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The role of the topographic effects and the representative grid point in the surface wind for simulations over the Iberian Peninsula

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An appropriate representation of the surface wind by mesoscale models could improve the development of several applications, such as the estimation and prediction of wind energy. However, previous studies have evidenced that limited-area models, such as the Weather Research and Forecasting (WRF) model, tend to overestimate the wind speed in valleys and plains and underestimate this magnitude in mountains and hills. Jimenez and Dudhia (2012) attribute this positive and negative bias to the smoothed representation of the topography. To overcome this drawback, the authors have developed a new parameterization based on the concept of a sink term in the momentum equations (Wood et al 2001) in order to represent the drag generated by the subgrid-scale orography, and a time allow for the representation of the speed up of the flow over mountains and hills. They tested the parameterization in a region of Spain characterized by a complex terrain in winter of 2001.

In this work, this parameterization is evaluated over the Iberian Peninsula. For this study, two simulations have been performed with WRFv3.4; one taking into account the topographic effects (new simulation) and another without considering the new scheme (reference simulation). The numerical experiments encompass the year 2005 covering the Iberian Peninsula with a 10 km horizontal spatial resolution, initialized and driven by the ERA interim reanalysis. The WRF code has been modified to obtain the wind components at 2-m. These simulations are assessed by comparison with observations acquired at 331 stations recoding the wind at 2-m above the ground level.

In the study, we assess January and July because the parameterization could have a different influence depending on the flow regimes. First, the simulations are evaluated by comparisons with the observations considering the nearest grid point. The results for the reference simulation depicts a systematic overestimation, more remarkable in the Mediterranean basin and the Ebro valleys. In July this positive bias is more significant. When the topographic scheme is activated the spatial variability of the wind speed is higher than the reference case, increasing significantly the wind speed in the mountainous ranges. This increase is more noticeable in January. There is a bias reduction for more than 80 % of the stations, both in July and January. Moreover, negative biases appear at some sites, mainly in January. Nevertheless, the wind speed representation is deteriorate by this scheme in some points located in areas with extremely complex terrain.

To overcome this disagreement Jimenez et al (2010) and Jimenez and Dudhia (2012) proposed to consider the most representative grid point instead of the nearest. For identifying this point, the wind speed bias of the nine nearest points are considered and the grid point with the minimum bias is namely as the most representative grid point. The result of considering the most representative grid point plus the new scheme strongly reduces wind speed bias. However this fact implies that the frequency of agreement between the nearest and most representative grid point is low. Moreover, the election of the most representative grid point could be an impractical task because this point depends on the season (differs for January and July), the statistic score (is different if we calculate the bias or RMSE) and the meteorological variable (is different if we analyze the wind speed, the wind direction or height).

Although this topographic scheme has been developed with the aim to correct the wind speed bias, the wind direction is also inspected. The spatial patterns of the wind direction with and without the topographic scheme are similar, with the main differences in the mountain systems, as the Pyrenees; but also in the Ebro valley. There is a significant RMSVE reduction with the new scheme activated. The spatial correlation between RMSE for wind speed and the RMSVE is around 0.5. We also have assessed the influence of this new scheme in other

meteorological variables (temperature, boundary layer height, convective precipitation and latent heat flux).