REACHOUT
shaping climate resilient cities

D2.9 Physical climate risk assessment approach for international real estate portfolios using European climate data and services

Year 3

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1 Introduction

1.1 The purpose of this report

The aim of this deliverable is to raise awareness among professionals in the real estate sector on the challenges associated with assessing physical climate risks within European real estate portfolios, in accordance with reporting regulations. To facilitate this understanding, we discuss direct and indirect impacts of climate change on real estate portfolios and provide a transparent methodology for evaluating EU-level flood risk.

This deliverable is based on the work that was carried out for the Amsterdam city hub within the REACHOUT project, with pension investor APG as the main hub partner. APG provides the pensions for more than 4.8 million people on behalf of several Dutch pension funds and manages assets in four of the seven REACHOUT city hubs, namely Amsterdam, Milan, Lillestrøm and Gdynia. APG's responsible investment specialists actively integrate climate risk information into their investment analysis. In doing so, they encounter a growing array of methodologies and climate datasets, each with its own set of assumptions. Given the significant impact these have on investment decisions, APG seeks a deeper comprehension of the methods, data and the underlying scientific principles. Of particular concern are issues such as the compatibility of different data types (e.g., physical risk scores versus financial assets) and the spatial accuracy of the data, both of which pose challenges in effectively incorporating climate risk information into their analyses. Supporting APG with these concerns, the REACHOUT partners developed a tool and comprehensive guidance, which were publicly released[1] to benefit users working in this sector across Europe.

Climate risk encompasses both transition risk and physical climate risk. The former refers to the financial risks associated with the shift towards a low-carbon and climate-resilient economy. This includes risks like changes in policy, technology, and market preferences. The latter involves the direct physical impacts of climate change on assets, such as damage from extreme weather events like floods and storms. In this deliverable report and the work that was carried out for APG, we focus on physical climate risk.

This deliverable is based on a wide variety of activities and academic research undertaken in the context of REACHOUT. The main findings of the five academic REACHOUT publications can be found throughout this deliverable in the form of background boxes, with reference to the full (open access) publications.

This first chapter of this report opens with an overview of climate change impacts on the real estate sector. It highlights the underestimation of financial risks by this sector and addresses the so-called issue of 'black box' methodologies considering EU reporting obligations. The second chapter introduces the Real Estate Asset Climate Testing (REACT) tool, with the aim of advancing EU-level flood risk assessment, detailing its methodology and potential impact on adaptation strategies. Furthermore, the chapter examines the broader implications of climate risks on investment frameworks, shedding light on both direct and indirect consequences for financial stakeholders. The final chapter underscores the importance of ongoing collaboration in effectively managing climate-induced risks in the real estate sector, with a presentation of user uptake experiences from both APG and real estate investment manager AEW. It also includes an overview of scientific findings and a knowledge agenda for improvement.

[1] https://zenodo.org/records/8333518

1.2 The impacts of climate change on the real estate sector

In 2022 alone, climate-related disasters caused over €50 billion of economic damage in Europe[2]. In a changing climate, the intensity and frequency of such climate-related disasters is increasing, which leads to higher climate risk in the absence of adaptation actions[3]. However, these financial risks are structurally being underestimated by the financial sector[4]. Climate-related disasters pose shocks to different parts of the financial sector, including insurance, bond and stock markets, banking, and international financial flows *(see Background 1*).

Background 1. Physical climate risk impacts on the financial sector (Zhou et al., 2023).
Zhou et al. (2023) reviewed the literature on the impacts of natural disasters and physical climate change risks on the financial sector (insurance, banking, bond and stock markets, and international financial flows). Generally, natural disasters reduce the profitability, underwriting capacity, and stability of the insurance industry. Impacts of natural disasters on insurance companies include claim payout of insured destroyed physical assets and infrastructure and business interruptions; devaluation and reduction on the returns of investment portfolios of (re)insurance companies; demand for insurance products may be enhanced, increasing the profits and stock returns of the insurance sector. Similar to the insurance industry, disasters are found to influence the profitability and stability of banks. Disasters may reduce banks' asset and collateral values and investment returns, while direct damage to their property, branches, and data centres may weaken their processing capacity. On the contrary, demand for bank credit may increase because of post-disaster recovery and reconstruction. Furthermore, natural disasters can significantly affect the equity market, such as impacts on stock market returns and stock price volatility. Regarding the bond markets, natural disasters may affect interest rates, inflation rates and default risk. Moreover, individuals' risk aversion may increase temporarily at the local level after a disaster event, resulting in higher risk premiums demand by investors. Finally, international financial flows are found to be impacted by natural disasters, although the effects vary. On the one hand, disasters may enhance international financial aid and remittances. On the other hand, net bank lending and foreign direct investment (FDI) tend to decrease after the occurrence of disasters. However, contrary to low- and middle-income countries, post-disaster and FDI inflows and international lending increase in the medium and long term for high-income countries. Future research calls for more forward-looking approaches and consideration of correlations and interactions between different hazards and different parts of the financial sector.

