A new combined interpolation approach for 1981–2010 monthly precipitation climatologies over Norway: joining numerical model output with in-situ observations

Alice Crespi (1), Cristian Lussana (2), Michele Brunetti (3), Andreas Dobler (2), Maurizio Maugeri (1,3), and Ole Einar Tveito (2)

(1) Department of Environmental Science and Policy, Università degli Studi di Milano, Italy (alice.crespi@unimi.it), (2) The Norwegian Meteorological Institute, Oslo, Norway, (3) Istituto di Scienze dell'Atmosfera e del Clima, CNR, Bologna, Italy

A new interpolation scheme has been developed and applied to compute the 1981–2010 monthly precipitation climatologies at 1 km resolution over Norway. The procedure integrates precipitation normals provided by in-situ observations with those derived from the HCLIM-AROME 2.5 km resolution hindcast dataset of hourly precipitation computed over Norway and part of Sweden by the convective permitting climate model version of HARMONIE. The idea of a combined interpolation approach derives from the need of overcoming the limitations of the availability of in-situ observations in remote regions characterized by a complex orography. Numerical models do not use rain-gauge information, so their estimates are not affected by the variability in data coverage. On the other hand, their accuracy could be improved by using the available station observations to correct or reduce possible biases of numerical model fields.

The observation database we used is composed by more than 2000 high-quality monthly precipitation series retrieved from the ECA&D and the MET Norway Climate archives and located over Norway and surrounding countries. Since HCLIM-AROME climate runs cover only the period 2003–2016, in order to obtain the corresponding climatological fields for the 30-year reference period, the hourly precipitation series were aggregated at monthly timescale and the climatological normals over the available period were extended and converted to the 1981–2010 reference period by applying at each 2.5 km grid cell a rescaling procedure based on the multiplicative anomalies of neighbouring station series. The obtained 1981–2010 monthly precipitation climatologies for the HCLIM-AROME dataset were then downscaled from their original resolution to the target 1 km grid. The 1981–2010 HCLIM-AROME monthly climatologies are finally used in the combined interpolation scheme as background and a kriging interpolation is applied on the residuals between station normals and the numerical model estimates at station sites.

The model accuracy was evaluated by the leave-one-out reconstruction of station monthly normals. The monthly mean absolute error ranges between 13.9 mm (January) and 6.3 mm (May), while R-squared is above 0.85 in most months. Moreover, the bias resulting by comparing the original 1981–2010 HCLIM-AROME climatologies with station normals is almost removed. The results were also compared with those provided by a kriging-based statistical interpolation model in which only observations are used. The reconstruction errors turn out to increase of about 2% in most months when the statistical model is applied using only observations. Moreover, a sensitivity test of the two approaches was managed over several Norwegian subregions characterized by different orography and station density. In all cases the combined model turns out to be significantly less sensitive to the variations in data availability.