

***Interactive comment on* “Evaluation of a photosynthesis-based biogenic isoprene emission scheme in JULES and simulation of isoprene emissions under modern climate conditions” by F. Pacifico et al.**

Anonymous Referee #2

Received and published: 14 January 2011

Overview:

This manuscript presents the incorporation of a semi-mechanistic isoprene emission module into the JULES land-surface scheme, together with its evaluation with above-canopy flux measurements and satellite-derived emission estimates. It aims at presenting the model performance before other studies addressing the feedbacks between biogenic emissions, atmospheric chemistry and climate are performed using this isoprene emission scheme within a global Earth System Model.

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The paper is well written and the scientific method clearly outlined. It gives a really interesting overview of the different steps of a biogenic emission model development and test. I therefore recommend this paper for publication in ACP. However, I would really like the following comments to be considered and taken into account beforehand. Indeed if publishing an emission model development and evaluation is a compulsory exercise, it does have to provide some new insights. I am convinced a good work is here and done and that value could be added to this paper underlining more the original aspects of this work compared to several other studies that have already been published in this field.

General comments:

In the abstract: the original aspects of this work should be clearly underlined: what is new compared to other published studies? What do we learn from this work?

In the abstract, line 14: precise in which simulation conditions the 1990s global annual isoprene emissions of 380 ± 7 TgC/yr is calculated: potential vegetation distribution? Are crops included?

Introduction, last paragraph: what is new and what are the strengths of this study? Does JULES have any specific characteristics compared to other land-surface models?

Introduction, lines 8-14: this sentence is too long and confusing. For example cut this sentence in two before “thus the work”.

Section 2.1, description of JULES : Considering, or not, crop distribution and extension can significantly affect VOC biogenic emissions estimates. Is there any specific treatment for crops in JULES? How are they included in the model and if not, is there any plan to include them? Can the vegetation distribution be prescribed in JULES and if not, how does the actual potential vegetation distribution compare with the real natural PFTs distribution?

Sections 2.2 and 2.3: when not already given, could you please specify the units for

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the variables used in the equations?

Page 28318, line 15: Is the leaf internal CO₂ concentration C_{lst} calculated by the model for each PFT, or is it prescribed to one particular value?

Page 28319, line 13: Does the basal isoprene emission depends on PFT in the model? Is it prescribed? What are the values for a standard present-day simulation?

Section 2.3, page 28319, line 19-21: The authors assume that the rate of photosynthesis is a reasonable approximation to the electron transport rate. Which references is your assumption based on? Did other published studies already based their model development on the same assumption or is it an original insight?

Section 2.4, page 28321, line 11: The authors specify that “The gap-filling technique was not applied to rainfall or snowfall rates” : so what was done for these particular variables when meteorological data were not available ?

Section 2.4: In your work, LAI is used to scale up emissions from leaf to canopy level (equation 8) and is therefore a critical variable for isoprene emission estimates. When comparing the model results with above-canopy isoprene fluxes which LAI did you use: did you have access to any LAI data for the measurements sites used for this evaluation? Was the LAI calculated by JULES?

Section 2.5, page 28323: The PFT distribution for the 1990-2001 run is based on the IGBP datasets and is kept fixed over the simulation period. What about LAI: was is calculated by the model and did it vary between years, seasons? Was a varying atmospheric CO₂ concentration considered when calculating LAI (photosynthesis. . .) or was is kept constant to 360 ppm? What was the starting point of this simulation: equilibrium in 1990?

Section 2.6: Remove this section which does not provide any new information, and specify at the end of the section 2.5 that the 1990-2001 simulation was also used for present-day isoprene emission estimates and comparison with previous published

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studies.

Page 28325, lines 23-25, and figure 5: as LAI is a key variable when calculating isoprene emissions at the canopy-level, it would be interesting to have more detailed information, both in the text and in the figure 5, of how the simulated LAI compares with data available (for example the work by Pressley et al. 2005 you're citing in the manuscript), not only considering the seasonal cycle but also the magnitude.

Section 3.3, page 28327, line 13-20, and figure 9 : Could you add more detailed information on the work by Arneth et al. (2007a) and Guenther et al. (2006) you're comparing your model results with? Which time periods were these works based on? Which global annual (possibly averaged) isoprene emissions? Could you also represent these results in the figure 9, so that the readers get a better idea of how those different estimates compare with each others?

Section 3.3, page 28327, line 21-25: How were the IEF needed to achieve 600 TgC/yr calculated: keeping the same emission proportion between PFTs?

Specific comments:

Throughout the paper I would suggest to change the term “modern” by “actual” or “present-day” to avoid confusion with the 16th-18th century period the term “modern” generally refers to in history.

Page 28313, line 20: replace “are considered the main contributors” by “are considered to be the main contributors”

Page 28314, line 26: replace “that seek to relate” by “seeking to relate”

Page 28314, line 29, and elsewhere in the paper: replace “the Arneth et al. (2007b) scheme” by “the scheme by Arneth et al. (2007b)”

Page 28320, line 16 and page 28328, line 7: to avoid repetition replace “diurnal cycle and daily variability” by “diurnal cycle and day-to-day variability”

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