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Turnover and storage of soil organic carbon from different land uses on an elevation gradient in the Peruvian Andes

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Tropical soils account for a third of global soil C and play a critical role in regulating atmospheric CO_2 concentrations. The continuing fast rates of deforestation in the tropics for agricultural expansion and subsequent abandonment of new land uses are of particular interest to the science of soil C because of the associated C losses and potential for C sequestration. This study seeks to improve understanding of soil C stock changes within managed land in different ecosystems over a 2600 m gradient in the south-eastern Peruvian Andes. Using a density fractionation technique and natural abundance isotopes, the effects of the diverse range of local land use changes on 23 sites were investigated: grazing and burning on high altitude montane grasslands; burning in montane cloud forests; agricultural practices (cultivated and abandoned banana plantations, pastures of different grazing intensity), selective logging and secondary forest succession in the premontane forests. Overall, the montane grasslands and montane cloud forest had very similar soil C stocks down to 30 cm (167 $\pm$ 12 and 162 $\pm$ 36 Mg C ha-1), with the premontane forest containing approximately 35 % less soil C (61 $\pm$ 2.5 Mg C ha-1). The majority of the soil C pool (75 %) was recovered in the mineral - associated density fraction, with the montane grasslands containing on average $\sim$ 10 % less C in this fraction than the premontane soils. Burning and grazing in the montane grasslands had no significant influence on the total C stocks but the distribution of physical density fractions were altered, with significantly lower labile fractions and burning alone causing higher occluded LFs. Burning in the upper montane forest had no significant effect on soil C stocks, except on one of the sites, which may have been a result of burning intensity or site-specific micro climate differences. Agricultural practices in the premontane elevation showed variable results in both total soil C and its distribution within the soil. Pineapple plantations had no effect on total soil C but significant losses in the free LF. Cultivated banana soils had significant total C losses (16.3 $\pm$ 0.5 Mg C ha-1), with the majority coming from the stable heavy F. The recovery of soil C was notable on an abandoned banana plantation of eight years due to the input of more recalcitrant material with forest regrowth and the same was found with the secondary forest. The total soil C stocks in the pasture soils were directly linked to the proportion of forest and grass derived C in the soil, with pasture sites containing the most forest derived C showing similar total C stocks to the mature forest. The data from this study show that the ability of the soils to maintain SOC stocks during land use changes are largely impacted by the physical distribution of C in the soil, the origin of C and dependent on type of land use.