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 #1

General Comments

The manuscript by Pan et al. investigates the impact of lamp-induced heating in an Aerodyne PAM-OFR, assessing the temperature distribution, flow dynamics, and chemical consequences resulting from UV lamp heating. The authors have used CFD simulation, KinSim kinetic model, and SOM model to investigate how the temperature affects the flow and average OH exposure and how the enhanced temperature impacts the chemistry of gas-phase reactions and SOA formation. They find that the temperature enhancement can be up to 15 °C and it has impacts on the gas-phase chemistry and the yield, size, and oxidation levels of SOA. Overall, this manuscript gives a relatively comprehensive evaluation of the increased temperature on the chemical processes in the PAM-OFR. However, some concerns need to be addressed before the manuscript can be considered for publication in AMT.

Major Specific Comments

R1.1: The authors find that the heating inside PAM-OFR is mainly from the heat transfer of the hot quartz sleeve (heated by the lamps) but not from the optical radiation. This is true since UV radiation generates little heat. Based on this finding, I would expect that the authors recommend moving the lamps out of the reactor, which can overcome the heating issue caused by the lamps. This can be found in the design of other OFRs in previous studies (e.g., Huang et al., Atmos. Meas. Tech., 10, 839–867, 2017; Simonen et al., Atmos. Meas. Tech., 10, 1519–1537, 2017; Li et al., Atmos. Chem. Phys., 19, 9715–9731, 2019) and should be discussed in "Section 3.5 Approaches to reduce the heating effect".

A1.1: We agree with that moving the lamps out of the reactor will help reduce the temperature increase. However, we do not think this method can overcome the heating issue. For examples, additional cooling methods were also applied for OFRs with UV lamps mounted outside. e.g., Huang et al. (2017) used circulating water to cool down the system; Li et al. (2019) used 30 L min^{-1} N_2 through the quartz tubes; Four fans were used to dissipate the heat in Xu and Collins (2021); The temperature increase of the tube wall could be 8 °C inside the Go:PAM when the intensity of UV lamps was maximum and the fan was turned on (Watne et al., 2018).

Following the reviewer's suggestions, we declare that moving the UV lamps outside of OFR is a method to mitigate the heating issue.

"**Moving the UV lamps outside the tube and designing a cooling system on the outer surface of OFR with circulating water or cold air can also be effective ways to improve the temperature control inside of OFR (Watne et al., 2018; Xu and Collins, 2021; Huang et al., 2017; Liu et al., 2018; Chu et al., 2016; Zhao et al., 2021; Li et al., 2019), however, these will require a substantial redesign of the hardware of OFR tubes and are beyond the scope of this manuscript. And mounting the lamps outside of the OFR limits the use of OFR185 mode due to the low transmission efficiency of quartz glass for light at 185 nm (Simonen et al., 2017) and OFR254 mode is usually used.**"

R1.2: The authors use the SOM model to investigate the influence of temperature on SOA formation, which highly relies on the performance of the model under different temperatures. It would be helpful to conduct SOA formation experiments with different temperatures to get accurate decreases in SOA yield under high temperatures. This comparison can be done with or without efficient heat removal methods including a high volume of N2 purge air and external fans as the authors have shown in the manuscript.

