Ocean Acidification

Introduction to OA

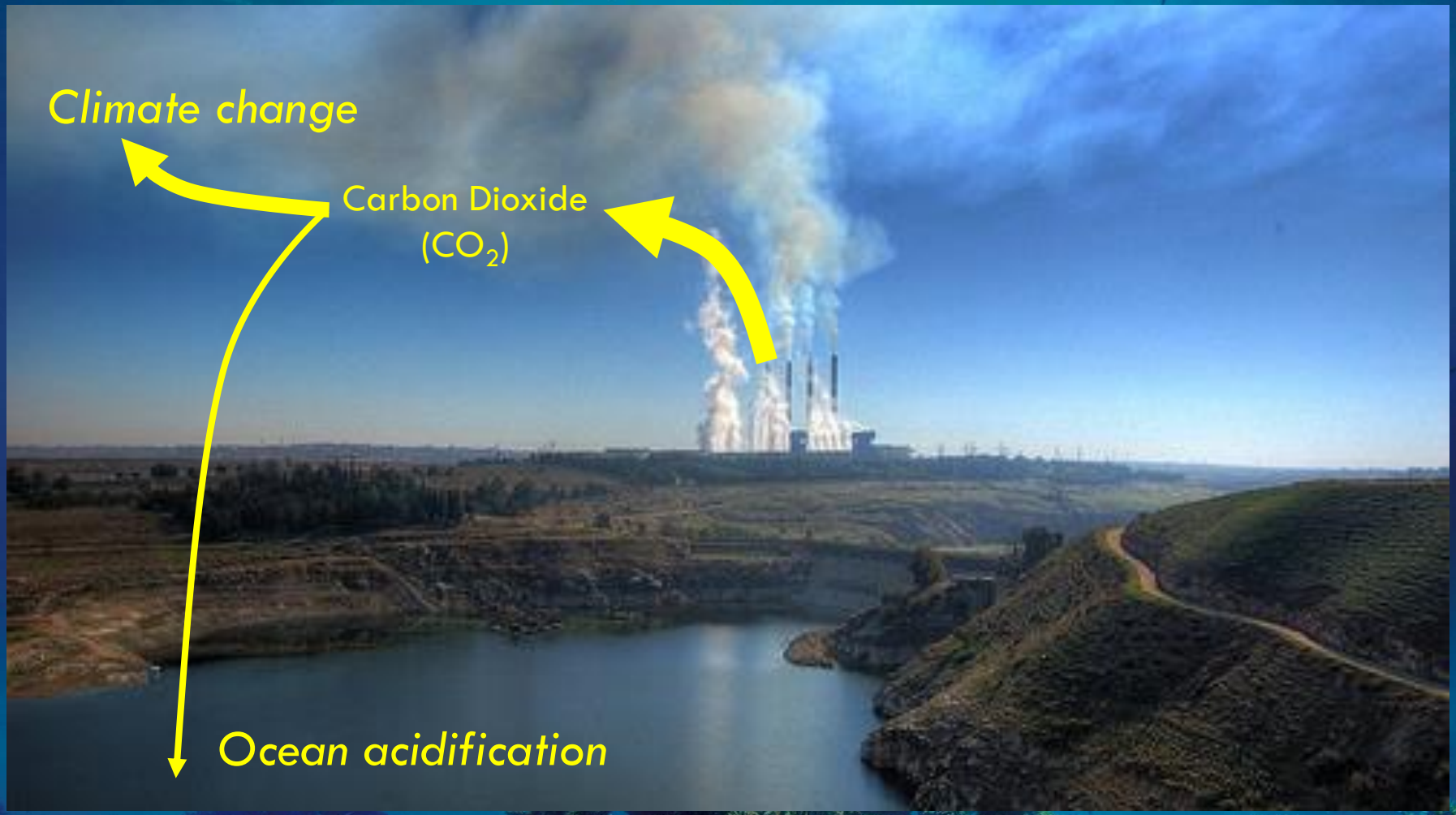
Pacific Islands Regional OA Workshop

October 7, 2015

Dr. Libby Jewett, Director
NOAA OA Program

http://www.oceanacidification.noaa.gov/

What is ocean acidification?



Sarah R. Cooley (scooley@whoi.edu)

Fate of Anthropogenic CO_2 Emissions (2011)

