# Using Autonomous Underwater Gliders to Observe Continental Margins and Oceanic Boundary Currents

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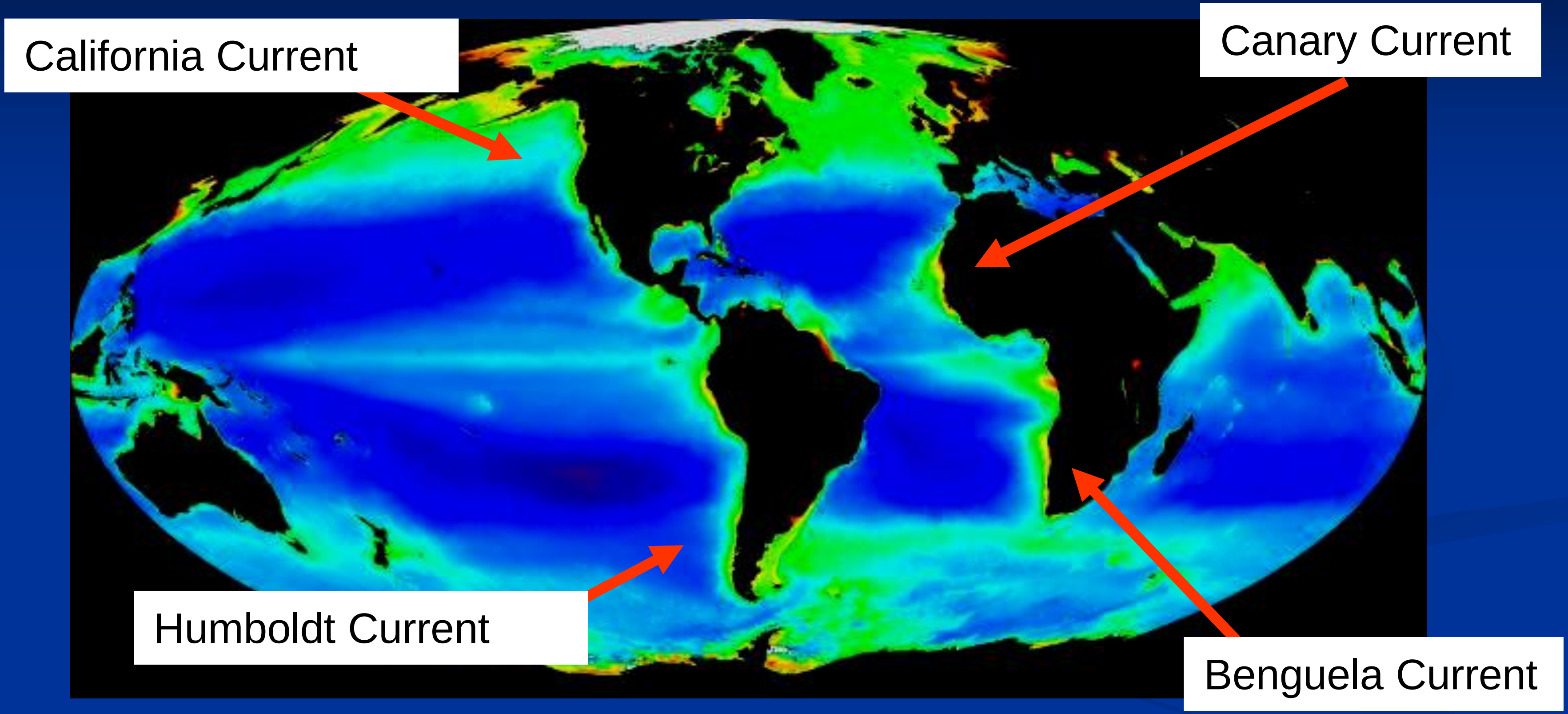
**PICES W4 Workshop**
**Yeosu, Republic of Korea**
**October 17, 2014**

