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Discussions

Interactive comment on "Carbon storage in phosphorus limited grasslands may decline in response to elevated nitrogen deposition: a long-term field manipulation and modelling study" *by* Christopher R. Taylor et al.

Anonymous Referee #1

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The N14CP model isn't described in much detail, but is reported to have been validated against an extensive range of sites. It appears to be a largely empirical, first-order mathematical approach with climate as the primary plant growth driver, limited by N and/or P availability to meet stoichiometric needs. The rate equations for P uptake and loss are not defined clearly, but the new "cleaving parameter" appears to be a rate coefficient for a first-order model. The authors finally mention root surface phosphatase enzyme activities on line 539. This should have been done much sooner as a justification for the model formulation and perhaps help inform model formulation. In all, it's

difficult to understand how the model works from the information provided.

The principle focus of simulations seemed to be to derive optimal parameter values that provided best fit to a set of field observations for aboveground biomass (AGB), and soil organic C, N and P pools. The comparisons were difficult to interpret given the scales of simulated vs observed data (Fig. 2). Although the overall relationship between simulated and observed AGB was reasonable, these relationships for soil pools were much weaker and would be better understood if scales were selected to spread the observations. From these data, there was no apparent relationship between observed and simulated values of C and P.

Given the weak validation test results, the lengthy discussions of many simulation patterns and details seem overemphasized. Many of the results are highly speculative and for reasons that aren't clear. For example, the authors discuss many potential interactions between N and P limitations, but how are these explanations based on mechanisms included in the model? On a more general topic, why simulations over such a long time period?

The effects of acidification on P availability regarding iron and aluminum complexes are more complex than referenced on lines 541-545 (see Barrow 2020). More information about how these sites, their mineralogy and pH might influence P availability would help interpret this idea.

In conclusion: this model revision seems to have improved the N14CP model's ability to respond to N and P limitations to plant growth, likely due to adding an organic P source, but the model doesn't capture much of the soil pool dynamics so it could be summarized in a much shorter article.

Barrow, N.J., 2020. Comparing two theories about the nature of soil phosphate. European Journal of Soil Science. https://onlinelibrary.wiley.com/doi/epdf/10.1111/ejss.13027.