# Numerical modeling of the effects of surface water and groundwater interactions on streambank erosion

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Long-term research on streambank erosion along a reach of the Goodwin Creek, Mississippi showed that the timing and extent of streambank failure are closely related to changes in pore-water pressure in the bank soils. Especially, the loss of matric suction in the upper profile of the streambank during storm events has shown to destabilize banks. Also, analysis of the factor of safety, which expresses the stability of a streambank, shows that it is rather sensitive to changes in groundwater table elevation. Soil water affects streambank erosion by influencing the apparent shear-strength of the soil (which is a combination of cohesion, a frictional component, and a pore-water pressure term) and soil erodibility. In saturated soils the apparent shear-strength is reduced because of positive pore-water pressures, whereas in unsaturated soils apparent shear-strength is increased due to negative pore-water pressures. The spatial and temporal soil-water distributions in streambanks are difficult to quantify because of the varied sources and sinks. Sources of soil water are typically infiltrating rainfall and lateral contributions from the adjacent stream and hill slope. Sinks of soil water are commonly seepage and vegetation- and soil-specific evapotranspiration. Field experiments showed that vertical pore-water distributions are greatly impacted by the root distribution, which varies significantly between vegetation types. Much research has been conducted to quantify the effects of soil water on soil shear-strength and streambank failure mechanics. However, improved quantification of the spatial and temporal soil water distributions in streambanks are needed to accurately predict the extent of streambank erosion. A numerical model has been developed using science from the USDA channel evolution model CONCEPTS and the riparian ecosystem management model REMM to simulate the movement of soil water in the riparian zone and its impact on stream morphology. The performance of the model to predict riparian soil water distributions has been assessed against observed pore-water pressures affected by different vegetation species. Model tests show that pore-water pressures and subsequent streambank erosion can be simulated satisfactorily as long as the position of the groundwater table and evapotranspiration are accurately calculated.