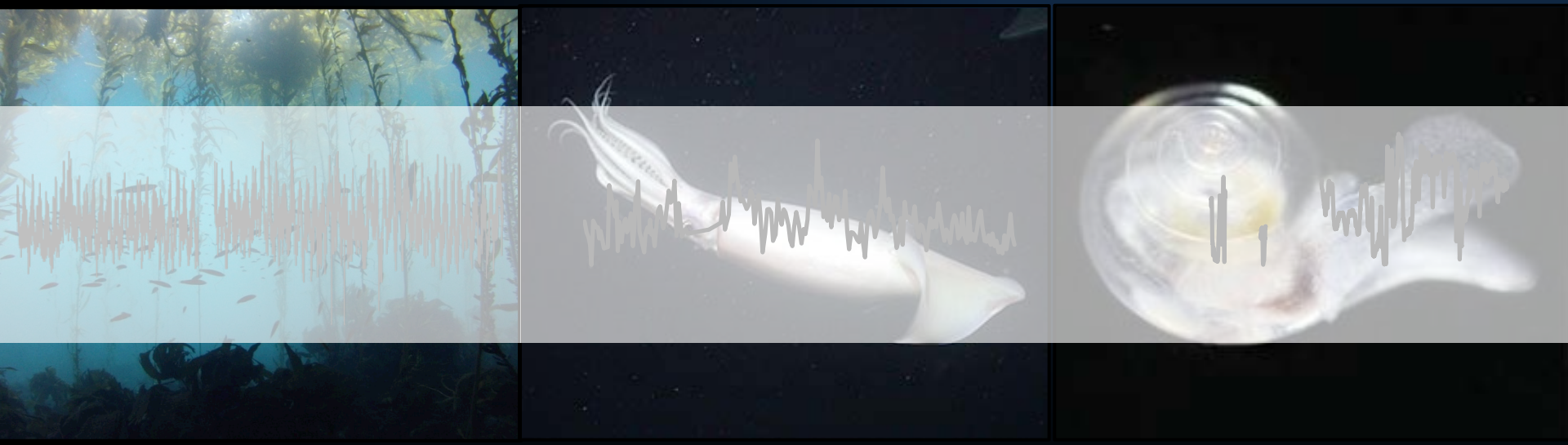
Ocean temperature, hypoxia, and acidification: detecting the fingerprint of climate change in California's coastal ocean



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June 16, 2015

UCDAVIS COASTAL AND MARINE SCIENCES INSTITUTE

UCDAVIS BODEGA MARINE LABORATORY

Sea Surface Temperature in Coastal CA

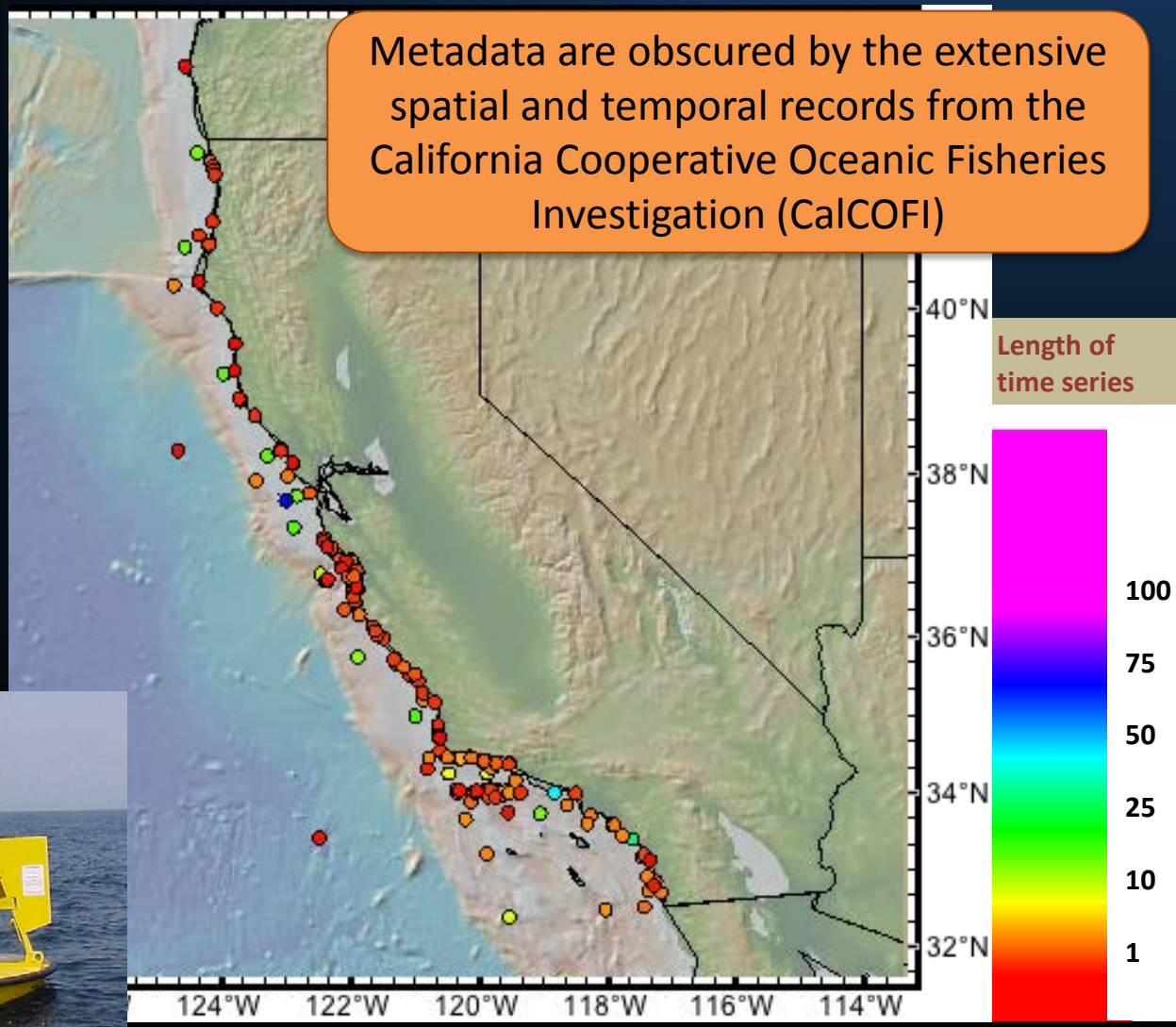
Sea surface temperature (SST, *e.g.* upper 20 m) is rising globally.

