Geophysical Research Abstracts
Vol. 13, EGU2011-11291-1, 2011
EGU General Assembly 2011

Preliminary Results of Short Term Wind Energy Prediction System (SWEPS) for Soma, Manisa in Turkey

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According to the recent IPCC Reports, globally averaged temperatures have been significantly increased since the mid-20th century due to increased anthropogenic greenhouse gas emissions. Since greenhouse gas emissions from the combustion of fossil fuels are mainly responsible for the general temperature trend, there is a strong need to shift the energy sources towards the renewable-clean energy sources. Wind power which is one of several renewable energy options, has no fuel costs, attractive and its operating costs are lower than the costs for power produced from fossil fuels.

Turkey is located at the Southeastern Europe. The country has significant wind energy potential due to its geographical location and atmospheric conditions. Therefore, wind energy, as a renewable energy source will be significant alternative to the fossil fuels based energy production in Turkey. One of the problem in using the wind energy as electricity production is the storage of energy due to the discontinuous nature of the wind and higher variability. Lack of any large-scale storage system for electricity after it is produced, forces accurate wind energy estimation within the wind farm regions and also the continuous management of the power system so that the supply meets the demand. For this reason, the wind energy forecasting in the region of wind turbines is important in designing of energy grids from wind resources.

The aim of this study is to develop short-range wind energy forecasting system for the western part of Turkey, specifically Soma, Manisa region. Short Term Wind Energy Prediction System (SWEPS) consists of three modules to predict wind energy for three days ahead. First, global weather forecasts model outputs are downscaled for the region by using one of the meso-scale numerical weather prediction models, WRF. This model is a non-hydrostatic atmospheric model so that nesting structure of this model lets the user increase the spatial resolution of the interested region up to a few kilometers. The accuracy of the model surface representation depends mostly on the horizontal resolution of numerical weather prediction model. The improvement of the forecasts due to the higher spatial resolution is even more significant over a complex terrain such as western part of Turkey. Therefore, the next stage of the modeling system is diagnostic wind model and/or Computational Fluid Dynamics (CFD) simulations. Diagnostic wind model (WAsP) represents the effects of topography, roughness and obstacles with up to a few hundred meters, and transforms wind speed forecast to wind power forecast. In this study, AES RüzgarSIM CFD software developed by AES Engineering Company (Turkey) is used to calculate the wind field under the influence of local topography and land use characteristics at fine resolution. Moreover, the wind field simulations can be achieved with the CFD model with the resolution lower than 100 meters. The general performance of model predictions are evaluated over one year using forecast evaluation measures such as the root mean square error, the absolute error etc. in the last module of the forecasting system. In this study, the preliminary results of SWEPS for one month (January 2009) will be evaluated and discussed for a wind farm Soma, Manisa region in Turkey.

Keywords: wind energy, renewable energy, meso-scale meteorological model WRF, diagnostic model WAsP, CFD, wind farm, wind power prediction system , energy planning