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sigma

Natural catastrophes and man-made disasters in 2016:
a year of widespread damages

Executive summary

There were a number of expansive disaster events in 2016 …

In terms of devastation wreaked, there were a number of large-scale disasters across the world in 2016, including earthquakes in Japan, Ecuador, Tanzania, Italy and New Zealand. There were also a number of severe floods in the US and across Europe and Asia, and a record high number of weather events in the US. The strongest was Hurricane Matthew, which became the first Category 5 storm to form over the North Atlantic since 2007, and which caused the largest loss of life – more than 700 victims, mostly in Haiti – of a single event in the year. Another expansive, and expensive, disaster was the wildfire that spread through Alberta and Saskatchewan in Canada from May to July.

… leading to the highest level of overall losses since 2012.

In total, in *sigma* criteria terms, there were 327 disaster events in 2016, of which 191 were natural catastrophes and 136 were man-made. Globally, approximately 11 000 people lost their lives or went missing in disasters. At USD 175 billion, total economic losses[1] from disasters in 2016 were the highest since 2012, and a significant increase from USD 94 billion in 2015. As in the previous four years, Asia was hardest hit. The earthquake that hit Japan's Kyushu Island inflicted the heaviest economic losses, estimated to be between USD 25 billion and USD 30 billion.

Insured losses from catastrophes were USD 54 billion, meaning many thousands caught in a disaster were better able to recover from the losses and hardships inflicted.

Global insured losses from catastrophes were also the highest since 2012, at around USD 54 billion in 2016, up from USD 38 billion in 2015. The implication of the increase is that many tens of thousands of policyholders in disaster events benefitted from having insurance cover in place, to receive speedy indemnification for their property losses, get their businesses back up and running quickly, and mitigate other economic and humanitarian hardships. For example, the wildfires in Canada devastated many homes and around 88 000 people were evacuated. In response, once the evacuation order was lifted, insurance personnel were given access to the affected regions to provide immediate assistance to returning residents. The outcome was that 68% of all personal property claims had been settled by the end of the year.[2] Another example was Hurricane Matthew, where a USD 23.4 million payout from the Caribbean Catastrophe Risk Insurance Facility to Haiti meant that thousands of displaced persons received food and shelter, and the authorities were able to buy medications.[3] A testimony to the positive impact of public/private partnership in insurance.

Nevertheless, the global catastrophe protection gap remains substantial.

However, insurance cover is not universal. There was an all-peril global catastrophe protection gap of USD 121 billion in 2016. So while a high-level of insurance penetration in New Zealand meant that households and business were well equipped to recover from the damage caused by the quake that struck the South Island in October 2016, less than 20% (USD 4.9 billion) of the economic losses resulting from the earthquake in Kyushu Island were covered by insurance. And in Ecuador, the quake on the same day as the one in Japan caused estimated economic losses of USD 4 billion and insured losses of just USD 0.5 billion, a coverage schism of USD 3.5 billion, or 88%.

This *sigma* includes a feature on underinsurance of flood risk in the US.

2016 was also a year of many severe precipitation events globally which in turn triggered major flooding over large areas. The US experienced multiple severe floods throughout the year, with Louisiana worst hit. In China there was extensive flooding along the Yangtze River basin in July. In view of the year's many damaging floods, this *sigma* assesses the flood protection gap in the US. Increased wealth and larger populations have elevated society's exposure to flood risk everywhere in the world, including the US. Today the majority of US flood coverage comes from the National Flood Insurance Program (NFIP), but the flood protection gap of around USD 10 billion annually shows that even the US remains critically under-insured for flood risk.

[1] From hereon, "total economic losses" expressed as "economic losses".
[2] Value taken from CatIQ data set.
[3] *Government of Haiti helps 1.4 million persons affected by Hurricane Matthew with CCRIF's Payouts*, CCRIF SPC, 7 November 2016, http://www.ccrif.org/news/government-haiti-helps-14-million-persons-affected-hurricane-matthew-ccrif-payouts

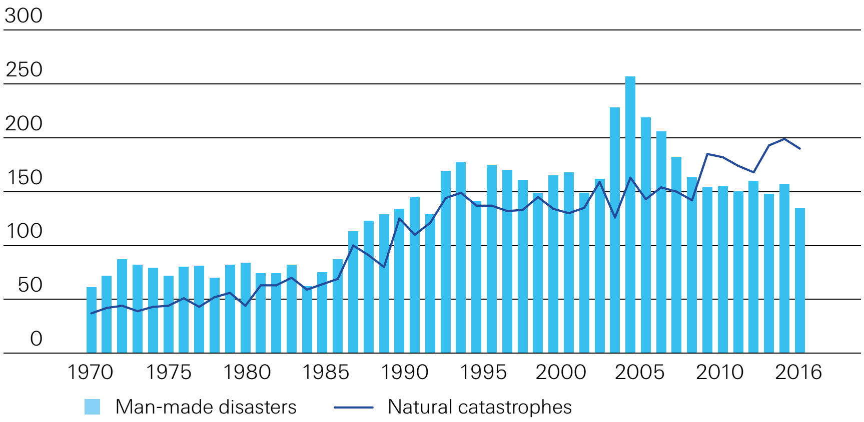
Catastrophes in 2016: global overview

Number of events: 327

There were 191 natural and 136 man-made disasters in 2016.

In *sigma* criteria terms, there were 327 catastrophes worldwide in 2016, down from 356 in 2015. There were 191 were natural catastrophes compared with 199 in 2015, and 136 man-made disasters (down from 157).

Figure 1
Number of catastrophic events, 1970–2016



Source: Cat Perils and Swiss Re Institute.

The *sigma* event selection criteria.

To classify as a catastrophe according to *sigma* criteria, an event must lead to economic losses, insured claims or casualties in excess of the thresholds detailed in Table 1.

Table 1
The *sigma* event selection criteria for 2016

Insured losses (claims)		
	Maritime disasters	USD 19.9 million
	Aviation	USD 39.8 million
	Other losses	USD 49.5 million
or Total economic losses		USD 99.0 million
or Casualties		
	Dead or missing	20
	Injured	50
	Homeless	2000

Source: Cat Perils and Swiss Re Institute.

Number of victims: approximately 11 000

Approximately 7000 people died or went missing in natural catastrophes ...

Approximately 11 000 people lost their lives or went missing in natural and man-made disasters in 2016. That was lower than in 2015 and one of the lowest recorded in a single year. There were approximately 7000 victims in natural catastrophes. Hurricane Matthew in Haiti and the earthquake that struck Ecuador in April claimed most lives, and a number of people also died in heat waves and floods in other countries.

... and around 4000 perished in man-made disasters.

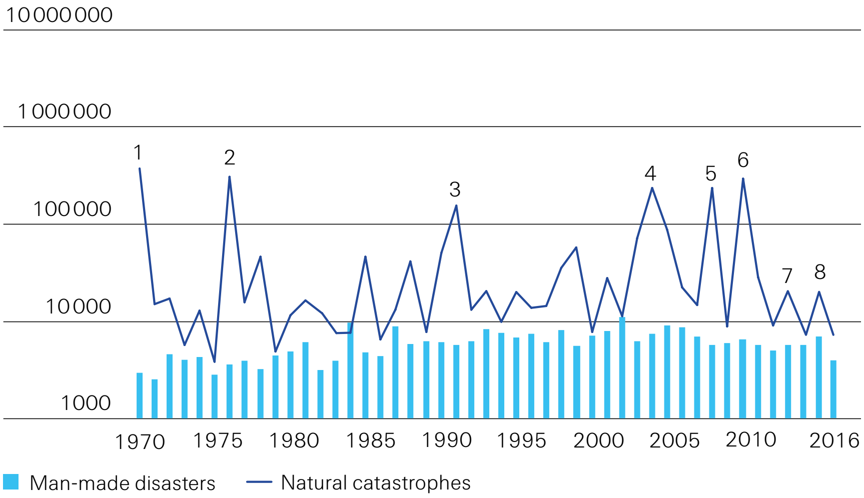
There were roughly 4000 deaths in man-made disasters in 2016, compared with around 7000 in 2015. A boat carrying migrants sank off the coast of Crete on 3 June 2016, an accident in which 358 perished. The total number of reported deaths in maritime disasters fell to 1596 from 2487 in 2015, but many more are believed to have died in unreported incidents of boats carrying migrants sinking.

Airplane crashes and other man-made disasters claimed many victims.

Other man-made events taking many lives included the collapse of a church roof in Nigeria, killing 160 people. In aviation disasters, 384 people died compared with 685 in 2015, with most of the fatalities in two plane crashes. In November, a jet travelling to Medellín in Colombia crashed after running out of fuel, killing 71. And on Christmas Day, an aircraft crashed shortly after take-off from Adler in Russia, killing 92. There were also 766 deaths in major fire and explosion events in 2016.

Figure 2
Number of victims, 1970–2016

1 1970: Bangladesh storm
2 1976: Tangshan earthquake, China
3 1991: Cyclone Gorky, Bangladesh
4 2004: Indian Ocean earthquake and tsunami
5 2008: Cyclone Nargis, Myanmar
6 2010: Haiti earthquake
7 2013: Typhoon Haiyan, Philippines
8 2015: Earthquake in Nepal



Note: Scale is logarithmic: the number of victims increases tenfold per band.
Source: Cat Perils and Swiss Re Institute.

Total economic losses: USD 175 billion

Economic losses in 2016 in line with the 10-year average.

Economic losses from natural catastrophes and man-made disasters across the world were an estimated USD 175 billion in 2016. This was almost double than in 2015 (USD 94 billion), and in line with the inflation-adjusted average of USD 175 billion of the previous 10 years. Catastrophe losses in 2016 were 0.24% of global gross domestic product (GDP), again in line with the 10-year average.

Global natural catastrophe-related losses were around USD 166 billion.

Natural catastrophe-related economic losses were around USD 166 billion in 2016, coming mostly from earthquakes, tropical cyclones, other severe storms and droughts in Asia, North America and Europe. Man-made disasters are estimated to have caused USD 9 billion of the economic losses, down from USD 12 billion in 2015.

Table 2
Economic losses in USD billion and as a % of global GDP, 2016

Regions	USD bn*	% of GDP
North America	59	0.29%
Latin America & Caribbean	6	0.14%
Europe	16	0.08%
Africa	3	0.14%
Asia	83	0.32%
Oceania/Australia	6	0.45%
Seas / space	1	
Total	**175**	
World total		**0.24%**
10-year average **	175	0.24%

* rounded
** inflation adjusted
Source: Swiss Re Institute.

Insured losses: USD 54 billion

Insured losses from natural hazards and man-made disasters were in line with the 10-year annual average …

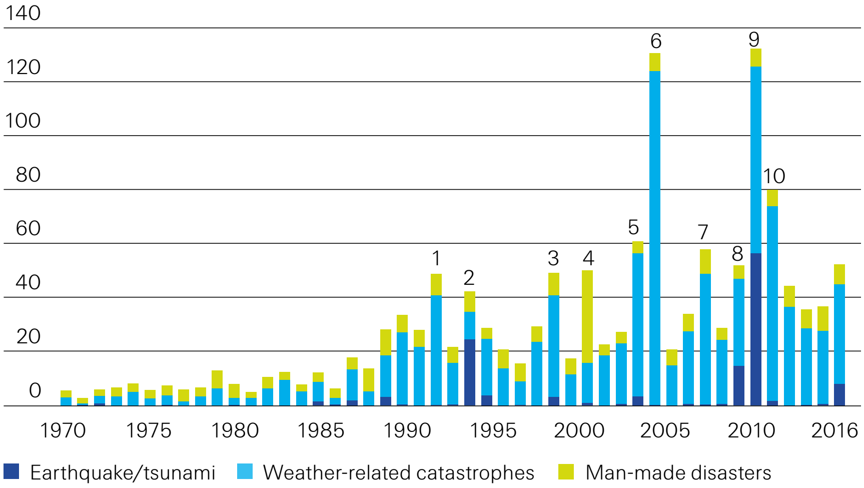
The insurance industry covered close to USD 54 billion – less than one third – of the economic losses from natural and man-made disasters in 2016, up from USD 38 billion in 2015 and in line with the inflation-adjusted annual average of the previous 10 years (USD 53 billion). Natural catastrophes resulted in claims of USD 46 billion, the same as the previous 10-year annual average. Insured losses from man-made disasters were USD 8 billion, down from USD 10 billion in 2015.

… and equivalent to 0.07% of GDP.

The natural catastrophe-associated insured losses were 0.06% of world GDP in 2016 and 2.9% of global property direct premiums written (DPW), in line with the respective 10-year annual averages. Overall insured losses from natural catastrophes and man-made disasters were 0.07% of GDP and 3.4% of DPW.

Figure 3
Insured catastrophe losses 1970–2016 in USD billion, at 2016 prices

1 1992: Hurricane Andrew
2 1994: Northridge earthquake
3 1999: Winter Storm Lothar
4 2001: 9/11 attacks
5 2004: Hurricanes Ivan, Charley, Frances
6 2005: Hurricanes Katrina, Rita, Wilma
7 2008: Hurricanes Ike, Gustav
8 2010: Chile, New Zealand earthquakes
9 2011: Japan, New Zealand earthquakes, Thailand flood
10 2012: Hurricane Sandy



Source: Cat Perils and Swiss Re Institute.

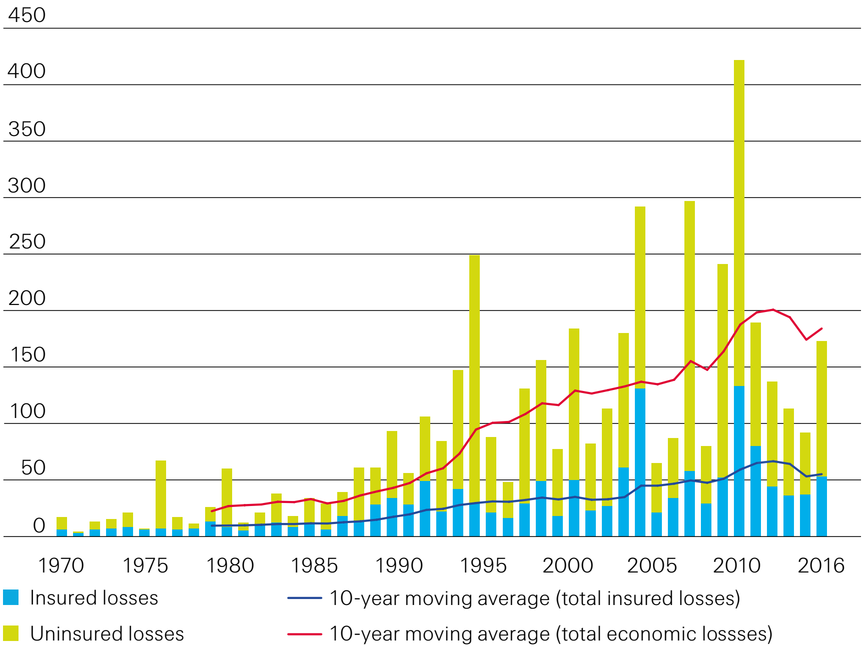
The largest single insurance-loss event of 2016 was the earthquake in Japan in April.

The largest insurance loss event globally in 2016 was the earthquake in Japan in April, which triggered claims of USD 4.9 billion. The second costliest was Hurricane Matthew in the US and the Caribbean, which resulted in insured losses of USD 4 billion. Twelve disasters triggered insured claims of USD 1 billion or more in 2016 (see Table 7), up from six such events in 2015.

The global insurance protection gap was USD 121 billion in 2016.