<u>How it is measured:</u>
Moored and shore-based sensors, and throughout the water column

<u>Datasets: 317</u>

- ongoing: 48%
- ≥ 50 years: 2%
- ≥ 10 years: 62%

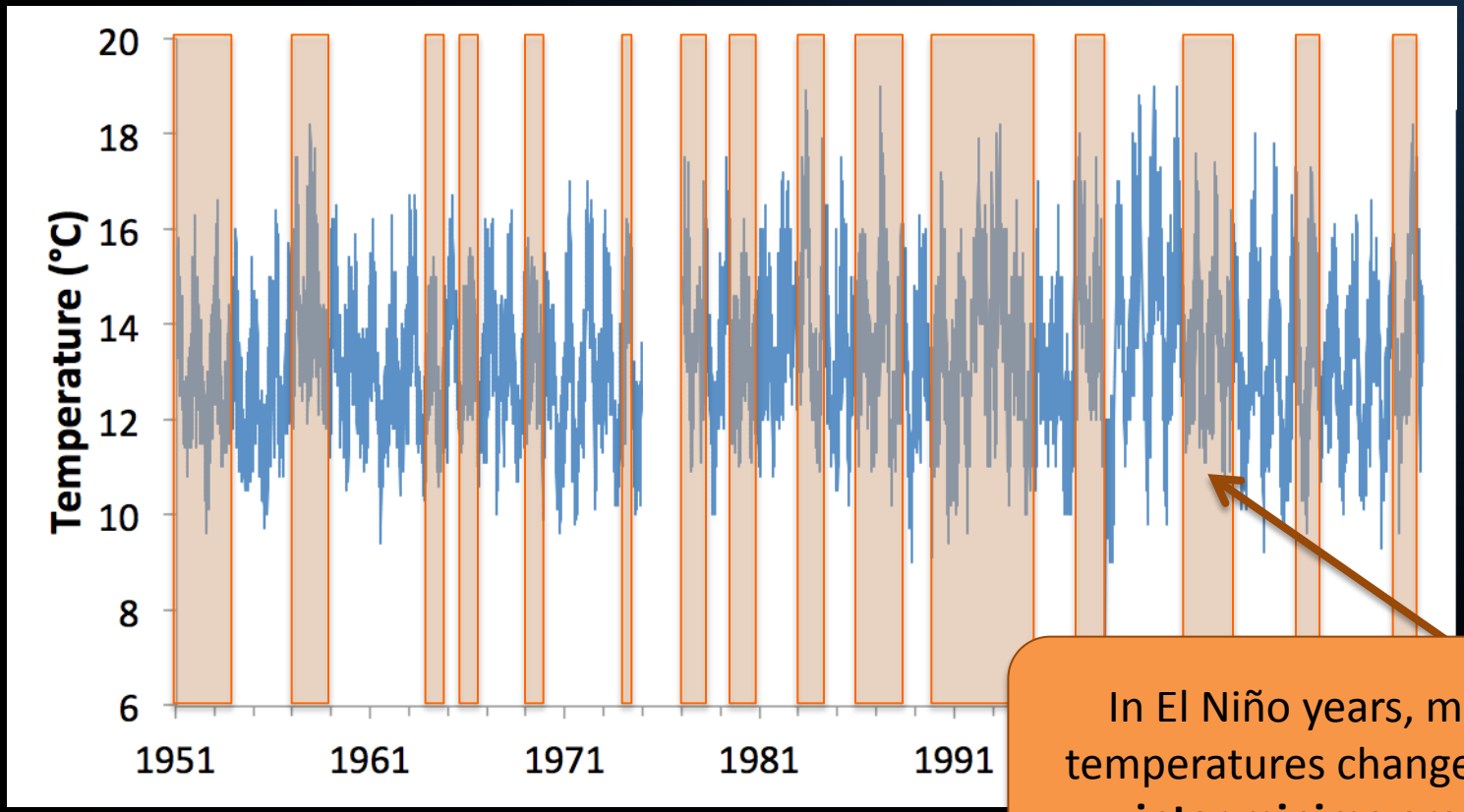
Metadata are obscured by the extensive spatial and temporal records from the California Cooperative Oceanic Fisheries Investigation (CalCOFI)



