# Mastering Earnings Risk:

## A study on Europe Climate Portfolio Management

## Introduction

The property and casualty (P&C) insurance C-suite is facing increasing pressure on its year-over-year financial performance. Insurers have traditionally focused on long-term value creation, understanding that even the most profitable firms can have a poor year due to the occurrence of a large catastrophe such as Hurricane Ian (2022) or Flood Bernd (2021).

However, between 2017 and 2022, many insurance firms did not just experience a single bad year driven by one or more large-scale catastrophes. Year-over-year financial performance lagged other industries, such as commercial or retail banking. According to McKinsey, less than half of insurers made their cost of capital during this period when catastrophe losses continued to grow. And efforts to modernize IT systems and processes did not result in the anticipated productivity enhancements. But not all insurance firms have experienced poor financial performance. Like many other industries, a market of clear winners and losers is emerging. Inequality appears to be growing, and economic profits are being distributed along a power curve where the top 10 percent of firms capture 80 percent of economic profits.[1]

When insurers struggle to meet their cost of capital over longer periods of time, shareholders, board members, and activists may begin questioning whether these firms not only understand large-scale catastrophes but also the smaller and more frequent events that eat into year-over-year earnings.

The management of earnings risk is crucial as it relates to the resilience of individual risk carriers and the overall reinsurance industry. The purpose of this white paper is to bridge the gap between the C-suite and the catastrophe modeling team on the subject of earnings risk. We will use European climate risk as a case study to examine the market challenge of understanding earnings risk. Our top three key findings, discussed in this white paper, are:

**The challenge of managing earnings risk may be well understood by the board of directors, but this understanding may not be fully shared by those involved in catastrophe management, from underwriting to portfolio management.**

1. The materiality of perils to earnings risk varies from country to country. In continental Europe perils such as hail, could account for more than 50 percent of losses in some countries.
2. Primarily focusing on peak perils overlooks the impact non-peak perils (or secondary perils) have on earnings risk. 80 percent of earnings risk arises from 11 peril/country combinations, six of which are non-peak perils.
3. Improper loading to account for non-peak perils can underestimate earnings risk. Firms applying an extra loading based on experience or on uncorrelated models may not capture an appropriate representation of risk.

As the leading risk management firm, Moody's RMS™ is committed to providing the most accurate and comprehensive risk management tools. These tools are essential for overall risk management, including calibration of strategies to achieve profitable growth, retention, transfer, avoidance or risk reduction. Therefore, one of our top priorities is to communicate with the industry how Moody's RMS is driving innovation in the context of helping clients better manage earnings risk and achieve profitable growth.

[1] Bernard, P-I., de Combles de Nayves, H., Binder, S., D'Amico, A., Strovink, K., Ellingrud, K., Kotanko, B., & Klais, P. (2022). *Creating value, finding focus: Global insurance report 2022.* McKinsey & Company. https://www.mckinsey.com/industries/financial-services/our-insights/creating-value-finding-focus-global-insurance-report-2022

# Role of Investors in Earnings Risk

Management of earnings risk is crucial for investors as it provides insights into the financial health of a company. Strong or poor earnings risk performance will often have a direct impact on the following key indicators:

- **Return on investment expectations:** Investors typically expect insurers and reinsurers to generate consistent and attractive returns on their investments. Investors may exert pressure for higher returns by investing in companies that demonstrate strong profitability and efficient management of earnings risk.
- **Stock performance:** Investors closely monitor the stock performance of insurance and reinsurance companies. Poor financial results or significant losses due to earnings risk can negatively impact stock prices, leading to investor dissatisfaction and potential sell-offs. Insurers and reinsurers face pressure to deliver favorable financial results to maintain investor confidence and support.
- **Risk appetite and risk management:** Investors assess the risk appetite and risk management practices of insurers and reinsurers. Investors expect companies to have robust risk management frameworks in place to effectively identify, assess, and mitigate earnings risk. Companies with inadequate risk management practices may face pressure from investors who prioritize sound risk management as a key factor in their investment decisions.
- **Transparency and disclosure:** Investors rely on accurate and timely information to make informed investment decisions. They expect to receive transparent and comprehensive disclosures regarding insurers' and reinsurers' exposure to earnings risk, including risk management strategies, catastrophe modeling methodologies, and financial implications of potential losses. Insufficient transparency can lead to investor concerns and potential pressure on a company.

