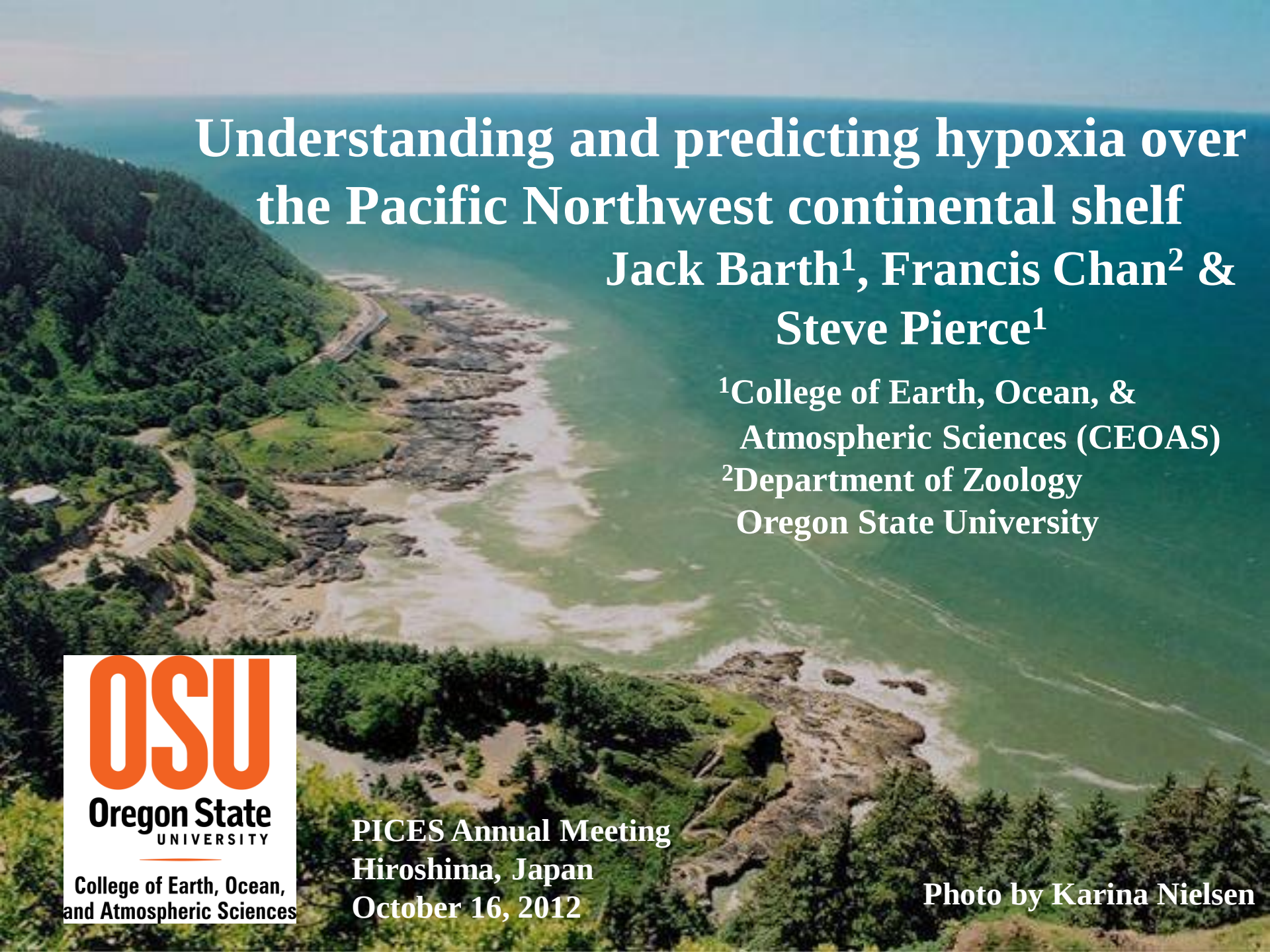

Understanding and predicting hypoxia over the Pacific Northwest continental shelf

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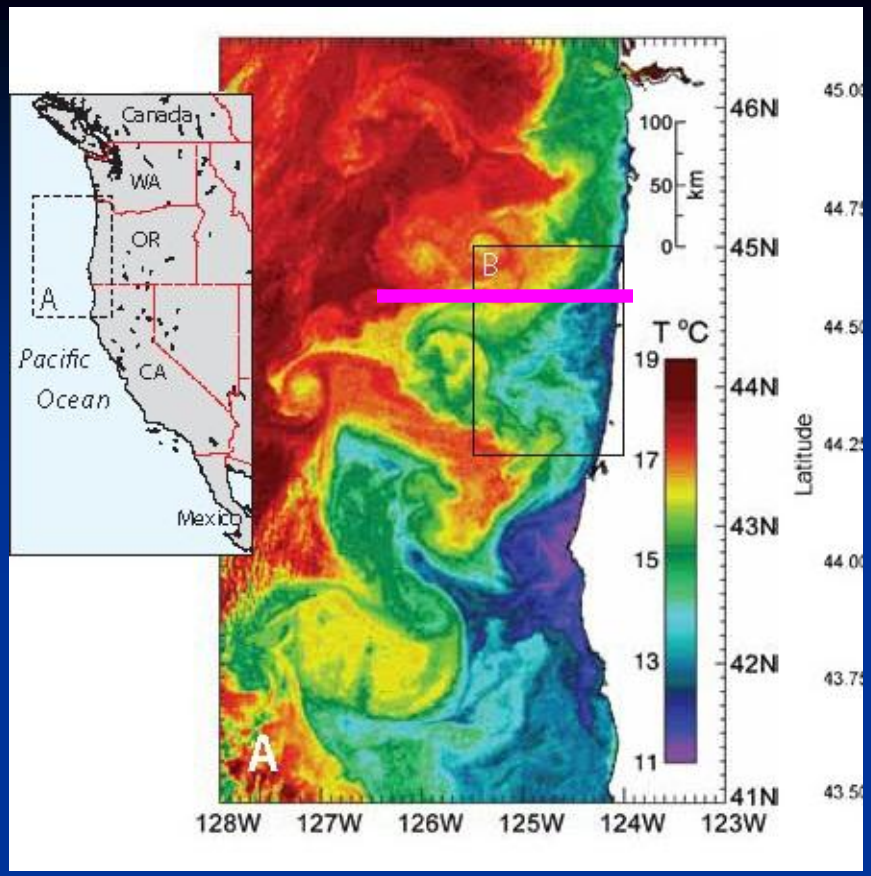
OSU
Oregon State UNIVERSITY
College of Earth, Ocean, and Atmospheric Sciences

