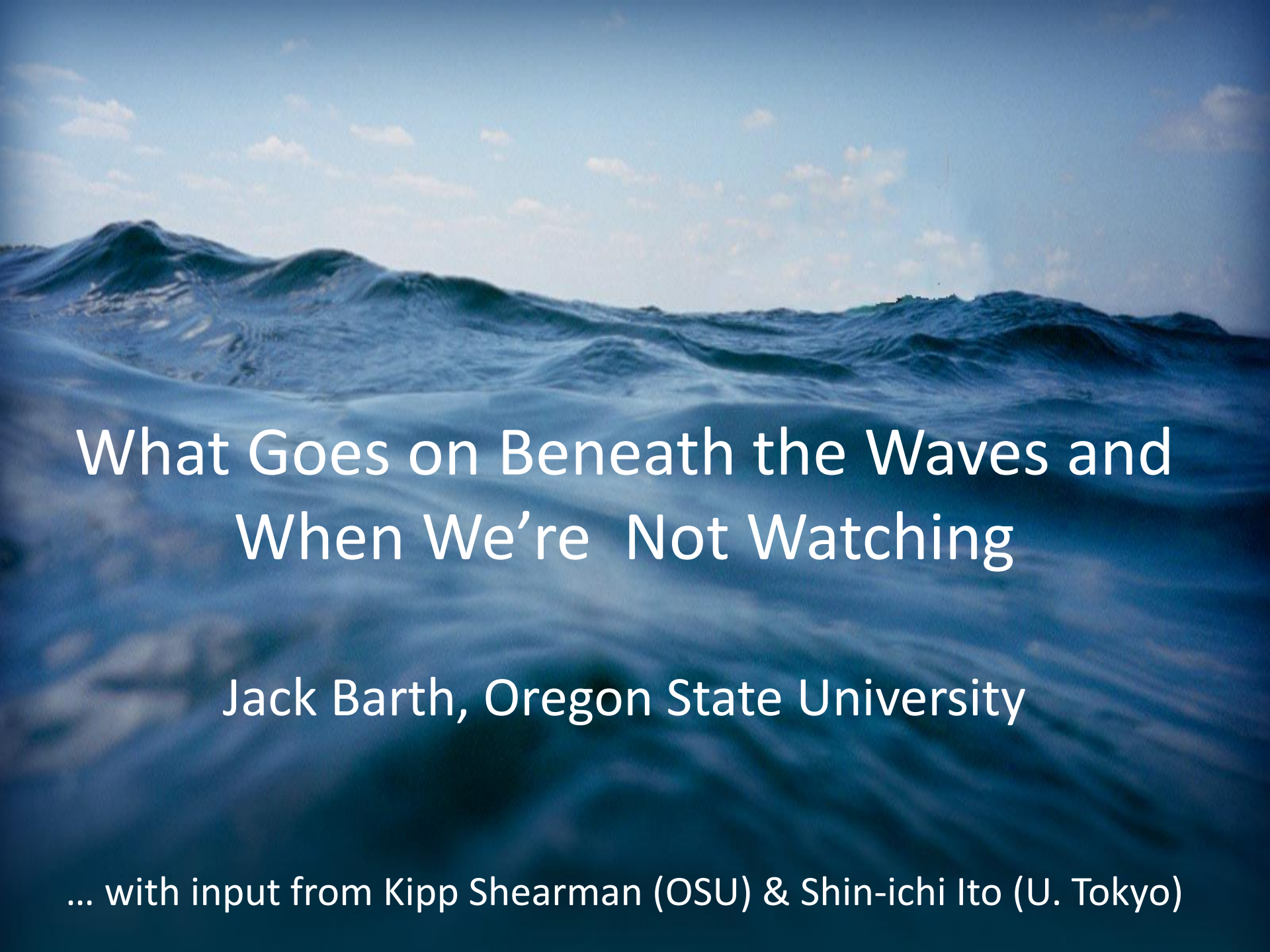
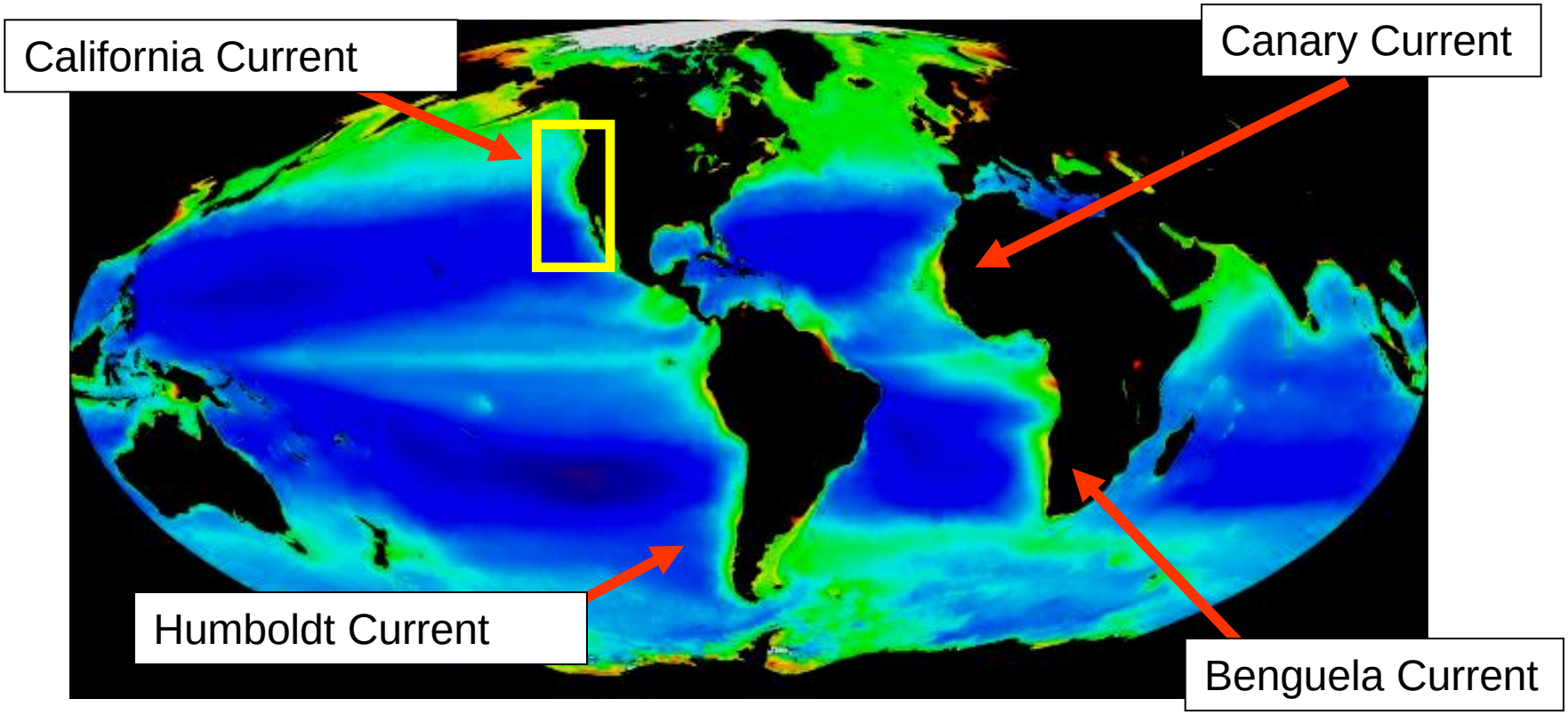


What Goes on Beneath the Waves and When We're Not Watching

Jack Barth, Oregon State University

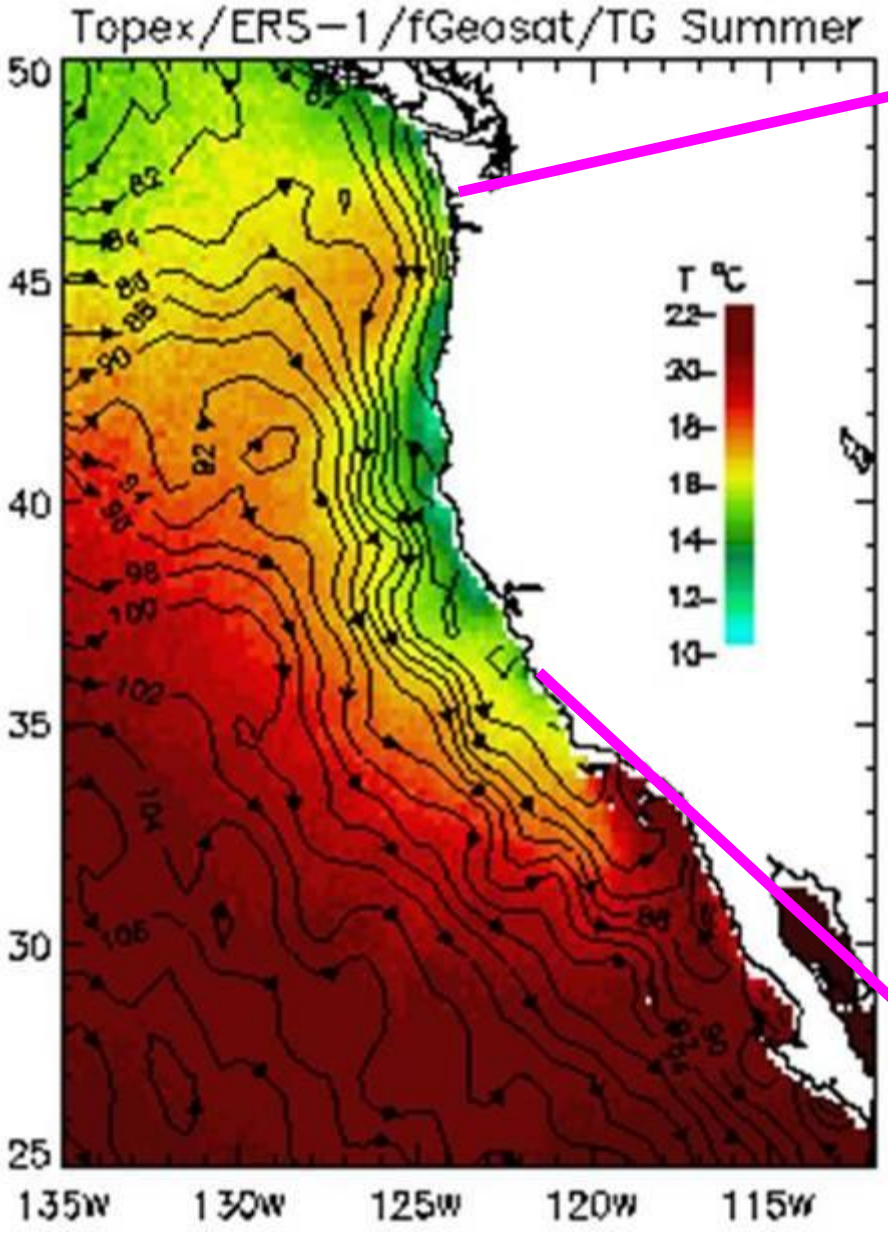
… with input from Kipp Shearman (OSU) & Shin-ichi Ito (U. Tokyo)

