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Goldman Sachs Finds Window For Profitable Investment In Coal Mining Is Closing

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58



18



4



0



80



Posted by:

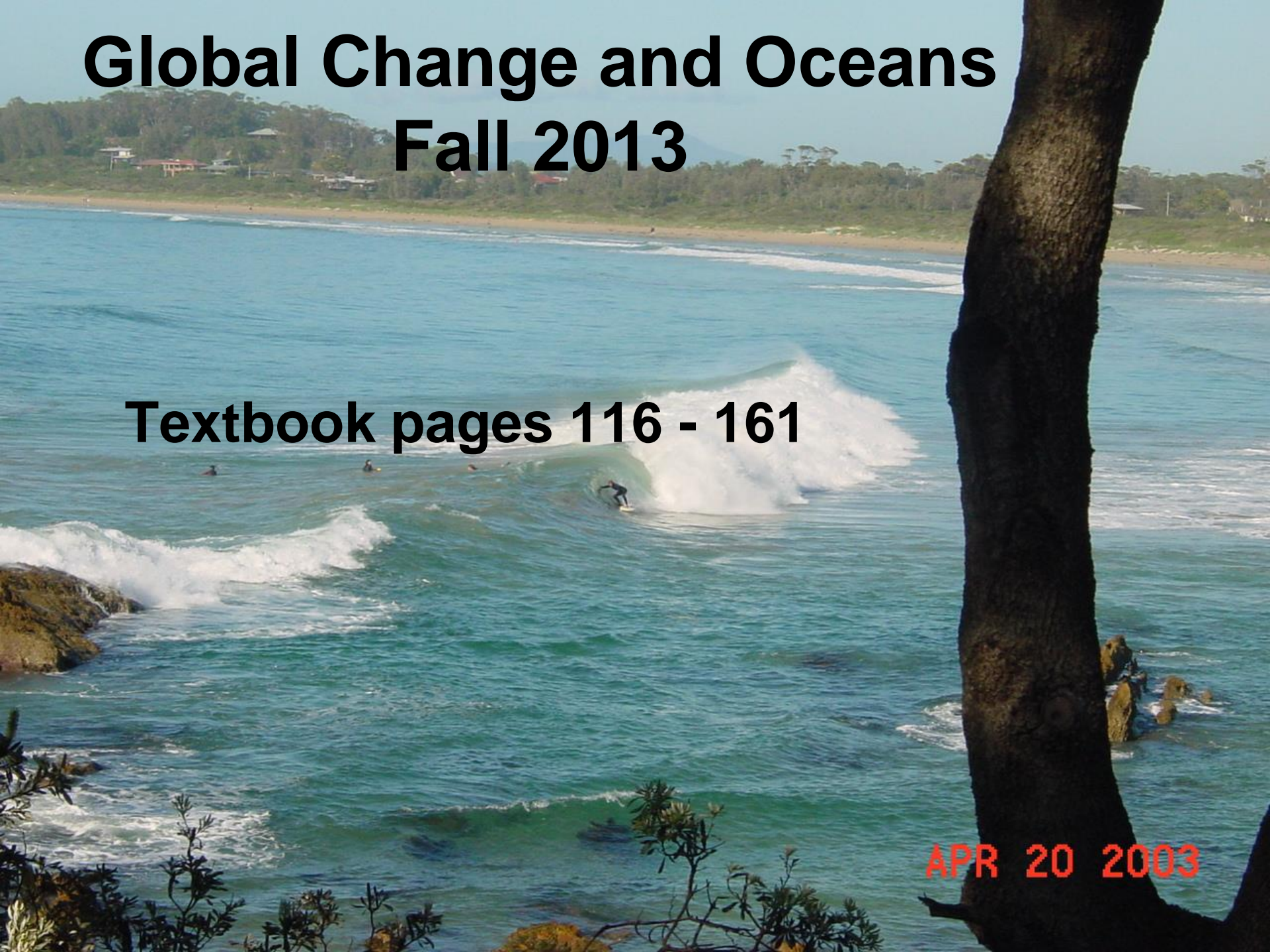
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Global Change and Oceans

