ANN-SOM approach for satellite data pre-processing in rainfall-runoff modeling

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Abstract: The use of artificial neural network (ANN) models in water resource applications as rainfall-runoff modeling has grown considerably over the last decade. In order to obtain more accurate models, the qualification of applied data must be improved. Satellite data as a source of proper data in field of rainfall measurement over a watershed is utilized in this paper. Doubtlessly, spatial pre-processing methods can promote the quality of precipitation data.
In the current research the self organizing map (SOM) is used for spatial pre-processing purpose. A two-level SOM neural network is applied to identify spatially homogeneous clusters of the satellite data in order to choose the most operative and effective data for the Feed-Forward Neural Network (FFNN) model which is trained by the Levenberg-Marquardt algorithm and considering only one hidden layer. The results indicate that the imposition of spatial pre-processed data to the FFNN model lead to promising evidence in the improvement of rainfall-runoff model.

Keywords:
Rainfall-runoff, wavelet, ANN, SOM, satellite data, pre-processing clustering- Gilgal Abay watershed

1 Introduction

An accurate model of rainfall-runoff process, which is embedded with high complexity, dynamism, and non-linearity in both spatial and temporal scales, can provide important information for the environmental planning, land use, flood and water resources management of a watershed. Therefore, numerous models have been developed to simulate this complex process [17]. The large number of ambiguous physical parameters in the rainfall-runoff process lead to vast usage of black box (lumped) models, which may have some advantages over fully distributed models [16]. Conventional black box time series models wildly applied in forecasting hydrological time series see [21]. Principally, these models are linear with assumption of the stationary data set and limited abilities in hydrological simulations.
Over the last decades Artificial Neural Networks (ANNs) have been subject to an increasing interest to model complex non-linear hydrological process such as rainfall-runoff. There are tremendous surge in research activities, indicate the success of ANNs in rainfall-runoff models e.g., [2, 4, 8, 20, 22].
The performance of an ANN-based rainfall-runoff model extremely relies on the quality and quantity of the input data (e.g. rainfall). For hundreds of years, rainfall has been measured by the