Coastal Upwelling Ecosystems



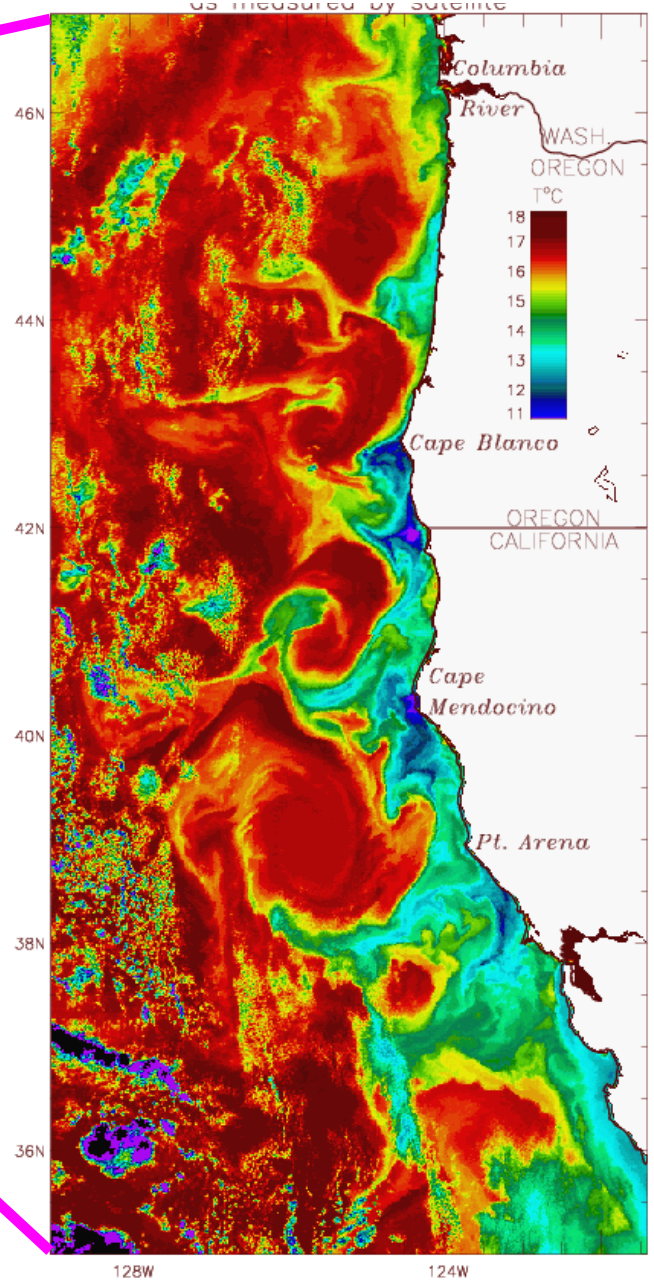
1% of surface area, but > 20% of wild caught seafood

Average summer SST and SSH

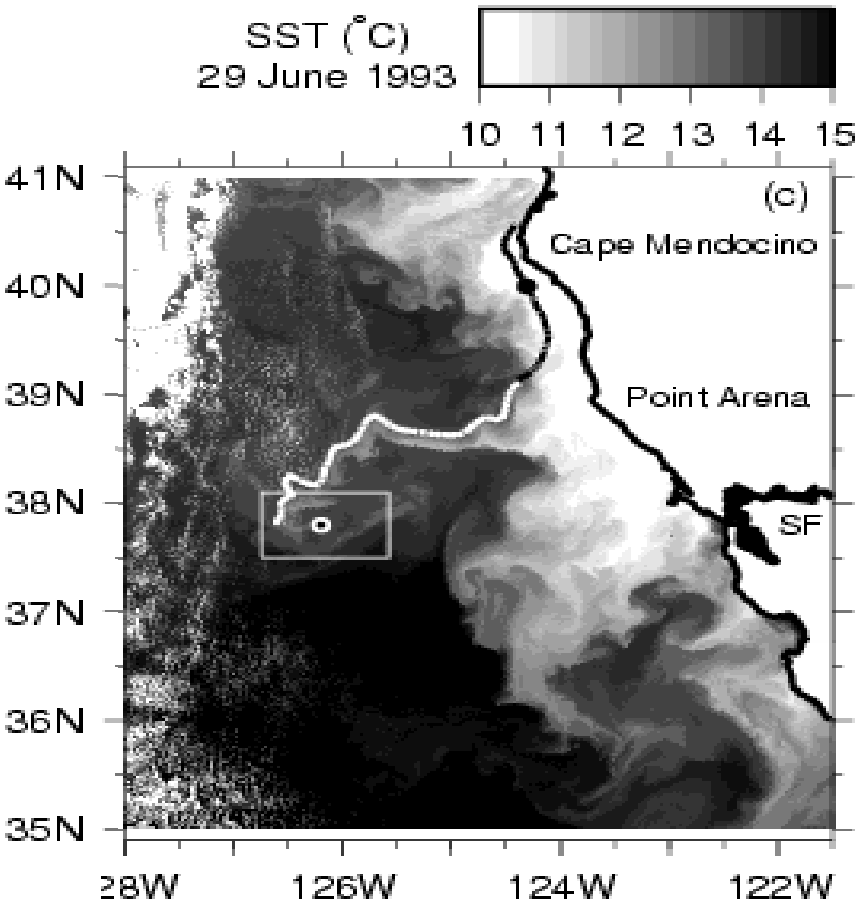


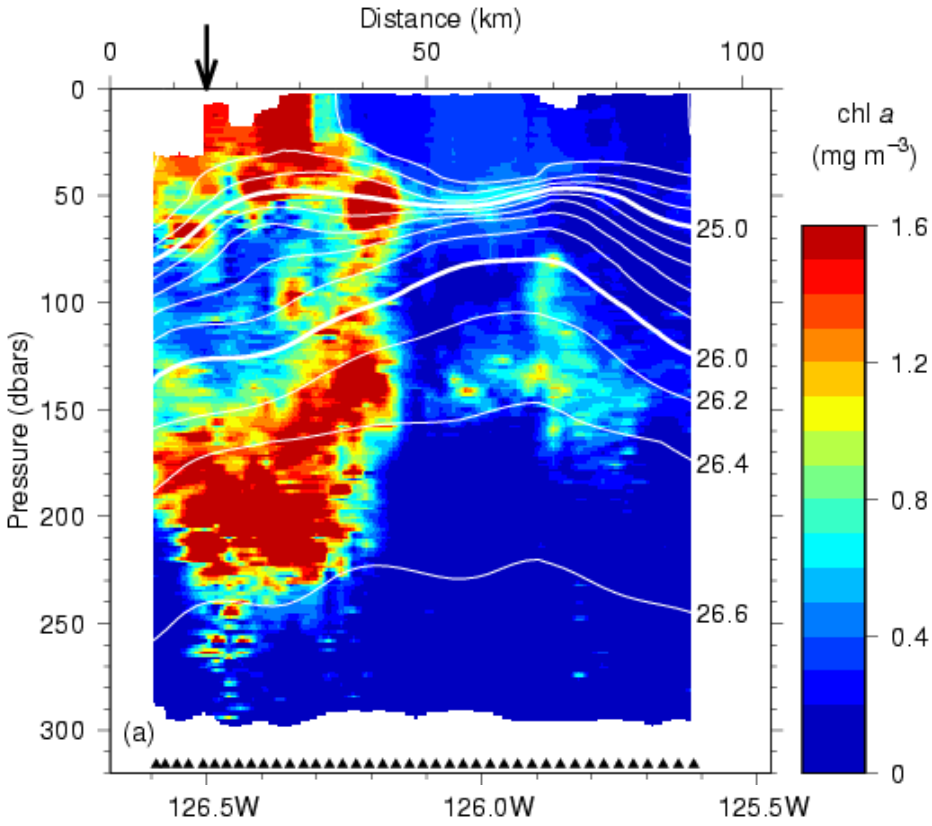
Strub and James (2000)

Daily satellite SST, 5 Sep 1994



Cross-shelf transport (mass, heat, salt, nutrients, carbon, larvae, eggs, …)



