Abstract

We have developed a General Ecosystem Model (GEM) that is designed to simulate a variety of ecosystem types using a fixed model structure. Driven largely by hydrologic algorithms for upland, wetland and shallow-water habitats, the model captures the response of macrophyte and algal communities to simulated levels of nutrients, water, and environmental inputs. It explicitly incorporates ecological processes that determine water levels, plant production, nutrient cycling associated with organic matter decomposition, consumer dynamics, and fire. While the model may be used to simulate ecosystem dynamics for a single homogenous habitat, our primary objective is to replicate it as a "unit" model in heterogeneous, grid-based dynamic spatial models using different parameter sets for each habitat. Thus, we constrained the process (i.e., computational) complexity, yet targeted a level of disaggregation that would effectively capture the feedbacks among important ecosystem processes. A basic version was used to simulate the response of sedge and hardwood communities to varying hydrologic regimes and associated water quality. Sensitivity analyses provided examples of the model dynamics, showing the varying response of macrophyte production to different nutrient requirements, with subsequent changes in the sediment water nutrient concentrations and total water head. Changes in the macrophyte canopy structure resulted in differences in transpiration, and thus the total water levels and macrophyte production. The GEM's modular design facilitates understanding the model structure and objectives, inviting variants of the basic version for other research goals. Importantly, we hope that the generic nature of the model will help alleviate the "reinventing-the-wheel" syndrome of model development, and we are implementing it in a variety of systems to help understand their basic dynamics.