Quantifying the Economic Impact of Hurricanes in the Caribbean:

A View from Outer Space

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INTRODUCTION

- The Caribbean is subject to many hurricanes

- Media mostly quantifies the effects of these events in terms of cost of physical damages

- But natural disasters can have much more wide reaching effects (ex: business interruptions etc.), potentially affecting economic growth in the short and long term

- Arguably policy makers may be even more interested in these latter effects

INTRODUCTION

Example: Grenada and Hurricane Ivan (2004)

Economic Growth Rate: 2003: +6.25% 2004: -6.75% 2005: +12.00%

- So how much is due to the event is not clear….→ econometric estimation

INTRODUCTION

- Example of econometric studies : Hurricanes in the Caribbean

  Hsiang (2010): no effect

  Bluedorn (2005): mean strike → short term effect of 0.6%↓

  Strobl (2011): mean strike → short term effect of 0.8%↓

- So the effect appears to be relatively small…

INTRODUCTION

- An important aspect of the literature – has focused on the aggregate (national or sectoral) impact
- But, hurricanes are actually very localized events…
- Problem: intra-national level data on economic activity virtually non-existent or non-attainable for most developing countries

This paper: examines the economic growth impact of hurricanes in the Caribbean at the localized level

INTRODUCTION

Basic Task - Estimate:

$$GROWTH_{ijt} = \alpha + \beta HURR_{ijt} + \varepsilon_{ijt}$$

Need:

1. Proxy of potential destruction of Hurricanes (HURR) for region *j* in country *i* at time *t*

2. Proxy of economic activity (GROWTH) for sub-region *j* in country *i* at time *t*

PROXY OF HURRICANE DESTRUCTION

What's a hurricane?

Tropical storm of a minimum strength of 119 km/hr wind speed (in the North Atlantic Region)

Characteristics of a hurricane?

Will typically have an eye and curved bounds of clouds and thunder-storms that move in a spiral fashion

