

Powering Oceanographic Observations with a Wave Energy Converter

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The Vision

Demonstrate a wave energy converter can power ocean observations in the Arctic

- *Design a wave energy converter buoy to be used in the Arctic*
- *Build a prototype*
- *Field test the prototype at PNNL-Sequim*



The Vision

Industry + University + National Lab



The Vision

Unique Roles of Each Institution

Pendulum System

Field Testing

Design Requirements



Intellectual Property



Engineers

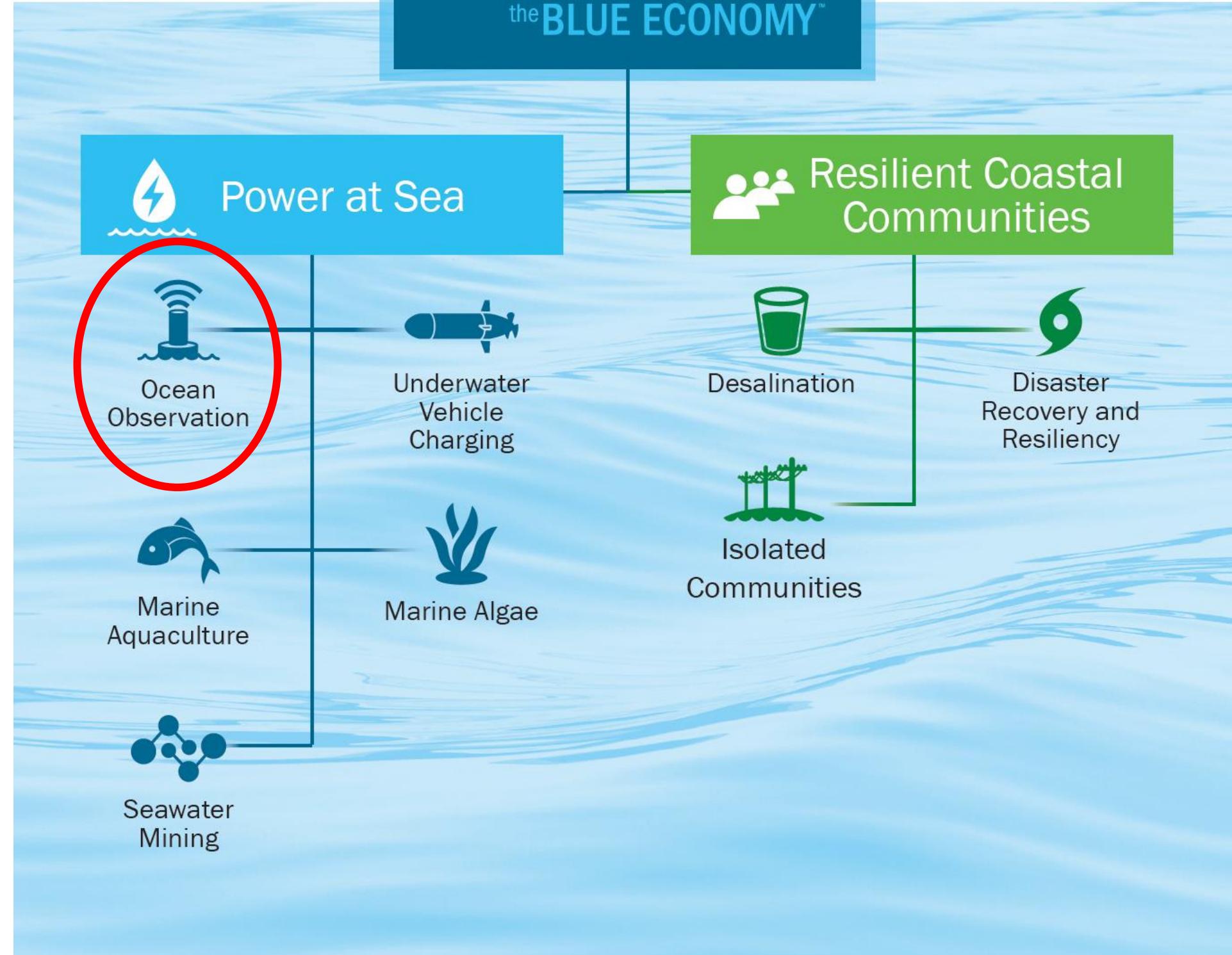


End User

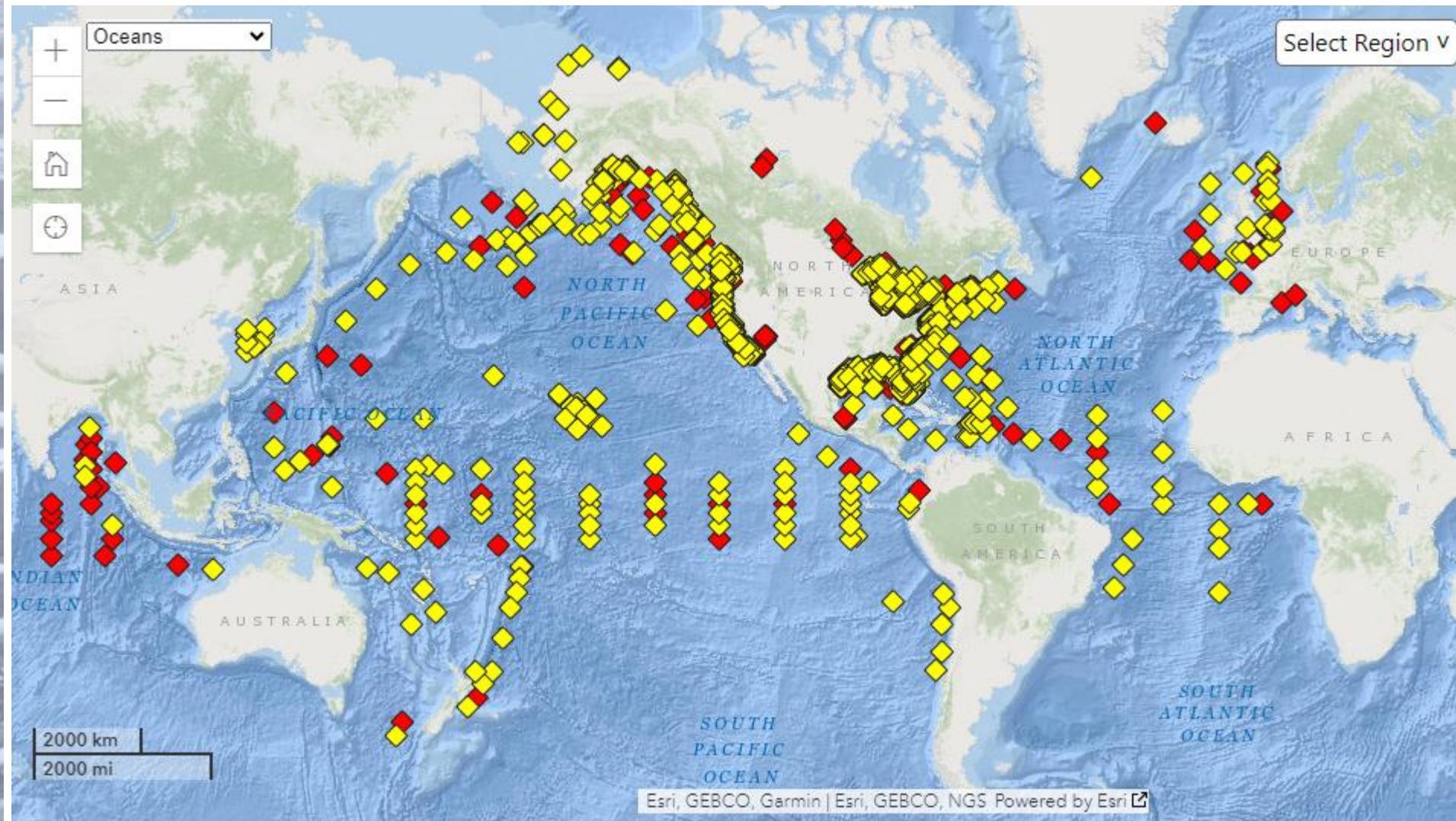


Pacific
Northwest
NATIONAL LABORATORY

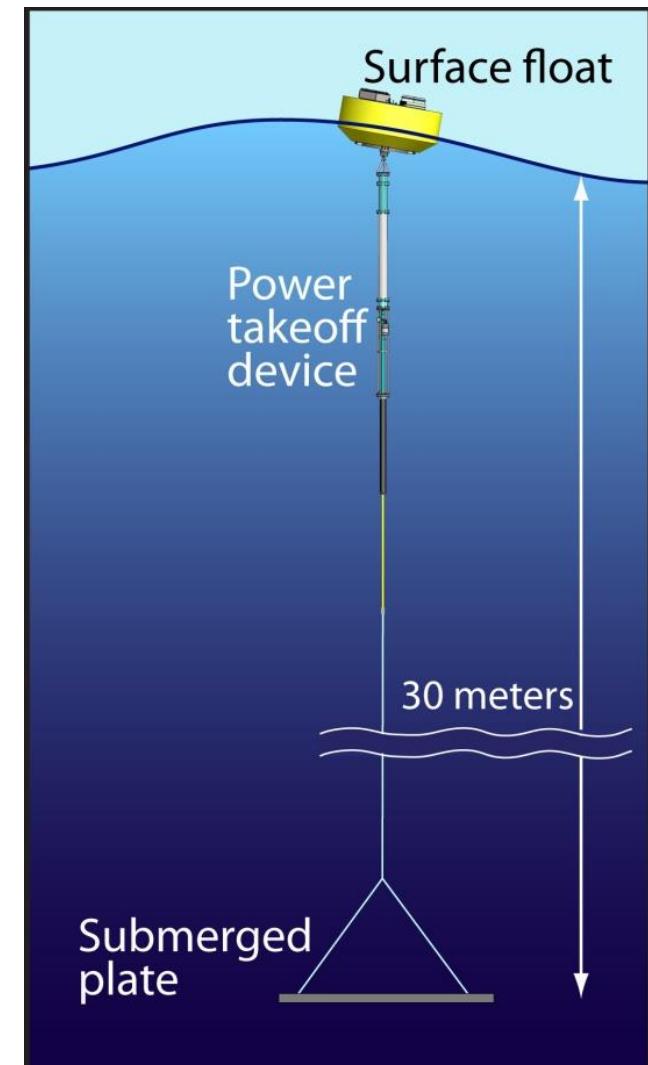
POWERING the BLUE ECONOMY™



Moored Wave Energy Converter Buoys

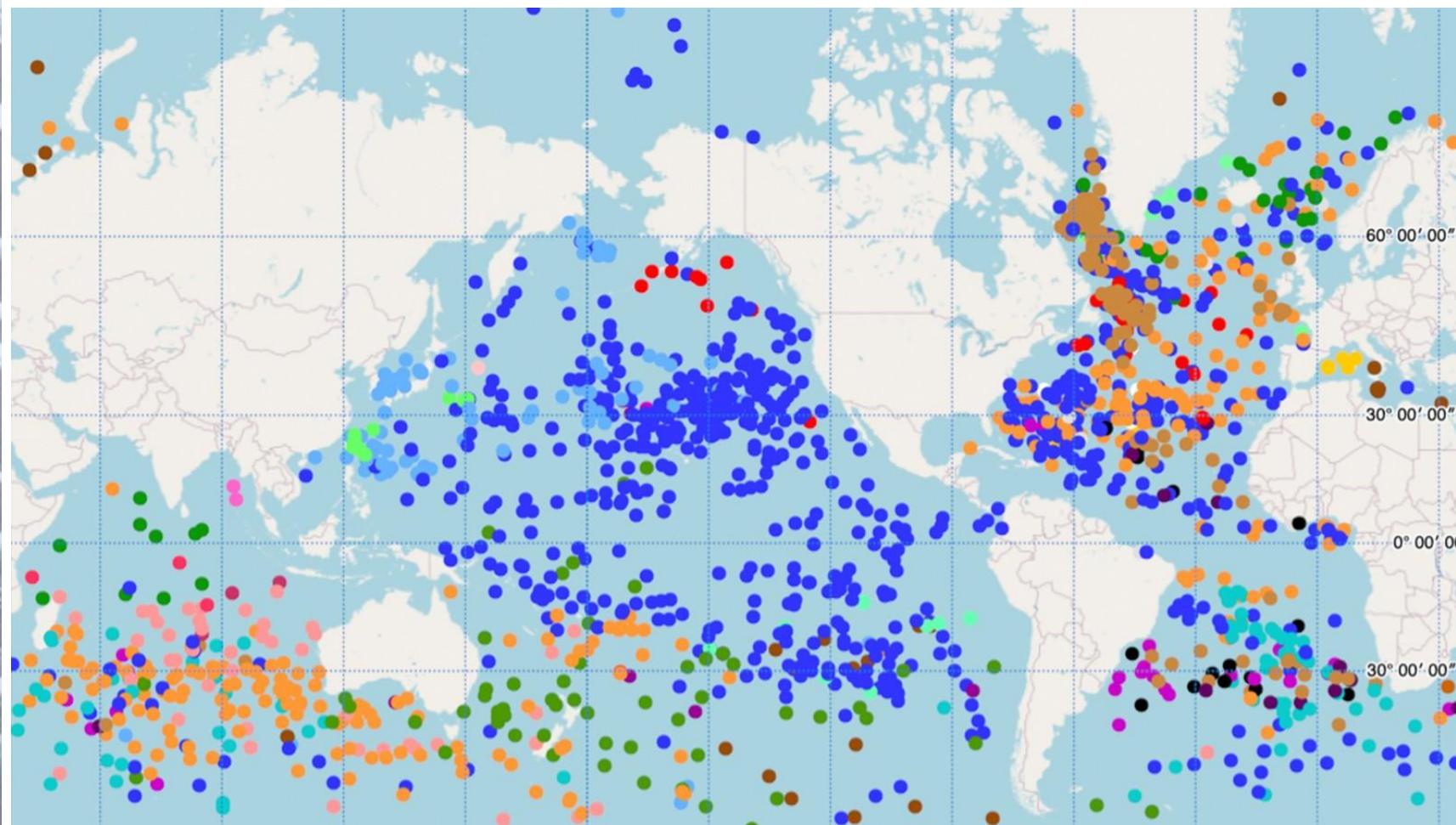


