S1. Field-Collected SOA: Sampling and Filter Extraction Methods

Sample Collection

Ambient OA was collected at the Denver La Casa CDPHE Air Quality Monitoring Site (4545 Navajo St. Denver, CO) from October 10-18, 2024. The sampler was operated from 04:00-10:00 each day for a total of 42 hours over the study period. Aerosol samples were collected on Pall Tissuquartz filters (P.N. 7204) using an MCV high volume sampler affixed with a PM1 sampling head. The sampler flow rate was set to 30 m^3 h^{-1}. At the end of the sampling period, the filters were transported on ice and stored at -10 °C until extraction.

Filter Extraction

A circular subsection (~31 cm^2) was cut from the filter using a clean razor blade. The filter was then extracted using 12 mL of ethyl acetate over 2.5 days and the resulting solutions were filtered through Teflon filters (1 μm pore size). The filtered extract was dried under a gentle stream of dry N_2 in a pre-weighed HPLC vial and the final mass was recorded. The sample was reconstituted in HPLC-grade acetonitrile (Fisher Chemical), to the desired concentration and stored at -10 °C until analysis by HPLC-VIA-CIMS.

S2. Separation and Detection of Carboxylic Acids

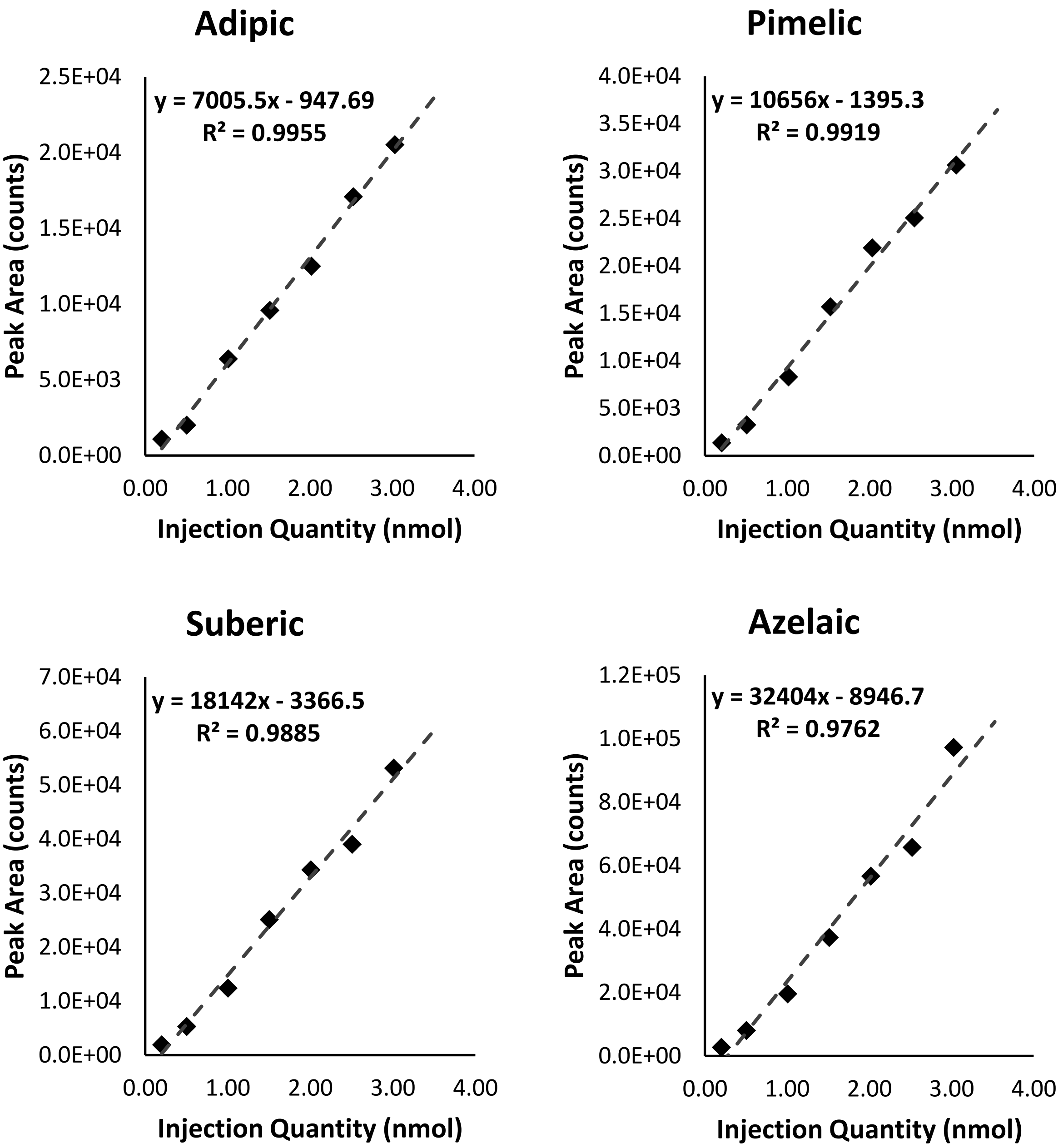

Figure S1. Calibration curves for the carboxylic acid standards used in this study.

