An Estuary in Real Time: Hatfield's Coastal Monitoring Station

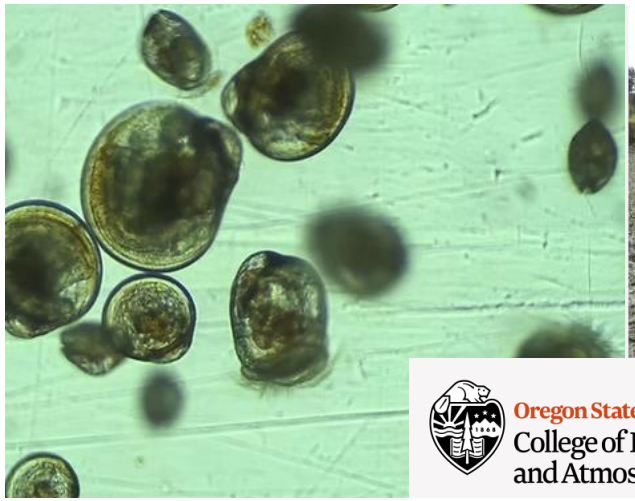
MBARI EARTH 2025

Newport, OR

Marnie Jo Zirbel
Research Facilities Coordinator
HMSC, OSU

Marine Science at Sea
1995-2024

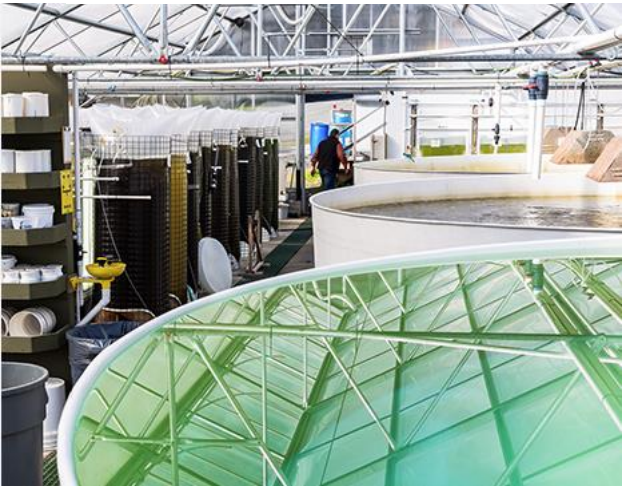
Oyster Hatcheries and Ocean Acidification 2017-2021



Oregon State University
College of Earth, Ocean, and Atmospheric Sciences

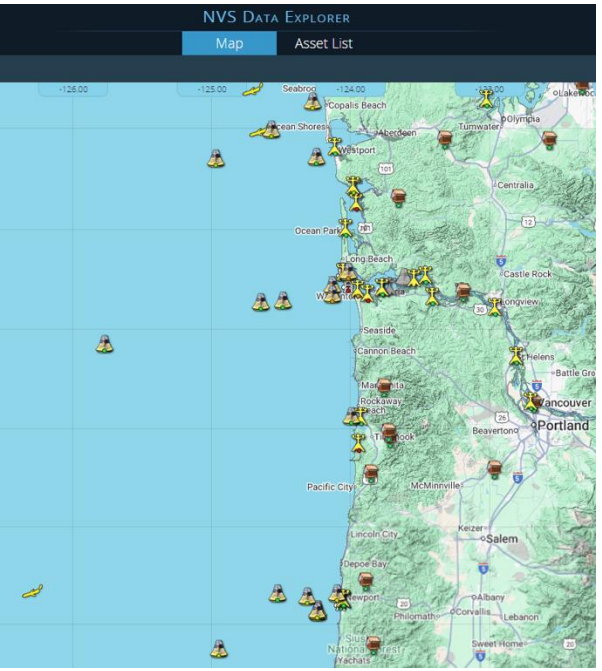
SINCE TAYLOR SHELLFISH 1890 Farms

WHISKEY CREEK SHELLFISH HATCHERY

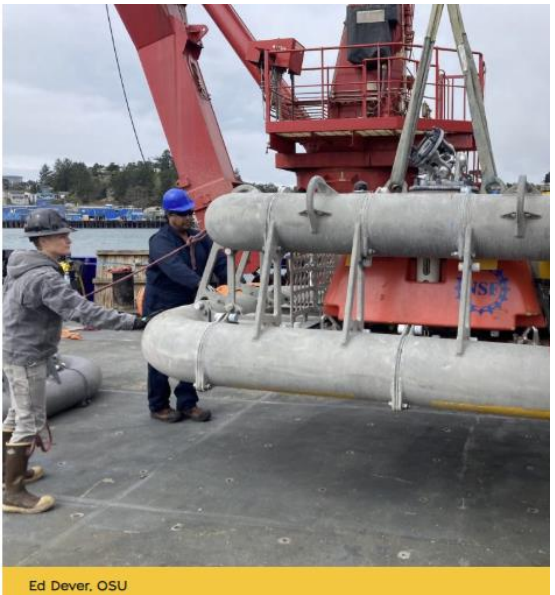


Ocean Observatories Initiative (OOI)

