Please note that this presentation was given during the United Nations Climate Change Conference (COP-15) in Copenhagen, December 7-18, 2009 for more information please visit http://www.cop15.state.gov/ .

“Coral reefs as causalities of climate change”

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Coral reefs:

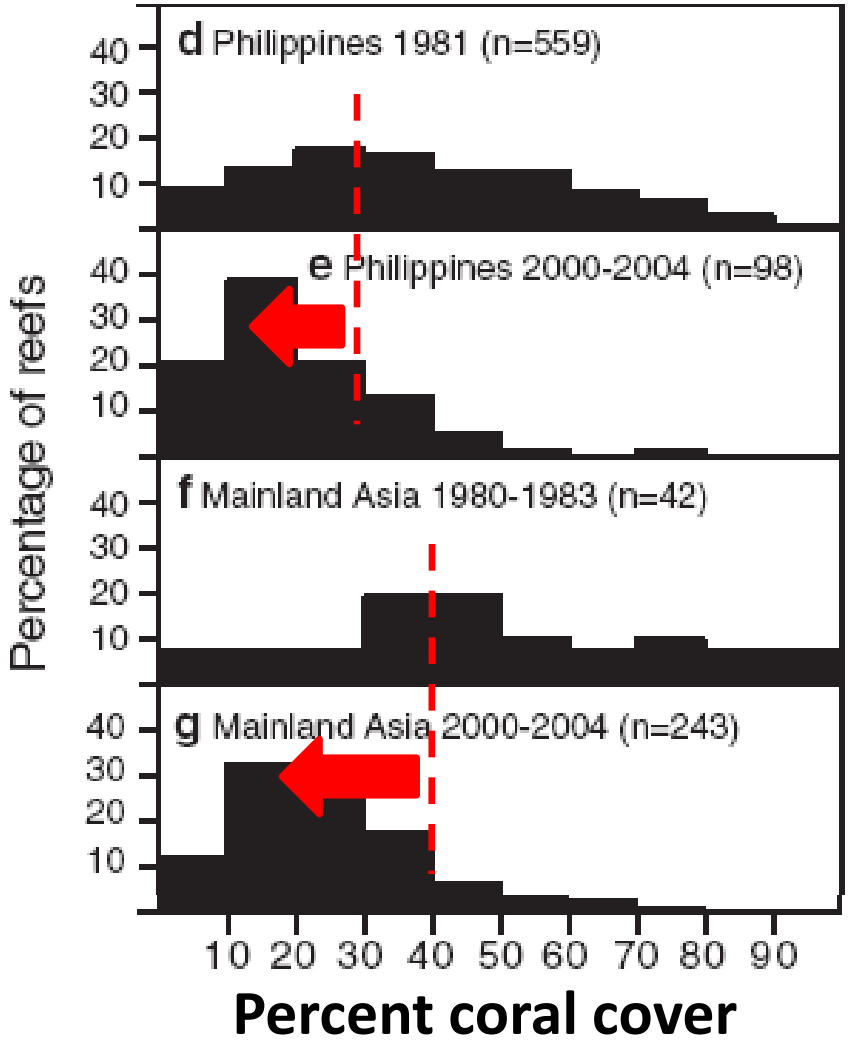
0.1% of the Earth's surface

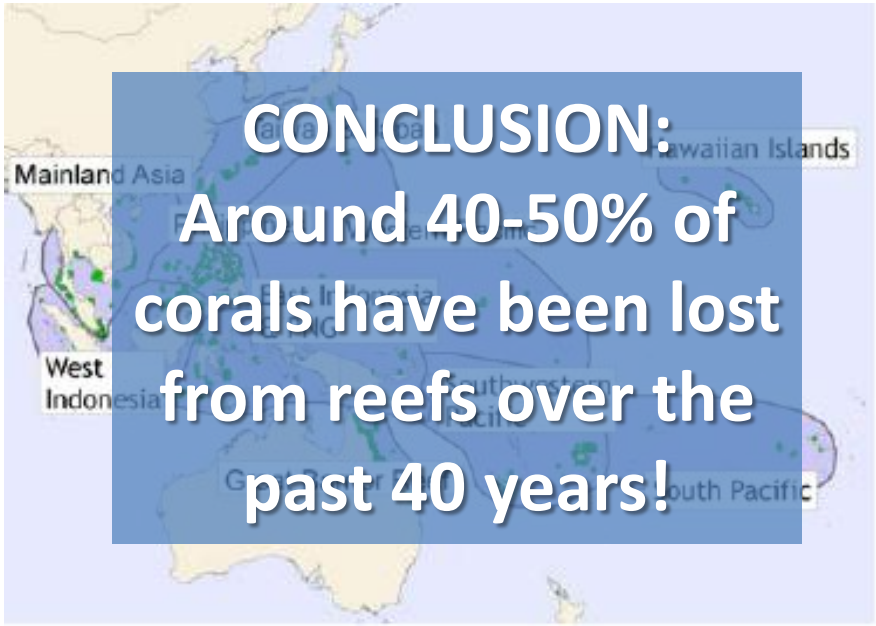
>500 million people, $ billion industries

