

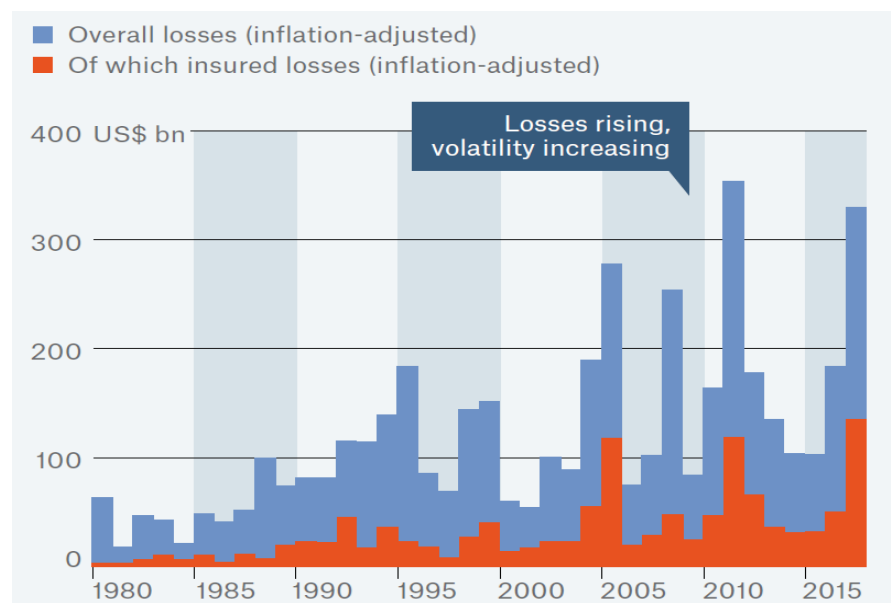
Risk Reduction Benefits of Mangroves in Jamaica



Michael W. Beck , Siddharth Narayan, Antonio Espejo, Sheila A. Herrero, Saul Torres, Ana Fernandez, Iñigo Losada



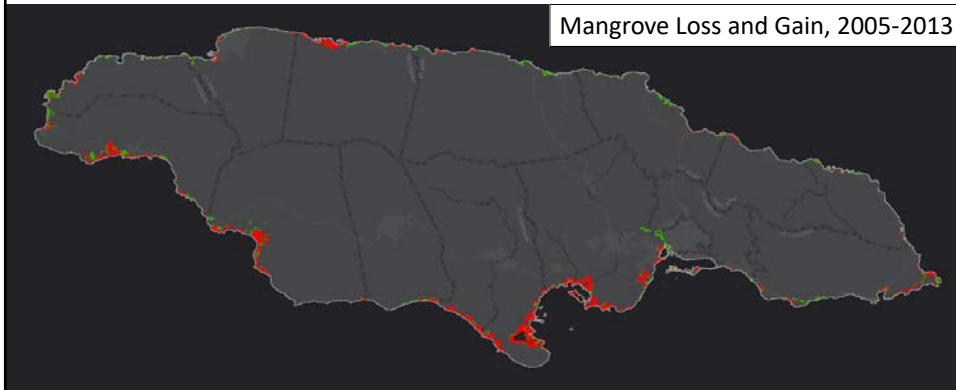
Risks & Losses Are Rising



Munich Re, 2018. Natural Catastrophes 2017. Press Release

Habitat Status and Recent Loss in Jamaica

Mangrove Loss and Gain, 2005-2013



~14,800 hectares in 2005

82% on country's southern coastline

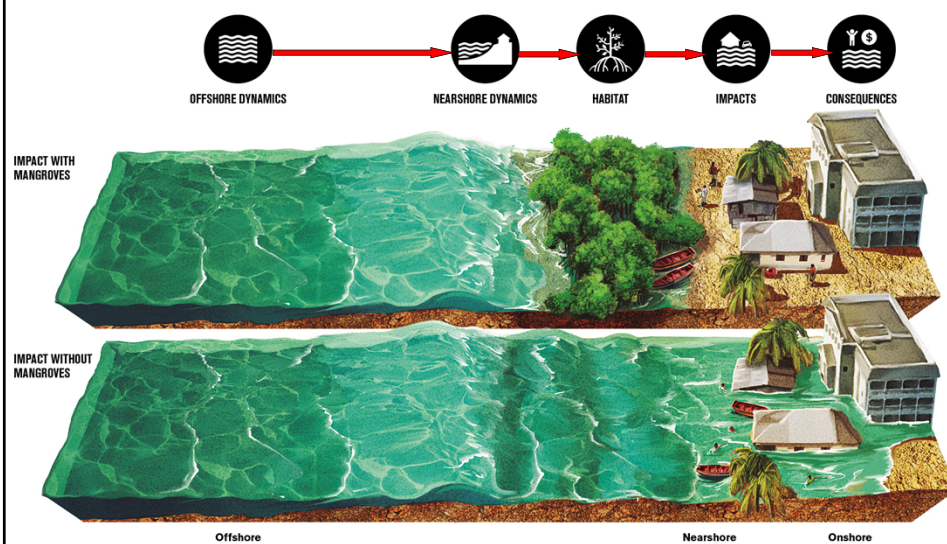
more than 770 hectares of mangroves lost over past two decades

IH cantabria
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The Nature
Conservancy

