



EGUsphere, referee comment RC1
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Comment on egusphere-2022-884

Anonymous Referee #1

Referee comment on "Potassium limitation of forest productivity – Part 2: CASTANEA-MAESPA-K shows a reduction in photosynthesis rather than a stoichiometric limitation of tissue formation" by Ivan Cornut et al., EGU sphere,
<https://doi.org/10.5194/egusphere-2022-884-RC1>, 2022

General comments

The manuscript submitted to Biogeosciences by Cornut et al. studies the impact of a potassium limitation on wood productivity and in particular on the allocation of carbon and potassium towards trunk, branches and bark, through the modelling and evaluation of the CASTANEA-MAESPA-K model. This is the Part2 of a two-part paper, Part1 being dedicated to the impact of K limitation on the C-source activity (GPP). The split in the 2 parts is relatively well done, and the present manuscript (Part 2) is sufficiently self-supporting, without the need of reading the Part 1 first.

The overall objectives of the manuscript are relevant; and the "Results" and "Discussion" sections report fairly on the model capacities at simulating biomass of each compartment (organ) for different K availability scenarios.

However, the manuscript needs a strong revision of the Methods section and some restructuration. Currently, this section contains too many inconsistencies in several equations, variable units, ... There is not a particular major deficiency but an accumulation of inaccuracies, which really prevents to access at the content of the manuscript. I address many of them in the Technical comments below.

Technical comments

Line 1: After "Potassium" add "(K)".

Line 9: Please rephrase "of wood productivity, growth, NPP" as it is unclear

Line 21: rephrase "from plots with trunk wood (every 6-7 years) from the stands".

Line 39: WUE_{GPP} to be defined prior to use it.

Line 48: "various" not "Various".

Lines 48-51: a bit unclear to me. Are the roles of K as enzyme co-factor and in cell turgor pressure, two "processes" you list here? If so, mention them in a single sentence, or in two separate ones but without using the colon (":"). Are the two processes not potentially related to K stoichiometry, not only enzyme cofactor. If so, maybe add "in order to preserve K stoichiometry" line 49 after "K deficiency".

Line 62: add "see Part 1" after "obtained"

Line 70: replace "year⁻¹" by "yr⁻¹"

Line 73: Remove one of the 2 "two".

Line 74: Replace ", which consisted in" by ":"

Line 74-75: Replace "K fertilisation: +K (" by "K fertilisation (+K treatment) with"

Line 76: Remove the end parenthesis (")")

Line 76: Replace ": oK" by (oK)

Line 80: Replace "at 1, 2, 3, 4, 5 and 6 years in each fertilisation treatment" by "in each fertilisation treatment at year 1, 2, 3, 4, 5 and 6 after planting"

Line 89: Replace "Cornut et al., submitted" by "Part 1"

Line 95: I would suggest using the present tense in the Methods section when describing the model features, instead of the past tense.

Line 100-108: As far as I understood, the allocation coefficients presented in subsections 2.3.2 and after are applied over "NPP - C allocated in leaves" not NPP. If this is correct, this should be clarified here. To my understanding, the sentence "The growth of all organs was a fraction of the daily NPP" does not reflect the way it is modelled. If "all organs" include leaves, it is in contradiction with the sentence "the generation of leaves ... was not directly dependant on NPP". If "all organs" means "all organs except leaves", their growth is a fraction of NPP_{org} , not NPP. To my opinion, NPP_{org} should be defined here and not line 200 of the current manuscript.

Line 105: To my opinion, the subsection 2.3.1 can be removed and its content merges with the paragraph right above (lines 100-104).

Line 110-111: The sentence is a bit unclear to me. Could you rephrase it ?

