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Entropy theory based multi-criteria resampling of rain gauge networks for hydrological modelling – a case study of humid area in southern China

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Abstract

Rain gauge networks are usually used to provide estimates of area average rainfall or point rainfalls at catchment scale and provide the most important input for hydrological models. Due to economical, technical and other constraints, rain gauge networks are usually not dense enough or not properly placed to measure precipitation at the resolution and extent necessary for determining the spatial variability of rainfall. It is therefore desirable to study the effect of rain gauge distribution and to design well distributed rain gauge networks with minimal gauge densities to provide best possible estimations with both rainfall amount and spatial-temporal variability. Based on a dense rain gauge network of 185 rain gauges in Xiangjiang River Basin, southern China, this study applied an entropy theory based multi-criteria method which simultaneously considering the information derived from rainfall series and minimizing the bias of areal mean rainfall as well as the information overlapped by different gauges to resample the rain gauge networks with different gauge densities. The optimal networks are tested using two hydrological models: the lumped Xinanjiang Model and distributed SWAT Model in order to investigate how the lumped and distributed models react to the number of rain gauges and their spatial distribution. The hydrological simulation results reveal that the performances of the lumped Xinanjiang Model using different optimized networks are stable while the distributed SWAT Model shows an improved trend in model performances with more rain gauges are included in simulation. The results indicate that the entropy theory based multi-criteria strategy provide a robust design of rain gauge networks and more stations are needed in order to realize the advantages of distributed models in hydrological simulations.