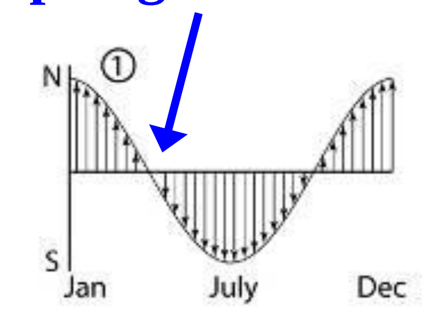
# Coastal Upwelling Ecosystems



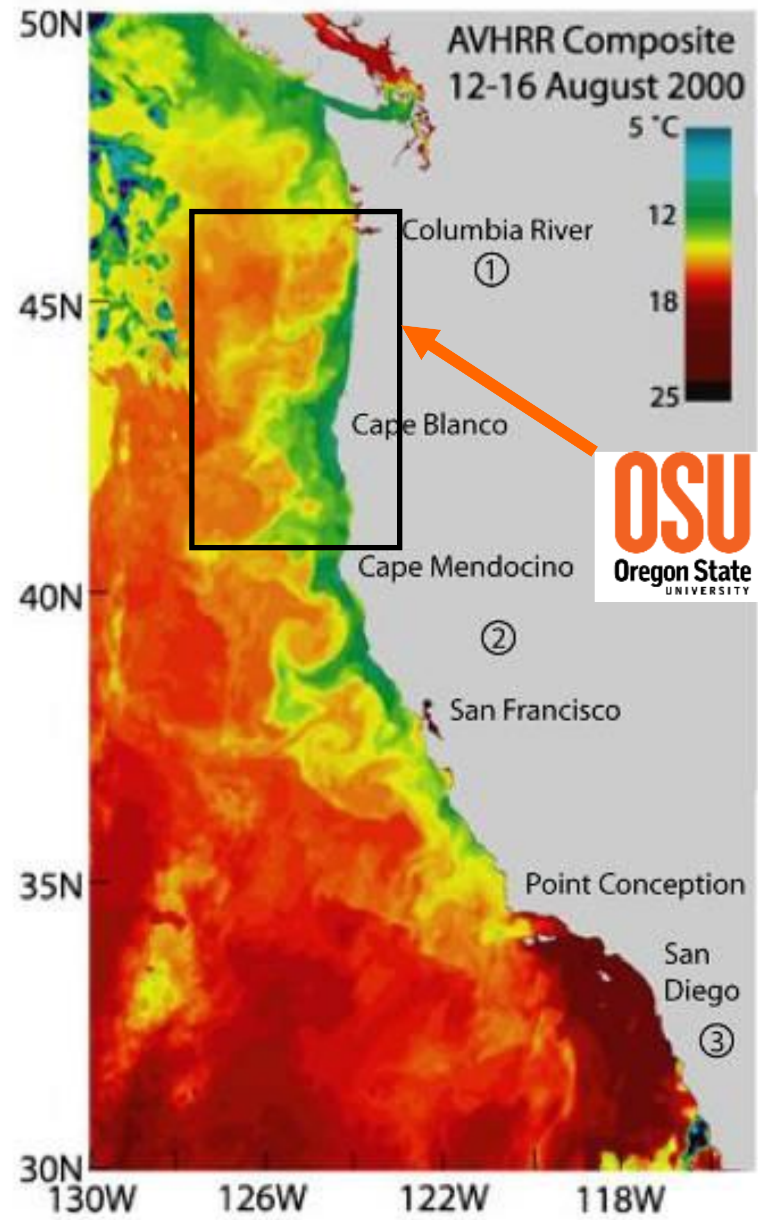

**1% of surface area, but > 20% of wild caught seafood**

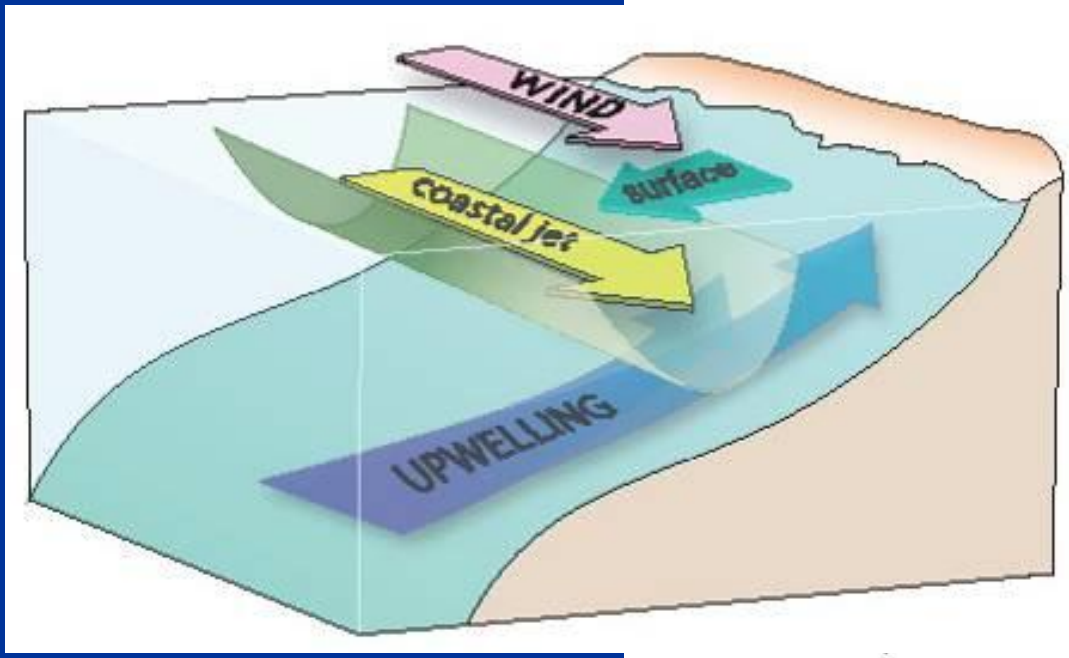
# upwelling

## Seasonal cycle of winds

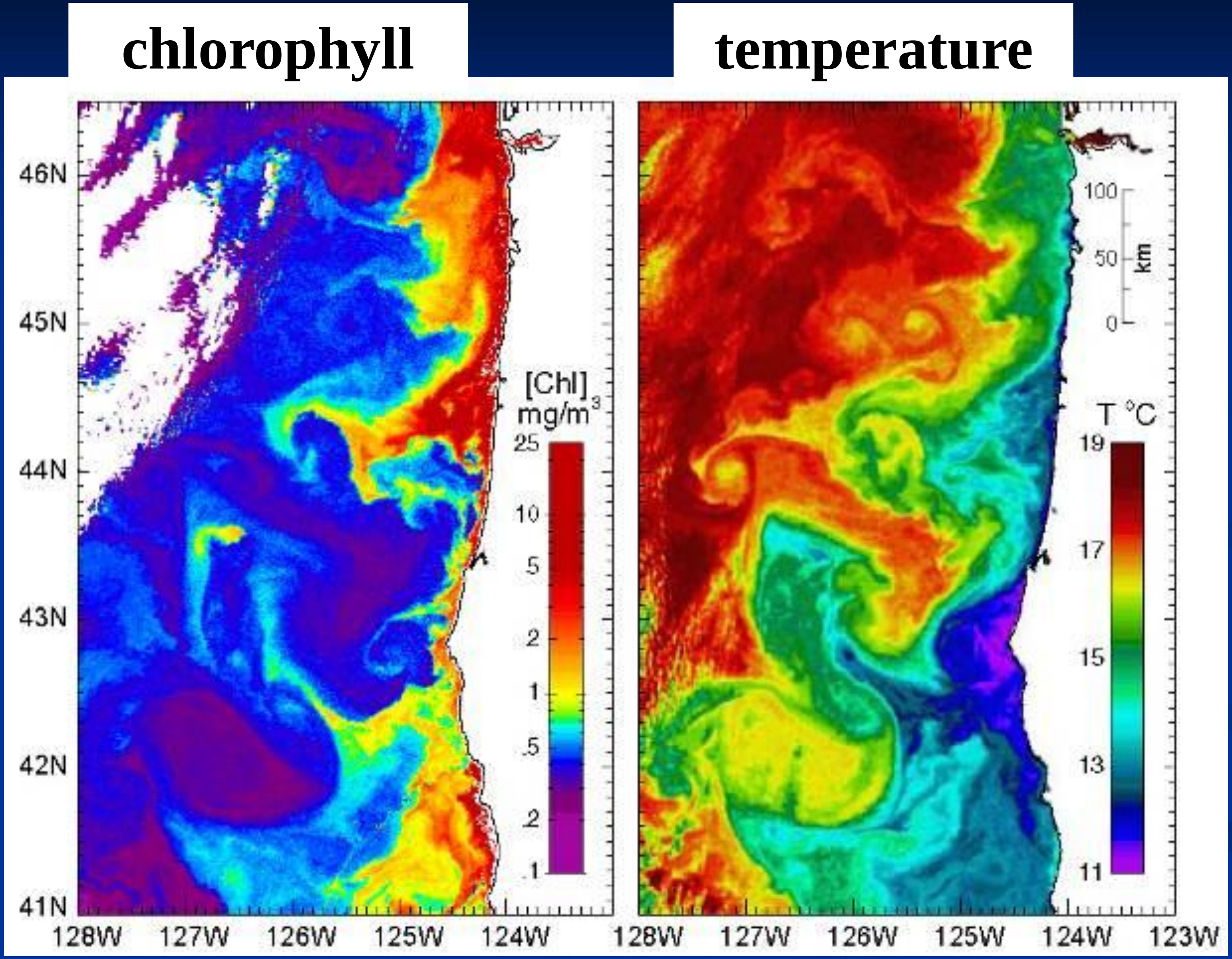



## Sea-surface temperature



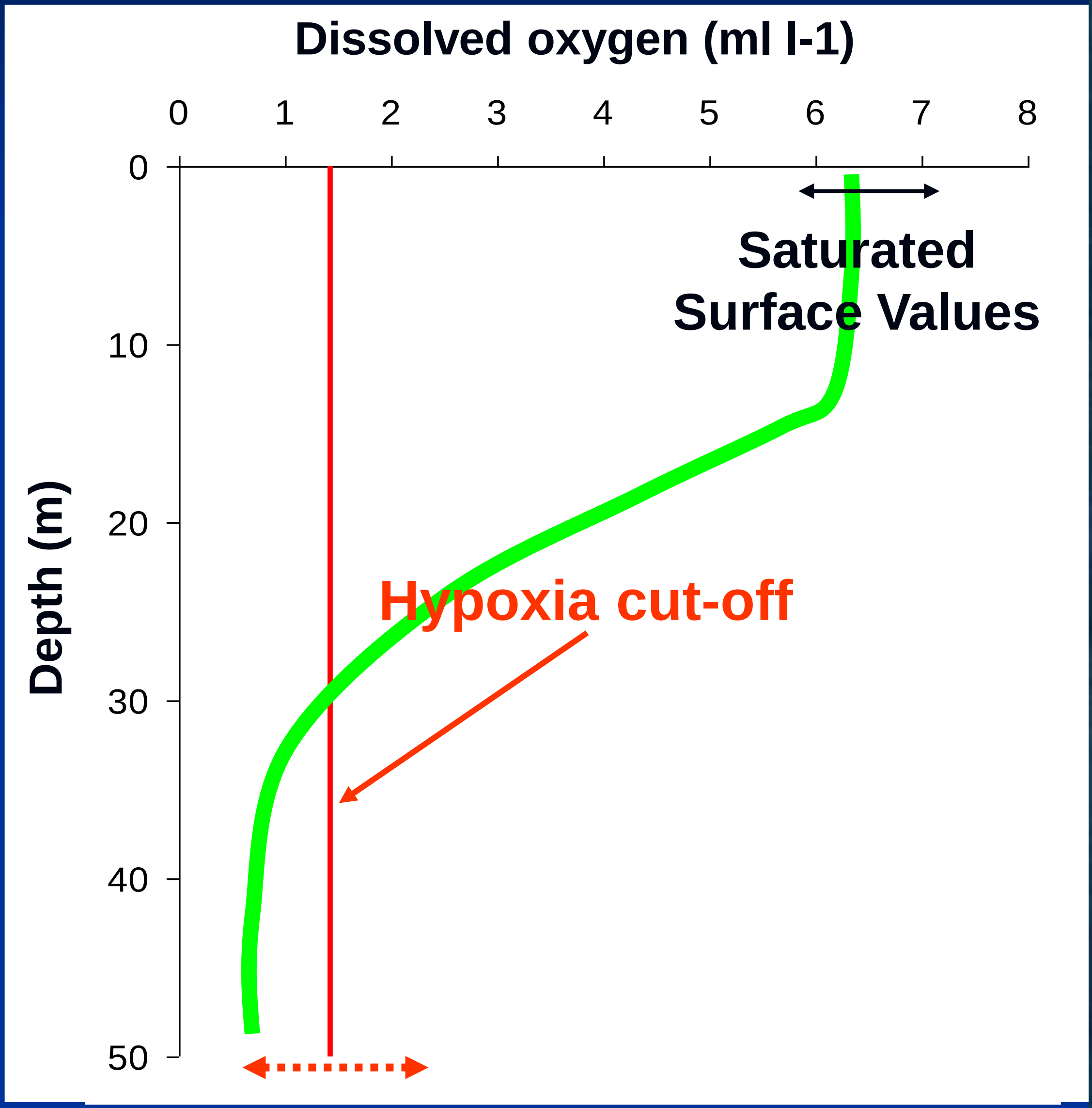



# wind-driven upwelling drives ocean productivity



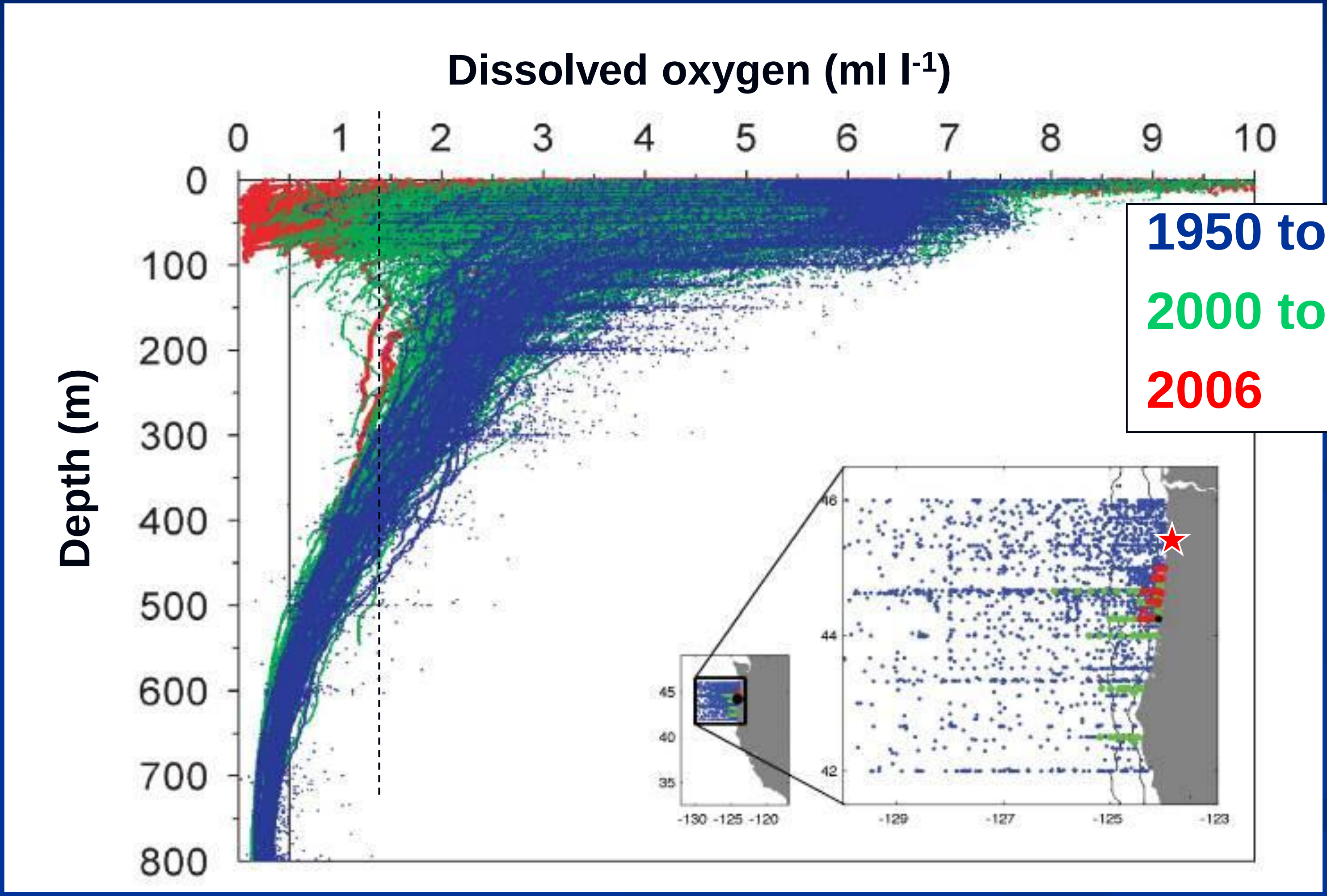

Courtesy of Ted Strub (OSU)

# Off Oregon, hypoxia develops on the open continental shelf




# Subsurface ocean observations off Newport for the last ~60 years

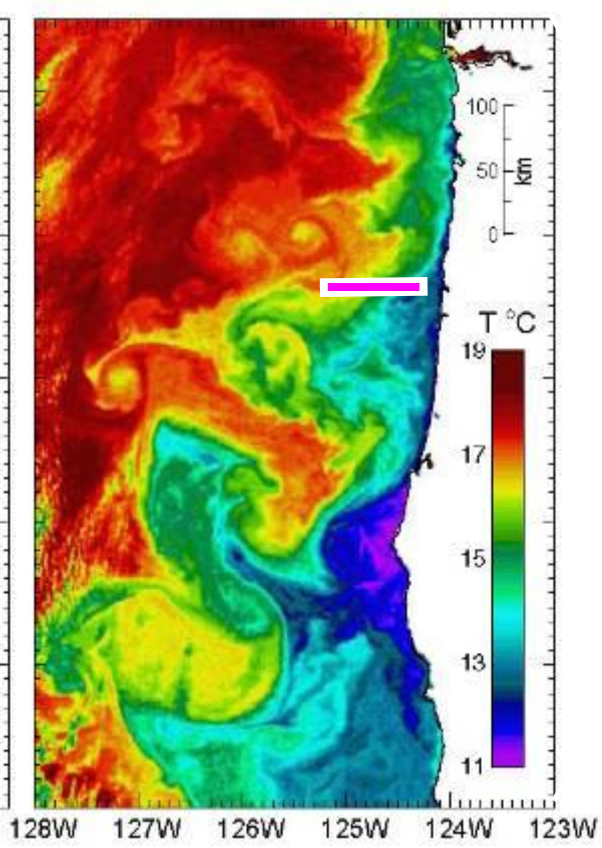
**N ~ 4000 hydrocasts**

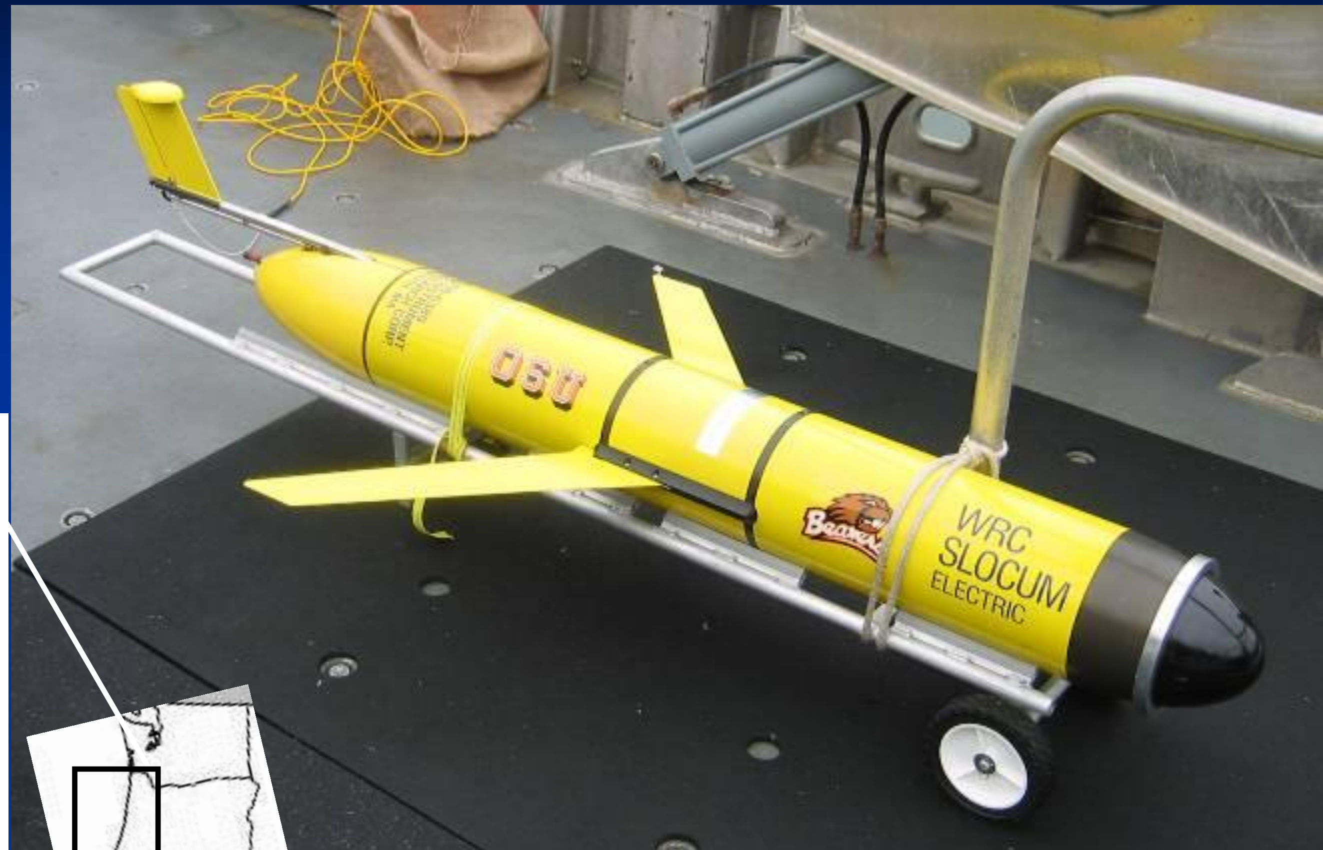



Chan et al. (2008, Science)

