Offshore Wind Power Location Assessment of the Rhode Island Sound

By Charles Knoff

Introduction

http://www.wwindea.org/technology/ch01/imgs/1_3_4_img3.jpg

- Test a designated area for wind farm potential in Rhode Island Sound
- GE 3.6s 104m turbines used in this study

Introduction

- Used NDBC data
- Buoy 44097

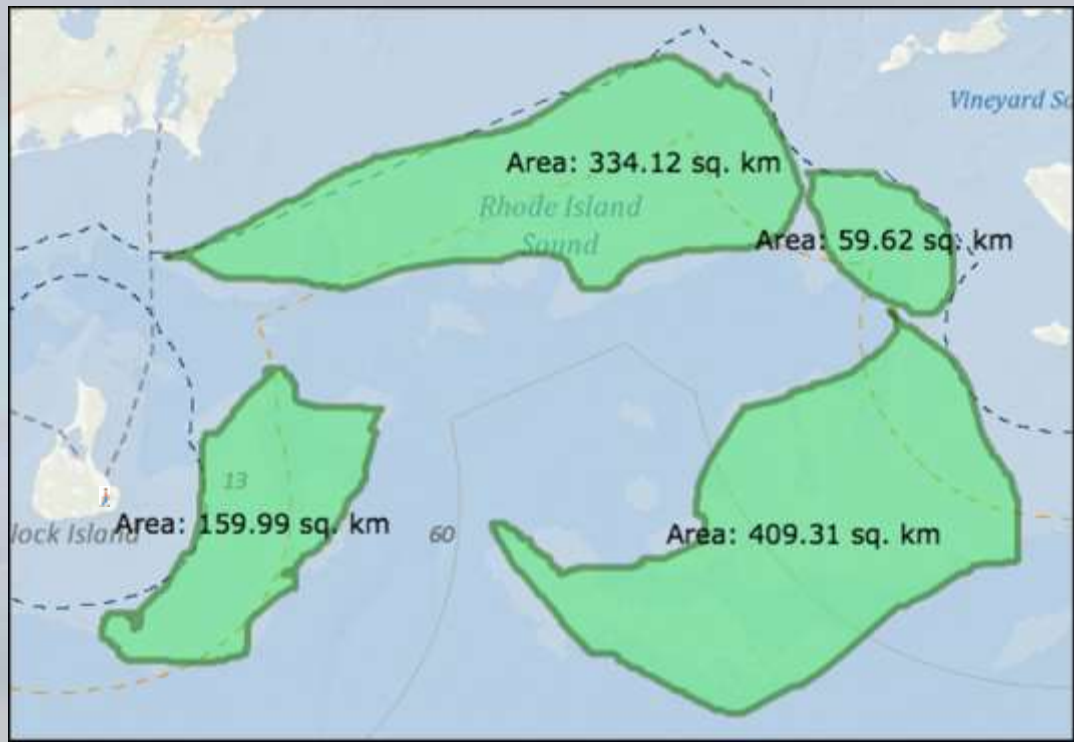
http://www.ndbc.noaa.gov/station_page.php?station=44017

- Buoy station BUZM3

http://www.ndbc.noaa.gov/images/stations/buzm3.jpg

Introduction

- Multipurpose Marine Cadastre program was used to map total area
- 1 km depth exclusion
- Other exclusions analysis was done, largely insignificant



Research Objective

- To conduct an assessment of the Rhode Island Sound
- Analyzed data will represent the viability of a wind farm
- Can be used to complete a market analysis

Methods

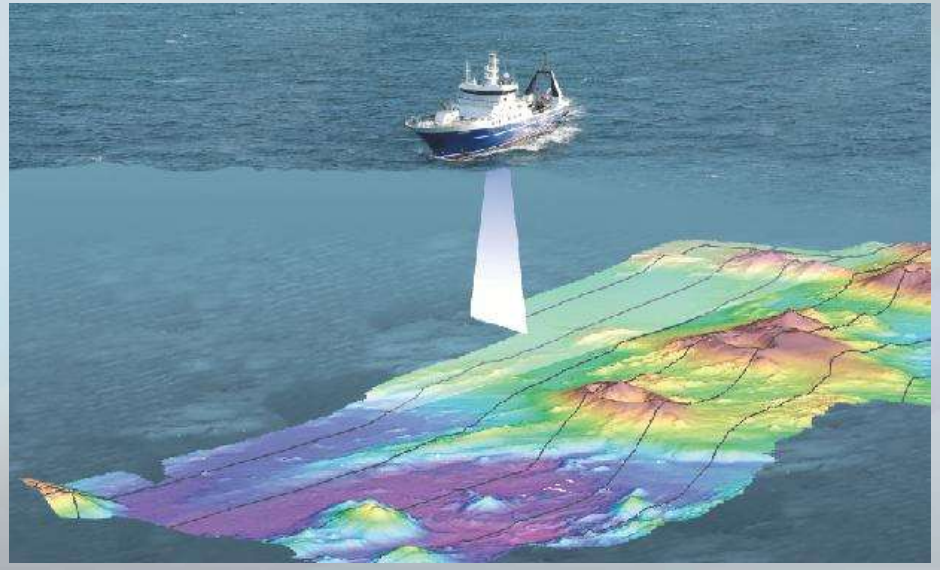
- Find total area ⇨ Max turbine count
- Assume 0.54^2 km per turbine

- Find max power output (MPO) per turbine
- Determine max potential power of area

