

Coastal Ecosystems Response to Climate Change and Human Impact in the Asia-Pacific Region (CERCCHI Project)

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In this presentation...

- **Introduction**
- **Threats to the coastal ecosystem**
- **State of the coastal ecosystems & environment in East Asia and the Pacific**
- **Integrated Coastal Zone Management**
- **The CERCCHI Project**



Importance of the Coastal Zone

- World's most important and intensely used of all areas settled by humans.
 - An estimated **50 to 70 percent** of the world's **population** lives in coastal zones.
- Given the definition of \pm 200 meters of the sea level", the coastal domain
 - occupies **18% of the surface** of the globe;
 - is where about **25% of global primary productivity** occurs;
 - supplies approximately **90% of world fish catch**;
 - is where **90% of the global sedimentary mineralization** occurs;
 - accounts for **75 to 90%** of the **global sink of suspended river load** and its associated elements or pollutants;
 - accounts for **80%** of the **global organic matter burial**;
 - accounts for over **50%** of present day global carbonate deposition.



Threats to Coastal Ecosystems

Erosion & siltation



Mangrove deforestation



Seagrass decline due to climate change and pollution



Gleaning



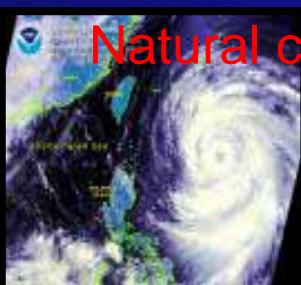
Natural grazing



Reef exploitation



Natural calamities



Eutrophication



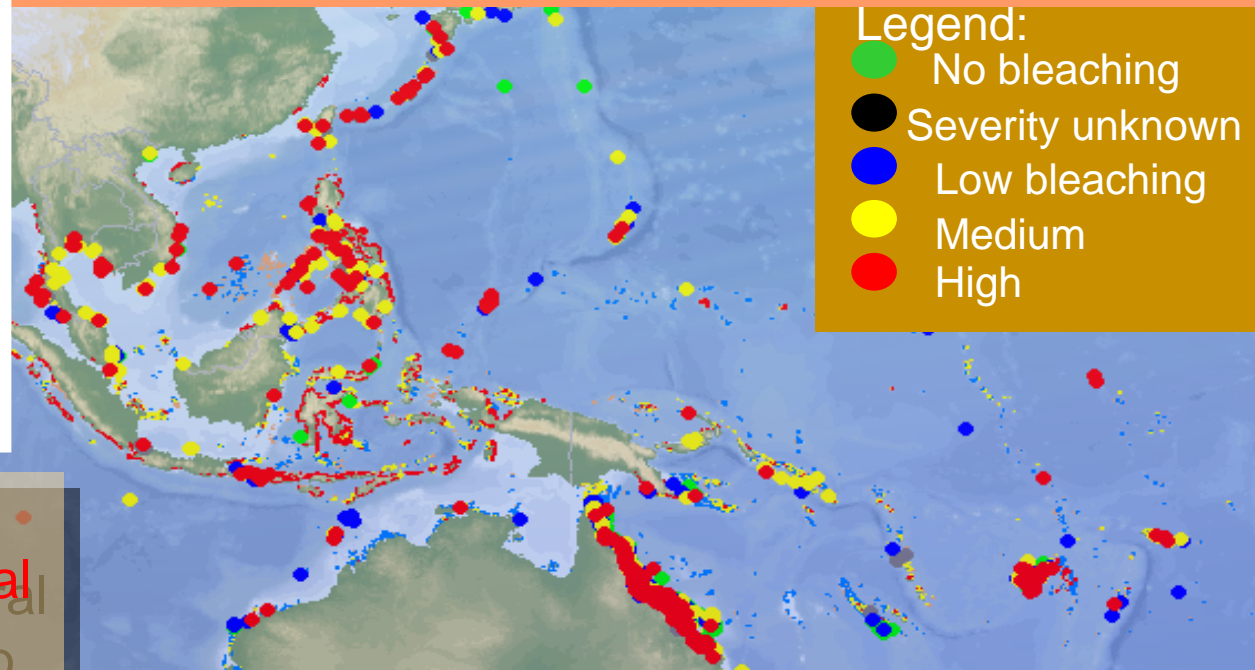
Over-fishing threatens 64% of the reefs, destructive fishing, 56%, coastal development, 25% & agriculture & deforestation, 20%

‘Predator plagues like **crown-of-thorns starfish (COTS)** may be initiated and certainly exacerbated by either **over-fishing of key starfish predators**; and/or **increases in nutrient runoff** from the land favors the planktonic stages of the starfish.’ (Goldberg and Wilkinson, 2004)



