

***Interactive comment on* “Enhanced SOA formation from mixed anthropogenic and biogenic emissions during the CARES campaign” by J. E. Shilling et al.**

Anonymous Referee #1

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General comments

This is an interesting paper describing aircraft data around Sacramento in order to determine the influence of various sources on secondary organic aerosol (SOA) formation. This paper is very easy to read and the overall presentation is well-structured and clear. Large organic aerosol (OA) mass concentrations were measured downwind of Sacramento and in the presence of biogenic volatile organic compounds (VOCs). Furthermore, OA mass concentrations were not high downwind of Sacramento in the absence of biogenic VOCs or away from the urban area in a region of large biogenic VOC concentrations.

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While this manuscript appears to show an example of enhanced SOA formation in mixed anthropogenic/biogenic plumes (which has been reported in other previously published papers on the region), the data presented here do not conclusively support this hypothesis. The analysis in this manuscript is incomplete, causing misinterpretation of the results, and the manuscript should not be published in its present form.

Specific comments

1) There are two major peaks in OA, CO, and ozone on 28 June at 16:00 and 17:00 PST (Figure 4). These two peaks appear to be located in the plume transect between T0 and T1, but were ignored in the manuscript. These peaks are not coincident with high m/z 69 and m/z 71 in the bottom time trace of Figure 4. A more-detailed examination of the wind speed data at T0 and T1 as well as the WRF-Chem forecast for CO is needed to rule out that these peaks were not from the aged, morning plume over Sacramento. The wind speed data at T0 and T1 from Zaveri et al. (2012) indicates that the winds were light that day (1-2 m/s). The morning plume was likely transported about 18-36 km in 5 hours with these winds, which puts it approximately where the afternoon plume was observed. However, the WRF-Chem forecast indicates that the Bay Area influenced plume which was centered over the T0 site in the morning is pushed farther east than the eastern-most portion of the flight (Figure 2 BD) and so the air mass sampled is believed to be from fresh (< 1 day) Sacramento and biogenic emissions. The results from the WRF-Chem forecasted CO are also questionable because the measured CO concentrations are much higher than estimated by summing the two CO sources (Figure 2 CD) for that afternoon.

2) These peaks in OA, CO, and ozone on 28 June at 16:00 and 17:00 PST need to be explained and compared to the peaks on 28 June at about 15:40 and 16:40 PST on the eastern-most portion of the flight that were coincident with biogenic VOCs. Indeed, if the OA data are plotted against the CO data for the 28 June afternoon flight and colored by high/low biogenic VOCs and their first-generation oxidation products, it appears that there is not a trend of higher OA with higher biogenic VOCs.

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3) As mentioned in the manuscript, the time scale for processing is important for determining the relevance of $\Delta\text{OA}/\Delta\text{CO}$ and previous studies have shown that there is a wide range of $\Delta\text{OA}/\Delta\text{CO}$ in the freshest urban air masses (Weber et al., 2007; de Gouw et al., 2008). The manuscript further states that a photochemical clock using toluene/benzene ratios was not available for this analysis because their concentrations fell below the detection limit outside of downtown Sacramento. Yet, concentrations for toluene are reported in Figures 4 and 10. So, it is surprising that benzene and toluene were below the detection limits for this dataset and could not be used as a clock. The fact that these are close to or below their detection limits indicates that the air mass sampled on the afternoon of 28 June is mostly older than one day.

Technical corrections

- 1) Section 2 – the detection limits for all measurements should be stated here, esp. since benzene and toluene were reported to be lower.
- 2) P.10, line 28 – probably m/z 43 should be m/z 93 (toluene).
- 3) Figures 5 and 7, along with associated text – should include m/z 93 (toluene).
- 4) P. 17, lines 24-28 – CO also increases (slightly) in the afternoon, so some of the OA could be from anthropogenic sources.
- 5) The CO measurements are relatively low (110-150 ppbv) for the anthropogenic dominated air mass (3 June and 12 June in Figure 9). There needs to be an explanation for this (higher wind speeds?).

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 26297, 2012.

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