Within the financial sector, the real estate sector is the most exposed to various types of physical climate risks, as real estate properties typically cannot be moved[5]. Climate hazards (e.g., flooding, hail, droughts, tropical storms) cause physical damage to such properties. Insurance may partially compensate the repair costs for the property, although insurance costs are also expected to increase under climate change[6]. Moreover, physical climate risks also affect the value of real estate investments[7]. The financial sector is currently not fully accounting for these risks and there is limited understanding about these risks within the real estate sector[8,9]. Forward-looking climate risk approaches are essential for investors to successfully manage the climate risk they are facing. However, current climate risk assessments are often

[2] European Environment Agency (2023).
[3] IPCC (2021).
[4] IPCC (2022).
[5] Giglio et al. (2021).
[6] Tesselaar et al. (2022).
[7] Bernstein et al. (2022).
[8] Arribas et al. (2022).
[9] Battiston et al. (2021).

qualitative in nature[10,11] and there is a gap between perceived risks and objective climate risks. Quantitative climate risk assessments help bridge this gap, as they create a price incentive for the financial sector to mitigate these risks *(see Background 2)*[12].

Background 2. Objective and subjective climate risk perceptions (De Wolf et al., 2024). *Individual risk perceptions often differ from actual risk levels. De Wolf et al. (2024) collected data during a five-day period when Hurricane Dorian was approaching the coast of Florida in 2019 using a real-time survey to examine flood risk perceptions during a direct threat of a hurricane making landfall. They compared the perceptions of three different dimensions of risk with the objective valuation of the risk indicators. While Dorian was a Category 1 and 2 hurricane, the majority of the sampled individuals overestimated the windspeeds. Therefore, most of the misperceptions occurred while the hurricane speed was low. In contrast, the wind speed was mainly estimated correctly during the three-day period in which Dorian developed into a Category 4 and 5 hurricane. Furthermore, as many as 1 in 4 citizens incorrectly perceived themselves as living in an area that was not forecasted to be impacted by Hurricane Dorian. These misperceptions show the importance of improving risk communication strategies, particularly in instances where risk perceptions are significantly lower than objective risk.*

1.3 EU regulations and the challenge of 'black box' approaches

Companies operating in Europe will increasingly be required to report on their physical climate risks as part of EU regulations, including the *EU Taxonomy*, *Corporate Sustainability Reporting Directive* (CSRD) and *Sustainable Finance Disclosure Regulation* (SFDR). Large, listed companies within the EU are already mandated to report on their contributions to environmental objectives, including climate change mitigation and adaptation[13]. Companies need to carry out a 'robust climate risk and vulnerability assessment'[14]. Reporting about physical climate risk will become mandatory for an increasing number of companies in the EU[15]. It is also to be expected that the European Central Bank (ECB) will increasingly require banks, pension institutions and insurers to increase their knowledge of climate risks and explicitly include these risks in their risk management[16]. However, research has shown that investors lack the tools and expertise required to accurately quantify physical climate risks for their assets and investments. The majority of financial actors are yet to acquire the specific expertise needed for conducting robust climate risk and vulnerability assessments[17].

Organizations often lack expertise in dealing with climate change, leading to the emergence of commercial providers offering methods to assess physical climate risk in the real estate sector. Many financial actors rely on these providers, and the number of climate-risk startups has increased in recent years[18]. However, many providers use 'black box' approaches with unpublished methodologies, lacking transparency and hindering trust. Recent analysis conducted by APG Asset Management on multiple data vendors offering risk metrics for a selection of real estate assets, revealed a concerning lack of correlation among the results. This divergence can be attributed to the widespread challenges faced by investors when utilizing these products. These include differences in methodologies, data sources, granularity

[10] Arribas et al. (2022).
[11] Zhou et al. (2023).
[12] De Wolf et al. (2024).
[13] Umweltbundesamt, 2022.
[14] European Commission 2021, Annex I
[15] EU Taxonomy Navigator, 2023.
[16] ECB, 2022.
[17] Hubert et al., 2021.
[18] Hubert et al., 2018; Ballard, 2023; Wirz, 2022.

levels, and underlying assumptions regarding scoring criteria. A study conducted in 2024 at the University of Regensburg had similar findings.[19] Following an analysis of physical climate risk scores for a pan-European real estate portfolio, it revealed significant disparities in results from different quantification tools. These disparities highlight the need for standardized scoring systems to improve financial decision-making in the industry, as current non-standardized tools may lead to misinformed decisions due to their oversimplified outputs. Current tools make it challenging to improve, compare and combine assessment results, limiting knowledge sharing[20.] To address these challenges effectively, promoting transparency and standardization in climate risk assessments is crucial for better collaboration and risk management. To contribute to this from REACHOUT, we present below a free and open method for analysing flood risk at EU level.

