



EGUsphere, referee comment RC2
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Comment on egusphere-2022-883

Anonymous Referee #2

Referee comment on "Potassium limitation of forest productivity – Part 1: A mechanistic model simulating the effects of potassium availability on canopy carbon and water fluxes in tropical eucalypt stands" by Ivan Cornut et al., EGU sphere,
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This work by Cornut et al. developed a K biogeochemical model based on the relative benefits of two processed-based models (i.e. MAESPA and CASTANEA). A lot of work has went into this model development, and the authors splitted the work into two manuscripts, with the current draft focusing on carbon and water fluxes simulations, and the second draft focusing on growth limitation. I appreciate the reason to do so. In this review, I provide my comments specifically to the first part of their work.

In this manuscript, the authors described the mathematical formulations of the K cycle, the coupling of MAESPA and CASTANEA, and model parameterization and evaluation, including some sensitivity tests. Here, MAESPA served as the canopy model and CASTANEA served as the ecosystem C model. The rationale as to why to integrate the two models were well described (L143 – 155), but the details on how the two models were merged were quite lacking. For example, it's unclear how the 3-d structure of MAESPA was simplified into the 1-d structure of CASTANEA. It's unclear how leaf photosynthesis and transpiration of MAESPA was integrated with the light interception component of CASTANEA. Etc. Considering the vague information, I can't help but wonder if the authors actually ran both models but used the output of one to feed into the other. I suspect not, but I think the authors should further elaborate details on how the two models were merged.

Furthermore, abstract can be improved, as in many places the results are vague. For instance: "Simulations showed that K-deficiency limits GPP by more than 50% during a

6-year rotation, a value in agreement with the literature". What level of K-deficiency limits GPP by more than 50%, and what does the literature say in terms of uncertainty range? Is it the same species and stand? Moreover, "The negative effects of K-deficiency on canopy transpiration and water use efficiency were also reported and discussed". Can you be more specific and describe some key results and implications? Moreover, "Litter decomposition processes were of lower importance". This sparks readers interest to understand why, and I think it's useful to briefly describe your understanding regarding this "lower importance".

Regarding the K cycle structure, I'm not sure how the mass balance for K was closed. The authors indicated that there are 7 pools of K, splitted into soil, soil fertilizer, litter, xylem, phloem, leaf and other plant organs. Can the authors describe how K was allocated in plants of different organ, and whether that matches with plant K uptake? In particular, I wonder why the authors did not consider allocation into root in their work? Did the authors consider the vertical growth of root and the associated K content at all? Furthermore, how soil K was mineralized and immobilized remains unclear. I suspect CASTANEA has a three soil organic matter pool structure for the soil component of the model, but this was not reflected in Figure 1. The process of plant litter entering soil and the associated biogeochemical processes should be better captured, or explained in the case of not included in this work.

Furthermore, this work introduces the limitation effect of K on many plant and ecosystem processes. Obviously, as the authors introduced, there are other limiting nutrients as well. In the current model structure, the authors did not consider the interactive effect of the relative limitation of N, P and K. I wonder if it is useful to discuss some of the potential influences on these interactive effects, and the challenges to actually implement them in a cohesive modelling framework?

Specific comments:

Page 6 Line 158-159: unclear. Details on how this conversion from 3-d into 1-d vertical structure is useful.

Page 7, line 188: What is Pleaf? Where do you get this k parameter from? Do you have a summary of the parameters, their uncertainties and source for the estimates?

Page 9, L263: What is "aK"? Can you check throughout the manuscript to make sure abbreviations are properly defined?

Figure 1. The figure is not properly described in the caption. What is "ind."? What do you mean by "#"? What does dotted line mean as compared to the solid line?

L274" But there is a specific pool for bark, branch, so what K concentration did you assume for them?

L276: What do you mean by "very lose K release rates"?

L280: But K concentration in different plant organs are different, right? But in litter you assume a fixed concentration? How to close the concentration imbalance?