2017 Natural Hazard Risk Summary & Analysis

Executive Summary

Annually, CoreLogic® spends time reflecting, analyzing, and evaluating the severity of natural hazard events across the United States in an effort to inform and protect homeowners and businesses from financial devastation.

2017's report includes a robust assessment of natural hazards from the California wildfires and the various flood events due to Hurricanes Harvey and Irma. It also includes a breakdown of earthquake, wind, hail, tornado, and even international events such as Hurricane Maria, Cyclone Debbie, and the Mexico earthquake. All the data compiled in this report is at minimum current through the first of December, with exceptions denoted otherwise.

Using granular hazard risk data and services, this evaluation accounts for both the physical scale as well as the financial burden of the damage caused during the calendar year. It also assesses the risk levels for both residential and commercial properties, and it draws implications about what this means for 2018.

Through these insights, we strive to empower our clients with comprehensive, granular hazard risk data and solutions, providing information which helps determine with certainty on the type of protection to insure.

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According to the National Oceanic and Atmospheric Administration (NOAA) Billion-Dollar Weather and Climate Disasters Table of Events, there were 16 individual weather and climate disaster events with losses exceeding $1 billion in the U.S. in 2017.[1]

There were many natural hazard events that severely impacted the U.S. during 2017:

- Overall hurricane activity in the Atlantic was higher than average with 17 named storms, 10 hurricanes, and six major hurricanes.[2]
- Flooding from Hurricanes Harvey and Irma resulted in an estimated $69 billion to $105 billion in residential and commercial damage.[3]
- Approximately 75 percent of the damage to residential properties from Hurricane Harvey was uninsured, and approximately 80 percent of the damage to residential properties from Hurricane Irma was uninsured.[3]
- Due to strong winds brought by Hurricanes Harvey and Irma, the land area impacted by severe winds was more than four times greater than in 2016.[3]
- Over 9 million acres burned in wildfire, the third highest in U.S. history.[4]
- The largest fire, in terms of structures destroyed, was the Tubbs Fire in northern California, which burned 36,807 acres and 5,643 structures. Until 2017, the two worst wildfires in California history – Tunnel in 1991 and Cedar in 2003 – destroyed 5,720 structures combined.[5]
- As of December 1, there were 818 identified earthquakes at a magnitude of

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northern California, which burned 36,807 acres and 5,643 structures. Until 2017, the two worst wildfires in California history – Tunnel in 1991 and Cedar in 2003 – destroyed 5,720 structures combined.[5]

- As of December 1, there were 818 identified earthquakes at a magnitude of 3.0 or greater across the country.[6]
- The hail event in Denver, Colorado, was the worst this year with losses of $1.4 billion from approximately 150,000 auto insurance claims and approximately 50,000 homeowner insurance claims.[7]
- This was the third most active year for tornadoes since 2005 with 1,522 recorded tornadoes.[8]

Many wonder if catastrophic hazard events will be on the rise or the decline as we look ahead to 2018. History has continually shown us that it is impossible to determine exactly when or where the next wildfire, flood, or earthquake will strike which is why preparedness, response, and post-loss assessment are essential.

This story map analysis includes interactive maps with zoom, scrolling and vertical swipe capabilities, allowing viewers to compare the natural hazard data. Click the interactive maps at the right for additional details, and note that the maps may take a few moments to load due to the multiple data layers displayed.

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2017: A Year of Record-Breaking Catastrophe

Catastrophic Floods in 2017

The two largest floods in the mainland U.S. in 2017 were caused by Hurricanes Harvey and Irma in August and September, respectively.

Flood damage to property had a significant impact across communities throughout the U.S. Hurricanes Harvey and Irma alone caused an estimated $69 billion to $105 billion of property damage. In the case of Hurricane Harvey, almost 75 percent of the flood damage was uninsured, the majority of which was residential properties.[3] The properties at greatest risk of flood are generally located in Special Flood Hazard Areas (SFHAs) as identified by the Federal Emergency Management Agency (FEMA), but the severe flooding from these events extended far beyond those boundaries.

Hurricane	Total Flood Damage (Billions)	Residential Flood Damage (Billions)	Commercial Flood Damage (Billions)
Harvey	$40 to $59	$25 to $37	$15 to $22
Irma	$29 to $46	$25 to $38	$4 to $8

Source: CoreLogic

2017: A Year of Record-Breaking Catastrophe

Hurricane Harvey

Rainfall from Hurricane Harvey was exceptional in both the amount of water that fell as well as the large geographic area the storm covered, with new river flood depth records set at 31 of the 67 government recording stations in the affected area. Nearly 500,000 homes experienced some type of impact, and of those 500,000 homes, an estimated 90,000 incurred severe damage from flooding. Almost 200,000 more homes suffered extensive flooding that impaired immediate occupancy, and an additional 200,000 suffered short-term impaired functionality. The Houston and Beaumont metropolitan areas of Texas were most severely impacted.

Hurricane Harvey rapidly de-intensified and stalled after making landfall near Port O'Connor, Texas, on August 25. This stall and continued rainfall led to record rainfall across Texas, with the highest accumulations in the Greater Houston metropolitan area and east into Louisiana. Cedar Bayou in Houston received almost 52 inches of rain from Hurricane Harvey, a new national record.[9] The U.S. Federal Emergency Management Agency (FEMA) issued a "Major Disaster Declaration" for 41 counties in Texas and an "Emergency Declaration" for the state of Louisiana.[10]

Historic River Flooding. The flooding in Texas was unprecedented in the modern era. River flows on the Neches River (above Beaumont, Texas) reached

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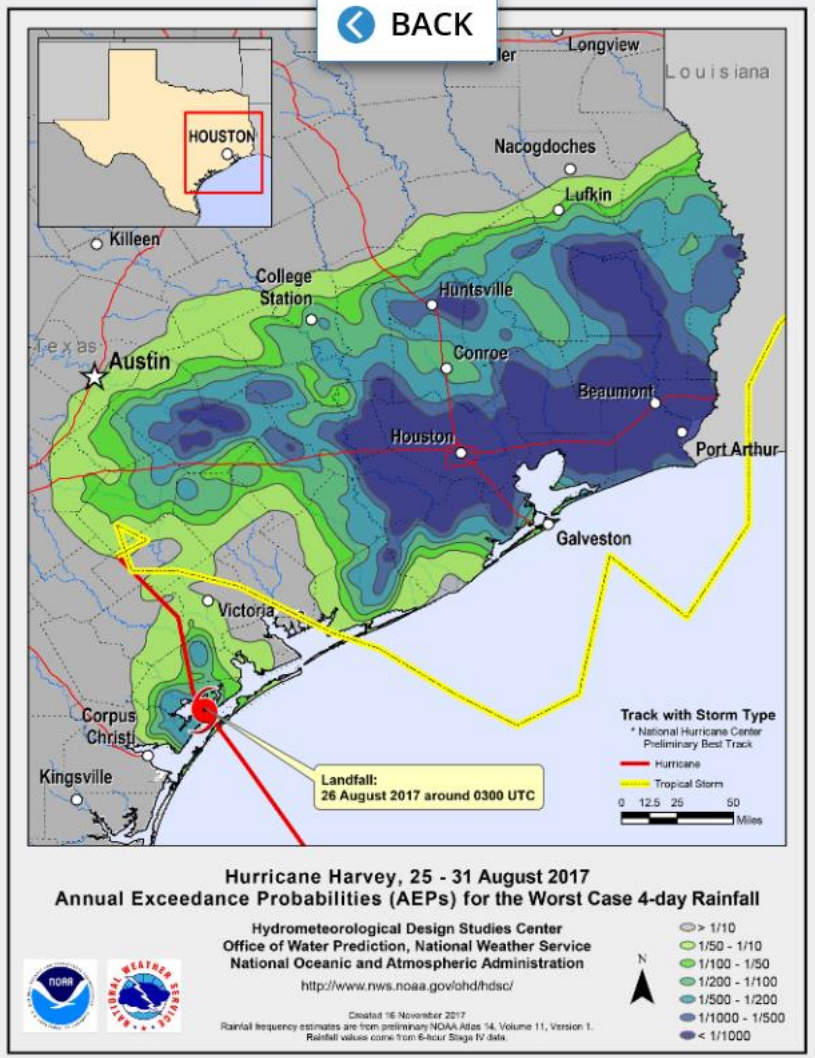

2017: A Year of Record-Breaking Catastrophe

Historic River Flooding. The flooding in Texas was unprecedented in the modern era. River flows on the Neches River (above Beaumont, Texas) reached the second highest level ever recorded – one foot below the level reached in 1884 and five and a half feet higher than the recent crest measured in June 2016.[11]

While the occurrence of hurricanes and persistent rainfall cannot be accurately predicted, data can be used to understand the flow path of water to anticipate the locations where flooding is likely. CoreLogic produces a Flood Risk Score, which designates properties as being at Extreme, Very High, High, Moderate, Low and Very Low risk of flooding, and can be used to help identify these locations. Properties within SFHA zones require flood insurance if the property has a federally insured mortgage. Properties outside SFHA zones are not required to carry flood insurance, and many property owners choose not to carry flood insurance if it is not required even though their property may be at significant risk of flood. Tables 1 and 2 show the risk levels for the properties of the seven metropolitan areas in the predicted path of Hurricane Harvey at the outset of the storm. As the event matured, the Houston-Sugar Land-Baytown and Beaumont-Port Arthur metropolitan areas became the center of precipitation and the resulting flooding.

Table 1: Total Properties at Risk by Flood Risk Level

	Outside Special Flood Hazard Area						
Total Properties	Extreme Risk	Very High Risk	High Risk	Moderate Risk	Low Risk	Very Low Risk

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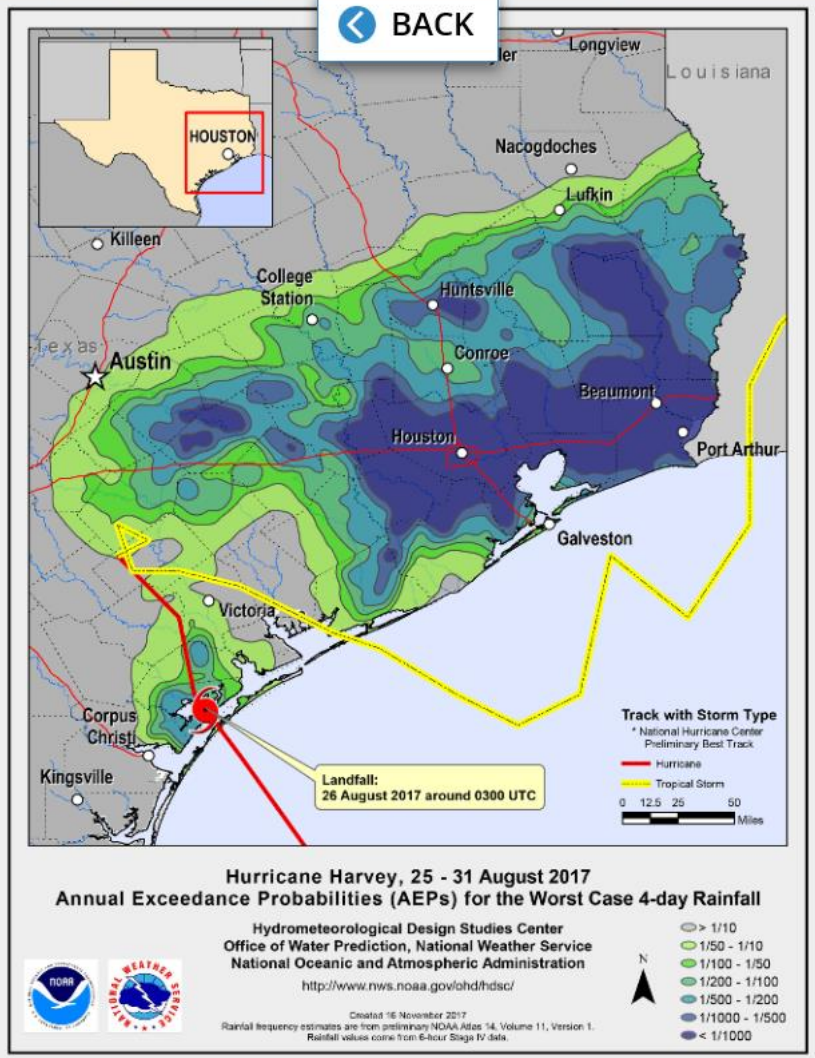

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Table 1: Total Properties at Risk by Flood Risk Level

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	Total Properties	Extreme Risk	Very High Risk	High Risk	Moderate Risk	Low Risk	Very Low Risk
Austin-Round Rock-San Marcos	701,325	7,233	15,628	52,622	74,451	66,110	485,281
Bay City	23,459	722	5,727	7,374	5,904	1,104	2,628
Baaumont-Port Aurther	194,610	1,990	19,774	39,096	67,090	19,531	47,129
College Station-Bryan	91,106	836	2,983	6,865	13,070	13,496	53,856
Corpus Christi	34,330	186	4,199	5,924	6,175	3,379	14,467
Houston-Sugarland-Baytown	2,340,343	57,077	211,851	494,983	715,202	287,098	574,132
Victoria	42,419	646	1,847	7,064	7,751	4,198	20,913

Source: CoreLogic, August 2017

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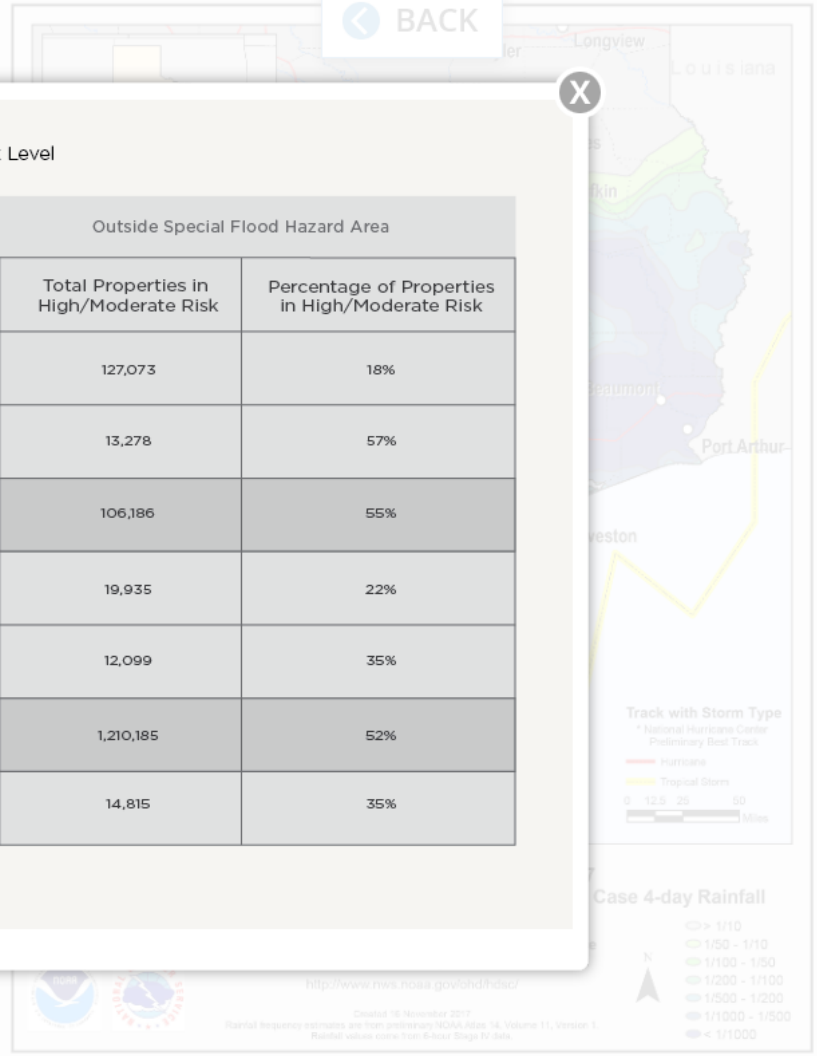
Table 2: Total Properties in the High/Moderate Risk Level

	Outside Special Flood Hazard Area		
	Total Properties	Total Properties in High/Moderate Risk	Percentage of Properties in High/Moderate Risk
Austin-Round Rock-San Marcos	701,325	127,073	18%
Bay City	23,459	13,278	57%
Baaumont-Port Aurther	194,610	106,186	55%
College Station-Bryan	91,106	19,935	22%
Corpus Christi	34,330	12,099	35%
Houston-Sugarland-Baytown	2,340,343	1,210,185	52%
Victoria	42,419	14,815	35%

*This analysis does not include risk from storm surge or flash flooding



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Hurricane Irma

Flood loss for residential properties from Hurricane Irma is estimated to be between $25 billion and $38 billion. This includes storm surge, inland flooding and flash flooding in Florida, Alabama, Georgia, North Carolina and South Carolina. Of this total, insured residential flood loss is estimated to be between $5 billion and $8 billion, and uninsured residential flood loss is estimated to be between $20 billion and $30 billion. This means an estimated 80 percent of flood damage to residential properties from Hurricane Irma is uninsured and, therefore, not covered by flood insurance.

Hurricane Irma traversed up the middle of Florida with the highest rainfall totals observed in Morgan, Georgia, at 4.91 inches.[12]

2017 Natural Hazard Risk Summary & Analysis

Flood

Year in Review

Heavy rainfall and two major hurricanes resulted in another year of billion dollar losses due to flooding in 2017. In 2016, the U.S. experienced six 1,000-Year flood events, and although 2017 did not repeat with multiple 1,000-Year flood events, there were major flood events that resulted in billions of dollars in property loss.

California Winter Floods

California experienced the first major flood event of the year in January. California had been experiencing drought conditions for the previous five years; however, during the rain/snow season (October through February), the state saw the highest level of precipitation in over 100 years. The National Centers for Environmental Information (NCEI) (formerly the National Climatic Data Center or NCDC) reported a total of 27.81 inches.

In February, the heavy rainfall totals resulted in flooding primarily in the central and north regions of California. The rainfall was fueled by a weather pattern called "Pineapple Express." This phenomenon is characterized by a strong and persistent flow of atmospheric moisture. It is also associated with heavy precipitation from the waters adjacent to the Hawaiian Islands, extending all the way to the Pacific Coast of North America.

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2017 Natural Hazard Risk Summary & Analysis

Flood

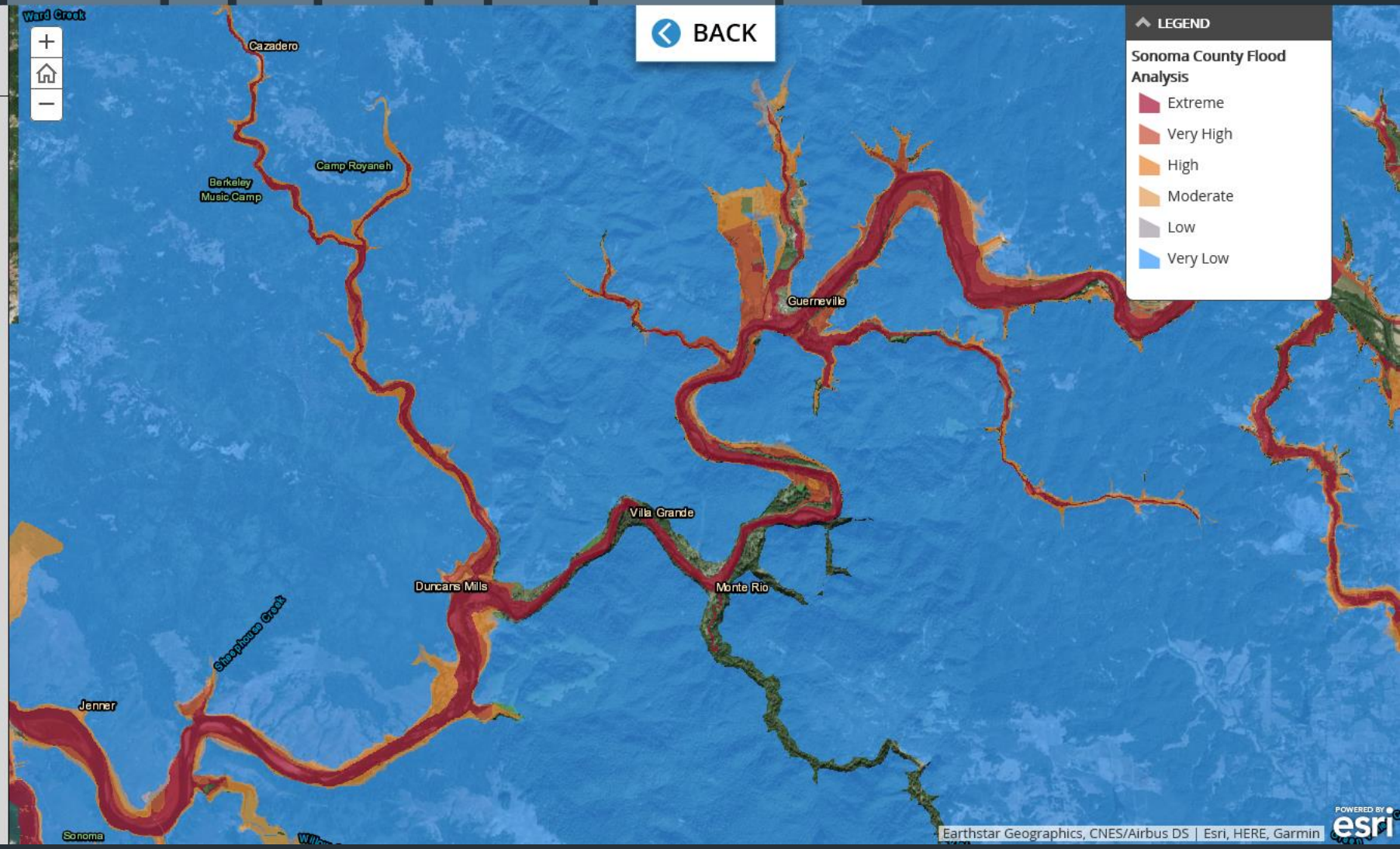
The NCEI estimates total property loss in California at $1.5 billion.[1]

In Sonoma County, California, the Russian River crested more than six feet above flood stage in Guerneville with an estimated 550 homes impacted by the flooding.[13]

San Jose, California, also experienced major flooding which resulted in the evacuation of over 14,000 residents. Many areas of San Jose fall within a FEMA Flood Zone D. This means there are possible but undetermined flood hazards, and no analysis of flood hazard has been conducted. Properties located within Zone D are not required to have flood insurance, but FEMA encourages property owners within this zone to purchase it.[14]

The Anderson Reservoir was at capacity, and with the repeated heavy rains, water from the reservoir began to flow over the spillway causing Coyote Creek to swell and flood communities downstream.

