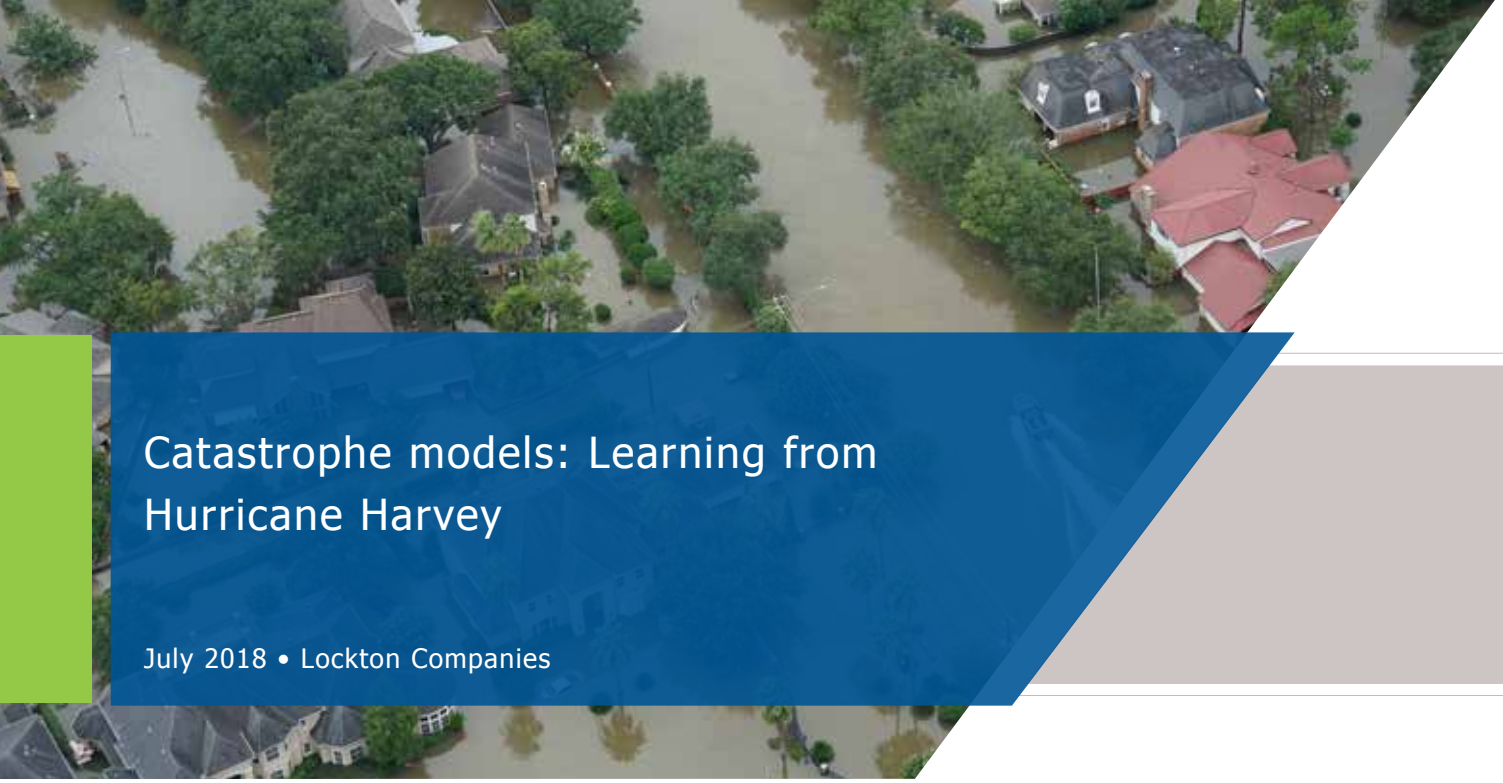

Catastrophe models: Learning from Hurricane Harvey

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Are you prepared for disaster to strike? While no one can ever be fully prepared for every situation, modeling natural disasters based on past experiences can help businesses examine possible scenarios and put appropriate risk management strategies in place. Equally as important is understanding potential pitfalls in the modeling process so that you can better account for them upfront and have fewer surprises when the unfortunate happens. Let's take a look at Hurricane Harvey and some lessons we can learn from it.

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Hurricane Harvey hit the coast of Texas on Aug. 25, 2017, as a Category 4 hurricane. Originally, it was considered a Category 1, but due to unusual and extreme circumstances, it rapidly became more dangerous. By Sept. 6, catastrophe modeling firm AIR Worldwide estimated Harvey's total insured losses to exceed $10 billion. Three days later, Risk Management Solutions estimated that same figure to be between $25 billion and $35 billion, which is well-aligned with the Swiss Re estimate of $30 billion in insured losses.

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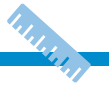
Was an event like Harvey considered in the models BEFORE it happened? To address this question, let's study the following ingredients of Harvey:

Track

RMS includes simulated events that closely match Harvey's veer toward the Gulf.

Storm surge



Harvey's storm surge levels were nothing compared to what we saw from Hurricane Sandy in 2012. The maximum storm surge produced from Harvey was only 12 feet. RMS simulates thousands of storms in this area, many of which have storm surges of 12 feet or more, so it is likely that its prediction of Harvey's surge was accurate.

