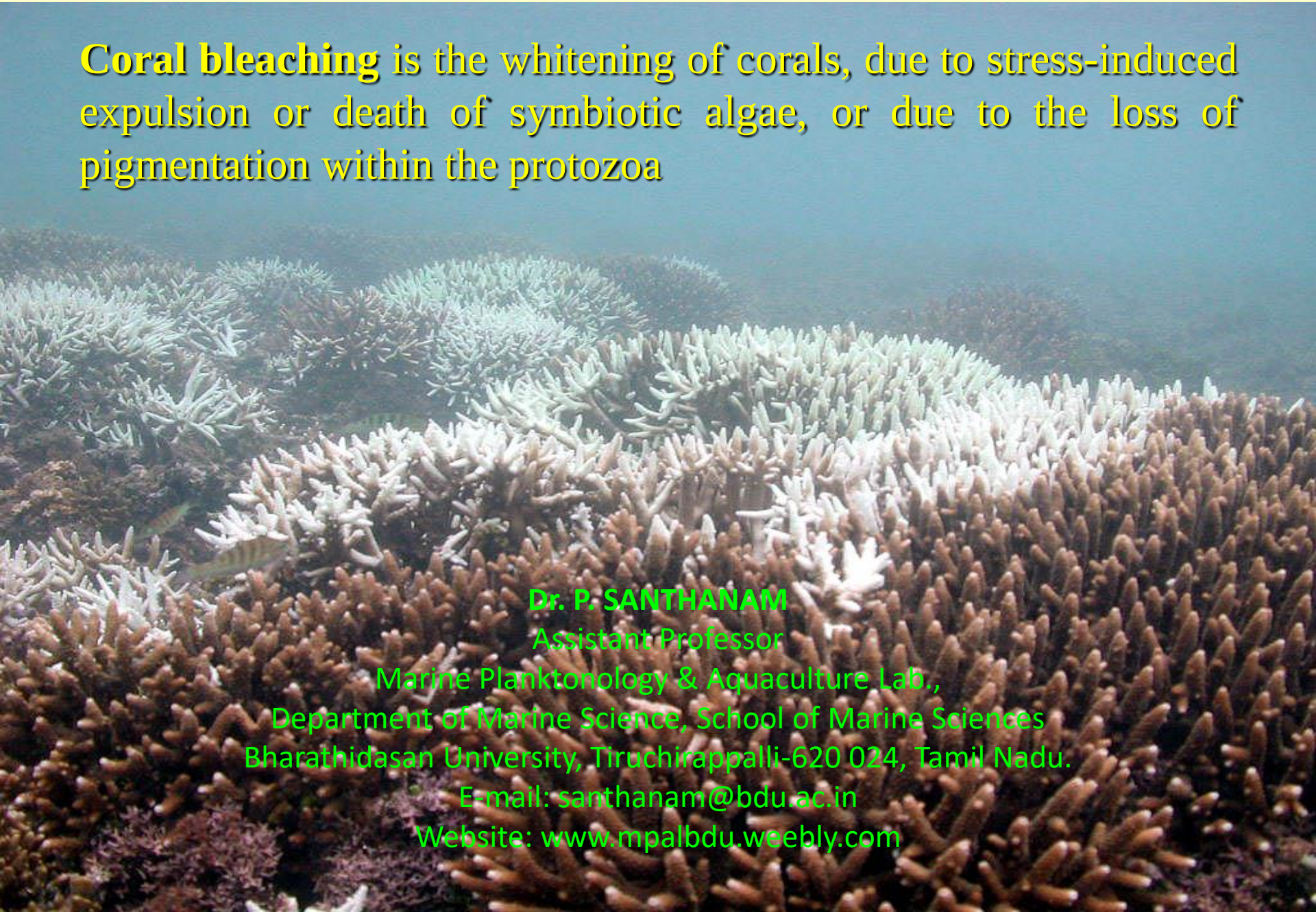
CORAL BLEACHING

Coral bleaching is the whitening of corals, due to stress-induced expulsion or death of symbiotic algae, or due to the loss of pigmentation within the protozoa



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CORAL BLEACHING

- The corals that form the structure of the great reef ecosystem of tropical seas depend upon a symbiotic relationship with unicellular algae called zooxanthellae, that are photosynthetic and live within their tissues.

- Zooxanthellae give coral its coloration, with the specific color depending on the particular clade.

- Under stress, corals may expel their zooxanthellae, which leads to a lighter or completely white appearance, hence the term "bleached".

