By-Peril Predictive Modeling for Homeowners

MEASURE, MANAGE, & REDUCE **RISK**SM

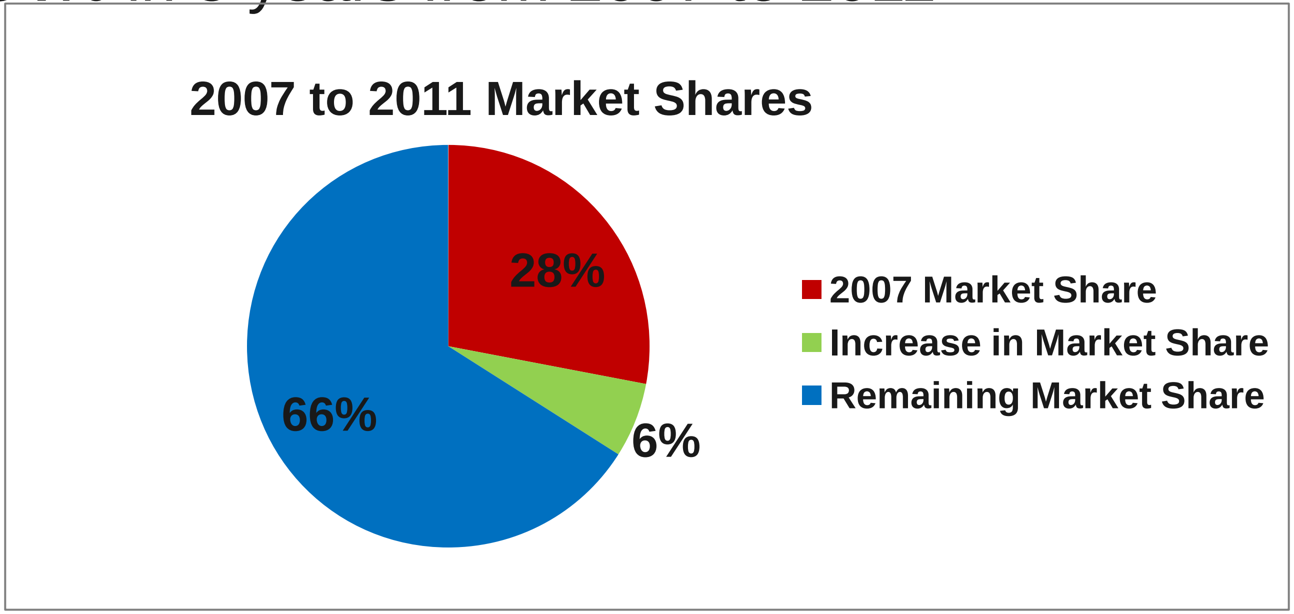
David Cummings
Senior VP – Personal Lines & Analytics

Opportunities in Predictive Modeling

- Lessons from Personal Auto
  - Major innovations in historically static rate plan
  - Increased competition
  - Profitable growth for adopters of advanced analytics
  - Hunger for the next innovation
- In comparison, much less modeling has been done in Homeowners
  - Translates into greater opportunity
  - By peril modeling is an important tool

Leading the Way With By-Peril Rating

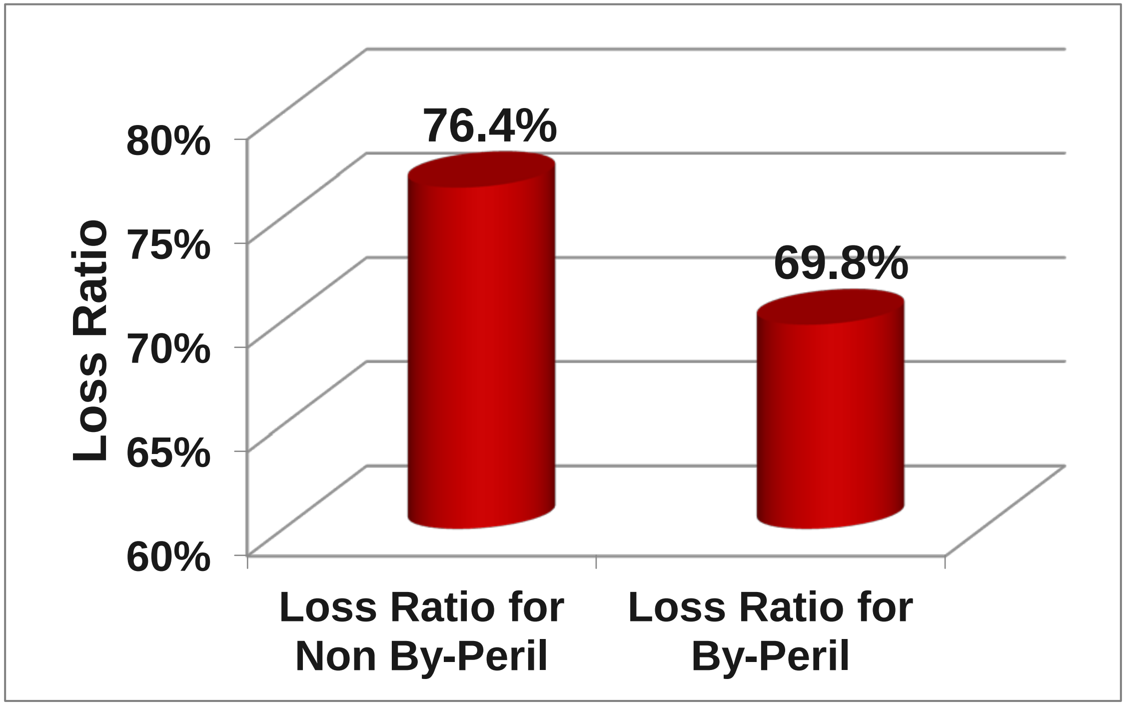
- Market Share Benefits
  - The 25 carriers using by-peril plans in 2011 have increased their combined market share from **28% to 34%** in 5 years from 2007 to 2011



Source: ISO research using Perr & Knight filings and 2007-2011 AM Best Financials

Leading the Way With By-Peril Rating

- **Loss Ratio Benefits**
  - –The 25 companies rating by-peril have loss ratios **6.6** points lower than their competition in 2011



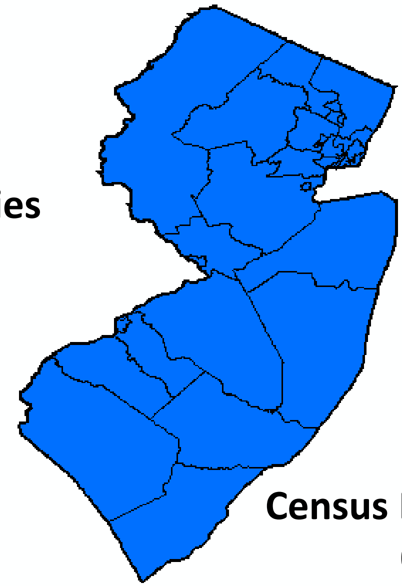
Source: ISO research using Perr & Knight filings and 2007-2011 AM Best Financials

Data Challenges With By-Peril Ratemaking

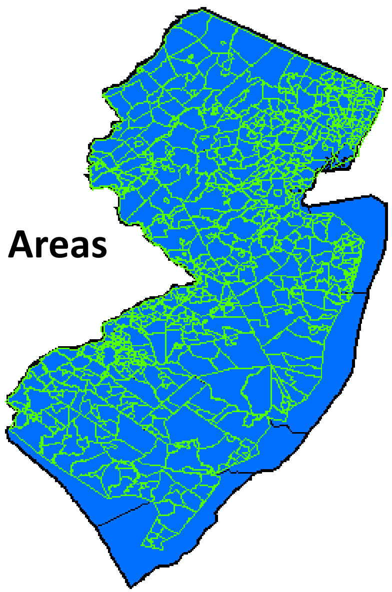
- Accurate by-peril Homeowners models require extensive data resources
  - Low frequency line – split further by peril
  - Severity is volatile and differs significantly by peril
- Level of peril detail available in claim records
  - More detail enables greater model refinement
  - Most carriers have limited detail in historical data

