Underwater Gliders as "Eyes Beneath the Sea:" Tracking Low-Oxygen Water

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with Steve Pierce, Anatoli Erofeev, Brian VerWey, Jace Marquardt and many others

In partnership with Joe Schumacker and the Quinault Indian Nation
and in collaboration with Charles Seaton (Columbia River Inter-Tribal Fish Commission)

NASEM Decadal Survey, Portland, Oregon, October 24, 2023

Oregon State University

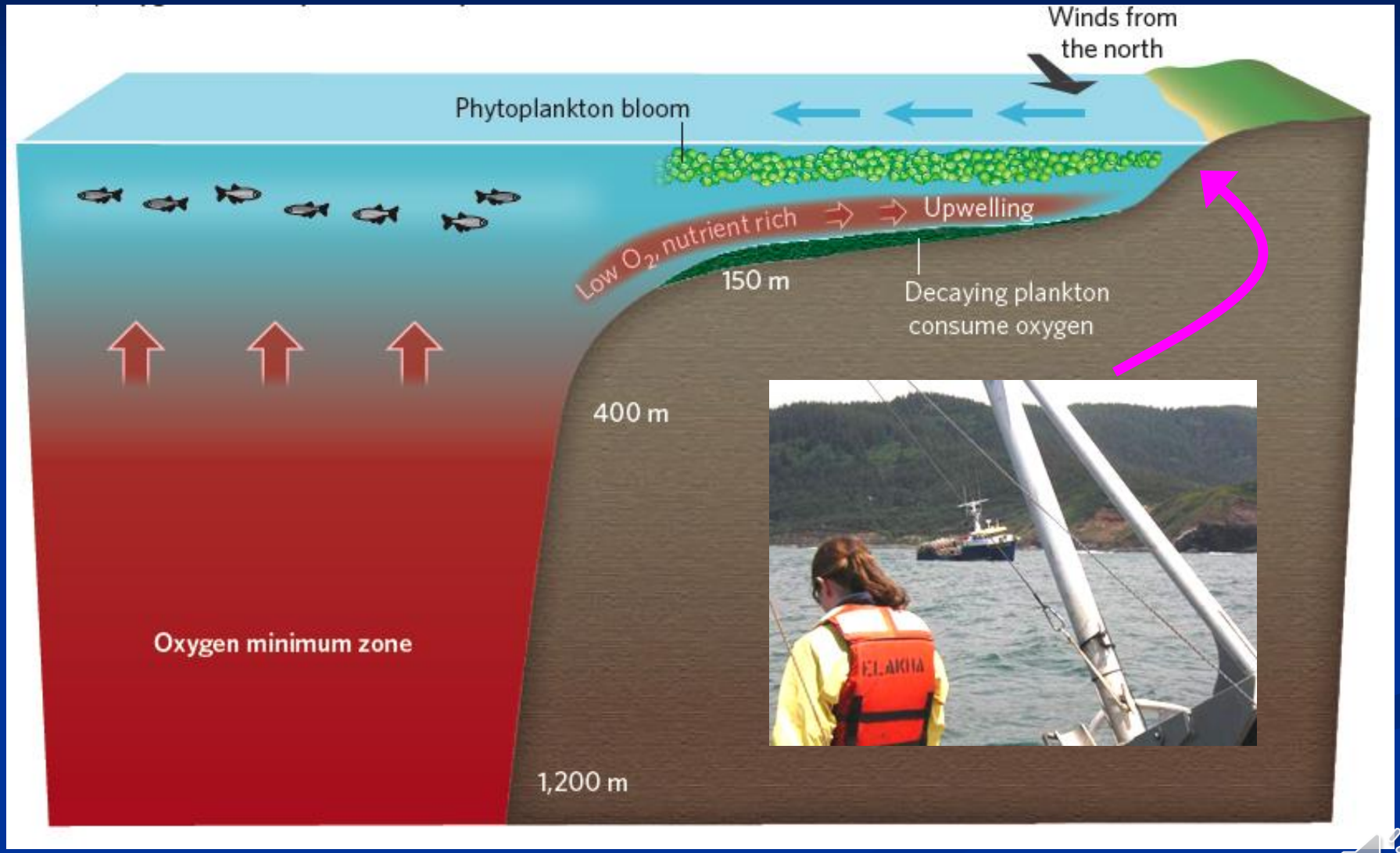