Figure 4 shows the difference between insured and economic losses over time, termed the insurance protection gap. It is the amount of financial loss generated by catastrophes not covered by insurance. In 2016, the global protection gap was approximately USD 121 billion. The rate of growth of economic losses has outpaced the growth of insured losses over the last 25 years. In terms of 10-year rolling averages, insured losses grew by 4.6% between 1991 and 2016, and economic losses by 5.6%.

Figure 4
Insured vs uninsured losses 1970–2016
in USD billion, at 2016 prices



Economic losses = insured + uninsured losses
Source: Cat Perils and Swiss Re Institute.

Regional overview

By region, insured losses were highest in North America in 2016.

Earthquakes, tropical cyclones and other storms in many parts of the world caused the highest insured losses in 2016. In Asia, the earthquake in Japan in April led to the biggest losses in the region, in both economic and insured loss terms. In the US, Hurricane Matthew and flooding in Louisiana caused the largest economic losses.

Table 3
Number of events, victims, economic and insured losses by region, 2016

				Insured losses		Economic losses	
Region	**Number**	**Victims**	**in %**	**in USD bn**	**in %**	**in USD bn**	**in %**
North America	66	1005	9.2%	30.4	56.6%	59.5	34.1%
Latin America & Caribbean	22	1009	9.3%	1.4	2.5%	6.4	3.7%
Europe	51	1509	13.8%	7.5	14.0%	15.5	8.9%
Africa	44	1761	16.2%	1.7	3.2%	3.0	1.7%
Asia	128	5309	48.7%	8.8	16.4%	83.0	47.6%
Oceania/Australia	7	52	0.5%	3.4	6.4%	6.4	3.6%
Seas / space	9	253	2.3%	0.5	0.9%	0.8	0.4%
World*	**327**	**10898**	**100.0%**	**54**	**100.0%**	**175**	**100.0%**

*Includes some rounded totals.
Source: Cat Perils and Swiss Re Institute.

North America

Severe weather, floods and wildfires caused most losses.

In North America, insured losses from disaster events were USD 30 billion in 2016, the highest of all regions. Most of the losses came from hurricanes, hailstorms, thunderstorms and severe flood events in the US. In Canada, wildfires from May to July caused the highest insured losses ever recorded there.

The number of storms in the North Atlantic hurricane season was above the long-term average.

The 2016 North Atlantic hurricane season produced 15 named storms (11 in 2015), seven of which became hurricanes (four in 2015) and three were "major" hurricanes (Category 3 or stronger on the Saffir-Simpson scale). Hurricane Hermine in early September was the first to make landfall in Florida since Wilma in 2005, coming in at Category 1. Later that same month, Hurricane Matthew, the strongest of the season, became the first Category 5 storm to form over the North Atlantic since Hurricane Felix in 2007. Hurricane Matthew hit Haiti as Category 4 but by the time it made US landfall in South Carolina, it had weakened to Category 1. Last year continued the decade-long stretch of no "major" hurricanes making US landfall, the longest since the 1860s.

Hurricane Matthew brought wind and flood damage to southeast US.

Hurricane Matthew and resulting storm surge caused wind and flood damage, beach erosion and infrastructure damage in Florida through North Carolina. Long after moving in from the eastern seaboard, moisture from record sea surface temperatures and associated storms brought downpours and inland flooding in the Carolinas, Georgia and Virginia, leading to heavy damage to agriculture. Economic losses from Matthew in the US and the Caribbean were approximately USD 12 billion, of which about USD 4 billion were insured. It could have been worse if, at Category 4, the centre of the storm had not stayed offshore. But if the US was spared the worst, the Caribbean was not. The Category 4 winds that hit Haiti caused devastation and took many lives there, and also in Cuba and the Bahamas.

Moisture from the Gulf of Mexico triggered pluvial flooding in Louisiana.

In mid-August, moisture from the Gulf of Mexico brought record precipitation over the Amite and Comite rivers basins, triggering major flooding particularly in the region of Baton Rouge, the capital of the State of Louisiana. More than 30000 people had to be rescued from floodwaters and, at the height of the flood, 100000 people were displaced. Sadly, 13 people died. As water receded, 50000 houses, 20000 vehicles and 20000 businesses were left damaged or destroyed, leading to estimated economic losses of USD 10 billion. The insured losses, however, were USD 3.1 billion, evidence of a large flood protection gap.

Tornado activity was below average, while insured losses from severe convective storms were above usual.

According to a preliminary count from the Storm Prediction Centre of the National Oceanic and Atmospheric Administration (NOAA), there were 1060 tornadoes in the US in 2016, below the annual average of 1221 of the Doppler radar era. Nevertheless, insured losses from tornado outbreaks and thunderstorms (severe convective storms) reached an estimated USD 15 billion, higher than in 2015 (USD 9.7 billion) and also higher than the previous 10-year annual average of USD 12.6 billion. In the spring, two severe hailstorms in Texas led to combined insured losses of about USD 4.7 billion. There were four independent severe convective storms in the US that caused losses of USD 1 billion or more, compared to just one in 2015. And there were 33 thunderstorms in 2016, a record high.

The costliest fire event in North America in 2016 was the Fort McMurray wildfire in Canada.

Other parts of the US and North America experienced severe dry weather conditions, and there were several wildfires. The most destructive in terms of buildings destroyed and number of hectares burnt was the Fort McMurray fire in Alberta, Canada. The resulting insured losses were close to USD 2.8 billion[4], making it the biggest insurance loss event ever in Canada, and the second costliest wildfire on *sigma* records, globally.

Warmer and drier climate will create favourable conditions for wildfires.

Scientists expect an increase in both the frequency and the severity of wildfires as a result of climate change,[5] with warmer and drier climates providing favourable conditions for burning. For example, the length of wildfire season has extended by 2.5 months over the last 30 years, according to the World Resources Institute.[6] Modest changes to precipitation rates and temperature can greatly influence conditions for large fires. An estimated 2°C mean temperature increase could extend the annual area burned in wildfires by 1.4 to 5 times in western US states, according to scientists publishing in Conservation Biology.[7] These large fires are also costly. In 2015, the US Forest Service spent more than half its annual budget combating forest fires. In 1995, fighting fires took up 16% of the budget.[8]

Canada burning: growing exposure yields large wildfire losses

Climate-influenced conditions allowed for rapid spread of the fire.

The Fort McMurray wildfire spread through Alberta and Saskatchewan from May to July 2016. The exact cause of the fire is unknown, but the authorities suspect it was due to human activity. Once ignited, high temperatures, low humidity and strong gusting winds contributed to the rapid spread of the fire. In addition, below-average precipitation rates in the preceding autumn and low snowfall in the winter associated with El Niño had dried out the vegetation, providing ample fuel for the flames to grow. The fire was declared contained on 5 July, having damaged approximately 2400 structures in Fort McMurray and burnt 590 000 hectares of forest land. During the course of the fire, 88 000 residents were evacuated from impacted areas.

The Fort McMurray wildfire resulted in Canada's largest insured loss ever.

Economic losses from the Fort McMurray fire were an estimated USD 3.95 billion.[9] Statistics Canada estimates that 7.6 million net work hours were lost due to the fire in the Fort McMurray area, and the rest of Alberta experienced a loss of 2.9 million work hours.[10] The overall financial impact, including indirect losses such as lost work hours, could be as high as USD 7 billion (CAD 9.5 billion).[11] During the fire, crude

4 Data from CatIQ.
5 Chmura et al., "Forest responses to climate change in the northwestern United States: Ecophysiological foundations for adaptive management", *Forest Ecology and Management*, 2011.
6 *Western U.S. Wildfires and the Climate Change Connection*, World Resources Institute, September 2014, http://climatechange.lta.org/wildfires/
7 McKenzie et al., "Climate change, wildfire and conservation", *Conservation Biology*, vol. 18, issue 4, 2004.
8 *The Rising Cost of Fire Operations: Effects on the Forest Service's Non-fire Work*, United States Department of Agriculture, 4 August 2015, https://www.fs.fed.us/sites/default/files/2015-Fire-Budget-Report.pdf
9 *Economic Impacts of the 2016 Alberta Wildfires*, The Conference Board of Canada, 17 May 2016, http://www.conferenceboard.ca/press/newsrelease/16-05-17/economic_impacts_of_the_fort_mcmurray_wildfires.aspx
10 *Wildfires in northern Alberta: Impact on hours worked, May and June, 2016*, Statistics Canada, 25 November 2016 http://www.statcan.gc.ca/daily-quotidien/161125/dq161125a-eng.htm
11 "Financial impact of Fort McMurray wildfire reaches $9.5 billion: study", *Canadian Underwriter*, 17 January 2017, http://www.canadianunderwriter.ca/catastrophes/financial-impact-fort-mcmurray-wildfire-reaches-9-5-billion-study-1004107558/

bitumen and synthetic crude oil production was reduced by 47 million barrels. The Conference Board of Canada estimates USD 1 billion in lost revenue. From the insurance perspective, the fire was the costliest event ever in Canada. The insured losses were USD 2.8 billion, nearly double the previous highest insurance event in the country, the flooding in Alberta in 2013. The associated high insurance penetration rates in the area, the proximity of the fire to the city of Fort McMurray, and the devastation of many surrounding neighbourhoods led to the record loss.

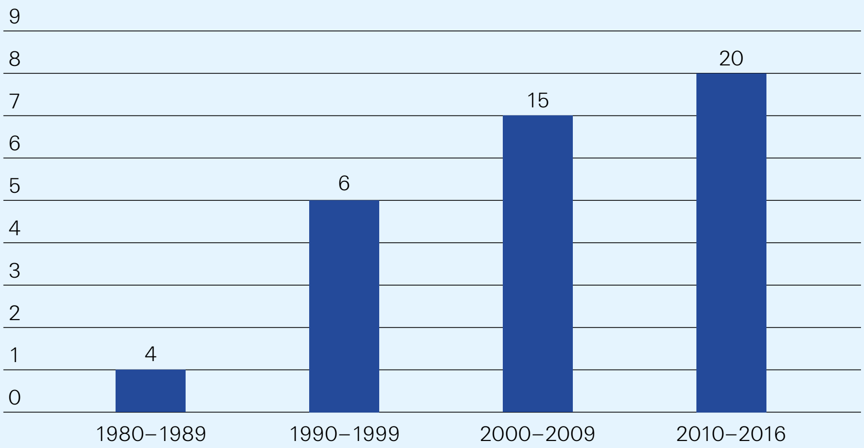
The expansion of oil sand operations and subsequent increased exposures contributed to the large losses, ...

Canada has the third largest oil reserves in the world, nearly all of which are in Alberta's oil sands.[12] The production capacity of the area has increased substantially, from about 1 million to more than 2 million barrels a day over the last decade. Alongside the build-up of production assets, the population of the Fort McMurray area – the Regional Municipality of Wood Buffalo – has grown rapidly to a pre-fire population of nearly 72 000 permanent residents, according to Statistics Canada. This in turn has pushed up property prices and the overall value of asset exposure. The municipality's economic report from late 2014 said the average home price in the areas was USD 459 000, well above average prices in cities such as Calgary or Edmonton, and the average household income is one of the highest in the whole country.

... and the exposures are only likely to grow further.

Wildfires are an-ever present hazard in the forest and grassland regions of Canada and North America, and are an essential part of the forest ecosystem. Figure 5 shows the insured losses from wildfires in the US, Canada and Australia, which together account for the great majority of fire-related losses globally. Most fires do not threaten communities, but some destroy vast expanses of timber resources. Insured losses from wildfires have been growing since 1980, and this is likely to continue as exposures in wildfire-prone regions continue to increase given expanding populations, the building of more property and infrastructure, and the possible effects of changing climates such as warmer and drier seasons.

Figure 5
Insured losses from wildfires in the US, Canada and Australia 1980–2016 in USD billion, at 2016 prices



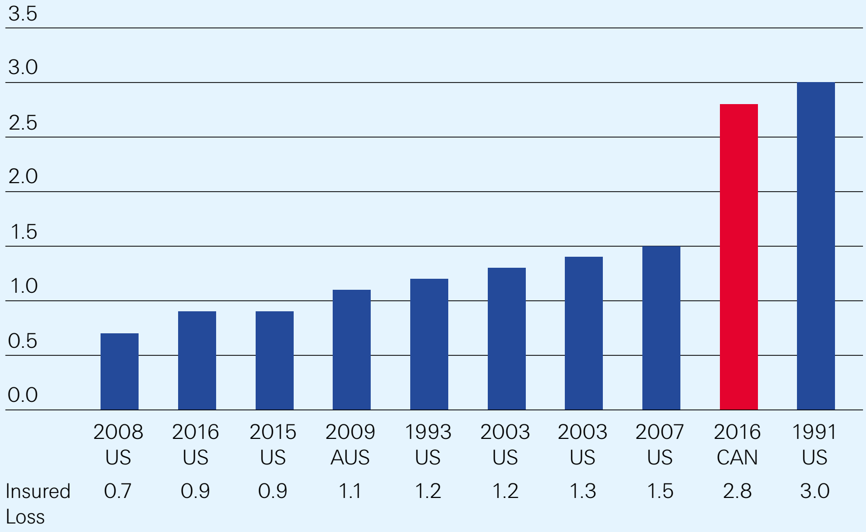
Numbers above the bars denote the number of wildfire events.
Source: Cat Perils and Swiss Re Institute.

The McMurray fire is the second costliest wildfire on record.

The Fort McMurray fire is the second costliest wildfire on *sigma* records. Only the 1991 Oakland Hills, California, fire resulted in higher insured losses (USD 3 billion).

[12] Data from Natural Resources Canada, http://www.nrcan.gc.ca/energy/oil-sands/18085

Figure 6
Costliest wildfires events 1980–2016
in USD billion, at 2016 prices



Source: Cat Perils and Swiss Re Institute.

Europe

Earthquakes and flooding caused the heaviest losses in Europe.

In Europe, economic losses from natural and man-made disasters were USD 15.5 billion in 2016, of which USD 7.5 billion were covered by the insurance industry. Most of the losses came from earthquakes in Italy, and thunderstorms and pluvial floods in central Europe.

Central Italy was repeatedly hit by earthquakes in August and October.

On 24 August 2016, a magnitude 6.2 earthquake hit the Apennines Mountains in central Italy, killing 299 people and devastating the small towns of Amatrice, Accumoli and Pescara del Tronto. The event was just the first of an extended series of damaging quakes in the region. On 26 October 2016, two aftershocks of magnitude 5.5 and 6.1 hit Visso, north of Amatrice, and on 30 October, a magnitude 6.6 quake struck Norcia, which lies between Amatrice and Visso. That last seism was the most powerful to hit Italy since 1980 and was felt through most of the country. The October shocks did not claim any lives thanks to the widespread evacuation of the area after the August quake, but they did add to the damage and destruction of buildings already weakened by the earlier earthquake event, and displaced thousands of residents. The combined economic losses from all the quakes were USD 6 billion, only a fraction of which were insured. The area is mainly rural, mountainous and scarcely populated, but the shallow depth of the tremors and the unreinforced buildings magnified the impact of the quakes.

The country has a long history of damaging quakes.

Italy's first seismic building code dates to 1909, but seismic mapping of the whole country only came into effect in 2003. Italy has a long history of damaging earthquakes. In 1908, Messina in Sicily was hit by a magnitude 7.2 earthquake and tsunami that claimed about 86 000 victims, making it the deadliest earthquake documented in Europe. A few years later, in 1915 a magnitude 7.0 quake struck the same area as the 2016 shakes, killing more than 30 000 people. And as Table 4 shows, six of the top 10 costliest earthquakes in Europe since 1970 have been in Italy.