2017-2024

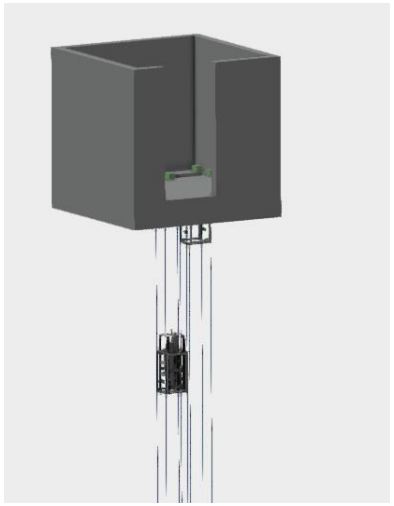


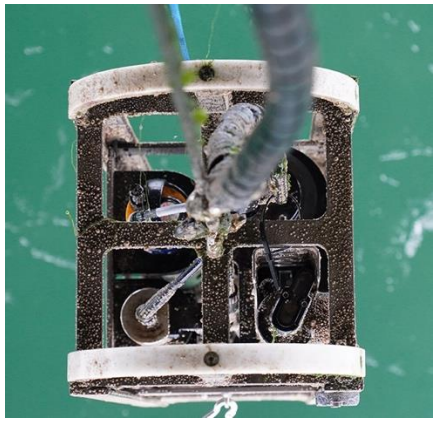
Credit: Kim Kenny. OSU.

