Caribbean Economic Research Team

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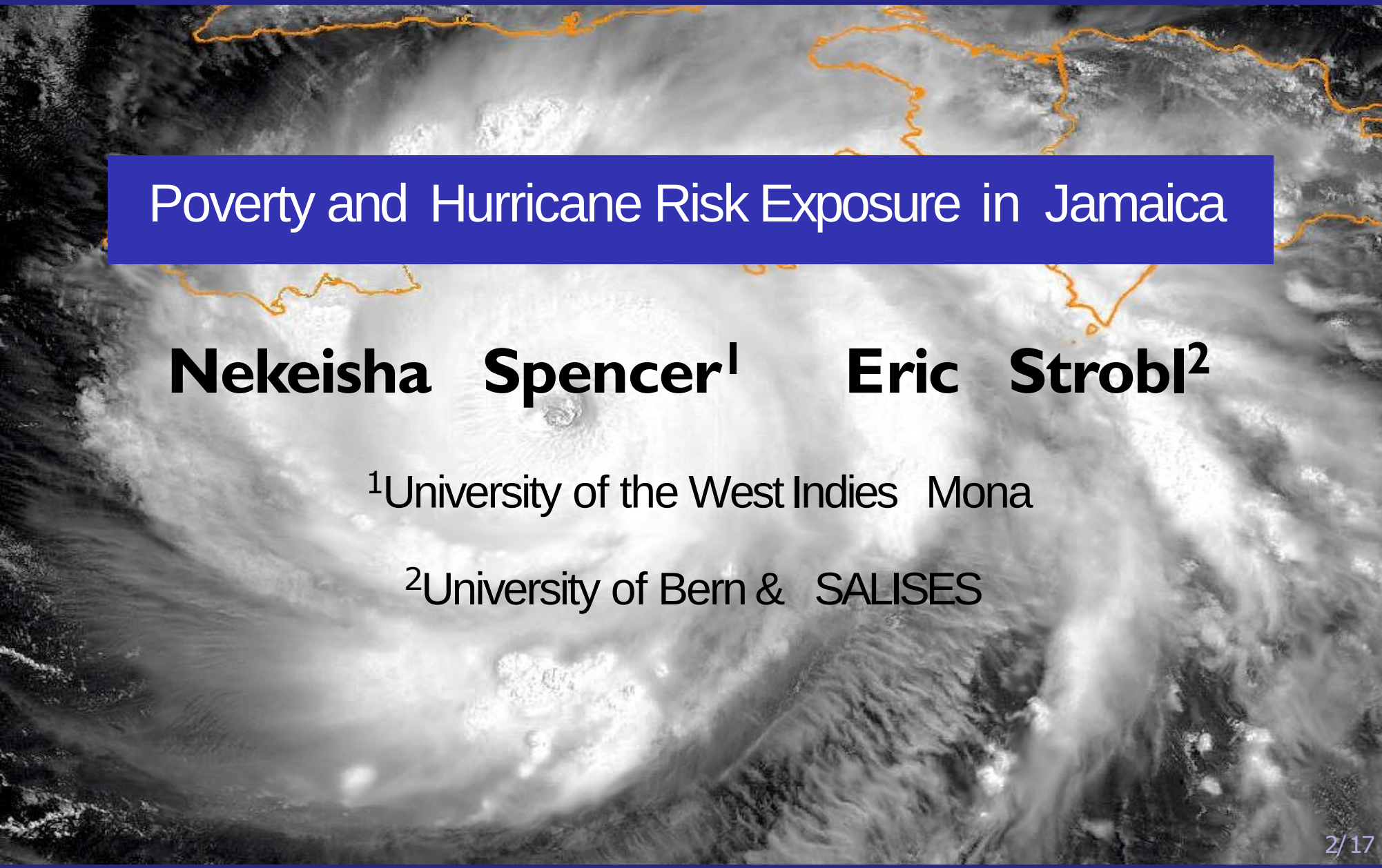

