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A validated finite element modeling tool for hydrodynamic loading and structural analysis of ocean deployed macroalgae farms

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“A validated finite element modeling tool for hydrodynamic loading and structural analysis of ocean deployed macroalgae farms”

Or

“Designing seaweed farms for really big waves and currents using computers and real farms together”



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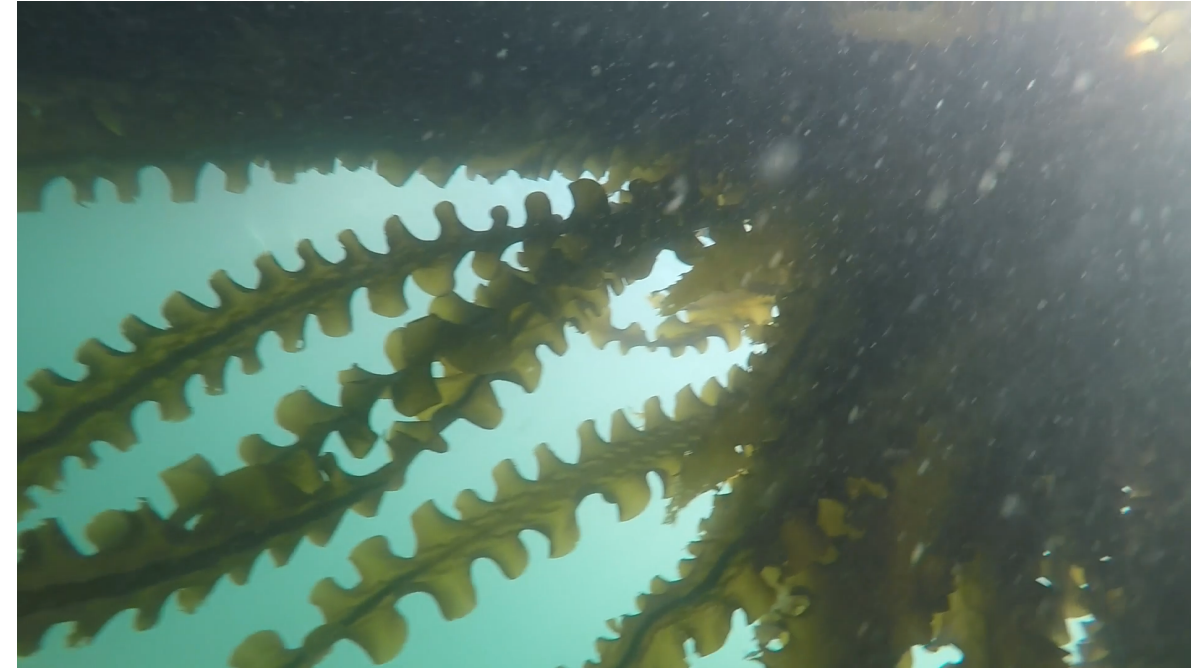
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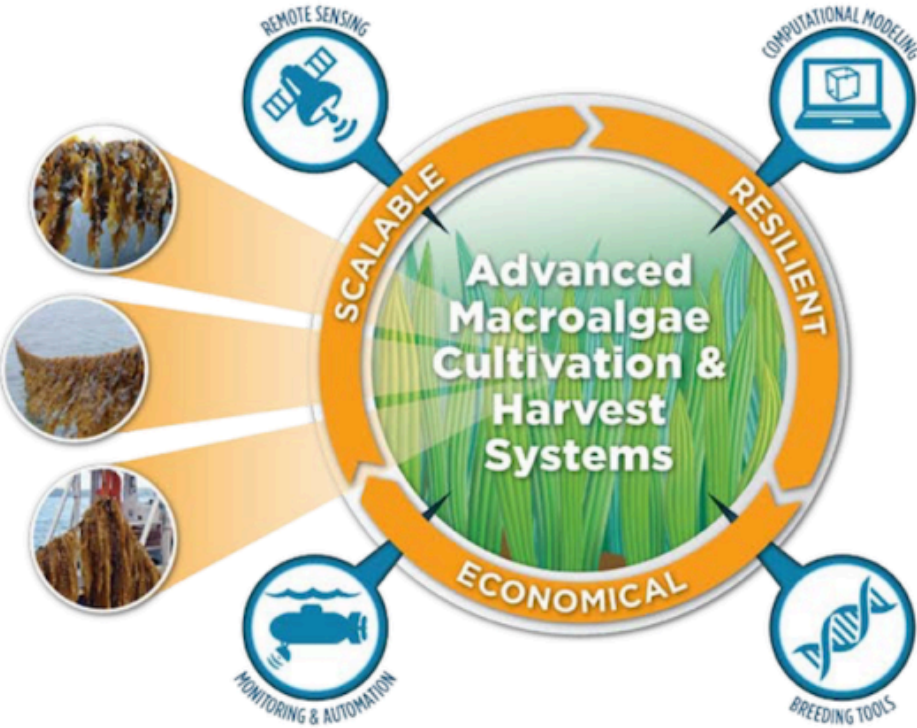




Advanced Research Projects Agency • ENERGY

MARINER

MacroAlgae Research Inspiring Novel Energy Resources



Macroalgae Biomass:

No Land

No Freshwater

No Fertilizer

MARINER creates new biomass production opportunities for the vast ocean resources of the United States.

Photos copyright (top to bottom):
Diana Barboiu/National Geographic, The Island Institute, Steve Smith/Washington Post

ARPA-E estimates the United States has suitable conditions to produce >500 million dry metric tons of macroalgae per year.

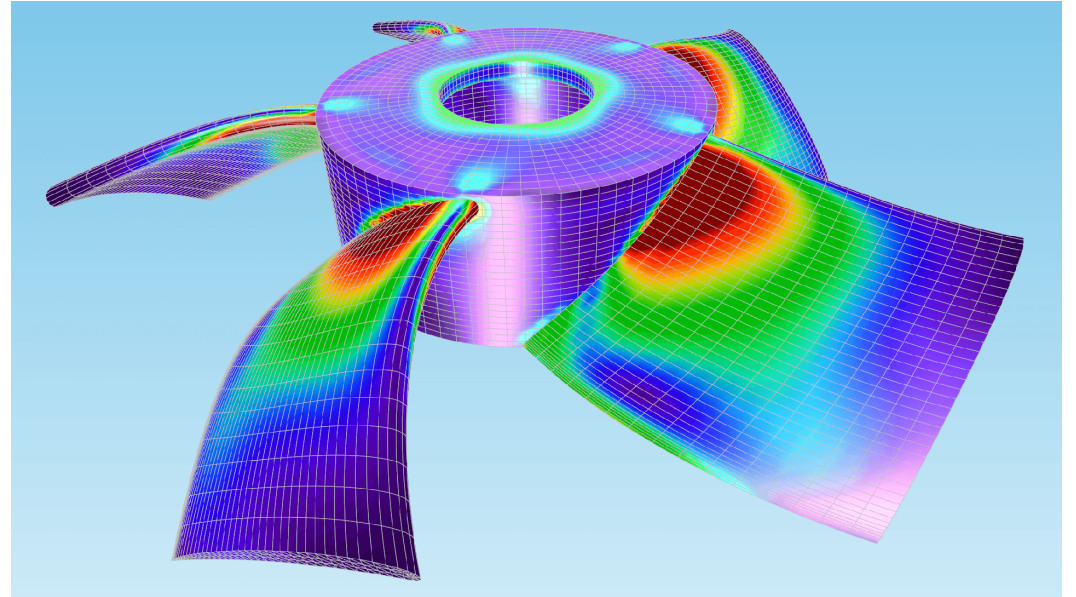
Could yield about 2.7 quadrillion BTUs (quads) of energy; roughly 10% of the nation's annual transportation energy demand.