Temperature Time Series

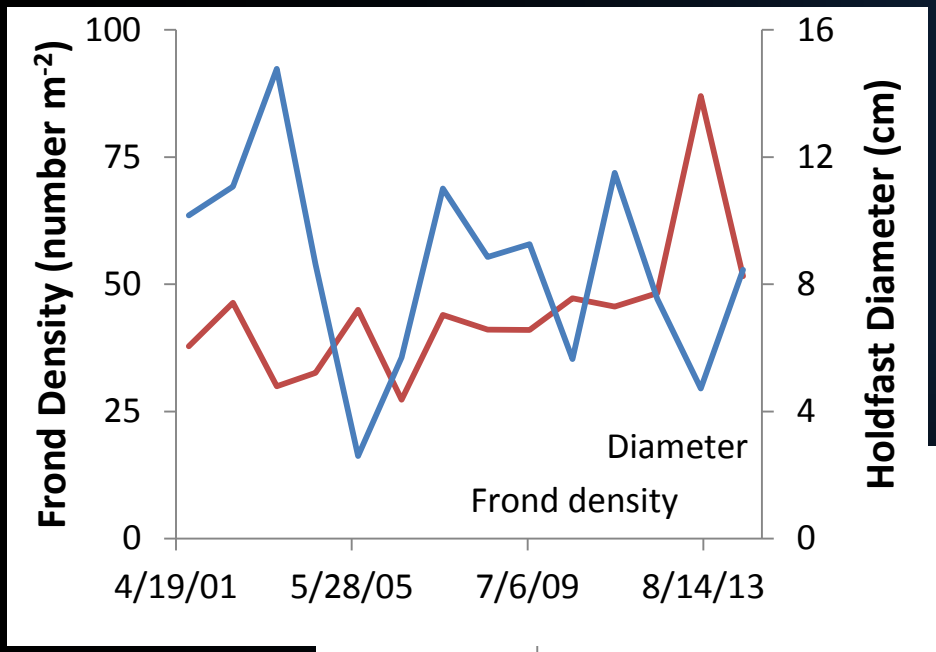
Data from CeNCOOS/UCSD Shore Station
Hopkins Marine Laboratory

What you see here:
Seasonal variability,
ENSO variability
Inter-decadal variability

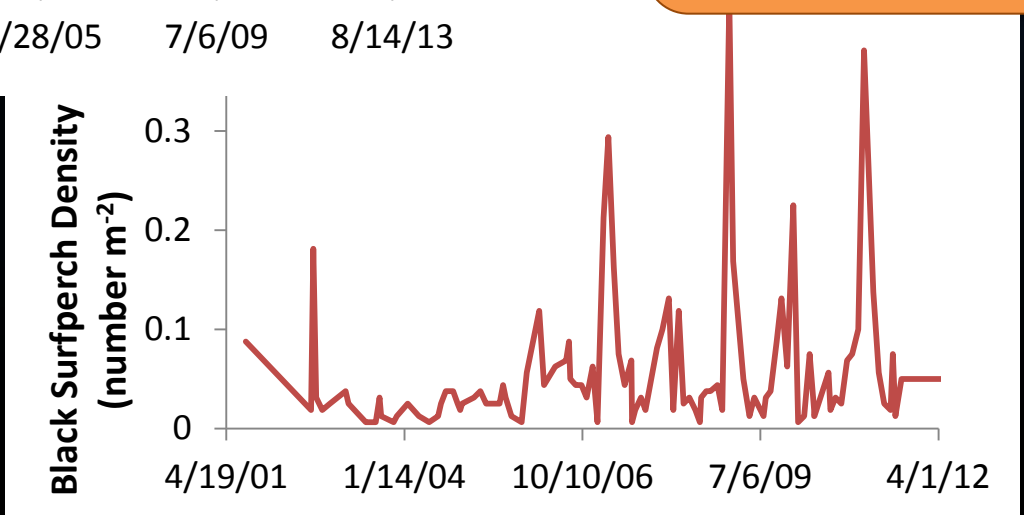


In El Niño years, maximum temperatures change little, but **winter minima are warmer**

Biological Indicator for Temperature:
Giant Kelp and Black Surfperch



Biological indicators are complex and highly variable. Should be monitored concurrent with physical indicators.



Dissolved Oxygen in Coastal CA

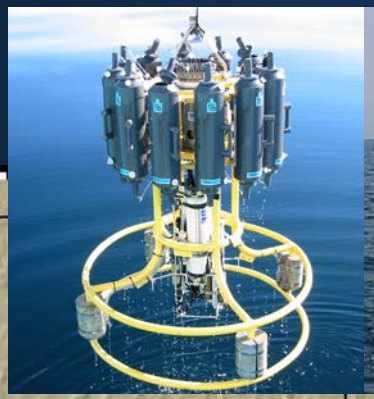
Oxygen concentrations are declining in the interior of the ocean:

- Ocean warming
- Increasing stratification
- Changing ocean circulation

<u>How it is measured:</u>
Moored sensors and throughout the water column in some places

<u>Datasets: 53</u>

- ongoing: 57%
- ≥ 50 years: 0%
- ≥ 10 years: 45% (CALCOFI)

