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The landscape influence on the wind energy distribution in height on the Latvian coast of the Baltic Sea

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**Abstract**

The paper presents results of the assessment made for the wind speed and energy distribution with height in Latvia and the Latvian coast of the Baltic Sea. The data are presented for observations made in 2007 – 2012 obtained from a meteorological mast equipped with LOGGER 9200 Symphonie measuring system in combination with ZephIR lidar for the heights from 40 to 160 *m* together with the meteorological data provided by "Latvian Environment, Geology and Meteorology Centre". The wind speed distribution with height is analyzed, and the coefficients of approximating functions calculated. Extrapolation results are shown for the distribution curves of averaged wind speed and energy density values at heights up to 200 *m*. The analysis includes comparison of vertical wind shear for three different terrain types (forest, complex urban area and coastal area). The impact of landscape variation on the wind speed approximating function is discussed. In some cases, under the influence of terrestrial roughness, the approximated wind speed distribution with height loses its exponential behaviour.

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## 1. Introduction

The Plan of National development of Latvia for 2014 – 2020 envisages a very important role of “green” energy, whose share in the total energy output is to reach 40 %. This will be achieved through the efficient use of the wind energy. Extensive and dense network of high-voltage power lines distributed in the territory of Latvia as well as its large unpopulated coastal areas makes attractive the use of onshore and offshore zones for the placement of new wind power plants (WPPs).

The locations of planned WPPs on the Baltic offshore and sea coast of Latvia are shown in Fig. 1. The planned WPPs are concentrated in the coastal region due to the obvious fact that the main stream of wind energy in Latvia comes from the south-west side of the Baltic Sea. However, currently there are no reliable maps showing the distribution of wind energy with height in the territory of Latvia, and it is problematic to consider the areas distant from the sea for construction of WPPs.

## 2. The Research Methodology of Wind Speed Distribution in Height

Systematic long-term measurements of wind speeds in Latvia, taking into account the wind speed distribution at several heights, have been carried out since 2007 at two sites on the north-west coast of the Baltic Sea in the Ventspils region (sites 1 and 3) and on the north of the country in the Ainazi region (site 2), 35 km from the sea shore [1].

The places where the meteorological equipment is located are shown on the map of Fig. 1 by red stars 1, 2 and 3.

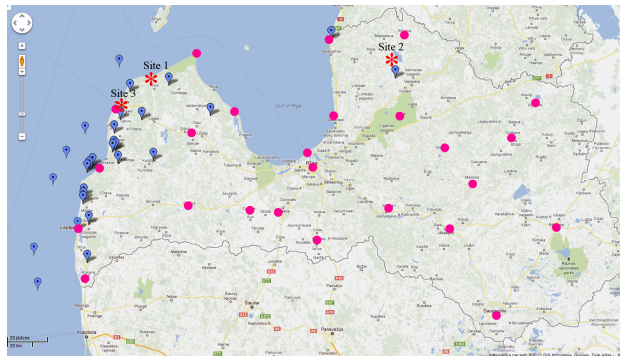


Fig.1. Map of the Latvian coast of the Baltic Sea with planned WPPs locations (blue markers); location of the wind speed measurement sites 1, 2 and 3 (red stars) and state MetStations (pink points)

By pink points on the map, the locations of MetStations are marked which keep observations on the wind speed.

The previous investigations pursued with the aim to estimate the wind energy potential (using the relevant database made up by the "Latvian Environment, Geology and Meteorology Centre" relate to the measurement height of 10 m above sea level. However, taking into account the Latvian topography with large territories covered by massive forests, for commercial purposes only the energy supplied by winds at heights 30 – 40 m can be used.

So far, in Latvia no systematic long-term measurements with gathering the relevant information have been carried out on the wind speeds at these heights and above.

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