Collaborative Design of Real-Time Displays of Forecast Fields for Targeted End-Users

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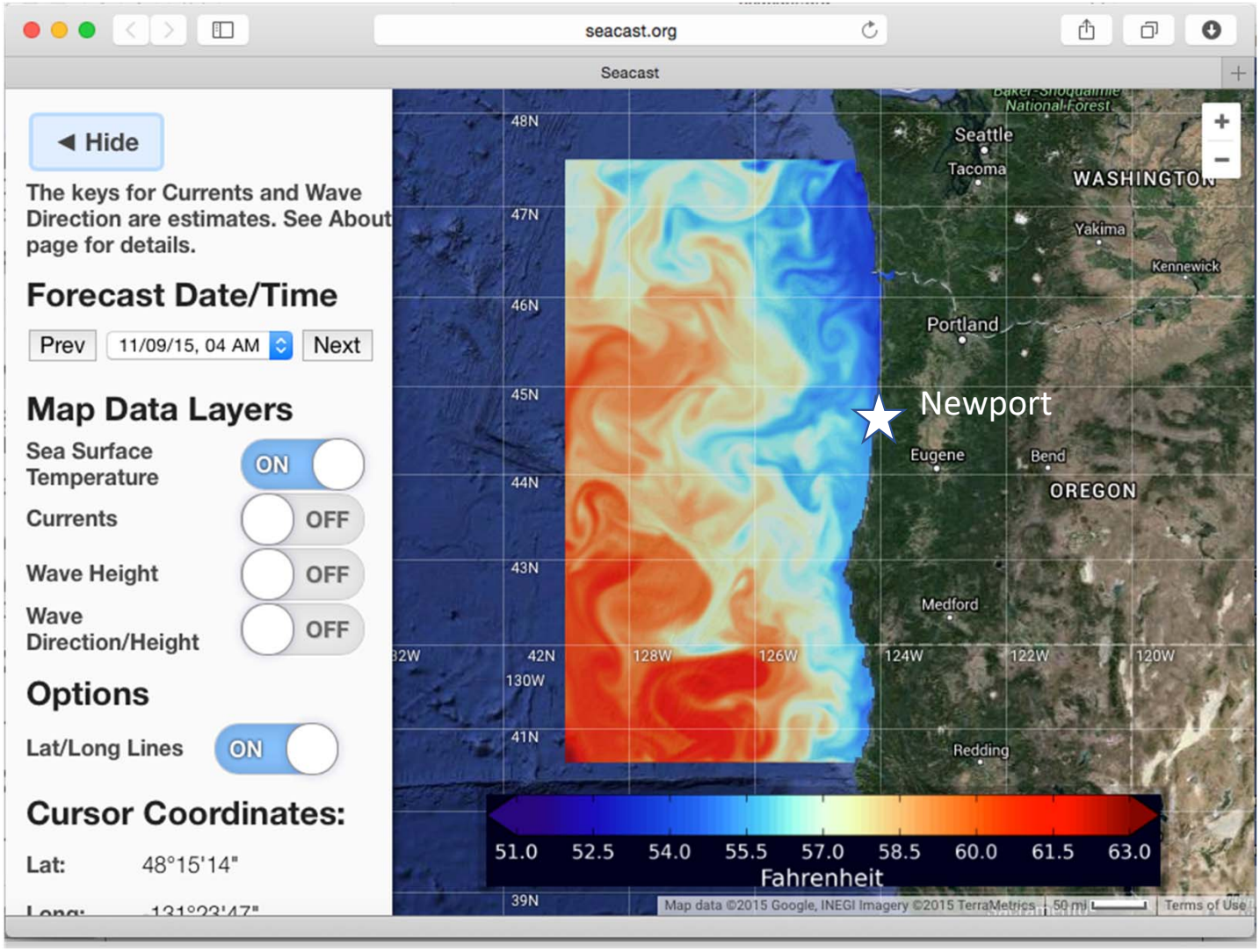
- Those using the marine environment are **making decisions** that need information regarding the **conditions under which they *will be*** working.
- The problem is their **Mutual Ignorance**:
  - Those with the data and model forecasts **don't know what decisions are being made** and what information would improve those decisions.
  - Those making the **decisions** don't know **what information is available** from the data and models.
- The obvious solution is to involve the end-users, so those providing the forecasts **understand the decisions** that need to be made and can *suggest* what information and displays might be provided to help with those decisions (the suggestions might be rejected).

Improvements and additions to seacast.org were made based on input from fishermen in group meetings.

The research into risk perceptions used individual interviews with fishermen, modelers and web designers.



SOLUTION (for the practical aspect):

- Develop a simplified web page (somewhat like the much more complex NANOOS Visualization System).

- Make it available to the a 'small' group of Newport fishermen; meet and get feedback (also through email and other e-media); modify the website; iterate.

