Date: 10/20/21

Virtual Meeting
(in lieu of meeting at the 2021 Fall National Meeting)

CATASTROPHE RISK (E) SUBGROUP
Wednesday, October 27, 2021
12:00 – 1:00 p.m. ET / 11:00 a.m. – 12:00 p.m. CT / 10:00 – 11:00 a.m. MT / 9:00 – 10:00 a.m. PT

ROLL CALL

Wanchin Chou, Chair
Connecticut
Halina Smosna
New York
Robert Ridenour, Vice Chair
Florida
Tom Botsko
Ohio
Laura Clements
California
Andrew Schallhorn
Oklahoma
Judy Mottar
Illinois
Will Davis
South Carolina
Gordon Hay
Nebraska
Miriam Fisk
Texas
Anna Krylova
New Mexico

NAIC Support Staff: Eva Yeung

AGENDA

1. Consider Adoption of its Sept. 28 minutes—Wanchin Chou (CT) 
   Attachment A

2. Discuss the Possibility of Allowing Third-Party Models to Calculate the Catastrophe Model Losses—Wanchin Chou (CT)

3. Consider Exposure of Proposal 2021-15-CR (Adding KCC Model)—Wanchin Chou (CT) 
   Attachment B

4. Receive an Update from the Catastrophe Model Technical Review Ad Hoc Group—Wanchin Chou (CT) and Halina Smosna (NY)

5. Hear a Presentation from RMS Regarding its Wildfire Model—Michael Young (RMS) 
   Attachment C

6. Discuss Impact Analysis on Different Wildfire Vendor Models—Wanchin Chou (CT)

7. Discuss Any Other Matters Brought Before the Subgroup—Wanchin Chou (CT)

8. Adjournment
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The Catastrophe Risk (E) Subgroup of the Property and Casualty Risk-Based Capital (E) Working Group of the Capital Adequacy (E) Task Force met Sept. 28, 2021. The following Subgroup members participated: Wanchin Chou, Chair, Susan Andrews, and Qing He (CT); Robert Ridenour, Vice Chair, David Altmaier, and Jane Nelson (FL); Li Lim, Laura Clements, Giovanni Muzzarelli, Mitra Sanandajifar, and Lynne Wehmueller (CA); Judy Mottar (IL); Gordon Hay (NE); Anna Krylova (NM); Halina Smosna (NY); Tom Botsko and Dale Bruggeman (OH); Andrew Schallhorn (OK); Will Davis (SC); and Miriam Fisk, Andy Liao, Rebecca Armon, and Monica Avila (TX).

1. Discussed its 2021 Working Agenda

Mr. Chou said one of the items in the 2021 working agenda that will require being accomplished by the 2022 Spring National Meeting is the implementation of the wildfire peril in the Rcat component for informational purposes only. He said he expects the Catastrophe Model Technical Review Ad Hoc Group will finish the entire review process by end of October. Mr. Chou also stated that different modeling firms are in the stage of performing the impact analysis. Then, the Subgroup will start developing the formula structure of the wildfire peril based on the analysis results and findings. Mr. Chou said he anticipates the initial structure will be shared with all the interested parties at the Fall National Meeting.

2. Heard an Update from its Catastrophe Model Technical Review Ad Hoc Group

Ms. Wehmueller said the ad hoc group met twice to review some additional technical questions with Karen Clark & Company (KCC) on its wildfire model since the Summer National Meeting. She said the ad hoc group gained a better understanding on different aspects of its model during this question-and-answer (Q&A) section. She also said the ad hoc group will meet next month with Risk Management Solutions (RMS) to review/discuss some technical questions of its model. She said she anticipates the ad hoc group will have a better idea on how to implement the risk-based capital (RBC) charge for wildfire peril after the impact analysis is completed by the modeling firms.

3. Heard a Presentation from KCC Regarding the KCC U.S. Wildfire Reference Model

Glen Daraskevich (KCC) said this presentation includes the following main topics: 1) current wildfire trends; and 2) an overview of the KCC U.S. wildfire reference model. He stated that wildfires are a major driver of the U.S. insured losses, particularly in California. He indicated that the KCC U.S. Wildfire Model employs a physical modeling approach, which includes hazard, vulnerability, and financial modules. He stated that the hazard module predicts where the future events are most likely to occur. The vulnerability module estimates the level of damage that would occur to any type of structures. He also said the model has undergone meticulous validation of simulated events versus historical footprints, and it details evaluations of insurer claims data at an event and location resolution.