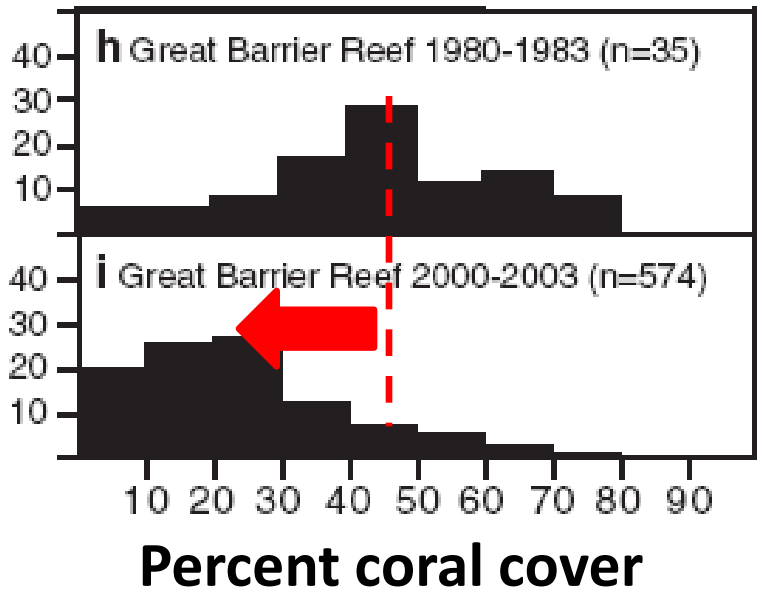
Ecological services: food, income, coastal protection

Bruno and Selig (2007)

Meta-analysis of over 6000 studies reporting coral cover







Bruno and Selig 2007, PLoS ONE 2, e711. doi:10.1371/journal.pone.0000711

Why are reefs deteriorating?

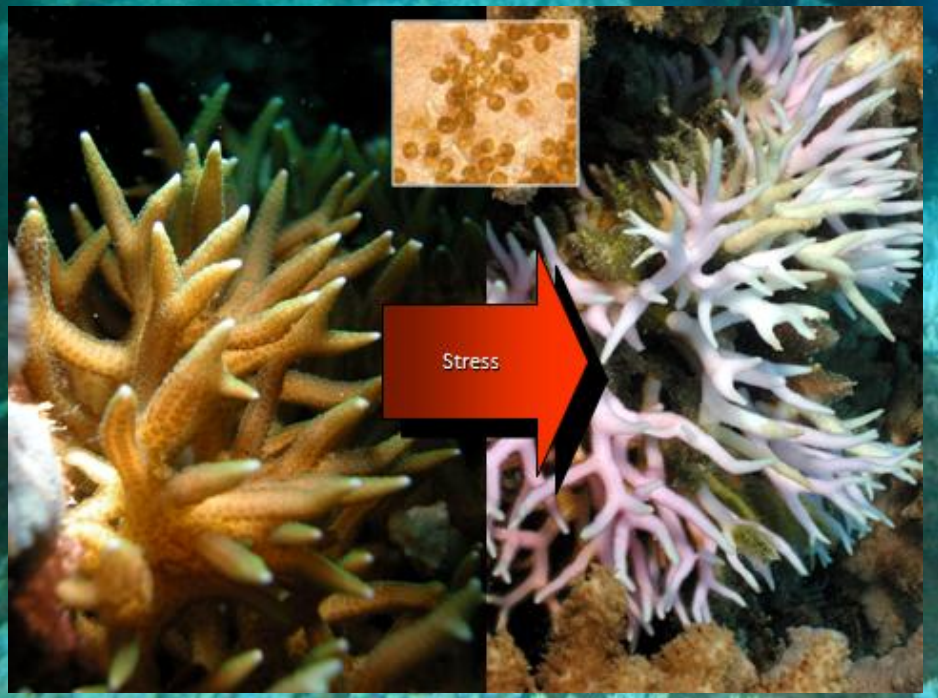
- Coastal development
  - Nutrients, toxins and sediments from agriculture, aquaculture and urban development
- Over-exploitation of marine species
  - Loss of critical functional groups
- Marine pollution
  - Sewage, petrochemicals, plastics
  - Shipping
- Physical destruction
  - Tourism; destructive fishing
- Climate change

