UNCTAD Regional Workshop

5 – 7 December 2017, Bridgetown, Barbados

"Climate Change Impacts and Adaptation for Coastal Transport Infrastructure in the Caribbean"

GIS Inventory and Risk Assessment for Critical Coastal Infrastructure Land Use in Caribbean SIDS

By

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Caribbean critical infrastructure inventory for regional risk assessment

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Marine Affairs Coastal Resilience Lab (MACRL)

UNCTAD Regional Workshop: Climate change impacts and adaptation for coastal transport infrastructure in the Caribbean

Bridgetown, Barbados, 5-7 December, 2017

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Deepening understanding

↓

Communicating Risk

↓

Engaging stakeholders

How can a more holistic approach to planning reduce climate risks within the environmental, social, economic, and political landscape?

Climate change challenges

Doubling of Cat 4 and 5 tropical storms

1-in-100 year storm event of today

Sea levels to rise 0.[illegible]1.9 meters by 2100

1-in-1 year storm event of 2100

Inland flooding

Hurricane Sandy photos courtesy Mary Lee Clanton, Port of NYNJ

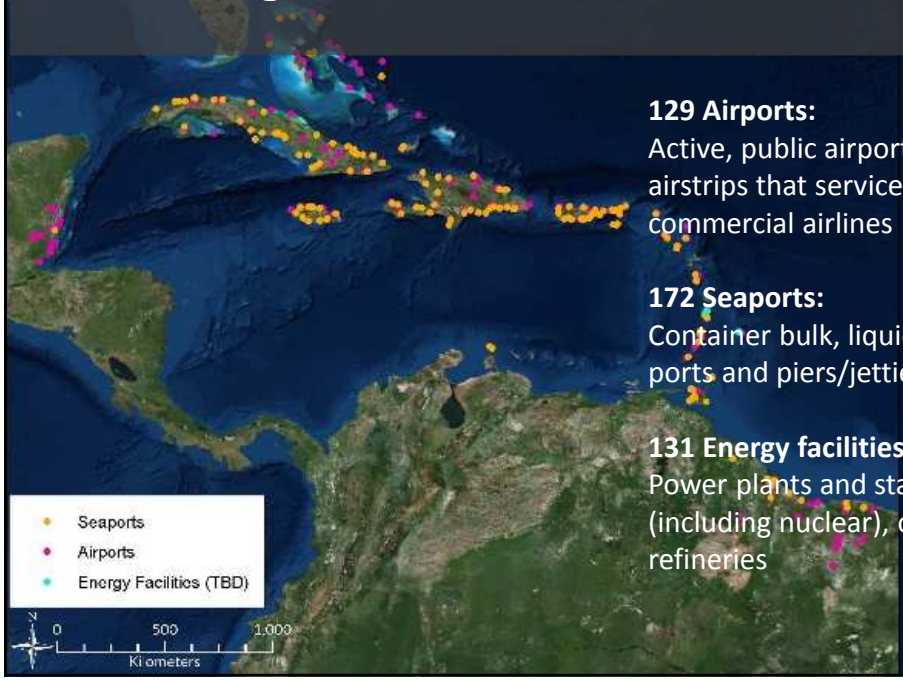
(Vousdoukas et al 2017, Bender et al. 2010; Grinsted et al. 2013; Rahmstorf 2010; Emanuel 2013; IPCC 2012; Tebaldi et al. 2012)

Caribbean SIDS challenges

- 60% of the region's population and 70% of economic activity within two miles of the coast
- Productive sectors, particularly tourism, are at risk given the proximity of infrastructure critical to development sited in low lying coastal areas
- Caribbean nations could face climate-related losses in excess of US $22 billion annually by 2050.

