

SOM modelling as it is done in most ecosystem models with first-order decay kinetics has been criticised for being too simplistic with a strict artificial division of available N between microbes, plant uptake, de/nitrification and other losses. Zhu et al. address this issue by introducing a soil nutrient competition model N-COM. At a first glance the model seems very interesting and comprehensive, but the way it has been tested and calibrated in the manuscript leaves many questions unanswered.

In the abstract the authors state that their results imply a certain competitiveness order for NH₄, NO₃, and PO_x. I would argue that this order comes mainly from calibrating the model to data than as an independent modelling result.

The importance of soil nutrient dynamics and carbon-nutrient interactions is stated to be critical for ESMs in the introduction (4060 L14). And the authors continue to state that resource competition is a critical improvement needed in ecosystem models (4061 L2). It has been shown (FACE MIP project; Medlyn et al. 2015 and serie of articles) that ecosystem models differ in their representation of many different processes with contrasting responses to perturbations to the system. So to say that nutrient competition is critical for the ESMs is a little too strong, as I think many other process brought to light in Medlyn et al. (2015) will have larger impacts.

The model at a first glance looks interesting (Eqn 13-21, A6-14 and B8), but the decision to keep the enzyme abundance of all consumers at a constant value (4068 L14) makes me disappointed. This results in that the model is based on the two variables VMAX and KM, which is extensively calibrated in the study. Eqns A6-11 could then to fully be represented by a simple eqn (plant NH₄ uptake as an example A6)

$$F_{NH_4}^{plant} = VMAX_{NH_4}^{plant} \frac{[NH_4^+]}{KM_{NH_4}^{plant}(const)}$$

This eqn is discussed in the results section (4076 L20-27). The assumption of fixed [E] gives you a model with no possibilities for the ecosystem (plants, microbes) to adjust their competitiveness under nutrient limitation, which most ecosystem models already have (plants increase root allocation under nutrient limitation). So by not activating a flexible [E] I think this study is missing a lot, which the manuscript is mentioning when stating that robust competition representation for climate-scale models will require representation of dynamic changes in plant allocation (4063 L3).

VMAX is mentioned throughout the paper, but isn't the constant to calibrate *k* in eqn B8, if flexible [E] is to be used?

Will the calibrated values of VMAX and KM be valid under flexible [E]?

The model was spun up for 100 years for the Puerto Rico simulation (4074 L19). I would like some more explanations on the spin up procedure (SOM build up? N/P uptake? etc) and the need for it as this is the only place it is mentioned in the manuscript.

The change of coarse woody debris turnover time by 50% (4075 L18) is significant and its consequences to the C, N and P cycles/stocks should be covered.

Figure 5 shows the result of the Hawaiian chronosequence experiment. It looks like modelled microbes is taking up close to nothing at all three sites and mineral all available P. Could this figure become clearer or is it that mineral is so competitively strong that they get 100% in the model?

For NH₄ at the Puerto Rico site, plant and microbe is opposite strong at taking up NH₄. Could this be adjusted if [E] became flexible?

I also miss how the model would affect plant growth, heterotrophic respiration, N fluxes compared to a normal first-order decay kinetics model. Have this test been done? If so could a section describe the differences in their behaviour? Or even add it to Figure 5 for comparison.

Specific comments

Update eqn numbering in appendix B

“to” or “-” p4061 L14/19 (days to months) or (months – years)

P4068 L7 missing a punctuation.

Reference

Medlyn et al. (2015) Using ecosystem experiments to improve vegetation models. Nature Climate Change 5, 528-534 doi:10.1038/nclimate2621