Biometric and eddy-covariance based estimates of annual carbon storage in five eastern North American deciduous forests

Contact: P.J. Hanson, hansonpj@ornl.gov, 865-574-5361
Sponsor: DOE/OBER (B&R code KP 12 03 01 0)

- **Accurate estimates of carbon uptake (sequestration) by natural ecosystems are needed as inputs to defensible carbon budgets for North America**
- **Tower-based micrometeorological data provides high quality short-term data but is subject to errors of integration. Comparisons with traditional methods are needed to constrain ecosystem C uptake estimates**
- **Both approaches show deciduous forest C uptake ranging from 1.8 to 3.2 Mg C ha^{-1} y-1 with no systematic difference among methodologies**
- **Understanding forest C uptake is a prerequisite demanded by stakeholders for input into possible environmental management plans for managing greenhouse gases**

Biometric and eddy-covariance based estimates of annual carbon storage in five eastern North American deciduous forests

Contact: P.J. Hanson, hansonpj@ornl.gov, 865-574-5361

Sponsor: DOE/OBER (B&R code KP 12 03 01 0)

Quantifying net carbon (C) 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. In eastern North America, five sites were established in deciduous forests to provide measurements of net ecosystem CO_2 exchange (NEE) using micro-meteorological methods, and measures of major carbon pools and fluxes, using a combination of forest mensurational, eco-physiological, and other biometric methods. The five study sites, part of the AmeriFlux network, ranged across 10° of latitude and 18° of longitude, but were all of similar age, canopy height, and stand basal area. Here we present a cross-site synthesis of annual carbon storage estimates, comparing meteorological and biometric approaches, and also comparing biometric estimates based on analyses of autotrophic carbon pools and heterotrophic carbon fluxes (net ecosystem production, NEP) versus those based on measurements of change in two major carbon pools (ΔC). Annual above-ground net primary production varied nearly two-fold among sites and was strongly correlated with average annual temperature and with annual soil nitrogen mineralization (N_{min}). Estimates of NEP ranged from 1.1 Mg C ha^{-1} yr^{-1} in northern Wisconsin to 3.5 Mg C ha^{-1} yr^{-1} in central Indiana, and were also well correlated with N_{min}. There was less variation among sites in estimates of ΔC (range, 1.8 – 3.2 Mg C ha^{-1} yr^{-1}). In general, ΔC more closely matched NEE than did NEP, but there was no systematic pattern among sites in over- versus under-estimation of the biometric compared to the meteorologically based measures. Root and soil carbon dynamics were significant sources of uncertainty in our biometric measures and represent a prerequisite area of study needed for accurate estimates of forest carbon storage.

Curtis PS, Hanson PJ, Bolstad P, Barford C, Randolph JC, Schmid HP, Wilson KB (2002) Biometric and eddy-covariance based estimates of annual carbon storage in five eastern North American deciduous forests. Agric For Meteorol 113:3-19.