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Interactive comment on "Modeling rhizosphere carbon and nitrogen cycling in Eucalyptus plantation soil" *by* Rafael V. Valadares et al.

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Dear reviewer,

We appreciate the anonymous reviewer's attention to detail and the helpful comments.

Sincerely yours,

Rafael V. Valadares

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Answers to anonymous reviewer's comments

Comment from Referees:" However, I cannot judge the soundness of the paper due to lacking information and confusion of units in the model description"

Author's response: Our model is running using the processes explained in the paper. Furthermore, the model is an improvement and specific application of a previously published model MCNiP – article entitled: "Stoichiometry constrains microbial response to root exudation-insights from a model and a field experiment in a temperate forest.

Some values are coeficients and have no unit.

Author's changes in the manuscript: We will review the units.

Comment from Referees: Without reading the cited publication informations are lacking: - on the evaluation data (what does one data point represent: a different plot, a different treatment, a time series? ...) - lack of information how the model was calibrated (just the one standard parameterization, or some parameters adjusted, once for all the data or different parameters by dataset or observation, ...)

Author's response: We wrote a topic inside the Material and Methods about the parameterization.

Author's changes in the manuscript: None.

Comment from Referees: There are unit errors in the model description E.g. in 21 the units of right and left hand side do not match.

Author's response:

EPc = Kep BCm

EPc = rate of enzymes production (μg/g/h)

Rate of enzymatic production per unit of biomass (Kep) = μg/μg/h

C in microbial biomass (BCm) = μg/g

EPc = (μg/μg/h)x μg/g

EPc= μg/g/h

It is correct. This means that the rate of the enzymes production per gram of soil in one step of the model.

Author's changes in the manuscript: Thank you for presenting your opinion.

Comment from Referees: There is confusion between rates (amounts be per hour) and pure amounts (here concentrations per g Soil).

Author's response: All the concentrations are with the correct unit.

Since our time step is one hour, we consider that it is unnecessary to express time (1 h) in all the rates. But we will change it.

Author's changes in the manuscript: We will insert explicitly the unit of the hour in all the rates. Many thanks for this suggestion.

Comment from Referees: In eq. 16 and 17, it is checked whether a rate is smaller than an amount (Uc < DOC). This makes sense in a model integration using a time step integration of 1 hour, but nevertheless is a category mistake. The model description needs to be better separated from the time integration of the model.

Author's response: It just means that the microbiota may only depolymerize smaller amounts of C and N from soil organic matter than it can take up. The enzymes compete for substrate sites and the soil itself competes for the substrate cleaved by them. Then, the amount of dissolved carbon and nitrogen clearly may be less than the uptake capacity of the microbiota.

Author's changes in the manuscript: Thank you for submitting your opinion.

Comment from Referees: It is very hard for the reader to always need to locate all the abbreviations in the tables S1 and S2. I recommend repeating the the abbreviations in the sections, where they are used for the first time. Because of these confusions and abbreviations, I did not check all the equations.

Author's response: If the manuscript goes on to later steps, such changes will be made.

Author's changes in the manuscript: We will repeat the abbreviations in the text.

Comment from Referees: The formulation of uptake (eq. 13, 14) is awkward. The uptake of DOC is proportional to biomass measured in carbon units (BCm) , while the uptake of DON is proportional to biomass measured in nitrogen units. I suggest computing the uptake of N to be stoichiometric with C using the CN-ratio of the DON. If microbial uptake is deliberaty described differential in C and N, I would at least make it proportional to microbial biomass measured in the same units.

Author's response:

Uc=(Vmaxuptake BCm DOC)/(Kmuptake+DOC)

Un=(Vmaxuptake BNm DON)/(Kmuptake+DON)

It already considers the dissolved C and N stoichiometric. DOC means organic C in solution. DON means organic N in solution.

DOC (i+1)=(1- Kpr)(DOC(i)+Ce+Dc+CYc+ELc)-Uc

DON (i+1)=(1- Kpr)(DON(i)+Ne+Dn+CYn+ ELn)-Un

Author's changes in the manuscript: Thank you for submitting your opinion.

Comment from Referees: N-Immobilization (eq. 19) is computed only by microbial demand. There is no upper limit of the immobilization rate, hence microbial growth is never limited by total N. Is this reasonable assumption for this site?

Author's response:

The amount of dissolved carbon absorbed limits the amount of N immobilization (most of the time, microbes are carbon limited!) (eq. 19, SUPPLEMENTARY MATERIAL). As the absorbed carbon is not unlimited, which is explained by the Michaelis Menten equation, C uptake represents the main upper limit (eq. 19). Respiration also limits N immobilization, as well as the carbon respiration for the enzymes production, for example. But if there is no inorganic N, immobilization also is limited. In this case, carbon overflow metabolism is activated to keep the microbial C/N ratio constant (eq. 28).

Author's changes in the manuscript: Thank you for submitting your opinion.

Comment from Referees: The transfer of Kpr*DOC(i) (+ Kpr* flux terms) from DOC to SOC needs more justification (Table S3). If the other flux terms were zero, the DOC would quickly go to zero because tranfering all to SOC. I strongly suggest a formulation of the form: DOC(i+1) = DOC(i) + ... and thinking of some alternative to the term: -Kpr DOC(i), e.g. if Kpr limits uptake, I suggest using Kpr in the uptake equation instead.

Author's response: Kpr is the effect of soil competing with microbes by the dissolved organic carbon and nitrogen. If the fluxes of DOC and DON reach zero, the product is zero. Thus, the soil formation will be zero in the rhizosphere soil. Some improvements in this part of work still depend on experimental evidence about C and N saturation on the rhizosphere soil. In the future, it can be established a relationship between mineralogy/texture, carbon, and nitrogen deficit and soil protection (Kpr).

Author's changes in the manuscript: Thank you for submitting your opinion.

Comment from Referees: Table S3: Again to avoid unit confusion, the multiplication with time (1hr) should be noted explicitly, or better a differential formulation (dX/time = input_rate_X - output_rate_X) should be adopted. Please, also report amounts consistently either per gram or per cm3

Author's response: We will consider rates with the unit plus hour-1 explicitly. The time step of the model is one hour, that is why it was not previously considered.

Author's changes in the manuscript: We will consider rates with the unit plus hour-1 explicitly.

Comment from Referees: It did not become clear to me how the 3-PG estimate of C flux allocated to roots/rhizodeposition is translated to inputs to the soil. Eq. 7 does depend only on root propoerties. If only root properties estimates by 3-PG are used, it should be checked that the sum of rhizodeposition as computed by the full model (eq. 7) is consistent, i.e. equals, the 3-PG C allocation flux to roots.

Author's response: 3-PG does not consider it explicitly. That is why we presented equations 1 to 8 (SUPPLEMENTARY MATERIAL).

The values of rhizodeposition are consistent with measurements done for trees.

Author's changes in the manuscript: Thank you for submitting your opinion.

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