Threats to Coastal Ecosystems

Occurrence & severity of coral bleaching
(Source: www.reefbase.org)



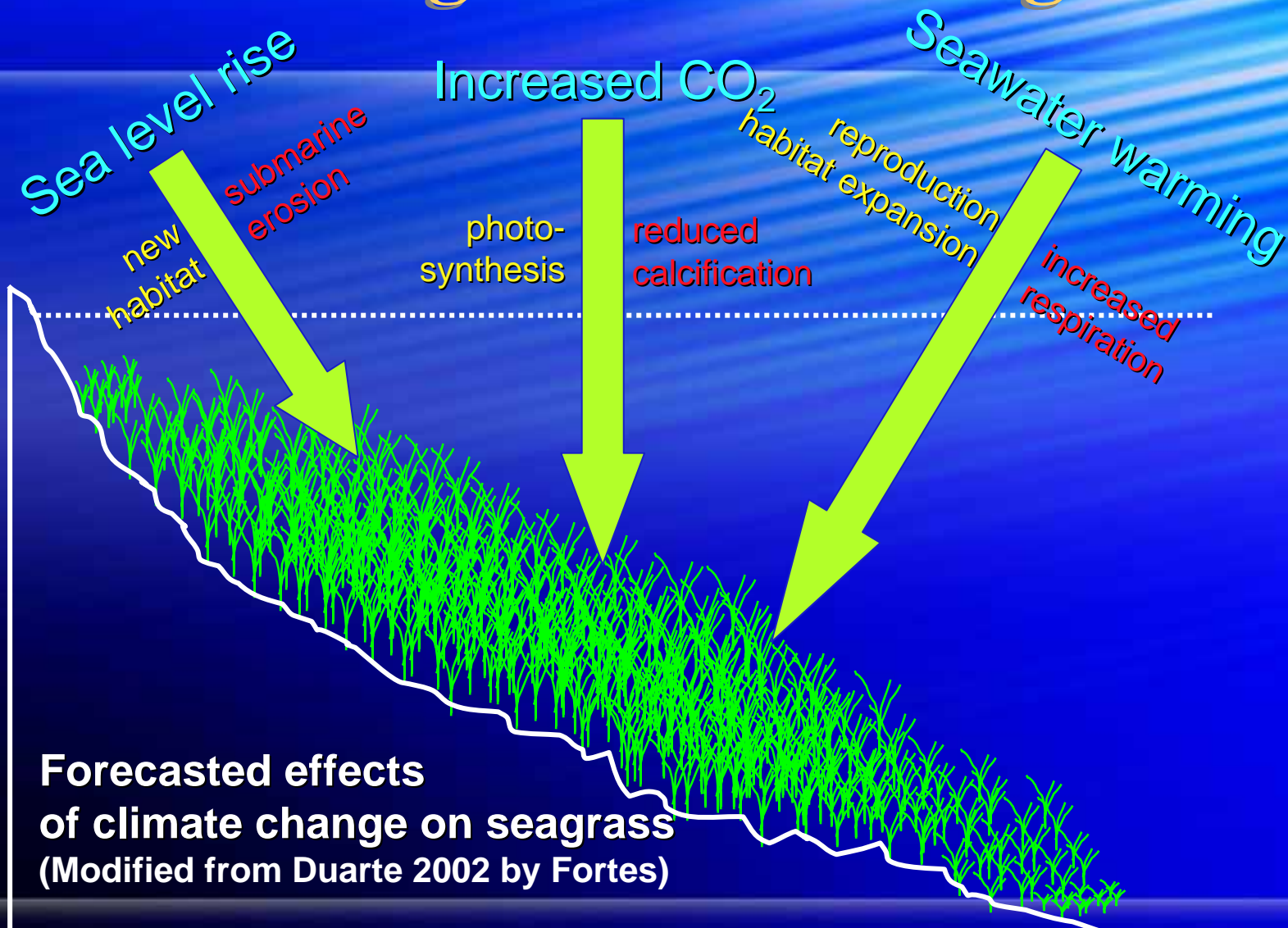
Coral Bleaching

A growing body of evidence links severe coral bleaching and mortality to **increasing rates of global climate change** attributed to rising levels of anthropogenic greenhouse emissions (Goldberg and Wilkinson, 2004).



