Earth Observations in the Coastal Zone: Critical Issues, Lessons Learned and Opportunities for Collaboration

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Key Coastal Management Challenges: Capacity Constraints

- Inadequate knowledge and understanding of many coastal systems, and limited capacity to acquire the information result in:

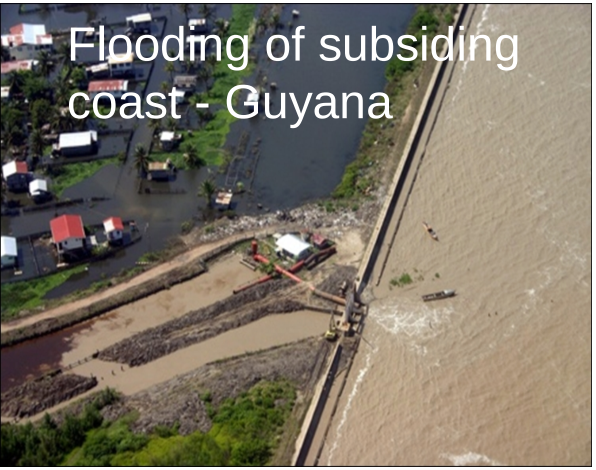
  ◙ Poor identification of data gaps

  ◙ Inability to make effective management decisions and interventions

  ◙ Unattractive to stakeholders – lack of ownership and commitment to program

  ◙ Frustration at the technical and policy-making level

Key Coastal Management Challenges: ICM must respond to (a) Present-day challenges (b) Projected/future changes



Key Coastal Management Challenges: Lack of Coastal Resource Inventories

- Coastal resource inventories serve many functions:

◙ A country cannot properly manage its assts if it doesn't know what exists: Location? How much? Spatial distribution? Seasonality?

◙ Useful decision making tool – Is the resource exploitable? If so, what is the threshold of exploitation beyond which the system will crash?

◙ Inventory is essential for undertaking *asset valuation*. It provides a basis for assessing the economic value (and other benefits) of a given resource.

◙ Inventories provide a baseline for quantitatively assessing spatial and/or temporal change in the status of a coastal asset.

Key Coastal Management Challenges: Coordination

- Coastal management requires data and information from multiple sources. This requires effective institutional coordination, which tends to be elusive for many reasons:

◙ Competing interests for federal, state or local funding

◙ Data collection programs reflect the narrow interests of a particular sector or institution

◙ Absence of incentives to encourage sharing and exchanging data

◙ Lack of a culture/tradition of inter-agency collaboration

Emerging Coastal Management Challenges: Climate Change

- Small island states highly vulnerable to adverse effects of climate change (IPCC, 2001, 2007).
- Climate change projections are derived from GCMs – resolution too coarse for land masses of sub continental and smaller spatial scales.

◙ While temperature projections are generally consistent among GCMs, projections for other parameters (e.g. rainfall) are highly variable.

◙ RCMs (e.g. PRECIS) and statistical downscaling provide products at finer resolution.

◙ High quality observational data still needed to calibrate model outputs – opportunity to collaborate with GEOSS?

Emerging Coastal Management Challenges: Climate Change

- Access to reliable sea level data that take crustal changes into consideration - critical for undertaking coastal vulnerability and risk assessments.

◙ Along an emerging shoreline (e.g. Barbados), the risk posed by sea-level rise may be over-estimated, if the rate of land uplift is not factored into analysis.

◙ On a subsiding coast (e.g. Guyana), the flood risk of and inundation from sea-level rise may be under-estimated, if the rate of subsidence is ignored.

Emerging Coastal Management Challenges: Climate Change

- Increasing urgency for coastal resource managers to identify and implement appropriate adaptation and mitigation responses.

◙ Coastal protection structures to respond to changing sea level, storm return periods and higher wave energy

◙ Changes in seasonal migration patterns of fish stocks

◙ Improved understanding of organism thresholds and tolerance to elevated SST and ocean acidification

◙ Salinity intrusion into coastal aquifers and soils → adverse consequences on freshwater supplies and coastal agriculture.

Lessons Learned: Multidisciplinary Approach to ICM

- Unconditional acceptance that integrated coastal management programs must be multi-disciplinary.

  ◙ While ICM acknowledges this principle, actions "*on the ground*" often show a strong marine/coastal bias.

  ◙ Terrestrial data collection efforts are often assigned *secondary* or even *peripheral* importance in ICM.

- Equally, data collection efforts of many 'land-based' disciplines (e.g. hydrology) are not driven by the needs of coastal scientists. Yet the outputs are vital in ICM practice (e.g. groundwater seepage into coast).

- GEOSS → integration of data outputs from these constituencies for improved decision making in ICM.

Lessons Learned: No Shortcuts to ICM

- ICM is a process NOT a project:

◙ Requires sustained commitment to data collection, for rational decision making.

