EGU26-9324, updated on 10 May 2026
https://doi.org/10.5194/egusphere-egu26-9324
EGU General Assembly 2026

A new copula-based approach for storm events analysis to support urban catchment modeling

Giulio Paradiso[1] and Daniele Ganora[2]
[1]Polytechnic, Polytechnic of Torino, Turin, Italy (giulio.paradiso@polito.it)
[2]Polytechnic, Polytechnic of Torino, Turin, Italy (daniele.ganora@polito.it)

Urban flood risk management requires innovative approaches to address the increasing variability of extreme meteorological events, intensified by climate change and urban expansion. This study proposes a novel and replicable methodology for the classification of rainfall events in urban areas to obtain more precise design storm events respect to the more used IDF curves. The selected study area is the hill of the municipality of Turin, characterized by steep slopes, widespread urbanization, and a dense network of minor streams, partially open-channel and partially culverted, which are not represented in standard flood hazard maps.

Extreme rainfall events exhibit complex dependencies among key attributes such as duration, intensity, and cumulative precipitation, which cannot be correctly described using univariate approaches that may cause significant over-simplification. To address this limitation, in this work a statistical framework based on an unconventional application of Peak Over Threshold (POT) theory and a trivariate copula-based dependence modeling is proposed to describe the joint behaviour of rainfall event characteristics and to estimate multivariate return periods.

Rainfall events are extracted from sub-daily pluviometric time series using the concept of the inter event time definition (IETD) and characterized in terms of duration, mean intensity, and cumulative depth. Suitable marginal distributions are identified for each variable and finally events exceeding predefined thresholds are analysed to assess their frequency of occurrence. Dependence structure among event characteristics is modelled using multivariate copula framework capable of capturing complex, non-linear relationships and tail dependences. The fitted model is then used to simulate synthetic rainfall events and to compute joint exceedance probabilities in the trivariate space. Multivariate return periods associated with compound extreme events are derived and visualized, highlighting the importance of dependence in the assessment of rainfall severity.

The proposed methodology wants to provide a robust and flexible tool for the probabilistic characterization of compound rainfall extremes and represents valuable support for flood risk assessment and hydrological design in complex urban settings.