Gallagher Re Natural Catastrophe Report of 2022

Expert analysis and insurance implications

JANUARY 2023

Gallagher Re

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Welcome to the Gallagher Re Natural Catastrophe Review of 2022.

During 2022, the world saw another year of impactful natural catastrophe events that once again emphasized the need to better account for the growing risks that these hazards bring.

Total insured losses were estimated at USD 140bn, of which USD 125bn was covered by private insurers and USD 15bn by public insurance entities (example: US National Flood Insurance Program). Gallagher Re notes that 2022 became the fifth year since 2017 to cross the USD 100bn threshold.

The increase in severity and in some cases frequency of events—particularly when focusing on secondary perils—presents reinsurers with a multifaceted and complicated challenge when it comes to risk protection and mitigation.

In this report, we summarize the major catastrophe events that occurred in each region around the globe in 2022, detailing the financial loss, fatalities, and other major considerations for our clients and beyond. A summary of major global events can be found in the appendix. All data estimates are from Gallagher Re, unless stated otherwise.

This report also aims to help readers give greater thought to how topics such as climate change, inflation and social inflation, and the macroeconomic environment are driving new and emerging types of risk. The risk profile faced by the private sector, governmental entities and beyond continues to evolve as new challenges arise.

Readers of this report can expect to:

- Explore global and regional catastrophe hazard and loss drivers
- Learn which regions have undergone higher annual losses
- Better understand climate change influence on individual event behavior and impacts

At Gallagher Re, we provide dedicated analytical, product and practice support to help our clients quantify, understand and more thoughtfully develop strategies to better assess their natural catastrophe risk. This includes developing partnerships and collaborations with institutions via our Gallagher Research Centre. We thank you for your support and look forward to helping you navigate your way through whatever challenges Mother Nature may bring in 2023.

Steve Bowen
Chief Science Officer
Gallagher Re

GLOBAL NATURAL CATASTROPHE OVERVIEW

Ian Dominates in Complicated Catastrophe Year

Natural hazard mitigation and adaptation needs amplify as annual cat losses show continued growth

2022 was a year marked by costly, consequential and historic natural catastrophe events around the world. The estimated economic cost of natural hazards was listed at USD 360bn. Private and public insurance entities covered USD 140bn, meaning 61% of global disaster losses were not covered by insurance, demonstrating the protection gap.

It was also another year where climate change, exposure growth and social inflation were the clear primary driving forces of loss.

The fingerprints of climate change were visible on virtually every major weather and climate event in 2022, once again highlighting the urgency to implement proper planning and investment strategies that will limit the risk to life and property.

How we collectively bring together financial institutions (insurance, asset managers, real estate, banking), governmental entities, academia, and emergency management to identify risk and implement actionable plans to improve our resilience, mitigation, and adaptation readiness will have hugely positive impacts on trying to slow the rate of annual catastrophe loss growth.

US Dominates Loss Costs

The US endured several large-scale and impactful events in 2022, led by Hurricane Ian. The storm was poised to result in at least USD 55bn loss for public and private insurance entities, and an overall economic loss of USD 112bn in the US alone. This marked one of the costliest natural disaster events ever recorded globally. The country also endured a prolific drought that was expected to result in USD 9bn in indemnity payouts via the United States Department of Agriculture (USDA) Risk Management Agency (RMA) crop insurance program. At least three Severe Convective Storm (SCS) outbreaks resulted in a multibillion-dollar insured loss, with 2022 marking the 15th consecutive year with aggregate insured SCS losses topping USD 10bn and the 8th year since 2010 that such losses have topped USD 20bn. A prolific late December winter storm and extreme cold snap led to significant societal disruption via power outages and impacted crops across a huge swath of the lower 48 states. This put a further spotlight on losses associated with secondary perils.

"A prolific late December winter storm and extreme cold snap led to significant societal disruption via power outages and impacted crops across a huge swath of the lower 48 states."

Historic and Consequential Global Events

The costliest event and one of the most consequential from a humanitarian perspective outside the US was the prolific seasonal monsoon flooding in Pakistan. A report from the World Bank cited a USD 15bn direct physical damage economic loss, while the country's National Disaster Management Authority cited 1,739 fatalities, 2.3 million homes damaged and 33 million people affected across 90 districts. Historic flooding also impacted several regions of Africa, notably in Nigeria where the country's insurance industry faced its most expensive natural catastrophe on record. The effects of a third consecutive La Niña occurrence were quite pronounced in Australia: the Insurance Council of Australia stated weather-related events had resulted in nearly USD 5bn in payouts alone, primarily from a historic flood event in late February and March.

Other notable events included a series of record summer heat waves in Europe that led to excess mortality totals into the tens of thousands; a powerful March offshore earthquake in Japan; record-setting SCS activity in France; extensive drought conditions across South America, Europe and parts of Asia; typhoon landfalls in Japan and the Philippines; Hurricane Fiona landfalls in Puerto Rico and Canada; multiple strong European windstorm vents to wrap the 2021–2022 season; and an intense May derecho in Canada.

Role of Climate Change

The implications of climate change on daily weather and climate events continues to become better understood. However, it remains a lengthy journey in defining how confident we are in our comprehension of what climate change will look like in its influence on individual events. New research from the academic realm has further identified how climate change is affecting the behavior of individual events, but it is not a linear interpretation. There are distinct differences on a per-peril and per-region basis. .

The following graphic attempts to simplify the current confidence levels in scientific research regarding how climate change is influencing individual perils. Temperature- and precipitation-focused perils are most confidently understood, but SCSs remain at the bottom of academia's current understanding.

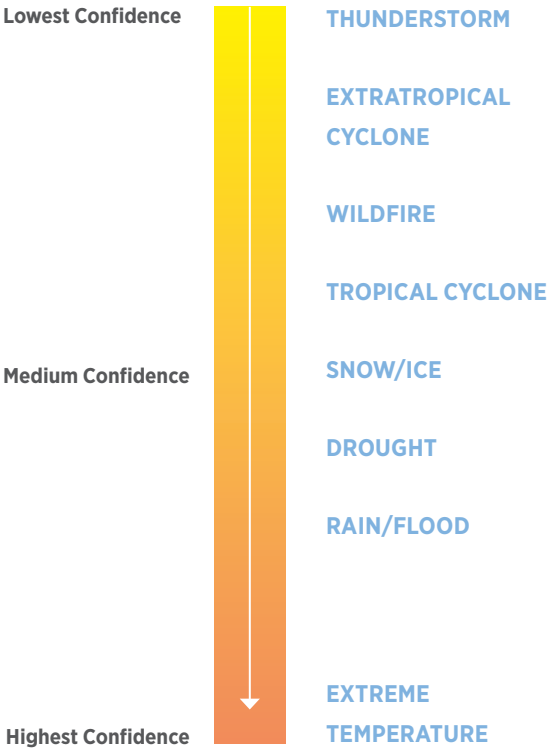


Figure 1: Current confidence in climate change attribution to individual perils
Source: Attribution of Extreme Weather Events in the Context of Climate Change

Most focus in the general public has typically been on event frequency. While it is expected that some perils may see an increased frequency of occurrence, the reality is that most global hazard event data sets do not show any obvious upward trends beyond anomalous years that may be more influenced by the phase of El Nino Southern Oscillation (ENSO). Where climate change is currently most evident is in the behavior or intensity of individual events. This includes but is not limited to:

- Higher percentage of tropical cyclones reaching Category 3, 4 or 5 on the Saffir-Simpson Hurricane Wind Scale
- Heavier precipitation (rain/snow) per event
- More intense and prolonged droughts
- Larger, faster-moving wildfires
- Greater extreme temperature events (hot/cold) as the jet stream becomes more undulated or blocked

Following a year in 2022 where virtually every continent on Earth was exposed to some type of record-breaking weather or climate activity, it grows more important by the day to account for the physical and nonphysical risks posed by climate change. Such risks are no longer hypothetical. They are already here.

It is also worth mentioning that there is a growing focus from private financial industries on how to more effectively build climate change into their climate and environmental, social, and governance (CESG) strategies. With the regulatory market around the world putting more emphasis on climate-related financial disclosures or rating agencies beginning to score companies based on their CESG performance, there is a growing need for financial firms to meet the growing demands on portfolio decarbonization and carbon accounting.

At Gallagher Re, there is a strong emphasis to invest internally and externally to build solutions that target three specific types of CESG risk: 1) physical risk, 2) transition risk and 3) liability risk. Each type of risk is a critical component within the broader CESG story, and the time to deliver innovative solutions with these risks is now.

Takeaways From IPCC AR6 and COP27

2022 marked an important year that featured the final two Working Group releases of the Sixth Assessment Report of the United Nations Intergovernmental Panel on Climate Change (IPCC AR6) and a November meeting of the 27th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP27). The aim of these high-profile facilities primarily focused on beginning to shift away from the identification of risk to actual implementation of policy recommendations that are vital to limit carbon emissions and subsequent temperature rises. The sense of urgency grows as the effects of climate change become more visible.

IPCC AR6: Working Group II and III Key Takeaways

- Climate change impacts are occurring at a faster pace than initially anticipated
- Adaptation processes are underway, but severe gaps exist between developed and less affluent economies
- Declining greenhouse gas (GHG) emissions and carbon reduction policies are reducing the chance of worst-case-scenario warming
- Climate financing and targeted funding capital will be critical to initiate meaningful mitigation/resilience efforts

COP27 Key Takeaways

- International agreement signed to finance loss and damage initiative that requires higher greenhouse gas (GHG)-emitting countries to subsidize lower-income nations most affected by climate change despite emitting the least GHGs
- Greater focus on accountability for goverments and private institutions that do not meet stated carbon goals
- Time to translate planning exercises into actual implementation of carbon reduction and climate investment

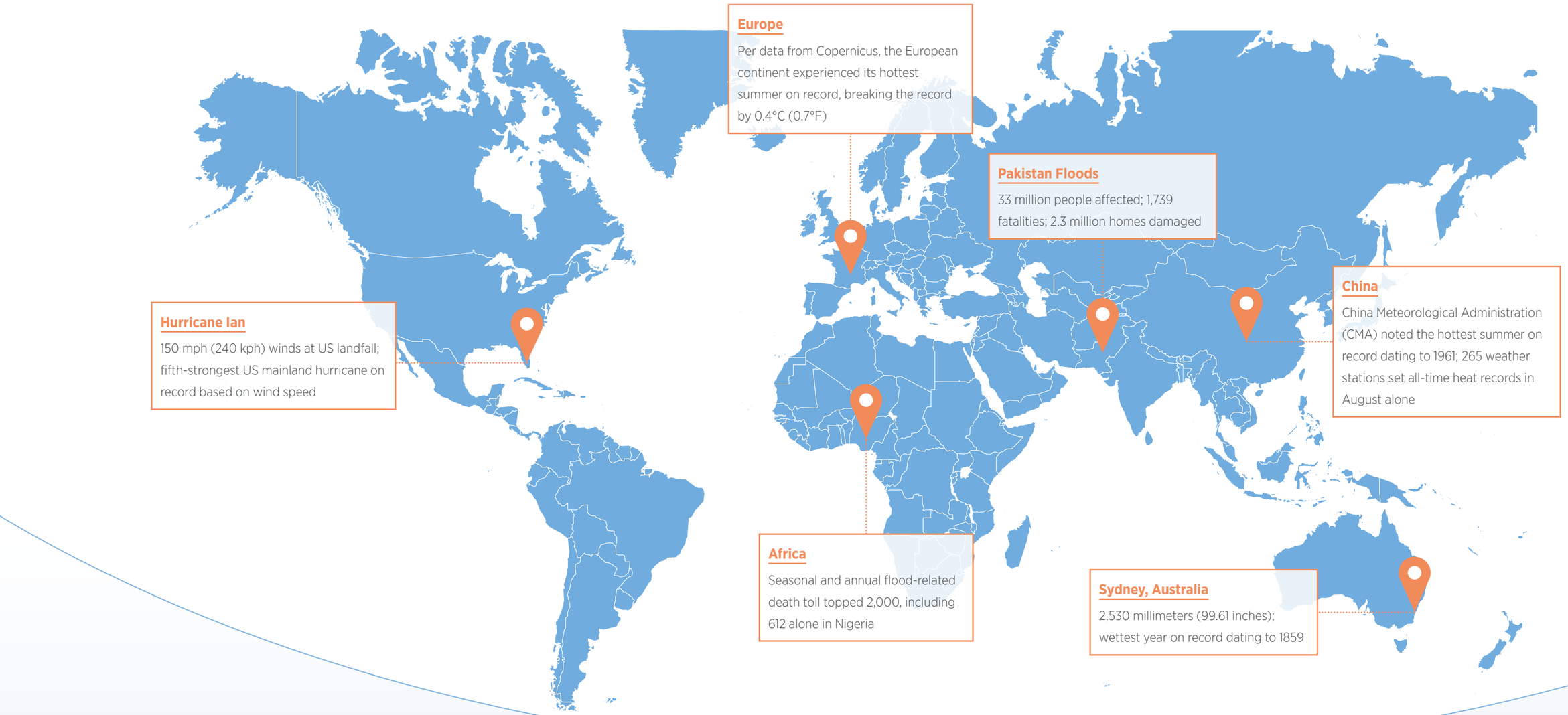
Why Policy Reform Matters

The biggest challenge in today's news cycle is maintaining positive momentum on enacting meaningful policy reforms that put the world on a more environmentally friendly and socially acceptable path forward. The European Union has been among the most proactive from a policy standpoint. It notably released the European Green Deal in 2020 that legally binds countries to collectively cut GHG emissions by 55% compared to 1990 levels as of 2030 and achieve net-zero carbon emissions by 2050. The US, the world's No. 2 carbon emitter, passed the Inflation Reduction Act in 2022, which included USD 370bn in climate change-related funding. The US Department of Energy noted this investment would bring GHG emissions to 40% of 2005 levels by 2030 and would also position the country to the goal of the goal of 50% to 52% of 2005 GHG emissions by 2030.

While these are merely two examples of recent policy reform, they are important to highlight. It will be key for the rest of the world's largest carbon emitters to adopt similar reforms. The science is clear that a warming atmosphere and oceans will bring more intense, impactful and costly disasters than we saw in 2022. We will never be able to reduce the risk to life and property to zero, but can make meaningful steps to limit it.

"The US, the world's No. 2 carbon emitter, passed the Inflation Reduction Act in 2022, which included USD 370bn in climate change-related funding. The US Department of Energy noted this investment would bring GHG emissions to 40% of 2005 levels by 2030 and would also better position the country to achieve the goal of 50% to 52% of 2005 GHG emissions by 2030."

Global Natural Hazard: Notable Statistics in 2022



NOAA: Sixth-warmest year on record for global land and ocean temperatures; 0.86°C (1.55°F) above the 20th century average

UK: All-time heat record of 40.3°C (104.5°F) set on July 19 in Coningsby, Lincolnshire; previous UK record was 38.7°C (101.7°F) in 2019

CMA: Yangtze River, the world's third longest, reached its lowest summer/peak monsoon season water height in 150 years of record-keeping

NOAA: New daily carbon dioxide (CO_2) record of 422.06 parts per million (PPM) on April 26, 2022, at NOAA's Mauna Loa Atmospheric Baseline Observatory in Hawaii

Hurricane Fiona: Made landfall in Nova Scotia with a central pressure of 931 millibars, the lowest for a Canadian landfalling storm on record; became the costliest hurricane in the history of Canada's insurance industry

Hunga Tonga/Hunga Ha'apai volcano: January 15 eruption sent atmospheric shock waves around the globe and volcanic plume debris reached as high as 58 kilometers (36 miles) into the air

US wildfires: Hermits Peak & Calf Canyon Fires combined to become New Mexico's largest and most destructive fire on record; 341,471 acres (138,188 ha); 903 structures destroyed

May 21 Canada derecho: Traveled 1,000+ kilometers (620+ miles) across southeast Canada's most populous corridor

US: 236 tornadoes in March; highest number of March tornadoes on record

Horn of Africa: 50 million people facing food insecurity following the worst drought in decades

India: India Meteorological Department (IMD) noted that it was the hottest March in 122 years

Japan: Japan Meteorological Administration (JMA) cited the hottest summer ever recorded dating to 1875; Tokyo recorded a record nine consecutive days with 35°C (95°F) temperatures

Global Natural Catastrophe Event Summary

2022 was a year marked by one exceptionally large catastrophic loss event and many moderately large events that aggregated to high economic and insured loss totals. Highlighting the enormity of the event, Hurricane Ian's economic and insured losses represented 32% and 39%, respectively, of the globe's entire annual total. The following table highlights the 11 events that resulted in a multibillion-dollar insured loss.

Event	Date(s)	Region	Fatalities	Economic Loss (USD)*	Insured Loss (USD)*
Hurricane Ian	Sept. 27–Oct. 1	US and Cuba	137	115bn	55bn
US Drought	Annual	US	N/A	21bn	9.0bn
Windstorms Dudley, Eunice, Franklin	Feb. 16–31	Europe	31	5.9bn	4.3bn
Eastern Australia Floods	Feb.–March	Oceania	22	6.8bn	4.0bn
France Drought/Subsidence	Annual	Europe	N/A	8.0bn	3.3bn
North America Winter Weather	Dec. 21–26	US and Canada	91	4.5bn	3.1bn
Japan Earthquake	March 16	Asia	3	8.5bn	2.8bn
US Severe Convective Storms	June 11–17	US	3	3.6bn	2.8bn
US Severe Convective Storms	April 10–14	US	1	2.8bn	2.3bn
US May Derecho	May 11–12	US	5	2.7bn	2.2bn
Storms Petra and Qiara	June 19–24	Europe	3	2.6bn	2.1bn

~50,000
Estimated Fatalities

USD 360bn
Economic Loss

USD 140bn
Insured Loss

*Estimates are subject to change. Insured loss totals include private and public insurance entities (such as the U.S. National Flood Insurance Program or the USDA's RMA Crop Insurance Program).

Figure 2: Natural Catastrophe Event Summary | **Source:** Gallagher Re

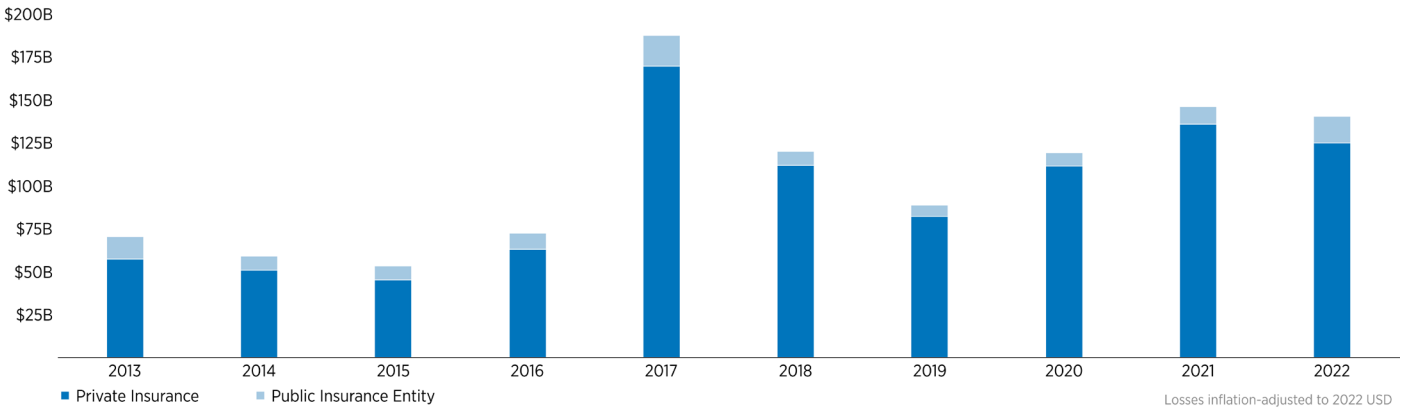


Figure 3: The last 10 years (2013-2022) of global insured losses index to today's dollars | **Source:** Gallagher Re

The topic of primary versus secondary perils has taken on heightened significance in recent years as these so-called secondary perils—marked by higher-frequency/lower-cost events—have shown accelerating loss growth and often aggregate to higher annual totals. Secondary perils were again the most expensive on an economic basis and exceeded those on the insured loss side.

- **Primary perils** (Economic/Insured): USD 149bn (41%)/USD 67bn (48%)
- **Secondary perils** (Economic/Insured): USD 211bn (59%)/USD 73bn (52%)

The US accounted for 53% of global economic losses and 74% of insured losses. The country boasts the most robust insurance market in the world and it is typically the predominant annual driver in insured losses given its regular frequency of high-dollar catastrophe events.

Additional year-end natural catastrophe statistics include:

- **Top three costliest perils (economic):** tropical cyclone (USD 130bn); drought (USD 77bn); flood (USD 65bn)
- **Top three costliest perils (insured):** tropical cyclone (USD 59bn); SCS (USD 39bn); drought (USD 15bn)
- **Billion-dollar natural catastrophe events (economic):** 43 (all)/42 (weather only)
- **Billion-dollar natural catastrophe events (insured):** 20 (all)/19 (weather only)

The main drivers of large weather events in 2022 were multi-faceted. The most important influencing factor on the year's weather events came from a prolonged La Niña cycle that brought more intense flooding and drought conditions to many parts of the world. As the year ended, La Niña conditions remained active, and it was forecast to extend into a third consecutive annual cycle through the first months of 2023 before transitioning to ENSO-neutral and possibly to El Niño later in 2023.

