RMS SEVERE WEATHER MODELING UPDATE

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WHAT IS NEEDED?
CAT MODEL INPUT AND OUTPUT

Input (from user)

Address

Physical characteristics of insured buildings

- Occupancy
- Year Built
- Construction
- Number of Stories
- Floor Area
- Other characteristics…

Coverages

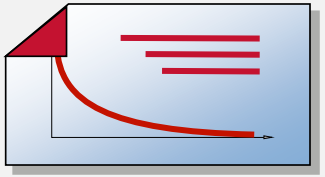
- Structures, Contents, Additional Living/Loss of Use
- Limits, Values, Deductibles
- Reinsurance

Output (key metrics for business decisions)

Average Annual Loss (AAL): the amount of modeled premium an insurer needs to collect in order to cover the average peril loss over time

- Combination of event frequency and mean event loss

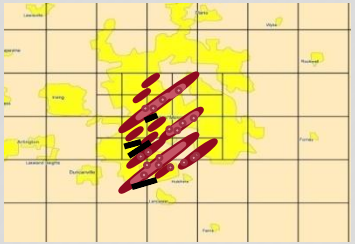
Exceedance Probability (EP) curve: the probability of exceeding a loss level in a given year. Most often referred to as 'return period'.



Two types of EP curve:

- Occurrence Exceedance Probability (OEP)
- Aggregate Exceedance Probability (AEP)

FRAMEWORK FOR MODELING SEVERE CONVECTIVE STORMS



Define Storm

Assess Tornado, Hail, Wind Speeds

Apply Exposure

Calculate Damage

Quantify Financial Loss

Stochastic Event Module	Hazard Module	Geocoding/ Exposure Module	Vulnerability Module	Financial Analysis Module

MODEL COMPONENTS

Includes losses from:

- **Hail**
- **Tornado**
- **Straight-line winds**
- **Lightning**

Includes events such as:

- **Large outbreaks**
- **Regional outbreaks**
- **Isolated occurrences**

Low Frequency Event Set

- **Small dollar losses from a single hailstorm or wind event**

High Frequency Event Set

HISTORICAL CHALLENGES IN MODELING SCS RISK

Data Challenges

- Incomplete observational and historical data record
- Gaps and biases
- Changing claims practices
- Concerns about model's ability to reflect historical loss experience

Technology Challenges

- Trade off between meaningful results and a model that can be used
- Resolution vs. runtime
- Concerns about model's ability to capture the spatial nature of the risk

Limited Business Benefits

- Limited value beyond portfolio management
- Too much uncertainty at sub-regional level
- Low confidence in model output

Result: SCS Catastrophe models have not been widely used

2014 MODEL UPGRADE

New Data

- $84 billion in industry loss data (‘08-13)
- Occurrence of recent tail events
- $5 billion in location-level claims data

New Methods

- Improving representation of tail risk
- Improving spatial representation of hazard, particularly hail and tornado

