TEXAS WINDSTORM INSURANCE ASSOCIATION

MEMORANDUM

DATE: January 5, 2023

TO: David Durden, General Manager

FROM: James Murphy, Chief Actuary | Vice President, Enterprise Analytics

RE: 2023 Funding – 100-Year Probable Maximum Loss and Reinsurance

The Association is required by statute to maintain total available loss funding in an amount not less than the Association's probable maximum loss (PML) for a catastrophe year with a one-in-100-year probability. At its December 6, 2022 meeting, the TWIA Board of Directors asked the Actuarial & Underwriting Committee for its recommendations in determining the 100-year PML for the 2023 hurricane season. To assist the Committee, I have prepared the following resolution template and attached reference exhibits to accompany a presentation by TWIA's catastrophe modeler, Aon.

In 2019, the Texas Legislature enacted statutory changes that require the Association to assess its member insurers to pay for any reinsurance it purchases in excess of the Association's 1:100 statutory minimum funding level. Member assessments to pay for this excess reinsurance are distinct from member assessments to pay losses and would not affect the Association's ability to assess member companies for excess losses incurred.

For reference, the resolutions regarding the 100-year PML and reinsurance passed by the TWIA Board at its March 22, 2022 meeting are set forth below:

1. The Board agrees to average the results from the four catastrophe models presented as a reference point for making its reinsurance purchase decision using the following weighting: AIR 25%; RMS 25%; Impact Forecasting 25%; and CoreLogic RQE 25%.
2. The Board agrees that the model results based on near term assumptions are preferable.
3. The Board agrees that the words, "total available loss funding" in statute contemplate inclusion of loss adjustment expenses in determining the probable maximum loss for the Association for a catastrophe year with a probability of one in one hundred.
4. The Board agrees based on the foregoing and the information presented that for catastrophe year 2022 the one in one hundred probable maximum loss amount is $4.236 billion.

5. The Board directs the Association's reinsurance broker to pursue placement of the reinsurance program for the 2022-2023 reinsurance contract year using a combination of catastrophe bonds and traditional reinsurance in an aggregate amount of $4.236 billion ($2.036 billion excess of $2.2 billion) on the most favorable terms that can be achieved in the market.
6. Staff is authorized and directed to submit these resolutions and supporting information to the Texas Department of Insurance for any review or approval that may be required by the Commissioner of Insurance under law.

Texas Administrative Code Rule §5.4160 requires the Association to discuss determining its one-in-100-year probable maximum loss for the year at the Association's first regular board meeting each year. Following the discussion at this meeting, the Association must determine its one in-100-year probable maximum loss for the year and disclose it to the Commissioner not later than April 1. The Association must disclose its method for determining its one-in-100-year probable maximum loss at the same time. The determination and information must be disclosed each year, regardless of whether the Association requests a reinsurance assessment.

Neither the statute nor TDI's rule guidance specify how the Association must determine its one-in-100-year probable maximum loss. However, the rule describes the information that must be included regarding the methodology used to determine the one-in-100-year probable maximum loss. This information has been provided in the attached summary. The rule can be found in its entirety online at the following link: Rule §5.4160.

Staff has developed a template for the Actuarial & Underwriting Committee based on the Board's resolutions from last March to assist the Committee in developing recommendations for the Board.

1. The Committee recommends to average the results from the catastrophe models presented as a reference point for making the Board's determination of the 100-year PML using the following weighting: AIR __% RMS __% Impact Forecasting __% CoreLogic RQE __%.
2. The Committee recommends that the model results based on [near] [long] term assumptions are preferable.
3. The Committee recommends that the words, "total available loss funding" in statute contemplate [inclusion] [exclusion] of loss adjustment expenses in determining the probable maximum loss for the Association for a catastrophe year with a probability of one in one hundred.
4. The Committee recommends based on the foregoing and the information presented that for catastrophe year 2023 the one in one hundred probable maximum loss amount is $___ billion.

Sec. 2210.453(f) of the Texas Insurance Code prohibits the Association from purchasing reinsurance from an insurer or broker involved in the execution of a catastrophe model on which the Association relies in determining the probable maximum loss applicable for the period covered by the reinsurance. TWIA's reinsurance broker, Gallagher Re, has not been involved in the execution of any of the catastrophe models to be relied on by the Committee or Board in determining the 100-year probable maximum loss.

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Exhibit 1 - Annual Timetable

Timing	Action
At the Association's first regular board meeting (February)	The association must discuss with the Board its methodology for determining its one-in-100-year probable maximum loss for the calendar year. The association must determine its one-in-100-year probable maximum loss for the calendar year In discussing its methodology, the Association must provide the information described in §5.4160(d) and make that information available to its members and the public.
After the first regular board meeting but not later than April 1	The Association must disclose to the Commissioner its one-in-100-year probable maximum loss for the calendar year and the Association's method for determining that probable maximum loss.
No later than the second regular board meeting (May)	If the Association elects to purchase coverage for reinsurance or alternative risk transfer mechanisms in excess of the one-in-100-year probable maximum loss, then the Association must also obtain a quote for coverage that provides funding equal to the one in 100-year probable maximum loss. The Association must provide each of the following to its board and make this information available to its members and the public: (1) the reinsurance or alternative risk transfer mechanism premium quote for coverage that provides funding equal to the one in 100-year probable maximum loss. (2) the total deposit premiums for all reinsurance or alternative risk transfer mechanism coverage for the year. If, at the time of the second regular board meeting of the calendar year, deposit premiums described above are not known, then the Association must provide its best estimate of those premiums to the board and make the estimate available to its members.
Following disclosure to the Commissioner of the one-in-100-year probable maximum loss	The department (TDI) will post one-in- 100-year probable maximum loss for the calendar year and the Association's method for determining that probable maximum loss on its website.

As soon as the Association knows the deposit premiums (June)	As soon as the Association knows the deposit premiums described in subsection (g) of this section, the Association must provide them to the board and make them available to its members.
Within a reasonable time after it knows its total reinsurance costs for that calendar year	If the Association must assess its members under Insurance Code §2210.453(d)(1) then the Association must request the Commissioner's approval within a reasonable time after it knows its total reinsurance costs for that calendar year.
By the later of either: (A) 120 days after the date the Association receives the [member premium data that TDI provides under §5.4162(f) for that year; or (B) December 1 of that year.	The Association must issue the assessment.
Within 30 days of receipt of notice of assessment.	Each member must remit to the Association payment in full of its assessed amount of any assessment levied by the Association within 30 days of receipt of notice of assessment.

Exhibit 2

Sec. 2210.453. FUNDING LEVELS; REINSURANCE AND ALTERNATIVE RISK FINANCING MECHANISMS; REINSURANCE FROM CERTAIN INSURER OR BROKER PROHIBITED.

(a) The Association may purchase reinsurance or use alternative risk financing mechanisms or both as necessary.

(b) The Association shall maintain total available loss funding in an amount not less than the probable maximum loss for the Association for a catastrophe year with a probability of one in 100. If necessary, the required funding level shall be achieved through the purchase of reinsurance or the use of alternative financing mechanisms, or both, to operate in addition to or in concert with the trust fund, public securities, financial instruments, and assessments authorized by this chapter.

(c) The attachment point for reinsurance purchased under this section may not be less than the aggregate amount of all funding available to the Association under Subchapter B-1.

(d) The cost of the reinsurance purchased or alternative financing mechanisms used under this section in excess of the minimum funding level required by Subsection (b) shall be paid by assessments as provided by this subsection. The Association, with the approval of the commissioner, shall notify each member of the Association of the amount of the member's assessment under this subsection. The proportion of the cost to each insurer under this subsection shall be determined in the manner used to determine each insurer's participation in the Association for the year under Section 2210.052.

(e) A member of the Association may not recoup an assessment paid under Subsection (d) through a premium surcharge or tax credit.

(f) The association may not purchase reinsurance under this section from an insurer or broker involved in the execution of a catastrophe model on which the association relies in:

(1) determining the probable maximum loss applicable for the period covered by the reinsurance; or
(2) adopting rates under Section 2210.355.

Exhibit 3

Information Required to be Disclosed to the Commissioner pursuant to §5.4160(d)

In disclosing its method for determining its one-in-100-year probable maximum loss, the association must include:

(1) the hurricane model or models it relied on, including the model vendors, the model names, and the versions of each model;

(2) the in-force date and the total amount of direct exposures in force for the policy data used as the input for each hurricane model the association relied on;

(3) all user-selected hurricane model input assumptions used with each hurricane model the association relied on;

(4) the one-in-100-year probable maximum loss model output produced by each hurricane model the association relied on;

(5) if the association relied on more than one hurricane model, the methodology the association used to blend or average the hurricane model outputs, including all weighting factors used; and

(6) any adjustments the association or another party made to the one-in-100-year probable maximum loss model outputs or the blended or averaged output, including any adjustments to include loss adjustment expenses.

Texas Windstorm Insurance Association

January 2023

Contents

Texas Windstorm Insurance Association

1

Exposure Change

Exposure Change

Year-Over-Year Exposure Summary

County	2022 Exposure	2021 Exposure	% Change Exposure
Jefferson	8,491,425,848	6,611,486,959	28.4%
Chambers	2,321,785,586	1,585,395,677	46.4%
Harris	1,549,856,289	1,272,272,205	21.8%
Galveston	29,307,918,350	23,778,480,935	23.3%
Brazoria	14,149,674,000	10,243,236,298	38.1%
Matagorda	1,531,677,501	1,281,962,878	19.5%
Calhoun	1,344,452,901	1,112,545,894	20.8%
Refugio	116,687,821	98,950,881	17.9%
Aransas	2,809,312,335	2,057,222,229	36.6%
San Patricio	2,497,199,720	1,771,761,160	40.9%
Nueces	14,875,727,997	12,103,454,712	22.9%
Kleberg	236,761,530	182,454,507	29.8%
Kenedy	7,457,823	3,501,441	113.0%
Willacy	109,451,634	93,572,782	17.0%
Cameron	3,516,100,296	3,026,803,086	16.2%
Total	82,865,489,629	65,223,101,644	27.0%

By line of business breakout available in appendix

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Modeled Loss Change

AON

Modeled Loss Change

Verisk Touchstone v9 AEP Gross Losses (excl. LAE)

AEP - All Perils (Warm Sea Surface Temperature)

Return Period	Verisk v9 11/30/2022	Verisk v9 11/30/2021	Loss Change
1000 yr	13,905.9	11,392.5	22.1%
500 yr	12,293.9	9,900.7	24.2%
250 yr	8,859.2	7,106.8	24.7%
200 yr	7,966.8	6,387.9	24.7%
100 yr	5,615.0	4,540.4	23.7%
50 yr	3,248.2	2,612.5	24.3%
25 yr	1,691.4	1,342.3	26.0%
20 yr	1,377.5	1,077.0	27.9%
Annual avg	290.1	230.2	26.0%
Std dev	1,123.2	908.6	23.6%

US $ in Millions

Including Demand Surge, Excluding Storm Surge

Average Annual Loss

Measure of overall catastrophe risk, function of both severity and frequency of losses

On average, you can expect to incur $290.1M (Verisk v9) of catastrophe loss in a given year

Probable Maximum Loss (PML) or Return Period Loss

An estimate of the likelihood that a catastrophic loss will be met or exceeded

The Verisk v9 100 yr return period is $5,615M – There is a 1% probability of having a loss of $5,615M or greater

Occurrence Exceedance Probability (OEP)

Probability that the single largest event loss in a year will exceed a loss threshold

Calculated by taking the max of all losses in each simulated year

Occurrence EP summary tells us how bad a single event can be and how likely it is to be that bad

Aggregate Exceedance Probability (AEP)

Probability that the aggregate event losses in a year will exceed a loss threshold

