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Regional climate model downscaling with Multimodel SuperEnsemble in the Alpine area and wildfire potential evaluation in the scenario

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The Regional Climate Models (RCMs) outputs show significant model errors in the control period in areas of complex orography like the Alps, when compared with the observed climatology. In this work we show the use of the Multimodel SuperEnsemble technique on a selection of the EU ENSEMBLES project RCMs outputs to downscale the temperature and precipitation fields over Piemonte region (North-western Italy) in order to reduce these errors.
First of all, an Optimal Interpolation technique was used to assimilate the daily ground station data on a selected regular grid map (0.125° resolution, with careful description of the complex orography of the region) based on a background field obtained by a linear tri-dimensional downscaling of ERA-40 archive from 1957 to 2001 and of the ECMWF objective analysis from 2002 to 2009. This gives us a coherent and wieldy observed climatology to use as comparison baseline.
Hence, the outputs of the reanalyses (from ERA40) and scenarios (nested in several Global Circulation Model runs on the A1B SRES scenario) from the RMCs were interpolated from their original 25 km grid to the same grid of observed climatology and the Multimodel SuperEnsemble technique was applied.
The reanalyses and scenarios obtained with Multimodel SuperEnsemble, thanks to the use of the high resolution analysis, allow a better characterization of the temperature variations in the alpine area, with differences between mountainous and plain regions.
Furthermore, we developed a new probabilistic Multimodel SuperEnsemble technique for the quantitative precipitation forecast, with a careful estimation of the Multimodel precipitation Probability Density Functions (PDFs) and prove here its promising results in the regional climatic model downscaling. We evaluate the observation PDFs conditioned to the RCMs reanalysis precipitation values and model them with appropriate distribution functions. We then apply these PDFs to the model reanalyses and scenarios and weight them with weights obtained with the inverse of the Continuous Ranked Probability Score of each model in a training period. The precipitation fields so obtained show a reasonable agreement with the observed precipitation in the control period.
We present also the first application of the down-scaled temperatures and precipitation so-obtained, using them in combination with other meteorological variables in order to evaluate future scenarios of wildfire potential with the Canadian Fire Weather Index. The sharp evaluation of forest fire danger behaviour in future climate scenarios, comparing different downscaling techniques of the fire weather indices with fires observed over Piedmont area, can be a key-point for adaptation and mitigation strategies especially in a rich biodiversity region such as the Alps.