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Effects of Land Use on Carbon Cycling of Tropical Ecosystems in Panama

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Abstract

Land-use change has a significant impact on the carbon cycling of ecosystems. In particular tropical ecosystems are affected by ongoing land-use changes. Due to biophysical and biogeochemical feedbacks this also influences the global climate. An improved understanding of the effects of land use on carbon cycling of tropical ecosystems can facilitate the development of mitigation strategies. However, continuous measurements of ecosystem carbon fluxes are sparse in tropical regions and only few localities exist in Central America. Thus, our objective is to analyse the carbon cycling of two tropical ecosystems (native tree species plantation and traditionally grazed pasture) in Sardinilla, Central Panama based on flux tower measurements using the eddy covariance method.

Considerable differences are observed in diurnal Net Ecosystem Exchange (NEE). In the rainy season, midday assimilation is higher in the pasture ecosystem. However, nighttime respiration rates in the pasture are higher during all seasons. Furthermore, the pasture is more susceptible to soil water limitations (likely due to shallow roots) and assimilation is reduced in the dry season gradually to zero until the beginning of the rainy season. Unlike, in the plantation ecosystem assimilation is lower on average but is sustained in most of the dry season. Consequently, the pasture ecosystem is a carbon source during most of the year, and particularly in the dry season. The plantation ecosystem remains almost continuously a carbon sink. Both ecosystems were carbon sources in April and May 2008, which might be related to ENSO (La Niña) and a prolonged dry season in 2008. Carbon release in the 9 hectare pasture seems to be related to grazing intensity.

Our results show considerable diurnal and seasonal differences of NEE between a tropical pasture and a native tree species plantation in Panama. High midday assimilation rates in the pasture ecosystem are related to the intense productivity of dominating C4 grasses. However, respiration losses exceed photosynthetic inputs. Besides the seasonal constrained availability of water, grazing intensity seems to be a major influence in the pasture ecosystem. Our results indicate a carbon storage potential for the plantation ecosystem.

Keywords: Carbon cycling, land use, Panama, tropical ecosystems

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