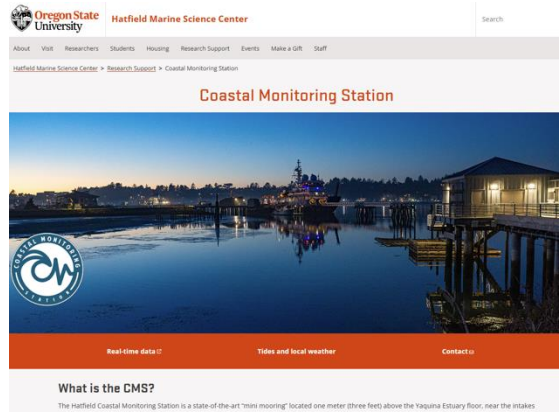


Ed Dever, OSU

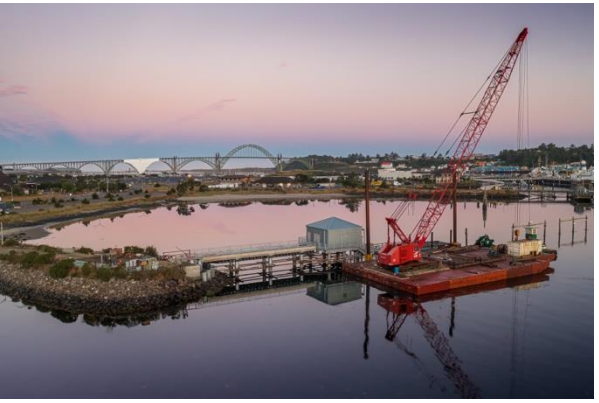
CMS Build Timeline







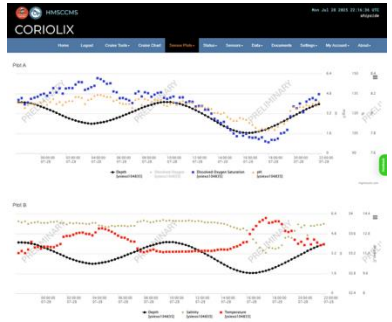
2021



2022

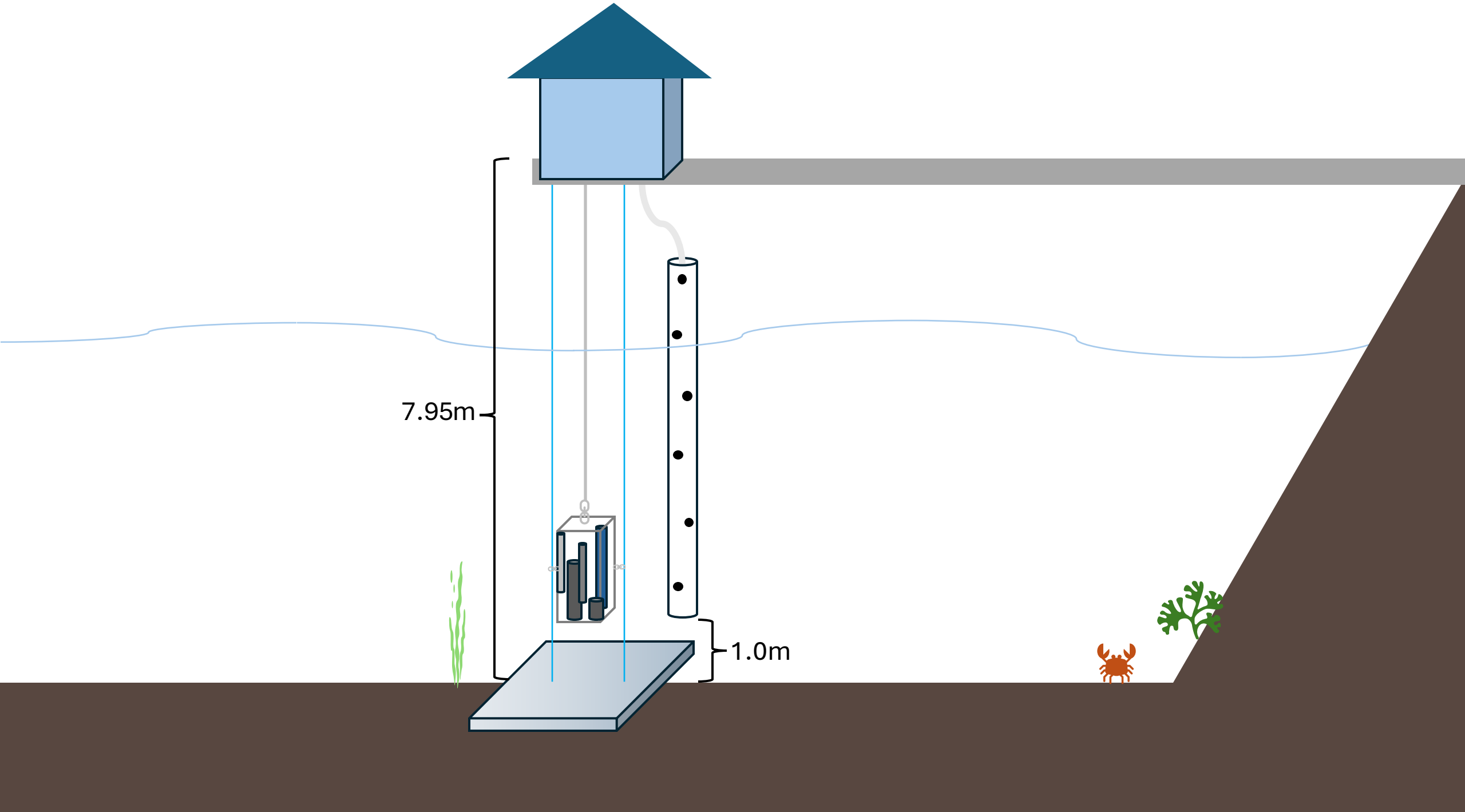
2023

2024



2025

But what *is* the CMS?


7.95m
1.0m

CMS Instruments

YSI EXO Sonde

Estuary monitoring workhorse:

-Salinity
-Temperature
-Depth (tide)
-pH
-Dissolved oxygen
-Phytoplankton fluorescence
-Turbidity

SEA-Bird ECO Triplet

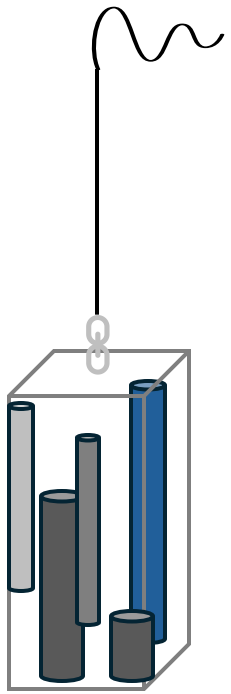
-Phytoplankton Chlorophyll *a* (695nm)
-Fluorescent Dissolved Organic Matter (460nm)
-Turbidity (700nm)

SEA-Bird SUNA

Did you know that dissolved nitrate in seawater absorbs ultra-violet light?

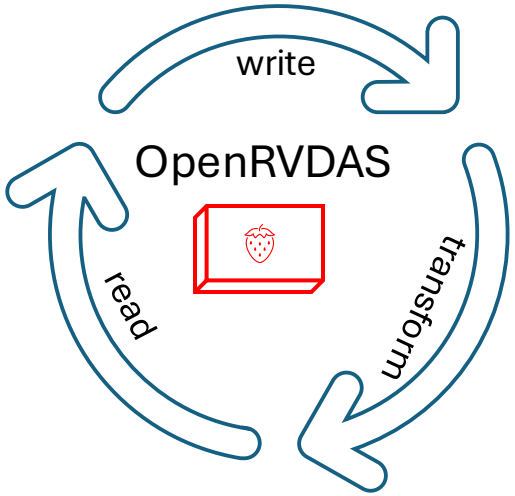
The SUNA is a UV spectrophotometer that calculates **nitrate** concentrations in the water from UV absorption.

CMS Data Architecture



Serial to USB:
SeapHOx →
SUNA →
EXO Sonde →
ECO Triplet →

Raw data



OSU ethernet

CORIOLIX

User interface

Database

VM in Salem OR Data Center

Raw and transformed data

HMSC VC Exhibit

HMSC Website

NANOOS, Zenodo, other repos?

CMS Exhibit


A CHANGING OCEAN
Marine organisms are exposed to a wide range of naturally fluctuating environmental conditions throughout the day or over a year such as water temperature, dissolved oxygen, and pH but these ranges are shifting.
WATER TEMPERATURE: The temperature of the ocean is critical to marine life
MARINE HEAT WAVES: Warm water impacts whole ecosystems and economies
DISSOLVED OXYGEN: Oxygen dissolved in water supports life in the ocean
UPWELLING
NORTH WIND
WARMER SURFACE WATER
COLDER, LOW pH, OXYGEN POOR, NUTRIENT RICH WATER
pH: Interlinked ocean chemistry
CO2 Time Series in the North Pacific
OCEAN ACIDIFICATION:
MULTIPLE STRESSORS: Compounding impacts

Obstacles

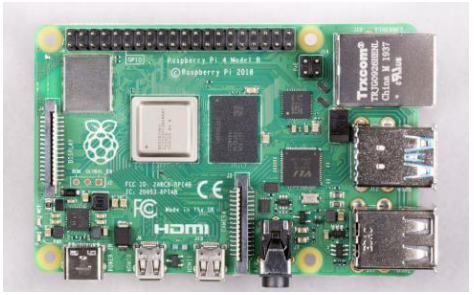
-Funding: Working grant to grant is like gig work. $$?

-Don’t like an instrument cable? Make a new one!

-Obsolete technology

-Training: Raspberry Pis didn’t exist when I was in grad school!

