

Extreme weather in Europe

The insurance industry impact of 2023 events and actionable steps for insurers to take a leading role in managing climate-related financial risks

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Anandi Shah, FIA
Ian Penfold, FIA
Menno van Wijk, AAG
Antoine Rainaud
Diana Dodu, Full Member ARA
Laura Witting, AVÖ
Arije Amara
Mohamed Benkhalifa, FIA
Francesco Pugassi
Niccolò Basetti Sani Vettori, ISOA
Jose Silveiro, IA
Valerie Lampert, IA
Monika Lis, CRSA



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Executive summary

The European insurance sector has witnessed significant transformation over the past two years, driven by escalating extreme weather events linked to climate change. In 2022, Europe grappled with a series of significant climate events including heat waves, wildfires, droughts, floods and hailstorms. The next year, 2023, set a new precedent in the global climate narrative, emerging as the warmest year on record, with a range of severe weather incidents across Europe.

This paper summarises the 2023 extreme weather events across 12 European countries and explores the short- and long-term impacts of these events on insurers, governments and citizens. It also presents immediate, actionable steps for insurers to take a leading role in managing climate-related financial risks and to help foster a more resilient, sustainable future for all.

Across Europe: Underinsurance, and a need for new risk models and risk-sharing mechanisms

In 2022, the insurance industry was already adapting to increased claims, facing higher-than-average costs and innovating insurance products to manage risks effectively. However, the demands of 2023 are calling for a more profound and immediate transformation. This necessitates the development of sophisticated risk models capable of accurately predicting and accounting for the increasing unpredictability of climate events, as presented in the Europe Overview section of this paper. Additionally, there is a pressing need for innovative insurance products tailored to emerging risks and customer

needs, particularly those that incentivise and promote sustainable practices.

Notably, the heightened frequency and unpredictability of events in 2023 intensified the pressure on reinsurance markets, leading to a significant surge in reinsurance premiums and a re-evaluation of risk-sharing mechanisms. Insurers throughout Europe are facing tightened reinsurance capacities and escalating premiums, highlighting a need to bolster their capital reserves and explore alternative risk transfer mechanisms, such as catastrophe bonds and sidecars.

The state of insurance coverage in Europe, particularly in light of escalating extreme weather events due to climate change, is a matter of growing concern. In Austria, for instance, insurance payouts have surged to approximately EUR 1 billion annually due to natural hazards. In countries like Italy, only small fractions of homes are insured against natural catastrophes, leaving the government to shoulder the costs associated with post-disaster relief. This underinsurance leads to delays in rebuilding efforts and contributes to business closures and property



Violent storms in the UK were among the 2023 extreme weather events.



abandonment. Similarly, other European countries have seen gaps in insurance coverage due to extreme weather events, prompting governments and insurers to develop strategies to mitigate these risks and ensure adequate protection for citizens and businesses.

In 2023, Europe's agricultural sector faced significant losses due to climate change impacts, particularly in countries like Austria, Italy, Luxembourg, Poland, Portugal and Spain, with Spain recording historic drought-related insurance claims. These scenarios underscore the growing importance of insurance in agriculture as a buffer against climate-induced financial losses, highlighting the interconnectedness of climate change and agricultural sustainability in Europe. They emphasise the need for the agricultural sector to adopt more resilient and adaptive farming practices, and for the insurance industry to develop comprehensive strategies and products to mitigate the financial risks associated with the escalating impacts of climate change on agriculture.

Governmental response to the risks posed by climate change

Policy responses to these extreme weather event challenges have been diverse. In Austria, Belgium and Germany, there is an emphasis on adapting existing insurance products to better cover elemental risks. Conversely, Italy and Portugal have seen governmental interventions in reforming insurance structures and coverage, particularly for natural catastrophes. In 2023, following discussion with the French government, French insurers committed to limit the policy premium increases below inflation.

For insurers, policy advocacy emerges as another critical focus area, including actively engaging with government policymakers to influence the development of regulatory frameworks. These frameworks should facilitate industry adaptation and strengthen resilience against the multifaceted challenges created by climate-related extreme weather events.

The interplay between government actions and insurance strategies underscores the need for collaboration. National adaptation plans, climate laws and sector-specific initiatives are examples of these types of synergy. For example, collaborative efforts like these aim to bridge the protection gap, enhance public awareness and foster a culture of preparedness and resilience against floods:

- In the Netherlands, Dutch insurers are developing solutions for flood risk associated with large rivers and are considering a public-private international reinsurance pool to share the risk of such damages.
- The Belgian government and insurance sector collaborated on a one-time plan to fully compensate flood victims of 2021, exceeding the legally established ceiling for damages.
- Flood Re, a joint initiative between insurers and the UK government, was established in 2016 to make household insurance more affordable for properties in flood-prone areas.
- Under the European Union's Floods Directive, the EU provided financial assistance to Romania to help with recovery efforts after heavy rainfall triggered severe flooding that caused significant damages to homes, vehicles, infrastructure and properties.

Emerging industry trends

Additional emerging insurance industry trends include innovative products like index-linked insurance in Austria and parametric insurance in Luxembourg. These products leverage advanced technologies such as artificial intelligence (AI) and data analytics for more precise and efficient risk quantification and compensation. Strategically, insurers are increasingly recognising their role as key players in promoting sustainable practices. This shift is evident in the growing focus on reducing carbon footprints, incentivising green policies and redirecting investments away from polluting projects and toward environmentally sustainable organisations.

In summary, 2023 stands as a pivotal point for the European insurance industry, highlighting the urgent need for adaptive strategies in the face of climate change. Insurers are compelled to reevaluate and evolve their products, pricing models and risk assessments to stay resilient as well as to develop prevention programmes. Concurrently, governments are stepping up with policy interventions and regulatory reforms to bolster the sector's capacity to withstand and respond to climate-induced challenges. The industry is at a crossroads, where adaptation and innovative solutions will define its resilience and sustainability in the years ahead.



Europe overview

The world's warmest year on record was 2023. The average temperature was 1.48°C higher than the preindustrial average, the period before significant fossil fuel combustion began. This warming trend saw almost daily records being set for global air temperatures from July onwards. These consistent record-breaking temperatures are bringing the world closer to surpassing critical international climate targets.

There are concerns that 2024 could be even warmer. Scientists at the European Union's Copernicus Climate Change Service have said it is likely that the critical 1.5°C warming threshold will be crossed for the first time in the 2024 calendar year. It has already happened over a 12-month timeframe.¹ At the 2023 UN Climate Change Conference (COP28), a landmark agreement was reached when countries agreed on the need to tackle fossil fuels for the first time. Although the agreement's language was weaker than many wanted and lacked mandatory action by countries, it is hoped that this deal will help slow down the rate of global warming.^{2,3}

The weather patterns in Europe in 2023 were a study in contrasts. June saw a hot and dry climate in Northern Europe, while Southern Europe experienced cooler-than-average temperatures. However, July and August reversed these patterns; Northern Europe's climate was colder and wetter than average, while Southern Europe was gripped by extreme heat waves

and wildfires. Despite these extremes, the overall summer season was warmer than average but not record-breaking—ranking as Europe's fifth-warmest summer on record. Additionally, there were several significant flood events and localised flash flooding.⁴

The continuous rise in global CO₂ emissions since 1750⁵ has been a major contributing factor to the impact of climate changes. Many researchers identify CO₂ emissions as the primary driver of global climate change, which manifests as weather-induced hazards and substantial damages from natural catastrophes.

To get an overview of the trend of extreme weather events in Europe over the last 13 years, Milliman analysed the European Extreme Events Climate Index (E³CI)⁶ dataset, using the years 1981 to 2010 as a reference period. Our analysis considers a variety of weather-induced hazards⁷—heat stress, cold stress, drought, extreme precipitation, extreme wind, forest fire and hail.



Valencia, Spain, was one of many locations that endured extreme heat in 2023.

1 Mavrokefalidis, D. (8 February 2024). Global warming exceeds 1.5°C limit for a full year. Energy Live News. Retrieved 28 February 2024 from <https://www.energylivenews.com/2024/02/08/global-warming-exceeds-1-5c-limit-for-a-full-year/>.
 2 Poynting, M. & Rivault, E. (9 January 2024). 2023 confirmed as world's hottest year on record. BBC. Retrieved 28 February 2024 from <https://www.bbc.co.uk/news/science-environment-67861954>.
 3 Carrington, D. (9 January 2024). 2023 smashes record for world's hottest year by huge margin. The Guardian. Retrieved 28 February 2024 from <https://www.theguardian.com/environment/2024/jan/09/2023-record-world-hottest-climate-fossil-fuel>.
 4 Copernicus Climate Change Service (3 October 2023). European summer 2023: A season of contrasting extremes. Retrieved 28 February 2024 from <https://climate.copernicus.eu/european-summer-2023-season-contrasting-extremes>.
 5 Ritchie, H. & Roser, M. (January 2024). CO₂ emissions. Our World in Data. Retrieved 29 February 2024 from <https://ourworldindata.org/co2-emissions>.
 6 IFAB: The European Extreme Events Climate Index. Observe, understand and manage Climate Change. Retrieved 29 February 2024 from <https://www.ifabfoundation.org/it/e3ci/>.
 7 E3CI. European Extreme Events Climate Index: Brief notes about the input dataset and the components' definition. Retrieved 29 February 2024 from https://e3ci.dataclimate.com/img/brief_notes.pdf.



Using the E³CI dataset, we calculated the probability of exceeding the 95th percentile threshold. Assuming that all indices follow a normal standardised distribution, the sum of the distributions should follow a Gaussian distribution. The probability can be approximated by the formula:

$$p(\text{index} > t) = 1 - p(\text{index} \leq t)$$

We started from each country's index values as provided by E³CI, weighted these based on the respective country's population and obtained aggregated results at the European level with the probability of exceeding the 95th percentile threshold over time for each hazard. This is shown in Figure 1.

We also checked whether the empirical observed index was above that 95th percentile threshold. We define the odds ratio⁸ as the ratio of the average of probability of exceeding the 95th historical percentile between the year 2023 (or the 2011-2023 period) and the reference period of 1981 to 2010, also shown in Figure 1. This means that:

- Odds ratio is less than 1: Lower observed probability of exceeding the 95th percentile than reference period.
- Odds ratio is greater than 1: Higher observed probability of exceeding the 95th percentile than reference period.

FIGURE 1: PROBABILITY OF EXCEEDING 1981-2010 THRESHOLD AND ODDS RATIOS, AT EUROPE LEVEL

	YEAR	DROUGHT	HEAT STRESS	COLD STRESS	EXTREME PRECIPITATION	EXTREME WIND	FOREST FIRE	HAIL	E ³ CI
	2012	3%	50%	25%	41%	1%	58%	3%	57%
	2013	4%	34%	23%	13%	16%	18%	0%	25%
	2014	0%	42%	0%	29%	2%	1%	0%	3%
	2015	3%	63%	0%	29%	14%	25%	4%	47%
	2016	4%	46%	0%	29%	2%	14%	1%	16%
	2017	14%	41%	2%	32%	26%	37%	3%	38%
	2018	16%	61%	4%	54%	27%	64%	0%	62%
	2019	1%	65%	0%	24%	6%	51%	1%	50%
	2020	52%	60%	1%	33%	37%	67%	1%	67%
	2021	29%	51%	1%	41%	5%	18%	15%	39%
	2022	63%	72%	0%	20%	18%	70%	0%	57%
	2023	0%	68%	0%	49%	29%	54%	6%	57%
Average	1981-2010	6%	7%	6%	6%	6%	6%	4%	6%
Average	2011-2023	17%	53%	4%	30%	14%	41%	3%	43%
Odds ratio	2011-2023	2.9	8.0	0.7	5.1	2.5	6.6	0.7	7.6
Odds ratio	2023	0.1	10.2	0.0	8.3	5.1	8.8	1.5	10.1

⁸ As example, an odds ratio of 10 means that, in the year considered, the probability of observing a 95th event or more was 10 times the reference period probability.



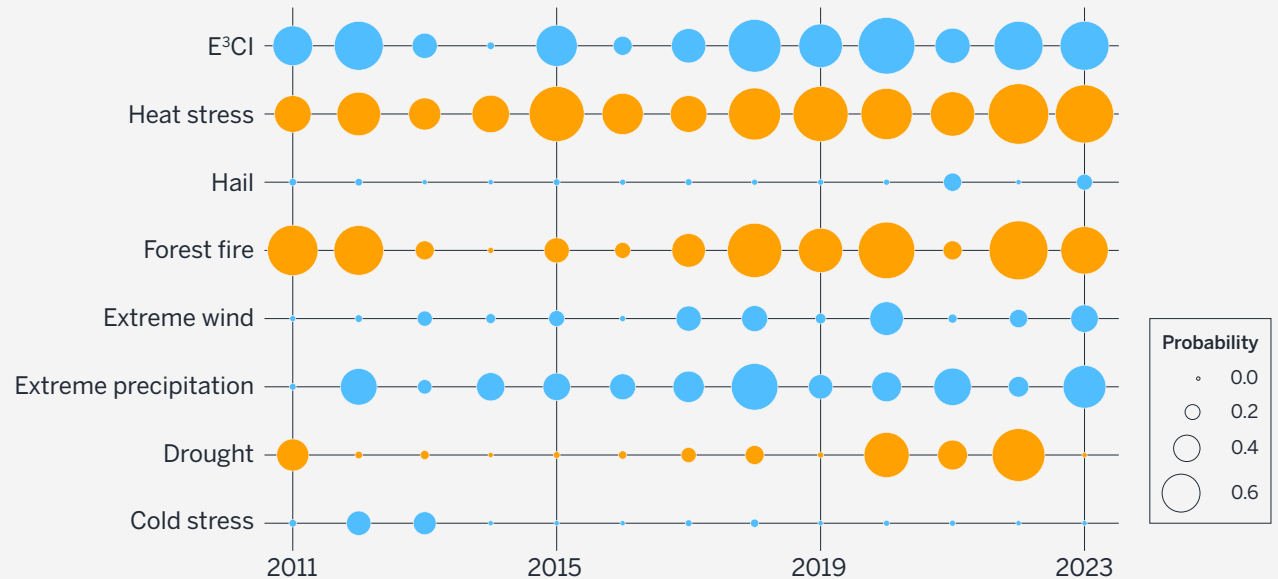
In 2023, the observed odds ratio was equal to 10.2 for heat stress (which means that extreme heat stress over the 95th percentile was 10 times more likely than what was reported in the reference period), 8.3 for extreme precipitation, 5.1 for extreme wind and 8.8 for forest fire. These values highlight that 2023 was an extreme year for Europe, but it was not an isolated case, as it aligns with a concerning trend that has been developing over recent years.

We also examined the odds ratio for the period from 2011 to 2023 for Europe. This timeframe is more robust in terms of consistency of statistical evidence, and we conclude that there is evidence of an increased frequency of extreme weather events, driven by climate change. Our findings are as follows:

1. The evidence of increased frequency is very robust for heat stress, forest fire and extreme precipitation indicators. It is almost statistically certain that observed number of events in the 2011-2023 years are deviating adversely compared to the 1981-2010 reference period.
2. The evidence of increased frequency is also robust for extreme wind and extreme drought indicators.
3. There is no statistically significant evidence of increased frequency for cold stress and hail indicators.

Figure 2 presents indices with higher variability and increasing trend due to climate change.

FIGURE 2: EXTREME INDICES TREND, 2011-2023 AT EUROPE LEVEL



Source: Milliman elaboration on IFAB data.

- **Heat stress:** Since 2012, this has consistently been over 30%, with a peak of 70% in 2022 and 68% in 2023. We can see a clear increasing trend in the period analysed.
- **Extreme wind:** In this case we clearly see two different behaviours: before and after 2017, with higher values starting from 2017.
- **Forest fire:** The trend can be explained by looking at the behaviours of heat stress, extreme precipitation and extreme wind. Increasing temperature and wind bring major fire risk, while increasing precipitation brings less fire risk. Indeed, in 2021 temperatures were less extreme, wind speed decreased, and precipitation showed a positive peak. Even forest fire shows an increasing trend from 2014, with higher variability from 2018 and peaks in 2020 and 2022.
- **Drought:** This index reports a near-zero value except in 2011, between 2016 and 2018 and between 2020 and 2022.

As we can see from Figures 1 and 2, climate change is not only resulting in increased average temperature across Europe over the years, but also in an increased probability of observing more extreme weather events. Constantly rising risks of heat waves, floods and other extreme risks could potentially lead to two main consequences: first, an urgent need to take action to mitigate or invert the trend; and second, an increasing need for governments and insurers to protect people and properties from such extreme events.

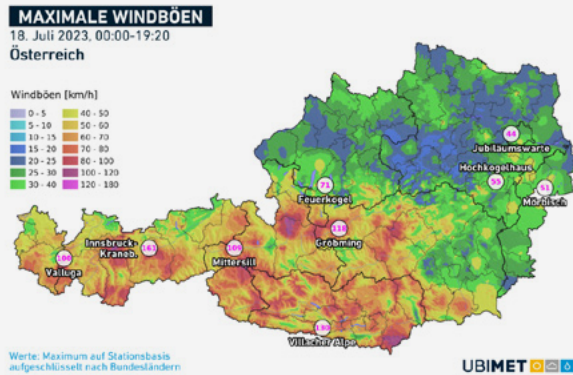


Austria

2023 EXTREME WEATHER EVENTS

Severe thunderstorms with hurricane-force winds struck Austria on 17 and 18 July, affecting the regions from Vorarlberg to Burgenland. Innsbruck Airport registered one of the peak wind speeds of up to 161 km/h during this weather event.⁹

FIGURE 3: MAXIMUM WIND SPEEDS ON 18 JULY AT THE RESPECTIVE MEASURING STATIONS



Source: Kräftige Gewitter im Westen und Süden am 18 Juli 2023 (uwz.at).

Widespread storms during 17 and 18 July occurred throughout Austria, with the highest wind speeds recorded in Tyrol, Carinthia, Upper Austria and Styria.

In Figure 3, wind speeds are depicted, ranging from low (blue) to very strong (deep purple). The regions highlighted in deep purple, situated in the western and southern parts of Austria, experienced the highest wind speeds.

- The most financially impacted regions were Carinthia, Styria and Upper Austria.
- Insurer Wiener Städtische Versicherung reported nearly EUR 30 million in losses, with significant damages predominantly in Carinthia and Styria, along with parts of Upper Austria, Lower Austria and Burgenland.¹⁰
- Austria's primary agricultural insurer, Hagelversicherung, estimated that agricultural losses exceeded EUR 9 million across Styria, Burgenland, Carinthia and Tyrol; 6,300 hectares of crops were impacted, including arable land and grasslands. Fruit and wine crops were also damaged.^{11,12}

From 3 to 5 August, heavy rainfall from the low-pressure system Zacharias primarily impacted southern Austria, especially in Styria and sections of Carinthia. This event resulted in floods and over 400 landslides in Styria,¹³ with some areas receiving up to 200 litres of rainfall per square meter within 48 hours. The total economic impact of this event surpassed EUR 110 million, with Styrian authorities receiving over 4,200 claims.¹⁴ Additionally, emergency relief funds distributed EUR 780,000. Unfortunately, one person lost his life after being swept into the Glan river¹⁵ during the deluge.

⁹ Zimmerman, N. (31 December 2023). Jahresrückblick 2023: Die markantesten Unwetter in Österreich. UWZ. Retrieved 29 February 2024 from <https://uwz.at/de/a/die-markantesten-unwetter-im-jahre-2023-in-oesterreich-uwz>. ¹⁰ Wiener Städtische (4 August 2023). Wiener Städtische: Juli-Unwetter kosten rund 30 Mio. Euro. Retrieved 29 February 2024 from <https://www.wienerstaetische.at/unternehmen/presse/pressemeldungen/detail/wiener-staedtische-juli-unwetter-kosten-rund-30-mio-euro.html>. ¹¹ Österreichische Hagelversicherung (18 July 2023). Hagelversicherung: Auch der Süden wurde geschädigt. Retrieved 29 February 2024 from <https://www.hagel.at/presseaussendungen/unwetter-kaernten/>. ¹² Österreichische Hagelversicherung (18 July 2023). Hagelversicherung: Unwetter ohne Ende. Retrieved 29 February 2024 from <https://www.hagel.at/presseaussendungen/unwetter-ohne-ende/>. ¹³ Eder, F. & Rossacher, T. (7 August 2023). Große Schäden nach Dauerregen im Süden, Neuschnee im Norden. Kleine Zeitung. Retrieved 29 February 2024 from <https://www.kleinezeitung.at/steiermark/6312765/Unwetter-in-der-Steiermark-Grosse-Schaeden-nach-Dauerregen-im>. ¹⁴ Styria to the ORF.at (13 October 2023). 780.000 Euro Hochwasser-Hilfe ausbezahlt. Retrieved 29 February 2024 from <https://steiermark.orf.at/stories/3228120/>. ¹⁵ Kleine Zeitung (6 August 2023). Todesopfer in Kärnten | Mann (53) stürzte in Hochwasser führende Glan: tot. Retrieved 29 February 2024 from https://www.kleinezeitung.at/kaernten/6312721/Todesopfer-in-Kaernten_Mann-53-stuerzte-in-Hochwasser-fuehrende.

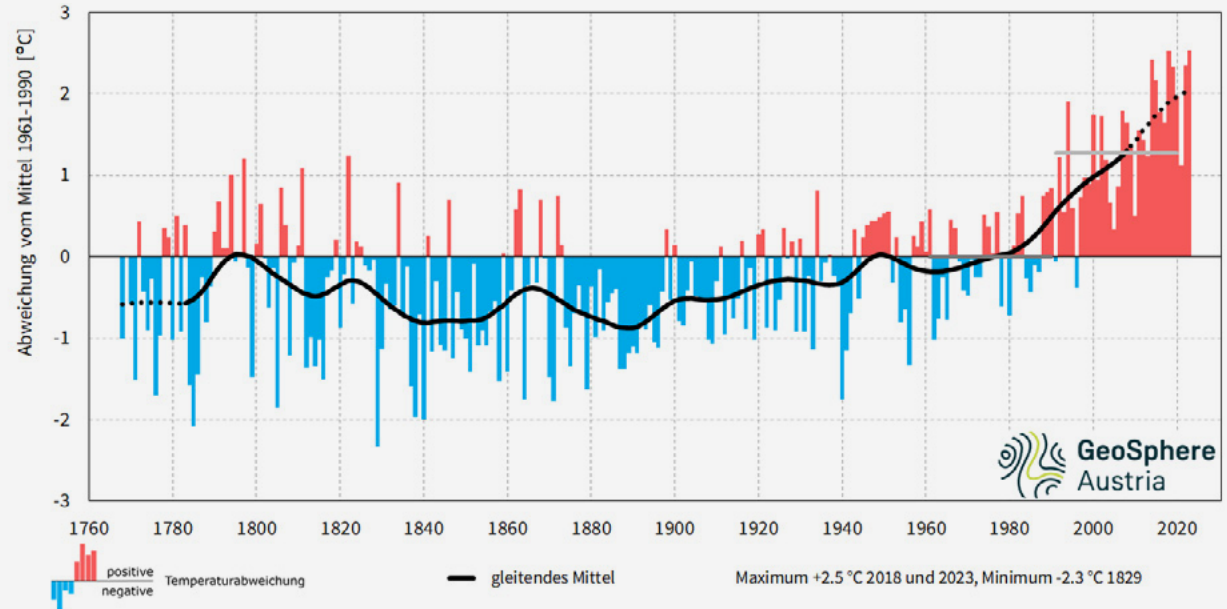


On 2 December, heavy snowfall occurred from Vorarlberg to Vienna, caused by an Italian low-pressure system. This event resulted in the most significant snow accumulation since March 2006, reaching up to 60 cm of snow in western Austria. Additionally, Vienna experienced 21 cm of snow cover, marking the city's highest accumulation since February 2013.¹⁶ The heavy snowfall resulted in numerous fallen trees,^{17,18} and motor accidents.

In terms of average temperature, 2023 tied with 2018 as the warmest year on record in the 256-year span of temperature recordings.¹⁹ Temperatures soared to unprecedented levels, surpassing the 1991-2020 average climate period by 1.3°C in the lowlands and by 1.0°C in the mountainous regions.

