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Fine-root biomass and soil properties across Peruvian forests

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To know the quantity of fine root biomass is crucial to understanding ecosystem structure and function. Soil characteristics and fertility are mainly determined by fine root dynamics, the turnover of this material is a major contribution of organic matter to soil structure and mineral nutrient cycles, and also the main source of carbon storage. Many studies of forests are mainly estimates of above-ground biomass. Here we report on differential patterns of fine root biomass allocation in Peruvian forests. Peru is divided into three large sub-regions, Amazon, Andean, and coast. These different ecosystems have also around 84 of the 103 ecosystems types and 28 of the 32 climates on the planet. A field study was conducted installing one-hectare permanent plots in each sub-region, this research was part of an intensive monitoring effort of the carbon cycle and functional traits in primary and secondary forests. To evaluate fine root biomass, 1 m² cross-section pits were set up in the plots where soil samples were collected every 10 cm up to 1 m depth and every 25 cm up to 2 m depth. Roots were retrieved and sorted into different diameter categories ≤0.5, 0.5 - 2.5, 2.5 - 5, and > 5 cm. Samples were rinsed with tap water over a 500-um sieve to loosen the soil and facilitate root sorting and to ensure that the sieve was fine enough to retain the finer roots. The roots after sorting were weighed fresh and then dried at 80°C for 48 hours, weighed to the nearest 0.0001 g, and stored in plastic vials for chemical analysis.

Total root biomass measurements displayed strong regional differences. Coastal dry forest at 370 to 422 m in elevation, where a one ha plot can support 651-681 stems (> 10 cm dbh) had root biomass values ranging from 7960 kg ha⁻¹ to 8130 kg/ha⁻¹. Andean forest plots at 1780 m.a.s.l., with 586 stems contained 17020 kg ha⁻¹ and Amazonian forest at 415 m.a.s.l., with 689 stems, had 33410 kg ha⁻¹ fine root biomass. Our results support the hypothesis that large root biomass in tropical forests is related to ecosystem type, climatic variables (temperature and moisture), and nutrients. The low bulk density and fine root biomass in tropical forests are inversely related to temperature and moisture. Fine-root turnover decreased with soil depth, which can also have important implications for the soil carbon stock and C cycling.