NSF

NOAA

NANOOS

Hypoxia extends to within 1 km of the surfzone

Encompasses important shallow ecological and fishery habitats



modified From Gewin, Nature 2011

Northwest Indian Fisheries Commission

Dead Zones Are a Symptom of a Warming Planet

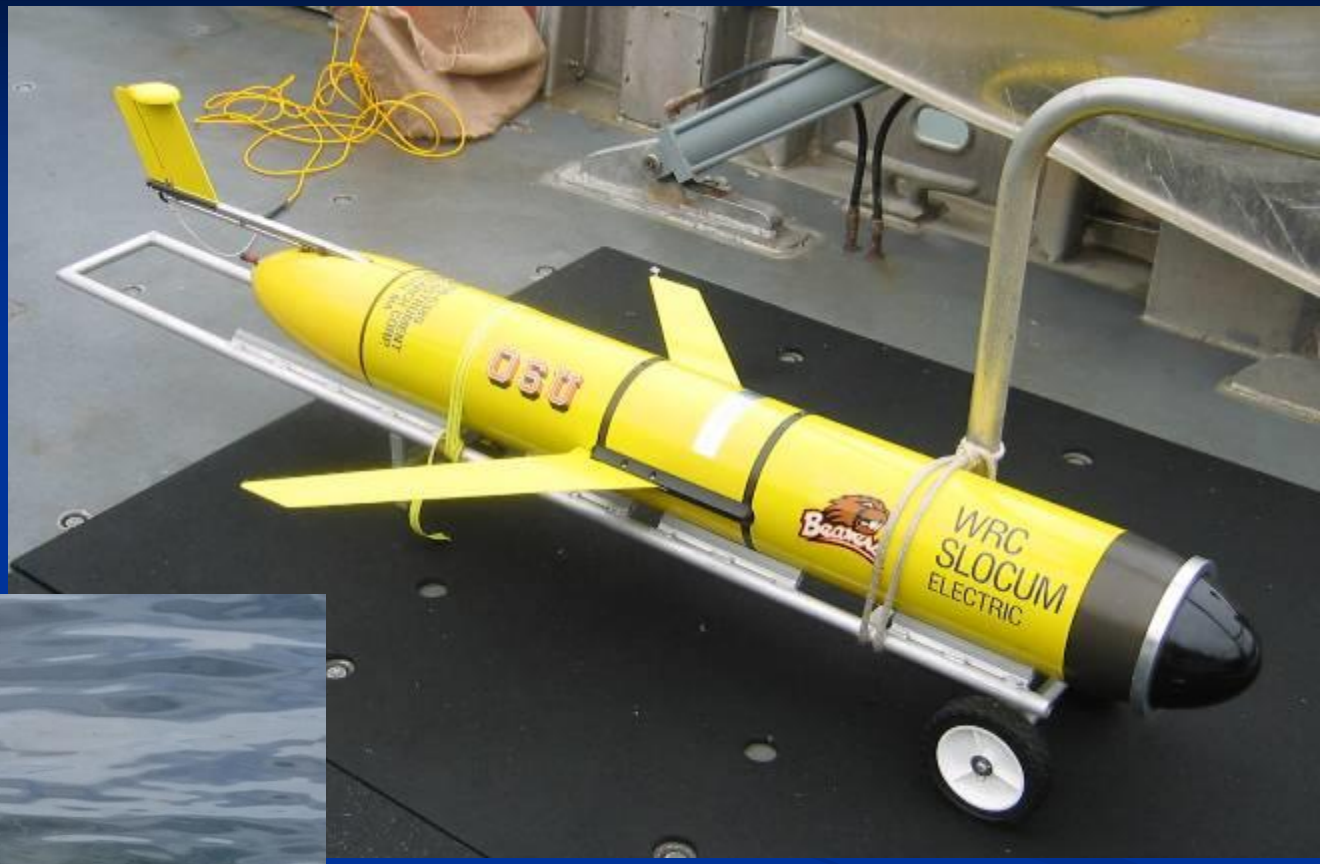
By Ed Johnstone - NWIFC Chairman

"we need to know when and where hypoxic events are happening (and) we also need to understand how low dissolved oxygen affects the ecosystem"