Global warming & Climate change

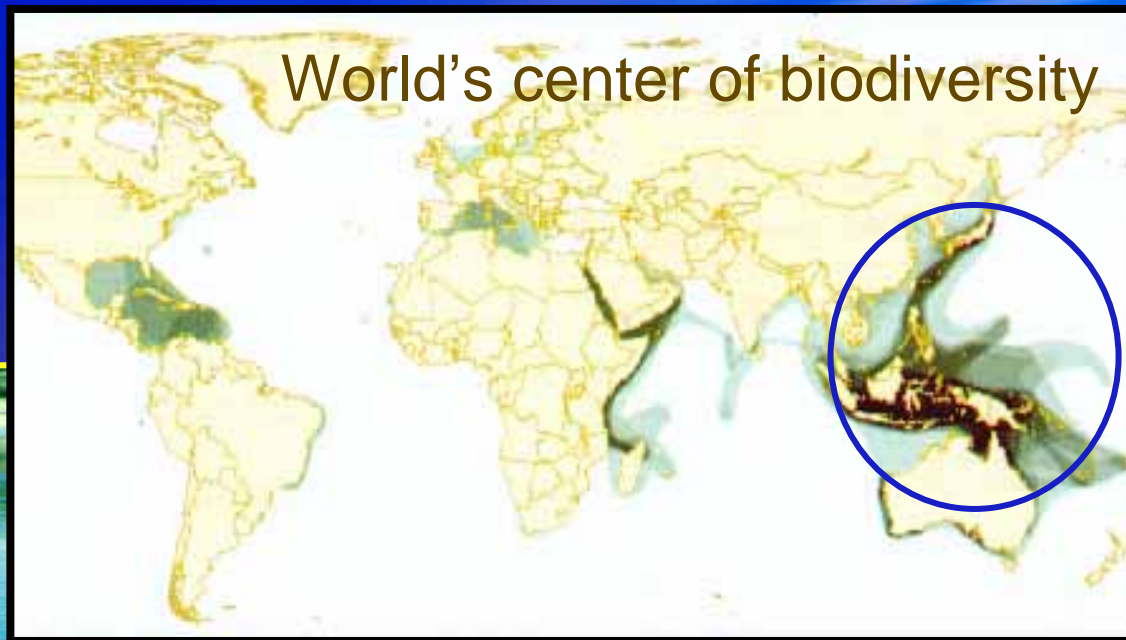
Climate change effects on seagrass



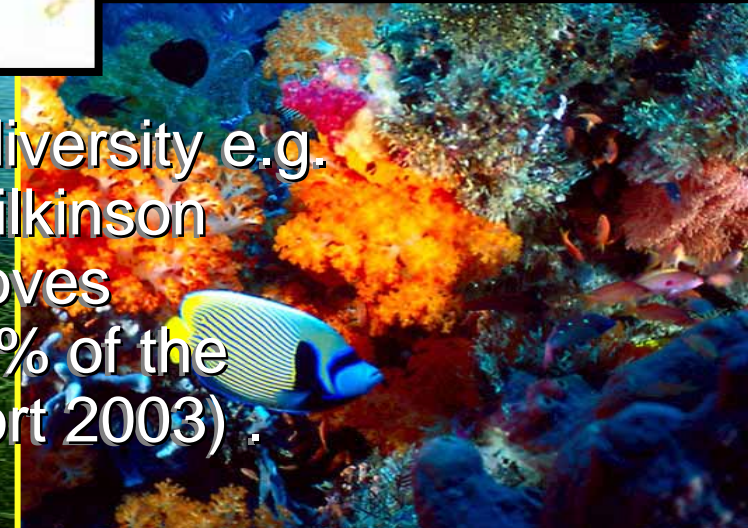
Forecasted effects of climate change on seagrass (Modified from Duarte 2002 by Fortes)



