



March 2016

## GLOBAL CATASTROPHE REVIEW – 2015

The year 2015 was a quiet one in terms of global significant insured losses, which totaled around USD 30.5 billion. Insured losses were below the 10-year and 5-year moving averages of around USD 49.7 billion and USD 62.6 billion, respectively (see Figures 1 and 2). Last year marked the lowest total insured catastrophe losses since 2009 and well below the USD 126 billion seen in 2011.

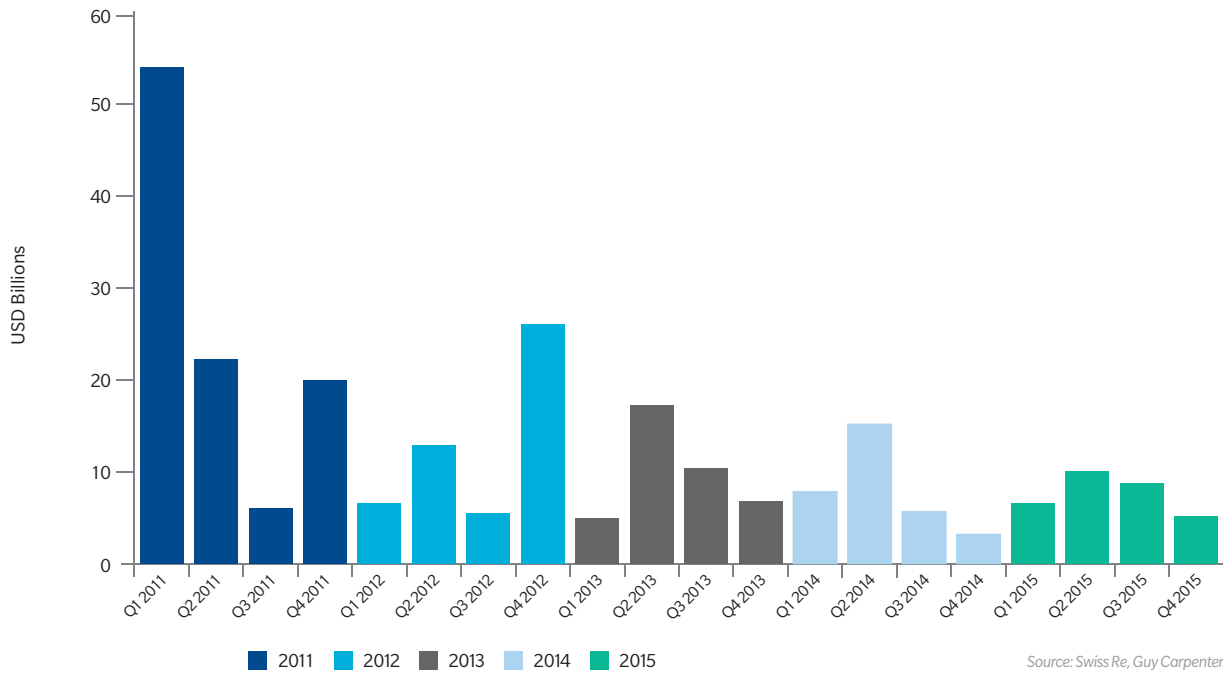
The most impactful event of 2015 was the Port of Tianjin, China explosions in August, rendering estimated insured losses between USD 1.6 and USD 3.3 billion, according to the Guy Carpenter report following the event, with a December estimate from Swiss Re of at least USD 2 billion. The series of winter storms and record cold of the eastern United States resulted in an estimated USD 2.1 billion of insured losses, whereas in Europe, storms Desmond, Eva and Frank in December 2015 are expected to render losses exceeding USD 1.6 billion. Other impactful events were the damaging wildfires in the western United States, severe flood events in the Southern Plains and Carolinas and Typhoon Goni affecting Japan, the Philippines and the Korea Peninsula, all with estimated insured losses exceeding USD 1 billion.

The year 2015 marked one of the strongest El Niño periods on record, characterized by warm waters in the east Pacific tropics. This was associated with record-setting tropical cyclone activity in the North Pacific basin, but relative quiet in the North Atlantic. Heavy Pacific typhoon activity affected Mainland China, Japan, the Philippines and Taiwan, while Mexico saw landfall of Hurricane Patricia, the strongest hurricane observed in the Western Hemisphere. The year also saw flooding in northern Chile and severe monsoon flooding in Chennai, India.

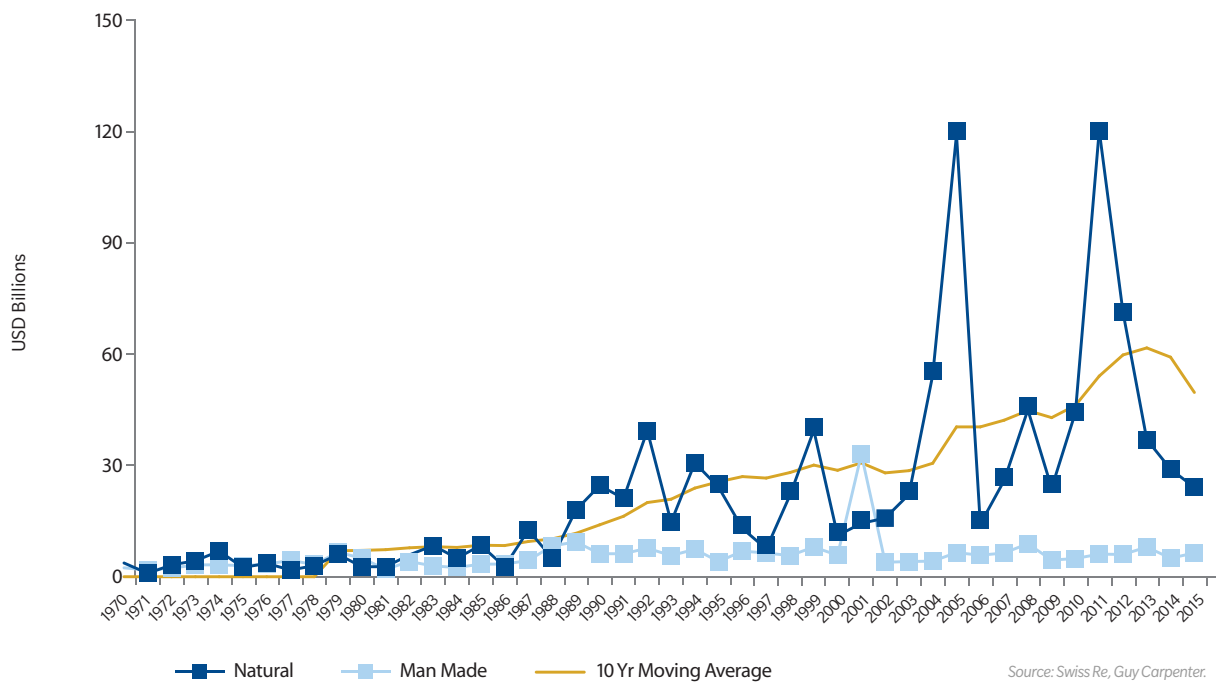
The most impactful earthquake of the year was the April magnitude 7.8 event in Nepal. This earthquake has been referred to as the most destructive and deadliest event of the year with the tragic loss of life around 9,000 and millions more lives affected, including 500,000 people rendered homeless. The following September, a magnitude 8.3 earthquake struck near Illapel, Chile, causing estimated insured losses ranging from USD 600 million to USD 900 million.

