



Unveiling Carbon Sequestration Dynamics in Bamboo Forests, China: An Observation-Based Approach Using Atmospheric Tracers

Shuangxi Fang, Oksana Tarasova, Yanxia Li, Jocelyn Turnbull, Yi Lin, Gordon Brailsford, and Sara Mikaloff-Fletcher

Zhejiang University of Technology, Zhejiang Carbon Neutral Innovation Institute, Hangzhou, China (fangsx@zjut.edu.cn)

Bamboo, a perennial grass species, exhibits rapid growth rates surpassing many native trees, offering substantial potential for atmospheric carbon capture and subsequent sequestration into durable products. Despite this promise, the carbon sequestration capacity of bamboo forests and its variability under different land management practices and environmental conditions remain underexplored. This study examines carbon sequestration in a representative bamboo forest in Anji, eastern China, employing a novel observation-based approach utilizing multiple atmospheric tracers (CO_2 , CO , and $^{14}\text{C-CO}_2$) measurements to attribute fluxes accurately. The study also includes regular biomass inventory to be able to compare CO_2 fluxes between two approaches. Departing from conventional inventory-based estimates of carbon emissions and uptakes, observations-based method yields detailed insights into individual carbon-cycle processes within bamboo ecosystems and identifies the most effective tracers for quantifying regional CO_2 fluxes. Leveraging high-resolution atmospheric CO_2 observations, coupled with advanced modeling systems and analytical tools—including machine learning techniques to reconstruct and correct prior Net Ecosystem Exchange (NEE) fluxes for the bamboo forest—we derive carbon fluxes while accounting for variations in management strategies and environmental factors. These findings enhance our understanding of bamboo's role in global carbon mitigation, informing sustainable forestry practices and climate policy. This work highlights the transformative potential of tracer-based methodologies for precise, scalable carbon flux assessments in managed ecosystems.

The study is supported by the Quadrature Climate Foundation (Grant No. 01-21-000133).