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Master of Advanced Studies in Real Estate

Assessing the impact of Physical Climate Risk on Real Estate Investment Portfolios: Methods, Tools and Market Implications through Zurich Insurance Group's global real estate portfolio

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List of abbreviations

ZIG	Zurich Insurance Group
ZGRE	Zurich Group Real Estate
ZIAG	Zurich Invest AG
ZRS	Zurich Resilience Solutions
IPCC	Intergovernmental Panel on Climate Change
RCP	Representative Concentration Pathways
FSB	Financial Stability Board
AR5	Fifth Assessment Report of the IPCC
AR6	Sixth Assessment Report of the IPCC
CMIP	Coupled Model Intercomparison Project
OSFI	Office of the Superintendent of Financial Institutions
US EPA	United States Environmental Protection Agency
TCFD	Task Force on Climate Related Financial Disclosures
CSRD	Corporate Sustainability Reporting Directive
SSPs	Shared Socio-economic Pathways
ECPF	European Core Property Fund
INREV	European Association for Investors in Non-Listed Real Estate Vehicles
UNDDR	United Nations Office for Disaster Risk Reduction
CRREM	Carbon Risk Real Estate Monitor
CS3D	Corporate Sustainability Due Diligence Directive
NOAA	National Oceanic and Atmospheric Administration
AAL	Average Annual Loss

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Executive Summary

The research investigates Zurich Insurance Group's (ZIG) methods for integrating physical climate risk assessments into its European Core Property Fund (ECPF) real estate investment choices. The research evaluates the ECPF portfolio's climate risk management strategy through its Climate Spotlight tool, to determine its effectiveness in managing climate risks, that affect asset performance and sustainability.

The Climate Spotlight tool evaluates 15 different hazards through the combination of IPCC projection data, and proprietary information to generate risk-based financial assessments for flood and wind and storm surge events. The research combines numerical data evaluation with an assessment of the tool's operational methods and its fundamental principles and its operational boundaries.

The chosen portfolio shows that flood risks, together with wind damage, hail impacts and drought conditions present the most substantial threats. The financial assessment shows that high-risk properties face their biggest potential financial losses from building destruction. The research demonstrates the importance of complete risk evaluation processes, which start with portfolio-wide screening and proceed to detailed site assessments and proposes specific risk reduction strategies for general and individual properties.

For the Climate Spotlight tool, Zurich Resilience Solutions achieved fast feature implementation, together with simple interface design, and dedicated support services, which produce high levels of customer contentment. The company's strengths match the requirements of modern regulatory standards including TCFD and CSRD, because these frameworks demand organisations to perform systematic climate risk evaluations and disclose their results transparently.

The current implementation of climate risk assessment faces ongoing difficulties in converting climate data into monetary values and investment worth. The industry advances toward better investment resilience yet needs additional research to enhance risk modelling and achieve complete financial planning integration of climate resilience. A better future awaits institutional real estate investors if they are willing to invest not only into real estate, but climate resilience solutions as well.

1 Introduction

Real estate investments worldwide face growing threats from extreme weather events which become more frequent and intense because of climate change. The rising occurrence of hurricanes floods and wildfires requires investors to understand their effects on real estate investment portfolios according to JLL, 2025, in "From climate risk to climate resilience" (JLL, 2025a). This research investigates the connection between physical climate risk and real estate asset performance to help institutional investors make decisions in an unpredictable environment

1.1 Research objectives

The primary objective of this research is to rigorously examine and determine how the Zurich Insurance Group, as a prominent institutional real estate investor, systematically integrates considerations of physical climate risks into its investment decision-making processes. This study aims to assess the extent to which Zurich Insurance Group's real estate investment portfolio is influenced by climate-related risk factors, thereby evaluating the consciousness and strategic foresight underlying their investment choices in the face of escalating climate uncertainties.

To achieve this objective, the following research questions will be addressed:

- How do physical climate risks affect the value and performance of real estate asstes?
- What strategies can investors employ to mitigate the impact of climate risks on their portfolios?

In conducting this thesis, advanced AI tools including ChatGPT, Perplexity, and Google Gemini were utilized to support the identification and citation of the most relevant and up-to-date information.

1.2 Scope of study

This study concentrates on physical climate risks, encompassing extreme weather events and long-term climate changes, and their impact on real estate investment portfolios, with a particular emphasis on the Zurich Insurance Group (ZIG) global real estate portfolio. The analysis will be confined to data from the past two decades, focusing on a specific real estate portfolio in Western Europe. Although the findings may have broader

implications, the scope remains limited to these parameters, providing insights and conclusions from the perspective of ZIG as an institutional investor.

The evaluation will involve assessing physical climate risks for 37 properties using Zurich's proprietary climate modeling and risk engineering tool, the Climate Spotlight. This tool is introduced in vast detail in Chapter 3.2, Methodology description for assessing Zurich Insurance Group's global real estate portfolio – the Zurich Climate Spotlight tool.

1.3 Research design

The research will be based upon quantitative data: leveraging Zurich's Spotlight climate modelling tool to assess physical climate risks on the Zurich global real estate portfolio. The tool will provide scenario-based analyses for the global real estate portfolio, on individual property, as well as portfolio level, offering detailed insights into potential climate impacts and different scenarios.

Additional historical data on real estate performance, property values, and occurrences of physical climate events might be quoted, in case relevant to the market, geographic location, or asset type. More data is shared in Chapter 3.3, The European Core Property Fund portfolio.

2 Theory: climate change and physical climate risks

Climate change represents a proven phenomenon which produces substantial changes in worldwide weather patterns across long time periods. Earth's average temperature has increased by 0.11°F (0.06°C) each decade since 1850 leading to a total rise of about 2°F. The warming trend showed rapid acceleration after 1982 until 2023 became the hottest year in recorded history. The period between 2014 and 2023 established itself as the decade with the highest recorded temperatures (Lindsey, R., Dahlman, L., 2025).

The rise in global average surface temperature creates significant impact on regional climate systems. The accumulation of heat causes temperature extremes and decreases snow cover, while it reduces sea ice, and strengthens rainfall patterns, and changes habitat distributions. The warming pattern is uneven, with land areas, particularly the Arctic, experiencing faster temperature increases compared to ocean areas. The Intergovernmental Panel on Climate Change (IPCC) confirms, that human activities through greenhouse gas emissions are the main cause of global warming. The path of

global temperature change depends on the amount of carbon dioxide and other greenhouse gases that enter the atmosphere. (IPCC, 2022).

The IPCC began its operations in 1988 through a joint initiative between the World Meteorological Organisation (WMO), and the United Nations Environment Programme (UNEP) to conduct thorough scientific evaluations of climate change. The IPCC emerged because scientists were documenting climate change evidence while policymakers required trustworthy information to handle this worldwide problem. The IPCC divides its work into three distinct working groups which study the physical science basis of climate change alongside its impacts and adaptation and its mitigation strategies. The organisation releases assessment reports at regular intervals which combine current scientific research to direct international climate policy decisions and actions. Through its work, the IPCC has played a crucial role in developing climate change knowledge which supports worldwide initiatives to reduce climate change effects and adapt to its impacts. (IPCC, without date).

