The Science of Ocean Acidification

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Recent Trends: Atmospheric CO2 and Ocean pH

Air $pCO_2$ trend = $+1.69 \pm 0.03 \mu atm \ y^{-1}$
Sea $pCO_2$ trend = $+1.88 \pm 0.15 \mu atm \ y^{-1}$

In situ pH trend = $-0.0019 \pm 0.0002 \ y^{-1}$
Ocean Acidification Scenarios

Aragonite Saturation Levels in 1765

Aragonite Saturation Levels in 1995

Aragonite Saturation Levels in 2040

Aragonite Saturation Levels in 2100

- **Shallow Coral**
- **Deep Coral**

Legend:
- 0.5: Extremely Low
- 1: Low
- 1.5: Marginal
- 2: Adequate
- 2.5: Optimal
Bringing it closer to home...
Uncharted Waters!
Coral Osteoporosis

Coral to “sea anemone” in acidified water

But sea anemones cannot build reefs
Reefs of the future

Remember

Business as usual = 650 ppm
Double pre-industrial CO₂ = 550 ppm
CO₂ lasts for centuries in the atmosphere
pH and Other Marine Organisms
Bottom Line: It’s Complicated
And these are simple studies:
Single species
One measure

10x 3x 2x Now 10x 3x 2x Now 10x 3x 2x Now
(2856 ppm 903 ppm 606 ppm 409 ppm)
Ocean Crises

An ever growing list of calamities