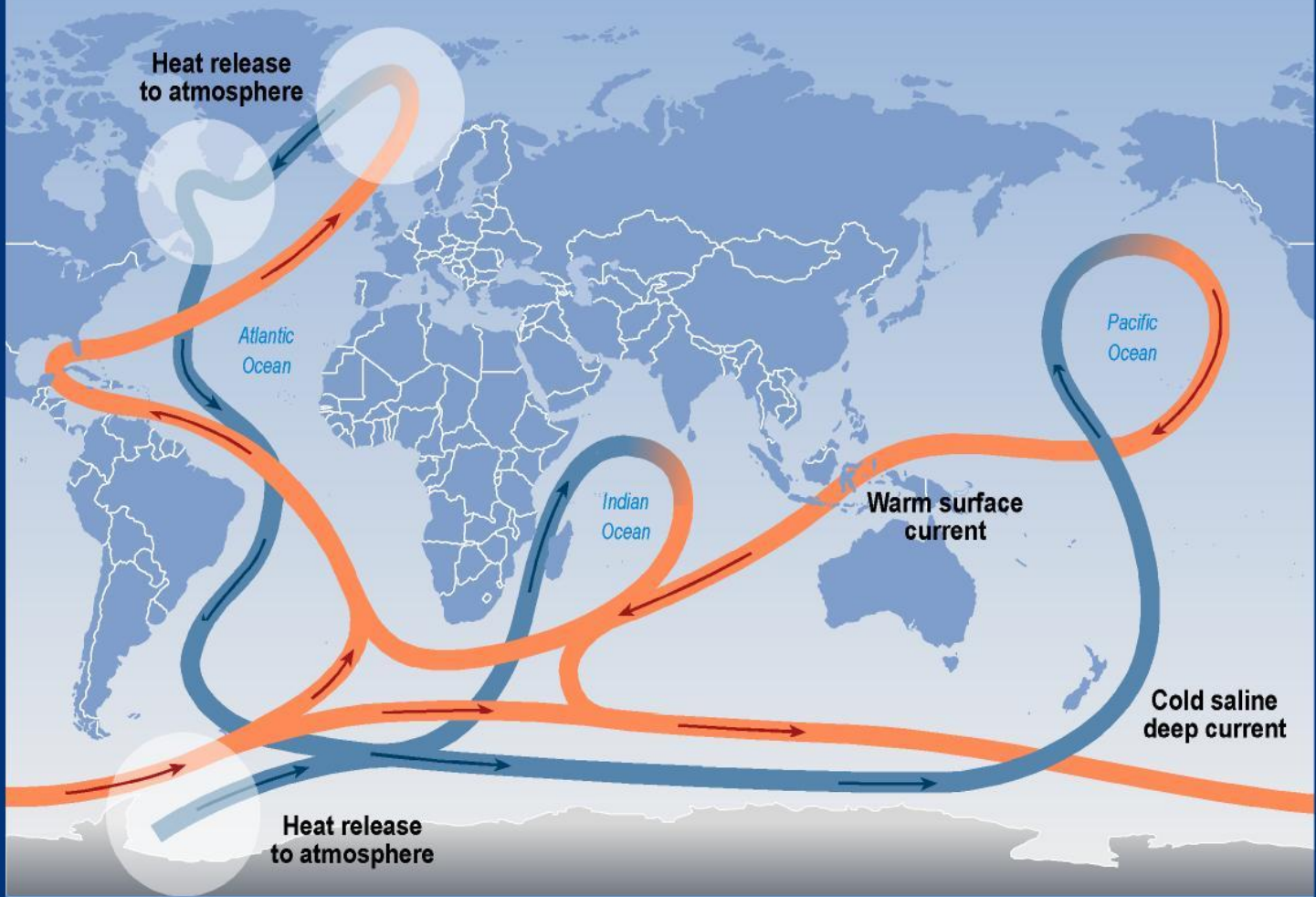
Fall 2013

Textbook pages 116 - 161

APR 20 2003



Great ocean conveyor belt

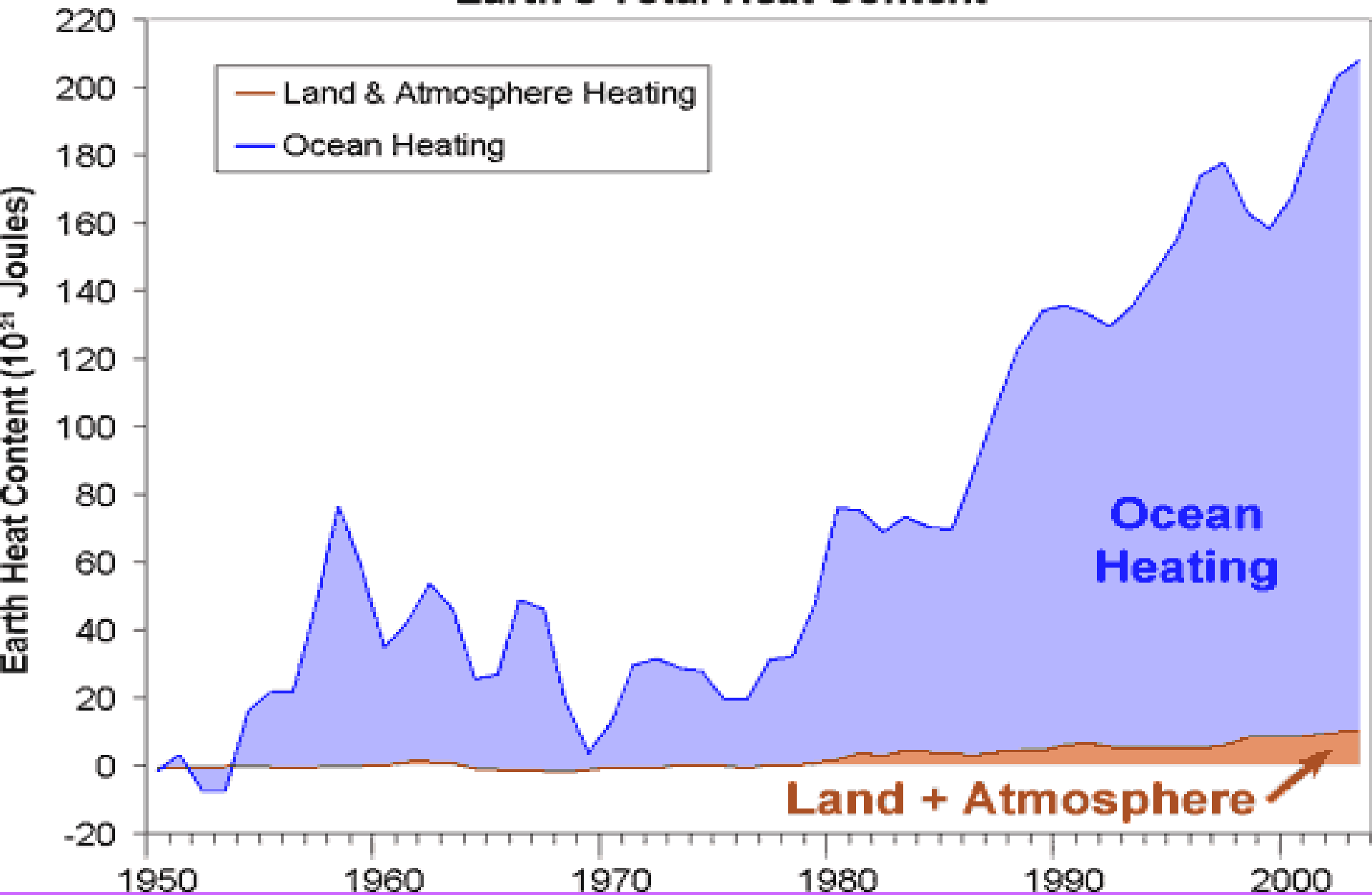


SYR - FIGURE 4-2

An aerial photograph of a mountain range, likely the Sierra Nevada, showing a large lake in the center and a thin layer of atmosphere visible at the top left. The text "The Atmosphere is very small" is overlaid in white.

**The Atmosphere is very
small**

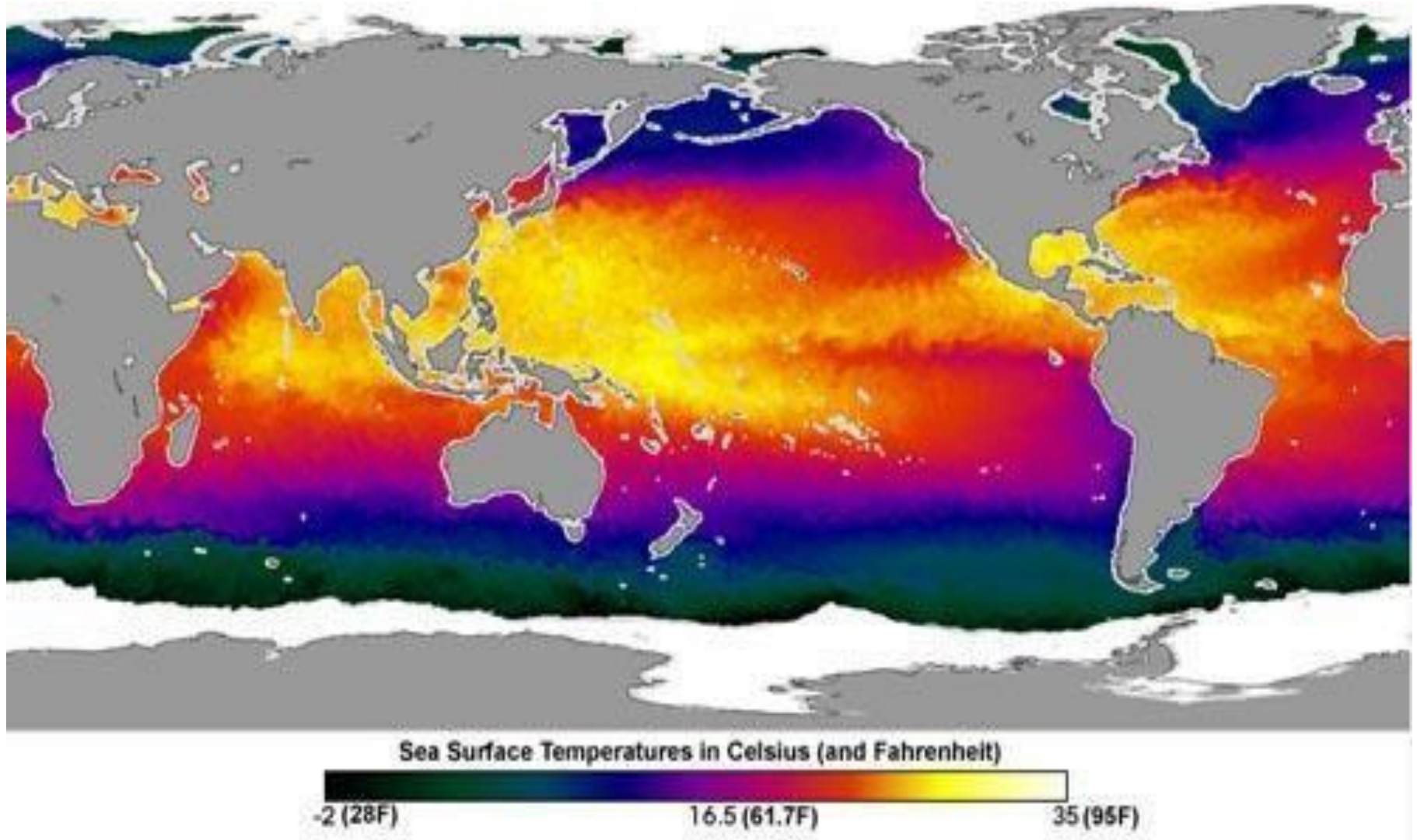
Earth's Total Heat Content



Data From Murphy et al 2009, Domingues et al 2008

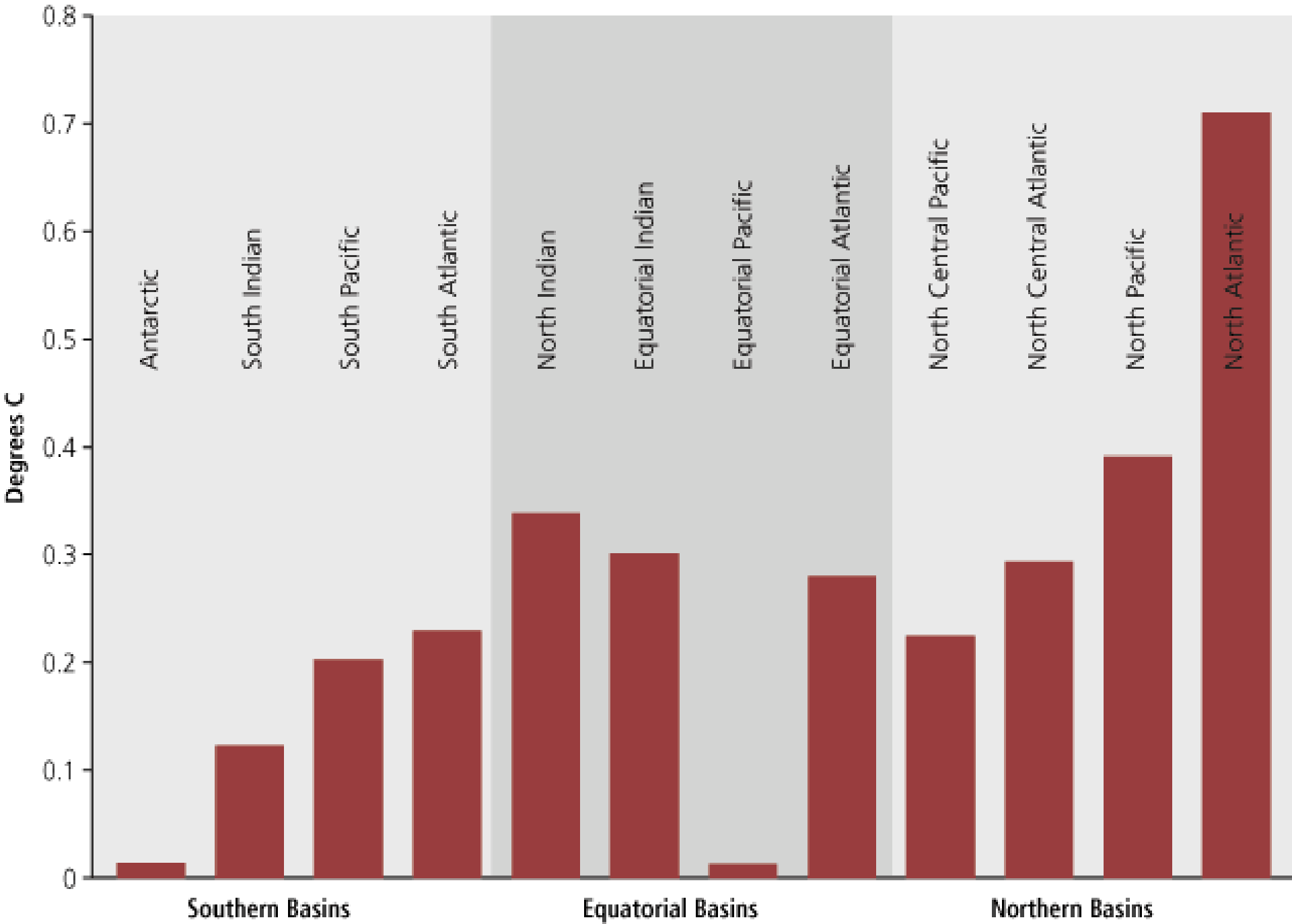
Graph from <http://www.skepticalscience.com/>

