AIR Currents Special Edition

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Storm Surge: A Growing Risk of High Losses

The steady growth of coastal residential and commercial property in recent decades has dramatically increased storm surge risk. In fact, according to next year's update to the AIR Hurricane Model for the United States, at today's exposures and sea levels, storm surge would account for 35% of ground-up losses from all hurricanes since 1900—a daunting figure. For individual storms, the percentage can be much higher. Most of the insured losses from Hurricane Sandy in 2012 and Hurricane Katrina in 2005, for example, were caused by storm surges.

WHAT IS STORM SURGE? A BRIEF LOOK BACK AT SANDY

Storm surge is the sometimes substantial increase in sea level that can accompany severe storms. High wind and low barometric pressure are the primary causes (see figure). The height of a storm surge relates to the storm size, intensity, forward speed, and path, as well as tidal cycles and coastal geography. Sandy, for example, a massive slow-moving storm, generated a substantial surge, even though wind speeds had dropped below hurricane levels at landfall.

The wide, gently sloping beaches along the New Jersey shore, and relatively shallow offshore waters, are particularly conducive to high storm surge. A dome of ocean water is pushed into increasingly shallow water. There is no place for this water to go but onshore.

"The severity of storm surge can be quite regional and temporal," notes AIR Senior Principal Scientist Tim Doggett. "Sandy could have been much more destructive at a time of higher tide or even in a different landfall location."

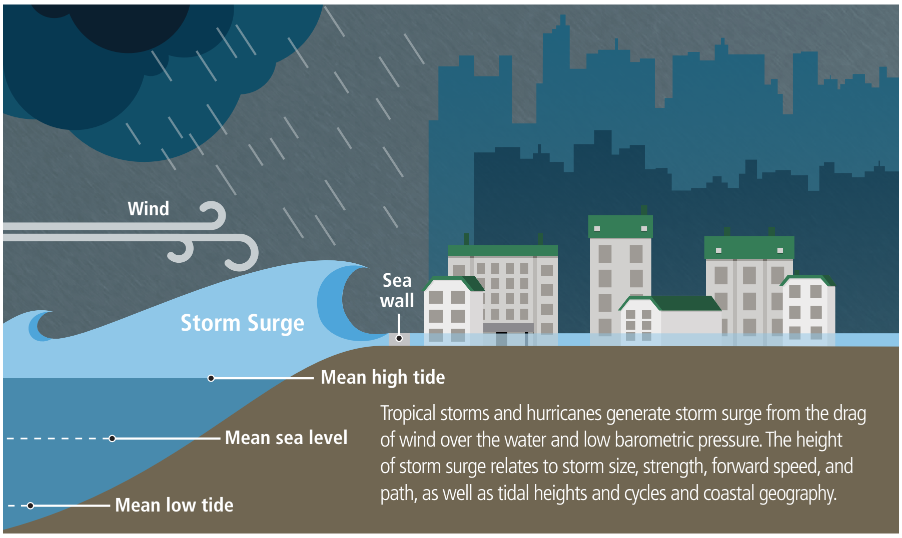
MODELING THE RISK

To generate a highly refined view of storm surge risk, AIR has developed an advanced hydrodynamic storm surge model—a key feature of the 2015 update to the U.S. hurricane model—that incorporates the important variables discussed above and many others.

"Effective storm surge modeling requires a robust view of the hurricane wind fields driving surge, at local and regional levels, as well as regional and temporal tidal variations," explains Doggett. "In AIR's new storm surge model, we integrate U.S. hurricane catalog storm parameters, downscaled through layers of hydrodynamic surge modeling, with high-resolution elevation data to create location-specific surge depths."

Louisiana (New Orleans, in particular) has received particular attention in the new model. Using the latest levee information from the U.S. Army Corps of Engineers, probabilistic modeling has been developed for the failure and/or overtopping of levees, floodgates, and other surge mitigation measures.

Storm surge damage can range from basement inundation, lower-floor flooding, foundation compromise, and content ruin to the complete relocation and/or destruction of structures and time-element claims. Detailed exposure data—including exact location, age, foundation type, number of basement levels, first floor elevation, service equipment placement, contents, and use—will enhance vulnerability analyses, improving the accuracy of storm surge modeling.



