Atmos. Chem. Phys. Discuss., 14, C2034–C2036, 2014
www.atmos-chem-phys-discuss.net/14/C2034/2014/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Heterogeneous reaction of N_2O_5 with airborne TiO_2 particles and its implication for stratospheric particle injection" *by* M. J. Tang et al.

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Received and published: 2 May 2014

Dear Tang et.al.

Thank your for your contribution to ACP. Unfortunately one Referee did not submit a report in time, so I provide a quick review to substitute a report of one Referee.

The manuscript describes the uptake of N2O5 to TiO2 aerosol and the impact of this on stratospheric N2O5 and ozone budgets. Such studies are highly relevant and needed to understand the consequences of recently proposed approaches of solar-radiation management. The study is carefully done and analysed, conclusions are well justified

and limitations are highlighted. Even thought it is not a complete study, I accept this manuscript for publication in ACP after some minor changes.

There are three main aspects that I ask you to discuss in more detail: * Could you give more details on the humidity and temperature conditions in the stratosphere for the altitude that shows highest TiO2 concentrations after injection. This would help the reader to relate your experimental study to the relevant environmental conditions. I feel that currently the relevance of the experimental settings is addressed rather late in the manuscript and the reader keeps wondering why you did experiments at RT and whether or not the RH are appropriate for the stratosphere. * You nicely show and discuss the dependence of N2O5 uptake on relative humidity and conclude that the water at the TiO2 surface is relevant. Taken that temperature is lower in the stratosphere than at RT (where I assume the Goodman, 2001, data were derived); how would the water coverage look like at stratospheric temperatures; is that known? * What is the effect of N2O5 <→ NO3 +NO2 equilibrium on your results. Removing N2O5 by uptake might lead to re-formation from NO3 and NO2. Did you by-pass the 100°C reaction chamber occasionally to observe changes in NO2?

Further, I hope you'll find the following detailed comments helpful: P4424 l15ff: Reword: This implies a connection between low stratospheric ozone and decrease in surface temperature.

P4428, l 20 ff: Could you include some more details about the eperimental set-up such as concentration. What does "largely reduce NO2" mean exactly. P 4430 l10: Wagner described this synthesis first, didn't they? Could you add a reference?

P4433 l9: "The diâŮĘerence of kw measured before and after introducing TiO2 aerosols in the AFT was insignificant, indicating that the N2O5 wall loss did not change significantly during the uptake experiment." How much did it change usually, could you specify. P4433 l15. It is not clear what "true loss rate" means in this context, could you specify?

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P4433 l 18+19: Change to Author (year)

P 4433 l25: define gamma and gamma(eff) and gamma(exp)

P4437l10: Why "Another“?

P4439l24 I don’t understand this: ,“and this may be a result of an overestimate of surface area densities caused by extrapolation over the poles“

P4440l10: "Whilst we acknowledge that there are limitations to these simulations, most notably the inclusion of only a single heterogeneous process on the TiO2, but also due to factors such as the omission of the TiO2 aerosols from the photolysis calculation, webelieve the qualitative conclusions from them are valid." This sounds a little vague. Could your summarize why your belive this?

P4441l15: At what concentration did Molina 1997 study the uptake? Are those atmospherically relevant?

P4442: What is QBC?

P4445, Caption fig 4: could you add experimental settings?

Section 3.1 and 3.2: âĂć What is the surface coverage of N2O5 and of H2O? âĂć How important is the thermal N2O5 →NO2 equilibrium as source of uncertainties âĂć Did you observe NO2 upon N2O5 uptake, or do your data suggest that N2O5 is completely taken up (as 2 HNO3) by the aerosol? Did this depend on humidity?

Introduction or Discussion: Are there other important loss processes in the stratosphere, i.e. photolysis that might be changed by TiO2 (and the induced changes on radiation). Could you elaborate on this?

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 4421, 2014.