Calculated by taking the sum of all losses in each simulated year

Aggregate EP summary tells us how bad a year can be and how likely it is to be that bad

TWIA purchases their Cat XOL cover based on the aggregate perspective

Modeled Loss Change

RMS RiskLink v21 AEP Gross Losses (excl. LAE)

AEP - All Perils (Near-Term)

Return Period	RMS v21 11/30/2022	RMS v21 11/30/2021	Loss Change
1000 yr	12,813.7	9,953.5	28.7%
500 yr	9,480.5	7,374.0	28.6%
250 yr	6,519.2	5,095.2	27.9%
200 yr	5,786.2	4,523.3	27.9%
100 yr	3,944.4	3,091.5	27.6%
50 yr	2,447.7	1,932.2	26.7%
25 yr	1,376.8	1,093.6	25.9%
20 yr	1,118.7	891.3	25.5%
Annual avg	241.1	191.2	26.1%
Std dev	958.1	748.5	28.0%

US $ in Millions

Including Demand Surge, Excluding Storm Surge

Modeled Loss Change

Impact Forecasting v15 AEP Gross Losses (excl. LAE)

AEP - All Perils (Near-Term)

Return Period	IF v15 11/30/2022	IF v15 11/30/2021	Loss Change
1000 yr	9,605.2	8,009.2	19.9%
500 yr	8,250.0	6,927.3	19.1%
250 yr	6,599.3	5,512.0	19.7%
200 yr	5,899.1	4,963.2	18.9%
100 yr	4,318.7	3,601.0	19.9%
50 yr	2,808.7	2,353.0	19.4%
25 yr	1,683.8	1,406.0	19.8%
20 yr	1,345.4	1,121.5	20.0%
Annual avg	263.1	220.2	19.5%
Std dev	866.5	725.5	19.4%

US $ in Millions

Including Demand Surge, Excluding Storm Surge

AON

Modeled Loss Change

CoreLogic RQE v21 AEP Gross Losses (excl. LAE)

AEP - All Perils (Near-Term)

Return Period	RQE v21 11/30/2022	RQE v21 11/30/2021	Loss Change
1000 yr	10,305.6	8,980.7	14.8%
500 yr	8,286.9	7,201.1	15.1%
250 yr	6,427.2	5,557.9	15.6%
200 yr	5,867.3	5,042.1	16.4%
100 yr	4,102.1	3,502.0	17.1%
50 yr	2,470.2	2,124.7	16.3%
25 yr	1,285.2	1,089.9	17.9%
20 yr	1,006.8	853.7	17.9%
Annual avg	216.6	182.4	18.8%
Std dev	821.6	709.5	15.8%

US $ in Millions

Including Demand Surge, Excluding Storm Surge

3

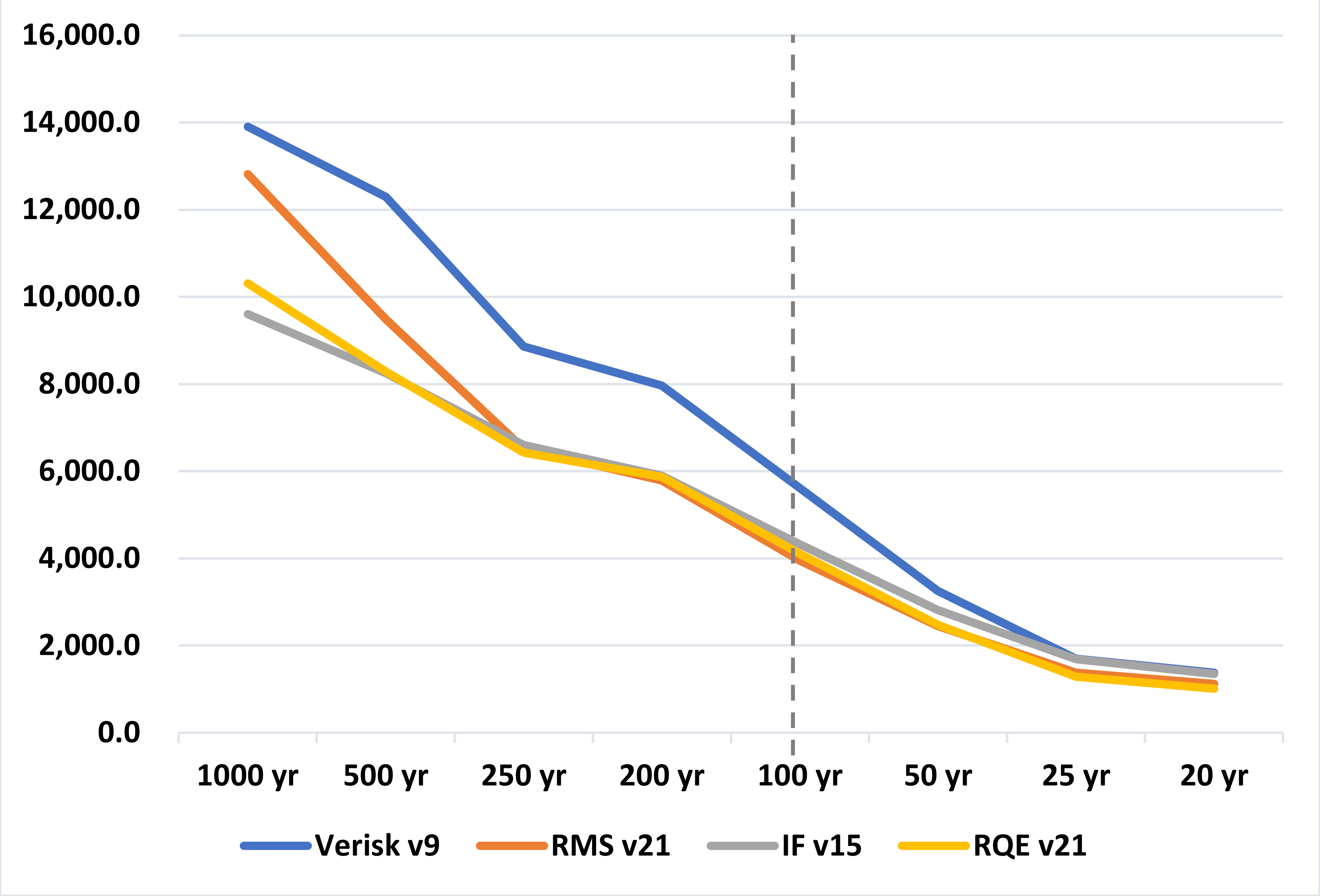
Multi-Model Comparison

Multi-Model Comparison – All Perils

Combined Hurricane (Near-Term) & Severe Conv. Storm AEP Gross Losses (excl. LAE)

AEP - All Perils (Near-Term/Warm Sea Surface Temperature)

Return Period	Verisk v9	RMS v21	IF v15	RQE v21
1000 yr	13,905.9	12,813.7	9,605.2	10,305.6
500 yr	12,293.9	9,480.5	8,250.0	8,286.9
250 yr	8,859.2	6,519.2	6,599.3	6,427.2
200 yr	7,966.8	5,786.2	5,899.1	5,867.3
100 yr	5,615.0	3,944.4	4,318.7	4,102.1
50 yr	3,248.2	2,447.7	2,808.7	2,470.2
25 yr	1,691.4	1,376.8	1,683.8	1,285.2
20 yr	1,377.5	1,118.7	1,345.4	1,006.8
Annual avg	290.1	241.1	263.1	216.6
Std dev	1,123.2	958.1	866.5	821.6



US $ in Millions

Including Demand Surge, Excluding Storm Surge

AON

Multi-Model Comparison – Hurricane

Hurricane AEP Gross Losses (excl. LAE)

AEP - Hurricane Only (Near-Term/Warm Sea Surface Temperature)

Return Period	Verisk v9	RMS v21	IF v15	RQE v21
1000 yr	13,905.7	12,847.8	9,591.2	10,283.4
500 yr	12,279.5	9,516.2	8,238.9	8,280.5
250 yr	8,852.2	6,556.5	6,582.5	6,410.5
200 yr	7,964.9	5,819.9	5,886.7	5,860.6
100 yr	5,605.7	3,968.4	4,309.8	4,070.7
50 yr	3,222.5	2,463.3	2,801.3	2,458.9
25 yr	1,676.0	1,379.7	1,672.7	1,264.1
20 yr	1,354.9	1,117.1	1,334.9	979.4
Annual avg	274.0	224.4	247.4	199.6
Std dev	1,123.1	957.9	866.2	820.5

US $ in Millions

Including Demand Surge, Excluding Storm Surge

Multi-Model Comparison – Severe Convective Storm

Severe Convective Storm AEP Gross Losses (excl. LAE)

AEP - Severe Conv. Storm

Return Period	Verisk v9	RMS v21	IF v15	RQE v21
1000 yr	466.4	195.2	269.5	524.4
500 yr	347.6	161.8	182.9	384.1
250 yr	270.5	133.6	125.0	270.6
200 yr	253.3	125.1	109.1	235.2
100 yr	175.5	100.5	76.7	155.6
50 yr	113.7	78.8	58.6	108.2
25 yr	71.4	59.6	46.3	72.8
20 yr	59.6	53.9	42.8	63.3
Annual avg	16.1	16.6	15.7	17.0
Std dev	36.6	22.0	23.0	42.5

US $ in Millions

Including Demand Surge (where available)

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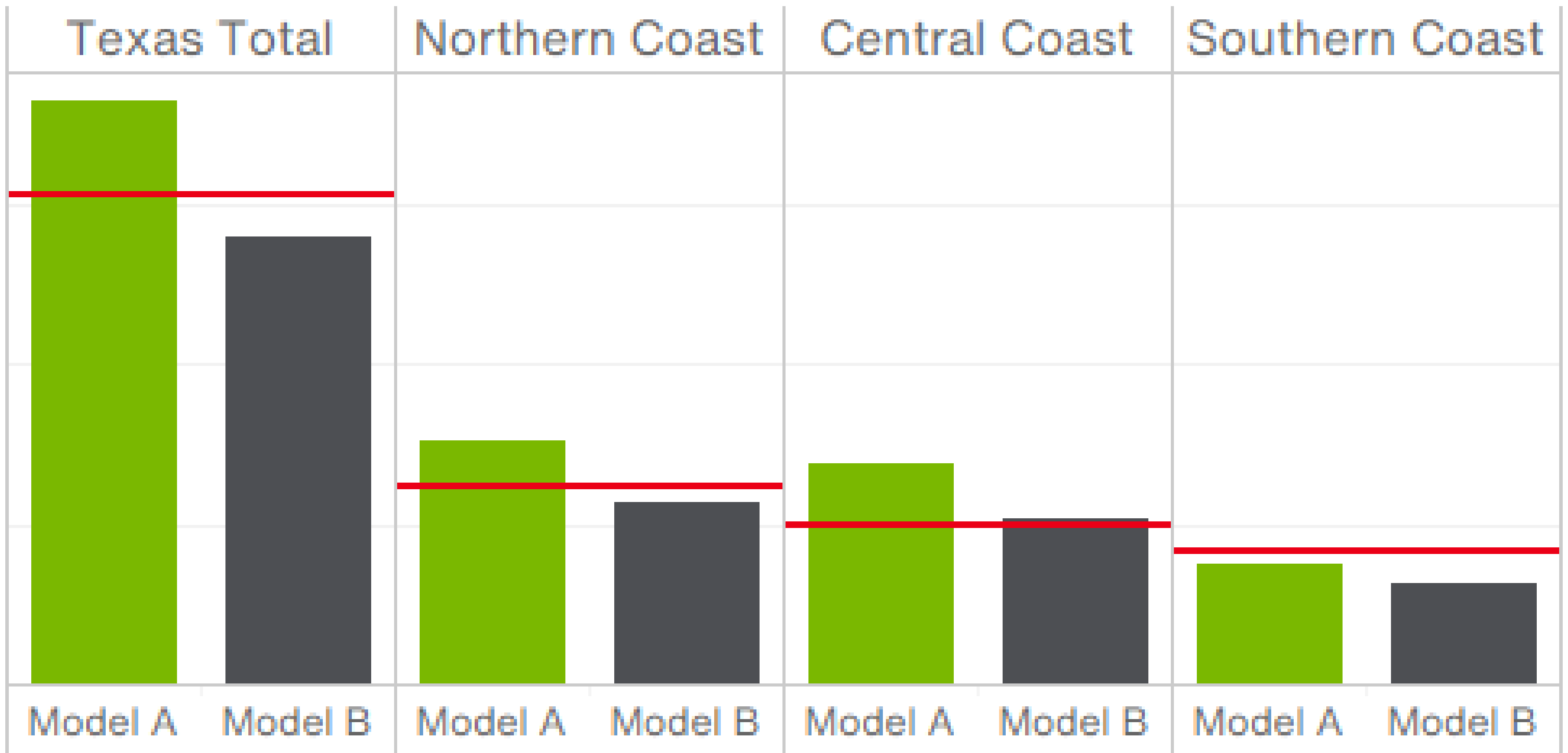
Texas Hurricane Model Comparison - Hazard Differences

