Particle Transport through Surface Waters of the Florida Everglades

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A key goal of the Everglades restoration is to increase the volume of water moving as sheet flow across the landscape. In addition to helping conserve the ridge and slough patterned landscape of the central Everglades, this planned increase in surface-water flow could influence the transport of potentially harmful chemicals, such as phosphorus, farther into the Everglades than ever before. As a significant fraction of water-column phosphorus is associated with suspended particulate matter, improved knowledge of particle transport is requisite to predicting how restoration efforts will influence phosphorus fate and distribution within the wetland.

We examined the transport of suspended particles through ridge and slough ecosystems within the interior of Water Conservation Area 3A. Surface-water flumes measuring 1.0 m wide and 4.8 m long were constructed in a *Nymphaea odorata* slough and *Cladium jamaicense* ridge at site WCA-3A-5. In each flume, fluorescent latex particles with an average diameter of 1.1 μm were injected at two depths for a period of 0.5 h under forced-gradient conditions. Samples of surface water were collected before, during, and after the particle injection period from six depths at stations located 0.5 and 3.5 m down gradient from the injection source and analyzed for particle concentrations. Advection, dispersion, and particle filtration by aquatic vegetation were quantified by comparing measured particle breakthrough curves to those calculated by a two-dimensional transport model.

The model-data comparisons indicate that longitudinal dispersion was an order of magnitude larger than vertical dispersion in the slough and the ridge, and that vertical dispersion of particles was greater in the ridge than in the slough. The particle advection rate in both flume experiments increased substantially from the bottom to the top of the water column, and these advection rates were greater than those calculated on the basis of measurements of volumetric discharge. This may reflect transport along preferred flow paths where the surface-water velocity exceeded the average velocity for the flume cross section. Filtration by aquatic vegetation lowered surface-water concentrations of particles and was irreversible over the time scale of our experiments. Nevertheless, particle filtration in both the ridge and slough experiments was less than that observed in a previously published particle-tracer experiment conducted in Shark River Slough.

Our findings reveal that advection, dispersion, and filtration of particles vary between ridge and slough environments and that, within a particular environment, particle-transport characteristics depend on depth within the water column. The sensitivity of the particle-transport response will complicate descriptions of particle-associated phosphorus transport and suggests that additional experiments conducted under conditions outside those tested in this study will be required to advance approaches suitable for predicting the fate of phosphorus in the Everglades.

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