

We appreciate the editor's valuable comments, and we have revised the manuscript accordingly. Listed below are our point-to-point responses (in **blue**) to the comments (in **black**) and changes of the manuscript (in **red**).

Editor comments

l. 44: Please clarify that these mass yields relate to the fraction of precursor present in the aqueous phase, not to the total phenol mass in the atmosphere.

The text has been revised as follows for clarification.

The mass yields of aqSOA from the phenolic precursors in atmospheric waters range from 50% to 140%,

l. 201/2: The references to the studies by Atkinson and Olariu are somewhat misleading here as they investigated phenol oxidation in the gas phase – which might not result in the same products and/or yields. Please make this clear in the text.

To address this comment, we have revised the text to explicitly state that the studies by Atkinson and Olariu investigated phenol oxidation in the gas phase. Furthermore, to provide information on branching ratios and product distributions of phenol •OH oxidation in the aqueous phase, we have now included relevant modeling studies by Kılıç et al. in the references. The text has been updated as follows.

According to previous studies on phenol oxidation in the gas phase (Atkinson, 1986; Olariu et al., 2002), it has been observed that at room temperature, only ~10% of the phenol + •OH reaction involves H-atom abstraction that leads to the formation of phenoxy radical, whereas ~90% of the •OH reaction proceeds through OH addition. Moreover, modeling studies have indicated that in both gas-phase and aqueous-phase •OH oxidation of phenols, the OH addition pathways exhibit considerably lower activation energy than the H-abstraction pathway (Kılıç et al., 2007). As a result, it is highly likely that the primary products of the •OH reaction with phenols are hydroxyphenols.

l. 233: What do you mean by ‘in the meantime’? Simultaneously in the same step?

Our intention was to convey that the H-atom abstraction/electron transfer between ³DMB* and GA results in the parallel formation of a GA phenoxy radical and a DMB ketyl radical. To enhance clarity, the sentence has been revised as follows.

In ³C*-mediated reactions, ³C* can oxidize GA via H-atom abstraction/electron transfer to form a phenoxy radical and/or a ketyl radical (Anastasio et al., 1997; Smith et al., 2014; Yu et al., 2014). The ketyl radical can react with O₂ to produce superoxide/hydroperoxy radical (O₂•⁻/HO₂•), which subsequently react to produce H₂O₂ (Anastasio et al., 1997).

Improvements of figures:

Figures 1, 3 (and similar ones): Please use a different color scheme and/or vary symbol types for the various traces of the experiments (e.g., circles, squares, diamonds etc). Currently, it is hard for readers with color vision deficiencies to distinguish the traces for the different experiments: <https://www.color-blindness.com/coblis-color-blindness-simulator/>

We have revised the color scheme and have incorporated different symbol types for the traces representing different experiments in Figures 1, 3, 6, 7, S10 and S11.

Figure 3: Please consider using a different color scheme other than ‘rainbow scale’ for the same reasons as above. Monochromatic schemes going from light to dark color shades are easier to distinguish.

We have revised the color scheme in Figures 3d-f and 3j-l by using lighter to darker shades instead of the rainbow scale.

Figures 6 and 7: What is the relevance or meaning of the fit equations ($y = A(1 - e^{-Bx})$) for the formation and decays? Can the rate constants be directly derived from these fit equations? If so, please describe. If the coefficients are just empirical and are not further used, consider removing the equations from the quite cluttered figure and just refer to the tables in the supporting information.

The fitted parameter B represents the first-order formation rate constant of an aqSOA factor in the photoreactor under the experiment conditions. The following sentences have been added to Section 3.3 for clarification.

The formation and decay rate constants of different generations of the aqSOA products were determined by performing exponential fits ($y = a(1 - e^{-bx}) + c$ and $y = ae^{-bx} + c$, respectively) to the time trends of the aqSOA factors (Figures 6d,f,h and 7d,f,h). The fitted parameter b (in the unit of h^{-1}) represents the first-order rate constant for the aqSOA formation or decay in the photoreactor.

Figure 4: Please add the unit of the rate constant to the axis label.

Corrected.

Technical corrections

l. 352: Define ‘AAE’

Updated.

l. 388: reword ‘than no extra oxidant’ – do you mean ‘than without extra oxidant’?

Yes. The text has been revised to ‘than without extra oxidant’.

l. 394: Define ‘OSc’

The definition of OSc has been provided in Section 2.2 (Line 139-140) of the manuscript. To address this comment, we have now reiterated the definition of OSc in Line 394.

l. 431: Can you give an estimate of the relative contributions of aqSOA losses by chemical reactions vs (wet and dry) deposition? How much aqSOA is removed by deposition within 48 hours?

In this study, the rate of loss for phenolic aqSOA during photochemical aging was found to be in the range of $0.017\text{--}0.11\text{ h}^{-1}$ (i.e., $5\text{--}30\times 10^{-6}\text{ s}^{-1}$). The photochemical kinetics in our RPR-200 photoreactor system were ~ 7 times faster than those experienced under ambient winter solstice sunlight in Northern California. Consequently, these observations indicate a photochemical lifetime of 3–17 days for phenolic aqSOA in ambient conditions. The deposition loss rate constant of submicron particles in the atmosphere, assuming wet deposition is the dominant process, is approximately $2\times 10^{-6}\text{ s}^{-1}$ (resulting in a lifetime of approximately 5 days) (Henry and Donahue, 2012; Molina et al., 2004). These findings suggest that the contribution of photochemical aging to the removal of phenolic aqSOA can be comparable to that of wet deposition.

We have included this discussion in the conclusion section of the updated manuscript.

Reference

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