The Coalition of Finance Ministers for Climate Action

How the analytical tools and methods used in the (re)insurance industry can support Ministries of Finance in their understanding of physical climate risks and their efforts to support climate adaptation

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Introduction

Analytical tools used in the (re)insurance context can support Ministries of Finance in understanding and managing physical climate risks. This contribution discusses how, for example, catastrophe models, risk layering, and protection gap analysis can help Governments identify and quantify physical climate risks and contingent liabilities, develop climate adaptation strategies, and prioritize resource allocation through a holistic approach to climate risk. If correctly designed and implemented, insurance provides a financial safety net for those at risk and supports economic stability. Insured individuals and businesses can bounce back more quickly, maintaining economic activity in the aftermath of shocks. (Re)insurance can help bolster national resilience by offering tailored solutions and capacity to assume some of the risks that would otherwise be borne by households, businesses, and Governments. This risk transfer function depends on strong risk analytics and good data. Over time, a range of models and approaches have emerged to evaluate the potential impact of disasters on populations, infrastructure, and economies, help quantify expected losses and probabilities of exceeding certain loss thresholds, and support decisions about adaptation (or "risk mitigation") and risk finance, as highlighted in Figure 1. This involves three integrated components: risk assessment, resilience and adaptation, and risk financing.

Figure 1. A holistic approach to risk management

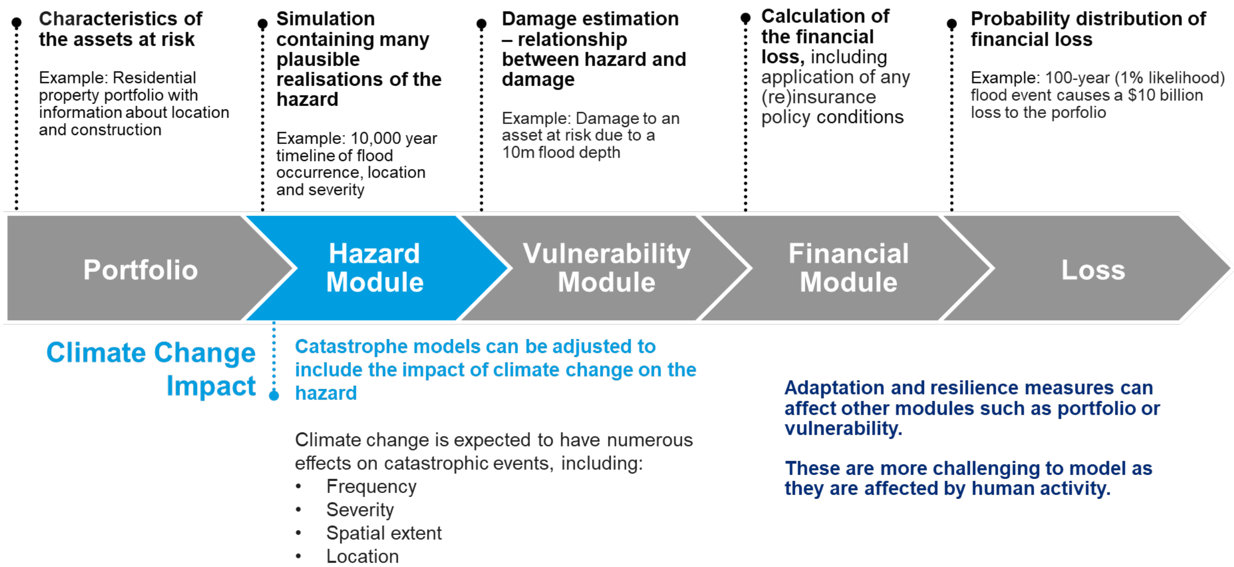
Source: Marsh McLennan (2024)

This approach emphasizes a "total cost of risk" perspective, combining risk finance and climate adaptation to create effective pathways for resilience, which will vary by region and risk characteristics.

What are catastrophe models and how can they support MoFs?

Catastrophe (CAT) models are sophisticated tools that use computer-assisted calculations to estimate potential losses from catastrophic events such as hurricanes, earthquakes, and other natural or anthropogenic disasters. These models integrate data from various fields, including meteorology, seismology, engineering, and actuarial science, to simulate thousands of plausible scenarios and assess risks. Figure 2 illustrates a typical sequence of analytical steps included in the assessment of catastrophe risk and the calculation of financial loss. The sequence starts with an analysis of the "portfolio" of risks, which is a selection of either assets or asset classes. This portfolio is then modeled against hazard, vulnerability, and exposure to establish "financial loss" based on the simulation of multiple plausible scenarios.