Flooding

Flooding due to the massive amount of rainfall was the key driver of loss from Hurricane Harvey. The amount of rain received from Harvey was the most tropical cyclone rainfall measured in any one place in the US in the past 50 years. However, inland flooding is not yet captured with the RMS model.

Indirect losses

Houston, the area hit hardest by Harvey, is among the top 10 cities in the US based on GDP. The severe flooding of Harvey caused thousands of homes and businesses to be evacuated, generating substantial business interruption (BI) claims. Although models quantify "direct" BI, measuring "indirect" BI is far more difficult.

Many companies will have contingent BI claims that result from power or transportation disruptions, as well as supply chain disruptions, that result from events like Harvey. Other sources of loss that vendor models ignore include losses from inability to access a facility (ingress/egress, civil authority) and infrastructure losses. Throughout the insurance industry, there is agreement that these sources of loss will be significant.

Although catastrophe models fail to consider all possible sources of loss, it would be naïve to fully discredit them. Companies must recognize model deficiencies and supplement where needed. Some considerations include:

> "The complexity of business interruption claims, where there are losses arising from disruption to the policyholders' business, makes it difficult to model and estimate losses. Modelling agencies can model BI losses within their catastrophe modelling software, but the diversity of policies covering BI means a generic modelling approach to loss estimates is highly problematic. [Incorporating business interruption losses into model estimates] can be very difficult, because the specific policies can be so nuanced as to what covers a loss or when you can claim on those business interruptions."
>
> Dennis Sugrue
> Standard and Poor's

When did the last major event in the area of interest occur? Longer time intervals between events will increase the uncertainty in loss estimates. For example, the last Category 4 hurricane to hit the Houston area before Harvey was Hurricane Carla in 1961.

What are potential sources of indirect losses, such as widespread power failures, transportation disruption or dam/levee failure?

Where are critical suppliers or distribution centers located?

Events like Harvey will continue to expose deficiencies in catastrophe models, particularly for areas with a limited historical record. To illustrate this point, consider the New Madrid seismic zone.

The last major New Madrid earthquake occurred 200 years ago. Given the limited historical record, it is highly unlikely that any model can accurately predict the cost of a significant New Madrid earthquake, but models are still a useful tool to evaluate "how bad bad can get."

In fact, a FEMA study suggests that a 7.7 magnitude earthquake in the New Madrid region would cause $300 billion of direct economic damage, while also suggesting that indirect losses could reach $600 billion. Insurers would bear 60-80 percent of the economic damages from this event, due to the relatively high takeup rate of earthquake insurance in the New Madrid region. Indirect loss contributors could include:

- Transportation infrastructure disruption, including more than 3,500 damaged bridges. Fifteen major bridges would be unusable.
- 425,000 breaks/leaks in interstate gas pipelines.
- Severely inhibited road, rail, air and river travel.
- Substantial damage to utility infrastructure, leaving millions without water or electricity.
- 42,000 personnel required for nearly 1,500 search and rescue teams.

In this example, the indirect losses are significantly greater than the direct losses. Albeit rare, events heighten the need to use catastrophe models with a critical eye. Considering the direct and indirect losses provides a comprehensive view of catastrophe risk, as Harvey highlighted.

What can be done to supplement modeled outputs?

- **Understand the policy coverages.** Does the policy provide coverage for loss due to service and utility disruption, contingent business interruption, extra expenses, civil authority or ingress/egress? Although models do not explicitly account for these loss sources, adjustment factors can be applied to modeled output if these are concerns for the insured.
- **Quantify the completeness and accuracy of data inputs.** Lockton offers a data completeness report for any insured, importance-weighing the critical data elements for catastrophe models. Lockton's report highlights data elements that are present or missing from the analysis.
- **Pinpoint the locations of critical suppliers and infrastructure dependencies.** Is your company dependent on a utility company located in a catastrophe-prone area? If a critical supplier is disrupted for weeks, or even months, how would this impact your business?

- **Stress-test catastrophe models.** What return period do the limits of insurance equate to? Are the covered locations in areas prone to flood or located near a levee in a high-risk area? Does your company have a concentration of exposures near one another, which could easily consume the limits of insurance? How sensitive are the modeled outputs to storm surge or demand surge? Catastrophe models now allow the user many options for modeling storm surge, such as the assumed NFIP takeup rates or if there will be "leakage" of storm surge losses paid by wind-only policies. It is critical to know which options were modeled by your broker and carrier. Lockton performed an analysis demonstrating that storm surge-related losses can differ by nearly 500 percent depending on the modeling options selected.
- **Recognize that each catastrophe has unique circumstances that no model will ever capture.** For instance, Hurricane Sandy hit the East Coast in 2012 as one of the most destructive hurricanes the US has ever seen. Post-Sandy, governors of the impacted states ordered property insurers to enforce all-other-peril (AOP) deductibles rather than percentage hurricane deductibles. If an insured has a 5 percent hurricane deductible for a $500,000 home, its hurricane deductible is $25,000, while the AOP deductible may be only $500 or $1,000. This issue alone creates a significant gap between the modeled loss estimates and reality.

Hurricane Harvey and other catastrophes remind us of the importance of planning and preparing for future losses. Lockton is readily available to assist companies with their modeling needs and any supplemental work to fill in the gaps of modeling results. A holistic approach to modeling will help companies determine the appropriate amount of property and business interruption coverage to include in their risk management strategies.