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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Emissions of biogenic volatile organic compounds and subsequent photochemical production of secondary organic aerosol in mesocosm studies of temperate and tropical plant species" *by* K. P. Wyche et al.

Anonymous Referee #2

Received and published: 7 August 2014

Overall Comment and Recommendation:

This manuscript examines the emissions of BVOCs from silver birch and three South-east Asian tropical plants grown in a whole-tree chamber. These BVOCs were then transferred to an irradiation chamber for subsequent production and characterization of gas- and aerosol-phase oxidation products. I have a number of reservations about the current version of this manuscript. I list these below and strongly encourage the authors to address these carefully before acceptance of this manuscript can be con-

sidered. I was surprised how little particle-phase data was presented and discussed from off-line filter analyses. Further, the SOA yields presented and discussed have many hidden issues that have to be carefully addressed in a revised manuscript. Overall, I recommend that this paper is not accepted until the Editor feels these specific comments below are adequately addressed.

Specific Comments:

1.) SOA yields and ELVOCs:

Based on the extra low-volatility VOCs (ELVOCs) recently discovered by Ehn et al. (Nature Letters, 2014) and isoprene-epoxydiols (IEPOX) (Paulot et al., 2009, Science), can the authors comment on the wall losses for these sticky low-volatile compounds? Specifically, how might these losses affect the interpretation of these results? This seems like a reasonable question to ask of the authors, especially considering that they report SOA yields throughout the entire text. These losses seem quite apparent, especially considering the effect of having pre-existing seed aerosol; that is, SOA was measurable and seed aerosol was typically more conducive to increasing SOA yields. My guess is as you guys increase the total surface area of your inorganic seed aerosol, you see more OA growth as a result of lower wall losses. Did the authors systematically test this? Since this is likely an issue, why focus the discussion on SOA yields?

2.) Page 14295, Lines 9-12:

The authors forget to mention the important effect of acidic aerosol on the reactive uptake of isprene epoxydiols (IEPOX), which are major 2nd genearation oxidation products from isoprene that yield most of the SOA from isoprene under low-NO conditions (Surratt et al., 2010, PNAS; Lin et al., 2012, ES&T).

3.) Page 14296, Line 25:

Did the plywood base emit BVOCs? Could these have leaked into chamber?

4.) Page 14301-14302, Line 28 and Lines 1-2:

Why wasn't the chemical composition dependent CE calculated as recently done by Middlebrook et al. (2012, AS&T)?

5.) Page 14302, Lines 3-5:

Were denuders used in front of quartz filters? I worry that gaseous absorption of ELVOCs or IEPOX could have occurred on these filters, and thus, skewing the chemical composition results due to positive artifact formation. Have the authors confirmed there are no artifacts. I have to admit the data presented from these filters is very weak and limited, and doesn't really add much to the text in terms of sources of SOA.

6.) Page 14302, Line 7:

Why didn't the authors consider extracting the filters with a more flexible solvent (such as methanol) that can remove both polar and less polar SOA compounds? I worry that water extractions really removes only the most polar SOA constituents and from my experiences with monterpenes (and especially sesquiterpenes). I have found methanol is a better solvent for these two classes of VOCs. Thus, do the authors worry they are missing important aerosol compounds in their off-line chemical analyses?

7.) Page 14303, Line 12-15:

What is the concentration of your atomizing solution? This should be listed.

How much volume of seed aerosol was injected into your experiments? This detail should be added to the experimental section or in the Table summarizing your experiments.

Did you all calculate the aerosol pH of your atomized seed aerosol? Since BVOC-derived SOA (especially isoprene-derived SOA) is so sensitive on aerosol pH, this could be an important parameter to add as well.

8.) Page 14303, Lines 16-28:

I would argue that for isoprene SOA formation, there is plenty of literature now that

clearly shows that it forms due to REQUIRED acidity that allows for the reactive uptake and subsequent particle-phase chemistry of IEPOX (Surratt et al., 2010, PNAS; Lin et al., 2012; Nguyen et al., 2014, ACP) and MAE (Lin et al., 2013, PNAS). Without acidic particles, SOA formation from isoprene will be quite limited (e.g., Lin et al. 2012, ES&T). Thus, I wonder how relevant these experiments are for isoprene SOA formation?

9.) Page 14319, Lines 18-21:

I would argue that this is due to the lack of acidic sulfate aerosol. This has been repeatedly shown as a requirement to produce isoprene SOA (Edney et al., 2005; Surratt et al., 2007; Surratt et al., 2010; Lin et al., 2012; Nguyen et al. 2014).

10.) Page 14321, Lines 27-28:

Why wasn't off-line filter characterization data presented for the tropical plants to confirm that isoprene oxidation wasn't making much SOA in the seeded experiments? Since the experiments are very humid, I would suspect a LOT of isoprene SOA in the aerosol phase, especially based on recent work by Nguyen et al. (2014) that utilized only ammonium sulfate seed aerosol.

11.) Page 14322, Lines 16-22:

Not EXACTLY. The methyl furan resulted from the decomposition of IEPOX-derived SOA, as recently shown by the Surratt group (Lin et al., 2012, ES&T; Budisulistiorini et al., 2013, ES&T).

12.) Page 14323, Lines 19-23:

Not only contrasting NOx environments, but also contrasting aerosol acidity environments (as shown by Lin et al., 2012, ES&T; Lin et al., 2013, ACP; Pye et al., 2013, ES&T).

Minor Comments:

1.) Page 14294, Line 12:

insert "have an"

2.) Page 14302, Line 9:

Delete the "d"

3.) Page 14303, Line 4:

insert comma between ppbv and respectively

4.) Page 14320, Line 10:

Please provide a citations for this range of yields.

5.) Page 14324, Lines 1-2:

Please provide supporting citations for this statement.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 14291, 2014.