Climate change creates extensive impacts on all human life domains which affect people, businesses, infrastructure, and agricultural systems. The growing need for countermeasures emerges, because weather patterns are becoming more extreme (IPCC, (2022). Switzerland has seen an increase in air conditioning usage because of rising heatwaves and temperature increases. The adaptive response demonstrates the need for innovative solutions and infrastructure improvements to preserve comfort and productivity.

The growing dependence on climate control technologies creates essential questions about energy usage and sustainability which strengthens the link between human activities and climate change. Physical climate risks have become more frequent and intense and unpredictable because of climate change which creates major threats to human safety and built environments. Real estate assets face multiple risks which include extreme weather conditions and sea-level rise and flooding and heatwaves and droughts and storms that affect their resilience and valuation and usability and long-term sustainability (Wüest Partner, 2025). Real estate operations now face rising expenses because of extreme weather events. The rising number of severe weather events leads to increasing costs for damage repairs and business recovery. The National Oceanic and Atmospheric Administration (NOAA) data shows that 27 billion-dollar extreme weather

events in the United States of America, during 2024, resulted in \$182 billion worth of damage (JLL, 2025b).

Real estate development requires specific knowledge of physical climate risks, because it involves assessing property and stakeholder exposure to changing risks, and developing strategies for asset resilience against disruptions. The complete understanding will establish the foundation for creating future-oriented adaptation strategies, and resilience measures which will lead to real estate development that meets user needs, while reducing climate-related physical risks (JLL, 2025b).

2.1 Climate change findings and forecasts by scientific organisations for the next 50-100 years

The IPCC uses multiple scenarios to predict future climate changes through different greenhouse gas emission levels. The Representative Concentration Pathways (RCPs) serve as different scenarios, which outline projected greenhouse gas concentration levels, and their resulting temperature increases, as well as climate effects. Here are the four most important RCP scenarios (IPCC, 2019, Table SPM.1, P.8.):

Scenario	Near-term: 2031-2050		End-of-century: 2081-2100	
	Mean (°C)	Likely range (°C)	Mean (°C)	Likely range (°C)
RCP2.6	1.6	1.1 to 2.0	1.6	0.9 to 2.4
RCP4.5	1.7	1.3 to 2.2	2.5	1.7 to 3.3
RCP6.0	1.6	1.2 to 2.0	2.9	2.0 to 3.8
RCP8.5	2.0	1.5 to 2.4	4.3	3.2 to 5.4

Table 1 - Projected global mean surface temperature changes relative to 1850-1900

2.1.1 RCP2.6 (Low Emission Scenario)

- Description: RCP2.6 represents a scenario where stringent mitigation efforts are implemented to limit greenhouse gas emissions.
- Temperature Increase: Global temperatures are projected to rise by approximately 1.5°C above pre-industrial levels by the end of the century.
- Sea Level Rise: Sea levels are expected to rise by about 0.3 to 0.6 meters.
- Key Features: Achieving RCP2.6 requires immediate and substantial reductions in emissions, widespread adoption of renewable energy, energy efficiency improvements, and carbon capture and storage technologies.

2.1.2 RCP4.5 (Intermediate Emission Scenario)

- **Description:** RCP4.5 represents a scenario with moderate mitigation efforts to stabilize greenhouse gas concentrations.
- **Temperature Increase:** Global temperatures are projected to rise by approximately 2.4°C above pre-industrial levels by the end of the century.
- **Sea Level Rise:** Sea levels are expected to rise by about 0.4 to 0.7 meters.
- **Key Features:** RCP4.5 assumes significant but less stringent mitigation measures compared to RCP2.6, including a mix of renewable energy, energy efficiency, and some carbon capture and storage.

2.1.3 RCP6.0 (Intermediate-High Emission Scenario)

- **Description:** RCP6.0 represents a scenario with modest mitigation efforts, leading to higher greenhouse gas concentrations.
- **Temperature Increase:** Global temperatures are projected to rise by approximately 3.0°C above pre-industrial levels by the end of the century.
- **Sea Level Rise:** Sea levels are expected to rise by about 0.4 to 0.8 meters.
- **Key Features:** RCP6.0 involves slower adoption of renewable energy and fewer emission reduction measures, resulting in higher greenhouse gas concentrations compared to RCP4.5.

2.1.4 RCP8.5 (High Emission Scenario)

- **Description:** RCP8.5 represents a scenario with minimal mitigation efforts and continued high emissions.
- **Temperature Increase:** Global temperatures are projected to rise by approximately 4.3°C above pre-industrial levels by the end of the century.
- **Sea Level Rise:** Sea levels are expected to rise by about 0.5 to 1 meter.
- **Key Features:** RCP8.5 assumes continued reliance on fossil fuels, limited adoption of renewable energy, and minimal efforts to reduce emissions, leading to the highest greenhouse gas concentrations and the most severe climate impacts.

2.2 Summary

The IPCC's scenarios illustrate the potential future climate conditions based on different levels of mitigation efforts:

- RCP2.6: Requires aggressive emission reductions to limit warming to about 1.5°C.
- RCP4.5: Moderate mitigation efforts lead to warming of about 2.4°C.
- RCP6.0: Modest mitigation efforts result in warming of about 3.0°C.
- RCP8.5: Minimal mitigation efforts result in the highest warming of about 4.3°C.

The described scenarios demonstrate why worldwide efforts to decrease emissions and fight climate change effects remain essential. The IPCC's Representative Concentration Pathways function as standard frameworks for climate projections, which multiple stakeholders, including scientific bodies, policymakers, companies, and businesses use. (G.P. Wayne, 2013, P.1.) These scenarios create a unified framework to evaluate future climate effects, while developing protection plans and establishing reduction targets.

RCPs serve as the scientific foundation for international climate agreements, national policies, corporate risk assessments and sustainability reporting, all of which ensure climate change efforts remain based on peer-reviewed science and they are all within the same standard of measurement framework. The widespread use of these scenarios demonstrates their essential function in directing worldwide climate research and action.

The understanding of climate risks enables organisations to create efficient strategies that reduce climate change effects. The two main categories of climate risks consist of transition risks and physical risks which have different characteristics and effects. The transition to a low-carbon economy produces policy and legal challenges together with technological and market and reputational obstacles (CFA Institute 2024a., P.4.). Physical risks emerge from climate change impacts on the environment through extreme weather events and long-term climate shifts and ecosystem changes. (CFA Institute, 2024b, P.4.). The following section examines these risks through an analysis of their origins and effects as well as their relationships.

