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Coral reef ecosystem and its threats

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DIDEM program

Regional thematic school on the Vulnerability of Reef heritage

Coral reef ecosystem and its threats

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June 10, 2024 – Blue Economy Research University of Seychelles



FONDS FRANÇAIS POUR
L'ENVIRONNEMENT MONDIAL

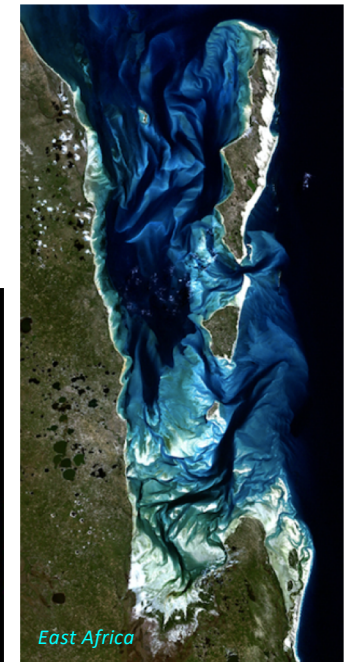
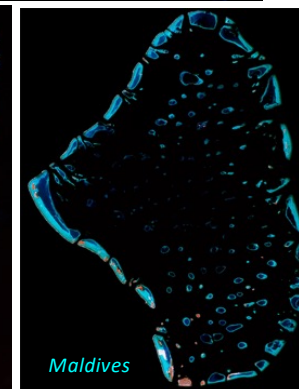
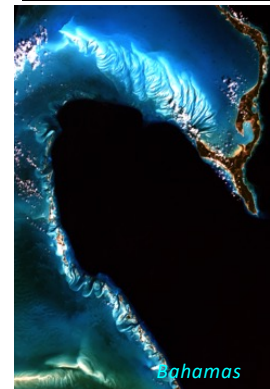
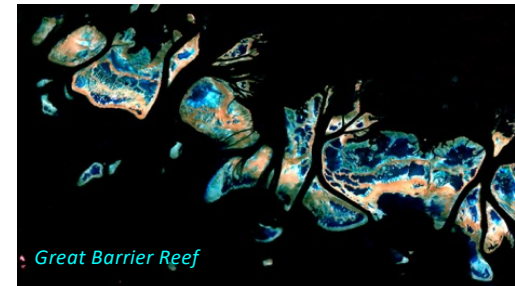
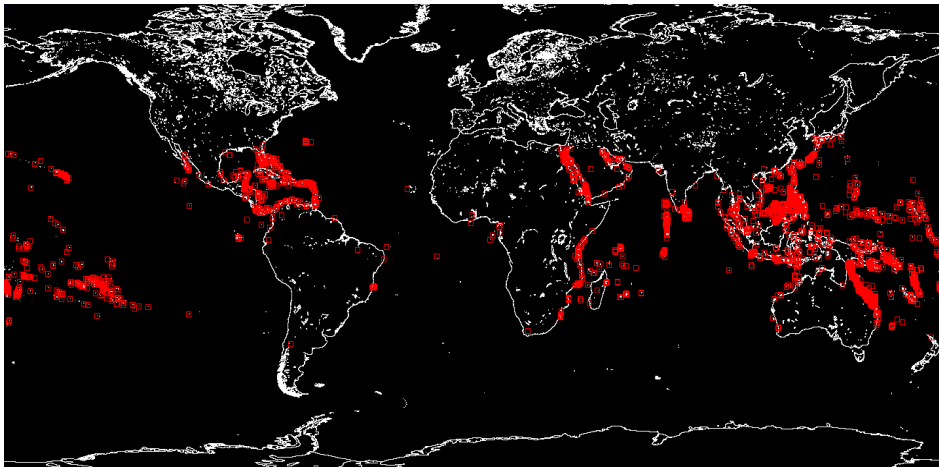


UNIVERSITY OF
SEYCHELLES
Knowledge hub of the Indian Ocean



INTRODUCTION

- Coral reefs found in **intertropical zone** (\approx between 33°N and 30°S) in > 100 countries and territories
- The **largest living structure** in the world -> Great Barrier Reef visible from space



Millennium Coral Reef Mapping Project (USF, IRD), Images acquired by the Landsat 7 satellite, NASA and USGS.

INTRODUCTION

The **most diverse marine ecosystem** on Earth ($\approx 100\ 000$ sp recorded)
30% marine biodiversity $< 0.2\%$ of the seafloor