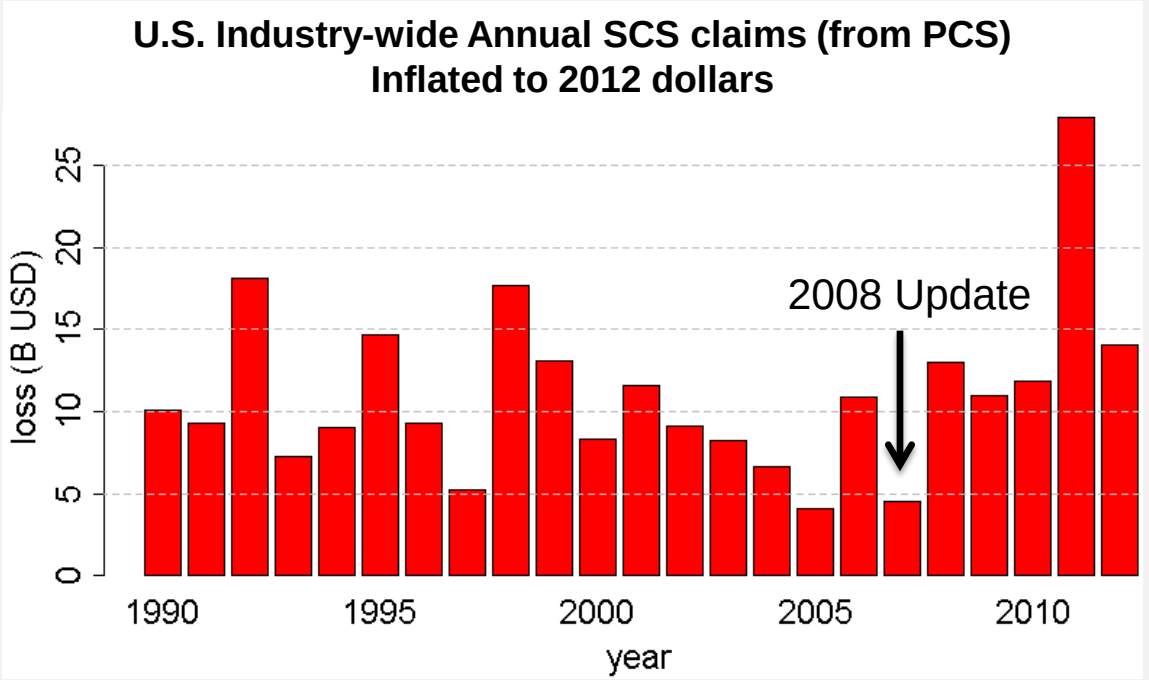
New Insights

- Trends into claims severity and inflation
- More granular hazard and vulnerability risk differentiation

Recalibrated and Enhanced SCS Model

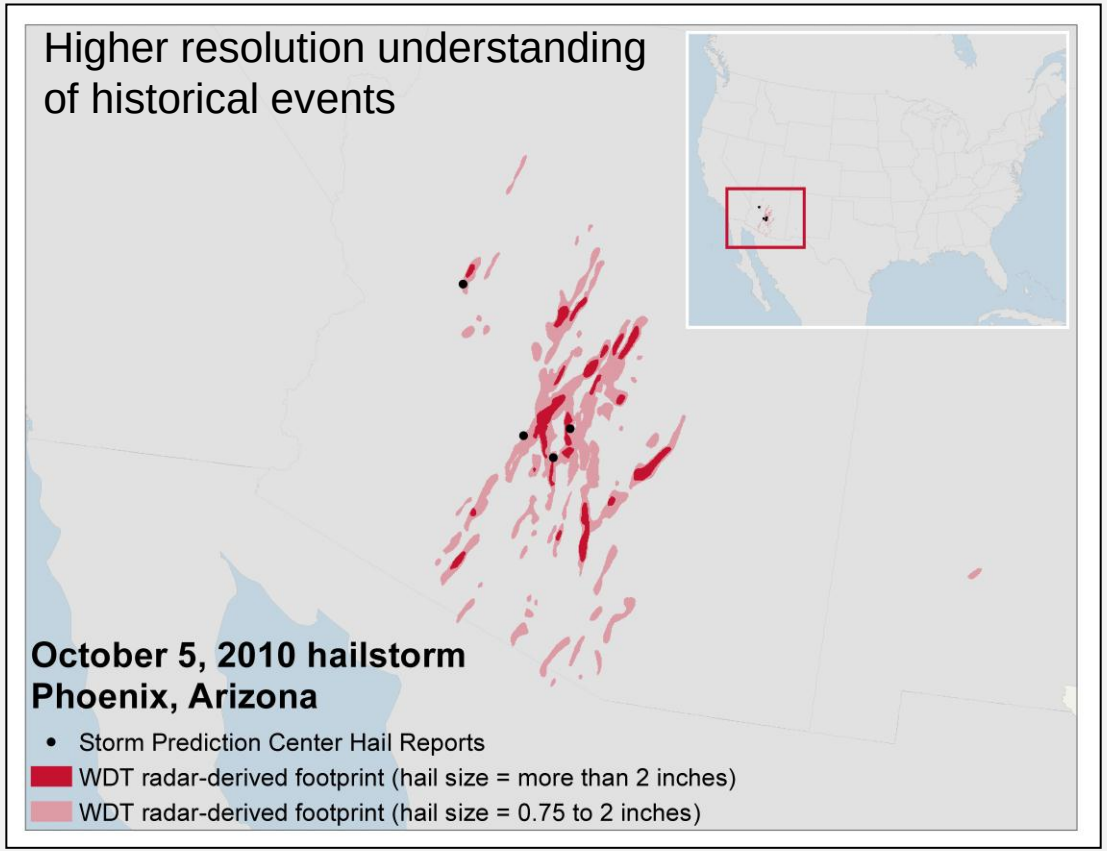
INCREASES IN EVENT SEVERITY

- Increasing populations and property exposures at risk
- Major SCS losses are happening
- $84 billion in insured losses from SCS outbreaks and extreme events 2008-2013
- Go beyond what is captured in claims and historical records