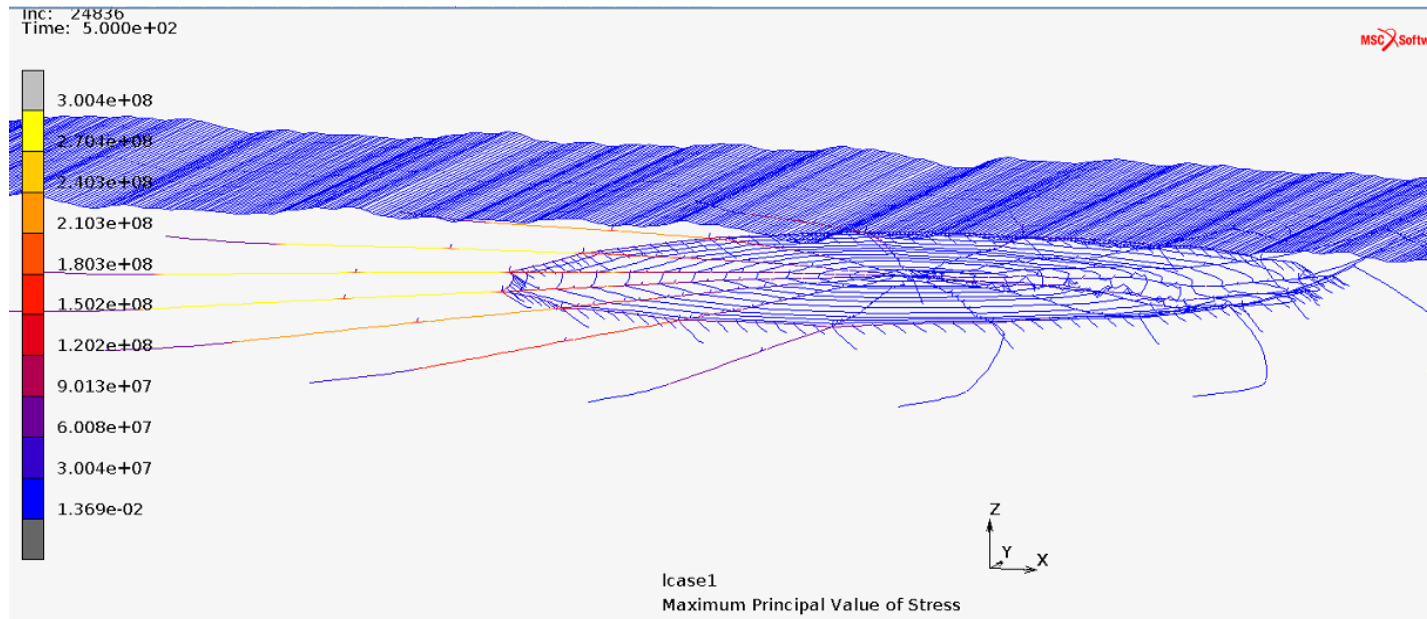
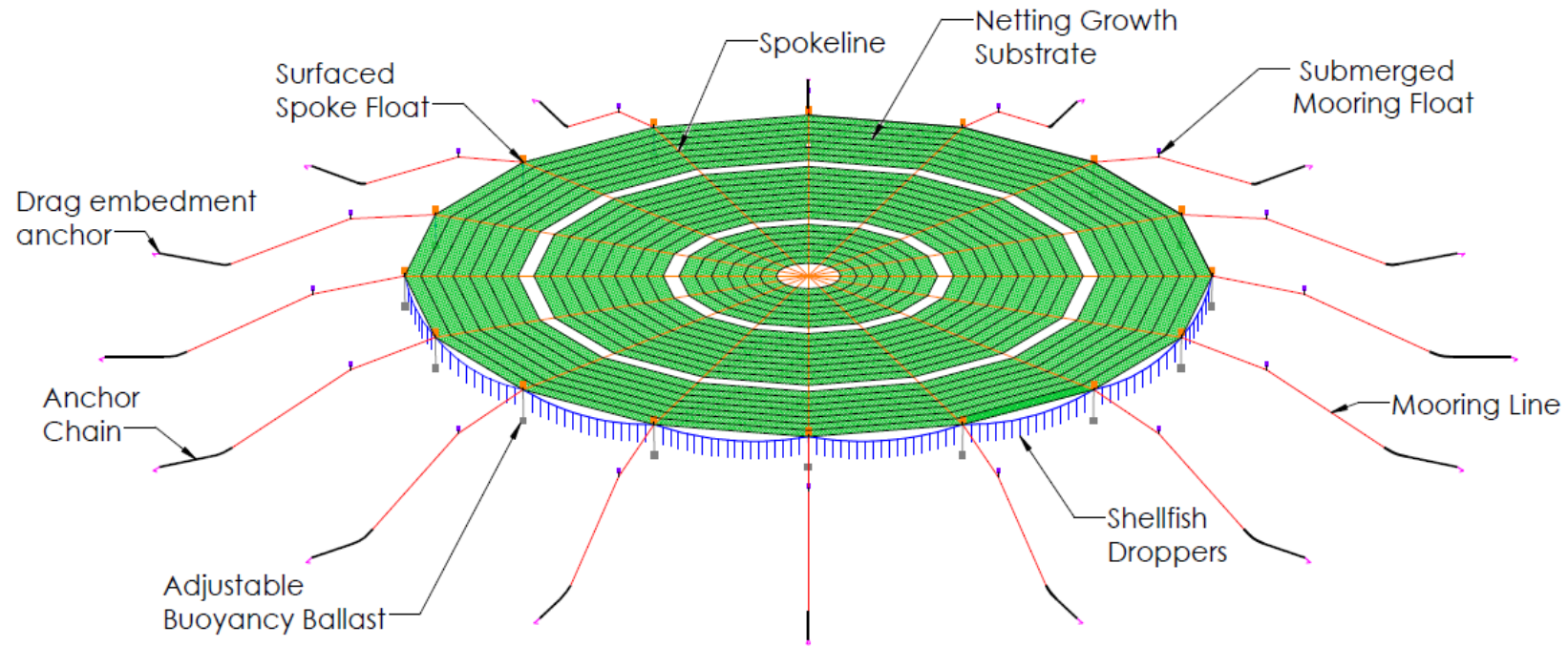
Projects seek to develop the tools to enable the United States to become a global leader in the production of marine biomass.

“A validated finite element modeling tool for hydrodynamic loading and structural analysis of ocean deployed macroalgae farms”

“The finite element method is the most widely used method for solving problems of engineering and mathematical models. Typical problem areas of interest include the traditional fields of structural analysis, heat transfer, fluid flow, mass transport, and electromagnetic potential.”

