T35 - Offshore Wind Resource Sciences Work
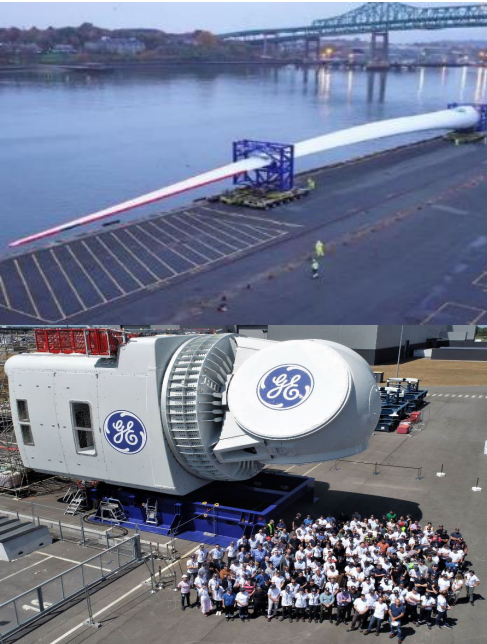
Program – Tech RD&T/Offshore-specific R&D

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5 August 2021

FY21 Peer Review - Project Overview

Project Summary:

- Overall effort is to advance offshore wind resource characterization by supplying DOE national laboratory modeling and observational capabilities to studies in collaboration with NOAA and FOA awardees. Key components of the work include:
  - Defining research needs for offshore wind resource science
  - Identifying error sources in models for offshore wind resource characterization
  - Improving the underlying physics and accuracy of these models

- Key project partners: ANL, LLNL, NREL, PNNL, NOAA

Project Objective(s) 2019-2020:
- Engage stakeholders in a workshop to define offshore research needs to support the development of a major new wind resource study
- Assist DOE in FOA development and create a flexible federal science plan to support collaboration with the awardee
- Carry out scoping studies to inform new offshore wind study

Overall Project Objectives (life of project):
- To improve physics of offshore wind numerical models for wind resource characterization and prediction and to work with NOAA to implement in operational forecast models where appropriate.
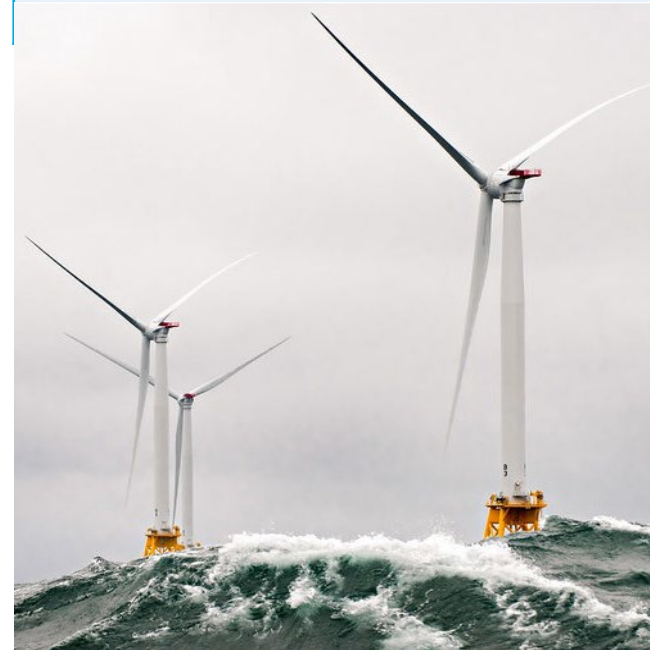
Project Start Year: FY18
Expected Completion Year: Ongoing
Total expected duration: 7 years

FY19 - FY20 Budget: $2.29M

Key Project Personnel: Will Shaw, PNNL; Rao Kotamarthi, ANL; Jeff Mirocha, LLNL; Caroline Draxl, NREL; David Turner and James Wilczak, NOAA

Key DOE Personnel: Shannon Davis

Project Impact

Expected Project Outcomes

- Insight into stakeholder priorities for offshore wind resource R&D
- Expand limited offshore wind database
- Multi-seasonal offshore validation of forecast models in wind energy areas
- Improvements of physics of wind forecast models for ocean conditions

Benefits to the Offshore Wind Industry

- Focused research that addresses challenges articulated by wind industry
- Comprehensive observations of joint atmosphere and ocean conditions freely available for industry use
- Validation of commonly used models against previously unavailable data in the rotor layer
- Model improvements ultimately part of NOAA's operational forecast models

Bureau of Ocean Energy Management's East Coast Call Areas for Offshore Wind Development as of August 2019

Program Performance – Scope, Schedule, Execution

FY2019 Execution

- **Workshop on Research Needs for Offshore Wind Resource Characterization**
  - Workshop held 5–6 March 2019, Alexandria, Virginia
  - Draft workshop report delivered to DOE in September 2019

