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Interactive comment on “Global simulations of nitrate and ammonium aerosols and their radiative effects” by L. Xu and J. E. Penner

R. Makkonen

risto.makkonen@helsinki.fi

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The manuscript by Xu and Penner studies the climate forcings of nitrate and ammonium aerosols. There exists only a few studies on the direct effects of nitrate aerosols, and even fewer studies on their indirect effects. The manuscript shows that the anthropogenic nitrate forcing via direct and indirect effects can be of similar magnitude. The study by Xu and Penner explores important aspects of the global nitrate aerosol system.

The last sentence mentions that the manuscript provides the first estimate of the anthropogenic indirect forcing of nitric acid gas. While this is true for the anthropogenic part, Makkonen et al. (2012) have quantified the indirect effect of the nitric acid gas. While the methods and focus behind the two manuscripts are somewhat different, there

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is room for comparison and some discussion. Xu and Penner (2012) addresses both direct and indirect effects of nitrate, while Makkonen et al. (2012) focuses on the 1st and total indirect effect of nitric acid gas. Xu and Penner (2012) presents results from pre-industrial and present-day simulations, while Makkonen et al. (2012) simulate present-day and future conditions. Finally, the two studies differ on the simulation setup and how the indirect effects are quantified.

The method for calculating the effect of gaseous nitric acid on cloud activation is different in the two studies. Xu and Penner (2012) apply the substitution method by Chen (2006), where available gas-phase nitric acid is distributed to fine-mode aerosol and cloud droplet activation is calculated after this redistribution. Makkonen et al. (2012) apply a parameterization by Romakkaniemi et al. (2005). The parameterization calculates the effect of nitric acid on activation based on temperature, pressure, updraft velocity, aerosol size distribution and the activated fraction (calculated with Abdul-Razzak and Ghan (2000)).

The diverse methods used in the two manuscripts, Xu and Penner (2012) and Makkonen et al. (2012), provide the first quantifications of the indirect effect of nitric acid and explore the related uncertainties. To help the reader in putting the results into context, I suggest adding the related references (Makkonen et al. (2012), Romakkaniemi et al. (2005)) to the manuscript. If possible, comparison of Chen (2006) and Romakkaniemi et al. (2005) would be helpful, at least with a sentence or two.

References:

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