- At some point, make it available to fishermen in other areas, using Newport fishermen also to present it.

- Finally, find a more permanent platform.

SOLUTION (for the research aspect):

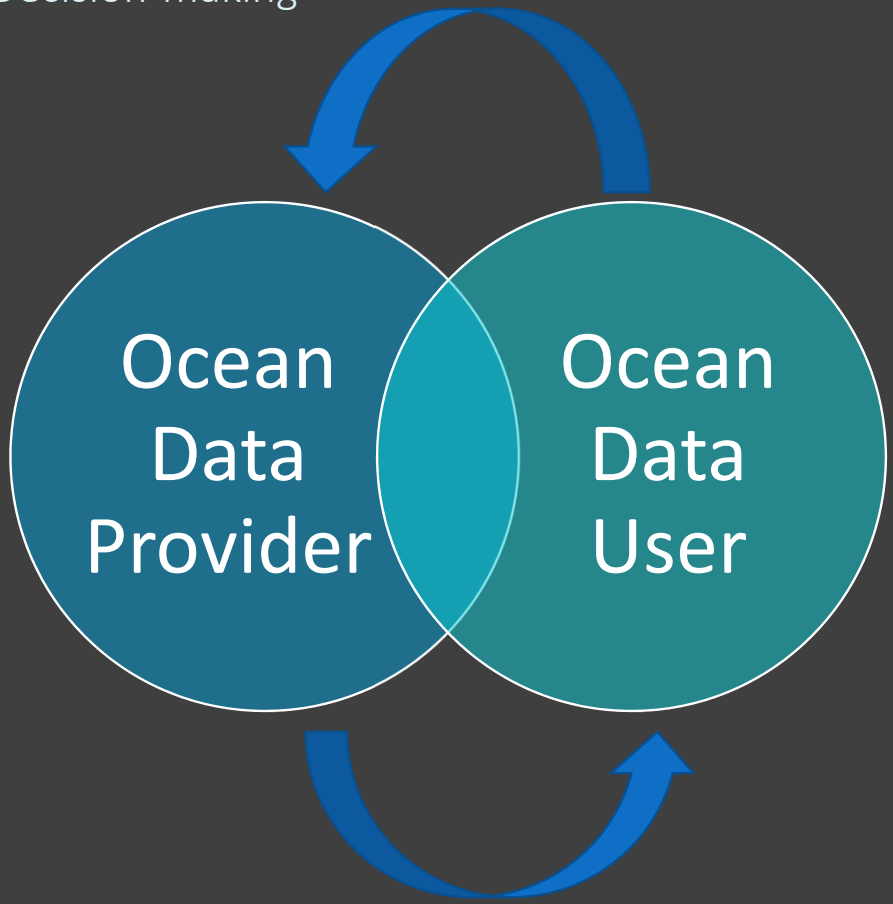
- Interviews to define the 'mental models' of ***risk*** and ***uncertainty*** for fishermen and their families ('data users'), forecast modelers and IT display experts ('data providers')

Jessica Kuonen

Ocean Views: Characterizing Risk Perception, Uncertainty, and Decision-making Within the Ocean Condition Forecast System

Research Questions

- What are similarities and differences in risk perception & comfort with uncertainty (R&U)?
- How do these impact what forecasts are made available?
- How do the available forecast fields impact fishermen's ability to make decisions?



Jessica Kuonen

Ocean Views: Characterizing Risk Perception, Uncertainty, and Decision-making Within the Ocean Condition Forecast System

- Fishermen face multiple, intersecting risks: both by going to sea and by not going to sea. Uncertainty is part of the lifestyle appeal, but they must minimize risk (physical/economic).
- Scientists perceive risk in the misuse of their forecasts, along with actual forecast errors. As with the fishermen, there are risks in providing a forecast and risks in not providing it.
- Fishermen want longer forecasts so they can use them on land and still have som confidence in them when they go to sea. They look to the future.
- Scientists prefer shorter forecasts to minimize errors. They look to the past to try to validate past forecasts to quantify errors/uncertainty.
- Fishermen compare all sources of information to develop their own 'intuition' as to the reliability of different sources.
- Scientists want to quantify uncertainty in terms of statistical error bars and margins of uncertainty.

