An Assessment of the External Condition for Offshore Wind Energy Using a Mesoscale Simulation and a Typhoon Simulation

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Introduction
In order to estimate the extreme wind speed, the wind climate in Japan is taken into account. The wind climate in Japan is the mixed climate and it is not only seasonal wind but also typhoon.

Typhoon Simulation
In order to obtain the wind speed during the typhoon period, typhoon simulation was carried out by using the method proposed by Ishihara et al. (2005).

50 year return period extreme wind speed
In order to obtain the extreme wind speed of 50 year return period, the extreme wind speed by seasonal wind and typhoon are estimated separately and then combined.

Seasonal wind
The extreme wind speed of 50 year return period by seasonal wind was calculated by the method proposed by Gomes and Vickers (1997), in which the extreme wind speed can be expressed as a function of the two parameters of the frequency distribution.

References

Mesoscale Simulation


Typhoon
The extreme wind speed of 50 year return period by typhoon was estimated by the results of 10,000 typhoons simulations.

The combination
The external conditions for offshore wind energy in Japan was investigated by using mesoscale simulation and the typhoon simulation. Following results were obtained.

Conclusion
The frequency distribution of wind speed is dominated by both seasonal wind and typhoon which means that for the fatigue design of wind turbine in Japan, typhoon has to be considered.

The frequency distribution of wind speed by seasonal wind at Choshi Meteorological Station

The frequency distribution of wind speed by typhoon at Choshi Meteorological Station

The combined frequency distribution of wind speed at Choshi Meteorological Station

The combination of the frequency distribution of wind speed by seasonal wind and typhoon

The total wind speed of 50 year return period was calculated so that the following equation is satisfied.

The contribution of seasonal wind and typhoon on the frequency distribution of wind speed is investigated by comparing the simulated and measured wind speed data.

Seasonal wind
From the meteorological simulation, the frequency distribution of wind speed for non-typhoon season was estimated.

The frequency distribution of wind speed by seasonal wind and typhoon at Choshi Meteorological Station

The frequency distribution of wind speed by typhoon for typhoon season was estimated.

The combined frequency distribution of wind speed at Choshi Meteorological Station

The frequency distribution of wind speed for typhoon season was estimated.

The combined frequency distribution of wind speed at Choshi Meteorological Station

The contribution of seasonal wind and typhoon on the frequency distribution of wind speed is investigated by comparing the simulated and measured wind speed data.

Verification
The mesoscale and the microscale simulation was verified using the measurement data at Choshi Meteorological Station.

Microscale Model
A non-linear model MASCOT (Microclimate Analysis System for Coastal Termination) was used to estimate the effect of OZC on wind climate.

Verification
The mesoscale and the microscale simulation was verified using the measurement data at Choshi Meteorological Station.