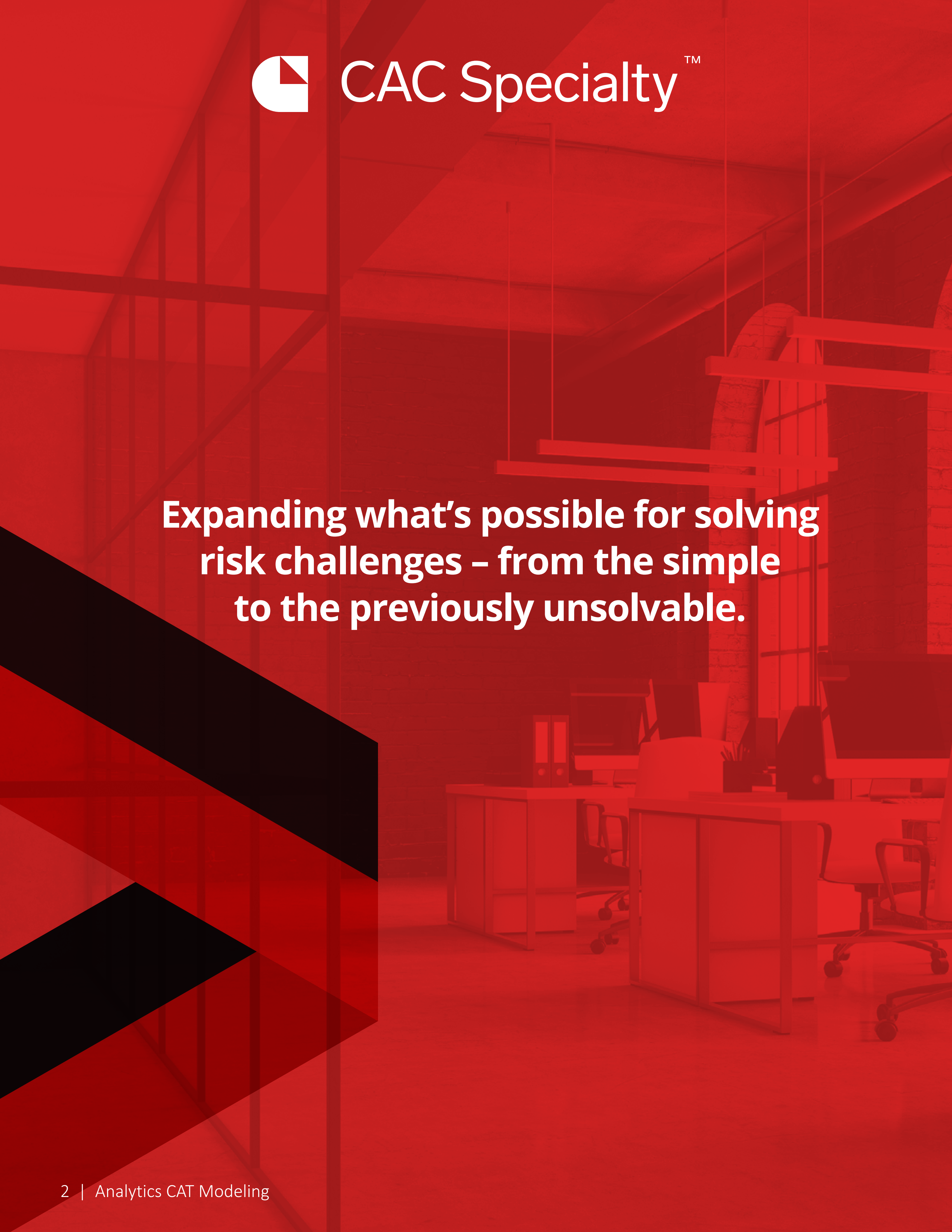
CAC Specialty™

2023

ANALYTICS

CATASTROPHE MODELING



CAC Specialty™

Expanding what's possible for solving risk challenges – from the simple to the previously unsolvable.

INTRODUCTION

As the rate of occurrence and severity of natural catastrophes continues to rise, determining the associated estimated financial impact on a set of locations has become increasingly important. However, using historical loss experience has proven problematic when estimating the likelihood and magnitude of future losses. Enter the use of catastrophe models: a sophisticated simulation model relying on scientific, engineering, and financial modeling expertise used to estimate future loss potential. This paper will focus on the AIR catastrophe model and provide a basic overview of the modeling framework, how to interpret results, and a section dedicated to FAQ's.

THE MODELING PROCESS

The AIR catastrophe model is based on a proprietary software that is an event catalog containing thousands of years of simulated catastrophes created from a combination of historical data and scientific expertise. The catalog can be split into multiple perils & geographic regions and contains a comprehensive view of risk by considering all potential future events, including the extreme tail risk. To run the model, client data is taken as an input and a loss analysis is run using the catalog of events, producing a unique loss scenario result for each event and year. Results are based on individual risks' various exposure characteristics such as the geographic location, insured values, and building characteristics. The client insurance program can then be overlayed to produce a loss estimate of the insured and retained losses. This final loss estimate output can be viewed using various metrics that measure different aspects of the risk, which are explained below in further detail.