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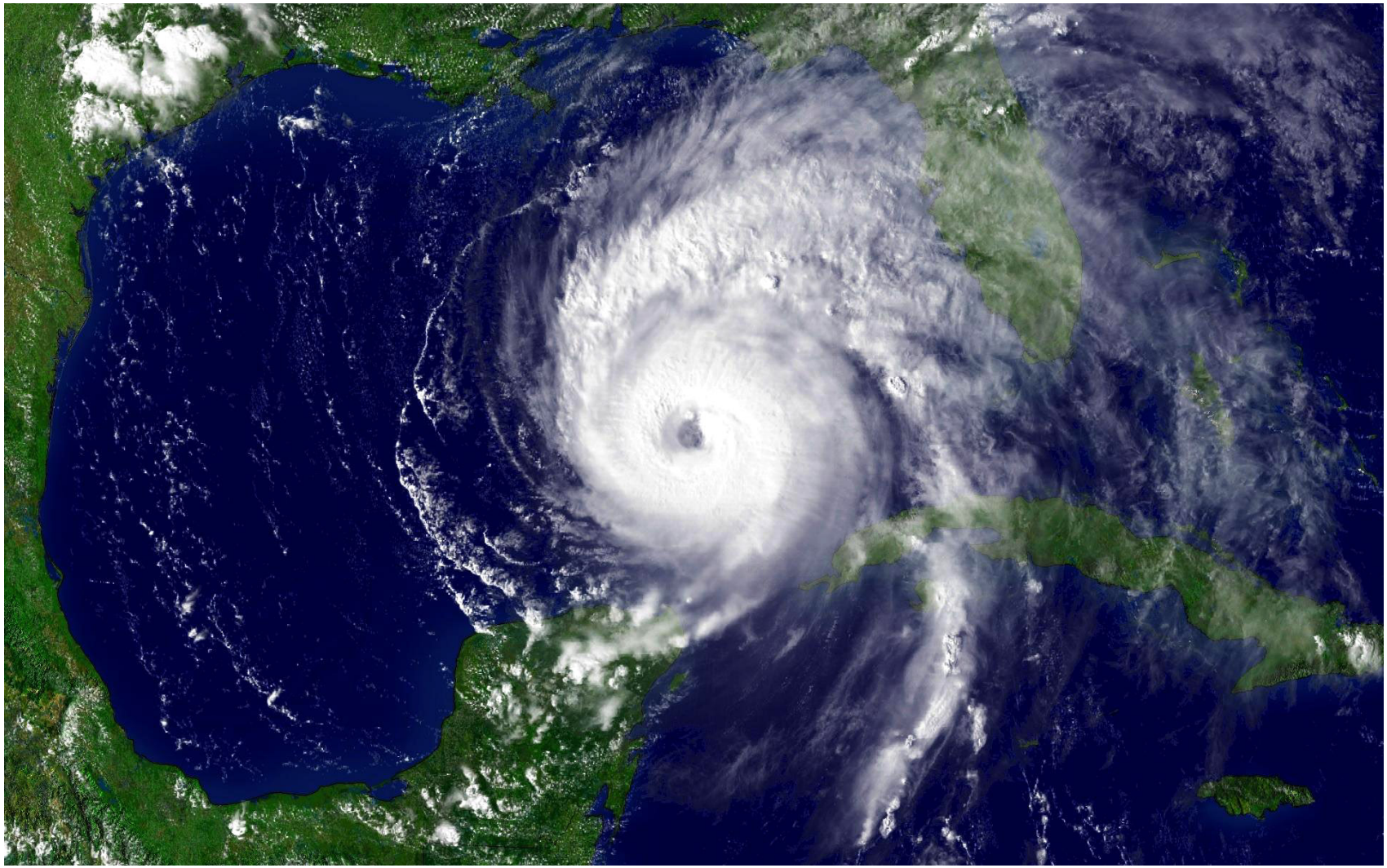
PROXY OF HURRICANE DESTRUCTION



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PROXY OF HURRICANE DESTRUCTION

- Destruction will take three forms:

  1. Winds/tornadoes cause damage to buildings

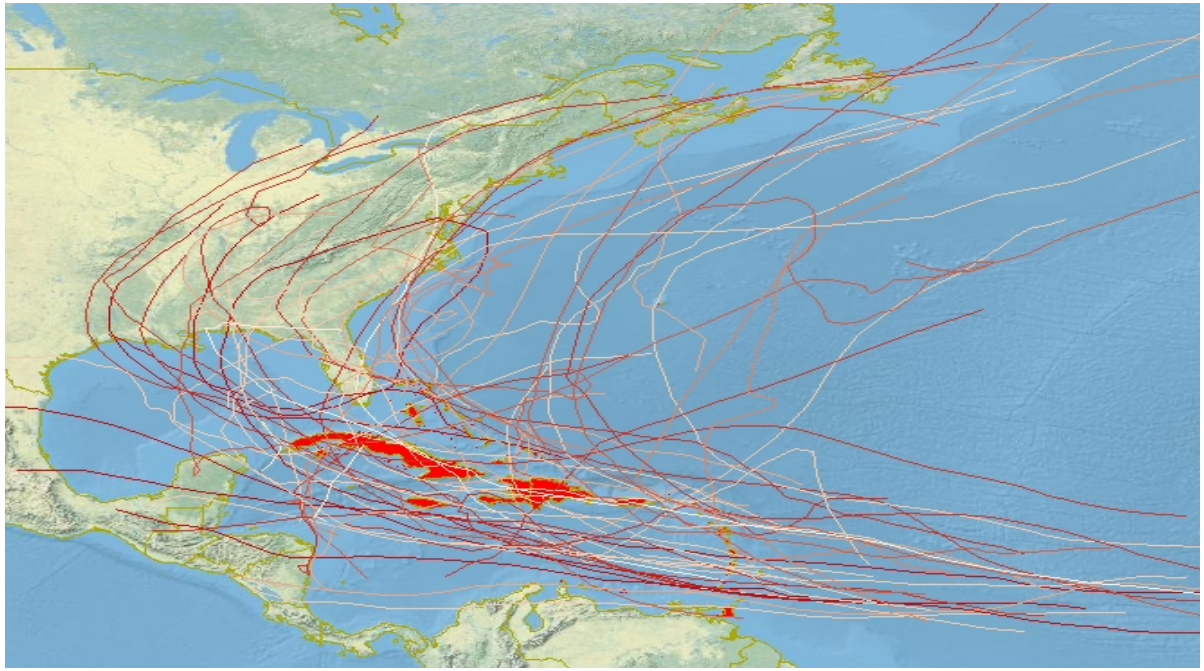
  2. Strong rainfall can result in flooding and mudslides

