An Introduction to the Marine Energy Atlas

May 27, 2021

Welcome!

WPTO R&D Deep Dive Webinar Series
A bi-monthly look into the ongoing work of WPTO sponsored projects and program areas

June R&D Deep Dive Webinars		
Date	Title	Registration Link
June 2, 2021: 2 PM – 3 PM EDT	Accelerating Irrigation Modernization	https://bit.ly/IrrigationModernizationWebinar
June 24, 2021: 3:30 PM – 4:30 PM EDT	Underwater Observations – Monitoring the Environment around Marine Energy Devices	https://bit.ly/UnderwaterObservationsWebinar
Keep an eye on the R&D Webpage for future webinars and recordings of past webinars! WPTO R&D Deep Dive Webinar Series		

Logistics

- This webinar will be recorded and made available to registrants.
- Attendees' microphones are muted and attendees are not visible on video.
- Feel free to submit questions in the chat box throughout the session to be addressed in Q&A. Be sure to select "Everyone."
- If you have technical issues, try calling into the webinar via phone.

Thank you for participating!

Speakers and Panelists

Speakers

Levi Kilcher, PhD

Principle Investigator

Haiku Sky

Product Portfolio Manager

Panelists

Aidan Bharath, PhD

Lead Researcher

Paul Susmarski

Lead Developer

Why is Marine Energy Resource Data Important?

- Public Knowledge
  - Marine energy opportunities from local to global scales
- Project Design
  - Where to build projects
  - How to design arrays
  - Selecting technologies that maximize resource potential
- Technology Design
  - Determining what environmental conditions technologies should be designed for:
    - Maximum wave heights or current speeds
    - Extreme events and turbulence
    - Suspended sediments, sea ice, bottom composition
- Techno-Economic Assessment
- Grid Integration Research
- Market Assessment
- Array-Design Tools
- Device Engineering Tools: WEC-Sim, MHKiT, SAM, etc.

Marine Energy Resource Characterization

Official Project Title: *Model Validation and Site Characterization for Early Deployment MHK Sites and Establishment of Wave Classification Scheme*

Delivering data and information for next-generation marine energy project siting, project planning, device design, and device certification.

- *Marine Energy in the U.S.: An Overview of Opportunities*
- Wave and tidal measurements at early-market sites
- High-resolution wave and tidal models
- Classification schemes proposed for inclusion in IEC standards
- Marine Energy Atlas – *NOW!*