UNIVERSITY OF CALIFORNIA
SANTA CRUZ

Valuing the Risk Reduction Benefits of Jamaica's Mangroves



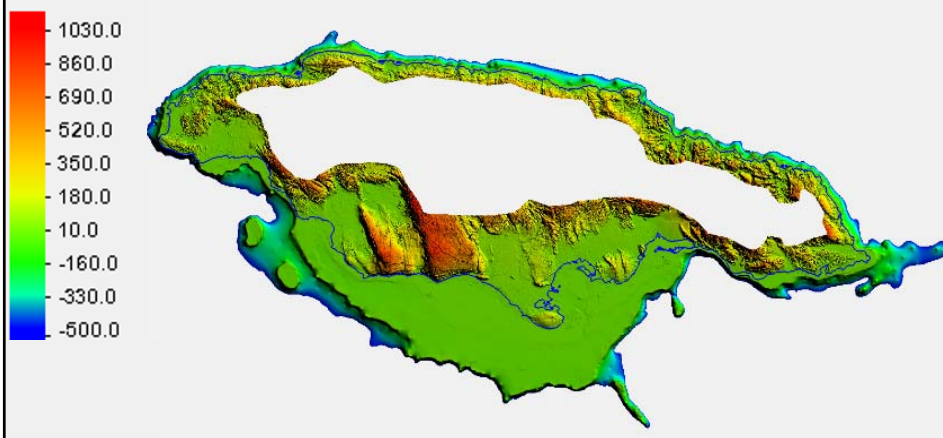
World Bank Guidelines: Avoided Damages Approach Beck & Lange (eds), 2016

Tropical Cyclones affect Jamaica every year



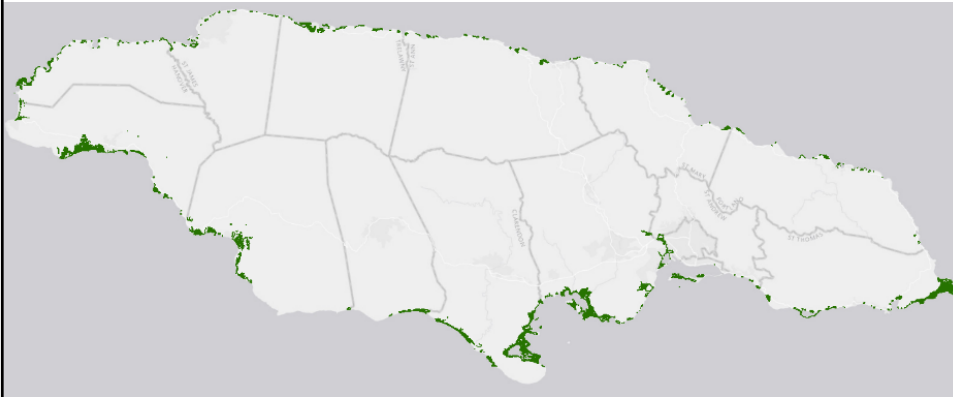
National Bathymetry and Topography

- Multiple data sources for nested bathy – topo map
 - Global datasets (1 km resolution)
 - Regional Nautical charts (90 m resolution)
 - National LANDSAT Satellite derived bathymetry (10 m)
 - National IKONOS Satellite derived topography – (6 m)



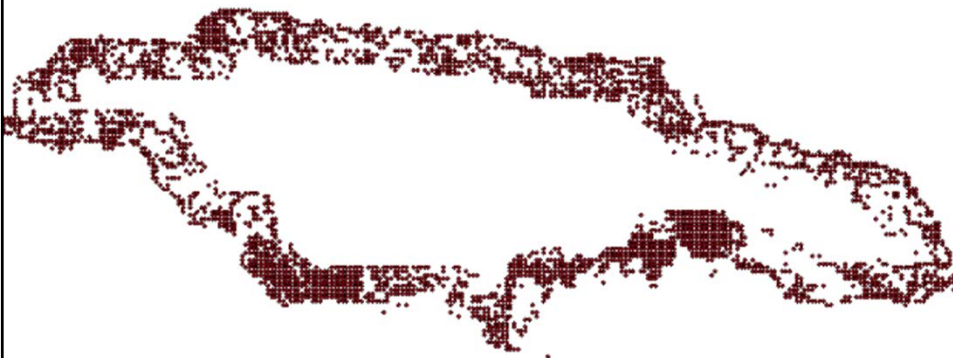
National Mangrove Extents in Jamaica

- Defining spatial extent of mangrove habitats nationwide in Jamaica
- Mangroves and reefs included as land cover parameter within flood model



National Socio-Economic Data: People and Property

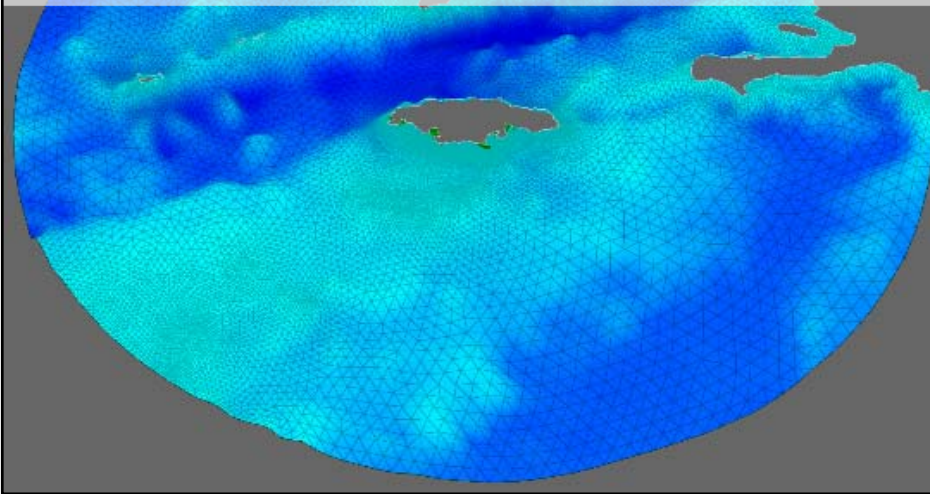
- Global human population data at 250 m resolution
- Global data on industrial, residential and public assets at 1 km resolution



