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# Addressing Physical Risk Impacts in Risk Management Practices

## Using return periods for stress testing

### Case Study

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# Executive Summary

The growing intensity of physical climate risks presents significant challenges for banks in managing credit risk and ensuring capital adequacy. This case study examines the use of short-term stress testing, leveraging return periods (e.g., 1-in-100 and 1-in-500 years) as severe yet plausible scenarios, to quantify the financial impacts of physical risks on credit. The results reveal that these impacts escalate non-linearly with scenario severity, disproportionately affecting counterparties with high physical risk exposure and weak financial resilience, as measured by operating margins.

Although portfolio diversification can mitigate some risk, its effectiveness is limited under extreme conditions due to hidden concentrations of exposure, such as geographic or sectoral clusters. Advanced modelling techniques, integrating physical risk data with existing credit risk frameworks (e.g., Probability of Default and Loss Given Default), are essential to account for tail risks and localised vulnerabilities.

This study underscores the need for banks to adopt more tailored stress testing approaches, strengthen credit-related physical risk assessment, and enhance portfolio steering and capital buffers strategies. By aligning these efforts with evolving regulatory expectations, such as those set by the European Banking Authority (EBA), institutions can enhance their resilience and navigate the complexities of an increasingly volatile climate risk landscape.

# Introduction

The impacts of physical climate risk are already evident and are expected to intensify over the next five years. Insured losses from U.S. wildfires, for example, have been rising at an alarming pace. Between 1965 and 2010, wildfires caused approximately $1 billion in insured losses. However, in the last 13 years alone, this figure has surged to $75 billion across more than 40 individual events.[1] The European Central Bank (ECB) estimates that extreme weather events could lead to losses of up to 5% of the euro area's economic output over the next five years, a shock comparable in scale to the global financial crisis. (European Central Bank, 2025). For banks, physical risks can translate into significant financial losses, including immediate damage to assets, reductions in collateral values, and deterioration in the long-term credit quality of loan portfolios. These effects contribute to both expected and unexpected losses, posing challenges for institutions to evaluate their ability to withstand and adapt to such risk.

In response to these growing challenges, policymakers across various jurisdictions are increasingly requiring financial institutions to integrate climate risk assessments into their risk management frameworks. Some regulators have gone further by mandating the incorporation of climate risk results into the Internal Capital Adequacy Assessment Process (ICAAP). For instance, the European Banking Authority (EBA) has amended Articles 73 and 74 of the Capital Requirements Directive, requiring banks to assess climate risks when determining internal capital needs. (European Banking Authority, 2025, paragraph 5, p.5) Under this directive, banks must demonstrate that their capital buffers are sufficient to absorb losses, including those arising from physical risks. Recently, the ECB imposed its first fines on banks for non-compliance with requirements on climate and environmental risk management, signalling increasing regulatory scrutiny.[2] Such enforcement actions are likely to become more frequent as regulatory expectations continue to evolve.

Banking authorities recognise scenario-based stress testing as a best practice for evaluating potential financial losses related to climate risk. In its latest publication, the European Banking Authority (EBA) outlined expectations for environmental scenario analysis, requiring institutions to assess their capital resilience to environmental shocks in particular over the short-term (European Banking Authority, 2025, p.3). Similarly, the Bank Negara Malaysia (BNM) and the Monetary Authority of Singapore (MAS) have introduced standardised short-term scenarios focused on 1-in-200-year flood events as part of their climate stress testing exercises. A return period refers to the likelihood of a specific event severity being exceeded within a given timeframe. For example, a 1-in-200-year event has a 0.5% annual probability of exceedance.

These regulatory developments underscore the growing emphasis on climate stress testing as a key tool for assessing short-term impacts from climate risk. Short-term & what-if scenarios (severe yet plausible), are particularly valuable for analysing near-term adverse shocks. They allow banks to assess their financial resilience with greater precision and evaluate the potential impact on their capital needs. As a result, developing robust short-term scenario analysis capabilities is becoming a critical focus for banks. These capabilities enable institutions to conduct meaningful stress testing exercises and integrate the resulting insights into their risk management and capital planning processes.

To navigate the complexities of an evolving regulatory landscape, banks face the challenge of effectively applying scenario analysis to support climate stress testing and quantify the impacts of credit-related physical risks. However, two key hurdles often arise when modelling physical risk impacts in terms of credit risk metrics. First, despite significant advancements in physical hazard modelling, traditional credit risk models struggle to capture the unique attributes of physical risks, as they typically rely on averages or central tendency assumptions that fail to fully account for the variability and extremity of these events. Second, many banks continue to depend on pre-set regulatory scenarios that are often too broad, linear, or focused on long-

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[1] Zandi, M. (Host). (March 18, 2025). Fires and Floods with Firas Saleh (Bonus Episode). Moody's https://www.moodys.com/web/en/us/insights/podcasts/inside-economics/fires-and-floods-with-firas-saleh.html

[2] European Central Bank. (2025, November 10). ECB imposes periodic penalty payments on ABANCA for failing to sufficiently identify climate risks. Retrieved from: https://www.bankingsupervision.europa.eu/press/pr/date/2025/html/ssm.pr251110~3e0b6f579e.en.html, November 2025

term assumptions. These limitations can obscure the impacts of short-term extreme conditions, leading to the underestimation of risks and leaving financial institutions unprepared for potential shocks.

