

Supplementary Information for:

**Effects of 222 nm Germicidal Ultraviolet Light on Aerosol and VOC Formation from
Limonene**

*Olivia J. Jenks^{1,2}, Zhe Peng^{1,2}, Melinda K. Schueneman^{1,2}, Madison Rutherford^{1,2}, Anne V.
Handschy^{1,2}, Douglas A. Day^{1,2}, Jose L. Jimenez^{1,2}, and Joost A. de Gouw^{1,2*}*

¹Department of Chemistry, University of Colorado, Boulder, Colorado 80309, United States

²Cooperative Institute for Research in Environmental Sciences (CIRES), Boulder, Colorado
80309, United States

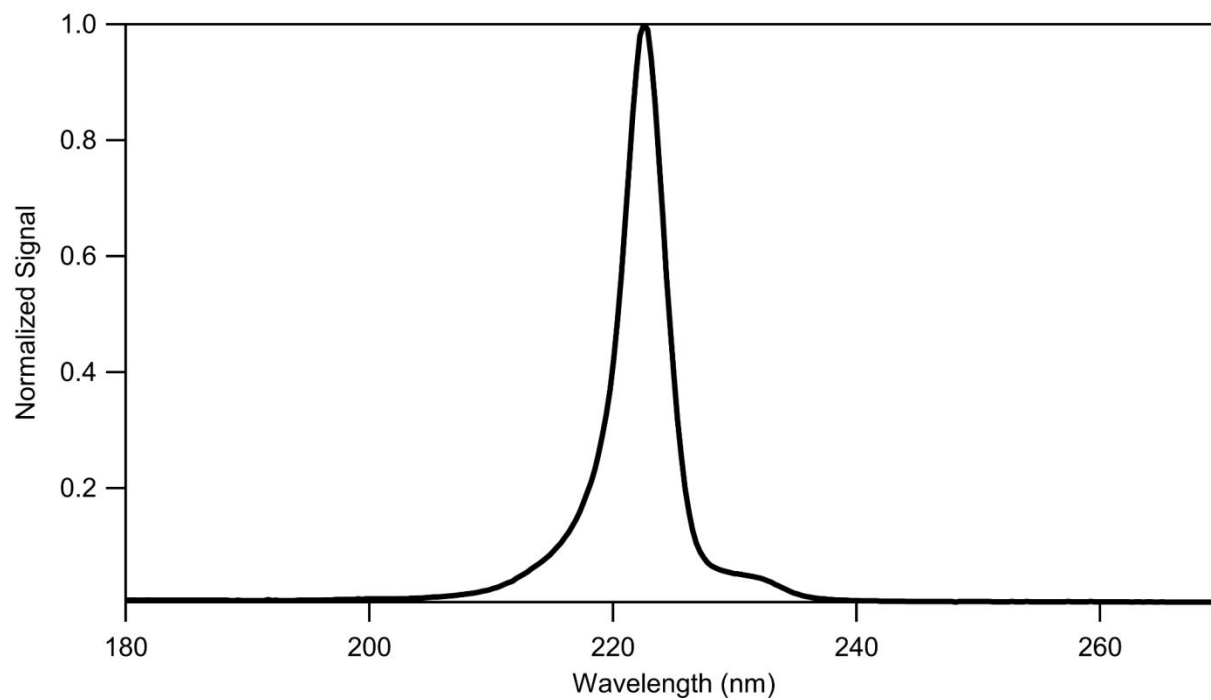


Figure S1. The emission spectrum of the Ushio B1 lamp.

