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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Influence of isoprene chemical mechanism on modelled changes in tropospheric ozone due to climate and land use over the 21st century" *by* O. J. Squire et al.

Anonymous Referee #1

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Review of Squire et al.

Squire et al. investigate the effect of using 4 different parameterizations of isoprene oxidation chemistry on predicted present day (tropospheric) O3 concentrations as well as the influence of the choice of such a parameterization on O3 under future climates. The parameterizations range from a near-explicit mechanism (MCM) to a strongly simplified version currently used in Earth System Models developed for long time integrations (LLSF). The presented study is an extension to a previous study (Squire et al., 2014). Here, both a box model as well as the aforementioned global chemistry-climate model of Squire et al. (2014) is used. The authors show that box model results are in qualita-

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tive agreement with the results of the global model simulations. They find considerable differences in the levels of O3 produced especially under high isoprene conditions due to the amount and type of peroxy radicals and their reactivity towards NO vs. HO2. Large differences were also observed in key isoprene-related NOx reservoir species.

The paper is very well written, the topic is adequate and certainly within the scope of Atmospheric Chemistry and Physics. Methods, discussion and conclusions are presented in a clear and straightforward manner. The methods used are sound, and the conclusions drawn sensible. The findings that not only the magnitude but potentially even the sign of O3 response to a changing climate are of major importance for the greater chemistry-climate modeling community, as they show once again our strong dependence of simulations of future climates on the methods employed. I strongly recommend publication in ACP, after these minor comments are addressed:

22393, 15: how did you calculate photolysis rates and how can you ensure that differences in your oxidation chemistry is not due to differences in photolysis between the mechanisms?

22393, 19-20: rephrase - without removal but including emissions your box model will never reach steady state. You will accumulate oxidation end products.

22393, 25ff: The editor suggested to do additional simulations with potential changes in NOx in the tropics (referring you to Paulot et al., acp, 12, 1307-1325, 2012, figure S12). Why did you not do this? Or is 22401, lines 20 ff meant to discuss this? Please clarify.

22395: you should discuss the overall significance of the exact numbers you give here - as your box model is not in equilibrium, what do those numbers tell us? They are picked at an arbitrary point in time.

22400, 3ff: it should be made more prominent that differences in the isoprene oxidation mechanisms does not only influence O3, but also key radicals like OH (what

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about NO3?). They are of prime importance also for other parameterisations like e.g., secondary organic aerosol formation.

22406, Conclusions: what is the way forward? How do we tackle these discrepancies? Is MCM 'right'?

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 22385, 2014.