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ORIGINAL PAPER

Development of satellite data based rainfall IDF curves and hyetographs for flood risk management in the Kashmir Valley

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Abstract

The sparsely gauged Kashmir Valley presents significant challenges for accurate hydrological modelling, due to its complex topography and limited rainfall observational network. To address these limitations, this study develops rainfall Intensity-Duration-Frequency (IDF) curves and storm hyetographs for 24 watersheds of the Jhelum Basin using satellite-based CHIRPS rainfall data. Validation of CHIRPS data against ground observations from six meteorological stations revealed a strong positive correlation ($R = 0.9$), confirming its reliability for regional rainfall assessment. The annual maximum rainfall values were extracted, and frequency analysis was performed using the Gumbel distribution to estimate precipitation depths for return periods ranging from 2 to 500 years. The IDF relationships were derived for the Jhelum Basin and validated using chi-square statistics, confirming the suitability of the Gumbel distribution for modeling regional rainfall data. The derived IDF curves highlighted significant spatial variability in rainfall intensities, with higher-altitude watersheds exhibiting greater intensities for shorter durations. The southern watersheds, particularly Lidder, recorded the highest intensities, whereas the northern watersheds, including Pohru and Viji Dhakil, exhibited the lowest. Understanding not only the spatial distribution but also the temporal patterns of rainfall is crucial for effective water resource management. Accordingly, hyetograph analysis revealed distinct temporal patterns, with southern watersheds exhibiting sharper peaks indicative of concentrated rainfall. These findings emphasize the spatial and temporal variability of rainfall within the region, underscoring the implications for flood risk management and climate adaptation strategies.

Keywords CHIRPS rainfall · Hyetograph · IDF curve · Jhelum basin · Return period

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