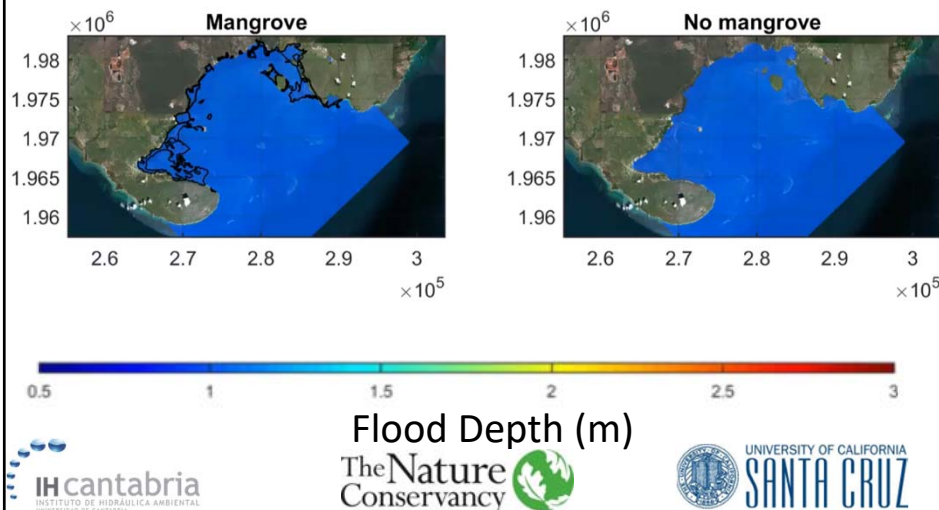
National Flood Risk and Mangrove Benefits Model

The ADCIRC Model

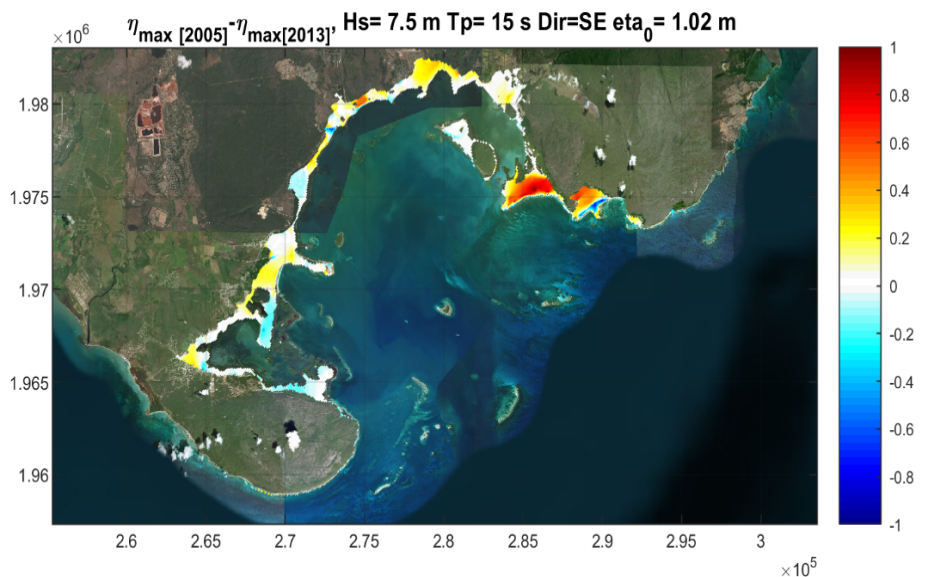
- Built to assess coastal and estuarine flooding from storms and high sea levels
- State of art model that provides flood extent and height information
- Used for forecasting cyclone hazards and risk assessments for critical infrastructure