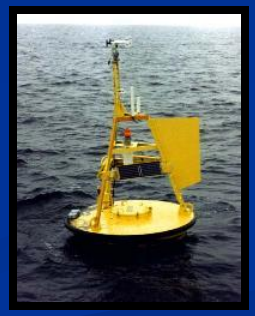
PICES Annual Meeting
Hiroshima, Japan
October 16, 2012

Photo by Karina Nielsen



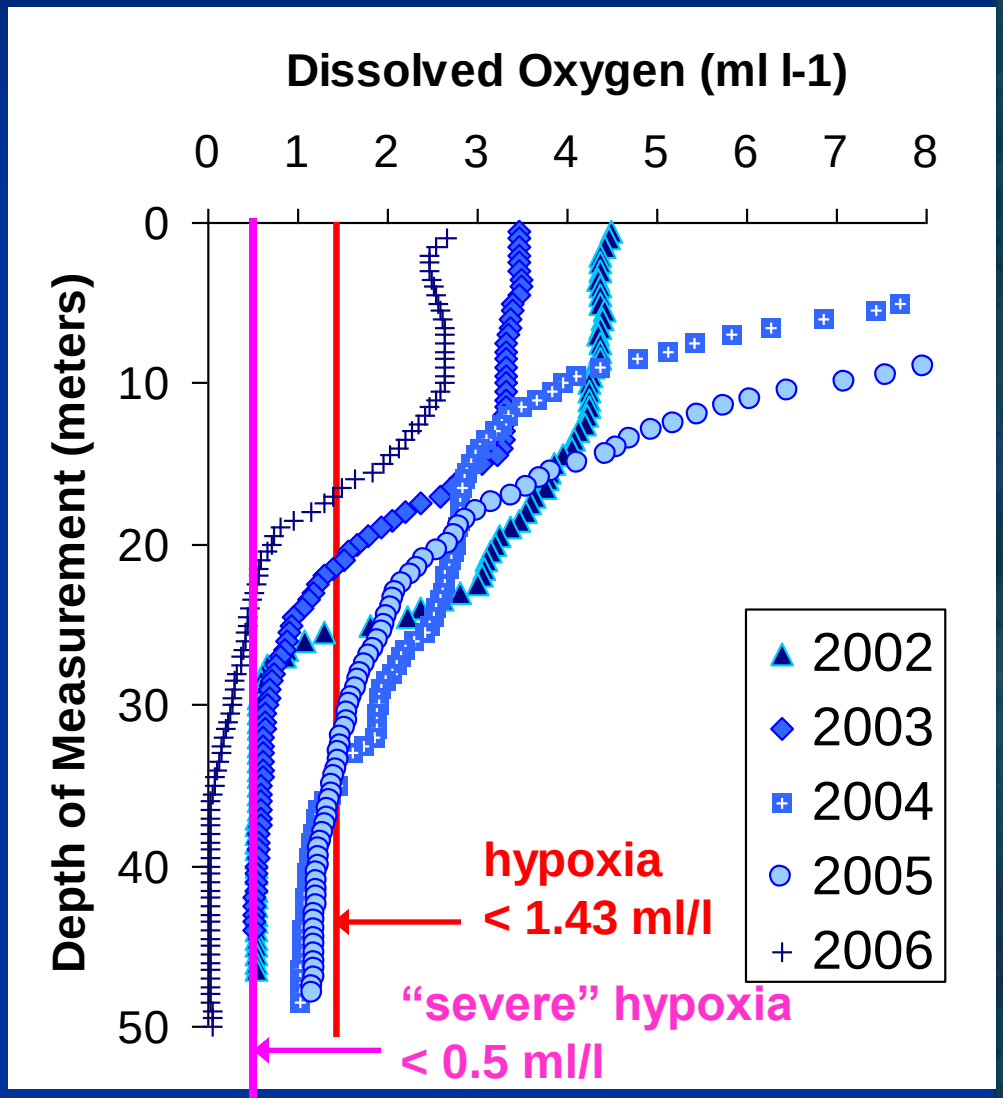
Data from

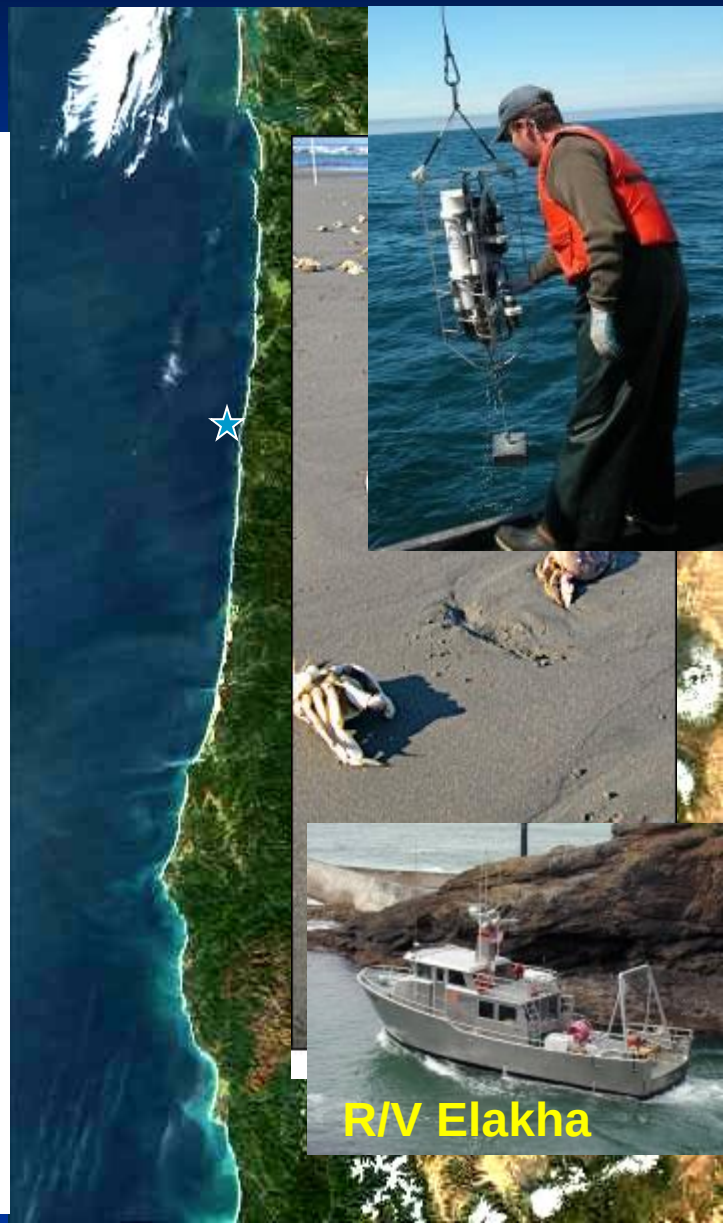
- 53-yr Newport Hydrographic Line
- NOAA NDBC Buoy 46050
- 7 years of glider data
- (moorings, bottom landers, …)