THE OUTPUT

EXCEEDANCE PROBABILITY (EP) CURVES

Exceedance Probability is the likelihood that losses in the upcoming year will be at least a given amount. The standard AIR model uses 10,000 simulated years of data for each peril in the model and ranks the subsequent loss scenarios based on the largest event loss in a simulated year. To then calculate the Exceedance Probability, the ranking is divided by the 10,000 simulated years to produce a percentage. For example, if the 200th largest loss is $75M, then 9,800 losses are less than $75M. Thus, the probability of a loss of $75M or greater in a given year would be 2% (200/10,000). These exceedance probabilities are pulled at various percentage thresholds to construct a clients' EP curve exhibit (see sample below).

This metric does a good job estimating the tail of the curve and potentially devastating losses, but does a poor job understanding the amount of loss you could expect in a given year. For instance, your exposure may lie predominantly in a Tier 1 coastal county that is susceptible to large hurricane losses, leading to large loss estimates on your PML curve. However, it would be inaccurate to assume that you will experience a significant hurricane on a yearly basis. The PML is designed to measure your what-if loss scenarios, not your expected loss scenario.

RETURN PERIODS (PML)

Rather than interpreting EP risk as a probability for a given year, it can also be expressed as a frequency measure called a return period. Since 200 of the 10,000 outcomes had a loss of at least $75M, it can be stated that on average losses of $75M or greater will occur once every 50 years. This can be calculated by taking the number of simulated event years divided by the ranking (10,000/200) or 1 over the Exceedance Probability (1/2%). This $75M loss would be interpreted as the 50-year return period or probable maximum loss (PML). These return periods are typically shown in conjunction with the EP curve exhibit (see sample below).

RETURN PERIOD	EXCEEDANCE PROBABILITY	ALL PERILS
10,000	*0.01%*	183,733,660
5,000	*0.02%*	181,870,060
1,000	*0.10%*	46,751,372
500	*0.20%*	37,107,042
250	*0.40%*	29,464,356
200	*0.50%*	23,505,995
100	*1.00%*	13,238,351
50	*2.00%*	7,290,724
20	*5.00%*	2,013,214
10	*10.00%*	527,179
5	*20.00%*	111,876

AAL

Another key metric is the Average Annual Loss (AAL). The AAL is the sum of the annual losses in each simulated year divided by the number of years in the catalog. It is an expected value for losses that occur in any given year, but it is important to note it is a long-term average.

For example, there could be a 10,000 year event set with 5 losses greater than 0. But for a catastrophe like earthquake with extremely low frequency and high severity, the 5 results may be hundreds of millions of dollars. This helps explain why the AAL metric will struggle to account for the large fluctuations in losses on a yearly basis as it is sensitive to the tail of catastrophe distributions. Even though the average in this case is well above 0, you are more than likely to not sustain a loss in any given year.

FAQ'S

WHY ARE CATASTROPHE MODELS BETTER THAN USING HISTORICAL DATA?

When deploying traditional actuarial methodologies to estimate catastrophe losses, the estimates tend to fall apart rather quickly. For starters, there is a very limited number of historical events with credible data. As natural disasters tend to be extremely unpredictable and unique, looking at only historical events does not provide a holistic or accurate picture of the risk. The ability to use a comprehensive model and develop a forward-facing view of the risk is a better way of estimating potential losses rather than relying on a sparse loss history.

Additionally, the ability to incorporate the science aspect is a strength of the catastrophe models that is unmatched. While traditional actuarial methods can account for loss & exposure trends to estimate losses, catastrophe models are frequently updated to account for changes in environmental scientific conditions such as rising sea levels, increasing sea surface temperatures, shifting weather patterns, drier soils, increasing rainfall, etc. In addition, property characteristics can also be analyzed using more scientific methods to determine their effect on potential losses. Items such as elevation, construction type, and roof shape can be measured and accounted for through controlled testing or lessons learned from past events. This methodology can be more confidently relied upon rather than traditional segmentation of losses to adjust rate relativities.

WHAT ARE THE ABOVE METRICS USED FOR?

When risks are marketed to insurers, they will often look at both metrics when underwriting and determining insurability. PML's are used for a variety of things including setting limits and determining deductible structures. AAL's on the other hand are predominantly used to determine pricing by taking the loss and loading additional insurer specific expense and profit margins. Coverage decisions are also frequently made at more granular levels by looking at results by peril, geography, or portfolio to further segment the exposure and determine any concentration issues.