Beyond natural catastrophes in 2015, there were significant events affecting the oil and aviation sectors, including the loss of the TransAsia flight over Taiwan and the downing of a Russian MetroJet over Egypt with 224 dead. The events of 2015 also saw the coordinated terror attacks in France on November 13.

## F-1 | GLOBAL SIGNIFICANT INSURED LOSSES, QUARTERLY – 2011 TO 2015



## F-2 | GLOBAL SIGNIFICANT INSURED LOSSES – 1970 TO 2015



## EUROPE/MIDDLE EAST/AFRICA

Tragically, the events of 2015 included the coordinated terror attacks of November 13 in Paris, France resulting in at least 130 fatalities.<sup>1</sup> Our thoughts and concerns remain with those affected by this event and with all victims of such incidents worldwide.

The aviation events of 2015 included the crash of MetroJet Flight KGL 9268, en route from Egypt to Saint Petersburg, Russia in October and the crash of Germanwings Flight 9525 in the French Alps in March. There were no survivors of these incidents. Another crash occurred in May when three of four engines failed during a test flight of an Airbus A400M, resulting in four fatalities.<sup>2</sup>

Natural events of the 2014/2015 winter season were characterized by a positive phase of the North Atlantic Oscillation (NAO), which is often associated with increased storm transits, and greater storm severity, in Northern Europe. This year proved no exception with windstorms Elon and Felix affecting Northern Europe in early January. Flood events affected Central Italy in early March.

The most significant events were Storms Mike and Niklas at the end of March, which followed each other in close succession. Storm Mike caused downed trees and transportation disruption, with a reported gust of 151 kilometers per hour (92 mph). Storm Niklas brought high winds and heavy rains to much of Northern Europe, with a wind speed of 190 kilometers per hour (116 mph) at Germany's highest mountain. Buildings in parts of Germany suffered serious wind damage, together with flooding and soil erosion. The storm also brought significant transportation disruption for air, rail and land. Wind impacts were reported in the United Kingdom, Ireland, France, Poland, Austria, Switzerland, the Netherlands, Belgium and the Czech Republic.<sup>3 4</sup> Winter Storm Niklas produced estimated insured losses of USD 1.0 billion.<sup>5</sup>

Severe thunderstorm events during the year happened in Germany on May 13 and in Italy on September 15. Later in the year, a slow-moving frontal system caused heavy rainfall in Southern France on October 3. The mechanics of the system, further enabled by warm, moist and unstable air from the Mediterranean, brought very intense rainfall and severe flooding. Rainfall amounts exceeded 150 millimeters (six inches) near Cannes and Antibes, with local amounts approaching 200 millimeters (eight inches). The excessive rainfall produced severe flooding, compounded by failure of the banks of the Brague River near Antibes. Several densely populated urban areas were affected, resulting in significant property and auto damage along with severe disruption to transportation infrastructure. The tourist regions of Cannes and Nice were severely affected. Estimated insured losses from this event are on the order of USD 605 million to USD 715 million.<sup>6</sup>

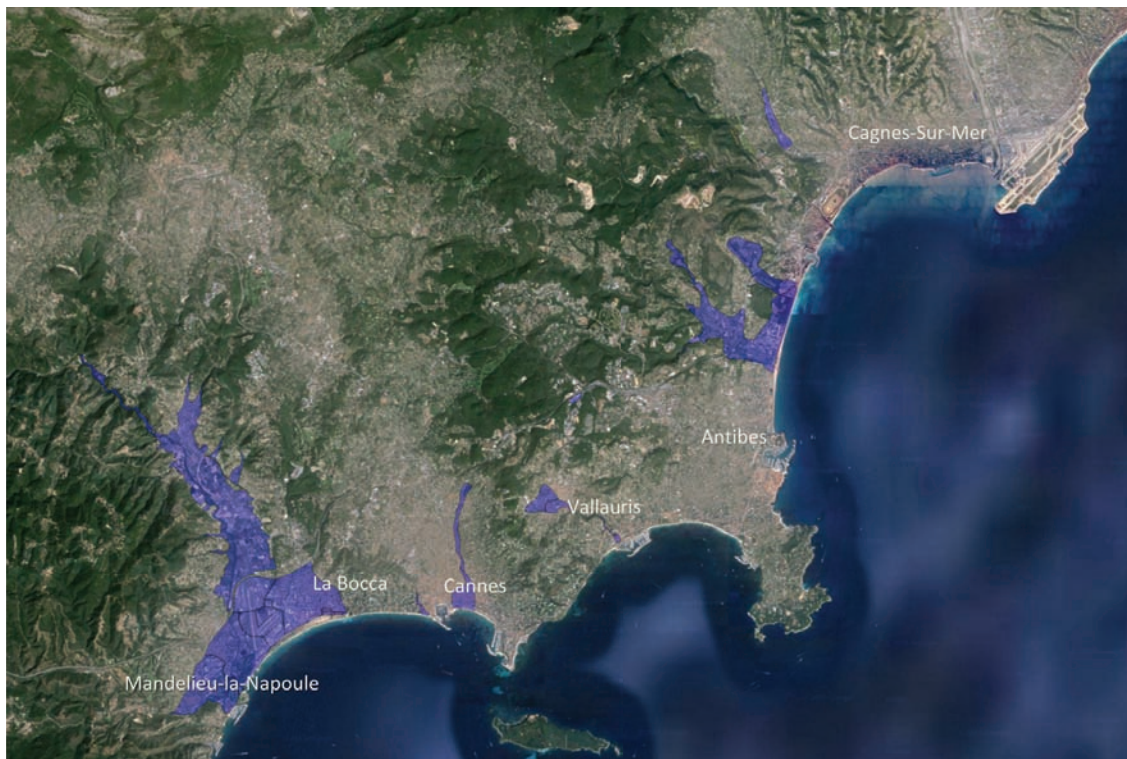
The year closed with the NAO again in a significant positive phase. In early December Storm Desmond, together with a moisture feed traceable to the Caribbean, affected areas including Northern Ireland, Iceland, the United Kingdom, Germany, Denmark, Sweden and Norway. Northwest England was affected by sustained winds of 110 kilometers per hour (67 mph). Desmond also produced excessive rainfall and flooding, with 341 millimeters (13.6 inches) of rainfall measured in Northwest England. The flooding affected several bridges and damaged nearly 6,500 properties.<sup>7 8</sup> Desmond is expected to render insured losses of around USD 936 million.<sup>9</sup>

1. BBC News, December 9, 2015. 2. Reuters, June 3, 2015. 3. AIR Worldwide, ALERT Report, April 1, 2015. 4. RMS Event Response, May 1, 2015. 5. Swiss Re Press Release, August 11, 2015. 6. Association Française de l'Assurance (AFA), October, 2015. 7. AIR Worldwide, ALERT Report, December 8, 2015. 8. RMS Event Response, December 28, 2015. 9. Perils, March 4, 2016.



