CoreLogic®

Loss Reserving Using Catastrophe Models

CAS Loss Reserve Seminar | Austin, TX

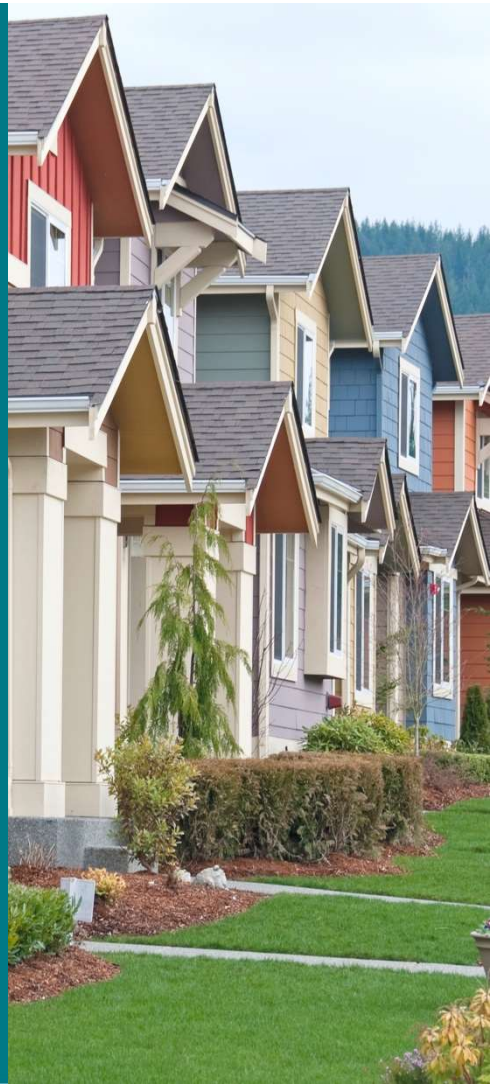
Howard A. Kunst, FCAS MAAA CCRMP

Agenda

- Focus on the types of catastrophe models, and the use cases for all of them
  - Deterministic models
  - Probabilistic models
  - Forensic models

- How can these models be used for determining losses for an specific location or portfolio?
  - Fraud detection
  - Claims estimation

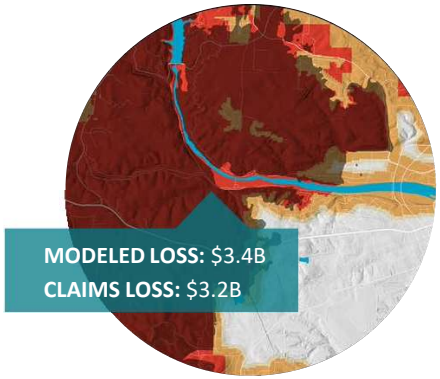
Models and Their Corresponding Uses



Types of Natural Catastrophe Models

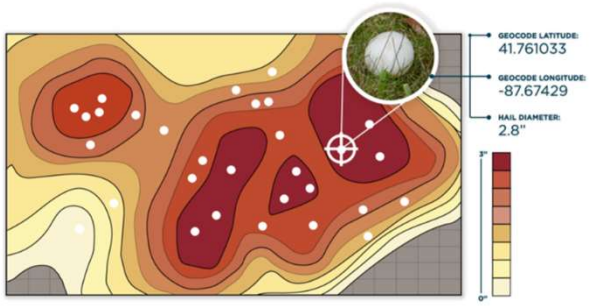
DETERMINISTIC

What could happen?



PROBABILISTIC

What if it happened?



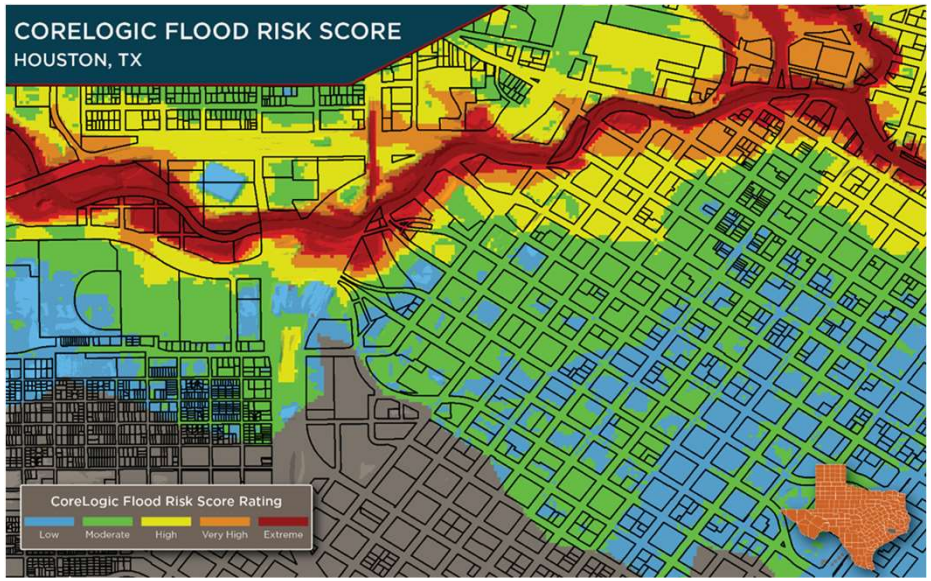
FORENSIC

What did happen?

Types of Natural Catastrophe Models

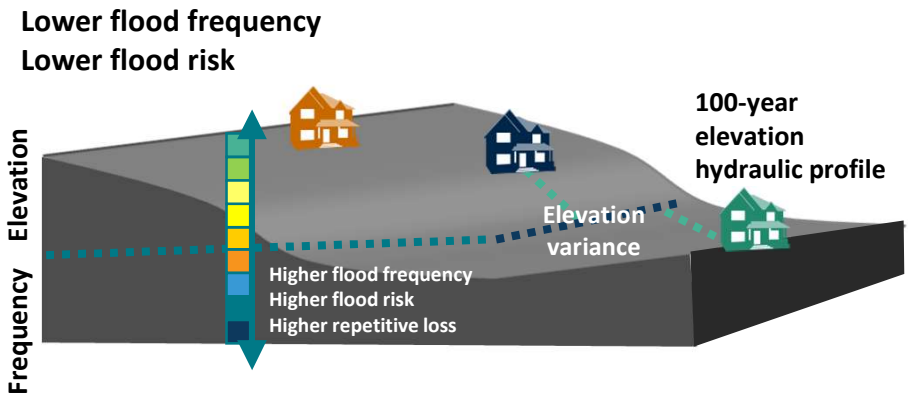
Deterministic Models

- Provides a score (1-100) that represents the relative risk for a specific peril, at a specific location
- May only be relative to the hazard/frequency of a damaging event, while some include a measure of estimated loss based on the structure present



Types of Natural Catastrophe Models

Deterministic Models – Flood Risk Scores

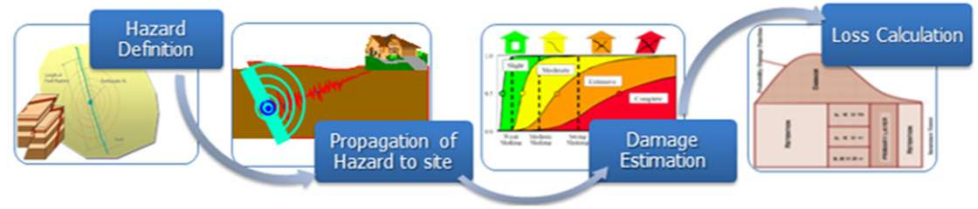


- Create comprehensive spectrum of flood risk classifications
  - Above/below 100-year flood elevation, up to 5,000-year flood event
  - 10–100 score
- Compare unknown (targeted property elevation) with known risk point (100-year flood elevation)
  - Derive risk scores based on elevation variances (elevation difference between 100-year elevations and property elevations)
- The challenge: to build 100-year flood surface profile to cover national rivers, lakes, coastal zones and other water bodies

Types of Natural Catastrophe Models

Probabilistic Models

- Start with a large event set (historical and simulated); each event has a frequency of occurrence
- Based on characteristics of the event at any location, the structure vulnerability and associated loss can be calculated
- Outputs include:
  - Event Loss tables and Yearly Loss tables
  - AAL's and PML's



Event Catalog:
- Magnitude
  - How Big?
- Frequency
  - How Likely?
- Where?