–Wikipedia



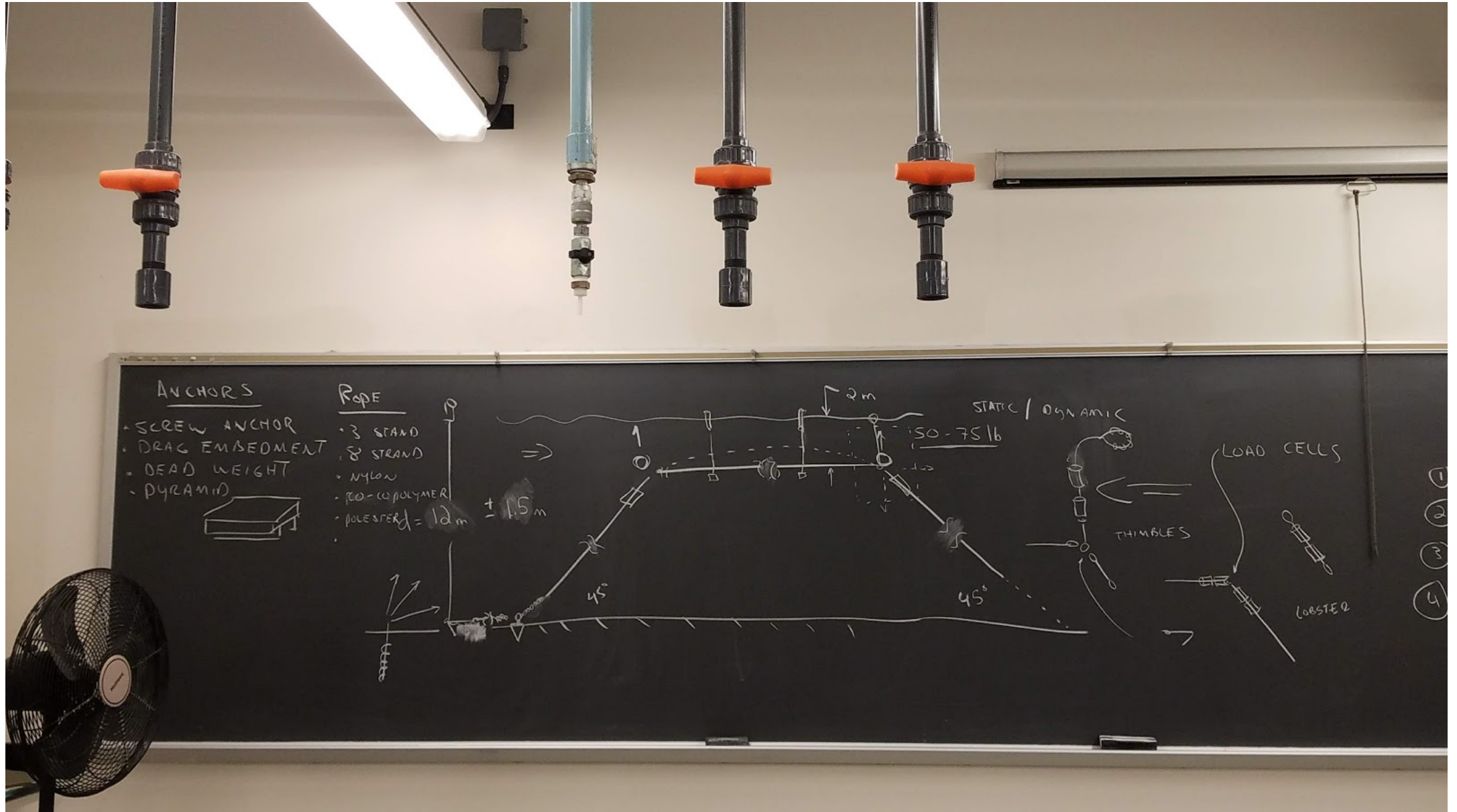


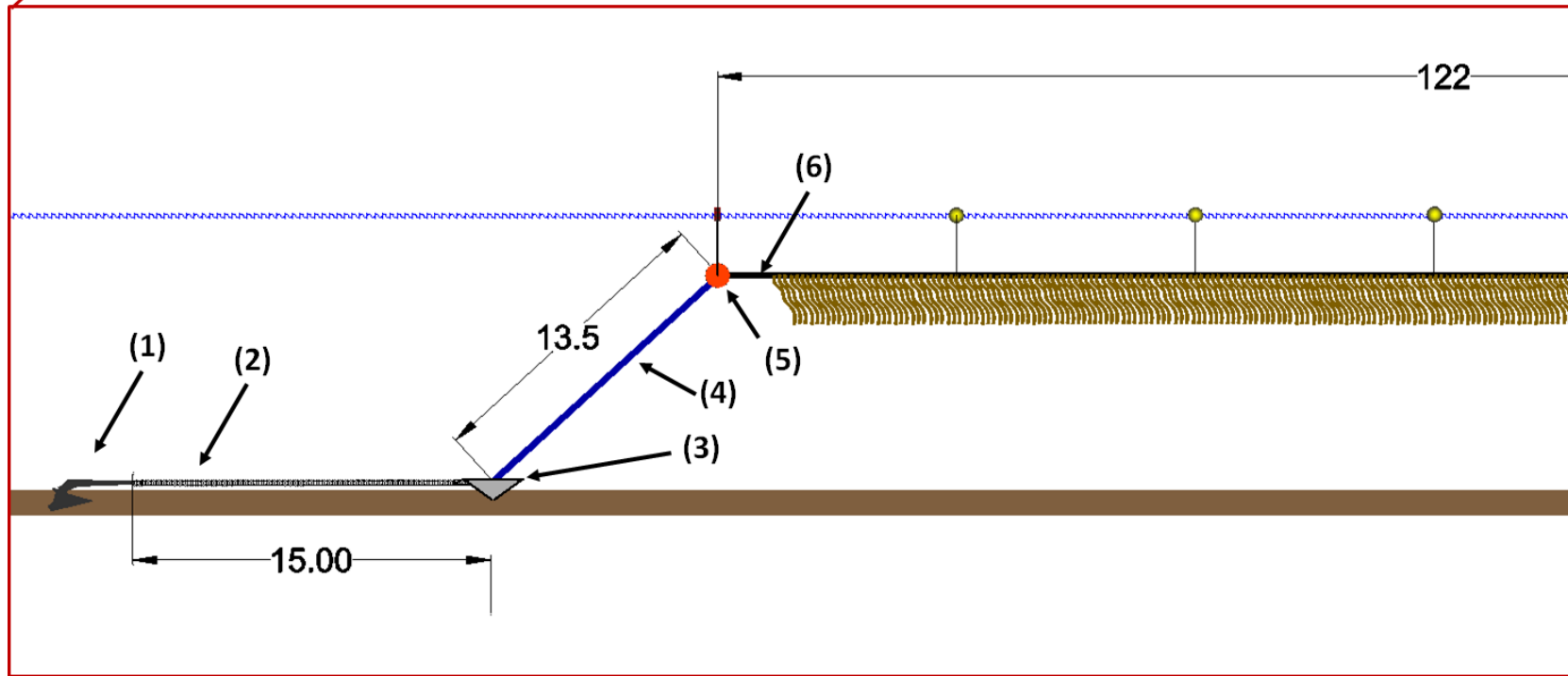
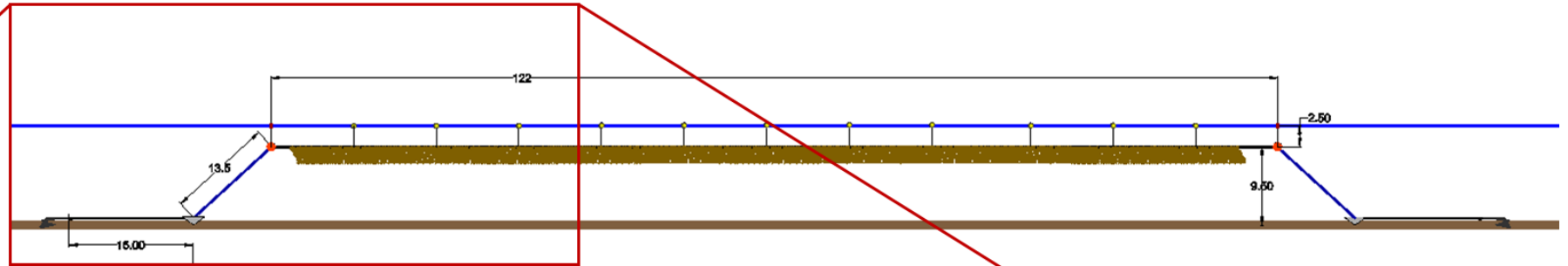
Design Process & Criteria

- No divers
- Limit max weight 250lbs
- Limited hardware
- Cost conscious
- Locally available supplies
- Mobile and removable
- Ease of deployment and access

