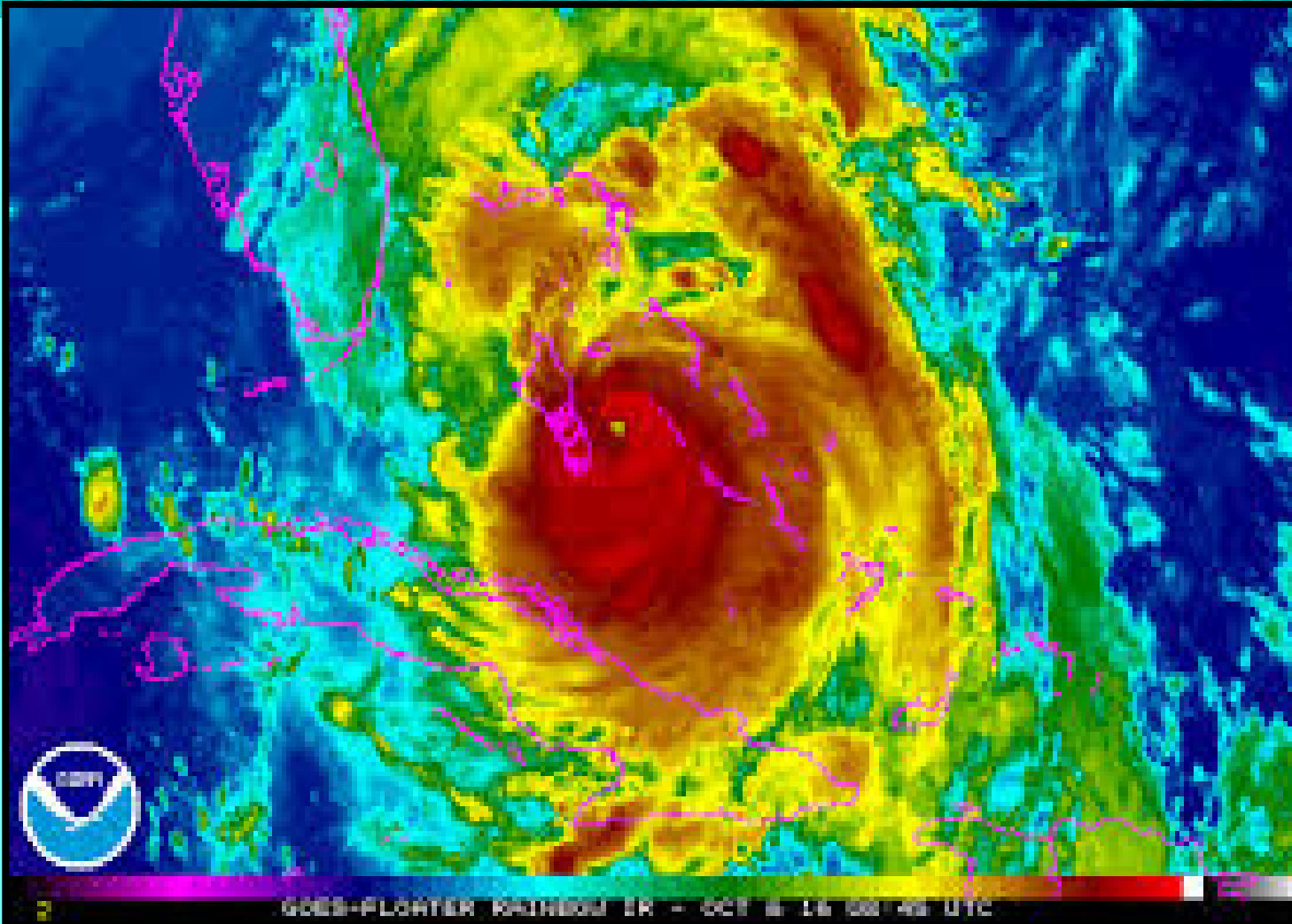


# Hurricanes, Coastal Restoration and Climate Finance for Small Islands



KATHLEEN  
SULLIVAN  
SEALEY

UNIVERSITY  
OF MIAMI

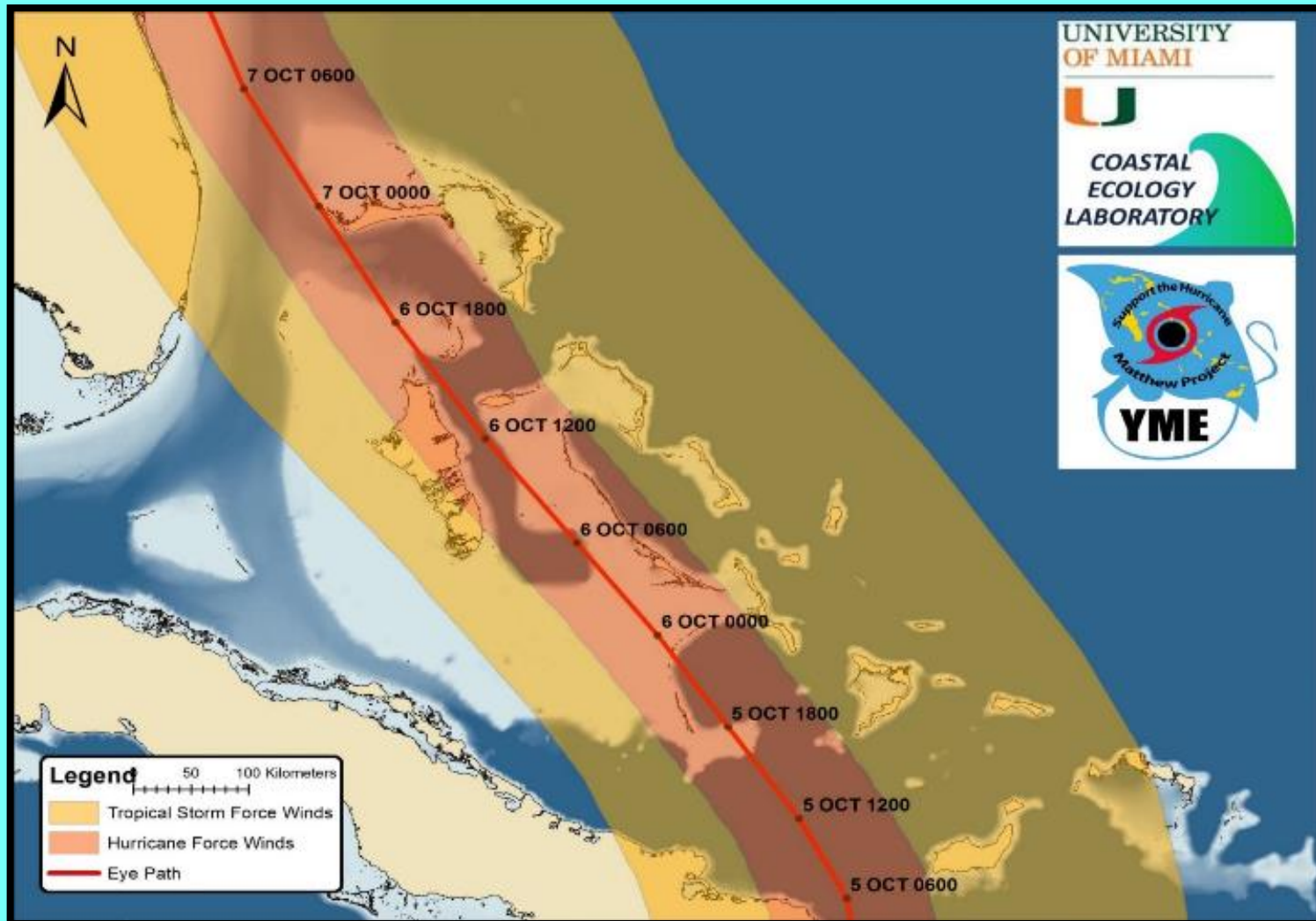


COASTAL  
ECOLOGY  
LABORATORY



***Hurricane Matthew battered The Bahamas from October 5<sup>th</sup> through the 6<sup>th</sup>, 2016 as Category 3 and 4 hurricane.***