To address these challenges, financial institutions must implement robust frameworks that effectively account for the complex, non-linear nature of physical risks within credit risk models. This involves applying adverse physical risk scenarios in stress testing exercises and integrating the resulting insights into broader risk management practices. Achieving this will likely requires banks to enhance their internal Probability of Default (PD) and Loss Given Default (LGD) models by incorporating external physical risk data and advanced analytics. Additionally, banks should move beyond standardized climate scenarios by developing stress tests that are customized to their specific risk management practices and nuanced understanding of physical risks. By addressing these components, banks will be better positioned to demonstrate that physical risks are effectively assessed and embedded within their risk management frameworks, aligning with best practices and adapting to the changing regulatory environment.

This paper presents a case study using Moody's-RMS Climate on Demand Pro (CoD Pro) Return Period Damage Ratios (DRs) as a scenario analysis tool for short-term portfolio stress testing. Return periods capture the full distribution of damage ratios across various physical risk hazards and are particularly useful for stress testing purposes as they assess severity at exceedance probabilities, capturing tail-risk damage ratios. Leveraging return periods for stress testing enables banks to understand how extreme damage ratios translates into financial impacts. For example, if a bank is resilient to a return period of 200 years level of damage, it implies that the bank has built sufficient capital and risk management buffers to handle events of that severity or less.[3]

For this case study, we analysed a portfolio of public companies, incorporating their financial statements and physical risk exposure metrics. We leveraged the framework outlined in the Bank for International Settlements (BIS) working paper on 'Incorporating Physical Climate Risks into Banks' Credit Risk Models'[4] to estimate unexpected losses from physical risk under the Pillar 1 Internal Ratings Based approach. This framework provides a simplified method for assessing credit-related financial losses under our scenario-based stress tests. The outputs highlight Risk-Weighted Asset (RWA) volatility at different return periods (1-in-50, 1-in-100, 1-in-200, and 1-in-500 years), quantified through credit risk metrics such as PD and LGD. While RWA serves as the framework for this case study because of its widespread usage in banking, the focus of this paper is not to explore capital allocation implications. Rather it seeks to provide insights into how physical risks interact with credit risk. By translating physical risk into RWA measures, the results can provide insights into credit-related impacts and support risk management decisions such as capital allocation and portfolio steering decisions.

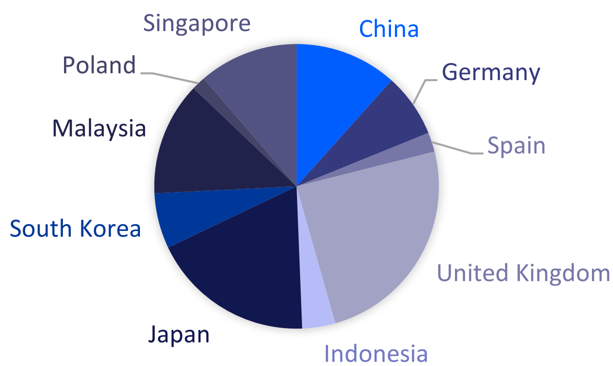
[3] This does not eliminate the possibility of more extreme events. There remains a 0.5% probability each year (equivalent to a 1-in-200-years chance) that an event causing damages greater than the bank's resilience threshold will occur.

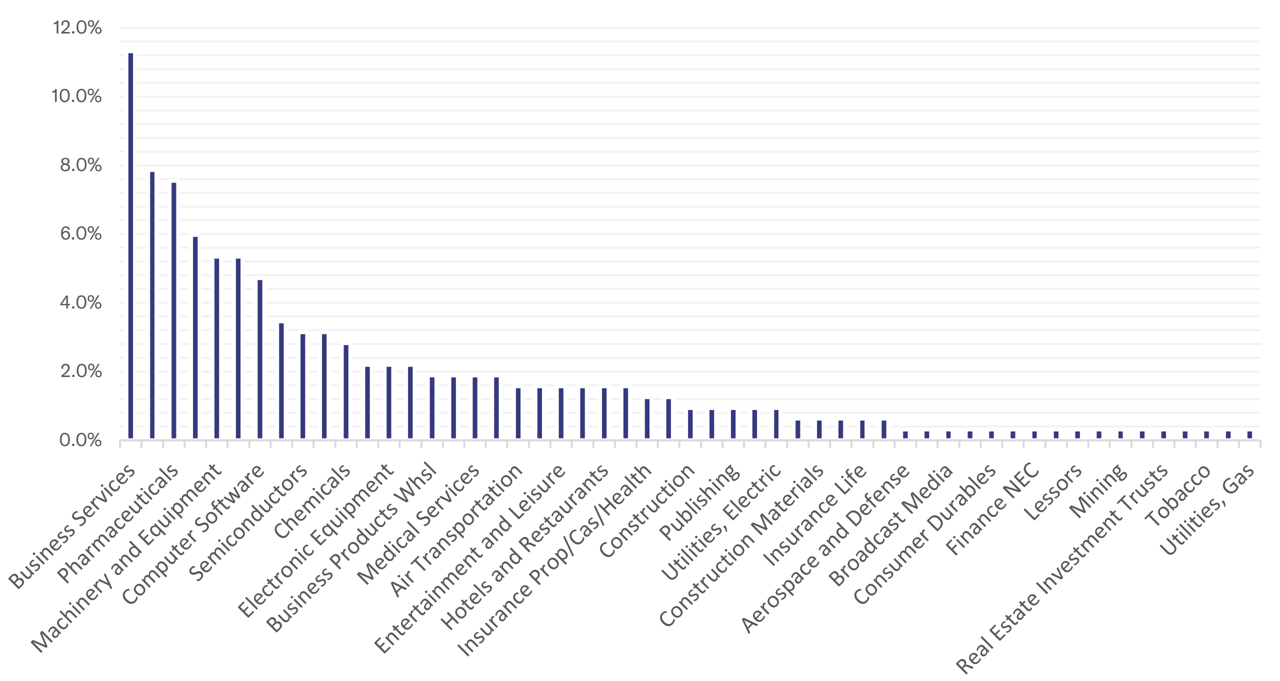
[4] Pozdyshev, V., Lobanov, A., & Ilinsky, K. (2025). Incorporating physical climate risks into banks' credit risk models. BIS Working Papers No 1274.