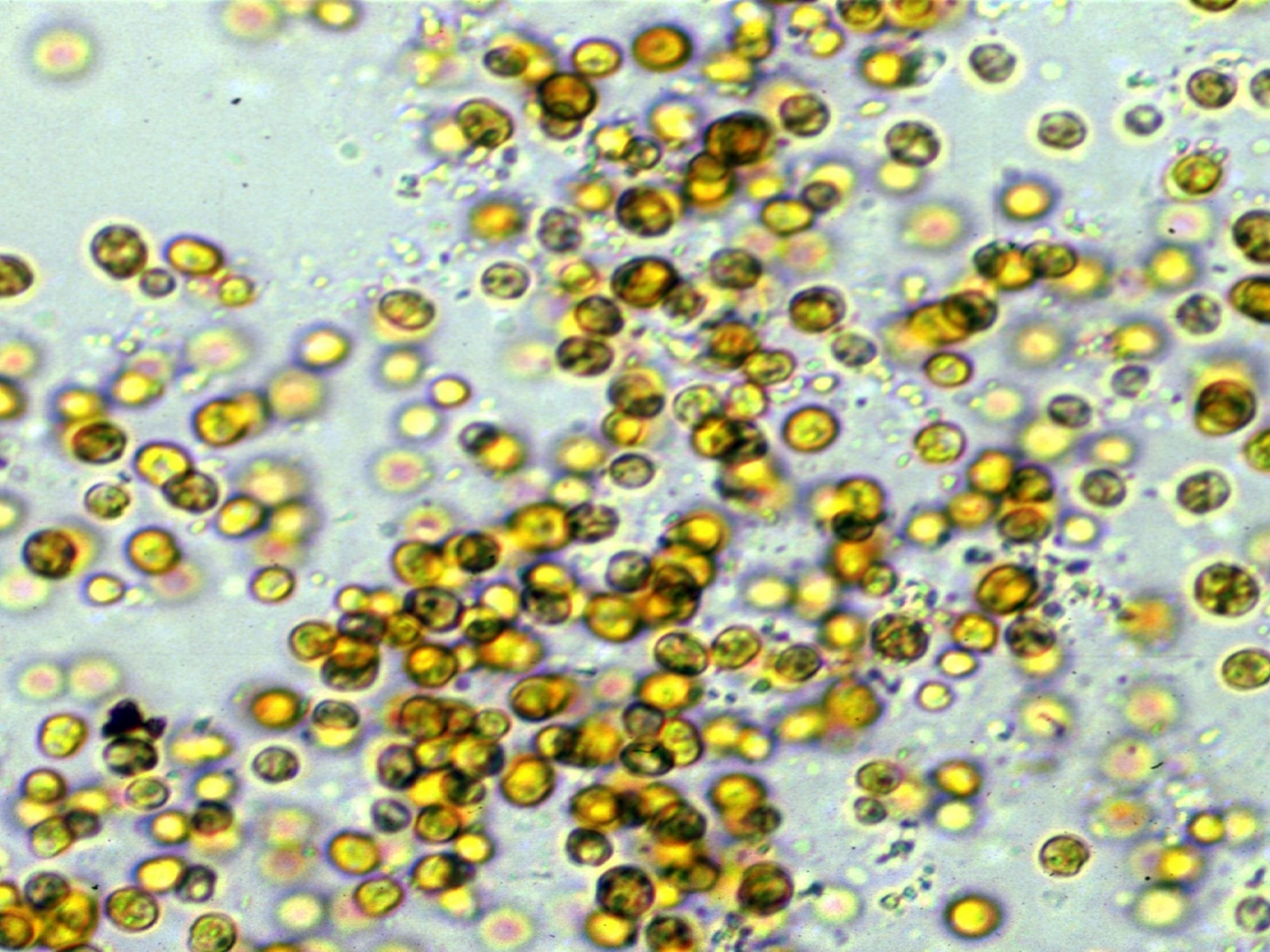
CORAL BLEACHING

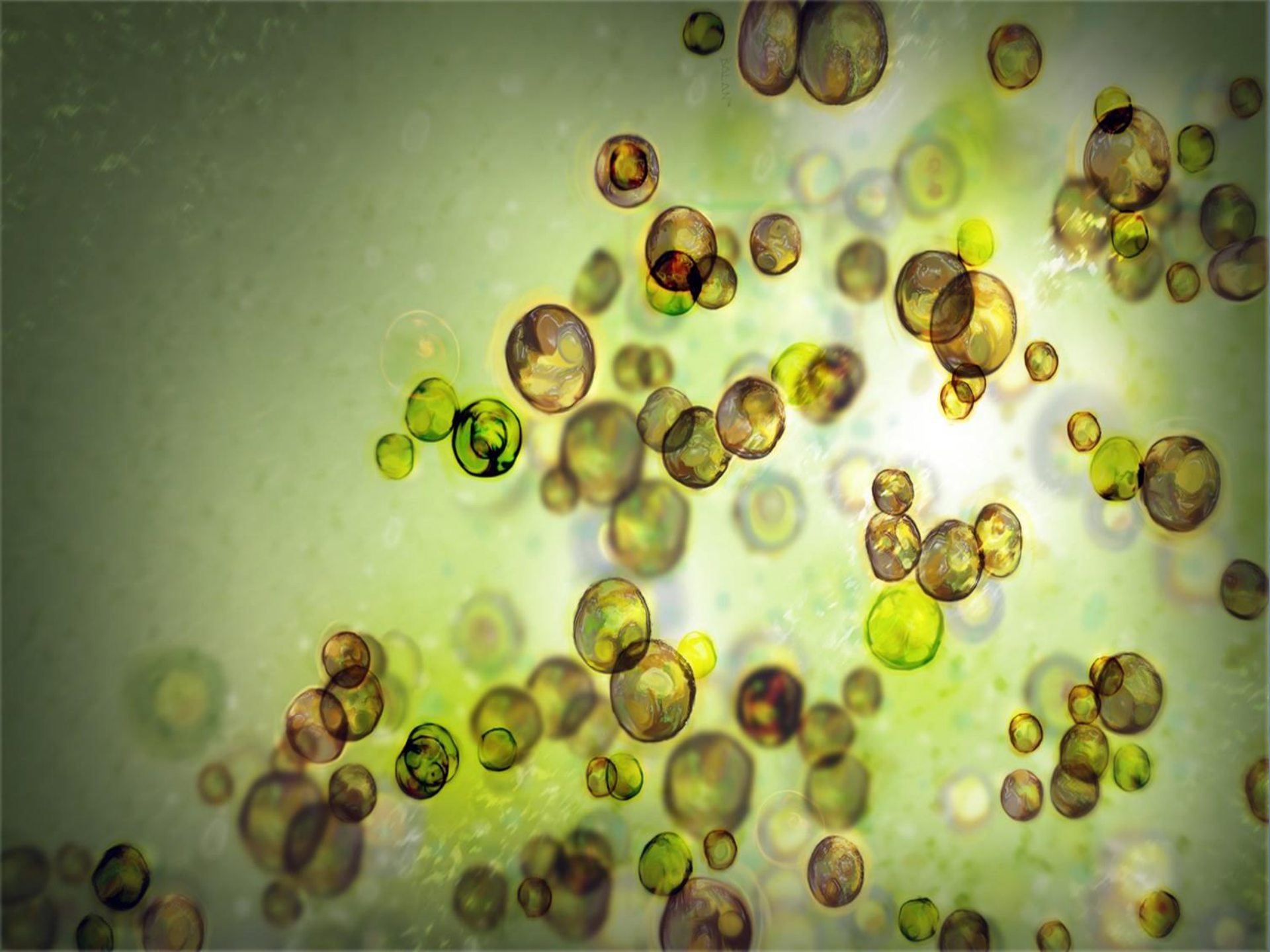
- Once bleaching begins, it tends to continue even without continuing stress.
- If the coral colony survives the stress period, zooxanthellae often require weeks to months to return to normal density.
- The new residents may be of a different species.
- Some species of zooxanthellae and corals are more resistant to stress than other species.

Zooxanthellae

- Zooxanthellae are dinoflagellate algae of the genus *Symbiodinium*, and live in coral tissue.
- They provide nutrients such as sugars and oxygen that are essential for the production of calcium carbonate (coral reef skeleton).
- Provide coral with beautiful coloration (without them corals are clear or white; phenomenon known as coral bleaching).
- More than 50% of the corals' nutrients are derived from photosynthetic products produced by zooxanthellae.


www.coralhub.info
Microscopic clusters of zooxanthellae





CORAL REEFS *are*

Biodiversity

Extremely high biodiversity
Highest in SE Asia W Pacific
The Coral Triangle

Food & Shelter

Millions of people depend on them
About 500 million
30 million very dependent

Economic Base

100 countries with reefs
~30 with only reefs
$13,200 per hectare p.a
(spend 0.1% to conserve)

but CORAL REEFS

Threatened

Degrading fast (near people)

Direct Human pressures

Global Climate Change

Poor Awareness, Capacity, Political Will

Solutions

Conserve biodiversity in habitats - MPAs networked & large

Assist Small Countries

Multi-disciplinary – good science, economics, law, management, policy

Status of Coral Reefs 1992

- 10% effectively lost
- 30% critical state – loss in 10 to 20 years*
- 30% threatened state – loss in 20 to 40 years*
- 30% remaining healthy

* unless we act soon
(estimates based on few data)

Status of Coral Reefs 1998

Reefs @ Risk analysis (World Resources Institute)

- **27% at high risk of loss**
- **31% at medium risk of loss**
- **42% at low risk of loss**

estimates based on some data

Status of Coral Reefs 2000

- 11% effectively lost
- 16% lost in 1998 big bleaching event
- 14% critical state – loss in 10 to 20 years*
- 18% threatened state – loss in 20 to 40 years*
- 41% remaining healthy

(Status of Coral Reefs of the World: 2000)

Status of Coral Reefs 2004

- 20% effectively lost
- 19% critical state – loss in 10 to 20 years*
- 21% threatened state – loss in 20 to 40 years*
- 40% remaining healthy

