

Offshore Resource Characterization T12

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FY17-FY18 Wind Office Project Organization

“Enabling Wind Energy Options Nationwide”

Technology Development

Atmosphere to Electrons

Offshore Wind

Distributed Wind

Testing Infrastructure

Standards Support and International
Engagement

Advanced Components, Reliability, and
Manufacturing

Market Acceleration & Deployment

Stakeholder Engagement, Workforce
Development, and Human Use Considerations

Environmental Research

Grid Integration

Regulatory and Siting

Analysis and Modeling (cross-cutting)

Project Overview

T12: Offshore Resource Characterization

Project Summary

- This project enables effective deployment of DOE's two AXYS WindSentinel lidar buoys and the collection of hub-height offshore wind data, as well as data on other important site-specific meteorological and water conditions. Data are stored in the Data Archive and Portal developed under the A2e Initiative and freely disseminated to interested parties.

Project Objective & Impact

- The objective of the project is to deploy both buoys directly or under loan or partnership agreements in order to help fill gaps in the available information needed for offshore wind project development. PNNL will facilitate ongoing planning and solicitations to identify and evaluate future partners and deployment options.

Project Attributes

Project Principal Investigator(s)

Will Shaw

DOE Lead

Michael Derby

Project Partners/Subs

N/A

Project Duration

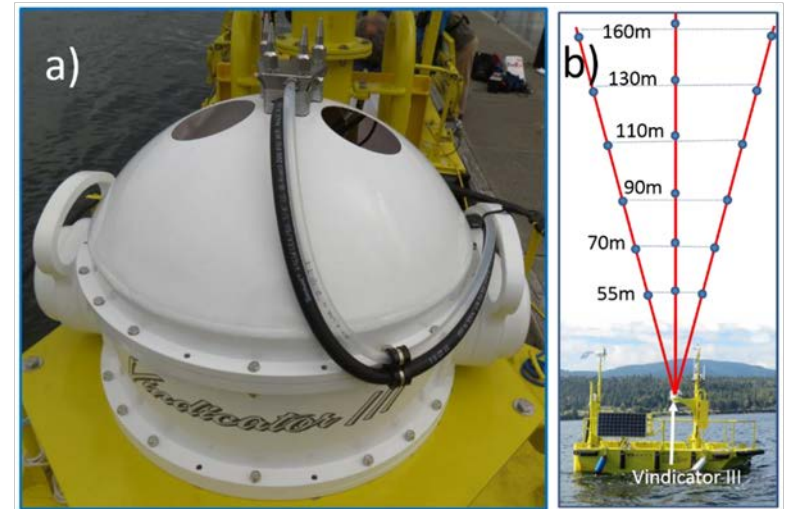
FY 2013 - FY 2018

Technical Merit and Relevance

- Addresses lack of long-term offshore hub-height wind observations in the U.S.
- Towers expensive offshore
- Buoy-mounted lidars offer alternative
 - Provide wind data at hub height
 - Increasingly accepted
 - Carbon Trust recommended practices
 - Offer additional met-ocean observations that can advance science and models



One of DOE's two WindSentinel® buoys



Lidar and sampling geometry

Approach and Methodology

- **Data Acquisition**

- Watchman 500
- Basic signal quality assurance
- Winds and averaging

- **Transmitted Data**

- 10-minute averages
- Via cell phone or satellite

- **Saved On Board**

- 1-second samples of all variables
- 1-second lidar beams
- Collected during maintenance visits

| Sensor Type | Manufacturer | Model |
|--|--------------------|----------------------|
| Wind Profile (6 range gates to ~200 m above MSL) | OADS | Vindicator III Lidar |
| Wind Speed (2) | Vector Instruments | A100R |
| Wind Direction | Vector Instruments | WP200 |
| Temperature, Relative Humidity | Rotronic | MP101A |
| Barometer | RM Young | 61302V |
| Pyranometer | Licor | LI-200 |
| Water Temperature | AXYS | YSI |
| Conductivity-Temperature-Depth (CTD) | Seabird | SBE 37SMP-1j-2-3c |
| Wave | AXYS | TRIAXYS NW III |
| Current Profile (ADP) | Nortek | Aquadopp 400 kHz |
| Tilt/Compass | MicroStrain | 3DM GX3 25 |

Approach and Methodology

- **With WETO staff, identify deployment locations**
- **Deploy systems for at least a year per location**
- **Engage marine services contractors for deployment**
- **Use PNNL technical expertise to assure data quality**
 - Lidar
 - Marine atmospheric boundary layers
- **Develop loan program to expand users**
- **Coordinate/share deployments with other agencies**
- **Carry out scientific analyses on data as resources allow**

