The Changing Face of Catastrophe Risk in the Caribbean

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Outline

• A short history of catastrophe hazard impacts in the Caribbean.
• Faced with increasing hazards and exposure, is our knowledge increasing fast enough to keep up?
• If the science is good enough, is it being used to develop and implement effective solutions in the private sector?
• Can private sector tools bring efficiencies and expanded penetration, and can partnerships foster risk management in the public sector?
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Nat cat history & role in development

- Montserrat
  - Volcanic eruption drove Amerindians from the island just prior to colonisation in early 17th Century
  - 1924 & 28 hurricanes destroyed most lime trees, bringing rapid decline to the historical export of the world’s best limes
  - 1934/35 – earthquakes related to ‘failed’ volcanic eruption destroyed all but a handful of sugar mills
  - 1989, Hugo damaged over 90% of all structures, led to closure of Air Studios
  - 1995, Soufrière Hills volcano started erupting, eventually causing huge economic damage
Soufrière Hills volcano
Other historical impacts

• Port Royal, 1692 – the buccaneer capital of the New World destroyed by liquefaction and severe earthquake shaking
Giddy House (liquefaction repeated in 1907 quake)
Other historical impacts

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- St Pierre, Martinique, 1902 – the ‘Paris of the Americas’ destroyed by pyroclastic flows after eruption of Mount Pelée
Other historical impacts

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- St Pierre, Martinique, 1902 – the ‘Paris of the Americas’ destroyed by pyroclastic flows after eruption of Mount Pelée
- Belize City, Belize, 1961 – Hurricane Hattie produced 140mph winds and 10-15ft storm surge (plus waves) – major loss of life, economic impact, and relocation of capital to Belmopan
Low-lying coastal city!
Haiti, 12 January 2010

- Take a shallow, M=7.0 event very close to one of the most densely-populated cities in the world in the poorest country in the western hemisphere – and it isn’t, unfortunately, rocket science.
Before …

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- Geophysics of the plate margin in Hispaniola reasonably well known (certainly from the regional perspective).
The Enriquillo-Plantain Garden fault zone (EPGFZ) extends from south-central Hispaniola to Jamaica and defines the southern edge of the Gonave microplate. The EPGFZ forms a continuous and prominent geomorphic lineament from the Enriquillo Valley of the Dominican Republic, through the southern peninsula of Haiti, across the Jamaica Passage between Jamaica and Haiti and along the Plantain Garden fault zone bordering the southern edge of the Blue Mountains of eastern Jamaica. The linearity of the fault and its association with an exploration fold, pull-apart basins, and restraining bends indicates that motion is left-lateral and late Quaternary in age. Historical earthquakes indicate that the last major ruptures of the fault occurred in an east to west time-space progression that began in 1751 in south-central Hispaniola and perhaps culminated in the Kingston, Jamaica, event in 1997. Recorded seismicity over the past 40 years is sparse as expected from a fully locked fault plane. GPS-constrained block models with elastic-strain accumulation give ~8 mm/year of slip rate on the fault. Since the last major event in south-central Dominican Republic was in 1751, that yields ~2 meters of accumulated strain deficit, or a Mw=7.2 earthquake if all is released in a single event today. The two largest cities within 30 km of the fault zone are Port-au-Prince, Haiti, and Kingston, Jamaica, with a combined population of 3.65 million inhabitants. We present initial results from a paleoseismic study of the Jamaica segment of the EPGFZ conducted in January, 2008, to determine the chronology of its historic and prehistoric ruptures. Such studies should be considered high priority in Jamaica, Haiti and the Dominican Republic given the seismic hazards posed by the fault.
Before …

- Hurricanes, and floods in particular, were the big disaster management focus.
- Geophysics of the plate margin in Hispaniola reasonably well known (certainly from the regional perspective).
- Even knowing the risk, it was always a difficult task to maintain earthquake awareness in the face of hydro-met hazards and other major developmental challenges.
The fault, and PaP suburb
The totality of the devastation in Haiti was the result of unique circumstances. However, elements of the damage are repeatable elsewhere in the region and could amount to major impacts in cities such as Port of Spain, Santiago (Dom Rep) and Kingston. Lack of risk transfer in Haiti exposed both individuals and the state to the entirety of the impact; penetration is higher regionally, but plenty of room for expansion.
Liquefaction & ground failure
Kingston port
Engineered buildings

- Can we build buildings to withstand MMI IX to X shaking?
- Yes, but in Haiti, most weren’t
- How about the rest of the Caribbean?
- Mixed; plenty of buildings are good, but also lots of room for improvement and lots of old buildings
Ranjit Kumar – Civil Engineer

• Key engineer in Trinidad after WW II
• Led engineering of reclamation of waterfront area (hosts port, main power station, etc)
• Also designed ‘upside down’ Hilton Hotel, completed during the 1960s
• Earthquake engineering not very advanced and not a priority
High-capacity buildings

Before

After
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How much do we know about what is changing in the cat risk landscape?

• Risk = Hazard * Vulnerability * Value
• Generally regard hazard as a constant
• Reducing risk means reducing vulnerability (e.g. building better, preparation) and removing value from hazardous areas (e.g. planning, evacuation)
• Caribbean GDP is increasingly undiversified and exposed to cat risk
  – tourism becoming more dominant
  – asset values tending to become more coastal and more aggregated
Climate change – inducing changes in hazard levels

• However, now the ‘playing field’ (hazards) isn’t level any more either. Climate change brings variability to hydro-meteorological hazards (generally upward, particularly for catastrophe hazards)

• Climate change presents both challenges and opportunities for the insurance industry, particularly in the Caribbean
  – Increased state involvement in climate change adaptation, creating new potential market for insurance services and products
Changing EP curve

- Loss
- Today’s climate
- Moderate climate change
- High climate change

Return period
- Years
- 0, 200, 400, 600, 800, 1000

Current 1,000-year event
Current 200-year event
Expected loss from wind, coastal and inland flooding
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How is the regional cat risk management industry responding?