Near the end of December, Storm Eva brought heavy rainfall over a short period of time to the United Kingdom, with soils still saturated from Desmond. The storm was closely followed by Storm Frank. Areas of northern England, northern Wales and Scotland were severely flooded as a result of heavy rainfall from Eva. Areas including Manchester, Yorkshire, Leeds and Lancashire were severely affected with some rainfall amounts exceeding 100 millimeters (four inches) and excessive flooding. In particular, large areas of the City of York were flooded. Thousands of homes were affected requiring evacuations in multiple areas, together with bridge collapses and severe transportation disruption.<sup>10 11</sup> Estimates of insured losses from Storms Eva and Frank are around USD 744 million.<sup>12</sup>

### F-3 | OCTOBER 2015 FLOOD FOOTPRINT – SOUTHERN FRANCE



SOURCE: GC CAT-VIEW<sup>SM</sup>, developed with data from social media.

#### F-4 | DECEMBER 2015 FLOOD FOOTPRINT – YORK, ENGLAND



SOURCE: GC CAT-VIEW<sup>SM</sup>, developed with data from drones.

#### F-5 | DRONE FOOTAGE CAPTURED AT PEAK FLOOD STAGE – YORK, ENGLAND



SOURCE: Guy Carpenter, Geospatial Insight.



## ASIA/AUSTRALASIA

Asia and Australasia endured an impactful year for both natural and man-made catastrophes in 2015. Natural disasters included bushfires, tropical cyclones and severe storms in Australia, flooding in India, a severe earthquake in Nepal and one of the most active tropical seasons on record in the Northwest Pacific basin. The leak of oil from the tanker Alyarmouk near the coast of Singapore early in the year and the crash of TransAsia Flight GE235 in Taiwan in February were the key man-made events.

The most impactful event occurred later in the year, on August 12, when two significant explosions occurred at a warehouse in the Port of Tianjin, China, among the largest ports in the world. The port is located about 170 kilometers (103 miles) southeast of Beijing, China. These explosions caused at least 146 fatalities and displaced over 6,300 residents from their homes.

The explosions rendered significant damage to local infrastructure and businesses, tens of thousands of shipping containers and new vehicles, surrounding residential areas and the immediate surroundings. The most severe damage was observed within a two kilometer (approximately 1.2 mile) radius of the explosion site, with buildings damaged as far as 10 kilometers (approximately six miles) away, according to media reports. The explosions also brought concern over several toxic substances, including sodium cyanide, with considerable concern for the local communities. The two explosions were equivalent to the detonation of three metric tons and then 21 metric tons of TNT and were associated with a warehouse fire (owned by a logistics company), which produced several smaller explosions.

The impact of this event on insurers was very complex with reinsurance implications affecting about fifteen companies involving marine, property, automotive, liability and aviation sectors and further effects for Contingent Business Interruption and Business Interruption exposures. Estimated insured losses for the Port of Tianjin explosions range between USD 1.6 and USD 3.3 billion<sup>13</sup>, with an estimate from Swiss Re of at least USD 2 billion.<sup>14</sup> This is likely to constitute one of the largest insured man-made losses to date in Asia.

Earlier in the year, on April 25, Nepal was devastated by a magnitude 7.8 earthquake near Lamjung, about 77 kilometers (approximately 47 miles) northwest of Kathmandu. This has been referred to as the most destructive and deadliest event of the year. Millions were directly affected, with exceptionally severe and widespread damage to homes, communities and infrastructure. The earthquake caused around 9,000 fatalities and left 500,000 homeless. Estimated economic and insured losses for this tragic event are around USD 4.8 billion and USD 210 million, respectively.<sup>15</sup> Our thoughts and concerns are with the millions affected and still recovering from this event.

The magnitude 7.8 earthquake and two major aftershocks that followed occurred in a seismically active region called the Himalayan Thrust Front. This is a region where the India Plate is subducting under the Eurasian Plate and is known as one of the most seismically active regions in the world. The earthquake occurred on or near the main frontal thrust on the subduction zone boundary.

These significant events occurred during a year with the third most active tropical season on record for the Northwest Pacific basin. A total of 16 typhoons reached or exceeded Category 3 strength on the Saffir-Simpson Scale, the most ever seen of any year in the historical record for the Northwest Pacific Basin.<sup>16</sup>

<sup>13</sup>. Guy Carpenter CAT-VIEW<sup>SM</sup> Event Briefing, August, 2015. <sup>14</sup>. Swiss Re Press Release, December 18, 2015. <sup>15</sup>. Munich Re Press Release, January 4, 2016. <sup>16</sup>. Northern Hemisphere Season Review, Phil Klotzbach, Colorado State University, December, 2015.

One of the most notable typhoon events of this active season was Super Typhoon Noul, which impacted the Northern Philippines as a Category 5 on the Saffir-Simpson Scale on May 10. Later in the year, Typhoon Chan-Hom made landfall in Zhoushan, China, near Shanghai, on July 11, bringing very heavy rainfall to Zhejiang, Anhui and Fujian. The heavy rainfall, exceeding 400 millimeters (16 inches) in some areas, caused significant flooding and landslides. Evacuations affected at least 2.8 million people, with destruction of at least 1,000 homes and significant impact on transportation and infrastructure. Estimated insured losses from this event were under CNY 2.25 billion or USD 340 million.<sup>17</sup> Later in the year, Typhoon Nangka made landfall near Muroto City, Japan on July 16.

Super Typhoon Soudelor then made landfall in Hualien County, Taiwan on August 8, with estimated one minute sustained winds of 195 km/hr (approximately 119 mph). Soudelor rendered widespread damage to Taiwan, along with inland flooding and mudslides from excessive rainfall. Local rainfall reports in Taiwan exceeded 1,000 millimeters (40 inches) for some areas. Soudelor made final landfall near Putian City in Mainland China on August 9, bringing heavy rainfall, flooding and mudslides to affected regions including Fujian and Zhejiang Provinces. Transportation and infrastructure were severely affected. Economic losses from Soudelor were estimated around USD 1.4 billion, with insured losses of around USD 120 million.<sup>18</sup>

A short time later, on August 24, Typhoon Goni made landfall on the Japan island of Kyushu as a Category 3 on the Saffir-Simpson scale. In Japan, Goni damaged at least 1,688 homes and buildings with winds and heavy rainfall, prompting evacuations for more than 100,000 residents. Goni also rendered significant impacts to the Northern Mariana Islands, the Philippines, Taiwan and the Ryukyu Islands of Japan.<sup>19 20</sup> Estimated insured losses from Typhoon Goni stand at around USD 1.16 billion.<sup>21</sup>