- **Recommendations for Technical Language for Offshore FOA**
  - Partner labs and NOAA had extensive discussions with DOE on FOA objectives and integration of federal lab roles
  - Draft narrative section for the FOA largely completed in September 2019, based on workshop and literature review

FY2020 Execution

- **Research Needs Workshop**
  - Final report published October 2019

- **Offshore FOA**
  - Provided draft FOA input December 2019
  - Federal labs provided reviews for FOA applications

- **Draft Science Plan**
  - Federal labs delivered general science plan to DOE for integration with FOA awardee

- **Research Needs Journal Article**
  - Milestone rescheduled to coordinate with Grand Challenges paper set

- **Case Studies for Model Evaluation**
  - Case studies defined for DOE; model evaluation initiated

Project Management

- Multi-lab project with ANL, LLNL, PNNL, and NREL in active collaboration with NOAA
- Project involves regular calls with DOE for interfacing with FOA
- Management occurs primarily through biweekly team calls and shared cloud drive
  - Calls include both management and technical discussions

Program Performance – Accomplishments & Progress

Workshop on Research Needs for Offshore Wind Resource Characterization

Summary Report

October 2019
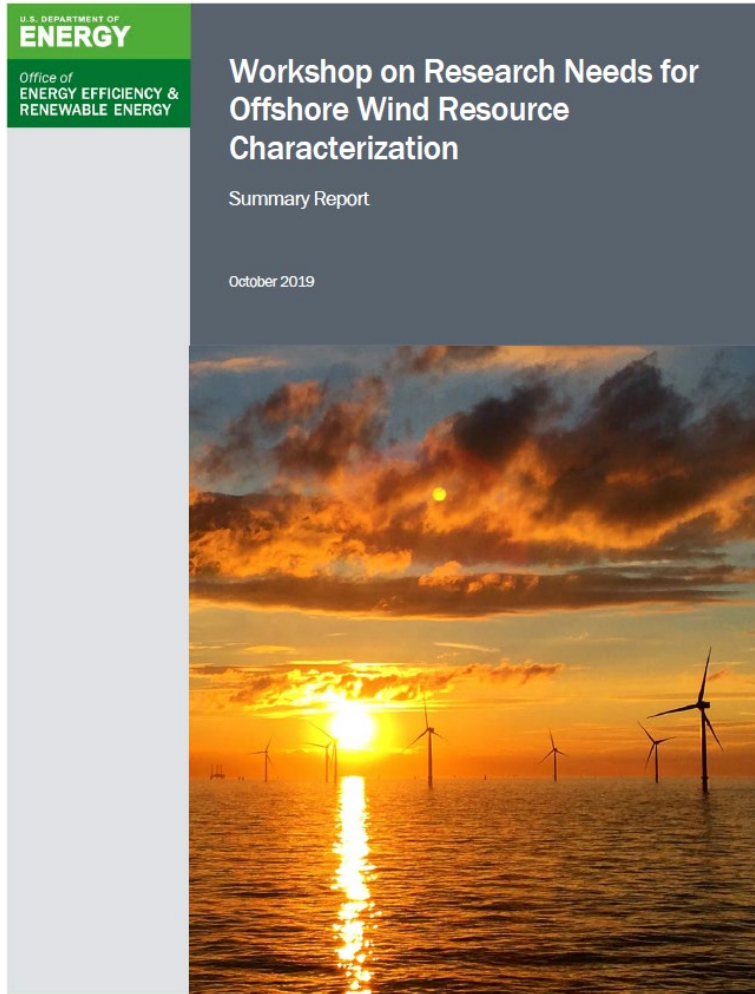
Research Needs Workshop

- Participation
  - 6–7 March 2019; 55 participants
  - Industry, academia, federal labs, Europe

- Key Science Challenges Identified
  - Stably stratified atmospheres
    - Owing to presence of large shear, veer
  - Overall depth of turbulent marine atmospheric boundary layer
    - Important for model accuracy
  - Depth and characteristic of atmospheric surface layer
    - Unique theory subject to known errors
  - Wind shear across the rotor layer
  - Modeling across key scales: fully coupled wind-wave-wake models
    - Necessary to capture local effects of coastally driven flows like low-level jets
  - Precipitation characteristics affecting leading-edge blade erosion

Model Evaluation Case Selection

- Work preliminary to collaboration with FOA awardee (in third Wind Forecast Improvement Project (WFIP3)
- Objective: Provide early look at model sensitivities and errors
- Three Data Sets
    - Floating lidars in New York Bight
    - Meteorological tower on New Jersey Coast (not shown)
    - Meteorological data Two Column Aerosol Project, including airborne turbulence measurements
- Cases Selected
    - All data from the two TCAP months
    - Floating lidars
        - 14 cases of high shear
        - 16 cases of low-level jets

