Review of "Global terrestrial isoprene emission models: Sensitivity to variability in climate and vegetation" by Arneth et al. Submitted to Atmos. Chem. Phys.

The authors investigate the differences between three isoprene models (MEGAN, BVOCEM and LPJ-GUESS), as well the sensitivity that each model exhibits to changing the data source for the driving meteorological parameters (CRU, NCEP or the UM), and the underlying vegetation (dynamically calculated or prescribed emission factors). Simulated isoprene emissions show notable changes when a model is used in a configuration different from "standard", most clearly shown by Figure 2. For annual total emissions, the largest impact comes from swapping in the MEGAN vegetation in the LPJ-GUESS model, with increases of 60% or more than a factor of 2 compared to the standard LPJ-GUESS (depending on the meteorology used). The BVOCEM model also shows a large impact from using MEGAN vegetation, but the emissions decrease. The MEGAN model seems less sensitive than the others to changes in the driving variables.

This subject is of great interest to many atmospheric chemistry and biogenic emission modelers, and I would recommend its eventual publication in ACP. It is helpful to have more information on these kinds of uncertainties when conducting atmospheric chemistry model simulations of past, present and future climates. The study also highlights the importance of validation when implementing a BVOC emission model in a different environment to its published version. These results are also pertinent to the Atmospheric Chemistry and Climate Model Intercomparison Project (ACCMIP), which includes an investigation into BVOC emissions in different atmospheric models. The discussion on short and long-term impacts on isoprene emissions is particularly relevant here.

I have only a few comments of a scientific nature, but I do have several comments on the text presentation. In particular, there are several long sentences and paragraphs that could be improved to make reading easier. As such, the list of technical comments below is quite lengthy, and I hope that they are of use to the authors. Furthermore, I would suggest that the authors re-read their revised text carefully to make sure their meaning is clear.

GENERAL COMMENTS

- From what we learn about how the models differ with their input climate, can something be said about how they might differ for past climate or future climate projections? E.g. can the last part of the discussion be expanded a bit?

- The discussion section consists of several long paragraphs, which could be clarified and broken up in smaller chunks. I have made several suggestions in Specific Comments, but I would underline my request that the authors re-read their text carefully.

- Figures and tables could be better introduced, rather than referring to them for the first time in passing. Sentences like "Figure 2 shows the change…" are helpful for the reader.

- Please consider re-writing the many instances of confusing parentheses with long sentences and references inside. Short text before/after a reference is ok: (e.g., as per Guenther et al., 2006).

SPECIFIC COMMENTS

P10616, L4-13. I agree with the other reviewer that this is too much introductory detail for an abstract, and the space would be better served talking about results.

P10617, L15-. The discussion in this paragraph could benefit from explicitly presenting the emission equations used.

P10622, L15. I'm not completely familiar with vegetation model terms, but to my mind "dynamic cores" refers to the physics used to solve fundamental atmospheric equations in GCMs.

P10625, L23-25. To clarify, do you mean that tropical emissions for JJA are equal to NH temperate emissions for JJA?

P10628, L11. How much was the seasonality dampened? E.g. what was the change in amplitude or max-min amount? Tropical seasonality is important in atmospheric chemistry, since the interaction of BVOC emissions and biomass burning can determine the ozone chemical regime (NO_x- or VOC-sensitive).

P10629, L2. Is the result of the combined effects in any way additive?

P10629, L21. If the relationship is a "clear linear" one, I think it ought to be shown (e.g. scatter plot). Also, there is no information about the confidence in the slope values (e.g. ±2-sigma from the regression). Do the authors think that this relationship would hold for late 21st century climates?

P10630, L1. What is meant by "weak linear relationships'? Do you mean low confidence, or small values?

P10630, L8. Instead of "10% around the average", you could compare standard deviations.

P10631, L25. Can you quantify "tends to be warmer" better?

P10633, L23. The accuracy of the emissions estimates with improved land cover will also surely depend on knowing the emission characteristics of the vegetation.