In early September, ongoing excessive rainfall, combined with the effects of Tropical Storm Etau, brought nearly twice the normal September precipitation to areas of Honshu Province in Japan. Etau crossed the Chita Peninsula on September 9 before passing over Honshu. The excessive rainfall brought flooding and mudslides to affected areas, with especially severe impacts for the Ibaraki and Tochigi prefectures. At least 12,095 buildings were flooded in the Ibaraki Prefecture alone and evacuations affected at least 2.8 million people. The Fukushima Daiichi nuclear power plant was also affected, with contaminated water escaping into the ocean as a result of overwhelmed site drains.<sup>22 23</sup>

Super Typhoon Dujuan then crossed Taiwan as a Category 3 on the Saffir-Simpson scale and then Mainland China as a Category 1 in late September on a very similar track to Soudelor. Once again, areas along the track were affected by excessive rainfall and flooding, with rainfall reports exceeding 900 millimeters (36 inches) in parts of Taiwan and 200 millimeters (8 inches) in areas of Mainland China. Fortunately, Taipei was spared significant wind impacts as the eye moved away from the city and across the mountains of the Taiwan interior.<sup>24 25</sup>

Shortly following Dujuan in early October, Typhoon Mujigae made landfall over Leizhou Peninsula in the southern Guangdong Province as a Category 3 on the Saffir-Simpson scale, with a central pressure of 940 millibars, producing strong winds, flooding and tornadoes. Evacuations affected at least 200,000 people and reports indicate at least six million were affected by the typhoon. At least 26,400 homes were damaged and another 8,800 destroyed, according to reports. The tornadoes rendered especially severe damage to Guangzhou and Foshan. The typhoon also caused significant disruption and damage to transportation and infrastructure. Guangdong suffered severe flooding. Typhoon Mujigae intensified rapidly while crossing the South China Sea prior to landfall. It is possible that this was the strongest October storm to affect Mainland China since 1949.<sup>26 27</sup>

17. AIR Worldwide, Press Release, July, 2015. 18. Munich Re NatCatSERVICE, January 2016. 19. AIR Worldwide, ALERT Report, August 25, 2015. 20. RMS Event Response, September 4, 2015. 21. A.M. Best, December 22, 2015. 22. AIR Worldwide, ALERT Report, September 11, 2015. 23. RMS Event Response, September 29, 2015. 24. AIR Worldwide, ALERT Report, September 30, 2015. 25. RMS Event Response, September 30, 2015. 26. AIR Worldwide, ALERT Report, October 8, 2015. 27. RMS Event Response, October 9, 2015.



In mid-October, Super Typhoon Koppu made landfall in Aurora Province in the Philippines. Koppu underwent a period of rapid intensification prior to landfall, making landfall as a Category 4 on the Saffir-Simpson scale. Koppu was a slow-moving storm, bringing heavy rainfall for an extended period of time with isolated amounts exceeding 1,000 millimeters (40 inches). Koppu produced extensive flooding and severely disrupted the transportation infrastructure in affected areas, damaging at least 113,000 homes. Fortunately, the heavily populated Manila area was spared the most significant impacts.<sup>28 29</sup>

The Philippines suffered yet another typhoon landfall in December 2015 with Super Typhoon Melor, a Category 4 on the Saffir-Simpson scale. Melor made landfall over the northern area of Northern Samar Province on December 14 before crossing the central Philippines. Melor brought another round of heavy rainfall and flooding to affected areas, forcing evacuation of at least 720,000 people in Bicol Province and damaging at least 279,480 houses.<sup>30 31</sup>

Super Typhoon Melor was the final typhoon of an exceptionally active 2015 tropical season in the West Pacific, with a record number of tropical systems exceeding Category 3 status on the Saffir-Simpson scale. This historic season was associated in part with one of the strongest El Niño seasons in history for the tropical East-Pacific Ocean. The season brought multiple, impactful typhoon landfalls to affect Japan, Mainland China, the Philippines and Taiwan.

In addition to an exceptionally active 2015 tropical season, heavy rainfall and flooding affected areas including China, Japan and India. Beginning in mid-May, the southeast area of Mainland China was impacted by heavy monsoon rainfall, bringing flooding, landslides and mudslides to areas including Fujian, Guangdong, Guansi, Hunan, Jiangxi and Guizhou provinces. Severe damage was rendered to property and crops and 8,600 homes were destroyed.<sup>32</sup> The heavy monsoon rains brought flooding to areas of the Yangtze River. In late June, ongoing, heavy monsoon rains caused further flooding and mudslides in central and eastern areas of Mainland China, damaging 64,300 homes and destroying another 6,200.<sup>33</sup>

Later in the year, in Chennai, India, over 1,000 millimeters (40 inches) of rainfall was measured in the month of November. This is the second-highest November rainfall for the area since 1918. In December, after even more rainfall, Chennai experienced the highest 24-hour rainfall total of any December day in history. The resulting flooding in Chennai City was described as the worst in a century in an area with the fourth-largest economy in India, with auto and high-tech manufacturing, banking and finance, software services, petrochemical facilities and manufacturing. The floods damaged personal property, infrastructure and public facilities, with transportation disruption and business interruption. At least 57,000 homes suffered structural damage. The rail infrastructure in the area suffered especially severe damage and the Chennai Airport experienced extensive flooding. Agriculture was especially hard hit with economic losses estimated to be on the order of USD 1.5 billion to USD 2.25 billion. It will take time for the full scope and severity of this event to become clear. However, initial estimates are that economic and insured losses may exceed USD 7.5 billion and USD 375 million, respectively.<sup>34 35</sup> The excessive rainfall was associated in part with the strong El Niño, a strong positive phase of the Indian Ocean Dipole and their influence on the northeast monsoon that affects South India in November and December.

