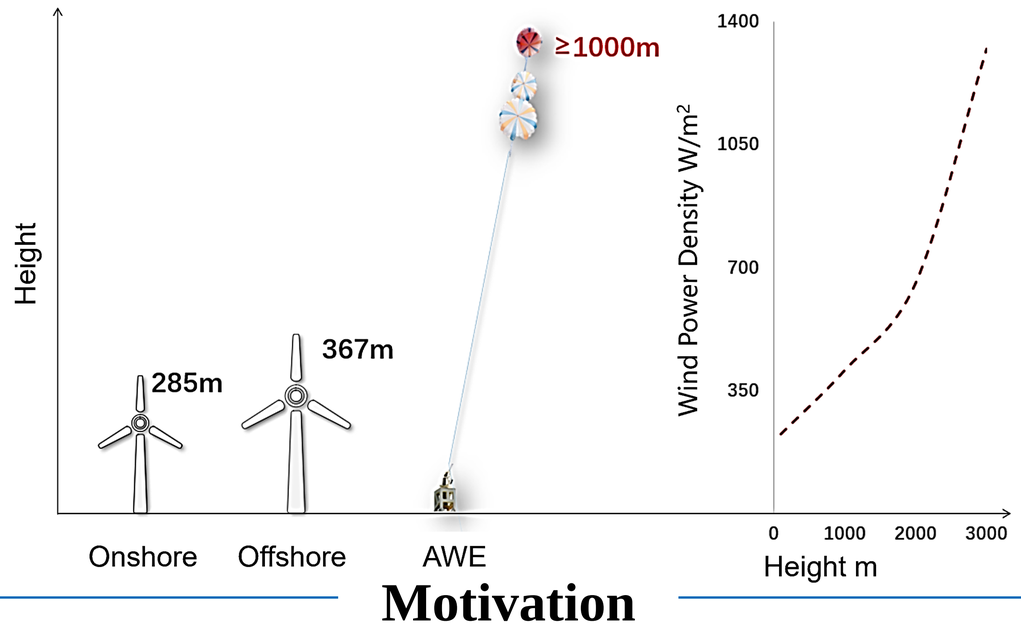
Wind Resource Analysis for Airborne Wind Energy Systems

Li Zhang, Zongdong Ren, Xiaoyu Li
China Power Engineering Consulting Group Co.,LTD.
Block D, Beichen Hui, No. 6 Beichen West Road, Chaoyang District, Beijing, China

For details contact: Xiaoyu Li, xyli@cpecc.net
Zongdong Ren, zdren@cpecc.net
Chief scientist: Li Zhang, lizhang@cpecc.net

Background

The Earth is abundant in high-altitude wind energy resources, which have advantages of high power density, more suitable wind direction compared with Near-surface wind resources, higher wind speed, etc. Besides, traditional wind generator may take large amount of area, which will probably waste land resources. Therefore, it's necessary and promising to develop high-altitude wind energy technologies to make the most use of wind resources.

