Comparison of three approaches to extreme precipitation analysis in a basin scale

In this study, three approaches to extreme precipitation analysis were compared in Chenar Rahdar river basin southern Iran. The approaches were 1) using gauge observations (so-called stationary approach), 2) utilizing climate change impact on extreme precipitations, and 3) nonstationary analysis. In the first approach, proper distributions were fitted to rain gauge observations during the base period of 1971-2010. In the second approach, climate change analysis was performed implementing HadCM3 and CGCM3 as two Global Circulation Models (GCMs) under A2 emission scenario utilizing three statistical downscaling methods; namely Change Factor (CF), Statistical DownScaling Model (SDSM), and Long Ashton Research Station Weather Generator (LARS-WG). Precipitations predicted by GCMs over the basin were downscaled to 24-hr rainfalls for the future period of 2011–2100 (2020's, 2050's, and 2080's). Nonstationary analysis was based on a Bayesian approach which estimates extreme value parameters during the base period with a Differential Evolution Markov Chain (DE-MC). Finally, uncertainty bounds of estimated return levels were determined through Bayesian inference. Comparison of results obtained by the three approaches showed that uncertainty bounds cover all estimates with the stationary and climate change approaches underestimating precipitation extremes by as much as 16% compared to the nonstationary approach. The former approaches may not be assumed suitable for infrastructure design in a changing climate. This finding suggests the need for careful consideration of extreme precipitation analyses presented for hydraulic structures design and their life expectancy in basins.

Keywords: extreme precipitation, climate change, stationary, Global Circulation Models, nonstationary.