In July 2006, miles of beach on the Reservation were littered with dead sea fish, crabs and other aquatic animals as a result of a hypoxic event along the coast. Any animal with gills could not breath in the oxygen starved water and died. *Photos by Larry Workman*

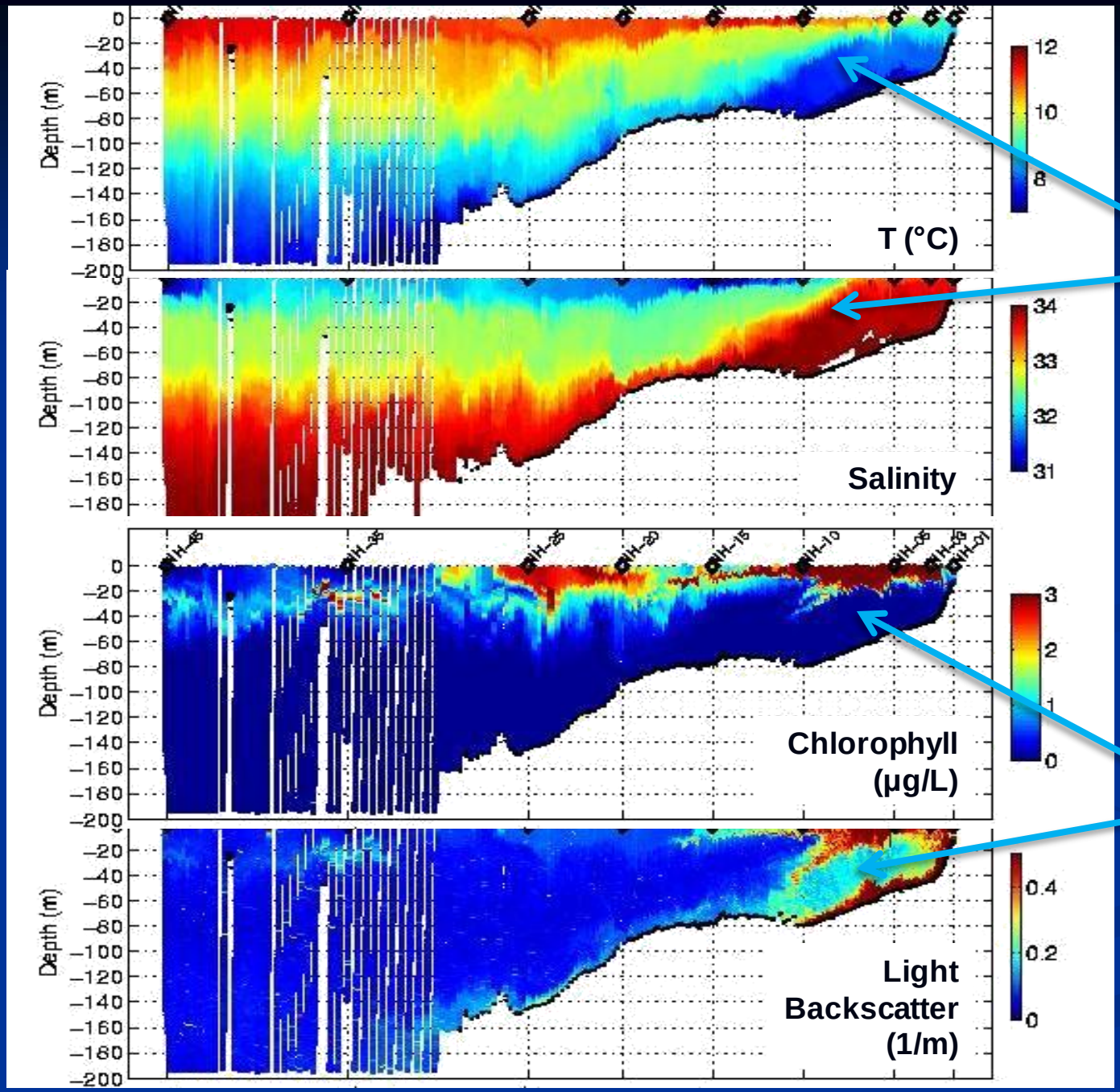
NUGGUAM, March 2023

Autonomous Underwater Vehicle Gliders



CTD
dissolved oxygen
chlorophyll fluorescence
CDOM fluorescence
light backscatter