A1.2: Thanks for reviewer's suggestions. We have incorporated these suggestions and did two experiments to prove that the SOA formation in the OFR was indeed decreased when the lights were on, as shown in Fig. S19 the revised manuscript. However, we cannot calculate the yield due to the PTR-MS which can be used to measure the VOCs mass concentration was broken in recent several months and still in repairing. Thus, we cannot compare the measured results with the SOM model simulation. More experiments will be done in the future.
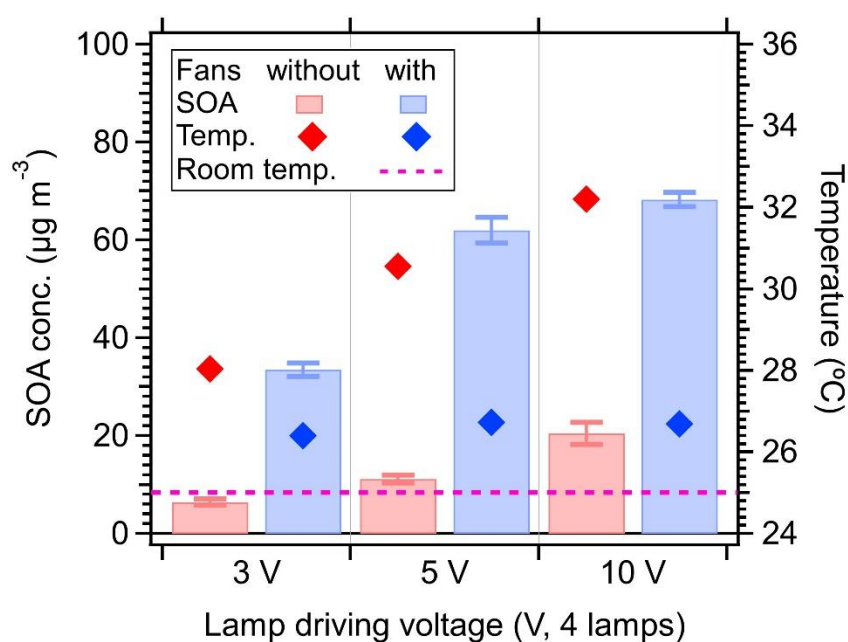

Figure S19. The SOA formation from benzene and OH radicals in the PAM-OFR as a function of light intensity. Two cases including PAM-OFR was blown with fans and without fans were both shown. The room temperature and temperature measured with the primary Temp&RH sensor set in the back panel were shown 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 ~30%.

The explanation was also added in the revised mian text:

"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."

R1.3: Similarly, SOA formation experiments with different voltage setting strategies need to be added in Section 3.5 to show the effectiveness.

A1.3: The SOA formation experiment between benzene and OH radicals was done to prove the effectiveness of the cooling method. The detailed results can be found in A1.2.

R1.4: The high temperature also leads to lower RH. How would this influence the SOA formation?

A1.4: Thanks for reviewer's question. Higher temperature indeed led to lower RH due to the increased dew points. The literatures have suggested that although some studies have found that the variations of RH can influence the SOA formation, the influences were complex and in conflict. To reflect the question by the reviewer, we added the statement in the main text:

Line 598-606: "**In addition to the direct influences, the increase of temperature within OFR lead to the decreases of the relative humidity (RH), which can also impact SOA formation. However, the literatures show that the impact of RH on SOA formation remains inconclusive. For example, Tillmann et al. (2010) found the SOA yield was higher at humid conditions (RH: 40-70%) compared to dry conditions (RH: 0-10%) as the RH influenced the formation of products in α-pinene ozonolysis experiments. In contrast, Zhang et al. (2019) found the SOA yield of m-xylene-OH oxidation decreased as RH increased in a chamber study, as the high RH led to the less formation of oligomers and inhibited the reaction of RO$_2$ autoxidation. Thus, elucidating the influence of humidity on various SOA**

formations is still a challenge and falls outside the purview of our research topic here. In addition, given the short residence time within OFR (seconds to minutes), the impact of liquid phase reactions to SOA formation in OFR should be minimal."

R1.5: It is confusing when comparing Figure 3 and Figure 6b. (1) The horizontal distance is >400 mm in Fig. 3 but <200 mm in Fig. 6b. (2) The temperature shows a monotonic increasing trend from the inlet to the outlet in Fig. 3 but a minimum in the middle in Fig. 6b. Can the authors further explain the differences?

A1.5: To clarity, we added an illustration of vertical direction, horizontal direction, and probing direction (depth) in Fig. 1(b), as shown below. The horizontal and vertical directions formed a plane perpendicular to the probing direction (depth);