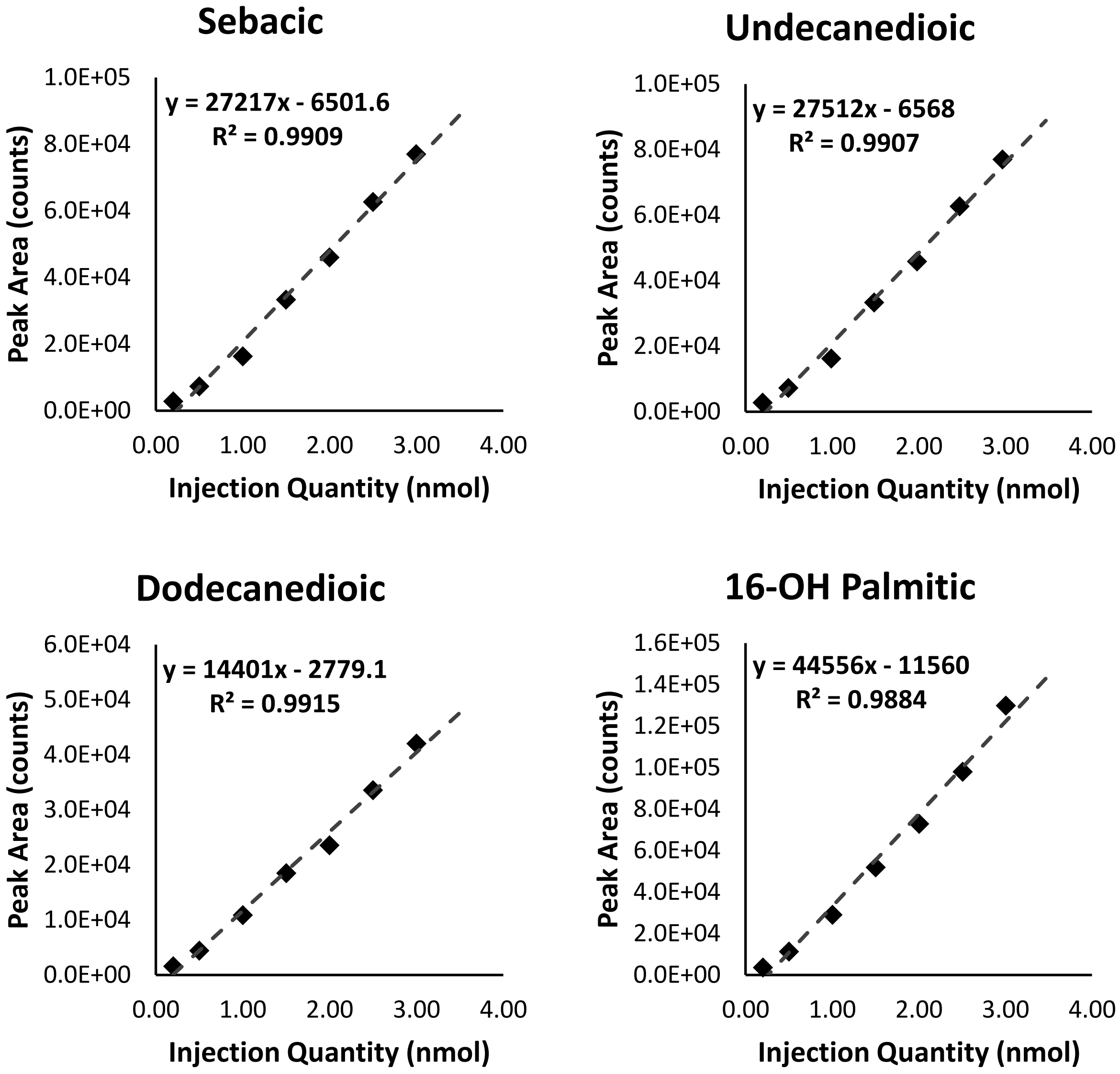

Figure S1 cont. Calibration curves for the carboxylic acid standards used in this study.

