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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Atmospheric Evolution of Molecular Weight Separated Brown Carbon from Biomass Burning" *by* Jenny P. S. Wong et al.

Anonymous Referee #1

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This manuscript by Wong et al. investigates the evolution of water-soluble brown carbon (BrC) light absorption due to photolysis and OH oxidation for both laboratory generated BrC from the pyrolysis of cherry hardwood and ambient biomass-burning BrC collected in Crete. The results show interesting behavior starting with increase in absorption (photoenhancement) followed by decrease in absorption (photobleaching). The rates of these two stages were observed to depend on molecular weight, with larger molecules (> 400 Da) dominating the contribution to light absorption after several days of UV exposure. This is a well-written manuscript addressing a timely topic, and the findings constitute a step forward in the understanding of the evolution of atmospheric BrC. Therefore, I believe this manuscript is suitable for publication in ACP after the following comments are addressed:

1. It is not clear why both water and methanol extractions were performed for ambient samples and just water for laboratory samples. Please provide justification.

2. In section 2.1.1, it is stated that the BrC was produced by pyrolysis of cherry hardwood at 210 C and oxygen-free conditions. Is there a rationale behind choosing these conditions? It is known that the physicochemical properties and optical properties of BrC depend strongly on burn conditions (e.g. Chen and Bond (2010); Saleh et al. (2014); Pokhrel et al. (2016), etc.). While this is somehow acknowledged in the last sentence of the manuscript, the limitations of using one fuel and one burn condition should be featured early on when discussing the results (i.e. in section 3.1) as well as the abstract. This is not to take anything away from the interesting findings of this study.

3. Section 3.1.1: Describe how MAC is calculated. The reference to Wong et al. (2017) is not enough, as this is a central piece of this paper and it will benefit the reader to have at least a brief explanation of how MAC is calculated.

4. Also, you need a short discussion of the meaning of MAC in this context. I assume this is a "bulk" MAC, which is related to but not the same as the MAC of suspended particles. See, for example, discussion in section 3.1.2 of Laskin et al. (2015).

5. Finally, there is an inconsistency between the terminology in the text (MAC) and Figure 2 (AbsWSOC).

6. While the molecular-weight separated results are interesting, I believe further discussion is required. First, it would be helpful to include a more detailed description of the SEC technique. In particular, the dependence of MW on elution volume (from Figure 3) seems to be very non-linear. Please elaborate more on this and how it affects the measurements.

7. Second, what is the rationale behind a) grouping into just low and high MW (why not low, medium, and high, for example?) and b) choosing 400 Da as the cutoff?

8. Finally, Figure 3b shows that BrC absorption is mostly due to molecules larger than 10,000 Da. The observation of these large molecules, on its own, should be highlighted and discussed. Have such large molecules been observed in biomass burning BrC before?

References: Chen Y, Bond TC (2010) Light absorption by organic carbon from wood combustion. Atmos Chem Phys 10(2001):1773–1787. Saleh R, et al. (2014) Brownness of organics in aerosols from biomass burning linked to their black carbon content. Nat Geosci:DOI: 10.1038/NGEO2220. Pokhrel RP, et al. (2016) Parameterization of single-scattering albedo (SSA) and absorption Ångström exponent (AAE) with EC/OC for aerosol emissions from biomass burning. Atmos Chem Phys 16(15):9549–9561. Laskin A, Laskin J, Nizkorodov S a. (2015) Chemistry of Atmospheric Brown Carbon. Chem Rev:DOI: 10.1021/cr5006167.

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