MILLIMAN REPORT

Extreme weather events in Europe for 2022 and beyond

Insurance industry impact and actionable steps for insurers to take a leading role in managing climate-related financial risks

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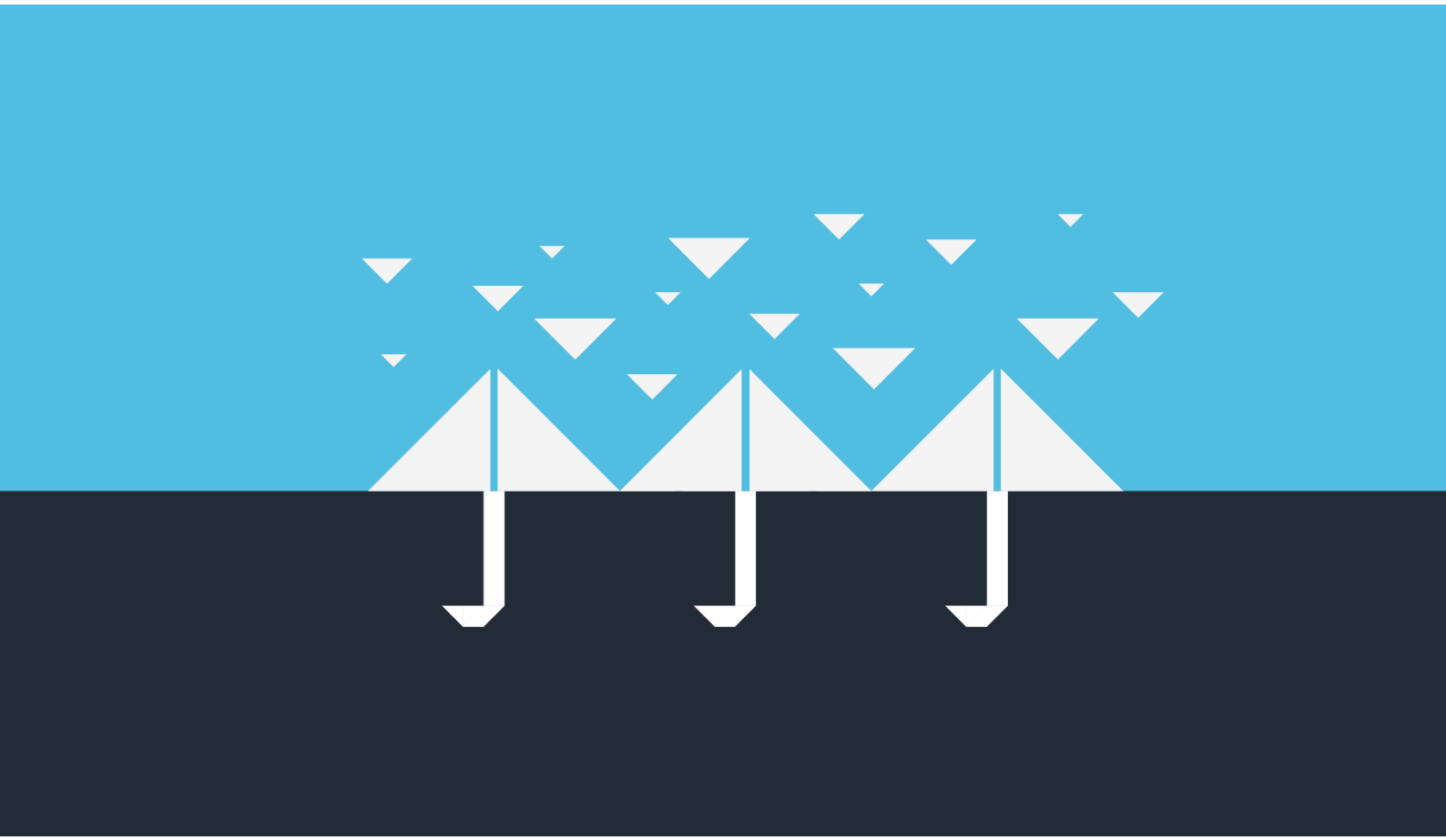
Tarik Aouragh
Niccolò Basetti Sani Vettori, ISOA
Mohamed Benkhalfa, FIA
Christoph Krischanitz, AVÖ, DAV
Ian Penfold, FIA
Eugenio Portales, IA
Antoine Rainaud, FIA
Giuseppe Semeraro, ISOA
Anandi Shah, FIA
Jose Silveiro, IA
Martijn van Rooijen
Menno van Wijk, AAG



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Executive Summary

As in other parts of the world, scientists are pointing to climate change as the cause of devastating extreme weather events in Europe. Temperatures here have increased at more than twice the global average over the past 30 years—the highest of any continent. As the warming trend continues, exceptional heat, wildfires, floods, and other climate change impacts will continue to affect society, economies, and ecosystems. The economic consequences are severe: Eurostat reports climate change cost the European Union about EUR 145 billion from 2010 to 2020. That's before the significant losses from 2021 and 2022.[1]

Europe was impacted by another year of record-breaking extreme weather in 2022, bringing above-average claims to European insurers

February 2022 storms brought hurricane-force winds, heavy rain and local flooding, and caused an estimated EUR 3.3 billion in European insured losses.[2] However, the costliest event for European insurers was the 2022 drought. Ranked as Europe's worst drought in 500 years,[3] this disaster cost an estimated EUR 19 billion in insured losses to the European agriculture, livestock and energy sectors. The drought ranks second on the Christian Aid's 2022 list of the costliest multibillion-dollar weather disasters of the climate change crisis. Only 2022's Hurricane Ian, with an estimated EUR 93 billion in insured losses, ranked as more costly.[4]

In addition to the severe drought, heat waves and record-breaking temperatures resulted in Europe's hottest summer on record, with average surface air temperatures in June through August 2022 close to 1ºC above the 1991-2020 average.[5] Extreme heat waves caused an estimated 20,000 excess deaths,[6] major reductions in crop productivity and a surge in subsidence claims. Across the 27-nation European Union, smouldering heat fueled disastrous wildfires that burned a total cumulative area exceeding 785,000 hectares (1.9 million acres), more than twice the average between 2006 and 2021.[7] Wildfire risk is a growing threat to insurance and reinsurance markets, and Chaucer has already seen some (re)insurers begin to limit their exposures as a result.[8]

This paper focusses on the extreme weather events in 2022 that had the most impact on Europe and individual countries, including Austria, Belgium, France, Germany, Italy, Luxembourg, the Netherlands, Portugal, Spain and the United Kingdom (UK), and it discusses the economic costs, human loss and impact on insurers. With thousands of fatalities, and billions of euros in damage to homes, property, motor vehicles and agriculture, extreme weather events in 2022 had a major impact on a society just recovering from the effects of the COVID-19 pandemic and dealing with rising inflation, energy shortages and other effects of the war in Ukraine.

Munich Re has observed that the impact of climate change is becoming more pronounced, and that insurers must adapt their loss models accordingly because "loss prevention is a fundamental component in mitigating the economic effects of climate change."[9] To that end, European insurers and reinsurers are uniquely positioned to leverage their expertise and data analytics capabilities to manage the financial risks associated with extreme weather events and climate change and help mitigate the impacts.

[1] World Economic Forum (2 December 2022). Climate change has cost the EU €145 billion in a decade. Retrieved 26 February 2023 from https://www.weforum.org/agenda/2022/12/climate-europe-gdp-emissions/.

[2] Actuarial Post. Floods and storms bring insured losses to USD 38bn 1H 2022. Retrieved 26 February 2023 from https://www.actuarialpost.co.uk/article/floods-and-storms-bring-insured-losses-to-usd-38bn-1h-2022-21057.htm.

[3] CNBC (23 August 2022). Europe is experiencing its worst drought in at least 500 years. Retrieved 26 February 2023 from https://www.cnbc.com/2022/08/23/europe-drought-worst-in-at-least-500-years-eu-report.html.

[4] El Pais (27 December 2022). The multibillion-dollar toll of the climate change crisis in 2022. Retrieved 26 February 2023 from https://english.elpais.com/international/2022-12-27/the-multibillion-dollar-toll-of-the-climate-change-crisis-in-2022.html (subscription required).

[5] New York Post (7 September 2021) Europe just had its warmest summer on record, EU scientists say. Retrieved 26 February 2023 from https://nypost.com/2021/09/07/europe-had-its-warmest-summer-on-record-eu-scientists-say/.

[6] The Guardian (24 November 2022). Over 20,000 died in western Europe's summer heatwaves, figures show. Retrieved 26 February 2023 from https://www.theguardian.com/environment/2022/nov/24/over-20000-died-western-europe-heatwaves-figures-climate-crisis.

[7] RFI (14 December 2022). Europe's record 2022 wildfires sent carbon emissions soaring, monitors say. Retrieved 26 February 2023 from https://www.rfi.fr/en/international/20221214-europe-s-record-2022-wildfires-sent-carbon-emissions-soaring-monitors-say.

[8] Artemis (20 July 2022). European wildfire risk growing, but hard to adequately price. Retrieved 26 February 2023 from https://www.artemis.bm/news/european-wildfire-risk-growing-but-hard-to-adequately-price-chaucer/.

[9] Munich Re (28 July 2022). Natural disaster review for the first half of 2022. Retrieved 26 February 2023 from https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2022/natural-disaster-figures-first-half-2022.html.

It is business-critical for insurers to take a leading role in not only managing these risks, but supporting adaptation and prevention. There are immediate, actionable steps they can take in 2023. See 2023 Actionable Steps for Insurers below, the last section in this paper, for thought leadership, best practices and tools for leveraging open data, climate change scenario analysis, causal modelling, complying with Solvency II Own Risk and Solvency Assessment (ORSA) requirements, understanding climate-related morbidity and mortality risks, making the uninsurable insurable and staying up to date with the latest climate change news and insights for insurers.

Extreme weather events in Europe

SUMMARY OF 2022 EXTREME WEATHER EVENTS ACROSS EUROPE

A trio of powerful storms slammed Western Europe in February

In 2022, winter storms struck north and northwest Europe with hurricane-force winds and a price tag of EUR 4.8 billion in damages:[10]

- From 16 to 20 February 2022, a polar vortex caused a series of three powerful storms in quick succession: Dudley, Eunice and Franklin. These storms battered the UK and western Europe with heavy rain and wind that damaged homes, buildings, infrastructure, motor vehicles and trees.
- Storm Eunice was the most powerful of the three storms, with winds measuring up to 196 km/h, the strength of a Category 3 hurricane.[11] Eunice was responsible for at least 16 fatalities, numerous injuries and power outages impacting millions of homes and businesses.[12] The storm also tore a hole in London's O2 Arena, caused a crane to crash onto the roof of a hospital in Belgium and disrupted travel.
- Storm Franklin hit two days after Eunice, unleashing heavy rain that caused widespread flooding throughout the UK.
- Although there is no evidence that these storms were more likely because of climate change, there is evidence that they were more damaging. Because climate change raises sea levels and increases rainfall, rain and storm surges are more intense, which leads to increased flooding and property damage.[13]

Summer 2022 was Europe's hottest on record

The stormy winter of 2022 was followed by Europe's hottest summer on record. Scientists say that European heat waves are becoming more frequent and severe at a faster rate than most places on Earth, including the western United States. Global warming is a contributing factor: Because temperatures are an average of 1.1ºC higher than in the late 19th century (before carbon emissions became widespread), extreme heat takes off from a warmer baseline. However, there are other factors. For example, the jet stream over Europe, which increasingly splits in two for longer periods and creates areas of weak winds and high pressure conducive to the build-up of extreme heat, contributed to Europe's record-breaking high temperatures during the summer of 2022:[14]

- Europe experienced the hottest summer in recorded history, with average surface air temperature during June-August 2022 close to 1ºC above the 1991-2020 average.[15]
- France experienced its hottest May on record, with record highs in some cities.[16]

[10] Ibid.

[11] Mongabay (22 February 2022). In trio of storms hitting Western Europe, role of climate change is complicated. Retrieved 26 February 2023 from https://news.mongabay.com/2022/02/in-trio-of-storms-hitting-western-europe-role-of-climate-change-is-complicated/#:~:text=In%20trio%20of%20storms%20hitting%20Western%20Europe%2C%20role,unleashing%20heavy%20rains%20and%20winds%20across%20the%20region.

[12] BBC (19 February 2022). Storm Eunice carves deadly trail across Europe. Retrieved 26 February 2023 from https://www.bbc.com/news/world-europe-60448716.

[13] Mongabay (22 February 2022), op cit.

[14] Visual Capitalist (20 July 2022). 5 things to know about Europe's scorching heatwave. Retrieved 26 February 2023 from https://www.visualcapitalist.com/5-things-to-know-about-europes-scorching-heatwave/.

[15] New York Post (7 September 2021), op cit.

[16] New York Times (18 July 2022). Why Europe is becoming a heatwave hot spot. Retrieved 26 February 2023 from https://www.nytimes.com/2022/07/19/climate/europe-heat-wave-science.html (subscription required).

- Europe experienced the second warmest June on record, with temperatures at about 1.6ºC above the average, according to the Copernicus Climate Change Service (C3S), part of the Copernicus Earth Observation Programme.[17]
- By mid-June 2022, temperatures in some parts of Spain and France were, on average, more than 10°C higher than the average for that time of the year.[18]
- In July 2022, Hamburg, Germany, and parts of the UK broke the 40°C barrier for the first time on record.[19,20]
- On 15 July 2022, when temperatures were forecasted to reach record highs, Britain's national weather forecaster issued its first red "extreme heat" warning for parts of England, triggering a “national emergency” alert level.[21]

According to The Guardian, during the summer’s heat waves, more than 20,000 people died in western Europe.[22] Because Europe has the oldest median age of any region, its residents are especially vulnerable to heat-related illness, particularly as most European homes are not designed for such high temperatures.

Extreme heat also affects the economy, leading to more hospital visits, reduced agriculture yields and even infrastructure damage. Workers are also less productive in hot weather, and children may struggle to learn, potentially leading to lower lifetime earnings, which can impact a country’s future economic growth. [23]

In 2022, Europe experienced its worst drought in centuries

The blistering heat during summer 2022 led to one of Europe’s worst droughts in at least 500 years,[24] with drought conditions made at least 20 times more likely by climate change.[25] On 22 August 2022, the Global Drought Observatory reported that two-thirds of Europe was under a drought warning. Combined with the extreme heat, the drought stressed summer crops throughout Europe, especially grain, corn, soybeans and sunflowers.[26] According to S&P Global Commodity Insights, 2022 EU corn production was expected to be down 12.5 million tons, and sunflower production was expected to be down 1.6 million tons, compared to 2021.[27]

The most visually dramatic effect of the drought was the dwindling levels in famous European rivers.[28] The unusually dry winter and spring, followed by the summer’s record-breaking temperatures, depleted essential waterways including the Rhine in Germany, the Loire in France and the Po in Italy. Water levels were down, water temperatures were overheated and fish populations were devastated.

[17] Copernicus Climate Change Service (7 July 2022) Strong June heatwaves throughout Europe and worldwide. Retrieved 26 February 2023 from https://climate.copernicus.eu/copernicus-strong-june-heatwaves-throughout-europe-and-worldwide-june-2022-was-third-warmest-june#:~:text=Europe%20as%20a%20whole%20had%20its%20second%20warmest,seen%20over%20Greenland%20and%20most%20of%20South%20America.

[18] UN News (17 June 2022). ‘Surprise’ early heatwave in Europe, harbinger of things to come. Retrieved 26 February 2023 from https://news.un.org/en/story/2022/06/1120692.

[19] Visual Capitalist (20 July 2022), op cit.

[20] Eco-Business (21 December 2022). Year in review 2022: 10 devastating extreme weather events in 2022. Retrieved 26 February 2023 from https://www.eco-business.com/news/10-devastating-extreme-weather-events-in-2022/.

[21] Reuters (15 July 2022). UK issues first extreme heat warning as record temperatures loom. Retrieved 26 February 2023 from https://www.reuters.com/world/uk/uk-issues-red-alert-warning-over-soaring-temperatures-2022-07-15/#:~:text=LONDON%2C%20July%2015%20%28Reuters%29%20-%20Britain%27s%20weather%20forecaster,record%20highs%2C%20triggering%20a%20%22national%20emergency%22%20ale.

[22] The Guardian (24 November 2022), op cit.

[23] World Economic Forum (19 July 2022). Here’s how heat waves can impact economies, as well as people and wildlife. Retrieved 26 February 2023 from https://www.weforum.org/agenda/2022/07/heat-waves-economy-climate-crisis/.

[24] CNBC (23 August 2022), op cit.

[25] Science News (22 December 2022). Extreme weather in 2022 showed the global impact of climate change. Retrieved 26 February 2023 from https://www.sciencenews.org/article/extreme-weather-climate-change-2022.

[26] EarthSky (26 August 2022). Drought around the world, August 2022, in dramatic images. Retrieved 26 February 2023 from https://earthsky.org/earth/drought-around-world-2022-revealing-hidden-artifacts/#:~:text=The%20Global%20Drought%20Observatory%20released%20a%20report%20on,summer%20crops%2C%20especially%20grain%20maize%2C%20soybeans%20and%20sunflowers.

[27] PhysOrg (12 August 2022). European drought dries up rivers, kills fish, shrivels crops. Retrieved 26 February 2023 from https://phys.org/news/2022-08-european-drought-dries-rivers-fish.html#:~:text=Boats%20lay%20on%20the%20dried%20lake%20bed%20in,as%20the%20Danube%2C%20the%20Rhine%20and%20the%20Po.

[28] EarthSky (26 August 2022), op cit.

In addition, there were significant economic consequences:

- The “low flow” on many European rivers strained energy supply when energy prices were already rising due to the Russian invasion of Ukraine.[29] Hydropower generation was down about one-fifth across Europe, and some nuclear power plants were unable to operate at normal capacity to ensure rivers weren’t overheated by the cooling water discharged by the plants.[30]
- To reduce their load, barges carrying coal, as well as raw materials for chemical companies and steelmakers, cut their capacity by 75%, leaving shipping costs up to five times more expensive.[31]
- In Italy’s economically important Po Valley, the Po River measured 2 metres lower than normal, crippling crop production. Hundreds of thousands of hectares were fallow because of doubts about the reliability of irrigation. The Italian government declared a state of emergency in five regions due to lack of water availability.[32]
- CNN reported that dried-up lakes and exceptionally low water levels on Europe’s most popular rivers impacted inland river cruise itineraries, caused cancellations, and could signal the death of river cruising in Europe.[33]

Summer 2022 was a record-breaking wildfire season in Europe

Europe’s summer heat waves and droughts led to dangerously elevated fire risk during its 2022 summer wildfire season. The fire season began earlier than normal as Europe experienced heat waves earlier and with more intensity than in 2021, a year that was already noted for catastrophic blazes around the world. June 2022 heat waves led to fires in Germany and Spain, when temperatures in each country reached 39°C and 43°C, respectively.[34]

Wildfires that blazed across Europe in 2022 burned a record land area and stoked carbon emissions:

- The European Forest Fire Information System (EFFIS) estimates that between January and mid-November 2022, more than 785,000 hectares (1.9 million acres) burned across the European Union, more than twice the 2006-2021 average burned area of 317,000 acres.[35]
- The Copernicus Atmospheric Monitoring Service (CAMS) estimates that wildfire emissions from the EU plus the UK from 1 June to 31 August totalled 6.4 megatons of carbon, the highest level for these months since 2007. The huge fires that blazed across Spain and France had a significant impact on local air quality.[36]
- By 20 July 2022, an estimated 1,977 wildfires blazed across Europe—almost three times the average, according to the EFFIS. In particular, the fires affected Mediterranean countries, and thousands of residents in France, Portugal and Spain were evacuated.[37]

Areas that face increasingly severe droughts are also at risk for larger and more frequent wildfires, as lack of rain and low humidity dries out trees and vegetation, providing fuel. In these conditions, a spark from lightning, electrical failures, human error or planned fires can quickly get out of control.[38]

[29] Godfrey Times (18 August 2022). Europe’s Scorching Summer Puts Unexpected Strain on Energy. Retrieved 26 February 2023 from https://godfreytimes.com/2022/08/18/europes-scorching-summer-puts-unexpected-strain-on-energy-supply/.

[30] Forbes (29 December 2022). 2022 Was a Year of Record-Breaking Extreme Weather Events. Retrieved [insert date] from https://www.forbes.com/sites/mariannelehnis/2022/12/29/2022-was-a-year-of-record-breaking-extreme-weather-events/?sh=480d8e59736b

[31] The Guardian. (2021) Europe’s rivers run dry as scientists warn drought could be worst in 500 years. Retrieved 26 February 2023 from https://www.theguardian.com/environment/2022/aug/13/europes-rivers-run-dry-as-scientists-warn-drought-could-be-worst-in-500-years.

