

A RISK IN FLUX

Exploring Europe's Changing Flood Reality for Insurers



Despite wind often being identified as the peak peril by the (re)insurance industry in Europe, flooding also has a long — and well-known — history in the region. Home to several large river systems and swathes of adjacent densely populated areas, Europe has experienced a number of significant events in the last 20 years — with losses largely stemming from these major waterways.

In recent decades, however, flood resilience measures and underwriting adjustments following major historical events have played a significant role in mitigating this type of flood exposure — and contributing to a reduction in losses from river flooding.

Despite this, looking at the wider picture paints an evolving story in Europe — with losses now more commonly stemming from smaller, rainfall-driven events and subsequently posing a potential new risk for insurers.

In this whitepaper from Gallagher Re's Property team, our catastrophe risk specialists explore:



> How Europe's changing flood reality is redistributing losses away from major urban centers and into smaller catchments.



> The accumulation risk this could pose to insurers, with flooding happening more regularly in areas in which loss experience alone may not provide a complete picture.



> How advanced flood analytics like Gallagher Re's Europe Flood Model can help fill the gaps of historical experience and identify exposure hotspots for more proactive decision-making.

Executive Summary

- Historically, most major loss-causing events were driven by river flooding in major urban areas, including widespread flooding in 1997, 2002 and 2013, all resulting in billions of euros in loss.
- However, many of these cities and river systems are now successfully defended by mitigation measures, reducing the risk of losses in these areas. In addition, carriers successfully adapted underwriting practices to reduce exposure following major historical events.
- In fact, Gallagher Re's analysis of Storm Boris suggests that current river defense infrastructure reduced losses by up to 50%, relative to the same event without any defense infrastructure in place. Additionally, adjusting for economic inflation, Storm Boris resulted in approximately three billion EUR less in loss than the 2002 floods — largely due to investment in flood defenses and tightening of underwriting conditions.
- On the other hand, new analysis shows that recent event losses are increasingly stemming from more regular, rainfall-driven flooding that typically impacts small- to mid-size urban areas, with the potential to cause cumulative losses for insurers. For example, in Germany alone, 84% of the country's largest flood events since 2002 were classed as rainfall-driven by the German insurance association, the GDV.
- Storm Bernd in 2021 is an example of this, generating a multi-billion EUR loss despite the storm mostly impacting small river catchments and communities of fewer than 50,000 residents.
- In this changing flood reality, and with the redistribution of losses to areas not typically considered peak flood-driving, carriers must leverage advanced insights from flood analytics to effectively manage risk.
- Gallagher Re's Europe Flood Model has been specifically developed to capture today's flood landscape. Built using KatRisk's extensive and science-backed flood hazard data, underpinned by the latest information on flood defenses and validated by Gallagher Re market data, the model provides insurers with an advanced tool to fully identify, assess, and quantify their flood risk.
- Ultimately, the question is no longer whether flood will continue to impact insurance annual losses across Europe. The question is how effectively organizations can manage that risk in an increasingly dynamic and interconnected flood landscape — and this is where Gallagher Re can help.

From River Flooding to Urban Resilience

Historically, Europe's most significant flood losses were concentrated along major river systems and densely populated cities (**Table 1**).

The 2002 and 2013 Central Europe Floods, for example, caused extensive damage along the Elbe and Danube river basins, with widespread impacts across Germany, Austria and the Czech Republic, and resulting in EUR5.5 billion and EUR3.4 billion in losses respectively (inflated to current day values).

Both of these events resulted in significant inundation of Prague's historic center, and demonstrated the susceptibility of many of Europe's largest cities.

Subsequently, these events became the catalyst for substantial investment in flood defenses, floodplain management and resilience measures in many countries across Europe, as well as the tightening of underwriting conditions for flood — both of which have led to a significant reduction in exposure in many traditional flood hotspots.

Event	Insured losses (EUR)	Main areas/Rivers impacted
1997 Oder Flood	1.1 billion	Rivers: Oder, Morava Cities: Wrocław, Frankfurt (Oder), Ostrava, Racibórz
2002 Central European Flood	5.5 billion	Rivers: Elbe, Vltava, Danube, Mulde Cities: Prague, Dresden, Passau, Linz
2013 Central European Flood	3.4 billion	Rivers: Danube, Elbe, Inn, Saale Cities: Passau, Dresden, Magdeburg, Prague

Table 1: Large fluvial (river) events across Europe, insured loss (inflated to current day values) and main rivers/cities affected



STORM BORIS: A CASE STUDY IN RESILIENCE

The impact of this infrastructure investment was demonstrated clearly during September 2024’s Storm Boris.