↔ **underwater rainforests**



INTRODUCTION

Major importance in tropical environments

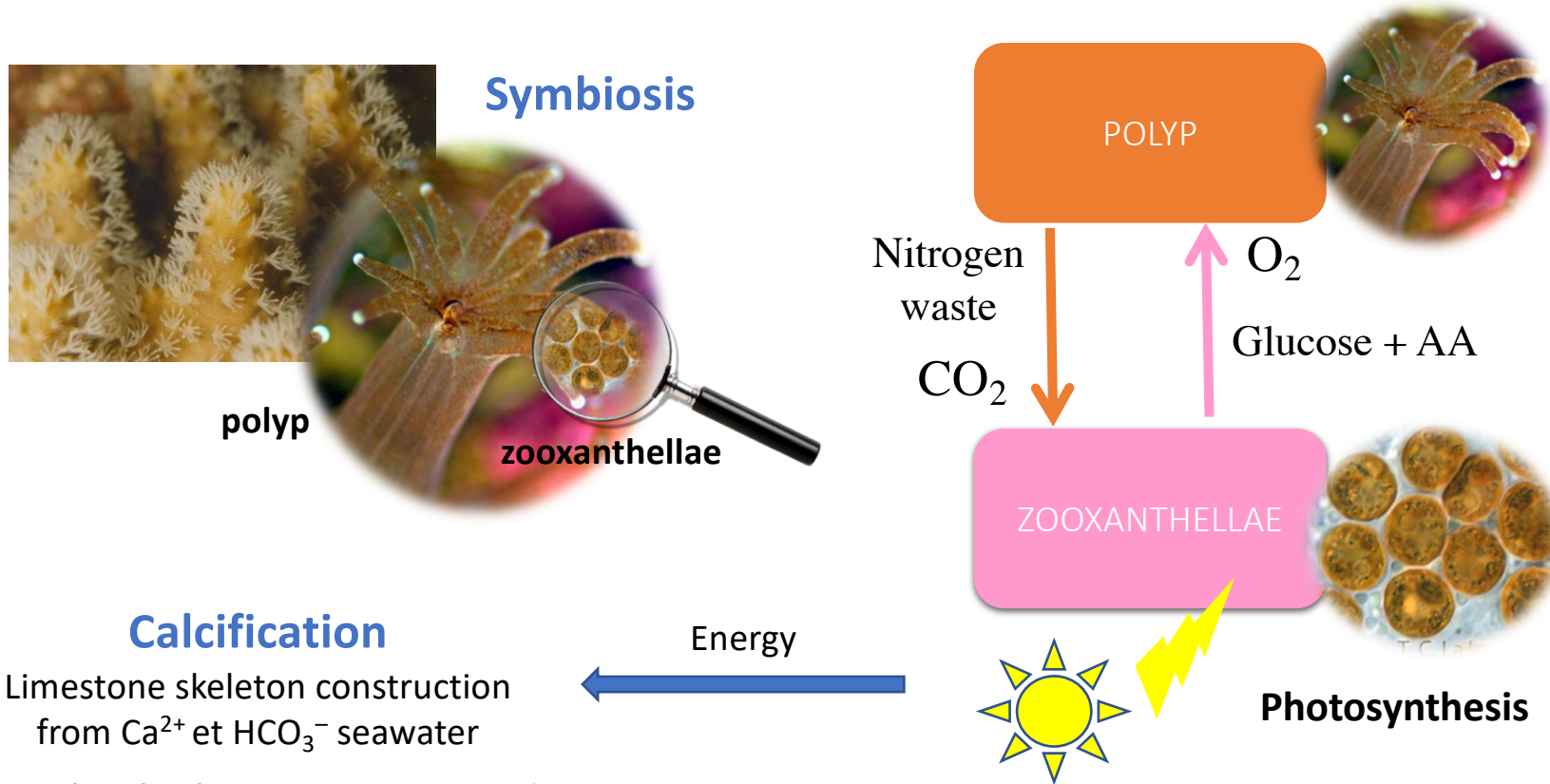
Ecosystem services

- Climate regulation
- Protection from storm surges
- Food source through subsistence fishing
- Income sources - commercial fishing, tourism
- Medical properties
- Cultural and patrimonial value



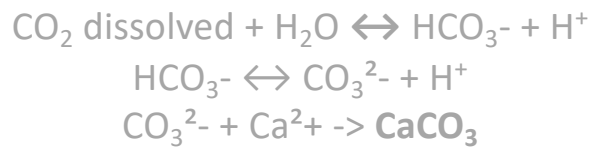
At the base of these underwater rainforests

a tiny animal, the **polyp** which associates with algae, the **zooxanthellae**



Calcification

Limestone skeleton construction from Ca²⁺ et HCO₃⁻ seawater



A successful association which requires a very stable environment

Temperature: 20° - 29° C (% sp range)
Illuminance: sufficient for photosynthesis
Depth: % transparency (1-50 m)
Salinity: normal (approx. 35/1000)
Turbidity: influences illuminance
Substrate: stable and solid

↔ Coastal environments

Stress

Any **environmental stress** ($T > 1^{\circ}\text{C}$) can break the symbiosis and cause zooxanthellae expulsion => **coral bleaching and death**