[32] The Guardian (10 July 2022). Quiet flows the Po: The life and slow death of Italy’s longest river. Retrieved 26 February 2023 from https://www.theguardian.com/environment/2022/jul/10/po-river-italy-drought-climate.

[33] CNN Travel (14 August 2022). Europe’s drought could signal the death of river cruising. Retrieved 26 February 2023 from https://www.cnn.com/travel/article/europe-drought-river-cruising/index.html.

[34] Financial Times (9 July 2022) Climate graphic of the week: Dry, hot Europe fuels 2022 fire season. Retrieved 26 February 2023 from https://www.ft.com/content/44ee6475-c292-41df-9d0d-e7acbd6228b4.

[35] RFI (12 December 2022). Europe's record 2022 wildfires sent carbon emissions soaring, monitors say. Retrieved (insert date) from https://www.rfi.fr/en/international/20221214-europe-s-record-2022-wildfires-sent-carbon-emissions-soaring-monitors-say

[36] RFI (14 December 2022), op cit.

[37] Visual Capitalist (20 July 2022), op cit.

[38] Global Climate Change (9 July 2019). A Drier Future Sets the Stage for More Wildfires. Retrieved 26 February 2023 from https://climate.nasa.gov/news/2891/a-drier-future-sets-the-stage-for-more-wildfires/.

We may see an increase in wildfires in Europe in the future:

- According to new research, the burning of Europe's forests—which act as a carbon sink and contribute to the continent's moisture and biodiversity—may compound the frequency of heat-induced fire weather.
- The 2022 UN Intergovernmental Panel on Climate Change (IPCC) report determined that climate change is likely to make wildfires more frequent and intense across Europe, particularly in the south, while new fire-prone regions could emerge in central and northern regions.
- Investment bank Jefferies noted that companies involved in fire control, such as makers of safety gear, helicopters, fire trucks and fire retardants, could see higher demand.[39]

IMPACT ON INSURERS

It can be difficult to tally the monetary losses from heat and drought, as effects such as industrial slowdowns due to a lack of cooling water can take time to emerge.[40] However, preliminary 2022 insurance industry losses due to extreme weather events include:

- **Winter 2022 storms Dudley, Eunice and Franklin.** The three February 2022 storms prompted estimated insured losses of EUR 3.3 billion in Europe.[41] According to Perils, 2022 European windstorms caused EUR 3.8 billion in insurance industry losses, the largest European windstorm loss since January 2007.[42]
- **Summer 2022 heat waves and drought in Europe.** According to Christian Aid, a UK-based relief and development agency, Europe's summer 2022 drought cost an estimated EUR 19 billion in insured losses to the agriculture, livestock and energy sectors. The European drought ranks second on Christian Aid's 2022 list of the costliest multibillion-dollar weather disasters of the climate change crisis. Only Florida's Hurricane Ian, with an estimated EUR 93 billion in insured losses, ranked higher than Europe's drought.[43]
- **Summer 2022 wildfires in Europe.** With a record-shattering total burnt area in 2022, wildfire risk is a growing threat to insurance and reinsurance markets, yet one that will be difficult to price until it is better understood and modelling is more sophisticated. Wildfires have only recently become a major priority as a peril. According to underwriting firm Chaucer, the move in Mediterranean countries away from traditional agriculture has caused vegetation to build up, sparking fires that are larger and more severe (for example, the land mass burned by wildfires in Europe jumped 75% from 2019 to 2020). Because of Europe's population density, there is potential for considerable property losses. Fires have also become more damaging because forest management practices have not kept pace with the way fires have changed and suppression methods are less effective. Due to all these factors, Chaucer has seen some (re)insurers reduce their exposure.[44]

2021 EUROPEAN EXTREME WEATHER EVENTS

In 2021, climate change also provoked record-breaking extreme weather in Europe, with catastrophic flooding and a summer that was the hottest at that point in history.[45] These events brought above-average claims to European insurers:

- The costliest event was the July 2021 flooding in Germany, Belgium and nearby countries. This flood disaster caused up to EUR 12 billion in insured losses, compared to more than EUR 37 billion in economic loss, indicating a very large flood protection gap. The flooding was the costliest natural disaster for the region since 1970 and the world's second-highest in that period, after the 2011 Thailand flood.
- Further devastating secondary peril activity included severe convective storms in June, with thunderstorms, hail and tornadoes causing widespread damage to property throughout Europe. The resulting insured losses are estimated at about EUR 4.1 billion.[46]

[39] Financial Times (9 July 2022), op cit.

[40] Munich Re (28 July 2022), op cit.

[41] Actuarial Post, Floods and storms bring insured losses to USD 38bn 1H 2022, op cit.

[42] Insurance Times (19 August 2022) European windstorms caused £3,142m in insurance industry losses – Perils. Retrieved 26 February 2023 from https://www.insurancetimes.co.uk/news/european-windstorms-caused-3142m-in-insurance-industry-losses-perils/1442095.article.

[43] El Pais (27 December 2022), op cit.

[44] Artemis (20 July 2022), op cit.

[45] Insurance Journal (25 April 2022). Climate Change Exacerbates Extreme Weather in Europe: Report. Retrieved 26 February 2023 from https://www.insurancejournal.com/news/international/2022/04/25/664440.htm.

[46] Insurance Journal (14 December 2021). Extreme Weather in 2021 Brings Above-Average Claims to Global Insurers: Swiss Re. Retrieved 27 February 2023 from https://www.insurancejournal.com/news/international/2021/12/14/645544.htm.

OUTLOOK FOR THE FUTURE

Europe warming faster than the rest of the world

According to IPCC's 2022 report, Europe's temperatures may rise faster than the worldwide mean average, and the devastation is likely to become substantially worse, with the frequency of extreme heat expected to accelerate and snow likely to diminish. The IPCC report's key conclusions for Europe are:

- Marine heat waves and other instances of extreme heat have become more frequent and intense over recent decades, and these trends are forecast to continue regardless of any reductions in greenhouse gas emissions.
- Frost days and cold spells will decline, and glaciers, permafrost and snow will decrease at all altitudes.
- From the Mediterranean north, precipitation is projected to decline in the summer. Meanwhile, in all regions but the Mediterranean, extreme rains and pluvial flooding will increase.
- Sea levels will rise in all European regions except those around the Baltic Sea, increasing coastal flooding and causing shorelines to recede.[47]

Economic consequences of increased droughts and heat waves

World Weather Attribution, which attributes extreme events to climate change, highlights the unusual nature of the European drought and warns that global warming could lead to similar droughts every 20 years. Without climate change, such a severe event would happen only every 400 years.[48] The impact of drought on food security is particularly concerning, because the 2022 drought hit as food prices were already elevated due to the war in Ukraine.

Climate change will also lead to more frequent and intense heat waves. By 2030, the International Labour Organisation predicts that heat waves could cut the number of hours worked worldwide by more than 2%. That equates to 80 million full-time jobs, at a cost of EUR 2.2 trillion. To physically and economically prepare for these changes, countries must adapt their buildings, infrastructure and work hours to higher temperatures.

However, air conditioning alone is not the answer. For many people, it is unaffordable, and for outdoor workers it is impractical. Even when more air conditioning is an option, there are eventual economic and environmental consequences:

- By 2100, greater air conditioning use will raise residential energy consumption by 83% around the world, according to the Proceedings of the National Academy of Sciences.
- If the energy needed to run the air conditioners comes from fossil fuels, the increased demand would contribute to global warming, further amplifying the heat waves that fueled the higher demand.[49]

The war in Ukraine is impacting Europe's clean energy transition

In 2021, Europe set the goal to reduce 55% of its greenhouse gas emissions by 2030. However, faced with rising inflation and high energy costs due to the war in Ukraine, some European countries paused their green energy plans and returned to coal and other fossil fuels.

For example, the UK granted Shell Oil Company a new permit to extract gas from the Jackdaw gas field in the North Sea.[50] Although climate experts said the decision flew in the face of clear evidence that countries must urgently cut emissions to avoid the worst effects of the climate crisis, the UK government said it was necessary to source more of the gas it needs from British waters to protect energy security.[51]

[47] United Nations (16 August 2021). Climate: Europe warming faster than the rest of the world. Retrieved 27 February 2023 from https://unric.org/en/climate-europe-warming-faster-than-rest-of-world-ipcc/.

[48] El Pais (27 December 2022), op cit.

[49] World Economic Forum (19 July 2022), op cit.

[50] Energy Voice (1 June 2022). Shell given thumbs up by regulators to develop Jackdaw gas field. Retrieved 27 February 2023 from https://www.energyvoice.com/oilandgas/north-sea/416535/breaking-shell-given-thumbs-up-by-regulators-to-develop-jackdaw-gas-field/.

[51] The Guardian (2 June 2022). Climate activists vow to fight as new gasfield gets go-ahead in North Sea. Retrieved 27 February 2023 from https://www.theguardian.com/environment/2022/jun/02/jackdaw-uk-new-gas-field-shell-north-sea-climate.

As energy prices soar, other nations have taken a different approach by making plans to replace Russian gas with renewables. By 2050, Belgium, Denmark, Germany and the Netherlands plan to construct enough offshore wind capacity in the North Sea to power 230 million homes. The European Commission also announced an offshore wind plan worth EUR 193 billion, while Germany's Economy and Climate Ministry unveiled measures to expand wind power generation onshore. In addition, France and Ireland are expanding their offshore wind farms,[52] with Ireland reporting that wind provided 37% of the country's electricity over the first five months of 2022.[53]

Overall, the war in Ukraine is expected to speed Europe's energy transition as the continent is forced to move away from Russian gas imports. According to Forbes, by 2024 34% of the continent's energy will come from nuclear and renewables—2% more than predicted before the conflict. Although these changes sound small, they are lasting and show that systemic change to Europe's energy system can happen quickly, without a race to the bottom. Although coal will play a small, short-term role bridging the gas shortfall, it will make up only 6% of this deficit as coal prices also are rising.[54]

Declining wind speeds might impact wind energy production

Wind energy may not provide the solution Europe needs. As carbon dioxide levels rise and the Earth's poles warm, researchers are predicting a decline in the planet's wind speeds. In late 2021, these conditions hit Europe as part of a so-called "wind drought," with wind speeds approximately 15% slower than average. Those months were among the least windy times in the UK in more than half a century, with significant impact on wind power: In September 2020, wind farms generated 18% of UK energy; a year later, they generated only 2%. The UK had to restart two closed coal plants to make up the difference.

These drops in surface winds across Europe renewed worries about a "global terrestrial stilling" associated with climate change. Wind is created by uneven temperatures—very cold at the poles and warm at the tropics. The temperature difference drives the winds, and it is weakening. The IPCC forecasts slowing winds for the coming decades and says that, by 2100, average annual wind speeds could drop by up to 10%. If wind speeds diminish, it could be harder for European countries to reach their wind energy production goals.[55]

Some European insurers are playing a key role in fighting climate change

Insurers are being called on to play a bigger role to combat climate, and some European insurers are taking impactful measures:

- A group of 30 leading insurers representing more than 15% of world premium volume globally joined the UN-convened Net-Zero Insurance Alliance (NZIA). NZIA members have committed to transition their insurance and reinsurance underwriting portfolios to net-zero greenhouse gas emissions by 2050, consistent with a maximum temperature rise of 1.5°C above preindustrial levels by 2100, to contribute to the implementation of the Paris Agreement on Climate Change.[56]
- Allianz, the fifth largest insurer in the world, set an oil and gas exit strategy. As of 2023, the Munich-based firm is ceasing coverage and withdrawing investment funds from numerous fossil fuel projects; it also will not renew policies for its existing fossil fuel clients. This will affect the biggest fossil fuel producers, who in 2020 accounted for 85% of worldwide production. Allianz's new strategy also applies to companies deriving 10% or more of their revenue from oil or tar sands operations.[57]

[52] GreenBiz (6 July 2022). Europe and Ireland take up large-scale wind power as energy costs soar. Retrieved 27 February 2023 from https://www.greenbiz.com/article/europe-and-ireland-take-large-scale-wind-power-energy-costs-soar-0.

[53] Wind Energy Ireland (7 June 2022). Wind energy monthly report. Retrieved 27 February 2023 from https://windenergyireland.com/latest-news/6701-wind-energy-monthly-report-34-of-ireland-s-power-provided-in-may.

[54] Forbes (9 May 2022). The Ukraine War Will Accelerate Europe's Energy Transition. Retrieved 27 February 2023 from https://www.forbes.com/sites/sverrealvik/2022/05/09/the-ukraine-war-will-accelerate-europes-energy-transition/?sh=2b0be461127f.

[55] GreenBiz. (30 September 2022). Global 'stilling': Is climate change slowing down the wind? Retrieved 27 February 2023 from https://www.greenbiz.com/article/global-stilling-climate-change-slowing-down-wind.

[56] UN Environnent Programme. Net-Zero Insurance Alliance. Retrieved 27 February 2023 from https://www.unepfi.org/net-zero-insurance/.

[57] GreenBiz. (10 May 2022). Insurance giant Allianz sets oil and gas exit strategy. Retrieved 27 February 2023 from https://www.greenbiz.com/article/insurance-giant-allianz-sets-oil-and-gas-exit-strategy.

- To shift the company's financial investments towards a more sustainable economy, Paris-based global insurer AXA developed a climate change strategy to achieve investment climate neutrality by 2050. AXA believes that insurers can integrate carbon-neutrality objectives into their core insurance underwriting activities and planned their total exit from the coal industry through investment and underwriting restrictions.[58]
- Insurance companies throughout Europe, the UK and North America are investing in circular economy funds that finance cutting-edge innovations with strong potential for financial and environmental returns. According to work by Accenture, the circular economy equates to a EUR 4.0 trillion value-creation opportunity globally while having the potential to reduce greenhouse gas emissions by 39%, according to the Circularity Gap Report 2021.[59]

There are immediate, actionable steps for insurers to take a leading role in managing climate-related financial risks. See 2023 Actionable Steps for Insurers below, the last section of this paper, for thought leadership, best practices and tools for leveraging open data, climate change scenario analysis, causal modelling, complying with Solvency II ORSA requirements, understanding climate-related morbidity and mortality risks, making the uninsurable insurable and staying up to date with the latest climate change news and insights for insurers.

Austria

2022 EXTREME WEATHER EVENTS

Austria experienced several severe storms and heavy rainfall in 2022, which caused massive damage:

- In May and June, torrential rain with large-scale flooding impacted Carinthia, southern Burgenland and Lower Austria. Hail and massive storm cells devastated more than 7,500 hectares of crops, including corn, soy, pumpkins and vegetables.[60]
- On 18 August, a storm front moved across parts of Austria with wind gusts up to 140 km/h. Southern Austria was particularly impacted with power outages, blocked roads and railways and millions of euros in damages to homes, property, cars, greenhouses, vineyards and agriculture.[61]

Extreme heat and drought also caused forest fires, water shortages and agricultural losses in Austria during the summer of 2022.

HUMAN LOSS

The 18 August severe storms caused five deaths in Styria and Carinthia. In a Lavant Valley recreational area, two children were killed by falling trees and 13 people were injured, including five children. Additionally, a fallen tree killed three hikers in Lower Austria. More than 75,000 households were without electricity and dozens of people were evacuated.[62]

ECONOMIC IMPACT

The 18 August hurricane-like storm caused significant property damage to houses, apartments and cars, with an estimated loss of up to EUR 50 million in Styria alone.[63] This loss does not include damage to infrastructure. The storm also caused up to EUR 2 million in damages to Austrian agriculture.[64]

The May and June storms caused more than EUR 8 million in estimated damages.[65]

[58] AXA (29 June 2022). 2022 Climate and Biodiversity Report. Retrieved 27 February 2023 from https://www.axa.com/en/press/publications/2022-climate-report.

[59] GreenBiz (29 June 2022). Investments in the circular economy are moving forward in Europe and beyond. Retrieved 27 February 2023 from https://www.greenbiz.com/article/investments-circular-economy-are-moving-forward-europe-and-beyond.

[60] Versicherungen.at (13 June 2022). Again there is massive storm damage. Retrieved 27 February 2023 from https://www.versicherungen.at/news/wieder-gibt-es-massive-unwetterschaeden/.

[61] Versicherungen.at (29 August 2022) First damage estimates in this country. Retrieved 27 February 2023 from https://www.versicherungen.at/news/erste-schadenschaetzungen-hierzulande/.

[62] Kurier (19 August 2022). Carinthia and Lower Austria: Five dead after severe storms. Retrieved 27 February 2023 from https://kurier.at/chronik/oesterreich/kaernten-und-noe-fuenf-tote-nach-unwettern/402115734.

[63] Styria News (22 August 2022). After storms: Compulsory insurance required, Retrieved 27 February 2023 from https://steiermark.orf.at/stories/3170051/.

[64] HV (19 August 2022). Hail Insurance: Storm Damage in Southern Austria. Retrieved 27 February 2023 from https://www.hagel.at/presseaussendungen/sturmschaeden/.

[65] Versicherungen.at (13 June 2022), op cit.

IMPACT ON INSURERS

As a result of Austria's 2023 extreme weather events, Klaus Scheitegel, CEO of GRAWE Insurance, is once again calling for natural catastrophe compulsory insurance—insurance for every household that covers storm, hail, snow, landslide and flood damages. Scheitegel would like to model Austria's natural catastrophe compulsory insurance to align with similar programmes in Switzerland and Belgium.[66]

SUMMARY OF 2021 EXTREME WEATHER EVENTS

Austria experienced heavy rain, damaging floods and severe hailstorms in 2021. The June hailstorms were the most expensive event for Austrian insurers in the last 20 years, with more than 64,500 claims and an estimated EUR 250 million in losses.[67,68] More than EUR 150 million in damage to agricultural crops was reported by agricultural insurer Österreichische Hagelversicherung. [69]

OUTLOOK FOR THE FUTURE

The effects of climate change are manifold in Austria. Average temperatures will continue to rise until the middle of this century. In the alpine region, potential consequences include increased intensity and frequency of precipitation and hail; more periods of drought; reduction of soil water content; and more floods, mudslides, glacier retreat and pest invasions. Additionally, the rise of the permafrost line leads to an increased danger of landslides in alpine regions.

- Hotter, drier summers are expected, with twice as many days above 30°C.
- Winters are likely to become less cold and snowy on average. Fewer days with snow cover is expected for several winter sports resort areas.

Although climate change impacts most industries, it is particularly damaging to the following Austrian sectors:

- Agriculture is one of the industries most affected by climate change. Increased drought and climate variability reduces crop yield and quality, so normal crop yields will continue to drop. Additionally, crop-damaging insect pests will develop more rapidly, with heat-loving species spreading to the north.
- Similar problems are also evident in forestry. Rising temperatures are doing the most harm to the spruce, the most common tree species in Austria, which is also under heavy pressure from increased drought stress and pest infestation. In many places, the protective function of the mountain forest is being lost. Summer forest fires could become a threat in Austria, similar to what is already happening in the Mediterranean region.
- Tourism will also be impacted. Alpine glaciers have lost about 50% of their ice in the last 100 years due to temperature increases and changes in precipitation, and this trend is expected to continue. The visible retreat of the glaciers in the Alps means a loss of natural water reservoirs and fewer tourists who are drawn to the natural beauty of the area. Mild winters without sufficient natural snow could negatively impact winter tourism.

In addition to economic and environmental damages, climate change in Austria also presents a danger to human health from heat stress in summer (including warmer nights) and from the changed spread of pathogens or their vectors.[70]

[66] Styria News (22 August 2022), op cit.

[67] Vienna Insurance Group (3 January 2022). 2021 is a record year for Wiener Städtische in terms of storm damage. APA OTS. Retrieved 27 February 2023 from https://www.ots.at/presseaussendung/OTS_20220103_OTS0016/wiener-staedtische-verzeichnet-2021-rekordjahr-bei-unwetterschaeden.

[68] Linz-Stadt (23 December 2021). "2021 was undoubtedly a year of extremes" – almost 160 million euros insurance benefits for storm damage. Retrieved 27 February 2023 from https://www.tips.at/nachrichten/linz/wirtschaft-politik/554252-2021-war-zweifellos-ein-jahr-der-extreme-knapp-160-millionen-euro-versicherungsleistungen-fuer-unwetterschaeden.

[69] Ibid.

[70] Oesterreich.gv.at. Climate Change and Its Consequences. Retrieved 27 February 2023 from https://www.oesterreich.gv.at/themen/bauen_wohnen_und_umwelt/klimaschutz/Seite.1000200.html.

