Flood Rating Plan Development

CAS Severe Weather Workshop

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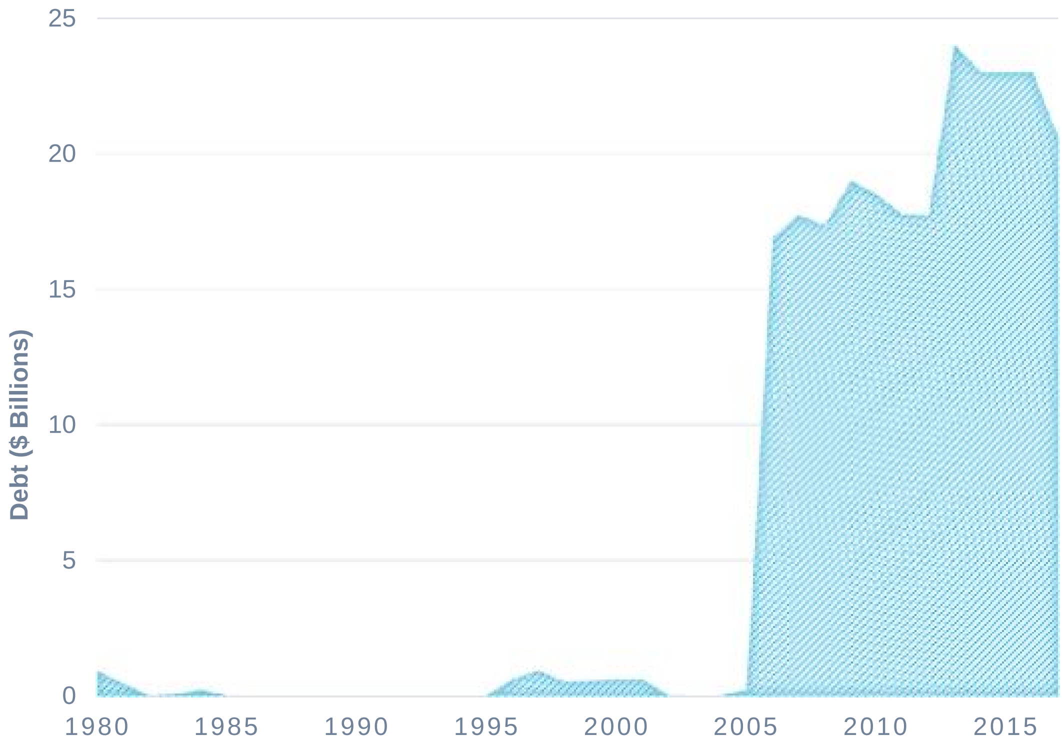
Overview

- Introduction
- Use of catastrophe models
- Flood pricing structures
  - Overview of structures
  - Advantages and disadvantages
  - Development and implementation needs
- Comparisons of rating plans
  - Florida example
  - Duval County inland flood example
- Hands-on flood rating and loss explorations

Introduction

Recent history of National Flood Insurance Program (NFIP) debt



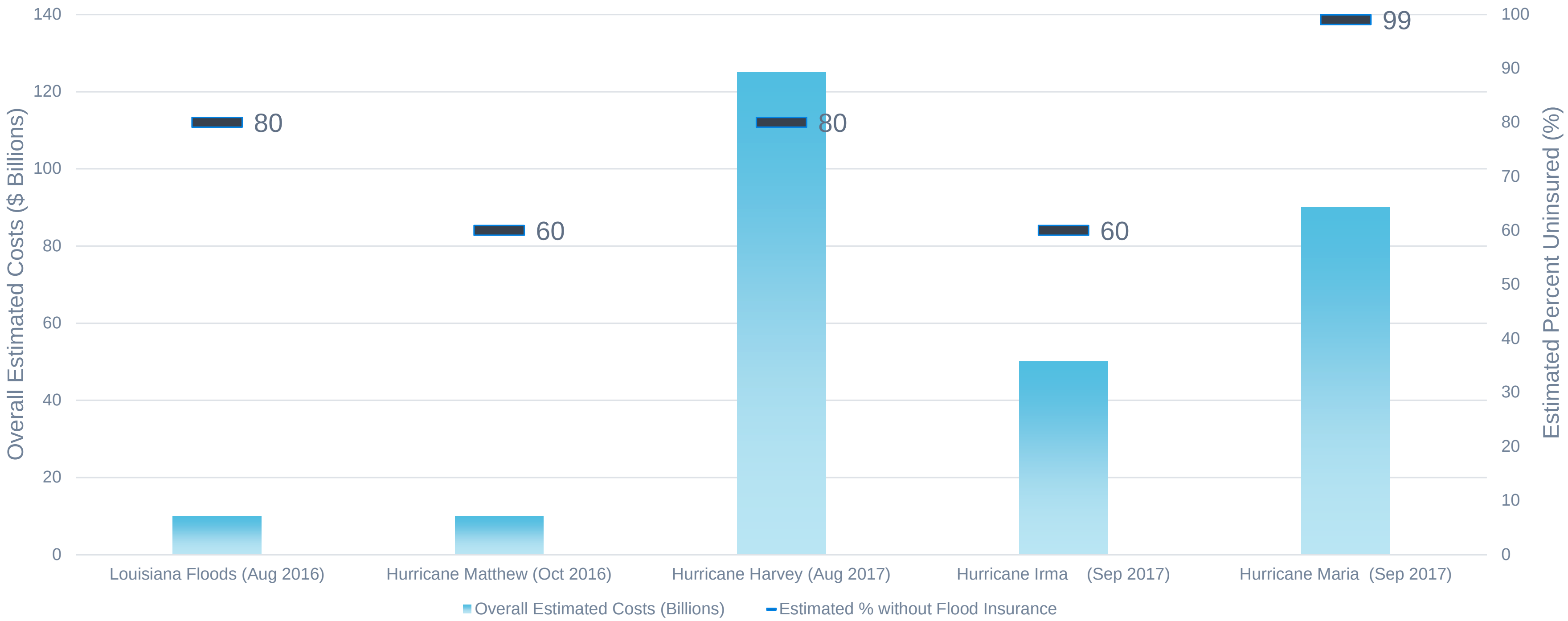
Source: CRS analysis of data provided by FEMA Congressional Affairs, November 20, 2017

NFIP Debt Changes

- Almost $17 billion borrowed in 2005 and 2006 after Katrina, Rita, and Wilma
- Over $6 billion borrowed in 2015 after Sandy
- Net debt decrease in 2017 is due to the unprecedented cancellation of $16 billion in debt by Congress. The cancellation allowed claims to be paid for Hurricanes Harvey, Irma, and Maria
- As of November 2017, NFIP debt was $20.525 billion compared to the authorized borrowing limit of $30.425 billion.

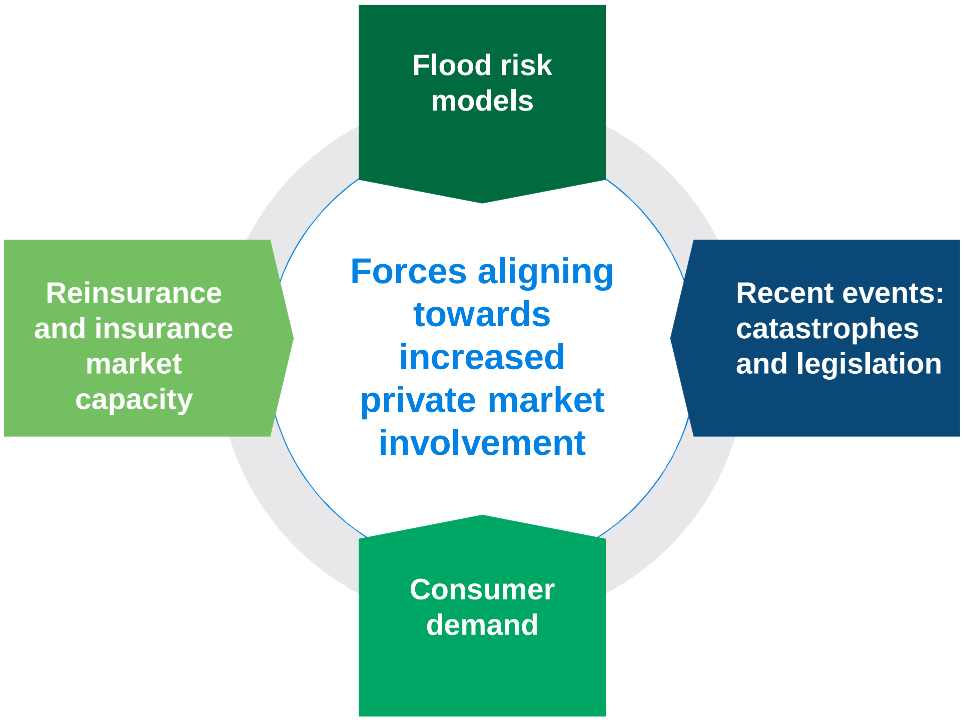
Estimated percent uninsured during recent loss events

Between 60% and 99% of those affected by five recent catastrophes did not have flood insurance.



