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An evaluation of daily precipitation downscaled using SDSM and WRF+WRFDA models over the Iberian Peninsula

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Downscaling via the Statistical DownScaling Model (SDSM) version 5.2 and two different configurations of the dynamical WRF model (with and without 3DVAR data assimilation) was evaluated for the estimation of daily precipitation over 21 sites across the Iberian Peninsula during the period 2010-2014.

ERA Interim data at 0.75 degrees were used as the initial/boundary conditions to run two different WRF simulations over the period 2009-2014 within a domain at 15 km grid resolution centered over the Iberian Peninsula. The first experiment (N) used the typical configuration of numerical downscaling studies. Information was fed through the boundaries of the domain. The second experiment (D) used 3DVAR data assimilation at 00 UTC, 06 UTC, 12 UTC and 18 UTC. In both cases 2009 was used as spin-up for the NOAH land surface model.

The most similar experiment to the configuration used in WRF simulations was designed for SDSM. The E79r experiment includes predictor variables created from ERA-Interim data at 0.75 resolution to calibrate the model from 1979-2009. Then, ensembles with 20-members were created for 21 stations evenly spaced over the Iberian Peninsula (2010-2014).

WRF runs and the SDSM experiment were evaluated against observations from both gridded datasets (TRMM, GPCP and E-OBS) and in-situ data (ECA&D). The nearest point to each station was selected from the gridded datasets in order to compare it with the measured precipitation on each station. Both WRF experiments and SDSM were as good as these datasets, but systematically the simulation with data assimilation (D) outperforms the N simulation without 3DVAR.

The analysis of precipitation is important from different points of view and the results show that the decision on which is the best downscaling technique depends on the evaluation of results. In some cases the focus can be the average, but in other occasions it can be of interest to analyze the dispersion of data around the average at certain percentiles. For weather forecasting applications, the precise time and spatial occurrence of precipitation events is important while, for climate applications, this is not expected. Thus, correlation coefficient is important for weather forecast while, for climate downscaling, the production of an adequate PDF is more important.

In our study, we show that SDSM ensemble mean, WRF D and ERAI obtained comparable correlations on four regions defined over the IP with individual ensemble members performing worse. The D experiment outperforms the SDSM mean for the 90th percentile and precipitation intensity, but not the average precipitation. The ensemble members generally produce better PDF-related scores than WRF-D. The number of consecutive dry days is overestimated by the SDSM mean and underestimated by the D experiment and the members of the ensemble. However, the maximum five-day precipitation is overestimated by the ensemble members and underestimated by D and SDSM mean. The best LEPS scores were obtained by the ensemble members, outperforming D and the SDSM mean. However, the BSS showed that the ensemble members do not produce any added value to the prediction.