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Uncertainty of Intensity-Duration-Frequency (IDF) curves due to varied climate baseline periods

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Abstract

Storm water management systems depend on Intensity–Duration–Frequency (IDF) curves as a standard design tool. However, due to climate change, the extreme precipitation quantiles represented by IDF curves will be subject to alteration over time. Currently, a common approach is to adopt a single benchmark period for bias correction, which is inadequate in deriving reliable future IDF curves. This study assesses the expected changes between the IDF curves of the current climate and those of a projected future climate and the uncertainties associated with such curves. To provide future IDF curves, daily precipitation data simulated by a 1-km regional climate model were temporally bias corrected by using eight reference periods with a fixed length of 30 years and a moving window of 5 years between the cases for the period 1950–2014. Then the bias-corrected data were further disaggregated into ensemble of 5-min series by using an algorithm which combines the Nonparametric Prediction (NPRED) model and the method of fragments (MoF) framework. The algorithm uses the radar data to resample the disaggregated future rainfall fragments conditioned to the daily rainfall and temperature data. The disaggregated data were then aggregated into different durations based on concentration time. The results suggest that uncertainty in the percentage of change in the projected rainfall compared to the rainfall in the current climate varies significantly depending on which of the eight reference periods are used for the bias correction. Both the maximum projection of rainfall intensity and the maximum change in future projections are affected by using different reference periods for different frequencies and durations. Such an important issue has been largely ignored by the engineering community and this study has shown the importance of including the uncertainty of benchmarking periods in bias-correcting future climate projections.