Measurements

Modeling

Classification & Characterization
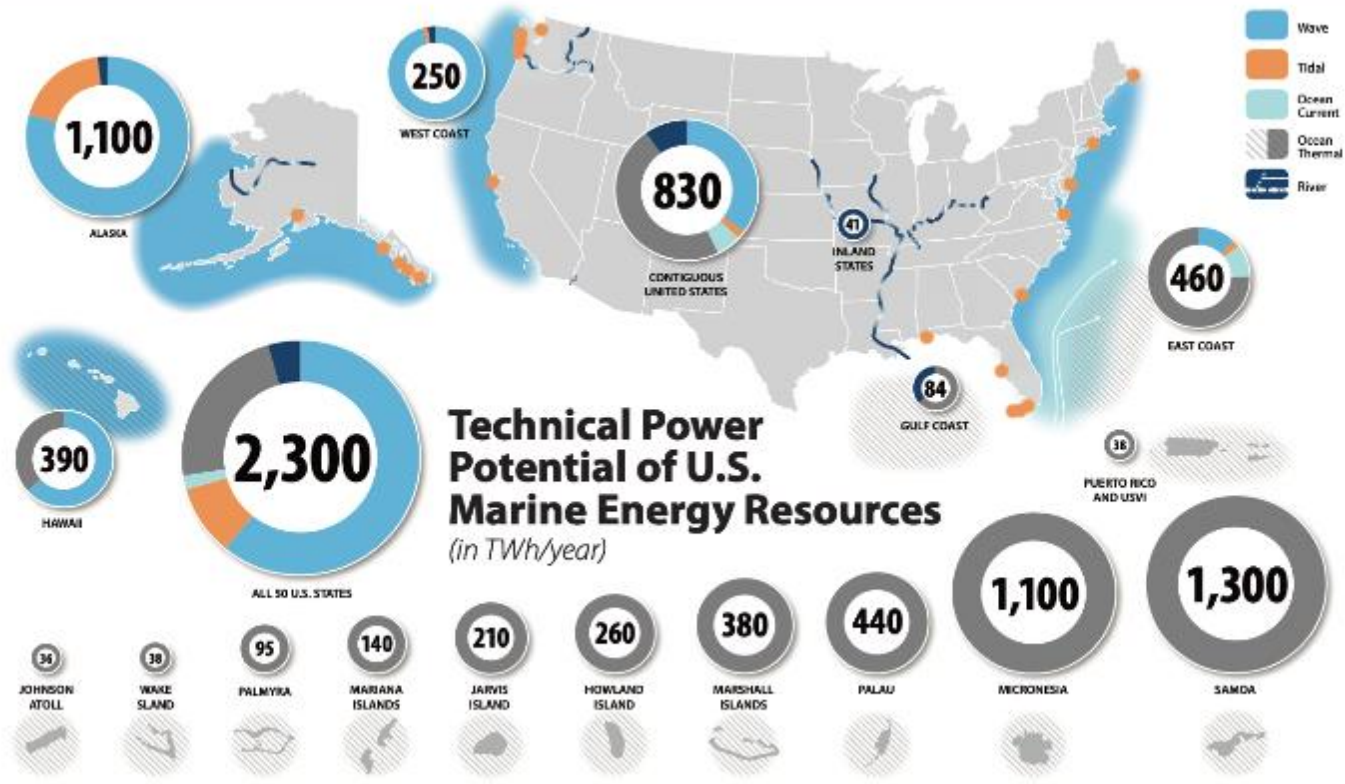
Kilcher, Fogarty, and Lawson. 2021. *Marine Energy in the United States: An Overview of Opportunities*. Golden, CO: National Renewable Energy Laboratory. NREL/TP-5700-78773. https://www.nrel.gov/docs/fy21osti/78773.pdf
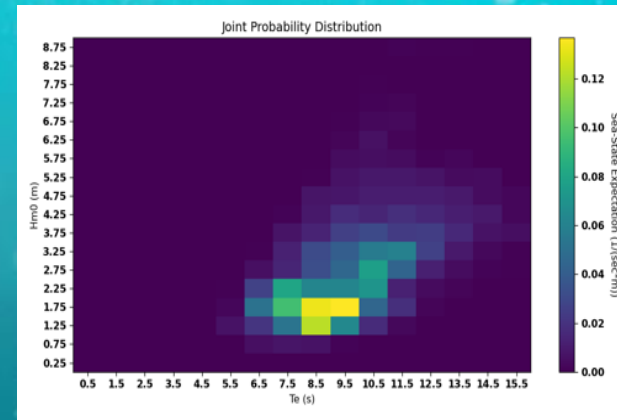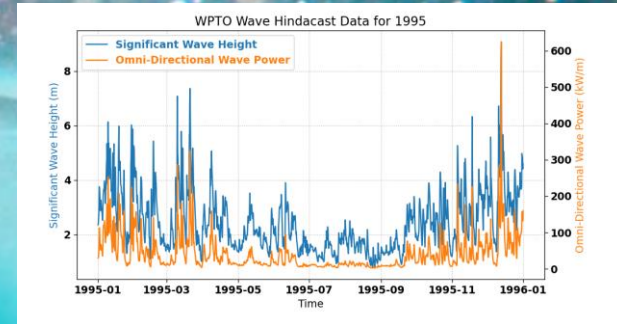
High-Resolution Wave Dataset

Spatial Datasets:

- 200-m spatial resolution spanning U.S. EEZ
  - More than 4 million grid points spanning East Coast, West Coast, and Hawaii
  - Alaska, Gulf of Mexico, U.S. Territories and Freely Associated States coming soon.
- Three-hour temporal resolution spanning 32 years (1979 – 2010)
  - Extend to 2020 next year

Virtual Buoy Datasets:

- One-hour temporal resolution at hundreds of sites
- Includes directional wave spectra

Data is freely available on AWS: registry.opendata.aws/wpto-pds-us-wave

High-Resolution Wave Dataset

- **Full Dataset can be Programmatically Accessed via MHKiT:**

- Data Access and Processing examples are provided:
  - WPTO Wave Hindcast Examples

- Code base is continually maintained and updated with new functionality and processing methods.

