



EGUsphere, referee comment RC1  
<https://doi.org/10.5194/egusphere-2022-883-RC1>, 2022  
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## **Comment on egusphere-2022-883**

Anonymous Referee #1

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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,  
<https://doi.org/10.5194/egusphere-2022-883-RC1>, 2022

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<https://egusphere.copernicus.org/preprints/2022/egusphere-2022-883/egusphere-2022-883.pdf>

Cornut et al present a description paper of a process-oriented model of an Eucalypt plantation with the major novelty of accounting for potassium cycling in an explicit way. The model is calibrated and evaluated based on data from a fertiliser trial in Brazil, and model predictions for potassium fluxes are described.

This is a timely and important endeavour and presents a challenging exercise. While the work is important and could provide an important step forward, there is a lack of attention paid to the description of the model calibration, separation of model evaluation from pure predictions, and the writing. Besides, there are some questions about the appropriateness of model assumptions.

**Major points:**

**Appropriate of model assumption:**

It is surprising that potassium leaching is observed to be negligible (L296) while potassium is assumed to be a highly water transported element in your model. How can there be no leaching of the K<sup>+</sup> experiment if potassium is added such that plants are non K limited?

Doesn't the modelled accumulation of soil K during the experiment (Fig 4) suggest the assumption is invalid? Are there site observations available which could indicate such an accumulation is realistic?

I could imagine that potassium might be efficiently adsorbed to organic matter preventing leaching losses? But if this is the case, why is it omitted in the model? If so, you should explain why this was omitted, and what the implications for the result are.

**Model description:** Not all fluxes are described with equations (e.g. K<sub>leaf</sub> → litter is missing) and not all changes in K pools are described (e.g. K<sub>soil</sub> or K in roots). Make sure all fluxes and pools are described. The overview figure is very hard to follow (see minor points below). The coupling of the water cycles is not described (see minor points).

**Description of model calibration:** There is hardly any information on how the calibration of parameters was achieved. e.g. what method was used, what data was used for a given parameter. Where does the data origin from, etc. It is not clear if Fig2 shows the results of model calibration or an evaluation (as suggested on Line 555).

**Lack of model evaluation.** The results are mostly describing model results with little confrontation with observation, etc. There are comparisons of model predictions and observations but they fail to identify and highlight predictions which are apparent results of the model and which are calibrated. The discussion would benefit from the

restructuring into distinct parts for evaluation and for prediction. Besides, all datasets and their purpose (evaluation, calibration) should be described in the method section, e.g. only in the discussion the Christina et al 2015 model data is explained.

## minor

### Section 2.3

This section is mostly focused on the motivation of revising the water cycle in CASTANEA than in describing what has been actually done, i.e. the new model structure of CASTANEA-MAESPA. It is not clear how the coupling has been achieved. I would suggest explicitly stating the modifications done to the underlying equation of CASTANEA given the scope of the paper as a model description and reference paper.

You should indicate units of all variables. Use a consistent format for units, e.g. there is a mix of /year and year<sup>-1</sup>

Figure 1: An overview figure is an excellent idea but the current figure is hard to follow.

- What does the broken line stand for? What do the different colours stand for?
- Caption indicates all K fluxes are based on Ohm's law which isn't the case. Rephrase.
- The figure is a mix of process, fluxes, relationships, pools. E.g. you could produce separate figures/panel: one for pool & fluxes, and one for the process linkage

Line 5: large-scale - specify what 'large' means here

Line 9: 'Through a sensitivity analysis, we used the model to identify the most critical processes to consider when studying K-limitation of GPP' The results are only valid for the assumed uncertain model structure and thus not generally applicable. I would suggest to rephrase

Line 10: internal/external is not clear unless you define the boundary of your system. I would suggest to rephrase

Line 25: there are better references which actually address nutrient limitation on GPP under increasing CO<sub>2</sub> ( rather than PS (Terrer et al ), or declining leaf nutrient concentration which could also be explained by (deliberate) downregulation of PS rather than limitation (other two refs) ). E.g. Ellsworth et al 2022  
<https://www.nature.com/articles/s41467-022-32545-0>

Line 26-30: not all studies point towards such a geographic pattern. e.g.  
<https://www.nature.com/articles/s41467-020-14492-w> The used references are not appropriate to support the statements as most of them are site level ones (Manu et al, Cunha et al). Better use studies looking at the global pattern like the one I gave which does not support the statement.

