

Interactive comment on “Multi-instrument comparison and compilation of non-methane organic gas emissions from biomass burning and implications for smoke-derived secondary organic aerosol precursors” by Lindsay E. Hatch et al.

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We thank the reviewer for the thoughtful comments. Their comments are reproduced here (R), with our responses noted (AC).

Anonymous Referee #1

This paper reports laboratory measurements of biomass burning (BB) emissions taken during the Fire Lab at Missoula Experiment (FLAME-4). Fresh BB emission were characterized using four complimentary techniques: open-path FTIR (OP-FTIR), protontransfer-reaction time-of-flight mass spectrometry (PTR-TOFMS), two-

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dimensional gas chromatography time-of-flight mass spectrometry (GC×GC-TOFMS), and whole air sampling (canister) with gas chromatography-mass spectrometry (GC-MS). FLAME-4 was the first application of PTR-TOFMS and GC×GC-TOFMS for laboratory BB emissions. FLAME-4 results from the first three techniques have been reported previously (OP-FTIR, Stockwell et al., 2014; GC×GC-TOFMS, Hatch et al., 2015; PTR-TOFMS, Stockwell et al., 2015). This paper synthesizes data from the four techniques to 1) compare the compositional space accessed and emission factors (EF) measured by the techniques, 2) provide comprehensive emission profiles for four fuels (Ponderosa Pine, Black Spruce, Indonesian Peat, and Chinese Rice Straw) and 3) characterize the volatility distribution of the emissions and identify potentially important secondary organic aerosol (SOA) precursors which have been understudied (e.g. in photochemical chamber experiments of SOA formation). This paper presents new and very valuable findings for biomass burning and atmospheric chemistry fields. The study quantifies emissions for 10's of compounds that have significant potential for SOA formation, but have received little or no attention in previous studies of SOA. By doing so this paper identifies potentially important gaps in our current understanding of BB impacts on SOA. The careful 4 instrument intercomparison presented in the paper may be useful for reinterpreting previous studies of BB that did not benefit from the unprecedented composition coverage and diversity of methods used here. I recommend this paper for publication pending consideration of the following comments.

Comments

R1.1: Please provide details on PP and BS fuels. Were they both boughs? How fresh? Was combustion limited to mostly needles and fine branch wood?

AC1.1: We have added notes on Page 3, lines 13-15 that pine and spruce boughs were burned during the selected fires and point the readers to our previous papers for more detailed fuel and fire descriptions.

R1.2: Pg 4 line 19. "chemical perturbation" does this include lamps? Was the chamber

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dark during influx of emissions and prior to acquisition of WAS?

AC1.2: Yes, the chamber was dark prior to and during the WAS sample collection. We have clarified this point in the text on line Page 4, line 21: “WAS samples were collected from dark smog chambers.”

R1.3: Figure 2b is messy and difficult to read. I suggest modifying to include only a handful of species that coincide with the main points of the corresponding text (P9, L24 – P10 L5)

AC1.3: We have replaced the text markers with shapes and O:C colorscale in Fig. 2b to improve the clarity.

R1.4: Any thought on why the high contribution of alkanes for peat versus other fuels?

AC1.4: The higher relative contribution of alkanes in peat smoke is possibly attributed to the fact that peat is composed of partially decayed plant matter. Indeed, peat is the first stage of coal formation and significant levels of n-alkanes have been measured in particulate matter derived from combustion of coal of various maturity levels (Oros and Simoneit, 2000). However, speciated measurements of additional peat fires should be performed to better understand the variability of alkane emissions from peat burning, and therefore we have not added this speculation to the current manuscript.

R1.5: P11, L19-33: Does the significant interference of C₆H₈ compounds at m/z 81 identified in this study suggest the previously reported MT EF using PTRTOFMS (Stockwell et al., 2015) should be revised? “The MT emission factors reported by Stockwell et al. (2015) were calibrated using m/z 81 due to the high degree of fragmentation of the α -pinene standard under the PTRTOFMS drift tube conditions utilized during FLAME-4.”

AC1.5: Although the PTR-TOFMS-derived monoterpene EF based on m/z 137 agreed significantly better with the GCxGC-TOFMS monoterpene EF, significant variability between the instruments was still evident, including potential interference at m/z 137 (e.g.,

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from bornyl acetate, as discussed in the manuscript). Therefore, we primarily seek to emphasize the potential interferences in the PTR-TOFMS determination of monoterpene emissions from biomass burning.

R1.6: P14, L33: The author not the OA concentrations were 1000-6000ug/m³. Where do these numbers come from? Are these from previously published FLAME-4 papers? Please explain the origin of the OA measurements.

AC1.6: The OA concentrations are based on filter measurements performed by the University of Iowa, which is now noted on Line Page 15, line 12. Although the OA analyses have not been published, the sampling protocol has been described and the citation is now included in the manuscript.

References:

Oros, D. R., and Simoneit, B. R. T.: Identification and emission rates of molecular tracers in coal smoke particulate matter, *Fuel*, 79, 515-536, Doi 10.1016/S0016-2361(99)00153-2, 2000.

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