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GRIFFITH FOUNDATION
PRESENT

Back to Basics: Climate Risk—Financial Resilience

JANUARY 23RD
12PM CENTRAL

NAIC | CENTER FOR INSURANCE POLICY AND RESEARCH
An Overview of Catastrophe Modeling

Dr. Randy Dumm
Director, Baldwin Risk Partners School of Risk Management and Insurance
University of South Florida
Risk aggregation analysis (pre-1980s)

Risk Mapping is visual:
• color codes
• pins
Our Story begins in 1989

Hugo’s toll

Worst storm ever to cost insurers at least $4 billion

The stead of claims created by Hurricane Hugo, now acknowledged by the insurance industry as the costliest storm on record, will not be enough to immediately house property/casualty insurance rate cutting, many industry observers contend.

The Property Claims Services division of American Insurance Services Group Inc. late last week estimated that Hugo caused $3.684 billion of insured property damage in the United States, Puerto Rico and U.S. Virgin Islands, a record for a storm-related toll.

However, many observers predicted the full cost of the storm—especially business interruption claims from devastated Charleston, S.C.—will not be known for months.

"The sleep dog in this whole thing will be business interruption losses," predicted Robert Hastings, a vp in the Charlotte, N.C., office of AIG Business Insurance.

"I'm sure we'll be tallying claims from this one a year or two from now. It's something that could take Charleston 10 years to clean up," said Larry Allmon, a claims manager in the Charleston office of Chubb Mutual Insurance.

An estimated 300,000 structures were damaged in the Charleston area alone, according to Eisman.

Kennedy, assistant catastrophe manager in the Dallas office of GAB Business Services Inc. and head of GAB's South Carolina operations.

According to AIG's estimates, insured damage in South Carolina totals an estimated $3.55 billion, including $1.52 billion in the four coastal counties of Charleston, Horry, Georgetown and 

Hugo is unlikely to trigger a major turnaround in the reinsurance marketplace, U.S. reinsurance executives say. See story, page 51.

In the fire sector, North Carolina losses are estimated at $73 million, while damage in Virginia and Georgia is set at $5 million and $1 million, respectively.

Meanwhile, insured property damage is estimated at $700 million in Puerto Rico and $545 million in the U.S. Virgin Islands, AIG announced.

These estimates do not include roughly $400 million in flood losses covered by the National Flood Insurance Program and by private insurers participating in the federally-backed "write-your-own" flood insurance program.

Quake’s insured losses estimated at $1 billion

By MICHAEL BRADFORD and LOUISE KERTESZ

While the California earthquake will cost insurers about $1 billion, or only a fraction of the up to $10 billion in total damage, the "psychological" impact of a disaster coming on the heels of Hurricane Hugo could increase property insurance rates, brokers say.

The Property Claims Services Division of the American Insurance Services Group estimated Friday that the net insured loss to buildings and vehicles in California from the quake is $960 million.

The earthquake increased total catastrophe losses in the United States this year through Oct. 17 to a record $6.6 billion. That figure does not include damage caused by last week's explosion at a Phillips Petroleum Co. petrochemical complex in Pasadena, Texas (see related story).

Even excluding the Phillips loss, this year's catastrophe toll far exceeds the previous industrywide record of $2.82 billion set in 1989.

Meanwhile, an AIG survey of insurers reveals that losses from Hurricane Hugo are slightly lower than a preliminary estimate of $3.88 billion. However, the preliminary estimate of Hugo's damage is not being revised since the latest survey is part of an interim progress report. A final estimate of Hugo claims will not be prepared for three months.

The California Insurance Department also estimates that insured losses from the earthquake will be $1 billion. But Assistant Insurance Commissioner Richard Roth noted that...
1989 Becomes a Record Year

NATIONAL UNDERWRITER

NOVEMBER 20, 1989
NUMBER 47 □ 93RD YEAR

’89 Marks Worst Year For Property Losses

BY ROBERT G. KNOWLES
CHARLESTON, S.C.—With 42 days left to go, 1989 already has become the worst year in American history for catastrophic property insurance losses.

