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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The fate of NO_x emissions due to nocturnal oxidation at high latitudes: 1-D simulations and sensitivity experiments" *by* P. L. Joyce et al.

Anonymous Referee #1

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General comments:

This paper reports 1-D modeling of nitrogen oxide chemistry in the Fairbanks, AK plume during its downwind transport during the month of November. It is clearly written, comprehensive and presents an original analysis. The treatment of N2O5 dry deposition is especially useful and puts an important constraint on this loss process for nitrogen oxides. The results will be of general interest for understanding the fate of primary pollutants, including NOx, O3 and precursors for particulate matter, in high latitude environments. I recommend it for publication in ACP following attention to the small number of specific comments listed below.

Specific comments:

Page 7392, line 24 and following discussion on emissions: Is sulfuric acid normally considered a directly emitted pollutant? Some sulfur sources, especially those with control technologies for NOx, are known to emit some of their sulfur as SO3, which readily converts to H2SO4. See Srivastava & Miller, J. Air & Waste Management Association, 54, 750-762 (2004). Nowak et al. (GRL, 39, L07804, 2012) discuss NH3 emissions from automobile sources and indicate good agreement between inventories and measurement derived emission factors. The authors may wish to update the NH3 emissions estimates from these sources with a more recent analysis.

Pate 7401, line 14: "Due to kinetic limitation" (insert "to")

Page 7404, line 25-27: Argument not clear. The formation rate of N2O5 (presumably meaning the NO2 + O3 reaction) is strongly T dependent, but the heterogeneous uptake rate is not? A smaller fraction remains unreacted due to this temperature dependence?

Page 7406, line 20: add the phrase "within Fairbanks" to clarify that the small contribution of NOx oxidation to PM non-attainment is limited to the immediate vicinity of the urban area.

Page 7406, line 24 and following discussion: How does the model treat dry deposition of NH3? Is the emission from Fairbanks carried as gas phase NH3 until it can react with an acid and form nitrate aerosol? Some comment on the potential for dry deposition of NH3 and how this would affect downwind ammonium nitrate should be included.

Figure 4: Axis labels are too small to be legible. Please increase font size.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 7385, 2014.