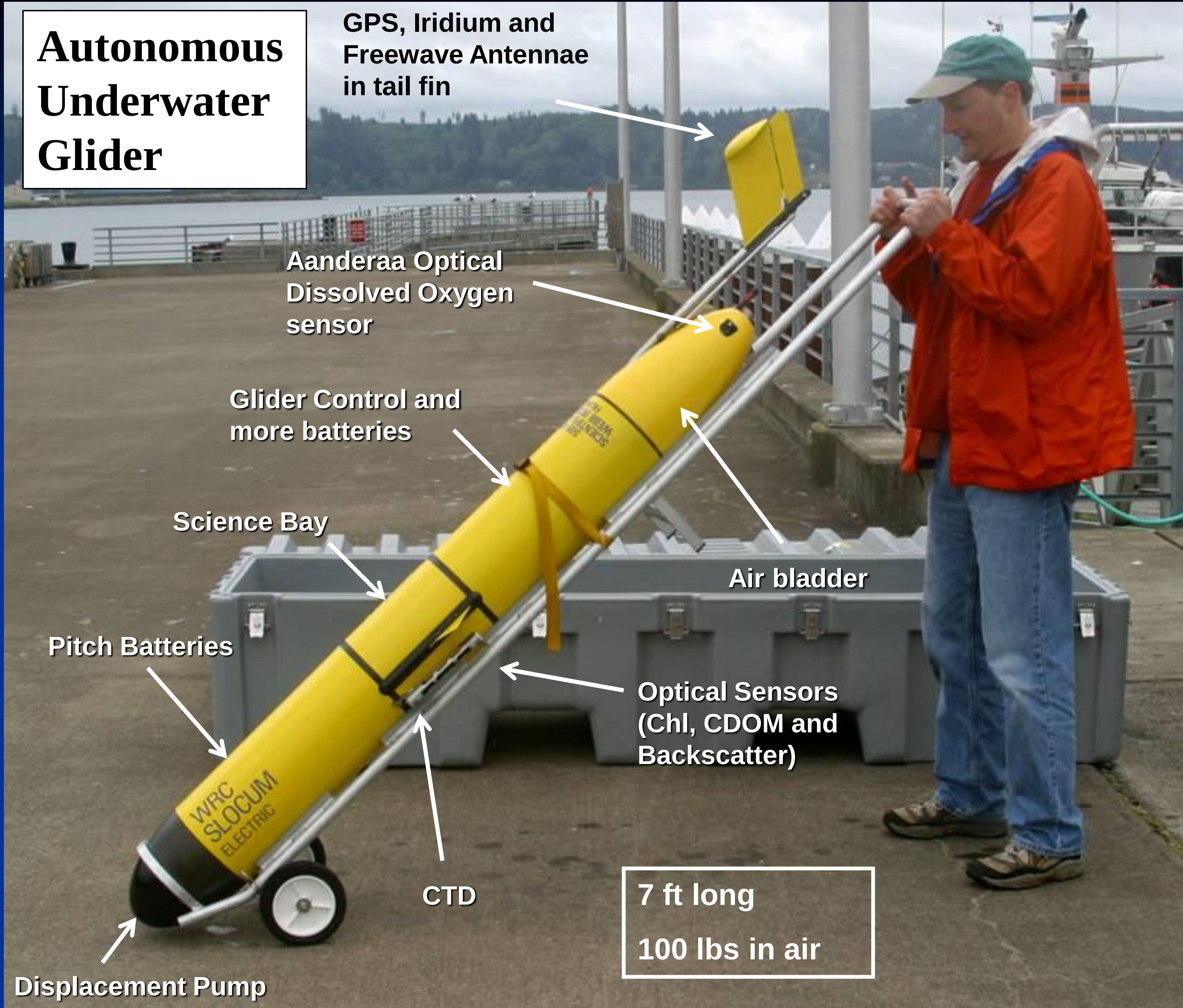
# Autonomous Underwater Vehicle Gliders

cross-margin transect twice per week since April 2006




CTD
dissolved oxygen
chlorophyll fluorescence
CDOM fluorescence
light backscatter
depth-averaged velocity



Autonomous Underwater Glider
GPS, Iridium and Freewave Antennae in tail fin
Aanderaa Optical Dissolved Oxygen sensor
Glider Control and more batteries
Science Bay
Air bladder
Pitch Batteries
Optical Sensors (Chl, CDOM and Backscatter)
CTD
Displacement Pump
7 ft long
100 lbs in air
WRC SLOCUM ELECTRIC

# University of Washington “Seaglider”



IEEE JOURNAL OF OCEANIC ENGINEERING, VOL. 26, NO. 4, OCTOBER 2001

## Seaglider: A Long-Range Autonomous Underwater Vehicle for Oceanographic Research

Charles C. Eriksen, T. James Osse, Russell D. Light, Timothy Wen, Thomas W. Lehman, Peter L. Sabin, John W. Ballard, and Andrew M. Chiodi

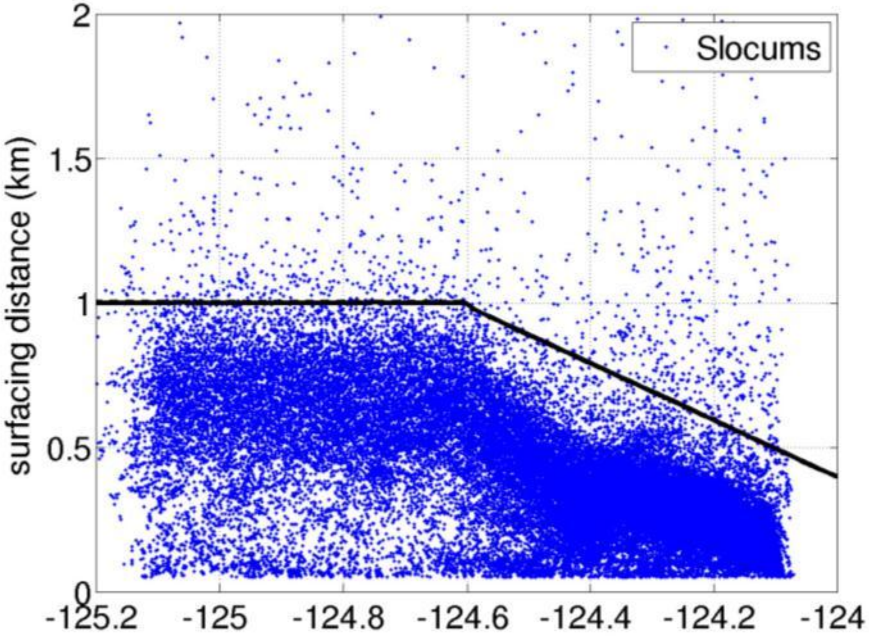
# Glider operations from just about any size boat