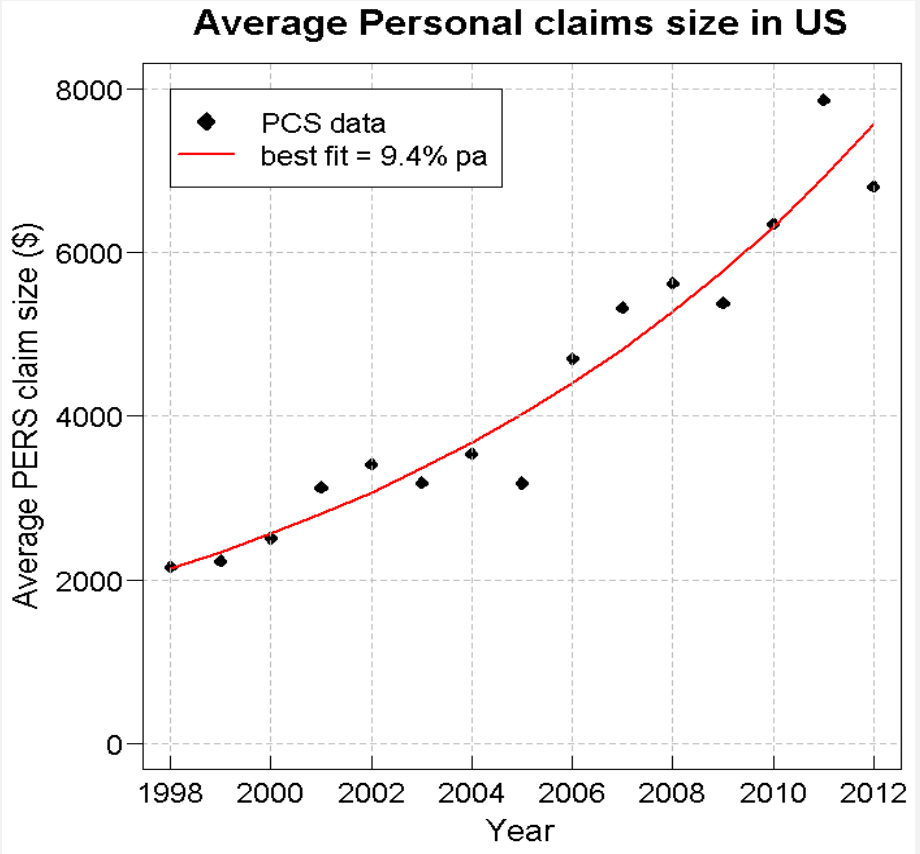
NEW INSIGHTS INTO HAZARD RISK DIFFERENTIATION

- Need to accurately represent small-scale nature and variability of SCS hazard
- Recalibrated hazard module against thousands of hail and wind observations from 70+ new events
- Focus should be on event attributes that drive losses (e.g. area coverage)



TRENDS IN HAIL CLAIMS

- Trends of increasing claims severity and claims inflation
- Becoming more apparent over time, particularly in high-risk areas
- Replace vs. Repair mentality for contractors



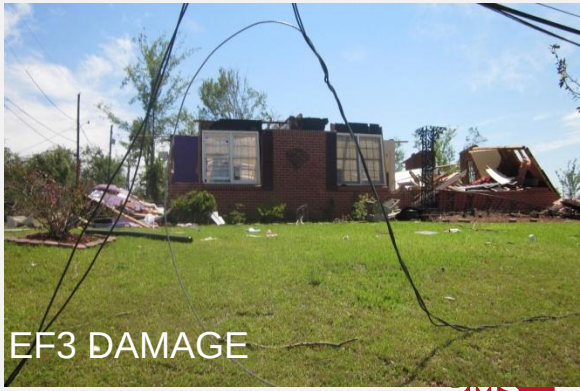
*Inflation has been removed from losses

TORNADO DAMAGE VALIDATION

Recent events have provided an opportunity to validate real-time tornado damage

1) Joplin 2011 tornado reports
2) Tuscaloosa 2011 tornado damage reports
3) Moore, OK 2013 tornado recon