Belgium

2022 EXTREME WEATHER EVENTS

There were three severe storms in Belgium in February 2022: Dudley, Eunice and Franklin.

1. North Sea storm Dudley crossed Belgium on 16 February with wind gusts up to 100 km/h.[71]
2. Storm Eunice pounded Belgium on 18 February. Eunice ranks as one of Belgium's top five heaviest storms in decades with very strong wind gusts. The highest official wind speed was measured at 133 km/h at Ostend airport and, in most places in Flanders, wind speeds exceeded 100 km/h.[72]
3. Two days after storm Eunice rolled through Belgium, storm Franklin caused severe damage to some areas and additional property damage throughout the country.[73]

Belgium also experienced its second-driest spring on record[74] and drought during the summer of 2022:

- In parts of West Flanders, drought and low groundwater levels and base flow rates caused major agricultural losses. The Flemish Environment Agency (VMM) measured historically low flow rates for 14-day average flows throughout Flanders:
  - Very low and low flows at 53% of measurement locations.
  - Low flows at 37.9% of measurement locations.
  - Normal flows were only measured at 9.1% of measurement locations.
  - No locations had high or very high flows.[75]
- In Wallonia, July and August were the driest months in over 20 years, according to the Royal Meteorological Institute of Belgium.[76] 19 municipalities were forced to limit their water consumption due to the drought. Rain in early September temporarily moistened the topsoil, which is the main resource for growing plants and crops.[77]
- By 2 August, Belgium faced a 250 mm precipitation deficit. Along the coast, in Westhoek and South-West Flanders, the precipitation deficit reached 330 mm.[78]

HUMAN LOSS

Storm Eunice caused two deaths in Belgium and several serious injuries.[79]

ECONOMC IMPACT

The drought had a major impact on vegetable farmers in West Flanders, who lost as much as 20% to 25% of their expected harvest. They were unable to harvest any beans and lost about 20% of their brussels sprouts and 40% to 50% of their early potato crops. As a result, farmers are calling for infrastructure investments, such as water buffers, to combat drought. Additionally, the increased cost of growing crops is expected to drive up vegetable prices.[80]

[71] VRT (17 February 2022). Storm Dudley blows past our country without a problem, tomorrow Eunice may bring gusts of up to 130 km/h. Retrieved 27 February 2023 from https://www.vrt.be/vrtnws/nl/2022/02/16/stormen-dudley-en-eunice/.

[72] HLN (18 February 2022). Overview: The largest and most notable damage from storm Eunice by province. Retrieved 27 February 2023 from https://www.hln.be/binnenland/overzicht-de-grootste-en-opmerkelijkste-schadegevallen-van-storm-eunice-per-provincie~ab14ce24/?referrer=https%3A%2F%2Fwww.google.com%2F.

[73] Brussels Times (20 February 2022). Storm Franklin: Code orange issued for coast, local gusts of up to 120 km/h possible. Retrieved 27 February 2023 from https://www.brusselstimes.com/207265/tbtb-code-orange-storm-franklin-to-bring-gusts-up-to-125-kph.

[74] Brussels Times (18 May 2022) Droughts 'here to stay': What water scarcity means for Belgium. Retrieved 27 February 2023 from https://www.brusselstimes.com/225667/droughts-here-to-stay-what-water-scarcity-means-for-belgium.

[75] Vilt (8 August 2022). Drought causes large losses in (West Flemish) agricultural sector. Retrieved 27 February 2023 from https://vilt.be/nl/nieuws/droogte-zorgt-voor-grote-verliezen-in-west-vlaamse-landbouwsector.

[76] Brussels Times (25 September 2022). Wallonia to feel effects of summer drought until the end of 2022. Retrieved 27 February 2023 from https://www.brusselstimes.com/294881/wallonia-to-feel-effects-of-summer-drought-until-the-end-of-2022.

[77] Brussels Times (20 September 2022). Rain brings relief but Belgium needs more. Retrieved 27 February 2023 from https://www.brusselstimes.com/belgium/292303/rain-brings-relief-but-belgium-needs-more.

[78] AgriPress Benelux (2 August 2022). Drought 2022 'historic' – Disaster fund/insurance. Retrieved 27 February 2023 from http://www.agripress.be/start/artikel/615707/nl.

[79] VRT (19 February 2022). Second death in Belgium after passage of storm Eunice. Retrieved 27 February 2023 from https://www.vrt.be/vrtnws/nl/2022/02/19/storm-eunice-the-day-afer/.

[80] Vilt (8 August 2022), op cit.

IMPACT ON INSURERS

February storms Franklin and Eunice caused more than half a billion euros in insured damages in Belgium according to a survey by Assuralia, the federation of insurers. Insurers received a record number of claims for storm damages—nearly 223,000 claims for damages to homes, outbuildings and solar panels, and about 10,000 claims for damages to motor vehicles.[81]

Agricultural losses incurred during the summer 2022 drought might be partially or completely covered by "broad weather insurance" or by the Flemish Disaster Fund. Broad weather insurance is a type of insurance policy offered by private insurance companies that covers crop and harvest damage caused by adverse weather conditions including frost, storms, wind gusts, snow and ice, heavy or persistent rain and severe drought. To qualify for relief from the Flemish Disaster Fund, at least 25% of the farm's total cultivation area must be insured through broad weather insurance. However, the disaster funds are limited and compensation for uninsured damages depends on the percentage of the total cultivation area that is covered by broad weather insurance.[82]

SUMMARY OF 2021 EXTREME WEATHER EVENTS

In 2021, record-breaking rainfall and flooding caused 42 deaths in Belgium.[83] Insurers received more than 71,000 claims with damages amounting to over EUR 2.1 billion. In addition to homes and buildings, 6,602 motor vehicles were damaged and most of them were irreparably damaged by water.[84]

OUTLOOK FOR THE FUTURE

Belgian insurers have seen a rise in storm frequency and intensity in recent years, along with major damage to homes and motor vehicles.[85] Future projections are challenging and model-dependent, and different research often yields contradictory findings. However, the most recent model forecasts that storms will continue to become increasingly frequent and severe.[86]

Moving forward, the insurance sector wants a different scheme to compensate for drought damage to homes, better problem mapping and the establishment of rules around building in drought-prone areas. Assuralia Managing Director Hein Lannoy explains, "If we don't limit future risks quickly, a financial safety net in the form of insurance will never suffice."[87]

To counter the effect of drought due to climate change and the risk of limited drinking water, Société Wallonne des Eaux implemented a proactive investment strategy, with a minimum of EUR 100 million a year, to enhance its infrastructure for producing and distributing water while ensuring an affordable supply for as many people as possible. This strategy helps ensure that the Wallonia region's water resources will be sustainably managed to help protect against the expected impact of climate change.[88]

[81] VRT (22 March 2022). Storms in February caused more than half a billion euros in damage. Retrieved 27 February 2023 from. https://www.vrt.be/vrtnws/nl/2022/03/22/stormen-februari-verzekerings/.

[82] Landbouwleven (29 August 2022). Still intervention from the Flemish Disaster Fund for drought damage? Retrieved 27 February 2023 from https://www.landbouwleven.be/14590/article/2022-08-29/toch-nog-tussenkomst-van-het-vlaams-rampenfonds-voor-droogteschade.

[83] HLN (29 July 2021). One of the last two missing persons found after floods in our country. Retrieved 27 February 2023 from https://www.hln.be/binnenland/een-van-de-twee-laatste-vermiste-personen-na-overstromingen-in-ons-land-teruggevonden~a4a4c681/

[84] Reinsurance News (11 November 2021). Belgium floods amount to €2.1 billion in damages. Retrieved 27 February 2023 from https://www.reinsurancene.ws/belgium-floods-amount-to-e2-1bn-in-damages/.

[85] Assuralia (2022). Insurers estimate damage from storms Eunice and Franklin at more than half a billion euros. Retrieved 27 February 2023 from https://press.assuralia.be/verzekeraars-ramen-schade-door-stormen-eunice-en-franklin-op-meer-dan-een-half-miljard-euro..

[86] Pinto et al (August 2012). Loss potential associated with European windstorms under future climate conditions. Retrieved 27 February 2023 from https://www.researchgate.net/publication/271253545_Loss_potential_associated_with_European_windstorms_under_future_climate_conditions.

[87] VRT (22 February 2022). Insurers to Constitutional Court to review regulation on drought damage to houses. Retrieved 27 February 2023 from https://www.vrt.be/vrtnws/nl/2022/02/22/geen-dekking-meer-door-brandverzekering-bij-schade-aan-woning-do/.

[88] European Investment Bank (13 May 2022). Belgium: EIB and Société wallonne des eaux sign €250 million loan for climate resilience investment. Retrieved 27 February 2023 from https://www.eib.org/en/press/all/2022-230-la-bei-et-la-societe-wallonne-des-eaux-signent-un-pret-de-250-millions-d-eur-pour-des-investissements-au-service-de-la-resilience-climatique.

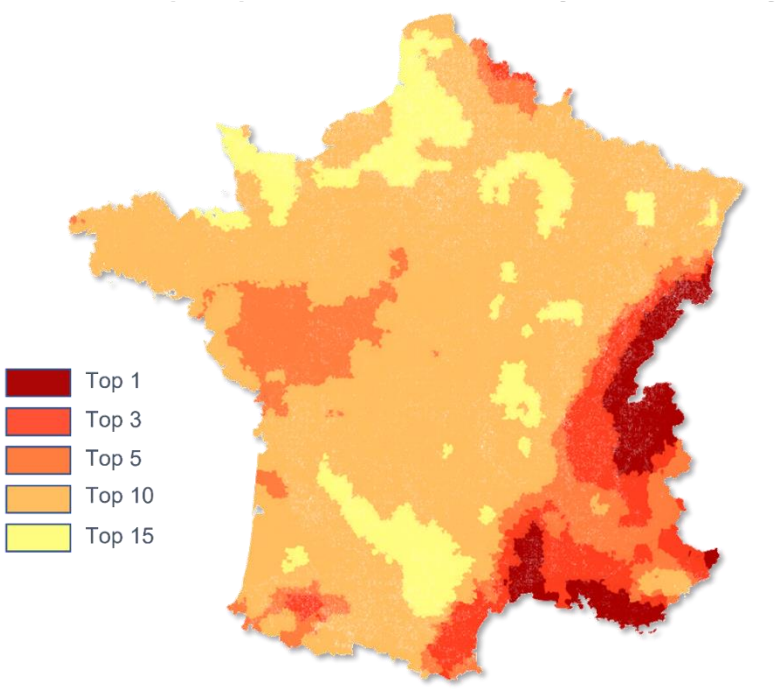
France

2022 EXTREME WEATHER EVENTS

Summer 2022 was France's second-warmest summer on record since 1900, with a deviation of +2.3°C compared to 1991-2020 averages, according to Météo France.[89] These temperature levels, and the extreme rainfall deficit that reached -33% in July, created a very severe meteorological drought that affected most of France.

The summer drought followed France's least rainy first quarter (Q1) in 30 years. The map in Figure 1 ranks the lack of Q1 2022 precipitation across France from most dry (Top 1) to least dry (Top 15), compared to Q1 precipitation over the last 30 years.

FIGURE 1: Q1 2022 PRECIPITATION IN FRANCE RANKED OVER 30 YEARS



Milliman August 2022 - Sources : ECMWF and IGN

Due to the lack of rainfall, France's soil moisture index reached a remarkable level of drought, which resulted in agricultural losses, wildfires and soil swell-shrinkage. According to Céré'Obs, the French monitoring tool for agriculture:

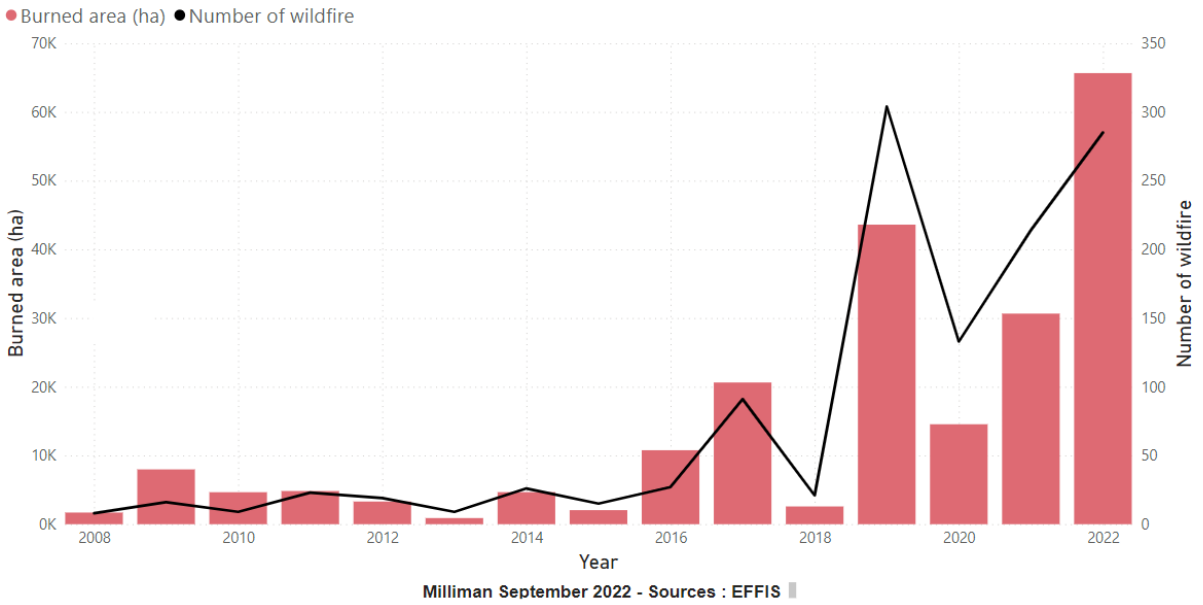
- Corn growing conditions declined sharply over the summer to below the growing condition levels measured during each of the last four years. In 2022, only 50% of corn fields were in good condition compared to 91% in the summer of 2021.
- Grass production also declined. The cumulative production of permanent grasslands was 21% lower than in 2021, and the decline accelerated in July.[90]

[89] Météo France (30 August 2022). Climate change: Summer 2022 could become the standard after 2050. Retrieved 27 February 2023 from https://meteofrance.com/actualites-et-dossiers/actualites/changement-climatique-lete-2022-et-ses-extremes-meteorologiques.

[90] Ministry of Agriculture (22 August 2022). Drought: 3rd meeting of the monitoring committee of the drought situation in the agricultural world. Retrieved 27 February 2023 from https://agriculture.gouv.fr/secheresse-3e-reunion-du-comite-de-suivi-de-la-situation-de-secheresse-dans-le-monde-agricole.

In 2022, wildfires burned 62,000 hectares of forest, making it the worst year of the century for wildfires in France, as shown in Figure 2. Wildfires blazed through areas that were typically spared from fires in the past, including the Bretagne region in eastern France, where about 37,000 people were evacuated.[91]

FIGURE 2: TOTAL BURNED HECTARES AND THE NUMBER OF WILDFIRES IN FRANCE FROM 2008 TO 2022



During the first quarter of 2022, hailstorms were the costliest climate event, with huge hailstones damaging factory roofs and forcing them to close. Operating losses are estimated at hundreds of millions of euros. Hail devasted numerous departments in central and eastern France and caused significant damage to vehicles and homes.[92]

HUMAN LOSS

The summer of 2022 saw the highest excess mortality since the 2003 heat wave, with an excess of over 10,000 deaths, according to Santé publique France, the French public health department. The organisation found 10,420 excess deaths (15,000 in 2003) and observed a greater relative excess of mortality in departments placed on red alert (+20%) by the French meteorological department.[93]

Regarding the direct impact of natural disasters, storms killed one person in July. Five people were killed in Corsica, which was hit by two consecutive violent storms on 18 and 19 August.[94]

ECONOMIC IMPACT

Over the last several years, the frequency and cost of natural disasters have escalated. However, it is very difficult to forecast physical and meteorological extreme events. In addition, the valuation of the ultimate cost of extreme events is complex due to variability of the severity, geographic sensitivity and uncertainty of the macroeconomic context.

[91] L'Argus de l'assurance (27 July 2022). Forest fires: Forest insurers hope for a gesture from the State to develop fire insurance. Retrieved 27 February 2023 from https://www.argusdelassurance.com/les-assureurs/incendies-de-foret-les-assureurs-specialises-esperent-un-geste-de-l-etat-pour-developper-l-assurance-forestiere.202342.

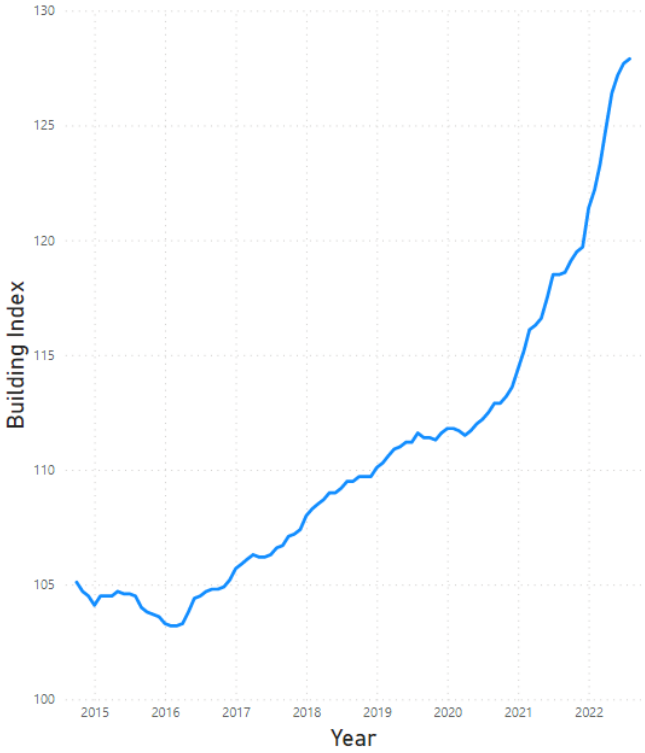
[92] L'Argus de l'assurance (21 September 2022). Climate: 2022, the summer of disasters. Retrieved 27 February 2023 from https://www.argusdelassurance.com/les-assureurs/climat-2022-l-ete-des-catastrophes.204247.

[93] Franceinfo. France Televisions. Retrieved 27 February 2023 from https://www.francetvinfo.fr/meteo/canicule/l-ete-2022-a-connu-la-surmortalite-la-plus-importante-depuis-la-canicule-de-2003-avec-un-exces-de-plus-de-10-000-deces-selon-sante-publique-france_5491278.html.

[94] Reuters (19 August 2022). Weather warning lifted for Corsica after violent storms left 5 dead. Retrieved 27 February 2023 from https://www.reuters.com/world/europe/french-island-corsica-faces-more-rain-after-storms-which-left-several-dead-2022-08-19/.

The chart in Figure 3 shows the French building index from 2015 to 2022, depicting the rising price of building materials and labour costs in the construction industry due to recent inflation. The index can explain, to a certain extent, the increasing cost of subsidence risk. For example, the cost of repairing a windscreen in 2022 is 40% more expensive than in 2021 and roof tiles are 33% more expensive. Therefore, the increased cost of subsidence risk can be attributed to both more frequent extreme weather events and the impact of hyperinflation. Since 2017, the cost of natural disasters increased each year in France, from EUR 3.5 billion in 2017 to an estimated EUR 5.2 billion in 2022 (excluding drought, which has delayed recognition).[95]

FIGURE 3: FRENCH BUILDING INDEX, 2015-2022



IMPACT ON INSURERS

Climate risks are a major challenge for insurers because their costs and frequency are constantly increasing, some perils are emerging, such as wildfires or drought, and diversification tends to decrease.

According to Mission des Risques Naturels (MRN), the 2022 drought is expected to result in subsidence claim costs between EUR 1.9 billion and 2.8 billion. The French Federation of Insurance, France Assureurs (FFA) estimates that the hailstorms will cost EUR 3.9 billion, with EUR 2.4 billion of that generated in just the 16 days between 18 June and 4 July 2022.[96]

In France, a mandatory natural catastrophic disaster cover is included in multi-risk insurance contracts. Therefore insurers shall compensate the material costs to repair homes or motor vehicles damaged by natural disasters. In 1982, France established a specific compensation scheme (public-private partnership) to compensate for a lack of natural catastrophe (nat cat) risk coverage, which until then had been inadequately insured. Insurers can subscribe to this nat cat reinsurance protection, which includes a French government guarantee and is delivered by Caisse Centrale de Réassurance (CCR), a public-sector reinsurer. However, this guarantee is limited as it only covers events that are recognised as natural catastrophes by an interministerial council and does not cover damages from hail or windstorms. The contribution is fixed at 12% of multi-risk home insurance premiums with 6% of motor vehicle damage contracts to ensure the balance of that regime. However, as the frequency and

[95] L'Argus de l'assurance (21 September 2022), op cit.