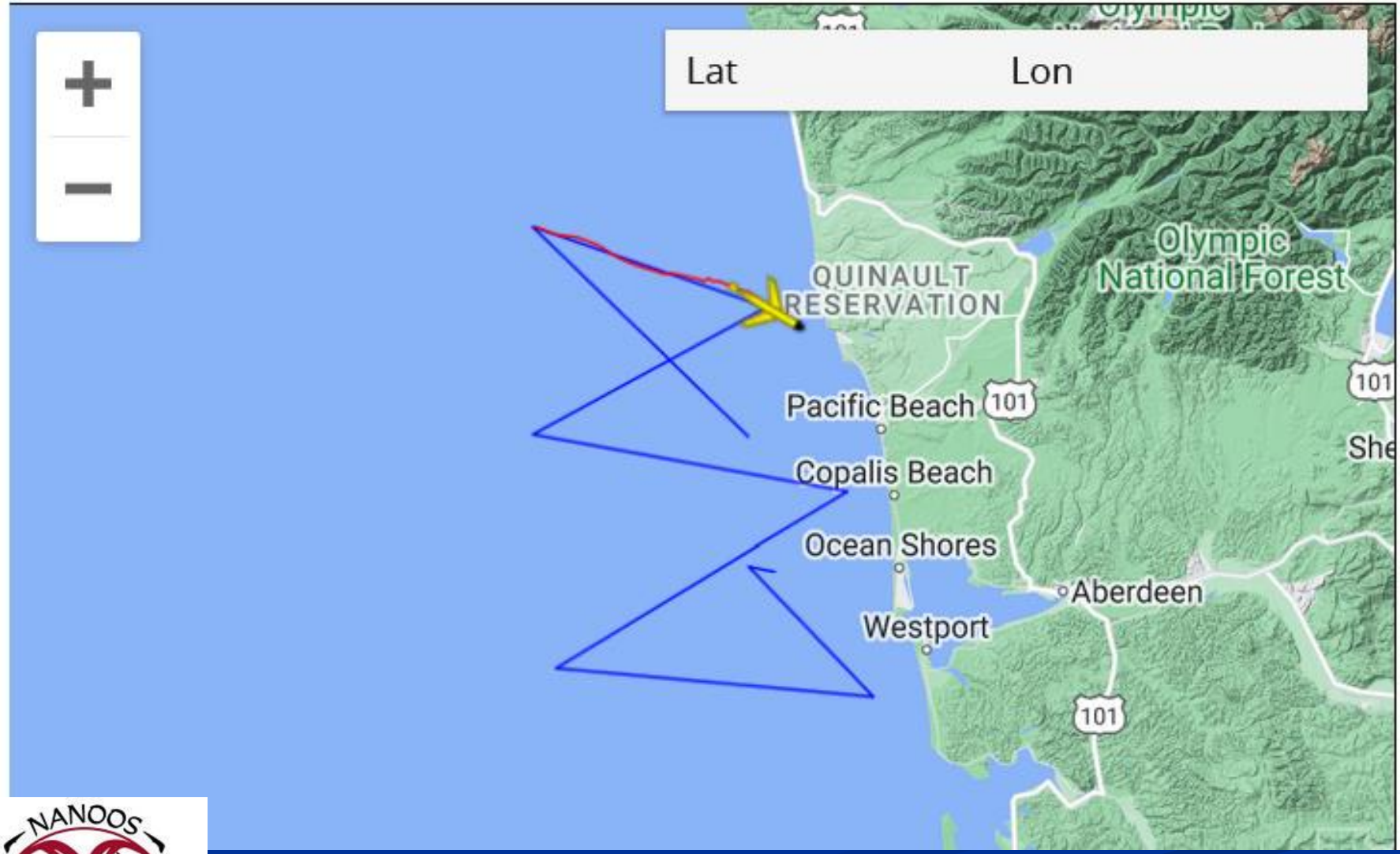
May 5 – 10, 2006



A temperature & salinity "front"