◙ Published, independent reviews of “successful” ICM programs suggest certain commonalities:

► Strong focus on data collection

► Phased, incremental approaches

► Emphasis on training.

► Programs span at least 20 years and are still ongoing (e.g. Ecuador, Sri Lanka, Barbados, Philippines, New Jersey, Rhode Island, Canada’s Atlantic Coastal Action Program).

◙ GEOSS commitment to ensuring sustained access to high quality earth observations (*remote, in situ, land and ocean-based*) adds value to the ICM process.

Lessons Learned: Institutional Strengthening

- Effective *governance and institutional mechanisms* take long to implement – but absolutely essential for achieving successful coastal management outcomes → vital for ensuring the sustainability of data collection programs.

- Often the political directorate and administrators see data collection as expensive and esoteric, as there are often no immediate, easily discernible 'benefits':

◙ It may take many years to demonstrate that a MPA is having the desired effect.

◙ Repeated coral reef surveys and water quality sampling are must be undertaken before it can be determined that organism stress levels are being reduced.

Potential Benefits of GEOSS: Enhancing the Coastal Resource Information System (CRIS)

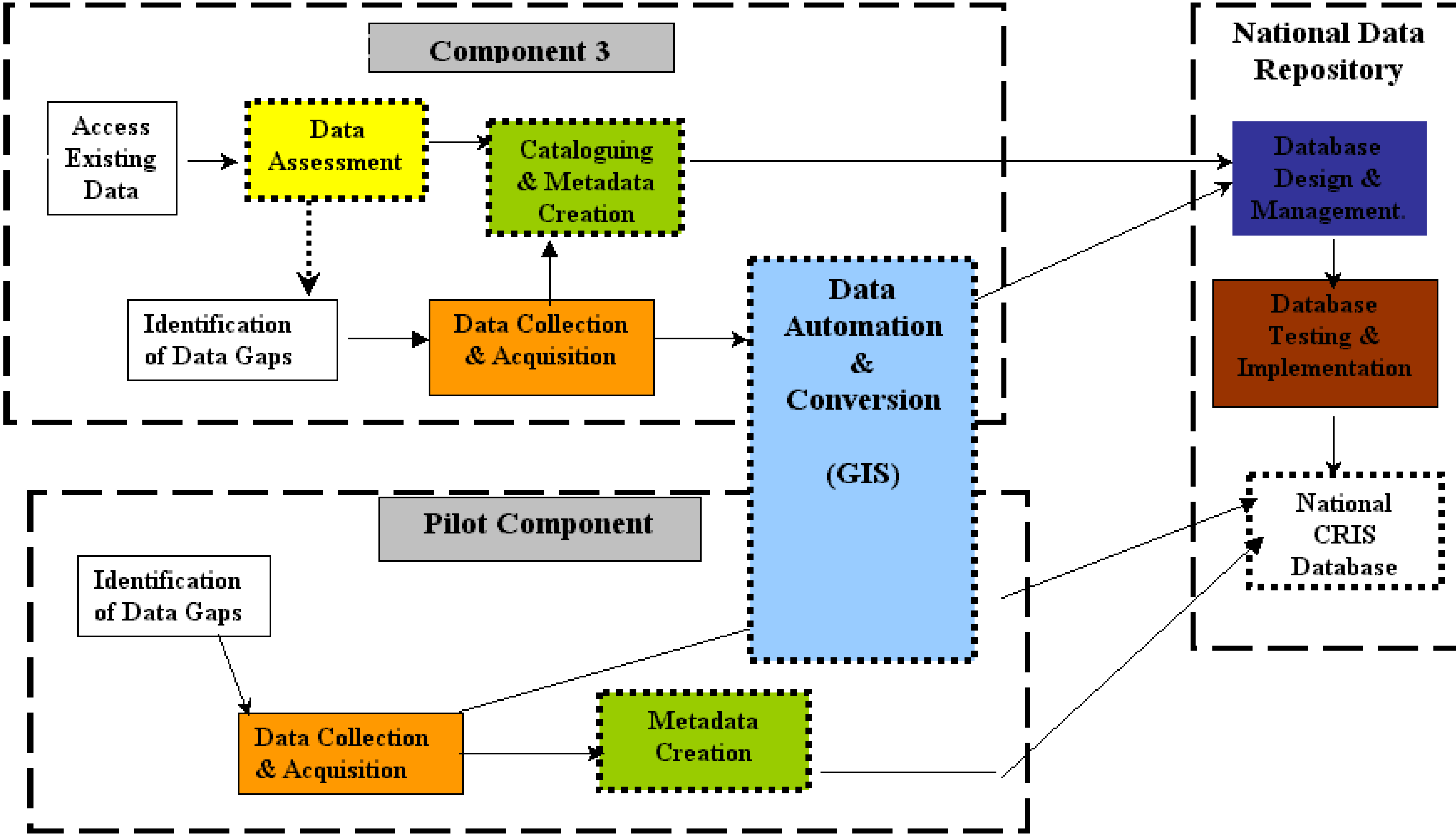
- The Caribbean CRIS was developed s a component of the GEF-funded project “ Caribbean Planning for Adaptation to Global Climate Change” (CPACC).