(Ramon Espinosa, Associated Press (Puerto Rico, Hurricane Maria); Jack Bauman 2017, ttps://www.guidester.com/caribbean-travel-after-hurricane/ (Hurricane Irma);Babun and Smith 2013 ttps://www.uschamberfoundation.org/blog/post/hurricane-season-2013-strong-ports-save-lives/31450 (Hurricane Georges)); The Inter-American Development Bank 2014

Regional Critical Infrastructure



129 Airports:
Active, public airports and airstrips that service commercial airlines

172 Seaports:
Container bulk, liquid fishing ports and piers/jetties/wharfs

131 Energy facilities:
Power plants and stations (including nuclear), oil refineries

The Need: Good modeling requires good data!

Understanding vulnerability for the entire region

- Data standardization standardized approaches for risk and vulnerability assessment
- Regional resiliency planning (decision support tool)
- Identify gaps and challenges (scenarios and impacts)

Climate models (e.g., surge and SLR)
Elevation Data
Asset Data

Project goals

1. **Regional inventory** of critical coastal infrastructure land use (ports, airports, energy facilities) updated at 5 year intervals and publically available via the web

2. **Risk assessment** for the region and for individual assets and asset classes at national or regional levels

Project partners (preliminary list)

- University of Rhode Island
  - Austin Becker, PhD
  - Gerald Bove, PhD
- Climate Central – detailed DEM, etc.
  - Ben Strauss
- Caribbean Community Climate Change Centre
  - Ulric Trotz, PhD
- UNCTAD
  - Regina Asariotis
- Joint European Research Centre
  - Michalis Vousdoukas, PhD
- University of the West Indies
  - Robert Kinlocke, PhD
  - Arpita Mandal, Ph.D

Project overview/status

1. Development of Standard Operating Procedures (SOP) initial challenge is the development of SOP
2. Database creation
3. Preliminary analyses

Standard Operating Procedures

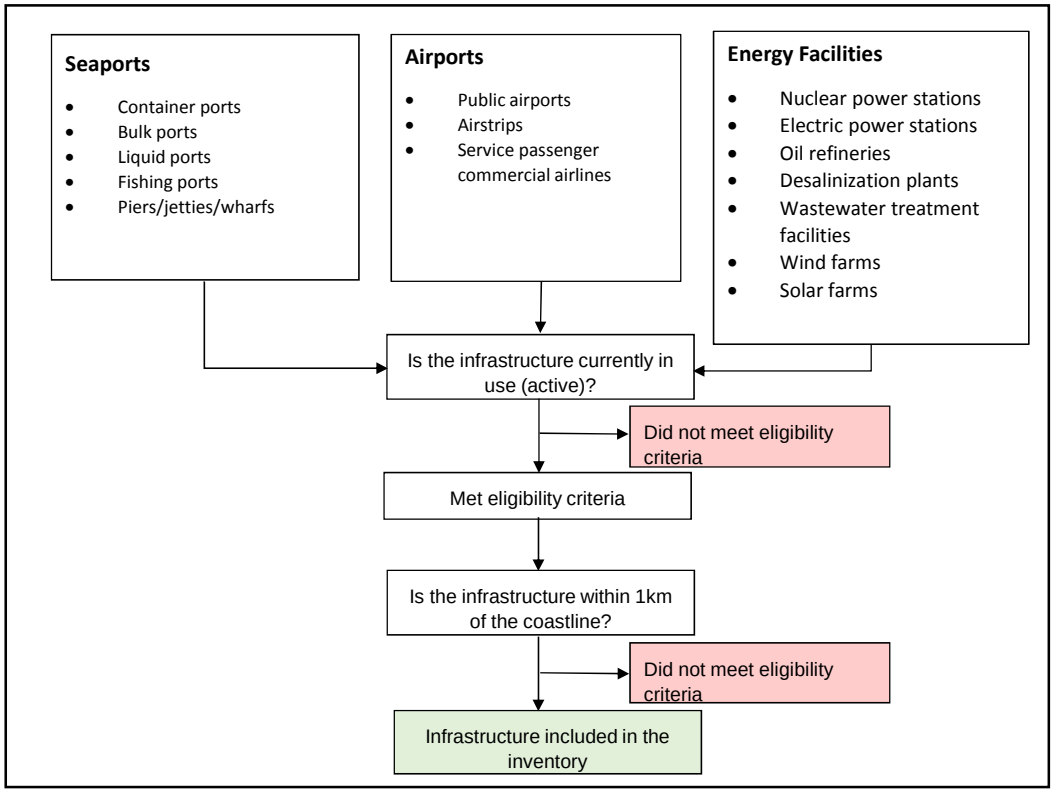
Input from regional and national partners will be critical in refining the framework