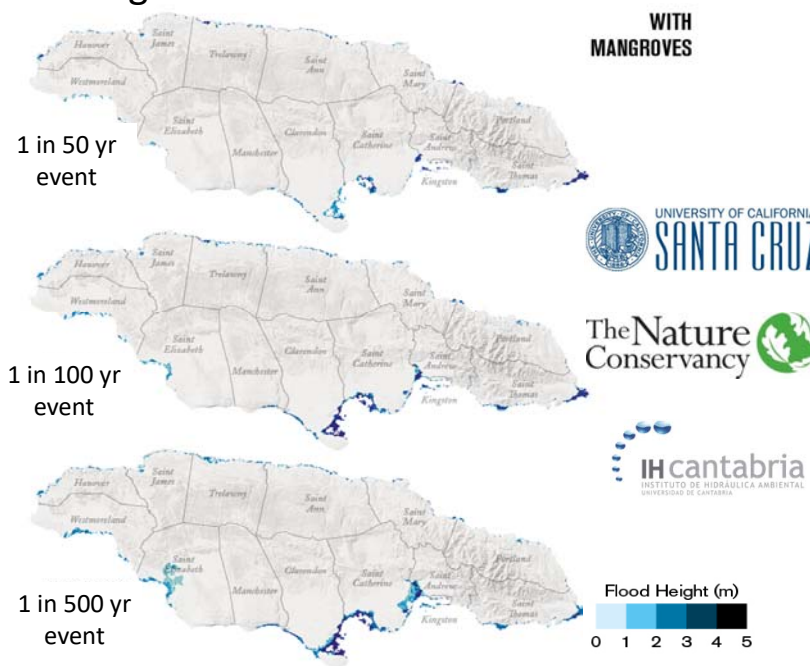
Old Harbour Bay Flood Model Video

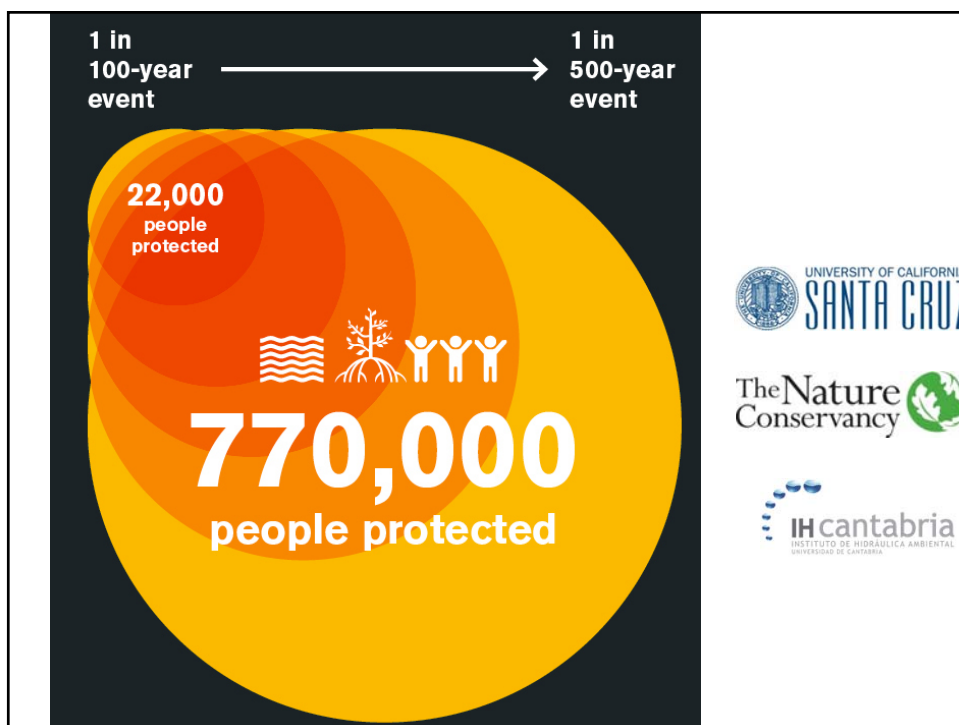
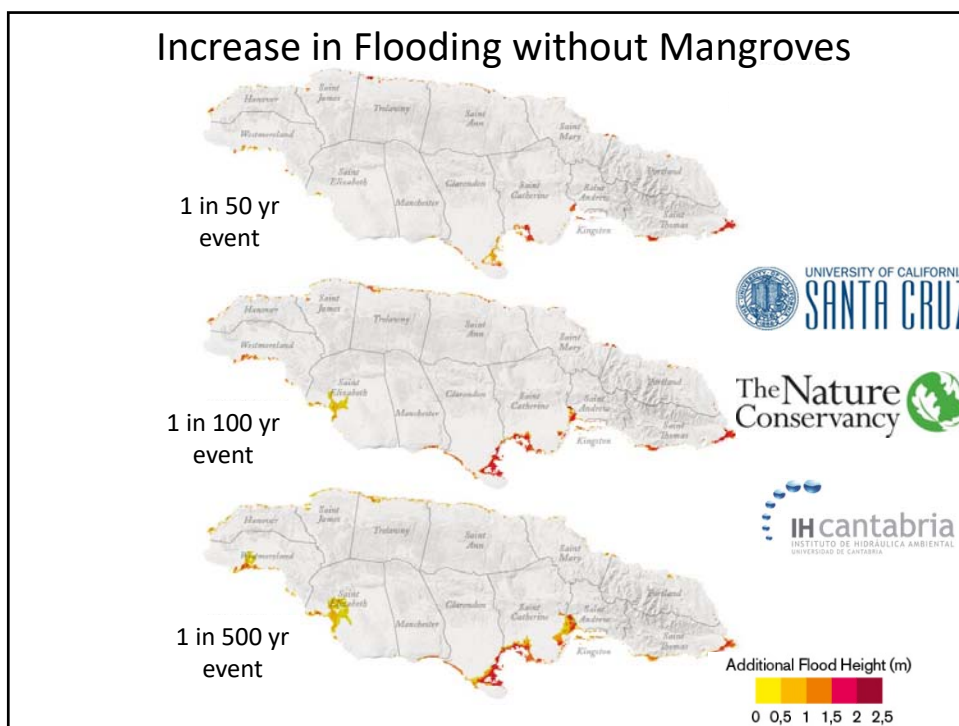