[96] Gallagher Re (January 2023). Natural catastrophe report of 2022. Retrieved 27 February 2023 from https://www.ajg.com/gallagherre/-/media/files/gallagher/gallagherre/gallagher-re-nat-cat-review-2022.pdf.

costs of natural disasters escalate, the contribution of 12% of home insurance premiums may no longer be sufficient. To maintain the plan balance, the Prudential and Resolution Control Authority (ACPR) proposed a raise to 18% of premium in its climate stress test exercise. But insurers concluded that the proposed contribution increase will be passed onto policyholders via higher premiums, which is discussed in detail in the paper Climate Stress Test : French Exercise Synthesis.

The highest short-term impact for the market relates to the material increase of natural catastrophe reinsurance costs coupled with a drop of coverage capacity (willingness). For example:

- The forecast for natural catastrophe perils without recent material claims experience equates to roughly +10% of the increase in reinsurance prices.
- The price adjustment is at least +20% on perils generating bad claims experiences, such as hail and drought.
- Catastrophe aggregate treaties become less interesting for reinsurers, so they are increasing their prices and tightening eligibility conditions (application of reduced franchise).
- Some players decided to no longer reinsure drought claims.
- Catastrophe treaties seem no longer profitable for reinsurers, and 2023 renewal discussions highlight a deep regression of reinsurers' capacity on these risks. For example, catastrophic bond aggregate solutions have become very complex to subscribe as the diversification between perils seems less respected.

The question of uninsurability is under discussion as insurers are estimating that the costs related to natural events could increase by 500% to 600% by 2050, which would require an estimated offsetting increase in policyholder premiums of 130% to 200%.[97] If the policyholders cannot afford to pay this increase, should the government step in to help offset the costs? Climate change should be handled through several management actions including better planning of urban and open spaces. The French government regional representatives must identify the territories at risk and put in place transformation plans, depending on the level of risk, to limit the territory's exposure to natural risk. The actions to be implemented should be added to the local urban plan and take precedence over all other considerations.

SUMMARY OF 2021 EXTREME WEATHER EVENTS

In early April 2021, an intense late deep freeze gripped most of France and became the nation's most costly agricultural insurance event since the introduction of multi-risk climate crop insurance in 2005. This event caused significant damage to crops across many vineyards and farms in 10 of the 13 regions of metropolitan France. In response, the government provided financial aid to farmers. In this context, a report ordered by the government on risk management in agriculture was issued in July 2021. This report recommends promoting the development of insurance for risks which are insurable and public intervention for extreme climate events. The Milliman white paper La couverture des risques agricoles au sein de la ferme France provides more detail.

OUTLOOK FOR THE FUTURE

According to the study from the FFA, "Impact of climate change on insurance by 2050," the total amount of claims due to natural events could reach EUR 143 billion cumulatively between 2020 and 2050, an increase of 93% (EUR 69 billion) compared to the 1989-2019 period. Three types of disasters account for the increased costs: storm costs are expected to increase by 46%, floods costs are expected to increase by 87% and drought costs are expected to increase by 215%. The cost increases are explained by:

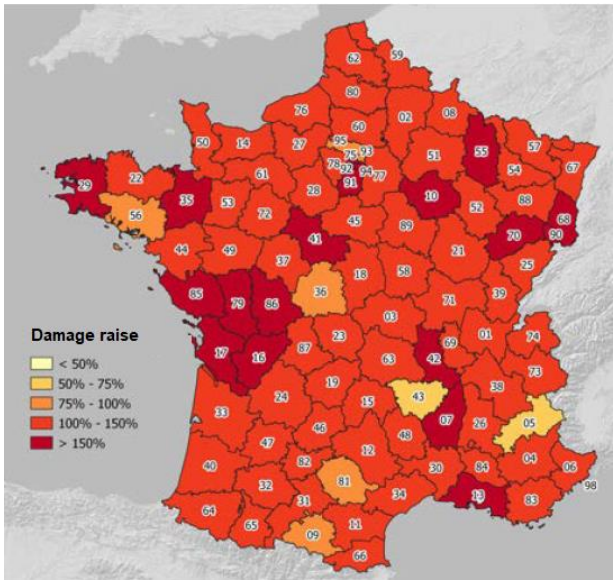
- Natural variability of the climate such as extreme events that did not occur during the previous period.
- Climate change especially for droughts and marine submersions.
- Increased cost of housing, factories and public infrastructure.[98]

[97] Milliman (May 2021). ACPR climate exercise: Summary of the main results. Retrieved 27 February 2023 from https://fr.milliman.com/fr-fr/insight/exercice-climatique-acpr-synthese-des-principaux-resultats.

[98] France Assureurs. Impact of climate change on insurance by 2050. Retrieved 27 February 2023 from https://www.franceassureurs.fr/wp-content/uploads/2022/09/vf_france-assureurs_impact-du-changement-climatique-2050.pdf.

The map in Figure 4 illustrates the projected changes to average annual damages due to flood runoff, indicating a 130% average annual increase in flood runoff and flash flood claims by 2050 due to a significant increase in extreme precipitation.[99]

FIGURE 4: PROJECTED CHANGES TO AVERAGE ANNUAL DAMAGES DUE TO FLOOD RUNOFF BY 2050



Source: Covéa, "Changement climatique & assurance: Quelles consequences sur la sinistralite a l'horizizon 2050?"

The geographical component of extreme weather events and natural disasters is quite complex. Mapping the risks linked to these events allows better understanding and undertaking of causes and effects. For example, for soil swell-shrinkage in France, the Geological and Mining Research Office provides data to analyse the exposure of the whole territory to this phenomenon. Data about flood risk areas that has been mapped by experts is also available.

More than a third of French municipalities have a natural risk prevention plan, but these plans are mainly for flooding. Additionally, only 2,000 of 36,000 communities have prevention plans for subsidence, which is an emerging risk.

Germany

2022 EXTREME WEATHER EVENTS

In 2022, heavy storms and heat waves damaged Germany:

- On 5 August, violent thunderstorms with strong wind gusts caused damage in northern Germany, including highway closures, power outages, fallen trees and train cancellations.[100]
- On 18 and 19 August, severe thunderstorms moved through southern Germany and Austria, causing local flooding.[101]
- In July, six Germany states were impacted by an extreme record-breaking heat wave that peaked at 40°C in some areas on 19 July. This was followed by heavy thunderstorms and power outages in some regions.[102]

[99] Covea (2 March 2022). Floods, storms, drought, hail: Covea publishes a white paper on climate risk modelling in mainland France. Retrieved 27 February 2023 from https://www.covea.eu/en/news/our-articles/floods-storms-drought-hail-covea-publishes-white-paper-climate-risk-modelling.

[100] The Weather Channel (5 August 2022) Injured, train and power failures: Heavy thunderstorms cause damage in the north. Retrieved 27 February 2023 from https://weather.com/de-DE/wetter/deutschland/news/2022-08-05-verletzte-zug-und-stromausfalle-heftige-gewitter-verursachen.

[101] News.de (20 August 2022). Heavy rain in August 2022: Severe storms in the Alps! Videos show flooding. Retrieved 27 February 2023 from https://www.news.de/panorama/856443900/starkregen-im-august-2022-in-bayern-und-baden-wuerttemberg-videos-zeigen-schwere-ueberflutungen-durch-starkregen-in-oesterreich/1/.

[102] News.de (21 July 2022) Heat wave currently in July 2022: Heat records in six federal states – damage caused by storm rollers. Retrieved 27 February 2023 from https://www.news.de/panorama/856385892/hitzewelle-heute-aktuell-in-deutschland-news-ticker-zu-extrem-wetter-unwetter-und-gewitter-nach-hitzerekorden-blitzschlag-im-allgaeu/1/.

HUMAN LOSS

At least four people were injured in auto accidents during the 5 August storm in northern Germany.[103]

ECONOMIC IMPACT

- In Allgäu, lightning strikes damaged residential buildings and tractors, with damage costs estimated at EUR 1.5 million.[104]
- During the July heat wave, a lightning strike temporarily closed train service in Baden Württemberg. The property damage is estimated between EUR 100,000 and EUR 150,000.[105]

IMPACT ON INSURERS

In December 2022 German Economy Minister Robert Habeck announced his plan to set up climate protection contracts with industrial companies in 2023 to support a transition towards cleaner production and a switch to hydrogen. Habeck plans to award 15-year subsidy arrangements to companies in energy-intensive industries, including chemicals and steel, which he calls climate protection contracts, in return for reducing carbon emissions in their production.[106] Because burning fossil fuels makes rainfall 3% to 19% stronger and at least 20% more likely, these climate protection contracts might help German insurers reduce the cost of insured losses from storms and floods in the future.[107]

SUMMARY OF 2021 EXTREME WEATHER EVENTS

Devastating floods during July 2021 caused more than 700 injuries and almost 200 deaths in Germany.[108] Munich Re, one of the world's leading reinsurers, estimates EUR 33 billion in total economic losses from these floods.[109] Hannover Re estimated that this flood disaster will cost insurers up to EUR 8 billion.[110] This makes the July 2021 floods the most expensive natural disaster for German insurers in the last 50 years and, as a result, some insurers have reviewed their catastrophic coverage for floods.

OUTLOOK FOR THE FUTURE

The German Weather Service and the 2021 Extreme Weather Congress published an extreme weather fact paper, which highlights the following:

- Temperatures in Germany have risen by 1.6°C between 1881 and 2021, significantly more than the global average. The rate of warming has increased significantly over the past 50 years, with nine of the 10 warmest years since the 1880s occurring since 2000.
- With unchecked greenhouse gas emissions, an increase of up to 20 hot days a year in Germany is expected for the period between 2031 and 2060. This poses an increased risk of forest fires and depleted levels of water in rivers to the extent that inland waterway vessels can no longer sail.
- However, heavy rainfall events can also become more frequent due to climate change. Scientists analysed the areas around the rivers Ahr and Erft, which have been particularly affected by extreme rainfall. Due to global warming, the intensity of extreme precipitation increased in these regions between 3% and 19%.

[103] The Weather Channel (5 August 2022), op cit.

[104] News.de (21 July 2022), op cit.

[105] Wetter.com (26 July 2022). Possible tornado: Storms cause major damage. Retrieved 27 February 2023 from https://www.wetter.com/news/moeglicher-tornado-unwetter-in-deutschland-richten-grosse-schaeden-an-gewitter-bilanz_aid_62df9a7009f0d55202221a82.html.

[106] US News and World Report (3 December 2022). Germany to Set up Climate Protection Contracts With Industry in 2023 – Minister. Retrieved 27 February 2023 from https://money.usnews.com/investing/news/articles/2022-12-03/germany-to-set-up-climate-protection-contracts-with-industry-in-2023-minister.

[107] DW (28 September 2022). Fighting climate change would help insurers. Retrieved 27 February 2023 from https://www.dw.com/en/climate-insurance-risks-extreme-weather-gas-oil-coal-green-finance/a-63266316.

[108] Meagan Fitzgerald, Carlo Angerer and Patrick Smith. "Almost 200 dead, many still missing after floods as Germany counts devastating cost." NBC News, July 19, 2021. Retrieved on March 3, 2023, from https://www.nbcnews.com/news/world/almost-200-dead-many-still-missing-after-floods-germany-counts-n1274330.

[109] Merker.de (19 October 2021). Flood disaster could become even more expensive for insurers. Retrieved 27 February 2023 from https://www.merkur.de/wirtschaft/flutkatastrophe-koennte-fuer-versicherer-noch-teurer-werden-zr-91058492.html.

[110] Hannover Re (18 October 2021). E+S Rück expects rising reinsurance prices after catastrophic weather events in Germany. Retrieved on March 3, 2023 from https://www.hannover-re.com/1804986/e-s-ruck-expects-rising-reinsurance-prices-after-catastrophic-weather-events-in-germany.

- Additionally, the number of violent thunderstorms is also increasing. Data from insurance companies show that the sums paid for losses after severe thunderstorms have been growing continuously for decades.[111]
- Cities need to be better prepared architecturally for extreme weather events. However, national and international governments should also aim to make changes.

Italy

2022 EXTREME WEATHER EVENTS

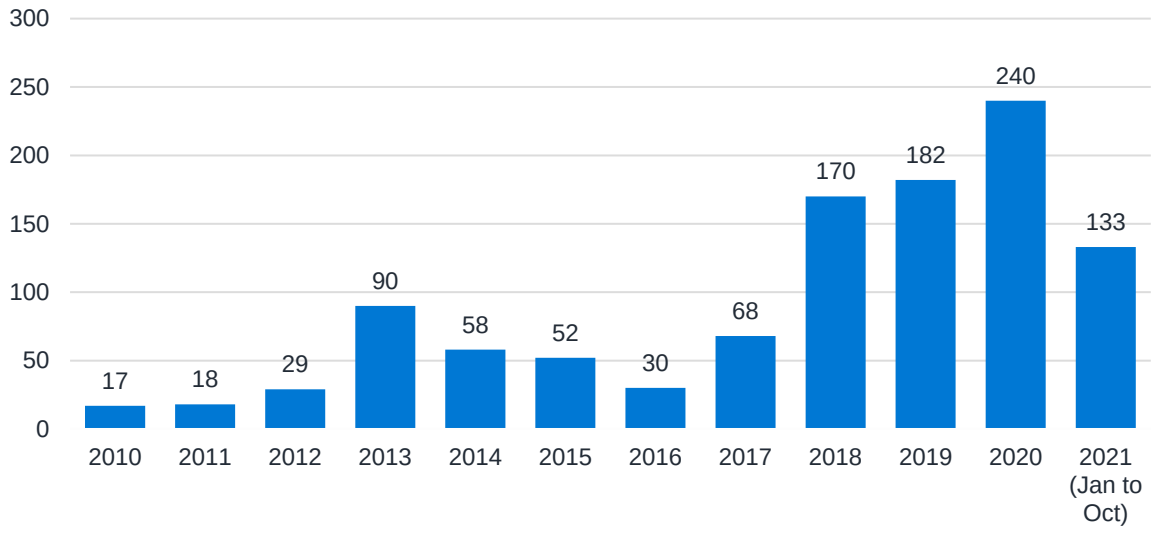
In the first half of 2022, about 132 severe weather events impacted every region of Italy. This number is higher than the annual average for the last decade, according to Legambiente, the Italian Environmental Association. During the summer, the Tuscany region was hit by different severe weather events on different days, including tornadoes, hailstorms and windstorms, which caused damage to both cities and rural areas. In Genova local storms caused about EUR 2 million in damages.[112]

Extreme weather event trends

From 2010 to 2021, the number of extreme weather events in Italy trended upward, as shown in Figure 5. With 132 extreme weather events in the first six months of 2022, the trend continued to increase:

- The number of extreme weather events tripled from 2017 to 2020.
- From January to October 2021, 130 extreme weather events were reported.

FIGURE 5: NUMBER OF EXTREME WEATHER EVENTS IN ITALY FROM 2010 TO OCTOBER 2021[113]



Floods in Italy: January 2010 through October 2022

The most common extreme weather events in Italy are floods:

- Prior to 2018, Italy reported about 10 to 20 flood events per year.
- In 2018 and 2019, Italy reported about 80 flood events per year.
- In 2020, Italy reported about 100 flood events.
- In 2021, Italy reported about 88 flood events.
- Between January and September 2022, Italy reported 62 flood events, indicating that Italy was about to report more flood events by the end of 2022 than in any previous year.

[111] Spiegel Science (24 September 2021). Extreme Weather Congress: The coming disasters. Retrieved 27 February 2023 from https://www.spiegel.de/wissenschaft/natur/extremwetter-wie-sich-deutschland-auf-zukuenftige-naturkatastrophen-vorbereiten-sollte-a-fcf8ac1a-8265-4bcf-b040-c4154d13d386.

[112] Legambiente. Il Clima È Gia Cambiato: Rapporto 2021 Dell'Osservatorio Di Legambiente Cittàclima. Retrieved 27 February 2023 from https://www.legambiente.it/wp-content/uploads/2021/11/Report-OsservatorioCittaClima2021.pdf.

[113] Ibid..

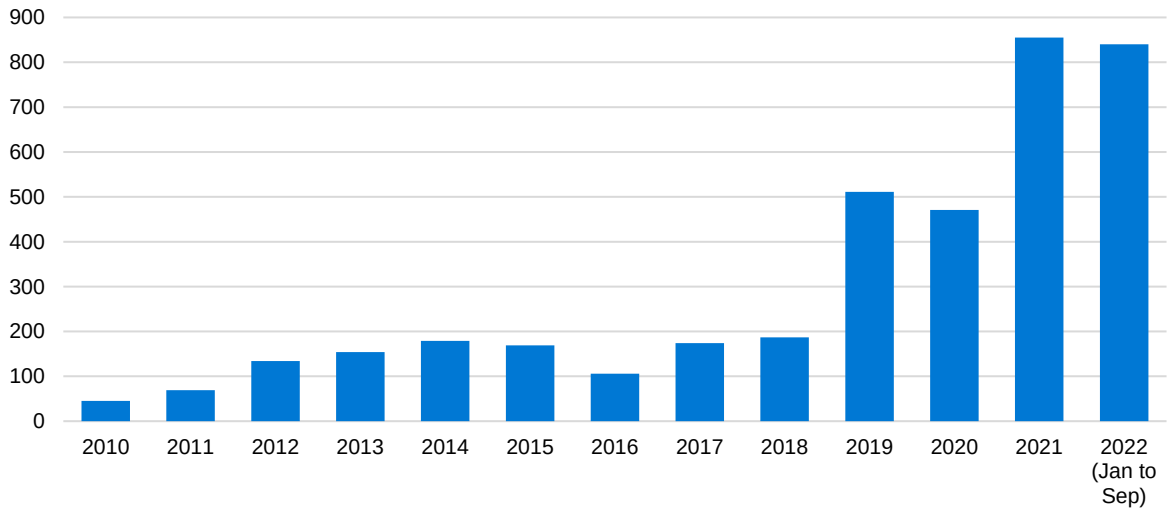
Large hail events in Italy: January 2010 through October 2022

Large hail events are the second-most common extreme weather event in Italy. The European Severe Weather Database defines large hail as the falling of hailstones having a diameter (in the longest direction) of 2.0 cm or more and/or smaller hailstones that form a layer of 2.0 cm thickness or more on flat parts of the earth's surface.[114]

The chart in Figure 6 shows that:

- Prior to 2019, Italy reported fewer than 200 large hail events per year.
- In 2019 and 2020, Italy reported about 500 large hail events per year.
- In 2021, Italy reported 855 large hail events, surpassing 2019's record-breaking number of hail events.
- Between January and September 2022 Italy reported 840 hail events.

FIGURE 6: NUMBER OF REGISTERED LARGE HAIL EVENTS IN ITALY FROM 2010 THROUGH OCTOBER 2022[115]



HUMAN LOSS

From January to September 2022, more than 20 people died in Italy due to extreme weather events. Others were injured or suffered property damage. Specifically:

1. Marche region: Floods and heavy rain caused 12 deaths and 50 injuries on 15-16 September. Roads and homes were damaged.
2. Sestri Levante (Genova): Downburst with large hail on 19 August caused about EUR 2 million in property damage.
3. Tuscany region: Floods and tornado events caused two deaths on 18 August. Roads and homes were damaged.
4. Marmolada (Trento): Avalanche caused 11 deaths and nine injuries on 3 July 2022.

From 2010 to 2020, 261 deaths were attributed to extreme weather events in Italy. Historically, an increase in floods has not correlated with an increase in victims. Construction innovations and newer preventive measures might account for the substantial reduction in the number of flood-related deaths since the early 1980s. However, flood-related deaths increased significantly from 2009 to 2019, which could be attributed to an increase in extreme weather events.

[114] European Severe Weather Database. Definitions. Retrieved 27 February 2023 from https://www.eswd.eu/cgi-bin/eswd.cgi?action=showdefinitions&lang=en_0.

[115] European Severe Weather Database. Selected data from the database. Retrieved 27 February 2023 from https://eswd.eu/cgi-bin/eswd.cgi.

