

Spatial and temporal variation in soil CO₂ efflux in an old-growth neotropical rain forest, La Selva, Costa Rica.

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Abstract

Our objectives were to quantify and compare soil CO₂ efflux of two dominant soil types in an old-growth neotropical rain forest in the Atlantic zone of Costa Rica, and to evaluate the control of environmental factors on CO₂ release. We measured soil CO₂ efflux from eight permanent soil chambers on six Oxisol sites. Three sites were developed on old river terraces ('old alluvium') and the other three were developed on old lava flows ('residual'). At the same time we measured soil CO₂ concentrations, soil water content and soil temperature at various depths in 6 soil shafts (3 m deep). Between 'old alluvium' sites, the two-year average CO₂ flux rates ranged from 117.3 to 128.9 mg C m⁻² h⁻¹. Significantly higher soil CO₂ flux occurred in the 'residual' sites (141.1 to 184.2 mg C m⁻² h⁻¹). Spatial differences in CO₂ efflux were related to fine root biomass, soil carbon and phosphorus concentration but also to soil water content. Spatial variability in CO₂ storage was high and the amount of CO₂ stored in the upper and lower soil profile was different between 'old alluvial' and 'residual' sites. The major factor identified for explaining temporal variations in soil CO₂ efflux was soil water content. During periods of high soil water content CO₂ emission decreased, probably due to lower diffusion and CO₂ production rates. During the 2-year study period inter-annual variation in soil CO₂ efflux was not detected.