0.9±0.5 Pg C y^{-1}

+

9.5±0.5 Pg C y^{-1}

5.2±0.2 Pg C y^{-1}

Atmosphere

50%

2.7±1.0 Pg C y^{-1}

Land

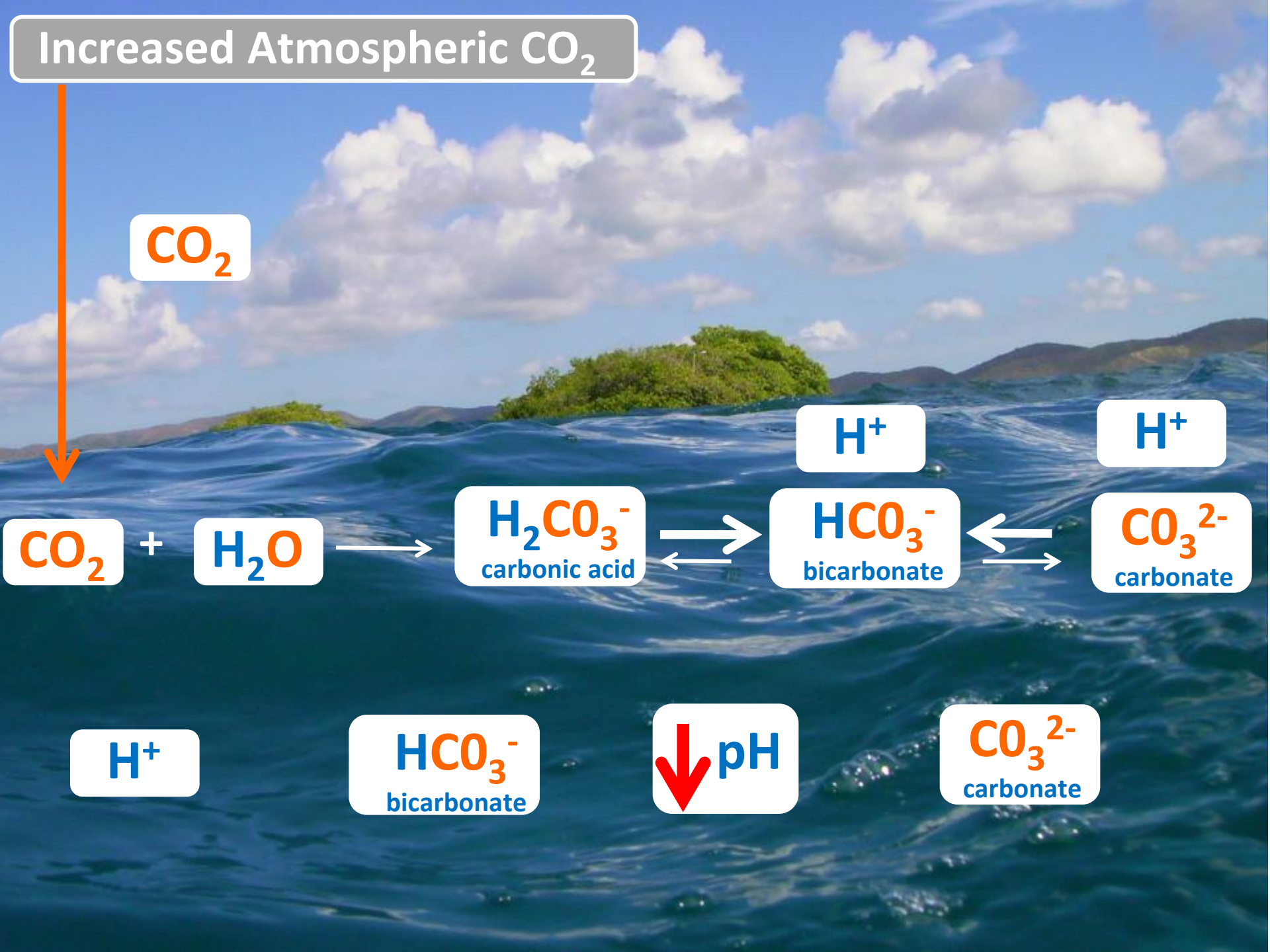
26%

2.5±0.5 Pg C y^{-1}

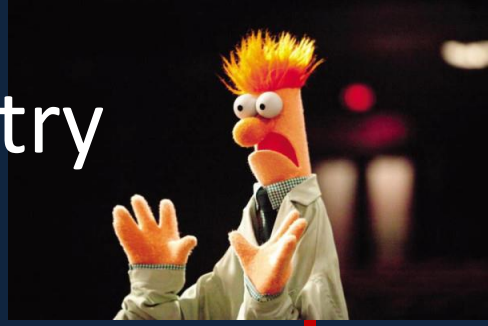
Oceans

24%

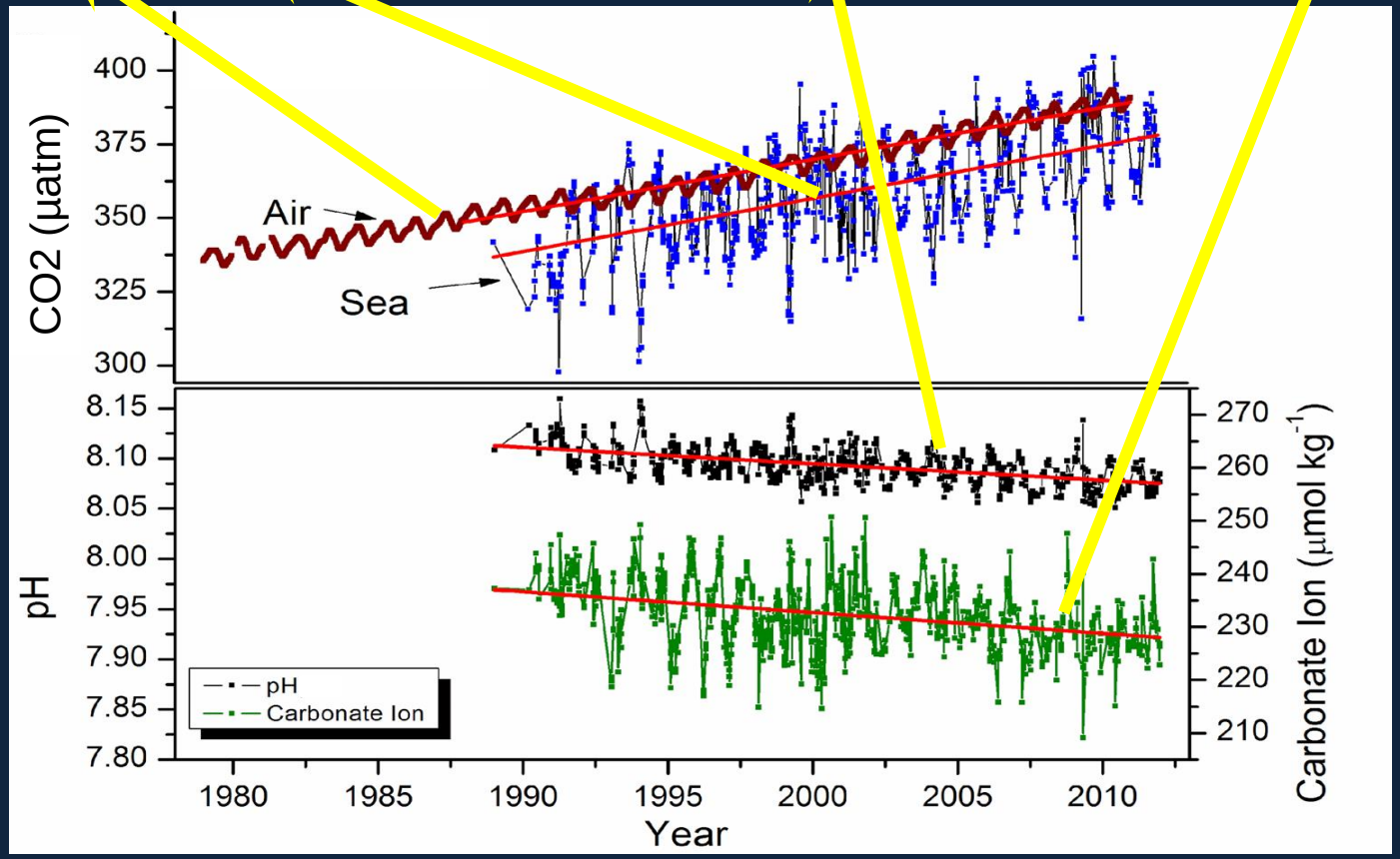
Global Carbon Project 2010; Updated from Le Quéré et al. 2009, Nature Geoscience; Canadell et al. 2007, PNAS


Increased Atmospheric CO_2
CO_2
CO_2 + H_2O
$H_2CO_3^-$
carbonic acid
H^+
HCO_3^-
bicarbonate
H^+
CO_3^{2-}
carbonate
H^+
HCO_3^-
bicarbonate
pH
CO_3^{2-}
carbonate

