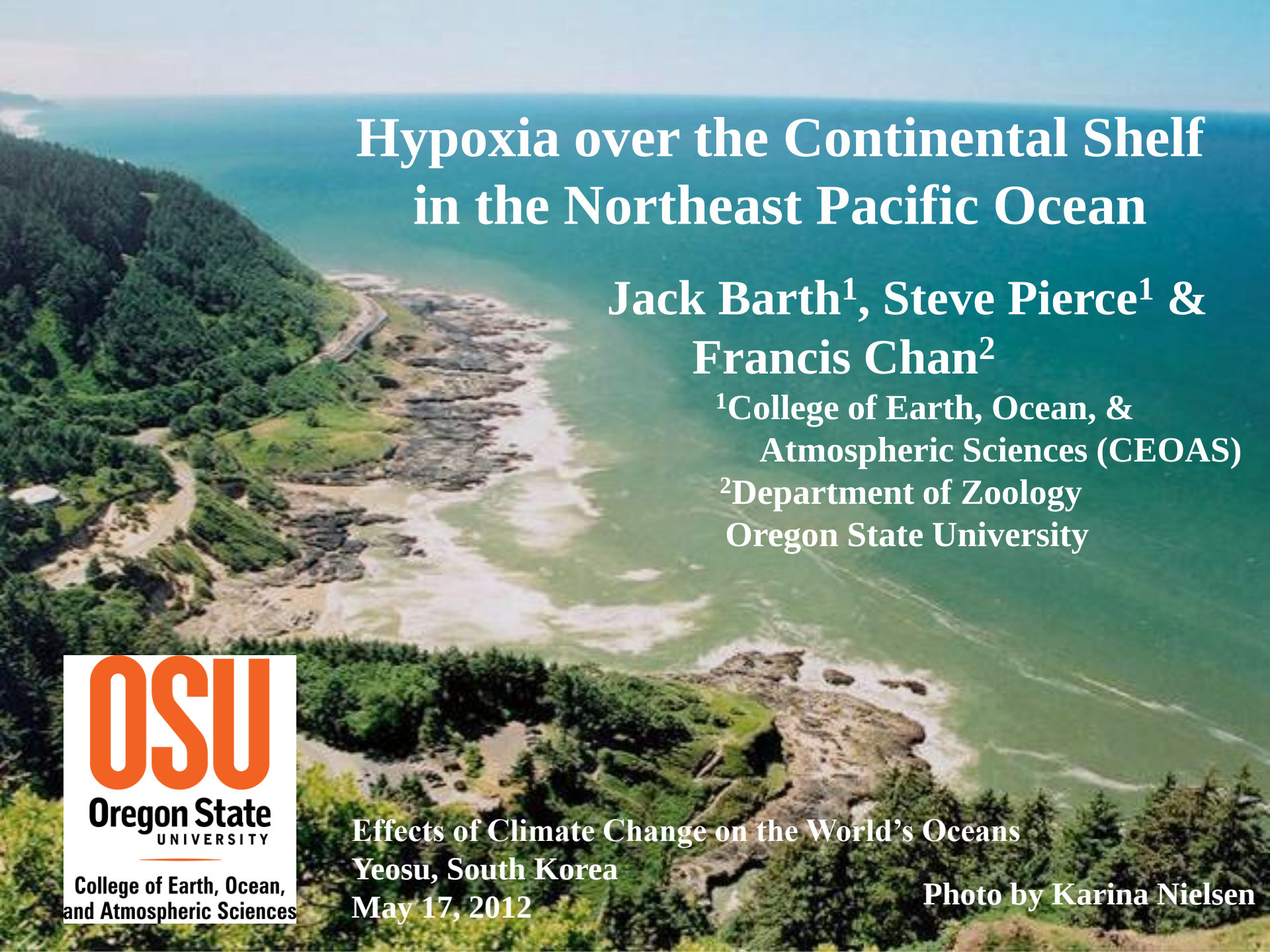

Hypoxia over the Continental Shelf in the Northeast Pacific Ocean

Jack Barth[1], Steve Pierce[1] & Francis Chan[2]

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[2]Department of Zoology

Oregon State University

OSU Oregon State University

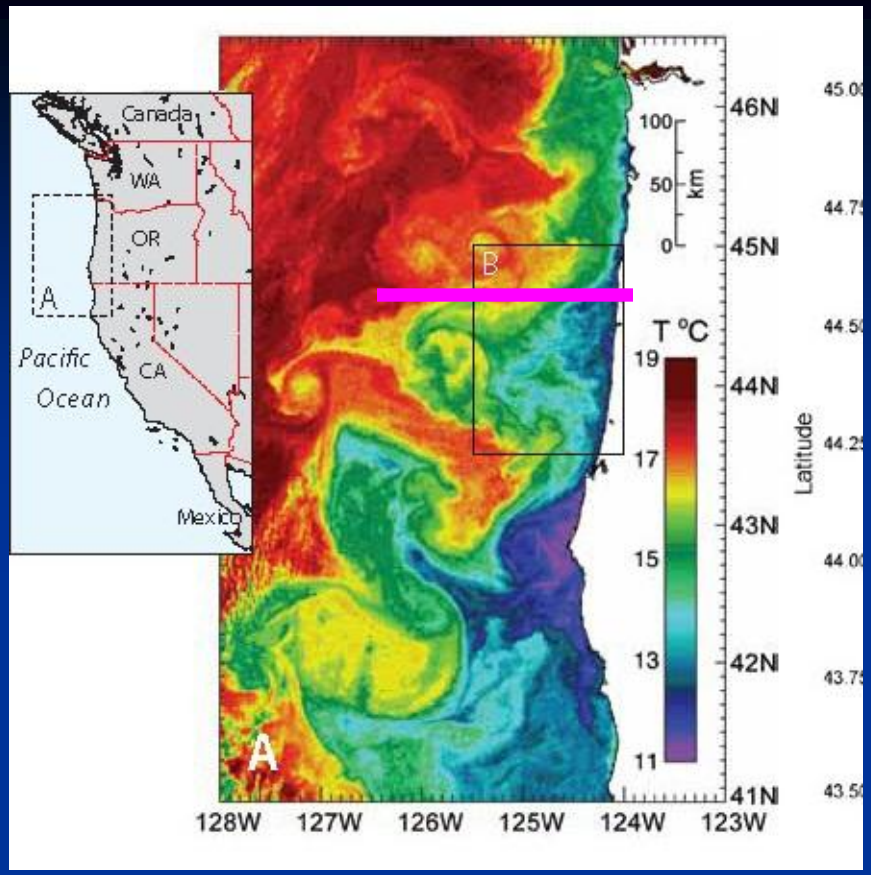
College of Earth, Ocean, and Atmospheric Sciences

