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Supplement of

A new oxidation flow reactor for measuring secondary aerosol formation of rapidly changing emission sources

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The PAM OH exposure as a function of ozone concentration measured after the PAM is presented in Fig. S1. The OH exposure was determined by measuring the SO_2 loss as in Sect. 2.4, and the different ozone concentrations are achieved by varying the lamp voltage.

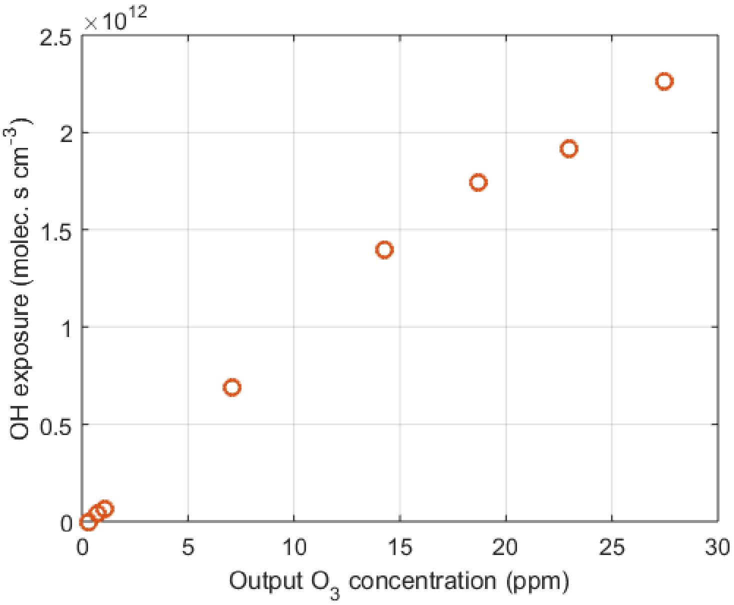

Figure S1. PAM OH exposure as a function of output ozone concentration at relative humidity of 27 – 29 %.

Figure S2 shows the sampling setup for engine exhaust measurements. The primary dilution ratio is adjusted by the amount of dilution air for the porous tube diluter and by the flow rate to the vacuum after the residence time chamber.