A "hotspot" for phytoplankton

Example of glider data from off Taholah, Washington

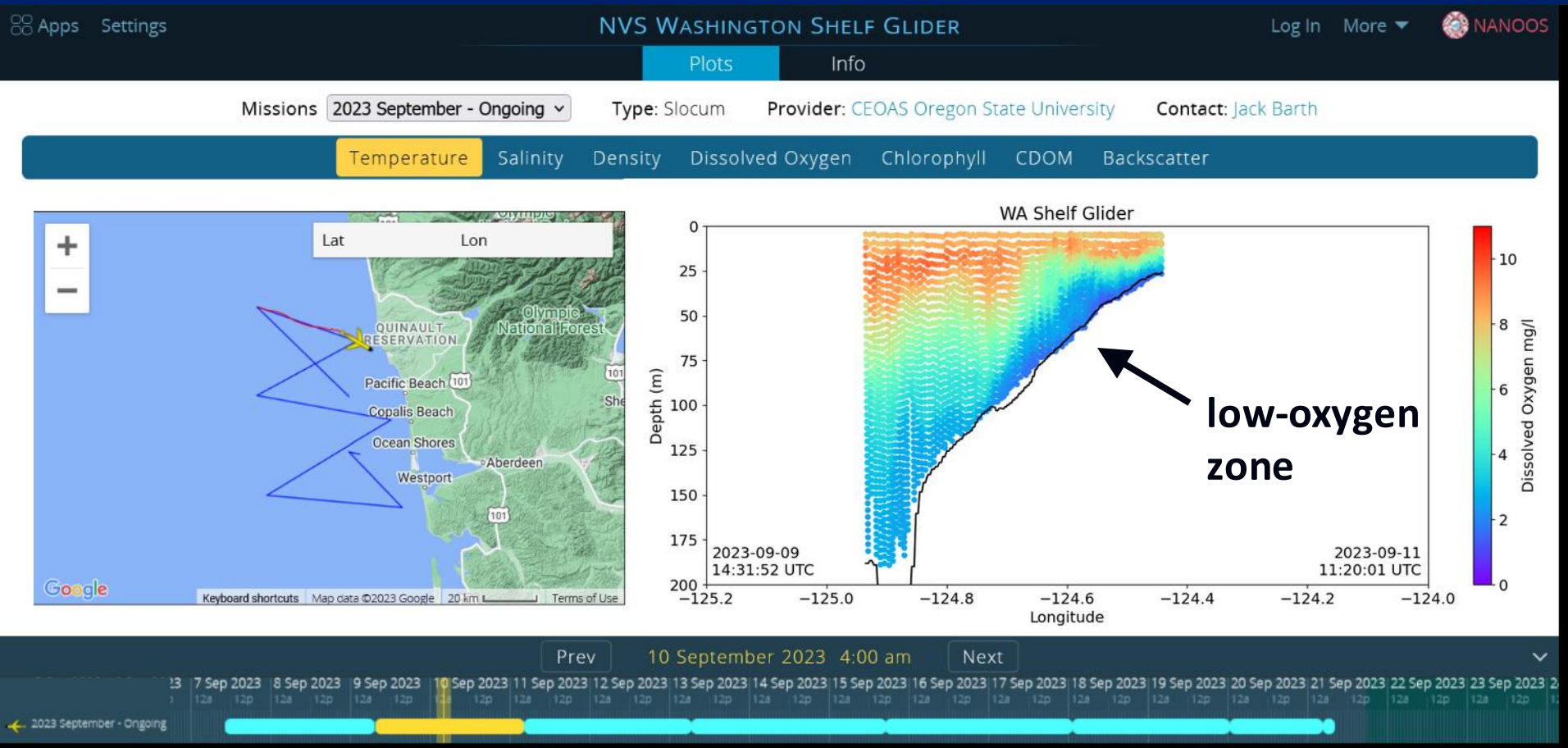


https://nvs.nanoos.org/GliderWashingtonShelf

Glider operations Westport, WA

