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Vulnerability of C stocks in Polylepis forests of the Peruvian Andes under climate change – evidence from laboratory incubations, microbial nutrient constraints and enzyme activities

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Soils are the largest stock of terrestrial carbon, the dynamics of soil organic C (SOC) are controlled by microbial physiology, but how it promotes stable SOC and how it would change with warming, remains unknown. The Huascarán National Park (HNP), the largest mass of tropical glaciers in the world, has lost 20-30% of its glacial cover and the temperatures in this biosphere have risen 0.1°C per decade since 1970. However, no information on the HNP soil carbon stocks is available. As managing SOC is important for global warming mitigation, we study the soil C stocks in Polylepis forests of three valleys in the HNP along a temperature gradient relative to elevation (3300 to 4500 m asl), and their vulnerability to decomposition with increasing temperatures and combined labile C and nutrient (N+P) additions.

We found that higher altitude soils have higher C:N:P ratios which indicates that, as expected, soils at high altitudes are nutrient limited. Also, the activities of the N acquiring enzymes: NAGase and leucine-aminopeptidase, C acquiring enzymes: beta-glucosidase, cellobiosidase, beta-xylosidase and phosphatase were positively correlated with altitude, which indicate that N and P availability decreased with altitude across our gradient. This could make high altitude soils vulnerable to C losses, not just due to increased temperatures, but also due to increased rhizosphere priming effects. Climate warming might increase plant growth and belowground C allocation, which in turn could lead to priming due to nutrient mining.

We found no differences across altitudes in microbial biomass (Cmic) measured with the chloroform fumigation extraction method. We are currently analysing microbial community composition (by PLFA's and DNA based methods). We will present data on microbial CUE of glucose decomposition, and how it is related to soil C/N ratios, nutrient availability and nutrient requirements, and community composition of the microbes. We also aim to test whether higher CUE is related to higher C stabilisation potential in the form of microbial necromass residues (amino sugars), or higher C loss when microbes efficiently growing on labile substrates will also increase the decomposition of more stable SOC (priming).