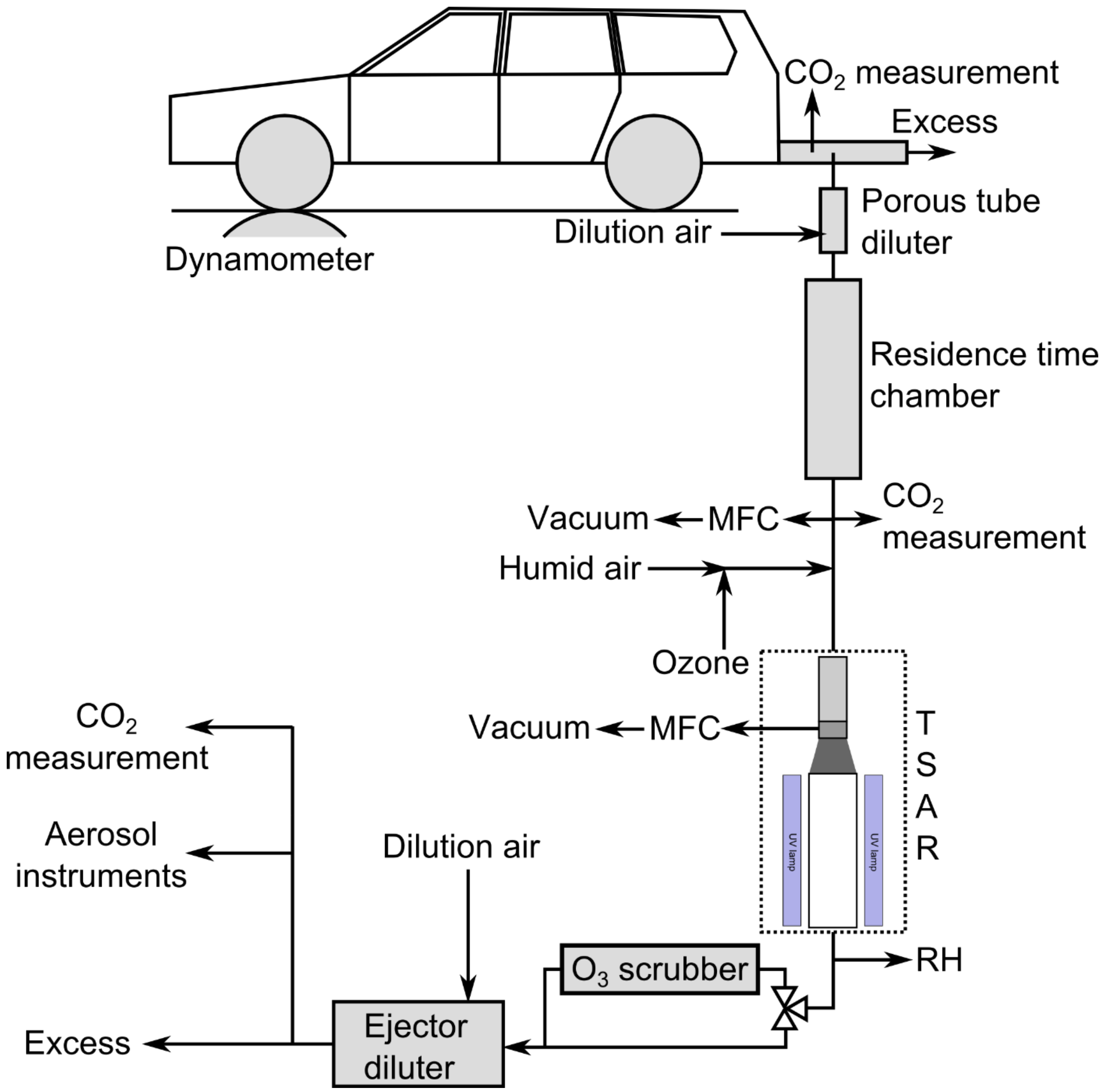

Figure S2. Engine exhaust sampling setup.