2 Advancing flood risk assessment in the EU

2.1 The Real Estate Asset Climate Testing (REACT) Tool

To address the aforementioned challenges with respect to the 'black box' problem of physical climate risk assessments, the Real Estate Asset Climate Testing (REACT) tool has been developed within the REACHOUT project. The goal of the tool is to offer a simple, flexible, and transparent approach for real estate investors, managers, and decision-makers to assess different types of flood risk (coastal, riverine, pluvial) for their assets, using free and open European scale data. The tool is a simplified version of a catastrophe model (the current state of the art for climate risk assessments in the insurance sector[21]) for flooding and is targeted at data analysts with some limited Geographic Information System (GIS) knowledge working at real estate organizations to do their own flood risk analyses without being reliant on 'black box' vendor models.

It should be noted that this tool offers relatively quick, simple, and transparent insights into the current and future state of flood risk. The approach of this tool should be considered a first step or screening of the physical flood risk of assets, and not a full-fledged risk analysis for which more tailored flood risk models and input data would be required[22]. The purpose of the tool is to go beyond qualitative indicator-based assessments which are often difficult to compare and interpret. Moreover, the upside is that it moves away from relying on 'black box' models[23,24], empowering data analysts by enabling them to perform risk assessments on their portfolios themselves and allowing for subsequent tweaking and integration in internal processes. The tool contributes to the provision of climate risk information, which has proven to play an essential role in the preparedness of society to flooding (see *Background 3*).

Background 3. Flood risk information and adaptive actions (Endendijk et al., 2023a).

Endendijk et al. (2023a) looked into the role of flood risk information, warnings, evacuation, and adaptation actions during the floods in the summer of 2021 in the Netherlands. Measures that are relatively easy and quick to implement after an early warning has been given are applied the most, such as placing sandbags and elevating household possessions. Households in areas with shorter warning times took fewer emergency flood damage

[19] Hoehn et al. 2024.
[20] Arribas et al. 2022.
[21] Botzen et al. (2019).
[22] For examples: see de Moel et al. (2014) or Al Assi et al. (2023).
[23] Arribas et al. (2022)
[24] Kelder et al. (2023)

reduction measures. Regarding structural flood damage reduction measures, elevating electrics and installing a water-resistant flood are commonly taken. Overall, respondents who were better informed regarding flood risk were better prepared for the flood event as they employed significantly more emergency preparedness actions, as well as structural measures. As such, flood risk information provision plays a vital role in flood risk management in addition to early warnings. With regard to evacuation, respondents who received evacuation advice evacuated significantly more during the flood event. Of those unwilling to evacuate, almost half listed a lack of perceived danger as the main reason for their unwillingness to evacuate. These results underline the previously mentioned importance of early warnings and accurate information provision.