Effects of Climate Change on the World's Oceans

Yeosu, South Korea

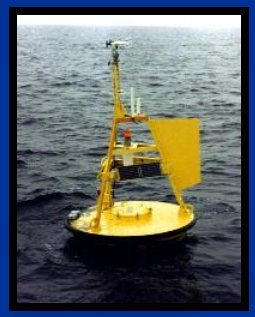
May 17, 2012

Photo by Karina Nielsen



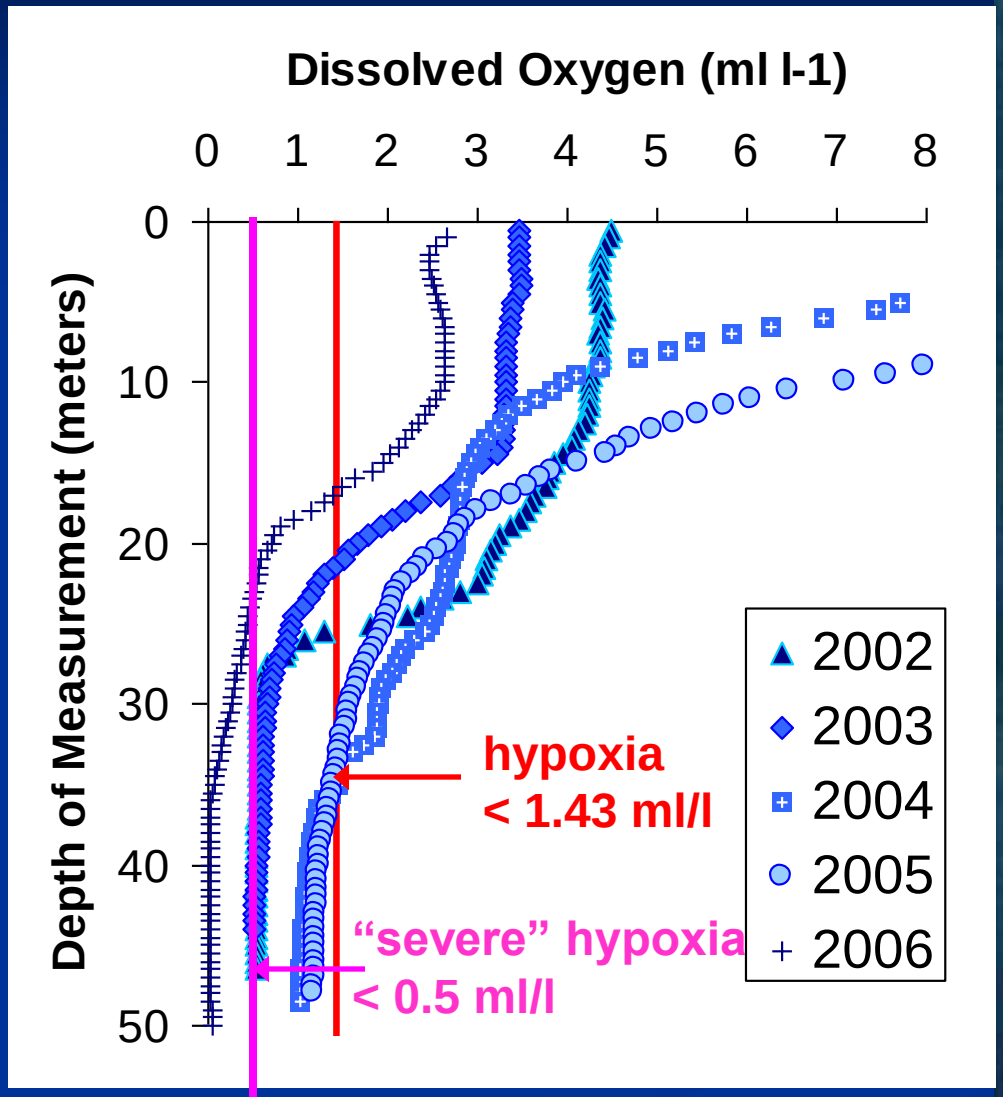
Data from

- **53-yr Newport Hydrographic Line**
- **NOAA NDBC Buoy 46050**
- **7 years of glider data**
- **OSU and NOAA ship surveys**
- **(moorings, bottom landers, …)**

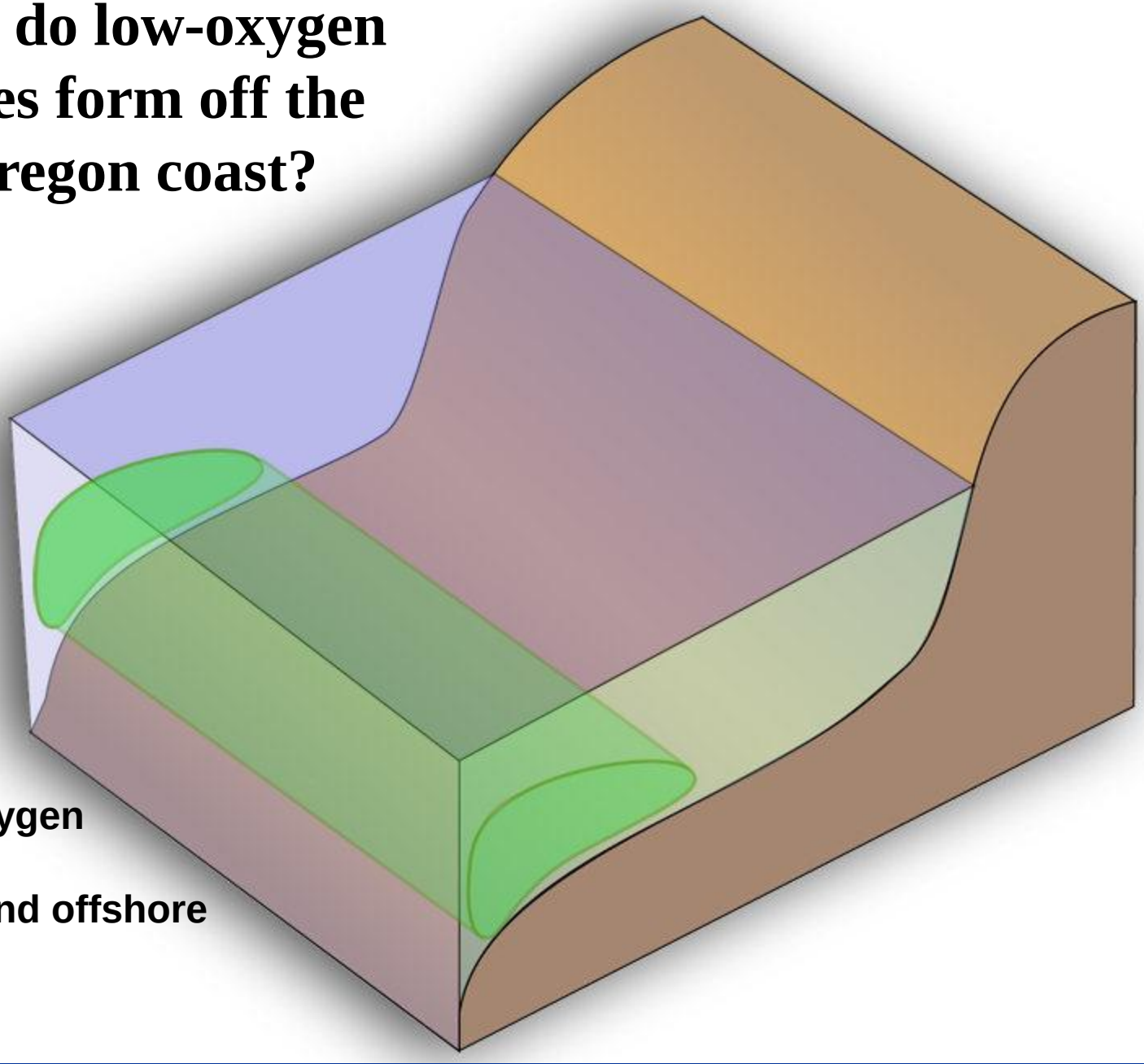


Newport, Oregon

Off Oregon, hypoxia develops on the open continental shelf

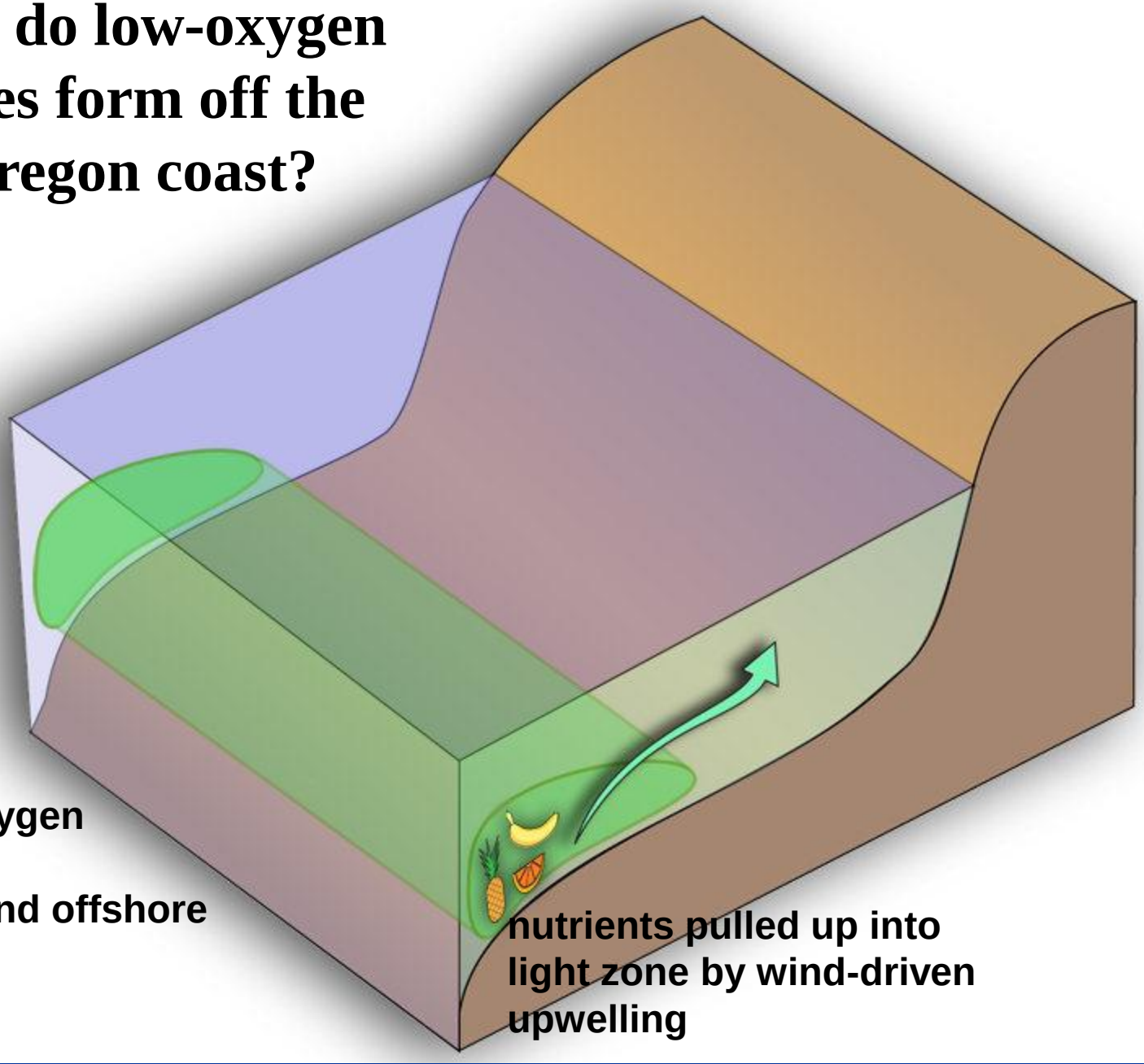


How do low-oxygen zones form off the Oregon coast?