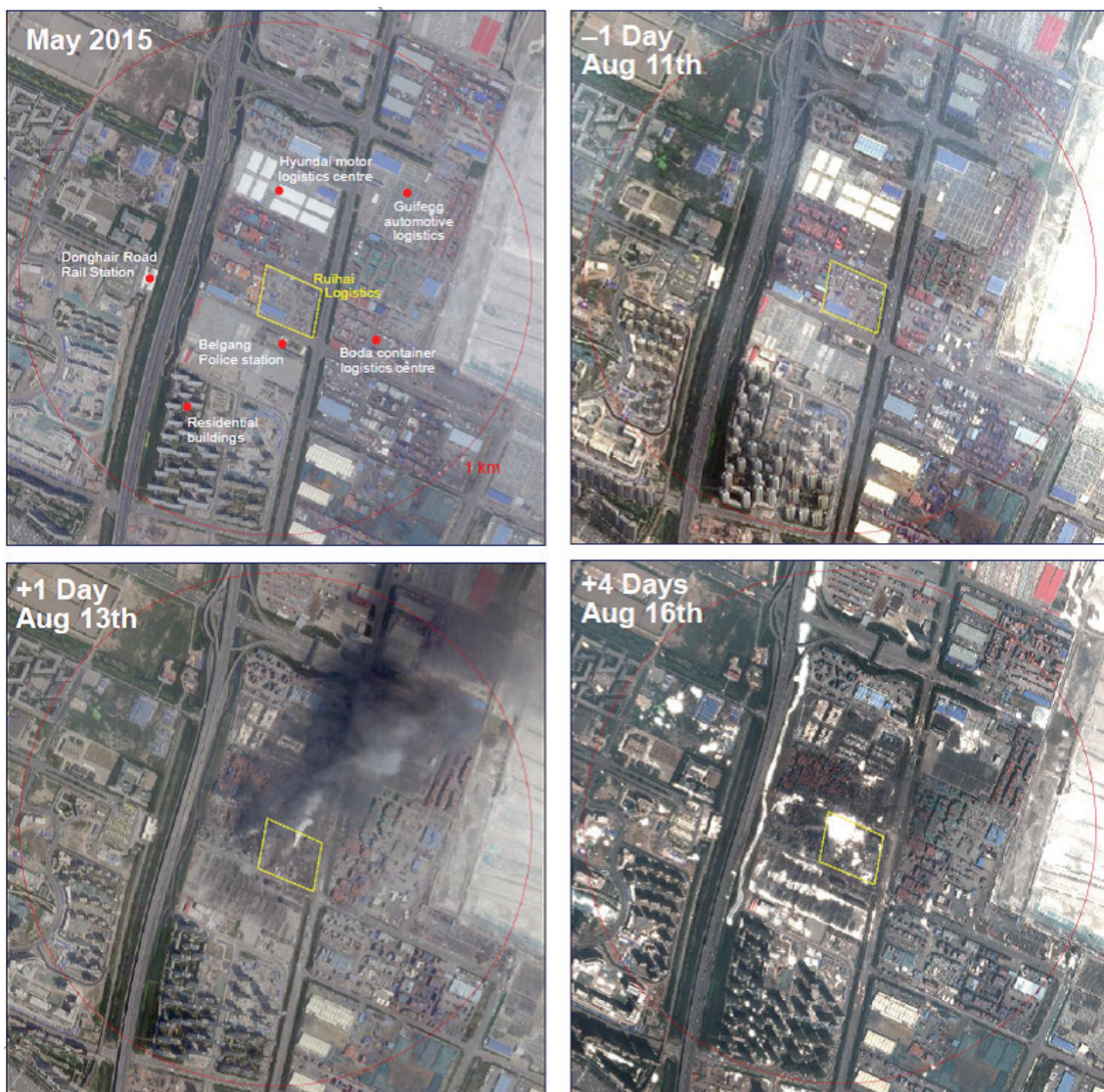
Natural disasters affecting Australia in 2015 began with a bushfire in South Australia in January. Shortly thereafter, on February 19, Severe Tropical Cyclone Marcia made landfall near Shoalwater Bay on the Queensland coast of Australia, equivalent to a Category 4 on the Saffir-Simpson Scale.<sup>36</sup> Marcia prompted evacuations and caused property damage in Queensland with estimated insured losses exceeding USD 359 million.<sup>37</sup> Simultaneously,

**28.** AIR Worldwide, ALERT Report, October 19, 2015. **29.** RMS Event Response, October 27, 2015. **30.** AIR Worldwide, ALERT Report, December 16, 2015. **31.** RMS Event Response, December 23, 2015. **32.** RMS Event Response, May 22, 2015. **33.** RMS Event Response, June 30, 2015. **34.** Flooding in Chennai, India, Guy Carpenter, December, 2015. **35.** RMS Event Response, December 10, 2015. **36.** RMS Event Response, February 25, 2015. **37.** Insurance Council of Australia Media Release, June 2, 2015.

Severe Tropical Cyclone Lam made landfall over the sparsely populated Gove Peninsula in the Northern Territory of Australia.<sup>38</sup> In April and May, a series of severe storms affected eastern Australia, including the New South Wales storm of April 21 and the April 25 hailstorm affecting Sydney. This succession of storms produced estimated insured losses in excess of USD 1.08 billion.<sup>39</sup>

Further north in the South Pacific, Severe Tropical Cyclone Pam caused exceptionally severe damage to Vanuatu in March. Estimates indicate about 14,000 homes were damaged or destroyed during the event, with significant disruption to local infrastructure including drinking water and food supply.

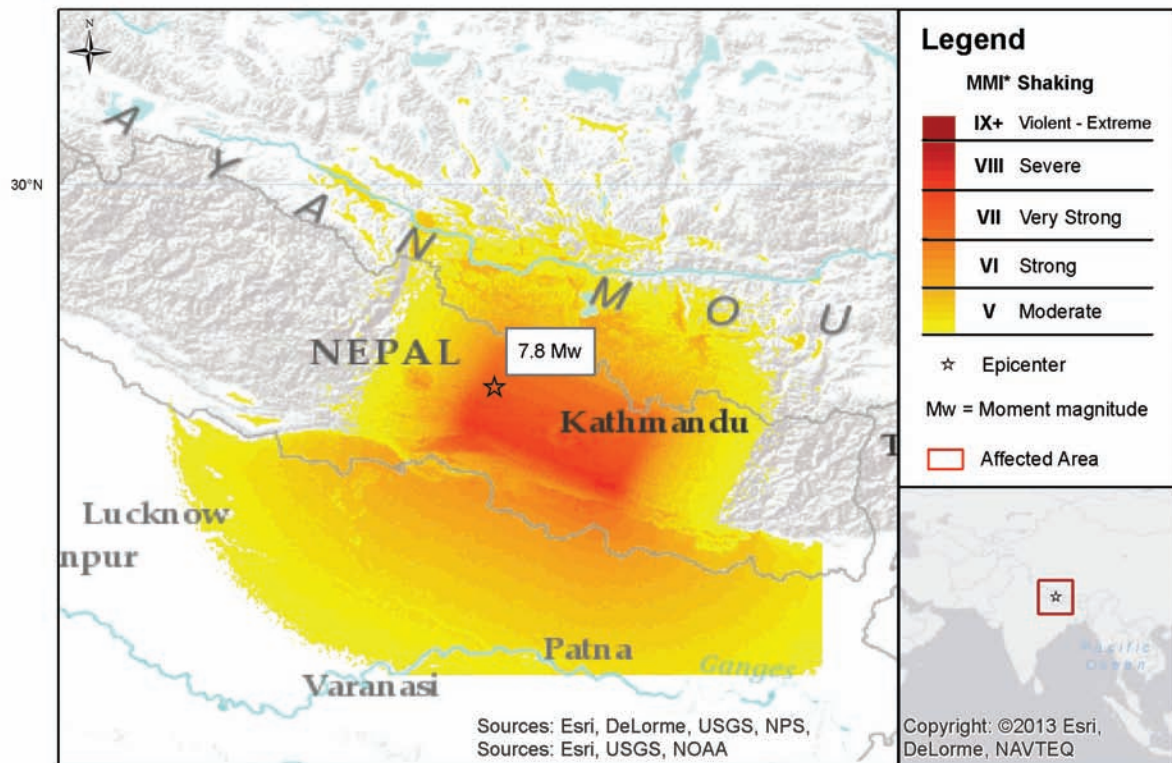
## F-6 | SATELLITE IMAGERY TIMELINE OF THE PORT OF TIANJIN EXPLOSION



SOURCE: GC CAT-VIEW<sup>SM</sup> report, developed with satellite data from Pleiades/SPOT-7 Airbus Defense & Space, Skybox/Google.