Tropical storms and hurricanes generate storm surge from the drag of wind over the water and low barometric pressure. The height of storm surge relates to storm size, strength, forward speed, and path, as well as tidal heights and cycles and coastal geography.

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Severe Thunderstorms, Risky but Manageable

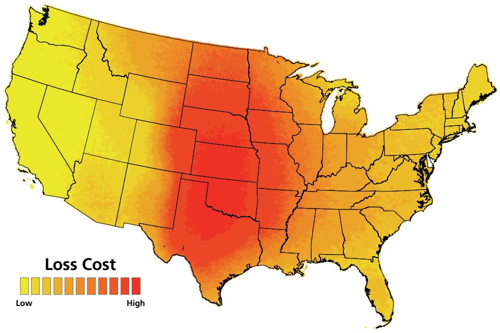
Severe thunderstorm is a relatively high-frequency peril, but aggregate losses can result in extreme volatility in financial results. For example, in 2011 alone, six severe thunderstorms generated insured losses of over USD 1 billion each, and total losses from 24 separate outbreaks that year exceeded USD 26 billion.

Generally, losses from individual severe thunderstorms in the U.S. are not as great as those from individual hurricanes or earthquakes, but severe thunderstorms have accounted for approximately one half of all U.S. catastrophic insured losses since 1990, according to data from ISO's Property Claim Services® (PCS®).

The tornadoes, hailstorms, and straight-line winds that make up a severe thunderstorm are highly localized events, and historical loss data do not tell the whole story about future storm occurrence potential. That's why relying on past claims data results in a narrow view of potential risk and can lead to unpleasant surprises. A severe thunderstorm model should not only capture the large outbreaks that produce insured losses in excess of USD 25 million (an amount that triggers the issuance of a PCS catastrophe serial number), but also the smaller events that may last only one day and produce much lower losses—but still impact a company's portfolio on an aggregate basis or a more rural portfolio on an occurrence basis.

One of the biggest challenges to modeling U.S. severe thunderstorm risk, however, is the sparseness of historical data due to underreporting. Through the "smart-smoothing" of historical storm reports to physically realistic locations using meteorological parameters that determine where storm formation is more likely, AIR scientist created full spatial coverage of simulated events throughout the continental U.S. This method accounts for risk in areas that may not have experienced major activity during the brief historical record, as well as in areas where activity occurred but went unreported.

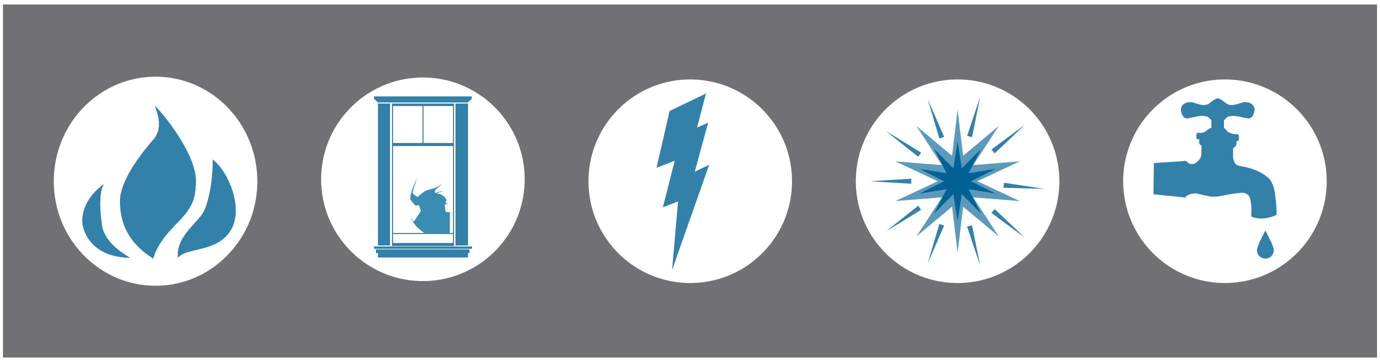
On an average annual basis, hail is the severe thunderstorm sub-peril that causes the highest losses to property, up to several billion dollars each year. The sub-peril with the highest annual occurrence rate is straight-line wind, while the least common (albeit most destructive) is tornado. AIR's recently updated model allows companies to analyze losses for each sub-peril individually as well as for all three combined to gain better insight into what is driving portfolio risk.