Event Footprints:
- Ground Motion Distribution
- How Intense?
- Attenuation Functions
- Soil Maps
- Site Adjustments

Vulnerability:
- Construction
- Occupancy
- Coverage
- Sub-Peril (Shake, Fire, Sprinkler, tsunami)
- Demand Surge

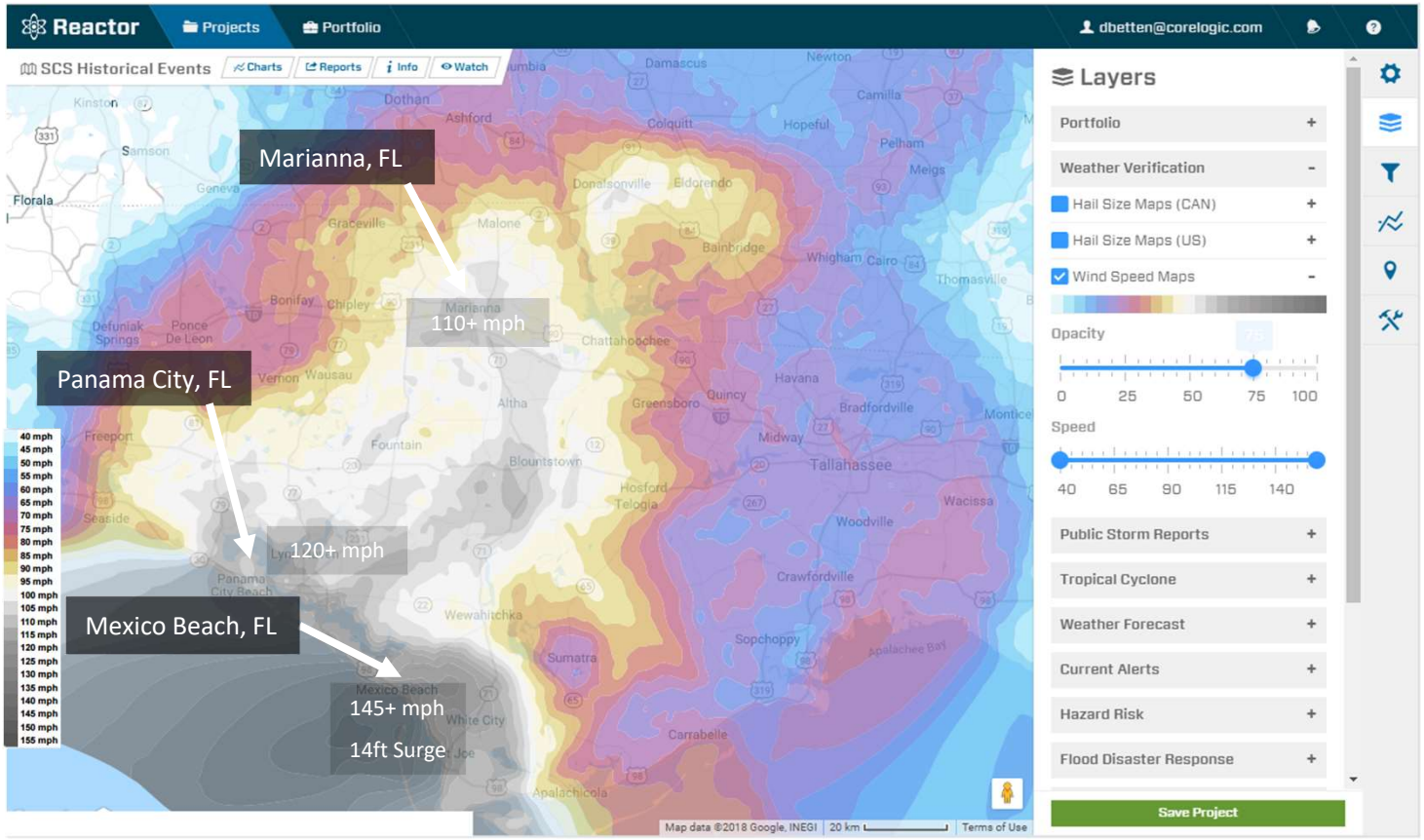
Losses:
- Policy Terms
- Validation
- LAE, other adjustments

Types of Natural Catastrophe Models

Forensic Models

- Post event analysis of what actually occurred
- Advanced radar
- Aerial imagery

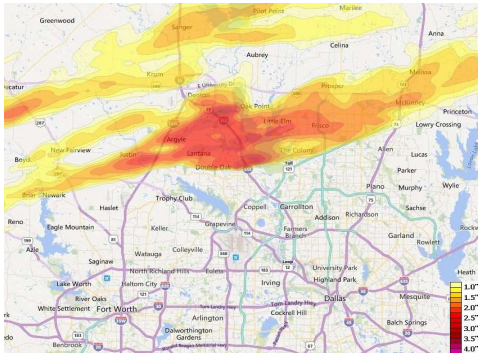
CoreLogic Reactor™ Windspeed Map for Hurricane Michael



Models Historical Hail Events

Individual Event Representation

Public Hail Reports (Green H's) – Dallas, TX 3/26/17
Source: Storm Prediction Center



Hail Size Map – Dallas, TX 3/26/17
Source: CoreLogic Reactor™

Public Report Based

- Storm Prediction Center (SPC) → incomplete and spatially inconsistent view of hail frequency
- Hail storm size not captured, limits spatial granularity of hail frequency
- Hard to accurately breakdown hail frequency by size