ECONOMIC IMPACT

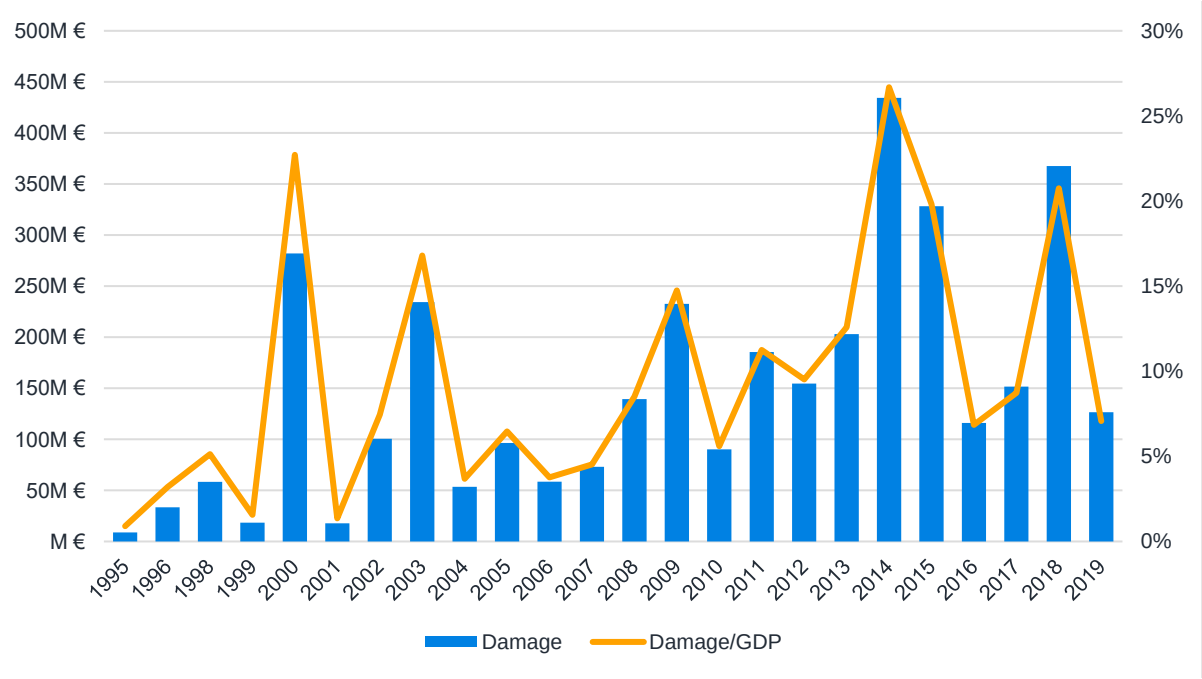
Italy's agriculture industry association estimates that the industry lost EUR 6 billion in 2022 due to extreme weather events, which is equal to 10% of national production.[116]

The Italian government spends about EUR 1.5 billion to manage emergencies related to extreme weather events, but only about EUR 300 million to mitigate weather risks—a 1-to-5 ratio of spending for prevention and damage repair.[117]

For historical context, Instituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA) compared Italy's flood losses with the country's gross domestic product (GDP) from 1995 through 2019, as shown in the chart in Figure 7.

- From 2006, the trend shows that the cost of flood damage was around 5% of Italy's annual GDP.
- In 2014, floods losses amounted to 27% of Italy's GDP.
- Very high losses relative to GDP are not unusual in Italy. For example, the 1996 flood losses amounted to 251% of total GDP and 1972 flood losses amounted to 112% of total GDP.

FIGURE 7: ECONOMIC COSTS OF FLOODS IN ITALY COMPARED TO GDP (1995-2019)[118]



IMPACT ON INSURERS

The Italian Association of Insurers (ANIA) estimates that only about 2% of properties in Italy were insured in 2022. The lack of coverage leaves the Italian government primarily responsible for the cost of extreme weather events, which has led to rebuilding delays, businesses closing and property abandonment.[119]

[116] SIR Information Agency (13 August 2022). Agriculture: Coldiretti, 2022 "the black year due to bad weather and drought with over 6 billion euros in damages." Retrieved 27 February 2023 from https://www.agensir.it/quotidiano/2022/8/13/agricoltura-coldiretti-il-2022-lanno-nero-per-maltempo-e-siccita-con-oltre-6-miliardi-di-euro-di-danni/.

[117] Legambiente, op cit..

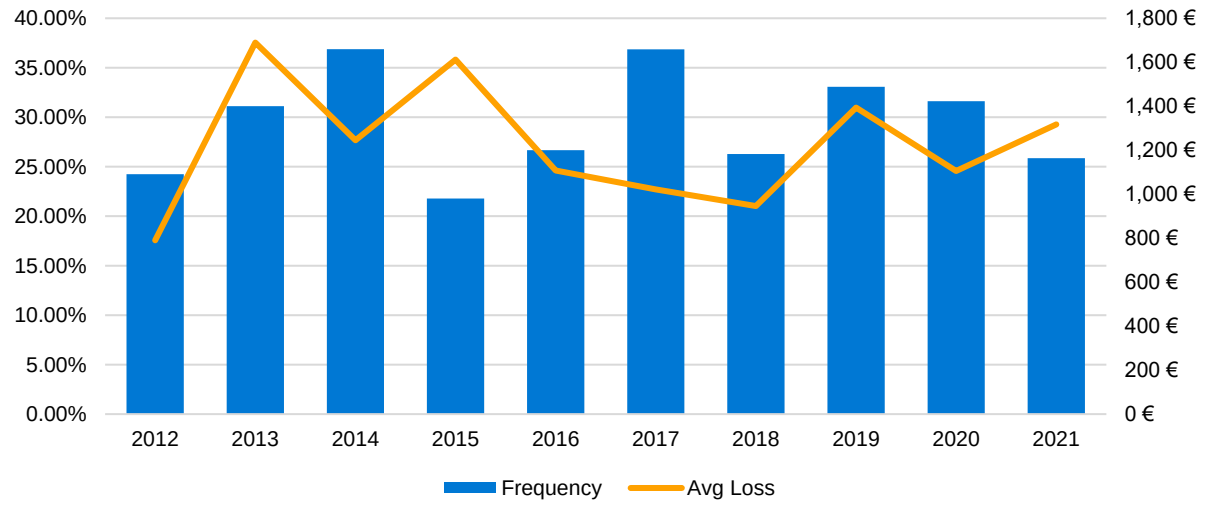
[118] ISPRA. Reports (yearbook of environmental data). Retrieved 27 February 2023 from https://annuario.isprambiente.it/sys_ind/report/html/404.

[119] ANIA. La gestione del rischio catastrofale e stima dei danni al patrimonio abitativo italiano. Retrieved 27 February 2023 from http://www.ordineattuari.it/media/6054/ANIA_280312_CONFORTI_RONCHI_094.pdf.

Milliman analysed historical ANIA data[120] to show the average cost and claims frequency of hail events in recent years for multi-risk policies, as shown in the chart in Figure 8. The analysis indicates that:

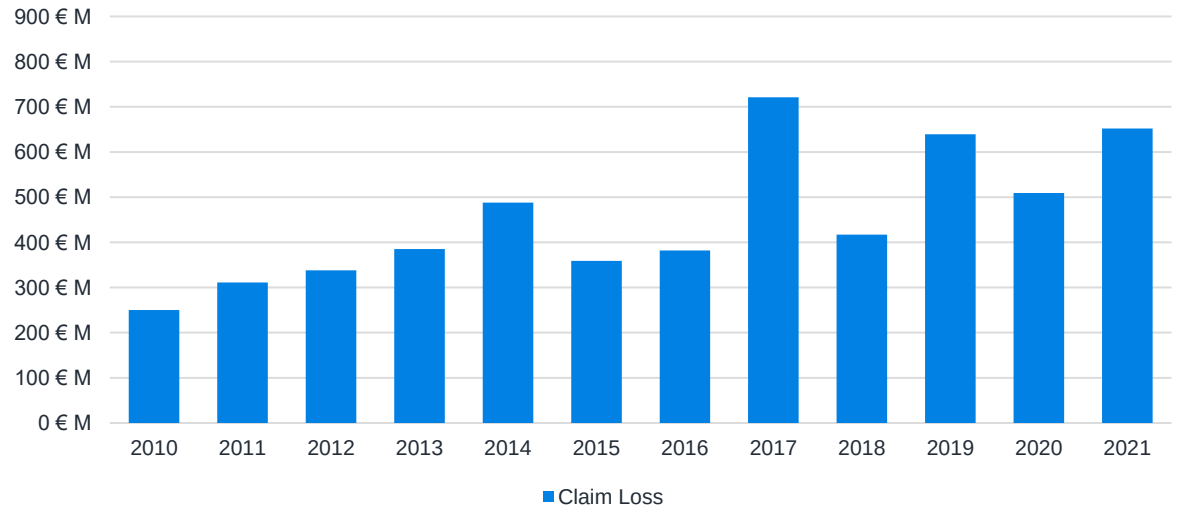
- An increase in the number of claims does not always correlate with an increase in costs, except in 2013 and 2019.
- Overall, frequency and costs have been similar in recent years.
- Although 2022 data is not yet available, Milliman expects these trends to continue.

FIGURE 8: HAIL CLAIMS FREQUENCY AND AVERAGE LOSS FOR MULTI-RISK POLICIES



Additionally, ANIA provides annual income statements for claims losses that occurred from 2010 to 2021. Although 2015 and 2016 were countertrend years, insurer losses due to hail events since 2010 follow an increasing trend, as shown in Figure 9.[121]

FIGURE 9: HAIL LOSSES FOR MULTI-RISK POLICIES (CLAIM LOSSES IN MILLIONS)



[120] ANIA. Historical statistics on hail for multi-risk policies. Data retrieved 27 February 2023 from https://www.ania.it/pubblicazioni/-/categories/52492.

[121] ANIA, Historical statistics on hail for multi-risk policies, op cit.

OUTLOOK FOR THE FUTURE

The latest Italian Institute for Environmental Protection and Research report shows that:

- Italy is one of Europe's most at-risk countries for landslides and floods, with about 94% of the cities at high risk and about 18% of the country at high risk.
- About 4% of Italy is exposed to flood risk, with high-probability scenarios in the next two to 50 years.
- These risks are distributed throughout Italy, with about 91% of municipalities within high to very high landslide hazard zones and/or medium flood hazard zones.
- About 12% of businesses are exposed to high flood risk.
- About 1.3 million people are exposed to high to very high landslide risk.
- About 6.2 million people are exposed to high flood risk (return period of 20 to 50 years) and medium flood risk (return period of 100 to 200 years).[122]

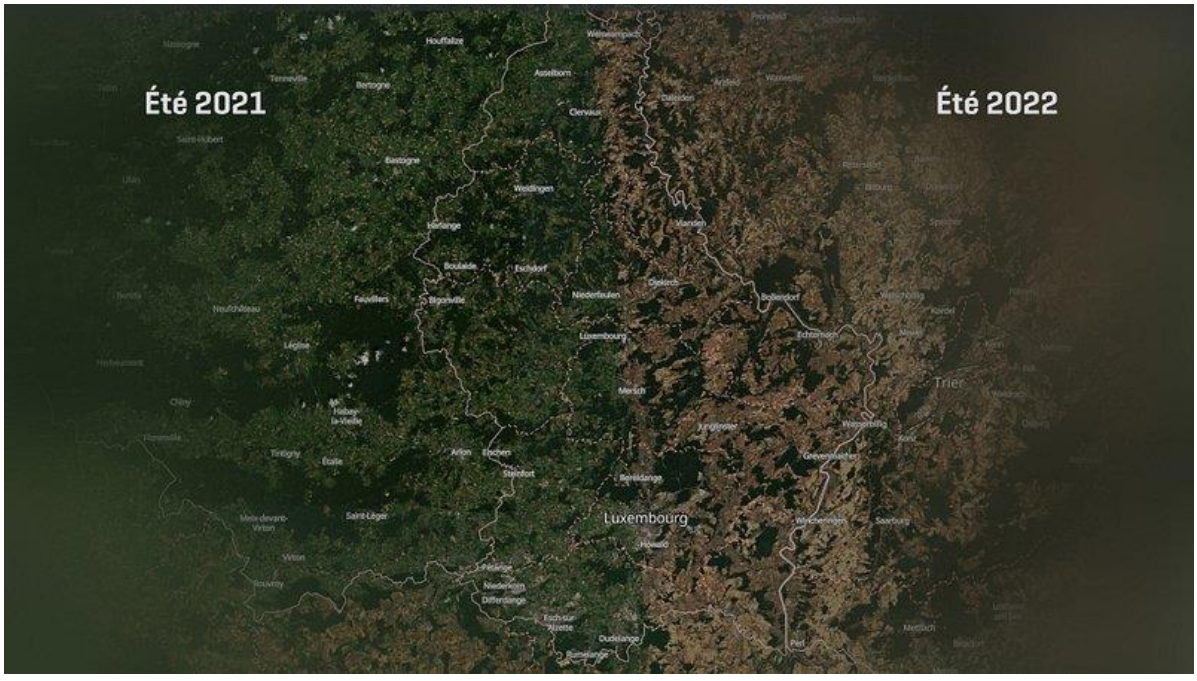
Luxembourg

2022 EXTREME WEATHER EVENTS

Although Luxembourg was hit by some storms in 2022, the impact was not as damaging as in neighbouring countries. However, the effects of the drought were significant:

- Météolux predicted in August that the summer of 2022 would be the driest since 1947, when records began.
- According to Météolux's initial evaluations, cumulative summer rainfall was approximately 70% lower than the previous three decades' average.
- As of 28 August, 66.2 litres of rainfall per square metre were recorded—significantly below the 217 litres per square metre average from 1991 to 2020.
- The extent of the drought in Luxembourg is clearly visible in the satellite photo in Figure 10, from Luxembourgian publication RTL Today. The image on the left shows Luxembourg on 21 July 2021 (summer 2021); the photo on the right shows the country on 10 August 2022 (summer 2022).

FIGURE 10: TWO SATELLITE IMAGES TAKEN ONE YEAR APART SHOW A CLEAR CONTRAST BETWEEN THE SUMMERS OF 2021 AND 2022.



Source: RTL Today

[122] ISPRA. Landslides and floods in Italy: Hazard and risk indicators – 2018 Edition. Retrieved 28 February 2023 from https://www.isprambiente.gov.it/en/publications/reports/landslides-and-floods-in-italy-hazard-and-risk-indicators-2013-2018-edition.

Luxembourg's summer of 2022 broke several records:

- In June, most of Luxembourg barely saw any precipitation, and temperatures ranged between 0.9ºC and 1.6ºC higher than the average from 1991 to 2020.
- July was marked by heat waves and droughts. Recorded precipitation deficits ranged from -67.5 mm to -54.6 mm.
- August was the hottest month since the start of monthly average recordings in 1838, according to a press release by the national weather administration Agriculture, Viticulture and Rural Development (ASTA).[123]

HUMAN LOSS

No fatalities due to extreme weather events were reported in Luxembourg in 2022.

ECONOMIC IMPACT

At the end of the summer, historically good early grain harvests were reported, but with strong regional fluctuations. The regionally different rain distribution in spring and the hot days in May and June caused the difference in harvest yields. Good yields were only achieved by farms that optimally managed and fertilised their crops. However, Claude Haagen, Luxembourg Minister for ASTA, expressed concern with corn and grassland yields:

- Starting in mid-June, grassland stopped growing almost nationwide due to a lack of precipitation.
- On the ASTA test plots, grassland yield losses over three cuts were about 30% and regionally the yield losses could have been even greater.
- In many places, corn did not survive the drought and was harvested with significant losses in yield and quality.
- Crop failure insurance gave farmers the opportunity to insure their crops against hail, heavy rain, frost and drought, with 65% of the contribution covered by the Ministry.[124]

IMPACT ON INSURERS

Winter 2022 storms did not have an extraordinary impact on insurance claims in Luxembourg. Since the 2022 yield losses of the agricultural industry are not fully in scope yet, there was little to no information available on the size of damage claims for insurers as of this writing.

SUMMARY OF 2021 EXTREME WEATHER EVENTS

Torrential rain caused heavy flooding in July 2021. Although no fatalities were reported, emergency services received more than 1,000 calls for help and more than 150 people were evacuated from their homes. Total estimated insured damage was more than EUR 120 million, making this extreme weather event the costliest disaster for insurers in Luxembourg's history. More than 6,000 homes and 1,000 motor vehicles were damaged. Most of the motor vehicles were destroyed beyond repair.[125]

OUTLOOK FOR THE FUTURE

According to Andrew Ferrone, climatologist and head of the ASTA weather service at the Ministry of Agriculture, drought and heat waves will persist, even if global temperature increases are limited to 1.5°C. Luxembourg also is projected to see a 20% rise in episodes of heavy rain. Vineyard owners and other types of farmers will have to adapt, whether by cultivating new crops such as soybeans, or by planting new varieties of grapes in the Moselle, where red wine could become more common.[126]

[123] Delano News (2 September 2022). Summer 2022 too dry and hot, says weather service report. Retrieved 28 February 2023 from https://delano.lu/article/summer-2022-too-dry-and-hot-co.

[124] Chronicle.lu (21 September 2022). Grain Harvest Good but Early, Forage Yields Below Average. Retrieved 28 February 2023 from https://chronicle.lu/category/agriculture-viticulture/42551-grain-harvest-good-but-early-forage-yields-below-average.

[125] ACA (21 December 2021). €120 million in damage following the floods: The costliest disaster in the history of Luxembourg insurance. Retrieved 28 February 2023 from https://www.aca.lu/media/60fa5ae43a0b7_cp_aca_inondations_2021_2.pdf.

[126] RTL Today (8 August 2022). More heatwaves and drought on the way, says ASTA climate expert. Retrieved 28 February 2023 from https://today.rtl.lu/news/23uxembourg/a/1951289.html.

The Netherlands

2022 EXTREME WEATHER EVENTS

In the Netherlands, 2022 began with a turbulent start. Three February storms—Dudley, Eunice and Franklin—hit the country within four days. Although two storms in a row are common, three in one week are rare, and the last time a triplet of storms hit the Netherlands was almost a century ago.[127]

- Storm Dudley was relatively uneventful, compared to Eunice and Franklin.
- On 18 February, storm Eunice hit the Dutch shores of the southern province of Zeeland and moved over the country from the southwest to the northeast. Eunice brought wind speeds up to 145 km/h and a wind force 10 measurement that lasted for several hours. Eunice ranked among the top three heaviest storms of the last 50 years and was the most damaging of the three February 2022 storms. Eunice not only hit the coastal provinces, but the entire country. The only place where the storm was less severe was the southern inland province of Limburg.[128]
- Storm Franklin arrived two days after Eunice. Less fierce than Eunice, Franklin mainly impacted the coastal provinces of Zeeland, North and South Holland and the area around the IJsselmeer. Franklin brought local heavy rainfall of 30 mm to 40 mm, which caused roads to flood in some areas.[129]

The Netherlands's second extreme weather event was the severe drought during the summer of 2022. The drought was caused by a combination of persistently warm weather with a high number of hours of sunshine and a shortage of rainfall:

- 2022 was the Netherlands' third-warmest summer since 1901, and only 2003 and 2018 were warmer.[130]
- As of 30 September 2022, the precipitation shortage was estimated at about 250 mm, according to the Royal Netherlands Meteorological Institute.[131]
- 2022 ranked among the top five driest years in recorded history. Only 1921, 1959, 1976 and 2018 were drier years since the Netherlands began record-keeping in 1906.[132]

The drought led to low levels of surface and ground water. Instead of keeping the water out, the Dutch were challenged to keep the water in. In several regions, irrigation was prohibited, negatively impacting flora, fauna and agriculture. In addition, low water levels created inland commercial shipping bottlenecks and increased waiting times for boats and ships to move through locks. The Rhine river, one of the main freight traffic arteries of Europe, was severely impeded upstream in Germany, which also impacted the Dutch shipping industry.[133]

HUMAN LOSS

The Royal Netherlands Meteorological Institute (KMNI) issued a warning one week in advance of the February storms, giving residents ample time to prepare. The public was advised to stay indoors during storm Eunice and public transportation was shut down during the height of the storm. In addition, several of the country's main flood defences were closed.

Despite the warnings, storm Eunice caused four fatalities in the Netherlands. Fallen trees caused three fatalities in the Amsterdam region and a motorist died after a collision with a fallen tree near Adorp.[134]

[127] Omroep Zeeland (21 February 2022). Dudley, Eunice or Franklin: Who was the strongest? Retrieved 28 February 2023 from https://www.omroepzeeland.nl/nieuws/14444288/dudley-eunice-of-franklin-wie-was-het-sterkst-zes-stormdagen-in-cijfers.

