Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2017-440-AC2, 2018

Biogeosciences Discussions
Open Access
EGU

Interactive comment on "Controls on spatial and temporal patterns of soil nitrogen availability in a High Arctic wetland" *by* Jacqueline K. Y. Hung et al.

Jacqueline K. Y. Hung et al.

jacqueline.hung@queensu.ca

Received and published: 25 January 2018

RC: Hung et al. examined spatial heterogeneity in soil nutrient pools, effects of prospective abiotic drivers of nutrient availability, and relationships of nutrients and soil moisture with carbon balance of a High Arctic ecosystem. The study identifies landscape positions and times within the growing season that support strong links between nutrients and productivity. Empirical studies such as this have potential to reveal relationships between source-sink dynamics of carbon and spatial and temporal variation in soil moisture that have previously been unrecognized. This study quantifies correlational relationships among carbon fluxes, nutrient availability, and abiotic attributes of

Printer-friendly version

Discussion paper

soils and extends these correlations to assess mechanistic relationships. Greater caution and scrutiny must be applied to interpreting correlational relationships to consider alternative explanations that do not include direct causal links between the measured attributes. For example, coherent temporal patterns between nitrogen pools and productivity might result if both are responding to a shared driver, and might not reflect a direct effect of nitrogen on plant production. The manuscript's context is broad relative to the limited spatial and temporal extent of data collection. There is value in such focused studies, as they can reveal key patterns that might affect processes at larger scales (e.g., regional C balance), but the patterns revealed by the current analyses and their potential implications tend to get lost among discussions of tangential processes not directly addressed by the data in-hand (e.g., phosphorus, N transformations). Finally, there is a missed opportunity to compare patterns in soil nutrients with nitrogen dynamics at the watershed scale, for which there are long-term observations at this site.

AC: We appreciate the insightful comments and questions posed by the reviewer here. Please see the attached supplementary for a revised abstract and more concise introduction. The title has also been changed to better reflect the paper's contents.

Specific comments

Abstract

RC: Line 15: Suggest replacing "highly" with "strongly" here and throughout when referring to correlations

AC: The wording has been changed and this has been addressed in the attached supplementary.

RC: Line 15: "dry tracks" and "wet tracks" not yet defined. The correlates of nitrate reflected in the R2 values are unclear.

AC: This has been clarified in the attached supplementary.

Introduction

RC: The Introduction is long relative to the study's objectives and to other papers published in this journal. Hone in on documented factors that influence nutrient availability and potential links between dynamics of nutrients and carbon fluxes, and pare away ideas that do not directly inform the present analyses.

AC: The introduction has been shortened by a page from the original submission; the attached supplementary has the revised introduction.

RC: p. 2, line 30: delete one instance of Arctic

AC: Sentence revised to read "Preliminary research has predicted that Arctic wetlands have the potential to increase C outputs. . ."

RC: p. 2, lines 31-32: Increased specificity needed here with respect to "projected increases." Does this refer to CO2 flux?

AC: The sentence has been changed to clarify the meaning; the sentence and its preceding sentence now read "Preliminary research has predicted that Arctic wetlands have the potential for increased greening and productivity with increased temperatures and precipitation inputs (Nobrega and Grogan, 2008; Hill and Henry, 2011). These potential increases can help offset the projected increases of CO2 flux through C uptake during photosynthesis."

RC: p. 3, lines 4-5: This text is identical to the text of Commane et al. Commane et al. is not included in the Literature Cited section.

AC: This sentence was taken out as it is not critical to the manuscript. This has been addressed in the attached supplementary.

RC: p. 3, lines 17-20: How are "high Arctic" and "wetlands" defined here? Many study sites cited as such are not classified by the original authors as wetlands or geographically within the high Arctc (e.g., alpine tundra in the Alaska range)

Printer-friendly version

Discussion paper

AC: The sentence should be edited to just read “Arctic wetlands have long been regarded as C sinks. . .”. Most studies refer generally to Arctic wetlands; this study here looks at a wet sedge meadow, a type of wetland representative of Arctic wetlands. References of studies in the Alaskan Range have been removed as they are not pertinent to this study. These changes are reflected in the attached supplementary.

RC: p. 4, line 5: define CBAWO

AC: CBAWO should be defined as the “Cape Bounty Arctic Watershed Observatory (CBAWO)”.

RC: p. 4, line 28: revise for grammar

AC: Sentence should read “Microbial controls on nutrient cycling are important processes to consider in High Arctic environments.”

RC: p. 6, line 14: Please describe the spacing of the points on the sampling grid.