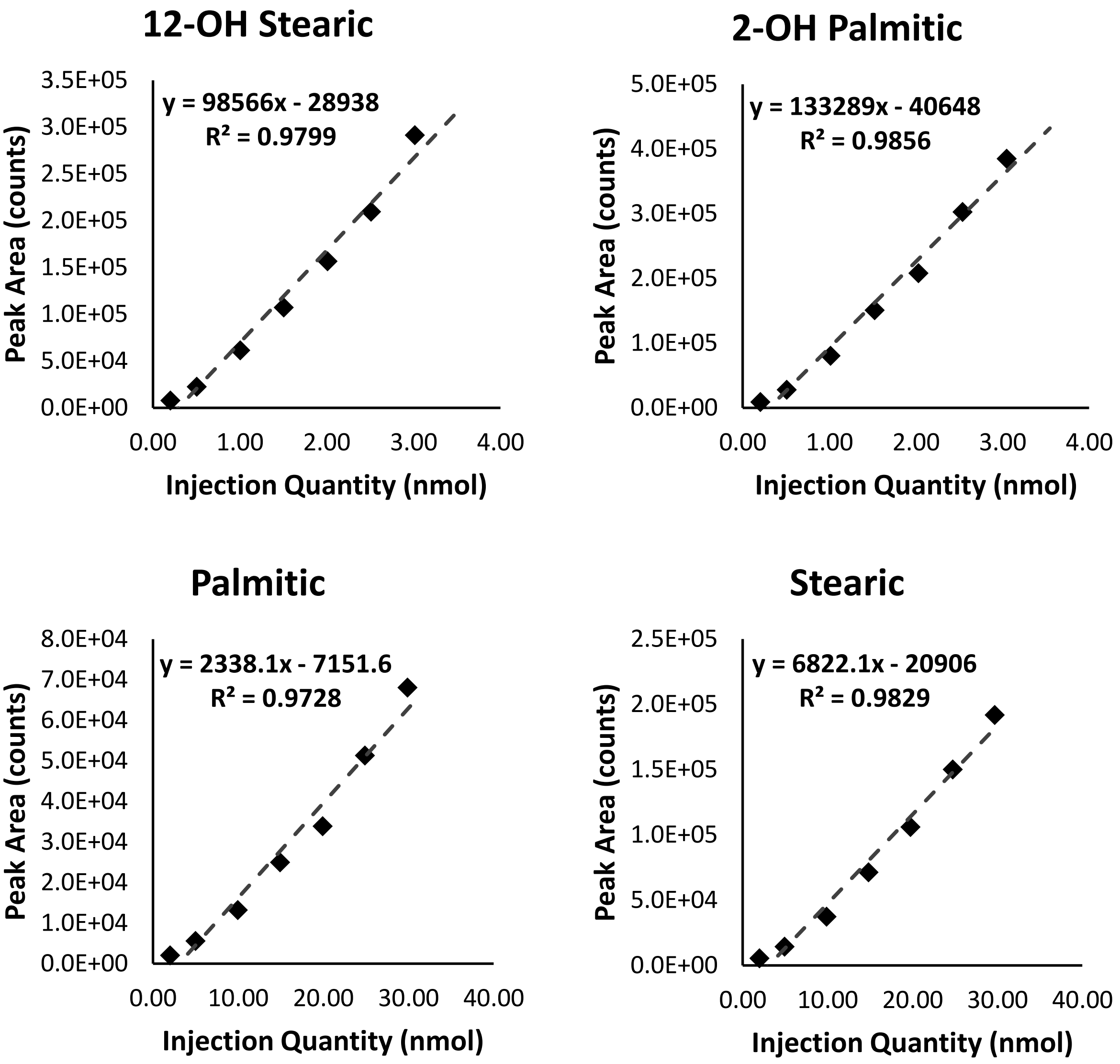

Figure S1 cont. Calibration curves for the carboxylic acid standards used in this study.

