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Evolution of the AURELHY method for spatial analysis of precipitation and temperature climatological fields over France.

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Spatial analysis of climatological fields of precipitation and temperature rely very often on models involving topography as a predictor. The AURELHY method (Benichou and Le Breton 1987) is based on a principal component analysis (PCA) of the topography, and on a linear model with a selection of predictors among the principal components. A kriging of the residuals of the linear model is then applied and the final result is the sum of the two contributions.

A new software has been written, based on the R language, offering a large panel of new options for AURELHY :
• It offers the possibility to apply the method on very different regions (size of the domain, target grid size, masks for maritime areas) provided that a Numerical Terrain Model is available.
• The PCA of the topography is applied on a matrix with each line corresponding to the elevations of a selection of points in the vicinity of each point of the target grid. The parameters of this selection (range, density, shape) can be tested and adapted. The spatial scale of the relation between the meteorological variable and the topography needs to be carefully scrutinized.
• The automatic selection of the principal components as best predictors is now possible with several methods.
• The kriging of the residuals offers numerous possibilities for the choosing the kriging parameters : range and nugget of the variogram, and model fitting of the variogram. In particular, Kriging with External Drift is now available.
• Cross-validation has also been implemented in the new software.
All these new methodological options were evaluated in order to improve the quality of the climatological fields produced by the method.

Another part of the study consists in improving the density and the quality of the input data, to improve the final result. All observation networks are confronted with the difficulty to produce long time-series of homogeneous daily observations covering the climatological period without gaps. A large experiment of gap filling for all the stations covering at least 50 % of the climatological period 1981-2010 was conducted. Independent estimates of the missing daily data were produced with a kriging of the neighbor stations. The number of stations available for the spatial analysis was increased by around 30 % for precipitation and 40 % for temperature. A careful analysis of improvement was conducted with special focus on mountainous zones.