MANGROVES AND MARSHES: A SHIELD AGAINST CATASTROPHE?

THE ROLE OF WETLANDS IN INSURANCE INDUSTRY RISK MODELS: WHEN IS $600M A LOT OF MONEY?

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&

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Who are Risk Management Solutions?

- RMS produces models used to quantify & manage catastrophe risk
- Work with most major insurance and reinsurance companies in US & Europe
- $2 trillion worth of insurance and capital markets transactions based on RMS risk models
- Trusted by regulators and rating agencies for over 20 years
- Collaborate with public-sector institutions to help them understand their exposure to risk
- 1,200 employees, over 200 in model development across London, California, Zurich and India
How do insurers / reinsurers use risk models?

- Establish **pricing guidelines** for different perils
- Determine **risk drivers** to their portfolios
- Develop **location-specific** view of risk
  - “what’s the annual likelihood of a property at (x,y) being flooded?”
- …and **portfolio-specific** view of risk
  - “what’s the annual likelihood of incurring $500M+ losses?”
- Determine **reinsurance** needs
- Estimate **post-event** losses
WORLDWIDE CATASTROPHE RISK MANAGEMENT

From earthquakes, hurricanes, and floods to terrorism and infectious diseases, RMS helps financial institutions and public agencies understand, quantify, and manage risk.
Key question:

Can we estimate how much “nature-based” defences are mitigating coastal flooding risks in the USA?

Can we put a price on the risk reduction benefit of wetlands?

This work is supported by the Lloyd's Tercentenary Research Foundation project “The Role of Coastal Habitats in Managing Natural Hazards and Risk Reduction”. [www.lloyds.com/coastalresilience](http://www.lloyds.com/coastalresilience)

HOW DO WE MODEL US HURRICANE STORM SURGE?
MODELLING US HURRICANE STORM SURGE

- Tropical cyclone-driven storm surges are amongst the **costliest natural catastrophes** on Earth
- In the USA, **4 of the top 5 costliest natural catastrophes** have involved storm surge

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**Hurricane Sandy**

**Typhoon Haiyan**
Image: Noel Celis, AFP
US HURRICANE MODEL FRAMEWORK

Define Hurricane
Stochastic Event Module
Generate set of ~50,000 synthetic hurricane events

Assess Wind & Wave Hazard
Hazard Module
Run deterministic wind & flood models for every event

Apply Exposure
Geocoding/Exposure Module
Associate hazard risk to every property in portfolio

Calculate Damage
Vulnerability Module
Relate wind speed/surge height to property damage

Quantify Financial Loss
Financial Analysis Module
Calculate financial loss for portfolio of properties
QUANTIFYING THE ROLE OF WETLANDS IN STORM SURGE RISK
CASE STUDY #1: OCEAN COUNTY

Do wetlands protect properties from annual storm surge damage in Ocean County (NJ)?

- Looked at ~2,000 synthetic storms
- Assume uniform grid of properties in the area
- Estimated annual flood losses for every property
- Wetlands and their watersheds delineated by Shepard et al. using GIS
- Are average annual losses different in areas protected by wetlands versus areas not protected?
DO WETLANDS PROTECT PROPERTIES FROM ANNUAL FLOOD DAMAGES IN OCEAN COUNTY?

Average annual losses from storm surge are greater in areas not protected by wetlands.
CASE STUDY #2: HURRICANE SANDY

- Hurricane Sandy: 2\textsuperscript{nd} costliest in US history
- Surge reached 9\textit{ft} above astronomical tide in NY

**Did wetlands reduce/increase economic losses during Hurricane Sandy?**

**Scenario-based analysis**

Run the surge model for Hurricane Sandy:
1) With wetlands as they are today
2) Assuming all wetlands are lost
HURRICANE SANDY: WETLANDS LOSS STUDY

SCENARIO 1: PRESENT-DAY WETLANDS (GREEN)

Wetlands roughness coefficients: 0.04 – 0.1

SCENARIO 2: WETLAND LOSS TO OPEN WATER (BLUE)

Wetlands’ roughness coefficient: 0.02 (=sandy bed)

Surface roughness of wetlands was reduced to simulate wetland loss to open water
Removing wetlands caused an increase in losses in most locations. Areas with higher wetland cover saw biggest relative loss increase.

Removing wetlands increases losses by >100% in some areas… … but what does this mean for absolute losses?
## DIFFERENCE IN DAMAGES BETWEEN BOTH SCENARIOS

<table>
<thead>
<tr>
<th>State</th>
<th>At Present ($M)</th>
<th>With Wetland Loss ($M)</th>
<th>Absolute Difference ($M)</th>
<th>Relative Difference (%)</th>
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<tbody>
<tr>
<td>Connecticut</td>
<td>2 181</td>
<td>2 181</td>
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<tr>
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<td>205</td>
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<tr>
<td><strong>TOTAL</strong></td>
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<td><strong>51,330</strong></td>
<td><strong>+625</strong></td>
<td><strong>+1.2</strong></td>
</tr>
</tbody>
</table>

- Highest relative savings in states with extensive wetlands (Delaware, Maryland, New Hampshire, and Virginia).

Figures give total economic loss from storm surge only.

**Total absolute saving:** $625M
SO – IS $625M A LOT OF MONEY?

It depends on who you ask…

- **“NO”:**
  - Fairly insignificant compared to total Sandy surge losses ($50.7Bn)

- **“YES”:**
  - If the benefits are focused on specific communities, organisations or stakeholders
    - In US, homeowners’ flood insurance is often through NFIP (federal agency)
    - Industrial facilities generally insured for wind & water damage, but often have localised flood defences
SUMMARY

- The effect of wetlands on **attenuating storm surge** for major hurricanes can be significant
- … and some of these effects can be accounted for in **risk models used by the insurance industry** to manage & price risk
- Who gains most from wetlands’ surge attenuation? Risk models can be used to gain further insights.

- RMS is committed to a 2-year partnership with The Nature Conservancy to explore this work further, extend the case studies to other habitats and expand the quantification throughout the US.

- [www.lloyds.com/coastalresilience](http://www.lloyds.com/coastalresilience)
Coastal Wetlands and Flood Damage Reduction: Using Risk Industry-based models to Assess Natural Defenses in the Northeast US

www.lloyds.com/coastalresilience
ABOUT RMS

RMS is the world’s leading provider of products, services, and expertise for the quantification and management of catastrophe risk. More than 400 leading insurers, reinsurers, trading companies, and other financial institutions rely on RMS models to quantify, manage, and transfer risk. As an established provider of risk modeling to companies across all market segments, RMS provides solutions that can be trusted as reliable benchmarks for strategic pricing, risk management, and risk transfer decisions.

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