R/V Oceanus 1976–2012

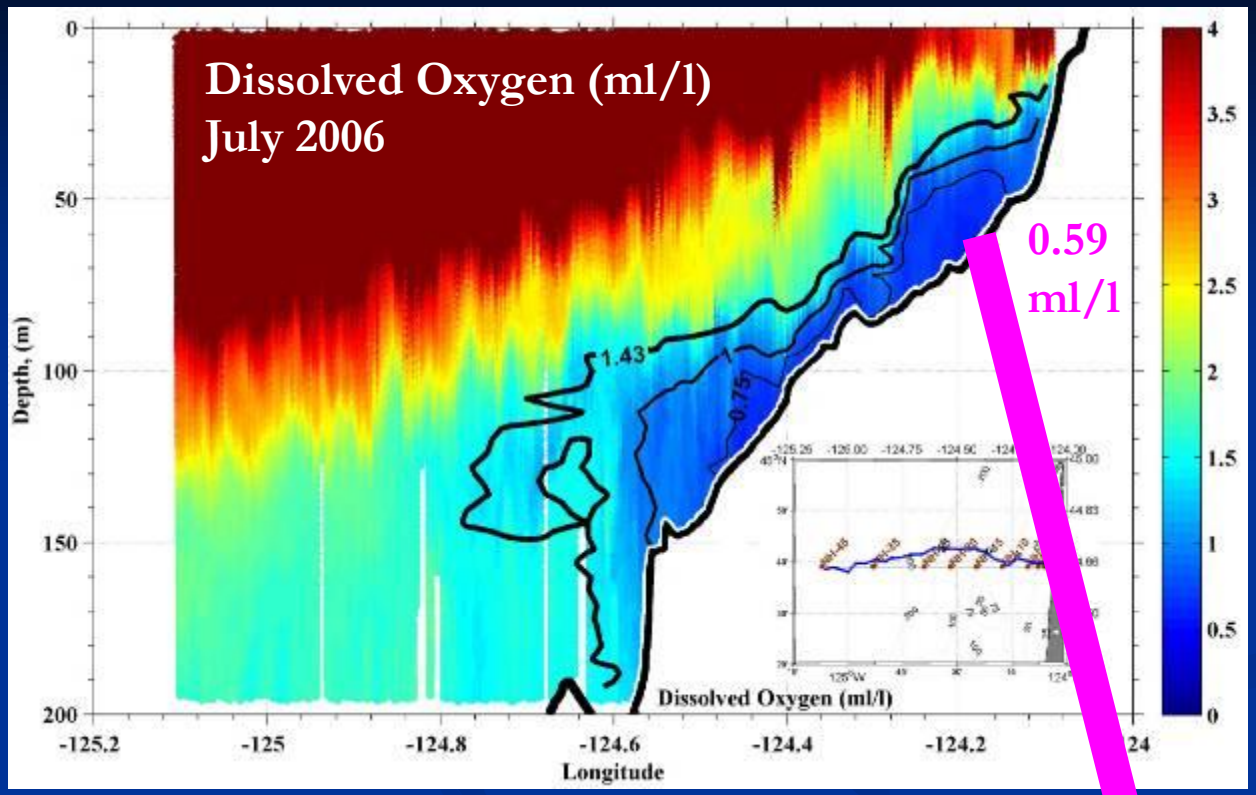
Off Oregon, hypoxia develops on the open continental shelf





Cross-shelf structure from autonomous underwater gliders

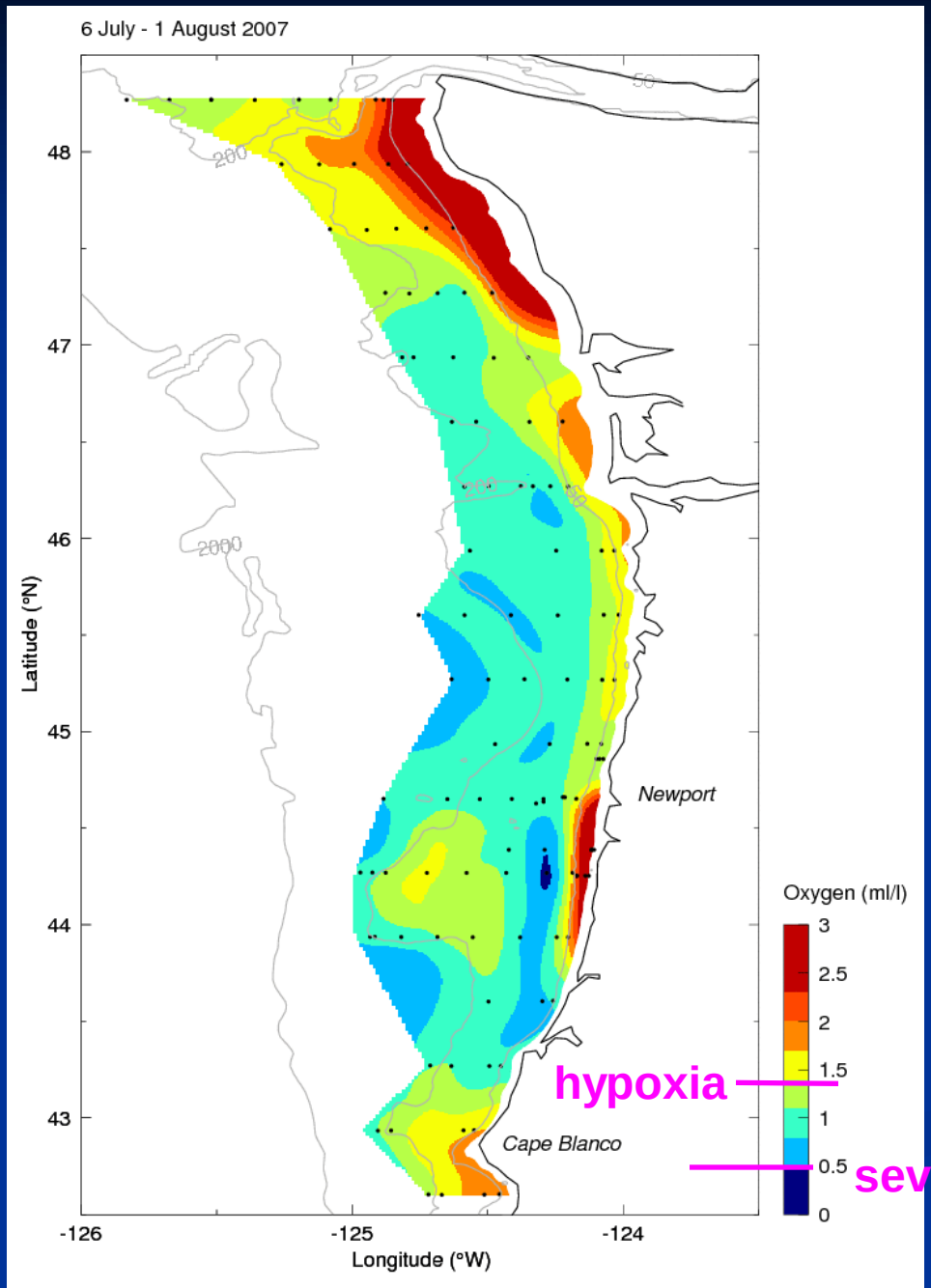
cross-margin transect twice per week since April 2006