Loggers of the past 20 years



A logger for the next 20 years?

Who uses CMS Data?

Hatfield Researchers

-NOAA Fisheries Oyster Hatchery

-Northwest Fisheries Science Center

-Visiting researchers using seawater

Hatfield Animal Care Team

-Giant Pacific Octopus exhibit

-Touch pool

-Fish tanks

Hatfield Facilities

-Only pump seawater at high tide

Other potential users

Fisherfolk

- Low oxygen (hypoxia) impacts crabs

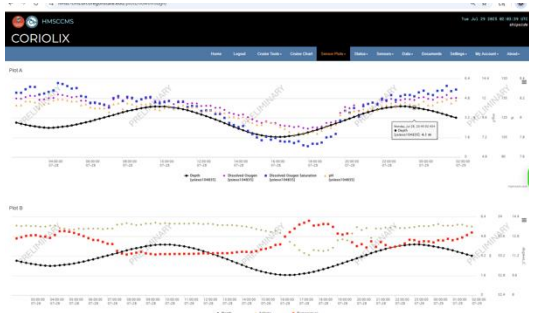
-Crabbing boats can only pump cold salty water into their holds to keep crab fresh

General public

- Shellfish harvesting

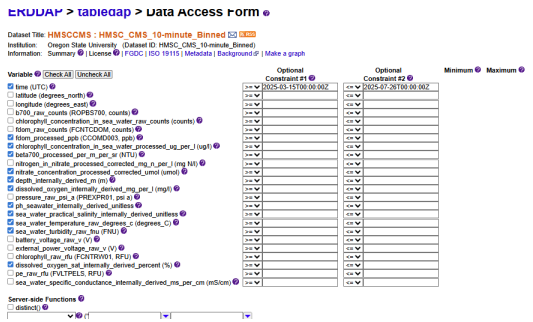
-Tides, weather, water temperatures

CMS Data: Ideas for Classrooms



Real-Time Data

Customizable Plots



ERDDAP Download

Use case #1: Real-Time Data

hmsc-cms.dri.oregonstate.edu/plots/flowthrough/

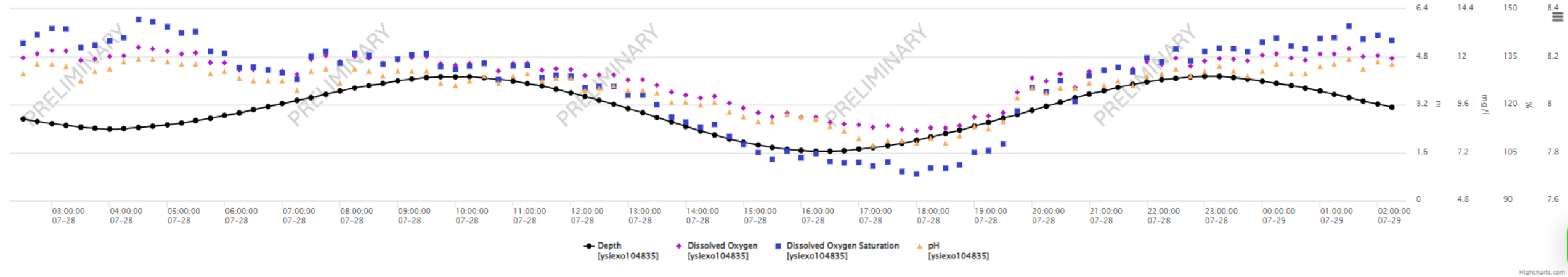
HMSCCMS

CORIOLIX

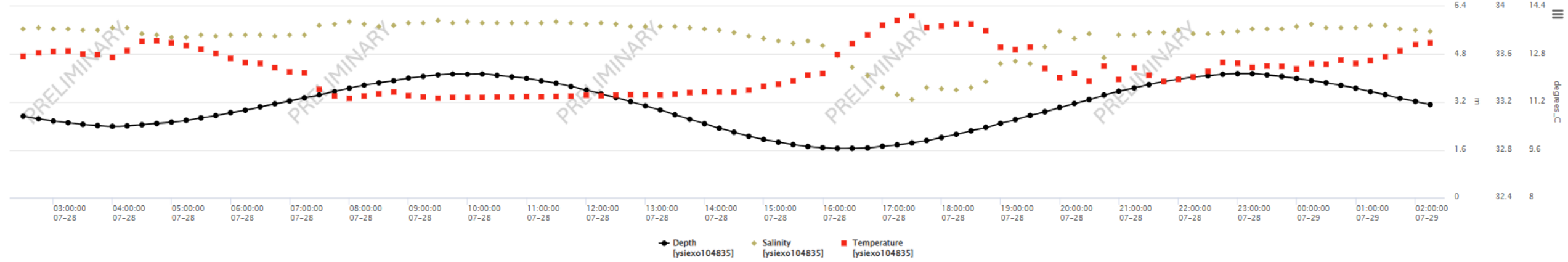
Tue Jul 29 2025 02:20:07 UTC
shipside

Home | Logout | Cruise Tools | Cruise Chart | Sensor Plots | Status | Sensors | Data | Documents | Settings | My Account | About