- Sea temperature
- Ocean acidification
- Sea level rise
- Storm frequency
- Altered precipitation
- Ocean circulation

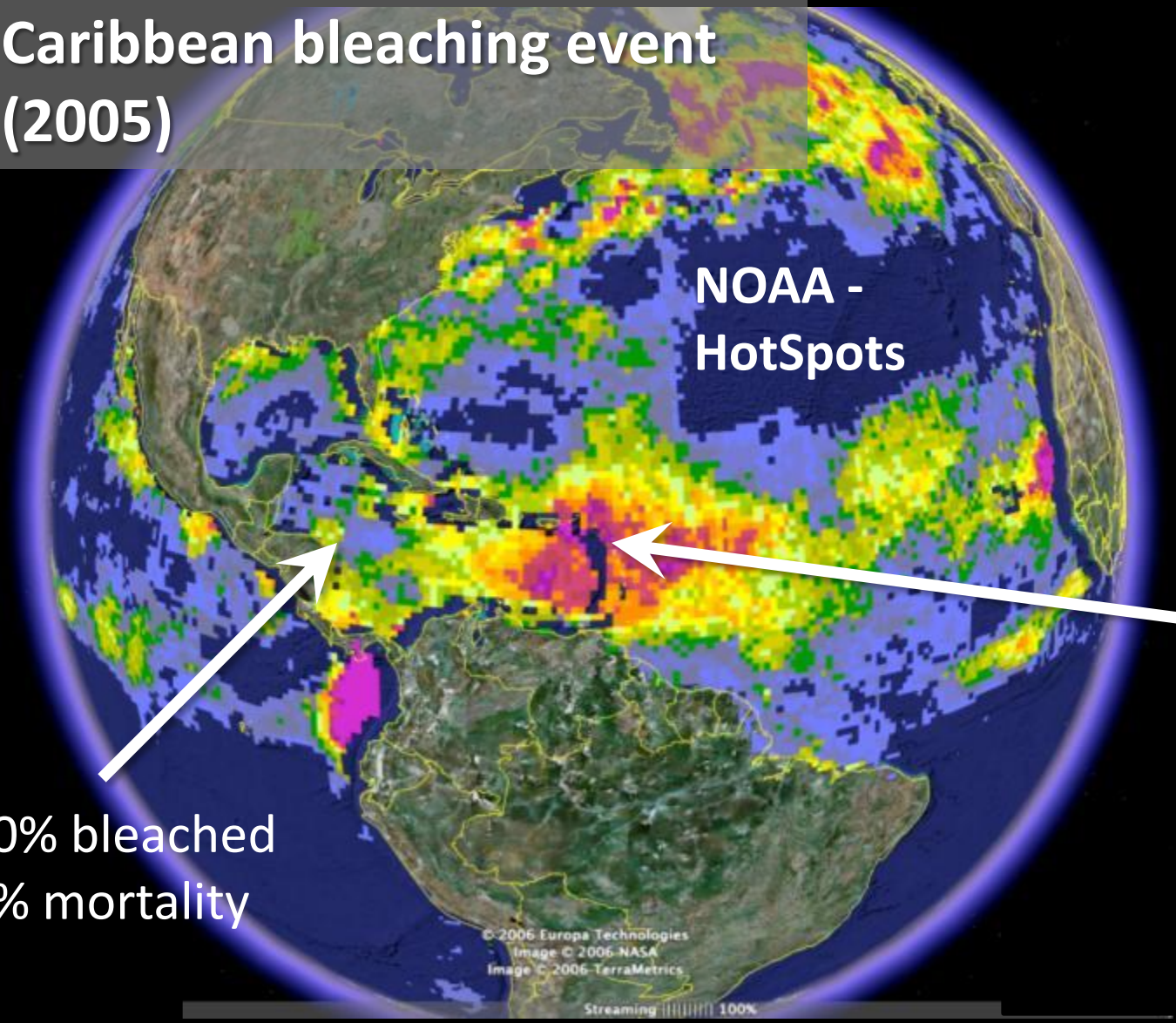
Mass coral bleaching

… FIRST APPEARS 1979

Triggered by 1°C increase in sea temperature above the long-term maxima summer maximum over 4 weeks (more begins to kill coral)