<https://www.ndbc.noaa.gov/obs.shtml>



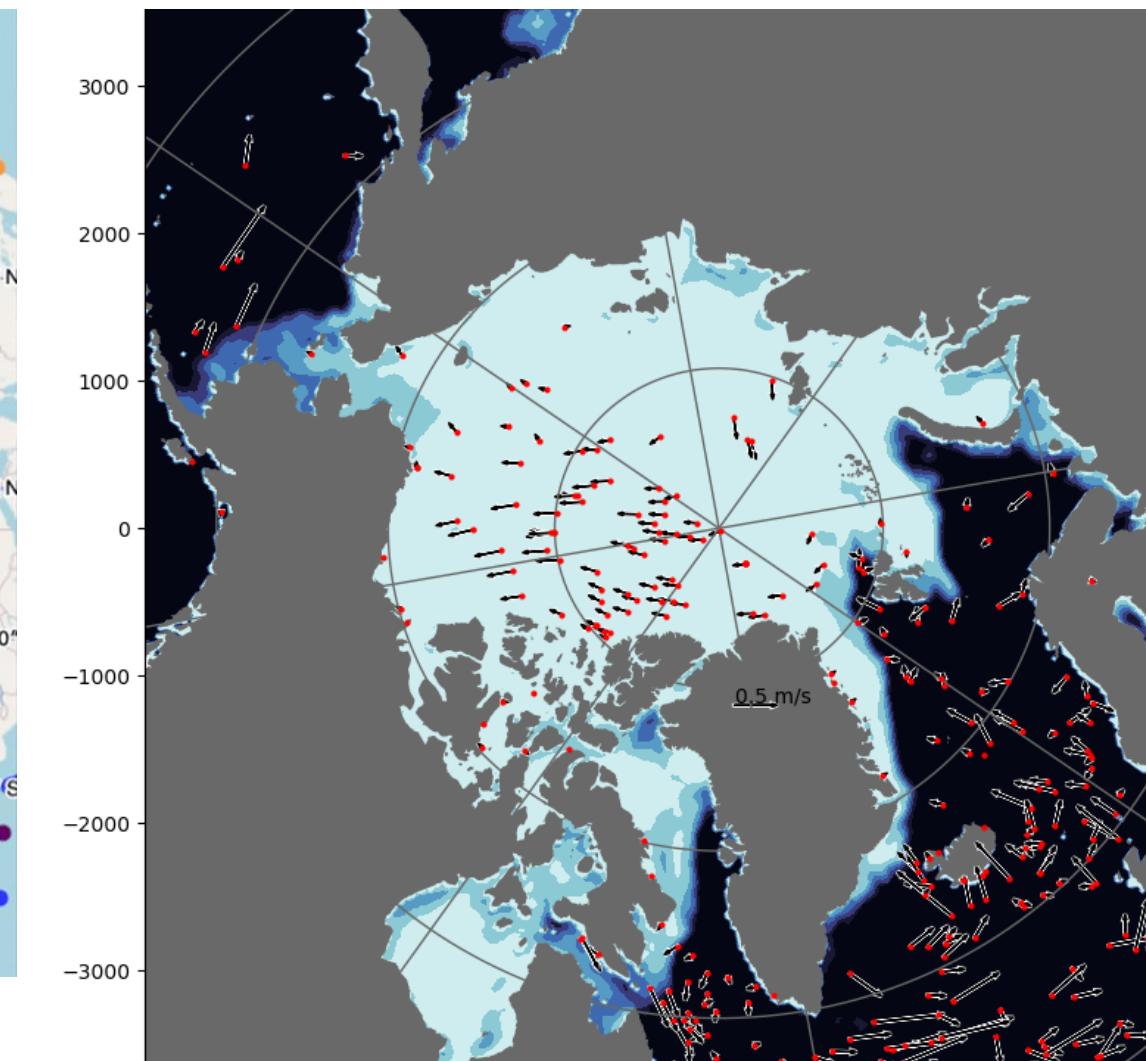
Drifting Wave Energy Converter Buoys

NOAA Global Drifter Program



<https://www.aoml.noaa.gov/global-drifter-program/>

International Arctic Buoy Program



<https://iabp.apl.uw.edu/>

Arctic Boundaries



AGREEMENT ON ENHANCING INTERNATIONAL ARCTIC SCIENTIFIC COOPERATION

NON-BINDING ILLUSTRATIVE MAP

This non-binding illustrative map shows the approximate extent of the Identified Geographic Areas described in Annex 1 of the Agreement on Enhancing International Arctic Scientific Cooperation. It is intended for illustrative purposes only and does not form part of the Agreement.

Approximate Extent of
Identified Geographic Areas

62°N

Arctic Circle

Additional areas covered
voluntarily by Canada