“There has never been a year to rival 1989,” Property Claim Services Division Manager William A. Gilluly told reporters at a news conference in Charleston’s hurricane-ravaged historic district.

He said the private insurance industry expects to pay a total of $6.63 billion for insured property losses incurred by policyholders in 31 catastrophes thus far this year.

31 Catastrophes To Cost Insurers $6.63 Billion

As Mr. Gilluly spoke, almost two months after Hurricane Hugo struck the South Carolina lowlands, the roar of chain saws and power tools still rattled windows in the area. The Category 4-storm smashed into the Carolinas on Sept. 21-22.

“Natural catastrophes in the second quarter of the year produced the greatest amount of insured property damage in the United States of any...
What we should have known...
Post-Andrew Outcomes

• Aggregation of risk not well understood
• Building codes matter
• Traditional approach for pricing risk with catastrophic elements does not work.
• Need for a new approach - computer-based catastrophe models
• Need to see inside the “black box”
  – Florida Commission on Hurricane Loss Projection Methodology
• Changes to ASOP
Catastrophe Model Specifics
The Catastrophe Model Framework

- Stochastic Event Module
- Hazard Module
- Vulnerability Module
- Financial Module

RMS: A Guide to Cat Modelling
# Model Output Example

## PML Summary

10k Standard, No Storm Surge, With/Without Demand Surge, Per Occurrence Basis

<table>
<thead>
<tr>
<th>Probability</th>
<th>Return Period</th>
<th>Loss Est</th>
<th>Probability</th>
<th>Return Period</th>
<th>Loss Est</th>
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<td></td>
<td>EV/AAL</td>
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<td></td>
<td>EV</td>
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<td>5.0%</td>
<td>20</td>
<td>8,459,103</td>
<td>5.0%</td>
<td>20</td>
<td>7,595,024</td>
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<td>2.0%</td>
<td>50</td>
<td>39,368,866</td>
<td>2.0%</td>
<td>50</td>
<td>35,307,742</td>
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<td>83,131,577</td>
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<td>73,108,706</td>
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<td>134,305,809</td>
<td>0.4%</td>
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<td>115,295,554</td>
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<td>0.2%</td>
<td>500</td>
<td>231,308,686</td>
<td>0.2%</td>
<td>500</td>
<td>194,177,943</td>
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<td>0.1%</td>
<td>1,000</td>
<td>313,161,930</td>
<td>0.1%</td>
<td>1,000</td>
<td>264,634,442</td>
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<tr>
<td></td>
<td></td>
<td>399,306,693</td>
<td></td>
<td></td>
<td>323,755,048</td>
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</table>
What Catastrophic Risks are Modeled?

- Extreme Wind
- Flood
- Earthquake
- Tsunami
- Fire
- Climate
- Cyber
- Pandemic
- Terrorism
- Others
Who Models Catastrophic Risk?

• Vendor Models
  – Verisk
  – Risk Management Solutions
  – CoreLogic

• Others
  – Applied Research Associates
  – Florida Public Hurricane Loss Model
  – Karen Clark & Company
  – Broker Models
  – Internal models
Who Uses Catastrophe Models?

- Insurers
- Reinsurance
- Reinsurance brokers
- Rating agencies
- Government entities/regulated entities
- Capital market participants
- Researchers
Models Produce Different Results
Model Challenges and Development

• Model Performance
  – 2004-2005 hurricane seasons
  – Model projections- Hurricane Katrina
  – Model Changes Post Hurricane Ike
  – Large Between-Model Loss Estimates

• Climate change concerns and model versions
  • Traditional versus near/short-term models

• Model Expectation and Uncertainty
Models and ILS Growth

Source: Company financial statements / Aon Business Intelligence / Aon Securities Inc.
“All models are wrong, but some [they] are [indeed] useful”
(Apologies to George E. P. Box, 1976!)