Dataset Accessible via Amazon Web Services:

### Spatial Datasets
Millions of points, 3-hour resolution
- Energy Period (s)
- Maximum Energy Direction (deg true)
- Omni-Directional Wave Power (W)
- Significant Wave Height (m)
- Water Depth (m)
- Directionality Coefficient
- Peak Period (s)
- Mean Absolute Period (s)
- Mean Zero-Crossing Period (s)
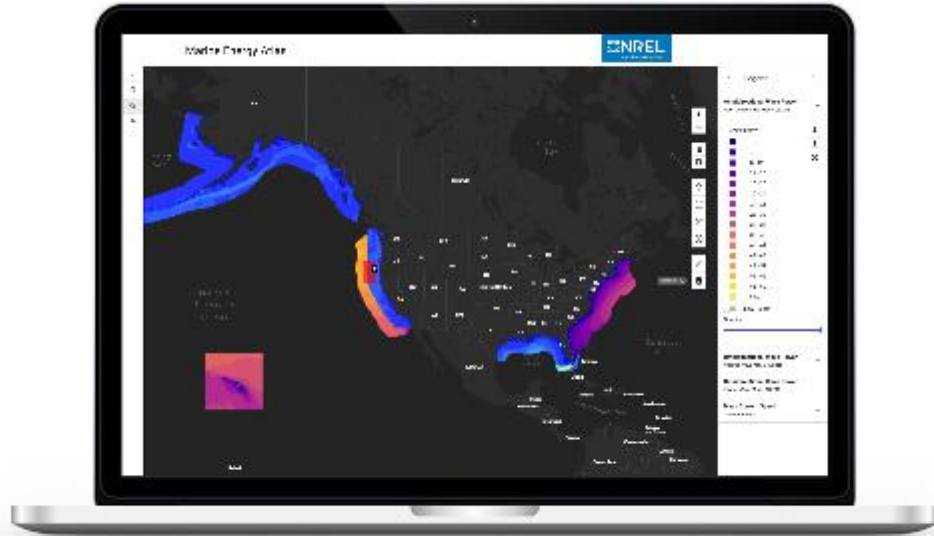- Spectral Width

Virtual Buoy Datasets
Hundreds of points, 1-hour resolution
- All spatial variables
- Directional Wave Spectrum ($m^2Hz^{-1}deg^{-1}$)

Bold variables *plotted on* Atlas
All variables *available via* Atlas "data downloader"

Directional Wave Spectrum
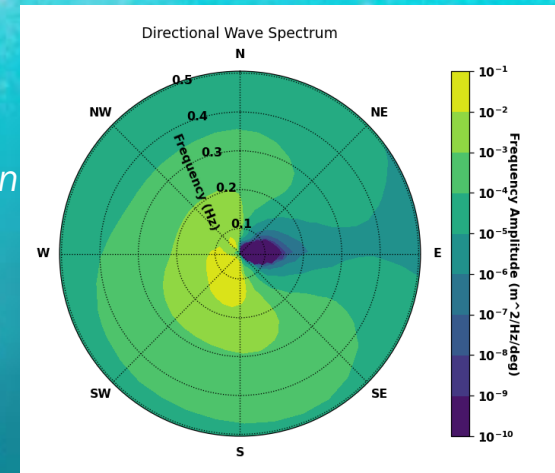
Marine Energy Atlas - Application Introduction
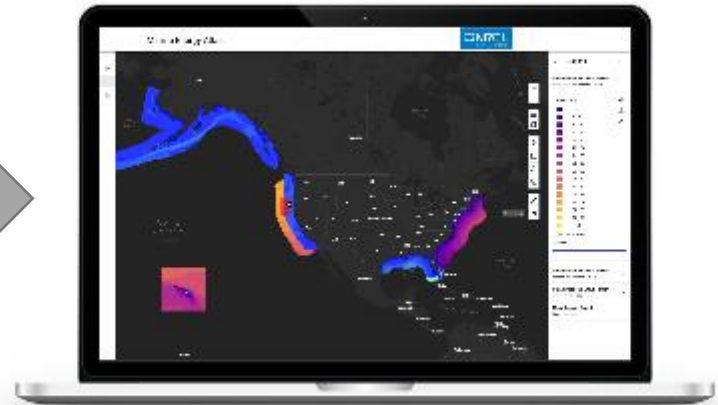

Marine Energy Atlas
maps.nrel.gov/marine-energy-atlas

What Has Changed?