Jessica Kuonen

Ocean Views: Characterizing Risk Perception, Uncertainty, and Decision-making Within the Ocean Condition Forecast System

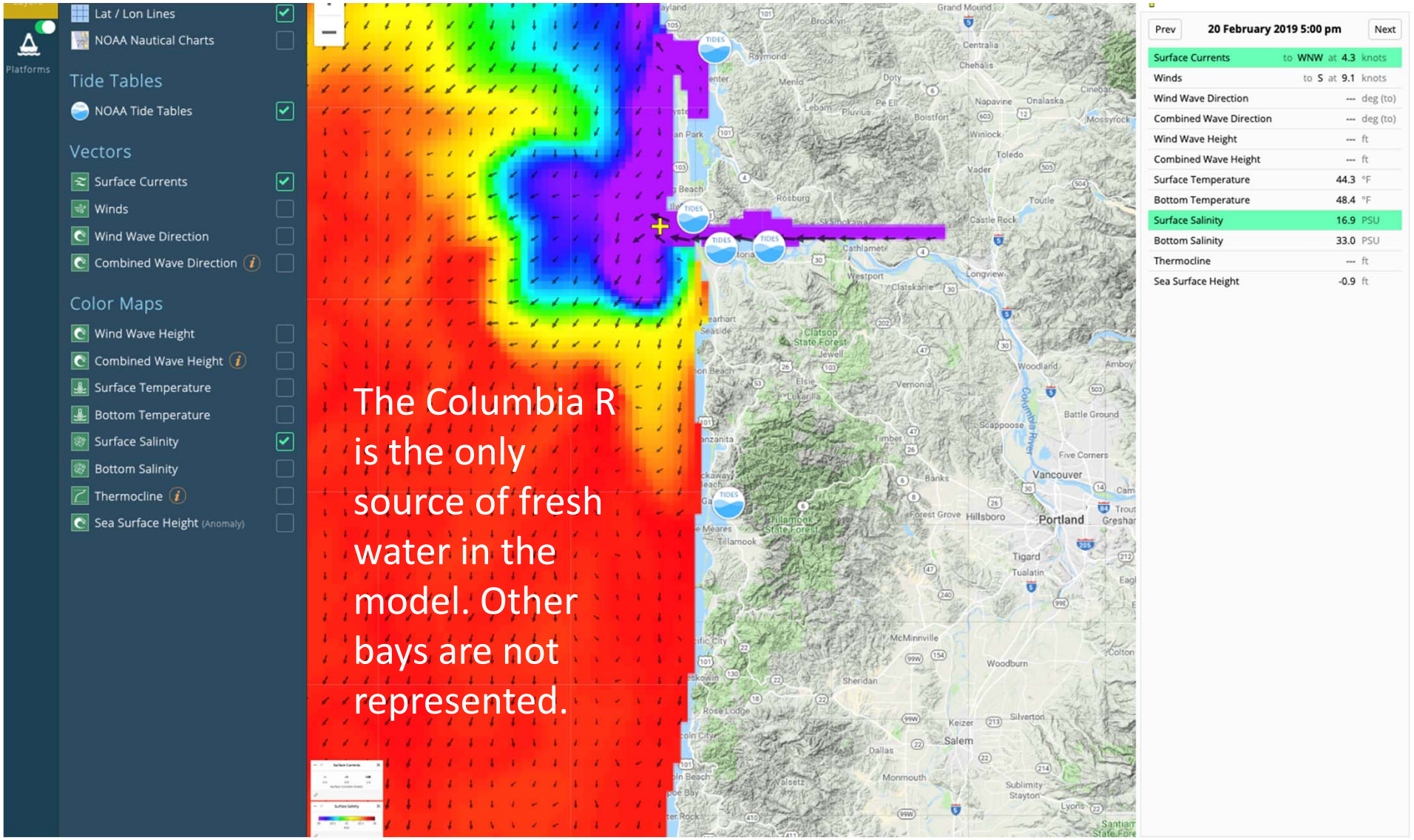
- Fishermen and scientists share a common reality – this is their livelihood.
- Fishermen and scientists consider forecasts to be both imperfect and useful: they both have an interest in improving them.
- Fishermen and scientists share a mutual curiosity about the ocean, but through different perspectives. Fishermen consider themselves 'citizen scientists'. They could be a source of data and information of use to scientists to validate the forecasts.
- Data providers, end-users and the entire data-collection and forecast effort comprise a single system. Cooperation between data providers and end-user communities is key to successfully creating value added products and improving the models.

Practical Lessons: General – Decisions are the Key

- The presence of many choices is initially a deterrent to use. They don't want to deal with unnecessary decisions. Working at sea is hectic/confusing/dangerous.
- They prefer to look at forecast fields on land, for calm decision-making. This requires longer forecasts that include the later period of their activity – more than a couple of days ahead.
- They do *not* want fields depicting uncertainty or expected error, $\pm xx.x$ They will compare forecasts to their own experience, other sources of data (buoys, observed drift & waves …).