Table 4
Costliest earthquakes in Europe since 1970 in USD billion, at 2016 prices

	Year	Country	Location	Economic Losses
1	1980	Italy	Irpinia	34.4
2	1999	Turkey	Izmit	28.8
3	1976	Italy	Friuli	14.6
4	2012	Italy	Emilia Romagna (2 events)	17.3
5	1977	Romania	Vrancea	6.7
6	2016	Italy	Central Italy (2 events)	6
7	1999	Greece	Athens	4.9
8	1979	Montenegro	Ulcinj	4.6
9	2009	Italy	L'Aquila	4
10	1997	Italy	Umbria	3

Source: Cat Perils and Swiss Re Institute.

In 2016, parts of Europe were hit by heavy rains and widespread flooding.

Europe also suffered heavy storms and subsequent flooding events in 2016. At the end of May and beginning of June, thunderstorms, torrential rain and flooding – river and flash floods – hit France, southern and central Germany and Belgium, leading to combined insured losses of USD 2.9 billion. According to the Deutscher Wetterdienst (German Weather Service), the flash floods were the worst ever seen in Germany.

There were also several terror attacks in Europe last year.

Once again, terrorists targeted Europe in 2016. The deadliest attack was in Nice during Bastille Day celebrations, when a lorry ploughed through a crowd of people, killing 84 people and injuring 202.

Asia

Asia has suffered the biggest losses from catastrophic events for five years running.

As in the previous four years, in 2016 Asia suffered higher economic losses due to natural and man-made catastrophes than any other region of the world. Economic losses from disaster events in Asia were an estimated USD 83 billion in 2016, of which approximately USD 9 billion were covered by insurance. The most destructive event was the magnitude 7.0 earthquake that hit Kyushu Island in southern Japan, close to the city of Kumamoto on 16 April 2016. It was the main quake of a series of notable fore- and aftershocks that stretched from 14 April to 19 April. A total of 137 people died and close to 2000 people were injured. The earthquake triggered landslides that complicated disaster relief efforts. More than 8500 buildings were destroyed, and an estimated 160000 buildings were damaged. Economic losses were estimated to be between USD 25 billion and USD 30 billion, of which USD 4.9 billion were insured.

Severe floods hit the Yangtze River basin.

China suffered many damaging floods in 2016, the most devastating along Yangtze River basin in July. Extreme rainfall caused pluvial and river floods, and also landslides in 11 provinces, with Hubei worst hit. The spread of the floods was accelerated by many localised precipitation events which caused the Yangtze and its tributaries to overflow. Economic losses were estimated at USD 22 billion, making it the costliest Yangtze River flood event since 1998. Since the 1998 floods, there has been massive investment in flood defences, and these helped curtail the economic losses in 2016. With low insurance penetration, however, insured losses from the 2016 floods were just USD 0.4 billion.

Latin America and the Caribbean

Insured losses in Latin America were over USD 1 billion in 2016.

Natural catastrophes and man-made disasters caused economic losses of more than USD 6 billion in Latin America and the Caribbean in 2016. Insured losses were approximately USD 1.4 billion. The main drivers were earthquakes, hurricanes and floods.

A powerful earthquake hit Ecuador, the deadliest earthquake of the year.

A magnitude 7.8 earthquake struck offshore near the central coast of Ecuador on the same day (16 April 2016) as the quake that stuck Kyushu Island in Japan. In Ecuador, there were 673 victims in the earthquake, along with widespread damage in the provinces of Esmeraldas and Manabí. This was the deadliest earthquake of 2016 globally and, with estimated economic losses of USD 4 billion, the costliest natural catastrophe event in Ecuador on *sigma* records. Insured losses, however, were just USD 0.5 billion.

Hurricane Matthew brought devastation to the Caribbean.

Later in the year, Hurricane Matthew made landfall in the southern provinces of Haiti on 4 October 2016 as a Category 4 storm, the first since 1964. It also made landfall in Cuba and the Bahamas, but most of the devastation was in Haiti. There 674 people lost their lives, the deadliest event to hit Haiti since the earthquake in 2010.

Oceania

An earthquake on New Zealand´s South Island was the biggest insurance loss event in Oceania.

Disaster events in Oceania triggered insured losses of USD 3.4 billion in 2016. The 13 November 2016 earthquake with magnitude of 7.8 on New Zealand's South Island caused most losses. The epicentre of the quake was around 93 km north of Christchurch and caused widespread damage in Kaikoura, a small tourist town. It also ruptured a series of six faults along the northeastern coast of the South Island. This was the most damaging quake in New Zealand since the shocks in 2010 and 2011 nearer to Christchurch. Last year's earthquake was stronger than in 2010/2011, but at USD 1.7 billion to USD 2.4 billion, the insured losses were lower because the quake struck a less heavily populated area.

Damage from subsequent landslides can cut supply chains.

The earthquake did trigger a tsunami, but the effect of the latter was dampened by coastal uplift which occurred during the shock, and also because the tsunami occurred at low tide. Geologists estimate that there were between 80 000 and 100 000 landslides in the aftermath of the quake.[13] Landslides can disrupt the flow of water and create landslide dams, which can pose additional hazards if the dams break. Landslides can also leave much debris and cut businesses and communities off from their supply chains and transportation routes.

The Category 5 Cyclone Winston caused large losses in Fiji …

Earlier in the year, in February the Category 5 Tropical Cyclone Winston hit Fiji. Winds up to 295 km/h and a storm surge cut a path of destruction across all four divisions of Fiji, claiming 44 lives. Overall, it caused economic losses of USD 1.4 billion (31% of GDP[14]), including severe losses for local sugar plantations.

… while it was a relatively quiet year for natural catastrophes in Australia.

In Australia, a winter storm – an East Coast Low – brought damaging winds, large waves, coastal erosion, and very heavy rainfall between 4–7 June 2016, causing flooding in areas of southeast Queensland, eastern New South Wales, eastern Victoria and large areas of northern Tasmania. The estimated insured losses were USD 0.3 billion. There were also some small wildfire and severe weather events in Australia, but their overall associated losses were below average.

[13] "Landslides and Landslide dams caused by the Kaikoura Earthquake", *geonet.org.nz*, November 2016, http://info.geonet.org.nz/display/quake/2016/11/18/Landslides+and+Landslide+dams+caused+by+the+Kaikoura+Earthquake

[14] *Emergency Assistance for Recovery from Tropical Cyclone Winston*, Asian Development Bank, June 2016, https://www.adb.org/sites/default/files/project-document/185540/50181-001-rrp.pdf

Africa

In Africa, approximately 1800 people died in disaster events in 2016.

Natural catastrophes and man-made disasters in Africa claimed approximately 1800 lives and caused economic losses of close to USD 3 billion in 2016. Insured losses were USD 1.7 billion, mostly relating to claims for accidents in oil and gas facilities. A magnitude 5.9 earthquake hit near the west shore of the Lake Victoria Basin between Tanzania, Uganda and Rwanda. The area is predominantly rural and 41% of the buildings are made of mud[15] and are hence vulnerable to quakes, and 117 721 people lost their homes.

A year of strong earthquakes and high uninsured losses

Economic losses from all earthquakes in 2016 were USD 43 billion. The associated insured losses were just USD 9 billion.

There were several major earthquakes in 2016, including the almost simultaneous quakes that struck Japan and Ecuador on 16 April 2016, and others in Italy and New Zealand later in the year. The combined economic loss of all seismic shocks in 2016 was an estimated USD 43 billion, of which around USD 9 billion was covered by insurance, signalling a still-large earthquake protection gap.

The earthquake protection gap is as much an advanced as an emerging market problem.

The protection gap is a global, not just an emerging market issue. Yes, the earthquake in Ecuador did cause economic losses of USD 4 billion and insured losses of just USD 0.5 billion. But the coverage schism is no less dramatic in many advanced markets. The quake in Japan on the same day resulted in economic losses of USD 25 billion to USD 30 billion, while insured losses were USD 4.9 billion. This was the second costliest earthquake in Japan in terms of insured claims on *sigma* records, primarily because of the increased uptake of residential property earthquake insurance since the Kobe earthquake of 1995. On the other hand, the level of earthquake insurance penetration for commercial property in Japan is among the lowest of the advanced countries, in spite of Japan being very prone to earthquakes.

For example, In Italy just 1% of residential buildings are insured for earthquake risk.

It is a similar story in Italy, which is also earthquake-prone. The quakes that hit central Italy in August and October caused combined economic losses of USD 6 billion and insured losses of just about USD 0.2 billion, according to Perils AG. Italy is the eighth largest economy in the world, but just 1% of residential buildings are insured against quake risk. Historically, the state has intervened with ex-post disaster programmes set up under the pressure of the emergency, resulting in long-lasting and much-more-than-budgeted-for reconstruction drives. Public debate regarding the need for increased insurance penetration, or for alternative public solutions, arises in the wake of each disaster. But to date, no associated legislation has been enacted.

The New Zealand experience demonstrates the positive benefit that earthquake insurance offers.

At the opposite end of the spectrum is New Zealand. According to the New Zealand Earthquake Commission, about 95% of buildings carry earthquake coverage,[16] due to a government-based initiative to promote public- and private-sector insurance schemes. Earthquake cover is provided to those who have bought private fire (property) insurance, which most people have. That means in New Zealand, households and businesses are better equipped to cope with a major earthquake event. Hence, while the October 2016 resulted in economic losses of USD 3.9 billion, of those USD 1.7-2.4 billion were covered by some form of insurance solution.

Many communities are exposed to earthquakes, but have no form of associated risk protection.

The low frequency of major earthquakes creates a false perception among exposed populations that earthquakes are not a major risk. This, and the absence of government awareness campaigns, means that the take-up rates of insurance protection remain low. The series of earthquakes in 2016 are not the biggest seismic events to have ever occurred. However, the death and destruction caused by these quakes is a stark reminder of the vulnerability of many people around the world.

[15] "Deadly earthquake in Tanzania (also felt in Uganda, Rwanda and Kenya)", *earthquake_report.com*, 10 September 2016, http://earthquake-report.com/2016/09/10/strong-earthquake-lake-victoria-region-on-september-10-2016/
[16] "Damage and losses to residential buildings during the Canterbury earthquake sequence", *nzsee.org.nz*, 2016 http://www.nzsee.org.nz/db/2016/Papers/O-04%20Horspool.pdf

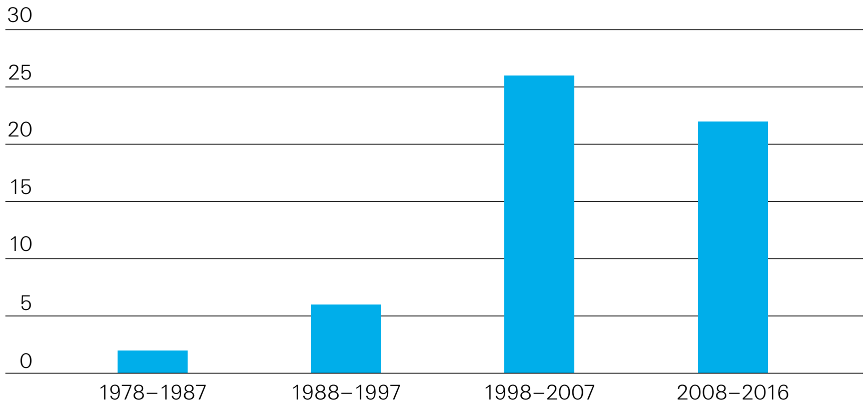
Floods in the US – an underinsured risk

A long history of floods

Heavy rains in Louisiana in 2016 caused the biggest flood losses in the US since Hurricane Sandy in 2012.

The US has suffered many major flood events over the course of its history. Figure 7 shows the level of flood related insurance losses covered by the US National Flood Insurance Program (NFIP), the public-sector and largest insurer of residential flood risk in the US, since 1978. Last year was no exception in the history of water inundation. The worst event was in mid-August, when extreme rainfall triggered major inland flooding in southern Louisiana and Mississippi, resulting in economic losses of US 10 billion. It was the costliest flood event in the US since Hurricane Sandy in 2012, a Category 1 storm that also led to widespread flooding as a result of storm surges on the east coast.

Figure 7
Total US insured NFIP losses by decade, 1978–2016, in USD billion



Source: NFIP.

The precipitation was triggered by tropical moisture from the Gulf of Mexico.

The Louisiana and Mississippi floods were the result of a stationary low pressure system combining with tropical moisture from the Gulf of Mexico, bringing record precipitation levels to the Amite and Comite river basins. The rains were heaviest in the south, including in and around Baton Rouge, the state capital of Louisiana. Many rivers burst their banks, flooding adjacent areas. Independent flash- and backwater flooding incidents which covered wide areas added to the havoc.

Louisiana is highly exposed to flood risk from multiple natural hazards.

The topography of southern Louisiana makes the region particularly vulnerable to flooding. It is largely wet and low-lying land, through which many large rivers run, and it is also exposed to the moisture from the Gulf of Mexico. The state has battled with expansive flooding – whether induced by tropical storms, torrential rains or rising waters – from early times. Very memorably, in 2005 it was New Orleans, further south on the coast of Louisiana, that bore most of the damage when the catastrophic failure of the levees let in the waters from the storm surges set off by Hurricane Katrina.

In 2016 there were many damaging floods in the US.

The Louisiana flood was just one of several damaging flood events in the US in 2016. There were four separate multi-billion-dollar-loss inland floods (unrelated to tropical cyclones), the highest number to have occurred in a single year since 1980, according to the NOAA. Three of the floods were clustered in Louisiana and Texas between March and August, causing combined economic losses of USD 16 billion.[17] And on the eastern seaboard, remnants of Hurricane Matthew caused inland flooding in North Carolina. The US was also hit by heavy floods in 2015, when inland flooding in South Carolina, Texas, Oklahoma, Missouri and the Midwest caused combined losses of more than USD 5 billion.

[17] 2016: A historic year for billion-dollar weather and climate disasters in US, *climate.gov*, 9 January 2017, https://www.climate.gov/news-features/blogs/beyond-data/2016-historic-year-billion-dollar-weather-and-climate-disasters-us

Flood types

The US is exposed to flood risk from storm surges, river overflows and heavy rains.

The experience of 2016 and recent years demonstrates that the US remains highly vulnerable to flood risk, as Figure 8 also suggests. Floods can come from different sources: in coastal states from storm surges, and inland from heavy precipitation, leading to fluvial (river water) and pluvial (surface water) flooding.

Figure 8
Swiss Re US flood zones

Source: US National Park Service, Swiss Re CatNet®.

Storm surges

Storm surges cause most flood-related losses.

The most severe water damage in the US is associated with storm surge-driven flooding. Storm surges are when, in a storm, seawater levels rise above tide levels to form powerful flood waves that travel inland. The most dangerous storm surges typically result from tropical cyclones along coastal areas in southeastern states and along the east coast. For instance, most of the loss of life and damage from Hurricane Katrina, the costliest recorded tropical cyclone, was inflicted by storm surges. Saltwater flooding in coastal areas can also be extreme when storm surges coincide with high tides, as was the case in Hurricane Sandy in 2012.

River floods

The Mississippi basin and Midwest have endured repeated flood events over history.

There are two forms of freshwater flooding. The first is river (fluvial) flooding, which results from a combination of contributing effects. Key drivers are long durations of heavy rainfall, particularly when preceded by heavy snowfall and then rapid snowmelt, filling river basins. Antecedent conditions like saturated soils can accelerate the build-up of water. Flooding occurs when the amount of water exceeds a river's capacity, and the surplus water overflows (breaks) the river's banks. This type of flooding occurs all through the US, but is particularly prevalent in the Midwest due to the confluence of large rivers, heavy precipitation and snowmelt. The Mississippi basin, for example, has been the scene of repeated (documented) major flood events, in 1809, 1825, 1844, 1851, 1927, 1937, 1973, 1993, 2008 and in 2011.