Plot A



Plot B



Use case #1: Real-Time Data

hmsc-cms.dri.oregonstate.edu/plots/flowthrough/

HMSCCMS

CORIOLIX

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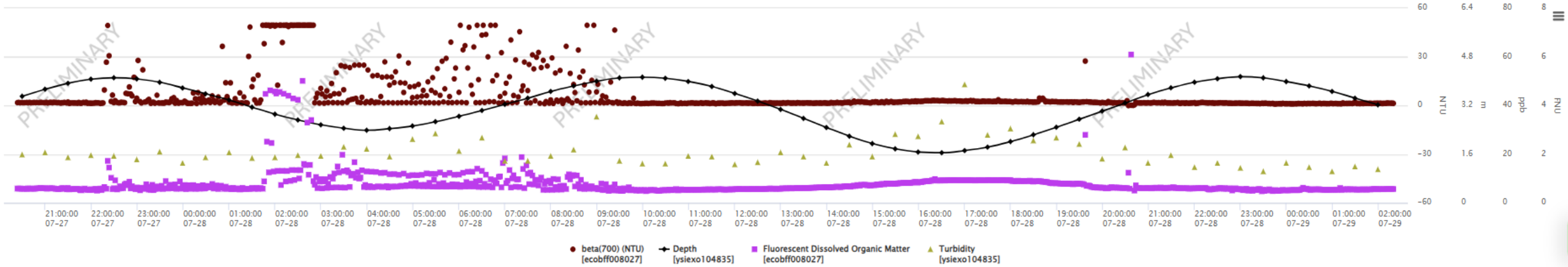
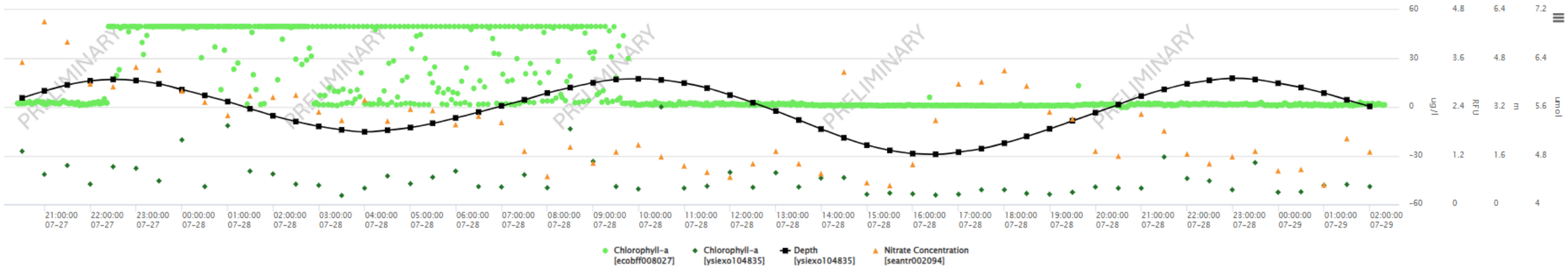
shipside

Home | Logout | Cruise Tools | Cruise Chart | Sensor Plots | Status | Sensors | Data | Documents | Settings | My Account | About

Plot C



Plot H



Use case #2: Customizable Plots

hmsc-cms.dri.oregonstate.edu/plots/custom/

HMSCCMS

CORIOLIX

Tue Jul 29 2025 02:18:16 UTC
shipside

Home | Logout | Cruise Tools | Cruise Chart | Sensor Plots | Status | Sensors | Data | Documents | Settings | My Account | About

Customizable Plots

Date Range

YYYY-MM-DD HH:MM:SS

Start Date 07/11/2025 02:13:54 UTC

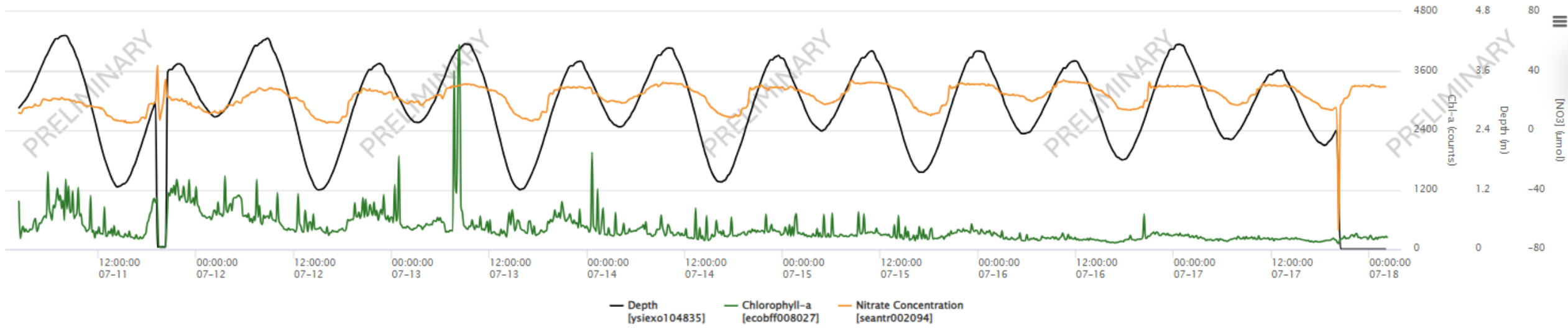
End Date 07/18/2025 02:13:54 UTC

Update Plot Loaded.