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

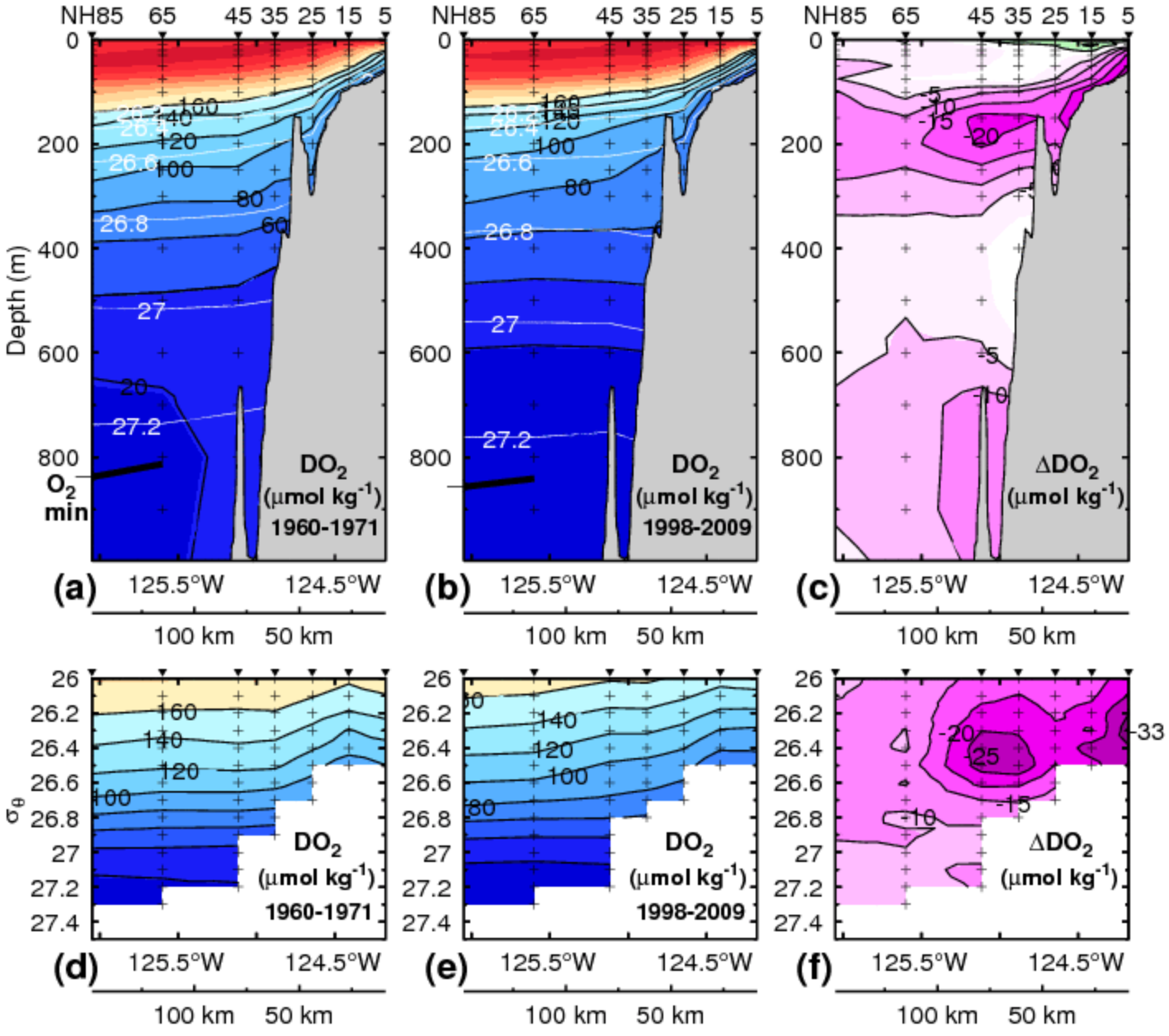
17,800 km^2 < 1.4 ml/l
(inshore of 200-m isobath)

Hypoxic area is slightly less than size of New Jersey, but on par with size of Mississippi River plume hypoxia region