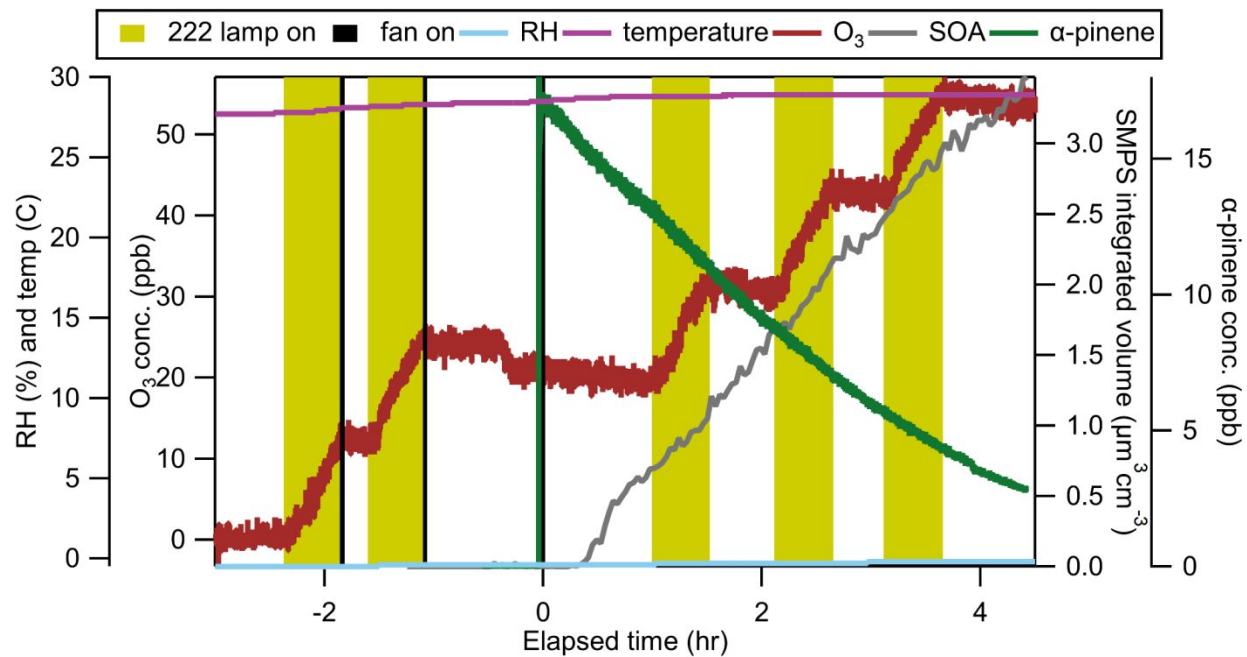


Figure S2. Time series of α -pinene, ozone, and SOA under dry conditions.

