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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Why are estimates of global isoprene emissions so similar (and why is this not so for monoterpenes)?" *by* A. Arneth et al.

A. Arneth et al.

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We thank the reviewer for the encouraging comments on the manuscript. The questions that are raised are important and we will attempt to address these in a revised version of the manuscript, and a detailed letter to the editor. Below are some initial comments and responses:

RC: With regards to the emission capacities (Section 3.2): Is the seasonal cycle of the emissions more significantly affected than the total? This would have consequences for atmospheric chemistry, if it changes the coupling between BVOC emissions and (e.g.) biomass burning. This point also applies throughout the discussion in Section 3, and perhaps especially to 3.7 where the authors comment on the effect of leaf growth stage and the seasonality of regional emissions.

AC: In the published literature the seasonality of emissions is sometimes presented as January and July maps of per sq.m. emissions. Seasonal patterns tend to be illustrated by examples from select gridcells and have rarely been reported as global or zonal totals. It is therefore not possible to judge how model-to-model differences will affect the seasonality on top of the annual sums.

A critical aspect in this context is whether the seasonal changes in emission capacity caused by leaf development as well as short-term weather fluctuations are accounted for in the model. The emission capacity may vary by a factor of three to four, even when spring and autumnal leaf development and senescence effects is already discounted and only mature leaves are considered. As a first approximation, we would argue that disregarding these effects in the models would perhaps not hugely affect annual totals (if the emission capacity used reflects the appropriate seasonal average). The seasonal amplitude of the emissions, however, is affected. It becomes much larger when the emission capacity responds to weather patterns. In an example calculation at our northern Sweden study location maximum leaf isoprene emission rates were simulated to vary between ca. 0.5 and 2 ug C m-2 h-2 and 0.1 and 4 ug C m-2 h-2, depending on whether or not short-term weather effects in emission capacity were included. And the MEGAN calculations (as discussed in Alex Guenther's 2006 paper), for instance, indicate a variation by a factor of up to three even in tropical environments that can be caused by weather history. We will expand our discussion on that point, e.g., in sections 3.3 and also in 3.7, including some examples from the literature to illustrate these effects. As with many processes, models do presently include these in a very rudimentary manner only. A wider range of controlled experiments is needed to provide the basis for algorithm development while also a larger number of observational studies that cover the entire growing season is needed to provide important model benchmarks.

RC: At the beginning of Section 3, the authors mention that it is unfortunate that LAI, GPP and NPP are not reported in model studies, yet they do not report these terms

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here. Is it possible to generate a figure/table that illustrates the relationship of isoprene/ monoterpene emissions with these quantities from data that they have available?

AC: The point we wished to make in that part of section 3 was that the available evidence from published literature alone does not allow to quantitatively conclude what is driving model-to-model variability. As mentioned in our response to the other reviewer, one important outcome of preparing this manuscript was to push for a model intercomparison to address this question in a more systematic way. Still, taking up the suggestion that was made, there may be the possibility to illustrate the potential sensitivities, at least for our own modeling framework, and this will be added to the manuscript.

RC: Also at the start of Section 3, the authors mention that 3 estimates lie outside +/- 1SD from the model mean. Can the authors offer any explanation as to why these studies in particular lie outside of the specified range? One of these studies (Valdes et al., 2005) is an estimate of PI isoprene emissions. As this paper is addressing present day emissions, what is the rationale for including this study (and that of Kaplan et al., 2006)? Lathière et al. (2005) also includes a PI emission estimate (albeit with static vegetation and present day climate).

AC: From the information available in the papers it is hard to speculate on why these studies are on the upper and lower end and we felt it would not be helpful to do so without having the required information. We included the PI calculations chiefly to increase the number of examples to be discussed in this manuscript and to draw attention to the fact, that -depending on the model experimental setup- even for pre-industrial climate (cooler than today's) annual totals could be on the upper end of the published values (as such we also felt it was too confusing to specifically include the PI experiment by Lathière et al.). We will add a brief explanation to the manuscript.

RC: Would it be possible to summarize the global Ei and Em estimates in Table 1 graphically? Perhaps a plot color-coded by the five groups of estimates?

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Interactive Comment

AC: In response to this comment we investigated possible ways to summarize the estimates from the table graphically. However, in the end we could not find that a Figure would provide important additional information that is not available from the table already. Since the response to both reviewers comments will lengthen the revised manuscript already and since we wish to keep the paper as concise as possible we therefore prefer not to add this additional figure.

RC: Technical and typographical corrections

AC: Thanks for the detailed list, we will address these in the revised manuscript.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 7017, 2008.