68% of shelf inshore of 200-m isobath is hypoxic

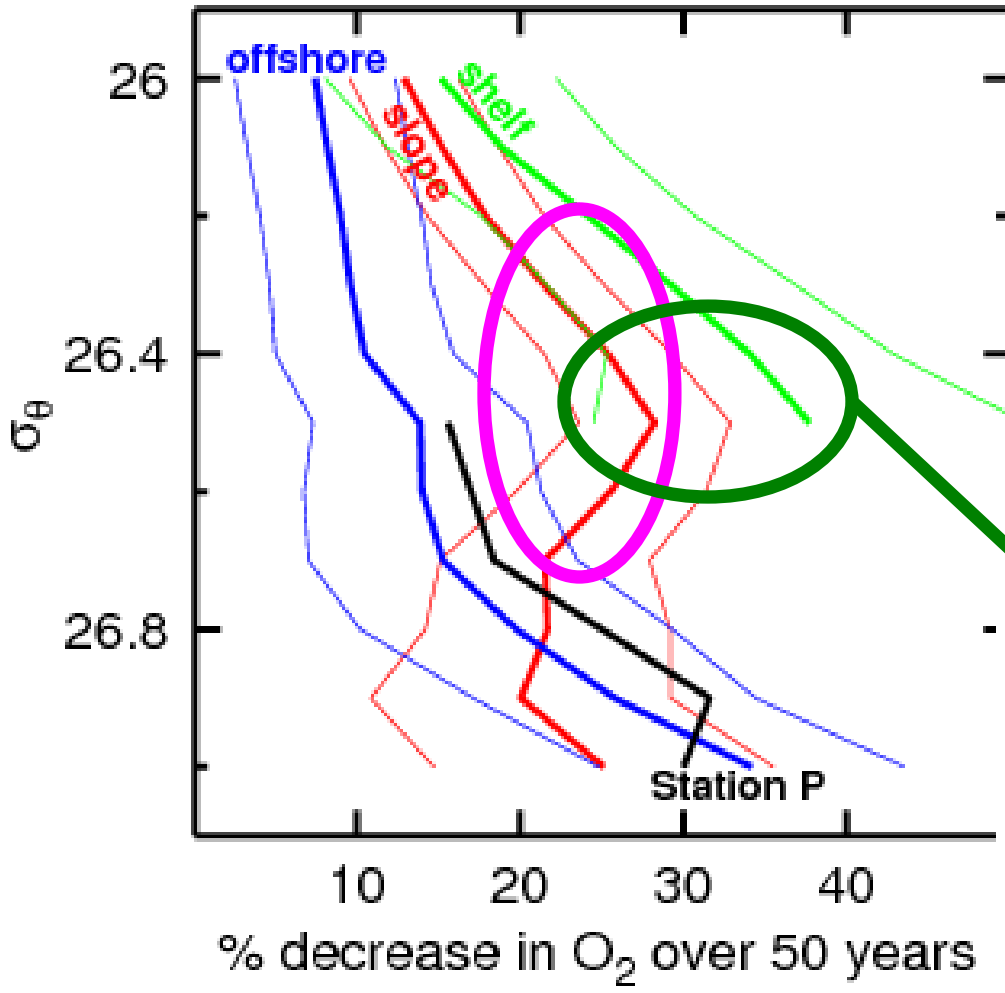
Data from:
- PISCO
- Newport-line glider
- NOAA NWFSC hake survey

1960-1971 1998-2009 difference



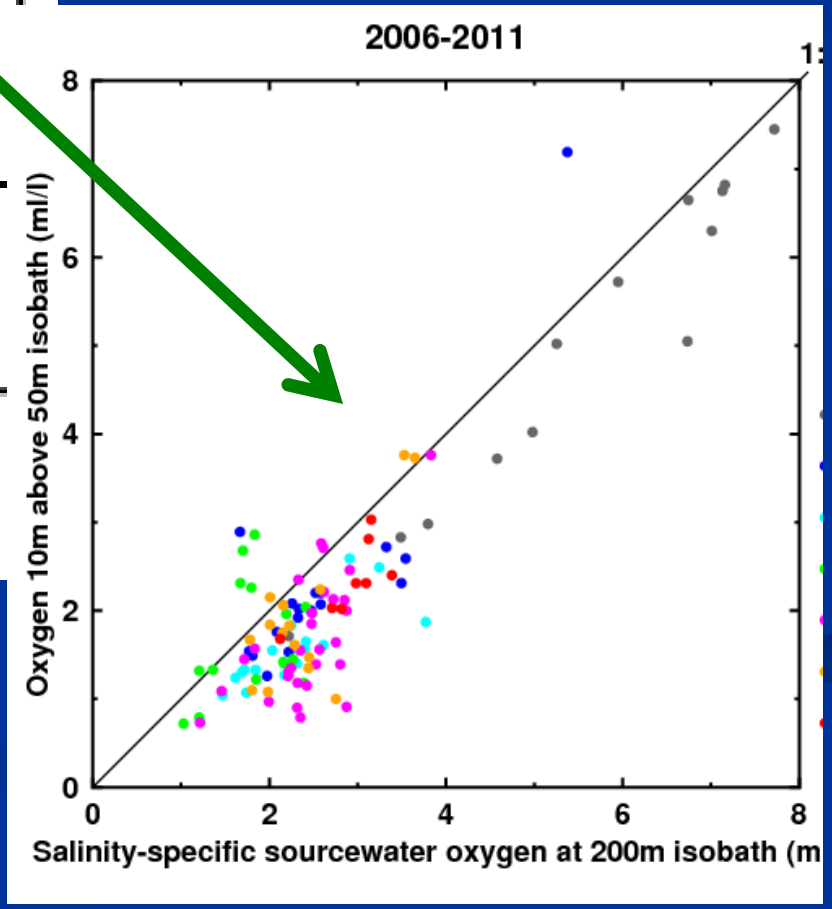
decline of
0.77 µmol kg^{-1} yr^{-1}

Pierce et al.
JPO (2012)

