

## ***Interactive comment on “The impact of biogenic, anthropogenic and biomass burning emissions on regional and seasonal variations in secondary organic aerosol” by Jamie M. Kelly et al.***

### **Anonymous Referee #1**

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This paper is a global modeling study of SOA. The paper is generally well written. I liked their Introduction. However, there are several points that need to be clarified before publication. Following are my major comments:

Page 10 near the top: Why does anthropogenic SOA have longer lifetime than biogenic and biomass burning SOA?

Biomass burning: Did the authors consider high altitude emissions of biomass burning VOCs? These can increase tropospheric long range transport of BBSOA and increase its lifetime.

Biomass burning SIVOC are not considered and biomass burning SOA formation rate

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is assumed to be similar to monoterpenes. There are a several issues with this. First, monoterpenes are not a major fraction of biomass burning SIVOC/VOC emissions, although I agree they are also emitted during wildfire burns. Most of the biomass burning SIVOCs would be branched/cyclic alkanes or other long-chain carbon compounds. Second, monoterpenes react much faster than SIVOC. The emissions of VOCBB and 13% yield are also arbitrary. The authors need to justify their choices here and cite appropriate measurements of biomass burning emissions of VOC/SIVOC, and their choice of yields.

For example, can model-measurement comparisons be used to understand if biomass burning SOA formation is fast (similar to monoterpenes used in this study) or is slow (as given by SIVOCs that are slower reacting but not considered here)?

Although SIVOC chemistry is uncertain, measurements certainly show evidence for large amounts of missing SIVOC emissions from biomass burning (see Yokelson et al. 2013 and related discussions in the global modeling study of Shrivastava et al. 2015). This means SIVOC emissions and chemistry cannot be completely neglected, they just need better constraints.

In summary, what is the justification for neglecting SIVOC emissions/chemistry in this paper?

Page 16: Welgegend: Can biomass burning be a large missing SOA source at this cite rather than anthropogenic SOA? For example, Shrivastava et al. 2015 report that including biomass burning as SOA source improves model-measurement agreement in terms of seasonality of SOA at this site.

Figure 14: The various lines need captions. The text and the legends in this figure need to be made clearer for readability. For example, it's not clear which is monoterpene only versus total all source SOA simulation.

The authors report that inclusion of biomass burning SOA source does not improve

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model performance with respect to aircraft measurements especially during ARCTAS. In sharp contrast, Shrivastava et al. 2015 reported a large increase in model performance especially at high altitudes, with respect to ARCTAS field campaign when they included biomass burning SOA source. Clearly, this reflects the large difference in biomass burning SOA treatment between this study and Shrivastava et al. 2015 study. Some discussions about why the authors don't see an improvement due to biomass burning SOA is warranted and also how their SOA treatment for biomass differs from Shrivastava et al. 2015 study.

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