Geographic Refinement

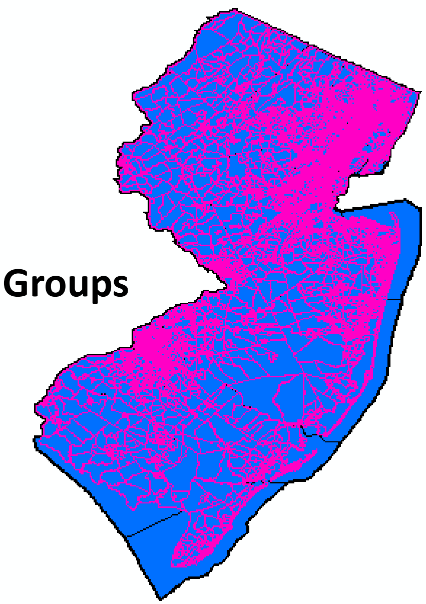
ISO Territories
26

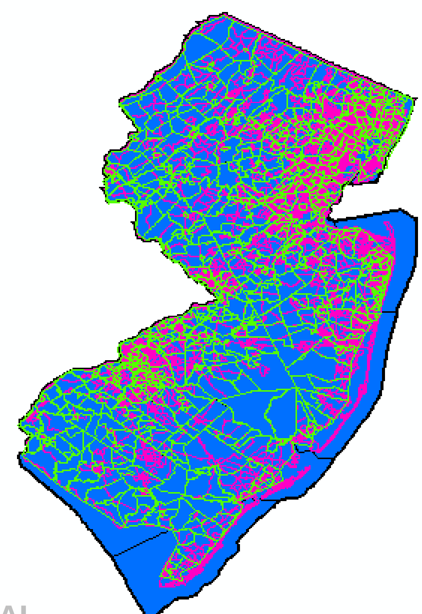


Fire Protection Areas
1,428



Census Block Groups
6,503





Fire Protection Areas &
Census Block Groups
7,042

New Jersey State Boundaries

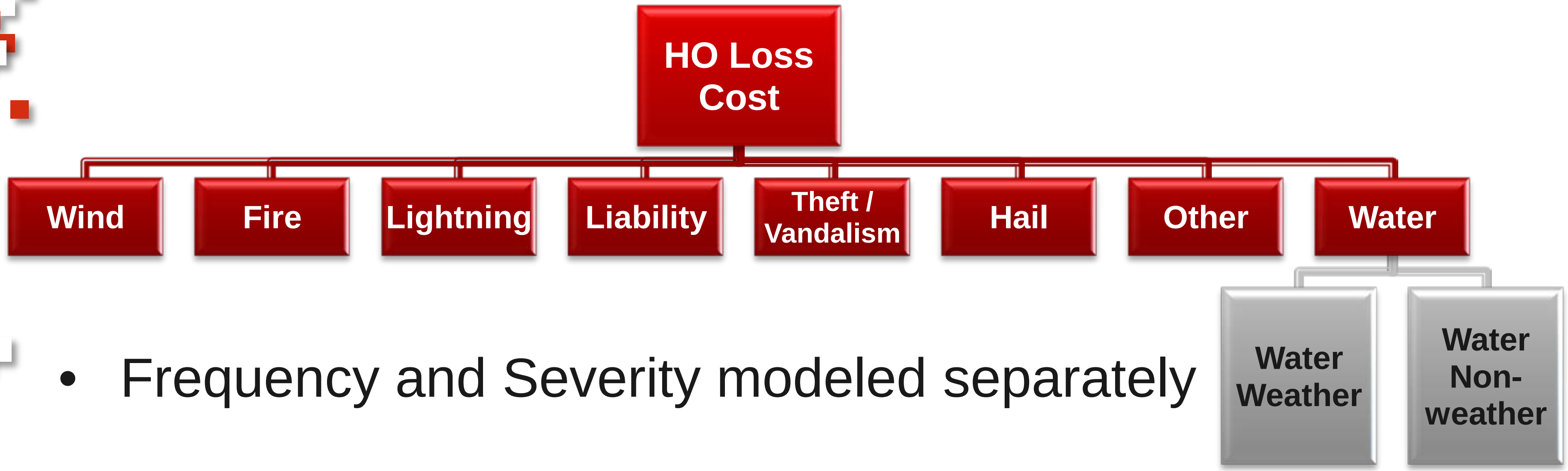
New Jersey ISO Territories

New Jersey Census Block Groups

New Jersey Fire Protection Areas

Features of the Model

- Modeled by peril (excluding hurricane)



- Frequency and Severity modeled separately
- Combine to form ‘all peril loss cost’ – multiplied frequency and severity – added across perils
- Rating factors from Risk Analyzer used to modify the loss costs by peril to account for the effect of amount of insurance, deductible and age of construction.

The Environment is the Exposure

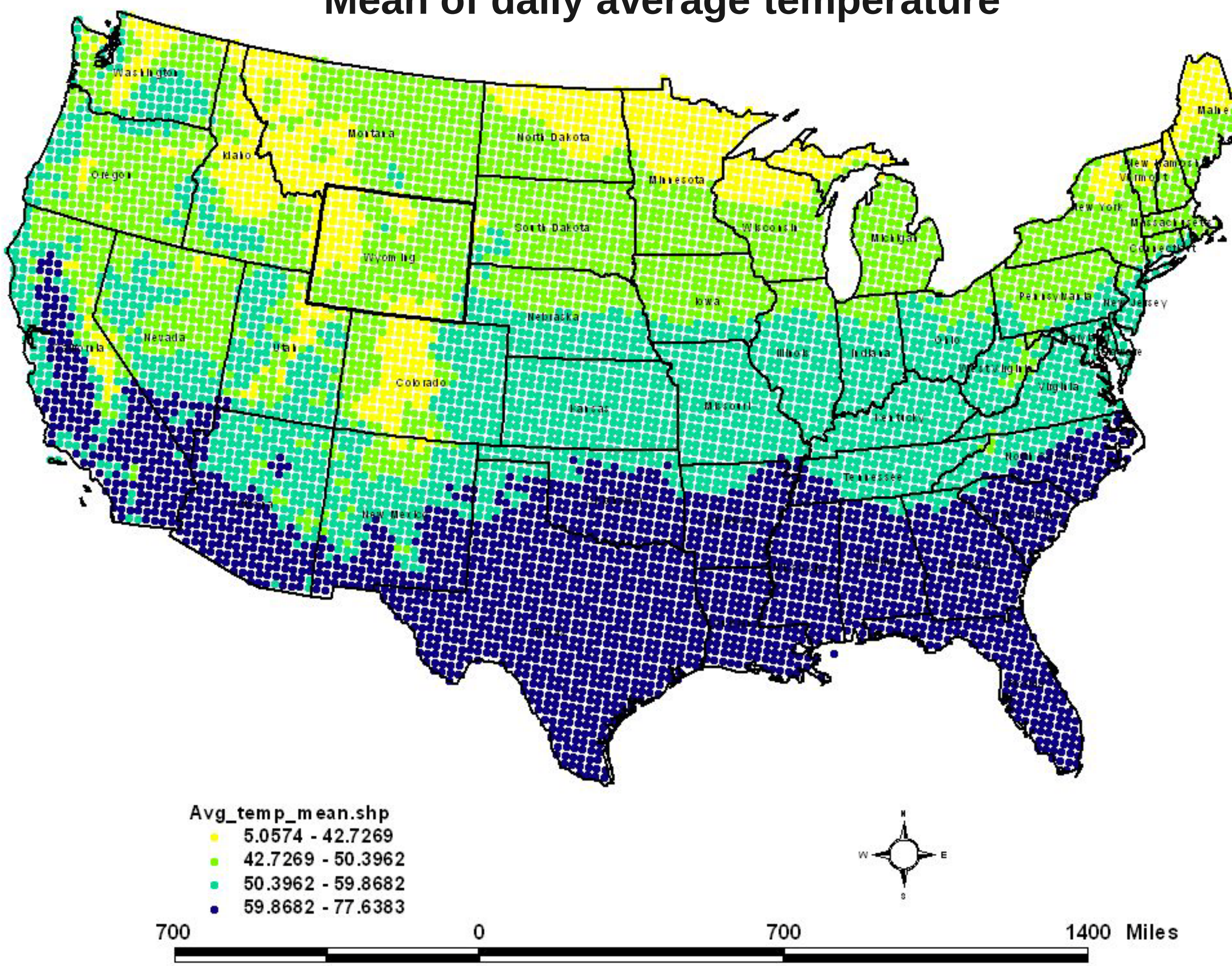
Rating Factors complement the environment predictions

