Evaluating the Risk: Can IOOS aid the Insurance Industry?

Dail Rowe
November 15, 2012
Agenda

- What is reinsurance?

- What’s the role of science in risk assessment?

- Why is geophysical data important to us?
  - Science
    - Climate
    - Hazard
  - Monitoring
    - Forecasting
    - Event response
  - An informed public
Insurance and The Value of Diversification

- Let’s say you’re an insurance company that insures 100 homes in New Jersey…
- … and that the probability of any single home being destroyed is 0.01 or once every 100 years
- On average, you would pay to rebuild one home each year
  
  \[(0.01 \text{ per year}) \times (100 \text{ homes}) = 1 \text{ home per year}\]
Insurance and The Value of Diversification

- But any given year will be different…
  Assuming that each home being destroyed is an independent event

<table>
<thead>
<tr>
<th>Number of Homes Destroyed</th>
<th>Annual Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.37</td>
</tr>
<tr>
<td>1</td>
<td>0.37</td>
</tr>
<tr>
<td>2</td>
<td>0.18</td>
</tr>
<tr>
<td>3</td>
<td>0.06</td>
</tr>
<tr>
<td>4</td>
<td>0.015</td>
</tr>
<tr>
<td>6</td>
<td>0.0005</td>
</tr>
<tr>
<td>9</td>
<td>0.000001</td>
</tr>
</tbody>
</table>

- So… your insurance company needs cash on hand to pay claims

\[ N \times (\text{home value}) = \text{cash required} \]

where \( N \) is relatively small
But what if?

NASA: Sandy on October 29, 2012
Catastrophes Create Correlated Risk

- But instead of uncorrelated risks, you now have correlated risk where a large percentage of your insured properties are damaged or destroyed at the same time

  … You’re out of business, and the people who depended on you have lost everything

- But you were smart!
  - You purchased reinsurance – insurance for insurance companies
Reinsurance is Catastrophe Insurance
Catastrophe Statistics are Inadequate

5.25 million car accidents per year
- National Highway Traffic Administration

370,000 home fires per year
- National Fire Protection Agency

1.8 hurricane landfalls per year
- National Hurricane Center
Data and Science Enable an Informed View of Risk
Model Ingredients

- Frequency and severity (probability distributions describing hurricanes)
  - How often do hurricanes make landfall?
  - Where?
  - How strong?

- Physical hazard model
  - What is the spatial pattern of the wind?
  - How high is the storm surge?
  - How much rain falls?

- Vulnerability model
  - How much damage is caused by the physical hazard?
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Climate Science and Hurricane Models

- Frequency and severity probability distributions are not stationary
  - Climate variability and climate change alter the probability distributions that describe hurricanes
    - More or fewer landfalling storms?
    - Changes in regional risk?
      - Should we expect more Sandy-like storms in the northeast?
    - Weaker or stronger?
  - Not just hurricanes…
    - Tornados
    - Floods
    - Severe winter storms
    - ....
Climate Variability: ENSO

- ENSO: El Nino / La Nina – Southern Oscillation
- Correlated with substantive changes in hurricane frequency
- Better data = better understanding
- Better nowcast = better forecast?

<table>
<thead>
<tr>
<th></th>
<th>Atlantic Basin</th>
<th>U.S. Landfalls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tropical Storms &amp; Hurricanes</td>
<td>All Hurricanes</td>
</tr>
<tr>
<td>1950-2011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>El Niño</td>
<td>8.8</td>
<td>4.7</td>
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<tr>
<td>Neutral</td>
<td>11.5</td>
<td>6.9</td>
</tr>
<tr>
<td>La Niña</td>
<td>12.1</td>
<td>6.6</td>
</tr>
</tbody>
</table>

*Average number of storms per year
Climate Variability: AMO

- AMO: Atlantic Multi-decadal Oscillation (AMO)

9-year running mean SST and Cat 3+ hurricane records
Climate Variability or Climate Change?

- What’s the real partition between natural and anthropogenic forcing of Atlantic SST?
- Are recent increases in hurricane activity part of a cycle or the new normal?
- Is anthropogenic climate change a now problem or a future problem for the insurance industry?

Ting et al. (2009) – J Clim
Data Stewardship

- Stewardship
  - Merriam-Webster:
    
    the conducting, supervising, or managing of something; especially: the careful and responsible management of something entrusted to one's care

- A significant portion of the uncertainty around hurricanes and climate change and variability is due to past inadequate data stewardship
  - and it is even worse for other perils – e.g., tornados

- It is crucial that we as a community embrace consistent and quality data stewardship as a core value
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and the Flood They Caused
Hazard Science and Hurricane Models

- There are a variety of wind and surge models in use
  - Some relatively simple
    - Algebraic descriptions of hurricane winds
    - SLOSH models of storm surge
  - Some quite complex
    - GFDL and WRF derived simulations of hurricane wind
    - ADCIRC based simulations of storm surge
  - All can improve
    - Improvement often motivated by comparison to data
    - Unfortunately, there isn’t much data
  - Significant uncertainty in key areas - e.g.
    - Development of boundary layer after landfall
    - Basic digital elevation and bathymetric data

- No government supported anemometer captured the peak winds of hurricane Ike

- All of the key wind observations were:
  - Purpose built instruments hardened against hurricane winds
  - Supported by
    - Academia (TTU and UFL)
    - Weatherflow
Event Response Data Needs

- Available in real-time
- Direct measures of the physical hazard
  - Wind speed
  - Water levels
  - Inundated?
- Known instrument qualities
  - Location, height, units, averaging time
Forecasting

- We need skillful, probabilistic weather-forecasts at all lead times
  - Decades to days
  - Longer lead-time information impacts strategy
  - Shorter lead-times assist with event management and response

- Improvements
  - Better models
  - Better initial conditions
    - Hurricane forecasts
      - It’s a life safety and an economic issue
      - $1 million dollars per mile of evacuated coastline according to NOAA
    - Medium and long-range weather and climate
An Informed Public

RenaissanceRe

RISK SCIENCES FOUNDATION INC.

SAFE HOMES FOR ALL
LEADERSHIP FORUM
A Hurricane Risk Mitigation Leadership Forum Event

Proprietary and Confidential Information
Can IOOS aid the Insurance Industry?

Yes!

Thanks!

Questions?