HISTORICAL CHANGES IN CARBON STORAGE OF THE EASTERN UNITED STATES: UNCERTAINTIES ASSOCIATED WITH FOREST HARVEST AND AGRICULTURAL LAND USE ACTIVITIES

[1]L.A. Joyce[1], A.D. McGuire[2,5], D.P. Coulson[3], J. Clein[4], T. Burnside[5]

[2]*USDA Forest Service Rocky Mountain Research Station*
[3]*US Geological Survey*
[4]*SI International*
[5]*University of Alaska-Fairbanks*

ABSTRACT

Process-based models are important tools in assessments because they are able to integrate mechanisms responsible for changes in carbon storage. Retrospective model analyses are important for clarifying land use impacts on carbon storage estimates. The objectives of our study were to: 1) develop a land use model that allows annual conversion of native ecosystems to agriculture and creation of age cohorts following harvest and cropland abandonment from 1600 to 2002; 2) compare modeled age class distribution with independent inventory data on stand age distributions, and 3) use these data sets to drive the Terrestrial Ecosystem Model (TEM) and evaluate how assumptions about soil degradation and CO_2 fertilization influence estimates of changes in carbon storage of the eastern US. The land use model integrates temporally and spatially explicit agricultural land use information from Ramankutty and Foley with estimates of forest area disturbed through harvest within 0.5 degree by 0.5 degree grid cells. Because little inventory data on forest area harvested is available, we developed a statistical model based on available inventory data to estimate forestland harvested over 1952 to 1997, and from 1600 to 1952, we interpolated the 1952 estimate to the date of first settlement, modifying interpolation with human population trends. Total US forestland area dynamics over 1600-2002 are within 10 percent of inventory estimates. The land use model slightly overestimates total US forestland harvested over the 1980-1990 period (2.1% versus inventory estimate of 2.0%). Several simulation experiments were conducted with TEM. Degradation of ecosystem nitrogen stocks by agricultural activities has the potential to influence the growth of forests on lands previously in agriculture. For the time period 1988-1992, inventory-based estimates of changes in vegetation C storage are most consistent with the simulations driven by constant CO_2 and where the assumption was that nitrogen was minimally lost after land use change. Uncertainties concerning the degree of historical nitrogen degradation represent an important uncertainty that may influence future carbon sequestration efforts. The results of this study suggest that increasing atmospheric CO_2 may be having little effect on forest vegetation carbon storage in the eastern United States.