Source: www.Artemis.bm, www.ClaimsJournal.com, www.usatoday.com, www.wsj.com,
NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2018). www.ncdc.noaa.gov/billions/

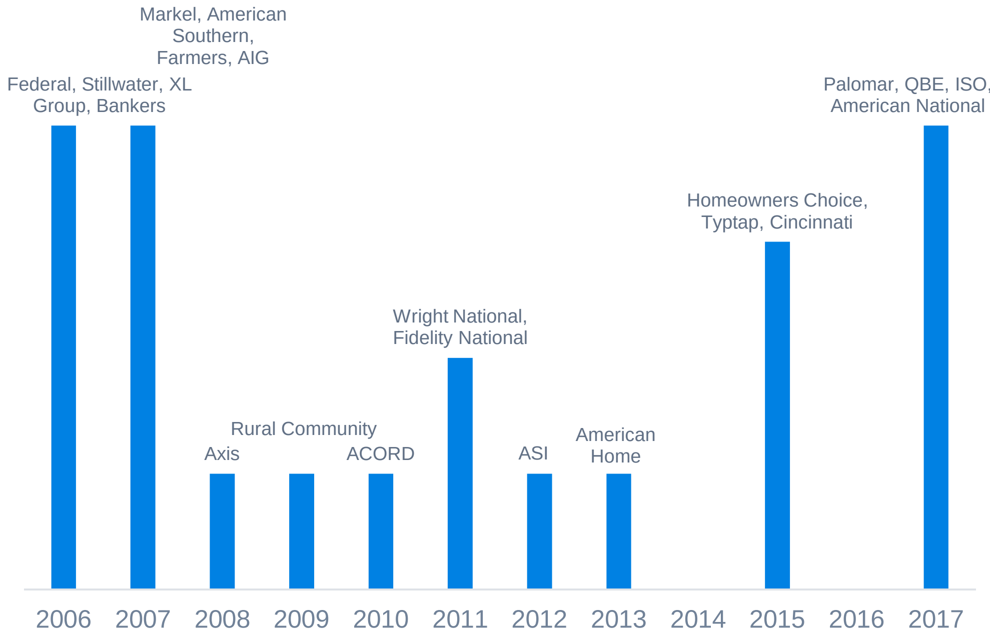
Why would primary insurance companies consider offering flood insurance?



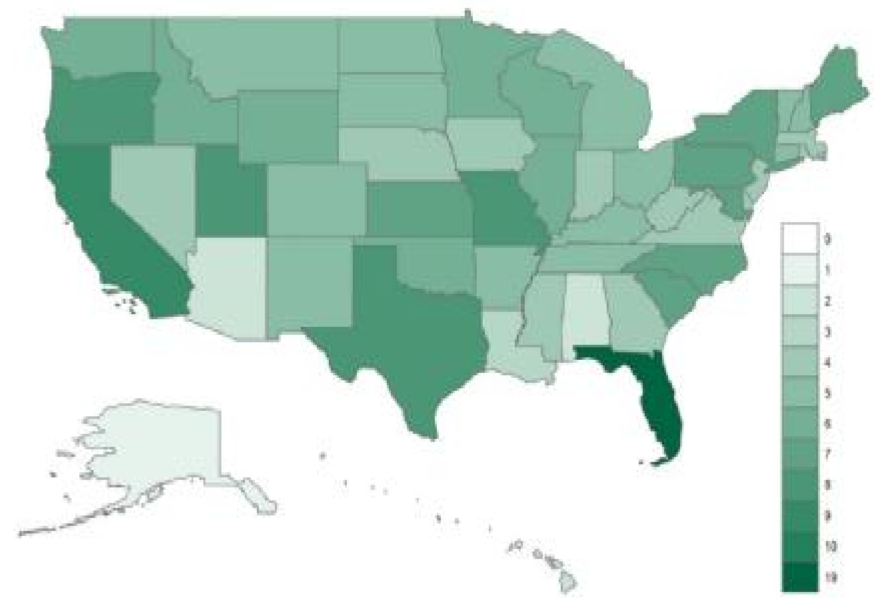
Private flood growth

Entrants to the private flood market have increased in recent years; highest activity in Florida

Private Standalone Flood Program Launches



Number of Private Standalone Flood Programs by State (2017)



Source: SNL.com; excludes non-admitted and endorsement programs

Current Florida flood programs

As of March 2018

Standalone

- American Home
- American Security (lender placed)
- Federal
- Homeowners Choice
- TypTap
- Lloyds Underwriters (surplus lines)
- Voyager Indemnity (surplus lines)

Endorsement

- AIG Property Casualty
- American Integrity
- ASI
- Centauri
- Florida Peninsula/Edison
- Homeowners Choice
- Progressive Property
- Safe Harbor*
- Southern Oak
- Tower Hill/Omega*
- Universal North America
- U.S. Coastal*
- Weston

Excess of NFIP

- American Home
- American Security (lender placed)
- ASI
- Bankers
- Federal
- Markel
- PURE
- Wright National

* Proprietary rates. All others based on NFIP or simplified rating structure.

Rapid Private Flood Growth in 2017

Private Flood written premiums grew over 50% in 2017, up to $624 million

State	Private Written Premiums (Millions)		2017 to 2016	
	2016	2017	% Change	$ Change
Florida	47.8	84.5	77%	36.7
California	48.8	72.0	48%	23.2
Texas	31.8	53.5	68%	21.7
New York	27.4	47.7	74%	20.3
New Jersey	17	28.9	70%	11.9
Pennsylvania	13.2	18.8	42%	5.6
Louisiana	11.5	17.9	56%	6.4
Massachusetts	9	15.3	70%	6.3
Ohio	5.6	14.2	154%	8.6
Illinois	9.8	14.0	43%	4.2

.Source: Insurance Journal. Originally reported by S&P Global

FEMA and NFIP reform

- FEMA aims to facilitate an expanded private insurance market to help insureds recover from disaster.
- In 2017, FEMA selected Milliman to design and roll out the redesign to all geographies and policy forms of the NFIP.
- With Risk Rating 2.0, FEMA will now employ innovative new rating techniques that will allow the agency and the private market to better understand and price flood risk on a granular level nationwide.

“To say it plainly: We need both the NFIP and an expanded private market if we want to markedly increase flood insurance coverage for the nation. ***FEMA recognizes the growing interest among private insurers to offer flood insurance*** *protection. And we’re fine with that. Because an insured survivor – regardless of how they purchase their coverage – will recover more quickly and fully.”*

– Roy Wright, FEMA Deputy Associate Administrator for Insurance and Mitigation

Source: Roy Wright’s Prepared Keynote Remarks: National Flood Conference 2017 – May 1st, 2017

Use of Catastrophe Models

Using models vs. historical experience

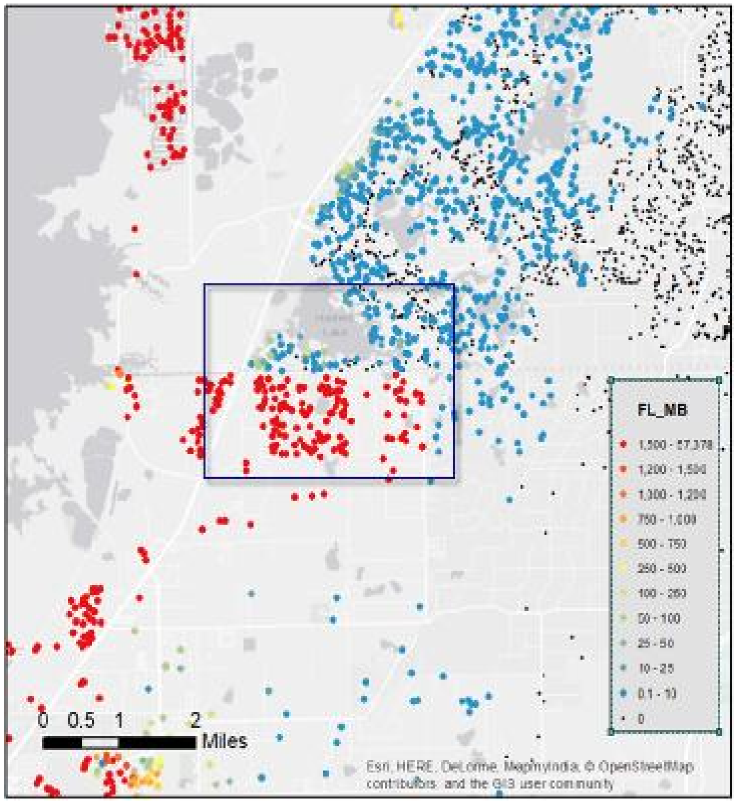
For catastrophic exposures, historical experience may not be sufficient to measure future risk

- Estimate of frequency depends almost entirely on selection of experience period
- Inclusion/exclusion of one large event can significantly change the estimated amount of risk.
- There is potential for major events that have not yet occurred
- Over a long historical period, many factors (e.g., building codes and enforcement, risk concentration, housing costs, insurance coverage) may have changed which impact future losses.

The catastrophic nature of flood requires assessing potential losses beyond past results.

- Considerable risk exists in areas with no available historical insured losses
- Special Flood Hazard Areas are benchmarked to the 100-year flood, yet the NFIP has only been operating about 50 years
- Many properties are not exposed to perceived 100-year floods, but less probable floods (such as 500-year) could cause considerable damage

Reliance on one cat model



- Flood models are less mature than those for other perils
  - There are currently substantial differences among the models
  - Model results should be assessed for reasonability both in aggregate and at the location level
- Does the model you are using
  - Have discontinuities?
  - Have many AALs that are zero (or nearly zero)?
  - Produce results that are illogical (e.g. very low in high risk areas or very high in low risk areas)?
  - Have (or not have) secondary modifiers that reflect important risk characteristics?
  - Include all the subperils that you think are important?
- Model comparisons can help identify outliers

Model blending example

Does blending solve issues of discontinuities and extreme values?

