Humboldt Ocean Carbon Observatory & Bay-wide Eelgrass Monitoring

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North Coast Water Quality Control Board

8 March 2017

Sea Grant California

HUMBOLDT STATE UNIVERSITY

OCEAN PROTECTION COUNCIL

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- Terry Sawyer (Hog Island Oyster Company)
- Joe Tyburczy (California Sea Grant)
- Stephen Kullmann (Wiyot Tribe)
- James Ray (CDFW)
- Kyle Weis (HSU)
- Brian Tissot (HSU)
- Eric Bjorkstedt (NOAA SWFSC/ HSU)

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Jennifer Phillips

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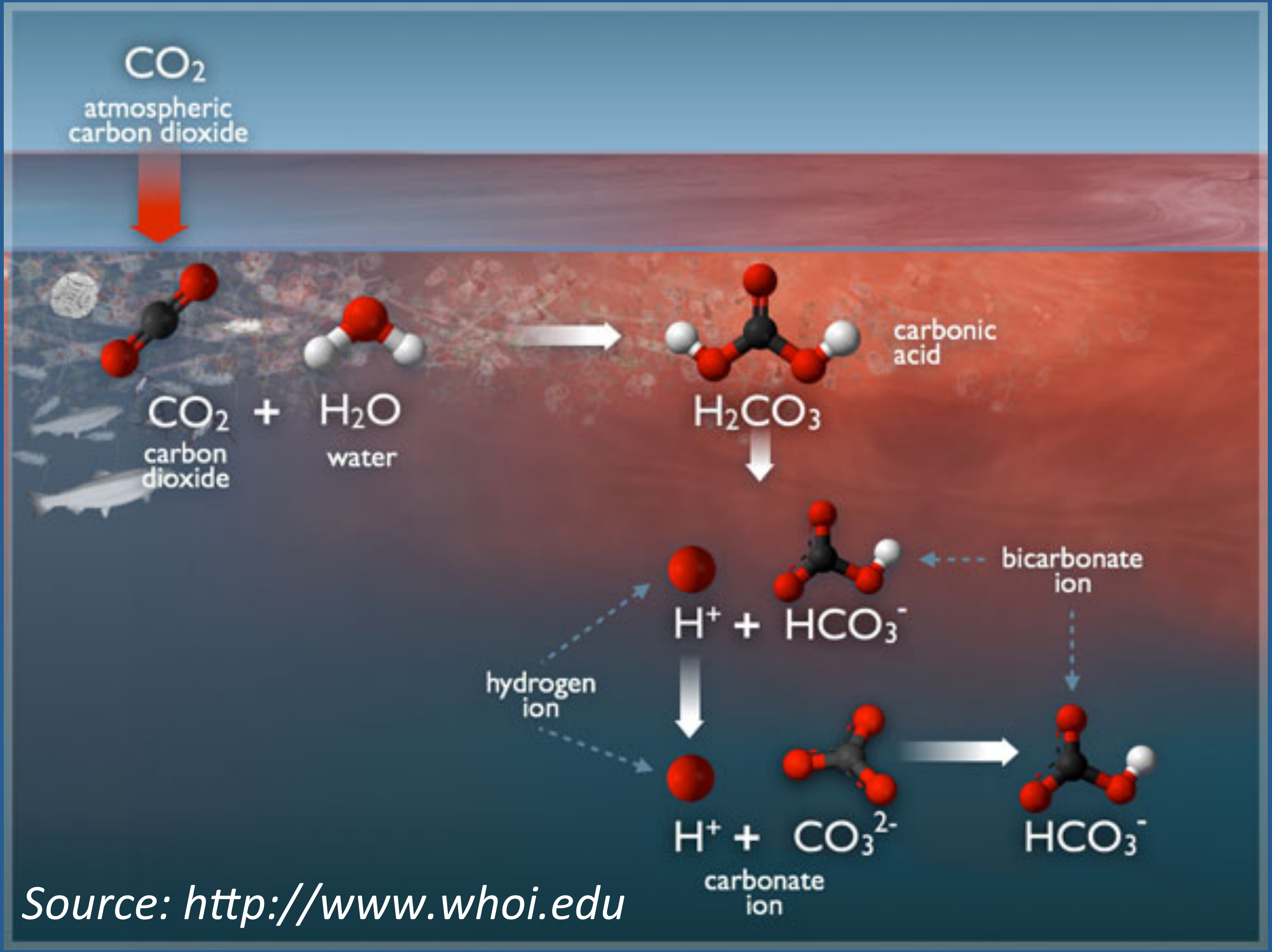
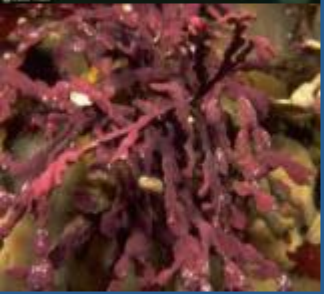


Higher CO_2 → Higher Carbonic Acid (H_2CO_3) →
Higher [H+] (Lower pH) & Lower [CO_3^{2-}]