***The islands that Hurricane Matthew directly hit were Great Exuma, New Providence, Andros, and Grand Bahama.***



# THE COMMONWEALTH OF THE BAHAMAS IS A SIDS



- ✓ 1273 Islands, rocks and cays
- ✓ Flat carbonate sediment environment.
- ✓ 13, 940km<sup>2</sup> of island territory, < 10% of bank area
- ✓ Capital: Nassau, located on New Providence
- ✓ Population: 325,000

# THREE MAJOR HURRICANES IN THREE YEARS IMPACTING TEN ISLANDS




Population: 267,000 (68% of total population )

Total area: 207.2 km<sup>2</sup>

HIGH DENSITY OF PEOPLE 1,289 persons per km<sup>2</sup>

## The Island of New Providence

### Legend

 Atlantis and Cruise ship Ports



Google Earth

Image © 2017 DigitalGlobe

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Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Image © 2017 TerraMetrics

5



10 km

# Growing Crisis for The Bahamas



# SIDS AND THE 2030 AGENDA

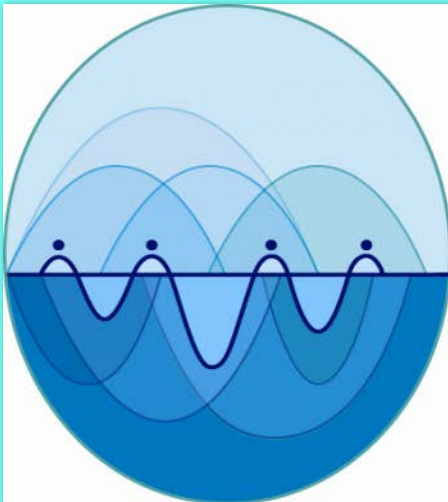
8 DECENT WORK AND ECONOMIC GROWTH



13 CLIMATE ACTION



6 CLEAN WATER AND SANITATION



ISLAND VOICES

GLOBAL CHOICES

UN Conference on  
Small Island  
Developing States  
Apia, Samoa | 2014

1 NO POVERTY



14 LIFE BELOW WATER



# ***WHAT HAS HAPPENED TO OUR COASTS?***

1. HOW DO WE ASSESS THE DAMAGE TO THE COASTS?
2. HOW CAN WE BUILD CAPACITY TO ADDRESS THE UN 2030 AGENDA?
3. HOW CAN WE FUND THE RESTORATION NEEDED TO BUILD RESILIENCE FOR ALL BAHAMIANS?



# Research Goal

Create a decision-making tool for coastal investment for restoration that aims to reduce the vulnerability of Bahamian communities..

Explore the investment conditions to support a Catastrophe Bond Market for coastal restoration aimed at community protection

# RAPID HURRICANE IMPACT ASSESSMENT



## BUILDING DAMAGE RANKINGS - CONTINUED

Examples of Building Damage:



**Building Damage Ranking 5:** Half of the house is gone, which is classified as wall structure failure and roof structure failure.



**Building Damage Ranking 5:** The roof structure is damaged. The right-most portion of the house is missing the roof entirely. Several windows were blown out and the door appears to be missing.



**Building Damage Ranking 4:** The roof structure is intact, but there is extensive roof sheathing damage. There is no visible window/door breakage. There is partial wall structure failure, but not enough to classify as a 5.



**Building Damage Ranking 3:** There is major roof cover loss (over 20%) that must be covered to prevent leaks. This is evident by the blue tarp on top. There are no visibly broken windows and doors.