Features to include in database:

- Airports – Active, public airports and airstrips that service passenger commercial airlines (openflights.org airport index, world airport codes)
- Seaports – Active container, bulk, liquid, fishing ports, piers/jetties/wharfs (Source: World Port Source and World Port Index)
- Power Plants -- electric power stations, nuclear power stations, oil refineries (desalinization plants, waste water treatment facilities, wind farms, and solar farms)
- Access roads -- leading from critical infrastructure to a major connecting roadway or until 1km in length

Database creation

- Database creation
  - Digitizing
  - CoastalDEM30™ – Based on SRTM 3.0 coastal area error corrected (reduction of <1/2 the RMSE(m) for 1-20m) (lidar data confirmed), 1 arcsecond (~30 m) horizontal resolution
- Preliminary analyses



28 Caribbean States and Territories

Airports: (129) public airports and airstrips that service commercial airlines
Seaports: (172) container bulk, liquid fishing ports and piers/jetties/wharfs
Energy facilities: power plants and stations (including nuclear), oil refineries, waste water treatment facilities and freshwater treatment plants

Critical Coastal Infrastructure: Barbados

Airports = 1.196 km²
Seaports = 0.699 km²
Energy Facilities = 0.114 km²

Data Source: World Port Index, World Port Source, OpenFlights.org, World Airport Codes, Google

CRITICAL COASTAL INFRASTRUCTURE: ST. LUCIA

(Preliminary Results)

SEAPORTS

Total area = 0.19 square km

4 Seaports (Viex Fort, Grand Cul de Sac Bay, Castries, and Soufriere)

AIRPORTS

Total area = 0.605 square km

2 Airports (George F.L. Charles Airport and Hewanorra International Airport)

ENERGY FACILITIES

Total area = 0.953 square km

2 Power facilities (St. Lucia Electricity Services (Lucelec))

1 Oil facility (Buckeye St. Lucia Terminal Ltd.)

Data Source: World Port Index, World Port Source, OpenFlights.Org, World Airport Codes, and Google
Austin Becker, abecker@uri.edu, University of Rhode Island
November 2017

