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Development and Application of a Boat-generated Wave-erosion Model for BSTEM

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ABSTRACT

Boat-generated waves are a major concern in large rivers, lakes and reservoirs. When they reach the banks, boat-generated waves can produce velocities and shear stresses near the water surface much larger than those generated from streamflow, particularly in lakes and reservoirs characterized by very flat energy slopes. Recurrent wave action along cohesive banks due to boat traffic may cause scouring the basal regions of streambanks, contributing to steepening, undercutting and eventual collapse of the upper part of the bank mass. Relative contribution of waves to bank erosion depends on the boat traffic flow and the wave characteristics. In this study a boat-wave erosion model is developed which incorporates a boat generated wave prediction model into the toe-erosion sub-model of the Bank Stability and Toe Erosion Model (BSTEM) of the USDA-ARS. The boat-wave sub-model predicts the maximum wave height and period based on the boat speed, boat geometry, local water depth and distance to the shoreline, and using the predicted wave properties, calculates an additional shear stress that is intermittently applied on the bank face. Like the toe-erosion sub-model within BSTEM, erosion for the time step is then calculated through an excess shear approach based on the critical shear stress of the surficial sediments. The erosion rate is integrated with respect to time to calculate the average erosion distance. The combined model was then successfully applied at 25 sites to predict bank erosion over a 15-year period