Accomplishments and Progress

- Completed basic analysis of buoy data
- Implemented buoy loan program
- Drafted RFP for buoy lidar upgrade
- Developed joint DOE-BOEM California deployment plan

| Key Milestone | FY 2017 | | | | FY 2018 | | | |
|--|---------|----|----|----|---------|----|----|----|
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| Q1: Announce buoy loan program | ■ | ■ | | | | | | |
| Q2: Evaluate applicants and make recommendations to DOE | | ■ | | | | | | |
| Q3: Provide DOE with informal buoy deployment plan | | ■ | ■ | | | | | |
| Q4: Provide data acquisition and dissemination report to DOE | | | ■ | ■ | | | | |
| Q4: Provide PNNL report on initial analysis of buoy data | | | | ■ | | | | |
| Q1: Deliver plan for DOE-BOEM joint deployment | | | | ■ | | | | |
| Q1: Disseminate analysis results in POWER-US or other meetings | | | | ■ | | | | |
| Q2: Reach agreement on go/no-go decision point for CA | | | | | | ■ | | |
| Q2: First half FY summary of analyses to DOE | | | | | | ■ | | |
| Q3: Provide summary to DOE of efforts to engage buoy borrowers | | | | | | | ■ | |
| Q3: Provide summary to DOE of FY analysis results to date | | | | | | | ■ | |
| Q4: Maintenance/upgrade/deployment plan to DOE | | | | | | | | ■ |
| Q4: Draft RFP for buoy upgrade to DOE | | | | | | | | ■ |
| Q4: PNNL report on year two data analysis | | | | | | | | ■ |

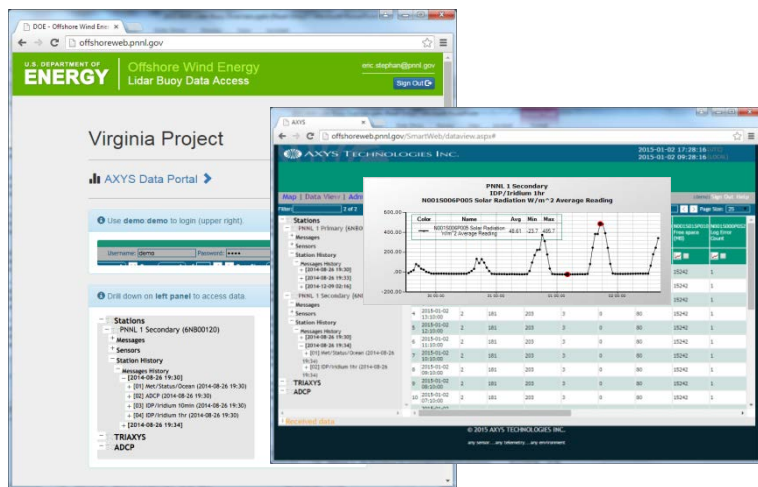
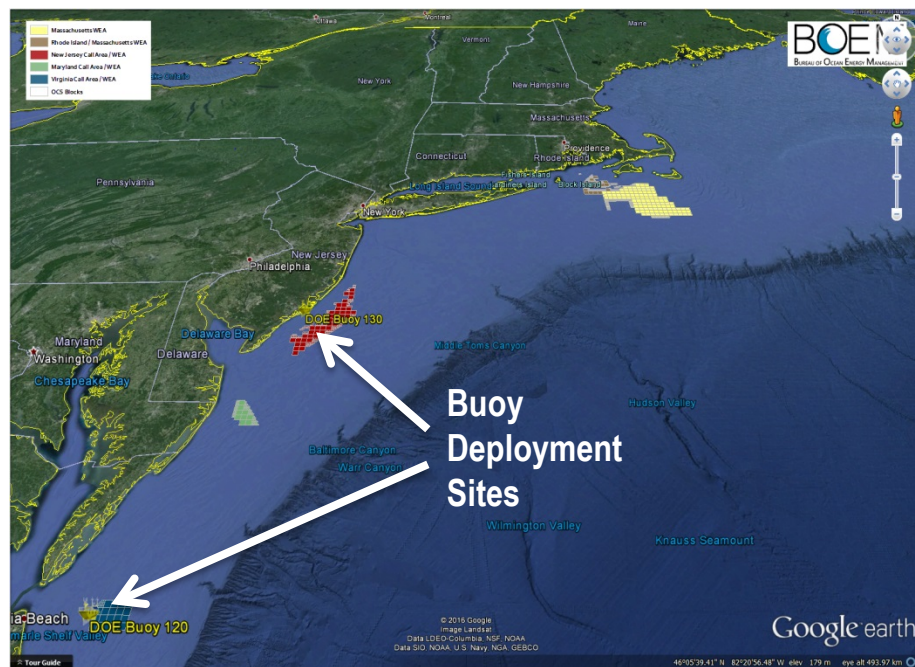
Accomplishments and Progress