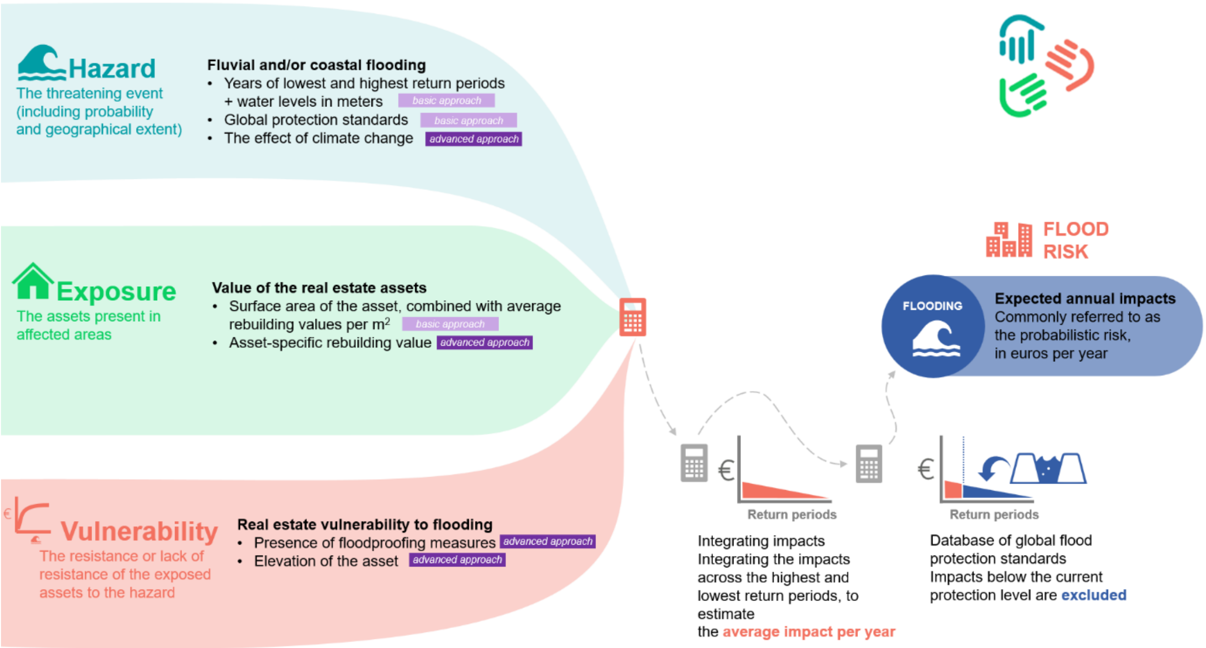

Figure 2.1. *General overview of the REACT tool and the required input data.*

Figure 2.1 gives a general overview of the REACT tool. The tool is designed to estimate the risk (in euro/year) for individual assets making use of a simplified risk calculation. The approach used is common in flood catastrophe models[25], where flood hazard, exposure, and vulnerability are combined to express flood risk in terms of Expected Annual Damage (EAD). Flood hazard refers to the probability and the intensity of flooding. These are included in the REACT tool through different open-source flood maps (e.g., WRI[26], JRC[27]). These maps include the inundation depth at different flood probabilities. An example of such flood maps is included in Figure 3.2 below. The flood hazard will be lower when there are flood protection standards in place. These flood protection measures, such as dikes, avoid the higher-probability flood events and, therefore, reduce flood risk in the area. With respect to the flood hazard, climate change affects the probability/severity of flooding[28]. Incorporating climate change can be achieved by using new flood maps that have been developed using climate change scenarios, or by adjusting the probabilities of existing flood maps.

[25] De Moel et al (2015).
[26] WRI (2020).
[27] JRC (2020).
[28] IPCC (2021).