# Relationship between Earnings Risk and the Annual Exceedance Probability 1–10

Earnings in the (re)insurance industry are traditionally calculated by subtracting expenses, interest, and taxes from revenues. However, this white paper will focus specifically on revenue (the premiums collected on insurance policies) and expenses (the claims paid out). Investment income will not be included, and other expenses, such as IT and human capital expenses, will also be excluded as they are typically easier to plan for and predict.

We will delve into the impact of natural catastrophe losses that – because of their frequency and severity – can significantly affect (re)insurers' earnings stability. Investors become concerned about earnings risk when the volatility in losses exceeds expectations. Earnings risk can be measured in various ways, but for simplicity, we will presume it to be proportional to the aggregate exceedance probability 1 in 10 (AEP 1-10) of a firms book of business, normalized to the premium.

Assuming companies have a good understanding of premium, the question is: Why do companies underestimate the AEP 1–10?

## Challenges Understanding the AEP 1–10

For a typical insurer, the AEP 1–10 at portfolio level will include a broad range of perils, each with regional-level frequency and severity depending on the overall portfolio composition. For instance, the AEP 1–10 of a typical global (re)insurance portfolio can be driven by a combination of events impacting local regions around the globe, such as such as ~1-in-20 North Atlantic hurricane, ~1-in-50 European windstorm, ~1-in-100 Japanese typhoon or earthquake, and so forth.

To effectively manage the AEP 1–10 at the overall portfolio level, insurers must have good control of a series of regional loss distributions at different frequency and severity, with ranking of importance based on the specific portfolio composition. The idea that insurers don't need to understand the tail risk for a non-peak peril/region to manage earnings risk must be dismissed.

A catastrophe representing a tail event for a specific peril/region will often contribute to the AEP 1–10 risk for a larger or more diverse portfolio. For example, Figure 1 shows a representation of a portfolio for continental Europe managed with a mix of three different models which, unless specifically calibrated, would lead to an uncorrelated and hence improper view of risk.

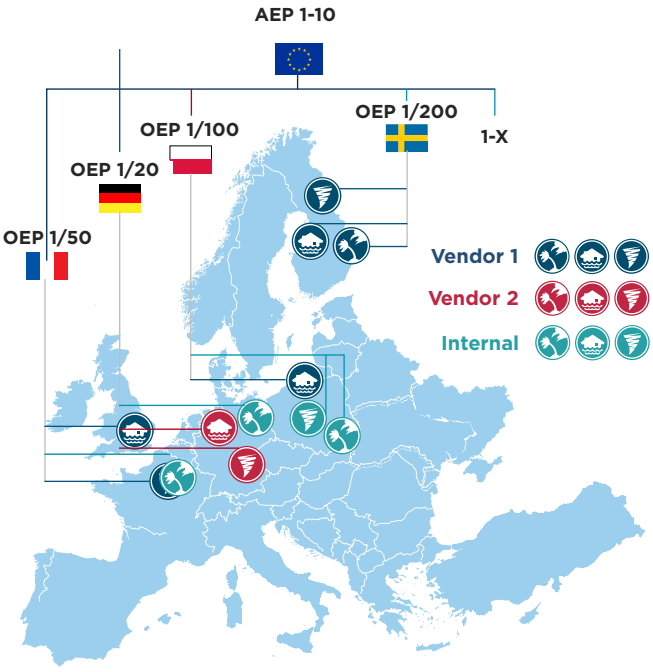


**Figure 1:** Composition of a European climate (re)insurance portfolio (AEP: aggregated exceedance probability, OEP: occurrence exceedance probability).