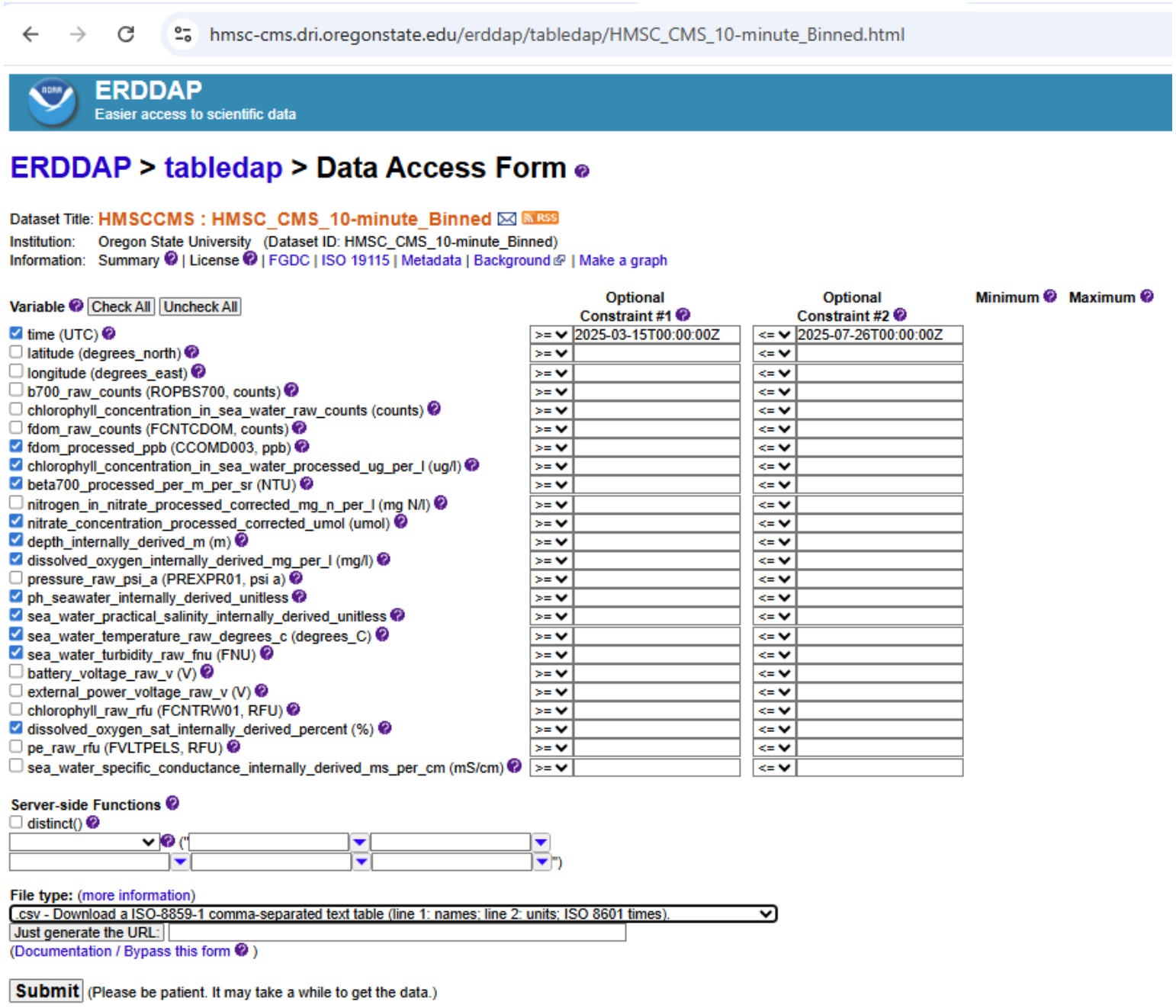
Parameters to Plot

1: YSI EXO2 Sonde : 23A104835 — Depth (m)
2: ECO-Triplet BBFL2W : BBFL2W-8027 — Chl-a (counts)
3: SUNA V2 : NTR-2094 — [NO3] (umol)
4:

Times are in UTC. For local Pacific Time: subtract 7hr 3/9/2025 - 11/2/2025, and subtract 8hr 11/2/2025 - 3/8/2026.



Use Case #3: ERDDAP Downloadable Data



hmsc-cms.dri.oregonstate.edu/erddap/tabledap/HMSC_CMS_10-minute_Binned.html

ERDDAP
Easier access to scientific data

ERDDAP > tabledap > Data Access Form

Dataset Title: **HMSCCMS : HMSC_CMS_10-minute_Binned**
Institution: Oregon State University (Dataset ID: HMSC_CMS_10-minute_Binned)
Information: Summary | License | FGDC | ISO 19115 | Metadata | Background | Make a graph

Variable (Check All / Uncheck All)	Optional Constraint #1	Optional Constraint #2	Minimum	Maximum
☑ time (UTC)	>= 2025-03-15T00:00:00Z	<= 2025-07-26T00:00:00Z		
☐ latitude (degrees_north)	>=	<=		
☐ longitude (degrees_east)	>=	<=		
☐ b700_raw_counts (ROPBS700, counts)	>=	<=		
☐ chlorophyll_concentration_in_sea_water_raw_counts (counts)	>=	<=		
☐ fdom_raw_counts (FCNTCDOM, counts)	>=	<=		
☑ fdom_processed_ppb (CCOMD003, ppb)	>=	<=		
☑ chlorophyll_concentration_in_sea_water_processed_ug_per_l (ug/l)	>=	<=		
☑ beta700_processed_per_m_per_sr (NTU)	>=	<=		
☐ nitrogen_in_nitrate_processed_corrected_mg_n_per_l (mg N/l)	>=	<=		
☑ nitrate_concentration_processed_corrected_umol (umol)	>=	<=		
☑ depth_internally_derived_m (m)	>=	<=		
☑ dissolved_oxygen_internally_derived_mg_per_l (mg/l)	>=	<=		
☐ pressure_raw_psi_a (PREXPR01, psi a)	>=	<=		
☑ ph_seawater_internally_derived_unitless	>=	<=		
☑ sea_water_practical_salinity_internally_derived_unitless	>=	<=		
☑ sea_water_temperature_raw_degrees_c (degrees_C)	>=	<=		
☑ sea_water_turbidity_raw_fnu (FNU)	>=	<=		
☐ battery_voltage_raw_v (V)	>=	<=		
☐ external_power_voltage_raw_v (V)	>=	<=		
☐ chlorophyll_raw_rfu (FCNTRW01, RFU)	>=	<=		
☑ dissolved_oxygen_sat_internally_derived_percent (%)	>=	<=		
☐ pe_raw_rfu (FVLTPELS, RFU)	>=	<=		
☐ sea_water_specific_conductance_internally_derived_ms_per_cm (mS/cm)	>=	<=		

