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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***

**Anonymous Referee #2**

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This paper combines the hybrid dynamic method from Feng and Penner (2007), and the dynamics of sulfate aerosol and its interaction with non-sulfate aerosols from Herzog et al. (2004) and Liu et al. (2005), to simulate global sulfate/nitrate/ammonium aerosols and nitric acid. Furthermore, the authors conducted detailed calculations for the direct and indirect forcing resulting from sulfate/nitrate/ammonium aerosols and nitric acid. This paper is well written. I would recommend for final publication after the following issues are addressed.

1. It is interesting that the first indirect forcing of nitrate ( $-0.09 \text{ W m}^{-2}$ ) is mainly from nitric acid gas ( $-0.08 \text{ W m}^{-2}$ ). On the other hand, I notice that there is another paper on ACPD (Makkonen et al. ACPD, 2012) that shows a much larger indirect effect ( $-0.46 \text{ W m}^{-2}$ ) due to nitric acid gas. I understand that the discrepancy can be largely due to

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the different parameterization of nitric acid on cloud activation in two models, but this indeed deserves some insightful discussion.

2. I am also curious about how well this model simulates nitric acid. In my understanding, nitric acid gas is often overestimated in some models.

3. Please comment on why the indirect effect of nitric acid gas is most significant over the coastal regions. Is it because of the high concentrations of nitric acid, sea salt aerosols, or other things?

4. I agree with reviewer #1 that, the authors should show how the model simulation is improved compared to Feng and Penner (2007) study, by incorporating the sulfate aerosol dynamics. Any comment on this would be useful.

5. Is it possible that the overestimate of nitrate over North America is partly due to ignoring organic nitrates in the model?

6. Page 10122 Line 13, “Table 1” should be “Table 3”.

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