Available Area Mapping

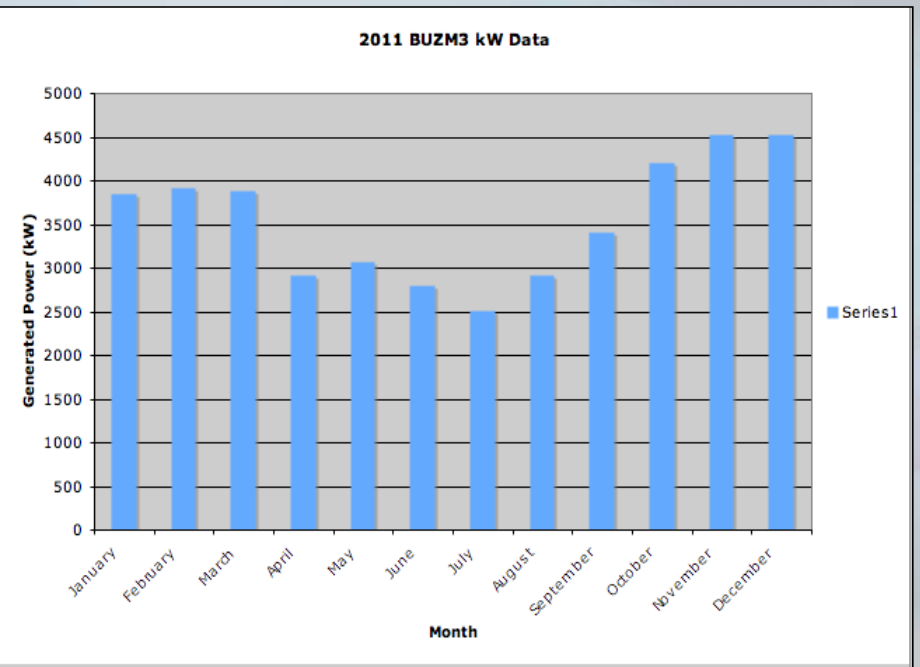
- Determine max potential are
- Marine Cadastre
- NOAA Bathymetric Maps
- 963.4 km^2

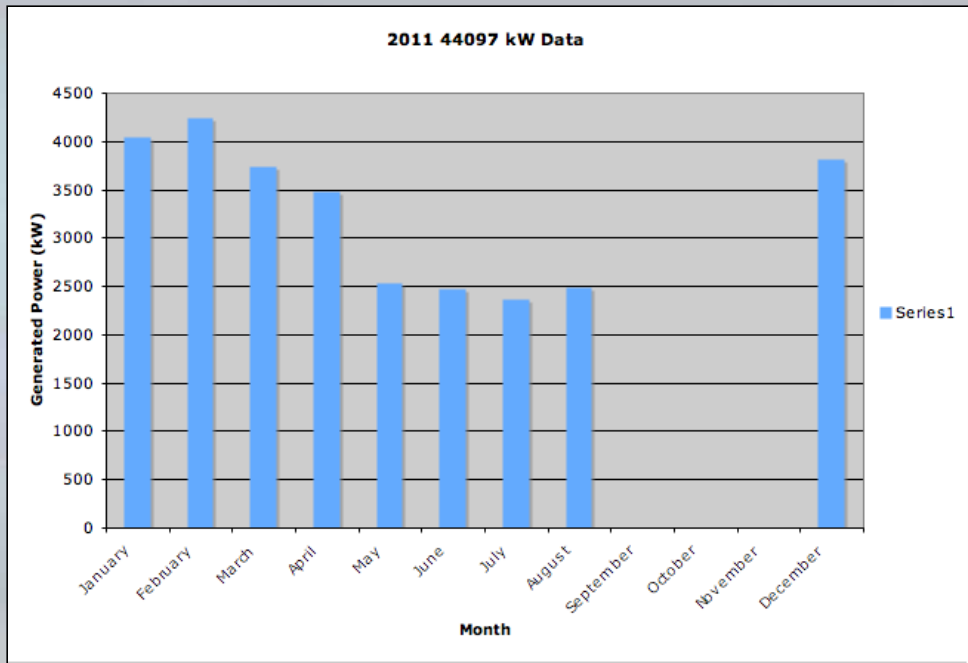
http://www.gns.cri.nz/Home/Our-Science/Earth-Science/Ocean-Floor-Exploration/Marine-Surveys/Marine-Geophysics



Data

Buoy (year)	Average buoy height wind speed (m/s)	Average extrapolated wind speed (80m) (m/s)	Average generated electricity (kW)
BUZM3 (2010)	7.9	8.8	3656.8
BUZM3 (2011)	7.4	8.4	3307.3
BUZM3 (2012)	7.5	8.4	3268.2
44097 (2010)	7.0	9.2	3656.8
44097 (2011)	6.4	8.5	3312.9
44097 (2012)	6.4	8.5	3353.9





Extrapolation

- Buoys take measurements near sea level
- 80m for this study
- Surface roughness coefficient assumed to be .000035

$$R = \frac{u_2}{u_1} = \frac{\log(Z_2/Z_0)}{\log(Z_1/Z_0)},$$

Power Production

- Using average wind speeds we can determine average turbine output
- Blade diameter of 104m

$$\overline{P_w} = \rho \left(\frac{2}{3} D \right)^2 \overline{U^3}.$$

Turbine Count

- Total usable area of = 963.4 km^2
- Array spacing corresponds to one turbine per 0.54 km^2
- Results in less than 10% wake loss
- 520 Turbines

Turbine Count

- Average yearly power per turbine = 3425.9 kW
- Average yearly power for the Rhode Island sound was calculated to be roughly 1,780,000 kW

1,780 MW

- As a comparison Indian Point points generates 2,020 MW

Conclusion

- Outlined methods involved in a full location analysis
- Data can be used in market analysis

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Questions

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