OCEAN SURFACE TEMPERATURES

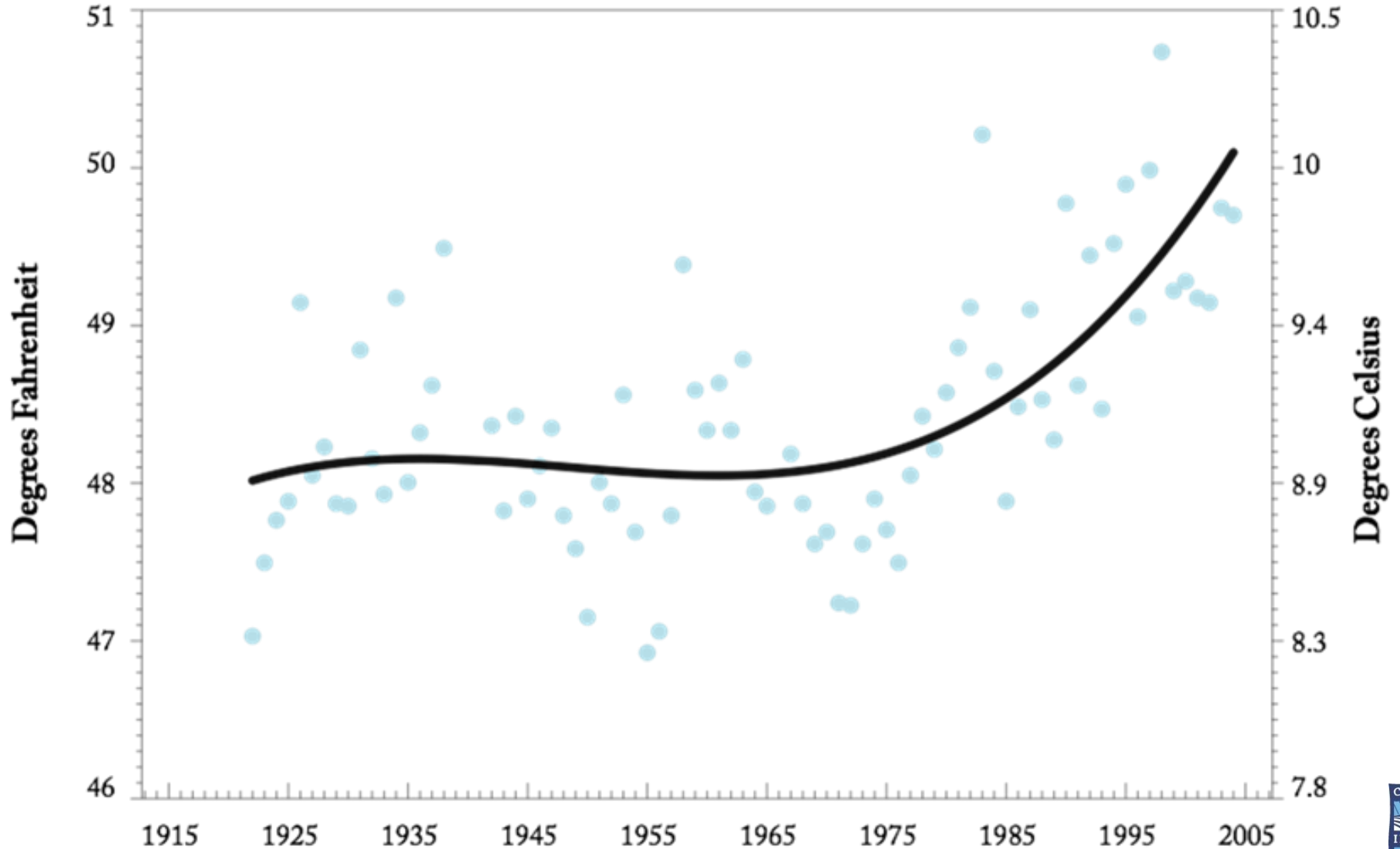


70% OF LAND IS IN NORTHERN HEMISPHERE

Change (SeaWiFS-CZCS) Sea Surface Temperature [1979 – 2002]

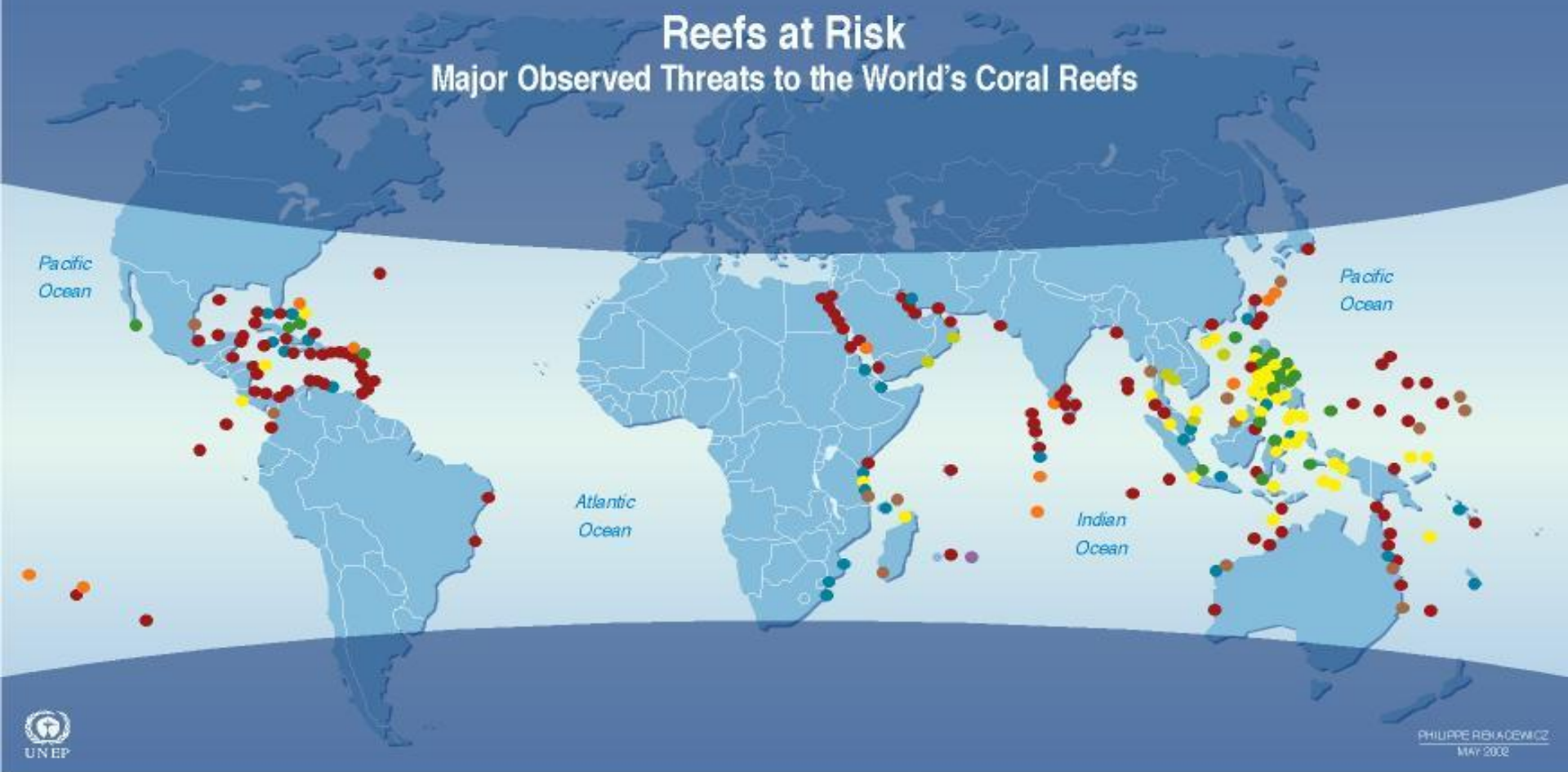


Sea Surface Temperature (Race Rocks lighthouse, Victoria)



Reefs at Risk

Major Observed Threats to the World's Coral Reefs

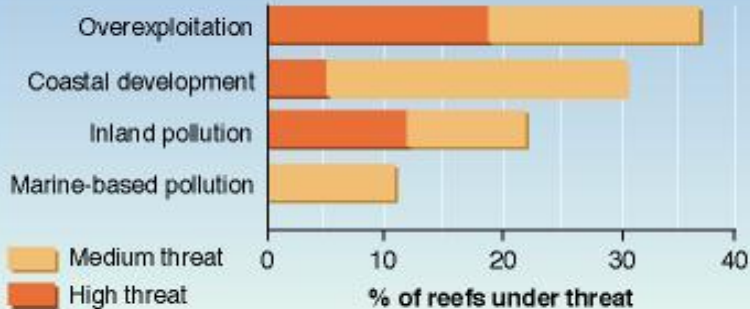


PHILIPPE RENKOWICZ
MAY 2002

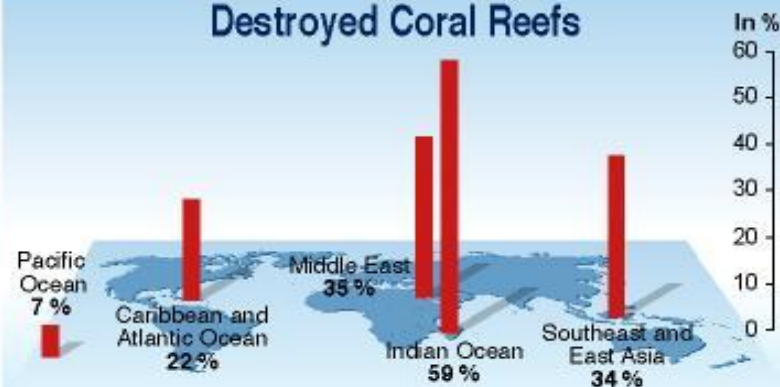
Categories

- Tourism
- Poison fishing
- Overexploitation
- Sedimentation
- Coral harvesting
- Dynamite fishing
- Pollution

