



OpenCTD as a Low-Cost Tool for Small-Scale Wave Energy Characterization

Lindsay Wentzel, Trip Taylor, Ryan Golden, Mike Muglia

Oceanography and Marine Hydrokinetic Energy Lab
Coastal Studies Institute, Wanchese NC

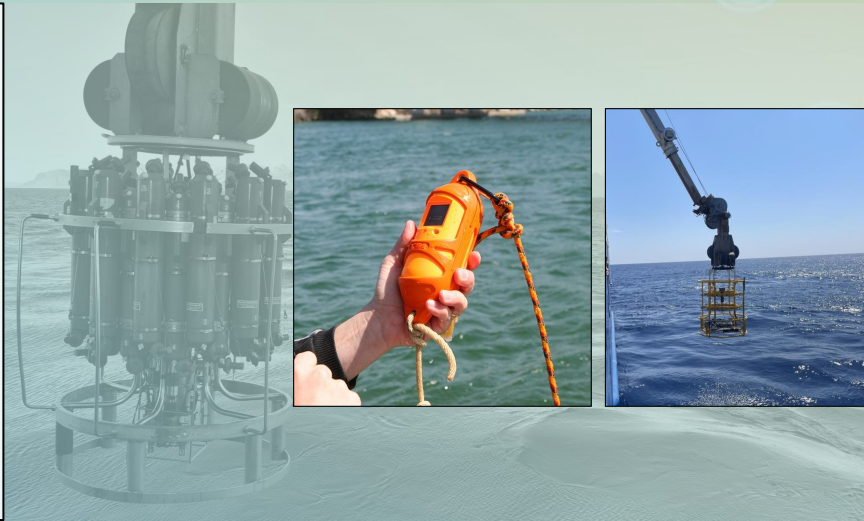


North Carolina
Renewable Ocean
Energy Program

The CTD Instrument

- “Conductivity” (Salinity)
- “Temperature”
- “Depth”

A tool to study the physical, chemical, and biological properties of a marine environment.



EXPENSIVE

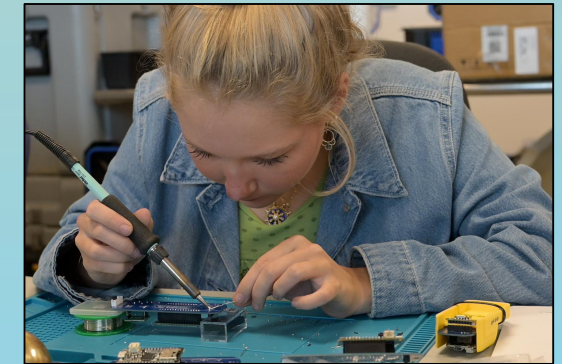
The OpenCTD



Low-Cost



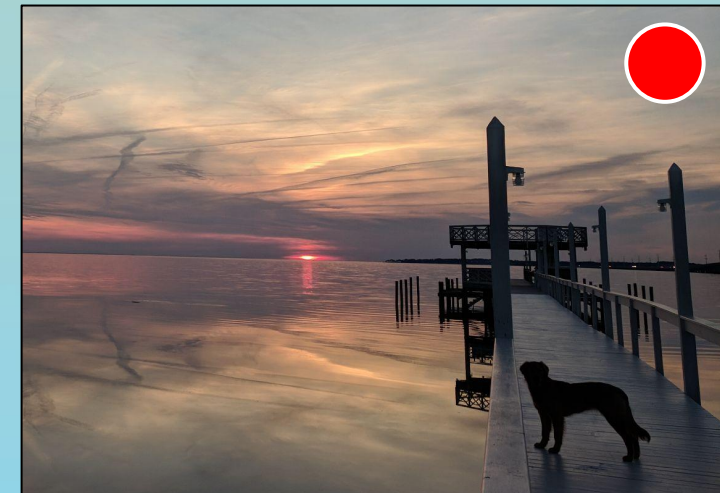
Open-Source



DIY

Objectives

1. Develop a local curriculum and workshop
2. Demonstrate a long term OpenCTD deployment
3. **Resource characterization of site-specific wave energy**