Temperature trends in Austria from 1760 to 2023 relative to the climate reference period from 1961 to 1990 are shown in Figure 4. Years with above-average temperatures are depicted in red, and years with below-average temperatures are depicted in blue. A smoothed trend line is shown in black. The chart illustrates that the temperature trend has been on the rise in recent years, with temperatures consistently surpassing the reference period averages. Furthermore, a significant consequence of warming temperatures is drought. According to Hagelversicherung, losses amounting to EUR 170 million in 2023 were attributable to drought in the Austrian agricultural sector,²⁰ constituting 70% of the total losses in the agricultural sector due to weather events.

FIGURE 4: TEMPERATURE TRENDS OVER THE YEARS AND YEARLY DIVERGENCE TO PERIOD 1961-1990



Source: Wärmstes Jahr der Messgeschichte.

16 Zimmerman, N. (2 December 2023). Wintereinbruch: Auf Schnee folgt Kälte. UWZ. Retrieved 29 February 2024 from <https://uwz.at/de/a/wintereinbruch-auf-schnee-folgt-kaelte>. 17 Hilbrand, R. (2 December 2023). SCHNEEMASSEN ÜBER OBERÖSTERREICH: Aufruf an die Bevölkerung, auf Autofahrten möglichst zu verzichten. SalzTV. Retrieved 29 February 2024 from <https://www.salz-tv.at/2023/12/02/schneechaos-kollision-zweier-fahrzeuge/>. 18 Kleine Zeitung (2 December 2023). Heftiger Wintereinbruch: Gesperrte Autobahnen, Orte nicht erreichbar. Retrieved 29 February 2024 from <https://www.kleinezeitung.at/oesterreich/17882127/grosse-lawinengefahr-und-verkehrsprobleme-in-westoesterreich/>. 19 GeoSphere Austria (28 December 2023). Wärmstes Jahr der Messgeschichte. Retrieved 29 February 2024 from <https://www.zamg.ac.at/cms/de/klima/news/waermstes-jahr-der-messgeschichte-1>. 20 Österreichische Hagelversicherung (29 December 2023). Jahresbilanz 2023: Erderwärmung bringt massive Zunahme an Schäden. Retrieved February 29, 2024, from <https://www.hagel.at/presseaussendungen/jahresbilanz-2023>.



IMPACT OF THESE EXTREME WEATHER EVENTS

Short-term impacts

According to the Austrian Insurance Association (VVO), in recent years insurers have paid approximately EUR 1 billion annually due to natural hazards.²¹ This represents a significant increase compared to the major flood event in 2002, which resulted in payouts of approximately EUR 300 million to 400 million.

After the storms and floods in July and August 2023, the Styrian Economic Chamber is demanding mandatory insurance covering elemental risk.²² Presently, insurance products only offer storm and hail coverage, and do not fully address the risks associated with other natural hazards. The VVO's proposed solution²³ is discussed below.

It is also important to highlight a trend concerning insurance for drought-related losses in the Austrian agricultural sector. Smaller reinsurers are increasingly reluctant to provide coverage for such losses, contributing to a parallel trend in escalating premiums driven by the growing frequency of drought events. In response to these challenges,

Hagelversicherung has revamped its drought insurance offerings, including the introduction of an index-linked product that enables farmers to receive compensation when precipitation and heat levels in their respective areas significantly deviate from long-term averages. To improve cost efficiencies, Hagelversicherung is leveraging satellite imagery and artificial intelligence for more accurate damage assessments.²⁴

Longer-term impacts

According to the VVO, the market falls short in offering comprehensive coverage for natural calamities. On average, home insurance policies designed for storm-related damages only provide up to EUR 10,000 in coverage. This limitation is primarily due to the fact that demand is often concentrated on affected properties. As a result, many affected households struggle with significant expenses. Although the government offers supplementary aid via emergency relief funds, there is no standard for the payout amount, along with no legal right to any payout.

The VVO is urging political action²⁵ to guarantee the insurability of natural hazards throughout Austria in the future. The idea is to provide a community-based, solidarity-based solution through legal regulation, with risk diversification to achieve an affordable and socially acceptable price for an insurance product. The VVO solution is based on the “Belgian model,” where natural catastrophe as an elemental damage package is integrated into existing fire insurance on a mandatory basis. The VVO estimates that implementing this model would lead to an increase in fire insurance premiums of about 10% to 15%.²⁶



In Austria, high heat and low rainfall damaged corn and other crops.

21 Kleine Zeitung (8 August 2023). Naturkatastrophen: Steirische Wirtschaftskammer fordert Pflichtversicherung. Retrieved 29 February 2024 from <https://www.kleinezeitung.at/wirtschaft/6313288/Besuch-betroffener-Betriebe-Naturkatastrophen-Steirische>. 22 Ibid. 23 Dworak, N. (9 August 2023). Versicherer fordern gesetzliche Anpassung bei Schäden durch Naturkatastrophen. DerStandard.at. Retrieved 29 February 2024 from <https://www.derstandard.at/story/3000000182245/versicherer-fordern-gesetzliche-anpassung-bei-schaeden-durch-naturkatastrophen>. 24 Auer, M. (21 September 2023). Klimawandel: Versicherungen stellen das Geschäft mit der Dürre in Frage. DiePresse.com. Retrieved 29 February 2024 from <https://www.diepresse.com/17496565/klimawandel-versicherungen-stellen-das-geschaef-mit-der-duerre-in-frage>. 25 OTS. Versicherungslösung für Naturgefahren – die Versicherungswirtschaft steht mit Lösungen bereit. VVO. Retrieved 29 February 2024 from https://www.ots.at/presseaussendung/OTS_20230809_OTS0046/versicherungsloesung-fuer-naturgefahren-die-versicherungswirtschaft-steht-mit-loesungen-bereit. 26 Troscher, A. (22 May 2023). Pro Jahr eine Milliarde Euro Versicherungsschaden durch Naturkatastrophen. SN.at. Retrieved 29 February 2024 from <https://www.sn.at/panorama/oesterreich/pro-jahr-eine-milliarde-euro-versicherungsschaden-durch-naturkatastrophen-139136602>.



Belgium

2023 EXTREME WEATHER EVENTS

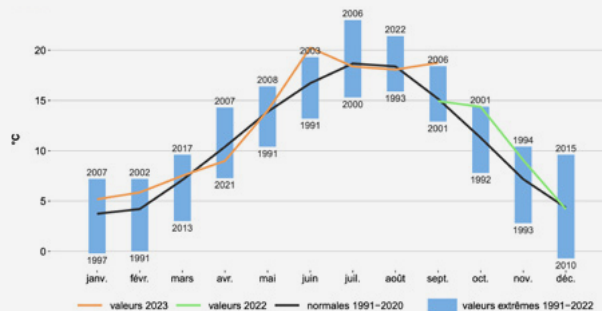
Belgium experienced record heat waves in 2023:

- For the first time since observations began in 1892, the Uccle station in Brussels recorded a heat wave in September.²⁷
- June and September 2023 set new benchmarks for record monthly temperatures:
 - June:** The average temperature surpassed 20°C for the first time since observations began in 1833—20.3°C compared to the previous record of 19.3°C set in 1976 and 2003. Additionally, the average maximum temperature reached 25.4°C, surpassing the previous record of 24.7°C set in 1976, and the average minimum temperature was 14.5°C, exceeding the previous record of 14.0°C set in 2021.²⁸
 - September:** The average temperature reached 18.8°C, surpassing the previous record of 18.4°C set in 2006. The average maximum temperature was 24.0°C, surpassing the previous record of 23.4°C set in 2006, and the average minimum temperature was 14.1°C, equaling the previous record set in 1999. The number of summer days with maximum temperatures higher than 25°C equaled the previous record set in 2006, with nine days recorded.²⁹
- Figure 5 illustrates a comparison of the average monthly temperature in 2023, represented by the orange curve, with the average monthly

temperatures from 1991 to 2020 depicted by the black curve. In addition, it includes a histogram in blue illustrating the extreme temperatures recorded from 1991 to 2022. The graphic highlights the record-breaking temperatures observed in June and September 2023.

- Overall, the graph shows that temperatures in 2023 consistently exceeded the historical average for most months, indicating the trend of higher temperatures throughout the year. For instance, in August there were six days with maximum temperatures exceeding 30°C, which is a threefold increase compared to the previous record of two days in 1906, 1911, 1919, 1949, and 2020.³⁰

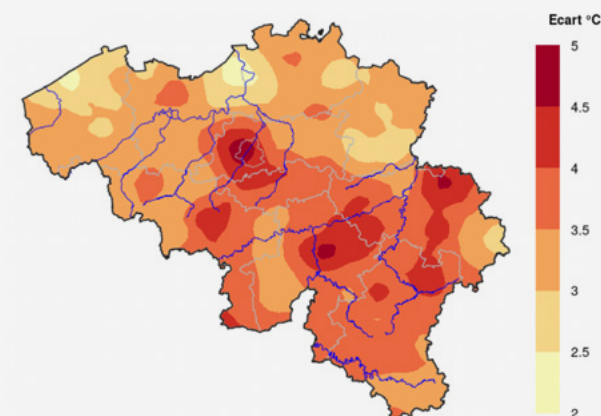
FIGURE 5: AVERAGE MONTHLY TEMPERATURES, UCCLE



Source: IRM, Bilan climatique mensuel (Septembre 2023).

To further illustrate above-average temperatures, Figure 6 shows the deviation from normal of the average temperature in September 2023 across Belgium.

FIGURE 6: DEVIATION FROM NORMAL OF SEPTEMBER'S AVERAGE TEMPERATURE



Source: IRM, Bilan climatique mensuel (Septembre 2023).

27 IRM (Septembre 2023). Bilan climatique mensuel. Retrieved 29 February 2024 from <https://www.meteo.be/uploads/media/651a4e0386b1e/bilan-climatique-mensuel-202309.pdf?token=/uploads/media/651a4e0386b1e/bilan-climatique-mensuel-202309.pdf>. 28 IRM (June 2023). Bilan climatique mensuel. Retrieved 29 February 2024 from <https://www.meteo.be/uploads/media/64a262098f93b/bilan-climatique-mensuel-202306.pdf?token=/uploads/media/64a262098f93b/bilan-climatique-mensuel-202306.pdf>. 29 IRM (Septembre 2023). op cit. 30 Ibid.



IMPACT OF THESE EXTREME WEATHER EVENTS

Short-term impacts

The 2023 extreme climate events are not anticipated to result in an immediate major increase in property insurance premiums within the insurance industry, thanks to the reserves held by public authorities and insurance companies. Nonetheless, a slight increase in premiums is expected over the next two years, in anticipation of the increased risk of natural disasters.³¹ However, according to Hein Lannoy, CEO of Assuralia (the association of domestic and foreign insurance and reinsurance companies operating in Belgium), due to the resurgence of natural catastrophes reinsurers have reduced the capacity available to insurers for reinsurance.³²

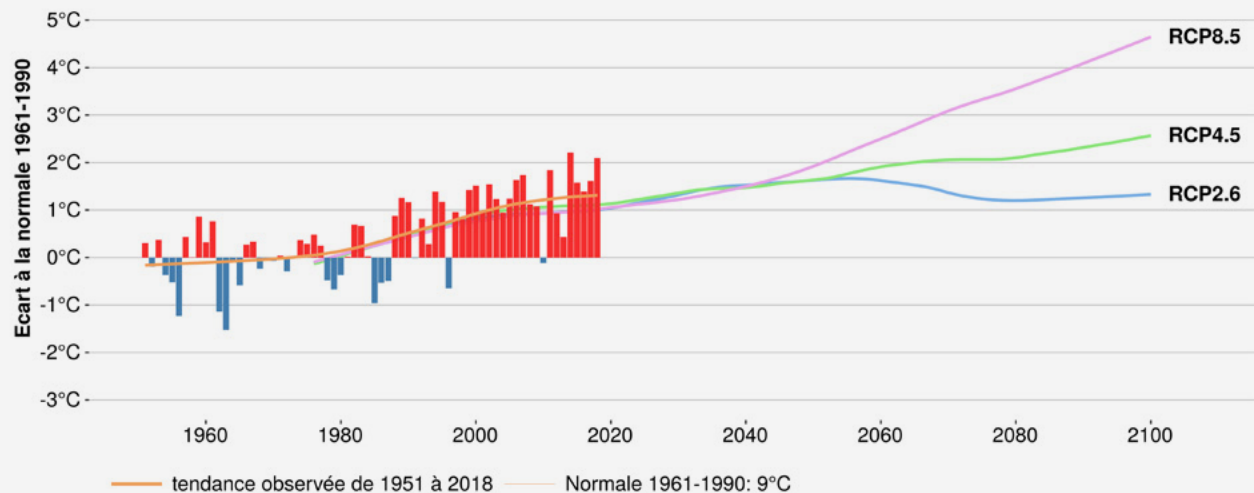
Notably, in response to the 2021 flooding event, the Walloon government submitted a draft exception decree to Parliament. This decree reinforces the existing agreement with insurers, specifying that insurers will directly pay claimants. Additionally, the decree stipulates an increase in coverage to EUR 590 million for the Walloon region, which surpasses the EUR 320 million financial intervention limit set by the Federal Act.³³

Longer-term impacts

Figure 7 shows the upward trend in the temperature measurements by depicting the evolution of mean temperatures in Belgium for the 1951-2100 period, compared with the 1961-1990 normal. The orange curve represents historical observed average temperatures based on greenhouse gas concentration trajectories or Representative Concentration Pathways (RCPs), while the blue, green and purple curves show the evolution of temperatures modelled according to the following scenarios:

- **RCP 2.6:** Carbon dioxide (CO₂) emissions start declining by 2020 and reach zero by 2100. Methane (CH₄) emissions drop to about half the CH₄ levels of 2020, while sulphur dioxide (SO₂) emissions fall to about 10% of those seen from 1980 to 1990.
- **RCP 4.5:** CO₂ emissions begin declining around 2045, reaching roughly half of the levels of 2050 by 2100. CH₄ emissions stop rising by 2050 and drop somewhat to about 75% of the CH₄ levels of 2040. SO₂ emissions decline to about 20% of those of 1980 to 1990.
- **RCP 8.5:** Emissions continue to rise throughout the 21st century.

FIGURE 7: EVOLUTION OF THE MEAN TEMPERATURE IN BELGIUM



Source: IRM, Rapport climatique 2020.

³¹ YAGO. Climatic disasters: Towards an increase in insurance prices? Retrieved 29 February 2024 from <https://www.yago.be/fr/assurance-habitation/tarifs-assurance/catastrophes-climatiques>. ³² Assuralia (23 June 2023). Insurers are campaigning for better compensation for victims after a natural disaster. Retrieved 29 February 2024 from <https://press.assuralia.be/les-assureurs-militent-pour-une-meilleure-indemnisation-des-victimes-apres-une-catastrophe-naturelle>. ³³ Boverie, M. (13 August 2021). Floods – exceptional agreement between Wallonia and insurers to increase the intervention ceiling, victims insured for simple risks will be fully compensated. UVCW. Retrieved 29 February 2024 from <https://www.uvcw.be/voirie/actus/art-6691>.

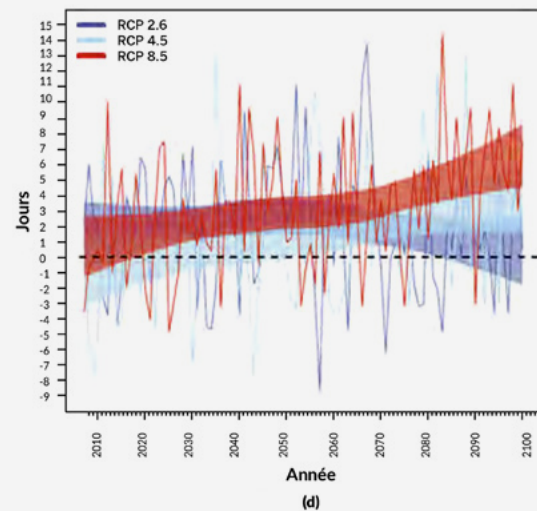


Depending on the scenario, the average temperature change for Belgium will be between 0.7°C and 5.0°C by the end of the century.

Changes in extreme rainfall can be assessed using various indices, such as the number of days with at least 10 mm of precipitation. Figure 8 illustrates the spatial distribution of the average variation in the number of days with more than 10 mm of precipitation in Belgium, according to the different scenarios described above, RCP 2.6 (a), RCP 4.5 (b) and RCP 8.5 (c) for the 2071-2100 period, compared to the 1976-2005 historical period.

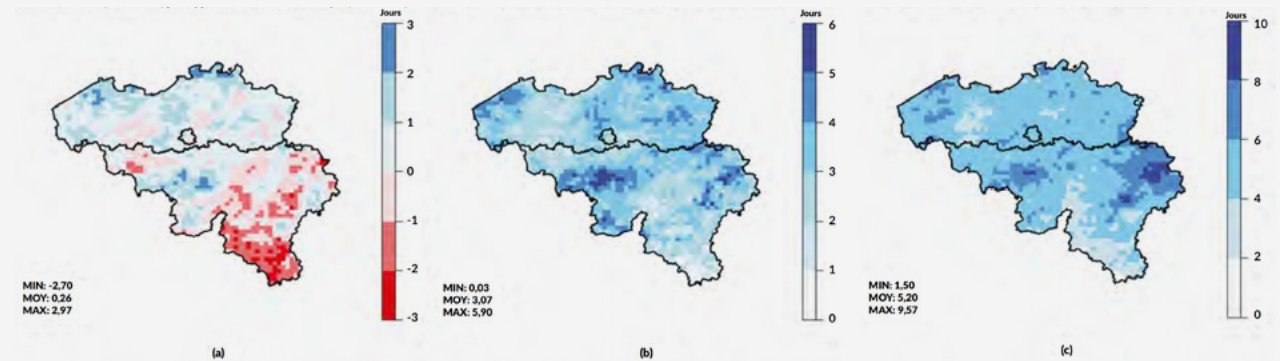
Figure 9 shows the evolution of the variation in the number of days per year with more than 10 mm of precipitation for the period 2005 to 2100.³⁴

FIGURE 9: EVOLUTION OF THE VARIATION IN THE NUMBER OF DAYS PER YEAR WITH MORE THAN 10 MM OF PRECIPITATION FOR THE PERIOD 2005 TO 2100



Source: IRM, Rapport climatique 2020.

FIGURE 8: AVERAGE VARIATION IN NUMBER OF DAYS WITH MORE THAN 10 MM OF PRECIPITATION, ACCORDING TO DIFFERENT CLIMATIC SCENARIOS



Source: IRM, Rapport climatique 2020.

The assessment of climate change on drought was conducted for scenario RCP 8.5, where emissions continue to rise throughout the 21st century. The projections indicate an expectation of more frequent droughts before the end of the century. The study further reveals that the severity of the drought directly correlates with an increased frequency. For instance, exceptional droughts, such as the one experienced in 1976, may occur up to five times more frequently than in the historical reference period (1951-2005).³⁵

On 3 March 2023, the Council of Ministers approved a package of 28 federal adaptation measures. These measures encompass discussions with regions regarding potential reform to adapting the criteria of flood risk zones determination, as mandated by law.³⁶ The current methodology is based on past floods and modelling that does not account for the increased probability of flooding due to climate change. Additionally, the existing methodology only considers the building's location, but not the extent to which it is adapted to be resilient against flooding events. As a result, incentives to build or renovate flood-protected buildings in high-risk areas are rare.

³⁴ IRM. Rapport climatique 2020. Retrieved 29 February 2024 from https://www.meteo.be/resources/misc/climate_report/RapportClimatique-2020.pdf.
³⁵ Ibid. ³⁶ Adapt2climate.be. Vers une société résiliente au changement climatique à l'horizon 2050. Mesures fédérales d'adaptation 2023-2026. Retrieved 29 February 2024 from <https://www.adapt2climate.be/wp-content/uploads/2023/03/Vers-une-societe-resiliente-au-changement-climatique-a-lhorizon-2050-Mesures-dadaptation-federales-2023-2026.pdf>.



This new measure impacts the insurance sector, as the insurer's ability to refuse coverage for the risk of flooding in a specific building depends on the classification of the risk zones.

The measures also mandated that, in collaboration with the office of the Minister of Economy, a task force examines possible ways to reform the system to improve insurance legislation to safeguard against extreme natural disasters.³⁷ The floods of July 2021 highlighted the limitations of the existing insurance system in the event of large-scale disasters.

Key considerations include:

- Addressing the lack of legal coverage to ensure protection for both the insured and insurers during reinsurance contract renewals, tackling issues such as premium increases and refusal of coverage.
- Mitigating the lack of insurance protection to address discrimination against policyholders.
- Addressing the need to prefinance disaster funds. Due to the regionalisation of powers, disaster funds were not fully funded during the 2021 flood.
- Determining the limit to individual insurer intervention in the event of a natural disaster by establishing a more balanced approach to insurer solvency and regional financing needs.

In response to the 2021 flooding event, the insurance sector, in collaboration with regional governmental bodies, agreed to a one-time plan to fully compensate victims. Although insurance companies are typically required to pay damages up to a legally established ceiling, the magnitude of the disaster led to a unique agreement between the government and insurers, allowing them to surpass this ceiling in this exceptional circumstance.³⁸

Since 2021, the insurance sector has advocated for a clear legal framework that removes legal uncertainty in the short term and fully protects customers in the event of another catastrophe.³⁹ The objective is to establish a uniform solution that is technically feasible from an insurance perspective while keeping premiums affordable for policyholders.⁴⁰

It is noteworthy that, to compensate policyholders affected by the 2021 floods, the Walloon region asked insurers to grant them a zero-interest loan. This enabled the regional government to cover the difference between the insurer's contribution and the amounts needed to provide total compensation to policyholders. Therefore, Wallonia provided a major percentage of the necessary financial support to fully indemnify the claimants.⁴¹

To implement such a solution, the legal framework for "simple risks" fire insurance (covering homes and small businesses) must include a provision for compensating victims in the event of a natural disaster through a public-private partnership. In practical terms, this entails cooperation among insurers, regions and both federal and European authorities.⁴²



Severe rainfall flooded farmland in Belgium.

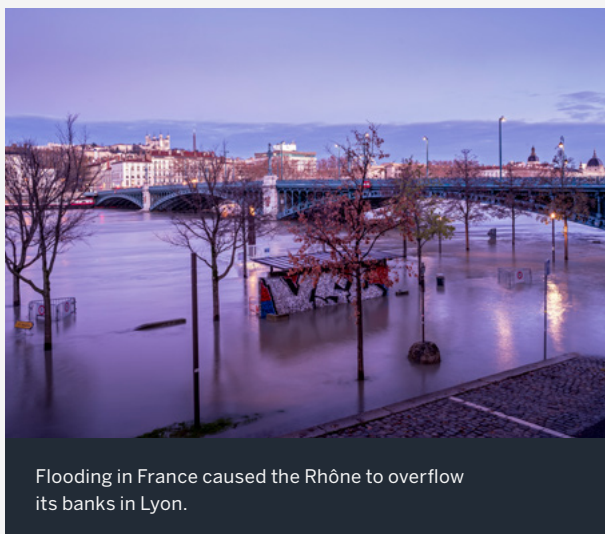
³⁷ Michiels, C. (14 July 2023). Two years after heavy floods, there is still no new law on natural disaster insurance. VRT.be. Retrieved 10 March 2024 from <https://www.vrt.be/vrtnws/nl/2023/07/13/verzekeringen-natuurrampen-overstromingen-wettelijk-kader/>. ³⁸ Ibid. ³⁹ YAGO, Climatic disasters, op cit. ⁴⁰ Assuralia (29 January 2023). July 2021 Flood Update. Retrieved 29 February 2024 from <https://press.assuralia.be/update-overstromingen-juli-2021>. ⁴¹ Assuralia (23 June 2023), op cit. ⁴² YAGO, Climatic disasters, op cit.



France

2023 EXTREME WEATHER EVENTS

As discussed in the 2022 Milliman European Extreme Weather Events report,⁴³ the year 2022 was catastrophic for France in terms of the frequency of extreme events such as hail, storms, droughts and wildfires. The compounding factor of soaring inflation raised average claim costs. In France, this combination resulted in an increase in both higher claim frequency and greater average cost. Consequently, (re)insurers' annual results were undermined by climatic events.



