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The Simulation of Inflow Discharge and Suspended Sediment Transport Rate for a Reservoir

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The major functions of a reservoir include flood-protection, public water-supply, irrigation, hydropower and tourism. Consequently, these functions can provide great contributions for economic development. Therefore, important issues associated with reservoir watersheds such as soil erosion and deposition must be carefully studied in order to enhance watershed management. Accurate and timely estimation of peak flow discharges into a reservoir is very crucial for flood protection strategies and the general safety of the reservoir. In this study, GIS is applied to a physiographical soil erosion-deposition model, using rainfall data as the primary input, to simulate both stream flow hydrographs and sediment transport into a reservoir.

In this study, the Shihmen Reservoir watershed is used as an illustrative example. The Shihmen Reservoir, a multiple-purpose reservoir for irrigation, hydropower, public water-supply, flood-protection, and tourism, is located on the mid-stream reach of the Tahan River. High-concentration sediment-containing flood flow events during storm periods are primarily responsible for the turbidity and sedimentation in the Shihmen Reservoir. Therefore, if incoming stream flow and sediment concentration hydrographs can be determined promptly during storm periods, high-concentration turbid water can be diverted from the reservoir and low-concentration water, during the recession, can be stored. Consequently, the deposition of the reservoir can be reduced extending the life of the reservoir. Therefore, the purpose of this project is to establish a physiographic soil erosion-deposition model for the Shihmen Reservoir watershed. Using rainfall data as input, we can simulate the hydrographs of both stream flow and sediment concentration entering the reservoir. The results obtained from our model can be used as a reference to aid in the operation of the Shihmen Reservoir concerning deposition prevention.

The numerical studies show that the peak flow and time to peak of the simulated runoff hydrographs, as well as their shapes agree favorably with those observed at Rofu Bridge for Typhoon Fungwong, Typhoon Sinlaku, and Typhoon Jangmi in 2008. The characteristics of the processes of flood and recession are also captured by our model. The suspended sediment transport hydrographs agree favorably with those observed at the Rofu Bridge for Typhoon Fungwong, Typhoon Sinlaku, and Typhoon Jangmi. The relative error between the estimated and observed sediment volume into the reservoir for Typhoon Fungwong, Typhoon Sinlaku, and Typhoon Jangmi is 10.47%. This small error demonstrates that the sediment yield predicted by our model is reasonable. It follows that our model is applicable and accurate when simulating hydrographs for water discharge and sediment discharge entering the reservoir during rainfall events.