California communities downstream from the Oroville Dam did not experience mass flooding; however, the heavy rainfall contributed to the evacuation of over 180,000 people when both the main and emergency spillways began to crumble as water was released from Lake Oroville. The lake had risen 50 feet during the winter months, and when water was released to relieve pressure, the main spillway began to collapse. For those downstream from the dam, this was a major



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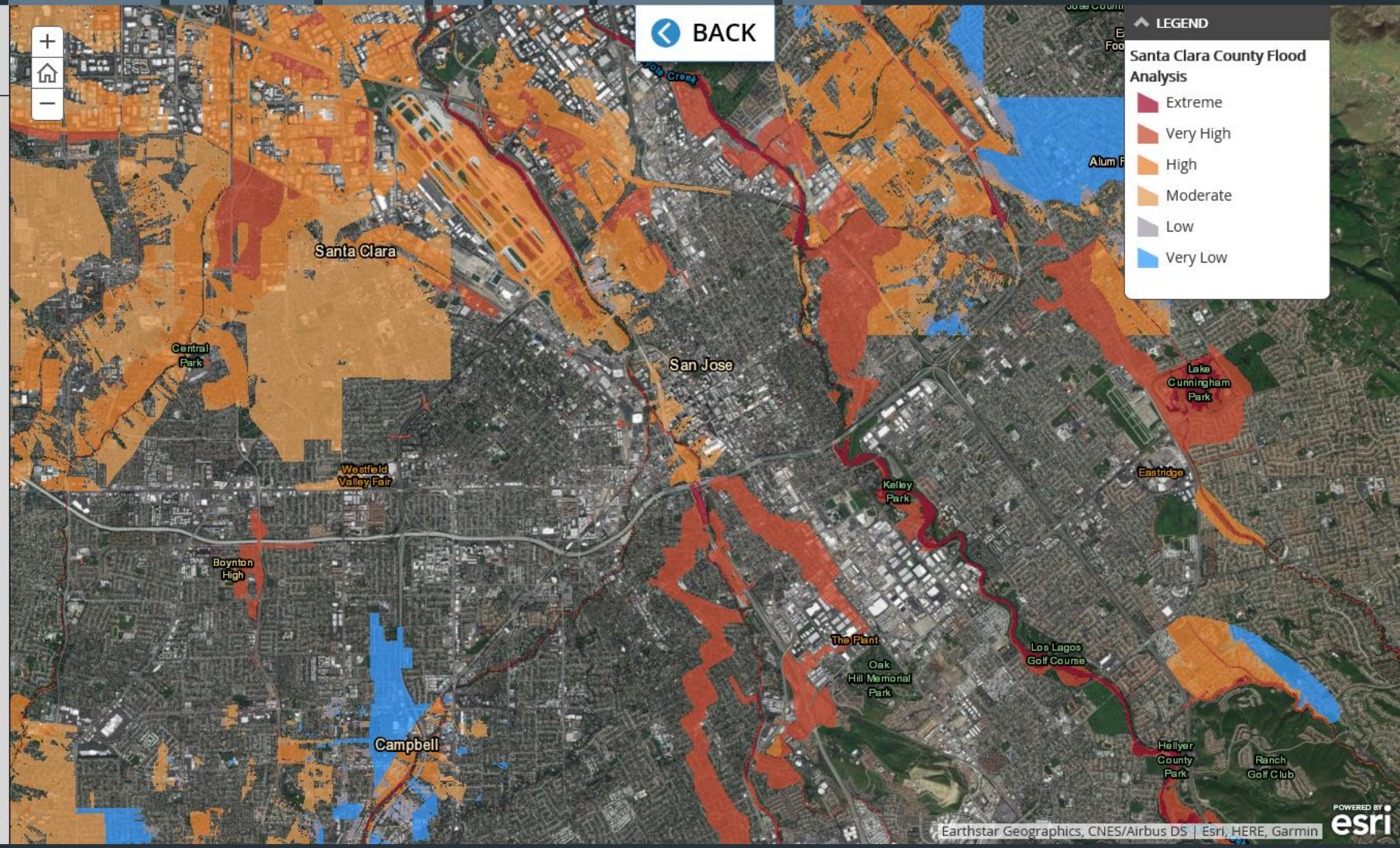

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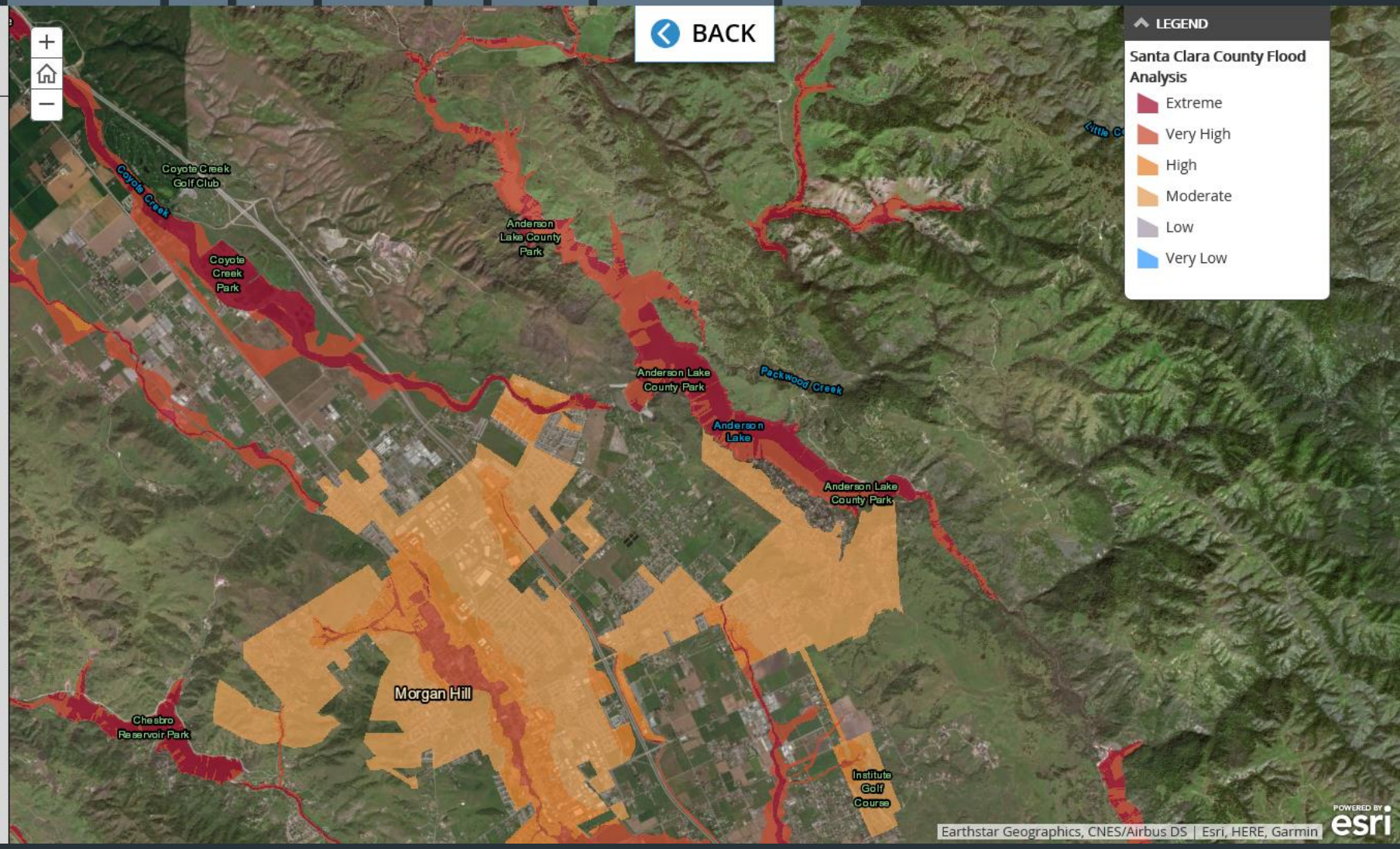

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Midwest April/May Flooding

Late April and early May brought a significant amount of rainfall in the Midwest with areas reporting 15 inches of rain, resulting in several rivers cresting above historic flood levels. The National Weather Service reported a total of 267 flood and flash flood events between Oklahoma and Ohio during a 36-hour period from April 29 to April 30. Flooding was most severe in Missouri, Arkansas and Illinois where widespread damage affected homes, businesses, infrastructure and agriculture.[16] The NCEI estimates total losses from this flood event at $1.7 billion.[1]

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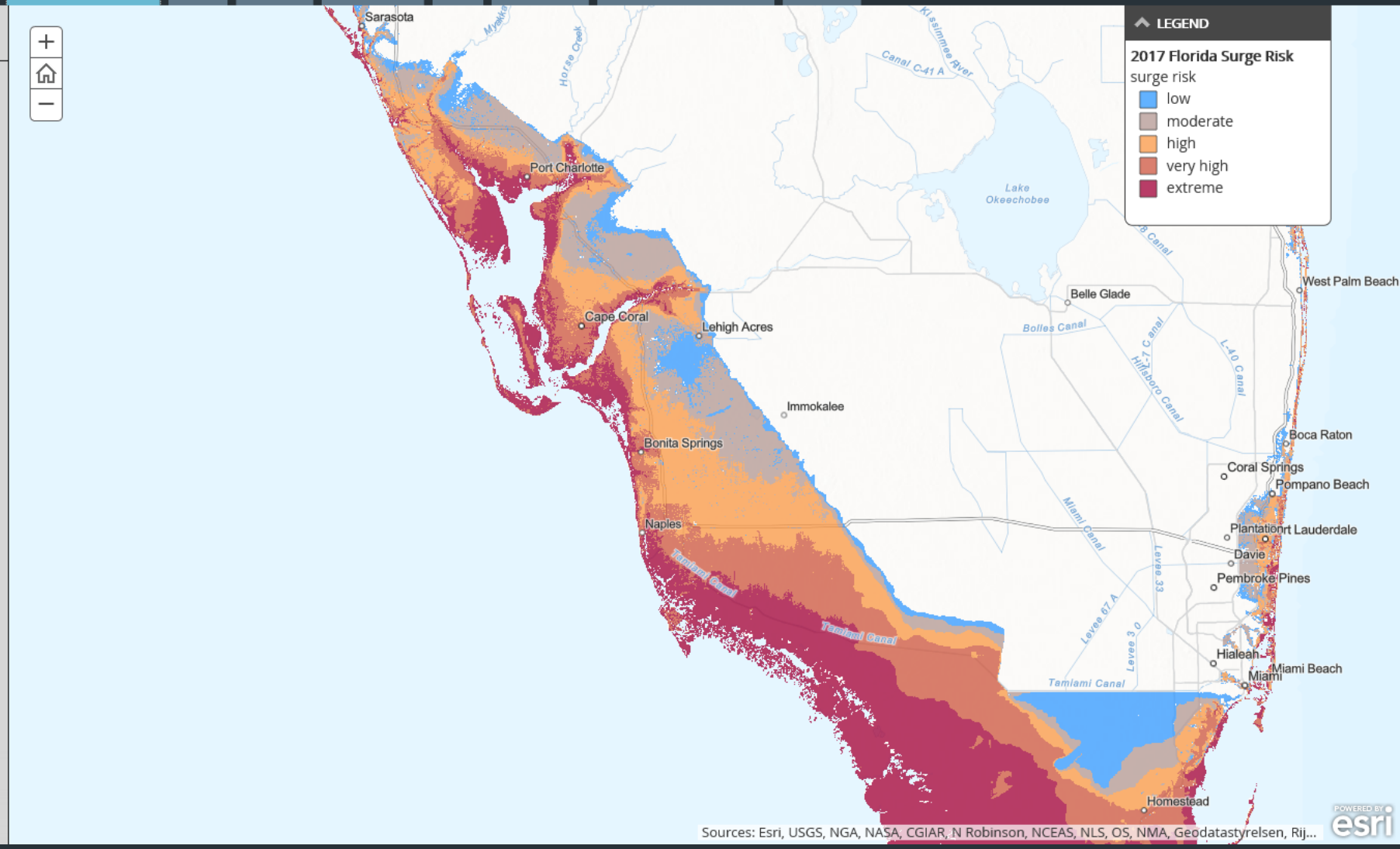
Atlantic Hurricanes

Last year marked the end of the hurricane landfall drought. The landfall of Hurricane Harvey near Port O'Connor, Texas in August represented the first landfall of a major hurricane along the U.S. Atlantic and Gulf coasts since Hurricane Wilma impacted Florida's Gulf Coast in 2005. The absence of a major hurricane landfall during this period was exceptional given the historic average of six major hurricanes per decade.[17] Overall hurricane activity in 2017 was significant with 17 named storms, 10 hurricanes and six major hurricanes.[2] The Accumulated Cyclone Energy (ACE) index is an important measure of the intensity of a hurricane season, with larger index values representing both the intensity of storms as well as their persistence. The longer hurricane force winds persist, the more likely the storm will remain strong at landfall. The preliminary ACE index places 2017 as the seventh most intense, behind the intense 2004 and 2005 seasons in the preceding decade.

The hurricane storm system brings wind, storm surge and inland flooding to impacted coastal areas. The highest and most damaging winds are in the coastal regions close to the landfall area. Mechanics of the storm combined with shoreline geometry and offshore bathymetry can greatly impact the storm surge. It is possible for the worst areas to be distant from the landfall of the storm, as seen by flooding in Jacksonville, Florida, during Hurricane Irma. Rainfall always



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Atlantic Hurricanes

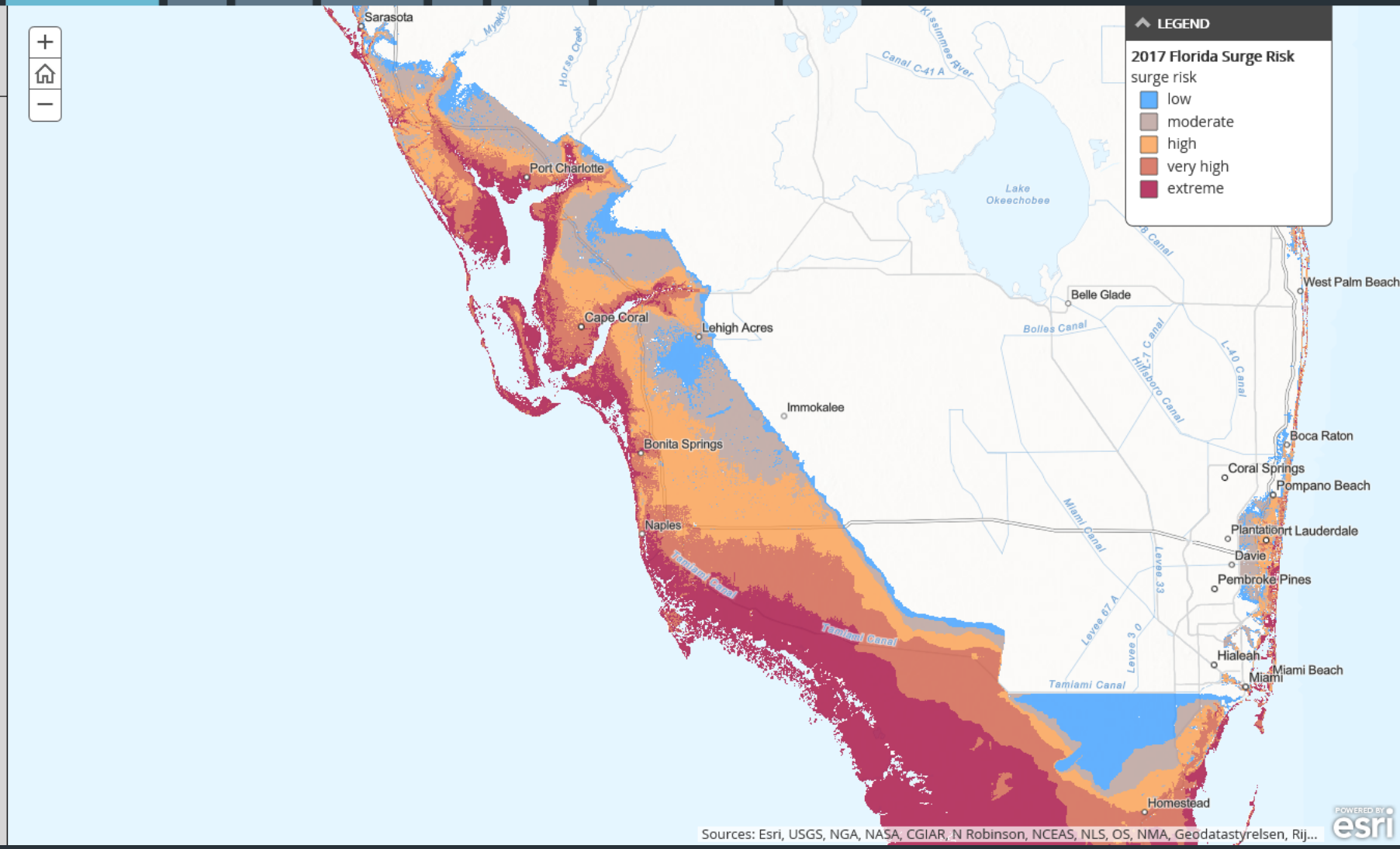
possible for the worst areas to be distant from the landfall of the storm, as seen by flooding in Jacksonville, Florida, during Hurricane Irma. Rainfall always accompanies hurricanes, and the storm trajectory and translational speed affect the regional impacts, as observed in Houston with several days of rainfall associated with Hurricane Harvey.

Storm Year Hurricane Summary

North Atlantic and Gulf of Mexico Basins

	2017	Long-term average (NOAA)
Named Storms	17	12
Hurricanes	10	6
Major Hurricanes	6	3

Wind losses from hurricanes have historically been covered by insurance. Hurricane Harvey, a Category 4 storm that made landfall in Texas, caused an estimated $1 billion to $2 billion in insured wind and storm surge loss to both residential and commercial properties, and Hurricane Irma, a Category 4 storm that made landfall in South Florida, caused an estimated $14 to $19 billion in insured wind and storm surge loss to both residential and commercial properties.



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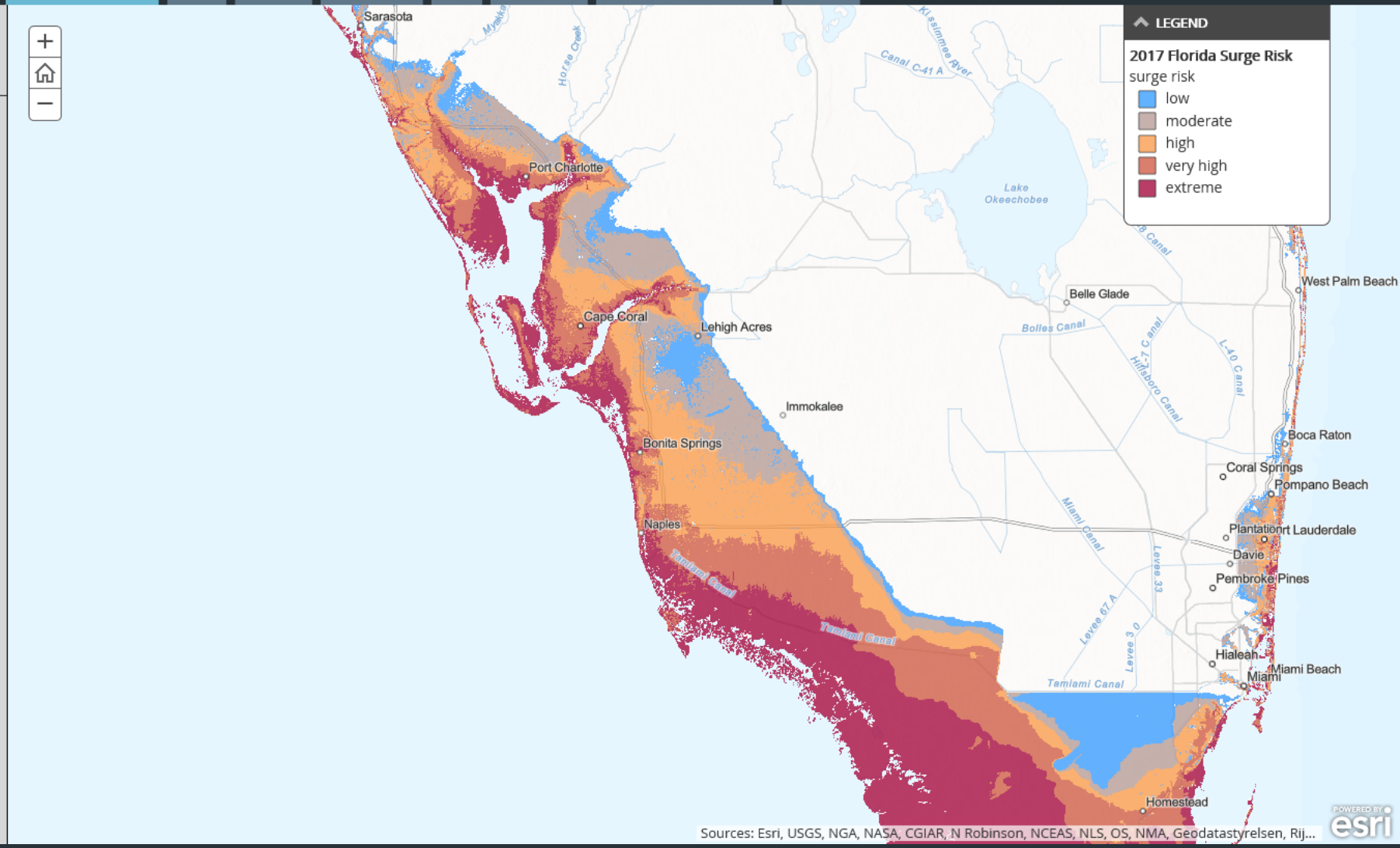
Atlantic Hurricanes

1990). These relatively lower losses are attributed to the landfall location in a lightly-populated county, far from any urban centers, and its rapid transition to a tropical storm.

Hurricane Irma was a Category 4 storm that made landfall in South Florida, causing an estimated $14 billion to $19 billion in losses. In comparison, the average Category 4 storm would cause $45 billion in losses to the current built environment (ranging from $15 to $72 billion). The track of Hurricane Irma exposed more than 5 million homes to winds at tropical storm force or greater, but only about 175,000 homes were exposed to extreme winds exceeding approximately 125 mph. Building performance to high winds varies with applicable building codes which specify design loads and performance standards, and newer buildings (especially ones built after Hurricane Andrew, 1992) generally perform better in hurricanes than older buildings. Detailed examination of building performance is ongoing, but a review of the properties affected by Hurricane Irma indicates that the homes that were most affected by Hurricane Irma were on average newer than the typical home in Florida. In other words, Hurricane Irma affected a newer and stronger subset of the Florida building population, and this helped constrain the potential losses from this event.



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2017 Natural Hazard Risk Summary & Analysis

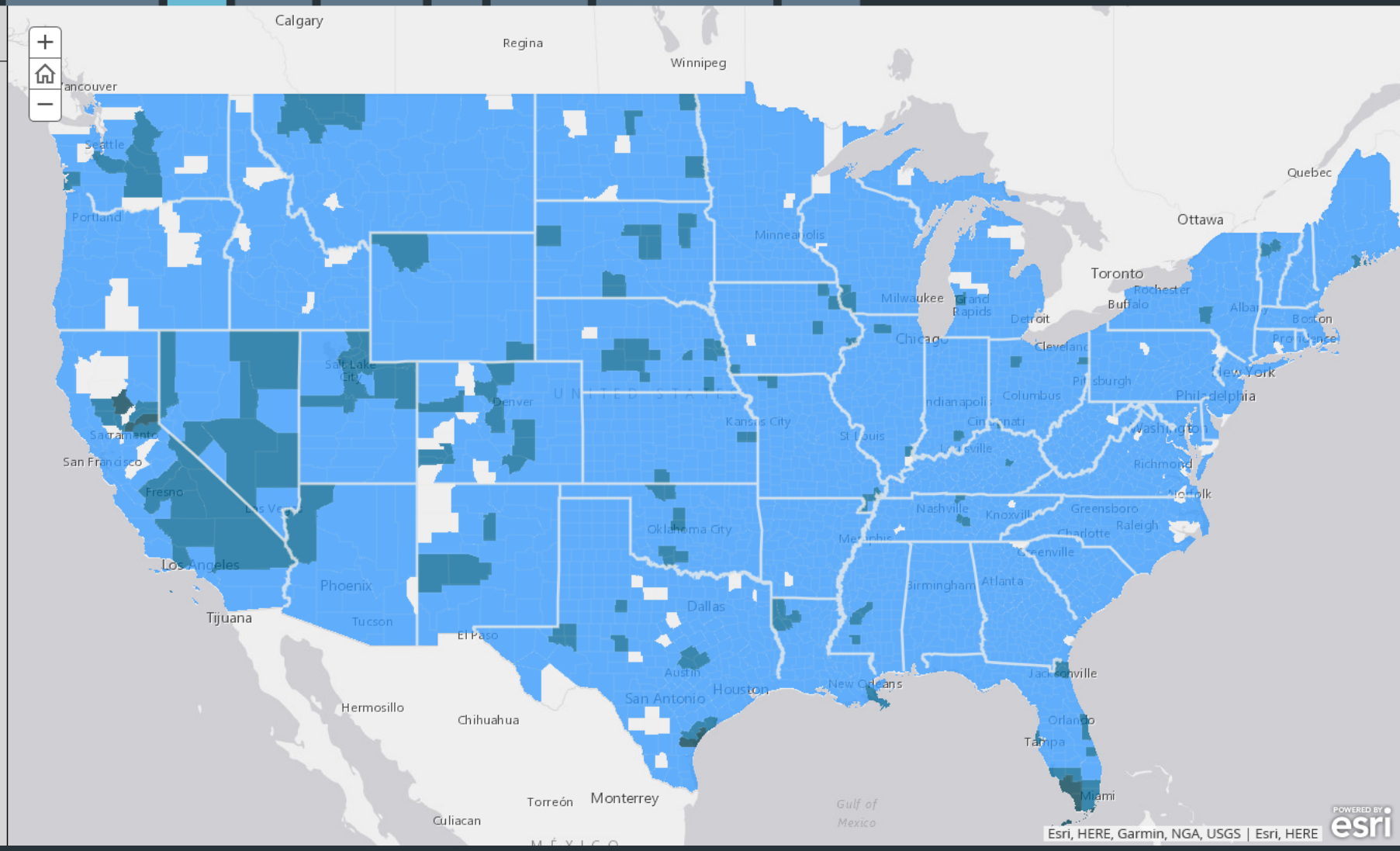
Wind

Year in Review

Overall, wind activity in 2017 was significantly above the CoreLogic calculated average (2009-2017), largely due to the two landfalling hurricanes. CoreLogic wind verification technology shows 1,128,455 square miles, or approximately 37 percent, of the Continental U.S. (CONUS) were impacted by severe wind gusts, which are defined as 60 mph or greater. Outside of mountainous areas, the strongest wind gust occurred near Port Aransas on the Texas coast during Hurricane Harvey on August 25 where winds were estimated by CoreLogic to be at least 131 mph. Meanwhile, Hurricane Irma made landfall as a Category 3 Hurricane on the southwestern tip of Florida and generated peak wind gusts of 125 mph near Marco Island.