Caribbean bleaching event (2005)



November 1, 2005: Largest Caribbean temperature anomalies and coral bleaching ever seen

95% bleached
65% mortality

60% bleached
1% mortality

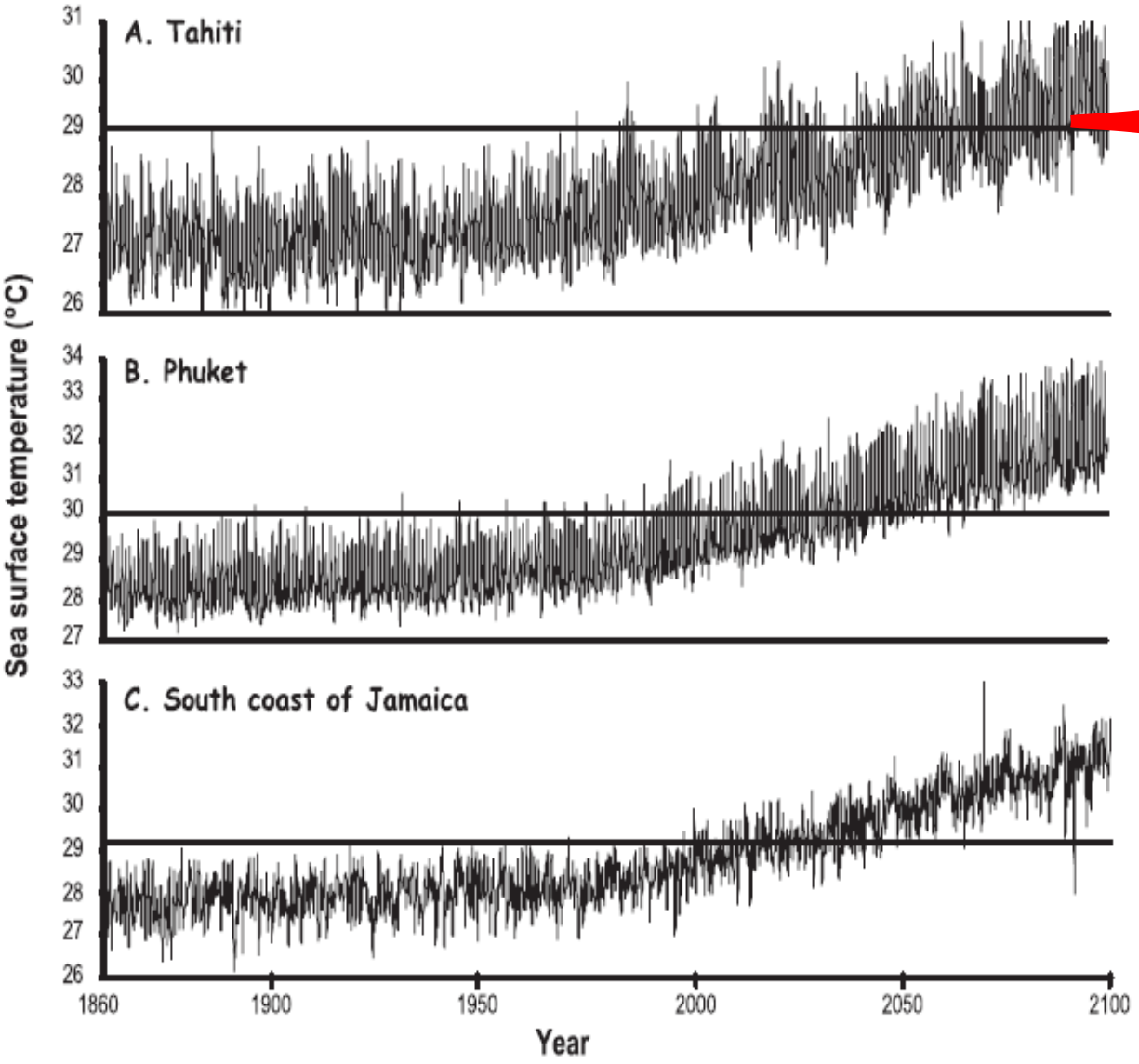
Anomaly size x time

Mild bleaching

Severe bleaching

Mass Mortality

Extrapolating from the past 30 years to the future (+2oC)



