anemos Energy Yield Index for Europe

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With the anemos Energy Yield Index for Europe we offer an index that is independent of production data and which was validated with production data of several reference wind turbines.

The time series of wind speed were transformed into energy yield time series applying power curves of five typical wind turbine generators with hub heights between 65 m and 140 m. Therefore, high resolution energy yield time series are available for index calculations for whole Europe including North Sea and Baltic Sea. The reference period (100 % level) of this energy yield index is always adapted to cover the last 20 years, i.e. it is shifted each year by one year.

The anemos Energy Yield Index is based on the anemos Wind Atlas for Europe with a spatial resolution of 20 km and a horizontal resolution of 10 minutes.

The anemos Wind Atlas for Europe 20 km is created by means of the meteorological mesoscale model PSU/NCAR-MM5[1]. MERRA-2 reanalysis data[2] is used as input and driving data in order to preserve the advantages of the worldwide available MERRA-2 reanalysis data set. These advantages are consistency, homogeneity, length of time series, continuous updates, and onshore as well as offshore availability. In addition, the disadvantages of relatively low spatial (0.5° latitude and 0.625° longitude) and temporal (3 h) resolution of MERRA-2 reanalysis data are surmounted by the anemos Wind Atlas for Europe 20 km.

[1] http://www.mmm.ucar.edu/mm5/mm5-home.html

[2] Modern-Era Retrospective Analysis for Research and Application version 2 (MERRA-2) Reanalysis data provided by the US National Aeronautics and Space Administration (NASA) from their Website at http://www.nasa.gov/

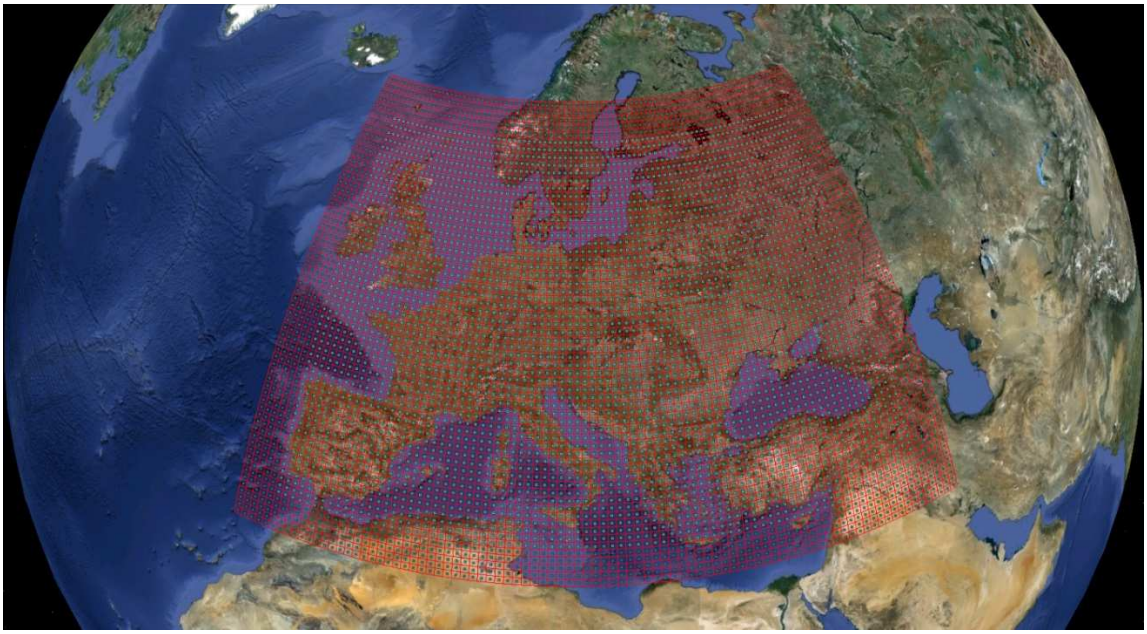

Fig. 1: Distribution of the original MERRA-2 reanalysis nodes for Europe (Google Earth Pro)

The MM5 model with its so-called multi-nesting ability (Fig. 2) allows for high resolution simulations and forecasts of the atmospheric circulation. Thereby, detailed ground level information can be adopted, which regard the influence of vegetation, roughness and topography. The atmospheric state variables are stored every 10 minutes on a grid of 20 x 20 km². The simulation covers the period 1990 up to date and is continuously extended. The atmosphere is divided into 22 vertical layers. Intermediate heights are derived by interpolation algorithms.

