Evaluation of the accuracy of convection-permitting sub-daily extreme precipitation simulations over Italy

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Convection-permitting models have the potential to capture crucial processes in the climate system, presenting an opportunity to significantly enhance climate projections by providing more accurate representations of precipitation extremes.

In this work, we conduct an evaluation of the accuracy of sub-daily precipitation extremes obtained from VHR-PRO_IT (Very High-Resolution PROjections for ITaly) over the Italian peninsula, which are obtained with the downscaling of the CMCC global climate model at a convection-permitting scale (Raffa et al., 2023). Indeed, VHR-PRO_IT is generated through dynamic downscaling of the Italy8km-CM climate projection (spatial resolution of about 8 km; output frequency = 6 h; driven CMIP5 GCM = CMCC-CM) at about 2.2 km resolution under the IPCC RCP4.5 and RCP8.5 scenarios, employing the Regional Climate Model COSMO-CLM.

Gauged locations are used to assess the accuracy of VHR-PRO_IT in reproducing observed extremes. More specifically, the observed dataset used as ground truth for the comparison is I^2-RED (Improved Italian – Rainfall Extreme Dataset; Mazzoglio et al., 2020). In this work, 742 rain gauges with a minimum of 30 years of short-duration (1, 3, 6, 12, 24 h) annual maximum rainfall depths recorded in the period from 1980 to 2022 are used (Figure 1). The dataset covers the entire peninsula, although some areas are characterized by a lower rain gauge density due to the complex station relocation performed about 30 years ago during the dismantlement of the national hydrological service (SIMN, Servizio Idrografico e Mareografico Nazionale). Conversely, the dataset derived from the VHR-PRO_IT climate projections includes annual maxima from a 30-year time series, connecting the historical period (1981-2005) with 5 years of the RCP8.5 scenario (2006-2010) of the CPM.

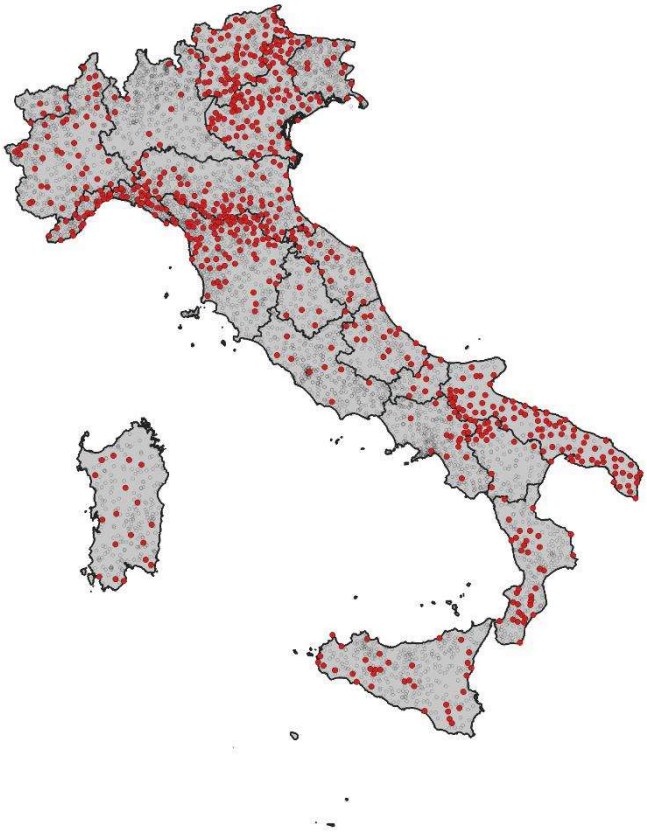

Figure 1 – Location of the 742 rain gauges with at least 30 years of data in the 1980-2022 period.

The comparison is made by assessing biases between quantiles of annual maximum rainfall obtained from the two empirical cumulative distribution frequencies. The considered quantiles are 0.1, 0.25, 0.5, 0.75 and 0.9. The biases are shown with respect to the orography and the proximity to the sea, to analyze potential correlation with their geographical position.

Further work will be performed to assess and quantify local biases between L-moments and GEV distributions. Also in this case, evaluating their dependence on the geographic position, orography, and proximity to the sea.

References

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