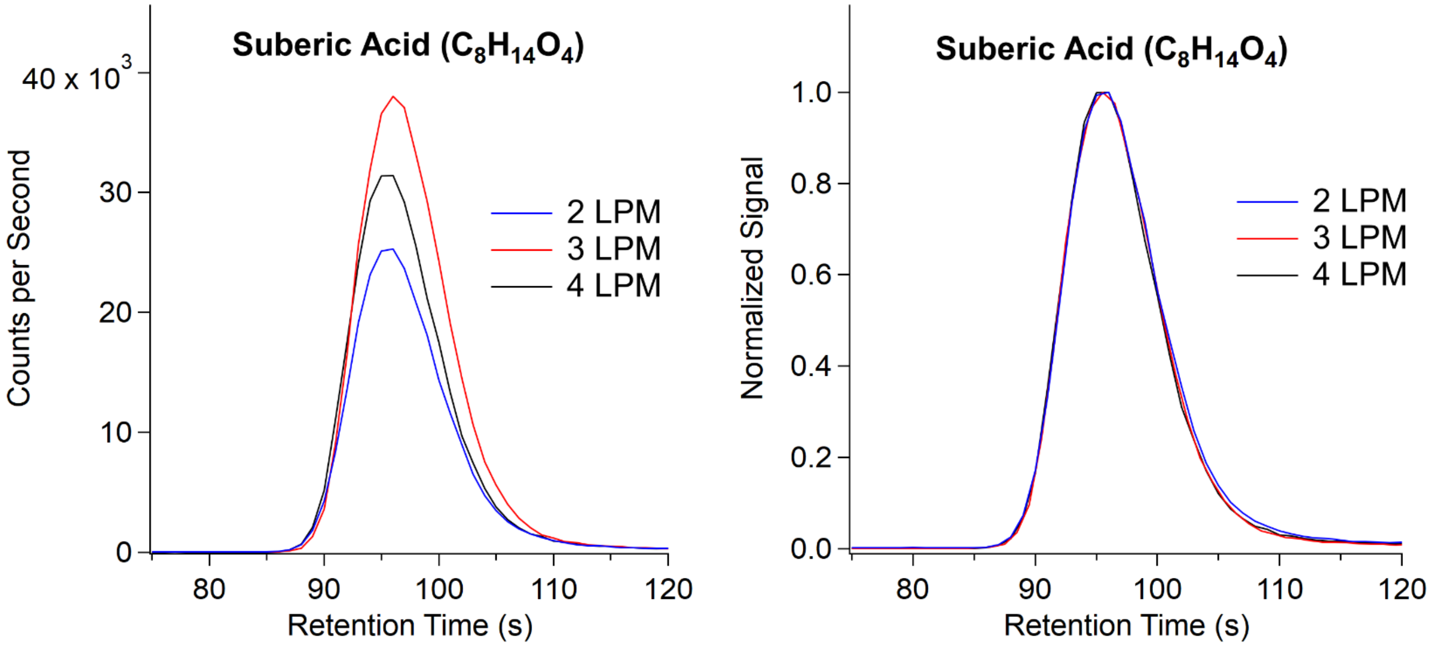

Figure S2. **Comparison of raw (left) and normalized (right) suberic acid signals at different system flow rates.**