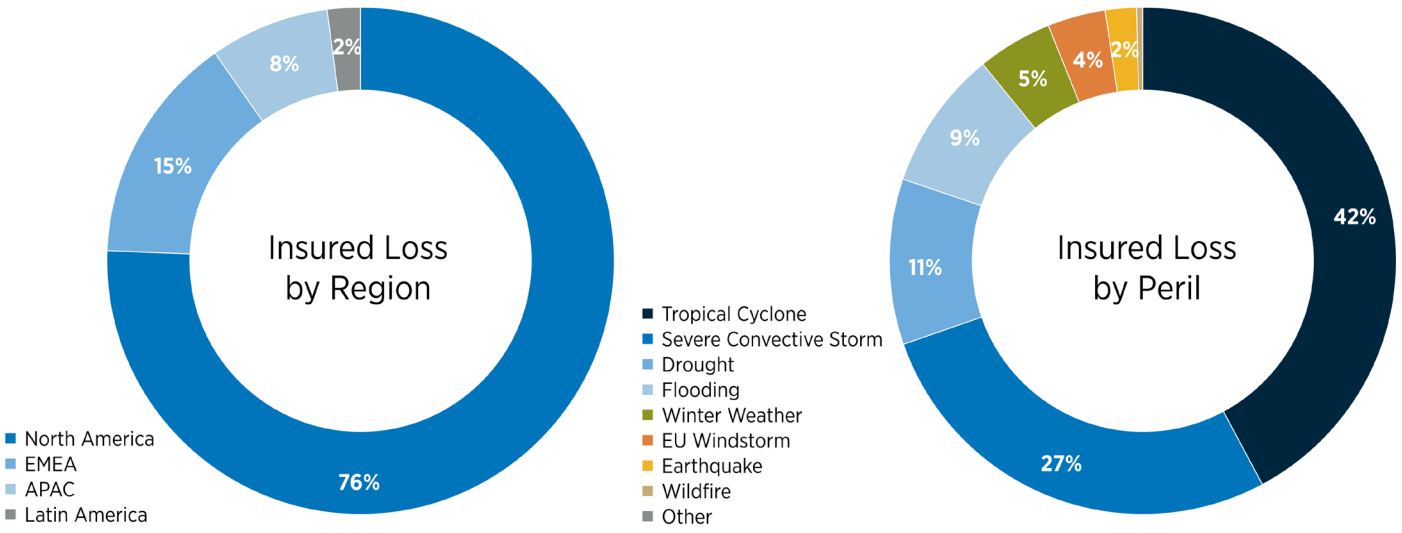


Figure 4: A regional and peril breakout of global insured losses during 2022 | **Source:** Gallagher Re

US/Americas

The largest insured loss from a single event came from September's landfall of Hurricane Ian. The estimated USD 55bn in wind- and water-/flood-related losses that were prolific across the state of Florida. Ian ranked as the second-costliest natural hazard event on record regardless of peril from an insurance perspective. The only other hurricane to make landfall during the 2022 Atlantic hurricane season was Hurricane Fiona. That storm led to catastrophic flooding in Puerto Rico before tracking northward and striking the Canadian Maritimes as a strong extratropical cyclone. Overall, the Atlantic hurricane season was near-average, with 14 named storms, eight hurricanes and two major hurricanes (Category 3+).

SCS events were again considerable in the US and Canada. There were at least seven SCS outbreaks (six in the US and one in Canada) resulted in at least USD 1bn in insured losses. A significant portion of the losses were due to large hail and damaging winds (including multiple North American derechos). Data from NOAA showed that the US preliminarily recorded roughly 1,200 tornadoes in 2022—a near-normal tally—though a March record of 236 tornadoes occurred. Exceptional drought conditions continued to affect large swaths of North and South America. Total combined economic losses were estimated in excess of USD 43bn, mostly in the US and Brazil. Extreme winter weather engulfed the US and Canada in late December.

EMEA

Several major weather catastrophes affected the European continent, though the most deadly arose from a series of intense heat waves in June, July and August that led to tens of thousands of fatalities. The three months marked the hottest summer ever recorded for Europe and exacerbated major drought conditions that led to widespread agricultural impacts. The year originally saw a series of windstorms in February (Dudley/Ylenia, Eunice/Zeynep, Franklin/Antonia) that resulted in USD 4.3bn in insured losses. The full 2022 calendar year saw European windstorm loss exceed USD 5bn for insurers. During the summer months, significant and highly damaging hailstorms resulted in more than USD 5.0bn in insured losses from more than one million filed claims in France alone.

Record-breaking flooding swept across several regions of Africa and resulted in at least 2,000 fatalities. Historic flood-related insurance losses were generated in Nigeria and South Africa. On the opposite extreme, the worst drought in decades left more than 30 million people facing food insecurity challenges in the Horn of Africa.

APAC

Historic flooding in Pakistan led to USD 15bn in direct physical damage, with additional losses to GDP estimated at another USD 15bn and a societal disruption to 33 million people. Extremely limited insurance takeup meant most damage was uninsured. Flooding also led to billions (USD) in damage across parts of India, China, South Korea and Thailand. A subdued Western North Pacific typhoon season saw manageable damage impacts. The most notable were Nanmadol and Talas in Japan, Hinnamnor in South Korea, and Nalgae in the Philippines. The continent's costliest non-weather disaster was an offshore Japan earthquake on March 16 that led to an estimated USD 8.5bn in economic damage.

Australia weathered the impacts of La Niña bringing incessant rainfall to the country's east coast. One prolific event in late February and March led to an estimated USD 4.0bn in insured losses across parts of New South Wales and Queensland.

"During the summer months, significant and highly damaging hailstorms resulted in more than USD 5bn in insured losses from more than one million filed claims in France alone."

IN FOCUS

Hurricane Ian: What Was Learned and What Happens Next

Hurricane Ian will long be remembered as one of the most consequential hurricanes on record for the global insurance industry and local residents in southwest Florida. The high-end Category 4 storm made landfall on September 28, with 150 mph (240 kph) winds and brought upward of 15 feet (4.6 meters) of storm surge in areas from Cape Coral to Fort Myers, Florida. Ian later crossed the Florida Peninsula and briefly emerged in the Atlantic Ocean before making a final landfall as a Category 1 storm with 85 mph (135 kph) winds in South Carolina.

The economic toll from Ian was USD 112bn in the US alone and marked one of the costliest tropical cyclones ever recorded globally, regardless of peril. Public and private insurance entities noted that as much as USD 55bn was insured. This marked just the second event in the insurance industry's history to reach USD 50bn on a nominal or inflation-adjusted threshold, second only to Hurricane Katrina (USD 99bn in 2022 terms).

Ian became one of Florida's costliest hurricanes on record, even after attempting to account for today's population, exposure (building stock), construction quality and other miscellaneous wealth metrics. It was also yet another tropical cyclone that underwent a period of rapid intensification so near to the point of landfall. Such behavior aligns with ample peer-reviewed scientific literature that attempts to identify a climate change signal in tropical cyclones.

For a full recap on Hurricane Ian's meteorological background, historical context, findings from Gallagher Re's on-the-ground damage survey, the role of climate change and financial implications, please click here.

Hurricane Ian

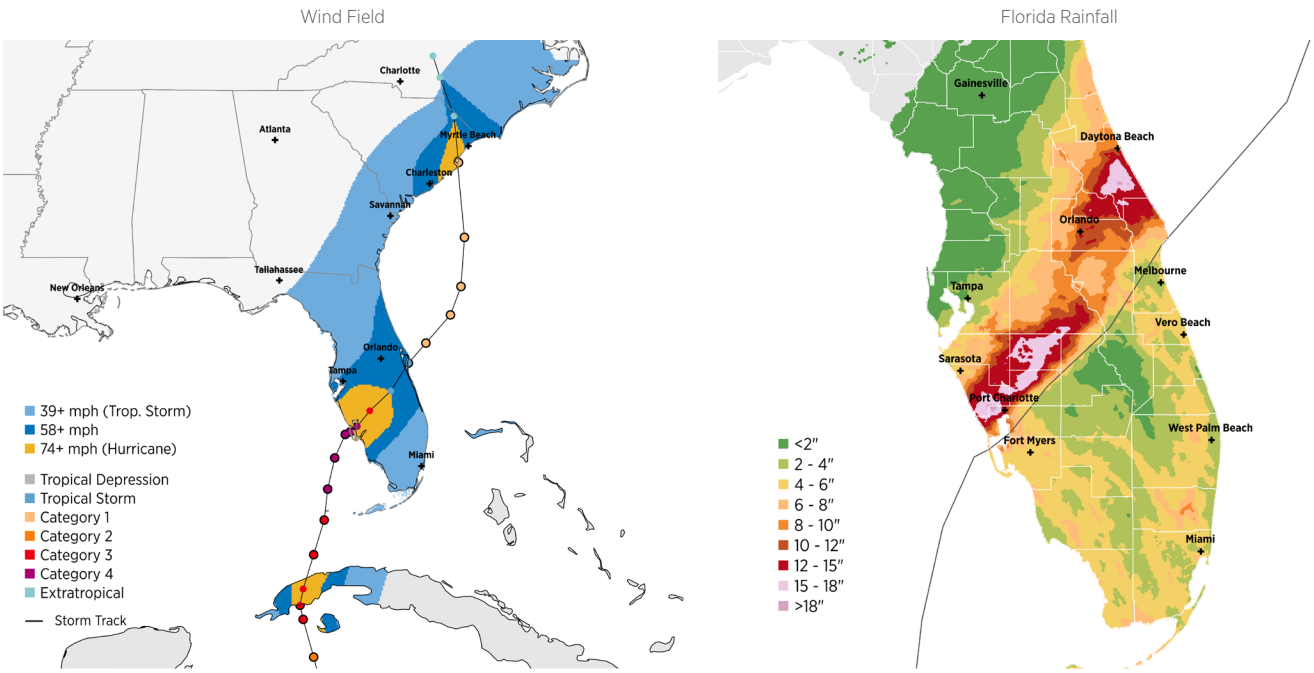


Figure 5: Track of Hurricane Ian showing its full wind field and rainfall across Florida | **Source:** NOAA

Ian Losses: It Could Have Been Worse

The scope of Ian's damage footprint was extensive across the Florida peninsula and into parts of South Carolina and elsewhere in the US southeast/Mid-Atlantic. The prominent nature of wind- and water-related impacts in Florida alone served as the latest reminder of how consequential tropical cyclones can be. This is also true in areas that are known to be most vulnerable to this type of risk and are considered best prepared to handle the highest-intensity events. While the damage from Ian was considerable in Florida, it is worth noting that the loss costs and associated damage could have been even more severe if not for a variety of factors.

A ground assessment by Gallagher Re colleagues a week after Ian's landfall worked to determine engineering success stories and where opportunities existed to better build in southwest Florida. Unsurprisingly from a wind perspective, the most damage was associated with older constructed properties prior to the enactment of updated building codes during the past 10–15 years. However, much of the Florida peninsula has seen anywhere from 25% to 50% of its entire housing unit stock built since 2000. This reason alone meant that a higher percentage of homes and commercial properties in southwest Florida were built to modern building construction mandates required by the state to withstand wind speeds topping 150 mph (240 kph) near the coast during Ian. Like other recent Florida hurricanes (Michael and Irma), the wind-related portion of damage costs from Ian will result from a high volume of minor damage that aggregates to a high number.

The photos on this page from the Gallagher Re damage survey show wind-related success stories of modern construction.

Another reason for Ian losses being lower centered on the speed at which hurricane-force winds began to decay while traveling inland. There were considerable initial concerns that Ian would maintain hurricane winds far inland and potentially impact the Tampa or Orlando metropolitan regions. An even larger wind field could have led to further impacts in the Miami tricounty area (Miami-Dade, Broward, Palm Beach) as well. But in reality, Ian's top winds weakened and the hurricane-force wind field shrank prior to reaching those areas. The lower wind speeds helped limit the number of wind-damaged properties and subsequent filed claims.

However, as successful as properties were at withstanding the winds, the water component to Ian was considerable and consequential. Storm surge inundation exceeding 15 feet (4.6 meters) left substantial coastal damage near the landfall location and pushed water well inland. Heavy rains left some rivers above major flood stage, causing even more damage to homes, businesses and vehicles. A report by CARFAX indicated that as many as 358,000 vehicles were damaged by Ian alone.

Figure 6: Comparison of old versus new roof construction on Fort Myers Beach, Florida | **Source:** Arthur J. Gallagher & Co.

Figure 7: Higher quality construction in mid- and high-rises showed minimal wind damage during Ian | **Source:** Arthur J. Gallagher & Co.

Perhaps the biggest what-if scenario that would have resulted in even higher loss costs was a landfall path into the Tampa Bay area. Original forecasts had Ian taking such a path. Had Ian tracked 100 miles (160 km) further to the north, this would have resulted in the first major hurricane landfall for the Tampa metro area since October 1921.

This part of Florida is considered one of the most vulnerable areas for tropical cyclone impacts in the world given unique underwater topography (bathymetry) that can maximize the storm surge potential and affect a highly concentrated area with of population and exposure. The lack of historical hurricane activity in this part of Florida means a greater portion of homes built prior to modern construction requirements. If Ian had struck the Tampa Bay area, the storm-related losses would have likely been much higher.

Urgent Fix to Florida's Insurance Industry

Even prior to Hurricane Ian's arrival, the Florida insurance industry was under serious distress. Years of increasing natural catastrophe losses combined with accelerated costs tied to claims litigation and third-party assessments that forced more than a half-dozen Florida insurance carriers to file for bankruptcy. These factors led to skyrocketing premiums for policyholders.

An emergency legislative session was called in December 2022 that set out to address most of the main drivers that were challenging the state's insurance market. A bill was quickly passed and signed into law. A selection of the key components of the bill included:

- Elimination of assignment of benefits (AOB) practices, a process that allowed a third party to assess and file a claim to an insurance company on the insureds' behalf, and then directly receive payment from the policyholder's insurer
- Elimination of one-way attorney fees in lawsuits from residential or commerical property claims filings
- Requires property insurance carriers to accelerate claim payments and closures
- Created the Florida Optional Reinsurance Assistance Program, which is funded with USD 1bn in state revenue to supply property insurers a chance to buy more reinsurance protection at near-market rates
- More requirements to qualify for a Citizens Insurance policy, including the purchase of flood insurance.

It will take time to determine whether the bill will be effective in stabilizing the market. There are some concerns regarding consumer protection and whether premiums will decline following two years of significant growth. The rising premiums were seen as required to properly price the risk and ensure the solvency of carriers. The increased difficulty for insureds to be able to file a lawsuit against their insurer will also be an issue to monitor, to determine whether any loopholes exist in the new law that may not limit litigation costs as much as originally hoped.

What to Expect Next

There continues to be concrete evidence that proper building codes and enforcement can limit some wind-related risks from catastrophic tropical cyclone events. The challenge will be ensuring that all residents are given access to the proper tools to either retrofit their homes or build to a modernized set of construction codes that consider the storms of tomorrow. To give equitable opportunity for everyone, there will need to be work done by the public and private sector to guarantee available funding to aid lower-income residents in improving the structural integrity of their homes.

There also needs to be a goal of lowering the protection gap for these events around the world. Even mature economies like the US have a significant portion of tropical cyclone losses remaining uninsured, given known challenges regarding limited flood insurance takeup or underinsurance given inadequate maximum coverage levels. As scientific research continues to suggest slower-moving tropical cyclones and more precipitation accompanying these events, the water-related damage component is likely to accelerate.

The insurance industry remains in a unique position to be able to bring together various governmental, academic, emergency manager and financial institutions to collectively establish insurance products or communication channels to identify, mitigate and adapt against future higher-impact events.

The Role of (Social) Inflation on Natural Disaster Costs

Natural catastrophe losses have shown consistent annual growth in recent decades, with data showing that 2022 became the fifth out of the last six years (2017, 2018, 2020, 2021, 2022) to result in at least USD 100bn in insured losses. Gallagher Re cites the 2022 insured loss tally at USD 140bn. The primary driver of the increase has been well documented in peer-reviewed research as being tied to significant population and exposure (property) growth in highly vulnerable regions around the world. This means that losses are typically location driven, and natural catastrophes cause the most damage when they impact developed or heavily urbanized areas.

When combining exposure concerns with the reality of more intense weather events due to climate change enhancing the behavior of individual events, it only further adds to the resultant damage and subsequent physical or indirect nonphysical financial losses. These higher losses are adding notable strain to governmental entities, residential and commercial property owners, the insurance industry, and beyond.

Inflation and social inflation are also notable factors adding to these increased natural disaster costs, and are now driving a non-negligible portion of catastrophe losses annually. The focus of this piece will be primarily on the insurance industry and insured losses, but the broader points are applicable to the overall economic cost of individual events.

Inflation

The impact of inflation dominated headlines around the world in 2022. There were many variables driving some of the highest inflation in decades for most regions of the globe, including but not limited to the residual impacts of COVID-19, supply chain disruption and energy implications from the conflict in Ukraine. All of this coincided with elevated natural catastrophe activity. For the insurance industry, all these variables contributed to driving up the overall cost of filed and processed claims. While supply chain concerns and the cost of labor supplies were declining by the end of 2022, they were still juxtaposed by increased costs—due to a lack of available labor—and higher supply prices, driven by increased demand.

Another contributing factor of global inflation has been the multiyear rise in home and property values. Higher home prices combined with elevated prices for construction materials and other commodities mean the cost to repair or replace a home is much greater than it was even five years ago.

The US Census Bureau noted that the average single-family home sale price was USD 425,000 in January 2017 but had increased 33% to USD 565,000 in July 2022. In an effort to cool this growth, government financial entities around the world raised interest rates, which in turn caused mortgage rates to spike throughout 2022. These actions did ease the rate of monthly home value growth. But the fact remains that the higher cost of home and other property values alone has aided, in some cases, a double-digit percent increase to an individual paid insurance claim.

Similar issues surround the automotive market, where a lack of inventory due to prolonged microchip shortages and factory part availability led to skyrocketing costs. The part shortages not only resulted in a backlog of new car orders, but huge spikes in the global average cost of used vehicles. The US Bureau of Labor Statistics highlighted a 57% increase in the consumer price index for used cars and trucks between June 2020 and January 2022 in the US alone. As global inflation levels began to ease in November and December 2022, the cost of used cars also declined slightly, but remained historically high.

Inflationary pressure has not only put strain on primary insurance carriers through higher claims costs, but also the reinsurance sector. Reinsurers cited elevated costs associated with access to capital, which in turn fueled one of the hardest contract renewal cycles on January 1, 2023, in many years. The cyclical nature of a hard reinsurance market due to more expensive and higher-volume claims payouts from natural disasters, geopolitical tensions, inflation, etc., means that premiums at the policyholder level also faced a price reevaluation to ensure insurance carrier solvency and the health of the broader market.

Data from the International Monetary Fund to the right highlights the annual growth rates of inflation on a global level. It shows the continued differences of inflation depending on whether a market economy is more advanced, emerging or developing, and unfortunately indicates that the most vulnerable populations to natural catastrophe and climate change risk are also those with the most fragile economies.

Social Inflation

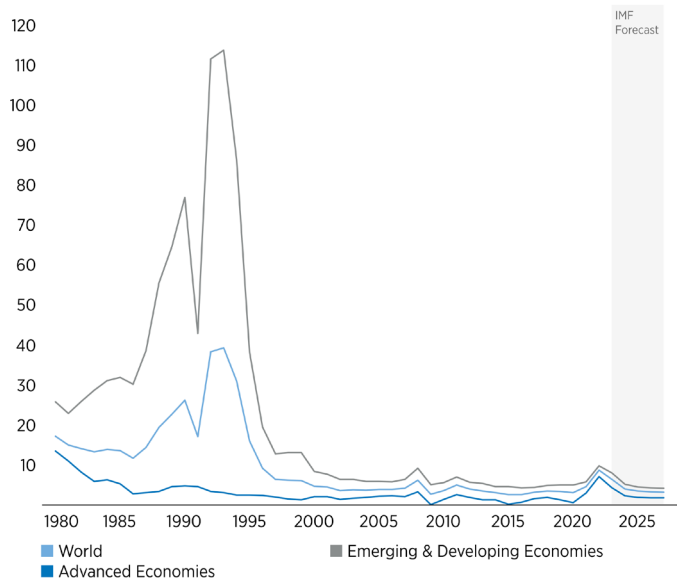
The acceleration of natural catastrophe loss costs can also be attributed to the concept of social inflation. This can broadly be defined in the insurance industry as the rise of claims costs for reasons beyond general inflationary parameters. Primary examples would involve claims litigation, third-party claims designations (assignment of benefits) or other liability issues. These factors have taken on enhanced influence in recent years, which has greatly added to final claims values. Many of these litigation cases involve fraudulent claims filings.

Issues surrounding the greater percentage of insurance claims being taken to court not only bring greater financial burden, but it prolongs the loss development of individual events. In the case of Hurricane Irma, which made landfall in Florida in September 2017, lawsuits were still in active trial phase more than five years later. Florida is a unique example since it has driven an outsize portion of claims litigation in the US. Such litigation exceeded USD 3bn in the state during 2019 alone. A recent commentary by Fitch Ratings noted that "[c]laims inflation has yet to be pushed up by social inflation or general inflation but we expect this to change in 2023, with negative implications for underwriting margins and reserves. Underestimating claims inflation for liability lines is one of the most significant risks for reinsurers." This could have particular influence on global underwriting performance and reinsurer earnings.

The following graphics show how the state of Florida has driven a significant portion of claims litigation in the US, which has in turn led to significantly increased homeowner premium rises as insurers have been forced to filter these costs down to the policyholder. This also shows that despite accounting for just 9% of homeowner claim filings, the state makes up nearly 80% of all lawsuits in the US.

Global Inflation (Annual % Growth)

By Economy Type



By Region

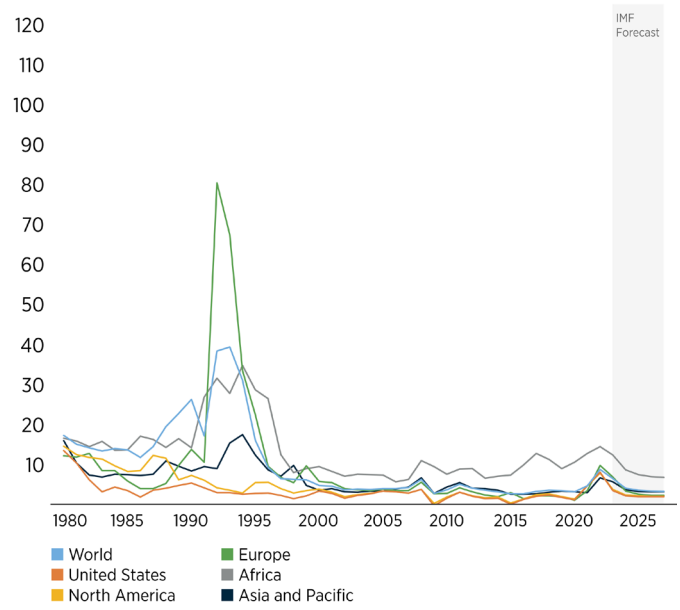
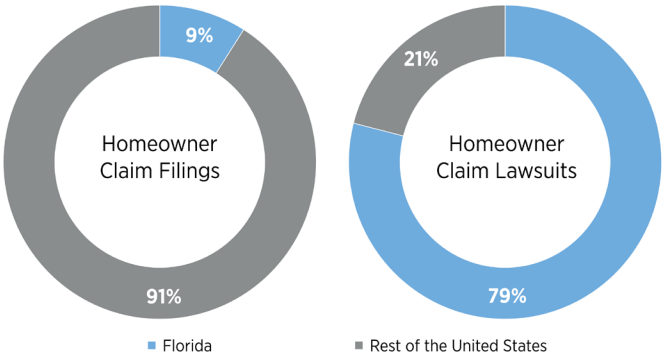
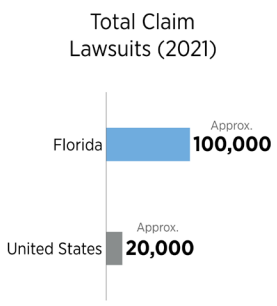


Figure 8: Annual rate (%) of global inflation by economy type and region of the world
Source: International Monetary Fund





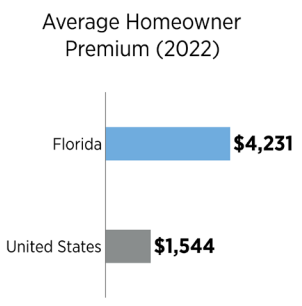


Figure 9: Various data points highlighting Florida's notable lead in US claims litigation and premium costs | **Source:** Florida Office of Insurance Regulation; National Association of Insurance Commissioners; Insurance Information Institute

What Comes Next?