New York State Energy Research and Development Authority buoy locations in the New York Bight as of August 2019
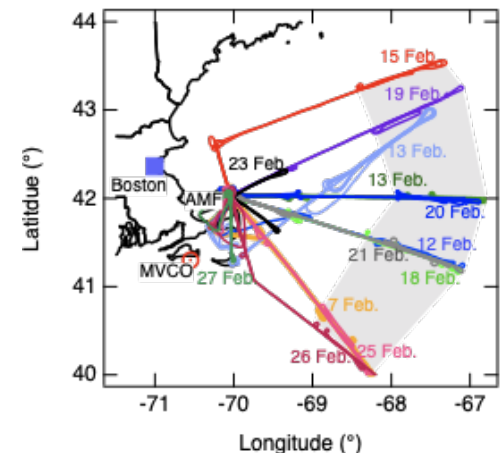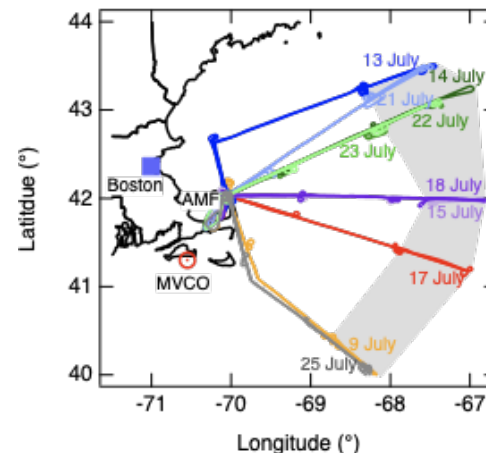
DOE research aircraft flight track off Cape Cod in July 2012 and February 2013 as part of the Two Column Aerosol Project (TCAP)

Project Performance - Upcoming Activities

FY21 Efforts

- Completion of research needs article and submission to Wind Energy Science (due 30 June)

- Continued evaluation of forecast and microscale models using offshore data identified for case studies in FY20

- Reports to DOE on recommended steps for model improvement, including the use of satellite data

Beyond FY21

- The FOA awardee is expected to begin work in Q1 of FY22.

  - Federal labs will immediately begin collaboration

    - To develop integrated science and field operations plans

    - To help execute the field campaign

  - The overall study will last five years
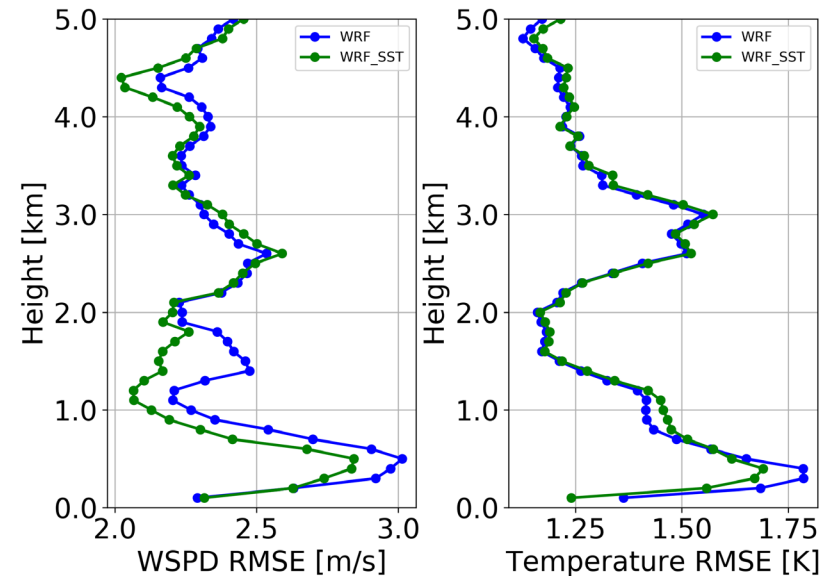
Evaluation of the Weather Research and Forecasting (WRF) model against4x daily radiosonde data during TCAP, July 2012. The green curve from higher-than-conventional spatial resolution of sea surface temperature, showing significant reduction of wind speed errors in the model.

Stakeholder Engagement & Information Sharing

- **Stakeholder Engagement**
  - Workshops
    - Key stakeholder engagement achieved through the offshore workshop
  - Industry meetings
    - The project will increase engagement at meetings such as ACP Offshore Windpower once collaboration is underway with WHOI
  - Technical meetings
    - Workshop findings have been presented at the Annual Meeting of the American Meteorological Society
    - Such meetings provide an opportunity to expand collaboration in the general scientific community
    - As science results emerge, presentations at scientific meetings, technical reports, and peer-reviewed publications will accelerate

- **Information Sharing**
  - Presentations
    - At technical and industry meetings
  - Publication of technical reports and peer-reviewed publications
  - WETO and Lab Communications
    - Newsletters
    - E-blasts
    - Engagement with general media
  - Data Archive and Portal (DAP)
    - The WETO DAP will serve as the enduring repository of all data collect in this project
    - Through the DAP, data will be easily discoverable and freely downloadable to any interested party