- Basic framework/architecture in place, but very few countries possess the necessary data for populating the system.

- The CRIS was designed to be a “living” system – to be frequently updated with the best quality controlled data. This is a challenge for many CARICOM states.

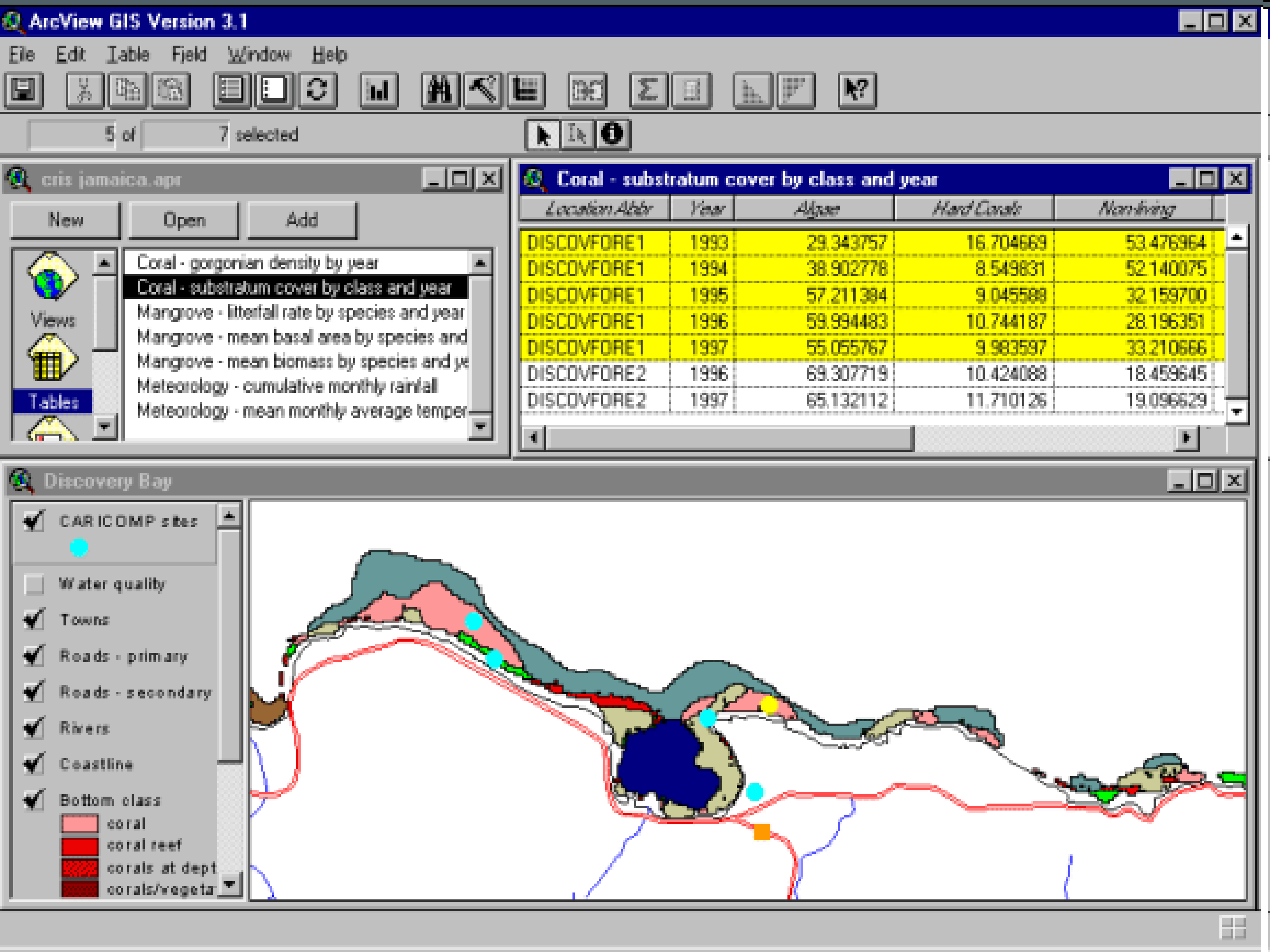
- Opportunity for GEOSS to assist the region → technical assistance exercise that focuses on *data access*, *training* and *capacity building*.

Diagram I: Implementation of Coastal resources and Uses
CPACC RPIU June 1999



Component 3: Training Modules.