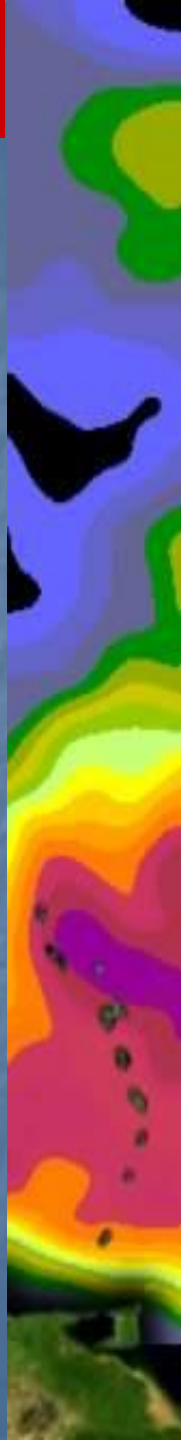
(Status of Coral Reefs of the World: 2004)

Status of Coral Reefs 1992-2004

year	Reefs lost %	Reefs critical	Reefs threatend	Reefs healthy
1992	10	30	30	30
1998	*	27	31	42
2000	27	14	18	41
2004	20	19	21	40

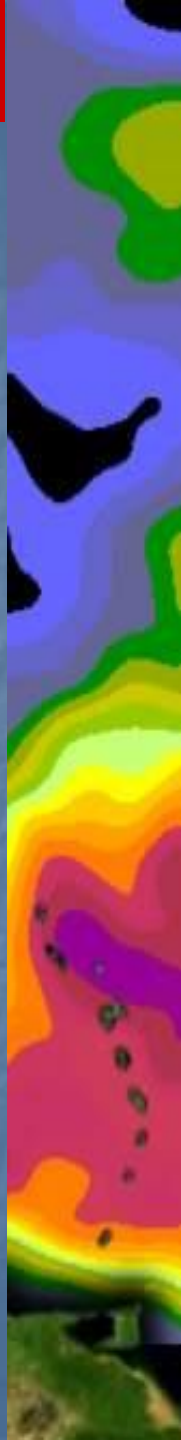
Coral Reef Status over 16 years

- Reefs lost x2 from 10% to 20%
- Due to human activity
- About 40% reefs healthy
- Most remote reefs OK (climate change major threat)
- Discovering deep warm water reefs &
  cold water reefs
- BUT all reefs threatened by climate change



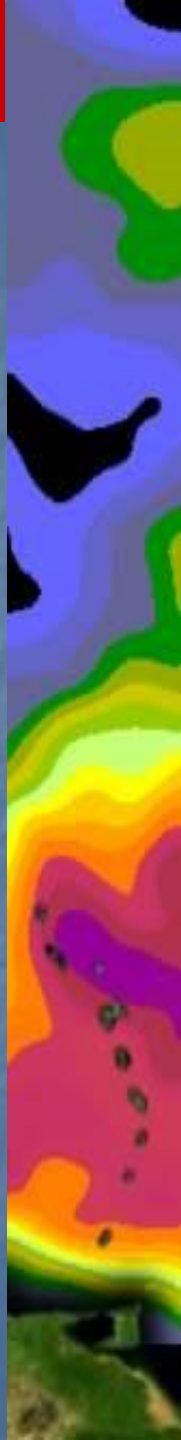
Coral Reef Status

- **Red Sea** – healthy
- **Persian Gulf** – devastated by Climate Change (1996, 1998 and since)
- **Indian Ocean** – 1998 losses recovering slowly; human damage in East Africa
- **South Asia** – continuing to decline after 1998



Coral Reef Status

- **SE & N Asia** – saddest case, biodiversity centre with largest pressures
- **Australia** – OK & well managed;
- **Pacific** – generally healthy, esp remote reefs



Top 10 Threats to Coral Reefs

Global Change Threats:

- Coral bleaching
- Rising levels of CO_2
- Diseases, Plagues and Invasives

Direct Human Pressures:

- Over-fishing (& destructive fishing)
- Sediments
- Nutrients
- Development

Governance, Awareness and Political Will:

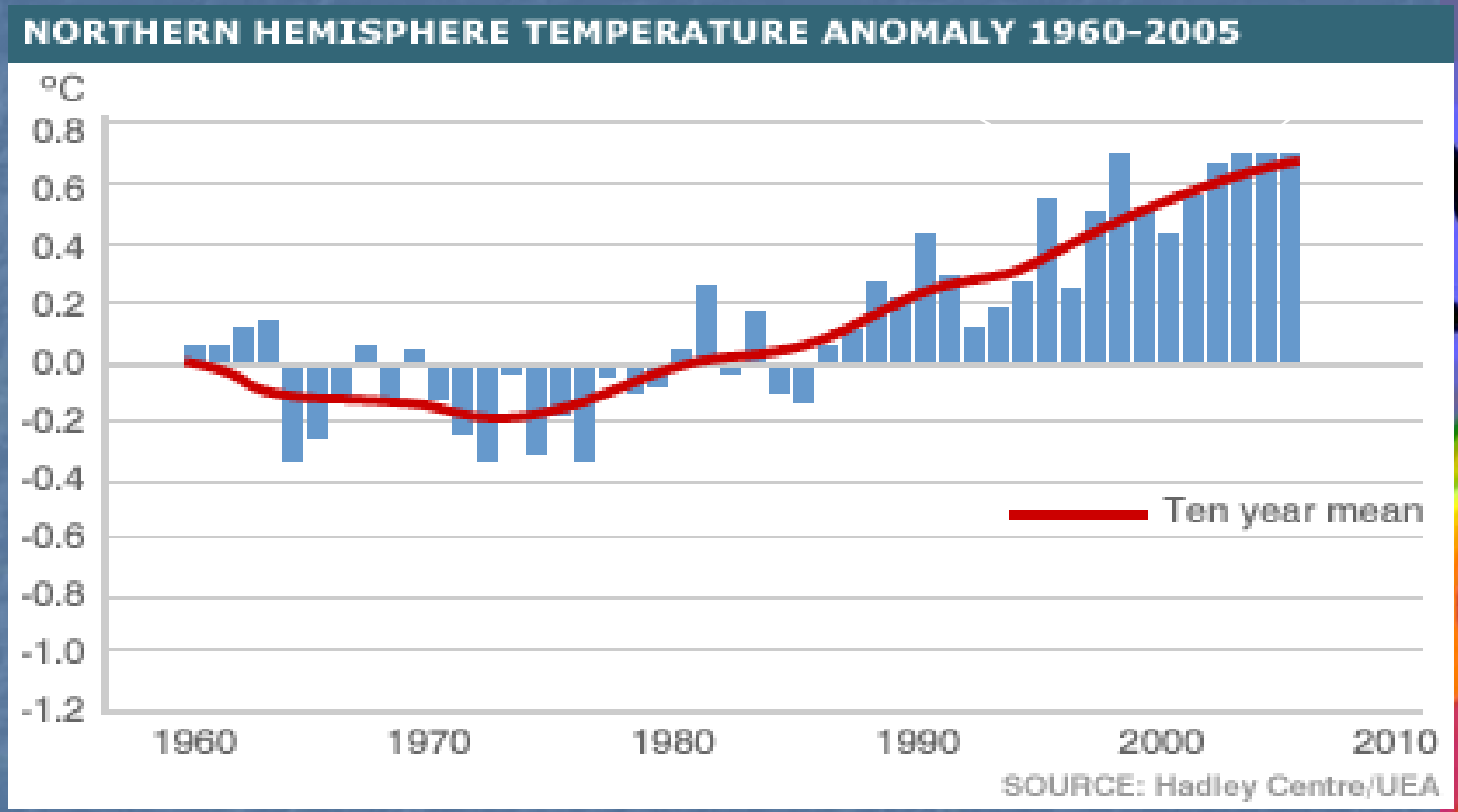
- Poor management capacity
- Rising poverty & growing populations
- Low Political Will