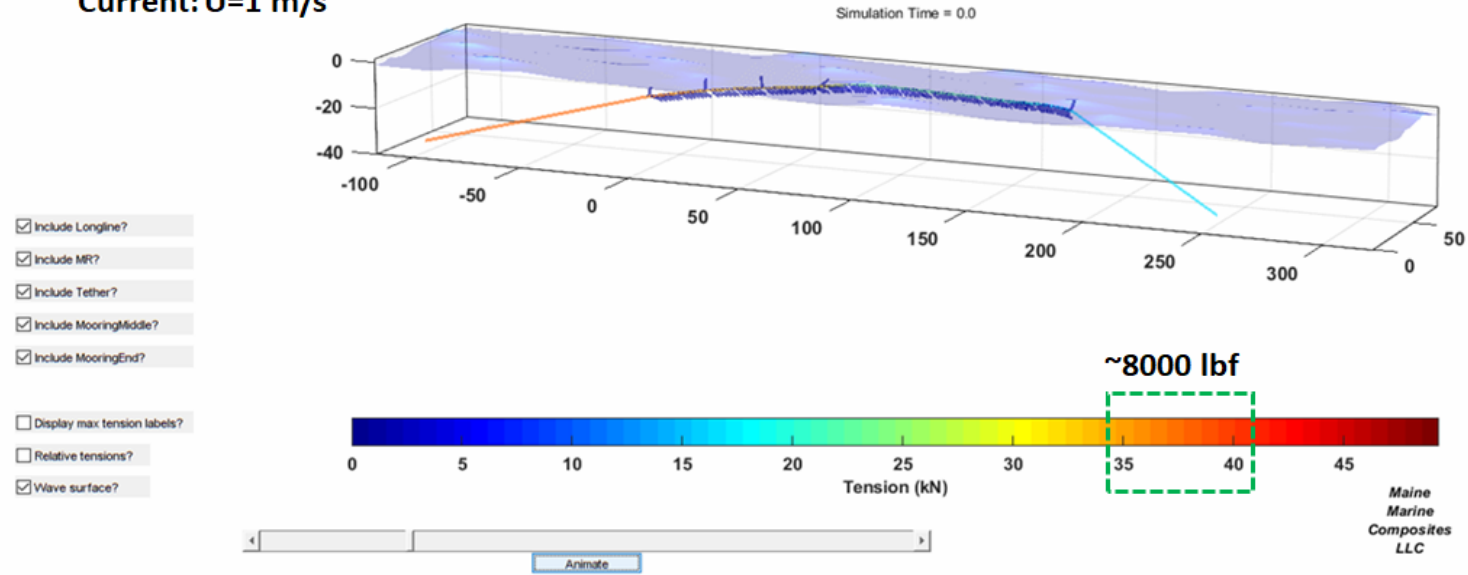


System Design from Chalkboard to Circuit board

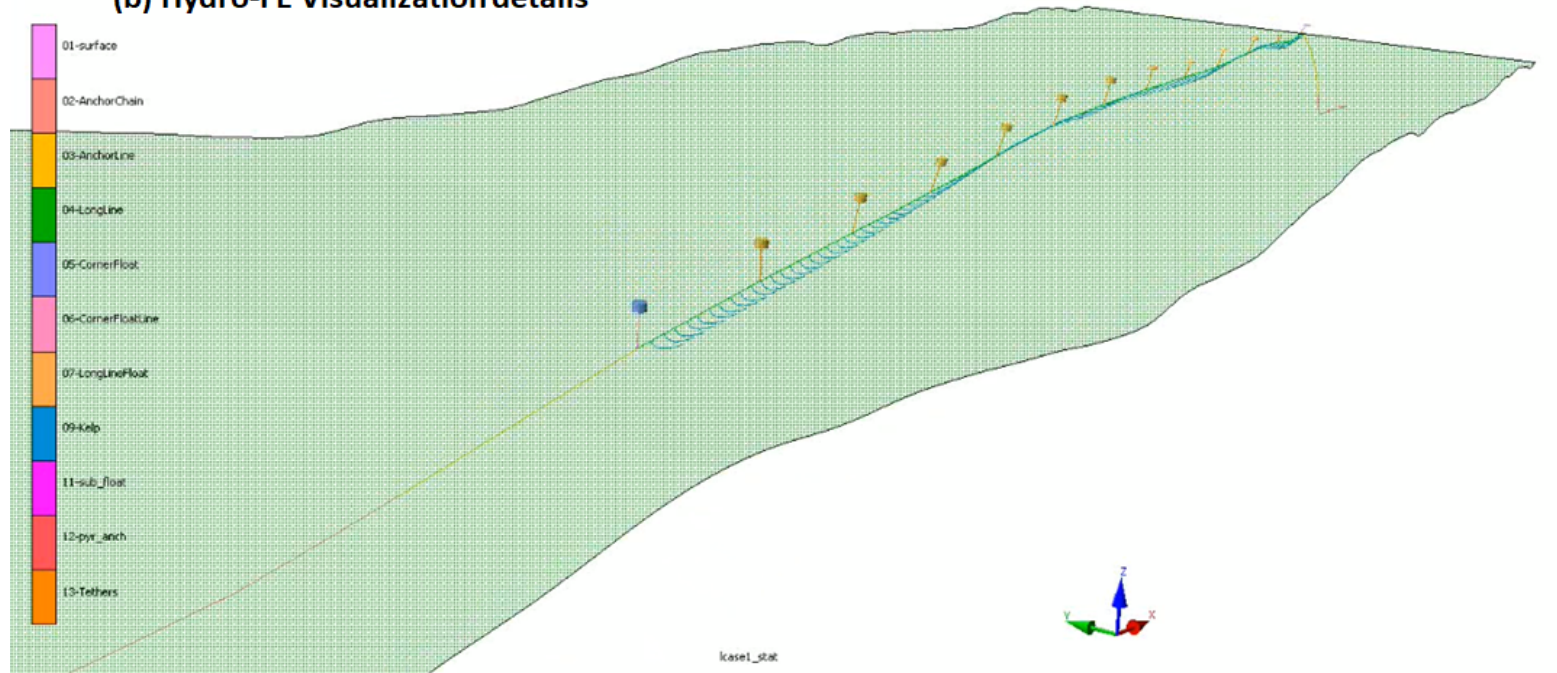


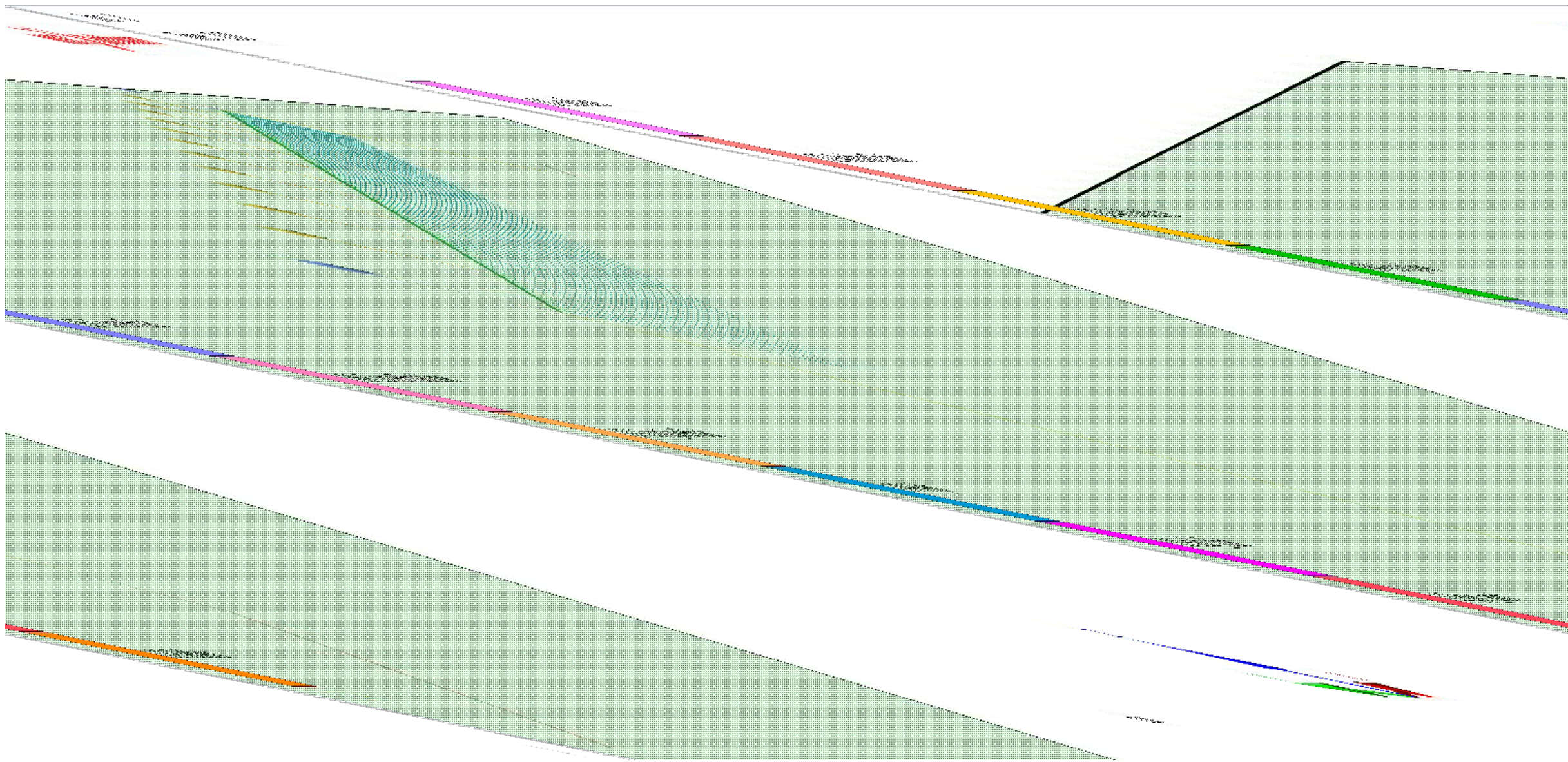


(a) **50-yr storm:**