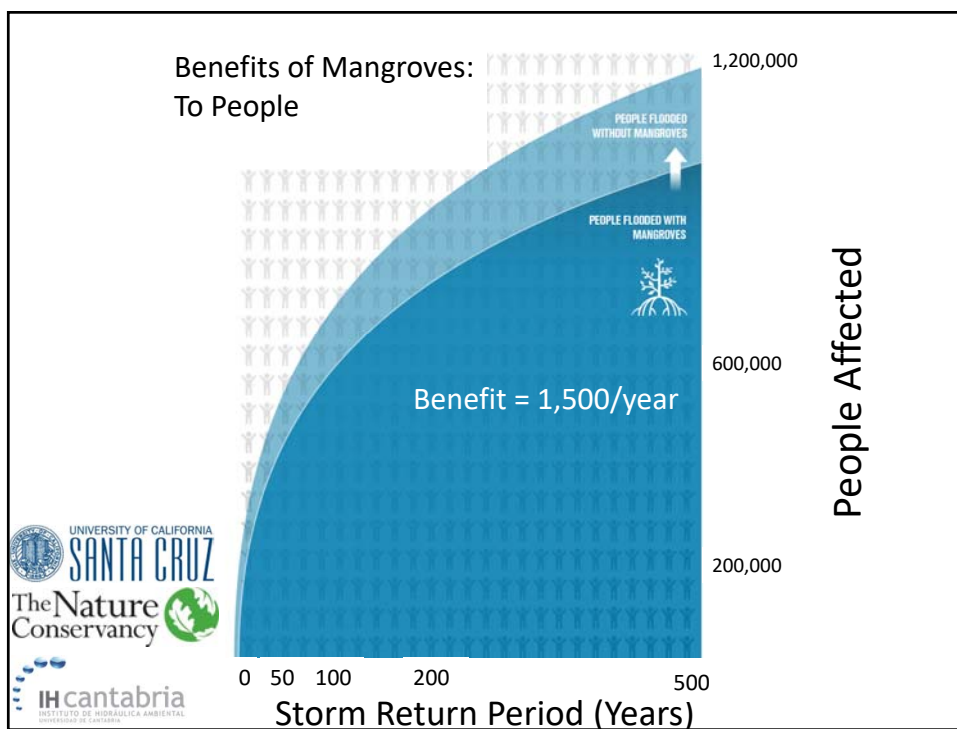
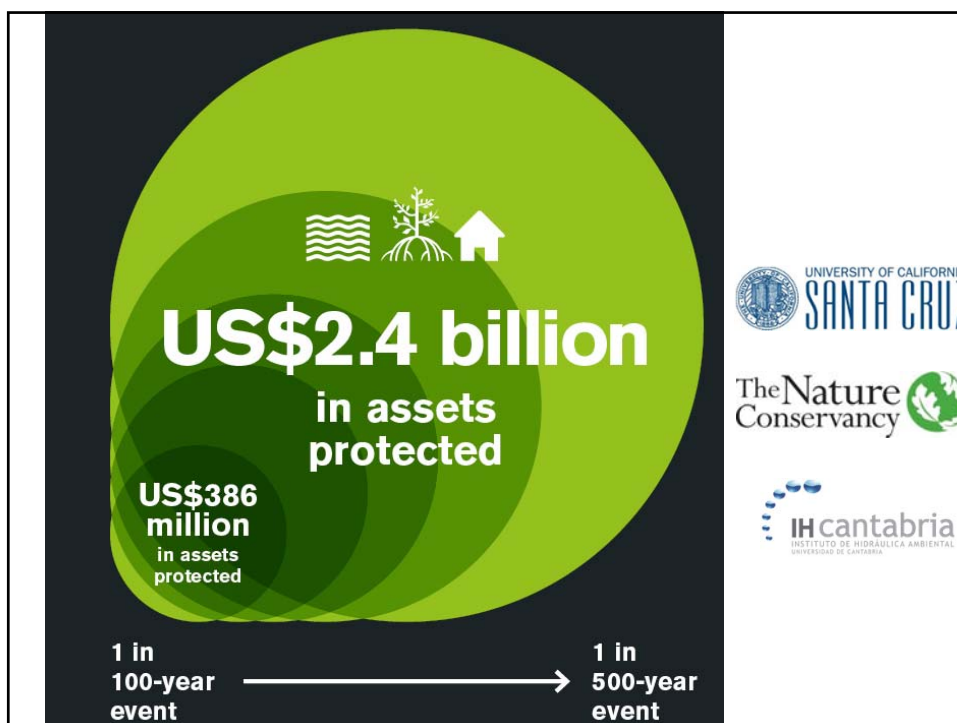
High Res Local Analysis of Lost Mangrove Benefits: 2005 to 2013