Angelina Lopez (OSU undergraduate student)

Example of glider cross-shelf section showing dissolved oxygen from September 2023



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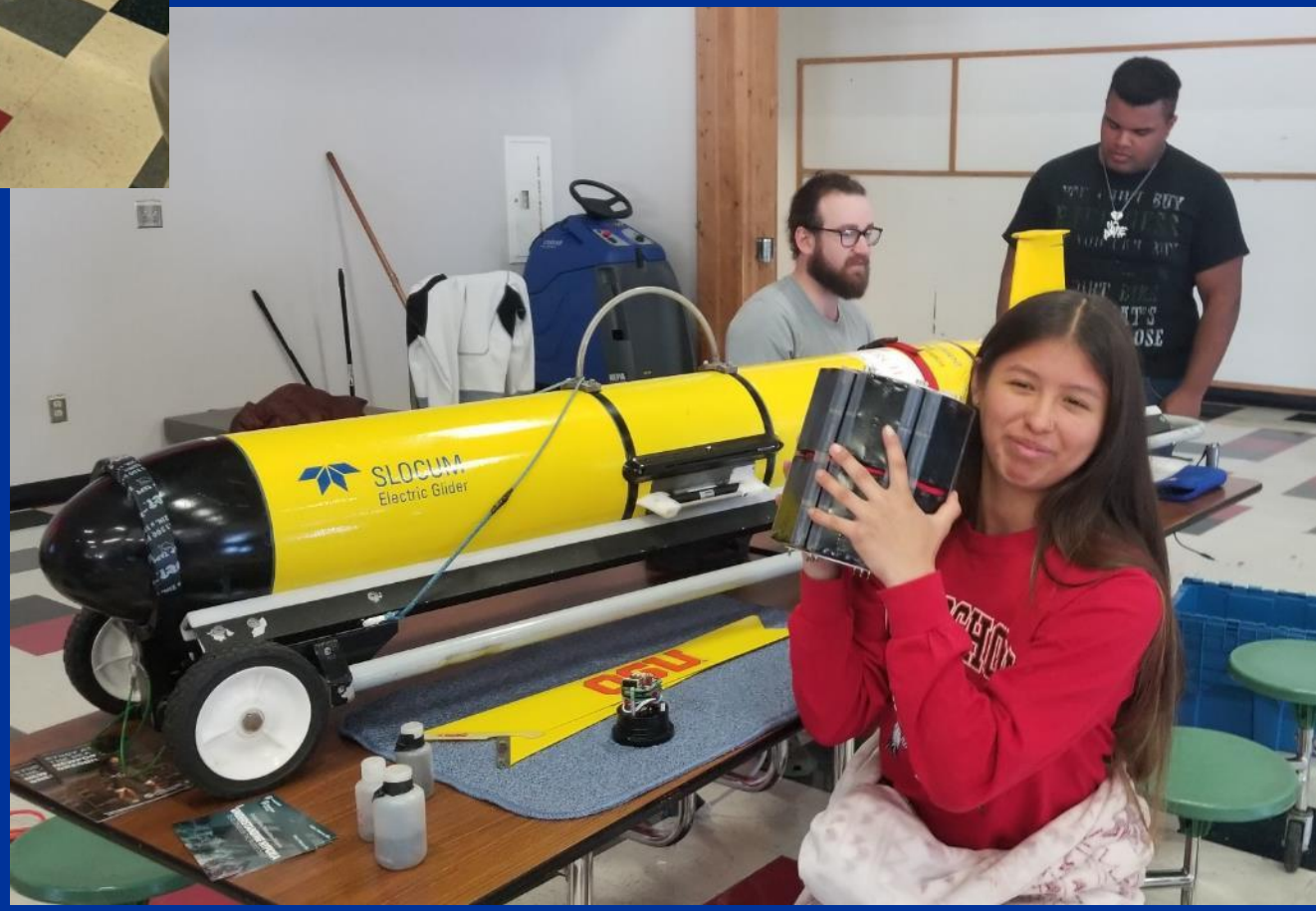


