NANOOS

NORTHWEST ASSOCIATION OF NETWORKED OCEAN OBSERVING SYSTEMS

IOOS

Meeting Stakeholder Needs in the Pacific Northwest US via the NANOOS Visualization System (NVS)

Jan Newton[1], Craig Risien[2], Troy Tanner[1], Jon Allan[3], Emilio Mayorga[1], Mike Kosro[2], Charles Seaton[4], Rachel Wold[1]

[1] University of Washington
[2] Oregon State University
[3] Oregon Health and Science University
[4] DOGAMI

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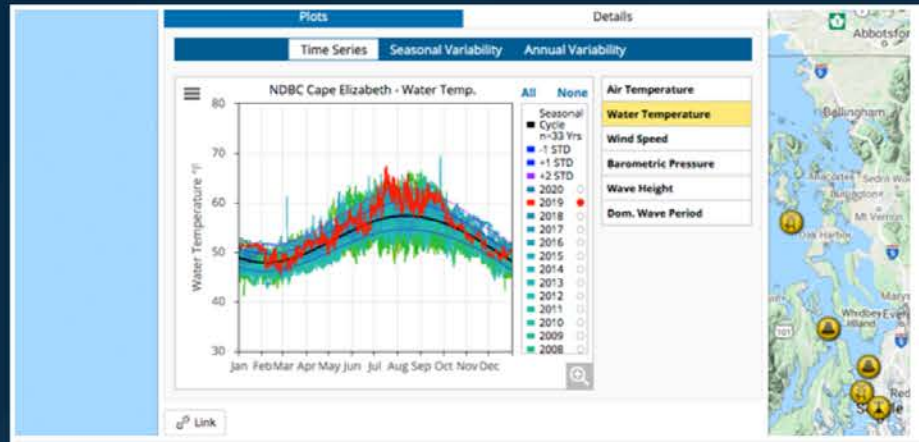
Welcome to NANOOS, the Northwest Association of Networked Ocean Observing Systems.

NANOOS Visualization System

NVS provides easy access to observations, forecasts, data, and visualizations.

Help



How Different Are Conditions?

New dynamic plotting capabilities have been added to the NVS Climatology app. Users can now explore year-to-year differences for a variety of data sets including water temperature and wave height. This makes comparing the two recent marine heat waves or comparing to other years easy. Click on the "+" in the lower right corner to expand the plot, then highlight any year in red by clicking the bubble next to the year. As always, use the comment link to let us know what you think of this new functionality.

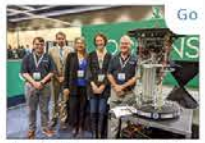
Visit the NVS Climatology App


How Different Are Conditions?


National Weather Service Assets Added to NVS

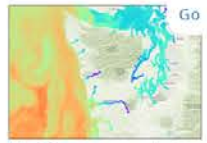

NANOOS Presentation for NOAA West Watch Tracks Marine Heat


2019 Marine Heat Wave in the News


Pacific Northwest HABs at Oceans19

2018 Puget Sound Marine Waters Overview


Improved Tsunami App on NVS

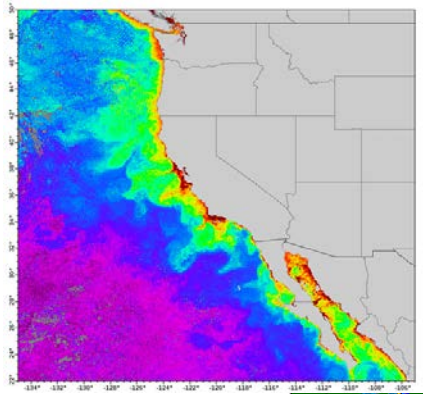

LiveOcean comes to the Salish Sea!

NVS Motivation (Disparate datasets, formats & sources)

- Buoy, C-MAN, CDIP, river gage observations
- NOS sea-level observations and predictions
- Glider observations
- Profiler observations
- HF/X-band Radar observations
- Numerical forecast models
- Satellite observations
- Beach and shoreline profiles
- Tsunami inundation maps
- NOAA nautical charts
- Webcams

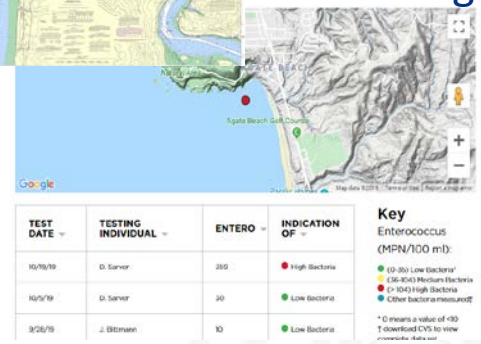
In Situ Observations

RS Observations



Charts/Maps

Citizen Monitoring

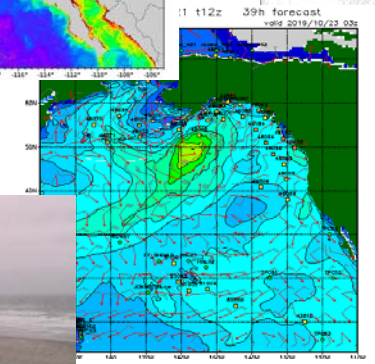


TEST DATE	TESTING INDIVIDUAL	ENTERO	INDICATION OF
10/19/19	D. Sarver	350	High Bacteria
10/5/19	D. Sarver	30	Low Bacteria
9/28/19	J. Bittmann	10	Low Bacteria

Key
Enterococcus (MPN/100 ml):
(0-30) Low Bacteria*
(30-104) Medium Bacteria
(> 104) High Bacteria
Other bacteria measured*
* 0 means a value of <10
† download CVS to view

Webcams

Models

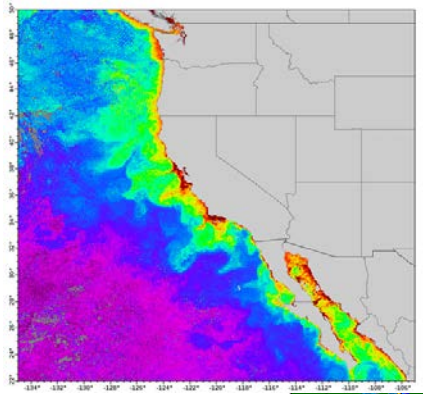


NVS Goal

To create an intuitive map-based platform that aggregates a multitude of diverse data sets and forecast model fields into one system with the goal of delivering a more seamless, tailored, one-stop-shopping experience for regional stakeholders.

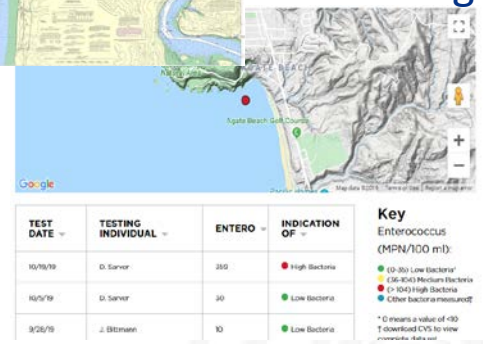
In Situ Observations

RS Observations

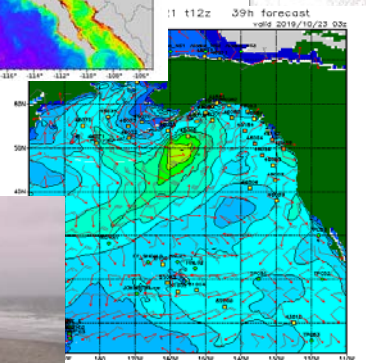


Charts/Maps

Citizen Monitoring



Webcams



Models

OceanObs'19

Iwamoto et al. 2019

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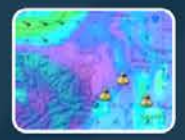