The challenge is how the reinsurance industry balances the continued effects of inflation, social inflation, elevated supply costs, and other variables today and in the future. There will inevitably be market adjustments to ensure solvency for the broader industry and individual companies as the quest for affordable capital takes on more urgency. The risks and costs associated with litigation and liability will only become more pronounced if more steps are not taken to add more protections for the industry and its consumers. The state of Florida has already enacted some meaningful reform; and more details can be found in the Hurricane Ian focus section of this report.

The overarching near- and long-term risk will inevitably come in the form of climate change. Scientific consensus continues to show how the behavior of weather and climate-related events are growing more intense and, with some perils, more frequent. While most current focus is on the physical risk aspect to climate change, the impacts extend well beyond whether or not an event leads to direct damage. As companies seek to better understand the future implications to their portfolios—as well as meet established carbon emission reduction goals—it will be critical to fully quantify and qualify risk.

The diversification or divestment of portfolios, in addition to determining the insurability for various perils in different parts of the world, will need to be an essential piece to strategic planning for the insurance industry and other financial institutions. The nonphysical piece of climate risk can feature losses from business interruption or costs associated with transitioning away from a fossil-fuel-driven balance sheet. Reputational risk from doing the bare minimum is also an important metric to keep in mind.

With a rapidly evolving regulatory environment and an increasing push for climate-related disclosures, there are growing mandates that will push global and regional insurers to take better account of how future climate scenarios will affect their bottom lines. Solvency is key. Rating agencies are also beginning to score how financial institutions are implementing CESG into their business operations.

There will inevitably be new variables that test how we handle the increased cost of natural catastrophes. Inflation is the biggest challenge today. How we implement our lessons learned from today's environment will be critical to how we handle the next hurdle tomorrow.

La Niña's Impact on Natural Catastrophes

A "triple-dip" La Niña marked the end of 2022. This unusual event meant that cooler than average sea surface temperatures (SST) were present in the equatorial Pacific Ocean during three consecutive Northern Hemispheric cold seasons (December to March). This was the third such occurrence of a triple-dip La Niña in the National Oceanic and Atmospheric Administration's (NOAA) 73-year record. Since September 2020, La Niña conditions have modified global atmospheric and oceanic patterns, with short interruptions toward an ENSO neutral phase. While no two La Niña cycles are exactly alike, these conditions are associated with amplified regional extremes of temperature and precipitation. La Niña years have historically generated elevated losses for the reinsurance industry principally due to amplified impacts in developed nations. These include a greater frequency of Atlantic tropical cyclones, southern US SCSs and Australian floods, among others.

What is ENSO?

The El Niño-Southern Oscillation (ENSO) is a pivotal seasonal climate phenomenon as it affects large-scale atmospheric and ocean circulations that influence global temperature and precipitation patterns. ENSO is a recurring oscillation involving changes in the temperature of waters in the central and eastern equatorial Pacific Ocean (170°W to 120°W longitude and 5°N to 5°S latitude). Warming periods are noted as El Niño cycles, while cooling periods are known as La Niña cycles. The ENSO footprint historically had the greatest influence during the Northern Hemispheric winter months (December to March). The Niño-3.4 Index, which measures the temperature of ocean waters in the tropical Pacific Ocean, is used to determine ENSO phases and cycles. It is important to note that to be considered in an ENSO phase, NOAA requires five consecutive three-month running mean averages of SST anomalies in the Niño-3.4 region to be +0.5°C (El Niño) or -0.5°C (La Niña).

Niño 3.4 (5°N-5°S, 120°W-170°W)

Sea Surface Temperature Anomalies

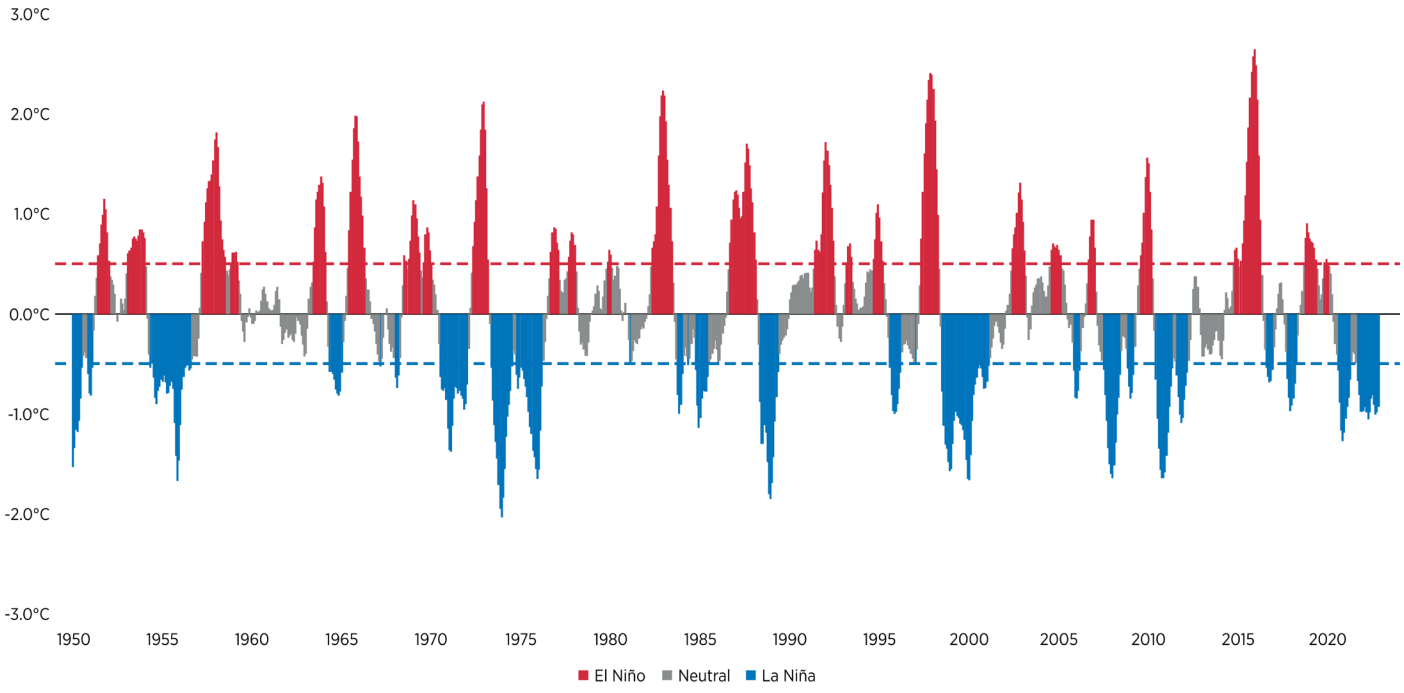


Figure 10: Monthly sea surface temperature anomalies in the Pacific Ocean's Niño-3.4 region dating to 1950 | **Source:** NOAA Climate Prediction Center

La Niña Influence in 2022

Large-scale atmospheric circulations associated with La Niña include rising air in the western Pacific, which aids in increased storminess and rainfall. In 2022, this had a marked influence on heavy rain and subsequent flooding in eastern Australia. Catastrophic inundation in late February and March resulted in an industry loss of at least USD 4.0bn. Additional significant events and catastrophes were declared by the Insurance Council of Australia after incessant rains continued in October and November. During this latter period, rainfall patterns were further affected by the negative phase of the Indian Ocean Dipole (IOD), an oscillation of SSTs in the western Indian Ocean. A negative IOD likewise enhances rain across much of Australia and southern Africa. The IOD typically peaks in intensity between the months of October to December. According to data from the Australian Bureau of Meteorology (ABOM), in 2022 Sydney saw its wettest calendar year since records began in 1859.

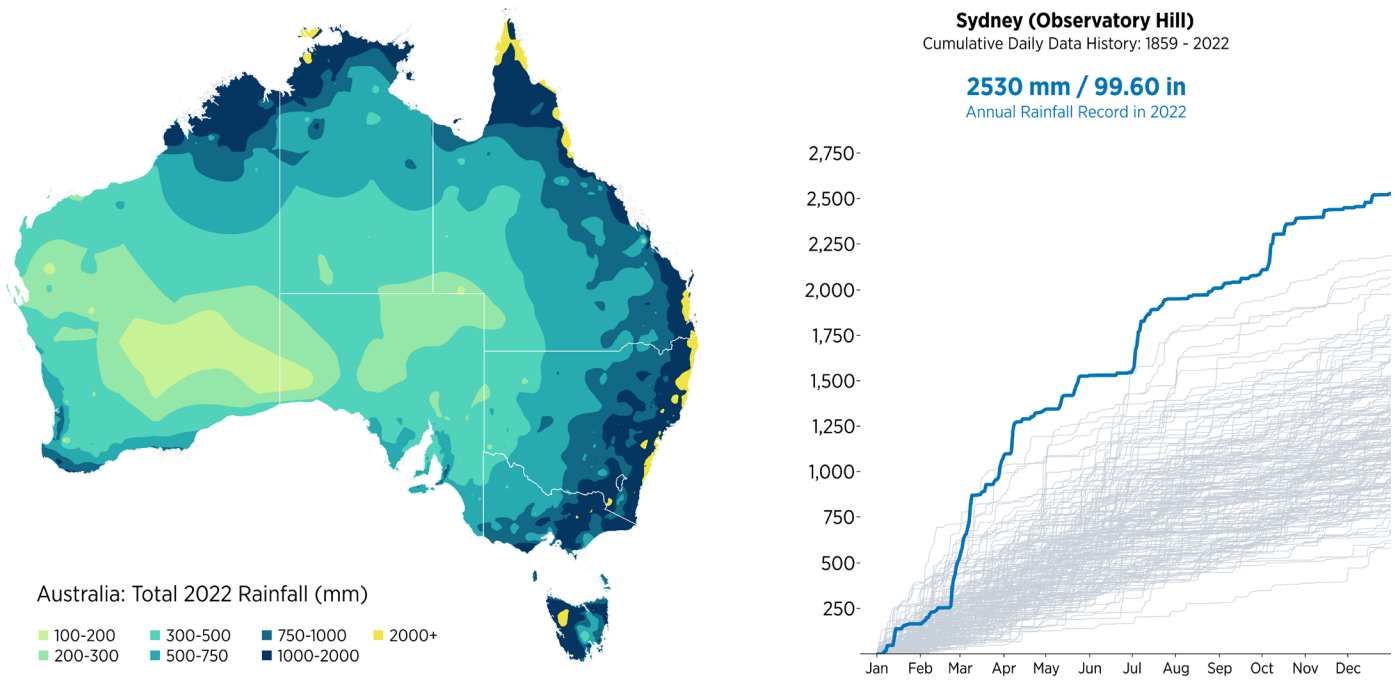


Figure 11: (Left) Total aggregated rainfall across Australia in 2022; (Right) Daily rainfall totals at Sydney and showing a new annual record for the city
Source: Bureau of Meteorology

Concurrently, last year was marked by wetter than usual episodes, augmented by La Niña, in regions of northern South America and Southern Africa, in tandem with more persistent monsoonal rainfall in southeast Asia. In Africa, despite exceedingly low insurance penetration in Nigeria, seasonal flooding damage in Q3 alone was expected to minimally reach USD 4.5bn, a significant loss for the national economy. Across southern Africa, research has demonstrated the duration of the rainy season is extended in La Niña years and shortened in El Niño years. Flooding in parts of Africa was further exacerbated by expanding urban populations and inadequate infrastructure.

In Asia, Pakistan was deluged by the most severe flooding in recent history between July and October. The Pakistan floods, most impactful in the provinces of Sindh and Balochistan, generated physical damage losses of nearly USD 15bn, and resulted in a humanitarian emergency. The situation was worsened by above-average temperatures and melting glaciers.

La Niña tends to be a component of sustained drier and milder conditions across the southwest US. This occurs due to a westward and northern shift in the jet stream (a band of strong wind in the upper levels of the atmosphere). According to the United States Drought Monitor, in July 2022 the western US saw the most expansive percentage of land affected by the highest category ("Exceptional Drought") since data collection began in 2000. Severe drought conditions continued to impact vast regions of the West throughout 2022, while expanding in the Southern Plains and Mississippi Valley. Elsewhere, severe drought persisted in the Horn of Africa and southern South America, notably in Brazil's southern growing regions.

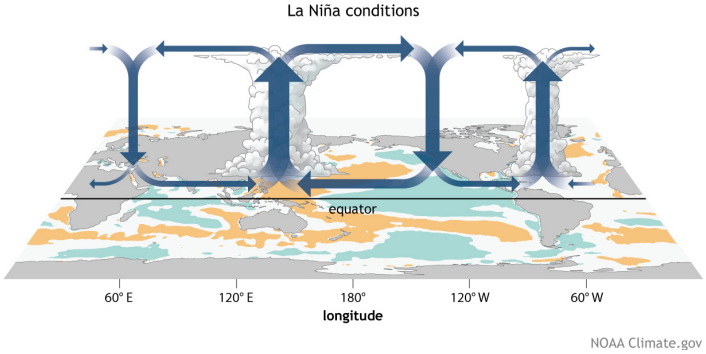


Figure 12: Visualization showing ocean and atmospheric circulation patterns during La Niña | **Source:** NOAA

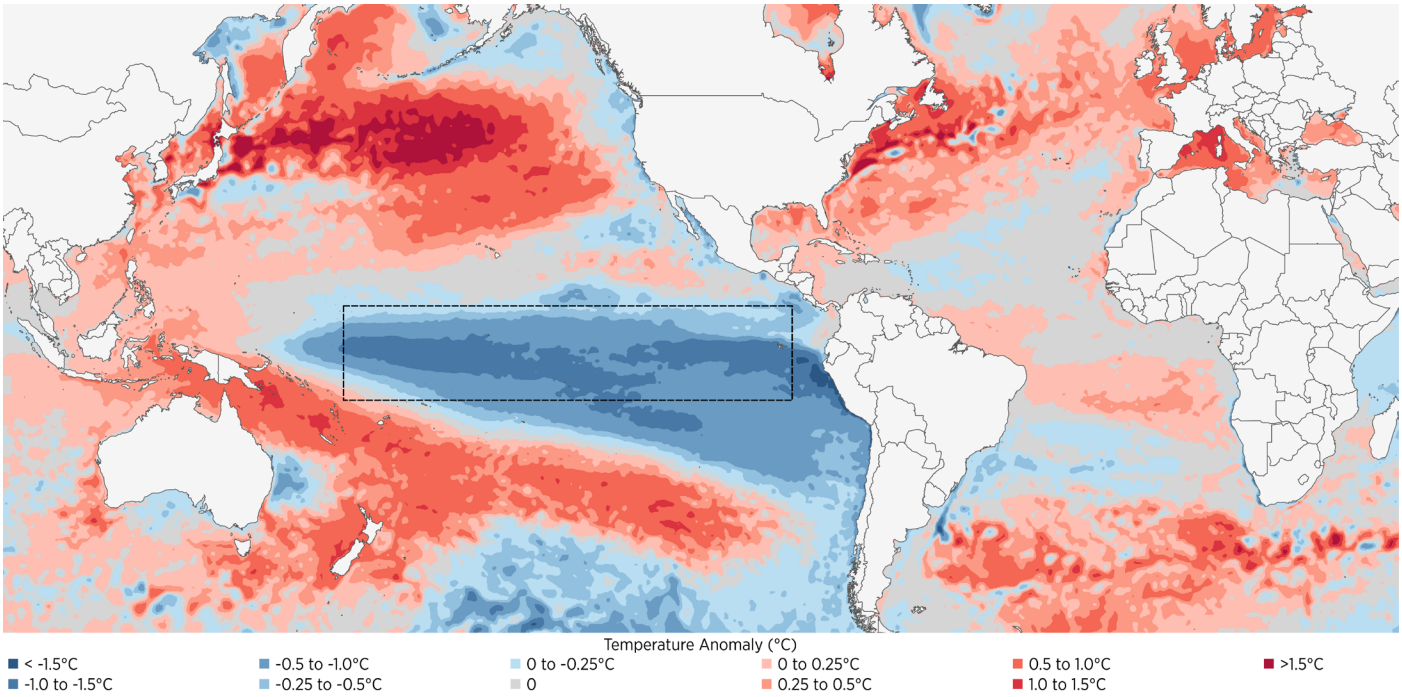


Figure 13: SST anomalies for January–December 2022 (°C) compared to the 1991–2020 averages. | **Source:** Copernicus/ECMWF/ERA5

In the tropics, La Niña can result in weaker vertical wind shear and trade winds in the Caribbean and eastern Atlantic. This has the potential to enhance basinwide tropical cyclone activity. Simultaneously, tropical cyclone activity can be suppressed in the Pacific. However, intra-seasonal variability and other drivers, such as the Madden Julian Oscillation, an eastward progression of enhanced and surpressed tropical rainfall, play a crucial role in tropical cyclone development and forecasting.

Higher catastrophe risk during La Niña years, especially in established markets, is anticipated to build demand for reinsurance offerings and could boost interest in nonconventional structures, such as parametrics triggers and covers.

Looking ahead, models are trending toward a transition to ENSO neutral and perhaps El Niño conditions by Q2 and Q3 of 2023. If realized, the redevelopment of El Niño would increase concern regarding heat and bushfires in Australia, and tropical cyclones in the Western North Pacific. While not always the case, a rapid swing from La Niña to El Niño can be troubling as regional weather patterns abruptly change from one extreme to another. Overall, the mean climate of the tropical Pacific is anticipated to continue changing in the coming century as a consequence of GHG emissions, peer-reviewed research showed an increased likelihood in the frequency of extreme El Niño events and a higher overall frequency of La Niña events.

Heat and Drought: The Underestimated Perils of 2022

Prolonged and record-breaking heat waves in tandem with below-average precipitation resulted in regionally elevated drought conditions around the globe in 2022, with notable events occurring across Europe, western North America, southern South America, Mexico and China, among other locations. The total economic cost of global drought events approached USD 80bn, with some of the most consequential totals seen in the US, Brazil and France.

Drought and heat were critical components in increased supply chain challenges, electrical grid stress, escalating food insecurity, business and shipping disruptions, and enhancing humanitarian crises, particularly in less developed nations. High temperatures and abnormally dry conditions were anticipated to remain costly natural hazards for the reinsurance industry in the coming decades, enhanced amid continued GHG emissions.

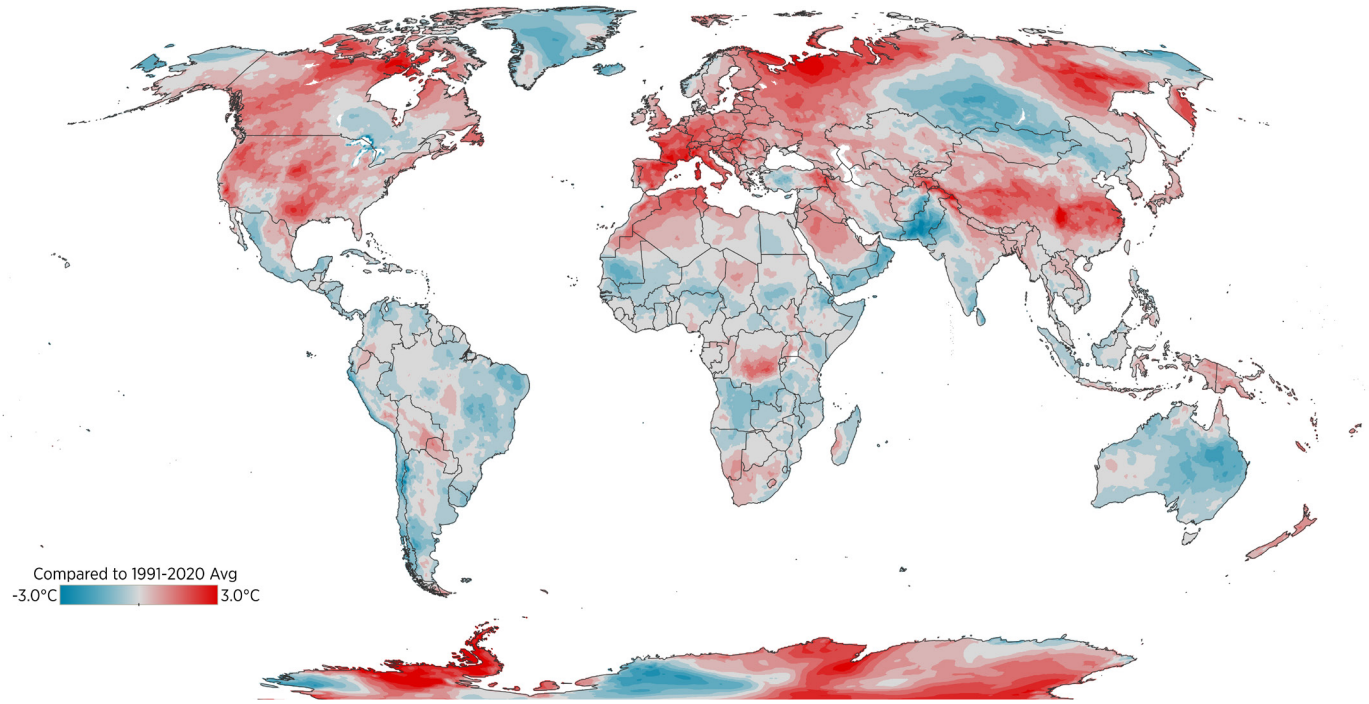


Figure 14: Average temperature comparison during June/July/August 2022 versus the 1991–2020 climatological norm | **Source:** Copernicus/ECMWF/ERA5

Drought was markedly concerning in Europe, as successive heat waves built across the continent between June and August. The relentless heat and dry conditions resulted in financial impacts to agriculture, infrastructure and commerce. According to the Intergovernmental Panel on Climate Change, there is high confidence that elevated agriculture production losses, compared to the long-term average, will continue across much of Europe throughout the 21st century due to influences from heat and subsequent drought. These losses will be further amplified under a warming climate.

