Approaching the estimation of high return period rainfall quantiles through a high-resolution investigation of local orographic gradients

SESSIONE
4 - STATUS AND CHALLENGES OF GEO-HYDROLOGICAL NATURAL HAZARD MODELING AT THE REGIONAL SCALE AND BEYOND

X ORAL
☐ POSTER

Approaching the estimation of high return period rainfall quantiles through a high-resolution investigation of local orographic gradients

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ABSTRACT

A reliable estimation of high return period rainfall quantiles is particularly challenging in data scarce or orographically complex areas. In this work, conducted selecting Italy as a case study, we approached this topic by exploring the spatial variability of rainfall extremes in areas with complex terrain features, considering the influence of local orographic gradients.
The Improved Italian – Rainfall Extreme Dataset (or I^2-RED), a collection of sub-daily annual maximum rainfall depths measured from 1916 up to the present by more than 5000 rain gauges allowed to extract about 3800 time series spanning at least 10 years to estimate average sub-daily annual maxima (the so-called "index rainfall") across Italy. Our approach incorporated a local regression model that accounts for elevation-dependent variations in the index rainfall in each 1 km grid cell used to segment Italy. In this work we addressed challenges like low data density and extrapolation difficulties at high and low elevations by suggesting simple but effecting solutions, such as the possibility of using a local sample only if a minimum elevation difference is granted.
By considering local topographic effects, our model enabled the generation of maps depicting average extreme rainfall patterns at 1 km resolution. Our findings revealed a predominantly negative orographic gradient for 1-hour extremes in large mountainous areas, while 24-hour mean rainfall extremes typically exhibit positive orographic gradients, with a few exceptions in mountainous regions. These results align with prior studies conducted in smaller areas.
The so-computed maps can contribute to studies focusing on the spatial variability of rainfall quantiles, crucial for hydrological design purposes.

References:

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