

Response to reviewers for the paper “A comprehensive evaluation of enhanced temperature influence on gas and aerosol chemistry in the lamp-enclosed oxidation flow reactor (OFR) system” in Atmos. Meas. Tech. Discuss. Doi: 10.5194/amt-2023-230

By Tianle Pan et al.

We appreciate the three reviewers' comments and support for the publication of this manuscript after revisions. Following the reviewers' suggestions, we have carefully revised the manuscript. To facilitate the review process, we have copied the reviewer's comments in black text. Our responses are in regular blue font. We have responded to all the referee comments and made alterations to our paper (**in bold text**).

Anonymous Referee #2

General Comments

Pan et al. observed a lamp-induced enhanced temperature inside the PAM-OFR based on measurements and investigated the impacts on flow and chemistry using model simulations. They find that the temperature enhancements have negligible impacts on gas-phase reactions, while large impacts on the SOA yields, chemical composition, and aerosol-phase chemistry. This study provides relatively systematically and detailed heating effects on chemistry inside the PAM-OFR, and should be suitable for publication in AMT. However, I have a few concerns that I would like the authors to address and some suggestions for improving the clarity of presentation.

Major Specific Comments

R2.1: The authors use “PAM-OFR” in the introduction and methods sections, while “OFR” is used in the rest of the manuscript. Can the authors use one terminology to keep constant throughout the manuscript?

A2.1 We replaced the “OFR” with “PAM-OFR” in the manuscript when the PAM-OFR

was specifically referred to.

R2.2: The authors find shorter residence time under the enhanced temperature than non-heated PAM-OFR. Generally, shorter reaction time leads to lower SOA yields. How would this contribute to lower SOA yields in SOM modeling results? Compared to gas-phase products evaporation, which is more important?

A2.2: This is a really good question. A short answer is the evaporation under high temperature impact more SOA formation in OFR than the change of residence time. As shown in Figs.10a and 10c, when the SOM results were calculated based on the residence time distribution (RTD) obtained at 25 °C, the SOA yield of dodecane decreased ~60% under high NO_x condition and ~14% under low NO_x condition as the temperature inside PAM-OFR increased from 25 °C (the red line) to 40 °C (the black line). When we considered the really measured RTD obtained at 40 °C (the black dashed line), the SOA yield of dodecane was even lower. But the impact of the RTD was weaker than the temperature, as only ~8% (high NO_x) and ~10% (low NO_x) decrease in the SOA yield was found compared to the results with RTD obtained at 25 °C (the black line). We revised the sentences related to the RTD on SOA formation as shown in the following:

Line 535-539: **“When the measured RTD at 40 °C was applied in the model, an even lower SOA yield was achieved due to the shorter residence time of reactants. However, this influence was weaker than the directly influences caused by the temperature increase on SOA formation. A decreased of ~8% of dodecane SOA yield was found at 40 °C under high NO_x condition and 10% under low NO_x compared to the results with RTD measured at 25 °C (Fig. 10).”**

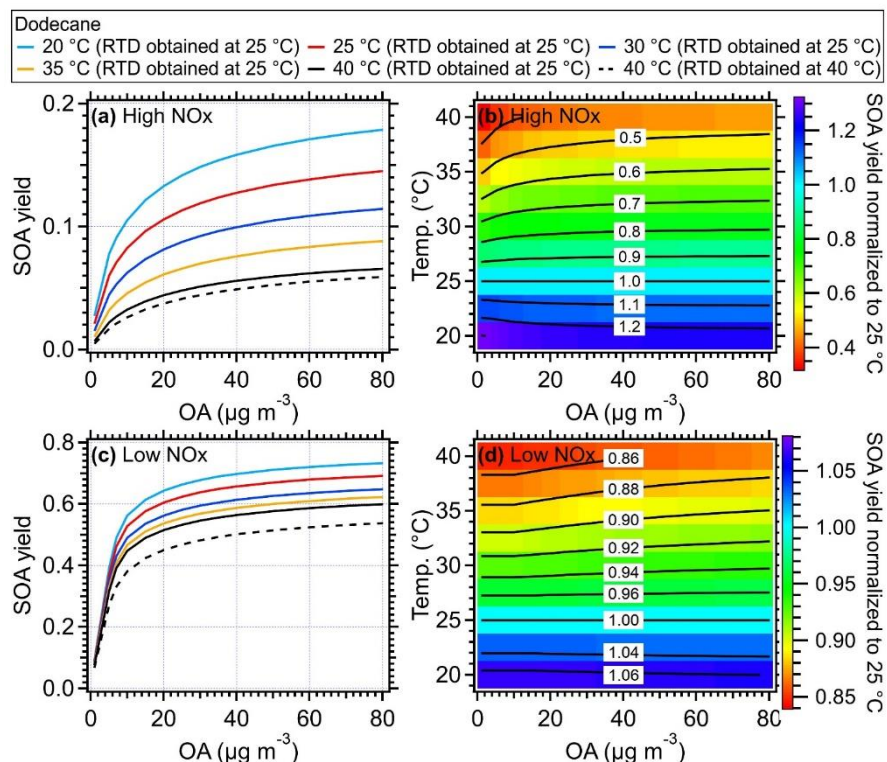


Figure 10: Simulated SOA yield of dodecane as a function of mass concentration of organic aerosol and temperature within the OFR under (a) high NO_x and (c) low NO_x conditions, respectively. The simulated results using the measured RTD obtained at 40 °C were shown as black dashed lines. The ratio of SOA yield of dodecane from different temperatures compared to that of 25 °C under (b) high NO_x and (d) low NO_x conditions. The equivalent aging time was 1 day by assuming the OH concentration equated to 1.5×10^6 molecule cm^{-3} (Mao et al., 2009).