Amid a multitude of felled high temperature records, the UK set an all-time heat record of 40.3°C (104.5°F) on July 19 in Lincolnshire, beating the previous country record of 38.7°C (101.7°F) set in 2019. Preliminary estimates based on Gallagher Re analysis of country-level excess mortality statistics, which determined totals by subtracting from recent decadal averages and COVID-19 spikes, suggested that as many as or more than 40,000 excess deaths may be attributed to the extreme heat across the continent during the summer months. Heat wave mortality was amplified in urban areas and locally exacerbated by lack of sufficient cooling systems, especially at higher latitudes.

Wildfires, fueled by dry conditions, were ignited amongst many regions of Europe and the Mediterranean, with notable events in France, Greece, Portugal and Spain. In Italy, water levels along spans of the Po River, the country's longest river, ran several feet below hydrometric zero, stressing regional crops and drinking water.

In China, data collected by the Beijing Climate Center showed that heat events in the summer of 2022 were the strongest since reliable records began in 1961, metrics were calculated in terms of intensity, impacts and duration of heat. Hundreds of recording stations, primarily in Hebei, Shaanxi, Sichuan, Hubei, Jiangsu, Zhejiang, Fujian, Guangdong and Qinghai, reached or exceeded their historical maximum temperature. The prolonged drought conditions had widespread impacts on agriculture, energy and provincial supply chains. Amplified stress on the country's electrical grid prompted power curbs across the most affected regions, closing factories and leaving residents temporarily in the dark, notably in and near Shanghai.

In South America, a multiyear drought centered on the La Plata Basin continued in 2022. In terms of economic losses, Brazil's Rio Grande do Sul state experienced one of the worst droughts in at least the last century, according to the state secretary of agriculture. More than 85% of municipalities in the state declared a state of emergency due to drought by September. The Rio Grande do Sul government cited that economic damage in the state alone was USD 7.5bn. Nationwide, 2022 was a challenging year for the industry in Brazil due to the severity of the drought and large volume of agribusiness claims.

In the Pantanal, the world's largest tropical wetland, which spans parts of Brazil, Bolivia and Paraguay, a marked increase in wildlife activity in recent years considerably influenced the abundant biodiversity of animal and plant species. The out-of-control fires, fueled by abnormally dry conditions and above-average temperatures, were primarily of anthropogenic origin and intended to clear land for agriculture.

In North America, expanses of the US, principally in the West and Southern Plains, continued to endure intense drought conditions in 2022. The US government's NOAA agency noted that drought-/heat-related economic losses were at least USD 21bn. In Q3, drought spread across the US Mississippi Valley. By October 22, the river gage along the Mississippi River at Memphis, Tennessee, reached a record low of -10.76 feet (-3.28 meters), falling below the previous low record from 1988 (meaning the gage dropped below an agreed-upon zero level).

Dry conditions concurrently impacted western Canada and northern Mexico. In Mexico, a peak 55% of the country experienced drought conditions simultaneously by the beginning of May, according to data from the North American Drought Monitor. The drought was an important driver in severe water shortages in the city of Monterey and surrounding localities.

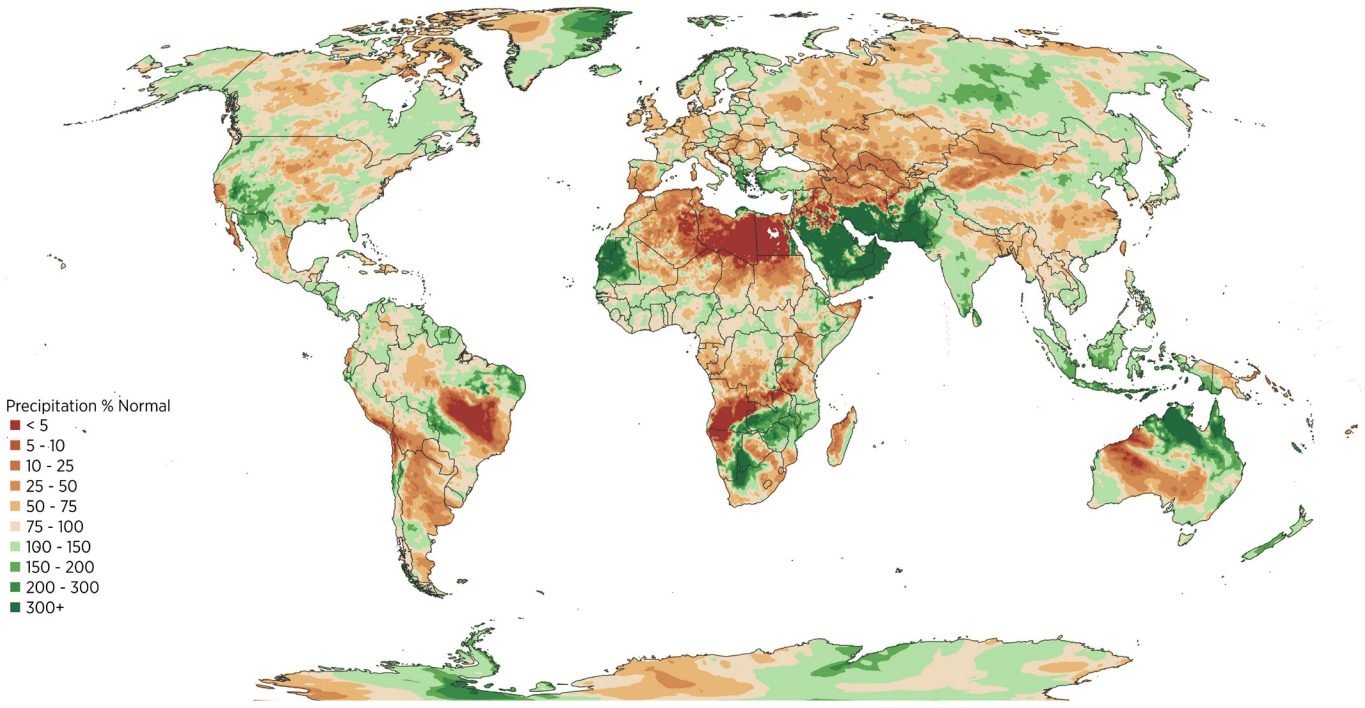


Figure 15: Precipitation totals in June/July/August 2022 as compared to the 1991–2020 climatological norm | **Source:** Copernicus/ECMWF/ERA5

Consistent with the Intergovernmental Panel on Climate Change findings, without near-term adaptation, reduced overall yields in crops and livestock production are projected to persist across North America in coming decades, when compared to historical averages. This will be amplified in drought-prone and rain-dependent regions and not expected to be offset by favorable long-term conditions in parts of the US Great Plains and Northwest.

Agriculture producers should be proactive in mitigating risk by being mindful of soil health, employing water conservation practices, making smart crop choices and enrolling in agriculture or crop reinsurance programs. At Gallagher Re, our global agriculture team offers specialist expertise, custom technology and local knowledge, which can aid insurers to better understand their exposures and manage volatility.

For example, innovative at-scale and country level-based insurance schemes are being applied across the African continent to strengthen financial resilience in the face of accelerated drought-driven agriculture and crop losses, as well as complex political environments.

Drought and the closely related heat wave and wildfire perils will continue to present amplified challenges to the global reinsurance industry, with an emphasis on crop insurance, business interruption coverage, and life and health insurance. In recent years, drought alone generated an increasingly larger percentage of global insured losses than was represented in longer-term averages.

The Capital Challenge in Natural Catastrophe

While there was sufficient capacity to meet the reinsurance needs of cedants at 1.1, it is also true that the amount of reinsurance capital being deployed was diminished in 2022. Cedants were, by and large, able to secure their required limit, but it came at a price.

There was a clear desire from reinsurers to force change onto the market at the most recent renewals: pushing retentions up and restructuring programs to improve profitability for 2023 and beyond.

While Gallagher Re does not have data detailing the capital allocation to natural catastrophe coverage, our einsurance market report, published twice a year, demonstrated a clear drop in total reinsurance dedicated capital for half-year 2022 (Figure 16) and illustrated the contribution of cat losses to the combined ratio for the subset of reinsurers which provide that disclosure (Figure 17).

However, the drivers of the drop in capital go beyond the runrate of losses from natural perils, and include macroeconomic factors, the impact of the reinsurance hard market, regional considerations and a greater scrutiny of models by reinsurers.

Total Industry Capital Decreased by 11% in HY 2022

Total Reinsurance Dedicated Capital (USD billions)

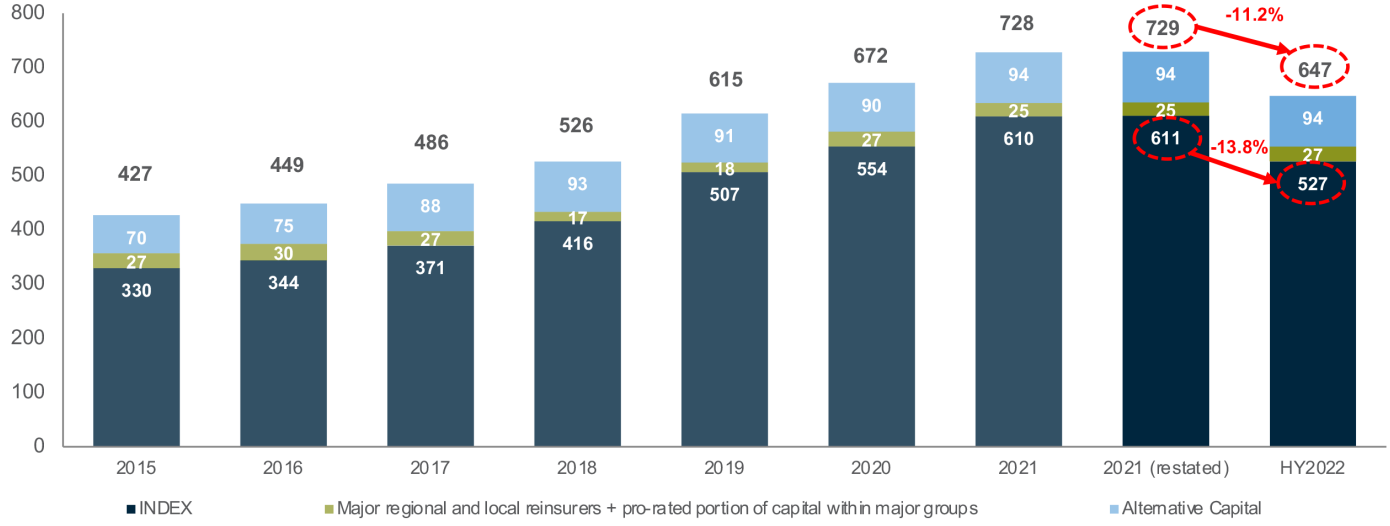


Figure 16: Total annual reinsurance capital (2015-2021) and HY 2022 | **Source:** Gallagher Re

Combined Ratio for the Gallagher Re Subset

Subset	2014 HY	2015 HY	2016 HY	2017 HY	2018 HY	2019 HY	2020 HY	2021 HY	2022 HY
Reported combined ratio	90.4%	90.4%	93.7%	94.0%	93.3%	94.9%	104.1%	94.1%	93.0%
Remove prior year development	4.5%	5.2%	5.2%	3.6%	3.0%	1.2%	0.7%	1.3%	1.6%
Accident year combined ratio	94.9%	95.6%	98.9%	97.6%	96.3%	96.0%	104.8%	95.4%	94.7%
Strip out natural catastrophe loss	-2.5%	-1.2%	-4.6%	-2.3%	-1.2%	-2.6%	-3.3%	-5.6%	-5.0%
Strip out COVID loss							-11.1%	-0.4%	-0.1%
Ex-natural catastrophe accident year CR	92.4%	94.4%	94.3%	95.3%	95.1%	93.4%	90.4%	89.4%	89.6%
Add in normalised natural catastrophe loss	6.4%	6.4%	6.4%	6.4%	6.4%	7.1%	8.2%	9.0%	10.1%
Underlying combined ratio	98.8%	100.8%	100.7%	101.7%	101.5%	100.5%	98.6%	98.4%	99.7%
Expense ratio					33.1%	32.2%	30.8%	29.6%	29.4%
Ex-natural catastrophe accident year loss ratio					62.0%	61.2%	59.6%	59.8%	60.2%
Ex-natural catastrophe accident year CR					95.1%	93.4%	90.4%	89.4%	89.6%

Takeaways:

- The reported combined ratio improved to 93.0% (HY 21: 94.1%), the lowest we have seen since 2015.
- The ex-natural catastrophe accident year loss ratio slipped slightly, from 59.8% in HY 21 to 60.2%, with rate increases not quite keeping up with inflation-driven rises in loss costs. The expense ratio was slightly improved at 29.4% (HY 21: 29.6%).
- Although still below 100%, the underlying combined ratio deteriorated to 99.7% (HY 21: 98.4%), driven by an increase of 1.1 percentage points in the five-year average assumption we use for a normalised natural catastrophe load.

Figure 17: The underlying combined ratio for HY2022 was hit by increased natural catastrophe losses | **Source:** Gallagher Re

* (5) The normalized natural catastrophe load is the five-year moving average of the SUBSET's natural catastrophe losses (including COVID -19 losses), calculated on the basis of annual results.

Macroeconomic Factors

Last year saw an unprecedented round of fiscal tightening in major economies, following more than a decade of low interest rates and cheap debt. Reinsurers have historically deposited much of their investment capital into investment-grade fixed-income instruments to keep volatility out of their portfolios and maintain as much liquidity as possible in case cash is needed to pay claims.

This worked well during periods of loose monetary policy, as quantitative easing and other measures kept money markets stable. But in recent months, a supply chain shock led to widespread inflation, resulting in a ramping up of interest rates.

That in turn caused a significant drop in the valuation of investment-grade bonds (particularly at the short duration end of the curve where reinsurers tend to invest), leading to a decline in available capital on a market-to-market basis.

Figures from Gallagher Re's latest Global reinsurers' financial results report demonstrated this, showing that for its cohort of global reinsurers, shareholders' equity dropped by an average of 34% in the first nine months of the 2022, driven by threats of recession and the rise in interest rates, which resulted in lower market values of bonds and equities held by reinsurers.

From a solvency perspective, many reinsurers were actually better off; rising risk-free rates resulted in higher solvency ratios as the reduction in liabilities—which in Europe are discounted at risk-free rates under Solvency II—exceeded the reduction in bond portfolio values.

However, the potential liquidity risk (that reinsurers may be forced to liquidate underperforming bonds, crystallizing the loss in bond value, to pay claims in the event of a large loss event) may be enough to make carriers think twice about whether they can afford to underwrite more natural catastrophe risk in the short term.

Elsewhere as inflation increased, so did primary insured values, creating a need for greater levels of reinsurance coverage. But the financial uncertainty made it more challenging for traditional reinsurers to raise capital, along with the fact that higher interest rates made it more expensive to finance.

Hard Market; Hard Choices

While the primary and retro markets were the early winners in the burgeoning hard market, by the middle of 2022 those rate rises had also fed through to reinsurance premiums.

However, increased rates on their own were not enough to result in a wave of capital being deployed—appetites were impacted by a variety of factors, including but not limited to:

- How reliant the reinsurer is on retro to underwrite (and therefore the availability of retro, which for 1.1.23 was extremely late to show its hand, but did ultimately come to the party)
- A lack of third-party capital reloading given some capital remained trapped from previous losses
- Investors had a broader set of higher returning investment classes to consider in the rising rates environment, and many were concerned about existing modeling adequacy, and the impact of climate change on event frequency and severity
- A drop in the number of ILS players fronting elements of reinsurance coverage when compared with previous years
- A reduction in appetite for lower attaching retentions, given the impact of secondary perils on results in the past few years
- Increasing level of scepticism regarding whether reinsurers' tools can adequately evaluate and price risk for the current risk environment, something that's exacerbated by the implications of climate change

Much also depends on the state of the individual cedants. In the US, smaller or more regional clients clearing less than USD 200mn of capacity broadly found coverage, so long as pricing was set at an appropriate level.

Considerably more challenging were the larger placements, particularly USD 500mn and above, where the broadest level of participation across the reinsurance market was required to clear capacity.

For the larger clients, there was a continuation of what was seen in the 6.1 and 7.1 renewals in 2022; some programs were impacted by a modest number of reinsurers that held placements hostage with unrealistic demands for pricing and/or terms and conditions, but ultimately deals got done.

As an example, capital did come in for wind risks relatively late but, at high prices with low leverage, resulting in many cedants declining to take up offers. Cedants were not bullied into panic-buying at any price, preferring instead to take bigger retentions.

Outside of the US, there was also no meaningful new capital raised for 1.1. While some underwriters moved out of the cat world altogether, choosing not to compete anymore after years of consolidated losses, others who were more highly geared were delayed in coming to market, initially left in the dark about their ultimate risk appetite until their retro providers showed their hand. Those less reliant on retro were able to take advantage of this delay and grew their books accordingly.

Third-party investors historically play little part in the likes of European treaties other than through some fronting deals, given the more complex nature of the multi-peril coverage and multiples. But there was even less capital deployed than normal here too, leading to a drain on capacity when compared with previous years, in particular around complex placements.

Concerns regarding climate change and the impact of secondary perils continued to grow among reinsurers too, particularly given the relatively light period for wind losses when compared with consecutive years of flooding and SCSs (see EMEA overview).

Any treaty with an element of loss frequency protection was difficult to place; lower layers were tough to find capacity for. Aggregate excess of loss policies would now only attract capacity if they attached after three or four major losses, not after the first event. And even where cedants might have been prepared to pay higher rates, there was a general feeling that reinsurers would do whatever was needed to give them the best chance of running a loss-free year in 2023.

This last point underlines a theme that resonated globally—property reinsurers, whether traditional or ILS, have largely failed to make money over the past five years.

The fact that losses have come from secondary perils, unmodeled perils, COVID, etc., is particularly challenging for ILS managers who have historically sold investors on being exposed to headline risk—the results have not borne that thesis out, which has also contributed to the lack of capital inflows.

The secondary perils experience has also led traditional reinsurance capital to largely move away from providing coverage at the lower levels, rejecting 1:3 year–1:5 year event coverage and instead coming in around the 1:10 level. It is a much simpler exercise to effectively underwrite yourself out of secondary perils by requiring higher attachment points.

Solutions and Silver Linings

Despite the challenging conditions, renewals were largely completed—thanks to a combination of collaboration and innovation.

Cedants, that were able to, agreed to higher absolute retentions, and through their broker partners, some were also able to place meaningful absolute annual aggregate deductibles (AADs) on first layers in an attempt to maintain some level of earnings coverage.

In the US, clients also investigated the use of captives—particularly the idea of using a captive to sell ultimate net loss coverage to a company, and then employing a parametric hedge like an ILW/bond/etc. to protect the captive and group results.

Brokers also helped establish innovation in structures, such as the use of non-indemnity solutions, which use a third-party vendor's model of loss cover to run a footprint over a client's portfolio post-event and, whatever that loss result is, that gets applied to the reinsurance layer, creating more certainty around loss outcome.

Looking ahead, there is consensus that more capital will flow into the market in 2023 and beyond. Even in the dying embers of 2022, companies were able to bring new capital to the property reinsurance market, and others were able to successfully complete equity raises.

Gallagher Re estimates that somewhere in the region of USD 1.5bn in new capacity was raised ahead of 1.1 for that renewal, although little of it was ultimately deployed, meaning there is some dry powder for the next round of negotiations.

Events such as the Floridian reforms announced at the end of 2022 will encourage more capital to play, most likely with those cedants considered best-in-class initially, as carriers dip their toes back in the water.

Ultimately, the industry has already proved that it is not a broken system, that even in the trickiest renewal many have seen in decades, deals got done; and that the market looks set to trade on into 2023.

NATURAL CATASTROPHE SUMMARIES BY REGION

Asia-Pacific: Flooding and Extreme Temperatures Dominate 2022

A manageable year for typhoons is offset by heavy Australian rainfall

Floods, earthquakes, typhoons, SCSs, wildfires and volcanic eruptions impacted the Asia-Pacific region in 2022, though the insured losses remained manageable when compared with the past decade.

Preliminary data totals across APAC showed an insured loss for 2022 at USD 11bn, which is consistent with totals seen in 2021 (USD 11bn) and 2020 (USD 14bn).

Lower industry losses in the last three years (2020–2022) follows a decade where the region was marked by significant and market changing events such as the Thailand floods (2011), Tohoku earthquake and tsunami (2011), New Zealand earthquakes (2010/2011), Typhoon Jebi (2018), and the Australian bushfire season of 2019/2020.

Much of the market commentary has focused on the effects of secondary perils and the ongoing need to further improve natural catastrophe modeling in the region, along with more proactive risk mitigation and assessment methods.

The pronounced insurance gap in particular countries also garnered much attention again last year—not least in Pakistan, where historic flooding led to an estimated USD 15bn in direct economic damage, but the insured outcome was negligible due to very limited insurance takeup.

Drought was evident in various areas of Asia: China's Meteorological Administration (CMA) noted the hottest summer on record dating to 1961, with 265 weather stations setting all-time heat records in August alone.

In addition, the Yangtze River, the longest river in Asia and the third-longest globally, reached its lowest summer/peak monsoon season water height in 150 years of record-keeping.

India's Meteorological Department also noted that the country had experienced its hottest March, third-hottest April and second-hottest December in 122 years.

A relatively quiet Western North Pacific Typhoon Season saw manageable damage reports, with the exception of Nanmadol and Talas in Japan, Hinnamnor in South Korea and Super Typhoon Noru in the Philippines. Overall activity in the basin was slightly below average for much of the year, including the number of landfalling events in Japan.

Although Nanmadol brought strong winds and heavy rainfall, resulting in some flooding and landslides, its impact was manageable, largely because the storm moved over an area of lower-value asset concentration compared with typhoons in 2018 (Trami, Jebi) and 2019 (Faxai, Hagibis).

"China's Meteorological Administration (CMA) noted the hottest summer on record dating to 1961, with 265 weather stations setting all-time heat records in August alone."