JOPLIN TORNADO FOOTPRINT



SCS IS A MATERIAL RISK TO THE INDUSTRY

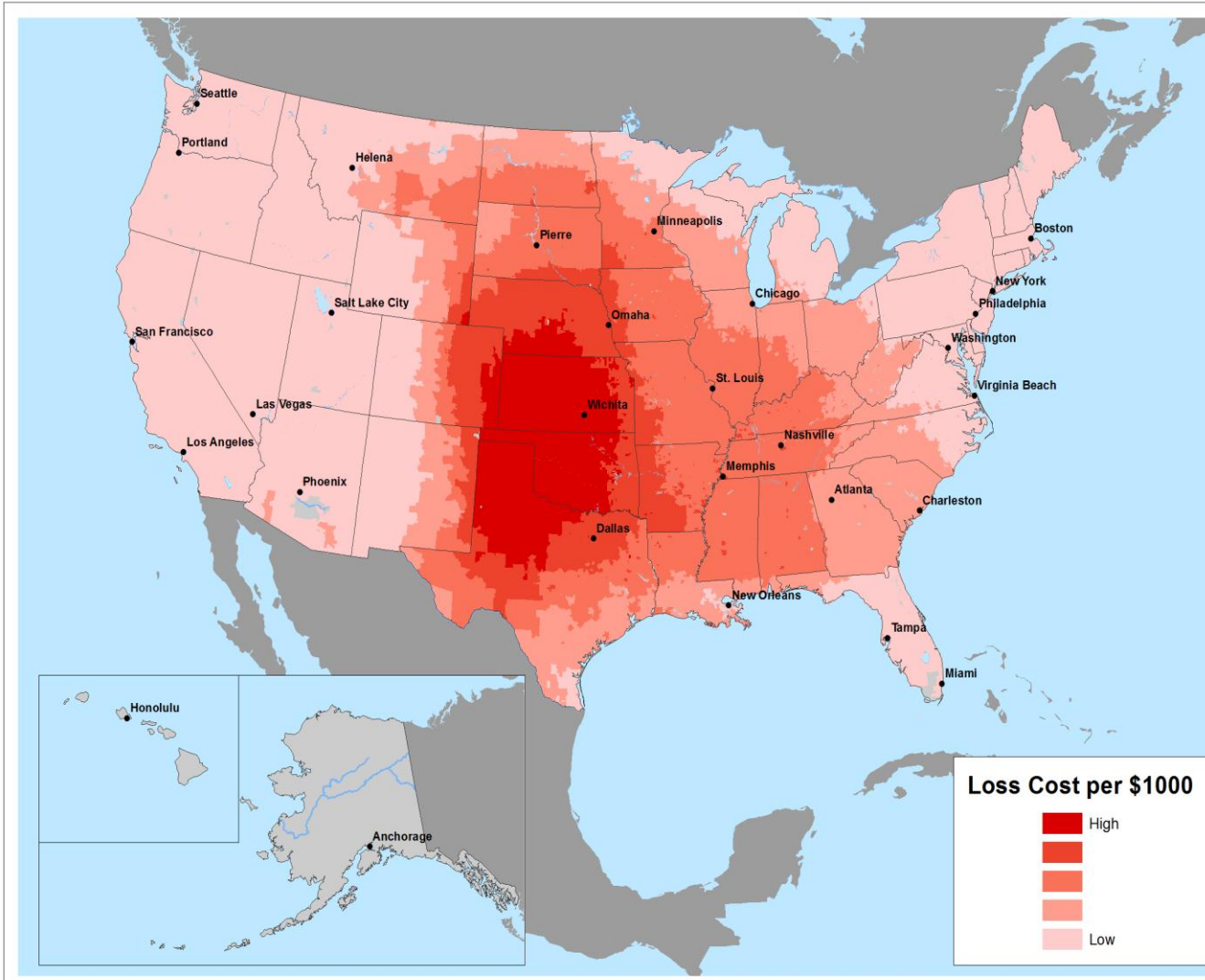
- Industry-wide SCS AAL is second only to hurricane
- Drives more than 1/3 of all U.S. peril AAL:
  - $11-13 B USD
- Drives more than 1/3 of all Canada peril AAL:
  - $400-450 M USD
- Highest SCS risks:
  - Aggregate covers
  - Auto Lines
  - Large single location risks

U.S. AAL by Peril	
Peril	**Percentage**
Hurricane	40%
SCS	35%
Flood	10%
Winterstorm	5%
Earthquake	5%
Wildfire	<2%
Total	100%