Continental shelf areas are not depicted.

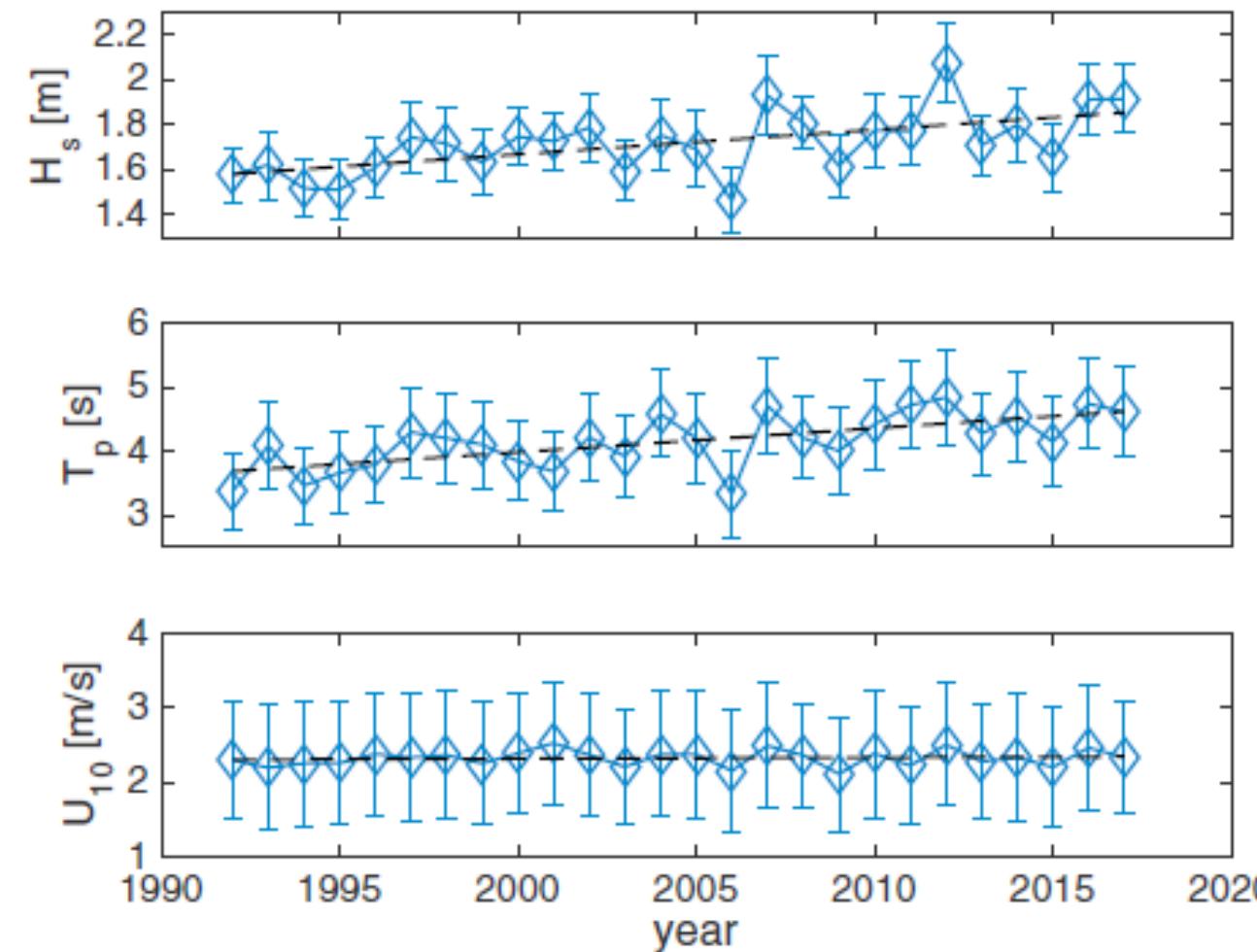
U.S. Department of State, OES/OPA, April 12, 2019

Why the Arctic?



- More observations are needed
- In-situ power generation = more observations and longer deployments
- Batteries drain quickly in the cold temperatures
- Battery performance degrades
- Remote locations make ship time expensive

Wave Energy is increasing in the Arctic

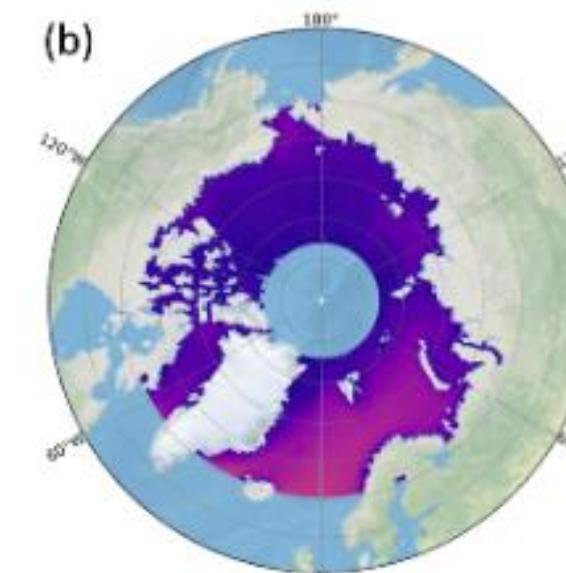
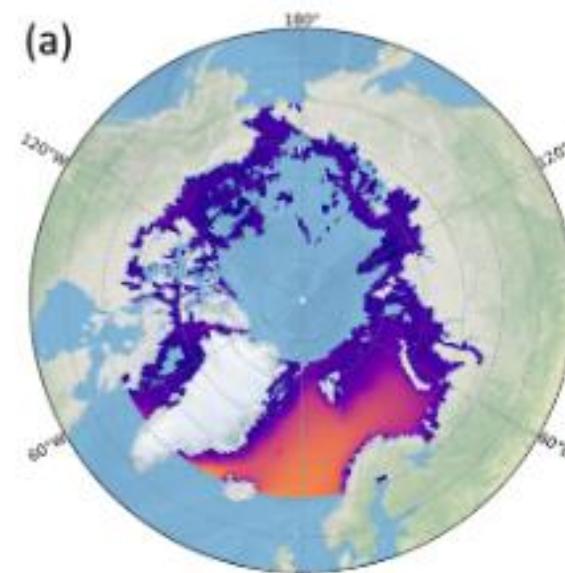


Thomson, J., Ackley, S., Girard-Ardhuin, F., Ardhuin, F., Babanin, A., Boutin, G., Brozena, J., Cheng, S., Collins, C., Doble, M. and Fairall, C., 2018. Overview of the arctic sea state and boundary layer physics program. *Journal of Geophysical Research: Oceans*, 123(12), pp.8674-8687.

