

# ***Interactive comment on “Secondary organic aerosol from chlorine-initiated oxidation of isoprene” by Dongyu S. Wang and Lea Hildebrandt Ruiz***

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We thank the referee for the suggestions and recommendations. Below are our responses to the comments.

(a) Reviewer: Introduction: The authors should add a Paragraph to the introduction about natural and anthropogenic halogen sources and sinks in the atmosphere to introduce this topic to the readers; e.g. by: Simpson et al., Tropospheric Halogen Chemistry: Sources, Cycling, and Impacts, Chem. Reviews, 2015. Roland von Glasow, Wider role for airborne chlorine, nature, 464, 2010. Finlayson-Pitts, Halogens in the Troposphere, Anal. Chem., 82, 770-776, 2010. Buxmann et al., Consumption of re-

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active halogen species from sea-salt aerosol by secondary organic aerosol: slowing down the bromine explosion, Environ. Chem., 12, 476-488, 2015.

ACPD

Response: We have added a discussion on natural and anthropogenic halogen sources and sinks to the introduction of the revised manuscript as suggested by the reviewer.

(b) Reviewer: p2 line 30: Please add the characteristics of the UVA light source: actinic flux, quantified UV/VIS spectrum.

Response: We have included additional information on the UV light source.

Manuscript changes in Section 2.1: "The UV spectrum is similar to other blacklight sources reported in literature (Carter et al., 2005). The NO<sub>2</sub> photolysis rate is used to characterize UV intensity and was determined to be 0.5 min<sup>-1</sup>, similar to ambient levels (e.g. 0.53 min<sup>-1</sup> at 0 degrees zenith angle, Carter et al., 2005)

(c) Reviewer: P3 line 31 "loss of organic vapors to Teflon surfaces" Teflon films, used for aerosol smog-chambers, are known to store various gaseous species, especially NO<sub>x</sub>, which is released from the Teflon film by UV radiation and increased temperatures. Has this been observed or taken into account? Please add a related statement to the manuscript.

Response: We have added a discussion on wall emissions and conducted chamber modeling to estimate the background contribution to secondary OH chemistry. Overall, chlorine-isoprene chemistry dominates gas-phase chemistry and secondary HO<sub>x</sub> production.

Manuscript changes in Section 2.1: "Between experiments, "blank experiments" were conducted in which seed particles, ozone, and chlorine gas (Cl<sub>2</sub> Airgas, 106 ppm in N<sub>2</sub>) were injected into the chamber at high concentrations and UV lights were turned on to remove any residual organics that are released from the Teflon<sup>®</sup> chamber under UV. Background effects were estimated using the SAPRC chamber modeling soft-

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ware (<http://www.engr.ucr.edu/~carter/SAPRC/>) in combination with the Carbon Bond 6 (CB6r2) chemical mechanism which was modified to include basic gas phase inorganic chlorine chemistry in addition to Cl2 and ClNO2 photolysis (Sarwar, Simon, Bhave, & Yarwood, 2012; Yarwood et al., 2010). Wall effects are represented within the model by a constant emission of nitrous acid (HONO) from the chamber walls on the order of 0.1 ppb min<sup>-1</sup>, which was determined separately in chamber characterization experiments (Carter et al., 2005)."

Manuscript changes in Section 3.4: "The SAPRC chamber model results indicate that more than 99% of the isoprene reacts with Cl; secondary OH chemistry is therefore only a very minor pathway in these experiments. Model results also show that HO<sub>2</sub> production is dominated by isoprene-chlorine chemistry, whereas wall effects dominate HO<sub>2</sub> production (>60 %) after all isoprene has been consumed. It is worth noting that the model does not explicitly represent Cl-initiated oxidation of reaction products, which can produce additional HO<sub>x</sub> radicals. Therefore, we expect the actual secondary OH chemistry to be more important than the current model estimation."

## References

Carter, W. P. L., Cocker, D. R., Fitz, D. R., Malkina, I. L., Bumiller, K., Sauer, C. G., Pisano, J. T., Bufalino, C. and Song, C.: A new environmental chamber for evaluation of gas-phase chemical mechanisms and secondary aerosol formation, *Atmos. Environ.*, 39, 7768–7788, 2005

Sarwar, G., Simon, H., Bhave, P., & Yarwood, G. (2012). Examining the impact of heterogeneous nitryl chloride production on air quality across the United States. *Atmospheric Chemistry and Physics*, 12(14), 6455–6473. doi:10.5194/acp-12-6455-2012

Yarwood, G., Jung, J., Whitten, G. Z., Heo, G., Mellberg, J., & Estes, M. (2010). Updates to the Carbon Bond Mechanism for Version 6 (CB6). In Presented at the 9th Annual CMAS Conference, Chapel Hill, NC, October 11-13 (Vol. 6, pp. 1–4).

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