Texas Statewide & Regional Landfall Rates

Both models reflect the historical behavior of higher landfall rates on the northern coast, followed by the central coast and then the southern coast – but Model A has higher rates statewide

Texas Long-Term Landfall Rate
Per 100 Years by Region and Model

Historical Rate (1900-2020) in red



Texas Historical Landfalls 1900-2020

Landfall data from HURDAT2 (February 2022 Vintage)

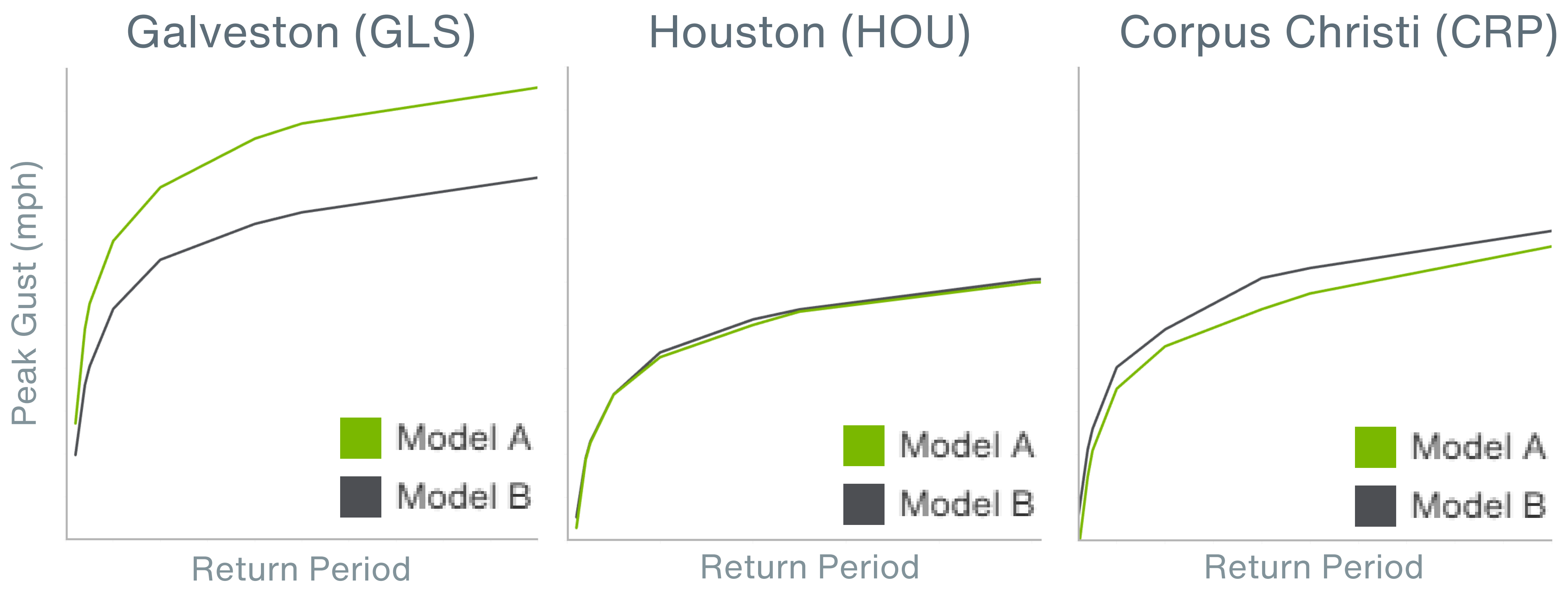
AON

Note: Model vendors calibrate rates regionally and include varying degrees of "extension" into Mexico in order to capture the losses from events that do not make a direct landfall on Texas but still have an impact to losses. Modeled and historical rates shown here are only for direct landfalls on Texas.

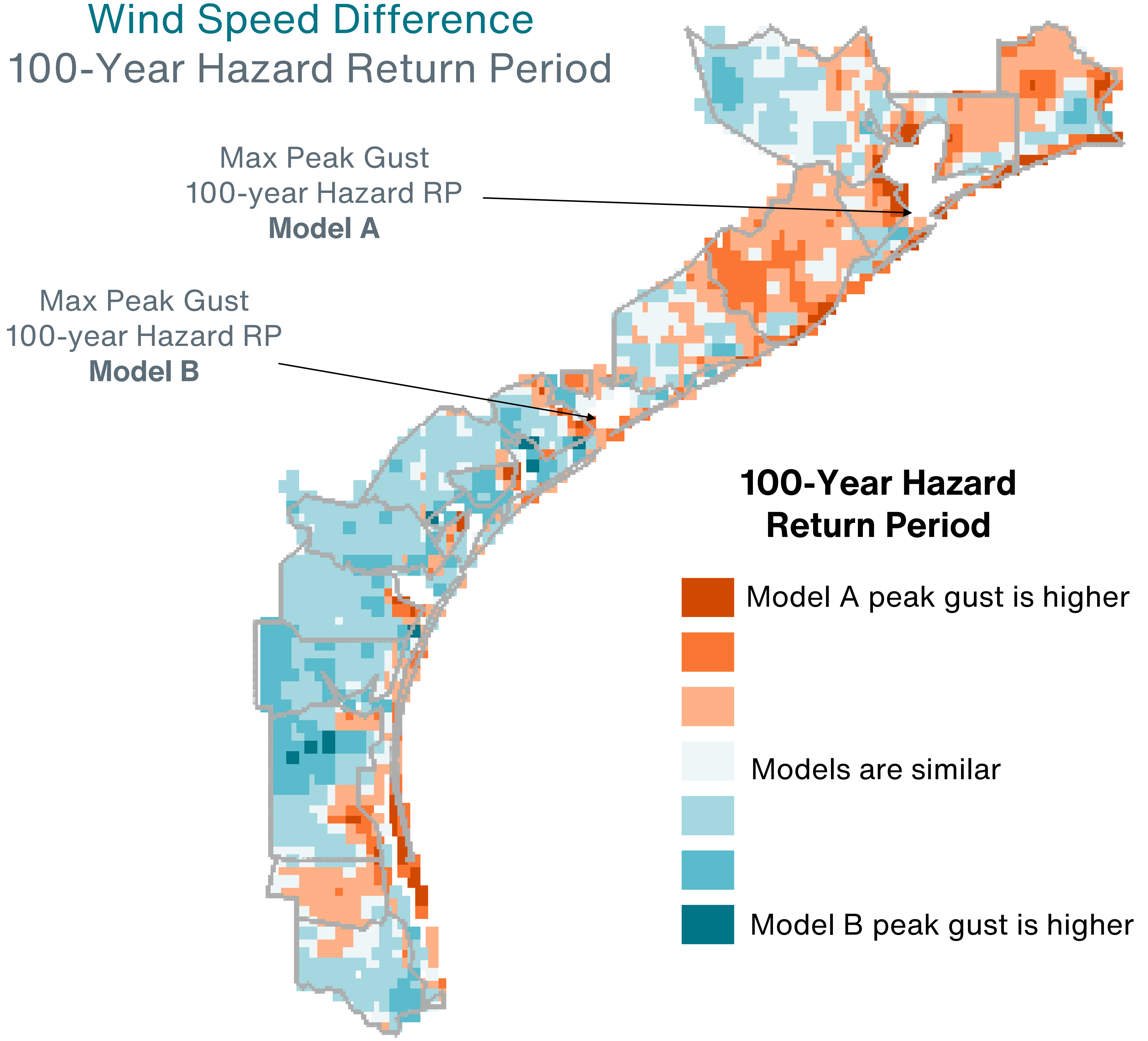
Hazard Return Period

In general, Model A has greater wind hazard than Model B on the northern coast, where population and TWIA exposure is greatest – contributing to higher losses

Peak Gust Hazard Curves



Wind Speed Difference
100-Year Hazard Return Period



Based on a 5 km grid and near-term rates. Model A 1-minute sustained wind speeds have been converted to 3-second peak gust using a factor of 1.22.

Frequency of High Wind Gusts

All along the Texas coastline, and particularly in populated Brazoria County and Galveston County, Model A has a greater frequency than Model B of very high wind speeds

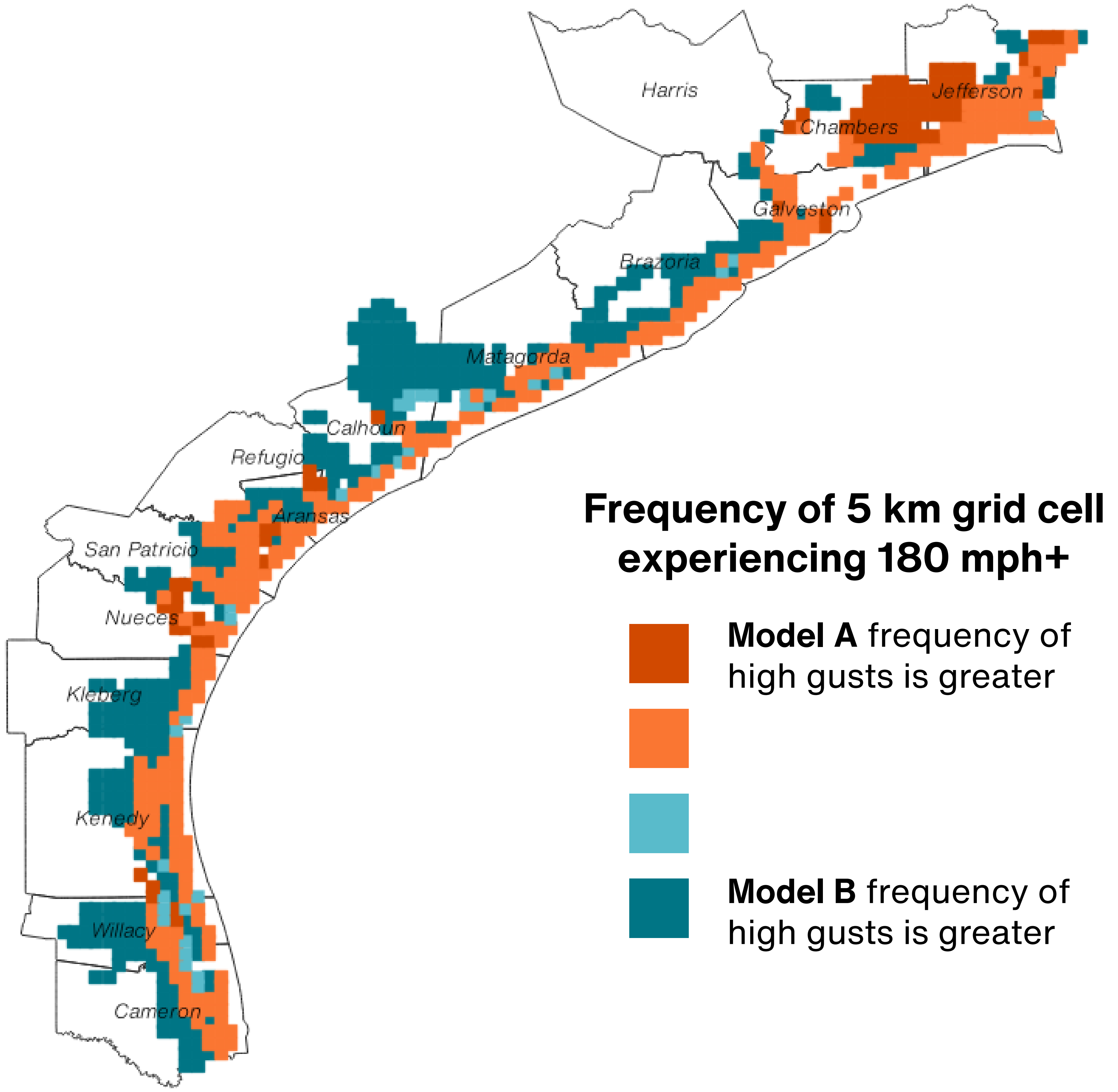
Annual modeled frequency of a location in the TWIA counties experiencing an event with a 180 mph gust