Top 10 Threats to Coral Reefs

Global Change Threats:

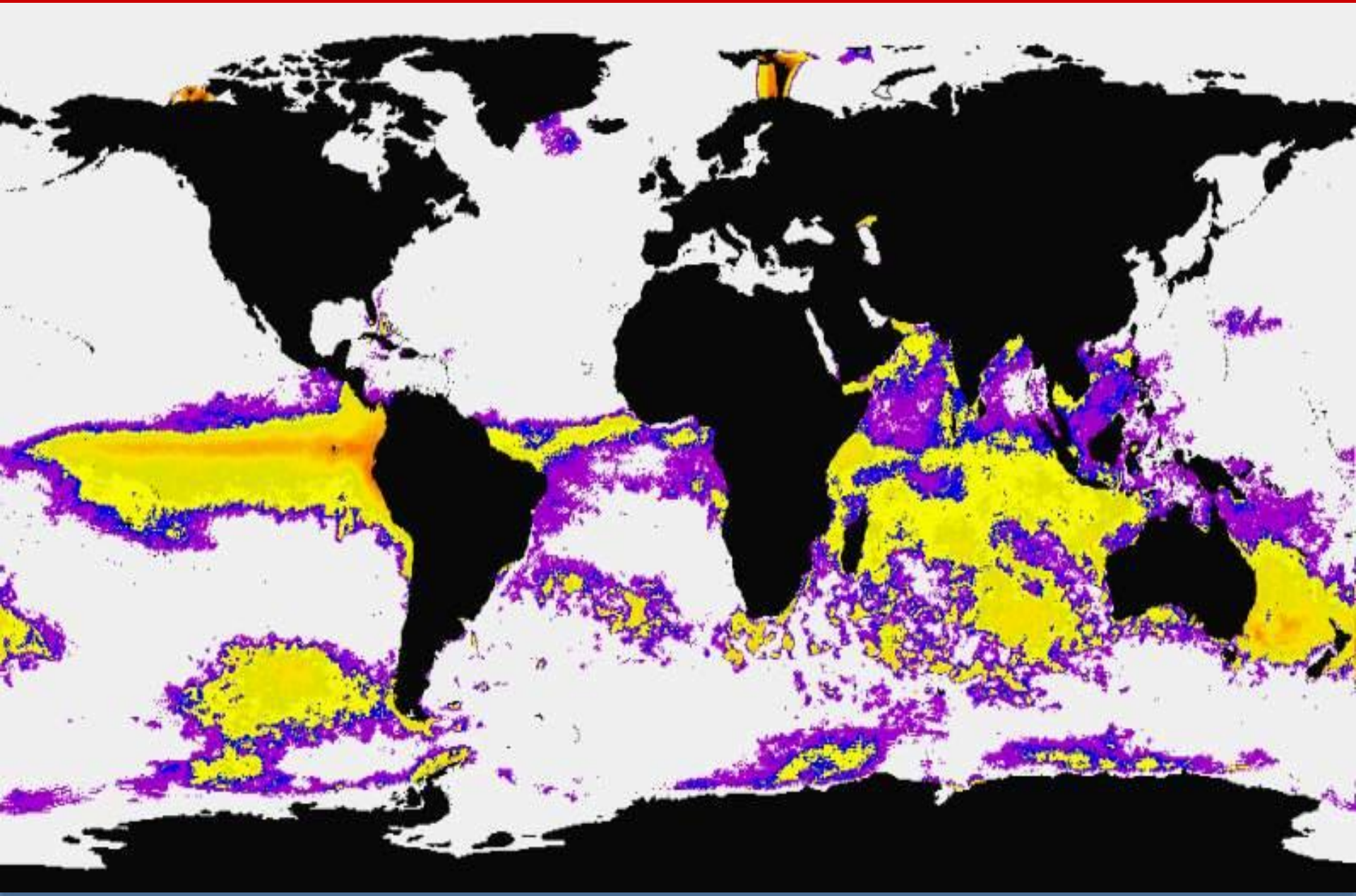
- **Coral bleaching** – from rising sea temperatures from global climate change
- **Rising levels of CO_2** – dissolved in seawater; will reduce coral calcification
- **Diseases, Plagues and Invasives** – all cause damage & linked to human disturbance

