Atmospheric
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Discussions

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Interactive comment on "Three Northern Regions Shelter Forest contributed to long-term increasing trend of biogenic isoprene emissions in Northern China" *by* Xiaodong Zhang et al.

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General comments

The paper touches an interesting topic of impact of human induced ecosystem changes on air quality. It studies trends of isoprene emission in Northern China with focus on artificially grown ecosystem of Three Northern Regions Shelter Forest (TNRSF). By using model of biogenic VOCs the paper shows that there is an increasing trend in biogenic isoprene emissions in the TNRSF region over the period of 1982 to 2010, which is likely to increase with further plantation of this human induced forest. Particularly, the study shows that promoted tree plantation in Central-North China region close to agglomerations of Beijing and Tianjin brings higher isoprene emissions to the vicinity

of potentially strong NOx sources, which can have significant impact on local air quality (e.g. surface ozone).

The base of the study is in modeling of isoprene emissions with the MEGAN model (Guenther et al., 2012). Additionally, the authors perform an uncertainty analysis of model inputs using the Monte Carlo method. And furthermore, they carry out a model evaluation by converting the measurements of total VOCs (TVOC) at several stations inside the forest to emissions of isoprene. Although the applied methodology of estimation of isoprene emission fluxes from measured TVOC concentrations is rather approximative, it provides a qualitative evaluation of modeled isoprene emissions.

The paper is comprehensibly structured, written in appropriate level of English. I recommend its publication in ACP after minor revisions. Please see my specific comments and technical corrections below.

Specific comments

1] Since the manuscript does not show any results on the impact of BVOC emissions on the 'ozone formation', it should not be included among the Key words.

2] P2L10 : "... emit harmful gases into the air ... " – gases that trees emit are not harmful per se, but they indeed contribute to air pollution through atmospheric chemistry. Please rephrase this sentence.

3] In section 2.1 authors do not mention which meteorological fields they used to drive the MEGAN model.

4] P11L7-L9 : Comparison of Northern China emissions with emissions calculated for regions in the US. This sentence is a bit vague. Authors should specify why they chose the US regions for comparison and be more precise, e.g. add numbers of total amounts.

5] It would be helpful for orientation in the Northern China geography, if the figures with maps of emissions and emission trends (Figs. 3-5, S4, S6a, S7) included indications

of meridians and parallels of latitude in the model domain.

6] It is not quite clear what is shown in Fig. 5. The description in the main text (P14L1) is not clear and the figure caption is the same as in Fig. 4b.

7] P16L4 – Authors compare their results of isoprene emissions in Central-North China regions with emission estimates by Li et al. (2013). They claim the results are comparable. However, the upper limit of their emission range is about 4 times lower than that of Li et al. (2013). Can authors comment on that, what could be the possible differences?

8] P22L2 – Discussion of the comparison of emissions in Northeast China and Inner Mongolia in 2010 and 1982 doesn't seem to be correct. While I agree with the authors' conclusion that emissions are lower in 2010 than in 1982 (shown in Fig. 3) due to lower air temperatures (Fig. S7), the premises seem to be confused. The emissions in this region do not have a trend (as shown in Fig. 4b and Fig. 6), but the forest coverage increased between 1982 and 2010 (Fig. S6a). Assumption that the mixed forest reaches a steady state is unclear though. Can you be more specific?

Technical corrections

Main text:

In the whole text please replace 'BVOCs emissions' by 'BVOC emissions', similarly 'VOCs emissions' by 'VOC emissions'

P2L17: replace 'anthropogenic emissions' by 'anthropogenic sources'

P2L18: isoprene is a subgroup of terpenes (hemiterpene), please replace 'terpenes' by 'monoterpenes' or 'monoterpenes and sesquiterpenes'

P3L10: replace 'monoterpene' by 'monoterpenes'

P3L14: replace 'was from isoprene emission' by 'was isoprene'

P4L10: replace 'tens percent' by 'tens of percent'

P5L11: replace 'modeled increased dry deposition' by 'increased modeled dry deposition'

P11L14: replace 'increased' by 'increase'

P12L1 : reference to Fig.1 seems to be redundant

P12L5: reference to Fig.3 seems to be redundant

P13L1: I'd recommend to replace 'applicable model grids' by 'model grids that fall within the TNRSF domain' or similar

P13L7: Fig.1 is not the right reference here since it does not show arid or semi-arid regions

P19L15: misspelled reference of Arneth et al.

P19L17; replace 'tens percent' by 'tens of percent'

P21L7: Sentence starting 'However, . . .' does not make sense. Did the authors mean 'However, it is not yet clear . . .' ?

P22L4: Missing space in 'between1982'

P22L14: Reference to Fig. 4b is misleading here. Either remove it, or refer to Fig. 4b directly after 'Northeastern China' in the same sentence and refer to Fig. 4a after '2000'.

References:

- missing year of publication for Guenther et al., Estimates of regional natural volatile organic compound fluxes from enclosure and ambient measurements.

Figure caption to Fig. 6 – please edit the text, only one dotted line is shown in the figure.

Supplementary material:

- in section of Simplified Gaussian model for an area source – variable 'Cis' is not defined

Figure caption to Fig. 6b – replace 'LAT' by 'LAI'