NAME: David Hollinger
ORGANIZATION: USDA Forest Service
PROGRAM AFFILIATION: TES
ABSTRACT TITLE: Supporting carbon cycle and earth systems modeling with measurements and analysis from the Howland AmeriFlux Site.

ABSTRACT: The overall goal of the proposed work is to understand the various (and interacting) impacts of a changing climate on carbon cycling at the Howland AmeriFlux site, representative of an important component of the North American boreal forest. *Our focus is on quantitatively and continuously partitioning respiration to better constrain carbon cycle models.* Specifically our goals include (1) using manipulative and isotopic methods to partition soil respiration into heterotrophic and autotrophic components, (2) evaluating whether a long-term trend of increasing C sequestration is related to reduced respiration or enhanced primary productivity, (3) determining what observational data best reduce uncertainties in simulated respiratory fluxes and below-ground processes, and (4) investigating the relationships between CO_2 and CH_4 emissions in this mosaic landscape of moderately well drained and very poorly drained soils.

Six soil respiration chambers have measured soil CO_2 and CH_4 fluxes, soil moisture and temperature at 90 minute intervals since 2011. In September 2012, trenches were excavated to 50cm depth around three of the chambers. Plastic tarp was placed along the trenched walls to prevent root regrowth into plots and the trenches were backfilled. Following trenching, CO_2 effluxes declined in the trenched plots relative to the control plots, however there was little change in measured CH_4 fluxes between control and trenched following trenching. The change in respiration is a direct indication of autotroph respiration.

Eddy flux measurements of whole ecosystem net carbon exchange indicate that this mature conifer forest has continued to sequester carbon (averaging ~ 200 g C m^{-2} y^{-1} since 1996; >300 g C m^{-2} in 2012) and that the rate of C uptake has increased by ~7 g C yr^{-1} (P<0.01) since measurements commenced. Much of this increase in C uptake is associated with an earlier start to the growing season in recent years. Whole ecosystem CH_4 flux measurements at Howland supported by TES are described in the companion poster by Shoemaker et al.

Continuous ^{13}C measurements of stem and soil respiration suggest that carbon isotope discrimination differences between the dominant species at the site (red spruce and eastern hemlock) are greater than between autotrophic and heterotrophic sources. This means that the isotopic measurements may not be useful in partitioning respiratory fluxes. However, these data provide important insight into plant water use efficiency and can constrain stomatal conductance parameters in ecosystem models.