AC: Please see supplementary Figure 1 showing the spacing of the points on the sampling grid and location of wet and dry tracks in relation to each other.

RC: p. 7, line 30: Please report limits of quantitation and how samples below these limits were handled.

AC: The limits of detection for the segmented flow analyzer used is sub-parts per billion; no samples went below that limit.

RC: p. 8, lines 16-17: Ecosystem respiration includes heterotrophic respiration, and therefore NEE-ER does not yield GPP. See Chapin et al. (2006) for consensus definitions of carbon cycling terms. Chapin, F. S., Woodwell, G. M., Randerson, J. T., Rastetter, E. B., Lovett, G. M., Baldocchi, D. D., et al. (2006). Reconciling carbon-cycle concepts, terminology, and methods. Ecosystems, 9(7), 1041–1050.

AC: All instances of net ecosystem exchange (NEE) changed to net ecosystem productivity (NEP) as per Chapin et al., 2006.

Methods

RC: p. 8, line 18: Regression and Pearson correlation analyses are duplicative and only one should be reported. If the coefficients are of interest and linear associations are expected, use regression.

AC: Results from the Pearson correlation analyses will be removed for revisions; only regression analysis will be reported.

Results

RC: p. 9, line 12: I am not certain of the interpretation of the epsilon terms reported here, but I believe they are associated with the deviation from the sphericity assumption of the rmANOVA. Typically those values are used to correct the final P-value. It is unclear whether corrected P-values are reported.

AC: The corrected P-values were not reported as they were significant at all levels, so the standard P-value was shown.

RC: p. 9, line 15: I recommend leaving out the within/between subjects language in favor of more straightforward reporting of the ecological pattern captured by each term.

AC: This will be addressed in the revision; within/between subjects language will be substituted with between moisture tracks/across the season.

RC: p. 12, line 19: These regression statistics would be easier to interpret if reported on the corresponding panels of figures 5 & 6. However, the regressions should be performed as multiple regressions to avoid inflating the chance of false positives. Further, collinearity among predictors should be addressed.

AC: The original submission of the last paragraph of Section 3.6 and Section 4.2 lacked much of the main findings from this study pertaining to comparison the strength of relationships between environmental variables in predicting carbon flux vs. inorganic N and environmental variables in predicting carbon flux. These findings will be included in

Printer-friendly version

Discussion paper

subsequent revisions of the manuscript. To summarize, as seen in the attached Figure 2, the strength and spread of the relationship to carbon dioxide exchange is tightened when plant-available nitrogen forms are factored in. Collinearity among the predictors was not an issue

RC: p. 13, line 8: Referring to a table or figure, rather than a p-value to support the result would provide clarity.

AC: This statement is in reference to Figure 2 of the original submission.

RC: p. 13, lines 30-32: Many correlational relationships are described here, and it would be fruitful to speculate about multiple potential causal associations. For example, seasonal patterns in these abiotic attributes might co-occur with the light regime and therefore NPP, resulting in less labile substrate to fuel ER, but with no direct effects of moisture, temperature, and active layer on ER.

AC: The manuscript revision will include discussion on the multiple regression models that were explored and the multiple potential causal associations that these results present.

RC: p. 14, line 10: Has it been established that soils at the study site are anoxic?

AC: The redox potential has not been assessed for this study site, but saturated soils of this nature are generally anoxic.

RC: p. 14, lines 17-20: There are some potentially interesting ideas about the drivers of N dynamics listed here, but the effectiveness of this discussion would be improved if the logic linking each of the factors was fully spelled out.

AC: The links between the factors will be clarified and expanded in the revised manuscript.

RC: p. 14, lines 26-30: Here is another example of interpreting correlations as causal relationships. It is plausible that another factor, likely seasonality, drove both NPP

Printer-friendly version

Discussion paper

and nitrate availability, rather than nitrate influencing GPP directly. Further, increased availability of nitrate in soils could occur due to lack of plant uptake of N.

AC: The revisions will be made using more careful wording of the implications of the results (i.e. “suggests” instead of “indicates”) to avoid misinterpretation of causal relationships.

RC: p. 14-15, lines 33-2: The parallelism between the present and Toolik Lake result is not quite clear. How are patterns in light reflected in the present dataset?

AC: The patterns in light are not reflected in the present dataset, although PAR measurements were taken (but not reported). The sentence should be rephrased to focus on the relationship between increased soil temperatures and higher ammonium availability; mentions of light attenuation will be taken out in revisions as they do not strengthen the argument.