Poverty and Hurricane Risk Exposure in Jamaica

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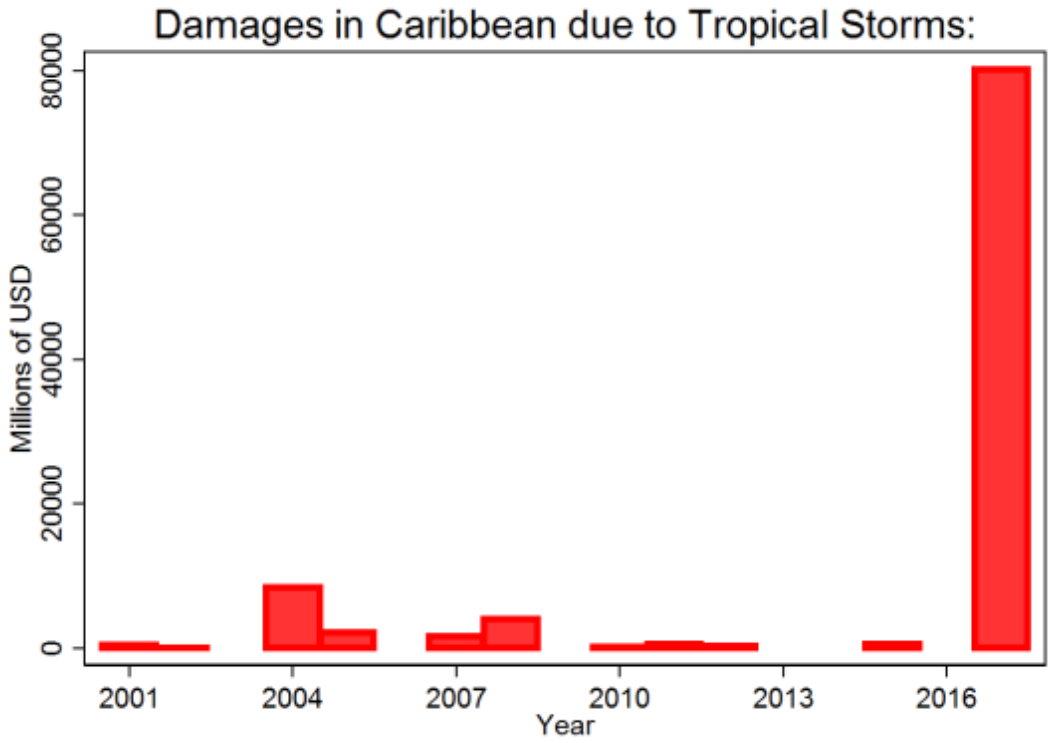
Introduction

- Since 2000 Caribbean has been affected by 40+ tropical storms → 10 billion USD in damages



Introduction

- Several studies [e.g.: Strobl (2012)]: hurricanes ⇒ potentially large (but short-lived) impact on Caribbean economies
- ... and similar result found at household level [Henry, Spencer and Strobl (2019) for Jamaica]
- Question: Will things get worse with climate change?
- Villani & Vecchi (2013): Hurricane intensity ↑ under climate change in North Atlantic Ocean Basin

This Paper

- **This Paper:** We compare expected poverty increases of Jamaican households for *Current* vs. *Future* Climate

