Sediment transport under floods is an important issue in lakes tributary modeling. Conventional models for sediment transport under floods typically incorporate sediment transport relationships developed under steady-flow conditions, and the unsteady flow component is often modeled as a succession of step-wise, short-duration steady flows. Existing sediment transport formulas for steady flows cannot provide an accurate description of unsteady sediment transport processes. Graf and Suszka (1987) have derived a system of bed-load formulas from their experiments that can successfully predict the sediment discharge in unsteady flow after some modifications of this formula in Song and Graf (1997). This unsteady sediment discharge formula is directly incorporated into a fully coupled system of equations governing the waterflow, sediment transport and bed movement. The proposed model can account for sediment and flow interactions with a synchronous solution scheme coupling river bed mobility and water column storage of sediment in mass conservation equations of flow and sediment. The matched asymptotic expansions perturbation method, an alternative to a direct computer solution, is applied to resolve the aforementioned fully-coupled system of flow-sediment equations by exploring asymptotically the change in flow and bed elevation with respect to a flood water wave, which are composed of an outer region, and an inner regions near the wave shock. By adding the solutions of the outer region and inner region together and then subtracting their common part, a uniformly valid nonlinear solution to describe the flood wave propagation in alluvial rivers can be obtained. From this study, the impact of a flood wave on the sediment concentration and bed elevation is clearly demonstrated, as well as the influence of sediment properties, Froude number, bed slope, bed roughness, bed porosity, channel width and flood volume on the flood hydrograph and sedimentograph.

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