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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The NO_x dependence of bromine chemistry in the Arctic atmospheric boundary layer" *by* K. D. Custard et al.

Anonymous Referee #3

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In this manuscript the authors present an analysis of gas-phase chemistry in the Arctic troposphere. The focus is on the impact of elevated NOx levels on bromine chemistry. They demonstrate using a simple 0-D model, constrained by ambient observations, that elevated NOx can lead to decreased BrO levels by tying Br and other radical species up in nitrogen-containing reservoir species. The study is well-designed and provides insight into Arctic atmospheric chemistry. I have a few technical questions or comments which should be addressed before publication.

- Snow chemistry may have a major impact on photochemistry in the Arctic (and specifically Br and NOx chemistry), but the representation of mass transfer to snow and snow chemistry is very simplified in the model used in this study. While many simplifications could be pointed out, for one thing, there appear to be no snowpack photolysis re-

actions, and these may have a significant impact on gas phase photochemistry. The authors should justify in the revised manuscript the use of such a simplified model and comment on the possible contributions of snowpack processes to discrepancies observed between modeled and measured data, e.g. Fig 5 and Fig 7.

- I agree with Reviewer 1 that the apparent lack of impact of NOx levels on the Br chain length demands more discussion.

- Figure 7 is too small to be legible.

- Some explanation is needed for the values in Table S4. How have the authors arrived at the different aqueous rate constants? I assume "actual" means the measured aqueous reaction rate constant, but how are the different values for "particle" and "snow" obtained?

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 8329, 2015.