Climate Change & Coral Reefs

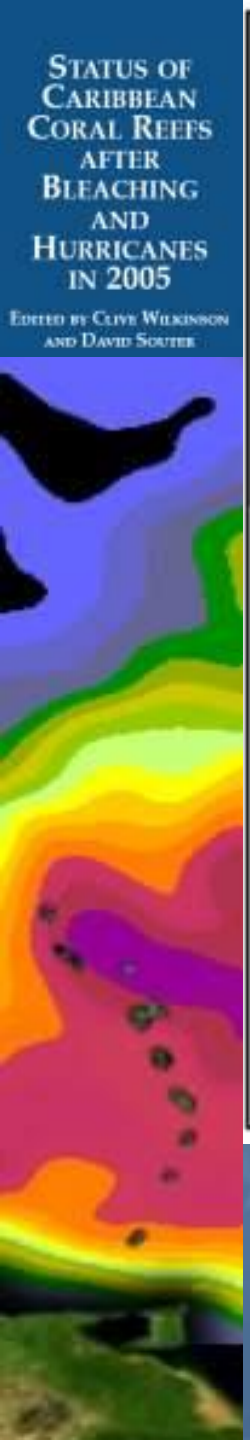


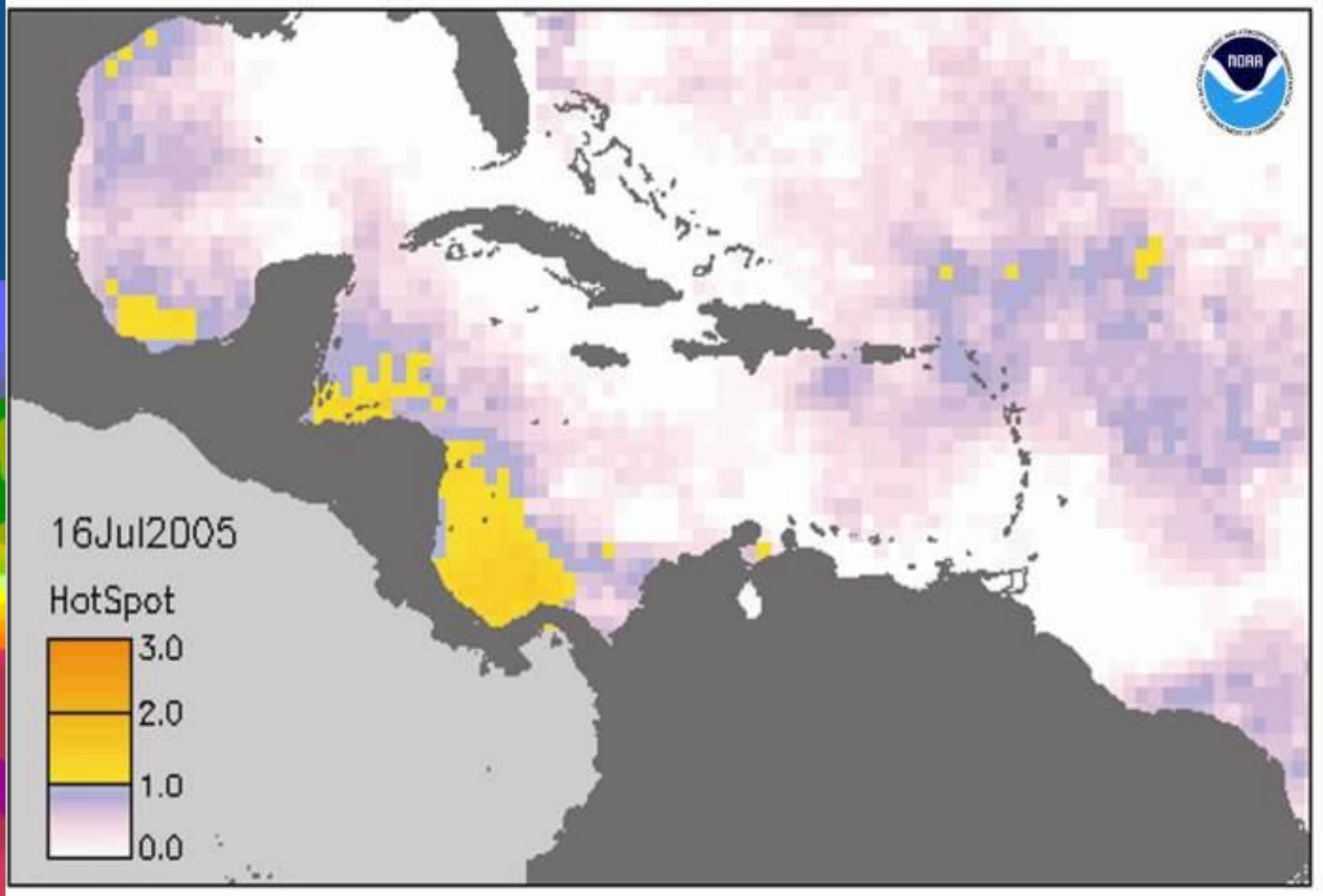
From Hadley Climate Center, UK; red line is 10 year running average.

1998 El Nino Bleaching event – 6 month accumulated hotspots

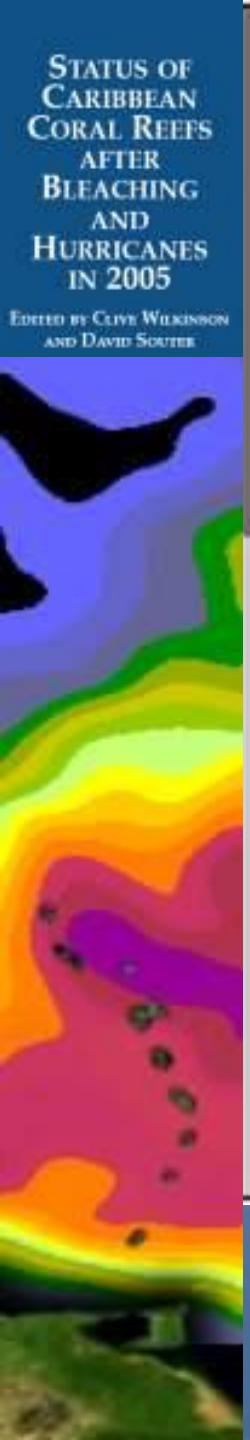


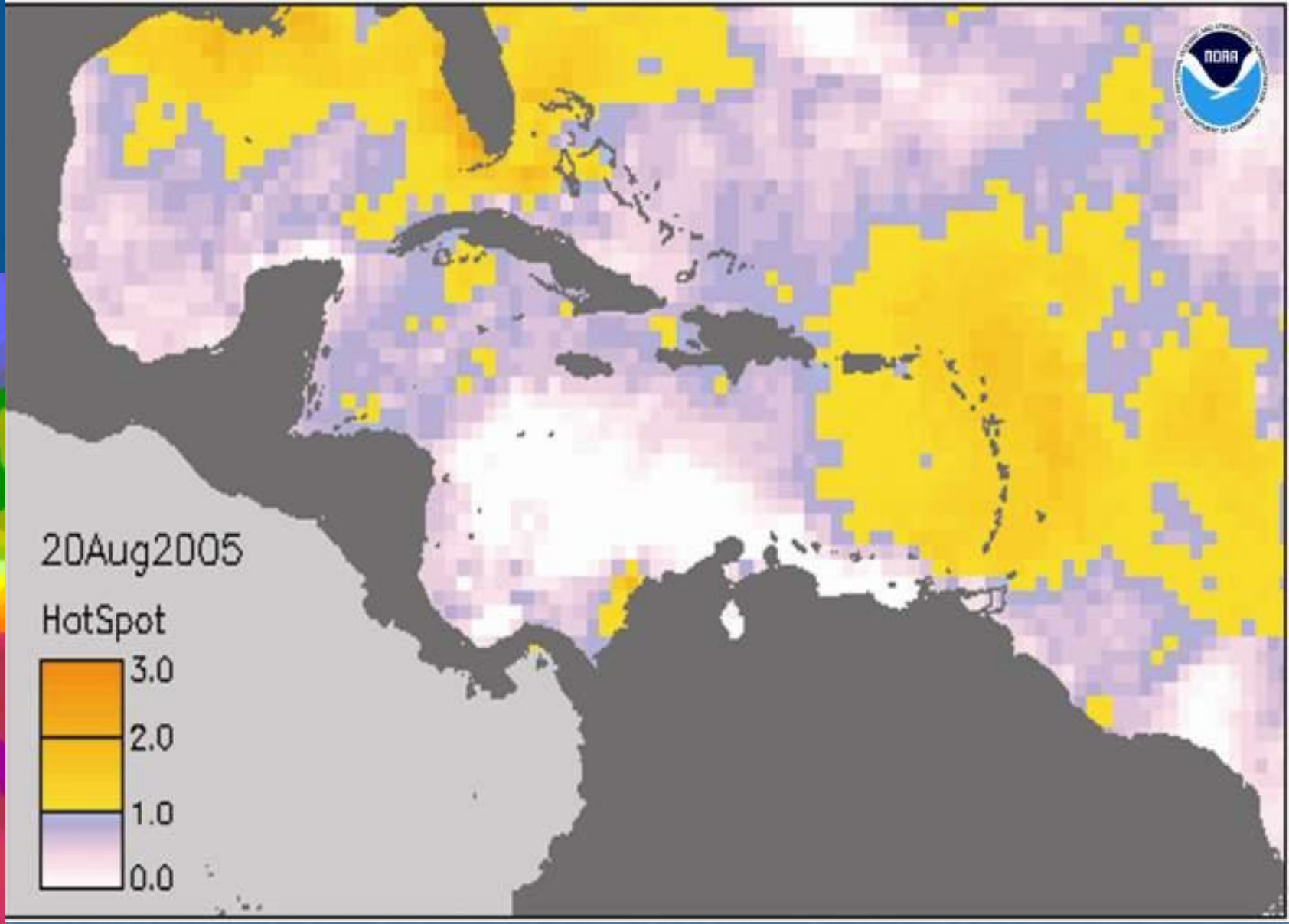
Coral Bleaching on the Great Barrier Reef