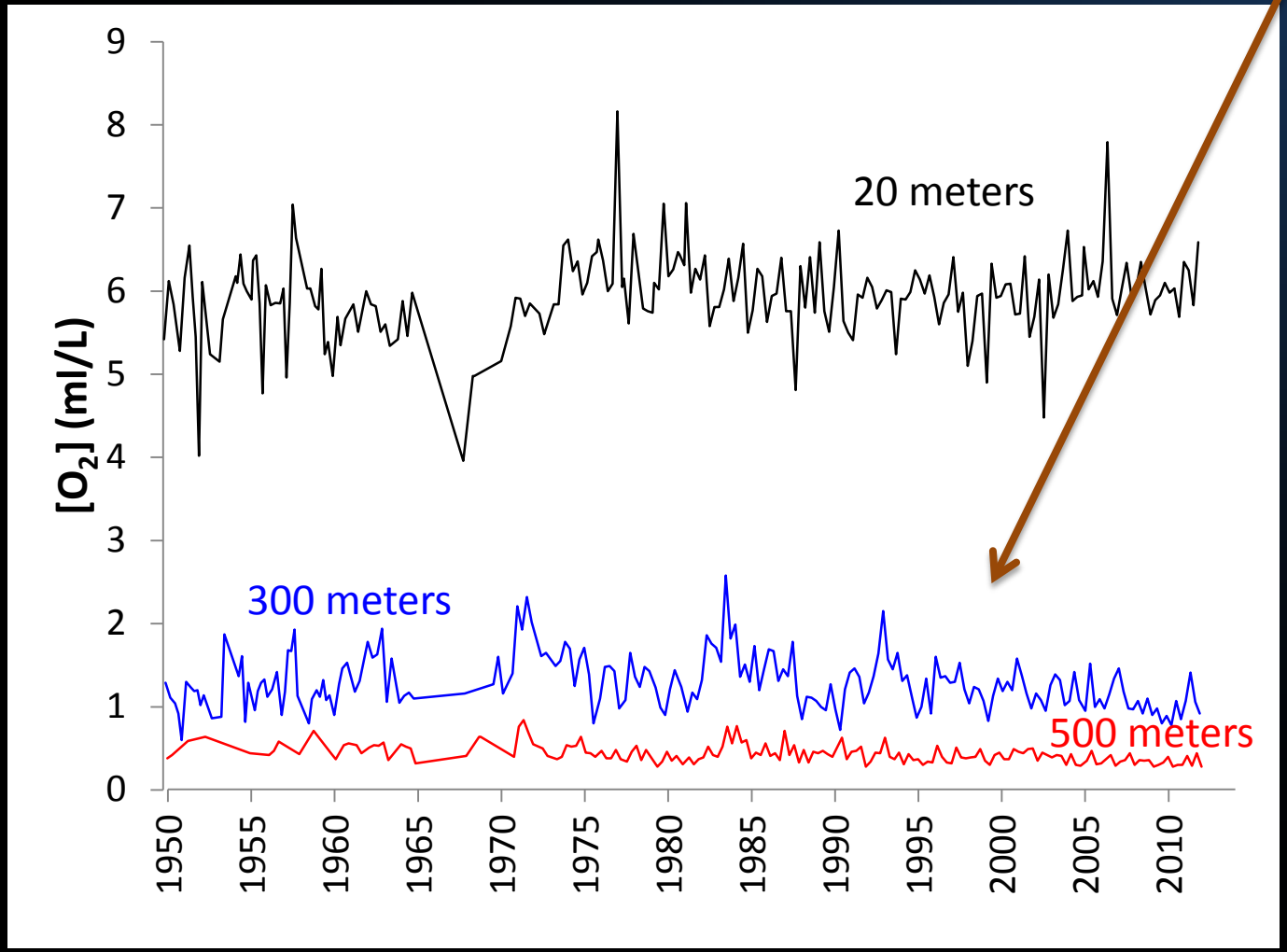


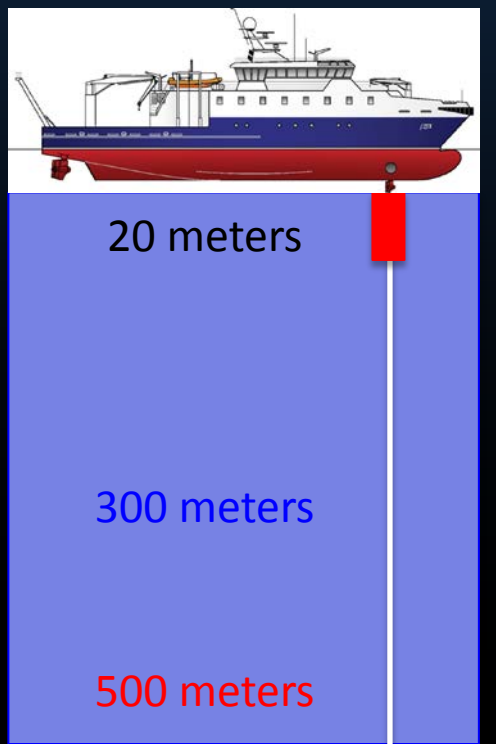
Oxygen Time Series

Data from California Cooperative Oceanic Fisheries Investigations (CalCOFI)

