Atmos. Chem. Phys. Discuss., 12, C4915–C4921, 2012
www.atmos-chem-phys-discuss.net/12/C4915/2012/

Atmospheric Chemistry and Physics Discussions

ACPD
12, C4915–C4921, 2012

Interactive Comment

Interactive comment on "Estimation of biogenic volatile organic compound (BVOC) emissions from the terrestrial ecosystem in China using real-time remote sensing data" *by* M. Li et al.

M. Li et al.

songyu@pku.edu.cn

Received and published: 22 July 2012

Reviewer 1:

General Comments:

This manuscript presents a set of BVOC emissions estimates for China using the MEGAN model [Guenther et al., 2006] driven using high resolution meteorological and satellite data. Overall, the paper is generally well-written with nice clean ïňĄgures, and several useful tables. I guess for those studying and/or interested in China's BVOC emissions it may be a useful future paper to refer to. That said, I'm not sure what new science (if any) is actually being presented. All the authors have really done is to run an established model (MEGAN) with a single prescribed set of high resolution MM5 and MODIS data. Other different high resolution meteorological or vegetation inputs have not been considered. It's hardly ground breaking work.

Response: Both the meteorological model and biogenic VOCs emission model (MEGAN) are important in estimating VOCs emissions. The land use and land cover in China have been changed a lot during the recent 30 years. However, the meteorological outputs from MM5 were often derived by using the USGS land surface data, which could be outdated. Another weakness is that the MEGAN model could use the MODIS data, which does not match USGS data default in MM5. In this study, both the MM5 and MEGAN are improved by using the real time MODIS land surface data, including the land use land cover, vegetation fraction, leaf area index etc. The results are compared with the past estimations and the VOCs fluxes measurements in China.

In addition, throughout the text there are statements that are slightly misleading, and in some instances plain wrong. I therefore echo the sentiments of the other reviewer in that for the manuscript to be published, careful rephrasing and corrections are needed (cf. the detailed comments of anonymous reviewer 2).

SpeciïňĄc Comments:

Page 6553, Line 5: "Natural NMVOCs equal or exceed anthropogenic VOC emissions: : :" – which is it?

Response: Accepted. We have rephrased it and for more detail, see Line 42-43.

Page 6553, Line 15: Based on a wide range of studies, I think it is safe to say isoprene and monoterpenes are the most dominate BVOC emissions.

Response: Accepted. For detail see Line 50-51.

Page 6554, Line 2: What are the 'signiïňĄcant implications'? Please explain to the reader what these might be.

ACPD

12, C4915–C4921, 2012

Interactive Comment

Response: Accepted. It means that BVOCs were an important source of atmospheric carbon budget and impact global carbon cycle. For detail please see Line 62-65

Page 6554, Line 20-21: The dependence of monterpene emissions on light has only been included in leading BVOC emissions models in the last few years. How can some of the early studies be deïňĄcient for only incorporating what was known at that time?

Response: Accepted. We have rephrased it and for detail see Line 79-81.

Page 6555, Line 5: Most BVOC emissions provide input to chemistry transport models (CTMs). A resolution of 0.5x0.5 degrees is not considered coarse for a CTM. The resolution one calculates the emissions at, is or course dependent on their application. Hence poor resolution input data is not a deïňĄciency – it's just a constraint.

Response: Yes, for chemical simulation on a national scale the resolution of $0.5^\circ \times 0.5^\circ$might be acceptable. However, to conduct a more precise simulation on a regional scale, we think it's not enough. More importantly, study showed that the low resolution may result in failure to capture the maximum values in BVOC estimations (Ashworth et al., 2010).

Section 2.2: I'm left unclear about the leaf area index (LAI) being used to derive MEGAN – where does it come from? The authors say they use the vegetation fraction (VGF) derived from MODIS NDVI but this is not the same as LAI. The vegetation fraction is the amount of each grid cell covered by vegetation; the LAI is the leaf size of that vegetation. Furthermore, the LAI in MEGAN should be weighted by the fraction of each grid cell covered by vegetation (as done in Guenther et al, 2006). Please provide more explanation on your approach.