**We believe there are at least four main challenges with understanding the AEP 1–10.**

## Challenge 1: Modeling Gaps for Secondary Perils

In recent years, the market has experienced an increase in frequency and severity of climate-related losses. Depending on the region, as much as 50 percent of annual losses have been associated with secondary perils or non-peak perils. These are perils that for legacy reasons (low materiality, lack of sophisticated models, reliance on loss history) the market is typically not costing with the same level of quality used for peak perils (e.g., U.S. tropical cyclone, European windstorm, U.S. earthquake), neither for internal risk management nor for risk transfer. The list of non-peak perils varies by territory but generally includes flood, severe convective storm, wildfire.

### Loss Experience Proven to Be Misleading

Ever since Hurricane Andrew (1992), key landmark catastrophes have helped increase the penetration of nat cat (re)insurance. In the absence of catastrophe models, actuaries have played a major role in setting the costing of non-peak perils, mostly based on historical loss experience. Reliance on recent history will have limitations in either omitting many potential extreme events or overemphasizing any extreme that falls within the sample period.

Nat cat presents challenges given its natural variability and low frequency, in which there may be:

- Accelerated growth in insurance penetration, across new regions and perils.
- Shifts in land use and land cover.
- Urbanization leading to concentration of risk and migration of people and assets in risky areas.
- Climate change.
- Change in claiming behavior and claims handling.
- Economic inflation.

Another consequence of using experience-based cat loadings is that they may not simply extend to peril/region-specific tail loss distributions. The result is that so-called non-peak perils have often been underestimated.

## Challenge 2: Underestimation of Risk Correlation

Risk correlation across portfolios is, correctly, often seen as a problem. However, there can also be anticorrelation, driving diversification, which can be very welcome. Most climate perils can show some correlation in space and time. Some perils are also cross-correlated with one another, such as tropical cyclone and tropical cyclone-induced flooding or hail and tornado. Many models may not be designed to reveal correlation because they focus on a single country and/or a single peril. But as we know, catastrophes do not respect political borders.

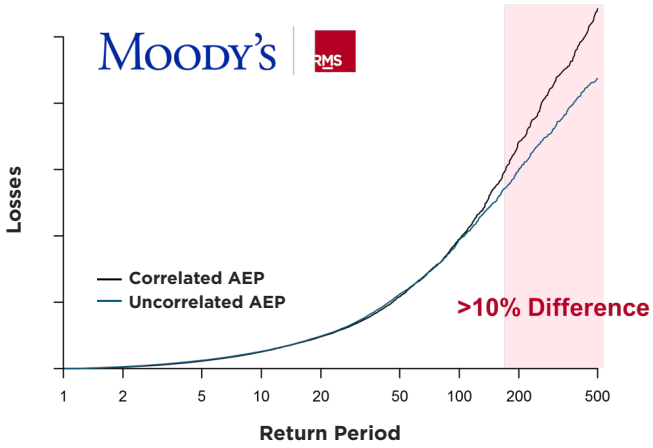


**Figure 2:** AEP for a flood portfolio in Germany and the Czech Republic, both with and without accounting for cross-country correlation.

The consequence of not understanding risk correlation (e.g. as consequence of a modeling set up similar to the one represented in Figure 1) may mean an unrealistic representation of compound loss volatility (the bad) and diversification (the good). Accordingly, an insurer might underprice coverages or overprice its offering out of the market. Figure 2 compares the impact of incorporating and the impact of disregarding correlation when modeling flood risk across a typical European flood portfolio spanning Germany and the Czech Republic.

Tail risk can be underestimated by more than 10 percent, an optimistic view that goes straight into the company-wide AEP 1–10, generating a misleading view of earnings risk. This is an important aspect that should be taken into account when combining loss distributions generated from disjointed modeling.

## Challenge 3: Lack of a Reference View for Risk Transfer

Nat cat models play a key role supporting risk transfer, enabling standardization in exposure data collection, and operating as currency of risk in the marketplace. Compared to a few years ago, models today have a much broader peril/region coverage across peak and non-peak perils.

And yet, while models are well established to transfer risk associated with peak perils, often non-peak perils are still unmodeled at the point of reinsurance renewal. This obstructs transparent risk conversations and discourages the capacity of the market to evolve and expand market resilience. This is particularly important in the current marketplace, where reinsurers have a reduced appetite to absorb volatility, leaving primaries with higher retention.