4. Discussed the Possibility of Allowing Additional Third-Party Models or Adjustments to the Vendor Models

Mr. Chou said another item listed in the working agenda that requires the Subgroup to address soon is to evaluate the possibility of allowing additional third-party models or adjustments to the vendor models to calculate the catastrophe model losses. He said the KCC earthquake and hurricane models have been reviewed and verified by the Florida Commission. He said he believes adding its models as one of the approved commercial models is worth considering. Mr. Botsko said he agrees. Scott Williamson (Reinsurance Association of America—RAA) said the RAA supports the KCC being added to the approval list. The seems to qualify under the same standards as the other modeling firms have. Mr. Chou said a proposal for adding the KCC models as one of the approval models for earthquake and hurricane perils will be drafted for discussion in the upcoming meeting.

Mr. Chou said the Subgroup will continue discussing all the outstanding issues in the meeting next month.

Having no further business, the Catastrophe Risk (E) Subgroup adjourned.
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The proposed change would add the KCC as one of the approved third party commercial vendor catastrophe models.

**REASON OR JUSTIFICATION FOR CHANGE**

To keep the consistency with other third party commercial vendors for earthquake and hurricane catastrophe models. KCC has got the approval from the Florida Commission on hurricane loss projection methodology on 6/19/2019 and 6/4/2021.

**Additional Staff Comments:**

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The projected losses can be modeled using the following NAIC approved third party commercial vendor catastrophe models: AIR, EQECAT, CoreLogic, RMS, KCC, the ARA HurLoss Model, or the Florida Public Model for hurricane, as well as catastrophe models that are internally developed by the insurer or that are the result of adjustments made by the insurer to vendor models to represent the own view of catastrophe risk (hereinafter “own models”).

However, an insurer seeking to use an own model must first obtain written permission to do so by the domestic or lead state insurance regulator. In the situation where the model output is used to determine the catastrophe risk capital requirement for a single entity, the regulator granting permission to use the own model is the domestic state. In the situation where the model output is used to determine the catastrophe risk capital requirement for a group, the grantor is the lead state regulator. In the situation where the insurer seeking permission is a non-U.S. insurer, the grantor shall be the lead state regulator. Under all scenarios, the regulator that is granting permission should inform other domestic states that have a catastrophe risk exposure and share the results of the review.

To obtain permission to use the own model, the insurer must provide the domestic or lead state insurance regulator with written evidence of each of the following:

1. The use of the own model is reasonable considering the nature, scale, and complexity of the insurer’s catastrophe risk;
2. The own model is used for catastrophe risk management, capital assessment, and the capital allocation process and the model has been used for at least the last 3 years;
3. The perils included in the RBC Catastrophe Risk Charge have been validated by the insurer and that these perils include both US and global exposures, where applicable;
4. The own model has been developed using reasonable data and assumptions and that model results used in determining the RBC Catastrophe Risk Charge reflect exposure data that is no older than six months;
5. The insurer has individuals with experience in developing, testing and validating internal models or engages third parties with such experience. The insurer must provide supporting model documentation and a copy of the latest validation report and the insurer is solely responsible for the relevant cost. For each peril included in the RBC Catastrophe Risk Charge, the validation report should attest that the projected losses are a reasonable quantification of the exposure of the reporting entity. The validation report must provide a description of the scope, content, results and limitations of the validation, the individual qualifications of validation team and the date of the validation. Both the model documentation and the model validation report must be provided at a minimum once every five years, or whenever there is a material change in the model or the insurer’s exposure to catastrophe exposure.
6. The results of the own model should be compared with the results produced by at least one of the following models: AIR, EQECAT, CoreLogic, RMS, KCC, ARA HurLoss, or the Florida Public Model. The insurer must provide the comparison and an explanation of the drivers of differences between the results produced by the internal model vs. results produced by the selected prescribed model.
7. If the own model has been approved or accepted by the non-U.S. group-wide supervisor for use in the determination of regulatory capital, the insurer must submit evidence, if available, from the non-US group-wide supervisor of the most recent approval/acceptance including the description of scope, content, results and limitations of the approval/acceptance process and dates of any planned future approval/acceptance, if known. The name and the contact information of a contact person at the non-US group-wide supervisor should also be provided for questions on the approval/acceptance process.