Storm Boris was caused by a Vb storm: a rare, cutoff, low-pressure system which stalled over much of Central Europe, causing a large amount of rainfall over four days, saturating river catchments.

However, despite being caused by the same type of Vb storm as the 1997, 2002 and 2013 events, and having a larger flood footprint than these events (**Figure 1**), Storm Boris resulted in approximately EUR3 billion less in loss than the 2002 floods (adjusted for inflation).

In addition, the Gallagher Re analysis of Storm Boris, using its Europe Flood Model, suggests that losses from the event were reduced by up to 50% due to flood defenses, relative to the same event without any defense infrastructure in place (**Figure 2**).

More specifically, river defenses in both Vienna and Prague both successfully contained peak flows during Storm Boris — two cities that had been severely impacted during the 2002 floods.

These investments demonstrate that resilience measures — coupled with historical tightening of underwriting conditions — have been fundamental in reshaping loss outcomes for river-flooding events.

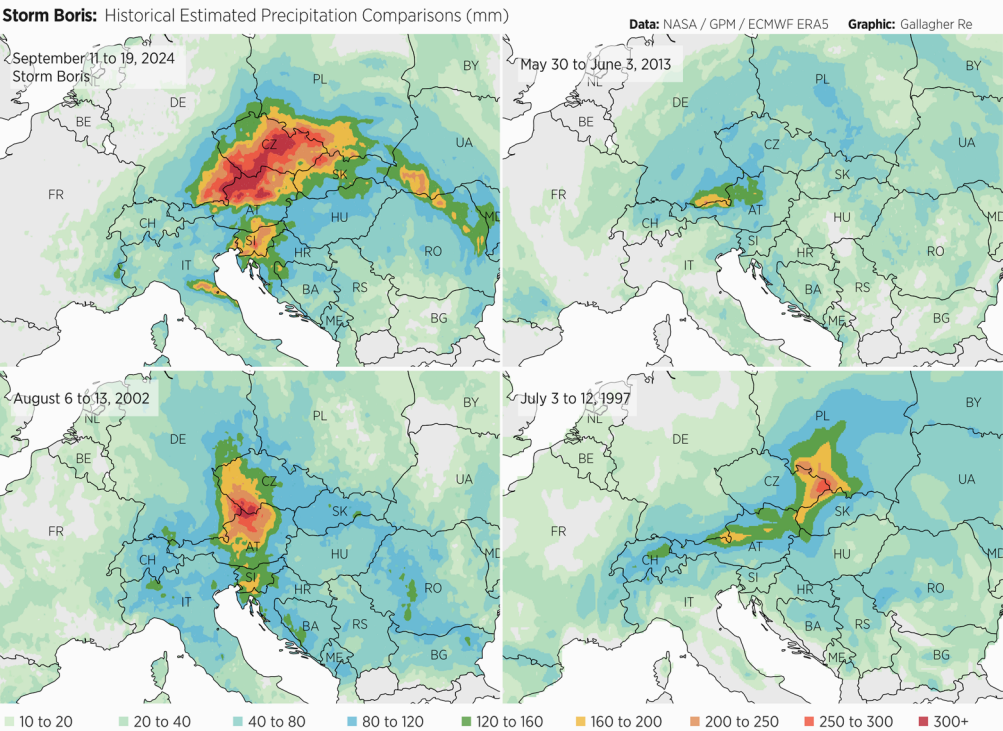


Figure 1: Rainfall footprints of Vb Storms in Europe’s history (1997, 2002, 2013, 2024)

