Atmos. Chem. Phys. Discuss., 10, C14103–C14112, 2011
www.atmos-chem-phys-discuss.net/10/C14103/2011/

Atmospheric Chemistry and Physics Discussions

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.

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Received and published: 24 February 2011

Response to referee 1

General comments:

In order to study how the results presented here are sensitive to the distribution of PFTs (Table 2) we have performed a sensitivity study. The description of this study has been added at p.28327 l. 20 'We have studied the sensitivity of isoprene emissions to a change in the conversion factors from IGBP to JULES surface types (Table 2). A 10%

increase/decrease on the dominant JULES PFT fraction for each IGBP land cover class (balanced by a correspondent decrease/increase over the remaining PFT fractions) results in a 9-11% increases/decrease in annual global total isoprene emissions'. We have also added the following comment in the discussion section p.28330 l. 28: 'We also show that our global total estimate of isoprene emissions is robust for reasonable variations in the conversion factors from IGBP to JULES surface types (Table 2).'

To emphasize the contribution that this study makes to the field we have replaced 'thus the work described here is designed to evaluate model performance prior to quantifying the feedbacks between biogenic emissions, atmospheric chemistry and climate within a global Earth System model (e.g., Arneth et al., 2010).' (p.28315, l.14) with 'Inclusion of process-based isoprene emissions is necessary in order to quantify the feedbacks between biogenic emissions, atmospheric chemistry and climate within a global Earth System model under current and future climates (e.g., Arneth et al., 2010). The work described here provides a comprehensive evaluation of the performance of the land surface model in simulating isoprene emissions, a necessary step to enhance confidence in feedback estimates.'

Specific comments:

Title: 'modern' has been replaced with 'present-day'

p.28315, l.14: to emphasize the novel aspect of this study we have replaced 'thus the work described here is designed to evaluate model performance prior to quantifying the feedbacks between biogenic emissions, atmospheric chemistry and climate within a global Earth System model (e.g., Arneth et al., 2010).' with 'Inclusion of process-based isoprene emissions is necessary in order to quantify the feedbacks between biogenic emissions, atmospheric chemistry and climate within a global Earth System model under current and future climates (e.g., Arneth et al., 2010). The work described here provides a comprehensive evaluation of the performance of the land surface model in simulating isoprene emissions, a necessary step to enhance confidence in feedback

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estimates.'

p.28318, l.11: we have defined JT and Je: 'JT is the total electron transport rate and Je is the extra electron transport rate needed to reduce the sugars to isoprene. Je is relatively small and can be neglected (Niinemets et al., 1999).'

p.28319: equation 7 has been re-written as

p.28323, l.13: to explain how the interpolation was performed we have replace 'The data were therefore interpolated to the 1-hour timestep required by the model.' with 'The data were interpolated, by the model itself, to the 1-hour timestep required by the model. The 1-hour interpolation used here was variable specific. Air pressure, specific humidity, air temperature and wind speed were linearly interpolated, while downward longwave and shortwave radiation, rainfall and snowfall were interpolated forward with time (Clark and Harris, 2009).'

p.28323, l.16: to explain the conversion from IGBP to JULES PFTs we have replaced 'The 17 land cover classes in this dataset were translated into proportional cover and characteristics of the five JULES PFTs and the proportional cover of the four JULES land cover types according to Table 2 and 3.' with 'The 17 land cover classes in this dataset were translated into proportional cover and characteristics of the five JULES PFTs and the proportional cover of the four JULES land cover types according to the scheme shown in Table 2 and 3. PFT distribution is kept fixed over the simulated time period but the model simulates changes in LAI for each of the PFTs.' We have also removed Table 3.

p.28324, l.1: this section has been removed, and at the end of section 2.5 we have added 'We have also estimated global isoprene emissions from 1990 to 1999 based on the global simulation described above. These estimates are compared with previous model-derived estimates from the literature.'

p.28326, l.4: in the manuscript we convert Tg/yr into TgC/yr, so it is 50 TgC/yr, with an

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uncertainty of 26 TgC/yr.

p.28326, l.5: the standard deviation shown here describes the interannual variability, so we have modified the sentence into: '(standard deviation over the total annual mean emissions: 2TgC/yr)'

p.28327, l.8: to comment on the differences with the study by Sanderson et al. (2003) we have added: 'The approach used to derive previous estimates vary from study to study; determining the underlying causes for differences between the various estimates would require analyses beyond the scope of the present paper.'