RC: p. 15, lines 19-20: Several papers from the Cape Bounty study have addressed nitrate dynamics from a catchment perspective. It seems relevant to place the present results into the existing context for the site.

AC: Addendums will be made to the revisions to include discussion on catchment-wide nitrate dynamics (i.e. Louiseize et al., 2014; Lafrenière et al., 2017).

RC: p. 16, lines 10-28: Discussion of steps in the N cycle and nutrients (P) not addressed by the present dataset (available nitrate and ammonium) is beyond the scope of this study and detracts from its take-home messages.

AC: This section will be taken out in the revisions as it does not pertain to the study.

RC: Fig. 4: It would be helpful if the symbol colors or sizes were proportional to the resin N content. Shapes could be used to represent wet/dry tundra. I don’t think spatial interpolation is appropriate here because the area between the two sets of points is unsampled, and therefore error in the estimates varies greatly across the study area.

Printer-friendly version

Discussion paper

AC: This figure will be taken out in the manuscript revision as it does not contribute significantly to the main findings.

RC: Tables 6-7: Interpretation of the B1, B2 identifiers is unclear.

AC: A, B1, and B2 are in reference to the total, early, and late season resin deployments; this will be clarified in the revised manuscript.

RC: Fig. 5: These plots require labels with units on both axes

AC: This change has been made for the revision.

Please also note the supplement to this comment:
https://www.biogeosciences-discuss.net/bg-2017-440/bg-2017-440-AC2-supplement.pdf

---

Interactive comment on Biogeosciences Discuss., https://doi.org/10.5194/bg-2017-440, 2017.

Printer-friendly version

Discussion paper

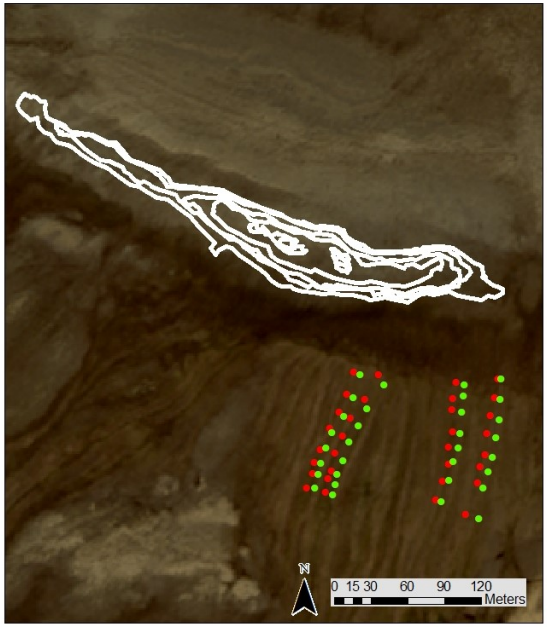

Fig. 1. Natural cover image of the study area with wet (red) and dry (green) plots overlaid

Printer-friendly version

Discussion paper

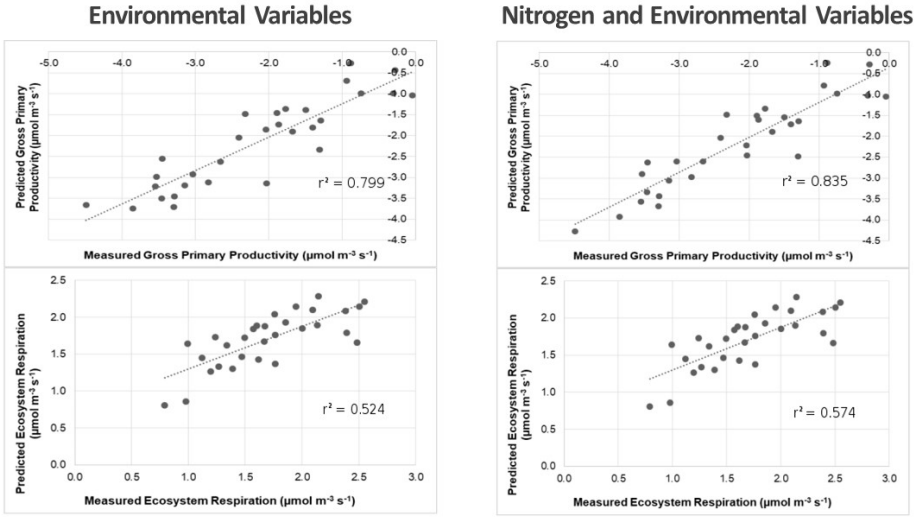

Fig. 2. Multiple regression results using environmental variables and nitrogen in predicting CO2 exchange

Printer-friendly version

Discussion paper