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Discussions

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Interactive comment on "Long-term Carbon and Nitrogen Dynamics at SPRUCE Revealed through Stable Isotopes in Peat Profiles" *by* Erik A. Hobbie et al.

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Anonymous Referee #2 Received and published: 26 November 2016 General responses: The reviewer provided a thoughtful critique of the paper's deficiencies. Comments were provided in a narrative style, with not many specifics, so in some cases responding adequately was challenging.

Comment: From the introduction as written, I do not 1) understand clearly the motivation to do this study (what real gap does it address?), 2) the reason for using this particular study location (aside from the fact that other stuff will be going on there), and 3) what the authors hope this paper will add to science. The authors bring up a few topics that might be useful to test, but none are presented in a way that suggests

apparent urgency or immediate / profound scientific consequence.

Response: In the rewritten introduction, we lay out where we feel current interpretations of C and N isotope patterns in peatlands have been inadequate and the therefore how our planned approach could provide some additional nuance to interpreting such patterns. This study location was used because the history is well-known through study of a nearby bog and because the multiple cores taken provided a good opportunity to actually examine spatial effects and have some statistical power to examine multiple factors influencing core isotopes, unlike in the majority of previous investigations of peatland isotopes.

Comment: In addition to the introduction's diffuse content, the writing style doesn't allow the messages to get across effectively. For one thing, the intro text contains many long sentences. The leadout sentence is an excellent example, failing to provide a hook, despite use of "imperative" as one of its 50+ words. In some sentences, words like "peat" are repeated 3 times, which could be avoided with some restructuring.

Response: We have tried to rewrite the paper to make it easier to follow. "imperative" (somewhat hyperbole in its effect) has been replaced with "necessary". We have pruned words where possible, particularly where the same word (like 'peat') is used multiple times in a sentence.

Comment: The authors also use terminology I've never heard used before (despite decent familiarity with the topic). Not only were the terms not explained, but some were used uniquely in the introduction. If they aren't used throughout the text, one might conclude that they are superfluous - with the net effect being reader frustration if not of immediate familiarity.

Response: We are unfortunately not sure what terminology is referred to here.

Comment: Why send the reader to find a 1980s paper in order to follow the narrative?

Response: We assume this refers to the Clymo 1984 paper. This has been updated

with a more recent paper (Belyea and Malmer 2004).

Comment: There is also mention of "our" conceptual model, but it's not clear whether the authors are referring to a shared community understanding/model, or a model that they've discussed before in papers they have authored, or a model they are proposing for this site.

Response: We are referring to the conceptual model given in Figure 1, which was our working model for the potential factors that would influence isotopic patterns in the peat profile.

Comment: Lastly, there are a large number of goals / objectives / hypotheses, for C:N, and isotopic signatures, jumbled together in a long paragraph that sets out a scope of work. Why do the authors present only vague exploratory goals for C:N but highly specific hypothesis for isotopic patterns?

Response: The focus of the paper was on using C and N isotope patterns as a tool to better understand the processes that would affect C and N cycling in peatlands, and specifically in peat cores. Thus, specific hypotheses for isotopic patterns were appropriate for our paper goals. Other information (like elemental concentrations and C:N ratios) could of course also provide insights, but was not the primary focus of the paper.

Comment: Which of the hypotheses are actually testable (with some definitive result)?

Response: From the perspective of having worked through the paper and the results, we would claim that hypotheses 1-3 are testable, and hypotheses 4-5 proved to be not testable in that too many competing mechanisms were available to produce definitive interpretations.

Comment: From this introduction as written, it is difficult to figure out intent or novelty. I had to read forward into the discussion in order to understand the content a bit better But after reading to the end, I'm unsure of motive. The second last sentence of the

manuscript gives what seems to be the strongest and loftiest motivation for the study - which is to populate long-timescale (100s - 1000s years) successional models of C and N evolution, in order to test and improve our understanding of isotopic dynamics in such systems. The other motivation seems to be that the study represents baseline conditions prior to a manipulation experiment, which is certainly weaker. If that second motive were true, would it reduce this study to a pre-experimental mapping of variables? Would it be research in that hypotheses are actually being tested? I think the manuscript aims to be both, but the context and importance to both aims must be clarified. Unfortunately the authors must re-write the introduction to better articulate intent, content, and novelty.

Response: The introduction has been rewritten to better articulate our goals of exploring what isotopic patterns in peat profiles can tell us, and what limits our ability to interpret those patterns. The study certainly represents baseline conditions prior to the manipulative experiment, but that does not mean that we regard our study solely in this context.