S3. α-Pinene Ozonolysis SOA

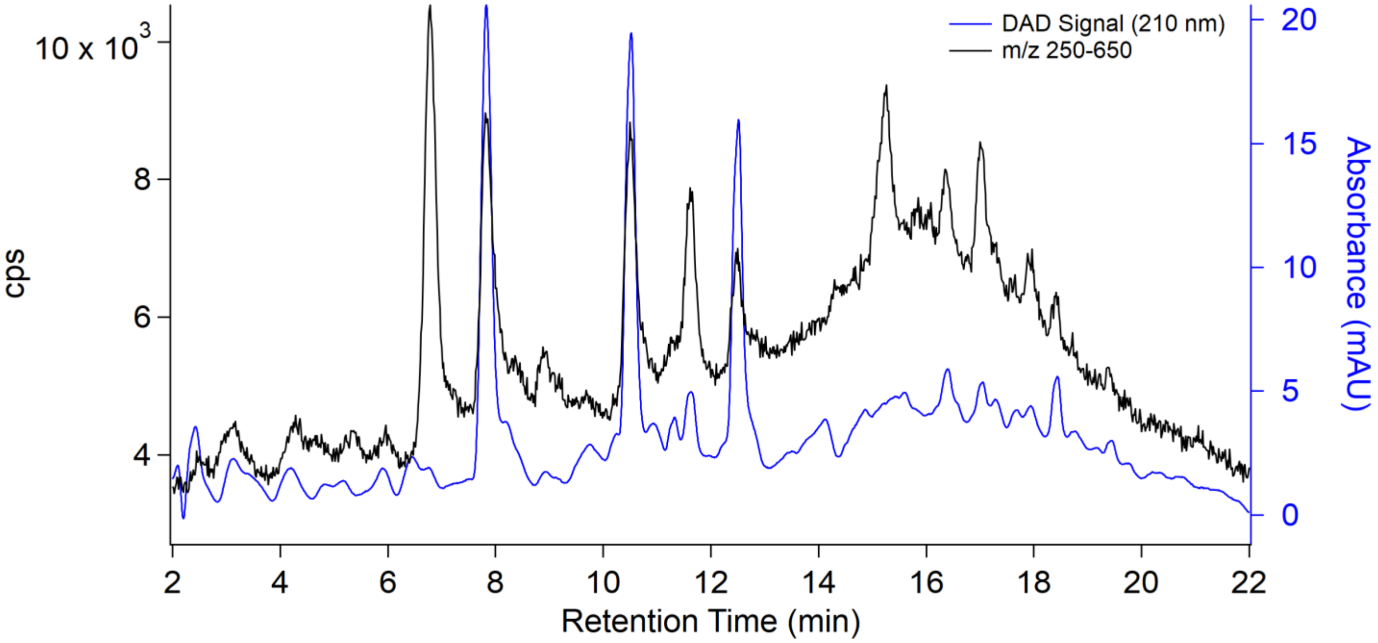

Figure S3. HPLC-VIA-CIMS and DAD chromatograms of α-pinene ozonolysis SOA. The sum of CIMS signal from m/z 250-650 was used to exclude reagent ion signal while including all expected analyte signals.