Without transparent and complete quantification of the full nat cat loss distributions within risk transfer, primary companies excelling in underwriting discipline can't be rewarded, while suboptimal underwriting would not be penalized. The market needs technical competition to evolve, attract investments, and remain resilient while still delivering its key value proposition: optimal deployment of capital to diversify risk, enabling sustainable economic growth.

## Challenge 4: Impact of Non-Modeled Loss Factors

Other factors posing higher pressure on earnings risk are the result of rapid changes in the way claims are generated, and how they can become inflated due to underinsurance, higher construction wages, material shortages, and social and economic inflation. Many of these factors are not modeled in catastrophe models, which are developed and calibrated to account for physical damage and associated repairs.

Among these[2] issues has been the significant cost pressure put on residential and commercial construction. Much of this stress arose as economic and production constraints imposed at the onset of the pandemic impacted global supply chains for construction material. The demand on construction material prices and labor costs continues to affect residential and commercial rebuild costs. Figure 3 provides normalized construction cost index for some representative European counties, this shows a clear upwards trend persisting in 2023. Similar trend is observed in North America and Asia Pacific.

## Capturing the Uncertainty of the European Climate 1-10 AEP

We can attempt, in Figure 4, to represent the situation around unmodeled non-peak perils during risk transfer:

- The grey AEP line represents the price of "peak perils" (Europe windstorm, with Belgium, Germany, and UK flood), underestimating European climate risk.
- The black AEP line represents the combined price for peak and non-peak perils. The difference between the black and grey lines at 1–10 years return period (RP) can be as great as 50 percent.
- The blue shaded area defines the range of risk quantification that may be derived empirically from recent loss experience.

In case of the overestimation of risk, an insurer might decide to buy too much reinsurance. But if the specific risk carrier is a reinsurer, then overestimation of risk might lead to too much prudence and being priced out of the market, i.e., not taking advantage of possible favorable conditions.

In case of the underestimation of risk, an insurer might minimize overall volatility and earnings risk, miscalculating the need to buy more reinsurance – leading to larger (unknown) retention and hence even higher volatility. Similarly, a reinsurer that underestimates risk might accept writing lower attachments without adequate premium, leading to not-well-rewarded volatility and, consequently, higher earnings risk.

Clearly, it is a fine line to walk. And having access to the best scientific loss distributions on which to base the most informed decisions is fundamental.

We will use Europe climate risk as a case study to examine the market challenge of understanding earnings risk.

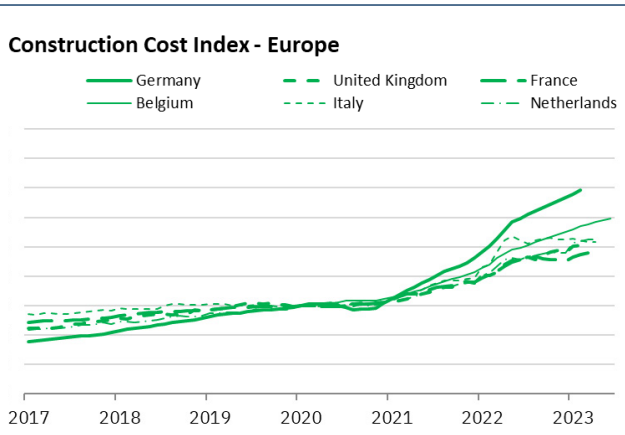


**Figure 3:** Construction cost index for representative European countries[2], period 2017-July 2023, values normalized to 2020.

