STOCHASTIC GENERATION OF SEDIMENT LOADS IN THE LOWER GANGES RIVER, BANGLADESH

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Sediment transport is complex and often subject to semi-empirical or empirical treatment. Sediment transport plays an important role in the regulation and control of rivers. Changes in sediment yield reflect changes in basin conditions including climate, soil erosion rate, vegetation, topography and land use (Gangyan et al., 2003). Fluctuations in sediment load affect many terrestrial and coastal processes including ecosystem responses, because many nutrients and chemicals are also transported along with the sediment load. Ability to accurately estimate sediment transport capacity is a key to the success of water resources projects. A number of relationships have been developed to compute the amount of sediment discharge as a function of the various flow parameters. None of the available equations for the calculation of sediment discharge has gained universal acceptance in confidently predicting sediment transport rate (Yang, 1996).

The calculation of sediment load from various equations often differs drastically from each other for a given set of observed data. This is partly due to inclusion of so many variables that influence sediment transport like the size of sediment, the fall velocity, specific weight, cohesion, porosity of particles etc. In most studies sediment transport predictions are based on a deterministic approach. Uncertainty in sediment transport models is not considered. Uncertainties can be related to the fact that transport formulas are obtained experimentally by including flow and sediment properties based on physical laws and available observed data. Uncertainty is inherent to these models, since the empirical derived formula itself, as well as its parameters are uncertain. Model uncertainty reflects the inability of the model to represent the true physical behavior of the river considered. Other uncertain parameters are sediment particle size, flow velocity and hydraulic roughness.

Stochastic modeling can be used is to generate synthetic streamflow sequences that are statistically similar to historical ones. Such synthetic streamflow sequences are useful for analyzing reservoir operation and river basin management policies. Streamflow records of very long duration are required to assess the possible extreme hydrological conditions for planning, designing and for evolving operational polices of water resources systems.

Most statistical analysis of hydrological data at the usual time scale (e.g. monthly or annual) are based on a set of fundamental assumptions, i.e. the series is trend-free and constitutes a stochastic process whose random component follows the appropriate probability distribution. In the present study, the regression test for linear trend was carried out for annual sediment load series from 1976 to 1989 at Hardinge Bridge station. The result shows that no linear trend could be detected in the annual sediment load at 5% significance level.

The mean and standard deviation of the monthly sediment load data have been tested for periodicity. The periodicity has been smoothened by harmonic analysis. The results show that even the six harmonics (maximum number of harmonics that can be fitted to monthly data) are not able to explain the minimum variance and hence it is considered appropriate to use the observed means and standard deviations.

Thomas and Fiering model (Thomas and Fiering, 1992) has been used to generate monthly stream flows /sediment loads. In this method the n-years of record are separated into twelve records, one for each month and twelve linear regression equations are used. The record for a given month is regressed upon that for the preceding month. The seasonal variation (periodicity) is catered for by the use of the monthly regression relationships. The model assumes, in fact, lag-one (monthly) persistence. The evaluation of the generated data has been made based on the comparison of the mean, standard deviation and correlation coefficient of the generated and historical sediment loads. The statistical parameters of observed and generated data match pretty well. Thus the generated sediment loads may be used for future planning and design of the water resources project in Bangladesh.

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