 Waves: $H_{m0}=4.2$, $T_p=11$,
 Current: $U=1$ m/s

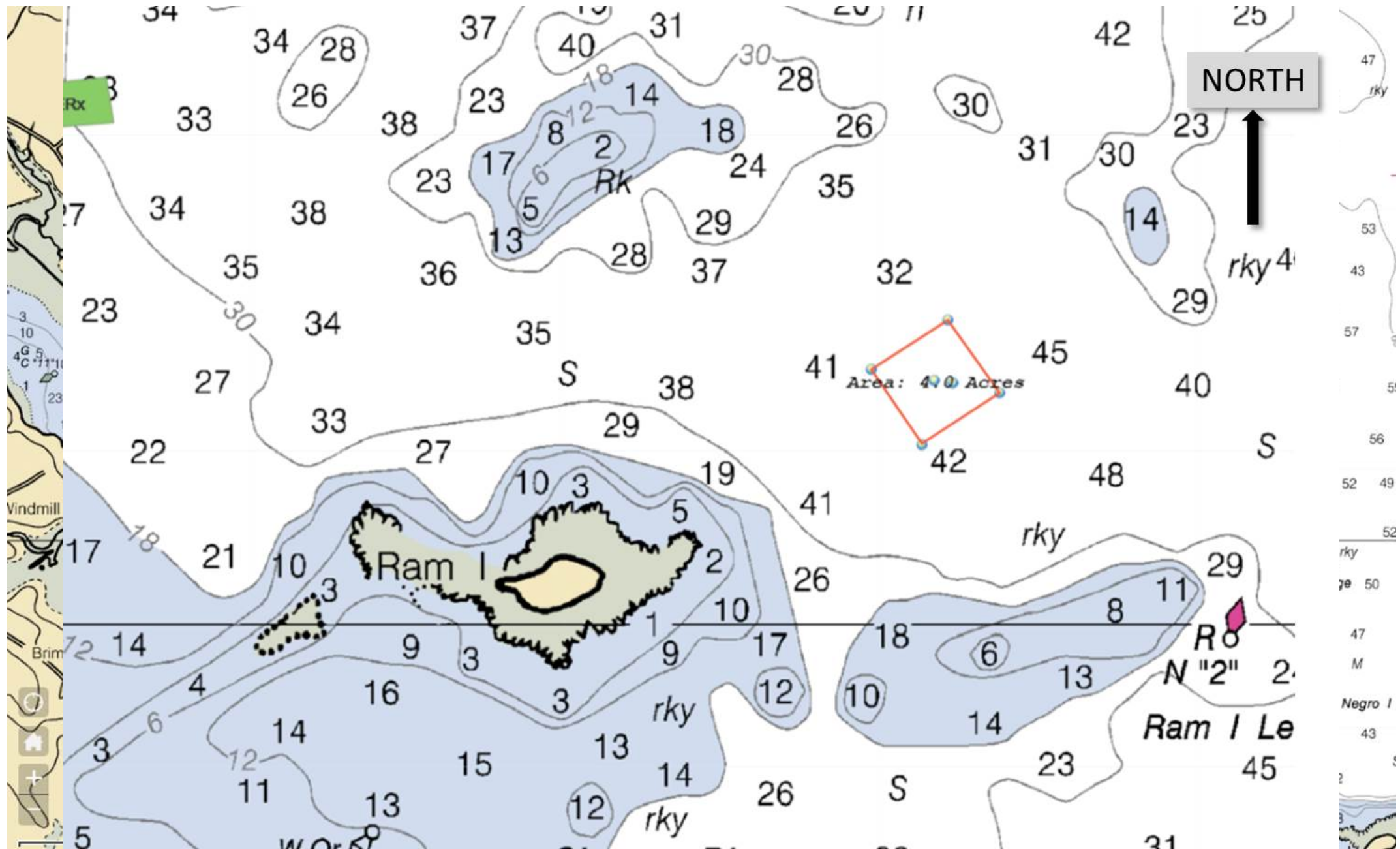


(b) **Hydro-FE Visualization details**

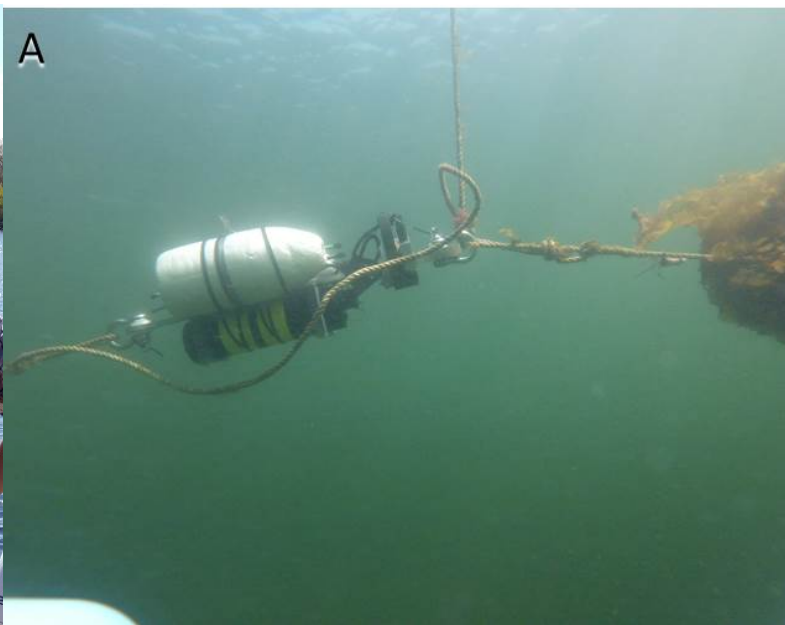
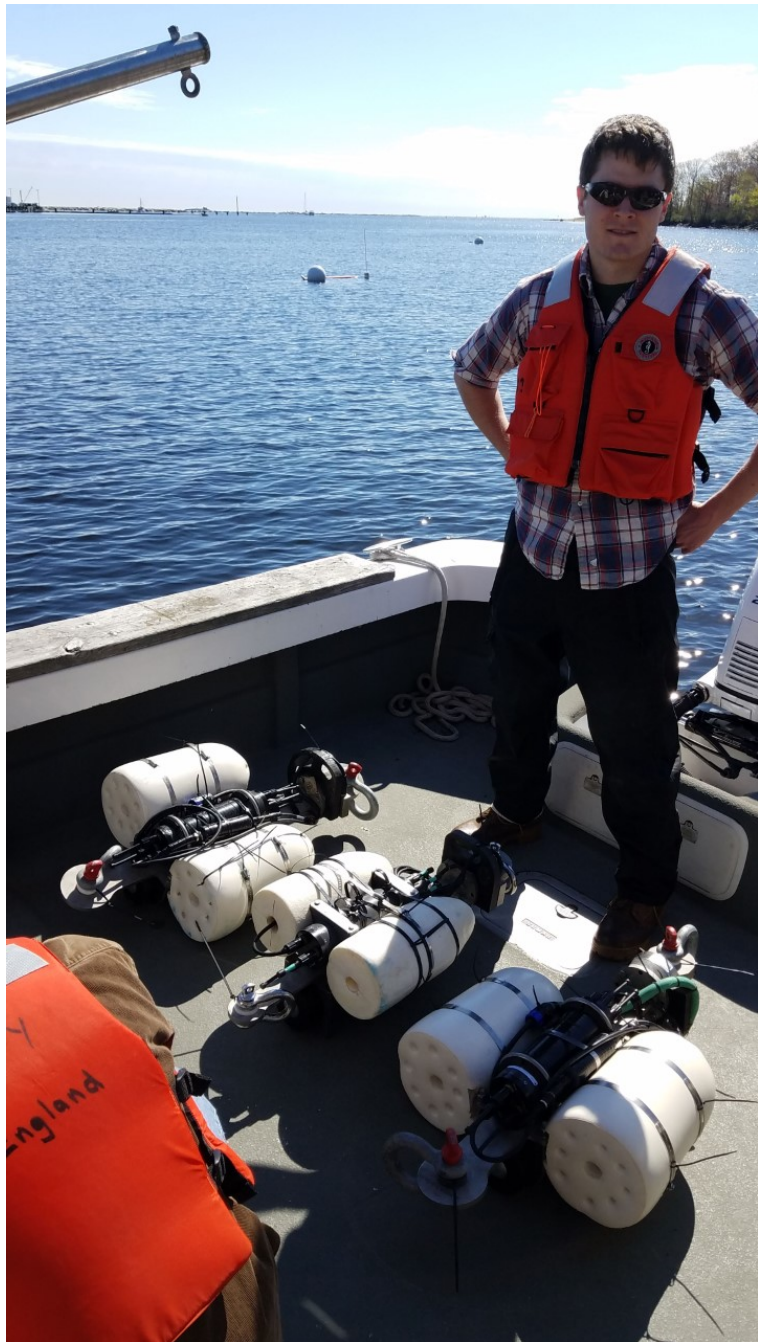