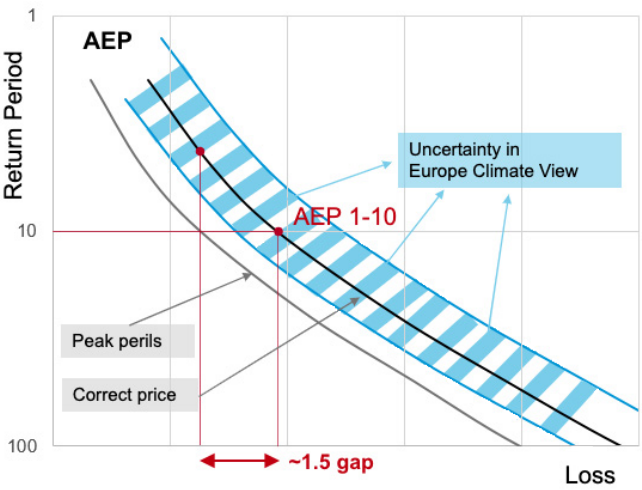


**Figure 4:** Risk quantification gap: the grey AEP line represents peak perils only, the black AEP line represents the full correct price, and the blue shaded area defines the range of risk quantification derived empirically from recent loss experience.

[2] Data from construction output price indices: U.K. Office for National Statistics (Office for National Statistics), U.K.; DESTATIS Statistisches Bundesamt, Germany (DESTATIS); cost and price indices in construction, INSEE, France; new-build homes, input price index construction costs 2000=100, from 1990, Statline, Netherlands (CBS Statline); STATBEL, Belgium; I.STATS, Italy.

# Managing European Climate Earnings Risk for (Re)insurers

The solution to managing European climate earnings risk is to make more informed, technically based decisions. To do this, risk carriers must prioritize the use of cat modeling to minimize the unknowns. In recent years, nat cat models have been extended to new geographies and perils. This expanded availability of models can aid internal risk management. It also facilitates data collection and risk transfer while encouraging greater discipline and transparent risk management – all of which can help build a more resilient market.

Moody's RMS has made significant efforts to deliver a more comprehensive set of models to include peak and non-peak perils across all relevant geographies. The new generation of models are high-definition (HD) and capture the correlation of risk in space and time. In addition, HD models offer higher resolution, greater transparency in space, across vulnerability and the overall loss-making process. These benefits are enabled by Moody's RMS proprietary methodology and the power and scale of cloud computing, which allows the use of larger stochastic sets and more flexible modeling. Each climate model's default setting includes 50,000 years of simulations that can be extended to help firms understand the uncertainty and control the convergence of the model across relevant portfolio sizes and use cases. The Moody's RMS financial HD Model makes transparent calculation of financial losses, calculating payout from location-coverage to any level of aggregation, accounting for policy and treaty terms and conditions just as occurring in the real world. We will highlight some of these capabilities with a deep dive into European climate risk.

In addition to a pan-European earthquake model, Moody's RMS offers three complementary models covering European climate risk (windstorm, severe convective storm, and inland flood) across 19 countries and seven sub-perils, a combination of 48 models. We call this solution our Europe Climate HD Models Suite. Its main characteristics are listed in Table 1, and the geographic scope is shown in Figure 5.

| Key Features | | | |
|---|---|---|---|
| | **Windstorm HD** | **Severe Convective Storm HD Models** | **Inland Flood HD Models** |
| **Perils** | Extratropical wind, coastal flooding | Straight-line wind, tornado, hail | Pluvial and fluvial flood |
| **Countries** | 16 | 17 | 14 |
| **Events** | 600K | 8M | 900K |
| **Simulation periods** | 50,000-year baseline, exendable by user-defeined samples | | |
| **Time elements** | Clustering, post-event loss amplification compounding, aggregate terms, bespoke hours clause, reinstatements | | |
| **Aggregated exposure** | Hazard sampling exposure disaggregation to sample realistic hazard levels across and geocoding resolution | | |
| **Secondary uncertainty** | Four parameters to achieve more realistic gross loss claimes distribution | | |