[128] KNMI (21 February 2022). Triple storm Dudley, Eunice and Franklin. Retrieved 28 February 2023 from https://www.knmi.nl/over-het-knmi/nieuws/drielingstorm-dudley-eunice-en-franklin.

[129] Twitter (20 February 2022). @BlueRadar NL Retrieved 28 February 2023 from https://twitter.com/BuienRadarNL/status/1495518900133539841?ref_src=twsrc%5Etfw%7Ctwcamp%5Etweetembed%7Ctwterm%5E1495518900133539841%7Ctwgr%5E73248475b4a4323f91b8ddf4ba402fde06dc5b69%7Ctwcon%5Es1_&ref_url=https%3A%2F%2Fwww.rtlnieuws.nl%2Fnieuws%2Fnederlan

[130] KNMI (31 August 2022). One of the hottest, sunniest and driest summers. Retrieved 28 February 2023 from https://www.knmi.nl/over-het-knmi/nieuws/zomer-2022.

[131] KNMI. Drought monitor. Retrieved 28 February 2023 from https://www.knmi.nl/nederland-nu/klimatologie/droogtemonitor.

[132] Weeronline (9 August 2022). 2022 in top 5 driest years, precipitation deficit continues to increase. Retrieved 28 February 2023 from https://www.weeronline.nl/nieuws/9-8-2022-droogte-top-5-droogste-jaren.

[133] Rijkswaterstaat (25 August 2022). 'We ensure that the impact on shipping is also taken into account.' Retrieved 28 February 2023 from https://www.rijkswaterstaat.nl/nieuws/archief/2022/08/impact-droogte-op-scheepvaart.

[134] NOS (19 February 2022). Four deaths, damage and evacuations caused by storm Eunice. Retrieved 28 February 2023 from https://nos.nl/artikel/2417956-vier-doden-schade-en-ontruimingen-door-storm-eunice.

ECONOMIC IMPACT

The Dutch Association of Insurers estimated that insured damage from the February storms amounted to at least EUR 500 million.[135] However, the Dutch people are well insured against damage caused by storms. In the Netherlands, mortgage providers typically require borrowers to purchase home insurance that covers storm damage. Therefore, we expect that most of the damage to private homes was covered. Although protection against natural damage is optional for motor vehicle insurance in the Netherlands, about two-thirds of the country's fleet of cars is insured against damage caused by storms.

IMPACT ON INSURERS

Dutch insurers received a record number of claims from the February storms, with more than 100,000 claims reported by the largest insurance firms.

- As of 24 February 2022, Nationale-Nederlanden and the labels OHRA, ABN AMRO Insurance, ING Insurance and SNS Insurance reported 22,000 claims and expected that number to increase. The insurers reported fewer motor vehicle claims than the 2018 storms, attributing this decrease to better preparation and adequate warning, so more people stayed home.[136]
- As of 19 February 2022, non-life insurers estimated EUR 3 million to 3.5 million in claims in Univé alone, including extreme damage where roofs and solar panels were blown off buildings.[137]
- As of 23 February 2022, ASR reported receiving more than 4,000 claims for more than EUR 60 million in damages. CEO Jos Baeten said that the damage from the February 2022 storms was much higher than that of other recent storms, including the approximately EUR 20 million burden from the 2021 floods in Limburg.[138]
- In the 11 August semi-annual report, Achmea reported claims expenses of more than EUR 100 million (after reinsurance) due to the February storms.[139]
- There was a large variance in the average claim amount among insurers, ranging from approximately EUR 1,000 to EUR 10,000 per claim.

In the Netherlands, it is common to reinsure storm damages and nearly all the large insurers had reinsurance for the February 2022 storm claims. For example, Achmea, one of the largest Dutch insurers, noted that reinsurance reduced their total claims from EUR 200 million in losses to EUR 100 million in losses.[140]

SUMMARY OF 2021 EXTREME WEATHER EVENTS

Heavy rainfall during the summer of 2021 caused flooding in Limburg, Noord-Brabant Heerlen, Kerkrade, Landgraaf, Gulpen, Meersen and Valkenburg. Damage estimates reached EUR 1.8 billion.[141] Although private insurance does not by default fully cover flood losses, many Dutch insurers tried to generously settle claims. The July 2021 floods caused broader discussion among insurers and between insurers and citizens regarding what can and should be covered going forward. Previously only one insurer offered insurance against flooding of "secondary weirs." After the 2021 floods, this coverage was added to standard fire insurance by two other large insurers.

[135] Dutch Association of Insurers (21 February 2022). More than 500 million euros in damage from February storms. Retrieved 28 February 2023 from https://www.verzekeraars.nl/publicaties/actueel/ruim-500-miljoen-euro-schade-door-februaristormen.

[136] Nationale Nederlanden (24 February 2022). More than 22,000 damage reports, 10% handled. Retrieved 28 February 2023 from https://www.nn.nl/Over-NationaleNederlanden/Actualiteiten/Persbericht/-Ruim-22000-schademeldingen-10-afgehandeld-.htm.

[137] RTL Nieuws (19 February 2022). Storm damage alone at Univé 3.5 million; much greater damage. Retrieved 28 February 2023 from https://www.rtlnieuws.nl/economie/artikel/5289406/storm-schade-verzekeraars-eunice-interpolis-unive-centraalbeheer-nn.

[138] De Telegraaf (23 February 2022). Price tag storm damage can be as high as EUR 60 million at ASR. Retrieved 28 February 2023 from https://www.telegraaf.nl/financieel/166537598/prijskaartje-stormschade-kan-bij-asr-oplopen-tot-60-miljoen.

[139] Achmea (11 August 2022) Operating result €115 million. Retrieved 28 February 2023 from https://nieuws.achmea.nl/halfjaarresultaten-2022/#:~:text=Het%20resultaat%20over%20het%20eerste%20halfjaar%20van%202022,lager%20dan%20over%20het%20eerste%20halfjaar%20van%202021.

[140] Ibid.

[141] ENW (20 September 2021). Hoogwater 2021 Feiten en Duiding. Retrieved 28 February 2023 from https://www.tweedekamer.nl/downloads/document?id=096991fc-8f54-41e4-8bba-6e94aed53293&title=Samenvatting%20ENW-rapport%20%27Hoogwater%202021.%20Feiten%20en%20Duiding%27%20d.d.%2020%20september%202021.pdf (PDF download).

OUTLOOK FOR THE FUTURE

KMNI published an assessment of the impact of climate change on the Netherlands, which included these key points:

- There is no clear evidence of increasing severity of storms. The average wind speed over land in the Netherlands has been decreasing since the 1960s because of building construction. In recent years, there have been fewer storm days in locations above the North Sea compared to the end of the last century.
- Climate change clearly leads to rising temperatures. Partially driven by temperature increases, the average yearly precipitation has increased. However, less rain falls during summer and droughts have become slightly more frequent.[142]

Portugal

2022 EXTREME WEATHER EVENTS

In 2022, more than 90% of Portuguese territory faced a severe or extreme drought, which threatened agricultural production and water supplies in mainland Portugal. By the end of June:

- 28.4% of Portugal was in extreme drought.
- 67.9% of Portugal was in severe drought.
- 3.7% of Portugal was in moderate drought.

Overall, higher-than-average temperatures and lower-than-average rainfall contributed to very low percentages of water in the soil throughout Portugal, especially in the interior North and Central regions, the Tagus Valley, Alentejo and the Algarve.[143]

The summer of 2022 was one of Portugal's hottest summers and the country suffered from an increase in wildfires caused by a combination of high temperatures, dry soil and gusty winds. More than 1,500 firefighters fought a wildfire in the central Covilha region that burned 10,500 hectares (40 square miles), including parts of the Serra da Estrela national park.[144] In July, firefighters tackled 200 different blazes in one day, and due to high temperatures the Portuguese government issued an extended a state of alert for wildfires.[145]

HUMAN LOSS

By mid-July an extended heat wave caused an estimated 1,700 deaths in Portugal and Spain, according to the European office of the World Health Organisation (WHO), and the toll was expected to increase over the rest of the summer.[146] Although there were no confirmed deaths from the Portuguese wildfires, 160 people, including at least 70 firefighters, were injured.

ECONOMIC IMPACT

Farmers in the northeast and southern regions of Portugal were hit the hardest financially by 2022 extreme weather events, and they requested financial assistance from the government.

[142] KNMI. Climate change observations. Retrieved 28 February 2023 from https://www.knmi.nl/kennis-en-datacentrum/achtergrond/waarnemingen-klimaatveranderingen.

[143] Portugal News (7 July 2022). Drought worsening in Portugal. Retrieved 28 February 2023 from https://www.theportugalnews.com/news/2022-07-07/drought-worsening-in-portugal/68480.

[144] Insurance Journal (12 August 2022). Wildfires Burn, Farmers Struggle as Another Heatwave Bakes Western Europe. Retrieved 28 February 2023 from https://www.insurancejournal.com/news/international/2022/08/12/680285.htm.

[145] Phys.org (14 July 2022). Villages battle wildfires in Portugal; Europe swelters. Retrieved 28 February 2023 from https://phys.org/news/2022-07-villages-wildfires-portugal-europe-swelters.html#:~:text=A%20forest%20fire%20reaches%20olive%20trees%20in%20the,people%20from%20their%20homes.%20Credit%3A%20AP%20Photo%2FArmando%20Franca

[146] Phys.org (22 July 2022). WHO says heatwave caused 1,700 deaths in Spain, Portugal. Retrieved 28 February 2023 from https://phys.org/news/2022-07-heatwave-deaths-spain-portugal.html#:~:text=WHO%20says%20heatwave%20caused%201%2C700%20deaths%20in%20Spain%2C,calling%20for%20joint%20action%20to%20tackle%20climate%20change.

To save water for homes and agriculture, the Portuguese government restricted the use of reservoirs for hydroelectric power production.[147] Portugal's government also recommended 43 municipalities temporarily increase water prices for their biggest consumers and suspend street-cleaning and watering in public parks and gardens.[148]

Additionally, Portugal's 2022 state budget included several measures concerning climate change:

- EUR 3.8 million for supporting the environment, a 30% increase over its 2021 investment.
- Reinforcement of decarbonisation efforts by allocating EUR 250 million to promote public transportation.
- The goal of generating 47% of energy through renewables, such as green hydrogen, by 2030.
- More public electric vehicles and financial support for the purchase of private electric vehicles.
- Reduced tax rate for solar panels.[149]

IMPACT ON INSURERS

The Mediterranean is forecast to experience the most drying among 26 worldwide regions, and Portugal is at the epicentre. The increasingly severe flooding, droughts and wildfires are already having a detrimental effect on residents, agriculture and the overall economy.

Going forward, climate change is forecast to hurt the productivity of Portugal's crops, particularly grapes and olives, as well as significantly decrease the value of farmland. Temperature increases are also expected to negatively impact tourism and human health.[150]

OUTLOOK FOR THE FUTURE

Portugal has witnessed an increase in the frequency of drought over the past 20 to 30 years, with lower rainfall and higher temperatures. Unfortunately, the future looks no better, as experts expect the country to see a further drop in average annual rainfall of 20% to 40% by 2100.[151]

Meanwhile, rising sea levels will lead to coastal flooding and erosion affecting Portugal's biodiversity, infrastructure, food system, human health and overall economy. The greatest impact will be felt in the areas around the Sado and Tagus estuaries, the Ria de Aveiro and the Ria Formosa coastal lagoons.[152]

Spain

2022 EXTREME WEATHER EVENTS

During 2022, heat-related events in Spain increased in severity compared to previous years, with 2022 heat waves ranking as some of the most intense on record. The most severe heat waves were in June and July:

- A major heat wave in June lasted eight days and temperatures reached up to 42°C in southern areas including Seville.[153]
- July was the warmest month of the year with temperatures reaching 2.7°C higher than the average of all previous Julys on record. The July heat wave lasted 17 days and was caused by a mass of hot air that originated in Africa.[154]

[147] Portugal.com (24 February 2022). Portugal facing extreme drought. Retrieved 28 February 2023 from https://www.portugal.com/news/ ortugal-facing-extreme-drought/#:~:text=The%20month%20of%20January%202022%20was%20the%20second-dryest,the%20wider%20issue%20of%20climate%20change%20worsens%20globally.

[148] US News and World Report (25 August 2022). Portugal's Drought Prompts Water Price Rise, Street-Cleaning Ban. Retrieved 28 February 2023 from https://www.usnews.com/news/world/articles/2022-08-25/portugals-drought-prompts-water-price-rise-street-cleaning-ban.

[149] Portugal.com (10 August 2022). Climate Change: Impact on Portugal. Retrieved 28 February 2023 from https://www.portugal.com/science/climate-change-impact-on-portugal/.

[150] Ibid.

[151] Insurance Journal (14 February 2022). Drought in Spain and Portugal Empties Reservoirs, Ruins Crops. Retrieved 28 February 2023 from https://www.insurancejournal.com/news/international/2022/02/14/653931.htm.

[152] Portugal.com (10 August 2022), op cit.

[153] AEMet (June 2022). Informe Mensual Climatologico. Retrieved 28 February 2023 from https://www.aemet.es/documentos/es/serviciosclimaticos/vigilancia_clima/resumenes_climat/mensuales/2022/res_mens_clim_2022_06.pdf.

[154] AEMet (July 2022). Informe Mensual Climatologico. Retrieved on March 3, 2023 from https://www.aemet.es/documentos/es/serviciosclimaticos/vigilancia_clima/resumenes_climat/mensuales/2022/res_mens_clim_2022_07.pdf

Additional extreme weather events include:

- Spain suffered from its most devastating fire season in over a decade. In 2022, more than 306,000 hectares (756,000 acres) were lost to wildfires, which was more than three times as much as 2021.[155] By 6 August, Spain accounted for almost 40% of the total hectares burned in the EU, with 236,575 hectares (584,000 acres) of the total 600,731 hectares (1.4 million acres) burned, according to data from the EFFIS.[156]
- From January through April, the temperature fluctuated between periods of cold weather and much warmer temperatures, creating big temperature differences within short time intervals.[157]
- Except for March, which had intense rainfall, the rest of the year was very dry, with January and February at 26% and 21% of the monthly rainfall averages respectively.[158]

HUMAN LOSS

Summer 2022 intense heat waves and high temperatures caused human fatalities in Spain. The Institute of Health Carlos III estimates the number of heat-related deaths based on the number of excess deaths compared to the previous years' average, as shown in Figure 11.[159] The 2022 model attributes over 4,700 fatalities to extreme heat through August, and of these about 3,800 fatalities occurred during July and August. According to the model, the total number of temperature-related fatalities in Spain during 2022 was 5,778.[160] However, some of these deaths might also be attributed to untreated illnesses and the difficulties associated with accessing medical care during COVID-19.

FIGURE 11: REPORTED TEMPERATURE-ATTRIBUTABLE MORTALITY

Period	0-14	15-44	45-64	65-74	75-84	>= 85	Total
Jun	4	6	28	65	185	529	830
Jul	10	20	90	191	509	1417	2223
Aug	8	14	77	178	366	1032	1610
Sep	0	1	7	7	15	38	63
2022 Total	22	41	202	441	1075	3016	4726

ECONOMIC IMPACT

The winter drought devastated crops in Spain. About half of all Spanish farms were considered at risk due to record low rainfall attributed to climate change. Grains, olives, nuts and vineyards risked losing 6% to 8% of their production, which spurred the Spanish government to commit to spending about EUR 570 million to improve irrigation.[161]

IMPACT ON INSURERS

Agrarian activity co-insured by the Insurance Consortium includes natural phenomena (hail, frost, fires, forest fires and livestock illnesses). Figure 12 shows volatile ratios from 2017 to 2021. Although it is difficult to predict, 2022 ratios could be greater than 2021, due to the record-breaking number of hectares destroyed by forest fires.

[155] Statista (23 February 2023). Area burned by wildfires in Spain from 2009 to 2022. Retrieved 28 February 2023 from https://www.statista.com/statistics/1265354/area-burned-by-wildfire-in-spain/.

[156] Epdata (8 August 2022). Forest fires, in data, statistics and figures. Retrieved 28 February 2023 from https://www.epdata.es/datos/incendios-forestales-datos-estadisticas-cifras/267.

[157] AEMet (April 2022). Informe Mensual Climatologico. Retrieved 28 February 2023 from https://www.aemet.es/documentos/es/serviciosclimaticos/vigilancia_clima/resumenes_climat/mensuales/2022/res_mens_clim_2022_04.pdf.

[158] AEMet (Spring 2022). Resumen Estacional Climatologico. Retrieved 28 February 2023 from https://www.aemet.es/documentos/es/serviciosclimaticos/vigilancia_clima/resumenes_climat/estacionales/2022/Est_primavera_22.pdf.

[159] Phys.org (20 July 2022). Europe counts cost of heatwave as Spain PM says more than 500 died. Retrieved 28 February 2023 from https://phys.org/news/2022-07-europe-heatwave-spain-pm-died.html.

[160] Momo. Reported, observed, expected, and temperature-attributable mortality. Retrieved 28 February 2023 from https://momo.isciii.es/panel_momo/.

[161] Spain in English (15 February 2022) Climate change blamed as winter drought devastates crops in Spain. Retrieved 28 February 2023 from https://www.spainenglish.com/2022/02/15/climate-change-blamed-winter-drought-devastates-crops-spain/#:~:text=%E2%80%94%20Emilio%20Morenatti%20%28%40EmilioMorenatti%29%20February%2013%2C%202022%20Around,of%20their%20production%2C%20Spanish%20farming%20orga

FIGURE 12: AGRARIAN ACTIVITY INSURED BY THE INSURANCE CONSORTIUM[162]

Agrarian Activity	Claims Ratio	Combined Ratio
2021	125.0%	133.4%
2020	44.6%	53.0%
2019	73.7%	82.0%
2018	126.0%	134.4%
2017	193.6%	202.3%

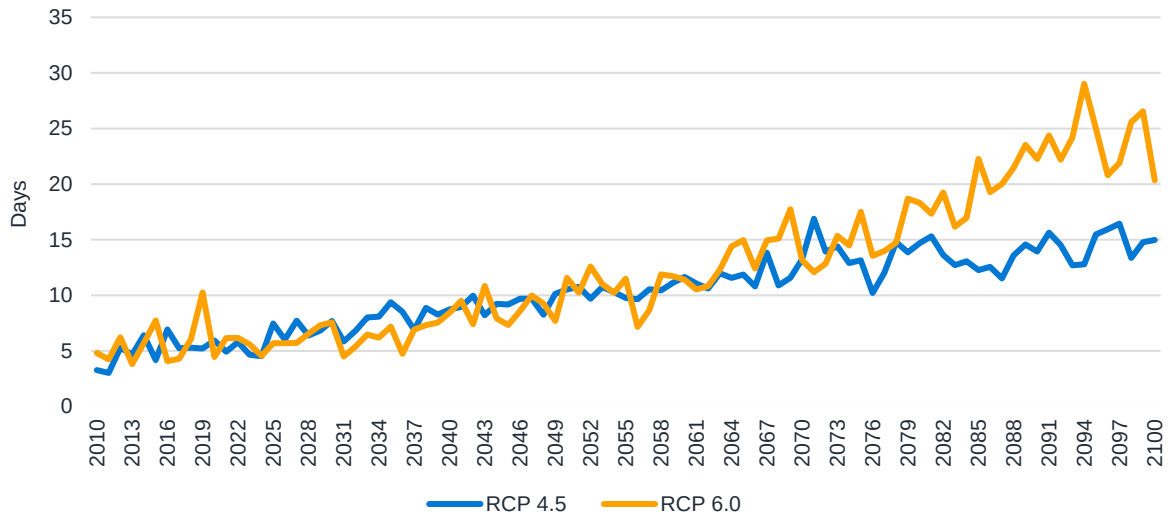
Temperature increases in Spain, along with drought and wildfires, have the potential to negatively impact human health, crop productivity and tourism, and damage homes, properties, infrastructure and motor vehicles.

OUTLOOK FOR THE FUTURE

The impact of temperature changes has had an intense effect on heat waves and cold weather episodes in Spain. The Spanish meteorology agency recently published predictions for how heat waves are expected to continue evolving. While the typical duration of a heat wave is approximately five days, Spain experienced a heat wave that lasted 17 days in 2022. The average duration is expected to double by 2050, which would have a big impact on fatalities due to excessive temperatures. The two models represented in the Representative Concentration Pathways (RCP) graph in Figure 13 take expected emissions produced during future years into account:

- RCP 4.5 depicts heat wave duration days in a medium-range future emissions scenario where emissions caused by human activity are limited.
- RCP 6.0 depicts heat wave duration days in a future emissions scenario where there are more emissions caused by human activity than in RCP 4.5.[163]

FIGURE 13: CHANGE IN HEAT WAVE DURATION DAYS IN SPAIN 2010-2100[164]



[162] Consorcio de Compensacion de Seguros. 2021 Annual Report. Retrieved 28 February 2023 from https://www.consorseguros.es/web/documents/10184/121530/INFORME_ANUAL_2021_CCS.pdf/232f76d4-7cec-4818-ab5f-6299af60d37a.