Pluvial floods

Pluvial floods are triggered by heavy downpours.

The second form of freshwater flooding is pluvial floods. These generally occur when there are large amounts of rainfall which the land surface cannot absorb or, in the case of urban flooding, which overwhelms the drainage system. The floods in Louisiana in 2016 and in South Carolina in 2015 were both pluvial floods.

Tropical moisture can intensify precipitation.

The weather systems that trigger extreme precipitation in the US include tropical moisture from the Gulf of Mexico and the Atlantic Ocean, and in the western states moisture from the Pacific. In the west, some of the most dramatic precipitation events are triggered by the so-called pineapple express, a type of atmospheric river consisting of narrow bands of moisture extending from the tropical Pacific Ocean to the coast of California. As the moisture hits the Sierra Nevada mountain range, heavy rains result. This is what happened at the end of 1996 and beginning of 1997, for example, when heavy precipitation led to widespread flooding and localised landslides in the western states of California, Oregon, Washington, Nevada and Idaho.

Thunderstorms can also cause pluvial flooding.

Extreme precipitation can also result from severe convective activity. For example, the precipitation that led to the 2016 Louisiana flood came from large thunderstorms activity fed by high levels of moisture from the Gulf of Mexico. US severe convective storms – large thunderstorms – are the most violent in the world and can wreak havoc through powerful tornadoes and large hail. But they can also trigger pluvial floods when they unleash extreme precipitation in urban drainage basins. In recent years, metropolitan areas such as Houston, Atlanta, Nashville, Oklahoma City, Dallas, Kansas City, Chicago and Detroit have all suffered severe pluvial flash floods, sometimes repeatedly. While river floods are rare, flash and pluvial floods generally occur frequently. They can happen almost anywhere and with little warning, they can last from a few hours to weeks, and can impact a wide range of spatial ranges, from single catchments or cities to entire river basins across multiple states.

The US flood protection gap

Population growth and urbanisation increase national exposure to flood risk.

The US is vast and has a great diversity of climatic regimes, meaning there are also many flood-generating natural hazards. Meantime, population growth and urbanisation has increased the exposure potential. There have been significant investments in infrastructure to mitigate flood hazard and regulate development in flood-prone areas. Nevertheless, urbanisation continues to extend to more flood-prone areas. For example, the Houston metropolitan area has expanded rapidly in the past 15 years, with the suburban sprawl spilling onto floodplains prone to flash floods in heavy rains.[18] In towns and cities there are fewer avenues for water discharge, and urbanisation also leads to more water-impermeable surfaces like roads and parking lots. The multi-billion dollar losses that Houston suffered after two separate inland flood events in 2016 and 2015 are not entirely inexplicable.

So too does the likelihood of more frequent extreme weather events.

Scientists expect flood events to become more frequent as rising temperatures load the atmosphere with more vapour, which will translate into more frequent downpours. The combination of population growth, urban development and more extreme weather events as temperatures rise all point to more extreme flood events also, and an increase in the associated costs.

Even so, the US remains under-insured for flood risk.

Yet, the US has been and continues to be critically under-insured with respect to flood risk. Table 5 lists the costliest flood events in the US since 1978 in economic loss terms, expressed in 2016 prices. The numbers estimate the economic losses from water damage only in the individual events, many of which also caused wind damage. The isolation of water-inflicted losses facilitates simple quantification of the protection gap for homeowners in the respective events. Table 5 also indicates the percentage of the losses carried by the NFIP. Using Hurricane Sandy in 2012 as an example, the economic losses from water damage were USD 70 billion, of which 17% were covered by the NFIP. Despite the NFIP, a significant portion of homeowners were uninsured and had to shoulder losses on their own.

[18] "How US inland flood became a peak peril", *carriermanagement.com*, 25 July 2016, http://www.carriermanagement.com/features/2016/07/25/156981.htm?bypass=c5c8e489f258184e403c97515bf8c4b2

Table 5
Economic losses from US flood events in USD billion, and NFIP losses as a % of economic losses

	Type of flood	Year	Event	Economic losses from flood damage	NFIP losses as % of economic losses from flood damage
1	Storm surge	2005	Hurricane Katrina, storm surge	140	17%
2	Storm surge	2012	Hurricane Sandy, storm surge	70	17%
3	Freshwater	1993	Midwest flooding	57	1%
4	Storm surge	2008	Hurricane Ike, storm surge	15	22%
5	Freshwater	2001	Tropical storm Allison – inland flood	15	13%
6	Freshwater	2008	Iowa and Midwest flood	13	1%
7	Storm surge	2004	Hurricane Ivan, storm surge	11	22%
8	Freshwater	2016	Severe storms and flooding in Louisiana	10	21%
9	Freshwater	1997	Northern Plains, Upper Midwest flood	8	4%
10	Freshwater	1996	West Coast Flood	7	1%

Note: Economic losses are adjusted for GDP growth.
Source: NFIP, Cat Perils and Swiss Re Institute.

Loss experience may not reveal the true underlying risk.

A shortcoming of loss experience from a selection of individual events is that they do not necessarily reveal the true extent of underlying risk. The historical timescale of events in Table 5 is relatively short, and some high impact/low frequency events that may not occur for several decades may be unaccounted for in the data set. For better understanding of the flood protection gap, flood catastrophe models have been developed to provide a more complete view of both high and low frequency events by going back over a longer period of time. Models can also be used to estimate the future impact of more frequent flooding events.

Storm surges drive most of the flood losses in the US.

According to Swiss Re's proprietary in-house catastrophe models, economic losses from flood events in the US are expected to amount to USD 15 billion annually. Of the economic losses each year, storm surges are estimated to account for on average USD 8 billion, with inland flooding the cause of the remaining USD 7 billion. And of the economic losses, only USD 5 billion are insured, meaning an annual protection gap of around USD 10 billion. Business segments with a high insurance penetration are commercial and industrial lines, with frequent all-risk policy covers. The gap is largest for small businesses and homeowners, despite the growth in NFIP coverage following the major flood events of past years

The insurance shortfall for flood risk is second only to the earthquake protection gap.

The flood protection gap is second only to the expected annual shortfall in earthquake insurance cover (USD 20 billion). The two perils have key differences. While earthquake risk is relatively concentrated in California, flood risk is distributed throughout the US. And while earthquakes are considered a more severe peril, resulting in very high losses, floods tends to occur more frequently, with lower associated losses.

Closing the protection gap

The Federal Emergency Management Agency provides flood coverage to homeowners through the NFIP.

For the annual expected USD 5 billion in insured flood-related losses in the US, the single largest insurer of residential flood risk is the NFIP, a branch of the Federal Emergency Management Agency (FEMA). The aim of this public scheme is to provide affordable insurance to homeowners and to encourage municipal authorities and communities to adopt and enforce floodplain management regulations and thus mitigate flood risk. There is also a mandatory insurance program, but that's only for federally-backed mortgaged homes in high flood risk zones. On average, about 15% of US flood losses are borne by NFIP. Besides the NFIP, the private insurance industry does offer a few flood insurance products, but these are very niche (eg, excess NFIP covers for high net value homes) and not widely available. Ultimately, the great majority of US households remain heavily exposed to flood risk, to the tune of USD 10 billion annually. This places a heavy burden on households, society and the economy in general.

Actions for resilience: improve risk awareness and make insurance products simple.

The flood protection gap can be addressed. First, households need better understanding of their exposure. Often homeowners do not grasp the full extent of their exposure to flood risk, or assume they are already covered through their standard homeowner policies. Second, homeowners need access to simple flood insurance products which are easily understood and comprehensive. Third, private/public partnerships can support financial resilience, for example by supporting covers for homeowners in high-risk zones at affordable prices.

Risk assessments tools are available to manage adverse selection and widen the insurability of flood risk.

Adverse selection is one of the key reasons for the lack of private flood insurance provision. For premiums to remain affordable and insurance to be sustainable, the risk must be spread among as many policyholders as possible. In the case of floods, reaching such critical mass is more challenging because homeowners can "select against" insurers by buying cover only in areas they consider to be at high risk of flooding. However, today risk assessment tools exist that allow insurers to fairly price flood risk by using location-specific risk based premiums, thus widening the insurability of flood risk. With the ever-changing nature of flood risk, regular updates of flood hazard maps are a necessary foundation for accurate risk assessment. So too is extending the assessment to consider forward-looking climate change studies to provide a basis for long-term sustainable planning.

Behavioural sciences can help improve consumers' perception of flood insurance.

Several other tools are available to insurers to increase flood risk coverage, including better understanding of behavioural patterns. When deciding to purchase flood insurance, rational decision-making factors such as affordability come into play, but so do behavioural biases like mental barriers or lack of awareness. Evidence shows that people tend to purchase flood insurance based on their experience of past events, and that they stop renewing their cover after enough time has passed since a loss occurred. Recent advances in behavioural sciences can help improve the perception of the value proposition of existing products, and create new concepts on how to offer insurance more effectively. Through a test-and-learn approach, insurance products and customer experiences can be designed in ways that align with the psychology of decision making.

Flood insurance can be available for the majority of US homeowners.

Reinsurance can also play a role in closing the protection gap, and is already doing so. The two largest storm surge events of recent years – Katrina and Sandy – generated total claims of USD 24.5 billion, causing severe funding issues for the NFIP. For this reason, in 2017 FEMA purchased reinsurance to offload some of the risk to the private sector. The placement transferred USD 1.042 billion in risk above a USD 4 billion deductible to 25 reinsurance companies.[19] Closing the flood protection gap in the US requires the collaboration of all stakeholders, in the private and public sectors, and is achievable. The expertise and tools needed to provide comprehensive and affordable flood insurance to most US homeowners are available today.

[19] *FEMA's 2017 Reinsurance Program Better Manages Future Flood Risk*, FEMA,3 January 2017, https://www.fema.gov/news-release/2017/01/03/femas-2017-reinsurance-program-better-manages-future-flood-risk

Tables for reporting year 2016

Table 6
Overall losses in 2016, by peril type

	Number	as %	Victims	as %	insured loss (in USD mn)	as %
Natural catastrophes	**191**	**58.4%**	**6884**	**63.2%**	**45944**	**85.5%**
Earthquakes	16		1386		9046	
Floods	65		3336		5694	
Storms	82		1640		20334	
Drought, bush fires, heat waves	16		340		4664	
Hail	6		0		6236	
Cold, frost	5		158		0	
Other natural catastrophes	1		24		0	
Man-made disasters	**136**	**41.6%**	**4014**	**36.8%**	**7797**	**14.5%**
Mining accidents	8		166		184	
Rail disasters (incl. cableways)	11		318		87	
Aviation disasters	11	3.4%	384	3.5%	248	0.5%
Crashes	7		383		117	
Space	2		0		41	
Damage on ground	2		1		90	
Major fires, explosions	47	14.5%	766	7.1%	4643	8.7%
Other fires, explosions	5		159		617	
Other buildings	11		387		0	
Industry, warehouses	17		84		2027	
Oil, gas	13		136		1921	
Department stores	1		0		78	
Miscellaneous	20	6.1%	684	6.3%	173	0.3%
Terrorism	15		601		173	
Other miscellaneous losses	4		83		0	
Social unrest	1		0		0	
Maritime disasters	36	11.1%	1596	14.7%	2463	4.6%
Tankers	5		66		98	
Passenger ships	19		1530		0	
Other maritime accidents	3		0		420	
Drilling platforms	9		0		1944	
Collapse of buildings/bridges	3	0.9%	100	0.9%	0	
Total	**327**	**100.0%**	**10864**	**100.0%**	**53516**	**100.0%**

Source: Cat Perils and Swiss Re Institute.

Table 7
The 20 most costly insurance losses in 2016

Insured loss (in USD mn)	Victims	Date (start)	Event	Country/region
4887	137	14.4.2016	Earthquakes	Japan
4000	734	6.10.2016	Hurricane Matthew	US and the Caribbean
3102	13	11.8.2016	Severe storms and flooding in Louisiana	US
2995	–	10.4.2016	Severe hailstorm in San Antonio, TX	US
2886	17	27.5.2016	Storms/floods (low-pressure systems Elvira and Friederike)	Germany, France
2782	–	2.5.2016	Fort McMurray wildfires	Canada
1700-2400	2	14.11.2016	Earthquake Mw 7.8	New Zealand
1689	–	23.3.2016	North Texas hailstorm, thunderstorms	US
ns	–	28.2.2016	Turret failure at a floating production, storage and offloading (FPSO) vessel	Ghana
1187	6	29.4.2016	Thunderstorms, large hail, tornadoes, flash floods	US
1135	–	28.7.2016	Thunderstorms, severe hail damage in CO, hailstorm in Wyoming	US
1037	8	16.4.2016	Flash flood, river flood in Houston region from torrential rains	US
920	1	17.3.2016	Thunderstorms, large hail in Forth Worth and Arlington in TX	US
919	14	28.11.2016	Chimney Tops 2 Fire spreads to forest areas in dry conditions	US
874	1	21.5.2016	Thunderstorms, tornadoes, hail	US
764	2	7.5.2016	Thunderstorms, hail, tornadoes	US
666	-	11.5.2016	Thunderstorms, hail, tornadoes	US
639	6	25.4.2016	Thunderstorms, hail, tornadoes	US
637	10	22.2.2016	Thunderstorms, 50 tornadoes, hail	US, Canada
ns*	-	31.3.2016	Steam generator falls and causes damage to nuclear power plant	France

ns = not showing
Source: Cat Perils and Swiss Re Institute.

Table 8
The 20 worst catastrophes in terms of victims in 2016

Victims	Insured loss (in USD mn)	Date (start)	Event	Country/region
734	4000	28.9.2016	Hurricane Matthew	US and the Caribbean
673	500	16.4.2016	Earthquake Mw 7.8	Ecuador
538	–	29.8.2016	Remnants of Typhoon Lionrock trigger floods along Tumen River	North Korea
358	–	3.6.2016	Boat carrying migrants capsizes	Greece, Mediterranean Sea
300	–	13.4.2016	Heat waves	India
299	69	24.8.2016	Earthquake Mw 6.2	Italy
289	403	30.6.2016	Severe floods along Yangtze River	China
289	187	18.7.2016	Severe floods	China
240	–	3.11.2016	Boat carrying migrants capsizes	Libyan Arab Jamahiriya
228	–	15.7.2016	Monsoon floods	India
191	104	15.5.2016	Remnants of Cyclone Roanu bring torrential rains and flooding, Arananayake landslide	Sri Lanka
178	–	21.9.2016	Overcrowded boat carrying migrants capsizes	Egypt
160	–	10.12.2016	Roof of a church collapses during a service	Nigeria
151	–	1.8.2016	Monsoon floods	India
150	–	20.11.2016	14 coaches of a passenger train derail	India
141	–	9.3.2016	River floods, flash floods, landslides	Pakistan
137	4887	14.4.2016	Earthquakes	Japan
122	–	21.7.2016	River floods, landslides	Nepal
117	618	6.2.2016	Earthquake Mw 6.4	Taiwan
112	–	10.4.2016	Explosion and fire at a temple in firework display	India

Source: Cat Perils and Swiss Re Institute.