T1: Metadata Regional Workshop
T2: Database Design Regional Workshop
T3: Data Collection and Automation Regional Workshop
T4: Systems Use & Decision Making National Seminars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New
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Tables
Coral - gorgonian density by year
Coral - substratum cover by class and year
Mangrove - litterfall rate by species and year
Mangrove - mean basal area by species and
Mangrove - mean biomass by species and ye
Meteorology - cumulative monthly rainfall
Meteorology - mean monthly average temper
Coral - substratum cover by class and year
Location Abbr
Year
Algae
Hard Corals
Non-living
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DISCOVFORE1 1994 38.902778 8.549831 52.140075
DISCOVFORE1 1995 57.211394 9.045588 32.159700
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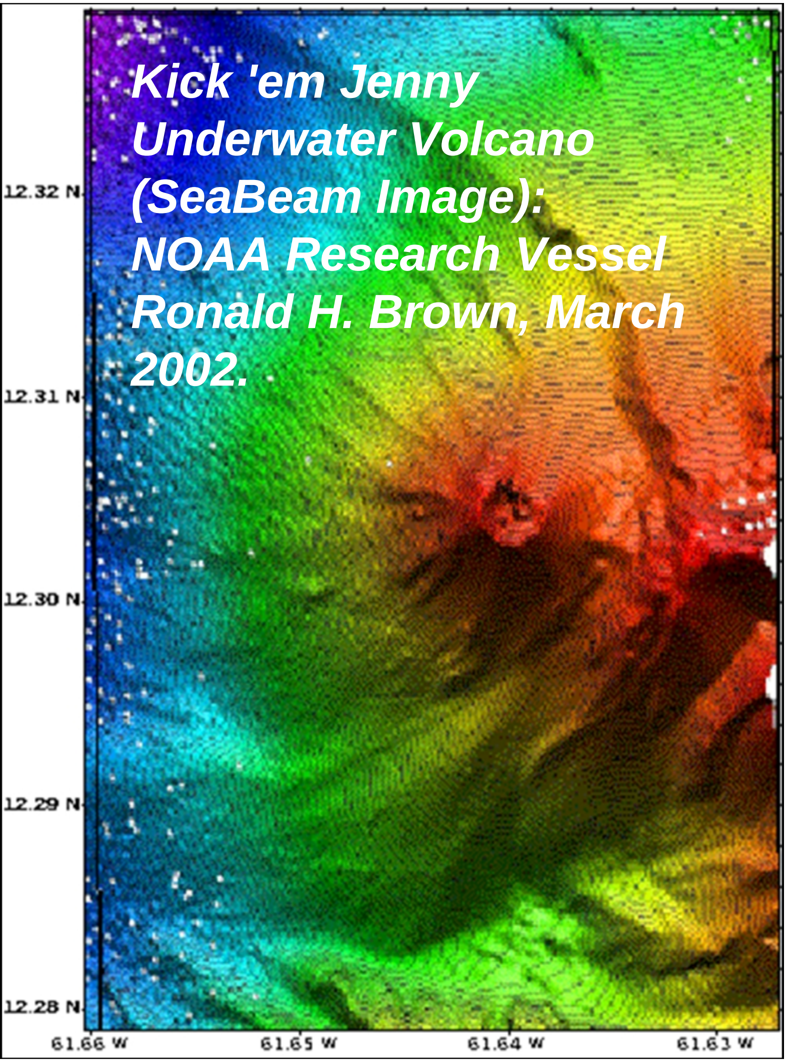
DISCOVFORE2 1996 69.307719 10.424088 18.459645
DISCOVFORE2 1997 65.132112 11.710126 19.096629
Discovery Bay
CARICOMP sites
Water quality
Towns
Roads - primary
Roads - secondary
Rivers
Coastline
Bottom class
coral
coral reef
corals at dept
corals/vegeta

Potential Benefits of GEOSS to Caribbean: Disaster/Hazard Management



Kick 'em Jenny Underwater Volcano (SeaBeam Image): NOAA Research Vessel Ronald H. Brown, March 2002.

•Expanded tsunami warning system for the Caribbean, through an expansion of the DART, and related seismic seafloor monitoring. System limited to providing early warning to Puerto Rico and the USVI.

•Improved capacity building for flood forecast modeling, including support for LIDAR surveys of critical watersheds. Barbados is only CARICOM state with good LIDAR coverage (with pilot projects in flood and storm surge modeling).

Benefits of GEOSS : Ecosystem Management

- Harmful algal blooms pose a serious threat to the health of ecosystems and the marine environment in general.

- Southern Caribbean periodically affected by discharge from continental rivers in the region – e.g. satellite imagery confirms seasonal sediment plume from Orinoco into Caribbean basin.

  - ◙ In 1999, heavy rainfall events precipitated a huge plume of silt-laden freshwater from Orinoco → reached many islands including Barbados, Grenada, and St Vincent.

  - ◙ The plume also carried the bacterium *Streptococcus iniae*, known to affect freshwater species in the Amazon. A massive fish kill followed → linked directly to *S. iniae*.

How would GEOSS help?