# Data & Methods

The case study we present focuses on a physical risk stress test applied to a portfolio of 318 public companies, weighted across multiple sectors and regions as shown below.

Figure 1: Portfolio region & sector breakdown




Before application of the stress test scenario to our selected portfolio, we assessed portfolio exposure to physical risk using company-level physical risk metric. We combined counterparty-specific Moody's CoD Pro's Annualized Damage Rates (ADR) and Standard Deviation (SD) metrics. We include the standard deviation for the purpose of reflecting the width of the distribution (uncertainty) of annual impacts. The 'ADR+SD' metric aggregates facility and asset-level exposures for each counterparty, providing granular insight into companies' global physical risk exposure. To guide our analysis, we established three risk exposure buckets (Low, Medium, and High) defined by specific thresholds derived from the 0.33, 0.66 and 0.99 percentiles of the 'ADR+SD' metric distribution. The exposure risk bucket categories were a key component in evaluating portfolio vulnerability to physical risk and understanding how company financials evolve under different climate scenarios.

The climate stress test applied to this portfolio used return periods as the basis for short-term physical risk severe yet plausible 'what-if' scenario analysis. We adopted a one-year time horizon and assessed physical risk impacts across return periods of 1-in-50, 1-in-100, 1-in-200, and 1-in-500 years. These return periods capture the statistical likelihood and severity of extreme annualised damage ratios. For this analysis we focussed on direct impacts to the company in the form of asset destruction and business disruption. This approach allowed us to examine tail-risk scenarios related to physical risk damage rates and how these affect counterparties and overall portfolio credit risk. By focusing on tail risk, banks can understand if they have built sufficient capital and risk management buffers within the next year to handle damage rates of that severity or less.

To estimate capital impacts under different return periods, we leveraged recent research by the Bank for International Settlements (BIS) in its working paper 'Incorporating Physical Climate Risks into Banks' Credit Risk Models' (Pozdyshev, Lobanov, Ilinsky, 2025). The BIS framework enhances the Vasicek one-factor model, used in the Basel Internal Ratings-Based (IRB) approach, by introducing physical climate risk as a distinct systematic factor. This allows extreme events, such as those in our stressed scenarios, to be modelled as binary shocks. Rather than requiring banks to build entirely new models, the BIS approach builds on existing credit risk frameworks (PD and LGD) and integrates third-party climate data, offering a practical methodology for addressing challenges in granular physical risk modelling. The outputs of this framework quantify capital impacts under Pillar 1 RWA calculations, which is generally understood by risk practitioners.

# Results

This stress test case study underscores the critical and complex nature of physical risk, revealing both the non-linearity of credit risk impact and the challenges of integrating it effectively into traditional credit risk models. Our analysis shows that disproportionate return period impacts, localised risks driving higher default correlations, and counterparty capacity to absorb losses collectively amplify vulnerability in ways that traditional risk management frameworks may fail to capture. These characteristics highlight the complexity of modelling physical risks and signal the need for banks to adopt more granular, forward-looking approaches to account for non-linear dynamics in the context of capital planning and portfolio steering.

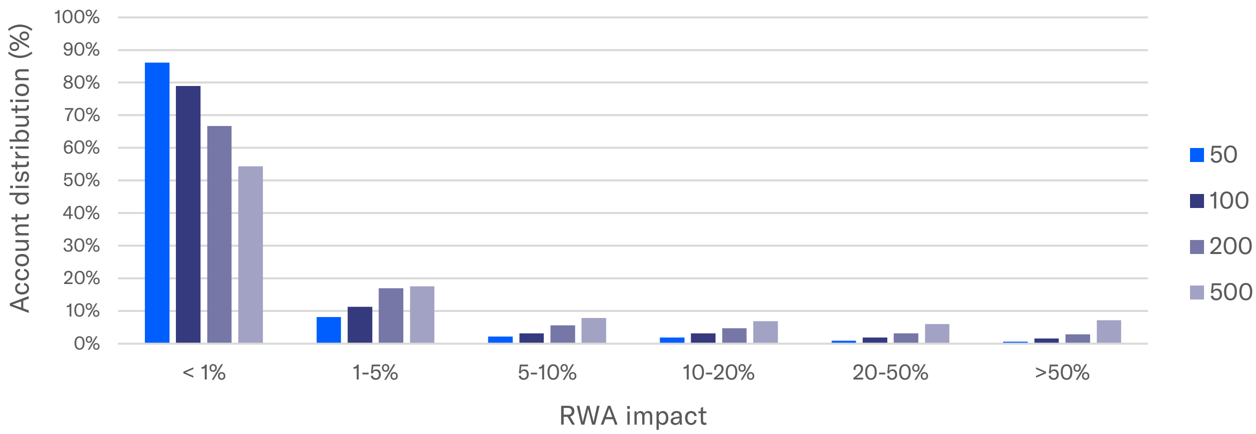
The non-linearity of financial impacts can be summarised in the following key insights:

### 1. Disproportionate return period impacts

Financial impacts, measured in terms of RWA, do not increase proportionally with the severity of return period scenarios. Figure 2 illustrates relative RWA impact distribution across return period scenarios.