2.3 Transition risks - mitigation

The achievement of 1.5°C global warming target requires a 45% decrease in emissions until 2030 followed by complete net zero emissions by 2050 (United Nations Climate Change, 2015). The goal of "net zero" involves minimizing greenhouse gas emissions until they reach almost zero levels while natural systems, including oceans and forests absorb any remaining emissions. A complete transformation of production systems

together with consumption patterns and transportation methods stands as the sole method to reach net zero emissions. The energy sector stands as the primary source of greenhouse gas emissions since it generates about 72% of current emissions thus plays a vital role in this initiative. The remaining roughly 28% of global emissions come from sectors like agriculture, land use and forestry, industrial processes, and waste, which collectively contribute the rest of the emissions not attributed to energy production and consumption. (JRC, 2023). The shift from oil power, gas, and coal to renewable energy sources including wind, and solar power will substantially decrease carbon emissions (World Resources Institute, 2023).

The speed and extent of emission reduction determines transition risks, but physical risks directly result from temperature changes. The chosen course of action determines both the magnitude and intensity of physical and transition risks, which requires understanding their trade-offs (USEPA, 2023). The main emphasis of this paper centers on physical climate risks but transition risks need to be acknowledged for a complete understanding.

2.4 Physical climate risks - adaptation

The IPCC defines physical climate risks as the negative effects of climate change on both natural systems, and human-made systems. The risks stem from changes in climate variables, which include temperature changes, precipitation patterns, sea level rise, extreme weather event frequency and intensity (O'Neill, Brian C., et al., 2024).

“According to the Recommendations of the Task Force on Climate-related Financial Disclosures (TCFD), physical climate risks are defined as risks arising from the impacts of climate change and can be categorized into two types: acute risks and chronic risks. Acute physical risks are event-driven and include the increased severity of extreme weather events, such as cyclones, droughts, wildfires, extreme precipitation, or floods. In contrast, chronic physical risks involve longer-term shifts in climate patterns, such as rising temperatures, which can lead to issues like sea level rise or persistent heat waves and change in precipitation patterns.” (Mastai, A. (2024). *Understanding Physical Climate Risk: Definition, Assessment, and Impact*, P.1.)

The IPCC has identified several major physical climate risks which are included in the below table. This table is based on information adapted from the IPCC's Sixth Assessment Report (AR6, Chapter 16, P. 46-63.), Working Group II chapter 16 titled: Key Risks across Sectors and Regions.

Climate risk	Description
Heatwaves and Extreme Temperatures	The rising occurrence of heatwaves together with their growing strength and longer duration creates major health threats for defenseless groups of people. Heatwaves create multiple impacts on agriculture as well as energy consumption and infrastructure systems.
Droughts	Changes in precipitation patterns can lead to more severe and prolonged droughts, impacting water availability, agriculture, and ecosystems. Droughts can also increase wildfire risks.
Flooding	The combination of heavier rainfall events with more frequent occurrences and rising sea levels creates higher flood risks. The combination of riverine flooding and flash floods and coastal flooding poses dangers to property infrastructure and ecosystems.
Sea Level Rise	The melting of polar ice caps and glaciers causes sea levels to rise which creates major threats to coastal communities. The combination of rising sea levels leads to three major coastal threats which include erosion and saltwater intrusion and flooding of low-lying areas.
Storms and Extreme Weather Events	The occurrence of tropical cyclones and hurricanes and typhoons will become more frequent and severe. These storms can cause extensive damage to infrastructure, disrupt economic activities, and result in loss of life.
Glacial Retreat and Snowpack Reduction	The melting of glaciers and the decrease in snowpack will have negative impacts on water resources, especially in areas that depend on meltwater for drinking water, agriculture, and hydropower.
Ocean Acidification	The oceans absorb rising CO2 concentrations which results in ocean acidification. The process of ocean acidification primarily damages marine life that includes calcium carbonate shell-forming organisms like corals and shellfish.
Biodiversity Loss and Ecosystem Changes	Climate changes trigger species distribution shifts which result in biodiversity decline and modifications to ecosystem structures and operational systems. The changes affect the ecosystem services which humans depend on.
Permafrost Thaw	The warming climate causes permafrost to melt which results in the emission of stored greenhouse gases including methane and carbon dioxide. The process accelerates climate change while damaging infrastructure throughout Arctic regions.

Table 2 - Types of physical climate risks (IPCC)

The concrete consequences of physical climate risks on real estate property can be extensive and multifaceted. Here are some of the key impacts:

Physical damage	Structural Damage	Flooding, storms, hurricanes, and wildfires can cause significant structural damage to buildings. This includes damage to foundations, walls, roofs, windows, and other critical components. In severe cases, properties may become uninhabitable and require extensive repairs or complete reconstruction.
	Increased Maintenance and Repair Costs	Frequent exposure to extreme weather events and changing climate conditions can lead to increased wear and tear on buildings, necessitating more frequent maintenance and repairs. This can result in higher costs for property owners and reduced overall profitability.
	Erosion and Land Degradation	Coastal properties are particularly vulnerable to erosion and land degradation due to rising sea levels and storm surges. This can undermine the stability of buildings and infrastructure and lead to loss of land.
	Decreased Property Values	Properties located in high-risk areas, such as flood zones or regions prone to wildfires, may experience decreased property values. Buyers and investors may be wary of purchasing or investing in properties with high exposure to climate risks, leading to a potential decline in market demand and property prices.
	Water Supply Issues	Droughts and changes in precipitation patterns can impact water availability for properties, affecting landscaping, water-dependent systems, and overall livability. Water shortages can also lead to increased costs for water usage and potential restrictions on water use.
Financial and operational risks	Higher Insurance Premiums	Insurance companies may increase premiums for properties in high-risk areas to account for the greater likelihood of damage and claims. In some cases, insurance coverage may become difficult to obtain or may come with significant exclusions, leaving property owners financially vulnerable.
	Increased Energy Costs	Rising temperatures and more frequent heatwaves can lead to higher energy consumption for cooling buildings, resulting in increased utility bills. Conversely, in colder climates, heavy snowfall and ice may increase heating costs.
	Disruption of Occupancy and Operations	Extreme weather events and climate-related disasters can lead to temporary or prolonged displacement of occupants. This can disrupt residential living, business operations, and rental income streams. For commercial properties, business interruptions can result in significant financial losses.
	Health and Safety Risks	Extreme weather events and poor air quality from wildfires can pose health and safety risks to occupants. This includes respiratory issues, heat-

		related illnesses, and injuries from structural damage or debris.
	Regulatory and Compliance Challenges	Governments and regulatory bodies may implement stricter building codes, zoning laws, and environmental regulations to address climate risks. Property owners may face increased compliance costs and challenges in meeting these new standards.

Table 3 - Consequences of physical climate risks (IPCC)

The above table is a compilation of summaries based on articles published by the IMF (Lepore, C., Fernando, R., 2023, P.22), the United States Environmental Protection Agency (US EPA, 2025, Table 2.), and the article that was published by Correntics (Mastai, A., 2024).

The long-term sustainability of real estate properties depends on a complete risk assessment system and resilient design principles and adaptive management strategies to handle climate challenges.

