Researchers develop virtual streams to help restore real ones

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Researchers at the University of Minnesota have developed a unique new computer model called the Virtual StreamLab, designed to help restore real streams to a healthier state. The Virtual StreamLab, which demonstrates the physics of natural water flows at an unprecedented level of detail and realism, was unveiled for the first time this week at the 2009 American Physical Society Division of Fluid Dynamics meeting in Minneapolis, one of the largest conferences in fluid dynamics with more than 1,500 attendees from around the world.

The University of Minnesota team of researchers led by civil engineering professor Fotis Sotiropoulos, director of the University's St. Anthony Falls Laboratory (SAFL), developed the Virtual StreamLab to help improve stream restoration processes. They have completed their first simulation of SAFL's Outdoor StreamLab, a scaled natural stream along the Mississippi River. More than 90 million data points have been mapped into the team's computer model resulting in the most accurate model of a real stream to date. The Virtual StreamLab employs sophisticated numerical algorithms that can handle the arbitrarily complex geometry of natural waterways, features advanced turbulence models, and utilizes the latest advances in massively parallel supercomputers.

The ability to simulate water flow over topography with this degree of realism provides researchers with the insights necessary to improve sustainable stream restoration strategies, helping to optimize techniques to fight erosion, help prevent flooding and restore aquatic habitats in

degraded waterways.

Recent national data shows that 44 percent of the nation's 3.5 million miles of rivers and streams have become degraded due to sedimentation and excess nutrients. This decline has led to impaired water quality over entire watersheds, rendering many streams unhealthy for recreation and public contact. The effects also have serious consequences for the health of aquatic life. Efforts to restore these bodies of water have resulted in an annual cost of more than $1 billion in the United States alone.

Historically, efforts have involved installing structures in the stream to change the direction and speed of the water, but with little ability to fine-tune a stream's reactions. Past computer models often oversimplify the stream systems and can't accurately simulate the beds, complicated bank shapes, turbulence, and natural or man-made structures within them.

"The practice of stream restoration has had a rocky rate of success as practitioners have struggled to alter a natural system with countless unknowns," Sotiropoulos said. "The need for more effective and reliable stream restoration strategies is clear, but the underlying physical processes which govern the behavior of a stream and its inhabitants are very complex. Our new Virtual StreamLab should provide researchers with a deeper understanding of those complexities."

Source: University of Minnesota (news : web)