



Environmental Controls of Soil Organic Carbon in Soils Across Amazonia

Carlos Alberto Quesada (1), Claudia Paz (1), Oliver Phillips (2), Raimundo Nonato Araujo Filho (1), and Jon Lloyd (3)

(1) Instituto Nacional de Pesquisas da Amazonia, Manaus, Brazil (quesada.beto@gmail.com), (2) University of Leeds, Leeds, UK, (3) Imperial College London, London, UK

Amazonian forests store and cycle a significant amount of carbon on its soils and vegetation. Yet, Amazonian forests are now subject to strong environmental pressure from both land use and climate change. Some of the more dramatic model projections for the future of the Amazon predict a major change in precipitation followed by savanization of most currently forested areas, resulting in major carbon losses to the atmosphere. However, how soil carbon stocks will respond to climatic and land use changes depend largely on how soil carbon is stabilized. Amazonian soils are highly diverse, being very variable in their weathering levels and chemical and physical properties, and thus it is important to consider how the different soils of the Basin stabilize and store soil organic carbon (SOC). The wide variation in soil weathering levels present in Amazonia, suggests that soil groups with contrasting pedogenetic development should differ in their predominant mechanism of SOC stabilization. In this study we investigated the edaphic, mineralogical and climatic controls of SOC concentration in 147 pristine forest soils across nine different countries in Amazonia, encompassing 14 different WRB soil groups. Soil samples were collected in 1 ha permanent plots used for forest dynamics studies as part of the RAINFOR project. Only 0-30 cm deep averages are reported here. Soil samples were analyzed for carbon and nitrogen and for their chemical (exchangeable bases, phosphorus, pH) and physical properties, (particle size, bulk density) and mineralogy through standard selective dissolution techniques (Fe and Al oxides) and by semi-quantitative X-Ray diffraction. In Addition, selected soils from each soil group had SOC fractionated by physical and chemical techniques. Our results indicate that different stabilization mechanisms are responsible for SOC stabilization in Amazonian soils with contrasting pedogenetic level. Ferralsols and Acrisols were found to have uniform mineralogy (kaolinitic) and thus the clay plus silt fraction was the best correlate for SOC but with crystalline iron oxides (dithionite-citrate minus ammonium oxalate – oxalic acid extractable iron) being also correlated to SOC in these soils ($R^2 = 0.74$). Most of SOC in these soils was found on the clay+silt fraction and in stable, clay rich aggregates. However, SOC of high activity clays and other less weathered soils such as Alisols, Cambisols and Plinthosols showed no correlation with particle size or iron oxides, being mostly stabilized by aluminium complexes. We found SOC of these soils to be better explained by a three way interaction among soil pH, carbon quality and dithionite-citrate extractable Al ($R^2 = 0.85$). Consistent with this observation, SOC in the less weathered soils was mostly found in the colloidal fraction (75%). SOC of Podzols and Arenosols on the other hand had only a small but significant influence from their clay plus silt fraction ($R^2 = 0.31$), with particulate organic matter accounting for most of its SOC.