  3. Storm surges in areas on or near the coast

- All of these depend on the wind speed of the hurricane

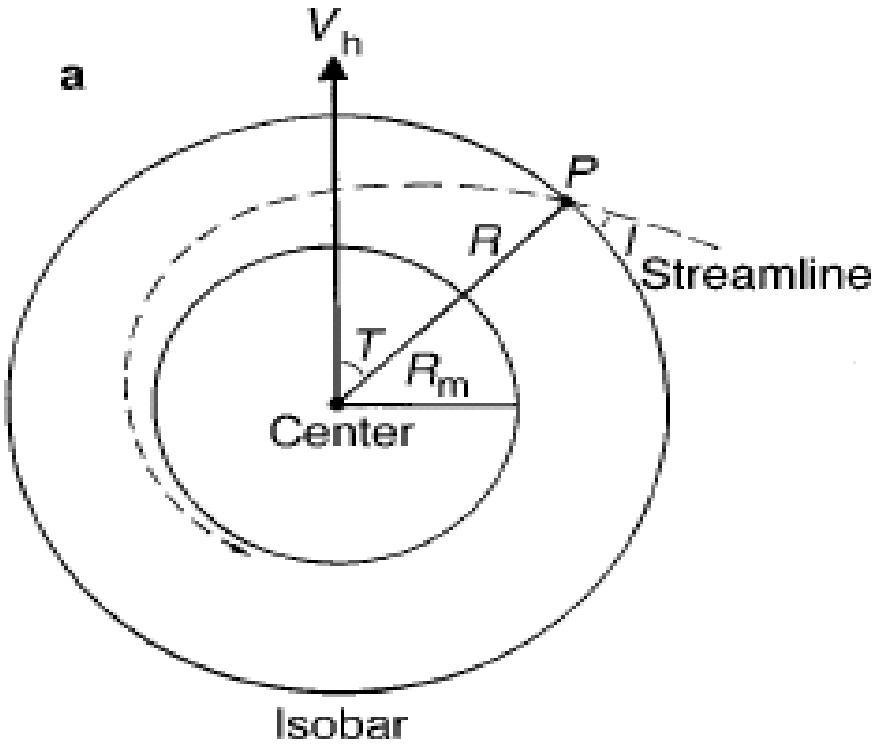
PROXY OF HURRICANE DESTRUCTION

- Data Source: HURDAT: hurricane track data – provides 6-hourly position and maximum wind speed and pressure for essentially all the hurricanes in the North Atlantic area (since 1851).
- Tropical Cyclone Activity (1992-2009):



PROXY OF HURRICANE DESTRUCTION

To translate these data into potential destruction for any point *P* we use a wind field model (Boose et al., 2004):



→ For each point *P* one then gets a measure of wind speed – the cubic power of this (Emanuel, 2006) is considered a proxy of potential destruction at *P*

PROXY OF ECONOMIC ACTIVITY

- Difficult to get sub-national level measures of economic activity for most developing countries
- Proposed Solution: brightness of nightlights as measured from satellites –(Henderson et al. (2012), Chen and Nordhaus (2011))