Flooding in France caused the Rhône to overflow its banks in Lyon.

By comparison, 2023 was a much less eventful year in France, although there were extreme weather events. Notable among them were heat waves in mid-August and mid-September, along with large storms throughout the year. Particularly significant was Storm Ciarán on 1 November, which struck northwestern France with gusts reaching 200 km/h. This storm resulted in three fatalities, the evacuation of thousands of people and more than a million homes left without electricity. Very heavy rainfall in the north and west of France as well as on the eastern massifs caused historic floods and flooding in the North in November as well as in the Alps and West in December.

Heat waves

In the summer of 2023, France experienced its fourth-hottest summer on record, with a global temperature exceeding the seasonal norm by 1.4°C. The hottest summer on record occurred in 2003, and the second- and third-hottest summers were in recent years, 2022 and 2018, respectively. Numerous heat waves occurred during 2023 in France, notably in mid-August when a 15-day heat wave caused about 400 deaths, primarily among people aged 75 and older. Overall, France encountered four heat waves in 2023, one more than in 2022. However, the heat waves in 2022 were more intense and caused about 2,800 deaths.⁴⁴

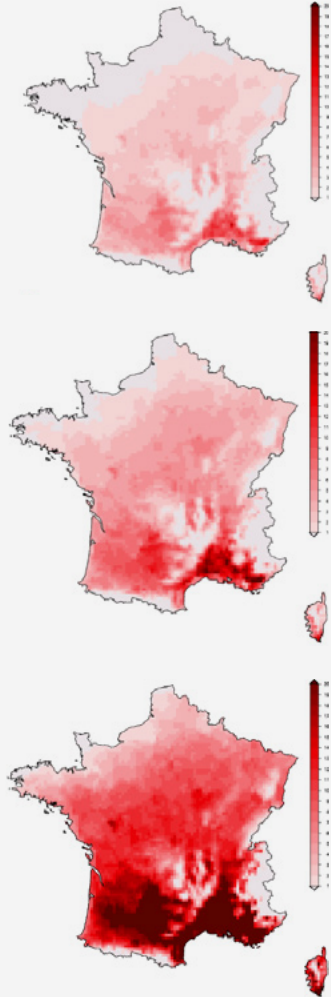
With climate change, the number of hot days (> 35°C) will increase, leading to more frequent and longer heat waves. Figure 10 illustrates these numbers of hot days over time—the redder the region, the more days with maximum temperatures over 35°C.

⁴³ Aouragh, T., Basetti Sani Vettori, N., Benkhalta, M. et al. (14 March 2023). Extreme Weather Events in Europe for 2022 and Beyond, Milliman news article. Retrieved 10 March 2024 from <https://www.milliman.com/en/insight/extreme-weather-events-in-europe-2022>. ⁴⁴ Sante Publique France (20 December 2022). Heat wave public health bulletin, Summer 2022 review. Retrieved 29 February 2024 from <https://www.santepubliquefrance.fr/determinants-de-sante/climat/fortes-chaleurs-canicule/documents/bulletin-national/bulletin-de-sante-publique-canicule-bilan-ete-2022>.



FIGURE 10: PROJECTED NUMBER OF HOT DAYS (> 35°C), RCP8.5: SCENARIO BUSINESS AS USUAL – EXTRACTED FROM DRIAS REPORT

(short term – 2040: top, mid-term – 2070: middle, long term – 2100: bottom)



Source: DRIAS Report.

Hail events

As discussed in the 2022 Milliman European Extreme Weather Events report,⁴⁵ 2022 marked the costliest year on record for hail in France, with approximately 1 million claims and a cost totalling EUR 3 billion.

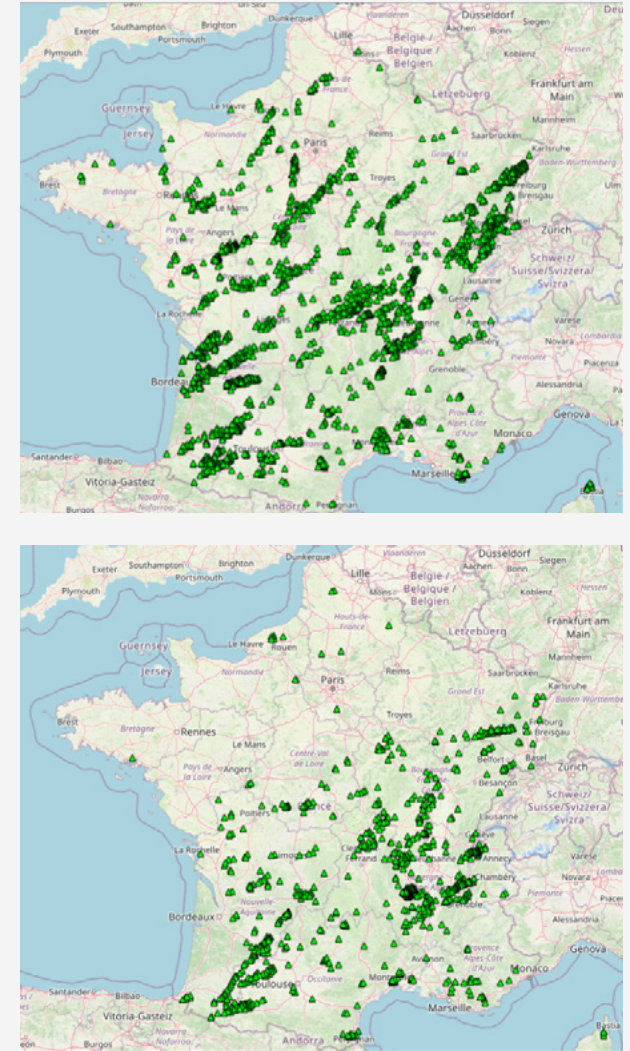
This unprecedented year highlighted the limitations of hail models, which failed to predict such an extreme event. In response, reinsurers reviewed all their hail models in 2023 with the aim of improving hail prediction capabilities.

According to Tamara Soyka, Swiss Re Nat Cat Director, the current references for the insurance industry are underestimating the frequency of extreme hail events. Soyka also emphasises that, specifically for France, the return period for a hail event causing about EUR 700 million in damages is less than 10 years.⁴⁶

The European Severe Weather Database enables the mapping of large hail occurrences across France and the comparison of 2022 and 2023 hail reports, as confirmed by reliable sources including the European Severe Storms Laboratory and the National Hydro-Meteorological Service. Maps in Figure 11 indicate that 2023 was less destructive than 2022 and highlight the areas with high hail probability.

⁴⁵ Ouragh, T., Basetti Sani Vettori, N., Benkhalta, M. et al. (14 March 2023). Extreme Weather Events, op cit. ⁴⁶ Dauvergne, G. (22 February 2023). Natural disasters: Lessons from an extraordinary year 2022. L'argus. Retrieved 29 February 2024 from <https://www.argusdelassurance.com/les-assureurs/catastrophes-naturelles-les-enseignements-d-une-annee-2022-hors-norme.212821>.

FIGURE 11: LARGE HAIL REPORTS CONFIRMED BY RELIABLE SOURCES IN 2022 (TOP, 2310 REPORTS) VS. 2023 (BOTTOM, 933 REPORTS)

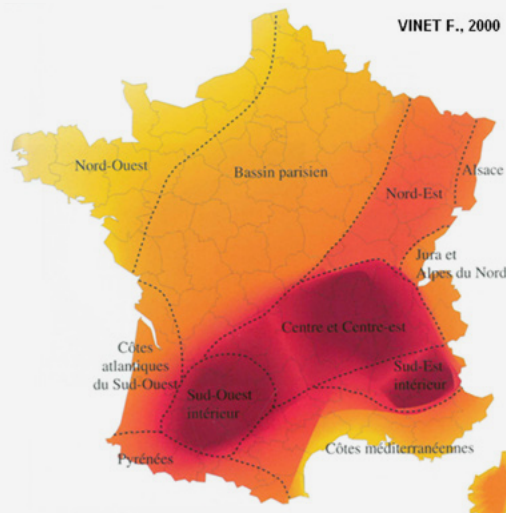


Source: European Severe Weather Database (ESWD).



Figure 12 shows a reference cartography representing hail risk in France, developed by Vinet in 2000, using dark red to highlight high-risk areas for hail. These locations form a “hail corridor” that is frequently damaged by hail, especially during the spring.

FIGURE 12: HAIL RISK MAP



Source: Vinet F., 2000.

According to the Intergovernmental Panel on Climate Change (IPCC) Assessment Report 6 (AR6), this hail corridor might widen with climate change, and hailstones may increase in size, causing more substantial damages. With a lower confidence index, the IPCC AR6 indicates that the frequency of hailstorms has likely already increased and is expected to further increase because of climate change.⁴⁷ Refer to [Appendix A](#) to learn more about understanding, mapping and modelling this particular risk.

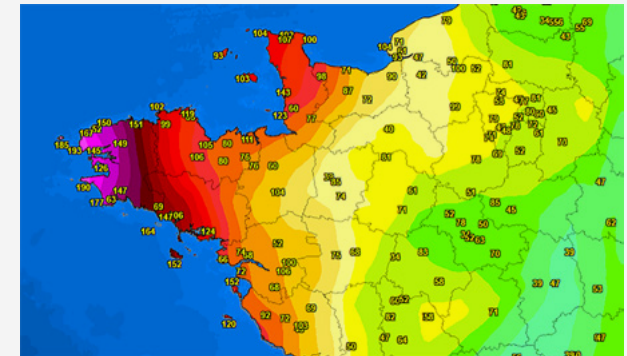
Severe storms

France is often impacted by severe winter storms. According to the French Weather Agency, Storm Ciarán in November 2023 ranks as the sixth most powerful storm in terms of winds since 1980.

Several insurers estimate that Ciarán’s intensity is comparable to 1999’s Lothar storm on the high end and 2010’s Xynthia storm on the low end. However, Ciarán impacted a relatively small percentage of territory when compared to Lothar or Xynthia.⁴⁸

Right after the Ciarán storm, a second, far less severe storm named Domingos occurred. This second storm corresponds to a phenomenon increasingly studied by insurers: the storm cluster. The combined impact of storms Ciarán and Domingos resulted in more than 500,000 claims and generated insured losses estimated at EUR 1.3 billion.⁴⁹ The Atlantic seaboard departments, especially Bretagne, were most impacted by these events.

FIGURE 13: MAP OF WIND GUST ON 2 NOVEMBER



Source: Météo Ciel.

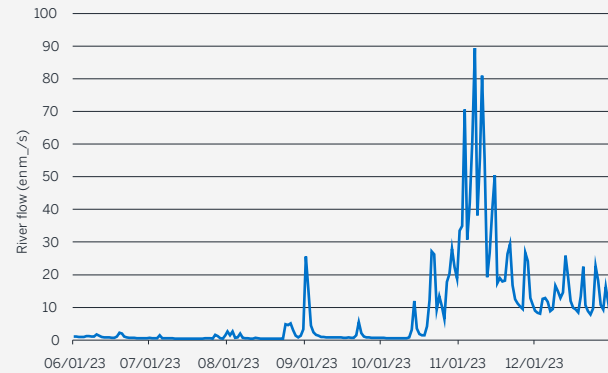
⁴⁷ IPCC (20 March 2023). Sixth Assessment Report. Retrieved 29 February 2024 from <https://www.ipcc.ch/assessment-report/ar6/>. ⁴⁸ L’argus (2 November 2023). Storm Ciaran: Insurers hard at work. Retrieved 29 February 2024 from <https://www.argusdelassurance.com/les-distributeurs/agents-generaux/tempete-ciaran-les-acteurs-de-l-assurance-se-mobilisent.227783>. ⁴⁹ Liberation.fr (13 November 2023). Storm Ciaran and Domingos: Damage estimated at 1.3 billion euros by insurers. Retrieved 29 February 2024 from https://www.liberation.fr/environnement/climat/tempete-ciaran-et-domingos-les-degats-estimes-a-13-milliard-deuros-par-les-assureurs-20231113_V6PJ06CF3BGKZGL4X20531YELQ.



Floods

After the November storms, river levels in northern France reached historically high levels. Additionally, the first half of November saw very heavy rainfall in the western Pas-de-Calais region, with rainfall measuring four times higher than the norm for a typical November.⁵⁰ This combination of heavy storms and rainfall resulted in extensive floods, causing damages estimated at EUR 550 million, according to the French Central Reinsurance Fund (CCR) for the insurance market. Notably, the Liane River, which runs through numerous towns in northern France, experienced a flow that exceeded all observed levels over the last 50 years.

FIGURE 14: LIANE RIVER FLOW (M3/S) IN 2023



Source: Hub'eau.

Reinsurance

Reinsurance premiums surged during the 2023 underwriting period, with increases ranging from +35% to +50%.⁵¹ Some guarantees were excluded from reinsurance contracts and capital availability was tighter, implying higher retention rates for insurers.

As a result, French insurers have explored alternative backup strategies, including internal reinsurance through group capacities and the development of catastrophe bonds and sidecars (ILS), which were initially developed in the aftermath of major events such as the 9/11 terrorist attacks and Hurricane Katrina in the United States.

For example, Scor, a prominent French reinsurer, is actively working to reduce its exposure to disasters following the events of 2022. The reinsurer aims for a -14% net probable maximum loss (PML) reduction at a 250-return period. According to L'argus de l'assurance, the main rate increases are seen on treaties covering natural catastrophes by event, and more particularly in North America and Europe, with increases of +71% and +44%, respectively.⁵²

IMPACT OF THESE EXTREME WEATHER EVENTS

Short-term impacts

The extreme climatic events of 2022 left their mark on France and, consequently, prevention was in the forefront in 2023. Many policyholders took the advice of their insurers and installed protective materials on their homes, including cofferdams, watertight doors and shutters to safeguard against floods. Policyholders also addressed roofing issues and tree maintenance to protect against storms. Additionally, alerts sent by insurers have been increased for every risk, except drought. However, prevention is hardly measured against its effectiveness and return on investment (ROI). Widespread alert systems could be very expensive, and insurers are considering A/B testing processes to quantify the ROI.

No climate strategy is complete without reviewing insurance pricing. With eroded loss ratios and a significant upward trend in claim costs, it becomes imperative to adjust pricing accordingly. To address this, insurers can incorporate climate risk indicators into their pricing operational processes or create entirely new climate risk area maps that reflect the risks and loss experiences. In 2023, following discussion with the French government, French insurers committed to limit the policy premium increases. In 2024, the French government is encouraging a reasonable rise in premiums.

⁵⁰ Rougerie, A. (15 November 2023). Floods: A historic rain record and more to come in Pas-de-Calais. FranceInfo. Retrieved 29 February 2024 from <https://france3-regions.francetvinfo.fr/hauts-de-france/pas-calais/inondations-un-record-de-pluie-historique-et-d-autres-a-venir-dans-le-pas-de-calais-2873405.html>. ⁵¹ Dauvergne, G. (6 September 2023). Reinsurance, renewals under close surveillance. L'argus. Retrieved 29 February 2024 from <https://www.argusdelassurance.com/les-assureurs/compagnies/reassurance-des-renouvellements-sous-haute-surveillance.223572>. ⁵² Dauvergne, G. (7 February 2023). SCOR: Reinsurance premiums down 12% over one year. L'argus. Retrieved 1 March 2024 from <https://www.argusdelassurance.com/reassureurs/scor-des-primas-de-reassurance-en-baisse-de-12-sur-un-an.211781>.



An emerging general practice is the creation of climate units that bring together people with diverse expertise to tackle the array of climate issues impacting the insurance industry. These units can serve dual purposes, acting as hubs for governance and coordination, while also facilitating the development of large use cases, tools and apps. The overarching goal is to provide support for policyholders, underwriters, brokers, marketing professionals and actuaries, with the purpose of accelerating the development of climate solutions.

While extreme weather events directly impact the insurance industry, the concept of double materiality recognises that the insurance sector also plays a role in impacting climate and, subsequently, in extreme weather events. This influence is exerted through investments, liabilities and policies associated with polluting projects such as fossil fuel extraction, transportation and refining. To limit these impacts, the insurance sector initiates the process by monitoring their carbon footprint for assets and developing key performance indicators (KPIs) to assess the overall impact on climate.

On the liabilities side, there is a heightened focus on the carbon footprint of motor vehicle insurance. Metrics such as total kilometres travelled in a year and average vehicle consumption are used to measure this footprint. Another strategic approach to capping the insurance sector's carbon footprint is to incentivise policyholders to choose fewer polluting policies in their investments.

Longer-term impacts

The CAT NAT (Natural Disasters) regime in France is a compensation system set up to cover damage caused by major natural events, such as floods, earthquakes or droughts. It is mandatory for all property insurance contracts (home, car, business) to include a guarantee against natural disasters. The regime operates on the principle of risk pooling: all insured parties contribute to a common fund through an additional contribution on their insurance premiums. In the event of a natural disaster, this fund is used to compensate victims.

The declaration of a natural disaster is made by public decree, after an assessment of the damage. The CAT NAT regime is managed by the CCR, a public company that reinsures insurance companies against the risks of natural disasters.

An increase in the financing premiums for the CAT NAT regime was announced at the end of 2023. This decision was made to ensure the sustainability and effectiveness of the scheme in the face of increasing natural disasters, influenced by climate change. This means that policyholders will see an increase in the additional contribution they make to the CAT NAT fund through their insurance premiums. This premium increase will be effective on 1 January 2025.

The French government has launched a major study focussed on climate risk insurability.⁵³ This study is designed to formulate solutions to guarantee the sustainability of the French CAT NAT compensation system and strengthen the role of the insurance system in preventing, mitigating and adapting to climate change on the long term.



November storms caused river levels in northern France to rise to historically high levels.

⁵³ Ministry of Ecological Transition and Territorial Cohesion (26 May 2023). Bruno Le Maire and Christophe Béchu launch a mission on the insurability of climate risks. Retrieved 1 March 2024 from <https://www.ecologie.gouv.fr/bruno-le-maire-et-christophe-bechu-lancement-mission-sur-lassurabilite-des-risques-climatiques>.



Germany

2023 EXTREME WEATHER EVENTS

In 2023, Germany, like many other European countries, experienced its warmest year since record-keeping began in 1881.⁵⁴ The average temperature for the year reached 10.6°C for the first time, marking a 1.34°C increase compared to the period of 1991 to 2020.

Summer storms Lambert and Kay, which moved across large parts of Germany from 19 to 23 June, caused severe damage, mainly due to hail and heavy rain. The estimated total loss attributed to these storms is EUR 740 million. Storm and hail damage accounted for EUR 250 million and approximately EUR 140 million was linked to heavy rainfall and flooding. Motor insurance claims constituted about EUR 350 million of the total amount.⁵⁵

Between 24 and 30 August, southern Germany experienced severe storms and hail, predominantly impacting southern Bavaria due to the influence of low-pressure system Denis. The total damages from this weather event amounted to EUR 900 million.⁵⁶

On 20 October, storm surge Babet struck the Baltic Sea off the coast of East Germany, mainly impacting the federal states of Schleswig-Holstein. Several coastal towns, including Flensburg, recorded their highest water levels in more than a century.⁵⁷ Damages are estimated at approximately EUR 200 million, with the biggest losses of about EUR 140 million attributed to tourism and municipal infrastructure and EUR 40 million in losses attributed to damages to coastal protection. A reconstruction fund provided by the federal government of Schleswig-Holstein is expected to cover about EUR 100 million of these losses.⁵⁸



Storms in June and August caused hail damage and a rise in motor insurance claims in Germany.

⁵⁴ German Weather Service (29 December 2023). Germany weather in 2023. Retrieved 1 March 2024 from https://www.dwd.de/DE/presse/pressemitteilungen/DE/2023/20231229_deutschlandwetter_jahr2023_news.html. ⁵⁵ GDV (29 June 2023). Summer storms cause damage amounting to 740 million euros. Retrieved 1 March 2024 from <https://www.gdv.de/gdv/medien/medieninformationen/sommerunwetter-verursachen-schaeden-in-hoehe-von-740-millionen-euro-136966>. ⁵⁶ GDV (11 September 2023). High insurance losses due to a series of storms at the end of August. Retrieved 1 March 2024 from <https://www.gdv.de/gdv/medien/medieninformationen/hohe-versicherungsschaeden-durch-unwetterserie-ende-august-149156>. ⁵⁷ MDR. 2023 – a year of natural disasters. Retrieved 1 March 2024 from <https://www.mdr.de/nachrichten/jahresueckblick/naturkatastrophen-des-jahres-in-bildern-100.html>. ⁵⁸ NDR (2 November 2023). Baltic Sea storm surge: Around 200 million euros in damage in SH. Retrieved 1 March 2024 from <https://www.ndr.de/nachrichten/schleswig-holstein/Ostsee-Sturmflut-Etwa-200-Millionen-Euro-Schaden-in-SH/wiederaufbaufonds100.html>.



IMPACT OF THESE EXTREME WEATHER EVENTS

Short-term impacts

The insurance industry estimates that the cost of damages caused by extreme weather events in 2023 is approximately EUR 4.9 billion. It is expected that the damage from the December 2023 floods will be added to this amount,⁵⁹ with the total sum amounting to an increase of around EUR 900 million compared to the previous year.⁶⁰

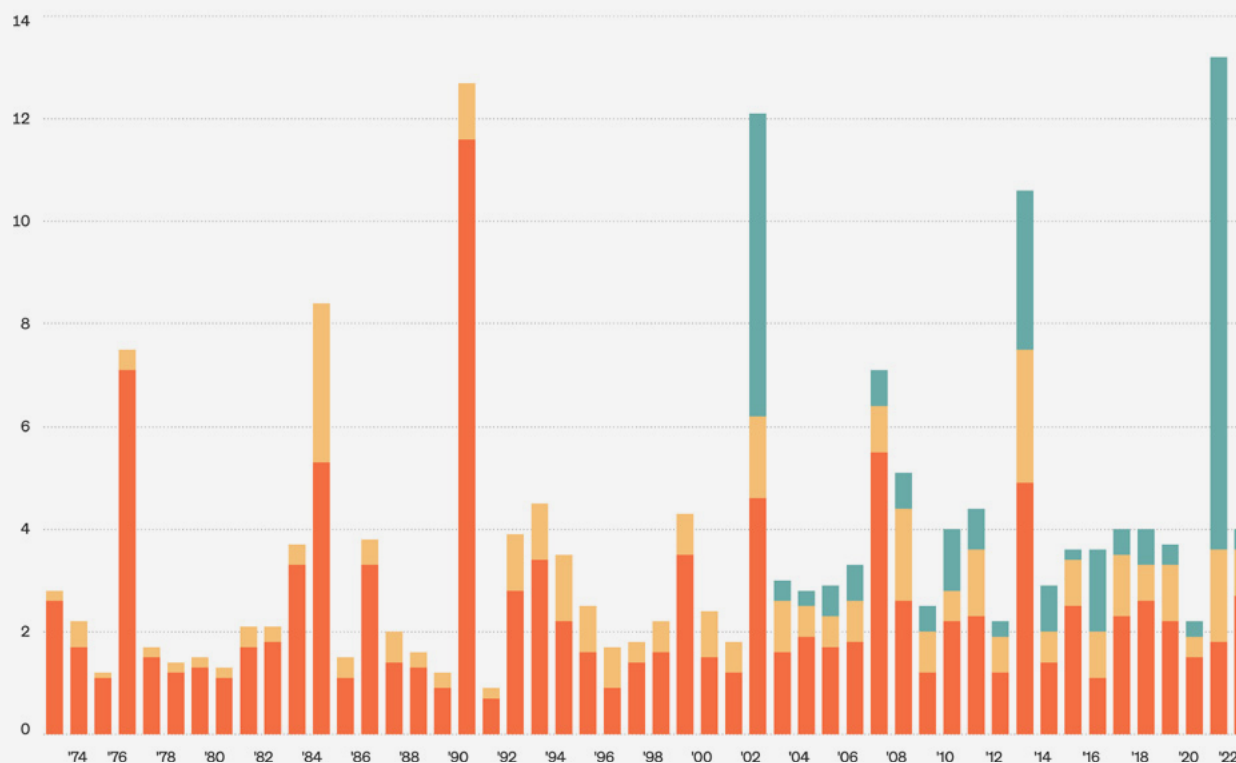
Figure 15 illustrates the evolution of extreme weather events from 1873 to 2023. The chart uses orange to represent damages from storms and hail, yellow indicates losses from motor incidents and green signifies other elemental risks. Predominantly, storm and hail events accounted for EUR 2.7 billion in damages, while other elemental risks, such as floods following heavy rainfall, amounted to EUR 900 million. Motor-related incidents resulted in EUR 1.3 billion in losses.