Data Explorer


Tsunami Evacuation Zones


Boaters

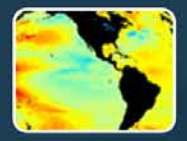

Tuna Fishers


Seacast


Surfers


Beach View


Shellfish Growers

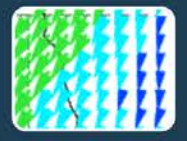

Climatology


Beach and Shoreline Changes


Maritime Operations


Cruises


Gliders

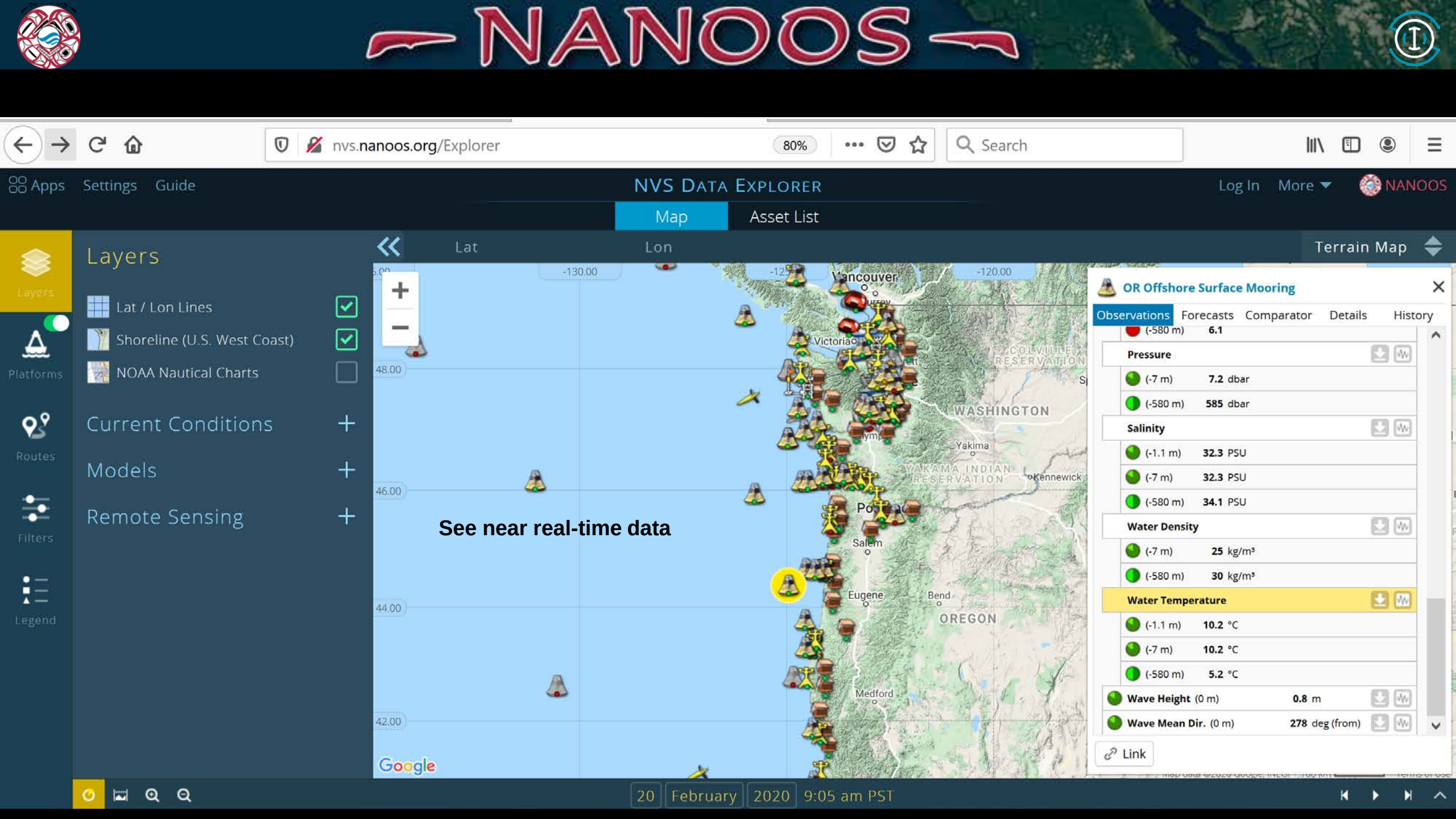

High Frequency Radar


Comment

Help

ADDITIONS & UPDATES

View Last 3 Months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Remote Sensing
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Terrain Map
See near real-time data
OR Offshore Surface Mooring
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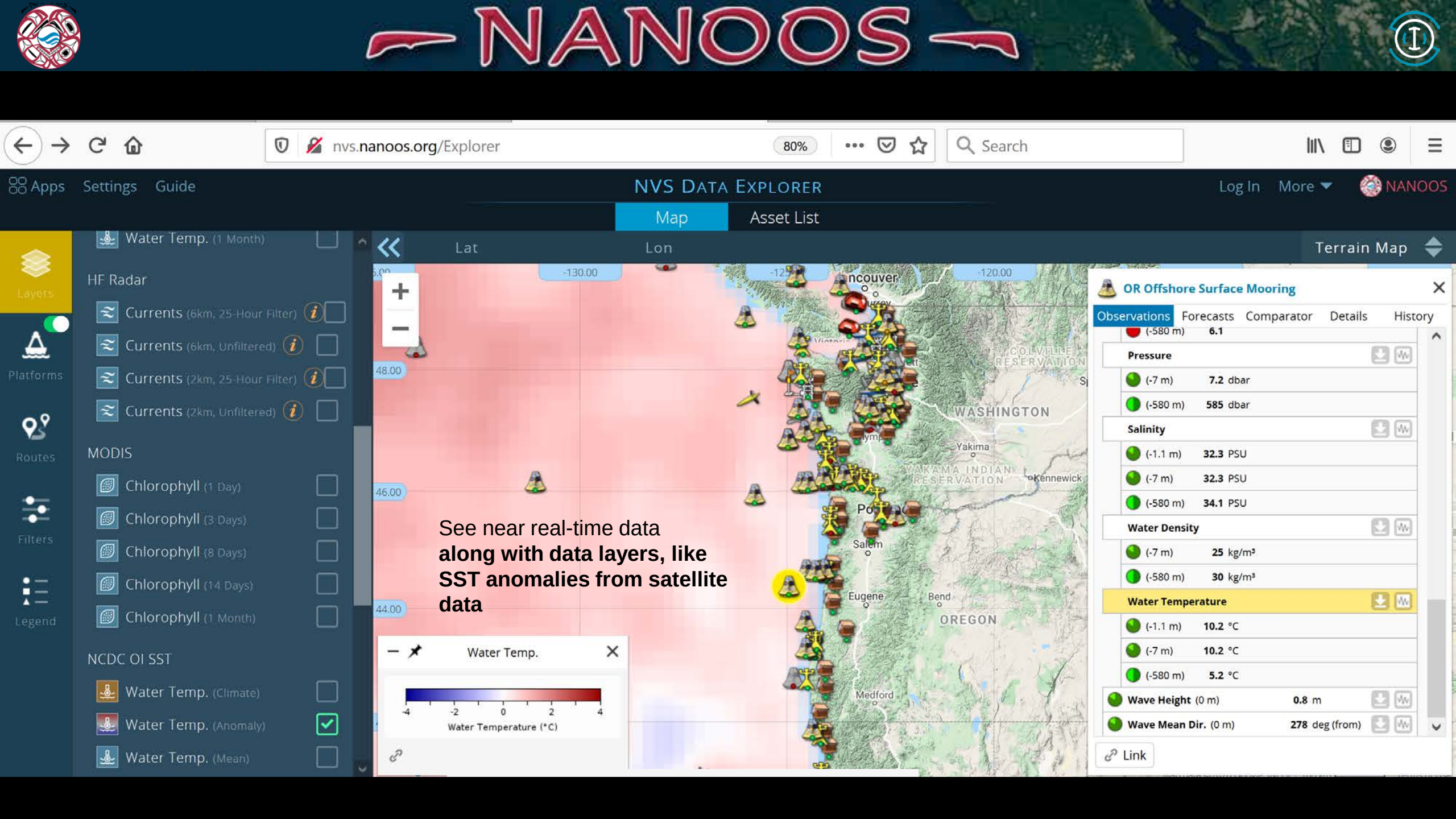
Details
History
Pressure
(-7 m) 7.2 dbar
(-580 m) 585 dbar
Salinity
(-1.1 m) 32.3 PSU
(-7 m) 32.3 PSU
(-580 m) 34.1 PSU
Water Density
(-7 m) 25 kg/m³
(-580 m) 30 kg/m³
Water Temperature
(-1.1 m) 10.2 °C
(-7 m) 10.2 °C
(-580 m) 5.2 °C
Wave Height (0 m) 0.8 m
Wave Mean Dir. (0 m) 278 deg (from)
Link
Vancouver
Victoria
WASHINGTON
Yakima
Kennewick
Salem
Eugene
Bend
OREGON
Medford
Google
20 February 2020 9:05 am PST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Currents (6km, Unfiltered)
Currents (2km, 25-Hour Filter)
Currents (2km, Unfiltered)
MODIS
Chlorophyll (1 Day)
Chlorophyll (3 Days)
Chlorophyll (8 Days)
Chlorophyll (14 Days)
Chlorophyll (1 Month)
NCDC OI SST
Water Temp. (Climate)
Water Temp. (Anomaly)
Water Temp. (Mean)
-130.00
-120.00
48.00
46.00
44.00
WASHINGTON
OREGON
Yakima
Kennewick
Salem
Eugene
Bend
Medford
COLVILLE RESERVATION
YAKAMA INDIAN RESERVATION
See near real-time data
along with data layers, like SST anomalies from satellite data
Water Temp.
-4
-2
0
2
4
Water Temperature (°C)
OR Offshore Surface Mooring
Observations
Forecasts
Comparator
Details
History
(-580 m) 6.1
Pressure
(-7 m) 7.2 dbar
(-580 m) 585 dbar
Salinity
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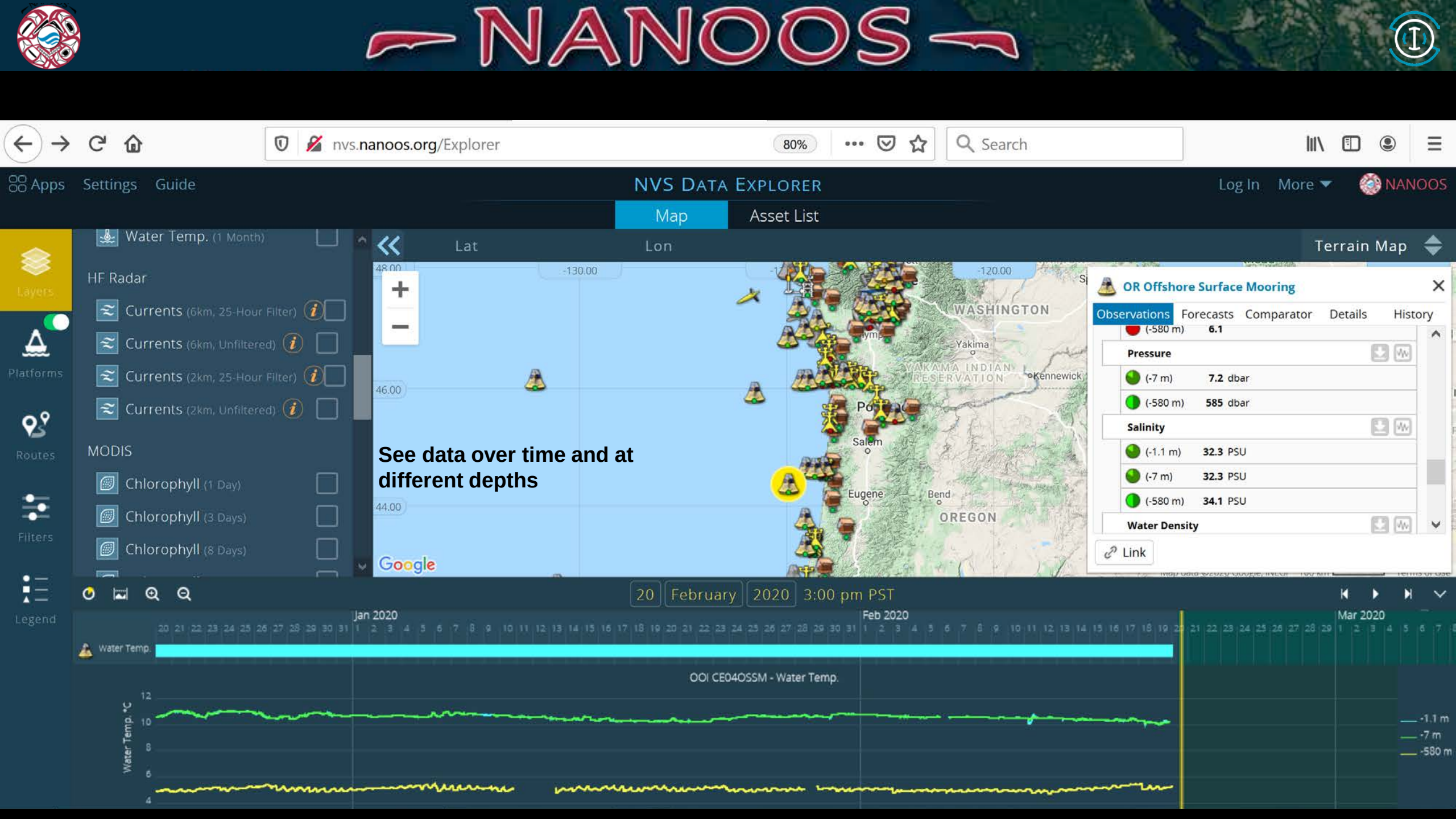
Wave Height (0 m) 0.8 m
Wave Mean Dir. (0 m) 278 deg (from)
Link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Currents (6km, Unfiltered)
Currents (2km, 25-Hour Filter)
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Chlorophyll (1 Day)
Chlorophyll (3 Days)
Chlorophyll (8 Days)
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Kennewick