For the question (1), the x-axis in Fig. 3 was the probing depth from the inlet to outlet in the probing direction (460 mm in total, as shown in Fig. 1a). The x-axis of Fig. 6b shows the horizontal distance in horizontal direction (Fig. 6b). For the question (2), the x-axis of the two graphs did not indicate the same position. In Fig.3, all the temperatures were measured at the center line (the horizontal distance was at 0 mm) from the inlet to outlet in the probing direction. These positions were the same as the markers with a horizontal distance of 0 mm in Figure 6b, where a lower temperature at 100 mm were also shown.
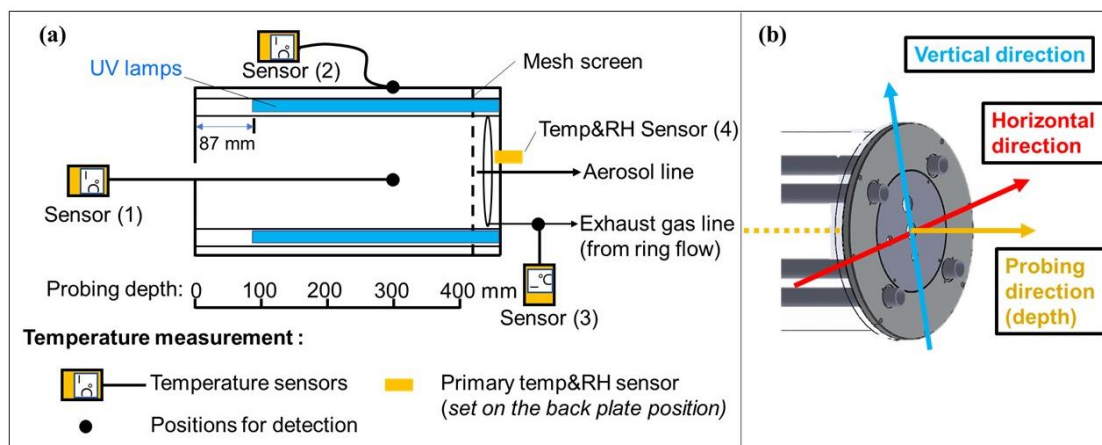

Figure 1: (a) Schematic plot for temperature measurement in the oxidation flow reactor of this study and (b) directions for temperature measurement. The center inlet, nut, and mesh screen near the front plate were removed when the temperature sensor was probed in the front direction. The information of different

temperature sensors used can be found in Table S1.

R1.6: Although PAM-OFR is the most commonly used OFR, there are many other types of OFRs. For other OFRs that put lamps outside of the reactor (like the ones listed above), the heating issue is not as serious as PAM-OFR. Using the terminology "OFR" in the Conclusion may lead to misunderstanding. Therefore, I would suggest the authors use the terminology "PAM-OFR" rather than "OFR" throughout the manuscript.

A1.6: We replaced the "OFR" with "PAM-OFR" in the manuscript when the PAM-OFR was specifically referred to. This revision certainly makes our statements more rigorous.

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 NOx condition and ~14% under low NOx 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 NOx) and ~10% (low NOx) 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 NOx condition and 10% under low NOx compared to the results with RTD measured at 25 °C (Fig. 10).**"
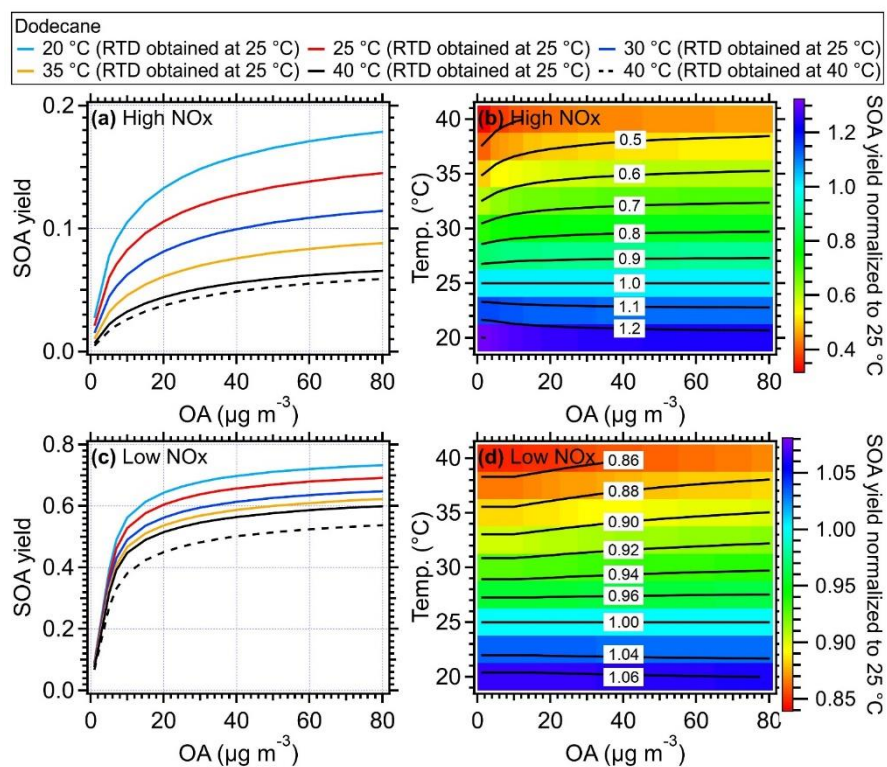

