Preservation and or restoration of riverine ecosystem requires quantification of alterations inflicted by water resources development projects. Long records of streamflow data are the first piece of information required in order to enable this analysis. Ungauged catchments located within data-scarce regions lack long records of streamflow data. In this dissertation, a multi-objective framework named Streamflow Prediction under Extreme Data-scarcity (SPED) is proposed for streamflow prediction in ungauged catchments located within large-scale regions of minimal hydrometeorologic observation. Multi-objective nature of SPED allows for balancing runoff efficiency with selection of parameter values that resemble catchment physical characteristics. Uncertain and low-resolution information are incorporated in SPED as soft data along with sparse observations. SPED application in two catchments in southwestern China indicates high runoff efficiency for predictions and good estimation of soil moisture capacity in the catchments. SPED is then slightly modified and tested more comprehensively by application to six catchments with diverse hydroclimatic conditions. SPED performance proves satisfactory where traditional flow prediction approaches fail. SPED also proves comparable or even better than data-intensive approaches. Utility of SPED versus a simpler catchment similarity model for the study of flow regime alteration is pursued next by streamflow prediction in 32 rivers in southwestern China. The results indicate that diversion adversely alters the flow regime of the rivers while direction and pattern of change remain the same regardless of the flow prediction method of choice. However, the results based on SPED consistently indicate more substantial alterations to the flow regime of the rivers after diversion. Finally, the value added by a limited number of streamflow observations to improvement of predictions in an ungauged catchment located within a data-scarce region is studied. The large number of test scenarios indicate that there may be very few near-universal schemes to improve flow predictions in such catchments.

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The public is welcome to attend.