COMMUNITY-LEVEL MODELING OF PERIPHYTIC DIATOMS IN RESPONSE TO SEA LEVEL RISE USING THE EVERGLADES LANDSCAPE MODEL

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Uncertainty about the degree to which freshwater restoration will mitigate saltwater intrusion into coastal freshwater wetlands has prompted the development of ecosystem modeling projects, such as the Everglades Landscape Model (ELM). The ELM is an ecosystem model that integrates dynamic ecological processes to simulate landscape patterns of water, nutrients, soils and vegetation under future scenarios of climate change and water management in the Florida Everglades. In this study, we add a diatom module to the ELM to simulate how periphytic diatom assemblages will respond to future alterations in salinity and phosphorus gradients caused by sea level rise. We used existing diatom community and environmental data collected from 34 sites in the southern Everglades to develop quantitative models for diatom assemblages in response to conductivity and phosphorus (P), two of the most dominant drivers of periphyton dynamics in the Everglades. Sites were classified into assemblages based on hierarchical cluster analysis and analysis of similarity; multinomial logistic regression (MLR) was then used to develop empirical functions predicting diatom assemblage as a function of conductivity and periphyton total P for the dry and wet season.

The cluster analysis identified 3 significantly dissimilar diatom assemblages in the dry season and 4 in the wet season. The misclassification error for dry and wet season MLR models was under 15%; and conductivity and mat TP were significant predictors ($p < 0.1$) for dry and wet season probability equations. The MLR-derived probability equations for diatom assemblages were encoded into ELM to simulate diatom distributions over 25 years under a baseline scenario and a sea level rise (SLR) scenario of 2 cm/yr. Under both scenarios, diatom assemblage distribution fluctuated in response to hydrology, salinity, and P with significant distributional differences between dry and wet seasons. However, under the SLR scenario, brackish, eutrophic assemblages became more widespread and the spatial boundary separating the native, freshwater assemblage from brackish weedy assemblages shifted inland.

This diatom module strengthens the power of ELM projections by including a microbial component - particularly diatoms which are powerful bioindicators and a key part of the ecologically important periphyton mats of the Everglades - allowing us to forecast potential ecosystem changes at all scales. Furthermore, community-level modeling provides more information than single species distribution models or bulk ecosystem properties by integrating responses by multiple species.