Result: calcium carbonate dissolves → hard to build and maintain calcified parts

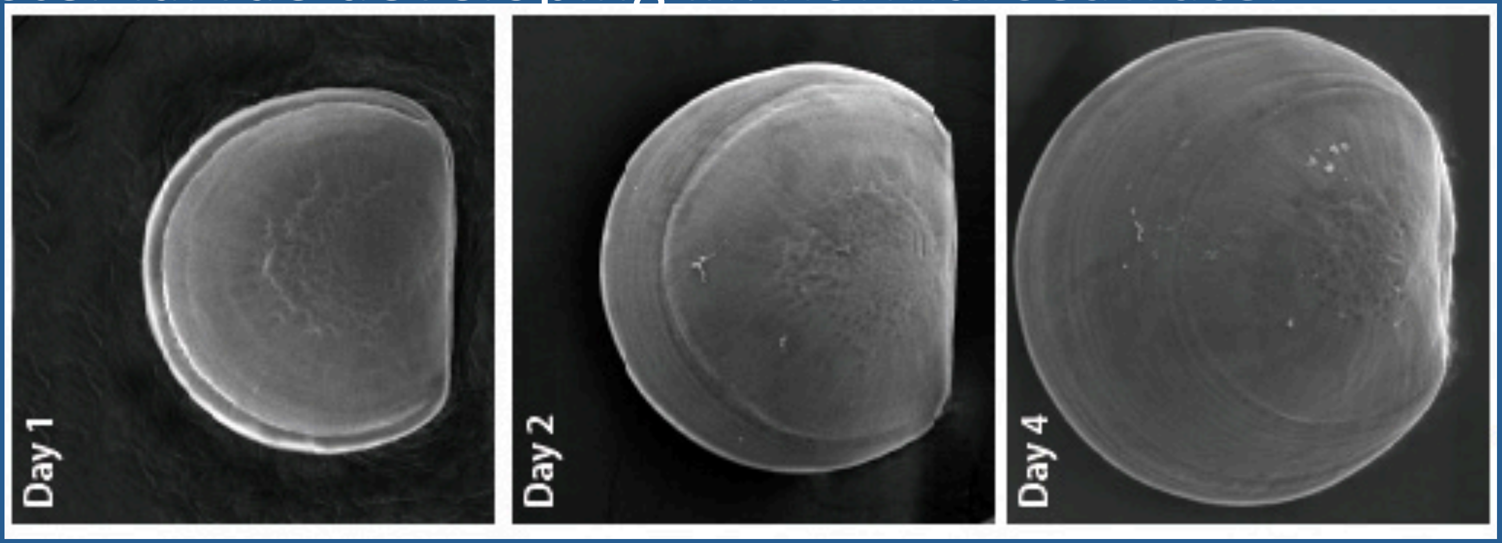




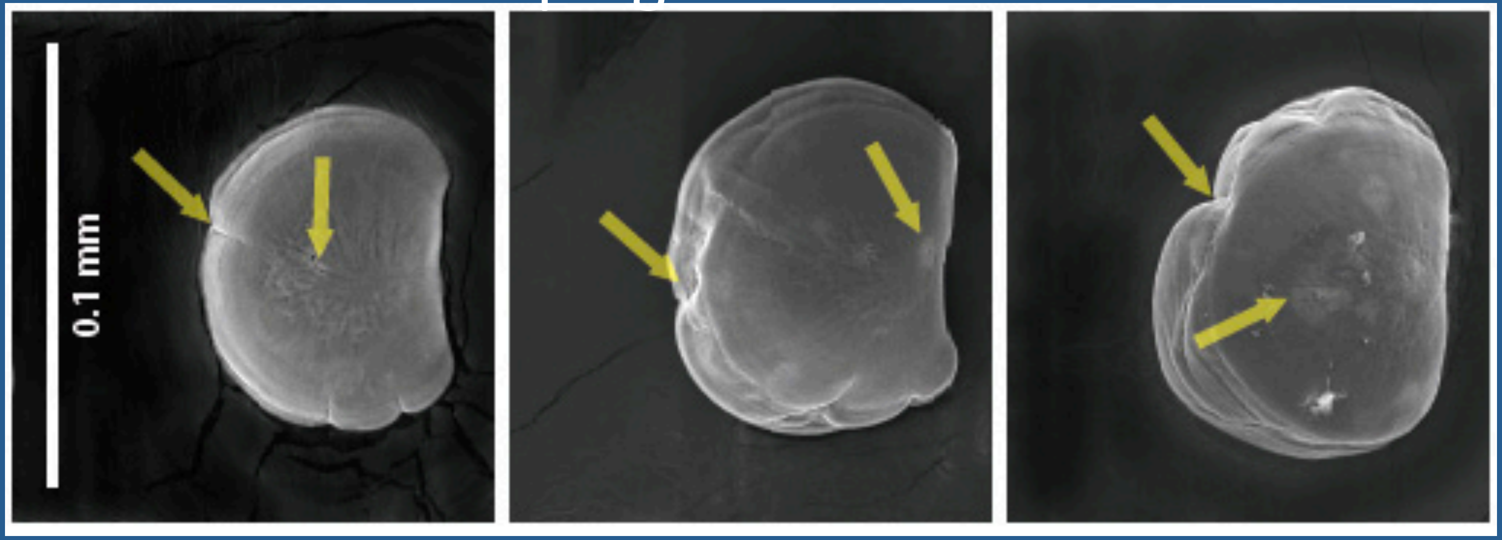


Organism		Calcium carbonate parts
Coccolithophores	→	Plates (coccoliths)
Stony corals	→	Coral skeleton
Sea urchins	→	Spines & test
Pteropods	→	Shell
Coralline algae	→	Fronds

Oyster larvae developing in: normal seawater

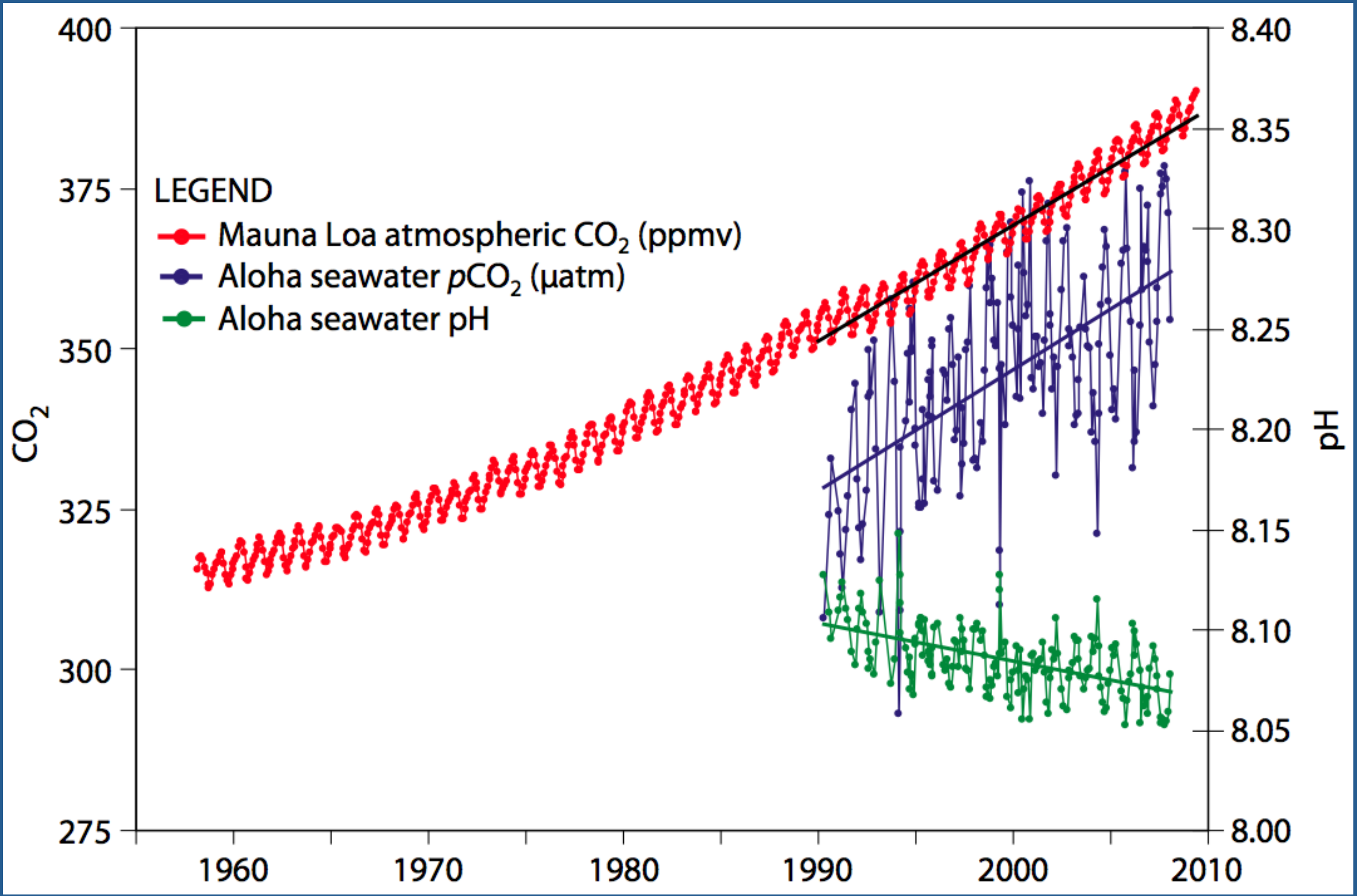


Oyster larvae developing in: acidified seawater



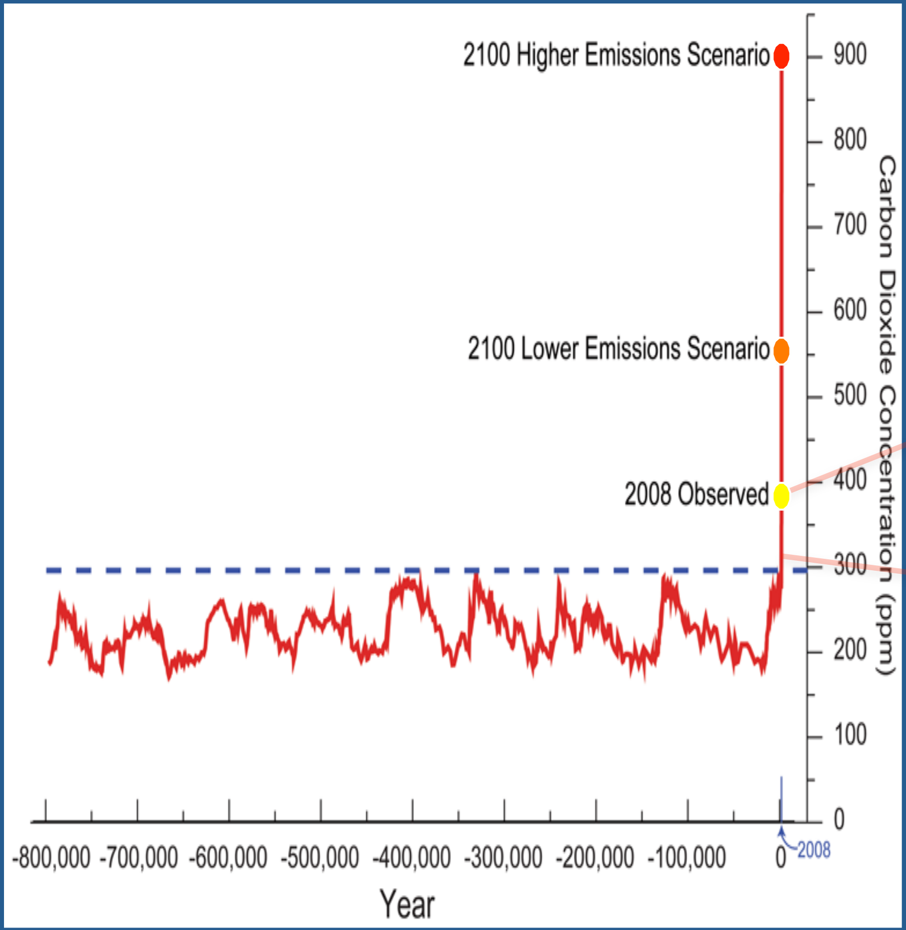
Elizabeth Brunner & George Waldbusser, Oregon State University