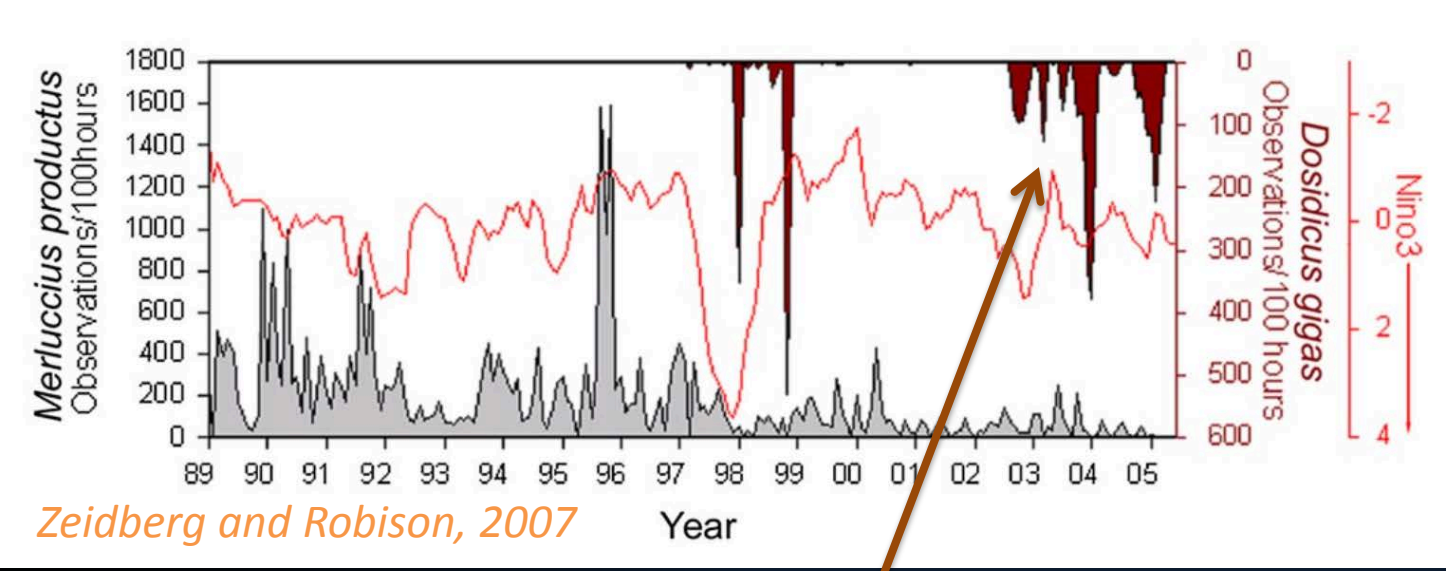
CalCOFI is documenting the decline of O_2 concentrations in subsurface waters

(Bograd et al., 2008)





Biological Indicator for Oxygen: Humboldt Squid



Zeidberg and Robison, 2007

Consequence of oxygen loss in the interior of the California Current: Invasion of predatory Humboldt Squid