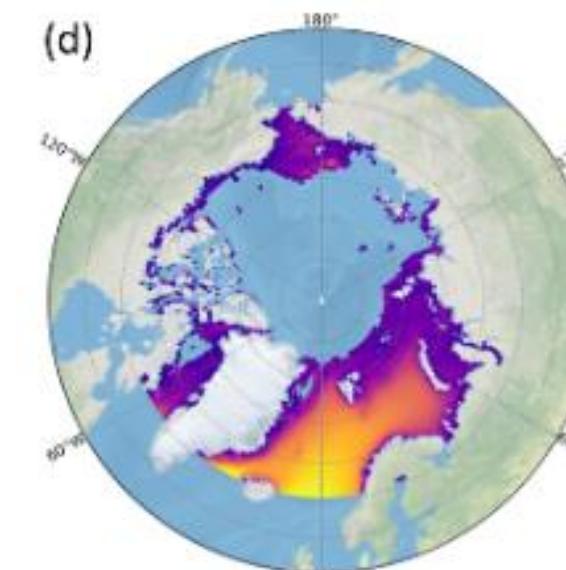
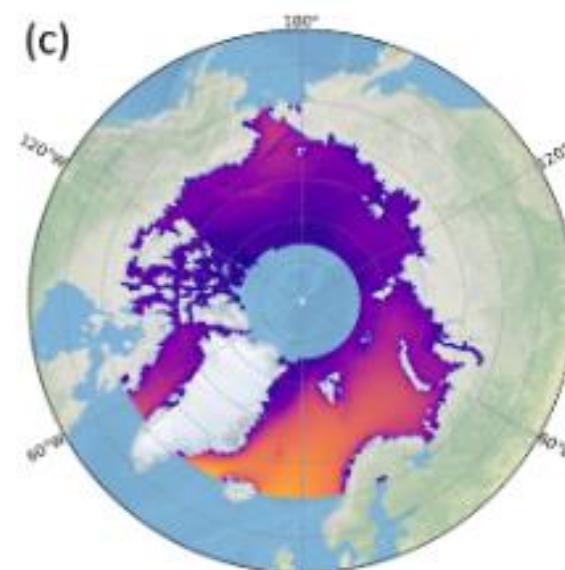


Wave Energy in the Arctic

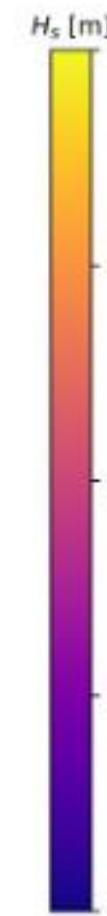
Spring



Fall

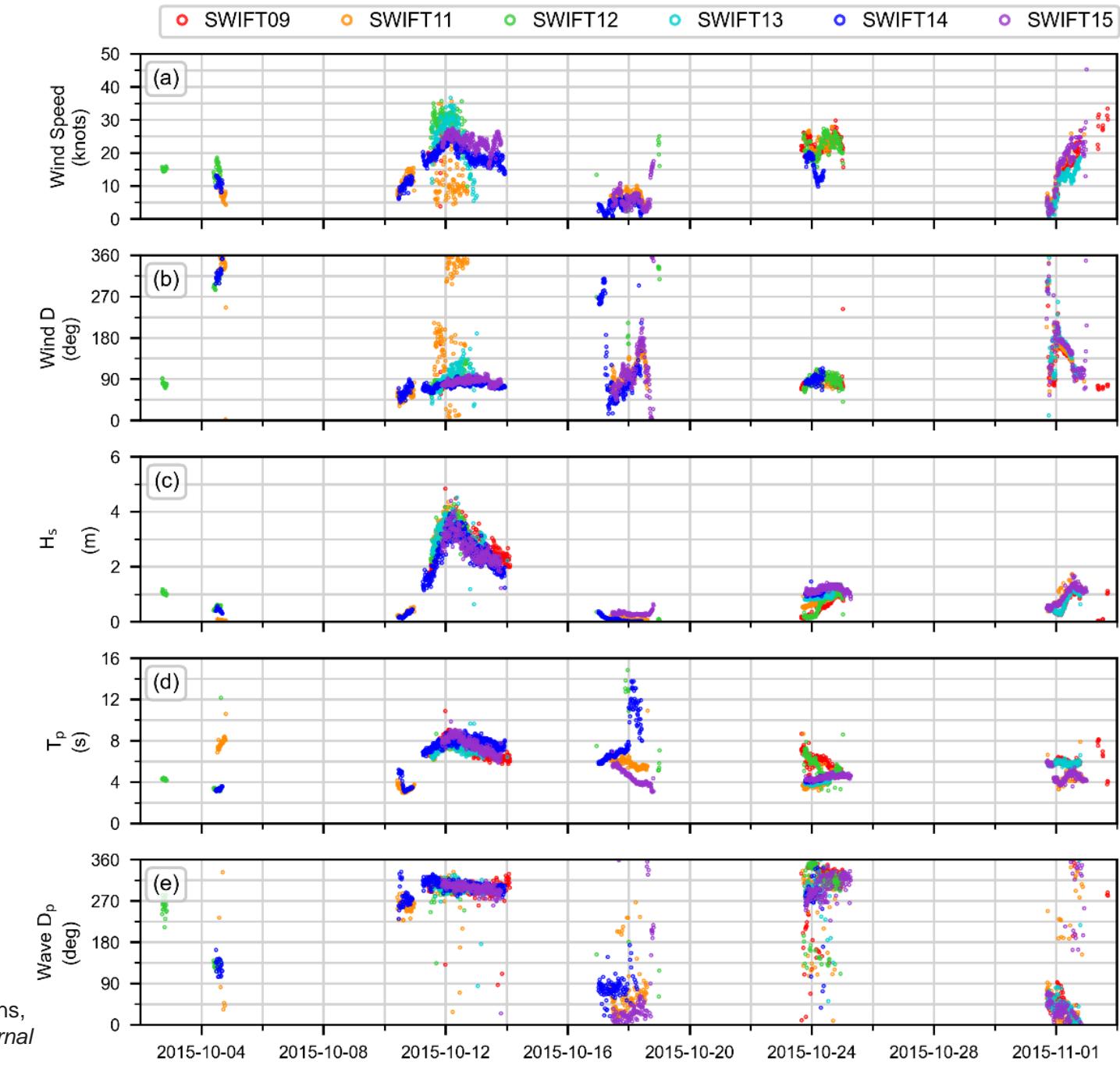
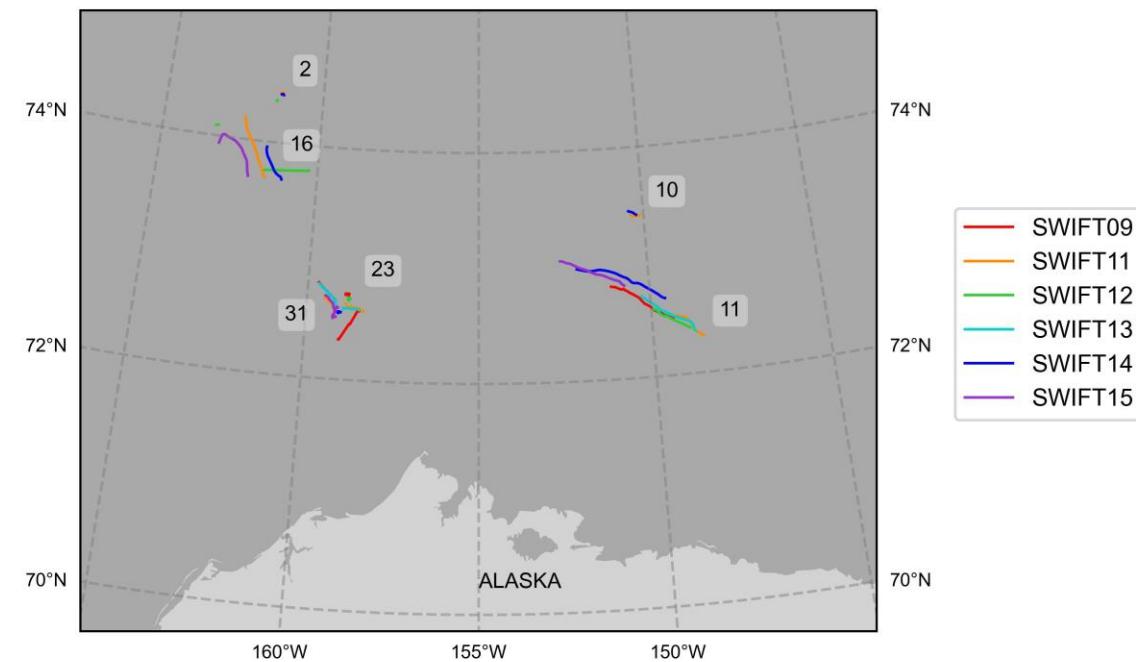