Marine Hydrokinetic Atlas

Marine Energy Atlas

Marine Hydrokinetic Atlas

- Original version released in 2012
- Subsequent iterations built on **OpenCarto** framework
- Contains 169 data layers across multiple resource types

What is OpenCarto?

- A framework of web-based geospatial applications & services
- Open-source software packages
- Custom code base
- Tech stack based circa 2013 web technologies

Marine Energy Atlas

- Launched April 2021
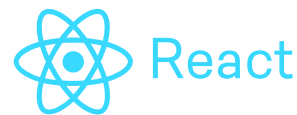- Built on **VADR** framework
- Modern open-source software packages
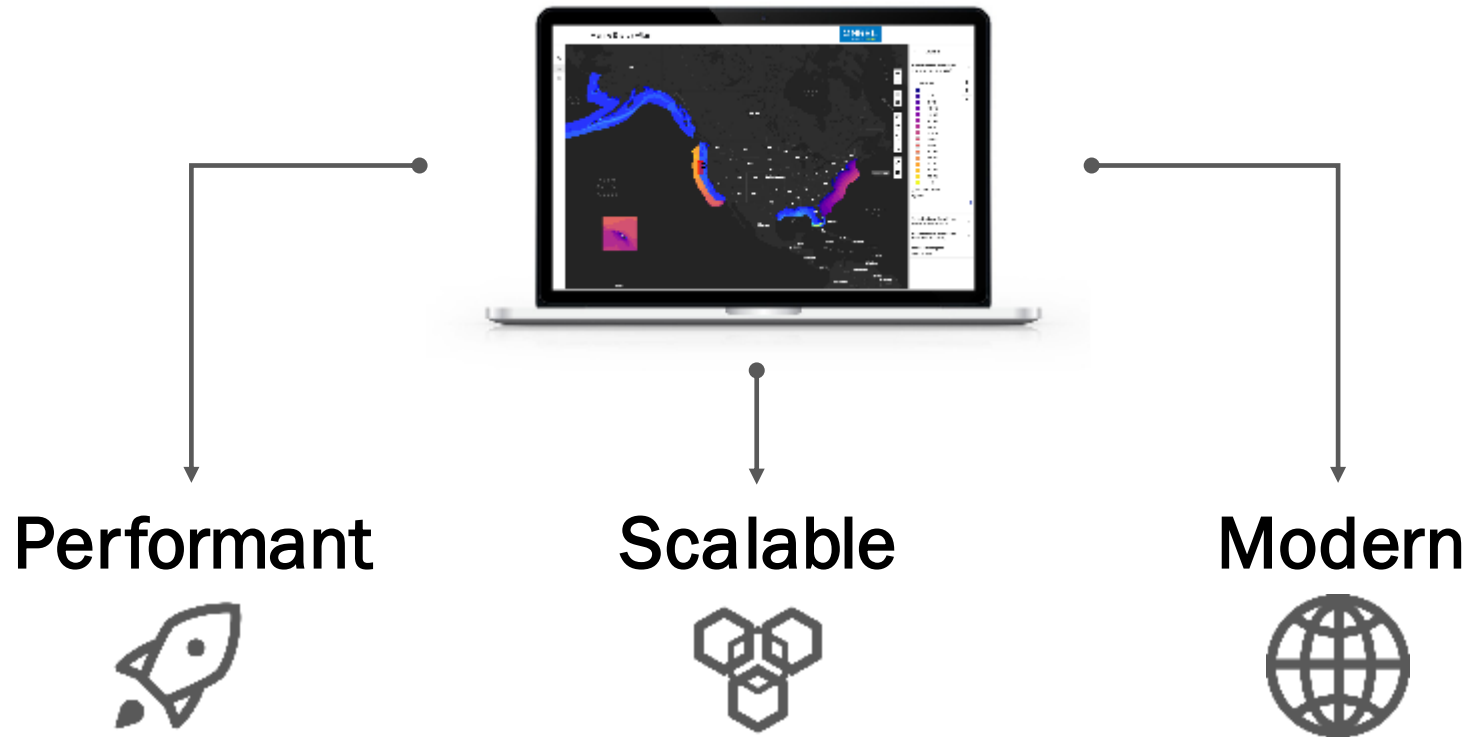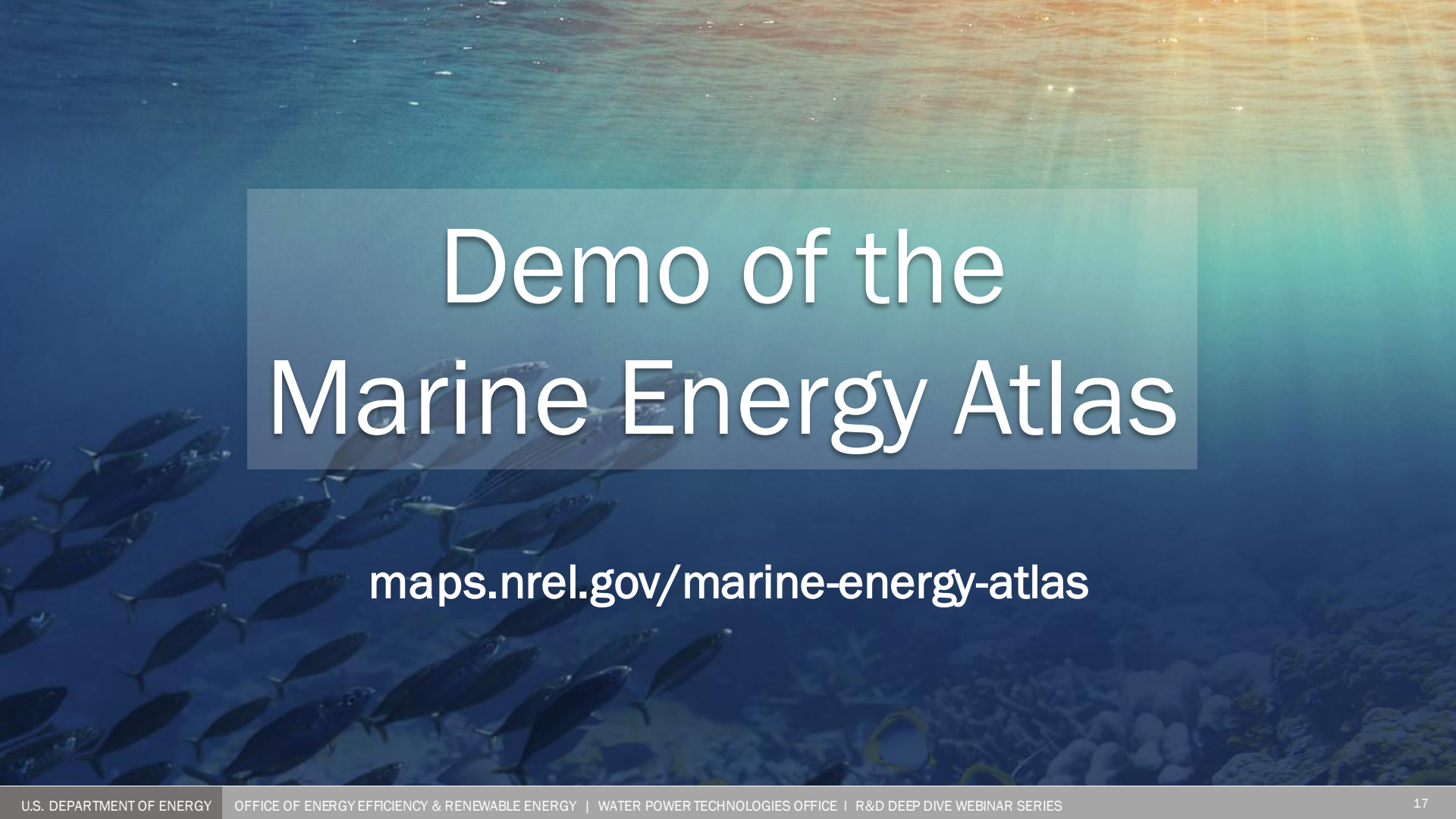
What is VADR?

- Visualization Analysis Research & Design (VADR) platform
- Monorepo for codebase
- Web application framework
- Web service framework
- CI/CD infrastructure
- Suite of AWS cloud resources

Marine Energy Atlas – How is it better?

Performant

Scalable

Modern

Demo of the Marine Energy Atlas

maps.nrel.gov/marine-energy-atlas

Q&A

Submit questions in the chat box and be sure to select "Everyone."

Thank you for attending!