Beach House

Model A	Model B	Model C
$1,000	$30	$20,000

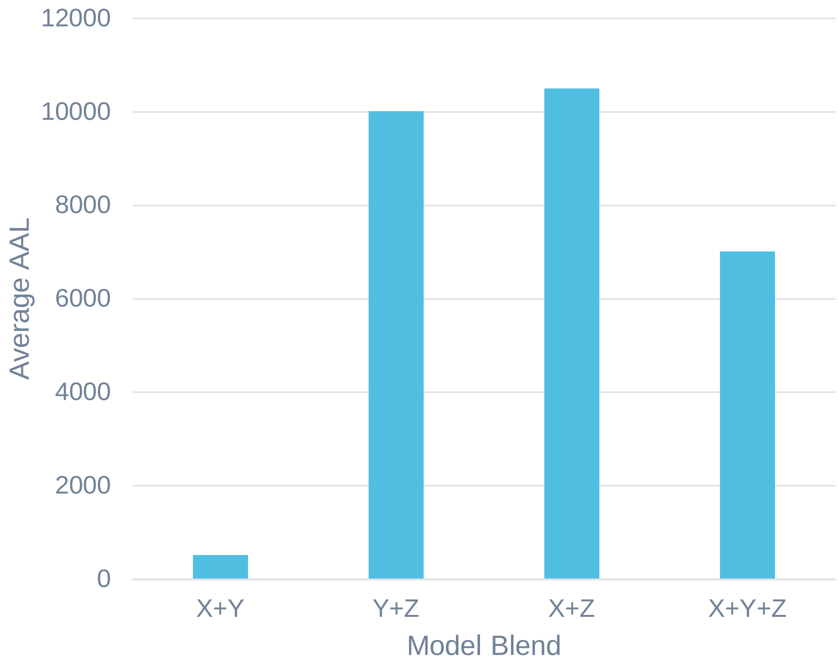
Inland Property

Model A	Model B	Model C
$1,500	$3	$30

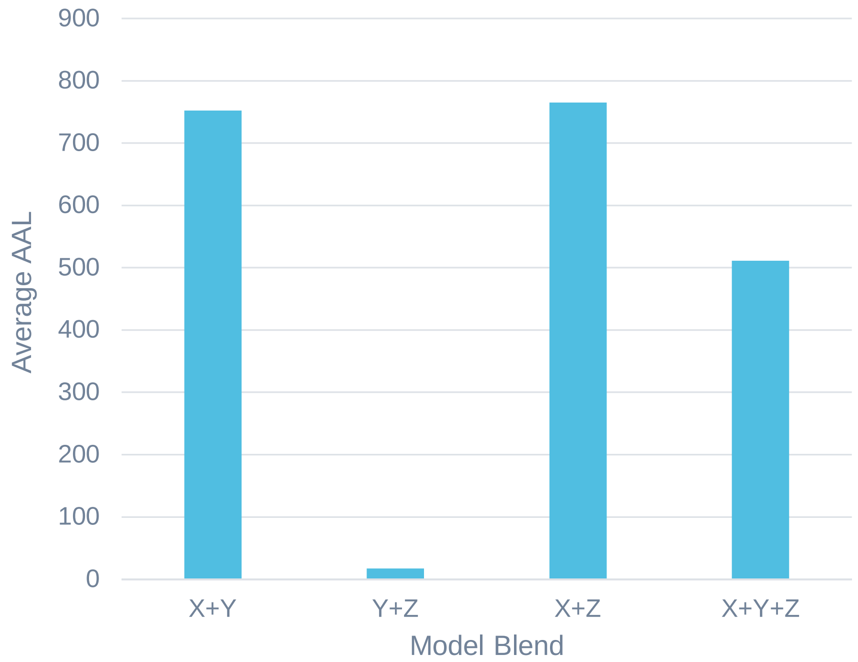
Blending can help, but still has limitations

An outlier has a large impact on the average

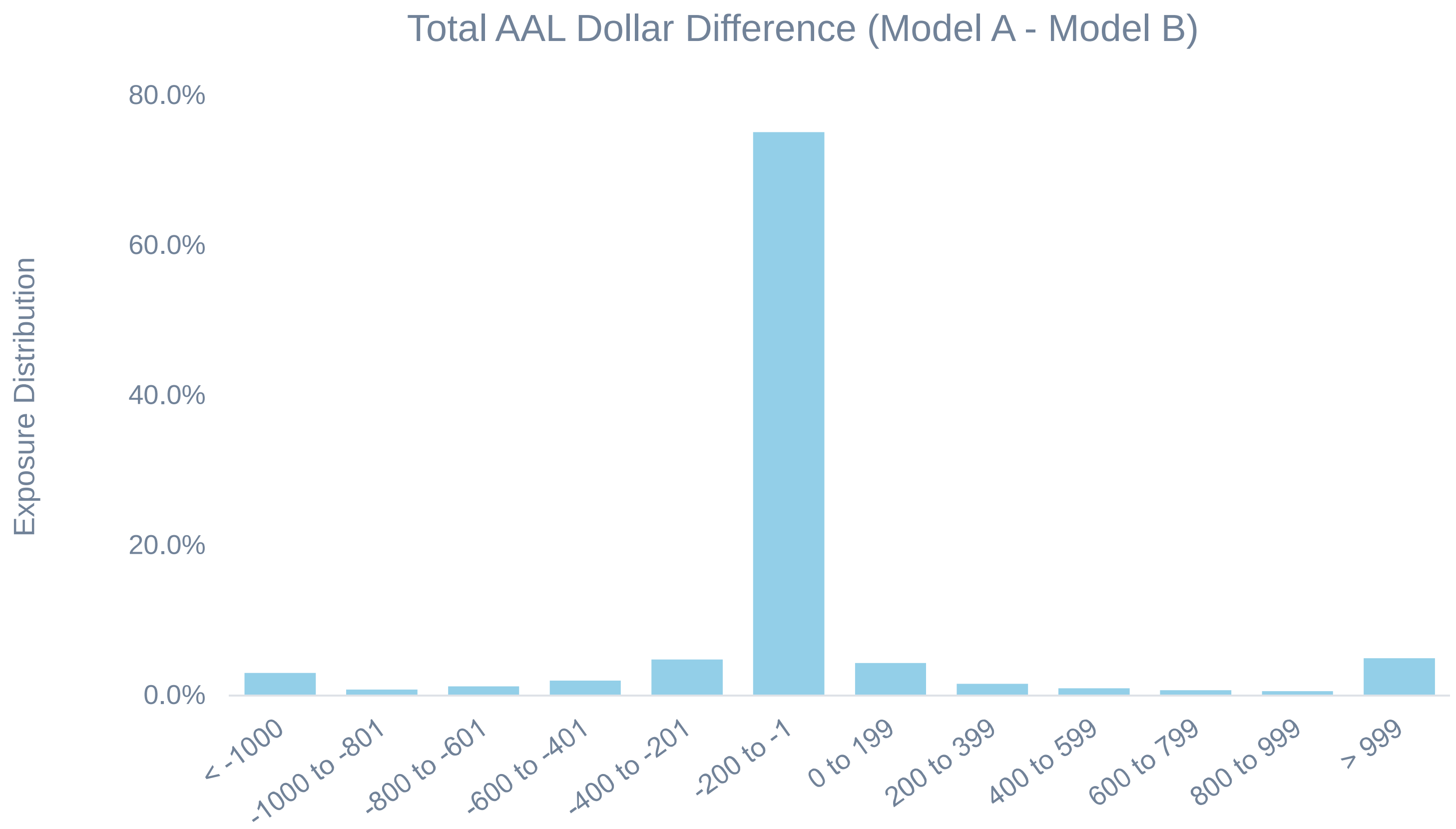
Beach House



Inland Property

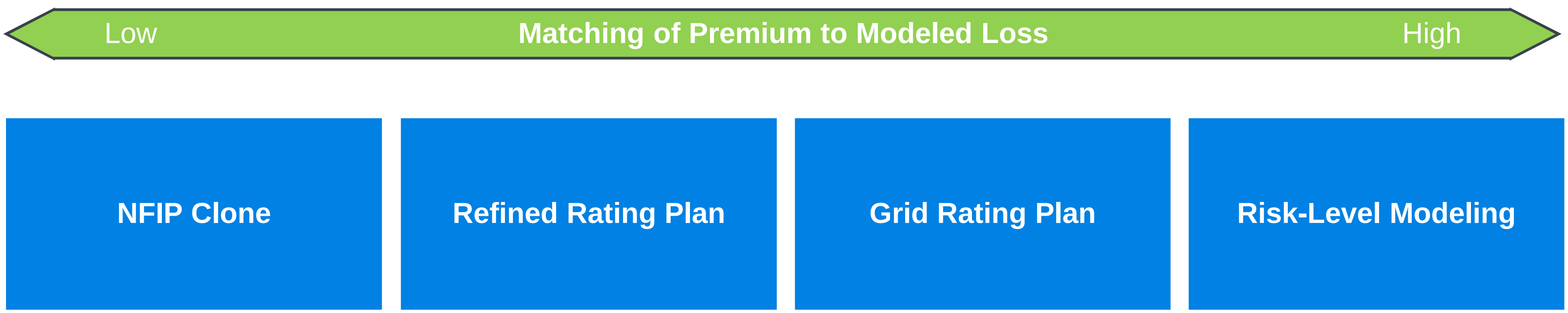


Model Comparison – Total AAL Dollar Difference



Flood Pricing Structures

Flood pricing structures



Risk-level modeling

- Cat model is run on every risk to derive annual average loss (AAL)
- Loss is loaded for reinsurance, expense, and profit to derive premium