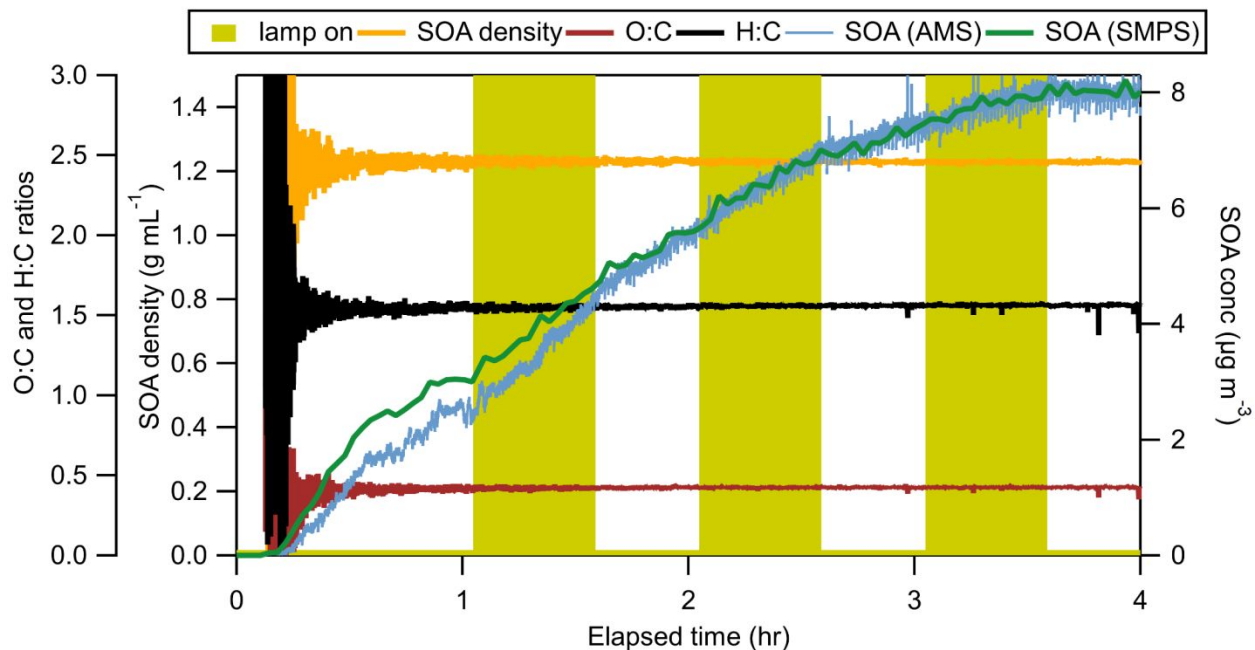


Figure S3. Oxygen to carbon (O:C) ratio and hydrogen to carbon (H:C) atomic ratios of the SOA measured by the AMS; high levels of noise at the start of the experiment are due to low SOA concentrations. The material density of SOA was estimated from the measured O:C and H:C using the method of Kuwata et al.⁴⁵ The SOA mass concentration calculated from the volume measured by the SMPS and the AMS density is also shown.

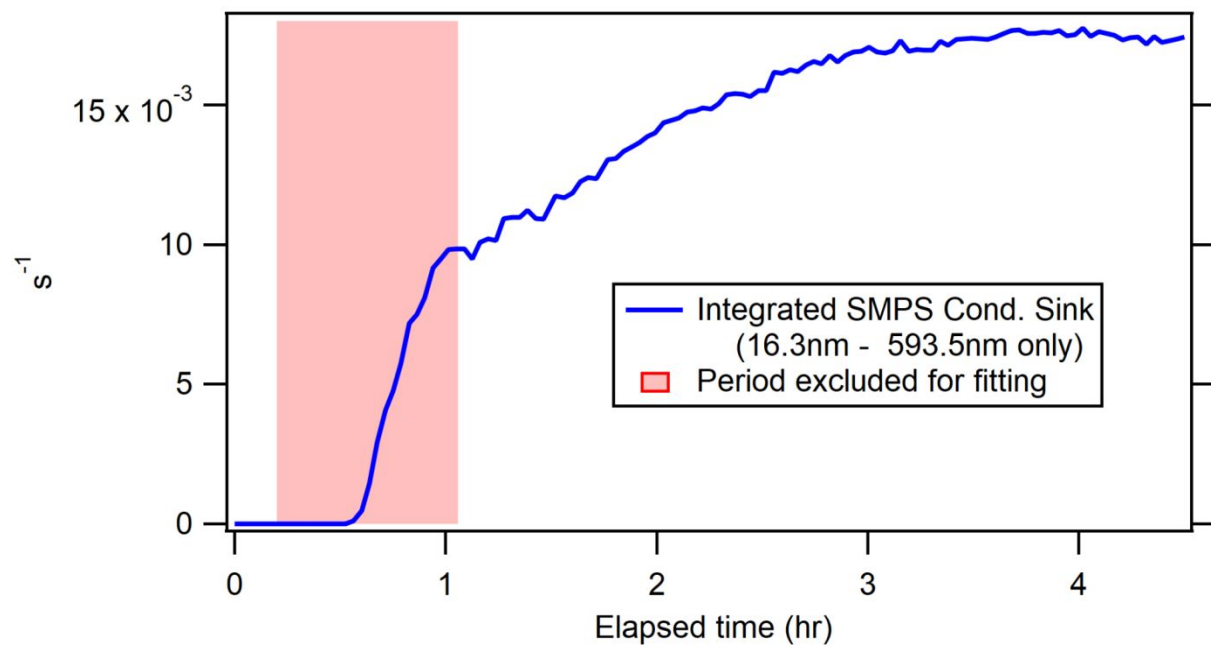


Figure S4. Condensation sink calculated from particle size distribution measured by the SMPS. The shaded area denotes the period excluded from fitting the limonene oxidation product molar yields.