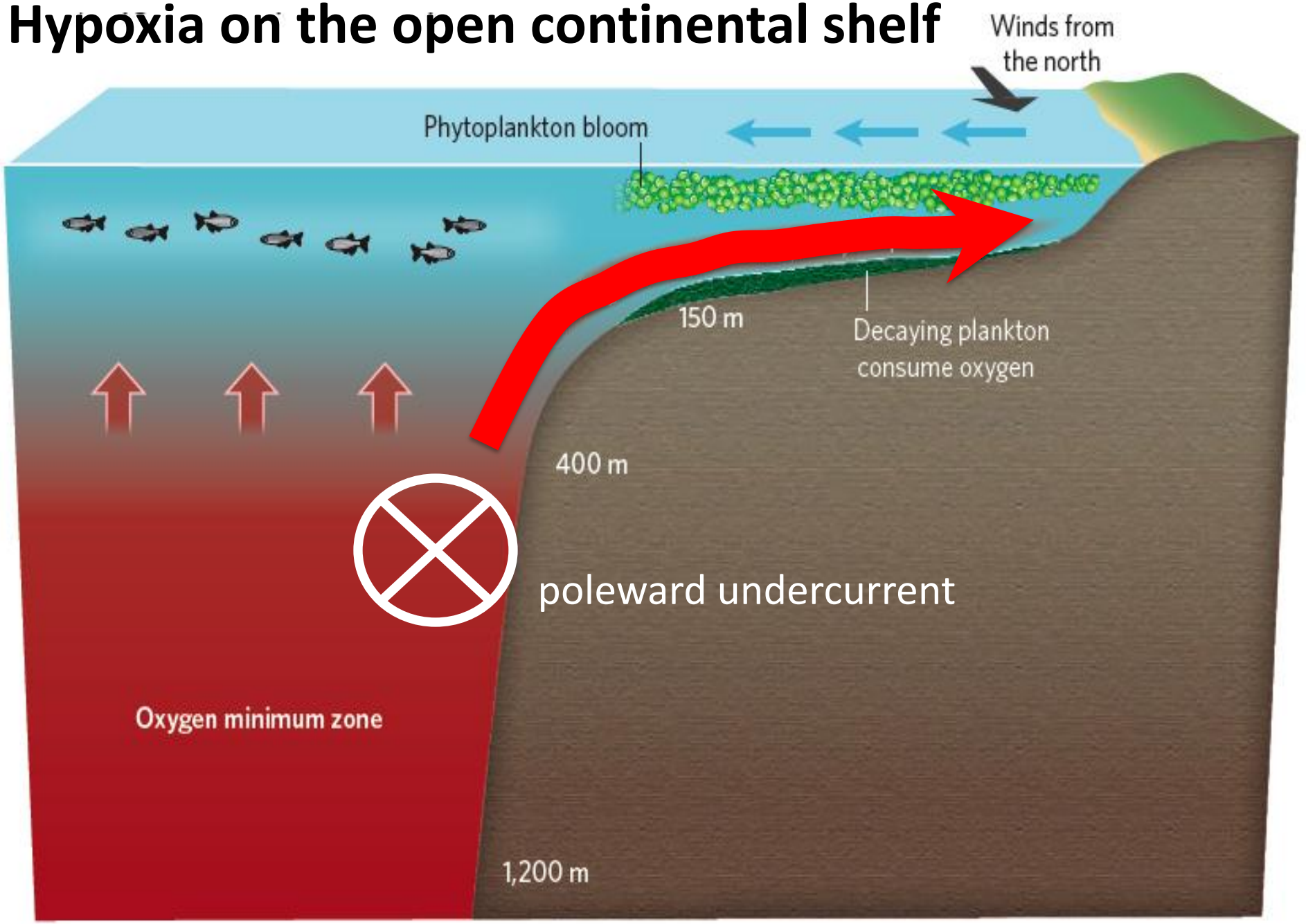


~20% of shelf production

5 events like this per year = measured benthic carbon mineralization rate

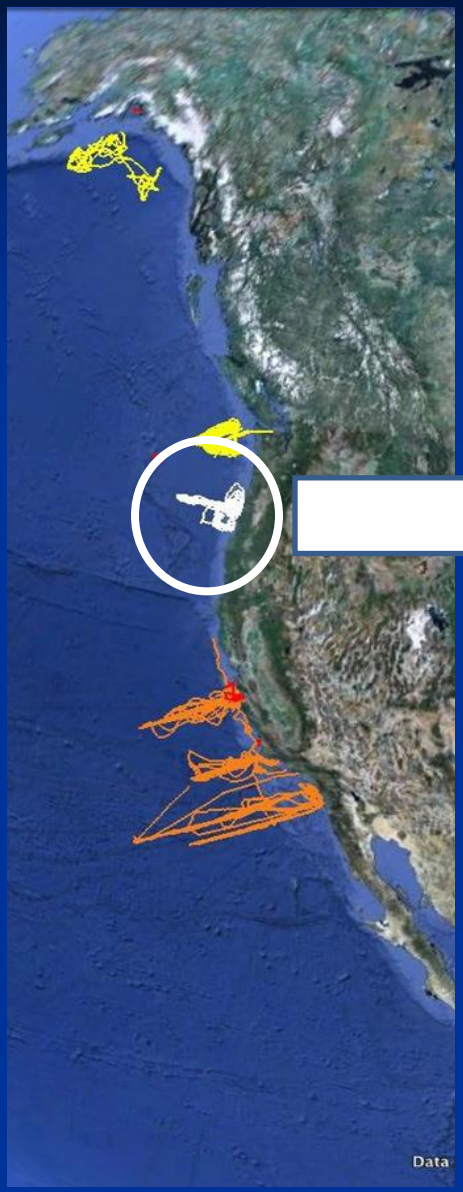
Barth et al. (2002)

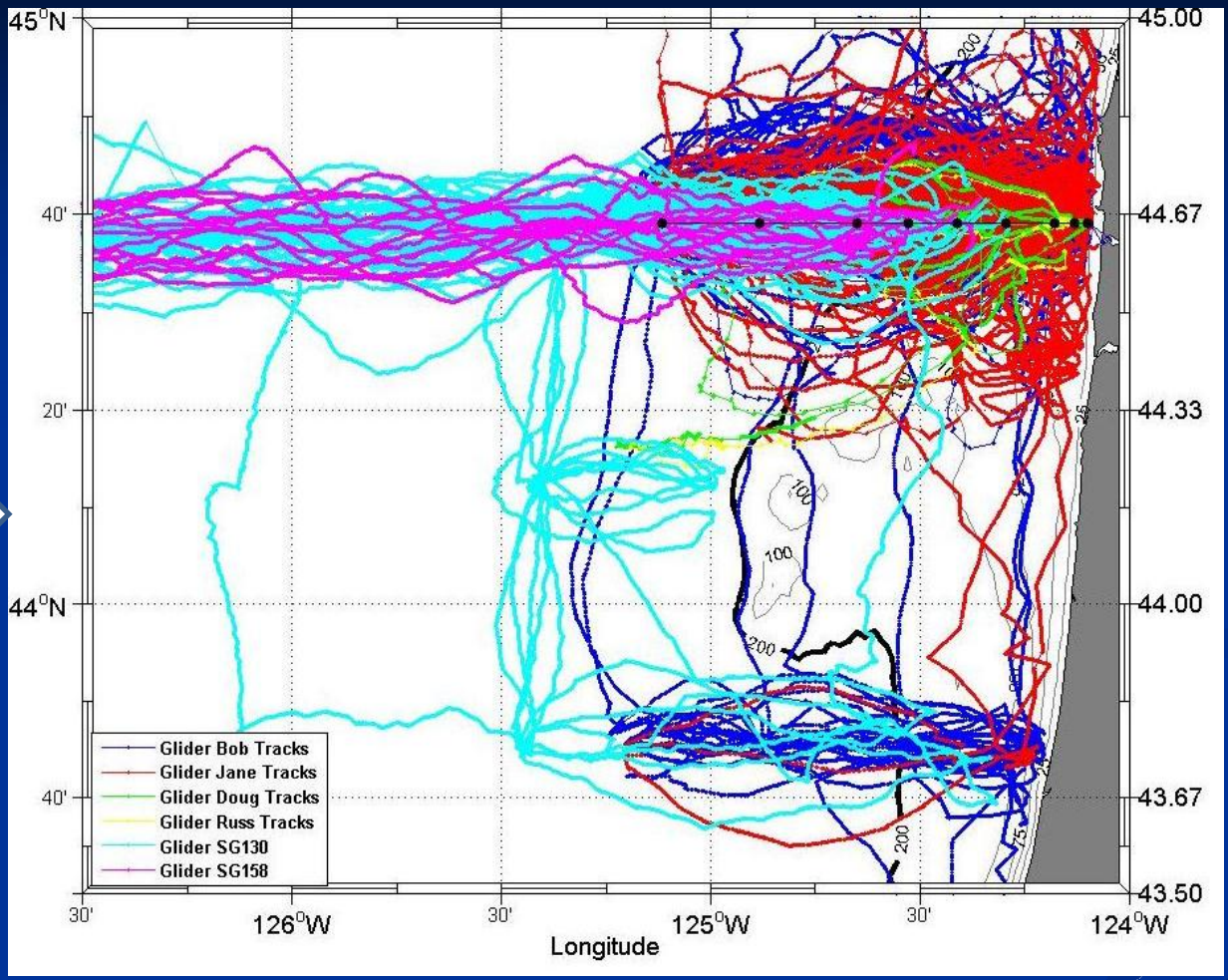
Hypoxia on the open continental shelf



Modified from Gewin (2011)