In response to the major flood in Ahrtal in 2021, the Federal Council in Germany unanimously proposed the introduction of “mandatory natural disaster insurance” in 2023. However, progress on this initiative has stalled. Unlike some other countries where coverage for natural disasters is inherently included in standard property or household insurance, in Germany it is an optional add-on.

FIGURE 15: LOSS FROM EXTREME WEATHER EVENTS IN GERMANY⁶¹

Langzeitbilanz: Schäden durch Naturgefahren - 2022 leicht unterdurchschnittlich

Schadenaufwand in der Sach- und Kraftfahrtversicherung in Mrd. Euro



Source: <https://www.gdv.de/gdv/medien/medieninformationen/naturgefahrenbilanz-2023-4-9-milliarden-euro-schaeden-durch-wetterextreme--162854>

⁵⁹ Factory. Climate change 2023: Temperature record in Germany and globally, extreme weather worldwide. Retrieved 1 March 2024 from <https://www.factory-magazin.de/news/klimawandel-2023-temperaturrekord-in-deutschland-und-global-extremwetter-weltweit>. ⁶⁰ GDV (28 December 2023). Natural hazard balance 2023: 4.9 billion euros in damage from weather extremes. Retrieved 1 March 2024 from <https://www.gdv.de/gdv/medien/medieninformationen/naturgefahrenbilanz-2023-4-9-milliarden-euro-schaeden-durch-wetterextreme--162854>. ⁶¹ Ibid.



According to the German Insurance Association (GDV), only 54% of residential buildings in Germany are insured against natural hazards. In the federal state of Lower Saxony, which is currently most affected by flooding, this percentage drops to just 32% according to the GDV.⁶² The Federal Council aims to proactively address escalating costs linked to global warming by advocating for mandatory natural disaster insurance.

Longer-term impacts

Following the summer storms Lambert and Kay, GDV managing director Jörg Asmussen emphasised the need for adequate insurance protection and prevention measures. He expressed the expectation that both state and federal governments should implement binding measures for climate impact adaptation.⁶³ “Climate damage could lead to a doubling of home insurance premiums,”⁶⁴ stated Asmussen. In an effort to prevent this, the GDV is promoting a comprehensive strategy developed by the insurance industry, encompassing prevention and climate impact adaptation, along with disaster preparedness and insurance coverage.

As part of this overall strategy, the GDV encourages societal actions such as climate-adapted planning, construction and refurbishment, a construction stop in flood-prone areas and a nationwide natural hazard dashboard. Recognising the potential limits of private insurance capacities, the GDV supports the idea of a “stop-loss regulation.” This form of public-private partnership suggests that the state would assume the losses above a predefined limit, which would be set above EUR 30 billion.



The Trave overflowed its banks after floods in Lubeck, Germany.

⁶² Lutz, J. (4 January 2024). Does Germany need compulsory flood insurance? WirtschaftsWoche. Retrieved 1 March 2024 from <https://www.wiwo.de/my/politik/deutschland/elementarschaeden-braucht-deutschland-eine-pflichtversicherung-gegen-hochwasser/29585586.html> (registration required). ⁶³ GDV (29 June 2023). Summer storms cause damage, op cit. ⁶⁴ GDV (14 June 2023). Climate damage could lead to a doubling of home insurance premiums. Retrieved 1 March 2024 from <https://www.gdv.de/gdv/medien/medieninformationen/klimaschaeden-koennten-zu-verdoppelung-der-praemien-in-der-wohngebaeueversicherung-fuehren-136474>.



Italy

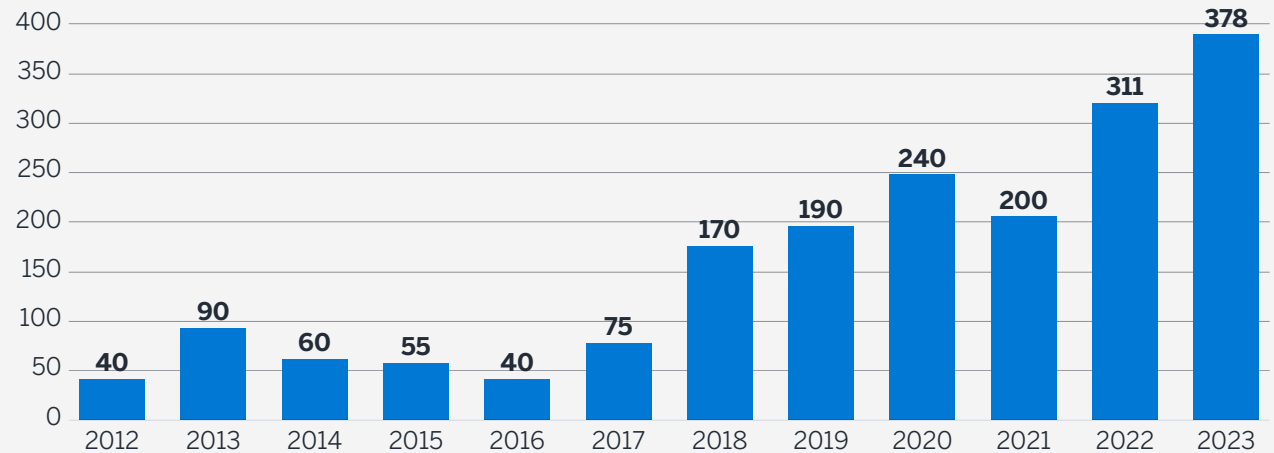
2023 EXTREME WEATHER EVENTS

In 2023, Italy witnessed its third-hottest year since 1800, according to a study conducted by Coldiretti, the country's largest association of farmers and agricultural entrepreneurs.⁶⁵ The study found that Italy experienced unprecedented heat, with temperatures surpassing the historical average by 0.7°C since researchers started collecting data over 200 years ago. In four northern regions of the country, temperatures exceeded the historical average by 0.9°C, making 2023 the second-hottest year in these regions since 1800. Furthermore, the escalation of temperatures exceeding 2.0°C above the July monthly average contributed to the development of wildfire scenarios, particularly in the southern regions of the country.⁶⁶

In 2023, severe weather impacted every region of Italy and resulted in 31 fatalities. There were 378 severe weather events, a 22% increase compared to 2022. This number surpasses the annual average recorded over the last decade, as reported by Legambiente,⁶⁷ the Italian Environmental Association. Additionally:

- There was a sharp increase in the damage caused by river floods, escalating from 13 incidents in 2022 to 35 in 2023—an increase of 170%.
- The temperature records registered in urban areas rose from eight in 2022 to 20 in 2023—an increase of 150%.
- The number of extreme weather events in Italy trended upward, as shown in Figure 16.

FIGURE 16: EXTREME WEATHER EVENTS IN ITALY



Source: <https://cittaclima.it/mappa>

⁶⁵ Coldiretti (17 August 2022). Caldo: è il terzo anno più bollente dal 1800 in Italia. Retrieved 1 March 2024 from https://www.coldiretti.it/meteo_clima/caldo-e-il-terzo-anno-piu-bollente-dal-1800-in-italia. ⁶⁶ EuroNews (7 August 2023). Wildfires: Hundreds evacuated in Italy's Sardinia as fires rage in Portugal and Cyprus. Retrieved 1 March 2024 from <https://www.euronews.com/2023/08/07/more-than-600-people-evacuated-as-wildfires-rage-across-italys-sardinia>. ⁶⁷ LEGAMBIENTE, Città Clima, Bilancio 2023 <https://cittaclima.it/wp-content/uploads/2024/01/Bilancio-CittaClima-2023.pdf>



Large hail events rank as the second-most common extreme weather event in Italy.

In particular, during July 2023, severe convective storms in Northern Italy brought damaging hail and winds. According to CRESTA's estimates those damages were strongly insured with an estimated insurance industry loss of EUR 2.02 billion,⁶⁸ which is the largest international industry loss in Q3 2023 according to the CRESTA CLIX loss list.

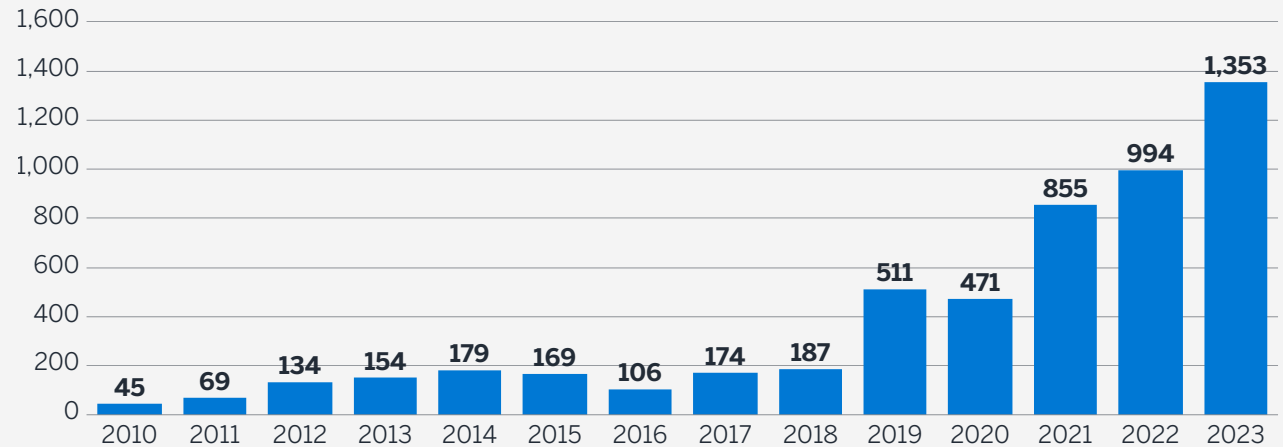
Figure 17 depicts data from the European Severe Weather Database (ESWD⁶⁹), which shows that:

- 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 and 2022 records were set for the highest number of hail events recorded.
- In 2023, Italy reported 1,353 large hail events, surpassing the record-breaking number observed in 2022.

A noteworthy incident took place on 24 July 2023, in Veneto, where a hailstone measuring 19 cm was discovered. This measurement is very close to the all-time largest hailstone recorded, which measured 20.3 cm and was found on 23 July 2010 in South Dakota, US.

The two most extreme climate events of 2023 (other than the convective storms cited above) were the floods in Emilia-Romagna and Tuscany.

FIGURE 17: LARGE HAIL EVENTS IN ITALY



Source: European Severe Weather Database <https://eswd.eu/cgi-bin/eswd.cgi>

In Emilia-Romagna, a series of devastating floods occurred between 2 and 17 May 2023, marking one of the most severe combined flooding incidents in the last two centuries. Two distinct extensive floods occurred between 2 and 3 May 2023 and 15 and 17 May 2023, with anticipated insured losses exceeding EUR 0.552 billion. This event stands out as the costliest weather-related event in Italy since 1970, according to Swiss Re. The estimated economic losses were approximately EUR 9.2 billion, and only 6% of the losses were insured by Italian insurers.⁷⁰ Key details include the following:

- During the May floods, the precipitation ratio⁷¹ soared to nearly eight times the historical average recorded for 2-17 May from 1981 to 2010, reaching

up to 610 mm in flooded areas. See Figure 18, where the delimited white dashed area indicates the extent of the flooded region.

- The precipitation in flooded communes accounted for 36% of the average annual precipitation.
- The return periods of these joint events are estimated to occur approximately every 1,000 years according to the Gumbel distribution estimation using observed data from 1950 to 2022. However, the most severe day of the floods shows a return period of less than about 30 years, which indicates that, although each day's precipitation is not as extreme as expected individually, the joint return period probability is astonishing.

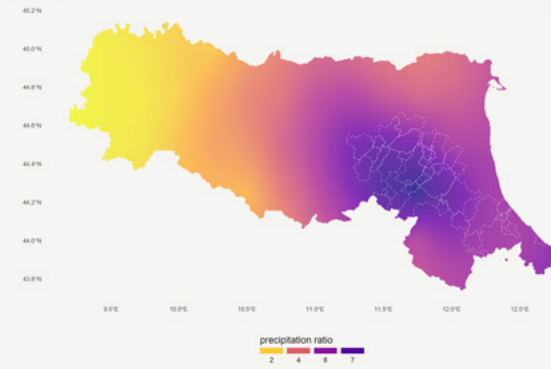
⁶⁸ Wells, K. (3 October 2023). Italy hailstorms largest international industry loss in Q3: CRESTA. Reinsurance News. Retrieved 1 March 2024 from <https://www.reinsurancene.ws/italy-hailstorms-largest-international-industry-loss-in-q3-cresta/>.

⁶⁹ See the European Severe Weather Database at <https://www.eswd.eu/>. ⁷⁰ Swiss Re (9 August 2023). Severe thunderstorms account for up to 70% of all insured natural catastrophe losses in first half of 2023, Swiss Re Institute estimates. Retrieved 1 March 2024 from <https://www.swissre.com/press-release/Severe-thunderstorms-account-for-up-to-70-of-all-insured-natural-catastrophe-losses-in-first-half-of-2023-Swiss-Re-Institute-estimates/cea79f3c-6486-41a8-9c6e-09df260efe30>.

⁷¹ Precipitation ratio=(2-17 May 2023 precipitation)/(2-17 May 1981-2010 precipitation).



FIGURE 18: EMILIA ROMAGNA 2023 MAY FLOOD

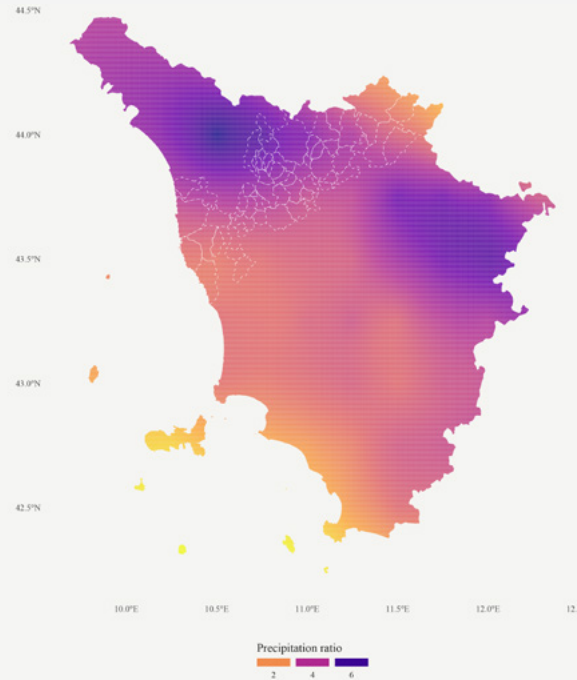


Source: Milliman elaboration on Copernicus data.

On 2 November 2023, Tuscany experienced a flash flood, accompanied by additional rainfall until 5 November 2023. Key details of the event include:

- Some areas received 200mm or more of rain⁷² in a very short timeframe of approximately three hours on 2 November 2023.⁷³
- The precipitation ratio during the November flood soared to seven times the historical average recorded between 2 November and 5 November from 1981 to 2010.⁷⁴
- The return period of this event is estimated to be around 60 years according to Gumbel distribution estimation on observed data from 1950 to 2022.⁷⁵
- The precipitation during the November flood constituted approximately 14% of the average annual historical precipitation.
- The total economic loss resulting from the flood is estimated at EUR 2 billion.⁷⁶

FIGURE 19: TUSCANY 2023 NOVEMBER FLOOD



Source: Milliman elaboration on Copernicus data.

IMPACT OF THESE EXTREME WEATHER EVENTS

Short-term impacts

Given the escalating frequency of natural catastrophe (nat-cat) claims, by 2024 policies covering natural catastrophes will be mandatory for every Italian enterprise.⁷⁷ This marks a significant change in the way the Italian government and insurance companies will cooperate in mitigating the insurance gap. Presently, despite homes being the most important asset for Italians, only 5% are covered against natural catastrophes.

In response to recent events, particularly the floods in Emilia Romagna and Tuscany, the Italian government decided to change the way natural catastrophes will be insured, at least for enterprises. Unlike some other countries where collaborative mechanisms between government and insurers already exist, this is a new development for Italy. Under this new collaboration, losses will be shared, with the government paying up to 50% (capped at EUR 5 billion) and the remaining portion paid by insurance companies.

⁷² FloodList (3 November 2023). Italy – State of Emergency After Storm Triggers Deadly Floods in Tuscany. Retrieved 1 March 2024 from <https://floodlist.com/Italy/Italy-floods-tuscany-november-2023>. ⁷³ Copernicus (12 November 2023). Flooding in Tuscany Region, Italy – November 2023. Retrieved 1 March 2024 from <https://www.efas.eu/en/news/flooding-tuscany-region-italy-november-2023>. ⁷⁴ Precipitation ratio=(2-5 November 2023 precipitation)/(2-5 November 1981-2010 precipitation). ⁷⁵ Precipitation ratio=(2-5 November 2023 precipitation)/(2-5 November 1981-2010 precipitation). ⁷⁶ IRPET (Dicembre 2023). La quantificazione del danno da alluvione per imprese e famiglie. Retrieved 1 March 2024 from <http://www.irpet.it/wp-content/uploads/2023/12/nota-di-lavoro-30-danni-alluvione-11-12-2023.pdf>. ⁷⁷ Hazan, A.M. (1 November 2023). Obligation to Contract in Catastrophe Policies. THMR. Retrieved 1 March 2024 from <https://www.thmr.com/lobbligo-di-polizza-catastrofi-non-vale-per-i-beni-in-leasing>.



According to a report from the Italian Association of Insurance Companies (ANIA),⁷⁸ Italy plans to increase nat-cat policies to close the protection gap between uncovered and covered climate-related losses. While large enterprises already have coverage incidence of around 90% for natural catastrophes, medium and small enterprises have a severe lack of natural catastrophe coverages, with less than 30% having coverage for flood and earthquake events.

The latest 2023 report from the Italian Institute for Environmental Protection and Research⁷⁹ discusses the following:

- Italy is one of Europe's most at-risk countries for landslides and floods, with approximately 94% of its cities facing high to very high risk of landslides, medium hydraulic risk and/or coastal erosion.
- About 5.4% of Italy's total area is exposed to high flood risk, with scenarios indicating a high probability of such events occurring in the next two to 50 years.⁸⁰
- About 13.4% of industries and services are exposed to high flood risk.
- About 1.3 million people are exposed to high to very high landslide risk.

- About 9.2 million people are exposed to high flood risk (with a return period of 20 to 50 years) and medium flood risk (with a return period of 100 to 200 years).
- 18.4% of the national territory is classified as having a higher risk for landslides and floods.
- 12.8% of municipalities are exposed to high to very high landslide risk.⁸¹

Longer-term impacts

According to the European Insurance and Occupational Pensions Authority (EIOPA),⁸² the penetration of Italian natural catastrophe insurance coverage for earthquake and flood risks remains below 25%. Despite growth in the retail segment over the last 10 to 15 years, nat-cat contracts are still predominantly held by enterprises, especially large enterprises that insure very large amounts with geographical diversification. ANIA reports that approximately 75% of private houses in Italy are exposed to nat-cat risks, yet only around 5% have insurance coverage—a percentage that, although steadily increasing in recent years, was nearly non-existent 15 years ago.

This lack of coverage leaves the Italian government primarily responsible for the cost associated with extreme weather events and post-disaster relief. The consequences include rebuilding delays, business closures and property abandonment. To address the gap where only 5% of private houses are insured against natural catastrophes, the Italian government has offered tax benefits since 2018 to individuals who secure coverage for their own homes. Furthermore, insurance companies are allowed to apply premiums "proportional to the risk," but they are restricted from imposing deductibles or excesses greater than 10% to 15% of the insured goods. These measures should lead to an increase in policy coverage, and ANIA reports a substantial increase, with earthquake and flood policies growing from 1,000 in 2020 to 98,000 in 2022. Consequently, in addressing climate change-related risks, it is imperative to enhance the protection system for citizens, businesses and territories by fostering cooperation between the government and insurance companies.

⁷⁸ Ania (2022). TRENDS incendi e catastrofi naturali nelle abitazioni. Retrieved 1 March 2024 from <https://www.ania.it/documents/35135/53789/Ania+Focus+Incendio++Settembre+2022.pdf/a6f2a852-0324-e01b-bd66-f0433c110938?version=1.0&t=1665435218588> ⁷⁹ ISPRA (17 May 2023). ISPRA Report 17: Quadro di sintesi generale della pericolosità e del rischio di alluvioni nella Regione Emilia Romagna. Retrieved 1 March 2024 from https://www.isprambiente.gov.it/files2023/notizie/pdf24_merged.pdf. ⁸⁰ IdroGEO. Hazard and risk data, ISPRA. Retrieved 1 March 2024 from <https://idrogeo.isprambiente.it/app/pir?@=41.55172525858242.12.573501484000001.1>. ⁸¹ ISPRA (2021). Dissesto idrogeologico in Italia: Pericolosità e indicatori di rischio. Retrieved 1 March 2024 from: https://www.isprambiente.gov.it/files2022/pubblicazioni/rapporti/rapporto_dissesto_idrogeologico_italia_ispra_356_2021_finale_web.pdf. ⁸² EIOPA. Dashboard on insurance protection gap for natural catastrophes. Retrieved 1 March 2024 from https://www.eiopa.europa.eu/tools-and-data/dashboard-insurance-protection-gap-natural-catastrophes_en. ⁸³ Ania (2022). TRENDS incendi, op cit.

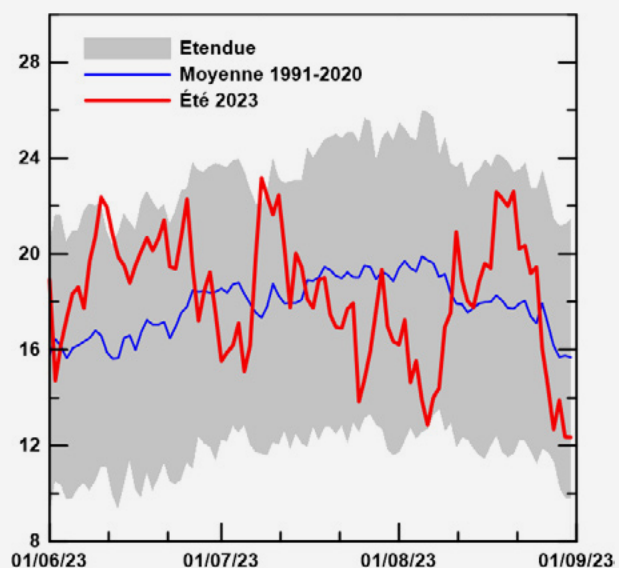


Luxembourg

2023 EXTREME WEATHER EVENTS

In 2023, the temperatures continued to rise. June marked the sixth-warmest June since observations began in 1838, with temperature anomalies ranging from $+2.6^{\circ}\text{C}$ to $+3.6^{\circ}\text{C}$.⁸⁴

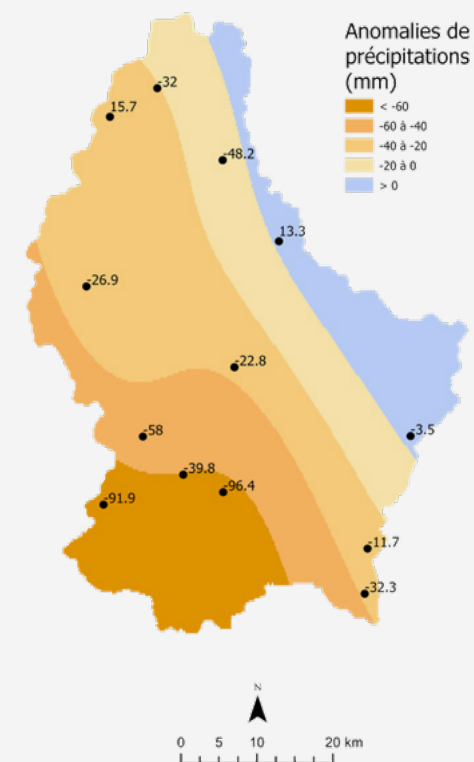
FIGURE 20: AVERAGE DAILY TEMPERATURE IN SUMMER 2023 COMPARED WITH THE REFERENCE PERIOD



Source: <https://gouvernement.lu/dam-assets/documents/actualites/2023/09-septembre/01-meteo/20230901-annexes-graphiques-agrimeteo-bilan-t-2023.pdf>

The precipitation levels across the country were notably below average. Figure 21 shows the difference between the winter precipitations of 2023 and those during the reference period (1991-2020). While the Northeast experienced normal rainfall, the rest of the country recorded lower levels of precipitation compared to the reference period. The Southwest was the most impacted, with precipitation levels lower than the reference period by more than 90 mm in some regions. By early July, Luxembourg faced the highest impact of drought among central European countries, with 100% of the country's land affected by drought.⁸⁵

FIGURE 21: DIFFERENCE BETWEEN WINTER 2022-2023'S TOTAL PRECIPITATIONS AND THOSE OF THE REFERENCE PERIOD



Source: [https://www.agrimeteo.lu/Internet/AM/themen_internet_LUAM.nsf/\(%20XP_LU_Aktuelles\)/1F4589C06B75AF4FC12589650053209C/\\$FILE/Bulletin_Hiver_2023.pdf](https://www.agrimeteo.lu/Internet/AM/themen_internet_LUAM.nsf/(%20XP_LU_Aktuelles)/1F4589C06B75AF4FC12589650053209C/$FILE/Bulletin_Hiver_2023.pdf)

⁸⁴ AgriMeteo. Bulletin météorologique ASTA Hiver 2022 – 2023. Retrieved 1 March 2024 from [https://www.agrimeteo.lu/Internet/AM/themen_internet_LUAM.nsf/\(%20XP_LU_Aktuelles\)/1F4589C06B75AF4FC12589650053209C/\\$FILE/Bulletin_Hiver_2023.pdf](https://www.agrimeteo.lu/Internet/AM/themen_internet_LUAM.nsf/(%20XP_LU_Aktuelles)/1F4589C06B75AF4FC12589650053209C/$FILE/Bulletin_Hiver_2023.pdf). ⁸⁵ Toussaint, T. (20 July 2023). All of Luxembourg affected by drought. RTL Today. Retrieved 1 March 2024 from <https://today.rtl.lu/news/luxembourg/a/2087662.html>.