The strongest wind gusts associated with severe thunderstorms occurred on June 26 in western Nebraska. Wind gusts of up to 115 mph were estimated by CoreLogic, missing the most populated areas by approximately 20 miles.

One of the most notable series of severe storms with related winds occurred from April 30 to May 1. Severe squall-lines caused sporadic wind gusts of at least 60 mph from southern Louisiana all the way to northern Vermont according to



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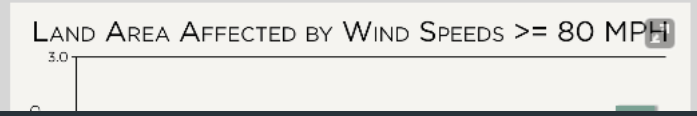
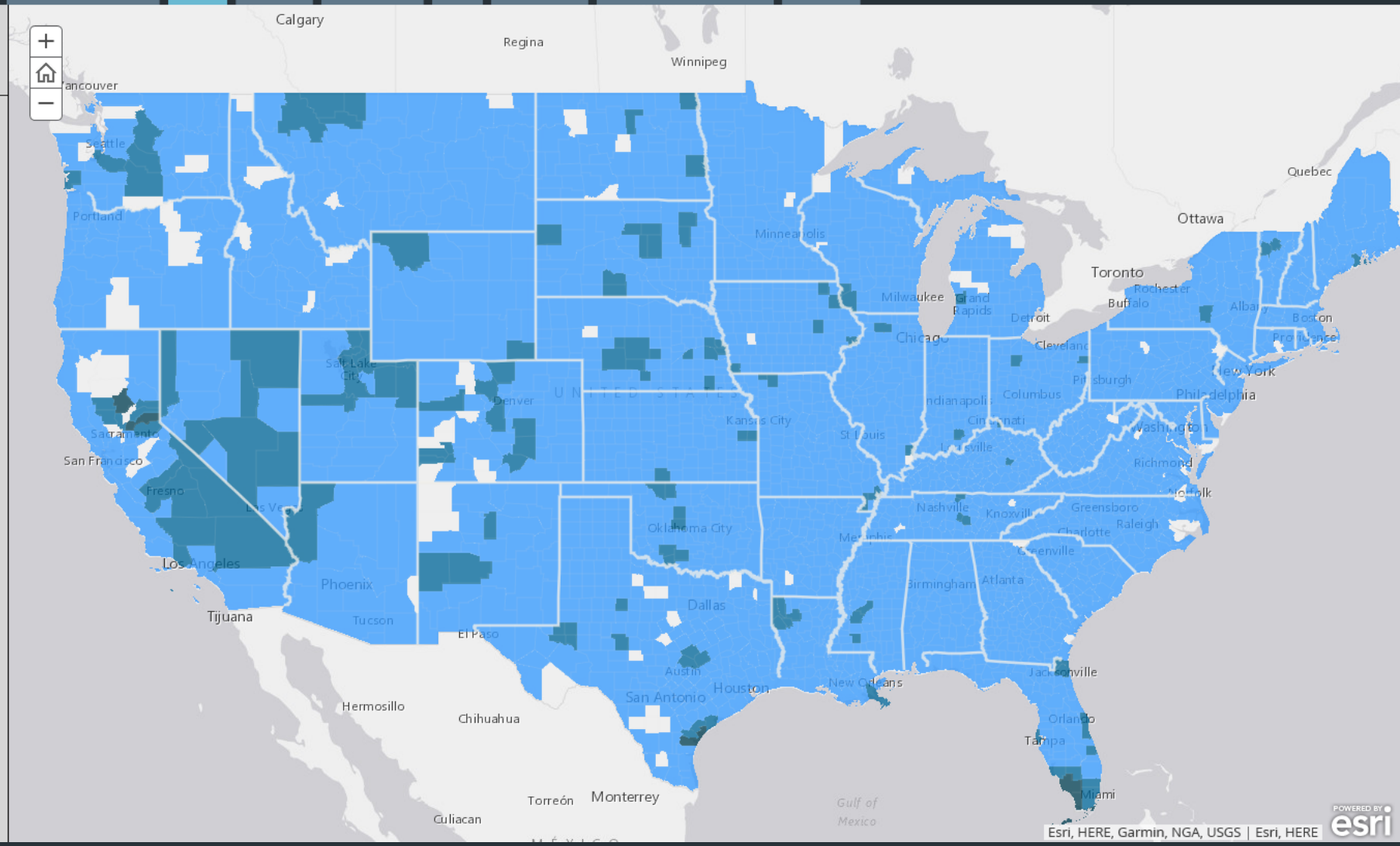
Maximum Wind Speed

- 60 - 80 mph
- 85 - 120 mph
- 125 - 150 mph

2017 Compared with Previous Years

When analyzing very severe wind gusts (>80 mph), 79,404 square miles, or 2.6 percent, of the CONUS was impacted in 2017, which is more than four times of the land area impacted in 2016. This was due in large part to Hurricanes Harvey and Irma, which hit the Texas and Florida coasts as major hurricanes – the first hurricanes to make landfall in the U.S. since Hurricane Wilma in 2005.





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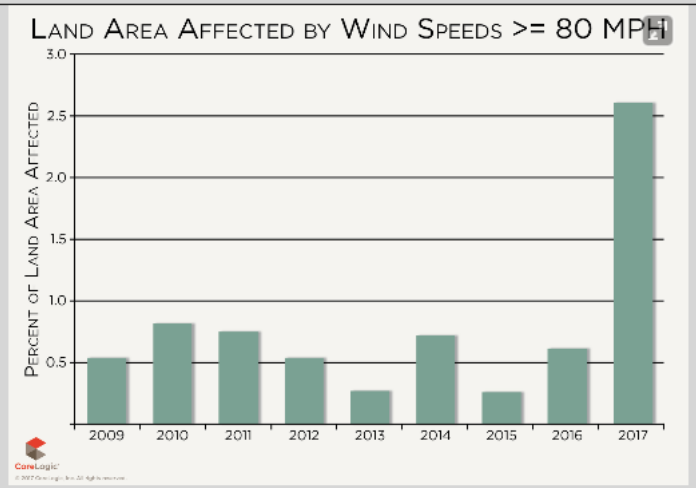
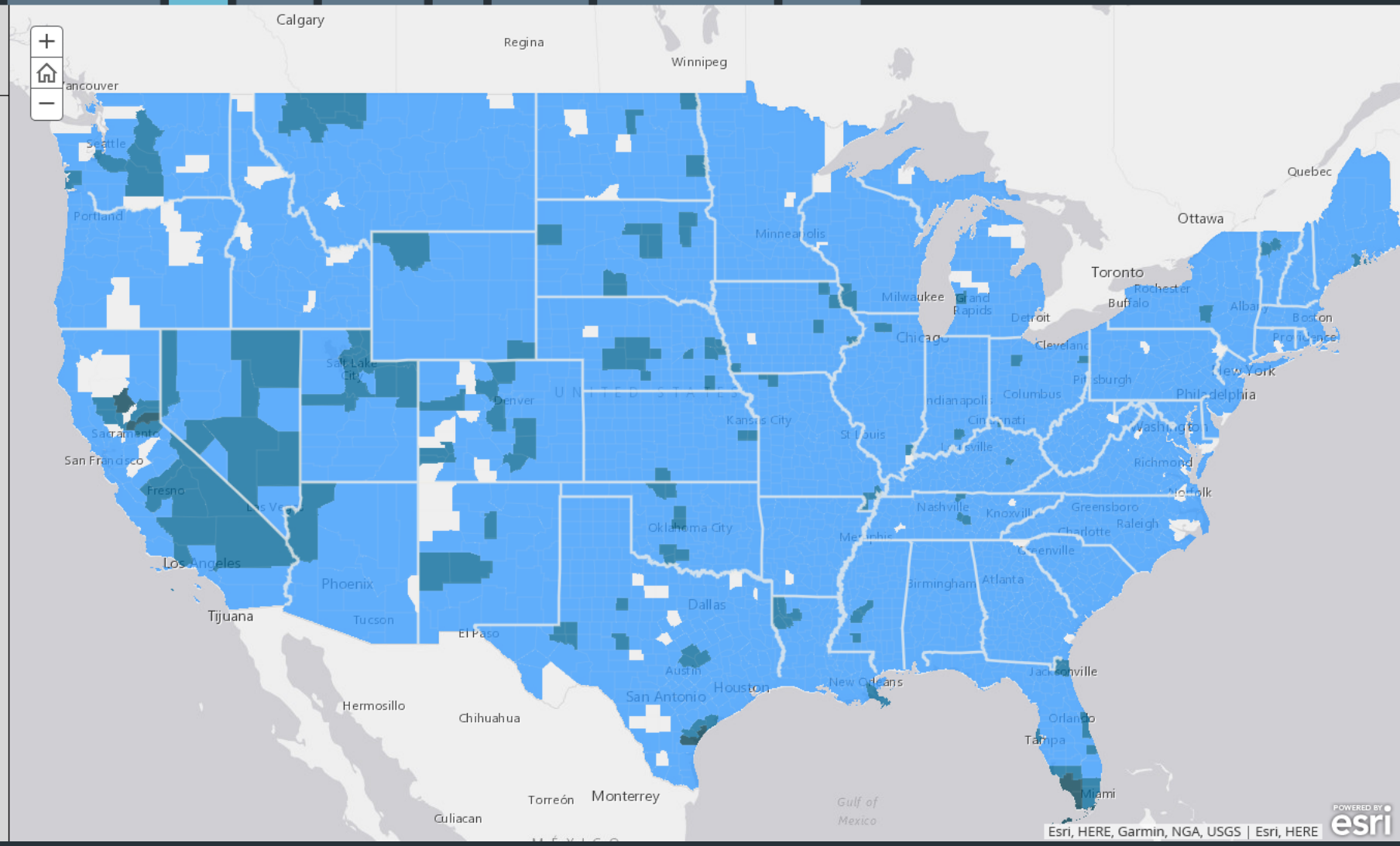


Snapshot View of Risk/Potential Damage

As we move into winter 2017-2018, moderate La Niña conditions, or cooling of waters in the equatorial Pacific, are expected to persist. Recent research suggests that when La Niña conditions are present, increased thunderstorm activity from the Plains into the southeast U.S. has been noted in late winter into the spring. Therefore, if La Niña conditions continue, severe winds can be expected across these areas through spring 2018.



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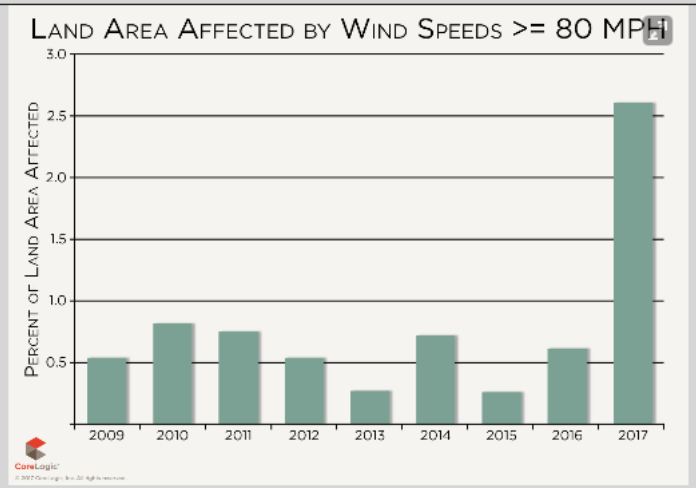

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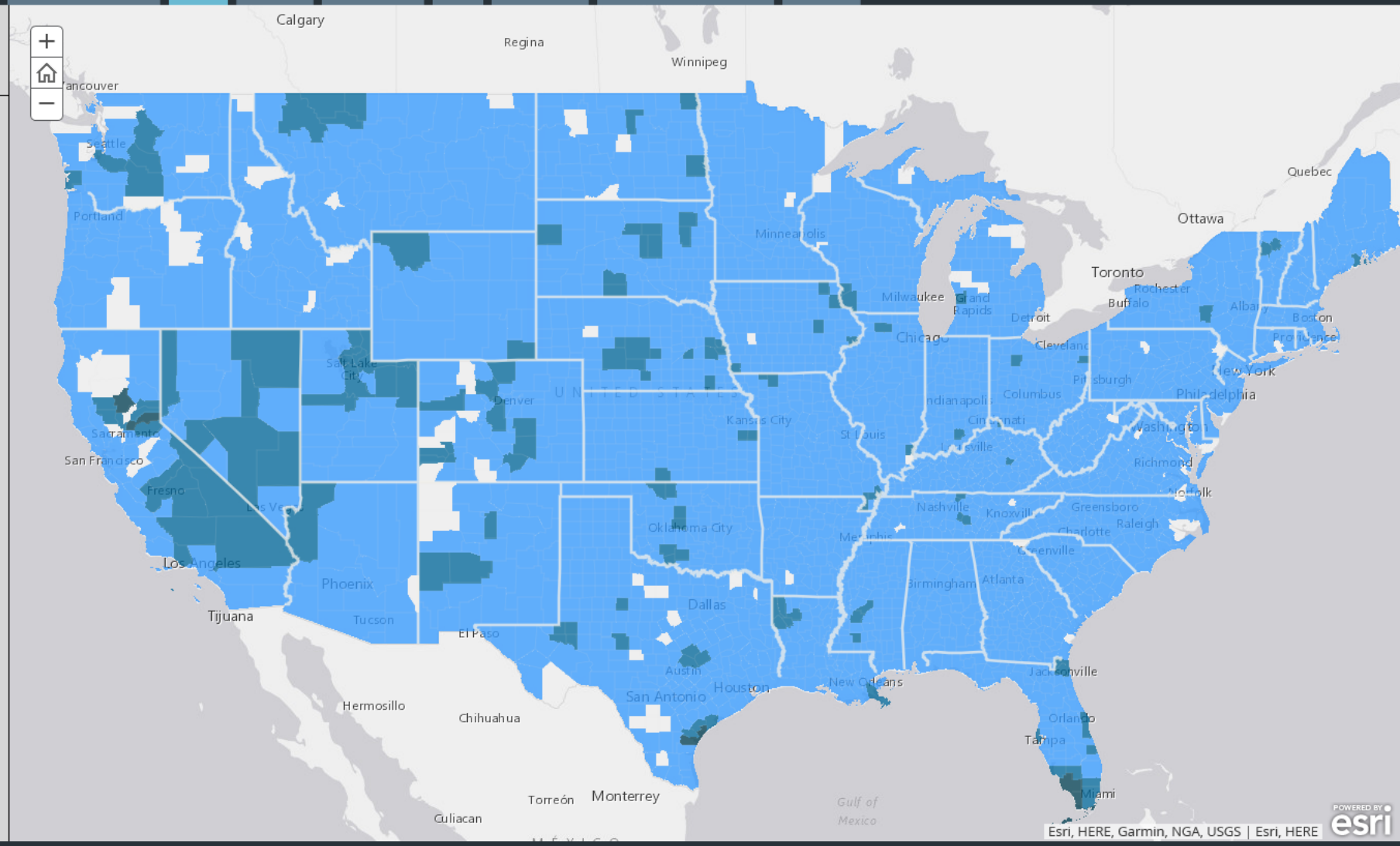

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Wildfire

Year in Review

Wildfire activity in the U.S. in 2017 reflected a significant increase from the previous year and approached the record number of acres burned in 2015. Unlike some other natural hazards which may not occur each year, wildfire damage is expected — the only questions are where and to what extent. Tragically, the devastating California firestorms of 2017 caused significant loss of life and loss of property. Multiple record setting fires occurred in late 2017 in both northern and southern California.

According to the National Interagency Fire Center (NIFC), through December 22, the total acreage burned (9,791,062) in 2017 ranks third, preceded by 2006 (9,873,745) and 2015 (10,125,149). California and Montana each lost more than 1.2 million acres to wildfire this past year[18] while Washington and Oregon each lost more than 400,000 acres.[5,19]

Wildfires in California

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Table 1: California State Totals for Number of Fires and Acres Burned

Source: Cal Fire, 2017

As indicated in Table 1[5], there were more fires in 2017 than in any of the previous 10 years, and 2017 ranked third for most acreage burned over that period.

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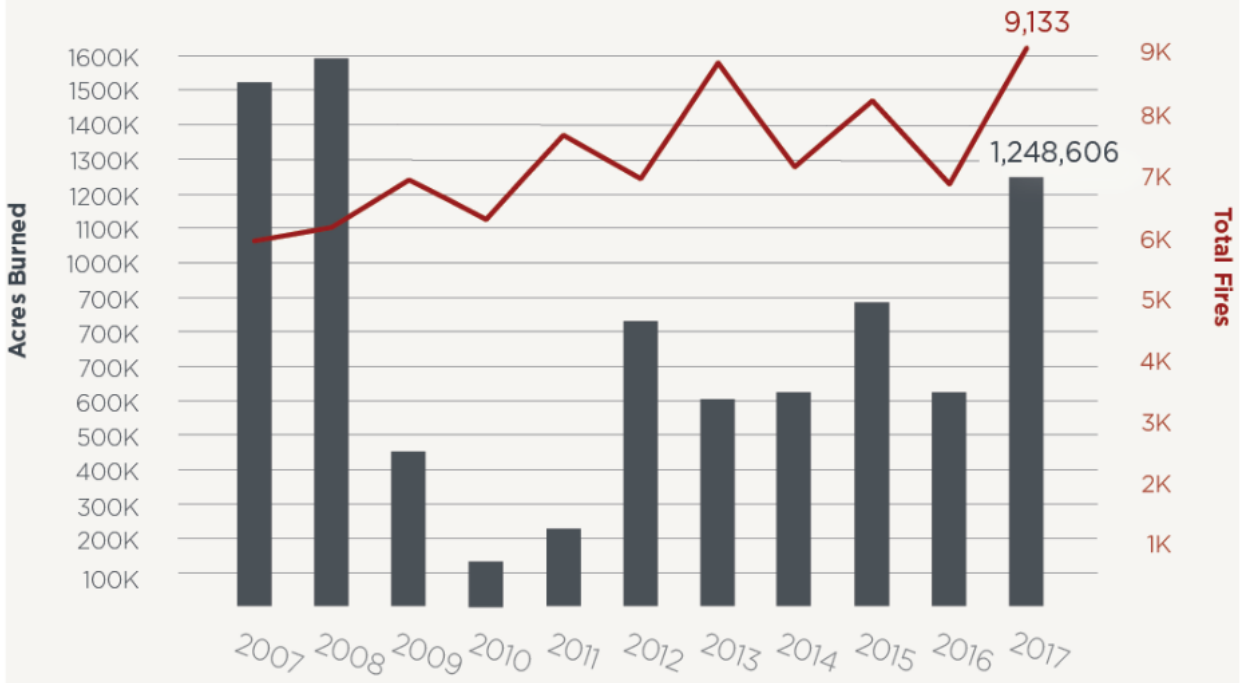


Source: Cal Fire, 2017

Wildfire

As indicated in Table 1[5], there were more fires in 2017 than in any of the previous 10 years, and 2017 ranked third for most acreage burned over that period. Additionally, the summer of 2017 saw a return to dry conditions, which combined with the recent growth of even more potential fuel from the earlier rains, 2017 turned into a record setting year for wildfires in California (Table 2[5]).

Table 2: How 2017 Fires Rank as Most Destructive Fires in CA History

Name	Structures Destroyed	Rank
Tubbs Fire	5,643	1st
Nuns Fire	1,355	6th
Thomas Fire **	1,063	7th
Atlas Fire	781	11th
Redwood Valley Fire	544	17th

** As of December 28 , 2017

Source: Cal Fire, 2017

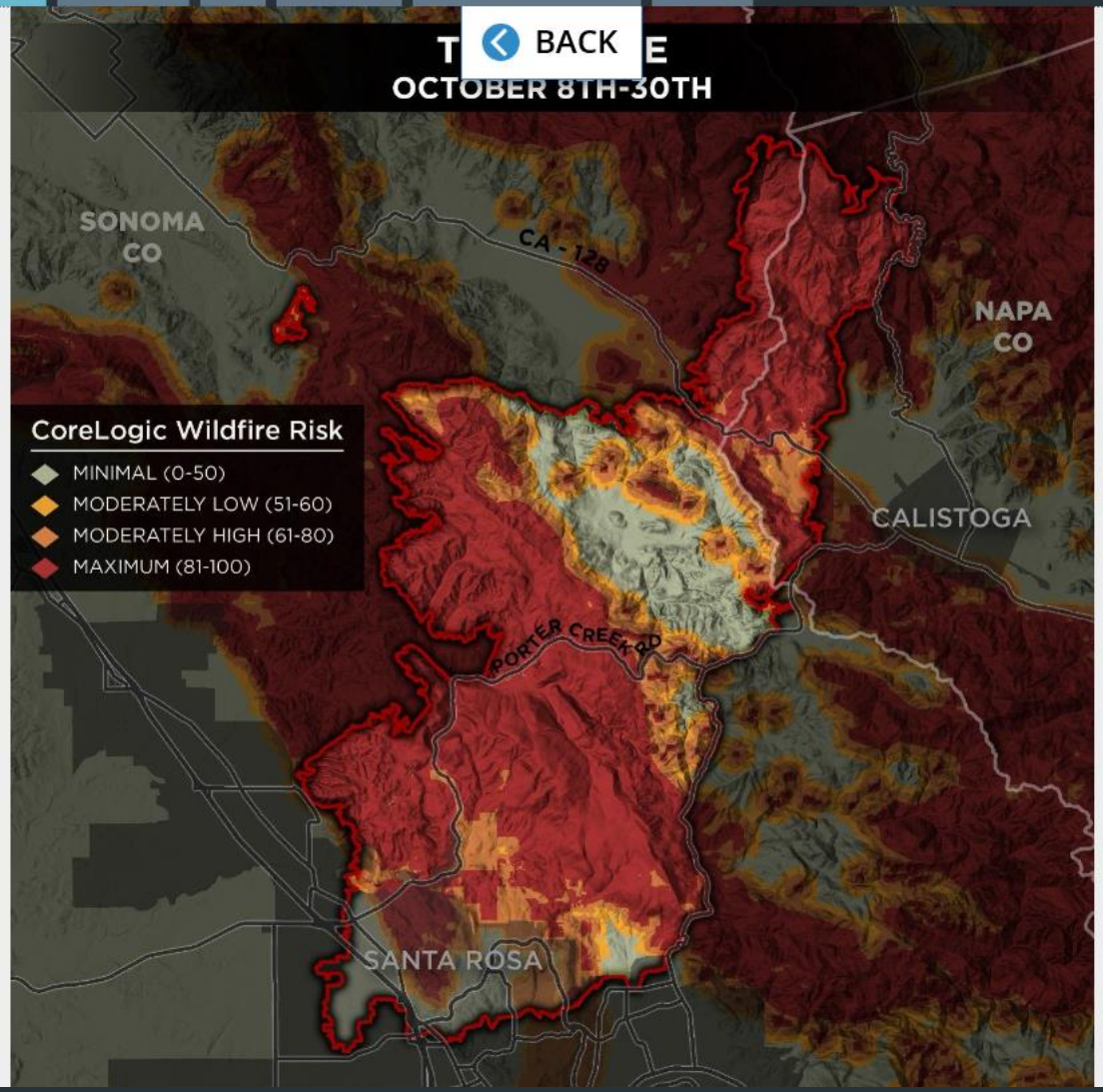
The onset of seasonal winds in both the north (Diablo) and south (Santa Ana) in the fall typically coincides with seasonal precipitation for the state. In years when the winds tend to begin earlier or the precipitation comes later, there is an opportunity for the wind to feed catastrophic wildfire events. This year, California experienced a worst-case scenario. The lack of precipitation preceding or during

Wildfire

experienced a worst-case scenario. The lack of precipitation preceding or during these long seasonal winds enabled fires in both the northern and southern parts of the state to expand in size and number.