Model A	Model B
1 in 111 years	1 in 250 years

Modeled TWIA AAL from these events

Model A	Model B
19%	10%

Difference in Frequency of Peak Gusts Over 180 mph



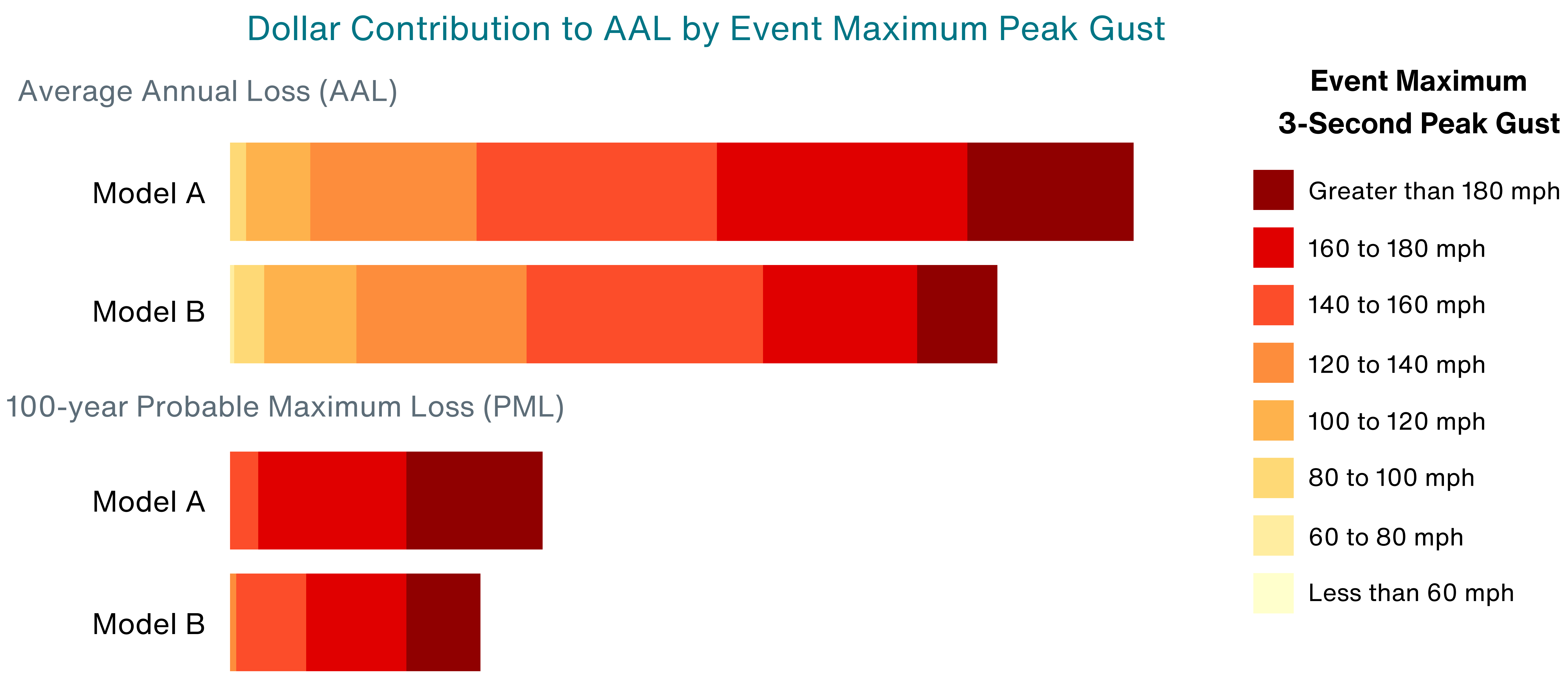
AON

Based on a 5 km grid and near-term rates. Model A 1-minute sustained wind speeds have been converted to 3-second peak gust using a factor of 1.22.

What Types of Events are Driving Losses in Each Model?

Maximum Peak Gust

Losses are more likely to be driven by very high (>160 mph) wind speeds in Model A than in Model B



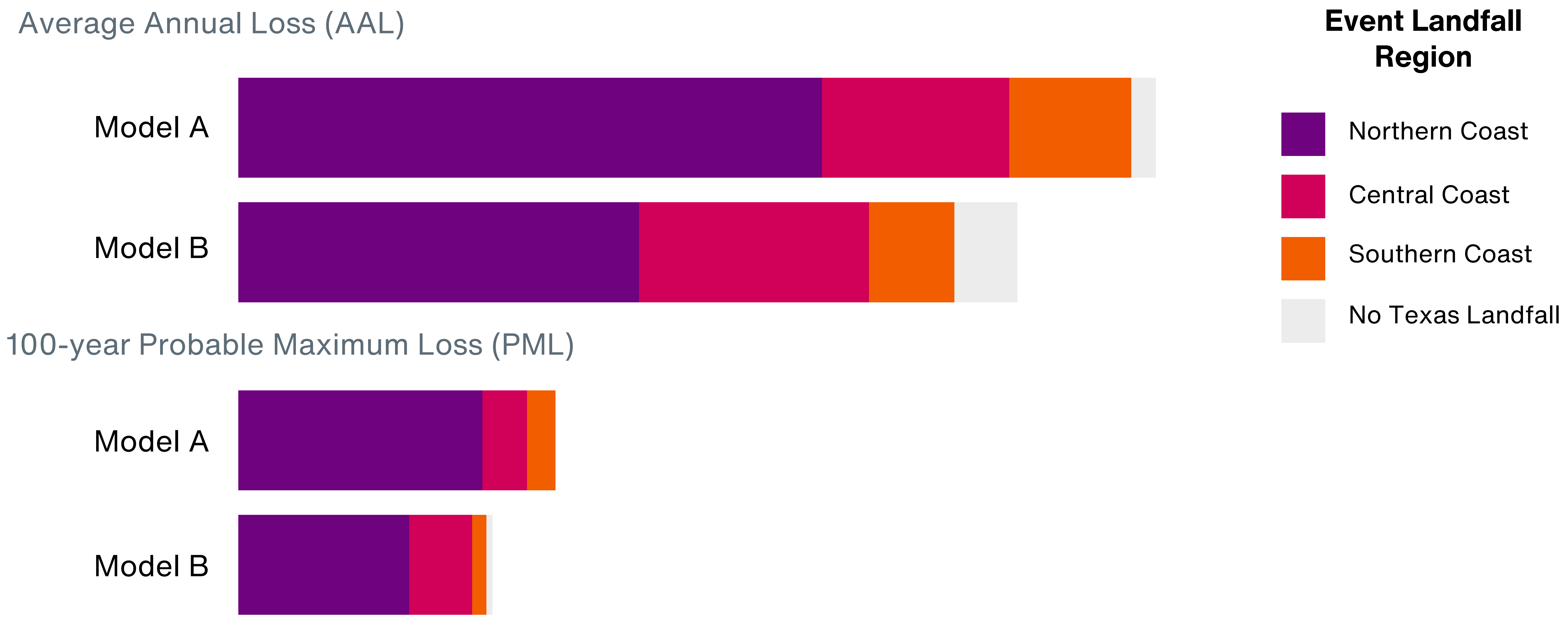
Based on TWIA exposure and near-term rates. Model A 1-minute sustained wind speeds have been converted to 3-second peak gust using a factor of 1.22.

What Types of Events are Driving Losses in Each Model?

Landfall Region

Losses are more likely to be driven by a landfall on the northern coast in Model A than in Model B

Dollar Contribution to AAL by Event Landfall Region



Based on TWIA exposure and near-term rates.

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Texas Hurricane Model Comparison – Coastal Vulnerability Differences

Texas Building Codes

How is TWIA different than the rest of the state?

Texas Building Code Adoption and Enforcement

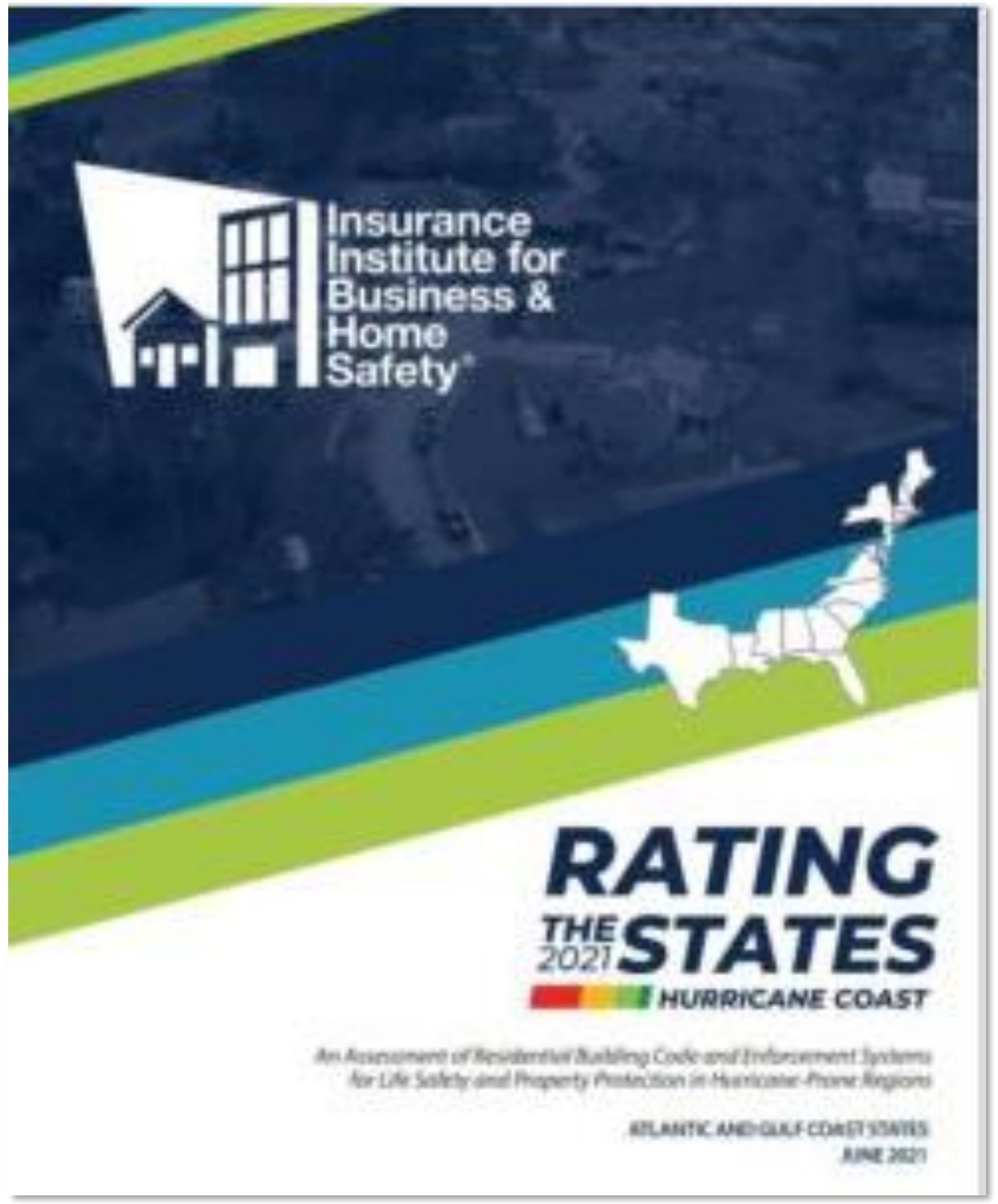
- Texas legislature adopted the 2000 IRC in 2001
  - Did not require mandatory adoption throughout the state
- All incorporated cities have adopted the code, but most unincorporated county jurisdictions have not
- 2017 state law requires unincorporated areas of certain counties to provide an inspection report showing construction complies with the current code
  - Potential conflict of interest as inspector is hired by the builder

