COUPLING OF 1D AND 2D HYDRODYNAMIC EQUATIONS FOR STREAM AND FLOODPLAIN INTERACTION

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Sediment is still reported as a major contributor to water quality degradation. The state of Pennsylvania tops the 2008 EPA list of degraded stream segments due to sediment (> 3000 segments are listed). Primary sources of fine-grained sediment in Pennsylvania are reservoir deposits behind old mill dams (which are being removed) and legacy sediment stored on the floodplain. The legacy sediment was eroded from hillslopes in the 19th century and has been stored along the valley bottoms. Because of reforestation of the landscape and other conservation practices upland sediment sources have reduced. As a result, relatively more sediment is being eroded from in-stream sources, commonly through streambank erosion, thereby remobilizing sediment behind dams and legacy sediment on the floodplain. This process is typical for the entire Piedmont region. One practice, which is becoming more popular, is enhancing overbank retention of flood water. Floodplain elevations are lowered or streambed elevations are increased (through stream restoration projects) to increase the occurrence of flooding. Fine-grained sediments will then deposit, and downstream sediment loads are reduced. The goal is then to maximize floodwater retention on the floodplain for a given discharge. It should be designed for: overbank elevation, streambed elevation, channel alignment, floodplain topography, vegetation distribution, etc. 1D models are efficient at simulating in-stream hydrodynamics and sediment transport for long reaches and time periods, however they cannot simulate overbank flow accurately. 2D models can simulate flow and sediment transport accurately both in the stream and on the floodplain; however they may not be very efficient for long reaches and long time periods, primarily because of the required mesh resolution in the stream. A mixed 1D-2D approach in which the 1D model simulates the processes in the stream and the 2D model simulates the processes on the floodplain therefore provides the best of both worlds. Herein, this study is mainly concentrated in the hydrodynamic portion of coupling 1D and 2D models and its comparison to fully 2D simulations.