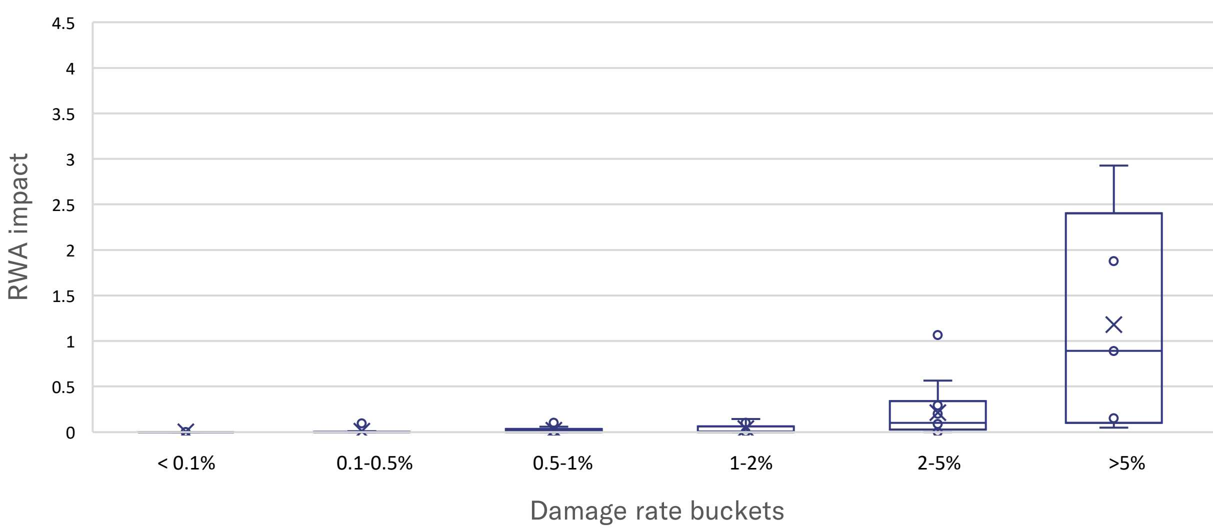
In figure 3, we show relative RWA impact distribution across companies by Damage Ratio Category buckets for 100-year return period scenario.

Figure 2: Percentage of accounts distributed across RWA impacts per return period




We observe that with increased scenario severity (in terms of return periods), more firms are subject to higher RWA impact. As the return period increases (from 50 to 500 years), the percentage of accounts with low RWA impact (<1%) steadily decreases, from 86% at the 50-year return period to 54% at the 500-year return period. Conversely, the percentage of accounts with very high RWA impact (>50%) grows notably, from just 1% at the 50-year return period to 7% at the 500-year return period. This highlights how a small subset of firms can be highly impacted under extreme Damage Rate scenarios. The broader distribution of RWA impacts also indicates that as scenario severity increases (longer return periods), the overall proportion of firms experiencing moderate to severe RWA impacts expands

Figure 3: Box Plot showing RWA Impact distribution by Damage Ratio buckets for 1–100-year return period



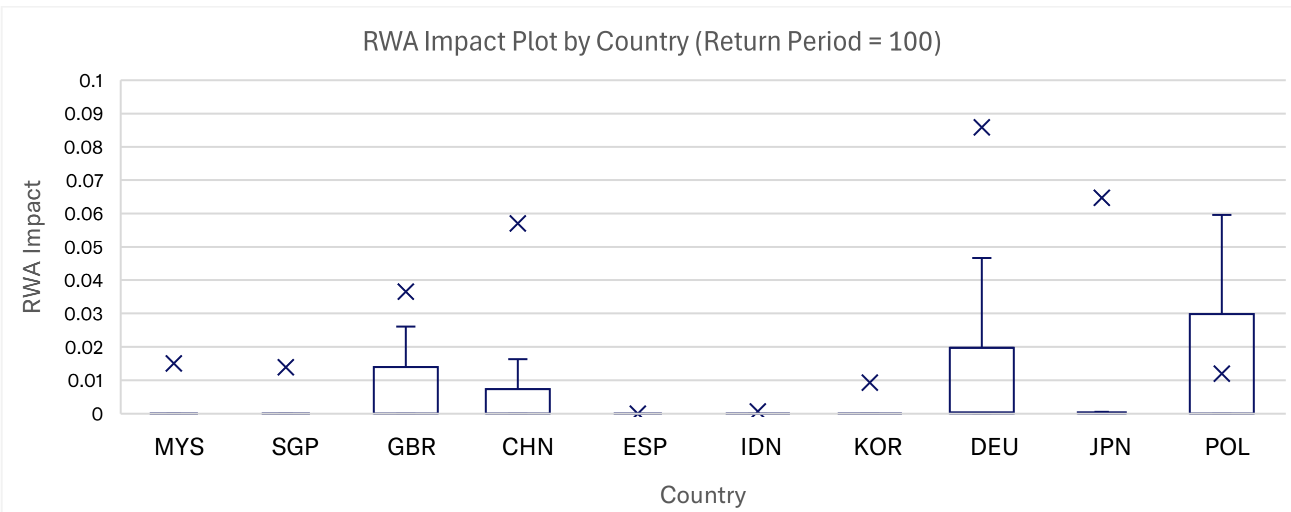

When looking at RWA impact distribution by damage ratios, the firms experiencing highest damage ratios (>5% annual damage ratio) exhibit the largest RWA impact – while median RWA increase is ~100%, impact can be as high as 200% to 300%. Interestingly, RWA impact doesn't have a linear relationship with experienced physical risk damage ratio under the stress scenario. (E.g. for firms experiencing damage ratio between '2-5%'), median RWA impact is ~20% whereas firms experiencing '>5%' damage ratio have median impact ~100% (i.e. ~2X increase in damage ratio may result in 5X increase in RWA impact). Similar pattern is observed for relatively small damage ratios. The relationship between return periods and RWA impacts reveals non-linear dynamics, where small changes in certain factors can result in disproportionately large financial impacts.