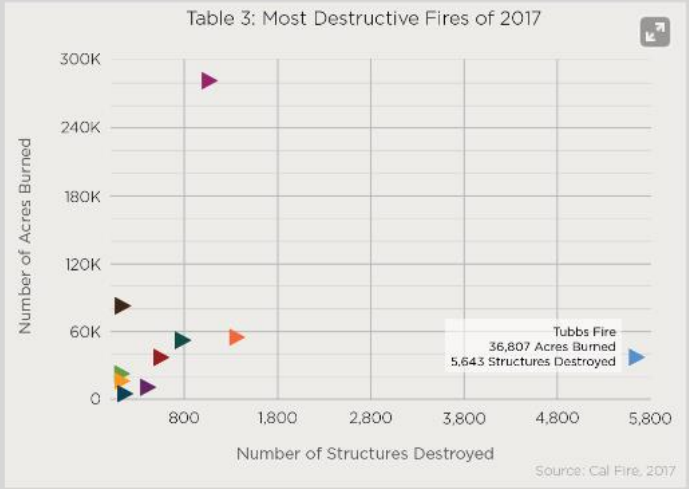
Average wind speeds of 20 to 40 miles per hour were accompanied by gusts that reached 70 to 80 miles per hour or greater for both the October fires occurring in and around Napa and Sonoma counties in the north and the December fires in the areas around Ventura, Los Angeles and San Diego counties. These extreme gusts provided the energy to lift a greater than average quantity of large embers into the air. These strong Diablo winds are responsible for pushing the Tubbs Fire[3] from the northeast to the southwest and into the city of Santa Rosa.

The gusts, coupled with unrelenting high winds, contributed heavily to the record setting destruction. Seasonal winds tend to intensify and then weaken either daily or over the course of a couple of days; rarely do they continue over longer periods. This relief enables responders to effectively combat the blazes as the winds abate. Gaining the edge on containing these fires often relies upon this declining period of winds. The 2017 seasonal winds in both the northern and southern fires were characterized by unrelenting high wind speeds and extreme gusts. Rather than the typical strengthening/weakening cycle, the high wind speeds tended to remain steady for a week or more at a time. This was especially true in Santa Rosa where high sustained winds caused the fire to migrate from



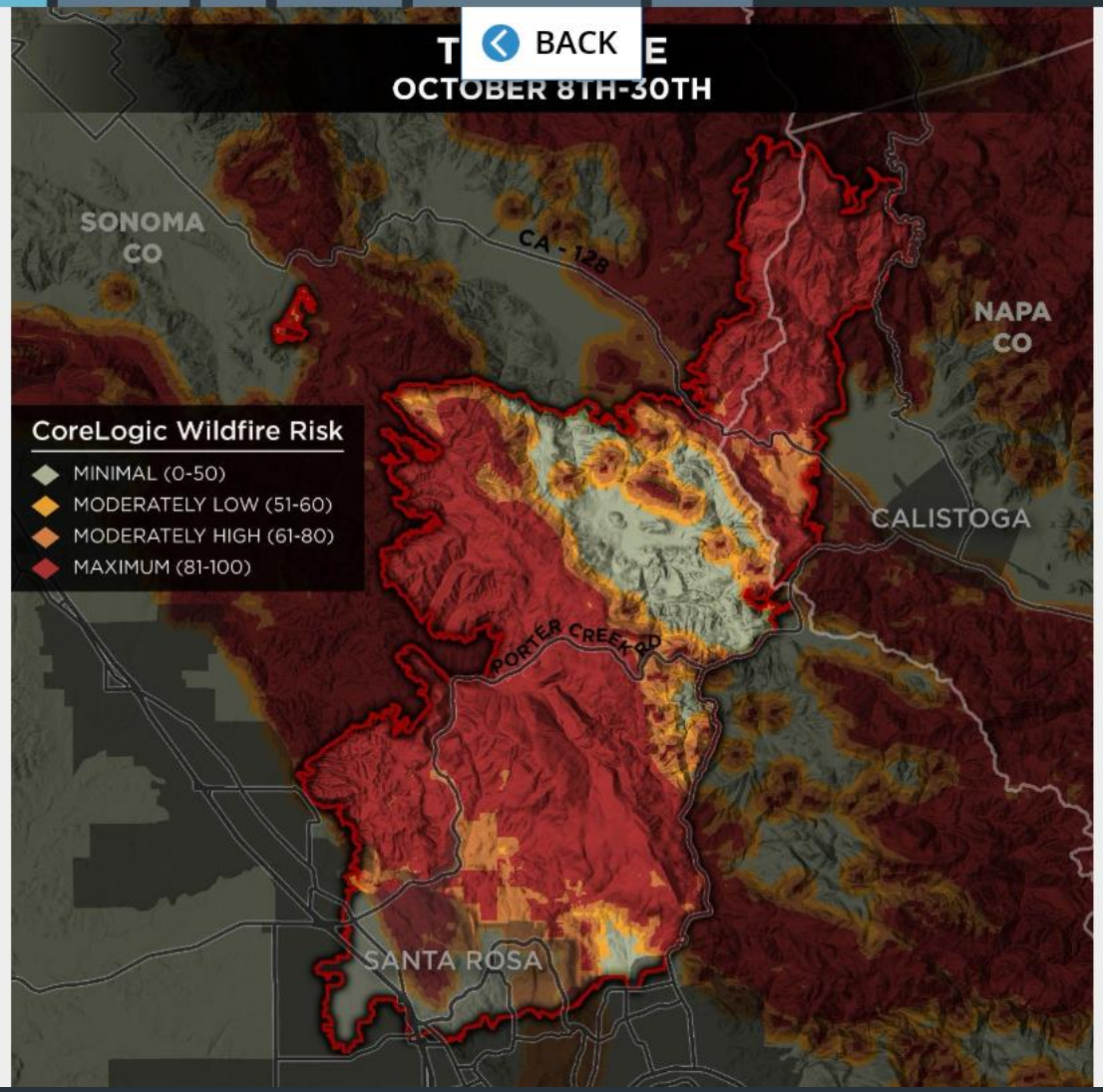
Wildfire

speeds tended to remain steady for a week or more at a time. This was especially true in Santa Rosa where high sustained winds caused the fire to migrate from house to house, and the lack of natural vegetation to act as a deterrent provided fuel for the fire and caused the destruction of entire neighborhoods. The result was that effective firefighting methods were difficult, or even impossible, to implement successfully. The fact that these fires were contained at all is a testament to the effort of the crews on the ground and in the air.



2017 Compared to Previous 10 Years

Burned acreage nearly reached a record high for the U.S. in 2017. The burned



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Wildfire

2017 Compared to Previous 10 Years

Burned acreage nearly reached a record high for the U.S. in 2017. The burned acreage total for 2017 ranks as the second highest compared to the previous 10 years. In contrast, the total number of fires in 2017 is the second lowest compared to the previous 10 years (Table 4)[4].

Table 4: US Total Number of Fires and Total Acreage Burned

** data as of 12/22/2017
other years are yearly totals

Source: National Interagency Fire Center, 2017

To put the 2017 California wildfires into perspective, the Tubbs Fire in Sonoma County in October destroyed more than 5,600 structures. In comparison, the two worst fires in California history up to that point (Tunnel in 1991 and Cedar in 2003)

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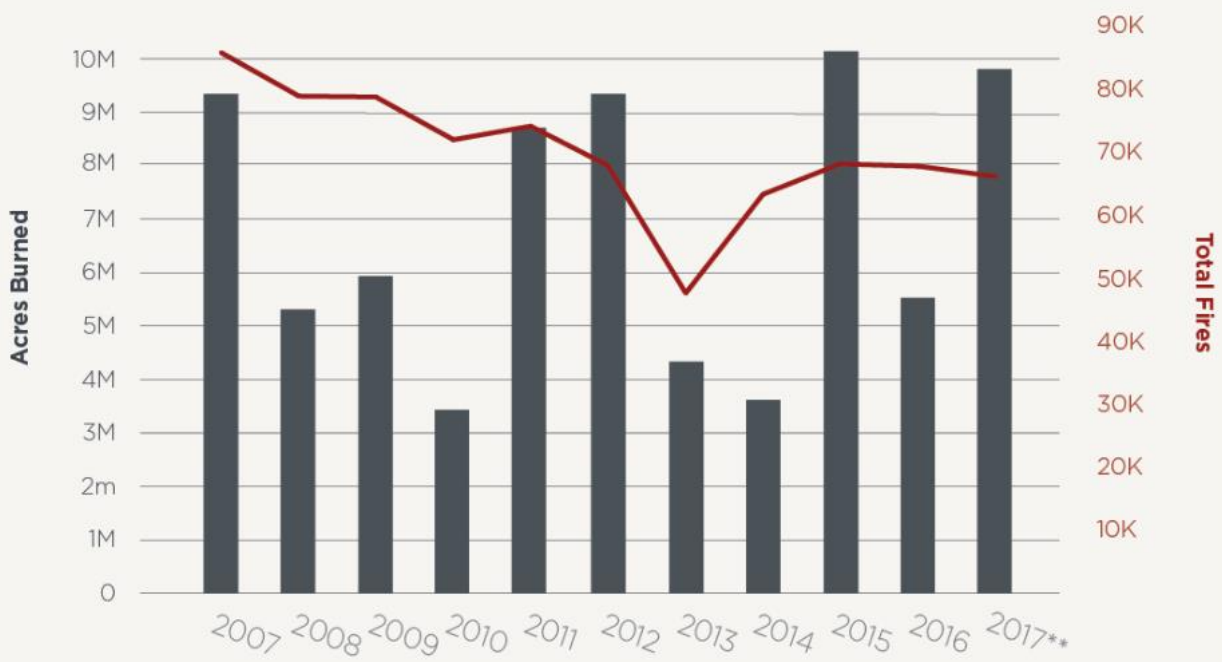
Table 4: US Total Number of Fires and Total Acreage Burned



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Source: National Interagency Fire Center, 2017

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2017 Natural Hazard Risk Summary & Analysis

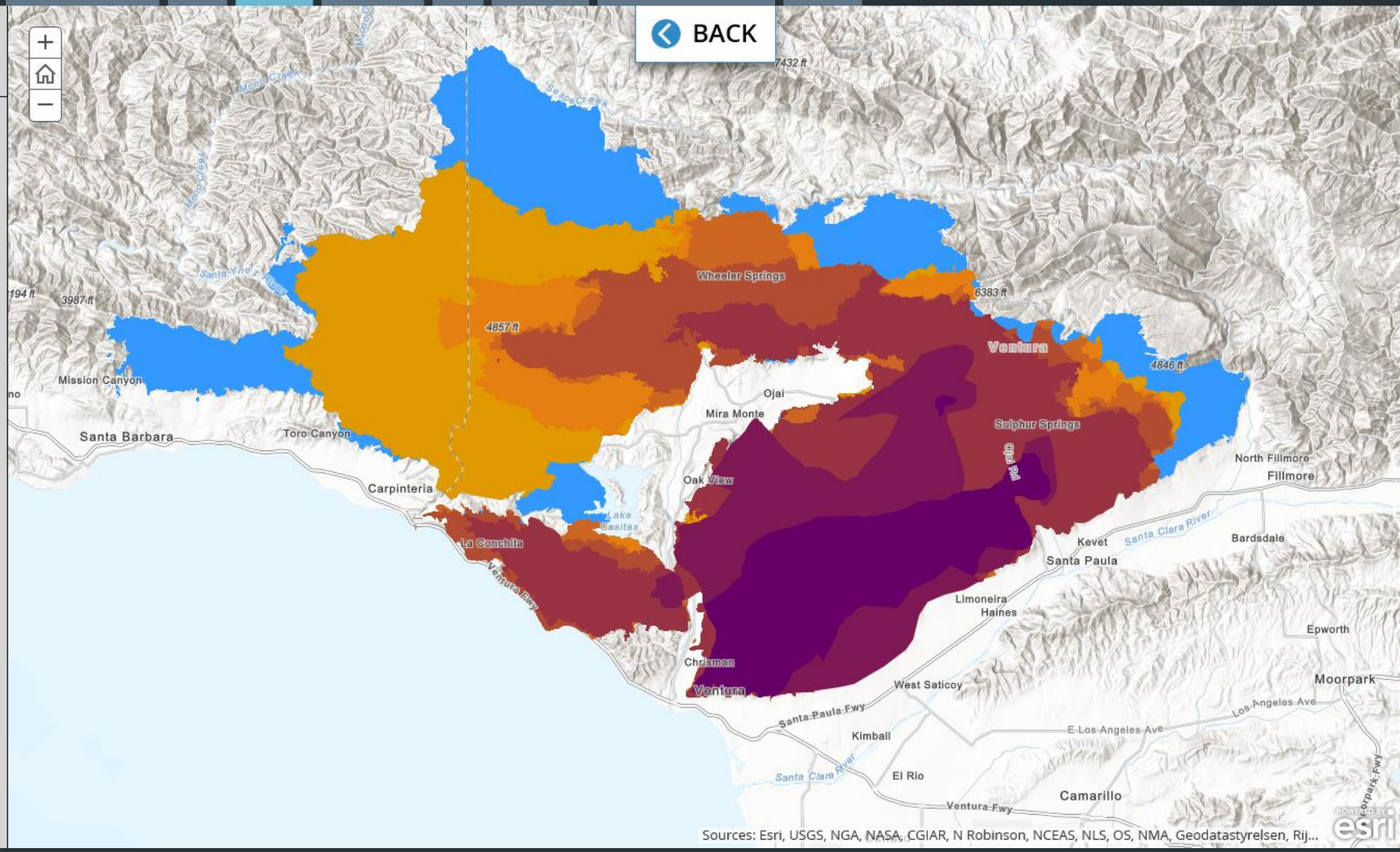
Wildfire

County in October destroyed more than 5,600 structures. In comparison, the two worst fires in California history up to that point (Tunnel in 1991 and Cedar in 2003) combined to destroy a total of 5,720 structures.

Pushed by strong unrelenting Santa Ana winds, the **Thomas Fire in Southern California's Ventura and Santa Barbara counties** grew to become the second largest wildfire in California history in December.[5]

Thomas Fire Perimeter Movement

Given the amount of property damage that occurred in 2017, it is clear that the number of fires is not necessarily correlated with the destruction of property. Past years have demonstrated that total acreage burned does not always lead to the loss of structures. However, the location of wildfire risk and the resulting fires that occur near densely populated areas is of primary concern for wildfire activity, and this can result in large property loss.



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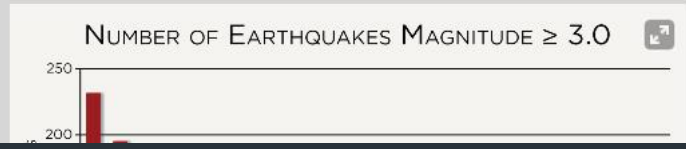
Earthquake

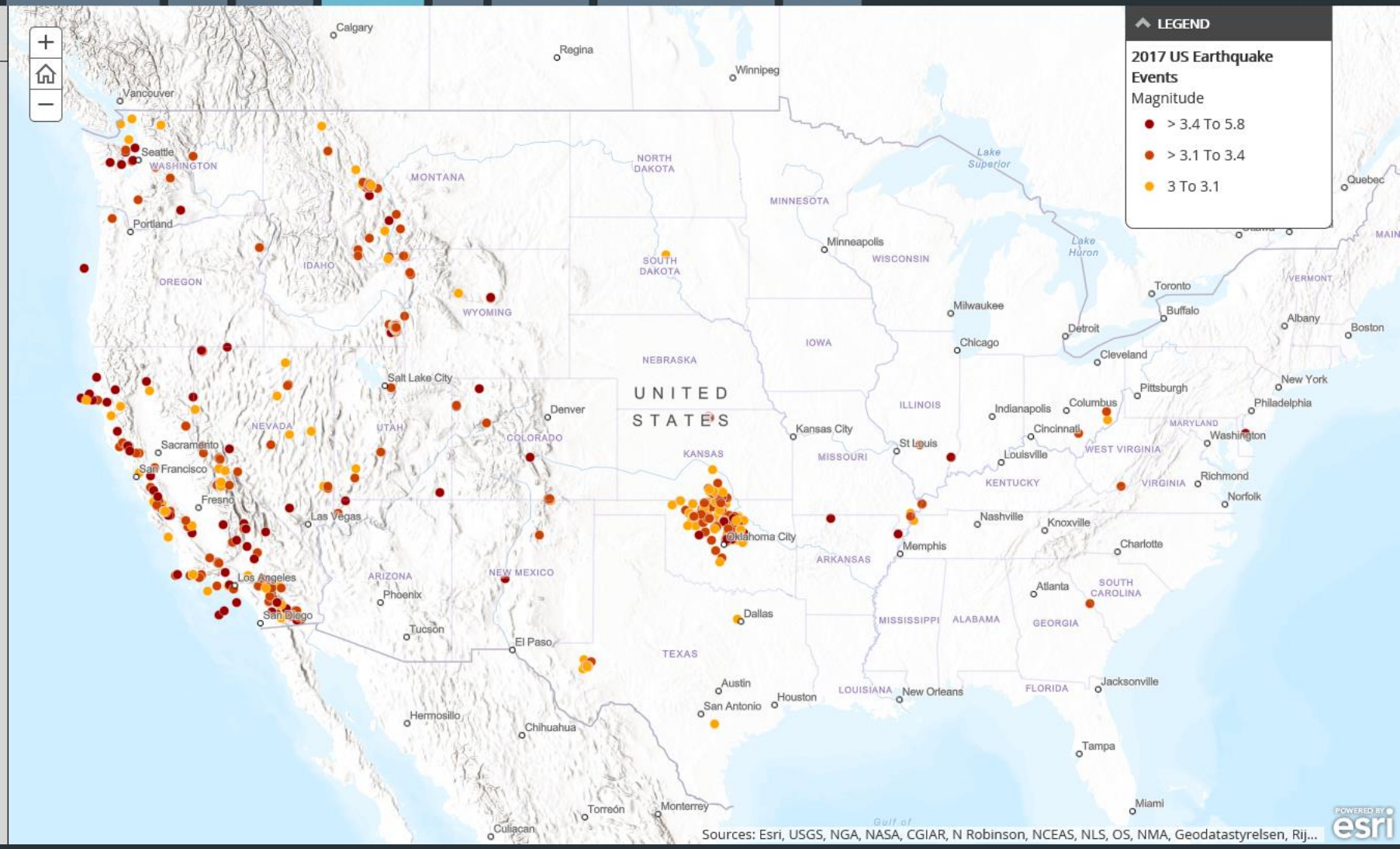
Year in Review

In 2017, the U.S. insurance industry did not experience a major damaging earthquake which is expected and normal. Three notable events highlighted the U.S. mainland earthquake landscape.

The largest magnitude (M) earthquake of 2017 was a M5.8 earthquake near Lincoln, Montana, on July 6. While this was the largest earthquake in the state in nearly 60 years, the event was consistent with the type of strike-slip faulting along the Lewis and Clark line. Many small aftershocks continued throughout western Montana in the weeks following the mainshock.[20]

On September 2, a M5.3 earthquake occurred in southeastern Idaho, near Soda Springs. The event began an active swarm of small aftershocks which continued for several weeks following the mainshock.[21] Figure 1 shows the total number of earthquakes by state in 2017.[6] Idaho ranks second on this list because of the swarm of events near Soda Springs.





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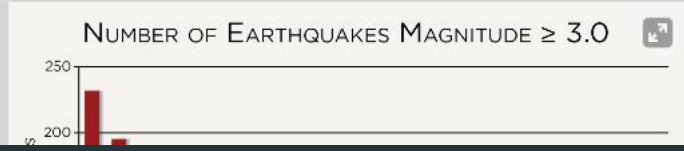

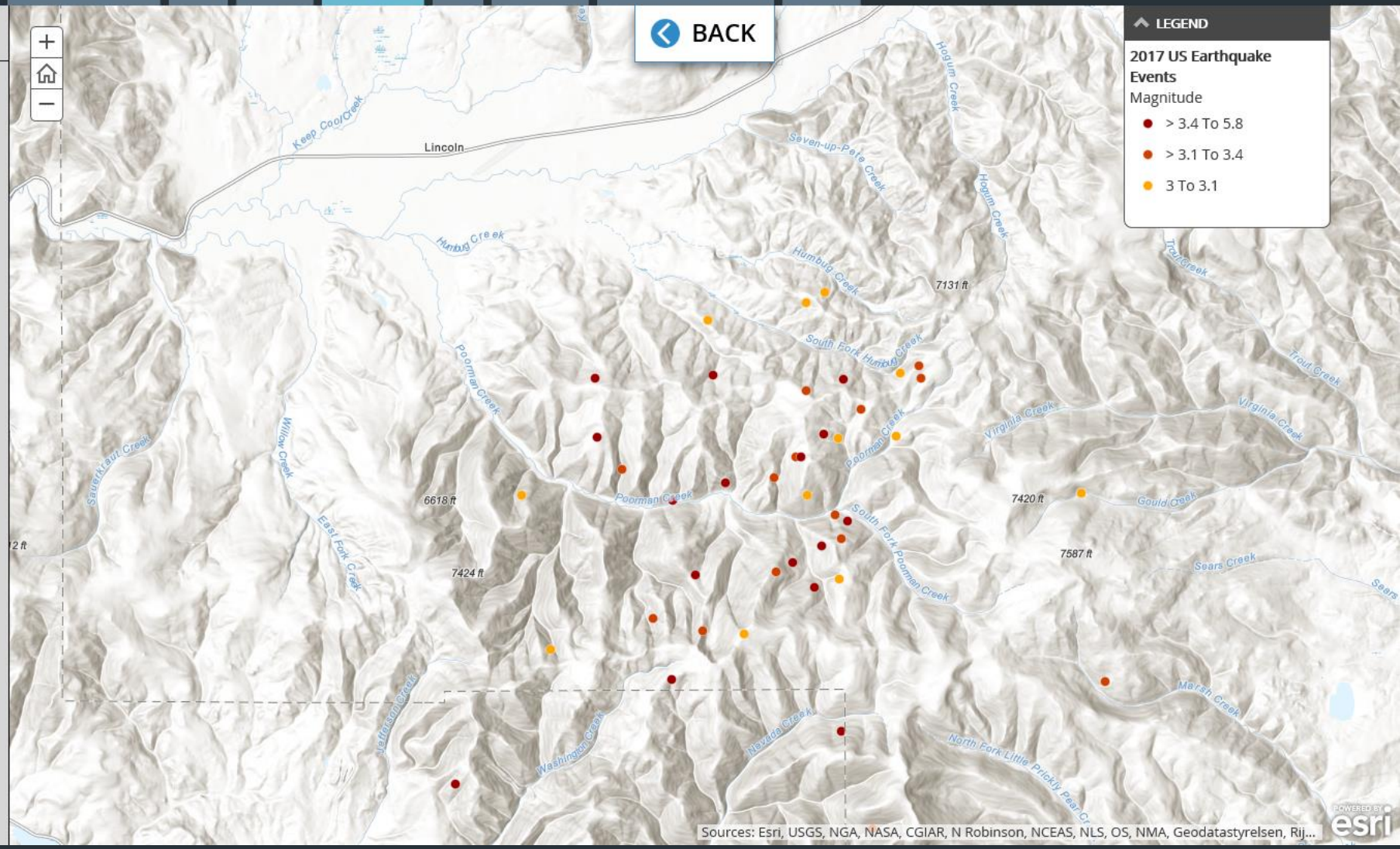

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2017 Natural Hazard Risk Summary & Analysis