Coastal Ecosystems in East Asia & the Pacific



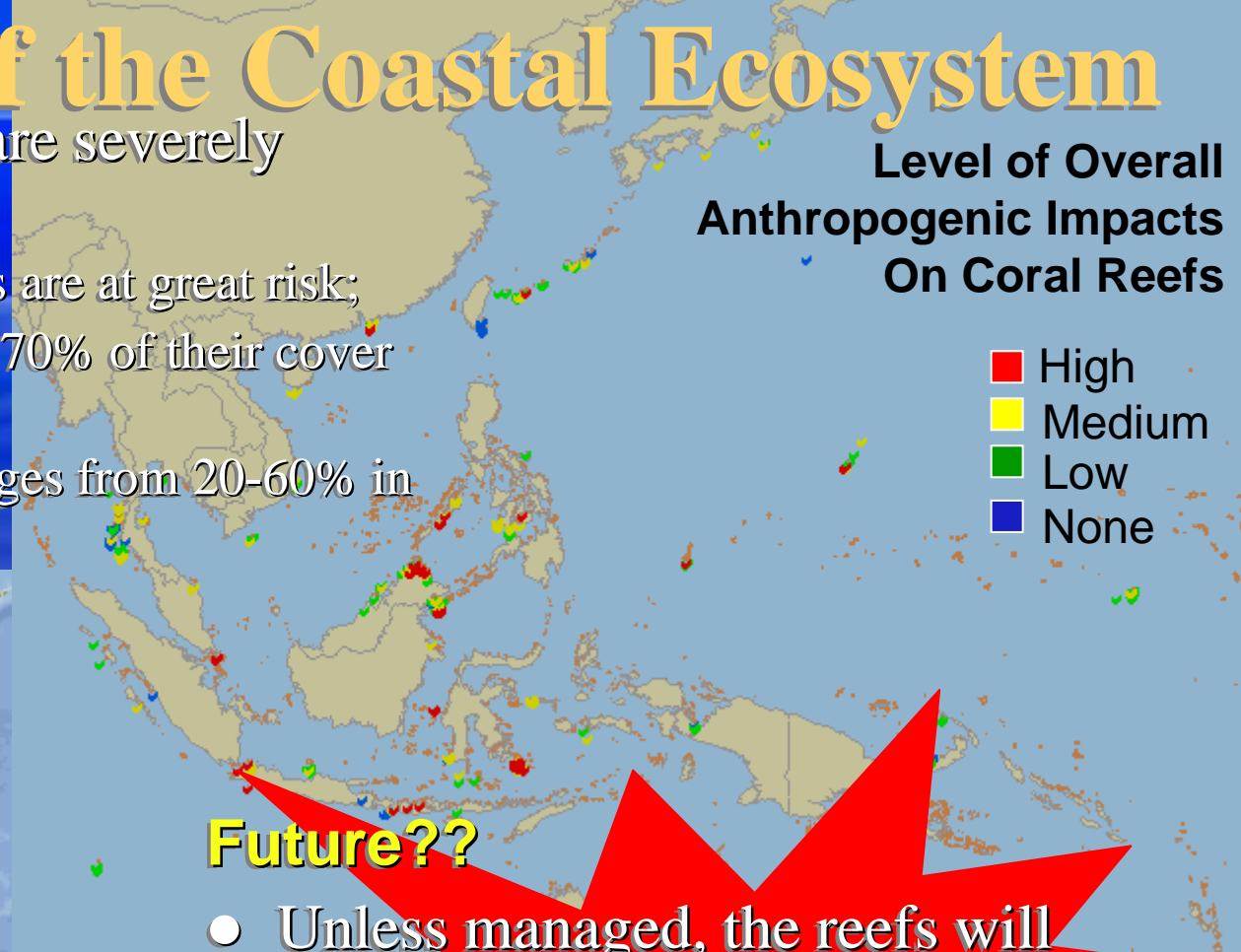
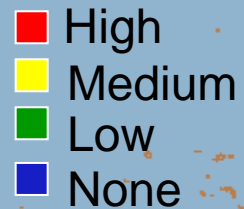
...globally significant for their biodiversity e.g. 30% of the world's coral reefs (Wilkinson 2002), 33% of the world's mangroves (Spalding et al. 1997), at least 10% of the world's seagrasses (Green & Short 2003).



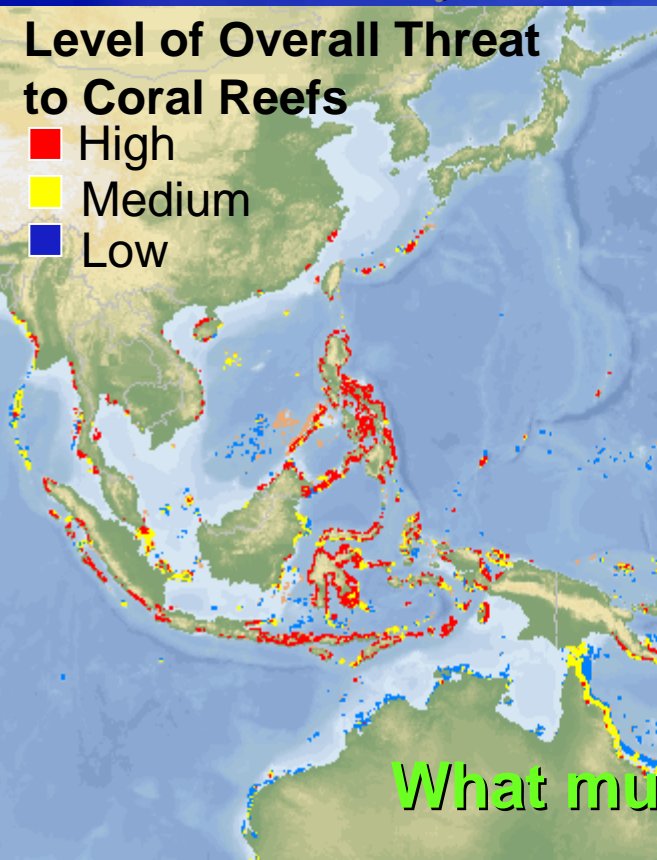
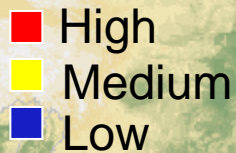
Present State of the Coastal Ecosystem