©2003 MBARI

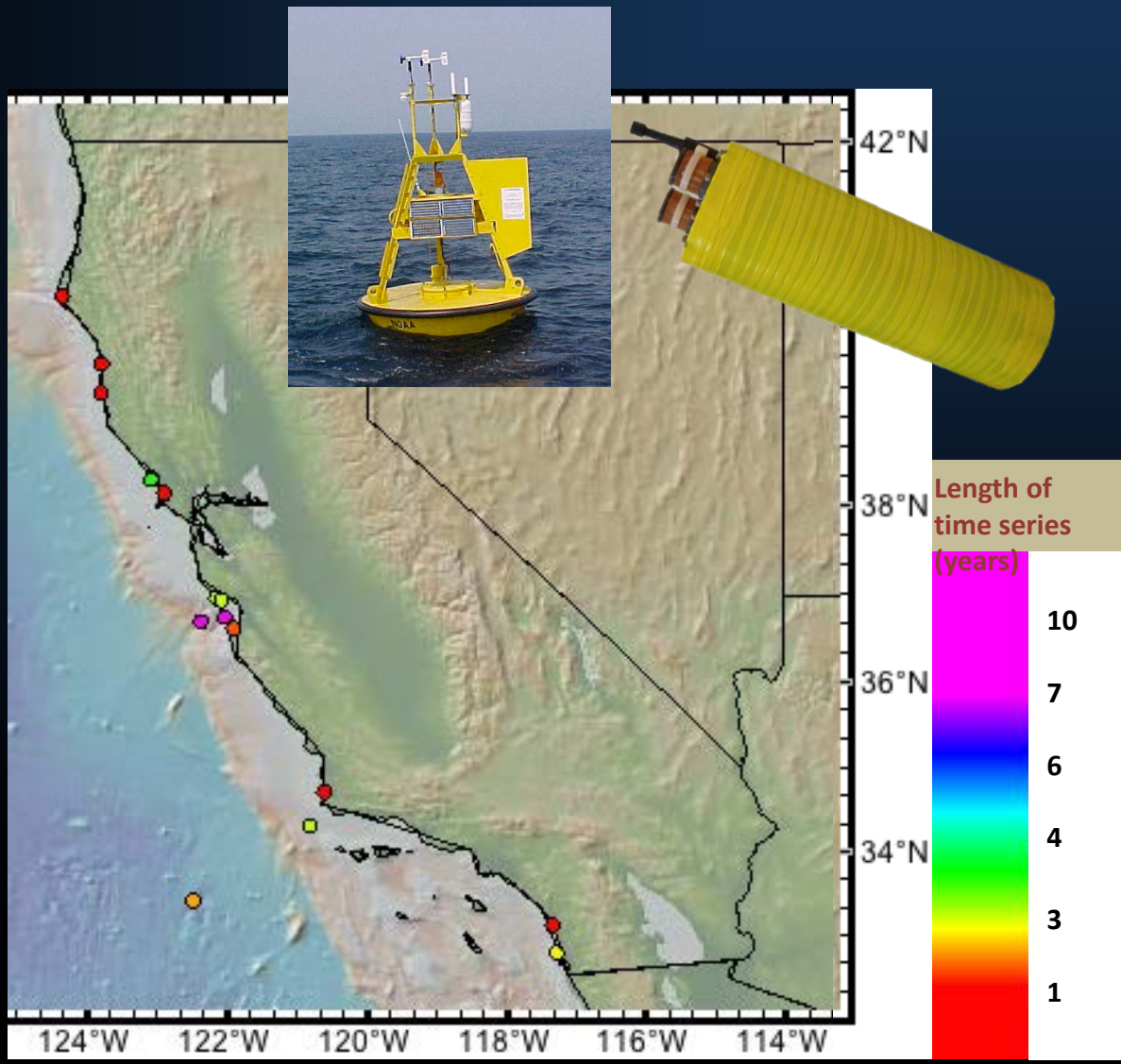
Ocean Acidification in Coastal CA

The ocean is acidifying as it absorbs anthropogenic CO_2. Consequently, pH and carbonate ion concentrations are decreasing.

<u>How it is measured:</u>
Moored, underway, and shore-based sensors record various carbonate chemistry parameters, usually pH and/or pCO_2.