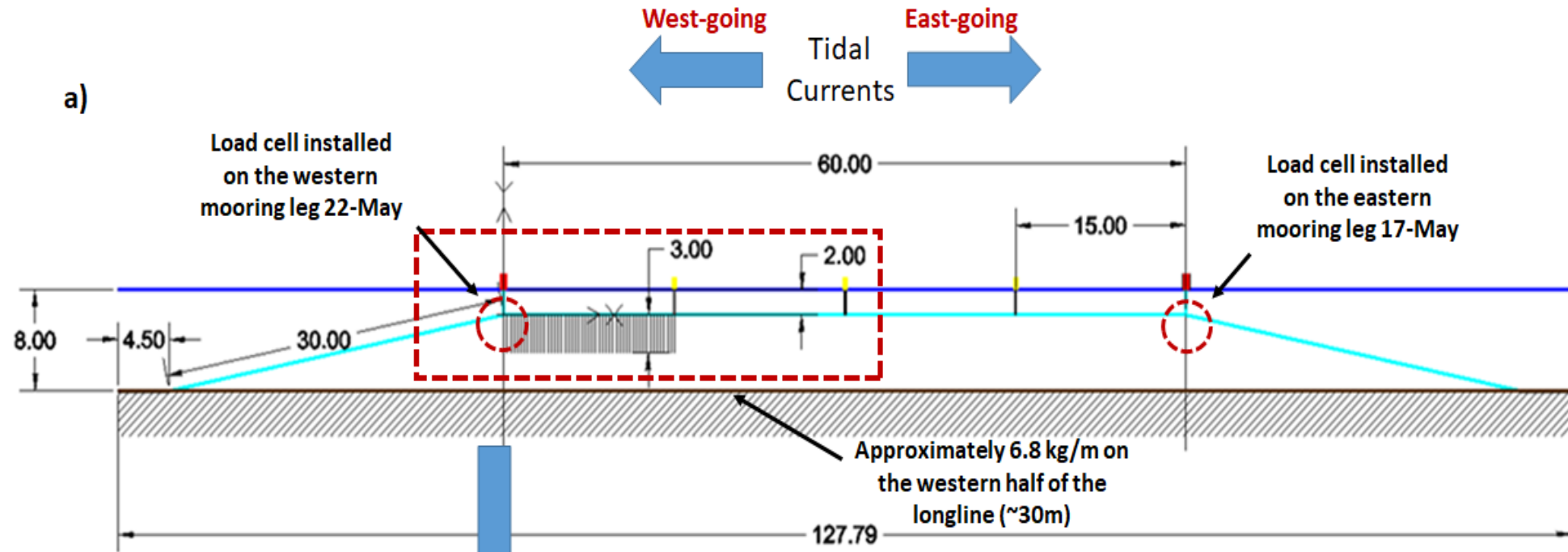


Model Validation



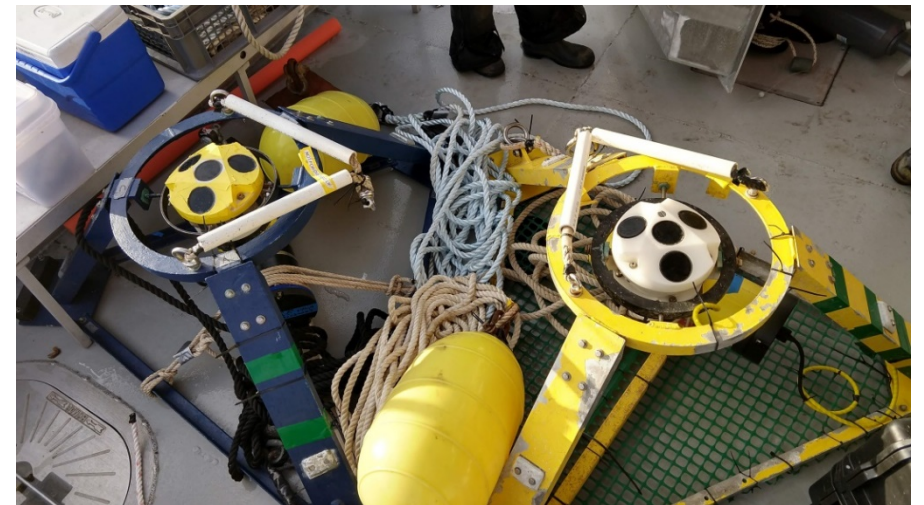
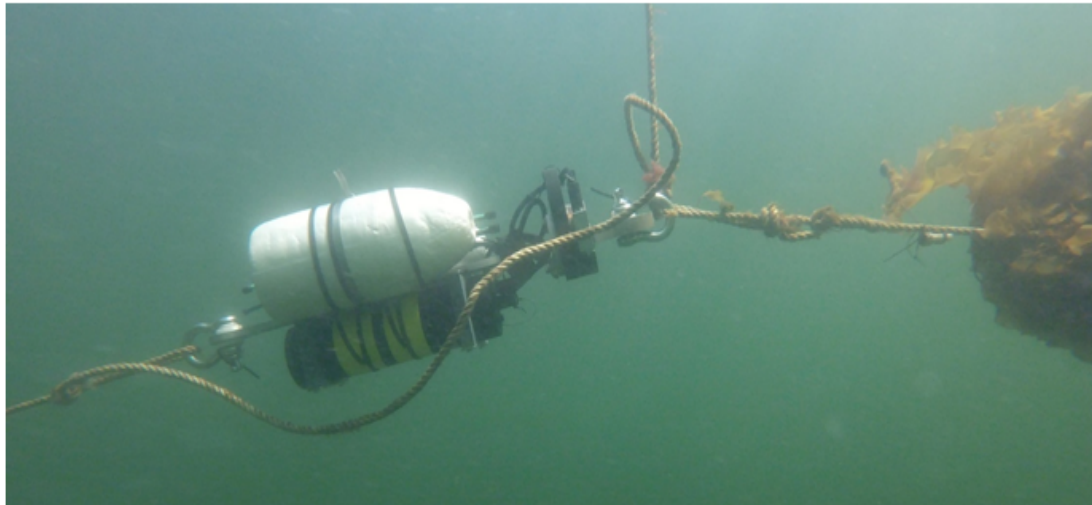