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See data over time and at different depths
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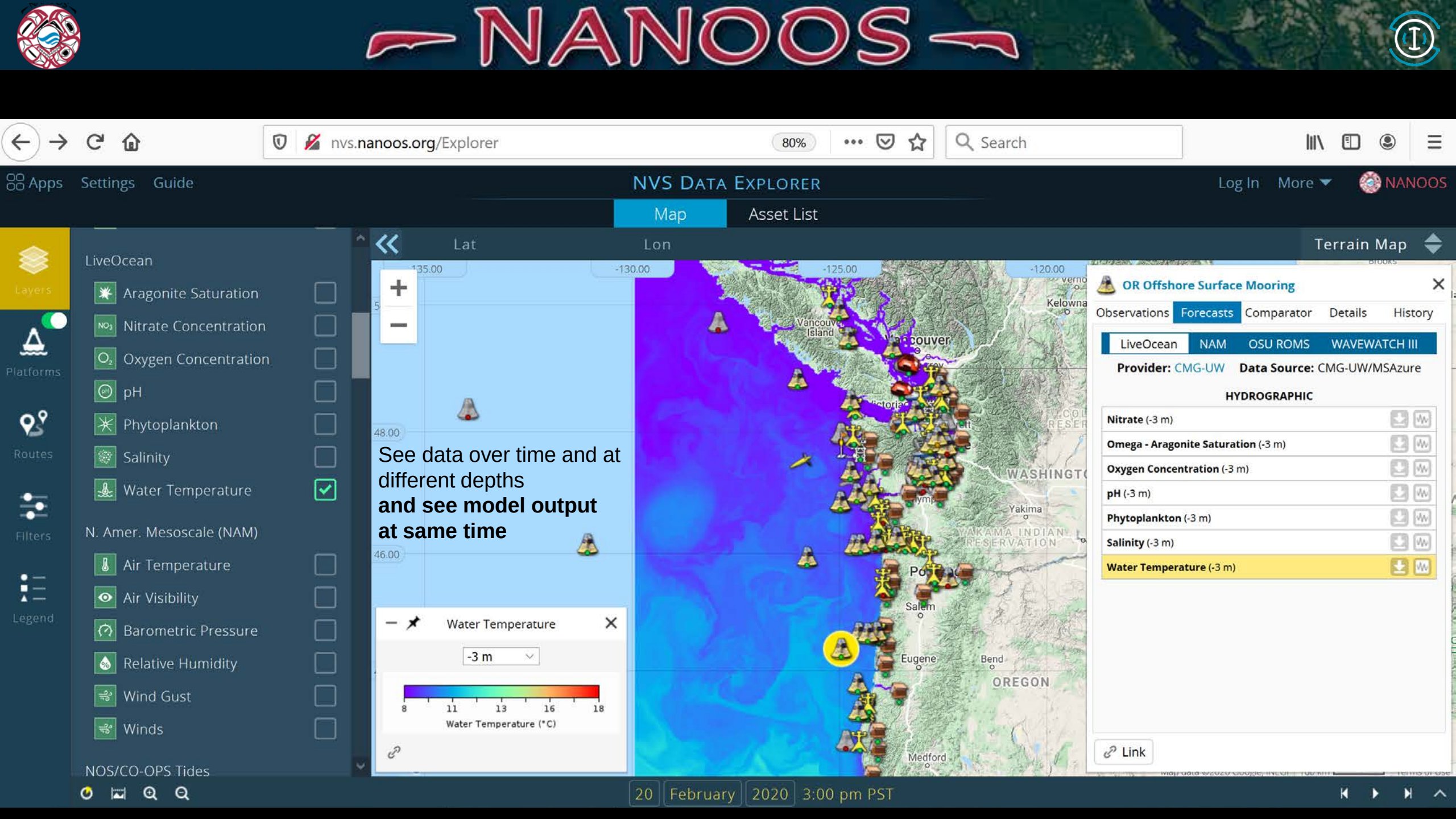
(-7 m) 32.3 PSU
(-580 m) 34.1 PSU
Water Density
Link
20 February 2020 3:00 pm PST
Jan 2020
Feb 2020
Mar 2020
Water Temp.
OOI CE04OSSM - Water Temp.
Water Temp. °C
-1.1 m
-7 m
-580 m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LiveOcean
Aragonite Saturation
Nitrate Concentration
Oxygen Concentration
pH
Phytoplankton
Salinity
Water Temperature
N. Amer. Mesoscale (NAM)
Air Temperature
Air Visibility
Barometric Pressure
Relative Humidity
Wind Gust
Winds
NOS/CO-OPS Tides
See data over time and at different depths
and see model output at same time
Water Temperature
-3 m
8
11
13
16
18
Water Temperature (°C)
OR Offshore Surface Mooring
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LiveOcean
NAM
OSU ROMS
WAVEWATCH III
Provider: CMG-UW
Data Source: CMG-UW/MSAzure
HYDROGRAPHIC
Nitrate (-3 m)
Omega - Aragonite Saturation (-3 m)
Oxygen Concentration (-3 m)
pH (-3 m)
Phytoplankton (-3 m)
Salinity (-3 m)
Water Temperature (-3 m)
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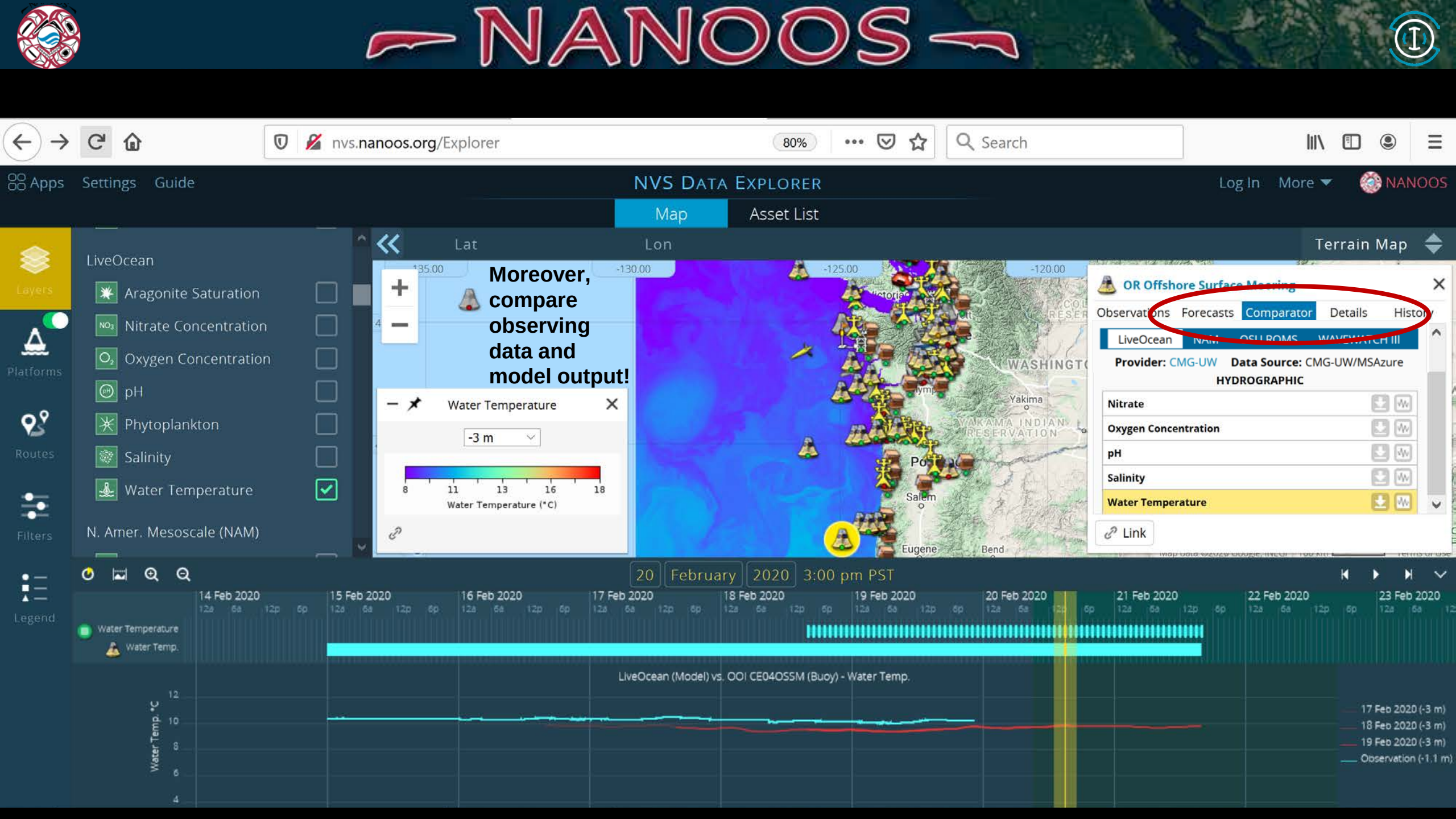
Kelowna
Yakima
Salem
Eugene
Bend
OREGON
Medford
20
February
2020
3:00 pm PST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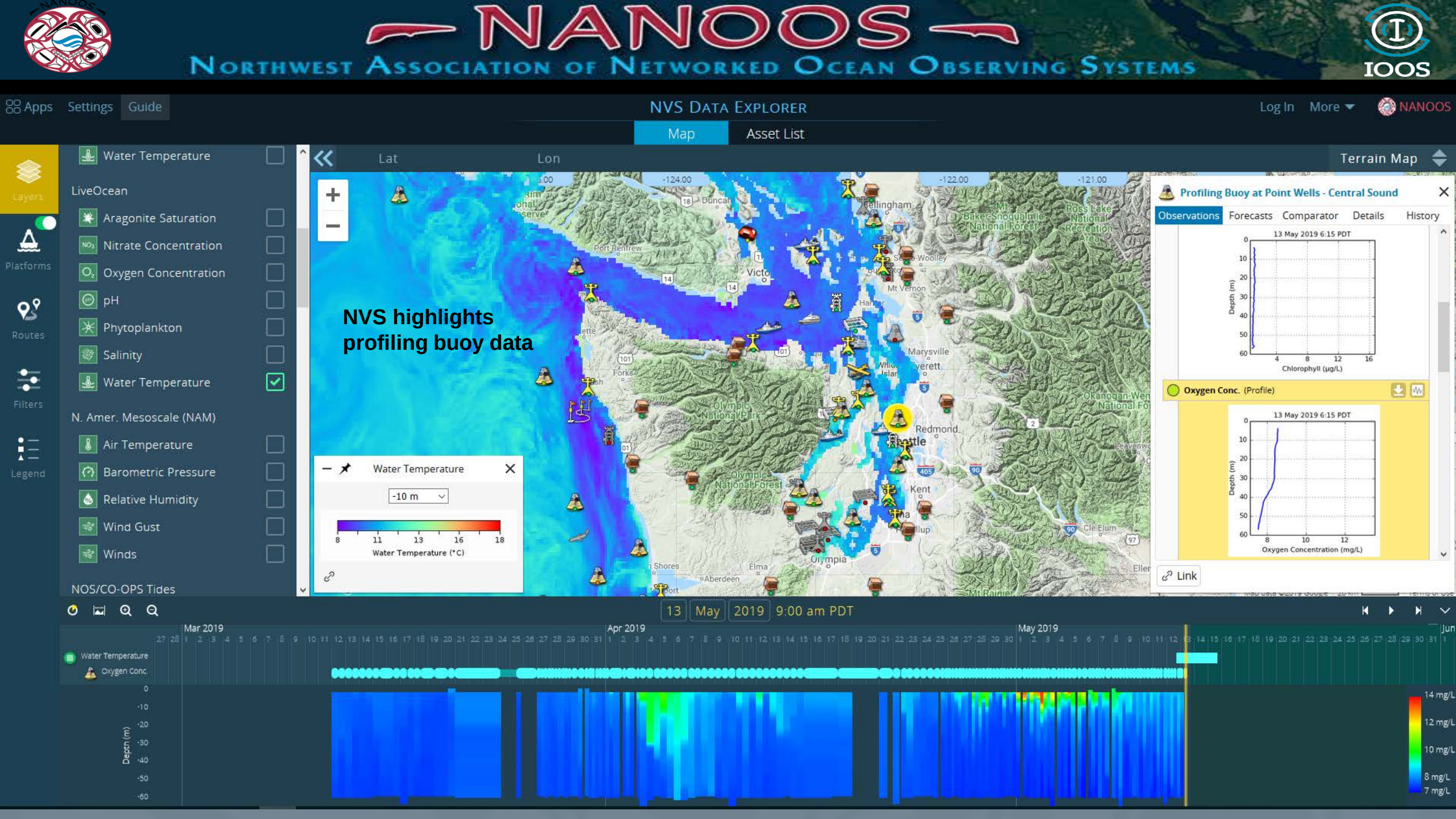
LiveOcean
Aragonite Saturation
Nitrate Concentration
Oxygen Concentration
pH
Phytoplankton
Salinity
Water Temperature
N. Amer. Mesoscale (NAM)
Lat
Lon
Terrain Map
Moreover, compare observing data and model output!
Water Temperature
-3 m
8
11
13
16
18
Water Temperature (°C)
OR Offshore Surface Mooring
Observations
Forecasts
Comparator
Details
History
LiveOcean
Provider: CMG-UW
Data Source: CMG-UW/MSAzure
HYDROGRAPHIC
Nitrate
Oxygen Concentration
pH
Salinity
Water Temperature
Link
Yakima
Salem
Eugene
Bend
20 February 2020 3:00 pm PST
14 Feb 2020
15 Feb 2020
16 Feb 2020
17 Feb 2020
18 Feb 2020
19 Feb 2020
20 Feb 2020
21 Feb 2020
22 Feb 2020
23 Feb 2020
Water Temperature
Water Temp.
LiveOcean (Model) vs. OOI CE04OSSM (Buoy) - Water Temp.
Water Temp. °C
17 Feb 2020 (-3 m)
18 Feb 2020 (-3 m)
19 Feb 2020 (-3 m)
Observation (-1.1 m)

