Geophysical Research Abstracts
Vol. 14, EGU2012-10524, 2012
EGU General Assembly 2012

Improving the representation of resolved and unresolved topographic effects on surface wind in the WRF model

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The WRF model presents a high surface wind speed bias over plains and valleys which constitutes a limitation for the increasing use of the model for several applications. The present study attempts to correct for this bias parameterizing the effects that the unresolved topographic features exert over the momentum flux. The proposed parameterization is based on the concept of a momentum sink term and makes use of the standard deviation of the subgrid scale orography as well as the laplacian of the topographic field. Both the drag generated by the unresolved terrain and the possibility of a speed up of the flow over the mountains and hills, where it is herein shown that WRF presents a low wind speed bias, are considered in the scheme.

The surface wind simulation over a complex terrain region located in the northeast of the Iberian Peninsula is improved with the inclusion of the new parameterization. In particular, the underestimation of the wind speed spatial variability resulting from the mentioned biases is corrected. The importance of selecting appropriate grid points to compare with observations is also examined. The wind speed from the nearest grid point is not always the most appropriate for this comparison nearby ones being more representative. The new scheme not only improves the wind climatology but also the intradiurnal variations at the mountains, wherein the default WRF shows limitations in reproducing the observed wind behavior. Some advantages of the proposed formulation for wind resource evaluation are also discussed.