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Interactive wind atlas of Croatia

Alica Bajić, Kristian Horvath, Stjepan Ivatek-Šahdan (DHMZ)

Keywords: wind, energy, meteorological modeling

Target groups

- **Energy**
- **Potentail wind farm investors, energy production planners and managers**
- **Energy authorities**

Relevance to the case-study requirements

The insecurity of traditional energy supplies and climate change threats make renewable energy – with the most significant contribution of wind energy - one of the main objectives of the EU sustainable development strategy. In Croatia the uptake of wind energy is rather low, but accelerating due to the huge private interest in the wind energy business. Therefore, wind power has a huge potential to become a progressive and competitive sector of the Croatian economy, provided the potentials of interested stakeholders are unlocked. Consequently climatological wind behavior is the crucial factor for the assessment of wind energy resources.

The approach

The mapping of wind speed is commonly preformed by using mesoscale meteorological model to dynamically regionalize or *downscale* the global atmospheric model reanalysis. For the Croatian wind atlas project wind regionalization was performed by using the last decade of ERA40 reanalysis 1992-2001. The dynamical downscaling has been performed by using the ALADIN/HR, a Croatian version of the mesoscale limited-area numerical atmospheric model ALADIN (*Aire Limitee Adaptation Dynamique Developement International*). The ALADIN/HR model was setup in a hydrostatic mode with grid spacing of 8 km and 37 vertical levels which are stretched in vertical to allow for the highest vertical resolution near the ground. The lateral and boundary conditions were provided by aforementioned ERA40 reanalysis with a 6-hourly temporal resolution. After the integration, model results from 12-hourly to 35-hourly forecast ranges with a 60-min frequency were dynamically adopted during a 10-yearly period to the smaller domain with grid spacing of 2 km (Ivatek-Šahdan and Tudor, 2004). Dynamical adaptation was performed by using 30 time steps with the reduced number of vertical levels above 1 km and with all parameterizations withheld apart from the parameterization of vertical diffusion. A 10-yearly time-series in each grid point was used to calculate the mean annual wind speed and power density at 10 m and 80 m above the ground level (Horvath et al., 2011) .

References:

Horvath, K., A. Bajić and S. Ivatek-Šahdan, 2011: Dynamical downscaling of wind speed in complex terrain prone to bora-type flows. *J. Appl. Meteor. Climatol.*, 50, 1676-1691.

Ivatek-Šahdan, S. and M. Tudor, 2004: Use of high-resolution dynamical adaptation in operational suite and research impact studies. *Meteorol. Z.*, 13, 99-108.

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The product

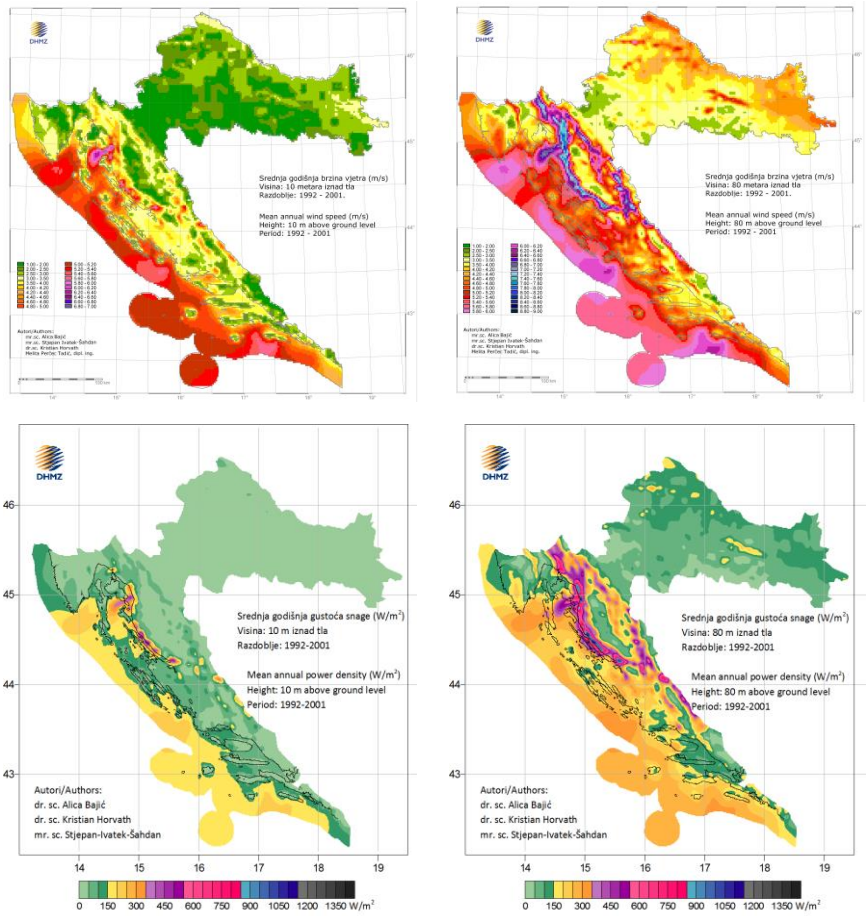

Fig.1. Men annual wind speed (m/s) (top) and power density (W/m^2) (bottom) at 10 m (left) and 80 m (right) above ground level.

The resulted wind maps suggest that wind resources are considerably greater in the coastal part than in the continental part of Croatia. The near-surface mean wind speed is highest in areas of the Vratnik Pass and downstream of it, on the lee sides of Velebit Mountain, and on prominent mountaintops. While mountaintops are frequent regions of enhanced wind resources, the other areas mentioned are known for bora severity and frequency, clearly identifying the primary role of bura wind in determining the wind climate of the wider area of the eastern Adriatic.

The importance of strong mesoscale local winds for wind climate and resource estimates in the coastal and complex terrains of Croatia and the remaining uncertainties in numerical modeling of these phenomena, confirm the need for further improvement of the results of dynamical downscaling and wind resource estimates for the region.

Fig 2. Graphical interface that enables users to enter the location coordinates which want for the wind speed (v) and power density (P) values or click on the map.

Making the product usable

The Croatian wind atlas is a basis for wind resource estimation in Croatia.
The results suggest that bora downslope windstorms are extremely important for wind energy utilization. Because of the gusty character of bora and its extreme turbulence, higher-resolution modeling seems to be the remaining challenges of relevant wind energy applications in Croatia.

Contact: alica.bajic@cirus.dhz.hr **Further information: http://meteo.hr**

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