- Access to data and information relating to:
  - ◙ Tracking of algal blooms and forecasting of algal outbreaks
  - ◙ Ocean color data for the tracking of South American river outflows (OCR?)

Benefits of GEOSS : Non-Living Resources

- Access to high resolution bathymetric & geophysical data would facilitate efforts to *identify*, *map* and *quantify* available non-living resources:

  Examples

  ◙ Offshore sand mining for coastal protection (beach replenishment) and coastal reclamation.

  ◙ Hydrocarbon prospecting → being pursued by states in Caribbean (e.g. Trinidad, Jamaica, Barbados).

  ◙ Submission of claims to the CLCS under Article 76 of UNCLOS for an extended continental shelf 200 NM beyond territorial sea. Data-intensive process. Barbados, Trinidad and Tobago, Suriname and Guyana have submitted claims.

Potential Benefits of GEOSS: Climate Change Mitigation and Adaptation

- Mitigation and adaptation in the energy sector are critical for abatement of GHG forcing of atmosphere.

- Renewable energy sources will be a key element in climate stabilization. Coastal management science, with critical inputs from GEOSS, has a role to play in the process, e.g. through the identification of:

◙ Suitable sites for coastal wind farms → being pursued by many small islands and coastal states

◙ Potential wave energy sites.

◙ Optimum locations for ocean thermal energy conversion (OTEC).

Barbados Coastal Zone Management Unit Data Collection Program: Weather

- 15 coastal weather stations
- Daily data since 2003

<u>Variables</u>

- Temperature
- Heat Index
- Humidity
- Wind (speed/direction)
- Rainfall
- Dew point

Barbados Coastal Zone Management Unit Data Collection Program: Currents and Tides

- 8 S4 and S4C wave recorders
- Data retrieved monthly since 2001

Parameters

- Temperature
- Salinity
- Current speed and direction
- Wave height, period, direction

Barbados Coastal Zone Management Unit Data Collection Program: Water Quality Indicators

- 24 Monitoring Sites
- Data collected approx every 3 months since 2006

<u>Parameters</u>

- Temperature
- Salinity
- Dissolved oxygen
- Turbidity
- Nitrates
- Phosphates
- Ammonia
- Total suspended solids

Barbados Coastal Zone Management Unit Data Collection Program: Beach Profiles

- > 80 Profile sites
- Sites referenced to BNG
- Data collected
- Commenced 1983
- Parameters

<u>Elevation</u>

- Breaker height
- Wind direction & speed
- Angle of breaking wave

Barbados Coastal Zone Management Unit Data Collection Program: Marine Habitat Temperature

- 4 nearshore and 4 offshore HOBO temperature gauges
- Data retrieved every 3 months

Parameters

- Temperature
- Radiance

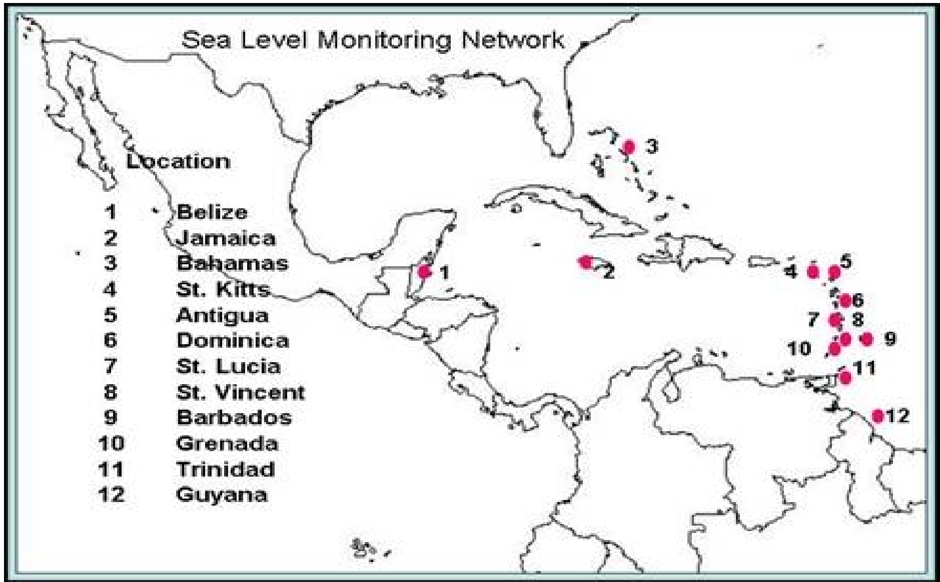
Barbados Coastal Zone Management Unit: Data Collection Program: Marine Habitat Health