- CSI MET Station
- Private Property
- Shipwreck

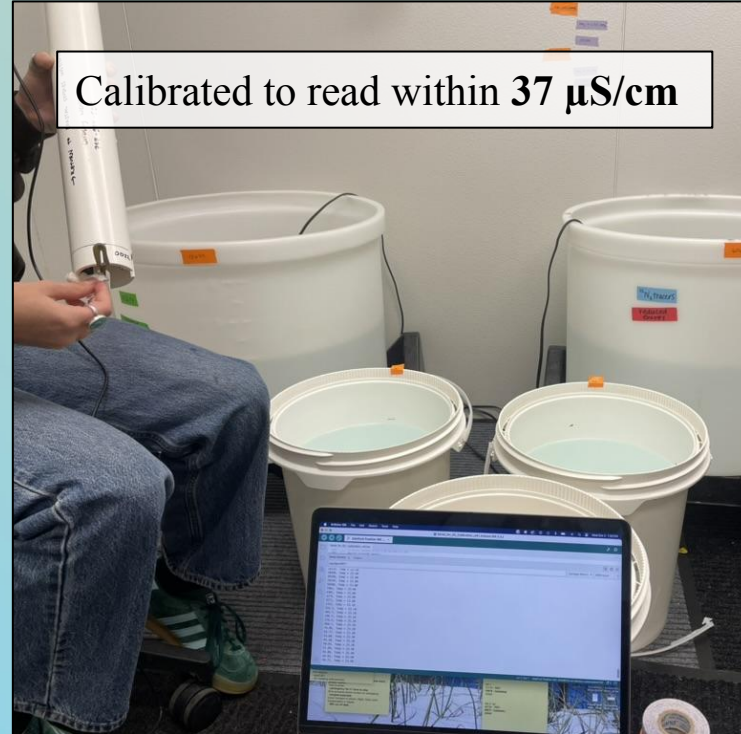
Outer Banks, NC

Atlantic Ocean

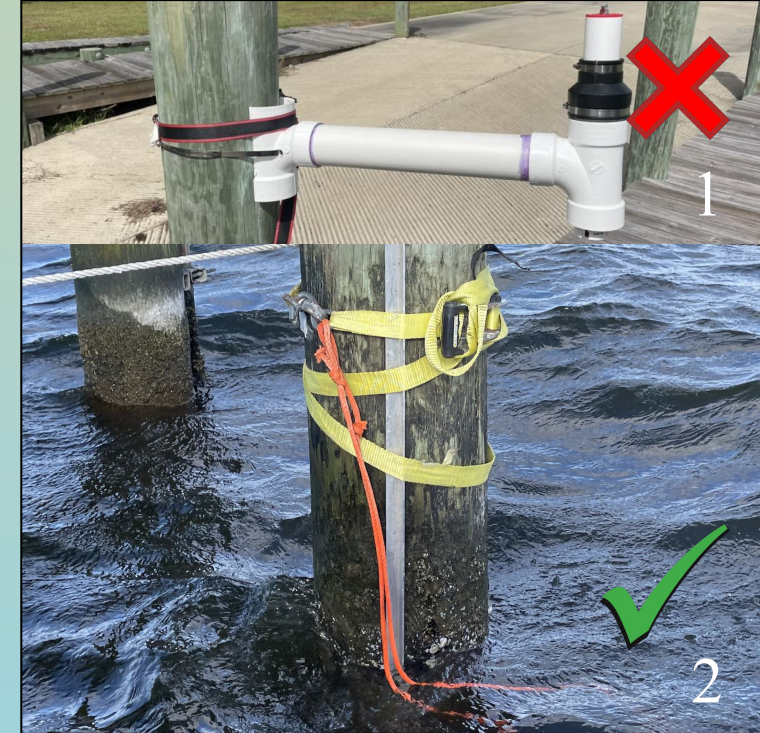
Construction



Calibration

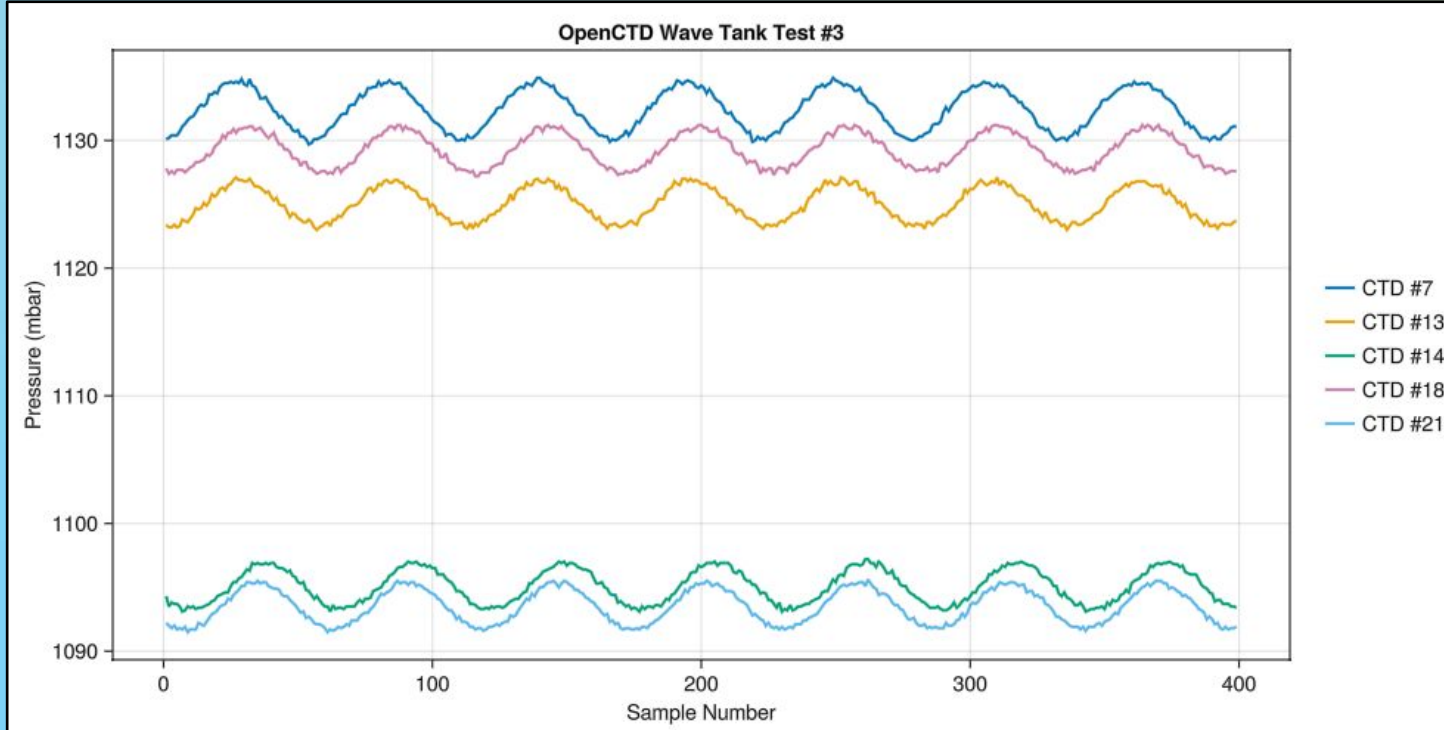


Field Testing

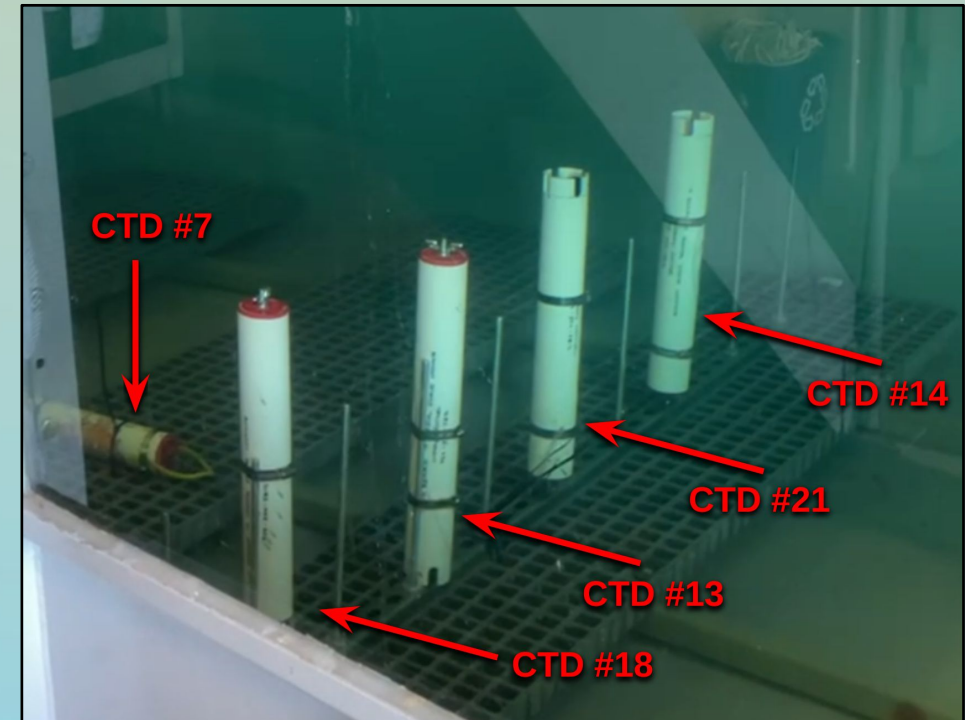


