Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2017-220-RC2, 2017

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Understanding the Primary Emissions and Secondary Formation of Gaseous Organic Acids in the Oil Sands Region of Alberta, Canada" *by* John Liggio et al.

Anonymous Referee #2

Received and published: 23 April 2017

This manuscript describes measurements of low molecular weight organic acids (LMWOA) from the oil sands in northern Alberta, and uses a box model to evaluate the measurements. The estimates of emission ratios, and impacts of those emission ratios on concentrations downwind is a useful addition to the growing literature on organic acids in the atmosphere. I recommend publication following minor revisions.

Comments:

- There are too many acronyms to keep straight! I suggest moving most of them into full words (e.g. OS -> oil sands), and reserving acronyms for extremely long word combinations ('LMWOA') or very commonly used acronyms (VOC, SOA).

- The authors set up an excellent case for their study in the Introduction – a solid description of relevant literature, and lines of evidence regarding exactly why anthropogenic sources from oil production could be regionally and globally relevant. However, the last sentence of the introduction ("It is expected that the results of this study will be broadly applicable to the secondary formation of LMWOA from other anthropogenic activities with hydrocarbon emissions") does not follow this level of logic and reasoning. For example, other anthropogenic activities with hydrocarbon emissions can range from vehicle emissions to natural gas extraction to industrial solvent production to human-induced biomass burning activities, etc. The VOC precursor emissions from each of these sources can vary widely, and thus I expect the LMWOA emissions to vary as well. After explaining how unconventional the oil sands region is – and that the emissions from that region can be different from other areas – I don't see how these measurements will be broadly applicable to other regions. The authors have built up a strong case for their work, and broad applicability to other anthropogenic hydrocarbon sources is unnecessary to convince me that this work is important. I strongly recommend the authors delete the sentence.

- Authors identify the deposition of organic acids downwind of the oil sands as a potential source of atmospheric acidity. My recollection of the acid deposition literature is that organic acids do not contribute to ecosystem acidity – formic and acetic acids are weak acids, in contrast to nitric and sulphuric acids, which are strong acids. Can the authors point to literature or back-of-the-envelope estimates to further back up this idea that deposition of organic acids could be relevant for ecosystems downwind of the study area? While I understand that this is not the focus of the paper, and a detailed estimation is beyond the scope of the paper, the suggestion that organic acids could influence ecosystem acidity is a large one, and I think that the authors would do well to provide a little more literature or evidence that this is a likely event.

Technical Comments

- pg.13, line 6: misspelled Lagrangian.

- Figure 4, Box D has the note that the blue square indicates the mean value; it is distracting to have this in the middle of the yellow bar – I suggest either removing the legend from the figure and merely describing it in the figure caption, or offsetting it from the data columns so that it can not be confused with actual data

- Figure 9. Please specify that these results are from the photochemical box modeling, as opposed to observationally-derived for clarity

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