U.S. west coast glider measurements



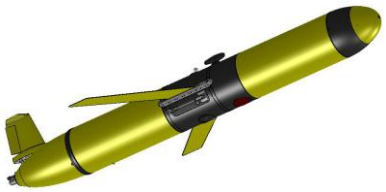


Oregon State University **April 2006–Sep 2014**

3485 glider-days **260,190 vertical profiles**

82,000+ km

Glider section of Dissolved Oxygen off Oregon in summer

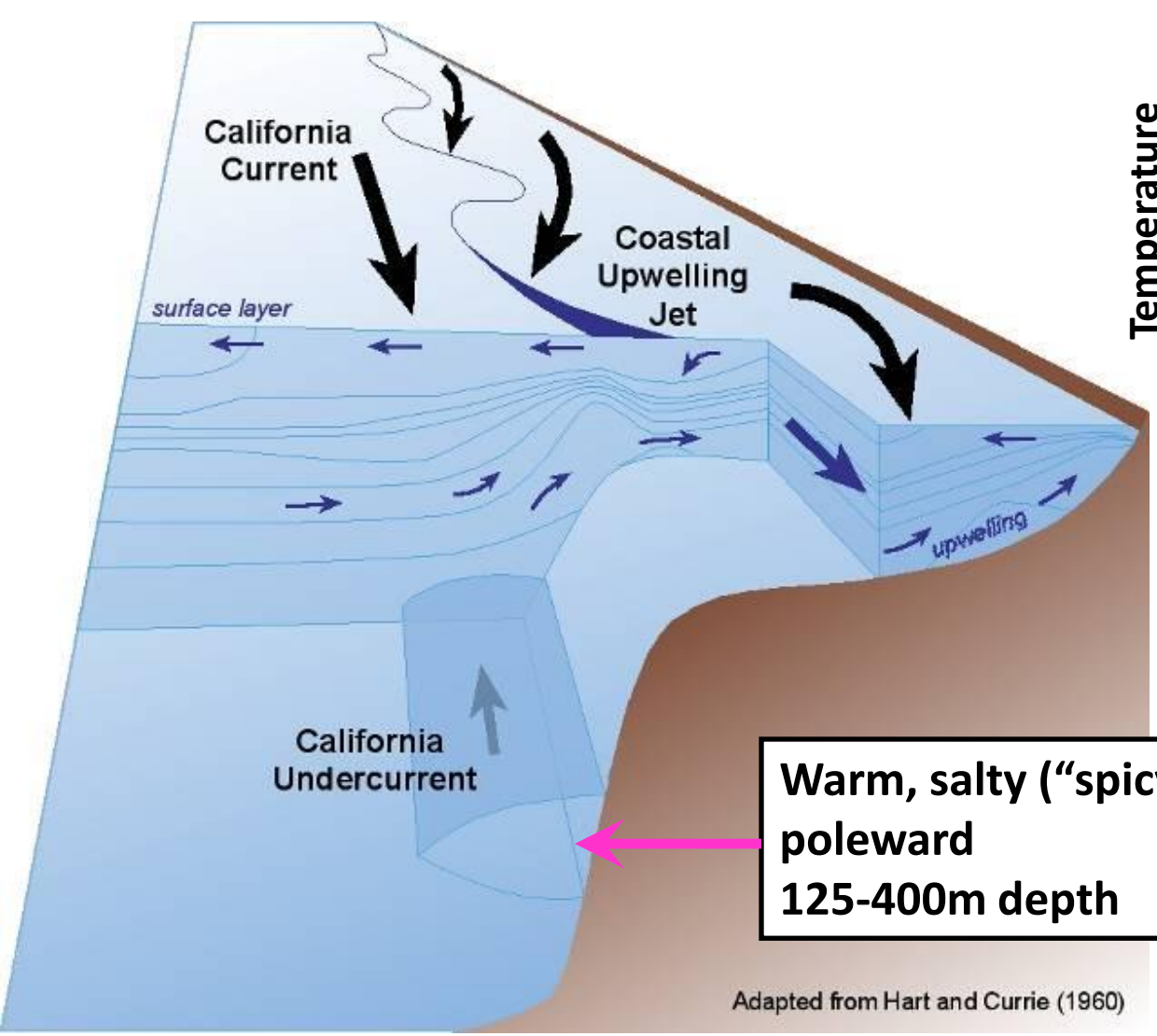


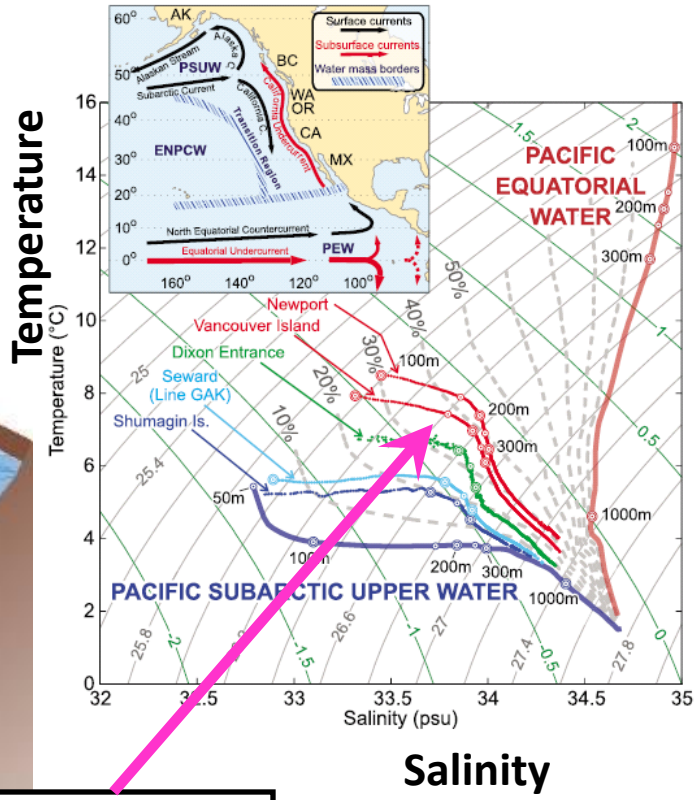
(> 300 profiles)

internal tide

Barth et al. (in prep)

Studies of poleward undercurrents



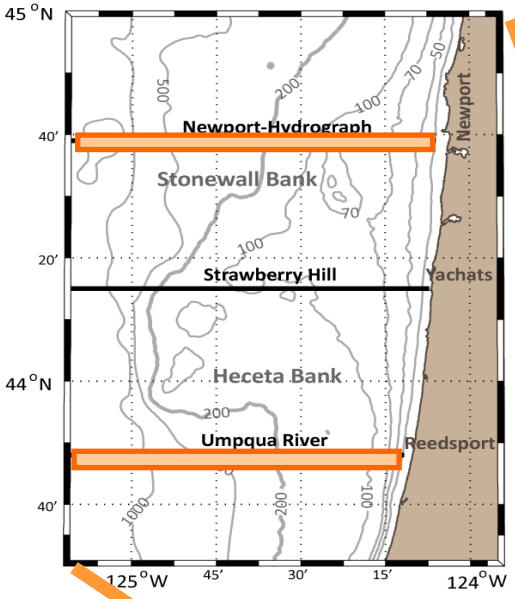


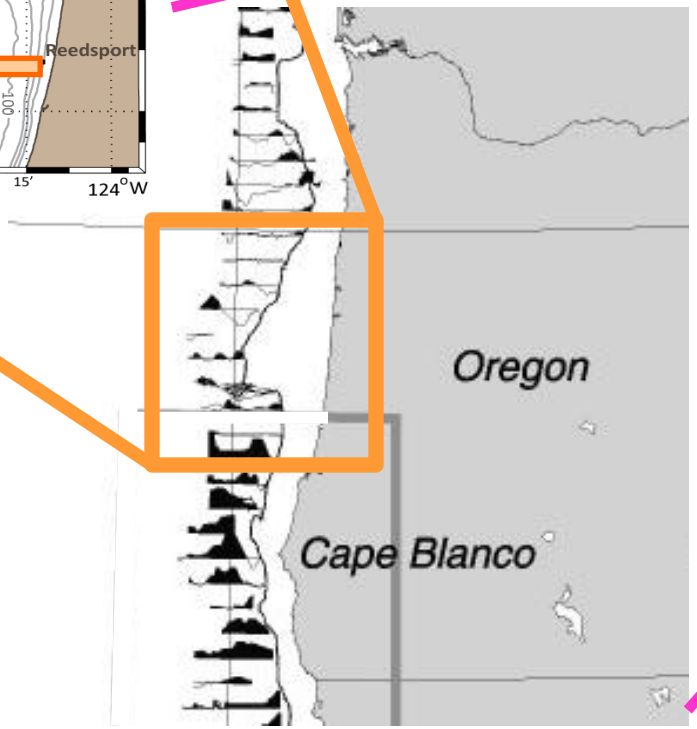
Warm, salty ("spicy") water poleward
125-400m depth

