STREAMFLOW RESPONSE OF A WATERSHED TO METEOROLOGICAL VARIABLES: DEVELOPMENT OF HYDROCLIMATIC CONCEPTUAL MODEL

ABSTRACT

Combined processes of land-surface hydrology and hydroclimatology influence the response of a watershed to different hydroclimatic variables. In this thesis, streamflow response of a watershed to hydrometeorological variables is investigated over a part of two Indian rivers – Narmada and Mahanadi. It is argued in many past studies that the performances of data-driven Artificial Intelligence (AI) based approaches are quite good and often show superiority over many conceptual or physically based models. Thus, initially, potential of Least Square-Support Vector Regression (LS-SVR), which is a data-driven kernel based AI approach, is investigated. The overall performance of LS-SVR is found to be impressive compared to other popular traditional parametric, viz., Box-Jenkins approach and AI based approach viz., Artificial Neural Network (ANN). However, the representations of physical processes are absent in this approach and somewhere hidden in the model parameters. Moreover, change in climate regime may hinder the applicability of this model due to its inherent static nature after the parameters are frozen. This issue is considered next and a hydroclimatic conceptual model is developed. The proposed HydroClimatic Conceptual Streamflow (HCCS) model is able to consider the time-varying basin characteristics and major hydrologic processes to model basin-scale streamflow using climate inputs. While comparing the performance of the proposed HCCS model with the performance of LS-SVR, the performance of HCCS model is found to be either comparable or better than that of

LS-SVR for both the basins. In addition, the proposed model is also able to provide additional overall estimates of groundwater recharge component and evapotranspiration component from the entire basin. Ability to consider the time-varying watershed characteristics and hydroclimatic inputs renders the proposed model usable for future water resources assessment. The HCCS model is also used to study future streamflow variation for both the basins. Compared to the historical observation, it is found that the future streamflow magnitudes increase during early monsoon months and decrease or remain almost same during the late monsoon months. Methodological approach of the proposed model is general in nature and can be applied to other tropical basins for streamflow modeling as well as future streamflow assessment.

Key Words: Streamflow Prediction, Hydrometeorology, Least Square-Support Vector Regression (LS-SVR), HydroClimatic Conceptual Streamflow (HCCS), Narmada River, Mahanadi River.