natural
low-oxygen
zone
deep and offshore

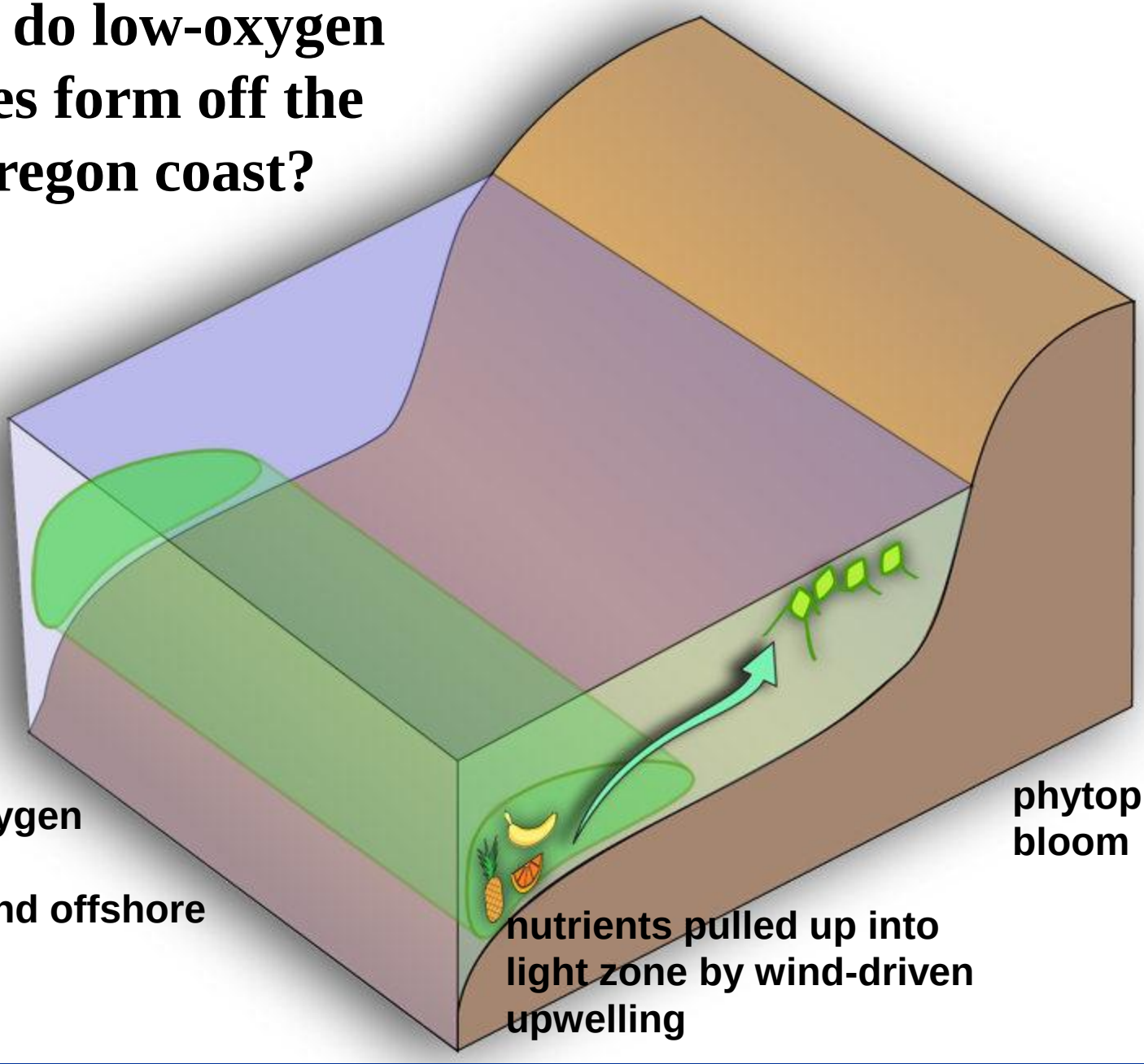
How do low-oxygen zones form off the Oregon coast?



natural low-oxygen zone deep and offshore

nutrients pulled up into light zone by wind-driven upwelling

How do low-oxygen zones form off the Oregon coast?

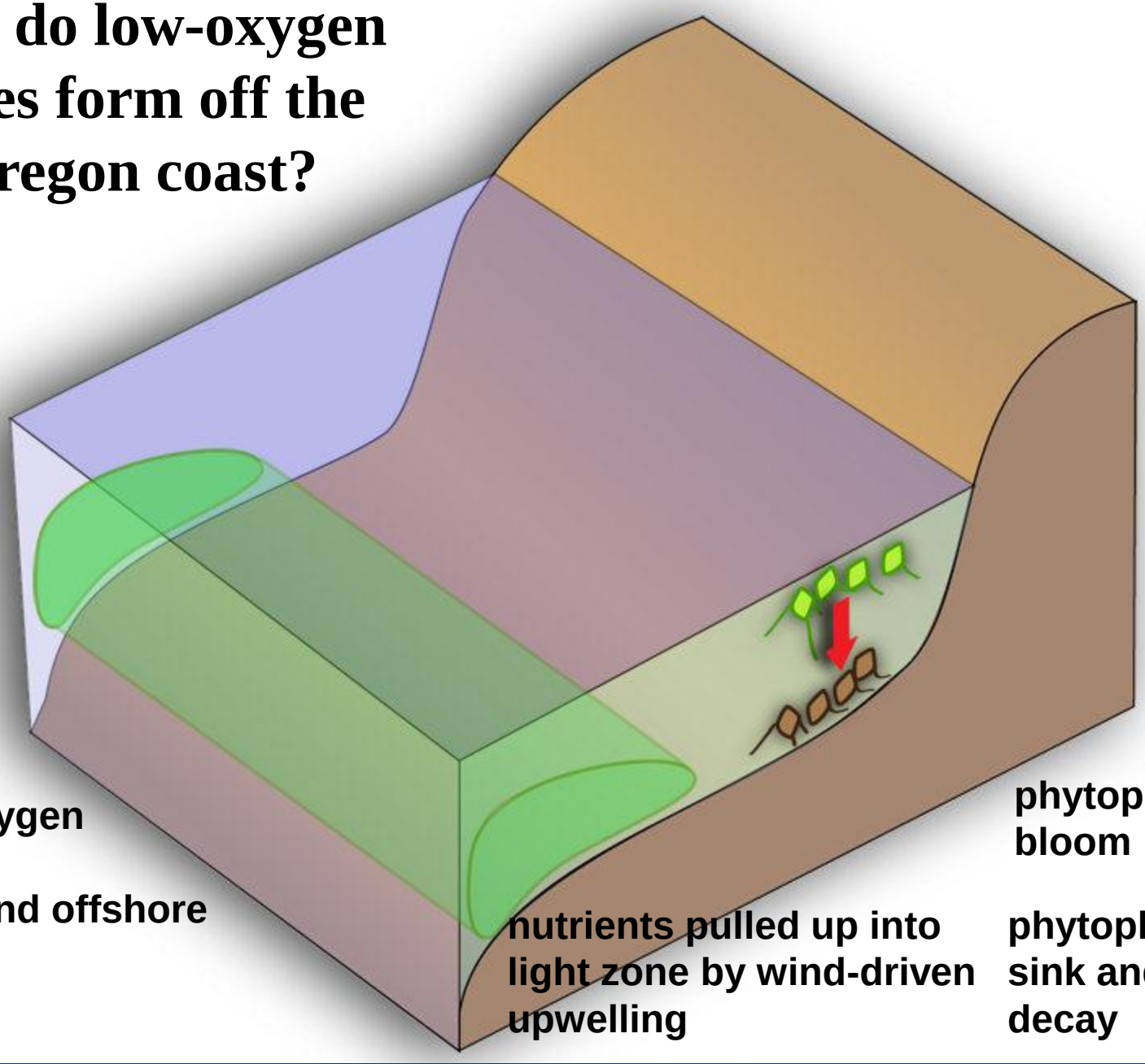


natural low-oxygen zone deep and offshore

phytoplankton bloom

nutrients pulled up into light zone by wind-driven upwelling

How do low-oxygen zones form off the Oregon coast?