Modifications

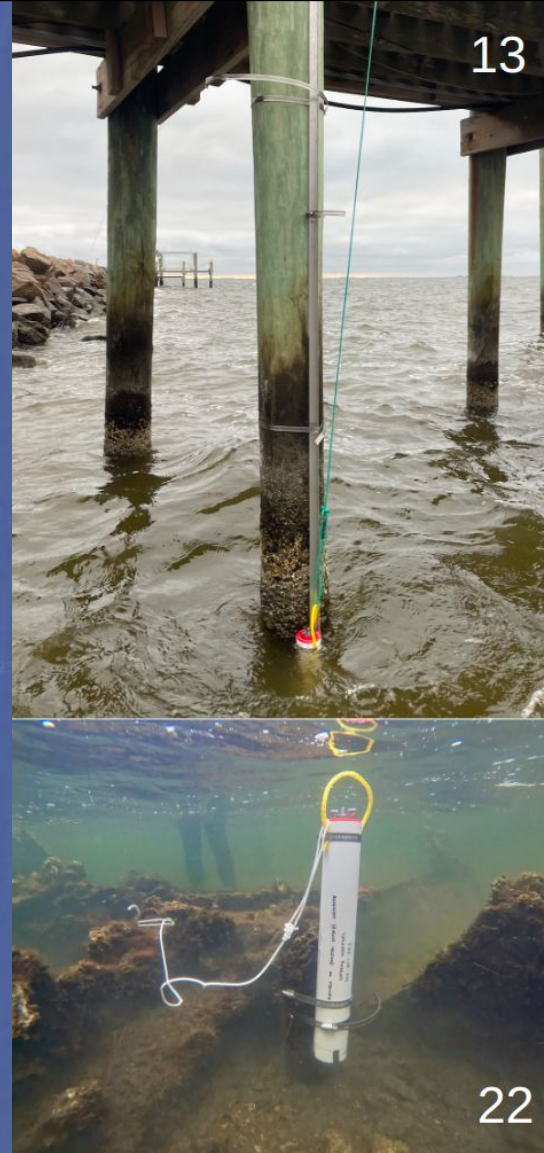
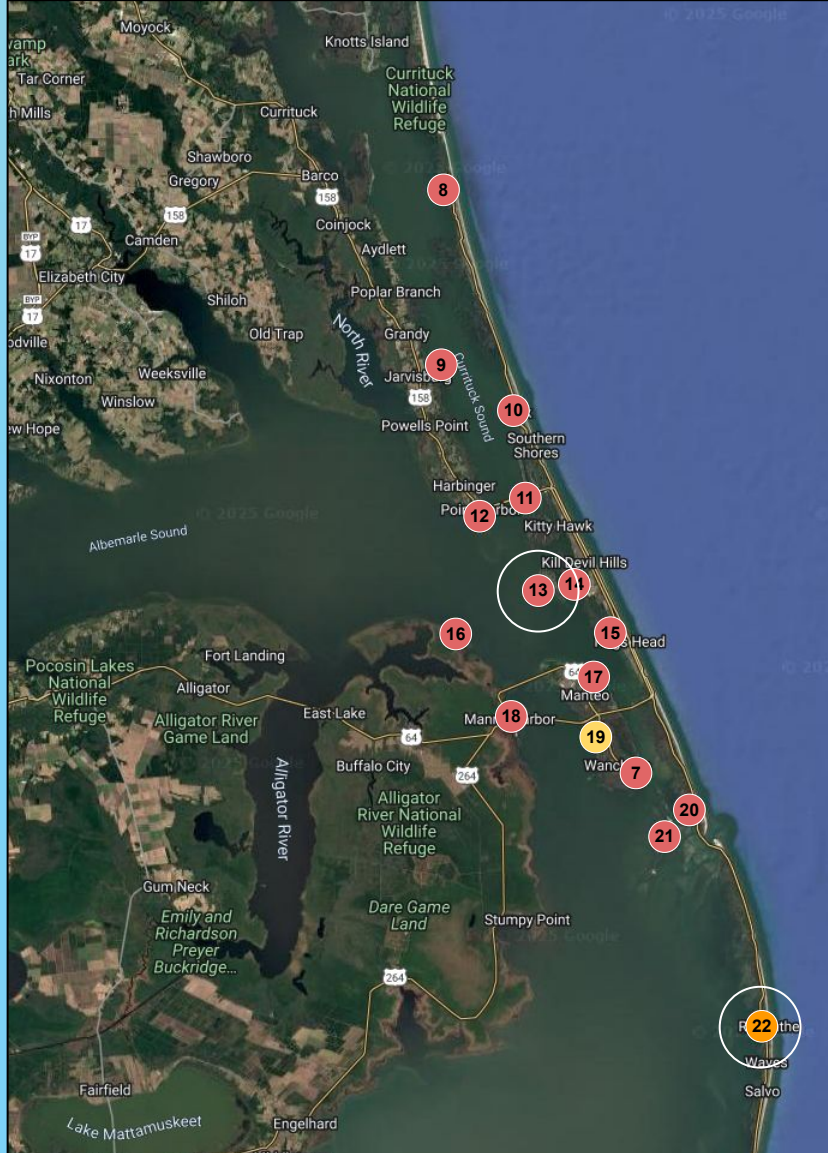
- ✓ Larger capacity battery
- ✓ Low power mode
- ✓ Limited power draw: 86+ days
- ✓ 20 Hz water level sampling
- ✓ Code for moored sampling: once every 5 minutes



