

Interactive comment on “Atmospheric nitrogen deposition to the northwestern Pacific: seasonal variation and source attribution” by Y. H. Zhao et al.

Anonymous Referee #2

Received and published: 10 June 2015

General comments This paper discussed atmospheric N deposition in the northeastern Pacific Ocean in relation to anthropogenic and natural reactive N emissions using the GEOS-chemical global chemistry model. The authors provided very important information on both dry and wet N deposition in Yellow Sea and South China Sea and compare their results with satellite data and emission inventory data with regional differences in anthropogenic reactive N sources. This is a significant contribution to scientific knowledge on how the terrestrial reactive N emissions affect N wet and dry deposition onto the northeastern Pacific Ocean (e.g. Yellow Sea and South China Seas).
Scientific comments The authors jointly used modeling tool, satellite observation and surface

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measurement to obtain relatively accurate and comprehensive information on atmospheric nitrogen deposition to the northwestern Pacific, especially the China Seas. The results of this study contribute to a better understanding of coastal atmospheric N deposition and help to make effective strategies for mitigating N deposition. To further improve the quality of the manuscript, I suggest that a section of the uncertainty analysis (as also mentioned in later) may be presented in the text. Technical corrections / comments Introduction Page13660. Line 7. The formation of ammonium particles increases. . . Page13660. Line 8. As dry removal of the particles. . . Sect. 2.1 General description Page 13662. Lines 10, 15. The monthly dry deposition velocities of Nr species (e.g. NO₂ and NH₃) over the northwestern Pacific and seasonality of them differ from the results reported by Zhang et al. (2010) over the China Seas. Did this study consider impact of the sea-surface height on the velocities? How is the reliability if using the current deposition velocities to the China Seas? Reference mentioned: Zhang Y., et al. Atmospheric deposition of inorganic nitrogen to the eastern China seas and its implications to marine biogeochemistry. Journal of Geophysical Research, Vol. 115, D00K10, doi:10.1029/2009JD012814, 2010. 3 Column concentrations and wet deposition fluxes over Asia Page 13667. Line 5. The highest sensitivities Page 13668. Line 5. This study shows that Annually model simulated nitrogen wet deposition (NH₄⁺ + NO₃⁻) fluxes over China averages 9.3 kg N ha⁻¹ a⁻¹ with NH₄⁺ contributing 70 %. However, this modeled magnitude of wet deposition was 1.6-times lower than the results reported by recent studies (Jia et al., 2014, 13.9 kg N ha⁻¹ a⁻¹; Zhu et al., 2015, 13.2 kg N ha⁻¹ a⁻¹) based on published large amount of Chinese surface measurements. In addition, although the contribution of NH₄⁺ to total wet N deposition (70%) was similar to that in north China (Pan et al., 2012, in the range of 63–78%), it might be overestimated at the national scale as an average value of 55% has been observed by Zhu et al. (2015) based on 41 in situ monitoring sites across China. Therefore, the modeled flux of wet deposition may have some uncertainties. Please make a comprehensive comparison in the text. References mentioned: Jia, Y. L. et al., 2014. Spatial and decadal variations in inorganic nitrogen wet deposition in China induced by human activity. Sci. Rep., 4,

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3763. Pan, Y. P. et al. 2012. Wet and dry deposition of atmospheric nitrogen at ten sites in Northern China. *Atmos. Chem. Phys.*, 12, 6515-6535. Zhu, J. X. et al., 2015. The composition, spatial patterns, and influencing factors of atmospheric wet nitrogen deposition in Chinese terrestrial ecosystems. *Sci. Total Environ.*, 511, 777-785. Page 13668. Line 5. are greater than 0.7. Page 13668. Lines 7-8. This is similar to Lv et al. (2007) who estimated. . . 4.1 Seasonal variation and deposition process Page 13669. Line 25. Accounting to Zhang et al. (2012), there were some uncertainties on seasonal amounts of NO_y deposition modeled by Geos-Chem. Does this affect the current findings? Please clarify. Reference mentioned: Zhang, L., et al. 2012. Nitrogen Deposition to the United States: Distribution, Sources, and Processes, *Atmos. Chem. Phys.*, 12, 4539-4554. Page 13670. Lines 1-2. higher than in April and July Page 13671. Line 10. spatial and seasonal variations of atmospheric nitrogen...

Interactive comment on *Atmos. Chem. Phys. Discuss.*, 15, 13657, 2015.