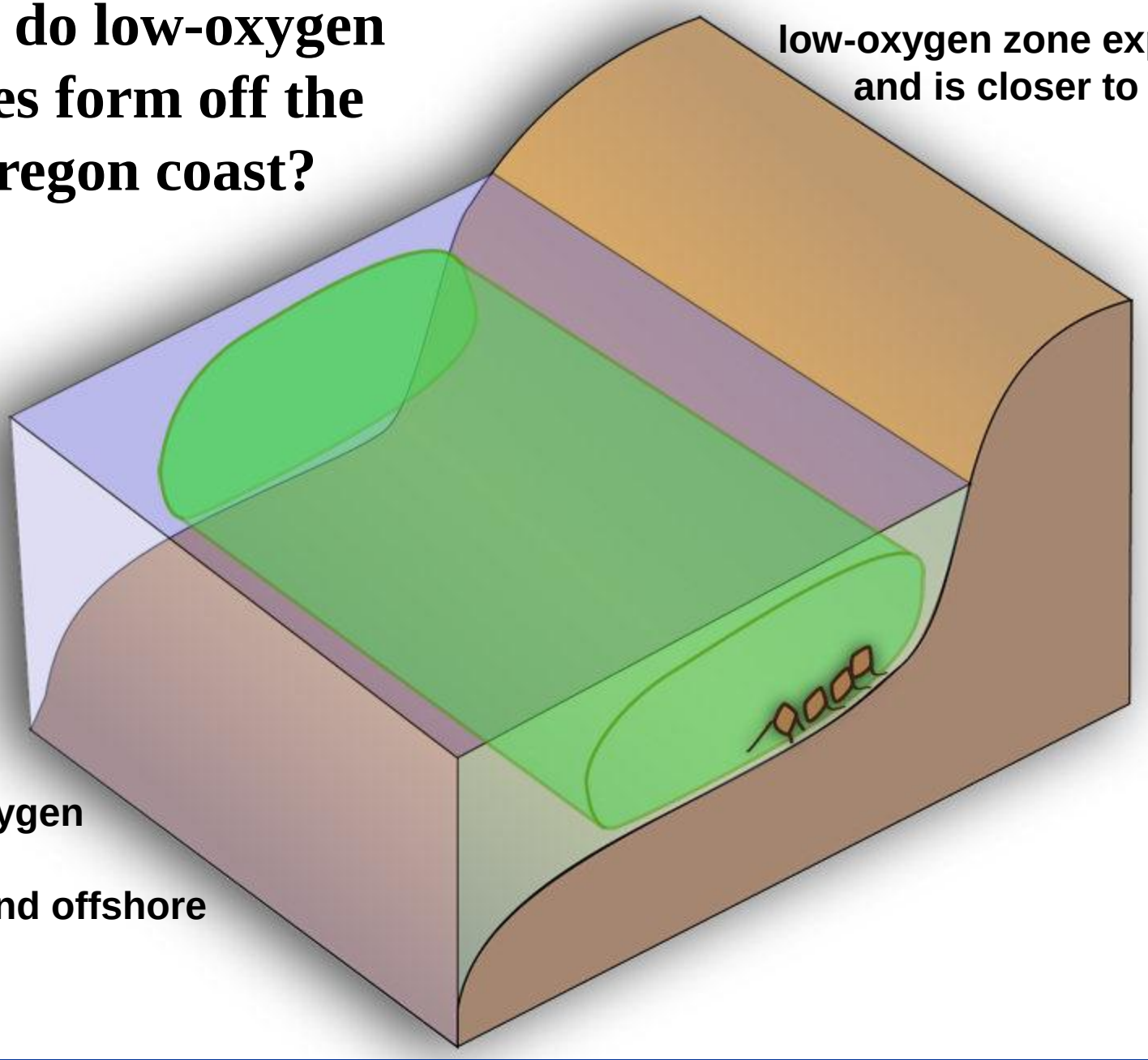
natural low-oxygen zone deep and offshore

phytoplankton bloom

nutrients pulled up into light zone by wind-driven upwelling

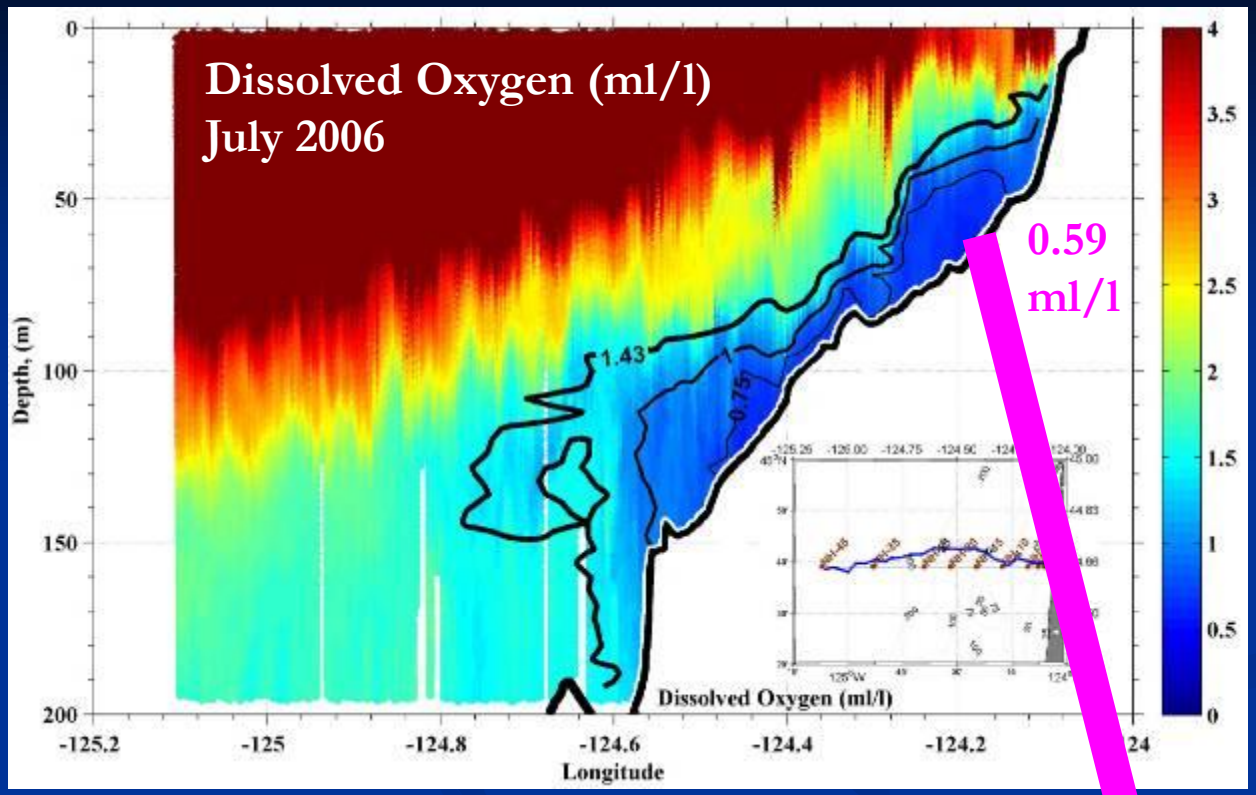
phytoplankton sink and decay

How do low-oxygen zones form off the Oregon coast?