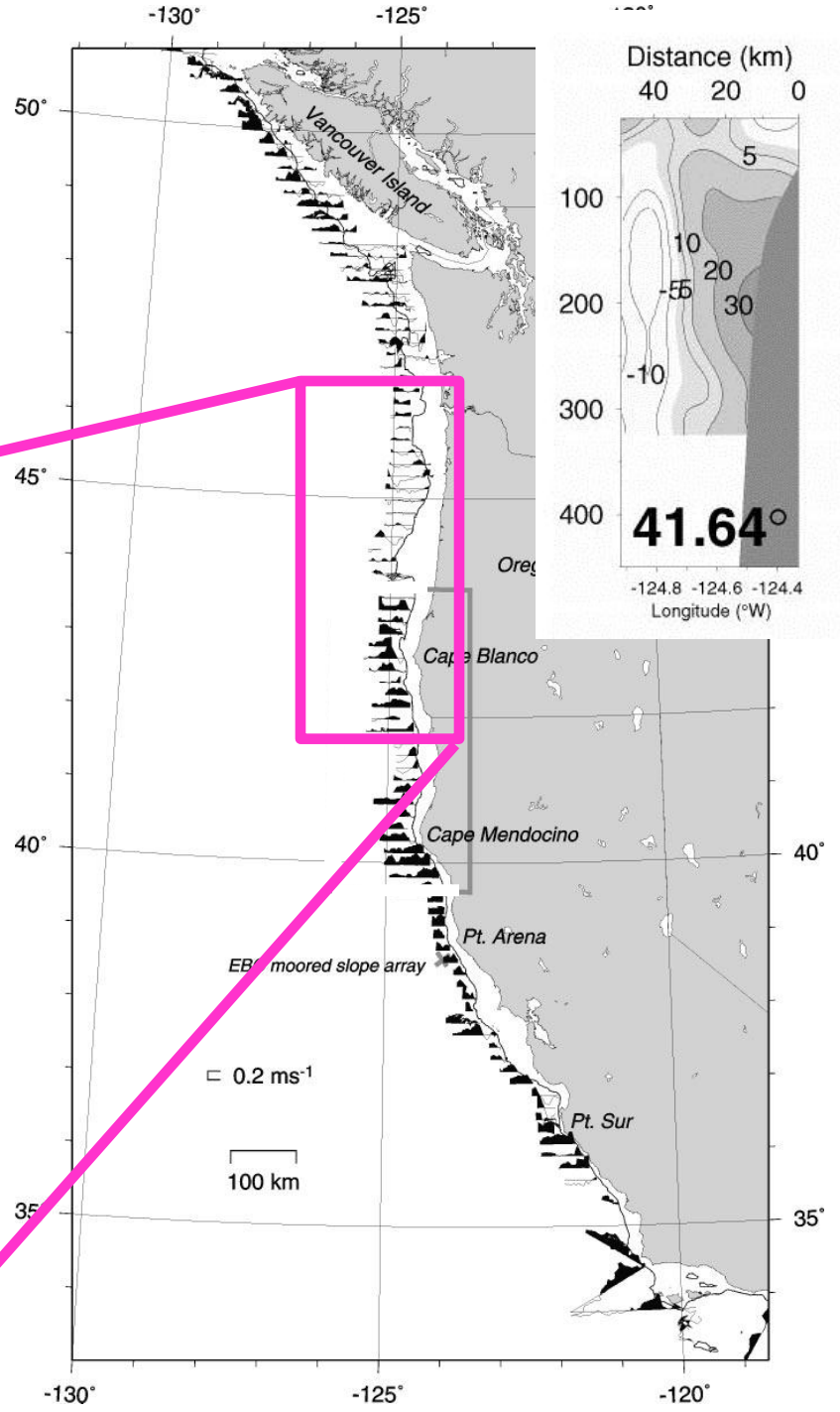
Adapted from Hart and Currie (1960)

Thomson & Krassovski (2010)

Poleward undercurrent – topography interaction



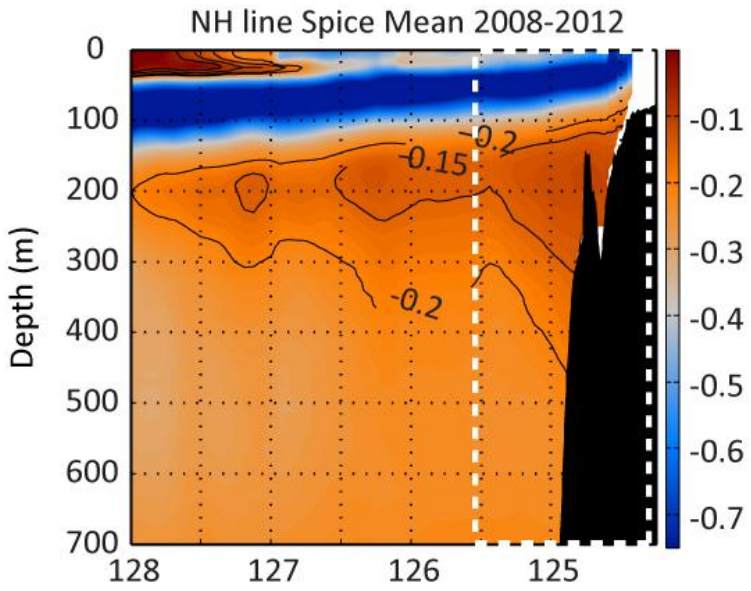




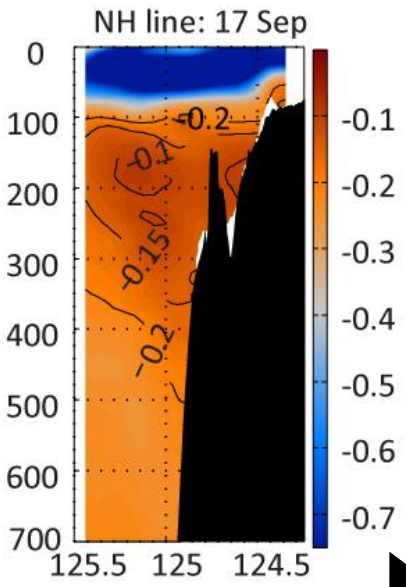
2-month fishery vessel survey; Pierce et al (2000)

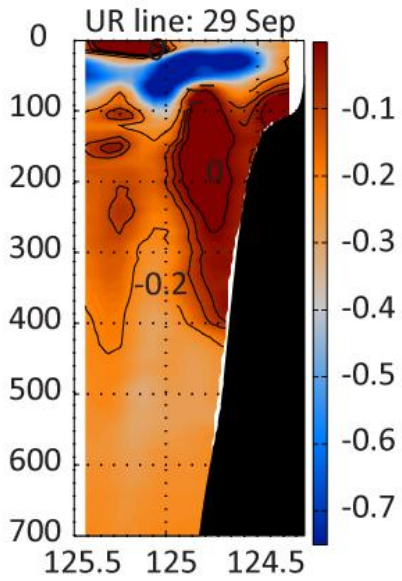
Glider-measured “spice”

