June 9, 2021
Japan Renewable Energy Corporation

Offshore wind field measurement method using scanning Doppler lidars established

Outstanding Presentation Award at Japan Wind Energy Association symposium

JRE and Professor Takeshi Ishihara of the University of Tokyo, Graduate School of Engineering, have conducted a joint study on a new method of wind field measurement for offshore wind power generation. We were able to establish an innovative method that enables accurate measurements and is more cost effective than the conventional method that requires the construction of meteorological masts. The study findings are anticipated to be of great benefit to offshore wind power generation in the future.

JRE and Professor Takeshi Ishihara[*1], the University of Tokyo, Graduate School of Engineering, co-wrote a research paper on a study to verify the accuracy of an offshore wind field measurement method using dual scanning Doppler lidars[*2]. We demonstrated that the method offers an effective procedure for obtaining wind data to assess economic efficiency and safety levels of offshore wind power plants. JRE employee Keiichiro Watanabe presented the paper at the 42nd Wind Energy Symposium sponsored by the Japan Wind Energy Association (JWEA) in November 2020, and the paper was awarded an Outstanding Presentation Award in February 2021[*3].

When constructing an offshore wind power plant, it is necessary to obtain data on wind conditions in the targeted sea area: wind speed, direction and turbulence intensity and vertical profiles of wind speed (i.e., wind speeds at different altitudes). The conventional method of obtaining such data is to build a marine meteorological mast. However, the structure requires considerable cost and time to construct, creating a major bottleneck at the early stages of project development.

In the study, we used two scanning Doppler lidars, which are more economical and quicker to install than meteorological masts, to obtain data on offshore wind speed, direction and turbulence intensity and the vertical profiles of wind speed. The data on wind speed and direction were then compared with those from an anemometer mounted on a meteorological mast to ascertain the accuracy of our dual scanning Doppler lidar method.

The study verified the usefulness of the dual scanning Doppler lidar method and resulted in the establishment of a new way of obtaining offshore wind field measurements. The study findings are as follows:

- Data on wind speed, direction and turbulence intensity obtained by transmitting laser beams from two onshore scanning Doppler lidars toward a single spot for fixed-point observation provides the same degree of accuracy as data from meteorological masts.
- It is also possible to obtain vertical profiles of wind speed by switching the angle of laser beam transmission at short time intervals.

JRE will take advantage of the study findings to contribute to the advance of offshore wind power generation. At the same time, we will continue to work toward the overall growth of renewable energy and the realization of a carbon free society.

(Click here for more information on the abovementioned paper. Japanese version only)

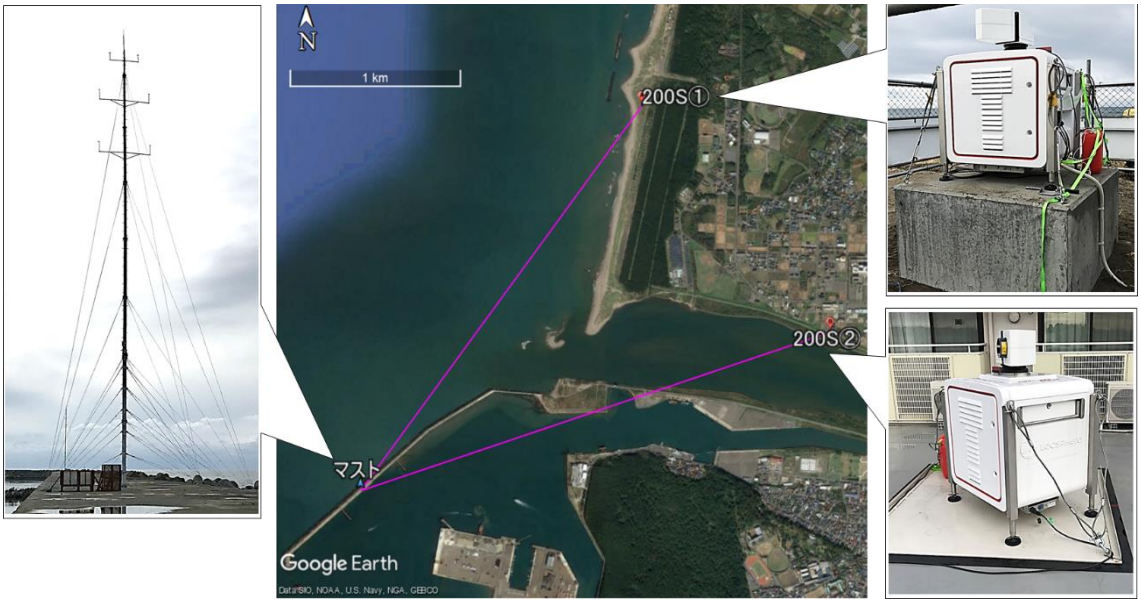
[*1]For more information on Professor Takeshi Ishihara:
http://windeng.t.u-tokyo.ac.jp/ishihara/e/

[*2]A Doppler lidar (DL) works by transmitting laser beams into the atmosphere. Wind speeds are determined on the basis of the Doppler effect of light energy scattered back by airborne aerosols (solid particles and liquid droplets). A scanning DL is a DL capable of transmitting laser beams 360 degrees laterally and 180 degrees vertically. As two DL units were used in tandem in the study, the method is referred to as dual scanning Doppler lidar measurement.

[*3]See JWEA website for the award: https://jwea.exblog.jp/30420547/ (Japanese version only)

Measurement method

- A meteorological mast with an anemometer mounted on the highest boom was placed on top of a breakwater. Laser beams were transmitted toward the anemometer, and dual scanning Doppler lidar measurements were made.
- Surveying was used to make adjustments so that laser emissions could be expected to be no more than two meters off target.



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