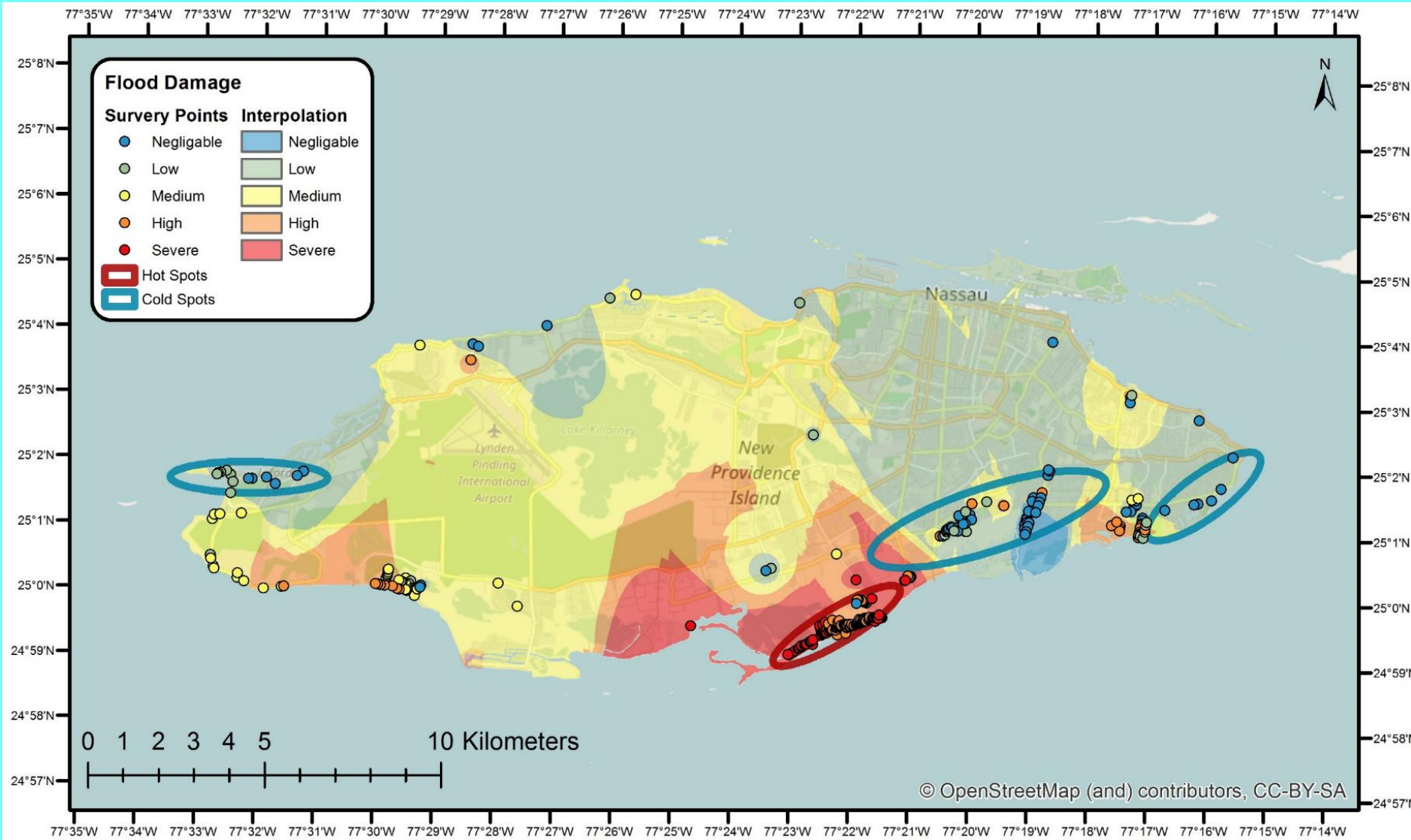
**Building Damage Ranking 2:** The house is in good condition and was minimally affected. The only damage sustained was the loss of a few shingles, which is less than 20% of the roof cover.



**Building Damage Ranking 1:** This house exhibits no visible damage following Hurricane Matthew.

A Spatial Database was constructed using natural communities, coastal geomorphology, coastal neighborhoods and infrastructure.