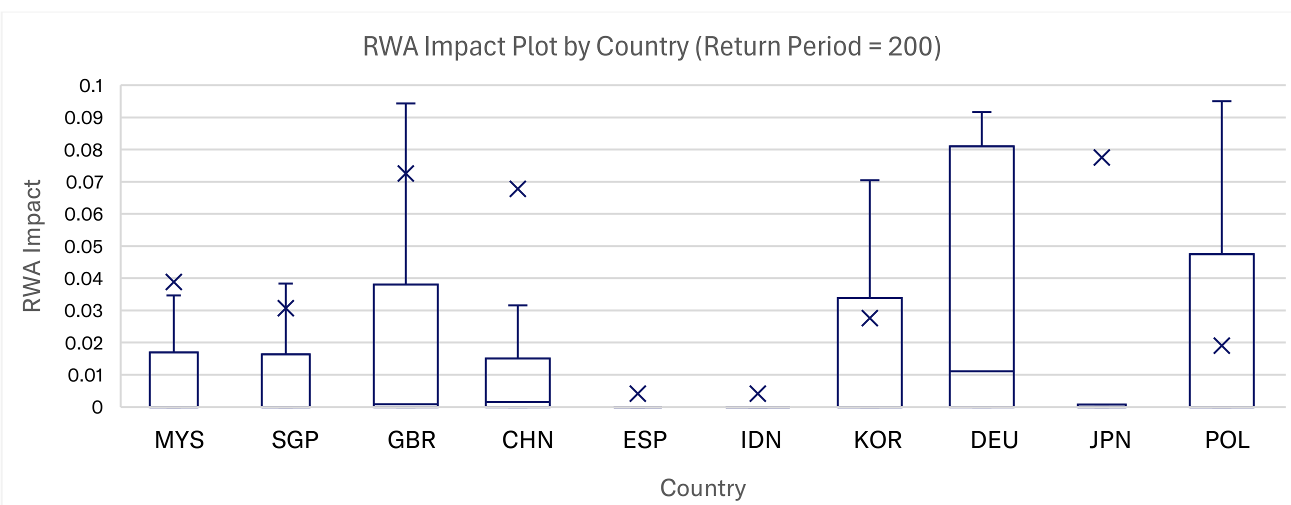
These findings challenge traditional stress testing approaches, which often assume proportionality. The data demonstrates that non-linear scaling of RWA impacts with physical risk exposure levels and scenario severity requires a more nuanced approach to risk assessment. Incorporating both granular physical risk assessment and return periods into portfolio risk analysis becomes necessary, as their interaction is highly variable across different risk levels. By integrating return periods into physical risk stress testing, allows for a more comprehensive understanding of the nonlinear characteristic of impacts and provides insight to portfolio management strategies.

## 2. Localised risk

Firms located across various geographies are not exposed to similar levels of physical risk. Instead, physical risk levels are highly localised and driven by country & location-specific climate vulnerabilities. Also, some locations experience relatively mild physical risk impact unless the scenario is relatively extreme. Figure 4 below shows relative RWA impact distribution across companies based in a country.

Figure 4: Box Plot showing RWA Impact distribution by Damage Ratio buckets for different return periods



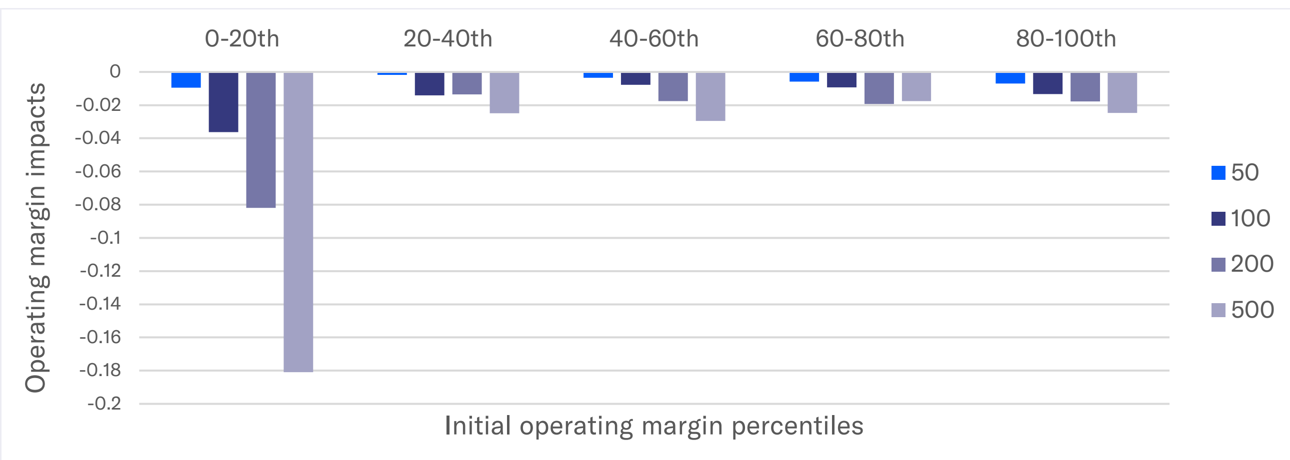
We observe that firms located in Germany (DEU), Poland (POL), United Kingdom (GBR) and China (CHN) exhibit relatively higher level of RWA impact whereas firms in countries like Spain (ESP), Japan (JPN) and Indonesia (IDN) experience a less significant level of physical risk damages. Note that this observation is linked to the specific portfolio and doesn't necessarily indicate higher or lower physical risks across these countries. Furthermore, some countries such as Malayia and Singapore do not show any observable RWA impact until the 200 year return period scenario. These observations highlight the variability in how physical risks manifest across regions/locations. This example shows that certain countries exhibit steep increases in impacts at higher return periods, causing physical risk to behave like a systemic risk factor.