**Table 1:** The three models at the core of the Europe Climate HD Models Suite

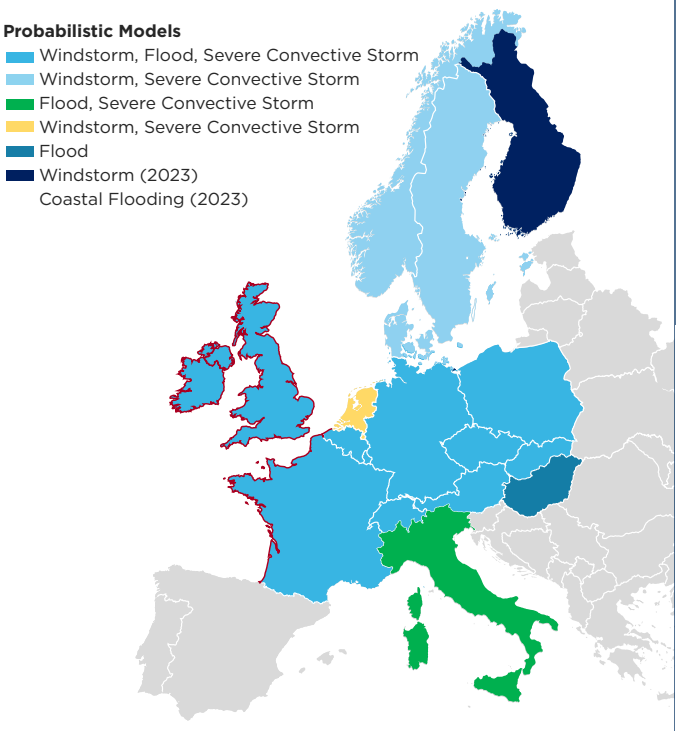


**Figure 5:** Geographic scope of the Europe Climate HD Models Suite

Over the last two decades, the market converged towards a standard of pricing Europe climate perils around Europe windstorm risk and Belgium, Germany, and U.K. used on an ad hoc basis. This was due, in part, to limited vendor model availability and the conviction that actuarial methods based on historical experience would help manage the totality of European nat cat risk.

Moody's RMS is now seeing a change in how the market is approaching European nat cat risk. The change is driven by (re)insurers who realize the benefit of being able to model the entirety of European risk more holistically through the use of more complete modeling such as the HD climate model suite for Europe.

In our case study examining the market challenge of understanding earnings risk, we discovered three key findings.

## Finding 1: The Materiality of Sub-Perils to Nat Cat Risk Varies by Country

The materiality of single sub-perils varies by country and by frequency. Figure 6 shows the country-specific proportion of loss costs[4] (LC) by sub-peril for an average European portfolio across the 12 countries for which all the modeled perils are material (also refer to Figure 5).

Windstorm is a main driver for the countries exposed to extratropical cyclone, especially Ireland, the U.K., Belgium, and France. With HD modeling, these four countries also benefit from high-resolution coastal flood (or surge) modeling, which correlates with windstorm hazard.

In continental Europe, severe convective storm risk (hail, straight-line wind, and tornado) becomes more and more important,

[3] For more information, see Moody's RMS High-Definition Models.

