



Will temperate forest soil take up or release C under future elevated atmospheric CO₂: A synthesis based on forest FACE experiments

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Tempered forest ecosystems are hypothesized to be large sinks for anthropogenic emissions of CO₂ due to regrowth and CO₂ fertilization. Forest free air CO₂ enrichment (FACE) experiments in aggrading temperate forests and plantations have demonstrated increases in net primary production under elevated CO₂. The extra C uptake due to FACE may in part be stored in the forest floor litter and mineral soil depending on allocation (above vs below ground), soil bioturbation and the physical and chemical stabilization of SOM. However, the increased availability of labile soil C under FACE may also cause a priming effect (loss of SOM).

FACE induced additional forest floor C sinks ranged between 0 and 52 g C m⁻² y⁻¹. Average increases of soil C sinks ranged between 27 and 54 g C m⁻² y⁻¹ under FACE, although during some years soil C was lost. Physical fractionation (light fraction and macro-, micro-, and micro within macro-aggregates) revealed no increased SOM stabilization under FACE at Duke Forest; stabilization of extra soil C under FACE at Oak Ridge; and increased SOM stabilization under FACE at POP-EuroFACE. The different results among the experiments are related to N dynamics, vertical C allocation, bioturbation, base saturation and soil type.