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Research Brief

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Modeling Local Hydrology for a Forest Wetland

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photo courtesy N. B. Comerford

Characterization of wetland hydrology provides an important initial step in describing the vulnerability of pond water to environmental contamination. The water flow mode is an important determinant for both direction and velocity of contaminant transport through subsurface porous media. During regional groundwater flow for example, surface water in a pond located down stream from an area of forest that receives a hypothetical application of a mobile herbicide may be vulnerable to contamination.

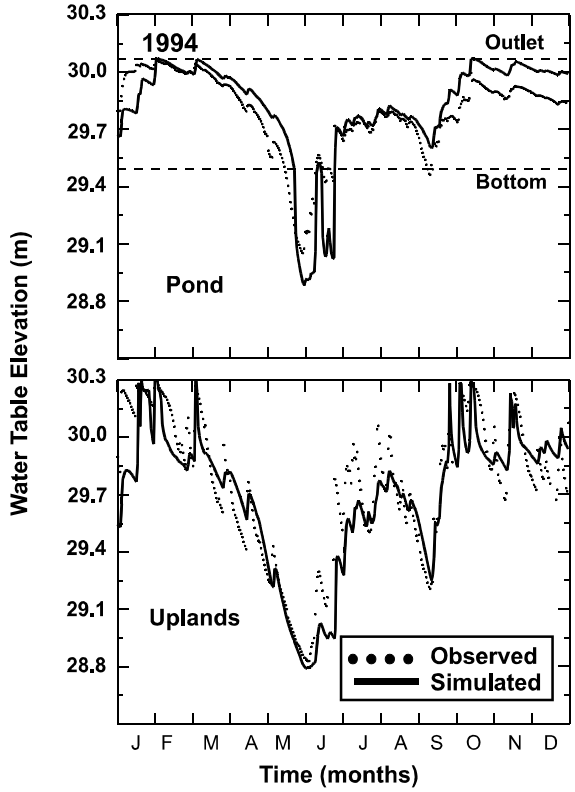
Important natural wetlands include **"cypress ponds"that occur in topographical depressions** within commercial pine forests of coastal plain landscapes. These relatively flat landscapes are characterized by unconfined aquifers with shallow groundwater tables that fluctuate seasonally with temporal changes in net rainfall (rainfall R minus evapotranspiration ET). During periods of positive net rainfall (R > ET) surface water accumulates within the cypress ponds, but recedes during periods of negative net rainfall (R < ET). More than 80% of annual rainfall for these wetlands may be consumed by ET.

Surface water in cypress ponds are strongly coupled with water in both the shallow unsaturated vadose and the underlying saturated groundwater zones in surrounding upland pine forests. Three modes of net water flow in the subsurface may occur between wetlands and surrounding groundwater: (i) **local groundwater discharge** (i. e., pond recharge), (ii) **local groundwater recharge** (i. e., pond discharge), and (iii) **regional groundwater flow** (flow through ponds).

A 3-dimensional mathematical model, ***WETLANDS***, for transient water flow and solute transport in variably-saturated porous media was used to successfully describe local hydrology for an individual cypress pond in a pine forest over a 3-year period. Regional groundwater flow was assumed negligible in the simulations and the Priestley-Taylor

climatological submodel was used to estimate ET. A minimal observed parameter set of daily rainfall, daily air temperature, soil characteristics, and pond geometry provided model input. Simulated water levels at wells located at the pond center and at 81 m from the pond center in an upland location compared favorably with observations. Annual rainfall for 1992, 1993, and 1994 represented 113.7, 85.5, and 93.2% of the 60-year average of 1330 mm. Annual rainfall patterns were characterized by 2 distinct periods of infrequent rainfall (April-June and October-December).

The model **successfully described temporal patterns of daily pond water and groundwater table elevations** with relatively small average deviations of -2 and +11 cm, respectively, over the 3-year period. Simulated and observed results for 1994 are shown in the figure. Potential exists for ***WETLANDS*** to be used as a predictive tool for hydrology and contaminant transport for wetland areas.



Taken from Mansell et al., 2000

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