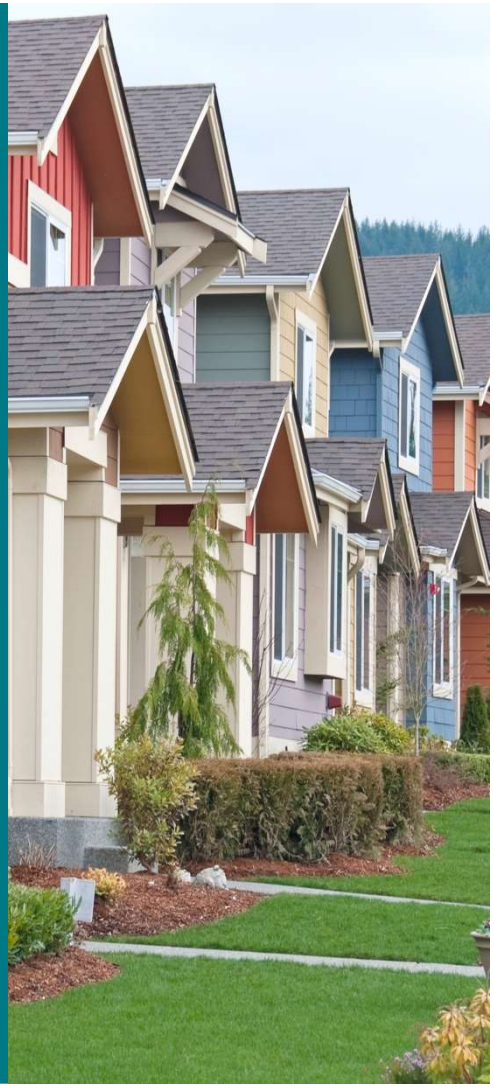
Forensic Algorithm Based

- Realistic, high-resolution hail footprints derived from proprietary radar-based weather forensic algorithm
- Footprints derived from weather radar data + public data + social media reports
- Every footprint is analyzed and quality controlled by our team of expert meteorologists

CoreLogic®

Industry Use Cases for Types of Models

Non-claim-related uses



Screening (Underwriting/Risk Selection)

- **Deterministic Risk Scores** [Most Common]
  - A good representation of relative risk, i.e., the higher the score the greater the risk. Depending on their risk appetite, an individual company can set its own thresholds for underwriting decisions
  - Score can be easily implemented/imported into U/W work stream, especially for homogenous lines of business
  - No need to run more sophisticated model
- **Probabilistic Model Results**
  - More complicated risks (e.g., larger commercial structures) may require more information
  - Understanding impacts of tail events
  - Impact on reinsurance placement / capital management

Pricing (Setting Rates/Premiums)

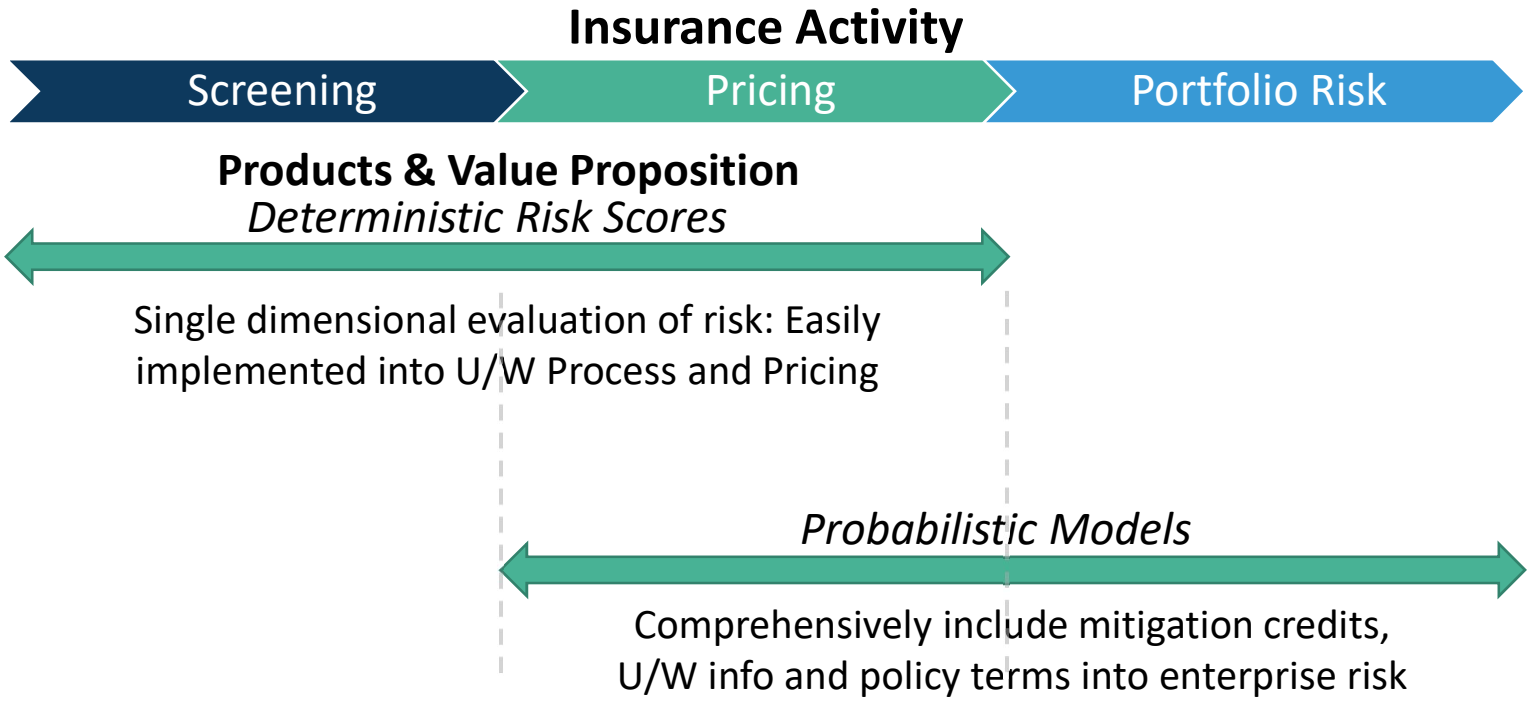
- **Deterministic Risk Scores**
  - Hazard risk scores provide a good representation of relative risk; a risk score can be translated into a rate relativity (relativity factor increases as score increases)
  - Score can be easily implemented/imported into a rating algorithm, especially for homogenous lines of business (law of large numbers)
- **Probabilistic Model Results**
  - More complicated risks (e.g., larger commercial structures) may require more information
  - Understanding impacts of tail events – Risk loads in addition to Avg Annual Loss
  - Building attributes are considered when calculating results – no need for any additional sets of rating factors when dealing with less homogenous structure types

Portfolio Risk/Capital Management/Reinsurance

- **Deterministic Risk Scores**
  - Hazard risk scores provide a method to look at the distribution of risk across various geographies
- **Probabilistic model results**
  - AALs and PMLs provide necessary information for senior management at companies to make a number of financial decisions
  - Based on a selected return period (100-year loss), it can advise as to how much reinsurance to purchase, to cover potential large-event losses extending beyond what the company can retain
  - Scenario testing – identifying the events that have the highest potential impact to the company's financials, and making decisions that impact the company's portfolio of insureds
  - Capital allocation is sometimes based on the potential for extreme losses; i.e., portfolios with higher PMLs for a selected return period may draw more capital to support

