Atmos. Chem. Phys. Discuss., 13, C891–C896, 2013
www.atmos-chem-phys-discuss.net/13/C891/2013/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "A study of the impact of land-use change in Borneo on atmospheric composition using a global model" *by* N. J. Warwick et al.

Anonymous Referee #1

Received and published: 2 April 2013

This study uses a high-resolution global chemical transport model to investigate the atmospheric chemistry and composition impact that could arise from a large expansion of oil palm plantations in Borneo. Oil palm plantations emit far more isoprene than the rainforests they replace, and this isoprene increase comes with additional NOx emissions, associated with the industrial processing of the oil palm. Observational data are used in this study from the 2008 NERC OP3 field campaign, based in Borneo.

After assessing how well different configurations of the model compares against OP3 observations (OH and isoprene can be matched; ozone is always overestimated), the authors present two scenario simulations: one where all of Borneo is converted to oil

palm plantations, and another with additional NOx emissions related to oil palm fertilization and processing. With only the higher isoprene emissions in the first simulation, ozone and OH levels decrease over Borneo. When the isoprene emissions are combined with NOx increases, the OH decreases are somewhat ameliorated (compared to the first simulation) whereas ozone increases.

While the manuscript is mostly well written and methodologically sound, my main impression is that the study adds very little to previous work. Ultimately the study amounts to examining the sensitivity of the atmospheric composition to different isoprene and NOx emissions, and to different assumptions about isoprene chemistry, all of which have been investigated by a raft of other studies, including some that involved the coauthors here. Overall, my recommendation is for the authors to revisit their analysis and consider how their data can bring something new to the discussion. Some specific ideas are below.

MAIN CONCERNS: The results from this study can be qualitatively arrived at from the several previous studies on isoprene emission changes and land use change. All that is new here is that the authors are applying a high(ish) resolution model over Borneo, as opposed to considering changes in the Amazon (e.g. Ganzeveld and Lelieveld, 2004), USA (e.g. Wiedinmyer et al., 2006) or globally (e.g. Ashworth et al., 2012). [I realize that Ashworth et al. (2012) specifically consider Borneo, albeit with a lower resolution model – is this study an extension of that? If so, this should be made clear in the Introduction.]

How can this data and manuscript bring new information? A couple of suggestions:

- Is there some way to apply the results? E.g. what is the maximum level for the associated NOx emissions in order to satisfy AQ concerns? - Is there something unique about the maritime/terrestrial nature of Borneo that means it deserves particular focus? Could we have halogen-mediated oxidation of isoprene even? (E.g. Orlando et al., 2003) - Are there upper atmosphere/further afield impacts? Is Borneo a re-

gion where, pound-for-pound, these impacts are more strongly felt? - Are there bigger "Earth system" effects to consider? E.g. knock-on impacts to natural soil NOx emissions, deposition impacts (was this changed?), links with biomass burning changes (e.g. changing from "natural" forest to palm oil might change emission composition, amount and frequency)

As is hinted at by the last two suggestions, the manuscript would also benefit from a clearer identification of why Borneo is the focus of such a study. Is it building on previous work? Due to the availability of measurement data? Undergoing a particularly quick change?

Along these lines, is p-TOMCAT the right tool for this study? I.e., why use a global model to investigate a local region, when there are tools like WRF-Chem? Furthermore, in the cited Pike et al. study, those authors make use of a 0.56° resolution p-TOMCAT version. Why is that not used here? Are there issues with the orography for that version? Something else?

SPECIFIC COMMENTS:

Title: Consider dropping "A study of"

Abstract: Consider shortening this and making a little more "punchy"

P7434, L1-2: Citation?

P7434, L18: Citation?

P7434, L26: Define HCFCs

P7438, L19-26: Not very clear for a non-specialist – please clarify

P7439, L3-4: "...taken from Stevenson et al. (2006)." (Sect. 3 and 4 could probably be considerably shortened, and combined to make a "Model set up" section, with two sub-sections)

P7440, L4-l23: There is a lot of text about possible palm oil scenarios here, only to finish with a sentence saying that none of that is taken into consideration and the whole of Borneo is going to be covered in palm oil. Perhaps this could be re-written with what was done, followed by a justification?

P7440, L11: What is the "NCAR vegetation distribution"? Citation?

P7440, L16: Why "(< 60%)" if "much is on Borneo"? What is the actual percentage?

P7441, L1-17: Why go into such detail with the NOx emissions if the palm oil isoprene emissions are rather more general?

P7441, L7-8: Does the fertilizer application vary randomly for each model run?

P7441, L14: what is meant by "believed to be"? Believed by who?

P7441, L24: Suggest that this last sentence is the first sentence of the section, in order to help those scanning the paper.

P7442, L20: "...excluding a morning peak" – please clarify what is meant here.

P7443, L8: Express as lifetime perhaps?

P7443, L27-: Are the results robust to boundary layer height uncertainties?

P7444, L20-: This discussion in this paragraph would be strengthened with some ozone budget statistics. Also, "an increase in VOC concentration results in an increased NET chemical sink for ozone". Higher levels of reasonably complex VOCs can also impact ozone production terms, by impacting NOy speciation.

P7445, L7-20: While it may be that moderate ozone concentrations can lead to adverse impacts on plants and humans, I feel that this connection is rather overplayed here. Why worry about 35 ppb in Borneo, where other regions of the world have far higher concentrations? In my view, highlighting potential health impacts needs much more justification than is there currently.

P7445, L22: "...decreases...up to 70%" (remove minus sign)

P7445, L29: “Significant”? As per which statistical test, and against which measure of noise? (Also, P7447, L29)

P7446, L11-24. Much of the content of this paragraph is the same as that at the end of Sect. 5.1

Figure 1: “Model fit to. . .” Clarify which model (i.e. not p-TOMCAT)

Figure 2: Needs larger text. Legend in first panel only.

Figures 3-6: Titles above and to the side of the panels would make quick reference much easier than deciphering the caption.

TYPOGRAPHICAL/TECHNICAL CORRECTIONS:

Throughout: “fertiliser” or “fertilizer”?

P7434, L1: “South East Asia”

P7437, L9: “. . .tropical rainforests.”

P7437, Sect. 3: Should be past tense for what you “did” with the model

P7448, L10: “Paper XXX” Is there/will there be a number?

REFERENCES:

Ashworth, K., Folberth, G., Hewitt, C. N., & Wild, O. (2012). Impacts of near-future cultivation of biofuel feedstocks on atmospheric composition and local air quality. Atmospheric Chemistry And Physics, 12(2), 919–939. doi:10.5194/acp-12-919-2012

Ganzeveld, L. N., & Lelieveld, J. (2004). Impact of Amazonian deforestation on atmospheric chemistry. Geophysical Research Letters, 31, L06105. doi:10.1029/2003GL01925

Orlando, J. J., Tyndall, G. S., Apel, E. C., Riemer, D. D., & Paulson, S. E. (2003). Rate

coefficients and mechanisms of the reaction of Cl atoms with a series of unsaturated hydrocarbons under atmospheric conditions. International Journal of Chemical Kinetics, 35, 334–353. doi:10.1002/kin.10135

Wiedinmyer, C., Tie, X., Guenther, A. B., Neilson, R., & Granier, C. (2006). Future changes in biogenic isoprene emissions: How might they affect regional and global atmospheric chemistry? Earth Interactions, 10, Paper No. 3. doi:10.1175/EI174.1

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 7431, 2013.