Wind Farm Construction on Land

Satellite-based data layers can ease estimations of the annual energy production for potential wind farms on land. A reduction of uncertainties would reduce the financing cost of wind farms.

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The challenge

Hundreds of site assessment analyses are carried out daily by wind energy and consultancy companies in Denmark alone. The purpose of such analyses is to estimate the wind resource at a given location and investigate the feasibility of wind farm construction.

Site assessment today is a rather manual process that involves digitalization or thorough quality control of background maps. Alternatively, all-purpose global data sets are used even though their temporal and spatial resolution is coarse. This shortcoming makes it difficult to characterize the land surface precisely.

> **The wind energy industry - turbine manufacturers, developers, investors - strives for every half-a-percent reduction in the uncertainty in annual energy production estimation, as it could lead to M. of euro financing cost reduction, depending on the size of the project.**
>
> *Yavor V. Hristov, Vestas*

Land cover classification followed by assignment of aerodynamic roughness lengths, which flow models for wind energy can utilize, represents a highly qualitative approach. It can lead to uncertainties and inconsistencies depending on the site and the specialist undertaking the analysis.

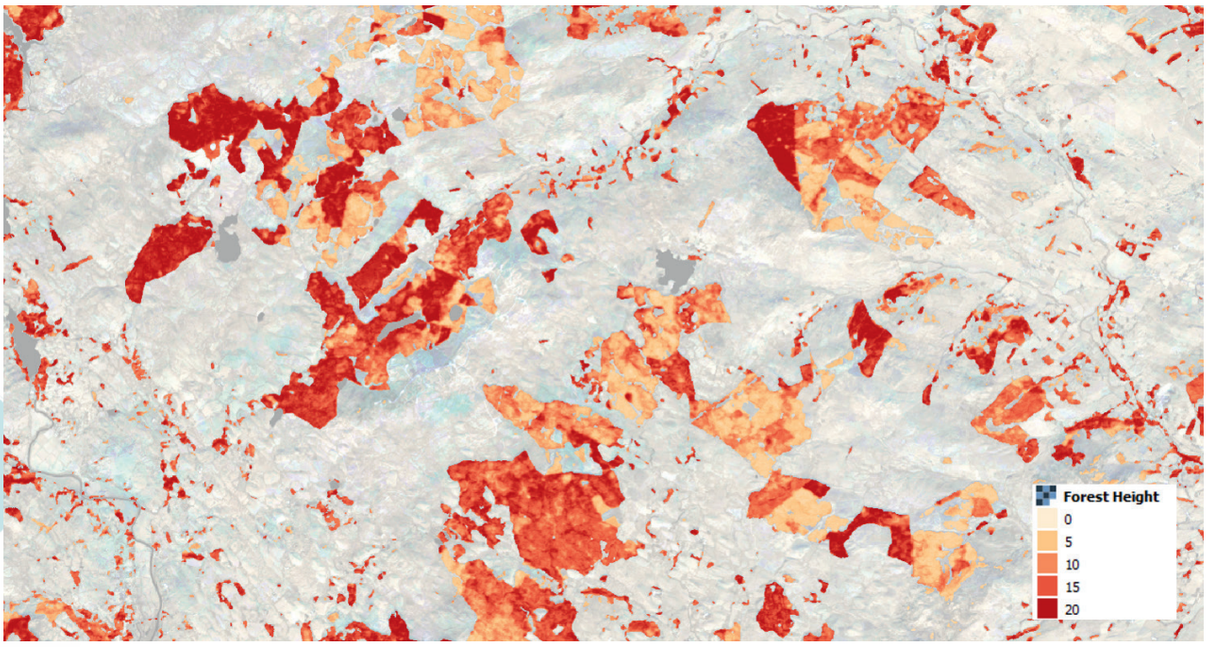
Researchers and specialists from the wind energy industry work together in the InnoWind project to automate procedures for site assessment by offering more and better data layers based on new generations of Earth Observation data from Copernicus.

The space-based solution

Raw satellite data from Sentinel-1 and Sentinel-2 forms the basis of a completely new product: a data package containing leaf area indices, land cover, and forest heights. Together, these parameters enable a new approach for modelling of wind resources over forests where the vegetation is characterized in physical terms as an alternative to the indirect roughness classification approach.

The development of novel tree height maps is a new and innovative achievement. Coherence of Synthetic Aperture Radar observations over time turns out to be correlated with the forest height. The forest height, in turn, plays an important role for the wind resource and thus for estimation of the annual energy production of a given wind turbine.

Analyses of 10 sites around the world indicate that there is a large potential for improving the accuracy of wind resource modelling through physical parameterization of the land surface. This would be extremely valuable for the wind energy industry.



Forest height map over a site in Scotland retrieved from Sentinel-1 and -2 observations delivered by Copernicus.

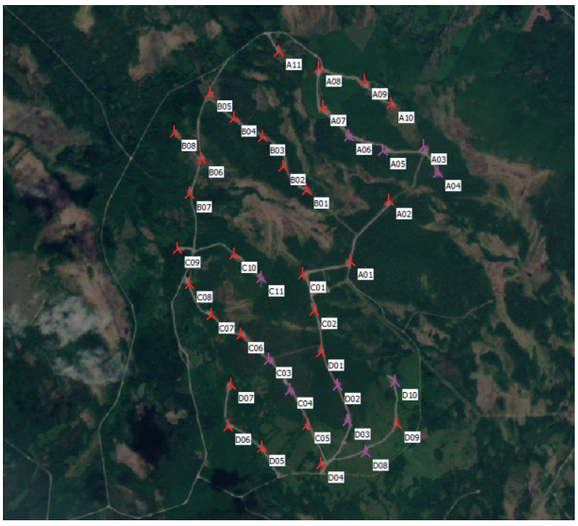
Benefits to citizens

The development of satellite-based products tailored to the wind energy industry has already created value. More than 40 new data layers from Copernicus and other data providers are now integrated in the portfolio of online data available to users of the wind prospecting tool WindPRO. These new products are used by more than 1500 software users.

Outlook to the future

The novel data layers, which InnoWind has delivered, indicate a grand potential for exploitation of Earth Observation data for more precise mapping of wind resources all around the globe.

Initiatives like The Global Wind Atlas and the New European Wind Atlas can benefit from such data layers as soon as their coverage is expanded to the global scale. At the national and regional scale, or for individual sites, there is a business potential in delivering tailor-made maps as 'Premium products' to users of flow modelling tools for wind energy applications.



High-resolution satellite data from Copernicus is used to estimate the annual energy production. Here for a site in Sweden.

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