Virginia

- Deployed 12 December 2014
- Recovered 15 June 2016
- 17 months of data delivered to archive

New Jersey

- Deployed 4 November 2015
- Recovered 03 February 2017
- 15 months of data delivered to archive



Data available from
<http://offshoreweb.pnnl.gov> or
<http://a2e.energy.gov/data#buoy>

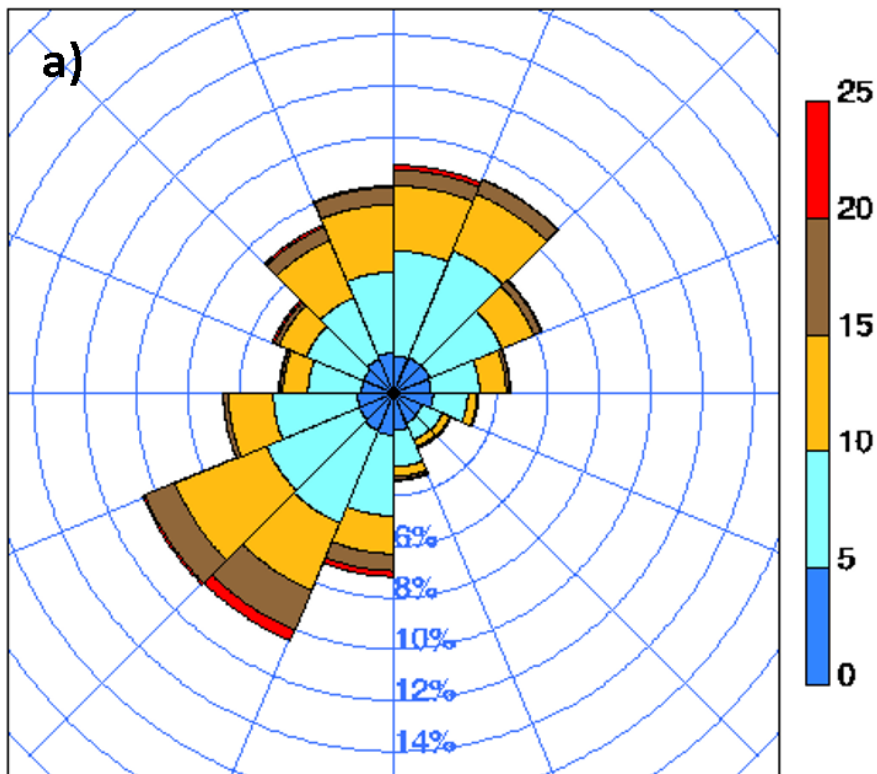


Buoy 120 42 km off Virginia shore

Accomplishments and Progress

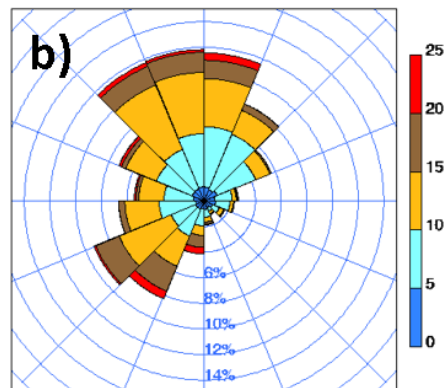
Full Annual Cycle of Winds at 90 m MSL

6NB00120, JAN thru DEC, Signal Threshold = 20.0

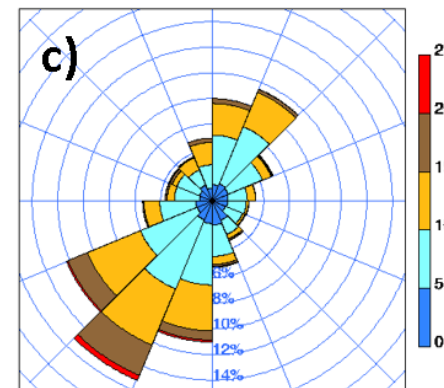


Wind roses produced by Rob Newsom, PNNL

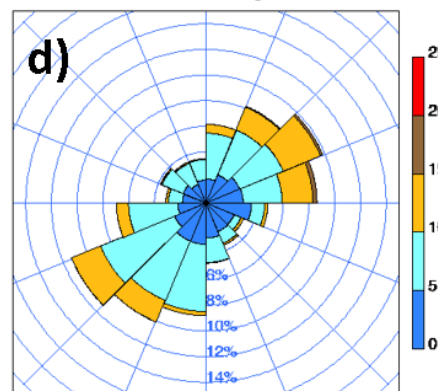
6NB00120, JAN thru MAR, Signal Threshold = 20.0



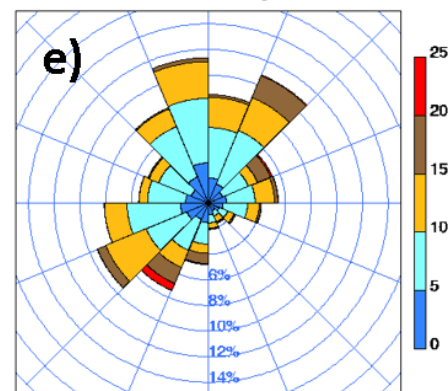