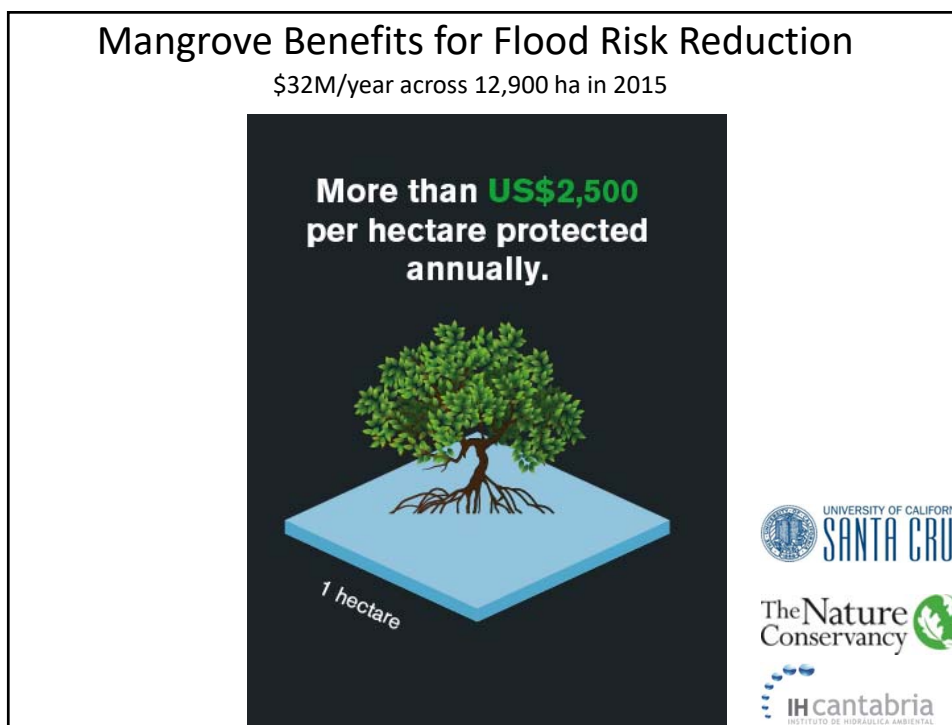
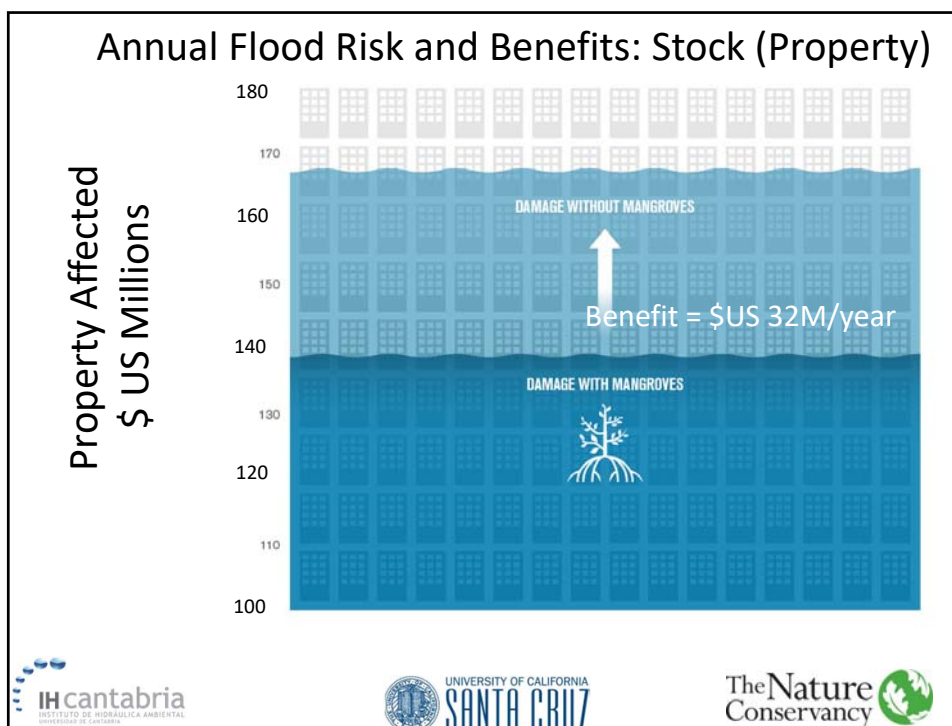


Existing National Coastal Flood Risk

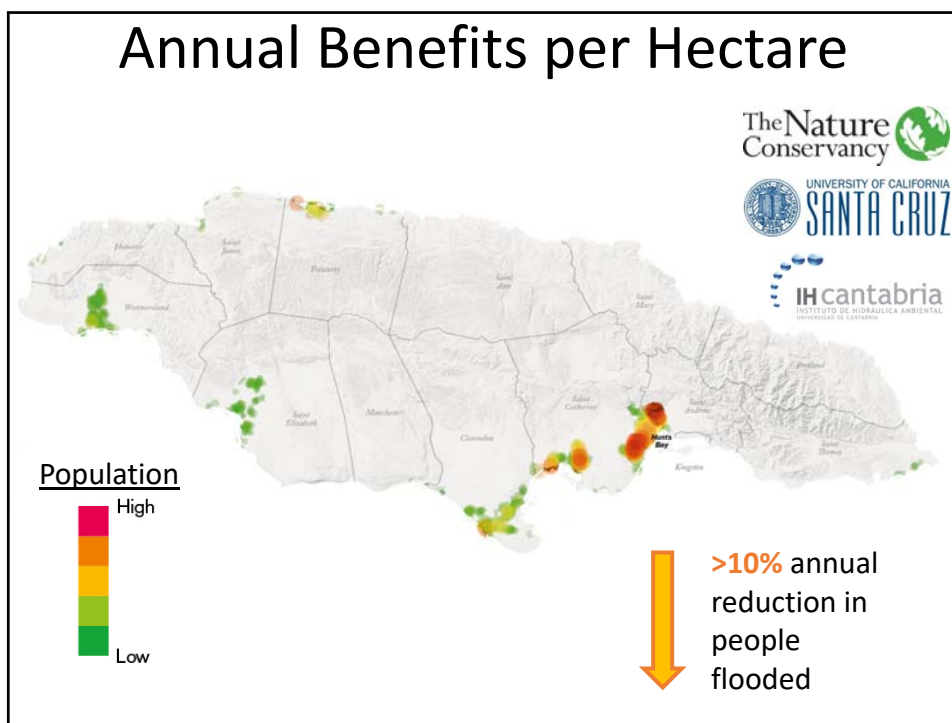








Annual Benefits per Hectare



Costs of Mangrove Restoration

Mangrove restoration costs less than US\$50,000 per hectare across the Caribbean region though data on costs are limited and variable.

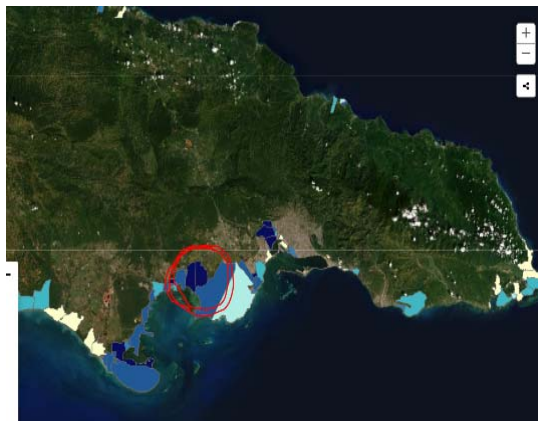
Sample restoration project costs:



Narayan, Bitterwolf, Beck, Acosta-Morel, 2019

Coastal Resilience Decision Support Tool: Overview

<https://maps.coastalresilience.org/jamaica/>



- Promote stakeholder engagement and inform planning processes
- Custom applications (apps) support **interactive** scenario planning with social, economic, and ecological data.

