

Interactive comment on “Response of hydrology and CO₂ flux to experimentally-altered rainfall frequency in a temperate poor fen, southern Ontario, Canada” by Danielle D. Radu and Tim P. Duval

Anonymous Referee #2

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This manuscript presents the results of a rainfall frequency manipulation experiment on vegetated peat monoliths' soil moisture characteristics and CO₂ fluxes. The authors raise the issue that climate projections predict more intense but less frequent rainfall. In peatlands, particularly those with non-vascular plant species as the main peat “builder”, near-surface drying has the potential to greatly influence atmospheric CO₂ exchange in these ecosystems. As the authors note, there is a body of literature examining this general topic, however an examination of the combined effects of vegetation community, water table and rainfall frequency on peat moisture characteristics

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and CO₂ fluxes would be a valuable addition.

There are a number of issues in this manuscript that if addressed, could help this paper make a stronger contribution. The method section includes a description of a field experiment that is mentioned only briefly in the results and discussion. As presented now, there is no need for any mention of the field experiment. However, I wonder how much overlap there is in the background, general research questions and conclusions that are reached in the field experiment manuscript currently in submission (Radu and Duval, submitted). As I note further below, it would seem these are complementary studies that would be much stronger presented together.

Because the peat monoliths are repeatedly measured for a variety of response variables, the data are not independent. I would recommend analysis be carried out using mixed effects models instead of ANOVA.

The authors conclude that less frequent rain and surface drying will give vascular plant species a competitive advantage. There is no data presented in this study that suggests a shift in plant community composition. On what basis are the authors making this conclusion? It would be important to discuss the mechanisms by which competition structures peatland vegetation communities and what might lead to changes in species composition in a fen like the one studied. In addition, I would suggest that the importance of Sphagnum as a peat builder and long-term storage of C is a key issue to raise in addition to shorter-term changes in peatland CO₂ exchange.

The variables with negative values (NEE, GPP, WT, soil tension) are not correctly described in a number of instances. For example, more negative NEE means greater net CO₂ uptake but the NEE value itself decreased.

The results section largely walks the reader through each figure and table (and there are 2-3 figures that are not necessary). I don't think this level of detail in the text is needed. In the discussion section, the results as presented again but this time in a more readable and informative way. I would recommend starting with the results

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statements found in the discussion and add only key details. Currently, the discussion is largely a review of the results with little discussion of mechanism or context within the body of literature on this topic. Similarly, the conclusion summarizes the results again. It might be that presenting the lab and field experiments in separate manuscripts limits what the authors can discuss/conclude, and the manuscript would be much stronger if these complementary studies were presented together.

Specific comments

Line 12: Typically it is volumetric water content or VWC

Line 20: Did your study show that there could be increased vascular plant growth?

Line 38: Should be "season"?

Line 73: And there field studies, e.g. Nijp et al. (2015) *Global Change Biology*, 21, 2309-2320.

Lines 73-75: Mostly a repeat of previous sentence. Reword.

Line 76: Use acronyms consistently throughout.

Line 93: Remove Section 2.2

Line 134: "integrated" rather than "composite"?

Line 135: Add "(SMS)"

Line 139-144: How soon after was the opaque chamber used? How much did temperature increase in the clear vs. opaque chamber? How might a difference in temperature affect estimates of GPP?

Lines 153-163: Remove.

Line 180: EC5 sensors only accurate to 2-3% VWC. Instead present as per 10 cm drop in WT?

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Line 184-197: Given these are monoliths in a lab, are the actual rates important to list? I recommend dropping Figures 2, 3, and 4 and describing trends more briefly.

Line 204: Change "demonstrates" to "illustrates".

Line 234-239: Why analyze ratios?

Line 375: Include the importance of WT position.

Line 610 and 625: Define acronyms and symbols in caption.

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