Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2019-1039-RC1, 2020

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Heterogeneous N_2O_5 reactions on atmospheric aerosols at four Chinese sites: Improving model representation of uptake parameters" *by* Chuan Yu et al.

Anonymous Referee #1

Received and published: 2 January 2020

The authors present new measurements of the N2O5 uptake coefficient from field measurements in China. The additional measurements are of great value to the ongoing interpretation of N2O5 heterogeneous chemistry. The manuscript is well written and should be published following the authors attention to the following details:

Line 78: It would be helpful to clarify what "rural" refers to. If this is meant to denote a chemical regime, it would be helpful to classify by chemical composition (e.g., PM2.5, NOx, O3, CO, etc).

Lines 92 – 121: A reference to the original work of Bertram et al should be included here as the design and sampling approach appear to very closely replicate the tech-

Printer-friendly version

Discussion paper

nique described in Bertram et al., AMT 2009. Also, the uncertainty is a function of the surface area and RH, I find it nearly impossible that the uncertainty ranges only between 37-40% for the range of atmospheric conditions sampled. If this is correct, more discussion should be included.

Line 156: It is not clear how the uptake coefficient at 50M H2O which is essentially pure water is significantly larger than 0.03 (that measured for pure water in the laboratory). The authors should provide some discussion for how the 'measured' uptake coefficients are exceeding the rate for N2O5 with pure water? The limit observed in Hallquist, Thornton, ad Bertram and Thornton (all laboratory studies) correspond to reaching the upper limit of N2O5 uptake to pure water.

Line 158: Linear not liner.

Line 180: Correct use of the Bertram and Thornton parameterization involves calculating the aerosol water content for both the organic and inorganic components. Also, something doesn't seem to add up in the parameterization of the uptake coefficient. What value for V/S and KH were used and what temperature was this run at? It was my understanding that the parameterization could not exceed 0.03 based on the hydrolysis rate and henry's law coefficient used in the parameterization.

A note on empirical parameterizations: I think there is an opportunity to use field measurements to tune mechanistic parametrizations. Although, it seems unlikely that field measurements will do a better job than laboratory measurements at constraining rate coefficients or ratios of rate coefficients for the inorganic reactions. Laboratory experiments are designed to do this, using targeted simple 1-2 component systems and 1000x the aerosol surface area. I would expect the real power is looking at the variability in the hydrolysis rate or henry's law terms that are required to match the measurements with the models. This is where the complexity of the atmospheric aerosol will cause issues in laboratory parameterizations.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2019-1039,

2019.