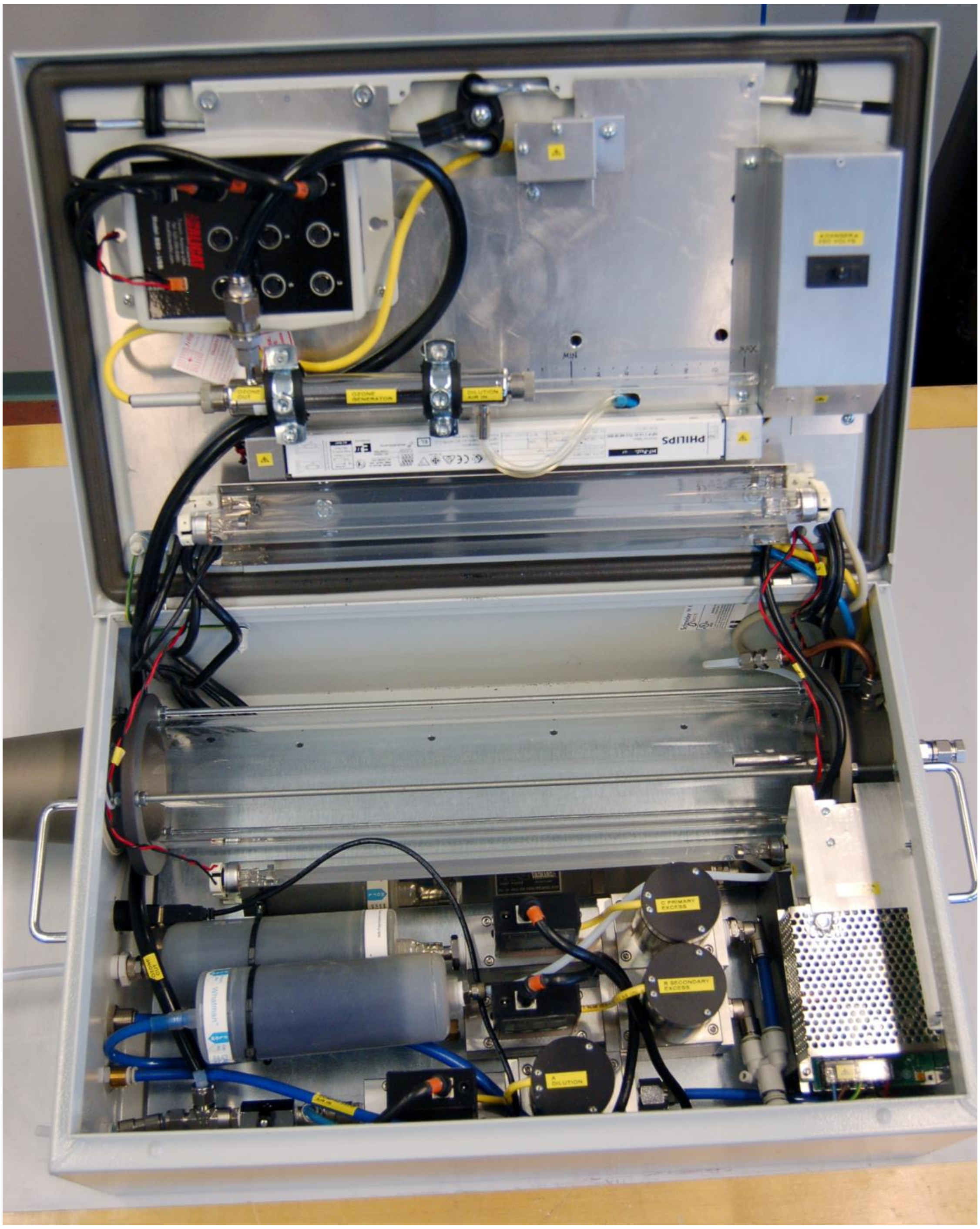

Figure S3. A photograph of TSAR

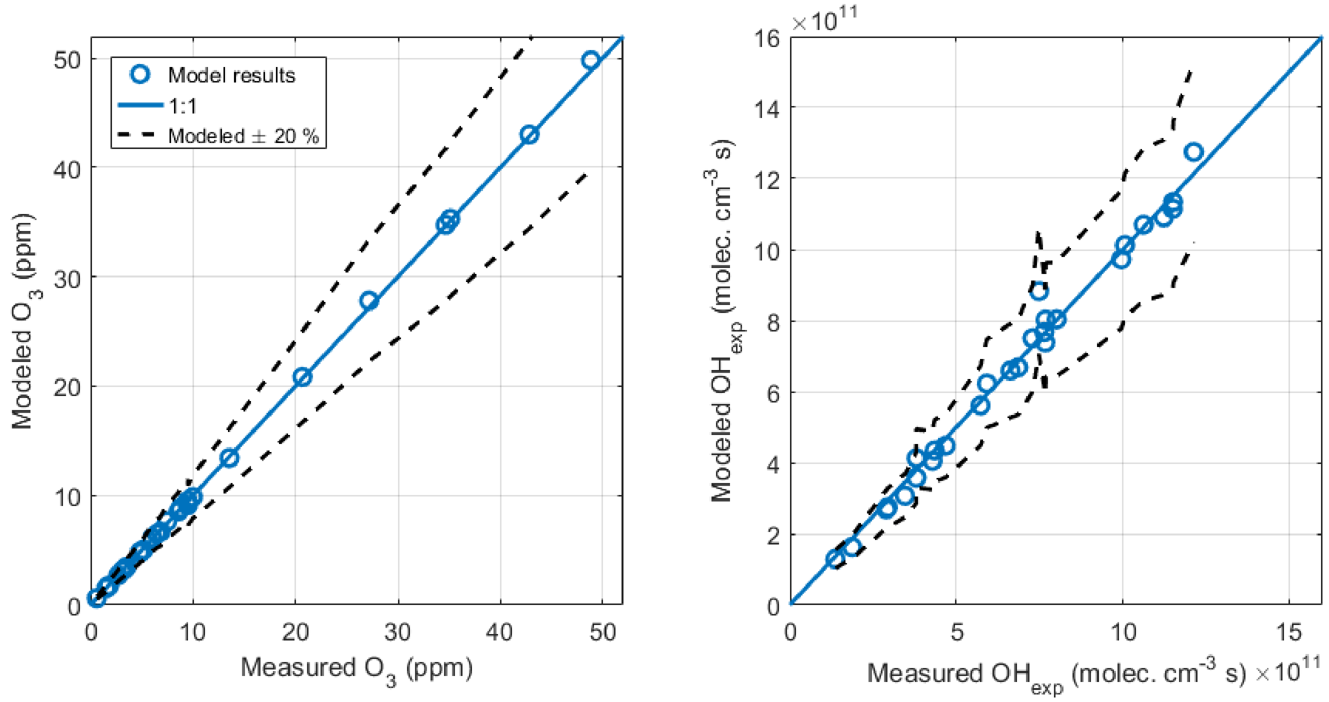

Figure S4. The measured and modeled ozone concentration after TSAR, and the measured and modeled OH exposure for the measurements done in Sect. 3.3.