"***I start my work day every day, by visiting the NVS data explorer*** *for the latest real time data and modelling forecasts. NANOOS and the NVS data explorer have become a routine resource and are an incredible benefit to the management and mitigation of Harmful Algal Blooms along Washington's outer coast for ORHAB.* ***One stop shopping to open-access mooring data, satellite imagery, and UW's LiveOcean model have been instrumental in advancing ORHAB's understanding of ocean processes and harmful algal bloom development along Washington's outer coast.***"

– Anthony Odell, Research Analyst Lead, Olympic Region Harmful Algal Bloom (ORHAB) Monitoring Partnership-University of Washington / Olympic Natural Resources Center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Water Temperature
N. Amer. Mesoscale (NAM)
Air Temperature
Barometric Pressure
Relative Humidity
Wind Gust
Winds
NOS/CO-OPS Tides
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Terrain Map
NVS highlights
profiling buoy data
Water Temperature
-10 m
8
11
13
16
18
Water Temperature (°C)
Profiling Buoy at Point Wells - Central Sound
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Forecasts
Comparator
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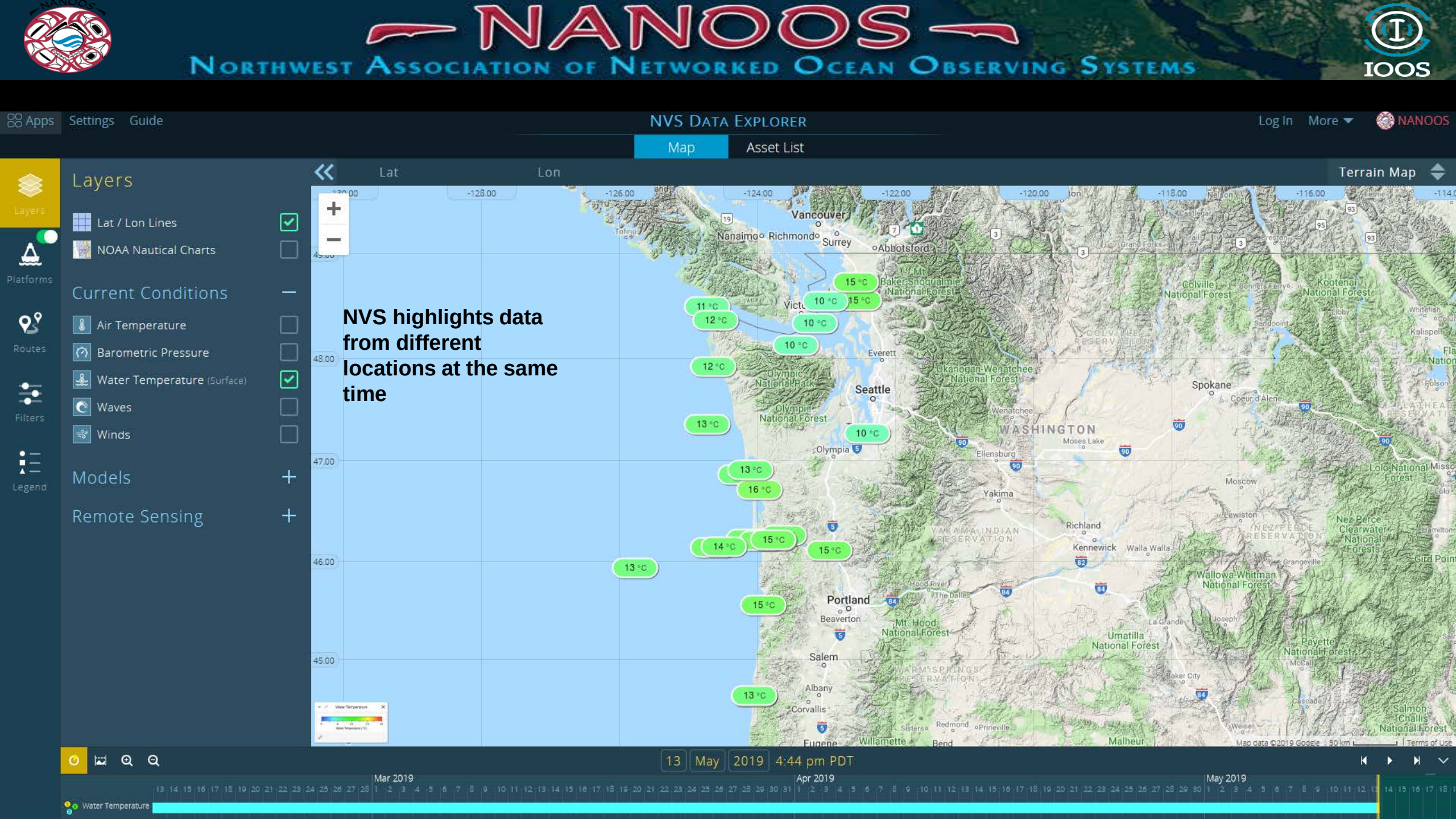
History
13 May 2019 6:15 PDT
Depth (m)
Chlorophyll (µg/L)
Oxygen Conc. (Profile)
13 May 2019 6:15 PDT
Depth (m)
Oxygen Concentration (mg/L)
Link
13
May
2019
9:00 am PDT
Mar 2019
Apr 2019
May 2019
Jun
Water Temperature
Oxygen Conc.
Depth (m)
14 mg/L
12 mg/L
10 mg/L
8 mg/L
7 mg/L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Current Conditions
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Barometric Pressure
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Waves
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Terrain Map
NVS highlights data from different locations at the same time
Vancouver
Nanaimo
Richmond
Surrey
Abbotsford
Everett
Seattle
Olympia
Spokane
Yakima
Richland
Kennewick
Walla Walla
Moscow
Lewiston
Portland
Beaverton
Salem
Albany
Corvallis
Eugene
Bend
Redmond
Prineville
Malheur
Wenatchee
Moses Lake
Ellensburg
Coeur d'Alene
Kalispell
Sandpoint
Colville National Forest
Kootenai National Forest
Okanogan-Wenatchee National Forest
Olympic National Park
Olympic National Forest
Mt. Baker-Snoqualmie National Forest
Mt. Hood National Forest
Umatilla National Forest
Wallowa-Whitman National Forest
Nez Perce Clearwater National Forests
Lolo National Forest
Salmon-Challis National Forest
WASHINGTON
YAKAMA INDIAN RESERVATION
WARM SPRINGS RESERVATION
NEZ PERCE RESERVATION
-128.00
-126.00
-124.00
-122.00
-120.00
-118.00
-116.00
48.00
47.00
46.00
45.00
11 °C
12 °C
10 °C
15 °C
13 °C
16 °C
14 °C
13
May
2019
4:44 pm PDT
Mar 2019
Apr 2019
May 2019
Water Temperature
Map data ©2019 Google
50 km
Terms of Use

"I just wanted to let everyone know that the real time data from the various buoys are incredibly helpful for those of us in the Marine Fish Science Unit at WDFW. ***We use this information to assist us with planning our field sampling on a daily and weekly basis; wind speeds and directions, as well as temperatures, help us determine the feasibility of our sampling routine.*** *We hope this network stays funded to provide long-term data that we can use to help understand the dynamics of forage fish and their trophic interactions in the southern Salish Sea and beyond!"*

– Todd Sandell, Senior Forage Fish Specialist, Washington Department of Fish and Wildlife

We heard that our Data Explorer can be overwhelming, suitable for scientists and data geeks, but not so much for the public, or for people with just a specific need.

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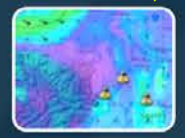
(All NANOOS assets and data streams)



Data Explorer

Tsunami Evacuation Zones

Boaters

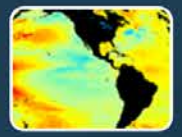
Tuna Fishers

Seacast

Surfers

Beach View

Shellfish Growers



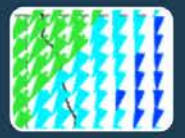
Climatology

Beach and Shoreline Changes

Maritime Operations

Cruises

Gliders



High Frequency Radar

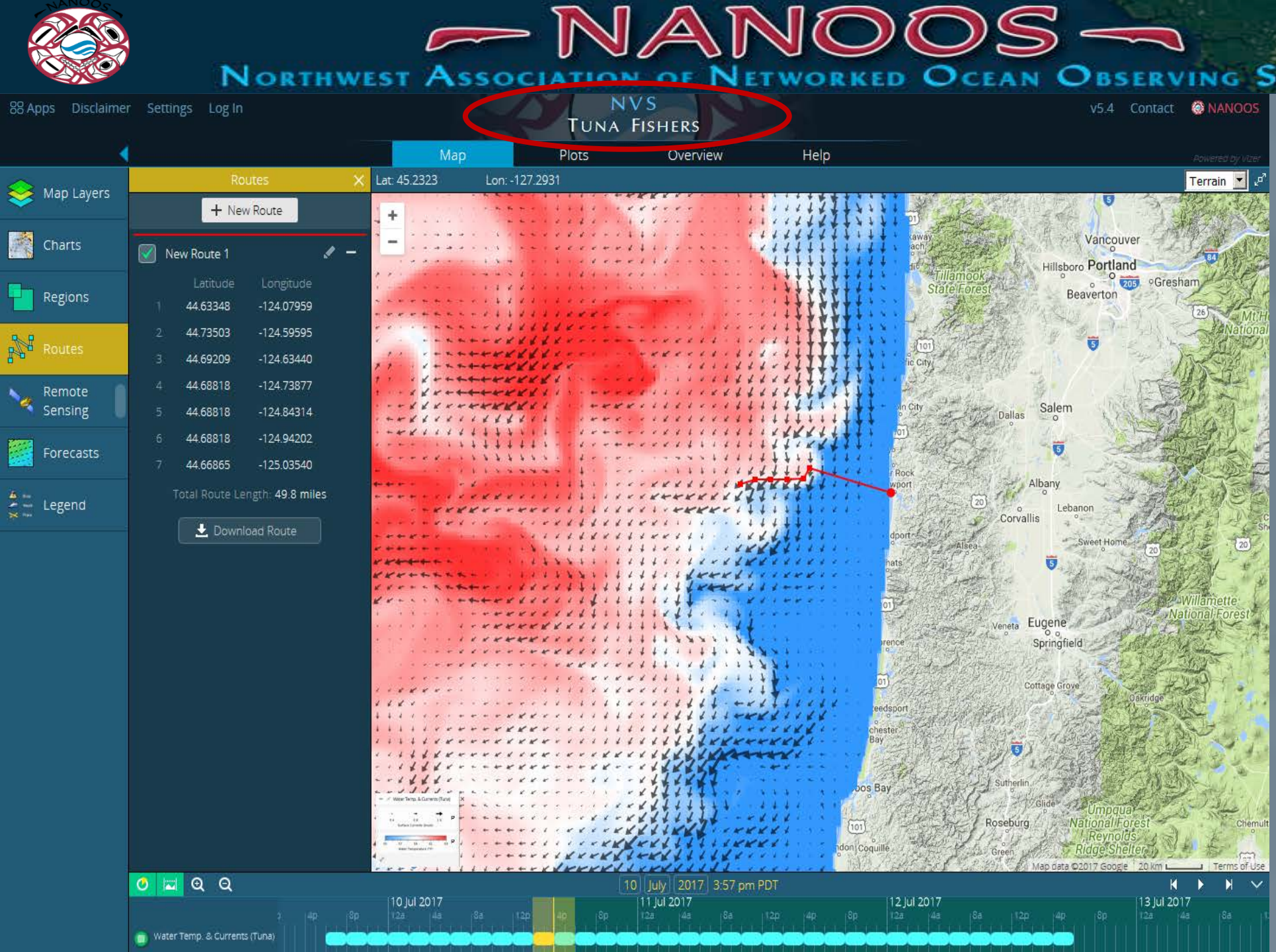
Comment

Help

So we developed NVS apps for specific user groups with targeted subsets of the data.

