SUPPLEMENT FOR THE RESPONSE TO REVIEWER #3

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Figure S2 in the revised supplement (Figure S1 in the original submission): The RF algorithm monthly performance of CNEMC with the 10-fold cross validation. R^2 and RMSE are calculated with equations below the figure (the unit of RMSE are kg N/S ha^{-1} yr^{-1}).

Figure S3 in the revised supplement (Figure S2 in the original submission): The same as Figure S2 but for NNDMN.

Table S9 in the revised supplement: Comparison of the annual V_d of nitrogen compounds by land use type in this and other studies (cm s^{-1}).

Land use type	Deposition velocity (cm s^{-1})						References
	NO_2	HNO_3	NO_3^-	NH_3	NH_4^+	SO_2	
Farmland	0.17	1.45	0.15	0.43	0.15	0.44	This study
	0.18	1.52	0.19	0.40	0.19		Xu et al. (2015)
	0.10	0.76	0.25	0.18		0.25	Zhang et al. (2004)
						0.56	Zhang et al. (2003)
Urban	0.14	1.37	0.15	0.44	0.15	0.44	This study
	0.06			0.78			Pan et al. (2012)
	0.03					0.20	Su et al. (2012)
						0.55	Zhang et al. (2003)
	0.07	1.77	0.44	0.28	0.44		Li et al. (2013)
	0.30	1.10	0.24	0.50	0.24		Luo et al. (2013)
Coastal	0.16	1.56	0.10	0.65	0.13	0.66	This study
	0.01	0.63		0.63			Zhang et al. (2010)
	0.01	0.84	0.27	0.55	0.27	0.63	Zhang et al. (2004)
						0.40	Su et al. (2012)
Forest	0.19	2.23	0.16	0.41	0.16	0.46	This study
	0.10	2.45	0.30	0.20	0.30		Zhang et al. (2004)
	0.19	2.23	0.16	0.41	0.16		Xu et al. (2015)
	0.04					0.16	Su et al. (2012)
Grassland	0.15	1.09	0.19	0.38	0.19	0.33	This study
	0.13	1.16	0.28	0.23	0.28	0.37	Zhang et al. (2004)
	0.15						Xu et al. (2015)
						0.49	Zhang et al. (2003)

Note: Zhang et al. (2004), Su et al. (2012), Xu et al. (2015), Zhang et al. (2010) and Zhang et al. (2003) applied RegADMS, NAQPMS, GEOS-Chem, MM5/CMAQ and AURAMS, respectively. In particular, Zhang et al (2003) focused on the global land use and did not provide specific discussion for China, and was thus excluded when calculating the mean of China.

Figure R1 The relative importance of interpretation variables (RIV) to the RF predictions. See Table S2 for the meanings of the abbreviations in the figure.