Fig. 2: Nested domains for MM5 simulations

The ground level elevations (Fig. 3) were taken from the SRTM data set (Shuttle Radar Topography Mission, USGS EROS Data Center) and interpolated onto the model grid. These data were collected in the year 2000 and are available with a spatial resolution of about 90 m. The vertical resolution is 1 m.

Any information about vegetation (Fig. 4) or roughness conditions (Fig. 5 and Fig. 6) within the boundaries of the simulation area was derived from the CORINE data set of the European Environment Agency (EEA). This information is based on data of the satellite LANDSAT 7 scaled 1:100.000. The grid data are available in a spatial resolution of 100 m. The data base was last updated in the year 2006.

The wind atlas data do by no means represent the true wind potential at some specific site. With model simulations, it is attempted to reproduce the natural processes in the atmosphere as good as possible. Therefore, the simulated data have to be considered as a rough estimate of the wind conditions on the selected grid of 10 minutes and must not be understood as absolute values. The purpose of the wind atlas data is to serve for the long-term correlation of short term wind measurements or wind turbine production data, as forcing data for small-scale site specific wind field simulations and to produce an overview of the regional distribution of the wind potential.

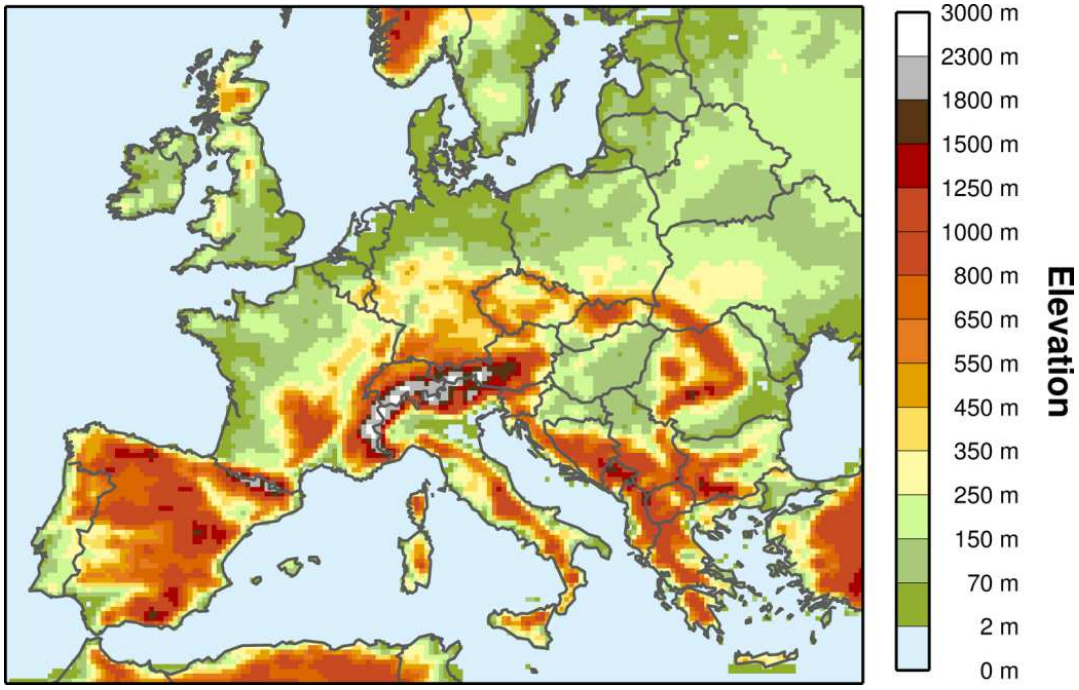

Fig. 3: Simulation area, orography of the anemos Wind Atlas for Europe 20 km

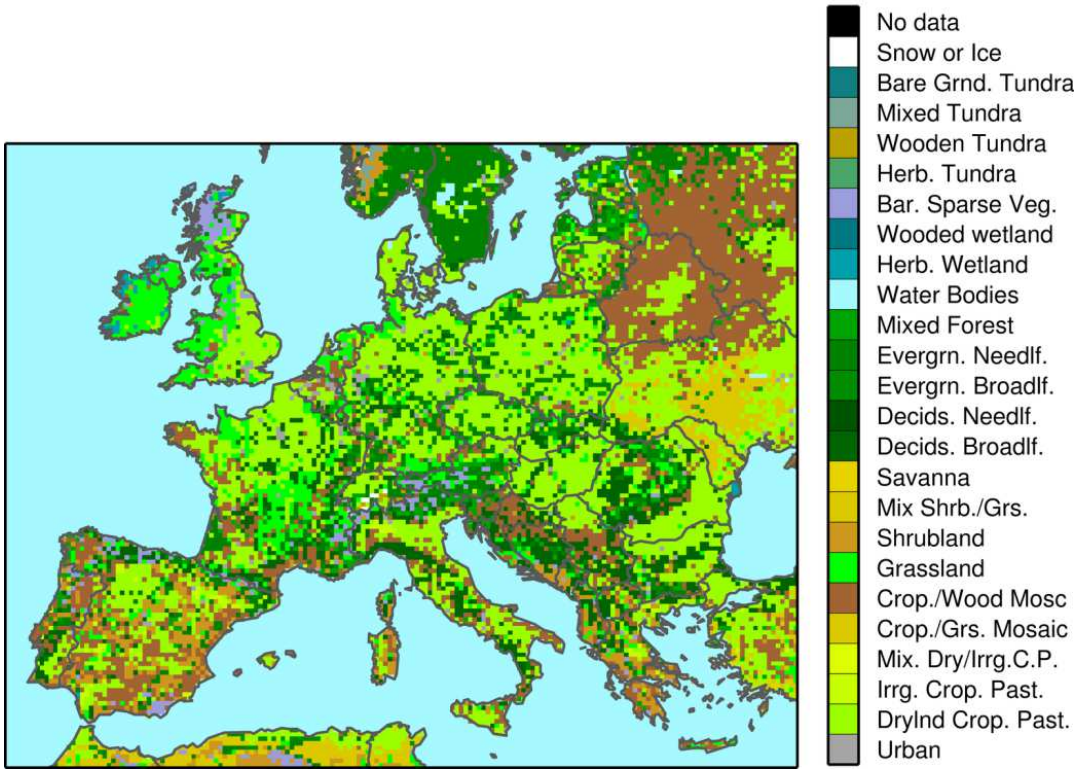

Fig. 4: Simulation area, land-use of the anemos Wind Atlas for Europe 20 km

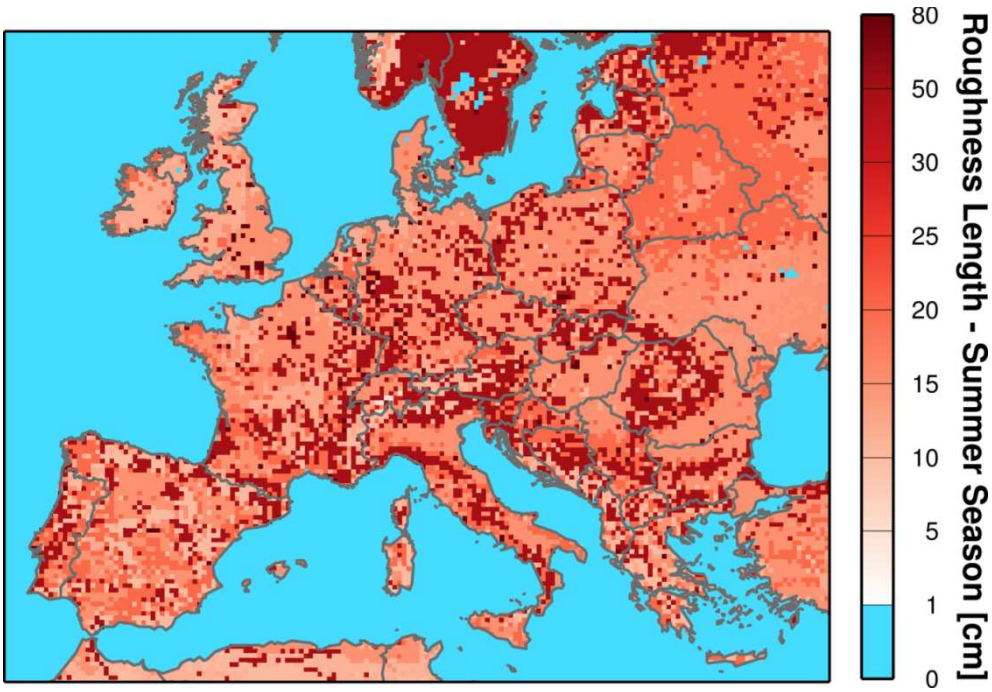

Fig. 5: Simulation area, roughness length of the anemos Wind Atlas for Europe 20 km in summer

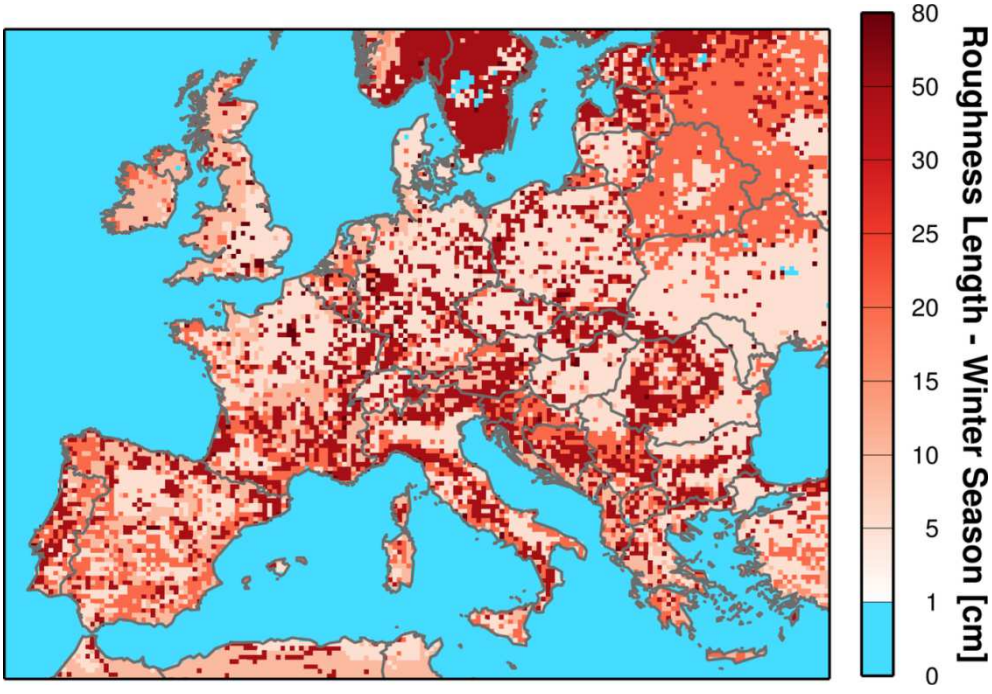

Fig. 6: Simulation area, roughness length of the anemos Wind Atlas for Europe 20 km in winter