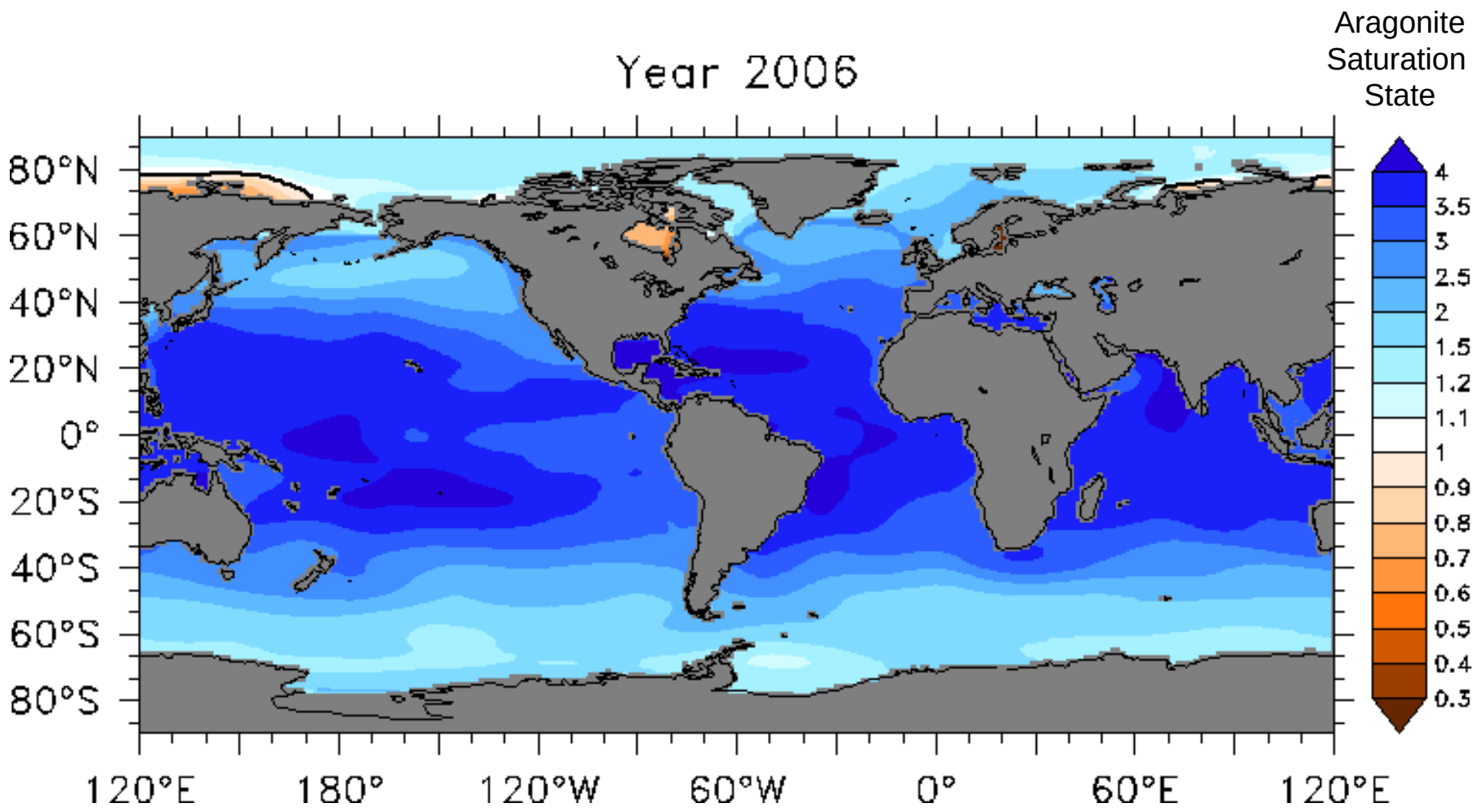
Ocean acidification: the chemistry



$$CO_{2(atmos)} \leftrightarrow CO_{2(aq)} + H_2O \leftrightarrow H_2CO_3 \leftrightarrow H^+ + HCO_3^- \leftrightarrow 2H^+ + CO_3^{2-}$$



Geographic variability



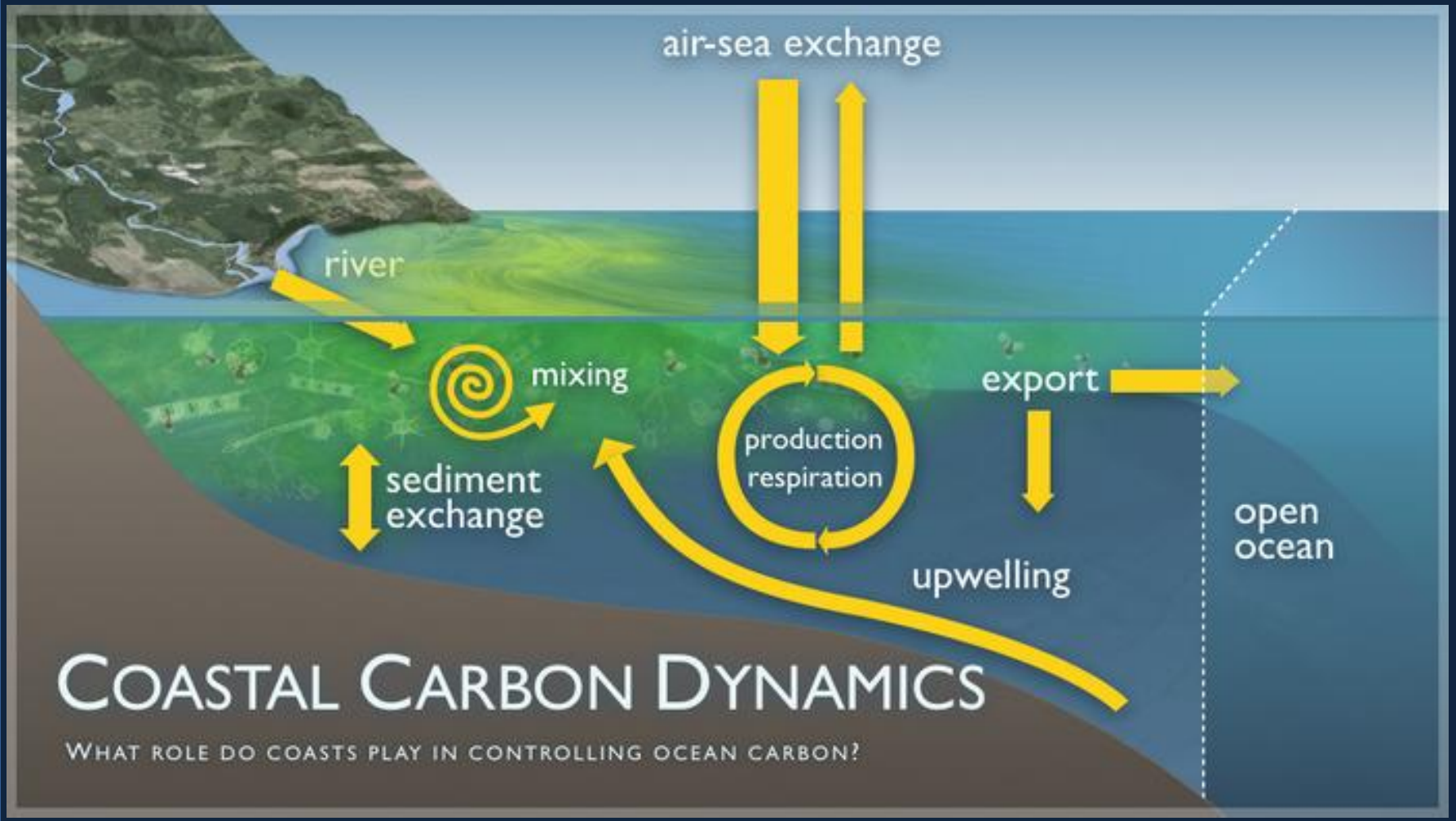
Jim Orr

Ocean acidity could increase 100-150% by the year 2100.