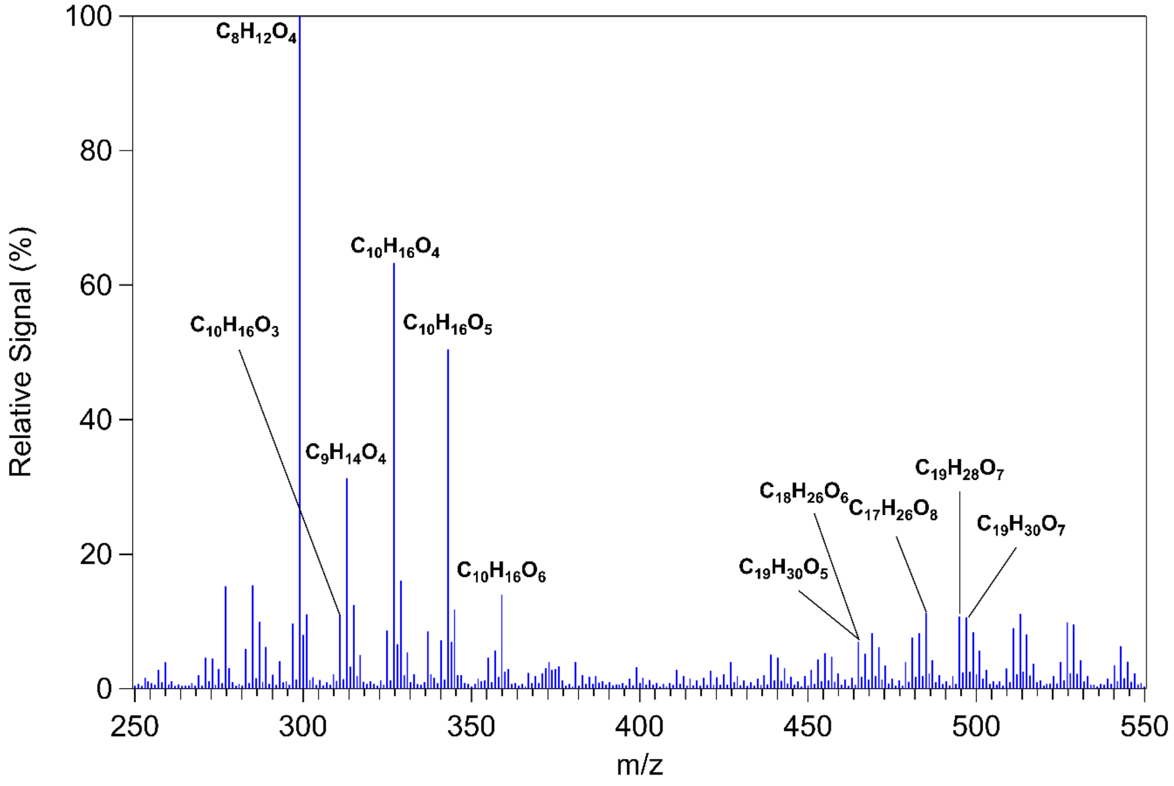

Figure S4. Average mass spectrum of α-pinene ozonolysis SOA between retention times of ~6 and ~18 min during HPLC-VIA-CIMS analysis. Compounds discussed in the main text are annotated without I^-. Signals were normalized relative to m/z 299.

