

Biogeosciences Discuss., author comment AC2
<https://doi.org/10.5194/bg-2022-145-AC2>, 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Reply on RC2

Johanna Pihlblad et al.

Author comment on "The influence of elevated CO₂ and soil depth on rhizosphere activity and nutrient availability in a mature *Eucalyptus* woodland" by Johanna Pihlblad et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2022-145-AC2>, 2022

Dear Reviewer #2

We thank anonymous reviewer #2 for carefully reading and suggesting edits to the manuscript titled "The influence of elevated CO₂ and soil depth on rhizosphere activity and nutrient availability in a mature *Eucalyptus* woodland" by Johanna Pihlblad et al., Biogeosciences Discuss (bg-2022-145) and are confident the work is better for it.

Below we have outlined how the suggested edits have been changed in response to the individual comments and questions.

Kind regards on behalf of all listed authors,

Dr Johanna Pihlblad

Specific Comments

Ln 17-18: I think this is one of the more interesting aspects of the study, however, this sentence in the abstract is very vague, and doesn't really tell me how eCO₂ influenced nutrient availability. A stronger sentence would help the abstract.

The sentence in the abstract was changed to: "We found decreasing nutrient availability and gross N mineralization with depth, however this depth associated decreased was reduced under elevated CO₂ which we suggest is due to enhanced root influence."

Ln 33 -34: The sentence structure here is rather awkward, can it be re-written for clarity?

The sentence was reworked to improve readability as follows: "Higher root exudation rates, stimulation of root growth and fine root production and turnover are all mechanisms that can potentially elicit SOM decomposition and subsequent nutrient release in the rhizosphere (Bernard et al., 2022)."

Ln 38: Referencing of these two Iverson pprs needs to be fixed.

The referencing style has been corrected throughout the manuscript.

Ln 47: 'thus promote' is a little awkward too - 'and thus promote' might work, or 'thus promoting', maybe?

The sentence has been changed to "thus promoting" as suggested by both reviewer #1 and reviewer #2.

Ln 90: Is there any information on belowground activity under eCO₂? Could water also be limited at this site? Also, what is the average rooting depth for these trees? How much for that is below 10 cm?

Yes, these questions are very interesting and warranted and the belowground activity is introduced later in this paragraph including the most up to date studies from the EucFACE facility. It is also common for Eucalyptus trees to have very deep structural and water seeking roots that can reach as far as down as 10-28 meters to access groundwater aquifers. No studies have been published from this specific site as of yet about the maximum rooting depth of this tree stand though long-term sensors at EucFACE have observed two aquifers in the top four meter of soil believed to be used by the trees. Especially during periods of drought there can be a case where the top one meter of soil is very dry to the point of being hydrophobic, but the trees are not drought stressed due to access to groundwater. However, this isn't included here due to the lack of published studies supporting any statement on maximum rooting depth and if the trees are water limited or not. The paragraph was however amended to include a general statement about rooting depth for Eucalyptus trees as follows: "Additionally, Eucalyptus trees are known to have very deep roots to access water from groundwater aquifers (Laclau et al., 2013), though fine roots capable of nutrient acquisition are thought to be most abundant in the surface soil layers (Piñeiro et al., 2020)."

Ln 143: I thought enzyme measurements were traditionally done on fresh soil samples. Why were these performed on (presumably)thawed samples, and how slowly were they thawed? Thawing too quickly will likely impose selection for tolerant members of the community. Maybe it's not a problem if all the samples are treated the same (enzymes measurements are potentials after all).

See response to reviewer #1 on similar comment.

Ln 200: comma after 'where'.

Changed as suggested by reviewer #2.

Ln 264: I'm not sure I quite understand the connection between microbial P and plant roots here. Maybe I missed the broader point, but I found this a little unclear.

The connection is that both microbial P and fine root density both declined in response to eCO₂ in the 0-10 cm depth. The sentence was edited to improve this as follows: "The microbial P concentration decreased under eCO₂ in the 0-10 cm depth in the bulk soil (Figure 6C), this is similar to the negative effect of CO₂ on fine root density (Figure 2), suggesting that root density and microbial P respond similarly to eCO₂ since both decreased".

Ln 271: What is the average water table depth at this site? I assume there is little strong redox chemistry occurring here that might impact the N-cycle and favor N-loss.

Yes, we agree that the redox reactions likely found here is affecting the P availability. As for the water table it was not found in the top 1 meter that was investigated in this study. There are at least two groundwater aquifers found within the first four meters of soil at this location (Data not shown).

Ln 287: I'm not sure I'm convinced by this argument. The site is not limited by N or C, right? And the allocation to enzymes is trivial relative to that required to build microbial

biomass (which increases under eCO₂). I guess this interpretation also depends on how you interpret the enzyme data, which can be notoriously difficult. Does an increase in enzymes represent the availability of a given substrate (feast mode), or microbial limitation by a given substrate (bet-hedging approach). How you interpret your enzyme data goes some way to how you interpret the enzyme response.

We have edited the context of the arguments weight by changing the sentence to include: "...enzymes (Olander and Vitousek, 2000), although there is no indication N or C are limiting for enzyme production in this system."

Ln 335: I tend to think it means the 'potential' is there to decompose plant material down the soil column.

The sentence has been edited to include a suggestion from reviewer 1: "... that plant matter have the potential of being decomposed throughout the soil profile."