- Coastal ecosystems are severely damaged:
 - over 80% of the reefs are at great risk;
 - mangroves have lost 70% of their cover in the last 70 years;
 - seagrass bed loss ranges from 20-60% in the last 50 years

Level of Overall
Anthropogenic Impacts
On Coral Reefs



Level of Overall Threat
to Coral Reefs



Future??

- Unless managed, the reefs will collapse within 20 years, all mangroves will be lost by 2030, & seagrass beds will follow suit, so will the resources & revenues derived from them (PEMSEA 2003)

What must be done to avoid such a bleak future?

Integrated Coastal Ecosystem Management

Link science and decision-making
(multidisciplinary approach)

Enable understanding of
interrelationships across
systems

Focus on water quality per se

Integrated Coastal Ecosystem Management

Focus on conservation

Consider complex interactions
in managing coastal
resources



The CERCCHI Project

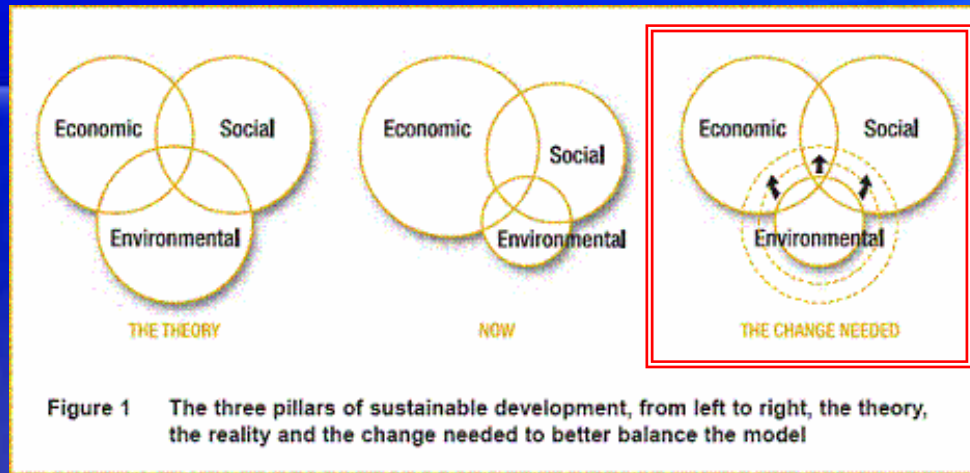
- Coastal Zone Management
 - must consider complex interactions between social, economic, environmental systems
 - must be responsive to local needs and in agreement with global efforts
- Present investigative efforts
 - narrow with results incompatible for understanding of interrelationships across systems

Scope

- **Spatial and temporal aspects of change** in natural and human systems in the tropical zone
- **Measurement of dynamic parameters:** CNP fluxes, sedimentation, sediment chemistry, tide level & wave action
- **Remote sensing data analysis** as a rapid, comparable and readily available source of spatial records



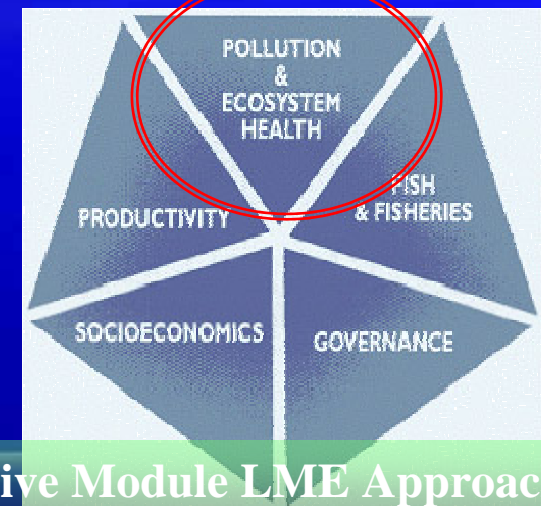
Integrated Coastal Zone Management



Underscores the need for improved assessment, monitoring and modelling of pollution and its effects on the coastal ecosystem

A Large Marine Ecosystems (LMES) Strategy for the Assessment and Management of International Coastal Waters