P10633, L25. "Although some of the anomalies correspond to climate fluctuations (e.g. cool summer temperatures in 1992), the variation…" Is this a Pinatubo effect? How does it compare to Telford et al. (2010, Effects of climate-induced changes in isoprene emissions after the eruption of Mount Pinatubo, Atmos. Chem. Phys., 10, 7117-7125)?

P10649 and P10650. Could these figures be made larger? For Figure 3, isn't the "L1" simulation conducted with dynamic vegetation? (At least according to Table 1). The caption says otherwise.

P10652. The "Ci/Ca" needs correct formatting in the legend. Could you use colors for the different fit lines? The "Possel fit" doesn't come out very well.

TYPOGRAPHICAL CORRECTIONS/SUGGESTIONS

P10616, L23-25. Clarify the last sentence of the abstract. A suggestion: "Our results highlight the need for modellers to evaluate their implementations of isoprene emission models when performing simulations that use non-standard emission model configurations."

P10617, L4. It is less clumsy to say "BVOCs" when referring to compoundS.

P10617, L4. "…total emission strength of BVOCs is in…"

P10617, L20 (and throughout). Generally, preference is for the order of the references to be chronological.

P10617, L21-22. "…to link global emission estimates to the biochemical processes…"

P10618, L8-13. "…although recent studies have inferred regional isoprene emissions indirectly using formaldehyde columns retrieved from satellites (Palmer et al. 2006; Barkley et al. 2008)."

P10618, L13 (and throughout). "Tg C a^{-1}" (space between Tg and C units)

P10618, L29. "Here, we compare three…"

P10619, L13. For ease of reference, I would suggest making "Isoprene emission models" the title of Section 2, with 2.1-2.3 for the descriptions of LPJ-GUESS, MEGAN and BVOCEM. "Experimental set-up" would then be Section 3, with 3.1 for Climate, 3.2 for Vegetation etc…

P10619, L23. "…Niinemets et al. (1999), which infers..."

P10619, L25. "…(2007b), with an improved…"

P10620, L8. "…emission capacity: the amount…" (colon)

P10620, L13. "(cf. MEGAN and BVOCEM below)" – assuming you mean "compare with"

P10621, L13. "…emissions, including…" (And then I would use a semi-colon to separate the items in the list that follows).

P10621, L19 (and throughout). "grid cells"

P10621, L20. "…each location. That is, the emission capacities are not only calculated for…"

P10621, L23. I'd start the section like: "BVOCEM (Biogenic….) (Lathiere et al. 2010) is the third emission model used in this study, and is largely based on the MEGAN parameterisations of Guenther et al. (2006)." Note the "s" in parameterisations (for consistency with spelling throughout the manuscript) as well as putting the reference in separate brackets to the spelling out of the abbreviation (see General Comments).

P10622, L9-10. Leave out this last sentence, since referenced above.

P10622, L20. New paragraph after "0.5 x 0.5", then reference Table 1 more explicitly. E.g. "Table 1 details the set-up of the different simulations in this study. For each model, four simulations are completed: …."

P10623, L8-14. Inappropriate application of semi-colons. A suggestion: "Three different climate….simulations. These are from the Climatic Research Unit (CRU) of the University of East Anglia (Mitchell and Jones, 2005), which is the standard climate used for LPJ-GUESS; the National Centers for Environmental Prediction (NCEP) reanalysis product (Kistler et al., 2001), used to in the standard MEGAN simulation; and climate model output from the UK Met Office Unified Model (UM) (Stainforth et al. 2005), used for the standard BVOCEM simulation.

P10623, L15. Suggest start new paragraph from this line.

P10624, L4-6. "…bioclimatic limits, which constrain…and survival; the models' carbon…calculations; and dynamical…"

P10625, L9. "LPJ-GUESS's" (Since you would say General Ecosystem Simulator's)

P10625, L13. Clearer if equation set on its own line.