The geographic clustering of high physical risk impacts suggests that portfolios with significant exposures in specific regions are at greater risk of systemic impacts, particularly under severe climate scenarios. These impacts could be further exacerbated by second-order effects, such as local supply chain disruptions, which fall outside the scope of this case study. Thus, it is essential for banks to implement regional risk assessments to identify clusters of highly physical risk exposure and build necessary risk management strategies to address ramifications of physical climate risk.

## 3. Company resilience

The financial impacts of physical risk include direct damage to assets and revenue losses arising from business interruptions. At the company level, the extent of these impacts on credit risk can be determined by a company's ability to absorb losses. Figure 5 below illustrates a financial statement analysis conducted based on initial operating margin percentiles and the impacts on operating margins across different return periods.

Figure 5: Distribution of Operating Margin Impact across initial operating margin percentiles by Return Period




As observed, the 0–20th operating margin percentile group experiences the largest negative impacts across all return periods. For example, even at shorter return periods, such as 100 years, the impact is -0.0363, which is considerably more severe than the impacts observed for higher operating margin percentile groups. In contrast, the highest percentile groups (60–80th and 80–100th) show smaller impacts compared to their lower-margin counterparts. For instance, at the 500-year return period, the impacts are -0.0176 (60–80th) and -0.0247 (80–100th), significantly lower than the -0.1808 impact observed in the 0–20th percentile group.

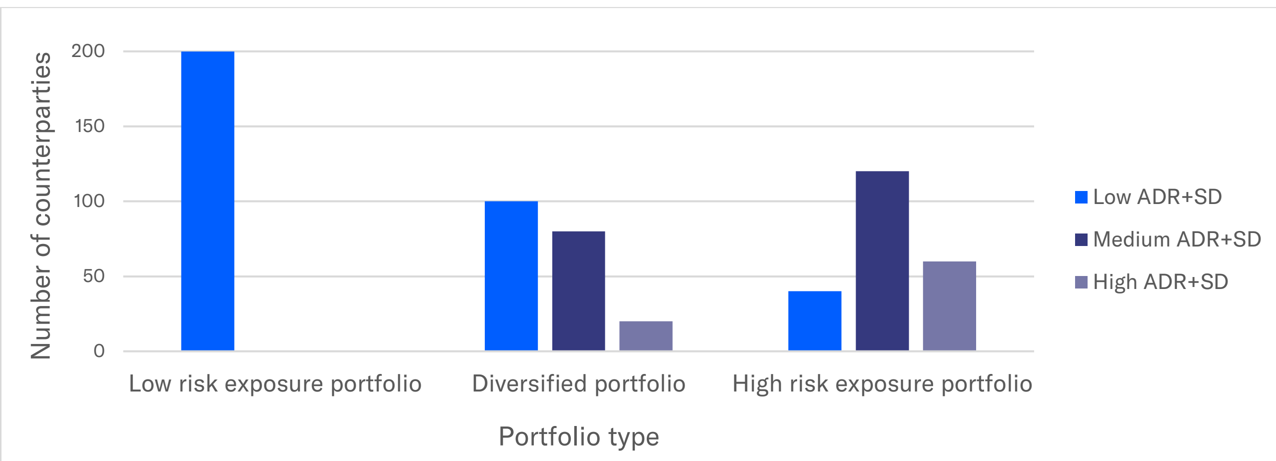
This analysis highlights that firms with initially weaker operating margins are disproportionately affected by extreme damage rates, whilst firms with stronger initial operating margins are better equipped to absorb such shocks. The findings suggest that stronger financial positions generally result in a reduced likelihood of potential credit risk deterioration under extreme damage rates. The results also indicate that companies with higher operating margins are better placed to handle losses, reinforcing the importance of financial resilience.

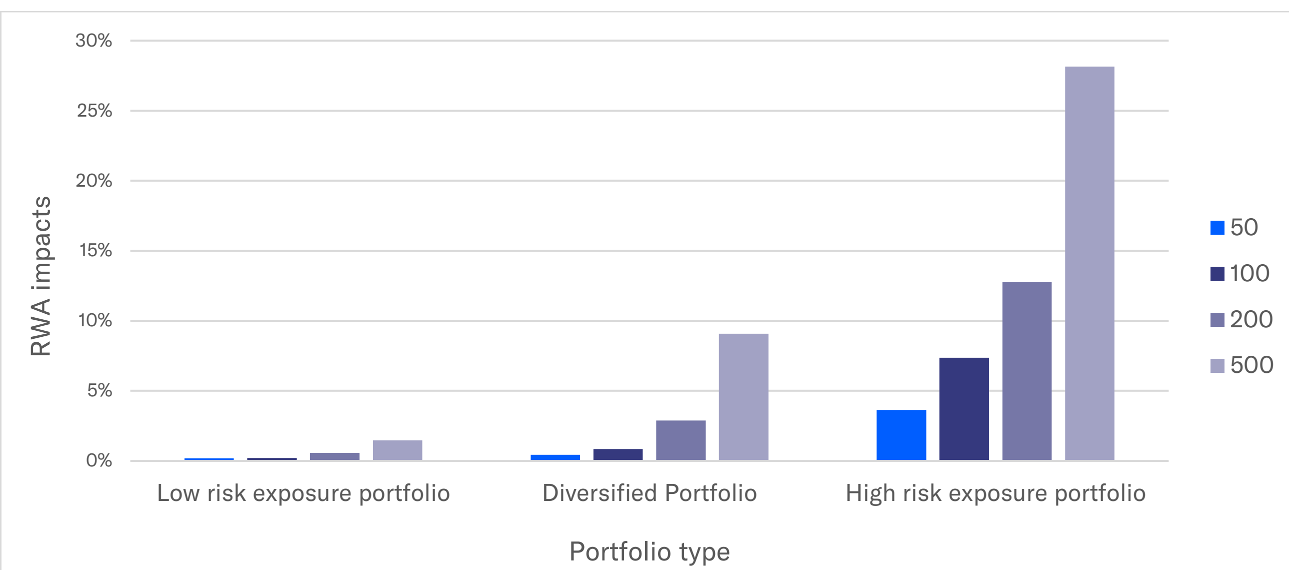
Counterparties with lower operating margins are, therefore, more likely to experience potential credit risk deterioration, underscoring the importance of portfolio segmentation based on financial strength. By identifying and prioritising counterparties with robust financial resilience, companies can mitigate portfolio-level credit risk and enhance long-term stability in the face of physical risks. While the case study does not evaluate counterparty-level adaptation and mitigation strategies, these are essential for understanding long-term resilience. Banks should assess counterparty resilience under extreme damage rate scenarios to anticipate potential credit deterioration and apply the necessary risk mitigation strategies.