Figure 10: Simulated SOA yield of dodecane as a function of mass concentration of organic aerosol and temperature within the OFR under (a) high NOx and (c) low NOx conditions, respectively. The simulated results using the measured RTD obtained at 40 °C were shown as black dashed lines. The ratio of SOA yield of dodecane from different temperatures compared to that of 25 °C under (b) high NOx and (d) low NOx 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 NOx 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 NOx conditions by the ratios of RO_2 reacted with NO or HO_2. Based on the definition in the most experiments studies, r(RO_2+NO)/r(RO_2+HO_2) > 1 represents the high NOx condition (Peng and Jimenez, 2017). However, in the SOM model, the reaction under low/high NOx 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 NOx 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 NOx 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:
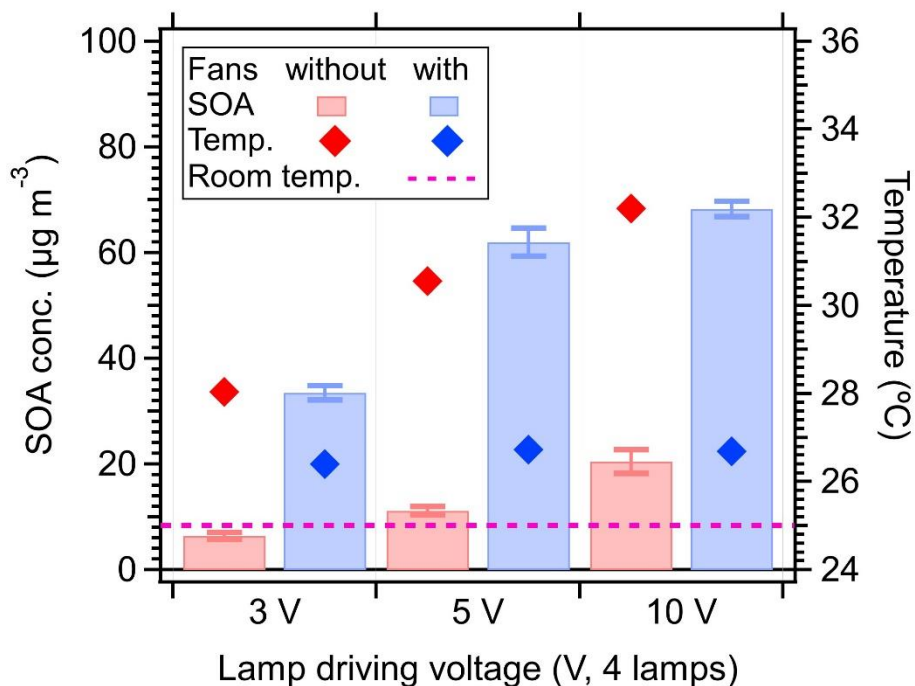
Figure S19. The SOA formation from benzene and OH radicals in the PAM-OFR as a function of light intensity. Two cases including PAM-OFR was blown with fans and without fans were both shown. The room temperature and temperature measured with the primary Temp&RH sensor set in the back panel were shown 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 ~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.