The chemistry behind ocean acidification

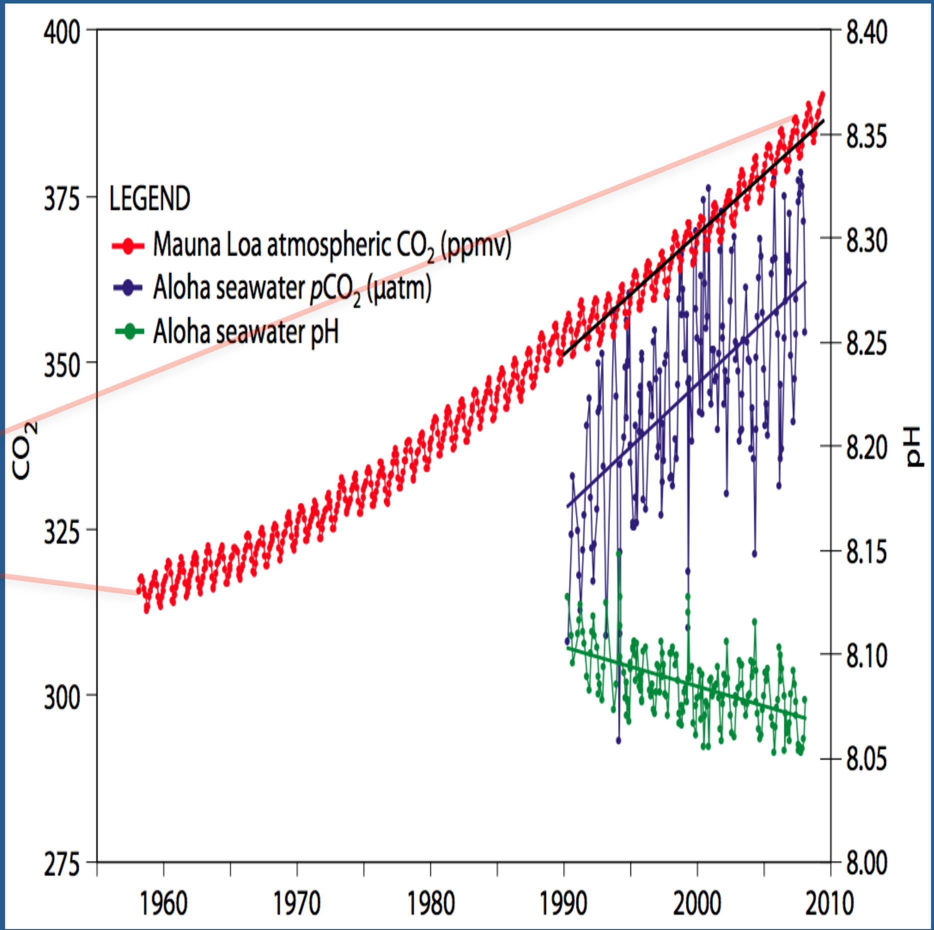


Feely, Doney & Cooley (2009) Oceanography 22(4) p. 38 Fig. 1.

The chemistry behind ocean acidification



U.S. Global Change Research Program, Global Climate Change Impacts in the United States (2009)



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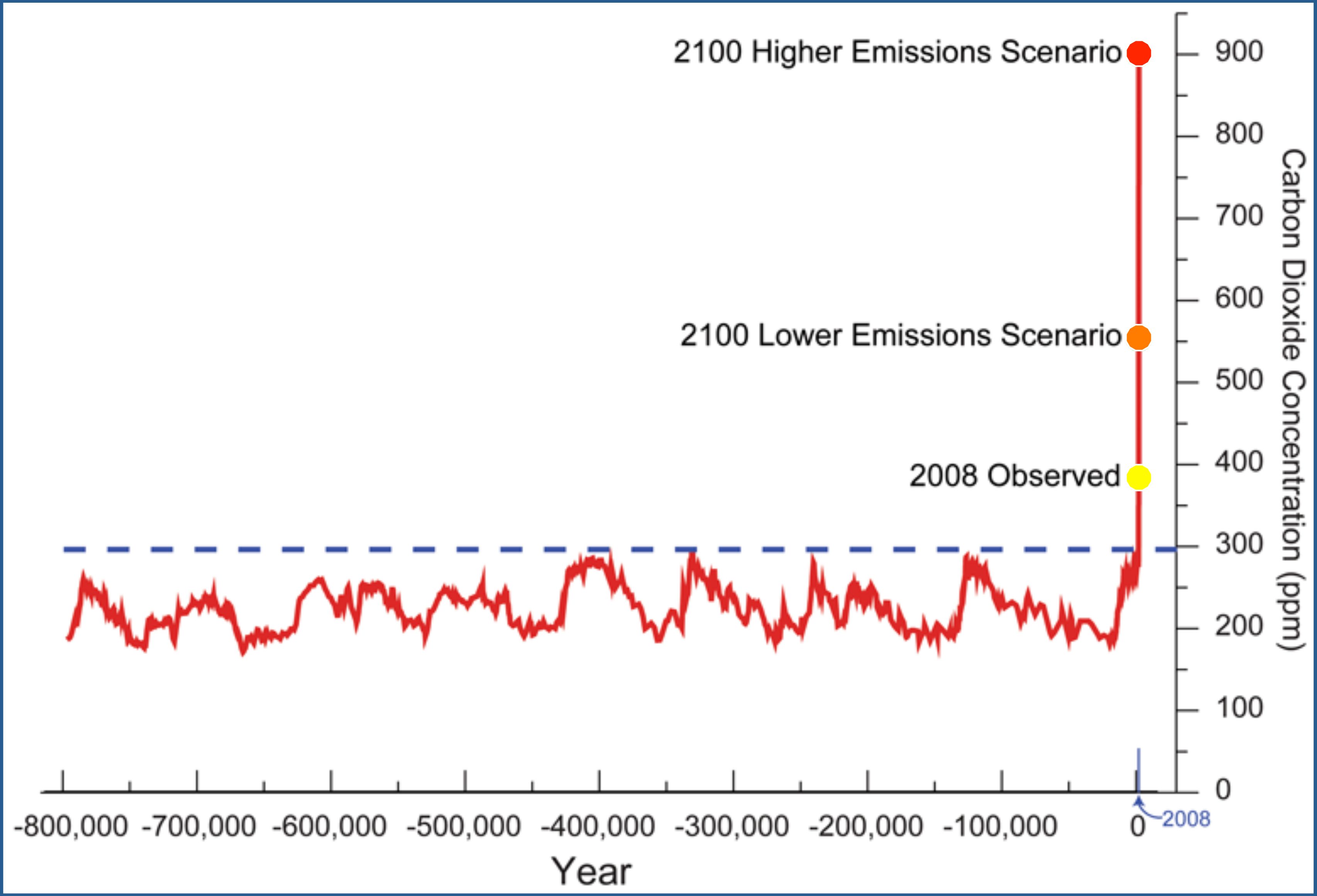

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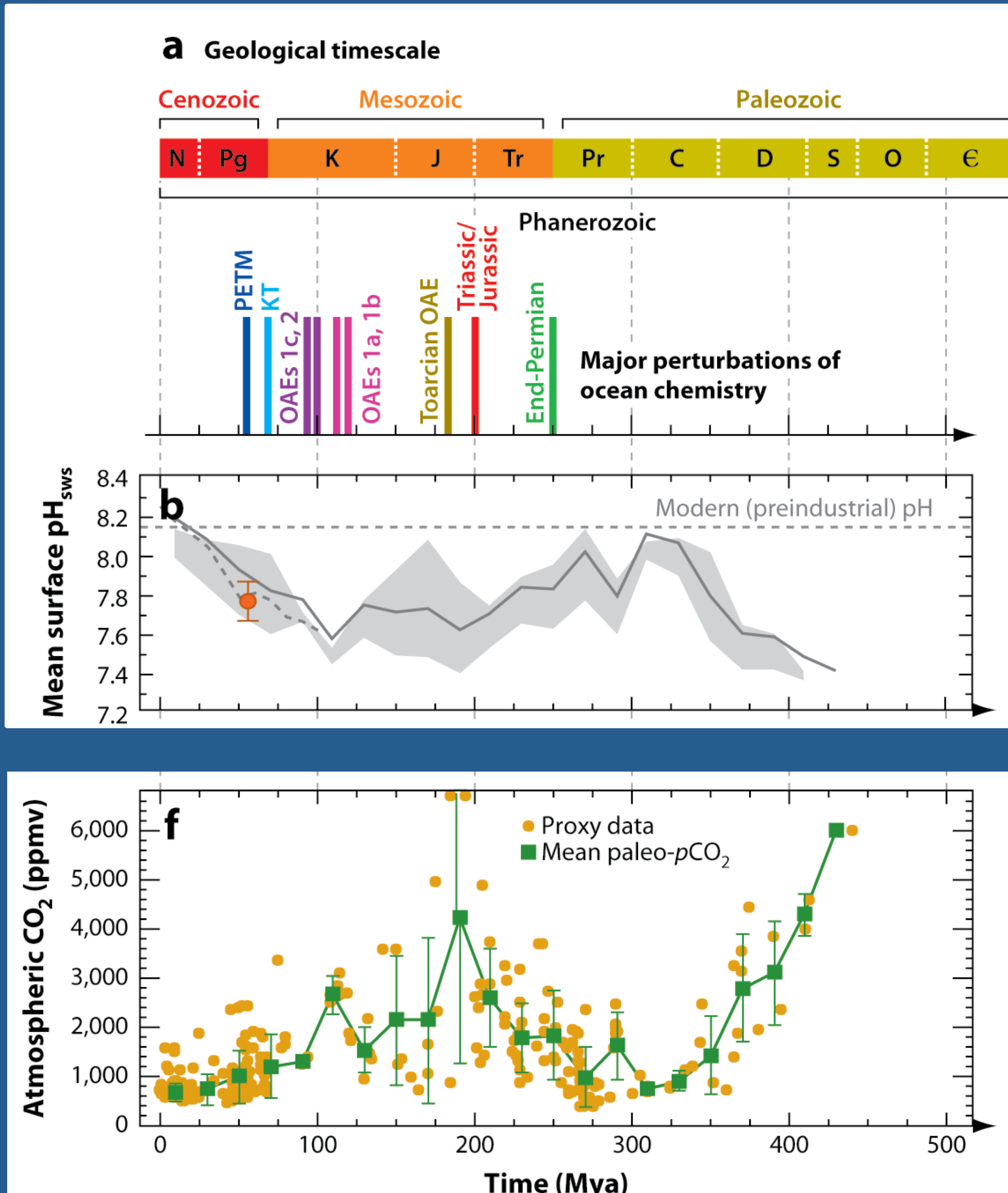