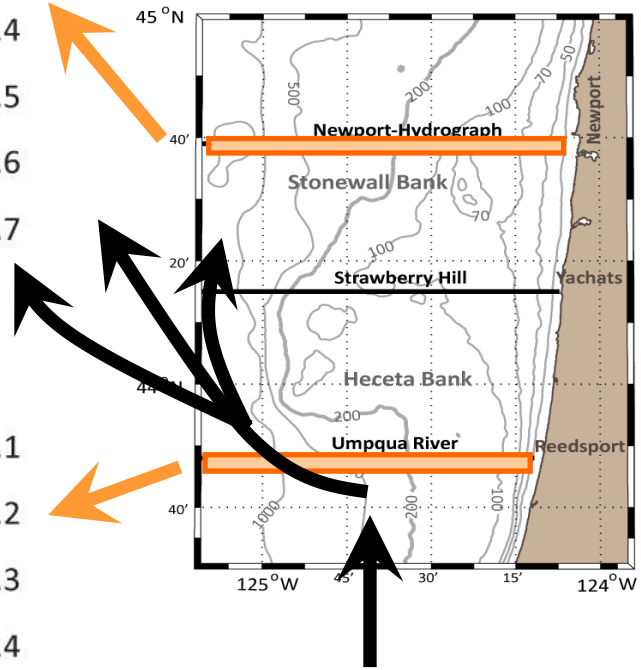
“Instantaneous” sections



Mean Spice 2008-2012





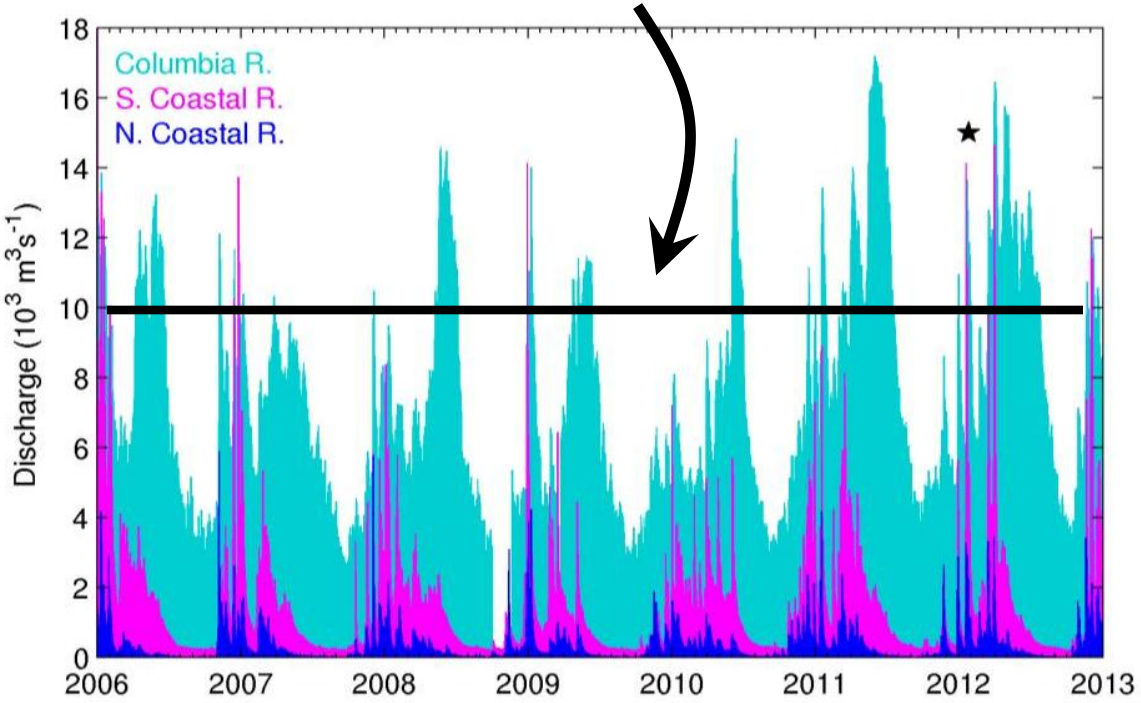


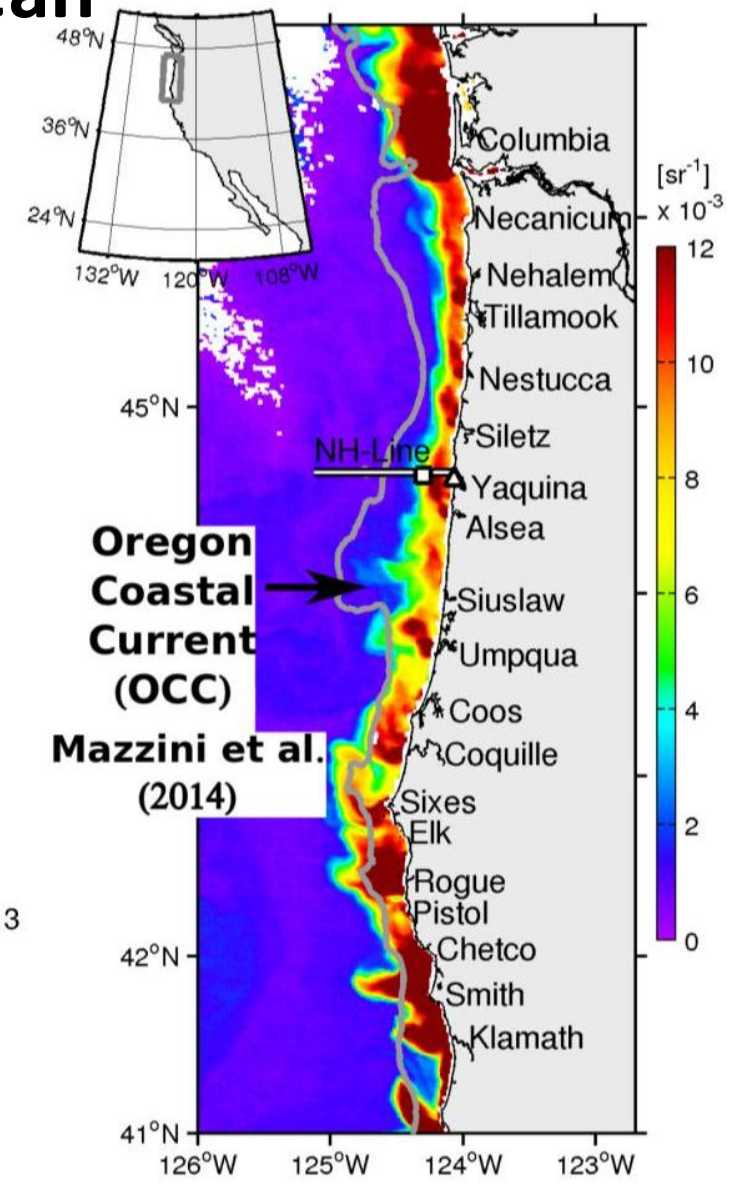
poleward undercurrent

Adams, Barth and Shearman (in prep)

During winter, coastal rivers add huge quantities of fresh water to the coastal ocean

10,000 m^3/second

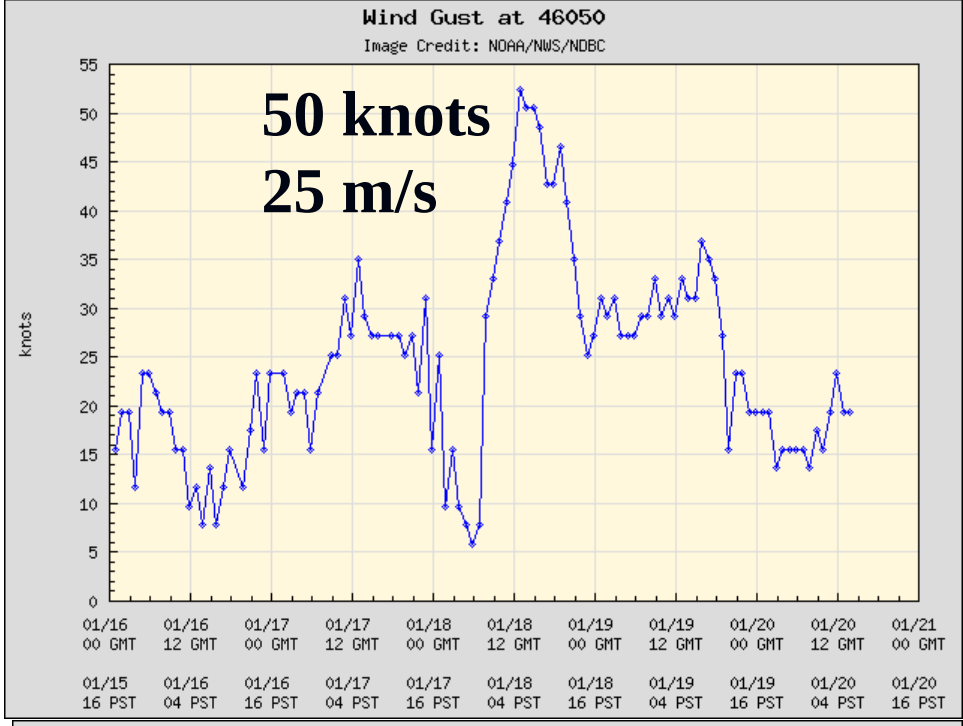


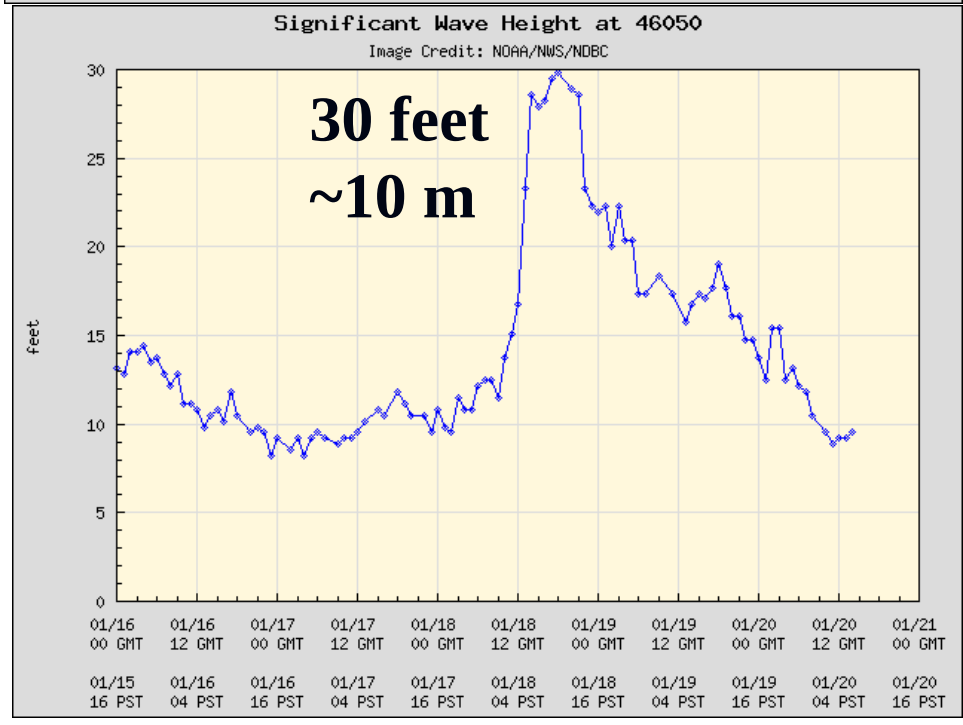


Oregon Coastal Current (OCC)

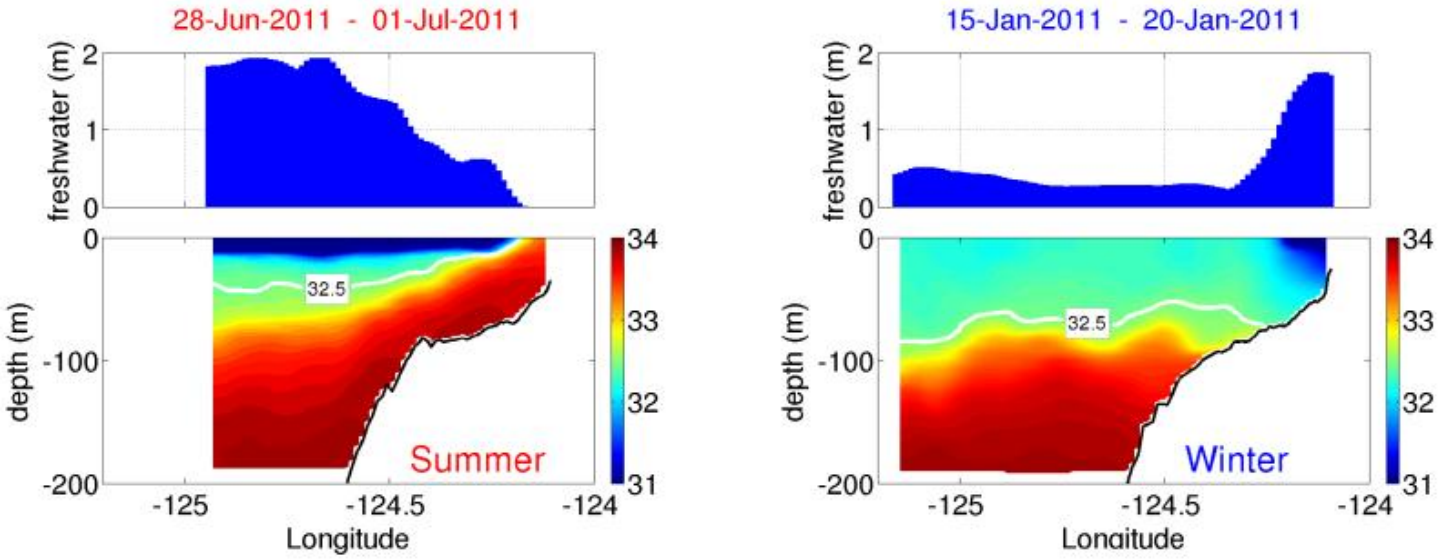
Mazzini et al. (2014)

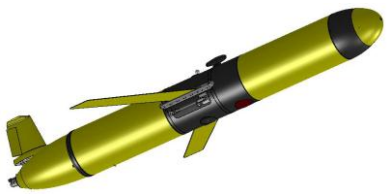
The challenge of winter-time sampling!