Due to weather extremes, Luxembourg's farming community faced a significantly unfavourable outcome. The drought of May and June was followed by excessive rainfall in July and August. As a result, the harvest was severely affected: More than 90%⁸⁶ of the wheat harvested after the July/August period was ruled to be of insufficient quality for its original goal of bread production. Including other crops, the total harvest was 15% lower than in 2022.⁸⁷

Insurance against crop losses has risen as a result of these events, to the level that insured yield loss values have now reached approximately EUR 150 million.⁸⁸ This was not only fuelled by the losses in crop yields themselves, but also by decreasing prices for sellers and increasing costs of production.

IMPACT OF THESE EXTREME WEATHER EVENTS

Short-term impacts

In response to the growing frequency of extreme weather events in recent years, insurers have increased flood and catastrophe insurance premiums.⁸⁹ Some insurers have revised their cover, often enhancing it:

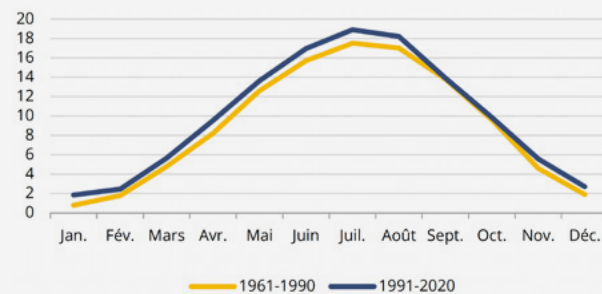
- Since March 2017, insurers have capped their cover for flood risk at EUR 20,000 in decennial risk zones and EUR 200,000 outside decennial risk zones (with the rest being covered by the state). However, some insurers have chosen to offer compensation beyond these limits.

- Some insurers also chose to eliminate deductibles and pay claims even if the damage does not exceed the usual thresholds.
- For professionals, some insurers have offered additional preventive measures, contingent on underwriting.⁹⁰

The pricing and contractual conditions, including limits and retention, for the renewal of reinsurance treaties for 2022 have become more stringent. This trend is expected to continue in the coming years, reflecting the heightened risk posed by climate change.⁹¹

A comparison of average temperatures between the 1961-1990 and 1991-2020 periods shows a consistent upward trend over the years. The most notable temperature difference is observed during spring and summer, with the average exceeding 0.9°C between 1991 and 2020.⁹²

FIGURE 22: AVERAGE TEMPERATURE RISE OF 0.9°C

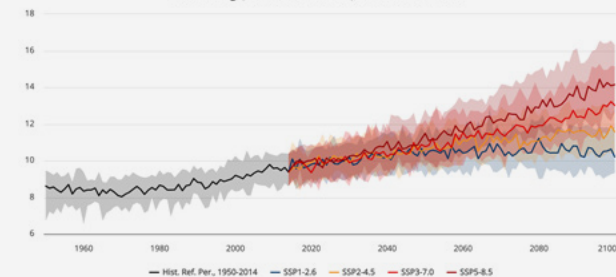


Source: <https://statistiques.public.lu/fr/publications/series/en-chiffres/2023/env-en-chiffres-2023.html>

Future projections indicate a continued rise in temperatures. In Figure 23, the black curve represents historically observed average temperatures, while the other curves show the evolution of temperatures modelled according to different Shared Socioeconomic Pathways (SSPs) climate change scenarios:⁹³

- SSP1-2.6: Low greenhouse gas (GHG) emissions, with CO2 emissions cut to net zero around 2075.
- SSP2-4.5: Intermediate GHG emissions/CO2, maintaining emissions around current levels until 2050, then decreasing but not reaching net zero by 2100.
- SSP3-7.0: High GHG emissions, with CO2 emissions doubling by 2100.
- SSP5-8.5: Very high GHG emissions, with CO2 emissions tripling by 2075.

FIGURE 23: PROJECTED AVERAGE MEAN SURFACE AIR TEMPERATURE (REF PERIOD: 1995-2014)



Source: <https://statistiques.public.lu/fr/publications/series/en-chiffres/2023/env-en-chiffres-2023.html>

⁸⁶ Hoscheid, M. (14 September 2023). Luxembourg's harvest season plagued by weather extremes. RTL Today. Retrieved 1 March 2024 from <https://today.rtl.lu/news/luxembourg/a/2114258.html>. ⁸⁷ Ibid. ⁸⁸ Ibid. ⁸⁹ CAA (30 November 2022). Note d'information n°22/11 relative à la situation un an après les inondations des 14-15 juillet 2021. Retrieved 1 March 2024 from https://www.caa.lu/uploads/documents/files/Note_info_22-11.pdf. ⁹⁰ Ibid. ⁹¹ Ibid. ⁹² <https://statistiques.public.lu/fr/publications/series/en-chiffres/2023/env-en-chiffres-2023.html>. ⁹³ Climate Change Knowledge Portal. Luxembourg: Climate Projections > Mean Projections. Retrieved 1 March 2023 from <https://climateknowledgeportal.worldbank.org/country/luxembourg/climate-data-projections>.



As indicated in the Europe Overview section in this report above, extreme precipitation and mean temperatures have increased in the past decade. With regard to precipitation in Luxembourg, in the 1991-2020 period winters have become wetter, while springs have become drier compared to the 1961-1990 period.⁹⁴ The drier springs in particular have potential consequences for the agricultural sector.

The rising temperatures contribute to increased evaporation and evapotranspiration, leading to heightened drought conditions. A comparison of drought indices between the 1961-1990 and 1991-2020 periods shows that in the latter period droughts have become both more frequent and more severe.⁹⁵

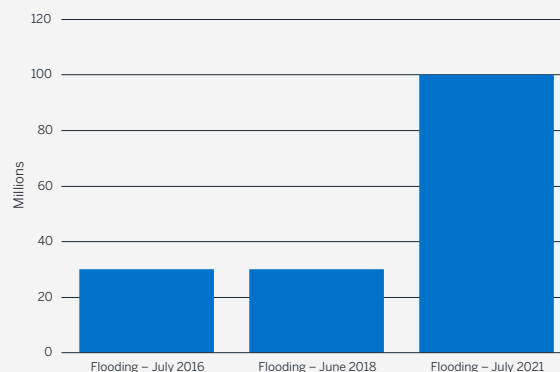
Extreme weather events have multiplied and intensified significantly in recent years. This trend is reflected in the scale of the public funds that have been allocated to cover the costs resulting from these climatic phenomena.⁹⁶

Insurance companies are also largely mobilised. Since 2016, they have disbursed EUR 362 million for consequences linked to climate-related disasters.⁹⁷

Longer-term impacts

After the floods of 2021, the government updated the flood zone and flood risk maps. The Flood Risk Management Plan (2017-2027), presented in 2021 and officially adopted in March 2023, focusses

FIGURE 24: TOTAL PUBLIC AID ALLOCATED TO NATURAL DISASTERS (IN € MILLIONS)



Source: <https://paperjam.lu>

on key aspects such as flood forecasting and the establishment of communal concepts for flash flood risk management.⁹⁸

To limit the negative consequences of climate change, the Ministry of the Environment, Climate and Sustainable Development has commissioned the establishment of a climate change adaptation strategy for Luxembourg. Measures have been developed for each identified sector.⁹⁹

For the economy sector, the government's measure is the adaptation of insurance services. The goal is to reduce agricultural vulnerability by providing insurance coverage against crop losses caused by climate-related factors, including high and irregular

rainfall and dry spells. The plan also addresses the risk of animal diseases, such as epizootics, through insurance.¹⁰⁰ To implement this measure, the government will take these steps:¹⁰¹

- Conduct an inventory of insurance coverage against crop loss and animal diseases, such as the types of production covered and the risks covered.
- Define a strategy based on the results of the inventory, in collaboration with the insurance sector.
- Define conditions for recourse to public aid in cases where damages are not covered by insurance.

Insurers are encouraging and supporting the transition efforts of their customers. For example, AXA Luxembourg implemented these initiatives to encourage environmentally friendly behaviour among policyholders.¹⁰²

- Offering a 15% to 25% reduction in premiums for hybrid and electric vehicles.
- Introducing new types of insurance, such as parametric insurance, designed to specifically address climate risk for farmers.
- Adding integrated coverage for new equipment such as photovoltaic panels and heat pumps.
- Establishing the AXA Climate School to train employees of businesses committed to a sustainable transition.

⁹⁴ Statistiques.lu. Environment in Figures: 2023 ed. Retrieved 10 March 2024 from <https://statistiques.public.lu/fr/publications/series/en-chiffres/2023/env-en-chiffres-2023.html>. ⁹⁵ Observatoire de la Politique Climatique. Annual Report 2022. Retrieved 1 March 2024 from https://environnement.public.lu/content/dam/environnement/documents/klima_an_energie/observatoire-politique-climatique/opc-ra-propositions-ok.pdf. ⁹⁶ Pailler, P. (26 January 2022). Will the climate crisis overwhelm insurers? Paperjam.lu. Retrieved 1 March 2024 from <https://paperjam.lu/article/crise-climatique-submergera-t->. ⁹⁷ Ibid. ⁹⁸ Government.lu (18 September 2023). Presentation of the 2018-2023 legislative report of the Ministry of the Environment, Climate and Sustainable Development. Retrieved 1 March 2024 from https://gouvernement.lu/fr/actualites/toutes_actualites/communiques/2023/09-septembre/18-presentation-bilan-legislature.html. ⁹⁹ Government of Luxembourg. Strategie et Plan D'Action: Pour L'Adaptation aux Effets du Changement Climatique au Luxembourg 2018-2023. Retrieved 3 March 2024 from https://environnement.public.lu/content/dam/environnement/documents/klima_an_energie/Strategie-Adaptation-Changement-climatique-Clean.pdf. ¹⁰⁰ Ibid. ¹⁰¹ Ibid. ¹⁰² Boob, A. (3 May 2022). "Only a radical change of all can limit climate risk." Paperjam.lu. Retrieved 3 March 2024 from <https://paperjam.lu/article/seul-changement-radical-tous-p->



The Netherlands

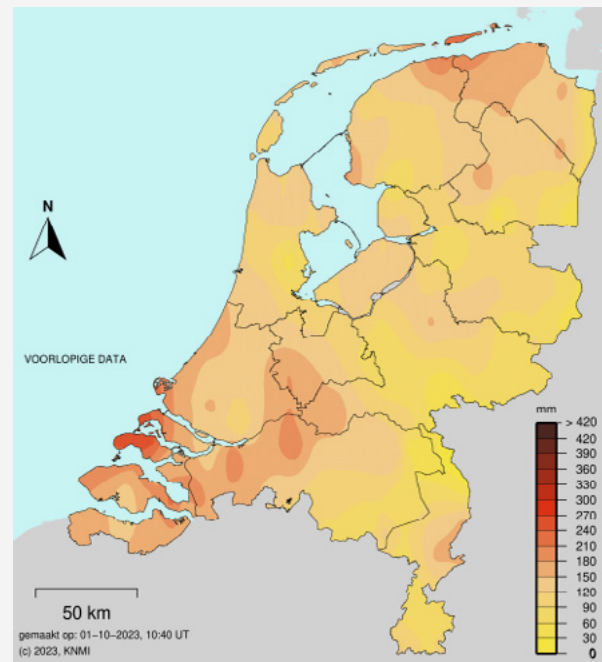
2023 EXTREME WEATHER EVENTS

In July 2023, the Netherlands was hit by summer storm Poly. The storm raged across the country, leaving a trail of damage and disruption:

- Poly stands out as one of the top seven most severe summer storms in over 50 years, according to the Royal Netherlands Meteorological Institute (KNMI).¹⁰³
- A wind gust reaching 146 km/h was recorded at the KNMI weather station IJmuiden, indicating a wind force 11—nearly equivalent to hurricane force.¹⁰⁴
- The storm took the life of one person, whose car was hit by a falling tree. In addition, several people were injured as a result of falling trees hitting cars and houseboats along canals.¹⁰⁵
- As of 6 July, just one day after the storm, Nationale-Nederlanden and the labels OHRA, ABN AMRO Insurance, ING Insurance and SNS Insurance received 600 damage reports and expected that number to increase.¹⁰⁶
- The Dutch Association of Insurers said that, according to initial estimates, “damage to homes, cars and commercial buildings due to storm Poly amounts to EUR 50 to 100 million.”¹⁰⁷

Climate change is also causing more frequent periods of drought. Although the 2023 drought period was not as severe as 2022, the precipitation deficit was significant in some areas of the country.

FIGURE 25: PRECIPITATION DEFICIT FROM APRIL TO SEPTEMBER 2023, BY GEOGRAPHICAL AREA¹⁰⁸

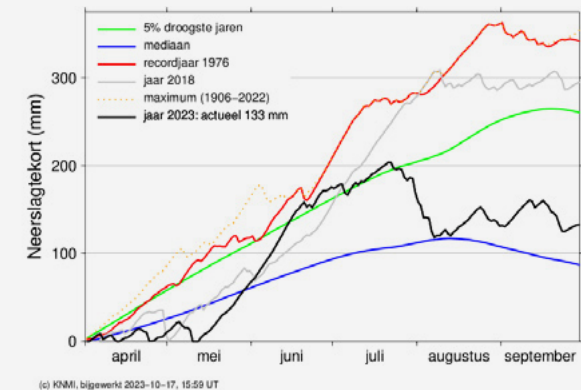


Source: <https://www.knmi.nl/nederland-nu/klimatologie/droogtemonitor>

¹⁰³ KNMI (5 July 2023). Very heavy summer storm Poly. Retrieved 3 March 2024 from <https://www.knmi.nl/over-het-knmi/nieuws/zeer-zware-zomerstorm-poly>.
¹⁰⁴ Ibid. ¹⁰⁵ Nationale-Nederlanden (6 July 2023). Damage reports from storm Poly. Retrieved 3 March 2024 from <https://www.nn.nl/nieuws/schademeldingen-storm-poly/>.
¹⁰⁶ RTL Today (& July 2023). Record storm cost up to 100 mn euros in damage: Dutch insurers. Retrieved 3 March 2024 from <https://today.rtl.lu/news/science-and-environment/a/2082835.html>.
¹⁰⁷ RTL Today (& July 2023). Record storm cost up to 100 mn euros in damage: Dutch insurers. Retrieved 3 March 2024 from <https://today.rtl.lu/news/science-and-environment/a/2082835.html>.
¹⁰⁸ KNMI. Drought monitor. Retrieved 3 March 2024 from <https://www.knmi.nl/nederland-nu/klimatologie/droogtemonitor>.

The precipitation deficit during the summer was significantly higher than the median value calculated over the 1906-2022 period. June and July were particularly dry, with the deficit exceeding that of the 5% driest years.

FIGURE 26: PRECIPITATION DEFICIT IN 2023 COMPARED TO HISTORICAL DATA



Source: <https://www.knmi.nl/nederland-nu/klimatologie/droogtemonitor>



In July 2023 the De Bilt station registered the longest-ever recorded drought period, lasting 34 consecutive days.¹⁰⁹

Additionally, notable high temperatures were observed during September 2023:

- With an average temperature of 17.5°C, September 2023 was the second-warmest September since measurements began in 1901. September 2006 in De Bilt was the only warmer September.¹¹⁰
- On 10 September, the highest temperature of the month (32.2°C) was recorded in Eindhoven and Eil, marking the warmest week of 2023. Such an exceptionally warm week occurs very rarely, with a likelihood of just 2% in the current climate—equivalent to once every 50 years or even less frequently.¹¹¹
- September 2023 also landed in the top 10 sunniest September months, with about 210 hours of sunshine across the country, surpassing the normal number of sunny hours, which is 159.¹¹²

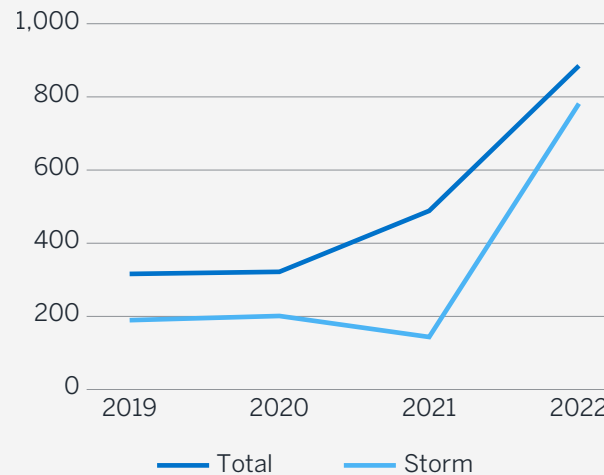
IMPACT OF THESE EXTREME WEATHER EVENTS

Short-term impacts

Due to the increasing frequency of extreme weather events, reinsurance premiums are rising and insurers are raising their premiums to pass on the additional costs to their policyholders. For example:

- Achmea experienced a 10% hike in reinsurance premiums, leading to CEO Bianca Tetteroo announcing that it is inevitable that part of the extra costs will be transferred to customers through increased premiums.¹¹³
- Alchemia is also increasing deductible amounts in response to escalating physical risks.¹¹⁴
- Notably, various insurers, primarily in the private insurance sector, have expanded their coverage with respect to flood risk.¹¹⁵

FIGURE 27: WEATHER DAMAGE PER YEAR (IN € MILLIONS)

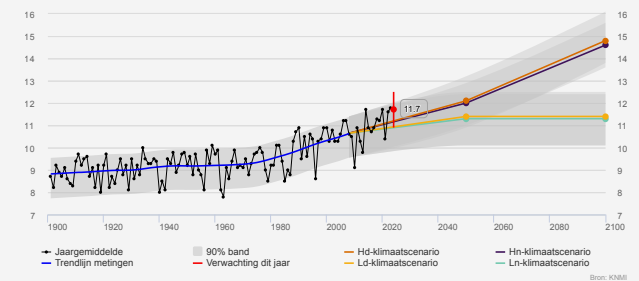


Source: <https://bijpublic.verzekeraars.nl/Home/ShowReport/5beb3391-1660-4b40-a9d5-6982d8cae31f>

Overall, the cost of insurance for weather-related damage is on the rise in the Netherlands.¹¹⁶ This increase is particularly driven by storms.

Temperature measurements reveal a consistent upward trend, as indicated by the blue line in Figure 28. Over the 1901-2022 period, the average annual temperature in De Bilt has increased by more than 2°C.¹¹⁷ All four KNMI climate scenarios—Hd (high CO2 emissions for dry days), Hn (high CO2 emissions for wet days), Ld (low CO2 emissions for dry days) and Ln (low CO2 emissions for wet days)—indicate a further rise in the average annual temperature in De Bilt.

FIGURE 28: ANNUAL AVERAGE TEMPERATURE IN °C



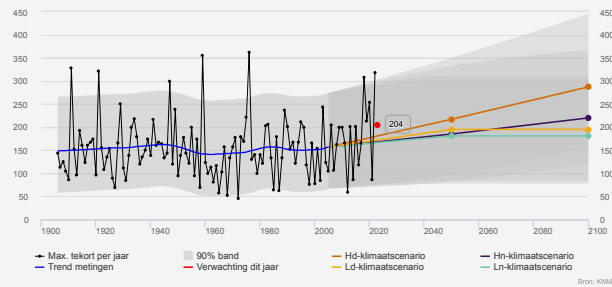
Source: <https://www.knmi.nl/kennis-en-datacentrum/achtergrond/achtergrondinformatie-klimaatdashboard>

¹⁰⁹ Dutch News (15 June 2023). New weather record set, no rain for 34 days, but storms ahead. Retrieved 3 March 2024 from <https://www.dutchnews.nl/2023/06/new-weather-record-set-no-rain-for-34-days-but-storms-ahead/>. ¹¹⁰ KNMI (2 October 2023). September second warmest since 1901. Retrieved 3 March 2024 from <https://www.knmi.nl/over-het-knmi/nieuws/september-2023>. ¹¹¹ Ibid. ¹¹² Ibid. ¹¹³ NL Times (24 August 2023). Extreme weather will cause insurance premiums to rise higher, Achmea warns. Retrieved 3 March 2024 from <https://nltimes.nl/2023/08/24/extreme-weather-will-cause-insurance-premiums-rise-higher-achmea-warns>. ¹¹⁴ Ibid. ¹¹⁵ Verbond van Verzekeraars. Flood. Retrieved 3 March 2024 from <https://www.verzekeraars.nl/verzekeringsthemas/klimaatbestendig-nederland/klimaat/infographic-verzekerbaarheid-klimaatrisico-s/overstroming>. ¹¹⁶ Verbond van Verzekeraars (2 May 2023). Klimatschademonitor. Retrieved 3 March 2024 from <https://bijpublic.verzekeraars.nl/Home/ShowReport/5beb3391-1660-4b40-a9d5-6982d8cae31f>. ¹¹⁷ KNMI (9 October 2023). Background information climate dashboard. Retrieved 3 March 2024 from <https://www.knmi.nl/kennis-en-datacentrum/achtergrond/achtergrondinformatie-klimaatdashboard>.