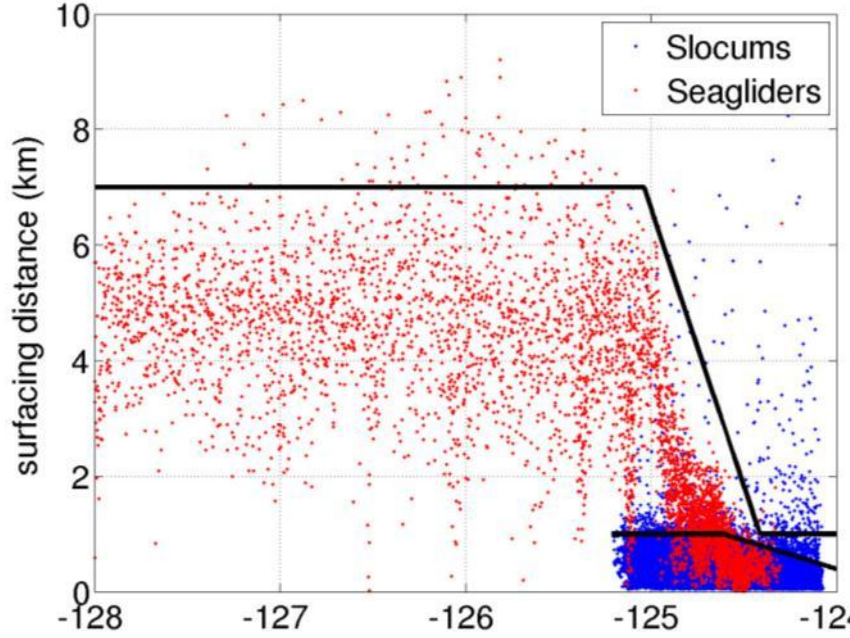
## OSU's 16-m R/V Elakha

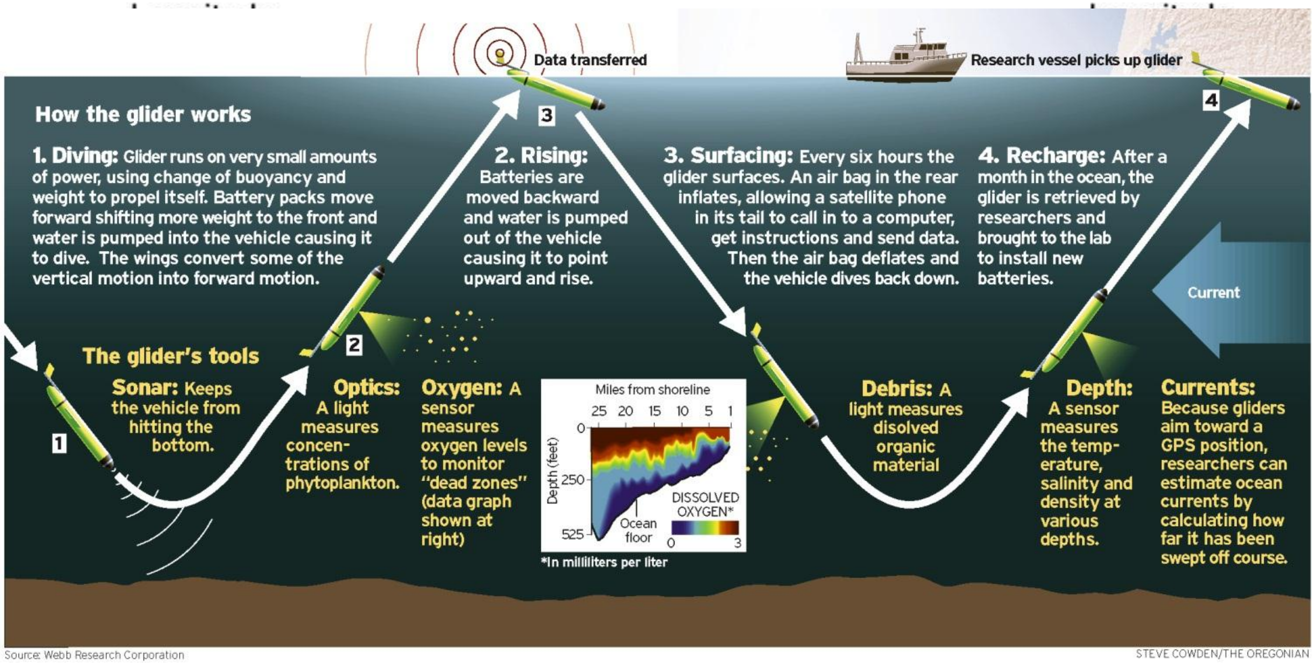


## from a rowboat off Chile

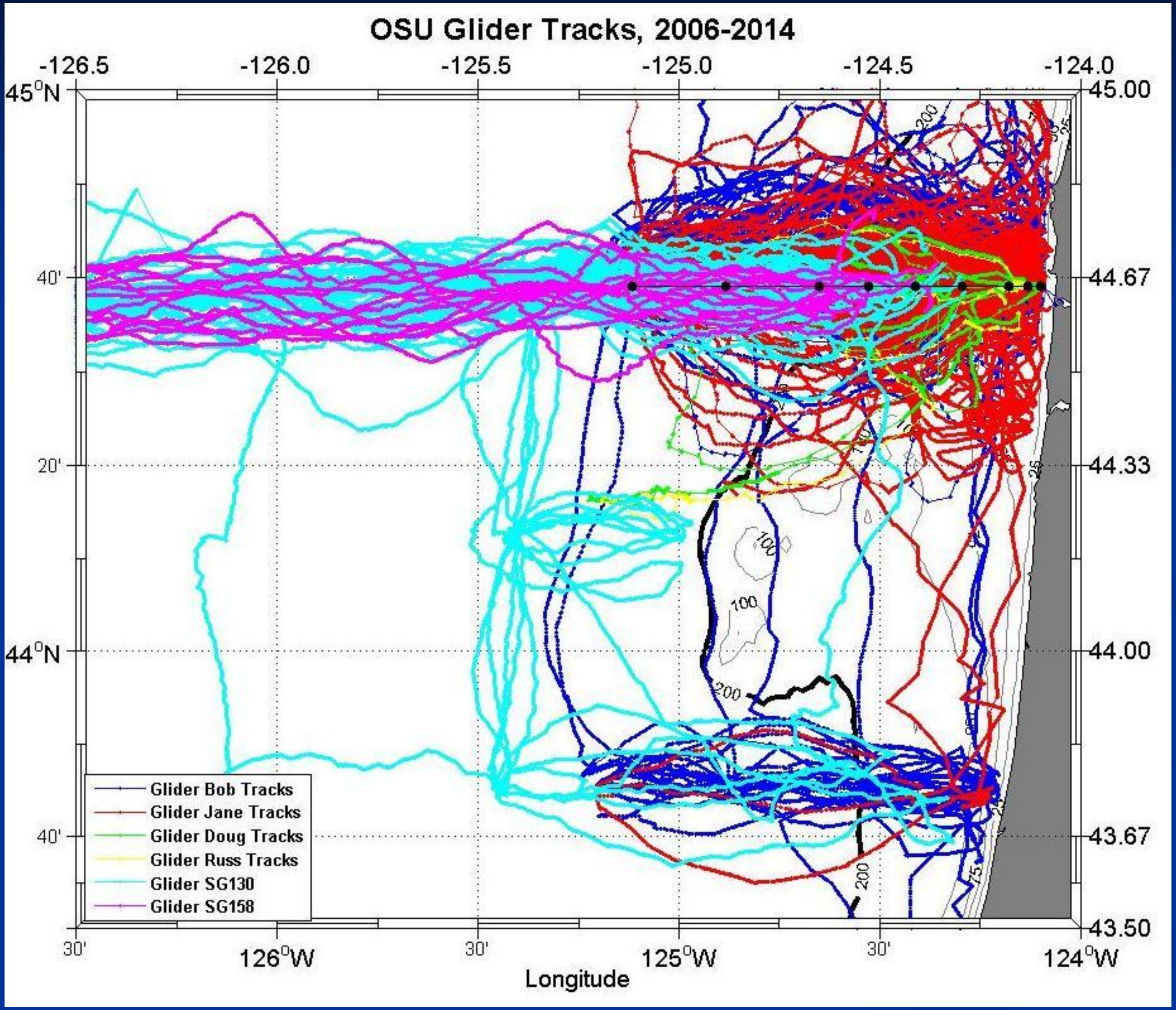
# Horizontal resolution



# OSU Glider Operations




April 2006–Sep 2014

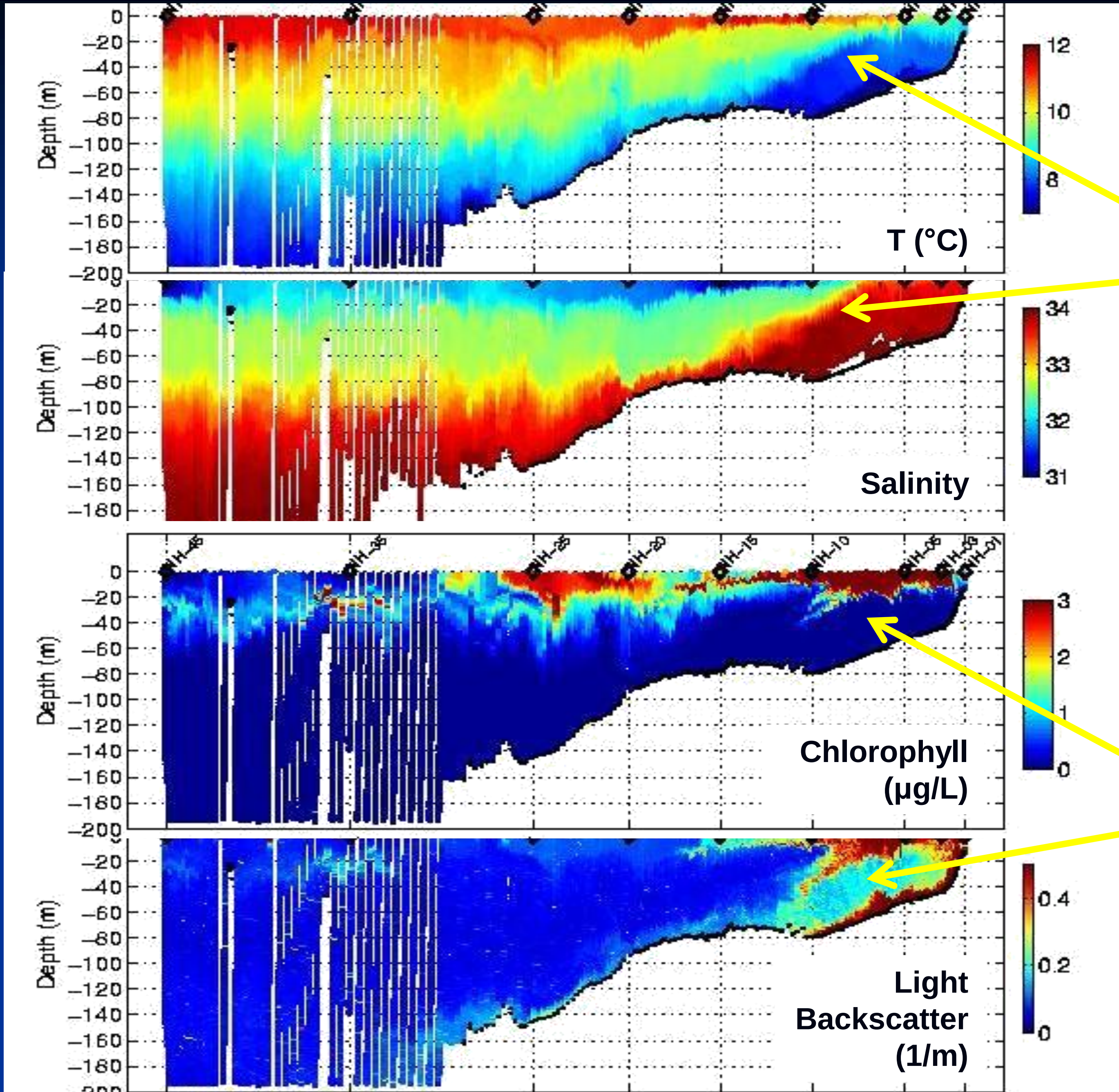
3485 glider-days

260,190 vertical profiles

82,000+ km

Over twice around the Earth!

**May 05 – 10, 2006**



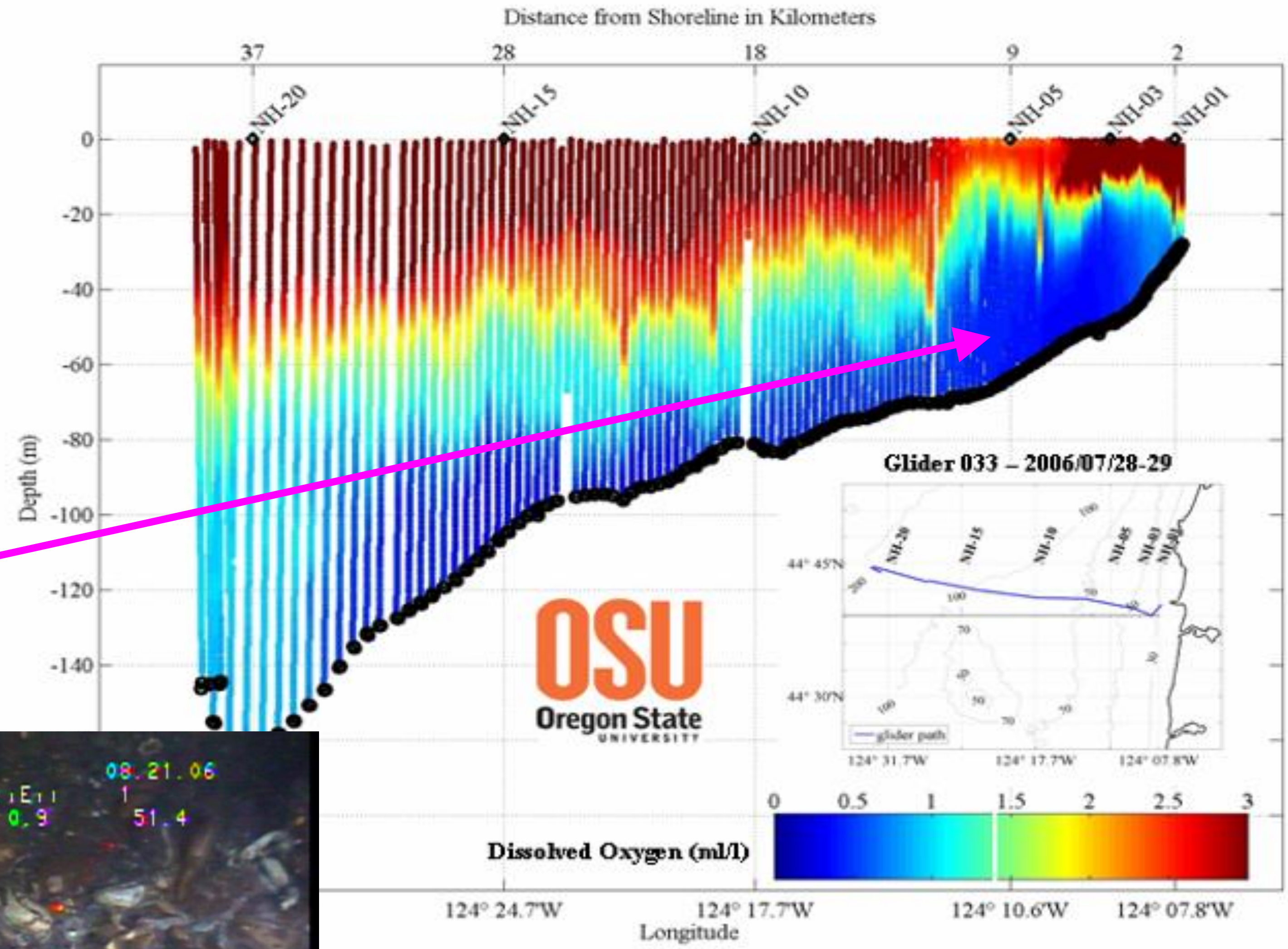

**A temperature & salinity "front"**

**A "hotspot" for phytoplankton**

Barth et al. (in prep)

