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ViewPoint

Analyzing Industry Issues from an Independent Perspective

2017 Catastrophe Insights

Behind the headlines

Beware of locusts! After a year with a wide variety of major catastrophes in the U.S., it can feel like the end of days is upon us. Headlines call out devastation and disaster, but what is really going on beyond these sound bites? With insights from the RAA Cat Risk Management Conference, hosted in Orlando, Florida, Holborn examines Severe Convective Storm activity, "HIM" Hurricanes, and the California Wildfires of 2017.

Severe Convective Storm (SCS)

While hurricanes grab the most attention, severe convective storms can have devastating effects. According to NOAA, there were 1,396 confirmed tornadoes in 2017 that, together with all other convective weather activity, cost the (re)insurance industry $18.6Bn.

> *"…there were 1,396 confirmed tornadoes in 2017…"*

Approximately ten years ago, there was a jump in the frequency and severity of large ($1Bn+) SCS events. Since that time, the numbers remain elevated. The research community attributes this, in large part, to two main factors: Development and Climate Change.

> *"…the atmosphere is more conducive to turbulent weather…"*

Development

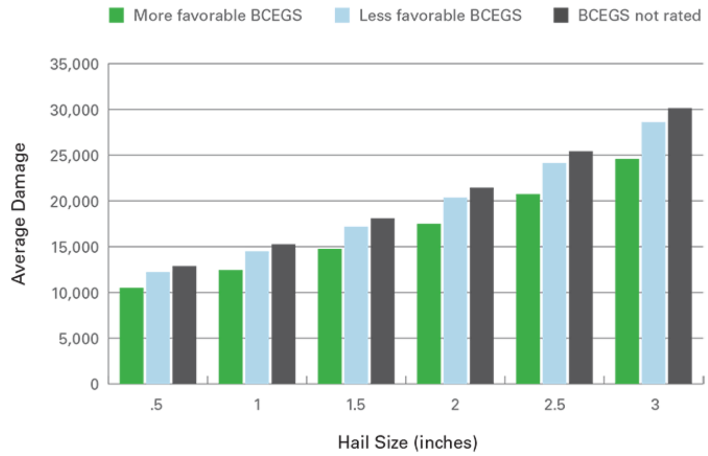
There is a misconception that tornadoes avoid heavily populated urban areas. It is simply a matter of land area – dense urban centers account for a much smaller square mileage than the suburban and rural land surrounding them. Suburban-sprawl, however, has increasingly spread population and building density outside of urban concentrations and, accordingly, made the "bullseye" bigger.

Climate Change

The latest research ties climate change (namely atmospheric warming) to more severe weather days annually and higher incidence rates of larger hail sizes. Put simply, the atmosphere is more conducive to turbulent weather. The debate as to whether this is part of a long-term, mankind-influenced trend, or the active phase of general climate cyclicality will continue unabated. There is, however, no denying that climate change is producing more turbulent weather.

An increasing share of SCS losses are attributable to hail in recent years. More frequent severe hail (1"+ or quarter-sized) storms, as observed in recent years, has exacerbated losses. Most notably, the May 2017 hailstorm in Denver, which produced an estimated $1.4Bn in damage; the costliest in the area's history.

Damage from hail naturally increases with hail size, as seen in Verisk Analytic's graph (opposite). This graph depicts Verisk's view, as informed by study of industry claim data, of the Missouri residential property market.



SOURCE: Verisk Analytics; BCEGS = ISO's Building Code Effectiveness Grading.

Modeling the Risk

Modeling SCS is very complex and computationally-intensive, due to:

- Temporal and spatial clustering,
- Lack of shape-uniformity and smoothness in hazard gradients, and
- Geographically narrow footprints of the various sub-perils, particularly tornadoes and hail.

With sustained elevated losses over the last decade, model vendors appear to be paying closer attention to the peril. Investment in new research and development is likely a response to client demands. Nearly all model vendors agree that there is a statistically significant connection between the ENSO cycle (El Niño / La Niña— the equatorial sea surface temperatures in central and eastern Pacific Ocean) and spring-time SCS activity.