Line 113: GSS_{max} is not defined

Line 114: add "(unitless)" after " G_{SS} " ; remove "(daily)"

Line 117: add " $(G_{CR}, \text{unitless})$ " after "roots"

Line 121: add " $(G_{FR}, \text{unitless})$ " after "roots"

Line 124: Remove "GFR was the allocation coefficient to fine roots,", and add "were" after " G_{SS} "

Line 131: add "(unitless)" after " G_W ". You can remove the end of the sentence from ", and $G_{FR} \dots$ "

Line 138: add "(unitless)" after G_{Br}

Line 144: the line may be removed

Line 151-152: Could you give slightly more information on how the growth respiration is computed?

Line 153 and after: Description of the maintenance respiration modelling is quite difficult to follow. This section needs clarifications (see below).

Line 155: maintenance respiration is a "function of their respective respiration rate per nitrogen unit, nitrogen content and surface temperature". Equation (9), in which we divide by N_{trunk} , defines the respiration rate per nitrogen unit (MRN_{trunk}). Equation (10) defines the maintenance respiration from MRN_{trunk} by multiplying it by N_{trunk} . So, RM_{trunk} (or more generally RM_{organ}) does not seem to be a function of the nitrogen content.

Line 159, equation (9): There is a problem with the 2 terms of the max functions (in brackets). Both terms are constants without any variable.

Line 159, equation (9): why expressing MRN_{trunk} in "mol CO₂" and not in "gC" . In all cases, you may put the different conversion factors in the terms of the max function.

Line 159, equation (9): Mention that MRN_{trunk} and more generally MRN_{organ} are respiration rate per unit nitrogen, at reference temperature T_{MR}

Line 161: add "C" between "unit" and "mass".

Line 164-166: Mention that the N_{branches} and N_{trunk} were defined assuming a Carbon content per biomass unit of 50% (0.5).

Line 167-168, equation (10): For clarification, you may rewrite 0.005 as 0.01×0.5 and inject the "0.01" into the min function terms.

Line 168: The terms "0.256", "-0.00854" and "0.0759" don't match with the values reported on Figure S2b while those of the equation for N_{branches} do match with values of on Figure S2a.

Line 173: RM_{organ} ($CO_2 \text{ hr}^{-1}$). Do you mean "mol CO_2 ". You may express it in "gC". Isn't there a " m^{-2} " missing in the units of RM_{organ} ?

Line 173: B_{organ} is "(gC m^{-2})" not "(gC)"

Line 174: " N_{organ} " not " N_{organ} "

Lines 176-177: I can't find any information on R_d in Part 1 manuscript.

Line 183: "The realised lifespan of leaves was influenced by their K status (see Part 1)". I could not find in Part 1 any information of the equation that relates $LLS_{realised}$ to K status.

Line 186: remove one of the 2 "the".

Line 192-268, Section 2.6: I think you can re-structure this section in two, one dedicated to 'K allocation' and another to 'K remobilization' (currently subsection 2.6.5). Paragraphs between line 225 and line 237 should be moved in the section on 'K remobilization'.

Line 198: "flexible" not "flexivle"

Line 199: I think you should replace K_{wood}^{opti} by K_{trunk}^{opti} as the branches are also made of wood. There are many places in the manuscript (and some figure captions) indeed, where you should replace "wood" by "trunk"

Line 210, equation (14): What's the link between eq (14) and eq. (21) of Part1. To my understanding, the use of Lim_{org}^K assumes that $K_{phloem \rightarrow leaf}$ has been deduced first from $K_{available, phloem}$ which is not mention in the text. Would not be more consistent with Part 1 and clearer, to use L_K in Part 2 as well, and not Lim_{org}^K ?

Line 214 and after, section 2.6.1 Wood: it is the only section where you deal with the cohort level. Is it really needed ? If so, you should better explain the cohorts principle. For instance, line 217-218: "trunk NPP was allocated daily to a cohort of wood". How is this cohort selected among all ?

Line 218-219: "optimal K concentration of newly formed wood was constant and to the maximum trunk concentration measured". In this respect, why equation (15) includes $\text{Lim}_{\text{org}}^K$ which tends to reduce $K_{\text{trunk}}^{\text{opti}}$

Line 229: equation (16) is not homogeneous.