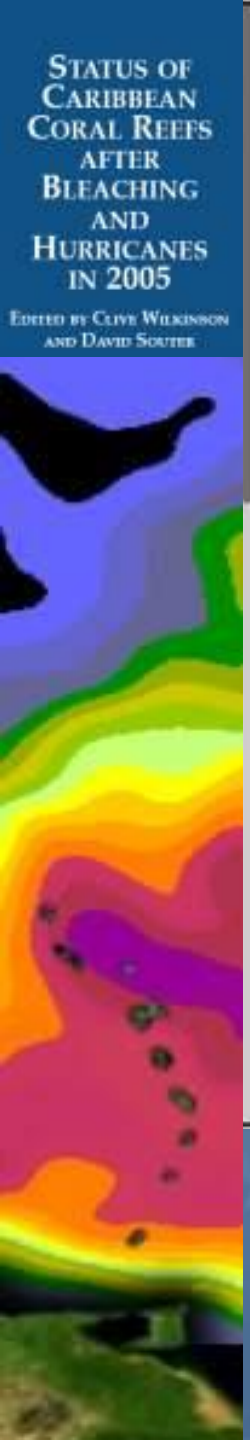


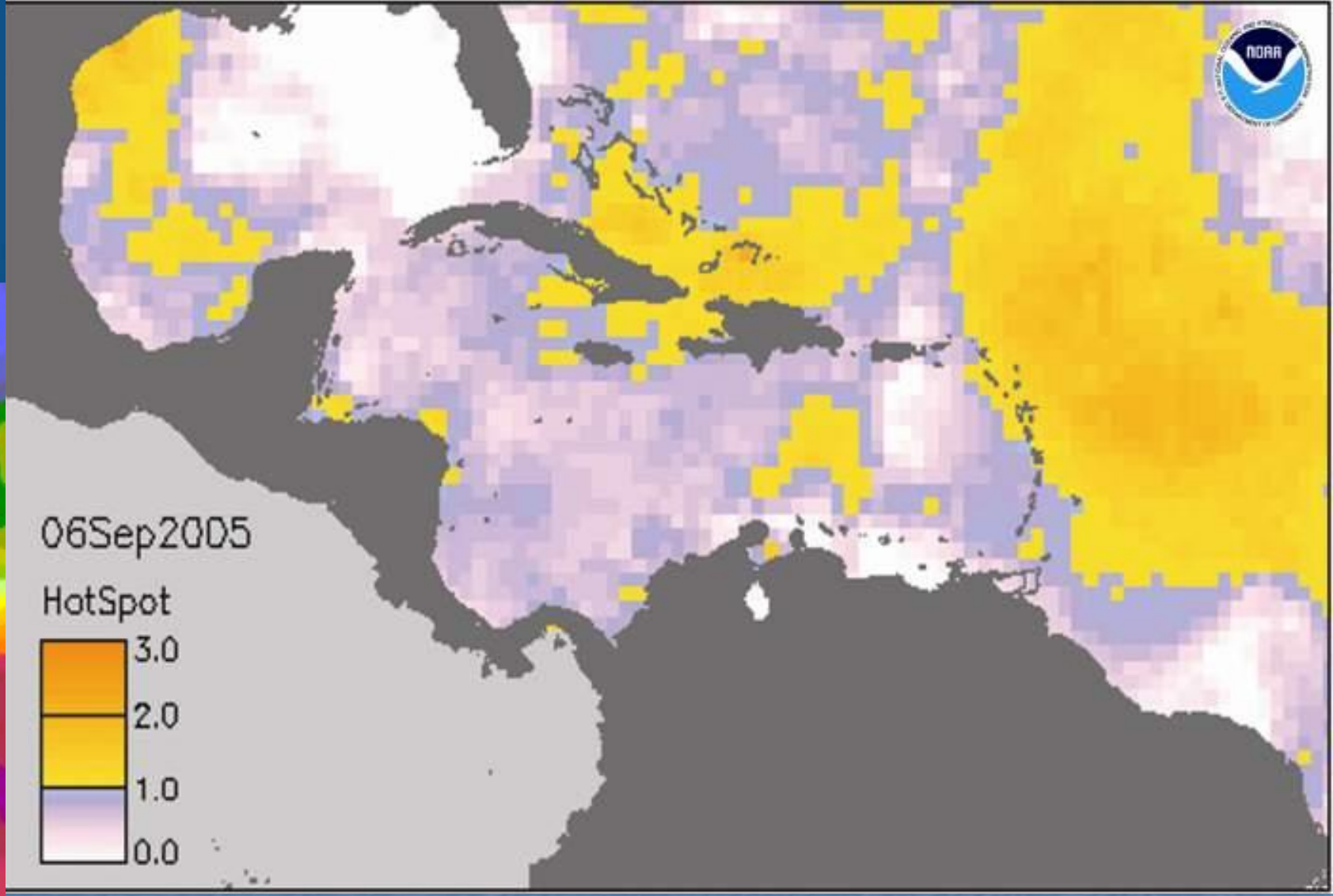
- 1º HotSpot image – July 2005



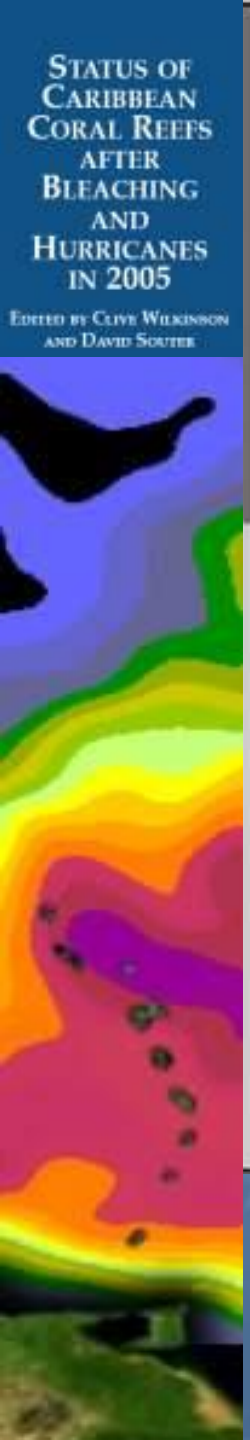


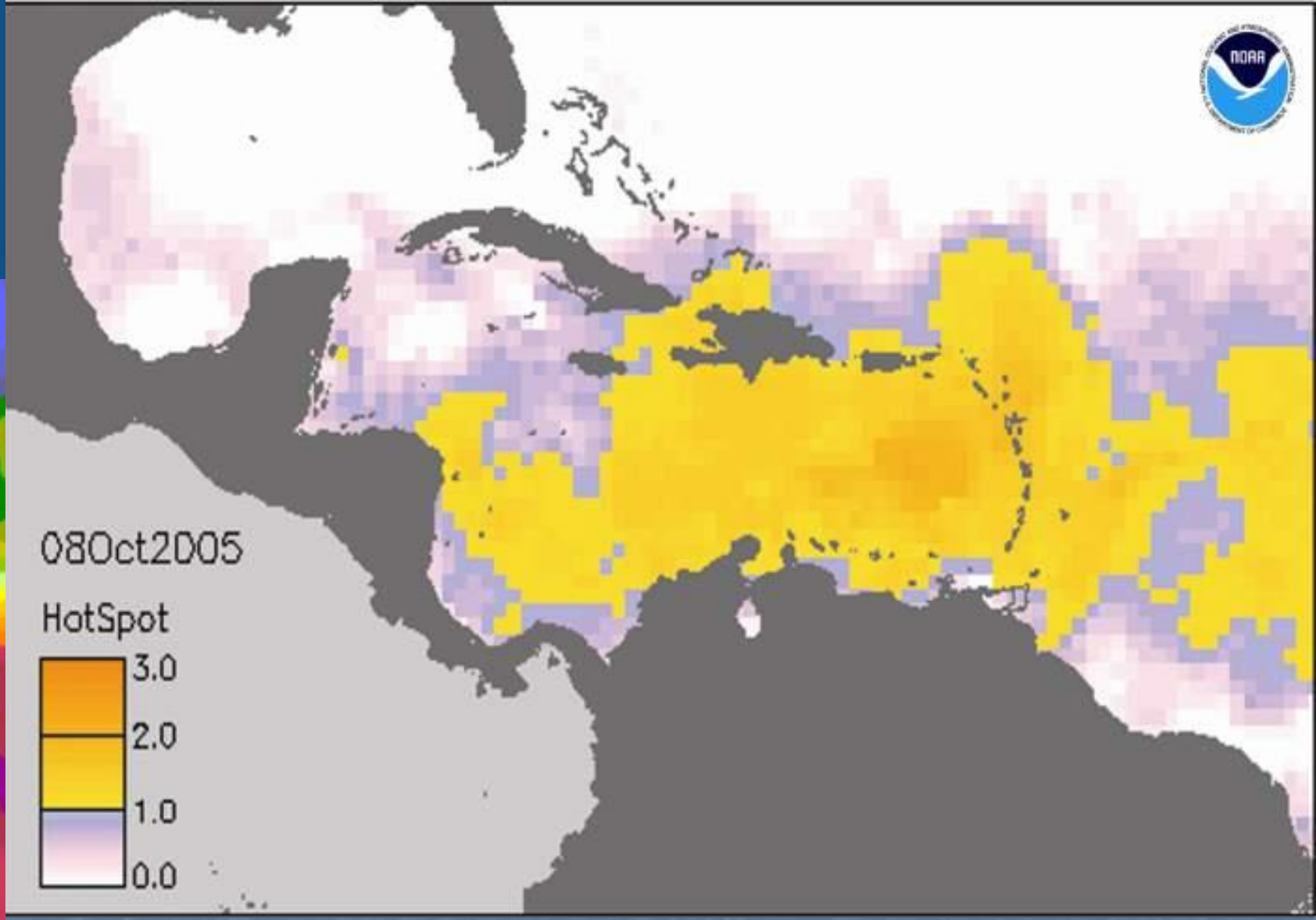
- 2º HotSpot image – August 2005





- 3º HotSpot image – September 2005





4º HotSpot image – October 2005

Major Threats to Coral Reefs

Direct Human Pressures:

- **Over-fishing (& destructive fishing)** – bomb & cyanide fishing, & fishing beyond sustainable yields, destroys reefs
- **Sediments** - from poor land use, deforestation, & dredging smother corals

Bomb fishing can reduce

This to this

Major Threats to Coral Reefs

Direct Human Pressures:

- **Nutrients and Chemical pollution** –carried with sediments, sewage, & industry wastes - stress corals
- **Development on coasts** – dredging, land clearing, ports, airports, harbours; reclaiming coral reefs; excess coral rock & sand mining

Major Threats to Coral Reefs

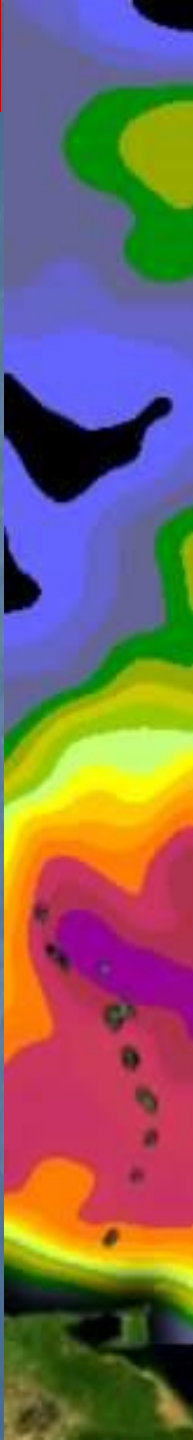
The Human Dimension – Governance, Awareness and Political Will:

- **Poor management capacity** –countries have few trained personnel & equipment for