The trend in precipitation deficit measurements is also rising, as indicated by the blue line in Figure 29. Future projections from all four KNMI climate scenarios indicate a continued rise in the maximum precipitation deficit for the period from April to September.¹¹⁸

FIGURE 29: MAXIMUM PRECIPITATION DEFICIT APRIL–SEPTEMBER IN MILLIONS



Source: <https://www.knmi.nl/klimaatdashboard>

Longer-term impacts

The government is currently working on updating the National Climate Adaptation Strategy (NAS). This follows the revised KNMI climate scenario set, which was published in October 2023. In this update a climate change adaptation monitoring framework will be included. In addition, the most recent risk assessments and adaptation measures are listed in the 2023 Delta Programme.¹¹⁹

Aligned with the EU legal framework for climate adaptation, the Netherlands has established a legal and regulatory framework for climate mitigation and adaptation regulations and guidelines. At the national level, the Netherlands has implemented a series of policies which are meant to be a complement to policies designed on the EU level. Among other points, these policies are revisions on the CO₂ levy for industry, energy and car taxes, CO₂ prices for power generation, additional investments in the infrastructure for green technologies and more strict regulatory and reporting requirements.¹²⁰

In the Netherlands, flood risk associated with large rivers and the sea is not currently insured. Insurers are actively working on developing a solution to address potential damage in the event of a large river breaching the dikes. There are also plans for the establishment of, for instance, a public-private international reinsurance pool in which (re)insurers would share the risk of such damages.¹²¹

Several Dutch insurers have joined international alliances under the United Nations to tackle the transition to net-zero greenhouse gas (GHG) emissions by 2050. Notable alliances include the Net Zero Asset Owner Alliance (NZAOA) and the Net Zero Insurance Alliance (NZIA).¹²²

Collaboratively, the Institute for Environmental Studies (IVM) and the Dutch Association of Insurers are working together to combat the consequences of climate change. This partnership aims to align research into climate risks with practical strategies.¹²³

¹¹⁸ Ibid. ¹¹⁹ International Monetary Fund. European Dept. (9 March 2023). Assessing Recent Climate Policy Initiatives in the Netherlands. Retrieved 3 March 2024 from <https://www.elibrary.imf.org/view/journals/002/2023/107/article-A002-en.xml>.

¹²⁰ Ibid. ¹²¹ Verbond van Verzekeraars. Insurers take next step in insuring flooding by large river or sea. Retrieved 3 March 2024 from <https://www.verzekeraars.nl/en/publications/news/insurers-take-next-step-in-insuring-flooding-by-large-river-or-sea>. ¹²² Deloitte. What are Dutch insurers doing to avoid climate change? Retrieved 3 March 2024 from <https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/financial-services/deloitte-fsi-what-are-dutch-insurers-doing-to-avoid-climate-change.pdf>. ¹²³ Verbond van Verzekeraars. Insurers and science join forces to combat climate change. Retrieved 3 March 2024 from <https://www.verzekeraars.nl/en/publications/news/insurers-and-science-join-forces-to-combat-climate-change>.



Poland

2023 EXTREME WEATHER EVENTS

Extreme weather events in Poland are intrinsically linked to the country's climate, encompassing torrential rains, hail, hurricane winds, floods and droughts. Historically, these events occurred cyclically every few years. However, in the past decade, there has been a notable increase in the frequency of droughts, shifting from an average occurrence every five years to every two and a half years. The distribution of extreme weather-related interventions by the fire service indicate that strong winds predominantly affect the Silesian and Masovian voivodeships, while torrential rains impact the southern regions.¹²⁴

In the previous decade, Poland's most severe weather events were floods and the country had to contend with the effects of excess water. In recent years, the biggest problem is drought. Agriculture, in particular, bears the brunt of this issue, incurring the highest losses.¹²⁵

The extreme weather events in 2023 included snowstorms, whirlwinds, droughts, heat waves and torrential rains. The Institute of Meteorology and Water Management – National Research Institute monitors Poland's climate through observations and measurements. It actively informs the public about threats resulting from climate variability and change.¹²⁶

A comprehensive list of extreme weather events has been consistently included in the Climate of Poland reports, published since 2020.¹²⁷ According to the analysis, the air temperature in selected large Polish cities has increased by 1.49°C to 2.30°C in the last century. Notably, the rate of temperature increase in large urban agglomerations has risen significantly over the past 40 years.

The number of extreme weather events reported in Poland over the last few years include:

- 35 in 2020: 23 local, 12 countrywide
- 39 in 2021: 26 local, 13 countrywide
- 27 in 2022: 14 local, 13 countrywide



Droughts are becoming more common in Poland, and 2023 agricultural yields were 20% below average.

¹²⁴ IOS-PIB. Atlas skutków zjawisk ekstremalnych w Polsce. Retrieved 3 March 2024 from https://klimada2.ios.gov.pl/files/2023/Atlas_skutkow_zjawisk_ekstremalnych_w_Polsce.pdf. ¹²⁵ ADMS (2023). Potential zones of drought: Winter cereals. Retrieved 3 March 2024 from https://susza.iung.pulawy.pl/en/mapy/2023.06.Zb_oz/. ¹²⁶ Instytut Meteorologii i Gospodarki Wodnej Państwowego Instytutu Badawczego. Temperatura Powietrza. Retrieved 3 March 2024 from https://modele.imgw.pl/cmm/?page_id=18489. ¹²⁷ Meteo IMGW-PIB. Klimat Polski 2022. Retrieved 3 March 2024 from https://www.imgw.pl/sites/default/files/inline-files/klimat-polski-2022_raport-koncowy-3.pdf.



All 2023 events share the same characteristics with those in previous years. They include severe local thunderstorms with hail and very strong wind gusts, leading to numerous floods (including flash floods caused by thunderstorms passing locally one right after another over the same area), heat waves, cold waves and heavy snowfalls with severe frost, blizzards and blowing snow causing icing conditions and glaze ice.¹²⁸

Additionally, statistics compiled by the Centre for Research on the Epidemiology of Disasters indicate that heat waves have been the leading cause of deaths due to extreme weather events in Poland, accounting for 90% of all deaths due to extreme weather events.¹²⁹

IMPACT OF THESE EXTREME WEATHER EVENTS

Short-term impacts

Extreme weather events result in annual losses ranging from 0.1% to 0.4% of Poland's gross domestic product (GDP), equating to an annual average cost of EUR 1.4 billion. The cumulative direct losses over the last two decades are estimated at EUR 27 billion (PLN 115 billion). Assuming a 60% loading on indirect losses, the total impact of natural disasters in the last 20 years amounts to EUR 43 billion (PLN 180 billion).

In years marked by severe events, the losses can escalate up to 0.5% to 1.0% of Poland's GDP. In 2023, agricultural droughts caused more than a 20% drop in yields compared to long-term average weather conditions.

The sector most impacted by extreme weather in Poland is agriculture, accounting for over 50% of total losses during the 2001-2019 period. The economic impact is evident, with losses amounting to PLN 1 billion, particularly due to spring frosts.

Long-term impacts

The Polish government has implemented various measures to manage and mitigate the impact of extreme weather events, including:

- The Retention Development Programme (2021-2027 with an outlook to 2030) and the Drought Plan: Investments under these plans adhere to the Guide to Investment Preparation with respect to climate change mitigation and adaptation, and resilience to natural disasters.¹³⁰
- Urban adaptation plans 2017-2019: The Ministry of Environment collaborated with local authorities and climate change experts to prepare urban adaptation plans for the 44 largest cities in Poland. These plans focus on addressing the threat of urban floods, water management programmes, heating supply systems and urban vegetation.

- Water Act provisions: Flood prevention measures align with the provisions of the Water Act, with investment decisions based on risk and broader flood risk management plans. The state water company Wody Polskie reported that the national water retention level has exceeded 7%, with a plan to reach 15% of average annual water outflow.¹³¹ Ongoing investments span 300 projects with a budget of EUR 4.7 billion and additional investments to follow in the future. Completed projects include more than 200 km of flood embankments and the construction of nine new water basins with a total capacity of almost 200 million m³.¹³²



Severe thunderstorms caused flash flooding in Poland.

¹²⁸ IMGW. Zjawiska ekstremalne. Retrieved 3 March 2024 from https://cmm.imgw.pl/cmm/?page_id=37030. ¹²⁹ IOS-PIB. Atlas skutków zjawisk ekstremalnych w Polsce, op cit., p. 21. ¹³⁰ Polska Izba Ubezpieczeń (2023). Klimat Rosnących Strat. Retrieved 3 March 2024 from https://piu.org.pl/wp-content/uploads/2023/07/PIU-raport-klimatyczny-2023_27-lipca_premiera.pdf. ¹³¹ Portal Samorządowy (22 March 2023). Polish Waters: Thanks to investments, the amount of retained water is increasing. Retrieved 3 March 2024 from <https://www.portalsamorzadowy.pl/finanse/wody-polskie-dzieki-inwestycjom-rosnie-ilosc-zatrzymywanej-wody,449378.html>. ¹³² Instytut Meteorologii i Gospodarki Wodnej Państwowego Instytutu Badawczego. Temperatura Powietrza, op cit.



Portugal

2023 EXTREME WEATHER EVENTS

Throughout most of 2023, Portugal experienced warmer-than-average temperatures and very dry conditions. By February, the trend of drought had already begun, with Portugal only receiving 11% of its normal precipitation for the month. This resulted in a significant decrease in groundwater levels, with most regions registering values below 60%.¹³³

Spring in Portugal was characterised by extreme heat and dry conditions, ranking as the second-hottest and the third-driest spring since 1931.¹³⁴ April, in particular, witnessed three heat waves spanning most of the month and impacting a large part of the country. The average air temperature in April exceeded the normal value for the 1971-2000 period by 3.43°C, and the average air temperature reached a record high of 23.8°C.¹³⁵ By the end of spring, all of continental Portugal was in a state of meteorological drought, with 35% of the territory classified as severe and extreme drought.

The summer of 2023 in Portugal continued the trend of extreme heat, particularly the months of June and August. A heat wave from 23 to 28 June saw temperatures reach 7°C above normal maximum and 5°C above normal minimum temperatures. August 2023 ranked as the fifth-hottest August since 1931, with 22 and 23 August marking the fifth- and sixth-hottest days in mainland Portugal over the past 15 years.¹³⁶

Portugal experienced heavy thunderstorms and hail during the first two weeks of June, which severely impacted the agricultural sector. Despite significant precipitation in June, high temperatures resulted in increased evaporation and ultimately drier soil. The drought worsened in July and August, when there was only 3.0 mm and 3.7 mm of rainfall, respectively. By the summer's end, 97% of Portugal was affected by drought, with 46% of the country experiencing severe and extreme drought. The Tagus Valley, Alentejo and the Algarve were the most severely affected regions.¹³⁷



By the end of spring 2023, all of continental Portugal was in a drought.

¹³³ IPMA. February 2023. Retrieved 3 March 2024 from https://www.ipma.pt/resources.www/docs/im.publicacoes/edicoes.online/20230307/NuFJcyledGEfrNzWqjOV/cli_20230201_20230228_pcl_mm_co_pt.pdf. ¹³⁴ IPMA (19 September 2023). Boletim Sazonal: Primavera 2023 Retrieved 3 March 2024 from https://www.ipma.pt/resources.www/docs/im.publicacoes/edicoes.online/20230919/EkCgVCaYRESouBillVeg/cli_20230301_20230531_pcl_sz_co_pt.pdf. ¹³⁵ IPMA. April 2023. Retrieved 3 March 2024 from https://www.ipma.pt/resources.www/docs/im.publicacoes/edicoes.online/20230509/mWDFUZwEUUvQeBnjjPcO/cli_20230401_20230430_pcl_mm_co_pt.pdf. ¹³⁶ IPMA (20 October 2023). Boletim Sazonal: Verão 2023. Retrieved 3 March 2024 from https://www.ipma.pt/resources.www/docs/im.publicacoes/edicoes.online/20231020/GVxZLnQxfBxBRvsKYzmV/cli_20230601_20230831_pcl_sz_co_pt.pdf. ¹³⁷ Ibid.



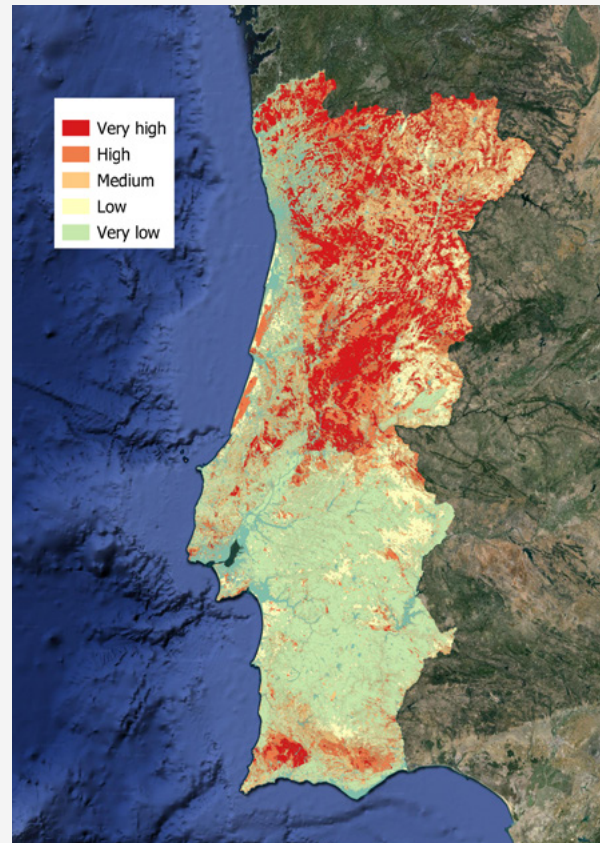
As in previous years, wildfires continued to impact Portugal in 2023. Notably, at the beginning of August, a wildfire blazed through the municipality of Odemira in Portugal's Alentejo region. About 1,000 firefighters were mobilised to battle the fire and approximately 1,400 people were evacuated. This wildfire destroyed over 7,000 hectares of land.¹³⁸ In total, about 35,000 hectares burned due to wildfires in Portugal in 2023.¹³⁹

IMPACT OF THESE EXTREME WEATHER EVENTS

Short-term impacts

Wildfires have become one of Portugal's biggest concerns in terms of climate risk in recent years. The 2017 wildfires, which burned over 560,000 hectares, were among the most devastating weather events in Portugal's history, causing at least 66 deaths and resulting in insurance claim costs of nearly EUR 250 million. It is important to note Portugal's high protection gap, which means that the total cost of these events was even higher.¹⁴⁰

FIGURE 30: WILDFIRE HAZARD IN PORTUGAL



Source: Direção-Geral do Território

The drought in Portugal has significantly impacted the agricultural sector, with visible effects noted as of May 2023. The hardest-hit areas were livestock farming due to a lack of pasture, as well as cereal and rice production, which incurred losses up to EUR 15 million and EUR 10 million, respectively.¹⁴¹ These losses are expected to add to the 12% drop in agricultural activity recorded in 2022. The Confederation of Portuguese Farmers (CAP) stated that, as a result of reduced production and rising production costs, price increases are inevitable. This trend was evident in 2022, when the price of olive oil increased by 50% compared to the previous year.¹⁴²

In June, the Ministry of the Environment and Climate Action responded to the worsening drought situation by implementing water restrictions in the Algarve. At the Odeleite-Beliche dam, these measures included a 20% reduction in water usage for agriculture and golf courses. The Portuguese Environment Agency (APA) also established a task force for the Algarve with the objective of reviewing the water resource usage permits that had been granted in the region.¹⁴³

These measures are in accordance with Portugal's preexisting drought management plan (PGSE), created to mitigate the environmental, social and economic effects of drought. The plan also aims to increase resilience in situations of drought and emphasises the importance of efficient water use.¹⁴⁴

¹³⁸ Demony, C. & Pereira, M. (8 August 2023). Wildfire rages for fourth day in southern Portugal, 1,400 people evacuated. Reuters. Retrieved 3 March 2024 from <https://www.reuters.com/world/europe/more-than-1000-evacuated-portugal-wildfire-spreads-2023-08-08/>. ¹³⁹ Copernicus. EFFIS Estimates for European Union. Retrieved 3 March 2024 from <https://effis.jrc.ec.europa.eu/apps/effis.statistics/estimates>. ¹⁴⁰ Autoridade de Supervisão de Seguros e Fundos de Pensões (2023). Relatório Anual de Exposição ao Risco Climático. Retrieved 3 March 2024 from <https://www.asf.com.pt/documents/42559/2647388/RERC23.pdf/7f0853c6-639c-2bab-a9f1-be25ca0e1a4a?version=1.0&t=1704279463677>. ¹⁴¹ Teixeira, F. (8 May 2023). Drought: Impact on agriculture with thousands of euros of losses. CNN Portugal. Retrieved 3 March 2024 from <https://cnnportugal.iol.pt/videos/seca-impacto-na-agricultura-com-milhares-de-euros-de-prejuizos/64595a1e0cf2cf922505f6a9>. ¹⁴² Sousa, J. (19 May 2023). Farmers anticipate "huge losses" because of the drought. Prices may rise, but shortages are rejected. Sapo. Retrieved 3 March 2024 from <https://eco.sapo.pt/2023/05/19/agricultores-anticipam-perdas-enormes-por-causa-da-seca-precos-podem-subir-mas-rejeita-se-escassez/>. ¹⁴³ Bruxo, M. (2 June 2023). Government imposes water restrictions in Algarve. Portugal Resident. Retrieved 3 March 2024 from <https://www.portugalresident.com/government-imposes-water-restrictions-in-algarve/>. ¹⁴⁴ APA. Drought and Shortage Management Plans. Retrieved 3 March 2024 from <https://pambiente.pt/agua/planos-de-gestao-de-seca-e-escassez>.



Long-term impacts

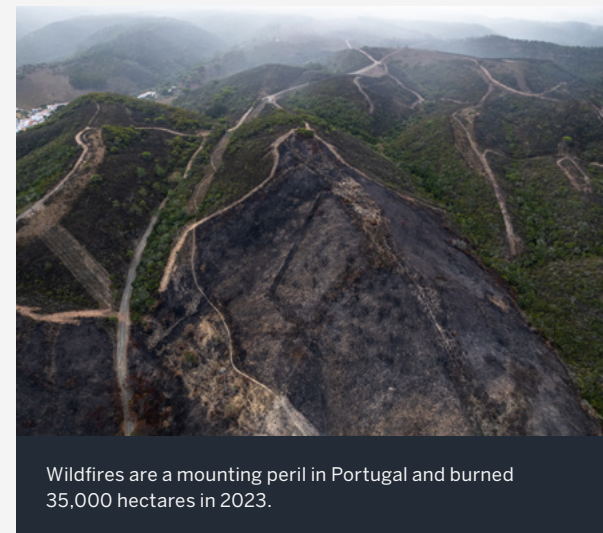
The Portuguese government has implemented several national plans to deal with and mitigate the long-term impacts of climate change. The Climate Law (Law no. 98/2021) consolidates objectives, principles and obligations across different levels of governance for climate action through public policies and establishes new provisions in terms of climate policy. Notably, Article 35 of this law outlines several measures for the consideration of climate risk and climate impact by public and private institutions. It requires that regulatory and supervisory entities submit annual reports on insurers' exposure to climate risk.¹⁴⁵

The National Energy and Climate Plan (PNEC 2030) lays out a transition strategy for the 2021-2030 period, in alignment with broader goals established by the European Union. The plan establishes targets for greenhouse gas emissions and renewable energy use, among others, in an effort to ensure that overall global warming does not exceed 1.5°C. In 2023, Portugal revised its plan to include more ambitious targets, such as requiring 80% of the energy produced in national territory to be of renewable origin by 2026. Portugal has also committed to achieving climate neutrality by 2045, compared to the previous goal of 2050. To meet these goals, Portugal will invest EUR 75 billion in green energy production projects.¹⁴⁶

Regarding wildfires, the Portuguese government has recognised that climate change is a key driver of the increasing risk that exists within the country. In response, the National Plan for Integrated Rural Fire Management was published in 2020. The plan establishes a vision for protecting Portugal from severe wildfires by focussing on prevention methods, including education on how community behaviours can help reduce risk, as well as the implementation of a vegetation management programme to prevent the spread of wildfires.¹⁴⁷

The insurance sector in Portugal has taken steps to assess the impact of extreme weather events and climate change on its activity. The Portuguese Insurance Association (APS) periodically publishes data related to the impact of extreme events on insurance portfolios for various lines of business.¹⁴⁸ In 2014, the APS also worked with the University of Lisbon to create flood risk maps under different climate change scenarios.¹⁴⁹

In terms of individual insurers, some are beginning to consider climate risk in annual reports. For example, a leading Portuguese insurer's "2022 Integrated Management Report" outlined the insurer's risks and opportunities related to climate change and the transition to a carbon-neutral economy. This insurer also established the objective of quantifying potential losses resulting from physical and transition risks under various climate change scenarios in the coming years.¹⁵⁰



Wildfires are a mounting peril in Portugal and burned 35,000 hectares in 2023.

¹⁴⁵ The full text of the Climate Law is available at <https://files.dre.pt/1s/2021/12/25300/0000500032.pdf>. ¹⁴⁶ Portugal.gov.pt (30 June 2023). A greener country, sooner: The National Energy and Climate Plan 2030 is being reviewed for the first time (video). Retrieved 3 March 2024 from <https://www.portugal.gov.pt/pt/gc23/comunicacao/noticia?i=-um-pais-mais-verde-mais-cedo-o-plano-nacional-de-energia-e-clima-2030-esta-a-ser-revisto-pela-primeira-vez>. ¹⁴⁷ AGIF (2020). 20-30 National Plan for Integrated Rural Fire Management. Retrieved 3 March 2024 from https://www.agif.pt/app/uploads/2020/12/20-30_NPIRFM_littledoc.pdf. ¹⁴⁸ APS. Extreme events in Portugal. APS Technical Studies. Retrieved 3 March 2024 from <https://www.apseguradores.pt/pt/publica%C3%A7%C3%B5es/estudos-t%C3%A9cnicos-aps/articleid/405/eventos-extremos-em-portugal>. ¹⁴⁹ APS. Flood Risk and Vulnerability Mapping in Climate Change Scenarios. CIRAC. Retrieved 3 March 2024 from <https://www.apseguradores.pt/Portals/0/doc/estudos/brochura-cirac-en%20-%20PORTAL.pdf?ver=2019-03-21-154635-070>. ¹⁵⁰ Fidelidade. (2022). Integrated management report. Retrieved 11 March 2024 from <https://www.fidelidade.pt/EN/fidelidade/investor-relations/announcements-and-reports/Documents/Sustainability/Integrated%20Management%20Report%202022.pdf>



Romania

2023 EXTREME WEATHER EVENTS

On 18 February, heavy flooding in the northern part of Romania caused severe damage to roads and interruption of rail services in Bistrița and Maramureș counties. This event resulted in destruction of homes and of farmland-triggering landslides, as well as destruction to rail and roads. In particular, a new section of the road that had been rebuilt two years earlier with EUR 2 million of European Union funds was severely damaged. The damage specifically raised concerns about the effectiveness of the drainage systems, prompting mitigating actions meant to evaluate and upgrade.



June heat and drought led to wildfires and crop loss in Romania.

On 25 June, a brief period of heavy rainfall triggered severe flooding in Arad County, an area located in the western part of Romania. This resulted in evacuations, damaged homes and vehicles, blocked roads, and one death.

In mid-June, Romania experienced severe and widespread vegetation stress due to the combined effects of a severe lack of precipitation and higher-than-normal temperatures. Due to the July and August heat waves, temperatures exceeded 40°C in some areas, increasing wildfire risk as well as expanding wildfires in areas, resulting in reduced crop yield.

IMPACT OF THESE EXTREME WEATHER EVENTS

Short-term impacts

Romania is part of the European Union's Floods Directive, which aims to reduce and manage flood risks in Europe. The European Union provided financial assistance to Romania to help with flood recovery efforts. Additionally, the Romanian government has provided emergency aid to the affected areas to support the recovery of road and rail infrastructure as well as aid to households.

Various implemented measures mitigated the impact of floods, including dams and dikes, reforestation initiatives and the establishment of early warning systems; however, many challenges remain, including the need for improved flood risk management due to the anticipated impact of climate change and its expected increase in the frequency and intensity of extreme weather events, including floods. The government has worked with international experts to update flood hazard and risk maps which



help identify areas most vulnerable to floods, enabling the planning of appropriate measures to reduce flood impact.

While not directly linked to the floods, noteworthy changes in 2023 included changes made to the Romanian compulsory insurance of housing against earthquakes, landslides and floods legislation, also known as the PAD law. This law regulates among other things the constitution, organisation and functioning of the Insurance Pool against Natural Disasters (PAID), which issues PAD policies for the risks mentioned above. These changes included among other things increases in policy prices. For example, the price of compulsory insurance for type A dwellings (reinforced concrete, metal or wood dwellings or with exterior walls made of stone, burnt brick, wood or other materials treated thermally and/or chemically) increased from EUR 20 to RON 130 (approximately EUR 26) per year, a 30% increase, to be more in line with increasing costs. Changes to the law were adopted by the Chamber of Deputies on 12 April 2023, and were promulgated by the President of Romania on 10 May 2023. They took effect six months after their publication in the Official Gazette on 11 May 2023 (specifically they took effect on 12 November 2023).