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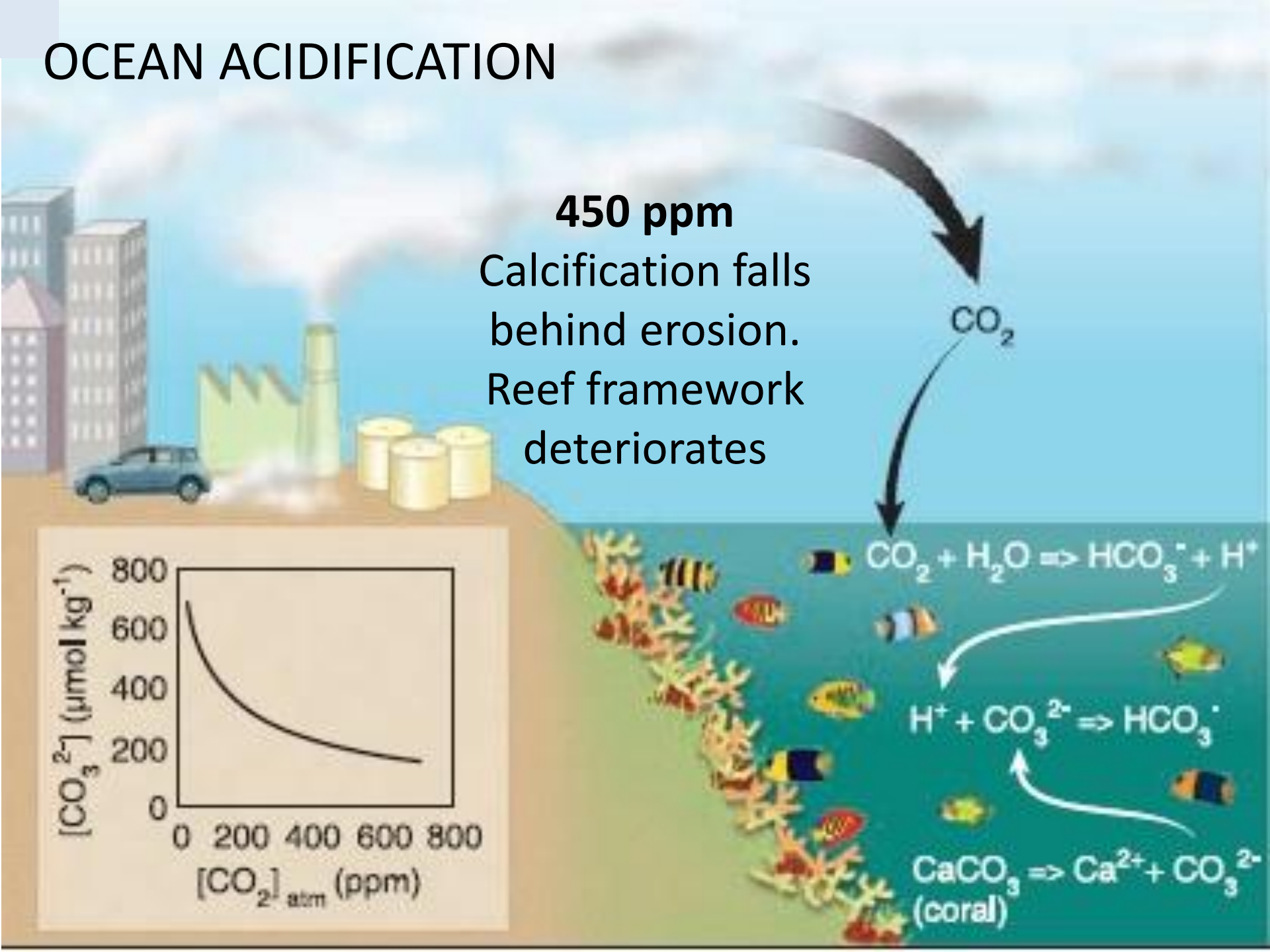
Threshold temperature – above which bleaching manifests itself (1°C above the long-term summer maximum temperatures)

WHAT DOES THE FUTURE HOLD?

