Geoscientific

Model Development

Discussions

[GMDD]

Interactive

comment

Interactive comment on "Stoichiometrically coupled carbon and nitrogen cycling in the MIcrobial-MIneral Carbon Stabilization model (MIMICS-CN)" *by* Emily Kyker-Snowman et al.

Anonymous Referee #1

Received and published: 17 January 2020

This paper develops a new version of MIMICS with nitrogen cycling that is coupled to carbon using the standard theory of element limitation. Like its predecessor, MIMIC-CN is tested against litter decomposition experiments conducted across a wide range of sites, but this time focusing on C and N interactions. General fits of other pools and ratios are also shown to correspond with data collected from several synthesis studies. This paper is well within the scope of GMD, it describes the model clearly and provides a thorough continental-scale analysis of model predictions. I do not have any major issues with the paper but do have some suggestions that I hope will be useful.

It is interesting that initial litter quality does not control the soil C:N. I just

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Discussion paper

saw a paper that uses the bare fallow experiments to argue the opposite (https://www.nature.com/articles/s41598-019-55058-1), but with a very different model. Just something to think about – and possibly to address in the discussion.

L32: I suggest "These models *can be* as good as" instead of they are. You can say the models with microbes are better in the papers cited at the end of the sentence, but not about the untested models in the previous sentence (to which the subject "these models" seems to refer).

L206: MIMICS-CN does "as well as or better than DAYCENT" based on what criteria? From the following sentences, I assume and would make explicit here that you are using RMSE. Because using R2 I would say DAYCENT does a bit better, and using bias they are equivocal but in different ways (I don't think this undermines your development, since this model also provides uniquely testable predictions). I would also give a brief summary of the R2 and bias measures in text since they are in the table.

L220: I would change "red dots" to red triangles or symbols throughout, since the word dots makes me look for circles.

L273-274: This sentence sounds like you are guessing that microbes are C-limited, but you can know for sure by checking for overflow respiration.

L297: I agree that microbial community dynamics can add variability, but there are a lot of other possibilities also, like soil moisture and mineralogy (that which isn't captured by clay, like Fe and Al content).

L350: I think doing this is a reasonable way to get the right soil C:N given the structure of MIMICS, but I don't think POM/free light explains it all because that fraction is not physically protected. You could also be missing a protection mechanism that bypasses microbial biomass like aggregation of POM.

Figure 1: This figure is a little confusing because DIN is a N-only pool, but the other pools are C and N together. It might look a little unwieldy to show all C and N pools

since you have additional pools. You could shade/color the background or the outline of each pool with two colors to represent that it is partly C and partly N. Figure 1 of these papers try some different strategies: https://doi.org/10.5194/gmd-11-2111-2018, https://doi.org/10.1002/2017JG003796, https://doi.org/10.1016/j.soilbio.2009.02.031)

Figure 2 : Can these panels have the same y-axis ?

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Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2019-320, 2019.