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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Current estimates of biogenic emissions from Eucalypts uncertain for Southeast Australia" *by* K. M. Emmerson et al.

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Thank you to reviewer #3. I am happy to include all your editorial comments and respond to your detailed questions below.

In the introduction, the MEGAN version 2.1 paper, Guenther et al. 2012, is often referenced (for example, page 1 line 32 and page 2 line4). However, there are earlier papers that introduce the ideas discussed that should be included (i.e., earlier Guenther et al. papers from the 1990's and the MEGAN version 1 paper, Guenther et al. 2006.).

I have included the Guenther et al 2006 and Guenther et al 1995 references to page 2 line 5.



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Discussion paper

On lines 23 of page 2, Muller et al. (2008) found overestimates of isoprene. How was this determined, and with what observations?

Muller used MEGAN v2 and compared the modelled formaldehyde column to GOME satellite observations.

I have rewritten the sentence at page 2 line 23 to read:

"Muller et al. (2008) found an overestimate of isoprene across northern Australia by comparing MEGANv2 to GOME satellite measurements of formaldehyde, and in subsequent work estimated the magnitude of this over-prediction to be a factor of 2-3 in January (Stavrakou et al., 2015)"

The outline of the high resolution model grids would be interesting to see on Figure 1.

Done.

Page 5: Why were the Acacia species in Australia assigned the lower emission rates?

Acacia species in Australia were assigned low isoprene and monoterpene emission rates in MEGAN because the only studies we know of in the scientific literature, which have been exclusively focused on African and North American Acacias, indicate that non-negligible isoprene and monoterpene emission does occur but it is exceptional with only one high monoterpene emitter and one high isoprene emitter reported for the eight species studied. Also, Rei Rasmussen (personal communication) has investigated isoprene emission from some common Australian Acacias and did not find any of them to be isoprene emitters.

I have altered the text on page 5 line 31 to say:

"Isoprene or monoterpene emissions have not been published for any Australian Acacias but eight Acacia species from South Africa (Guenther et al., 1996; Harley et al., 2003) and the US (Guenther et al., 1999; Papiez et al., 2009) have been investigated and only one isoprene emitter and one monoterpene emitter have been identified.

Based on these observations, the MEGAN model assumes low isoprene and monoterpene emission rates for Australian Acacia species."

Page 6, Section 2.3.3: The authors develop a high resolution PFT emission factor map specific to Australia based on an IGBP land cover dataset. Why was this land cover map used? It seems very old, and there are many other more recent land cover datasets available? And is this consistent with the land cover/land use datasets applied in the chemical transport models?

The Bonan et al 2002 paper was a good place to start as they showed a method to directly convert IGBP landcover into the 16 PFT classes required by the MEGAN model. It was the simplest thing to do once it became evident that the coarse resolution PFT global maps would not be suitable. I have added the following to the supplementary section, page 1 line 16:

"When emission factor maps are used, as is the case for the major biogenic species isoprene and a- and b-pinene, the emission rates are not particularly sensitive to this PFT map. Testing the CSIRO-CTM without the emission factor maps would increase the sensitivity to PFT, which could be tested in future work. This could also be a good opportunity to test alternative land cover datasets".

Page 7, line 6: Is the broadleaf evergreen temperate tree PFT in the study dominated by Eucalypts?

Yes, Tumbarumba is surrounded by Eucalypt species of E. delagatensis (Alpine Ash) and E. dalrympleana (Mountain Gum) as described in the field campaign section on page 3 line 29.

I have altered page 7 line 13 to read: "The combination of high emission factors and percentage of broadleaf evergreen temperate trees in the Tumbarumba grid (Eucalypts, section 2.1.3) enables up to 3.2 ug/m2/h of isoprene to be emitted"

Page 8: The authors perform a sensitivity test on the emissions rates. Why (or how)

were the factors of 3 for isoprene and 3.5 for monoterpenes chosen? (Lines 27-30).