6NB00120, APR thru JUN, Signal Threshold = 20.0



6NB00120, JUL thru SEP, Signal Threshold = 20.0



6NB00120, OCT thru DEC, Signal Threshold = 20.0



Wind roses at 90 m MSL from the buoy lidar for (a) all of 2015; (b) winter; (c) spring; (d) summer; (e) fall.

Accomplishments and Progress

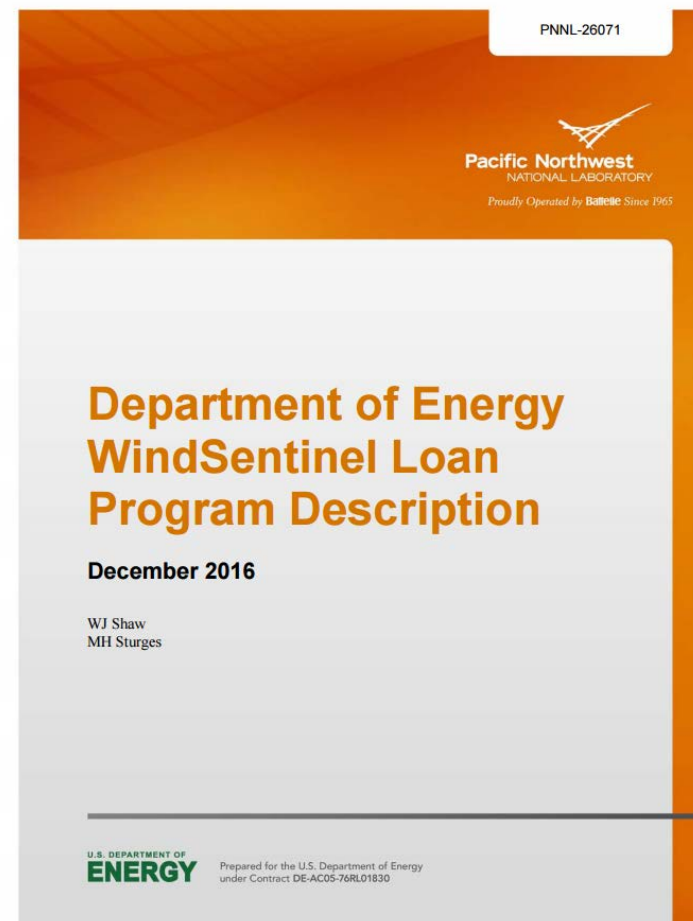
Development of Buoy Loan Program

- **Available to Non-DOE Organizations**

- Includes other agencies, industry, and academia
- Buoy use to be consistent with the mission of DOE's Wind Energy Technologies Office
- Borrowers to manage all aspects and costs of deployment
- All data to be publicly available through A2e Data Archive and Portal

- **Applications**

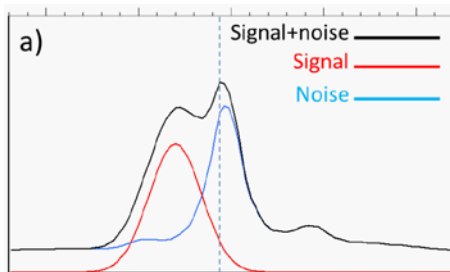
- Accepted on a continuing basis
- More info: <http://wind.pnnl.gov>



