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Optimal raingauge density for rainfall runoff modeling

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The hydrological significance of rainfall time-space distribution on flood hydrograph is well known and assessed in literature. The density of the raingauge network and the way of areal and temporal distribution of rainfall can affect the results of calibration and validation of distributed rainfall-runoff modeling.
The aim of this work is to assess the influence of changing the composition of raingauge network, successively reducing the number of gauging stations, while maximizing the performance of the hydrological model.
The case study is the Mignone river basin (500 km2), located in Central Italy, equipped with 5 raingauges.
The approach is based on the generation of N synthetic rainfall fields on an hourly basis . The simulated output, while reproducing the spatial variability of the recorded events, allows to change the temporal variability in the achievement of the total rainfall volumes.
The N flood hydrographs and water volumes at the closing section are evaluated through a WFIUH (Width Function Instantaneous Unit Hydrograph) rainfall runoff model, considering various raingauges configuration, and the performance of each configuration is evaluated by the errors on peak discharge, peak time and Nash-Sutcliff efficiency coefficient.
Then, each considered raingauge configuration is also evaluated on the basis of the quantity of available information evaluated through the concept of entropy. The results, evaluated by Nash-Sutcliff efficiency coefficient, are used to highlight the effects of raingauge network density on runoff volume and peaks.