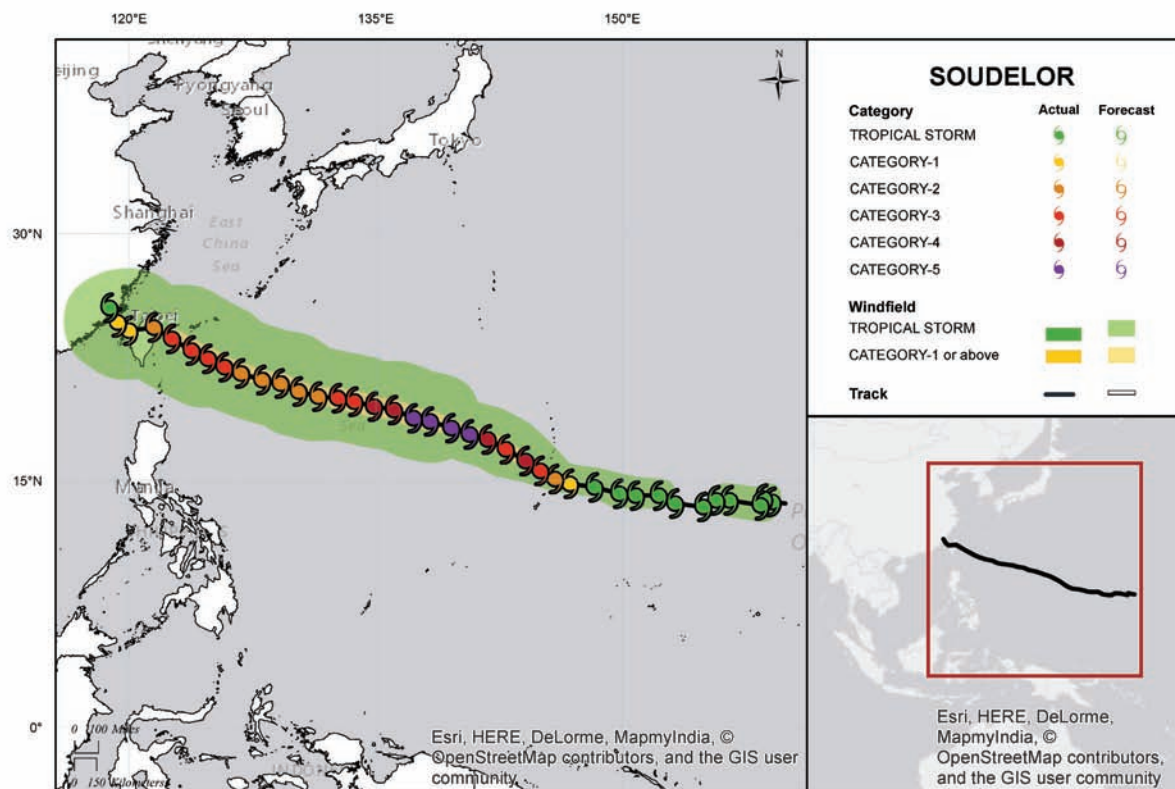
## F-7 | MMI INTENSITY MAP, NEPAL EARTHQUAKE, APRIL 2015



\* Modified Mercalli intensity (MMI) measures the perceived strength of shaking produced by the earthquake at a certain location. for more information on MMI scale see [www.earthquake.usgs.gov/learning/topics/mercalli.php](http://www.earthquake.usgs.gov/learning/topics/mercalli.php)

SOURCE: Guy Carpenter, USGS.

## F-8 | TRACK OF TYPHOON SOUDELOR



SOURCE: Guy Carpenter, Joint Typhoon Warning Center.



## THE AMERICAS

Impacts to oil refineries, a significant earthquake in Chile and notable flood and severe convective events in the United States all occurred in 2015. The 2015 winter was one of the coldest on record for much of the northeastern United States. During the summer months, the strong El Niño impeded North Atlantic tropical activity, but was associated with an exceptionally active North Pacific Ocean, producing the strongest tropical cyclone on record for the Western Hemisphere.

Man-made events affecting the Americas involved the oil industry, including an oil spill in June causing several beach closures in Los Angeles and in early May, the Chevron Big Foot project in the Gulf of Mexico suffered setbacks when some of the platform tethering cables sank. More notable events included a February explosion on an offshore oil rig near Brazil. This was followed by a separate explosion in April on a Mexican oil rig also located in the Gulf of Mexico incurring estimated losses of USD 780 million.<sup>40</sup> Other notable events were the loss of a Mexican satellite mission in May and the NASA SpaceX Falcon 9 rocket, resulting in the loss of USD 110 million in equipment.<sup>41</sup> Meanwhile, the sinking of the El Faro cargo ship in the Bahamas during Hurricane Joaquin resulted in 33 fatalities and the loss of cargo.<sup>42</sup>

Natural catastrophes of 2015 were relatively light for Canada, following prior years of flooding and severe thunderstorm events. Nevertheless, the 2015 season saw an impactful drought affecting Canadian agriculture, along with several notable wildfires. Key events also include two important severe thunderstorm events in the third quarter resulting in estimated insured losses of around CDN 340 million or USD 235 million.<sup>43</sup>

Meanwhile in Chile, heavy rainfall in normally dry northern areas of Antofagasta, Atacama and Coquimbo caused significant flash flooding. The heavy rains were the result of a cut-off low and robust moisture feed, in part related to the onset of El Niño conditions in the tropical east Pacific Ocean. Nearly 11,000 people were displaced as a result of the floods with significant damage to property and infrastructure. The floods caused estimated insured losses of around USD 512 million.<sup>44 45</sup>

Later in September, a magnitude 8.3 earthquake struck west of Illapel and near the coast of Coquimbo, followed by dozens of aftershocks. The earthquake and resulting tsunami forced at least one million people to evacuate their homes and power loss affected at least 240,000. Some flooding occurred in nearby coastal towns. The quake occurred along the subduction zone between the Nazca and South American plates. Initial estimated insured losses for this event range from USD 600 million to USD 900 million.<sup>46</sup>

Among the most extreme natural perils of 2015 was winter storm. From late January to early March, frequent severe arctic cold fronts affected the northeastern United States and Canada. The frontal boundary between this arctic cold air and warmer air from the Gulf of Mexico and Atlantic Ocean enabled the frequent development of low pressure systems. Some of these low pressure systems intensified rapidly upon reaching the Atlantic, bringing especially severe winter conditions to the Northeast.

