

AUSTRIAN WIND POTENTIAL ANALYSIS (AuWiPot)

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1. Introduction

Due to the variability of the Austrian orography with its complex terrain and distinct river valleys in the West as well as flat areas in the East, the Austrian wind resources are characterised by a large variety of local winds, low level jets and supra-regional wind streams. Due to the interaction of the different wind systems, an accurate simulation of the *theoretical* wind conditions is neither possible through stand-alone application of dynamic models nor through geo-statistical techniques.

Previous estimations of the theoretically achievable wind potential in Austria were only based on criteria of regional planning, but other crucial parameter for wind farms, like technical development of turbines and profitability have been neglected so far. This combined with inaccurate wind resource estimations caused severe uncertainties in the results. In order to overcome these shortcomings, the project "Austrian Wind Atlas and Wind Potential Analysis (AuWiPot)" (<http://windatlas.at>), funded by the Austrian Research Promotion Agency (FFG), was initiated in March 2009. The project lasted for two years and was finished in April 2011.

The aim of this study was on one hand the development and testing of a new modelling approach in order to calculate a detailed wind resource map with very high resolution (100 m × 100 m grid spacing) and accuracy and, on the other hand, the subsequent comprehensive modelling of the wind potential that is theoretically achievable under changing economical/technological conditions.

2. Methodology

For the calculation of the wind resources a combination of the dynamic non-hydrostatic regional climate model MM5 with 2 km horizontal resolution and a geo-statistical interpolation method have been applied in order to reach the final resolution of 100 m × 100 m. Due to this novel approach, several improvements have been implemented, especially with respect to the spatial variability of wind speeds as well as their quality by means of thorough error estimation. The quality of the simulation results were further improved by the application of spatially distributed empirical/statistical error correction functions derived from more than 200 surface stations. This way the variability of the Austrian orography and wind resources was approximated in high detail and with known quality.

In order to allow sophisticated but also flexible 'on-the-fly' calculations of the theoretically achievable wind potential, a comprehensive GIS model has been set up. This model not only considers aspects of regional planning and environmental restrictions but also aspects of systems engineering (like different turbine capacities, power curves) and economic parameters (like investment costs, operational costs, feed-in tariffs). Based on the simulated wind maps the theoretically possible number of turbines and

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the energy yield, respectively, are calculated in a bottom up manner. The interrelationship of each individual parameter has been investigated and a validation of the results has been performed by using observed energy yields of existing wind farms.

3. Results

The main output of the project is a web-based GIS application (<http://www.windatlas.at>) enabling the user to explore Austria's wind energy potential depending on technical, economical, and environmental constraints. The so calculated theoretically achievable wind energy potential is illustrated on district level.

A further output are highly resolved (100 m × 100 m grid spacing) wind maps of mean annual wind speeds of the period 1981 to 1990 (as a climatological representative period for current climate conditions) in several hub heights covering the entire Austrian territory. By means of integrated error correction techniques the project consortium was able to significantly reduce the overall modelling error to a standard deviation of the annual biases of 0.8 m/s in the final wind maps.

The web-based GIS application, the wind maps and their reliability, as well as the underlying methodological approaches will be presented.