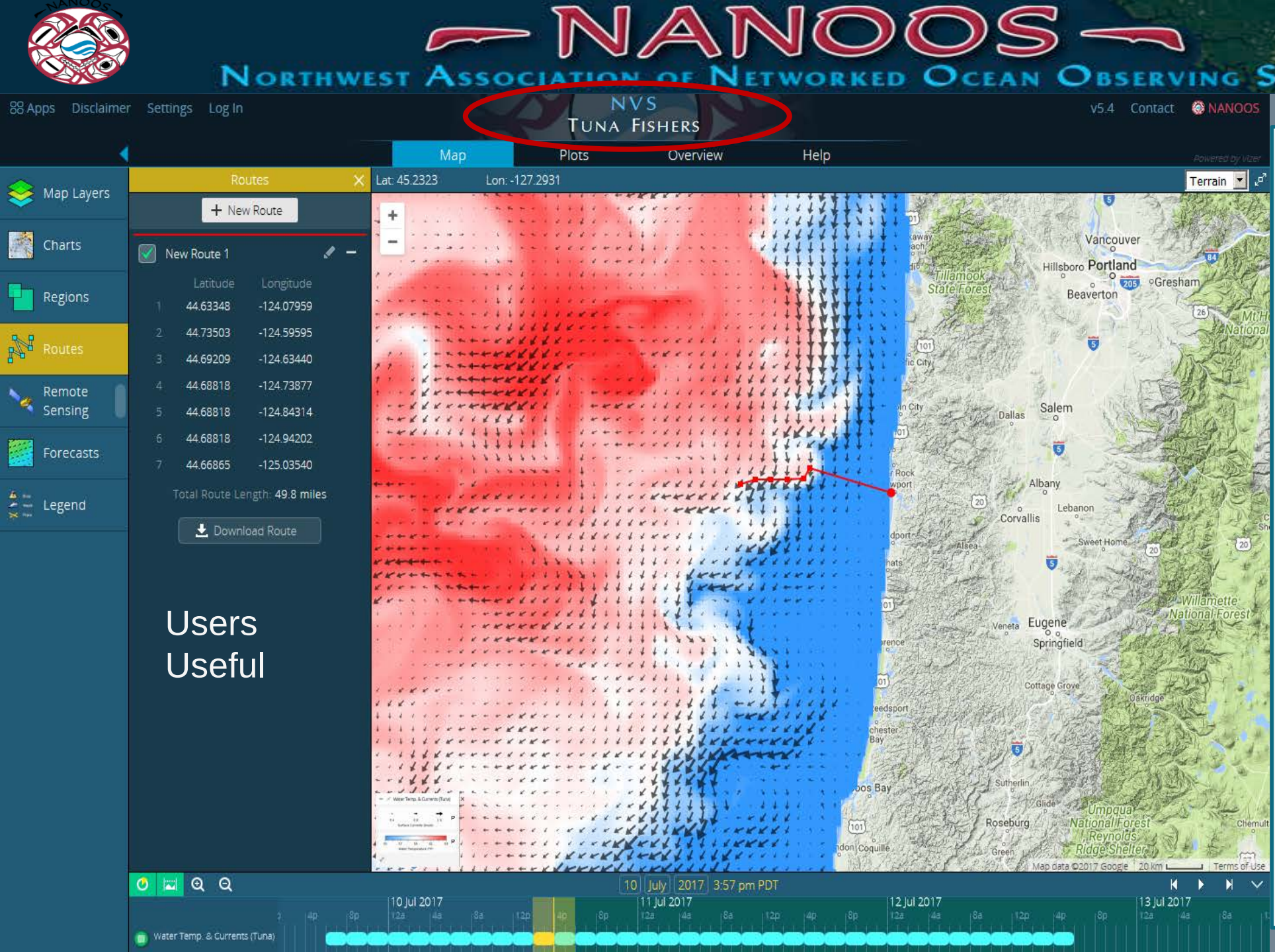
ADDITIONS & UPDATES

View Last 3 Months



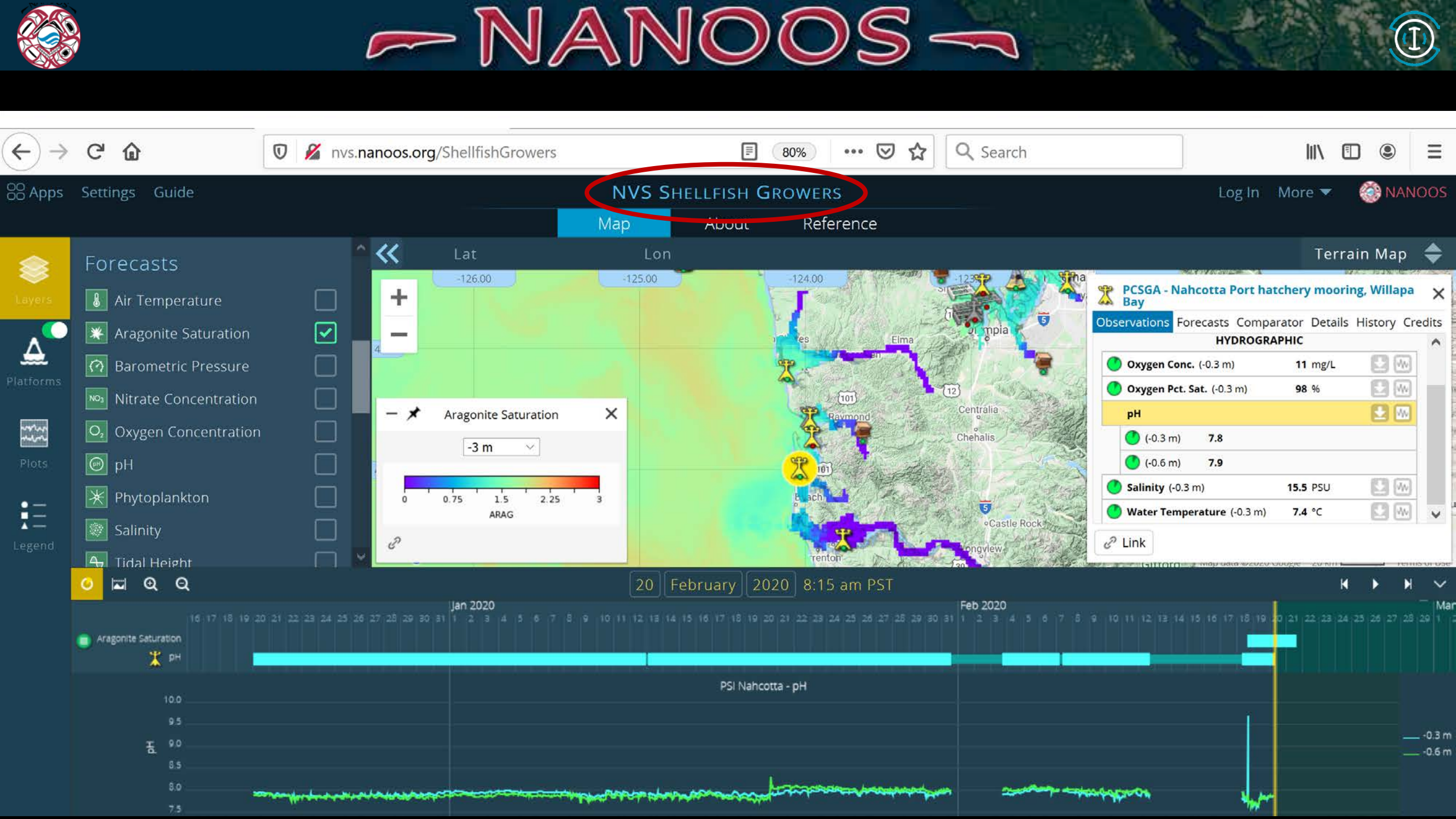
To get **Users**,
need to make it **Useful**

NANOOS learned early on, hearing from a tuna charter company that using red for waters where tuna would be found and blue for waters too cold, that it made this model output **useful.**



Users
Useful

"As an ocean sport fisherman, I want to give a huge shout out to the team at NANOOS. ***The NVS Tuna Fisher application has given myself and other sport boats the ability to narrow our search area for the fish we seek.*** *As a sport halibut fisherman, wave height, wind and current direction are very important in how far we travel off shore as well as setup for fishing. Your tools provide us the ability to glimpse hours out into the day before I leave the dock to ensure I have the best knowledge possible on where to go, but more importantly, whether or not to go.* ***The education I have received from your tools has paid off greatly, saving us time and money. Lower fuel consumption is good for all of us. We love your toolset. Keep up the great work."***
– Wallace Coon, F/V Kimberlie Marie, Oregon Resident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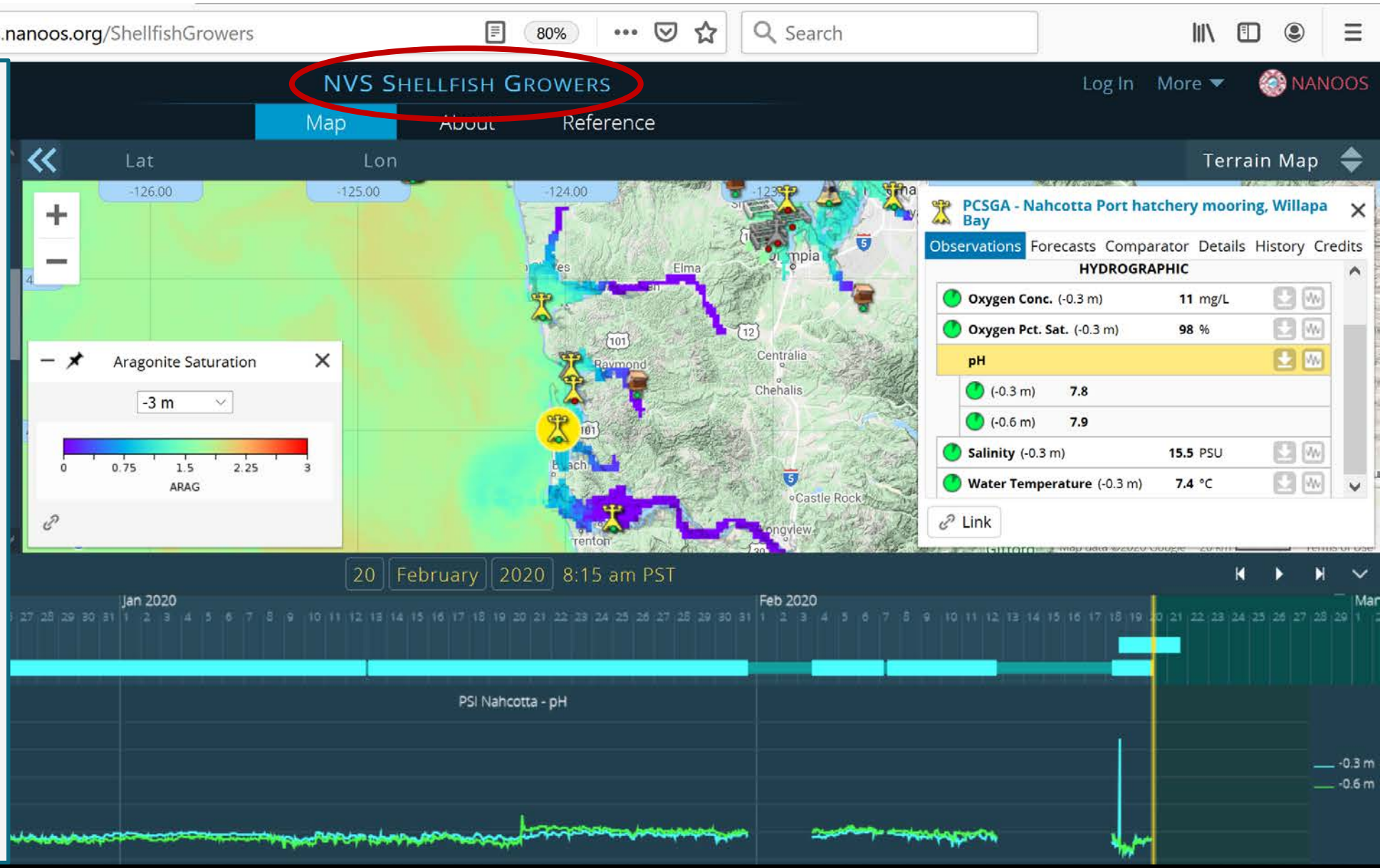
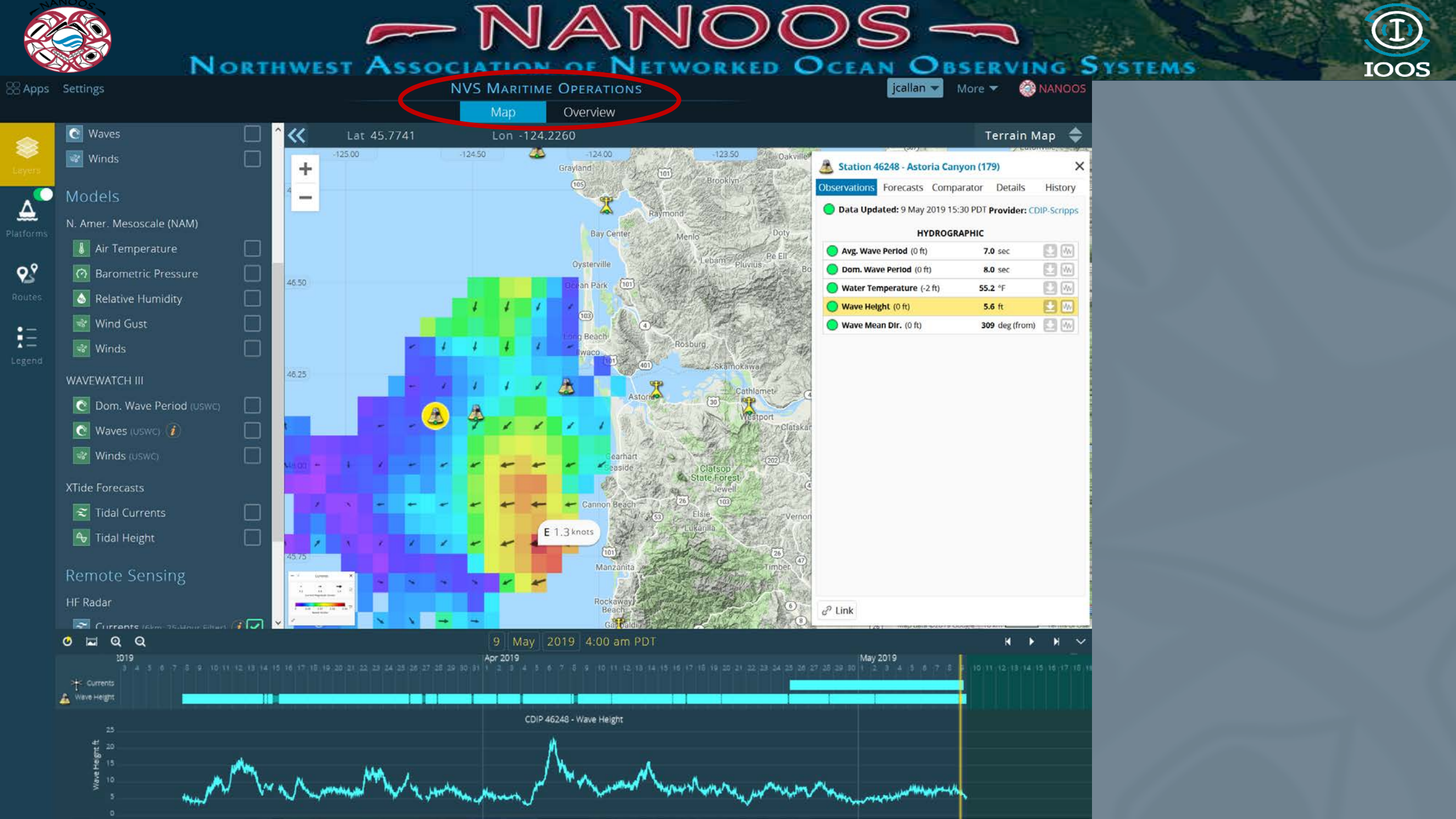
Legend
Forecasts
Air Temperature
Aragonite Saturation
Barometric Pressure
Nitrate Concentration
Oxygen Concentration
pH
Phytoplankton
Salinity
Tidal Height
Lat
Lon
Terrain Map
-126.00
-125.00
-124.00
Aragonite Saturation
-3 m
0
0.75
1.5
2.25
3
ARAG
PCSGA - Nahcotta Port hatchery mooring, Willapa Bay
Observations
Forecasts
Comparator
Details
History
Credits
HYDROGRAPHIC
Oxygen Conc. (-0.3 m) 11 mg/L
Oxygen Pct. Sat. (-0.3 m) 98 %
pH
(-0.3 m) 7.8
(-0.6 m) 7.9
Salinity (-0.3 m) 15.5 PSU
Water Temperature (-0.3 m) 7.4 °C
Link
Elma
Centralia
Chehalis
Raymond
Castle Rock
Longview
Olympia
20
February
2020
8:15 am PST
Jan 2020
Feb 2020
Aragonite Saturation
pH
PSI Nahcotta - pH
10.0
9.5
9.0
8.5
8.0
7.5
pH
-0.3 m
-0.6 m