Earthquake

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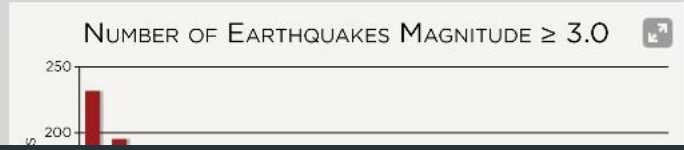

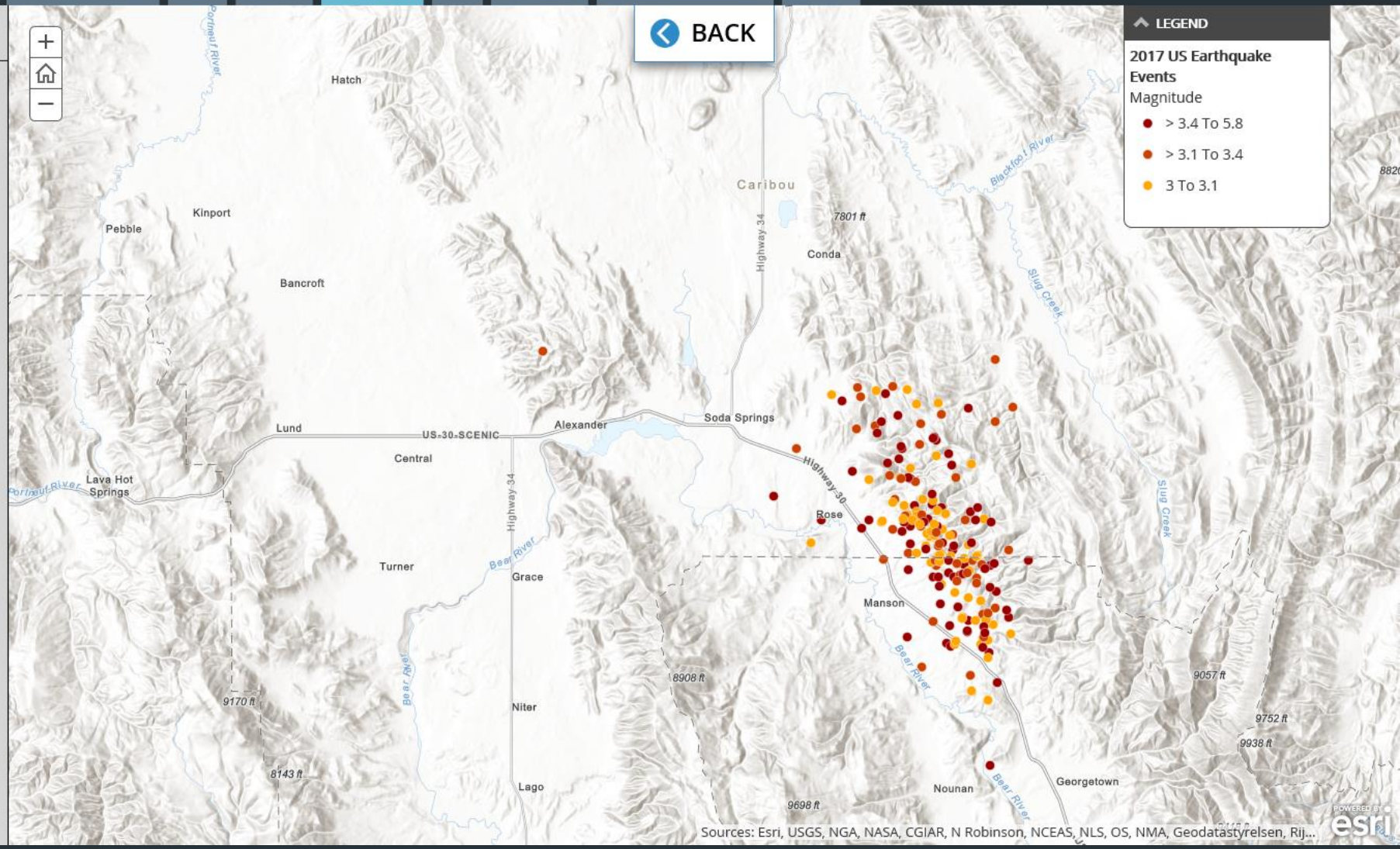

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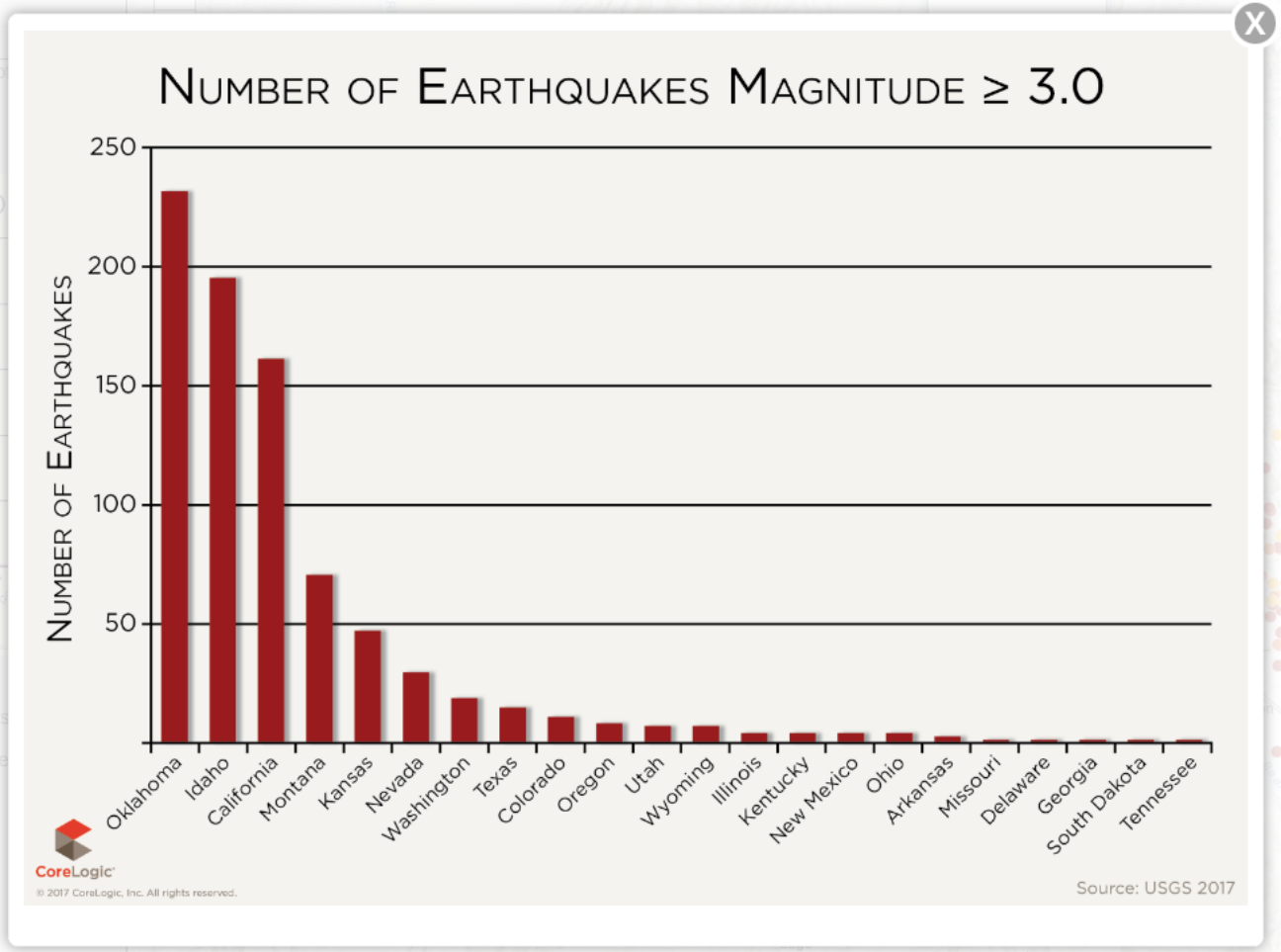
NUMBER OF EARTHQUAKES MAGNITUDE ≥ 3.0
NUMBER OF EARTHQUAKES
250
200
150
100
50
Oklahoma
Idaho
California
Montana
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Nevada
Washington
Texas
Colorado
Oregon
Utah
Wyoming
Illinois
Kentucky
New Mexico
Ohio
Arkansas
Missouri
Delaware
Georgia
South Dakota
Tennessee
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Source: USGS 2017

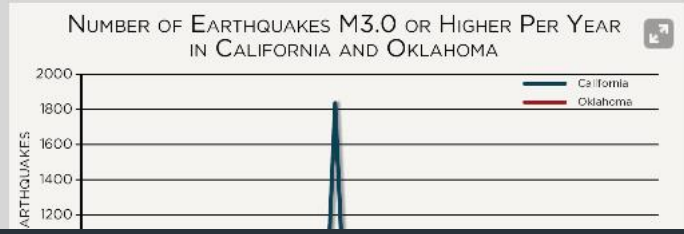
Earthquake

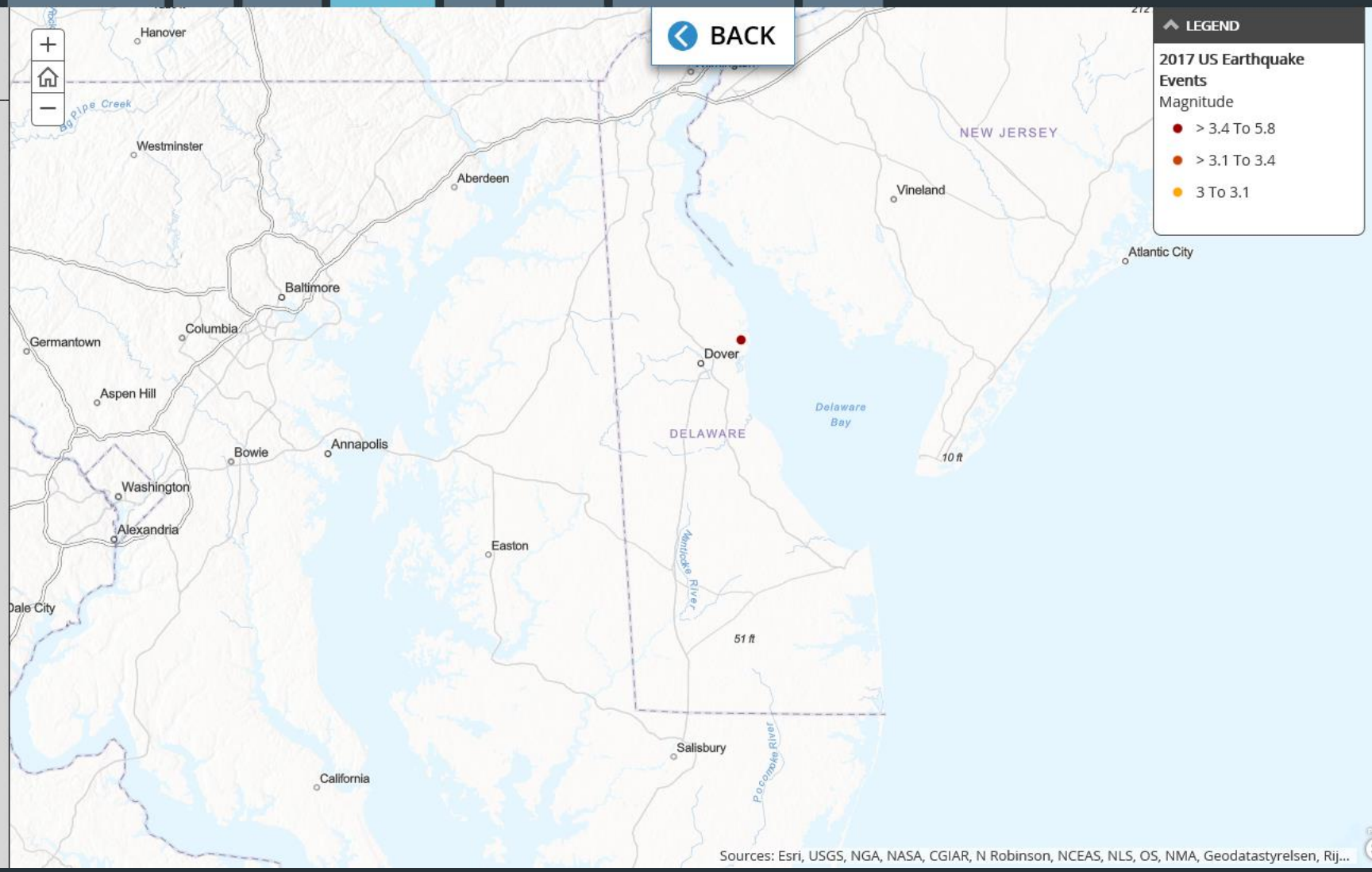
Source: USGS 2017

The final notable earthquake of 2017, while not among the largest events, was one of the most felt – a M4.1 event centered in Delaware that shook the East Coast on November 30.[22]

Oklahoma: What a Difference a Year Makes

For much of the past decade, the number of earthquakes in Oklahoma has garnered the attention of scientists and risk managers across the country. While the number of earthquakes and associated increased seismic hazards in Oklahoma continued to dominate the earthquake landscape in 2017, the rate of earthquake activity has decreased quite substantially over the past two years. As of December 1, the U.S. Geological Survey (USGS) had located 818 earthquakes of M3.0 or higher across the contiguous U.S., with 28 percent of these events occurring in Oklahoma (Figure 1)[8] compared with approximately 60 percent in 2016.





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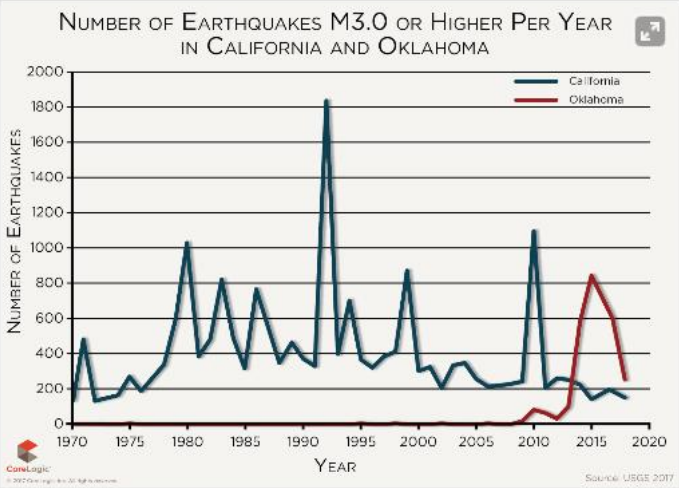

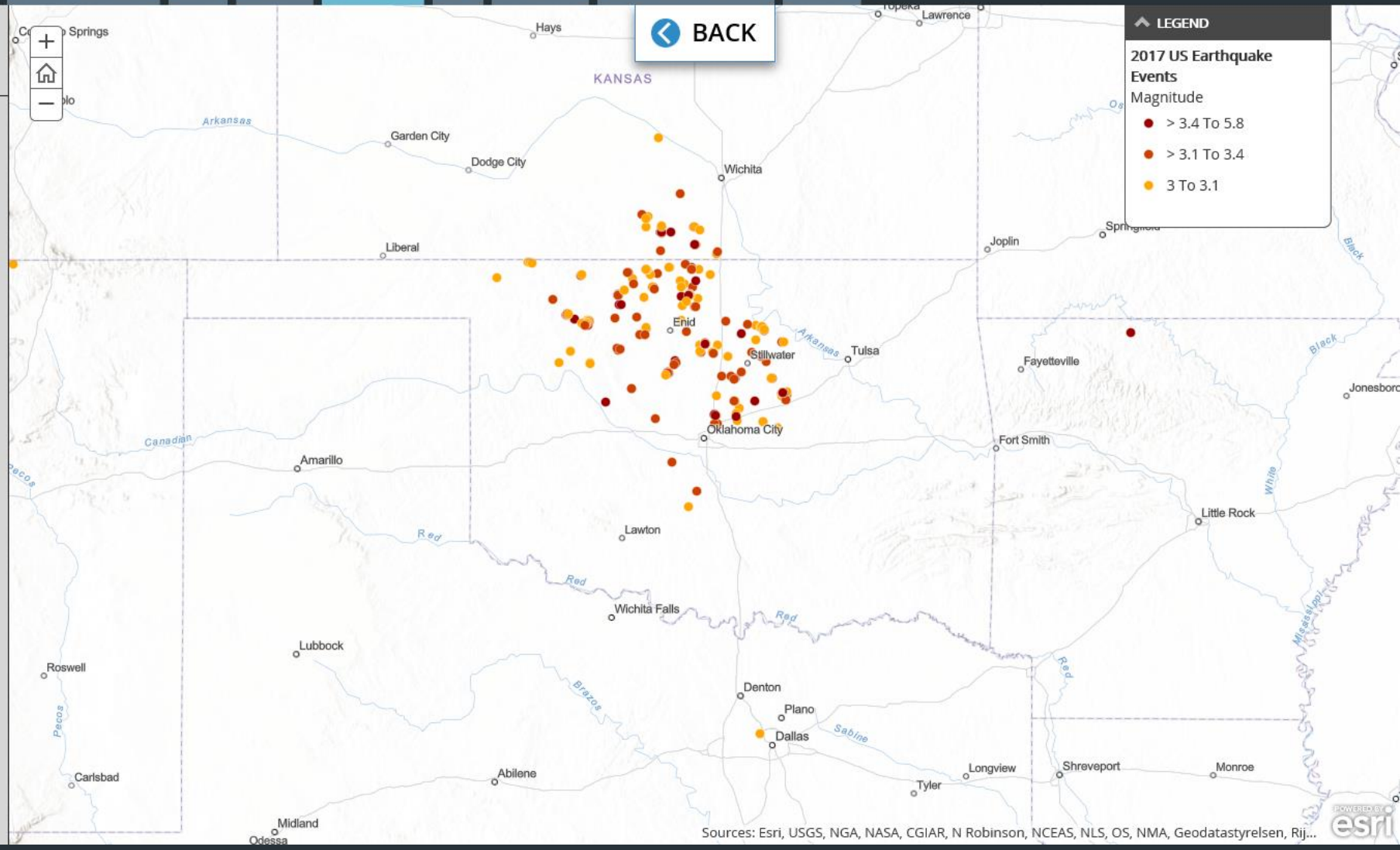

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Earthquake

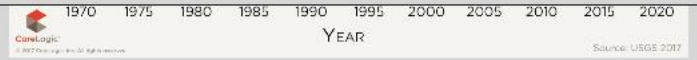
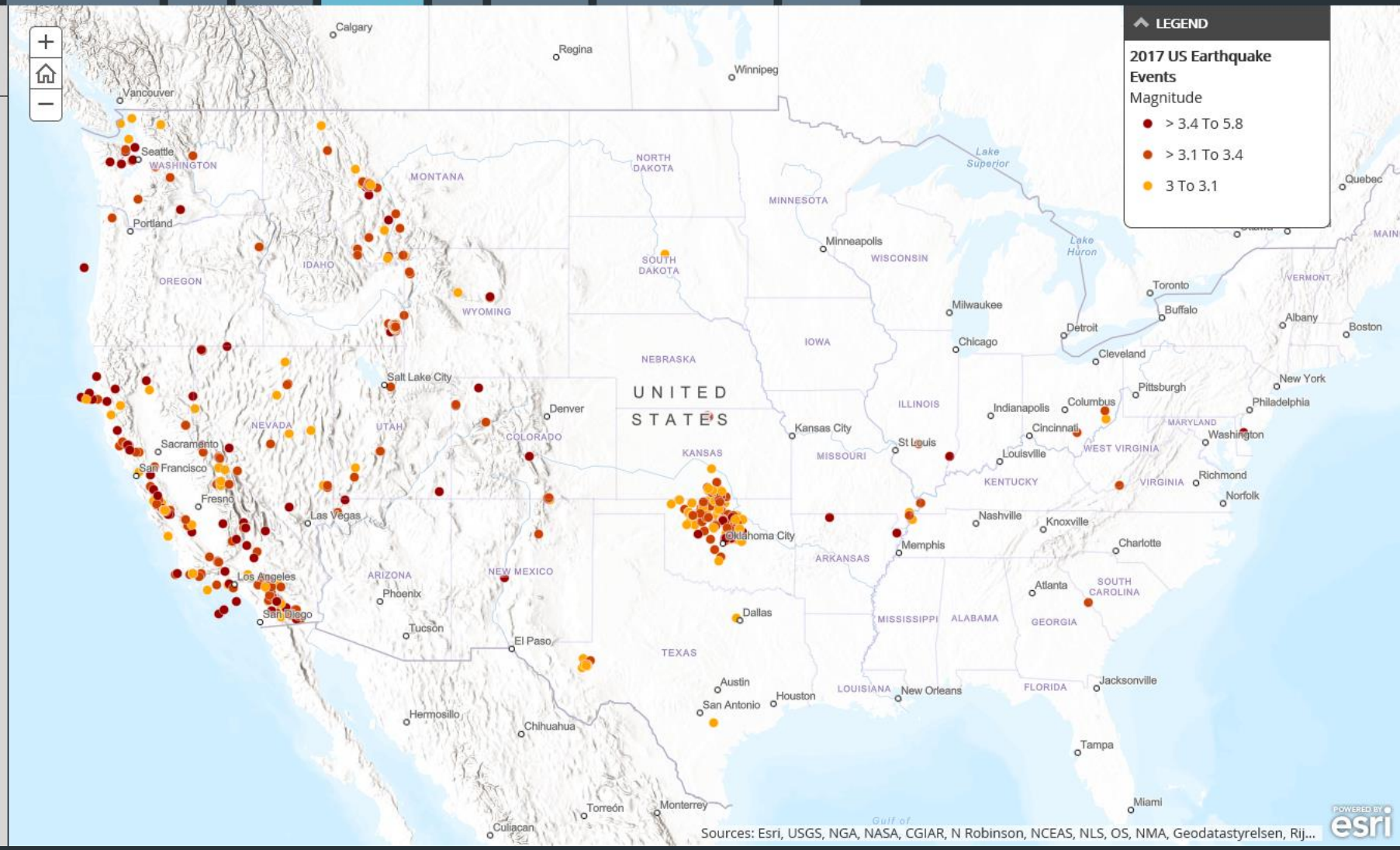


Figure 2 shows this rapid change in the rate of earthquakes in Oklahoma compared to California since 1970. The number of earthquakes in California has remained relatively constant over time--apart from the years in which a major earthquake occurred, and the rate of earthquakes increased due to aftershocks following the event. Conversely, Oklahoma experienced very low earthquake activity until 2009 when the rate began to rapidly increase, and this increase is believed to correlate with increased oil and gas activity, specifically the pumping of waste water at fluid injection wells.[23] 2015 saw the peak of earthquake activity in Oklahoma with the number continuing to decline in the past 2 years.

