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High-resolution precipitation database for the last two centuries in Italy: climatologies and anomalies

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The availability of gridded high-resolution spatial climatologies and corresponding secular records has acquired an increasing importance in the recent years both to research purposes and as decision-support tools in the management of natural resources and economical activities.
High-resolution monthly precipitation climatologies for Italy were computed by gridding on a 30-arc-second-resolution Digital Elevation Model (DEM) the precipitation normals (1961-1990) obtained from a quality-controlled dataset of about 6200 stations covering the Italian surface and part of the Northern neighbouring regions. Starting from the assumption that the precipitation distribution is strongly influenced by orography, especially elevation, a local weighted linear regression (LWLR) of precipitation versus elevation was performed at each DEM cell. The regression coefficients for each cell were estimated by selecting the stations with the highest weights in which the distances and the level of similarity between the station cells and the considered grid cell, in terms of orographic features, are taken into account. An optimisation procedure was then set up in order to define, for each month and for each grid cell, the most suitable decreasing coefficients for the weighting factors which enter in the LWLR scheme.
The model was validated by the comparison with the results provided by inverse distance weighting (IDW) applied both to station normals and to the residuals of a global regression of station normals versus elevation. In both cases, the LWLR leave-one-out reconstructions show the best agreement with the observed station normals, especially when considering specific station clusters (high elevation sites for example).
After producing the high-resolution precipitation climatological field, the temporal component on the high-resolution grid was obtained by following the anomaly method. It is based on the assumption that the spatio-temporal structure of the signal of a meteorological variable over a certain area can be described by the superimposition of two independent fields: the climatologies and the anomalies, i.e. the departures from the normal values. The secular precipitation anomaly records were thus estimated for each cell of the grid by averaging the anomaly values of neighbouring stations, by means of Gaussian weighting functions, taking into account both the distance and the elevation differences between the stations and the considered grid cell. The local secular precipitation records were then obtained by multiplying the local estimated anomalies for the corresponding 1961-1990 normals. To compute the anomaly field, a different dataset was used by selecting the stations with the longest series and extending them both to the past, retrieving data from non-digitised archives, and to the more recent decades. In particular, after a careful procedure of updating, quality-check and homogenisation of series, this methodology was applied on two Italian areas characterised by very different orography: Sardinia region and the Alpine areas within Adda basin.