Cross-shelf structure from autonomous underwater gliders

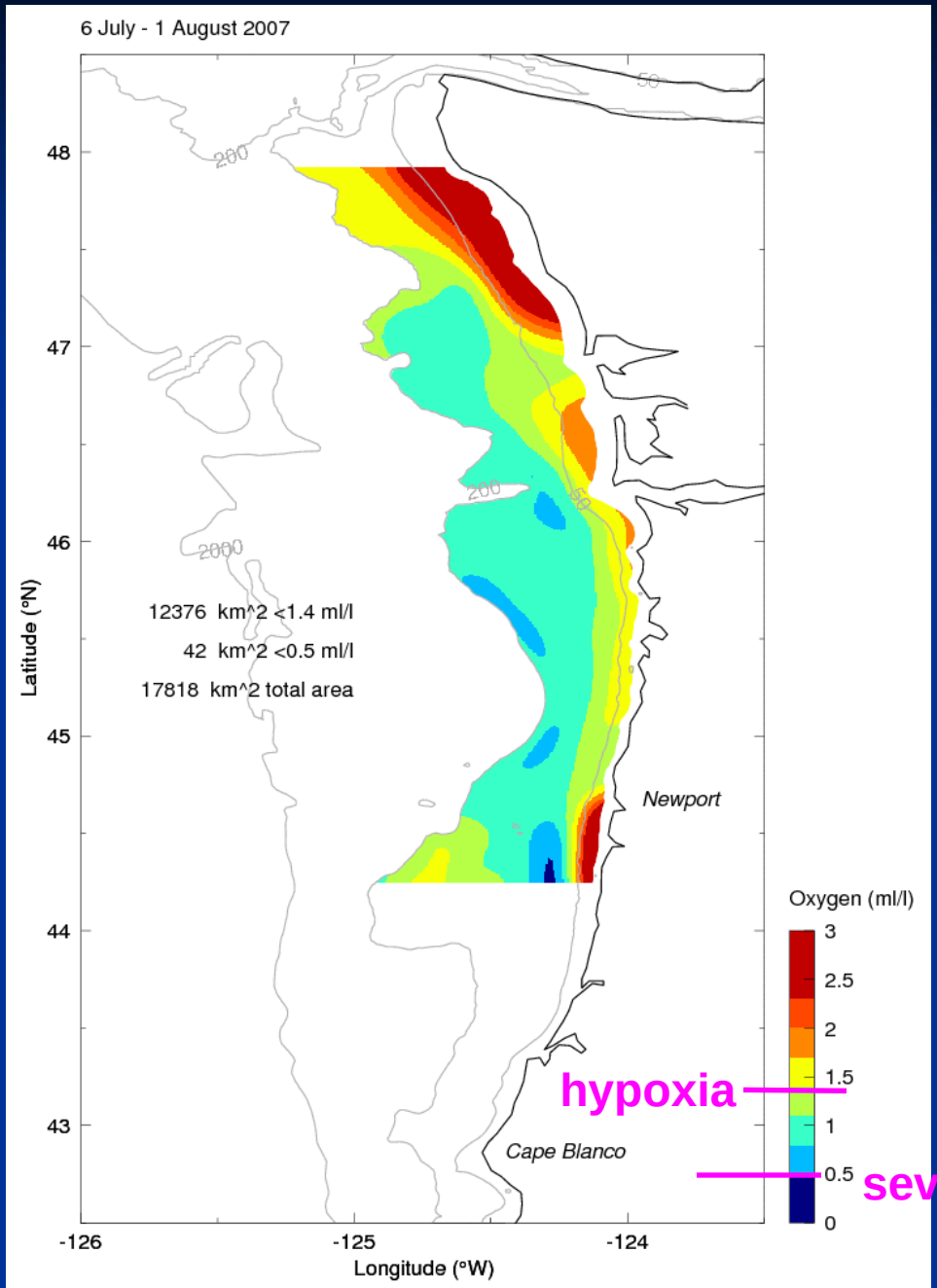
cross-margin transect twice per week since April 2006



temperature, salinity, pressure
dissolved oxygen
chlorophyll fluorescence
colored organic matter fluorescence
light backscatter
velocity (depth-averaged, shear)

OREGON
Fish & Wildlife

Near-bottom hypoxia over the PNW continental shelf



July 2007

In order to compute statistics in uniform way for each map, restrict the area of interest to the largest common area inshore of the 200-m isobath

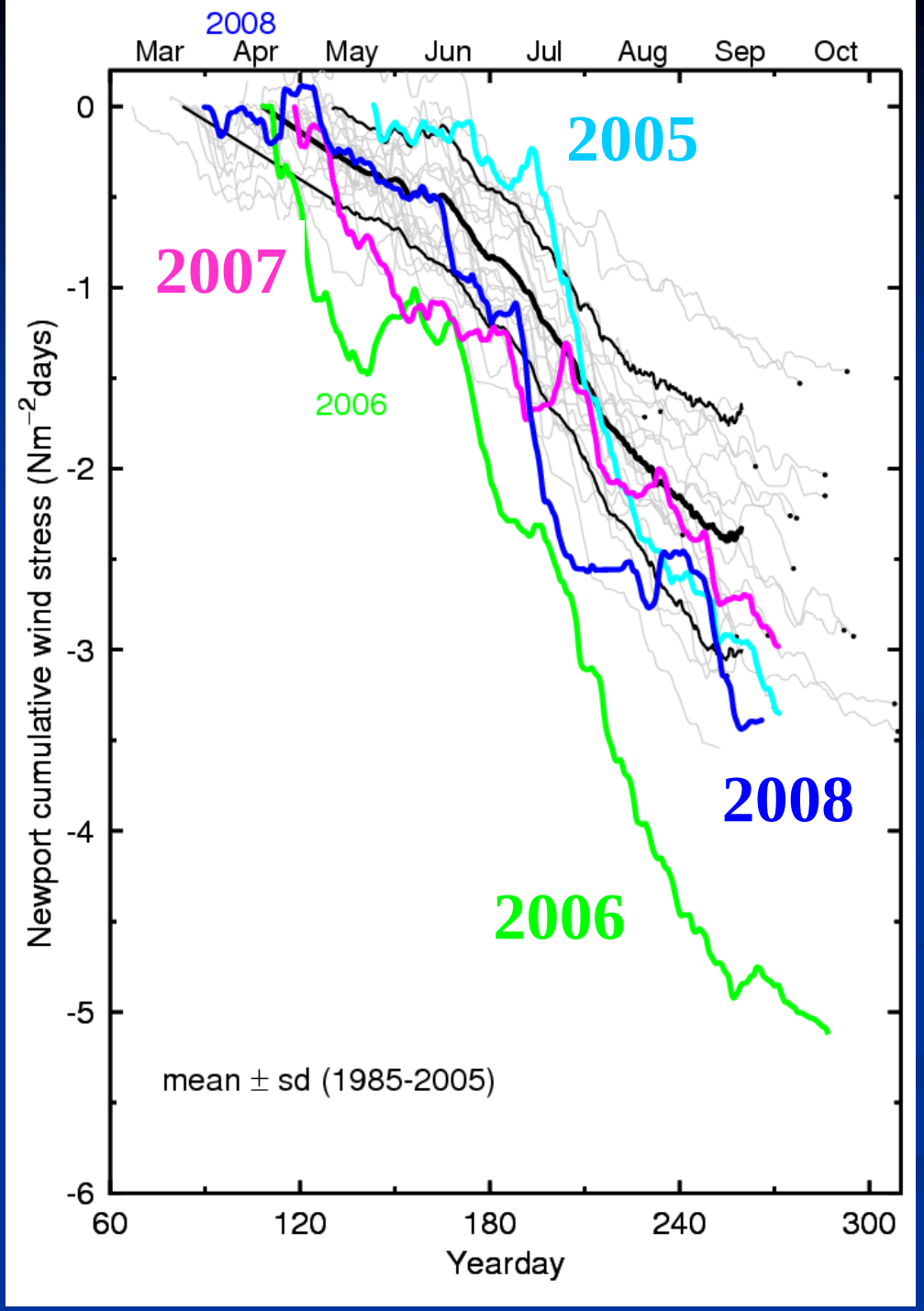
12,516 km² < 1.4 ml/l

(total area = 17,818 km²)