- Wave generator produced 5cm wave height with 1s period.
- CTDs recorded different pressures due to varying sensor depths.
- Pressure signals misaligned from real-time clock offsets.



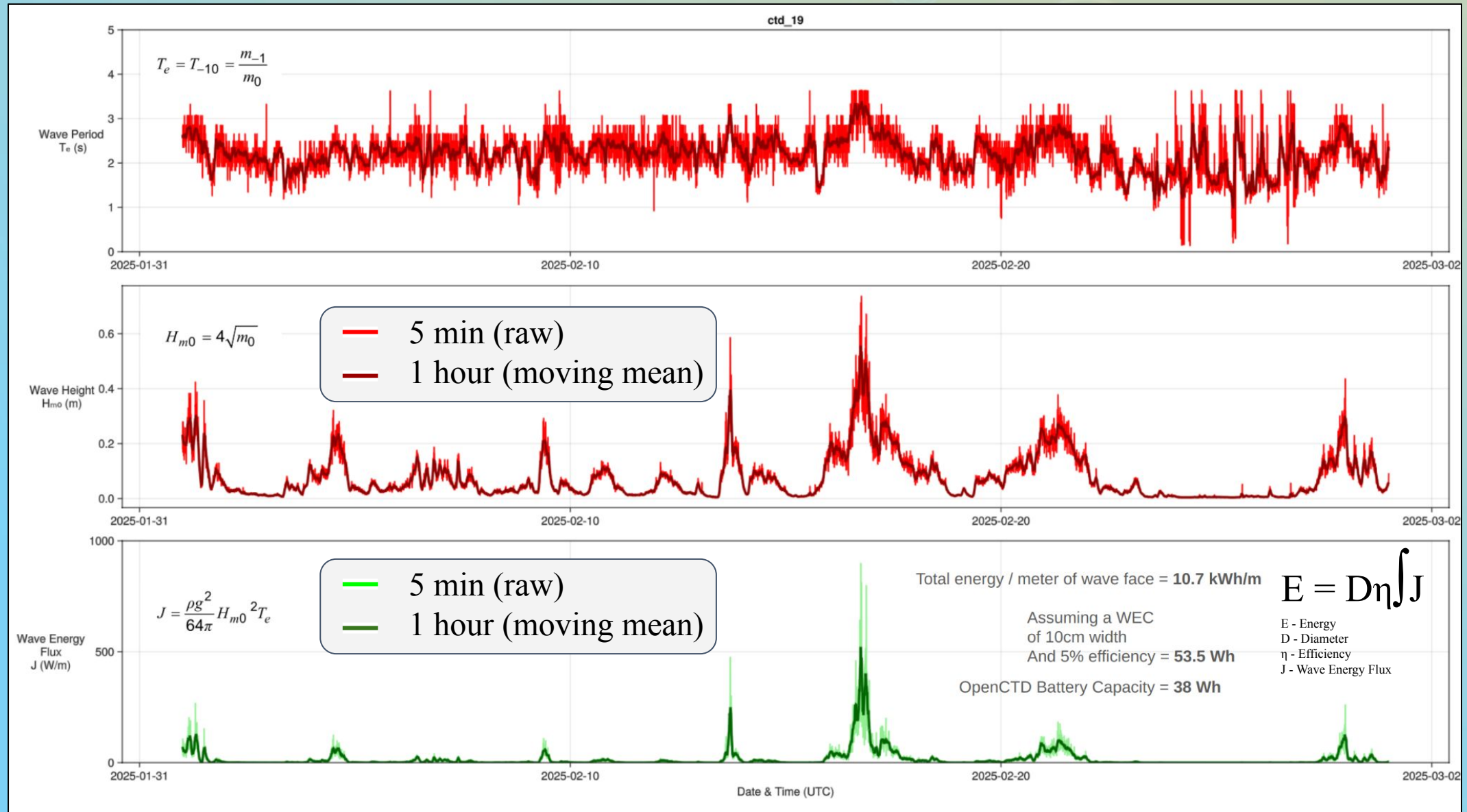
Deployment (Nov. 2024 - Mar. 2025)