Modeling Techniques Employed

- Variable Selection – univariate analysis, transformations, known relationship to loss
- Sampling
- Regression / general linear modeling
- Sub models/data reduction – splines, principal component analysis, variable clustering
- Spatial Smoothing

External Data – Weather

Mean of daily average temperature



Source:
North America Regional Reanalysis

Length:
27 years of data (1979 -2005)
8 daily readings

Resolution:
32 x 32 km
Interpolated using 4 nearest grid centroids (weights = inverse distance)

2 person-years work

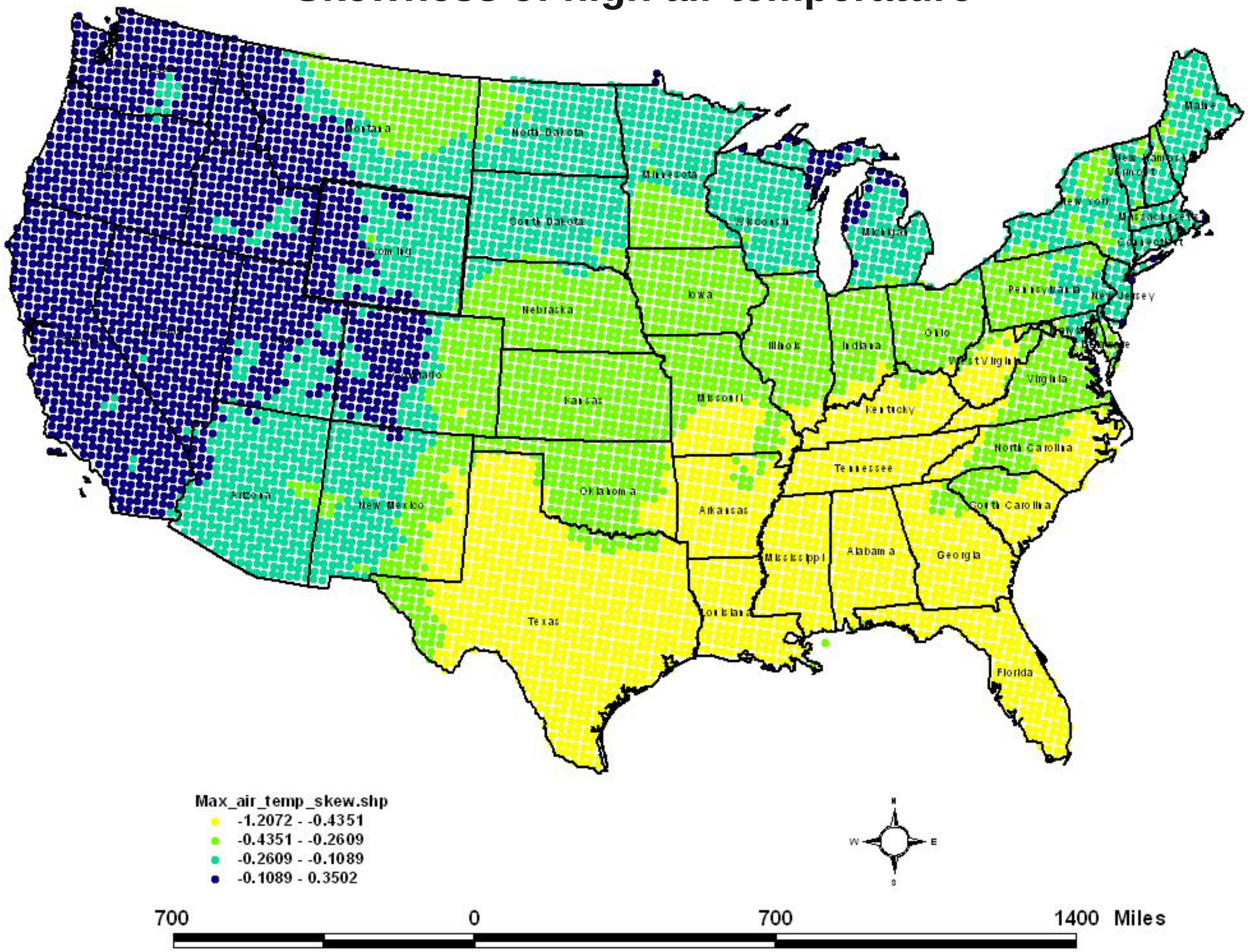
External Data – Weather
Derive Novel Data Features

(Indicators, daily, consecutive days, number of days)

- Temperature
  - Below freezing / High temperatures
  - Variations / Average / min / max / deviation
- Precipitation, Wind and Snow
  - With / Without
  - Average / min / max / deviation
- Interactions
  - Weight of snow (snow + temp)
  - Ice (rain + temp)
  - Fire (no rain, high temp + high wind)
  - Blizzards (snow + wind)