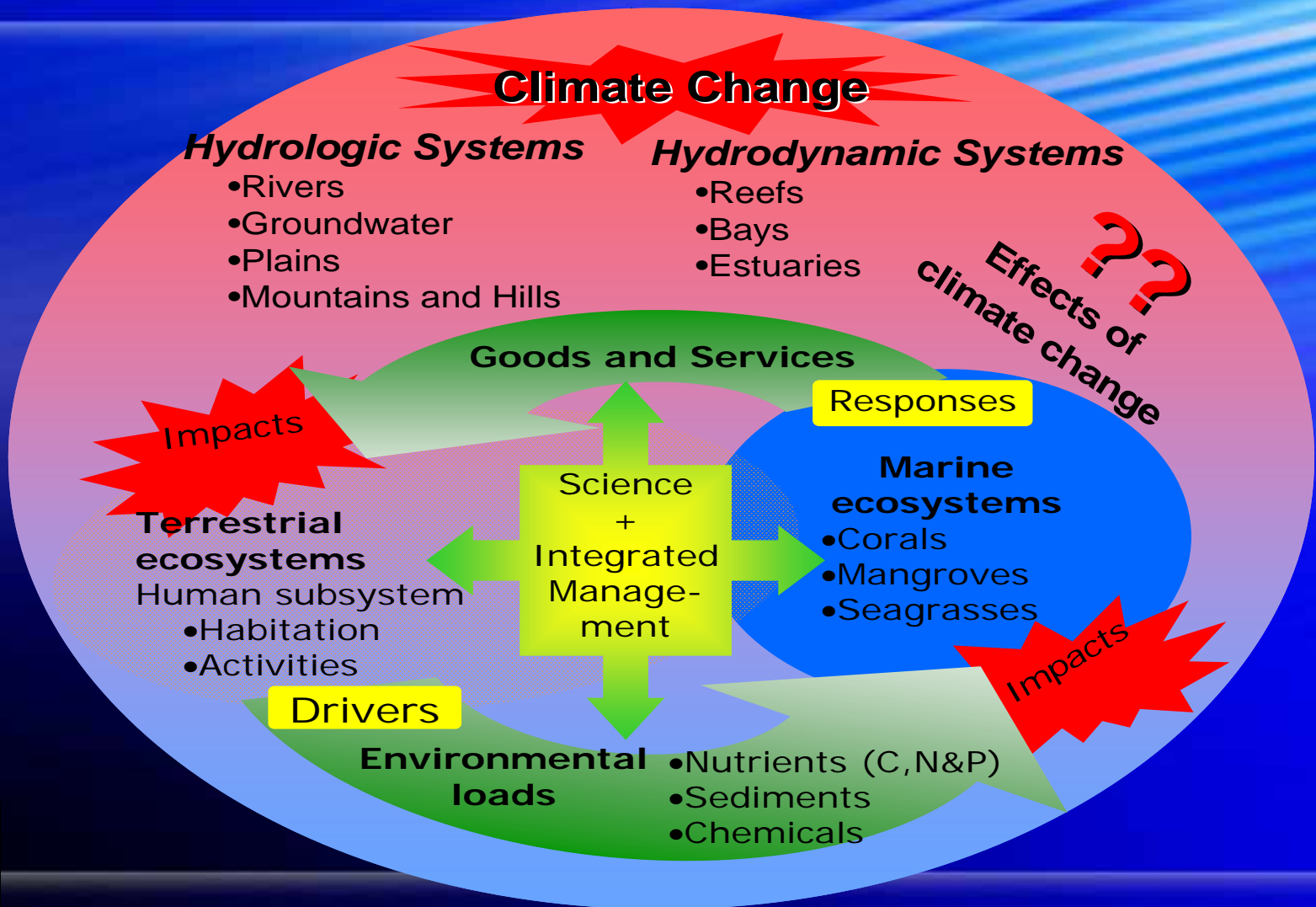
- A global effort under way
- **World Conservation Union (IUCN), UNESCO (IOC), other UN agencies, and the US NOAA**
- **To improve the long-term sustainability of resources and environments of the world's LMES and linked watersheds.**