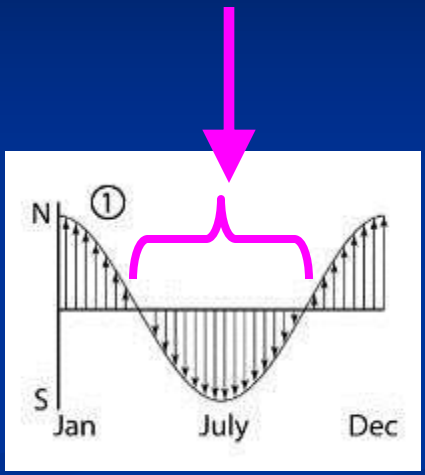
68% of shelf hypoxic

Cumulative wind stress since Spring Transition

Upwelling favorable

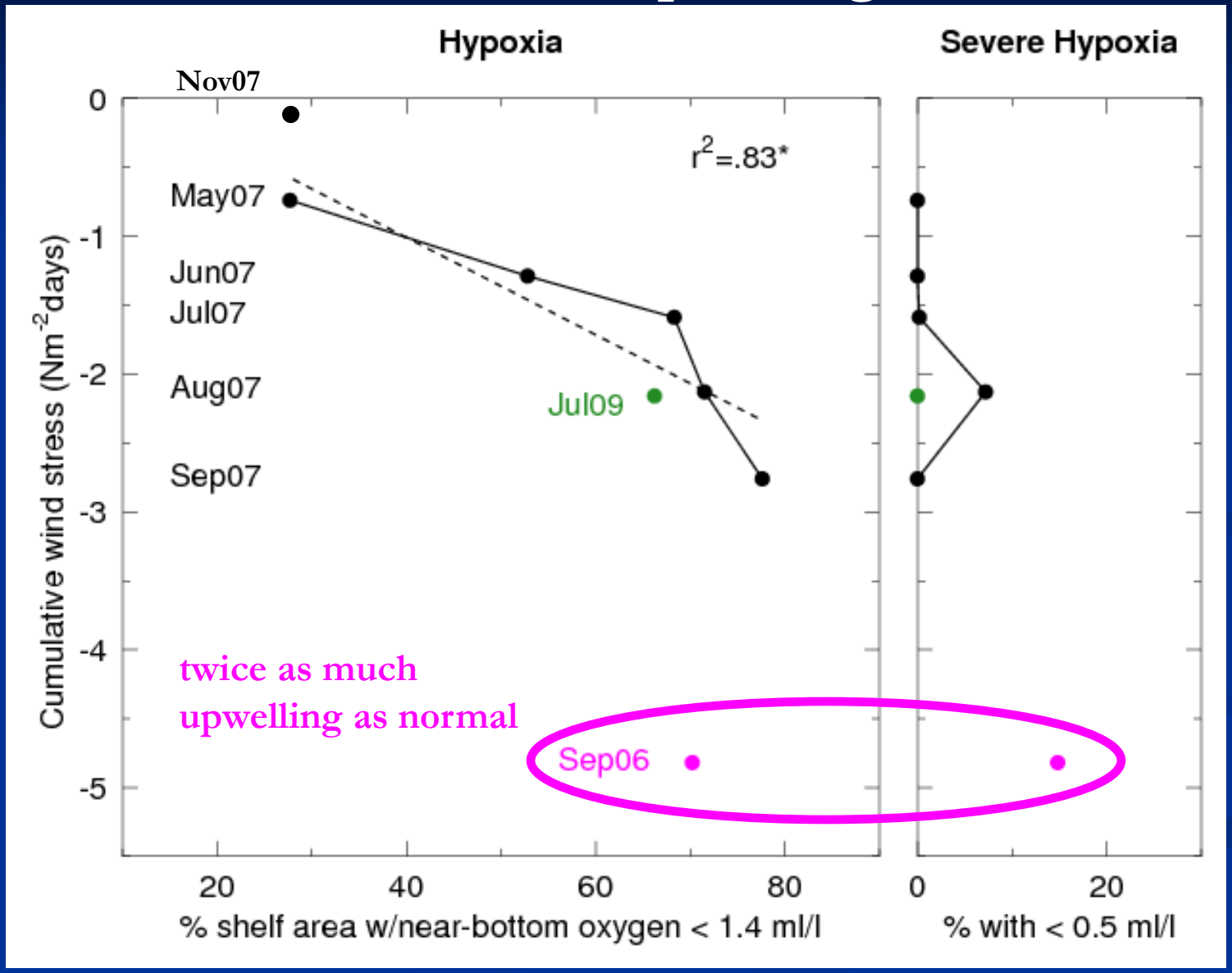


Add up seasonal upwelling



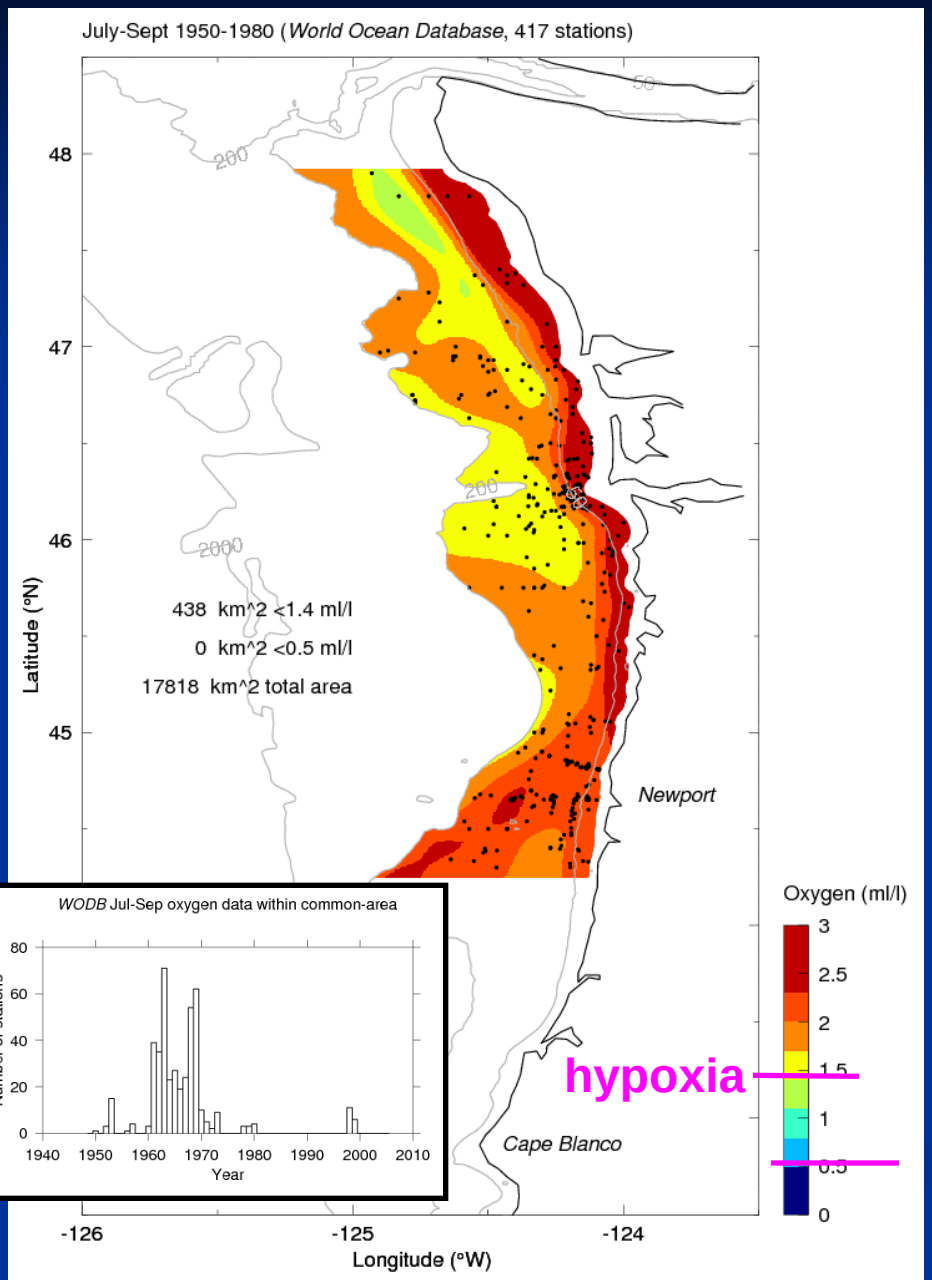
Barth/Pierce (OSU)

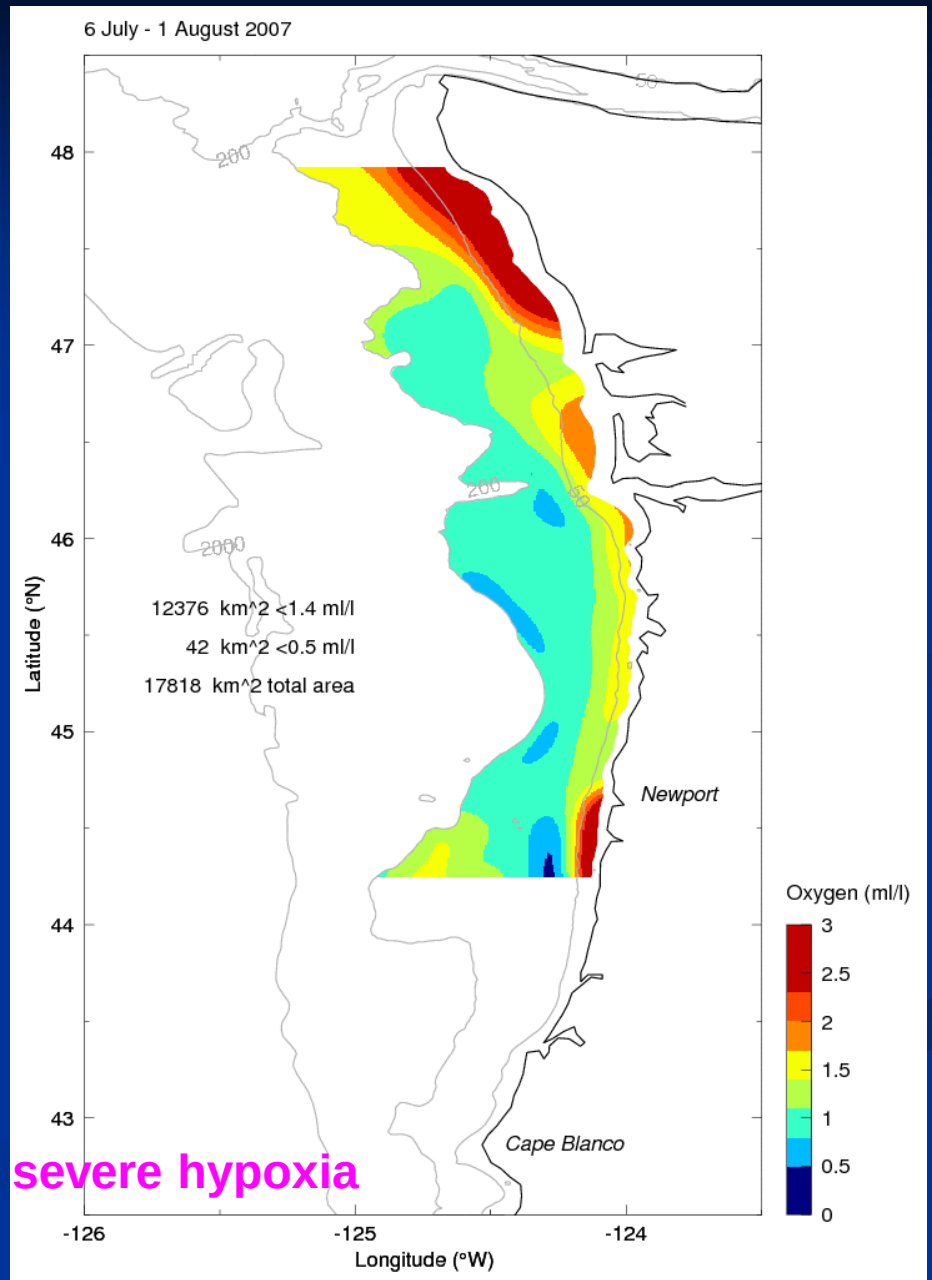
Percent of the shelf covered by near-bottom hypoxia as a function of cumulative upwelling wind stress