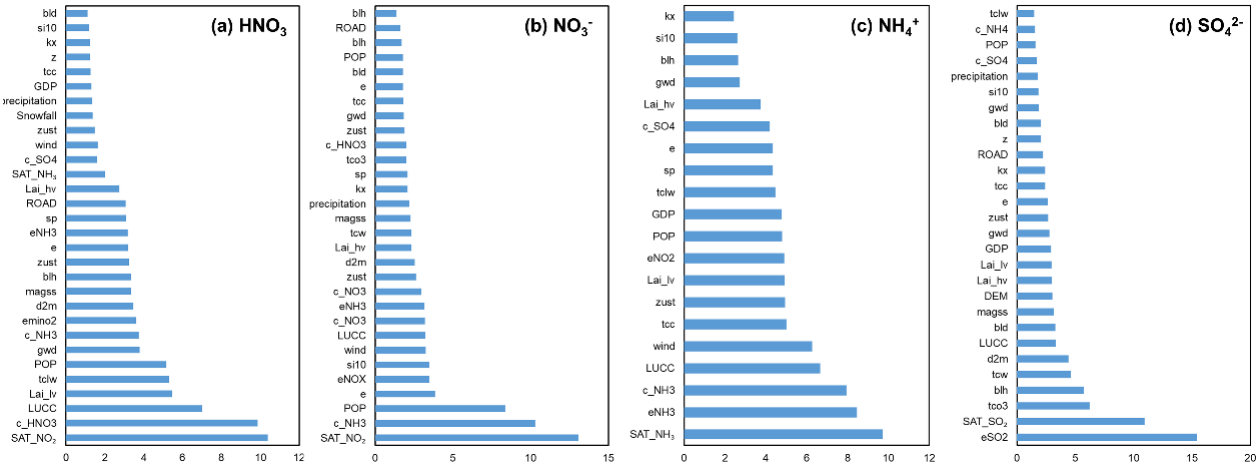
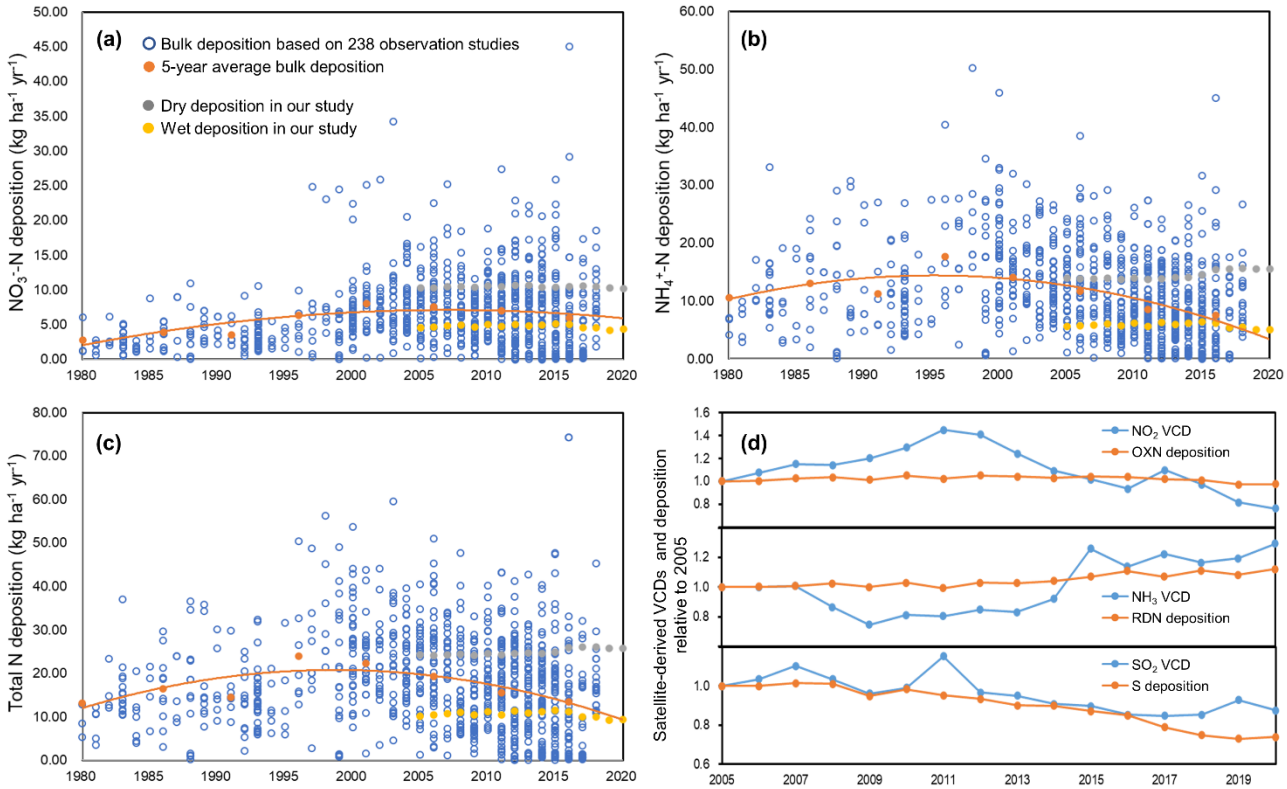


Figure R2 (a-c) Annual mean wet and dry deposition of the N species derived from two complementary databases: (1) published data of bulk N deposition covering 1980–2018 and (2) wet and dry deposition based on the machine learning methods for 2005-2020 in this work. For (1), the blue open circles represent annual average bulk N deposition. The orange curve shows the trends in inorganic N bulk deposition, while the orange dots represent the 5-year average bulk deposition. For (2), the grey dots represent the dry deposition and the yellow dots represent the bulk deposition. (d) The interannual variations of satellite-derived VCDs and total deposition for China in 2005-2020. All the data are relative to the 2005 levels.