# Dissolved Oxygen from glider

Hypoxia





July 2006

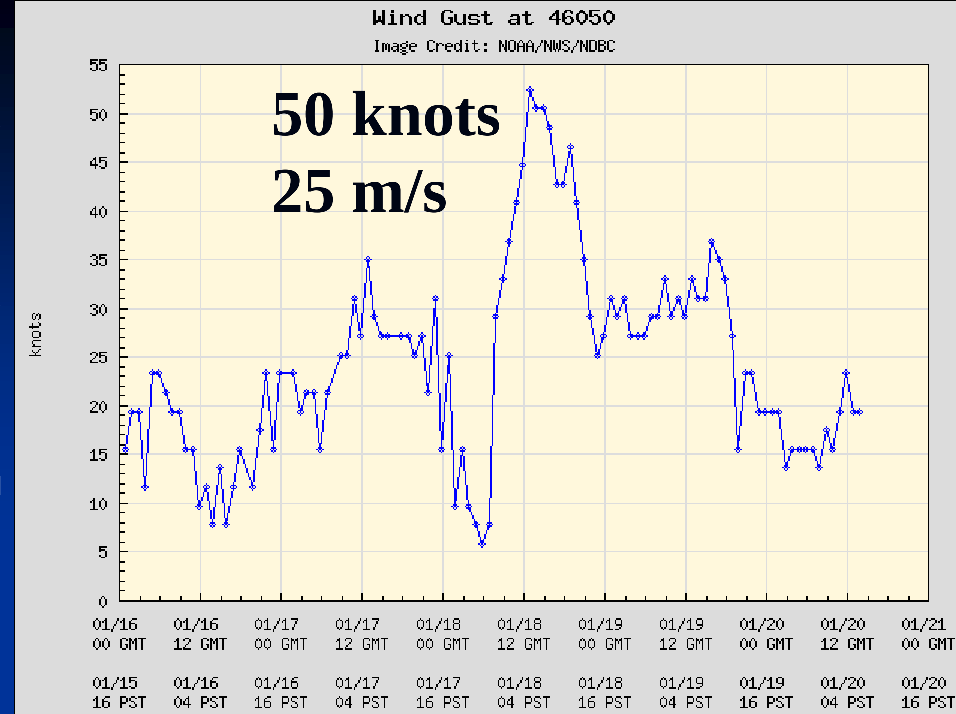
Barth et al. (in prep)

# glider “bob” in the January 18-19, 2012 storm

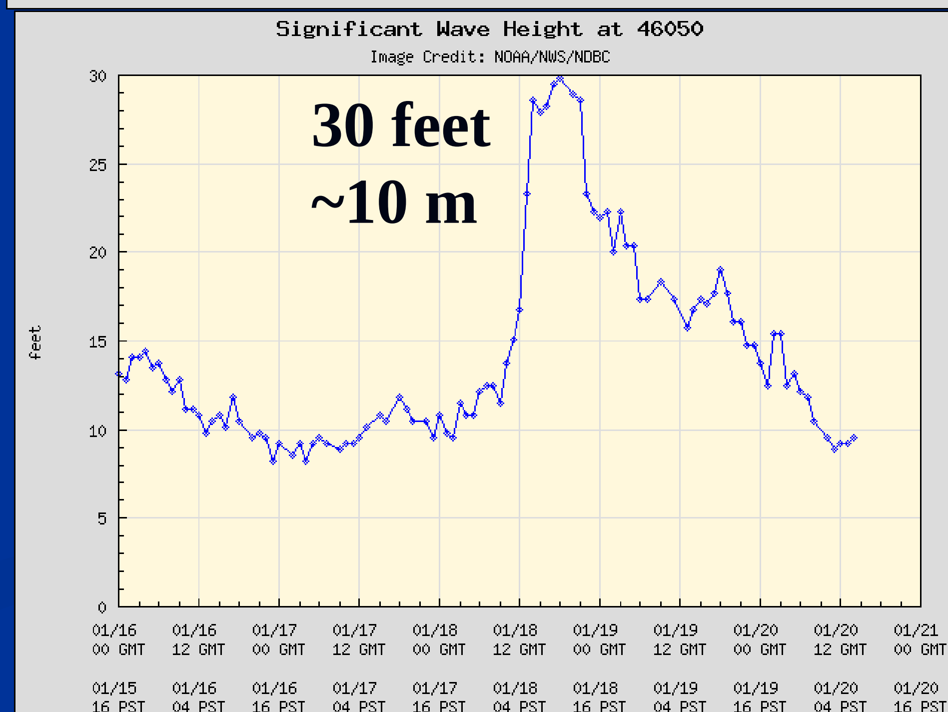

November 28, 2001

NOAA Buoy 46050

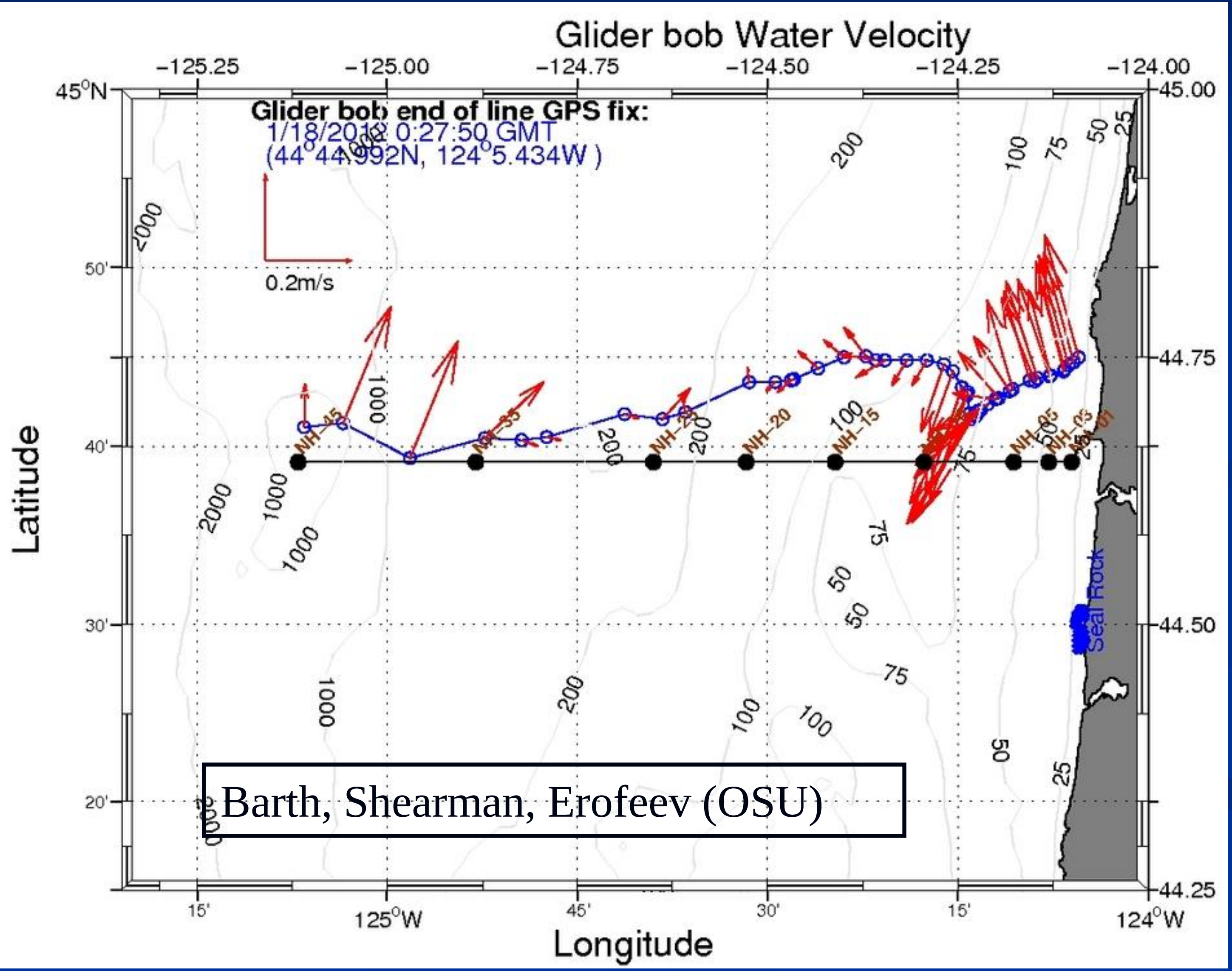
wind speed (knots)



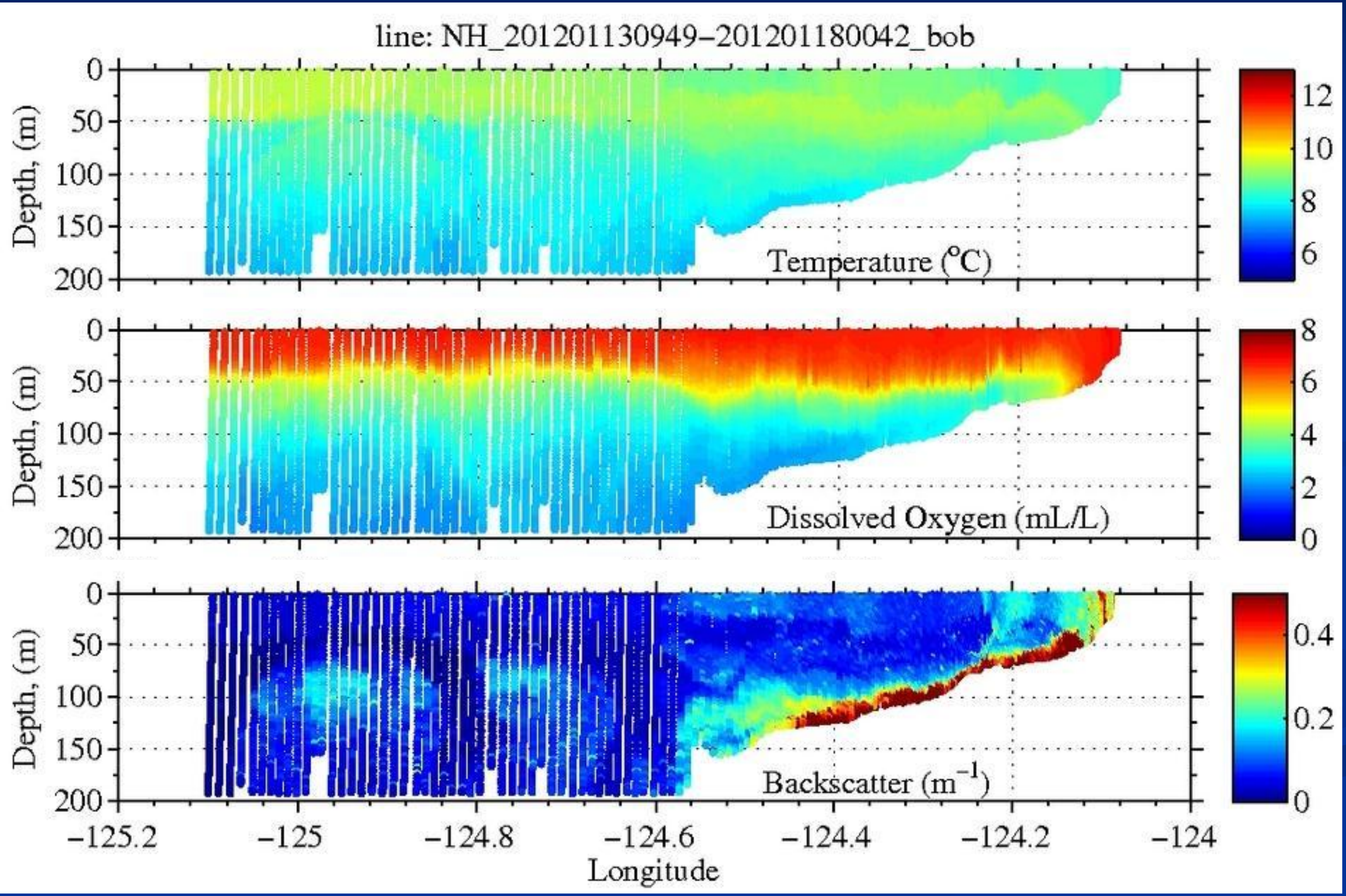

wave height (feet)