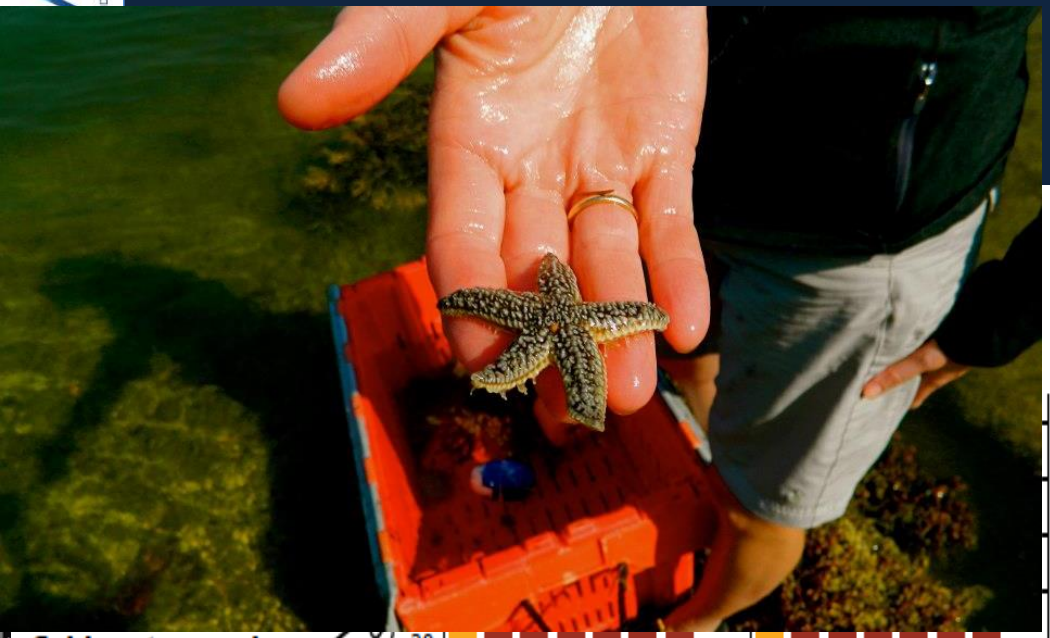
The rate of acidification is 10-100 times faster than any time in the last 50 **MILLION** years.

