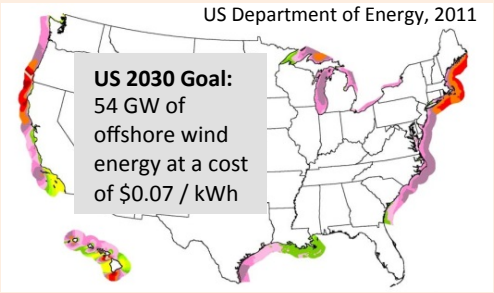
Improving the Nation's Wind Power Generation

NOAA Earth System Research Laboratory, Boulder, Colorado

Motivation: To optimize the extraction of wind energy for the nation's energy needs.

What is needed?

- Better daily wind forecasts
- Identification of the best wind turbine locations and layouts



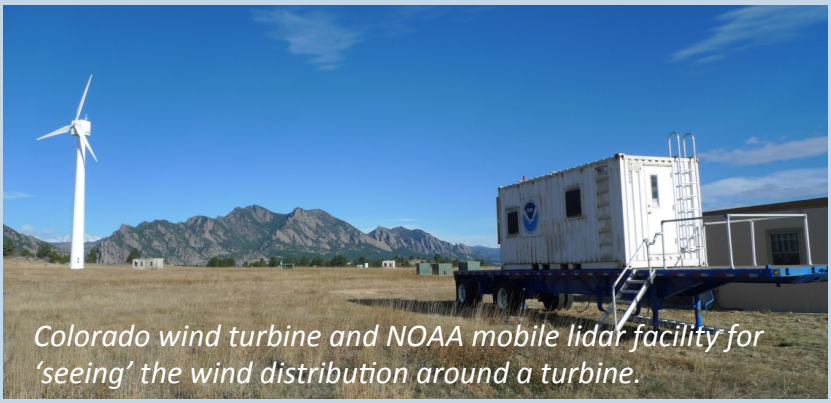
U.S. offshore wind speed estimates

Improving NOAA's weather forecast models for power generation

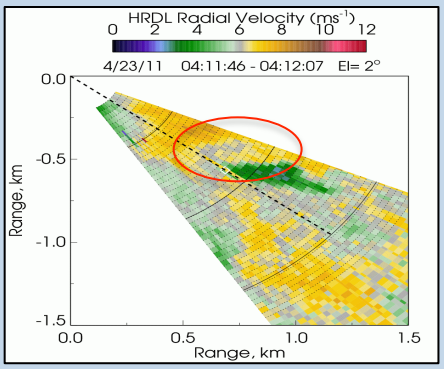
- Better short term forecasts of the wind strength at turbine height allow for more efficient integration of wind resources into the power grid.
- In the absence of measurements at turbine levels, the accuracy and fidelity of model predictions are unknown.
- A primary goal is to reduce uncertainty in assessments of inland and offshore wind resources. NOAA lidar observations of winds and turbulence can validate forecast models, assess offshore wind resources, and characterize complex terrain effects that impact model accuracy.

Optimizing wind farm locations and turbine layout

- Characterizing the impact of complex terrain and turbine wake effects allows for more efficient planning for and utilization of wind resources.



Colorado wind turbine and NOAA mobile lidar facility for 'seeing' the wind distribution around a turbine.



A turbine wake visualized with lidar is shown as the dark green color which indicates a 5 meter/sec velocity reduction downwind of the turbine.

The Bottom Line

NOAA high-resolution lidar observations of wind flow are used to study the turbine wake, predict wind resources at sites on flat or complex terrain and over the oceans, and validate NOAA weather prediction models.