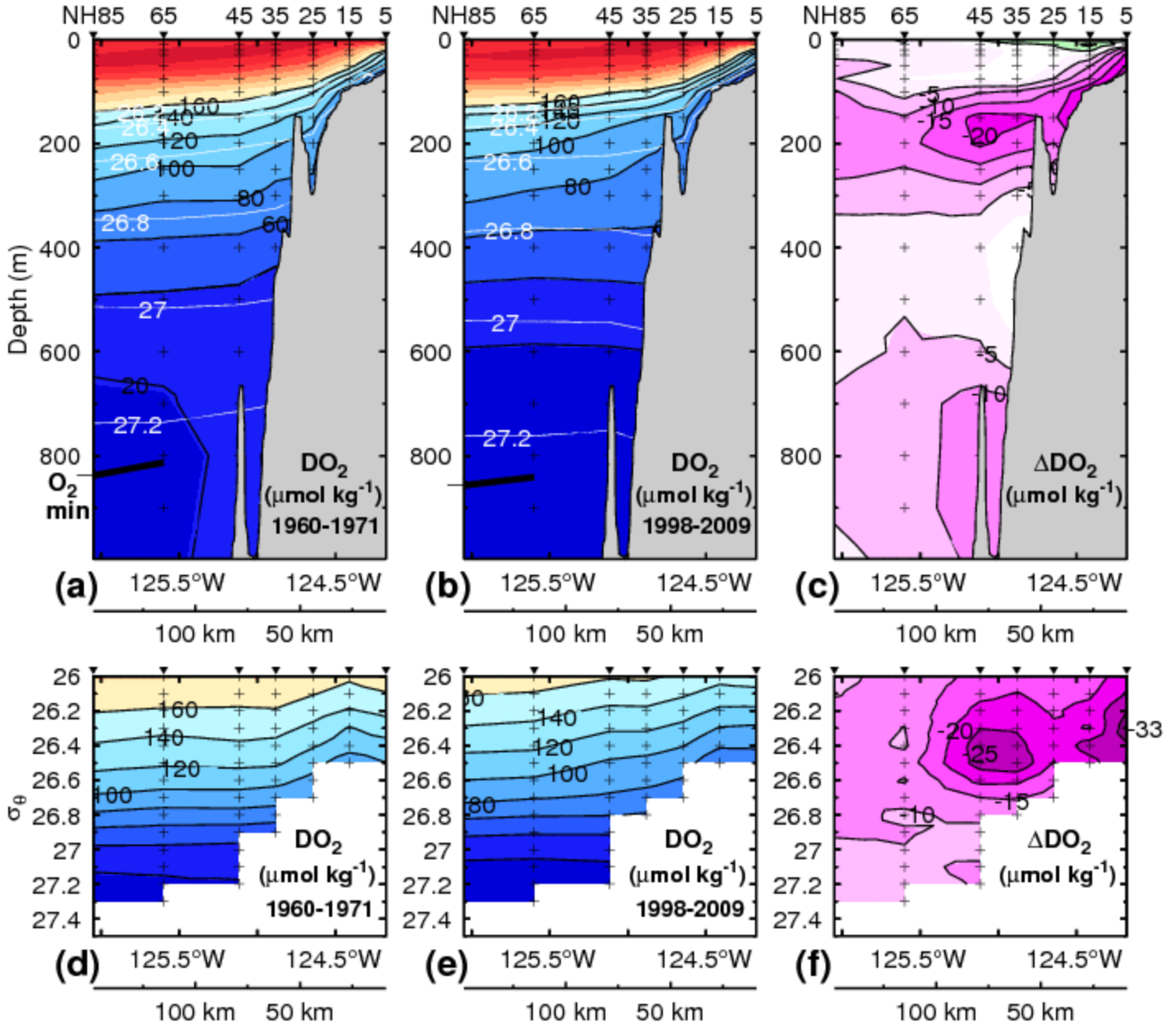
Historical view: Jul-Sep 1950-1980

July 2007



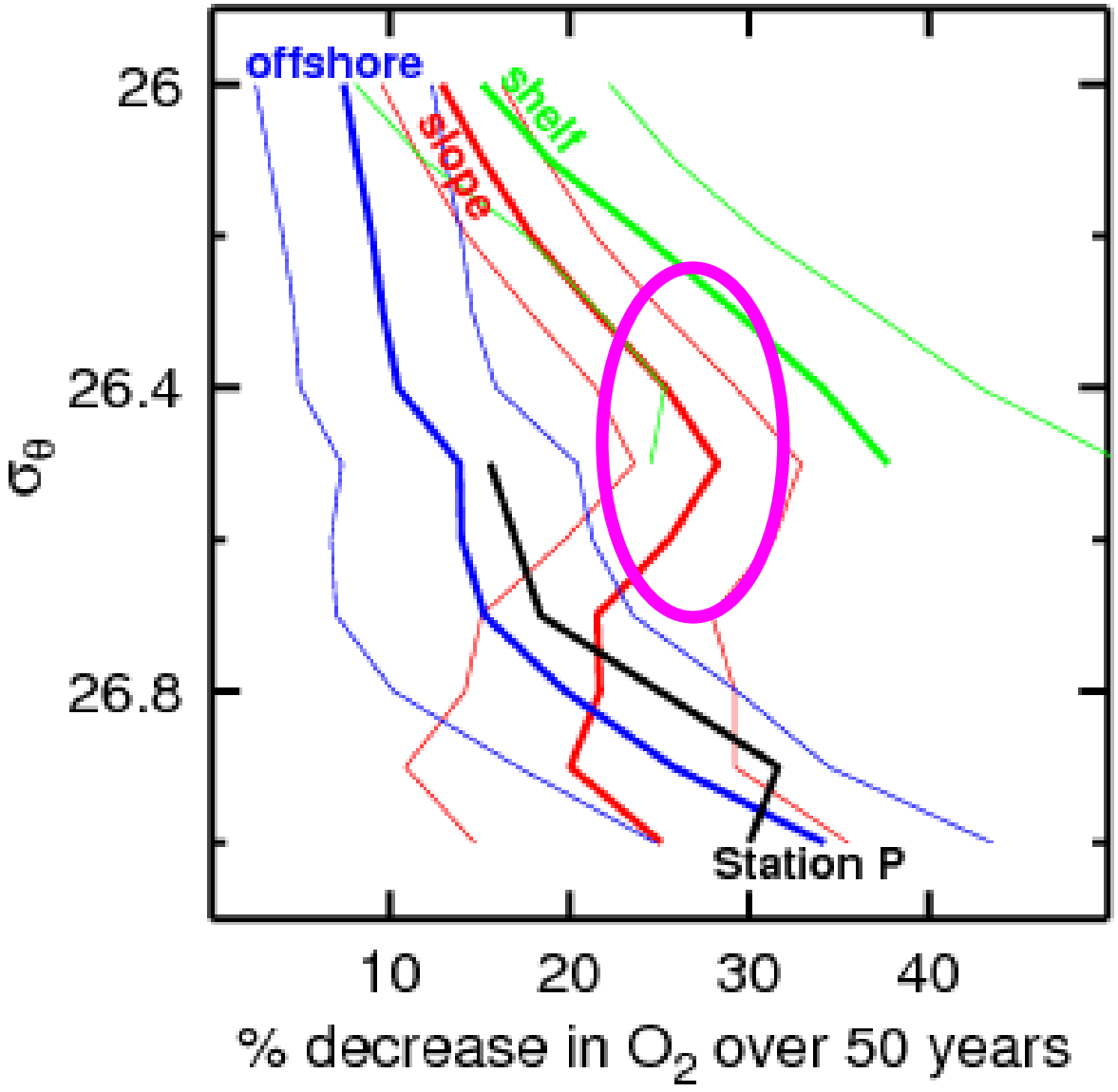


1960-1971 1998-2009 difference



decline of
0.77 µmol kg^{-1} yr^{-1}

Pierce et al.
JPO (2012)