  - management,
  - raising awareness,
  - enforcement &
  - monitoring;
- most MPAs not managed effectively

Major Threats to Coral Reefs

Rising poverty & growing populations – all put more pressures on reef resources beyond sustainability

Low Political Will –solutions require strong political will & governance of resources; assist with **Integrated Oceans Governance**

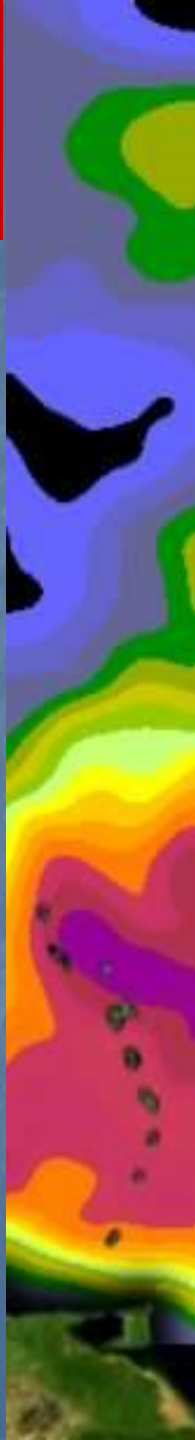


Solutions for Reef Biodiversity

Better Governance

Assist Developing Countries (esp SIDS) to:

- **Devolve authority to local governments & communities**
- **Improve communication, education, awareness raising on $ value of biodiversity & conservation & MPAs**
- **Reduce population & poverty traps**

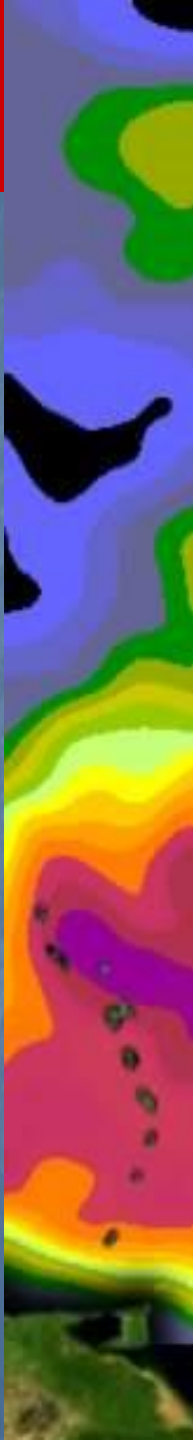


Solutions for Reef Biodiversity

Multilateral Environment Agreements

Assist Developing Countries to:

- **Integrate MEA meetings**
  - **regional pre-meetings, group countries**
- **Ensure training is required & combined**
- **Educate how to use MEAs**
- **Harmonise reporting (& meetings)**
- **Assist in application / report writing**

