

Carbon budget of the Harvard Forest Long-Term Ecological Research site: pattern, process, and response to global change

Objective

How, where, and why carbon (C) moves into and out of an ecosystem through time are long-standing questions in biogeochemistry. In this monograph, we bring together hundreds of thousands of C-cycle observations at the Harvard Forest in central Massachusetts, USA, a mid-latitude landscape dominated by 80–120-yr-old closed-canopy forests. These data answered four questions: (1) where and how much C is presently stored in dominant forest types; (2) what are current rates of C accrual and loss; (3) what biotic and abiotic factors contribute to variability in these rates; and (4) how has climate change affected the forest's C cycle?

Impact

The study, published in *Ecological Monographs*, reveals that the rate at which carbon is captured from the atmosphere at Harvard Forest nearly doubled between 1992 and 2015. Much of the increase in storage capacity is due to the growth of 100-year-old oak trees, still vigorously rebounding from colonial-era land clearing, intensive timber harvest, and the 1938 Hurricane – and bolstered more recently by increasing temperatures and a longer growing season due to climate change.

Trees have also been growing faster due to regional increases in precipitation and atmospheric carbon dioxide, while decreases in atmospheric pollutants such as ozone, sulfur, and nitrogen have reduced forest stress.

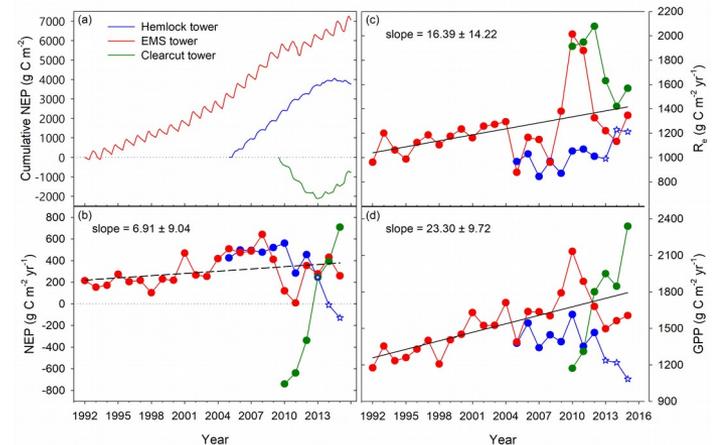


Figure Caption

(a) Cumulative and (b) annual net ecosystem production (NEP) and its component fluxes (c) total ecosystem respiration (R_e) and (d) gross primary production (GPP). Star symbols represent years during which hemlocks were in decline. The black lines in panels b–d represent the significant (solid) or nonsignificant (dashed) trends in increasing NEP, R_e , and GPP with time at the EMS site (NEP, $\text{Adj-}r^2 = 0.06$, $P = 0.127$; R_e , $\text{Adj-}r^2 = 0.17$, $P = 0.026$; GPP, $\text{Adj-}r^2 = 0.51$, $P < 0.001$)

Finzi et al., *Ecological Monographs*, 90(4), 2020, e01423