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Assessment of regional wind energy resources over the Ukraine

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Abstract

Purpose of the paper is to provide preliminary assessment of wind resources for different regions of Ukraine. Investigation is based on thirty-minute wind observations collected through an 8-year period (2001 to 2008) for seven airports of Ukraine.

By applying of probabilistic analysis techniques to wind data series, different temporal variations of wind speed and direction are derived. The statistic characteristics obtained were compared with the correspondent values provided for 1936-1960 and 1961-1990 periods and site-related temporal changeability is determined.

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Keywords: wind energy resources, specific power of wind flow, statistic characteristics of wind velocity

1. Introduction and objectives

Energy is presently considered one of the most valuable commodities in the economic progress and wealth generation of a country, being one of the main driving forces of industrial development. Considering the escalating costs of the traditional fossil energy sources, supported by the growing global demand for energy production, an intensive search for alternative sources of energy (preferably renewable ones) has been pursued in the recent past [1,2]. Among the several available renewable energy sources, wind-derived energy is the one that has witnessed greatest growth in the recent years. The purpose of the study has been to provide a preliminary assessment of wind resources of different regions of the Ukraine.

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2. Data and methodology

Investigation is based on thirty-minute wind observations collected through an 8-year period (January 1, 2001 to December 31, 2008) for seven airports of the Ukraine such as Dnipropetrovsk, Donetsk, Kyiv, Kryvyi Rih, Lviv, Odesa and Simferopol. In the same period for two stations of Kyiv and Odesa the radiosounding data are used in order to determine the wind speed and direction at height of 1000 m by applying linear interpolation method. Wind speed at this height is often close to the geostrophic wind [3], which is an important characteristic for renewing wind profile. Statistic characteristics and frequency distributions are obtained by applying the probabilistic analysis techniques to series of wind data [4]. The Weibull distribution is fitted to samples of surface wind speed for all available airports and of wind speed at 1000 m for Kyiv and Odesa.

3. Results and discussions

3.1. Results of the probabilistic analysis of the surface wind speed

The highest annually mean wind speeds occur in Odesa (coastal zone) and Simferopol, which is situated in the hollow between mountain ranges. Such high values can be explained with impact of local circulation.

Table 1. Statistical characteristics of wind data for seven airports of the Ukraine.

	Dnipropetrovsk	Donetsk	Kyiv	Kryvyi Rih	Lviv	Odesa	Simferopol
\bar{V}	4.1	4.0	3.6	4.1	2.9	4.4	4.6
V_{\max}	35	45	15	24	16	22	24
σ_x	2.28	2.50	1.98	2.02	2.26	2.31	2.64
C_V	0.55	0.62	0.56	0.50	0.78	0.53	0.57
Mo	3	3	3	3	0	5	3
Me	4	4	3	4	3	4	4
AS	0.34	0.49	0.67	0.41	0.48	0.45	1.03
$(\bar{V})^3$	70.0	64.6	45.2	68.1	23.8	84.4	98.0
$\overline{(V)^3}$	138.3	147.8	92.6	121.6	73.3	160.2	212.9
	Weibull parameters						
γ	1.63	1.58	1.65	1.66	1.36	1.70	1.66
β	4.07	3.92	3.43	4.11	2.74	4.38	4.81

where \bar{V} – mean wind speed; V_{\max} – maximum wind speed; σ_x – standard deviation; C_V – variation coefficient; Mo – modal value; Me – median; AS – coefficient of skewness; $(\bar{V})^3$ – cube of mean wind speed; $\overline{(V)^3}$ – mean cube of wind speed; γ and β – parameters of Weibull distribution .

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