Response: I'm sorry for making you confused about the use of LAI in my study.

(1) It's true that LAI is thoroughly different from VGF and in this study VGF is just an input parameter of MM5. Because many past studies indicated the land surface parameters in MM5 were inaccurate and may led to error in model outputs (Crawford

ACPD

12, C4915–C4921, 2012

et al., 2001; Kurkowski et al., 2003; Tian et al., 2004; de Foy et al., 2006). In section 2.2, we introduce how to modify the land-use and VGF parameters in MM5 with MODIS data to improve the simulation performance.

(2) In this study, we used the 1 km $\times$ 1 km 8-day MODIS LAI data (MCD15A2) for the year 2006 to calculate the modifications of LAI (γLAI) and leaf age (γage), based on the algorithms described in Guenther et al. (2006) (For detailed description of MODIS LAI data and its advantages, see Line 138-147).

(3) In our study, although we gave the estimated results based on 12 km $\times$ 12 km grids, indeed we calculate BVOC emissions based on 1 km $\times$ 1 km grid cell (because the resolutions of LAI data and EFs were 1 km). So because of high spatial resolution (1 km) we assumed the fraction of each grid cell covered by vegetation to be 100%.

Section 3.4: This section seems long-winded and over-elaborate. In my opinion, it could be shortened to a one/two paragraphs.

Response: Accepted. We have shortened this section and for detail please see section 3.5.

Section 3.5: A ïňĄgure of the anthropogenic emissions would be useful.

Response: Because the discussion focused on province-level comparisons of VOC emissions of natural and anthropogenic sources, we just gave the emission data in Table 4.

Sections 3.6 and 4.1: Address the well-made comments made by reviewer 2.

Response: Accepted.

(1) In section 3.7.1, we gave more thorough analyses of comparisons with MEGAN-based results (Guenther et al., 1995; Klinger et al., 2002; Guenther et al., 2006; Tie et al., 2006) and estimated results by other approaches, e.g. GUESS-ES emissions based on process-based approach (Arneth et al., 2007; Schurgers et al., 2009). Addi-

ACPD

12, C4915–C4921, 2012

tionally, we also conduct several case studies to explore the reasons responsible for the differences between the recent study by Tie et al. (2006) and ours. In section 3.7.2, we conduct a comparison with limited field measurements results (Bai et al., 2004; Baker et al., 2005; Geron et al., 2006; Gao et al., 2011) as suggested by reviewer 2. For detail, see section 3.7.

(2) Because we did not give any quantitative analyses of the uncertainty we delete section 4.

Page 6569, Line 15: In the full MEGAN canopy model, on which the PCEEA algorithm is based, the humidity and wind speed are taken into account.

Response: Accepted. I just mean in the PCEEA algorithms the influence of humidity and wind speed are not taken into account.

Section 4.2: The assignment of basal emissions capacities, whether it be in a canopy-scale model like MEGAN or a leaf scale algorithm like LPJ-GUESS (Arneth et al., 2007), are known to be a large uncertainty. You're not saying anything new.

Response: Accepted and we have deleted it.

Page 6571, Line 15-16: You've only used a different set of input data (which have uncertainties), not made 'obvious improvements'.

Response: Accepted.

Page 6573, Line 9: Small typo.

Response: Accepted.

Reference

Arneth, A., Niinemets, U., Pressley, S., Back, J., Hari, P., Karl, T., Noe, S., Prentice, I. C., Serca, D., Hickler, T., Wolf, A., and Smith, B.: Process-based estimates of terrestrial ecosystem isoprene emissions: incorporating the effects of a direct CO2-isoprene

ACPD

12, C4915–C4921, 2012

interaction, Atmos Chem Phys, 7, 31-53, 2007.