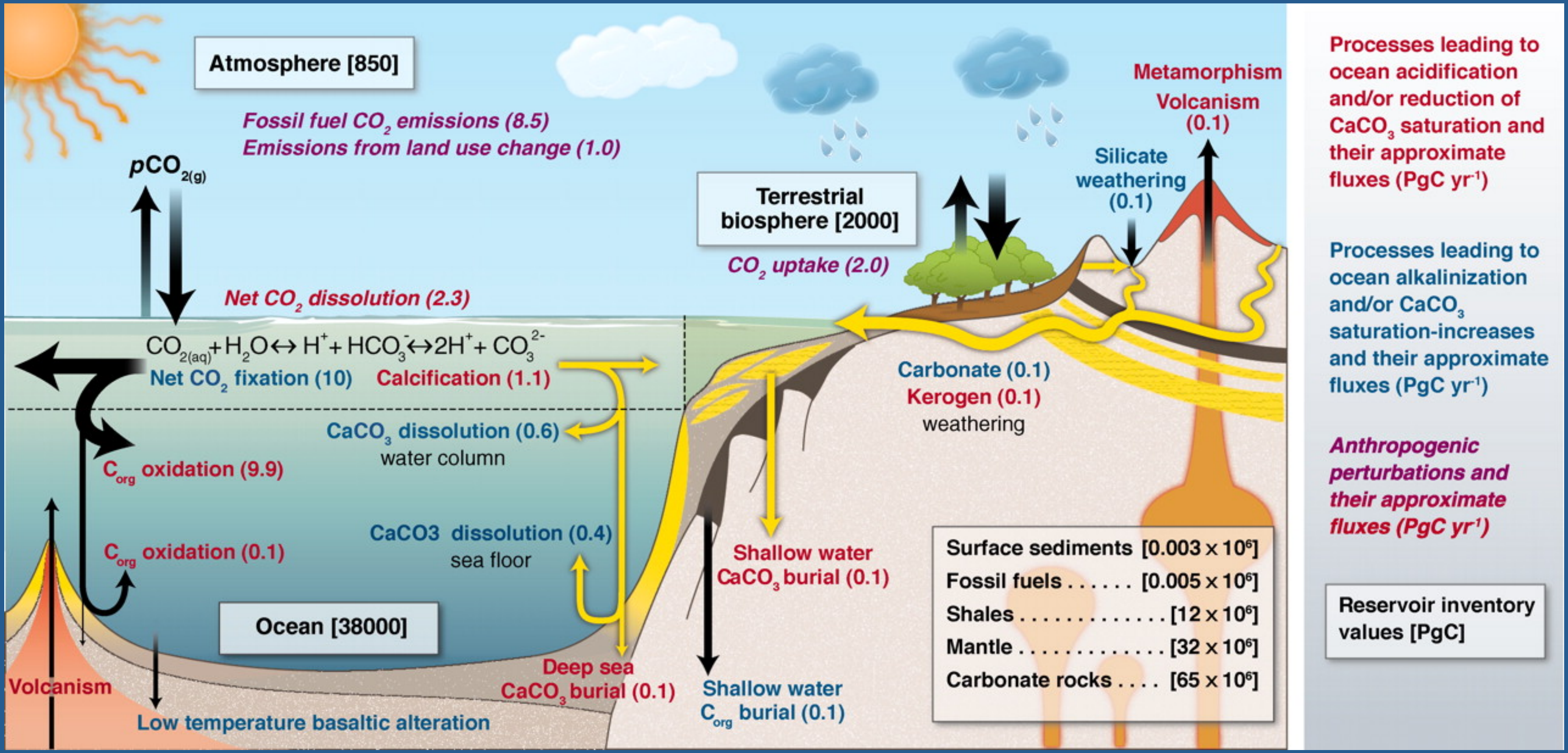
Zeebe RE. 2012.

Annu. Rev. Earth Planet. Sci. 40:141–65

“[T]he current rate of (mainly fossil fuel) CO_2 release stands out as capable of driving a combination and magnitude of ocean geochemical changes potentially unparalleled in at least the last ~300 [million years] of Earth history, raising the possibility that we are entering an unknown territory of marine ecosystem change.”

B Hönisch et al. Science 2012;335:1058-1063

The chemistry of the world's oceans is controlled by several factors



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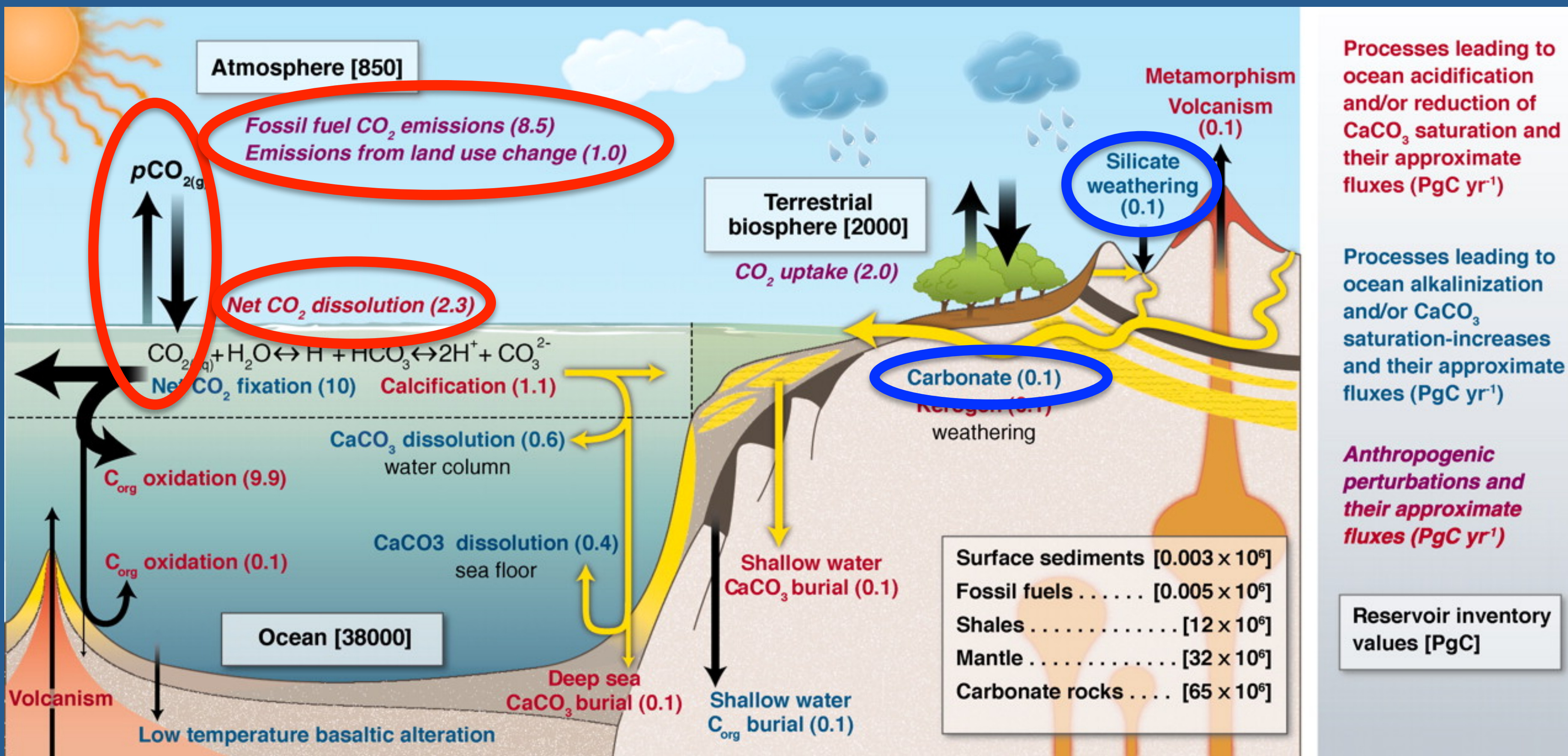
The chemistry of the world's oceans is controlled by several factors, specifically:

(1) Atmospheric CO_2 concentration

(2) Weathering of rocks on land



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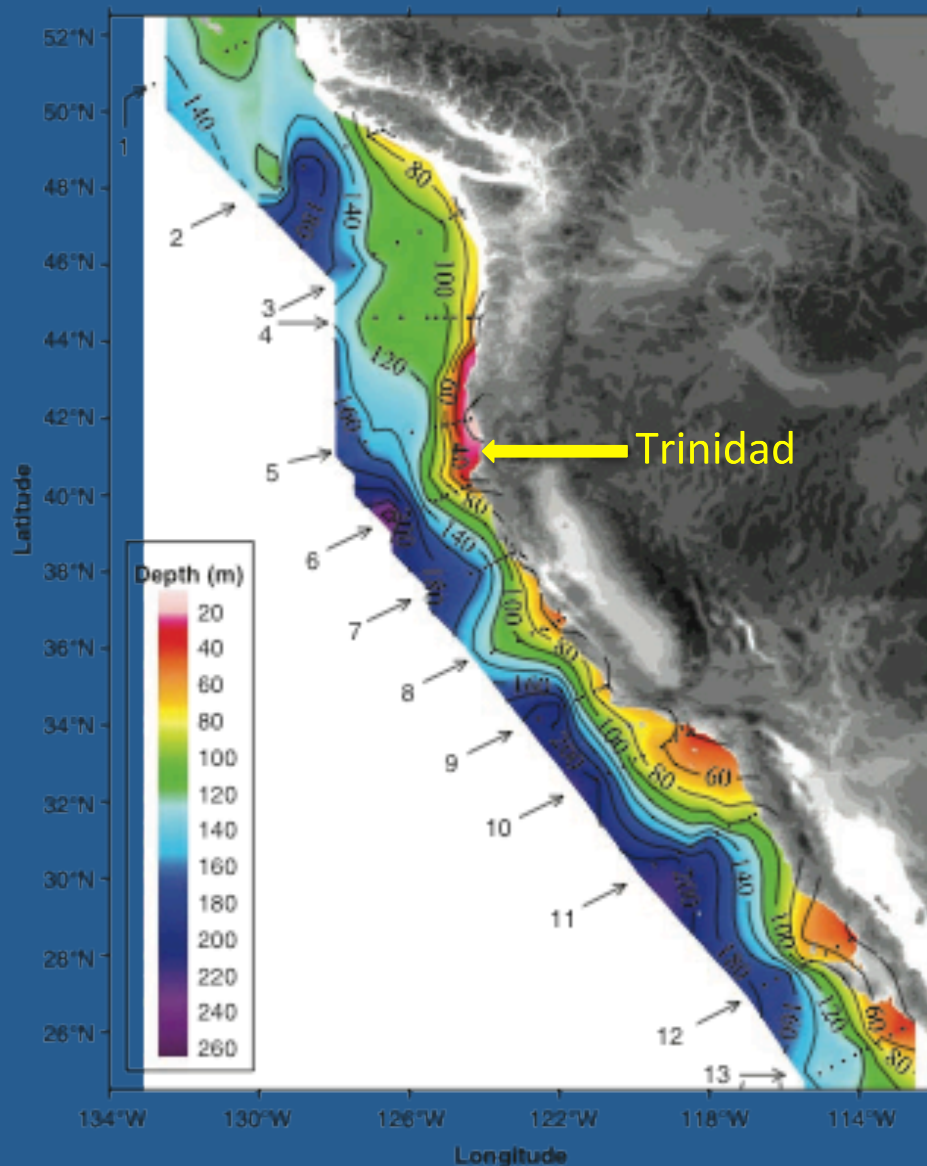
Upwelling intensifies OA on the West Coast

Upwelling draws more acidic (low pH, high CO_2) water upward from depth into shallow, coastal regions.

Water acidic enough (pH less than 7.75) to corrode shells made of aragonite (a type of calcium carbonate) extends to very shallow depths along the West Coast.

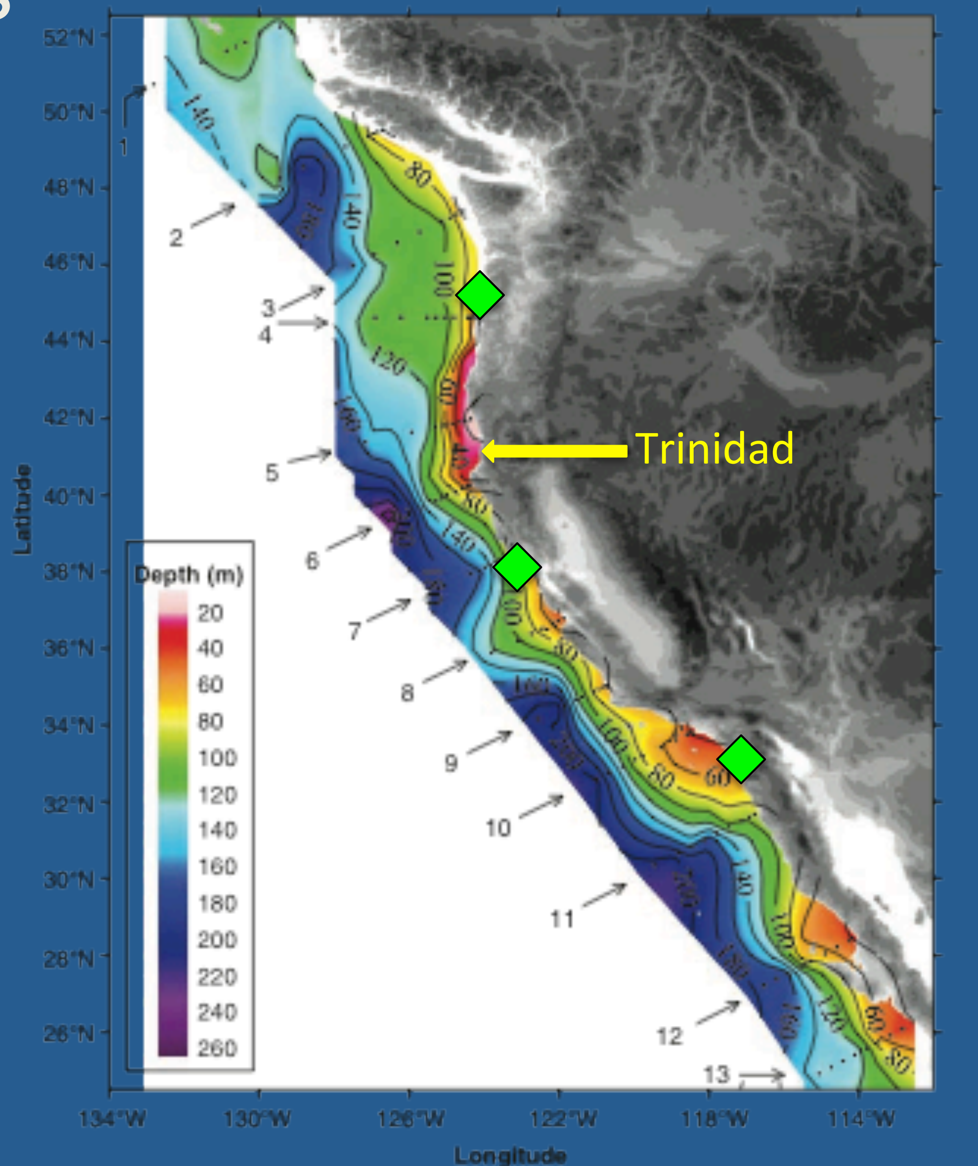


Feely, et al. 2008. Evidence for Upwelling of Corrosive "Acidified" Water onto the Continental Shelf. Science, vol 320, p. 1490-2.