On March 1, the USGS released an updated view of hazard, which indicated the hazard due to induced seismicity in the central U.S. has decreased.[24] This decrease is attributed to the fewer number of earthquakes in 2016 compared to 2015. Speculating the cause for the decrease in the number of earthquakes, the USGS states, "This may be due to a decrease in wastewater injection resulting from regulatory actions and/or from a decrease in oil and gas production due to lower prices."[24] The price of oil began decreasing in 2014, which led to a decrease in oil production.[25]

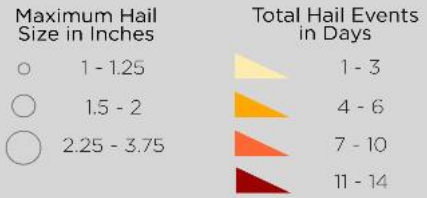


2017 Natural Hazard Risk Summary & Analysis

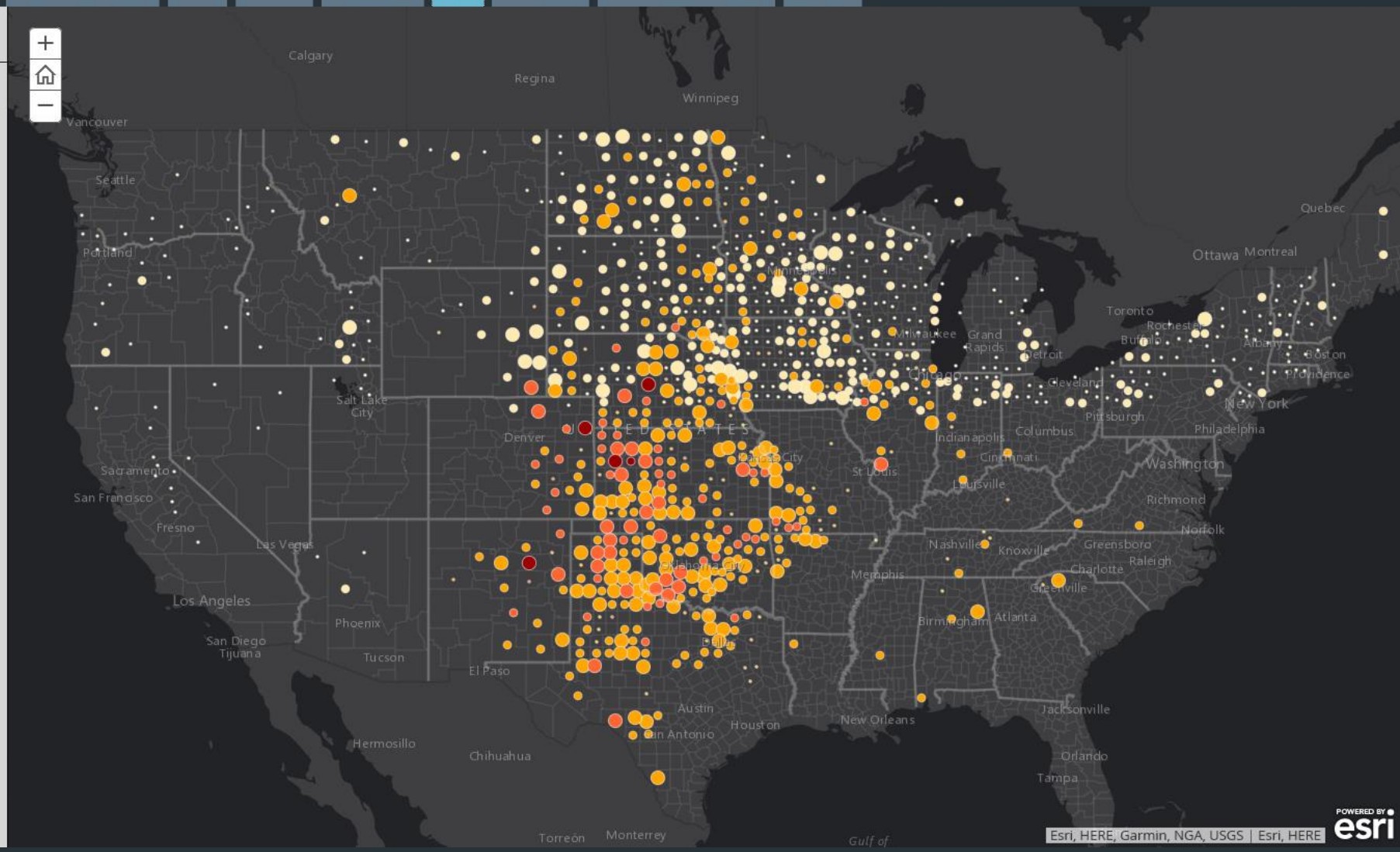
Hail

Year in Review

Overall, hail activity in 2017 was near the CoreLogic calculated average (2009-2017). CoreLogic hail verification technology shows 168,905 square miles, or 5.5 percent, of the Continental U.S. (CONUS) were impacted by severe hail, which is defined by the National Weather Service as 1.0 inch or greater. Some of the largest hail occurred on June 29 near Papillion, Nebraska, southwest of Omaha, where CoreLogic estimated hail up to 4 inches in diameter. Additionally, on September 1, hail up to 3.75 inches impacted areas just to the south of Raleigh, North Carolina.



State/Metro Areas with the Most Activity and Damage Costs



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Hail

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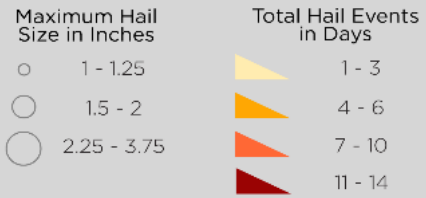
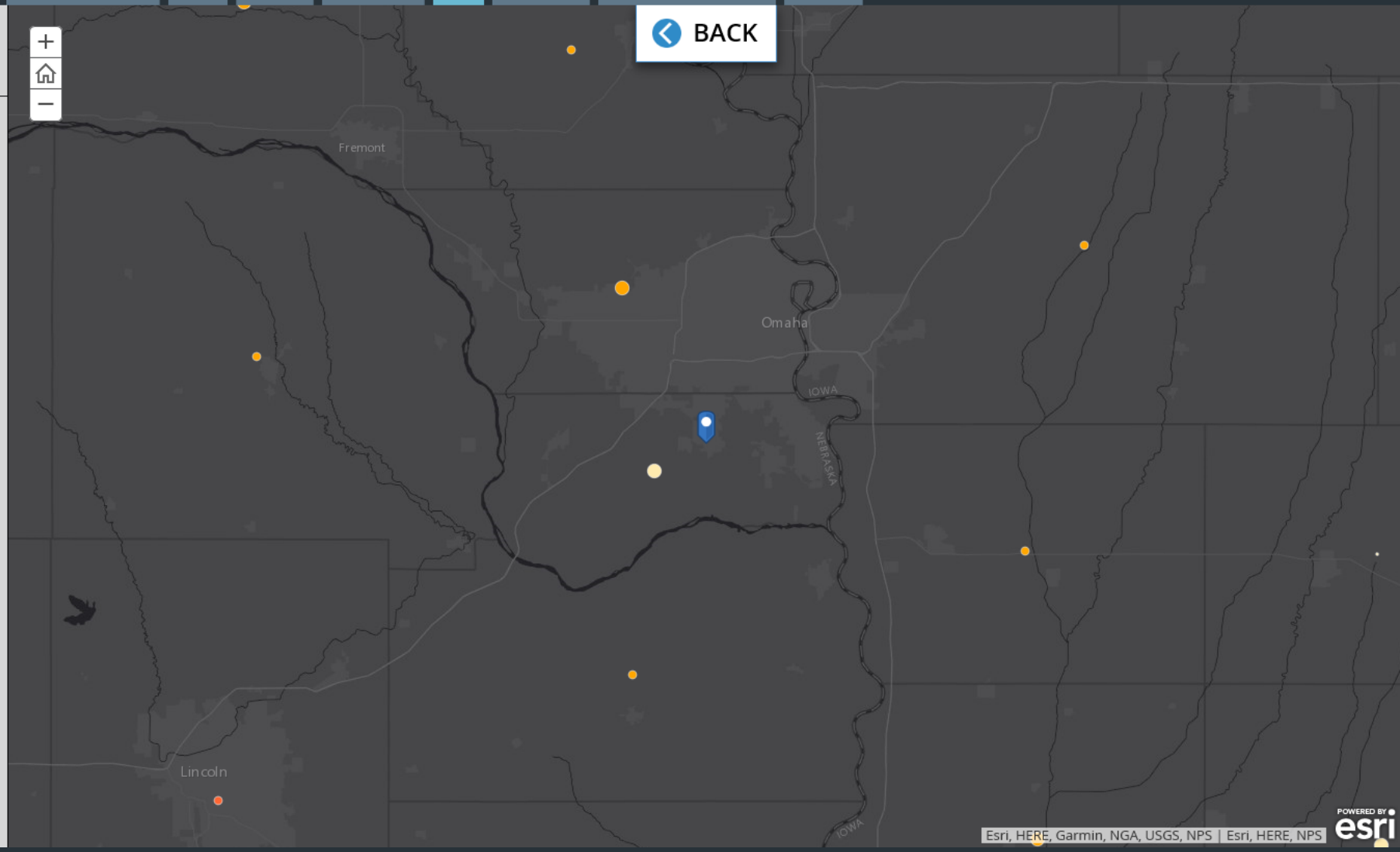


State/Metro Areas with the Most Activity and Damage Costs

During rush hour, late in the afternoon on May 8, a severe thunderstorm dropped up to baseball-sized hail across the Denver, Colorado, metropolitan area. Some of greatest impacted cities included Lakeside and Wheatland, northwest of downtown Denver. According to data provided by the Rocky Mountain Insurance Information Association (RMIIA), the May 8 hailstorm is one for the records and will top the insured losses list for the state. RMIIA estimates losses to be an astonishing $1.4 billion from an estimated 150,000 auto insurance claims and an



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2017 Natural Hazard Risk Summary & Analysis

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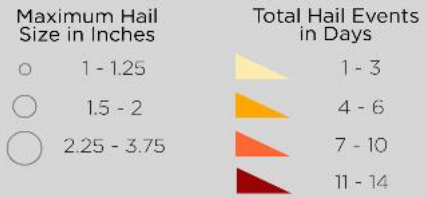

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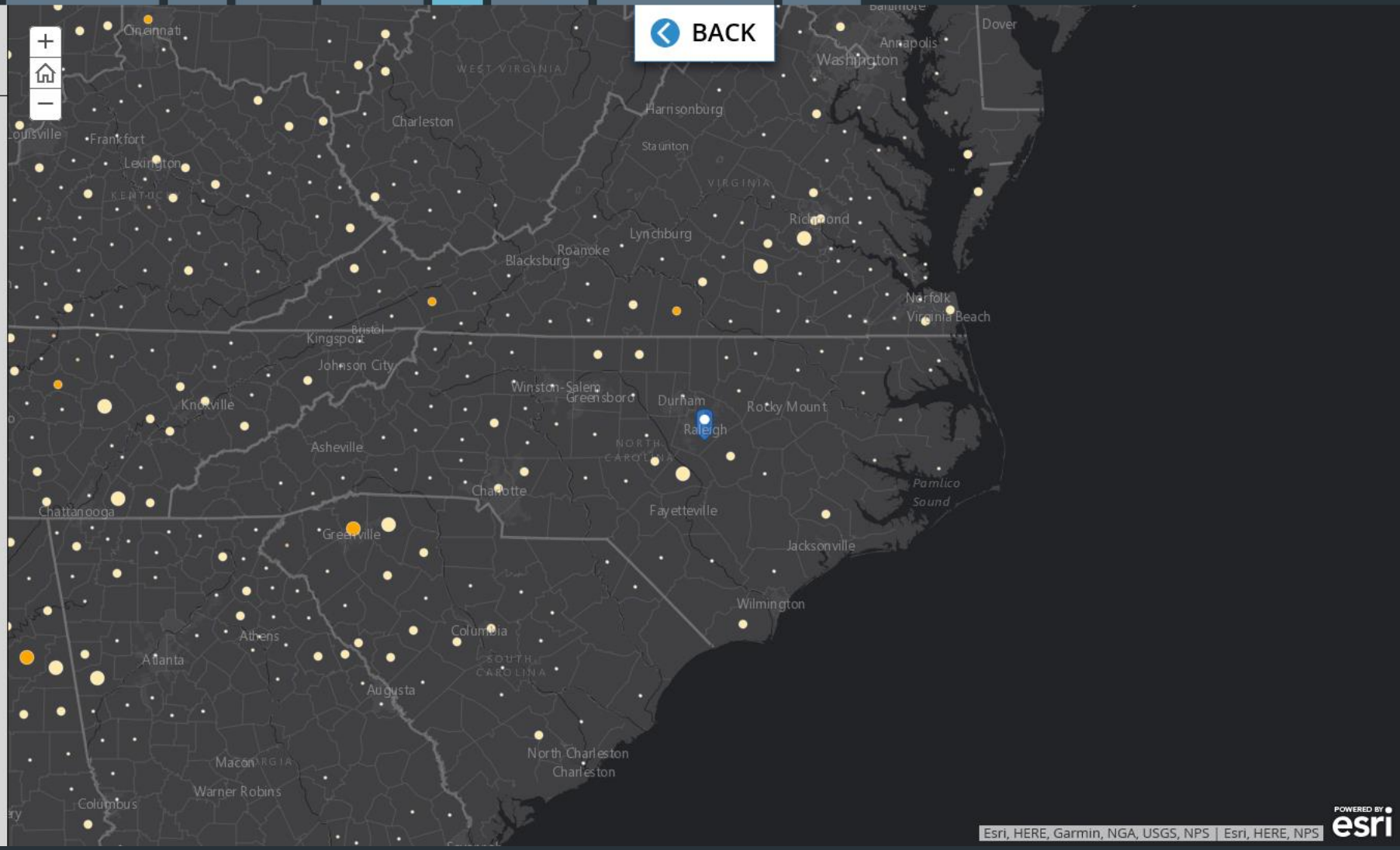

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Hail

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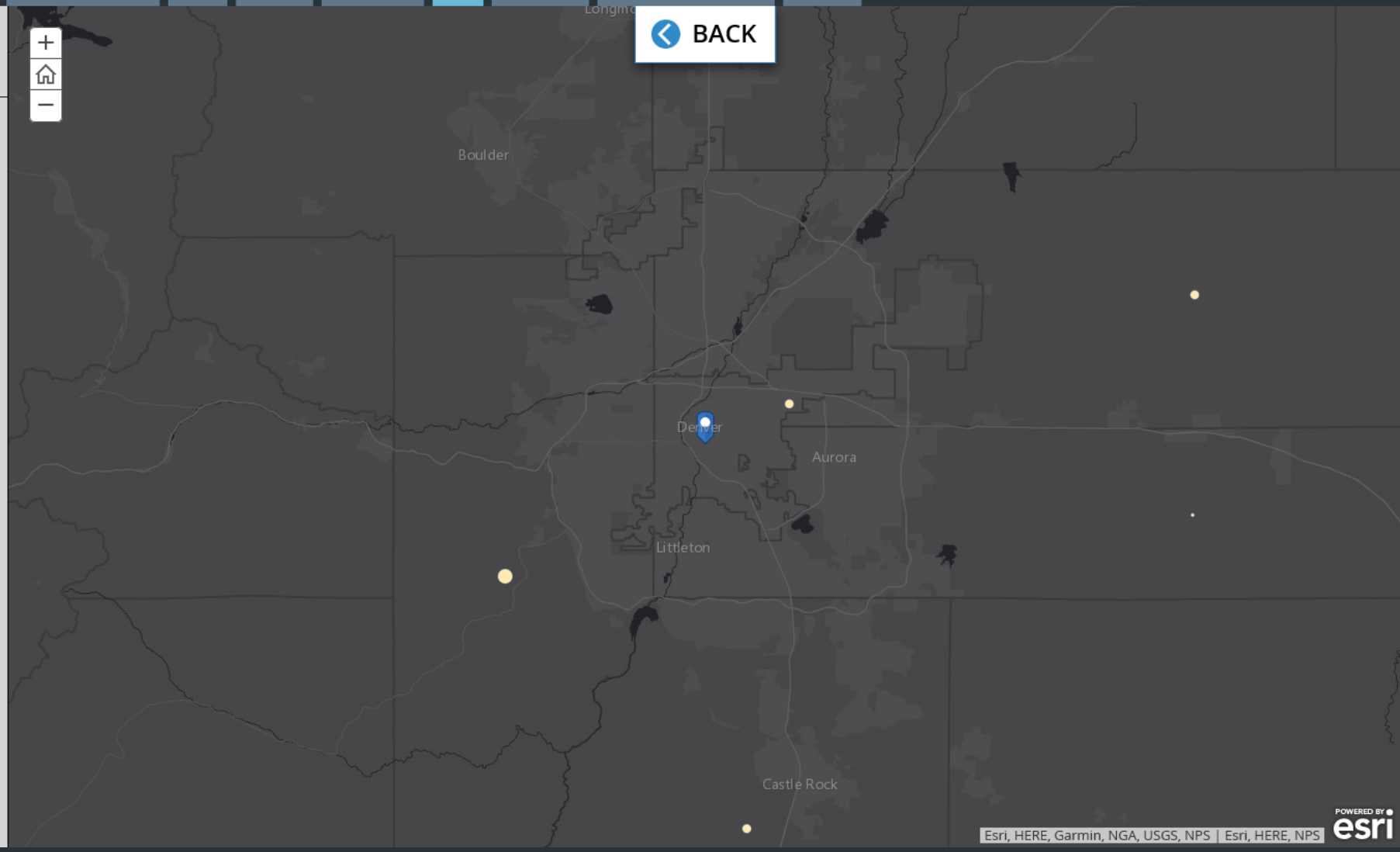
Other significant hail events also took place in 2017, including a storm that pummeled the city of Odessa, Texas, with up to softball-sized hail on June 14. According to the Insurance Council of Texas, this storm caused an estimated $480 million in damages.[26]

During the evening hours of March 26, up to baseball-sized hail impacted numerous communities north of the Dallas-Fort Worth metroplex. Some the greatest impacted cities included Corinth and Highland Village where the Insurance Council of Texas estimated losses at $300 million.



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2017 Natural Hazard Risk Summary & Analysis

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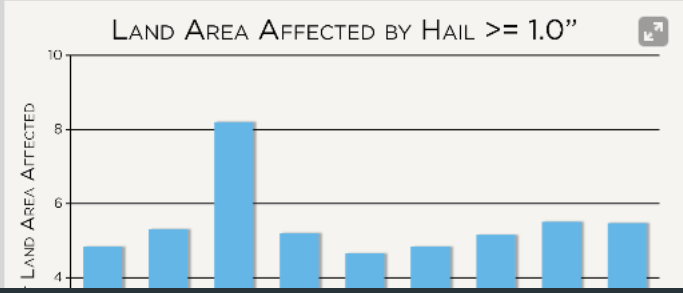
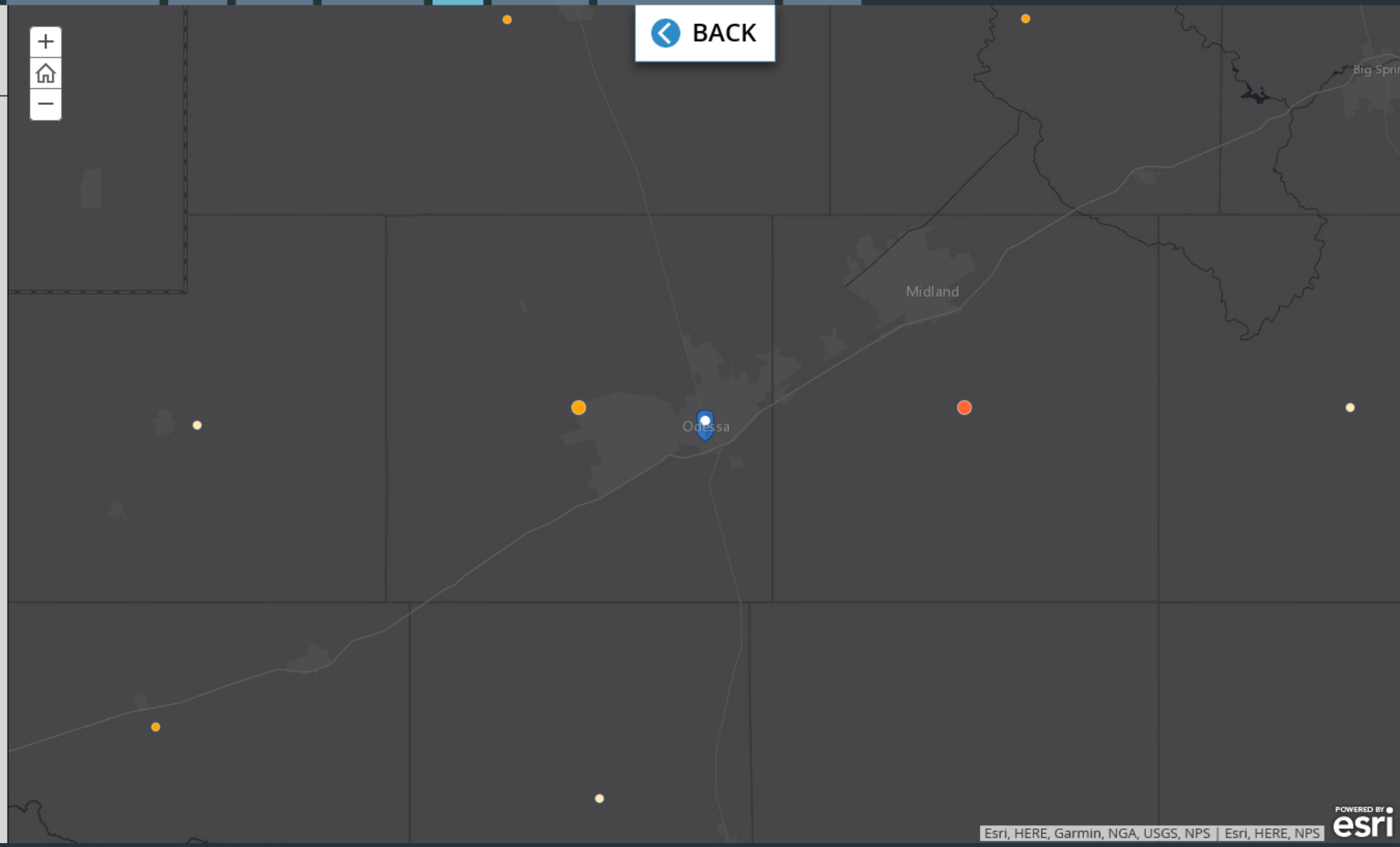
2017 Compared with Previous Years

Severe hail coverage across the CONUS in 2017 was very similar to the three previous years, but still significantly lower than in 2011, the most active year, as indicated in the *Land Area Affected by Hail >1.0 Inch* graph.