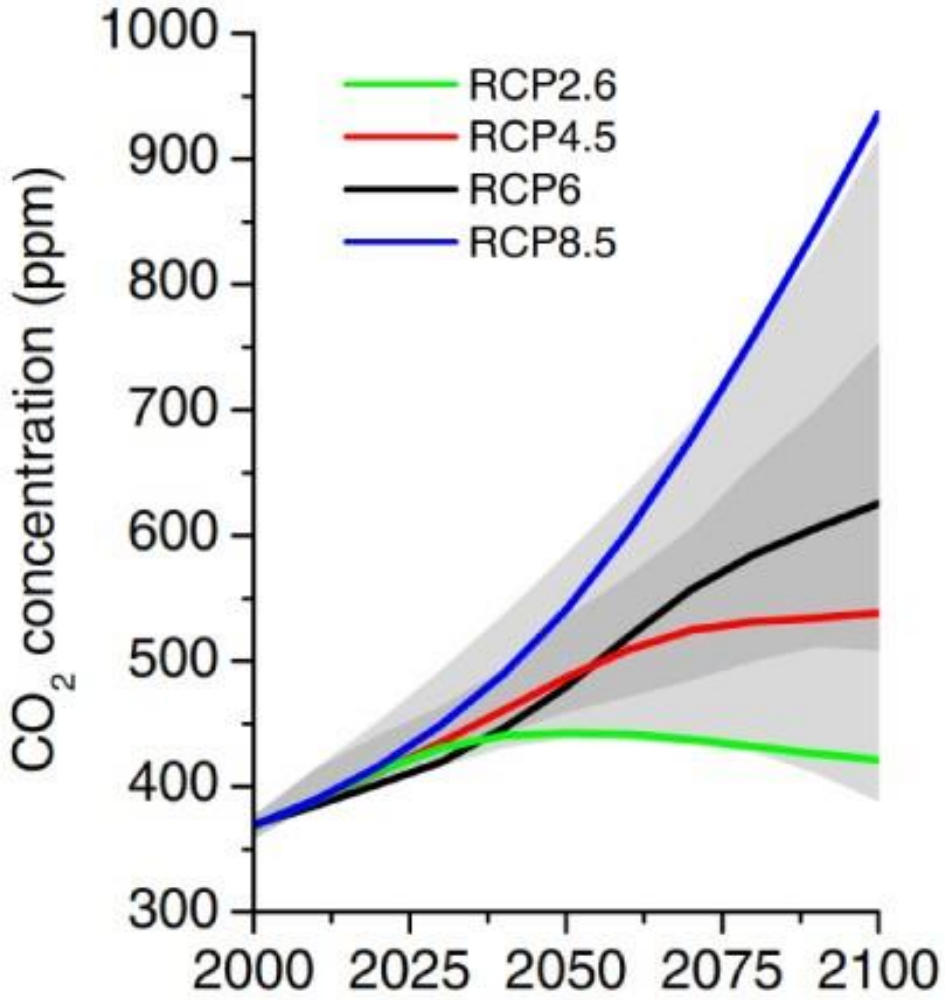
- **Approach**:
  1. Generate sets of synthetic hurricanes under current and future climate in the North Atlantic Basin
  2. Predict their impact on poverty in Jamaican households
  3. Compare expected losses

Climate Change Scenarios

- Future climate typically predicted under different GHG emission projections - but many different models
- We use 5 (CCMS5, IPSL5, MICRO5, MPI5, & MRI5) for Current (1981-2000) vs. Future (2081-2100) Climate RCP 8.5 GHG emission projection
- RCP 8.5, high emissions scenario:
  - High population growth
  - Relatively low income growth
  - Low technological improvements

$\Rightarrow$ high energy demand $\Rightarrow$ high GHG emissions!

Climate Change Scenarios



Synthetic Hurricane Generation

- To create set of hurricanes under each climate setting (current vs. future) for each model - **Emanuel et. al (2008)**
- **Emanuel et. al (2008)**: models development, movement, & intensity of synthetic tropical storms
- 5,000 hurricanes generated for each setting

$\Rightarrow$ 2 scenarios x 5 models x 5,000 hurricanes

Poverty Impact Approach

- Need to translate storms into household poverty
- Henry, Spencer and Strobl (2019): estimate how local wind experienced during hurricane ↓ welfare over 1990-2010
- Similar approach but allow for differences in the damage function according to household wall type.
- Use estimate to infer the impact of hurricane damages to household poverty due to each storm

Household Poverty

- Impact of hurricanes spatially heterogenous $\Rightarrow$ need local distribution of a measure of household poverty
- **Problem:** 2012 Survey of Living Conditions (SLC) provides info on household consumption but not exhaustive...
- ....Population Census is exhaustive but no info on household consumption

Solution: Small Area Poverty Estimation [Elbers et al. 2003)]

Small Area Mapping

- Method used to acquire estimates for areas of a population for which data are lacking
- We "borrow the strength" of the Census/its representativeness, ⇒ poverty estimates for all small areas that are not covered in the SLC
- **Two stages:**