Table 9
Chronological list of all natural catastrophes in 2016

Floods

Date	Country	Event	Number of victims and amount of damage (where data available), in local currency and/or USD
24.1.–25.1.	Ecuador Esmeraldas, San Lorenzo	Torrential rains cause flash floods	9 dead 2000 homeless
3.2.–6.2.	Mexico Tamaulipas, Veracruz, Chihuahua	Flash floods caused by torrential rains – over 20 000 houses flooded	2 dead >3000 homeless
5.2.–24.2.	Indonesia Central Java, West Sumatra, Bangka Belitung, Riau, Jambi	Floods, landslides – 1767 houses destroyed	14 dead >2000 homeless
10.2.–15.2.	Tanzania Rufiji	Flash floods	3000 homeless
28.2.	Haiti Grand´Anse,	River floods, flash floods – 10 000 houses flooded	1 dead, 4 missing 2000 homeless
29.2.–1.3.	Angola Lubango, Huíla	Flash floods	29 dead, 25 missing
8.3.–12.3.	United States TX, LA, AR, MS	Severe flooding along the Sabine River basin on the Texas and Louisiana border – over 1000 buildings damaged or destroyed	5 dead USD 333mn insured loss USD 2.3bn total damage
9.3.–29.3.	Pakistan Azad Jammu and Kashmir, Punjab, Khyber Pakhtunkhwa, Gilgit-Baltistan	River floods, flash floods, landslides – 857 buildings damaged	141 dead 127 injured
10.3.–11.3.	Brazil São Paulo	River floods (Pinheiros River), flash floods, landslides	30 dead 24 injured
19.3.–23.3.	China Jiangxi, Hunan, Guangdong, Guangxi, Guizhou	Floods, landslides – 1100 houses destroyed, 72 000 houses damaged	5 dead USD 170mn total damage
2.4.–4.4.	Afghanistan Daykundi, Ghazni, Uruzgan	Flash floods	30 dead
2.4.–7.4.	Ethiopia Jigjiga	Floods along Fafen River	28 dead 80 injured
2.4.–8.4.	Pakistan Khyber Pakhtunkhwa	River floods, flash floods, landslides – 1200 buildings damaged	92 dead 77 injured
4.4.–15.4.	Argentina La Paz, Entre Ríos, Santa Fe, Chaco, Corrientes	River floods – severe damage to agriculture	1 dead 12 000 homeless >USD 50mn insured loss USD 1bn total damage
8.4.–10.4.	Malawi Mzuzu, Karonga	Flash floods	12 dead 2800 homeless
15.4.–21.4.	Uruguay, Argentina Artigas, Colonia, Durazno, Paysandú, San José, Treinta y Tres, Montevideo	Inland floods, river floods along Cabayú Cuatia River, La Paz, Entre Rios	6 dead 270 injured
16.4.–17.4.	Afghanistan Baghlan, Samangan, Takhar, Badghis	Flash floods	31 dead
16.4.–19.4.	United States Houston, TX, CO	Flash and river floods in Houston region after torrential rains – over 1000 houses flooded	8 dead USD 1.031bn insured loss USD 2.7bn total damage

Tables for reporting year 2016

Date	Country	Event	Number of victims and amount of damage (where data available), in local currency and/or USD
20.4.–24.4.	Angola Luanda	Flash floods	19 dead, 4 missing 50 injured 2400 homeless
22.4.–24.4.	Tanzania Morogoro, Kilosa, Kilombero, Malinyi	Remnants of Cyclone Fantala trigger inland flood – 315 houses destroyed, 3095 houses damaged	13 dead 13 933 homeless
28.4.–30.5.	Kenya Nairobi, Turkana, Wajir, Marsabit	River floods along Garissa and Tana rivers, flash floods	4 dead 6675 homeless
4.5.–11.5.	China Zhejiang, Fujian, Jiangxi, Hubei, Hunan, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan	River floods. landslides – 5200 houses destroyed, 74 000 houses damaged	66 dead USD 700mn total damage
7.5.–8.5.	Rwanda Districts of Gakenke (Nothern Province), Ngororero (Western Province), Muhanga (Southern Province)	Flash floods, landslides – 2317 houses destroyed	54 dead 4000 homeless
9.5.–20.5.	Ethiopia Oromia, Bale, Southern Nations, Nationalities and People's Region	River floods along Shabelle River, massive landslide in Kindo Didaye	100 dead
15.5.–19.5.	Sri Lanka Colombo, Gampaha, Kegalle	Remnants of Cyclone Roanu bring torrential rains and flooding, Arananayake landslide – 691 houses destroyed,	89 dead, 102 missing 50 injured LKR 15.5bn (USD 104mn) insured loss USD 1.2bn total damage
1.6.–28.6.	Myanmar (Burma) Ayeyarwady, Bago, Sagaing	Monsoon floods – 280 houses destroyed, 5000 houses damaged	14 dead 2000 homeless
17.6.–24.6.	Indonesia Purworejo, Banjarnegara, Kebumen, Sukoharjo, Bahyumas and Rembang, Central Java Province	River floods, flash floods, landslides	43 dead, 19 missing
18.6.–23.6.	China Hunan, Guizhou, Fujian	Monsoon floods	35 dead USD 60mn insured loss USD 1.5bn total damage
18.6.–23.6.	China Jiangsu, Zheijiang, Anhui, Jiangxi, Gansu, Shaanxi, Qinghai, Hubei, Hunan, Guangxi	River floods	31 dead, 6 missing USD 1.5bn total damage
21.6.–16.7.	Burkina Faso Ouagadougou, Kadiogo Province	River floods, flash floods	4 dead 10 injured 2500 homeless
22.6.–23.6.	United States OH, IN, IL, WV, VA	Thunderstorms, hail, tornadoes, severe flash floods, river floods, landslides and mudslides in West Virginia – 1500 roads damaged or destroyed	23 dead USD 100–300mn insured loss USD 1bn total damage
27.6.–30.6.	Sudan Sennar	Flash floods – 1160 houses destroyed, 1320 houses damaged	4000 homeless
30.6.–15.7.	China Jiangsu, Anhui, Jiangxi, Henan, Hubei, Hunan, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan	Severe floods along Yangtze River	289 dead CNY 3bn (USD 432mn) insured loss USD 22bn total damage

Date	Country	Event	Number of victims and amount of damage (where data available), in local currency and/or USD
1.7.–2.7.	India Chamoli, Pithoragarh, Uttarakhand State	Monsoon floods along Alaknanda and Mandakini rivers	61 dead
3.7.–6.7.	Pakistan Chitral District, Khyber Pakhtunkhwa Province	Flash floods	43 dead
4.7.–17.7.	India Jorhat, Golaghat, Assam State	Monsoon floods	34 dead
7.7.–19.7.	India Bhopal, Shajapur, Jabalpur, Satna, Harda, Madhya Pradesh State	Monsoon floods – 2360 houses destroyed, 17 236 homes damaged	37 dead, 9 missing 2000 homeless
11.7.–23.7.	Mali Gao, Mopti Segou, Sikasso	River floods, flash floods	13 dead 2100 homeless
13.7.–26.8.	Sudan Kassala, North Darfur, Khartoum, Al Jazirah	Flash floods, river floods – >18 000 houses destroyed, >14 000 houses damaged	36 dead 147 injured USD 10mn total damage
15.7.–11.8.	Niger Agadez, Tahoua	Flash flood, river floods – 1700 houses destroyed	11 dead 3000 homeless
15.7.–20.8.	India Bihar, Uttar Pradesh	Monsoon floods	228 dead
18.7.–21.7.	China Hebei, Henan, Beijing, Tianjin, Shanxi, Inner Mongolia Region, Liaoning, Shandong	Severe floods – 125 000 houses damaged or destroyed	164 dead, 125 missing CNY 28.1bn (USD 4.047bn) total damage
21.7.–27.7.	Nepal Pyuthan, Gulmi, Palpa, Makwanpur, Udaypur, Baglung, Banke, Rupandehi	River floods, landslides – 374 houses destroyed, 561 houses damaged	122 dead
24.7.–9.8.	India Assam	Monsoon floods	36 dead USD 150mn total damage
1.8.–22.8.	India Maharashtra, Madhya Pradesh	Monsoon floods	151 dead USD 300mn total damage
6.8.–7.8.	Pakistan Karachi, Hyderabad, Tando Allahyar, Mirpur Khas	Flash floods, inland floods	22 dead 60 injured
8.8.–16.8.	Philippines Llocos Sur, Bataan, Pampanga, Negros Occidental	Monsoon floods – 276 houses destroyed, 151 houses damaged	23 dead, 3 missing 12 injured PHP 665mn (USD 13mn) total damage
11.8.–31.8.	United States Louisiana, Mississippi	Severe storms and flooding in Louisiana – 50 000 houses, 20 000 vehicles and 20 000 businesses damaged or destroyed, 100 000 people displaced, more than 30 000 people rescued from floodwaters	13 dead 10 000 homeless USD 3.1bn insured loss USD 10bn total damage
29.8.–31.8.	North Korea North Hamgyong	Remnants of Typhoon Lionrock trigger floods along Timern River – 30 000 houses damaged or destroyed	138 dead, 400 missing USD 61mn total damage
1.9.–20.9.	Nigeria Dutse, Jahun, Hadejia, Babura, Ringim, Gumel, Malammadori, Birninkudu	Seasonal river floods – 6637 houses destroyed	18 dead 12 000 homeless
11.9.	South Africa Gauteng	Flash floods	6 dead USD 100mn total damage
20.9.–22.9.	Indonesia Garut	Flash floods, landslides	53 dead USD 22mn total damage

Date	Country	Event	Number of victims and amount of damage (where data available), in local currency and/or USD
21.9.–29.9.	India Andhra Pradesh, Telangana	Floods in Andhra Pradesh	28 dead INR 3bn (USD 44mn) insured loss INR 40bn (USD 589mn) total damage
28.9.–30.9.	Canada, United States Windsor, Leamington, ON	Flash floods in Windsor, ON and Detroit, MI	USD 108mn insured loss USD 169mn total damage
3.10.–10.10.	Thailand Nakornsawan Province	River flood – 68 000 houses damaged	4 dead USD 120mn total damage
9.10.–16.10.	Viet Nam Ha Tinh, Nghe An, Quang Binh, Quang Tri, Thua Thien Hue	River floods	26 dead
18.10.–22.10.	Colombia Chocó Department	River floods – San Juan River and Condoto rivers burst their banks	4 dead 2200 homeless
27.10.–29.10.	Egypt Hurghada, Red Sea Governorate	Thunderstorms, flash floods, torrential rains	29 dead 73 injured
3.11.–5.11.	Mexico Tamaulipas, Veracruz, Chihuahua	Thunderstorms, flash floods, hail – 20 000 houses damaged	2 dead 3000 homeless
5.11.–8.11.	Haiti Cap-Haitien, Nord Department; Jérémie, Grand'Anse department	Inland river floods, flash floods, landslides	13 dead 2 injured 2780 homeless
7.11.–21.11.	Dominican Republic Cabrera, María Trinidad Sánchez	River floods (Tío Marcos, Bajabonico and Angostura rivers) – damage to agriculture	15 dead 2400 homeless
9.11.–15.11.	Indonesia West Java Province	River flood, flash floods – 5776 houses damaged	5 dead 6373 homeless
26.11.–5.12.	Spain Malaga, Cadiz, Huelva, Valencia	Floods, rainstorms	2 dead 1 injured EUR 60mn (USD 63mn) insured loss
21.12.–23.12.	Viet Nam Binh Dinh, Quang Ngai	River floods	24 dead
27.12.	Congo, Democratic Republic of (DRC) Boma	Floods along Kalamu River	50 dead

Storms

Date	Country	Event	Number of victims and amount of damage (where data available), in local currency and/or USD
1.1.–5.1.	Iran	Blizzards, heavy snowfall in 21 provinces	84 injured
5.1.–8.1.	United States CA	Multiple low pressure systems bring rainstorms, mudslides, debris flow, floods, 1 tornado	USD 25–100mn insured loss
22.1.–24.1.	United States VA, MD, NJ, PA, KY, NC, GA, NY, TN, DE, WV, SC, DC, OH, MA, CT, RI	Winter storm Jonas, strong winds, heavy snowfall, storm surge, coastal flooding, record snow fall in Baltimore, Maryland and New York City, 13 000 flights cancelled	58 dead USD 100–300mn insured loss
23.1.–24.1.	Japan	Winter storm, heavy snowfall	8 dead 610 injured
29.1.–30.1.	United Kingdom	Winter storm Marita	1 dead GBP 47mn (USD 58mn) insured loss
31.1.–1.2.	United States Los Angeles, Ventura (CA)	Thunderstorms, flash floods, landslides	USD 25–100m insured loss
7.2.	United Kingdom, France	Winter storm Ruzica-Susanna	USD 168m insured loss
13.2.–15.2.	United States NY, MA, NJ, CT, RI, PA, NH, MD, VT, DC	Winter storm, heavy snowfall, flooding	USD 300–600mn insured loss
19.2.–20.2.	United States IL, MI	Thunderstorms, strong winds	USD 100–300mn insured loss
20.2.–22.2.	Fiji, Tonga	Cyclone Winston Cat 5 with winds up to 295 km/h – 11 989 houses destroyed, 18 380 homes damaged, severe damage to sugar plantations	44 dead 83 injured USD 50mn insured loss USD 1.351bn total damage
22.2.–25.2.	United States, Canada US: TX, NC, LA, FL, GA, VA, NY, SC, PA, MA, AL, CT, MS, DC, DE, Canada: New Brunswick, Ontario, Quebec	Thunderstorms, 50 recorded tornadoes (1 EF3 in Pensacola, FL – 1 EF3 tornado in Appomattox County, VA), hail in southern and eastern states	10 dead 56 injured USD 600mn – 1bn insured loss USD 1.03bn total damage
1.3.	United Kingdom, Ireland	Winter storm Aloisia	3 dead EUR 85mn (USD 90mn) insured loss
3.3.–9.3.	China Guizhou, Fujian, Yunnan, Kinjiang	Thunderstorms, torrential rains	USD 200mn total damage
5.3.–11.3.	United States LA, TX, CA, MS, AR, TN, OK	Thunderstorms, flooding in California, hail, mudslides	5 dead USD 300mn–600mn insured loss
8.3.–11.3.	United Arab Emirates, Oman	Thunderstorms, hail, widespread floods	USD 100mn insured loss USD 300mn total damage
13.3.–14.3.	United States SC, AR, NC	Thunderstorms, hail, tornadoes	USD 100mn–300mn insured loss
13.3.–15.3.	United States IL, WA, CA	Thunderstorms, hail, tornadoes	USD 100mn–300mn insured loss
17.3.–18.3.	United States TX, LA, MS, AR, FL, AL	Thunderstorms, large hail in Forth Worth and Arlington in TX	1 dead USD 600mn–1bn insured loss USD 1.2bn total damage
27.3.	United States IN	Thunderstorms, hail	USD 25mn–100m insured loss
27.3.–29.3.	United Kingdom	Winter storm Jeanne	1 dead GBP 118mn (USD 146mn) insured loss
30.3.–1.4.	United States TX, OK, MS, AR, AL, LA, KS	Thunderstorms, hail, tornadoes, flash floods	7 dead USD 100mn–300mn insured loss
2.4.–3.4.	United States IN, OH, NJ, IL, PA, MD, VA, NY, DE, DC	Thunderstorms, hail	USD 100mn–300mn insured loss

