**Atmospheric
Chemistry
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Discussions

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Interactive comment on "Heterogeneous reaction of N$_2$O$_5$ with illite and Arizona Test Dust particles" *by* M. J. Tang et al.

Anonymous Referee #2

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Overall

This paper presents laboratory measurements of the reactive uptake coefficient of N2O5 on mineral dust particles, which is important for understanding the NOx removal rate and evaluating its impacts. Comparison of the N2O5 uptake coefficient of two kinds of mineral dust particles shows that illite has much larger coefficient than Arizona Test Dust (ATD) particles and has stronger dependence on RH, which may be explained by the difference in chemical composition of illite and ATD. The paper is generally well written and the interpretation is plausible. I suggest publication on ACP after the following comments are addressed.

Specific comments

1. In the abstract, it is stated that the uptake coefficient of ATD is independent on RH. This is not what shows in Figure 6. For ATD, it is clear that the uptake coefficients at RH = 0 and RH = 30% are 1.5 times (Table 1) larger than the coefficient at RH = 50% and RH = 70%. I believe a statistical test (T-test) will result in significant difference between them at 95% confidence level. The measurement at 20% is lower than those at RH = 0 and RH = 30% but has the largest uncertainty, so could that measurement be an outlier? A related question is that it is not clear how many repeated experiments were conducted at each RH and, how are the error bars calculated in Figure 6?

In comparison, for illite, the uptake coefficients at RH = 0 and RH = 20% are 2.3 times greater than the coefficient at RH = 70%. Therefore, a more accurate way to present the difference is "the uptake coefficient of ATD has a weaker dependence than that of illite".

2. The uptake coefficient of illite does not decrease until RH > 20%, whereas the ratio of the mass of absorbed water to the mass of illite increased significantly for RH of 0-20%. This does not support the explanation that the adsorbed water "deactivates" the reactivity of illite. More interpretation is needed.

3. An interesting point for Figure 6 is that the uptake coefficient of ATD starts to decrease when RH > 30%, while the uptake coefficient of illite starts to decrease for RH > 20% – there seems to be some threshold of the RH dependence, which is worth mentioning.

4. A minor point is to label the two panels of Figure 6 as (a) and (b).

5. On P24867, it says quartz does not have surface OH. In fact, quartz has surface OH, and that explains the dependence of uptake coefficient on RH for ATD. The low hygroscopicity of ATD can account for its weaker dependence on RH.

6. In Figure 3, it is better to show surface area concentration, which is a more related parameter than number concentration.

7. P24864, Line 17, the formula of the slope shouldn't include Nd.

8. P24866, L6-7, "decreased by a factor of 2-3 as RH was increased from 0 to 67%." Again, there is no decrease in uptake coefficient between RH = 0 and RH = 20% for illite.

9. P24866, Line 10 – 14, "One possible explanation for the decrease in (N2O5) with increasing RH is the competitive adsorption between H2O and N2O5, whereby the increased coverage of H2O at high RH may result in blocking of particularly reactive surface sites, which are then unavailable for N2O5 uptake, yet have insufficient water to support solvation/ionization of N2O5 to NO2 and NO3." I don't follow the reasoning here. How does increased coverage of H2O at high RH result in insufficient water? Please clarify.

Technical corrections

1. Abstract: ATD is not defined.

2. P24861, L18, "(Wagner et al., 2008)" -> Wagner et al. (2008)

3. P24864, L17, "According to Eqs. (2) and (3) The" -> "According to Eqs. (2) and (3), the"