Physical climate risks create financial threats that affect property owners, banks, insurers, and investors. The value of properties directly affects financial markets because decreased mortgage lending values reduce the collateral worth of bank loans. The risk of non-payment from borrowers grows because of expensive renovations and increased insurance costs and higher interest rates. The situation results in elevated borrowing expenses which could potentially cause complete financial market instability (Wüest Partner, 2025).

2.5 Regulatory drivers to analyse and report physical climate risks, world-wide examples

Major jurisdictions have started to introduce mandatory disclosure requirements for physical climate risk analysis and reporting, while the regulatory environment continues to evolve quickly. The new regulations require companies to use international standards for their assessments, while performing scenario analyses and integrating physical risk assessments into their corporate governance and strategic planning.

Organisations undergo global regulatory pressure to perform systematic physical climate risk assessments and disclosure reporting. The main regulatory forces behind this development consist of mandatory disclosure laws and directives. The European Union's Corporate Sustainability Reporting Directive (CSRD) mandates large and publicly listed

companies to submit periodic environmental risk reports including physical climate risks through the European Sustainability Reporting Standards (ESRS). The initial reports under these regulations will appear in 2025 for organisations that produce the most significant effects on people and the environment (European Commission, no date)

The European Union has taken further steps to update its framework for corporate sustainability by introducing Directive (EU) 2025/794, known as the Sustainability Omnibus Package and “Stop-the-Clock” Directive¹. The directive, introduced in April 2025 extends the timeline for essential sustainability reporting and due diligence requirements by two years, which affects both, the Corporate Sustainability Reporting Directive (CSRD), and the Corporate Sustainability Due Diligence Directive (CS3D).

Specifically, the deadline for Member States to transpose the CS3D into national law has been moved to July 2027, and the directive’s first application to the largest companies is now scheduled for July 2028. The CSRD reporting obligations which were initially scheduled for 2026 and 2027 have been postponed for the affected companies. The European Parliament and Council accelerated the adoption of these changes to resolve the urgent implementation problems that organisations encountered (Clearly Gottlieb, 2025. P.2.)

The CS3D originated from Directive (EU) 2024/1760, which mandated large companies to perform due diligence for identifying, preventing, and mitigating adverse impacts on human rights and the environment throughout their value chains. It also mandates the creation of climate transition plans aligned with the Paris Agreement and EU climate neutrality targets. The directive strengthens corporate accountability through civil liability provisions and enforcement mechanisms and sanctions which provide legal instruments for stakeholders to handle negative impacts. The first implementation plan began with company size phases in 2027, but recent amendments have pushed these deadlines to provide businesses with more time to comply. The CSRD established Directive (EU) 2022/2464 to expand mandatory sustainability disclosure requirements for listed companies and large public-interest entities and certain SMEs. Organisations need to disclose detailed information about environmental, social, and governance (ESG) factors through the European Sustainability Reporting Standards (ESRS), to enhance data

¹ The EU Directive 2025/794, commonly known as the "Stop-the-Clock" Directive, was adopted on 14 April 2025 and published in the Official Journal on 16 April 2025. It postpones the application dates of their reporting and due diligence obligations to give companies more time to comply and reduce administrative burdens. (EUR-lex, 2025.)

transparency and comparability for investors and stakeholders. The reporting requirements under Directive (EU) 2025/794 have been extended by amendments which give businesses more time to adapt (Clearly Gottlieb, 2025, P.2.).

The postponements enable businesses to prepare better, which decreases administrative challenges while maintaining high standards for sustainability governance. The amendments achieve this goal through standardized reporting and due diligence requirements across directives which eliminates duplication and establishes a more competitive business environment for European businesses. The regulatory environment beyond legislative changes is undergoing changes to meet these new requirements. The changes in the regulatory environment and the business environment are happening simultaneously, posing challenges for all parties involved.

The International Association of Insurance Supervisors has released updated guidelines to help insurance companies manage climate-related risks, while the European Banking Authority has launched an ESG dashboard to monitor climate risk indicators within the EU/EEA banking sector (Clearly Gottlieb, 2025, P.4.) In the climate finance and carbon markets domain, the French Ministry for the Environment has published a Charter on carbon credits, and industry-led initiatives like the Net Zero Banking Alliance and UNEP FI have issued guidance for banks on setting climate targets. The EU demonstrates its practical and adaptable method of sustainability objective advancement through these regulatory changes. The EU enables organisations to handle climate-related risks and opportunities during the energy transition, through deadline adjustments and enhanced regulatory frameworks. The main objectives consist of improving transparency, corporate reporting quality, and climate risk disclosure in financial and non-financial reports (Clearly Gottlieb, 2025, P.8.).

The United States requires California businesses to disclose their climate-related financial risks through Senate Bill 261 which sets a 2026 deadline for physical risk disclosure. The new law follows international standards from the Task Force on Climate-related Financial Disclosures (TCFD) and will impact all businesses operating in the state (California Legislative Information, 2024).

Switzerland is implementing mandatory climate reporting for companies by 2025, necessitating alignment with international standards and a focus on both physical and transition risks (Swiss Investor Relations, 2024).

The UK's Prudential Regulation Authority (PRA) anticipates that insurers will further integrate climate risk management, including scenario analysis for physical risks, into their operations by 2025. The PRA is revising its supervisory statements to strengthen these expectations (Laidlaw, J., 2025). In Canada, the OSFI (Office of the Superintendent of Financial Institutions) requires federally regulated financial institutions to disclose their physical and transition climate risks through historical and forward-looking information with a phased implementation from 2024 to 2026.

In response to the impact of extreme weather events, Italy passed a new law requiring climate insurance for all buildings from 1 January 2025. “Climate risks have spurred regulatory changes to reduce the economic burden on local governments by addressing insurance coverage gaps and enforcing stricter building codes for enhancing resiliency,” says Wahib Ghazni, Senior Product Manager and Lead Financial Economist at Jupiter Intelligence (JLL, 2025b, P.6-7.).

Paris will introduce new 'bioclimatic' town planning regulations from 2025 to develop buildings that are more resilient. The new regulations will require low carbon construction materials, renewable energy production on buildings over 1,000sqm, and nature and green space on roofs (JLL, 2025b).

The TCFD framework guides many regulations through its four pillars which focus on governance and strategy and risk management and metrics/targets. The International Sustainability Standards Board (ISSB) has adopted the four pillars which serve as the foundation for its framework. FINMA in Switzerland demands companies to disclose material climate-related financial risks together with their effects on strategy and financial planning and their risk identification and management processes which follow international best practices (Deloitte, 2023).

EU and UK insurance regulators adjust capital requirements and risk management standards through updated climate data and risk models to address rising physical climate risks including floods and storms (Naik, G., 2025).

These regulations aim to improve transparency by showing investors and stakeholders and the public how climate risks affect company performance and resilience. These regulations require companies to include climate risk assessment within their fundamental risk management systems and strategic planning activities. The regulations help create a

sustainable climate-resilient economy by establishing uniform methods for physical climate risk measurement and disclosure and management practices (Bank of England, 2025).