Ashworth, K., Wild, O., and Hewitt, C. N.: Sensitivity of isoprene emissions estimated using MEGAN to the time resolution of input climate data, Atmos Chem Phys, 10, 1193-1201, 2010.

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.

Baker, B., Bai, J. H., Johnson, C., Cai, Z. T., Li, Q. J., Wang, Y. F., Guenther, A., Greenberg, J., Klinger, L., Geron, C., and Rasmussen, R.: Wet and dry season ecosystem level fluxes of isoprene and monoterpenes from a southeast Asian secondary forest and rubber tree plantation, Atmos Environ, 39, 381-390, DOI 10.1016/j.atmosenv.2004.07.033, 2005.

Crawford, T. M., Stensrud, D. J., Mora, F., Merchant, J. W., and Wetzel, P. J.: Value of incorporating satellite-derived land cover data in MM5/PLACE for simulating surface temperatures, J Hydrometeorol, 2, 453-468, 2001.

de Foy, B., Molina, L. T., and Molina, M. J.: Satellite-derived land surface parameters for mesoscale modelling of the Mexico City basin, Atmos Chem Phys, 6, 1315-1330, 2006. Gao, X., Zhang, H., Cai, X., Song, Y., and Kang, L.: VOCs fluxes analysis based on micrometeorological methods over Litchi Plantation in the Pearl River Delta, China, Acta Scientiarum Naturalium Universitatis Pekinensis, 47, 916-922, 2011.

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.atmosenv.2005.11.022, 2006.

Guenther, A., Hewitt, C. N., Erickson, D., Fall, R., Geron, C., Graedel, T., Harley, P., Klinger, L., Lerdau, M., Mckay, W. A., Pierce, T., Scholes, B., Steinbrecher, R., Tallam-

ACPD

12, C4915–C4921, 2012

Interactive Comment

raju, R., Taylor, J., and Zimmerman, P.: A Global-Model of Natural Volatile Organic-Compound Emissions, J Geophys Res-Atmos, 100, 8873-8892, 1995.

Guenther, A., Karl, T., Harley, P., Wiedinmyer, C., Palmer, P. I., and Geron, C.: Estimates of global terrestrial isoprene emissions using MEGAN (Model of Emissions of Gases and Aerosols from Nature), Atmos Chem Phys, 6, 3181-3210, 2006.

Klinger, L. F., Li, Q. J., Guenther, A. B., Greenberg, J. P., Baker, B., and Bai, J. H.: Assessment of volatile organic compound emissions from ecosystems of China, J Geophys Res-Atmos, 107, Artn 4603. Doi 10.1029/2001jd001076, 2002.

Kurkowski, N. P., Stensrud, D. J., and Baldwin, M. E.: Assessment of implementing satellite-derived land cover data in the Eta model, Weather Forecast, 18, 404-416, 2003. Schurgers, G., Arneth, A., Holzinger, R., and Goldstein, A. H.: Process-based modelling of biogenic monoterpene emissions combining production and release from storage, Atmos Chem Phys, 9, 3409-3423, 2009.

Tian, Y., Dickinson, R. E., Zhou, L., Myneni, R. B., Friedl, M., Schaaf, C. B., Carroll, M., and Gao, F.: Land boundary conditions from MODIS data and consequences for the albedo of a climate model, Geophys Res Lett, 31, Artn L05504. Doi 10.1029/2003gl019104, 2004.

Tie, X. X., Li, G. H., Ying, Z. M., Guenther, A., and Madronich, S.: Biogenic emissions of isoprenoids and NO in China and comparison to anthropogenic emissions, Sci Total Environ, 371, 238-251, DOI 10.1016/j.scitotenv.2006.06.025, 2006.

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/12/C4915/2012/acpd-12-C4915-2012-supplement.pdf

---

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 6551, 2012.