RMS' VIEW OF SCS RISK

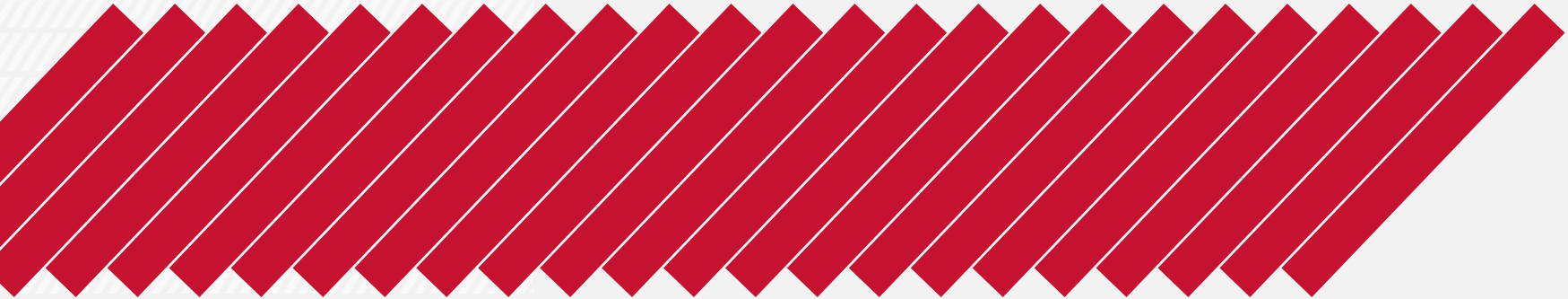
- It's not just Tornado Alley (about 1/3 of SCS AAL) that's prone to significant SCS risk:
  - Northern Plains (MT, ND, SD, WY)
  - Texas
  - Southeast (AL, GA, LA, MS)

- Annual likelihood of an event causing X in insured losses:
  - $10B → 2%



What's Coming ?

U.S. Flood Models



GOAL:

Develop modeling solution covering all sources of flooding in US

- ✓ Tropical Cyclone Surge
- ❑ Tropical Cyclone Precipitation
- ❑ Non-Tropical Cyclone Precipitation

Suite of US Flood products:

- ✓ Storm Surge within Hurricane Model

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- ❑ US Flood Hazard Data Product *coming soon!*
- ❑ US Flood HD Model

New US Inland Flood model (lower 48 states) set to be released on RMS(one)

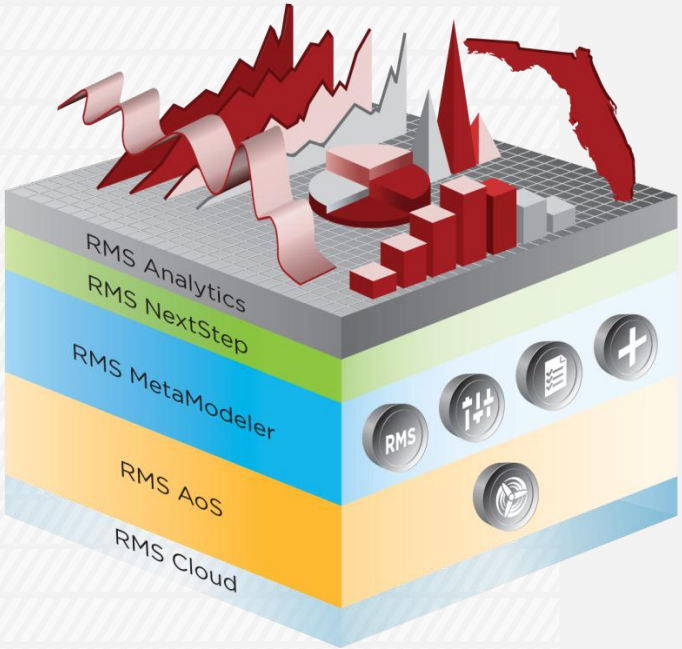
Probabilistic model is precipitation-driven

Includes tropical cyclone and non-tropical cyclone precipitation

Covers both floodplain (major and minor) and off-floodplain (i.e. flash flooding) events

Continuous simulation accounts for antecedent conditions

BUILDING MODELS IN RMS(ONE)



- **HD Simulation**: Allows for continuous simulation of events
  - Similar meteorological events can lead to very different hazard & loss events
    - **Antecedent conditions** strongly influence the severity of a flood
  - Able to capture clustering and correlation
- New financial model enabled by **Contract Definition Language** (CDL)
  - Properly model hours clause and complex flood policy terms
- Performance offered by the **Cloud**

RMS FLOOD HAZARD DATA PRODUCT

Coming soon!

- Coverage: 48 states & District of Columbia
- All sources of flooding:
  - Coastal flooding from storm surge
  - Tropical cyclone precipitation
  - Non-tropical cyclone precipitation
- Return periods:
  - Multiple return periods, 20 years to 1000 years
  - Catchments by hydrological regions
- RMS(one) functionality:
  - Location-level underwriting, flood zone lookup frequency and severity with return period and flood depth
  - Accumulation management
  - Flood hazard visualization

RMS FLOOD HAZARD DATA PRODUCT

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Example 200-year return period hazard map