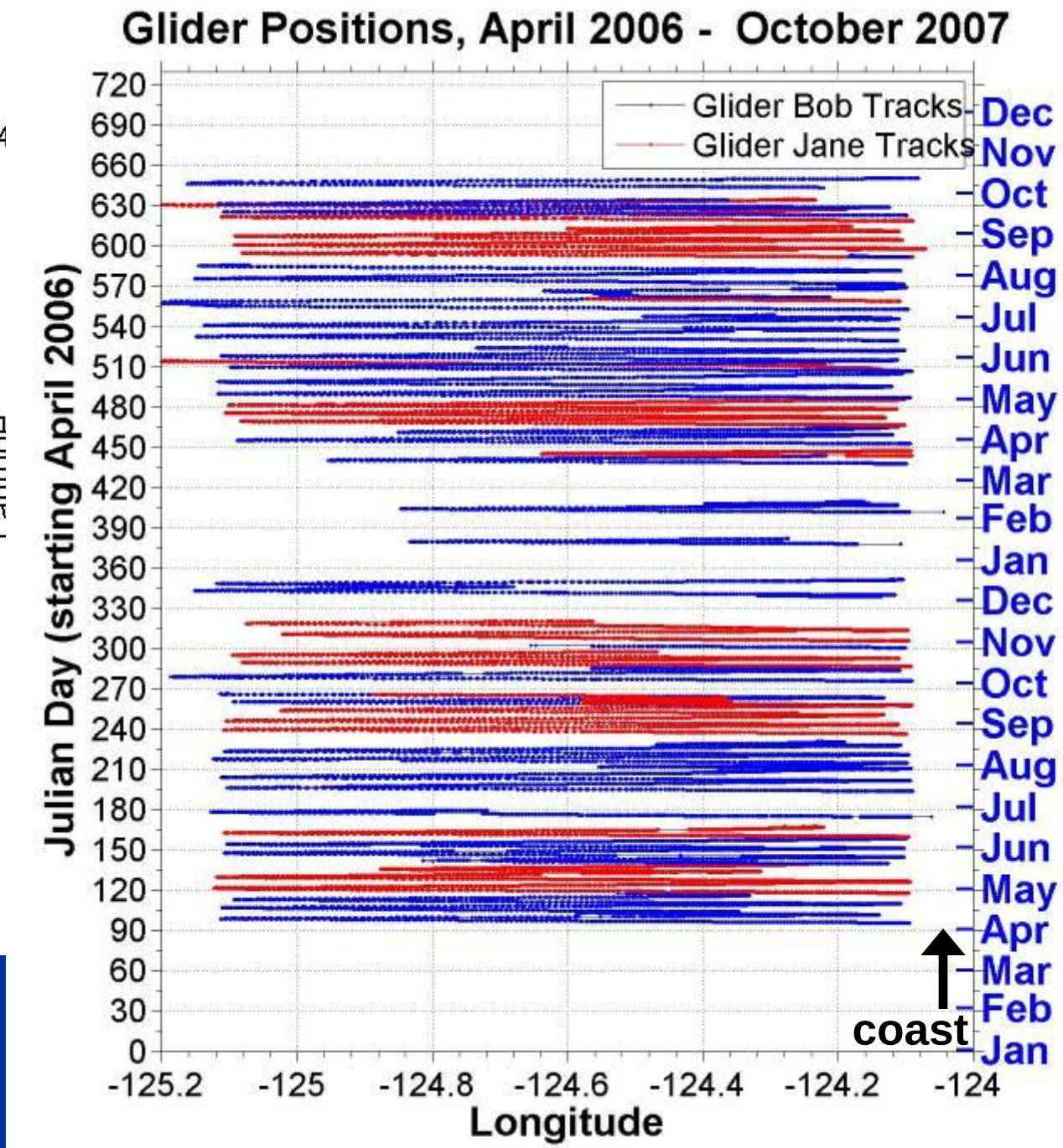


decline of
0.7 ± 0.2 µmol kg^{-1} yr^{-1}
(0.016 ± 0.005 ml l^{-1} yr^{-1})

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

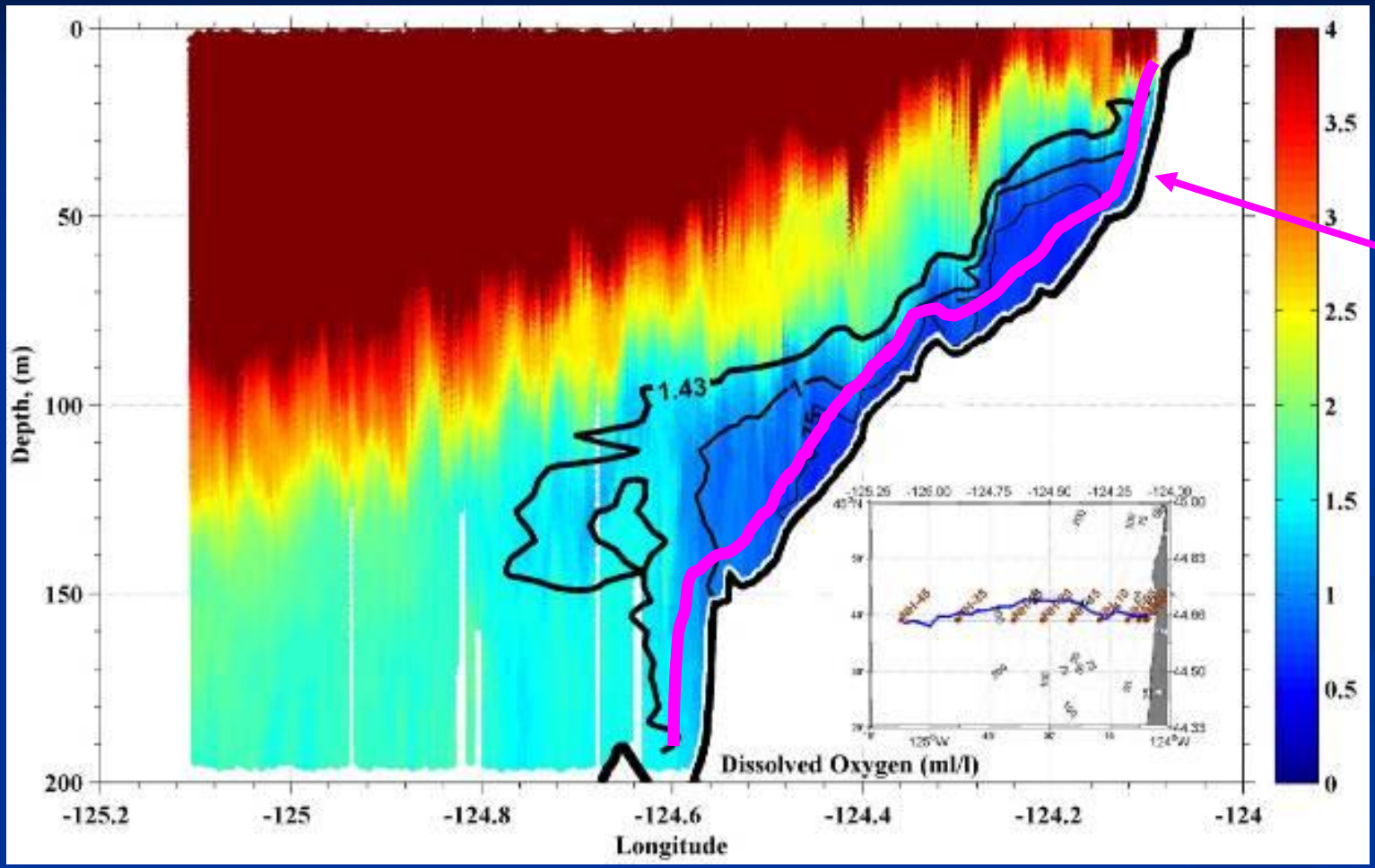


Pierce et al.
JPO (2012)