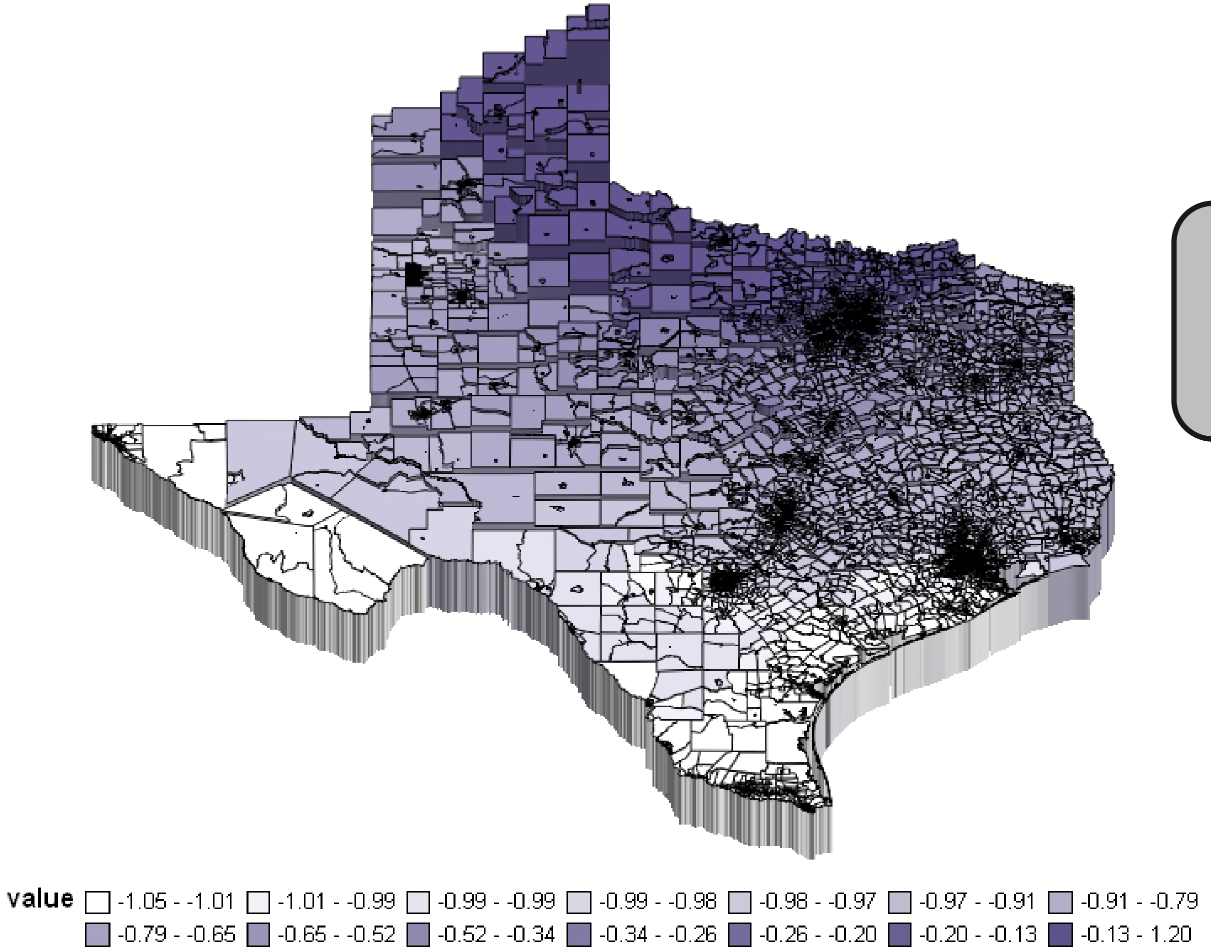
External Data – Weather

Skewness of high air temperature



Visualizing Weather Interactions

% of days with High < 32 and % of days with Low > 72 (Texas)



Positive coefficient in Wind Frequency model

Using SAS/Graph

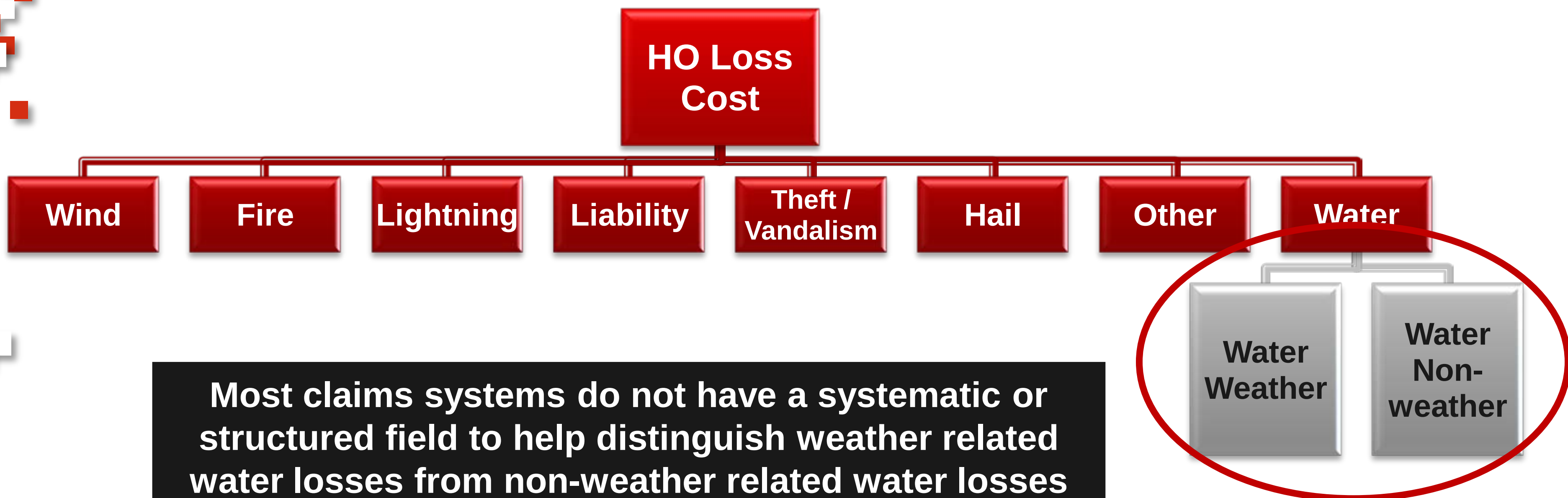
By-Peril Modeling – Serendipitous Discoveries

Weather & Elevation	FIRE	LIGHT	WIND	HAIL	WW	LIAB	THEFT
Elevation	■			■	■		
Temperature	■	■	■	■	■	■	■
Precipitation	■	■	■		■		■
Relative Humidity				■	■	■	
Snow			■	■	■	■	
Wind		■	■	■	■		■
Ice Pellets	■			■	■		

External Validation:

Ellen Cohn. "Weather and Crime". *The British Journal of Criminology* 30:51-64 (1990)

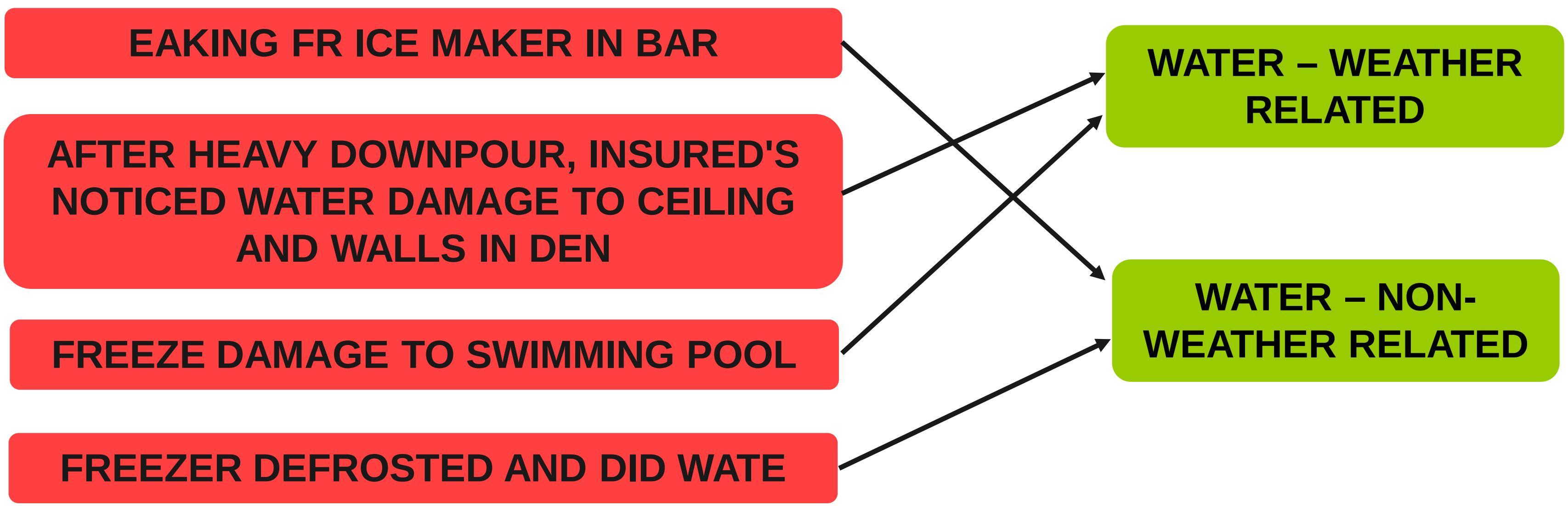
Decomposing Water Losses



Most claims systems do not have a systematic or structured field to help distinguish weather related water losses from non-weather related water losses

Text Mining for Cause-Of-Loss

- Rich information buried in Unstructured data, such as Loss Descriptions or Adjuster Notes
- E.g., Extracting the “Type of Loss” from the Loss Description



Public Protection Class (PPC)

- Derived from detailed review of local fire protection capabilities
- Applies within fire district boundaries, plus considerations of available water supply and fire station distance
- By-Peril Modeling allows PPC to be used differently than current Loss Costs