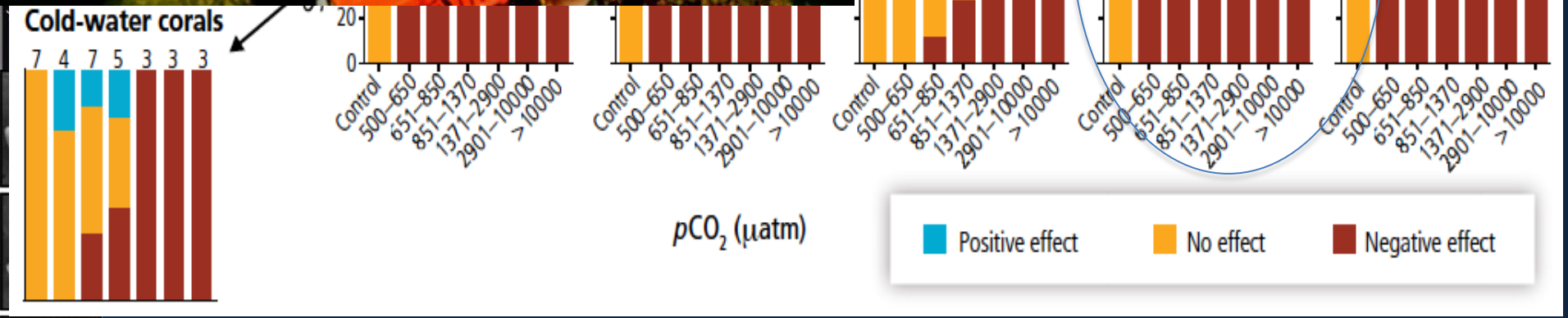
Ocean Acidification v2.0

v2.0 v1.0



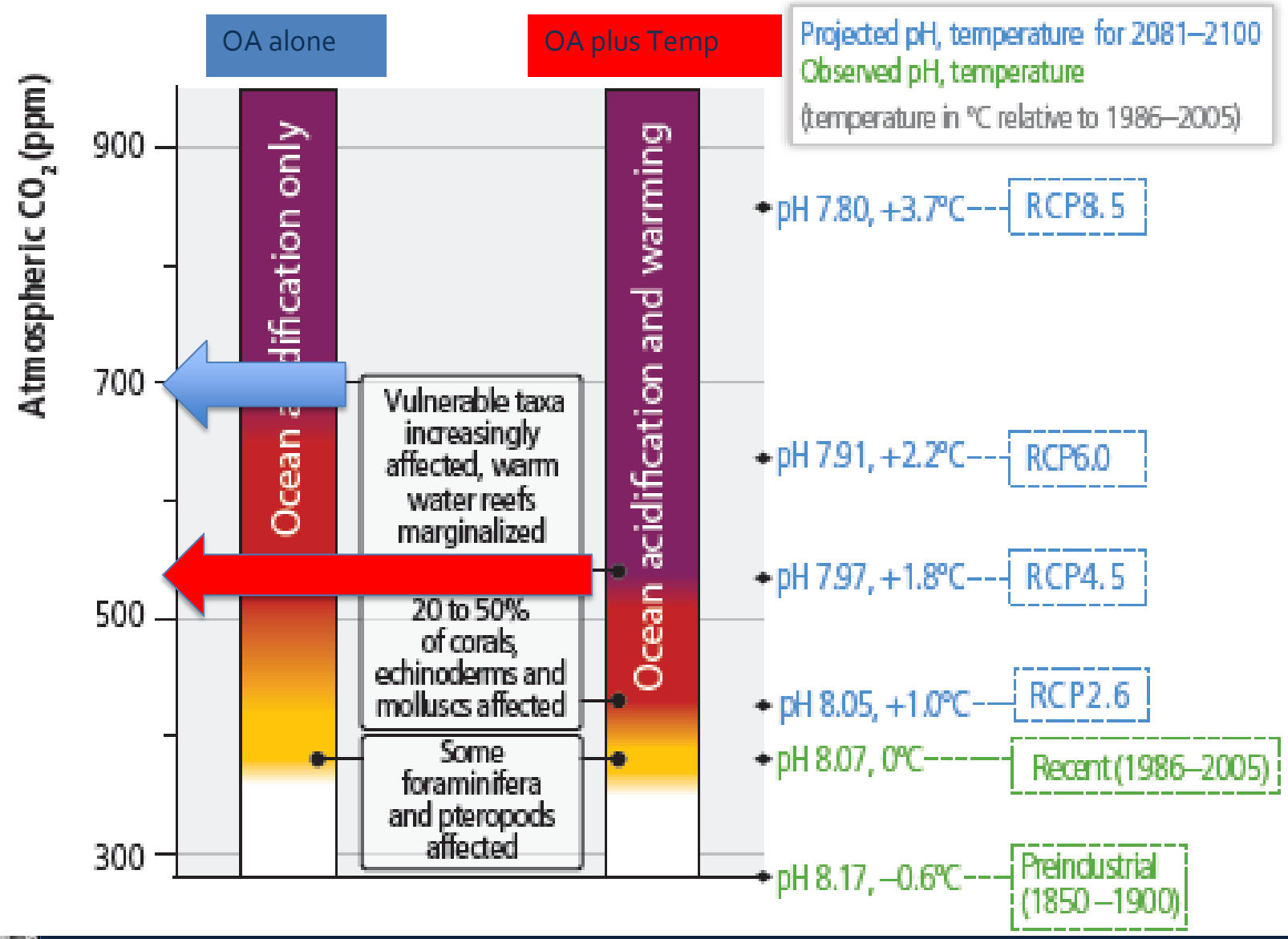
Sensitivity to Ocean Acidification Across Phyla



