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## ***Interactive comment on “The NO<sub>x</sub> dependence of bromine chemistry in the Arctic atmospheric boundary layer” by K. D. Custard et al.***

### **Anonymous Referee #1**

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The manuscript by Custard et al. reports results of 0-D box model simulations which seek to unravel the manner in which NO<sub>x</sub> influences Arctic bromine chemistry. It is certainly an important and interesting topic for investigation, but I have read this manuscript several times, and am still confused as to its main points. I think it would benefit greatly by some restructuring and rewriting in places, to maintain a focus on the key results.

To start: the authors constrain the model amounts of halogens to a set of observations, then simulate a 10 day period with imposed high and low NO<sub>x</sub> amounts. But surely, since the gas phase halogens are already determined by nature, this will "twist" the chemistry in unrealistic ways in order to "keep up" with the observed Br<sub>2</sub> and Cl<sub>2</sub>? Perhaps I am missing something ... This problem pops up in a few places in the MS, in

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discussing times when observational halogen data was absent (pg 8338, lines 19-23; pg 8340, lines 18-20; pg 8341, lines 13-14).

Even accepting this limitation, I was left wondering about several of model results. The major result (not clearly stated) seems to be that there is no difference in bromine chain length between the High- and low-NO<sub>x</sub> cases. There is a brief discussion of this on pages 8337 and 8338, but I do not really follow the reason for why this is the case. Likewise, it is not clearly explained why the O<sub>3</sub> loss rate behaves the way it does in the two model scenarios (pg 8339).

Some more minor points: On page 8337 (line14), it is stated that BeONO is not considered to be a sink for BrO<sub>x</sub>, yet in Section 3.4 it is considered in just that way.

I do not understand how Eqn 2 is obtained.

Pg 8340, lines 2-6 about the importance of BrONO<sub>2</sub> in ODEs seems a bit of a non-sequitur.

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

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