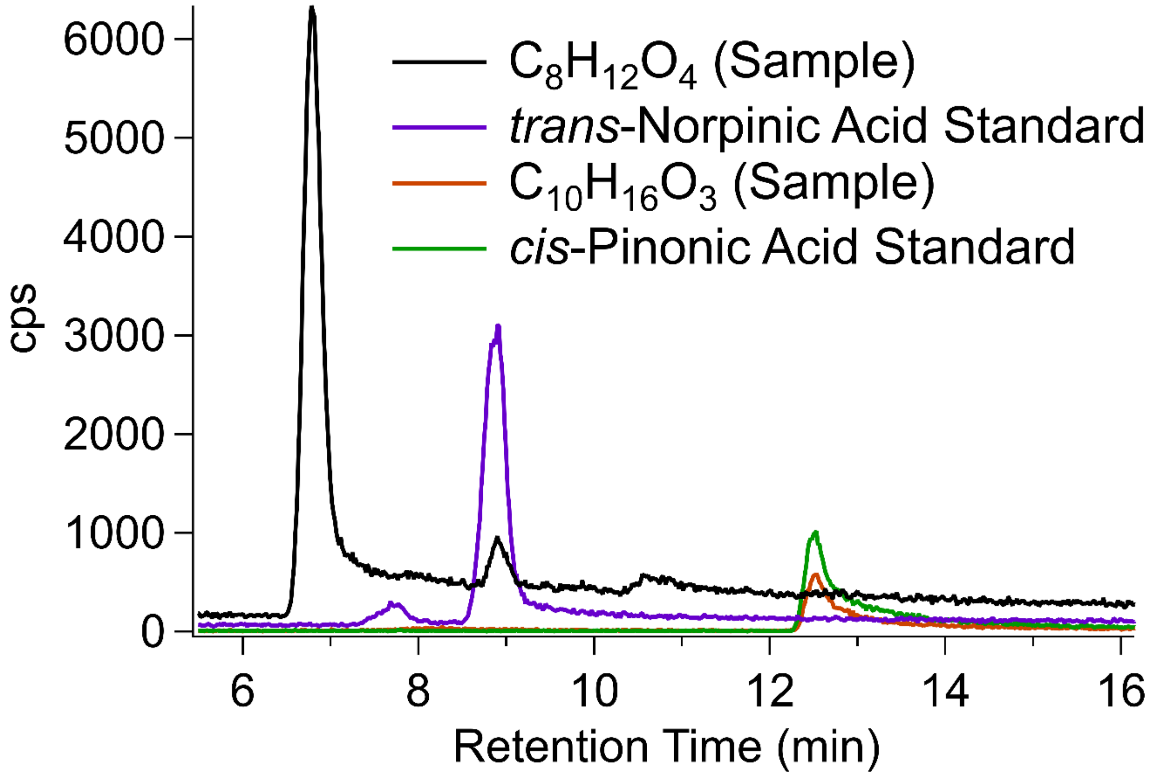

Figure S5. Chromatograms of trans-norpinic ($C_8H_{12}O_4$) and cis-pinonic acid ($C_{10}H_{16}O_3$) standards compared with corresponding chromatograms of α-pinene SOA. The first peak in the trans-norpinic acid trace (~7.5 min) is likely an impurity with the same molecular formula. The $C_8H_{12}O_4$ peak at 7 min in the SOA sample is assumed to be a structural isomer of trans-norpinic acid.