The winter of 2015 broke many records, with repeated outbreaks of severe arctic cold bringing the coldest month on record for Bangor, Maine; Buffalo, New York and Worcester, Massachusetts. The coldest February on record was observed in Caribou, Maine; Cleveland, Ohio; Chicago, Illinois; Hartford, Connecticut and

40. Reuters, April 28, 2015. 41. Agence France Presse, July 20, 2015. 42. Agence France Presse, November 16, 2015. 43. Canadian Underwriter, October 21, 2015. 44. RMS Event Response, March 30, 2015. 45. Munich Re NatCatSERVICE, July, 2015. 46. AIR Worldwide, ALERT Report, September 21, 2015.

Harrisburg, Pennsylvania. A significant snowpack developed for much of the Northeast with an all-time seasonal snowfall record for Boston, Massachusetts. The snowpack was maintained in part because of persistent cold temperatures from late January through early March.

Several of the winter storms were quite impactful, causing power outages, some structural damage and significant transportation disruption. In New York City, the subway system was shut down completely in preparation for the January blizzard, the first time in its 110 year history.<sup>47</sup> The significant snowpack resulted in roof collapse and significant ice damming issues for many Northeast interests. Structures with old or flat roofs also faced higher risk of roof collapse, especially after the mid-February snowstorm. Ice damming and roof collapse were key impacts affecting the industry, together with pipe freeze, power outages and auto issues. Estimated insured losses from the U.S. winter storms of 2015 were around USD 2.1 billion.<sup>48</sup>

Following the impactful winter weather of 2015, a persistent weather pattern produced heavy rainfall events across the Southern Plains states. On a statewide basis, Oklahoma, Colorado and Texas saw the highest May rainfall over 121 years of recorded history, leading to especially severe and historic flooding. The storm systems also produced tornadoes, hail and damaging wind gusts for several areas. The floods caused extensive property damage and forced evacuations of affected areas, rendering over USD 412 million in losses to the U.S. National Flood Insurance Program.<sup>49</sup>

Later in October, a frontal system over the southeast United States, together with available moisture from the distant Hurricane Joaquin, brought significant rainfall to the Carolinas. The resulting floods were especially severe, particularly for the Congaree River near Columbia, South Carolina. Media reports indicated that 13 dams failed during this event. Later in October, persistent onshore winds together with spring tides caused coastal flooding for areas including South Carolina and Georgia. Tidal levels peaked at 8.68 feet (above mean lower low water) in Charleston Harbor and 10.43 feet near Savannah, Georgia, according to the U.S. National Weather Service.

In contrast to these notable floods, the 2015 summer saw record U.S. wildfire activity, with over 10.12 million acres burned, surpassing the prior 2006 record of 9.87 million acres burned.<sup>50</sup> Nine of the ten worst wildfire seasons in terms of acres burned, have occurred between 2000 and 2015. The 2015 wildfire season set record suppression costs exceeding USD 2.1 billion, passing the inflation-adjusted USD 2.0 billion of the 2006 wildfire season.<sup>51</sup>

The severe wildfire season was related in part to a strong ridge of high pressure that maintained very hot and dry conditions in the western United States. This came after an exceptionally warm and dry winter in western areas left reduced snow packs. Large areas from Montana to California were under extreme to exceptional drought, amplifying the wildfire threat during the summer of 2015. Some of the most impactful wildfires were the California Valley and Butte fires, collectively burning at least 2,775 structures and claiming over 146,900 acres. Meanwhile, the Okanogan complex in the state of Washington grew to the largest wildfire complex in that state's history. Estimated insured losses for U.S. wildfire activity stand at about USD 960 million.<sup>52</sup> Winter rains associated with the strong El Niño have since helped to offset the dry conditions in the western United States.

<sup>47</sup>. New York Times, January 28, 2015. <sup>48</sup>. Munich Re Press Release, January 4, 2016. <sup>49</sup>. Significant Flood Events, [www.fema.gov](http://www.fema.gov). <sup>50</sup>. National Interagency Fire Center. <sup>51</sup>. National Interagency Fire Center. <sup>52</sup>. Munich Re NatCatSERVICE, January, 2016.

The onset of the strong El Niño earlier in the year influenced the 2015 tropical season to a great degree. As with typical El Niño years, wind shear was elevated in the Atlantic basin, and to record levels in 2015. This had the effect of disrupting tropical cyclone development. However, in the East and Central Pacific basins, enhanced enabling conditions produced record-setting tropical cyclone activity.

The Tropical Atlantic basin saw 11 named storms, four hurricanes, and two major hurricanes (Category 3 or higher on the Saffir-Simpson Scale). One of the most notable of these was Hurricane Joaquin, which rendered significant impacts to parts of the Bahamas. The 2015 season is the tenth season without a major hurricane landfall in the United States and the tenth season without a Florida hurricane landfall, both the first such periods in recorded history.

Meanwhile, the Tropical North Pacific basin, including the East, Central and West Pacific basins, saw the most active season in the historical record, surpassing the exceptional 1992 season. The 2015 tropical season produced 27 major hurricanes, surpassing the 21 major hurricanes seen in 1992.

The Northeast Pacific basin saw its second-highest activity on record, only barely surpassed by the exceptionally active 1992 season. The 2015 season produced 11 major hurricanes, compared to 10 in 1992. The strongest of these, Hurricane Patricia, was the strongest hurricane in observed history for the Western Hemisphere, with maximum sustained winds of 215 mph and a central pressure of 872 millibars.<sup>53 54</sup> While areas immediately adjacent to the landfall point suffered especially severe devastation, these areas were relatively sparsely populated. Patricia made landfall between the two major coastal cities of Puerto Vallarta and Manzanillo, Mexico and also missed a direct hit over the major city of Guadalajara. Estimated insured losses were not expected to exceed USD 200 million for this event.<sup>55</sup>

