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Master Thesis Abstract

of Zohreh Ghazanchaei

Using catchment scale soil moisture to understand river flooding hazard

This work aims to assess the potential of remotely sensed soil moisture products to characterize the coefficients of a power law equation (K) used to describe hydro-graph recessions in rivers belonging to different climatic and geomorphological settings. This is especially relevant for the development of methods to constrain recently proposed mechanistic-stochastic models of flood magnitude and frequency in the absence of discharge data. The analysis is carried out by selecting 11 catchments from different climate regions across the USA. Observed series of rainfall and streamflow are used to estimate model's parameters (in particular K_REC) in each season, for a total number of 40 case studies. Soil moisture conditions at catchment scales are assessed by using soil water index time series (SWI - TS), from Dec 2007 to May 2017. SWI-TS provides information on soil moisture at different depths (labeled as T from 1 to 100) within the root zone. The correlation analysis between streamflow and SWI - TS identifies T = 5 as the most correlated with streamflow. Thus highlighting the importance of top soil layers in determining streamflow dynamics. The potential of catchment-scale satellite soil moisture observations to predict seasonal recession coefficients is assessed by studying the relations between K_REC and statistical properties (i.e., mean and coefficient of variation) of SWI -TS. The results imply a week correlation between mean seasonal values of SWI -TS and K_REC, and a stronger relationship between the coefficients of variation of SWI-TS and K_REC calculated for every event in a catchment. However, both obtained relationships are still associated with high variability in K_REC in the catchments with the same coefficient of variation in SWI -TS. The stronger relationship between the coefficient of variation of SWI-TS and K_REC shows the variability of hydrologic response in a catchment is strongly controlled by the variability of the soil moisture in the root zone.