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2nd Wind Forecast Improvement Project: 2015–2017

A Field Campaign of DOE and the NOAA Earth System Research Laboratory

Scientific Research That Is Needed to Enhance Operational Efficiency of Wind Energy

- Improved forecasts of wind at the height of the turbine rotors
- Better characterization of wind-flow properties in the lower atmosphere

Potential Benefits to the Nation

- Increased viability of wind energy and thereby reduced dependency on fossil fuels
- Improvements in all weather forecasting, because of advances in modeling of the atmosphere near Earth's surface

Wind turbines near the Columbia River in eastern Oregon

The 2nd Wind Forecast Improvement Project (WFIP2) is a Department of Energy and NOAA sponsored field campaign to improve atmospheric understanding, weather prediction modeling, and rotor-layer wind for ecasting as they affect wind-energy efficiency and operations.

Location: Columbia River Basin in eastern Oregon

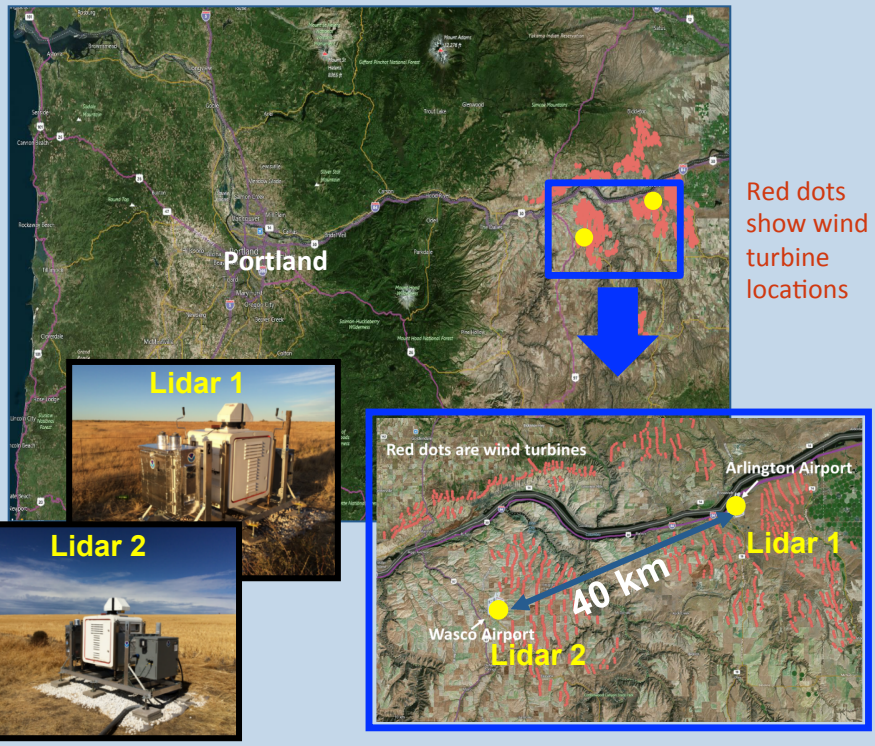
Duration: 18 months, 2015-2017

NOAA/ESRL/CSD Contribution:

- Deploying two Doppler lidars in key locations in the Columbia River Basin, operated remotely from Boulder, Colorado
- Supplying unique, high-quality wind profile data from these lidars via a real-time web site every 15 minutes
- Verifying model-predicted winds at the rotor level using real-time data (a first!)
- Operating multiple scanning Doppler lidars 24/7 in an operational forecasting project (another first!)

Partners: Department of Energy, NOAA Earth System Research Laboratory, NOAA National Weather Service, Vaisala

The Columbia River Basin of Oregon-Washington is a major supplier of energy to the West Coast, including California.



Red dots show wind turbine locations

http://www.esrl.noaa.gov/csd/projects/wfip2/
http://www.esrl.noaa.gov/gsd/renewable/wfip2.html
http://www.esrl.noaa.gov/psd/renewable_energy/wfip2/

Expected Payoffs of WFIP2

- Improved atmospheric understanding related to wind-energy generation in complex terrain
- Improvements to numerical weather prediction models that will benefit all weather forecasting

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