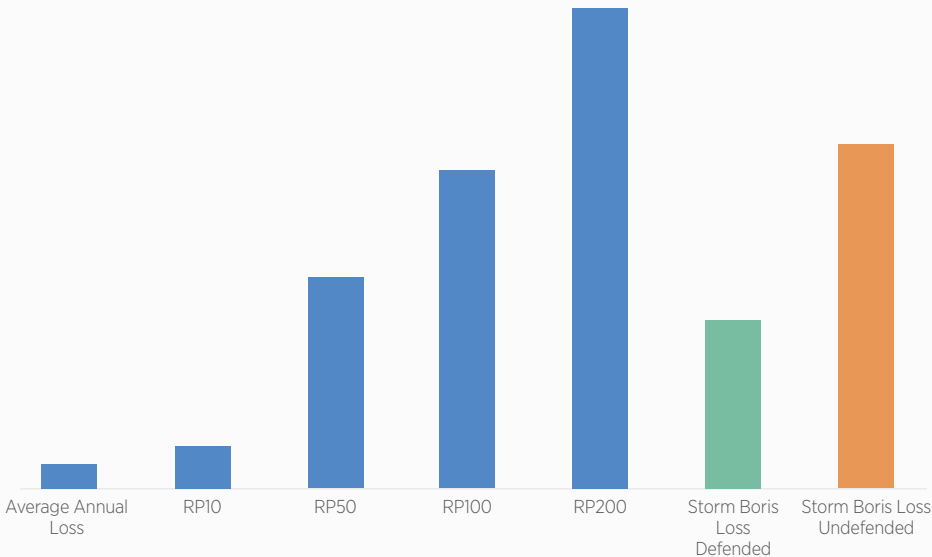


Figure 2: Modeled Losses using the Gallagher Re Europe Flood Model. Using a representative market portfolio, the Gallagher Re Europe Flood Model estimates Boris as approximately a 40-year loss event under current defense conditions. However, when the same event is modeled without flood defenses, losses would be approximately 50% larger.



Flood losses are increasingly concentrated in smaller, less-protected communities beyond traditional flood zones.

The Wider Picture: A Redistribution of Flood Losses

However, when considering flood risk more broadly, recent events have highlighted a changing picture across the region.

We have seen a redistribution of losses from flood across Europe, away from major waterways and into smaller catchments and towns, which is largely driven by heavy rainfall (pluvial flooding) — demonstrating potential exposure in locations outside major metropolitan areas.

These loss locations include secondary catchments, mountainous regions, suburban developments and smaller communities where protection standards are often lower and historical loss experience is less extensive.

This is creating a new, and sometimes overlooked, pattern of loss.

FLOOD RISK SPOTLIGHT: GERMANY AND STORM BERND

Germany provides a compelling example of how Europe's flood landscape is evolving.

As with much of Europe, historically, the country's largest insured losses were associated with major river systems such as the Elbe, Danube, Rhine and Oder. However, the overwhelming majority of significant flood events since 2002 have been driven by heavy rainfall.

Analysis from the German Insurance Association (GDV) (**Table 2**) shows that, of the country's 37 largest flood-related insurance events recorded since 2002, 32 events (86%) were classified primarily as heavy rainfall/flash flooding pluvial events, compared with only five events primarily driven by river flooding. These events accounted for 58% of the insured losses recorded from flooding.

Importantly, this does not mean that river flooding is no longer a concern. The 2002 and 2013 floods remain among Germany's largest on record, while the June 2024 floods generated preliminary insured losses approaching EUR2 billion.

Yet the emergence of regular rainfall-driven events since 2014 highlights the increasing importance of flood mechanisms occurring outside traditional river corridors — demonstrated through Storm Bernd in 2021.

Unlike the major river floods of 2002 and 2013, Bernd was driven by extreme rainfall leading to flash flooding across relatively small catchments. Impacts were most notably concentrated in the Ahr Valley in Rhineland-Palatinate and the Erft Basin in North Rhine-Westphalia, with the hardest-hit communities generally comprising populations of fewer than 50,000 residents.

Despite hitting smaller urban communities, the event still generated indexed losses exceeding EUR10 billion, becoming the costliest flood in modern German insurance history — highlighting how relatively small river catchments and communities outside Europe's major cities are now increasingly driving loss dynamics.

	Events		Losses	
Flood Mechanism	Number	Percentage (%)	Indexed Losses (EUR bn)	Percentage (%)
Fluvial flooding	5	14	11.9	42
Rainfall-driven pluvial flooding (incl. flash flooding)	32	86	16.3	58
Total	37	100	28.2	100

Table 2: Germany's largest flood events Since 2002 by flood mechanism. **Source:** GDV events exceeding EUR25 million indexed to 2024 values, 2002-2023

Figure 3 helps explain this, showing Germany's economic exposure overlayed on its flood hazard landscape. Areas where major river systems are now heavily defended are shown as black lines along the main rivers.