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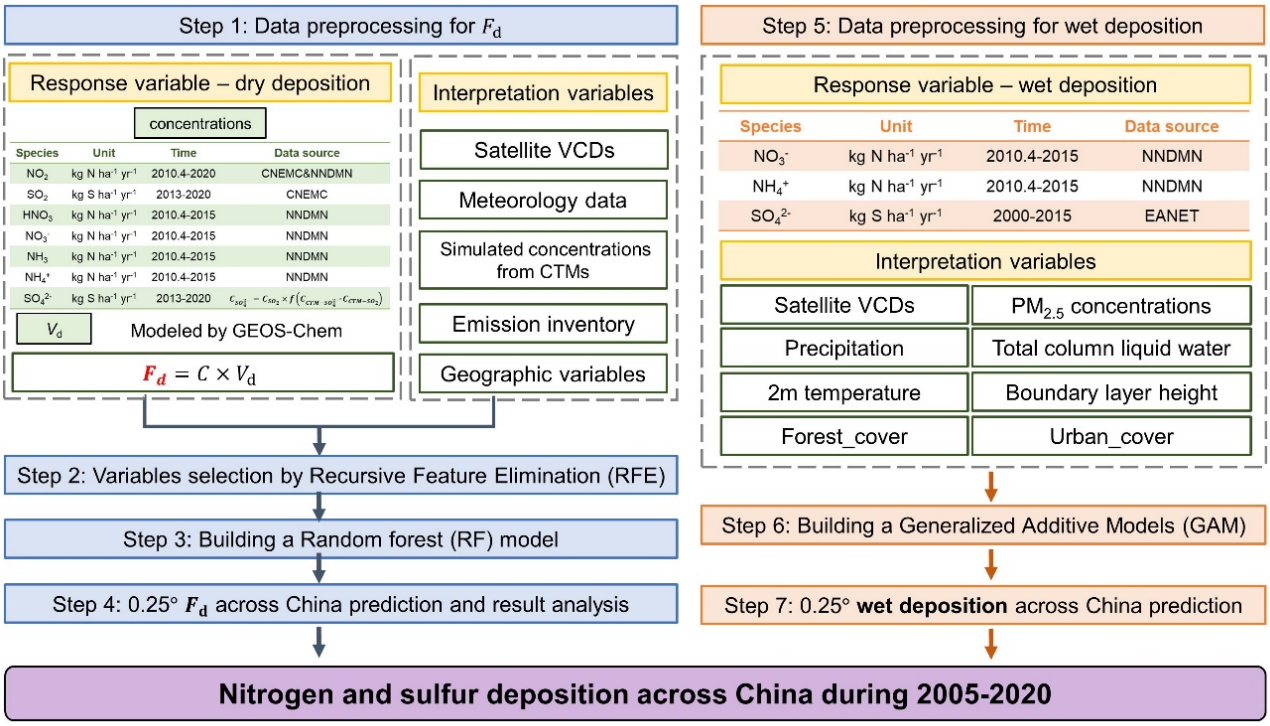