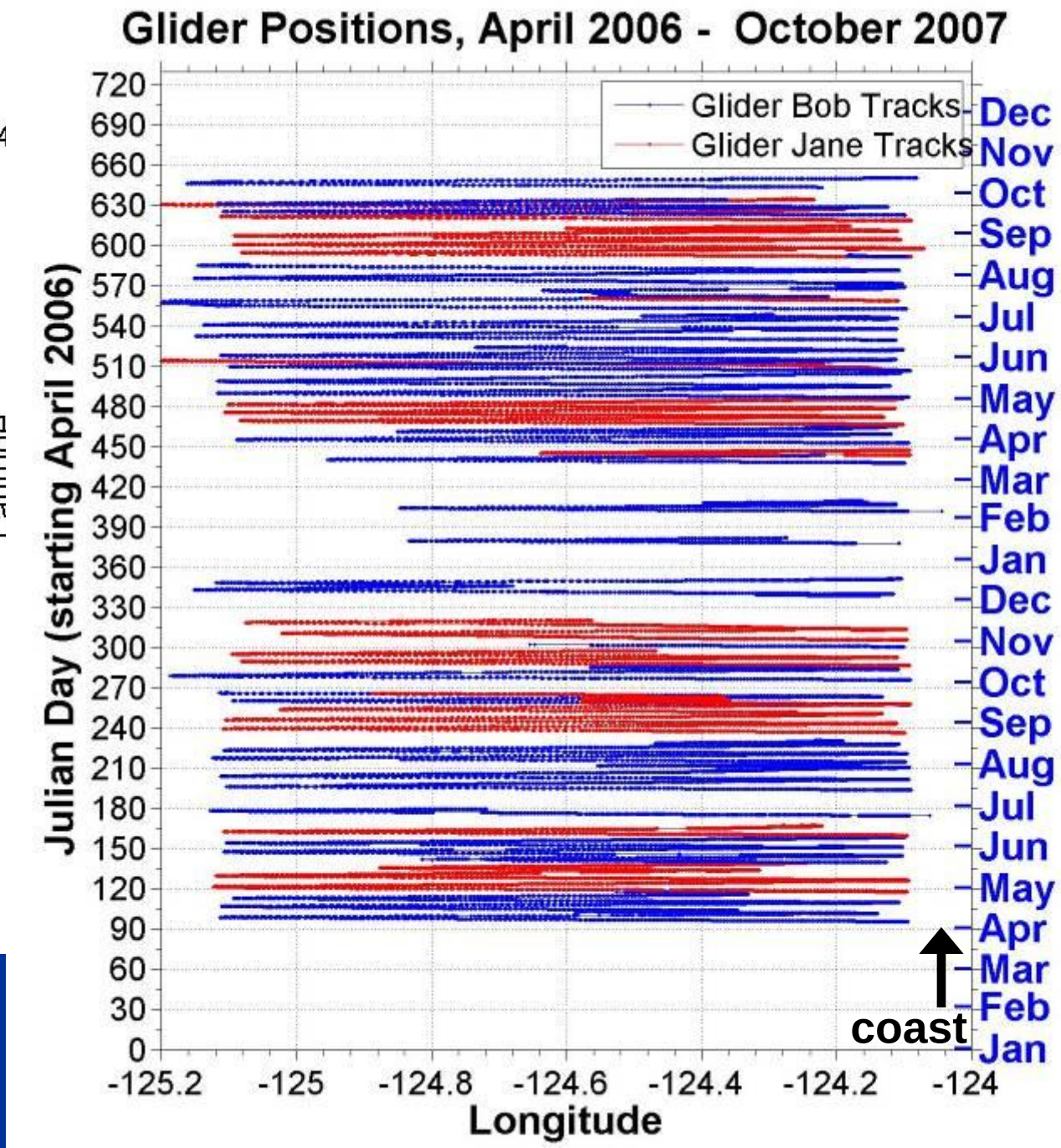


decline of
0.7 ± 0.2 µmol kg^{-1} yr^{-1}
(0.016 ± 0.005 ml l^{-1} yr^{-1})

35 µmol kg^{-1} in 50 years
(0.8 ml l^{-1} in 50 years)

Pierce et al.
JPO (2012)

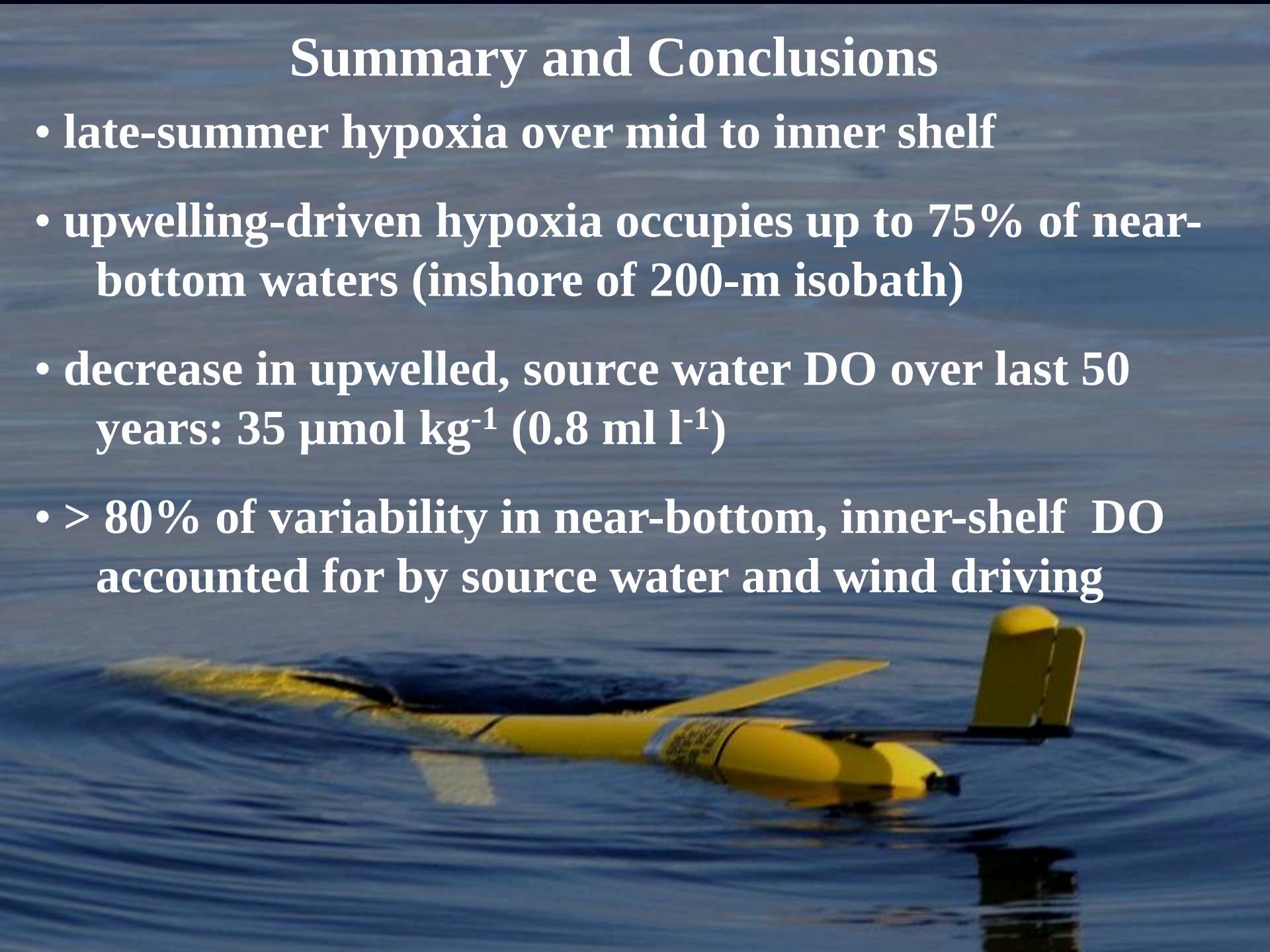
Station P results from Whitney et al., 2007).


Glider Positions, April 2006 - October 2007
Glider Bob Tracks
Glider Jane Tracks
Julian Day (starting April 2006)
720
690
660
630
600
570
540
510
480
450
420
390
360
330
300
270
240
210
180
150
120
90
60
30
0
Dec
Nov
Oct
Sep
Aug
Jul
Jun
May
Apr
Mar
Feb
Jan
Dec
Nov
Oct
Sep
Aug
Jul
Jun
May
Apr
Mar
Feb
Jan
coast
-125.2
-125
-124.8
-124.6
-124.4
-124.2
-124
Longitude


WRC
SLOCUM
ELECTRIC

Summary and Conclusions

- late-summer hypoxia over mid to inner shelf
- upwelling-driven hypoxia occupies up to 75% of near-bottom waters (inshore of 200-m isobath)
- decrease in upwelled, source water DO over last 50 years: 35 µmol kg^{-1} (0.8 ml l^{-1})
- > 80% of variability in near-bottom, inner-shelf DO accounted for by source water and wind driving



Thank you for your attention!

Thanks to the OSU glider group (Kipp, Anatoli, Zen, Justin, Laura, Amanda, Kate, Piero, Chris, Pat, Meghan) and my many OSU colleagues!

Thanks to my Northeast Pacific colleagues who shared oxygen survey data, especially Bill Peterson's group

Cape Meares, Oregon (Photo by Dudley Chelton)