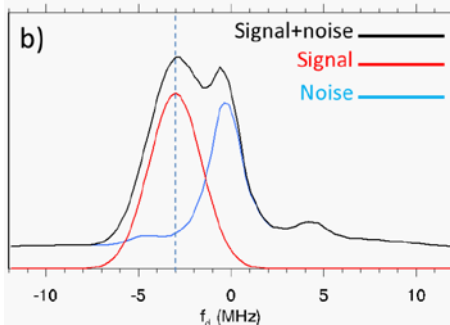
Accomplishments and Progress

Lidar Accuracy Assessed – Replacement Planned

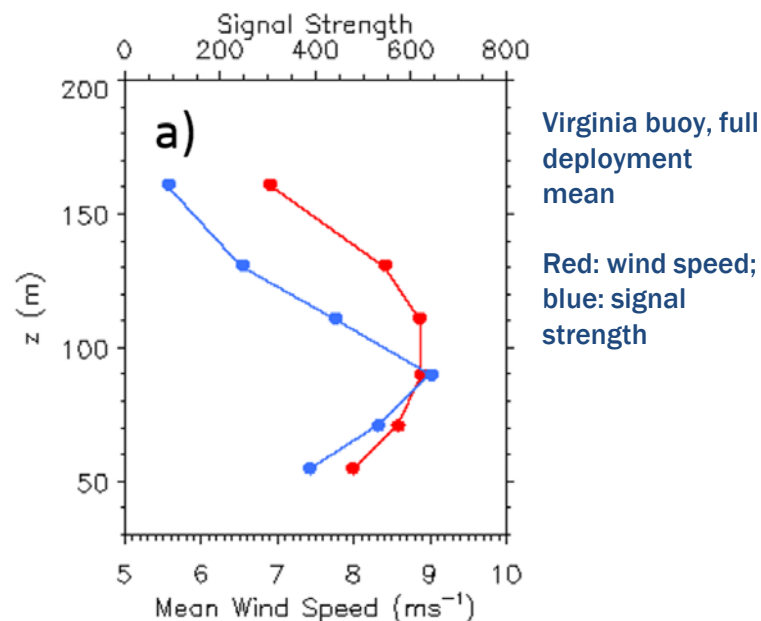
- **Spurious Low-Level Jets Observed**
 - Low-level jets exist, just not all the time
- **Cause Traced to Too-Weak Lidar**
 - Analysis carried out by PNNL
 - Reported in Technical Report PNNL-255512



(a) Signal too weak; noise peak at zero Doppler shift dominates



(b) Signal sufficient; noise peak does not dominate



- **RFP to Replace Lidars**
 - Currently being executed

Accomplishments and Progress

Interagency Collaboration with BOEM

- The Bureau of Ocean Energy Management (BOEM) approached PNNL and DOE in mid-2017 regarding deploying one of the buoys near one of the possible wind energy lease areas off the coast of California
- PNNL provided a statement of work with cost- and schedule-based go/no-go decision points
- DOE and BOEM agreed to support a West Coast deployment through a cost-sharing agreement.
- Progress slowed in 2018 due to delays at BOEM regarding site selection, which is tied to the necessary pre-deployment permitting process
- Deployment is now anticipated in late summer 2019, pending the buoy lidar upgrade process

Project Milestones and Decision Points

- All milestones but one completed
 - 18Q4 milestone report on FY18 analysis results slipped to FY19
- Go/No-go decision points
 - FY18: Should we proceed with detailed planning after initial California deployment cost estimate? Decision: Go
 - FY18: Should we proceed with expenditures to secure permitting at selected California deployment site (depends on BOEM site selection)? Decision: No-go; site selection not complete by BOEM

Communication, Coordination, and Commercialization

- **Conference Presentations**
 - Meteorological conferences
 - POWER-US
 - International Partnering Forum
 - AWEA Offshore
- **RFP for Buoy Loan Program**
- **Web Pages for Buoy**
 - <https://wind.pnnl.gov>
- **Buoy Data Publicly Available**
 - <https://a2e.energy.gov/data>
- **Planning Underway for Deployment with BOEM (shared costs)**

Upcoming Project Activities

- Award of contract for new buoy lidars
- Expanded analysis of lidar data, including modeling (pending outcome of merit review)
- Determination with BOEM of California buoy deployment location
 - Includes scheduling with lidar upgrades
- Evaluate opportunities for deployment of the 2nd buoy