Line 38: be more specific. It concerns modelling wheat K uptake

Line 48cc: this paragraph lists mostly evidence for Eucalypts. I would suggest rephrasing the paragraph to focus on Eucalypt or provide additional evidence for other tree species.

Line 68: It is not clear why it is a prerequisite one could also theoretically start modelling with the sinks than with the source.

Line 86: specify how many plantations and for which region they are representative for

Line 104 : 'during a rotation cycle'.

Line 106: specify what a 'split-plot fertilisation trial' is

Line 108: specify to what extent this clone is comparable to the other one?

Line 126: is this a novel technique ? Give references or additional information on how you derived the damaged leaf area.

L168-171: repetitive.

L167: does this mean you have (365 days \*6 years ->) 21190 leaf cohorts at the end of a 6 year rotation ? Is this really needed?

L185: m<sup>2</sup> of ground ? leaf?

L 187: what is P<sub>leaf</sub> ? ; units of k are missing

L188: indicate how the calibration was performed (which obs variable did you target, time step, method of calibration, etc)

L196: LLS units missing

L190cc: equation/description for leaf fall is missing

Section 2.4.3: explain how leaf life span of cohorts were derived from measurements.

L200: leaf area evolution ?

Eq2:  $\Delta S / \Delta t$  shouldn't that be  $\Delta LA / \Delta t$ ?

Section 2.4.4. : explain and show how this equation was fitted.

L245 : indicate how is alpha computed. Is it a fixed input parameter?

L253: which cycle? You mean ecosystem?

L254: causality is not clear.

L261: typo `trhough`

L263: typo `aK`

L264: is there no biological mediated K release from litter?

What about the unavailable soil K. indicate how this was represented.

What about root and wood litter production? Was this omitted?

Is K immobilisation by soil organisms really negligible? The initial loss from litter might be due to leaching, but the question is rather how much of all the K in litter is lost via leaching. Can you elaborate on this.

L294: typo units

L326: why not call it maximum K conc instead of optimal K? Can you rule out that the optimal conc < max conc?

L354: which 'part 2'?

L383: this single sentence paragraph is not well connected with what comes before/next.

L396: you mean 'was higher'?

Throughout the text: 'The offer' - why not call it available K or supply?

L429: what is the significance of the speed of senescences for the equation?

L452: explain how K affects the wood production in this paper.

L453: impact on what?

L459: explain the logic of the model. E.g. what are the main assumptions.

L472: you mean 'was replaced with'?

L471-476: indicate to what extent this causes (or not) inconsistency between flows of water, K, and leaf area.

L412: remove brackets from reference

L 511.517: specify what type of data was used. Is it measured, derived, modelled etc?

L527: add number of parameters tested and where they are listed.

L535: indicare over which period. Does this refer to Table 2?

L549: important for what ? you mean higher?

### Section 3.1

These model predictions should be compared to data from this site or others.

L560: remove ', that reached its maximum (LLS, fixed value).'

L580-600: does the good agreement with Christina et al 2015 mean we don't need a potassium model to capture GPP and transpiration? The motivation for comparing your results with the ones of Christina et al 2015 should be given in the methods. Also a description of the data from Christina et al 2015.

L598: why was it done for both? The K+ treatment effectively shuts off most of the model developments and is thus not really informative. It makes sense to report for traceability of impact of model developments, but might be better off in the SI as this is mostly relevant for MEASPE developers.

L607: why 'but' ?

L630-649: This is a collection of rather general statements regarding modelling. Some of them are repetitive (e.g. L639-641 vs L657-659 ). It could be greatly condensed, and parts moved to the method and introduction section. Iso repeat bits

L674-678: WUE: you never defined the modelled WUE. Avoid comparing apples with oranges. (e.g. <https://hal.archives-ouvertes.fr/hal-01606915>)

L678-679: K and GPP vs N and NEP - what is the connection?

L711: remove 'intimate'