Monitoring ocean chemistry monitoring: existing spatial gaps

Only 3 Burkolators on U.S. West Coast:

- Netarts, OR
  (300 mi. north)
- Tomales Bay, CA
  (250 mi. south; not open coast)
- Carlsbad, CA
  (680 mi. south)



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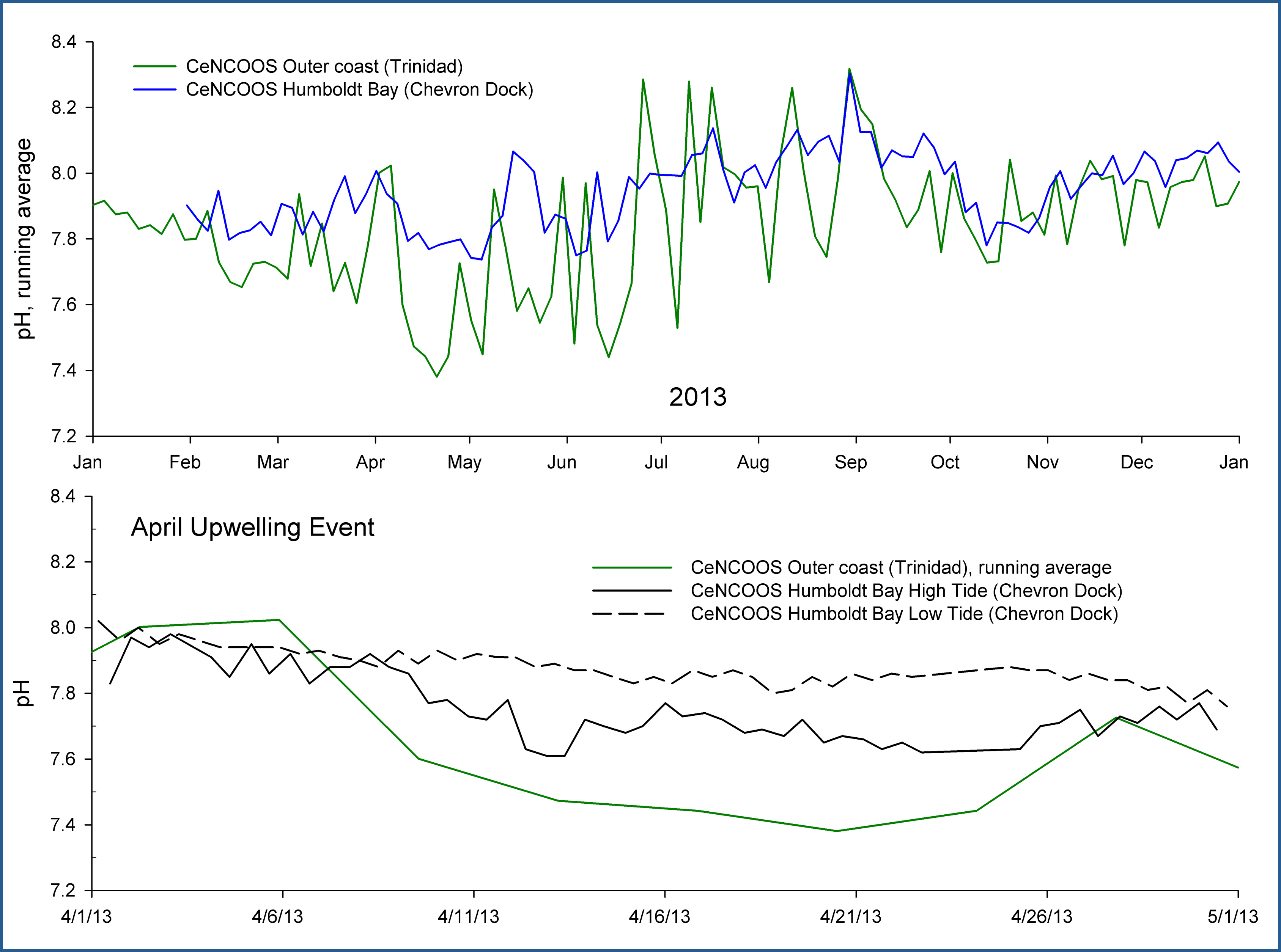
Humboldt Bay appears to be naturally buffered



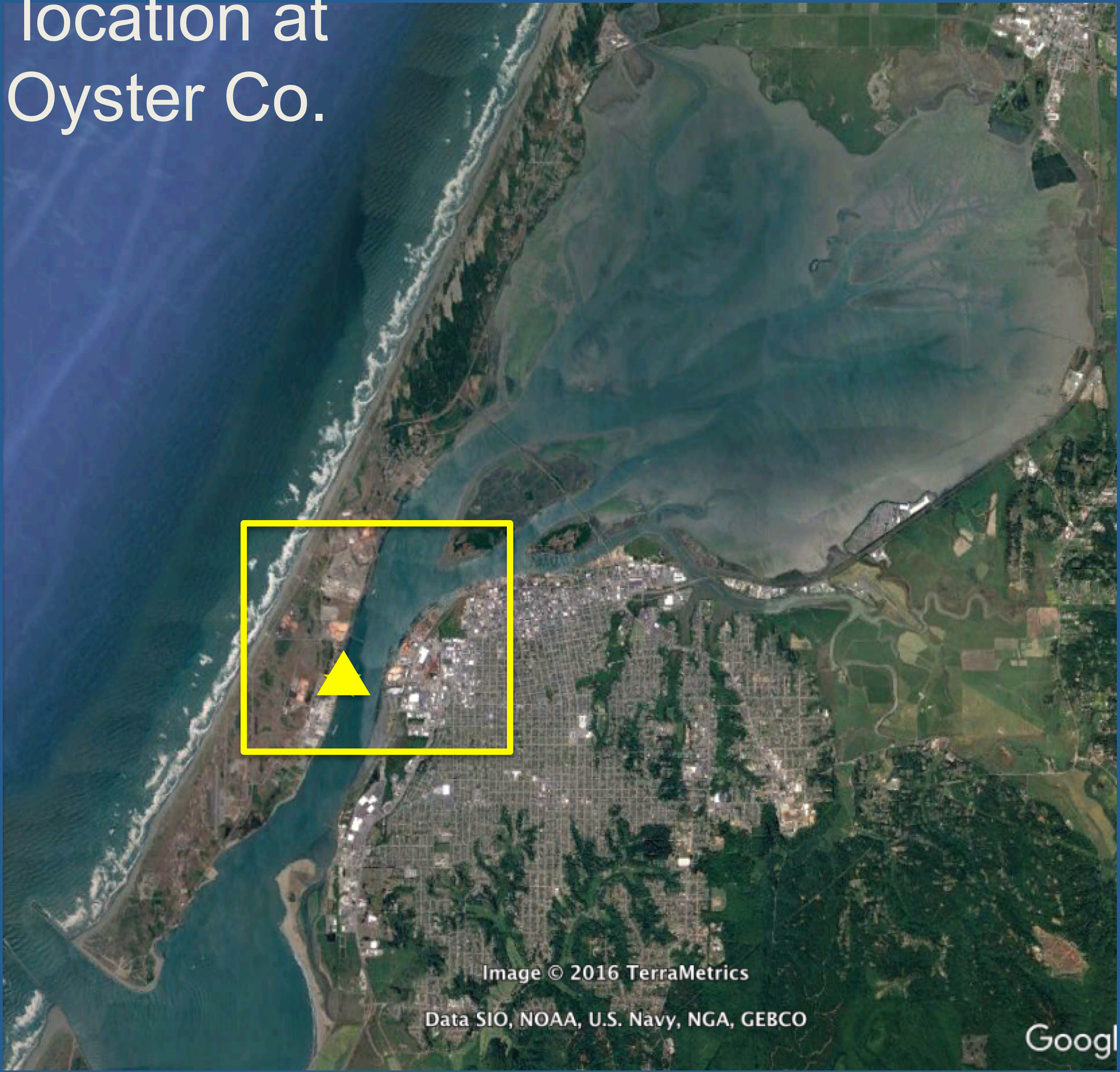
Eelgrass may play an important role in buffering

