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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Regional Influence of Wildfires on Aerosol Chemistry in the Western US and Insights into Atmospheric Aging of Biomass Burning Organic Aerosol" *by* Shan Zhou et al.

Anonymous Referee #1

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This is a paper concerning AMS observations of biomass burning smoke during BBOP from a gound-based site. Detailed observations are systematically reported and factorisation is performed, yielding three factors related to biomass burning. The factorisation and an analysis of volatility offer some new and interesting insights and there is a case study looking at trends with atmospheric ageing time, which sheds new light on the aging timescales of these aerosols.

While this isn't the first paper on this general topic, the depth of analysis does provide some new insights, so it is within the scope of ACP. It is also very well written in general and comes with a decent amount of supplementary information supporting the methods used in factorisation (something that is lamentably absent from many papers). I

recommend this be published subject to the following comments:

General comments

I generally found that comparisons with previous works in the literature to be inadequate. While there are certainly novel aspects of this work, there have been a number of papers published previously on this topic and yet most of these are only given a cursory mention to say that the results here are qualitatively consistent. As cited in the manuscript, there have been a number of papers reporting the ageing of biomass burning with an AMS (e.g. Cubison et al., 2011), so a more quantitative comparison should be possible here. Also, there have been other studies reported where multiple BBOA factors have been derived (e.g. http://www.atmos-chem-phys.net/15/2429/2015/), so a detailed comparison should be possible there. By placing the results here in the wider context better, this will improve the quality of the paper's conclusions.

Specific comments

Line 152: The 1.5 μg/m3 cutoff is not adequately justified and seeing as many AMS factorisations have been performed successfully with signals lower than this, it would appear to be an odd thing to do. Why was this chosen as the cutoff? What were the actual S/Ns, according to the error model? Why wasn't the low S/N data simply downweighted, as is standard practice? It seems to me that the real benefit of this strategy is so that the factorisation will be of the high-intensity plumes (the subject of interest) than background data (which can hinder convergence not through low S/N but through rotational ambiguity). This is, in its own way, justifiable, but it should be presented as such, rather than a simple S/N issue.

Line 207: How was potassium measured? This is important because it affects the credibility of the data. What constitutes 'low'? A quantitative comparison with other studies should be given.

Line 276: While a combined approach to PMF can improve factorisation and aid in-

terpretation, it can also harm the analysis. The fact that the sources and processes governing inorganics are often fundamentally different to those of organics means that their inclusion can introduce 'model error', in turn increasing rotational ambiguity. Also, because of the high 'strength' of the inorganic variables (owing to their relative lack of fragmentation), they may lead the factors, causing the organic data to more reflect inorganic, rather than organic, sources and processes. This note of caution should be added to the text. Did the authors try running PMF without the inorganics? How did the solutions differ?

Line 330: The results here do not necessarily prove that BBOA-3 was formed through processing. While the addition of oxygen would be consistent with other observations of ageing in biomass burning, it does not discount the possibility that an amount of it was in the form of primary humic-like substances, which are known to be formed during biomass burning (e.g. http://www.atmos-chem-phys.net/6/5213/2006/). These generally bear a resemblance to highly oxygenated secondary organic aerosol in terms of their volatility, chemical functionality and AMS mass spectra, so a caveat should be added.

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