Specific Lessons - Some Obvious, Some Difficult, Some Surprises

- Use of non-standard units, knots, fathoms, degrees F, …
- Distance and straightest path from port to XX degree water, SST and CHL fronts
- Maps of anoxia on bottom and low pH water – need ecosystem models
- Currents needed for laying out lines of gear, crab pots – especially direction
- Strong currents pull marker buoys under and gear can not be found
- Salinity – water below 20 psu kills crabs – they pump water into holds to keep crabs alive; pumping while travelling through river plumes can kill crabs; problems occur especially in bays while waiting to deliver full loads of crabs to the buyers. The models don't include bays.
- *SOLUTION:* With our final funds, we placed a real-time salinity station in one bay.


Platforms
Lat / Lon Lines
NOAA Nautical Charts
Tide Tables
NOAA Tide Tables
Vectors
Surface Currents
Winds
Wind Wave Direction
Combined Wave Direction
Color Maps
Wind Wave Height
Combined Wave Height
Surface Temperature
Bottom Temperature
Surface Salinity
Bottom Salinity
Thermocline
Sea Surface Height (Anomaly)
The Columbia R is the only source of fresh water in the model. Other bays are not represented.
Prev
20 February 2019 5:00 pm
Next
Surface Currents to WNW at 4.3 knots
Winds to S at 9.1 knots
Wind Wave Direction --- deg (to)
Combined Wave Direction --- deg (to)
Wind Wave Height --- ft
Combined Wave Height --- ft
Surface Temperature 44.3 °F
Bottom Temperature 48.4 °F
Surface Salinity 16.9 PSU
Bottom Salinity 33.0 PSU
Thermocline --- ft
Sea Surface Height -0.9 ft
Portland
Vancouver
Salem
Hillsboro
Tillamook
McMinnville
Woodburn
Tigard
Tualatin
Lake Oswego
Gresham
Battle Ground
Woodland
Longview
Kelso
Astoria
Seaside
Cannon Beach
Rosburg
Clatskanie
Westport
Cathlamet
Scappoose
Five Corners
Forest Grove
Banks
Sheridan
Dallas
Monmouth
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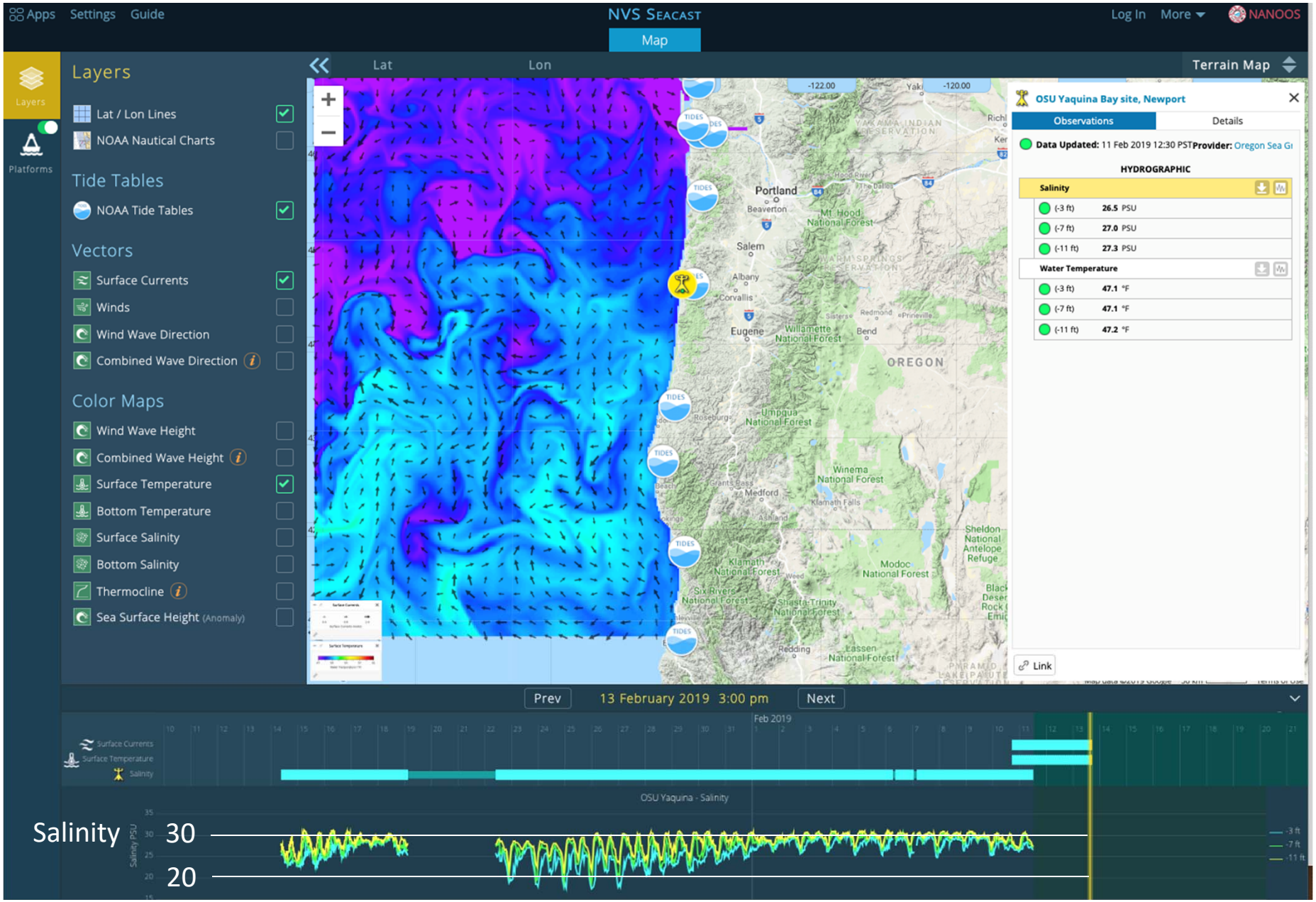
Keizer
Toledo
Castle Rock
Napavine
Centralia
Chehalis
Raymond
Brooklyn
Grand Mound
Columbia River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Sea Surface Height (Anomaly)
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Terrain Map
Portland
Salem
Eugene
OREGON
OSU Yaquina Bay site, Newport
Observations
Details
Data Updated: 11 Feb 2019 12:30 PST Provider: Oregon Sea Gr
HYDROGRAPHIC
Salinity
(-3 ft) 26.5 PSU
(-7 ft) 27.0 PSU
(-11 ft) 27.3 PSU
Water Temperature
(-3 ft) 47.1 °F
(-7 ft) 47.1 °F
(-11 ft) 47.2 °F
Link
Prev
13 February 2019 3:00 pm
Next
Feb 2019
Surface Currents
Surface Temperature
Salinity
OSU Yaquina - Salinity
Salinity PSU
35
30
25
20
-3 ft
-7 ft
-11 ft
Salinity
30
20