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2017 Natural Hazard Risk Summary & Analysis

Hail

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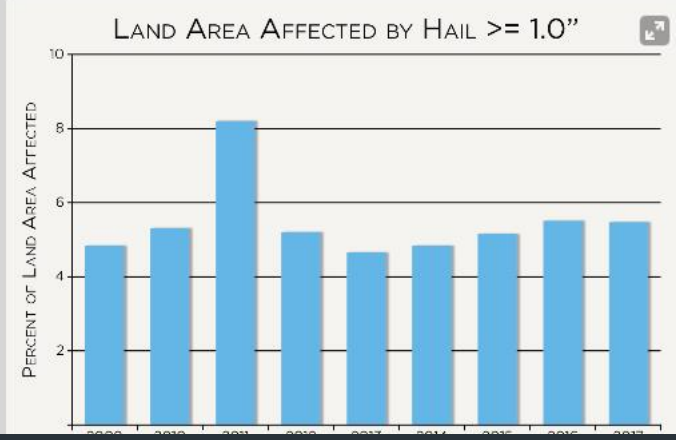

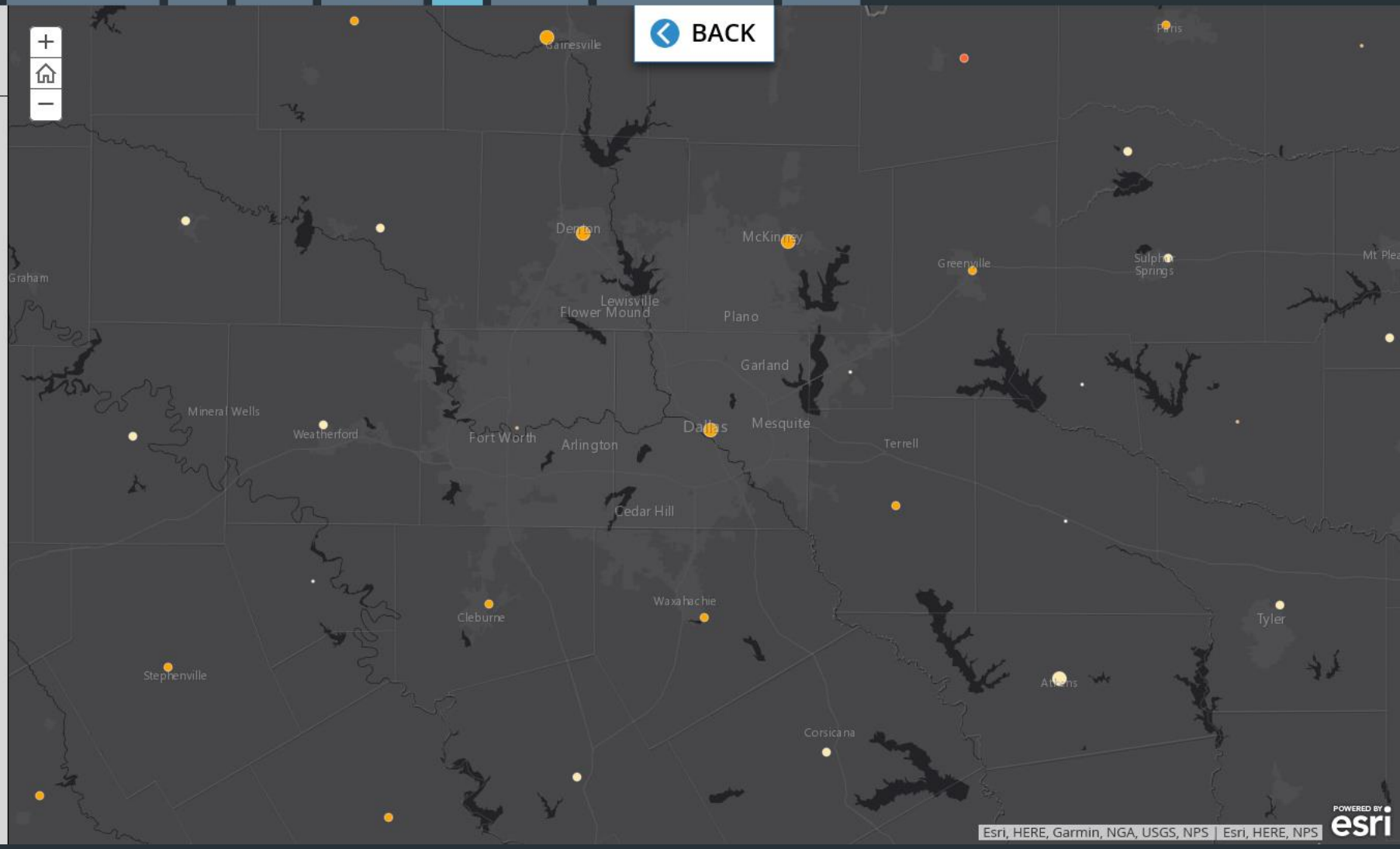

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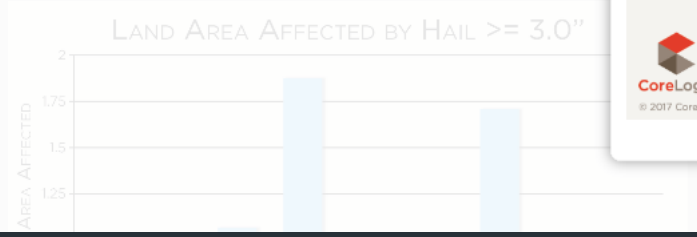
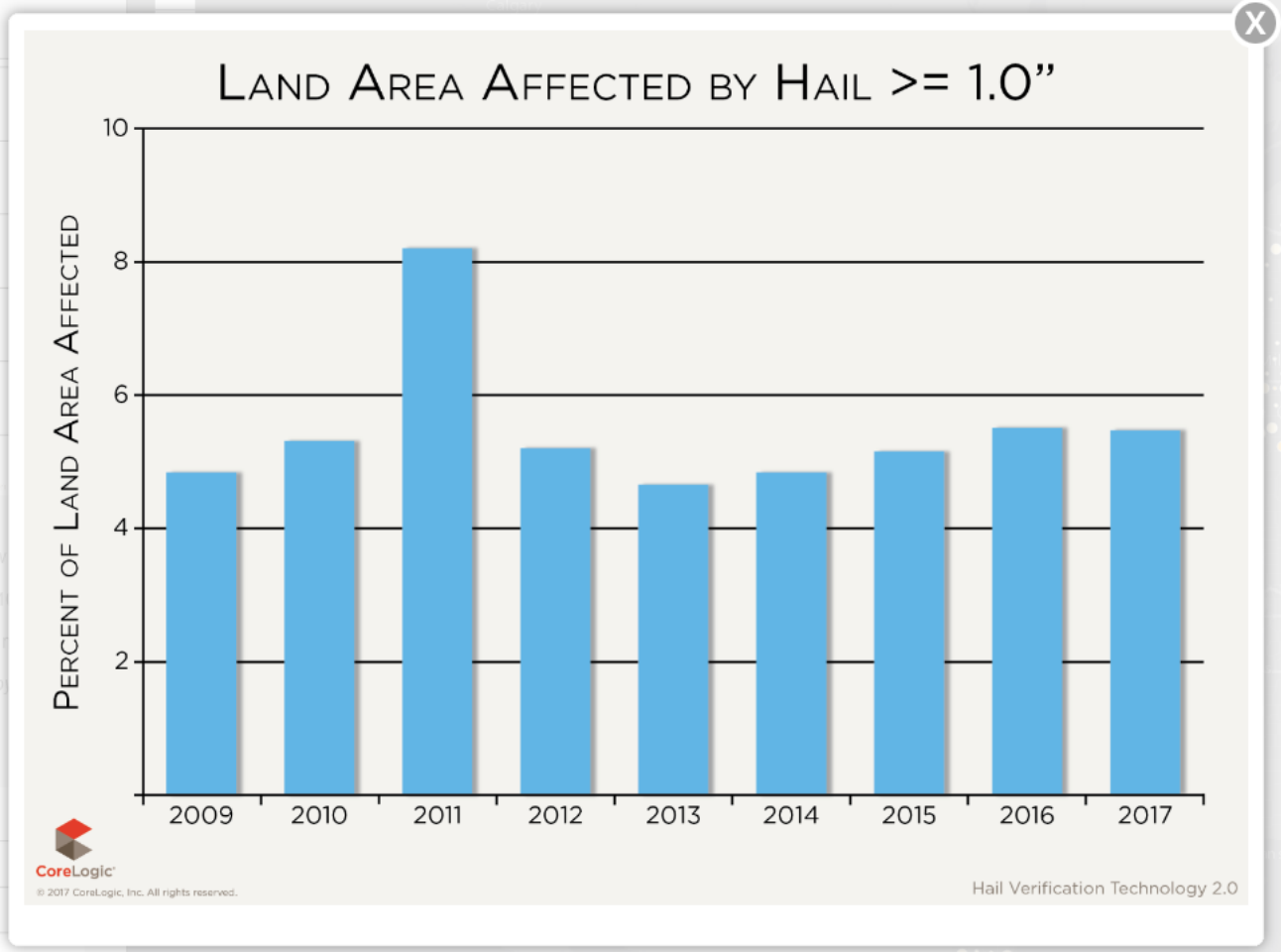
Hail

When analyzing very large hail (> 3.0 inches), activity in 2017 was below CoreLogic calculated average (2009-2017) and very similar to 2009, 2011 2013. Additionally, very large hail coverage in 2017 remained under the active years – 2012 and 2015 – as indicated in the *Land Area Affected by >3.0 Inches* graph below.

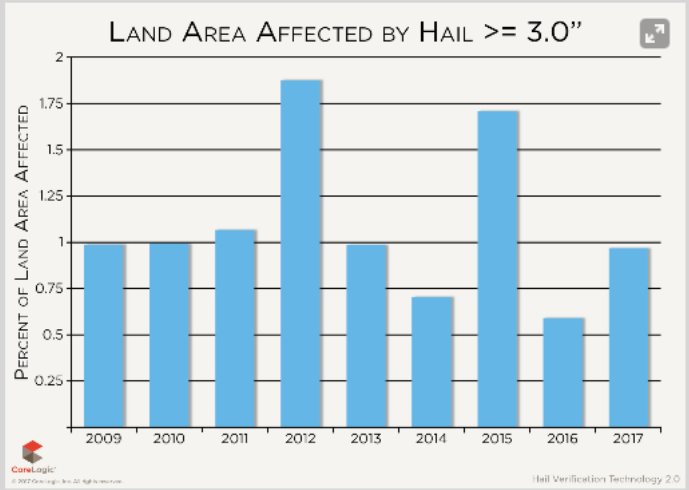




2017 Natural Hazard Risk Summary & Analysis

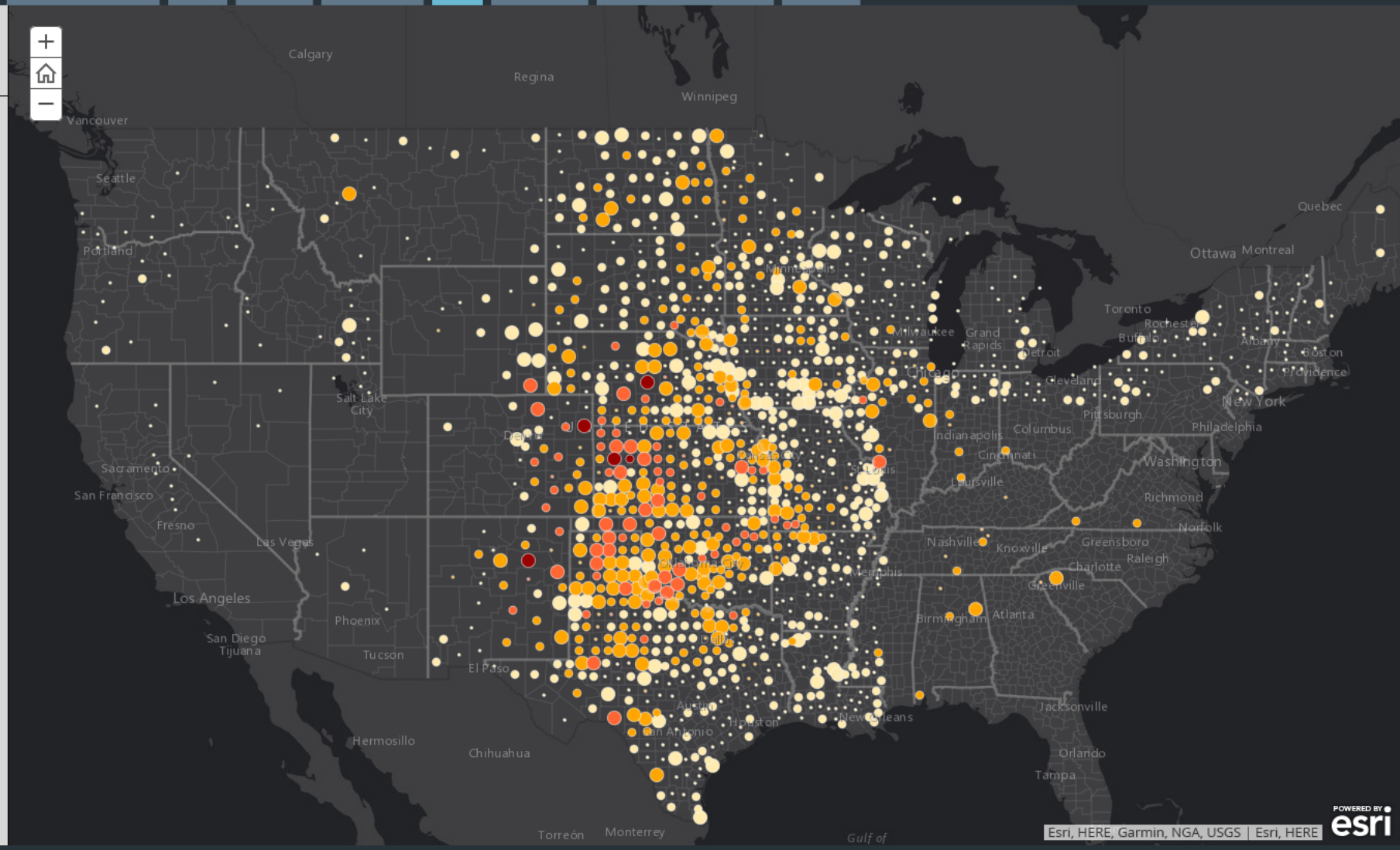
Hail

When analyzing very large hail (> 3.0 inches), activity in 2017 was below the CoreLogic calculated average (2009-2017) and very similar to 2009, 2010 and 2013. Additionally, very large hail coverage in 2017 remained under the most active years – 2012 and 2015 – as indicated in the *Land Area Affected by Hail >3.0 Inches* graph below.



Snapshot View of Risk/Potential Damage

As we move into winter 2017-2018, moderate La Niña conditions, or cooling of



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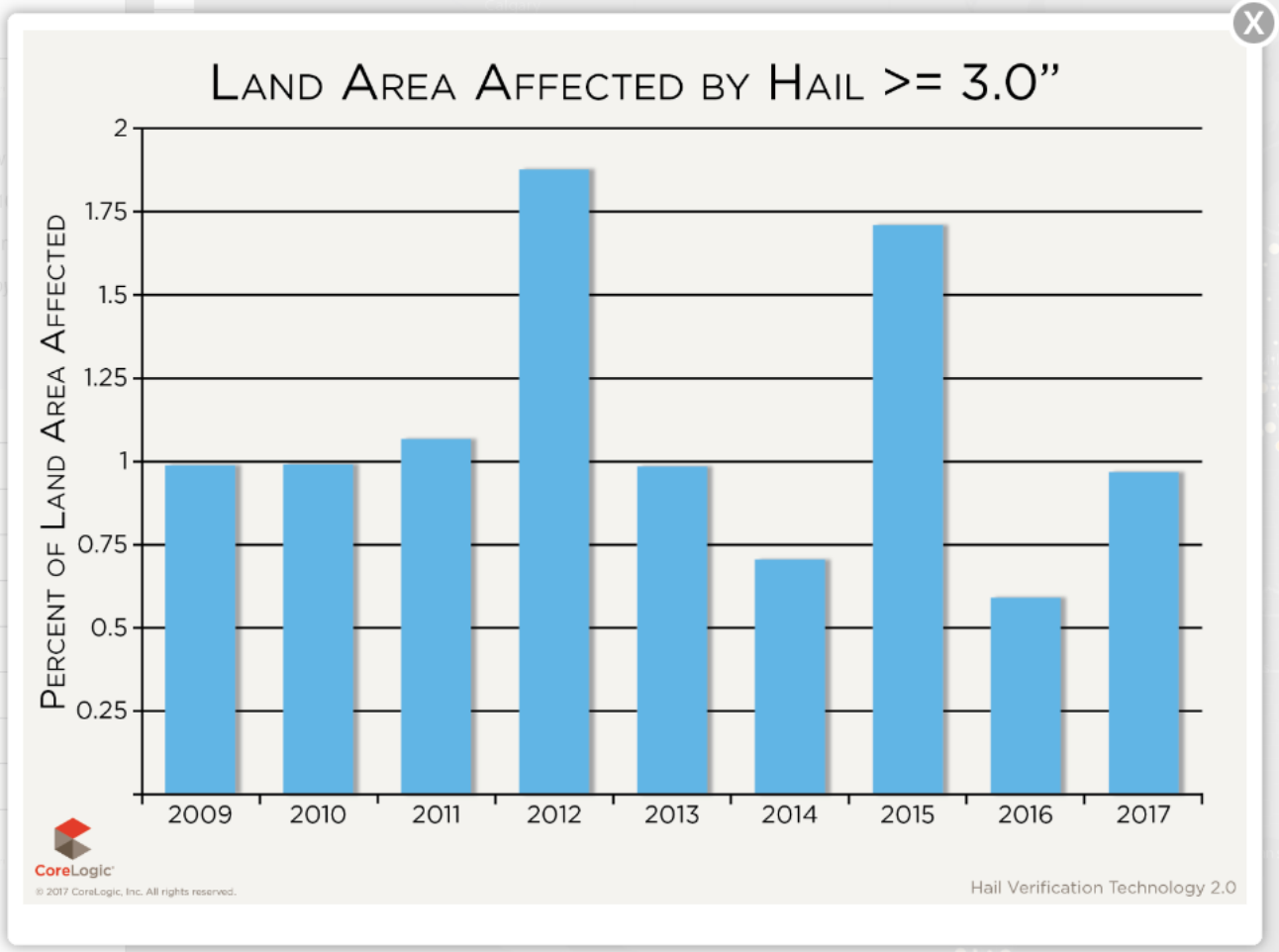

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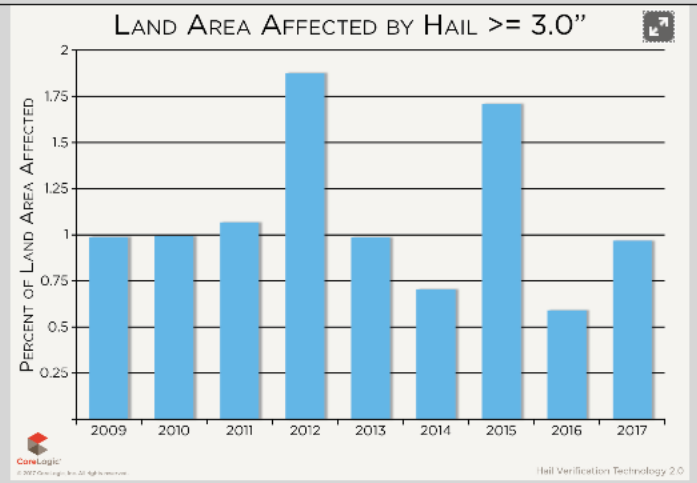
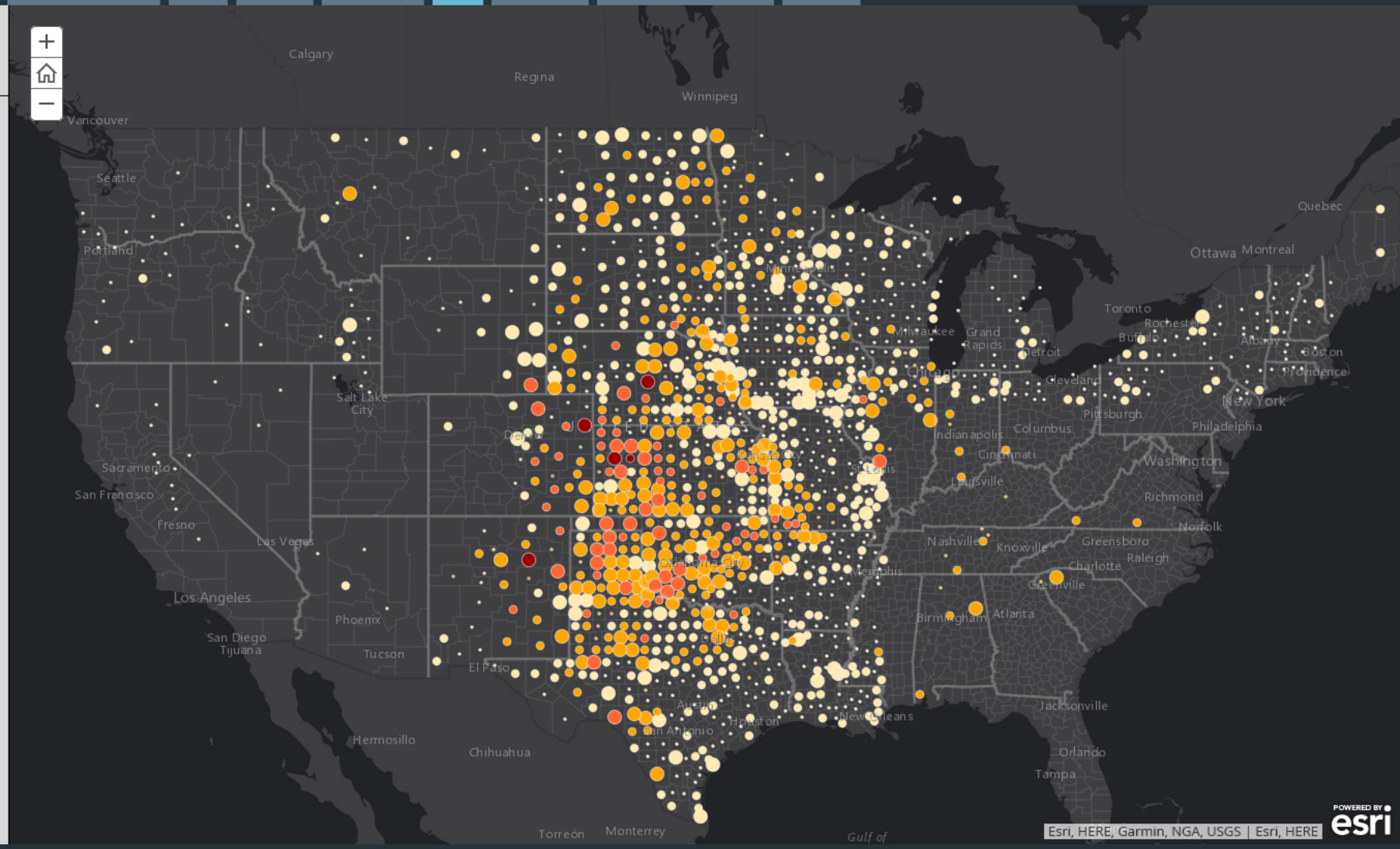
2017 Natural Hazard Risk Summary & Analysis

Hail



Snapshot View of Risk/Potential Damage

As we move into winter 2017-2018, moderate La Niña conditions, or cooling of waters in the equatorial Pacific, are expected to persist. Recent research suggests that when La Niña conditions are present, increased thunderstorm activity from the Plains into the southeast U.S. has been noted in late winter into the spring. Therefore, if La Niña conditions continue, increased severe storm activity, including hail, can be expected across these areas in spring 2018.[27]



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2017 Natural Hazard Risk Summary & Analysis

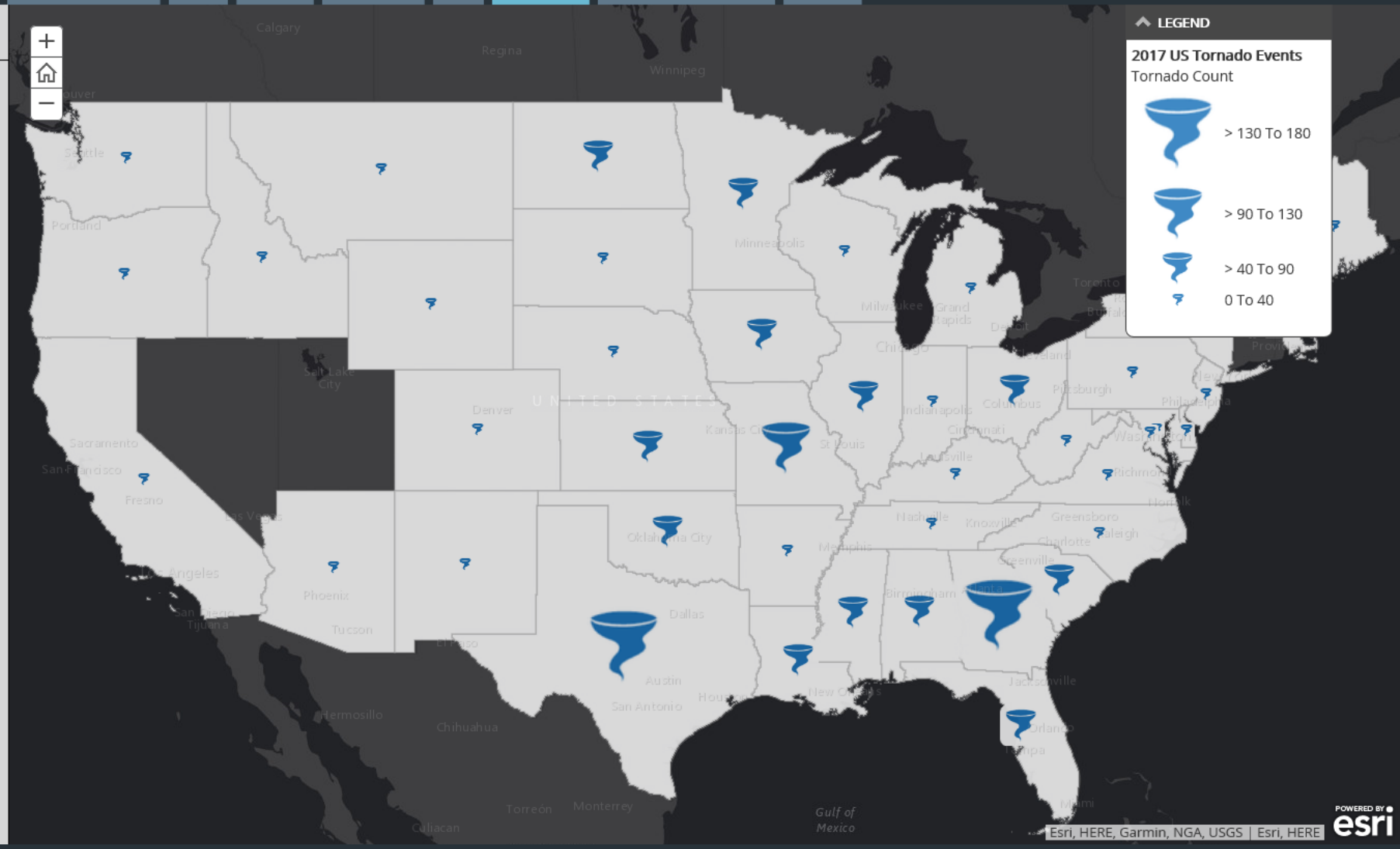
Tornadoes

Year in Review

With the third most tornado reports since 2005, overall tornado activity in 2017 was above average compared with previous years.[8] According to the Storm Prediction Center (SPC), a federal entity under the National Oceanic and Atmospheric Administration (NOAA), 1,522 tornadoes were logged through December. According to the SPC, and adjusting for inflation, only 2008 experienced more tornadoes through the first three months of the year since records began in 1954.[8] Adjusting for inflation takes into account that fewer tornadoes go unreported today due to advanced technology.