Figure 2. Catastrophe model framework approach



Source: Guy Carpenter analysis, in Marsh McLennan (2024)

Over time, catastrophe models have been adapted to include climate change considerations in the hazard module. In general terms, catastrophe models can help Governments identify and quantify risks associated with various catastrophic events. By providing detailed insights into potential disaster impacts, CAT models can assist in formulating policies and planning for infrastructure development and emergency response, which are crucial for minimizing the socioeconomic impacts of disasters. Governments can also use CAT models to inform decisions on public insurance schemes and the financial reserves needed to cover potential losses, helping to ensure that adequate financial resources are available to support recovery efforts and maintain economic stability in the aftermath of shocks. CAT models can be leveraged to guide investment in infrastructure and community development projects, ensuring these investments are resilient to future catastrophic events. However, the incorporation of adaptation and resilience measures, which are influenced by human activity, into the models tends to be challenging. It is common for some types of interventions, such as large-scale flood protection schemes, to be incorporated, but it is still early days for other adaptations, including nature-based solutions, such as mangroves, which can significantly influence risk levels. This is an emerging area, where industry and academia collaborate to improve analytical tools and approaches, including nature based solutions to reduce wildfire risk (Chirouze et al., 2021), cross-sectoral collaboration for coastal risk management (Kelso et al., 2024), and nature-based flood risk management in the Netherlands as part of the EU Naturance project.[1]

What is risk layering and how can it support MoFs?

A combination of tools and models, including risk layering, can help to establish a holistic view of risk that includes resilience and adaptation measures. Risk layering is a concept that originated in the insurance industry and is used in risk management to handle potential losses based on their probability and severity. It involves dividing risks into different layers, each covered by specific financial instruments or strategies, to manage and mitigate the impact of disasters or catastrophic events effectively. Risk layering in the context of disaster risk management and climate adaptation is used to find a balance between reducing, retaining, and transferring risks. It involves organizing risks into layers based on the probability and severity of potential losses. This approach helps in selecting appropriate risk management options for different probability levels, similar to how insurance providers determine when to cede (reinsure) risks.

1 https://www.naturanceproject.eu/innovation-labs/

Risk layering involves exploring the optimal combination of risk retention, transfer, and risk reduction strategies. Lower layers, which involve high-frequency but low-severity events, are often best managed through risk reduction interventions and budgetary instruments such as reserves or contingency funds. Higher layers, involving less frequent but more severe events, require large-scale risk reduction efforts and the use of market-based instruments such as insurance and catastrophe bonds (see also Hochrainer-Stigler and Reiter, 2021).[2]

Risk layering aids understanding of the best combination of tools to effectively manage the financial risks associated with climate change. Evaluating the implementation of this approach requires an awareness of both the current and anticipated protection gaps. This analysis aids in determining the degree to which individuals, businesses, and Governments are either underinsured or completely uninsured against various risks, as well as the potential financial burden on the Government in the absence of insurance, and how this situation may evolve over time.

The insurance protection gap refers to the segment of economic losses from various risks—such as natural disasters, cyberattacks, or health crises—that remain uncovered by insurance or other financial risk management instruments. A substantial protection gap implies that, in the event of disasters or crises, Governments must frequently intervene to provide assistance or compensate for losses. This contingent liability for the public sector can place significant strain on public finances and redirect resources from other critical areas. Uninsured losses can considerably hinder economic recovery following catastrophic incidents. Moreover, extensive uninsured losses can pose systemic risks to the financial system, impacting banks, investors, and other economic stakeholders. In certain nations, fewer than 5% of losses from climate-related catastrophes are insured, particularly in low-income countries. However, even among G20 nations, notable disparities exist regarding the use of risk transfer mechanisms for specific climate risks, as illustrated in Marsh McLennan (2023), based on Swiss Re data. Protection gaps are shaped by demographic changes, climate change, economic conditions, public policy, and regulatory frameworks.

It is important for MoFs to understand the protection gap today and in the future in order to consider how climate risks will impact public finance and to develop strategies in response. By addressing the insurance protection gap, MoFs can enhance their country's economic resilience, promote financial stability, and support sustainable development. This proactive approach can lead to more efficient use of public resources and a stronger, more robust economy in the face of various risks and challenges.

How can the availability and affordability of insurance be analyzed in the face of changing risks?

Understanding the current and future insurability of climate risks requires a multi-faceted approach to capture demand, supply, and regulatory aspects that determine if and how insurance is available in a country or region. MoFs can assess trends in the affordability and availability of insurance against specific climate risks, such as floods or wildfire, through several key methods and data points, as demonstrated for wildfire in Oliver Wyman (2023).