Emails from fishermen describe the benefits of the real-time salinity station:

"Yesterday was perhaps the best example of the value of the new salinity station. ***Lots of rain … and a short weather window.***

Many boats blown off the ocean at the same time and (this resulted in) ***many boats having to wait (sometimes several hours) to unload.*** Price just went up ($4.75/lb). ALL those that had to wait were ***deciding (whether to) re-circulate and/or provide aeration.***

When we crossed (the bar) 2 hours after low water, the ***salinity was at 11%, 12% and 13% (at 3', 7', & 11' depth): all toxic numbers for crab.*** We ***shut off our pump*** and held the crab in good water until we could unload. ***Zero dead / lost. Zero weak crab. Excellent!"***

Short Summary

To provide data/information to end users, one must understand the decisions they will make using the data.

Pilot Salinity Monitoring Station: Net Result

Thank You

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

Sea Grant Oregon

NANOOS

NASA Space Grant

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NOAA National Oceanic and Atmospheric Administration, U.S. Department of Commerce

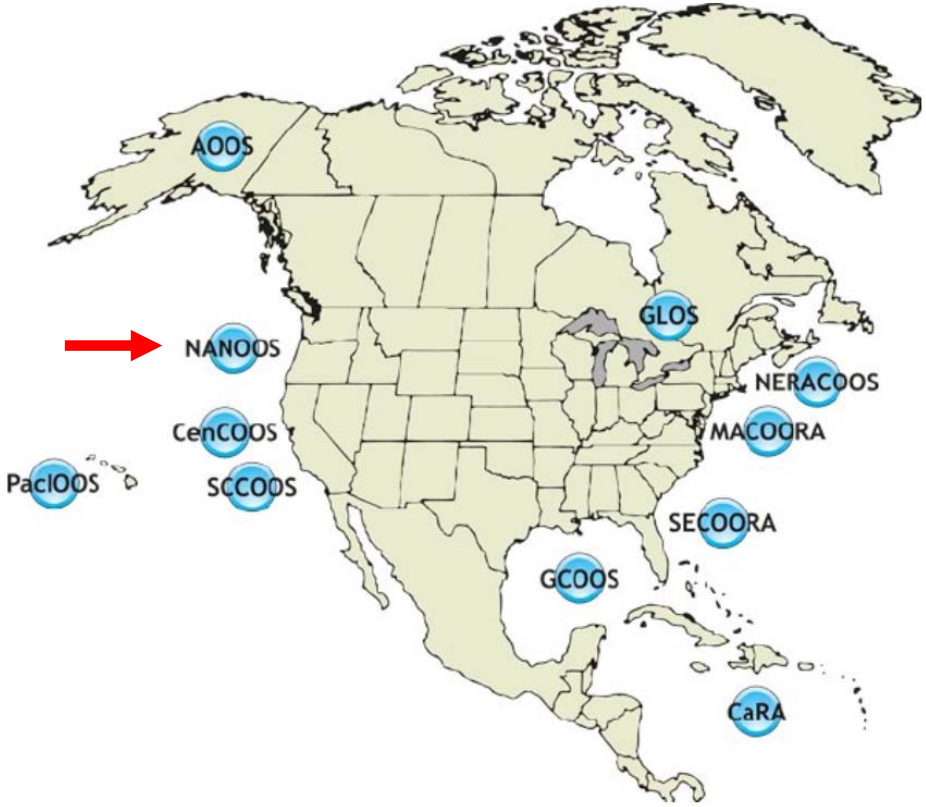
Kuonen, J., Conway, F., Strub, T., 2019, Relating ocean condition forecasts to the process of end-user decision making: A case study of the Oregon commercial fishing community, *Marine Technology Society Journal, 53(1)*, 53-66, doi:10.4031/MTSJ.53.1.1