Critical Coastal Infrastructure: St. Lucia

Seaports total area 0.19 km2

Viex Fort, Grand Cul de Sac Bay, Castries, Soufriere

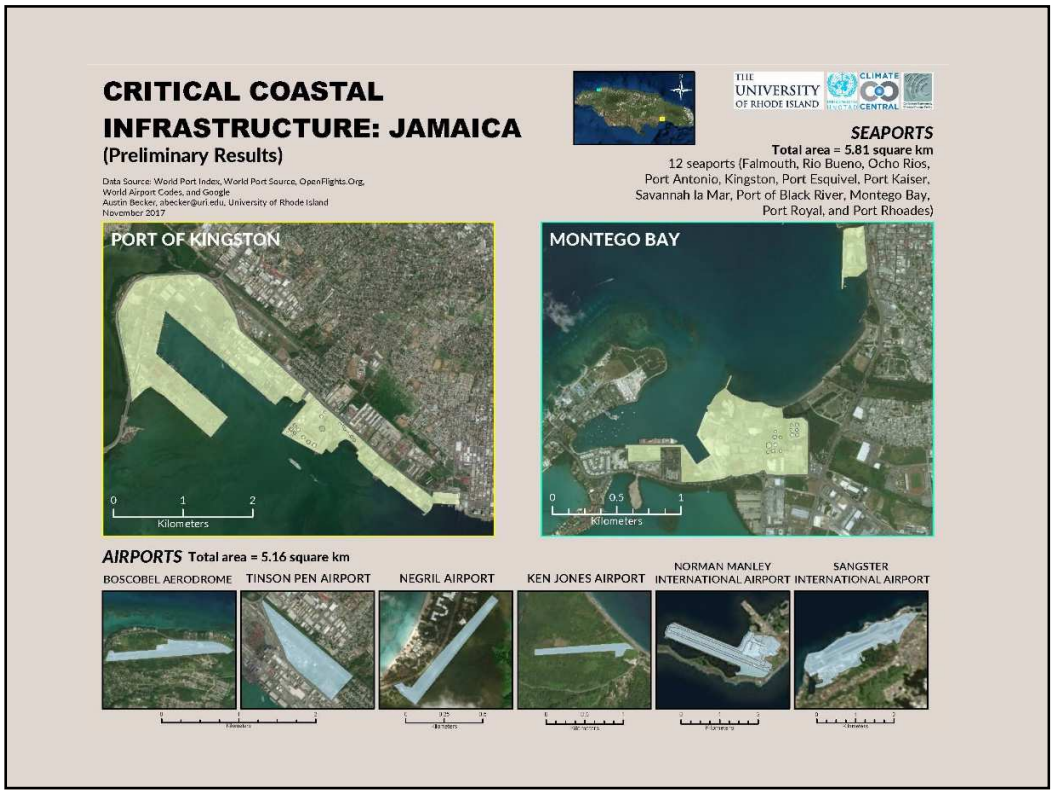
Airports total area 0.605 km2

George F.L. Charles, Hewanorra Int.

Energy facilities total area 0.953 km2

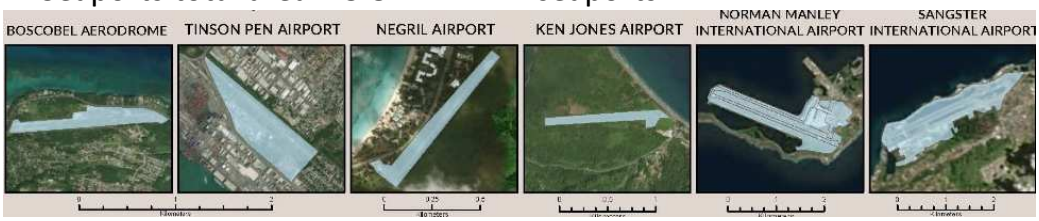
2 power facilities: St. Lucia Elec. Services; Lucelec

1 oil facility: Buckeye St. Lucia Terminal Ltd.



Critical Coastal Infrastructure: Jamaica

Seaports total area = 5.81 km2: 12 seaports



Airport total area = 5.16 km2

Critical Coastal Infrastructure: Jamaica, Norman Manley airport: 0.5 m rise in sea level

Critical Coastal Infrastructure: Jamaica, Norman Manley airport: 1.0 m rise in sea level

Critical Coastal Infrastructure: Jamaica, Norman Manley airport: 2.0 m rise in sea level

Coastal Infrastructure: Barbados, Grantley Adams airport: 0.5 m rise in sea level

Coastal Infrastructure: Barbados, Grantley Adams airport: 2.0 m rise in sea level

Coastal Infrastructure: St. Lucia, George F.L. Charles airport and Port of Castries: 0.5 m rise in sea level

Coastal Infrastructure: St. Lucia, George F.L. Charles airport and Port of Castries: 1.0 m rise in sea level

Coastal Infrastructure: St. Lucia, George F.L. Charles airport and Port of Castries: 2.0 m rise in sea level

Example: Risk Assessment Report

Coastal Infrastructure: St. Lucia Hewanorra International: 2.0 m rise in sea level

Applications of regional inventory and risk assessment

Increase capacity for regional hazard and vulnerability assessments to guide resiliency planning and increase convergence and action through partnership with regional institutions

- Credit rating agencies
- Insurance
- Planning
- Research
- Disaster relief and response
  - Increased capacity to communicate, transfer and manage information in support of emergency response activities; before, during, and after disaster events;
  - Each entity to contain searchable information that includes contact information for the facility
  - Disaster response data can be served for use in mobile applications making them accessible without the use of tethered internet