Natural Catastrophe Offerings to Insurers

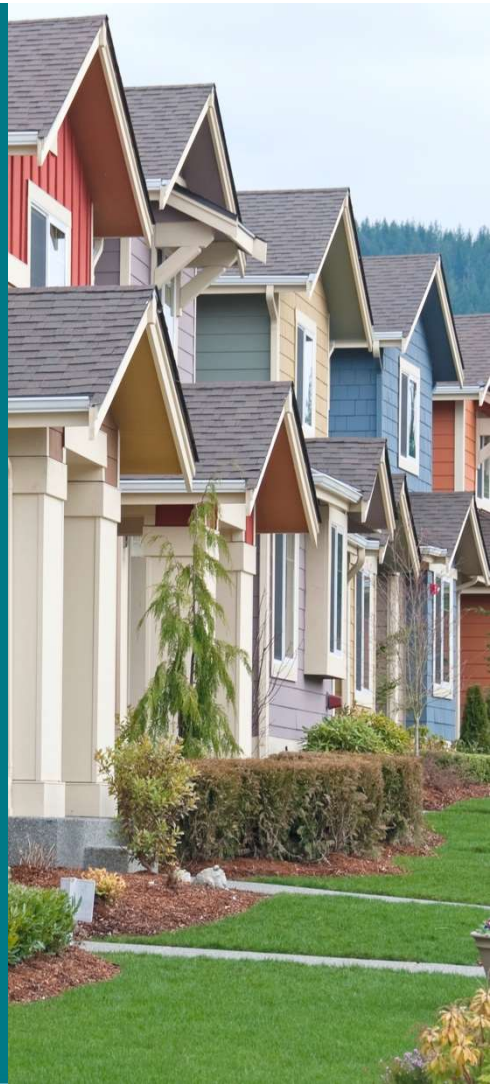
A Complete Suite of Products to Cover the Insurers' Needs



CoreLogic®

Industry Use Cases for Types of Models

Claims-related uses of natural catastrophe models



Claims/Fraud Identification

- **Forensic Models**
  - Identifying the impacts of an event across the entire geographic footprint of the event
  - Understanding where the event occurred relative to insured portfolio allows company to triage claims resources
  - Can be used to verify coverage (i.e., did hail actually occur at a specific address)
  - In conjunction with vulnerability information from the probabilistic models, a reasonable first estimate of the total losses from an event can be made

Event Estimation – Post-Event Estimates

Using the models to estimate for entire industry or a specific portfolio

- **Forensic Models**
  - Identifying the impacts of an event across the entire geographic footprint of the event
  - In conjunction with vulnerability information from the probabilistic models, a reasonable first estimate of the total losses from an event can be made

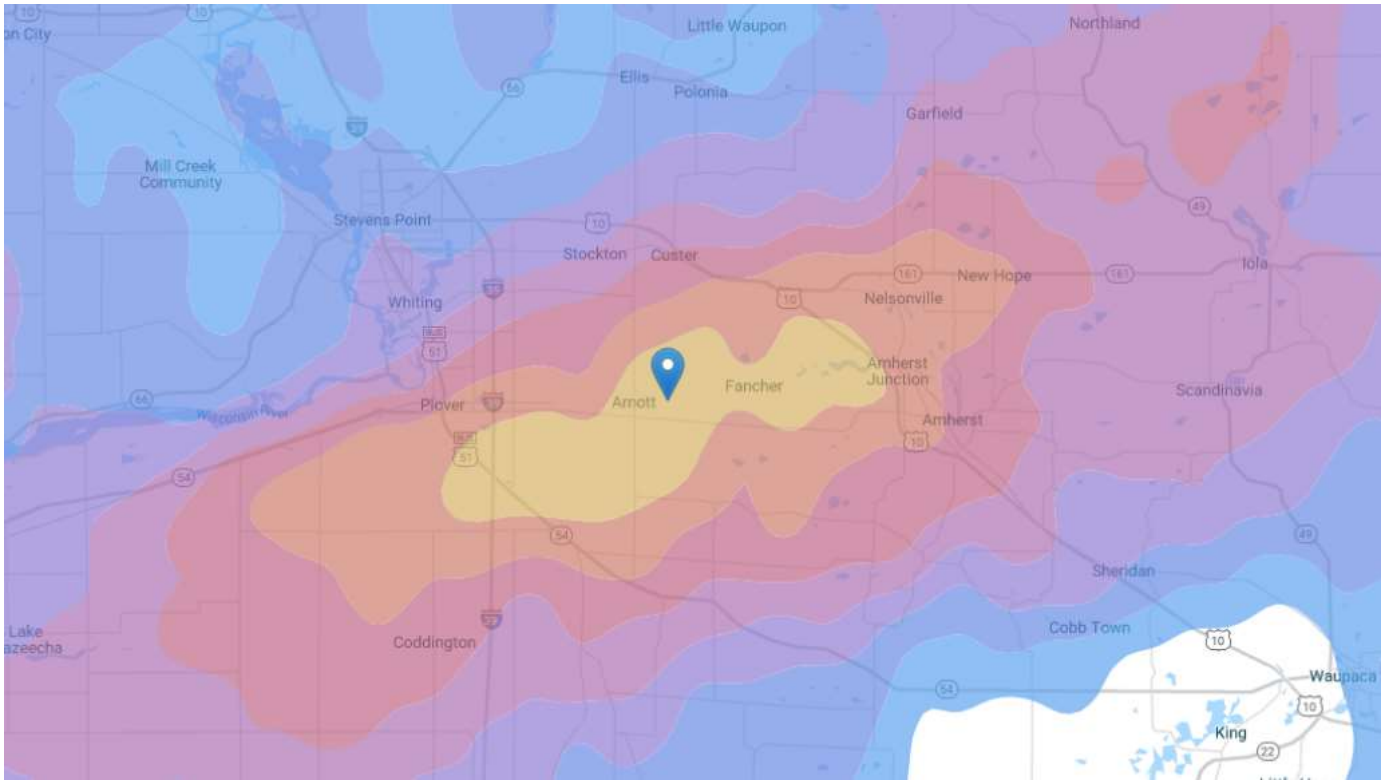
Event Estimation – Post-Event Estimates

Using the models to estimate for entire industry or a specific portfolio

- **Probabilistic Models**
  - If possible, select an event (or set of events) from the stochastic event set that closely represent the actual or estimated event
    - If not possible, a new event will be created with the necessary detail (variables needed by the model to estimate loss)
  - Using the appropriate vulnerability tables, building characteristics and reconstruction costs, the damage for each location / structure can be estimated
    - Vulnerability functions varies by coverage and/or structure component
      - Actual property damage vs loss of use (Additional living expenses)
      - Roof damage vs Windows vs contents
    - Sum up the estimates for all locations to get the baseline total event estimation