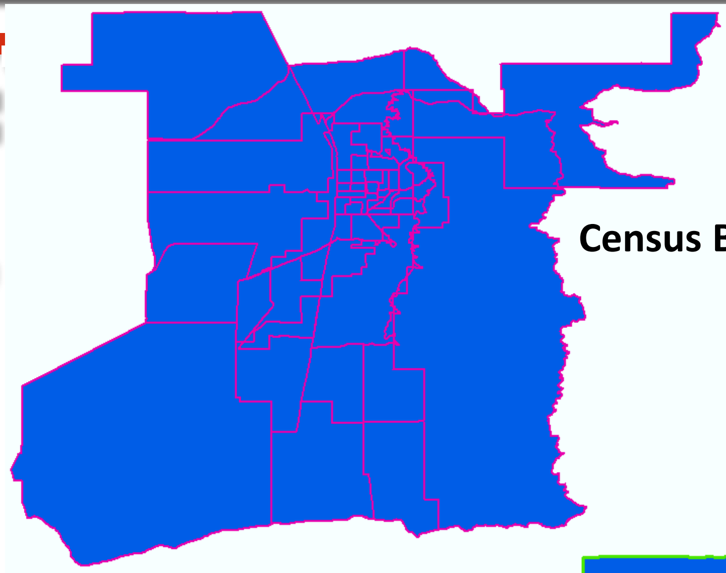
Current ISO Loss Costs

- Single factor applies to all-perils loss cost
- Only geographic refinement below Territory

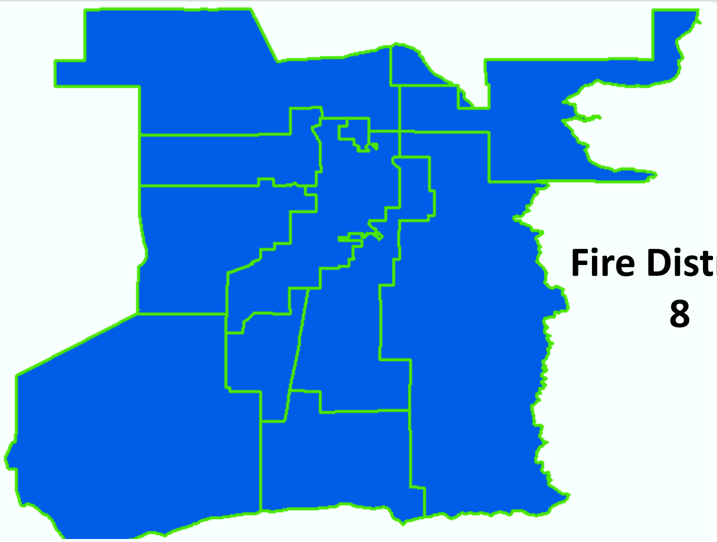
By-Peril Modeling

- Input variable in peril models
- Applies to perils where statistically significant
- Multivariate analysis with other geographic variables

