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Modeling the extreme precipitation using the generalized extreme value models with Southern Oscillation Index (SOI) as a covariate in the Beas basin, India

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Variations in frequency and intensity of extreme hydrological events greatly affect the human society and the environment. Currently one of the major challenges that face the hydrologic science communities is to understand the characteristics, processes and mechanisms of extreme hydrological events. The hydrology of Himalayan basins is not well understood due to the complexities in the climatic and geographic conditions, and the scarcity of data. The Beas River, one of the Western Himalayan rivers in India, is one of the main branches of the Indus River system. However, the characteristics of extreme precipitation in this river basin have rarely been explored yet. In this study, the monthly maximum rainfall data from 1982 to 2005 are modeled using generalized extreme value (GEV) models for seven stations in the Beas River basin. Firstly, the autocorrelation, Mann-Kendall test, and wavelet analysis were used to detect the presence of serial correlations, trends, and periodical components. Secondly, the modeling of extreme precipitation was applied to the monthly block maxima and the likelihood ratio test was used to determine the best-fitting model. The Mann-Kendall test showed the existence of trend for some stations and suggested a non-stationary model. Therefore, we fitted the extreme precipitation with both stationary and non-stationary GEV models. The non-stationary model fitted the GEV with El Nino-Southern Oscillation index (Southern Oscillation Index, SOI) as a covariate with a linear link to the location parameter. The results suggested that the covariate SOI model was a significant improvement over the model without a covariate. Thirdly, the return periods and return levels of the extreme precipitation were estimated based on the best fitting models. The 10, 20, 50 and 100-years return levels and their 95% confidence intervals were provided. This research has important implications for policy makers for designing flood prevention plans, and in anticipating future severe rainfall and the associated consequences of severe flooding.