“The emergence of catastrophe modeling has brought a new era of risk assessment, enabling insurance experts to comprehend and mitigate complex perils driven by environmental factors.” (Waterstreet, 2023)

“With all the advances in the science and computing power we need to adopt, embrace new methodologies [and] new ways of building accurate models” (Karen Clark, 2022)
Key NAIC Nat Cat and Climate Related Solvency Activities

Bruce Jenson
Assistant Director, Solvency Policy
National Association of Insurance Commissioners
Key NAIC Nat Cat and Climate Related Solvency Activities

• 2010 - Initial NAIC Climate Risk Disclosure Survey launched
• 2013 - Climate change guidance added to NAIC Examiners Handbook
• 2017 - RCAT charge added to RBC for hurricane/earthquake
  • Wildfire charge effective 12/31/23
  • Convective storm 12/31/23 for information purposes only
• 2020 - NAIC Climate & Resiliency (EX) Task Force established
  • Solvency Workstream
• 2022 - NAIC adopts updated Climate Risk Disclosure Survey aligned with the international Task Force on Climate-Related Financial Disclosures (TCFD)
Key NAIC Nat Cat and Climate Related Solvency Activities

• 2022 – NAIC establishes a new Center of Excellence for CAT Modeling to support regulators
• 2023 – NAIC adopts updated guidance for Financial Analysis and Examination handbooks

Pending Developments:
• Property/Casualty Data Call
  • Zip code level data on Homeowners policies
• Climate Scenario Analysis
  • Medium-term scenario proposed for collection with RCAT
• CAT Reinsurance Program Description
  • Proposed RBC RCAT Interrogatory
Credit, Market and Liquidity Repositories:
• Assess the potential risk of climate change/transition and asset devaluation risk on insurer’s invested assets by utilizing information in:
  • SEC filings (if applicable)
  • ORSA filings (if applicable)
  • Climate Risk & Disclosure Survey (if applicable)
  • NAIC’s U.S. Insurance Industry Climate Affected Investment Analysis
Pricing/Underwriting and Strategic Repositories:

- Assess the insurer’s exposure to Catastrophic Events including potential for increased physical losses, prospectively, due to climate change
  - RBC
  - ORSA
  - Climate Risk & Disclosure Survey
  - Other information (e.g., Cat Modeling used by the insurer)

- Assess the adequacy of CAT reinsurance coverage in place
  - Use of CAT modeling results in reinsurance decision-making (e.g., retention levels, coverage limits, exclusions, reinstatement provisions, or use of non-traditional reinsurance).
 Repositories
 Investments
 Reinsurance (Assuming and Ceding)
 Underwriting

 Exhibits
 Exhibit A (Planning Procedures)
 Exhibit B (Planning Questionnaire)
 Exhibit DD (Critical Risk Categories)
 Exhibit I (Planning Memo)
 Exhibit V (Prospective Risks)
 Exhibit Y (Interview Questions)
# Example Risks - Underwriting Repository

<table>
<thead>
<tr>
<th>Identified Risk</th>
<th>Possible Controls</th>
<th>Test of Controls</th>
<th>Detail Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insurer has not established CAT risk exposure limits</td>
<td>Concentration limits set by peril and zone through scenario analysis or CAT modeling</td>
<td>Verify that limits are set and enforced through underwriting practices and/or reinsurance coverage</td>
<td>Evaluate the appropriateness of limits in comparison to capital position, industry standards, etc.</td>
</tr>
<tr>
<td>CAT risk exposure calculations are not produced by a reliable process</td>
<td>Controls over:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Input data</td>
<td>Review data reconciliations, rationale for assumptions, validation reports, etc.</td>
<td>Test accuracy of input data, consider engaging specialist to review modeling assumptions, backtest modeled results.</td>
</tr>
<tr>
<td></td>
<td>• Model assumptions</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Non-modeled risks</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Model validation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Exhibit V – Prospective Risk Example

• Example Risk
  • The company may experience increased frequency and/or severity of natural hazards due to climate change, impacting its ability to achieve its long-term business strategy.

• Risk Mitigation
  • Short-term scenario results presented in the ORSA report.
  • Medium-term scenarios projected over 5-10 year horizon and used for strategic planning
    • Significant increase in loss costs may require changes in UW/Reinsurance strategy or additional capital.
    • Evaluating impact on long-term business strategy with plans to present recommendations to BOD.