3 Data model and analysis

The following chapter provides an overview of existing physical climate risk assessment products available in the market and offers an in-depth description of the climate modeling tool developed by Zurich Insurance Group, Zurich Resilience Solutions team; the Climate Spotlight platform. This section will elaborate on the structure and key mechanisms of the Zurich-developed tool, as well as its application to assessing a real estate portfolio. First, an overview of existing tools provided by competitors will be provided, followed by summarizing common features and challenges for all discussed tools. Then, the Zurich-developed tool, the Climate Spotlight tool will be described in more detail.

3.1 Existing methods and tools on the market to assess physical climate risks

Market participants, like institutional investors as the Zurich Insurance Group, now incorporate environmental factors into their underwriting and investment processes as well as their portfolio management and credit assessment activities. The approaches for integrating environmental factors include modifying return expectations to account for climate risks, and incorporating environmental capital expenditures², and using environmental scoring for credit decisions. The market is witnessing the development of new practices which include decarbonization pathways, and green IRR³ calculations, as well as physical climate risk assessments. Investors employ ESG scoring and 'green IRR' models to evaluate, both, risks stemming from inaction, and opportunities from sustainable investments, which helps them select assets and manage risks. The market practices continue to evolve, but they lack standardization at this time (INREV, 2025, P.10.). In this evolving market and regulatory environment, several financial

² Often as environmental CapEx; refers to funds allocated by an organisation to acquire, upgrade, or maintain assets primarily to decrease environmental pollution, increase protection and to comply with environmental laws and regulations (lawinsider.com, Environmental CapEx definition).

³ An IRR calculated for green investments, using the same methodology as other types of investments, but focused on projects with positive environmental impacts.

services companies, universities and sustainability experts firms have developed tools that measure climate risks.

The following section reviews the current methods and tools available in the market for evaluating physical climate risks, highlighting their strengths and limitations.

There is a broad selection of risk management tools available to assess physical climate risks, aimed at supporting organisations, investors, and regulators in understanding and addressing the effects of climate change on their assets, operations, and portfolios. These tools facilitate the identification, measurement, and mitigation of risks associated with climate-related hazards, including extreme weather events, flooding, drought, and long-term changes in climate patterns.

The following table provides a list of the main platforms, provided by Zurich Insurance's most relevant competitors, based on the information available currently and publicly, without the aim of drawing a complete picture of all products available. The information is sourced from the providers' websites, all of which is included in the bibliography in detail, as well as in the footnotes.

Provider	Platform / tool	Brief description	Additional comments
Allianz	Climate Risk Assessment Solutions	Digital and consulting-based services; site-level climate risk screening; asset mapping; integration with insurance and underwriting; supports disclosures.	Reliant on consulting services and less standardized digital platform (Refinq website, 2025).
AXA Climate	Altitude	Cloud-based platform for climate and biodiversity risk; multi-site screening; IPCC-aligned scenarios; adaptation guidance; CSRD/TCFD/SFDR-ready.	Gaps in emerging market data; some methods and data sources are proprietary (Higuera Roa, O. et al, 2025).
Chubb	Climate+ Risk Engineering Services	On-site climate risk diagnostics from risk engineers; tailored resilience strategies; regulatory compliance support (e.g. CSRD, SEC).	Manual and consulting-heavy delivery, standardized analytics; limited automation ³ .
Jupiter Intelligence	ClimateScore Global	High-resolution, peril-specific risk modeling across sectors; forward-looking analytics to 2100;	Costly for large portfolios; model complexity ⁴ ; potential

		robust APIs for enterprise integration; TCFD-aligned.	for inconsistent outputs across scenarios.
Moody's	Climate on Demand	Multi-hazard asset- and portfolio-level risk analysis; risk scoring to 2100; regulatory disclosure support; combines physical and financial impact modeling.	Relies on proxy data in some regions; transparency of assumptions varies; asset-level detail can vary (UNDDR, 2024)
Munich Re	Location Risk Intelligence Platform	Modular SaaS suite with natural catastrophe and physical climate risk scoring; 28 hazard types; scenario modeling; TCFD/CSRD/EU Taxonomy alignment.	Regional data granularity can vary; modeled hazard data may not reflect site adaptation/resilience (UNPRI, 2025).
Swiss Re	CatNet Climate Risk Solutions	Global NatCat and climate hazard visualization/scoring; scenario and loss modeling; used for risk underwriting; supports regulatory reporting tools.	Regional/urban granularity; focus on major perils; integration often insurance-centric ⁵ (source on previous page).

Table 4 - High-level overview of physical climate risk platform solutions, focusing on insurance providers

3.1.1 Commonalities of insurance-provided platforms compared to Climate Spotlight

Based on Table 4, above, the following can be concluded: Munich Re, along with AXA Climate, Swiss Re CatNat, Jupiter Intelligence, Moody's, Chubb, and Allianz provide competitor platforms that deliver multi-hazard climate risk analytics and scenario modelling, as well as regulatory-aligned outputs comparable to Climate Spotlight. The platforms provide risk exposure analysis services using self-service digital tools, consulting-driven bespoke analysis, or a combination of both approaches, allowing users to assess multiple sites and various types of perils. ZRS Climate Spotlight offers the same functionality as competitor tools, which allow users to analyze portfolios or assets through customized outputs suitable for TCFD and CSRD disclosure frameworks.

Competitor tools deliver comprehensive dashboards with downloadable reports along with API access for workflow integration that mirrors Climate Spotlight's live dashboard, and risk report download features. The risk screening tools from AXA Climate and Jupiter Intelligence use similar functions to ZRS's Core and Expert offerings

through their emphasis on rapid multi-site assessments and scenario analytics, and adaptation planning.

The platforms combine their proprietary climate data with standardized IPCC scenarios for risk identification and strategic adaptation planning, which mirrors ZRS's approach using Zurich's proprietary climate data and 2100 scenario range (Araullo, K., 2024.).

Some competitor platforms differentiate through their advanced modeling capabilities and extra risk variables that include biodiversity risk assessment (e.g., AXA Climate). Risk engineering-based platforms, like Chubb and Allianz depend on consulting-based expert analysis over automated dashboard tools for their operations. ZRS Climate Spotlight functions for all organisations, but certain platforms target exclusively insurance and finance sectors.

All major risk management tools provide fundamental features including site-level and portfolio risk identification with scenario analysis and reporting functions and framework compliance. Top platforms differ in their modeling complexity, geographic coverage, customization options, processing speed, user-friendliness, unique data sources, and the level of expert support available. Each platform offers a different mix of these features to meet various user needs. Information used for chapter 3.1.1 was collected by visiting the relevant website and tool of each competitor.

3.1.2 Common limitations of platforms in general

In summary, on the improvements side: The main drawbacks of climate risk assessment platforms stem from their frequent data gaps and inconsistencies, because essential information about building characteristics, past losses, and hazard exposure remains scattered across different systems or is simply absent. Risk assessments become less reliable because of insufficient high-quality consolidated data (Archipelago website, 2025).