Summer

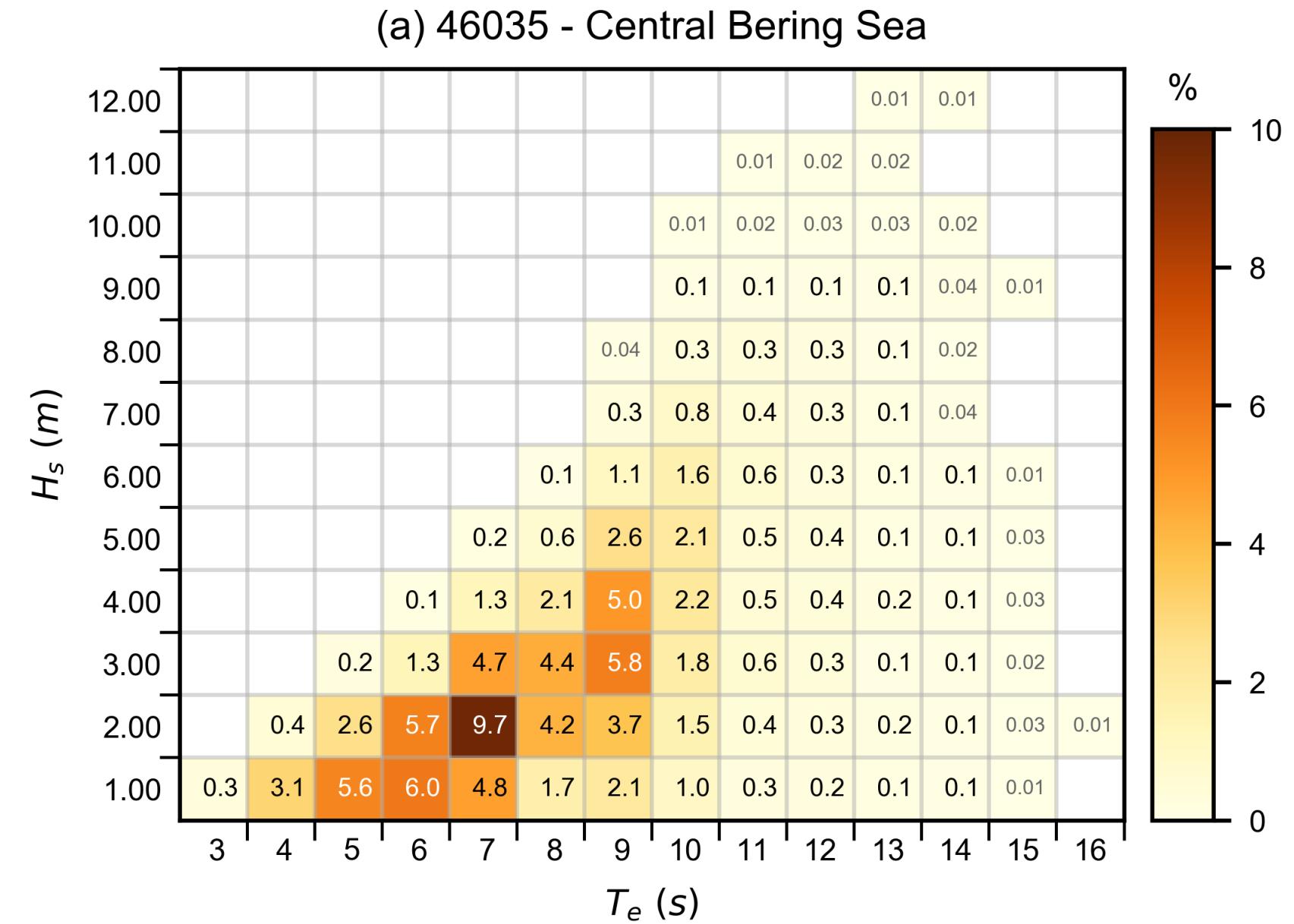


Winter

Wave Energy in the Arctic



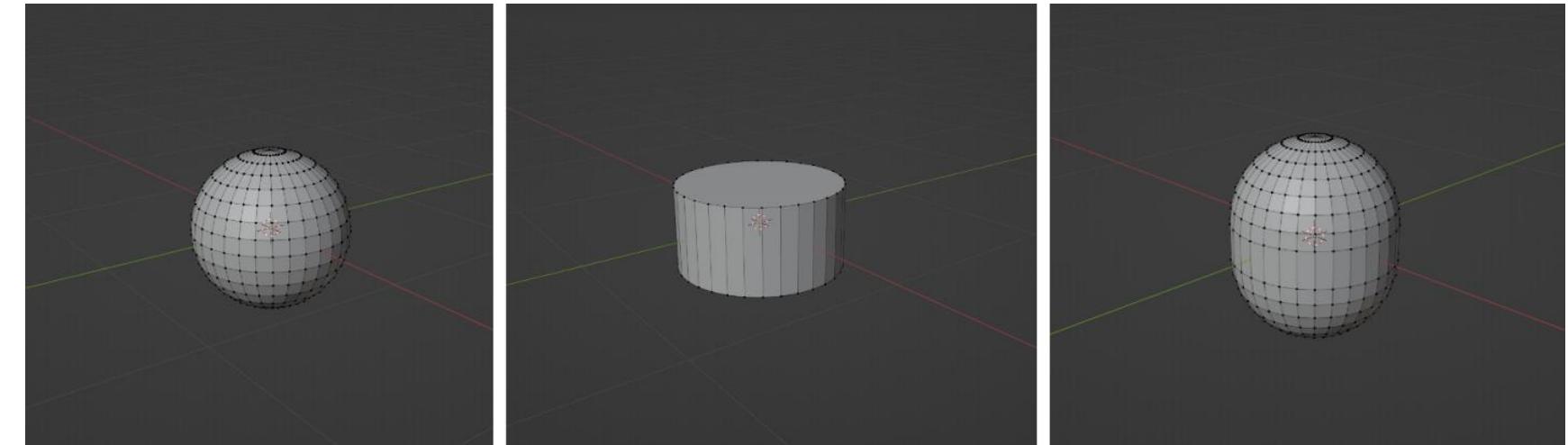
Wave Energy in the Arctic



Design Requirements

- Measure sea surface temperature
- Operating temperatures: -2 °C to 20 °C
- Deployable by small boat
- Communicate via satellite
- Six rapid-burst measurements every hour
- 60 mW average power

