U.S. Private Flood Market

NAIC Catastrophe Risk (E) Subgroup

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Agenda

- Flood market background
- The need for flood catastrophe models
- Flood and catastrophe model regulation
- Flood model evaluation
Flood market background
Flood risk is increasing…

“The rain broke records set just 11 days before by Tropical Storm Henri, underscoring warnings from climate scientists of a new normal on a warmed planet: Hotter air holds more water and allows storms to gather strength more quickly and grow ever larger.”

New York Times, September 7, 2021

“The United States is expected to experience as much sea level rise by the year 2050 as it witnessed in the previous hundred years…sea levels along the coastline will rise an additional 10-12 inches by 2050 with specific amounts varying regionally, mainly due to land height changes.”

National Oceanic and Administration Association, February 15, 2022
…but the U.S. flood insurance market is underserved

- Current U.S. residential flood insurance market
  - Estimated 4% of SFHs have flood insurance (2021)
  - NFIP: **$3.6B** total premium on **4.8M** policies (2019)
  - Private insurers reported **$735M** in Private Flood DWP (2020) vs. **$577M** in DWP (2019)
  - About one-third of Private Flood DWP is estimated to be residential
  - **175** private carriers writing flood insurance (2020) vs. 152 in 2019
  - Potential U.S. residential flood insurance market is between **$37B** and **$47B** of DWP
- For comparison purposes, 2020 HO DWP was **$110B**

![NFIP Take-Up Rate Estimates](chart.png)
What makes an insurance market sustainable?

**Availability**
- Insurer can manage and measure the risk
- Insurer can charge premiums that represent the cost of risk transfer

**Affordability**
- Policyholders are able to pay the premium

**Reliability**
- Insurer will be able to pay claims
- System will be stable over the long term
The need for flood catastrophe models
Flood risk is local
Varies greatly over short distances and requires granular rating
Flood risk is catastrophic
Requires advanced catastrophe models for risk measurement and management
FEMA is updating the NFIP risk rating methodology through the implementation of a new pricing methodology called Risk Rating 2.0. The methodology leverages industry best practices and cutting-edge technology to enable FEMA to deliver rates that are actuarially sound, equitable, easier to understand and better reflect a property’s flood risk.

Risk Rating 2.0 was implemented for new policies in October 2021 and will apply to renewal policies in April 2022. As part of the rate development process, FEMA supplemented NFIP’s historical loss experience with commercial catastrophe models for inland flood and storm surge.

Description of RR 2.0 methodology and data sources: https://www.fema.gov/flood-insurance/risk-rating
Flood models are used to estimate the effect of sea-level rise.
Flood models are necessary for climate-readiness

Under a high climate scenario, an estimated 750k single-family properties in the US will face major repricing by 2050

Flood and catastrophe model regulation
Catastrophe model treatment varies widely among states

<table>
<thead>
<tr>
<th>Prohibition of the use of catastrophe models for some or all purposes in establishing rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silent on the use of catastrophe models</td>
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<tr>
<td>Questionnaires and case-by-case model validation</td>
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<tr>
<td>Regulations piggybacking on other state reviews</td>
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<tr>
<td>Statewide body for scientific and technical review of catastrophe models</td>
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</tbody>
</table>
How different states treat catastrophe models

Florida
Models used in rate filings must be accepted by Florida Commission on Loss Projection Methodology, which conducts extensive reviews of hurricane and now flood models

South Carolina
Models must be approved in South Carolina; historically have followed Florida’s lead

Hawaii
Models must be accepted but historically have not been reviewed frequently, resulting in the requirement to use old models

California
Not allowed for setting overall rate levels (except for Earthquake and Fire Following Earthquake). Allowed for setting rate relativities, granular territory definitions, underwriting/tiering.