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

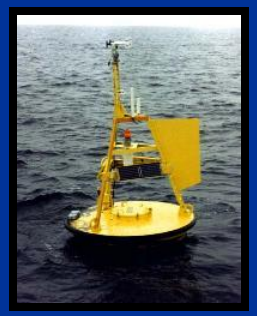
Dissolved Oxygen, July 2006

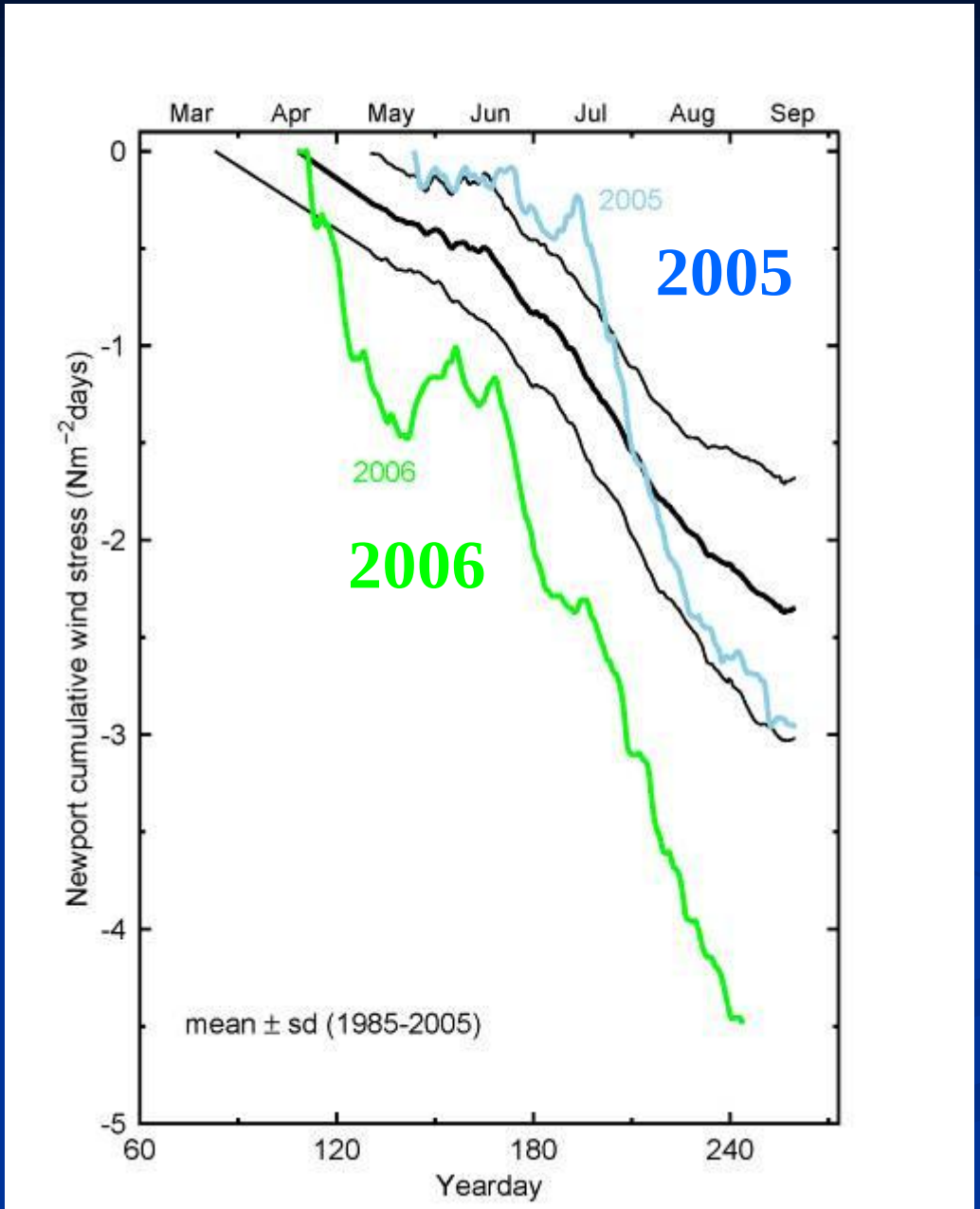


plot DO 10 m above bottom

Upwelling-favorable wind stress

Upwelling favorable

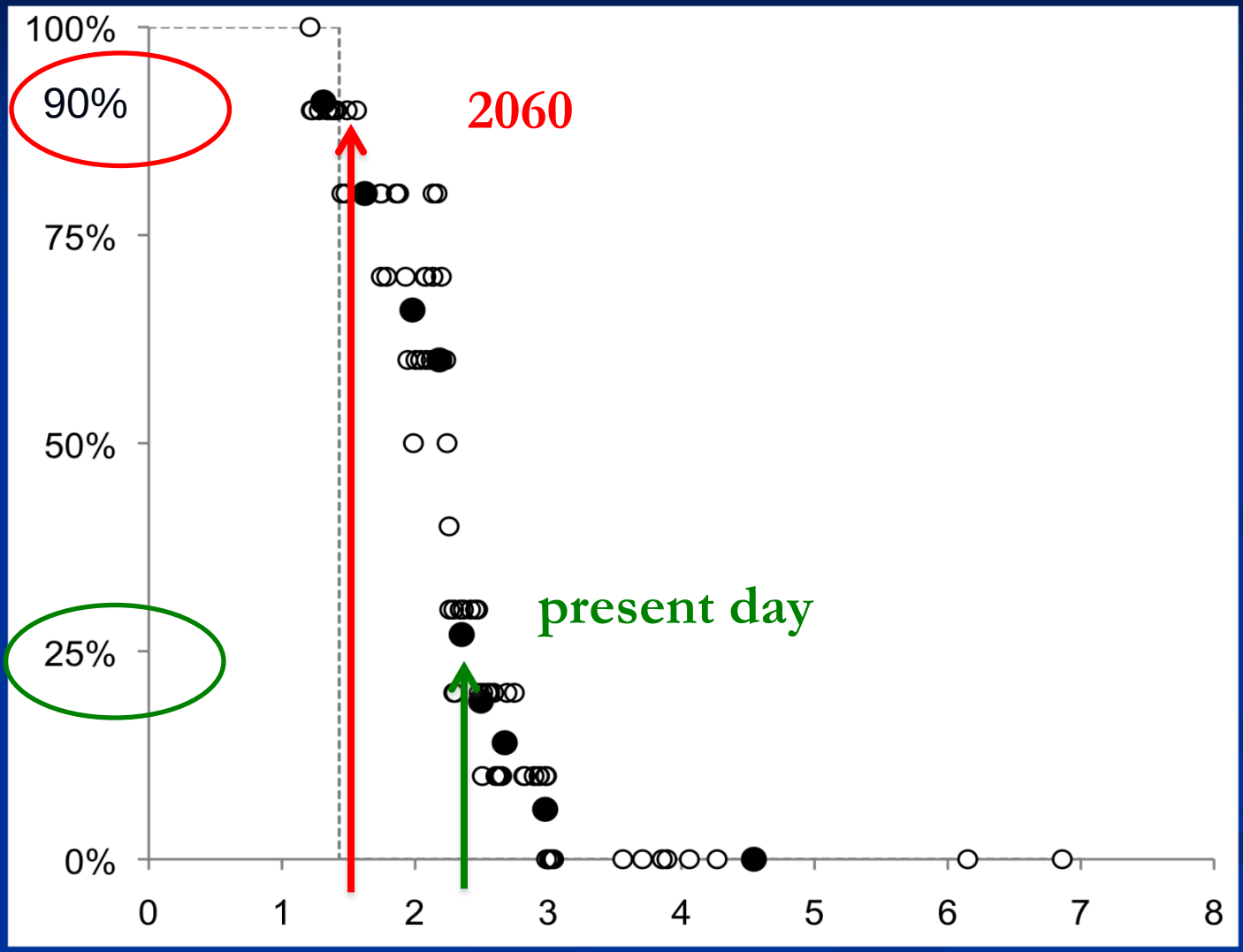




2005 upwelling was delayed by 1-2 months

