**Atmospheric
Chemistry
and Physics**
Discussions
Open Access

Interactive comment on "Worldwide biogenic soil NO$_x$ emissions inferred from OMI NO$_2$ observations" *by* G. C. M. Vinken et al.

Anonymous Referee #2

Received and published: 4 July 2014

The authors propose an estimation of soil NOx emissions using tropospheric NO$_2$ column measurements from OMI. The study focuses on 11 regions dominated by soil emissions. They report a general increase of the emissions compared to the a priori from Hudman et al. (2012), except over Midwestern US. They compare with NO$_2$ measurements from monitoring stations in Africa, US, and Europe. This study is interesting and appropriate for this journal. However, several points are unclear and need additional clarification. I recommend publication provided that the following points are adequately amended in a revised version.

General comments

- The β values shown in Table 2 are much higher than the values reported in Lam-

sal et al. (2011). One possible explanation put forward is the boundary effects (p. 14696, l. 15), however, I doubt it in view of the short NOx lifetime over the regions considered. The authors should prove their point (maybe by using regions of different sizes) or remove the argument. Comparison is made difficult because Lamsal et al. provided annual averages for β, and the values given here are reported mostly for summer due to the filtering scheme. I would strongly recommend providing annual averages for the purpose of comparison. In lines 25-26 of p.14696, agreement is said to be good with Lamsal et al. in low NOx areas, however, over the few regions where comparison is possible (Midwest US and Spain/France) the values reported by Lamsal et al. are about a factor of 2 (or more) lower than in this study. The authors should clarify the reason of these discrepancies.

- The comparison with ground-based measurements is nice, however, the derived RSMD is not much reduced. The authors should provide comparison also with SCIAMACHY measurements using a priori and top-down emissions.

- A possibly important issue is the use (or not) of averaging kernels in the comparisons. Could you specify whether the DOMINO averaging kernels have been applied?

- p.14691, line 21 : Why is the minimum number of observations taken to be only 3 per month and pixel, given the small size of OMI pixels? Would a higher threshold reduce the number of available data for comparisons?

- p. 14695, line 17-23 : The small values of the slope in Australia likely mean that OH is very high in this region, whereas the high slopes in wintertime over India and Sahel are due to lower OH levels caused by less sunlight, not non-linearity. The feedbacks between NOx emission and NO$_2$ lifetime do exist but are not the main factor determining the spatial and temporal variations in the lifetime. Note that NO$_2$ columns are similar over Australia and Sahel, despite having different

slopes. Please adapt the discussion, for example in line 23, replace "such non-linearities" by "the variability of NO_2 column lifetime".

Specific comments

- p. 14688, Consider citing here previous OMI-based studies, like the global studies of Miyazaki et al. (2012) and Stavrakou et al. (2013), and the regional study of Lin et (2010) over China.

- What is the diurnal profile of soil emissions in GEOS-Chem model?

- What are the GEOS-chem choices for relevant reactions like $OH+NO_2$, HO_2+NO, HO_2 uptake on aerosol? Those reactions were shown lead to substantial uncertainties on top-down NOx emissions, especially for natural sources (factor of 2 for soil emissions) (Stavrakou et al. 2013).

- More details on Hudman et al. parameterization would be needed, as well as differences with Steinkamp et al.(2011), and discussion of the uncertainties.

- p.14690, l.10 : Insert "that the" before "smallest".

- p.14691, l.10 : Add "s" to "observation".

- p.14694, l.2 : Replace "of" by "due to".

- p.14694, l.11 : "the response of the modeled...with 1%" should read "the modeled NO_2 column obtained by increasing emission source i by 1%".

- p.14694, l.13 : Replace "response to" by "obtained by".

- p.14695, l.27 : Please specify the fitting period (month or year).

C4500

- Figure 4 caption should more clearly explain the content of the plot. What represent the symbols?

- p.14699, l.17-19 : Not clear. Rephrase.

- p.14700, l.5 : Are those measurements daily averages?

- p.14702, l.1 : The 25% model error seems arbitrary and overly optimistic, given the discussion provided in the cited studies.

- p.14702, l.19 : To convince the reader that the error on β is 25%, differences with the results of Lamsal et al. must be elucidated.

- p.14702, l.8-10 : I really do not see why the approach would be robust to biases in either OMI or GEOS-Chem. Those biases will influence the values of the slope κ of the regression between OMI and GEOS-Chem and therefore the top-down emissions.

- p.14703, l.24 : How is it proved that NO_2 responds linearly to emission changes in anthropogenic source regions?

- p.14704, l.9-13 : This statement shuld be moderated since this study addresses only a small fraction of total soil NOx emissions.

- p.14714. In the table caption please mention that the value of Hudman et al. is modified to account for CRF.

- There are some problems with the quality of the inset label in some of the figures, e.g. Fig. 3, 5, 6, 9.

- Consider removing Figure 8. It does not convey more information than already present in the text.