On a broker & client basis, these metrics can also be used to have conversations around loss mitigation, geographic expansion, and risk control. This frequently results in improved data quality (more data, cleaner data, etc.) and better understanding of how a clients' strategy will affect the affordability and availability of their insurance program.

ARE PMLS OR AALS ADDITIVE?

As mentioned above, a common request is viewing your risk split out by peril, geography, or portfolio alongside an aggregated view. When combining these views, an important distinction exists in that AAL's are additive while PML's are not. This can be better explained through an example of combining perils to create an "all perils" view.

When creating by peril EP curves, results are ranked across the simulated years for each peril individually. Thus, the n-th ranked result out of the 10,000 year event catalog will nearly always be different year between any two perils. To accurately produce the all perils EP curve, the losses for each simulated year must first be added across all individual perils and then the aggregated years are ranked.

The process to calculate the all peril AAL on the other hand is straightforward - the by peril AAL's are additive. Since AAL for an individual peril is calculated as the average loss across all simulated years, it is independent of the year ranking required by EP curves. The all peril AAL is therefore the sum of the individual peril AAL's.

WHAT IS THE DIFFERENCE BETWEEN AGGREGATE AND OCCURRENCE?

Aggregate results take in to account the cumulative event totals that take place in a simulated year, while occurrence results take into account only the largest event in a simulated year. In any given year, we could experience multiple catastrophes of the same or different types. For example, there could be a major wildfire and earthquake or multiple named hurricanes that occur in the same simulated year.

To better understand how this impacts our metrics, let's start by looking at the difference among EP Curves:

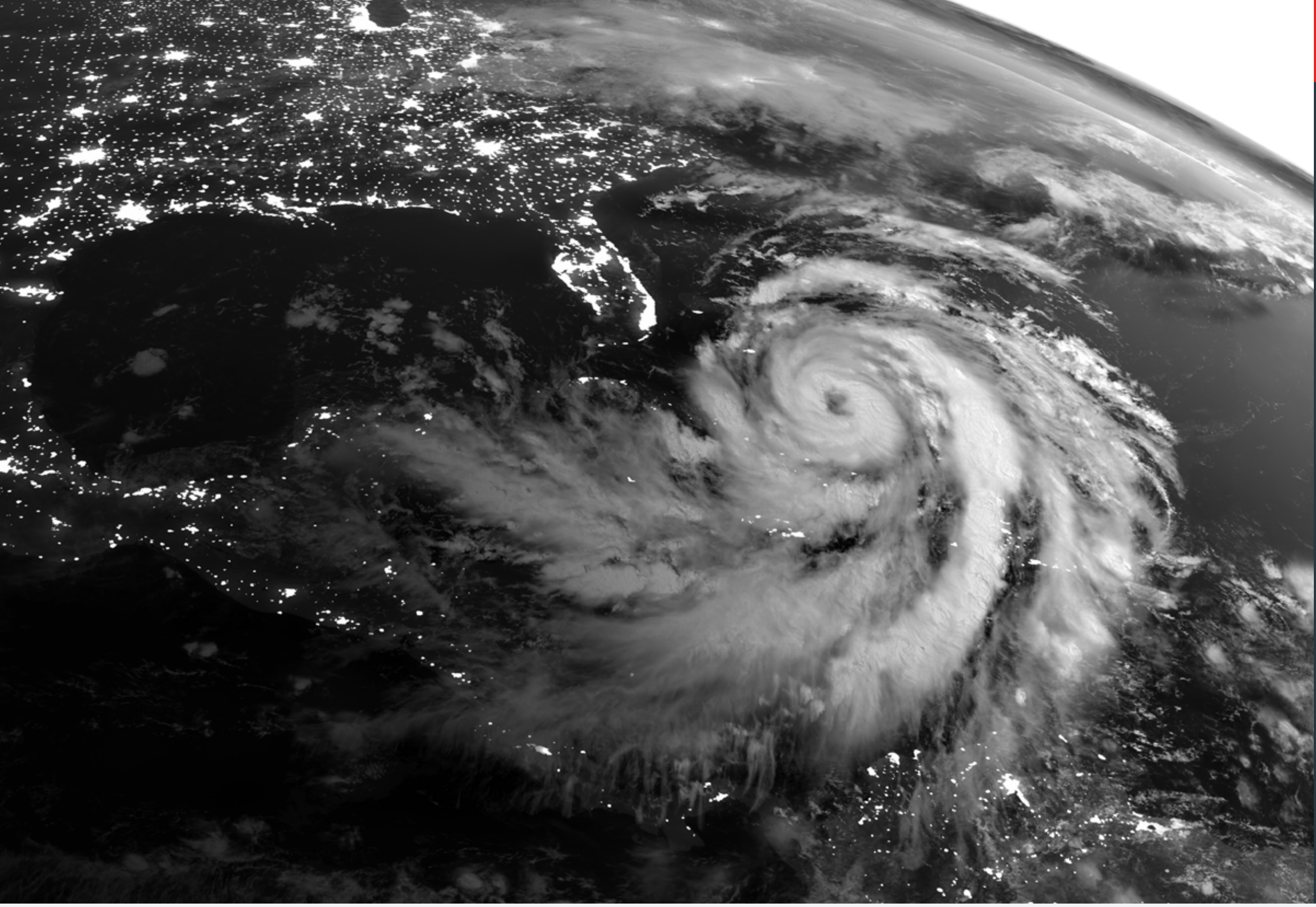
- Aggregate EP (AEP) Curves will take the sum of all the losses from all events in a simulated year and rank them to establish exceedance probabilities
- Occurrence EP (OEP) Curves will take the maximum loss event from each simulated year and rank them to establish exceedance probabilities