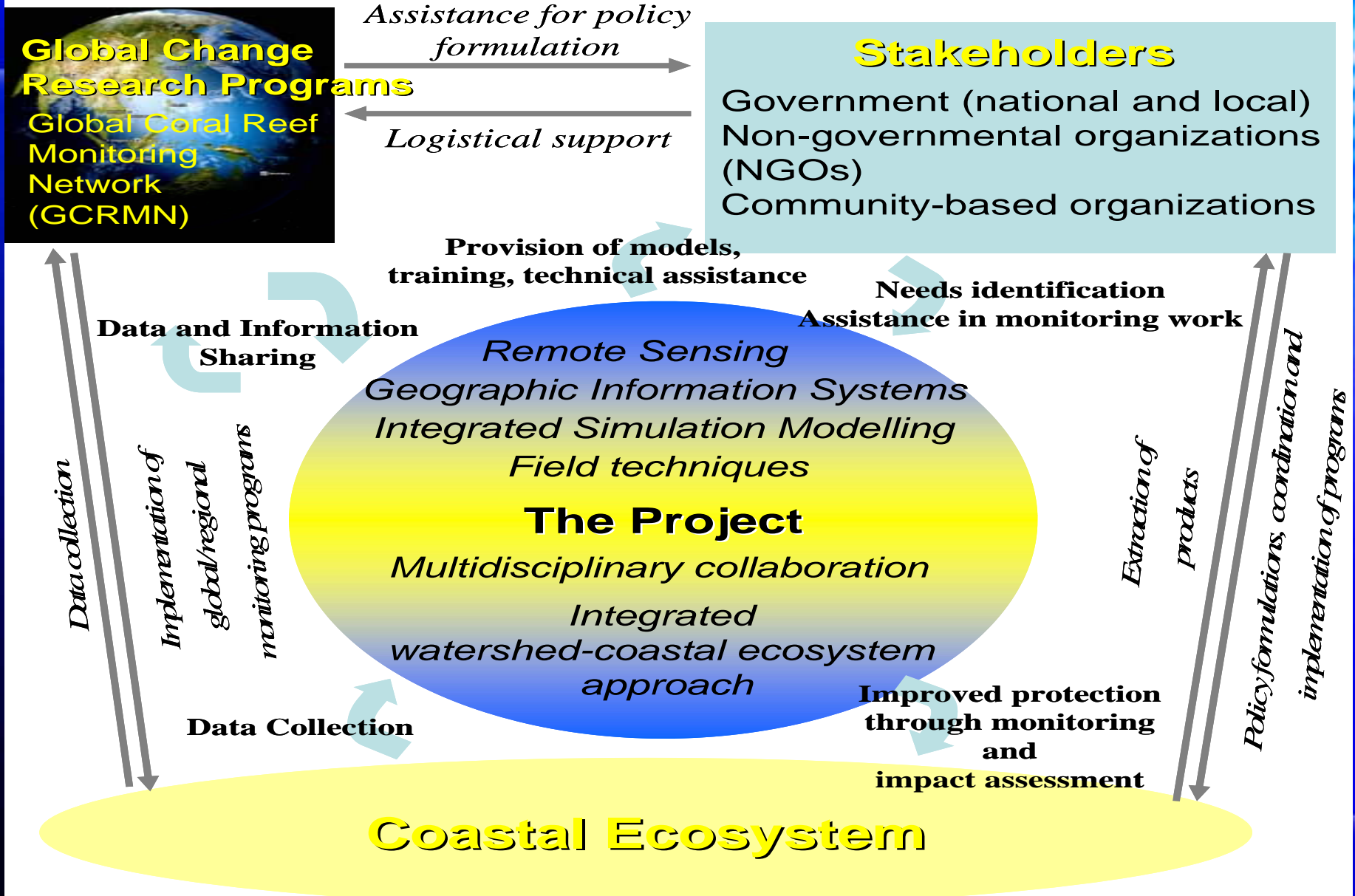
Five Module LME Approach



Linkages between tropical ecosystems



The Project Approach



Project Objectives

Provide an understanding of the driving/forcing effect socio-economically induced changes on environmental loads on the tropical coastal ecosystems

Produce an accurate set of multi-date coastal resource information particular to needs of managing changes in the coastal zone and consistent to allow comparison

Assess human welfare impacts of changes in coastal resource systems in terms of social costs and benefits considering different management strategies

Achieve and apply understanding of the causes and consequences of present and future environmental change of tropical ecosystems in management decisions

Develop capacity building through workshops standardized methods of processing in-situ, remotely-sensed data and environment-related socio-economic surveys

Strengthen the network, and reinforce linkages among coastal scientists and managers thru shared expertise and resources

Project Implementation

Capacity-building

(joint workshops; decision support tools suited for local management)

Development of a policy-relevant prognostic model
(environmental quality indicators and optimization technique to value resources and social priorities)

Assessment and analysis of changes
(changes in human and natural ecosystems considering hydrologic and hydrodynamic processes by use of physical and ecological models)

Analysis of multi-temporal satellite images
(to detect changes in land use patterns and coastal habitats)

Collection and assessment of existing studies and relevant data
(changes in the coastal and human impacts in tropical marine ecosystems; identify information gaps)