Longer-term impacts

Romanian insurers and the Romanian government are implementing a range of measures to mitigate flood risk. These measures include:

- Continuing attempts to offer insurance products that cover both natural and man-made disasters and attempts to revise the obligatory household legislation to increase penetration.
- Supporting the development and utilisation of flood hazard and risk maps. These maps provide information about areas with potential significant flood risk, along with projections of expected damages and losses in various scenarios.
- Investing in innovative technologies and data platforms to provide access to real-time data on weather conditions and emergency response.
- Collaboration with the World Bank and the Global Facility for Disaster Reduction and Recovery to leverage risk information solutions and other innovative solutions to reduce risk and improve emergency response capabilities.
- Collaboration with the World Bank meant for the modernisation of nationwide emergency infrastructure to ensure that first responders can rely on safer and more resilient response facilities.
- Enhancing awareness and preparedness among the population with campaigns and training programmes focussed on disaster risk reduction and resilience.



In 2023, Romania changed its compulsory insurance of housing against landslides, earthquakes, and floods legislation, also known as the PAD law.



Spain

2023 EXTREME WEATHER EVENTS

The spring of 2023 was Spain's hottest on record, with the average temperature in the peninsular region reaching 14.2°C—1.8°C higher than the seasonal average. Particularly noteworthy were the exceptionally high temperatures in late April, when a hot and dry air mass from North Africa entered the peninsula, resulting in temperatures exceeding 35°C in various parts of the south. Spring 2023 was also the second-driest spring on record, especially March and April, when precipitation plummeted to only 36% and 22% of the normal values for these months, respectively.^{151, 152, 153}

The summer of 2023 was also very hot, continuing the trend of increasingly hotter summers. Spain experienced its hottest August on record in 2023, with average maximum temperatures soaring to 2.2°C above normal values. Two prolonged heat waves with temperatures surpassing 40°C impacted most of the country, and temperatures reached 45°C in parts of the Valencia and Andalusia regions.¹⁵⁴

Throughout the year, Spain experienced widespread drought. By September, 14.6% of the country was declared by the government as being under emergency due to water shortages and an additional 27.4% was under alert. Spain's water reserves were especially low, at just 37% of total capacity.¹⁵⁵

Wildfires continued to be a persistent issue in Spain during the hotter months. As of October, Spain ranked third in the EU for the largest burned area in 2023, with over 85,000 hectares. While this figure marks a substantial reduction from the devastating wildfire season of 2022, where 306,555 hectares were burned, the early onset of Spain's wildfire season in 2023 was attributed to the spring's high temperatures and lack of rainfall.¹⁵⁶



Wildfires, including blazes on the Canary Islands, burned more than 85,000 hectares in Spain.

¹⁵¹ AEMET (18 April 2023), Resumen Mensual Climatológico: March 2023. Retrieved 4 March 2024 from https://www.aemet.es/documentos/es/serviciosclimaticos/vigilancia_clima/resumenes_climat/mensuales/2023/res_mens_clim_2023_03.pdf.
¹⁵² AEMET (19 May 2023), Resumen Mensual Climatológico: April 2023. Retrieved 4 March 2024 from https://www.aemet.es/documentos/es/serviciosclimaticos/vigilancia_clima/resumenes_climat/mensuales/2023/res_mens_clim_2023_04.pdf.
¹⁵³ AEMET, Resumen Mensual Climatológico: Primavera 2023. Retrieved 4 March 2024 from https://www.aemet.es/documentos/es/serviciosclimaticos/vigilancia_clima/resumenes_climat/estacionales/2023/Est_primavera_23.pdf.
¹⁵⁴ AEMET (9 September 2023), Resumen Mensual Climatológico: August 2023. Retrieved 4 March 2024 from https://www.aemet.es/documentos/es/serviciosclimaticos/vigilancia_clima/resumenes_climat/mensuales/2023/res_mens_clim_2023_08.pdf.
¹⁵⁵ MITECO (2023), El 14,6% del territorio está en emergencia por escasez de agua y el 27,4%, en alerta. Retrieved 4 March 2024 from <https://www.miteco.gob.es/content/dam/miteco/es/prensa/23.09.12.%20NdP.%20EI%2014,6%20por%20ciento%20del%20territorio%20est%20en%20emergencia%20por%20escasez%20de%20agua%20y%20el%2027,4%20por%20ciento,%20en%20alerta.pdf>.
¹⁵⁶ Copernicus, EFFIS Estimates for European Union, op cit.



- The first large wildfire of the year occurred at the end of March in the Alto Mijares region, impacting the provinces of Castellón and Teruel. Asturias also experienced a surge of over 200 wildfires in late March and early April, with 13 classified as large wildfires.¹⁵⁷
- The worst wildfire of the year occurred on the island of Tenerife, burning over 15,000 hectares and promoting widespread evacuations. The fire began in mid-August and was mostly contained throughout September; however, it was reactivated in early October due to high temperatures and dry conditions.¹⁵⁸

From 2 to 4 September, Spain endured severe precipitation and widespread flooding due to a depression that originated off the northwestern coast. While most of the country was impacted, the hardest-hit areas were the southern province of Cádiz and the centre of the peninsula, where total precipitation exceeded 150 mm.¹⁵⁹ This flooding event caused eight fatalities and extensive material damages to infrastructure, buildings and crops.¹⁶⁰ Notably, the force of the water's current, intensified by heavy rainfall, resulted in the collapse of multiple bridges in Aldea del Fresno, Madrid.¹⁶¹ Although

the rainfall provided some relief from the country's drought, it was not enough to solve the ongoing water shortage issues.

IMPACT OF THESE EXTREME WEATHER EVENTS

Short-term impacts

Over the past decade, arable crops in Spain have been increasingly impacted by drought, leading to a rise in demand for agricultural insurance. The Spanish Agricultural Insurance Consortium (Agroseguro) reported that the 2023 harvest experienced the most severe drought loss in the history of agricultural insurance, with estimated indemnities reaching EUR 455 million. The total farmland area affected by adverse weather in 2023 increased by 85% compared to 2022 and over 200% compared to 2021.¹⁶²

The drought particularly affected the sunflower crop in Andalusia, a major production area. As of September 2023, the assessed damages in this region totalled EUR 10.3 million, with EUR 7.94 million related to drought. Nationally, the estimated compensation for sunflower damage exceeded EUR 30 million.¹⁶³

The intense precipitation and flooding experienced in early September also had a substantial impact on the insurance sector. Home insurance claims caused by atmospheric events increased by 232% compared to the number of claims in the same week of the previous year.¹⁶⁴ It is estimated that these events will cost insurers EUR 24 million, with an additional EUR 100 million to 115 million covered by Spain's Insurance Compensation Consortium, which covers losses caused by extreme flooding events.¹⁶⁵

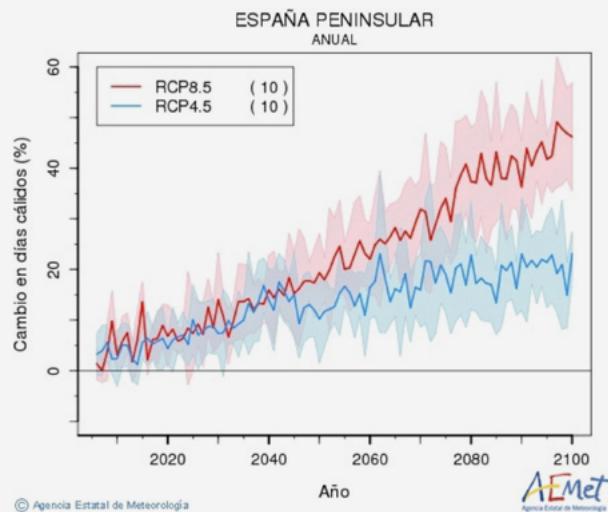
¹⁵⁷ WWF (2023). Incendios Extremos e Inapagables. Retrieved 4 March 2024 from [https://wwf.es/assets.panda.org/downloads/wwf_incendios_extremos_e_inapagables_informe_2023.pdf?64721/Informe-sobre-incendios-forestales-2023](https://wwf.es/assets/panda.org/downloads/wwf_incendios_extremos_e_inapagables_informe_2023.pdf?64721/Informe-sobre-incendios-forestales-2023). ¹⁵⁸ El Mundo (11 September 2023). They control the Tenerife fire after almost a month since its start and more than 14,000 hectares burned. Retrieved 4 March 2024 from <https://www.elmundo.es/espana/2023/09/11/64fee4d8fc6c83ee138b4594.html>. ¹⁵⁹ AEMET (14 September 2023). Informe Sobre el Episodio Meteorológico de Precipitaciones Intensas Ocasionadas por una Dana Durante los Días 2, 3 y 4 de Septiembre de 2023. Retrieved 4 March 2024 from https://www.aemet.es/documentos/es/conocerlas/recursos_en_linea/publicaciones_y_estudios/estudios/informe_dana_sep2023.pdf. ¹⁶⁰ Ministerio del Interior (25 September 2023). The Government declares a catastrophic area and approves aid for those affected by the DANA in September. Retrieved 4 March 2024 from <https://www.interior.gob.es/opencms/es/detalle/articulo/El-Gobierno-declara-zona-catastrofica-y-aprueba-ayudas-para-los-afectados-por-las-DANA-de-septiembre/>. ¹⁶¹ El Economista (14 September 2023). This will be the reconstruction of the three Aldea del Fresno bridges destroyed by DANA. Retrieved 4 March 2024 from <https://www.economista.es/actualidad/noticias/12444200/09/23/asi-sera-la-reconstruccion-de-los-tres-puentes-de-aldea-del-fresno-destrozados-por-la-dana.html>. ¹⁶² Agroseguro (1 September 2023). Hoy, 1 de septiembre, comienza el plazo para suscribir los seguros de herbáceos, frutos secos y olivar. Retrieved 4 March 2024 from https://agroseguro.es/wp-content/uploads/2023/09/NP-Agroseguro_seguros-de-inicio-contratacion-1-de-septiembre.pdf. ¹⁶³ Agroseguro (22 September 2023). Agroseguro pays more than 9 million euros to Andalusian sunflower producers for the accidents that occurred during this campaign. Retrieved 4 March 2024 from <https://agroseguro.es/agroseguro-abona-mas-de-9-millones-de-euros-a-productores-andaluces-de-girasol-por-los-siniestros-ocurridos-durante-esta-campana/>. ¹⁶⁴ Inese (13 September 2023). Losses caused by atmospheric phenomena increase by 232% in Hogar with the latest DANA. Retrieved 4 March 2024 from <https://www.inese.es/los-siniestros-causados-por-fenomenos-atmosfericos-aumentan-un-232-en-hogar-con-la-ultima-dana/>. ¹⁶⁵ Inese (18 September 2023). The DANA rains at the beginning of the month initially cost insurers almost 24 million. Retrieved 4 March 2024 from <https://www.inese.es/las-lluvias-por-la-dana-de-primeros-de-mes-cuestan-inicialmente-casi-24-millones-a-las-aseguradoras/>.



Long-term impacts

There is a clear trend of rising temperatures and increasing drought conditions in Spain, which is expected to escalate in the coming years. According to the State Meteorological Agency (AEMET), since the beginning of its records in 1961 nine out of 10 of Spain's hottest summers have occurred in the 21st century.¹⁶⁶ Projections indicate that Spain will experience a higher rate of warming than the global average, with a regional increase of 1.5°C for each

FIGURE 31: PROJECTED CHANGE IN NUMBER OF HOT DAYS (%) WITH RESPECT TO PERIOD 1961-1990



Source: AEMET. https://www.aemet.es/es/serviciosclimaticos/cambio_climat/result_graficos?opc4=0&w=2&opc1=Espan&opc2=Tx&opc3=Anual&opc6=0&img=3

1°C of global warming. It is also projected that the number of rainy days each year will decrease, and that precipitation is expected to be concentrated into fewer, yet more intense events, which could increase the risk of flooding.¹⁶⁷

Figure 31 shows the expected change in number of hot days in Spain up to the year 2100, with a hot day defined as one with a maximum temperature surpassing the 90th percentile of the reference 1961-1990 period. Under both the RCP 4.5 and 8.5 scenarios, a clear upward trend is evident. The more extreme RCP 8.5 scenario projects that, by 2050, Spain could witness an approximate 15% increase in the number of hot days, escalating to almost 50% by the year 2100.¹⁶⁸

Climate change is expected to affect tourism in Spain. Mediterranean countries will likely see a considerable reduction in summer tourism demand over the long term due to rising temperatures. However, it is also possible that the main tourism season may shift from summer to spring and fall, when temperatures could be more tolerable.¹⁶⁹

Spain's government has adopted multiple measures to combat climate change in the long term. In May 2021, the country passed its Climate Law, which focuses on climate change and energy transition. The law aims to reduce greenhouse gas emissions, promote renewable energy and improve energy efficiency. Notably, Spanish insurance companies are directly impacted by

this law, as it mandates that all insurers must publish an annual climate-related financial disclosure report, following the recommendations of the Task Force on Climate-Related Financial Disclosures (TCFD).¹⁷⁰

Spain has also implemented its National Climate Change Adaptation Plan 2021-2030. The plan identifies key vulnerabilities across various sectors, including water resources, agriculture and biodiversity, proposing a range of adaptation measures to reduce these vulnerabilities and increase resilience. These measures include improving climate monitoring and forecasting, integrating climate change considerations into planning and decision-making processes and promoting research and innovation in climate change adaptation.¹⁷¹

The insurance sector in Spain is also beginning to take action with respect to climate change, and some insurers have started publishing climate-related disclosure reports outlining the risks and opportunities the company faces as a result of climate change, as well as the potential impacts to its business. One firm's report also describes the insurer's process for climate risk management, including the modelling of catastrophic physical risks to calculate the possible financial impact of natural catastrophes. The company is also actively developing and analysing different climate change scenarios for use in the assessment of losses derived from climate change risk.¹⁷²

166 IAEMET. Resumen Mensual Climatológico: Verano 2023. Retrieved 4 March 2024 from https://www.aemet.es/documentos/es/serviciosclimaticos/vigilancia_clima/resumenes_climat/estacionales/2023/Est_verano_23.pdf. 167 Greenpeace (4 July 2023). Race Against the Climate Clock. Retrieved 4 March 2024 from <https://es.greenpeace.org/es/wp-content/uploads/sites/3/2023/07/exeter.pdf>. 168 AEMET. AR5-IPCC Regionalization, Evolution Graphs, Dynamic Regionalization, Peninsular Spain. Retrieved 4 March 2024 from https://www.aemet.es/es/serviciosclimaticos/cambio_climat/result_graficos?opc4=0&w=2&opc1=Espan&opc2=Tx&opc3=Anual&opc6=0&img=3. 169 JRC (2023). Regional Impact of Climate Change on European Tourism Demand. JRC Technical Report. Retrieved 4 March 2024 from <https://op.europa.eu/en/publication-detail/-/publication/6185be71-faab-11ed-a05c-01aa75ed71a1/language-en>. 170 The full text of the Climate Law is available at <https://www.boe.es/buscar/act.php?id=BOE-A-2021-8447>. 171 MITECO. National Climate Change Adaptation Plan 2021-2030. Retrieved 4 March 2024 from https://www.miteco.gob.es/content/dam/miteco/es/cambio-climatico/temas/impactos-vulnerabilidad-y-adaptacion/pnacc-2021-2030-en_tcm30-530300.pdf. 172 MAPFRE (2022). Informe TCFD. Retrieved 4 March 2024 from https://www.mapfre.com/media/TCFD-MAPFRE-ene23_-ES.pdf.



United Kingdom

2023 EXTREME WEATHER EVENTS

The UK was hit by a series of storms throughout the second half of 2023:

- **Storm Antoni (August 2023)**
 - Amber weather warnings were issued in the UK due to this storm.
 - It was the first Met Office-named storm of the 2022-2023 season.
 - Parts of England were hit by wind gusts reaching up to 78 mph.¹⁷³
- **Storm Babet and Storm Ciarán (Autumn 2023)**
 - Storm Babet brought severe rainfall to England and Scotland. In some areas of Suffolk, 79 mm of rain fell in two days, while parts of Scotland were impacted by 200 mm of rain.¹⁷⁴
 - Storm Ciarán impacted southern and southeastern England, with wind gusts of up to 80 mph.¹⁷⁵
- **Storm Debi (November 2023)**
 - Storm Debi marked the fourth storm of the 2023-2024 season in the UK.
 - Stormy conditions led to wind gusts exceeding 70 mph in some areas, with flood warnings issued in 15 locations.¹⁷⁶
- **Storm Gerrit (27 to 28 December)**
 - This storm brought damaging winds and heavy rain to the UK, particularly affecting Wales, northwest England and Scotland.
 - In the most exposed locations, winds gusted at over 81 mph.
 - Heavy rains raised concerns about increased flooding.¹⁷⁷



Strong winds characterised the late-2023 storms that struck the UK.

¹⁷³ Sachdeva, M. (6 August 2023). Storm Antoni hits UK with 78mph winds and heavy rain. Independent. Retrieved 4 March 2024 from <https://www.independent.co.uk/weather/storm-antoni-flooding-winds-uk-b2388289.html>. ¹⁷⁴ Moore, T. (21 October 2023). Why Storm Babet brought so much rain – and why we're likely to see more storms like it. Sky News. Retrieved 4 March 2024 from <https://news.sky.com/story/why-storm-babet-brought-so-much-rain-and-why-were-likely-to-see-more-storms-like-it-12989128>. ¹⁷⁵ Met Office (31 October 2023). Storm Ciarán. Retrieved 4 March 2024 from <https://www.metoffice.gov.uk/about-us/press-office/news/weather-and-climate/2023/storm-ciaran-latest>. ¹⁷⁶ Nicolaci da Costa, A. (14 November 2023). Storm Debi: Strong winds and heavy rain hit UK. BBC. Retrieved 4 March 2024 from <https://www.bbc.co.uk/news/uk-67396689>. ¹⁷⁷ Met Office. Storm Gerrit, 27 to 28 December 2023. Retrieved 4 March 2024 from https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2023/2023_12_storm_gerrit.pdf.



Data from the Association of British Insurers (ABI) reveals that UK insurers are expected to pay out £560 million as a result of damages caused by Storms Babet, Ciarán and Debi. This amount surpasses the cost of 2022 Storms Dudley, Eunice and Franklin, which totaled £497 million, as well as exceeding the cost of 2020 Storms Ciara, Dennis and Jorge, which totaled £543 million. The £560 million allocation for the 2023 storms is divided among repairs for damaged homes (£362 million), repairs for damaged businesses (£155 million) and repairs for damaged vehicles (£53 million). The 48,700 notified claims were divided among home insurance claims (36,100 claims), business interruption claims (5,370 claims) and claims for damaged vehicles (7,210 claims).¹⁷⁸

According to catastrophe insurance data provider PERILS, the initial industry loss for Storm Babet, inclusive of Aline floods, is estimated at EUR 509 million.¹⁷⁹ The majority of these losses occurred in the UK, primarily impacting the property lines of business. It was also noteworthy that the majority of losses in the UK were related to floods, with limited losses attributed to wind-related damages.¹⁸⁰

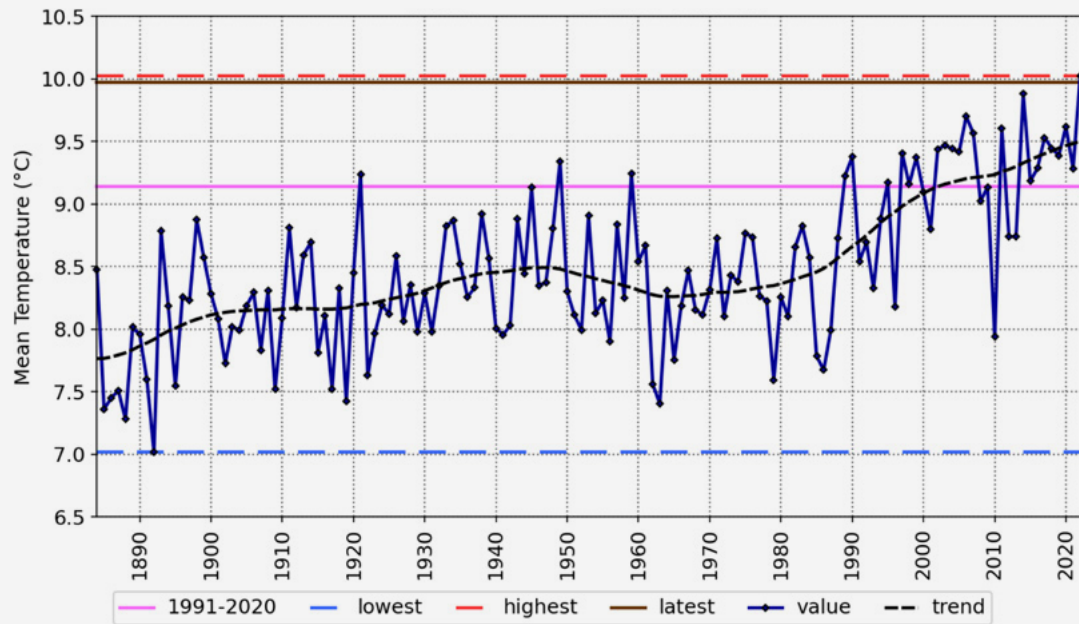
IMPACT OF THESE EXTREME WEATHER EVENTS

Short-term impacts

Provisionally, the UK experienced its second-warmest year on record in 2023, with a provisional mean temperature of 9.97°C, which is slightly lower than the 10.03°C recorded in 2022.¹⁸¹ Figure 32 shows the

UK mean temperature for every year since 1884, along with the underlying trend. The graph illustrates that the 10 warmest years on record in the UK have all occurred since 2003. Despite the variability in the annual mean UK temperature, the discernible upward trend since 1970 is clearly visible.

FIGURE 32: MEAN UK TEMPERATURE BY YEAR



Source: Met Office. Contains public sector information licensed under the Open Government Licence v3.0 © Crown copyright, Met Office.

¹⁷⁸ ABI (14 December 2023). Weathering the Storm. Retrieved 4 March 2024 from <https://www.abi.org.uk/news/news-articles/2023/12/weathering-the-storm/>. ¹⁷⁹ Artemis (4 December 2023). Windstorm Babet and Aline industry loss estimated at €509m by PERILS. Retrieved 4 March 2024 from [https://www.artemis.bm/news/windstorm-babet-and-aline-industry-loss-estimated-at-e509m-by-perils/#:~:text=Windstorm%20Babet%20and%20Aline%20industry%20loss%20estimated%20at%20%2%82%AC509m%20by%20PERILS,-4th%20December%202023&text=Recent%20European%20windstorms%20Babet%20and,catastrophe%20data%20aggregator%20PERILS%20AG](https://www.artemis.bm/news/windstorm-babet-and-aline-industry-loss-estimated-at-e509m-by-perils/#:~:text=Windstorm%20Babet%20and%20Aline%20industry%20loss%20estimated%20at%20%2%82%AC509m%20by%20PERILS,-4th%20December%202023&text=Recent%20European%20windstorms%20Babet%20and,catastrophe%20data%20aggregator%20PERILS%20AG.). ¹⁸⁰ McGee, S. (15 December 2023). Storm Ciarán spares UK insurers with losses pegged at £1.63bn. Insurance Post. Retrieved 4 March 2024 from <https://www.postonline.co.uk/news/7954787/storm-ciaran-sparers-insurers-with-losses-pegged-at-ps163bn>. ¹⁸¹ Met Office (2 January 2024). 2023 was second warmest year on record for UK. Retrieved 4 March 2024 from [https://www.metoffice.gov.uk/about-us/press-office/news/weather-and-climate/2023/2023-was-second-warmest-year-on-record-for-uk#:~:text=2023%20is%20provisionally%20the%20warmest,1836%2C%20and%20wettest%20since%202002](https://www.metoffice.gov.uk/about-us/press-office/news/weather-and-climate/2023/2023-was-second-warmest-year-on-record-for-uk#:~:text=2023%20is%20provisionally%20the%20warmest,1836%2C%20and%20wettest%20since%202002.).