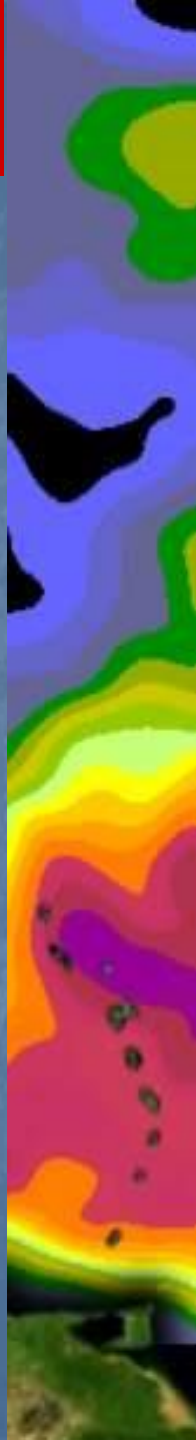


Solutions for Reef Biodiversity

Integrated Coastal Management

Assist Developing Countries to:

- **Reduce sediments & nutrients e.g. forestry, agriculture, development, sewerage**
- **Make reef fisheries sustainable & protect breeding stocks**
- **Develop sustainable aquaculture & aquarium collection**
- **Provide alternative livelihoods**

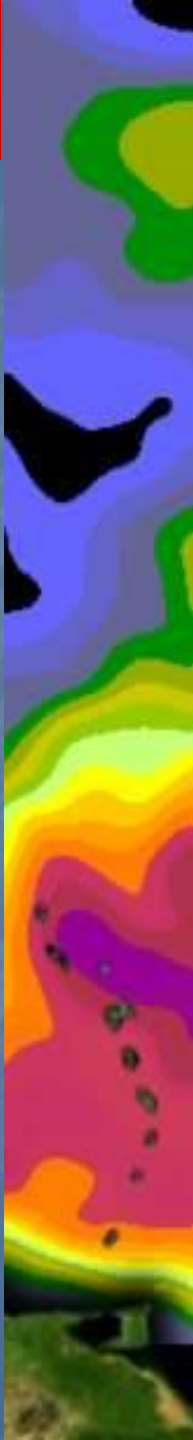


Solutions for Reef Biodiversity

Marine Protected Areas

Assist Developing Countries to:

- **Develop, plan, manage & enforce large no-take MPAs**
- **Include resistant & resilient corals**
- **Demonstrate $$ benefits e.g. tourism**
- **Involve communities & local government**



Factors Affecting Coral Bleaching

Temperature: Fluctuation of low and high sea temperature accompanying intense upwelling.

- Winter: Change from -3°C to -5°C for 5 to 10 days
- Summer: Change from 1 to 2°C for 5 to 10 days (more common)

Salinity: Zooxanthellae are sensitive to low salinity due to precipitation and runoff. Therefore, they tend to live near shallow, clear waters (no deeper than 100m) with plenty of sunlight.

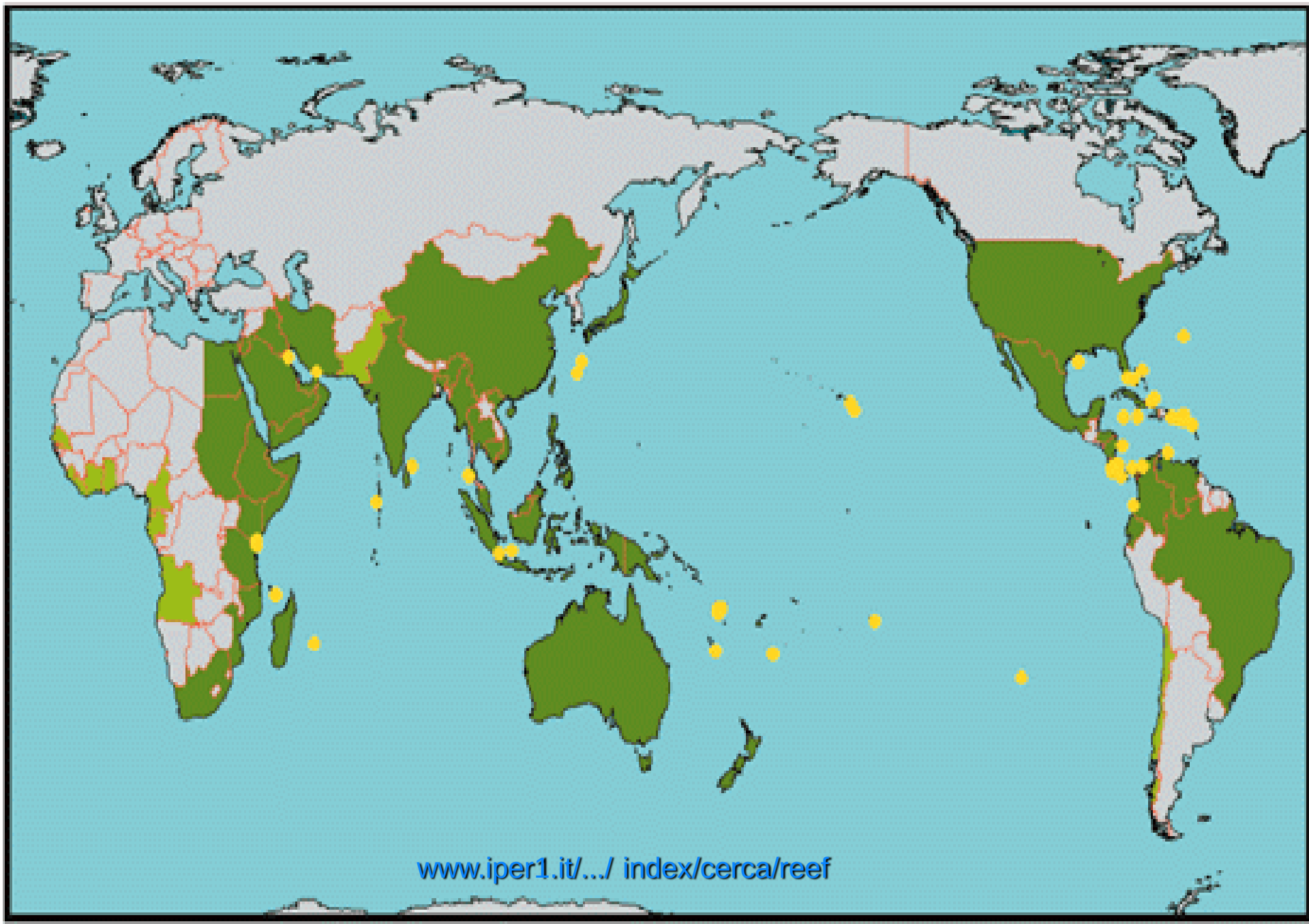
UV radiation: High levels of photosynthesis leads to high amounts of nitric oxide production by zooxanthellae.

Factors Affecting Coral Bleaching

Natural Phenomenon: Violent storms, flooding, ENSO (El Niño Southern Oscillation), predatory outbreaks, and tsunami are devastating to coral reefs.

Anthropogenic Phenomenon: Overexploitation, overfishing, increased sedimentation, and nutrient overloading.

Map of coral bleaching over the past 15 years, and major coral bleaching events (yellow dots).



Global Warming

Global warming is a major concern:

- If temperatures continue to increase to 1-2^{o}C, for the next 20 years there will be mass coral bleaching worldwide.
- The high seawater temperature elevation will affect over 95% of the species living within the coral and lead species to become extirpated or extinct.


It is for the children- dance