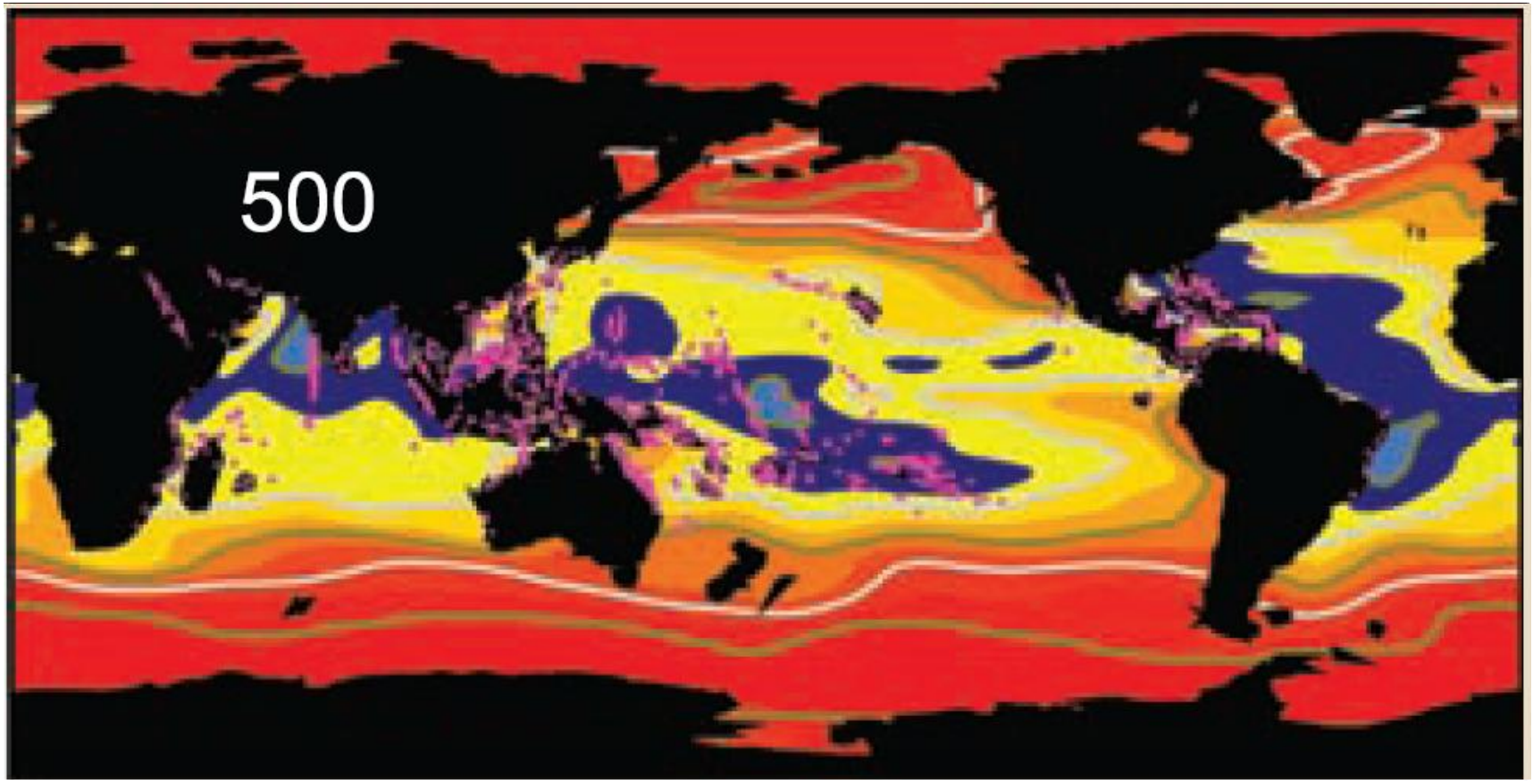
92A (doubling of CO_2 by 2100)