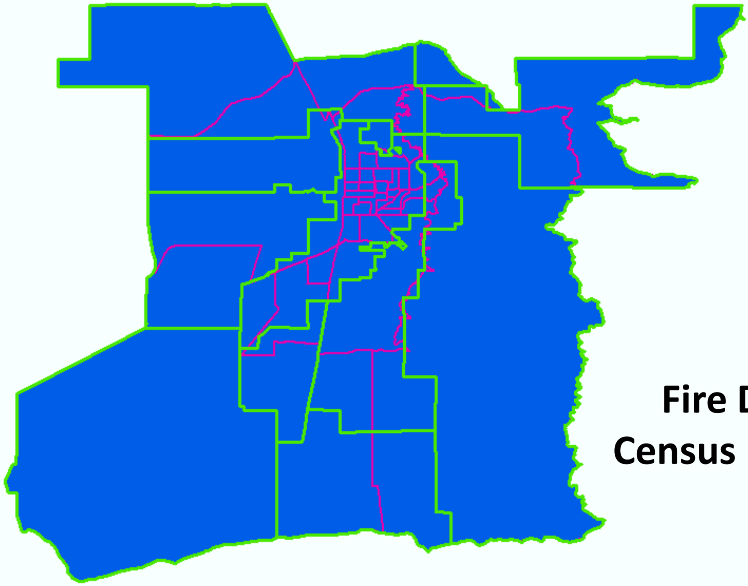
Geographic Units



Census Block Groups
73



Fire Districts
8

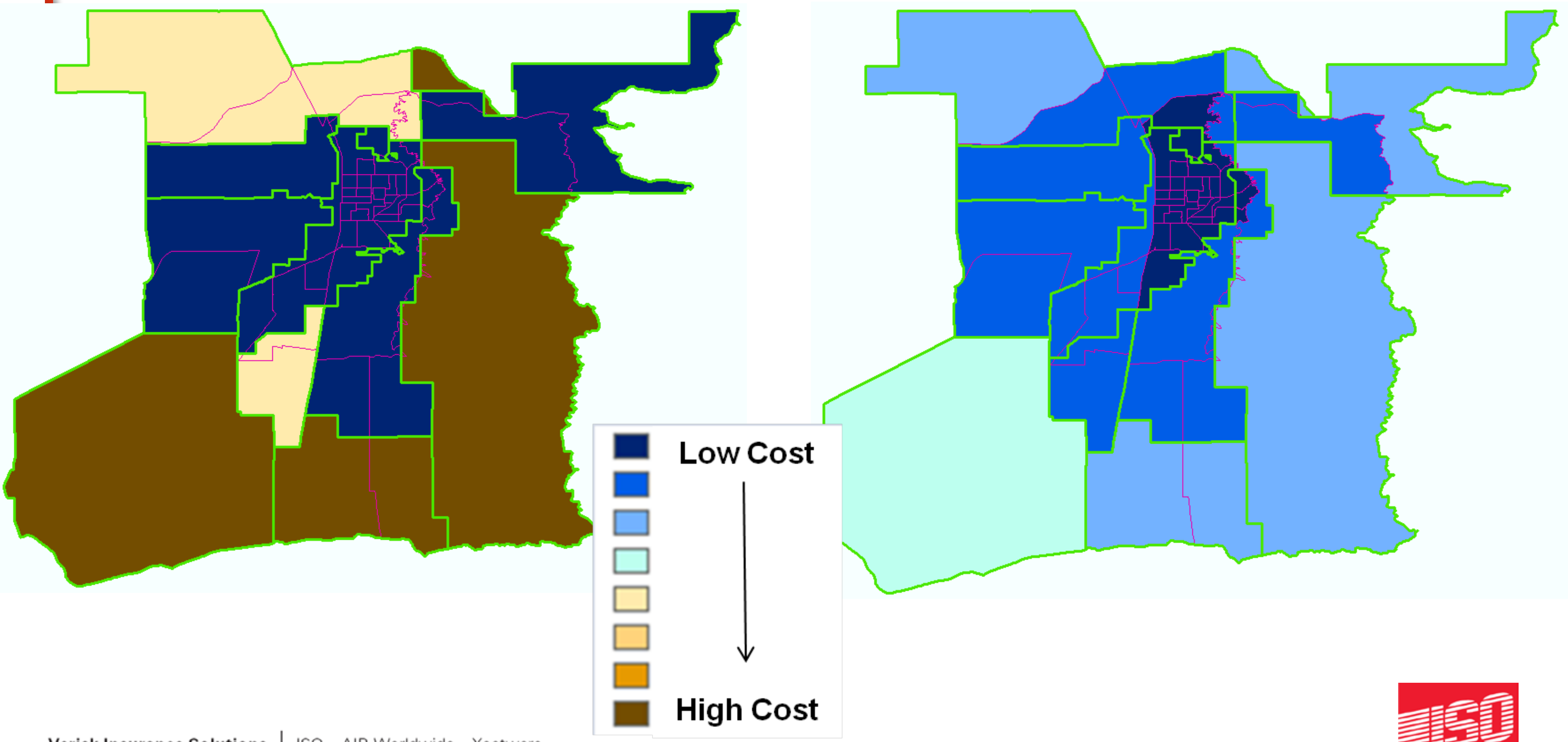


Fire Districts &
Census Block Groups
94

Geographic Units

ISO
TOTAL LOSS COST
WITH PPC

BY-PERIL MODEL
TOTAL LOSS COST
WITH PPC



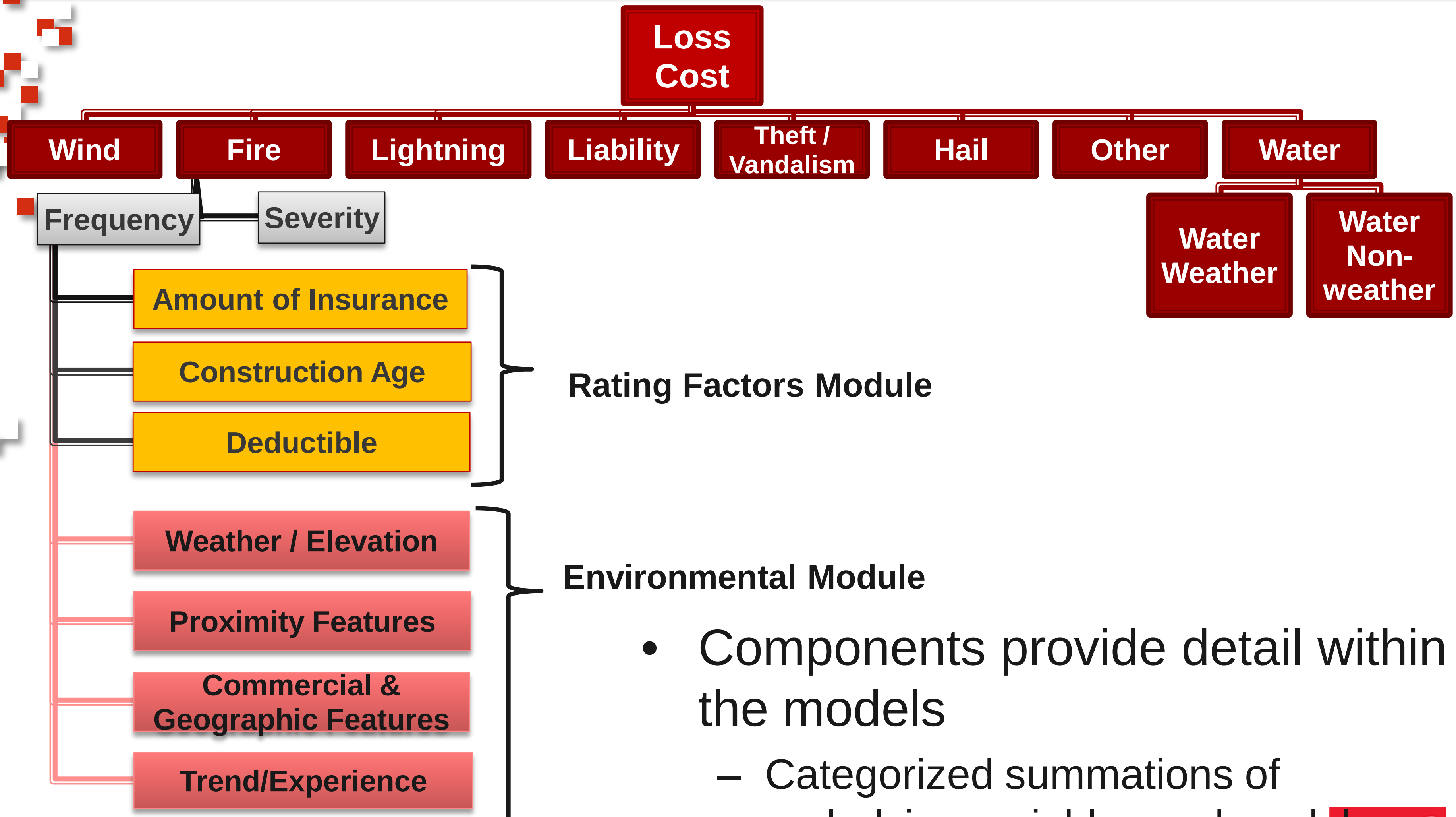
Dealing with Data for By-Peril Modeling

- Accurate by-peril Homeowners models require extensive data resources
  - Low frequency line – split further by peril
  - Severity is volatile and differs significantly by peril

- Components create re-usable data features
  - Derived from modeling on larger datasets
  - Can be used directly as inputs into models on smaller datasets – Ensuring stable results without overfitting

- Components enable efficient modeling
  - Customized lift while short circuiting variable selection

Components



- Components provide detail within the models
  - Categorized summations of underlying variables and model parameters

Example of Variables Environmental Components

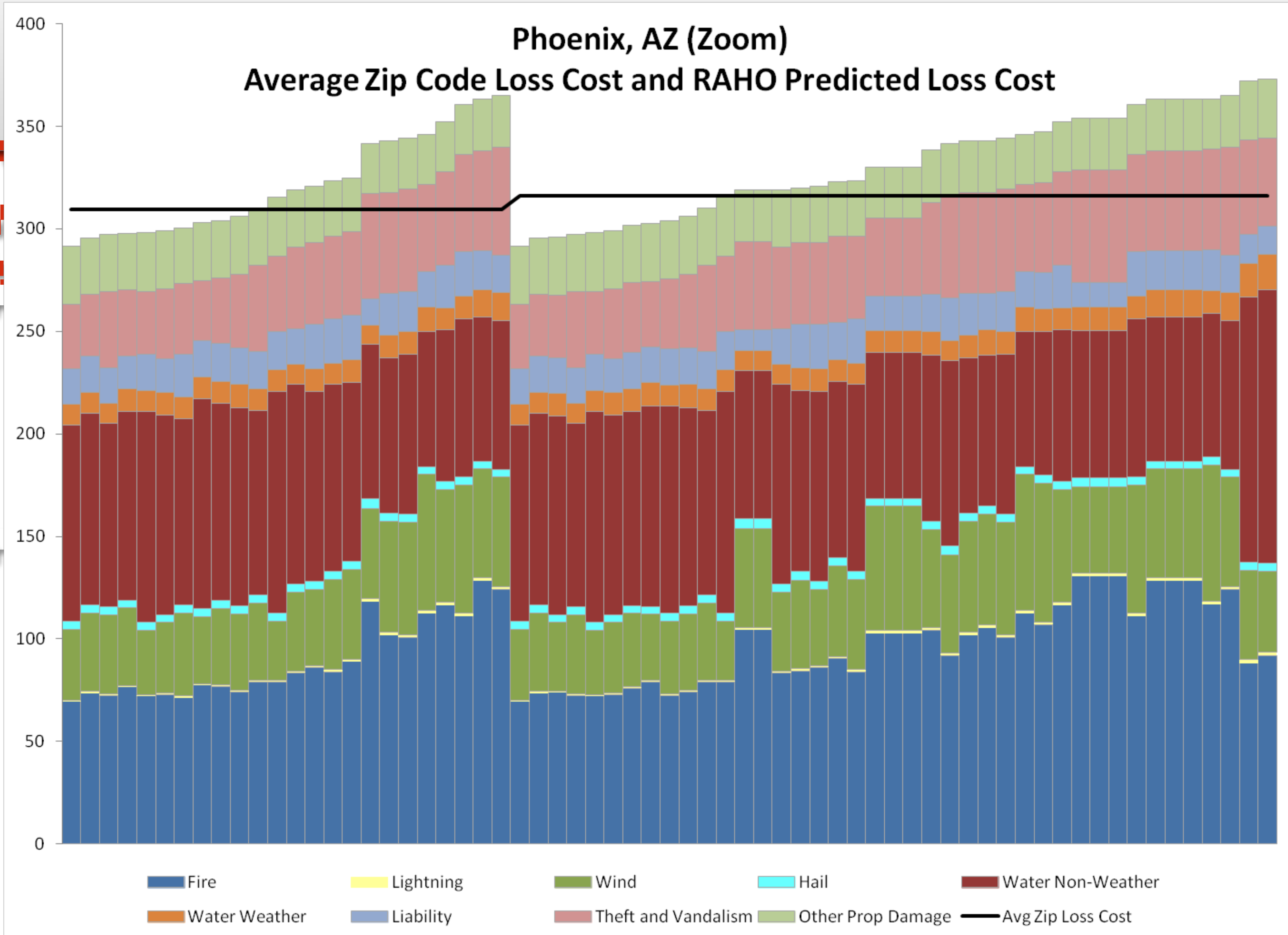
Unique for each peril model (freq/severity)