Having originally intensified to super typhoon status, Nanmadol weakened as it made landfall on September 18, landing near Kagoshima City with the Japan Meteorological Agency estimating 10-minute sustained wind speeds of 167 kph (104 mph) and a minimum central pressure of 935mb. The Joint Typhoon Warning Center (JTWC) estimated one-minute sustained winds at 160 kph (100 mph) at landfall.

Typhoon Nanmadol produced heavy rainfall across Kyūshū, with more than 500 mm (20 in) recorded in less than 24 hours in several areas and more than 700 mm (27.5 in) in 24 hours in Miyazaki. The peak rainfall accumulations recorded during the passage of Typhoon Nanmadol were in Ebino City, Miyazaki (903.5 mm / 35.6 in), and Misato Town, Miyazaki (880 mm/34.6 in).

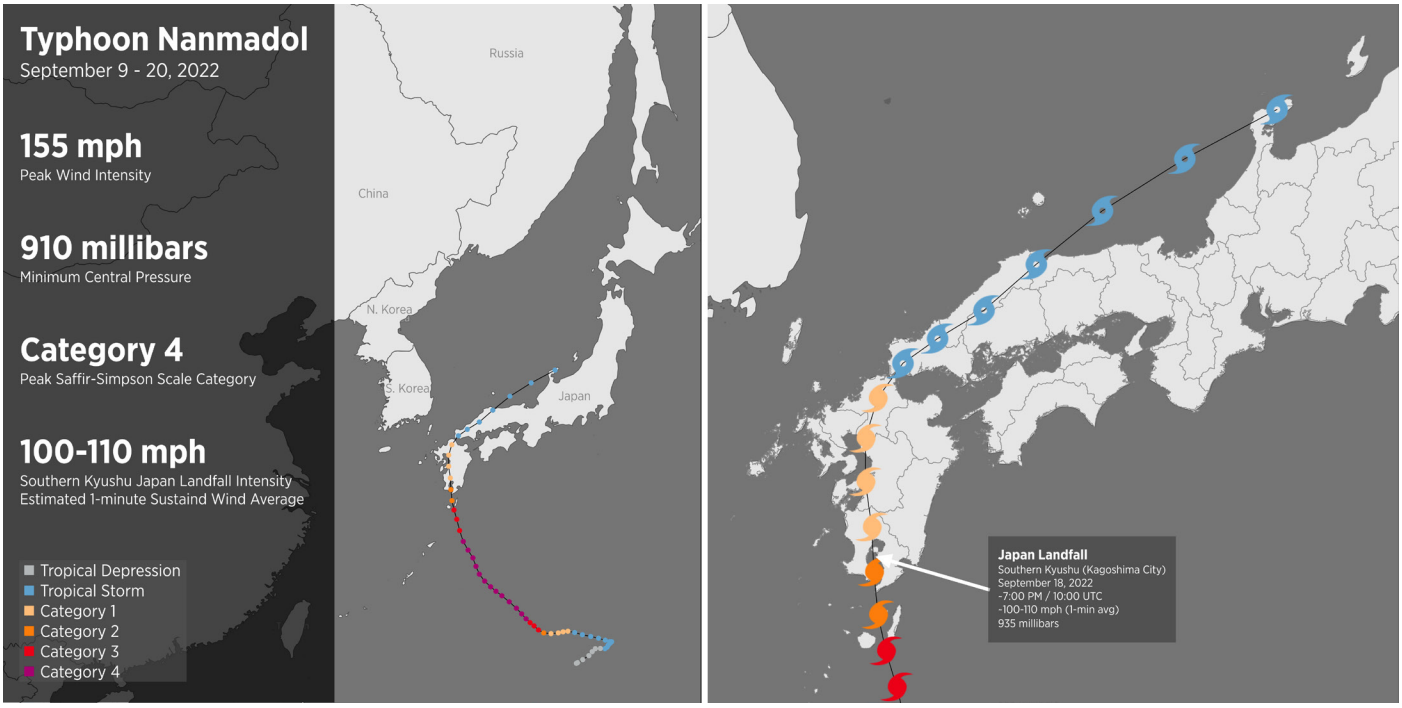


Figure 18: Full track and landfall point of Typhoon Nanmadol in Japan | **Source:** NOAA/Japan Meteorological Agency

More than 7 million people were told to take refuge in sturdy buildings to ride out the storm, with at least 20,000 people spending the night in shelters in Kyūshū's Kagoshima and Miyazaki prefectures. As many as 161 people were injured, with five fatalities reported by local authorities.

There was also damage reported to 2,744 buildings and approximately 350,000 households lost power.

The southern Japanese islands are frequently exposed to extreme weather and have a very high level of preparedness, which helped mitigate the impact of the storm. Claims data as of November 30, 2022, from the General Insurance Association of Japan (GIAJ) put the combined insured loss from Nanmadol and the smaller Typhoon Talas, which also hit Japan in September, at USD 935mn. Further loss growth was anticipated as more claims are filed and processed.

Super Typhoon Hinnamnor passed through South Korea, Japan and the Philippines in September, generating an estimated USD 256mn in insured loss. Typhoon Nalgae resulted in 164 people losing their lives and an estimated insured loss of USD 7.5mn in the Philippines.

The Japanese typhoons followed much of Japan enduring one of its hottest summers in recent memory. Tokyo endured its hottest summer on record with nine consecutive days of temperatures reaching at least 35°C (95°F) temperatures, according to the Japan Meteorological Administration. Official records date to 1875.

Japan was also the location for the continent's costliest non-weather disaster, a magnitude-7.3 offshore earthquake that struck near Fukushima Prefecture on March 16. This led to an estimated USD 2.8bn in insured loss, of which the GIAJ cited residential claims accounting for USD 1.9bn.

The event occurred as the result of thrust faulting within the Pacific plate, at or near the subduction zone boundary between the Pacific and North America plates.

The M7.3 earthquake was preceded by a M6.0 foreshock at a depth of 57.2 kilometers approximately two minutes earlier. A small 30-centimeter (12-inch) tsunami was reported immediately after the event in Ishinomaki Port, Miyagi Prefecture.

The area is one of potential heightened seismicity following the 2011 earthquake in Tohoku, as a result of stress redistribution around the 2011 rupture area.

At least 56,935 buildings were damaged, with four deaths and 247 injuries recorded by the local authorities. Power supply to around 2.2 million households was cut, including several hundred thousand properties in Tokyo. Reports of damage to roads was also evident, and 16 of a 17-carriage Yamabiko train derailed—however none of the 100 passengers on board were injured.

Japan's nuclear energy authority declared that no abnormalities were detected at the Fukushima No. 1 nuclear plant.

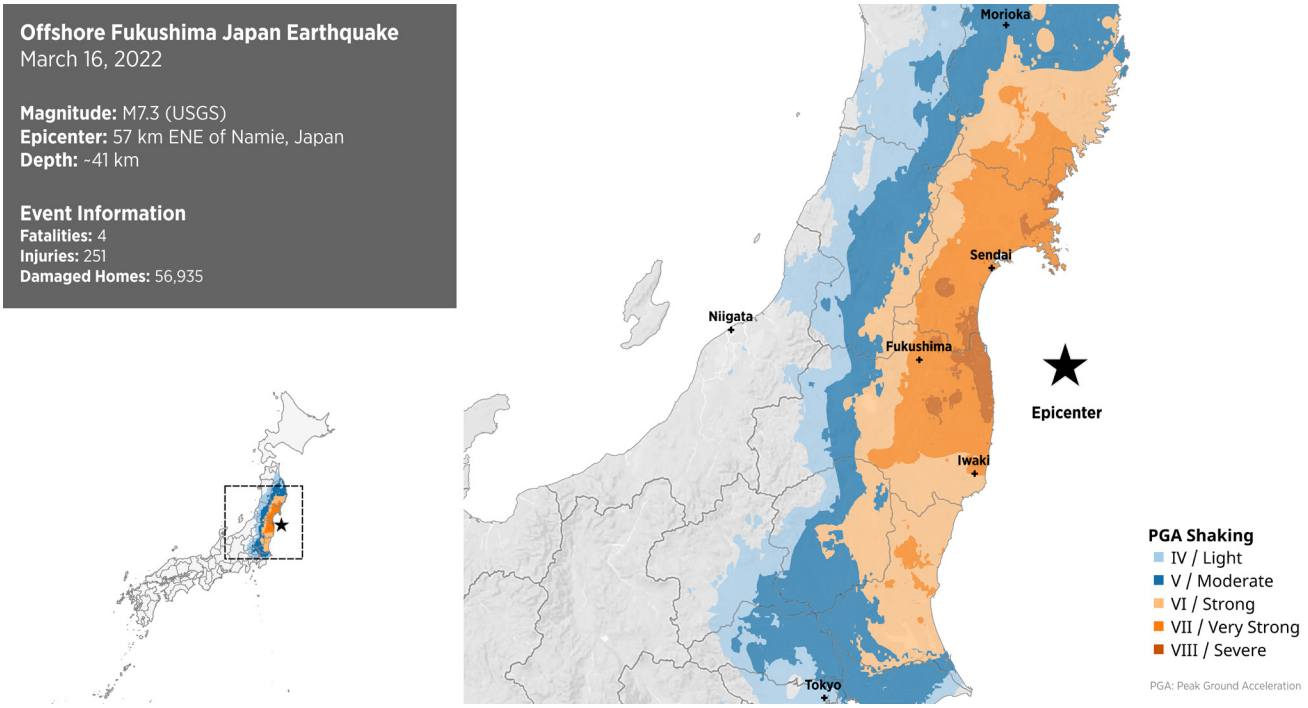


Figure 19: Peak Ground Acceleration (PGA) across Japan's Honshu Island during the March 16 offshore earthquake
Source: USGS; Japan's Fire and Disaster Management Agency

La Niña Impact on Australia

Incessant rainfall hit Australia's East Coast in February and March, leading to the wettest year on record being declared, with records dating back to 1859.

Insured losses were tallied at USD 4.0bn across parts of New South Wales and Queensland, with the economic loss at USD6.8 bn.

The damage was caused predominantly by two separate weather events—the first lasting from February 26 to March 1, and the second running from March 4–8. The former was categorized as a hybrid tropical dip and subtropical low with embedded thunderstorm activity that effectively sat over southeast Queensland and northern New South Wales for days, while the latter was an easterly low-pressure trough with embedded thunderstorm, which initially formed offshore before migrating southward to intensify off the central Sydney and Illawarra coasts.

Some of the key developments during Australia's 2022 flooding were:

- The city of Gympie recorded its highest flood in a century
- Brisbane received 31.2 inches (792.8 mm) of rain in three days—the previous record was 23.6 inches (600.4 mm) in 1974.
- Rosebank in New South Wales recorded 27.62 inches (701.88 mm) on February 28, which was the highest daily total recorded in NSW since 1954 and the highest in Australia since 1998.
- This resulted in the flooding of the Lismore, which exceeded the previous flood peak of March 1974.
- 22 people died as a result of the extreme flooding event.
- Around 20,000 properties were flooded in Queensland and 5,000 in New South Wales.
- Byron Bay's central business district was heavily impacted by the flooding, with the impacts continuing to be felt into the Easter period.

There was subsequent flooding in October 2022 across southeastern Australia, driven by ow-pressure system that initially formed south of the mainland (Figure 20). The frequent flood events that featured throughout eastern Australia resulted from a combination of climatic factors.

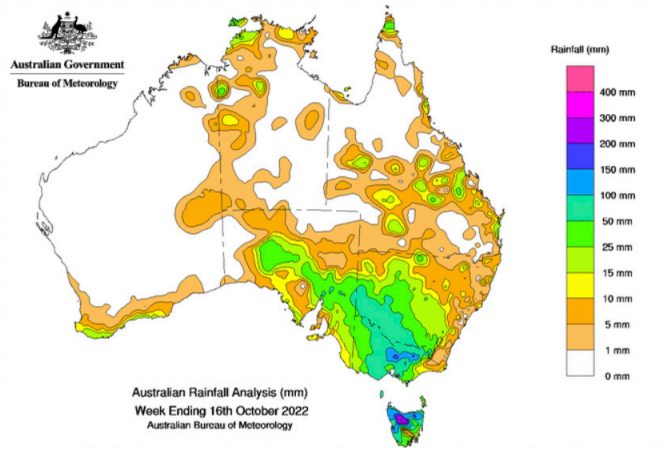


Figure 20: Seven-day rainfall accumulations to October 17
Source: Australian Government, Bureau of Meteorology

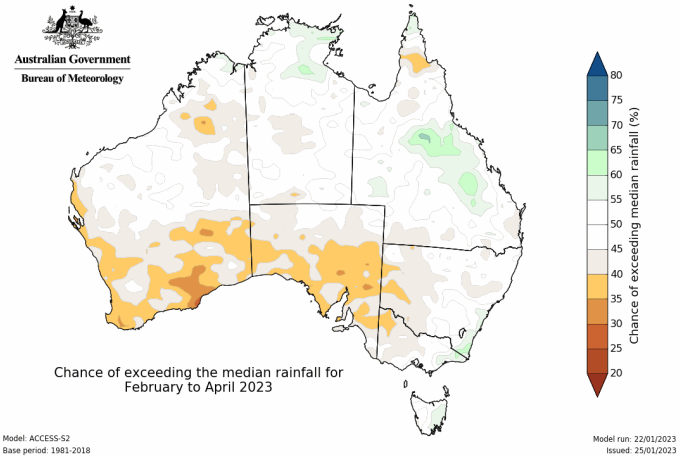


Figure 21: Chance of above median rainfall between February 2023 and April 2023
Source: Australian Government, Bureau of Meteorology

Europe, Middle East, Africa: A Year of Extremes

Heat, drought, hail and record floods affect the region

2022 proved to be an active year for natural catastrophes in Europe, the Middle East and Africa.

While much of the region endured significant storm events, 2022 was also the year in which vast swaths of the continent were engulfed in a series of intense heat waves.

At the beginning of the year, three notable February windstorms, Dudley/Ylenia, Eunice/Zeynep and Franklin/Antonia, resulted in a collective insured loss of up to USD 4.3bn. But the summer months' SCSs and hailstorms that followed exceeded that total, with more than USD 5bn in insured losses arising from the 1 million-plus claims in France alone.

June, July and August saw the hottest summer ever recorded for Europe, worsening existing major drought conditions, and leading to a wide range of agricultural impacts and hydroelectrical power scarcity.

In Africa, record-breaking flooding swept across several regions, resulting in at least 2,000 fatalities and historic flood-related insurance losses being generated in Nigeria and South Africa.

Winter Storms and Thunderstorms

Damage from the February windstorms, Dudley/Ylenia, Eunice/Zeynep and Franklin/Antonia, was widespread, hitting Germany, the Netherlands, Belgium, France, the UK, Luxembourg, Poland, the Czech Republic, Austria, Denmark and Switzerland, resulting in close to 1.9 million individual insurance claims being filed.

The combination of a lobe of the Polar Vortex sinking southward out of the Arctic and a strong Azores High and Icelandic Low in the North Atlantic Ocean helped initiate a large-scale temperature contrast that fueled the formation of the trio of storms.

Generally, sequences of windstorms in short succession are not unusual for this time of the year on the continent, but the intensity that characterized the three windstorms in February was more uncommon. These storms once again sparked conversations within the reinsurance market regarding reinsurance recoveries, specifically relating to event definitions and hours clause applications.

Event definitions for reinsurance purposes across Europe are not homogenous and can include meteorological conditions as well as aggregation periods that range from 72 to 168 hours.

Eunice/Zeynep, the second storm to hit, was the most severe and damaging in the series. It underwent explosive cyclogenesis—also known as a bombogenesis or a bomb cyclone—initially tracking across Ireland, before moving through the southern areas of the UK and onto Poland, recording maximum wind speeds of 196 km/h (121 mph) in exposed coastal areas in southwest UK.

Dudley/Ylenia, the first of the three storms, predominantly resulted in wind-related claims in northern Europe and the UK, while Franklin/Antonia primarily affected the British Isles, causing localized flooding.

Fatalities from the three low-pressure systems totaled 31 according to loss aggregator PERILS, with deaths caused by fallen trees and flying debris reported in Belgium (2), Germany (7), France (2), UK (8), Ireland (1), the Netherlands (4) and Poland (7).

While Eunice/Zeynep was a notable storm for the 2022 season, it proved to be a fast-moving system that was smaller in scale with fewer insured losses compared to recent historical storms such as Xynthia (2010), Klaus (2009) or Kyrill (2007).

With the arrival of spring came the earliest heat wave to hit southwestern Europe since 1947, according to statistics from Météo-France, followed by an unprecedented number of convective events.

The storms struck France (see France Spring-Summer Hail Events on following page), Germany, Italy, Switzerland, Czech Republic, Poland and Austria between May and July, with the most severe storms hitting between June 18 and July 4, resulting in nearly USD 3.0bn of insured loss, according to the French Federation of Insurance, France Assureurs (FFA). Hailstones of up to 10 cm (4.0 in) were recorded as France's Meteo Office issued an orange level alert for 65 departments for the first time in 20 years. Two other major hailstorms struck the region during this period, occurring May 21–28 and June 2–5, collectively resulting in an additional USD 1.6bn of insured loss, according to the FFA.

France Spring-Summer Hail Events

From May 20 to July 4, 2022, France experienced the most severe hail losses recorded in recent years.

The French Federation of Insurance, France Assureurs (FFA), estimated the series of SCSs incurred EUR 3.9bn (USD 4.1bn) in claims for the French market, with some EUR 2.4bn of that generated in just 16 days between June 18 and July 4.

By comparison, the next most severe hailstorm in France, Storm Ela in 2014, caused EUR 850mn of claims costs for the market. Many catastrophe excess of loss layers were heavily affected by the 2022 hail events, and this led some reinsurers to demand higher retentions, prices and paid reinstatements.

Four separate 72-hour clause-basis high-severity hail events, with maximum hail size of at least 7 centimeters (2.75 inches) in diameter and at least 170 verified reports, were recorded in France by the European Severe Weather Database (ESWD).

The table below summarizes all hail that was reported to the ESWD in France between May 20 and July 4, ordered by start date. Severity ranges from high (h) to none/minimal (0).

StartDate	EndDate	MainDate	Maximum Hail Diameter (cm)	No. Reports: Total	No. Reports: MainDate	No. Reports Average	Likely event severity
5/3/22	5/5/22	5/4/22	0	15	9	5	0
5/15/22	5/17/22	5/15/22	5	61	60	20	l
5/18/22	5/19/22	5/18/22	5.5	24	16	12	l
5/20/22	5/22/22	5/22/22	12	174	109	58	h
5/23/22	5/23/22	5/23/22	5	14	14	14	0
6/2/22	6/4/22	6/4/22	10	569	329	190	h
6/5/22	6/6/22	6/5/22	5	34	31	17	l
6/18/22	6/18/22	6/18/22	4	10	10	10	0
6/19/22	6/21/22	6/20/22	13	417	185	139	h
6/22/22	6/23/22	6/23/22	7	87	52	44	m
6/24/22	6/26/22	6/26/22	7	292	247	97	h
6/28/22	6/30/22	6/30/22	8.5	77	51	26	m
7/3/22	7/4/22	7/3/22	6	17	9	9	0

Figure 22: Peak 72-hour hail reports in France during the period from mid-May to early July. | **Source:** European Severe Weather Database

According to Gallagher Re estimates (based on vulnerability of market exposure in the regions of event reports and geographic information system-based extrapolation of ESWD hail reports, shown in Figure 23), the hailstorm event with the largest market loss potential in France occurred from June 19 to 22.

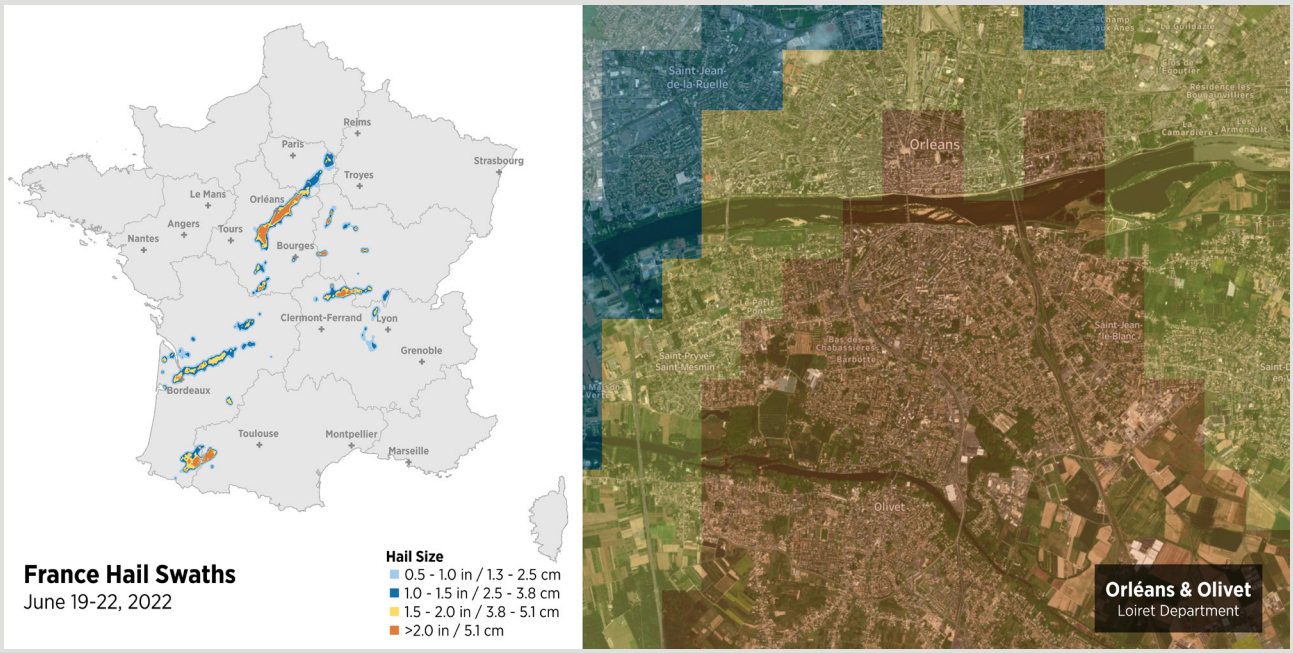


Figure 23: Gallagher Re footprint of the most severe hail event from June 6 to 22, 2022 (ESWD) | **Source:** Arthur J. Gallagher & Co.