[4] Loss costs equal the average annual loss divided by total insured value

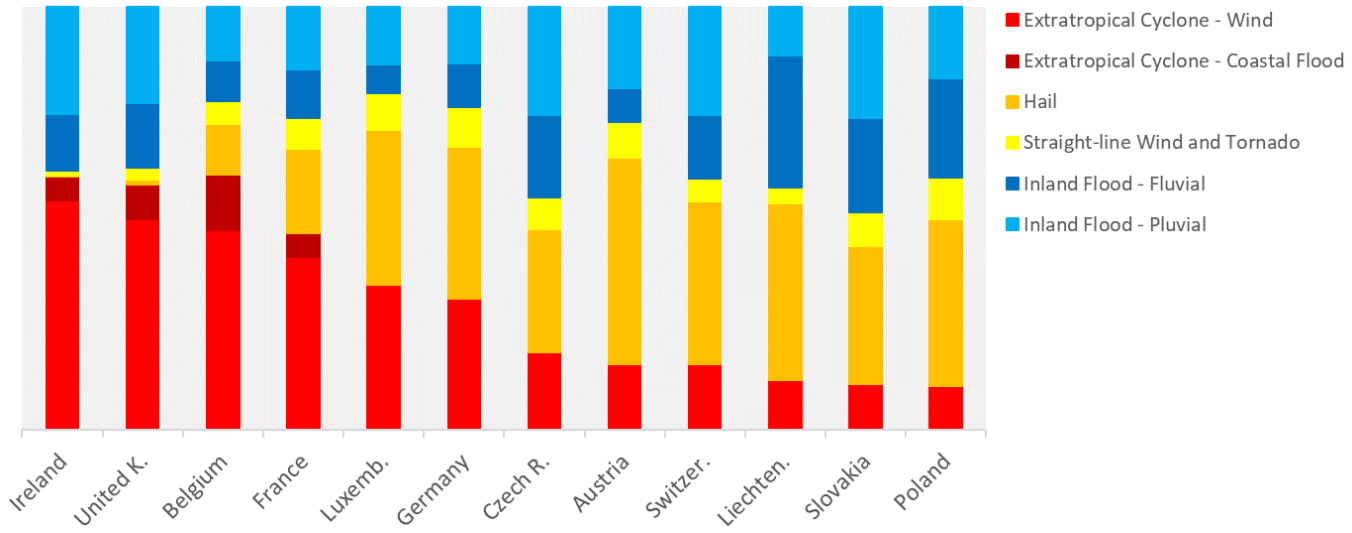


**Figure 6:** Climate risk landscape across some of the most important European countries, expressed as a proportion of gross loss cost

particularly hail, which in some countries is the main driver of LC. While not presented in Figure 6, Italy experiences the highest portion of severe convective storm losses in Europe. The Moody's RMS Europe Severe Convective Storm HD Model suite captures unique hot spots of severe convective storm risk, such as The Po Valley, which is the peak hail risk zone in Europe.

The Moody's RMS Europe Flood Models, which include Italy and Hungary (in addition to the countries in Figure 6), enable firms to differentiate between pluvial and fluvial flooding. At expected average loss, pluvial flood risk is typically higher than fluvial, which becomes more material at lower frequency when flood defenses start to fail. Indeed, pluvial risk is a main source of flooding, sometimes also called flash flood. This sub-peril is typically covered by regular flood policies, and it is particularly challenging because its frequency/severity is expected to increase due to changes in land use and land cover and also as a consequence of the increase in rainfall intensities driven by a warmer climate.

## Finding 2: Primarily Focusing on Peak Perils Overlooks the Impact Non-Peak Perils have on Earnings Risk

As mentioned, risk carriers have traditionally been very diligent when using models to understand contribution of peak perils to tail distributions. But now with access to more complete models in terms of geographic scope and perils covered, disentangling the loss contribution to any risk metric is possible. By focusing on the AEP 1–10, we can define a new perspective (see Table 2).

The proportion of the AEP 1–10 driven by a single peril/country combination can be expressed in excess average annual loss (XSAAL) at 10 percent frequency (XSAAL 1–10). Referring to Table 2, our findings are as follows:

- **Tier 1 earnings:** Traditionally, the industry considers European windstorm (wind and coastal flood) to be a peak peril, and it is certainly a peak peril for capital risk and solvency. However, when isolating single-country contributions across all relevant perils (and sub-perils) and when focusing on earnings risk, it becomes clear that not all countries are equally important and other perils should also be considered tier 1. Indeed, for an average European portfolio, 80 percent of the AEP 1–10 (approximately 80 percent of earnings risk, assuming a proportional split of AAL) is driven by 11 peril/country combinations: six of which are non-peak perils.
- **Tier 2 earnings:** On top of the 80 percent from tier 1, an addition of nine countries contribute to an extra 10 percent of the AEP 1–10. This group is evenly split among windstorm, flood, and severe convective storm.
- **Tier 3 earnings:** The remaining 28 peril/country combinations contribute to the last 10 percent of the AEP 1–10.