While these rivers continue to present potential risk, the image demonstrates the high number of smaller rivers and tributaries that remain less protected outside of major urban centers, and highlights the prominence of pluvial flood risk throughout the country.

It also reveals the widespread of economic exposure throughout the country, outside of major waterways or in large urban centers, with hotspots also found in secondary cities, suburban developments and small catchments, for example, the area around Hannover.

Germany's fluvial and pluvial flood hazard and economic exposure

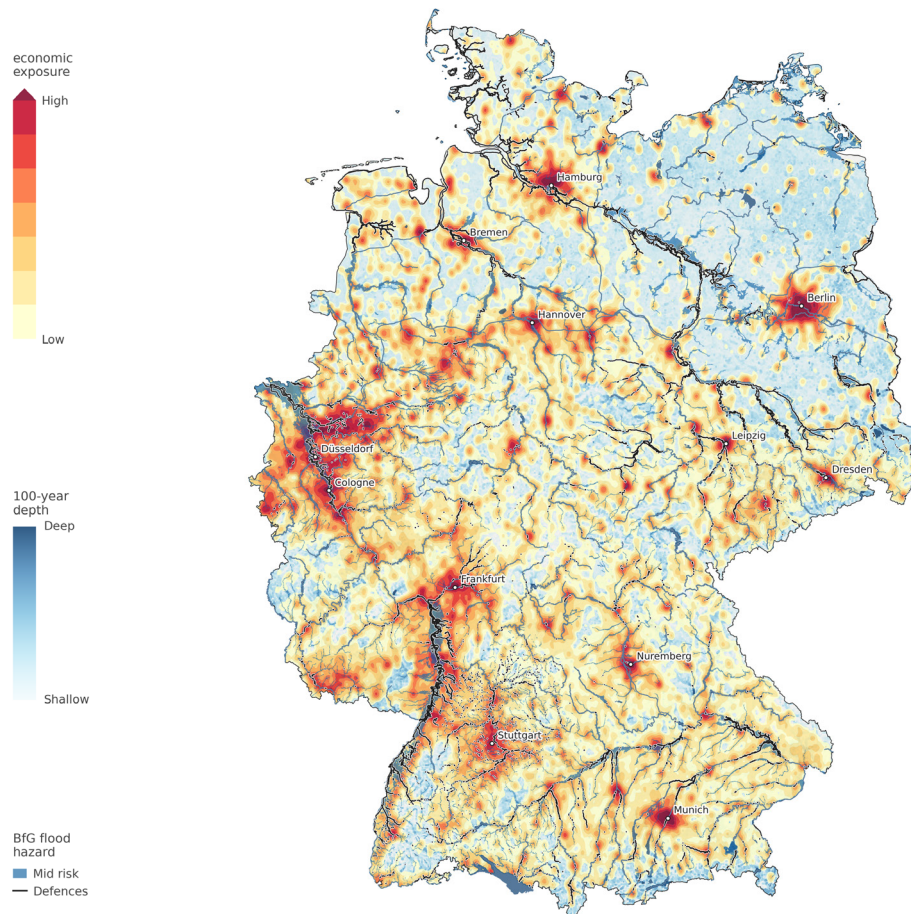


Figure 3: Germany's economic exposure density, flood hazard and defenses. Gallagher Re economic exposure density estimated as sum insured per km², KatRisk 100-year return period flood map (fluvial and pluvial), BfG mid-risk flood zones: Bundesanstalt für Gewässerkunde (BfG). Überflutungsrisikozonen Deutschland (Hochwasserrisikomanagement-RL 2. Zyklus 2016-2021), accessed October 2025, Flood defenses from Gallagher Re's database.

Leveraging Advanced Analytics in a More Complex Flood Landscape

As exposure growth continues beyond established urban centers, insurers face the challenge of identifying concentrations of risk in areas where loss experience alone may not provide a complete picture.

The result is a widening gap between where flood losses have historically occurred and where future losses may emerge.

This is likely to become more important as many regions across Europe are expected to experience more frequent and intense rainfall.