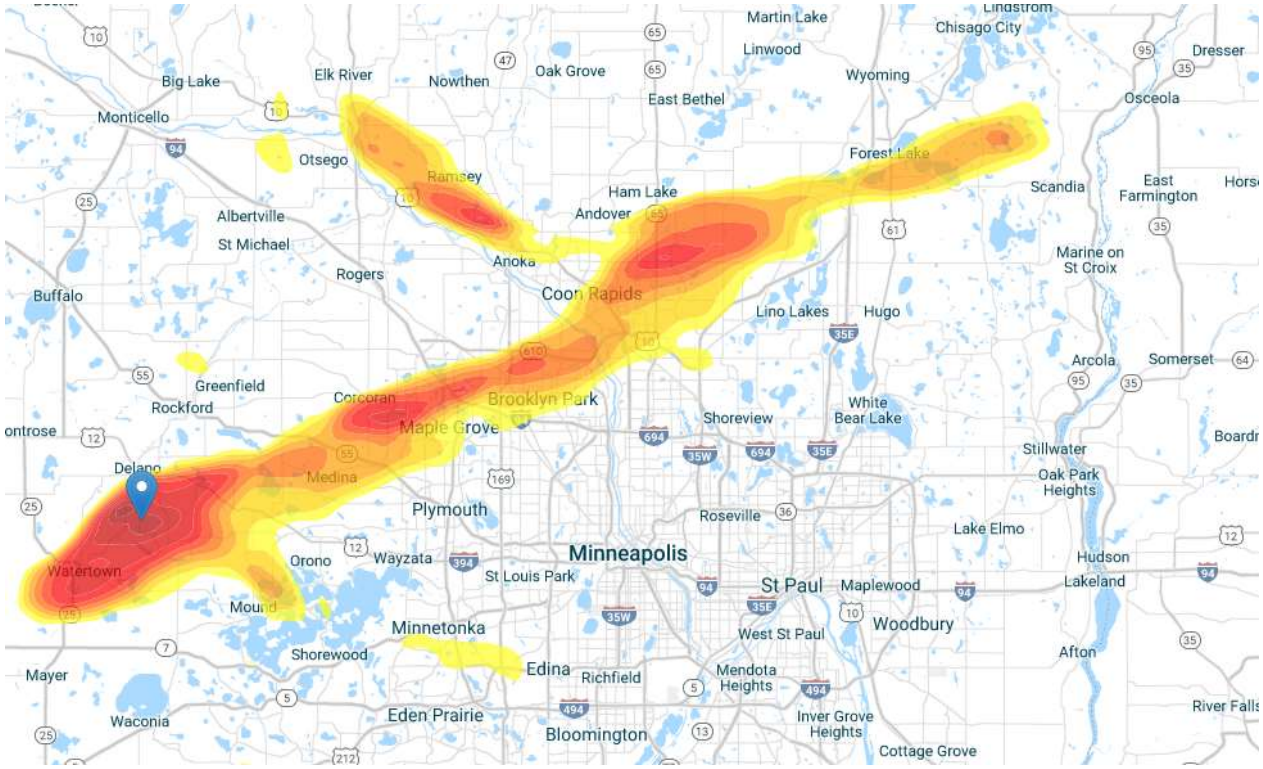
Forensic Model Review – Identify Impacted Areas

July 20 Straight Line Wind – Central Wisconsin (Portage County)



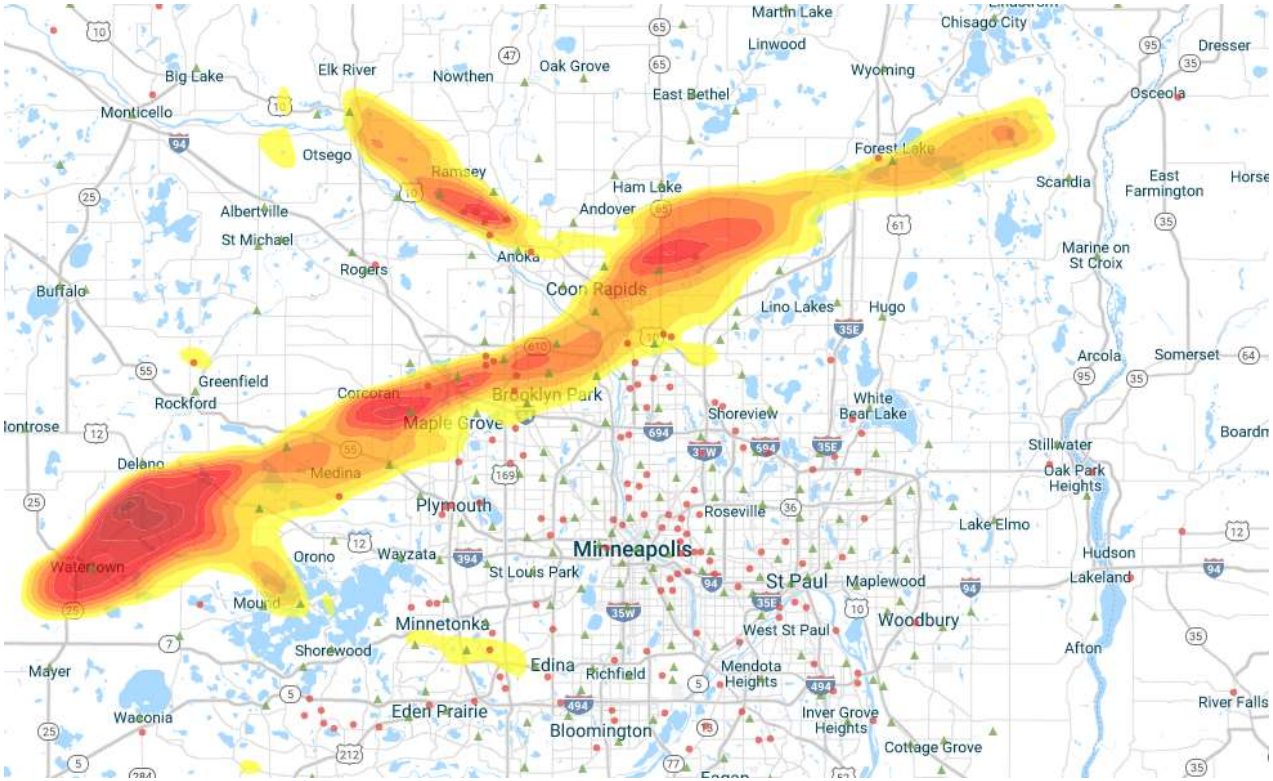
Forensic model review – Identify impacted areas