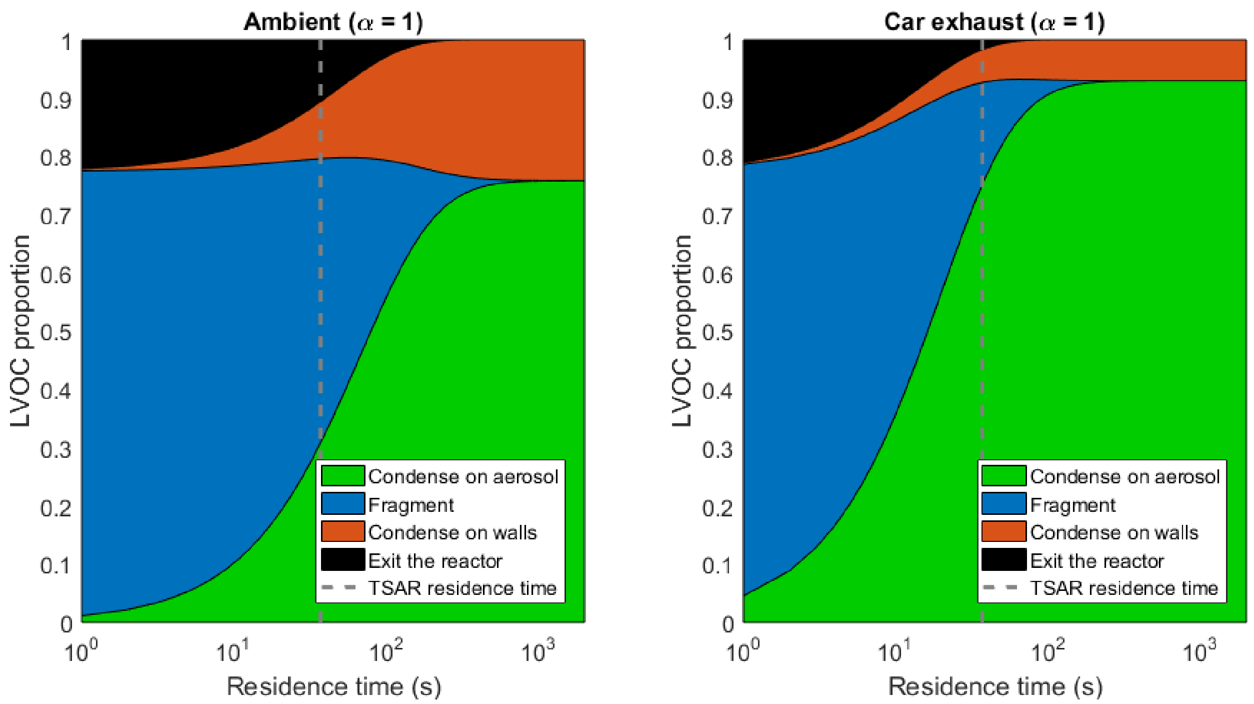

Figure S5. The fate of LVOC as a function of residence time for the ambient and the car exhaust case.

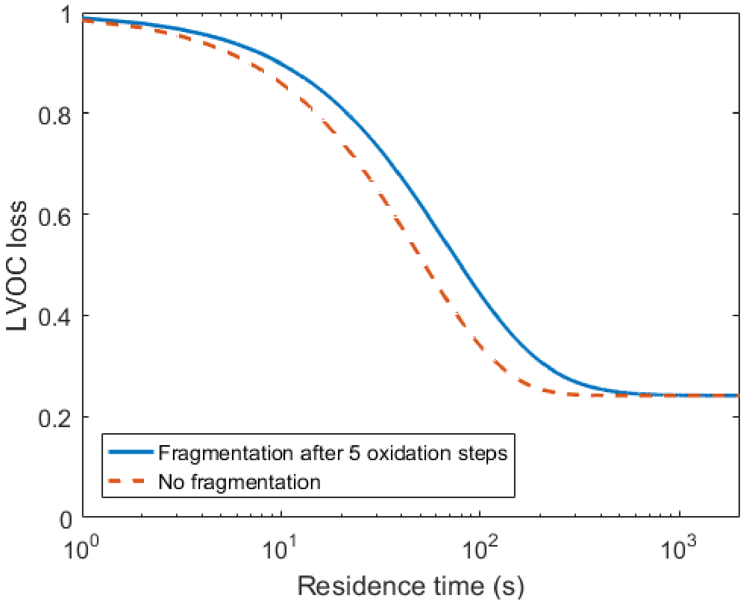

Figure S6. The sensitivity of fragmentation parameter in LVOC loss model for the ambient case. If no fragmentation occurs, the losses are slightly lower at residence times between 10-300 s.

