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Moisture recycling over the Iberian Peninsula. The impact of 3DVAR data assimilation

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The moisture recycling is defined as the fraction of precipitation over a delimited region that comes from the evaporation over that region. Its importance lies in the fact that it is an approximated measurement of a regional feedback between the atmosphere and the surface. Thus, this study estimates the spatio-temporal distribution of moisture recycling over the Iberian Peninsula (IP), and focuses on the impact of the use of 3DVAR data assimilation during the modeling stage.

For that purpose, two different simulations were run using the Weather and Research Forecasting (WRF) model with a horizontal resolution of 15 km over the IP. The first simulation (WRF N) was nested inside ERA-Interim as usual in numerical downscaling exercises, with information passed to the domain through the boundaries. The second run (WRF D) presents the same configuration as WRF N, but it also includes 3DVAR data assimilation step every six hours (at 00, 06, 12 and 18 UTC). Sea surface temperature was updated daily, and observations in PREPBUFR format included in the NCEP ADP Global Upper Air and Surface Weather Observations dataset were used for the data assimilation step. Only those inside a 120-minute window centered at the analysis times were assimilated. Both simulations cover the period 2010-2014, but the experiment WRF D was extended later until 2018.

The lowest values of moisture recycling (around 3 %) are obtained from November to February, while the most remarkable values are observed in spring (around 16 %) in both simulations. The moisture recycling is confined to the southeastern corner of the IP during winter. However, during spring and summer, a gradient of higher values towards the northeastern corner of the IP are observed in both simulations. The differences between simulations, associated to the dryness of the soil in the model, are highlighted during summer and autumn. WRF D presents a lower bias and produces more reliable results because of a better representation of the atmospheric moisture.

A Cross-Correlation Function (CCF) based analysis was performed for each combination of moisture recycling, accumulated precipitation and mean soil moisture over the IP. For the common period (2010-2014), the results show that the WRF D experiment extends the lifespan of moisture over the IP. The CCF analysis for soil moisture against precipitation also shows an unphysical negative lag (-1 month) for WRF N, whilst for WRF D both variables are simultaneous. For the extended WRF D simulation (2010-2018), it was found that the delay between precipitation and moisture recycling over the IP is five months.