August 5, 2019 | Hail: Minneapolis/St. Paul area



Claims Estimation/Fraud Identification

August 5, 2019 | Hail: Minneapolis/St. Paul area



Claims Estimation – Example using Forensic model

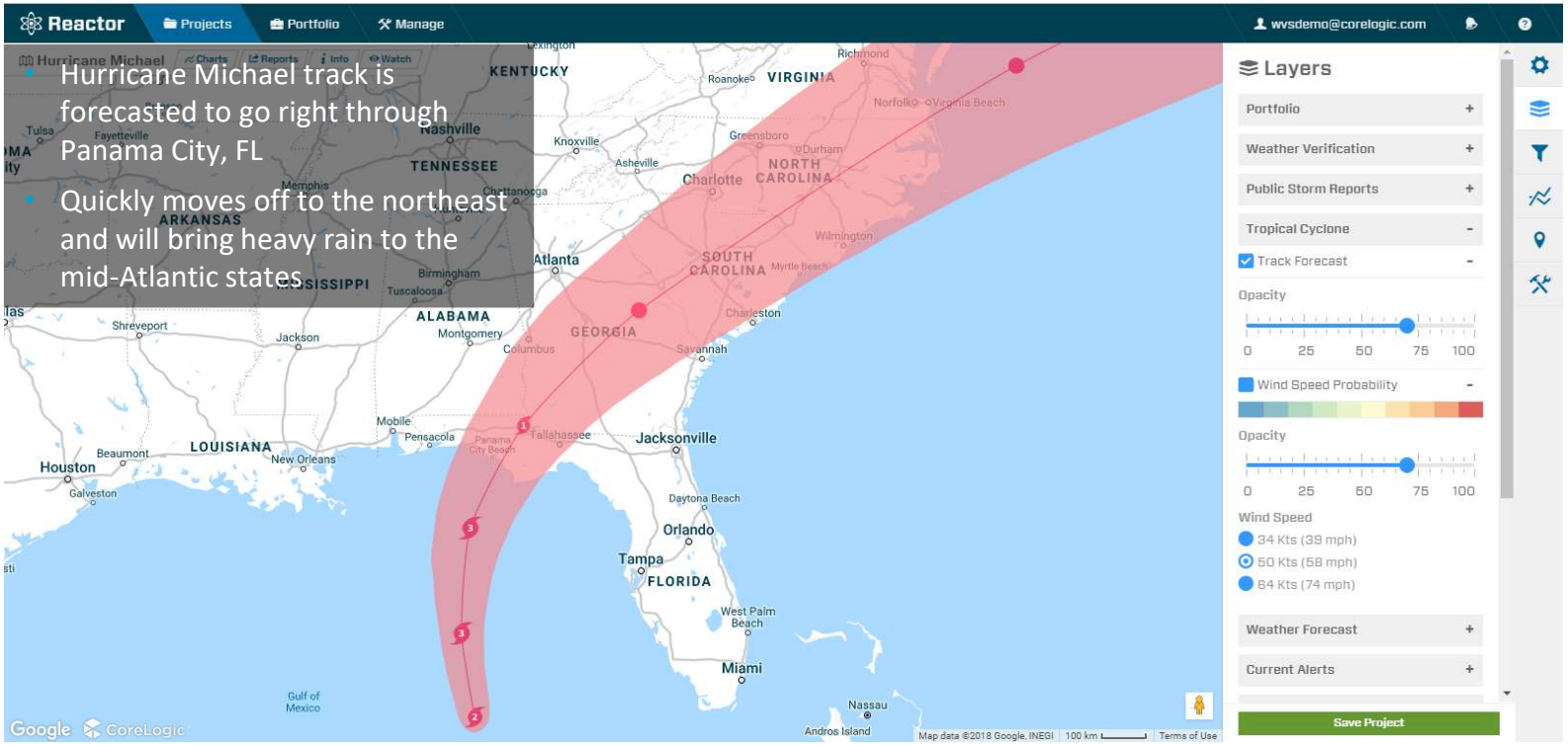
August 5, 2019 | Hail: Minneapolis/St. Paul area

hail_diamet	latitude	longitude	referer	street_address	locality	region	postal_code
1.25	45.1083868	-93.3038886	15010	1707 85th Avenue North	Brooklyn Park	MN	55444-1437
1	45.08767405	-93.37739494	15542	7301 West Broadway Avenue	Brooklyn Park	MN	55428-1216
1.5	45.05500341	-93.634776	16010	259 North Medina Street	Loretto	MN	55357
1.75	45.10741657	-93.45112148	16044	13450 Maple Knoll Way	Maple Grove	MN	55369
1.5	45.13170729	-93.34535711	16126	9700 Regent Avenue North	Brooklyn Park	MN	55443-1402
1.25	45.2700472	-92.98825697	16255	879 Southwest 4th Street	Forest Lake	MN	55025-1549
1	44.16420017	-92.17070948	16332	330 1st Avenue Southwest	Plainview	MN	55964-1361
2.5	44.96322934	-93.84164085	16586	401 Carter Street Northeast	Watertown	MN	55388-9283
1	44.93581066	-93.61932042	16610	3750 Shoreline Drive	Wayzata	MN	55391-9784
1	45.1901823	-93.29555509	16717	1199 121st Avenue Northwest	Coon Rapids	MN	55448-2014
1.25	45.00845955	-93.66364119	17145	1645 Pioneer Avenue	Maple Plain	MN	55359
1	45.13217528	-93.2422031	17272	1141 89th Avenue Northeast	Blaine	MN	55434-3341
2	45.24443324	-93.4713245	17768	15050 Armstrong Boulevard Northwest	Ramsey	MN	55303-4322
1.5	45.12072878	-93.40252169	17827	415 Central Avenue	Osseo	MN	55369-1163
1.75	45.10939367	-93.35463817	17833	5700 85th Avenue North	Brooklyn Park	MN	55443-1819
2	45.18694327	-93.23815889	17914	11920 Ulysses Street Northeast	Blaine	MN	55434
1	44.13065297	-92.2508855	18034	135 East Main Street	Elgin	MN	55932-9731
1	44.90068939	-93.44148422	18332	5700 Rowland Road	Minnetonka	MN	55343
1	45.24661656	-93.412845	18416	15153 Nowthen Boulevard Northwest	Ramsey	MN	55303-6140
1.25	45.04089367	-93.52424913	18910	92 Hamel Road	Hamel	MN	55340-9625
2.5	45.08070049	-93.50133193	18911	6900 Lawndale Lane	Maple Grove	MN	55311-3001
1	45.30627147	-93.56740393	18920	415 Jackson Avenue	Elk River	MN	55330-1327
1.5	45.15599433	-93.30414108	19001	1460 Egret Boulevard	Coon Rapids	MN	55433-4828

impact_date	Monday, August 5, 2019
region	MN
Hail size	Count of locations
1.00	32
1.25	21
1.50	5
1.75	7
2.00	11
2.25	5
2.50	2