• Examiner Review
  • Review the short-term scenarios outlined in ORSA to stress UW results and CAT cover.
  • Review the medium-term stress scenarios to assess impact
  • Refer to analysis for on-going monitoring, including review of BOD recommendations.
CAT Modeling COE

To provide regulators with:
1. Access to information on vendor models
2. CAT education designed for regulators
3. CAT research projects requested by regulators
INDUSTRY EFFORTS TO STRENGTHEN FINANCIAL RESILIENCE

Susan Denike
January 23, 2024

A business of Marsh McLennan
Climate Risk and the Insurance Industry

• Climate change could threaten the financial health of insurers, and cause disruptions in the availability and affordability of coverage if insurers become more risk averse as a result.
• Insurance companies could face higher losses and potential increased frequency and severity of events could make existing catastrophe models and pricing practices less effective.
• Risk Mitigation efforts including more robust building codes, research into resilient construction practices and retrofitting have shown encouraging results in recent events and will continue to evolve and improve.
• There is also a role for nature-based solutions: actions to protect, sustainably manage, or restore natural ecosystems.
• Proper evaluation and quantification of the current and future risk to insurers’ portfolios should consist of:
  – Exposure Management
  – Hazard Mapping
  – Catastrophe modeling
Exposure Management

- Insurers must continue to invest in high-quality, high-resolution data collection
- Underlying data must be Complete, Correct and Current
- Align valuations with current costs of rebuilding
- Mitigation efforts need to be reflected in exposures modeled
- Utilize third-party tools for data augmentation – Hazard Scoring / Insurtech
- Leverage mapping tools to reveal “hot spots” of exposure concentrations
Stress Exposure for Climate Scenarios

Hazard Mapping

• Hazard maps are an effective way to provide quantitative risk-differentiating metrics for specific locations.

• Hazard mapping and scoring can also be used to help insurers understand the regional and site-specific impacts of specific perils resulting from different climate stresses.

RCP 4.5 (2050) is described by the Intergovernmental Panel on Climate Change (IPCC) as a moderate/intermediate scenario in which emissions peak around 2040 and then decline.
Stress for Climate Scenarios

- Models are built and calibrated to historical loss severity and event frequency.
  - Prior to selecting Stress scenarios, evaluate if current model is fit for purpose - an uplift of loss may be required to represent the present-day risk accurately.
  - Vendors have long provided the ability to adjust hurricane frequency based on a “near term” event set.
- Most catastrophe model climate adjustments focus on the peril of North Atlantic Hurricane
  - Catastrophe model output is derived from thousands of event scenarios each representing an event of a particular severity occurring at a particular geographic location. Each will have an associated likelihood of occurring
  - Vendors have released scenario files giving the user the ability to apply model adjustments with a specific focus on changing climate.
  - Users can adjust frequency and severity for future climate change projections, at various time horizons
- Tools also exist for quantifying potential increased severity and frequency of flooding, wildfire, severe storms (incl. Hail) and Winter storms.

Modeled output
Innovation is needed to ensure adequacy of coverage

Traditional and Non-Traditional Risk Financing

• Catastrophe risk is currently funded through a variety of sources, including:
  – Insurance Companies
  – State-Based Insurance Funds and Pools and Reinsurance Funds
  – FEMA (Flood)
  – Traditional Insurance and Reinsurance
  – Catastrophe Bonds

• As climate-related weather risks become increasingly complex and unpredictable and potentially more severe, the need for innovative insurance structures rises:
  – Parametric (Re)Insurance: Alternative Risk Solution with a triggered payout, indexed-based cover
    • Example: New York MTA MetroCat Parametric Cat Bond
  – Public/Private Partnerships: Address protection gaps
Key Takeaways

The dynamics of a changing climate will challenge the insurance and reinsurance industry to manage capital, evaluate and execute growth plans while adapting to shifts in volatility.

There is no one solution for understanding climate change, quantifying the financial impact and proactive management of a peril impacted by a changing climate.

Insureds, regulators, insurers, academic institutions, modeling vendors and reinsurers all have a role to play to ensure that insurance remains available and affordable and that protection gaps are filled.
Thank you for attending!

Please fill out our brief feedback survey: surveymonkey.com/r/b2bfinancialresilience