Kuonen, J., Conway, F., Strub, T., 2019, Navigating mental models of risk and uncertainty within the ocean forecast system: An Oregon case study, *Weather, Climate and Society, 11*:431-447. doi:10.1175/WCAS-D-18-0057.1.

The End Game

Would another program take over the Seacast development? The IOOS system regional nodes provide information to regional users.

The Northwest Association of Networked Ocean Observing Systems (NANOOS)



Coastal ocean:
Northern extent of California Current
Winds, topography, freshwater input, ENSO & other climate cycles

Major inland basins:
Puget Sound-Georgia Basin, Columbia River
Urban centers, nearshore development, climate variation

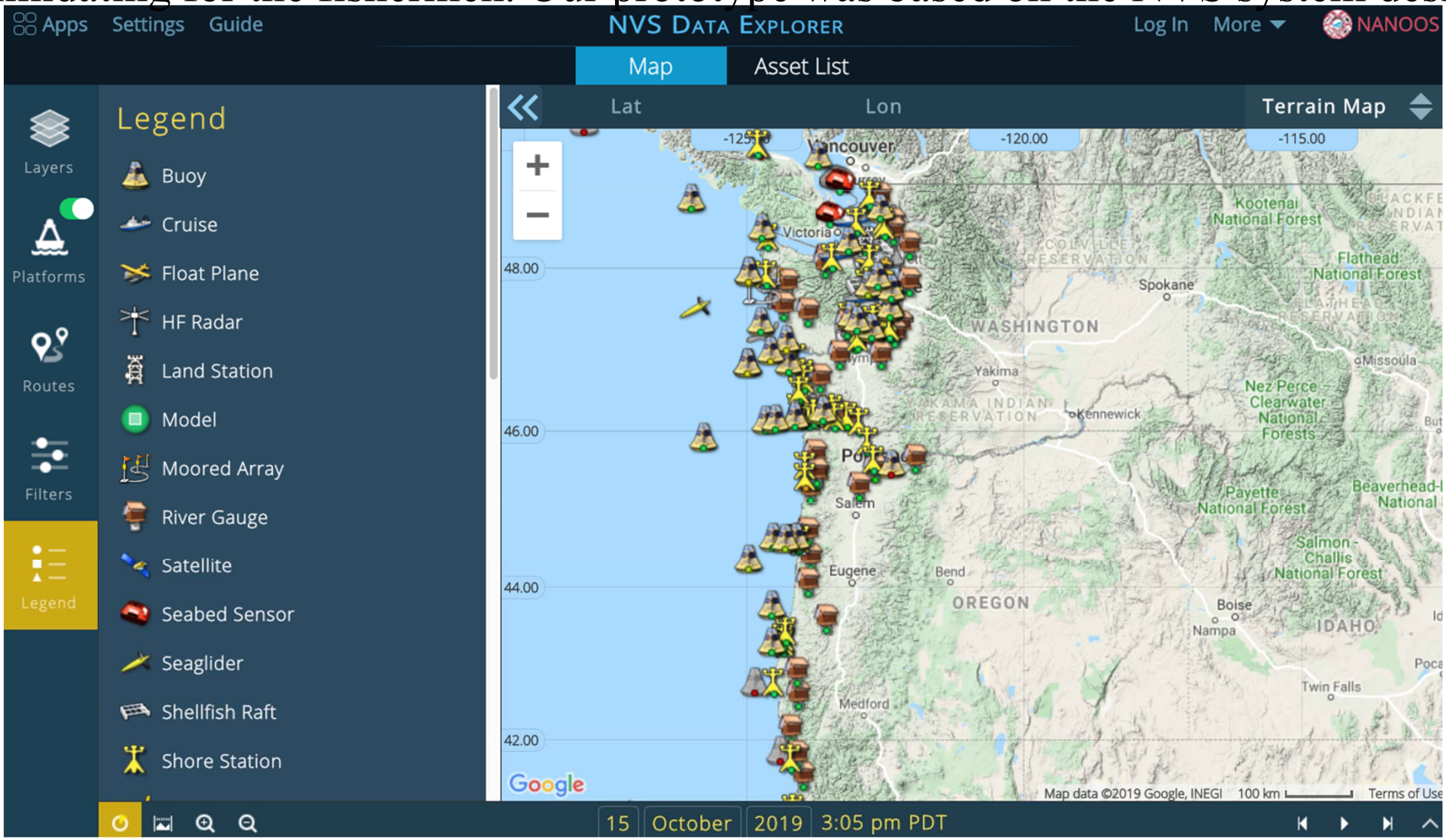
Coastal estuaries:
Willapa Bay, Grays Harbor, Yaquina Bay, Coos Bay, +20
Resource extraction, development, climate