# glider "bob" approaches shore and gets carried north in the January 18-19, 2012, storm



# oceanographic data from across the shelf in 30-foot (~10 m) seas!




**Barth, Shearman, Erofeev (OSU)**

# Let’s take a closer look at freshwater forcing

Siletz River,
central Oregon coast

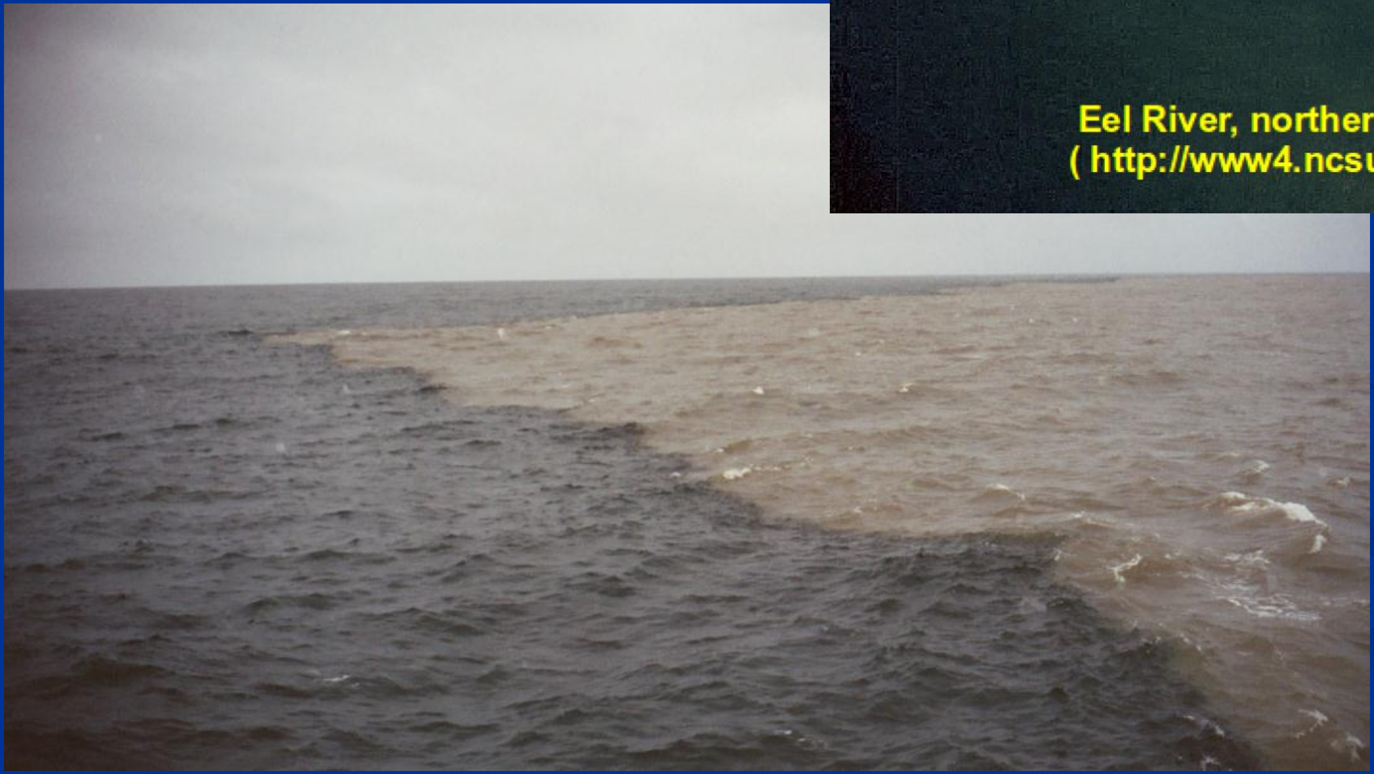
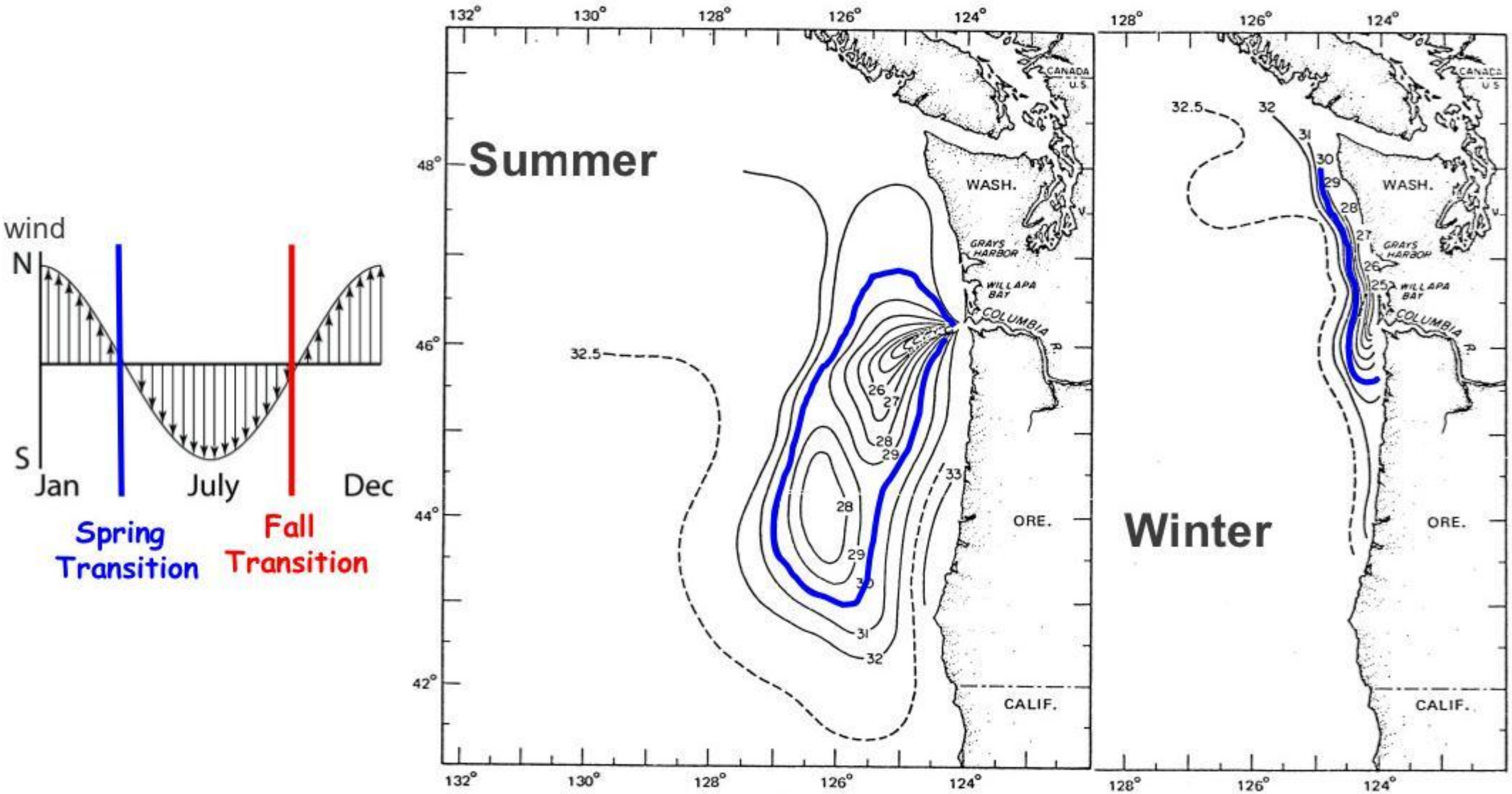


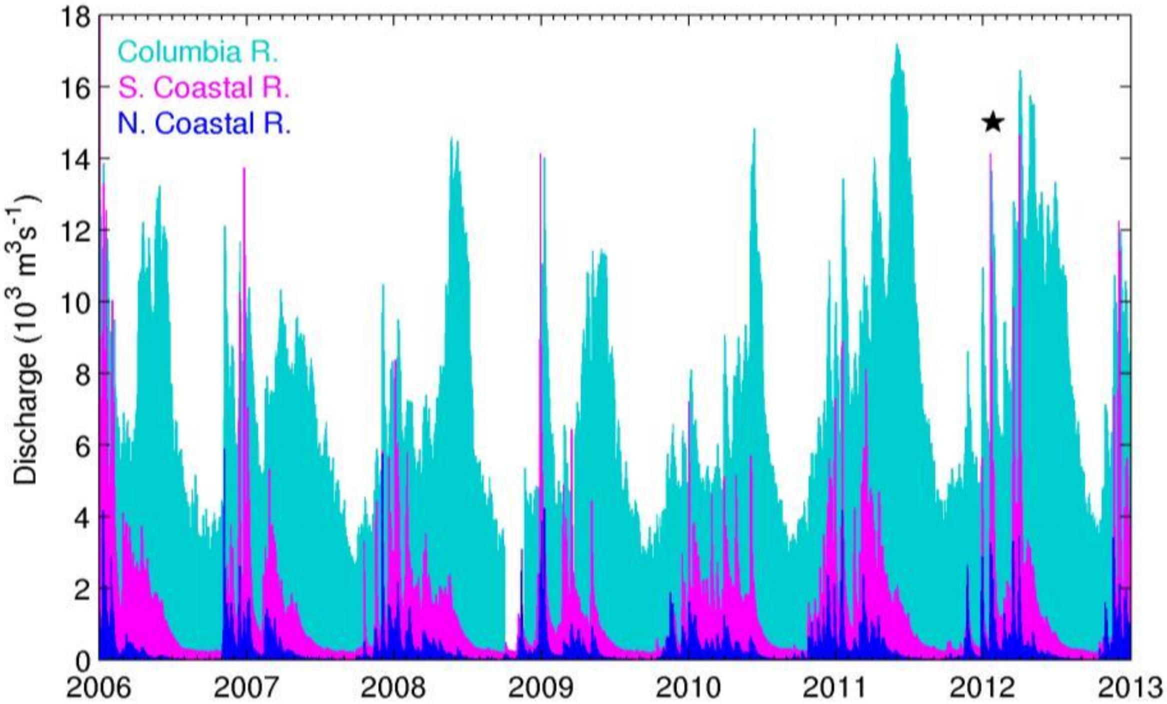

Photo by
J. Barth

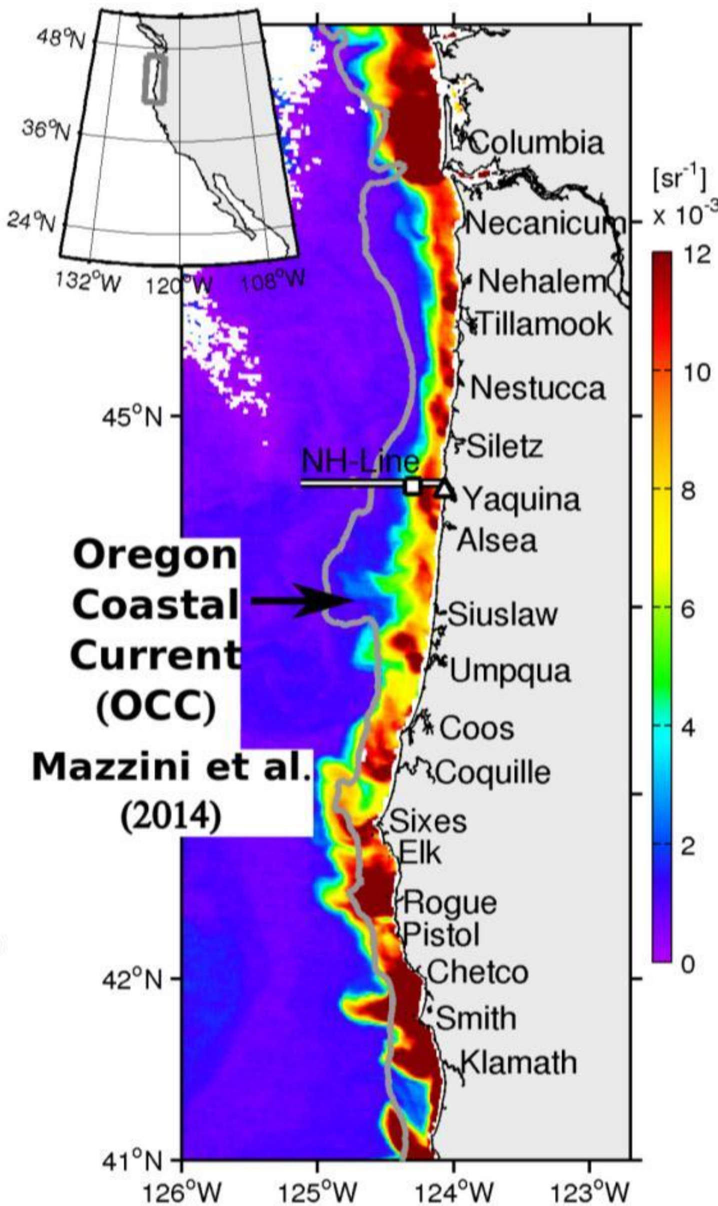
# Columbia River – largest river on US west coast



