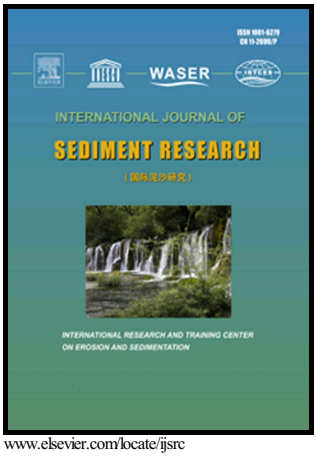

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Estimation of bedload discharge in sewer pipes with different boundary conditions using an evolutionary algorithm

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Abstract

Sediment transport is a complex phenomenon due to the nonlinearity and uncertainties of the process. The present study applies Gene Expression Programming (GEP) to develop bedload transport models in sewer pipes. In this regard, two types of bedload were considered: loose bed (deposition state) and rigid bed (limit of deposition state). In order to develop the models, two scenarios with different input combinations were considered: Scenario 1 considers only hydraulic characteristics and Scenario 2 considers both hydraulic and sediment characteristics as inputs for modeling bedload discharge. The results proved the capability of GEP in prediction of sediment transport and it was found that for prediction of bedload transport in sewer pipes Scenario 2 performed more successfully than Scenario 1. According to the outcome of sensitivity analysis, F_{rm} (Modified Froude number) and d_{50}/y (relative particle size) for rigid boundary and F_{rm} for loose boundary had key roles in the modeling. The outcome of the GEP models also was compared with existing empirical equations and it was found the GEP models yielded better results. It was also found that pipe diameter affected the transport capacity of the sewer pipe. Increasing pipe diameter caused an increase in model efficiency. A pipe with a diameter of 305 mm yielded to the best results.

Keywords

Sediment transport, Loose boundary, Rigid boundary, Genetic expression programming, Empirical equation