Public Abstract
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Graduation Term: Summer
Graduation Year: 2006

Title: Simulating cottonwood tree growth in flood plains using the LIGNUM modeling method

ABSTRACT

As a flood-tolerant and fast-growing species, cottonwood is a promising species in flood plain and short-rotation forestry. Understanding tree growth will provide critical assistance in flood plain forest management and forest configuration practice. Computer based tree growth simulation models provide a complementary tool for forest managers and scientists to learn the underlying tree growth mechanisms and a tree's response to different growing environments. LIGNUM, a functional-structural tree growth simulation model, was applied to simulation of the cottonwood growth in a flood plain area in central Missouri.

The key characteristics of the LIGNUM model are the linkage between tree spatial structure and physiological function. L-system was adopted in structural derivation of the tree. Physiological processes including photosynthesis and growth allocation were embedded in LIGNUM model. Communication between L-system and LIGNUM model was implemented during model simulation.

Based on the general framework from the previous LIGNUM version, the application of cottonwood growth simulation with LIGNUM modeling method required a few new developments, including real photon flux data input, a voxel space photon flux interception module, a photosynthesis

product module, three nested short time modeling steps, and stand growth simulation. The link to actual weather data enabled better convergence of model results with real world tree growth. The voxel space photon flux interception module replaced tree compartments with regular voxels as the calculation unit, resulting in efficient photon flux interception operation. Three nested short time steps were used according to the growth speed of cottonwood to capture the rapid change in tree structure. The biochemically-derived model on photosynthetic production – Farquhar's model – was applied to accumulate net leaf CO2 assimilation all over the tree. The application of LIGNUM in mono-cohort, even-aged, and tightly spaced cottonwood stand is a new extension of the LIGNUM model.

The simulation results reflected well the real cottonwood growth for the first four years. Simulated results respond logically to photon flux input variation. The model is sensitive to several parameters in the photosynthesis module. Further application of LIGNUM model can be used in more complicated forest research.