If the lead or domestic state determines that permission to use the own model cannot be granted, the insurer shall be required to determine the RBC Catastrophe Risk Charge through the use of one of the third party commercial vendor models (AIR, EQECAT, CoreLogic, RMS, KCC, ARA HurLoss (hurricane only)), or the Florida Public Model for hurricane, as advised by the lead state or domestic state.
If the lead or domestic state determines that permission to use the own model can be granted to determine the RBC Catastrophe Risk Charge, the model will be subject to additional review through the ongoing examination process. If, as a result of the examination, the lead or domestic state determines that permission to use the own model should be revoked, the insurer may be required to resubmit the risk-based capital filing and any past filings so impacted where own model was used, as directed by the lead state or domestic state.

If the insurer obtains permission to use the own model, it cannot revert back to using third party commercial vendor models to determine the RBC Catastrophe Risk Charge in subsequent reporting periods, unless this is agreed with the lead or domestic state that granted permission.

The contingent credit risk charge should be calculated in a manner consistent with the way the company internally evaluates and manages its modeled net catastrophe risk.

Note that no tax effect offsets or reinstatement premiums should be included in the modeled losses. Further note that the catastrophe risk charge is for earthquake and hurricane risks only.

As per the footnote on this page, modeled losses to be entered PR027A and PR027B in Lines (1) through (4) are to be calculated using one of the third party commercial vendor models – AIR, EQECAT, Corelogic, RMS, KCC, ARA HurLoss (hurricane only); or the Florida Public Model (hurricane only) or the insurer’s own catastrophe model; and using the insurance company’s own insured property exposure information as inputs to the model. The insurance company may elect to use the modeled results from any one of the models, or any combination of results of two or more of the models. Each insurer will not be required to utilize any prescribed set of modeling assumptions but will be expected to use the same exposure data, modeling, and assumptions that the insurer uses in its own internal catastrophe risk management process. Any exceptions must be explained in the required Attestation Re: Catastrophe Modeling Used in RBC Catastrophe Risk Charges within this RBC Report.

The Grand Total (PR027) page includes an interrogatory to support an exemption from filing the catastrophe risk charge. Any company qualifying for exemption from the earthquake risk charge must identify the particular criteria from among (1a), (1b), (2) and (3) that provides its qualification for exemption, and may leave the other three items from this group of four possible qualifications for exemption blank; except identification of criteria (3) as the basis for the exemption requires a further answer to (3a) and (3b). If an insurer does not write or assume earthquake risks leaving no gross exposure, enter an “X” in interrogatory 3, with no need to fill in (3a) and (3b). Any company qualifying for exemption from the hurricane risk charge must identify the particular criteria from among (4a), (4b), (5) and (6) that provides its qualification for exemption, and may leave the other three items from this second group of four possible qualifications for exemption blank. If the company qualifies for exemption from the earthquake risk charge, page PR027A and line (1) on this page may be left blank. If the company qualifies for exemption from the hurricane risk charge, page PR027B and line (2) on this page may be left blank. If an insurer does not write or assume hurricane risks leaving no gross exposure, enter an “X” in interrogatory 6.

In general, the following conditions will qualify a company for exemption: if it uses an intercompany pooling arrangement or quota share arrangement with U.S. affiliates covering 100% of its earthquake and hurricane risks such that there is no exposure for these risks; if it has a ratio of Insured Value – Property to surplus as regards policyholders of less than 50%; or if it writes Insured Value – Property that includes hurricane and/or earthquake coverage in catastrophe-prone areas representing less than 10% of its surplus as regards policyholders.

“Insured Value – Property” includes aggregate policy limits for structures and contents for policies written and assumed in the following annual statement lines – Fire, Allied Lines, Earthquake, Farmowners, Homeowners, and Commercial Multi-Peril.