Gallagher Re Quantification of Hail Risk

The Gallagher Re Severe Convective Storm index (SCSi) is based on data released by the European Centre for Medium-Range Weather Forecasts (ECMWF).

The ECMWF's Re-Analysis v5 (ERA5) data provides an indication of how many days during the year the weather conditions were favorable to create a severe thunderstorm in a specific location.

A comparison of the average SCSi for 2022 with historical records as seen in Figure 24 shows that 2022 provided an exceptionally high number of days with favorable atmospheric conditions for convective storm development. Notwithstanding the severity of this year's hail events, scientific research on the impact of climate change on the occurrence of hail, particularly with regards to spatial trends of occurrence, is thus far indeterminate (Raupach et al, 2021).

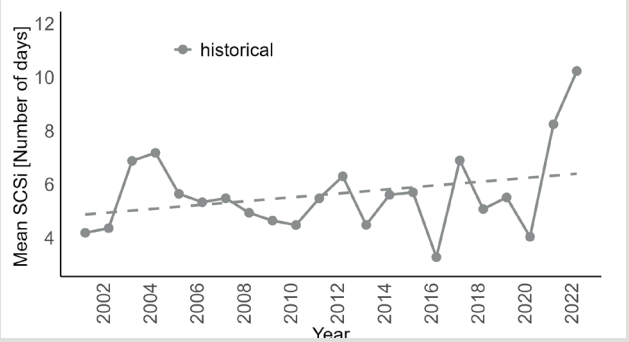


Figure 24: Data showing an increase in optimum conditions for severe thunderstorms in 2022
Source: Gallagher Re/ECMWF

France Subsidence

In 2022, France endured the second-warmest summer on record since 1900, with the average temperature between June and August 2.3°C warmer than the 1991–2000 average.

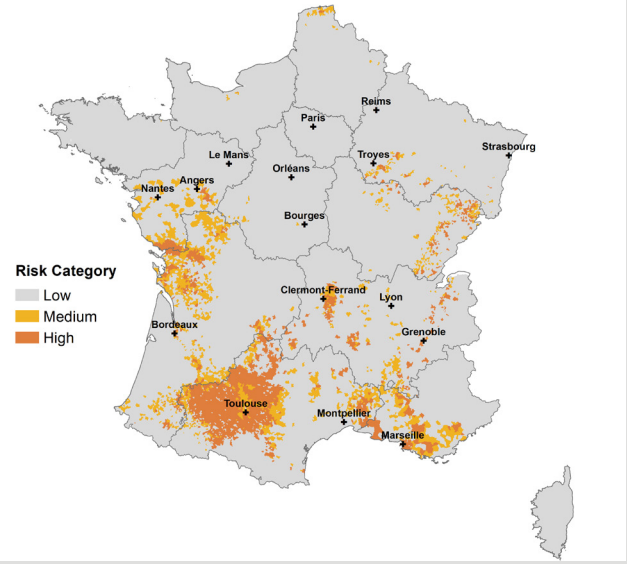


Figure 25: Zones most affected by subsidence risk in 2022, produced by Gallagher Re subsidence model
Source: Gallagher Re

The first seven months of the year also saw average rainfall fall by 33%, while most areas of eastern and southern France recording a reading of extremely dry on the standardized soil water index.

France is vulnerable to subsidence because much of the land area contains soils with high concentrations of clay. As shown in Figure 25. almost half of Metropolitan France is exposed to subsidence risk.

According to Mission des Risques Naturels (MRN), the annual subsidence claim cost for France ran between EUR 1.9bn–2.8bn in 2022. Should the final figures be confirmed in excess of EUR 2.1bn, that will make it the costliest year in history. An analysis using Gallagher Re's subsidence model showed that insured losses could reach as high as USD 2.7bn.

Subsidence claims are often not made until several months after the period of severe drought/wetness, so it will be some time until confirmed losses are finalized.

Summer Heat Waves and Wildfires

As June gave way to July and August, a series of intense heat waves occurred across Europe, with temperatures exceeding 40°C (104°F) recorded in multiple countries, breaking many long-standing national records.

Gallagher Re estimates that as many as or more than 40,000 excess deaths were recorded between June and August from heat-related activity in the region, which particularly hit the UK, France, Spain and Portugal. This was conducted based on national-level mortality analysis.

According to the European Forest Fire Information System (EFFIS), the cumulative burn area in 2022 for European Union countries was 250% higher compared to the 2006–2021 baseline average.

Damaging wildfires occurred on July 19, which is unusual for the UK, with more than 50 properties reported being destroyed in the London area. The Gironde area of France and Algarve region of Portugal were also notably affected.

The below-average levels of precipitation during the previous winter and spring months exacerbated the intensity and longevity of heat wave conditions during summer. Heat stress led to reduced EU crop yields, and reduced river discharge levels impacted hydroelectric power generation in certain regions. According to preliminary reports from the European Drought Observatory (EDO) the drought was the most severe Europe had observed in 500 years.

Unsurprisingly, the prolonged nature of the 2022 heat waves raised discussions as to whether the events were linked with climate change. Scientists at the World Weather Attribution group investigated the record UK temperatures observed in July 2022 using climate model simulations and estimated that anthropogenic climate change made the event 10 times more likely to occur, as compared to in the preindustrial era.

Climate change is expected to lead to higher average summer temperatures and more frequent drought conditions in Europe, particularly in Mediterranean countries (IPCC). However, the magnitude of such future changes currently remains uncertain.

Deadly Floods and Storms in Africa

At the other end of the spectrum, Africa experienced above-average rainfall during its rainy season in 2022, with South Africa (Durban) and Nigeria particularly badly hit.

April 11–13 saw an estimated USD 1.8bn claimed in insured losses related to Storm Issa, which formed over the central interior of South Africa before dropping heavy precipitation over the regions of Margate, Durban, Sezela and Mt. Edgecome.

Now recorded as one of the worst storms in South Africa's history, Storm Issa resulted in a national state of disaster being declared by the government. More than 300 millimeters of rainfall was recorded in just 24 hours, leading to landslides, riverbanks bursting and 461 fatalities.

The social impact included 12,000 homes being damaged that led to 40,000 people being displaced. Hundreds of schools, health clinics and other facilities were also damaged.

The Port of Durban, vital to the South African economy and one of the busiest on the continent, and a Toyota factory were also severely affected, resulting in long-term supply chain issues.

In Nigeria, 33 of its 36 states were affected by excess rain and flooding between June and November.

While normally recognized as a rainy season for the country, excess soil moisture, extreme weather conditions owing to climate change, inadequate dam functioning (especially those close to the country's borders) and topography also contributed to a huge amount of damage in 2022, around 30% of which was insured.

According to Nigeria's National Emergency Management Agency, an estimated USD 750mn of the USD 4.5bn of total losses were insured, as heavy rain and flooding destroyed an estimated 676,945 hectares (1.67 million acres) of farmland and partially damaged a further 268,044 hectares (662,000 acres), along with destroying more than 180,000 homes and disrupting fuel supplies.

South Africa

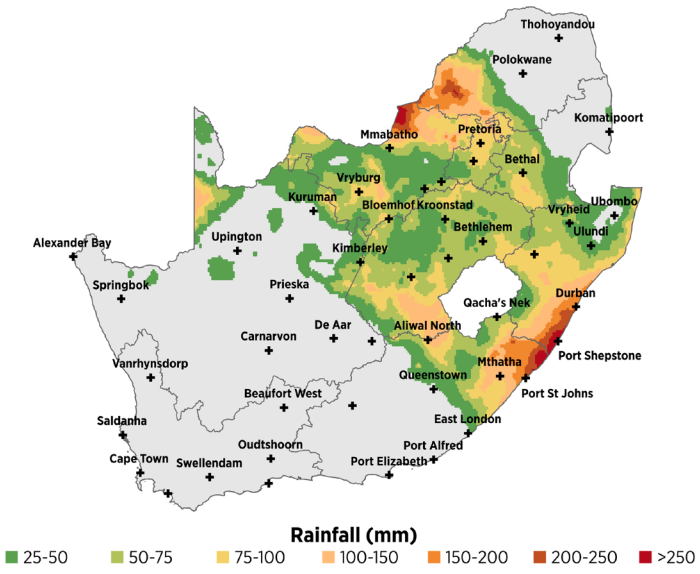


Figure 26: Rainfall in South Africa from April 8-15 | **Source:** NASA GPM

Nigeria

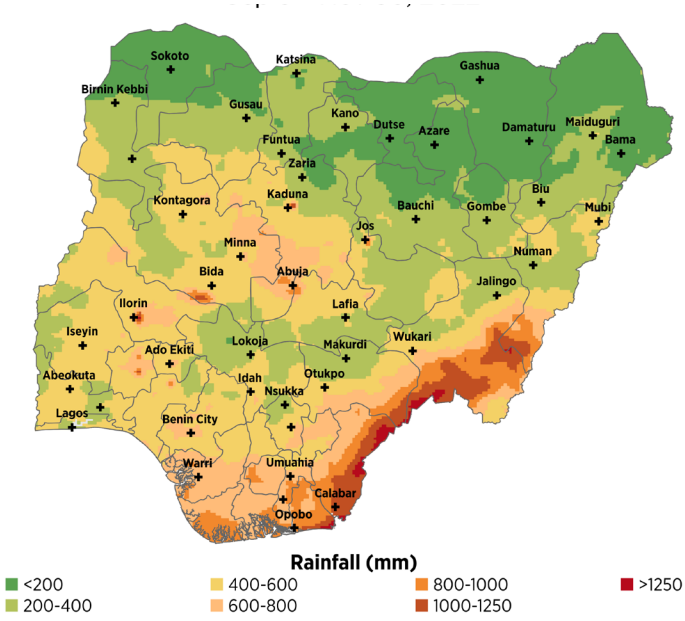


Figure 27: Rainfall in Nigeria from September 9 to November 30
Source: NASA GPM

US: Hurricane Ian, SCS and Drought

Ian became the second-costliest US hurricane on record for insurers

In the US, 2022 industry losses were driven by a few large events: Hurricane Ian, the year's largest loss-causing natural catastrophe, brought immense damage to Florida. A series of SCS, occurring April through June, spread large losses across portions of the Midwest, with the states of Arkansas, Minnesota, Nebraska, South Dakota and Ohio particularly hard hit. And an ongoing drought in the West and Southern Plains caused significant agricultural loss, as well as concerns over reservoir depletion and wildfire risk.

Despite an unexpected lull in hurricane activity through most of July and August, the 2022 Atlantic hurricane season became just the third season to top USD 50bn in insured losses, due mainly to Hurricane Ian. With landfalls on both Florida and South Carolina, Ian was the deadliest and costliest natural catastrophe event in 2022. Ian brought extreme winds, torrential rain and a prolific storm surge to densely populated areas in Florida. Economic losses in the US alone were listed at USD 112bn, with public and private insurers covering at least USD 55bn of the total cost. It marked the second-costliest hurricane on record for the insurance industry, only behind Hurricane Katrina (2005). Ian formed as a tropical storm on September 23 and strengthened to Category 3 intensity before striking western Cuba with wind speeds of 125 mph (200 kph) on September 27. Ian then strengthened to Category 4 intensity, before making a second landfall south of Punta Gorda, Florida (Figure 28). Ian brought a catastrophic storm surge to the west coast of Florida along with widespread intense rainfall of nearly 20 inches (500 millimeters), resulting in major flooding across the peninsula all the way to the Atlantic coast. Ian exited Florida as a tropical storm into the Atlantic, then restrengthened to Category 1 intensity as it moved northward and made a third landfall on the South Carolina coast near Georgetown on September 30. Ian brought a storm surge of three to six feet, severely damaging buildings and businesses along the Carolina coasts.

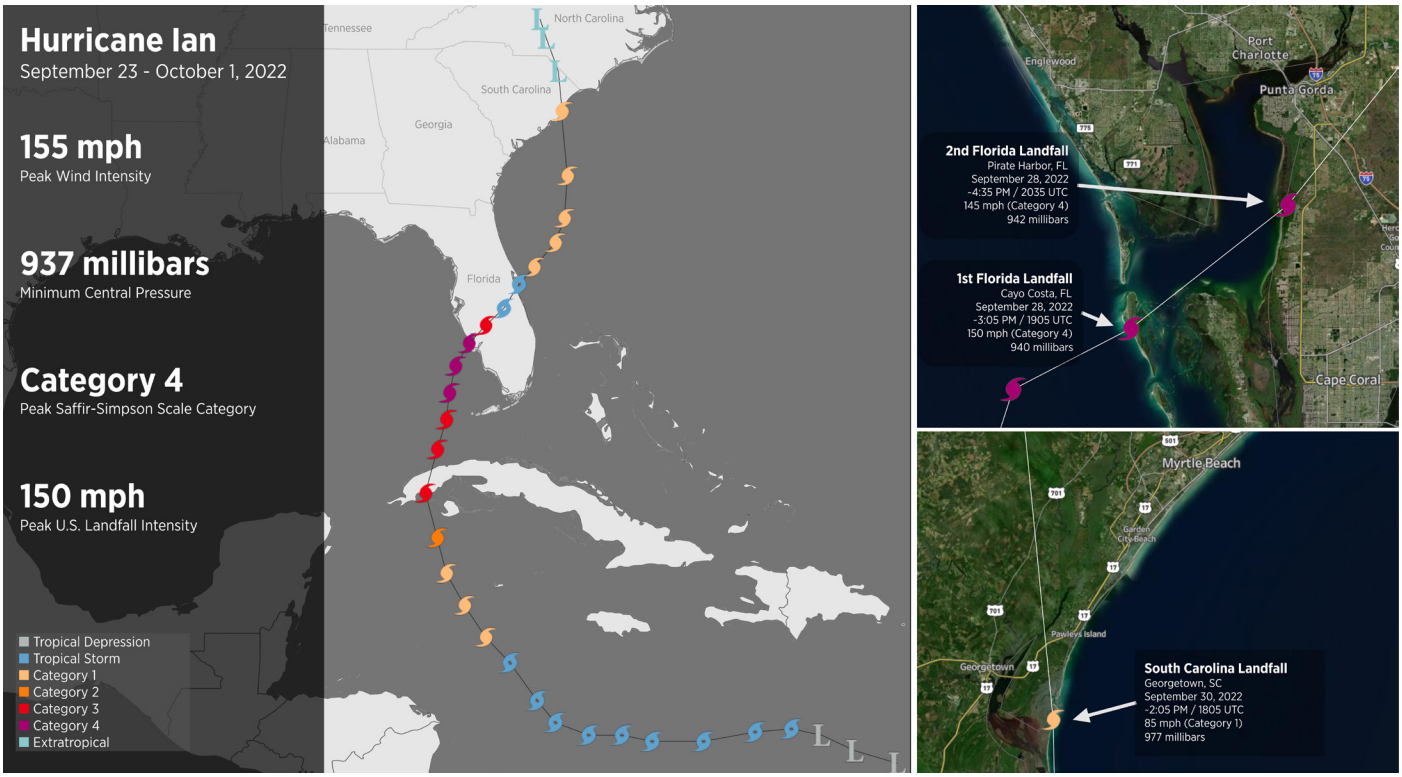


Figure 28: Track of Hurricane Ian and US landfall points | **Source:** NOAA

Hurricane Ian's post-tropical remnants would later bring heavy rains to parts of the mid-Atlantic and Northeast states. Heavy rains were noted from the Carolinas to New York. Ian's remnants would later sit off the coast of New Jersey for several days and eventually spawn inland and coastal flooding that was reminiscent of a Nor'easter weather system.

From spring to early summer of 2022, the midwest US experienced a series of severe thunderstorms with tornadoes, hail, wind and heavy rainfall events. Six of the outbreaks each caused insured losses exceeding USD 1bn and, among those, three caused insured losses exceeding USD 2bn.

The costliest single outbreak this year, with economic losses greater than USD 3bn, resulted from widespread thunderstorm activity marked by damaging straight-line winds causing damage in nearly two-dozen states from June 11–17.

Also of note were three SCS outbreaks during the months of April and May that combined to cause more than USD 5bn in insured losses. One of the most significant events occurred in the Upper Midwest from May 19–22. This included a significant hail swath that affected the greater Minneapolis-St. Paul metro region on May 20. A multiday tornado outbreak from April 10–14 spawned at least 73 touchdowns, and also prompted periods of large hail and damaging non-tornadic winds in the Plains and Southeast.

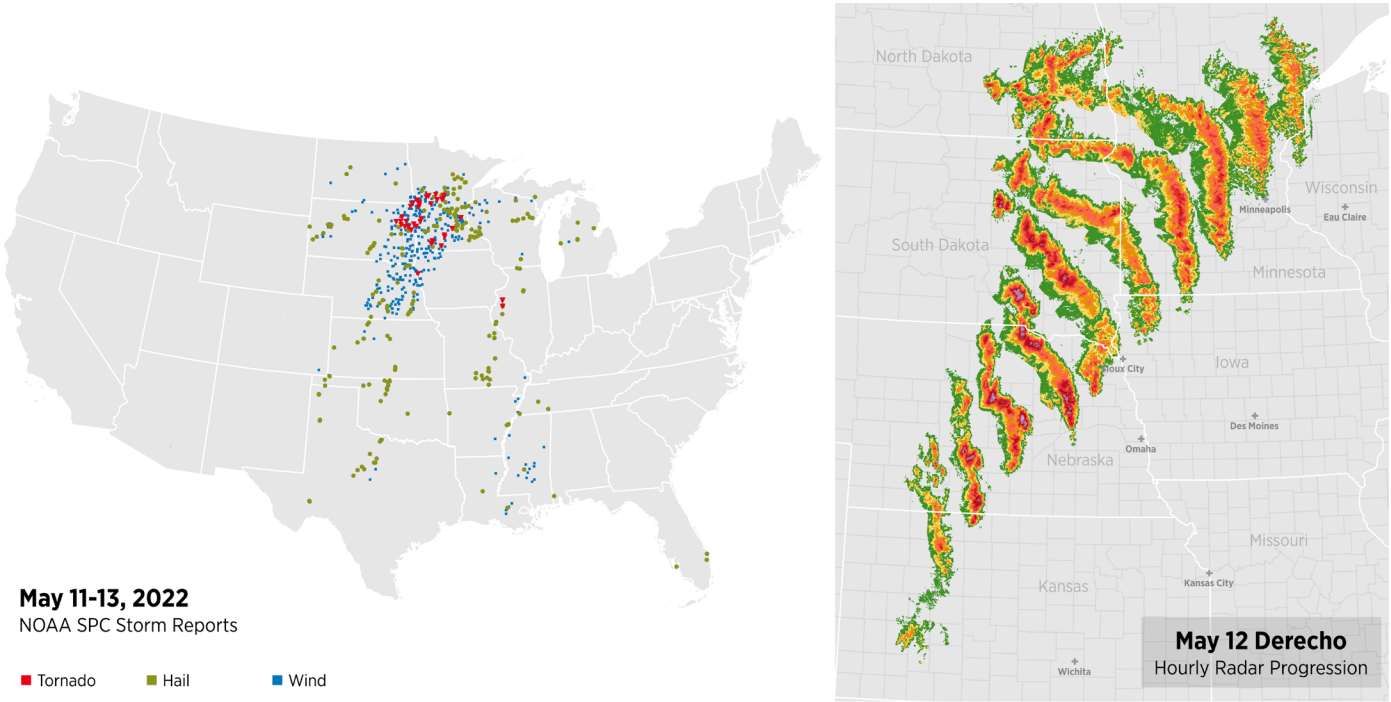


Figure 29: Severe weather storm reports from May 11-13 and a radar progression of the May 12 derecho | **Source:** NOAA

Another major US weather story included record drought conditions and several major heat waves in 2022. NOAA cited the economic cost of drought conditions in the Plains and West at USD 21bn, the most expensive US drought since 2012 (USD 39bn in today's dollars). The six-month average temperature for the contiguous US from June to November 2022 was the eighth warmest in 128 years of official record-keeping. The significance of the drought in the western states resulted in further depletion of critical lakes and reservoirs including Lake Mead, Lake Powell, Lake Oroville and Shasta Lake. Lake Mead, the country's largest reservoir, and the Great Salt Lake were both at historic low levels by the end of 2022. Multiple summer heat waves resulted in dozens of direct fatalities, and only further amplified drought and agricultural impacts.

