

Interactive comment on “Deposition of dinitrogen pentoxide, N₂O₅, to the snowpack at high latitudes” by D. M. Huff et al.

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We thank Anonymous Referee #2 in comment C11326 for the constructive comments on the manuscript and specific comments regarding improvement of the manuscript. We are glad that our approach of verifying the gradient method via the use of the heat flux was appreciated by this reviewer.

We have made all the requested changes in the supplemental document; however, we felt a couple of the comments should be discussed here.

p25331, 1. 5 , R3 is is the total heterogeneous hydrolysis of N₂O₅ and is not yet divided into the subprocesses of R3a and R3b. We will clarify the wording in this section to specify aerosol uptake.

C14545

p25332, 1.3 Because we do not have measurements of the aerosol surface area, it is not possible to estimate the total uptake by aerosol to quantify the amount of the missing sink.

p25333, 1.5 We discuss the chloride (Cl-) pathway of reaction of N₂O₅ in aerosol and snowpack in p25331 lines 22-24. However, as the referee notes we don't have measurements of chloride in the snow so cannot really discuss it here. Clearly future work is needed with respect to halogen reactions of N₂O₅.

p. 25339, l. 18 The reviewer notes that: "The change in the N₂O₅ thermal decay lifetime for a 1C temperature change is ~12%. Could this temperature difference affect the N₂O₅ gradient and thus the flux of N₂O₅? Given that the temperature profile is positive, I would expect this to lead to an underestimate of the actual depositional flux. You may be able to estimate such an effect using a method similar to that described by (Wolfe et al., 2009) for PAN." While it is true that N₂O₅ decays faster at warm temperatures, the overall thermal decay lifetime of N₂O₅ is on the order of hours at these temperatures, so does not compete with the minute-timescale losses observed in this study. Additionally, we observe gradients in N₂O₅ even when the inversion strength is weak. As an example, see Fig. 3, Panel C, which shows a large gradient of N₂O₅ with nearly no temperature gradient.

We thank the reviewer for the helpful comments and are incorporating them into the revised document.

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