Wind Forecast Model Intercomparison for Wind Energy

Juan Ferreira*, Alfredo Rocha, José Castanheira, Carlos Marques and Paulo Melo-Gonçalves
Departament of Physics, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
*juan@fis.ua.pt

Introduction

The main purpose of this project is to predict wind speed in a region were it is settled an eolic power plant. In the University of Aveiro there are two models (MM5 and WRF), one of them (WRF) with three different configurations, running in operational mode for Portugal and Iberian Peninsula weather prediction. Wind speed of these models were extracted and compared with observations of an automatic meteorological station.

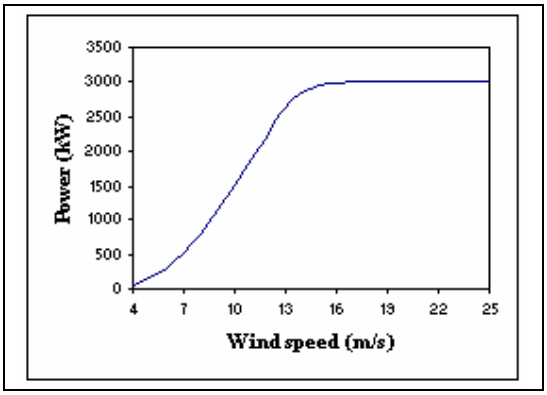

Figure 1- Power curve of an eolic generator

The use of this kind of information is very useful for the Portuguese company of electricity distribution, once, by law, they are obligated to buy all the electric energy that is produced by means of renewable sources. The previous knowledge of the amount of power produced by eolic source permits to manage the amount of energy to buy to the non-renewable power plants.

One of the problems in predicting wind for eolic power plants arises from the location were they are settled, usually in very complex orography regions. Hence, high spatial resolution models are needed to better represent the orographic effects in the results. Other problem comes from the characteristics of the eolic generators. The power produced depends non-linearly on the wind speed, in a wide range of wind speed values (an example of this dependence is shown in figure 1).

Methodology and Results

To evaluate the better way to forecast wind speed in the power plant location, the results of the models and configurations that were already in use for weather prediction at Portugal were considered. Additionally, the WRF model was configured to run with a higher spatial resolution than the operational models. A description of the characteristics of each model is summarized in table 1.

Table 1- Used models

Designation	Model	Version	Finest Grid Resolution (Km)
wrf1	WRF	1.0	20
wrf2	WRF	2.0	10
wrf3	WRF	2.1	3
wrf4	WRF	2.1	12
mm5	MM5	3.0	9

The simulations were carried out in the period between 13th to 17th October of 2005, in 48 hours forecasts.

Wind observations from the automatic meteorological station located at Aveiro were used to assess the quality of the forecasts.

The results shown in figure 2 are comparisons of three 48 hours forecasts of each model in table 1 with observations. The color code of figure 2 is the following: wrf1 – blue, wrf2 – green, wrf3 – red, wrf4 – magenta, mm5 – light blue, mean of the models – black line with

open circles, observations – blue line with open circles.

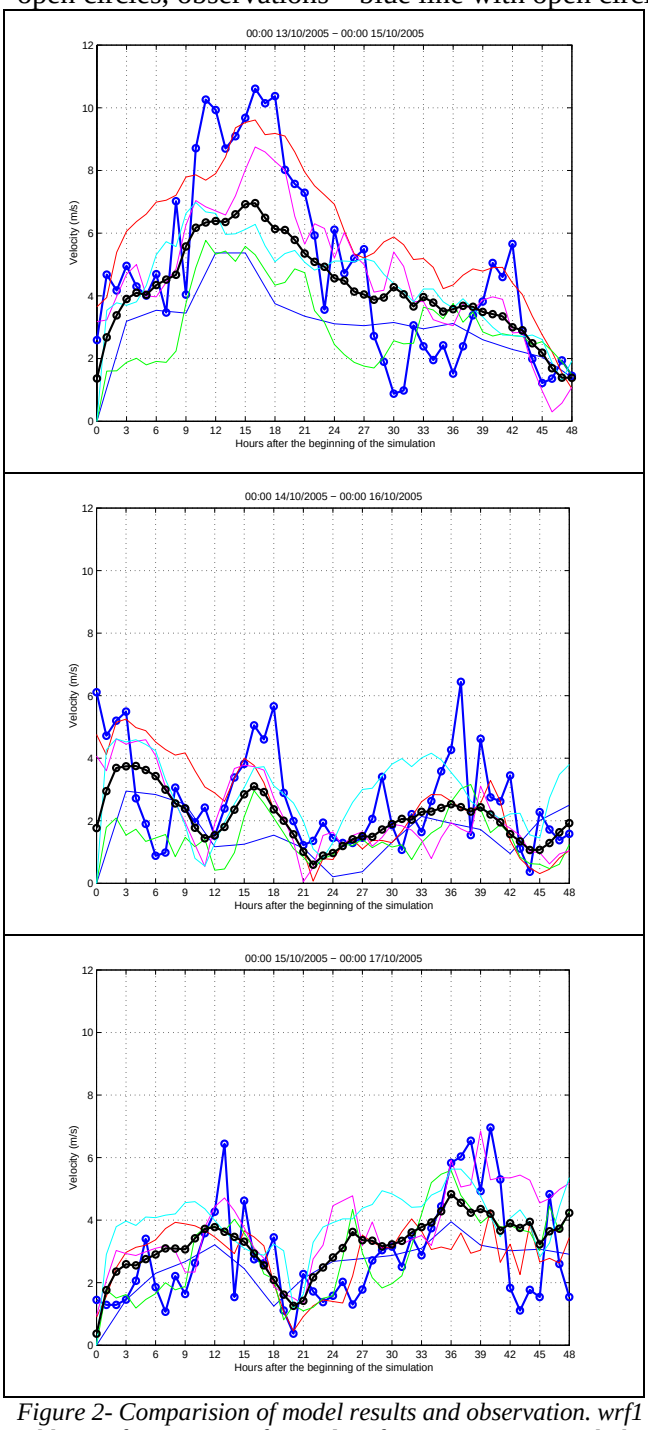

Figure 2- Comparision of model results and observation. wrf1 – blue, wrf2 – green, wrf3 – red, wrf4 – magenta, mm5 – light blue, mean of the models – black line with open circles, observations – blue line with open circles

These initial results suggest the following remarks:

- All models seems to reproduce the general behaviour of the observations.
- It appears that the most recent version of the WRF model has the best performance.
- Forecasts are worst for low wind speed values. However, the eolic potential is negligible for low wind speed.

From the dispersion of these forecasts, it seems preferably the use of an ensemble approach, which would permit to build confidence intervals for the electric power forecast production.

Aknwolodgments

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