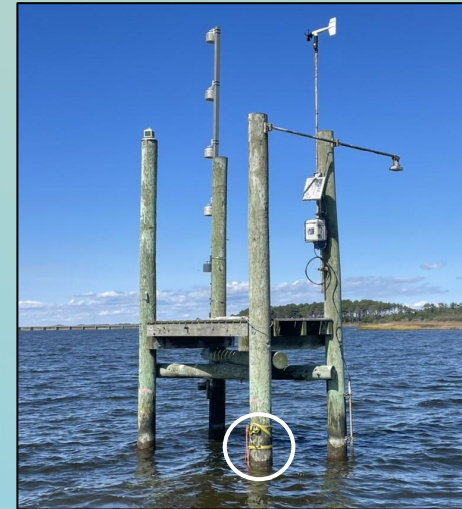
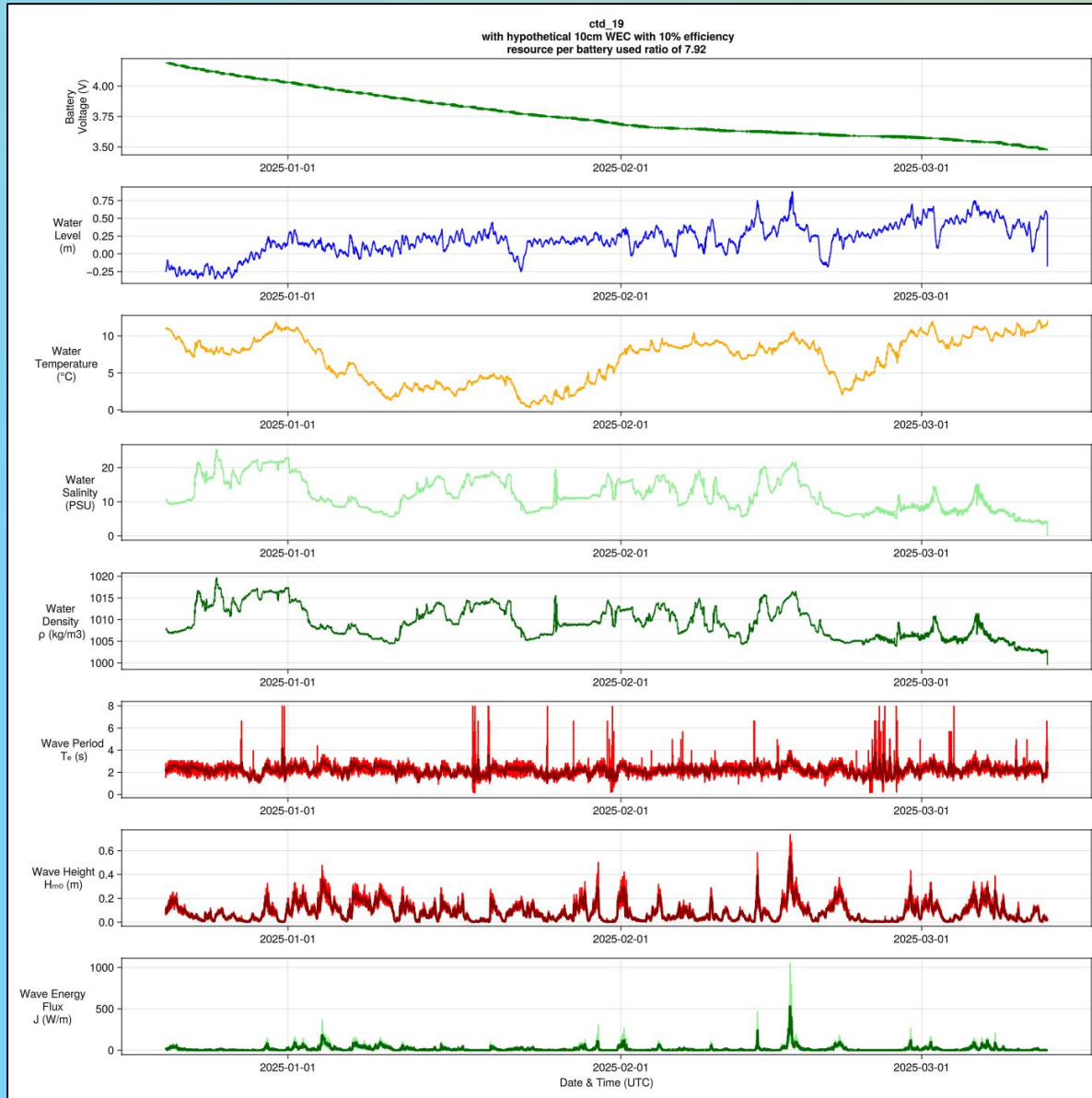
- Mid-November: 16 CTDs deployed
- Early-December: 6 recovered
- Late-December: All sites re-installed/serviced
- Mid-March: All sites recovered