New York
Does not allow catastrophe models
Flood model evaluation
Evaluation of emerging models

Specific actuarial techniques

- Calibration versus out-of-sample validation
- Reasonability checking
  - Is the aggregate AAL believable?
  - How often does it produce unreasonable location level AALs?
  - Does it produce logical relationships with risk?
  - Does it produce discontinuities?
- Does it reflect important variables that alter vulnerability?
- Does it include all important sub-perils?
- How does it compare to other models (if available)?
- Give special consideration to outliers
Example: Annual Average Loss (AAL) by model

Average AAL impacts the rate level

Wide disparities exist across different models for inland flood

Storm surge also shows sizeable variation of AALs across models
Example: Inspection of individual risks
Which modeled AALs are most reasonable?

<table>
<thead>
<tr>
<th>Beach house</th>
<th>Inland property</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model A</td>
<td>Model A</td>
</tr>
<tr>
<td>$1,000</td>
<td>$1,500</td>
</tr>
<tr>
<td>Model B</td>
<td>Model B</td>
</tr>
<tr>
<td>$30</td>
<td>$3</td>
</tr>
<tr>
<td>Model C</td>
<td>Model C</td>
</tr>
<tr>
<td>$20,000</td>
<td>$30</td>
</tr>
</tbody>
</table>
**Example: Correlation among models**

Higher agreement in relative risk for storm surge than inland flood

### Inland flood (4 counties)

<table>
<thead>
<tr>
<th></th>
<th>Model A</th>
<th>Model B</th>
<th>Model C</th>
<th>Model D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model A</td>
<td>1.00</td>
<td>0.26</td>
<td>0.36</td>
<td>0.33</td>
</tr>
<tr>
<td>Model B</td>
<td>1.00</td>
<td>0.30</td>
<td>0.23</td>
<td></td>
</tr>
<tr>
<td>Model C</td>
<td>1.00</td>
<td>1.00</td>
<td>0.34</td>
<td></td>
</tr>
<tr>
<td>Model D</td>
<td></td>
<td>1.00</td>
<td></td>
<td>1.00</td>
</tr>
</tbody>
</table>

*None of the models are highly correlated for inland flood*

### Storm surge (2 counties)

<table>
<thead>
<tr>
<th></th>
<th>Model A</th>
<th>Model B</th>
<th>Model C</th>
<th>Model D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model A</td>
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<td>0.85</td>
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<td>Model B</td>
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<td>0.91</td>
<td></td>
</tr>
<tr>
<td>Model C</td>
<td>1.00</td>
<td>1.00</td>
<td>0.83</td>
<td></td>
</tr>
<tr>
<td>Model D</td>
<td></td>
<td></td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

*Significantly higher correlation among storm surge AALs*
Example: Spatial analysis of inland flood

- Model A shows limited high AALs
- Model B shows high AALs farther away from rivers
- Model C shows more high-AAL locations, generally very close to rivers
- Model D shows high AALs the farthest away from rivers

AALs

- 0 - 25
- 26 - 50
- 51 - 100
- 101 - 200
- 201 - 500
- 501 - 1,000
- 1,001 - 5,000
- 5,001 - 35,832
## Proposal for catastrophe model clearinghouse

### Multi-disciplinary panel to develop standards, select expert reviewers, and manage model review process

- Consistent professional review team for all models for a given peril
- Expert team would depend on nature of model but could include engineers, scientists, technologists, actuaries, claims experts, other professionals

### Third-party experts chosen by panel to perform confidential reviews

- Retention of state-level control of ultimate determination of acceptability
- States may add filing-specific questions regarding model usage

### Voluntary participation by states who wish to rely on expert model review

- Standardized modeler disclosures
- Market basket output for state level regulatory analysis, comparison
- Third-party expert reports reviewing model compliance with standards, suitability for specific purposes

### Potential clearinghouse deliverables
Vision for sustainable private flood insurance market

Available, affordable, reliable insurance

Agents and insurers actively competing to provide variety of options for consumers

Higher participation / take-up rates across all flood zones

Affordable risk-based premiums for the greatest number of households

Continuous improvements in data, modeling and risk communication

Ability to anticipate, measure and plan for future climate scenarios

Reduced reliance on disaster assistance + faster rebound post-event
Thank you

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