Study on Wind Resources at Mid-Altitude

Ilona Bastigkeit, Peter Rohde, Gerrit Wolken-Möhlmann, Adrian Gambier
Fraunhofer Institute for Wind Energy and Energy System Technology IWES

Ilona Bastigkeit

Research Associate
Fraunhofer Institute for Wind Energy and Energy System Technology IWES
Division Wind Farm Planning and Operation

Am Seedeich 45
27570 Bremerhaven
Germany

ilona.bastigkeit@iwes.fraunhofer.de
www.iwes.fraunhofer.de

A literature review shows that there are only few studies regarding the properties of mid-altitude winds which are crucial for the assessment of airborne wind energy (AWE) generators [1,2]. Wind data in mid-altitudes is available in low resolution in space and time such that they only can be used for general qualitative analysis.

Three years of research in the field during the execution of the project Onkites [3] have shown that a comprehensive assessment of the potential of AWE systems is extremely difficult. One reason is the limited availability of data on the meteorological conditions in heights above 150 m. Therefore, several measurement campaigns were carried out in the framework of the project. For this aim, a WindCube V2 was used which is a pulsed LIDAR system that can sample up to 12 different heights and up to 250 m altitude. The LIDAR averages values over a range of 20 m during the operation.

Results show that in the case of sunny and warm days, the wind is very turbulent with similar wind speeds at all layers. This phenomenon was observed during all measurement campaigns. It is important to remark that the described effect appears only in the time series with a resolution below minute/hour. In annual time series, where the wind data are daily averaged, the phenomenon remains hidden because of the long-time averaging range. Because AWE systems have to be kept flying all the time, it is very important to know about the wind resources between 200 m and 1000 m at one minute sampling times. However, this information is not available yet and much work has to be done in this direction because many questions are still unsolved.

The currently running follow-up project Onkites II deals with more accurate investigations of specific questions which have remained open in the earlier project. These are especially the wind properties of the upper winds at different thermal stratification and the development of a methodology for yield assessment. During two measurement campaigns, the use of a new scanning LIDAR system is planned, which is able to measure the wind speed up to 1000 m height.

References:
[1] Archer C. L., Caldeira K.: Global assessment of high-altitude wind power. Energies, Vol. 2, pp. 307–319 (2009)
[2] Archer C. L.: An introduction to meteorology for airborne wind energy. In: Airborne Wind Energy. Springer (2013)
[3] Gambier A.: Project Onkites. Summarising Final Report (2014)

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