The latest research asserts that a strong La Niña (low temperatures) from December – February is positively correlated with heightened U.S. SCS activity in the three months that follow. La Niña was moderate-to-strong from December 2017 to February 2018, which is very similar to the prior year period. By comparison, the 2016/17 and 2017/18 periods are about half the "signal strength" of the 2007-2008 and 2010-2011 periods, which preceded two extremely active SCS seasons.

ENSO conditional event sets (catalogs) are an offshoot of this research and may already be incorporated by some vendors. How carriers potentially extract strategic and operational value from these model developments remains to be seen

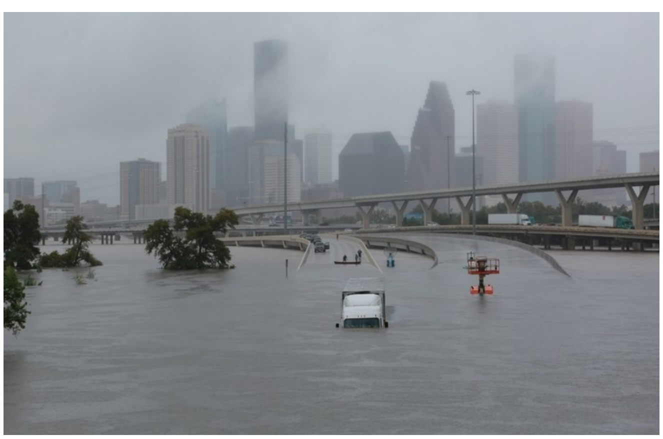
Hurricane

The 2017 Atlantic Basin Hurricane season ranked high on the ACE (Accumulated Cyclonic Energy) Index, and its active nature can be largely attributed to fertile atmospheric conditions / instability (for tropical wave creation and subsequent correlation with centers of air circulation) in Western Africa.

A Unique Season

The 2017 season marked the first time on record (1851 to present) two Category 4 storms (Harvey and Irma) making landfall on the continental U.S. A third, Maria, made landfall on Puerto Rico, a U.S. Territory. All three storms are within the Top 5 costliest U.S. hurricanes on record, according to NOAA's National Hurricane Center: Harvey second, Maria third, and Irma fifth.

Interestingly, though Harvey is remembered as a flood event (image of Houston below), it had higher sustained winds at landfall than Irma did in mainland Florida. Irma's insured losses have been exacerbated by high LAE, due to short supply of independent adjusters, and Assignment of Benefits (AOB). Both factors remain an issue that may cause losses to increase over time.



Maria, on the other hand, had a substantial amount of uncertainty from the loss amounts themselves, due to the inaccessibility of the islands. This uncertainty in early insured loss estimates predominantly stemmed from the commercial and industrial segments, including Business Interruption and Contingent Business Interruption related to extensive power grid damage. By comparison, residential property was relatively well understood (and modeled) from the outset.

Harvey

Storm Overview

Hurricane Harvey caused $100-125Bn in economic losses, but only ~$30Bn was (re)insured mainly due to low flood take-up rates. On August 17, 2017 Potential Tropical Cyclone 9, the system that would eventually develop into Hurricane Harvey, organized 300 miles east of Barbados.

As it developed, Harvey moved westward and hit the Lesser Antilles as a weak tropical storm, then dissipated in the central Caribbean Sea. The storm then quickly intensified as a Category 4 hurricane before making landfall in Port Aransas, Texas on August 26th.

Harvey then stalled for four days. Two high pressure systems, to its northwest and east, impeded its forward motion. During this time more than 60 inches of rain fell over southeast Texas.

Facts & Figures

Measure	Data	Location
Lowest pressure	938mb / 27.58in	Central TX coast
Strongest sustained winds	130mph	Near TX central coast
Landfall pressure & sustained winds	938mb / 130mph	Rockport, TX
Max storm surge height	12.5ft	Aransas County, TX
Max rainfall	60.58in	1.5mi SW Nederland, TX
U.S. Economic Loss	$100-125Bn	
U.S. (Re)insured Loss	~$30Bn	

Insights

Climate change is also seen by the research community as a driver of the unique characteristics of Harvey, especially as regards to precipitation. In addition, recent history shows that storms, particularly those in the Gulf of Mexico, can rapidly intensify prior to landfall, due to warm sea surface temperatures in conjunction with low wind shear. As the main source of hurricane energy, higher water temperatures result in larger, more intense, and longer-lasting storms, as well as increased rainfall.