Drifting Wave Energy Converter Buoy



Proteus DS used to choose the buoy hull shape

Drifting Wave Energy Converter Buoy

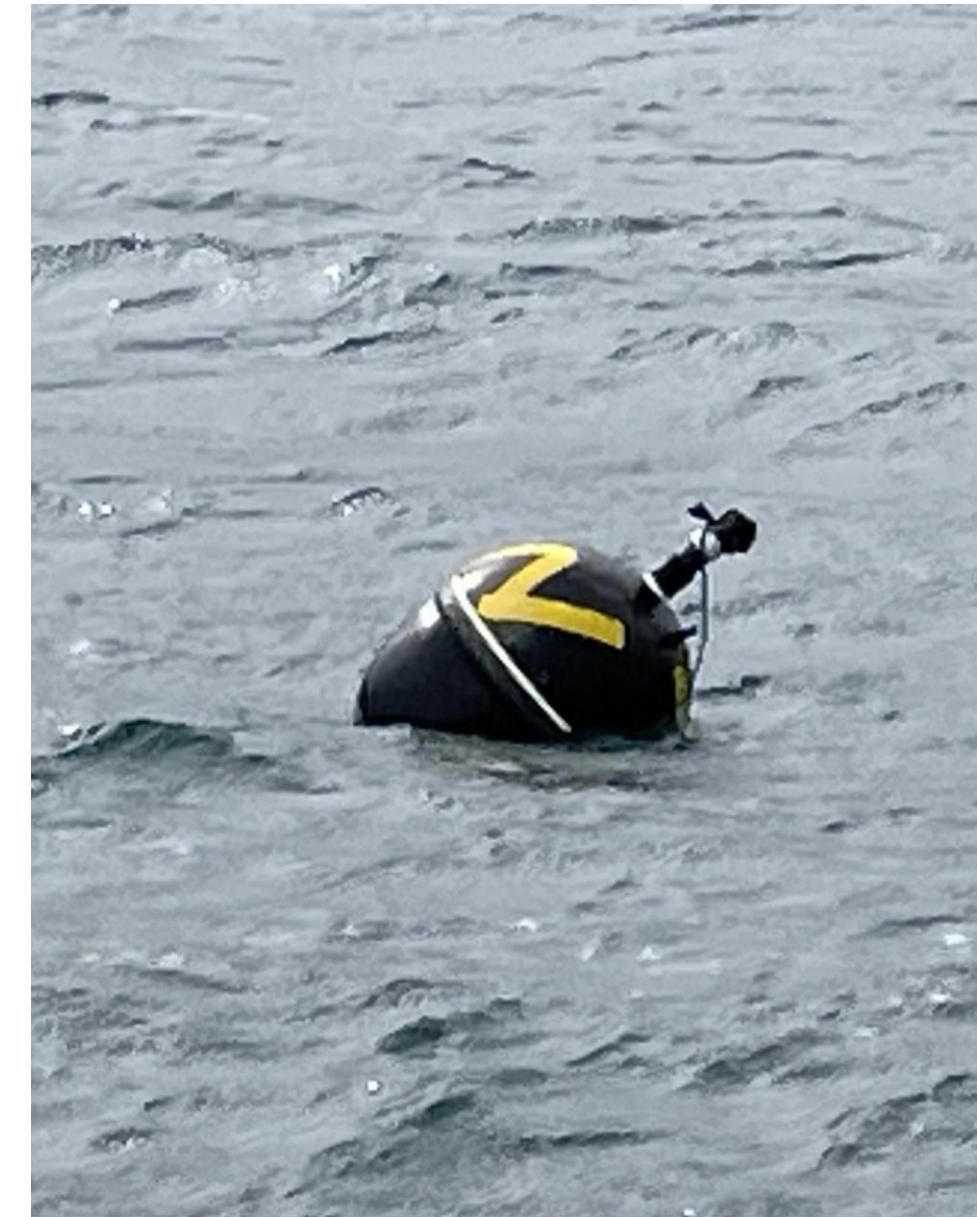


Witt Energy



Pacific Gyre Buoy

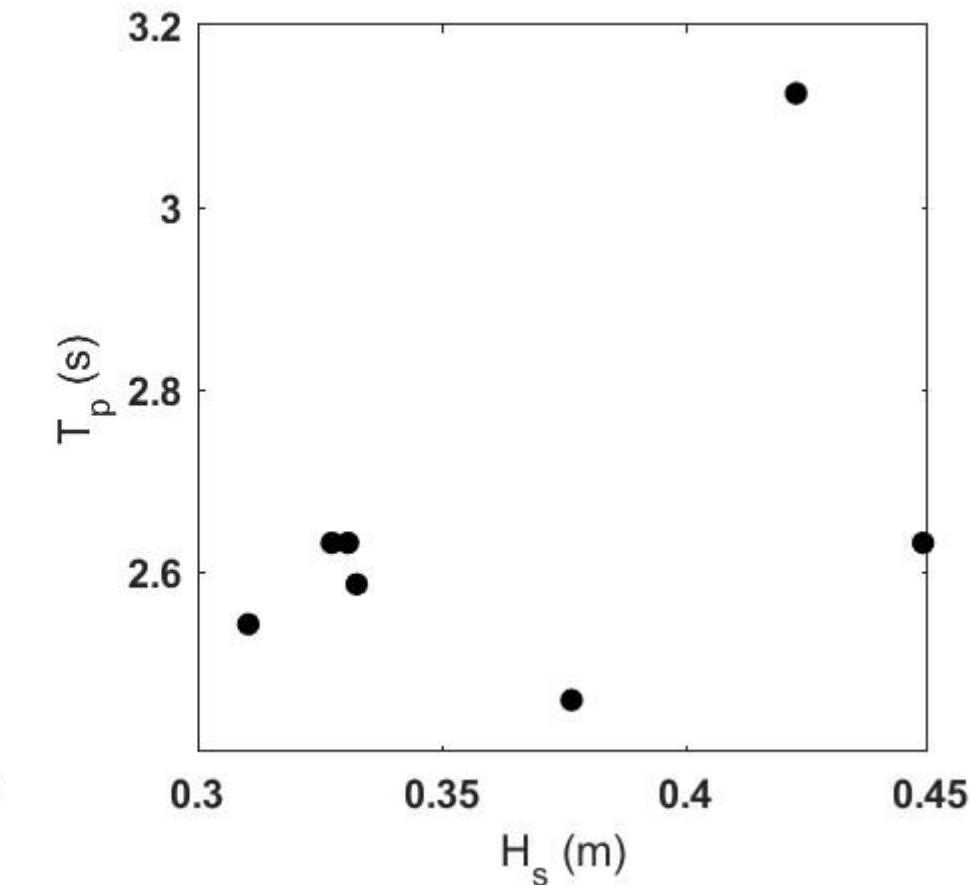
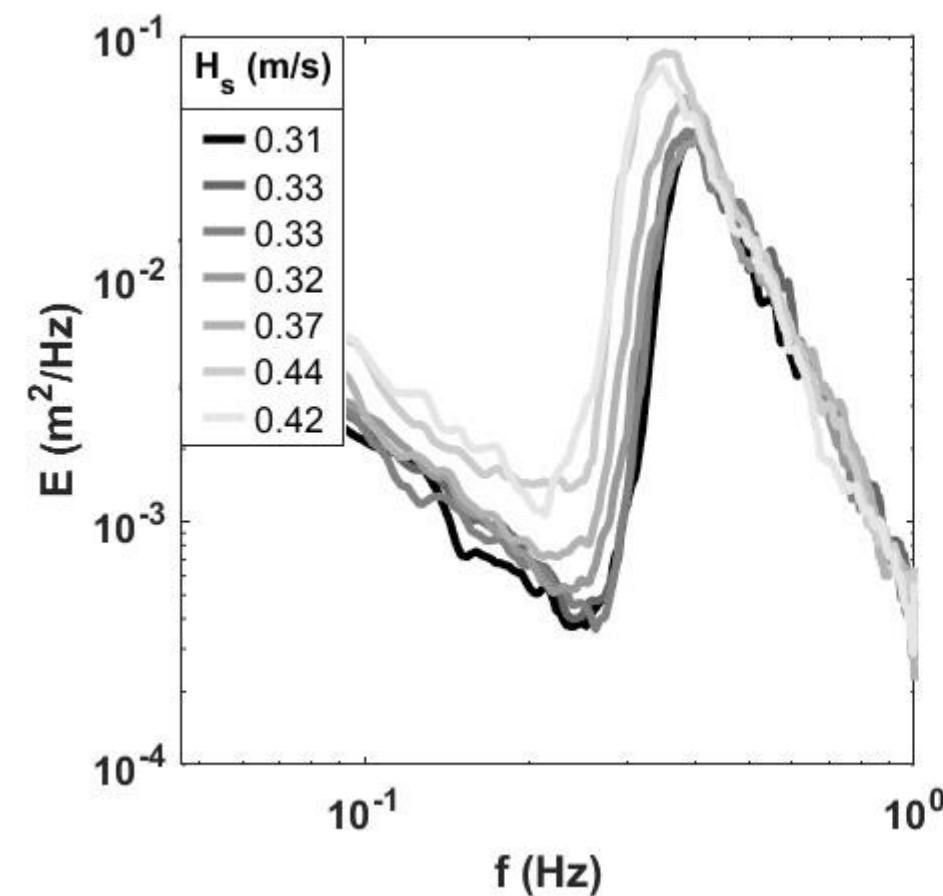
Field Tests