Nightlight Data:

DEFENSE METEROROLOGICAL SATELLITE PROGRAM:

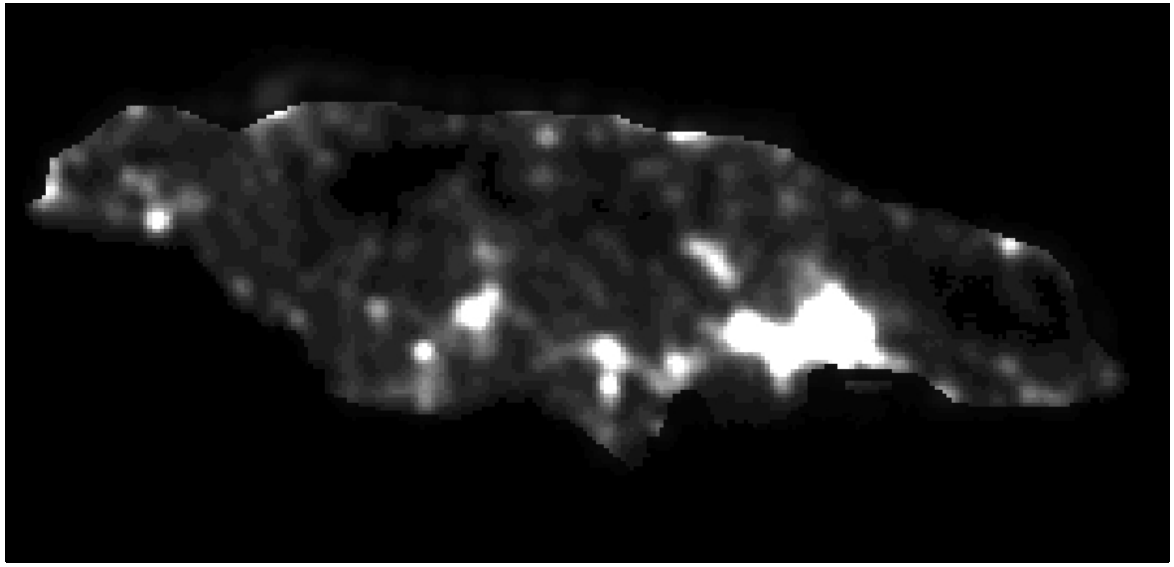
- ground-level night time imagery since the 1970s (digital archive extends back to 1992);
- resulting images are normalized across satellites to a scale ranging from 0 (no light) to 65 (maximum light); resolution 1km^2
- night light data represents human activity (e.g. electrified human/industrial settlements);

PROXY OF ECONOMIC ACTIVITY

Advantages:

