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Erosion Modeling of Surface Water Systems for Long Term Simulations

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Abstract : Flow and erosion modeling provides an avenue for simulating the fine suspended sediment in surface water systems like streams and creeks. Fine suspended sediment is highly mobile, and many contaminants that may have been released by any sort of catchment disturbance attach themselves to these sediments. Therefore, a knowledge of fine suspended sediment transport is important in assessing contaminant transport. The CAESAR-Lisflood Landform Evolution Model, which includes a hydrologic model (TOPMODEL) and a hydraulic model (Lisflood), is being used to assess the sediment movement in tropical streams on account of a disturbance in the catchment of the creek and to determine the dynamics of sediment quantity in the creek through the years by simulating the model for future years. The accuracy of future simulations depends on the calibration and validation of the model to the past and present events. Calibration and validation of the model involve finding a combination of parameters of the model, which, when applied and simulated, gives model outputs similar to those observed for the real site scenario for corresponding input data. Calibrating the sediment output of the CAESAR-Lisflood model at the catchment level and using it for studying the equilibrium conditions of the landform is an area yet to be explored. Therefore, the aim of the study was to calibrate the CAESAR-Lisflood model and then validate it so that it could be run for future simulations to study how the landform evolves over time. To achieve this, the model was run for a rainfall event with a set of parameters, plus discharge and sediment data for the input point of the catchment, to analyze how similar the model output would behave when compared with the discharge and sediment data for the output point of the catchment. The model parameters were then adjusted until the model closely approximated the real site values of the catchment. It was then validated by running the model for a different set of events and checking that the model gave similar results to the real site values. The outcomes demonstrated that while the model can be calibrated to a greater extent for hydrology (discharge output) throughout the year, the sediment output calibration may be slightly improved by having the ability to change parameters to take into account the seasonal vegetation growth during the start and end of the wet season. This study is important to assess hydrology and sediment movement in seasonal biomes. The understanding of sediment-associated metal dispersion processes in rivers can be used in a practical way to help river basin managers more effectively control and remediate catchments affected by present and historical metal mining.

Keywords : erosion modelling, fine suspended sediments, hydrology, surface water systems
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