**Atmospheric
Chemistry
and Physics
Discussions**

Interactive comment on "Estimates of global terrestrial isoprene emissions using MEGAN (Model of Emissions of Gases and Aerosols from Nature)" *by* A. Guenther et al.
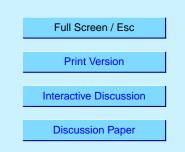
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This work is an excellent paper, and presents a very comprehensive study of the factors affecting isoprene emissions from vegetation. However it is quite a long read, and for the non-specialist (like myself) it is easy to miss important information by having too much detail. Having said that, most of the detail is relevant and I would suspect be of interest to specialists in the field. I appreciate it is difficult to satisfy both audiences in one paper.

One aim of the paper is to give global chemistry modellers algorithms to simulate iso-

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prene emissions interactively within their models. The authors point out that the full MEGAN algorithm is more detailed than needed by most modellers. However even for the MEGAN-EZ model, it was not entirely clear what parameters the modeller needs to supply.

In spite of the reservations mentioned above, this paper is an excellent review of the subject. I hope that atmospheric chemistry modellers will try to incorporate the algorithms detailed in this paper into their models.

Specific comments:

page 114, wind speed and humidity are mentioned here as inputs to MEGAN, but I can't see anywhere in the algorithms where they are used. I guess they must be used in the canopy calculations, this should be explained. u_star is mentioned in the calculation for rho, but doesn't appear in the parameter list here. The 24hr and 240hr temperatures specified here are for the leaf surface, whereas the instantaneous temperatures are for the ambient air - this seems inconsistent, and within the algorithms for gamma_T instantaneous leaf temperatures are used, not ambient air.

Page 122: I think more explanation here is needed about what the canopy model does, and the relationship between above canopy quantities and leaf quantities. I assume it uses meteorological input data (it would be useful to have these listed) to generate leaf temperatures and leaf PPFDs. I was a little confused here as to whether PPFD in eqn (4) is the above canopy flux, or a leaf flux. In eqn (7) the 24hr average PPFD is compared with leaf PPFDs. Both an above canopy PPDF and leaf PPFDs are listed as standard MEGAN variables. The T used in the calculation of gamma_T is the leaf temperature, but as mentioned above, this is not in the MEGAN variable list. Are T, T_24 and T_240 all calculated using the canopy model?

Page 123: Equation (7) uses different P_0 coefficients for sunny and shaded leaves. The authors should explain how sunny and shaded leaves are differentiated. At what stage are the results from sunny and shaded leaves combined - in the calculation of

C_p, or gamma_P, or gamma_PT? Is the weighting simply the fraction of leaves of each type?

Page 124, last paragraph: Given that gamma_CE has an explicit factor of LAI in eqn (3), what these graphs are showing is that gamma_PT decreases with LAI. I would guess that this is primarily due to gamma_P, as the PPFD on each leaf decreases with LAI due to canopy shading. The authors should explain this in the text. It might be more useful to plot gamma_P against LAI rather than gamma_CE to clarify this point.

Page 126, equation (12): Is T_t ambient temperature or leaf temperature?

Page 137: It should be specified that eqn (17) only applies for $0<a<180$. I was not quite sure whether a canopy model is needed to generate the driving data for MEGAN-EZ. Is the PPFD a canopy top or a leaf value? Are the temperatures ambient or leaf? - T_opt requires 240hr leaf temperatures according to eqn (8). The methods for calculating phi need a bit more elaboration.

page 138: I know at least that Sanderson et al., 2003 scaled their isoprene emissions to give the same result as Guenther et al. 1995. If the same is true in the other papers quoted here, it is not surprising that the results are all within 10%.

page 144, paragraph 2: Explain what is causing the changes in PPFD, is it clouds, aerosols, something else? Are the clouds changing globally or moving towards (or away from) isoprene emitting regions. Does increase in scattering increase or decrease isoprene emission through changing the ratio of diffuse to direct radiation (e.g Gu et al JGR 2002)?

Page 144, last paragraph: How robust is this increased sensitivity of isoprene emissions to temperature in MEGAN? How tightly are the parameters in equations (6)-(9) constrained? And how much would uncertainties in these parameters affect the sensitivity? Earlier (beginning of section 7.1) the authors state that MEGAN is less sensitive to temperature than MEGAN-EZ. Does this mean that MEGAN-EZ (which is probably

what most chemistry modellers will use) will predict isoprene increases of even more than a factor of two by 2100? Can the authors estimate (or preferably

conduct the experiments to calculate) how much more sensitive MEGAN-EZ is, and what chemistry modellers can do to ameliorate this? Some comments about the acclimatisation of vegetation to higher temperatures are needed here. Do we expect vegetation to respond to century-scale temperature changes in the same way that they have be found to respond to seasonal scale changes?

Technical comments:

page 109, 3rd line from bottom: "comprises" -> "comprise"

pape 115, 3rd line of paragraph 2: "˜84%"-> "about a factor of six"

page 122, 6th line: "Guenther et al. (1999)" -> "Guenther et al. (1999a)"

page 139, 1st line: "databases can all" -> "databases all"

page 140, last line: "Shim et al." -> "Shim et al., (2005)"

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 107, 2006.

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