OCEAN ACIDIFICATION

450 ppm
Calcification falls behind erosion.
Reef framework deteriorates



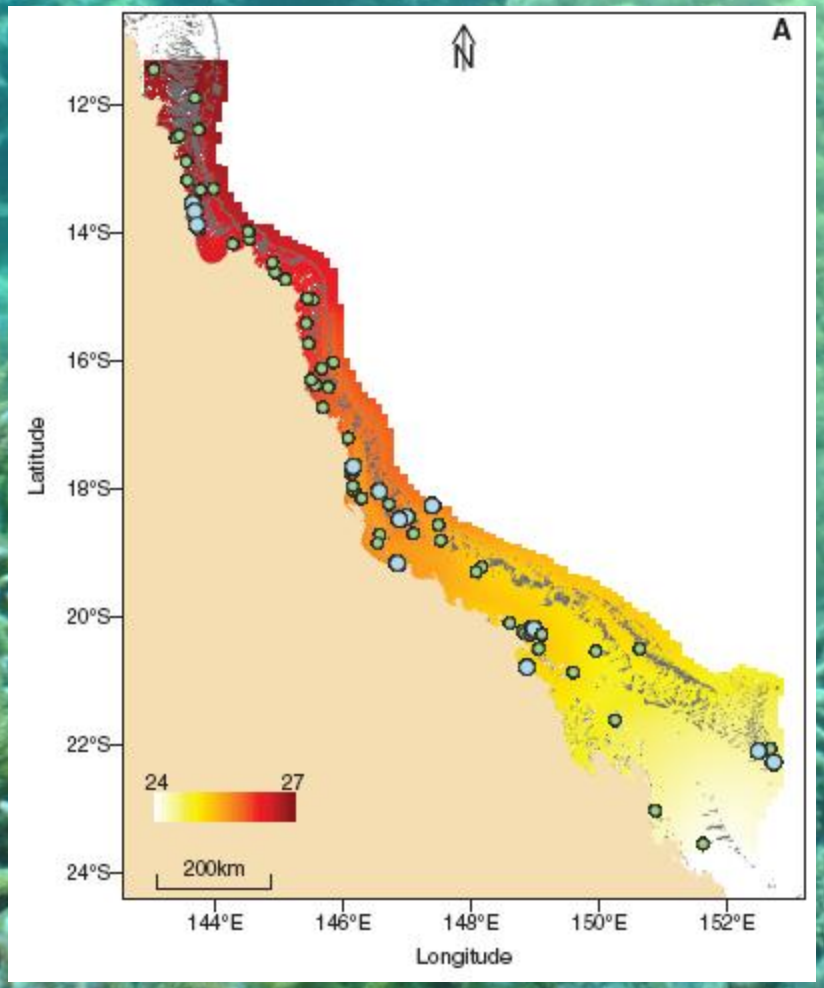
Projections from process knowledge

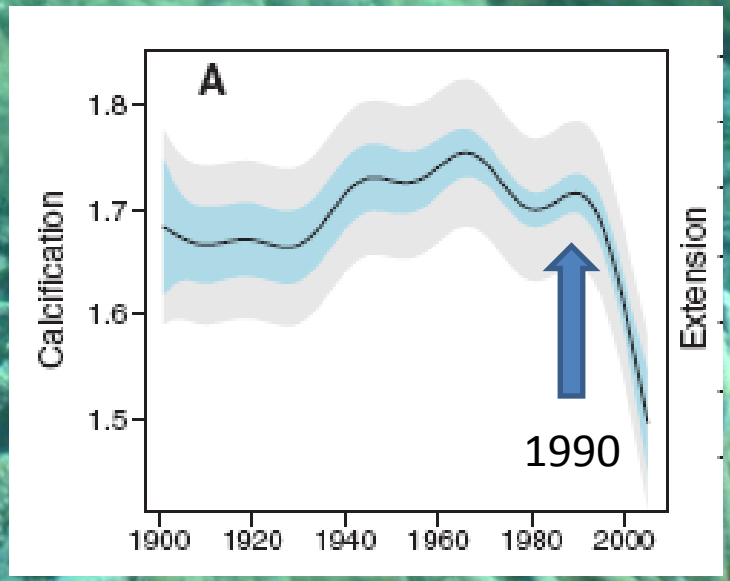


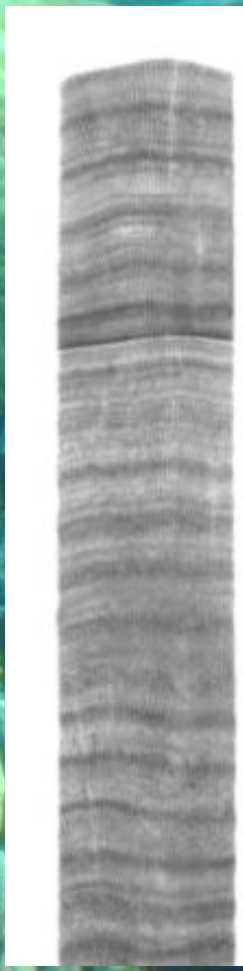
Long Cao and Ken Caldeira

3.3 (limit for carbonate coral reefs)

