iFAST: The International Forum on Advanced Environmental Sciences and Technology

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8 a.m. CST, 9 a.m. EST, Wednesday, March 4, 2026
2 p.m. GMT, 10 p.m. China, Wednesday, March 4, 2026

MARK BRADFORD
YALE UNIVERSITY
https://environment.yale.edu/directory/faculty/mark-bradford

Mark A. Bradford is the E.H. Harriman Professor of Soils and Ecosystem Ecology at the Yale School of the Environment and The Forest School. His group's research investigates how soil biology governs carbon cycle responses to global change and ecosystem management. Their current work spans questions that address uncertainties in carbon cycle-climate feedback to quantifying management impacts on soil carbon. He is particularly interested in applying causal inference approaches to applied questions in ecosystem management. He is author of over 200 academic papers and is an ISI highly cited author in cross-disciplinary fields.

Bradford connects to policy and practice through collaborations with eNGOs and other entities to produce and synthesize evidence that helps inform the management of agricultural soils and forests for climate mitigation and adaptation. He teaches soil science, ecosystem science, and science synthesis for policy and practice. He holds bachelor of science and doctoral degrees in biological sciences from Exeter University (UK), did his graduate work at the then UK government Institute of Terrestrial Ecology, postdoctoral research at Imperial College, London, and Duke University, and joined the faculty at the University of Georgia, Athens, in 2005. He joined the Yale University faculty in 2009.

Soil Carbon: Improving Evidence to Build Confidence in Greenhouse Gas Accounting and Climate Mitigation

Abstract Causal approaches employed at the scale of working landscapes, such as commercial agriculture and productive forests, are required to build high-quality evidence about the extent to which natural disturbances and management are changing the amount of carbon stored in soils. This carbon underpins the climate resilience of agriculture and forests, and its losses to, and gains from, the atmosphere are a major flux in the global carbon cycle. Confidence in the magnitude of these fluxes and what is driving them is essential for informing greenhouse gas emission targets to achieve desired climate outcomes. However, the belief that quantification of net soil carbon losses and gains, attributable to disturbances and management, is infeasible through direct management has led to low confidence in estimated losses and gains. We use multiple, measurement-and-remeasurement datasets of soil carbon stocks from tens to hundreds of fields and forest plots to show that empirical estimates of average change in soil carbon stocks are robust despite huge variability in stocks both within and among fields and forest plots. The uncertainty introduced by variation in soil carbon stocks at local and regional scales is not the barrier to robust quantification that is assumed under the "infeasibility assumption" that has led to proliferation of modeling versus empirical approaches for soil carbon accounting. The variability in soil carbon stocks does, however, create spurious estimates of change at the scale of individual fields and forest plots, which emerges through the statistical artifact of regression-to-the-mean, a pattern caused by randomly sampling a noisy variable. We show how project design decisions minimize regression-to-the-mean to an extent that landscape and regional-scale accounting can be considered robust. The findings have significant implications for addressing uncertainty in the accuracy of soil carbon accounting and for generating datasets that can be used to independently test and advance the capabilities of process-based and digital soil mapping approaches as potential alternate approaches to scale soil carbon quantification.

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