Abstract

Water management infrastructure and operations have fragmented the greater Everglades into separate, impounded basins, altering flows and hydropatterns in these internationally recognized wetlands. A significant area of this managed system has experienced anthropogenic eutrophication. This combination of altered hydrology and water quality has interacted to degrade vegetative habitats and other ecological characteristics of the Everglades. As part of a massive plan to "restore" the Everglades, simulation models are being applied to better understand the systemÕs hydrologic and ecological dynamics, evaluating options for restoration plans. One such tool is the Everglades Landscape Model (ELM), a process-based, spatially explicit simulation of ecosystem dynamics across a heterogeneous, 10,000 km^2 region. The model development has proceeded in tandem with advances in Everglades research, improving its algorithms and calibration to best capture dynamics of key landscape attributes. The first spatial application of the model was in an intensively studied subregion along an anthropogenic nutrient gradient. The model captured the spatio- temporal dynamics of hydrology, surface and ground water phosphorus, periphyton biomass and community type, macrophyte biomass and habitat type, and peat accumulation. Refinements to the model have improved its hydrologic and ecological performance, with good calibrations of long term hydrologic and surface water quality dynamics across most of the Everglades landscape. Using this updated version, we evaluated phosphorus loading throughout the Everglades system under two base scenarios. The 1995 base case assumed current management operations, with phosphorus inflow concentrations fixed at their long term, historical average. The 2050 base case assumed future modifications in water management, with all managed inflows to the Everglades having reduced phosphorus concentrations (due to filtering by constructed wetlands). In an example "indicator" subregion that currently is highly eutrophic, the 31-yr simulations predicted that desirable periphyton and macrophyte communities were maintained under the 2050 base case, whereas in the 1995 base case, periphyton biomass and production decreased to negligible levels and macrophytes became extremely dense. The negative periphyton response in the 1995 base case was due to high phosphorus loads and rapid macrophyte growth that shaded this algal community. Along an existing 11 km eutrophication gradient, the model indicated that the 2050 base case had ecologically significant reductions in phosphorus accumulation compared to the 1995 base case. Indicator regions (in Everglades National Park) distant from phosphorus inflow points also exhibited reductions in phosphorus accumulation under the 2050 base case, albeit to a lesser extent due to its distance from phosphorus inflows. The ELM fills a critical information need in Everglades management, and has become an accepted tool in evaluating scenarios of potential restoration of the natural system. Refinements to the model will enable us to evaluate the full suite of ecological responses to management scenarios throughout the greater Everglades.