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Moisture balance over the Iberian Peninsula computed using a high resolution regional climate model. The impact of 3DVAR data assimilation.

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A numerical downscaling exercise over the Iberian Peninsula has been run nesting the WRF model inside ERA Interim. The Iberian Peninsula has been covered by a 15km x 15 km grid with 51 vertical levels. Two model configurations have been tested in two experiments spanning the period 2010-2014 after a one year spin-up (2009). In both cases, the model uses high resolution daily-varying SST fields and the Noah land surface model. In the first experiment (N), after the model is initialised, boundary conditions drive the model, as usual in numerical downscaling experiments. The second experiment (D) is configured the same way as the N case, but 3DVAR data assimilation is run every six hours (00Z, 06Z, 12Z and 18Z) using observations obtained from the PREPBUFR dataset (NCEP ADP Global Upper Air and Surface Weather Observations) using a 120' window around analysis times. For the data assimilation experiment (D), seasonally (monthly) varying background error covariance matrices have been prepared according to the parameterisations used and the mesoscale model domain.

For both N and D runs, the moisture balance of the model runs has been evaluated over the Iberian Peninsula, both internally according to the model results (moisture balance in the model) and also in terms of the observed moisture fields from observational datasets (particularly precipitable water and precipitation from observations). Verification has been performed both at the daily and monthly time scales. The verification has also been performed for ERA Interim, the driving coarse-scale dataset used to drive the regional model too.

Results show that the leading terms that must be considered over the area are the tendency in the precipitable water column, the divergence of moisture flux, evaporation (computed from latent heat flux at the surface) and precipitation. In the case of ERA Interim, the divergence of Qc is also relevant, although still a minor player in the moisture balance. Both mesoscale model runs are more effective at closing the moisture balance over the whole Iberian Peninsula than ERA Interim. The N experiment (no data assimilation) shows a better closure than the D case, as could be expected from the lack of analysis increments in it. This result is robust both at the daily and monthly time scales. Both ERA Interim and the D experiment produce a negative residual in the balance equation (compatible with excess evaporation or increased convergence of moisture over the Iberian Peninsula). This is a result of the data assimilation process in the D dataset, since in the N experiment the residual is mainly positive.

The seasonal cycle of evaporation is much closer in the D experiment to the one in ERA Interim than in the N case, with a higher evaporation during summer months. However, both regional climate model runs show a lower evaporation rate than ERA Interim, particularly during summer months.