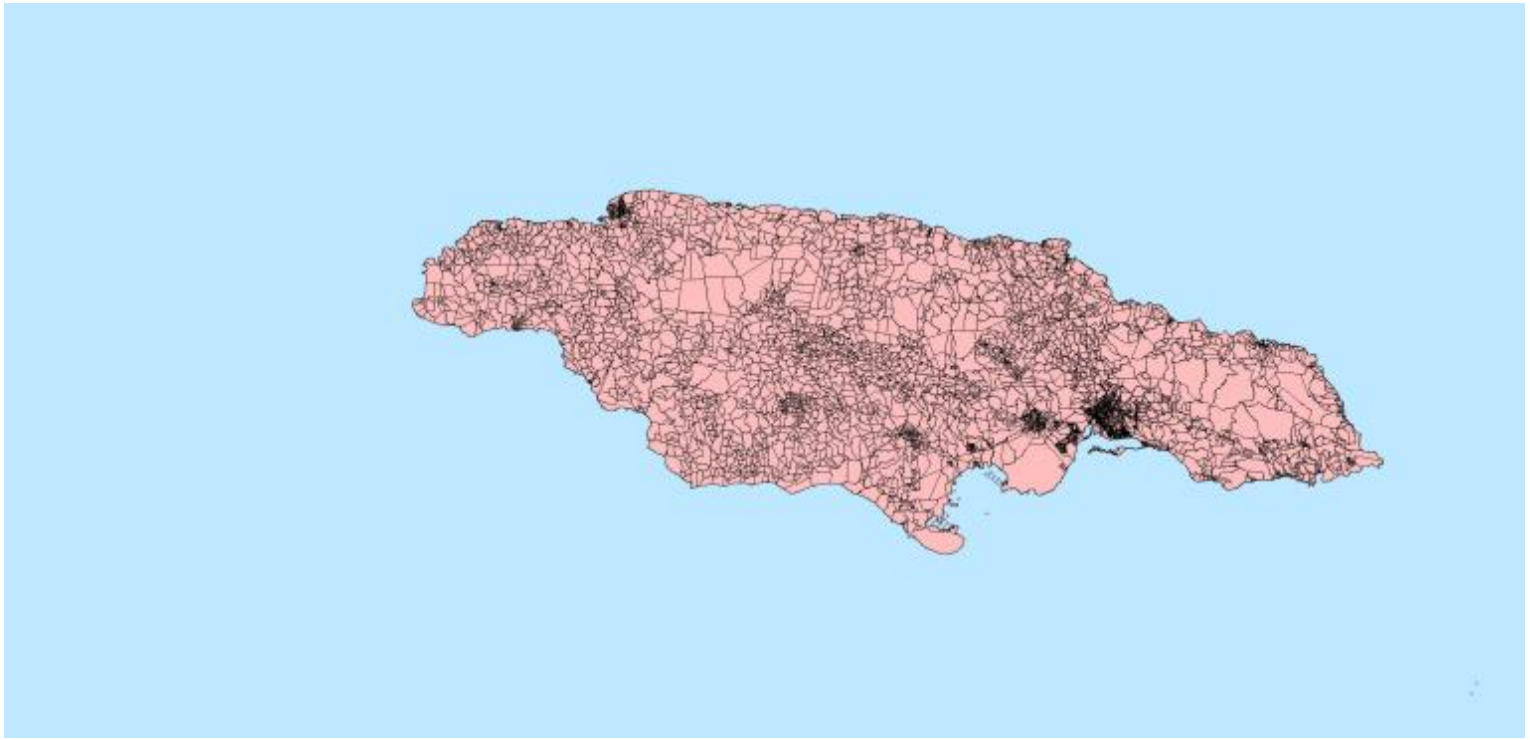
  1. Estimate poverty model using household consumption per capita & characteristics incl. hhsize, building material, share of children