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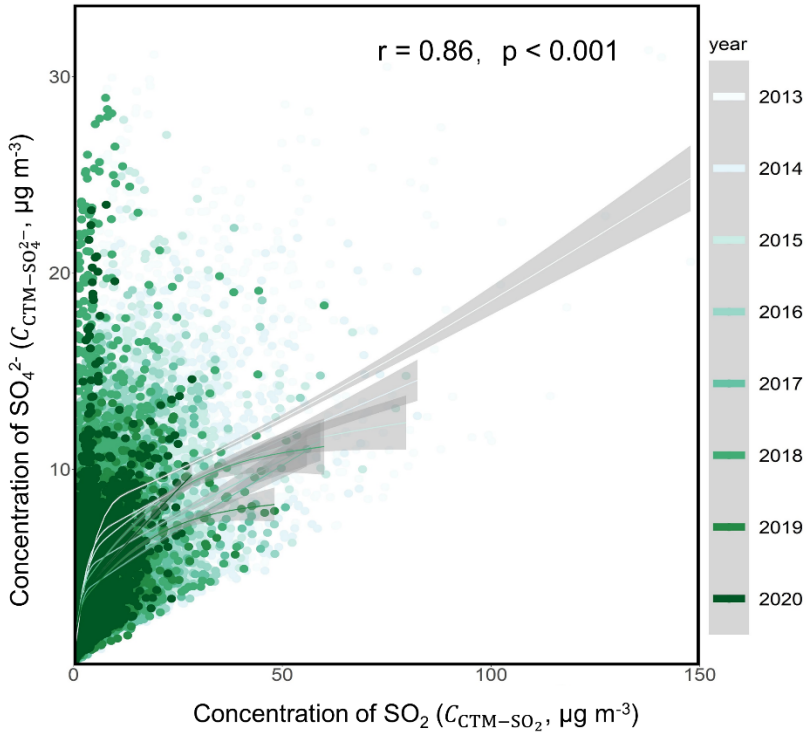
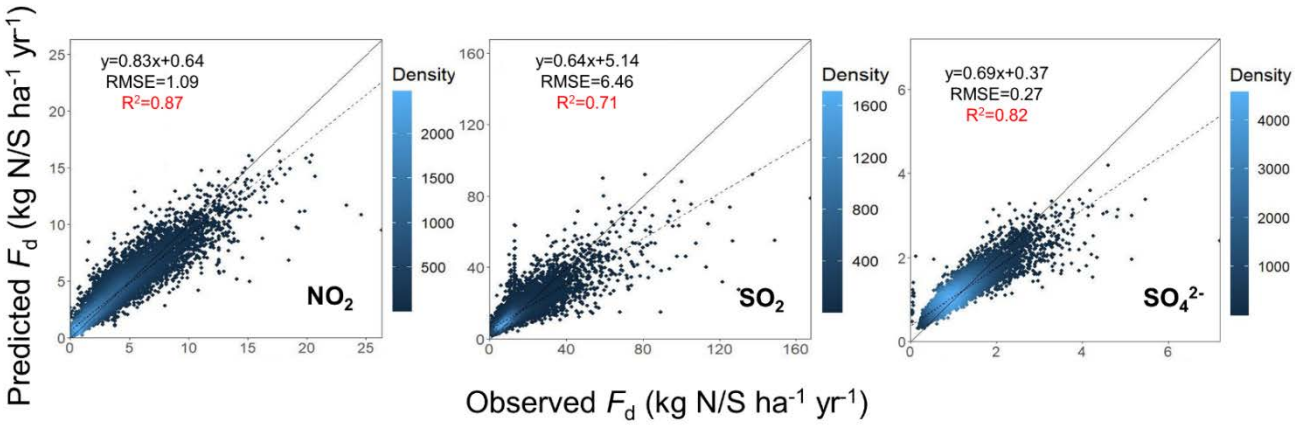


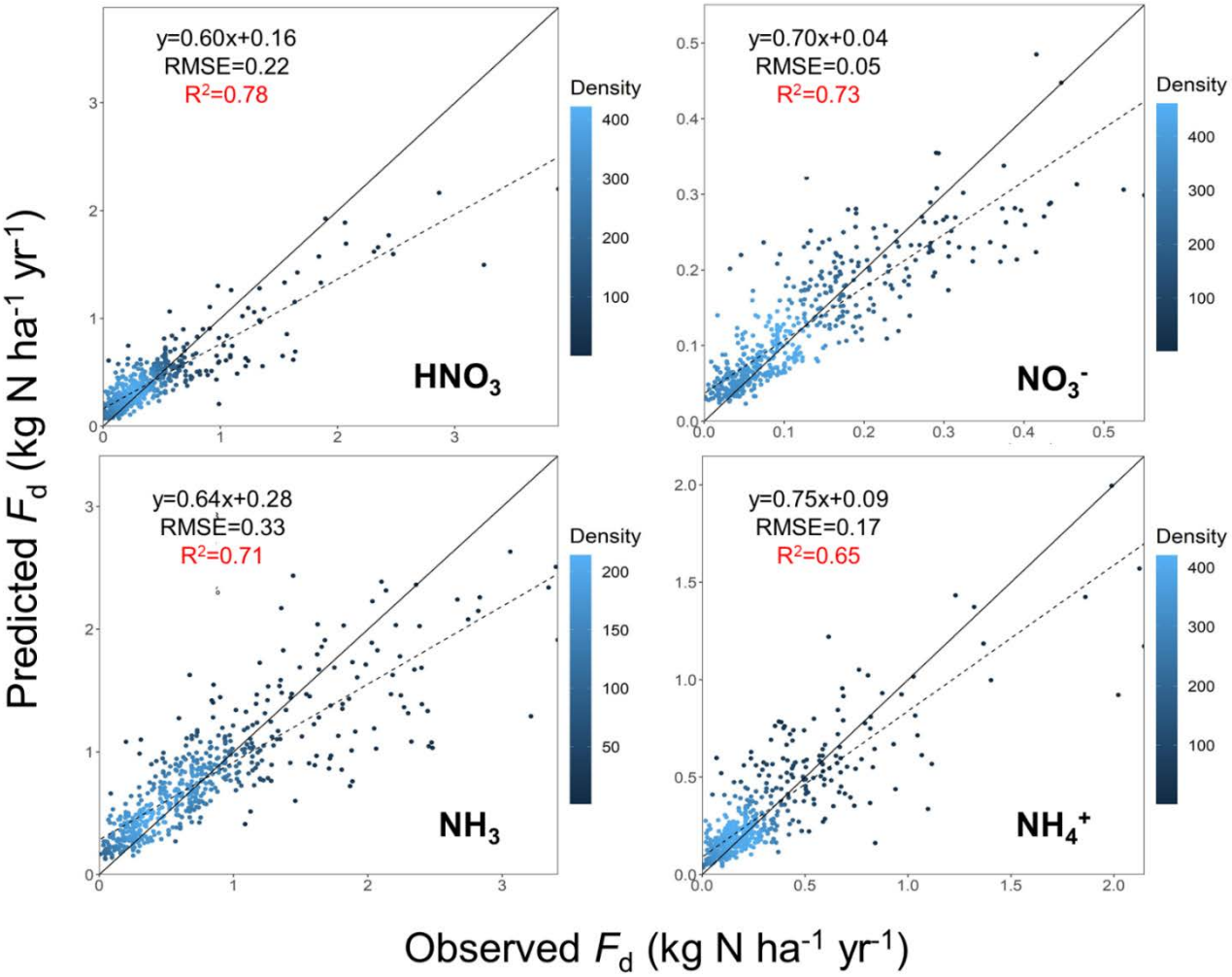
Figure S2 in the revised supplement (Figure S1 in the original submission): The RF algorithm monthly performance of CNEMC with the 10-fold cross validation. R^2 and RMSE are calculated with equations below the figure (the unit of RMSE are kg N/S ha^{-1} yr^{-1}).