NANOOS

*This **current generation of shellfish farmer is reliant upon data and services from NANOOS**. Checking the NANOOS app before seeding a beach or filling a setting tank has become standard practice.*
- Margaret Barrette, Director Pacific Coast Shellfish Growers Association

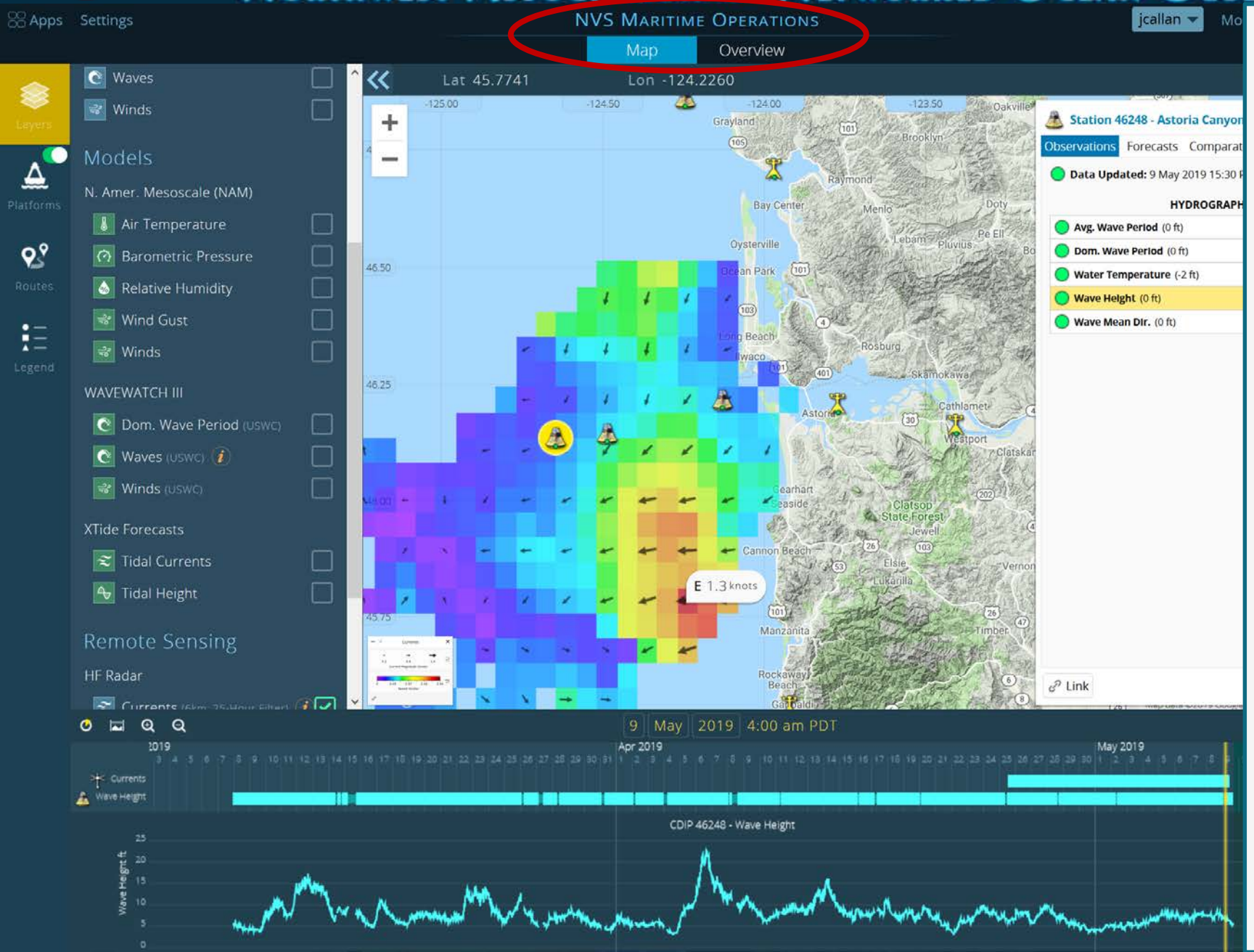
*The **services NANOOS provides are critical** to understanding current and predicting future marine conditions.*
- Paul Williams, Shellfish Program Advisor Suquamish Tribe Fisheries Department




NANOOS
Northwest Association of Networked Ocean Observing Systems
IOOS
Apps
Settings
NVS Maritime Operations
Map
Overview
jcallan
More
NANOOS
Layers
Platforms
Routes
Legend
Waves
Winds
Models
N. Amer. Mesoscale (NAM)
Air Temperature
Barometric Pressure
Relative Humidity
Wind Gust
Winds
WAVEWATCH III
Dom. Wave Period (USWC)
Waves (USWC)
Winds (USWC)
XTide Forecasts
Tidal Currents
Tidal Height
Remote Sensing
HF Radar
Lat 45.7741
Lon -124.2260
Terrain Map
Station 46248 - Astoria Canyon (179)
Observations
Forecasts
Comparator
Details
History
Data Updated: 9 May 2019 15:30 PDT Provider: CDIP-Scripps
HYDROGRAPHIC
Avg. Wave Period (0 ft) 7.0 sec
Dom. Wave Period (0 ft) 8.0 sec
Water Temperature (-2 ft) 55.2 °F
Wave Height (0 ft) 5.6 ft
Wave Mean Dir. (0 ft) 309 deg (from)
Link
E 1.3 knots
9 May 2019 4:00 am PDT
Apr 2019
May 2019
Currents
Wave Height
CDIP 46248 - Wave Height
Wave Height ft