“Catastrophe-Prone Areas in the U.S.” include:

i. For hurricane risks, Hawaii, District of Columbia and states and commonwealths bordering on the Atlantic Ocean and/or the Gulf of Mexico including Puerto Rico.

ii. For earthquake risk or for fire following earthquake, any of the following commonwealth or states: Alaska, Hawaii, Washington, Oregon, California, Idaho, Nevada, Utah, Arizona, Montana, Wyoming, Colorado, New Mexico, Puerto Rico, and geographic areas in the following states that are in the New Madrid Seismic Zone - Missouri, Arkansas, Mississippi, Tennessee, Illinois and Kentucky.
CALCULATION OF CATASTROPHE RISK CHARGE FOR EARTHQUAKE  PR027A

<table>
<thead>
<tr>
<th>Earthquake Reference</th>
<th>Modeled Losses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1) Direct and Assumed</td>
</tr>
<tr>
<td>(1) Worst Year in 50</td>
<td>Company Records</td>
</tr>
<tr>
<td>(2) Worst Year in 100</td>
<td>Company Records</td>
</tr>
<tr>
<td>(3) Worst Year in 250</td>
<td>Company Records</td>
</tr>
<tr>
<td>(4) Worst Year in 500</td>
<td>Company Records</td>
</tr>
<tr>
<td>(5) Y/N</td>
<td></td>
</tr>
</tbody>
</table>

(5) Has the company reported above, its modeled earthquake losses using an occurrence exceedance probability (OEP) basis?

<table>
<thead>
<tr>
<th>Reference</th>
<th>Amount</th>
<th>Factor</th>
<th>RBC Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(6) Net Earthquake Risk</td>
<td>L(2) C(2)</td>
<td>0</td>
<td>1.000</td>
</tr>
<tr>
<td>(7) Contingent Credit Risk for Earthquake Risk</td>
<td>L(2) C(3) - C(4)</td>
<td>0</td>
<td>0.018</td>
</tr>
<tr>
<td>(8) Total Earthquake Catastrophe Risk (AEP Basis)</td>
<td>If L(5) C(5) = &quot;N&quot;, L(8) C(6) = L(6) C(7)+ L(7) C(7), otherwise &quot;0&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(9) Total Earthquake Catastrophe Risk (OEP Basis)</td>
<td>If L(5) C(5) = &quot;Y&quot;, L(9) C(6) = L(6) C(7)+ L(7) C(7), otherwise &quot;0&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(10) Total Earthquake Catastrophe Risk</td>
<td>L(8) C(7) + L(9) C(7)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Lines (1)-(4): Modeled losses to be entered on these lines are to be calculated using one of the following NAIC approved third party commercial vendor catastrophe models - AIR, Corelogic, RMS, or KCC, the ARRA HurLoss Model, or the Florida Public Model for hurricane; or a catastrophe model that is internally developed by the insurer and has received permission of use by the lead or domestic state. The insurance company's own insured property exposure information should be used as inputs to the models. The insurance company may elect to use the modeled results from any one of the models, or any combination of the results of two or more of the models. Each insurer will not be required to utilize any prescribed set of modeling assumptions, but will be expected to use the same data, modeling, and assumptions that the insurer uses in its own internal catastrophe risk management process. An attestation to this effect and an explanation of the company's key assumptions and model selection may be required, and the company's catastrophe data, assumptions, model and results may be subject to examination.

† Column (3) is modeled catastrophe losses that would be ceded under reinsurance contracts. This should be associated with the Net Modeled Losses shown in Column (2).

†† Column (4) is modeled catastrophe losses that would be ceded to the categories of reinsurers that are not subject to the RBC credit risk charge (i.e., U.S. affiliates and mandatory pools, whether authorized, unauthorized, or certified).

Denotes items that must be manually entered on the filing software.
CALCULATION OF CATASTROPHE RISK CHARGE FOR HURRICANE PR027B

<table>
<thead>
<tr>
<th>Hurricané Reference</th>
<th>Direct and Assumed</th>
<th>Net</th>
<th>Ceded Amounts Recoverable</th>
<th>Ceded Amounts Recoverable with zero Credit Risk Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Worst Year in 50 Company Records</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2) Worst Year in 100 Company Records</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) Worst Year in 250 Company Records</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4) Worst Year in 500 Company Records</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(5) Has the company reported above, its modeled hurricane losses using an occurrence exceedance probability (OEP) basis?