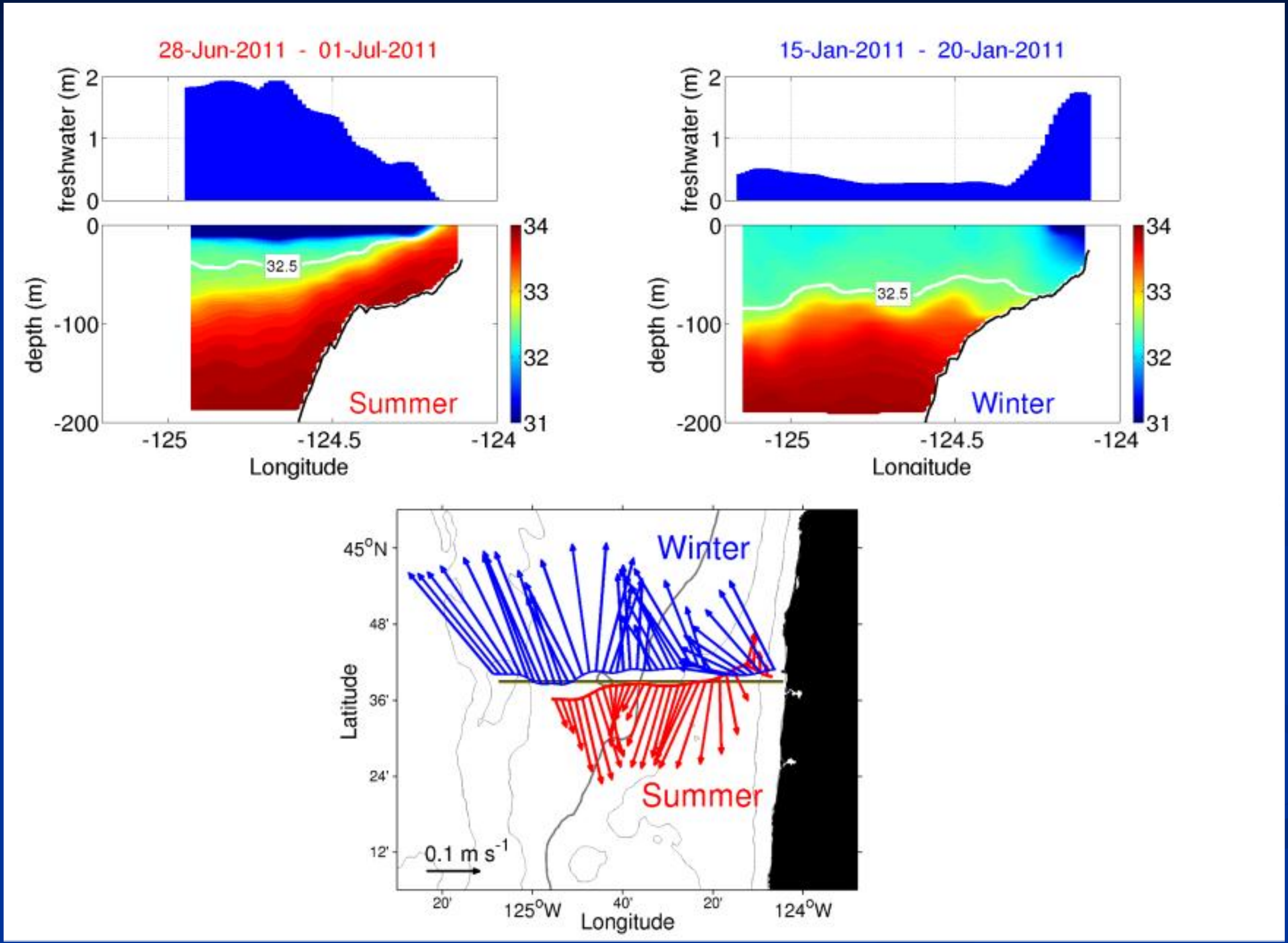

Barnes *et al.* (1972)

# The Oregon Coastal Current (OCC)



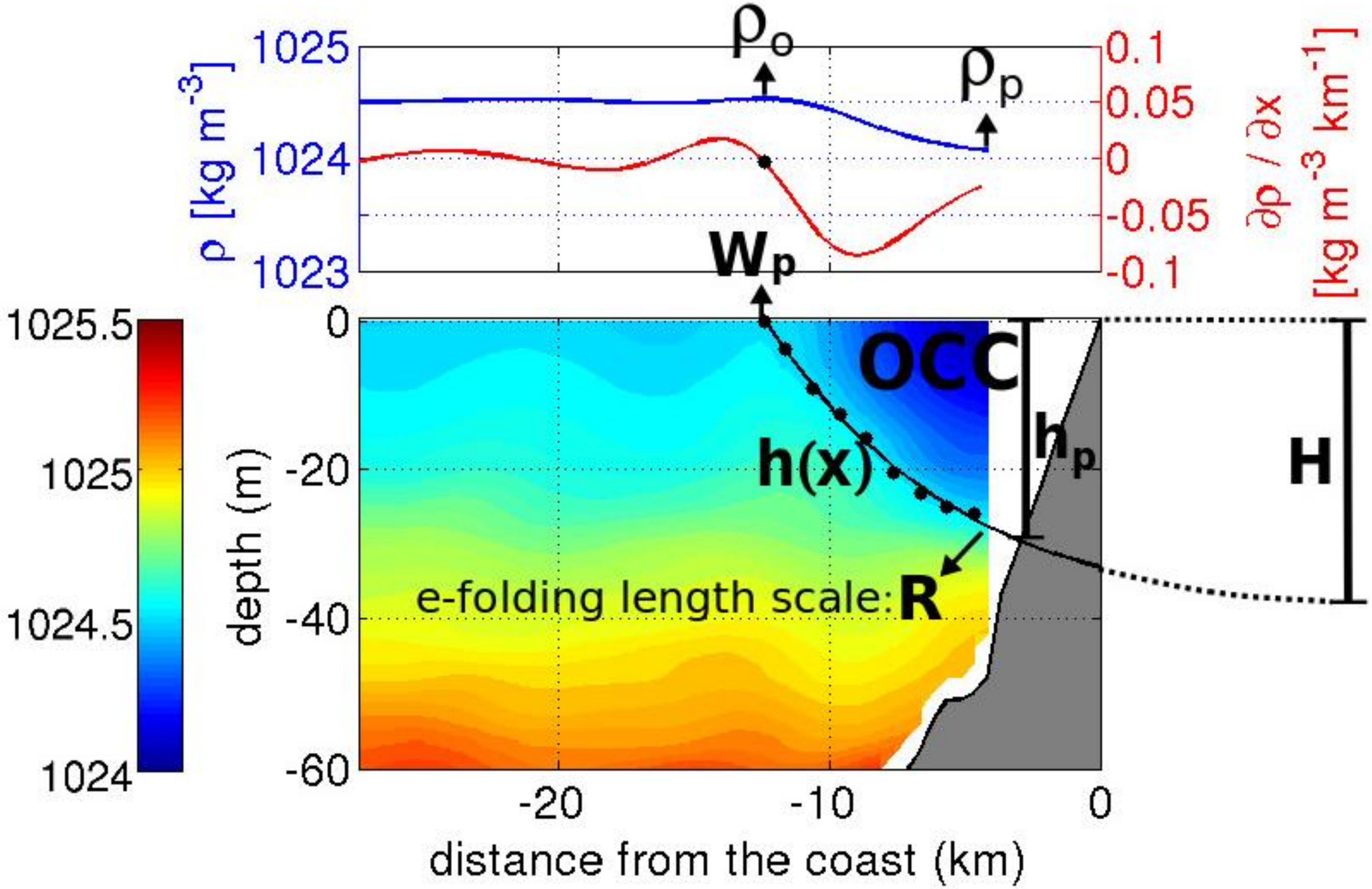
# Example glider lines: summer vs. winter




**Mazzini, Barth, Shearman and Erofeev (JPO, 2014)**

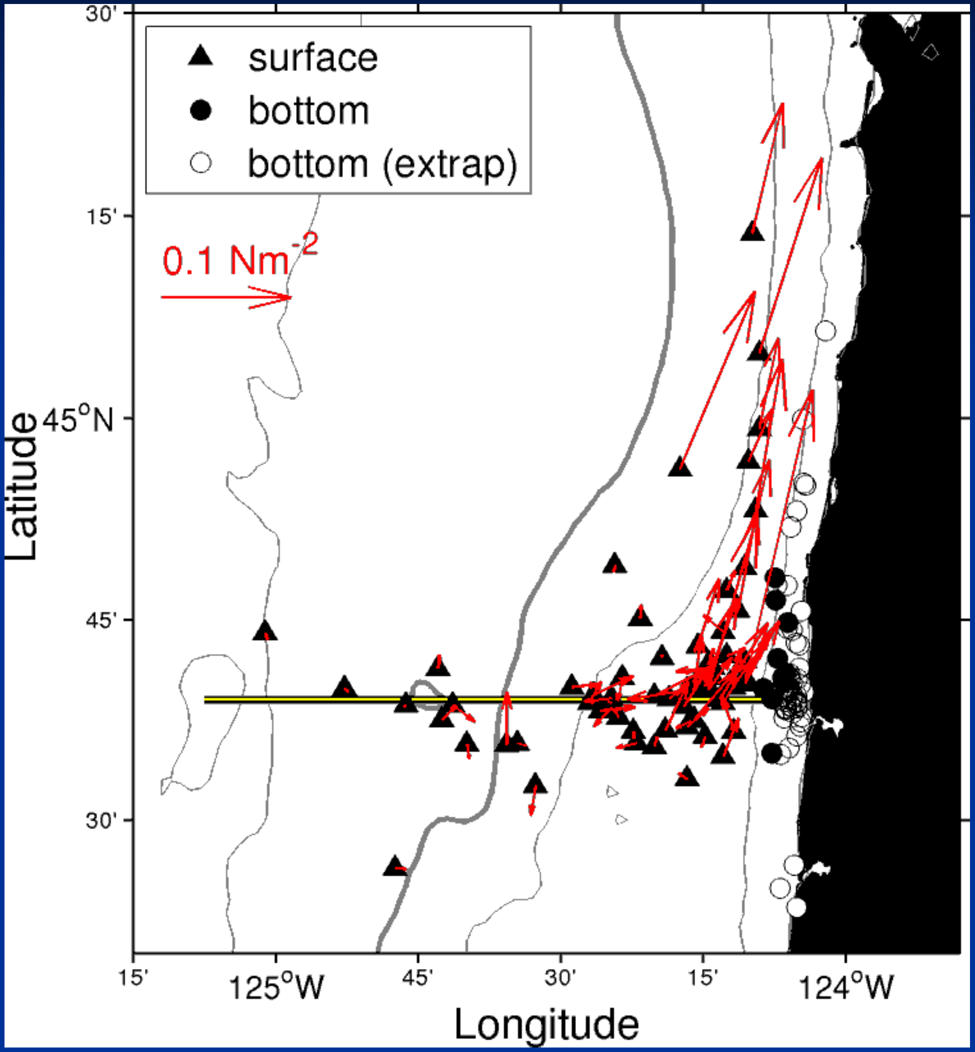
# Use glider data to describe buoyancy front/current

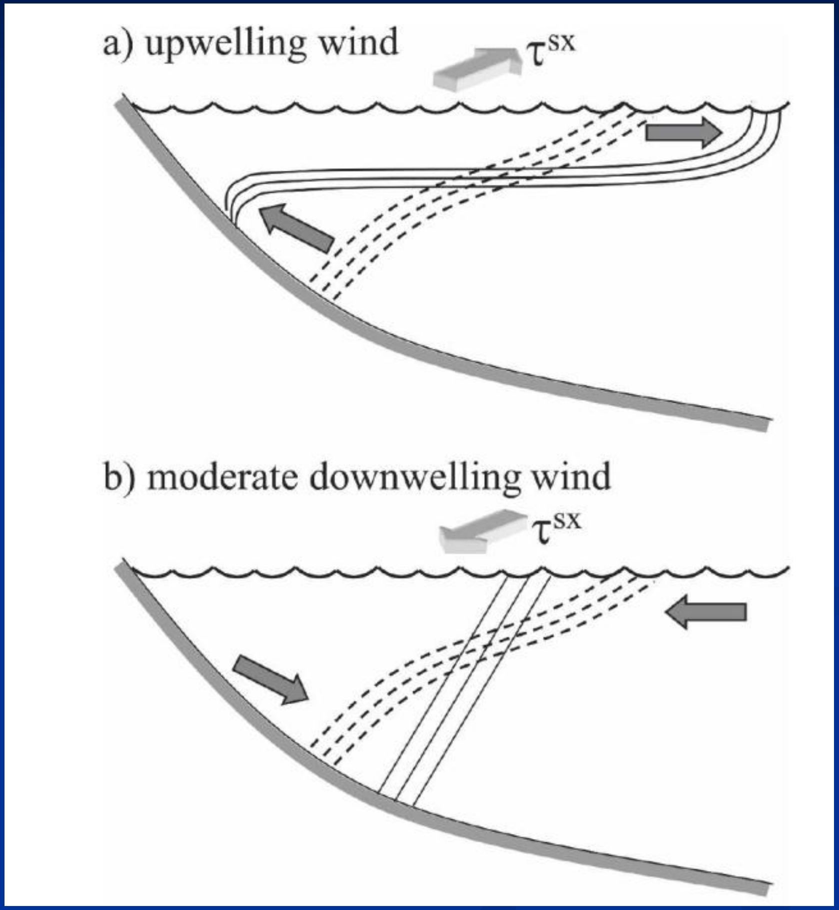
Fit: $h(x) = H[1 - e^{-\left(\frac{x+W_p}{R}\right)}]$, finding $W_p$, $R$ and $H$.




