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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Possible catalytic effects of ice particles on the production of NO_x by lightning discharges" *by* H. S. Peterson and W. H. Beasley

Anonymous Referee #2

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General Comments: This manuscript presents theoretical calculations showing that catalytic reactions on ice crystals may play an important role in the production of NOx from lightning. The authors speculate that chemical processes on ice may enhance NOx production, and possibly account for the large NOx production by cloud flashes that has been noted by some investigators in the analysis and modeling of field observations. Detailed assumptions concerning ice crystal number concentrations, sizes, and masses, as well as temperatures during the cooling phase following a discharge are used in the analysis. While I am not adequately qualified to judge the accuracy of all of these assumptions, the methodology used in the analysis appears to be sound. The authors draw some conclusions at various stages of the analysis which need fur-

ther explanation. I have noted these instances in the detailed comments below. I recommend publication after the authors address my specific comments listed below.

Specific comments: Abstract: The abstract needs to be more clear on what type of analysis the authors have actually performed (ie., is it modeling, theoretical analysis, laboratory work, etc.)

p. 12650, line 21: change to: ....photochemical smog (see review of lightning NOx production by Schumann and Huntrieser, 2007).

p. 12650, line 22: change to: ....stratospheric ozone (see review by Cohen, 2003).

p. 12651: Section 2 heading: "ice particles"

p. 12651, lines 23, 24: the mechanism may indeed prolong the availability of N atoms. But, doesn't the availability of free O atoms need to be considered? Are the O atoms still available at the longer times after the discharge?

p. 12653, lines 5-6: what thunderstorm variables were considered?

p. 12653, lines 11-15: What is the range of mass of individual ice crystals that typically exist in a thunderstorm. Need to know this before jumping to the conclusion in the next paragraph.

p. 12656, line 5: It looks to me like the range should be 7.9 x 10**18 to 7.9 x 10**22, based on the values of number of N atoms in the channel and the number of adsorbing ice crystals given.

p. 12657, line 1: 7.9 x 10**18

p. 12658, Eq. R4: shouldn't N2 be H2?

p. 12658, Eq. R5: are the O atoms still present at 3000 and 2000K. You have discussed a mechanism to prolong the lifetime of the N atoms. Don't you also need a mechanism to prolong the availability of O atoms as well?

p. 12659, Eq. 3: please explain how this equation was derived.

p. 12661, lines 26-27: please explain how this conclusion was reached.

Table 1: change Bucsela from Field Study to Satellite Add DeCaria 2005 Theoretical 460 moles Add footnotes for DeCaria 2000, DeCaria 2005, and Ott 2010. Modeling constrained by anvil aircraft observations from field studies.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 12649, 2011.