The increased "waviness" in the atmosphere, or atmospheric disturbance that can induce large pressure gradients, is another factor. Harvey's stalling, as noted above, resulted from the existence of a high pressure system "blocking mechanism." By stalling on the Texas coastline, Harvey retained access to the warm Gulf of Mexico waters which exacerbated both wind speeds and precipitation.

Wind damage from Harvey could have been much more significant had the storm made landfall either farther south in the Corpus Christi area, or farther north in Galveston / Houston.

For the flood component, the NFIP's out-of-date maps give reason for concern. There are large areas of flood inundation where maps are 15 – 25 years old and, arguably, understate the flood risk. If the maps were current and based on the latest available research and technology, perhaps property development would have been disallowed, or at least less economically feasible, resulting in less devastation.

Irma

Storm Overview

Irma developed from a tropical wave near Cape Verde on August 30. Favorable conditions allowed Irma to rapidly intensify into a Category 3 hurricane on August 31. However, the storm's intensity fluctuated between Categories 2 and 3 for the next several days, due to a series of eyewall replacement cycles.

On September 4, Irma resumed intensifying and become a Category 5 hurricane by early the next day. On September 6, Irma peaked with 185 mph sustained winds. Another eyewall replacement cycle caused Irma to weaken back to a Category 4 hurricane, but the storm quickly regained Category 5 status. Path projections at that point were quite dire,

> *"...Irma most certainly defines a "near-miss!"..."*

with some predicting a Category 5 direct hit on Miami and estimates of (re)insured losses in excess of $200Bn. Ultimately, Irma continued on its westward track longer than anticipated, which meant more meaningful land interaction with Cuba and landfall on the southwest side of the Florida peninsula. This area has lower population density and property values than other parts of the state. Irma most certainly defines a "near-miss!"

Although interaction with Cuba weakened Irma to a Category 3 storm, the system re-intensified to a low Category 4, as it crossed the warm waters of the Straits of Florida. On September 10, the storm made landfall on Cudjoe Key, with sustained winds of 130 mph (215 km/h). Irma then significantly lost strength prior to another landfall on Marco Island (mainland Florida) later that day, as a weak Category 3. Further weakening to a Category 2 followed shortly thereafter, ending over a week long period of major hurricane status. In the end, Irma held Category 5 strength for five of those days.

Facts & Figures

Measure	Data	Location
Lowest pressure	914mb / 26.99in	
Strongest sustained winds	185mph	
Landfall pressure & sustained winds	929mb / 130mph	Cudjoe Key, FL
Max storm surge height	7.8ft	Fernandina Beach, FL
Max rainfall	16in	Ft. Pierce, FL
U.S. Economic Loss	~$50Bn	
U.S. (Re)insured Loss	~$25Bn	

Insights

Two of the most important storm parameters relating to damage potential are:

- **Saffir Simpson (SS) Category** and,
- **Radius of Maximum sustained winds (RMax)**, which is the distance from storm center that SS Category winds extend.

A week into its life cycle, Irma was near record-setting on both fronts. Landfall in Cuba and exposure to increased wind shear, as the storm turned northward toward Florida, took a lot of the "punch" out of Irma. When it hit mainland Florida, Irma was a disorganized Cat 3 with an RMax of less than 50 miles (and dropping).

Generally, a hurricane is more intense when there is a defined eyewall and symmetrical structure, as seen in satellite imagery. These characteristics indicate an alignment of atmospheric conditions that permit "clean" organization and, accordingly, the continued intensification of the storm when there is access to warm water. The below image depicts the difference in storm organization of Irma (right, 2017) and Andrew (left, 1992). Hurricane Andrew is the most intense storm to ever hit Florida.

