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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Temperature response measurements from eucalypts give insight into the impact of Australian isoprene emissions on air quality in 2050" *by* Kathryn M. Emmerson et al.

Anonymous Referee #1

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I have enjoyed reading the manuscript and find it a remarkable piece of work, stretching from individual measurements to continental scale impact estimates. At each level, interesting results are presented, starting with uncertainties connected with assumptions regarding emission potential and temperature sensitivity in standard emission models. The analysis is timely and thorough although the literature overview could be a bit more comprehensive. The text is well written and the conclusions are sound. My only concern is that disregarding the CO2 effect in the scenario analyses might call for exaggerated calls for action. Thus, I would appreciate a 7th simulation to account for this, e.g. a scenario such as the 6th run but with increased CO2, despite the fact that I am aware of the inconsistency with the measurements (and also with some uncertainties

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Discussion paper

related to a shift of temperature response curves under higher CO2 as shown by Sun et al.).

From the few specific remarks, I would like to stress the benefits from an improved literature overview (i.e. L25ff). The generally high emission potential of eucalypts in comparison with other species have firstly been depicted in Evans et al. 1982 and can also been derived from Kesselmeier and Staudt – although the values concentrate on E.globulus. Karlik and Winer as well as Geron et al. provide an additional emission rate of E.camaludensis (28, 14.6, add to Table 1) and a couple of other eucalypt species – although not under Australian conditions.

You may also note that different temperature responses and emission factor variability have been obtained before, starting with the original Guenther et al. 1991 publications and widely discussed e.g. in Niinemets et al. 2010 (e.g. L44ff).

In the end of chapter 2.2 (93ff), I got the impression that the authors are carried away a bit. First, the last paragraph seems to fit better into a discussion; and second, the first sentence is not logical (the measurements are hardly going to change but emission rates and species abundance probably will). By the way, I am still uncertain to which degree these 4 eucalypt species are actually representative for the Australian forests or how abundant the are in relative terms (L163).

With one sole reference, the protective functions of isoprene to sun flecks and very high temperatures are not very well acknowledged (L268ff). There are several publications (e.g. Behnke et al.) and reviews (Loreto and Fineshi) that illustrate this function. In fact, emission is prolonged even under carbon deficit conditions (Yanez-Serrano et al.).

Finally, the thought came to my mind that instead of removing the trees (which is of course not recommended), the forest management might be compelled to introduce species others than Eucalypts that are not emitting isoprene (L314ff). However, given the protective function mentioned above, this option might not be advisable because non-emitters might not be able to withstand the coming heat (Penuelas and Munne

Bosch, Ryan et al.).

Indicated references

Behnke, K., Loivamäki, M., Zimmer, I., Rennenberg, H., Schnitzler, J.P. and Louis, S. 2010 Isoprene emission protects photosynthesis in sunfleck exposed Grey poplar. Photosynth. Res., 104 (1), 5-17.

Evans, R.C., Tingey, D.T. and Gumpertz, M.L. 1982 Estimates of isoprene and monoterpene emission rates in plants. Botanical Gazette, 143, 304-310.

Geron, C., Harley, P. and Guenther, A. 2001 Isoprene emission capacity for US tree species. Atmos. Environ., 35 (19), 3341-3352.

Guenther, A.B., Monson, R.K. and Fall, R. 1991 Isoprene and monoterpene emission rate variability: Observations with Eucalyptus and emission rate algorithm development. J. Geophys. Res., 96 (D6), 10799-10808.

Karlik, J.F. and Winer, M. 2001 Measured isoprene emission rates of plants in California landscapes: comparison to estimates from taxonomic relationships. Atmos. Environ., 35 (6), 1123-1131.

Kesselmeier, J. and Staudt, M. 1999 Biogenic volatile organic compounds (VOC): An overview on emission, physiology and ecology. J. Atmos. Chem., 33 (1), 23-88.

Loreto, F. and Fineschi, S. 2015 Reconciling functions and evolution of isoprene emission in higher plants. New Phytol., 206 (2), 578-582.

Niinemets, Ü., Arneth, A., Kuhn, U., Monson, R.K., Peñuelas, J. and Staudt, M. 2010 The emission factor of volatile isoprenoids: stress, acclimation, and developmental responses. Biogeosciences, 7 (7), 2203-2223

Peñuelas, J. and Munne-Bosch, S. 2005 Isoprenoids: an evolutionary pool for photoprotection. Trends Plant Sci., 10 (4), 166-169.

Ryan, A.C., Hewitt, C.N., Possell, M., Vickers, C.E., Purnell, A., Mullineaux, P.M. et al. 2013 Isoprene emission protects photosynthesis but reduces plant productivity during drought in transgenic tobacco (Nicotiana tabacum) plants. New Phytol., 201 (1), 205–216.

Sun, Z., Hüve, K., Vislap, V. and Niinemets, Ü. 2013 Elevated [CO2] magnifies isoprene emissions under heat, alters environmental responses and improves thermal resistance in hybrid aspen. J. Exp. Bot., 64 (18), 5509-5523

Yáñez-Serrano, A.M., Mahlau, L., Fasbender, L., Byron, J., Williams, J., Kreuzwieser, J. et al. 2019 Heat stress causes enhanced use of cytosolic pyruvate for isoprene biosynthesis. J. Exp. Bot., 70 (20), 5827-5838.

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