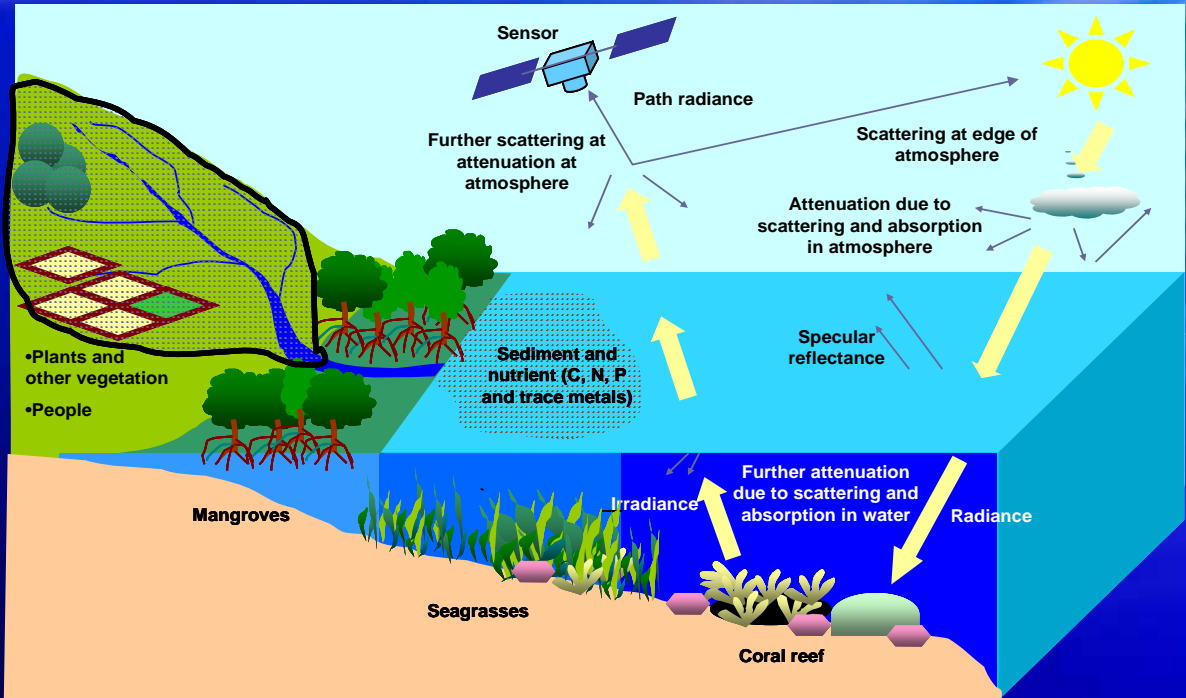
Data and information sharing and dissemination
(data, information and knowledge base exchange among collaborators and the public)

Fundamentals of the Project Approach

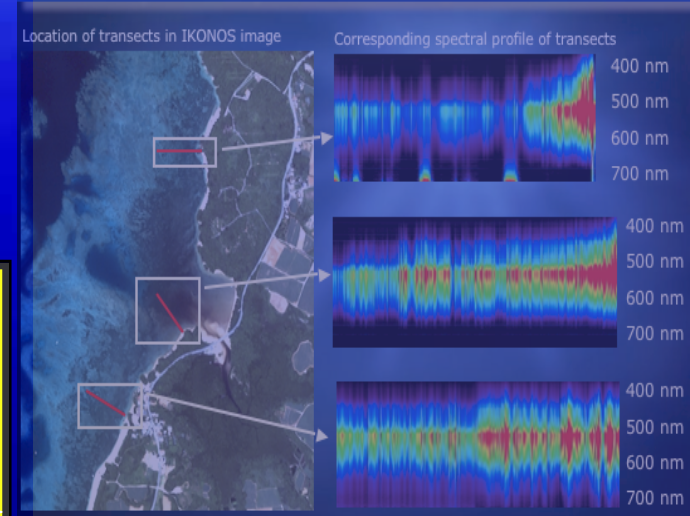
Remote Sensing for Coastal Environments

Basis of remote sensing for coastal environments:

- Coral reefs
- Mangrove forest
- Seagrass beds



Spectral profiles along transects



Development of seagrass assessment & monitoring methodology using remote sensing



Expected Outcomes and Outputs

- **Impacts of changes to coastal ecosystems** in East Asia and the Pacific region as depicted in **processed multi-temporal images**
- **Standardized *in-situ* data collection protocol, uniform methods** for processing remotely-sensed data and socio-economic surveys
- An **integrated physical and ecological model** specific to assessment of environmental changes in tropical ecosystems
- A science-based, user-driven practical **decision support system (DSS)** suited for management concerns in coastal zone
- A group of **coastal scientists** in the region proficient in environmental change evaluation methods
- **Managers trained** in using **DSS** for tropical coastal environment
- **Documentation** and other **relevant publications** for promoting provisional and actual use of the integrated model

