Abstract:

OFRs allow studying SOA formation and aging in both laboratory and field experiments. The concentration of an oxidant (OH, O₃, or NO₃) can be increased, leading to hours–months of equivalent atmospheric oxidation during the several-minute residence time. Typically, more SOA formation is observed from nighttime than daytime air. Measured ambient VOCs cannot explain the observed SOA formation, suggesting that typically unmeasured S/IVOCs (possibly VOC oxidation products or direct emissions) are important ambient SOA precursors. A kinetic model is used to study OFR chemistry. OH exposure (OH_{exp}) can be estimated within a factor of ~3 using model-derived equations, and verified using VOC decay measurements. OH_{exp} is strongly dependent on external OH reactivity, which may cause significant OH suppression in some circumstances (e.g., lab/source studies with high precursor concentrations). UV photolysis and O atoms are typically minor reaction pathways, except under high OH suppression. Low-volatility organic gases (LVOCs) fate is dependent on particle condensational sink. For the range of particle condensational sink at a remote pine forest, ~60% of produced LVOCs were predicted to condense onto aerosols for an OH_{exp} of ~1 day, with the remainder lost to walls. Similar to chamber wall loss corrections, a correction is needed to relate OFR sampling to the atmosphere, where condensation onto aerosols is the dominant LVOC fate. At high OH_{exp} (>20 days) in an OFR, LVOCs are predicted to be oxidized many times, leading to formation of volatile fragmentation products that no longer form SOA. Changes to preexisting OA at high OH_{exp} are a result of heterogeneous oxidation. The fate of RO₂ and NO₃ is being investigated with the model. SOA yields specific to OFR oxidation were investigated using standard addition of individual VOCs into ambient air, and were consistent with laboratory large chamber yields.