Recent flood events such as Storm Bernd (2021), Storm Daniel, which impacted Greece, Turkey and Bulgaria (2023), and the Eastern Spain DANA Floods (2024) demonstrate the significant role that extreme rainfall is already playing in driving major flood losses across the continent.

As a result, catastrophe models must evolve to match this changing reality.

Gallagher Re's Europe Flood Model

Gallagher Re's Europe Flood Model has been developed to provide purpose-built flood analytics that capture evolving hazard patterns and growing exposure distributions.

By combining advanced physical flood modeling with local defense knowledge and the flexibility to incorporate a user's own view of risk, the model provides a framework to better quantify and manage one of Europe's most significant perils — as it exists today.

Outputs can be used to improve understanding of emerging accumulations, supporting underwriting, portfolio management and reinsurance purchasing.

The model uses the KatRisk European Model event set, which is combined with Gallagher Re's adaptive resolution grid (with a variable resolution of up to 10 meters), vulnerability and financial modules.

Spotlight: KatRisk Flood Hazard Expertise



The Gallagher Re Europe Flood Model is built on KatRisk's flood hazard data — the scientific foundation that describes where, how deeply, and how often flooding occurs across Europe.

As a global leader in flood risk modeling, KatRisk uses physical flood science rather than statistical approximation to capture how water actually moves across the landscape.

Physically based, high-resolution hazard

KatRisk simulates flooding using detailed terrain data at resolutions down to 10 metres across Europe, revealing risk not only along major rivers but street by street in the smaller towns and catchments where losses are increasingly concentrated.

Built for today's flood drivers

The data captures both river (fluvial) flooding and the rainfall-driven (pluvial) flooding behind recent events such as Storm Bernd — represented consistently, so insurers gain a complete view of exposure rather than a partial one.

Defences that reflect reality

KatRisk also provides the flood defence data underpinning the model. Validated and supplemented with Gallagher Re's local market knowledge, these layers let the model reflect the true level of protection in place — and test how losses change when defences hold or are overtopped.

Together, this gives insurers a clear, credible picture of European flood risk as it exists today — and the ability to manage risk with confidence.

To learn more about KatRisk and their catastrophe risk solutions, [visit the website](#).

Use case: Modeling the impacts of defense infrastructure

As we have seen, insured losses are now heavily influenced by local flood protection standards, with many of Europe's main waterways now successfully defended against severe events.

Catastrophe models, therefore, need to quantify not only where flooding occurs, but also how effectively communities are protected when it does, to capture risk realistically.

Within the Europe Flood Model, all major defenses surrounding large urban areas are modeled, with the ability to turn this layer on or off during analysis — this allows clients to understand both the worst-case scenarios and the realistic scenarios for each portfolio.

Importantly, the Gallagher Re database of defenses is used to validate and supplement the underlying KatRisk defense layers where necessary, incorporating local market knowledge and enabling a more comprehensive representation of protection across different regions.

Use case: Capturing new risk hotspots

As rainfall-driven pluvial flooding increasingly affects small- and mid-sized towns/cities, often beyond major urban areas, today's flood analytics must enable insurers to effectively identify these hotspots.

The Europe Flood Model simulates fluvial and pluvial flooding over 50,000 years using a continuous and physically correlated hazard module, effectively and consistently capturing flood risk from multiple sources at a continental European level.

The stochastic event catalog in the model includes events with footprints comparable to storms Boris and Daniel and the Eastern Spain Floods, allowing insurers to evaluate how similar large-scale, precipitation-driven flood scenarios could impact portfolios in the future, including the impacts of compound events occurring across several countries concurrently.

The extent of the event catalog, coupled with the ability for users to customize the features of the model to add their own view of risk, enables carriers to assess both current and future risk accumulation in an environment where hazard, exposure and resilience are continuously evolving.