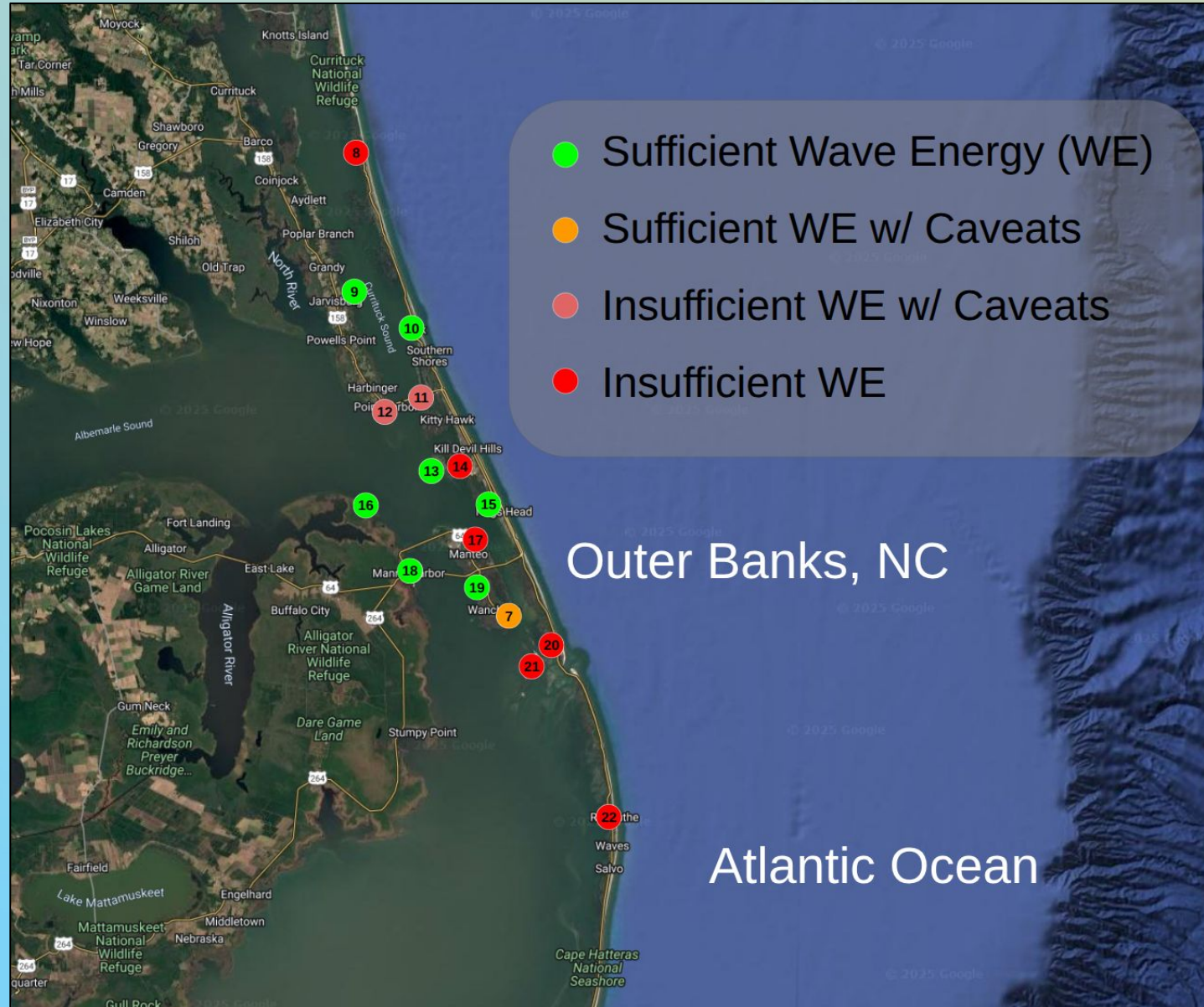
Results: Wave Characterization

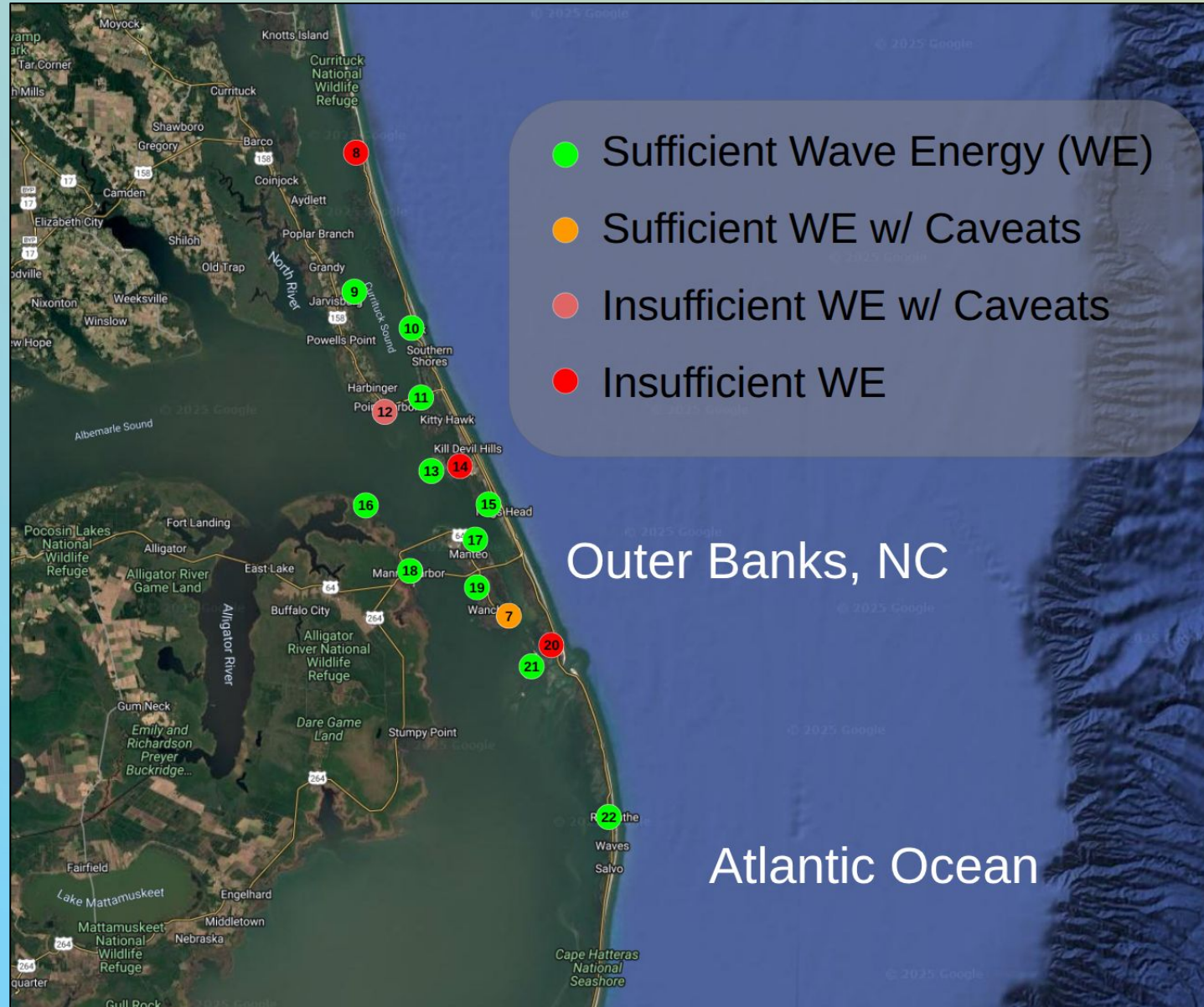


Results: Site Viability Analysis

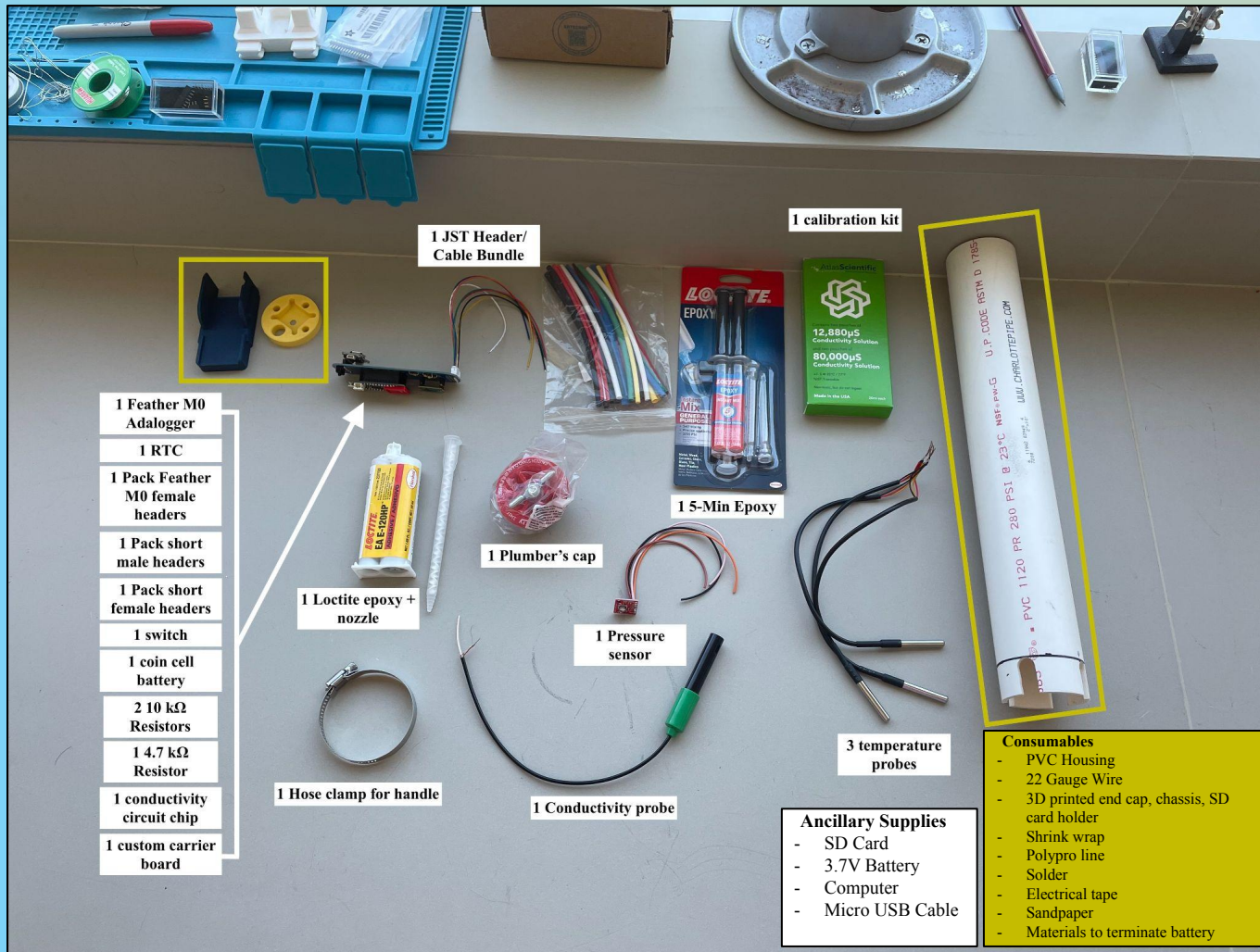


Site #	Location	WE/BE conservative (10cm + 10% η)	WE/BE reasonable (20cm + 20% η)
7	Wanchese	0.10	0.40
8	Corolla Light	0.22	0.87
9	Jarvisburg	4.62	18.49
10	Duck	2.04	8.15
11	Kitty Hawk	0.52	2.06
12	Powells Point	0.01	0.03
13	Colington	2.17	8.70
14	Colington	0.04	0.18
15	Nags Head	1.75	6.99
16	Mashoes	9.79	39.14
17	Manteo	0.48	1.91
18	Manns Harbor	7.39	29.55
19	Wanchese	7.92	31.68
20	Herring Shoal Island	0.06	0.22
21	Oregon Inlet	0.68	2.73
22	Rodanthe	0.92	3.69