‘Burkolator’ – gold standard in real-time carbonate chemistry monitoring

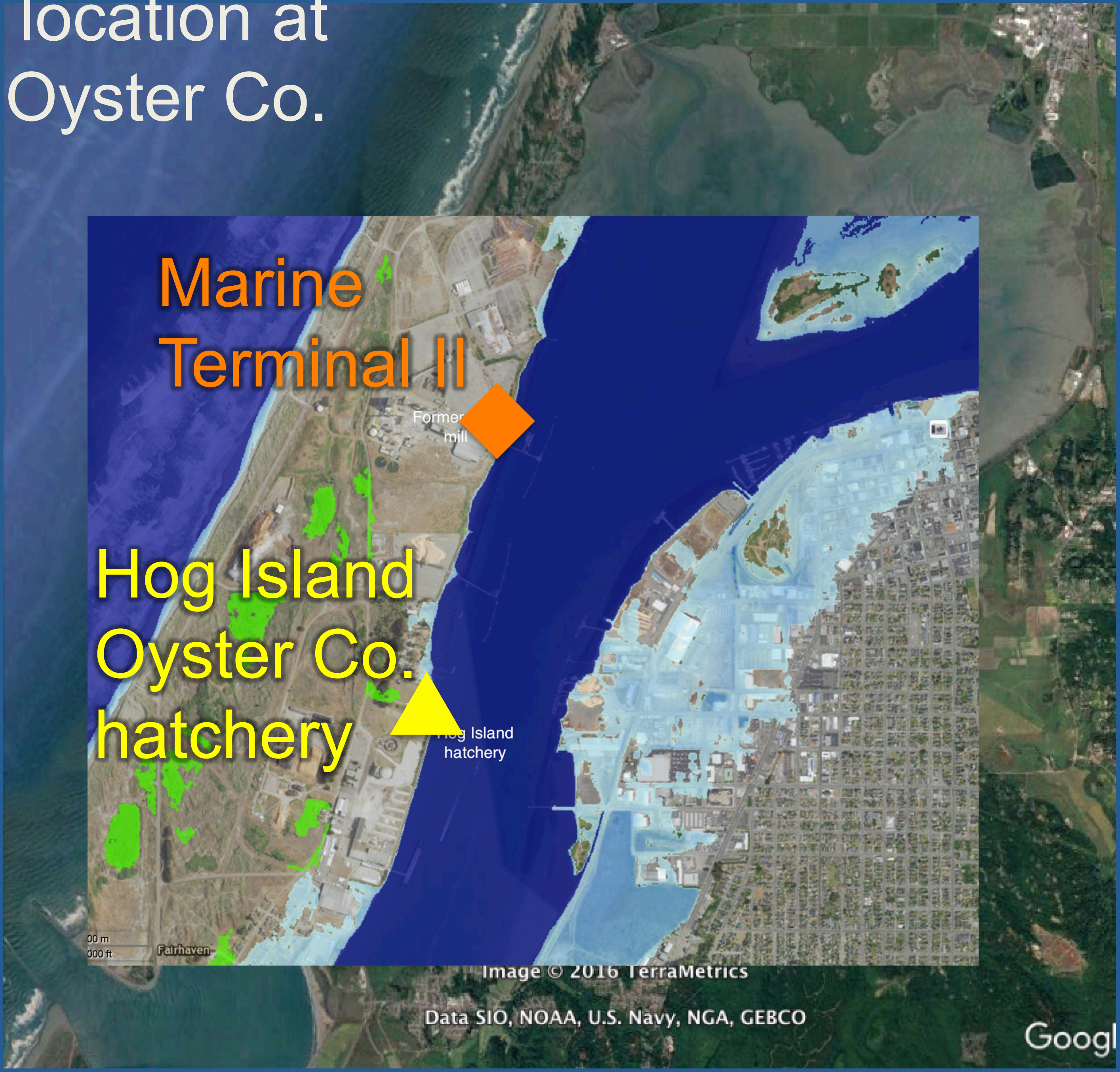
- Useful to aquaculture industry, especially hatcheries.
- Improved understanding of ocean chemistry, effects on coastal ecosystems, role of eelgrass.
- Will facilitate research:
  - Oceanographic surveys
  - Mesocosm experiments
- Cutting-edge, industry-relevant experience for students.

‘Burkolator’ location at Hog Island Oyster Co. hatchery

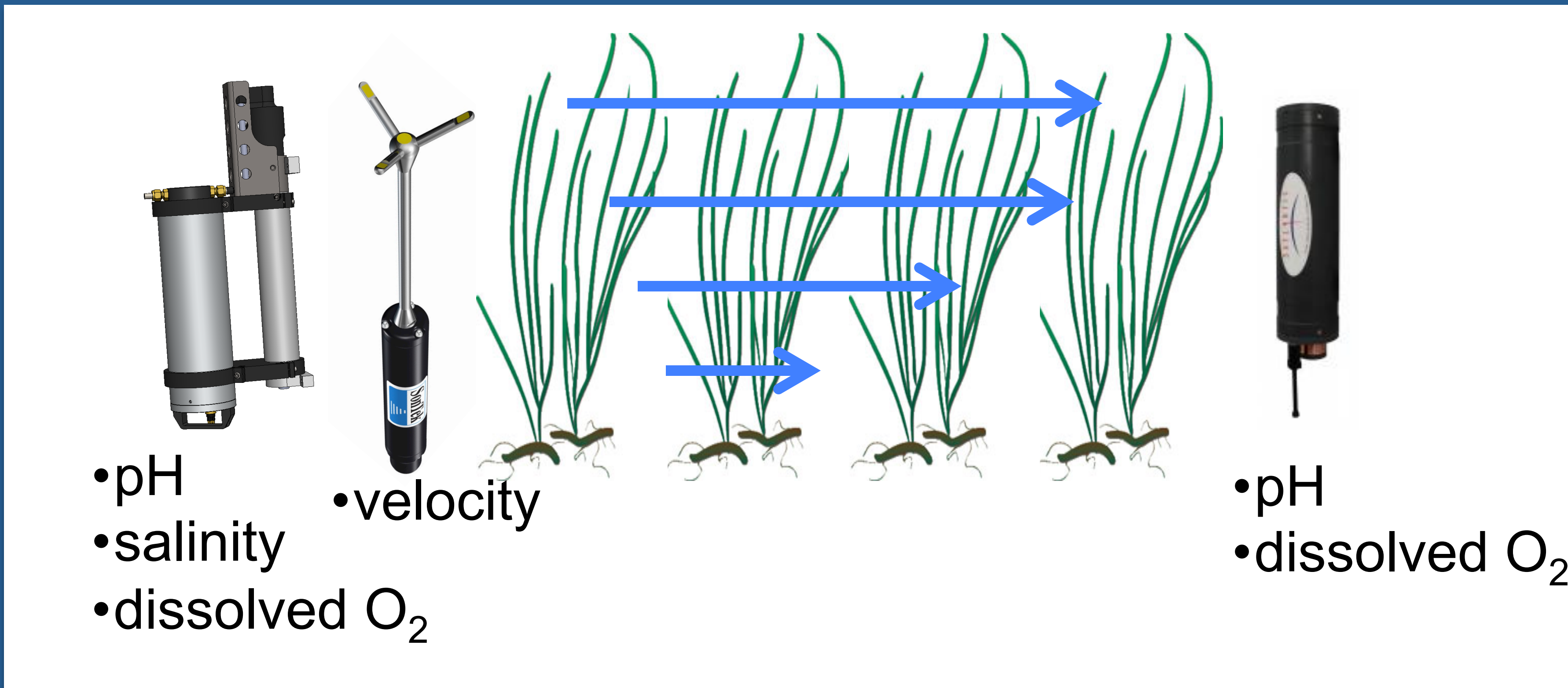
'Burkolator' location at Hog Island Oyster Co. hatchery