Date	Country	Event	Number of victims and amount of damage (where data available), in local currency and/or USD
15.4.	Uruguay Dolores	EF3 tornado – 251 buildings destroyed, 13 912 buildings damaged (70% of buildings of Dolores)	5 dead 230 injured USD 3mn total damage
19.4.–24.4.	Myanmar (Burma) Mandalay, Sagaing, Magway, Shan, Chin	Thunderstorms, large hail, flash floods – 7500 houses destroyed	14 dead 12 000 homeless
20.4.–25.4.	China Hubei, Henan, Shaanxi, Guangxi, Guizhou, Shandong	Thunderstorms, large hail	49 injured CNY 1.4bn (USD 202mn) total damage
25.4.–28.4.	United States TX, KS, MO, IN, WV, OK, IL, NC, MS	Thunderstorms, hail, tornadoes	6 dead 19 injured USD 600mn–1bn insured loss
29.4.	Bangladesh Sunamganj	Nor'wester – 200 houses damaged	1 dead 50 injured
29.4.–3.5.	United States TX, AR, VA, IN, NC, MD, OK, GA, MO, IL, WV	Thunderstorms, large hail, tornadoes, flash floods	6 dead USD 1bn–3bn insured loss USD 2.4bn total damage
3.5.–5.5.	India Ujjain, MP	Thunderstorms, large hail, torrential rains – tents erected for religious festival uprooted	8 dead 81 injured
7.5.–10.5.	United States NE, KY, TX, OK, CO, TN, KS	Thunderstorms, hail, tornadoes	2 dead 10 injured USD 600mn–1bn insured loss
11.5.–12.5.	United States MO, TX, NE, IL	Thunderstorms, hail, tornadoes	USD 600mn–1bn insured loss
16.5.–19.5.	United States TX	Thunderstorms, hail	USD 100mn–300m insured loss
17.5.–23.5.	Bangladesh	Cyclone Roanu, storm surge – 23 940 houses destroyed, 216 771 houses damaged	28 dead USD 600mn total damage
21.5.–28.5.	United States TX, MT, KS, MO, CO	Thunderstorms, tornadoes, hail	1 dead USD 600mn–1bn insured loss USD 1.1bn total damage
27.5.–7.6.	Germany, France, Switzerland, Belgium, Luxembourg, Poland, Austria, Romania	River and flash floods caused by thunderstorms and heavy rains due to low-pressure systems Elvira and Friederike	17 dead 35 injured EUR 2.736bn (USD 2.886bn) insured loss EUR 3.8bn (USD 4.0bn) total damage
29.5.–2.6.	United States TX	Thunderstorms, floods, tornadoes	15 dead USD 100mn–300m insured loss
1.6.–2.6.	Pakistan Islamabad, Rawalpindi, Khyber Pakhtunkhwa	Thunderstorms, torrential rains, flash floods – glass roof of a shopping mall collapses	34 dead 191 injured
2.6.	China Qinqhai	Thunderstorms, hail	2200 homeless USD 60mn total damage
3.6.–7.6.	Australia QLD, NSW, VIC, TAS	Winter storm (East Coast Low) brings wind, storm surge, coastal erosion and flood damage	4 dead AUD 422mn (USD 305mn) insured loss
6.6.–7.6.	United States Denver, CO	Thunderstorms, hail	USD 100mn–300mn insured loss
16.6.–18.6.	United States VA, GA, AL, SC	Thunderstorms, hail, torrential rains	USD 100mn–300mn insured loss
16.6.–18.6.	United States ND, MN, SD	Thunderstorms, hail	USD 100mn–300mn insured loss
23.6.	China Yancheng, Jiangsu	Thunderstorms, large hail, EF4 tornado (Jiangsu tornado)	99 dead 846 injured USD 500mn total damage
23.6.	Netherlands North Brabant, Limburg	Thunderstorms, hailstorm – severe crop damage	EUR 500mn (USD 527mn) insured loss EUR 800mn (USD 844mn) total damage
24.6.–25.6.	Germany Westfälische Provinzial, Provinzial Rheinland, Bavaria	Thunderstorms, large hail, flash floods (depressions Lea, Marine, Neele)	92 injured EUR 240mn (USD 253mn) insured loss

Date	Country	Event	Number of victims and amount of damage (where data available), in local currency and/or USD
28.6.–30.6.	Canada Okotoks, Claresholm, Edmonton, Calgary (AB), SK, MB	Thunderstorms, large hail, flash floods, 1 tornado	CAD 86mn (USD 64mn) insured loss CAD 110mn (USD 82mn) total damage
5.7.–7.7.	United States MN, TN, KY, WI	Thunderstorms, hail, flash floods in TN	USD 100mn–300mn insured loss
7.7.–9.7.	United States CO, MI, NC, TN	Thunderstorms, large hail	USD 100mn–300mn insured loss
8.7.–12.7.	Philippines, Taiwan, China	Typhoon Nepartak	111 dead USD 1bn total damage
13.7.–15.7.	United States CO, OK, IL, AR, MO, KS	Thunderstorms, hail, tornadoes	USD 300mn–600mn insured loss
15.7.–16.7.	Canada Lethbridge, Calgary, Arbour Lake (AB), SK	Thunderstorms, large hail, flash floods	CAD 75mn (USD 56mn) insured loss
18.7.–20.7.	Canada Alberta, Manitoba, Saskatchewan	Thunderstorms with winds up to 122 km/h, tornadoes, large hail, flash floods	CAD 99mn (USD 74mn) insured loss
20.7.–21.7.	United States MN	Thunderstorms, hail	USD 25mn–100mn insured loss
24.7.–26.7.	South Africa Cape Town, Durban	Thunderstorms, flash floods – >2300 buildings flooded	7 dead ZAR 2bn (USD 146mn) insured loss
30.7.–1.8.	United States MD, NJ, NY, PA, VA	Thunderstorms, flash floods in Maryland and New Jersey, hail	2 dead USD 100mn–300mn insured loss
30.7.–1.8.	Canada Alberta, Saskatchewan, Manitoba	Thunderstorms with winds up to 113 km/h, large hail, 3 tornadoes, flash floods in the Prairie	CAD 439mn (USD 327mn) insured loss
31.7.–3.8.	Philippines, China, Viet Nam	Typhoon Nida	USD 150mn total damage
2.8.–5.8.	Mexico, Belize	Hurricane Earl, storm surge, floods	67 dead USD 25mn insured loss USD 250mn total damage
6.8.–7.8.	Macedonia, Skopje	Cloudburst triggers flash floods	22 dead 77 injured USD 50mn total damage
9.8.	Pakistan Bannu	Thunderstorms	2 dead 59 injured
17.8.–30.8.	Japan, China	Typhoon Lionrock	79 dead
18.8.–22.8.	China, Vietnam	Tropical storm Dianmu	17 dead USD 270mn total damage
24.8.–25.8.	United States IN, OH	Thunderstorms, tornadoes, hail, flash floods	20 injured USD 25–100m insured loss
31.8.–4.9.	United States FL, GA, NC, SC, VA, DE	Hurricane Hermine (Cat 1), storm surge	USD 100mn–300mn insured loss
2.9.	Iran Golestan	Thunderstorms, flash floods – 900 buildings damaged	4 dead 2000 homeless
8.9.–13.9.	China Shandong, Henan, Fujian	Thunderstorms. large hail, floods – 2000 houses damaged, crop damage	USD 175mn total damage
14.9.–16.9.	China, Taiwan, Philippines	Typhoon Meranti	44 dead <USD 400m insured loss USD 2.5bn total damage
19.9.–23.9.	United States WI, MN, IA	Thunderstorms, hail, tornadoes, river floods in the Cedar River basin, Shell Rock River, flash floods	USD 100–300m insured loss
23.9.–28.9.	China, Taiwan China: Zhejiang, Fujian, Jiangxi	Typhoon Megi, floods, landslides	10 dead, 17 missing 625 injured USD 951mn total damage

Date	Country	Event	Number of victims and amount of damage (where data available), in local currency and/or USD
28.9.–8.10.	United States, Haiti, Barbados, Saint Lucia, Saint Vincent and The Grenadines, Cuba, Bahamas, Dominican Republic, Colombia, Jamaica	Hurricane Matthew, storm surge, wind damage, inland river floods and flash floods in eastern North Carolina	606 dead, 128 missing 150 000 homeless USD 4bn insured loss USD 12bn total damage
3.10.–6.10.	Japan, South Korea	Typhoon Chaba, storm surge	9 dead, 4 missing USD 200mn insured loss USD 800mn total damage
9.10.–11.10.	Canada Sydney, Cape Breton, Burgeo (Newfoundland and Labrador), Nova Scotia	Remnants of Hurricane Matthew bring wind and inland flood damage from heavy rainfall and winds. Record rainfall in Sydney, Nova Scotia, with over 1000 houses suffering flood damage	CAD 108mn (USD 80mn) insured loss
13.10.–15.10.	Viet Nam	Tropical storm Aere	31 dead USD 100mn total damage
16.10.–19.10.	Philippines, China	Typhoon Sarika with winds up to 210 km/h – 2421 houses destroyed, 16 956 houses damaged	2 dead USD 729mn total damage
19.10.–21.10.	Philippines, China	Typhoon Haima with sustained winds of up to 225 km/h and gusts of 310 km/h, storm surge – 14 564 houses destroyed, 79 371 houses damaged	15 dead 17 injured USD 1.083bn total damage
19.10.–22.10.	Taiwan, Japan	Typhoon Malakas	1 dead USD 300mn total damage
24.10.	Mozambique Maputo	Thunderstorms, large hail – 400 houses destroyed	12 dead 200 injured 1500 homeless
11.11.	Australia Mildura, VIC, SA, NSW	Thunderstorms, large hail, heavy rains – extensive damage to vehicles and crops (vineyards, almonds, stone fruit, wheat)	AUD 272mn (USD 197mn) insured loss
21.11.–26.11.	Nicaragua, Costa Rica, Panama	Hurricane Otto (Cat 2) with winds up to 175 km/h, storm surge , inland flash floods, landslides	18 dead 2054 homeless USD 1mn insured loss USD 50mn total damage
28.11.–1.12.	United States TN, AL, GA, SC, MS, LA, NC	Thunderstorms, tornadoes	8 dead 33 injured USD 100mn–300mn insured loss
12.12.–14.12.	India Tamil Nadu, Andaman, Nicobar Islands	Cyclone Vardah, flash floods	12 dead USD 52mn insured loss USD 1bn total damage
25.12.–28.12.	Philippines Catanduanes Island, Calabarzon, Mimaropa, Region V	Typhoon Nock-Ten (Nina) with sustained winds of 185 km/h and gusts of 255 km/h – 85 229 houses destroyed, 228 538 houses damaged	13 dead, 21 missing PHP 12.115bn (USD 244mn) total damage

Earthquakes

Date	Country	Event	Number of victims and amount of damage (where data available),in local currency and/or USD
4.1.	India, Bangladesh, Bhutan Imphal, Manipur	Earthquake Mw 6.7	21 dead 350 injured USD 60mn total damage
6.2.	Taiwan Kaohsiung, Tainan	Earthquake Mw 6.4 – 19 buildings destroyed, 565 buildings damaged, including collapse of a 17-storey block and damage in an industrial park	117 dead 551 injured 770 homeless
13.4.	Myanmar (Burma), India, Bangladesh Mawlaik	Earthquake Mw 6.9	2 dead 182 injured
14.4.–16.4.	Japan Kumamoto, Kyushu	Earthquakes – 8549 buildings destroyed, 162 969 buildings damaged	137 dead 2054 injured JPY 570bn (USD 4.9bn) insured loss USD 25bn to 30bn total damage
16.4.	Ecuador Muisne	Earthquake Mw 7.8 – 1100 buildings destroyed, 36 149 buildings damaged	664 dead, 9 missing 6274 injured 140 000 homeless USD 501mn insured loss USD 4bn total damage
18.5.	Ecuador Mompiche, Esmeraldas	Earthquake Mw 6.7 (aftershock of April 16 event) – 32 buildings destroyed	1 dead 162 injured
18.5.	China Shimen	Earthquake Mw 4.9	2 dead >5000 homeless USD 60mn total damage
24.8.	Italy Amatrice, Accumoli, Pescara del Tronto	Earthquake Mw 6.2	299 dead 368 injured 2500 homeless EUR 66mn (USD 69mn) insured loss
10.9.	Tanzania, Uganda Nsunga, Bukoba	Earthquake Mw 5.9 – 2500 houses destroyed, 15 400 houses damaged, 1700 government buildings damaged	21 dead 447 injured 117 721 homeless
11.9.	Macedonia Skopje	Earthquake Mw 5.3, aftershocks	137 injured
21.10.	Japan Tottori	Earthquake Mw 6.6	7 injured JPY 5.8bn (USD 50mn) insured loss JPY 16bn (USD 137mn) total damage
26.10.–30.10.	Italy Norcia	Series of earthquakes, Mw 5.5 and 6.1 in Visso on 26 October and Mw 6.6 in Norcia on 30 October	38 injured EUR 125mn (USD 132mn) insured loss
14.11.	New Zealand Culverden, Kaikoura	Earthquake Mw 7.8 triggers tsunami and coastal uplifting	2 dead 57 injured USD 1.7-2.4bn insured loss USD 3.9bn total damage
7.12.	Indonesia Sigli City, Aceh Province	Earthquake Mw 6.5 – 18 752 houses damaged	103 dead 755 injured 85 256 homeless
8.12.	China Shihezi, Xinjiang	Earthquake Mw 6.0	CNY 935mn (USD 135mn) total damage
30.12.	Philippines Surigao City	Earthquake Mw 6.7	8 dead 202 injured

Drought, bush fires, heat waves

Date	Country	Event	Number of victims and amount of damage (where data available),in local currency and/or USD
1.1.–19.6.	Cyprus Nicosia, Larnaca, Famagusta	Drought, wildfires	EUR 181mn (USD 191mn) total damage
1.1.–30.6.	India	Drought	USD 400mn insured loss USD 3bn total damage
1.1.–31.12.	United States	Drought in North East and South East	USD 1.5bn total damage
1.1.–31.12.	Zimbabwe	Severe drought	>USD 500mn total damage
6.1.–12.1.	Australia Waroona, Yarloop, Preston Beach, WA	Yarloop bushfires – 181 buildings destroyed, 69000 ha of land burnt	2 dead 4 injured AUD 71mn (USD 52mn) insured loss
10.1.–12.1.	South Africa Ngaka Modiri Molema	Heatwave with temperatures up to 43 degrees Celsius	21 dead
1.2.–31.12.	Bolivia	Severe drought – damage to agriculture	>USD 100mn total damage
4.2.–20.8.	China	Drought	USD 200mn insured loss USD 4bn total damage
13.4.–22.4.	India Orissa, Telengana, Andhra Pradesh	Heat wave with record temperatures up to 51 degrees Celsius	300 dead
2.5.–9.5.	Canada Fort McMurray, Alberta	Fort McMurray wildfires – 2400 houses destroyed, 590000 ha of land burnt	CAD 3.731bn (USD 2.782bn) insured loss CAD 5.3bn (USD 3.953bn) total damage
1.7	France	Drought – crop damage	EUR 240 mn (USD 253 mn) insured losses
22.7.–26.7.	United States CA	Wildfires (Sand fire)	USD 25mn–100m insured loss
6.8.–8.8.	Japan Yamanashi, Kawanehoncho, Shizuoka	Heat wave	3 dead 490 injured
8.8.–13.8.	Portugal Funchal, Calheta, Madeira	Wildfires – 154 houses destroyed, 233 houses damaged, 6000 ha of land burnt	EUR 157mn (USD 166mn) total damage
22.11.–27.11.	Israel Haifa	Wildfires, urban fires (believed to be man-made) – > 600 houses destroyed or damaged, 13000 ha of land burnt	USD 520mn total damage
28.11.–30.11.	United States Gatlinburg, Pigeon Forge, TN	Man-caused fires spread to forest areas due to dry conditions (Chimney Tops 2 Fire) – 2121 houses and 85 commercial buildings destroyed, 85 houses and 5 commercial buildings damaged	14 dead 191 injured USD 600mn–1bn insured loss USD 1.2bn total damage

Cold frost

Date	Country	Event	Number of victims and amount of damage (where data available), in local currency and/or USD
1.1.–3.1.	Poland	Cold spell	21 dead
1.1.–12.1.	Ukraine	Cold spell	37 dead
20.1.–26.1.	Taiwan, Thailand	Cold wave	100 dead
24.1.–27.1.	China, North Korea, Taiwan	Frost damage from winter weather, heavy snowfall	70 injured >USD 800mn total damage
18.9.–21.9.	Australia Western Australia, WA	Frost in freezing temperatures damages crops	AUD 140mn (USD 101mn) total damage

Hail

Date	Country	Event	**Number of victims and amount of damage** (where data available), in local currency and/or USD
23.3.	United States Dallas, Fort Worth, Plano (TX)	North Texas hailstorm, thunderstorms	USD 1bn–3bn insured loss USD 2.1bn total damage
8.4.	Bangladesh Baralekha, Moulvibazar	Hailstorm – 2800 houses damaged	>2000 homeless
10.4.–15.4.	United States San Antonio, TX, FL	Severe hailstorm in San Antonio, TX	USD 1bn–3bn insured loss USD 3.5bn total damage
22.7.	Canada Moose Jaw, SK	Hailstorm	CAD 75mn (USD 56mn) insured loss
28.7.–29.7.	United States CO, WY	Thunderstorms, severe hail damage in CO, hailstorm in Wyoming	USD 1bn–3bn insured loss
4.11.–6.11.	United States TX, NM	Hailstorm in El Paso, TX, thunderstorms	USD 300mn–600mn insured loss

Other natural catastrophes

Date	Country	Event	**Number of victims and amount of damage** (where data available), in original currency and/or USD
23.5.	Yemen Lasbah, Al-Shamayaten District, Taiz Governorate	Heavy rains trigger landslide	24 dead

Table 9 uses loss ranges for US natural catastrophes as defined by Property Claims Services. For Canada loss estimates, the data is from CatIQ.

