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Interpolation of Regionalized Intensity Duration Frequency (IDF) Estimates based on the observed precipitation data of Baden Wurttemberg (BW), Germany

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This study is intended to carry out the spatial mapping with ordinary Kriging (OK) of regional point Intensity Duration Frequency (IDF) estimates for the sake of approximation and visualization at ungauged location. Precipitation IDF estimates that offer us valuable information about the frequency of occurrence of extreme events corresponding to different durations and intensities are derived through the application of robust and efficient regional frequency analysis (RFA) based on L-moment algorithm. IDF curves for Baden Wrttemberg (BW) are obtained from the long historical record of daily and hourly annual maximum precipitation series (AMS) provided by German Weather Service from 1960-2020 and 1949-2020 respectively under the assumption of stationarity. One of the widely used Gumbel (type 1) distribution is applied for IDF analysis because of its suitability for modeling maxima. The uncertainty in IDF curves is determined by the bootstrap method and are revealed in the form of the prediction and confidence interval for each specific time duration on graph. Five metrics such as root mean square error (RMSE), coefficient of determination (R^2), mean square error (MSE), Akaike information criteria (AIC) and Bayesian information criteria (BIC) are used to assess the performance of the employed IDF equation. The coefficients of 3-parameteric non-linear IDF equation is determined for various recurrence interval by means of Levenberg–Marquardt algorithm (LMA), also referred to as damped least square (DLS) method. The estimated coefficients vary from location to location but are insensitive to duration. After successfully determining the IDF parameters for the same return period, parametric contour or isopluvial maps can be generated using OK as an interpolation tool with the intention to provide estimates at ungauged locations. These estimated regional coefficients of IDF curve are then fed to the empirical intensity frequency equation that may serve to estimate rainfall intensity for design purposes for all ungauged sites. The outcomes of this research contribute to the construction of IDF-based design criteria for water projects in ungauged sites located anywhere in the state of BW.

In conclusion, we conducted IDF analysis for the entire state of BW as it is considered to be more demanding due to the increased impact of climate change on the intensification of hydrological cycle as well as the expansion of urban areas rendering watershed less penetrable to rainfall and

run-off, the better understanding of spatial heterogeneity of intense rainfall patterns for the proposed domain.