Severe thunderstorm loss costs for three sub-perils combined

Companies can also enter many secondary risk features based on their own exposure information, such as roof characteristics and details on building envelope. The model's sub-peril-specific damage functions reflect unique damage mechanisms and are based on the latest scientific research, post-disaster damage surveys, and more than USD 40 billion in claims data.

Based on a decade's worth of new data and having undergone extensive peer review, the 2014 model provides the most robust view of U.S. severe thunderstorm risk available, allowing companies to tailor analysis of this risk to their individual portfolios and understand it at a highly granular level.



Exploring the Impact of Risk from Non-Catastrophe Perils

Catastrophes are not the only challenges facing insurers. In many situations, non-catastrophic sources of loss—primarily fire, but also lightning, explosion, vandalism, and sprinkler leakage—contribute significantly to losses. Non-catastrophe perils can be the key to truly understanding the entire risk profile.

Various business situations require analysis of both catastrophe and non-catastrophe perils. Underwriters often need to address both, as many direct and facultative accounts are written on an "all risk" basis. To price them appropriately, all aspects of loss must be assessed. Similar situations arise in treaty reinsurance or in the periodic reporting of managing general agents with binding authority.

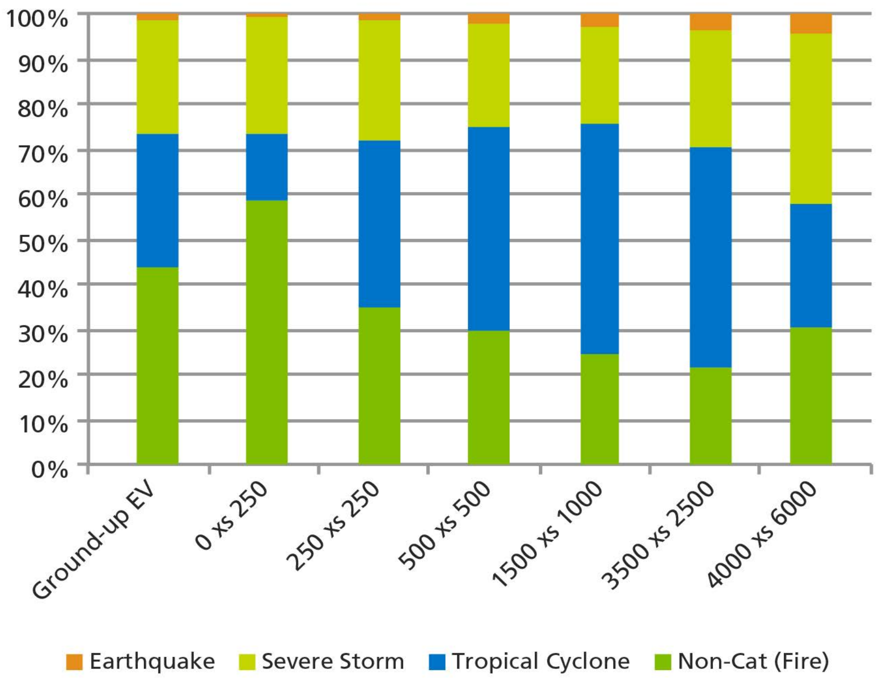
New functionality added to Touchstone® this year allows companies to analyze non-catastrophe risk to property exposures using exposure data that have already been input for catastrophe modelling. As well as accounting for both catastrophe and non-catastrophe risks in a single platform, Touchstone leverages data from our sister company, ISO®, a leading source of information about property/casualty insurance risk.

For example, non-catastrophe expected losses for a specific account can be calculated quickly by running the catastrophe models for tropical cyclone, severe storm, and earthquake, and then using the ISO Commercial Property Basic Group I loss costs. ISO loss costs can be adapted for use outside the U.S., or user-specified loss costs can be entered.

The expected ground-up non-catastrophe losses can be distributed into excess layers using ISO's Property Size-of-Loss Database (PSOLD™) curves. With over one million individual curves, PSOLD is well-validated to distribute losses into multiple layers of coverage, both in the U.S. and around the world.

