Time series-based soft computing tool for wicked water problems

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METHODOLOGY

The limitations of conventional time series techniques have forced researchers to develop innovative and predictive soft computing methods (Jain & Kumar, 2007; Zounemat-Kermani & Teshnehlab, 2008). Here, a predictive model based on soft computing techniques is presented and implemented on Baitarani River (India). This river is one of the major rivers of the Orison state in India, and it drains an area of 14 218 km^2 into the Bay of Bengal. The average annual rainfall is 1187 mm. The rainfall in the basin mainly comes from the southwest monsoon and lasts from June to October.

Wicked water problem can be split in three parts/modules

Module 1 involves determination of input parameters in the form of runoff, which affects the river flow and further defining of an event characterization function (ECF) for each variable. River flow depends upon following these two inputs, namely; antecedent inflow values and exogenous input variables such as precipitation, evaporation. These two inputs parameters are selected in the form of runoff values at different time lags that can be best represented by time series based on a soft computing model. A further event characterization function is defined for each input parameter.

Calculate ECF(t) for each selected input as: $ECF(t) = (x_{i+1}(t + 1) - x_i(t)) / x_i(t)$, where ECF would be calculated for given time series data for a given time frame of period T.

Module 2 involves evaluating the variables which affect water quality. Based on correlative analysis, major evaluating factors that affect water quality are: COD, DO, water temperature, turbidity, pH, alkalinity, chloride, NH_4, +N, –N, NO_2 and hardness. However, COD and DO affect the water quality to a larger degree (Zhao Ying *et al.*, 2007). In addition, today's COD and DO values have some impact on the next day's values as well. Hence this paper studies the forecast of COD and DO for Baitarani, Orissa Basin. The proposed model intends to achieve a better forecast of the next day's COD and DO value from today's COD and DO, along with other water quality variables.

Module 3 presents a predictive model by combining the inferential knowledge of Module 1 and module 2. This module utilizes the runoff value, COD and DO variables together in such a way that water index can be generated and forecast precisely using the model represented in Fig. 1.

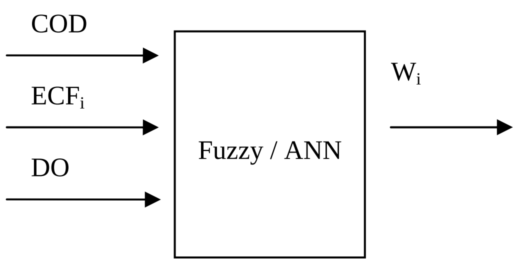

Fig. 1 Predictive Water Model.

Here, W_i = Fuzzy/ANN (ECF_t, COD_t, DO_t); where, W_i (Water index) is water level of next day. On the basis of $W_{i,}$ accurate demand forecasting can also be attained.

KEY LESSONS

Knowledge of water level in advance can significantly improve the utilization of water resources and has considerable importance in decision making units for wicked water problems. Accurate water level can be forecast by the water index using the presented predictive model.

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