

ABSTRACT

Project title: Disturbance, succession and forest carbon dynamics: a large-scale experiment at the University of Michigan Biological Station

Principal investigator: Peter S. Curtis, Ohio State University

Co-Investigator: Christoph S. Vogel, University of Michigan

Co-Investigator: Christopher M. Gough, Virginia Commonwealth University

Co-Investigator: Gil Bohrer, Ohio State University

1. *Objectives:* a) Quantify C exchange processes during and after a successional shift from a mature aspen to a young mixed conifer/deciduous forest. b) Investigate the interactive role of disturbance and succession in governing landscape-level variability in C fluxes and storage. c) Generalize effects of canopy structure on flux exchange. d) Continue measurements of mass and energy exchange over an aspen-dominated hardwood forest, building on >10 years of continuous measurements. e) Leverage this novel, large-scale experiment to build a new multi-disciplinary climate change research platform.
2. *List of hypotheses:* Our overarching hypothesis is that forest NEP across much of the upper Great Lakes region will increase following transition from aspen dominated ecosystems to those of later-successional species with biologically and structurally more complex canopies. *Ecological hypotheses:* a) Tree mortality will prompt a short-term reduction in NEP. A rapid recovery and stabilization of NEP above that of the control forest will be linked to the magnitude of N leaching losses and the pattern of redistribution of available N. b) Successional change will increase spatial variation in microclimate and nutrient distribution, both of which constrain landscape-level variability in C storage. *Meteorological hypotheses:* Successional changes to canopy structure will a) increase its roughness length and decrease its displacement height, and b) create consistent localized flux patterns.
3. *Location:* The University of Michigan Biological Station AmeriFlux site, Pellston, Michigan.
4. *Methods:* In Spring 2008, we implemented the NICCR-funded Forest Accelerated Succession Experiment (FASET) by stem girdling all aspen and birch (>6,700 trees, ~35% canopy LAI) within a 33 ha stand in the footprint of a new eddy-flux tower and in three nearby 2 ha replicate stands. Our unmanipulated AmeriFlux site serves as control. Pre-treatment ecological and meteorological measurements in experimental and control stands established their intercomparability and will continue for quantifying the interacting effects of disturbance, succession, and climate on C pools and fluxes. New work will include physical simulations of wind and fluxes inside and above the canopy using large eddy simulations with 3-D heterogeneous canopy coupled to a dynamic vegetation model.
5. *Deliverables:* Our objectives support focus 3 of the NICCR RFP-04, improving our understanding of the biological and climatic controls over C and energy cycles. We expect this research will allow us to continue to produce 3 to 4 peer-reviewed publications per year (35 total/10 years) and a dozen presentations annually. Graduate, undergraduate, and post-graduate research training remain a high priority.