Source: Cat Perils and Swiss Re Institute.

Table 10
Chronological list of all man-made disasters in 2016

Aviation disasters

Date	Country	Event	Number of victims and amount of damage (where data available), in local currency and/or USD
24.2.	Nepal Tirkhe Dungha, Myagdi	Tara Air Viking Air DHC-6 Twin Otter 400 craft crashes in poor visibility	23 dead
15.3.	Peru Pastaza	Aviación del Ejército Ecuatoriana IAI Arava 201 crashes en route	22 dead
19.3.	Russia Rostov-On-Don Airport	Flydubai Boeing 737–8KN (WL) crashes on landing	62 dead
26.3.	Space	JAXA ASTRO-H (Hitomi) X-ray astronomy satellite disintegrates in orbit after spinning out of control	USD 286mn total damage
19.5.	Egypt 200 km north of the Egyptian coast line	EgyptAir Airbus A320-232 crashes in unknown circumstances	66 dead
3.8.	United Arab Emirates Dubai	Emirates Boeing 777-31H catches fire shortly after crash landing	1 dead
28.10.	United States Chicago	American Airlines B767-300ER catches fire shortly ahead of take-off	
28.11.	Colombia Medellín	LaMia Avro RJ.85 crashes en route to Medellín after running out of fuel	71 dead
1.12.	Space	Roscosmos Progress-MS-4 cargo spacecraft lost due to launch failure	
7.12.	Pakistan Havelian	PIA ATR 42-500 crashes en route to Islamabad	47 dead
25.12.	Russia Adler	Russian Air Force Tupolev 154B-2 crashes shortly after take-off	92 dead

Collapse of buildings / bridges

Date	Country	Event	Number of victims
8.3.	Nigeria Lagos	Five-storey building collapses	35 dead
31.3.	India Kilkata	Bridge collapses	23 dead
3.8.	India Raigad District, Maharashtra	Buses and vehicles plunge into Savitri River after bridge collapses	24 dead, 18 missing
10.12.	Nigeria Uyo, Akawa Ibom	Church roof collapses during a service	160 dead 200 injured

Major fires, explosions

Date	Country	Event	Number of victims and amount of damage (where data available), in local currency and USD
1.1.	Philippines Manila	Fire at a shanty town triggered by firecrackers during New Year's Eve celebrations	3000 homeless
5.1.	Pakistan Lahore	Gas leak from an ice factory	150 injured

Date	Country	Event	Number of victims and amount of damage (where data available), in local currency and USD
8.1.	Japan Chita	Explosion at a steel plant	
15.1.	Canada Fort McMurray, Alberta	Fire and explosions at an oil sand facility	1 dead 1 injured
21.1.	Hungary Zala	Fire at a petrochemicals plant	
1.2.	Russia Sharypovo, Krasnoyarsk	Fire at a coal power plant	
8.2.	Germany Paderborn	Fire at a meat factory	2 injured
15.2.	Colombia Antioquia	Fire at a hydroelectric plant	
16.2.	Russia Yaroslavl	Gas explosion in an apartment block	39 dead
5.3.	United States Texas	Fire and explosion at an oil refinery	
28.3.	Germany Lohne	Fire at a meat processing plant	
31.3.	France Paluel	Steam generator falls, damages nuclear power plant	
2.4.	Qatar Doha	Fire at a shopping mall	
10.4.	India Paravur, Kollam	Explosion and fire at a temple in a fireworks display	112 dead 350 injured
21.4.	Mexico Coatzacoalcos, Veracruz	Explosion at a petrochemicals plant	32 dead 136 injured
21.4.	United States Chicago	Fire at a furniture warehouse	
29.4.	Kenya Nairobi	Residential six-storey building collapses in bad weather; building had been declared unsafe and was illegally occupied	49 dead, 21 missing 135 injured
9.5.	South Korea Chungcheongnam	Fire at a power station	
29.5.	Pakistan Tehsil Fateh Jang, Punjab	Silo collapses at a cement company	
15.6.	Canada British Columbia	Damage at a gas pipeline during flooding	
18.6.	Philippines Isabela City	Fire at a residential area – 560 houses destroyed	2000 homeless PHP 105m (USD 2m) total damage
21.6.	Philippines Zamboanga City	Fire at a residential area – 600 houses destroyed	5 injured 2000 homeless PHP 5m total damage
27.6.	United States Jackson County, Mississippi	Fire and explosion at a gas plant	
7.7.	Iran Bandar Imam Khomeini	Fire at a petrochemicals plant	
14.7.	Russia Khanty-Mansi Autonomous	Fire and explosion at a gas plant	
16.7.	Russia Ufa	Explosion at an oil refinery	8 dead
16.7.	Spain Seville	Fire at a food processing plant	
20.7.–22.7.	Canada Maidstone, Saskatchewan	Pipeline bursts and spills 225 000 litres of heavy oil and diluent into the North Saskatchewan River	
23.7.	Madagascar Ambalavato, Ikalamavony	Fire at a house party	38 dead

Date	Country	Event	Number of victims and amount of damage (where data available), in local currency and USD
2.8.	India Bellary, Karnataka	Accident at a steel plant	
11.8.	China Dangyang, Hubei	Explosion at a power plant	21 dead 5 injured
11.8.	United States St. Clair County, Michigan	Fire and explosion at a power plant	
3.9.	Ethiopia Addis Ababa	Fire at a prison	23 dead
10.9.	Bangladesh Gazipur	Explosion and fire at a packaging factory	31 dead, 8 missing
30.9.	Germany Bochum	Fire at a hospital	2 dead 16 injured
10.10.	China Wenzhou, Zhejiang Province	Four adjacent residential buildings collapse	22 dead 6 injured
17.10.	Germany Ludwigshafen	Explosion at a chemical plant	1 dead, 6 missing 7 injured
17.10.	India Bhubaneswar	Fire at a hospital	21 dead 100 injured
24.10.	China Xinmin, Shaanxi	Explosion at a prefabricated house in a residential complex – 5 buildings destroyed, 58 buildings damaged	14 dead 147 injured
13.11.	Philippines Mandaluyong City	Fire at residential establishments – 500 houses damaged	2 dead 2000 homeless
24.11.	China Fengcheng, Jiangxi	A construction platform for a power plant collapses	74 dead
26.11.	Bahrain Sitra	Fire and explosion at a refinery	
1.12.	Italy Pavia	Fire and explosion at an oil refinery	
2.12.	United States Oakland	Fire at a two-story warehouse during a party	36 dead 2 injured
5.12.	Pakistan Karachi	Fire at a hotel	12 dead 75 injured
20.12.	Mexico Tultepec, Mexico City	Explosion at a fireworks market	33 dead

Maritime disasters

Date	Country	Event	Number of victims (where data available)
1.1.	India Mumbai	Damage to oil rig during piling operations	
5.1.	Mediterranean Sea, Turkey Ayvalik	Boat carrying migrants capsizes	9 dead, 13 missing
5.1.	Turkey Marmaris	Fire on two recreational boats	
6.1.	China South China Sea	Damage to oil rig during jacking operations	
8.1.	Indian Ocean, Somalia Sanag	Boat carrying migrants capsizes	106 dead
21.1.	Turkey, Mediterranean Sea Foca, Izmir	Boat carrying migrants capsizes	12 dead, 20 missing
22.1.	Greece Kalolimnos	Boat carrying migrants capsizes	44 dead

Date	Country	Event	Number of victims (where data available)
26.1.	Denmark North Sea	Accident at a drilling platform	
28.1.	Turkey Samos	Boat carrying migrants capsizes	26 dead
30.1.	Turkey, Mediterranean Sea Ayvacik	Boat carrying migrants capsizes	39 dead
31.1.	United States Louisiana	Bulk carrier collides with barge on the Mississippi River, a towing vessel and two other facility structures	
1.2.	Iraq Persian Gulf	Damage to oil rig during jacking operations	
7.2.	Gulf of Mexico Bay of Campeche	Fire and explosion at a drilling platform	
8.2.	Canada off Nova Scotia	Damage at a drilling platform during a storm	
9.2.	Mediterranean Sea Aegean coast of Turkey	Boat carrying migrants capsizes	23 dead
28.2.	Ghana Jubilee Field	Turret failure at a floating production, storage and offloading (FPSO) vessel	
6.3.	Turkey, Mediterranean Sea Didim	Boat carrying migrants capsizes	25 dead
18.3.	Taiwan Keelung	Container runs aground	
30.3.	Libyan Arab Jamahiriya, Mediterranean Sea Zawiya	Boat carrying migrants capsizes	54 dead
17.4.	Myanmar (Burma), Indian Ocean Sittwe	Boat carrying migrants capsizes	21 dead
1.5.	Australia South China Sea	Damage to oil rig	
8.5.	Nigeria Niger Delta	Damage at a drilling platform	
27.5.	Libyan Arab Jamahiriya, Mediterranean Sea	Boat carrying migrants capsizes	45 dead
3.6.	Greece, Mediterranean Sea Off Crete	Boat carrying migrants capsizes	358 dead
1.9.	Space Cape Canaveral Air Force Station	Explosion destroys SpaceX Falcon 9 rocket and Amos-6 satellite during static-fire test	
1.9.	Germany Hamburg	Explosion and fire on a containership	
18.9.	Thailand Ayutthaya	Overcrowded double-decker boat capsizes on Chao Phraya River after hitting a bridge	28 dead 33 injured
21.9.	Egypt Rosetta	Overcrowded boat carrying migrants capsizes	178 dead
1.10.	Yemen	Cargo vessel sinks	
15.10.	Myanmar (Burma)	Ferry capsizes on the Chindwin River	73 dead
1.11.	Pakistan Gadani	Explosion and fire on an oil tanker at a shipbreaking yard	26 dead 59 injured
2.11.	Philippine Sea Batam, Indonesia	Overcrowded boat carrying migrants capsizes	18 dead, 44 missing
3.11.	Libyan Arab Jamahiriya	Boat carrying migrants capsizes	240 dead
4.11.	Indonesia	Boat carrying migrants capsizes	54 dead
17.11.	Libyan Arab Jamahiriya	Boat carrying migrants capsizes	100 missing
7.12.	Indian Ocean off Socotra	Cargo vessel sinks	40 missing

Mining accidents

Date	Country	Event	Number of victims (where data available)
22.1.	South Africa Rustenburg	Fire at a mining company	4 dead
25.2.–28.2.	Russia Vorkuta, Komi Republic	Three gas explosions at Severnaya coal mine	36 dead
17.7.	Canada Saskatoon	Equipment collapse at a potash mine	
27.9.	China Shizuishan City	Explosion at an illegal coal mine	18 dead, 2 missing
31.10.	China Laisu, Chongqing	Gas explosion at a coal mine	31 dead
29.11.	China Qitaihe, Heilongjiang	Explosion at a coal mine	21 dead
3.12.	China Chifeng, Inner Mongolia	Explosion at a coal mine	17 dead, 15 missing
29.12.	India Godda, District, Jharkhand	Landslide at a coal mine	16 dead, 6 missing

Rail disasters (incl. cableways)

Date	Country	Event	Number of victims
19.1.	Italy Cagliari	Two metro trains collide due to signal failure	70 injured
9.2.	Germany Bad Aibling, Rosenheim	Two commuter trains collide head-on	12 dead 89 injured
8.4.	Costa Rica San Jose	Two passenger trains collide head-on	245 injured
23.6.	South Africa Lamontville, Durban	Two trains collide head-on	121 injured
12.7.	Italy Corato, Puglia	Two passenger trains collide head-on	23 dead 52 injured
15.9.	Pakistan Multan, Punjab	Passenger train crashes into a freight engine	6 dead 150 injured
29.9.	United States Hoboken, NJ	Commuter train fails to stop, derails and hits a wall at NJT Hoboken Terminal	1 dead 110 injured
21.10.	Cameroon Eséka, Centre Region	Passenger train crashes	75 dead 550 injured
20.11.	India Pukhrayan, UP	14 coaches of a passenger train derail	150 dead 260 injured
25.11.	Iran Semnan	Two passenger trains collide; four carriages derail and two catch fire	49 dead 103 injured
28.12.	India Kanpur, UP	Passenger train derails	2 dead 68 injured

Miscellaneous

Date	Country	Event	Number of victims
15.1.	Burkina Faso Ouagadougou	Series of coordinated terrorist attacks at a restaurant and a hotel	30 dead 55 injured
20.1.	Pakistan Charsadda	Mass shooting and suicide bombing at Bacha Khan University	20 dead 60 injured
22.1.	Somalia Mogadishu	Car bomb explosion outside a restaurant	20 dead 17 injured
25.1.	Cameroon Bodo	Suicide bombing at a market	28 dead 65 injured
9.2.	Hong Kong	Riots over removal of illegal street stalls during New Year celebrations	90 injured
13.3	Turkey Ankara	Car bomb explosion in a crowded area	34 dead 125 injured
22.3.	Belgium Brussels	Suicide bombing at Brussels airport and a metro station	34 dead 260 injured
12.6.	United States Orlando, FL	Mass shooting at a nightclub	49 dead 53 injured
28.6.	Turkey Istanbul	Terrorist attack at Istanbul airport	41 dead 239 injured
28.6.	China Shenxian, Shandong	Leak at chemical plant	131 injured
1.7.	Bangladesh Dhaka	Mass shooting at a restaurant	24 dead, 2 missing 50 injured
14.7.	France Nice	Lorry ploughs through crowd during Bastille Day celebrations	84 dead 202 injured
8.8.	Pakistan Quetta	Suicide bombing at a hospital	93 dead 130 injured
20.8.	Turkey Gaziantep	Suicide bombing at a wedding	57 dead 66 injured
2.9.	Philippines Davao City	Explosion at an open market	14 dead 70 injured
1.10.	Ethiopia Bishoftu	Stampede at a religious festival	52 dead
15.10.	India Varanasi	Stampede at a religious gathering	24 dead 20 injured
9.11.	United Kingdom Croydon	Tram derails	7 dead 51 injured
10.12.	Turkey Istanbul	Two bomb explosions outside a football stadium	44 dead 150 injured
11.12.	Egypt Cairo	Two bomb explosions outside a cathedral and a nearby church	27 dead

Source: Cat Perils and Swiss Re Institute.