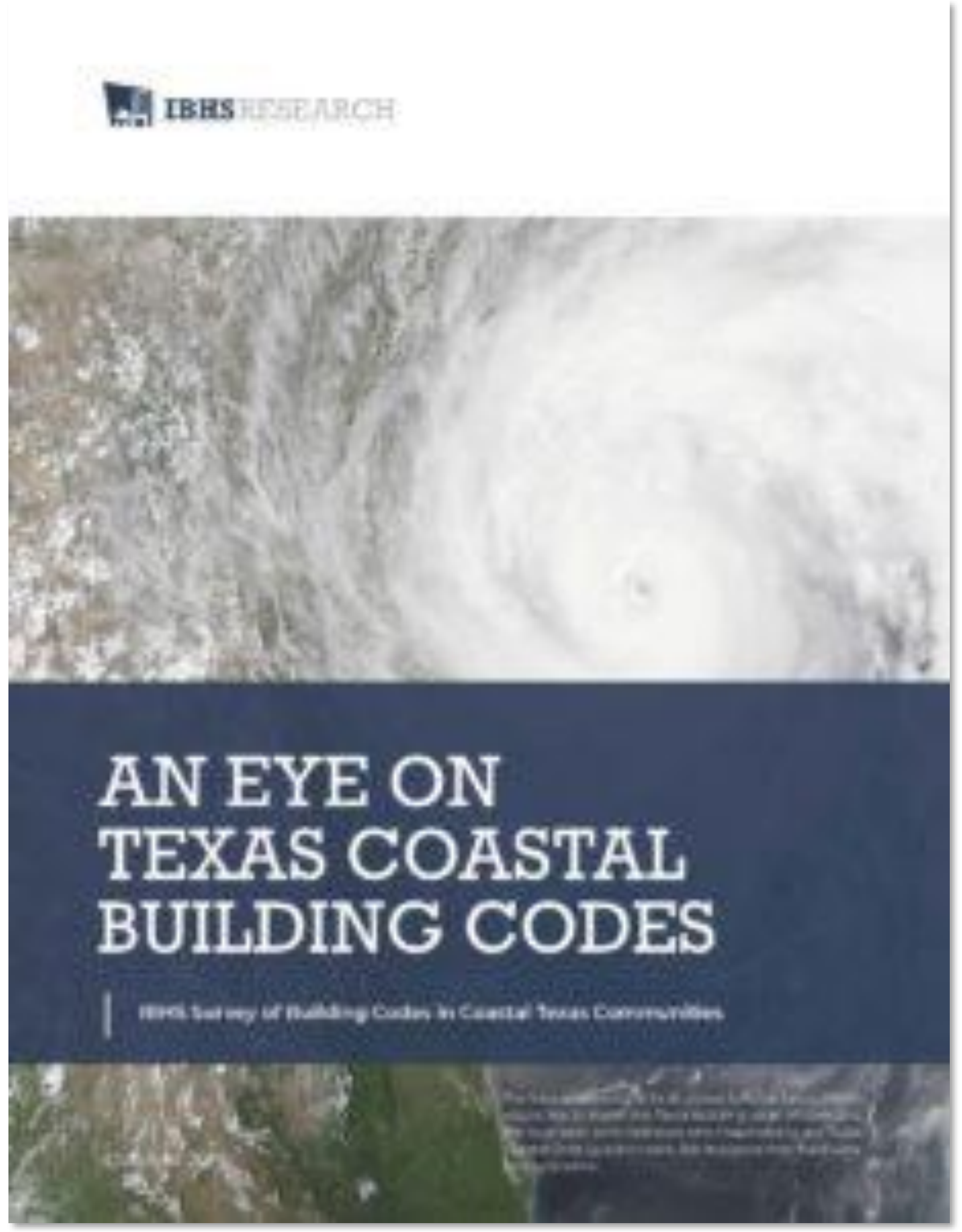
What Does IBHS Say About Texas Building Code Adoption and Enforcement?

- Ranked #15 out of 18 coastal states
- Texas received a score of 34/100
- Unincorporated coastal communities are particularly vulnerable

How is TWIA Different than the State of Texas?

- TWIA requires mandatory adoption and enforcement of high wind standards in the IBC





Year Built by Model Vendor

Year Built Bands by Model Vendor for the State of Texas

Both models use year built bands to differentiate key points in time when building code adoption and enforcement was impacted

Bands vary by model vendor and do not always align well with TWIA, which has more stringent building code adoption and enforcement requirements than the rest of the state

What Does this Mean for TWIA?

- Out-of-the-box view may not reflect the more stringent construction and inspection processes for risks insured by TWIA
- TWIA could consider a custom view of risk that better reflects the higher standard required by TWIA relative to the rest of the state
- This could be achieved through:
  - Different secondary modifier assumptions
  - Loss factor adjustments
  - Custom vulnerability curves
- Potential data modification or adjustments could be validated against detailed claims data

Texas Residential Hurricane Vulnerability by Year Built

TWIA Gross AAL by Model and Year Built
Exposure as of 11/30/2021

	Model A	Model B	% Difference
Pre-1995	165.1	129.4	28%
1995 to 2001	19.4	14.9	30%
2002 to 2008	17.8	16.6	7%
Post-2008	15.3	17.2	-11%
Total	217.6	178.1	22%

Based on near-term rates.

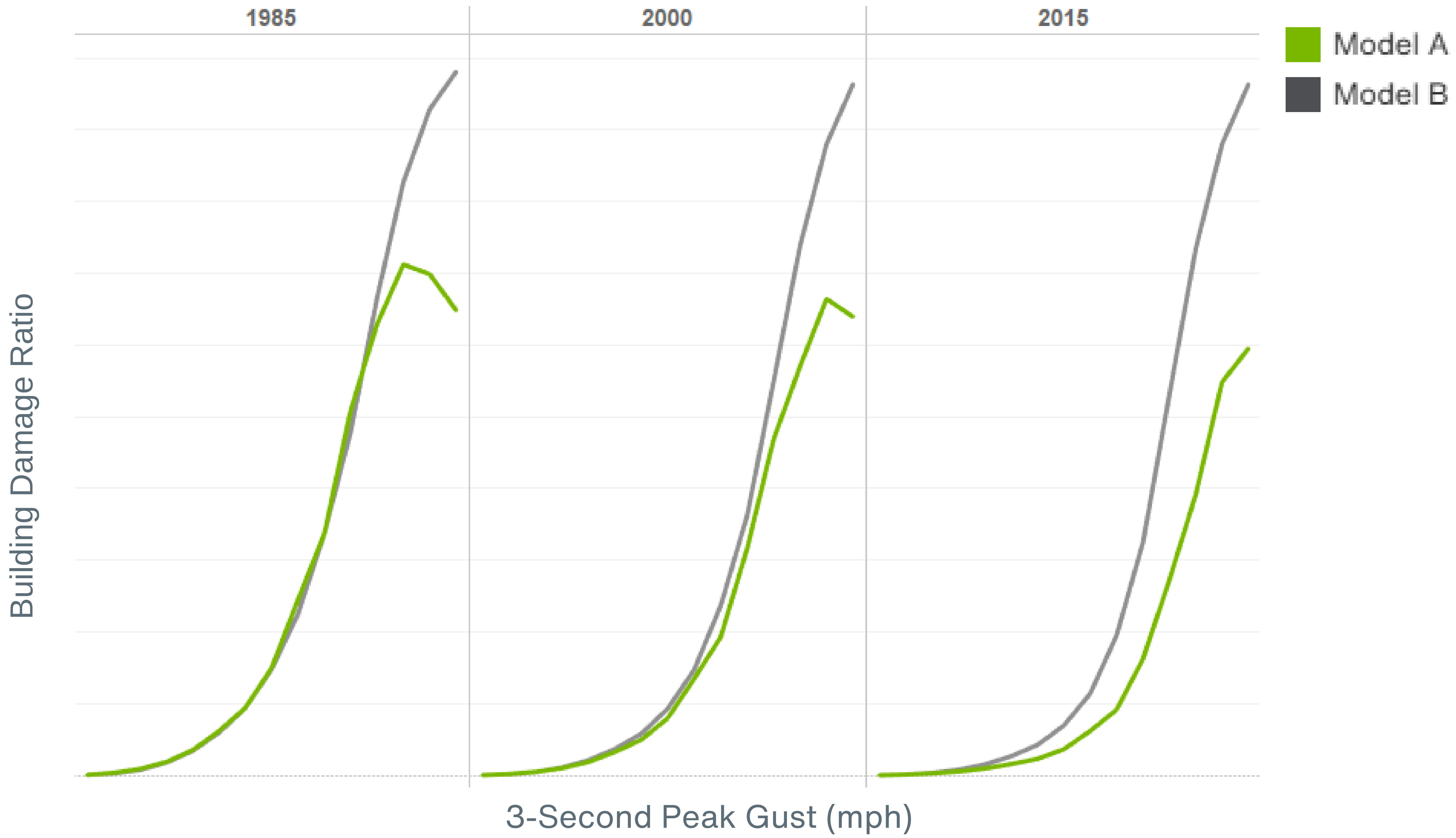
Includes demand surge. Excludes storm surge.