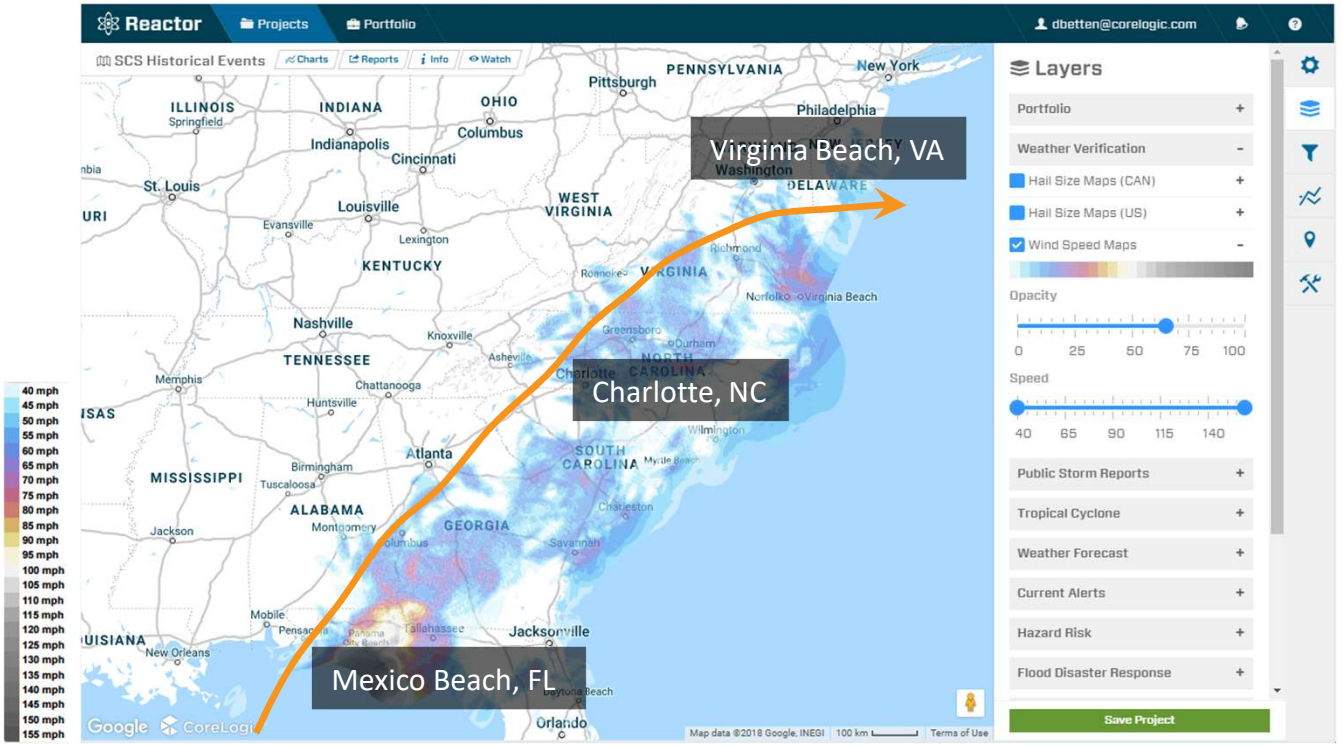
Hurricane Michael

Forecast Track

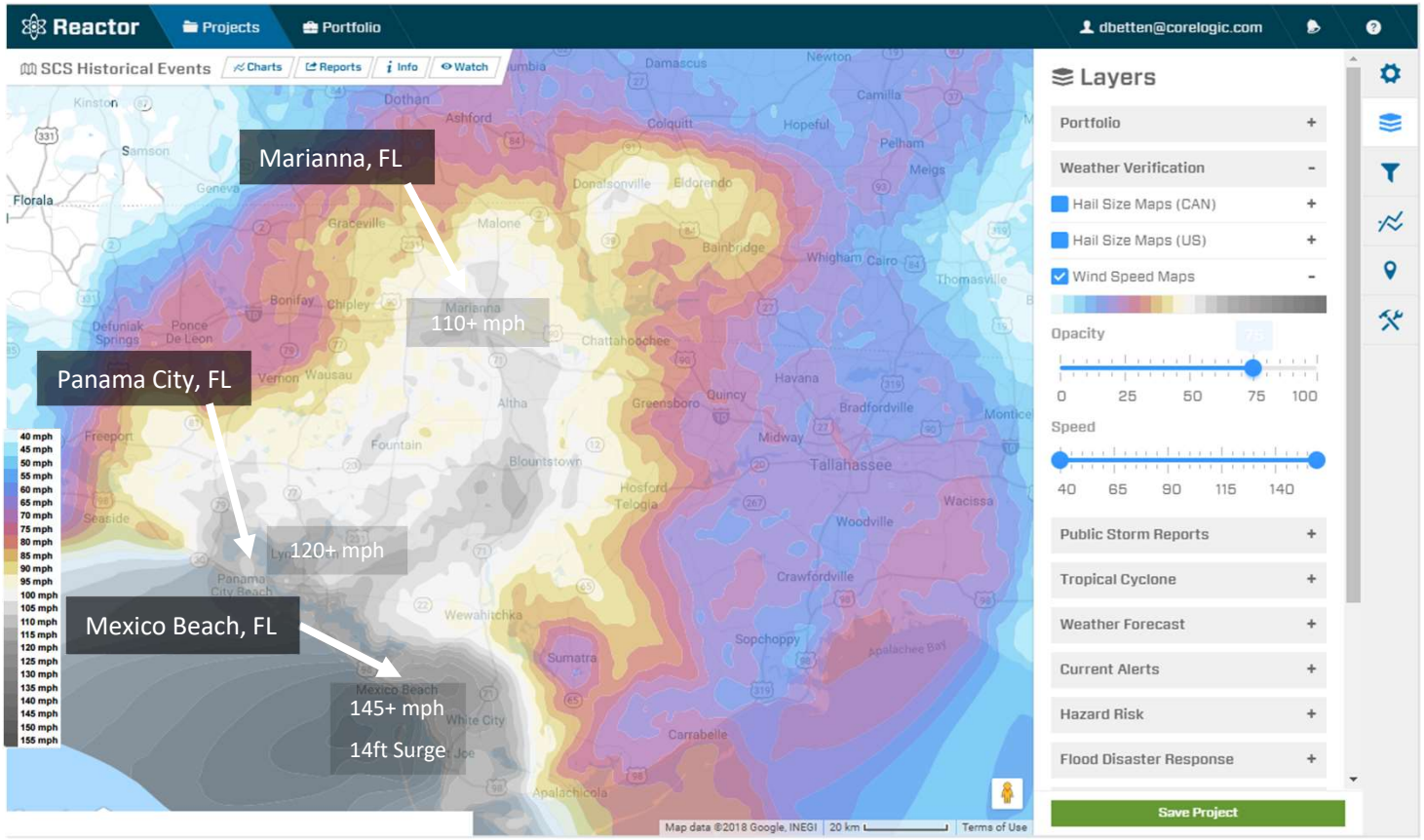


Hurricane Michael

Wind Speed Map



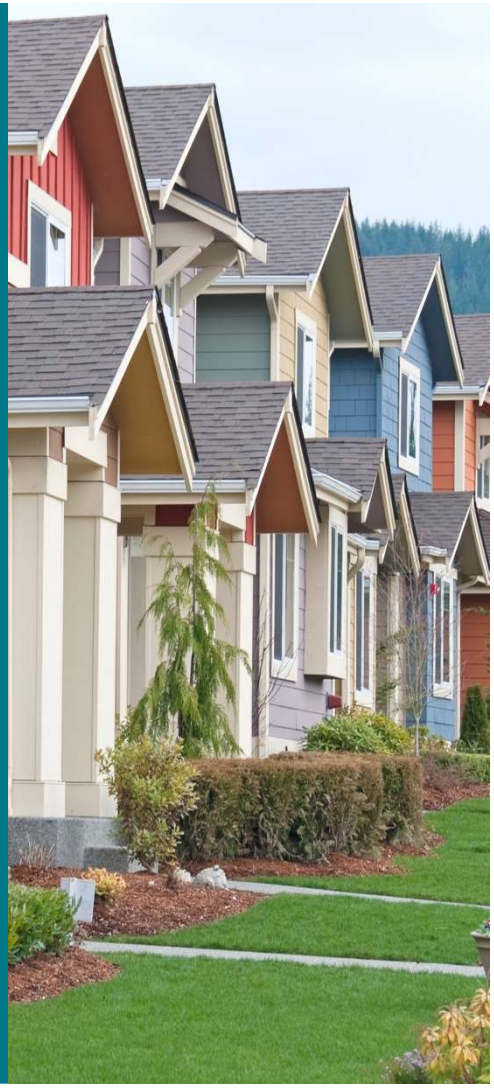
CoreLogic Reactor Windspeed Map for Hurricane Michae