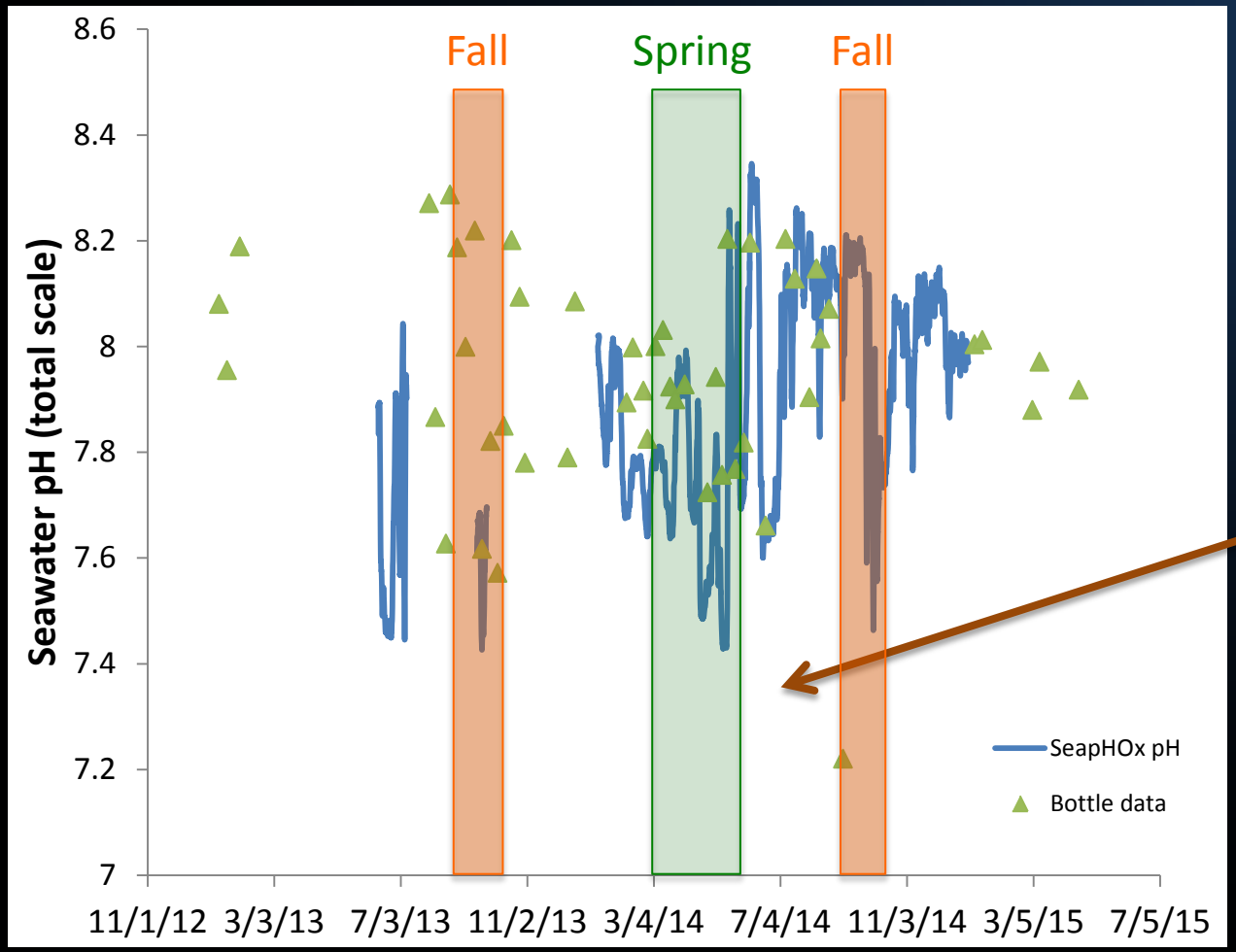
<u>Datasets: 28</u>

- ongoing: 25%
- ≥ 50 years: 4%
- ≥ 10 years: 11%



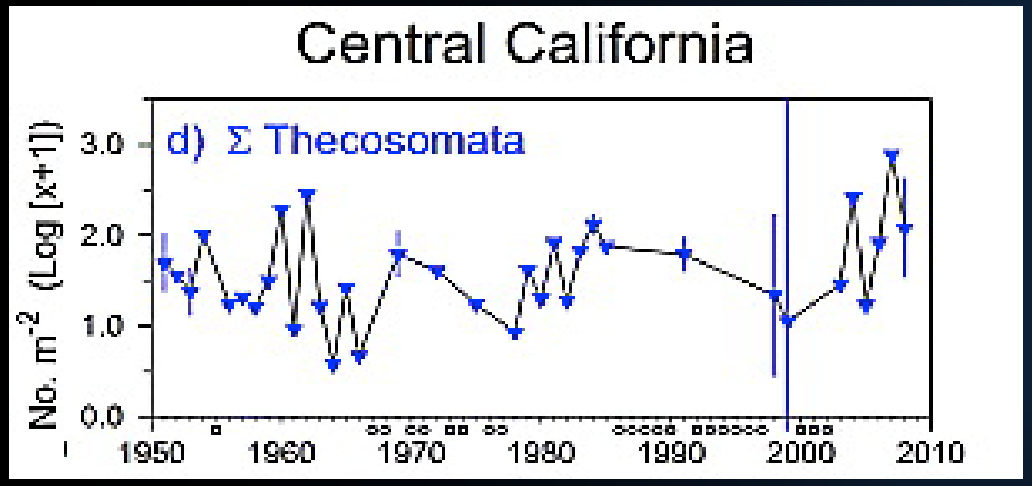
Ocean Acidification Time Series

Data from Bodega Marine Laboratory (BML)



Bodega Marine Lab is measuring carbonate chemistry in coastal ocean, producing data with signals of seasonal upwelling.

Biological Indicator for Ocean Acidification:
Pteropods



Pteropod monitoring in plankton community

from laboratory experiments). This organism is an acidification “canary”.