Vulnerability is comparable between models for older risks, but severity of loss is much greater for coastal risks in Model A

Model B vulnerability is more conservative than that of Model A for newer year builts, resulting in more similar losses for these risks

TWIA Exposure by Year Built for Single Family Risks

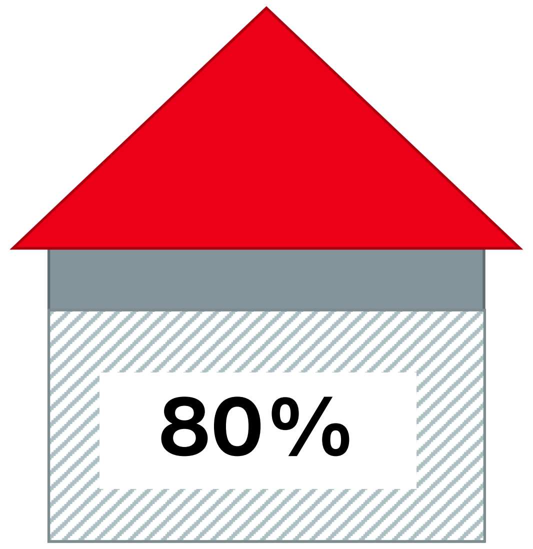
Single Family Wood Frame Building Vulnerability by Year Built



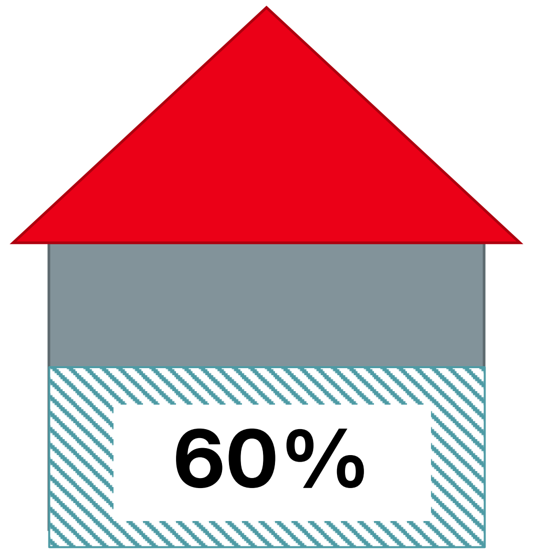
What About Storm Surge?

When a hurricane analysis is run in Model A...

Damage to both wind and storm surge are considered

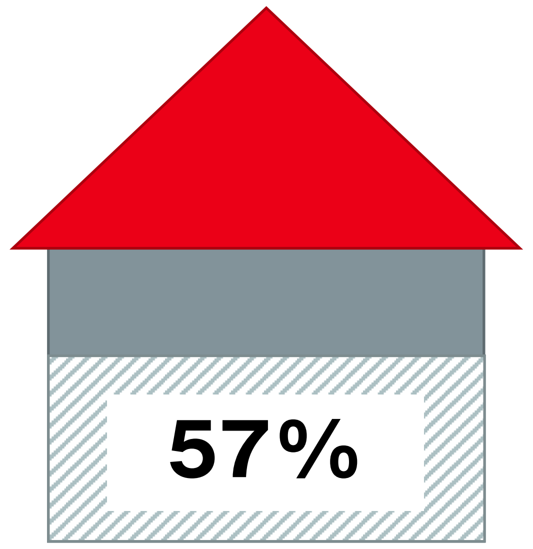


Wind Damage Ratio

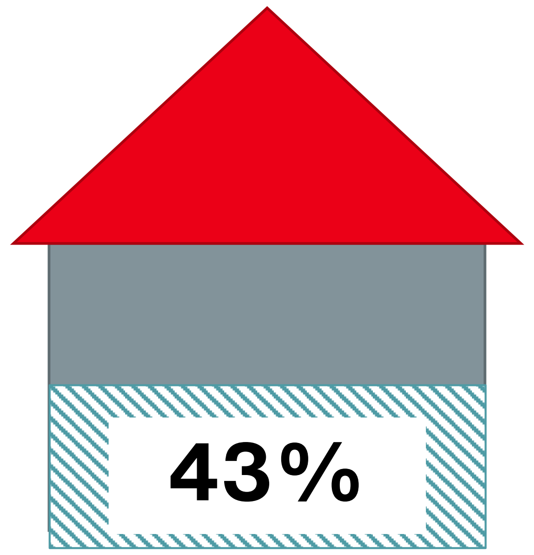


Storm Surge Damage Ratio

Wind and storm surge damage is normalized to 100% where damage exceeds 100% from the combined perils, **even when storm surge is not modeled**



Wind Damage Ratio

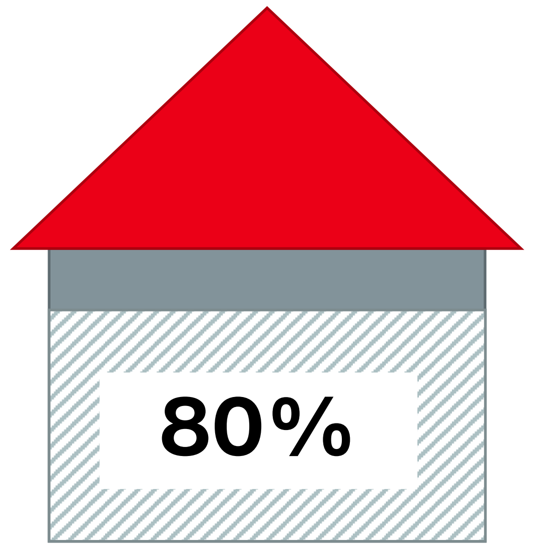


Storm Surge Damage Ratio

vs.

When a hurricane analysis is run in Model B...

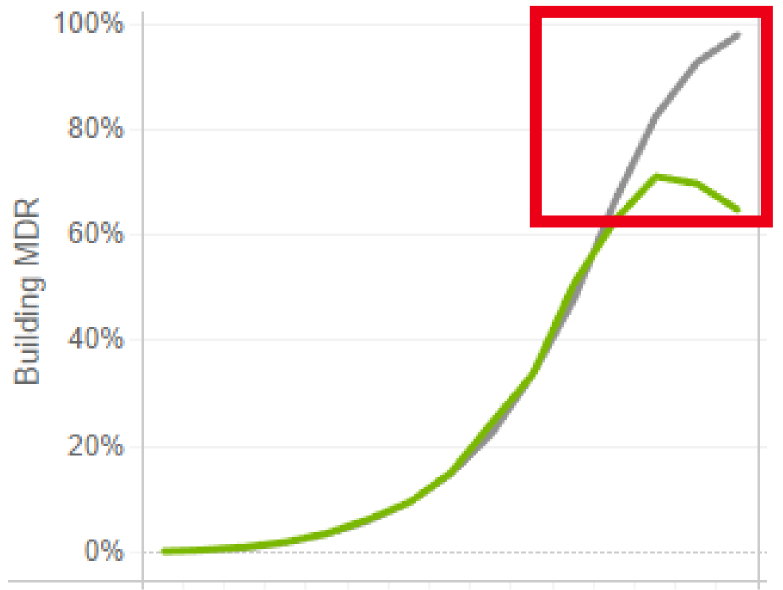
Full damage from wind is considered and storm surge is ignored for wind-only analyses



Wind Damage Ratio

What does this mean for wind-only loss estimates?

Wind-only loss estimates may be understated for locations that are subject to events that result in both significant wind and storm surge effects



Impact of storm surge normalization in the Model A vulnerability curve reduces wind damage in Model A relative to Model B at wind speeds greater than 170 mph peak gust

The impact of storm surge normalization in Model A can be meaningful for individual events at select locations but is minimal overall

6

TWIA View of Risk

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Model Choice

Who are the Modeling Firms?

Model Vendor	Model Vendor Ownership
RMS	Moody's Analytics
AIR	Verisk
CoreLogic	Stone Point Capital
Impact Forecasting Powered by Aon	Aon

What's in the Pipeline?

- New model platforms
- Regular hurricane model updates to maintain compliance with FCHLPM standards + some vendors are considering more meaningful enhancements
- Outdated SCS models for most model vendors are being updated

Modeled Alternative Hurricane Landfall Rates

All models have alternative views of landfall rates to address elevated sea surface temperatures and/or near-term basin conditions

The RMS model provides a "Medium-Term" event set

- Five-year forward-looking estimate of landfall rates
- Ensemble approach based on 13 statistical models
  - Each reflects a different theory on drivers of hurricane activity
  - Considers current and projected near-term climate trends
- Can result in both higher or lower landfall rates relative to the historical perspective
- Pros: Current and comprehensive
- Cons: Volatile and complicated

Other models provide a "Warm Sea Surface Temperature" or "Near-Term" event set

- Based on a subset of the historical years in which sea surface temperatures are warmer than average
- Years designated as "warmer than average" vary by model
- Results in higher landfall rates = higher losses
- Pros: Stable and transparent
- Cons: Based on limited historical data

Source: AIR 2018

Source: RMS 2018

Secondary Modifier Impacts

Secondary Modifier completeness largely unchanged year-over-year, mitigating any adverse impact by roll-on portfolio

Improvement in capture of known modifiers will continue to improve model accuracy of the portfolio

AIR Worldwide Corporation

AEP

Return Period	HUNT 2nd Mod Impact %	TO 2nd Mod Impact %
250 yr	(5.6%)	(6.0%)
200 yr	(5.7%)	(6.0%)
100 yr	(6.9%)	(4.8%)
50 yr	(7.4%)	(7.0%)
Annual avg	(6.4%)	(5.5%)

Risk Management Solutions, Inc.

AEP

Return Period	HUNT 2nd Mod Impact %	TO 2nd Mod Impact %
250 yr	(6.5%)	(5.9%)
200 yr	(6.5%)	(5.9%)
100 yr	(6.2%)	(6.2%)
50 yr	(5.8%)	(6.4%)
Annual avg	(5.3%)	(6.3%)

- Inclusion of secondary modifiers decreases modeled loss by 5%-7% at key return periods by peril/model
- Study completed on 11/30/2021 data

Historical Perspective

OEP - Hurricane Only (Near-Term/Warm Sea Surface Temperature)

Return Period	Verisk v9	RMS v21	IF v15	RQE v21
1000 yr	13,905.7	12,847.8	9,336.2	10,073.9
500 yr	12,007.9	9,516.2	7,869.8	8,038.7
250 yr	8,202.7	6,556.5	6,338.8	6,199.0
200 yr	7,734.3	5,819.9	5,666.3	5,645.5
100 yr	5,467.7	3,968.4	4,142.2	3,877.2
50 yr	3,055.4	2,463.3	2,665.7	2,319.8
25 yr	1,555.3	1,379.7	1,593.2	1,179.4
20 yr	1,239.8	1,117.1	1,266.6	909.1
Annual avg	274.0	224.4	247.4	199.6
Std dev	1,123.1	957.9	866.2	820.5

US $ in Millions

Including Demand Surge, Excluding Storm Surge

Variability in both loss magnitude and share indicates a need for more insightful view of historical experience and catastrophe models

- Trended TWIA losses indicate that the Cat program could be significantly (Harvey) to completely (Ike) impacted if events similar to those in the historical catalog were to occur again
- TWIA market share of total PCS event loss carries significant variation, indicating potential for outsized impact on the program
- Trended PCS losses shown using CAS Collins & Lowe methodology through Feb. 2022
  - Trended TWIA losses excl. LAE calculated using market share from orig. PCS events
- PCS Industry losses cited below exclude flood and auto loss
- Recast loss shows high degree of model variability and extreme event potential if a storm similar to the 1900 Galveston hurricane were to occur again

Named Storm	Orig Incurred Loss & ALAE	Trended Incurred excl. 15% LAE	TWIA % Share excl. 15% LAE	Orig. PCS Res+Comm Loss	Trended PCS Res + Comm Loss
Hurricane Bret	6.5	14.9	20%	28.0	75.5
Hurricane Claudette	16.9	31.2	17%	85.0	184.7
Hurricane Rita	161.9	264.8	7%	2,005.0	3,858.1
Hurricane Dolly	327.2	451.0	56%	495.0	802.6
Hurricane Ike	2,443.9	3,368.2	22%	9,500.0	15,403.1
Tropical Storm Hermine	6.0	7.9	5%	110.0	170.0
Hurricane Harvey	1,535.8	1,558.5	8%	15,850.0	18,922.7
Hurricane Hanna	12.0	10.7	3%	295.2	309.4
Hurricane Laura	21.9	19.5	3%	601.0	629.9
Hurricane Delta	22.0	19.6	11%	166.8	174.8

*Losses shown US $ in Millions

Recast Event	AIR Gross Loss	RMS Gross Loss
Hurricane Harvey	1,669.3	841.8
Hurricane Ike	1,085.7	789.6
Hurricane Rita	424.7	313.2
Hurricane Alicia	692.4	575.7
Hurricane Carla	1,266.9	747.9
1900 Galveston Hurricane	7,452.4	4,280.6

*Losses shown US $ in Millions

A TWIA-owned View of Risk

How would a bespoke view of risk benefit TWIA?