Server-side Functions
☐ distinct()
(") "

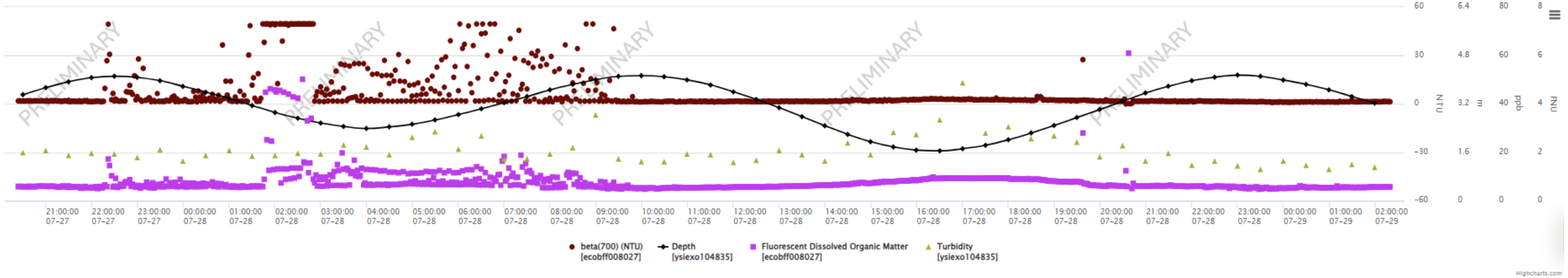
File type: (more information)
.csv - Download a ISO-8859-1 comma-separated text table (line 1: names; line 2: units; ISO 8601 times).
Just generate the URL:
(Documentation / Bypass this form)

Submit (Please be patient. It may take a while to get the data.)

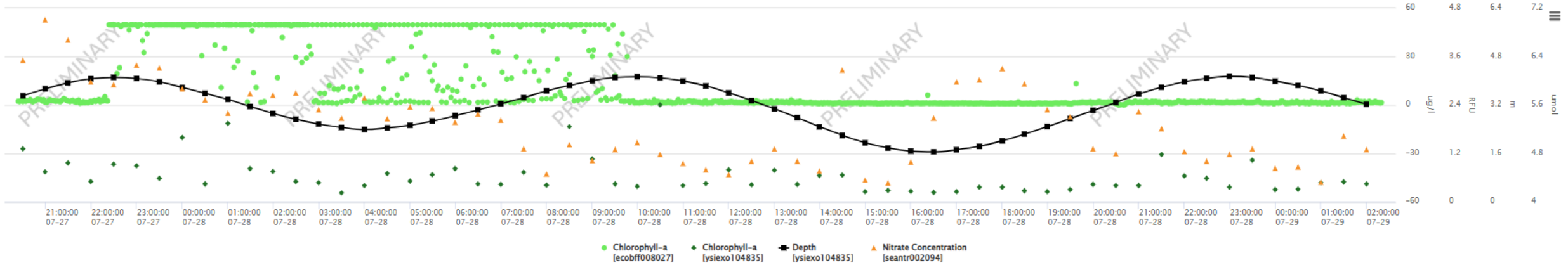
Activity Idea: Data literacy

How do we know we're looking at good data? Discerning scientists ask:

-What is known about the range of values measured in this environment?
(This baseline is changing)
-What was the range of values used to calibrate this instrument?
-What are the minimum and maximum values detectable by this instrument?



Plot H



PO Box 518
620 Applegate St.
Philomath, OR 97370

WET Labs

(541) 929-5650
Fax (541) 929-5277
www.wetlabs.com

ECO Chlorophyll Fluorometer Characterization Sheet

Date: 2/3/2023 S/N: BBFL2W-8027

Chlorophyll concentration expressed in µg/l can be derived using the equation:

CHL (µg/l) = Scale Factor * (Output - Dark counts)

	Digital
Dark counts	62 counts
Scale Factor (SF)	0.0122 µg/l/count
Maximum Output	4130 counts
Resolution	1.0 counts
Ambient temperature during characterization	21.0 °C

Dark Counts: Signal output of the meter in clean water with black tape over detector.

SF: Determined using the following equation: SF = x ÷ (output - dark counts), where x is the concentration of the solution used during instrument characterization. SF is used to derive instrument output concentration from the raw signal output of the fluorometer.

Maximum Output: Maximum signal output the fluorometer is capable of.

Resolution: Standard deviation of 1 minute of collected data.

