Insurance sector needs: a personal view (Steve Lyons, 2004)

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Insurance/re-insurance

- Need information on long-term climate how it relates to risks
- However only specific to a few regional areas
- Need better information to be used in commercial risk models
- Where does an IOOS fit in?
A personal view of insurance

- Take in premiums - invest $ - gather the profits - have good underwriting so they don’t lose it!

- When the stock market and other financial markets soften - so does profit

- 5 years ago markets softened - companies tried to underwrite real time hurricane landfall as energy risk (degree day heating) - many got burned

- Presently traditional reinsurance is relatively strong so they now stick to traditional underwriting.
Different risks and Insurance

- Life, health, auto, unemployment, protection and indemnity, D & O, product liability, Terrorism

- IOOS - Property/catastrophic insurance - long term view - can’t dump customers because of a Bill Gray - bad forecast!
Risks of interest (re-insurers)

- Tropical Cyclones-landfall (frequency and intensity) long term - mainly US/Japan/Australia
- Earthquake (frequency and intensity) existing areas and concerns about new areas - including underwater (Tsunamis)
- Windstorms (europe) (frequency/seriality)
- Flood (in europe) - US covered by Govt.
- Tornado
- Hail
- Fire
## Top 5 Insured Losses, 1970-2000

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
<th>Deaths</th>
<th>Insured Loss (Billions 2000 $US)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hurricane</td>
<td>1992</td>
<td>38</td>
<td>20</td>
</tr>
<tr>
<td>Andrew</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northridge</td>
<td>1994</td>
<td>60</td>
<td>16</td>
</tr>
<tr>
<td>Earthquake</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typhoon Mireille</td>
<td>1991</td>
<td>51</td>
<td>7</td>
</tr>
<tr>
<td>Winterstorm Daria</td>
<td>1990</td>
<td>95</td>
<td>6</td>
</tr>
<tr>
<td>Winterstorm Lothar</td>
<td>1999</td>
<td>80</td>
<td>6</td>
</tr>
</tbody>
</table>

Swiss Re, sigma no. 2/2001
The great weather and flood catastrophes over the last forty years

Losses in US billion dollars

Source: Munich Re Group, 1999.
Sources: T.P Whorff, Scripps, Mauna Loa Observatory, Hawaii, Institute of Oceanography (SIO), University of California, La Jolla, California, United States, 1999.
US Losses From Hurricanes

Herbert, P.J., J.D. Jarrell, and M. Mayfield, 1996
US Losses From Hurricanes
(Normalized for Inflation, Wealth, and Population)

Pielke and Landsea, 1998
Climate Research

- Wealth of new knowledge
- No knowledge of certainty about the future climate
- No certainty of how man’s actions will influence the complicated climate system
- No methods to reliably predict the behaviour of this complex system
- Do not know how to write for Climate change - no buyers - little interest
Swiss Re have a more enlightened approach

- Need to understand the climate system better through research
- Must tackle the uncertainty as a risk which can be systematically analysed and overcome
Global Climate Protection

- Create adequate awareness of the problem (ignoring the problem will not make it go away)
- Industry needs to help pursue a political solution (need to find ways to implement climate protection measures which are socially and economically acceptable)
Swiss Re’s climate change approach

- Using research in products (RPI)
- Developing risk management strategies which exceed the boundaries of traditional insurance cover - even a small change can bring big casualties (dams, dykes)
- Involved with UNEP - international climate conventions
- Realization of the problem: political, social, economic, technical and cultural issues
What can IOOS provide?

First Global insurance world cares about the US - $’ s drive the business

Improve historical and current data on risks

Improve all aspects of the models

Provide information to the public about the reality of changing climate. Public risk model?
Only 65 Major Landfalling Hurricanes In 20th Century

Major United States Landfalling Hurricanes 1899-1996

NCDC web site
Storm Surge Produces Sand Layers

[Diagram showing layers of sand and mud on a barrier island with labels for Ocean, Barrier Island, Lake, Sand, and Mud]
Overwash From Hurricane Winds Leaves Sand Layers

Kam-biu Liu, 1998
Location Map for Landfall Proxy Sites
Annual Probability of Cat 3 Winds based on Falloff Wind Calculation