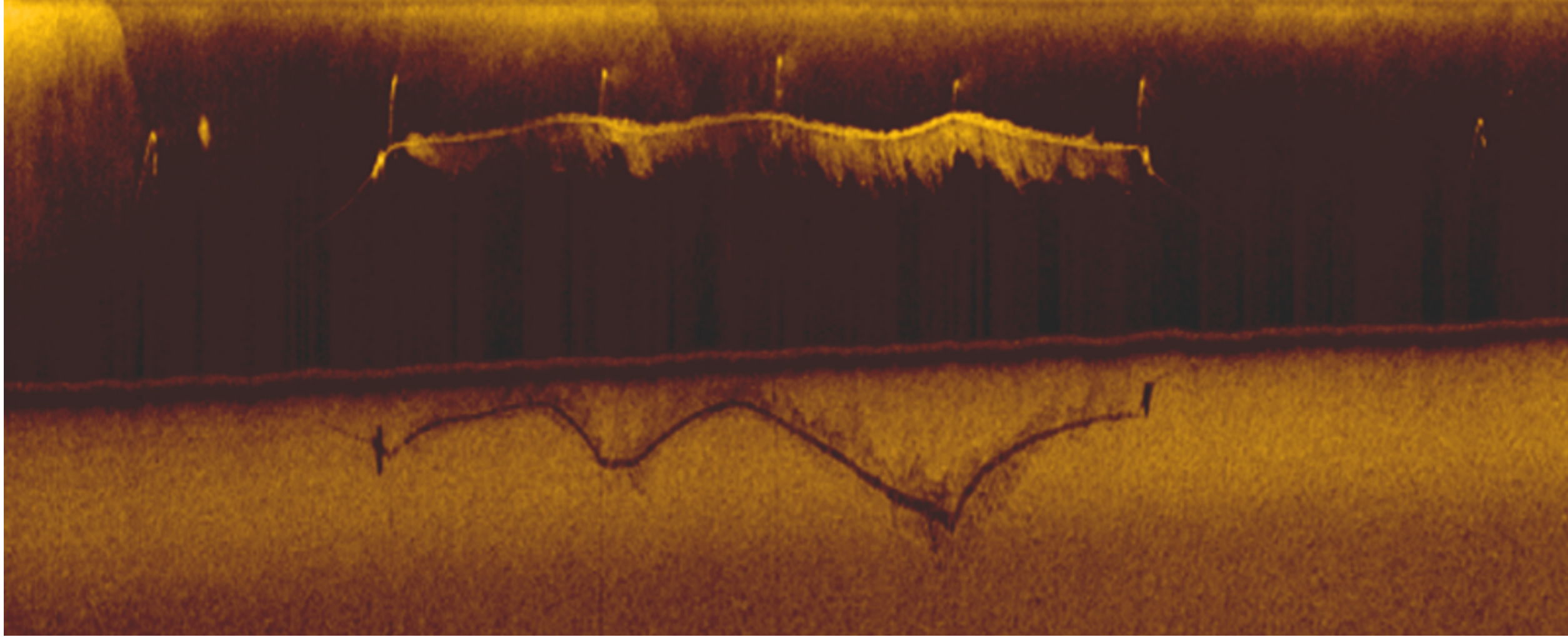




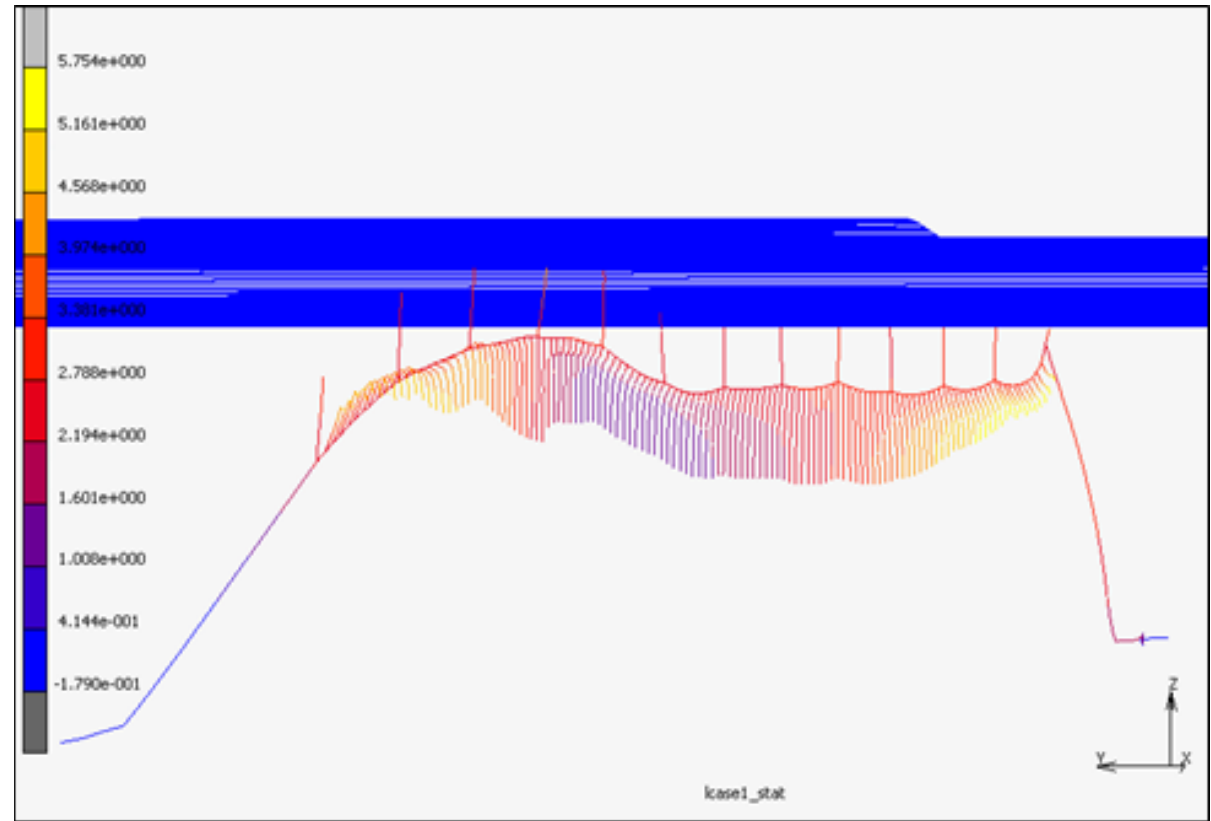
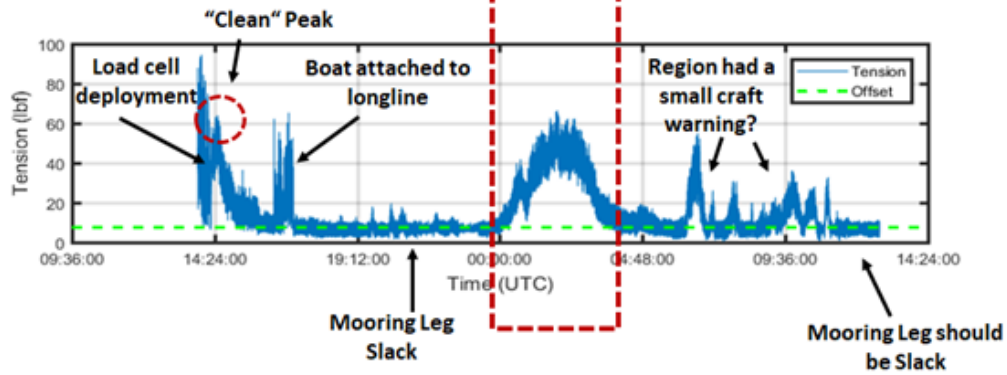
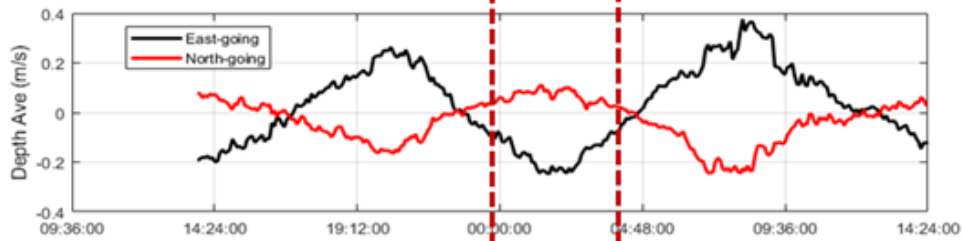
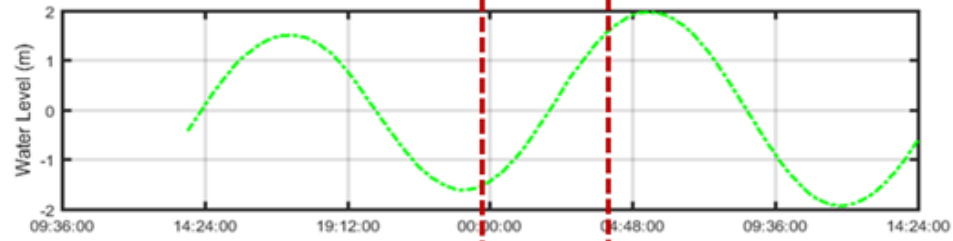
b)

