# **Response to reviewers' comments and main revisions**

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Title: Estimating nitrogen and sulfur deposition across China during 2005-2020 based on multiple statistical models

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We thank very much for the comments and suggestions from the reviewer, which help us improve our manuscript. Following are responses to the comments and corresponding revisions. Please note that the line numbers mentioned following refer to the clean version of the revised manuscript, unless specifically noted.

# **Comments from Reviewer #2**

The manuscript was well revised according to the reviews' comments. Especially, the delay of deposition decline was discussed. Some very minor comments are: 1. Line 33: delete one 'a' at the end of this line.

## **Response and main revisions:**

We thank the reviewer's reminder and it is corrected as suggested.

#### 2. Line 46: The reason for the different ratio need be added here as conclusion.

#### **Response and main revisions:**

We thank the reviewer's comment and the reason is added as: "....., while smaller deposition to emission ratios (D/E) existed in developed eastern China, attributed to more intensive human activities and thereby anthropogenic emissions."

#### 3. Line 357: What is the different between bulk and wet-only? Some reference?

#### **Response and main revisions:**

We thank the reviewer's comment. Actually we include relevant analysis and references in Section 3.4, as indicated in lines 697-705:

For example, dry deposition was observed to account for around 20% of the bulk at three rural stations in the North China Plain, and the contribution could reach 39% in some urban areas (Zhang et al., 2015; Zhang et al., 2008). In contrast, the difference between bulk and wet deposition of dissolved inorganic nitrogen (DIN) was equal to 12% of the bulk in a rural site in SW (Kuang et al., 2016; Song et al., 2017). Basically, the uncertainty was greater in areas with a higher proportion of dry to total deposition (such as NW and NE areas with less precipitation), and smaller in areas with a lower proportion (such as SE with more precipitation).

#### **Reference:**

- Kuang, F., Liu, X., Zhu, B., Shen, J., Pan, Y., Su, M., and Goulding, K.: Wet and dry nitrogen deposition in the central Sichuan Basin of China, Atmos. Environ., 143, 39-50, https://doi.org/10.1016/j.atmosenv.2016.08.032, 2016.
- Song, L., Kuang, F., Skiba, U., Zhu, B., Liu, X., Levy, P., Dore, A., and Fowler, D.: Bulk deposition of organic and inorganic nitrogen in southwest China from 2008 to 2013, Environ. Pollut., 227, 157-166, https://doi.org/10.1016/j.envpol.2017.04.031, 2017.
- Zhang, G., Pan, Y., Tian, S., Cheng, M., Xie, Y., Wang, H., and Wang, Y.: Limitations of passive sampling technique of rainfall chemistry and wet deposition flux characterization, Res. Environ., 28, 684-690, https://doi.org/10.13198/j.issn.1001-6929.2015.05.03, 2015.
- Zhang, Y., Liu, X. J., Fangmeier, A., Goulding, K. T. W., and Zhang, F. S.: Nitrogen inputs and isotopes in precipitation in the North China Plain, Atmos. Environ., 42, 1436-1448, https://doi.org/10.1016/j.atmosenv.2007.11.002, 2008.

# 4. Line 401: Here the national emission of NOx and NH3 should be shown and compared.

#### **Response and main revisions:**

We thank the reviewer's important comment. In MEIC, the national emissions of  $NO_X$  and  $NH_3$  were estimated at 7.2 and 8.3 TgN/yr for 2005-2020, respectively. Therefore, the proportions of RDN and OXN to total N deposition (58% and 42%) are close to those of emissions (54% and 46%, respectively). We have added the comparisons in lines 401-403 in the revised manuscript.

## 5. Line 403: it fraction in total deposition reaching...

#### **Response and main revisions:**

We thank the reviewer's comment and it is revised as suggested.

## 6. Line 474: declining R before 2011 resulted...

#### **Response and main revisions:**

We thank the reviewer's comment and it is revised as suggested.

#### 7. Line 574: relatively high NH3...

#### **Response and main revisions:**

We thank the reviewer's comment and it is corrected as suggested.

#### 8. Line 579: The monsoon season is also growing season and fertilization period.

### **Response and main revisions:**

We agree the reviewer's comment, but both dry and wet deposition of RDN could be enhanced in the growing season and fertilization period, thus it cannot be an exclusive reason for the abundant wet deposition.

# 9. Line 587: western regions?

# **Response and main revisions:**

We thank the reviewer's reminder and it is corrected as suggested.

# 10. Line 607: How about the detailed data on the fluxes out of the land? Did they support for the delay by declining long-range transport?

# **Response and main revisions:**

We thank the reviewer's important comment. Due to lack of observation data, however, we could not quantify the fluxes out of the land with the machine learning techniques in this work. We will take the reviewer's suggestion and continue the research on the S/N transport out of land to further evaluate the delay of deposition decline in the future.