  2. Monte Carlo Simulations ⇒ stage 1 estimates applied to census ⇒ data for all Jamaica

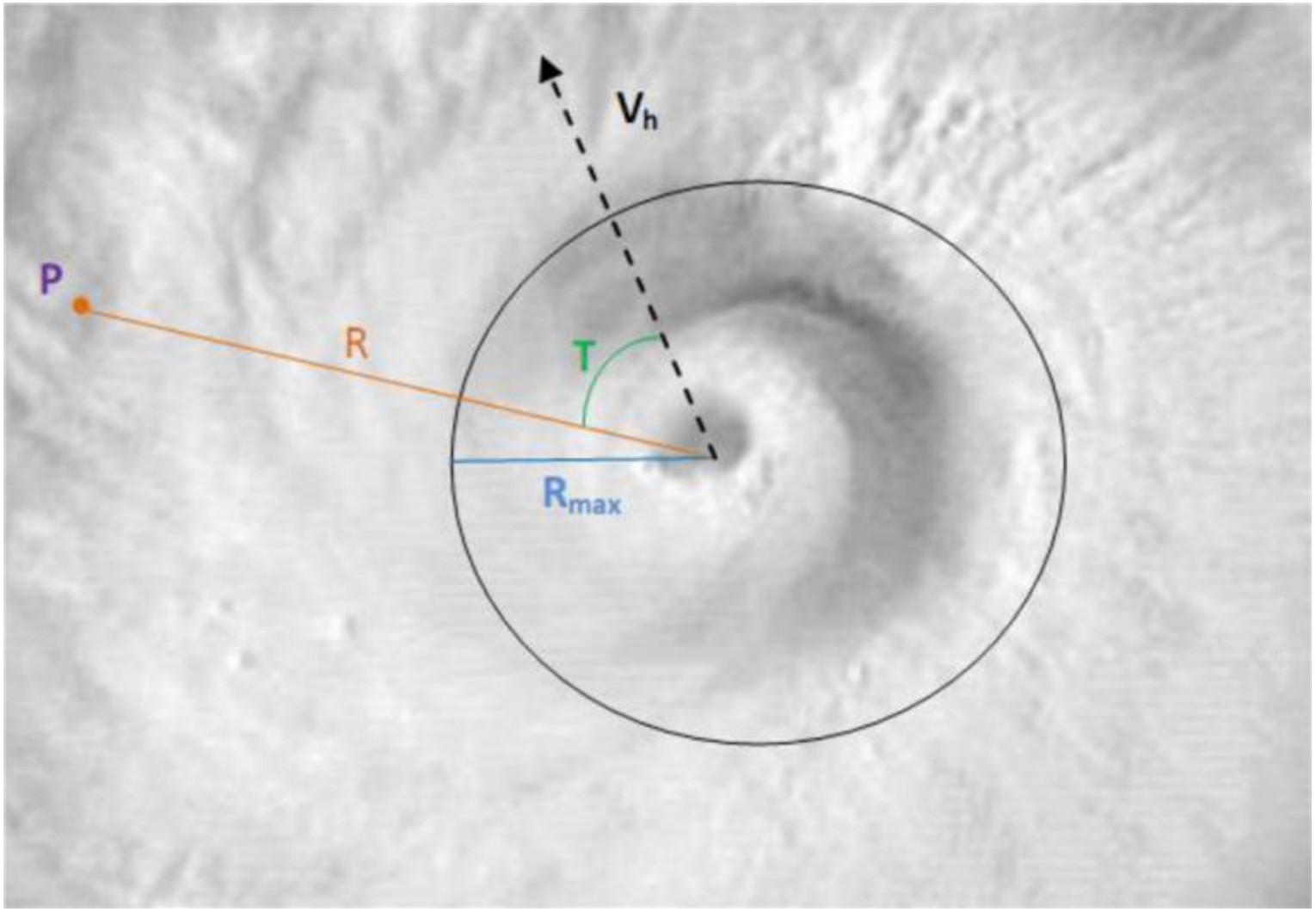
Local Hurricane Wind Speed

- Household location identified by enumeration district
- Thus need local maximum wind speed for each synthetic hurricane for each enumeration district
- **Holland (1980)**: wind field model requiring minimum input to estimate local wind speed during a storm

