From plant litter to soil organic matter: a game to understand carbon dynamics

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Frontiers in Ecology and the Environment, 2024, e2724

DOI: https://doi.org/10.1002/fee.2724

Abstract

Managing ecosystems to sequester soil carbon requires a thorough understanding of complex soil processes. Here, we integrate these soil processes through the metaphor of a game—one that moves through multiple dimensions (from macro-aggregates to micropores and clay particles) and scales (from centimeters to nanometers) of the soil. The rules of the game are based on current understanding of soil carbon persistence, which differs from the classic humus concept of molecular complexity. The game's objective is to win points, by keeping "tokens" (plant-derived organic compounds) within the soil organic matter for as long as possible. The game begins when tokens enter different "pool-levels" (plant litter, particulate organic matter, dissolved organic matter, and mineral-associated organic matter) of the soil, either directly or after metabolic transformation by soil biota. Points are lost through either respiration by soil biota or leaching. We invite readers to play this game and explore different natural ecosystems and land-use scenarios to better comprehend complex soil processes.