NANOOS

Northwest Association of Networked Ocean Observing Systems

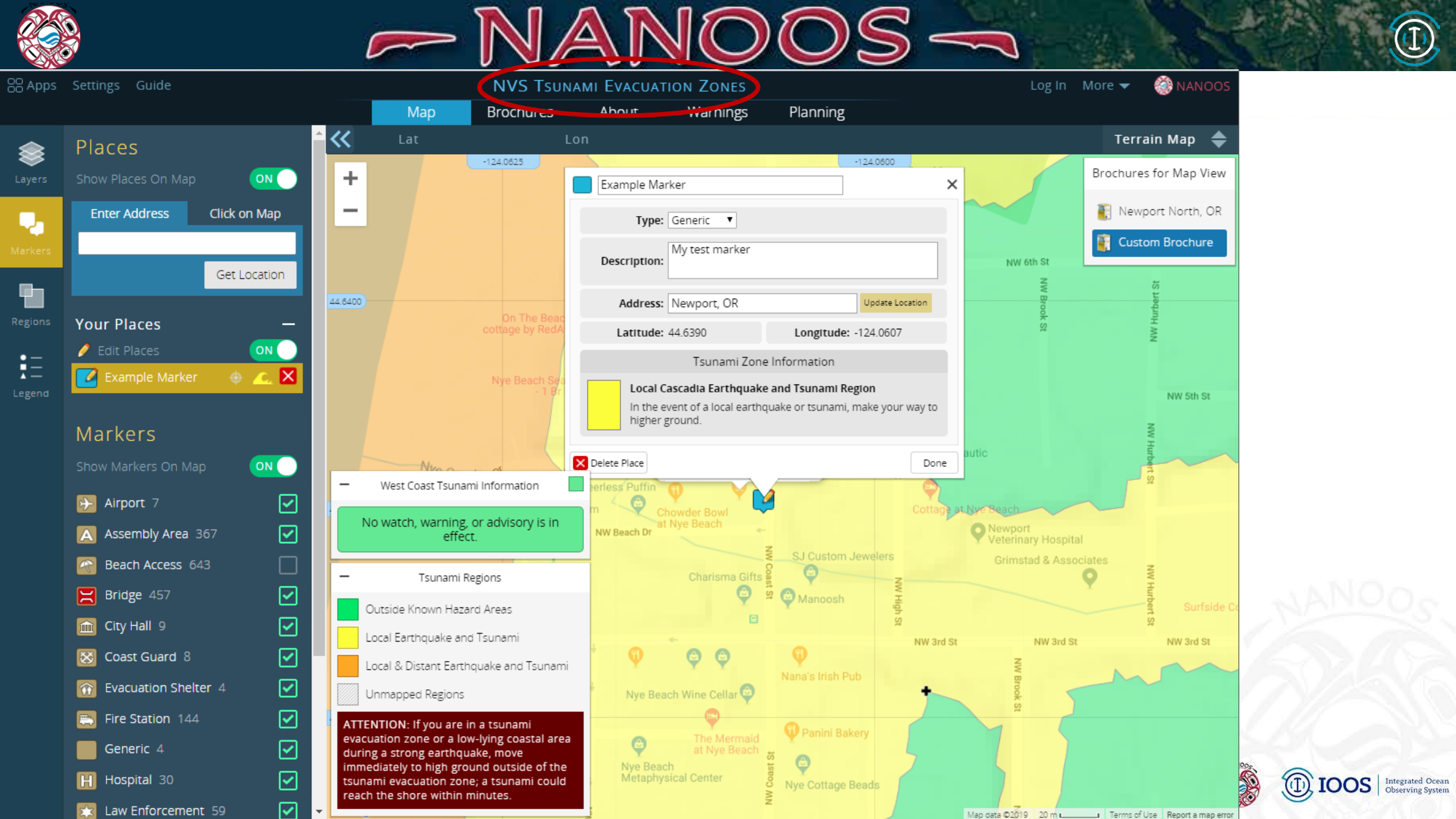


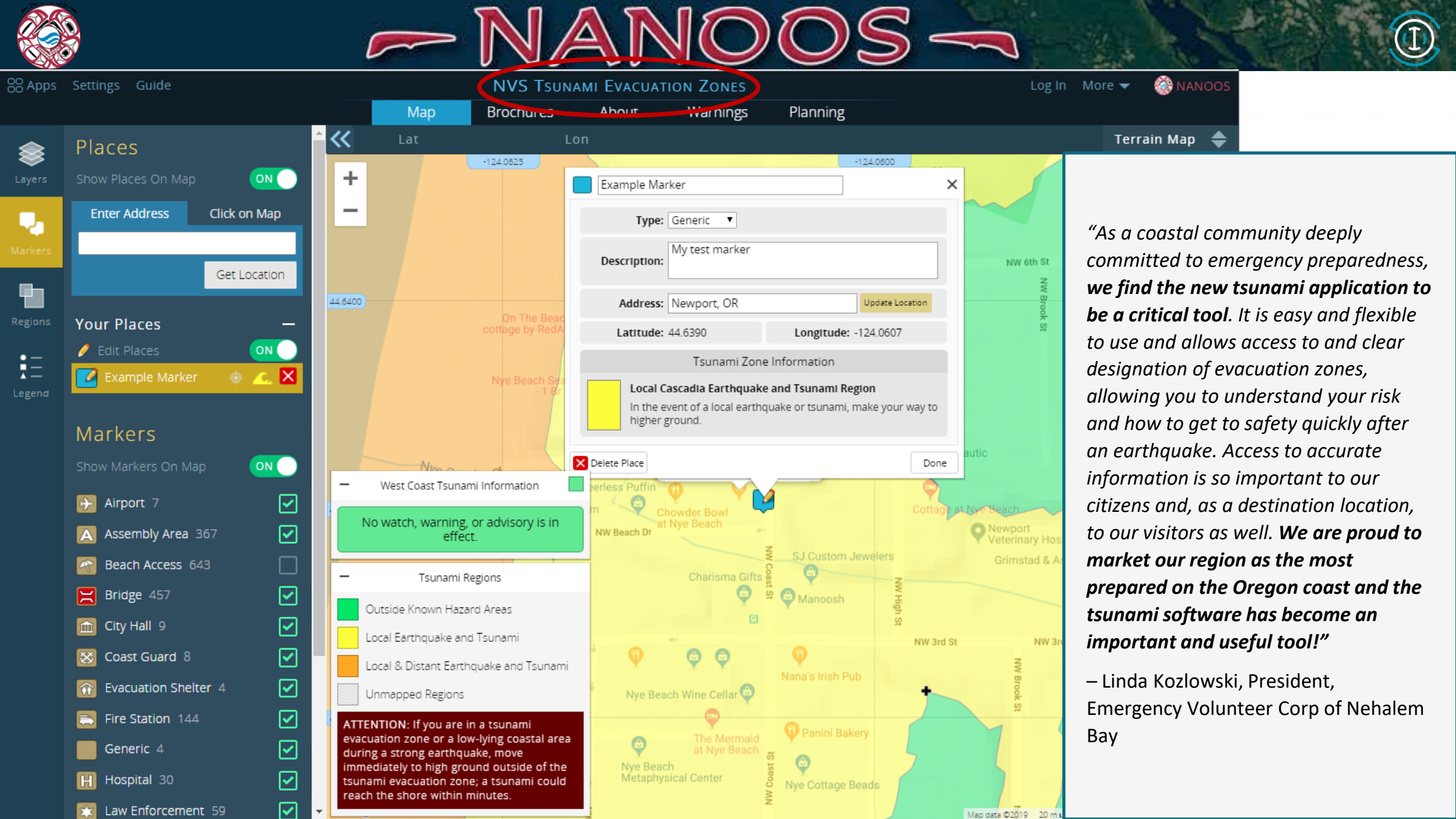
"Ships crossing the Columbia River Bar face one of the most dangerous harbor entrances in the world. The Columbia River Bar Pilots rely on weather forecasts, real time buoy data along with wave and current models when determining safe times for ships to cross the bar. ***NANOOS provides an excellent location for us to see and compare all the available data sources.****"*

– Captain Dan Jordan, Columbia River Bar Pilots

*"****NANOOS addresses a critical gap in recreational boater safety.*** *Too many safety incidents on Pacific Northwest waters happen to pleasure boaters who make poorly informed decisions about if, when, how, and where weather may impact their safety. Sadly, many don't know how to access marine weather information freely available to them.* ***NANOOS provides easy access weather information and routing tools to support better decision making by recreational boaters. I'm confident it will help save lives****."*

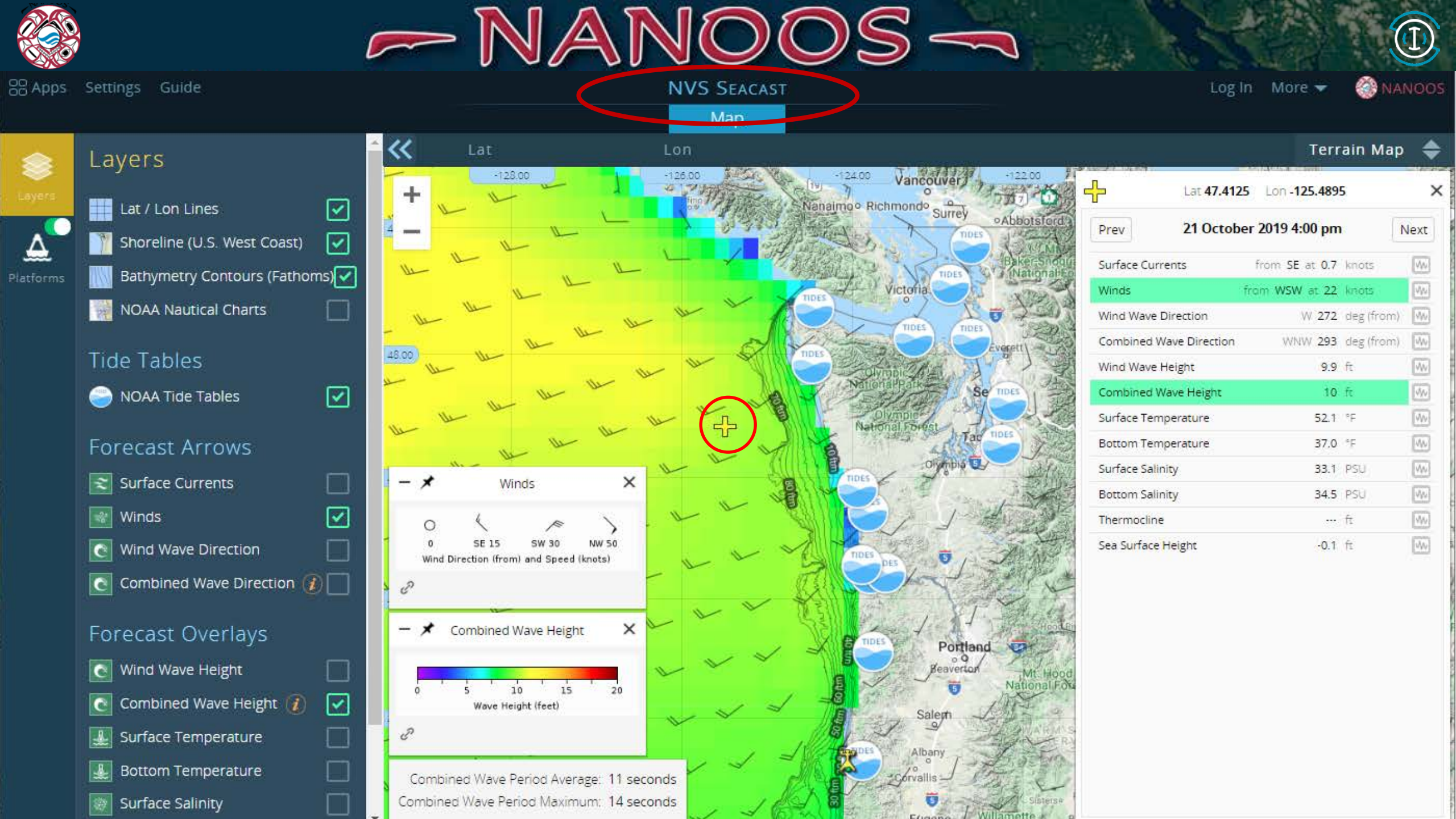
– Captain Margaret Pommert, National Association of Safe Boating Law Administration


NANOOS
Apps
Settings
Guide
NVS Tsunami Evacuation Zones
Log In
More
NANOOS
Map
Brochures
About
Warnings
Planning
Layers
Markers
Regions
Legend
Places
Show Places On Map
ON
Enter Address
Click on Map
Get Location
Your Places
Edit Places
ON
Example Marker
Markers
Show Markers On Map
ON
Airport 7
Assembly Area 367
Beach Access 643
Bridge 457
City Hall 9
Coast Guard 8
Evacuation Shelter 4
Fire Station 144
Generic 4
Hospital 30
Law Enforcement 59
Lat
Lon
Terrain Map
Example Marker
Type: Generic
Description: My test marker
Address: Newport, OR
Update Location
Latitude: 44.6390
Longitude: -124.0607
Tsunami Zone Information
Local Cascadia Earthquake and Tsunami Region
In the event of a local earthquake or tsunami, make your way to higher ground.
Delete Place
Done
Brochures for Map View
Newport North, OR
Custom Brochure
West Coast Tsunami Information
No watch, warning, or advisory is in effect.
Tsunami Regions
Outside Known Hazard Areas
Local Earthquake and Tsunami
Local & Distant Earthquake and Tsunami
Unmapped Regions
ATTENTION: If you are in a tsunami evacuation zone or a low-lying coastal area during a strong earthquake, move immediately to high ground outside of the tsunami evacuation zone; a tsunami could reach the shore within minutes.
NW 6th St
NW 5th St
NW 3rd St
NW Brook St
NW Hurbert St
NW Coast St
NW High St
NW Beach Dr
Chowder Bowl at Nye Beach
Cottage at Nye Beach
Newport Veterinary Hospital
Grimstad & Associates
SJ Custom Jewelers
Charisma Gifts
Manoosh
Nana's Irish Pub
Nye Beach Wine Cellar
The Mermaid at Nye Beach
Panini Bakery
Nye Beach Metaphysical Center
Nye Cottage Beads
Map data ©2019
20 m
Terms of Use
Report a map error
IOOS
Integrated Ocean Observing System



"As a coastal community deeply committed to emergency preparedness, ***we find the new tsunami application to be a critical tool****. It is easy and flexible to use and allows access to and clear designation of evacuation zones, allowing you to understand your risk and how to get to safety quickly after an earthquake. Access to accurate information is so important to our citizens and, as a destination location, to our visitors as well.* ***We are proud to market our region as the most prepared on the Oregon coast and the tsunami software has become an important and useful tool!"***

