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Estimation of wind power resources in complex terrain prone to bora and scirocco flows

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Finding a suitable wind speed distribution is an essential requirement for estimation of wind energy potential at specific location. For that purpose the two-parameter Weibull distribution is traditionally used. The Probability Density Function (PDF) of a Weibull random variable is determined by scale and shape parameters, which are used for assessment of Wind Power Density (WPD). This paper explores the applicability of Weibull distribution to wind speed data at different vertical levels in complex terrain, as well as the vertical variability of WPD.

We have analyzed the 2011-2013. period wind speed data at 10, 40, 60 and 80 m AGL from Bubrig and Vela Glava wind towers located in the hinterland of the middle part of Eastern Adriatic coast. Weibull PDF parameters were estimated using the maximum likelihood method, while goodness of fit was performed with Chi-squarre and Kolmogorov-Smirnov statistical tests. As a complimentary method for WPD calculation we utilized so-called Wind Frequency Histogram Method (WFHM), which uses histogram class median values weighted by relative frequency.

Based on the results of statistical tests, the two-parameter Weibull PDF has proven to be inappropriate for describing measured wind speed distributions at all heights. However, WPD calculations based on the Weibull parameters did not differ significantly from those obtained by WFHM method. Using the 60 and 80 m wind direction data, we isolated the situations with dominant bora and scirocco winds, as well as other (weaker) flows to examine their distributions. It turned out that bora flows with mildly bimodal distribution mostly contribute to deviation of measured data from Weibull distribution. The largest WPD differences were observed between the first two vertical levels and were significantly larger than those among higher levels. To further extend the knowledge on the vertical profile of WPD we analyzed the SODAR data from coastal station Split.