Shorelines:
Rocky to sandy, dynamic: storms, erosion
Winds, development, climate

Major rivers:
Columbia River (~75% FW input to Pacific from US WC)
many rivers (e.g., Fraser, Skagit) via Strait Juan de Fuca
Dredging, water regulation, climate change

NANOOS Region User Groups:
Maritime: shipping, oil transport/spill remediation
Fisheries: salmon, shellfish, crab, groundfish, aquaculture
Environmental management: HABs, hypoxia
Shoreline: erosion, inundation
Hazards: Search and rescue, national security
Educators: formal, informal, research
Marine recreation: boating, surfing, diving

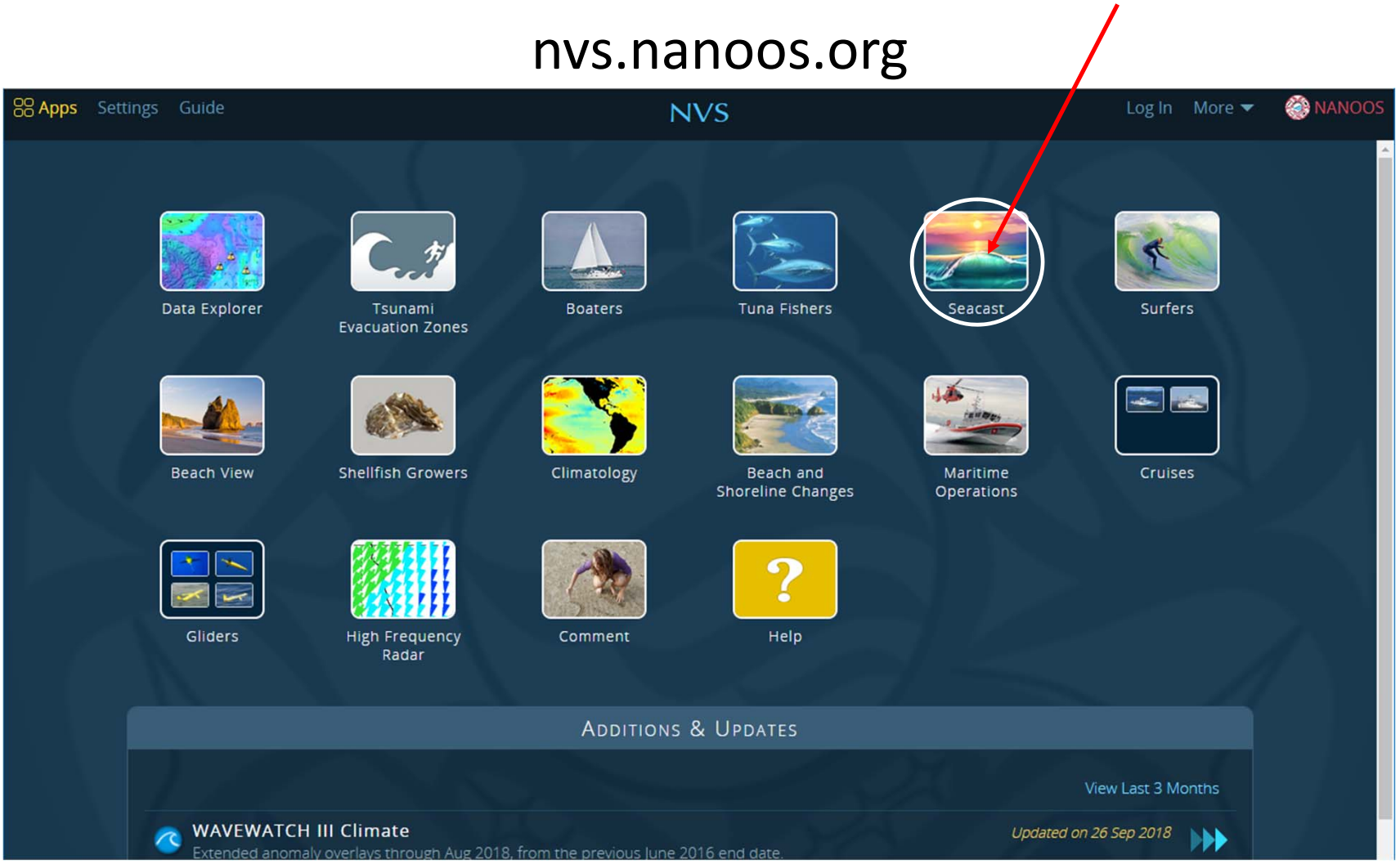
The NANOOS Visualization System had been considered at the beginning but had been to intimidating for the fishermen. Our prototype was based on the NVS system design.