FLOOD DAMAGE




## WHAT HAS HAPPENED TO OUR COASTS?

LOSS OF ECOSYSTEM SERVICES THAT INCLUDE

- LOSS OF COASTAL STABILITY
- DEGRADATION OF WATER QUALITY
- LOSS OF BIOLOGICAL DIVERSITY
- INCREASED FLOODING OF PROPERTY

# South Beach Consituency Map

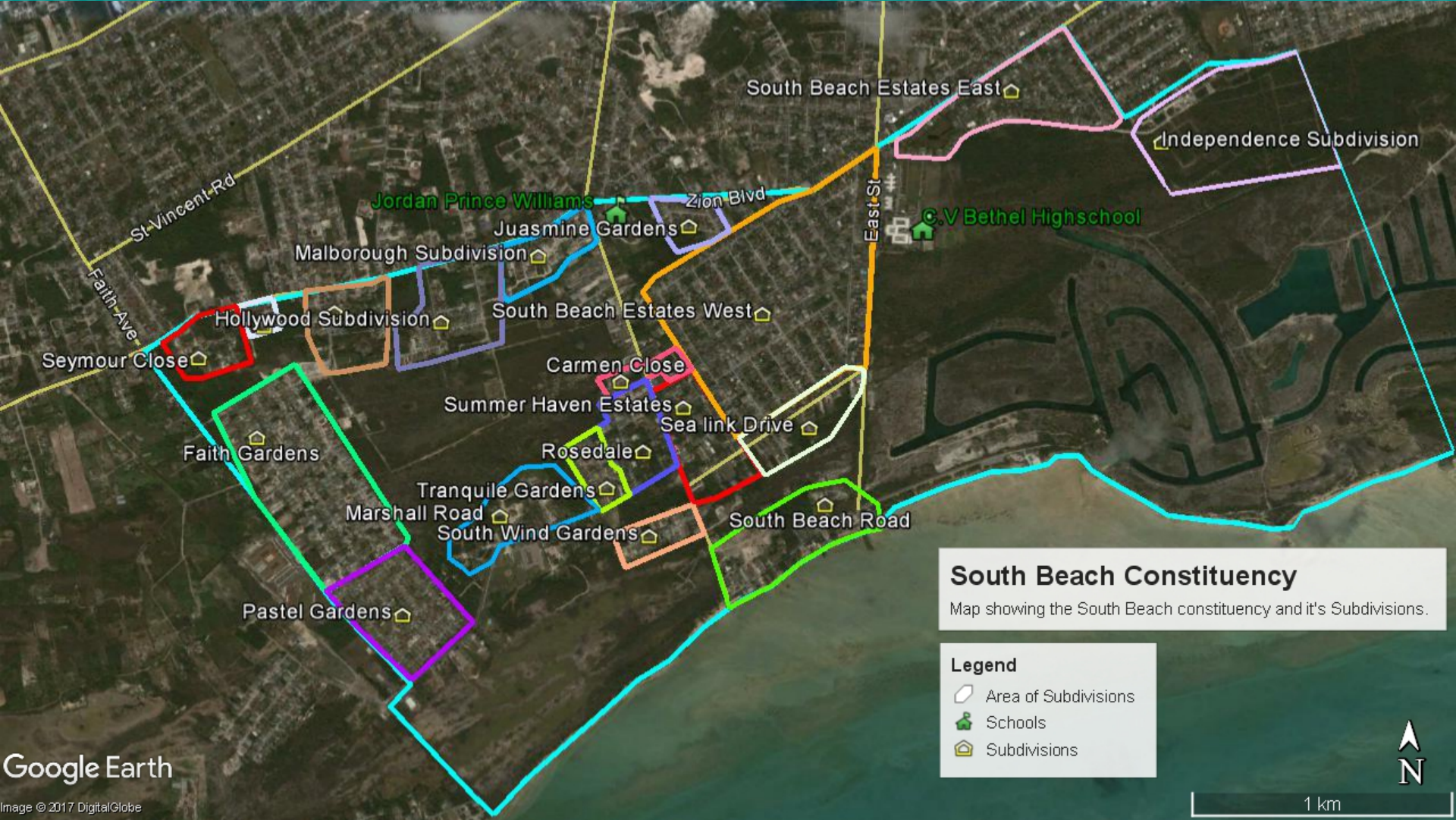
**Legend**

-  South Beach Consituency






Google Earth

Image © 2017 DigitalGlobe  
© 2017 Google  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO  
Image © 2017 TerraMetrics




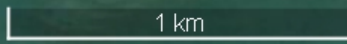
**South Beach Constituency**  
 Map showing the South Beach constituency and it's Subdivisions.