Taholah School visit
September 21, 2023

Take home points:

- physical oceanography shapes marine ecosystems
- we have the tools to map and study important ecosystem stressors

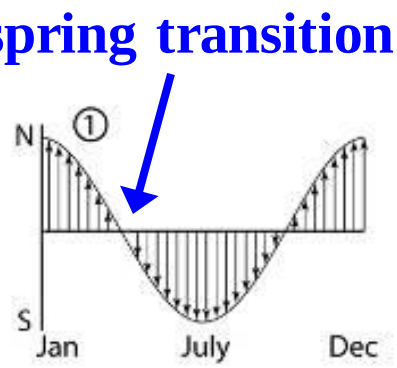
- every time we look closer we learn more
  - submesoscale (10 m to 10 km)
  - boundary layers
  - multidisciplinary sensors from same platform

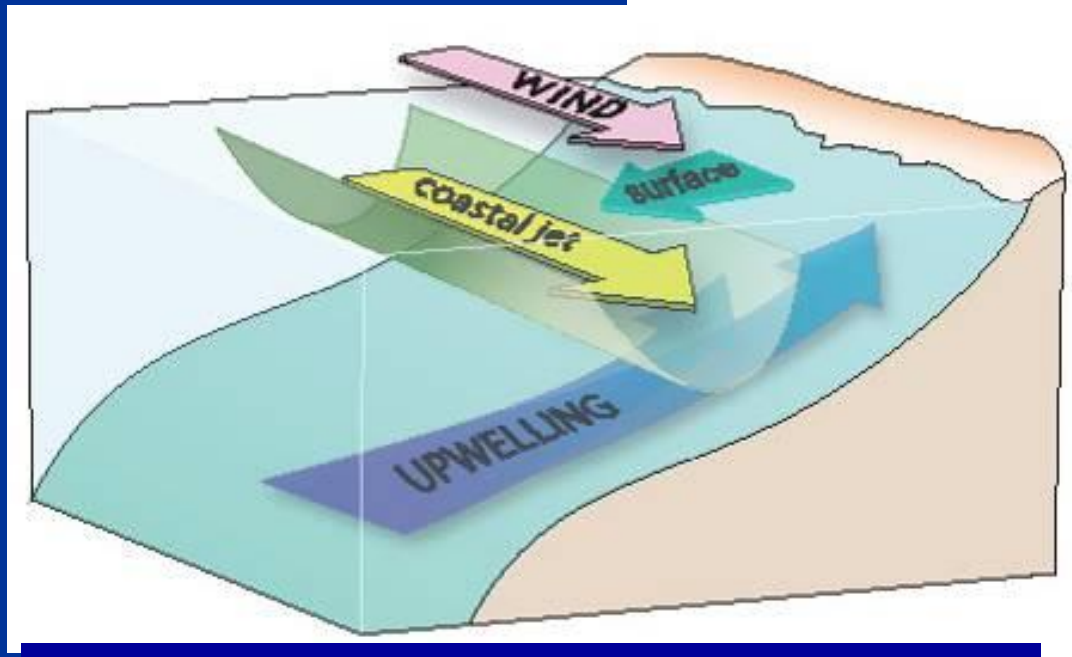
- subsurface data still lacking and underutilized …
  need data “heroes/ambassadors” to make best use of existing data