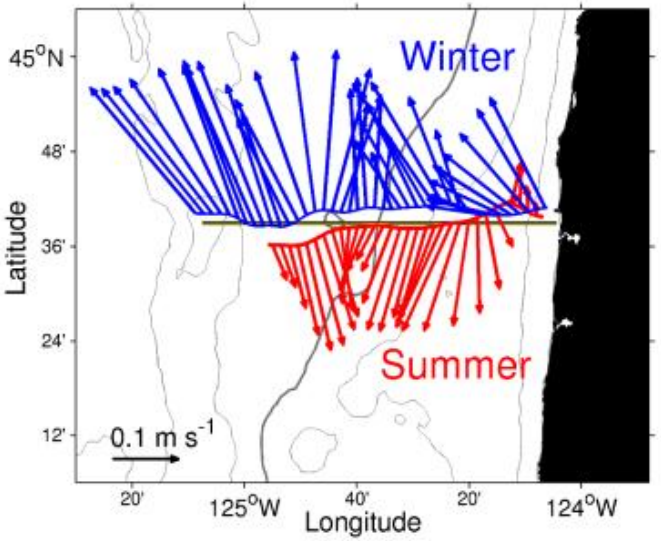




Example glider lines: summer vs. winter





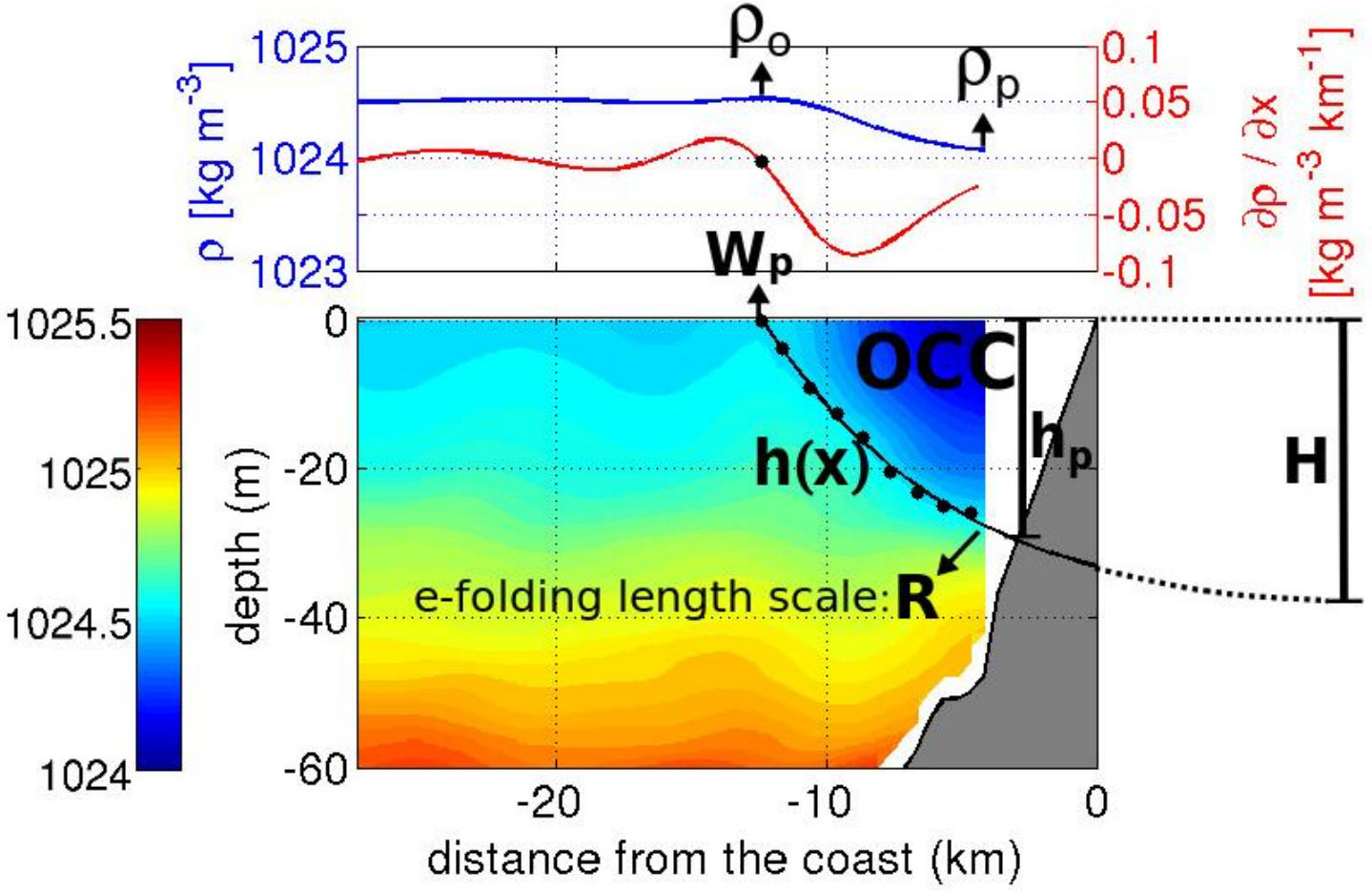


Analyze 67 fall/winter glider sections →

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

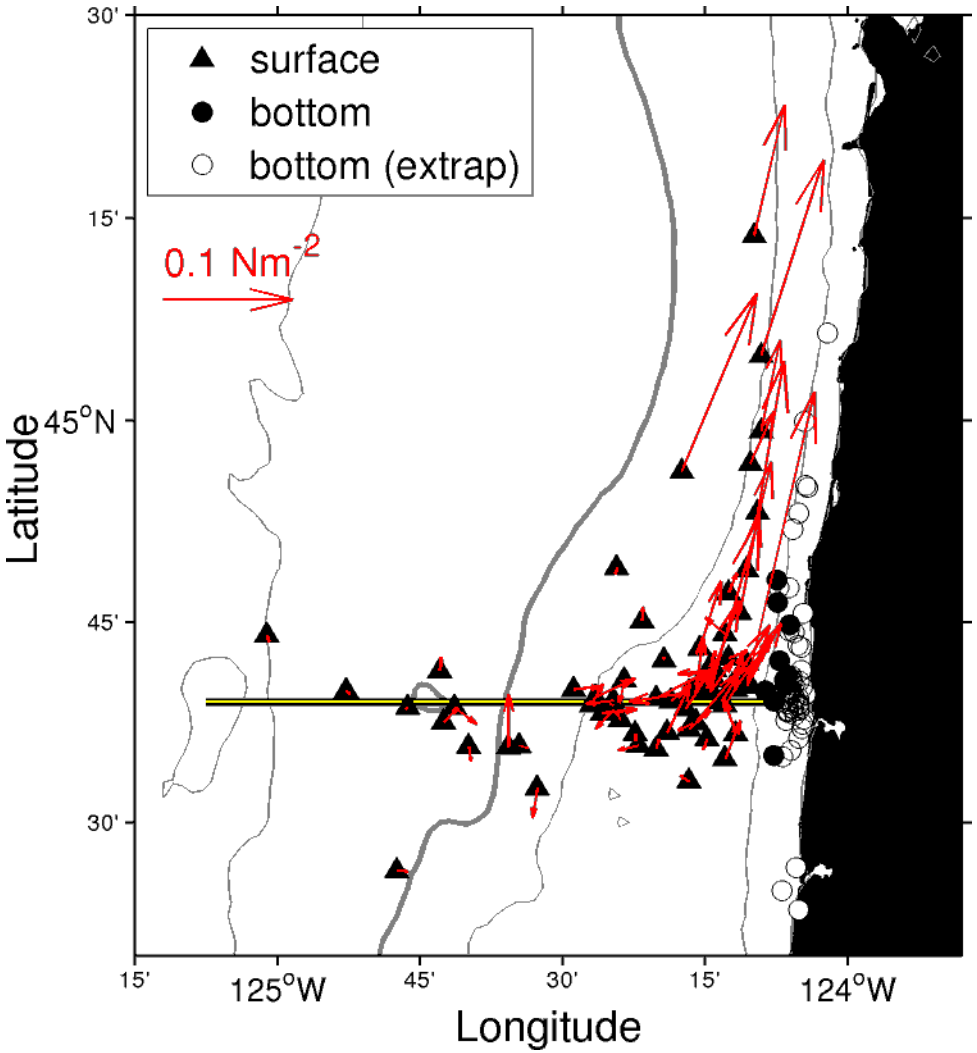
Use glider data to describe buoyancy front/current