The relationship between fluorescence and chlorophyll-a concentrations in-situ is highly variable. The scale factor listed on this document was determined using a mono-culture of phytoplankton (Thalassiosira weissflogii). The population was assumed to be reasonably healthy and the concentration was determined by using the absorption method. To accurately determine chlorophyll concentration using a fluorometer, you must perform secondary measurements on the populations of interest. This is typically done using extraction-based measurement techniques on discrete samples. For additional information on determining chlorophyll concentration see "Standard Methods for the Examination of Water and Wastewater" part 10200 H, published jointly by the American Public Health Association, American Water Works Association, and the Water Environment Federation.

Other Activity Ideas

-Rain, tide and salinity

-Turbidity aquarium and mussels / oysters

-Summer upwelling temp, DO and pH patterns vs winter

-???


I have questions for you...

Pre-existing Curriculum

Do you already teach about water quality or climate change? What works?

What field trips have you taken or planned around these topics?

How do we make activities modular so they can be worked into what is already taught?

Workforce Development

Lots of skills were needed in building out the CMS:

-Carpentry

-Welding

-3D printing

-Electronics

“Edutainment”?

Touchscreen Interaction at Hatfield

How can we engage different types of visitors?

The 3 second visitor

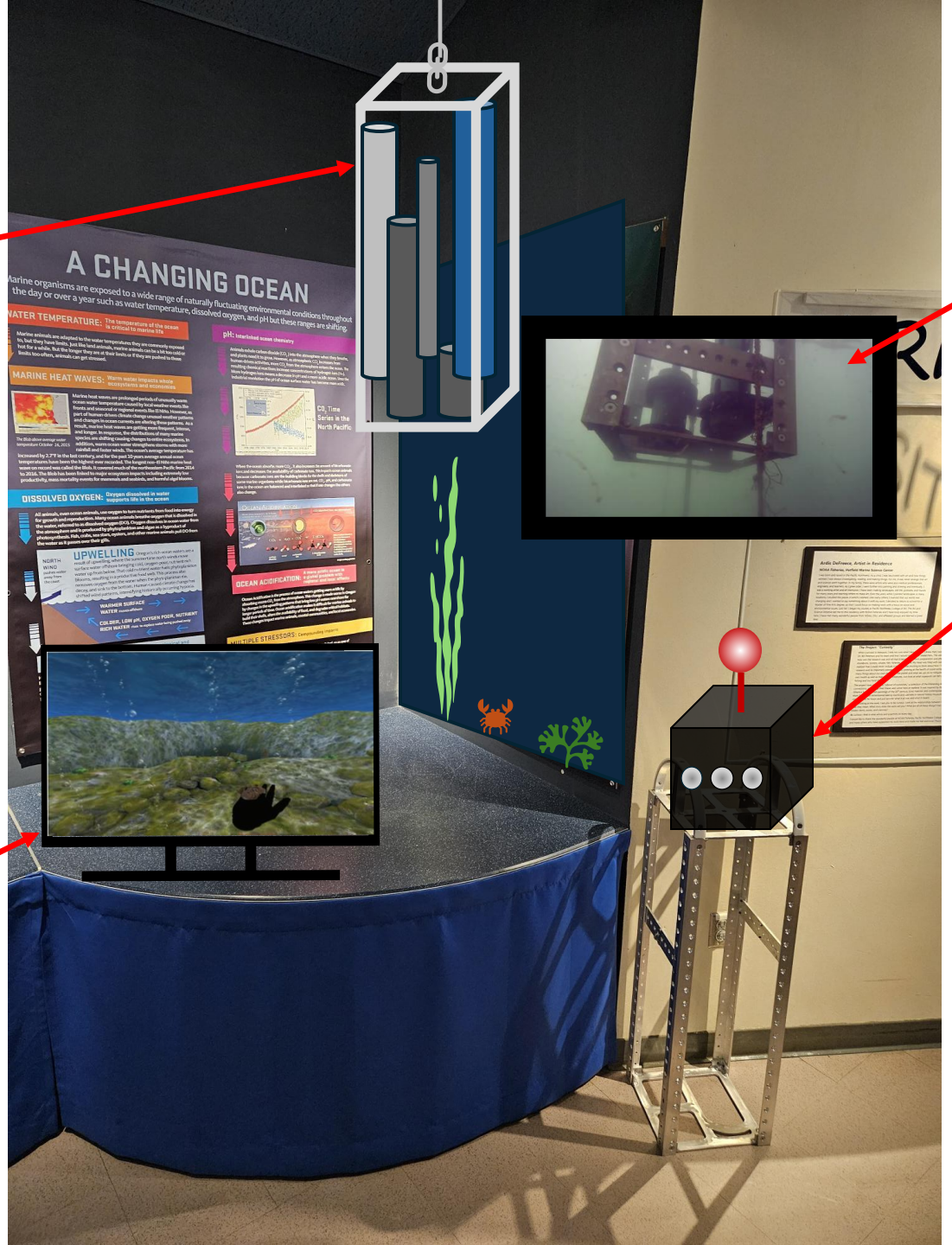
The 3 minute visitor

The 30 second visitor

How can we engage different types of visitors?

The 3 second visitor

Instrument frame replica: Suspended 1 meter above bench to replicate estuary floor.



Estuary Floor Cam: Spy on the estuary floor by moving camera with joystick, push buttons to zoom and turn on light.

The 30 second visitor

Joystick camera control box

The 3 minute visitor

Touch screen: Toggle input between real-time water quality data and interactive OAH video game.