| | Windstorm, coastal flood | Pluvial and fluvial flood | Hail, straight-line wind, tornado | No. of perils/ country | Contribution to overall European climate XSAAL 1-10 |
|---|---|---|---|---|---|
| **Tier 1 earnings** | Belgium, France, Germany, The Netherlands, United Kingdom | France, Germany, Switzerland, United Kingdom | France, Germany | 11 | Approx. 80% |
| **Tier 2 earnings** | Denmark, Ireland, Switzerland | Belgium, Czech Republic, Italy | Austria, Italy, Switzerland | 9 | Approx. 10% |
| **Tier 3 earnings** | Austria, Czech Republic, Finland, Liechtenstein, Luxembourg, Norway, Poland, Sweden, Slovakia | Austria, Hungary, Ireland, Liechtenstein, Luxembourg, Poland, Slovakia | Belgium, Czech Republic, Denmark, Ireland, Liechtenstein, Luxembourg, The Netherlands, Norway, Poland, Sweden, Slovakia, United Kingdom | 28 | Approx. 10% |

**Table 2:** Peril/country contributions to European climate risk for the AEP 1–10

How does this impact earnings risk? To improve management of earnings risk, it is critical for the market to consider all relevant perils, beyond just the peak perils. The materiality of peril/country contribution varies greatly across portfolios (e.g., for Italy-only portfolios, Italy flood and severe convective storms would be tier 1). To manage earnings risk, all perils that matter for a given region (i.e., part of offered (re)insurance) need to be well quantified.

### Finding 3: Loading to Account for Non-Peak Perils Can Underestimate Earnings Risk

This is the key question that many risk carriers have been trying to answer, especially reinsurers. The most common practice at the time of risk transfer is to price European climate risk based on European windstorm and, depending on the portfolio, also flood for Belgium, Germany, and the U.K.

Unless they are using models that cover all perils and regions in Europe such as the Europe Climate HD Models Suite, firms apply an extra loading based on experience or based on uncorrelated models. These uncorrelated models typically do not holistically represent European climate risk, as they not only lack correlation but also sometimes are missing appropriate representation of sub-perils. The difference between the real risk potential and one based on a simplistic methodology can be very large.

Let's consider an average European insurance portfolio analyzed with Moody's RMS Europe Climate HD Models Suite[5]. The largest underestimation of risk is on an aggregated basis (AEP), with the difference being particularly material at high-frequency return periods. If an aggregated program modeled with just European windstorm and flood for Belgium, Germany, and the U.K is intended to attach at AEP 1-10, when accounting for all perils the corresponding return period would be below AEP 1-5.

On the other hand, if a Cat XL program is intended to attach at OEP 1-10, the attachment would be below OEP 1-7. The difference remains high all the way to tail events on an AEP basis (e.g. AEP 1-100 being an AEP 40-70 on the full modeling basis), where OEP presents a stronger decay (OEP 1-100 being an OEP 60-90 on the full modeling basis).

## Conclusion

The (re)insurance market is currently facing an important challenge due to the impact of natural catastrophe volatility on earnings risk, a metric that is fundamentally important for insurance firms to manage and attract investor attention and to remain resilient. This challenge might require natural catastrophe management teams to expand their scope to include earnings risk. For the resilience of single risk carriers and the industry overall, building a comprehensive and consistent view of risk has never been more important.

Moreover, challenges such as a changing climate, inflation, and a hardening of the reinsurance market are creating greater urgency for companies to rethink how they analyze risk. The increase in frequency and severity of climate-related losses, along with the availability of a complete view of risk with the Moody's RMS Europe Climate HD Models Suite, is an opportunity for the market to rethink risk transfer, design new structures to protect against risk, and achieve the growth it is seeking.

### Find Out More

For more information, visit **www.rms.com**, email **sales@rms.com**, or contact your Moody's RMS sales representative.

[5] In the Europe Climate HD Models Suite, theEurope Windstorm Models include the HD models and not the legacy detailed loss model (DLM). Similarly, flood models for Belgium, Germany, and the U.K. refer to the HD version of the Europe Inland Flood HD Models.

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Moody's RMS has shaped the world's view of risk for over 30 years, leading the catastrophe risk industry that we helped to pioneer. Our unmatched science, technology, innovation, and 300+ catastrophe risk models help risk and insurance leaders evaluate and manage the risks of natural and man-made disasters.



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