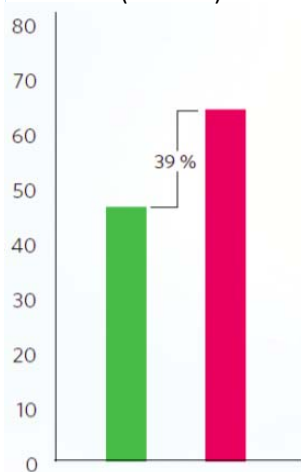
Supported by:
Jamaica Ministry for the
Environment, Natural Conservation,
Housing and Natural Safety
Based on a Division of the German Bundestag

The Nature
Conservancy
Protecting nature. Preserving life.

INTERNATIONAL
FEDERATION

Global Annual Expected Benefits from Mangroves

People Flooded
(Millions)

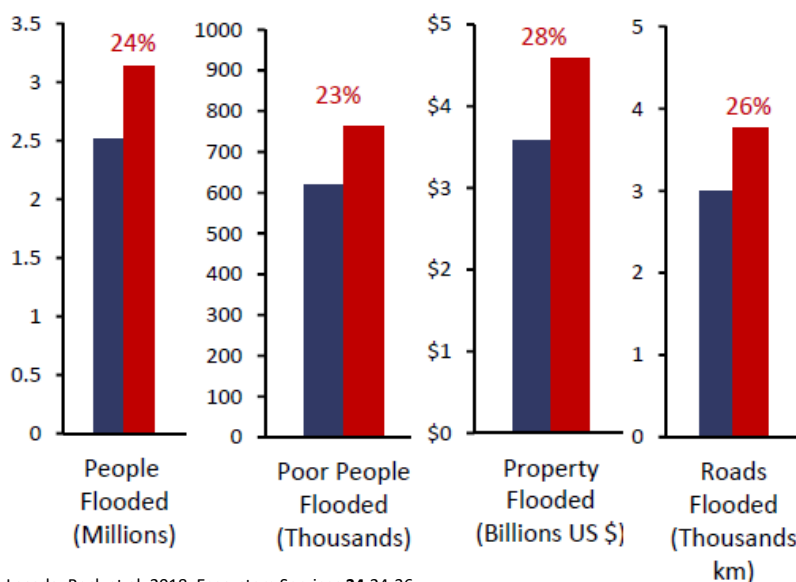


Property Damaged
(\$ Billions)



■ With mangroves ■ Without mangroves

Annual Benefits of Philippine Mangroves



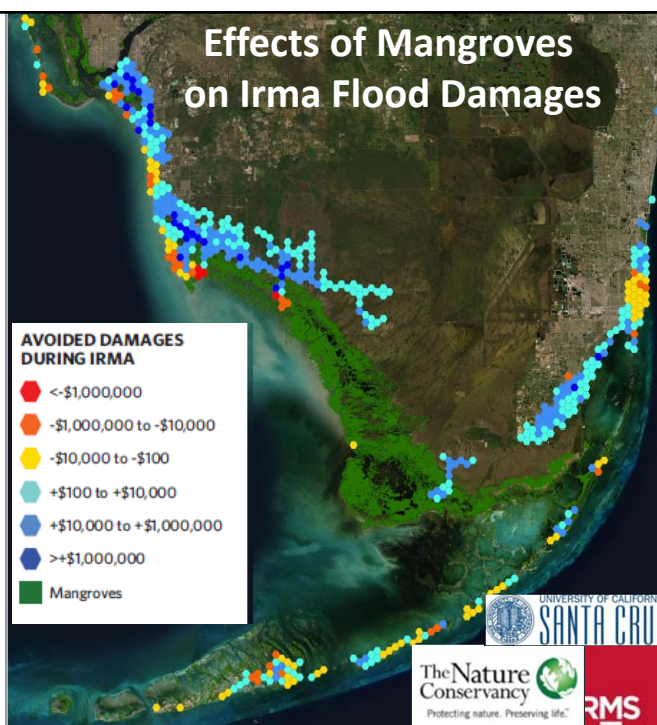
Menéndez, Losada, Beck et al. 2018. Ecosystem Services **34**:24-36
 Menéndez, Losada, Beck et al. 2019. PLoSOne. 14(8): e0220941