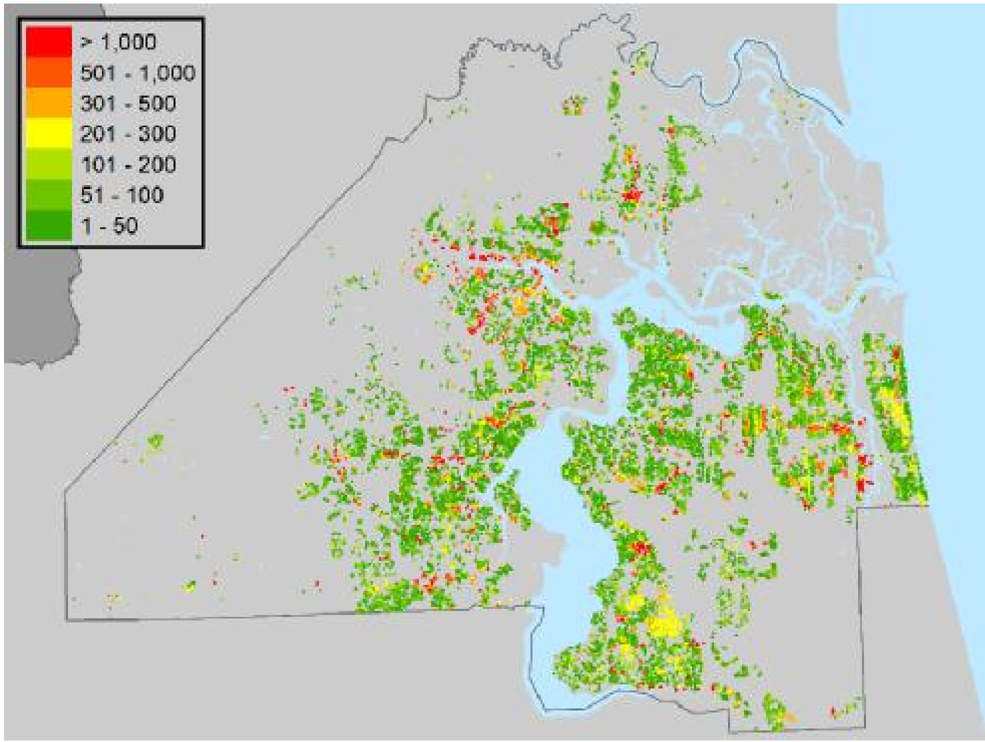
Advantages

- Low requirements and time to develop
- Matches premium to modeled loss
- Large market of profitable risks

Disadvantages

- Requires cat model call at quote
- Limited transparency for agents, regulators, and internal stakeholders
- Difficult to control pricing strategy
- Discontinuities and extreme values
- Reliance on one cat model

Duval County Inland Flood Base Rates



Milliman

Risk-level modeling – example algorithm

Modeled AAL

x (1 + LAE / Loss Load)

x (1 + Reinsurance / Loss Load)

/ (1 – Expense Ratio – Profit Load)

= Calculated Premium

Coverage A

x Minimum Rate per $1,000 of Coverage A

= Minimum Premium

Final Premium = greater of Calculated Premium and Minimum Premium

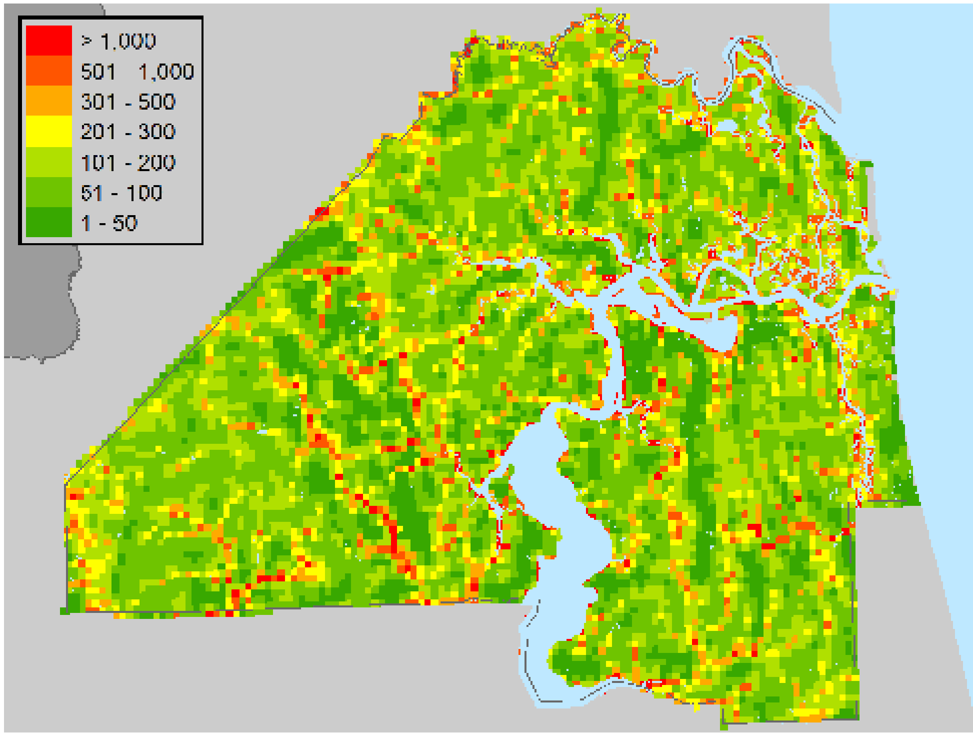
What you need for risk level modeling

- Cat models for storm surge and/or inland flood, depending on underwriting rules
- Expense and profit assumptions
- Underwriting rules and process
- IT setup allowing cat model(s) to be pinged in real time

Grid rating plan

- Precompiled approach to all geographical characteristics from risk-level modeling
- Grids typically based on latitude and longitude, but could use other features such as census block
- Rates for each grid use base risk cat model results to determine geographic component of rate
- Utilizes separate factors for building characteristics and policy terms
  - Number of Stories
  - Amount of Insurance
  - Insurance to Value
  - Deductible
  - Presence of Basement
  - First Floor Height
  - Construction
  - Year Built

Duval County Inland Flood Base Rates



Grid rating plan

Advantages

- Can be similar to risk-level modeling without having to call a cat model at quote
- Large market of profitable risks
- Easier regulatory approval than risk-level modeling
- Can control pricing strategy around building characteristics

Disadvantages

- Maintenance of base rates can be difficult
  - At 10 meter resolution (100 square meters), Florida has over 1.7 billion grids.
  - At 30 meter resolution (900 square meters), Florida has over 180 million grids.
- Lower resolutions can be used, but premium will diverge from modeled loss as resolution decreases
  - There are about 454,000 census blocks over land in Florida.
  - The median size is over 21,000 square meters. Average size is over 312,000 square meters.
- Similar issues to risk-level modeling regarding:
  - Limited transparency for agents, regulators, and internal stakeholders
  - Difficult to control geographic pricing strategy
  - Discontinuities and extreme values

Grid rating plan – example algorithm

<u>Storm Surge</u>

Territory Base Rate
x Number of Stories
x Foundation Type
x Limit
x Deductible Factor
= Storm Surge Premium

<u>Inland Flood</u>

Territory Base Rate
x Number of Stories
x Foundation Type
x Limit
x Deductible Factor
= Inland Flood Premium

Total Flood = Storm Surge + Inland Flood

What you need for a grid rating plan

- Market basket or portfolio of exposures
- Cat models for storm surge and/or inland flood, depending on underwriting rules
- Predictive modeling capabilities for building characteristics and policy terms
- Expense and profit assumptions
- Underwriting rules and process
- IT setup allowing lookups on large tables or access to GIS lookups in real time

Refined rating plan

- Complete rating plan with unique territories, rating factors, and algorithm
- Reflects geographical and building characteristics that relate to flood risk