Both aggregate and occurrence EP curves are used by insurers, but OEP tends to be the dominant metric. Insurers are primarily concerned with the worse-case scenario in a given year when offering coverage and determining limits & deductibles, which generally translates to looking at the tail risk of a single occurrence. However, the difference amongst the two tends to decrease as you move further up the EP curve towards the 10,000 year return period since one large event will dominate your loss estimates at higher return periods.

The same difference can also be explained for AAL:

- Aggregate Average Annual Losses will take the sum of all losses across each of the simulated years and divide by the event catalog size to reach an AAL.
- Occurrence Average Annual Losses will take the sum of the maximum loss event across each of the simulated year and divide by the event catalog size to reach an AAL.

For most client and insurer perspectives, aggregate AAL is a better measure of portfolio risk than occurrence AAL. Aggregate AAL provides you with estimates of the full range of your losses in a given year rather than relying on a one event maximum. When comparing these metrics, a good rule of thumb is that your occurrence metrics should always be less than or equal to your aggregate metrics. Accounting for all possible loss events in a simulated year will always equal or exceed the maximum loss event occurring in a simulated year.



WHAT RISK CHARACTERISTICS AFFECT THE MODELING OUTPUT?

A risk generally consists of information on geographic, financial, and primary & secondary risk characteristics. While the geographic & financial data is necessary to obtain a result, the other risk characteristics can be viewed more as optional modifiers. Leaving these fields as "Unknown" is acceptable, but including the data, if available, will paint a more accurate picture of the catastrophe risk. There are 5 primary characteristics that can significantly impact the modeling output when provided: Construction, Occupancy, Number of Stories, Square Footage, and Year Built. In addition, there are various secondary characteristics that are rarer but can still be included in the model. These include things such as Roof Covering, Roof Geometry, Roof Year Built, and Base Flood Elevation.

Based on current client experience, below is a list of some of the items we look out for on a regular basis.

- For projects currently being constructed, we look to use the current year rather than leaving it blank. The model only accepts the current year or older as a valid year built. This will improve the modeled result across all perils as it is viewed as a new build rather than unknown.
- By providing latitude & longitude coordinates instead of address information, we can guarantee correct geocoding of the exposure. This will provide the most accurate view of the risk at the exact location rather than relying on geocoding, which may reduce the granularity to a street parcel or postal code centroid if the address is new or contains errors.
- For structures that are built above the base elevation, the amount (in feet) should be disclosed in the Base Flood Elevation field. This will improve the Inland Flood modeled results.

CLOSING

As catastrophe models continue to evolve, the ability to use and interpret results will become increasingly more important. Whether it be enhancements to the existing hurricane & earthquake perils or increased scrutiny & emphasis around emerging perils such as wildfire and flood, catastrophe models will remain an important tool to help clients understand their risk.

ABOUT *CAC SPECIALTY*

We are a risk solutions company that brings you seasoned and proactive industry leaders, operating as a nimble and collaborative partner who puts you and your business first. With a knowledge-driven approach informed by data and decades of honed instinct, CAC Specialty brings an innovative vision to insurance broking to solve your risk challenges.

We are nimble and can flex to meet client demand. Allowing us to provide large, national broker services, with a boutique broker feel. Since we are 100% employee owned, every employee that our clients speak with has a vested interest in creating a positive client experience, 100% of the time.

ANALYTICS *INTRODUCTION*

With a wide range of skillsets & background, CAC Analytics' team is well positioned to provide industry leading data & analytics services for all our clients. Our continuous evaluation process challenges the status quo to understand the impacts that industry, legal, societal, emerging risk, and insurance marketplace trends may have on executing an organization's risk management strategy.

Our combination of data, analytics, industry experience and client inputs equip organizations with risk insights to aid decision making and drive better outcomes.

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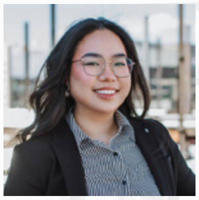

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