R2.3: For low and high NO_x conditions, what are the concentration levels? If the authors intend to distinguish the fate of peroxy radicals in two conditions, NO concentrations should also be provided.

A2.3: In the PAM-OFR experiments, we distinguish high and low NO_x conditions by the ratios of RO₂ reacted with NO or HO₂. Based on the definition in the most experiments studies, $r(\text{RO}_2+\text{NO})/r(\text{RO}_2+\text{HO}_2) > 1$ represents the high NO_x condition (Peng and Jimenez, 2017). However, in the SOM model, the reaction under low/high NO_x conditions was processed by using different parameters (m_{frag} , ΔLVP , p1-p4, Table

S3) without considering concentration of NO gases in PAM. These model parameters were obtained by fitting the simulated results to the measured chamber results under high and low NO_x conditions, respectively (Eluri et al., 2018; Cappa et al., 2016).

We added the corresponding explanations in line 226-228: “**These parameters were obtained by fitting the simulated results to the measured chamber results under high and low NO_x conditions, respectively (Eluri et al., 2018; Cappa et al., 2016). Thus, the exact NO concentration was not considered in the SOM model during the simulation**”

R2.4: It would be helpful if the authors can provide experiment results to show the heating effects on SOA formation inside the PAM-OFR, e.g. using *vs* not using the external fans.

A2.4 Thanks for your suggestions. We added the measured results of SOA formation in PAM-OFR using *vs.* not using fans. Distinguished decrease on the SOA masses was found when the fans was not used, confirming the heating effect on SOA formation inside the PAM-OFR, as shown in the following:

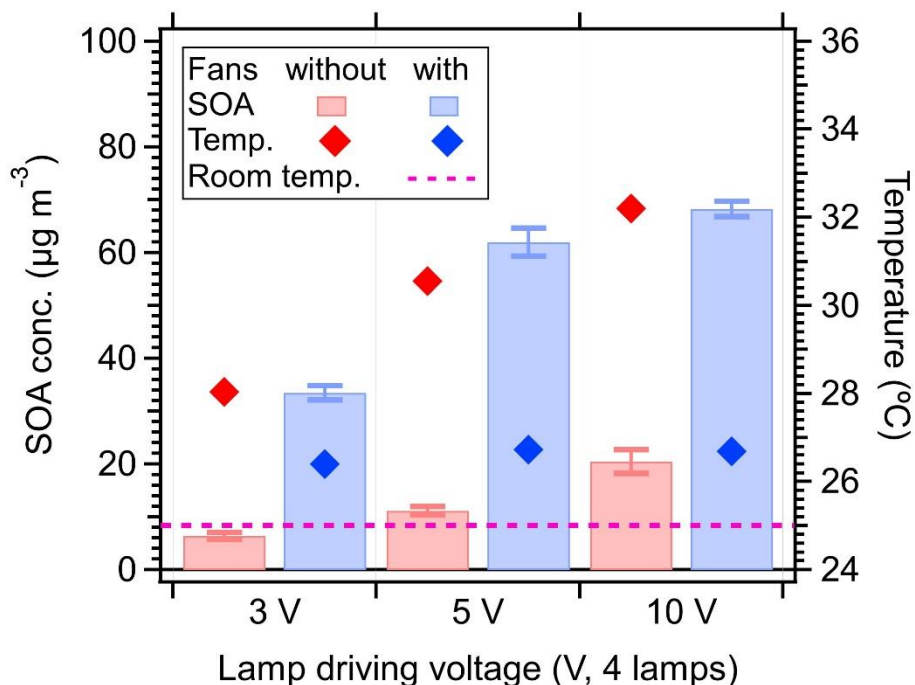


Figure S19. The SOA formation from benzene and OH radicals in the PAM-OFR as a function of light intensity. Two cases including PAM-OFR was blown with fans and without fans were both shown. The room temperature and temperature

measured with the primary Temp&RH sensor set in the back panel were shown in the right axis. Note the OFR temperature reported here is the lower limit as discussed in section 3.1.5. The gas-phase benzene (99.80%, Sigma-Aldrich) was generated with syringe pumps. Benzene was used as gas-phase precursor in this experiment due to its lower k_{OH} , since benzene will not be totally consumed under the high OH exposure at high voltage settings in OFR. The flow rate in this experiment was 4.5 L min^{-1} , and the RH was $\sim 30\%$.

The explanation was also added in the revised miantext:

“To confirm the model results, we did a simple laboratory experiment and found the formed SOA masses was indeed substantially decreased in OFR due to the heating effect (Fig. S19), which is consistent with the simulated model results.”

R2.5: Line 573: “decreased” not “deceased” I would say.

A2.5 We have corrected the typo.

R2.6: Line 585: one bracket is redundant.

A2.6 We have deleted the left bracket.