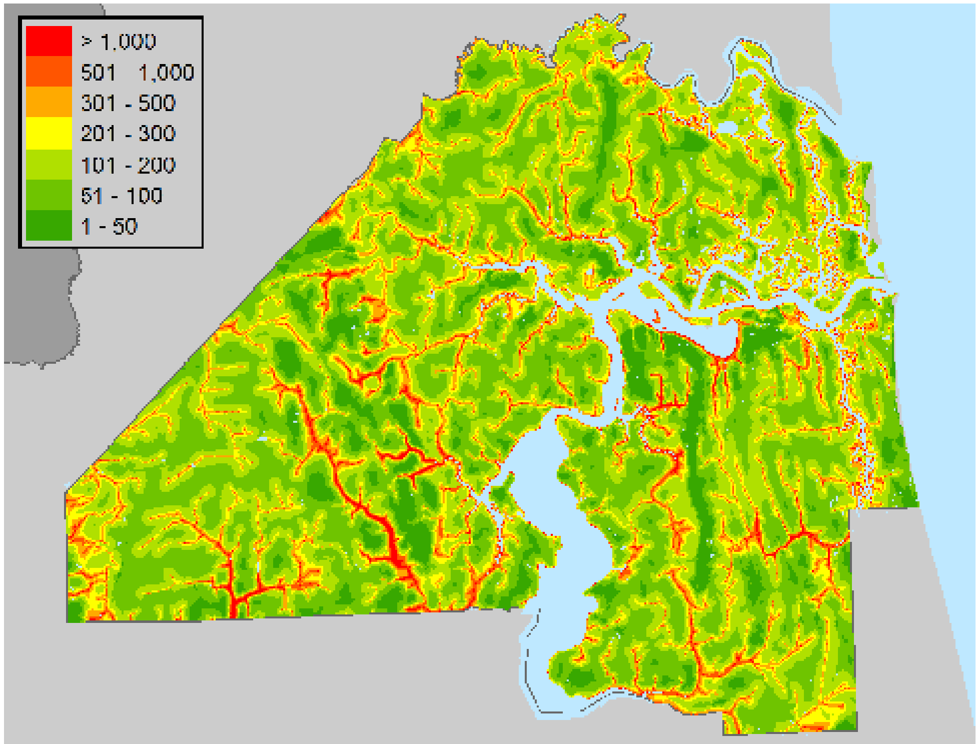
Advantages

- Easy to explain to agents and regulators
- Easiest method to compare and use multiple catastrophe models
- Can control pricing strategy
- Fewer discontinuities and extreme values
- Large market of profitable risks

Disadvantages

- High development time required to ensure rating plan is an accurate estimate of modeled loss
- Requires significant Geographic Information Systems (GIS) expertise

Duval County Inland Flood Base Rates

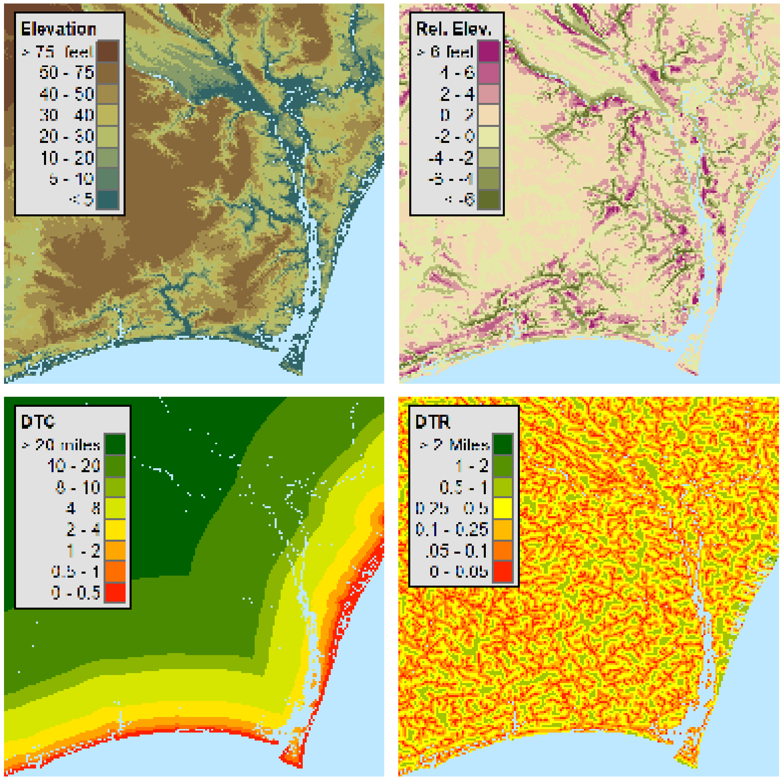


Milliman

Refined rating geographic variables

Flood Risk Factors

- Elevation
- Relative elevation (elevation relative to nearby elevation)
- Distance to coast
- Distance to river / stream
- Size of river / stream
- Hydrological units / watersheds
- Slope
- Curvature
- Flood protection and levees



Milliman

Refined rating plan - typical algorithm

Storm Surge

Territory Base Rate
x Elevation
x Distance to Coast
x Number of Stories
x Foundation Type
x Limit
x Deductible Factor
= Storm Surge Premium

Inland Flood

Territory Base Rate
x Relative Elevation
x Distance to River
x Number of Stories
x Foundation Type
x Limit
x Deductible Factor
= Inland Flood Premium

Total Flood = Storm Surge + Inland Flood

What you need for a refined rating plan

- Market basket or portfolio of exposures
- Cat models for storm surge and/or inland flood, depending on underwriting rules
- **GIS data for coastline, elevation, etc.**
- **Predictive modeling expertise**
- Expense and profit assumptions
- Underwriting rules and process
- **IT setup allowing access to GIS lookups in real time**

NFIP clone

- § Rates and territories follow NFIP
- § Underwriting used to avoid unprofitable areas

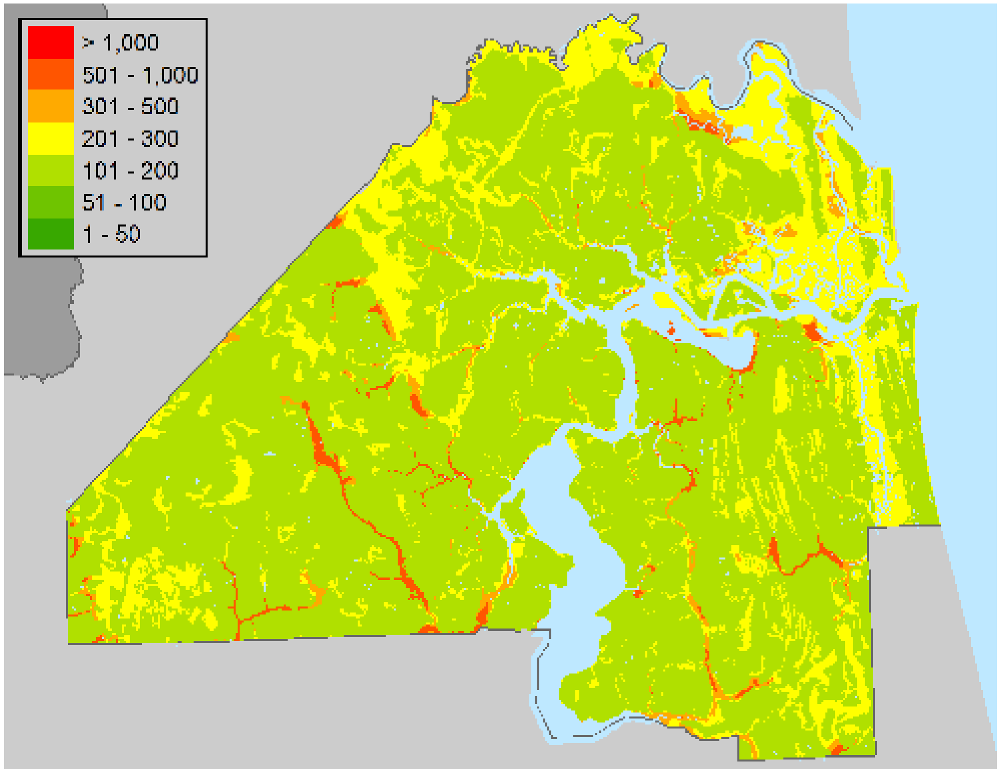
Advantages

- § Low requirements and time to develop
- § Easy to explain to agents and regulators
- § Faster IT implementation time

Disadvantages

- § Limited market of profitable risks
- § Limited rate differentiation, especially outside of Special Flood Hazard Area (SFHA)
- § Underutilization of technology and advanced analytics
- § Rates may be obsolete once NFIP rolls out refined rate structure

Duval County Inland Flood Base Rates



NFIP clone – example algorithm

Limit in $100s
x Rate per $100 of coverage*
x Deductible Factor
x Elevated Risk Credit
= Total Premium

**Rates may vary based on flood zone, year built (pre-FIRM or post-FIRM) and first floor elevation relative to BFE*

What you need for an NFIP clone

- NFIP rating manual
- Source of NFIP flood zones and BFE at quote
- Expense comparison to NFIP
- Cat models to see where you can write profitably
- Underwriting rules and process

The simpler the rating plan, the more comprehensive the underwriting needs to be

NFIP clone – example underwriting rules

Eligible

- Only X zone
- Only coastal
- Locations based on DTC/elevation/zip
- Locations based on DTR/relative elevation/zip

Ineligible

- If inside the 250-year flood plan
- If filed premiums are less than target premiums calculated using risk-level modeling approach
- If filed premiums are less than target premiums calculated using refined rating plan approach

Comparison of Risk-Level Modeling vs. NFIP Clone:

Florida Example

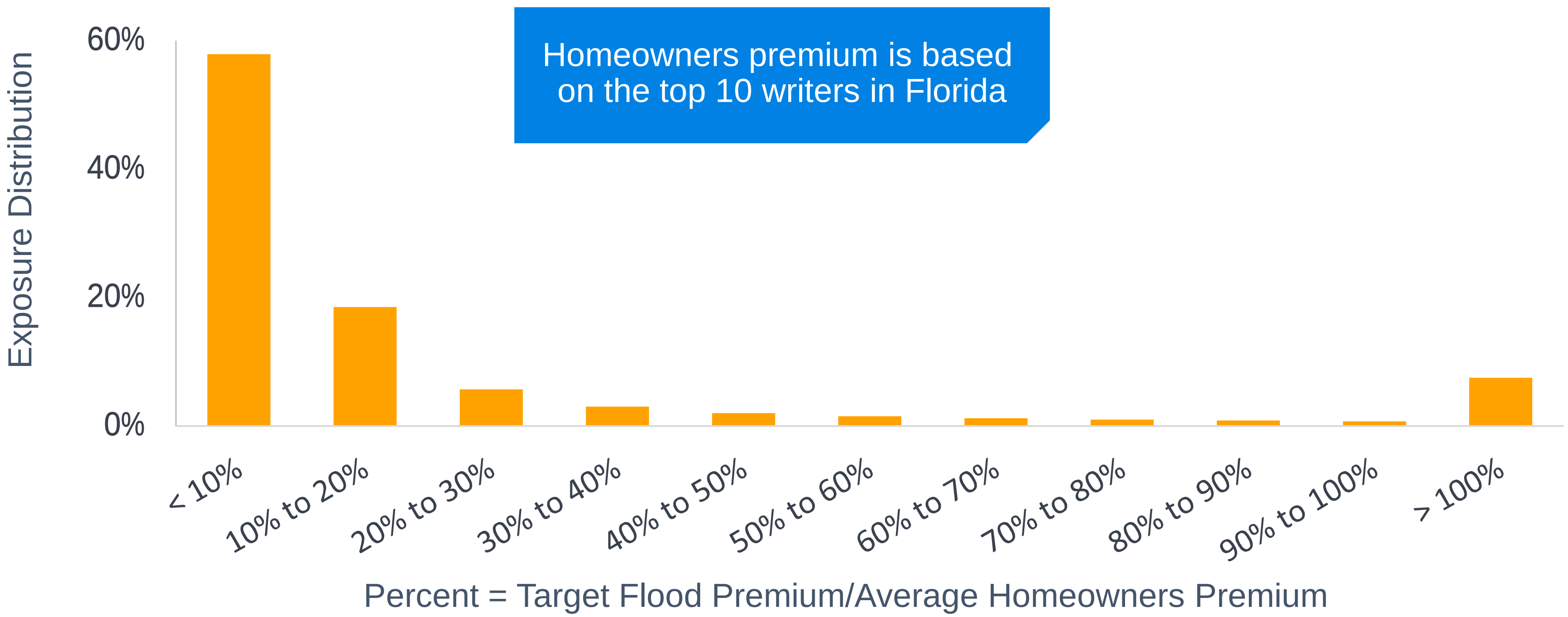
Critical assumptions and data underlying Florida study

- **Market basket** of 400,000 risks representing single family homes in Florida, developed by Milliman based on parcel data and other third-party sources
- **GIS variables** created by Milliman based on data from NOAA and USGS
- **Maximum flood limits** of $250k, consistent with NFIP coverage
- **NFIP rates** current as of October 2017 (most recent available)
- **KatRisk catastrophe model** to estimate inland flood and storm surge losses
- **Target loss ratio** of 35% assumes 65% for expenses, reinsurance and profit
- **$100 minimum premium**, no additional provision for non-modeled losses

This is just an example – the use of different data sources, catastrophe models and target expense assumptions will produce different results.

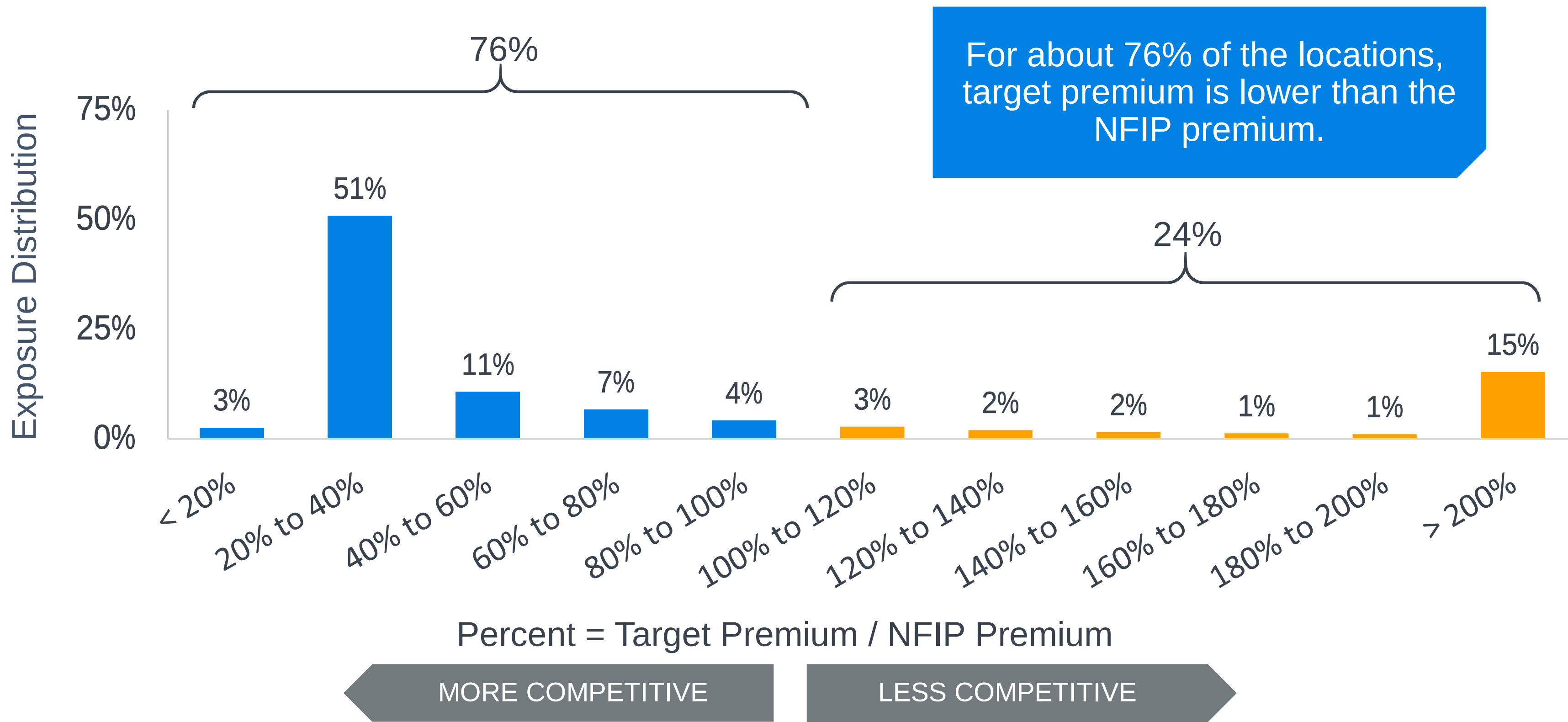
Overall – target flood premium vs. homeowners premium

Target Flood Premium as % of Homeowners



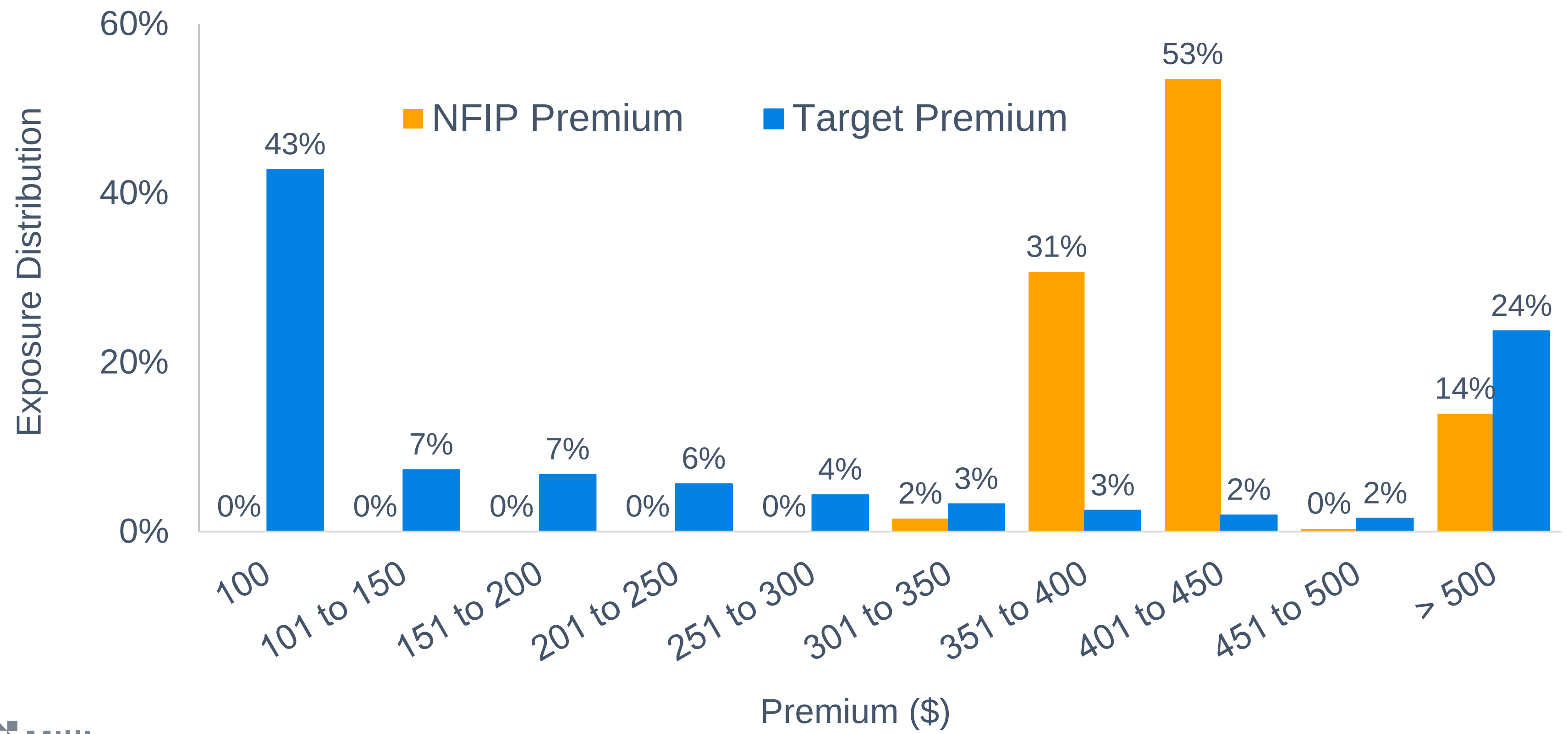
Overall – target flood premium vs. NFIP premium