Table 11
The 40 most costly insurance losses (1970–2016)

Insured loss[1] (in USD mn, indexed to 2016)	Victims[2]	Start date	Event	Country/region
80 699	1836	25.8.2005	Hurricane Katrina, storm surge, damage to oil rigs	US, Gulf of Mexico
37 344	18 451	11.3.2011	Earthquake (Mw 9.0) triggers tsunami	Japan
30 141	237	24.10.2012	Hurricane Sandy, storm surge	US, Caribbean, Canada
27 368	65	23.8.1992	Hurricane Andrew, floods	US, Bahamas
25 456	2982	11.9.2001	Terror attack on WTC, Pentagon, other buildings	US
24 773	61	17.1.1994	Northridge earthquake (Mw 6.7)	US
22 577	193	6.9.2008	Hurricane Ike, floods, damage to oil rigs	US, Caribbean, Gulf of Mexico
17 072	185	22.2.2011	Earthquake (Mw 6.1), aftershocks	New Zealand
16 417	119	2.9.2004	Hurricane Ivan, damage to oil rigs	US, Caribbean, Venezuela
16 005	815	27.7.2011	Heavy monsoon rains, extreme flooding	Thailand
15 447	53	19.10.2005	Hurricane Wilma, torrential rains, flooding	US, Mexico, Caribbean
13 199	34	20.9.2005	Hurricane Rita, floods, damage to oil rigs	US, Gulf of Mexico
11 498	123	15.7.2012	Drought in the Corn Belt	US
10 033	36	11.8.2004	Hurricane Charley	US, Caribbean, Gulf of Mexico
9950	51	27.9.1991	Typhoon Mireille/No. 19	Japan
8852	71	15.9.1989	Hurricane Hugo	US, Caribbean
8804	562	27.2.2010	Earthquake (Mw 8.8) triggers tsunami	Chile
8577	95	25.1.1990	Winter storm Daria	France, UK, Belgium, NL et. al.
8356	110	25.12.1999	Winter storm Lothar	Switzerland, UK, France, et. al.
7789	321	22.4.2011	Major tornado outbreak; 349 tornadoes, hail	US
7522	177	20.5.2011	Tornado outbreak, winds up to 405 km/h, hail	US
7057	54	18.1.2007	Winter storm Kyrill, floods	Germany, UK, NL, Belgium et. al.
6546	22	15.10.1987	Storm and floods in Europe	France, UK, NL, et. al.
6388	50	26.8.2004	Hurricane Frances	US, Bahamas
6062	51	22.8.2011	Hurricane Irene, floods	US, Canada, Caribbean
5820	26	22.9.1999	Typhoon Bart/No 18	Japan
5695	600	20.9.1998	Hurricane Georges, floods	US, Caribbean
5649	64	25.2.1990	Winter storm Vivian	Switzerland, Germany
5502	–	4.9.2010	Earthquake (Mw 7.0), over 300 aftershocks	New Zealand
4895	3034	13.9.2004	Hurricane Jeanne; floods, landslides	US, Caribbean
4890	43	5.6.2001	Tropical storm Allison; heavy rain, floods	US
5000	137	14.4.2016	Earthquakes	Japan
4555	45	6.9.2004	Typhoon Songda/No. 18	Japan, South Korea
4259	25	27.5.2013	Floods	Germany, Czech Republic, et. al.
4180	51	2.5.2003	Thunderstorms, tornadoes, hail, flash floods	US
4066	78	10.9.1999	Hurricane Floyd, heavy rain, floods	US, Bahamas
4000	734	6.10.2016	Hurricane Matthew	US, Caribbean
3954	–	27.7.2013	Hailstorms	Germany, France
3946	77	1.10.1995	Hurricane Opal, floods	US, Mexico, Guatemala
3893	6434	17.1.1995	Great Hanshin earthquake in Kobe (Mw 6.9)	Japan

Note: Mw = moment magnitude scale.
Source: Cat Perils and Swiss Re Institute.

[20] Property and business interruption, excluding liability and life insurance losses;
US natural catastrophe figures based on Property Claim Services (PCS)/incl. NFIP losses (see "Terms and selection criteria" on page 42).
[21] Dead and missing.

Table 12
The 40 worst catastrophes in terms of victims (1970–2016)

Victims[19]	Insured loss[20] (USD mn, indexed to 2016)	Start date	Event	Country/region
300 000	–	11.11.1970	Storm and flood catastrophe	Bangladesh
255 000	–	28.07.1976	Earthquake (Mw 7.6)	China
222 570	110	12.01.2010	Earthquake (Mw 7.0), aftershocks	Haiti
220 000	2541	26.12.2004	Earthquake (Mw 9) triggers tsunami in Indian Ocean	Indonesia, Thailand, et. al.
138 373	–	02.05.2008	Tropical cyclone Nargis, Irrawaddy Delta flooded	Myanmar, Bay of Bengal
138 000	4	29.04.1991	Tropical cyclone Gorky	Bangladesh
87 449	409	12.05.2008	Earthquake (Mw 7.9) in Sichuan	China
74 310	–	08.10.2005	Earthquake (Mw 7.6); aftershocks, landslides	Pakistan, India, Afghanistan
66 000	–	31.05.1970	Earthquake (Mw 7.9) triggers rock slide and floods	Peru
55 630	–	15.06.2010	Heat wave, temperatures of up to 40°C	Russia, Czech Republic
40 000	211	20.06.1990	Earthquake (Mw 7.4), landslides	Iran
35 000	1645	01.06.2003	Heat wave and drought in Europe	France, Italy, Germany, et. al.
26 271	–	26.12.2003	Earthquake (Mw 6.5) destroys 85% of Bam	Iran
25 000	–	07.12.1988	Earthquake (Mw 6.8)	Armenia
25 000	–	16.09.1978	Earthquake (Mw 7.7) in Tabas	Iran
23 086	–	13.11.1985	Volcanic eruption on Nevado del Ruiz triggers lahars	Colombia
22 300	316	04.02.1976	Earthquake (Mw 7.5)	Guatemala
19 737	136	26.01.2001	Earthquake (Mw 7.6) in Gujarat	India, Pakistan
19 118	1441	17.08.1999	Earthquake (Mw 7.6) in Izmit	Turkey
18 451	37 344	11.03.2011	Earthquake (Mw 9.0) triggers tsunami	Japan
15 000	144	29.10.1999	Tropical cyclone 05B in Orissa	India
14 204	–	20.11.1977	Tropical cyclone in Andhra Pradesh	India
11 683	589	22.10.1998	Hurricane Mitch in Central America	Honduras, Nicaragua, et. al.
11 069	–	25.05.1985	Tropical cyclone in Bay of Bengal	Bangladesh
10 800	–	26.10.1971	Odisha cyclone, flooding in Bay of Bengal	India
10 000	317	12.12.1999	Floods, mudflows and landslides	Venezuela
9500	1056	19.09.1985	Earthquake (Mw 8.0)	Mexico
9475	0.4	30.09.1993	Earthquake (Mw 6.4)	India
8960	162	25.04.2015	Earthquake Mw 7.8	Nepal, India, China, Bangladesh
8135	525	08.11.2013	Typhoon Haiyan, storm surge	Philippines, Vietnam, China, Palau
7079	–	17.08.1976	Earthquake (Mw 7.1) triggers tsunami in Moro Gulf	Philippines
6434	3893	17.01.1995	Great Hanshin earthquake (Mw 6.9) in Kobe	Japan
6304	–	05.11.1991	Typhoon Thelma (Uring)	Philippines
6000	–	02.12.1984	Accident in chemical plant – methyl isocyanates released	India
6000	–	01.06.1976	Heat wave, drought	France
5749	48	27.05.2006	Earthquake (Mw 6.4); Bantul destroyed	Indonesia
5748	515	14.06.2013	Floods caused by heavy monsoon rains	India
5422	–	25.06.1976	Earthquake (Mw 7.1)	Indonesia
5374	–	10.04.1972	Earthquake (Mw 6.6) in Fars	Iran
5300	–	28.12.1974	Earthquake (Mw 6.0)	Pakistan

Note: Mw = moment magnitude scale.
Source: Cat Perils and Swiss Re Institute.

[22] Dead and missing
[23] Property and business interruption, excluding liability and life insurance losses.

Terms and selection criteria

A natural catastrophe is caused by natural forces.

Natural catastrophes

The term "natural catastrophe" refers to an event caused by natural forces. Such an event generally results in a large number of individual losses involving many insurance policies. The scale of the losses resulting from a catastrophe depends not only on the severity of the natural forces concerned, but also on man-made factors, such as building design or the efficiency of disaster control in the afflicted region. In this *sigma* study, natural catastrophes are subdivided into the following categories: floods, storms, earthquakes, droughts/forest fires/heat waves, cold waves/frost, hail, tsunamis, and other natural catastrophes.

A man-made or technical disaster is triggered by human activities.

Man-made disasters

This study categorises major events associated with human activities as "man-made" or "technical" disasters. Generally, a large object in a very limited space is affected, which is covered by a small number of insurance policies. War, civil war, and war-like events are excluded. *sigma* subdivides man-made disasters into the following categories: major fires and explosions, aviation and space disasters, shipping disasters, rail disasters, mining accidents, collapse of buildings/bridges, and miscellaneous (including terrorism). In Tables 9 and 10 (pages 23–39), all major natural catastrophes and man-made disasters and the associated losses are listed chronologically.

Losses due to property damage and business interruption that are directly attributable to major events are included in this study.

Economic losses

For the purposes of the present *sigma* study, economic losses are all the financial losses directly attributable to a major event, ie damage to buildings, infrastructure, vehicles etc. The term also includes losses due to business interruption as a direct consequence of the property damage. Insured losses are gross of any reinsurance, be it provided by commercial or government schemes. A figure identified as "total damage" or "economic loss" includes all damage, insured and uninsured. Total loss figures do not include indirect financial losses – ie loss of earnings by suppliers due to disabled businesses, estimated shortfalls in GDP and non-economic losses, such as loss of reputation or impaired quality of life.

The amount of the economic losses is a general indication only.

Generally, total (or economic) losses are estimated and communicated in very different ways. As a result, they are not directly comparable and should be seen only as an indication of the general order of magnitude.

The term "losses" refer to insured losses, but do not include liability.

Insured losses

"Losses" refer to all insured losses except liability. Leaving aside liability losses, on one hand, allows a relatively swift assessment of the insurance year; on the other hand, however, it tends to understate the cost of man-made disasters. Life insurance losses are also not included.

NFIP flood damage in the US is included.

NFIP flood damage in the US

The *sigma* catastrophe database also includes flood damage covered by the National Flood Insurance Program (NFIP) in the US, provided that it fulfils the *sigma* selection criteria.

Selection criteria
sigma has been publishing tables listing major losses since 1970. Thresholds with respect to casualties – the number of dead, missing, severely injured, and homeless – also make it possible to tabulate events in regions where the insurance penetration is below average.

Thresholds for insured losses and casualties in 2016

For the 2016 reporting year, the lower loss thresholds were set as follows:

Insured losses (claims):		
	Maritime disasters	USD 19.9 million
	Aviation	USD 39.8 million
	Other losses	USD 49.5 million
or Total losses:		USD 99.0 million
or Casualties:		
	Dead or missing	20
	Injured	50
	Homeless	2000

Source: Cat Perils and Swiss Re Institute.

Adjustment for inflation, changes to published data, information

Losses are determined using year-end exchange rates and are then adjusted for inflation.

sigma converts all losses for the occurrence year not given in USD into USD using the end-of-year exchange rate. To adjust for inflation, these USD values are extrapolated using the US consumer price index to give current (2016) values.

This can be illustrated by examining the insured property losses arising from the floods which occurred in the UK between 29 October abd 10 November 2000:

Insured loss at 2000 prices: USD 1 045.7 million
Insured loss at 2016 prices: USD 1 457.5 million

Alternatively, were one to adjust the losses in the original currency (GBP) for inflation and then convert them to USD using the current exchange rate, one would end up with an insured loss at 2016 prices of USD 1 192.5 million, 18% less than with the standard *sigma* method. The reason for the difference is that the value of the GBP declined by almost 18% against the USD in the period 2000–2016. The difference in inflation between the US (39.4%) and the UK (38.5%) over the same period was slightly less than 1%.

Figure 9
Alternative methods of adjusting for inflation, by comparison

Floods UK		**Exchange rate**		**US inflation**
29 October–10 November 2000	GBPmn	USD/GBP	USDmn	USDmn
Original loss	700.0	1.494	1045.7	1045.7
Level of consumer price index 2000	72.7			100.0
Level of consumer price index 2016	100.7			139.4
Inflation factor	1.385			1.394
Adjusted for inflation to 2016	969.3	1.230	1192.5	1457.5
Comparison			82%	100%

Source: Swiss Re Institute.

Changes to loss amounts of previously published events are updated in the *sigma* database.

If changes to the loss amounts of previously published events become known, *sigma* takes these into account in its database. However, these changes only become evident when an event appears in the table of the 40 most costly insured losses or the 40 disasters with the most fatalities since 1970 (See Tables 11 and 12 on pages 40–41).

Only public information used for man-made disasters

In the chronological lists of all man-made disasters, the insured losses are not shown for data protection reasons. However, the total of these insured losses is included in the list of major losses in 2016 according to loss category. *sigma* does not provide further information on individual insured losses or about updates made to published data.

Sources

Newspapers, direct insurance and reinsurance periodicals, specialist publications and other reports are used to compile this study.

Information is collected from newspapers, direct insurance and reinsurance periodicals, specialist publications (in printed or electronic form) and reports from insurers and reinsurers.[24] In no event shall Swiss Re be liable for any loss or damage arising in connection with the use of this information (see the copyright information on backpage).

Exchange rate used, [25] national currency per USD

Country	Currency	Exchange rate, end 2016
United Arab Emirates	AED	3.6724
Australia	AUD	1.3808
Canada	CAD	1.3408
Europe	CHF	1.0162
China	CNY	6.9444
Costa Rica	CRC	555.5556
Egypt	EGP	18.1488
Euro area	EUR	0.9481
Fiji	FJD	2.1142
UK	GBP	0.8089
India	INR	68.0272
Japan	JPY	116.2791
South Korea	KRW	1250
Sri Lanka	LKR	149.2537
New Zealand	NZD	1.4339
Oman	OMR	0.3850
Philippines	PHP	49.5050
Qatar	QAR	3.6417
Russia	RUB	60.9756
Tonga	TOP	2.3095
Taiwan	TWD	32.3625
US	USD	1.0000
South Africa	ZAR	13.6799

Source: Swiss Re Institute.

[24] Natural catastrophes in the US: those *sigma* figures which are based on estimates of Property Claim Services (PCS), a unit of the Insurance Services Office, Inc (ISO), are given for each individual event in ranges defined by PCS. The estimates are the property of ISO and may not be printed or used for any purpose, including use as a component in any financial instruments, without the express consent of ISO.
[25] The losses for 2016 were converted to USD using these exchange rates. No losses in any other currencies were reported

Recent *sigma* publications

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