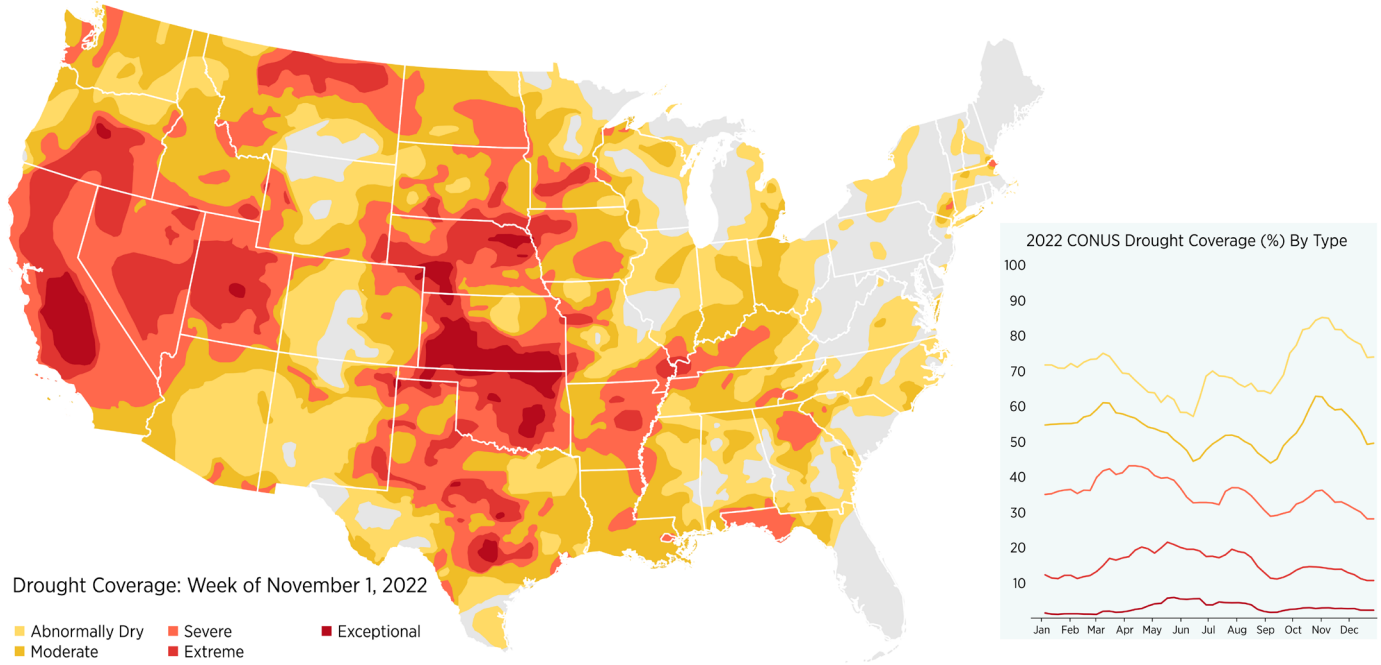


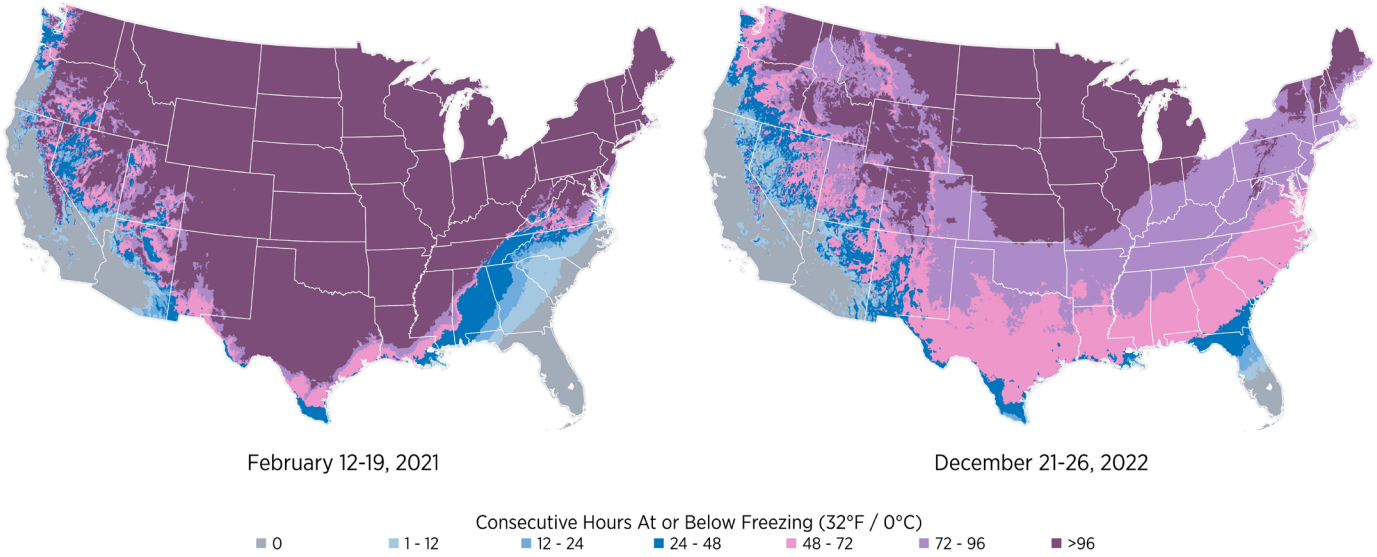
Figure 30: Peak US drought conditions during the week of November 1 | **Source:** NOAA's Drought Monitor

December 2022 Arctic Outbreak

The year concluded with a long and highly impactful winter storm and Arctic air outbreak at the end of December, which generated an industry loss of at least USD 3.0bn in the US alone. While comparisons can be made, the December 2022 event was less disruptive than the February 2021 extended freeze, the latter of which produced insured losses nearing USD 15bn—largely due to failure of the Texas power grid. The February 2021 event was markedly more expansive in terms of reach and duration of sub-freezing and subzero (°F) temperatures.

The December 21–26 Arctic outbreak was aided by a rapidly depending low-pressure system across the Great Lakes in tandem with a strong area of Arctic high pressure plunging into the Rockies. At the peak, nearly 200 million people in the US were impacted by windchill warnings or advisories as subfreezing and near to record-breaking low temperatures spread southward as far as the Gulf of Mexico. The temperature in Cheyenne, Wyoming, dropped 41°F in the span of an hour on December 21. Concurrently, winter weather hazards stretched from the Pacific Northwest toward the East Coast. The storm stranded motorists across the country, instigated thousands of flight cancellations and resulted in 1.5 million power outages nationwide.

In New York, an unprecedented blizzard was responsible for at least 41 fatalities near Buffalo, where blizzard conditions persisted for at least 37 straight hours. In total, the winter storm and related impacts claimed 91 lives in the US and Canada. Globally, this was the most expensive winter weather event for insurers in 2022.



Takeaways:

The February 2021 Polar Vortex was longer, more intense and physically more consequential than the December 2022 Polar Vortex.

Figure 31: A comparison of consecutive hours at or below freezing between the February 2021 and December 2022 arctic outbreak events | **Source:** NOAA

Latin America and Canada: Crops and Quakes Command Attention

Hurricane Fiona and drought lead insured loss tallies

The natural catastrophe focus of reinsurers during the past decade has primarily been centered on tropical cyclones and earthquakes, though recent activity has drawn more interest to drought and flood events.

The Eastern Pacific hurricane season contained 19 named storms, of which 10 became hurricanes and four intensified to major hurricanes (those with winds of 111 mph or greater). Hurricanes Agatha, Kay, Orlene and Roslyn made landfall along the western coast of Mexico, but none of these storms caused significant economic or insured losses.

This year was a near-average period for hurricanes in the North Atlantic Basin. This hurricane season saw 14 named storms, of which eight became hurricanes and two intensified to major hurricanes. One notable aspect of this season was the absence of any hurricanes recorded in August, which is a first for a year with La Niña conditions. Of the 14 storms, seven passed through Latin America and the Caribbean (Bonnie, Fiona, Ian, Julia, Karl, Lisa and Nicole), and only two had a significant impact.

Julia caused severe damage, bringing torrential rain to large swaths of Central America, triggering floods and landslides in northern Colombia, Nicaragua, Honduras, Guatemala, Costa Rica, El Salvador and Panama. It is estimated that economic losses reached USD 730mn for this storm.

The most consequential event in the region was Hurricane Fiona. It made landfall in Puerto Rico as a Category 1 storm, nearly five years to the day after Hurricane Maria in 2017. Fiona continued as a Category 1 over the Dominican Republic, before intensifying into a Category 4 hurricane (the first major hurricane of the season) as it moved north away from the Caribbean toward Canada.

The rainfall from Hurricane Fiona in Puerto Rico, at 31.22 inches (793 millimeters) in 72 hours, was nearly identical to that recorded during Hurricane Maria. Maria, which was a high-end Category 4 at landfall, remains the benchmark for all Puerto Rico hurricane events and was primarily driven by wind effects. Storm surge and inland flood was less of a primary factor. Fiona's winds were much weaker (low-end Category 1) and losses from the storm were largely derived from flooding impacts.

The storm would eventually lead to significant economic losses elsewhere in the Caribbean and Canada. Such totals included USD 375mn for the Dominican Republic and USD 1.2bn in Canada. According to NOAA National Center for Environmental Information (NCEI), the economic losses in Puerto Rico from Fiona were USD 2.5bn—substantially lower than Maria. Furthermore, the death toll was also smaller in Puerto Rico, with 25 fatalities attributed to Fiona, far fewer than the 2,975 during Maria.

Hurricane Fiona was the first major excess of water catastrophe to occur in Puerto Rico, and this has raised local market concerns for reassessment of flood policies. Most insured losses were from extra expenses coverage, such as the use of diesel in generators. Business interruption in the case of flood is not covered. Insurers who offer flood cover as a stand-alone policy were impacted greatly by this event, more so than those offering cover as a sublimit in package policies or through the National Flood Insurance Programme (NFIP). Losses from Hurricane Fiona were expected to be absorbed by the insurance markets and proportional treaty reinsurers, while impact to catastrophe excess of loss reinsurance layers was also expected to be minimal.

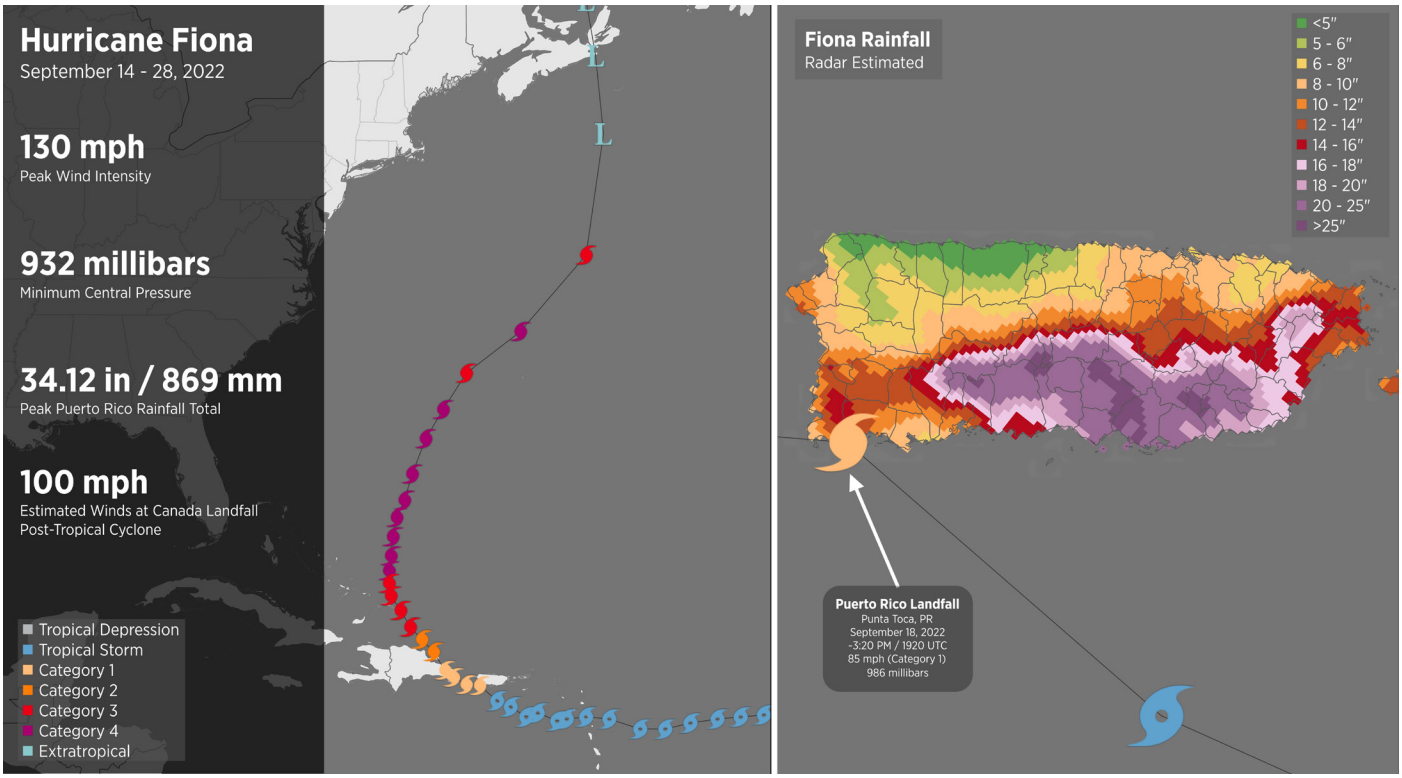


Figure 32: Track map of Hurricane Fiona and radar-estimated rainfall and landfall details in Puerto Rico | **Source:** NOAA

Major Droughts Reduce Crop Yields

The rare triple-dip La Niña conditions referenced elsewhere in this report also caused severe droughts across Latin America, with major impacts for Brazil and Argentina. The drought persisted throughout the entirety of 2022, and significant rainfall was not expected to return until well into 2023. The Brazilian government cited drought-related costs to agriculture at up to USD 18bn. Further non-negligible losses were seen in Argentina.

The agricultural sector was particularly hard hit as soy, corn and wheat production suffered due to the water deficit. This drop in production, combined with the war in Ukraine, contributed to the increase in global food prices and inflation as demand outstripped supply. According to the Rosario Grain Exchange, wheat production in Argentina for 2022 to 2023 is projected to be 11.5 million tons, which would be approximately half the total of last year's record crop of 23 million tons.

Despite high economic losses in Argentina, insured losses were minimal as the current insurance market does not provide drought cover in multi-peril crop insurance products for all farmers. Insurance companies in Brazil have faced a significant reduction in capacity to sell multi-peril crop insurance against drought, and have had to account for this in technical underwriting and loss adjustments. Due to the significant losses from this event, it is thought that this drought will represent a point of inflection in the agricultural reinsurance market with important adjustments in terms of original rates, triggers, technology applied in underwriting, monitoring and loss adjustments.

Strong Earthquake Rattles Mexico

On September 19, a USGS-registered 7.6 earthquake struck the Michoacán region of Mexico (this is the exact date of two past significant earthquakes, in Michoacán in 1985 and in Puebla in 2017). A M5.8 aftershock occurred to the west of the epicenter of the original event on September 20 and was followed by a M6.8 aftershock on September 22, which struck a similar area. Secondary effects included a tsunami of 79 centimeters (2.59 feet), and multiple landslides were also recorded.

The economic and insured losses from this earthquake were relatively insignificant, and loss of life remained low at five deaths. The insurance impact was also negligible.

In contrast to the previous two events, the impact to Mexico City has been minimal, and the area around the epicenter is generally sparsely populated and with limited insurance penetration. Nonetheless, this event has been magnified in the public consciousness due to the significance of the September 19 date, linking it to earthquakes that have caused significant economic and humanitarian loss in the past.

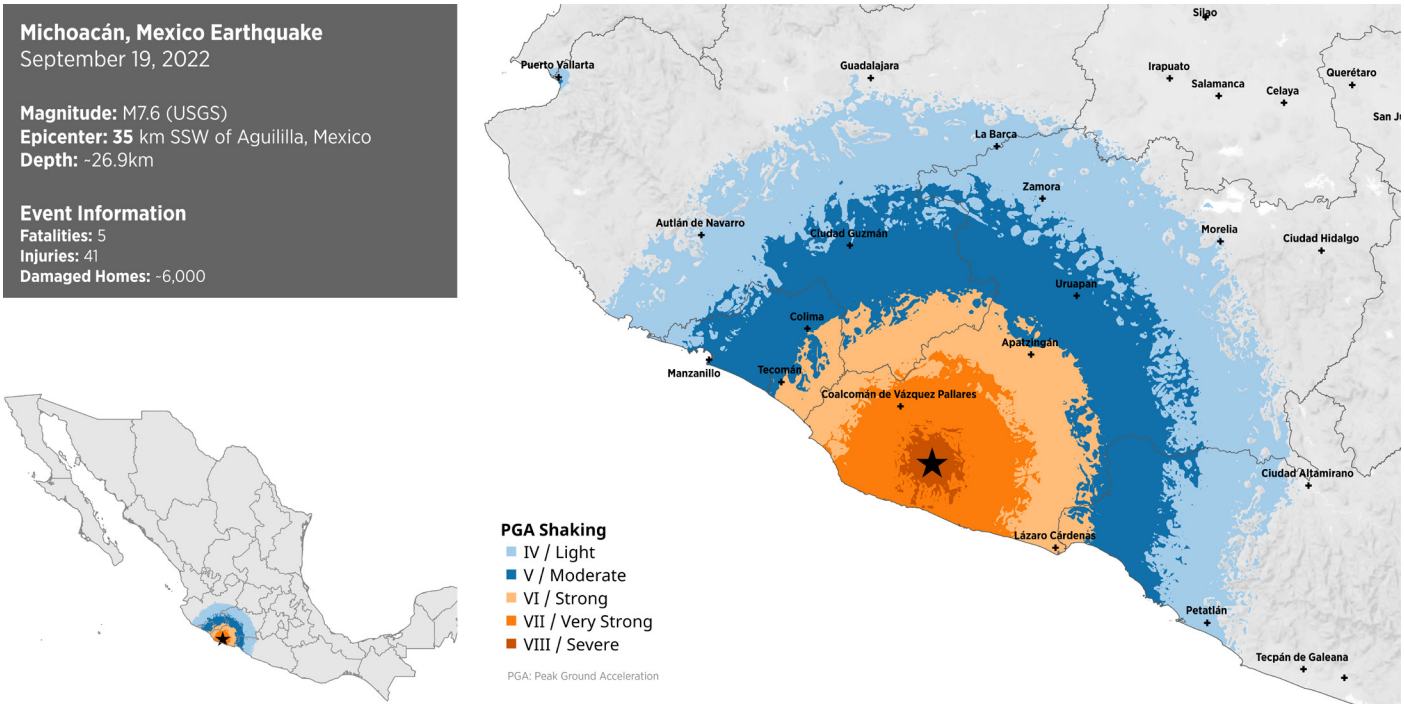


Figure 33: Peak Ground Acceleration (PGA) shaking felt in Mexico during the September 19 earthquake | **Source:** Peak Ground Acceleration (PGA) shaking felt in Mexico during the September 19 earthquake

Aided by unseasonably warm temperatures and a stalled frontal boundary, a damaging and deadly line of storms traversed southern Canada's most populous regions in Ontario and Quebec on May 21. The derecho, which is defined as a widespread, long-lived windstorm associated with a band of rapidly progressing showers and thunderstorms, tracked nearly 1,000 miles (620 kilometers) on May 21 and impacted major urban corridors including Toronto, Ottawa, Montreal and Quebec City. The line of storms produced straight-line winds that approached 90 mph (145 kph), along with flooding rain, large hail and embedded tornadoes, which included an EF2 tornado that caused notable damage near Uxbridge in Ontario. The derecho claimed at least 12 lives and left 1 million customers without power. Extensive impacts to property and electrical infrastructure generated nearly USD 1bn in insured losses, ranking among the most damaging SCS events for the Canadian market on record.

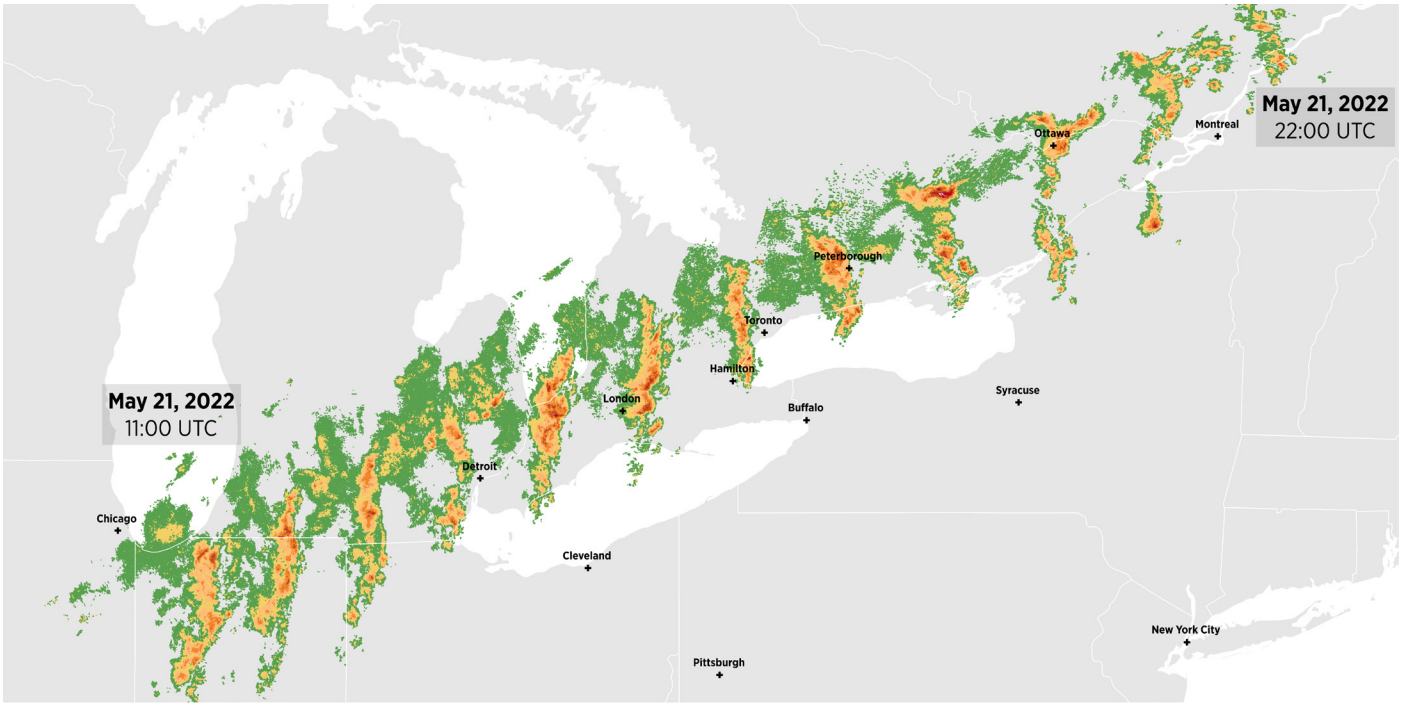


Figure 34: Hourly radar progression of the southern Canada derecho on May 21, 2022 | **Source:** NOAA

APPENDIX

Please note that the Appendix includes a select listing of global events that resulted in >USD 100mn in economic loss and/or >10 fatalities. It does not include a listing of aggregated loss totals from agencies which are not easily attributed to an individual event.

