

Interactive comment on “Implementation of the biogenic emission model MEGAN(v2.1) into the ECHAM6-HAMMOZ chemistry climate model. Basic results and sensitivity tests” by Alexandra-Jane Henrot et al.

Anonymous Referee #2

Received and published: 1 November 2016

The presented paper describes implementation of the module for estimation of biogenic VOC emissions inside a chemistry climate model ECHAM6-HAMMOZ with links to land surface model JSBACH. The biogenic VOC module is based on the algorithm of the MEGAN model and in its reference setting the module is driven by emission factor data and PFT distributions provided by the MEGAN model. The authors went on to adapt the PFT categories from JSBACH to comply with and be usable by the biogenic VOC module. The correspondence between PFT categories from JSBACH and in the biogenic module can be a useful advantage in case of land cover experiments (past or future scenarios). The authors performed series of simulations in order to compare re-

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sults of their BVOC emission module with previous studies and to address sensitivities of the emission estimates to input data (emission factors and PFT distributions, impact of soil moisture deficit and nudged meteorology). The resulting reference emissions are comparable with previously published studies and the sensitivity analysis suggests limits and uncertainties of modeled emissions. Overall, the paper presents a successful integration of an online module for estimation of biogenic VOC emissions inside the ECHAM6-HAMMOZ model system. This development allows the model to use BVOC emissions consistent with the rest of the system (e.g. using same meteorological fields, leaf area index) and provides a useful tool for simulating BVOC emissions under changing climate and/or vegetation distributions.

I find the manuscript well prepared. It is structured in a straightforward way. The methodology and results are described in very comprehensively. I therefore recommend the manuscript to be published in GMD after addressing minor comments mentioned below.

Specific comments

Section 2.3.1 Emission activity factor gamma

I believe there is a missing parenthesis at the end of Eq. (3) and the γ_{LAI} factor multiplies the light independent as well as the light dependent part. The approach to calculation of the gamma factor is a combination of the algorithm used in the newest MEGANv2.1 (Guenther et al., 2012) and the simplified parameterized approach (PCEEA) described in Guenther et al. (2006) for isoprene, i.e. for light dependent species.

The authors should make clear that the Eq. (3) as it is described is actually not used by MEGANv2.1, but already includes edits after application of PCEEA. I think it would increase clarity if the authors described with a little bit more detail how they derived Eq. (3). Guenther et al. (2006) do not discuss light-dependent and light-independent parts (as the paper is focused on isoprene only) and Guenther et al. (2012) introduce

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light dependent fraction factor, but do not mention the final equation for calculation of gamma_CE for both light-dependent and light-independent parts in a way as it is used in the model code (which I assume was a starting point for the presented study), therefore it is not straightforward how authors end up with Eq. (3).

I assume the construction of Eq (3) was the following and I'd suggest the authors to include its derivation (in modified way) in the manuscript.

Equation for calculation of gamma_CE in MEGANv2.1 (as written in the MEGANv2.1 code) is

$$\text{Gamma_CE} = (1 - \text{LDF}) * \text{gamma_TLI} * \text{gamma_LAI} + \text{LDF} * \text{Cce} * \text{LAI} * \text{gamma_TLD}$$

Following Guenther et al. (2006) the calculation of light-dependent factor with detailed canopy environment model (i.e. $\text{Cce} * \text{LAI} * \text{gamma_TLD}$) was replaced by parameterized canopy environment emission activity factor ($\text{gamma_LAI} * \text{gamma_P} * \text{gamma_T}$)

My other comment to Eq (3) is that gamma_TLI factor (accounting for temperature dependence for light-independent species) is in MEGANv2.1 calculated for sunlit and shaded leaves at 5 canopy levels. This approach is obviously not used in the current study. I think the authors should mention the simplification they have done for calculation of the light-independent factor and eventually comment on its implications.

P7L29 : Loss of biomass (annual cycle of LAI) also contributes to seasonal variation of emissions.

P13L5: Sindelarova et al. (2014) suggested that a considerable uncertainty in applying the soil moisture activity factor lies in the wilting point value which differs among the models. Authors mention the importance of wilting point selection themselves. Could they comment on why they chose 35 % of the maximum soil water content as a wilting point value?

P14L14-15: I suppose that the reductions of 1 Tg(C)/year for isoprene and 0.08 Tg(C)/year are averages over the modeled period. It should be mentioned in the sen-

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tence that these are mean values.

P16L3-5: The authors say that “The use of emission factors derived from PFT distributions . . . results . . . to the largest changes in the spatial distribution of BVOC emissions” but it is not clear what they compare here. Largest changes compared to other simulations in the current paper?

Table 6. Please revise the unit in the Table caption

Technical comments

P3L20: please add a reference for ERA-Interim dataset

P4L28: change “classe” to “class”

P6L25: correct “nitric oxyde” to “nitric oxide”

P10L23 : The whole reference Guenther et al. (2012) should be enclosed in parenthesis

P11L9: erase “the” from “increases of all the monoterpene compounds”

P11L9-10: please rephrase “due to the presence in the major part of Australia of temperate shrub PFTs, which are strong emitters of monoterpenes” to “due to the presence of temperate shrub PFTs, strong monoterpene emitters, in major part of Australia”

P11L12: erase “the” from “to the larger spatial coverage”

P11L17 and L19: replace “oxid” with “oxide”

P11L20: erase “the” from “due to the very low”

P11L22: erase “the” from “The much higher values”

P12L3-4: please rephrase “which are replaced in the JSBACH distribution by cool/cold C3 grasses or bare soil at high latitudes of the Northern Hemisphere” with “which are replaced by cool/cold C3 grasses or bare soil at high latitudes of the Northern

Hemisphere in the JSBACH distribution”

P12L12: replace “PFT cover” by “PFT coverage”

P15L4: correct the sentence: either “decreases are” or “decrease is”

P15L6: correct: “only weakly impacts global mean”

P15L31: add “the” before “Earth”

P16L14: replace “highlight” with “highlights”

P16L15: replace “it’s ” by “its”

P16L17: replace “water” by “moisture”

Figure 1, 5, 8, 12: Label for the y-axis is missing

Figure 2: Labels for the x- and y-axis are missing

Figure 3, 4, 6 and 15: Numbers on colorbars are very difficult to read. They would benefit from bigger fonts.

Figure 13: Please use brackets to enclose the unit in the y-axis labels.

Interactive comment on Geosci. Model Dev. Discuss., doi:10.5194/gmd-2016-248, 2016.

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