## 4. Portfolio-level analysis

We analysed physical risk impact at the portfolio level to determine whether physical risk exposure diversification can mitigate the RWA impacts. To this end, we created three portfolios with varying degrees of physical risk diversification, leveraging counterparty level 'ADR+SD' scores. The first portfolio consists exclusively of low-exposure counterparties. The second portfolio (distributed) includes a mix of low- and medium-risk counterparties. The third portfolio comprises high-risk exposure counterparties.

Figure 6: Firm count and RWA impacts by portfolio type



| | Relative impacts as scenario return period increases | | |
|---|---|---|---|
| Portfolio type | 50 to 100 | 100 to 200 | 200 to 500 |
| Low risk exposure portfolio | 0% | 200% | 150% |
| Diversified portfolio | 100% | 263% | 214% |
| High risk exposure portfolio | 105% | 73% | 120% |

The results reveal that exposure diversification can be a factor in managing RWA impacts under physical risk scenarios, but its effectiveness diminishes at higher return periods. When considering the relative increase in impacts for the different return period scenarios, the Diversified Portfolio shows a higher rate of change (263%) between the 100-year and 200-year return periods compared to both the Low Risk Exposure Portfolio (200%) and the High Risk Exposure Portfolio (73%). This indicates that, as physical risks intensify, the Diversified Portfolio sees a sharp escalation in impacts, suggesting that diversification struggles to mitigate the rapid growth of risks at these intermediate return periods. The RWA impacts for the Diversified Portfolio grow significantly with increasing return periods, reaching 263% difference at the 100- to 200-year return period, suggesting diversification does not achieve the dramatic risk reduction that might be expected.

The portfolio-level results demonstrate the non-linearity of losses, even when diversification of ADR+SD risk exposure is considered, suggesting diversification is only partially effective. While the distributed portfolio spreads exposure across many counterparties, it may still contain pockets of concentration risk. This indicates that, although the portfolio appears diversified, it is not fully diversified across physical risk drivers, which can disproportionately affect subgroups (e.g., specific regions). Diversification provides a buffer against smaller, more frequent events but is less effective in mitigating extreme losses when localised or correlated risks materialise. Portfolio managers must therefore focus on identifying and addressing these hidden clusters of risk.

The results reveal that exposure diversification can play a role in managing RWA impacts under physical risk scenarios, but its effectiveness is limited. When examining different return period scenarios, the Diversified Portfolio demonstrates that, while diversification reduces risk compared to high-risk portfolios, its ability to prevent significant impacts at higher return periods remains constrained.

Physical risk creates non-linear financial impacts that traditional models often miss. This stress tests case study show RWA does not scale proportionally with scenario severity (doubling ADR+SD exposure can nearly quadruple RWA) highlighting the need for advanced modelling. Physical risk are highly localised, with regions like Singapore and Malaysia showing sharp escalations under severe scenarios, amplifying default correlations and systemic vulnerabilities. Counterparty resilience matters: firms with strong margins absorb losses better, while weaker ones face severe deterioration, making resilience metrics essential. The trend observed from this stress test case study highlights a key feature in Physical risk assessments, a minority of assets carry most of the exposure, and return period severity drives impact, reinforcing the need for granular counterparty-level analysis supported by forward-looking scenario design.

## Building on these findings

While this climate stress test case study focused on return period scenarios (the tail of the ADR distribution), it serves as a valuable tool for identifying concentrations of risk exposure and quantifying the potential financial materiality of that exposure. Understanding financial risk across portfolios, as well as how that risk is distributed, is essential for informing management and risk strategies. For example, financial institutions can implement targeted strategies to at-risk companies, such as portfolio rebalancing or exploring opportunities to raise adaptation finance to address physical risk exposure.

We apply the results from this case study to develop an approach that supports banks' portfolio steering practices in the context of physical risk. Banks can use this information for screening purposes to identify high-risk counterparties, adjust lending limits and provisions, and design targeted de-risking strategies. By considering magnitude of physical risk exposure, analysts can prioritise efforts on the most vulnerable assets and companies.

Among the characteristics analysed, physical risk exposure metrics such as the ADR+SD emerge as a strong indicator of physical risk exposure and RWA volatility. Our results also show that increases in RWA driven by scenario severity are particularly pronounced for counterparties with lower operating margins, given their limited ability to absorb losses. These two components, physical risk exposure and operating margin, provide a clear view of counterparty-specific vulnerability and resilience. We used these to develop quantitative indicators that identify counterparties likely to experience high RWA volatility. The proposed approach offers an actionable approach for banks, aligning with observed patterns of RWA volatility based on our findings.

