Understanding and predicting hypoxia over the Pacific Northwest continental shelf

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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 Wecoma 1976-2012
Off Oregon, hypoxia develops on the open continental shelf

![Graph showing dissolved oxygen levels and depth of measurement](graph.png)

**Dissolved Oxygen (ml l⁻¹)**

- Hypoxia: < 1.43 ml/l
- Severe hypoxia: < 0.5 ml/l

**Depth of Measurement (meters)**

R/V Elakha
Cross-shelf structure from autonomous underwater gliders

cross-margin transect twice per week since April 2006

Dissolved Oxygen (ml/l) July 2006

0.59 ml/l

temperature, salinity, pressure
dissolved oxygen
chlorophyll fluorescence
colored organic matter fluorescence
light backscatter
velocity (depth-averaged, shear)
Near-bottom hypoxia over the PNW continental shelf

July 2007

17,800 km² < 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
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)
Dissolved Oxygen, July 2006

plot DO 10 m above bottom
Upwelling-favorable wind stress

2005 upwelling was delayed by 1-2 months

2006 had twice as much upwelling as normal
Consequence of source water DO declines

Source water dissolved oxygen (ml l⁻¹)
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%

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