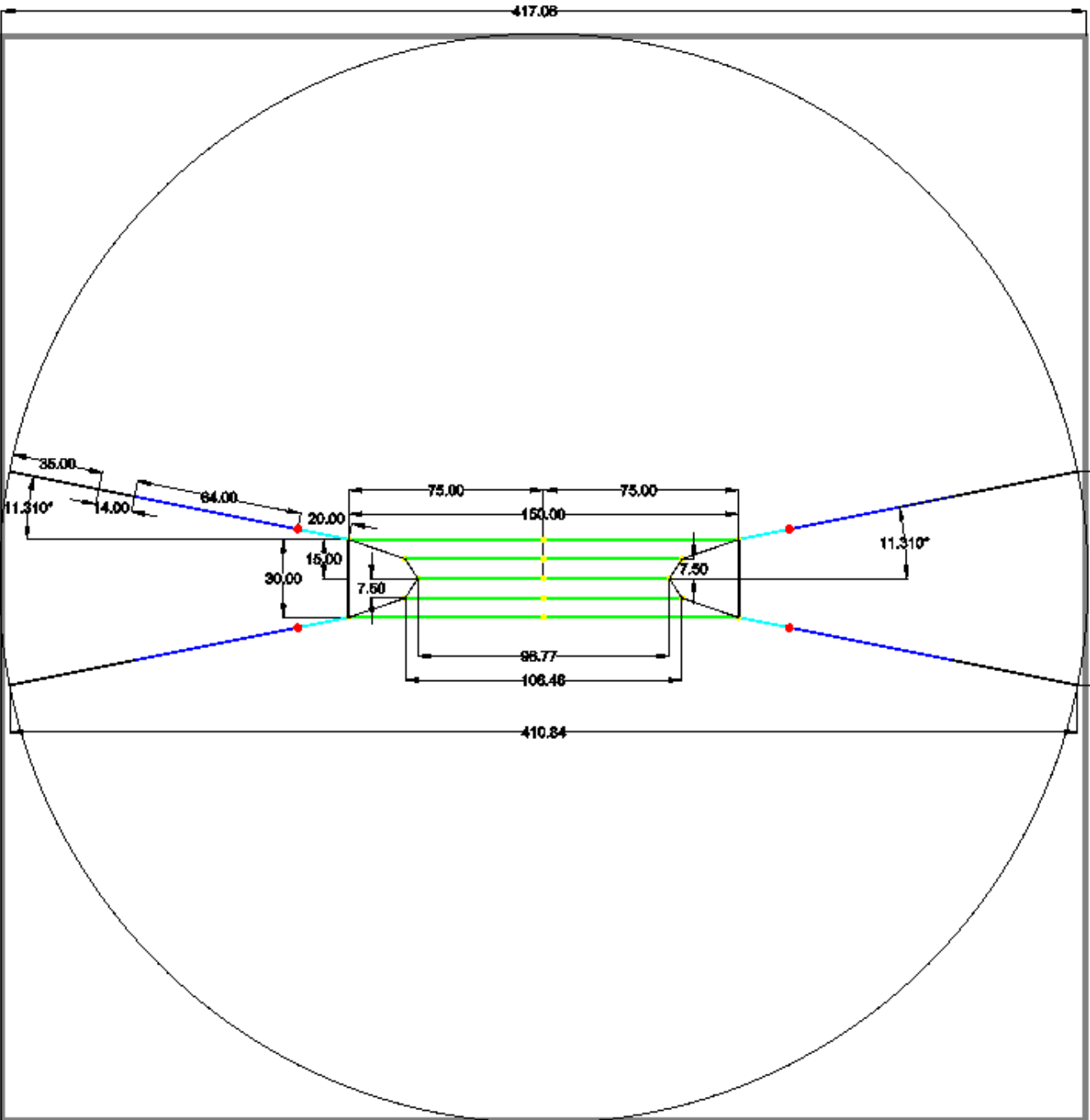
All Dimensions are in meters



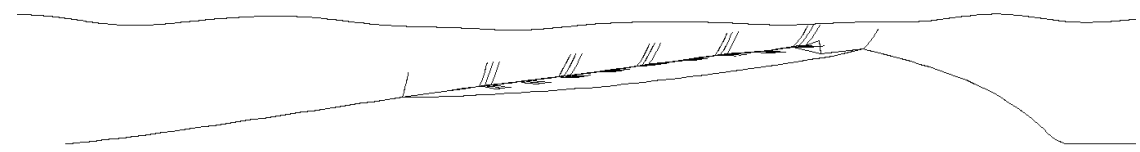


Appears to be
"clean" data

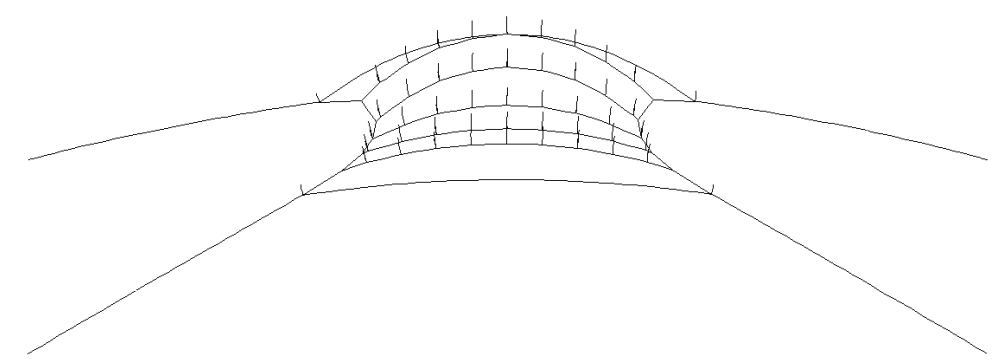


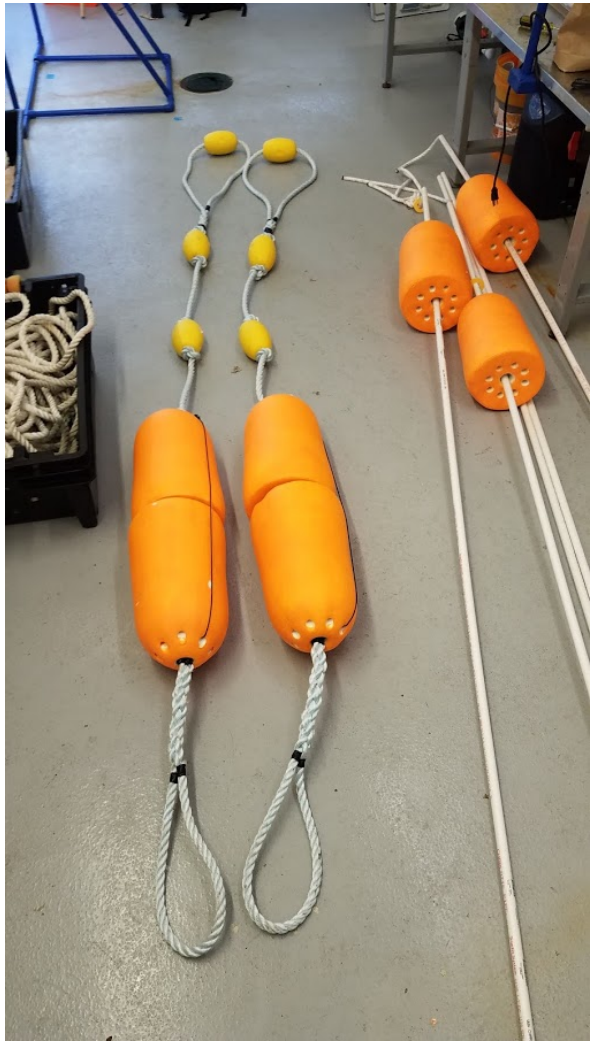


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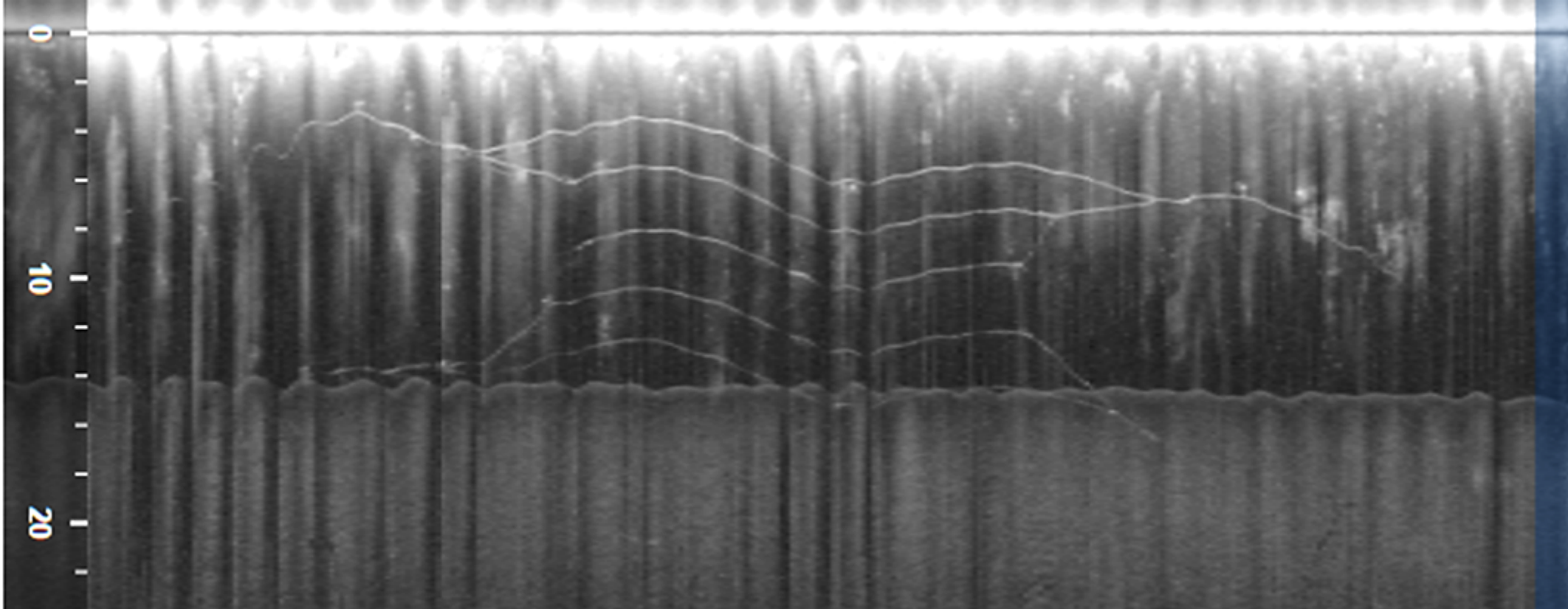


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Thanks for listening!