Major Threats to Reefs

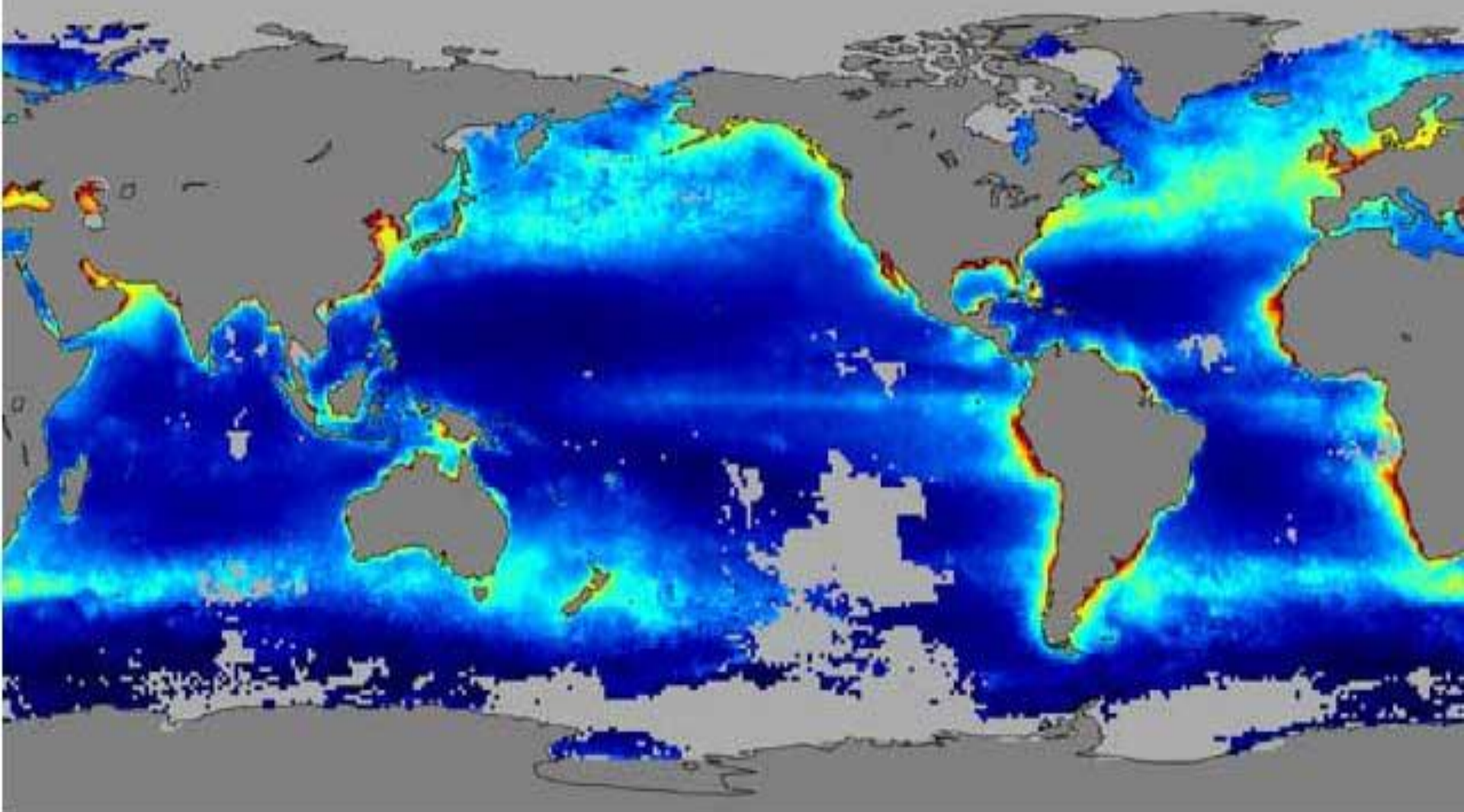


Destroyed Coral Reefs

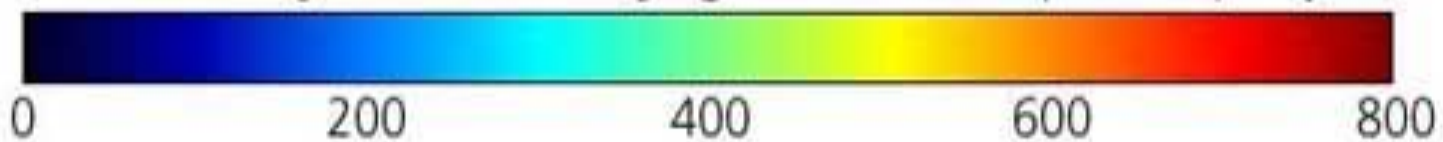




**BLEACHING OF
CORAL REEFS BY
OCEAN TEMPS >
85deg**

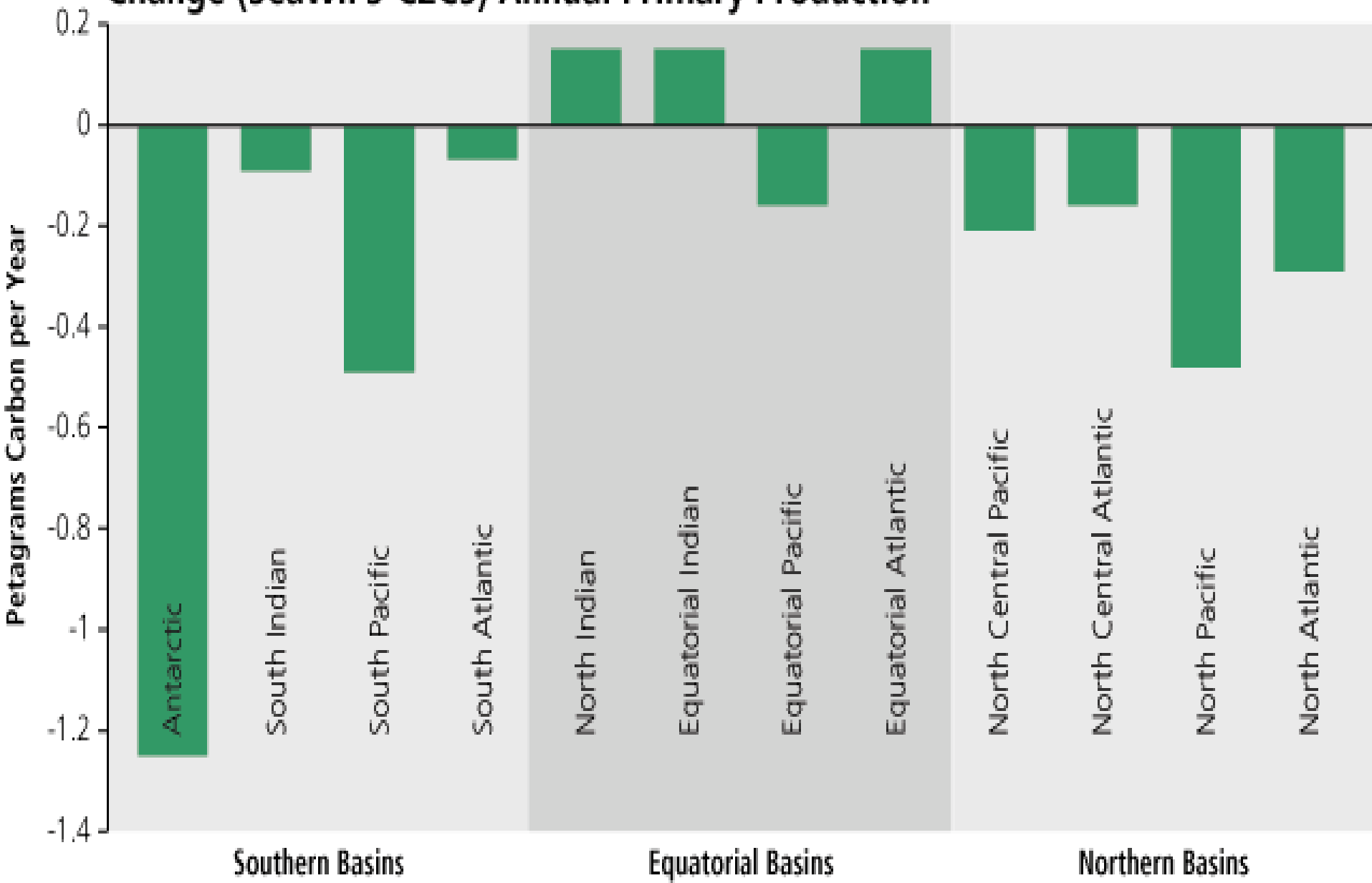


Net Primary Productivity (grams Carbon per m² per year)



CHANGE IN OCEAN NPP [1979 - 2002]

