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Comment on acp-2020-1214

Anonymous Referee #1

Referee comment on "Kinetics and impacting factors of HO_2 uptake onto submicron atmospheric aerosols during the 2019 Air QUAlity Study (AQUAS) in Yokohama, Japan " by Jun Zhou et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-1214-RC2, 2021

The authors present in situ measurements of HO2 reactivity, using an aerosol concentrator and filter to assess specifically the contribution of HO2 uptake to aerosol particles. The authors use simultaneous observations of aerosol composition and surface area to derive an HO2 reaction probability and assess drivers of the variability thereof. This is a nice experiment, and the results are well described and placed in context of previous work. I recommend publicaiton after the authors have addressed some minor comments below.

1) Deatils on the VACES: The authors should more clearly describe in the main manuscript (not just the SI) the size distribution of aerosol in the reactor as determined by the VACES. Provide mean radius, geometric standard deviation, and ideally compare composition of post VACES aerosol to ambient aerosol measurements. The issue is to what extent is the VACES alterning the particle sizes and types in the reactor compared to the ambient.

2) Neglect of gas-phase diffusion corrections to the determination of the reaction probability seems problematic. My recollection is that limitations are significant (greater than 10%) for gamma > 0.1 and particle sizes > 0.5 micron. It is hard to know from what is provided in the main manuscript whether this issue is dealt with adequately.

3) I appreciate the authors providing the 25th and 75th percentile gamma values, but then state the gamma was 0.33 "on average". Was this the mean, or the median? I would suggest given the variability that the median be reported instead of the mean.

4) I would like to see a deeper assessment of uncertainty at low surface areas and small particles. The derived ka is likely a small number from the difference of two large numbers with uncertainties due to precision and systematic variability given that a filter must be used serially at a different time to determine ka. The trend towards higher gammas with

low surface area and small particles is at best more uncertain and possibly somewhat artificial if a) negative ka are excluded from the analysis, or b) a small positive ka is divided by a smaller surface area, leading to a bigger gamma, but which isn't robust due to uncertainty (instrumental error).

As it is, the measured gamma time series is extremely noisy - noisier than the aerosol mass (surface area) and composition measured by the AMS. Some discussion of the different variability in these quantities is warranted and possibly provide shading that indicates the absolute error of each measurement.

5) Given the lack of size information given in the main paper, it was difficult to assess the role of particle composition, particular the role of sea spray as contribtors to surface area, but not measured mass composition (the AMS will not measure sea salt). Thus, this could bias gamma's high if sea salt is unmeasured, or the SMPS do not scan high enough, etc.