Comment: Despite the difficult introduction, the study itself is straightforward. A bunch of variables were collected, and analyzed by regression analysis, in order to explore changes in C and N cycles during 10,000 years of succession. In large part the C and N variations through time were explored using isotopic indicators. The results and discussion sections are very detailed, and quite a bit clearer. Within the results and discussion, the authors interweave history (bog changes true time) and process (causal factors). It might create a less dilute narrative if these were pulled apart to some extent. Right now some sections read like a time by time (depth by depth) exploration of process. That's hard for a reader to parse. It might be better to present the history for a specific variable, and then summarize the driving processes. In the manuscript, the whole successional question could be better partitioned from the rest because it's a sub-plot in its own. There is not a whole lot of restructuring here, but some would be useful.

Response: This was a challenge in this study, that at any time point (depth), multiple processes could be influencing a block of peat. And of course, the peat we measured reflected not only initial conditions of climate and vegetation, but also the subsequent modifications of that block of peat by numerous factors. We have done some restructuring of the discussion to address the reviewer's concerns, but we are not sure it is feasible to restructure it in the discrete manner suggested.

Comment: I would suggest the authors use the past tense for all matters relating to results and discussion. "Isotopic patterns with depth reflect climate and vegetation", it's markedly different than saying "Isotopic patterns with depth reflected climate and vegetation". While only two letters differ, he meaning is altogether different. The first proclamation is sweeping and universal, applying at once to this system and all similar systems. The second is technically correct and measured, articulating the fact that at this place, and at the time we did our study, our data led us to believe x. While many authors can use the present tense effectively, in this case I think the past tense would work better - particularly since the study is not definitive because of interactive variables. The authors should exercise caution in their statements.

Response: We agree with the reviewer and the results and discussion have been rewritten to largely use the past tense.

Comment: The titles of the discussion sections are useful in that they articulate the main message. This approach is stylistically modern. But when overused it's dangerous in that these missives provide no nuance if not well conceived. From the existant titles, it would seem that this study is packed with a whole suite of equally important drivers of variation including climate, vegetation, suess effect, tree proximity, stoichiometry, etc. But they AREN'T all equally important. Or more accurately, they WEREN'T. I would suggest the authors revisit these titles to add nuance and accuracy. Which are "secondary" or "tertiary" drivers, for example? Which are simple co-related to some degree? An adjective or adverb here or there can go a long way. Which are a surprise, and which are somewhat self evident or expected even without the data?

Response: The order of the discussion sections has been redone to reflect their importance, with the order now 4.1, 4.2, 4.6, 4.4, 4.5, 4.3, and 4.7. Titles have been changed to be more revealing of their main point. For example, 4.2. "%N, %C, and C:N stoichiometry influence δ13C and δ15N patterns" has been changed to "%N, %C, and C:N stoichiometry primarily influenced δ15N patterns", and 4.7. "Methanogenesis and methane oxidation" has been changed to "No clear evidence that methanogenesis and methane oxidation influenced δ13C patterns".

Comment: The scientific part of this study that gives me some cause for concern is that variables are "interactive", in the words of the authors. Another researcher with a more glasshalf- empty attitude might instead say that the variables are confounded. Because so many are related to one another, definitive conclusion is impossible. The authors mention this problem only passingly in the conclusion. But it's important. Before the discussion, they should carve out some time to discuss this issue. It comes down to certainty. While analytical error probably isn't a big problem in a study like this, there is some uncertainty as to which drivers lead, and which respond. And that sort of understanding is critically important when building mechanistic models (a proposed follow up activity). The authors could provide some better forward navigation here, otherwise their results may be interpreted or used by others incorrectly or out of context.

Response: We believe that the concerns about 'confounded' variables have been largely dealt with in our statistical reworking of the data, as suggested by Reviewer #1.

Comment: The conclusion didn't summarize important points or really draw any conclusions from the work. This section could be strengthened.

Response: Our revised concluding paragraph more clearly contrasts what we learned against the conceptual model that guided our investigations.

Comment: Overall, the study contains good data and is scientifically valid. The study is not highly novel it doesn't seem, but there could be aspects of novelty that simply

aren't communicated well.

Response: The novelty of the study is probably the detailed data set of C and N isotope patterns in a well-studied peatland. Our statistical approach to understanding these isotopic patterns was also novel, we believe, although we also concluded that the multiple processes that could influence the isotopic patterns limited our ability to pin isotopic patterns to unique factors.

Comment: The datasets and findings will likely be of use to the community of peatland researchers. Some discussion around the topic of uncertainty is warranted, resulting from the problem of confounded variables.

Response: The statistical approach has been redone in response to comments of Reviewer #1 and the issue of confounded variable has been reduced by greatly decreasing the number of fitted variables (from $\sim$40+ to 10 and 13).

Comment: The manuscript needs work to improve 1) clarity, 2) accuracy, and 3) narrative.

Response: We believe that the revised manuscript has improved in these three areas.

Comment: Please accept my apologies for the delayed review.

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