Figure 7: Illustrative example of this approach for 1-in-100-year Return Period

| Operating Margin (percentile) | Low | Medium | High |
|---|---|---|---|
| 0-20th | 0.00% | 2.52% | 15.08% |
| 20-40th | 0.00% | 0.31% | 27.41% |
| 40-60th | 0.00% | 0.03% | 0.00% |
| 60-80th | 0.00% | 0.64% | 0.27% |
| 80-100th | 0.00% | 0.00% | 0.00% |

These quantitative indicators show that the interaction between physical risk exposure and operating margin creates a compounding effect: firms with lower margins are far more sensitive to physical risks, while higher-margin firms experience near immunity from risk-driven volatility. Our analysis indicates that firms with stronger operating margins (above the 40th percentile) are significantly less affected by physical risk exposure, suggesting that profitability acts as a financial buffer against risk-induced volatility.

RWA volatility is concentrated among firms with low operating margins and high physical risk exposure, making this segment a priority for capital allocation buffers and portfolio steering. Targeted risk mitigation strategies should focus on firms within this quadrant, as they are key contributors to volatility due to their limited ability to absorb shocks effectively. Banks can deploy mitigation measures—such as capital buffers, provisions, or climate adaptation incentives—for these exposures. These actions can enhance overall portfolio resilience and help reduce RWA volatility over time.

Return period scenarios provide a powerful lens for identifying risk clusters and quantifying financial materiality at the tail of the ADR distribution. Our findings show that physical risk exposure and operating margin are key determinants of RWA volatility, with low-margin, high-risk firms driving the greatest instability. By prioritising these exposures and deploying targeted mitigation and portfolio steering strategies—such as capital buffers, provisions, and climate adaptation incentives—banks can strengthen portfolio resilience and reduce systemic vulnerabilities. Ultimately, adopting forward-looking, scenario-based approaches supports banks with strong insights to make informed risk management decisions such as capital adequacy and portfolio steering while positions institutions to meet evolving regulatory expectations.

# Concluding remarks

The growing intensity of physical climate risks demands a paradigm shift in how banks approach credit risk, capital adequacy planning and portfolio steering. This study demonstrates that physical risks are inherently complex, driven by non-linear financial impacts, localised vulnerabilities, and counterparty-specific resilience factors. Addressing these challenges requires advanced modelling techniques, forward-looking scenario design, and targeted risk mitigation strategies.

By leveraging return period scenarios as a stress test exercise and integrating physical risk metrics with advanced credit risk frameworks, banks can better quantify financial vulnerabilities and prioritise mitigation efforts. Institutions that adopt these approaches will not only strengthen their portfolios and capital positions but also align with evolving regulatory requirements.

Ultimately, the ability to manage physical climate risks effectively will be a defining factor in the resilience of financial institutions in the years to come. By taking decisive action —through bespoke stress testing, enhanced capital planning, and granular physical risk assessments—banks can navigate the challenges of an increasingly volatile climate landscape.

The insights from this case study focus on leveraging advanced tools, frameworks, and strategies to better integrate physical risk into risk management and capital planning processes. By leveraging these actionable insights, banks can reduce systemic vulnerabilities, enhance portfolio resilience, and deploy forward-looking risk management strategies. Some key actionable insights include:

1. **Adopt Granular and Tailored Stress Testing Frameworks:** Banks should move beyond standardised scenarios, to develop bespoke stress tests tailored to their specific portfolios. For example, by incorporating return period scenarios, banks can assess the financial impact of tail-risk events. These frameworks should integrate counterparty- and region-specific physical risk metrics (e.g., ADR+SD) to provide a more realistic and precise view of potential vulnerabilities.
2. **Leverage Data and Analytics:** Integrating external climate data and analytics, with internal credit risk models (e.g., PD and LGD models) can enhance the precision of risk assessments. By using tools that quantify tail risks and exceedance probabilities, banks can better understand how physical risks translate into financial impacts, enabling more informed decision-making.
3. **Prioritise High-Risk Counterparties:** Metrics such as physical risk exposure (ADR+SD) and operating margins provide a powerful lens to identify high-risk counterparties that may drive credit risk volatility. Banks should focus on firms with high physical risk exposure and low financial resilience, as these are the most vulnerable to climate shocks. Actionable steps include adjusting lending limits, increasing provisions, and offering climate adaptation financing to help these firms build resilience.
4. **Focus on Portfolio Diversification and Hidden Risk Clusters:** While diversification is a key portfolio risk management strategy, this study highlights its limitations under extreme scenarios. Banks should go beyond superficial diversification by identifying hidden clusters of risk within portfolios, such as sectoral or geographic concentrations. Proactive measures, such as rebalancing portfolios or de-risking concentrated exposures, can help mitigate the systemic effects of physical risks.
5. **Enhance Capital Planning and Buffers:** Capital adequacy frameworks must account for the disproportionate and non-linear impacts of physical risks. Banks should allocate additional capital buffers to high-risk segments, particularly for portfolios with concentrated exposures to regions or counterparties vulnerable to tail-risk events. This ensures resilience against extreme scenarios and aligns with regulatory expectations, such as those outlined in the European Banking Authority (EBA) guidelines.
6. **Prepare for Regulatory Scrutiny:** With regulatory bodies such as the ECB and EBA increasing their focus on climate risk, banks must ensure that their risk management frameworks align with regulatory expectations. Demonstrating the integration of physical risk into ICAAP processes, conducting scenario-based stress tests, and providing evidence of sufficient capital buffers will be critical to avoiding penalties and maintaining regulatory compliance.

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