**Legend**

-  Area of Subdivisions
-  Schools
-  Subdivisions

Google Earth

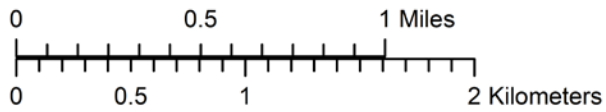
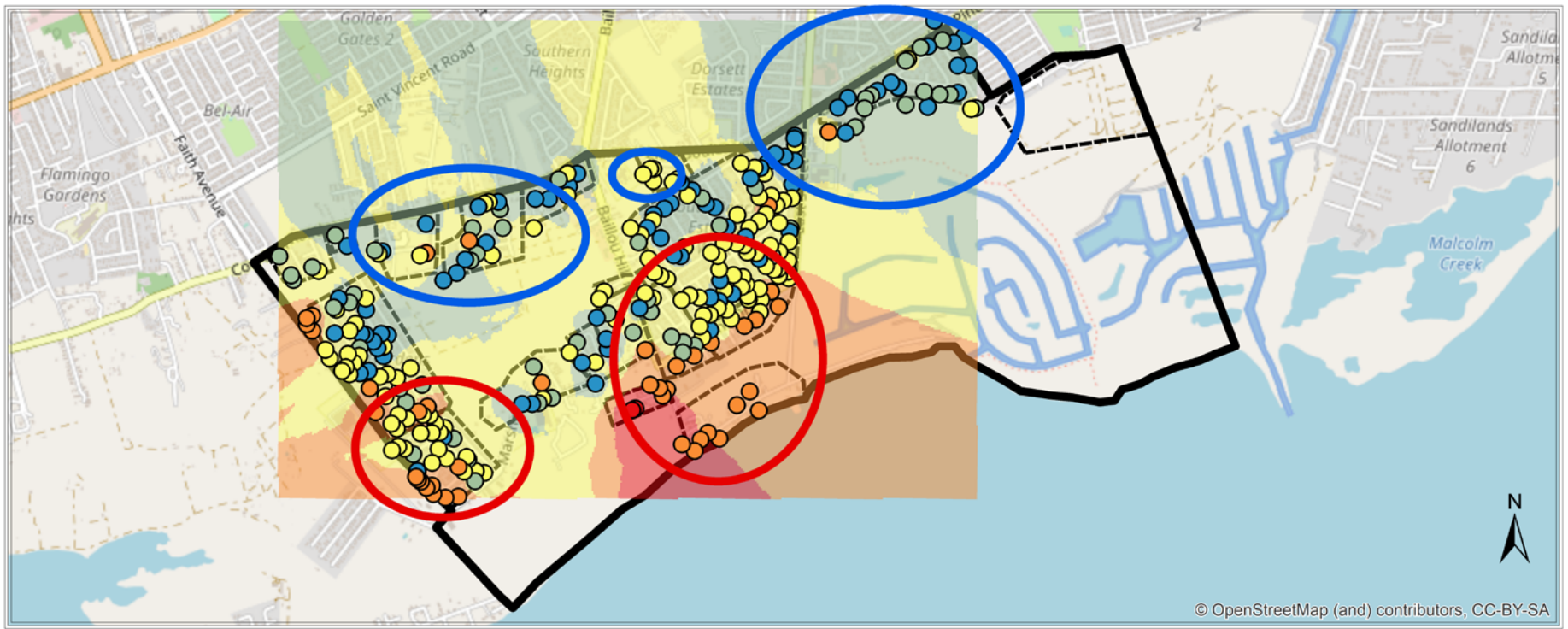
Image © 2017 DigitalGlobe

  
 1 km





Who are the Residents of South Beach?



