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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Quantifying atmospheric nitrogen deposition through a nationwide monitoring network across China" *by* W. Xu et al.

Anonymous Referee #1

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The manuscript 'Quantifying atmospheric nitrogen deposition through a nationwide monitoring network across China' presents the results from 5 years of reactive nitrogen atmospheric concentrations and bulk deposition monitoring combined with modelled dry nitrogen deposition across China. This is an important contribution to the field of reactive nitrogen monitoring in a rapidly developing hotspot of air pollution. However, some general aspects may need to be improved so that results can be interpreted correctly.

The description of the results is based on ranking Chinese regions according to their levels of reactive nitrogen pollution and nitrogen deposition levels. However, the monitoring sites included within each region are not homogenously distributed since some regions include more urban sites, with higher pollution levels, than others or a higher

proportion of background sites, away from pollution sources. Thus, the mean value obtained in each region may not be informative of the pollution levels of the whole region. The analysis of the representativeness of the network that would be needed to compare regional averages is not presented. Alternatively, the comparisons between regions can be based on the analysis across urban sites, rural and background sites. For instance, the regional ranking based on mean dry deposition levels can change depending on whether all sites are considered (as it is now in the manuscript), only background sites or only rural sites. The same may be true for wet and total deposition. The comparisons across regions would be fairer this way.

In the same line with the previous comment, Table 2 presents a comparison between NNDMN results and other monitoring networks. This comparison is biased by the fact that CASTNET monitoring sites, unlike NNDMN, are located in rural and protected areas, with no sites in urban environments. EMEP data considered here is produced from modelled data representing large scale areas within each grid cell that make comparisons with point measurements difficult. EMEP also has a monitoring network of background sites across Europe with data downloadable from the internet that may be more useful for comparisons in Table 2. Also, of the 10 EANET sites presented by Endo et al. (2011), 8 were classified as remote stations, one rural and only one urban. The latter two stations showed higher nitrogen deposition fluxes than remote sites. It was recognized in this study that concentrations in Japan were generally lower compared to other EANET sites in East Asia because most locations were categorized as remote sites. Thus, comparisons in Table 2 with CASNET, EMEP and EANET Japan should be based only on rural and/or background sites of the NNDMN.

Another general comment is related with the terminology. Throughout the manuscript it is said that wet deposition was measured with precipitation gauges. However, in the discussion it is acknowledged that dry deposition in precipitation gauges can account for 20 to 40% of the deposition measured in precipitation. Thus, bulk deposition was in fact monitored and the terminology should be clarified in the manuscript.

Finally, the analysis of uncertainties in section 4.4 does not mention the uncertainties associated with the location and spatial coverage of the network. From Figure 1 it is evident that large areas of the country or islands lack of sampling points maybe missing hotspots of nitrogen deposition and/or pristine sites. Some recommendations about this issue could probably be suggested.

Other comments and queries to the manuscript are:

P18368, L18: Include some measure of variability in the averaged nitrogen deposition fluxes in China to show that important reactive nitrogen deposition gradients exist in the country. P18374, L20 and S5: Which land use map was used to model the deposition velocities across China and how was the land use selected in each sampling point? P18376, L2: The comparison presented here is also true for other regions apart from NC, SE and SW? P18376, L4: What about NH3 levels in urban and background sites? P18376, L9: The comparison of urban and rural areas for NO2 also holds for other regions of China? P18379, L5: Were there any differences in reduced/oxidized nitrogen ratios depending on the site type (urban, rural or background)? P18379, L13: It is interesting that, despite reactive nitrogen concentrations in rural sites are consistently lower than in urban sites, total annual mean deposition fluxes are quite similar. Have the authors any hypothesis to explain this result? P18379, L14: grassland sites -> background sites P18380, L23: I believe the authors refer here to Figure S2 d and e. P18381, L10: The discussion here would have benefited from an analysis of differences between regions across land use types. Are all the rural sites in China homogeneously affected by reactive nitrogen pollution? P18383, L4: Does this hypothesis work in the monitoring sites in China? In other words, was the NHx/NOy ratio in urban sites different from rural or background sites in this network? P18384, L19: There is no mention in this section of the discussion to differences in modelled deposition velocities for China compared with other estimates, as presented in table S4. This is also applicable in P18387, L8. Figures 2 and 4: Vertical lines could be included to separate regions or even land use categories within regions in order to ease comparisons.

Supplement S2: Renumber subsections as 2. X. Supplement S2.1: Thirty -> Thirteen Supplement S2.5: 2 rural sites -> 5 rural sites Supplement S5: The tables referenced here should be S3 and S4.

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