Irma's peak storm surge in the U.S. was in the Jacksonville, FL area, demonstrating that landfall and peak storm surge locations are not always the same. Wind direction relative to the coast, shape of coast-line (concave vs. convex), and a sheared back half of the storm were the main drivers of Irma's unusual storm surge impact on mainland Florida.

West coast winds at landfall were offshore, pushing the water away from the coast. The back half of the storm, where winds reverse direction, was relatively calm. On the contrary, winds on the east coast were onshore and longer in duration. The gently concave shape of the Florida / Georgia border channeled, rather than dispersed, the wind-driven water.

Post-loss, Assignment of Benefits (AOB) is an ongoing concern for Irma, particularly related to water damage restoration claims resulting from storm surge. AOB is an agreement that transfers the insurance policy's rights or benefits from the policyholder to a third party (e.g., contractor). It is prevalent in water and roof claims across Florida.

In addition, independent adjusters were in short supply due to Irma occurring on the heels of Harvey. The combination of AOB and LAE inflation, related to independent adjusters demand, is having a meaningful impact on total (re)insured losses. Market intelligence suggests Irma LAE ranges from 13-15% of indemnity range, as compared to 8-10% for Harvey.

Maria

Storm Overview

Hurricane Maria formed as a tropical storm on September 16. Just two days later, Maria was a Category 5 storm and the tenth most intense Atlantic hurricane on record. After making landfall on the island of Dominica on September 19, Maria briefly weakened to a high-end Category 4 before regaining Category 5 status as it barreled towards Puerto Rico. As it approached landfall just south of Yabucoa, Puerto Rico on September 20, Maria underwent an eyewall replacement cycle, which weakened it to a Category 4 but broadened its RMax.

Puerto Rico was the final direct interaction with land. On September 28, Maria gradually degraded and weakened to a tropical storm and moved east over the open Atlantic. It eventually became extra-tropical on September 30, then dissipated by October 3.

Facts & Figures

Measure	Data	Location
Lowest pressure	908mb / 26.81in	
Strongest sustained winds	175mph	
Landfall pressure & sustained winds	917mb / 155mph	Yabucoa Harbor, PR
Max storm surge height	15ft	Toa Baja, PR
Max rainfall	37.9in	Caguas, PR
U.S. Economic Loss	~$90Bn	
U.S. (Re)insured Loss	~$30Bn	

Insights

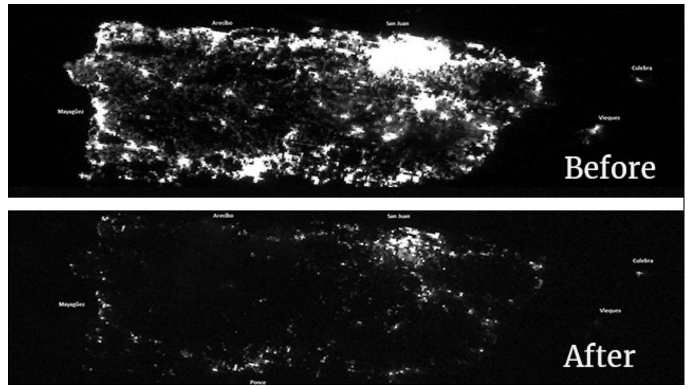
Residential property in Puerto Rico is generally built with reinforced concrete, in order to withstand high winds in this hurricane-prone part of the world. However, many homes had highly susceptible wood frame second stories, the construction of which was permitted by in-force building codes. Nearly all of these structures were totaled.

Residential property insurance take-up rate is about 50% (for standard perils of fire, wind, etc.). Less than one-third of homeowners have a mortgage and, accordingly, are mandated to purchase insurance. The majority of homes are owned outright, having been passed down through generations.

For commercial and industrial risks, where the take-up rate is higher, Business Interruption and Contingent Business Interruption are the "wild cards." Very broad-ranging and high early loss estimates reflected this uncertainty. Actual loss figures have developed much lower than these original estimates.

Despite localized events (i.e., Toa Baja, Puerto Rico), storm surge was not a major issue, as water generally disperses, rather than channels, around an island. That said, rainfall amounts were tremendous and resulted in significant inland flooding. Many areas measured over 20 inches of rain, which equates to 1:1,000+ return period. The NFIP take-up rate in Puerto Rico is very low, at 1%. By comparison, Florida take-up rate is 15%, Louisiana is 24% and Texas 6%.

