Supplement of

An oxidation flow reactor for simulating and accelerating secondary aerosol formation in aerosol liquid water and cloud droplets

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Supplement S1- Control and stability of flows, RH, temperature, and droplet size distributions

(a)





Figure S1. Example of control over several hours of (a) the inlet-gas and inlet-aerosol flow rates and (b) the temperature of the reactor and dew point of the inlet-gas flow. The steps in the inlet gas dew point reflect changes in the humidified air flow rate, which themselves result from changes in the flow rate from the O_3 generator. The inlet-aerosol flow dew point is assumed to always be 14.5 °C, which was determined experimentally using the approach described in the text.



Figure S2. Consistency of the droplet size distribution measured at the outlet of the APPA over more than one year.





Figure S2. Dry particle number size distributions of the initial K_2SO_4 seed particles (black) and of the cloud-processed particles exiting the reactor (red) that had grown as dissolved SO_2 was oxidized by O_3 to form aerosol-phase sulfuric acid.

Figure S2 shows an example of the dry size distributions measured at the outlet of the APPA by the SMPS for an experiment in which the cloud droplets formed on injected 0.04 μ m seed particles. Ozone was injected during both measurements, while SO₂ was for only the experiment resulting in the red distribution in the figure. The small mode to the right of the main peak corresponds to particles having two elementary charges when separated by the DMA shown in Figure 2 in the main text, and that subsequently lost one of those charges in the neutralizer downstream of it. The separation between the singly-charged and doubly-charged particle modes decreases accompanying the formation of sulfuric acid in part because the mass added to both modes is the same, which causes a greater relative change in size for the smaller singly-charged particles than the larger doubly-charged ones. The dry particle mode diameter increased from 0.040 μ m to 0.051 μ m.

Table S1. Aqueous-phase reactions added to the KinSim "OFR radical chemistry" module. The rate constants are effective values used to express the rates as if the reactions occur in the gas-phase per cm³ of air in the reactor. They were calculated for an LWC of 0.3 g m⁻³ and with the assumption that aqueous phase concentrations are described by Henry's Law.

No.	Reaction	Effective rate constant (cm ³ molec ⁻¹ s ⁻¹)
R1	$OH + HO_2 \rightarrow H_2O + O_2$	8.37 × 10 ⁻¹¹
R2	$OH + O_3 \rightarrow HO_2 + O_2$	5.29×10^{-17}
R3	$HO_2 + HO_2 \rightarrow H_2O_2 + O_2$	5.22×10^{-11}
R4	$OH + H_2O_2 \rightarrow HO_2 + H_2O$	7.87×10^{-12}
R5	$HO_2 + O_3 \rightarrow 2O_2 + OH$	7.65×10^{-15}
R6	$OH + CO_2 \rightarrow HCO_3$	1.3×10^{-18}