In the example analysis below, drilling into each layer of coverage to show the contribution by peril reveals that non-catastrophe losses make up the majority of the total in the lowest layer. The contribution of non-catastrophe losses decreases in the higher layers, but it still remains a significant portion of the total—almost a third of the highest layer analyzed.

This simple example highlights just how significant non-cat catastrophe perils can be to an account's risk profile. The powerful analytics readily available through Touchstone streamline analysis and reporting and provide a more comprehensive view of risk.



The contributions to layer losses by peril

THE ANATOMY OF A TORNADO

Tornadoes are one of the most destructive forces on Earth.

- ~1,200 in the U.S. every year
- Tangential wind speed: 40 mph to >300 mph
- Ground speed: <10 mph to >70 mph
- Track length: several feet to >200 miles
- Duration: minutes to hours

How Severe Tornadoes Form

1 Under unstable and highly sheared atmospheric conditions, a rotating thunderstorm, called a supercell, can form thousands of feet above the earth.

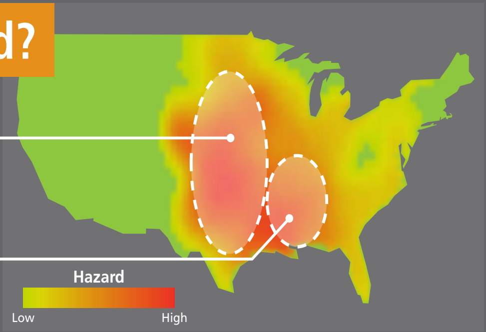
2 Interactions between the storm and its environment can cause a concentration of the supercell's rotation into a small, rapidly spinning parcel of air, called a funnel cloud.

3 This parcel can grow in size, eventually becoming a tornado—forming one continuous column of rotating air between the ground and the bottom of the supercell.

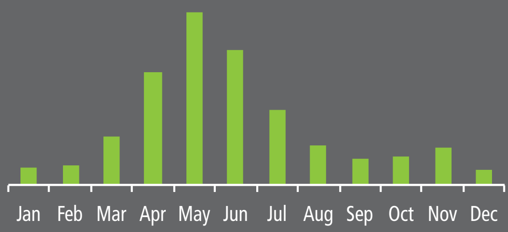
Where's the Hazard?

Most common in "Tornado Alley"

Notable activity also in "Dixie Alley"

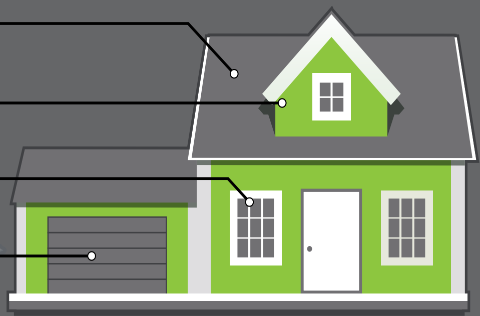


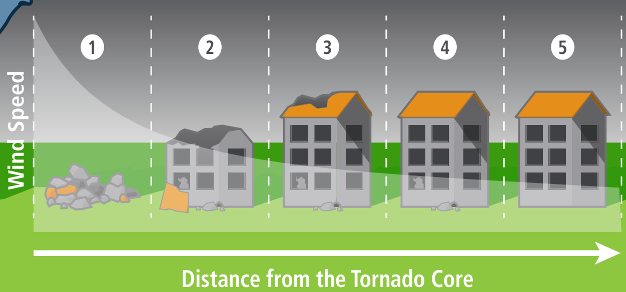
A Season for Tornadoes?



Activity peaks in April–June, but tornadoes can develop any time of the year—some regions even experience a secondary peak in early fall

Understanding Tornado Damage





Tornadoes Have Wind Fields Too

1. Catastrophic destruction
2. Significant structural damage
3. Moderate damage to building envelope
4. Minor damage to non-structural components
5. No significant damage

Managing the Risk

Insured average annual loss for tornado is nearly $4 billion—hail and straight-line wind add an extra $9 billion

Losses are highly volatile from year to year, but growing exposure concentrations mean that the potential for large losses is increasing

Using historical data alone does not tell the whole story about future loss potential

Detailed modeling using a blend of statistical and physical methods overcomes data limitations to provide a comprehensive view of the risk

Sources: AIR, NOAA

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