Biogeosciences Discussions

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# Comment on bg-2021-341

Anonymous Referee #2

Referee comment on "Update of a biogeochemical model with process-based algorithms to predict ammonia volatilization from fertilized cultivated uplands and rice paddy fields" by Siqi Li et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-341-RC2, 2022

The authors describe an update to the CNMM-DNDC model to improve ammonia emission simulations. First, they performed a calibration and parameterization across upland agriculture sites. Second, they added a new algorithm to simulate ammonia emissions from rice paddy fields with flood irrigation. Finally, the authors conduct a sensitivity study to analyze the contributions to ammonia emissions over a variety of environmental factors (including atmospheric conditions, soil properties, and management of irrigation and fertilizer).

The manuscript is novel in that it brings a new management practice, flood irrigation, into a biogeochemistry model for calculation of ammonia emissions. This is a valuable addition to the field and should be considered in future models because of the differences in volatilization from management practices. I think the paper is well written and interesting and fits in the Biogeosciences scope. However, the paper could benefit from some additional clarification before it is ready for publication.

**General comments:**

Line 47-50: Might also want to mention efforts in ESMs such as Riddick et al., 2016 and Vira et al., 2020.

Line 63: “dose and application methods…” The type of fertilizer used (e.g., manure vs. synthetic fertilizer) will also have an effect on volatilization of NH3.

Line 102-104: The algorithms were already in the model, my understanding from reading the manuscript is they calibrated and parameterized the model further. However, this is never fully explained in the text under the materials and methods section.

Materials and methods section, I suggest organizing this differently. The authors start with a description of the sites, but I think it would be better after the model description, but this is optional

Line 155: What regional scale simulations were performed?

Section 2.2.2:

- The authors indicate recalibration and parameterization, but don't indicate how this was done or which components were included in the process. In fact, since the authors don't introduce the original model, it is difficult to understand the significance of the modifications to upland volatilization. Perhaps the authors can expand this section or include a supplement that provides more detail on the original and modified algorithms. Also, how the f values are calculated is also missing in the documentation.
- Were NH3 emissions calculated differently from different fertilizer applications (e.g.., manure vs. synthetic fertilizer or urea vs. ABC) or was only synthetic fertilizer applied at the sites?
- For eq 1, how does the depth of the fertilizer application play a role in the NH3 flux?

Line 267-272: As noted previously, can the authors provide a description of the method used to calibrate the model? More explanation is needed for the process used to calibrate parameters. Because there isn't a good introduction to the initial model, I am left to wonder about the role the parameters play in the emissions process and how sensitive the model is to parameter modification. This would be another good opportunity for a sensitivity analysis. Also, are the final parameter values used for all the sites or are they site/environment specific. Perhaps include a table of the parameters changed and their initial and final values would help.

Section 2.4: I think it would also be interesting to look at a sensitivity of the model parameters as well. This would provide an indication of which parameters have the largest influence in the model simulations of emissions and which parameters are

Section 4:

- The section begins with discussion of the factors affecting emissions and moves into why the model performs poorly for certain conditions. Perhaps split into two sections or separate in different paragraphs.
- Section 4.2 begins by unnecessarily repeating methods (line 473-483), and again discusses model limitations rather than influences on emissions as the section heading suggests.
- I suggest a separate section for model limitations or changing the header of 4.1 and 4.2.
- Section 4.4 reads more like a conclusion than the actual conclusion in the paper.

The conclusion feels like more of an abstract and repeats methodology.

Data availability: Providing model output is useful but does not allow duplication of this effort. A suggestion would be to provide the actual model used by the authors.

**Technical comments:**

Line 16-18 (and elsewhere): "…evaluated and modified using NH3 volatilization observations from 44 and 19 fertilizer application events in cultivated upland areas and paddy rice fields in China, respectively." The wording is slightly confusing. I suggest "evaluated and modified using NH3 volatilization observations from fertilizer application events in 44 cultivated upland areas and 19 paddy rice fields in China."

Section 2.1: The authors should reference Table S6 when discussing the upland sites.

Line 451: is missing a space between placement and 5.

Text is awkward, particularly Line 452-454.

Section 4.3 is missing; the titles jump from 4.2 to 4.4

**References:**

Riddick, S., Ward, D., Hess, P., Mahowald, N., Massad, R., and Holland, E.: Estimate of changes in agricultural terrestrial nitrogen pathways and ammonia emissions from 1850 to present in the Community Earth System Model, Biogeosciences, 13, 3397–3426,

https://doi.org/10.5194/bg-13-3397-2016, 2016.

Vira, J., Hess, P., Melkonian, J., and Wieder, W. R.: An improved mechanistic model for ammonia volatilization in Earth system models: Flow of Agricultural Nitrogen version 2 (FANv2), Geosci. Model Dev., 13, 4459–4490, https://doi.org/10.5194/gmd-13-4459-2020, 2020.