

LANDSCAPE AND CLIMATIC CONTROLS ON SPATIAL AND TEMPORAL VARIATION IN SOIL CO₂ EFFLUX IN AN EASTERN AMAZONIAN RAINFOREST, CAXIUANÁ, BRAZIL

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Abstract

Quantification of temporal and spatial variation of soil CO₂ emissions is essential for an accurate interpretation of tower-based measurements of net ecosystem exchange. Here, we measured in the old-growth forest of Caxiuana, Eastern Amazonia soil CO₂ efflux and its environmental controls from two Oxisol sites with contrasting soil texture and at different landscape positions. Average CO₂ efflux was 21% higher for sand ($3.93 \pm 0.06 \mu\text{mol CO}_2 \text{ m}^{-2}\text{s}^{-1}$) than for the clay ($3.08 \pm 0.07 \mu\text{mol CO}_2 \text{ m}^{-2}\text{s}^{-1}$). No difference was detected for soil temperature between sites, while soil water content in sandy soil ($23.2 \pm 0.33 \%$) was much lower than the clay soil ($34.5 \pm 0.98 \%$), for the two-year period. Soil CO₂ efflux did not differ between dry and wet season, but we detected a significant interaction between season and topographic position. The variation caused by topography was in the same order of magnitude as temporal variation. Mean contribution of the litter layer to the CO₂ efflux rates was 20% and varied from 25% during the wet season to close to 0% during the dry season. The relation between soil water content and soil CO₂ efflux showed an optimum for both soil textures but the shape and optimum of the curves were different. The results of our study illustrate that soil moisture is an important driver of temporal variations in soil CO₂ efflux in this old-growth forest. When extrapolating soil CO₂ efflux to larger areas, the significant influences of soil texture, litter, and the interaction of topographical position and time illustrate that it is necessary to include some of the complexity of landscapes.

Keywords: Amazon, carbon cycle, CO₂, litter, NEE, soil respiration, soil temperature, soil water content, spatial variation, topography.

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