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Canadian RCM projected changes to flood events: A bivariate frequency analysis using the copula approach for the Ottawa River basin

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Extreme hydrological events, such as floods, have significant economic and social consequences, and therefore, better understanding of flood characteristics (i.e. flood peak, volume and duration) from a multivariate viewpoint is useful in the assessment of future changes to these extreme events in the context of changing climate. Conventional univariate analyses can be insufficient for hydrologic design and flood management, since flood characteristics are random in nature and mutually correlated. Multivariate analysis of hydrological extremes can be performed using copulas. In this study, we provide a general theoretical framework to derive appropriate bivariate joint distributions of flood characteristics utilizing the Archimedean copula and a set of parametric distributions for modelling individual characteristics of flood events. Daily streamflows derived from an ensemble of ten 30-year Canadian RCM simulations, of which five correspond to current climate (1961–2000) and the remaining five are the matching simulations for the future climate (2041–2070), are used to study changes in bivariate return periods of flood events for the Ottawa River basin in Canada. The results of projected changes to flood characteristics for the 2041–2070 period with reference to 1971–2000 suggest a decrease in return periods suggesting severe and frequent floods in future over the Ottawa River basin.