Anonymous Referee #3

General Comments

Tianle Pan et al. present a study on the influence of the heating effect of oxidation flow reactor (OFR) UV lamps on oxidant chemistry, flow conditions and secondary organic aerosol (SOA) formation. The authors find that while the increase in temperature does not greatly affect the oxidant chemistry, the effect of temperature gradient on residence time distribution shortens the mean residence time. Thus, the OH exposure at higher light intensities is affected by the heating effect. The temperature increase in the OFR influences the SOA yields and composition, so that the SOA yield is lower at higher temperatures and the O to C ratio of SOA is higher at higher temperatures.

The heat caused by the OFR lamps is an important aspect of OFR studies that has not been well characterized earlier. The measurements and analysis in this study are comprehensive and thoroughly done. However, the quality of reporting and language is not fully adequate. Another concern is the relevance of the SOM model for the SOA formation in the OFR. Thus, I recommend publishing this study in Atmospheric Measurement Techniques, but only after the following remarks have been addressed. Especially the language needs to be improved.

Major Specific Comments

R3.1: The reporting should be concise, and all statements should be well-defined and unambiguous. Currently, the text contains unnecessary extra words (like 'around', 'might'), which are sometimes necessary but could be mostly removed. The authors often use word 'support', which in many places could be replaced by a more exact wording. Furthermore, for many sentences in Section 3 it is unclear what the authors actually mean. Some of these are included in the following specific comments, but I recommend the authors read through the paper and for each sentence ponder whether the sentence is necessary, and whether the statement is unambiguous.

A3.1: We appreciated the reviewer's suggestions and comments. We carefully examined the manuscript sentence by sentence and revised the whole manuscript

thoroughly. As shown in the tracked version of the manuscript, most of the sentences (>70%) were carefully revised. Here are some examples:

(1) Line 399-401: "**This <u>indicated that</u> the primary T/RH sensor in the backplate with default OFR settings <u>lead</u> to underestimation of the temperature inside of OFR, which should be verified and corrected by the users based on the configuration of their instrument.**" We replaced "<u>suggests</u>" with "<u>indicated that</u>" and "<u>might lead</u>" with "<u>lead</u>"

(2) Line 243-245: "**These results <u>indicated</u> that the temperature increase inside of the PAM-OFR was mainly due to the heat from the lamps, which was further <u>confirmed</u> by Fig. 3b**". We replaced "<u>supported</u>" with "<u>indicated</u>" and "<u>confirmed</u>".

(3) Line 255: "a**ssuming a mixing water ratio of <u>1.88%</u>**" and Line 255: "**assuming ambient OH concentration of <u>1.5x10^6</u> molecules cm^{-3}**". We deleted "<u>around</u>" before "<u>1.88%</u>" and "<u>1.5 x10^6</u>".

(4) Line 271-273: We modified "**This inconsistency is mainly due to the lamps starting at 10 V with colder conditions (e.g., room temperatures or lower voltage settings), meanwhile, the OFR reactor has a thermal mass that needs time to accumulate or dissipate heat.**" to "**This discrepancy was primarily attributed to the fact that the lamps were initiated at 10 V under cooler conditions (e.g., room temperatures or lower voltage settings), while the OFR reactor had a thermal mass that required time to accumulate or dissipate heat.**"

(5) Line 629: "**cold air <u>can</u> also be effective ways**". We replaced "<u>might</u>" with "<u>can</u>".

R3.2(a): It is unclear why the authors used the ring flow manifold in RTD measurements when it was not used in the simulations. In my opinion, this is justified since the ring flow is typically used in actual measurements. However, the authors could discuss this justification when they describe the RTD measurement and simulation. This difference between measurement and simulation should also be mentioned in Fig. 8 caption.

A3.2(a): Thanks for reviewer's comments. Previously, we measured the RTD by

sampling through ring flow. Then, we also realized that the simulation and measured results shall use the same flow set. When we submitted our manuscript to AMTD, the measured RTD results were already updated to these measured by sampling only from aerosol line at 5 L min^{-1}. However, we forgot to change the discussion. Thus, the modelled and measured RTD shown in Fig. 8 shall be consistent with each other. The sentence of "**This inconsistency is probably because i) we only considered the airflow sampled from the center outlet in the backplate, but not the ring flow manifold, which caused more recirculation**" was deleted.

R3.2(b): In addition, I think the description of RTD measurement (p. 13, l. 412-415) should be moved to Section 2.

