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A downscale wind forecasting method based on WRF-HDMW coupling

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ABSTRACT

Wind power has growth quickly in recent years mainly due to government-imposed renewable energy targets motivated by climate change. Wind-generated electricity differs from other conventional ones because it is more variable and intermittent due to the wind complex nature. In order to guarantee the planning of electricity supply, one of the main challenge is to provide an accurate short-horizon forecast for individual wind farms.

In this paper, we propose a wind prediction strategy based on a mesoscale-microscale coupling technique. We will use the Weather Research and Forecast (WRF) [3] prediction as input data for the High Wind Defintion Model (HWDM) [2] to yield the forecast on a wind farm.

The WRF model is a high-resolution limited-area, fully compressible, Eulerian, non-hydrostatic, numerical weather prediction model with a large suite of options for numerical schemes and parametrization of physical processes. This mesoscale model are able to predict the hourly wind regime at resolutions of several kilometers (until 1 km resolution), but cannot properly resolve the wind speed up induced by the local topography. The HWDM model arrives from an asymptotic analysis of Navier-Stokes equations and gives a three-dimensional convective model governed by a two-dimensional equation. It takes into account topography, the buoyancy forces, slope effects, and mass conservation. The wind field is adjusted to the measure provided by WRF model through an optimal control problem. Numerically, the problem is efficiently solved by using a reduced basis method [1]. The proposed strategy is applied and validated in terrain located at La Serena, Chile.

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