2017 Compared with Previous Years

If every storm report through December 2017 is processed and verified, the potential total of 1,522 tornadoes will be slightly more than the totals recorded in previous years (*Annual Tornado County by Year* graph). The 131 potential tornadoes in Georgia marks an all-time high for the state, besting the previous record of 84 in 2008.



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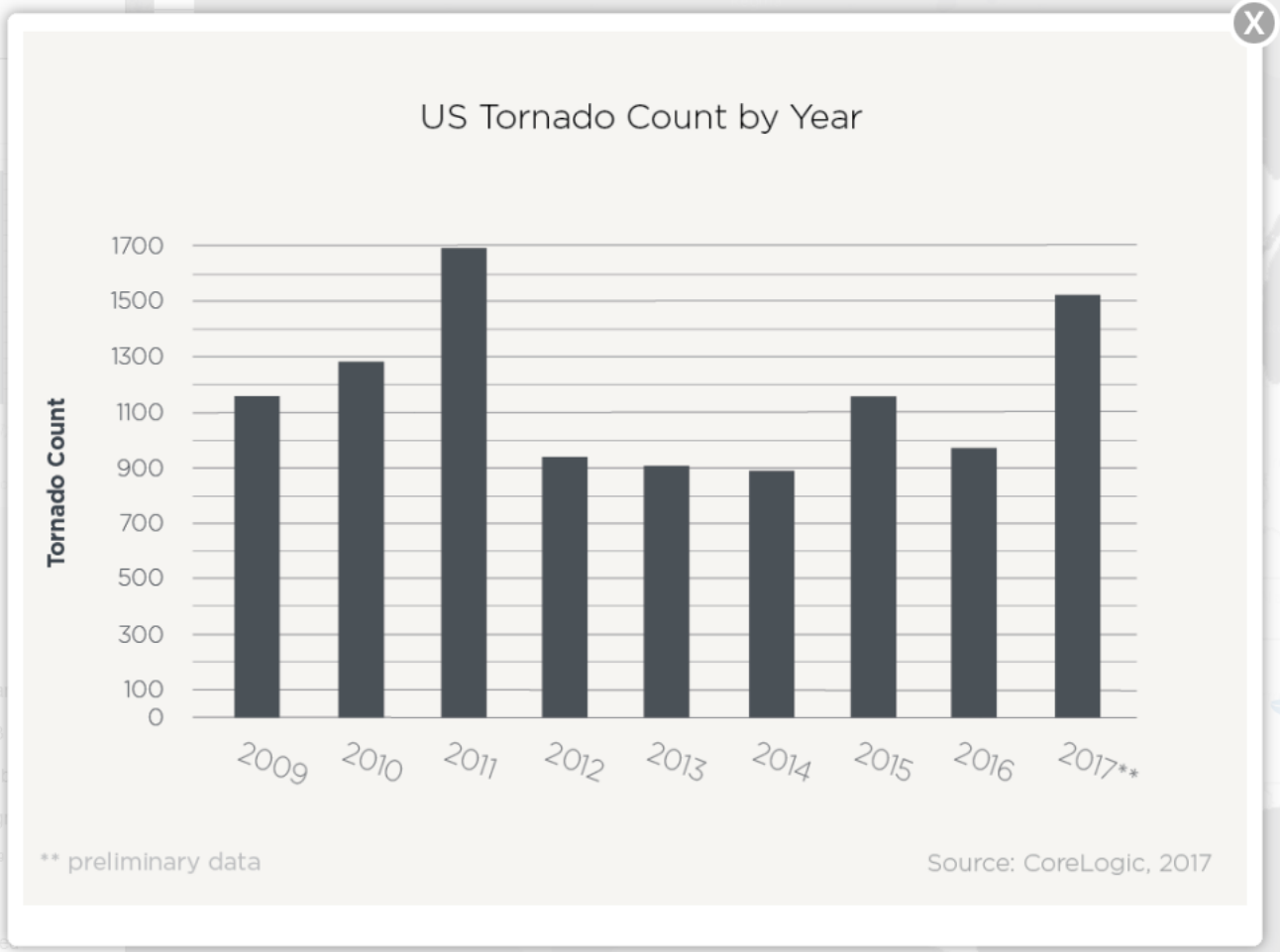


2017 Natural Hazard Risk Summary & Analysis

Tornadoes

** preliminary data

Source: CoreLogic, 2017

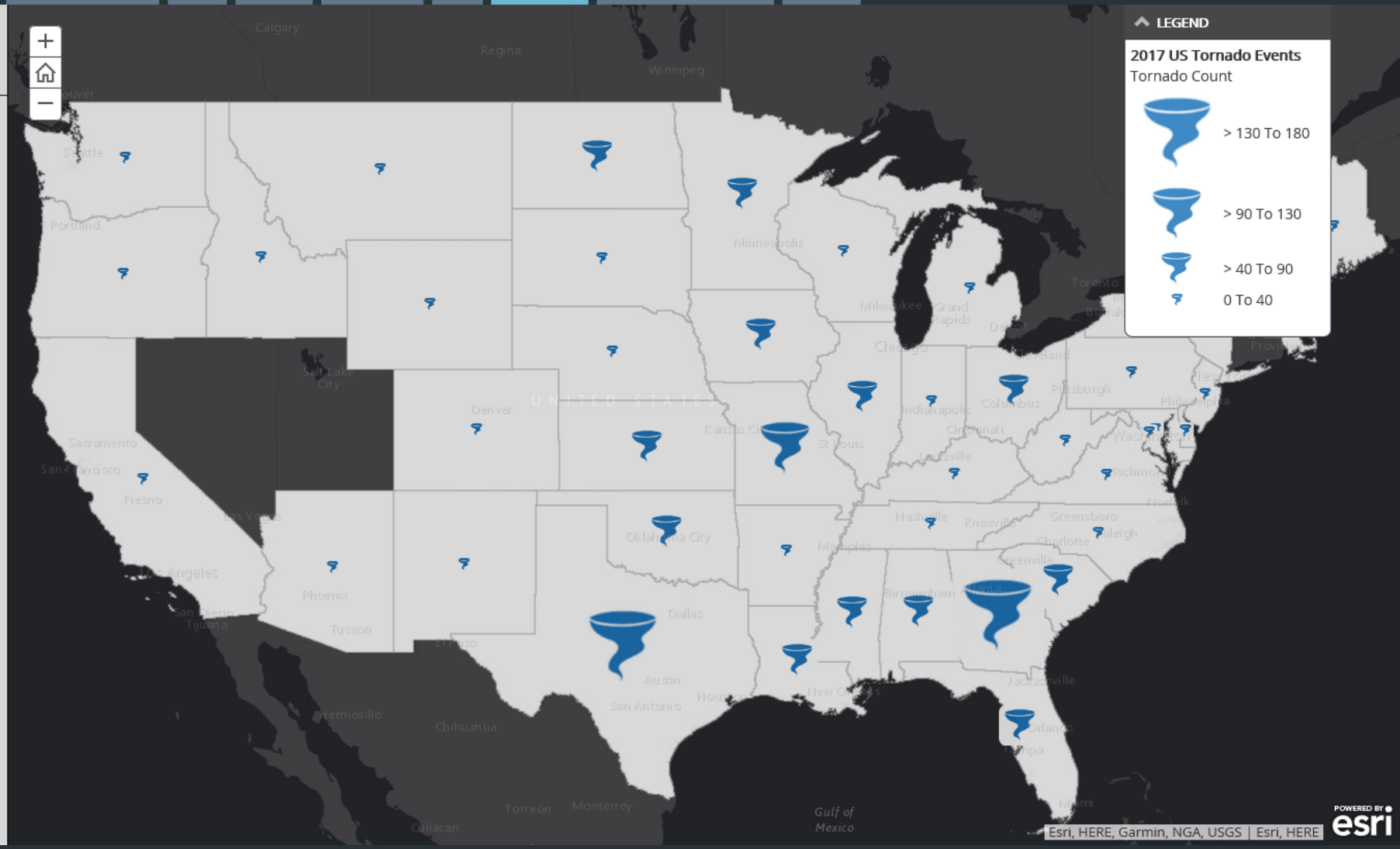
State/Metro Areas with the Most Activity and Damage Costs

In one of the largest and deadliest tornado outbreaks for the month of January, 81 confirmed tornadoes were reported between January 21 and January 23 across the southeastern U.S. Tragically, tornadoes caused at least 20 fatalities between Mississippi and Georgia, with the Albany, Georgia, EF3 tornado on the ground for over 70 miles with a maximum path width of one and a quarter miles.[28,29]

One month later, between February 28 and March 1, at least 71 confirmed tornadoes touched down across the Ohio Valley, causing four fatalities.[28] The strongest of these was an EF4 tornado which remained on the ground for 50 miles from Perryville, Missouri, into southern Illinois.[30]

On April 29, seven tornadoes were confirmed near Canton, Texas, ranging from EF3 to EF4. The tornadoes occurred only a few miles apart on the east, west and south sides of Canton, resulting in four fatalities.[31]

Snapshot View of Risk/Potential Damage



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2017 Natural Hazard Risk Summary & Analysis

Tornadoes

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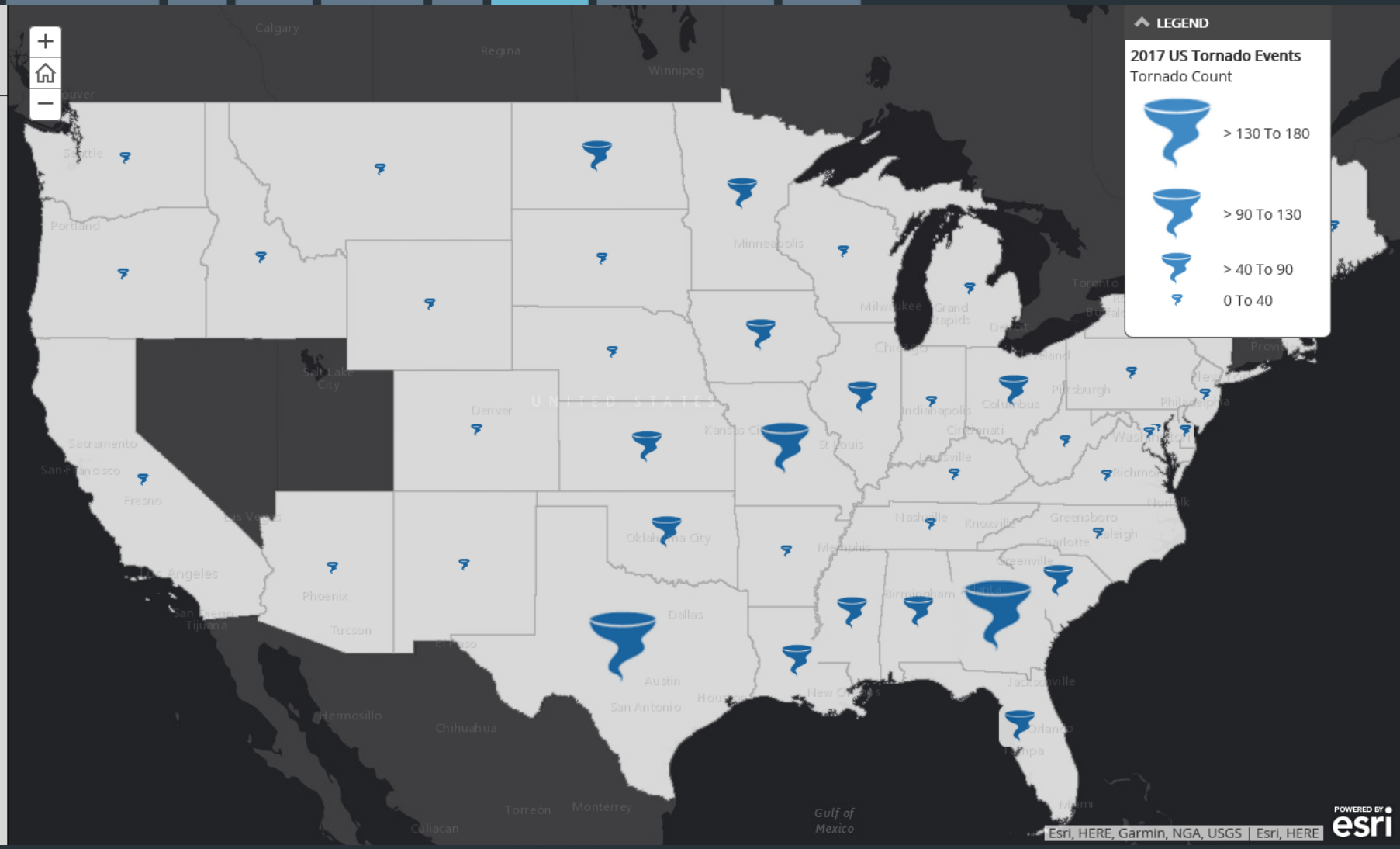
Snapshot View of Risk/Potential Damage

The weak La Niña pattern, or cooling of waters in the equatorial Pacific, experienced during the winter of 2016-2017 led to a slight increase in severe storm activity and tornadoes across the U.S.

After returning to neutral conditions over the summer, La Niña conditions have returned and appear to be stronger than last year and are expected to persist through winter 2017-2018. Recent research suggests that when La Niña conditions are present, increased thunderstorm activity from the Plains into the southeast U.S. has been noted in late winter into the spring. Therefore, if La Niña conditions continue, increased severe storm activity, including tornadoes, can be expected across these areas through spring 2018.



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2017 Natural Hazard Risk Summary & Analysis

International Incidents

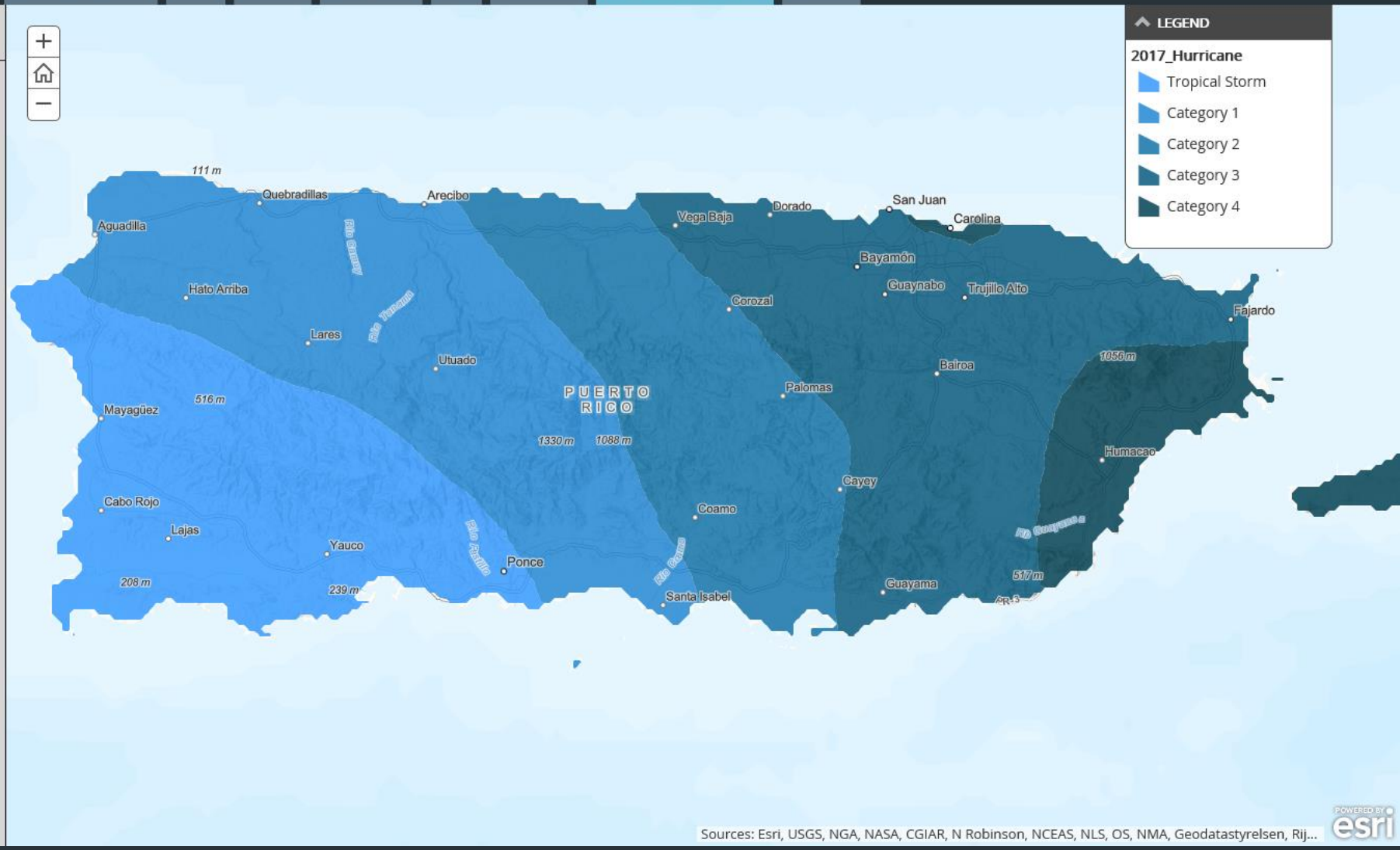
Hurricane Maria Inflicts $20 Billion of Damage in San Juan

Hurricane Maria was the 13th named storm and fourth major hurricane of the 2017 Atlantic Hurricane season. Hurricane Maria made landfall on September 20 as a strong Category 4 hurricane. The southeast corner and some beach areas of San Juan saw the strongest winds (Category 4), while the entire island saw at least tropical storm force winds.

Damage to residential and commercial private property from hurricane winds and rain is estimated to be between $20 billion and $25 billion. Damage to key infrastructure, including roads, bridges, power generation and distribution, which was not included in the estimate, is expected to impede the restoration of normal activities on the island.

M7.1 Earthquake in Mexico causes More Than $20 Billion in Property Damage

A magnitude (M) 7.1 earthquake struck Central Mexico on September 19, 2017. The epicenter was approximately 100 kilometers from Mexico City and intense shaking was felt throughout the region. More than 100 fatalities were attributed to this event, and, according to CoreLogic, damage likely exceeded $20 billion.



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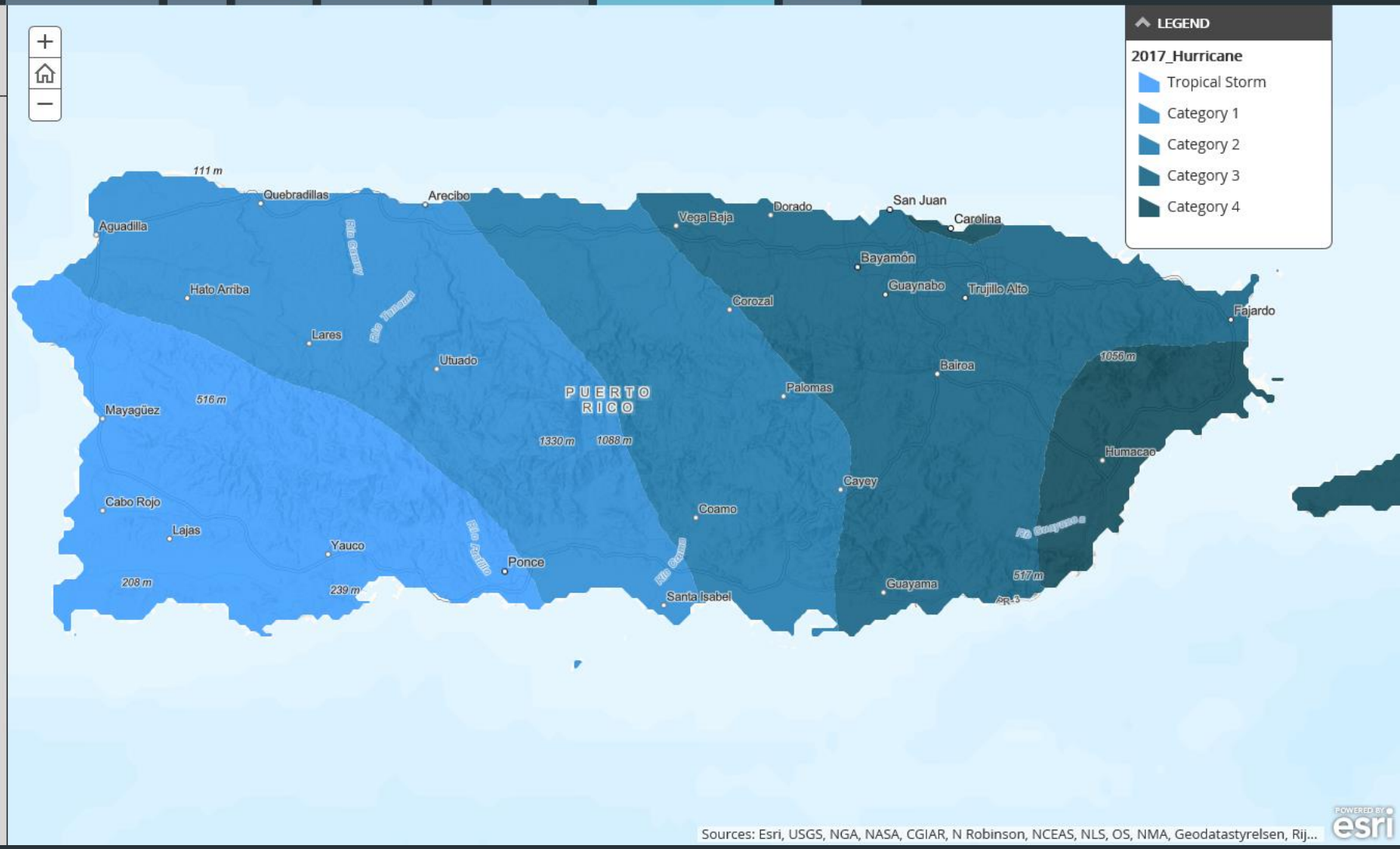
2017 Natural Hazard Risk Summary & Analysis

International Incidents

The epicenter was approximately 100 kilometers from Mexico City and intense shaking was felt throughout the region. More than 100 fatalities were attributed to this event, and, according to CoreLogic, damage likely exceeded $20 billion. There were observations of collapsed reinforced concrete structures, although properties constructed to the latest code requirements generally performed adequately. This event occurred on the anniversary of the 1985 M8.5 Michoacan Earthquake which devastated Mexico City, but the rupture mechanism and epicenter of the 2017 event are distinctly different.

Cyclone Debbie Causes $1 Billion to $2 Billion in Property Damage to Northern Queensland, Australia

Cyclone Debbie was the most dangerous cyclone to impact Queensland since Cyclone Yasi in 2011. Striking land close to Townsville, Debbie quickly degraded after landfall, becoming a low-pressure system that delivered torrential rain with extensive flooding into southern Queensland. Insured losses are estimated to be between $1 billion and $2 billion USD (1.3 to 2.5 billion AUD). This loss is from wind and flood combined, and includes residential, commercial and industrial exposure, but not losses from crops. This estimate has not been revised after the event.



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