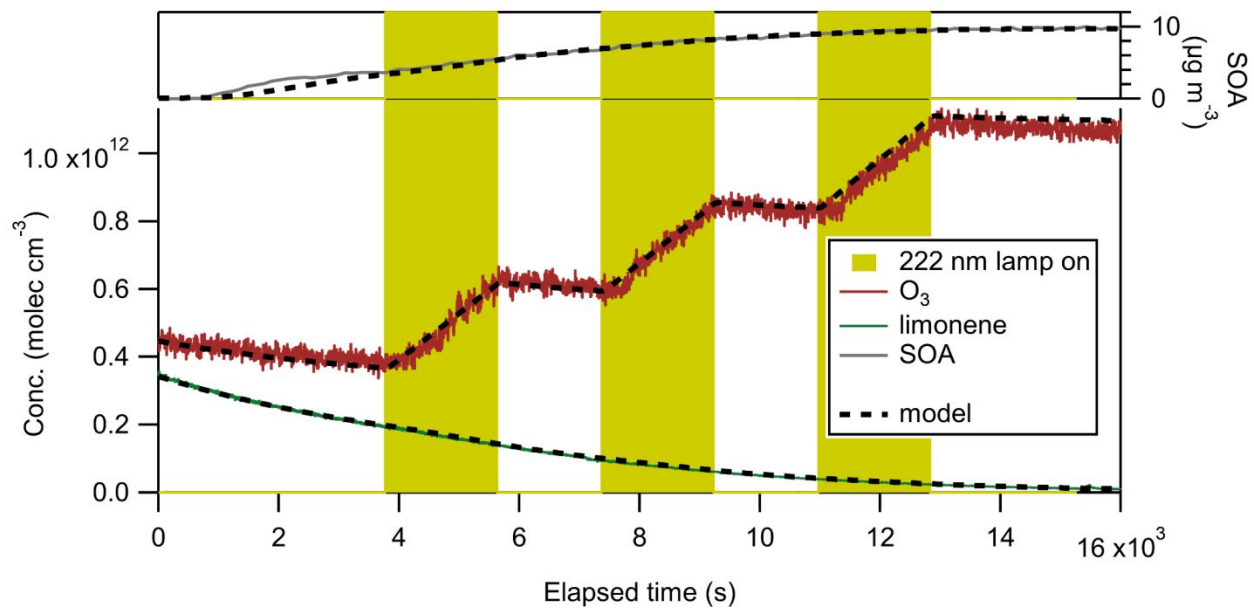


Figure S5. Modeled and experimental results for limonene ozonolysis under humid conditions, in the same format as Figure 1.