- co-design/co-production in response to societal needs

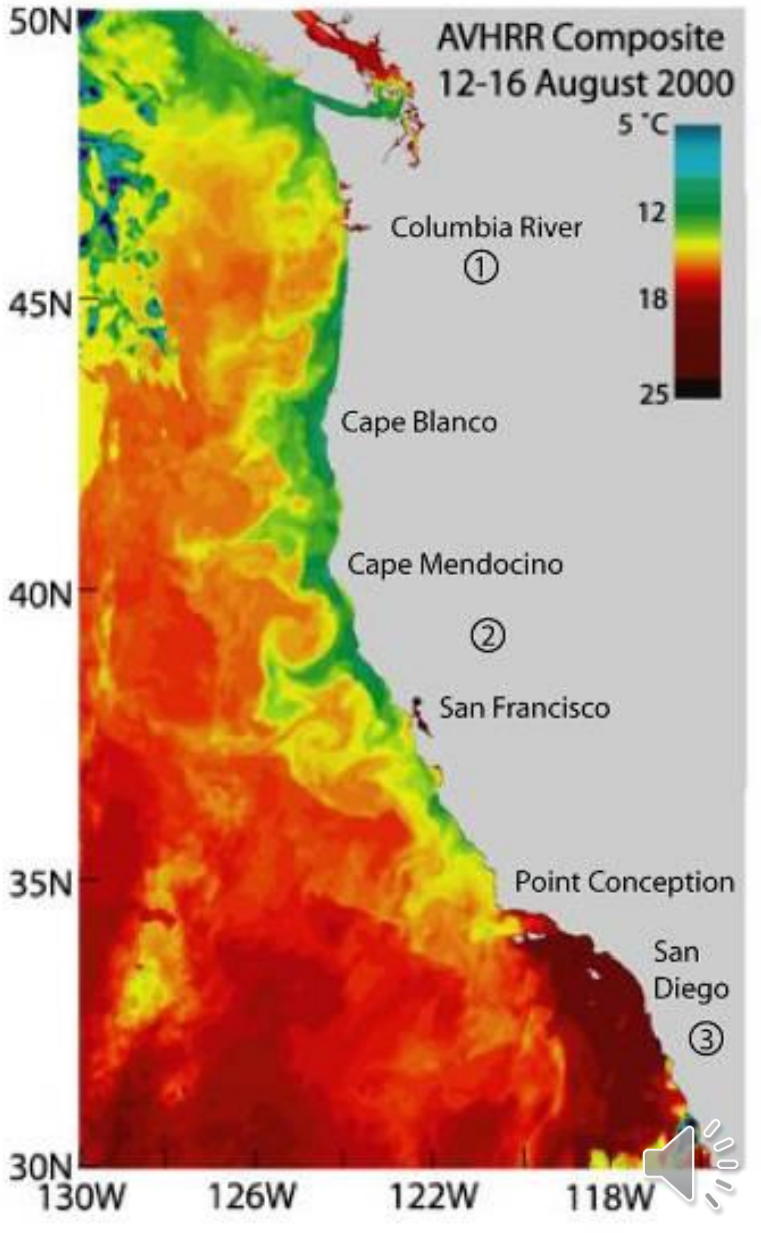
upwelling

Seasonal cycle of winds





Sea-surface temperature



Barth (2007)
Barth and Checkley (2009)

By Ed Johnstone - NWIFC Chair

"we need to know when and where hypoxic events are happening (and) we also need to understand how low dissolved oxygen affects the ecosystem"

Not only do we need to know when and where hypoxic events are happening, we also need to understand how low dissolved oxygen affects the ecosystem.

Quinault is partnering with Oregon State University and the Columbia River Inter-Tribal Fish Commission to send robotic gliders to the sea floor to measure dissolved oxygen. And tribes— including Quinault— and nontreaty crabbers have taken action by attaching oxygen sensors to crab pots.

But we need to do more than monitor hypoxia. We need to address climate change on a global scale through the United Nations Framework Convention on Climate Change and the Paris Agreement. We need to cut down our worldwide dependence on fossil fuels, remove greenhouse gases from the atmosphere and reduce the amount of nutrients released into our oceans from agriculture and wastewater.