. 6959 lines 1-3).

Specific comments

1) Page 6954, line 10: The reference Marais et al. 2012 should be added here
The Marais et al., 2012 reference has now been added.

2) Page 6957, lines 14-16: If I well understood, the errors detailed in the lines above are related to individual observations. The authors should precise and discuss the errors on the 1x1 degree gridsquare observations as well.
Assuming that the error for individual scenes reduces by 1/sqrt(n), where n is the number of observations, the error in OMI-derived isoprene emissions of 1.4 $\times$ 10^{12} atoms C cm^{-2} s^{-1} (annual average for a gridsquare over the equatorial forests) would reduce to 2.9 $\times$ 10^{10} atoms C cm^{-2} s^{-1} (2 %) at high NO_x and 2.9-6.6 $\times$ 10^{10} atoms C cm^{-2} s^{-1} (2-5 %) at low levels of NO_x. We would prefer to show in the text the error on individual OMI scenes. Our error estimate for monthly average gridsquares provided here is optimistic, as it assumes all error contributions are random.

3) Page 6964, lines 5-8: In order to evaluate the effect of isoprene emissions on surface concentrations of ozone and particulate matter, the authors compared GEOS-Chem simulations with and without the isoprene emission. I wonder if considering no isoprene emissions does not introduce a non-linearity in the chemistry and makes the simulations with and without isoprene emissions not really comparable by the end. Is the impact of isoprene emissions linear from 0 to the 77 Tg C a^{-1}*?*
In Africa the effect of isoprene emissions is positive over regions with high levels of NO_x (northern and southern savannas), so that the impact of isoprene emissions on ozone is linear.

4) Figure 1: I would suggest the authors to add a table with all the references cited in the caption reported with the measurements conditions summarized.
Thank you for your suggestion. We now include Tables 1a and 1b.

References:

Marais, E. A., Jacob, D. J., Kurosu, T. P., Chance, K., Murphy, J. G., Reeves, C., Mills, G., Casadio, S., Millet, D. B., Barkley, M. P., Paulot, F., and Mao, J.: Isoprene emissions in Africa inferred from OMI observations of formaldehyde columns, Atmos. Chem. Phys., 12, 6219-6235, doi:10.5194/acp-12-6219-2012, 2012.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 6951, 2014.