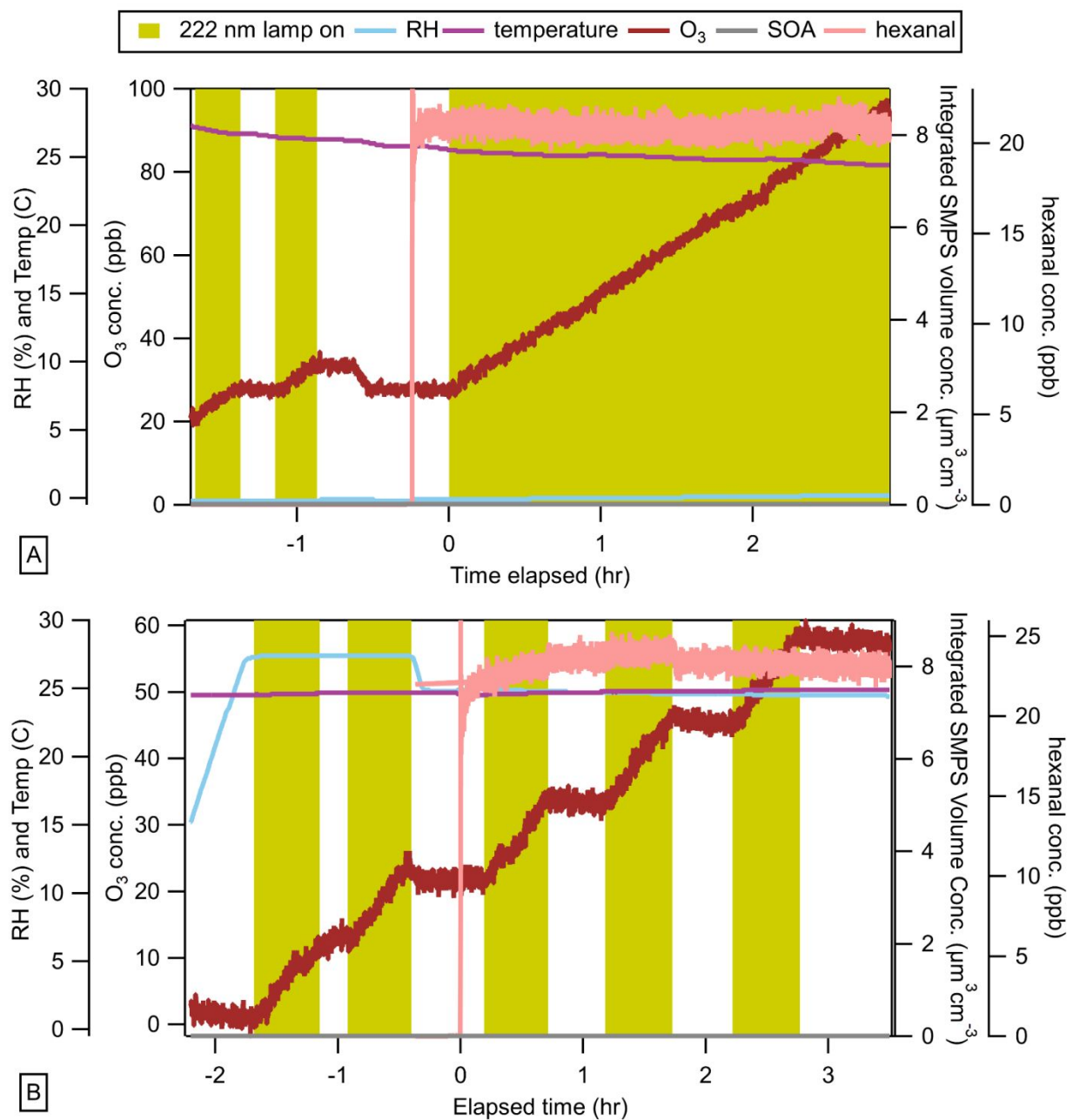


Figure S6. Time series of hexanal, ozone, and integrated particle volume concentration under dry conditions (A) and humid conditions (B). No limonene was present during these experiments.