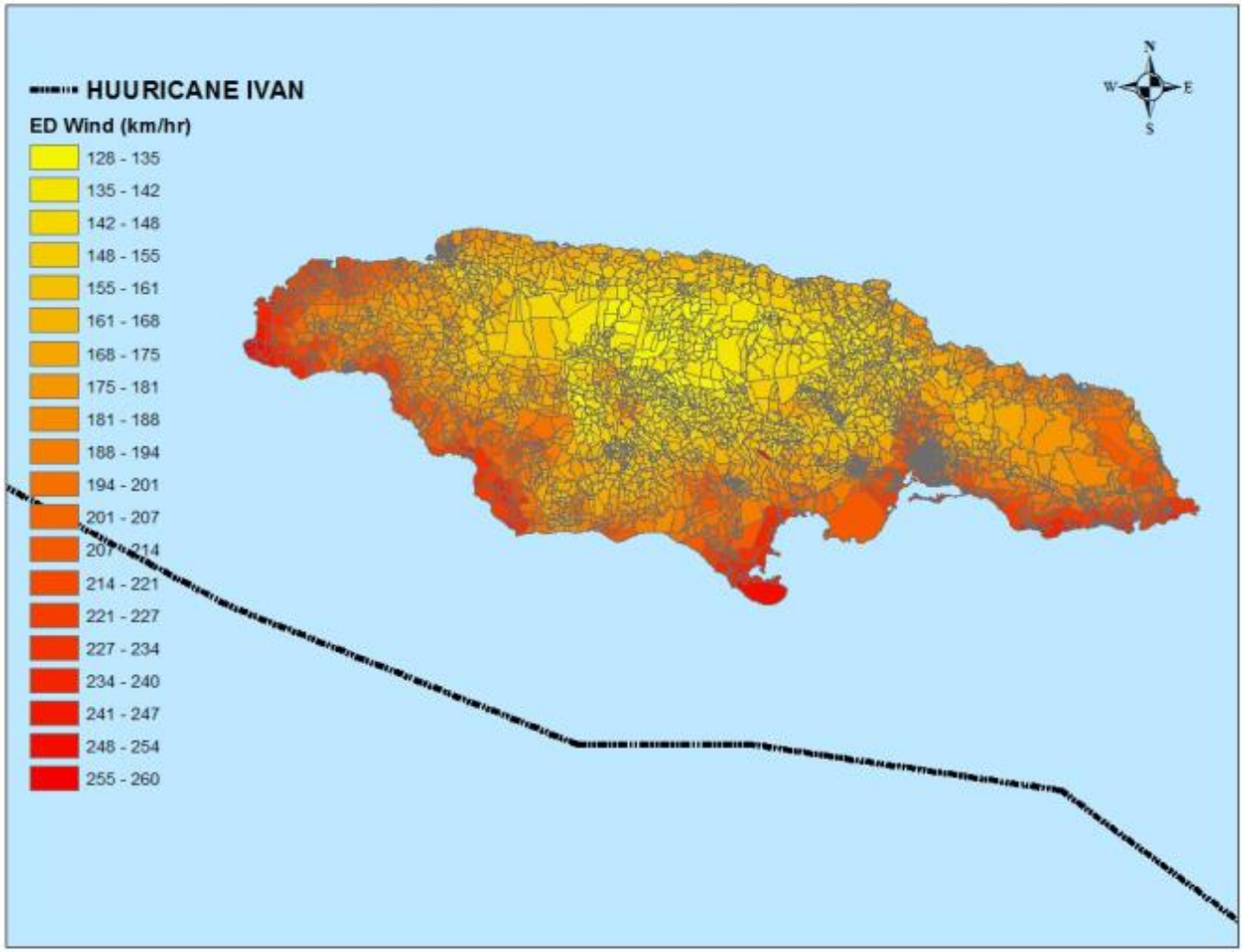
Jamaica: Enumeration Districts



Wind Field Model



Wind Field Model Example: Hurricane Ivan (2004)



Storm Probabilities

- Approach above allows us to generate local maximum wind speed for each synthetic storm
- For expected losses we need the probability of each storm
- Following Emanuel (2011) for each of the ten sets of synthetic storms:
  1. Randomly pick a year (ex: 1980, 1981..., 2000)
  2. Randomly pick storm(s) within that year
  3. Do this 100,000 times

  $\Rightarrow$ probability of each storm

  $\Rightarrow$ calculate the distribution of implied annual impacts

Changes in Household Poverty ($\%\Delta$)

GCM	CCMS5	IPSL5	MICRO5	MPI5	MRI5
20-year	-9.68	100.00	95.23	62.58	-65.27
50-year	-64.25	53.28	95.35	53.51	-98.83
100-year	-73.37	80.47	97.96	57.49	34.32
500-year	-93.23	73.46	98.90	52.99	46.73

Conclusion

- Findings: under most GCM models poverty will increase, likely to be substantial
- Policy: Find ways to buffer expected impacts
- Caveats:
  - Future emissions Uncertainty
  - Model Uncertainty
  - Adaption Uncertainty