WAITING FOR THE BIG ONE
THE CONTINUED EARTHQUAKE RISK
OF PORT-AU-PRINCE, HAITI.

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Outline

• The 2010 Haiti earthquake in brief
• Seismic hazard
• Exposure & vulnerability
• Earthquake scenario
2010 Haiti Earthquake

• 7.0M earthquake
• 2150-220,000 fatalities
• 300,000 wounded
• 1.5 million displaced

Port au Prince, Haiti
Hillside suburb after the Jan 12th Earthquake
"Riskscapes" are Dynamic

Lightening
Hurricanes
Accidents
Economic Risks
Disease
Hail
Drought
Theft
Crime
Earthquakes
Tornadoes
Floods
Fires
Storms

Vulnerability
Resilience
Strength

RISKSCAPES
Seismic Hazard

• The 2010 event was not the “Port-au-Prince earthquake.” It was the “Leogane earthquake.”
• 2010 earthquake occurred along a blind thrust fault in the Leogane plain, not the Enriquillo-Plantain Garden Fault (EPGF).
• Field-work conducted by USGS in 2010 and 2012 has further provided clear evidence that the EPGF did not participate in the 2010 rupture, yet that it has experienced significant and repeated surface ruptures in the recent geological past.
Seismic Hazard

This evidence provides a sobering counter-argument to the general belief that the region can confidently look forward to a period of earthquake tranquility in the coming decades.

Historical evidence of seismic clustering (1751, 1770 events).

This could suggest that the 2010 event could mark the beginning of a new cycle of seismic activity on the Enriquillo fault system.
Scenario Rupture

40 km on EPGF
7.0M event

=> Plausible event (NOT predicted)
Simulated Ground-Motion Fields

- Probability density of loss for a single structure given an event E:

\[ f(loss_1 \mid E) = \int \int G(Loss \mid DM) \, dG(DM \mid IM) \, dG(IM \mid E) \]

- Probability density of loss for numerous structures given an event E:

\[ f(loss_{total} \mid E) = f(Loss_1) \otimes f(Loss_2) \otimes \cdots \otimes f(Loss_n) \]

\[ \int \int G(Loss \mid DM) \, dG(DM \mid IM) \, dG(IM \mid E) \]

Spatially correlated ground-motion intensity
Simulated Ground-Motion Fields

Intensity Measure v.s. Longitude

Intensity Measure

Longitude

0.0 2.0g
Simulated Ground-Motion Fields

Generated 10,000 simulations
Exposure and Vulnerability
Fragility Modeling of Buildings

Collapse Fragility Curve

- Structure 1
- Structure 2

Probability of Collapse vs. Peak Ground Acceleration
Multivariate Logistic Fragility Model

\[ f(z) = \frac{1}{1 + e^{-z}} \]
\[ z = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k \]

Predictor Variables
- Estimated PGA
- Structural Type
- Slope
- Building Density
- Wall Type
- # Stories
Scenario Results
Scenario Results

Actual 2010 earthquake 31,000
Expected (mean) EPGF scenario $\mu = 63,000$

Probability distribution of # collapsed buildings from the EPGF scenario
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