Change (SeaWiFS-CZCS) Annual Primary Production



Ocean acidification

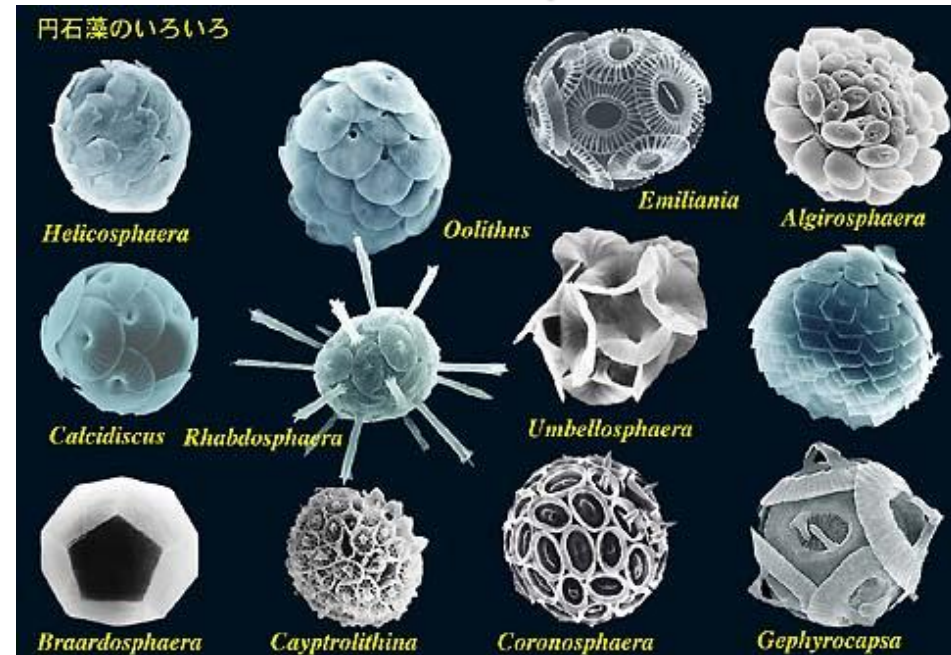
- CO_2 is corrosive to the shells and skeletons of many marine organisms

Corals



Photo: Missouri Botanical Gardens

Calcareous plankton

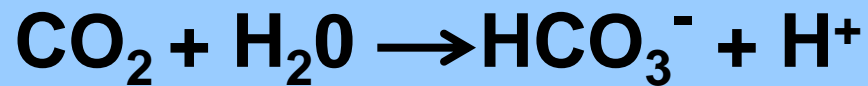


<http://www.biol.tsukuba.ac.jp/~inouye>

Ocean Acidification

Over the last 200 years, about **50%** of all CO₂ produced on earth has been **absorbed by the ocean**. (Royal Society 6/05)

Dissolves in sea water



(ACID)

Water becomes more acidic.

Remains in the atmosphere (greenhouse gas)

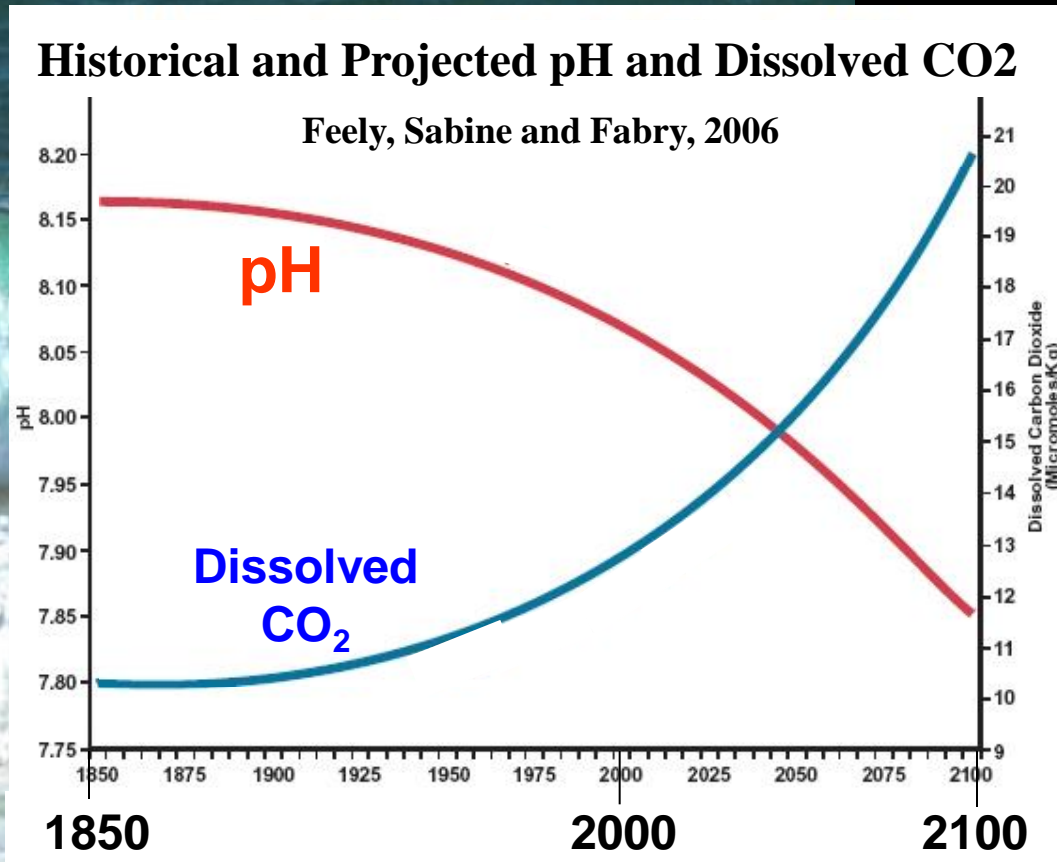
CO₂

CO₂



Ocean Acidification

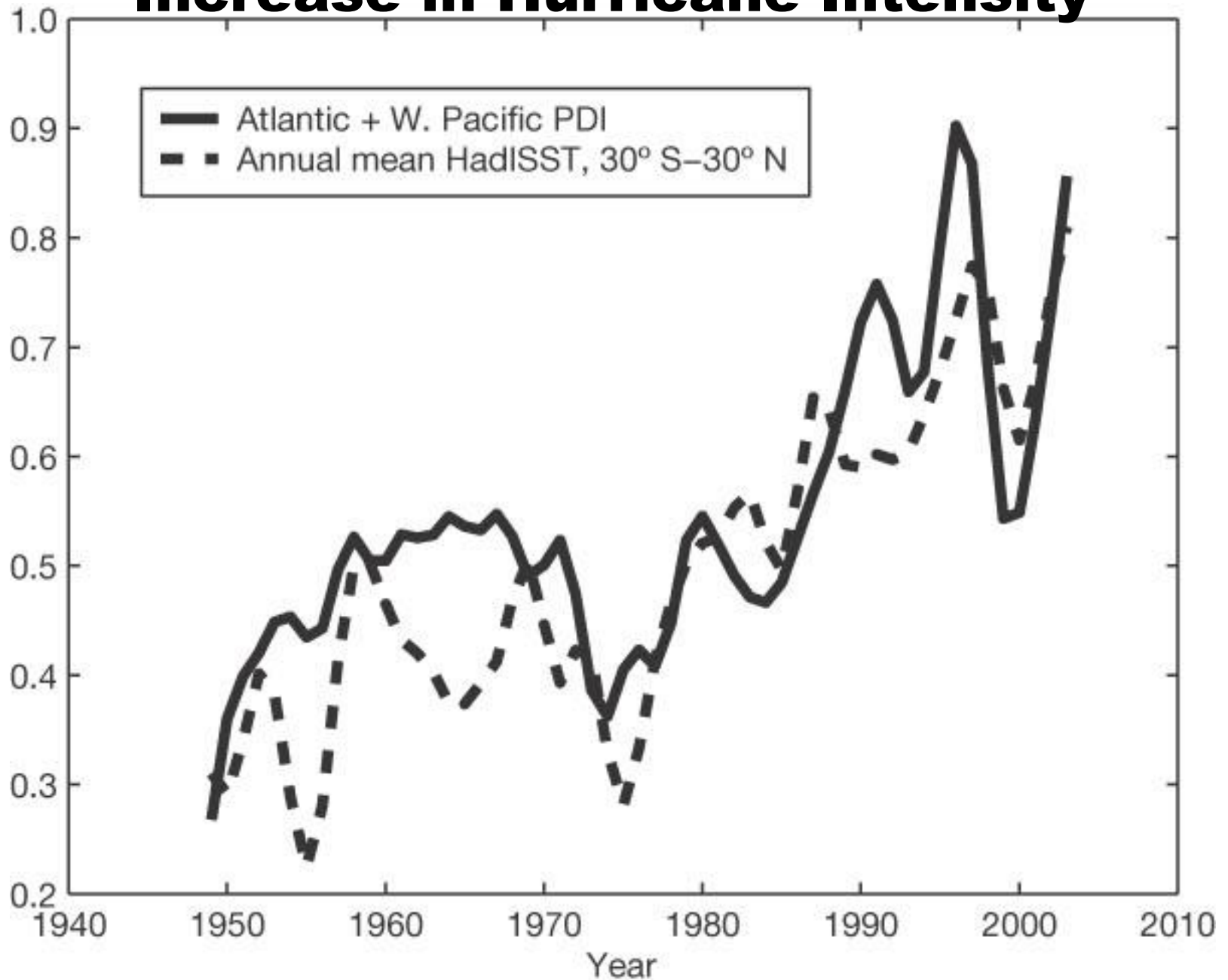
Lower pH = MORE ACID



- Since 1850, ocean pH has decreased by about 0.1 unit (**30% increase in acidity**). (Royal Society 2006)
- At present rate of CO₂ emission, pH predicted to increase by 0.4 units (**3-fold increase in H ions**) by 2100.
- Carbonate ion concentrations decrease.



