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Spatio-temporal analysis of the extreme precipitation by the L-moment-based index-flood method in the Yangtze River Delta region, China

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The regionalization methods which "trade space for time" by including several at-site data records in the frequency analysis are an efficient tool to improve the reliability of extreme quantile estimates. With the main aims of improving the understanding of the regional frequency of extreme precipitation and providing scientific and practical background and assistance in formulating the regional development strategies for water resources management in one of the most developed and flood-prone regions in China, the Yangtze River Delta (YRD) region, in this paper, L-moment-based index-flood (LMIF) method, one of the popular regionalization methods, is used in the regional frequency analysis of extreme precipitation; attention was paid to inter-site dependence and its influence on the accuracy of quantile estimates, which hasn't been considered for most of the studies using LMIF method. Extensive data screening of stationarity, serial dependence and inter-site dependence was carried out first. The entire YRD region was then categorized into four homogeneous regions through cluster analysis and homogenous analysis. Based on goodness-of-fit statistic and L-moment ratio diagrams, Generalized extreme-value (GEV) and Generalized Normal (GNO) distributions were identified as the best-fit distributions for most of the sub regions. Estimated quantiles for each region were further obtained. Monte-Carlo simulation was used to evaluate the accuracy of the quantile estimates taking inter-site dependence into consideration. The results showed that the root mean square errors (RMSEs) were bigger and the 90% error bounds were wider with inter-site dependence than those with no inter-site dependence for both the regional growth curve and quantile curve. The spatial patterns of extreme precipitation with return period of 100 years were obtained which indicated that there are two regions with the highest precipitation extremes (southeastern coastal area of Zhejiang Province and the southwest part of Anhui Province) and a large region with low precipitation extremes in the north and middle parts of Zhejiang Province, Shanghai City and Jiangsu Province. However, the central areas with low precipitation extremes are the most developed and densely populated regions in the study area, thus floods will cause great loss of human life and property damage. These findings will contribute to formulating the regional development strategies for policymakers and stakeholders in water resource management against the menaces of frequently emerged floods.