The approach of using historical climate data and expert assumptions to fill information gaps can fail to detect rapidly changing climate patterns and extreme weather events, which result in underestimated actual risks. The limited regional detail in available data can create a problem, because developed regions receive better representation than emerging markets thus making global assessments less relevant and less accurate (Higuera Roa, O. et al, 2025., P.13.).

The advanced software – used by the climate platform providers - delivers excessive amounts of complex information which creates a significant barrier for users. Users encounter challenges when interpreting results, because advanced risk assessment platforms present various score types alongside different risk scenarios and time horizons for acute and chronic hazards. The use of proprietary risk models results in conflicting outputs, which hinders tool comparison and creates confusion among stakeholders (MetLife Investment Management, 2024, P.3.).

The projections of climate risk modeling platforms face challenges in validation, because climate systems change more quickly, than the models are updated. The sector needs ongoing model improvements together with scenario-based planning to stay current with real-world changes and needs to decrease its dependence on expert judgment or backward-looking assessments (Higuera Roa, O. et al, 2025., P.13.).

Chapters 3.2 through to 3.5 of the original paper have been redacted from this public version, due to confidential client data.

4 Discussion

Multiple scientific models demonstrate that climate change exists as an active and proven process. Several trustworthy sources show that asset managers, together with portfolio managers, use risk models to protect their properties from potential threats (Zurich Resilience website, 2025). Several studies show that these models are essential for both management operations and acquisition activities in the industry. To provide further evidence for the above-mentioned, JLL states in a recent article: “Proactively quantifying climate risks can also give investors an opportunity to take action and prepare. By understanding climate exposure, owners can acquire assets that meet internal objectives or make modifications to existing properties to reduce risk across a portfolio. Building upgrades can fortify structures to enhance resiliency during extreme weather events, and improving a property’s energy efficiency and water consumption can reduce the environmental impacts that perpetuate these hazards” (JLL, 2025c, P.3.).

It would be noteworthy for a following study to investigate how risk models influence actual business decisions, as their impact on real-world investment choices remains unclear today.

4.1 Climate risk plays an increasing role in property decisions

Real estate buyers now ask for price reductions to compensate for anticipated climate damage to properties, according to a research conducted by the Green Real Estate Engagement Network. The increasing number of environmental risk indicators from brokers and platforms, together with research, prove that climate risks affect property market prices, and therefore indicate that climate risks will play an even larger role in determining property worth (Green Real Estate Engagement Network, 2025). The increasing occurrence of severe weather events, because of climate change will force investors to request additional payment for projected property destruction. The absence of adaptation measures in properties leads to rising discount rates and decreasing market value, because of climate threats. The market shows flexibility in maintaining value, but adaptation remains rather a rare topic in investment and pricing discussions.

The Green Real Estate Engagement Network investigates through research, how physical risk adaptation methods protect real estate assets from damage. Two case studies focus on the Netherlands alongside the United States. Residential property values decline by

5%, when exposed to flooding, but diked properties preserve their market worth. Studies show, that flood protection systems installed by property owners result in a 3-4% increase in their property value according to research conducted in both the United States and the Netherlands (Green Real Estate Engagement Network, 2025).

These research findings lead to two main conclusions that investors should understand. The value of private properties increases when public adaptation investments are made so investors should examine local government adaptation plans before making their decisions. The market value of properties depends directly on their adaptive measures and resilience which means investors need to track price changes pre- and post-adaptation to assess effectiveness. A thorough evaluation process must be conducted for large-scale projects to determine their effects on neighboring properties because such projects benefit from scale advantages (Green Real Estate Engagement Network, 2025).

Additional research combined with extensive data collection will reveal the extent of price impact on properties while helping investors adopt proactive adaptation measures pre-transaction. Asset development will transition toward physical climate risk resiliency because of enhanced regulations which focus on ESG metrics and climate resilience.

4.2 How impactful are the results, key challenges on the market today

The following section explains the primary obstacles, which prevent environmental elements from being incorporated into real estate underwriting models.

The main obstacle to integrating environmental factors into underwriting models stems from the lack of sufficient, dependable, and uniform data availability. The combination of substandard data quality and inconsistent measurement methods, together with multiple approaches to evaluate transition, and physical climate risks, produces fragmented data, that proves challenging to analyze or apply uniformly.

The process of accurate climate risk evaluation faces ongoing difficulties, because of restricted access to high-quality data which forces investors to exercise caution in their decisions. Underwriting models fail to consistently incorporate transition risks through financial penalties for buildings, with low energy performance, because different approaches exist for their implementation.

Investment managers implement two different methods to handle carbon performance, by 1) either modifying financial projections, or 2) using energy standards without linking them to actual cash flow data. The available data regarding energy consumption and carbon emissions, as well as climate risk exposure at the asset level remains incomplete, and shows inconsistent reporting patterns. The reports fail to specify which areas of the building the data represents between tenant spaces, common areas, auxiliary facilities, and third-party certifications. Hence, these fail to deliver sufficient details for evaluating actual asset performance (INREV, 2025, P12-17).

Managers address data deficiencies through two methods, which include making educated predictions, and developing their own environmental assessment methods, that produce different results within the same organisation. The same asset receives different physical risk evaluations from external rating systems, because they employ proprietary assessment methods.

In addition to previously mentioned complexities, the market shows inconsistent application of CRREM as a framework to establish net zero carbon (NZC) pathways. The application of CRREM frameworks in business planning varies between managers, who use them as direct implementation tools, and those who treat them as planning references. CRREM faces multiple restrictions, because it fails to measure embodied carbon, and does not support all asset types, and geographic areas, and unfortunately is uses benchmarks that exclude building height. The existing limitations in these frameworks drive investors to develop their own assessment criteria or seek technical evaluations for precise evaluations.

The measurement of physical climate risks, including floods and extreme heat remains challenging, because there are no established standards for assessment. Investors use two main methods to address physical climate risks: 1) through discount rate adjustments, and 2) capital expenditure increases based on insurance data, and physical protection installations. The implementation of these measures does not always result in higher asset values, because insurance costs and regulatory variations between nations create additional complexity for underwriting international investment portfolios (INREV, 2025, P12-17).

Environmental capital expenditures present operational difficulties for property managers. The distinction between environmental capital expenditures and standard maintenance activities remains unclear in most cases and multi-tenant building cost-sharing structures create obstacles for implementing building upgrades. The process of reporting environmental improvements to investors becomes challenging because upgrades are not always identified as environmentally relevant which hinders the demonstration of value creation. The failure to properly establish and maintain new systems prevents expected energy savings from occurring which negatively affects the accuracy of projected cash flow projections.

The relationship between environmental enhancements and property market value remains an unresolved question. The relationship between sustainability performance and property value does not exist, because high sustainability does not guarantee higher sale prices, and low-performing buildings do not receive automatic price reductions. The absence of market-based evidence forces investors to make subjective decisions about environmental investment returns, because they lack observable data (INREV, 2025, P16-17).

