Effects of Super-Extremes in the evaluation of the design rainfall: a case study in Northern Italy

EGU23-668, updated on 26 Apr 2023
https://doi.org/10.5194/egusphere-egu23-668
EGU General Assembly 2023

Effects of Super-Extremes in the evaluation of the design rainfall: a case study in Northern Italy

Paola Mazzoglio, Ilaria Butera, and Pierluigi Claps
Politecnico di Torino, Department of Environment, Land and Infrastructure Engineering, Torino, Italy
(paola.mazzoglio@polito.it)

In recent years, several major rainfall events have been observed in Italy, with amounts that have broken previous all-time records. Several questions concerning the adequacy of the statistical tools that we have at our disposal to determine the "real" rarity of these events emerge, especially considering the limited availability of long and complete rainfall records. In this work, we investigate the influence of "Super-Extremes" on the rainfall regional frequency analysis framework. More specifically, we consider the all-time Italian record events up to now, some of which were observed in 2021 (377.8 mm / 3h, 496 mm / 6h, 740.6 mm / 12h).

The approach is undertaken through a rainfall regional frequency analysis performed over the North-West of Italy based on the patched kriging (PK) technique. PK requires a year-by-year application of ordinary kriging, that overcomes the data inconsistency by considering all the time series, without the need to discard those shorter than a specific length. The morphology of the areas is quite complex, which implies that extremes are expected to be influenced by the elevation: the orographic gradient is computed and removed and, for each duration, the sample variogram is evaluated as the mean of the annual variograms weighted on the number of active rain gauges for any year.

The sequential application of the ordinary kriging allows to reconstruct both a "rainfall data cube" and a "variance data cube" in the (x, y, t) space. A complete series of measured and estimated values are obtained by coring the data cube along the time axis in each location. The cored series are then used to compute the L-moments, in a framework that assigns weights based on the kriging variance, to consider the different nature of the data (measured and estimated). To overcome possible inconsistencies of the L-moment, a bias-correction procedure is applied to preserve the coefficient of variation from the smoothing effect induced by the spatial interpolation.

The methodology is applied to short-duration (1 to 24 hours) annual maximum rainfall depths recorded by rain gauges coming from the Improved Italian – Rainfall Extreme Dataset (I^2-RED). The effects in the local frequency curves when introducing new record-breaking data are examined and commented, in view of the role that these values assume in the surrounding region.