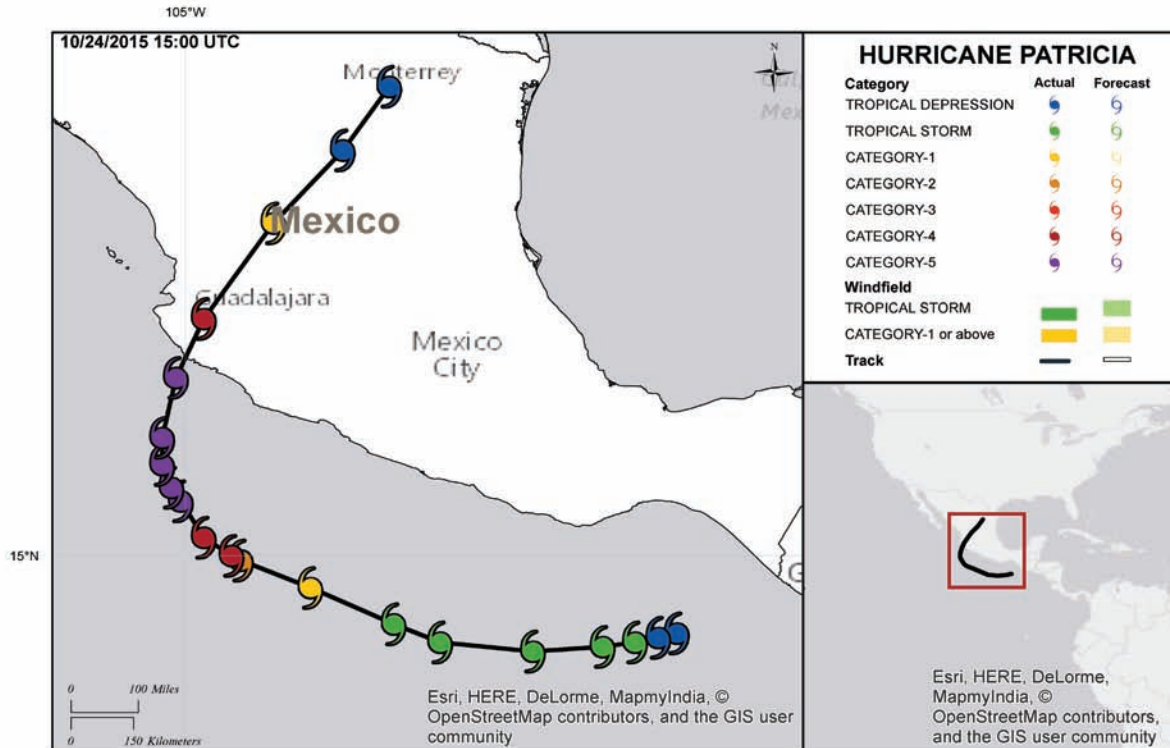
For the 2015 severe convective season, tornado and hail reports fell below the 2005-2014 average for the United States.<sup>56</sup> Nevertheless, two notable severe thunderstorm events in late May and early July produced insured losses together of around USD 2.6 billion.<sup>57</sup>

The year closed with a complex frontal system affecting areas from the U.S. Southwest to the Great Lakes to the Northeast, in late December. Nearly 40 inches of snow fell in New Mexico. A period of heavy, persistent rainfall affected the Central Mississippi Valley, with three-day accumulations surpassing 12 inches. The heavy rains produced significant floods on the Mississippi, Illinois and Arkansas Rivers, together with many tributaries. Thousands of homes and businesses suffered flooding as a result. Severe thunderstorms also produced tornadoes from North Texas to Mississippi. National Weather Service ground surveys confirmed an EF-4 tornado affecting Dallas and Rockwall Counties and another EF-2 tornado in Collin County, causing several fatalities and extensive structural damage.

<sup>53</sup>. Northern Hemisphere Season Review, Phil Klotzbach, Colorado State University, December, 2015. <sup>54</sup>. Hurricane Patricia Tropical Cyclone Report (EP202015), National Hurricane Center, 2016. <sup>55</sup>. AIR Worldwide, ALERT Report, October 25, 2015. <sup>56</sup>. U.S. Storm Prediction Center. <sup>57</sup>. Munich Re, NatCatSERVICE, January, 2016.

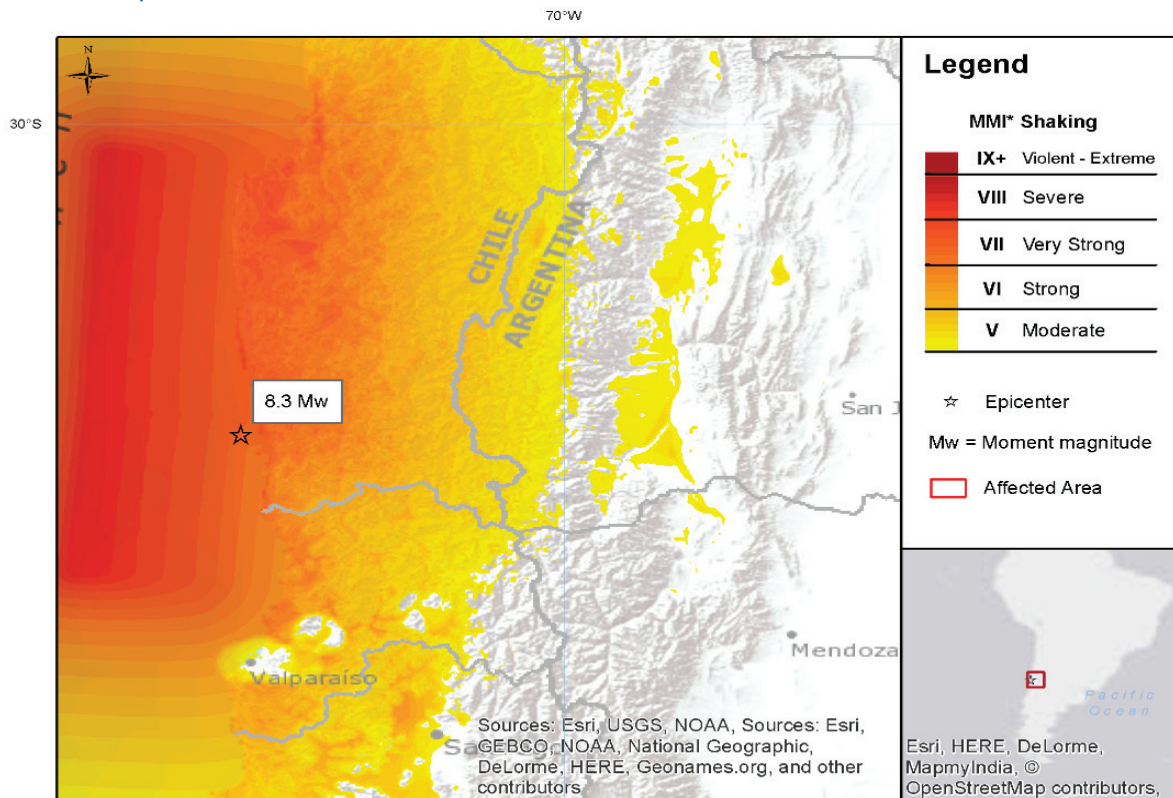


## F-9 | HURRICANE PATRICIA TRACK



SOURCE: Guy Carpenter, National Hurricane Center.

## F-10 | MMI INTENSITY MAP, CHILE EARTHQUAKE, SEPTEMBER 2015



\*Modified Mercalli Intensity (MMI) measures the perceived strength of shaking produced by the earthquake at a certain location. For more information on the MMI scale please see [www.earthquake.usgs.gov/learning/topics/mercalli.php](http://www.earthquake.usgs.gov/learning/topics/mercalli.php).

SOURCE: Guy Carpenter, USGS.

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