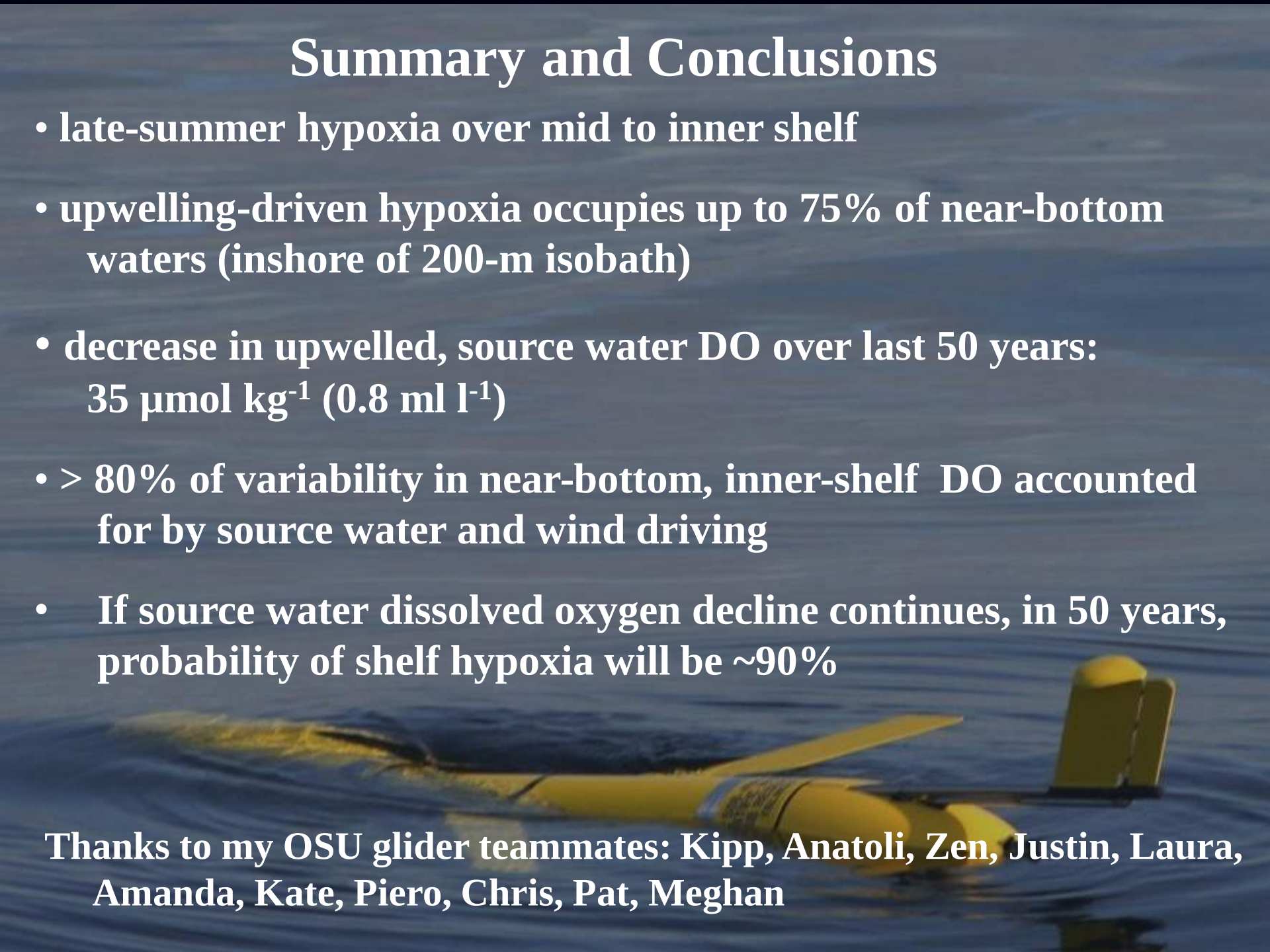
2006 had twice as much upwelling as normal

Consequence of source water DO declines



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
- If source water dissolved oxygen decline continues, in 50 years, probability of shelf hypoxia will be ~90%



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