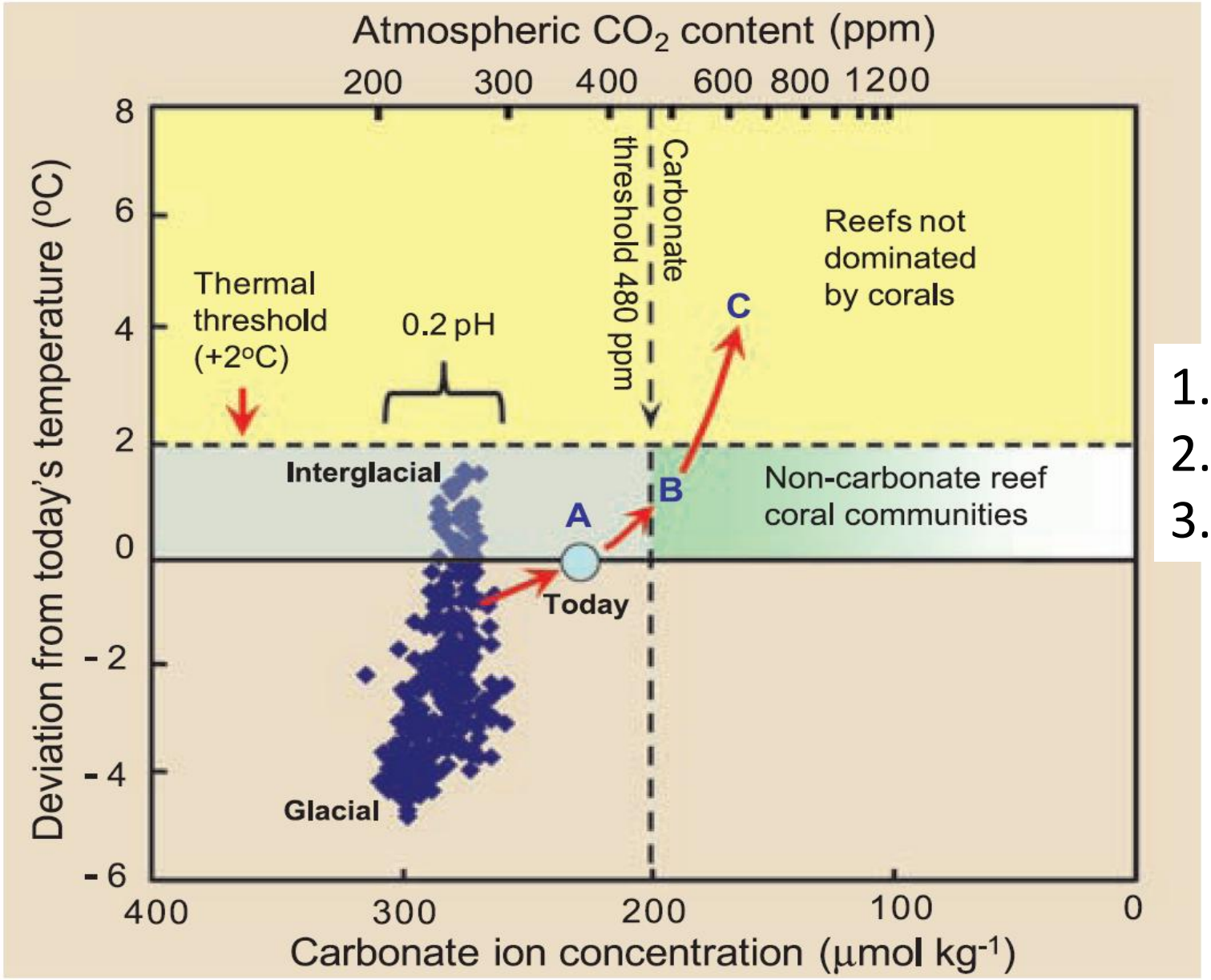
Calcification rate of GBR *Porites* corals has slowed by 14.5% since 1990 – unprecedented in 400 years of record (De'ath et al. 2009 Science)







Conditions where coral reefs have been for the last 420,000 years



1. Unusual
2. Rapid
3. Thresholds

Hoegh-Guldberg et al. (2007, Science , 318)


MORE THAN
JUST CORALS

Summary

1. Carbonate coral reef ecosystems are not sustainable beyond 450 ppm (CO_2) or global temperatures +2^{o}C over preindustrial values.

2. Eliminating coral reef habitats will lead to the extinction of 10-20% of marine species who depend on coral reefs for their existence.

3. Losing coral reefs will have enormous consequences for food and income of over 500 million coastal people living in 90 nation states.

4. Longer term consequences include reduced coastal protection which will exacerbate the impacts of higher sea levels and stronger storms.

Policy implications

1. Targets must take us to safe concentrations of carbon dioxide (350 ppm), even if this takes time to achieve. Otherwise coral reefs will disappear in the next 50 years.

2. The 350 ppm pathway must minimise time near or above CO_2 concentrations of 450 ppm.

3. This means emissions must peak in 2015 rapidly decrease by 30-40% by 2020, and over 90% by 2050.

4. This decision has huge implications for coral reefs, biodiversity and plight of millions of dependent people.