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Incorporating Backward-forward Stochastic Particle Tracking Model into the EFDC model for Probable Sedimentation Source identification in Typhoon events

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The reservoir siltation has been of critical environmental concerns in recent years. The vulnerability and the overdevelopment in the reservoir watershed are the causes of the reservoir sedimentation. While typhoon events happen, in addition to the great amount of sediment volume transported from the upstream to the reservoir region, the density currents may evolve, which will steeply increase turbidity levels for the periods of time. In particular, the Shihmen Reservoir, one of essential hydraulic engineering projects in northern Taiwan, has been exposed to crisis that the sedimentation may fill up in the next few decades. Therefore, in order to maintain the reservoir capacity to an operational extent, modeling the sediment transport patterns in Shihmen Reservoir will utilize the three-dimensional Environmental Fluid Dynamics Code (EFDC) for quantifying sediment concentrations during the typhoon event. Calibration and validation of EFDC are performed by comparing two independent sets of event-based hydrodynamic and sediment concentration data with assistance of the parameter optimization algorithm. Next, the Backward-forward Stochastic Particle Tracking Model (BF-SPTM) is further incorporated into the EFDC hydrodynamic module to check the likelihood of the potential source of sediment particles. Results of simulations are expected to provide a more precise release timing for flow regulation to ensure the effective slag removal for density currents. Additionally, with probable sedimentation sources available for a reservoir, effective land use change and restrictions on overdevelopment of the risk prone areas can be enforced to decrease the sediment yields into the reservoir. It is expected that this incorporation of BF-SPTM into EFDC can be applied to simulate sediment transport in typhoon events, and to provide appropriate reservoir management alternatives.

Keywords: Environmental Fluid Dynamics Code (EFDC), suspended sediment concentration, Backward-forward Stochastic Particle Tracking Model, Probable sedimentation source