Line 230-231: Unit of $K_{\text{trunk} \square \text{xylem}}^i$ $\text{gK m}^{-2} \text{day}^{-1}$ instead of gK m^{-2} ? Unit of K_{trunk}^i : gK (gC)^{-1} ? Unit of $T_{K\text{Trunk}}$: (unitless)?

Line 247-250: I think you can rephrase the sentences to gain in clarity.

Line 257: Replace "there no measurements were available" by "no measurement was available".

Line 267: add "(unitless)" after $R_{K\text{branches}}$

Line 267: maybe replace "rate" by "fraction"

Line 272: " m^{-2} "

Line 272: Add an end parenthesis after "planting"

Line 281: "blocks" instead of "blocs"

Lines 285 to 305: There is probably a problem with the numbering of section 2.9 and subsections 2.9.1 to 2.9.3: 2.9 -> 2.8.1 ; 2.9.1 -> 2.8.2 ; 2.9.2 -> 2.8.3 ; 2.9.3 -> 2.8.4

Line 285-287: name explicitly and define the different CUE you use in the Results section : CUE_{NPP} , $\text{CUE}_{\text{trunk}}$, ; I think you only report CUE values in the Result for the full rotation period by computed a mean CUE as the cumulated NPP divided by the cumulated GPP. If this is correct, specify it here (and also for WUE).

Line 289-290: define also here WUE_{GPP} for which you report values in the Results section.

Line 293: "C-based metric" may refer to CUE; you may replace it by "C flux"

Line 295, equation (20): as it is defined, KUE_{NPP} seems to be a function of the length of the rotation. Is it really expected? It does not appear to be a very handy metric to compare experiments with different rotation length. You could use the mean daily C flux over the length of the rotation instead of the cumulated one. This would imply to express KUE_{NPP} in $gC\ day^{-1}\ (gK)^{-1}$

Line 295: As "i" index refers to time, you could replace it by "t".

Line 307: replace "and dividing it" by "divided"

Line 309, equation (21): $K_{fertiliser}^{added}$ should be sum for $i=0$ to k as well, in particular to account for the fertiliser regime with 4 applications.

Line 317-320: I think it is sufficient to report the five-year mean annual GPP values (those in parenthesis), not the cumulated fluxes.

Line 321: "Table 2", I think you want to refer to "Table 3" of Part 1, not Table 2

Line 323: replace "trunk NPP_{trunk} " by " NPP_{trunk} "

Line 325: add an end parenthesis after "Fig. 2e"

Line 325: add a "," after "stand".

Line 326: give units to the RMSE values. Replace "for" by "of simulated"

Line 328: replace "age 59 months" by "month 59 after planting"

Line 333: replace "carbon use efficiency (defined as the ration of NPP to GPP)" by " CUE_{NPP} "

Line 334: replace "0.52 vs 0.40" by "0.40 vs 0.52"

Line 336: replace "CUE" by " CUE_{NPP} "

Line 338: add "relative" before "increase"

Line 339-340: "This was further amplified by leaf NPP representing 13% of GPP in oK compared to 7% in +K". Is this remark related to the difference in CUE_{trunk} , only (and not CUE_{NPP})? If so, please specify.

Line 345: replace "0, 3, 10 and 20 moths of age" by "month 0, 3, 10 and 20 after planting"

Line 353: add "located in" between "were" and "the".

Line 363: add a comma after "model".

Line 393: "Potassium concentrations in trunk wood and branches are correctly simulated". Could you provide a quantitative metric for this "correct simulation performance" ? In addition, you should probably highlight that for branches at least, there is a large spread in the measurements in particular for low biomass values.

Figure 2: You may put x- and y-labels bigger. Add "Measured and" at the beginning of the figure legend.

Figure S2 b), replace "wood" by "trunk" in the Y-label