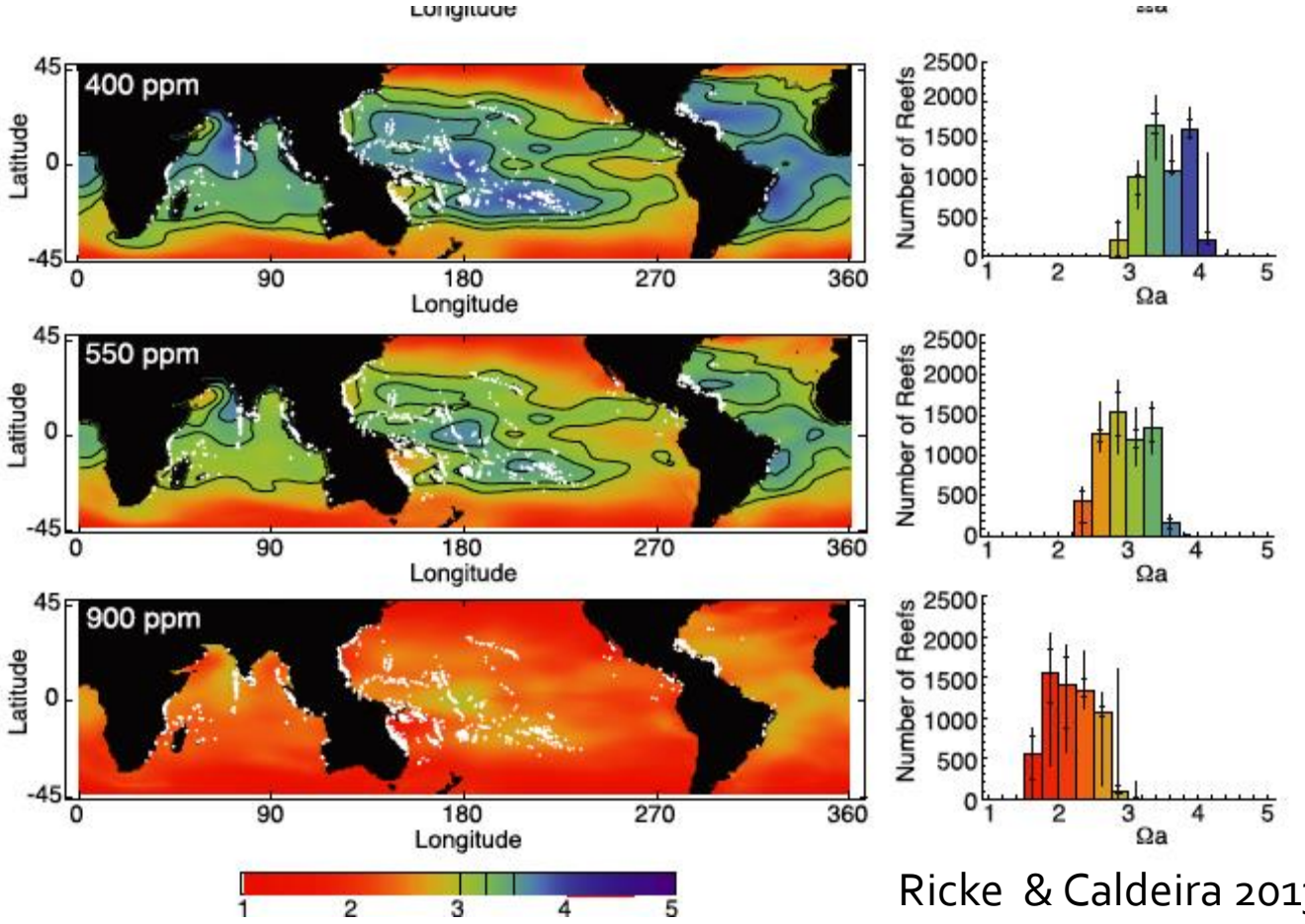


High Confidence → Lower Confidence

The Combined Effects of T and CO_2 Make Marine Ecosystems More Vulnerable in the Future