Mold from water intrusion is an ongoing concern, given widespread and sustained power outages. Limited cooling and dehumidifying capabilities thwarted general mitigation and restoration efforts. Water intrusion coverage varies by line of business and coverage form and it is unknown whether these losses are contemplated in existing loss estimates or will result in additional claims creep.



SOURCE: Suomi NPP Satellite imagery of Puerto Rico at nighttime before and after Maria, depicting power outage impact

WILDFIRE

Overview

Wildfires can occur in clusters within a season, when short-term conditions are ripe. WUI (Wildland-Urban Interface) is where residential development intersects with undeveloped lands replete with fuel sources. These areas are especially prone to fire – e.g., Coffey Park on southwest edge of the Tubbs Fire. Ongoing WUI penetration, which began in the 1960s, is a significant driver of loss.

Human ignitions are most prevalent in high-hazard areas, causing 84% of wildfires in the U.S. and accounting for half of the area burned. High winds can be a significant exacerbating factor, as was the case in 2017. Fire breaks (e.g., roads) can be rendered ineffectual once winds reach a certain threshold, known as "spotting."

2017 California Fires

Latest estimates, which have grown over time, estimate the California wildfires are up to $15Bn of (re) insured loss. Approximately 80% of the loss is from the October Northern California fires, which burned 228,000 acres and destroyed 8,400 structures. The remaining 20% of loss is from the Southern California fires in December. More acreage burned in these fires (308,000), but significantly less structural damage was inflicted (1,362 properties destroyed, and another 460 damaged).

The nine month period beginning in March 2017 was the driest in over 100 years, and it was preceded by a wetter than average winter, which aided vegetation growth and resulting in "fine fuels" (grasses, small twigs, and needles that allow fires to start and spread). This unfortunate confluence amounted to extremely ripe conditions for wildfire.

Following the torrential rains in January 2018 and resulting mudslides, California state regulators deemed the 2017 wildfires as the proximate cause. Debate remains as to whether the wildfires were actually a significant causative agent. It is possible that the mudslides would have occurred anyway, given the magnitude of rain, but regardless of who is "right" in this debate, standard property insurance policies are responding.

Modeling the Risk

AIR will release a new wildfire model in summer 2018. The new model will expand from just California to 13 western states, including Texas and Oklahoma, up through Montana and the Pacific Northwest. AIR views wildfire risk as increasing, based on the amount of activity since 2011. AIR also plans to fully revamp their model in California, with guidance on changes to be provided later this year.

Wind speed and direction are primary drivers of loss. AIR is using historical "sustained" wind data, and fitting curves to allow for variability beyond historical events.

For purposes of model calibration, the bulk of loss data is residential and includes smoke. Damageability for wildfire is often binary – "all or nothing" – with high severity potential. Fire-wise communities, defensible space, roof cover, wall siding, glass type, and skylights are examples of secondary modifiers that are important to measure loss potential. Vulnerability is heavily impacted by the weakest link, such as stacked firewood next to the house or an open window, as compared to relatively less impactful construction or occupancy factors.

Conclusion

The events of 2017 tested both insurers and reinsurers' claims handling, coverage response, and financial strength. Model vendors' and, accordingly, their clients' view of prospective Cat risk was also challenged.

However, post-loss provides a good opportunity to solidify relationships, demonstrate value, and proactively incorporate "lessons learned." The industry is faced with opportunity and room for improvement in areas including:

- Closing the "protection gap" (e.g., flood),
- Risk mitigation,
- Managing AOB,
- LAE management, and
- Harnessing data and technology to find new and better ways to serve clients in their times of need.

Holborn understands the importance of trust-based relationships and open communication during trying times. The Holborn team is here to support clients' evolving needs in areas such as reinsurance strategy, capital support, accumulation analysis, and risk mitigation. No one hopes for another active Cat year, but if the frequency and severity of 2017 repeats, the Holborn team is ready to stand alongside clients and their policyholders to make lives whole again.