<table>
<thead>
<tr>
<th>Amount</th>
<th>Factor</th>
<th>RBC Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(6) Net Hurricane Risk</td>
<td>L(2) C(2)</td>
<td>L(2) C(3) - C(4)</td>
</tr>
<tr>
<td>(7) Contingent Credit Risk for Hurricane Risk</td>
<td>If L(5) C(5) = &quot;N&quot;, L(8) C(6) + L(9) C(7) = L(7) C(7), otherwise &quot;0&quot;</td>
<td></td>
</tr>
<tr>
<td>(8) Total Hurricane Catastrophe Risk (AEP Basis)</td>
<td>If L(5) C(5) = &quot;Y&quot;, L(9) C(6) + L(9) C(7) = L(7) C(7), otherwise &quot;0&quot;</td>
<td></td>
</tr>
<tr>
<td>(9) Total Hurricane Catastrophe Risk (OEP Basis)</td>
<td>L(8) C(7) + L(9) C(7)</td>
<td></td>
</tr>
</tbody>
</table>

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Denotes items that must be manually entered on the filing software.
FLORIDA COMMISSION ON HURRICANE LOSS PROJECTION METHODOLOGY

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Vacant
Insurance Consumer Advocate,
Florida Department of Financial Services

Vacant
Professional Structural Engineer

Vacant
Insurance Finance Expert

June 11, 2019

Dr. Nozar Kishi
Karen Clark & Company
116 Huntington Avenue
Boston, MA 02116

Dear Dr. Kishi:

This will confirm the finding of the Florida Commission on Hurricane Loss Projection Methodology on June 11, 2019, that the Karen Clark & Company model has been determined acceptable for projecting hurricane loss costs and hurricane probable maximum loss levels for residential rate filings. The determination of acceptability expires on November 1, 2021.

The Commission has determined that the KCC US Hurricane Reference Model 2.0, RiskInsight® 4.9.2 (Build 190307:1700) limited to the options selected in the input form provided in Standard A-1, Hurricane Modeling Input Data and Output Reports, Disclosure 4 complies with the standards adopted by the Commission on October 25, 2017, and concludes that the KCC US Hurricane Reference Model 2.0, RiskInsight® 4.9.2 (Build 190307:1700) limited to the Florida hurricane model options selected (Standard A-1, Hurricane Modeling Input Data and Output Reports, Disclosure 4) is sufficiently accurate and reliable for projecting hurricane loss costs and hurricane probable maximum loss levels for residential property in Florida.
On behalf of the Commission, I congratulate you and your colleagues. We appreciate your participation and input in this process.

Sincerely,

Floyd Yager, Chair
Florida Commission on Hurricane Loss Projection Methodology
June 4, 2021

Mr. Glen Daraskevich
Karen Clark & Company
116 Huntington Avenue
Boston, Massachusetts 02116

Dear Mr. Daraskevich,

This will confirm the finding of the Florida Commission on Hurricane Loss Projection Methodology on June 2, 2021, that the Karen Clark & Company model has been determined acceptable for projecting hurricane loss costs and hurricane probable maximum loss levels for residential property in Florida. The determination of acceptability expires on November 1, 2023.

The Commission has determined that the KCC US Hurricane Reference Model Version 3.0 on RiskInsight® 4.10.3.129 (primary platform), limited to the options selected in the input form and reported in the output form provided in Standard A-1, Hurricane Modeling Input Data and Output Reports, Disclosures 4 and 5:

(1) complies with the hurricane standards adopted by the Commission on October 29, 2019, and

(2) is sufficiently accurate and reliable for projecting hurricane loss costs and probable maximum loss levels for residential property in Florida.

On behalf of the Commission, I congratulate you and your colleagues. We appreciate your participation and input in this process.

Sincerely,

Floyd Yager, Chair
THE WEST IS IN A HISTORIC DROUGHT

- Many places in the West are in an historic drought (27.68% in D4 Exceptional Drought)
- 99.12% of the West is drier than normal
- Most areas receive minimal rainfall during the summer months
- Drought is expected to continue/worsen through the end of the wildfire season
RATIONALE FOR DEVELOPMENT OF A NORTH AMERICA WILDFIRE MODEL

Recent Events

7 events >$1B in previous three years

Focus on risks in “body” of EP curve

First Wildfire insolvency in 2018

Avoid Surprises with Probabilistic Accumulations

Deterministic tools not enough
Simple mapping/scoring techniques and models that don’t explicitly consider ember travel, smoke, and urban conflagration are no longer sufficient.

