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Regionalization of Runoff Coefficient and Parameters of an Event Based Nash-Cascade Model for Predictions in Ungauged Basins

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Reliable predictions of runoff events, specifically their magnitude and temporal characteristics, are the very essentials for design of flood protection measures such as flood retention reservoirs, dikes and landuse planning in flood plains. Hydrological models, the nuts and bolts for a hydrologist to predict runoff characteristics, are traditionally calibrated against the hydrological responses observed within a catchment in order to tune the model output with the hydrological behavior of the catchment. But the traditional approach of calibration of a hydrological model against observed responses cannot be adopted in case of the catchments where,

- rivers/streams are not gauged or poorly gauged, and

- the hydrological conditions in the catchment are subjected to changes.

This is the prevalent situation, especially, in developing regions of the World, the rivers are poorly gauged and due to the nature and human induced impacts the hydro-climatic conditions in the catchments are continuously shifting. This research work is aimed at developing a reliable approach to estimate the parameters of an event based model without past observations where they are not available or if the geo-hydrological conditions in a catchment are changed.

Regionalization, the mapping of basins in similar regions with similar hydrological or morphological characteristics with a set of similar model parameters which are related to the basin characteristics by a transfer function, is widely recognized as a potential way to tackle the problem of predictions in ungauged catchments. During this work, an

innovative approach to regionalization by deriving the transfer function between geo-hydrological variables and model parameters by simultaneous calibration, instead of conventional procedure of individual calibration and regression, is being investigated.

An event based semi-distributed unit hydrograph model based on Nash-Cascade concept has been developed for predictions of runoff characteristics. Nash-Cascade parameters, the number of reservoirs (N) and retention constant (K), as well as runoff coefficients (Rc) are related to priori estimated geo-hydrological variables using a transfer function. The geo-hydrological variables are classified into 3 categories namely, event dependent (e.g. API), time variant (e.g. landuse) and time invariant (e.g. average slope). The coefficients of the transfer function will be optimized via simultaneous calibration procedure using a calibration measure aggregated over the number of catchments in calibration set. Initially, the transfer function is assumed to be a linear multivariate function, but it may also take a non-linear form. The approach is being implemented over 27 catchments of areas ranging from 73 km2 to 694 km2 in the state of Baden-Württemberg, Germany, for that the catchments are divided into sub-catchment, and further into relatively homogeneous zones of landuse and soil.