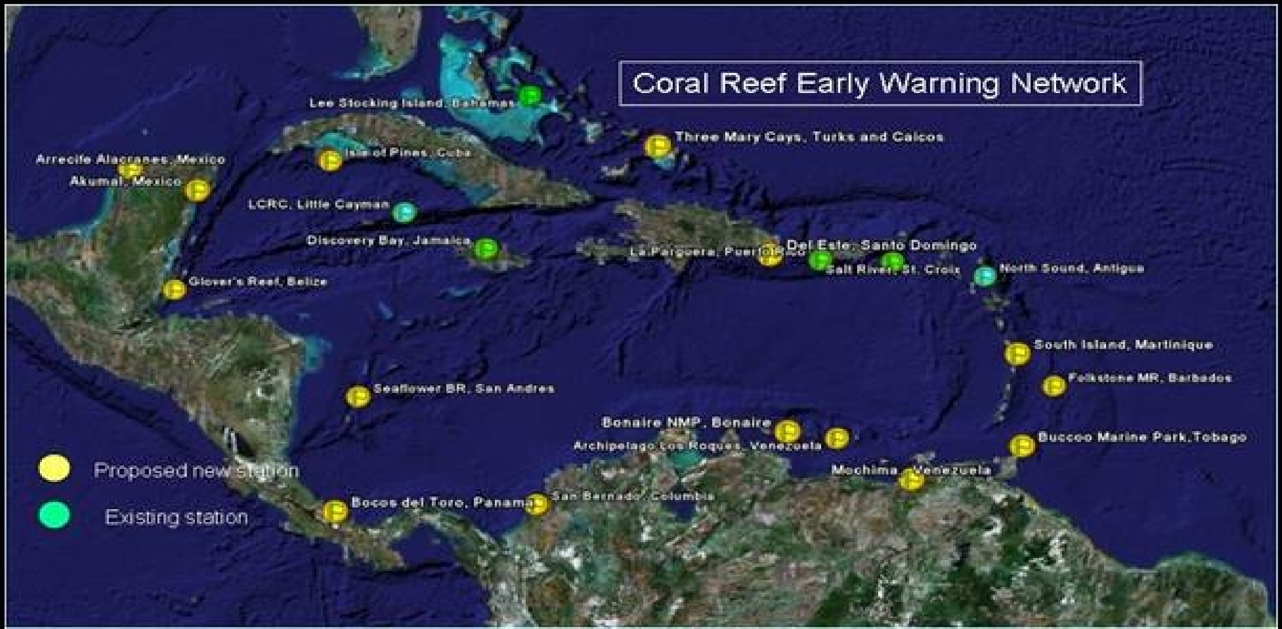
- 42 coral reef sites: *fringing, bank, patch*
- Sites resurveyed at 5-year intervals, since 1982

Parameters

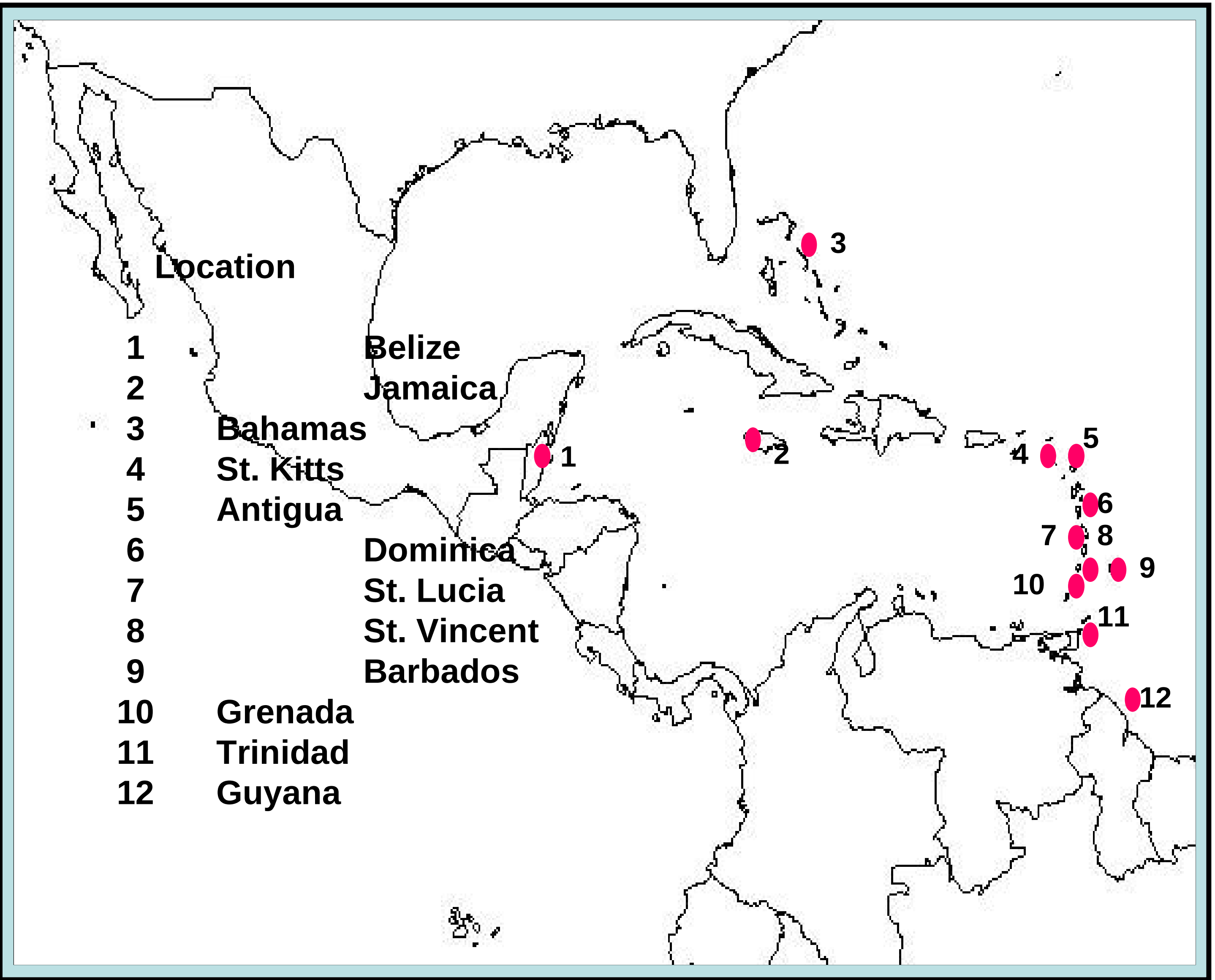
- Coral abundance and diversity
- Algal abundance
- sponge abundance
- Disease prevalence and types

