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Soil organic carbon stocks under different páramo vegetation covers in Ecuador's northern Andes

Marlon Calispa[1,2], Raphaël van Ypersele[1], Benoît Pereira[1], Sebastián Páez-Bimos[3,4], Veerle Vanacker[3], Marcos Villacís[4], Armando Molina[2,5], Bert de Bièvre[6], Teresa Muñoz[7], and Pierre Delmelle[1]

[1]UCLouvain, Earth and Life Institute, Environmental Sciences, Louvain-la-Neuve, Belgium (marlon.calispa@uclouvain.be)
[2]Universidad de Cuenca, Programa para el Manejo del Agua y Suelo (PROMAS), Facultad de Ingeniería Civil, Cuenca, Ecuador
[3]UCLouvain, Georges Lemaître Centre for Earth and Climate Research, Louvain-la-Neuve, Belgium
[4]Escuela Politécnica Nacional, Departamento de Ingeniería Civil y Ambiental, Facultad de Ingeniería Civil y Ambiental, Quito, Ecuador
[5]KU Leuven, Department of Earth and Environmental Sciences, Leuven, Belgium
[6]Fondo para la Protección del Agua (FONAG), Quito, Ecuador
[7]Empresa Pública Metropolitana de Agua Potable y Saneamiento (EPMAPS), Quito, Ecuador

The Ecuadorian páramo, a neotropical ecosystem located in the upper Andes, acts as a constant source of high-quality water. It also stores significant amounts of C at the regional scale. In this region, volcanic ash soils sustain most of the paramo, and C storage results partly from their propensity to accumulate organic matter. Vegetation type is known to influence the balance between plant C inputs and soil C losses, ultimately affecting the soil organic C (SOC) content and stock. Tussock-forming grass (spp. Calamagrostis Intermedia; TU), cushion-like plants (spp. Azorella pedunculata; CU) and shrubs and trees (Polylepis stands) are commonly found in the páramo. Our understanding of SOC stocks and dynamics in the páramo remains limited, despite mounting concerns that human activities are increasingly affecting vegetation and potentially, the capacity of these ecosystems to store C.

Here, we compare the organic C content and stock in soils under tussock-forming grass (spp. Calamagrostis Intermedia; TU) and soils under cushion-like plants (spp. Azorella pedunculata; CU). The study took place at Jatunhuayco, a watershed on the western slopes of Antisana volcano in the northern Ecuadorian Andes. Two areas of similar size (~0.35 km^2) were surveyed. Fourty soil samples were collected randomly in each area to depths varying from 10 to 30 cm (A horizon) and from 30 to 75 cm (2Ab horizon). The soils are Vitric Andosols and the 2Ab horizon corresponds to a soil buried by the tephra fall from the Quilotoa eruption about 800 yr. BP. Sixteen intact soil samples were collected in Kopecky's cylinders for bulk density (BD) determination of each horizon.

The average SOC content in the A horizon of the CU sites (9.4±0.5%) is significantly higher (Mann-Whitney U test, $p<0.05$) than that of the TU sites (8.0±0.4%), probably reflecting a larger input of root biomass from the cushion-forming plants. The 2Ab horizon contains less organic C (i.e. TU:

4.3±0.3% and CU: 4.0±0.4%) than the A horizon, but the SOC contents are undistinguishable between the two vegetation types. This suggests that the influence of vegetation type on SOC is limited to the A horizon. The average SOC stocks (in the first 30 cm from the soil) for TU and CU are 20.04±1.1 and 18.23±1.0 kg/m^2,respectively. These values are almost two times greater than the global average reported for Vitric Andosols (~8.2 kg/m^2), but are lower than the estimates obtained for some wetter Andean páramos (22.5±5 kg/m^2, 270% higher rainfall) from Ecuador. Our stock values further indicate that vegetation type has a limited effect on C storage in the young volcanic ash soils found at Jatunhuyaco. Despite a higher SOC content, the CU soils store a stock of organic C similar to that estimated for the TU soils. This likely reflects the comparatively lower BD of the former soils (650±100 vs. 840±30 kg/m^3). Additional studies are needed in order to establish the vegetation-related factors driving the SOC content and stability in the TU and CU soils.