• As little of the peak cat risk is retained in the private sector, it is ‘someone else’s problem’
• That ‘someone else’ is taking it seriously (Lloyds, Munich Re, Swiss Re), and will increasingly need and value support from primary underwriters and from focussed R&D
• At sovereign level, adaptation to climate change has become increasingly important as mitigation (emissions reductions) has proven too slow to avoid at least significant climate change (with increased variability, and therefore extreme events) being most significant for Caribbean
‘Insurance’ in the UN-FCCC process

- AOSIS, in which Caribbean plays a big role, first proposed ‘climate insurance’ at the Rio Earth Summit in 1992 as a means of financing the additional burdens brought on by CC
- Evolved to an ‘international insurance mechanism’ as part of a three-pronged approach to manage climate risk as a key part of the adaptation text in Copenhagen
- CCRIF became main example for implementation of a regional risk pooling mechanism
CoP 15 Negotiating Text

**Risk Management Component**
Promote risk assessment and risk management tools at all levels
Facilitate implementation of risk management measures

**Insurance Component**
Address climate-related extreme weather events which result in loss and damage (cyclones, droughts, etc.)

**Rehabilitation / Compensatory Component**
Address progressive negative impacts such as sea level rise, increasing land / sea temperatures that result in loss and damage (land loss, desertification, water availability, etc.)

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**Cost/benefit**

- **Risk Management**
  - Engineering (sea wall)
  - Building Code Enforcement
  - Watershed Management

- **Risk Transfer**

- **Residual Risk**

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**Averted loss**

- 0
- 1.0
- 2.0
- 3,000
Science is helping

- Stress re-distribution after earthquakes can now be applied to almost any big quake
- Seasonal and per-storm forecasts are improving year-on-year, lowering uncertainty about seasonal activity and about the impacts of actual storms in the days before arrival
- BUT, the overall level of understanding of catastrophe risk models, and particularly the uncertainties, is still below where it should be, given the critical role that modelling plays in the Caribbean risk management space
Science at work – stress re-distribution

Legend
- Fault sections
- Population density (Landscan 2004)
- NEIC epicenter
- Aftershocks on 1/26/10

Open-File Report 2010-1019

USGS • WHOI • DPRI Coulomb Stress Model
for the 12 Jan 2010 Mw = 7.0 Haiti Earthquake
Version 1.0, 27 Jan 2010, 12:00PM PST

Coulomb stress changes (bars) on individual ‘receiver’ faults
(friction coefficient = 0.4)
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What lies ahead?

• IT (GPS and GIS) advances have brought great potential benefits to re/insurers (and brokers) in being better able to characterise and manage portfolios of risk

• Increasing awareness of sovereign cat risk analysis and transfer issues, as part of comprehensive disaster risk management, will bring improvements in public-sector driven aspects of RM (planning, building codes etc.)

• Climate change adaptation funding will create opportunities to improve data collection and analysis capacity (physical and intellectual) and expand markets for risk transfer
Sovereign risk management

![Sovereign Risk Management Diagram]

**Key**
- Red: Very high
- Orange: High
- Yellow: Medium
- Green: Low

**Legend**
- Relative Impact:
  - Limited (1)
  - Minor (2)
  - Moderate (3)
  - Significant (4)
  - Catastrophic (5)

**Relative Likelihood**
- Low (1)
- Medium Low (2)
- Medium (3)
- Medium High (4)
- High (5)
What lies ahead?

• Other global innovations have great potential for Caribbean applications
  – CCRIF is leading the way in terms of pooled parametric cat risk solutions at sovereign level
  – Index insurance for agriculture is in an advanced stage of development, and other index-based and/or micro-insurance developments have potential to expand markets in many sectors
  – ART (cat bonds etc) and captives are examples of risk management tools with great applicability in the region
  – Regional weather derivatives market seems like a good fit; most economic activity is exposed to weather risk, and region is a reasonable diversifier for most potential counterparties
Conclusions

• Cat risk in the Caribbean isn’t going anywhere
• It has always impacted the region hard, and hazard and value (at risk) are both increasing while vulnerability is only slowly improving
• Private sector needs to stay engaged in technological advances and test/implement new tools to better manage risk
• Public sector needs to be supported in applying existing tools to underpin sustainable development in the face of climate change, but can also be driver of innovation
To ponder over coffee…

• There is a lot going on, both in a changing risk landscape and in innovations to manage that risk.

• There is an increasing alignment of public and private sectors, with each somewhat unfamiliar with the other, but both needing to work in harmony to overcome the challenges.

• I believe the industry needs to develop a comprehensive ‘playbook’, supported by a research programme and drawing on regional and global best-practice, to navigate the coming ‘perfect storm’…
A perfect storm?

• To paraphrase Nick Stern, the Caribbean region is faced with sustaining its development path in an increasingly hostile environment, both physical and economic.

• Natural hazards feature prominently on all risk maps across the region – for a country, a multi-national corporation or a subsistence farmer.

• The expertise and experience necessary to manage that risk is here in this room; but it will need more than talk...