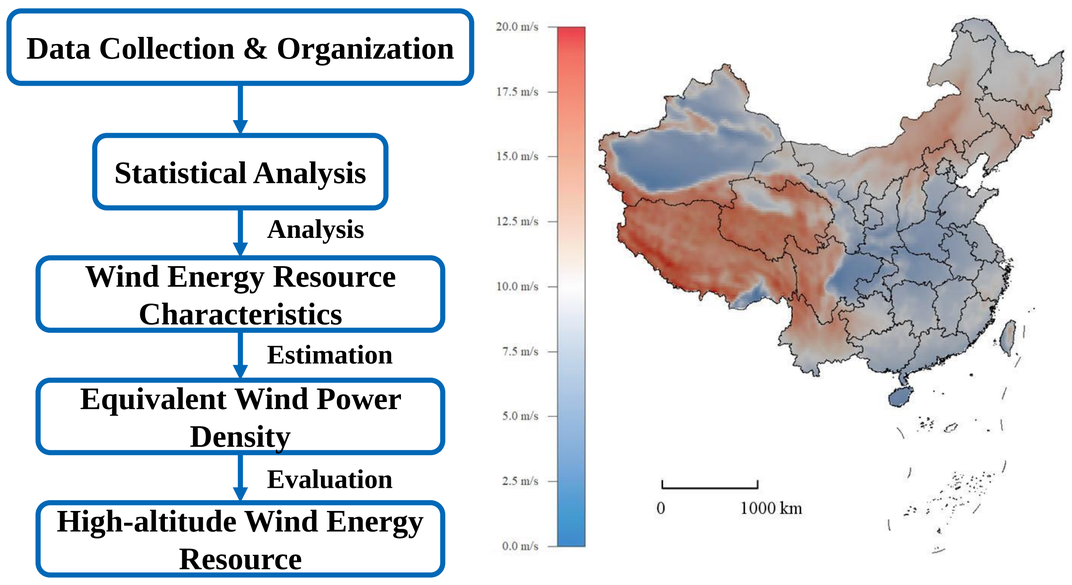


Motivation

Wind resource assessment is a critical step for location selection of high-altitude wind farms, and its accuracy is crucial for the future actual operation and benefits of wind farms.

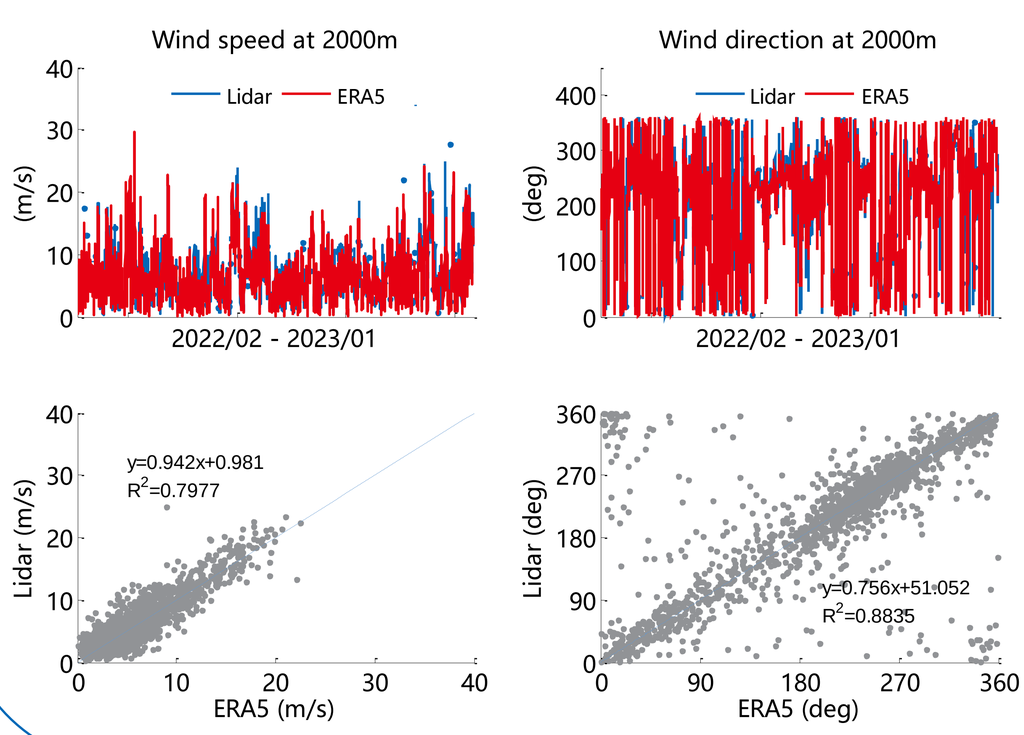
Methodology

In order to study the amount of wind energy that could be captured by an Airborne Wind Energy System (AWES), we conducted year-round monitoring of wind speed, wind direction at heights between 300 meters and 3,000 meters using laser wind profilers and wind profiling radars at the test site. The spatial distribution, vertical profile, and temporal variation of wind speed and wind power density between 300m and 3,000m were analyzed using the monitoring data and the ERA5 reanalysis data from 2012 to 2021. As shown in the figure, the laser wind profiler monitoring data and the ERA5 data for wind speed and wind direction have a good match.



Results

Correlation of wind speed and wind direction between laser wind profiler and reanalysis data (at 2000m)



Achievements

Demonstration projects:

Project in Wuhu

Project in Jixi