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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Multiphase modeling of nitrate photochemistry in the quasi-liquid layer (QLL): implications for NO_x release from the Arctic and coastal Antarctic snowpack" *by* C. S. Boxe and A. Saiz-Lopez

Anonymous Referee #1

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The manuscript of Boxe and Saiz-Lopez describes a multi-phase model used to investigate the chemistry of photochemically-derived NOx fluxes in Arctic and coastal Antarctic snowpacks. They use several parameterizations that can account for the differences in chemistry and transfer processes that will occur due to the presence of the quasi-liquid layer on snow/ice surfaces.

This paper is an appropriate contribution to Atmospheric Chemistry and Physics and discusses a timely topic in atmospheric heterogeneous chemistry. As our knowledge of ice/snow chemistry increases from both lab and field studies, it is important to reassess

models and incorporate the newest findings into atmospheric models. This manuscript describes a 1-D multiphase model that attempts to include parameterization for both chemistry within the quasi-liquid layer of ice and also the transfer of photochemically generated species out of the quasi-liquid layer to the overlying atmospheric boundary layer.

The introduction is well written and sufficiently detailed with appropriate, up-to-date references. The model is described in sufficient detail and the supplemental section gives the model reactions and rate constants used. The findings are supported by the model results and are compared to suitable literature reports of NOx fluxes in the Arctic and Antarctica.

My only question regarding the results and modeling is the use of a snowpack depth of 54 cm for the QLL volume (liquid content). The result of this calculation is used to then "scale" the transfer of species from the QLL to the gas phase...however not all 54 cm of the snowpack is going to be photochemically active. This is going to result in a smaller k(mix) and thus a smaller flux from the snowpack. How significant of a change would it make to the model results if the effective snowpack depth (i.e. the photochemically active portion) were a more reasonable 10-15 cm?

A minor comment is that the manuscript should refer to the "condensed phase" (not condense phase).

Other minor corrections: Page 6011 line 16: "...generated OH radicals by reaction (R8)." Page 6014 line 16: "...and bulk concentrations of..." Page 6016 line 21: "...aqueous phase reaction rates.." Page 6021 line 3: "...possibly leading to the production of..."

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 6009, 2008.

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Interactive Comment