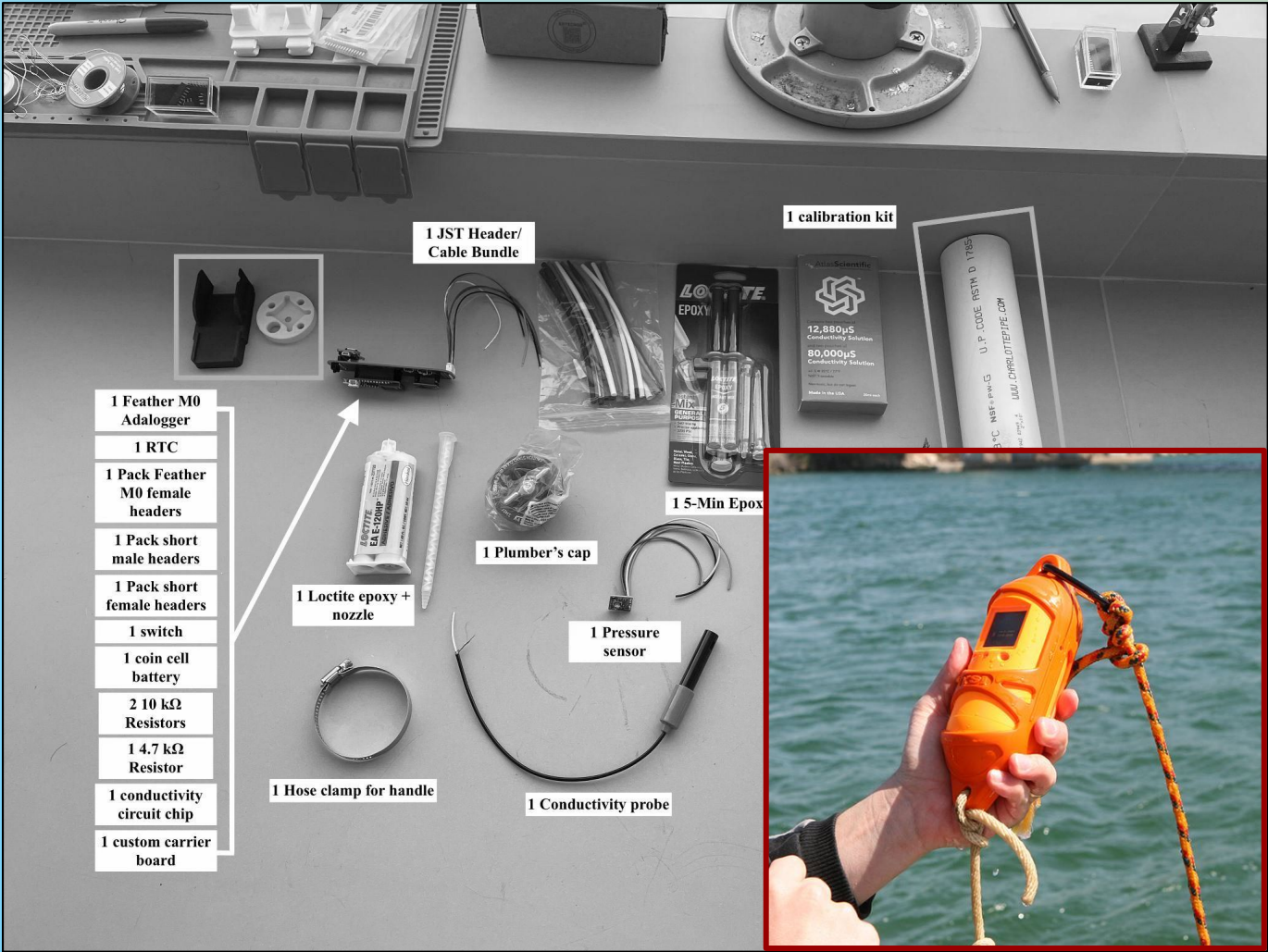
Impact: Accessible, Open, and Low-Cost



OpenCTD Materials & Supplies



Impact: Accessible, Open, and Low-Cost



OpenCTD Materials & Supplies



	Per Unit	Per 16 Units
OpenCTD Materials	\$381.15	\$6,098.40
Mount	\$47.42	\$758.72
Total	\$428.57	\$6,857.12
YSI SonTek CastAway-CTD	\$7,100	\$156,200

Landowner Engagement

- Citizen scientists and property impacts
- Interest in continuing and expanding study sites

Submerged Historic Properties

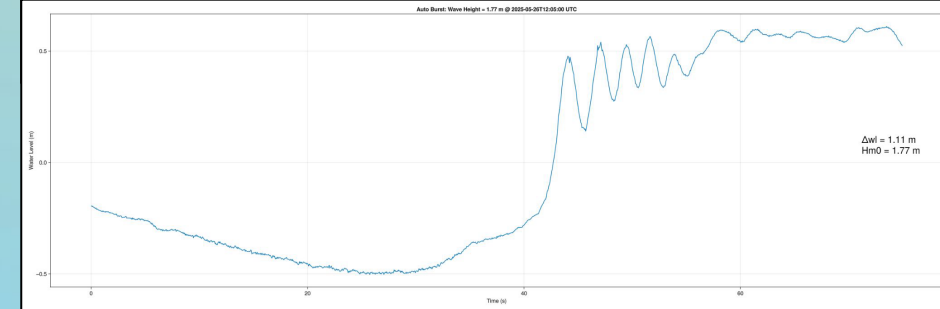
- Salinity/Temp → corrosion studies
- Waves → sedimentation studies
- Interest from NC UAB in expanding to state-wide monitoring

NC Aquaculture

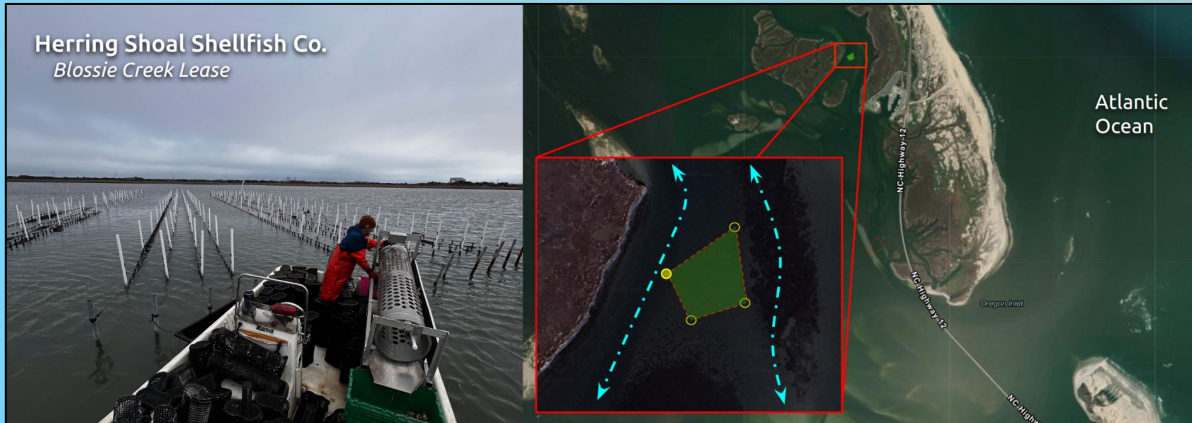
- Optimizing oyster harvest at peak salinity
- Interest in real-time salinity monitoring by local oyster farms

Integrating Marine Energy

- Future design and integration
- Some sites have demonstrated adequate wave power
- Limited battery draw



Herring Shoal Shellfish Co.
Blossie Creek Lease



Thank you!

Lindsay Wentzel
wentzell23@ecu.edu

Trip Taylor
taylorp@ecu.edu



North Carolina
Renewable Ocean
Energy Program

Oceanography
for Everyone

**Images courtesy of presenting authors, John McCord,
Parker Murphy, Lauren Kerlin, and Jeremy Borrelli.*