[Map showing the location map for landfall proxy sites with arrows indicating probability levels.]
Ocean Processes due to Hurricanes

- **Storm surge**
  Dome of water due to pressure drop (barometric tides + wind setup)

- **Storm waves**
  10 – 16 sec waves generated by wind shear stress

- **Wave breaking**
  Wave setup in coastal area

Illustration: Not to scale

Cheung, 2003
Slosh Model Storm Surge Simulation
Cat 3 into northern New Jersey

Donnelly, 2003
December, 1999

ERC Frankonia  RMS  Munich Re

Also, Benfield, Swiss Re (and others?)
Important Questions

- How clustered are European wind storms? The Bermuda bus concept!
- Why are they clustered? Are they 1 or 2 events?
- Which factors are most important?
- Can seriality be predicted?
- Will seriality increase in the future?
- All require integrated ocean/atmos data
ENSO and U.S. Landfalling Hurricanes
1900-1996

O’ Brien et al., 1997
Annual Probability Of Exceeding $1 Billion Insured Losses
RPI’s Influence On Risk Models

- Focusing atmospheric research on topics with relevance to RPI sponsors
  - New RMS hurricane model includes Extra-Tropical Transitions

Research on Extra-tropical Transitions of Tropical Cyclones

- Number Of Items
- Decade: '30s, '40s, '50s, '60s, '70s, '80s

Figure courtesy of J. Darr, Risk Management Solutions
Existing Risk Models

- AIR, EQE, RMS, etc.
  - Proprietary, non-disclosure agreements with licensee

- “In-house” models
  - Proprietary, won’t be seen outside a company

- FEMA’s HAZUS
  - Public, but source code not available

- Florida’s Wind Loss Model
  - Will be public; but, will source code be available???
Catastrophe Risk Model

Hazard

- landfall probability
- maximum sustained winds
- peak wind gust
- radius of maximum winds
- forward speed and direction
- decay rate
- latitude
- longitude
- elevation
- topography
- construction type
- surrounding structures

Damage

- physical damage
- repair costs

Insured Loss

- terms of coverage
How Good Are The Models?

- Significant effort devoted to development of each model; but, do you know:
  - Which model is better?
  - Which models, if any, have skill?

- Insurers essentially use multi-model ensemble forecasting to estimate uncertainty

- No “public” verification, but each company has their own opinion on which model is best for a given situation
An Ensemble Of Risk Models

Ensemble of 9 Wind, 9 damage, and 3 friction/topography algorithms

Kinetic Analysis Corporation, 2003
What Are The Models Missing?

- **Standardization**
  - Not easy to incorporate new or alternate data

- **Flexibility**
  - Not easy to change hazard or damage algorithms

- **Transparency**
  - Proprietary aspects limit understanding and uses

- **Verification**
  - No public assessment of model skill
Why Do Insurers Need An Open-Source Risk Model?

- Accelerate Development of Risk Models
  - Access to latest scientific/engineering advances

- Enhance Liquidity of Alternative Risk Products
  - Direct Securitization, e.g., Cat Bonds

- Rationalize Insurance Regulation
  - Florida Hurricane Commission
  - California Earthquake Authority

- Promote Financing of Natural Catastrophes in Developing Countries
  - World Bank programs
IOOS and the Insurance sector

- Interested in prediction - realize that the ocean is an important driver of climate
- Interested in reliable data
- Tools and products have to integrate with models
- Future directions: An open-source risk model?
On the web:
http://www.bbsr.edu/rpi/
RISK PREDICTION INITIATIVE
The Goal of the RPI

To support research on natural hazards and to transform science into knowledge that our sponsors can use to assess risk.
RPI Structure

RPI Core
- Workshops
- In-house Products

**RPI Research Group**
- Tropical cyclone forecasts and variability
- Proxy records of intense hurricane landfall
- European weather and climate
- Earthquakes?
Extreme Weather Events

Society (Increased Population, Wealth, Vulnerability)

Natural Disasters
Fossil Fuel Emissions

6 Pg C/y = $6 \times 10^{15}$ g C/y

6 billion people, 50 kg (110 pounds) each => 0.3 Pg