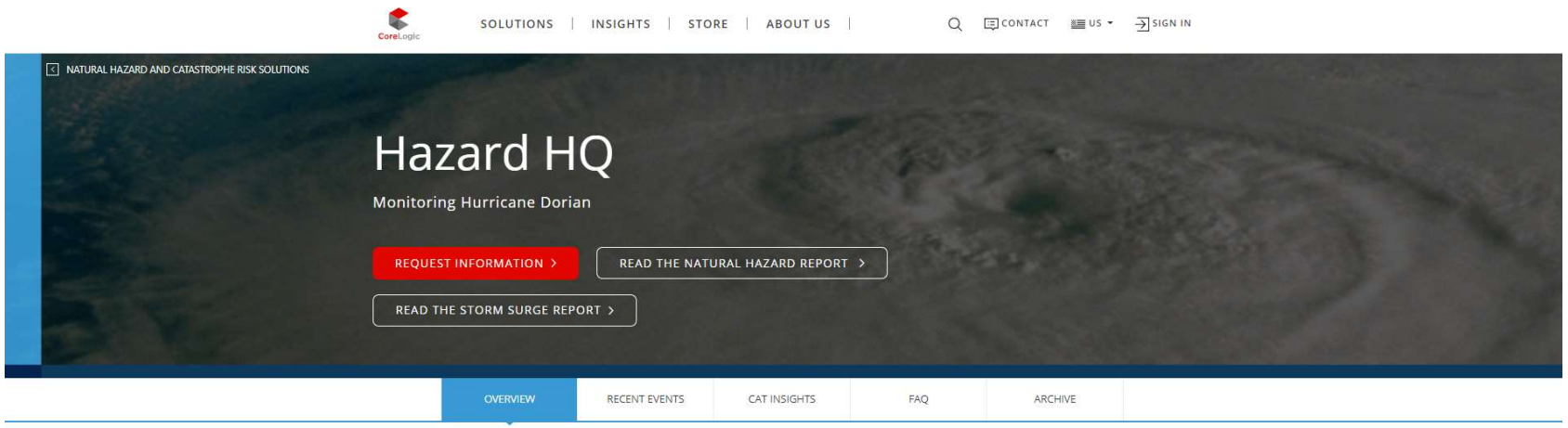


CoreLogic®

Real-Time Event Response

Hazard HQ™





[9/1 Update] Hurricane Dorian

Hurricane Dorian is now a Category 5 hurricane with maximum winds at 180 mph according to the National Hurricane Center. The hurricane force wind field has expanded by 50%, going from a 30 mile radius to a 45 mile radius.

The majority of forecasts keep Dorian offshore, but some still show landfall in central or north Florida or even along the coasts of North and South Carolina. Even without an official landfall (where the eye crosses over land), the whole coast is within the possible track; however, at no point does the expected track actually touch land.

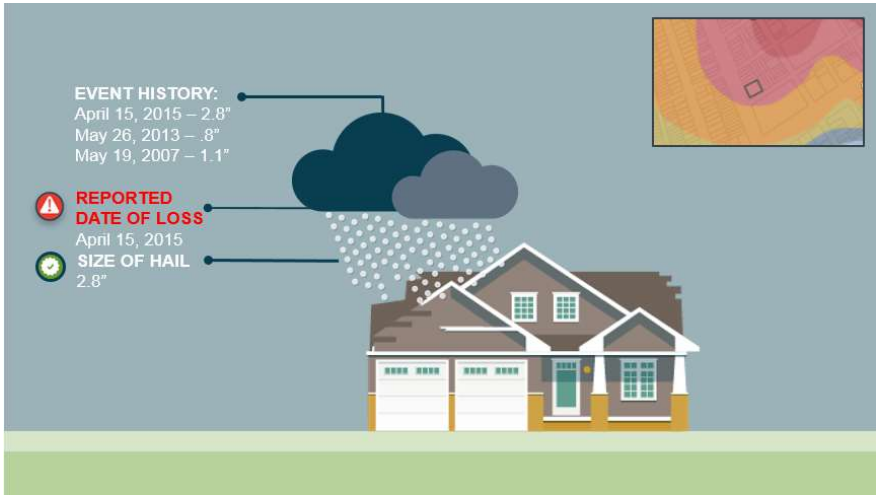
CoreLogic released updated numbers for Hurricane Dorian exposure in North Carolina and South Carolina in addition to the earlier exposure numbers from Florida. Since there is a great deal of uncertainty in both the track and the intensity, CoreLogic has included how many

CoreLogic Event Response – Hazard HQ

- Pre-landfall proxies for major TC events
- Webinars for major events as they unfold
- Proxies post major events to allow clients to estimate portfolio losses
- Event footprints for integration into RQE®
- A number of additional services are available for North American events:
  - Reactor, which provides rapid visualization of weather event impacts (hail, wind, flood) on a portfolio
  - Property Valuation (Reconstruction & Market), Open Liens, Equity, Foreclosure, Ownership
  - Property Characteristics

SCS Real-Time Event Management

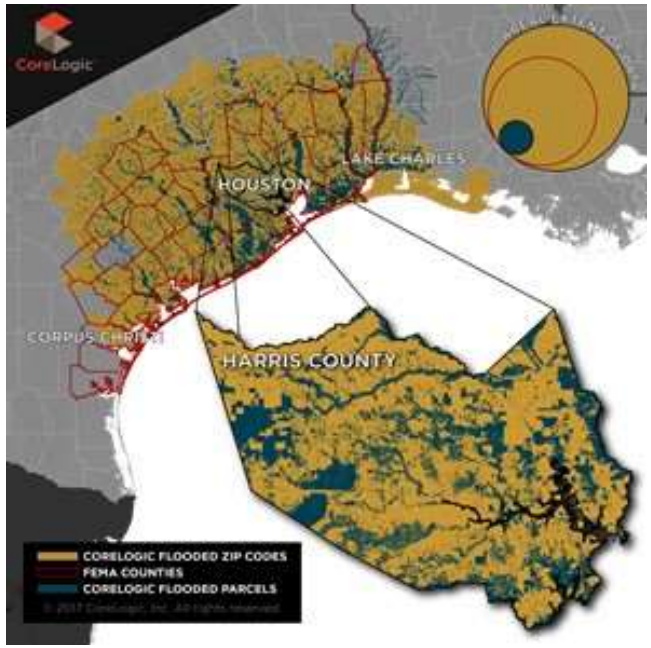
- Allows users to import real-time SCS event data into RQE to access the **loss impacts for live events**
- High-resolution modeling based on the CoreLogic proprietary radar-based **weather forensic algorithm**
- **What's in it for you?**
  - Claims management process
  - Capital outlays
  - Quick access to loss impacts on the business and enable timely reporting to users groups and personas



Forensic Hail Verification Model

Hurricane Harvey (2017)

- CoreLogic (Aug. 31, 2017) estimates
  - Total residential insured and uninsured flood loss: **$25 - $37 billion**
  - NFIP loss: **$6 - $9 billion**
- Current modeled NFIP loss (RQE v18) **$9.1 billion**
- To date, NFIP has paid claims of **$8.9 billion***
- Approximately 70% of flood damage is uninsured
- More than 50% of properties in Houston at high and moderate risk of flood are not in designated flood zones



*https://www.fema.gov/significant-flood-events

California Wildfires (2018)

Camp Fire Analysis based on November 15, 2018 Perimeter

Wildfire Perimeter	Number of Structures at High or Extreme Risk	Reconstruction Cost Value (RCV)
Within the Perimeter	16,344	$3,935,833,947
0 to 0.5 Miles Outside the Perimeter	2,114	$438,626,530
0.5 to 1 Mile Outside the Perimeter	1,359	$287,346,084

CoreLogic Loss Estimates | November 27, 2018

	Residential Loss ($ Billions)	Commercial Loss ($ Billions)	Total Loss ($ Billions)
Camp Fire	8 – 9	3 – 4	11 – 13
Woolsey Fire	3.5 – 5.5	~0.5	4 – 6
Total	11.5 – 14.5	3.5 – 4.5	15 – 19