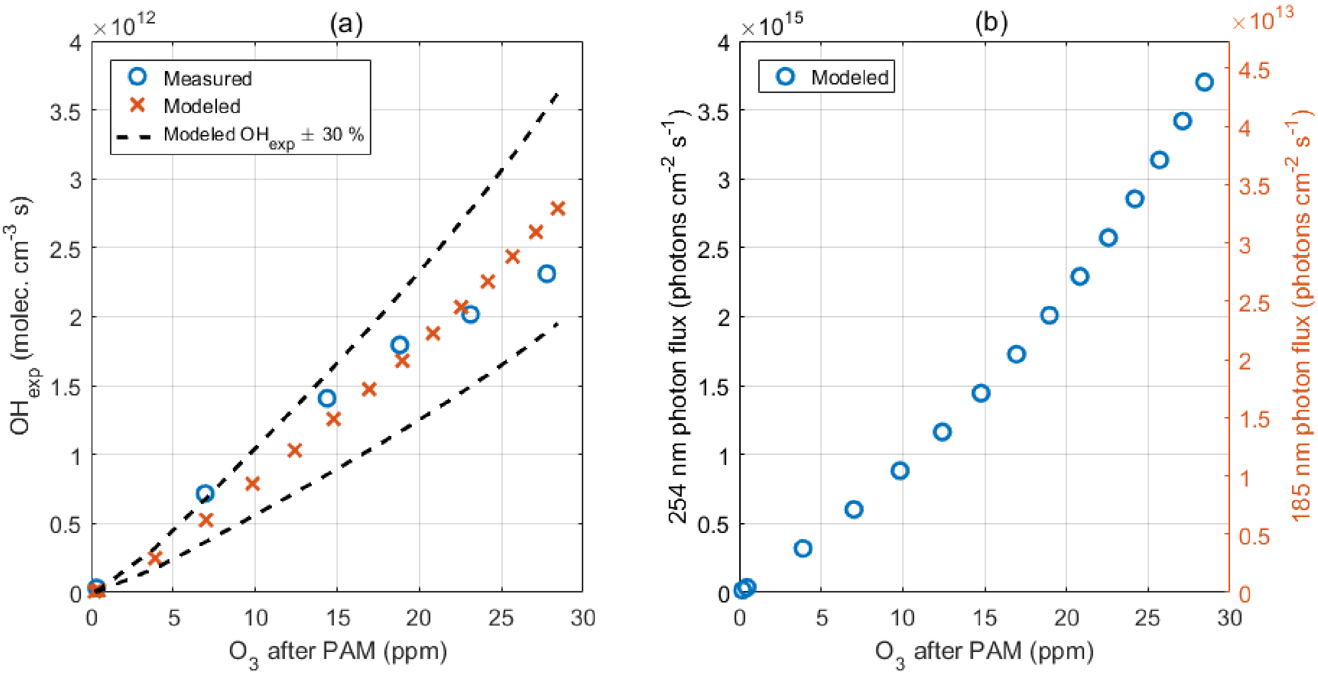

Figure S7. Comparison of model and measurement results of PAM OH exposure characterization (a), and the modeled photon flux as a function of modeled ozone concentration after PAM (b). The results were obtained by assuming OH wall loss coefficient of 8.3 s^{-1}, ozone wall loss coefficient of 7.5×10^{-4} s^{-1} and that the 185 nm photon flux is 1.28 % of 254 nm photon flux. The input parameters were relative humidity, temperature, the initial SO_2 concentration and the 254 nm photon flux.

Calculation of CS and k_w in LVOC loss model

The condensational sink for a discrete particle size distribution is defined as

$$CS = \sum_i \beta(r_i) r_i N_i \,,$$

where r_i is the radius of particles in the ith size bin, N_i is the number concentration of particles and β is the transitional correction factor.

$$\beta = \frac{Kn + 1}{0.377Kn + 1 + \frac{4}{3\alpha}Kn^2 + \frac{4}{3\alpha}Kn},$$

where α is the accommodation coefficient of condensing vapor. Kn is the Knudsen number.

$$Kn = 3\sqrt{\frac{\pi m}{8kT}}\frac{D}{r},$$

where m is the molecular mass and D is the diffusion coefficient of the condensing vapor. (Pirjola et al., 1999)

The first-order wall loss rate coefficient is calculated with equation

$$k_w = \frac{2A}{\pi V}\sqrt{k_e D},$$

where A is the reactor surface area, V is the volume of the reactor, D is the diffusion coefficient of the condensing compound and k_e is the coefficient of eddy diffusion. (Palm et al., 2016) The reactor volume dependent value of k_e is calculated as in (Krechmer et al., 2016):

$$k_e = 0.004 + (5.6 \times 10^{-3}) \cdot V^{0.74}$$

References

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