Fig. 2, 3, 4: locations were already included in the plots' labels. In the caption 'Isoprene emissions were simulated using standard isoprene emission factors (IEFs) from Guenther et al. (1995) and local IEFs when available.' has been turned into 'Isoprene emissions were simulated using standard isoprene emission factors (IEFs) from Guenther et al. (1995) and local IEFs when available (second row of figures).' The legend has been corrected representing local IEF with a square. The axes label 'model' was replaced with 'modelled emissions (mgC/m2/h)'

Fig. 5: individual plots have been labeled with 2000 and 2002 and the solid and dashed lines in the legend were redrawn.

Fig. 7 (referee said Fig 6. but it should be Fig. 7): units corrected as gC/m2/h

Minor corrections and typos:

p.28323, l.14: turned 'programm' into 'programme'

p.28324, l.17: '(1 time step in the model)' removed

p.28326, l.4-6: units updated as (TgC/yr)

Captions

Fig. 2. Scatter plots of simulated and ground-based measured hourly isoprene emis-

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sions at the flux tower sites listed in Table 1, including regression line, 95% confidence interval (Scheffe's method) and 1:1 line. Isoprene emissions were simulated using standard isoprene emission factors (IEFs) from Guenther et al. (1995) and local IEFs when available (second row of figures).

Fig. 3. Scatter plots of simulated and ground-based measured daily average isoprene emissions at the flux tower sites listed in Table 1, including regression line, 95% confidence interval (Scheffe's method) and 1:1 line. Isoprene emissions were simulated using standard isoprene emission factors (IEFs) from Guenther et al. (1995) and local IEFs when available (second row of figures).

Fig. 4. Scatter plots of simulated and ground-based measured daily maximum isoprene emissions at the flux tower sites listed in Table 1, including regression line, 95% confidence interval (Scheffe's method) and 1:1 line. Isoprene emissions were simulated using standard isoprene emission factors (IEFs) from Guenther et al. (1995) and local IEFs when available (second row of figures).

Fig.5. Comparison of simulated and ground-based measured seasonal cycle of daily mean isoprene emissions (Pressley et al., 2005) and LAI (Pressley et al., 2006) at UMBS for 2000 and 2002.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 28311, 2010.

