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Responses of tropical forest soil organic matter pools to shifts in precipitation patterns

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Subsoils contain more than half of global soil organic matter (SOM) stocks. Given that sequestration and turnover processes of SOM are slower in the subsoil than in the topsoil, subsoil carbon (C) stocks are likely to be vulnerable to shifts in precipitation patterns. Therefore, we investigated the responses of different sources of tropical forest soil organic C (SOC) pools to a delayed onset and increased intensity of seasonal precipitation in a 10-year rainfall manipulation experiment. While total SOC varied with soil depth, regardless of shifts in rainfall pattern, we observed that changes in precipitation patterns affected the composition of SOC pools. A delayed wet season increased both the content and proportion of the light fraction C in the SOC at the 0–10 cm depth, potentially due to a decrease in the light fraction decomposition. The delayed wet season also led to a higher content of iron (Fe)-bound organic C, due to impacts on free iron (Fe^{3+}) and aluminum oxides. In addition, wetter wet season led to a higher content of lignin phenols in the top- and subsoil (0–70 cm), due to anoxic conditions preventing lignin decomposition. However, this precipitation shift decreased both the content and proportion of fungal necromass in the SOC in the subsoil (50–70 cm), this was attributed to fungal necromass decomposition by microorganisms facilitated by increased N-acquisition enzyme activity. Overall, greater precipitation intensity increased the vulnerability of subsoil C to losses, primarily due to greater microbial decomposition under increased N limitation. Our study demonstrates the subsoil C-cycling processes in shaping SOM stocks to global changes in precipitation patterns.

Keywords: Tropical forest, Rainfall changes, Soil carbon fractions, Microbial necromass, Lignin phenols, mineral bound carbon

Biography

Dr. Feng Sun research focuses on soil ecology, focusing on the biological connections between aboveground and belowground ecosystem communities and their impacts on soil nutrient cycling, particularly the interactions between plants and soil microorganisms and nematodes. Currently, I am primarily researching tropical and subtropical forest ecosystems. Using controlled experiments, data assimilation, and large-scale model simulations, I am investigating the impacts of global change on soil carbon and phosphorus cycling in tropical and subtropical forests at the individual plant, ecosystem, and regional scales.

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