

Climate and litter C/N ratio constrain soil organic carbon accumulation

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Soil organic carbon (SOC) plays critical roles in stabilizing atmospheric CO₂ concentration, but the mechanistic controls on the amount and distribution of SOC on global scales are not well understood. In turn, this has hampered the ability to model global C budgets and to find measures to mitigate climate change. Here, based on the data from a large field survey campaign with 2600 plots across China's forest

ecosystems and a global collection of published data from forested land, we find that a low litter carbon-to-nitrogen ratio (C/N) and high wetness index (P/PET, precipitation-to-potential-evapotranspiration ratio) are the two factors that promote SOC accumulation, with only minor contributions of litter quantity and soil texture. The field survey data demonstrated that high plant diversity

decreased litter C/N and thus indirectly promoted SOC accumulation by increasing the litter quality. We conclude that any changes in plant-community composition, plant-species richness and environmental factors that can reduce the litter C/N ratio, or climatic changes that increase wetness index, may promote SOC accumulation. The study provides a guideline for modeling the carbon cycle of various ecosystem scales and formulates the principle for land-based actions for mitigating the rising atmospheric CO₂ concentration.

Keywords: litter carbon-to-nitrogen, wetness index, annual litterfall, soil texture, soil organic carbon