The factors are somewhat arbitrary, and chosen by comparing the modelled isoprene and monoterpene diurnal cycles with the observations. The increase/decrease factors varied enormously across the campaigns, however the observed monoterpene profile at Tumbarumba was ignored because it was different to the other measured monoterpene profiles. A decrease factor of 3 for isoprene suited SPS1 best whilst an increase of 3.5 suited the MUMBA monoterpenes profile best.

The text has been updated on page 8 line 33:

"The factors chosen are somewhat arbitrary. A decrease factor of 3 for isoprene suited the SPS1 profile best whilst an increase of 3.5 suited the MUMBA monoterpenes profile best."

Figure 1: Which version of MEGAN emission factors are shown here? The MEGAN emission factor maps are listed as version 2011 and dated 20 March 2013. I have added the following text to page 5 line 15: "(version 2011)"

Editorial Comments

I have made all the changes suggested in this section by reviewer #3

Page 2, lines 1 and 2: The sentences should read: "all of these processes"

Page 3, line 17: I suggest rewording this sentence: "Two intensive field campaigns took place: SPS1 occurred between . . ."

Page 4, line 30: Remove "as" before "per"

Page 5, line 35: I suggest rewording this sentence: "The PFTs listed in Table 2 of Guenther et al (2012) are comprised of various plant species that include high, moderate, low and very low emitters." I am not sure what the point is of the following sentence, and this could be removed.

We are trying to highlight how high the isoprene emission factor assigned to Australian Eucalypts (ie using approach 1 (page5, equation 1) where the model is not sensitive to PFTs) is compared to approach 2 (PFT sensitive). I have deleted the sentence and reworded to:

". . .assigning Eucalypts an isoprene emission factor of 24 mg/m2/hr. This is more than double the isoprene emission factor used for broadleaf evergreen temperate trees if approach 2 is used (PFT sensitive)."

Page 7, line 30: remove the comma after "dominate"

Page 8, lines 1-2: The wording of this should be changed so that the references identified are properly cited. For example: "Calculated ratios of emitted isoprene to monoterpene carbon were found to be 26.4 for forests in Michigan (Kanawade et al. 2011) and 15.2 in the Amazon (Greenberg et al. 2004).

"Data" are plural (i.e., page 7, line 16; page 9, line 4)

References:

Guenther, A., Archer, S., Greenberg, J., Harley, P., Helmig, D., Klinger, L., Vierling, L., Wildermuth, M., Zimmerman, P., and Zitzer, S.: Biogenic hydrocarbon emissions and landcover/climate change in a subtropical savanna, Phys Chem Earth Pt B, 24, 659-667, Doi 10.1016/S1464-1909(99)00062-3, 1999.

Harley, P., Otter, L., Guenther, A., and Greenberg, J.: Micrometeorological and leaf-level measurements of isoprene emissions from a southern African savanna, J Geophys Res-Atmos, 108, Artn 8468 doi:10.1029/2002jd002592, 2003.

Muller, J. F., Stavrakou, T., Wallens, S., De Smedt, I., Van Roozendael, M., Potosnak, M. J., Rinne, J., Munger, B., Goldstein, A., and Guenther, A. B.: Global isoprene emissions estimated using MEGAN, ECMWF analyses and a detailed canopy environment model, Atmos Chem Phys, 8, 1329-1341, 2008.

Papiez, M. R., Potosnak, M. J., Goliff, W. S., Guenther, A. B., Matsunaga, S. N., and Stockwell, W. R.: The impacts of reactive terpene emissions from plants on air quality in Las Vegas, Nevada, Atmos Environ, 43, 4109-4123, 10.1016/j.atmosenv.2009.05.048, 2009.

Stavrakou, T., Muller, J. F., Bauwens, M., De Smedt, I., Van Roozendael, M., De Maziere, M., Vigouroux, C., Hendrick, F., George, M., Clerbaux, C., Coheur, P. F., and Guenther, A.: How consistent are top-down hydrocarbon emissions based on formaldehyde observations from GOME-2 and OMI?, Atmos Chem Phys, 15, 11861-11884, 10.5194/acp-15-11861-2015, 2015.

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