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Discussions

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Interactive comment on "Modelling Nitrification Inhibitor Effects on N$_2$O Emissions after Fall and Spring-Applied Slurry by Reducing Nitrifier NH$_4^+$ Oxidation Rate" *by* Robert F. Grant et al.

Robert F. Grant et al.

rgrant@ualberta.ca

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Anonymous Referee #2

The authors have modified the ecosystem model to simulate effects of nitrification inhibitors on N2O emissions. The subject is interesting and useful. However, there are several issues that need to be improved before it can be accepted. My detailed comments are listed below:

1. Ln 73-77 recent references for modelling of nitrification inhibitor should be included. For example, Y Li et al., 2020. Modelling nitrification inhibitor effects on emissions of

nitrous oxide (N2O) in the UK, Science of The Total Environment, 709: 136156.

This paper, which had not been published when I submitted the manuscript last year, is now cited. I also contrast this model with ours in Sec. 6.5 which has been added to the manuscript.

2. Original model seems too long although most of them are putted in Supplementary materials. This distracts from the modified parts and novelties. It would be better if this paper can focus more on the modified parts of nitrification inhibitor. I would like to use a subsection to describe briefly the original model, such as oxidation reduction reaction. On the other hand, Section 2.9 should include more details, such as some equations related to the modification of nitrification inhibitor.

I have reworded sec. 2.1 to clarify the relationship between the description of earlier model components in sec. 2.2 to 2.8, and nitrification inhibition in sec. 2.9. However because readers' understanding sec. 2.9 requires their understanding of sec. 2.2 to 2.8, I am reluctant to abbreviate them, as I frequently refer to these sections to explain model behavior in the Discussion. In fact, Sec. 2.9 includes all equations by which NI activity is modelled in this paper. I have removed Sec. 2.10 and 2.11, and all later references to them, to shorten the manuscript.

3. For the site description, it is better to add a figure to show the location of specific fields.

There was only 1 set of experimental plots located in only 1 field in this study. Further details about plot topography and size have been added to Sec. 3.1 with further details in an earlier paper by Lin et al. (2018)

4. Ln240, the Arrhenius equation of fTs could be given.

I now cite the Arrhenius equation in sec. 2.9 as [A6] in S1 of the Supplementary material in which all parameters are given.

5. It is unclear what Fall and Spring in Fig. 2 are since Fig. 2 (a)-(d) were in 2014-2016.

I have added seasonal indicators to Fig. 2.

6. It may not be sufficient to examine the sensitivity of one parameter, KiNH4 (Table 9) because other parameters should be important, such as RI, K_CO2 and temperature coefficients in fTs.

I examine the sensitivity to two parameters, It=0 and KiNH4 which could not be estimated from experimental studies. The other 2 parameters, RI and Fts could at least be estimated from other studies, although I now discuss issues concerning this estimation in Sec. 6.5 which had been added to the paper.

7. What is ftl in Eq. (3)?

This has been corrected to fTsl as in Eq. 1.

8. Other factors, such as soil moisture and pH, can also affect N2O emission with the nitrification inhibitor. The limitations should be discussed due to the neglection of these factors.

I have added a note to this effect in Sec. 6.4, but insufficient data are available for model parameterization.

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