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Reconstruction of historical precipitation based on radar fields: application on Catalonia region (Spain)

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This research study aims to establish a methodology for the reconstruction of large homogeneous time series of daily high-resolution precipitation fields. The originality of this methodology is the use of precipitation patterns from recent weather radar observations in the interpolation of past observations, with the aim of improving the spatial variability of precipitation fields.

The method consists of two steps: the analyses of radar maps to retrieve the characteristic precipitation patterns and the reconstruction of the past. In a first step, a Principal Component Analysis is carried out on the current database of daily radar-based precipitation fields (for the period 2008-2011) to obtain a reduced number of patterns describing the rainfall variability. Secondly, the obtained patterns are used to reconstruct the historical rainfall fields by linear combination constrained to the records of the historical rain gauges records.

This method has been implemented and tested in Catalonia (Spain) in order to reconstruct historical precipitation fields in the period 1940-2007. Different tests have been conducted to assess the historical reconstruction. First, cross validation shows that the reconstructed daily rainfall values at raingauge locations are in correspondence with gauge observations. Second, when comparing the reconstructed fields with an external reference based on radar -data not used during the calibration procedure- the results are very satisfactory. The correspondance between both fields is excellent and the spatial variability of precipitation is preserved.

These reconstructed high-resolution precipitation fields have then been used to compute Intensity-Duration-Frequency (IDF) and Standard Precipitation Index (SPI) maps. This new accuracy on the occurrence and intensity of past extreme events can be used to analyze the historical trends and to improve future predictions.