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Biogeosciences Discussions



# *Interactive comment on* "Simulation of nitrogen deposition in the North China Plain by the FRAME model" *by* Y. Zhang et al.

**Anonymous Referee #2**

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In this paper the authors use a Lagrangian model (FRAME) to examine atmospheric nitrogen deposition budget in the North China Plain. The FRAME model contains only a limited treatment of atmospheric chemistry and is missing several key reactions. Therefore, I would consider this study as a screening level study at best. It is difficult to assess how well these modeling results represent the true budget because no comparisons against a model with a more complete treatment of atmospheric chemistry (e.g. EMEP, RADM, STEM, CMAQ) were made for this modeling domain. Additionally, the inability of FRAME to address the bidirectional exchange of NH3 in such an agriculturally dominated region would likely have significant impacts. I also have concerns about the deposition velocities used by FRAME in calculating the deposition for some species. For example, HNO3 is a significant contributor to the oxidized nitrogen budget and to model the deposition velocity with a constant value seems inappropri-



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ate. HNO3 deposition is highly dependent on the aerodynamic resistance which can be quite variable. Aerosol deposition velocities cannot be appropriately modeled as constant values either as this should be a function of particle size (which can vary with humidity), aerodynamic resistance, and other factors. Given these limitations in the model used, I have little confidence in the results presented and would therefore recommend that, in its present form, the paper is not acceptable for publication.

I offer the following additional comments to guide the revision process, should it occur:

Abstract

- "contributed nitrogen budgets" needs rewording - "upper limit of 30 kgN ha-1" is not clear in the context of the abstract

Introduction

- Note that Kim et al (2003) used a nested grid with a grid size of 8.9 km over the NCP. Unfortunately, their simulations did not cover the same year as this study making direct comparisons difficult.

Methods

- Check p 8164, lines 5-7 for grammar

Model application

- The model evaluations provided in Fig 4 actually indicate little skill by the model in simulating these values. The regression coefficient does not tell the whole story. I suggest that you start with trying to improve model performance for this area as a first step. What would model performance look like for a model with a more complete treatment of atmospheric chemistry? Results and Discussion

- I'm not sure I really see the point of your comparisons of the NCP budget with those from other countries. The emissions, meteorology, land cover, etc in the NCP are quite different than those areas. The usefulness of this comparison is not brought out in your



BGD

8, C3489–C3491, 2011





discussion.

- Page 8169, lines 14-18: “bi-exchanged” might be better expressed as bidirectionally exchanged. You acknowledge here the importance of the bidirectionality of the ammonia flux, but the model doesn’t include this. I’m not sure how that then leads to some of your explanations for your modeling results. Also, all gases are modeled in the resistance paradigm with some connection to the canopy resistance, not just bidirectionally exchanged ones.

- Page 8169, line 20: I would think that HNO3 deposition would play a very strong role in the oxidized nitrogen deposition and probably more so than NO2 deposition. To only look at correlation with concentration and not consider the deposition velocity may lead to incorrect conclusions.

- Page 8170, line 2: Shen et al (2009) did not measure deposition. They used monitored concentrations paired with a deposition velocity (inferential method) to obtain deposition estimates.

- Page 8170, line17: “in spite of” – this sentence is unclear

- Page 8170, line 21: “this value” what are you referring to?

- Page 8170, line 26: “upper scale” maybe should be “upper limit”

- Section 3.4 in general: I’m not sure I understand why you chose the critical load of 30 kg/ha/y when the cited studies for that number are for other ecosystems.

- In general, I don’t think your development of critical loads is described well enough.

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Interactive comment on Biogeosciences Discuss., 8, 8161, 2011.