Storm Boris: Modeled Flooded Areas

PL, CZ, AT



Graphic & Analysis: Gallagher Re

Helping our clients to understand their changing risk

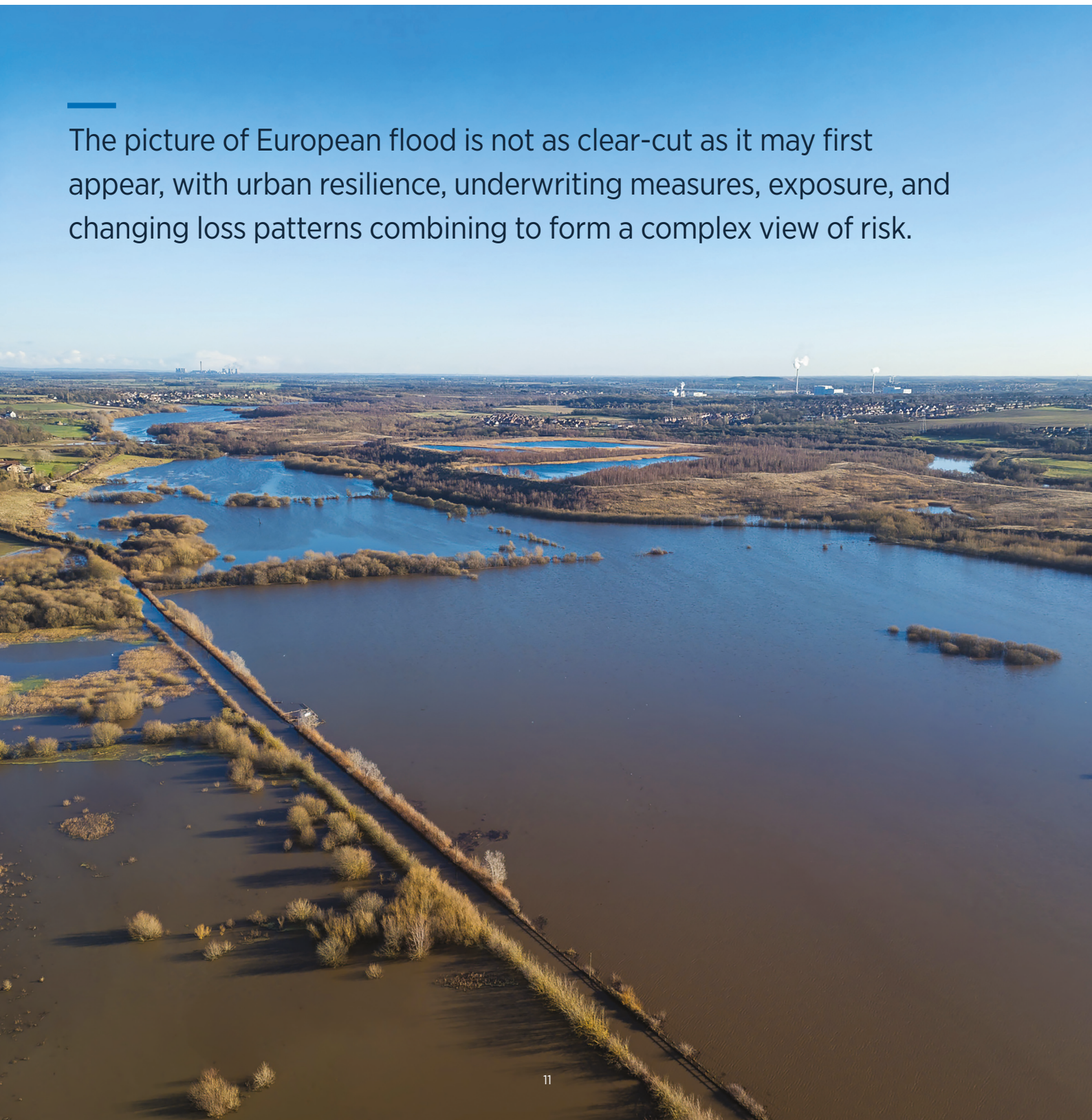
For the (re)insurance industry, long-term performance and risk management will depend on understanding not only where flood hazard exists, but how exposure, vulnerability and protection combine to influence losses.

This requires analytical solutions that can identify emerging accumulations, quantify the value of resilience measures, effectively model rainfall-driven events and assess the loss impact on a portfolio of possible events.

The Gallagher Re Europe Flood Model has been developed to overcome this challenge, supporting our clients in navigating underwriting, portfolio management, reinsurance purchasing and capital allocation decisions in this changing landscape.

To learn more about the Europe Flood Model, and how it can help you, reach out to the team below — we look forward to working with you to help manage your risk.

The picture of European flood is not as clear-cut as it may first appear, with urban resilience, underwriting measures, exposure, and changing loss patterns combining to form a complex view of risk.



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It's the way we do it.



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