Target Premium as % of NFIP Statewide Distribution



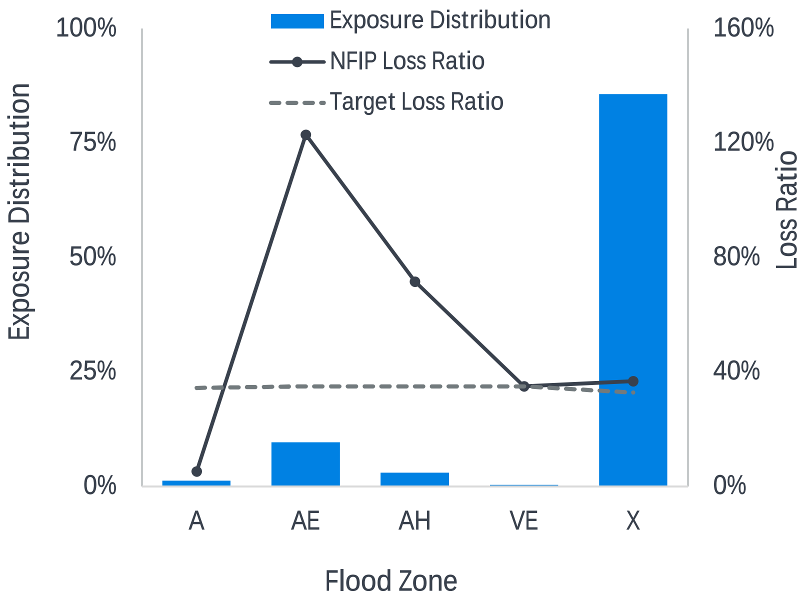
Overall – distribution of target and NFIP premiums

Target vs. NFIP Premium Distribution

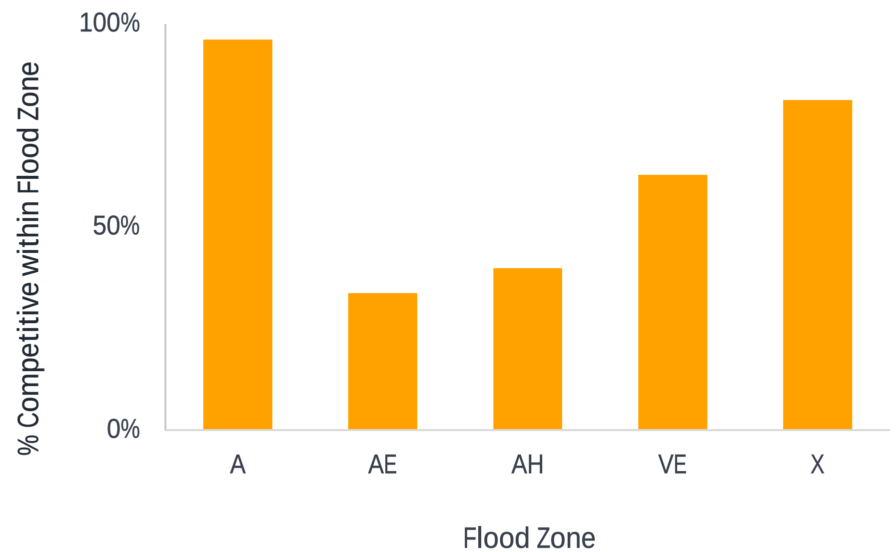


Flood zone

NFIP Modeled Loss Ratios by Flood Zone



Risks with Target Premium Lower than NFIP by Flood Zone



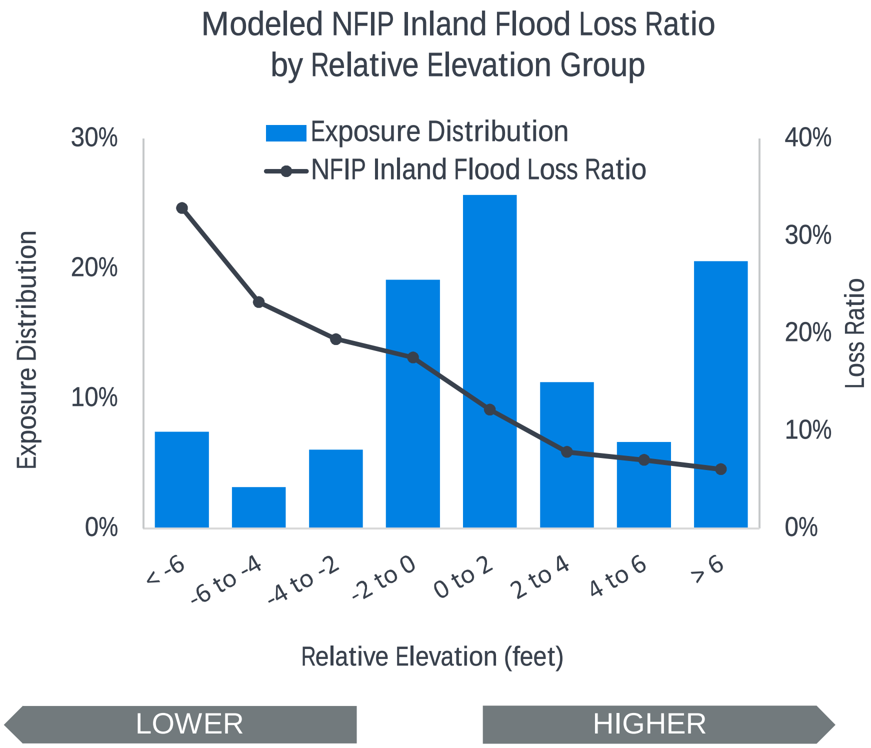
Modeled NFIP loss ratios by segment

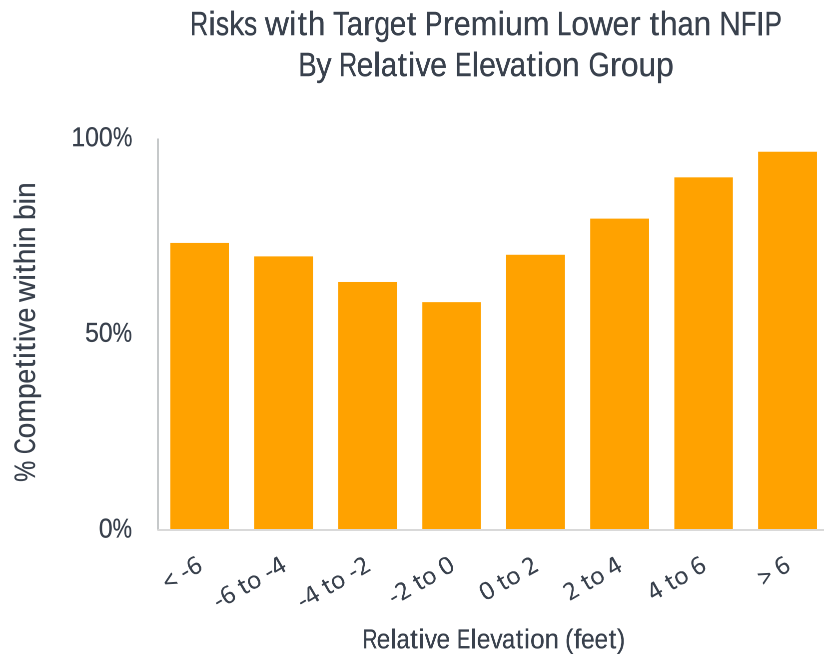
Policies that can be written at less than current NFIP rates can be identified based on several key factors

Segmentation buckets are based on:

- Elevation
- Relative Elevation
- Distance to Coast
- Insurance to Value

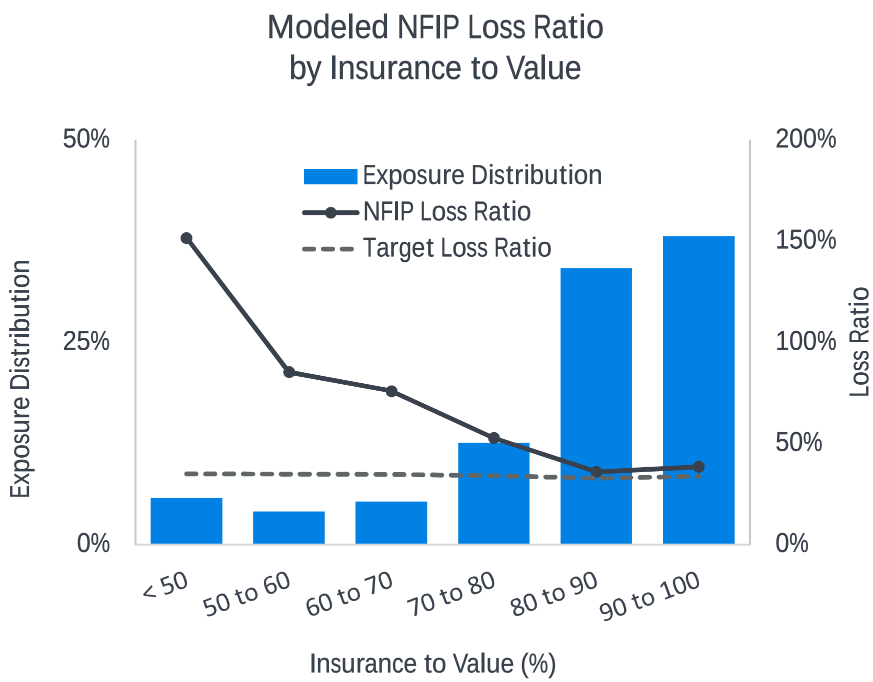
Relative elevation

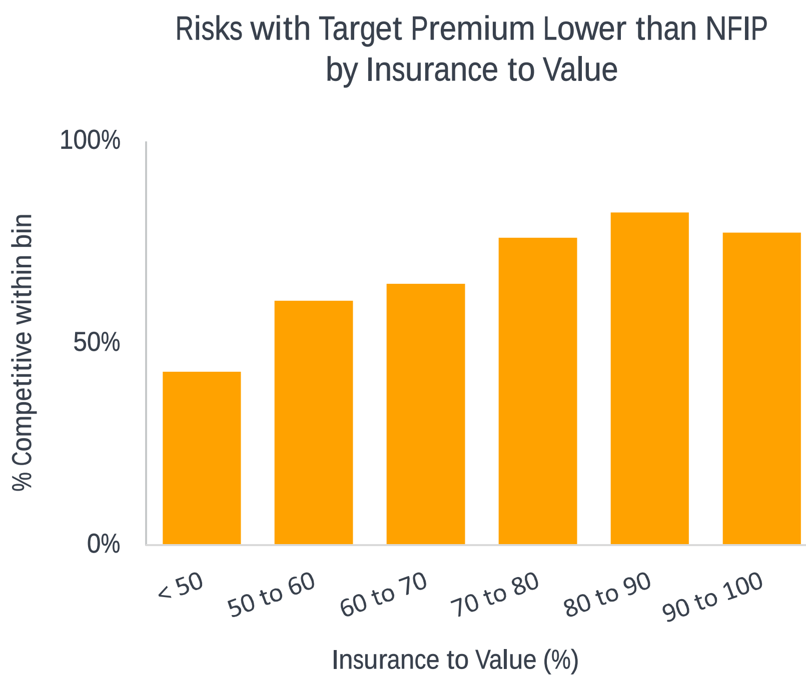




NFIP inland flood loss ratio decreases at higher elevations relative to surrounding areas.

Insurance to value (ITV)





NFIP loss ratio decreases as ITV increases.

Rating Plan Structures:

Duval County Inland Flood Examples

Duval County inland flood example

- Started with the same data and assumptions underlying the study above, only used records for Duval County
- Each model uses property characteristics such as first floor height and number of stories
- Similar to an NFIP clone plan, one model uses flood zone to capture some geographic risk
- Another model developed using a GLM includes both distance to river and relative elevation instead of flood zone, similar to a refined rating plan
- Third model uses 50 meter grids for base rates

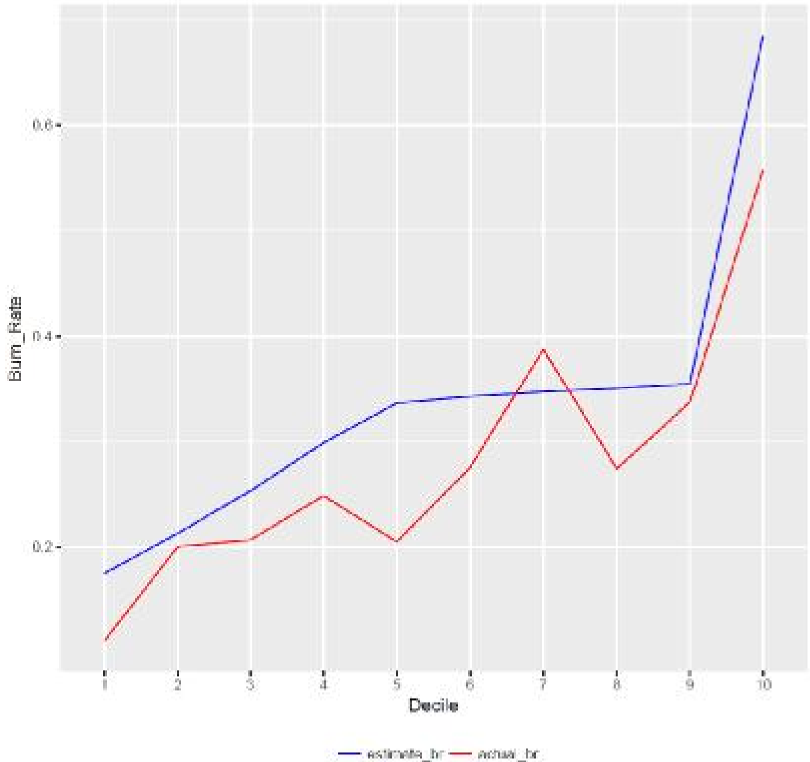
This is a simple example to show the predictive power of using GIS derived variables in a refined rating plan. Many other considerations would be needed to create a robust refined or grid rating plan.

Refined rating plan key considerations

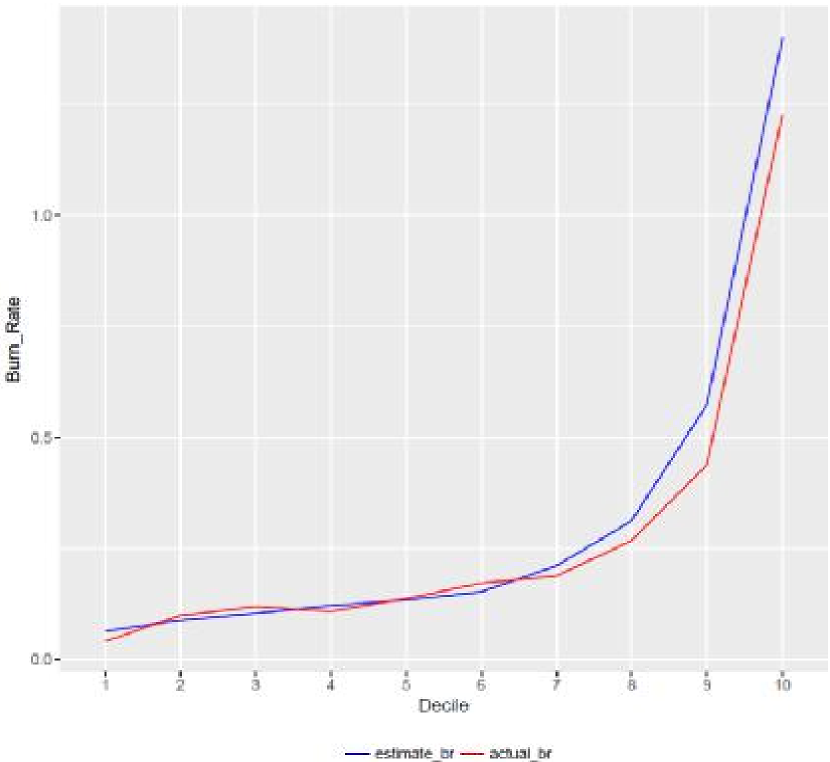
- What GIS variables should be included?
- Do relationships between modeled loss and rating variables vary by geography?
- Correlations between structure and hazard
- Residual analysis is critical
- Balance between transparency and complexity
- Use of multiple catastrophe models is a significant advantage for this structure

Estimated vs. actual burn rates

Even a simple refined rating plan is significantly more predictive than only using flood zone.



Flood zone based plan



Refined rating plan

Milliman

Interactive loss and rate exploration

Site: www.millimanpixel.com

Email: Milliman.Demo.#@outlook.com
Where # is the number you received on your handout.

Password: dde-DM-$123

Access to Duval County losses and premiums shown today is available for 1 week.

Email me at david.d.evans@milliman.com with any questions.

Thank you

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