

PROJECT ABSTRACT

Forest-Atmosphere Exchange of CO₂ over a Mixed Hardwood Ecosystem in the Midwest

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(1) Project Objectives. Our research is directed at providing quantitative measures of net ecosystem carbon exchange and its seasonal and interannual variation of a Midwestern deciduous forest ecosystem, in cooperation with AmeriFlux and NACP partners. New research initiatives include the evaluation of the spatial variability of biophysical control-processes in the forest (radiation, gully flows, turbulence structure), footprint modeling to assess the spatial representativeness of flux measurements. Measuring and modeling the CO₂ exchange reveals the effectiveness of extensive forest carbon sinks in the Midwest to respond to variations in their biophysical controls. Data from this study are used to assess the linkages between ecosystems and carbon cycles across the region. The proposed work will enhance understanding of soil-vegetation-atmosphere interactions for deciduous forests. This project continues the operation of an established AmeriFlux site (the MMSF~Flux project) and provides data for a number of associated projects.

(2) Location of research activities. The MMSF~Flux tower is located in the Morgan-Monroe State Forest, south-central Indiana. Lat.: 39° 19' 23.34" N, Lon: 86° 24' 47.3004"; Elevation: 275 m above sea level.

(3) Hypotheses/Research questions. Within deciduous forests of the Midwest, what are the biological and atmospheric controls on the dynamics of carbon exchange? The following hypotheses are to be evaluated in this project:

- (i) Midwestern hardwood forests contribute to long-term carbon sequestration as net sinks for atmospheric CO₂.
- (ii) Net ecosystem production responds to interannual climatic variations (radiation, water, temperature).
- (iii) Topography induced spatial variations in biophysical parameters significantly affect carbon exchange.

(4) Approach and Methods. The principal approach is to measure fluxes and concentrations of carbon dioxide, water vapor, sensible heat, and momentum using eddy-covariance equipment.

(5) Expected Deliverables. Quantifying changes in net carbon storage by forests is a necessary step in the validation of carbon sequestration estimates and in assessing the possible role of these ecosystems in offsetting fossil fuel emissions. Our long-term measurements of the forest-atmosphere exchange of two of the most important greenhouse gases (CO₂, H₂O) contribute to improve the ability to predict future concentrations of these gases and the associated global climate change. Beyond enhancing empirical and theoretical understanding of soil-vegetation-atmosphere interactions for deciduous forests, we expect deliverables including:

1. Data set (hourly values), deposited at Fluxnet data archive.
2. Final report (due October, 2007)
3. Publications in peer reviewed international journals
4. Public Presentations: at conferences and universities
5. Education of graduate students (M.S. and Ph.D. degrees), and undergraduate assistants