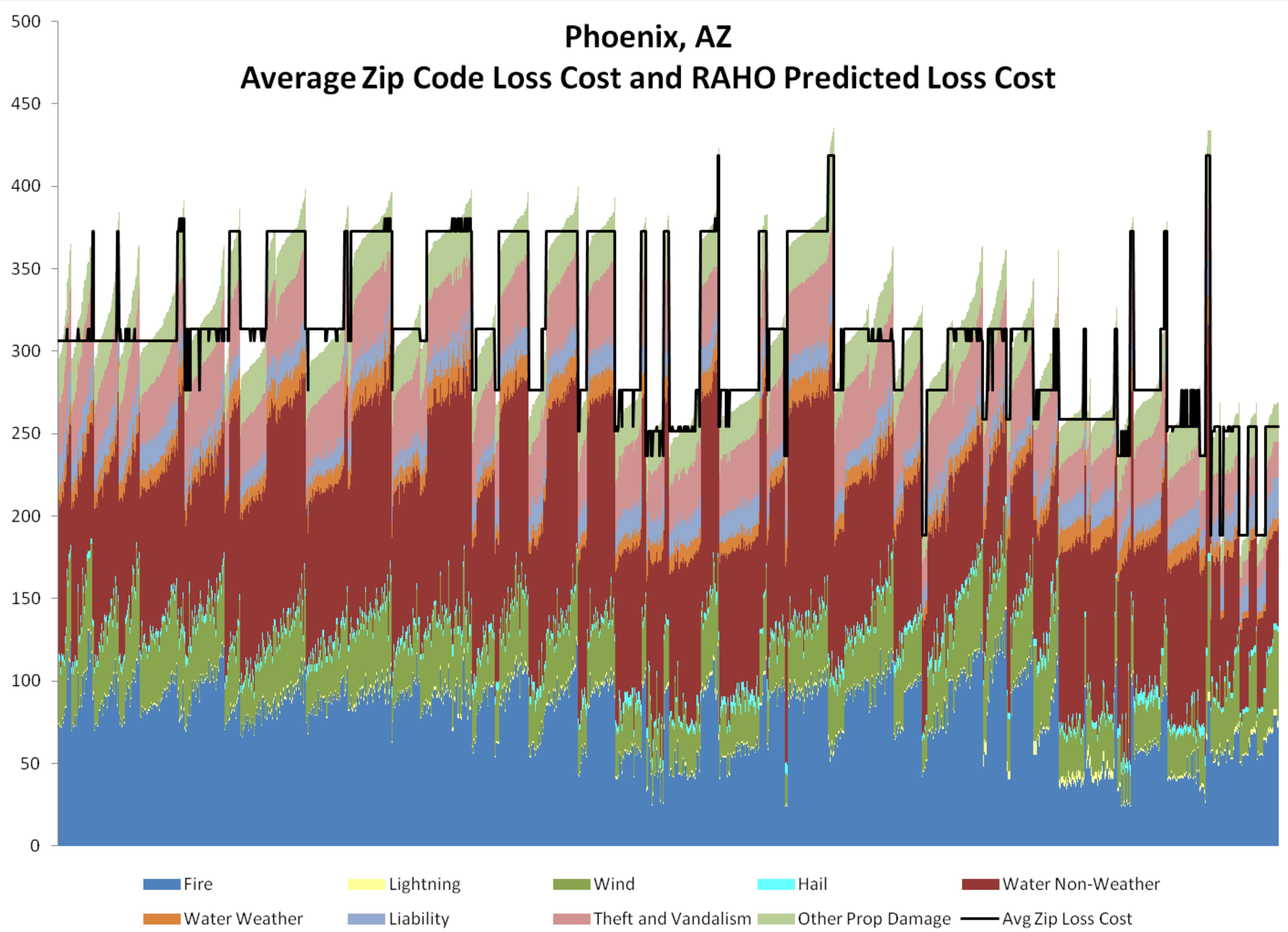
- Weather / Elevation:
  - Elevation
  - Measures of Precipitation
  - Measures of Humidity
  - Measures of Temperature
  - Measures of Wind

- Proximity:
  - Commuting patterns
  - Population variables
  - Public Protection Class

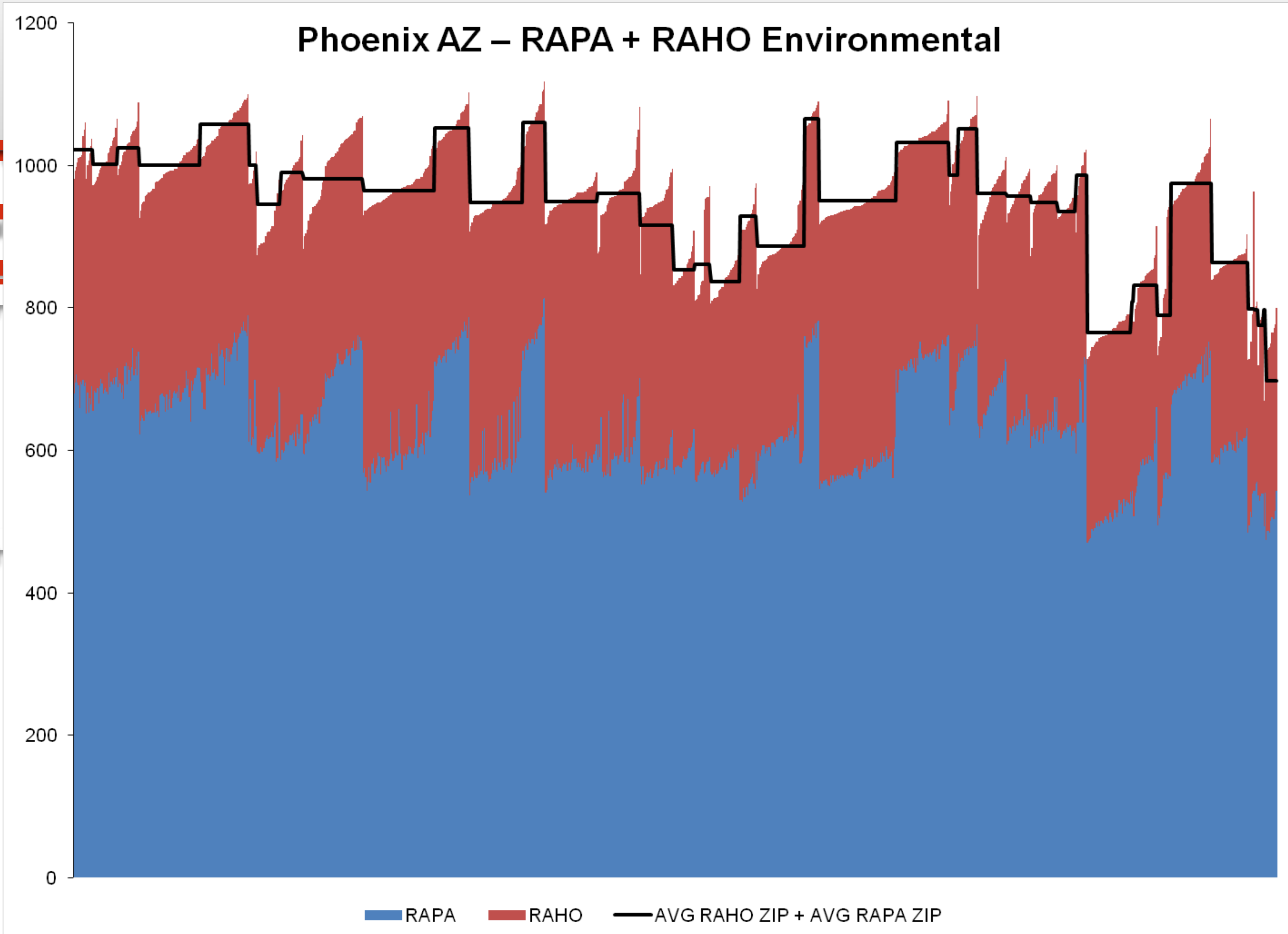
- Commercial & Geographic Features:
  - Distance to coast
  - Distance to major body of water
  - Local concentration of types of businesses (i.e. shopping centers)