Caribbean Community Climate Change Centre: Monitoring Network





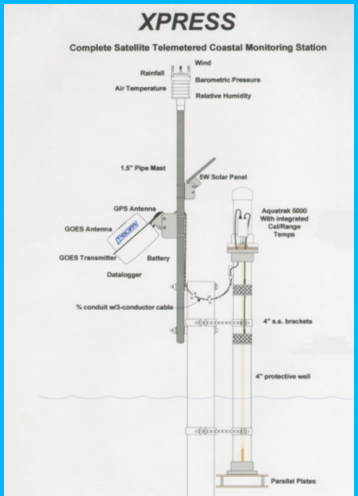
THE RECENTLY ESTABLISHED SEA LEVEL MONITORING NETWORK



Parameters monitored

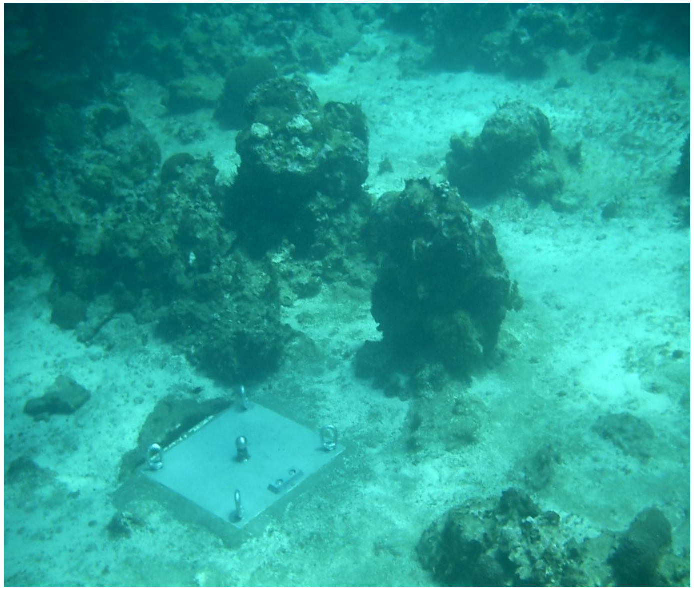
Atmospheric:
1. Wind
2. Rainfall
3. Temperature
4. Humidity

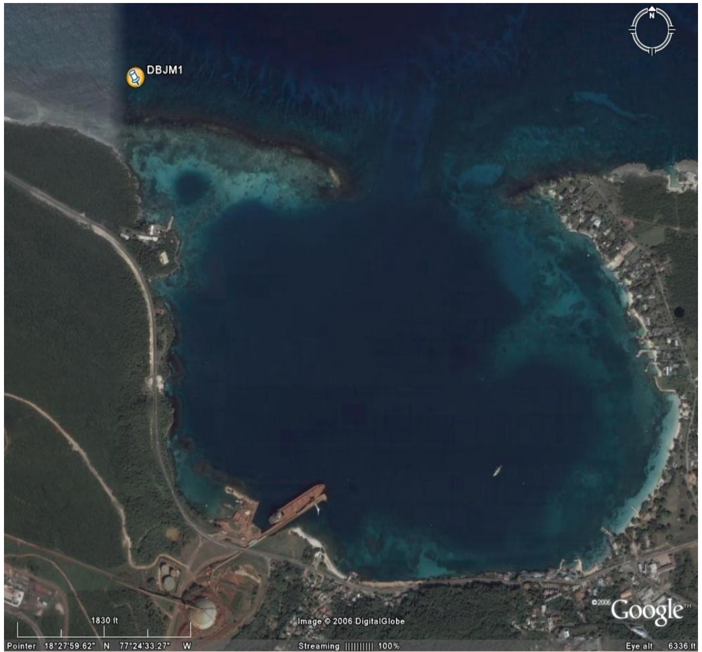
Oceanic
1. Wave height
2. Sea level
3. Sea Temperature