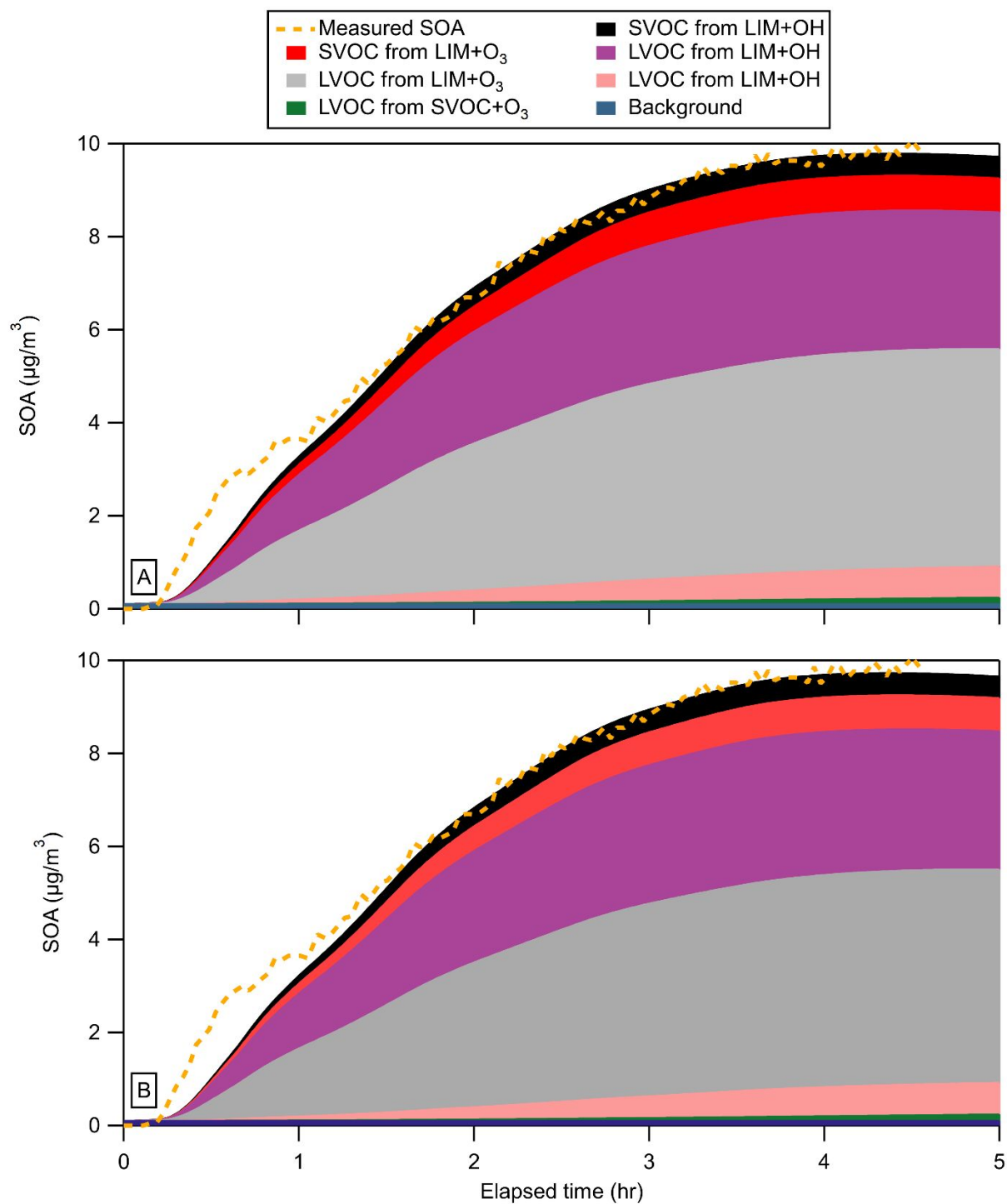


Figure S7. Measured SOA (dashed) and the stacked modeled SOA distribution (solid) for limonene irradiation by GUV222 under dry (A) and humid (B) conditions.

