Comparing Background and Recent Erosion Rates in Degraded Areas of Southeastern Brazil

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Abstract

Soil erosion is a major problem in northwestern Rio de Janeiro State where, during the last three centuries, major land-use changes took place, associated with the replacement of the original rainforest by agriculture and grazing. The combination of steep hillslopes, erodible soils, sparse vegetation, natural and human-induced fires, as well as downslope ploughing, led to an increase in surface runoff and surface erosion on soil-mantled hillslopes; together, these actions and responses caused a decline in soil productivity. In order to estimate changes in erosion rates over time, we compared erosion rates measured at different spatial and temporal scales, both background (natural) and short-term (human-induced during last few decades). Background long-term erosion rates were measured using in-situ produced cosmogenic 10Be in the sand fraction quartz of active river channel sediment in four basins in the northwestern portion of Rio de Janeiro State. In these basins, average annual precipitation varies from 1,200 to 1,300 mm, while drainage areas vary from 15 to 7,200 km2. Short-term erosion rates were measured in one of these basins from fallout 210Pb in soil samples collected along a hillslope transect located in an abandoned agriculture field. In this transect, 190 undisturbed soil samples (three replicates) were collected from the surface to 0.50 m depth (5 cm vertical intervals) in six soil pits. 10Be average

background, basin-wide, erosion rates in the area are ~ 13 m/My; over the last decades, time-integrated (210Pb) average hillslope erosion rates are around 1450 m/Myr, with maximum values at the steepest portion of convex hillslopes of about 2000 m/Myr. These results suggest that recent hillslope erosion rates are about 2 orders of magnitude above background rates of sediment generation integrated over many millennia. This unsustainable rate of soil loss has severely decreased soil productivity eventually leading to the abandonment of farming activities in areas where soil loss is severe.

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