

## ***Interactive comment on “Increased nitrate and decreased $\delta^{15}\text{N}\text{--NO}_3^-$ in the Greenland Arctic after 1940 attributed to North American oil burning” by Nathan J. Chellman et al.***

**Anonymous Referee #2**

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This paper relates the changes in NO<sub>x</sub> emissions to the observed deposition of nitrate (and isotopes) and additional tracer. This paper is interesting and well written, and brings new information to the understanding of the ice core records in the Northern hemisphere. I have however one major comment that the authors should address before publication. Namely, while they acknowledge that there is significant range/uncertainty in the isotopic composition of the various NO<sub>x</sub> emissions, by the time they perform the analysis using the isotopic mixing model, a single value is used. It seems that it would be quite critical to explore the range of uncertainty to bring this information into the possible mix of emissions. I would therefore recommend that the authors take a more probabilistic approach to their mixing model and perform, for ex-

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ample, a certain number of simulations to span the range of uncertainties.

Minor comments

Page 1, line 29: I would change "budget" to "fluxes into the troposphere"

Page 6, line 14: the assumption of NO<sub>x</sub> emission scaling with CO<sub>2</sub> seems to be inappropriate for the conditions after the existence of catalytic converters. A clear case is the drastic recent reduction in NO<sub>x</sub> emissions from the US power plants while the CO<sub>2</sub> emissions are obviously unchanged.

Page 7, line 25: there is a wide variety of emission databases (especially for the last few decades), especially for biomass burning. What is the sensitivity of the results to the choice of the database.

Page 7, lines 17,18,21: the sigma symbol did not print correctly

Page 7, line 22: any idea on what happened in 1987?

Page 8, line 2: a more recent and widely used reference is Stohl et, 2008 (<http://onlinelibrary.wiley.com/doi/10.1029/2005JD006888/abstract>) It would be good to check the findings of the studies.

Page 9, line 22: there should be a more quantitative statement than "consistent".

Page 12, line 6: this seems to assume that the same fraction NO<sub>x</sub> makes it to be nitrate deposition. It seems that it would be worth discussing whether this should be the case (changes in transport, chemical background, ...)

Figure 5: how do these emission estimates compare to standard emission databases (such as EDGAR)

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