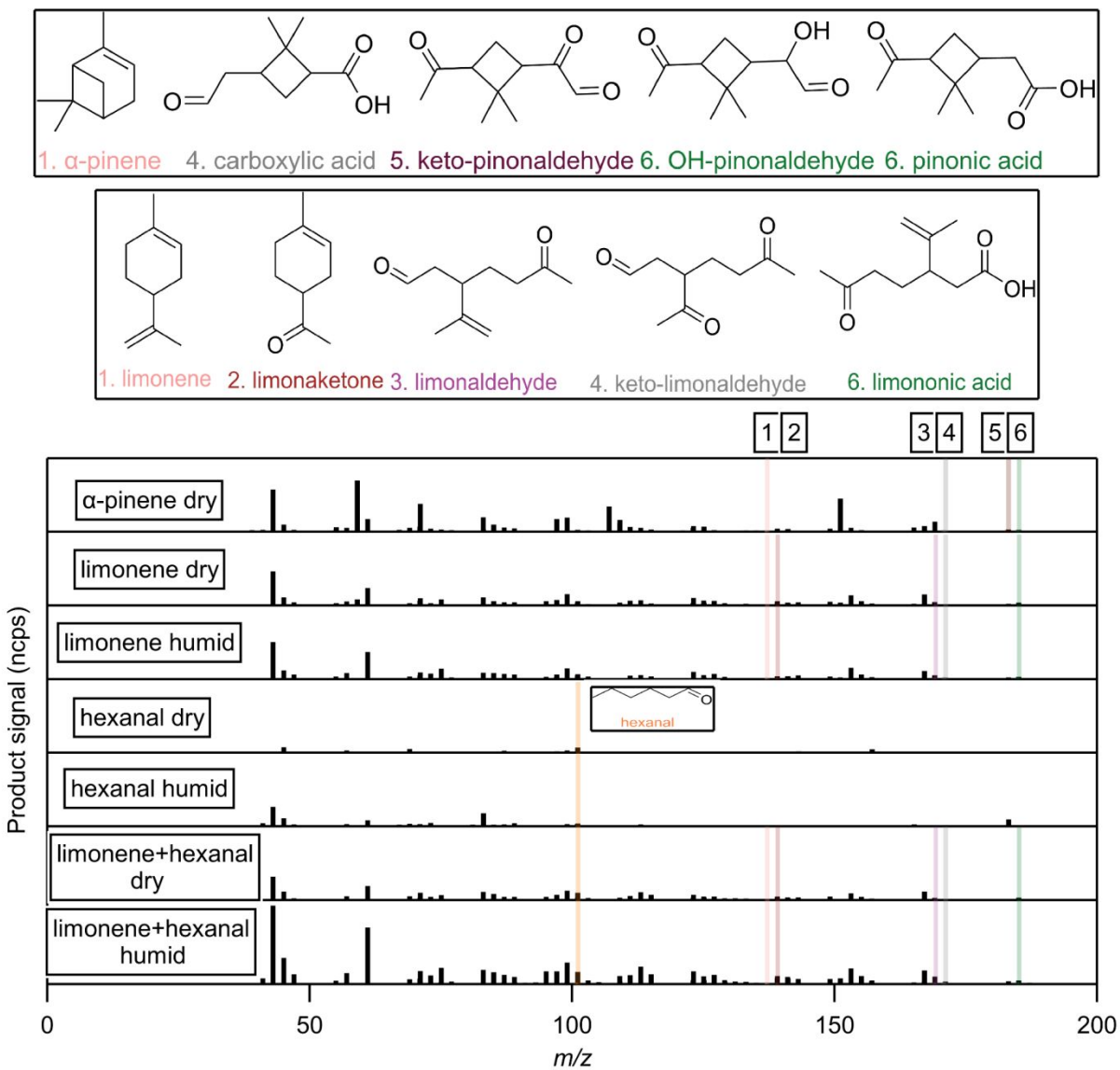


Figure S8. Mass spectra of oxidation products from α -pinene under dry conditions, limonene under dry and humid conditions, hexanal under dry and humid conditions, and limonene and hexanal under dry and humid conditions measured by the PTR-TOF. Some oxidation products are highlighted. The numbers above the spectra correspond to the numbers on structures above.