Mazzini, Barth, Shearman and Erofeev (JPO, 2014)

# Wind effects width and shape of front/current

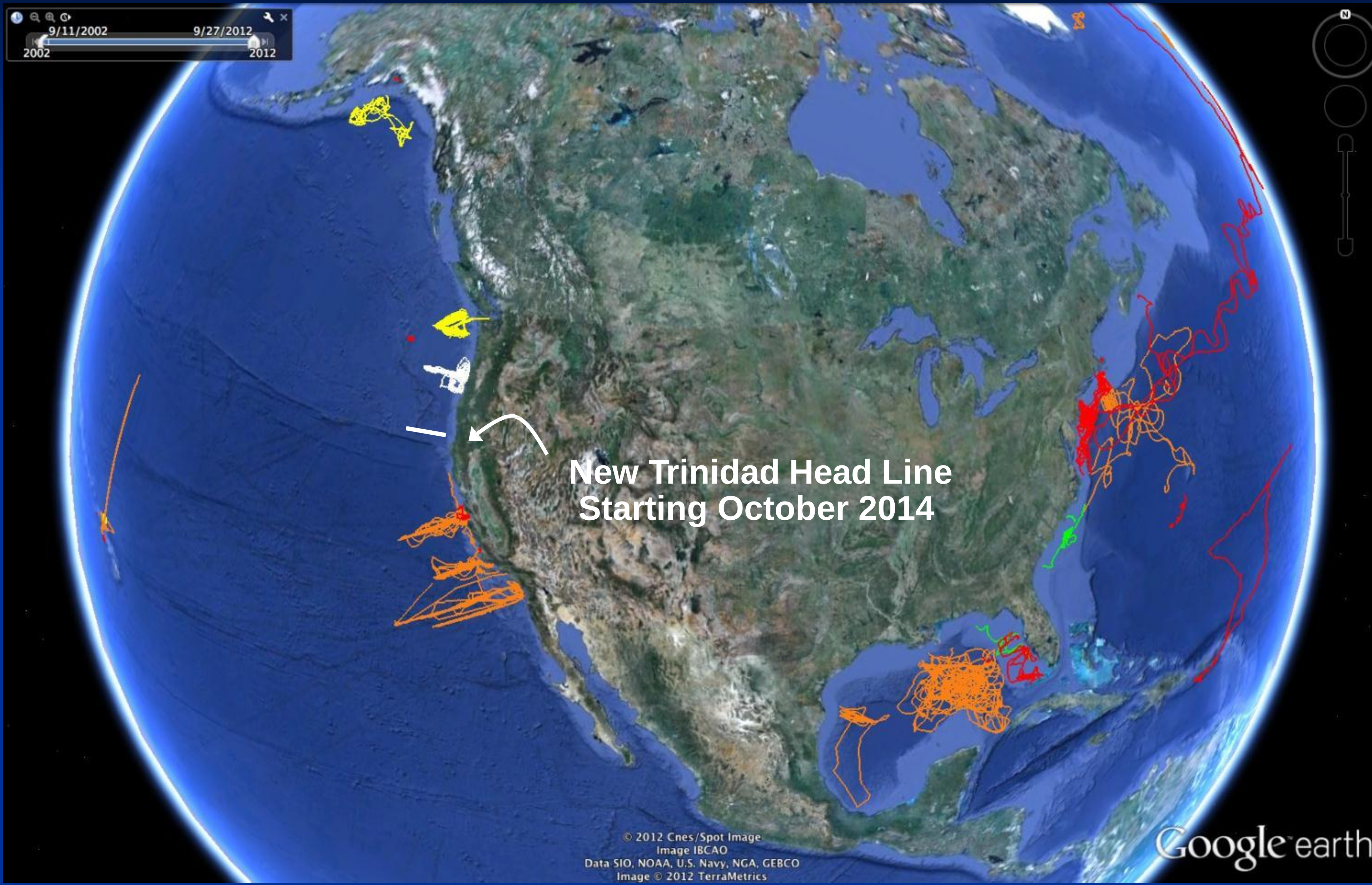



Lentz and Largier (2006)

Mazzini, Barth, Shearman and Erofeev (JPO, 2014)

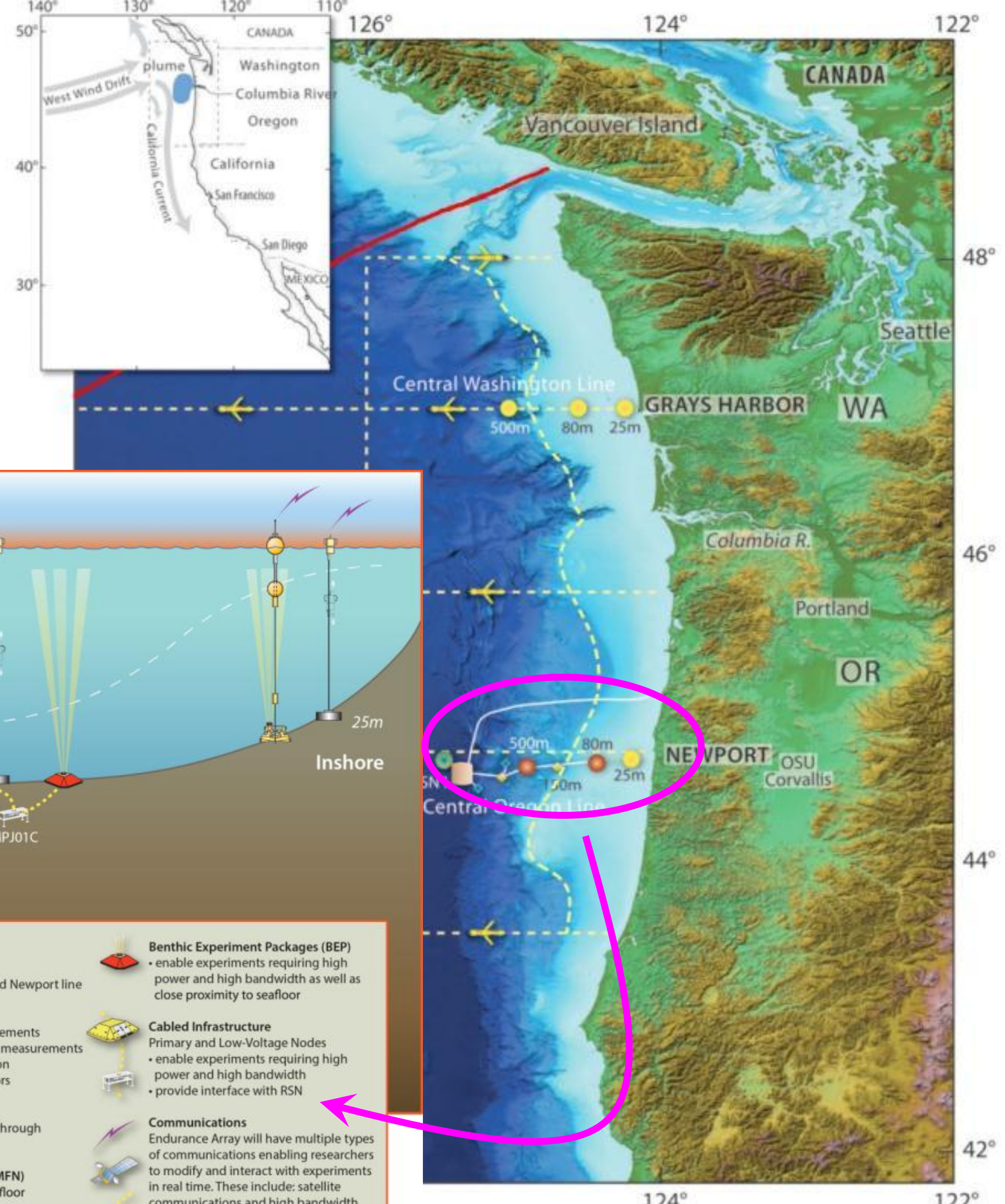
# Glider measurements from around the US

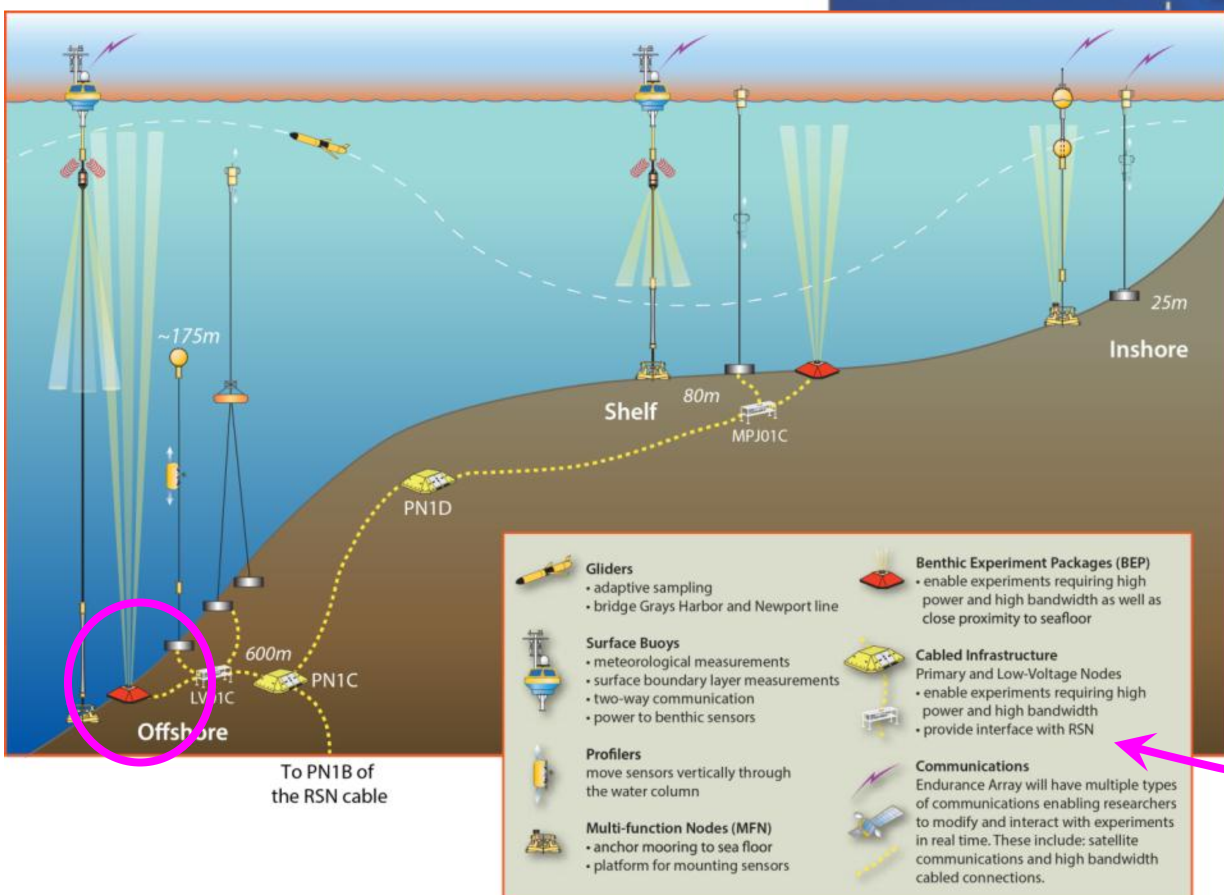


# Ocean Observatories Initiative (OOI)

Installing observing arrays off the Pacific Northwest
2010-2015

(operate for 25-30 years)



# Using Gliders to Explore Boundary Currents

- high spatial and temporal resolution
- cost effective
- physical, bio-optical, chemical measurements
- use in combination with moorings and ship-based work
- future work: additional sensors (e.g., bioacoustics)

Thanks to my OSU glider teammates: Kipp, Anatoli, Zen, Justin, Laura, Amanda, Kate, Piero, Chris, Pat, Meghan