The work by Oliver Wyman involved quantitative and qualitative assessments and included the analysis of insurance market data covering supply and demand side aspects, such as market exits of insurers, consumer behavior, renewal/non-renewal rates, enrolment or uptake of existing insurance schemes, and premium trends to track changes in insurance premiums over time, particularly in wildfire-prone regions. Significant increases may indicate affordability issues. On the demand side, the analysis of risk distribution examines how wildfire risk and insurance challenges are distributed across different geographic areas and demographic groups, and how insurance availability and affordability issues intersect with socioeconomic factors such as poverty rates and housing burden. To better understand the supply side, an assessment of risk models and pricing can be undertaken. This would evaluate the accuracy and granularity of wildfire-risk models used by insurers for underwriting and rating and look at how this is incorporated into pricing models. Inaccurate models may lead to

2 https://www.insuresilience.org/knowledge/instruments/

overpricing or unavailability of coverage. Specific innovations, such as parametric insurance or public-private partnerships can play a role in addressing affordability and availability—understanding their effectiveness is an important element in an MoF risk finance strategy. Finally, the evaluation of adaptation and risk reduction efforts assesses the impact of home-specific or community-wide mitigation efforts (such as creating wildfire risk reduction buffers) on insurance availability and pricing. By systematically evaluating these factors, an MoF can gain a comprehensive understanding of the wildfire insurance landscape, identify areas of concern, and develop targeted policies to address affordability and availability issues.

How can adaptation and resilience measures be incorporated to achieve a holistic view of risk?

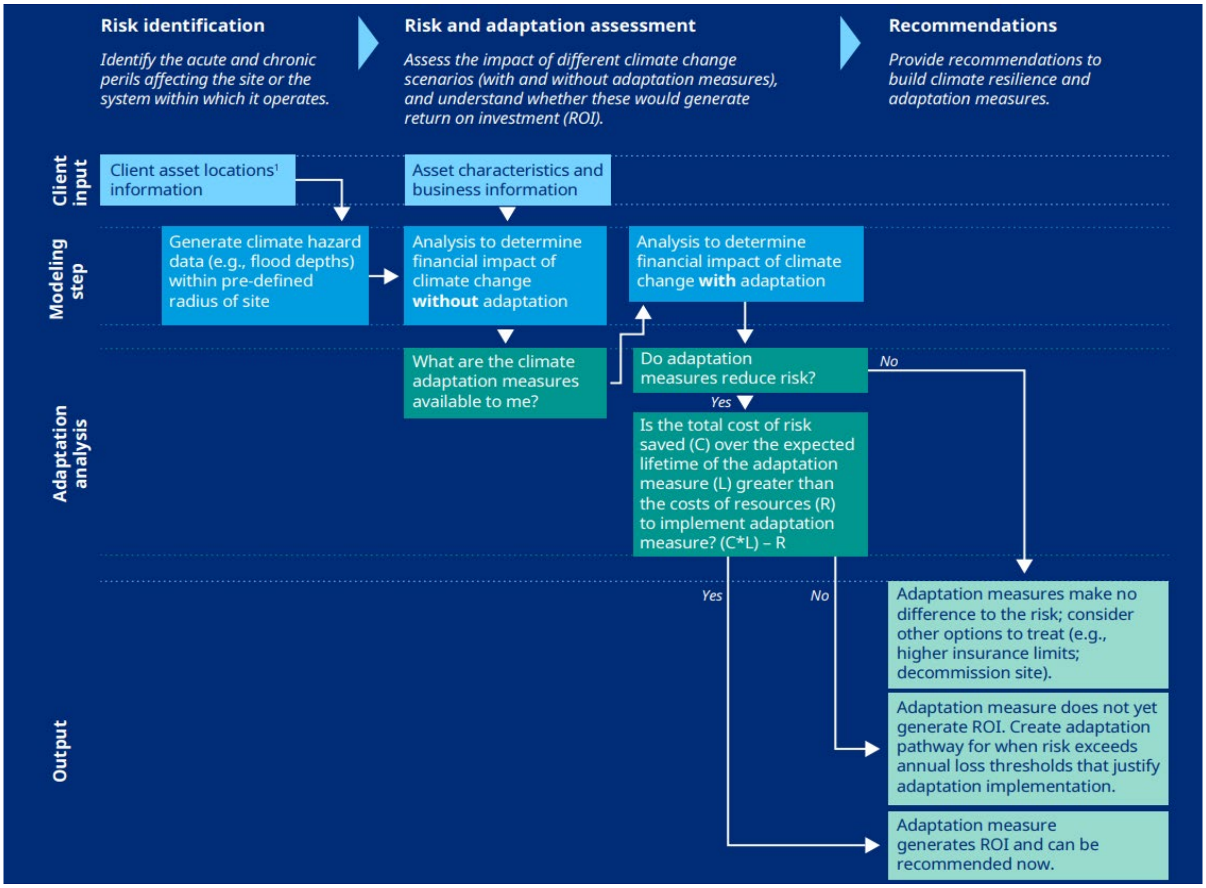
Catastrophe models, risk layering techniques, and insurance analysis can be combined to explore what an optimal climate risk financing and adaptation strategy could look like today and in the future for different projected climate pathways at the state, local government, and community levels. This approach involves different analytical elements, combining climate scenarios with physical risk models and actuarial analysis to estimate the economic impact of current and future physical risks and the amount of insurance and risk transfer required to protect against them, and to devise strategies for adaptation strategies:

- Perform probabilistic, multi-year modeling using proprietary capital model and simulations to assess tail risk
- Stress test assumptions and the frequency and severity of various perils
- Assess the current insurance penetration rate and identify the protection gaps for government liabilities, high-risk properties, vulnerable populations, etc.

By utilizing this approach, a bespoke climate risk management plan specific to a country/region/city risk profile and its financial capacity to respond to disasters can be developed. Key components include:

- Reviewing existing and available resilience and adaptation measures (pre-disaster risk mitigation options through direct grants, financial/tax incentives, etc.)
- Altering and enhancing model outputs to estimate how adaptation investments could reduce the overall economic loss potential and to identify the most egregious offenders with probable maximum loss
- Securing a practical level of insurability for at-risk communities until mitigation investments bear fruit
- Including any assumptions on insurance claims payouts, use of reserve funds, post-disaster financial aid, etc.

Figure 3: A quantitative approach to assessing and prioritizing adaptation interventions



Source: Marsh analysis, in Marsh McLennan (2024)

Importantly, the return on the investments made in mitigating risk and strengthening the local insurance market will not be realized immediately. Therefore, recommendations to counter long-term effects include the following:

- Assess access to disaster relief funding and claims management;
- Align and create synergies with other mitigation schemes while ensuring the sustainability of communities going forward;
- Forecast the impact of risk mitigation investments on risk financing over time by modifying catastrophe modeling exposure data.

Figure 3 outlines a quantitative approach to assessing the return on investment for adaptation interventions, allowing for a clear decision tree for a government or a company to incorporate asset or systems data, and building on risk identification and risk and adaptation assessments.

Combining catastrophe models and risk analysis can help develop optimal climate risk financing strategies. This involves assessing current risks, insurance penetration rates and protection gaps to create tailored climate risk management plans specific to a country/region/city/business risk profile and take into account their financial capacity to respond to climate risks. Incorporating climate adaptation into risk management can enhance risk understanding and potentially reduce the widening insurance protection gap.

This contribution is based on ['How a Holistic Risk Approach Increases Resilience in the Face of a Changing Climate'] (Marsh McLennan, 2024).

References

Chirouze, M. et al. (2021) *Quantifying Insurance Benefits of a Nature-based Approach to Reducing Risk: Wildfire Risk Reduction Buffers*. Report, The Nature Conservancy/Marsh McLennan. https://www.guycarp.com/content/dam/guycarp-rebrand/pdf/Insights/2021/Quantifying-Insurance-Benefits-Wildfire-Risk-Reduction-Buffers.pdf

Hochrainer-Stigler, S., and Reiter, K. (2021) Risk-Layering for Indirect Effects. *International Journal of Disaster Risk Science* 12, 770–778. https://doi.org/10.1007/s13753-021-00366-2

Kelso, M. A., Stovall, A. E., Reguero, B. G., Franco, G., and Beck, M. W. (2024) *Nature-based Solutions and Risk Management: Recommendations for Integrating Nature into Risk Science and Insurance*. UCSC and USACE, Washington, D.C. https://escholarship.org/uc/item/9305j0t4

Marsh McLennan (2023) *Staying Above Water: A Systemic Response to Rising Flood Risk*. Reoprt. https://www.marshmclennan.com/insights/publications/2023/february/staying-above-water-a-systemic-response-to-rising-flood-risk.html

Marsh McLennan (2024) *How a Holistic Risk Approach Increases Resilience in the Face of a Changing Climate*. https://www.marshmclennan.com/web-assets/insights/publications/2024/november/adapting-to-climate-challenges-report.pdf

Oliver Wyman (2023) *Homeowner Availability Study*. https://doi.colorado.gov/announcements/homeowners-insurance-availability-study-now-available-sb22-206