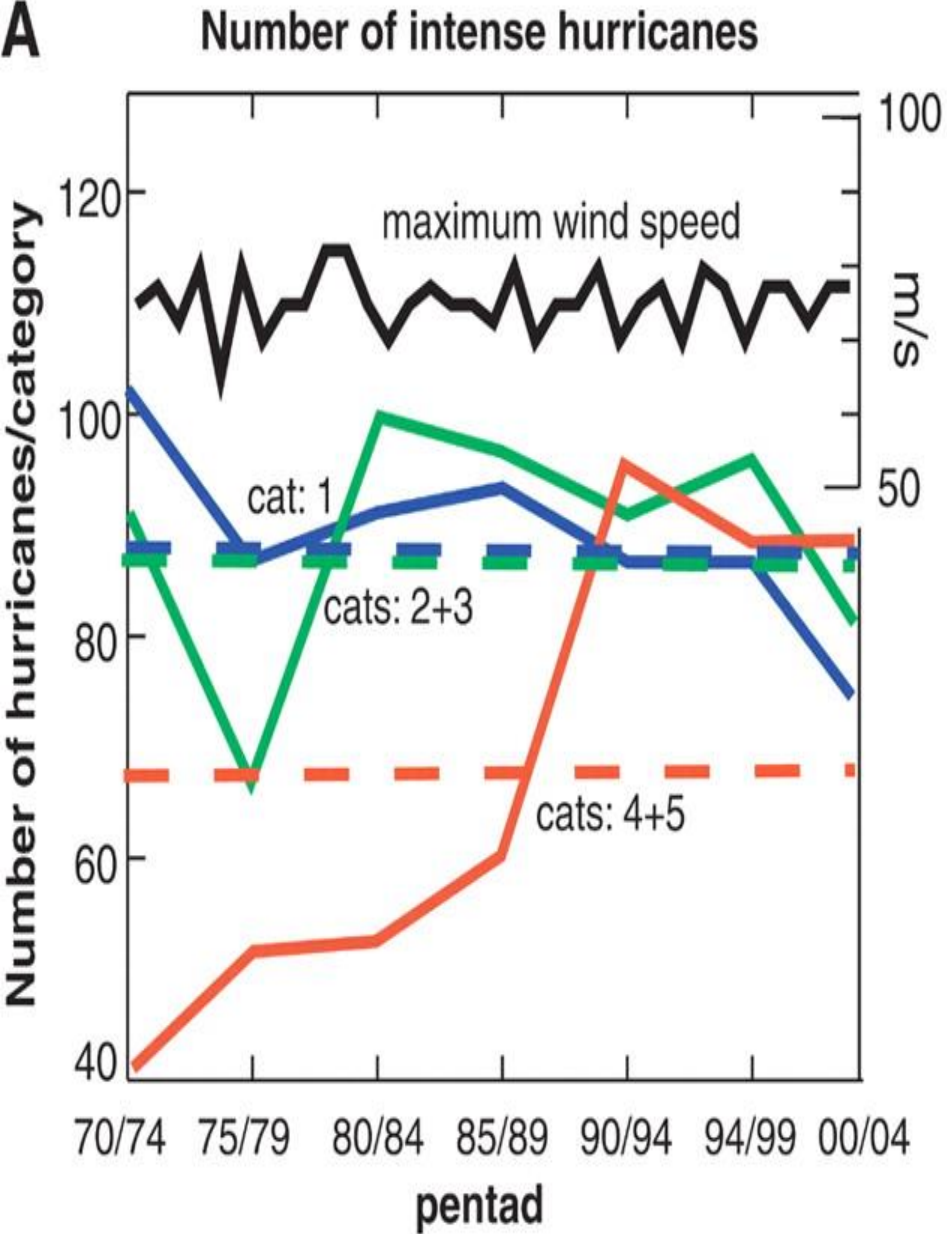
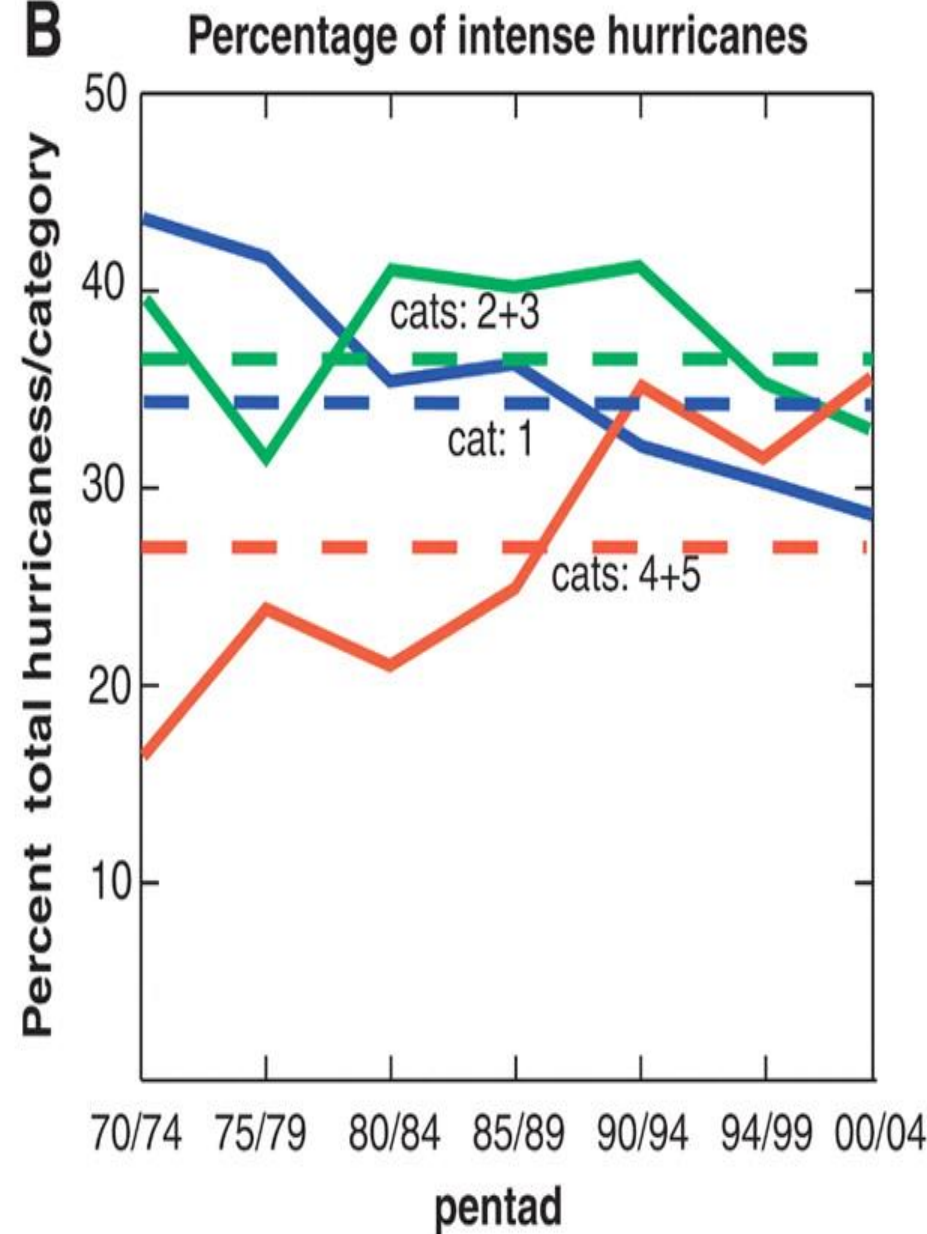
Increase in Hurricane Intensity



