A regionless local regression approach for the reconstruction of the spatial variability of rainfall extremes in a complex terrain

H35B-04 - A Regionless Local Regression Approach for the Reconstruction of the Spatial Variability of Rainfall Extremes in a Complex Terrain

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McCormick Place - E352 (Lakeside, Level 3)

Abstract

We present the results of studies on the dependence of extreme rainfall on elevation in a relatively wide area (Italy, ≅300,000 km^2) characterized by complex morphology. Our starting point is a database of sub-daily rainfall extremes measured by more than 5200 rain gauges from 1916 until 2021 (the Improved Italian – Rainfall Extreme Dataset, or I^2-RED). To deal with high variability of morphologies, climates and rain gauge density in mapping the average of sub-daily rainfall extremes, we have first investigated the relationships between rainfall and geomorphology at national- and regional-scale. Multiple regressions did not produce spatially uniform residuals, despite variables like elevation, geographic position, mean annual rainfall and distance from the coastline were significant in wide areas. Significant improvements were obtained on subdomains of geomorphological classifications already using only simple regressions with elevation. Then, we considered an individual regression over each grid cell: the new regionless approach is performed by selecting, for each 1-km grid cell covering Italy, rain gauges available within a 1 to 50 km radius. We identified a criterion for the optimal selection of the radius based on the station density variability, and conditioned the search of a local rainfall gradient with elevation on the basis of at least 5 stations with a minimum elevation range. The procedure was conditioned to avoid significant elevation extrapolations, that produce unrealistic estimates and artifacts. In the various steps used for selecting the best regionless regression application, we compared results by using a leave-one-out cross-validation, having in mind to check the spatial uniformity of residuals. The results obtained allowed us to confirm that a marked inverse orographic effect (i.e., a decrease of rainfall depth with the elevation) is evident for 1-hour extremes over most of the Alps, the Liguria region, and portions of the Apennines. These areas can be identified more clearly using the local regressions, and will allow investigations aimed at a physically-based attribution. The quality of the results

obtained with the proposed method outperforms previous approaches and allows us to proceed to further spatial assessments of extreme rainfall quantiles.

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