[163] AEMet. Interpretation: Graphical results of regionalised climate change projections. Retrieved 28 February 2023 from https://www.aemet.es/es/serviciosclimaticos/cambio_climat/result_graficos/ayuda.

[164] AEMet. AR5-IPCC regionalisation. Evolution graphs. Similar statistical regionalisation. Mainland Spain. Retrieved 28 February 2023 from https://www.aemet.es/es/serviciosclimaticos/cambio_climat/result_graficos?opc4=0&opc1=Espan&opc6=0.

United Kingdom

2022 EXTREME WEATHER EVENTS

Winter storms

The UK was hit by three named storms between 16 and 21 February 2022:

- Storm Dudley left thousands of homes without power in Cumbria, Yorkshire and Lancashire.[165]
- Storm Eunice was more powerful, and caused the Met Office to issue two rare red weather warnings, meaning a "danger to life," in southwest England, south Wales and the east of England, including London. The impact of the worst winds in 30 years left 1.4 million homes without power, caused widespread travel disruption and tore a hole off the roof of London's O2 Arena.[166]
- Storm Franklin brought heavy rainfall that caused rivers to rise and flooded hundreds of homes in England and Wales. Although rivers were at record high levels, however, more than 40,000 properties were saved by flood defences.[167]

Summer heat waves and drought

According to the Met Office, July 2022 was the driest July in England since 1935 and the driest July ever for southeast and southern England and East Anglia. The UK saw just 56% of its average July rainfall (46.3 mm), the lowest since 1999, which saw 46.1 mm. All months, except for February, were drier than average through July 2022.[168]

Summer temperatures in the UK broke records between 18 and 19 July 2022:

- A new record daily maximum high of 40.3°C was recorded on 19 July 2022 at Coningsby, Lincolnshire, surpassing the previous high point by 1.6°C.
- Across the UK, readings at 46 weather stations surpassed the previous UK record high of 38.7°C. Many stations with century-old records saw their highest-ever temperature, some by margins of 3°C to 4°C.
- Overnight heat exceeded records, too, as Kenley Airfield, in Greater London, saw a new highest minimum temperature of 25.8°C, nearly 2°C higher than the mark recorded in 1990.

The heat caused the Met Office to issue its longest-range amber extreme weather warning ever, with a lead time of six days, which cautions against temperatures so high that "fit and healthy" people, not only individuals at high risk, could face illness or even death. Then the Met Office announced its first ever *red* extreme weather warning, noting heat that is likely so severe it could cause serious illness or danger to life.

Of the 30 hottest days on record in the UK, 14 occurred over the past 100 years. Although five of those days were during the infamous summer of 1976, the heat then was much less intense than in 2022.[169] World Weather Attribution analysis determined that greenhouse gases made the July heat at least 10 times more likely and 4°C hotter than it would have been.[170]

[165] BBC News (17 February 2022). Storm Dudley: Thousands of people lose electricity due to damage. Retrieved 28 February 2023 from https://www.bbc.com/news/uk-england-tyne-60394507.

[166] ITVX (22 February 2022). Storm Eunice 2022: The impact of the worst winds in 30 years. Retrieved 28 February 2023 from https://www.itv.com/news/2022-02-17/storm-eunice-tracker-when-will-it-hit-my-region.

[167] Floodlist (23 February 2022). UK – Hundreds of Homes Damaged After Storm Franklin Causes Rivers to Rise. Retrieved 28 February 2023 from https://floodlist.com/europe/united-kingdom/floods-storm-franklin-february-2022.

[168] Met Office (1 August 2022). Driest July in England since 1935. Retrieved 28 February 2023 from https://www.metoffice.gov.uk/about-us/press-office/news/weather-and-climate/2022/driest-july-in-england-since-1935.

[169] Met Office (22 July 2022). A milestone in UK climate history. Retrieved 28 February 2023 from https://www.metoffice.gov.uk/about-us/press-office/news/weather-and-climate/2022/july-heat-review.

[170] Insurance Journal (1 August 2022). Climate Change Made Deadly UK Heat Wave at Least 10 Times More Likely. Retrieved 28 February 2023 from https://www.insurancejournal.com/news/international/2022/08/01/678230.htm.

The combination of extremely dry ground and sweltering temperatures caused wildfires to spread on 19 July 2022.[171] Fire services declared major incidents in London, Yorkshire, Leicestershire, Hertfordshire, Suffolk and Norfolk.[172] Homes were destroyed in Barnsley, Norfolk and London, where the fire service was busier than on any day since World War II.[173] There has been a recent uptick in wildfires in the UK, with almost 30,000 hectares (74,000 acres) burnt in 2019.[174]

The days that followed the July heat wave saw some heavy rain and thunderstorms, but drought was officially declared across eight regions of England on 12 August 2022, with a ninth (Yorkshire) added a few days later.[175] By 30 August 2022, the Environmental Agency agreed that all of southwest England was in a drought.[176] Water companies banned hosepipes in many areas during August 2022.

HUMAN LOSS

Three people were killed on roads and several other people were injured by falling trees and flying debris because of storm Eunice.[177]

At least 13 people died while swimming in rivers, reservoirs and lakes during the record-breaking heat wave; seven of them were teenage boys.[178]

The London School of Hygiene & Tropical Medicine attributed 950 deaths in England and Wales to July's record heat.[179] The death count for the entire summer may have exceeded the summer 2020 death count, when the stifling temperatures claimed more than 2,500 lives.[180]

ECONOMIC IMPACT

Heat waves cause positive and negative effects. Positive effects include:

- The possibility of higher economic output. For example, in 2003 high temperatures in the UK drove higher electricity use, which triggered a surge in industrial output and GDP growth.
- Higher sales of products such as ice cream and cold drinks will help some retail sectors gain revenue.
- Domestic tourism is likely to boom due to staycations.[181]
- Farmers can grow fruits that previously could not be grown to a commercially viable level in the UK.[182]

[171] Love Exploring. Dramatic weather events from 1900 to today. Retrieved 28 February 2023 from https://www.loveexploring.com/gallerylist/84422/dramatic-weather-events-from-1900-to-today.

[172] iNews (21 July 2022). Households hit by heatwave fires must turn to insurance firms to rebuild homes and lives. Retrieved 28 February 2023 from https://inews.co.uk/news/households-heatwave-fires-insurance-firms-rebuild-homes-1753139.

[173] Insurance Journal (1 August 2022), op cit.

[174] Financial Times (14 July 2022). The British think heatwaves are fun—not for much longer. Retrieved 28 February 2023 from https://www.ft.com/content/8262c541-7206-4eef-8cad-65599d524ee2 (subscription required).

[175] The Guardian (19 August 2022). Why are some areas of the UK in a drought? Retrieved 28 February 2023 from https://www.theguardian.com/environment/2022/aug/19/why-areas-uk-drought-visual-guide.

[176] GOV.UK (30 August 2022). All of England's South West region now in drought. Retrieved 28 February 2023 from https://www.gov.uk/government/news/all-of-england-s-south-west-region-now-in-drought.

[177] BBC News (17 February 2022). As it happened: Deaths and damage as Storm Eunice causes havoc. Retrieved 28 February 2023 from https://www.bbc.com/news/live/uk-60421388.

[178] Reuters (20 July 2022). Britain counts cost of historic heatwave as 13 die. Retrieved 28 February 2023 from https://www.reuters.com/world/uk/britain-counts-cost-hottest-day-ever-2022-07-20/.

[179] Mirror (11 August 2022). Wildfire threats in parts of the UK as fears raised heatwave may have killed 950 people. Retrieved 28 February 2023 from https://www.mirror.co.uk/news/uk-news/wildfire-threats-parts-uk-fears-27719922.

[180] World Economic Forum (21 July 2022). 5 things to know about Europe's scorching heatwave. Retrieved 28 February 2023 from https://www.weforum.org/agenda/2022/07/heatwaves-europe-climate-change/.

[181] RTE News (5 July 2018). The economics of a heatwave. Retrieved 28 February 2023 from https://www.rte.ie/brainstorm/2018/0704/976340-the-economics-of-a-heatwave/.

[182] The Guardian (1 August 2022). UK farmers count cost as heatwave kills fruit and vegetable crops. Retrieved 28 February 2023 from https://www.theguardian.com/environment/2022/aug/01/uk-farmers-count-cost-as-heatwave-kills-fruit-and-vegetable-crops.

However, heat waves cause many negative effects:

- When temperatures reached 40°C, roads started melting and rails buckled. Passengers were advised to stay at home and only travel if necessary. Train services were slashed or slowed significantly to ensure safety. On 19 July, Luton Airport closed its runway due to the pavement buckling, resulting in diverted or cancelled flights.[183]
- The heat wave caused fruits and vegetables to die on the vine, resulting in lower yields. Suppliers and supermarkets were not financially impacted by these losses because they already signed contracts with the growers, but farmers were hit financially. The dry weather also severely hampered grass growth, which could impact winter 2023 feed supplies and increase costs to livestock farming businesses, at a time when costs are already significantly increasing due to inflation.[184]
- Employee productivity may decline in the heat. During the 2003 heat wave, the Centre for Business Research determined that, if temperatures rose above 38°C, productivity would drop 62%.[185]
- New homes may not be able to withstand rising temperatures, forcing residents without homeowners insurance to look for government assistance. UK insurer Aviva estimates that almost 600,000 homes built in England since 2016 would not survive future heat waves.[186]

IMPACT ON INSURERS

During 2021, floods, storms and other weather events caused 27% of all home insurance claims, according to analytics agency GlobalData. Meanwhile, the Association of British Insurers (ABI) found that domestic property claims for weather-related incidents more than doubled from 2019 to 2020.[187]

According to the ABI, the February 2022 storm damage will likely cause insurers to pay out almost GBP 500 million across 177,000 claims, including almost 170,000 claims related to property damage worth GBP 473 million.[188]

In addition, insurance companies experienced a surge in subsidence claims after the 2022 summer's hot weather caused cracks to appear in thousands of homes across London and the southeast.[189]

- LV=GI, one of the main homeowners insurance companies in the UK, covering 2.4 million homes, received GBP 1.2 million in claims after the July heat wave. Most were due to fires that began in open fields and spread to their policyholders' properties. Some burned fences, decks and garages, but 8% of claims involved a total home loss. Between June and July 2022, LV=GI saw a 205% increase in subsidence cases. If the August heat is factored in, subsidence claims may rise an amount similar to 2018 levels, when claims increased 51% due to exceptionally hot weather.[190]
- Aviva, which insures 2.9 million or just over 10% of UK households, received more customer queries regarding subsidence following the hot weather.[191]

[183] ITVX (20 July 2022). UK heatwave: Why can't roads and rail cope with the extreme heat? Retrieved 28 February 2023 from https://www.itv.com/news/anglia/2022-07-19/why-cant-uk-roads-and-rail-cope-with-the-heat.

[184] The Guardian (1 August 2022), op cit.

[185] RTE News (5 July 2018), op cit.

[186] iNews (21 July 2022), op cit.

[187] Life Insurance International (28 February 2022). Week of storms reinforces climate change risk as 27% of household claims relate to weather incidents. Retrieved 28 February 2023 from https://www.lifeinsuranceinternational.com/analysis/week-of-storms-reinforces-climate-change-risk-as-27-of-household-claims-relate-to-weather-incidents/.

[188] ABI (29 April 2022). Insurers expect to pay out nearly £500 million to support customers hit by damage from Storms Dudley, Eunice and Franklin. Retrieved 28 February 2023 from https://www.abi.org.uk/news/news-articles/2022/04/insurers-expect-to-pay-out-nearly-500-million-to-support-customers-hit-by--damage-from/.

[189] Financial Times (19 August 2022). Heatwave leads to surge in housing subsidence claims across southern England. Retrieved 28 February 2023 from https://www.ft.com/content/e2dd1e47-254c-43fe-8c86-0c6b52be5c21 (subscription required).

[190] The Guardian (10 August 2022). UK fire and subsidence claims will rise due to extreme heat, says insurer. Retrieved 28 February 2023 from https://www.theguardian.com/business/2022/aug/10/uk-fire-subsidence-claims-extreme-heat-insurer-lv-gi.

[191] Financial Times (19 August 2022), op cit.

- Sedgwick, UK's largest loss adjuster, registered a surge event on 15 August 2022, citing that subsidence claims it received from insurers over two weeks were more than 200% above normal levels. Sedgwick expected claims to increase to 400% over ordinary levels in the following few weeks.
- 2022 could prove to be worse than 2018, when 23,000 claims were made across the industry, amounting to a bill of GBP 145 million.[192]

When insurers assess high temperatures as a hazard, they should recognise two distinct types of heat: drought heat and humid heat.

- Drought heat leads to a water deficit that can kill trees and crops, shrink clay soils, and displace shallow building foundations, with 11% of UK properties expected to experience subsidence by 2070. Drought and heat together also significantly increase wildfire risk.
- Humid heat, which occurs when high humidity accompanies high temperatures, is the most dangerous to humans because it compromises the ability of perspiration to have a cooling effect. Humid heat may increasingly be covered by cancellation insurance for outdoor events when temperatures are dangerously high.[193]

SUMMARY OF 2021 EXTREME WEATHER EVENTS

Storm Christoph brought strong winds, heavy rain and snow to the UK between 19 and 21 January 2021 and estimated losses range between GBP 80 million and GBP 120 million.[194] Storm Darcy brought some strong winds and heavy snow to parts of southeast England on 7 February, while persistent snow showers resulted in significant accumulations across eastern England and Scotland. In the wake of the snowstorm, Braemar recorded -23°C on 12 February, the lowest temperature in the UK since 1995.[195]

Unusual July 2021 flooding resulted from several isolated days of intense rainfall across East and Southeast England. Londoners saw their homes "wrecked" and belongings "destroyed" after the July 2021 flash floods overflowed the capital's roads and poured into properties. Damage to businesses, infrastructure and residential buildings was estimated in the millions of pounds after a month's worth of rain fell in just over an hour.[196] Aggregate insured losses from the 2021 July floods are estimated at more than GBP 100 million.[197,198]

OUTLOOK FOR THE FUTURE

A recent Met Office study shows that even if greenhouse gas emissions are halved in the second half of the 21st century in line with current pledges, extreme heat will become more common in the UK and, by 2090, UK temperatures will exceed 40°C about once every decade.[199]

[192] Ibid.

[193] Moody's (22 July 2022). Two Types of Heat and Their Insurance Implications. Retrieved 28 February 2023 from https://rms.com/blog/2022/07/22/two-types-of-heat-and-their-insurance-implications.

[194] Insurance Business (25 January 2021). Revealed: Estimated insurance losses from Storm Christoph. Retrieved 28 February 2023 from https://www.insurancebusinessmag.com/uk/news/breaking-news/revealed-estimated-insurance-losses-from-storm-christoph-244464.aspx.

[195] Met Office. Severe winter weather and storm Darcy, February 2021. Retrieved 28 February 2023 from https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2021/2021_02_low_temperatures.pdf.

[196] Metro (13 July 2021). London floods cause millions in damage after "biblical" storms hit city. Retrieved 28 February 2023 from https://metro.co.uk/2021/07/13/tube-lines-suspended-after-flash-flooding-in-london-14919615/.

[197] JBA Risk Management. A Retrospective Look at London Surface Water Flash Floods. Retrieved 28 February 2023 from https://www.jbarisk.com/flood-services/event-response/a-retrospective-look-at-summer-2021-london-flash-floods/.

[198] PERILS. Facilitating Risk Transfer: Losses. Retrieved 28 February 2023 from https://www.perils.org/losses.

[199] Financial Times (14 July 2022), op cit.

The UK has the capacity and resources to adapt to warmer temperatures. But beyond adopting zero-carbon technologies, it requires adapting existing infrastructure.[200] Over the past decade, little work has been done to address the risk of infrastructure damage and overheating in buildings. The country remains ill-equipped to cope with extended heat waves:

- Currently 20% of existing infrastructure in the UK is at risk of overheating, and this will rise as average temperatures continue to increase.
- The infrastructure most at risk is rail, water and electricity, which will have significant impact on public life as heat waves intensify in the UK.[201]
- Small, modern houses with poor insulation will trap heat and kill thousands of residents each summer by 2050.[202]

2023 actionable steps for insurers

European insurers and reinsurers are uniquely positioned to leverage their expertise and data analytics capabilities to manage the financial risks associated with extreme weather events and climate change and help mitigate the impacts. It is business-critical for insurers to take a leading role in not only managing these risks, but also in supporting adaptation and prevention. The following actionable steps for insurers have been notably identified.

LEVERAGE OPEN DATA TO BETTER UNDERSTAND CLIMATE RISKS

Open data, which is readily available and can be used by anyone, has many benefits for insurers to enrich their knowledge of climate change risk and can be a helpful tool for risk mapping, monitoring and predictions. The Milliman white paper, "Les apports de l'open data pour les assureurs," provides more detail about these methods.

On 12 November 2022, the Global Resilience Index Initiative (GRII) announced that it will provide open reference data, metrics and projections for all countries. This is a key milestone in developing an open, standard set of climate metrics and data for measuring the risk to ecosystems, infrastructure and people, which will foster climate resilience and adaptation and mobilise the significant economic investment required for this effort.

Additionally, GRII launched the Global Systemic Risk Assessment Tool (G-SRAT) demonstrator at the 2022 United Nations Climate Change Conference (COP27). The tool displays risk from climate hazards at a global scale, and includes data on hazards, vulnerability and exposure under different future climate scenarios.[203] Open data and geomatics make it easier to measure and represent climatic phenomena. For example:

- The exposure of water-sensitive clay to subsidence can be determined using soil analysis data.
- For underwriting, open data enables insurers to know different risks at fine geographic scale, so insurers can adjust their offers to their desired levels of risk.

Monitoring climate risk can also take the form of decision support tools such as dashboards and key performance indicators that make it possible to understand a peril's consequences. For example, Milliman consultants recently worked with an open database of French industrial facilities to map and understand flood risk in the Paris region by leveraging risk data, specifically expert geographical and hydrological data. This data was associated with a return period for each risk category, from low to high. Using two open databases, we mapped the geographic position for about 30% of all industrial facilities in the Paris region to represent a dummy insurer portfolio.[204,205]

[200] World Economic Forum (22 July 2022). Climate change: Can water, rail and electricity systems cope with rising temperatures? Retrieved 28 February 2023 from https://www.weforum.org/agenda/2022/07/united-kingdom-climate-change-infrastructure-britain-heatwave/#:~:text=Currently%2C%2020%25%20of%20existing%20infrastructure,heatwaves%20intensify%20in%20the%20UK.

[201] Ibid.

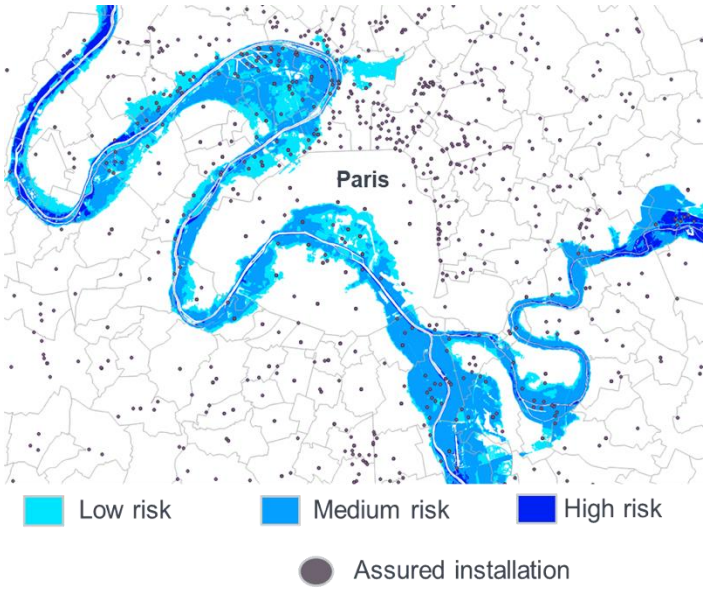
[202] The Guardian (30 July 2022). 'Soon the world will be unrecognisable': Is it still possible to prevent total climate meltdown? Retrieved 28 February 2023 from https://www.theguardian.com/environment/2022/jul/30/total-climate-meltdown-inevitable-heatwaves-global-catastrophe.

