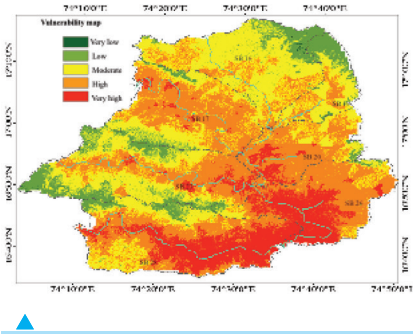
Predictive modeling and risk assessment of hydrological extremes

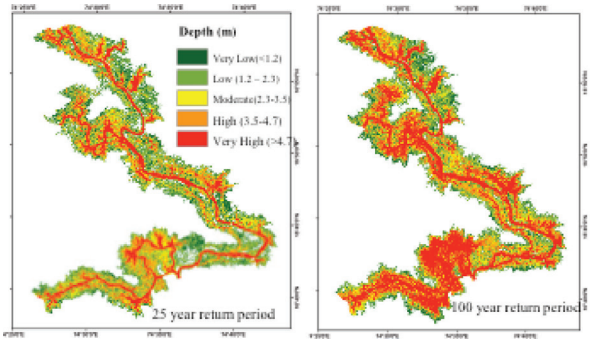
Various parts of the world often confronts with hydrological extremes of floods and droughts. The extreme events can be studied quantitatively through event magnitude / severity, peak, duration, spatial extent, etc. To manage the extremes in a region, it requires understanding the expected frequency of multiple characteristics of flood (drought) extreme (say, magnitude for different durations and spatial extent). To understand the risks and plan the activities, generation of flood (drought) vulnerability mapping and flood inundation maps, etc., are very useful in different contexts. Also the univariate frequency analysis may lead to over / under estimation of extreme events. Hence, for better understanding the nature of hydrological extremes, it is critical to analyse the frequency of simultaneous occurrence of multiple characteristics of extreme events, as its characteristics are mutually correlated, involve nonlinear dependence and may follow different distributions.

Our research group engaged in developing multivariate statistical tools (e.g., copula methods) and employing it to overcome the limitations of conventional methods for multivariate risk analysis of hydrological extremes. Multivariate statistical tools were developed for modeling the floods (droughts) and applied for risk analysis vis., derivation of severity-duration-frequency (SDF) curves, severity-area-frequency (SAF) curves, estimation of multivariate return periods, etc., in several regions of India. Also forecasting is an essential means for developing an early warning system and preparedness of the events. Because of the complexities involved in the hydrological processes, the accurate prediction of extreme events is a challenging task, which demands for deeper understanding and appropriate modeling. Also there is a lot of uncertainty in prediction of extreme events; therefore apart from prediction of mean hydrological state, it is essential to specify the associated prediction uncertainty.

Our group also works on developing improved procedures for predicting the extremes and its associated uncertainty by employing artificial intelligence methods and advanced multivariate statistical methods.



Flood vulnerability mapping in upper Krishna basin



Flood inundation mapping in upper Krishna basin

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