Robust and defendable

- Multi-model blends are:
  - Simple to explain
  - Take advantage of multiple viewpoints, which are beneficial in instances where historical data is limited (e.g., Cat 4 and Cat 5 events in Texas)
- Multi-model blend challenges:
  - Consistent implementation across the business
  - May dilute precision and risk differentiation
- Advantage of a custom view of risk based on a single model robust and defendable approach tailored to TWIA's experience and risk tolerance thresholds

Reduce model dependency

- Model vendors do regular hurricane model updates that include hurricane rate updates and vulnerability re-calibration
- Major updates to hurricane models that include new event set generation has been avoided for several years
- Some model vendors are considering these updates over the next few years, along with updates to modeling platforms that will further influence losses
- Defining a custom view of risk ahead of these model updates and socializing the view with internal and external parties will help minimize model change disruption and reduce dependence on out-of-the-box models

Deeper knowledge Greater confidence Own the view

- Model vendors develop vulnerability curves to reflect expected loss behavior in Texas as a whole
- TWIA loss experience may look different than the state as whole due to:
  - A more stringent inspection process
  - Mandatory adoption and enforcement of IBC high wind standards
- A custom view of risk takes into account how TWIA's portfolio may result in different loss experience than Texas as a whole
- Derive more value from models

Discussion of the 100 yr PML Threshold

Model	Weight	All Perils (Near-Term/WarmSST) 100yr PML - AEP	All Perils (Near-Term/WarmSST) 100yr PML - OEP	All Perils (Long-Term/Standard) 100yr PML - AEP	All Perils (Long-Term/Standard) 100yr PML - OEP	HU Only (Near-Term/WarmSST) 100yr PML - AEP	HU Only (Near-Term/WarmSST) 100yr PML - OEP	HU Only (Long-Term/Standard) 100yr PML - AEP	HU Only (Long-Term/Standard) 100yr PML - OEP
AIR v9	25%	5,615.0	5,467.7	5,200.0	4,983.6	5,605.7	5,467.7	5,194.1	4,983.6
RMS v21	25%	3,944.4	3,797.5	3,920.3	3,781.9	3,968.4	3,968.4	3,944.6	3,782.0
IF v15	25%	4,318.7	4,142.2	4,170.9	4,001.3	4,309.8	4,142.2	4,155.8	4,001.3
RQE v21	25%	4,102.1	3,876.8	3,619.5	3,463.6	4,070.7	3,877.2	3,601.0	3,464.4
Blend	100%	4,495.1	4,321.1	4,227.7	4,057.6	4,488.7	4,363.9	4,223.9	4,057.8
Blend w/ LAE	100%	5,169.3	4,969.2	4,861.8	4,666.2	5,162.0	5,018.5	4,857.5	4,666.5

Model	Weight	All Perils (Near-Term/WarmSST) 100yr PML - AEP	All Perils (Near-Term/WarmSST) 100yr PML - OEP	All Perils (Long-Term/Standard) 100yr PML - AEP	All Perils (Long-Term/Standard) 100yr PML - OEP	HU Only (Near-Term/WarmSST) 100yr PML - AEP	HU Only (Near-Term/WarmSST) 100yr PML - OEP	HU Only (Long-Term/Standard) 100yr PML - AEP	HU Only (Long-Term/Standard) 100yr PML - OEP
AIR v9	50%	5,615.0	5,467.7	5,200.0	4,983.6	5,605.7	5,467.7	5,194.1	4,983.6
RMS v21	50%	3,944.4	3,797.5	3,920.3	3,781.9	3,968.4	3,968.4	3,944.6	3,782.0
IF v15	0%	4,318.7	4,142.2	4,170.9	4,001.3	4,309.8	4,142.2	4,155.8	4,001.3
RQE v21	0%	4,102.1	3,876.8	3,619.5	3,463.6	4,070.7	3,877.2	3,601.0	3,464.4
Blend	100%	4,779.7	4,632.6	4,560.1	4,382.7	4,787.0	4,718.1	4,569.4	4,382.8
Blend w/ LAE	100%	5,496.7	5,327.5	5,244.1	5,040.1	5,505.1	5,425.8	5,254.8	5,040.2

LAE 15%

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11/30/2022 Results: future exposure change and inflation is excluded from this perspective

100 yr PML Limit Comparison Year-Over-Year

	2022 Placement	2023 Placement	$ Difference	% Difference
100 Yr Selected PML	4,236.3	5,169.3	933.0	22.0%
Retention	2,200.0	2,280.0	80.0	3.6%
Limit Required	2,036.3	2,889.3	853.0	41.9%

US $ in Millions

11/30/2022 Results: future exposure change and inflation is excluded from this perspective

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Appendix A

Catastrophe Analytics Supplement

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Exposure Change by Line of Business

Year-Over-Year Exposure Summary

County	2022 Exposure				2021 Exposure				% Change Exposure			
	Commercial	Mobile Home	Residential	Total	Commercial	Mobile Home	Residential	Total	Commercial	Mobile Home	Residential	Total
Jefferson	498,049,575	4,143,950	7,989,232,323	8,491,425,848	312,902,692	2,574,950	6,296,009,317	6,611,486,959	59.2%	60.9%	26.9%	28.4%
Chambers	66,074,529	4,000,243	2,251,710,814	2,321,785,586	55,038,755	2,497,152	1,527,859,770	1,585,395,677	20.1%	60.2%	47.4%	46.4%
Harris	123,247,176	192,000	1,426,417,113	1,549,856,289	34,468,064	200,500	1,237,603,641	1,272,272,205	257.6%	-4.2%	15.3%	21.8%
Galveston	3,140,710,659	14,430,568	26,152,777,123	29,307,918,350	2,517,441,555	12,785,367	21,248,254,014	23,778,480,935	24.8%	12.9%	23.1%	23.3%
Brazoria	460,867,981	13,882,389	13,674,923,630	14,149,674,000	355,776,456	11,607,542	9,875,852,300	10,243,236,298	29.5%	19.6%	38.5%	38.1%
Matagorda	103,140,131	1,919,807	1,426,617,563	1,531,677,501	75,961,563	1,350,907	1,204,650,408	1,281,962,878	35.8%	42.1%	18.4%	19.5%
Calhoun	131,887,632	4,434,394	1,208,130,875	1,344,452,901	115,305,088	4,109,896	993,130,910	1,112,545,894	14.4%	7.9%	21.6%	20.8%
Refugio	18,576,730	1,556,800	96,554,291	116,687,821	20,479,733	1,176,804	77,294,344	98,950,881	-9.3%	32.3%	24.9%	17.9%
Aransas	334,111,773	10,181,130	2,465,019,432	2,809,312,335	252,534,304	8,361,889	1,796,326,036	2,057,222,229	32.3%	21.8%	37.2%	36.6%
San Patricio	133,727,579	3,971,912	2,359,500,229	2,497,199,720	101,011,954	2,714,051	1,668,035,155	1,771,761,160	32.4%	46.3%	41.5%	40.9%
Nueces	2,453,933,896	2,149,100	12,419,645,002	14,875,727,997	1,652,394,652	1,913,700	10,449,146,360	12,103,454,712	48.5%	12.3%	18.9%	22.9%
Kleberg	22,736,963	-	214,024,567	236,761,530	17,079,158	-	165,375,349	182,454,507	33.1%	N/A	29.4%	29.8%
Kenedy	694,441	144,500	6,618,882	7,457,823	694,441	144,500	2,662,500	3,501,441	0.0%	0.0%	148.6%	113.0%
Willacy	19,550,150	326,045	89,575,439	109,451,634	17,523,860	326,045	75,722,877	93,572,782	11.6%	0.0%	18.3%	17.0%
Cameron	1,232,168,354	2,695,600	2,281,236,342	3,516,100,296	1,012,077,170	2,927,618	2,011,798,298	3,026,803,086	21.7%	-7.9%	13.4%	16.2%
Total	8,739,477,568	64,028,438	74,061,983,623	82,865,489,629	6,540,689,445	52,690,921	58,629,721,278	65,223,101,644	33.6%	21.5%	26.3%	27.0%

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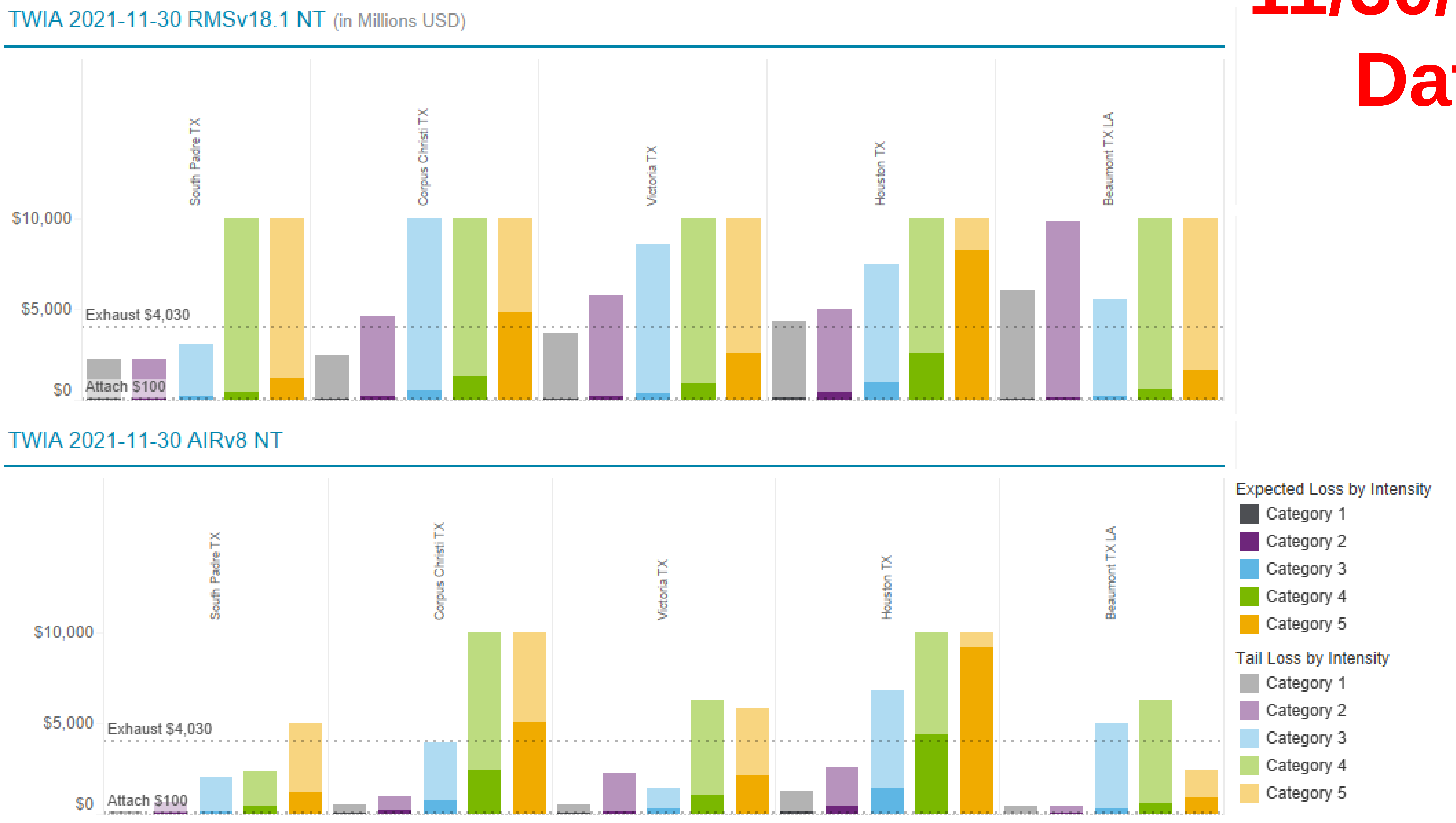
Funding Level Considerations

by Saffir-Simpson Intensity and HVG Gate | Cat 1-5 Hurricanes

11/30/2021 Data



*The above light bar graphs should be read as: Given that a Category X hurricane makes landfall in Gate Y; the average loss severity of the top 0.01% of Cat X landfalls in Gate Y is $
*The above dark bar graphs should be read as: Given that a Category X hurricane makes landfall in Gate Y; the expected (mean) loss of Cat X landfalls in Gate Y is $

How are Losses Derived?

