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Atmospheric Measurement Techniques Discussions

Interactive comment on "An in-situ flow-tube system for direct measurement of N_2O_5 heterogeneous uptake coefficients in polluted environments" *by* Weihao Wang et al.

Anonymous Referee #2

Received and published: 2 August 2018

General Comments The authors propose a new variation of the N2O5 reactivity measurement introduced by Bertram et al in 2009. Specifically, the authors utilize an iterative box model coupled with measurements of NO, NO2, and O3 to compute the loss rate of N2O5 in the flow reactor when high and variable concentrations of NO, NO2, and O3 complicate the retrieval of N2O5 uptake coefficients. The paper is suitable for publication following the authors attention to the comments below:

1) I strongly encourage the authors to show results of laboratory tests on a model aerosol (e.g., NaCl or (NH4)2SO4) with varying inlet concentrations of NO, NO2, and O3 as this will cement the uncertainty analysis and the retrieval of N2O5 uptake co-

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efficients that are reported here. 2) Often, NO3 reactivity can be dominated by VOCs (e.g., isoprene)? If these VOCs are not measured, their effects on N2O5 uptake would not be captured by the model. Discussion of the potential effects should be included.

Specific Comments: Page 2 Line 4: The units do not cancel when representing C in m/s and Sa in um2/cm3. Either remove the units or place all in common units m2/m3 for surface area.

Page 2 Line 9: What is a “pure” or “synthetic” aerosol? I would replace with model aerosol compounds based on the references cited.

Page 2 Line 27: The flow tube of Bertram et al was deployed to sites in Boulder, CO and Seattle, WA, and La Jolla, CA. I would not characterize any of these sites as rural, based on local NOx concentrations.

Page 4 Section 2.2: What is the concentration of NO2 and O3 in the flow tube?

Page 4 Section 2.3: Please confirm that surface area was measured at same RH of the flow tube. Also, was RH measured in the flow tube?

Section 3: The RTD by definition is a distribution of residence times. The shape of this distribution can bias the retrieved N2O5 uptake coefficients. If the distribution is normal, I would expect use of the mean residence time to be appropriate. If the distribution is not normally distributed, then the tails of the distribution can impact the retrieval of the N2O5 uptake coefficient. The authors site a mean of 149 +/-2, but that does not capture the distribution in residence time. Error induced by having a distribution of reaction times should be discussed in more detail here. I expect that this factor alone will carry uncertainty that is larger than the 9-17% cited in the abstract.

Section 5: The propagation of errors and calculation of the overall uncertainty from the Monte Carlo method is interesting. It should be clearly stated that the uncertainty is a strong function of Sa. The number cited are for 1000 um2/cm3, for delta RH (aerosol on vs off) of less than 1% and for a specific delta in NO3 reactivity (0.01 s-1, between

aerosol on and off). This should be cast in terms of an equivalent [NO].

Page 9 Line 11: The retrieval of the N2O5 uptake coefficient is sensitive to a difference in NO3 reactivity between the aerosol on and off states. It would be helpful if the authors also stated how the difference in NO concentration between the on and off states impacted the retrieval.

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