**Flood Damage**

<b>Rank Points</b>	<b>Rank Interpolation</b>
● Negligible	■ Negligible
● Low	■ Low
● Medium	■ Medium
● High	■ High
● Severe	■ Severe

<b>Hot Spot Analysis</b>	<b>South Beach Constituency</b>
◻ Hot Spots	◻ Subdivisions
◻ Cold Spots	◻ Subdivisions

Created By: Alexio Brown, Jacob Patus and Dr. Kathleen Sealey  
 Date: 10-Oct-2017  
 Data Credits:  
 Waypoints and Damage Ranking- Alexio Brown, Nikita Shiel Rolle  
 Damage Ranking Interpolation Layer- Jacob Patus  
 Hotspot Analysis- Jacob Patus  
 Countries of the World Shapefile- ESRI  
 Base Map- Open Street Map, ESRI

# Cost of Rebuilding after Hurricane Matthew

Approx. #of houses in South Beach	Average total Sqft.	Average Rebuild Value	Rebuild Total (\$US)
1,785	2190	\$ 438,000	\$ 461,279,700




\*Current Bahamas Building Code at BD \$200/Sqft.

# WILL HOME OWNERS RE-BULD OR RE-LOCATE ?



# South Beach

## Legend

 Coastal Segements of South Beach



**Poorly Managed Coastline**

**Illegal dumping**

**Sand Mining and removal of dunes**

**Filled Wetlands**

**Invasive Australian Pines**

**South Beach = \$16,380,00**



<b>Project</b>	<b>Structure/ Service</b>	<b>Cost per Linear Feet (\$US)</b>	<b>Cost per Linear Meter (\$US)</b>
<b>Saunders Beach Restoration</b>	Groynes	<b>\$1,182</b>	<b>\$3,900</b>

**South Beach = \$5,420,000**



Project	Structure/ Service	Cost per Linear Feet (\$US)	Cost per Linear Meter (\$US)
<b>Bakers Bay</b>	Invasive Tree removal Dune Restoration Artificial reefs	<b>\$378</b>	<b>\$1,230</b>

Insurance, re-insurance, & catastrophe bonds, are novel ways for diversifying investments BUT these instruments are driven in a BUSINESS ENVIRONMENT.

Environmental risks are known but poorly articulated to investors in terms of recovery and restoration costs.