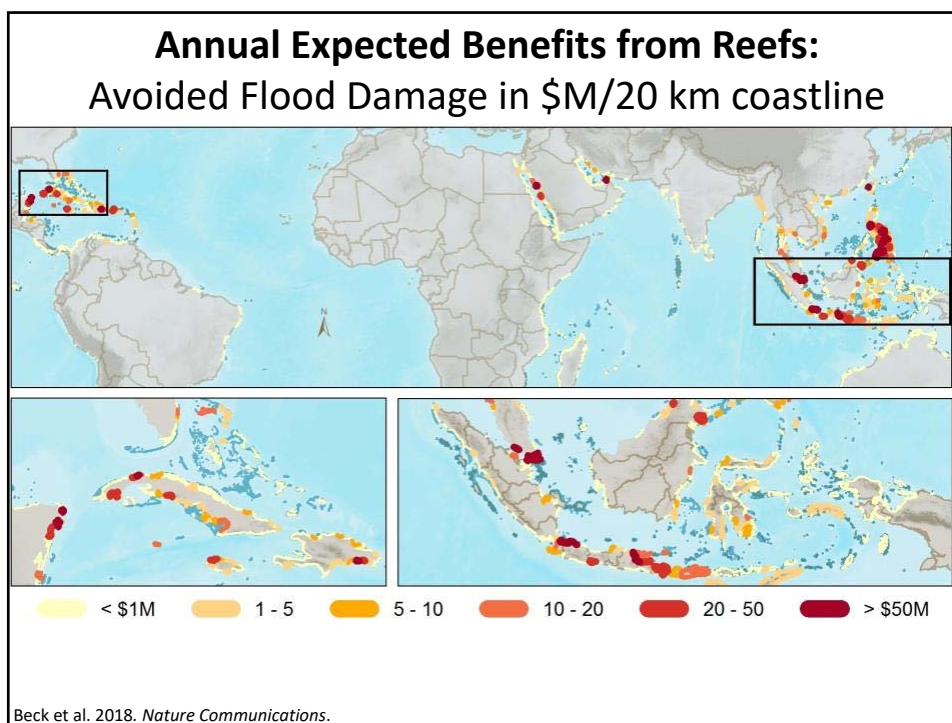
\$1.5 Billion in Avoided Property damages during Irma

25% Annual Reductions

Narayan, Beck et al. 2019. TNC.

https://www.nature.org/content/dam/tnc/nature/en/documents/Mangrove_Report_digital_FINAL.pdf





Annual Expected Benefits of Reefs for Flood Protection				
Annual Averted Damages (\$Millions)			Annual Averted Damages/GDP	
1	Indonesia	639	Cayman Islands	0.98
2	Philippines	590	Belize	0.37
3	Malaysia	452	Grenada	0.30
4	Mexico	452	Cuba	0.25
5	Cuba	401	Bahamas	0.16
6	Saudi Arabia	138	Jamaica	0.14
7	Dominican Republic	96	Philippines	0.13
8	United States	94	Antigua and Barbuda	0.13
9	Taiwan	61	Dominican Republic	0.11
10	Jamaica	46	Malaysia	0.09
11	Vietnam	42	Seychelles	0.06
12	Myanmar	33	Turks and Caicos	0.06
13	Thailand	32	Guadeloupe	0.05
14	Bahamas	14	Indonesia	0.04
15	Belize	9	Solomon Islands	0.04

Beck et al. 2018. *Nature Communications*.

Implications and Opportunities

- **Include Nature in Industry Risk Models**
- **Private incentives-** Insurance, Resilience Bonds
- **Public incentives-** Pre- and Post- disaster spending, Green bonds
- **Prioritizing Adaptation & Resilience-building Investments**
- **Prioritizing Natural Infrastructure in Policy** (Philippines Greening Program, US ACoE)

Photo credit: Jim Wright/LightHawk/TNC



Catalyzing Public and Private Investment In Reef Restoration

- Significant Funding
- Insurance opportunities
- Recovery Funding is biggest source
- Need critical data on benefits & costs
- All approaches for funding gray infra open to Nat Infra



Financing Natural Infrastructure
For Coastal Flood Damage Reduction

LLOYD'S



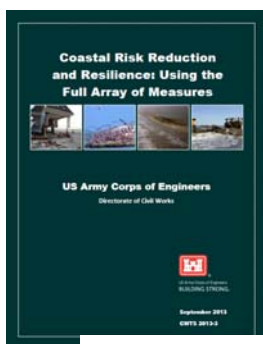
Opportunities- Examples

ECOSYSTEM-SERVICE ASSESSMENT:
RESEARCH NEEDS FOR COASTAL GREEN
INFRASTRUCTURE

PRODUCT OF THE
Committee on Environment, Natural
Resources, and Sustainability
OF THE
NATIONAL SCIENCE AND TECHNOLOGY COUNCIL



LEVERAGING CATASTROPHE BONDS
As a Mechanism for Resilient
Infrastructure Project Finance



A BILL

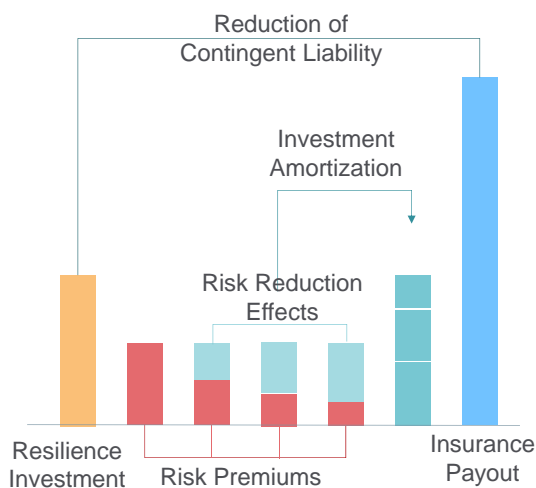
To reauthorize the Coral Reef Conservation Act of 2000 and to establish the United States Coral Reef Task Force, and for other purposes.

- 1 *Be it enacted by the Senate and House of Representa-*
- 2 *tives of the United States of America in Congress assembled,*
- 3 **SECTION 1. SHORT TITLE; TABLE OF CONTENTS.**
- 4 (a) **SHORT TITLE.**—This Act may be cited as the
- 5 **"Restoring Resilient Reefs Act of 2019".**

Combining Reef Restoration & Insurance to Build Resilience

A resilience insurance solution overcomes trade-off between risk reduction & risk transfer:

- Up front reef restoration investment reduces risk
- The risk mitigating impact reduces premiums
- An incentive is created for restoration & risk transfer



Reguero, Beck et al. 2020. [Financing coastal resilience with coral reefs and insurance](#). *Ecol. Economics*.