Year Based Event Losses

- Occurrence losses are mapped to specific years
- Losses have a definite value
- Losses are assigned to years
  - Aggregate calculations are less complex
- Probabilities are defined by the number of years in the event set
  - Ex: 10,000 year event set implies each year has a 1/10,000 probability

Frequency Distribution (Ret. Period, Year) / Severity Distribution (Loss)

EventID	Ret. Period	Year	Loss	Description
270127481	10,000	4732	15,765,324,549	Cat 5 Houston gate
270205654	5,000	7622	15,690,509,265	Cat 5 Houston gate
270249179	3,333	9238	14,698,437,861	Cat 5 Houston gate
270256687	2,500	9516	12,690,509,002	Cat 4 Houston gate
270249947	2,000	9268	12,413,555,132	Cat 4 Houston gate
270215352	1,667	7977	12,389,984,482	Cat 5 Houston gate
270201846	1,429	7481	12,068,446,885	Cat 4 Houston gate
270035034	1,250	1302	12,030,984,543	Cat 4 Houston gate
270159943	1,111	5918	11,392,344,590	Cat 4 Houston gate
270214877	1,000	7959	11,160,836,760	Cat 4 Houston gate
…	…	…	…	…
270038792	102	1441	4,511,034,355	Cat 3 Houston gate
270039916	101	1482	4,493,561,816	Cat 4 Houston gate
270119776	100	4450	4,478,380,306	Cat 3 Houston gate
270226564	99	8392	4,374,081,357	Cat 4 Corpus Christi gate
270136428	98	5059	4,317,968,689	Cat 5 Houston gate

Similar event descriptions to top of curve around 100 yr. Return Period

Probability Based Event Losses

- Each event is a random variable and losses have a definite value
- An event rate is assigned to each event describing how often the event occurs on an annual basis
  - Aggregate calculations are more complex
- Return Period = 1/Cumulative EP

Frequency Distribution (Ret. Period, Rate) / Severity Distribution (Loss)

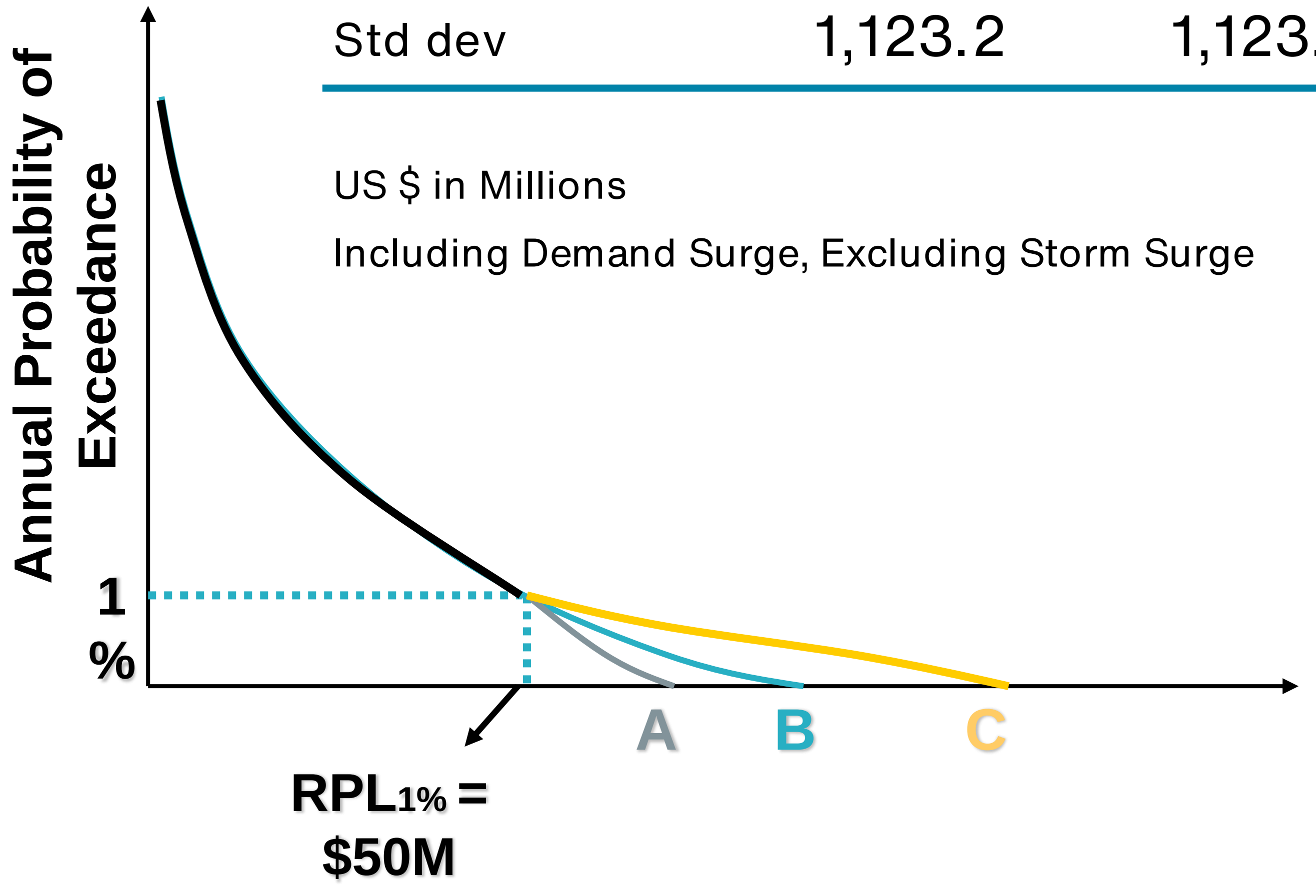
EventID	Ret. Period	Rate	Loss	Description
2862476	223,139	5.72E-06	31,090,763,789	Cat 5 Galveston Co TX
2873171	81,812	7.33E-06	27,806,138,925	Cat 5 Jefferson Co TX
2858622	55,749	4.12E-06	25,954,051,000	Cat 5 Galveston Co TX
2849633	39,258	3.44E-06	24,691,567,473	Cat 5 Kenedy Co TX
2849520	29,102	3.35E-06	23,423,728,225	Cat 5 Galveston Co TX
2863287	19,966	2.86E-06	22,044,002,190	Cat 5 Galveston Co TX
2854831	18,917	6.05E-06	21,851,897,644	Cat 5 Galveston Co TX
2849173	14,742	2.37E-05	20,982,674,969	Cat 4 Galveston Co TX
2858711	10,406	2.28E-06	19,654,667,404	Cat 5 Galveston Co TX
2865997	9,876	4.39E-06	19,436,645,401	Cat 5 Galveston Co TX
…	…	…	…	…
2870221	101	3.73E-05	3,123,174,538	Cat 3 Galveston Co TX
2865600	101	7.75E-06	3,121,933,427	Cat 4 Brazoria Co TX
2850680	100	1.07E-06	3,110,958,306	Cat 5 Cameron Co LA (TX bypass)
2869831	100	1.14E-06	3,109,536,702	Cat 4 Nueces Co TX
2868829	99	4.09E-05	3,099,072,340	Cat 4 Galveston Co TX

Managing Tail Risk Tolerance

What is TVaR and how can it inform your coverage decisions?

Tail Value at Risk (TVaR)

- Average value of loss given that a loss at least as large as the selected EP return period loss has occurred
- Measures not only the probability of exceeding a certain loss level, but also the average severity of losses in the tail of the distribution
- Example: AIR 100 yr return period loss equals $5,615.0m
  - TVaR is $9,272.0m (TVaR will always be greater or equal to return period loss)
- Interpretation
  - PML: There is a 1% annual probability of a loss exceeding $5,615.0m
  - TVaR: Given that at least a $5,615.0m loss occurs, the average severity will be $9,272.0m



AEP - All Perils (Near-Term/Warm Sea Surface Temperature)

	Verisk Touchstone v9			RMS RiskLink v21		
Return Period	TVaR	VaR	TVaR Ratio	TVaR	VaR	TVaR Ratio
1000 yr	16,366.7	13,905.9	1.18	17,995.8	12,813.7	1.40
500 yr	14,729.8	12,293.9	1.20	14,466.4	9,480.5	1.53
250 yr	12,646.1	8,859.2	1.43	11,112.0	6,519.2	1.70
200 yr	11,751.5	7,966.8	1.48	10,115.6	5,786.2	1.75
100 yr	9,272.0	5,615.0	1.65	7,419.9	3,944.4	1.88
50 yr	6,776.5	3,248.2	2.09	5,250.9	2,447.7	2.15
25 yr	4,557.6	1,691.4	2.69	3,532.1	1,376.8	2.57
20 yr	3,953.6	1,377.5	2.87	3,073.7	1,118.7	2.75
Annual avg	290.1	290.1	1.00	241.1	241.1	1.00
Std dev	1,123.2	1,123.2	1.00	958.1	958.1	1.00

US $ in Millions

Including Demand Surge, Excluding Storm Surge

Higher TVaR ratio in RMS indicates greater severity deviation from the aggregate 100 yr, although AIR has higher overall modeled losses

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B

Appendix B

Modeling Firm Disclaimers

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Limitations Regarding Use of Catastrophe Models

This report includes information that is output from catastrophe models of AIR Worldwide Corporation (Verisk), CoreLogic, Impact Forecasting, LLC (IF), and Risk Management Solutions, Inc. (RMS). The information from the models is provided by Aon Benfield Inc. (Aon) under the terms of its license agreements with Verisk, CoreLogic, IF, and RMS.

The results in this report from Verisk, CoreLogic, IF, and RMS are the products of the exposures modeled, the financial assumptions made concerning insurance terms such as deductibles and limits, and the risk models that project the dollars of damage that may be caused by defined catastrophe perils. Aon recommends that the results from these models in this report not be relied upon in isolation when making decisions that may affect the underwriting appetite, rate adequacy or solvency of the company.

The Verisk, CoreLogic, IF, and RMS models are based on scientific data, mathematical and empirical models, and the experience of engineering, geological, meteorological and terrorism experts. Calibration of the models using actual loss experience is based on very sparse data, and material inaccuracies in these models are possible. The loss probabilities generated by the models are not predictive of future hurricanes, other windstorms, or earthquakes or other natural or man made catastrophes, but provide estimates of the magnitude of losses that may occur in the event of such catastrophes.

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