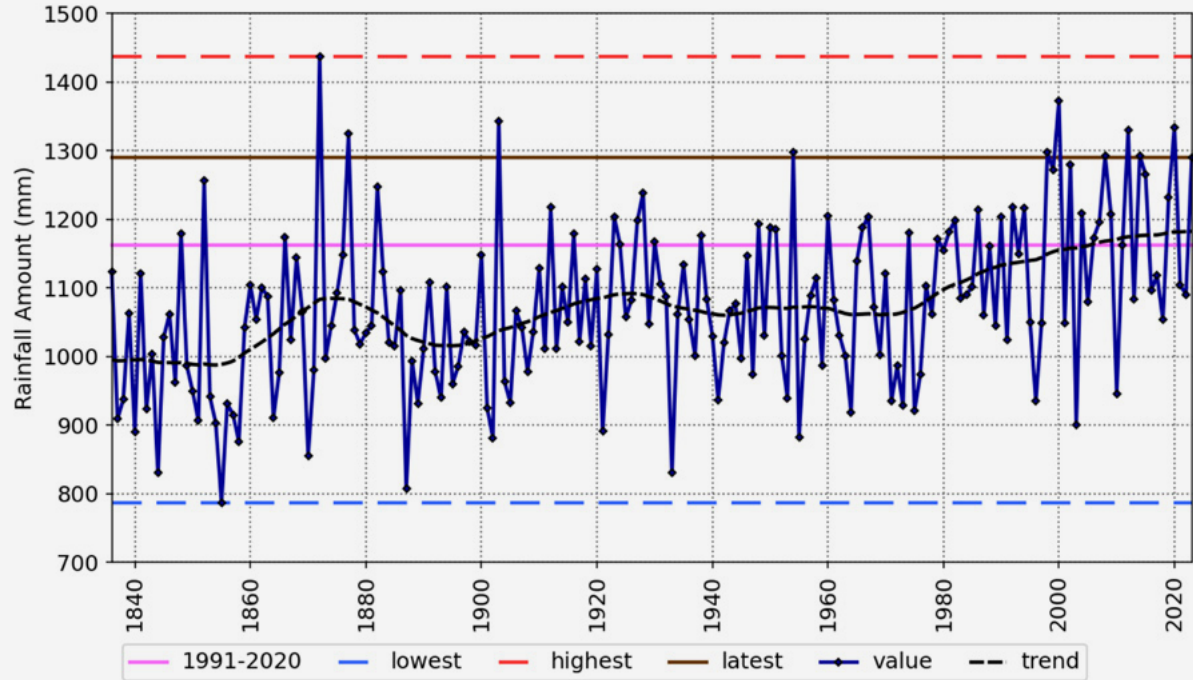


Studies conducted by Met Office scientists have revealed that a mean average temperature of 9.97°C is considered approximately a 1-in-3-year event in the current climate. In a climate unaffected by human impact, such an event would be a rare 1-in-500-year phenomenon. Projections indicate that the mean temperature of 9.97°C will continue almost every year by the end of the century under a medium emissions scenario (RCP 4.5).

Although 2023 did not produce the largest volume of rainfall in the UK, the recorded rainfall amount exceeded the average UK figure by 11%, due to the earlier-mentioned storms. The provisional UK rainfall figure for 2023 is 1,289.8 mm, with some parts of the UK experiencing a third more rainfall than normal. Figure 33 shows the UK rainfall amounts for every year since 1884, along with the underlying trend. Although there is significant variability in annual UK rainfall, the upward trend since 1980 is clearly visible.

Figure 33 also shows that climate change is resulting in warmer weather, leading to a warmer atmosphere. A warmer atmosphere has a greater capacity to hold moisture, consequently leading to more rainfall.

FIGURE 33: MEAN UK RAINFALL BY YEAR



Source: Met Office. Contains public sector information licensed under the Open Government Licence v3.0 © Crown copyright, Met Office.



Due to the extreme heat waves experienced in the UK in 2022, where temperatures peaked at 40.3°C, ABI has highlighted a significant surge in claim payments related to subsidence. In the second quarter of 2023, these payments rose by 21% compared to the same quarter in the previous year, amounting to £54 million as opposed to £45 million in the equivalent prior quarter.¹⁸²

The UK Environment Agency, a public body established in 1996 to protect and improve the environment, has established its priorities until 2025.¹⁸³ The agency is committed to promoting sustainable development and addressing the climate emergency through a comprehensive plan that includes the following three key objectives:

1. Creating a nation that is resilient to climate change:

- a. Ensuring that the nation is well-prepared for coastal changes, flooding and drought.
- b. Advocating for investments in adaptation strategies to combat climate change.

2. Promoting healthy air, land and water:

- a. Ensuring cleaner and healthier air.
- b. Improving the water quality in rivers and lakes.
- c. Protecting and enhancing the overall quality of nature and land.

3. Fostering green growth and a sustainable future:

- a. Encouraging greener and cleaner growth.
- b. Reducing waste crime and developing a circular economy.
- c. Delivering sustainable business commitments and striving to achieve net-zero emissions by 2030.

In 2021, the ABI initially released a Climate Change Roadmap,¹⁸⁴ detailing key milestones that needed to be met by 2025 to achieve the goal of net-zero emissions by 2050. The ABI reports that its members are making good progress, with 90% on track to reach the 2025 milestones and 84% with board-approved net-zero targets.

The ABI updated its road map in July 2023,¹⁸⁵ now structured around four major pillars:

▪ Pillar One – Achieving Net Zero by 2050

- The UK insurance and long-term savings sector is committed to reaching net zero by 2050, with an interim goal of reducing emissions by 50% by 2030.

▪ Pillar Two – Unleashing Investment Capacity

- Focussing on supporting the transition away from carbon-intensive activities and replacing them with sustainable and renewable innovations.

▪ Pillar Three – Sustainable Industry Operations

- Engaging with suppliers to include supply chain emissions within the scope of reducing emissions by 50% by 2030.

– Pillar Four – Helping Society Adapt

- Assisting customers and stakeholders in mitigating the impact of rising temperatures, reducing emissions and becoming more resilient to the effects of climate change.

Additionally, in July 2023, the Bank of England (BoE) published its Climate Transition plan,¹⁸⁶ which details its own goals and strategies to reach net-zero emissions.¹⁸⁷ The report highlights that the BoE will prioritise reducing absolute emissions, aiming for a 90% reduction by 2040, with interim targets on the way, which are detailed in Figure 34.

FIGURE 34: BOE INTERIM CLIMATE TRANSITION PLAN MILESTONES

	2025	2030	2035	2040
Emissions Reduction from 2015/2016 Baseline	40%	62%	84%	90%

The BoE has committed to incorporating information about its carbon footprint and progress in decarbonisation in its annual climate change disclosure. BoE will publish updates to its Climate Transition Plan, highlighting amendments and progress achieved toward its goals. Additionally, BoE will internally track its Scope 1 and Scope 2 emissions on a quarterly basis.

¹⁸² ABI (19 September 2023). Home insurance payouts up 11% to help UK householders keep a roof over their heads. Retrieved 4 March 2024 from <https://www.abi.org.uk/news/news-articles/2023/9/home-insurance-payouts-up-11/>. ¹⁸³ Gov.UK (31 October 2022). Environment Agency: EA2025 creating a better place. Environment Agency. Retrieved 4 March 2024 from [https://www.gov.uk/government/publications/environment-agency-creating-a-better-place/environment-agency-creating-a-better-place#:~:text=The%20plan%20sets%20out%20growth%20and%20a%20sustainable%20future](https://www.gov.uk/government/publications/environment-agency-creating-a-better-place/environment-agency-creating-a-better-place#:~:text=The%20plan%20sets%20out%20growth%20and%20a%20sustainable%20future.). ¹⁸⁴ ABI. Climate Change Roadmap. Retrieved 4 March 2024 from <https://www.abi.org.uk/about-the-abi/sustainability/climate-change-roadmap/>. ¹⁸⁵ ABI (July 2023). ABI Climate Change Roadmap. Retrieved 4 March 2024 from <https://www.abi.org.uk/globalassets/files/publications/public/climate-change/abi-climate-change-2023-roadmap.pdf>. ¹⁸⁶ BoE (6 July 2023). The Bank of England's Climate Transition Plan. Retrieved 4 March 2024 from <https://www.bankofengland.co.uk/climate-change/the-bank-of-englands-climate-transition-plan>. ¹⁸⁷ Ibid.



Long-term impacts

The Department for Environment, Food and Rural Affairs (DEFRA) has invested £5.2 billion in flood and coastal erosion schemes since 2015, which have improved protection for more than 381,000 properties. However, experts believe that the UK is inadequately prepared to cope with future storms because not enough effort has been invested in flood resilience, and because current actions are more reactive than proactive.¹⁸⁸

According to the National Audit Office (NAO), there has been a 40% reduction in the number of properties that were expected to be better protected against flooding by 2027, with the number of homes forecasted to have enhanced flood protection slashed from 336,000 to 200,000. This means that 136,000 more homes will be at risk of flooding since the 2020 plans were formulated.

Additionally, 500 of the 2,000 new flood defence projects have been abandoned. The Environment Agency (EA) blames inflation for these cuts in protection. Despite the EA's efforts, which added flood protection to 59,000 properties in England since 2020, the NAO warns that the government has not set a long-term target for the level of flood resilience it expects to achieve and lacks concrete plans beyond 2026 to meet long-term goals.¹⁸⁹ Furthermore, the Met Office has forecasted that, by 2080, instances of extreme rainfall could be four times more frequent compared to the levels recorded in the 1980s.¹⁹⁰ See Appendix B for a comprehensive analysis.

The UK government has established the National Adaptation Programme (NAP3), featuring a five-year plan to protect against climate change risks.¹⁹¹ This plan includes reviewing resilience planning, increasing adaptation funding, introducing a new health agency to improve the health system's response to the heightened frequency and severity of extreme events and the implementation of a Climate Resilience Board to oversee climate adaptation and resilience. Mandated by the 2008 Climate Change Act, the UK government is required to conduct a climate risk assessment every five years.

In a shift to its approach to achieving net zero by 2050, the UK government has delayed the implementation of several key green policies.¹⁹² Notable changes include a five-year postponement of the ban on the sale of new petrol and diesel cars and a nine-year delay on the ban of fossil fuel heating for off-gas-grid homes. These changes have led experts to believe that the UK's 2050 net-zero target is now more distant than before. However, the UK government is committed to reaching net zero by 2050.¹⁹³ Scotland has set an even more ambitious target of net zero by 2045 and has published a report outlining its plans and progress.

Flood Re, a joint initiative between insurers and the UK government established in 2016, aims to make household insurance more affordable for properties in flood-prone areas. However, this is a temporary scheme, ending in 2039, highlighting the need for the UK to take urgent action to combat climate change and to ensure that the UK is well-prepared to handle

flood risk after 2039. To facilitate this, Flood Re has released a 'Transition Plan' outlining key initiatives:

- Supporting research and working with partners to create a comprehensive scoring methodology for property flood resilience (PFR) adaptations.
- Introducing Flood Performance Certificates, allowing current and future homeowners to assess the flood protection level of their properties.
- Establishing a Centre of Excellence to drive innovation and adaptation in the UK's response to flooding.

In recent years, Flood Re has also launched the "Build Back Better" initiative, a programme where insurers can offer up to £10,000 for flood-resilient measures in addition to repair costs following an eligible flood claim. Flood-resilient measures can include:

- Raising plug and electric sockets.
- Installing flood doors or using flood barriers on doors.
- Adding waterproof membrane to the walls of the house.
- Changing the materials used in the construction of the property.
- Installing non-return valves on drains.
- Installing self-closing air bricks.

¹⁸⁸ Horton, H. (7 November 2023). UK ill-prepared for havoc future storms could wreak, scientists warn. The Guardian. Retrieved 4 March 2024 from <https://www.theguardian.com/uk-news/2023/nov/07/uk-ill-prepared-for-havoc-future-storms-could-wreak-scientists-warn>. ¹⁸⁹ Horton, H. (14 November 2023). Flood protection plans for English homes cut by 40%. The Guardian. Retrieved 4 March 2024 from <https://www.theguardian.com/environment/2023/nov/15/flooding-defence-protection-england-properties-cut-nao>. ¹⁹⁰ Met Office (7 March 2023). New research shows increasing frequency of extreme rain. Retrieved 4 March 2024 from <https://www.metoffice.gov.uk/about-us/press-office/news/weather-and-climate/2023/new-research-shows-increasing-frequency-of-extreme-rainfall-events>. ¹⁹¹ Gov.UK (17 July 2023). Government sets out adaptation programme to tackle climate impact. Retrieved 4 March 2024 from <https://www.gov.uk/government/news/government-sets-out-adaptation-programme-to-tackle-climate-impact>. ¹⁹² Francis, S. (20 September 2023). Rishi Sunak delays petrol car ban in major shift on green policies. BBC. Retrieved 4 March 2024 from <https://www.bbc.co.uk/news/uk-politics-66871457>. ¹⁹³ UK Parliament (14 November 2023). The UK's plans and progress to reach net zero by 2050. House of Commons Library. Retrieved 4 March 2024 from <https://commonslibrary.parliament.uk/research-briefings/cbp-9888/>.



Conclusion and actionable steps for insurers

In conclusion, 2023 has emerged as a pivotal year for the European insurance industry, signalling new challenges and opportunities in the face of extreme weather events caused by climate change. The industry's adaptation to these evolving realities necessitates not only internal transformation within insurance companies, but also a broad collaboration across sectors and nations to foster a more resilient and sustainable future. Key strategies for insurers include:

- **Enhanced risk modelling:** Developing more sophisticated risk models, such as the ones presented in this paper, that factor in the increasing unpredictability of climate events.
- **Product innovation:** Creating and scaling innovative insurance products that align with emerging risks and customer needs and encourage policyholders to adopt green practices.
- **Sustainable investments:** Redirecting investments away from polluting projects and toward environmentally sustainable organisations, thus contributing to a greener economy.
- **Policy advocacy:** Actively engaging with government policymakers to shape regulatory frameworks that support industry adaptation and resilience to climate challenges.
- **Education and awareness:** Raising public awareness and understanding of insurance products, weather-related risks and the vital role of insurance in climate adaptation.
- **Prevention:** Helping policyholders with tools and services that will help them prevent claims from physical climate risk.

The evolving role of the Net-Zero Insurance Alliance (NZIA), which experienced a significant decline in membership in 2023, underscores the complex landscape insurers must navigate when it comes to climate change mitigation efforts. As a coalition of leading insurance companies and reinsurers, the NZIA is committed to transitioning its underwriting portfolios to net-zero greenhouse gas emissions by 2050. Formed in 2021 during the G20 summit in Venice by eight of the largest (re)insurers, including Allianz, Aviva, AXA, Generali, Munich Re, Scor, Swiss Re and Zurich, the alliance experienced a significant evolution during 2023, when the number of members plummeted due to pressures from outside the EU. This illustrates that, despite steps taken in Europe to address climate change, the region is impacted by global dynamics.

Looking ahead, insurers must adopt dual roles as risk mitigators and catalysts for positive change. Many are turning for support to actuaries, who can conduct climate stress testing and help design insurance and risk financing frameworks aligned with evolving climate risks.

Stay current with the Milliman Climate Resilience Initiative

The Milliman Climate Resilience Initiative (MCRI) is a comprehensive programme that brings together expertise from various sectors, including industry, government, academia and nonprofit organisations, to address and manage the most pressing climate risks. The initiative focusses on modelling complex risks, helping stakeholders understand and measure the impact of climate change and developing effective response strategies.

Leveraging Milliman's deep experience in risk modelling and assessment, the MCRI aims to provide clear insight into the costs, benefits and uncertainties associated with climate resilience. It specifically addresses insurable property hazards affected by climate and uses advanced tools to study both macro shifts in climate and their micro effects on communities, thereby enhancing risk signals and customising resilience solutions. The MCRI represents Milliman's commitment to helping clients navigate the challenges posed by climate change, offering a range of services including feasibility studies, product development, regulatory support and other key initiatives.

To stay informed about the latest MCRI research, webinars and other developments, visit milliman.com/mcristudy to learn more and join our mailing list.



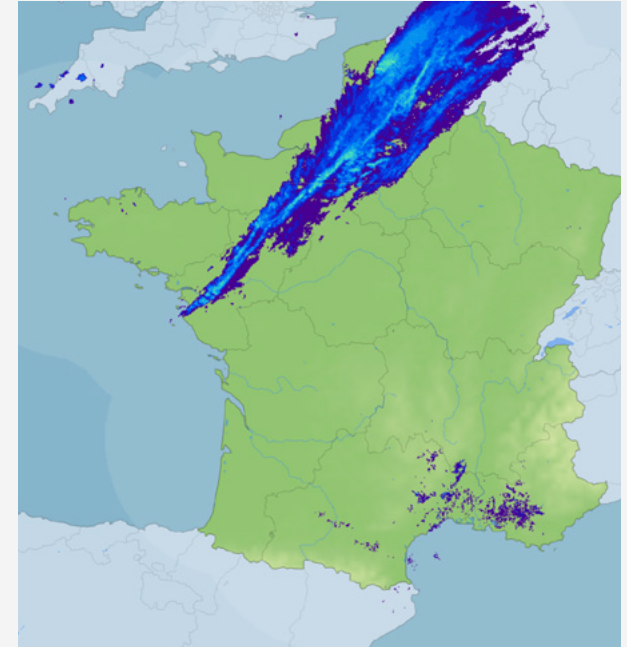
Appendix A: France, hailstorm modelling

To effectively understand, model, map and monitor the highly specific and complex risk of hailstorms, precise meteorological and atmospheric data is needed that can describe the formation of a thunderstorm and determine whether it will evolve into a hailstorm or not. This data, such as air parcel adiabatically from different pressure level layers, mid-tropospheric moisture and deep layer wind shear,¹⁹⁴ is very difficult to measure and compute.

As of now, Switzerland and the US are the only countries equipped with dedicated hail radar capable of measuring this data and monitoring a hailstorm. Other nations, like France, rely on their standard radar systems and compute meteorological and atmospheric data to approximate the likelihood of hail occurrence.

For example, Figure 35 shows a map of precipitation radar data from Météo France, the Meteorological French Agency. This map is an example of the data used to estimate hail occurrence. These radar images are updated every five minutes with a 1 km spatial precision. Previously, this data was only available on a pay-per-use basis. The data is also available on the Open Data platform, which also provides additional reliable and precise data from Météo France, creating opportunities for weather-related modelling.

FIGURE 35: PRECIPITATION RADAR IMAGE



Source: Météo France

¹⁹⁴ Radler, A.T. et al. (3 March 2018). Detecting Severe Weather Trends Using an Additive Regressive Convective Hazard Model (AR-CHaMo). Journal of Applied Meteorology and Climatology Volume 57 Issue 3. Retrieved 4 March 2024 from <https://journals.ametsoc.org/view/journals/apme/57/3/jamc-d-17-0132.1.xml>.

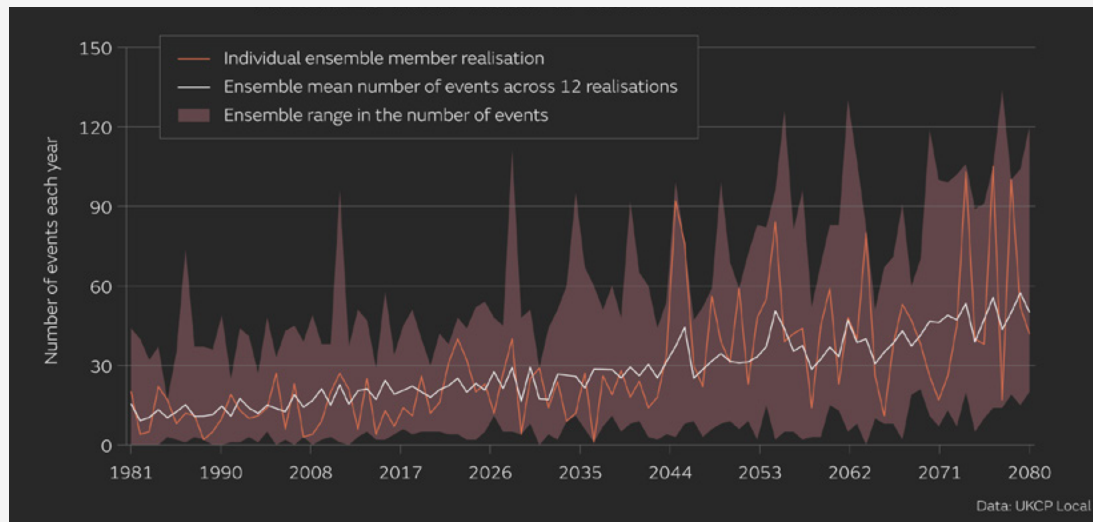


Appendix B: UK, rainfall forecasts

The Met Office has forecasted that, by 2080, instances of extreme rainfall could be four times more frequent compared to the levels recorded in the 1980s.¹⁹⁵ Assuming a high emissions scenario (RCP 8.5, which assumes a continued acceleration of greenhouse gas emissions), the frequency of heavy rainfall in the UK could see a substantial increase. Specifically, instances of rainfall exceeding 20 mm/hr are expected to become four times more common by 2080 than

they were in the 1980s. This trend, however, will vary regionally. In Northwest Scotland, the frequency of such events could increase by a factor of 10. In contrast, a threefold increase is anticipated in southern parts of the UK. Figure 36 illustrates these projections by showing the results of a Met Office model that covers a 100-year period, spanning both past and future data.

FIGURE 36: NUMBER OF EVENTS EACH YEAR ACROSS THE UK WHEN 20 MM/HR OR MORE OF RAIN IS RECORDED



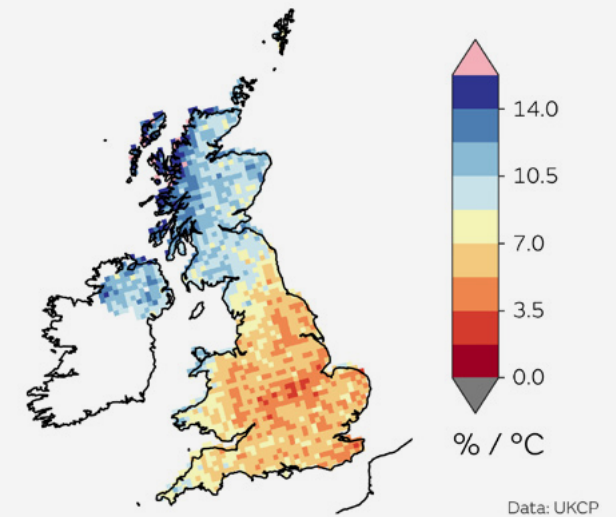
Source: Met Office. Contains public sector information licensed under the Open Government Licence v3.0 © Crown copyright, Met Office.

¹⁹⁵ Met Office (7 March 2023), op cit.



Figure 37 shows how the intensity of downpours could increase as regional temperatures increase. The chart clearly indicates that the greatest change occurs in the Northwest of the UK, where the intensity of downpours increases by about 15% for each degree Celsius of temperature rise.

FIGURE 37: UNDERLYING CHANGE IN THE INTENSITY OF EXTREME HOURLY PRECIPITATION FOR EVERY DEGREE OF WARMING



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Milliman is among the world's largest providers of actuarial and related products and services. The firm has consulting practices in life insurance and financial services, property & casualty insurance, healthcare, and employee benefits. Founded in 1947, Milliman is an independent firm with offices in major cities around the globe.

[milliman.com](https://www.milliman.com)

Contacts

UK

Anandi Shah
anandi.shah@milliman.com

Ian Penfold
ian.penfold@milliman.com

Belgium, Netherlands, Luxembourg

Arije Amara
arije.amara@milliman.com

Menno van Wijk
menno.vanwijk@milliman.com

Germany and Austria

Laura Witting
laura.witting@milliman.com

France

Mohamed Benkhalfa
mohamed.benkhalfa@milliman.com

Antoine Rainaud
antoine.rainaud@milliman.com

Italy

Francesco Pugassi
francesco.pugassi@milliman.com

Niccolò Basetti Sani Vettori
niccolo.basetti@milliman.com

Spain and Portugal

Jose Silveiro
jose.silveiro@milliman.com

Valerie Lampert
valerie.lampert@milliman.com

Romania

Diana Dodu
diana.dodu@milliman.com

Poland

Monika Lis
monika.lis@milliman.com