Catastrophic Consequences of Earthquake Destruction of the Saluda Dam

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Summary

We model the flow of water in the Saluda river valley to determine the extent of flooding resulting from a failure of the Saluda Dam due to an earthquake. The model is divided into two parts: the flow of water in the river, and the evolution of the dam breach. We consider two questions in detail: How far up Rawls Creek, 3.3 km from the dam, will the flooding extend? And will the State Capitol in Columbia, 14 km downriver from the dam, get wet?

We assume that the dam fails as a result of overtopping after the dam slumps due to soil liquefaction. We model the shape of the breach as an enlarging trapezoid. This model provides the essential time-varying boundary conditions for the flow in the river and results in the dam collapsing in 3 to 4 min.

The model for the water flow is based on dividing the river into sections of varying sizes. Tunable parameters for each section allow shaping of the valley along the river. The geometry of each cross section is modeled as a piecewise-linear function with three parameters (two for the slopes, one for the length). In addition, the length of each section of the river can be adjusted to obtain greater resolution for regions of interest. We model the flow of the water by the transfer of momentum and volume between the sections of the river. The equations governing these exchanges comprise a low-order finite-volume advection scheme. For our geometry, the flow is sub-critical and momentum-dominated, allowing the above simplified physics model for the flow.

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We check convergence and stability of the results by varying the time resolution.

The simulations of the model indicate major flooding in Rawls Creek up to 2.4 km from the Saluda River, but flooding will not extend to the State Capitol.

[EDITOR'S NOTE: This Meritorious paper won the Ben Fusaro Award for the Flood Planning Problem. Only this abstract of the paper appears in this issue of the *Journal*.]