5 Outlook

Real estate asset and portfolio managers use risk models as essential tools to address the proven reality of ongoing climate change. Real estate professionals use these models for management and acquisition purposes, yet research has not been conducted to study their actual impact on business operations.

The real estate market shows increasing evidence of climate risk exposure, because investors and buyers now expect lower prices for properties, that face such threats. The occurrence of more frequent extreme weather events will probably make this trend stronger.

Real estate properties without adaptation measures must give into using greater discount rates, and decreased market value, which demonstrates why climate resilience matters for property valuation purposes. In this paper's specific flood example, the implementation of flood protection measures, among other adaptation strategies will further enhance property values. Public investments in adaptation projects create value increases for

private properties, so investors should evaluate local adaptation plans and their post-implementation results.

The integration of climate- and environmental risks into real estate underwriting faces major obstacles, despite recent progress, as discussed in chapter 4. The main obstacle preventing real estate underwriting from incorporating climate and environmental risks, stems from insufficient reliable, consistent and complete data availability. However, a progression towards standardization of data administration and its integration into real estate transaction processes is expected. Moreover, the application of frameworks and certifications remains inconsistent, while operational difficulties continue to exist because of the challenge to identify and document environmental enhancements.

The relationship between sustainability performance and property value remains unclear, because high sustainability does not guarantee higher property values and inefficient buildings do not always receive price reductions. Investors must make personal assessments about environmental investment returns because there is no established method to evaluate them objectively. The integration of climate risk and adaptation into real estate investment decisions requires additional research and standardized data, as well as better measurement systems to achieve full implementation.

The current overall situation is challenging, however trends point toward a better future in the world of physical climate risks on real estate portfolios in terms of risk management, mitigations and valuation.

6 Bibliography

Allianz website (2025). *Tackling climate change*. Found under:

<https://www.allianz.com/en/sustainability/sustainability-hub/sustainability-at-allianz/climate-change.html#climate-related-opportunities>, accessed on 21.07.2025

Araullo, K. (2024). *Zurich introduces Climate Spotlight for global risk analysis*. Found

under: <https://www.insurancebusinessmag.com/uk/news/environmental/zurich-introduces-climate-spotlight-for-global-risk-analysis-515714.aspx>. Accessed on: 22.07.2025

AXA website (2023). *AXA Climate expands its service for asset managers with new*

Altitude functionality, Found under: <https://climate.axa/publications/axa-altitude-new-functionality/>. Accessed on 21.07.2025.

Archipelago website (2025). *Advanced Climate Risk Management for 2025 & Beyond*.

Found under: <https://www.onarchipelago.com/blog/climate-risk-management>. Accessed on: 22.07.2025.

Bank of England (2025). *CP10/25 – Enhancing banks’ and insurer’ approaches to managing climate-related risks – Update to SS3/19*, found under:

<https://www.bankofengland.co.uk/prudential-regulation/publication/2025/april/enhancing-banks-and-insurers-approaches-to-managing-climate-related-risks-consultation-paper>. Accessed on 05.07.2025.

Blobel website (2025). *Containment systems*. Found under:

<https://www.blobel.com/products/containment-systems.html>. Accessed on 21.08.2025.

California Legislative Information (2024). *Senate Bill No. 261 Chapter 383*. Found under:

https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202320240SB261. Accessed on 05.06.2025.

CFA Institute (2024a). *Course 1: Climate Science, Risks and Regulations. Week 2:*

Climate-Related Risks and Opportunities. Lesson 2: Transition Risks

- CFA Institute (2024b). *Course 1: Climate Science, Risks and Regulations. Week 2: Climate-Related Risks and Opportunities. Lesson 1: Physical Risks*
- Chubb website (2025). *Climate+ Risk Engineering Services*. Found under: Climate+ Risk Engineering Services. Accessed on 21.07.2025.
- Clearly Gottlieb website (2025). *Climate and Energy EU Policy and Regulation Update*. Found under: <https://www.clearlygottlieb.com/news-and-insights/publication-listing/climate-and-energy-eu-policy-and-regulation-update-for-30-april-2025>. Accessed on 21.08.2025.
- Climate Solutions zurich (2025), Zurich Resilience Solutions. *Climate Spotlight Data and Methodology*, non-public, internal methodology document
- Consolidated Financial Statements European Core Property Fund, 31.12.2024. Internal document.
- Deloitte (2023). *What is the TCFD and why does it matter?* Found under <https://www.deloitte.com/ch/en/services/consulting-risk/perspectives/tcf-and-why-does-it-matter.html>. Accessed on 05.06.2025.
- European Commission (no date). *Corporate sustainability reporting*. Found under https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en. Accessed on 05.06.2025.
- Green Real Estate Engagement Network website (2025). *How adaptation can preserve property values*. Found under: <https://green-engagement.org/how-adaptation-can-preserve-property-values/>. Accessed on 30.08.2025.
- Higuera Roa, O. et al, (2025.), Environmental Research Letters, *Challenges and opportunities in climate risk assessment: future directions for assessing complex climate risks*, found under: https://pure.iiasa.ac.at/id/eprint/20512/1/Higuera_Roa_2025_Environ._Res._Lett._20_053003.pdf, accessed on: 20.07.2025

IPCC (2022). *Summary for Policymakers* [H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A. Alegría, M. Craig, S. Langsdorf, S. Löscke, V. Möller, A. Okem (eds.)]. In: *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löscke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 3-33, doi:10.1017/9781009325844.001.

InsuResilience Global Partnership website (2025). *Climate and Disaster Risk Finance and Insurance – Specific Terms*. Found under:
<https://www.insuresilience.org/knowledge/glossary/>

IPCC (without date). *History of the IPCC*. Found under:
<https://www.ipcc.ch/about/history/>

IPCC (2023). *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Summary for Policymakers*. Edited by H. Lee and J. Romero. Geneva: IPCC. Found under <https://www.ipcc.ch/report/sixth-assessment-report-cycle/>.

IPCC (2019). *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate: Summary for Policymakers*. Edited by H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, M. Nicolai, A. Okem, J. Petzold, B. Rama, and N. Weyer. Geneva: IPCC. Found under <https://www.ipcc.ch/srocc/download/>

INREV (2025). *Integrating environmental considerations in real estate underwriting*. Found under: https://www.inrev.org/system/files/2025-04/INREV-Integrating-environmental-considerations-in-real-estate-underwriting_1.pdf

JLL (2025a). *From climate risk to climate resilience*. Found under
<https://www.jll.com/en-uk/insights/from-climate-risk-to-climate-resilience>

JLL (2025b). *How climate risks are impacting real estate insurance costs*. Found under <https://www.jll.com/en-us/insights/how-climate-risks-are-impacting-real-estate-insurance-costs>.

JLL (2025c). *Value in a time of climate risk: How owners can adapt*. Found under: <https://www.jll.com/en-us/insights/value-in-a-time-of-climate-risk-how-owners-can-adapt>. Accessed on 30.08.2025.