P10625, L26. "…emissions was…"

P10626, L9. "…Guenther et al. 2006). These too reflected the longer…"

P10627, L28. "also enhanced in some parts of tropical areas, but in…"

P10628, L8. "(panels k and l in Fig. 2)"

P10628, L8-. "In the case of LPJ-GUESS, the change in vegetation led to a…"

P10628, L12. “Changing…several-fold: the vegetation…” (Does this list really constitute “several-fold?”)

P10628, L21. Suggest defining “cerrado regions” for the ACP audience.

P10628, L21. “….and, in LPJ-GUESS and BVOCEM, temperate…”

P10629, L4. “…vegetation, emissions…”

P10629, L5. “..in LPJ-GUESS the combined…” (delete comma)

P10629, L16 (and throughout). Suggest replacing “between-year” with “interannual”.

P10629, L23 (and throughout). Suggest cutting down on the number of instances of “not shown”, as they aren’t all needed.

P10629, L27. Start new paragraph before “When investigating…”

P10630, L3. “…from 0.3 to 0.6. Similarly, neither temperatures in December-February nor annual…”

P10630, L13-15. “…than for isoprene. But, here too, a relationship…isoprene was only notable for…” (Or replace “eminent” with some other clearer word.)

P10630, L20. “The standard versions’…” or “Monthly emission rates for the standard versions varied…”

P10630, L22. Delete “mutually”.

P10630, L26-27. “…of the seasonal cycle in the southern and northern…”

P10631, L1-20. I got a bit lost with this paragraph. Might be helpful to break up into 2 or more paragraphs, and say that you are conducting a quasi-evaluation of the seasonality of tropical emission.

P10631, L3. “Satellite-retrevied formaldehyde (HCHO) columns indicate a minimum in HCHO concentrations above the Amazon…”

P10631, L6. “a major isoprene oxidation product…”

P10631, L12. “…foliage has been found…”

P10631, L14. “latitudinal AND longitudinal averaging”?

P10631-P10632. Again, I'm getting a bit lost in this paragraph. Would suggest dividing up into smaller paragraphs, and perhaps clarifying. More specific suggestions below.

P10631, L26. "…in the tropical regions. This gives rise to…"

P10631, L29. New paragraph after "simulation."

P10632, L3. "…dry regions would increase the rate of…(Schaphoff et al., 2006), and hence isoprene production, which could…"

P10632, L6. "…PFT distribution, which…"

P10632, L9. "Such a vegetation shift compensates for…"

P10632, L11. Start new paragraph from "Finally…"

P10632, L16. "…in LPJ-GUESS + NCEP, as well as…"

P10632, L18-19. "…also led to reductions (11%; Guenther et al. 2006), but smaller than observed in our experiment (WHICH WAS?)"

P10632, L21. Define "BEIS" (or say what type of model it is).

P10632, L25. "…Africa compared to…" (remove comma)

P10633, L2. Was it "a reduction" in annual emissions?

P10633, L11. "…(Sitch et al., 2003), meaning much lower…"

P10633, L12. Start new paragraph at "The boreal…"

P10633, L12. "The boreal regions, where all…was applied,

P10633, L16. "…capacities since, after…"

P10634, L8. Remove comma after "tropical regions"

P10634, L11. Start new paragraph from "For the two…"

P10634, L14. "…conditions that increase isoprene emissions…"

P10634, L15. "…GPP and LAI – for instance, by…"

P10635, L4. "…simulations of future trace gas composition (e.g. Sanderson…" (not just about "ozone").

P10635, L12. New paragraph from “However, an increasing…”

P10635, L14. “…CO2 levels, possibly…”

P10636, L3. Define “CLM”, “SRES-A1B”. The text in the brackets is too long.

P10636, L12-16. This sentence is a bit long and wordy. Suggest simplifying.

P10647. Figure 1 caption. “…emissions for the period…”

P10649. Fig. 3 caption: “L2-L1; see Table 1)”.

P10650. Fig. 4 caption: “the same as those in Fig. 3…”