Project abstract: An integrated approach to offshore wind energy assessment: Great Lakes 3D Wind Experiment

Name of submitting organization: Indiana University

Project director/principal investigator(s):

R.J. Barthelmie and **S.C. Pryor** Indiana University
J.I.D. Alexander and D.H. Matthiesen Case Western Reserve University Cleveland
R. Calhoun Arizona State University
C.B. Hasager Risoe Danish Technical University
P. Marzocca Clarkson University
G. Brown SgurrEnergy
M.L. Hendrickson Horizon Wind Energy LLC

Topic Area DE-FOA-0000414. Topic Area 6: Resource characterization and Design Conditions. Sub-Topic 6.2 Advanced research topic

Brief description of the project

Offshore wind energy developments require uniquely accurate assessments of wind and turbulence characteristics away from the surface in the marine boundary-layer. This project is a public-private collaborative between academia and industry to effectively address offshore resource assessment and design condition needs. We will integrate ground-based remote sensing measurements (including multiple vertical and scanning lidar systems), observations from an Unmanned Aerial Vehicle (UAV) and a tethered balloon with in situ measurements from meteorological towers and satellite-borne radiometers to define horizontal/vertical gradients of both wind speed and turbulence at high temporal and spatial resolution in the coastal/offshore areas of Lake Erie, in an area that has been earmarked for offshore wind farm development. The datasets to be collected within the project will be (i) linked to existing resource estimates, (ii) used in a closure (instrument inter-comparison) analysis based in part on the in situ observations, (iii) used to evaluate meteorological and wind farm models (iv) analyzed to characterize meteorological conditions in the coastal Great Lakes region where highly resolved observations are currently lacking, and (v) used to develop best-practice strategies and documentation for each measurement type focused on its application to wind energy.

Objectives

i) To evaluate the potential of use of innovative (ground-based and satellite-borne) remote sensing technologies in offshore wind energy resource assessments.
ii) To promote greater understanding of the variability of wind and turbulence in offshore and coastal areas at heights and scales and precision/accuracy of relevance to wind energy using a combination of remote sensing, in situ measurements and state-of-the-art model tools.
iii) To develop a uniquely detailed and integrated dataset for model validation efforts focused on the temporal and spatial variability of potential power at turbine hub-heights and turbulence generated loads across the wind turbine rotor plane.
iv) To develop instrument deployment, and data analysis and integration protocols codified in a best-practice report.

Anticipated outcomes

Uniquely detailed 3D description of wind characteristics to provide:

i) Greater understanding of the variability of wind and turbulence intensity in offshore and coastal areas at heights and scales and precision/accuracy of relevance to wind energy
ii) An integrated dataset for model validation efforts focused on the temporal and spatial variability of potential power at turbine hub-heights and turbulence generated loads across the rotor plane
iii) Best practices for measurement technologies deployed for offshore wind energy characterization based on a comprehensive measurement inter-comparison and evaluation

The project will also develop additional expertise within the field of offshore wind energy.