Live corals



Coral bleaching



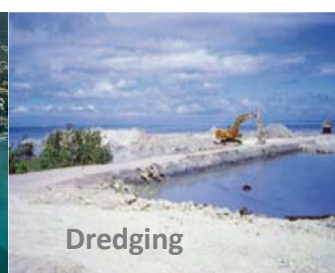
Dead corals – macroalgal-dominated

THREATS – LOCAL HUMAN STRESSORS

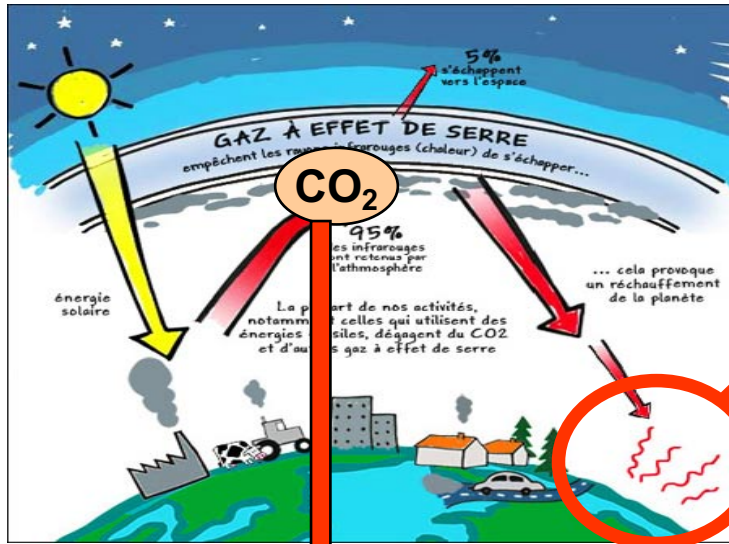
25% of coral reefs have disappeared, 50% are in critical condition (ICRI, 2021)

Main threats come from human activities

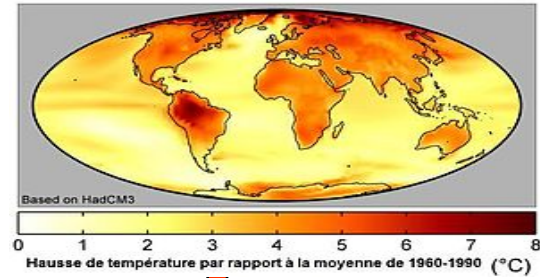
- **Land-based sources of pollution** ⇔ coastal development, deforestation, agriculture => sedimentation, pollution, eutrophication, pathogens ...
- **Marine pollution** ⇔ sewage, oil spills, anti-fooling, ...
- **Overfishing** => declines in fish populations and disrupting the food web of the ecosystem + coral habitat alteration due to destructive fishing practices
- **Invasive species** => competition with native reef species / *Pterois volitans*, *Xenia sp*
- **Unsustainable tourism and development** and recreative activities



THREATS – CLIMATE CHANGE



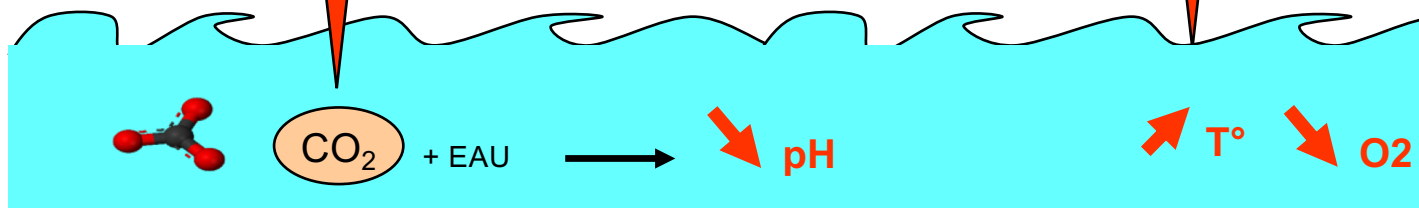
Prévisions des hausses de températures pour 2070-2100



≥ 2°C ?

Ocean acidification 25%

Global warming 93%



1850- 2020 2020-2100
 pH +30% → +150%

1850- 2020 2020-2100
 T° +0.9° → +2 to +5°

(IPCC, 2022)

THREATS – CLIMATE CHANGE

Local human impacts make coral reef less resilient to global change

- **Rising temperature** => massive coral bleaching
- **Changing weather**
 - stronger extreme events (cyclones, typhoon) => physical destruction of coral reefs
 - stronger precipitation => increased runoff of freshwater, sediment & land-based pollutants to reefs
 - more frequent El Niño events => ↑ heat waves (intensity and frequency) and massive coral bleaching
- **Sea level rise** => increased marine submersion and coastal vulnerability to wave energy
- **Ocean acidification**
=> increases water acidity and decreases the concentration of carbonates => reduction of coral growth, reproduction and overall coral reef calcification



Coral reef degradation

⇒ **destruction and fragmentation of habitats and loss of biodiversity**

- Reduced resilience
- Decline in keystone species (parrotfish, sea urchins, ...)
- Disruption of trophic interactions and cascading effects => ecosystem instability
- Altered ecosystem function as well as goods and services provide to people
- Cascading effects on fisheries, tourism, coastal protection, human security

Protecting coral reef is essential to maintain ecosystem resilience, their functioning and services they provide

