An Oregon Primer on Ocean Acidification and Hypoxia Science

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Why should Oregon be so special? Low dissolved O$_2$ and high CO$_2$ is hardly rare in the ocean (down deep).
But we see much higher (and more variable) pCO2 than most areas of the ocean.

Coastal Ocean: Oregon Nearshore

Open Ocean: Gulf of Alaska

Station Papa data from PMEL
We have upwelling!

Gewin 2011 Nature
Still, shouldn't low DO and high CO₂ be natural?
But the system has changed...

Dissolved oxygen (ml l\(^{-1}\))

1950 to 1999

Canonical hypoxia threshold

Inner/Mid-Shelf

Oxygen Minimum Zone (OMZ)

Chan et al. Science 2008
But the system has changed...

Dissolved oxygen (ml l$^{-1}$)

- 1950 to 1999
- 2000 to 2005

Inner/Mid-Shelf

Oxygen Minimum Zone (OMZ)
But the system has changed...
We are facing new challenges from global “Ocean Deoxygenation”
The ocean has absorbed ~¼ of our carbon emissions.

Latest CO₂ reading
January 23, 2018

408.47 ppm

Carbon dioxide concentration at Mauna Loa Observatory

7th graders
“385 ppm kids”
CO₂ uptake has measurably changed ocean chemistry.

The ocean is acidifying at the fastest rate in 300 million years.

Marine life are being impacted today.

Bigger changes are yet to come.

modified from Feely et al. 2008
But, isn’t high CO$_2$ natural for upwelling systems?

Given dissolved O$_2$, we can calculate what CO$_2$ should be
Is this natural or is this OA?

* Using a pre-industrial (280 ppm) atmosphere as a starting point
Is this natural or is this OA?

Observation $pCO_2$ (atm)

DO ($\mu$mol kg$^{-1}$)

but when we compare to what we actually measure, we have more $CO_2$ than we should
Is this natural or is this OA?

Estimated $pCO_2$ (μatm)

*numbers only add up if we add CO$_2$ from a 340ppm (~1980) atmosphere

hypoxia

Anthropogenic Changes
What will the near future hold?

*When we fast forward and see what a 400ppm atmosphere starting point looks like (by ~2050)*...
Importance of Oregon leadership in OAH science and partnerships

You just heard from Alan about OA collaborations...

*crab fishery data courtesy Al Pazar

ODFW ROV Surveys
Just in terms of tracking OAH...

Burke Hales (OSU) and the “Burke-o-lator”

State of the art ocean observing array

Long-term oceanography time-series

Dissolved Oxygen (ml*l⁻¹)

2009-2017 mean, s.d.
Citizen scientist collaborations are monitoring OA exposure across all 5 marine reserves.
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- These changes are driven directly by CO$_2$ uptake (OA) and indirectly by changes to the climate system (hypoxia)
- Our state waters are already being impacted and larger, unavoidable changes are ahead
- At stake is an ever growing list of marine life that we now know to be harmed by OA and/or hypoxia
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• Oregon is on the frontlines of global ocean chemistry changes

• These changes are driven directly by CO$_2$ uptake (OA) and indirectly by changes to the climate system (hypoxia)

• Our state waters are already being impacted and larger, unavoidable changes are ahead

• At stake is an ever growing list of marine life that we now know to be harmed by OA and/or hypoxia

• Oregon’s leadership in OAH science and partnerships are essential not only for our state but the region and the nation in being prepared to confront the changes ahead