PRISM approach within GIS environment for rainfall interpolation in the mountainous terrain of Uttarakhand region in India

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Abstract: Numerous statistical and spatial techniques have been developed and adopted for interpolation of point data such as climatic data. However, these generalized tools do not meet specific needs such as topographically accurate rainfall spatial interpolation in the mountainous regions. In this study a Precipitation-elevation Regression on Independent Slopes Model (PRISM), a hybrid spatio-statistical approach, under GIS environment is developed and evaluated. PRISM establishes the basic relations between elevation and rainfall through an iterative, contextual and statistical process. PRISM approach was applied to monthly rainfall data over 41 stations in the hilly terrain (180 m to 6621 m amsl) of Uttarakhand (53,483 km^2), India. Rainfalls of all the 12 months have been spatially interpolated for the entire state using this technique, analysed for errors and compared. Various search distance radii (30 km to 100 km) were evaluated based on which the 100-km-radius was considered to be the optimal limiting distance for interpolation. Overall accuracy of around 90 to 95% was obtained for all the months. Sensitivity analyses have revealed that the error variations due to dropping of stations are less than 3%, unless until the stations are representative observations of the region. RMSE calculated after dropping 20% of the total rain-gauge stations, was 5% more, on an average, when compared to the RMSE obtained with all the stations included.

Keywords: PRISM, GIS, Spatio-statistics, Interpolation, Rainfall, Mountainous terrain.