– Linda Kozlowski, President, Emergency Volunteer Corp of Nehalem Bay


NANOOS
Apps
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NVS SEACAST
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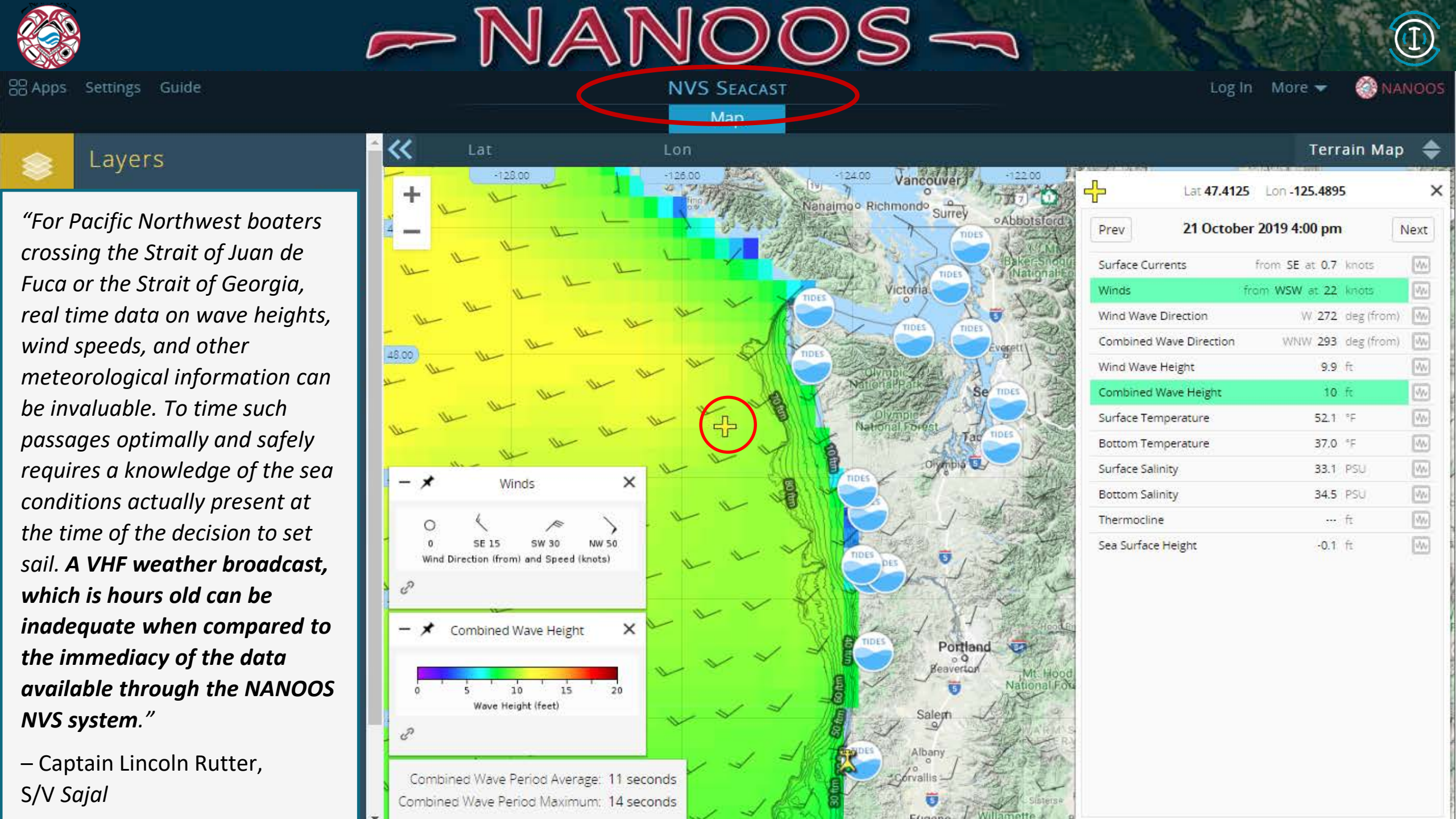
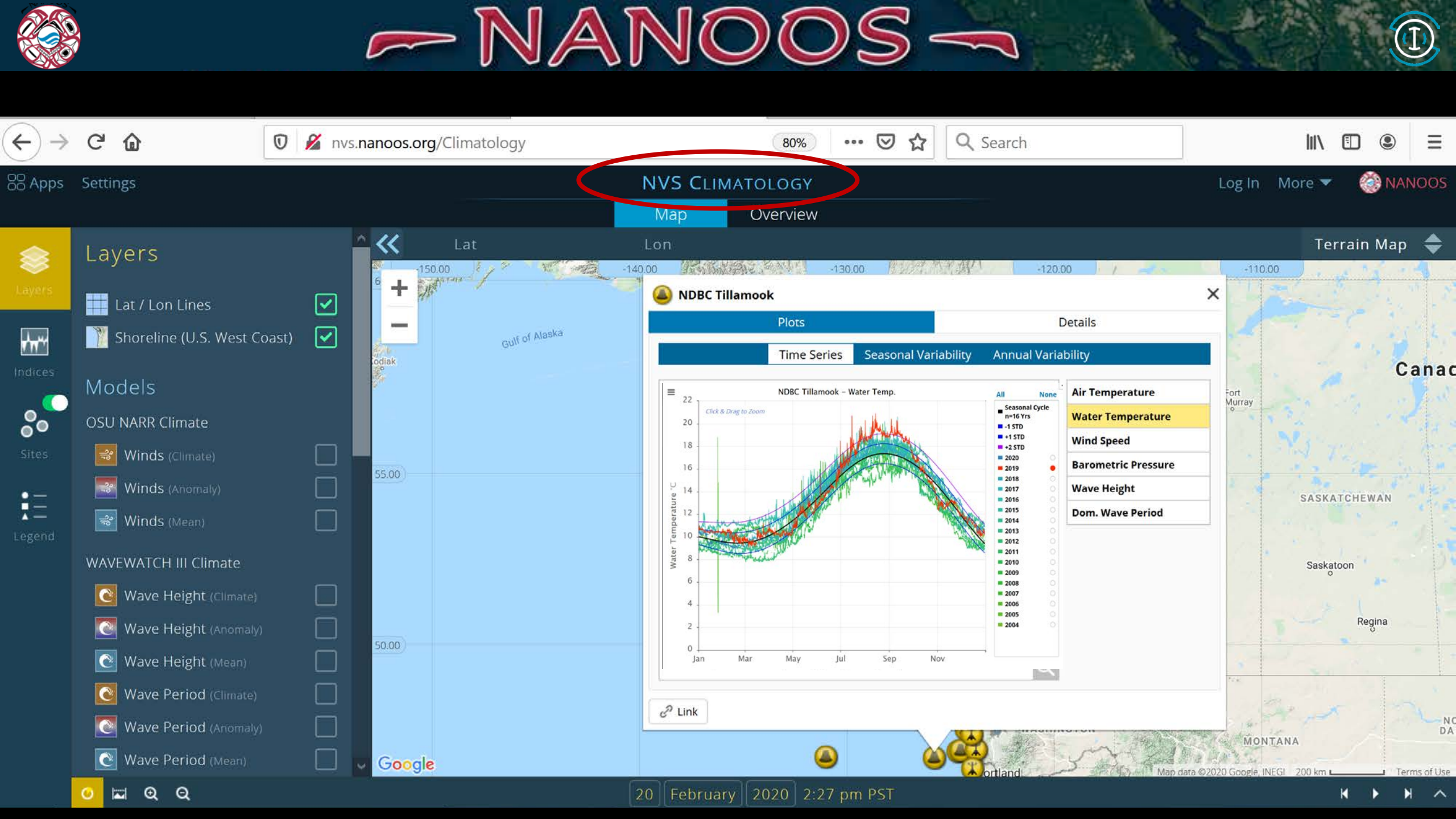
Log In
More
NANOOS
Layers
Platforms
Layers
Lat / Lon Lines
Shoreline (U.S. West Coast)
Bathymetry Contours (Fathoms)
NOAA Nautical Charts
Tide Tables
NOAA Tide Tables
Forecast Arrows
Surface Currents
Winds
Wind Wave Direction
Combined Wave Direction
Forecast Overlays
Wind Wave Height
Combined Wave Height
Surface Temperature
Bottom Temperature
Surface Salinity
Lat
Lon
Terrain Map
-128.00
-126.00
-124.00
-122.00
48.00
Vancouver
Nanaimo
Richmond
Surrey
Abbotsford
Victoria
Everett
Olympic National Park
Olympic National Forest
Olympia
Portland
Beaverton
Salem
Albany
Corvallis
Winds
0
SE 15
SW 30
NW 50
Wind Direction (from) and Speed (knots)
Combined Wave Height
0
5
10
15
20
Wave Height (feet)
Combined Wave Period Average: 11 seconds
Combined Wave Period Maximum: 14 seconds
Lat 47.4125
Lon -125.4895
Prev
21 October 2019 4:00 pm
Next
Surface Currents from SE at 0.7 knots
Winds from WSW at 22 knots
Wind Wave Direction W 272 deg (from)
Combined Wave Direction WNW 293 deg (from)
Wind Wave Height 9.9 ft
Combined Wave Height 10 ft
Surface Temperature 52.1 °F
Bottom Temperature 37.0 °F
Surface Salinity 33.1 PSU
Bottom Salinity 34.5 PSU
Thermocline --- ft
Sea Surface Height -0.1 ft



"For Pacific Northwest boaters crossing the Strait of Juan de Fuca or the Strait of Georgia, real time data on wave heights, wind speeds, and other meteorological information can be invaluable. To time such passages optimally and safely requires a knowledge of the sea conditions actually present at the time of the decision to set sail. ***A VHF weather broadcast, which is hours old can be inadequate when compared to the immediacy of the data available through the NANOOS NVS system****."*

– Captain Lincoln Rutter,
S/V *Sajal*


NANOOS
nvs.nanoos.org/Climatology
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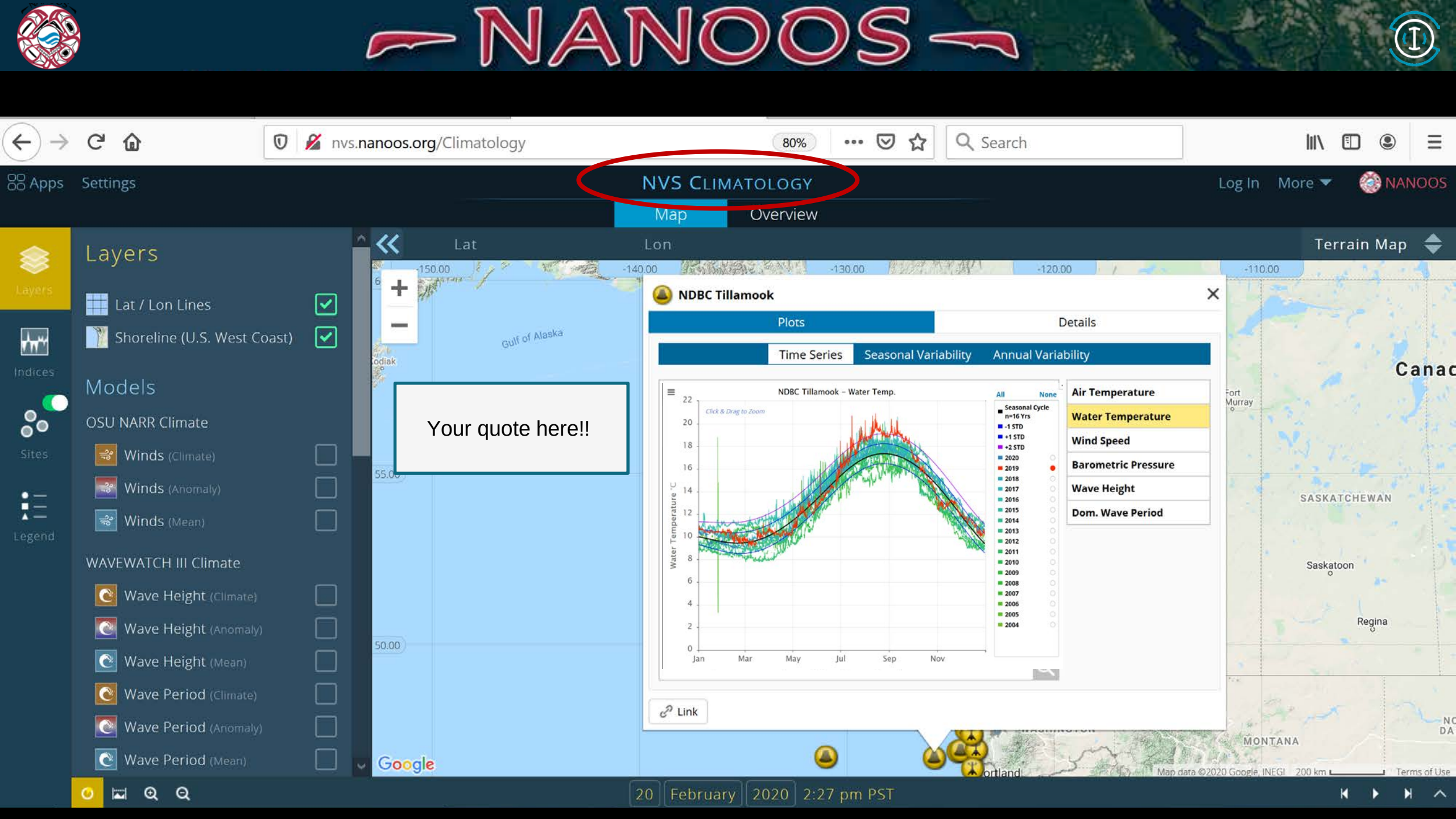
OSU NARR Climate
Winds (Climate)
Winds (Anomaly)
Winds (Mean)
WAVEWATCH III Climate
Wave Height (Climate)
Wave Height (Anomaly)
Wave Height (Mean)
Wave Period (Climate)
Wave Period (Anomaly)
Wave Period (Mean)
Lat
Lon
Terrain Map
-150.00
-140.00
-130.00
-120.00
-110.00
55.00
50.00
Gulf of Alaska
NDBC Tillamook
Plots
Details
Time Series
Seasonal Variability
Annual Variability
NDBC Tillamook – Water Temp.
Click & Drag to Zoom
Water Temperature °C
Jan
Mar
May
Jul
Sep
Nov
All
None
Seasonal Cycle n=16 Yrs
-1 STD
+1 STD
+2 STD
2020
2019
2018
2017
2016
2015
2014
2013
2012
2011
2010
2009
2008
2007
2006
2005
2004
Air Temperature
Water Temperature
Wind Speed
Barometric Pressure
Wave Height
Dom. Wave Period
Link
Fort Murray
SASKATCHEWAN
Saskatoon
Regina
MONTANA
Google
Map data ©2020 Google, INEGI
200 km
Terms of Use
20
February
2020
2:27 pm PST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nvs.nanoos.org/Climatology
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Wave Height (Mean)
Wave Period (Climate)
Wave Period (Anomaly)
Wave Period (Mean)
Lat
Lon
Terrain Map
Your quote here!!
NDBC Tillamook
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Time Series
Seasonal Variability
Annual Variability
NDBC Tillamook – Water Temp.
Click & Drag to Zoom
Water Temperature °C
Jan
Mar
May
Jul
Sep
Nov
All
None
Seasonal Cycle n=16 Yrs
-1 STD
+1 STD
+2 STD
2020
2019
2018
2017
2016
2015
2014
2013
2012
2011
2010
2009
2008
2007
2006
2005
2004
Air Temperature
Water Temperature
Wind Speed
Barometric Pressure
Wave Height
Dom. Wave Period
Link
Gulf of Alaska
SASKATCHEWAN
Saskatoon
Regina
MONTANA
Google
Map data ©2020 Google, INEGI
200 km
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20
February
2020
2:27 pm PST

It works!!

OceanObs'19

Iwamoto et al. 2019