[203] Insurance Development Forum (12 November 2022) COP27: Global Resilience Index Initiative (GRII) launches Demonstrator. Retrieved 28 February 2023 from https://www.insdevforum.org/grii-cop27/.

[204] Ministry of Ecological Transition and Territorial Cohesion. Industrial facilities. Retrieved 28 February 2023 from https://www.georisques.gouv.fr/donnees/bases-de-donnees/installations-industrielles.

[205] Ministry of Ecological Transition and Territorial Cohesion. Flood zoning – Report 2020. Retrieved 28 February 2023 from https://www.georisques.gouv.fr/donnees/bases-de-donnees/zonages-inondation-rapportage-2020, September 2022.

FIGURE 14: MAPPING FLOOD RISK IN PARIS



Finally, we used geographic information system (GIS) tools to compute spatial analysis to associate each installation with a risk and evaluate the risk of the insurer portfolio. Each time a new installation is insured, the insurer can use the dashboard to follow the evolution of his portfolio and monitor the firm's risk appetite for underwriting.

FIGURE 15: MAPPING INSTALLATION RISKS

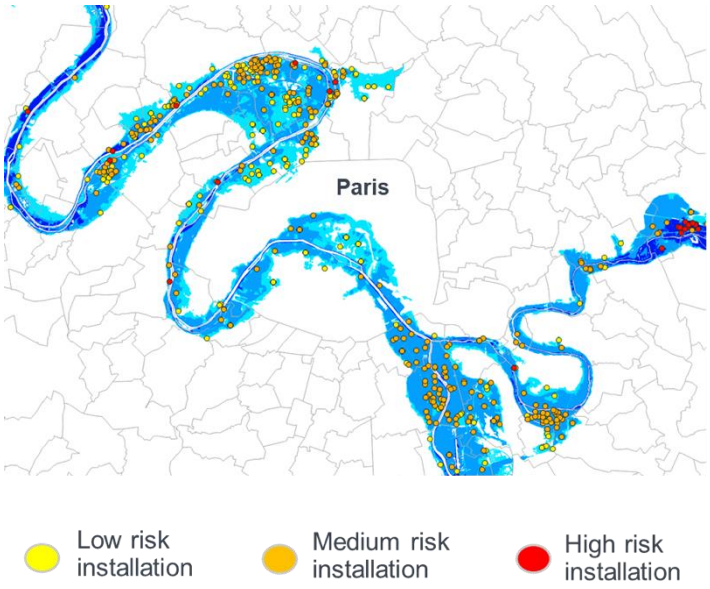
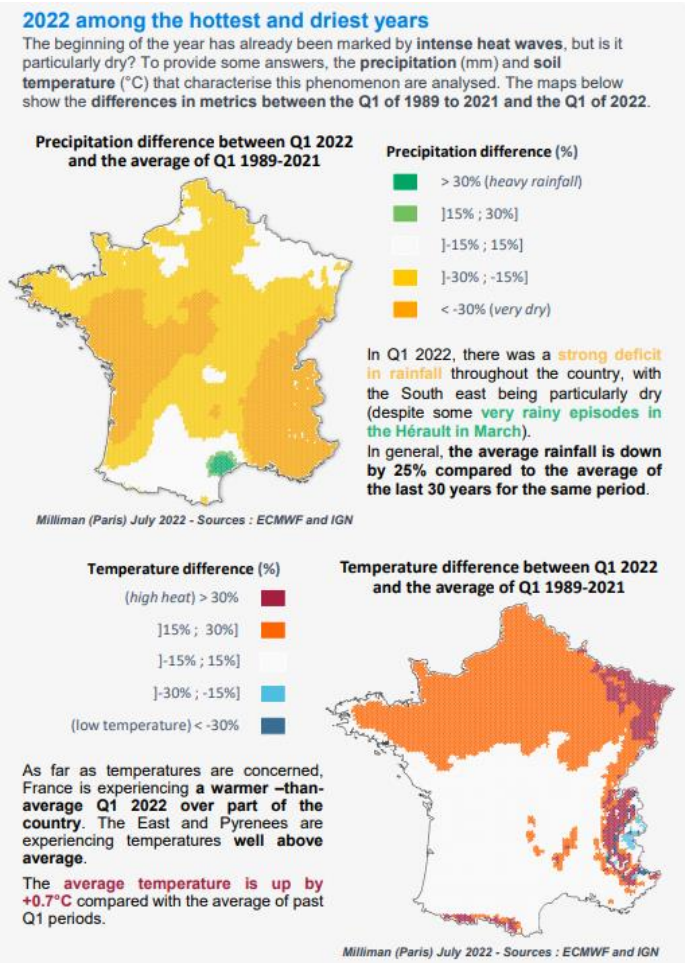


Figure 16, from the paper, "Drought 2022 – Analysis of subsidence risk in France," shows how open data can be used to map subsidence risk.

FIGURE 16: ANALYSIS OF SUBSIDENCE RISK IN FRANCE

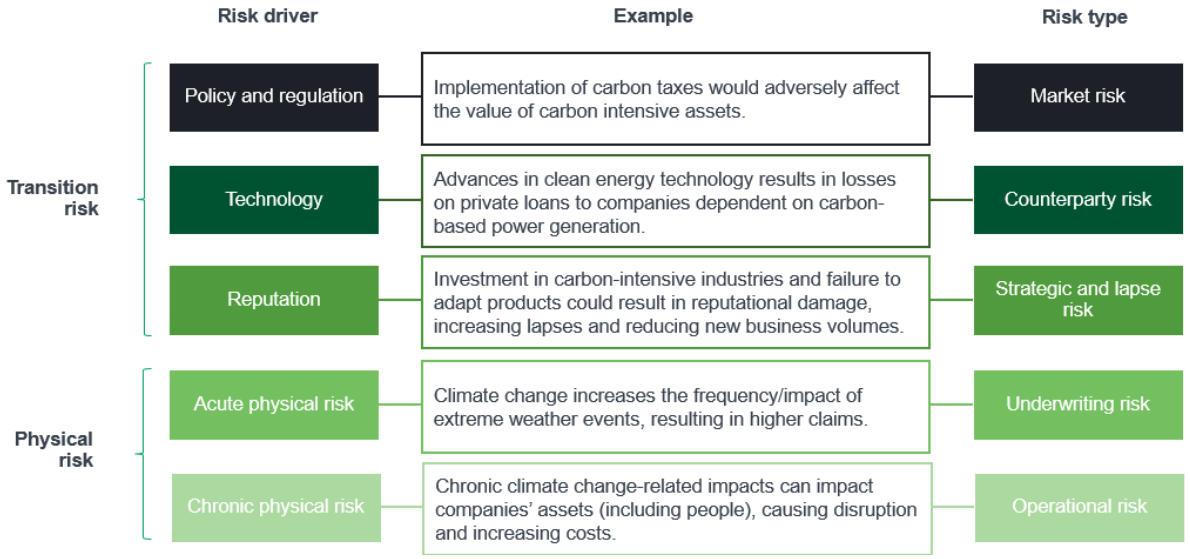


INCORPORATE CLIMATE CHANGE RISK STRESS AND SCENARIO TESTING

Climate change scenario analysis activity is a powerful tool that enables insurers to understand the potential impacts of climate change on their business and respond accordingly. Such activity may also present insurers with opportunities through identifying potential new product or service areas or enabling them to ascertain which companies would be expected to fare well in the transition to a net-zero economy. As stress and scenario testing develops and evolves, we anticipate that understanding of climate change-related risks will rapidly improve.

Firms typically start their climate change stress and scenario testing journey by identifying how their existing key risks are impacted by climate change. The diagram in Figure 17 shows some examples of how climate-related risks may map to existing, common risk types for insurers.

FIGURE 17: EXAMPLES OF MAPPING CLIMATE RISKS TO COMMON INSURANCE RISKS



Firms can consider each of the different risk types in more depth. For example, for underwriting risk it would be useful for firms to consider the key root causes and drivers of claims and premiums across multiple time horizons and across physical, transition and liability risks. This will vary depending on the type of insurance contracts offered. Extreme weather events and changing climate conditions impact the frequency and severity of claims, while government policy responses, customer operational policy responses (such as changes to business travel policies for employees) and shifts in customer demand may impact premiums and claims from a transition risk point of view.

The Milliman paper "Climate change risk stress and scenario testing" covers current market practices, resources for developing climate change risk scenario frameworks, common challenges firms face with respect to climate change risk, best practice examples and a case study demonstrating a potential future development that makes stress and scenario testing more thorough and sophisticated.[206]

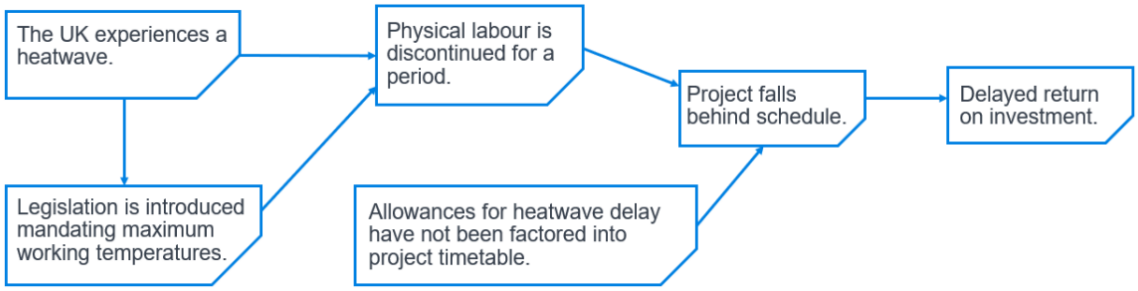
USE CAUSAL MODELLING TO CONSIDER CLIMATE RISK AND ASSET RETURNS

Climate change is undoubtedly one of the defining risks of our time and foreseeable future. The challenge of modelling is clearly very topical, as expected climate risks and impacts already feature in investment decisions, and their influence is expected to grow as data, analysis and understanding develops. As a decision support tool, causal modelling can help insurers get a better frame of reference and appreciate the dynamics of a complex problem like climate change.

Causal modelling makes use of expert judgement about the composition of a problem to develop a picture of the risk using structured and unstructured data. This "picture" typically captures the causal links between the understood elements of cause and effect to create a nonlinear model of the problem. The result is a model which describes multiple risk outcomes through a series or chain of events. Consider the simplified example in Figure 18, where a heat wave could impact returns on an infrastructure project. Legislature, however, has the potential to amplify the risk outcomes.

[206] Milliman (December 2022). Climate change risk stress and scenario testing. Retrieved 28 February 2023 from https://uk.milliman.com/en-gb/insight/climate-change-risk-stress-and-scenario-testing.

FIGURE 18: SIMPLIFIED EXAMPLE OF A CAUSAL CLIMATE PROBLEM



As a decision support tool, causal modelling should help insurers get a feel for the specific challenges posed to their business models and their key drivers and then help explore potential mitigating solutions based on the available information. The paper "Causal modelling: A possible application considering climate risk and asset returns" explains this topic, discusses climate implications for asset returns and presents an illustrative model that shows how climate influences are likely to reduce expected future investment returns and increase risk as measured by return volatility.[207]

DEVELOP CLIMATE RISK SCENARIOS FOR SOLVENCY II ORSA

Developing scenarios for climate risks for the ORSA will become an important requirement for the industry. European insurers will be required to identify material climate change risks that affect their business and integrate these risks into their system of governance, risk management and ORSA. In August 2022, the European Insurance and Occupational Pensions Authority (EIOPA) published application guidance which presents a lot of interesting material on how such scenarios should be constructed and explicitly states that companies could simply reuse the shocks from other climate-risk-related stress testing exercises.

Climate risk for financial institutions includes two basic risk types: physical climate risk, which arises from the direct impact of climate change, and transition climate risk, which can arise from the process of adjustment to a low-carbon economy. Transition risks are likely to materialise over the short to medium term on the asset side of balance sheets. Figure 19 shows the drivers of transition risk.

FIGURE 19: DRIVERS OF TRANSITION RISK

POLICY	TECHNOLOGY	LITIGATION	MARKET SENTIMENT AND REPUTATION
▪ Carbon tax ▪ Emission reduction targets ▪ Restrictions on coal usage ▪ Mandates on renewable energies	▪ Advances in clean technology ▪ Replacement of existing products and services by lower-emission technologies ▪ Displacement of older technologies	▪ Increased litigation against companies failing to adapt	▪ Changing consumer preferences ▪ Business re-evaluations

[207] Milliman (October 2022). Causal modelling: A possible application considering climate risk and asset returns. Retrieved 28 February 2023 from https://us.milliman.com/en/insight/Causal-modelling-climate-risk-asset-returns.

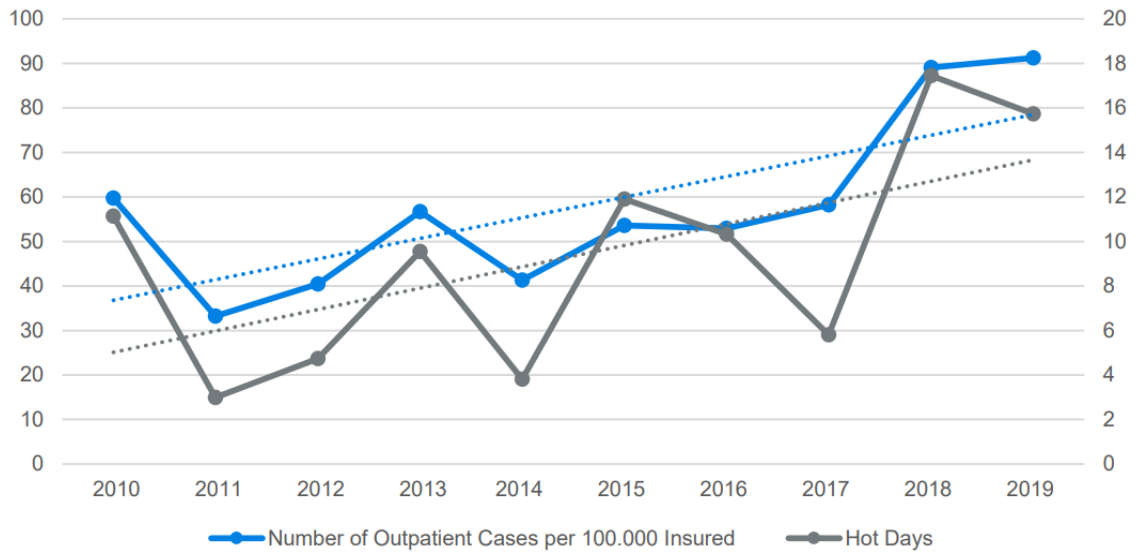
”Scientific” calibration of asset shocks could be a big challenge for all insurance companies, and it seems that regulators expect that initial ORSA stress tests will be explorative by nature while market best practice emerges. For more on this topic, see “Developing climate risk scenarios for Solvency II ORSA.” This paper explains the nature of transition risks, describes how to design the process and define scenarios, explores past prudential stress tests and provides a practical numerical illustration with shocks calibrated to the most recent EIOPA stress test for Institutions for Occupational Retirement Pensions (IORPs), which we understand should represent a fully legitimate approach for ORSA reporting.[208]

EXPLORE APPROACHES TO MEASURING CLIMATE CHANGE IMPACTS FOR EUROPEAN MEDICAL INSURERS

Understanding the morbidity and mortality risks from climate change can be challenging. The “cause-to-effect” path is not well-defined and historical data to assess the impact of future climate-related events is extremely limited. Nevertheless, several tools are available which can help insurers build a profile on their insured populations and identify specific risk factors for climate-related events.

The paper “Approaches to measuring climate change impacts for medical insurers” explores a conceptual framework for considering the impact of climate change on medical insurers. It presents the ways in which we could use historical data in the UK and Germany to help develop parameters for future modelling. For example, the risk of increased morbidity or mortality from climate change can be event-driven (acute) due to heat waves, floods, windstorms or wildfires, or longer-term, chronic due to shifts in climate patterns. Figure 20 shows that these changes can result in short-term spikes as well as affecting long-term trends. Both short-term and long-term effects may lead to higher claims costs.

FIGURE 20: OUTPATIENT CASES DUE TO HEAT STRESS-RELATED ILLNESS (HEAT FATIGUE, HEAT EXHAUSTION, HEAT CRAMPS AND HEAT STROKE) IN RELATION TO THE NUMBER OF HOT DAYS IN NORTH RHINE-WESTPHALIS (NRW) GERMANY[209]



[208] Milliman (October 2022). Developing climate risk scenarios for Solvency II ORSA. Retrieved 28 February 2023 from https://us.milliman.com/-/media/milliman/pdfs/2022-articles/10-12-22_developing-climate-risk-scenarios-solvency-ii-orsa.ashx.

[209] Milliman (May 2022). Approaches to measuring climate change impacts for medical insurers. Retrieved 1 March 2023 from https://us.milliman.com/en/insight/Approaches-to-measuring-climate-change-impacts-for-medical-insurers-2022.

AVOID A CRISIS OF UNINSURABILITY THAT MAY ARISE FROM CLIMATE CHANGE DISASTERS

Are all risks insurable for the right price? What about a truly uninsurable risk, for which no company can potentially profitably offer insurance? If an insurance premium is less than the expected loss loaded for expenses and profit, then ruin of the insurance company is certain over a long enough time horizon. For a risk to be insurable, its expected loss must be able to be statistically quantified, but this condition is not always satisfied. With climate change making catastrophe risk both more common and more uncertain, the insurance industry is in danger of seeing more expected losses that are so large they can't be quantified. This may result in a crisis of uninsurability.

To avert this potential crisis, insurers must first understand how and why expected losses become unquantifiable. This involves a statistical field called Extreme Value Theory, which can teach insurers how to think about extreme events. With an understanding of heavy-tailed risk, insurers may be able to mitigate some of the causes of insurance availability crises. For more on this topic, our paper "Making the uninsurable insurable" explores what the math of extreme risk can tell insurers about the insurance availability crisis, and what to do about it.[210]

For example, in France the question of uninsurability is under discussion as insurers are estimating that the costs related to natural events could increase by 500% to 600% by 2050, which would require an offsetting increase in policyholder premiums of 130% to 200%.[211] If the policyholders cannot afford to pay this increase, should the government step in to help offset the costs? Climate change should be handled through several management actions including better planning of urban and open spaces. The French government regional representatives (prefects) must identify the territories at risk and put in place, depending on the level of risk, transformation plans to limit the territory's exposure to natural risk. The actions to be implemented should be added to the local urban plan and take precedence over all other considerations. More than a third of French municipalities have a natural risk prevention plan, but these plans are mainly for flooding. Additionally, only 2,000 of 36,000 communities have a prevention plan for subsidence, which is an emerging risk.

STAY CURRENT WITH THE MILLIMAN CLIMATE RESILIENCE INITIATIVE

Building on a foundation of expertise modelling complex risks, the Milliman Climate Resilience Initiative (MCRI) unites perspectives across industry, government, academic and not-for-profit sectors to anticipate and measure the most pressing climate risks and drive effective responses. To provide comprehensive educational information on climate risk management and measurement, Milliman recently collaborated with the Society of Actuaries to develop the first Climate Risk Certification Program where participants complete six out of 10 self-paced online learning courses to achieve certification. Sign up to receive notifications about upcoming MCRI webinars and events, access the latest research and best practices and explore products and services designed for climate resilience.[212]

[210] Milliman (11 October 2022). Making the uninsurable insurable. Retrieved 1 March 2023 from https://us.milliman.com/en/insight/Making-the-uninsurable-insurable.

[211] Milliman (May 2021), op cit.

[212] Milliman. Milliman Climate Resilience Initiative. Retrieved 1 March 2023 from https://us.milliman.com/en/insurance/milliman-climate-resilience-initiative.

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CONTACT

Benelux

Tarik Aouragh
tarik.aouragh@milliman.com

Martijn van Rooijen
martijn.vanrooijen@milliman.com

Menno van Wijk
menno.vanwijk@milliman.com

France

Mohamed Benkhalfa
mohamed.benkhalfa@milliman.com

Antoine Rainaud
antoine.rainaud@milliman.com

Germany & Austria

Christoph Krischanitz
christoph.krischanitz@milliman.com

Italy

Niccolò Basetti Sani Vettori
niccolo.basetti@milliman.com

Giuseppe Semeraro
giuseppe.semeraro@milliman.com

Spain & Portugal

Eugenio Portales (Spain & Portugal)
eugenio.portales@milliman.com

José Silveiro (Spain & Portugal)
jose.silveiro@milliman.com

UK

Ian Penfold (UK)
ian.penfold@milliman.com

Anandi Shah (UK)
anandi.shah@milliman.com