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

Anonymous Referee #2

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General comments The study by Valadares and co-authors proposes a mechanistic model (ForPRAN) for the prediction of rhizosphere C and N cycles in Eucalyptus plantations. It is based on different belowground processes and uses (i) the 3-PG ecophysiological process model to simulate fine growth and rhizodeposition release on the basis of PAR radiation. Rhizosphere dimensions were estimated on the basis of root length and diameter. As a second part of the ForPRAN model, (ii) the stoichiometrically-constrained microbial decomposition simulation model (MCNiP model) was used to explore the dynamic relationships between organic C and microbial processes and estimate microbial N decomposition. The MCNiP model was refined by considering climatic factors as well as microbial movement. The development of modelling approaches for the prediction of rhizosphere processes and especially of rhizodeposition

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Discussion paper

and microbial priming effects is an urgent task. However, I am not completely convinced that the current model is actually approaching this task. For one, rhizodeposition is modelled from PAR, which is used for representing root length growth (P. 5, l. 27): what is the basis of the assumption that there is a direct connection between these two players? Exuded C of trees can also originate from C storage in trees. In addition, the rate of exudation is highly responsive to different environmental conditions. Secondly, priming effects seem to be a central focus of this study, but the definition of it is rather vague. Priming effects are defined as change in native C mineralization in response to increased labile C input, e.g. from rhizodeposition. Priming effects in its narrower sense describe the increase in soil respiration or N mineralization that originates neither from background respiration or mineralization nor from respiring or mineralizing the additional organic C, but rather from microbial mining of additional recalcitrant SOM. The model in its current formulation does not describe this effect. Finally, I think the general reasoning for the set-up of the study could be improved: Why is it important to derive predictions on rhizosphere C and N cycling for Eucalyptus plantations specifically? Why is rhizosphere priming important? Some language editing is also needed throughout (some typos need to be erased).

Specific comments P. 1, l. 11: The unit for fine root length is unusual, please change to m m-2 or similar. P. 1, l. 14: …for the prediction of rhizosphere C and N cycling… P. 1, l. 19: Do you mean root or soil respiration? N mineralization? N immobilization? …immigration, and SOM formation. P. 1, l. 21: …variables that influenced N gain from rhizosphere N mineralization most were… P. 2, l. 6: I think the expectation that additional N is expected in deeper soil layers than in the topsoil is quite surprising: Where should this N come from? N enters the ecosystem from N fixation and N cycling with leaf litter, which are both processes that are mostly occurring in the topsoil. P. 2, l. 7: …higher than……observation that growth responses… P. 2, l. 14: …rhizosphere processes……N supply for some trees… P. 2, l. 16: …in the form of dead roots… P. 2, l. 32: The abbreviation for the Microbial Carbon and Nitrogen Physiology model is 'MCNiP'. P. 2, l. 33-34: It remains unclear why mineralization rates need to be linked to plant growth and root development, as well as to microbial population dynamics. This is the reasoning for the development of ForPRAN and, thus, should be given some more room. P. 3, l. 1-3: Why is it a step forward to develop a specific model for Eucalyptus from the more general (stoichiometrically-constrained) MCNiP model? P. 4, l. 5: ...influencing the ecosystem priming effect... P. 5, l. 11: Responsible for elevation? Figure 2: Parts of this figure are not legible. Figure 7: kinetic Fig. 10: Eucalytpus

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