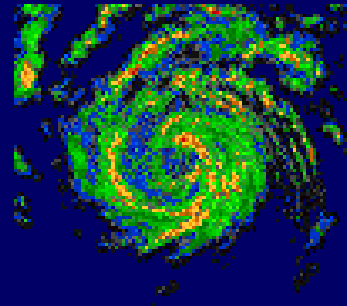
PDI = Potential Destructiveness Index

Emanuel, Nature 4 August 2005

Increase in Category 4-5 Hurricanes 1970 - 2004

A**B**

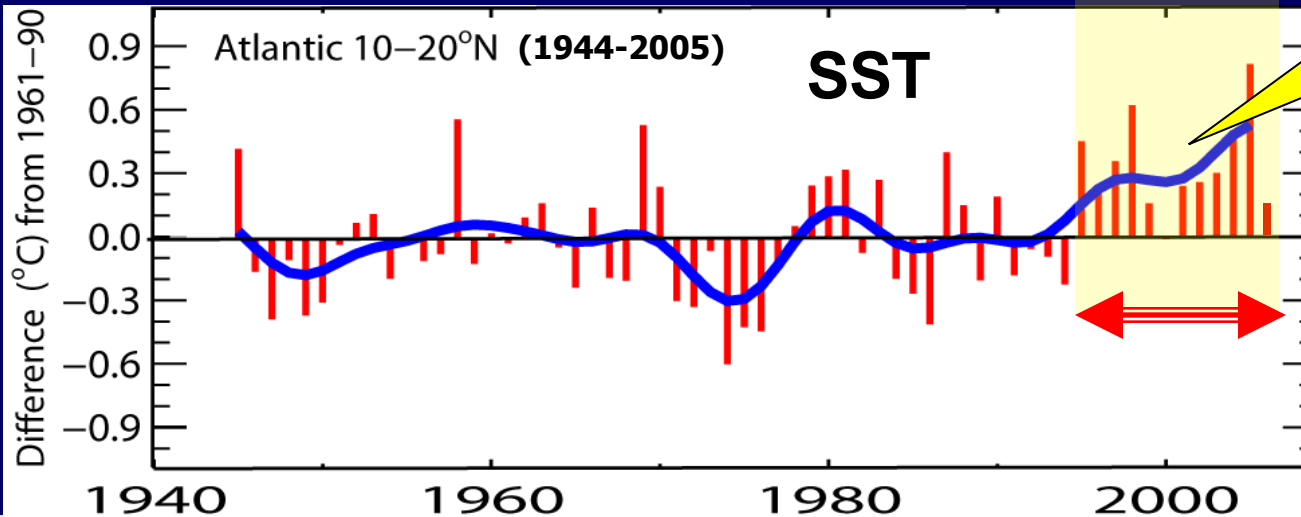
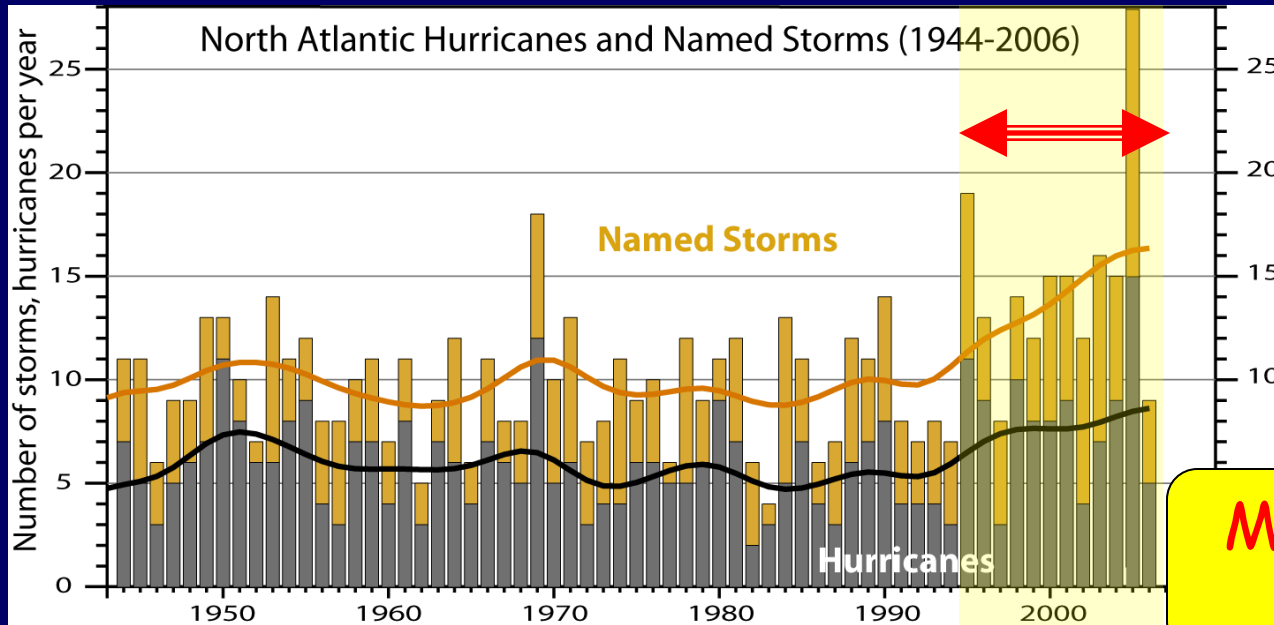
North Atlantic hurricanes have increased with SSTs



N. Atlantic hurricane record best

Marked increase after 1994

Global number and percentage of intense hurricanes is increasing

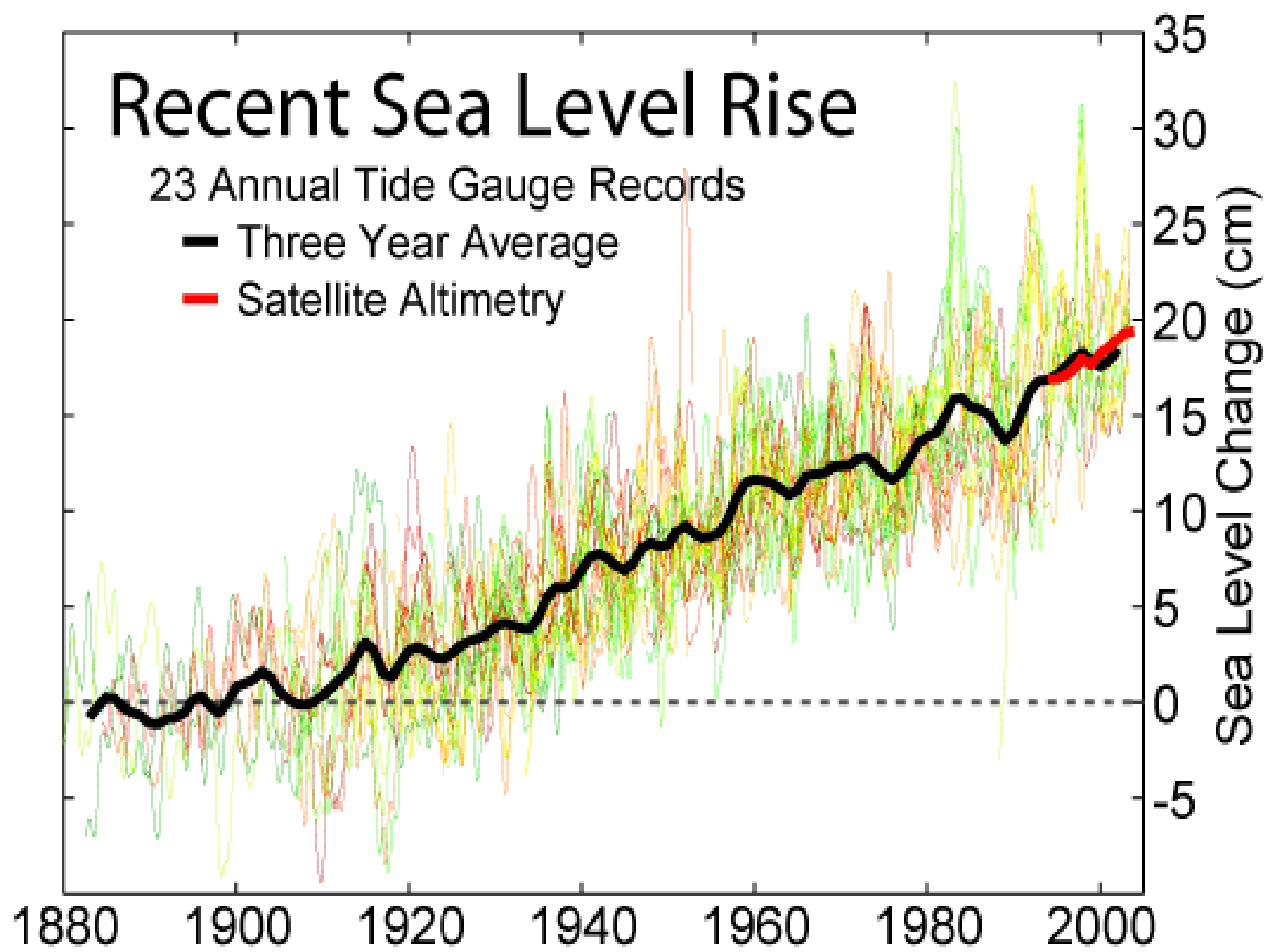


Recent Sea Level Rise

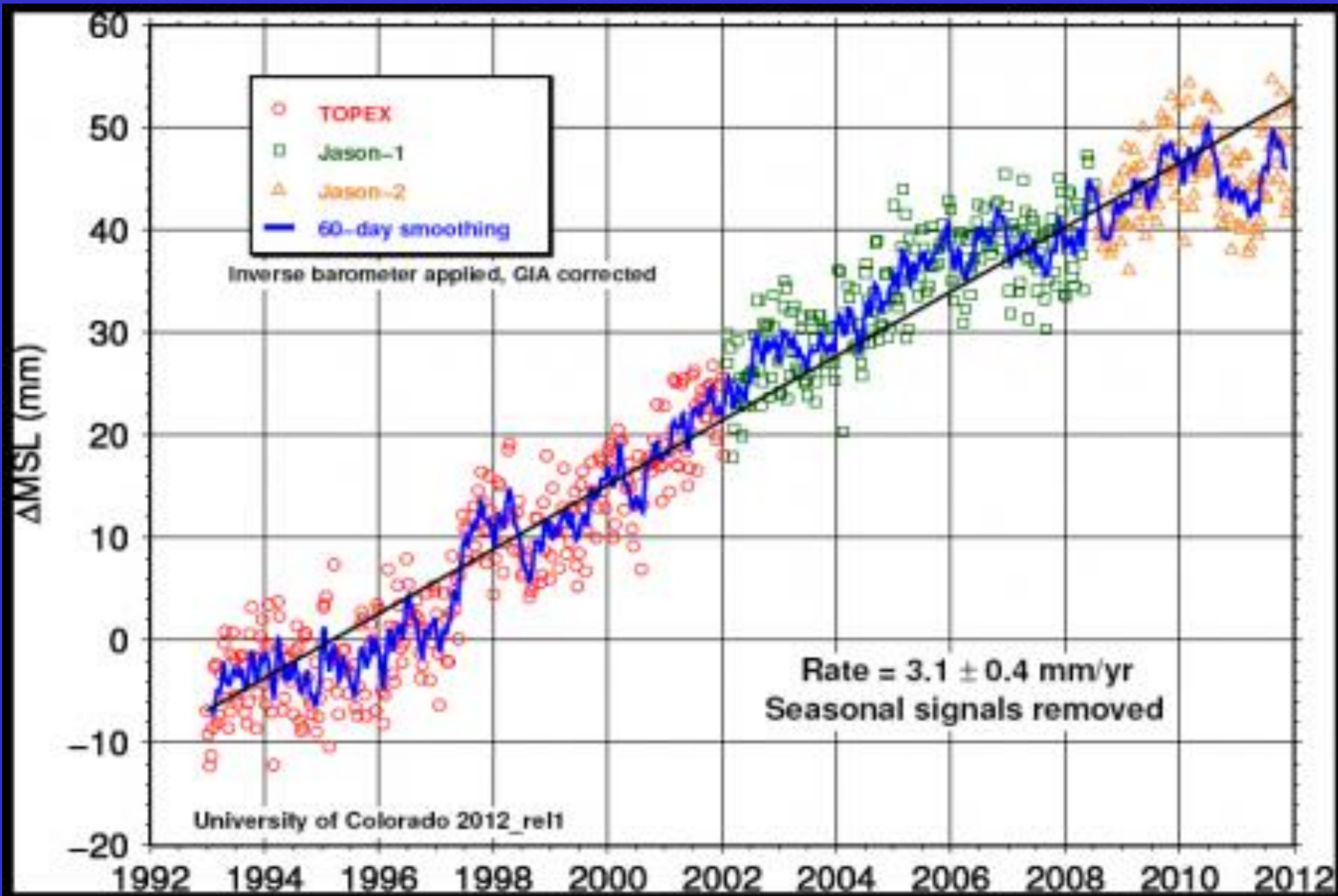
23 Annual Tide Gauge Records

— Three Year Average

— Satellite Altimetry



SEA LEVEL RISE



Sea-level Rise Projections Include:



