

Interactive comment on “Coupled eco-hydrology and biogeochemistry algorithms enable simulation of water table depth effects on boreal peatland net CO₂ exchange” by Mohammad Mezbahuddin et al.

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Referee's comment: This manuscript describes simulations of peatland biogeochemistry using the ecosys model, and compares the results to observations from a flux tower, chambers, and water table observations. The model is used to support a detailed analysis of interactions among soil microbial processes, mosses, vascular plants, and hydrology under different water table regimes. The model does a very good job of replicating measured hydrology and carbon cycling at the site, and the analysis produces some very interesting insights about the peatland response to changes in water

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table. The explanation of how different components of the peatland (vascular plants, non-vascular plants, aerobic decomposition, etc) interact differently under saturated, unsaturated, and deep water table conditions was especially interesting, and I think this has great promise to be a useful framework for future analyses in this field. Overall, I think this was a really nice paper, with novel insights, an impressive model, and clearly written (though dense) presentation.

Referee's comment: My only major suggestion in that a visualization of the interactions at different water table levels might help to summarize the results in a way that's easier for readers to grasp. Sections 2.1.2 and 2.1.3 lay out a lot of competing responses to water table depth (oxygen availability, decomposition, root growth, nitrogen availability, : : :). While the description is pretty clear, I think a visualization would be really helpful. This could be as simple as a table or text box with columns for vascular plants, non-vascular plants, aerobic microbes, etc and rows for different hydrological regimes with the key processes affecting each ecosystem component.

Authors' response: A flow chart will be added to depict the key biogeochemical and physiological responses to different water regimes (e.g. aerobic vs. anaerobic) that were modelled in ecosys and described in section 2.1. An example of the flow chart is attached herewith as figure 1.

Referee's comment: Also, there are a lot of interesting mechanistic explanations in the Discussion, but I think there's an opportunity to tie these to the existing literature a little better. Are these new insights about process interactions that have not been discussed in the past? Or are these known interactions that have not been successfully modeled before? A little discussion of the novelty of the process interpretations and general framework of the results versus the novelty of the model itself might help place the results in a better context.

Authors' response: The mechanistic explanations in the discussion will be summarized in a table to facilitate the comparison between modelled processes and existing liter-

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ature. This will be done by comparing modelled outputs of different components of carbon and nutrient cycling against measurements available for the site or for similar sites in the literatures with references. The intention of the mechanistic discussion was to test the adequacy of existing knowledge of our process interpretation to reproduce WTD-C feedbacks in a northern boreal fen which has not been done before. The novelty of the process interpretations vs. modelled processes will be briefly discussed in the discussion section wherever applicable.

Referee's comment: Specific comments: Lines 17-22: This sentence is really long and hard to follow. I would suggest rewriting it.

Authors' response: Will be done.

Referee's comment: Lines 38-40: This is an important result, and it might help to also briefly explain the process behind it (e.g. more drainage eventually leads to limitation of GPP due to water limitation).

Authors' response: Will be done.

Referee's comment: Line 46: The units of g/yr don't seem right.

Authors' response: It should be g m⁻² yr⁻¹, will be corrected.

Referee's comment: Lines 316-318: This sentence has some grammatical issues. I suggest rewriting it.

Authors' response: Will be done.

Referee's comment: Lines 642-666: These root responses were very interesting. I don't think I've seen this process represented in ecosystem models in the past. Lines 682-686: It's very interesting how vascular plants have an optimum at an intermediate water depth while non-vascular plants don't. Very interesting implications for changes in relative biomass under different conditions.

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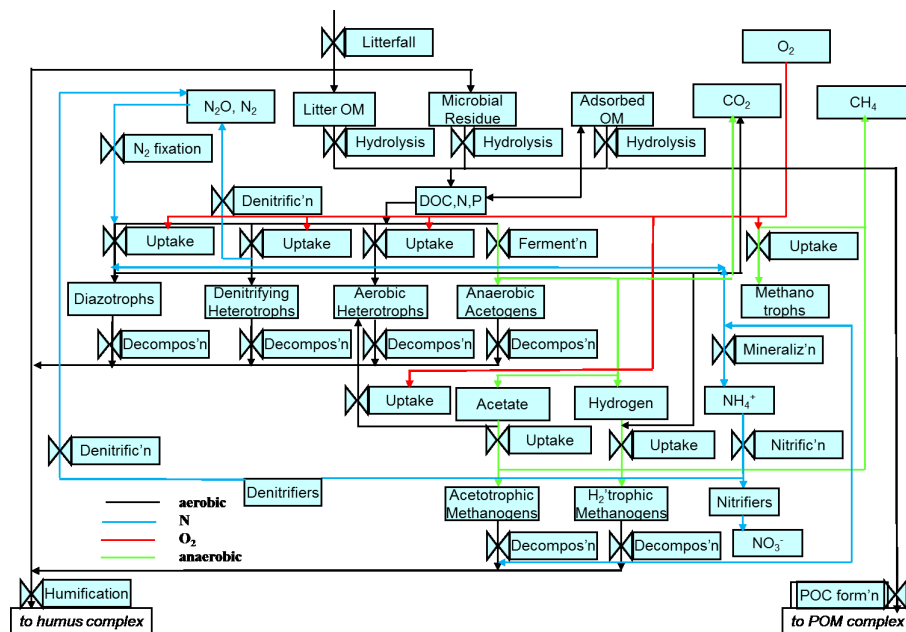


Fig. 1.

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