Outcomes

- Outcome
- 1 : Strengthened capacity for comprehensive disaster information management implementation at the regional level
  - ex. online regionally accessible high quality data for coordination preparedness, response and recovery at the regional level
- Outcome 2: Increased and sustained knowledge management for comprehensive risk management to empower facility managers determine how vulnerable the region is to events which are outside the control of the residents

Sources of funding (pending)

- Lawrence Foundation (submitted)
- FedEx Foundation (submitted)
- Cruise Industry Charitable Foundation (submitted)
- Energy Foundation (in prep)
- Rockefeller Brothers Fund (in prep)
- Gordon and Betty Moore Foundation (in prep)
- Packard Foundation (in prep)

Marine Affairs Coastal Resilience Lab (MACRL)

VISION

The MACRL vision is a world in which science informs coastal resilience decisions for the benefit of society.

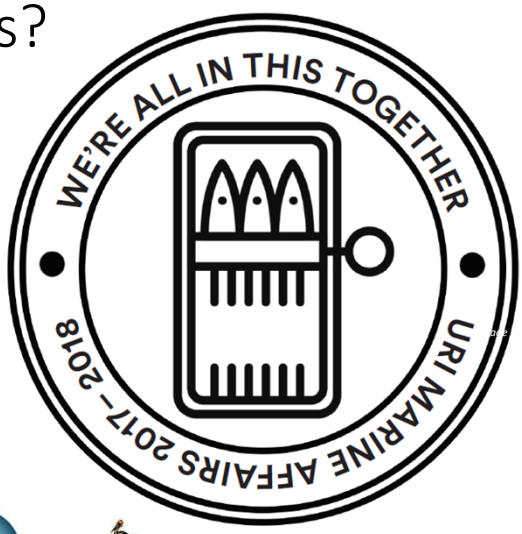
MISSION

The MACRL mission is to create knowledge and provide services that help decision makers be proactive in building coastal resilience to natural hazards.

We do this by:

- Deliberately assembling and leveraging a diverse, "no boundaries thinking," team that connects disciplines and professional expertise;
- Developing tools and methods to understand and communicate the impacts of climate change on coastal infrastructure and environments;
- Creating an interconnected group of students and professionals that exists inside and outside of the bounds of the URI Marine Affairs program;
- Supporting creative and rigorous approaches to problem solving through graduate and undergraduate education.

Questions?



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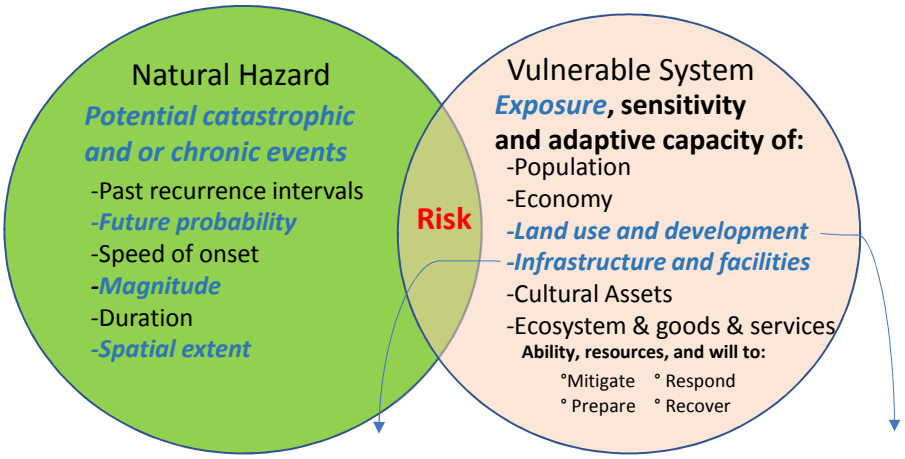
References



encourage 'transformative development for land use and infrastructure

Regional innovation focus
In the face of environmental challenges