Drought

Event Name	Date	Region	Countries Affected	Economic Losses (USD mn)	Fatalities
Horn of Africa Drought	April 1—Dec. 31	Africa	SO, ET, KE, MW	2,008	—
China Drought	Jan. 1–Dec. 31	Asia	CN	6,070	—
Austria Drought	Jan. 1–Dec. 31	Europe	AT	125	—
Croatia Drought	Jan. 1–Dec. 31	Europe	HR	132	—
France Drought	Jan. 1–Dec. 31	Europe	FR	8,000	—
Hungary Drought	Jan. 1–Dec. 31	Europe	HU	1,220	—
Italy Drought	Jan. 1–Dec. 31	Europe	IT	6,200	—
Slovakia Drought	Jan. 1–Dec. 31	Europe	SK	150	—
Spain Drought	Jan. 1–Dec. 31	Europe	ES	10,130	—
Argentina Drought	Jan. 1–Dec. 31	Latin America	AR	2,000	—
Brazil Drought	Jan. 1–Dec. 31	Latin America	BR	18,000	—
Mexico Drought	Jan. 1–Dec. 31	Latin America	MX	603	—
Canada Drought	Jan. 1–Dec. 31	North America	CA	1,000	—
US Drought	Jan. 1–Dec. 31	North America	US	21,000	—

Earthquake

Event Name	Date	Region	Countries Affected	Economic Losses (USD mn)	Fatalities
Qinghai Earthquake	Jan. 8	Asia	CN	510	—
—	Jan. 17	Asia	AF	0.4	28
—	Feb. 25	Asia	ID	1.0	18
Fukushima Earthquake	March 16	Asia	JP	8,500	3
Afghanistan and Pakistan Earthquake	June 22	Asia	AF, PK	120	1,163
Luzon Earthquake	July 27	Asia	PH	75	11
Sichuan Earthquake	Sept. 5	Asia	CN	835	117
West Java Earthquake	Nov. 21	Asia	ID	256	635
Hormozgan Earthquakes	July 2	Middle East	IR	142	—
Northern California Earthquake	Dec. 20	North America	US	150	2
Papua New Guinea Earthquake	Sept. 11	Oceania	PG	15	12

European Windstorm

Event Name	Date	Region	Countries Affected	Economic Losses (USD mn)	Fatalities
Hannelore	Jan. 16–17	Europe	NO, SE, DK, PL, FI, LT, LI	112	—
Malik/Nadia/Valtteri	Jan. 29–30	Europe	DK, DE, SE, AT, CZ, UK, NO, PL, SK, LT, LV	509	7
Roxana	Feb. 6–7	Europe	DE, FR, BE, UK	153	—
Dudley/Eunice/Franklin	Feb. 16–21	Europe	DE, NL, BE, LU, UK, IE, FR, PL, CZ, AT, DK, CH	5,944	31
Nasim	April 6–7	Europe	DE, BE, NL, FR, UK	249	—

Flooding/Landslides

Event Name	Date	Region	Countries Affected	Economic Losses (USD mn)	Fatalities
—	Jan. 1–25	Africa	RW	0.2	15
—	Jan. 8–9	Africa	ZA	66	10
—	Jan. 17	Africa	MG	0.3	10
KwaZulu-Natal Floods	April 8–15	Africa	ZA	3,500	461
Rwanda and DRC Flooding	April 23–25	Africa	RW, CD	53	20
—	April 26	Africa	TZ	2.5	10
Sudan Seasonal Floods	May 1–Aug. 31	Africa	SD	10	89
Niger Seasonal Floods	June 1–Nov. 30	Africa	NE	100	195
Nigeria Seasonal Floods	June 1–Nov. 30	Africa	NG	4,505	665
—	June 16–21	Africa	CI	1.0	12
Chad Seasonal Floods	July 1–Oct. 31	Africa	TD	125	22
Mali Seasonal Floods	July 1–Nov. 30	Africa	ML	5.8	10
CAR Seasonal Floods	July 21–Nov. 30	Africa	CF	9.5	13
—	July 25–Aug. 18	Africa	MR	1.0	14
—	July 30–Aug. 1	Africa	UG	0.0	29
—	Aug. 15–Oct. 31	Africa	CM	9.5	11
—	Aug. 20–Oct. 31	Africa	SS	100	146
—	Sept. 1–Oct. 20	Africa	BJ	1.0	41
—	Sept. 4–6	Africa	UG	1.3	19
—	Oct. 1–10	Africa	GH	1.5	14
Malawi Rainy Season	Nov. 15–Dec. 31	Africa	MW	2.0	40
Yaoundé Landslide	Nov. 27	Africa	CM	1.0	15
—	Dec. 3	Africa	ZA	1.5	16
—	Dec .12–13	Africa	CD	2.0	120

Flooding/Landslides continued

Event Name	Date	Region	Countries Affected	Economic Losses (USD mn)	Fatalities
—	Dec. 15–Jan. 4	Africa	AO	0.0	11
—	Dec. 20	Africa	UG	0.3	10
—	Jan. 1–6	Asia	AF	2.5	11
—	Jan. 1–6	Asia	OM, IR, PK, AF	95	14
—	Jan. 6–19	Asia	ID	2.3	11
—	Jan. 20–25	Asia	PK	0.5	12
—	Feb. 25–March 2	Asia	MY, TH	9.0	12
—	May 2–7	Asia	AF	0.5	29
—	May 9–13	Asia	CN	240	1
Bangladesh Seasonal Floods	May 17–Sept. 30	Asia	BD	500	141
India Seasonal Floods	May 17–Oct. 31	Asia	IN	2,500	2,047
China Seasonal Floods	May 23–Sept. 30	Asia	CN	14,490	197
Nepal Seasonal Floods	June 5–30	Asia	NP	0.5	32
—	June 14–30	Asia	PK	7.5	37
Afghanistan Seasonal Floods	June 21–22	Asia	AF	0.5	19
Nepal Seasonal Flood	July 1–31	Asia	NP	0.1	35
Pakistan Monsoon Floods	July 1–Sep 30	Asia	PK	14,900	1,735
—	July 5–11	Asia	AF	2.0	63
—	July 24–Aug. 1	Asia	AF	0.2	39
—	Aug. 3–4	Asia	JP	100	—
—	Aug. 8–9	Asia	KR	420	14
—	Aug. 13	Asia	AF	0.0	31
—	Aug. 16–21	Asia	AF	0.5	63
—	Sept. 15–17	Asia	NP	1.0	25
—	Sept. 27–29	Asia	ID	0.3	19
—	Oct. 1–31	Asia	CN	220	—
—	Oct. 4–9	Asia	ID	1.5	10
—	Oct. 7–31	Asia	TH	750	—
—	Oct. 23–Nov 3	Asia	ID	0.8	11
—	Nov. 11–19	Asia	ID	2.0	5
Batang Kali Landslide	Dec. 16	Asia	MY	0.3	31
—	Dec. 25–27	Asia	PH	75	52
Black Sea Floods	June 24 –27	Europe	RU, TR	244	2
Reili	Sept. 15–16	Europe	IT	35	11
Ischia Landslide	Nov. 26	Europe	IT	4.0	12
—	Jan. 1–14	Latin America	BR	400	18
—	Jan. 1–May 31	Latin America	EC	385	11
Sao Paulo Floods	Jan. 27–30	Latin America	BR	68	31

Flooding/Landslides continued

Event Name	Date	Region	Countries Affected	Economic Losses (USD mn)	Fatalities
Quito Floods	Jan. 29–Feb. 1	Latin America	EC	50	28
—	Feb. 8	Latin America	CO	1.3	16
—	Feb. 15–16	Latin America	BR	26	232
—	March 16–June 30	Latin America	CO	28	80
Rio de Janeiro Floods and Landslides	March 31–April 2	Latin America	BR	131	23
Guatemala Seasonal Floods	May 1–June 30	Latin America	GT	50	13
Pernambuco Floods	May 25–28	Latin America	BR	450	129
Colombia Seasonal Floods	July 1–Nov. 30	Latin America	CO	250	271
—	Sept. 23	Latin America	VE	1.0	13
—	Oct. 25–Nov. 5	Latin America	VE	2.0	10
—	Nov. 28–Dec. 4	Latin America	BR	65	10
Risaralda Landslide	Dec. 4	Latin America	CO	0.5	34
Fars and Tehran Floods	July 22–29	Middle East	IR	200	95
—	July 23–24	Middle East	YE	0.0	14
—	Aug. 1–5	Middle East	YE	0.0	16
Canada Red River Spring Floods	April 22 –25	North America	CA	157	—
Southwest Monsoon	July 15–25	North America	US	175	2
Missouri and Kentucky Floods	July 25–28	North America	US	1,500	28
Southwest Monsoon	July 26–31	North America	US	283	3
Texas and Mississippi Floods	Aug. 18–24	North America	US	1,200	2
—	Sept. 11–13	North America	US	160	—
Montreal Flash Floods	Sept. 13–14	North America	CA	663	—
—	Dec. 23–27	North America	CA	130	—
Late December Atmospheric River	Dec. 26–Jan. 4	North America	US	200	5
QLD and NSW Floods	Feb. 23–March 31	Oceania	AU	6,750	22
—	March 20–29	Oceania	NZ	113	—
—	July 2–6	Oceania	AU	418	—
Eastern Australia Floods	Oct. 12–28	Oceania	AU	697	—
Eastern Australia Floods	Nov. 12–14	Oceania	AU	259	2

Heat Waves/Miscellaneous

Event Name	Date	Region	Countries Affected	Economic Losses (USD mn)	Fatalities
South Asia Heatwave	April 28–May 9	Asia	IN, PK	N/A	90
Japan Seasonal Heatwave	May–Sept.	Asia	JP	N/A	71
China Seasonal Heatwave	July 1–Aug. 31	Asia	CN	N/A	35
Summer European Heatwaves	June–Sept.	Europe	AD, HR, FR, DE, GR, HU, IE, IT, LT, BA, ME, NL, NO, PL, PT, RO, SK, SI, ES, CH, UK	N/A	40,000+
Marmolada Glacier Collapse	July 3	Europe	IT	N/A	11
US June Heatwave	June 1–30	North America	US	N/A	55
Tonga Eruption and Tsunami	Jan. 15–16	Oceania	TO	117	5

Severe Convective Storm

Event Name	Date	Region	Countries Affected	Economic Losses (USD mn)	Fatalities
—	March 14–17	Asia	CN	105	—
—	April 11–15	Asia	CN	130	3
—	April 23–25	Asia	CN	120	—
—	May 16–June 1	Asia	NP	0.2	20
North China Storms	June 10–14	Asia	CN	300	13
North China Storms	June 19–23	Asia	CN	180	5
—	July 25–28	Asia	CN	630	24
—	Aug. 1–31	Asia	CN	500	—
Emmelinde	May 20	Europe	FR, DE	630	—
Finja	May 22–25	Europe	FR, IT, AT, HU, CH, SI	470	—
Leocardia and May	June 2–6	Europe	FR, CH, DE, SI, AT, CZ, HU	1,906	—
Petra and Qiara	June 19–24	Europe	FR, DE, AR, CH, IT, CZ, PL	2,761	3
Rebecca and Scarlett	June 26–29	Europe	AT, NL, FR, CZ, DE, IT, PL	1,536	2
Ulrike	June 30–July 1	Europe	FR, DE, PL	345	—
Carolin	July 20	Europe	CH, FR, DE, AT, PL	198	—
Karin and Lavinia	Aug. 17–21	Europe	FR, IT, AT, SI, CH, CR	488	13
—	Feb. 2	Latin America	BR	120	16
—	Feb. 21	Latin America	BR	150	—
—	Jan. 21–22	North America	US	175	—

Severe Convective Storm continued

Event Name	Date	Region	Countries Affected	Economic Losses (USD mn)	Fatalities
—	Feb. 21–22	North America	US	1,075	—
—	March 5–7	North America	US	755	8
—	March 11–13	North America	US	220	—
—	March 14–16	North America	US	520	—
New Orleans Tornado/SCS	March 21–23	North America	US	825	5-
—	March 29–31	North America	US	1,250	2
—	April 2–4	North America	US	295	—
—	April 3–7	North America	US	1,450	3
—	April 10–14	North America	US	2,800	1
—	April 15–17	North America	US	875	—
—	April 21–24	North America	US	605	—
Andover Tornado/SCS	April 26–30	North America	US	565	3
—	May 1–3	North America	US	1,150	—
—	May 4–6	North America	US	930	—
—	May 9–10	North America	US	2,150	—
Upper Midwest May Derecho	May 11–12	North America	US	2,700	5
—	May 13–16	North America	US	690	—
—	May 17–19	North America	US	215	—
—	May 19–22	North America	US	2,400	2
Southern Canada Derecho	May 21	North America	CA	1,350	12
—	May 23–25	North America	US	365	—
—	May 29	North America	US	200	—
—	May 30–June 2	North America	US	690	—
—	June 1–3	North America	US	100	—
—	June 4–8	North America	US	1,900	—
—	June 11–17	North America	US	3,550	3
—	June 22–23	North America	US	125	—
South Dakota Derecho	July 1–7	North America	US	640	—
—	July 7–13	North America	US	845	—
—	July 18–21	North America	CA	118	—
—	July 21–25	North America	US	1,250	—
—	Aug. 1–4	North America	US	200	1
—	Aug. 11–12	North America	US	170	—
—	Aug. 20–21	North America	US	675	—
—	Aug. 27 –29	North America	US	250	4
—	Aug. 28–Sept. 6	North America	US	400	—
—	Sept. 18–21	North America	US	500	—
—	Oct. 1–4	North America	US	170	—

Severe Convective Storm continued

Event Name	Date	Region	Countries Affected	Economic Losses (USD mn)	Fatalities
c	Oct. 15–16	North America	US	250	—
—	Oct. 24–25	North America	US	245	—
Southern Plains Tornado Outbreak	Nov. 4–5	North America	US	400	4
—	Nov. 4–5	North America	US	175	—
—	Nov. 11	North America	US	150	—
Western Pennsylvania Hail	Nov. 27	North America	US	115	—
—	Nov. 29–30	North America	US	125	2
Mid-December Tornado Outbreak	Dec. 13–14	North America	US	350	3

Tropical Cyclone

Event Name	Date	Region	Countries Affected	Economic Losses (USD mn)	Fatalities
Tropical Storm Ana	Jan. 22–25	Africa	MG, MZ, MW	25	142
Cyclone Batsirai	Feb. 2–7	Africa	MG, MU, RE	190	123
Tropical Storm Dumako	Feb. 15–16	Africa	MG	5.0	14
Cyclone Emnati	Feb. 22–24	Africa	MG	15	15
Cyclone Gombe	March 8–18	Africa	MG, MZ, MW	95	72
Tropical Storm Jasmine	April 26–27	Africa	MG	1.0	10
Tropical Storm Megi	April 8–13	Asia	PH	200	214
Typhoon Chaba	July 2–4	Asia	CN	460	3
Super Typhoon Hinnamnor	Sept. 1–6	Asia	JP, KR, PH	1,530	17
Typhoon Muifa	Sept. 1–6	Asia	CN, TW	437	—
Super Typhoon Nanmadol	Sept. 18–20	Asia	JP, KR	3,505	6
Tropical Storm Talas	Sept. 22–23	Asia	JP	1,600	3
Super Typhoon Noru	Sept. 25–29	Asia	PH, VN	420	48
Tropical Storm Sitrang	Oct. 24–25	Asia	BD	30	35
Typhoon Nalgae	Oct. 26–31	Asia	PH, CN	404	164
Hurricane Fiona	Sept. 16–27	Latin America	PR, CA, DO, GP, DM, TC, AG, BM	4,168	31
Hurricane Julia	Oct. 7–11	Latin America	VE, GT, SV, HN, NI, PA, TT, MX, CO	830	91
Tropical Storm Alex	June 2–6	North America	US	500	3
Hurricane Ian	Sept. 27–Oct. 1	North America	US, CU	115,000	137
Hurricane Nicole	Nov. 9–11	North America	US, BS	1,020	—

Wildfire

Event Name	Date	Region	Countries Affected	Economic Losses (USD mn)	Fatalities
Corrientes Wildfires	Jan. 15–Feb. 28	Latin America	AR	732	—
Hermits Peak and Calfs Canyon Fire	April 6– May 31	North America	US	500	—

Winter Weather (Snow, Cold, etc.)

Event Name	Date	Region	Countries Affected	Economic Losses (USD mn)	Fatalities
—	Jan. 7–8	Asia	PK	0.0	23
—	Jan. 20–24	Asia	CN	101	—
—	Jan. 25–29	Asia	CN	280	—
—	Feb. 1–3	Asia	CN	140	—
—	Feb. 6	Asia	AF	0.1	15
—	Feb. 11–14	Asia	CN	287	—
—	Feb. 16–22	Asia	CN	1,171	1
—	June 20–24	Asia	AF	0.0	12
—	Dec, 17–20	Asia	JP	150	11
—	Dec. 22–23	Asia	JP	100	8
Tyrol Avalache	Feb. 3–6	Europe	AT, CH	0.0	11
European Cold Blast	April 1–4	Europe	FR, ES	901	—
UK Extended Freeze	Dec. 9 - 17	Europe	GB	900	—
—	Jan. 2–3	North America	US	495	5
—	Jan. 14–17	North America	US	900	3
—	Feb. 1–5	North America	US	500	10
—	Feb. 16–18	North America	US	355	—
—	Feb. 17–19	North America	CA	219	—
—	Dec. 10–12	North America	US	150	—
Christmas Winter Storm and Freeze	Dec. 21–26	North America	US, CA	4,455	91

Country Abbreviations

Country Name	Abbreviation
Afghanistan	AF
Aland Islands	AX
Albania	AL
Algeria	DZ
American Samoa	AS
Andorra	AD
Angola	AO
Anguilla	AI
Antarctica	AQ
Antigua and Barbuda	AG
Argentina	AR
Armenia	AM
Aruba	AW
Australia	AU
Austria	AT
Azerbaijan	AZ
Bahamas	BS
Bahrain	BH
Bangladesh	BD
Barbados	BB
Belarus	BY
Belgium	BE
Belize	BZ
Benin	BJ
Bermuda	BM
Bhutan	BT
Bolivia	BO
Bonaire, Saint Eustatius and Saba	BQ
Bosnia and Herzegovina	BA
Botswana	BW
Bouvet Island	BV
Brazil	BR
British Indian Ocean Territory	IO
Virgin Islands (UK)	VG
Brunei	BN
Bulgaria	BG
Burkina Faso	BF
Burundi	BI

Country Name	Abbreviation
Cambodia	KH
Cameroon	CM
Canada	CA
Cape Verde	CV
Cayman Islands	KY
Central African Republic	CF
Chad	TD
Chile	CL
China	CN
Christmas Island	CX
Cocos Islands	CC
Colombia	CO
Comoros	KM
Cook Islands	CK
Costa Rica	CR
Croatia	HR
Cuba	CU
Curacao	CW
Cyprus	CY
Czech Republic	CZ
Czech Lands	CZ
Czechoslovakia	CZ
Democratic Republic of the Congo	CD
Denmark	DK
Djibouti	DJ
Dominica	DM
Dominican Republic	DO
East Timor	TL
Ecuador	EC
Egypt	EG
El Salvador	SV
Equatorial Guinea	GQ
Eritrea	ER
Estonia	EE
Ethiopia	ET
Falkland Islands	FK
Faroe Islands	FO
Fiji	FJ

Country Name	Abbreviation
Finland	FI
France	FR
French Guiana	GF
French Polynesia	PF
French Southern Territories	TF
Gabon	GA
Gambia	GM
Georgia	GE
Germany	DE
West Germany	DE
East Germany	DE
Ghana	GH
Gibraltar	GI
Greece	GR
Greenland	GL
Grenada	GD
Guadeloupe	GP
Guam	GU
Guatemala	GT
Guernsey	GG
Guinea	GN
Guinea-Bissau	GW
Guyana	GY
Haiti	HT
Heard Island and McDonald Islands	HM
Honduras	HN
Hong Kong	HK
Hungary	HU
Iceland	IS
India	IN
Indonesia	ID
Iran	IR
Iraq	IQ
Ireland	IE
Isle of Man	IM
Israel	IL
Italy	IT
Ivory Coast	CI

Country Abbreviations

Country Name	Abbreviation
Jamaica	JM
Japan	JP
Jersey	JE
Jordan	JO
Kazakhstan	KZ
Kenya	KE
Kiribati	KI
Kosovo	XK
Kuwait	KW
Kyrgyzstan	KG
Laos	LA
Latvia	LV
Lebanon	LB
Lesotho	LS
Liberia	LR
Libya	LY
Liechtenstein	LI
Lithuania	LT
Luxembourg	LU
Macao	MO
Macau	MO
Macedonia	MK
Madagascar	MG
Malawi	MW
Malaysia	MY
Maldives	MV
Mali	ML
Malta	MT
Marshall Islands	MH
Martinique	MQ
Mauritania	MR
Mauritius	MU
Mayotte	YT
Mexico	MX
Micronesia	FM
Moldova	MD
Monaco	MC
Mongolia	MN

Country Name	Abbreviation
Montenegro	ME
Montserrat	MS
Morocco	MA
Mozambique	MZ
Myanmar	MM
Namibia	NA
Nauru	NR
Nepal	NP
Netherlands	NL
Netherlands Antilles	AN
New Caledonia	NC
New Zealand	NZ
Nicaragua	NI
Niger	NE
Nigeria	NG
Niue	NU
Norfolk Island	NF
North Korea	KP
Northern Mariana Islands	MP
Norway	NO
Oman	OM
Pakistan	PK
Palau	PW
Palestinian Territory	PS
Panama	PA
Papua New Guinea	PG
Paraguay	PY
Peru	PE
Philippines	PH
Pitcairn	PN
Poland	PL
Portugal	PT
Puerto Rico	PR
Qatar	QA
Republic of the Congo	CG
Reunion	RE
Romania	RO
Russia	RU

Country Name	Abbreviation
Soviet Union	RU
Rwanda	RW
Saint Barthelemy	BL
Saint Helena	SH
Saint Kitts and Nevis	KN
Saint Lucia	LC
Saint Martin	MF
Saint Pierre and Miquelon	PM
Saint Vincent and The Grenadines	VC
Samoa	WS
San Marino	SM
Sao Tome and Principe	ST
Saudi Arabia	SA
Senegal	SN
Serbia	RS
Serbia and Montenegro	CS
Seychelles	SC
Sierra Leone	SL
Singapore	SG
Sint Maarten	SX
Slovakia	SK
Slovenia	SI
Solomon Islands	SB
Somalia	SO
South Africa	ZA
South Georgia and the South Sandwich Islands	GS
South Korea	KR
South Sudan	SS
Spain	ES
Sri Lanka	LK
Sudan	SD
Suriname	SR
Svalbard and Jan Mayen	SJ
Swaziland	SZ
Sweden	SE
Switzerland	CH
Syria	SY

Country Abbreviations

Country Name	Abbreviation
Taiwan	TW
Tajikistan	TJ
Tanzania	TZ
Thailand	TH
Togo	TG
Tokelau	TK
Tonga	TO
Trinidad and Tobago	TT
Tunisia	TN
Turkey	TR
Turkmenistan	TM
Turks and Caicos Islands	TC
Tuvalu	TV
Virgin Islands (U.S.)	VI
Uganda	UG
Ukraine	UA
United Arab Emirates	AE
United Kingdom	GB
United States	US
United States Minor Outlying Islands	UM
Uruguay	UY
Uzbekistan	UZ
Vanuatu	VU
Vatican	VA
Venezuela	VE
Vietnam	VN
Wallis and Futuna	WF
Western Sahara	EH
Yemen	YE
Zambia	ZM
Zimbabwe	ZW

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