A3.2(b): Yes, we moved the description for the RTD measurement to Sec. 2.

"In addition to the temperature measurement in OFR, we measured the residence time distribution (RTD) at different voltages to explore the effect of temperature on RTD. Specifically, we first turned on the lights to make the temperature stable. Then, a 2 s pulse of 50 ppm SO$_2$ was injected into a 5 L min^{-1} carrier gas (N$_2$) with RH <10%. N$_2$ was selected as the carrier gas to prevent the reaction between SO$_2$ and the generated oxidant when UV lamps were turned on. We measured the RTD with lamp driving voltage set at 0 V, 5 V and 10 V. Note that we only used the outlet for aerosol line for sampling (5 L min^{-1}) during the RTD measurement for better comparison with simulation results in Sec. 2.3."

R3.2(c): What were the flow rates in aerosol line and exhaust line during RTD or temperature measurements? The authors provide the flow rates in different occasions, but it is not clear whether this is the total flow rate (aerosol line + exhaust line) and what is the ratio between the aerosol line and exhaust line.

A3.2(c): Most of the time, sampling through the exhaust line was used for the temperature experiments. However, the ratio between aerosol line and exhaust line shall play very minor impact on the absolute temperature enhancement measured in side of OFR. We clarify the flow sampling strategy in the maintext: "**Most of the temperature**

experiments were done with sampling exhaust line from the ring flow.". For the RTD experiment, the flow sampled from the aerosol lines was displayed in Fig. 8. We clarify this in the main text "**Note that we only used the outlet for aerosol line for sampling (5 L min$^{-1)}$ during the RTD measurement for better comparison with simulation results in Sec. 2.3.**"

R3.3: The authors use term 'Enhanced temp.' in figures to describe the difference between OFR and ambient temperature. In my opinion, e.g. 'Temp. enhancement' or just ΔT would be better.

A3.3 We replaced all the 'Enhanced temp.' with $\Delta T_{(OFR-amb.)}$ in the figures in the revised manuscript.

R3.4: When discussing the approaches to reduce the heating effect in Sect. 3.5, the authors actually only discuss approaches to reduce the effect of increased temperature. For example, when the fans are used to cool down the OFR external surface, the heat transfer inside the OFR is improved and this affects the RTD since the heat transfer occurs via convection. However, the authors did not characterize the effect of different cooling methods on the RTD, which at least should be mentioned in this section or the section headline should be changed.

A3.4: We appreciated the reviewer's reminding. This is a really good point. Corresponding explanation about the potential influence on RTD was added in this section. **"Cooling down the OFR would also affect RTD since the heater transfer occurs via convection inside of OFR, which needs to be further investigated in the future."**

R3.5: The authors sometimes mix past and present tense. See e.g. Fig. 3 caption: four lamps were turned on, flow rate is 5 lpm.

A3.5: We examined all the tenses used in the text and made corresponding corrections. All the revisions can be seen in the tracked version of manuscript.

R3.6: Based on the current description of the SOM model, it seems that the authors first

model the SOA formation in "normal" temperature and then study its evaporation in elevated temperature (e.g. p. 17, l. 494: "for the newly formed SOA in the OFR, the temperature impact was simulated based on SOM model"). In that case, what is the temperature where the SOA formation is modeled? If this is the case, the model results regarding e.g. the SOA yield are not very relevant, because in the OFR the SOA formation would take place in the elevated temperature.

The authors should change the heading of Section 3.4 to "Temperature influence on OA evaporation", and describe more clearly that they are modeling the evaporation of SOA that was formed in temperature X and then injected into the OFR at elevated temperature. This needs rewriting of Sect. 3.4 so that the authors discuss OA evaporation instead of SOA formation.

A3.6: I think there is a misunderstanding. The OA evaporation and SOA formation are two separate topics in our discussions. We simulate the SOA formation using SOM under different temperatures directly. No OA seed was considered. To clarify, we separate the original section 3.4 into two sections, which is "**3.4 Temperature influence on the evaporation of ambient OA**" and "**3.5 Temperature influence on the SOA formation**".