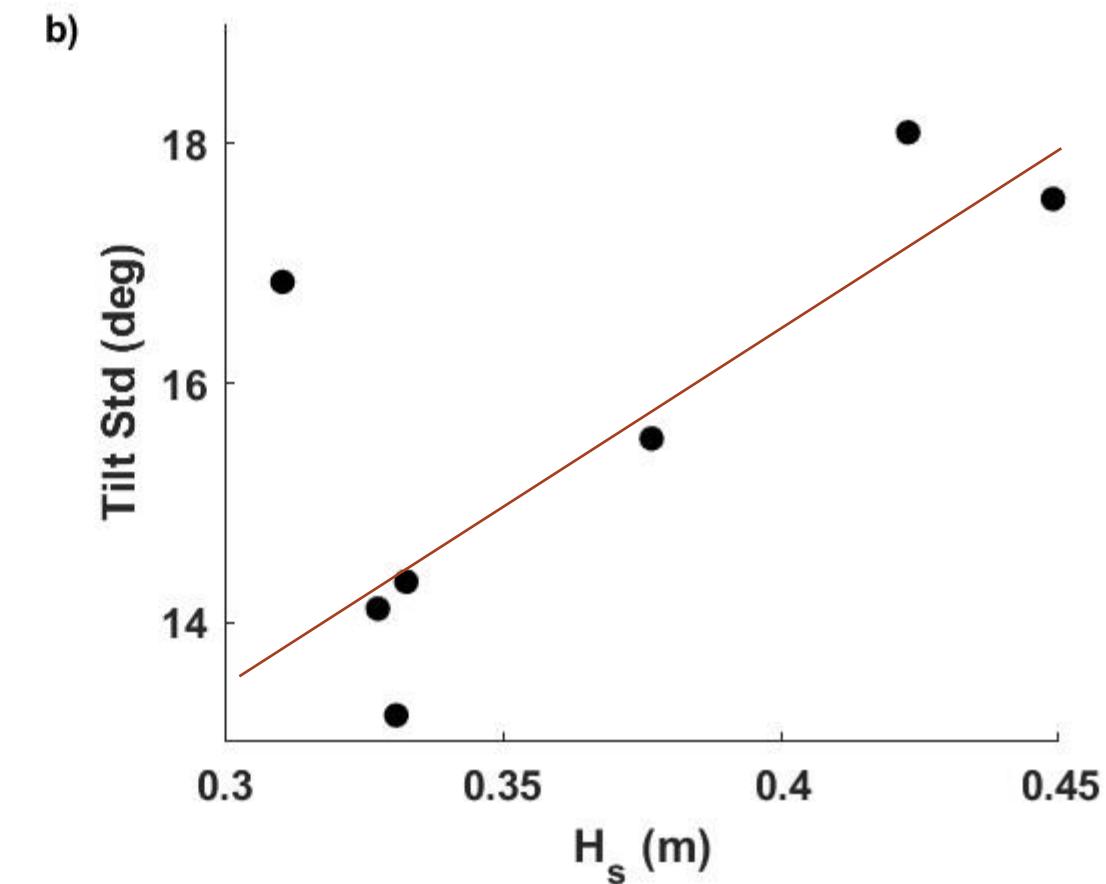
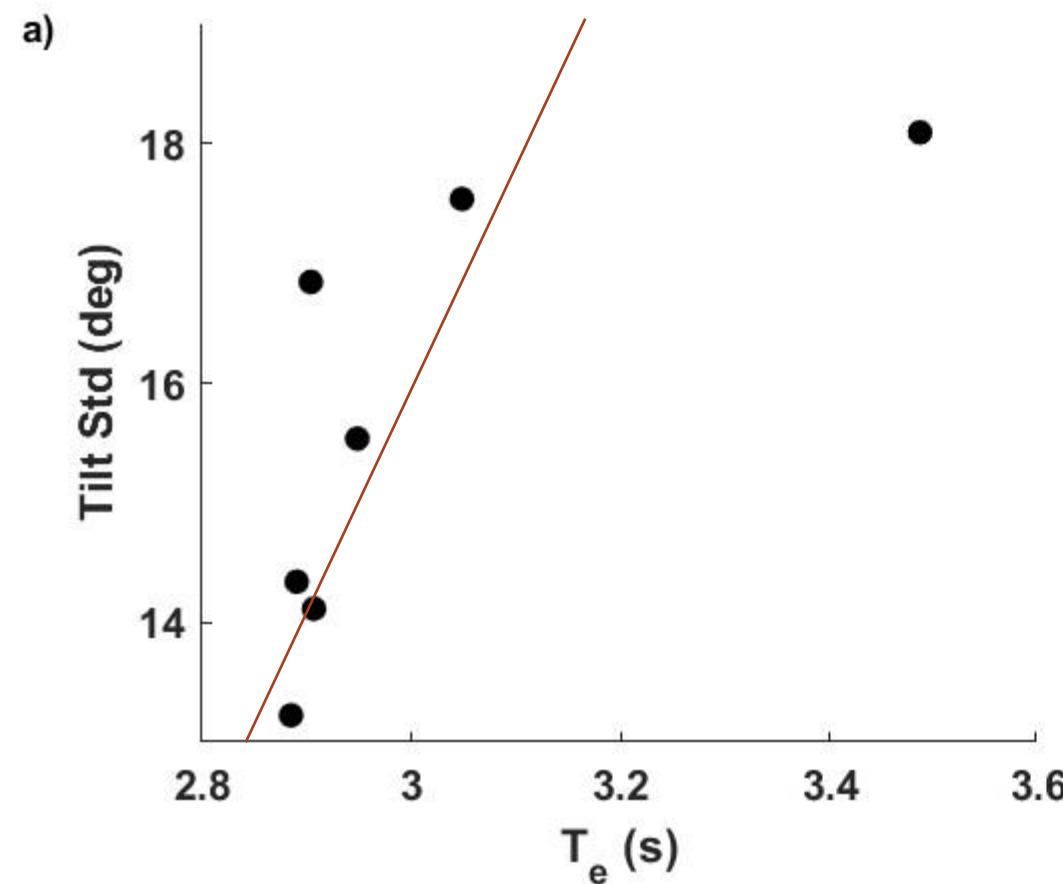
Field Tests