- Trend / Experience
  - Peril's proportion of ISO Loss Cost
  - Trend
  - Base Level parameters for:
    - HO Form
    - Construction type
    - Liability amount


Phoenix, AZ (Zoom)
Average Zip Code Loss Cost and RAHO Predicted Loss Cost
400
350
300
250
200
150
100
50
0
Fire
Lightning
Wind
Hail
Water Non-Weather
Water Weather
Liability
Theft and Vandalism
Other Prop Damage
Avg Zip Loss Cost



* Loss cost are calculated @ Territory Representative Risk

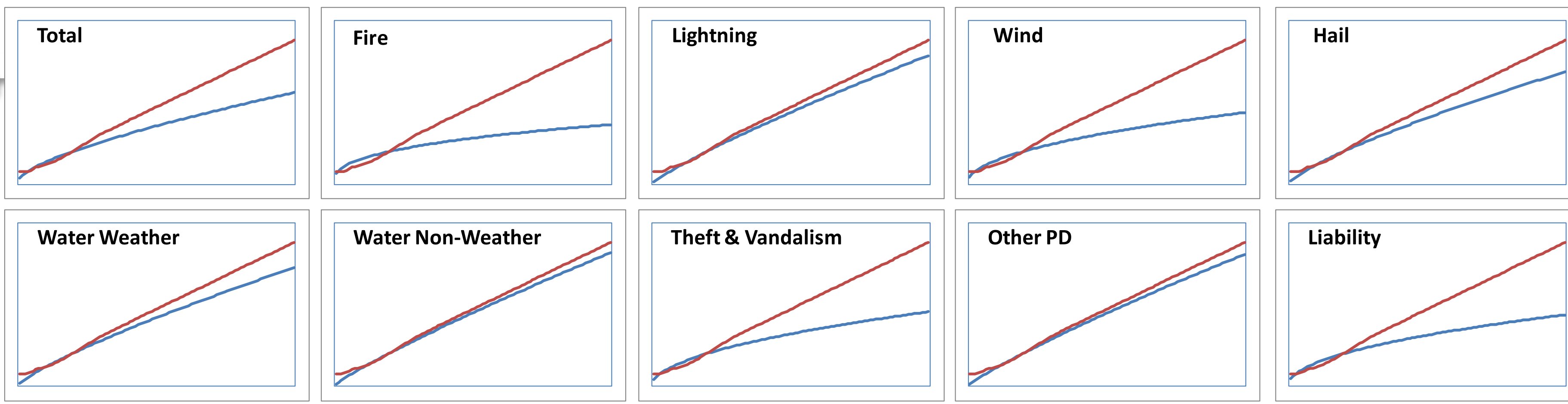


Phoenix AZ – RAPA + RAHO Environmental
1200
1000
800
600
400
200
0
RAPA
RAHO
AVG RAHO ZIP + AVG RAPA ZIP

By-Peril Rating Factors

- Modeled simultaneously with geographic variables
  - Amount of Insurance
  - Deductible
  - Age of Construction

- Produces a set of countrywide tables by peril for each rating factor



By-Peril Rating Factors + Environmental Factors

- Why are by peril rating factors more accurate?
  - By-peril rating factors allow for a more explicit recognition of the impact of perils *varying by location*
  - By-peril rating factors more dynamically react to changing peril contributions over time

Peril	Amount of Insurance Factor	Location A	Location B	Location C
Fire	1.5	30%	25%	50%
Wind	1.2	20%	25%	15%
Water	1.0	40%	25%	20%
Other	2.0	10%	25%	15%
All-Perils Factor	1.37	1.29	1.43	1.39

By-Peril Rating Factors + Environmental Factors

- Relativities that vary by peril provide lift
- Adds accuracy and complexity
  - All-peril relativities can be derived from peril-based relativities according to peril mix within the area
  - Local Prediction by peril results in varying peril loss costs at the address level
- Effectively produces all-peril rating factor relativities that vary at the address level

Gaining Customized Lift Using RAHO By-Peril Rating Factors

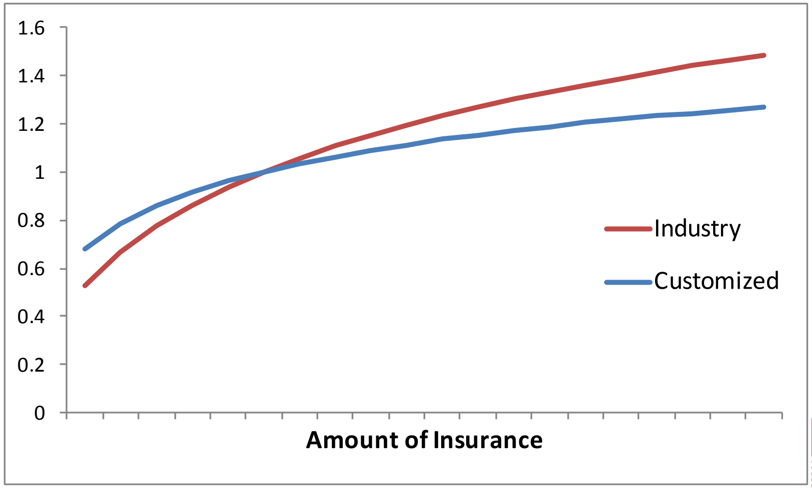
- Step 1: Score your data using RAHO By-Peril Rating Factors

Policy Number	Amount of Insurance	RAHO AOI Factor (Fire Severity)
1	210,000	1.32
2	140,000	1.13
3	370,000	1.63

- Step 2: Fit your GLM using scored variable
  - Use continuous predictor (variate)
  - Apply transformations as needed

$$\cdots + \beta \times (\text{RAHO AOI Factor}) + \cdots$$

- Result:
  - Customized rating factor indication requiring less of your data
  - Avoids overfitting by preserving information from industry model



ISO Risk Analyzer® Homeowners

Perils

Fire	Light	Wind	Hail	Water Weather	Water Non Weather	Theft	Other PD	Liability

Module

Environmental	Rating Factors	Building Characteristics

Environmental
- Weather
- Census
- Commercial Features

Rating Factors
- Amount of Insurance
- Age of Construction
- Deductible

Building Characteristics
- Features
- Dimensions
- Layout

Peril	AOI factors
Fire	1.4
Wind	1.6
Hail	2.0

Building Characteristics Example

For illustrative purposes only


RAHO Environmental	Location PPC	State B 5	State B 5
RAHO By Peril Rating Factors	AOI Age of construction Deductible	$300,000 25 $1000	$300,000 25 $1000
ENV-BPR Loss Costs**		244	244
All perils combined factor **% Discount/Surcharge**		1.19 +19	0.99 -1%
Building characteristics	Heating Code Structure Code	Steam/Hot Water Contemporary	Heat Pump Colonial
Top 3 Perils	Other PD	Water Weather	Wind

** ENV-BPR Loss costs – based on environmental and rating factors inputs

Roof is Asphalt and square feet is between 2500-3000 for both properties

Opportunities for Enhanced Segmentation

- Use sum-of-peril loss cost estimates
  - Build new territories
  - Refine existing territories
- Use peril-specific models to break apart all-peril rating
  - Geographic exposures and rating variables
- Using components as input to models
  - Incorporate new predictive data with simpler sourcing, preparing, and selecting of variables
  - Enables accurate predictions on smaller data sets

Questions?

David Cummings
dcummings@iso.com