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Interactive comment on "Modelling Nitrification Inhibitor Effects on N_2O Emissions after Fall and Spring-Applied Slurry by Reducing Nitrifier NH_4^+ Oxidation Rate" *by* Robert F. Grant et al.

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Anonymous Referee #3 Nitrification inhibitors (NI) have attracted much interest recently because retarding nitrification by NI can reduce the emission of N2O from farmland, thus reducing the climate forcing of food production. However, it is difficult to simulate effects of nitrification inhibitors on N2O emission from agriculture due to complex interaction among NI, nutrients, soils and weather. This paper modified Ecosystem model to incorporate NI processes and applied it to evaluate effects of NI on N2O emissions. Thus, the topic of the paper is highly relevant. However, it may require some changes before acceptance for publication. Below is a list of major and minor comments.

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Major comments 1. Many of the described method in this study are already stated in their previous works. Some of them have included from their previously published works.

I have retained sec. 2.2 to 2.8 because readers' understanding sec. 2.9 on NI requires their understanding of sec. 2.2 to 2.8, and I frequently refer to these sections to explain model behavior in the Discussion. I have removed Sec. 2.10 and 2.11, and all later references to them, to shorten the manuscript.

2. In Section 3.1, more details are needed; for example, describe the vegetation, in terms of species, snow depth, drainage patterns of the fields, slope, ... This information will help for repeatability of this study. Also, this information can be used in a larger study for globalizing the model capability addressed in this study.

I have added a few further details about the experimental site in Sec. 3.1, noting that this experiment was already described in an earlier publication (Lin et al., 2018).

3. In Section 4, it is unclear what site boundaries were modelled. Ecosystem could be a 3D model for water and nutrient transports in S4. Did the authors simulate the 3Dfluxes in soils in this study? More details should be provided for the site topology and slopes for a 3D simulation if yes.

Field plots were simulated as 1D soil profiles with a subsurface water table at 1.2 m as now described in Sec. 4.1.

4. In Section 5, though the paper stressed effects of snowmelt and freeze-thaw on NI and N2O emissions, no results were reported on the freeze-thaw processes, such as snowpack depths, and snowmelt water pools. For example, in Section 5.2.1, oxygen transfer and uptake are explained using snowmelt and drainage of meltwater. However, snowpack was not provided in both measurement and simulations. In Lines 439-441, the smaller rises and subsequent declines in N2O in Fig. 5 were attributed to effects of information of thawing and refreezing. However, Fig. 5 does not provide information of

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snow depth and freeze-thaw.

I have added further information in Sec. 5.2.1 about how snowmelt and freezing-thawing affect N2O fluxes modelled in ecosys. These effects are further described in Grant and Pattey (1999) as now cited in Sec. 5.2.1. To some extent freezing and thawing can be inferred from temperatures plotted in Figs 4 through 7. I have not added any further graphics about snowmelt and soil thawing because the focus of this paper is on NI effects on N2O emissions rather than the emissions themselves, and the paper is already rather long.

Minor comments 5. Lines 49-51, give references.

Done

6. Lines 74-77, a testing of modelled NI effects on N2O emissions has been performed in Science of The Total Environment recently.

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.

7. In Conclusions, it is better to include quantitative results of NI effects.

I have added a range of N2O emission reductions modelled with NI

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