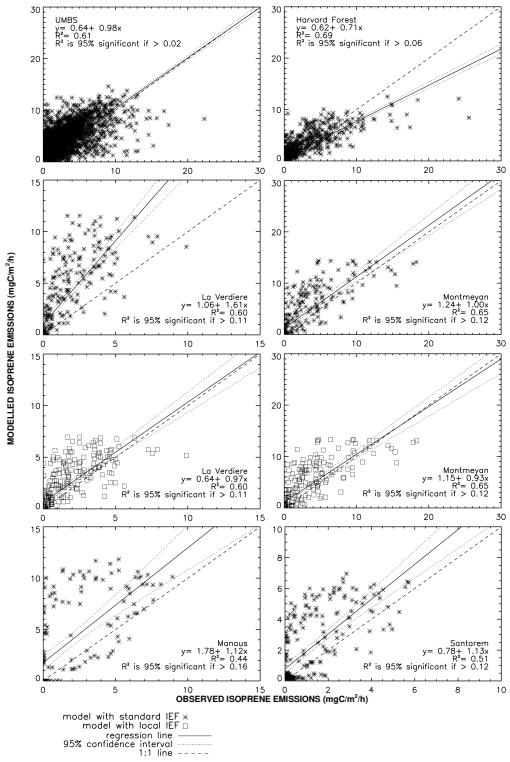

Fig. 1. Fig.2 See caption in Text

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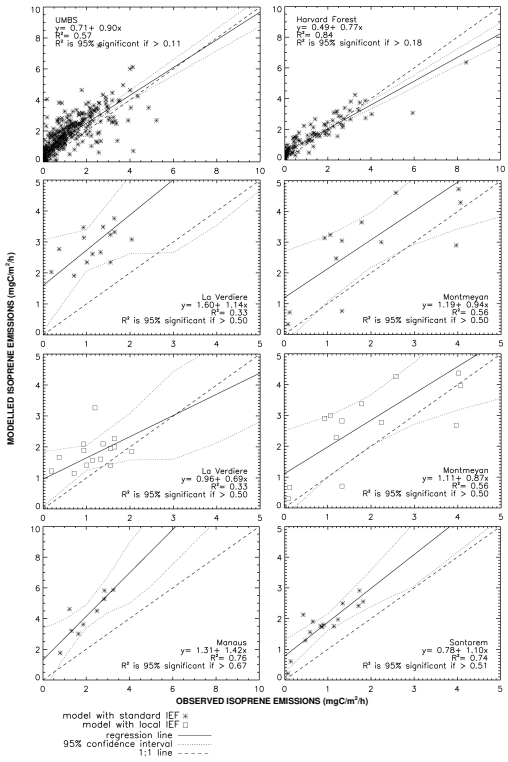

Fig. 2. Fig.3 See caption in Text

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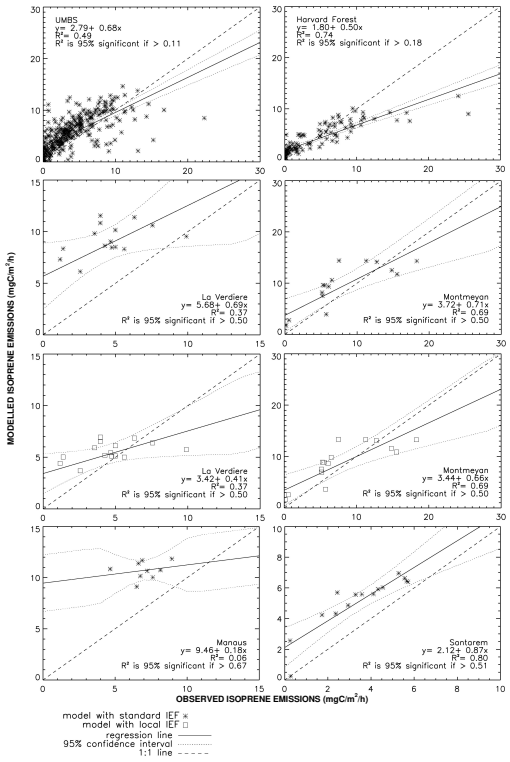

Fig. 3. Fig.4 See caption in Text

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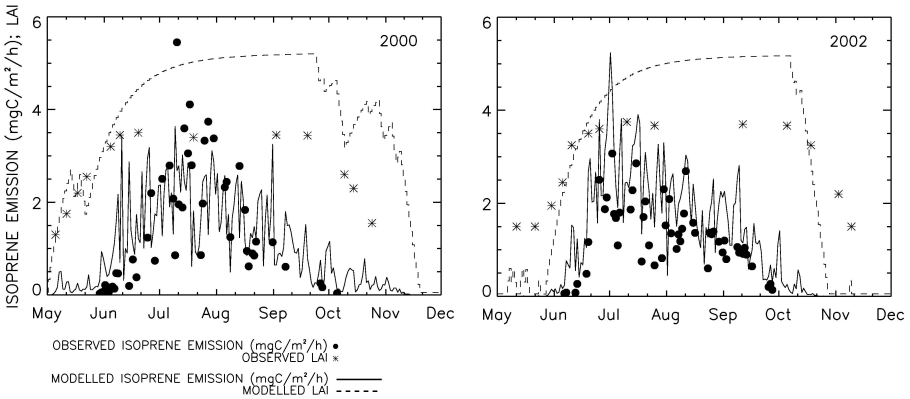

Fig. 4. Fig.5 See caption in Text

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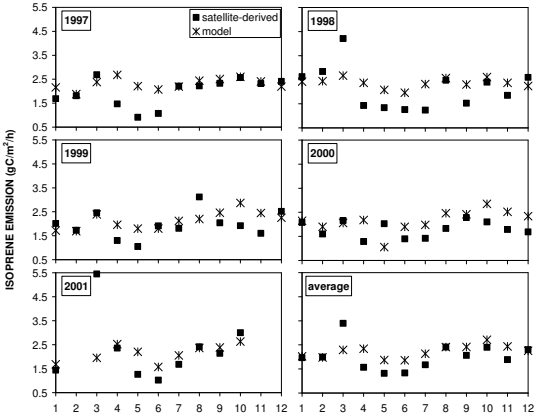

Fig. 5. Fig.7 See caption in Text

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