Note: The R^2, RMSE, MPE and RPE were calculated using following equations (*P* and *O* indicates the results from prediction and observation, respectively):

$$\mathbf{R^2} = \frac{\sum_{i=1}^{n}(P_i - \overline{O})^2}{\sum_{i=1}^{n}(O_i - \overline{O})^2} \qquad \mathbf{RMSE} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(P_i - O_i)^2}$$

Figure S3 in the revised supplement (Figure S2 in the original submission): The same as Figure S2 but for NNDMN.



References

Pan, Y. P., Wang, Y. S., Tang, G. Q., and Wu, D.: Wet and dry deposition of atmospheric nitrogen at ten sites in Northern China, Atmos. Chem. Phys., 12, 6515-6535, https://doi.org/10.5194/acp-12-6515-2012, 2012.

Su, H., Yin, Y., Zhu, B., Wang, Z., Li, J., and Pan, X.: Numerical simulation and sensitive factors analyse for dry deposition of SO_2 and NO_2 in Bohai Rim area of China, China Environ. Sci., 32, 1921-1932, 2012.

Xu, W., Luo, X. S., Pan, Y. P., Zhang, L., Tang, A. H., Shen, J. L., Zhang, Y., Li, K. H., Wu, Q. H., Yang, D. W., Zhang, Y. Y., Xue, J., Li, W. Q., Li, Q. Q., Tang, L., Lu, S. H., Liang, T., Tong, Y. A., Liu, P., Zhang, Q., Xiong, Z. Q., Shi, X. J., Wu, L. H., Shi, W. Q., Tian, K., Zhong, X. H., Shi, K., Tang, Q. Y., Zhang, L. J., Huang, J. L., He, C. E., Kuang, F. H., Zhu, B., Liu, H., Jin, X., Xin, Y. J., Shi, X. K., Du, E. Z., Dore, A. J., Tang, S., Collett, J. L., Goulding, K., Sun, Y. X., Ren, J., Zhang, F. S., and Liu, X. J.: Quantifying atmospheric nitrogen deposition through a nationwide monitoring network across China, Atmos. Chem. Phys., 15, 12345-12360, https://doi.org/10.5194/acp-15-12345-2015, 2015.

Zhang, L., Brook, J. R., and Vet, R.: Evaluation of a non-stomatal resistance parameterization for SO_2 dry deposition, Atmos. Environ., 37, 2941-2947, https://doi.org/10.1016/s1352-2310(03)00268-1, 2003.

Zhang, Y., Wang, T. J., Hu, Z. Y., and Xu, C. K.: Temporal variety and spatial distribution of dry deposition velocities of typical air pollutants over different land-use types, Climatic Environ. Res., 9, 591-604, 2004. (In Chinese)