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A High Resolution Diagnostic Wind Model. Application to Downscaling Mesoscale Model Results for Wind Forecasting

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The mass consistent wind model proposed in [1] and updated in [2, 3], is improved by introducing three items: the new 3-D mesh generator MECCANO [4] applied to complex terrains, the current atmospheric stability definition by Zilitinkevich [5] including new wind profiles, and a specific preconditioner for the linear systems arising in a wind model [6]. The aerodynamic roughness length (z_0) and the displacement height (d) are critical for wind modelling based on the log vertical profile. It is well known that the values of these parameters depend on weather conditions and land coverage. A comprehensive literature review has been performed to collect the ranges of z_0 and d for each surface type. In particular, we have focused on the coverages present in the "Information System of Land Cover of Spain" (SIOSE) [7]. Using these ranges, we propose a procedure to construct z_0 and d maps through a downscaling wind model. Results from the HARMONIE-AROME and ECMWF mesoscale numerical weather prediction models are downscaled using our 3-D diagnostic wind model with adaptive finite element method [8]. The values of z_0 and d are estimated with a memetic algorithm that combines the Differential Evolution method and L-BFGS-B algorithm with a rebirth operator [9]. So, the root mean square error (RMSE) of the wind model is minimised against the observed wind data. Some numerical experiments are presented to show the performance of the model.

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