**MODERN FINANCE aims to reduce risk for investments through diversification**



**CREDIT DRIVES LAND  
USE CHANGE**

**3**

**1**

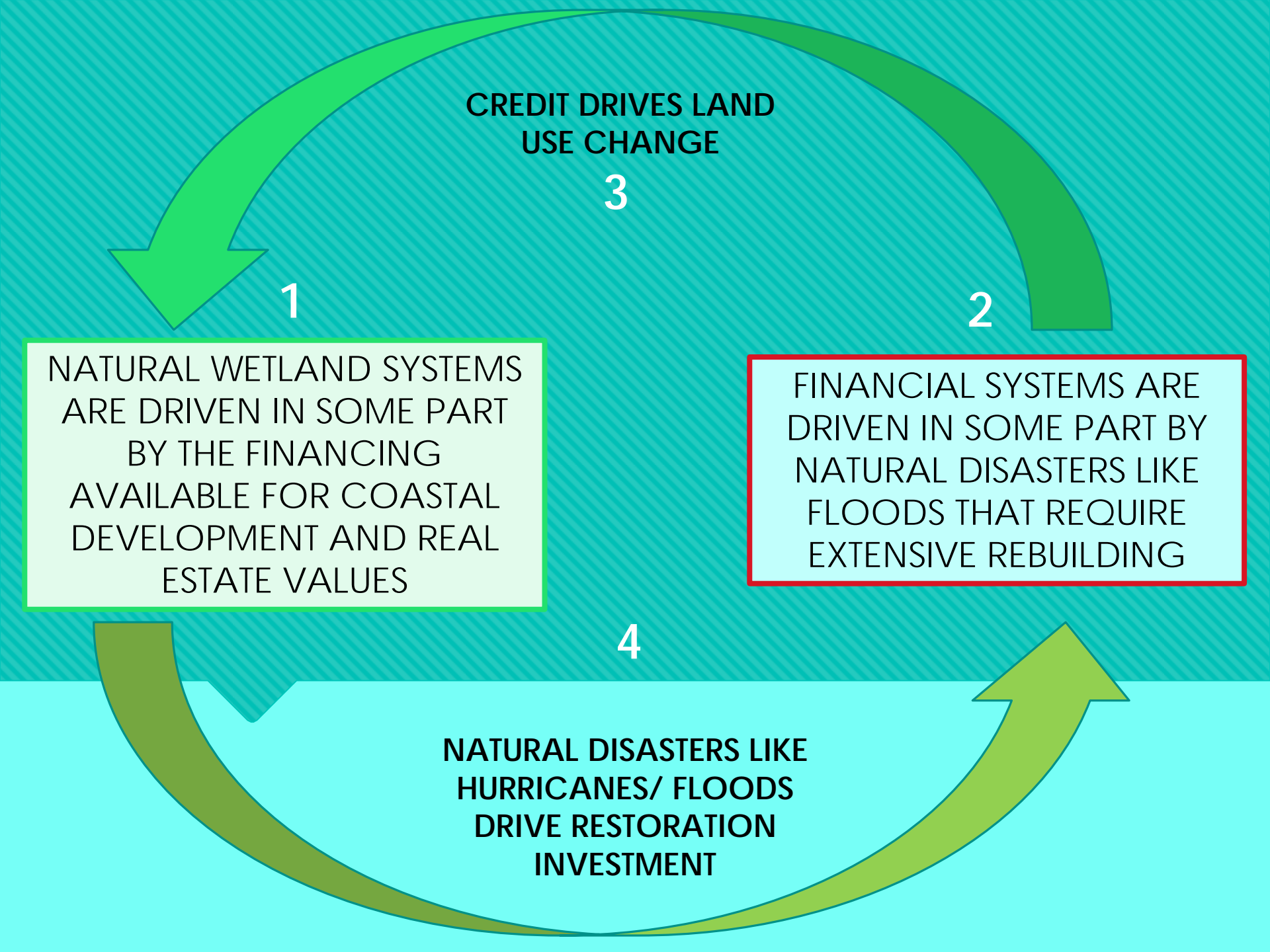
**2**

NATURAL WETLAND SYSTEMS  
ARE DRIVEN IN SOME PART  
BY THE FINANCING  
AVAILABLE FOR COASTAL  
DEVELOPMENT AND REAL  
ESTATE VALUES

FINANCIAL SYSTEMS ARE  
DRIVEN IN SOME PART BY  
NATURAL DISASTERS LIKE  
FLOODS THAT REQUIRE  
EXTENSIVE REBUILDING

**4**

**NATURAL DISASTERS LIKE  
HURRICANES/ FLOODS  
DRIVE RESTORATION  
INVESTMENT**



# Catastrophe or “Cat” Bonds

- Cat bonds provide collateralized (re)insurance usually protecting against low-frequency / high severity natural catastrophe events.
- Cat bonds are motivated by weather-related losses, or fear of the possibility
- Cat Bonds are required by investors or the Government
- Cat Bonds require KNOWN and documented costs associated with a disaster = known financial risk

\$21.8 MILLION IN COASTAL RESTORATION TO  
PREVENT \$461 MILLION IN REPAIRS TO PROPERTY

**RISK ASSESSMENT** for  
catastrophic events must  
account for linked natural and  
human systems

# GET INVOLVED!



Partnerships with scientists and community-base groups can provide valuable support for coastal restoration cost- benefits for small communities.

# Acknowledgments to our Funding and Partners:

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