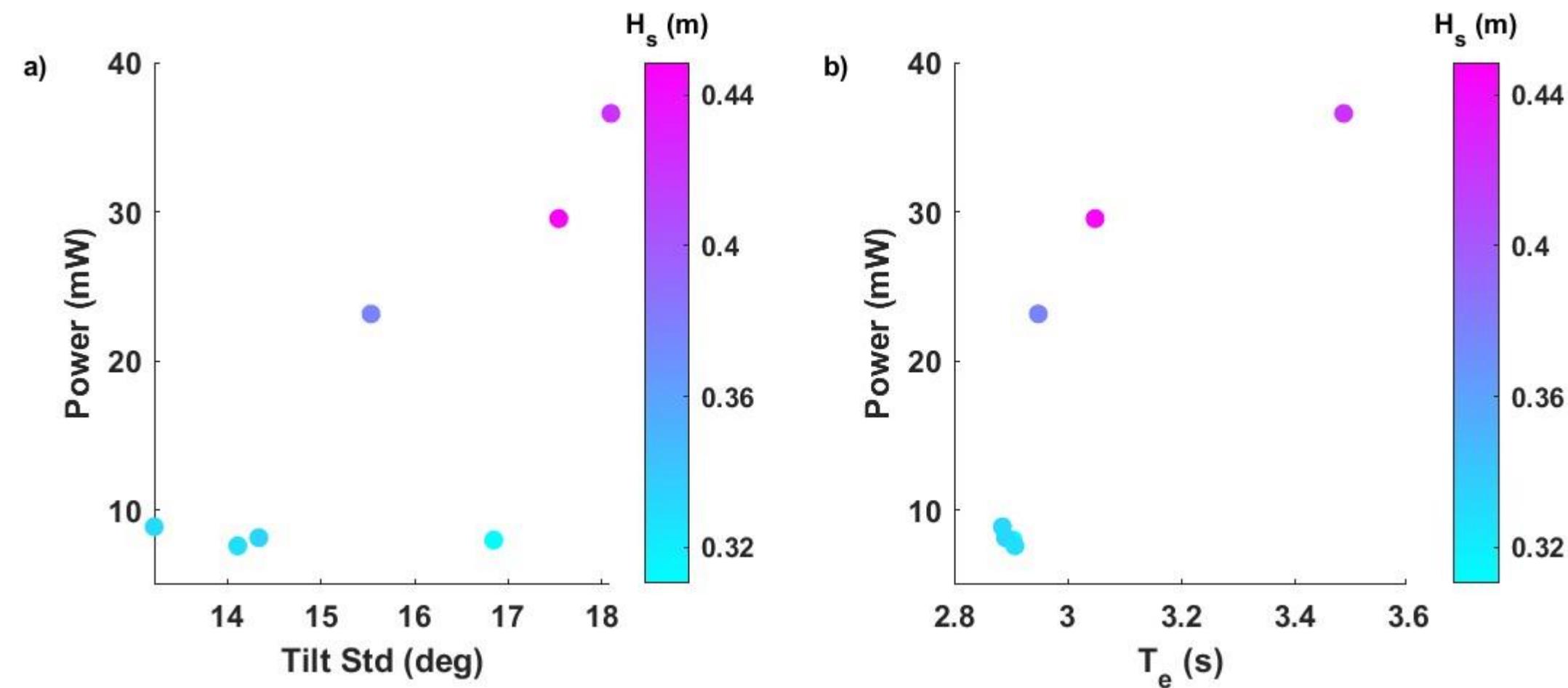
Wave Conditions



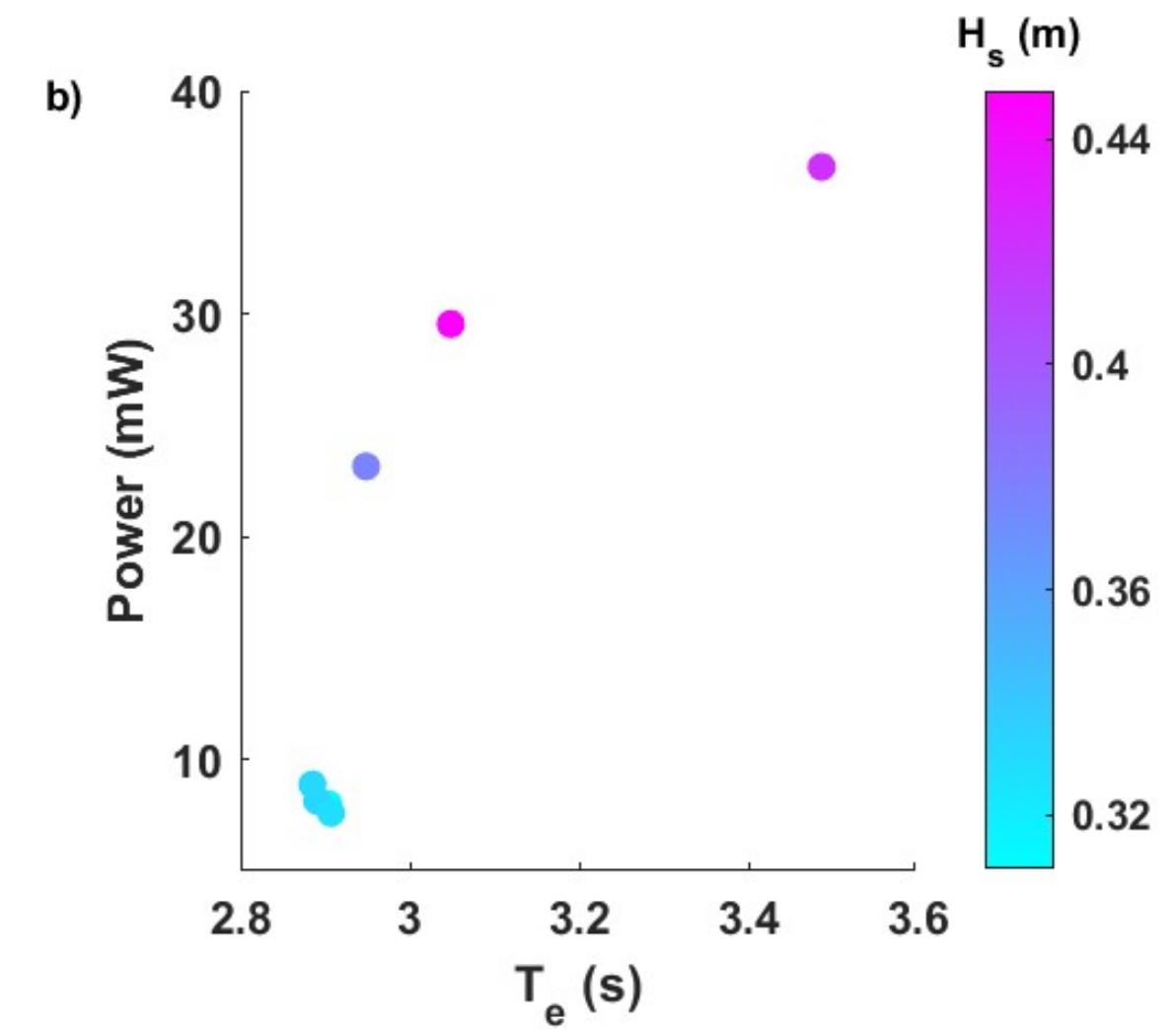
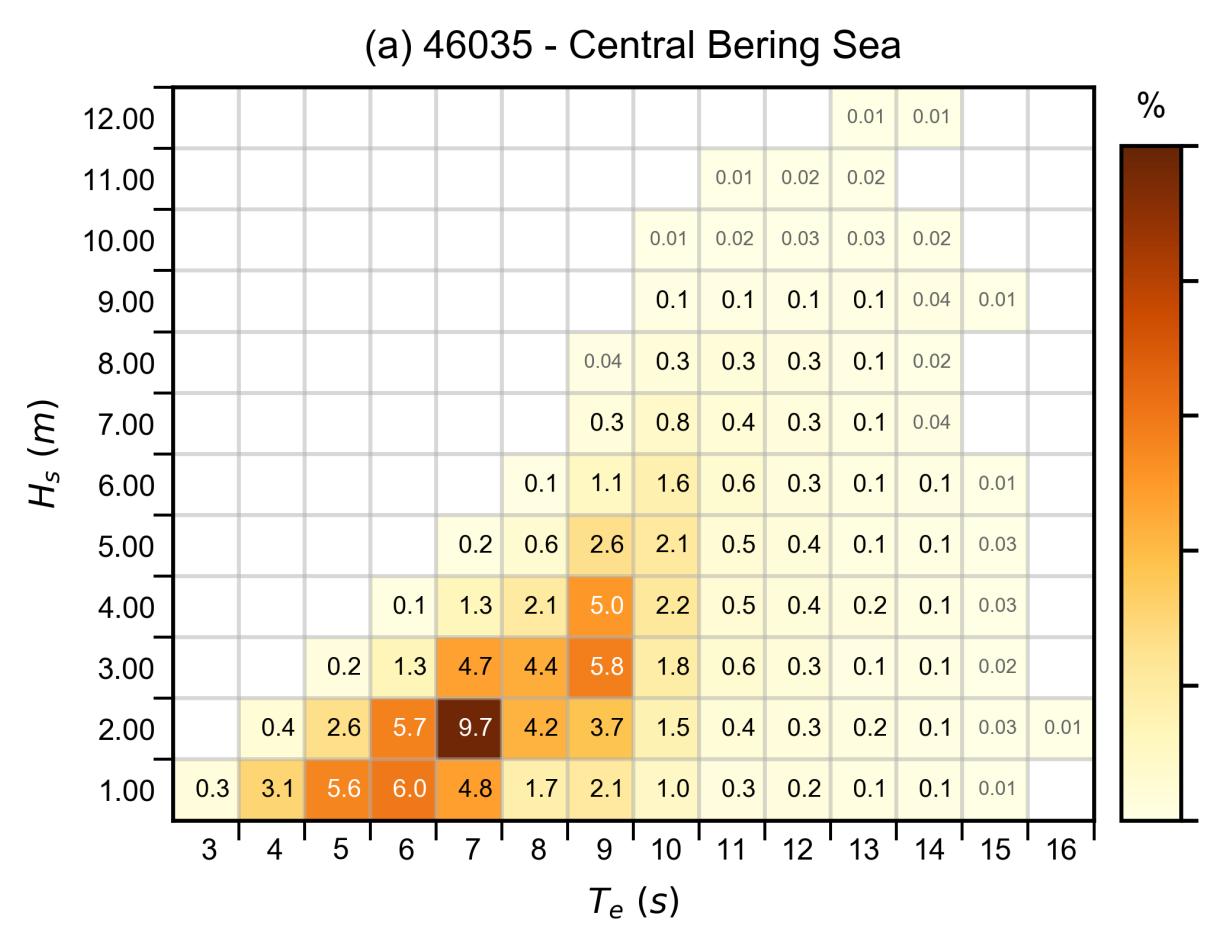
Buoy Tilt



Power Produced



Power Produced



Future Testing





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Thank you

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