- ocean expansion resulting from increased water temperatures;

National Park Service



- meltwater runoff from mountain glaciers around the world; and

NASA



- a contribution due to increased ice flow from Greenland and Antarctica **at the rates observed for 1993-2003.**

Source: IPCC *Climate Change 2007: The Physical Science Basis—Summary for Policymakers.*

Sea-level Rise Projections DO NOT Include:

- Ice sheet instability
- Carbon dioxide uptake changes

IPCC: “Larger values cannot be excluded, but understanding of these effects is too limited to assess their likelihood or provide a best estimate or an upper bound for sea-level rise.”

Photo Roger Braithwaite



iStockphoto.com



Source: IPCC *Climate Change 2007: The Physical Science Basis—Summary for Policymakers.*

Threshold risks:

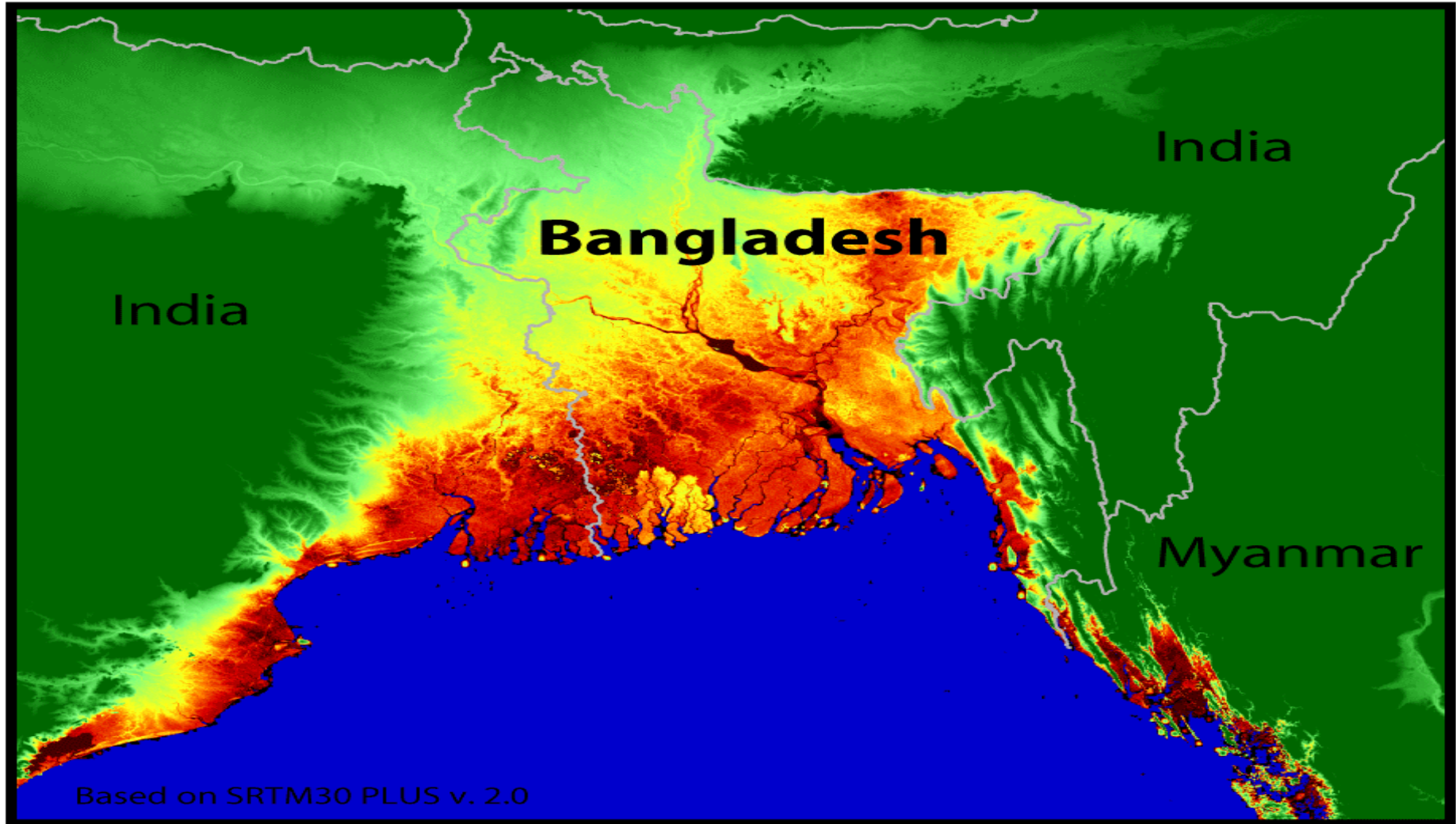
Some models do suggest that sustained warming between 2-7°F above today's global average temperature would initiate irreversible melting of the Greenland ice sheet—which could ultimately contribute about **23 feet** to sea-level rise.



Weiss and Overpeck U. Arizona

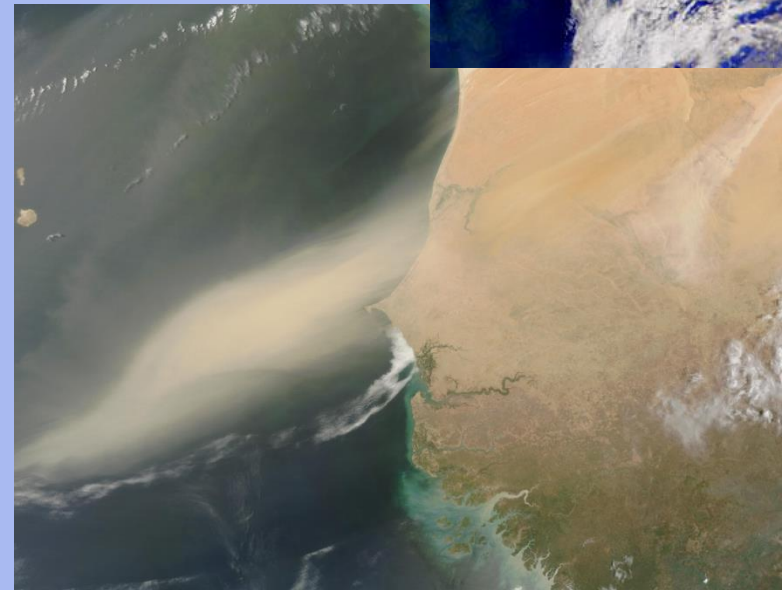
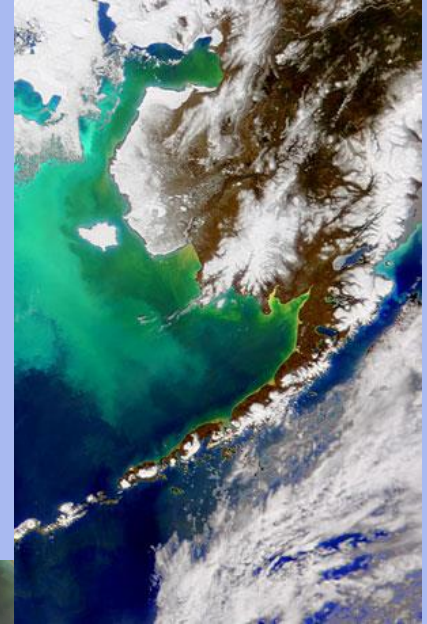
Source: IPCC *Climate Change 2007: The Physical Science Basis*—Summary for Policymakers.

Sea Level Risks - Bangladesh



Iron in the Oceans

- Sources of naturally occurring iron
 - Volcanic coastal shelves
 - Dust in blown in from land
 - Upwellings
- Role in ecosystems
 - Key nutrient that helps plants take up nitrogen





“Give me a few oil tankers full of iron,
and I’ll give you an ice age.”

– *John Martin, WHOI Scientist*

Cashing in on Carbon Offsets

FERTILIZING OCEANS FOR FUN AND PROFIT

1 A boat goes out to the middle of the ocean and sprinkles micron-size iron shavings onto the surface of the water.



2 The iron shavings stimulate the growth of photosynthesizing algae, which uses sunlight to draw carbon dioxide out of the air.



3 When the algae dies, it bleaches and sinks into the sea. If it sinks to 1,000 feet, the carbon should be trapped for decades.

PHOTO-ILLUSTRATION: MAGICTORCH

- Climos taking over with \$3.5 million in funding
- Planktos bottom up after Galapagos proposal





Will the Carbon
stay sequestered
long enough to
help?

NOPE!