Wildfire cat analytics must catch up with the sophistication used to manage other nat cat perils.
WILDFIRE SEVERITY MAY BE THE NEW (AB)NORMAL

Including 30 major fires from 2017 - 2020. $47B in insured losses to date.

Wiped out 25 years of U/W profit in California (recovered via subrogation)

Average annual loss
$4.7 billion

10 years

< $100 million
$600 million

1964 - 1990
1991 – 2010
2011-2020

Average Annual Loss (AAL) from United States wildfires

WHY?

- More houses in high risk areas
- Climate change
- Aggressive firefighting in 20th century → excessive burnable vegetation

WHY?

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Average Annual Loss (AAL) from United States wildfires

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- Aggressive firefighting in 20th century → excessive burnable vegetation

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EDUCATIONAL DOCUMENT – AVAILABLE ON NAIC INTRANET

- Summary of RMS HD Wildfire model
- Component development
- Validation
- Data sources
- Uses

Available through NAIC / CIPR
- Regulator Use only
RMS North America Wildfire model – Comprehensive view of wildfire risk

Key Features
- Probabilistic Wildfire simulations: 50,000 years
- Number Events: 72 million
- Coverage: United States
- Realistic fire, smoke, and ember footprints at 50 m resolution
- Underwriting Data:
  - Wildfire Hazard Data products (Distance to Vegetation / Fuel Type)
  - Risk Score Data products

Key differentiators
- Explicit ember and smoke simulations to detail impacts beyond the historical fire perimeters
- Robust set of Secondary Modifiers to capture building / community Mitigation and Fire Suppression
- Urban Conflagration model captures extreme tail risk events (like 2017 Wine Country)
- Hours & Spatial Clauses in Reinsurance Treaties
CATASTROPHE MODELING FRAMEWORK

Stochastic Event Catalogue
Simulate wildfire scenarios for 50,000 versions of next year

Assess Hazard
Quantify spatial extent & intensity of heat, ember, smoke hazards using physical science models

Apply Exposure
Apply replacement value of properties at risk for structure, contents, and business interruption

Calculate Damage
Estimate damage for different vulnerability classes based on material, height, occupancy, year built & mitigation measures

Quantify Financial Loss
Apply insurance terms & conditions to estimate loss to policy holder, insurer, reinsurer
WILDFIRE HAZARD MODELING FRAMEWORK

Landscape & Fire Behavior Parameters

Fire Weather Simulations

Fire Ignitions

Fire Spread

Ember Intensity

Urban Conflagration

Smoke Spread

Topography
Surface Fuels
Canopy Fuels
Forest Fuels
Dist. to Vegetation

50,000-year Extreme Weather Simulations

50,000-year Extreme Wind Simulations

Climate Change “So-Far”

Simulate Ignitions considering urbanization patterns

Minimum Travel Time Algorithm = Realistic fire durations

Explicit Ember Transport Modeling

Structure to Structure Spread = Next Coffey Park

Smoke Footprints: Emission and Transport models

Up to 20% of loss
STOCHASTIC FIRE WEATHER SIMULATIONS

Simulate 50,000 years of daily fire weather
- ERC from NFDRS
  - Fuel moisture correlates with ignition risk & fire spread.
- PCA approach
  - Short & long-term Fuel Moisture,
  - Temperature, Humidity, Precipitation, Teleconnections (ENSO)
  - Daily wind speed & directions for each simulated month

Fire weather trends/variability dictate frequency & correlation of wildfire risk

Simulate extreme wind events and associated dryness
- Frequency & duration studies on Santa Ana & Diablo winds in California
- Special wind regions outside of California based on FEMA, ASCE

Extreme Weather drives tail risk for this peril
FIRE IGNITION MODELING

Simulate 50,000 years of wildfire ignitions

- Generalized Additive Model (GAM)
  - Human (utility, arson) & Natural (lightning) causes
  - Weather, Landscape, Fuel, Distance To Road Network
- Historical FSOD data on US fire ignitions
  - Fire ignitions, causes, size, discovery, containment
  - 1992-2015 data from USFS
- Large fires contribute 90-95% total historical burned areas
  - >300 ac in Western US & >100 ac in other states
  - 1,350 wildfires per year on average

GAM model captures historical trends as well as potential ignitions in areas not observed in historical record