Corresponding explanations were added in the section 3.4: "**Here, we estimated the potential losses of input ambient OA due to evaporation under enhanced temperature in OFR. This estimation is mainly based on literature results and modeling work.**"

Specific comments

R3.7: p. 1 l. 44: box model using radical chemistry → radical chemistry box model
A3.7: Corrected

R3.8: p. 2 l. 82: The high temperature inside the OFR does not cause the recirculating flows, it is the temperature gradient caused by lamp heating.
A3.8: Corrected

R3.9: p. 3 l. 88: SOA simulation and study → SOA simulations and studies

A3.9: Corrected

R3.10: p.3 l. 102: The acronym ARI has not been declared earlier.

A3.10: We added the definition in line 101: "**The PAM-OFR (Aerodyne Research, Inc., abbreviated as ARI) used in this study…**"

R3.11: p. 4, Fig. 1: What is the exhaust gas line? It seems that sensor (3) is measuring the ring flow outlet, but in the text it is unclear whether the exhaust gas means the ring flow or the N2 purge flow. Please clarify.

A3.11: The exhaust gas line means the ring flow. We added the explanation in line 336 and specify the exhaust gas line come out from ring flow in Fig.1:

Line 338: "The dissipation of energy through the exhaust air **(from the ring flow) from the PAM-OFR**"
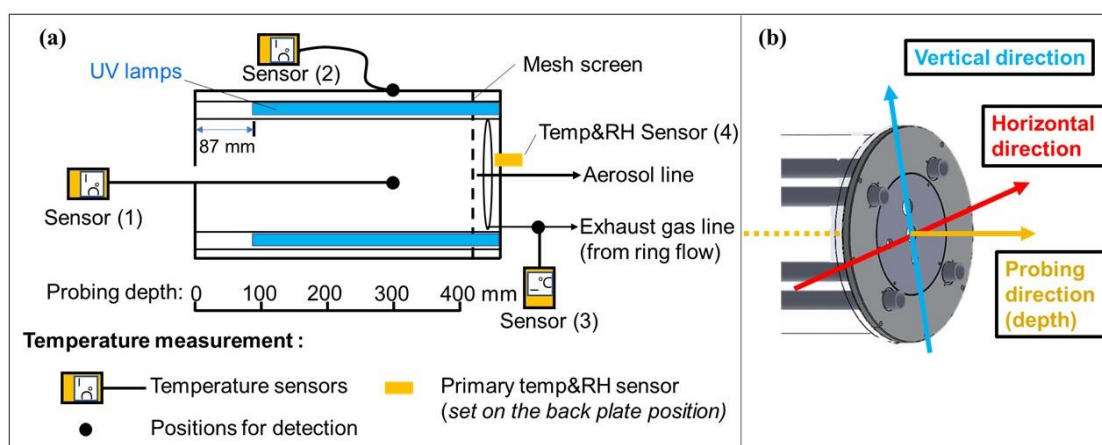

Figure 1: (a) Schematic plot for temperature measurement in the oxidation flow reactor of this study and (b) directions for temperature measurement. The center inlet, nut, and mesh screen near the front plate were removed when the temperature sensor was probed in the front direction. The information of different temperature sensors used can be found in Table S1.

R3.12: p. 7 Fig. 2 caption: "assuming ambient OH concentrations are around 1.5e6..." I suppose you have used an exact value of 1.5e6 in the calculations, so please remove the word 'around' (also earlier regarding the water mixing ratio).

A3.12: We removed the 'around' in the caption of Fig.2. And we modified the expression in line 238 for mixing ratio: "**(assuming the water mixing ratio is**

1.88%, RH=60%, external OH reactivity=30 s^{-1}).”

R3.13: p. 10 l. 296: “In our case, the...” → “In our case, when the...”

A3.13: Corrected

R3.14: p. 10 l. 298: What is “vertical axial direction”? I think axial would mean the direction of the central axis of rotation. It would be helpful to define the different directional terms (vertical, horizontal, probing depth) graphically e.g. by adding another panel in Fig. 1.