Coral Reef Early Warning System Network

CREWS STATION – Discovery Bay, Jamaica

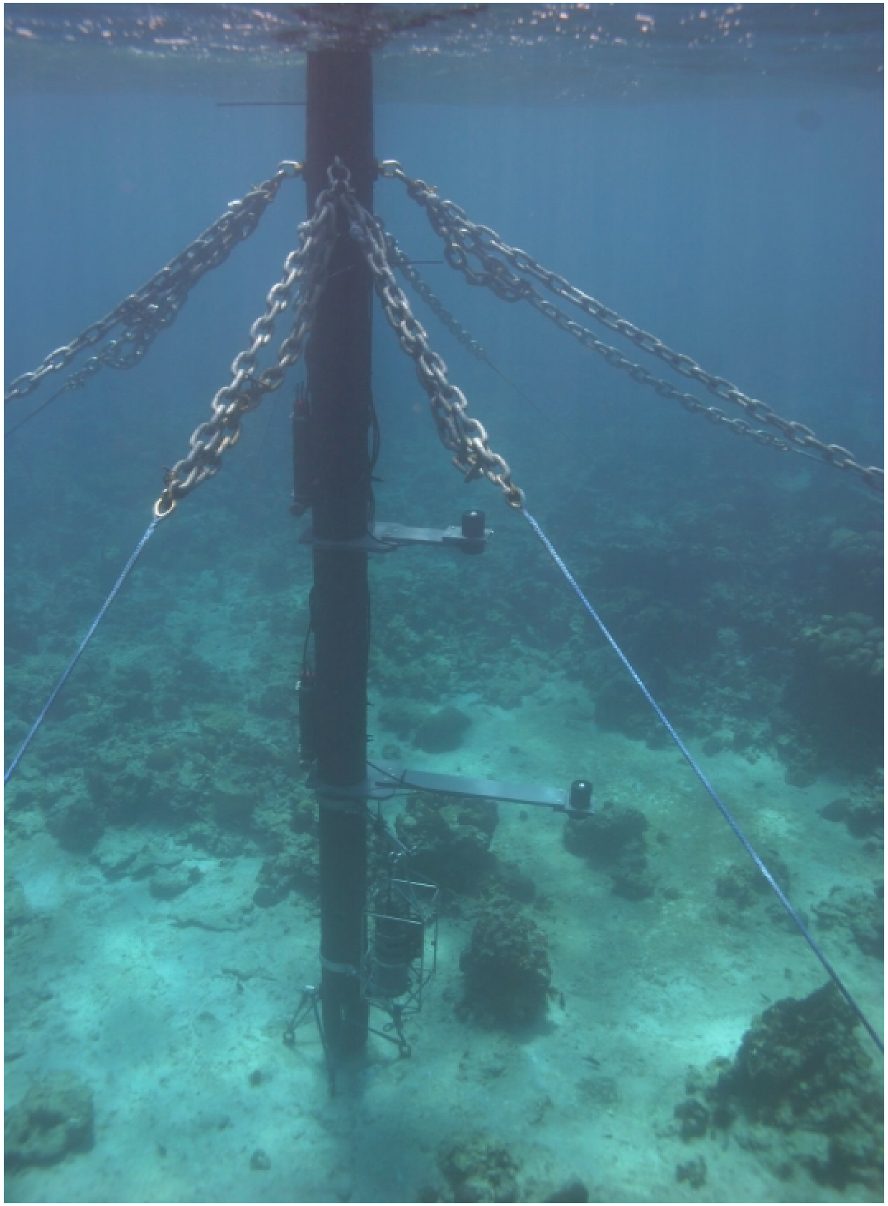




Montego Bay CREWS Station: Atmospheric Sensors

- Air Temperature
- Wind Speed
- Wind Direction
- Barometric Pressure
- Humidity
- Precipitation
- Light
  - Photosynthetically Available Radiation (PAR)
  - Ultraviolet Radiation (UVR)

Montego Bay CREWS Station: Marine Sensors



Shallow and Near Bottom

- Sea Temperature
- Salinity
- Light (UV, PAR)

Additional Sensors

- pCO_2 (ocean acidification)
- Pulse Amplitude Modulating (PAM) Fluorometry (real-time monitoring of coral stress response)

Local partners undertake eco-forecast validation and instrument maintenance


Thank You