84% of wildfire ignitions are human-induced
Coffey Park neighborhood:
Area of WF-Induced Urban Conflagration:

Key Drivers:
Triggered by extreme weather, Santa Ana/Diablo winds
Ember Transport and Accumulation
Topography and Structure Spacing

California Department of Insurance (as of 01/31/2018)
- $10B in Insured Loss
- Majority from Tubbs Fire
  - 5,000+ destroyed structures
  - 20,000 claims
40% of destroyed structures were “unzoned”
Initiation of urban conflagration

Modeled conflagration extent

Function of:
- Population/Structure Density
- Extreme Weather
- Fuels
- Suppression assumptions

Attachment C
SMOKE MODELING

- Additional 20% of Wildfire losses can be from smoke & evacuation
- Numerous low severity claims for clean-up due to health concerns
- Can turn Smoke on/off in model

Modeled Smoke Footprint include:
- Dominant wind direction and uncertainty
- Smoke concentration distance
- Smoke dispersion effect
SMOKE MODELING

- Additional 20% of Wildfire losses can be from smoke & evacuation
- Numerous low severity claims for clean-up due to health concerns
- Can turn Smoke on/off in model

Cumulative Smoke Footprints
- Highly Damageable Smoke
- Moderate Damageable Smoke

2003 Cedar Fire
Factors Influencing Wildfire Losses

- Rate of Fire Spread
- Distance to Flammable Vegetation
- Fuel Type
- Heat Intensity
- Slope
- Wind-Borne Embers
- Smoke

Attachment C
WILDFIRE VULNERABILITY FRAMEWORK

Site Hazard Data *
- Slope
- Distance to Vegetation
- Fuel Type

Primary Modifiers
- Occupancy
- Construction
- Number of Stories
- Year Built
- Floor Areas

Secondary Modifiers
- Roof Characteristics
- Ember Accumulators
- Cladding/Deck
- Infrastructure
- Accessibility
- Conditions

* Users can override model defaults
AUTOMATICALLY DETERMINES KEY RISK PARAMETERS FROM HIGH RESOLUTION DATA SET

Distance To Vegetation

Fuel Classes

50 m Resolution
INDIVIDUAL BUILDINGS CAN BE MITIGATED FOR WILDFIRE

Wildfire-Resistance: Make the "RIGHT" Choices

Source: IBHS  
https://disastersafety.org/
APPLICATION OF WILDFIRE MITIGATION TO INSURED PROPERTY EXPOSURE

Demonstrate ability of CAT models to reflect structure-specific and community level mitigation.

- Summary of IBHS & NFPA Firewise USA recommendations
- These mitigation benefits modeled for 3 sites in California, Oregon, Colorado
- A simple cost-benefit analysis of these mitigation features is examined and documented.

Key Return Periods of Industry Loss

Occurrence Return Periods (OEP) - CA
- Camp 2018 ~ 70 yr.
- Wine 2017 ~ 90 yr.

Annual Return Periods (AEP) - CA
- 2017 Season ~ 80 yr.
- 2018 Season ~ 70 yr.

MODEL VALIDATES WELL AGAINST KEY HISTORICAL EVENTS

California Occurrence EP
All LOB (Fire + Smoke)

Exceedance Probability
Loss ($)
Billions

Camp Fire (2018)
Wine Country Fires (2017)

Industry Reported Losses (2018)
Modeled IED Loss (GR)

+ $100B events are possible
A SOLUTION FOCUSED ON QUALITY

- Continental Coverage and High Resolution
- Explicit Heat, Embers, and Smoke
- Flexible Financial Modeling Framework
- RMS Wildfire Solutions
- Construction and Mitigation Measures
- Industry Partnerships
- Consistent Underwriting Data

Enable Accumulation Management
Drive Portfolio Growth
Ensure Consistent Underwriting
Quantify Mitigation Impacts
ABOUT RMS

RMS is the world’s leading provider of products, services, and expertise for the quantification and management of catastrophe risk. More than 400 leading insurers, reinsurers, trading companies, and other financial institutions rely on RMS models to quantify, manage, and transfer risk. As an established provider of risk modeling to companies across all market segments, RMS provides solutions that can be trusted as reliable benchmarks for strategic pricing, risk management, and risk transfer decisions.

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