Biogeosciences Discussions

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Reply on RC2

Marina Corrêa Scalon et al.

Author comment on "Contrasting strategies of nutrient demand and use between savanna and forest ecosystems in a neotropical transition zone" by Marina Corrêa Scalon et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2022-63-AC2, 2022

Referee #2 suggested using different terms for nutrient uptake and use efficiency, which could be a bit misleading and suggested some missing references and corrected some wrong citations. We addressed all comments, changed the terms following reviewer's suggestion and revised all references. Please find our point by point answer to the referee #2 comments below.

Referee comment: Nutrient use and uptake efficiencies: These two terms a bit confused me as I thought that the uptake efficiency indicates the efficiency of nutrient uptake per unit uptake cost (or unit carbon or something like that). However, the uptake efficiency was calculated as the ratio of NPP to unit mass of the nutrient that was taken up from soils. Perhaps, 'nutrient-use efficiency (uptake basis)' or 'NuUEuptake' might be a more suitable term for example. Similarly, the use efficiency could be described as 'nutrient use efficiency (demand basis)' 'NuUEdemand'. Also add the definition of nutrient use efficiency in the abstract.

Reply: Done. We added definition for nutrient use efficiency in the abstract (, i.e., the amount of production per nutrient unit). We also added definition of all terms used (nutrient efficiency, nutrient demand and uptake, nutrient resorption) in the first paragraph of the introduction. We used the suggested term for nutrient use efficiency uptake or demand base.

Referee comment: There were missing or errors in citations. I listed them in the specific comments. Please carefully double-check the literatures.

L 15 I recommend the authors delete 'for the first time'. There is a study that simulated vegetation-level nutrient-use efficiencies and flux by coupling NPP with stoichiometry.

Wang, Y., Ciais, P., Goll, D., Huang, Y., Luo, Y., Wang, Y.-P., … Zechmeister- Boltenstern, S. (2018). GOLUM-CNP v1.0: A data-driven modeling of carbon, nitrogen and phosphorus cycles in major terrestrial biomes. Geoscientific Model Development, 11, 3903–3928.

https://doi. org/10.5194/gmd-11-3903-2018

Reply: Done.

Referee comment: L 24-26 I recommend the authors rewrite or delete this statement. I did not get how the authors evaluated the efficiencies of fine root and wood production. Did the authors calculate nutrient use efficiency in the production of fine roots or wood?

Reply: We understand the confusion we may have caused using the term efficiency to describe nutrient allocation in relation to biomass production. We re-worded here and throughout the text, avoiding using "efficiency", but clearly stating whether there was more or less nutrient allocated to a given biomass. It now reads: "*The proportional difference in nutrient allocation to the different biomass components suggesting cerrado species allocate less nutrient to a given fine root biomass, but more nutrient to a given wood biomass.*"

Referee comment: L 27 how did the authors know the P and K limitation in the forests? I need the evidence that the forests are considered under P and K limitation. For example, P- or K-resorption efficiency was higher than global average, etc.

Reply: We meant cerradão species were more limited in P and K than cerrado species – sentence was reworded. "*Our findings suggest that cerradão species are more limited in P and K than cerrado species, inducing a higher resorption to compensate for low uptake.*"

Referee comment: L 28 I am not sure if this is a trade-off or not. I think that trees can increase N uptake and N-use efficiency simultaneously.

Reply: We agree. Sentence now reads:

"This difference in nutrient dynamics explains how similar soils and the same climate dominated by savanna vegetation can also support forest-like formations."

Referee comment: L 29-30 I thought that this simply means that Ca and Mg were little resorbed before leaf fall.

Reply: We deleted this sentence from the abstract to avoid confusion. We were referring to a comparison between sites (cerrado vs. cerradão) but we understand it was misleading.

Referee comment: L 30 'species composition' came out of nowhere. It would be good to clarify why species composition can be the major factor.

Reply: We now added the information that the communities were composed by different species in the beginning of the abstract: "*Here, we describe different nutrient use and allocation strategies in Neotropical savanna (cerrado) and transitional forest (cerradão) tree communities composed by different species, report leaf nutrient resorption and calculate ecosystem-level nutrient use efficiency*."

Referee comment: INTRODUCTION: the introduction was well edited.

L 73-76 it would be good to add references to these sentences.

Reply: Done – we added Vergutz et al. (2012).

Vergutz, L., Manzoni, S., Porporato, A., Novais, R. F., and Jackson, R. B.: Global resorption efficiencies and concentrations of carbon and nutrients in leaves of terrestrial plants, Ecol Monogr, 82, 205-220, https://doi.org/10.1890/11-0416.1, 2012.

METHOD:

Referee comment: L 143-144 As much as I remember, MLCF in Vergutz et al. 2012 is the ratio of green-leaf mass to senescent leaf mass but not Ca. Please double-check.

Reply: Yes, you are correct. We removed this reference and added Vitousek and Sanford (1986)

Vitousek, P. and Sanford R. Nutrient cycling in moist tropical forest. Ann Rev Ecol Syst 17: 137-167. https://doi.org/10.1146/annurev.es.17.110186.001033, 1986.

Referee comment: L 144-145 I would recommend the authors provide the equation to calculate community weighted manes.

Reply: This was deleted from this paragraph and detailed in the statistical analysis subsection.