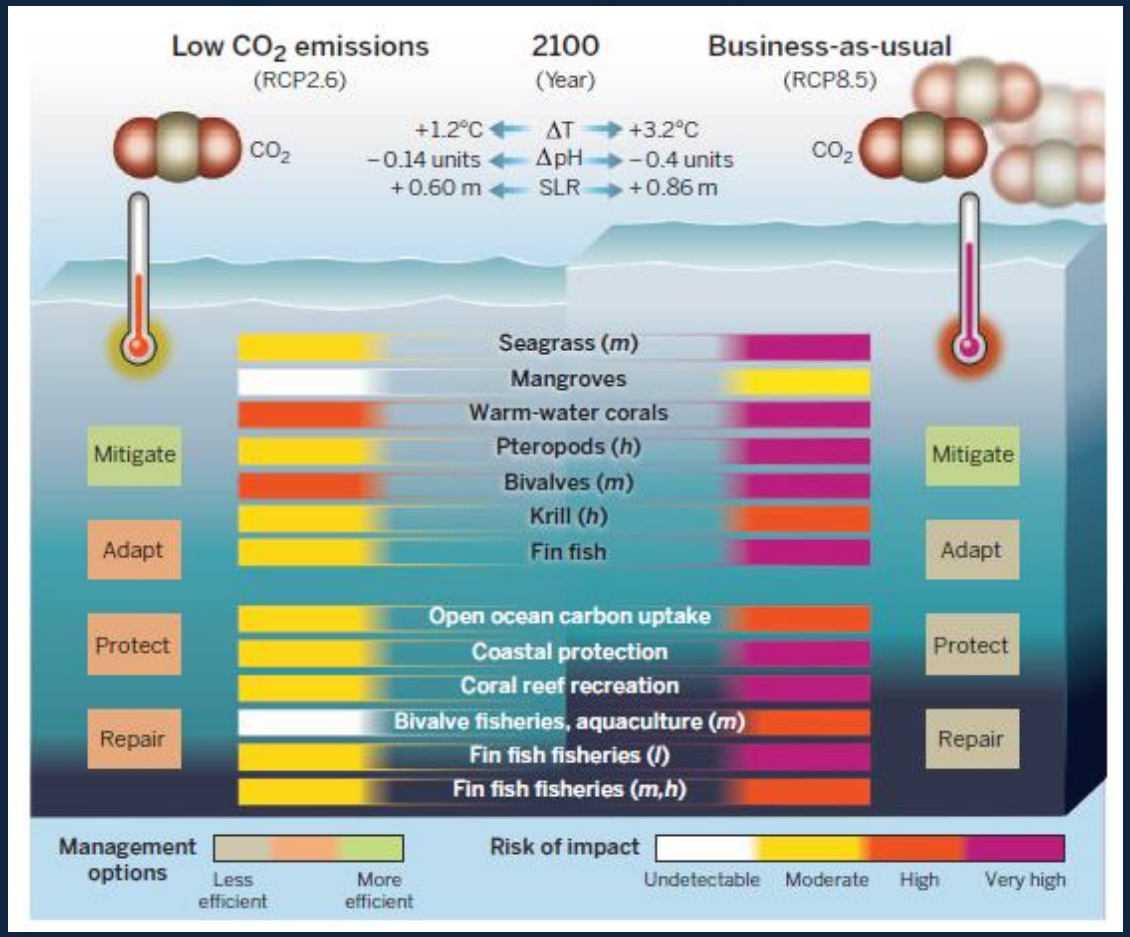


Coral Reef Vulnerability



Ricke & Caldeira 2013

Evidence since IPCC AR5

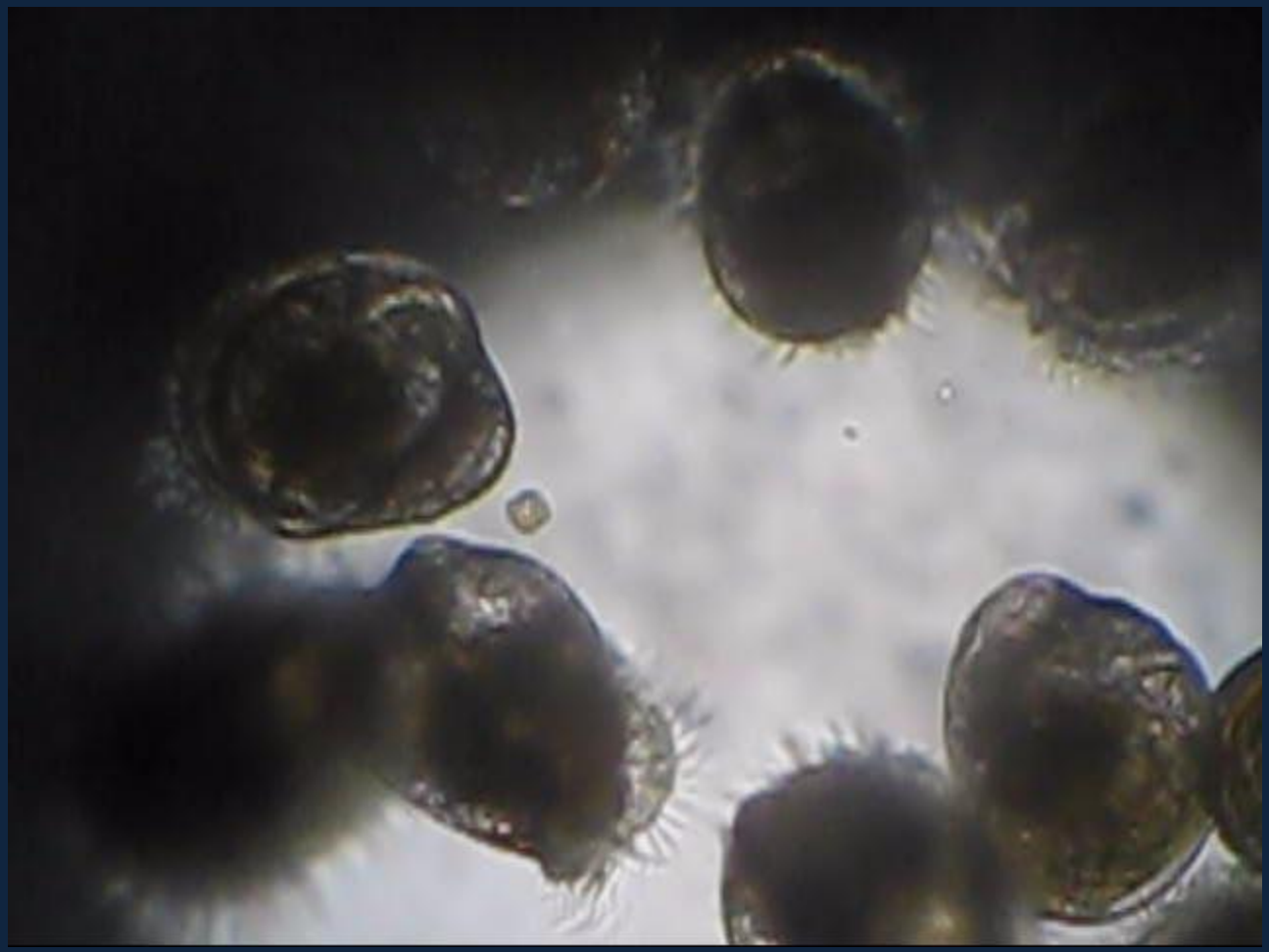


Gattuso et al. *Science* 2015

OA will affect marine food webs

OA impacts on just one or a few species can have big effects on the food web and ecosystem services

Oyster larvae




NOAA OCEAN ACIDIFICATION PROGRAM
0 days
15 days
30 days
45 days
-280 ppm CO2
200 µm
-390 ppm CO2
200 µm
-750 ppm CO2
200 µm
-1500 ppm CO2
200 µm


Monitoring


Education &
Outreach


Biological &
Ecosystem
Response


OAP
NOAA OCEAN ACIDIFICATION PROGRAM


Adaptation


Data
Management
Ocean Acidification Program Office & Regions
Alaska
Global Monitors
Great Lakes
Northeast
West Coast
PMEL
Newport OR
Seattle WA
Sandy Hook NJ
OA Program Office Silver Spring


Modeling

Actions?

- Observe the change (eg. track aragonite saturation state; coral cover)
- Understand which species and habitats are vulnerable (research)
- Protect those species/habitats so they will be more resilient (create protected areas)
- Reduce nutrient inputs into coastal waters (fertilizers, sewage)

Ocean Acidification Observing