‘Burkolator’ location at Hog Island Oyster Co. hatchery

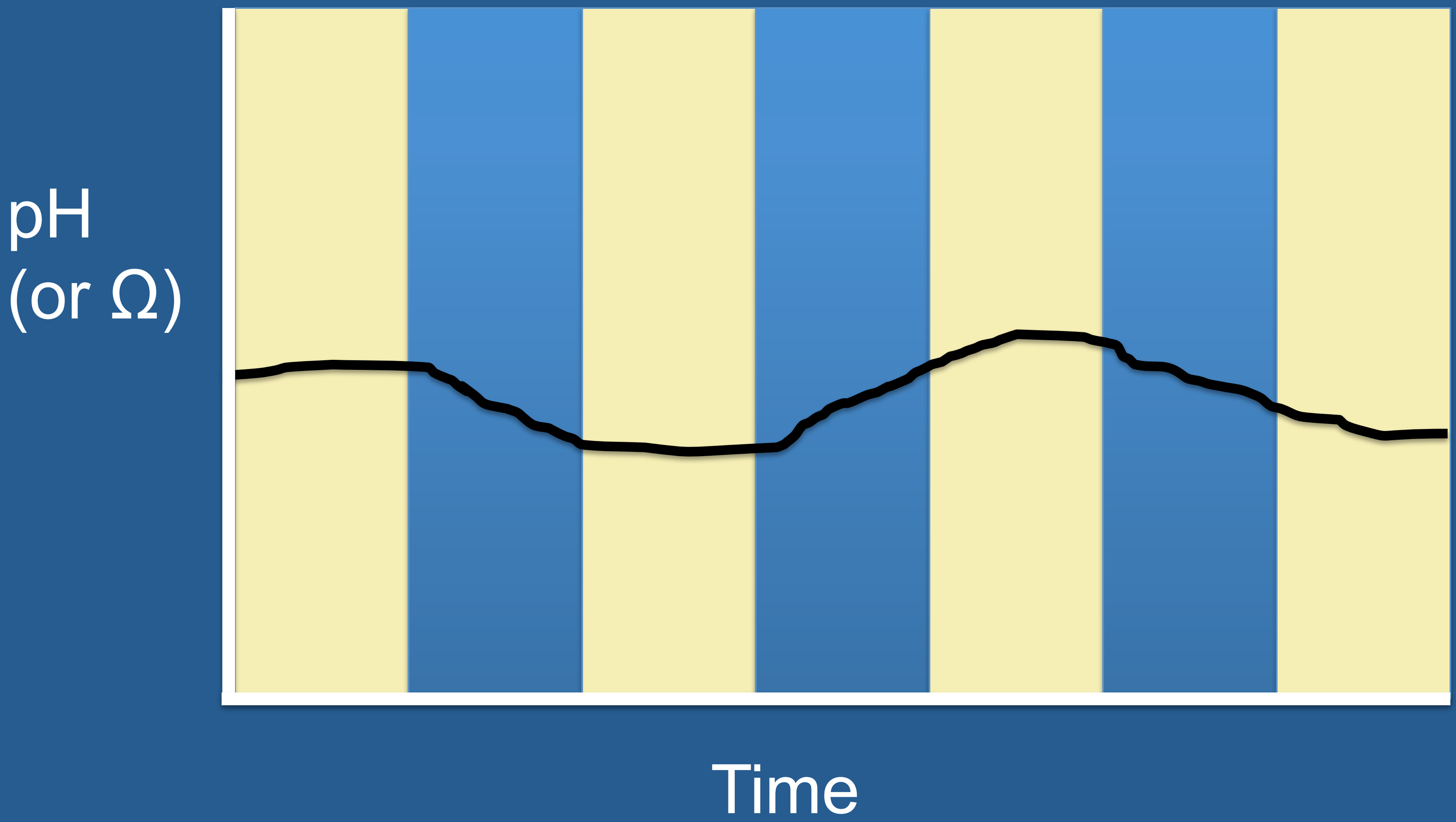


Eelgrass ecosystem function/service

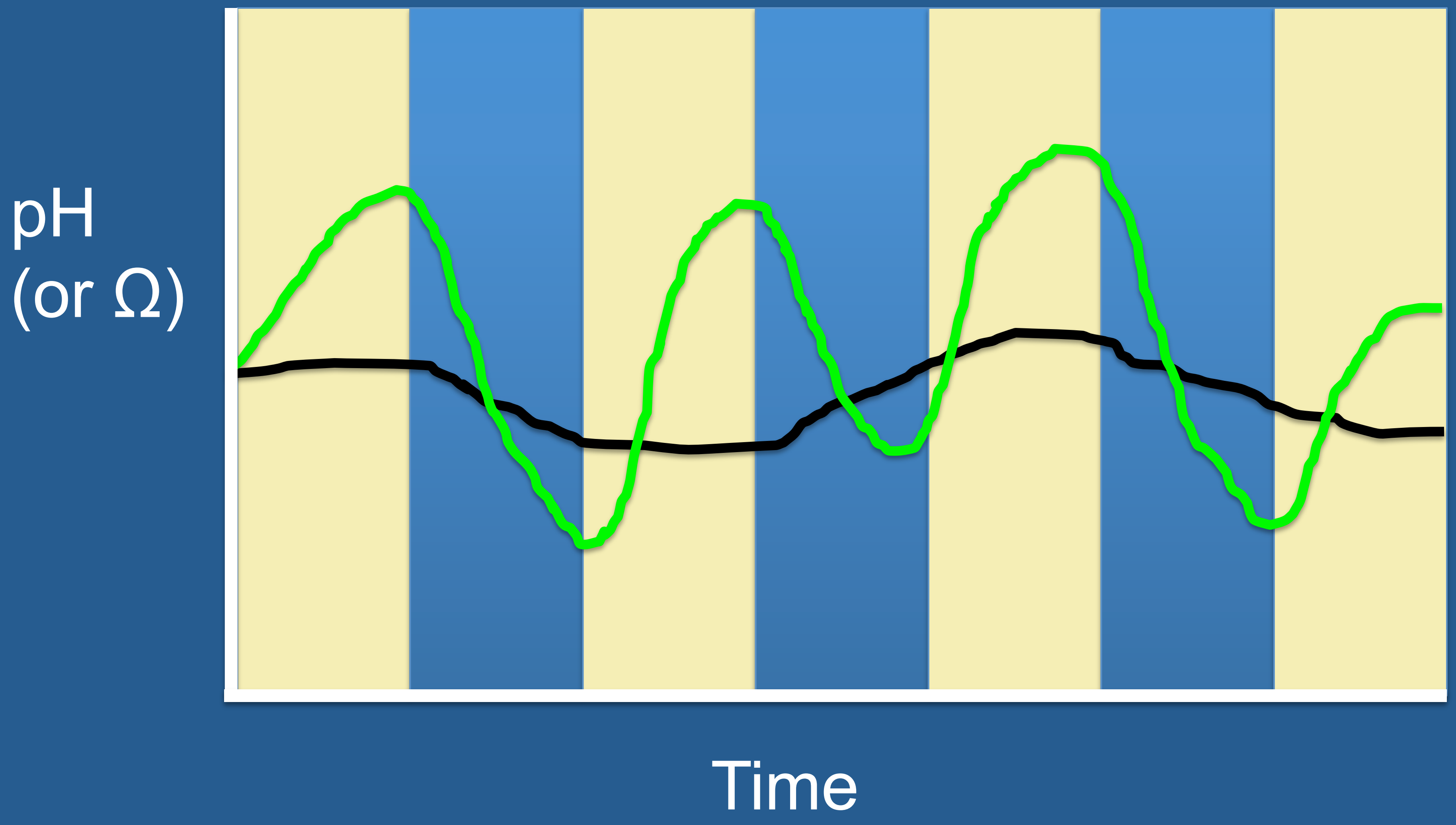


- Quantify the extent to which eelgrass mitigates (buffers) and exacerbates OA.
- Evaluate physiological status of eelgrass, impacts (e.g. shading)
- Inform management

Conceptual model of eelgrass mitigation of OA

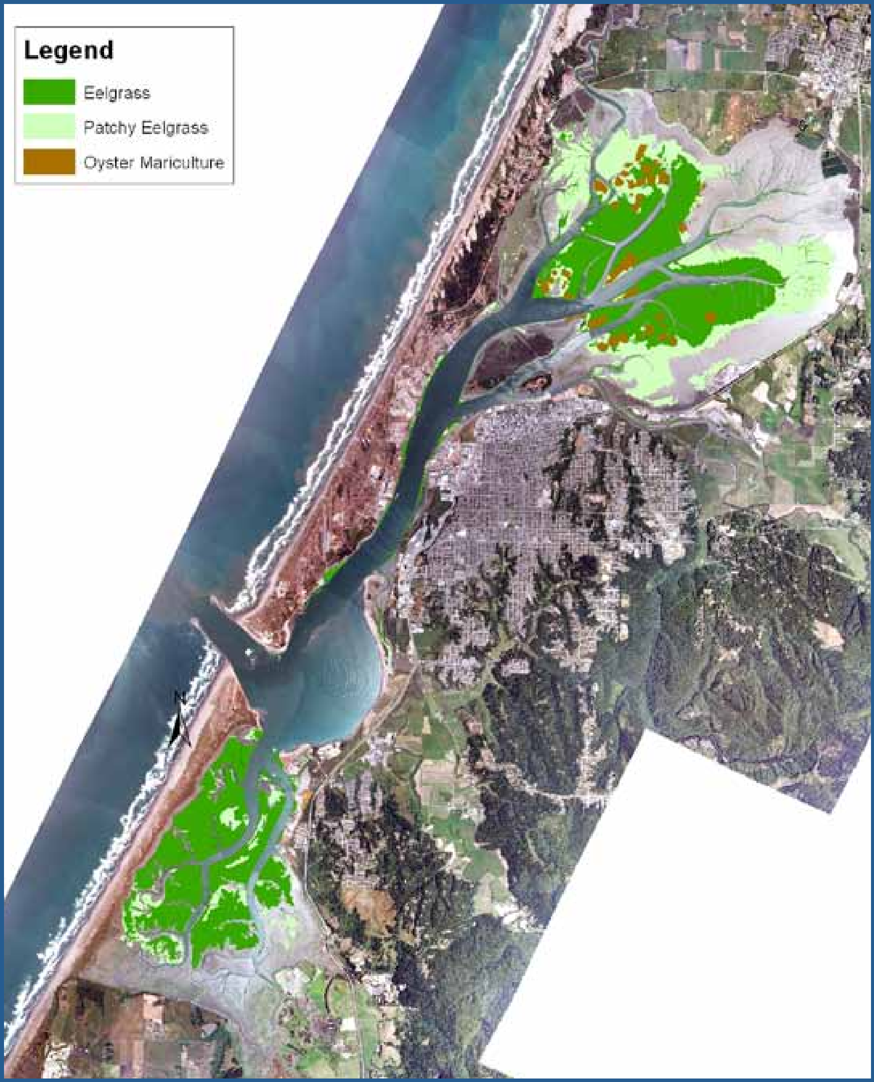


Conceptual model of eelgrass mitigation of OA



Bay-wide eelgrass monitoring

- Detect changes in eelgrass abundance/distribution
- Quantify stressors/limitations (temperature, light availability)
- Compatible with existing monitoring efforts (MPA, CDFW, aquaculture permitting)
- Ground-truthing for remote-sensing (e.g. aerial/UAV photos)
- Baseline via 2 funded years, continued w/ minimal funding afterward



Thank you!

Any questions?

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