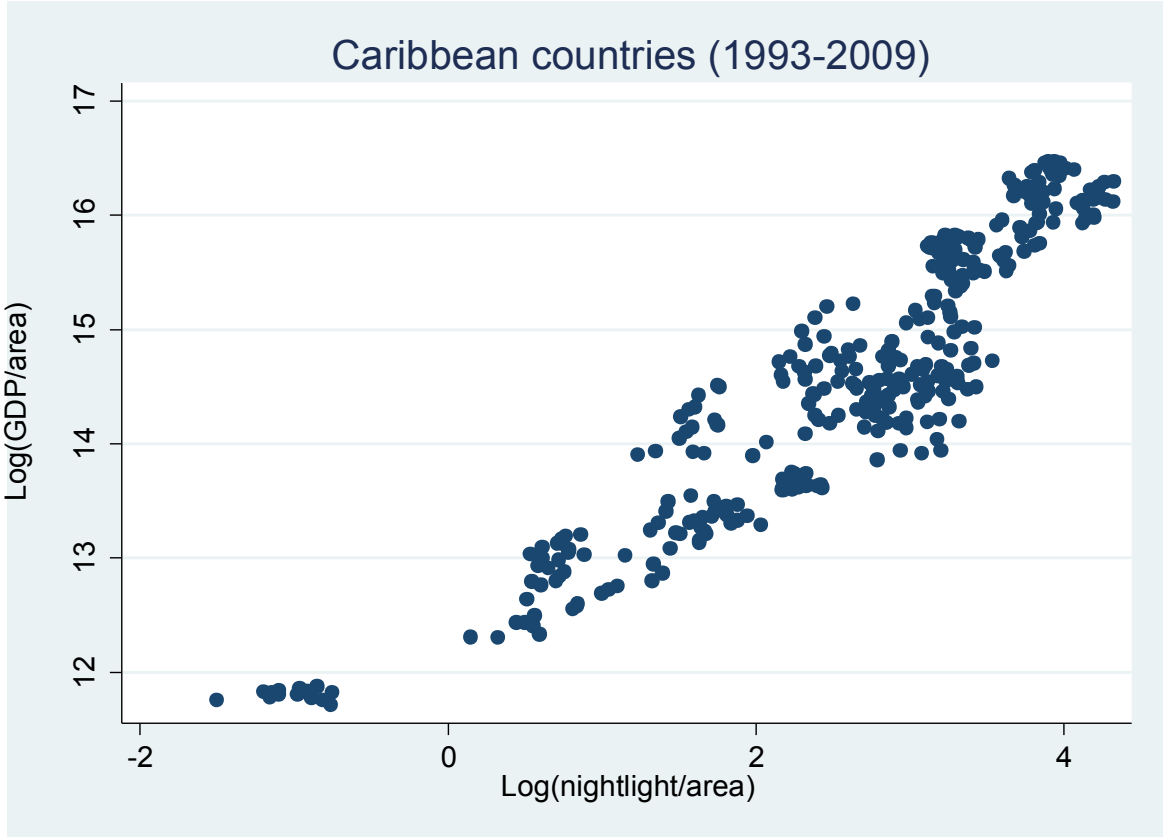
[1] Available at very local (1 km) level

Jamaica:



PROXY OF ECONOMIC ACTIVITY

[2] Strong Correlation with Income:



Disadvantage: Still ONLY a Proxy!

ECONOMETRIC ESTIMATION

Want to estimate:

$$GROWTH_{ijt} = \alpha + \beta HURR_{ijt} + \mu_{ij} + \eta_t + \varepsilon_{ijt}$$

where the spatial unit's *ij* are 1km grid cells

→ unbalanced panel: 17 years; 22 Caribbean countries; +140,000 cells; +1.6 mill. Observations

	(1)	(2)	(3)
PDI_t	-0.524***	-0.511***	-0.518***
	[0.106]	[0.105]	[0.105]
PDI_{t-1}		0.178	0.171
		[0.127]	[0.125]

ECONOMETRIC RESULTS

- How to translate these nightlight changes into a `more' economic unit?
- Link between nightlight and per capita income at country *i* level (Henderson et al, 2012):

  $Gr\_GDP/area_{i,t} = \beta Gr\_Nightlight/area_{i,t} + \mu_j + \eta_t + \varepsilon_{i,t}$

- Result: [22 Caribbean nations, 351 obs.]

  $\beta=0.444^{**}$

- → fall in1.5% economic growth of average strike
- Strobl (2012): using a similar ex-ante measure of potential destruction with aggregate GDP measures → fall of 0.8 %

CONCLUDING REMARKS

- Examined the impact of hurricane strikes in the Caribbean at the local level
- Results indicate that aggregation masks some of the impact (about half)
- Even at the local level the impact is small and short-lived
- Could be many reasons for this: (a) actually true, (b) data masks underlying differences, (c) `bad' data

Current Research: use of synthetic tracks to generate risk maps and distributions of likely economic growth impacts for the Caribbean