A3.14: Following reviewer's suggestions, we defined the direction of measurement in Fig. 1b and modified the text in line 126-128: “**Briefly, we measured the air temperature inside PAM-OFR at varied positions (vertical and horizontal directions, as well as different depths from inlet (Fig. 1b)) under different lamp configurations (e.g., number of lamps, types of lamps, intensity of lamps) and flow rates**.”
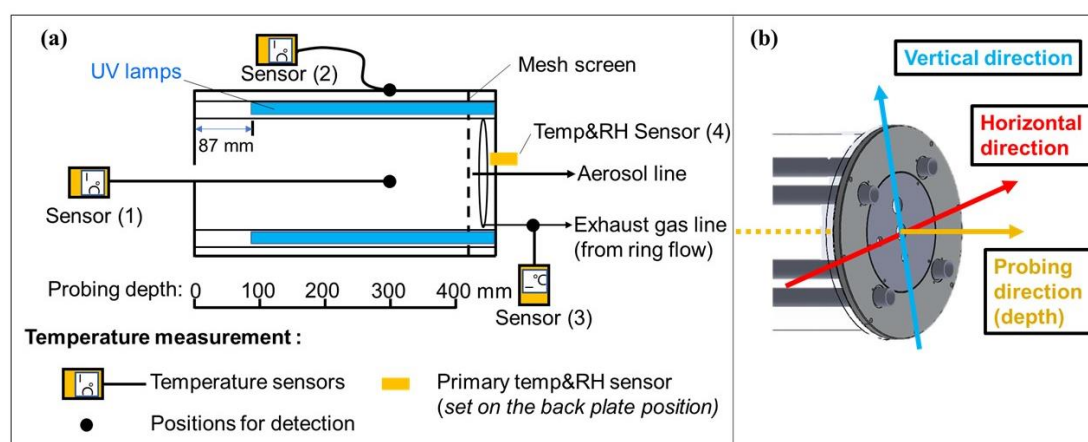

Figure 1: (a) Schematic plot for temperature measurement in the oxidation flow reactor of this study and (b) directions for temperature measurement. The center inlet, nut, and mesh screen near the front plate were removed when the temperature sensor was probed in the front direction. The information of different temperature sensors used can be found in Table S1.

R3.15: p. 11 l. 319: “OFR chambers (OFR metal tubes)” → “OFR surface”

A3.15: We replaced the “OFR chambers (OFR metal tubes)” with “OFR surface”.

R3.16: p. 11 l. 331: surfaces → surface

A3.16: Corrected.

R3.17: p. 11 l. 333-339: The authors discuss in length why the temperature of the external surface is lower than that of the gas inside the reactor, while it is basic physics that since the OFR is not isolated and the ambient temperature is lower than the OFR internal temperature, there will be heat transfer from inside the OFR to the ambient, and the medium between these (the surface) will be at lower temperature than the OFR internals. This is correctly described in lines 338-339. The thermal mass of the OFR is not relevant, as it affects only the rate of temperature increase but not the final equilibrium temperature that is discussed here.

A3.17: We agree with the reviewer's comments on balanced condition. However, when the temperature equilibrium between OFR tube and air was not balanced, the thermal mass would be a reason as well. To reflect that we move the original cause "ii" (heating transfer) to be cause "i". Then explain the original cause "i" only work when the thermal system was not balanced.

"ii) When the temperature equilibrium between the air and OFR was not balanced, an additional reason will cause the lower temperature in OFR tube. The aluminum OFR chamber has a higher thermal mass than the air. Although the specific heat capacity of metal (0.908 J g^{-1} K^{-1} at 301.60 K) is similar to that of air (1.005 J g^{-1} K^{-1} at 300 K) (Giauque and Meads, 2002; Kieffer, 1956), the flow tube is considerably heavier than the air due to its significantly higher density (2700 Kg m^{-3} vs 1.29 Kg m^{-3}), resulting in a lower temperature for the OFR tube than the inner air."

Reference

Cappa, C. D., Jathar, S. H., Kleeman, M. J., Docherty, K. S., Jimenez, J. L., Seinfeld, J. H., and Wexler, A. S.: Simulating secondary organic aerosol in a regional air quality model using the statistical oxidation model – Part 2: Assessing the influence of vapor wall losses, Atmospheric Chemistry and Physics, 16, 3041-3059, https://doi.org/10.5194/acp-16-3041-2016, 2016.

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