S4. Field-Collected SOA

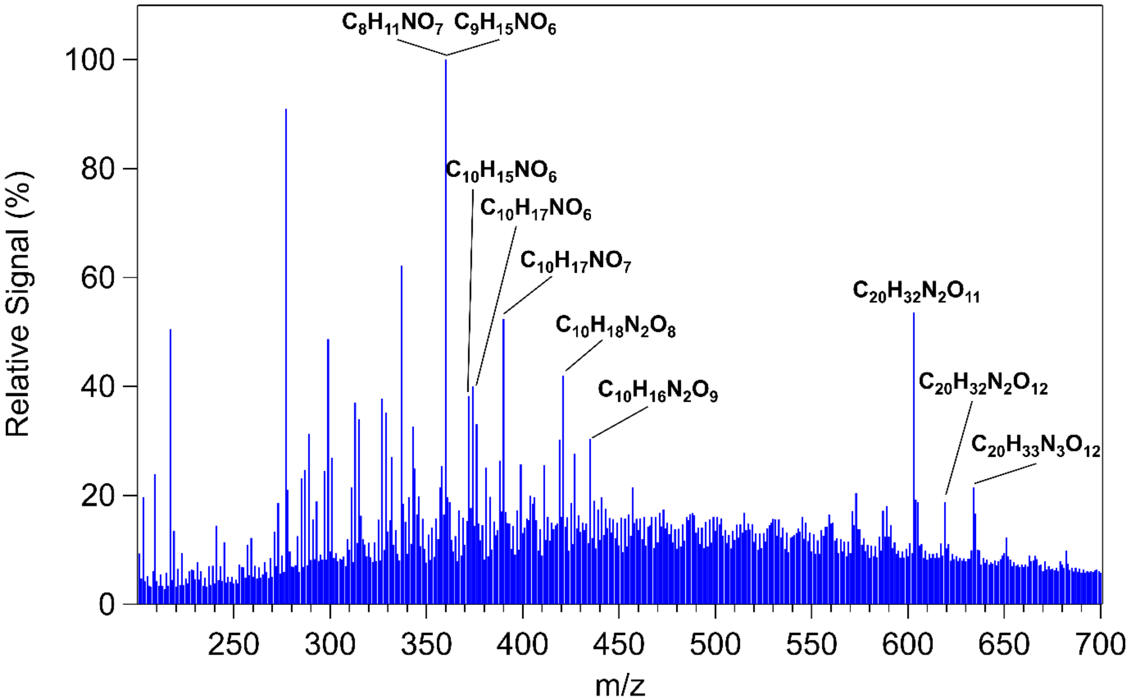

Figure S6. Average mass spectrum of field-collected SOA between retention times of ~8 and ~20 min during HPLC-VIA-CIMS analysis. Compounds discussed in the main text are annotated without I⁻. Signals were normalized relative to m/z 360.

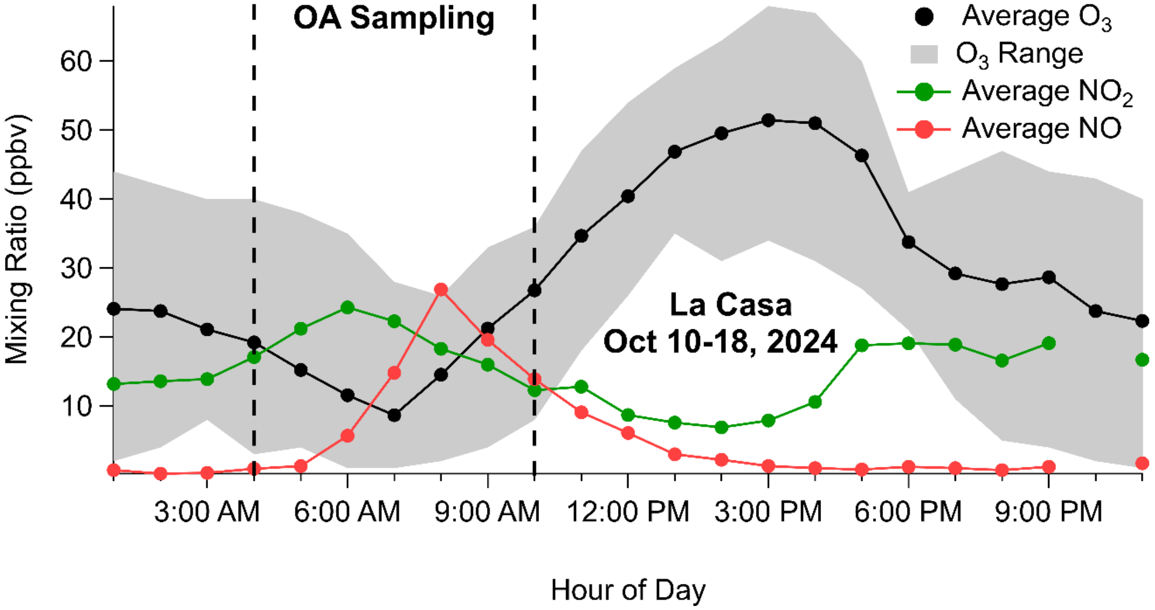

Figure S7. Average hourly concentrations of O_3, NO_2, and NO at the Denver, CO ASCENT site during the week of October 10-18, 2024. All data were obtained from the Colorado Department of Public Health & Environment through publicly available air quality reports (https://www.colorado.gov/airquality/report.aspx).