Report #1

https://egusphere.copernicus.org/preprints/egusphere-2023-2750#RC1

We thank the reviewer for the thoughtful and constructive suggestions, and we provide a detailed response to the comments below :

The paper deals with the effect of vegetation on nutrient availability in high-elevation ecosystems of the Andes. The subject is interesting and the paper is well written. However a few concerns arise and have been listed below:

Line 22: Why are particularly interesting?

They have low soil microbial decomposition rates, and therefore high soil carbon stocks. We will specify this in the revised version.

Line 32: change into ….with effects on nutrient cconcentrations in rivers and high-mountain lakes.

Thanks for this observation, we will modify the text.

Line 39: change into….. that releases nutrients into the biological environment (Chadwick et al., 1999; Hedin et al., 2003; Dixon et al., 2016).

Thanks for this observation, we will modify the text.

Line 48: do you exclude the input through the wet depositions? I think that rainfall not only influence the vegetative growth cycles but represents also an input of nutrients to the soil, expecially relevant at high elevation.

Atmospheric deposition (including wet and dry deposition) indeed contributes to replenish soil nutrient stocks, and their relative contribution can be pertinent in nutrient-poor soil systems (e.g. study by Hofhansl et al., 2011). We will add a sentence to clarify this.

Line 64: change into…. the role of vegetation communities and soil hydrology in influencing the soil nutrient availability

Thanks for this observation, we will modify the text.

Line 68: change into…..because persistently at cool temperatures, ranging between 2 and 10 °C…..Do these values represent the mean monthly maximum and minimum temperatures? Moreover, do the mean annual precipitation include also the snow water equivalent?

The mean annual temperatures vary between 2 and 10°C, but strong diurnal fluctuations are common, ranging from below freezing to as high as 20 °C. Mean annual precipitation ranges between 500 and 3000 mm including snow water equivalents. Most weather stations are *located below 4500 m asl where snowfall is rare. We will provide this information in the revised text.*

Lines 71-72: Do you have data on soil carbon stock in the area?

Hribljan et al. (2016, 2024) have established carbon stocks of the peatlands in the high Tropical Andes. In the revised version of the manuscript, we will provide the estimates (total soil organic carbon stock : 1628 Mg ha^{-1}) that they made for the paramo ecosystems in the Tropical Andes (Colombia, Ecuador) based on observations from 8 cores in Colombia and 8 cores in Ecuador. We want to indicate that these cores were all retrieved in areas with deep (> 300 cm deep) polygenetic soils developed on volcaniclastic material (Fig. 1, Hribjan et al., 2024). As our study site is located in southern Ecuador where volcanic soils are developed on andesitic parent material, volcanic soils are generally less than 120 cm deep. Total soil organic carbon stocks for the southern Ecuadorian Andes are not yet available, and more research is needed on the effect of substrate lithology on total carbon stocks in the High Andes.

Lines 73-75: Do you assume that the dissolved organic carbon is leached from the soil particularly rich in organic carbon?

Many thanks for pointing this out. We know that the dissolved organic carbon fluxes that are leached from the organic-rich soils can be particularly high based on empirical work on soil solute biogeochemistry that is currently ongoing in the High Andes (Páez-Bimos et al. 2023). Various authors of this manuscript are involved in these long-term monitoring sites. In Páez-Bimos et al. (2023), we showed that the soil solutes are particularly charged in dissolved organic carbon: we measured mean annual DOC concentrations in soil solutes in the topsoil horizons of 47.3 ± 2.3 mg L^{-1}. By integrating the measurements in a hydrological model, we obtained mean annual dissolved organic carbon fluxes of 17.4 g m^{-2} yr^{-1} despite relatively low water fluxes. We will add this information in the revised manuscript.

Line 92: change into asl

We will rewrite this

Line 97: this value of precipitation is significantly different from what reported in line 68

This might have been confusing. On L68, we gave the mean annual precipitation rates for the High Andes, while we mentioned the mean annual precipitation for the study area on L97. We will give the precipitation range for paramo environments in the introduction (« mean annual precipitation between 500 and 3000 mm »); and keep the sentence on L97 with the mean annual precipitation in the study area of 911 mm.

Figure 1 Caption: Since the forest is present only in poorly accessible sites (by humans?) means that the other land covers (cushion-forming plants, tussock grasses) have been shaped by human activity? Moreover in the figure maybe better soil profiles than soil samples.

Forest patches are above the continuous forest line, and they are now found in poorly accessible areas by humans. Whether the vegetation pattern is determined by anthropogenic disturbance and/or microclimate is often unclear, and hard to determine. In the tropical High Andes, all land covers have experienced human influence to some extent as a result of livestock grazing, use of fire and (ancient) roads. Besides, microclimatic conditions also contribute to shape vegetation development, particularly in these regions with rapid and strong variations in temperature and solar irradiance (Bader et al., 2007). We will add a sentence in the text to clarify that vegetation patterns are the result of human land use and natural processes.

Thanks for the observation on the legend, the points are indeed the profiles and multiple samples were taken at one profile. We will make the necessary change in the figure.

Line 131: please add the standard deviation to the average soil depths.

We will add this information, and report mean (± 1 SD) of soil depths.

Lines 132-133: How did you calculate the depletions in base cations?

This is based on a chemical mass balance approach where we estimated mass losses and gains in soil compared to the underlying parent material using Ti as reference element. This information will be added in the text.

Line 177: Please specify what kind of genetic horizons are the upper horizons

We will add this information. They sample water from the overlying A and AC horizons.

Line 222: model & Line 228: was

We will correct these errors

Line 266: Caption Figure 1. Maybe better Depth-distribution

We will rephrase the caption : « depth-distribution of root development ».

Line 268: Caption Table 1: explain the meaning of Y and N. Yes? No?

This might have been confusing. Also reviewer#2 suggested to remove the 'Yes' – 'No' statement, as this information is redundant when giving the p-values. We will change the table, and only give -values.

Line 274: Table 2. Did you test if the mean concentrations were different between the vegetation types?

Yes, this is given in Table 1. We will cross reference the table to avoid confusion.

Line 299: Does this impermeable layer origin from pedogenetic processes?

The low permeability of the C horizon is observed under cushion-forming plants where the effective root depth is limited to 33 ± 4 cm. Limited biological activity can enhance the development of a massive horizon.

Figure 7: I think that the sentence "the high values recorded at the beginning of the measurement period (October 2022) are likely due to the incomplete stabilization of the lysimeters before the first sampling" should be moved in the text and better explained. For example it seems that this phenomenon is particularly relevant in the forest, for Mg, Ca and K. Why?

We agree that this needs to be addressed differently, and will revise this.

Line 385: Is this a native forest?

This sentence was confusing, and we will rewrite it. The work by Rada et al. (2019) is on plant functional diversity in tropical Andean páramos, and is based on ecological research on native species.

Line 434: Do you exclude for P a potential contribution of soil microbial immobilization?

Thank you for this comment. The formation of metal-humus complexes in the nonallophanic Andosols can increase the P fixing capacity by protecting P from microbial and enzymatic decomposition (Delfim et al., 2018; Borie et al., 2019). We will add a sentence in the discussion.

Line 457: Here and previously in the Introduction, please specify better what kind of anthropogenic disturbances could be expected in the area

This concerns future changes in land use as a result of changing policies for livestock grazing, soil labor and use of fire.

References cited herein

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