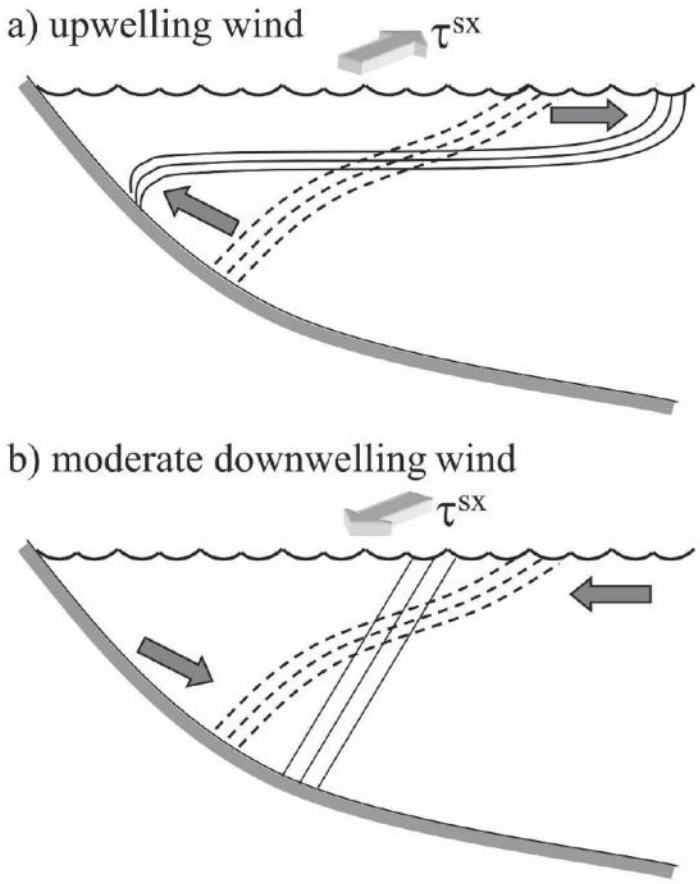
Fit: $h(x) = H[1 - e^{-\left(\frac{x+W_p}{R}\right)}]$, finding W_p, R and H.



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

Wind effects width and shape of front/current



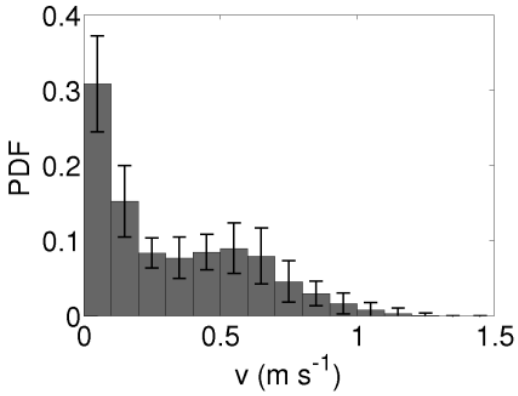


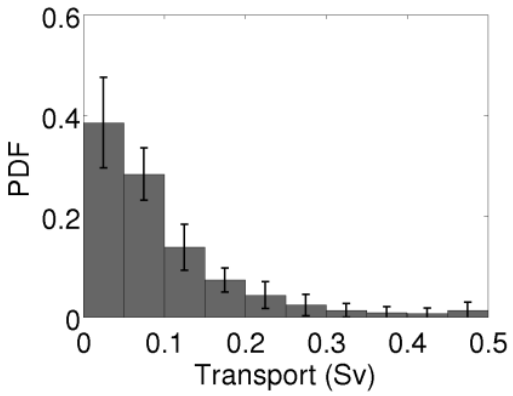
Lentz and Largier (2006)

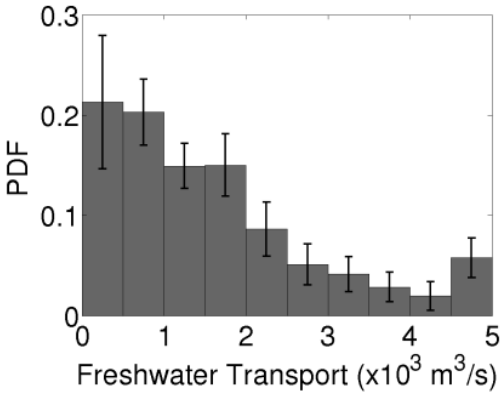
Mazzini, Barth, Shearman and Erofeev (JPO, 2014)

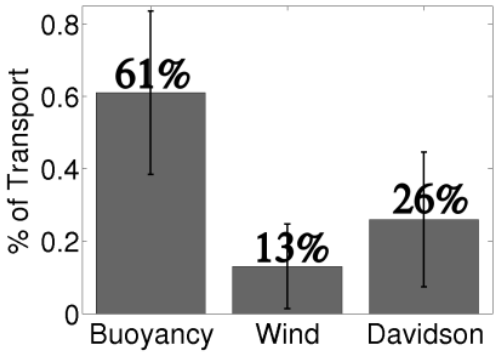
Calculate velocity/transport due to different forcings

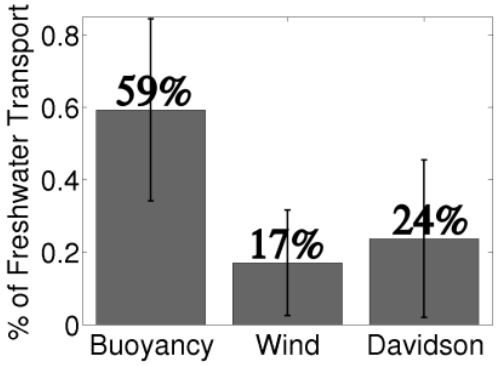
$$v(x) = \underbrace{\frac{g'H}{fR}\, e^{-\left(\frac{x+W_p}{R}\right)}}_{\text{buoyancy-driven}} + \underbrace{\frac{\tau_o^y}{\rho_o r}}_{\text{wind-driven}} + \underbrace{v_D}_{\text{Davidson Current}}$$



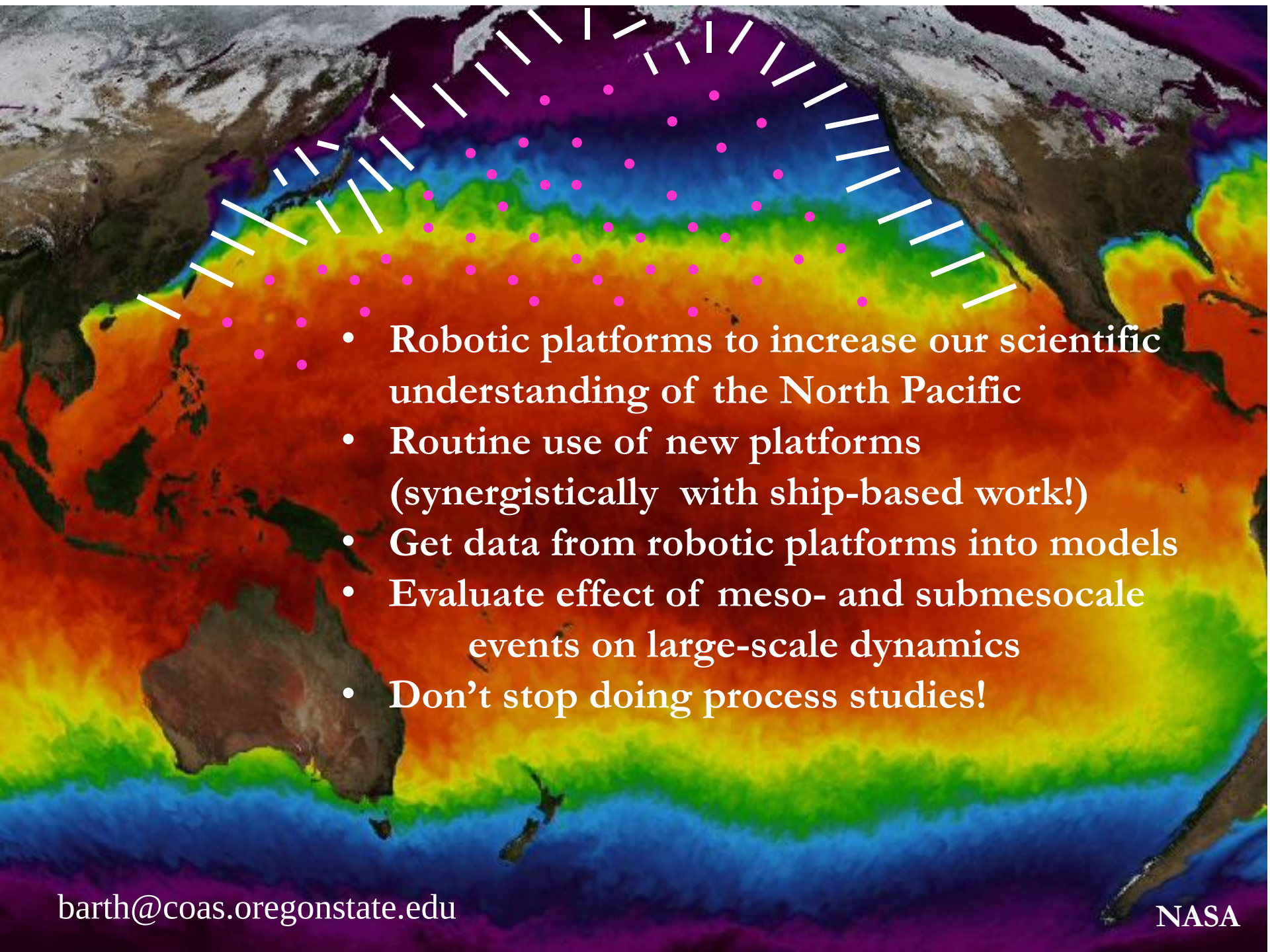








Mazzini, Barth, Shearman and Erofeev (JPO, 2014)


• Robotic platforms to increase our scientific understanding of the North Pacific
• Routine use of new platforms (synergistically with ship-based work!)
• Get data from robotic platforms into models
• Evaluate effect of meso- and submesocale events on large-scale dynamics
• Don't stop doing process studies!
barth@coas.oregonstate.edu
NASA