

Post-review decision: gmd-2021-317

The authors have done a good job responding to reviewer comments and concerns. There are some remaining improvements to be made, I think, but these are relatively minor. Thus, I recommend *publication with minor revisions* (with a final review by me).

Primary comments

Reviewer 1 comment 2

Reviewer 1 asked specifically about *ecosys* performance with regard to high-frequency fluctuations. It's unclear whether that's included in the R^2 value for NEE listed on line 151—what frequency was that analysis at?

There's nothing in the new text about N_2O performance; please add some text pointing to Grant et al. papers as you did for in the response to the reviewer (although that level of detail isn't necessary): "1) the papers of Grant et al (2006, 2008) to find the influences of fertilizer rate and temperature on N_2O emissions in fertilized agriculture soil; 2) the paper of Grant et al (1999) to find the influences of spring thawing; and 3) the papers of Grant et al (2010, 2016) to check the N_2O simulation performances at managed forest and grassland."

The Wang et al. (2021) reference is missing from the References, and I can't check Yang et al. (2022) because it's only been submitted.

Reviewer 1 comment 3

Yes, you cited the Miller (2021) thesis, which has chamber measurement uncertainty. But I think the reviewer was saying it would be good to explicitly compare the uncertainty in the simulations to the uncertainty in the chamber observations. Please add some discussion of this.

Reviewers 2 and 3: Out-of-sample performance

The reviewers seem to have missed that Chamber 6 served as an out-of-sample evaluation. This should be made clearer throughout the manuscript.

- Figs. 2 and 3 should indicate (graphically and in caption) which chamber was out-of-sample
- Figs. 4 and 5 should *only* include the out-of-sample chamber as the observation. (It's unclear whether this is already the case.) This should be mentioned in their captions.
- Same for Tables 1–3.

You also point to how the model behaves when there is no chamber observation data as an additional out-of-sample test. While you may *suspect* it does well, without any measurement data, it's not justifiable to use this as a certain measure of performance. Please revise lines 424–429 to reflect that (e.g., "poor **assumed** performance," "**assumed** improvement).

Reviewer 3: N_2O fluxes and NO_3 concentrations higher than normal

In your reply to Reviewer 3, you posited that you saw peaks of N₂O around 20 mgN m⁻² day⁻¹ and NO₃ around 40 mgN kg⁻¹. However, it appears from Figs. 2 and 3 that those are actually about 60 mgN m⁻² day⁻¹ and 95 gN m⁻², respectively. Compare to the papers you cited (units converted as necessary to match yours):

N ₂ O emissions (mgN m ⁻² day ⁻¹)	Reference
4.8	Venterea et al. (2011) Figs 3–4
8.2	Fassbinder et al. (2013), p. 612
19.2	Grant & Pattey (1999) abstract
18	Grant et al. (2006) Fig. 2
34	Grant & Pattey (2008) Fig. 3
38	Grant & Pattey (2008) Fig. 4
50	Hamrani et al. (2020)

NO ₃ concentration (mgN kg ⁻¹)	Reference
7.1	Grant & Pattey (1999) Table 3
80	Venterea et al. (2011) Fig. 8

It's not a problem that your peaks are higher than seen in other studies, but as Reviewer 3 suggested, this should be disclosed (perhaps in the Discussion).

Minor corrections

- L140-1: Should be “respiration, and NO₂⁻ becomes **an** alternative electron acceptor” (note not “respirations”)
- L143: Should be “considers”
- L216-8:
 - Should be “Since **up to**”
 - 16/24 is 2/3, not 3/4
 - Should be “of the day **is**”
- “and meanwhile present slight variations”—it’s unclear what this means
- L257: “**the** highly ranked”
- L375: What is a “hot moment”? Please define for less-technical readers.
- L560: “from **a** PB model to **an** ML model”
- L565: “We expect our validation results will be more solid” is a little too casual and vague. Maybe something like, “We expect to further validate and refine our model”
- L567: “Will be inevitable” why?
- L568: “surrogate” isn’t a verb. Maybe replace “to efficiently surrogate” with “efficiently emulating”
- Line 723: “structuress”