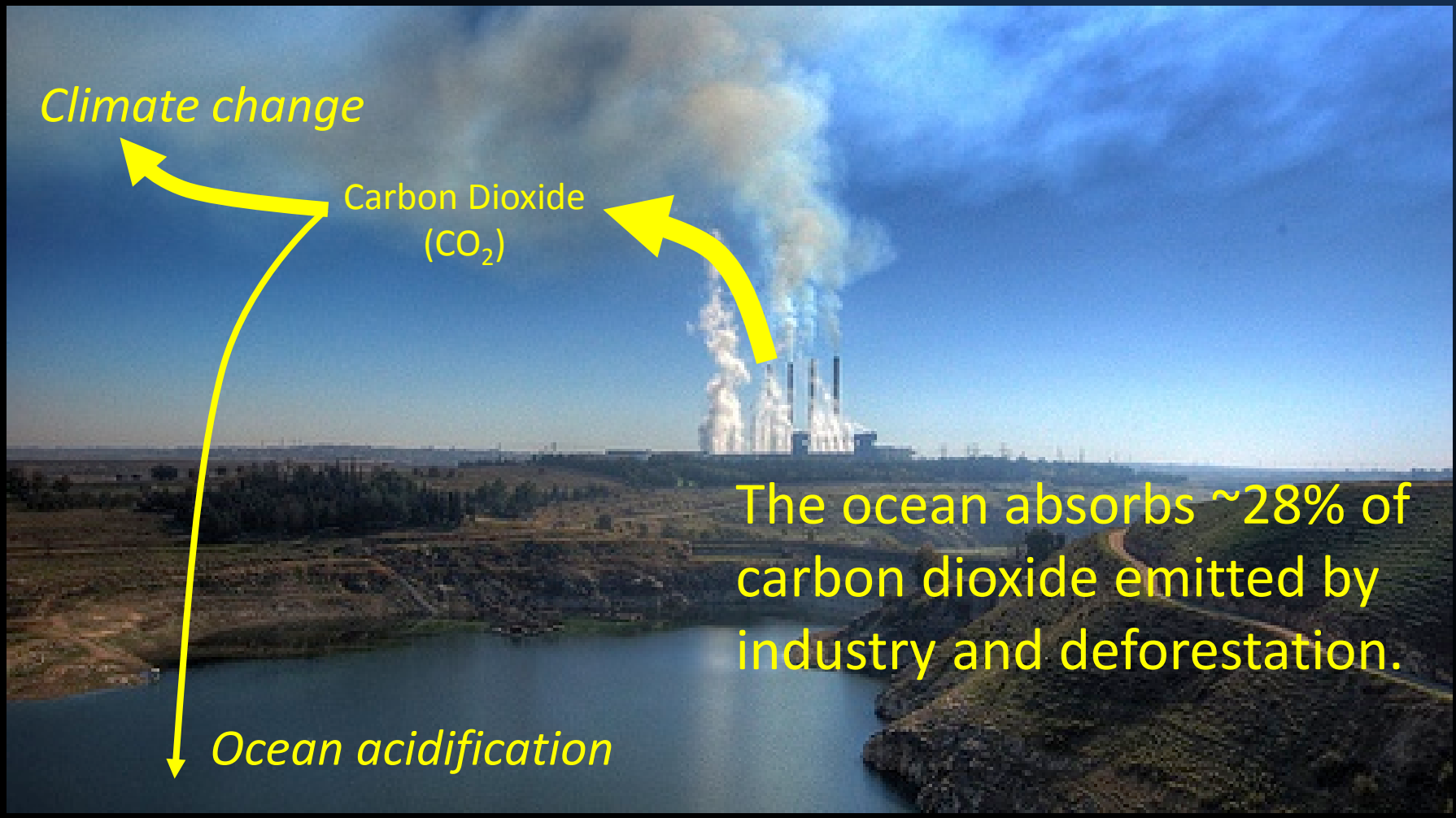
California is a global leader

We want to continue to be the leader for documenting impacts of climate change in coastal marine ecosystems

How can we do this? By supporting:

- Existing time series to prevent data gaps
- Data collection distributed across CA
- Expansion of OA monitoring sensor networks
- Co-location collection of abiotic and biotic data

What is ocean acidification (OA)?



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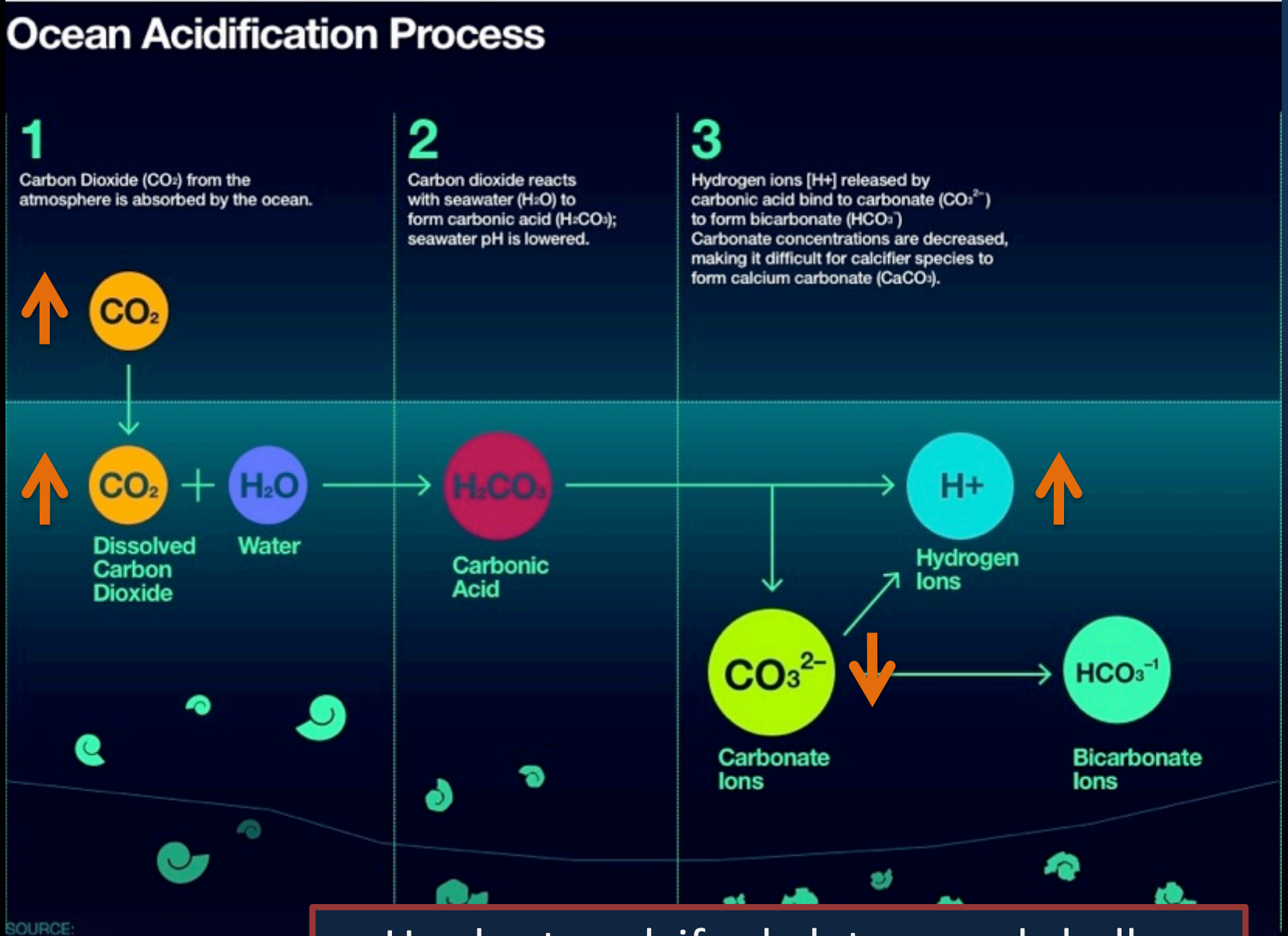

- Harder to calcify skeletons and shells
- Disturbed acid/base physiology