JRC Science for Policy Report (2023). *GHG Emissions of all world countries*. Found under: https://edgar.jrc.ec.europa.eu/booklet/GHG_emissions_of_all_world_countries_booklet_2023report.pdf, accessed on 21.08.2025

Jupiter website, Jupiter Intelligence (2025). *Resilience Planning and Engineering*, found under: <https://www.jupiterintel.com/solutions/resilience-planning-and-engineering>, accessed on 21.07.2025

Laidlaw, J. (2025). *EU plans to simplify sustainable finance framework, Mexico sustainability reporting rules, ISSB climate disclosure guidelines*. Found under <https://www.spglobal.com/esg/insights/esg-regulatory-tracker-january-2025>

Lepore, C., Fernando, R. (2023). *Global Economic Impacts of Physical Climate Risks*. International Monetary Fund. Found under: <https://www.imf.org/en/Publications/WP/Issues/2023/09/08/Global-Economic-Impacts-of-Physical-Climate-Risks-538947>

Lindsey, R., Dahlman, L. (2025). *Climate change: global temperature*. National Oceanic and Atmospheric Administration, found under <https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature>

Mastai, A. (2024). *Understanding Physical Climate Risk: Definition, Assessment, and Impact*. Found under: <https://www.correntics.com/understanding-physical-climate-risk-definition-assessment-and-impact/>, assessed on 22.07.2025

MetLife Investment Management (17.12.2024). *Pitfalls & Mitigants of Climate Assessment Software*. Found under: <https://irei.com/wp->

content/uploads/2024/12/pitfalls-and-mitigants-of-climate-assessment-software.pdf, accessed on: 22.07.2025

Moody's website (2025). *Catastrophe models and risks*, found under:
<https://www.moody.com/web/en/us/capabilities/catastrophe-modeling.html>
 accessed on 21.07.2025

Morningstar (2025a.). *SFDR Article 8 and 9 Funds: Requirements, Inflows, ESG Risks*

Morningstar (2025b.). *SFDR Article 8 and 9 Funds: Q1 2025 in Review*

Munich Re website (2025). *Munich Re's Climate Change Edition*, found under:
<https://www.munichre.com/.mp/en/products/location-risk-intelligence/climate-change-edition.html>, accessed on 20.07.2025

Naik, G., Insurance Journal (31.01.2025). *Europe's Insurers May Face New Capital Rules for Climate Risk*, found under:
<https://www.insurancejournal.com/news/international/2025/01/31/810286.htm>,
 accessed on 205.07.2025

Nofloods website (2025). *Nofloods Alu Barrier*. Found under: <https://nofloods.com/alu-barriers/>. Accessed on 29.08.2025.

Refinq website (21.01.2025). *Top Climate Risk Management Tips 2025*. Found under:
<https://www.refinq.com/blog/best-practices-climate-risk-management-2025>,
 accessed: 19.07.2025

O'Neill, Brian C., et al. (2024). *Scenarios in IPCC assessments: lessons from AR6 and opportunities for AR7*. *npj Climate Action* 3, no. 1. Found under <https://doi.org/10.1038/s44168-023-00082-1>.

Onsite website (2025). *The impace of climate change on property management*. Found under: <https://www.onsite-hq.com/insights/the-impact-of-climate-change-on-property-management>. Accessed on 30.08.2025.

Self Closing Flood Barrier website (2025). Found under:
<https://selfclosingfloodbarrier.com/>. Accessed on 29.08.2025.

Swiss Investor Relations (2024). *Climate Reporting in Switzerland: Tracking Progress Towards 2025 Mandatory Compliance*. Found under: <https://www.irclub.ch/en/ir-news/climate-reporting-in-switzerland-tracking-progress-towards-2025-mandatory-compliance.html>

Swiss Re website (2025). *CatNet – Our property location intelligence tool*. Found under: <https://www.swissre.com/reinsurance/property-and-casualty/solutions/property-solutions/catnet.html>, accessed on 19.07.2025.

The Geneva Association (2020). *Flood risk management in Germany*. Found under: <https://www.genevaassociation.org/sites/default/files/flood-risk-management-germany.pdf>. Accessed on 29.08.2025.

Tittmann, A. (2024), IGB Leibniz Institute of Freshwater Ecology and Inland Fisheries. *Better flood protection*. Found under: <https://www.igb-berlin.de/en/news/better-flood-protection>. Accessed on 29.08.2025.

UNDDR, PreventionWeb website (02.07.2024). *Crucial gaps in climate risk assessment methods*, paragraph 2-3. Found under: <https://www.preventionweb.net/news/crucial-gaps-climate-risk-assessment-methods>, accessed on 19.07.2025.

United Nations Climate Change (2015). *The Paris Agreement*. Found under <https://www.un.org/en/climatechange/paris-agreement>.

United Nations Principles for Responsible Investment (04.2025), *Assessing physical climate risk in private markets: a technical guide*. Found under: <https://www.unpri.org/download?ac=23033>, accessed on: 21.07.2025

United States Environmental Protection Agency (2023). *Climate Risks and Opportunities Defined*. Found under <https://www.epa.gov/climateleadership/climate-risks-and-opportunities-defined>

World Resources Institute (2023). *What does “Net-Zero Emissions” Mean? 8 Common Questions, Answered*. Found under <https://www.wri.org/insights/net-zero-ghg-emissions-questions-answered>

Wüest Partner (2025). *Climate risks in the real estate sector: Wüest Partner collaborates with CLIMADA Technologies*. Found under <https://www.wuestpartner.com/2025/03/24/climate-risks-in-the-real-estate-sector-wuest-partner-collaborates-with-climada-technologies/>

Zurich Resilience Solutions, Knowledge Hub (2025). *Systems and Tools, Climate Spotlight*, internal sharepoint

Zurich Resilience Solutions (2025a.). *Financial Quantification Explainer*, internal sharepoint

Zurich Resilience Solutions (2025b.). *Methodology Uncertainty*, internal sharepoint

Zurich Resilience website (2025). *Asset managers are using climate risk analyses to optimize their billion-dollar portfolios. Here's why*. Found under: <https://www.zurichresilience.com/knowledge-and-insights-hub/articles/asset-managers-are-using-climate-risk-analyses-to-optimize-their-billion-dollar-portfolios>. Accessed on 30.08.2025.

7 Appendix

Ehrenwörtliche Erklärung

Hiermit erkläre ich, dass ich die vorliegende Arbeit selbstständig und ohne Benutzung anderer als der angegebenen Hilfsmittel angefertigt habe. Mir ist bekannt, dass ich die volle Verantwortung für die Wissenschaftlichkeit des vorgelegten Textes selbst übernehme, auch wenn KI-Hilfsmittel eingesetzt und deklariert wurden. Alle Stellen, die wörtlich oder sinngemäss aus veröffentlichten oder nicht veröffentlichten Schriften entnommen wurden, sind als solche kenntlich gemacht. Die Arbeit ist in gleicher oder ähnlicher Form oder auszugsweise im Rahmen einer anderen Prüfung noch nicht vorgelegt worden.

Zurich, den 05.09