Table S1. Experiment summary.

| Experiment | α -pinene dry | limonene dry | limonene humid | hexanal dry | hexanal humid | limonene + hexanal dry | limonene + hexanal humid |
|--|-------------------------------------|--|-------------------------------------|-------------------------------------|-------------------------------------|--|--|
| Instruments used | Vocus, SMPS, O ₃ monitor | Vocus, SMPS, O ₃ monitor, AMS | Vocus, SMPS, O ₃ monitor | Vocus, SMPS, O ₃ monitor | Vocus, SMPS, O ₃ monitor | Vocus, SMPS, O ₃ monitor, AMS | Vocus, SMPS, O ₃ monitor, AMS |
| Initial monoterpene conc. (ppb) | 17±2.0 | 17±2.0 | 17±2.0 | N/A | N/A | 16±2.0 | 18±2.0 |
| Initial hexanal conc. (ppb) | N/A | N/A | N/A | 22±2.0 | 22±2.0 | 23±2.0 | 21±2.0 |
| O₃ conc. beginning - end (ppb) | 20±0.9 - 54±1.0 | 22±0.71 - 52±0.65 | 20±0.82 - 64±0.63 | 28±0.79 - 96±1.0 | 12±0.92 - 58±0.95 | 17±0.65 - 48±0.91 | 20±0.84 - 46±0.52 |
| O₃ prod. Rate when GUV222 on (ppb hr⁻¹)¹ | 26 | 25 | 25 | 26 | 24 | 21 | 23 |
| RH (%) | 0 ² | 0 ² | 26±0.18 | 0.05±0.1 | 25±0.16 | 0.1±0.07 | 27±0.17 |
| Temp (°C) | 29±0.095 | 27±0.17 | 28±0.12 | 25±0.28 | 25±0.11 | 27±0.46 | 26±0.14 |
| Estimated GUV222 fluence rate (μW cm⁻²) | 2.5 | 2.4 | 2.4 | 2.5 | 2.3 | 2.0 | 2.2 |
| Max SOA concentration (μg m⁻³) | 3.60±0.07 | 9.60±0.10 | 9.60±0.10 | 0.01±0.02 | 0.76±0.05 | 6.00±0.08 | 8.40±0.07 |

¹ Measured in the absence of limonene.² Below the detection limit of the instrument.

Table S2. Part of the reaction mechanism relevant to gas-particle-wall partitioning of the products for the KinSim model. The subscripts “p” and “w” indicate that the species are in the particle phase and adsorbed on the wall, respectively. Species without these subscripts are in the gas phase. The full mechanism will be made freely available at https://gitlab.com/JimenezGroup/KinSim_Cases_Mechs when the paper is accepted. The mechanism can be run within KinSim, which can be freely downloaded from <http://tinyurl.com/kinsim-release>.

| Process | Rate / rate coefficient | Reference for rate / rate coefficient |
|---|--|--|
| limonene + OH → 0.0823 SVOC + 0.0816 LVOC | $1.71 \times 10^{-10} \text{ cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$ | Stockwell et al., 1997 |
| limonene + O ₃ → 0.0823 SVOC + 0.0816 LVOC | $2.0 \times 10^{-16} \text{ cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$ | Stockwell et al., 1997 |
| SVOC + OH → 0.955 LVOC | $1 \times 10^{-10} \text{ cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$ | Estimated based on MCM (Jenkin et al., 2015) |
| SVOC + O ₃ → 0.955 LVOC | $1 \times 10^{-17} \text{ cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$ | Estimated based on MCM (Jenkin et al., 2015) |
| SVOC → SVOC _w | 3.6 h ⁻¹ | Krechmer et al., 2020 |
| LVOC → LVOC _w | 3.6 h ⁻¹ | Krechmer et al., 2020 |
| SVOC _w → SVOC | 0.55 h ⁻¹ | Calculated based on Liu et al., 2019 |
| SVOC → SVOC _p | Constrained by SMPS measurements | N/A |
| LVOC → LVOC _p | Constrained by SMPS measurements | N/A |

| | | |
|--|------------------------------------|------------------|
| SVOC _p → SVOC | Calculated real-time in simulation | N/A |
| LVOC _p → LVOC | Calculated real-time in simulation | N/A |
| SVOC _p (LVOC _p) wall deposition | 0.052 h ⁻¹ | Day et al., 2022 |

References

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