Referee comment: L 149-150 Add brief explanations for the NPP measurement. I was wondering if the NPP was estimated by litterfall monitoring and tree census.

Reply: As requested, this information is now provided: "*Data were collected following GEM protocols (Malhi et al. 2021) and methods are described in detail in Mathews et al. (2014) and Malhi et al. (2015). Briefly, for the canopy NPP component estimation, litter traps sampled biweekly together with monthly canopy leaf area index were used. For wood component estimation, annual census and dendrometers measuring growth rates were converted into woody biomass production. Fine root production was measured with ingrowth cores installed and sampled every three months*."

Referee comment:L 157-158 As I mentioned in the major concerns, the nutrient uptake efficiency might be a bit misleading.

Reply: We changed to nutrient use efficiency (uptake basis) following your suggestion

Referee comment: L 162 I think this sentence includes typos

Reply: Sentence was changed.

RESULTS:

Referee comment: L 240-242 Please make where this statement came clear. Maybe, Tsujii et al. 2020?

Tsujii Y, Aiba S-I, Kitayama K. Phosphorus allocation to and resorption from leaves regulate the residence time of phosphorus in above-ground forest biomass on Mount Kinabalu, Borneo. Funct Ecol. 2020;34: 1702–1712. https://doi.org/10.1111/1365-2435.13574

Reply: Reference was added.

Referee comment: L 242-245 Which results support this statement?

L 245-246 Aoyagi & Kitayama (2016) is a good reference for this statement but not for the following statement (L 247-248).

L 248 Aoyagi & Kitayama (2016) might not focus on P residence time. Please double check this reference.

Reply: Yes, we are sorry about that. We deleted this reference and left only Tsujii et al. 2020 to support the statement. We included Aoyagi & Kitayama (2016) as a reference in the previous statement on the mechanism of allocating P to the canopy to maintain higher photosynthetic rates.

Referee comment: L 250 P content in wood may be also affected by reproductive status, such as masting. For example,

Ichie, T., & Nakagawa, M. (2013). Dynamics of mineral nutrient storage for mast reproduction in the tropical emergent tree Dryobalanops aromatica. Ecological Research, 28(2), 151–158. Retrieved from https://doi.org/10.1007/s11284-011-0836-1

Reply: That is an interesting reference but we decided to not include it since we were not controlling for reproductive status of the vegetation.

Referee comment: L 284-258 Please carefully check the citations. As much as I remember, Aoyagi & Kitayama (2016) did not estimate P residence time. Tsujii et al. (2020) estimated P residence time in above-ground forest biomass (canopy + wood). Gleason et al. estimated P residence time in canopy, but also estimated P-use efficiency at the above-ground biomass level (i.e. including canopy and wood). In addition to these papers, Paoli et al. (2005) estimated P residence time in canopy.

Paoli, G. D., Curran, L. M., & Zak, D. R. (2005). Phosphorus efficiency of Bornean rain forest productivity: Evidence against the unimodal efficiency hypothesis. Ecology, 86(6), 1548–1561. Retrieved from https://doi.org/10.1890/04-1126

Reply: Thank you for noticing that. Indeed, we wanted to refer to aboveground biomass instead of canopy. We also included the reference suggested.

Referee comment: L 285-286 The following papers analysed nutrient concentrations and estimated nutrient stocks in wood and/or fine roots for tropical trees.

Hughes, R. F., Kauffman, J. B., & Jaramillo, V. J. (1999). Biomass, Carbon, and Nutrient Dynamics of Secondary Forests in a Humid Tropical Region of Mexico. Ecology, 80(6), 1892. Retrieved from https://doi.org/10.2307/176667

Imai, N., Kitayama, K., & Titin, J. (2010). Distribution of phosphorus in an above-tobelow-ground profile in a Bornean tropical rain forest. Journal of Tropical Ecology, 26(06), 627–636. Retrieved from https://doi.org/10.1017/S0266467410000350

Johnson, C. M., Vieira, I. C. ., Zarin, D. J., Frizano, J., & Johnson, A. H. (2001). Carbon and nutrient storage in primary and secondary forests in eastern Amazônia. Forest Ecology and Management, 147(2–3), 245–252. Retrieved from https://doi.org/10.1016/S0378-1127(00)00466-7

Kauffman, J. B., Cummings, D. L., Ward, D. E., & Babbitt, R. (1995). Fire in the Brazilian Amazon: 1. Biomass, nutrient pools, and losses in slashed primary forests. Oecologia, 104(4), 397–408. Retrieved from https://doi.org/10.1007/BF00341336

Tsujii Y, Aiba S-I, Kitayama K. Phosphorus allocation to and resorption from leaves regulate the residence time of phosphorus in above-ground forest biomass on Mount Kinabalu, Borneo. Funct Ecol. 2020;34: 1702–1712. https://doi.org/10.1111/1365-2435.13574

Reply: Citations were added accordingly.

CONCLUSION:

Referee comment: L 303-305 It might be good to say 'the cerrado vegetation allocated more nutrient to root and wood' rather than say 'less efficient in their production'.

Reply: We agree with this suggestion and changed accordingly.

Tables & Figures:

Referee comment: Figure 1 I did not find asterisks.

Reply: Indeed, for some unknown reason the asterisks were not displayed in Fig 1. Differences are now shown in the figure and tests were acknowledge in the text.