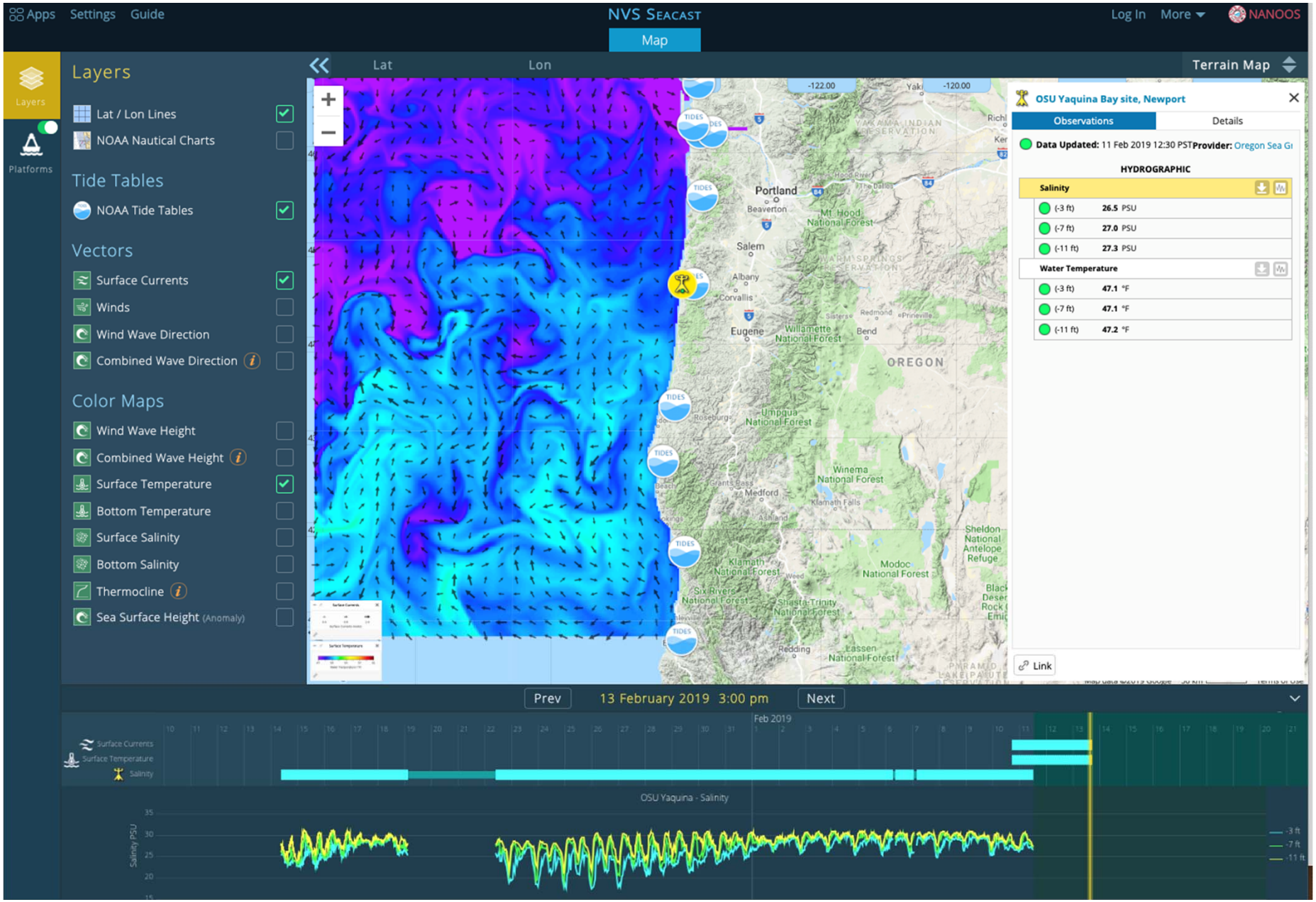


The End Game

The NANOOS Visualization System has moved toward providing simplified subsets of data for specific users. Seacast is a natural addition.

nvs.nanoos.org

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