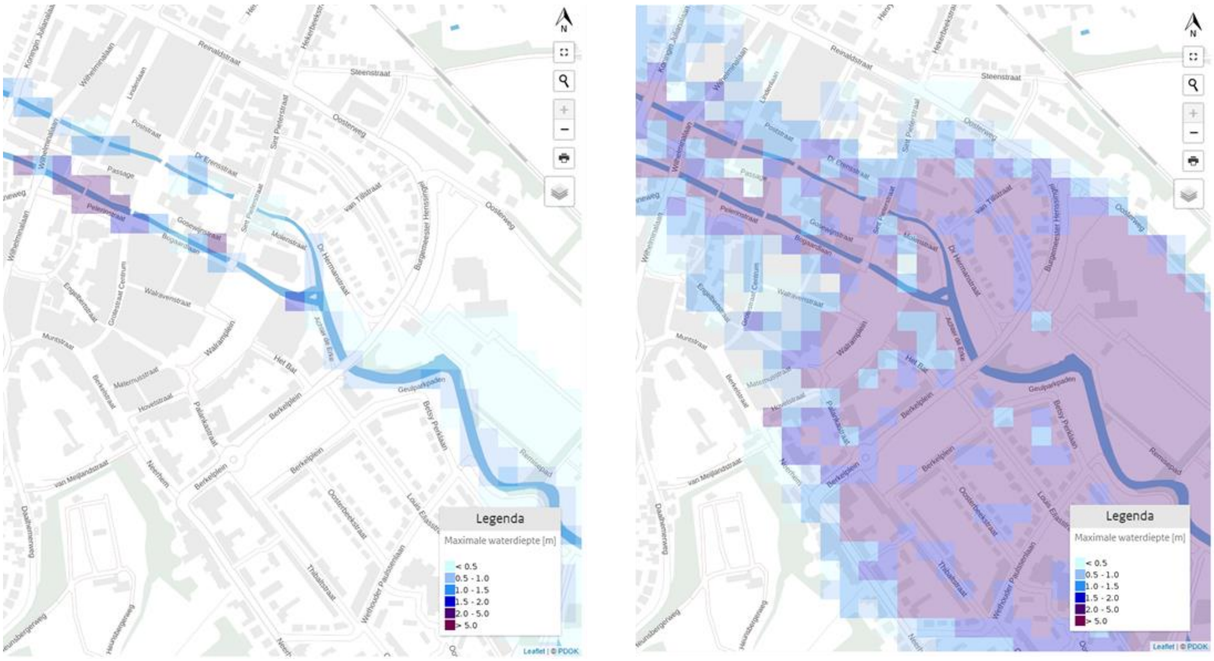

Figure 2.2. 10 Year (left) and 1000 year (right) return period scenarios that serve as an input for the hazard component of the REACT tool.

The second component included in the REACT tool is exposure, which indicates the value at risk of flooding. This is denoted by the location and the economic value of individuals assets within the real estate portfolio. The value of the asset can be inserted using the rebuilding value per m^2 or by directly using the building's maximum rebuilding value[29], as the rebuilding value of the property represents the value of the economic damage. The last component of the flood risk tool is vulnerability, which reflects the real estate susceptibility to flooding. Vulnerability is often denoted using depth-damage functions (also referred to as stage-damage functions, flood damage curves, or vulnerability curves). These functions describe the pattern of flood damage based on inundation depth. JRC[30] offers a global database on depth-damage functions, although more specific curves can give higher accuracy for specific countries (Figure 2.3) or asset types. Adaptation actions on the building level affect the building's vulnerability (see *Background 4*)[31].

Background 4. The effectiveness of flood adaptation measures (Endendijk et al., 2023b).

Using a data set collected after the 2021 flood event in the Netherlands, which contains experienced damages and the implementation of flood damage reducing measures on the household level, Endendijk et al. (2023b) estimated flood damage vulnerability models that include the effect of flood adaptation actions. In contrast to the existing flood damage curves, the new vulnerability models can be updated for flood damage reducing adaptation measures (Figure 2.3). Emergency actions can protect flood damage to buildings by almost 30% of their total value. Structural adaptation actions reduce flood damage by 20%. These results highlight the importance of early warning systems and information provision in facilitating effective emergence response and flood risk management.

[29] Huizinga et al. (2017).
[30] Huizinga et al. (2017).
[31] Endendijk et al. (2023a).

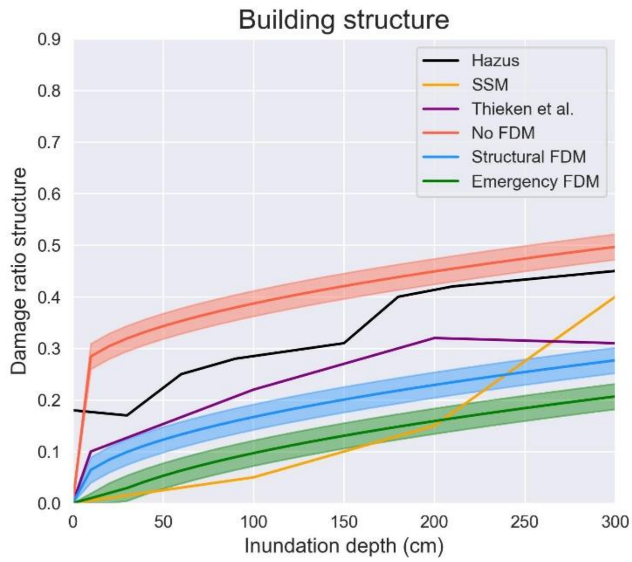

Figure 2.3. *Overview of different depth-damage curves for residential buildings (from Endendijk et al., 2023). The red line gives the function without flood damage mitigation (FDM) actions. The green and blue curves account for structural and emergency measures. The black, orange and purple curves give other historical depth-damage functions, not accounting for adaptation on the building level.*

This REACT tool is offered as an Excel workbook and gives insight into flood risk for individual assets as well as entire asset portfolios. The local-level approach offers insights into potential adaptation strategies for asset managers. The portfolio approach allows for both an absolute and relative assessment of portfolio risks. An advantage of the approach in the Excel tool and technical documentation is the transparency of the assessment of flood risks. Both a basic and an advanced approach are offered. The basic approach only requires the area of the building, flood protection standards, and two flood scenarios as input. Figure 2.4 gives an example of the use of the basic approach.

	A	B	C	D	E	F	G	H	N
1	Asset	Country	Protection standard	Start probability	Start Water Level	Max probability	Max Water Level	Size	
2	(name or number)	(dropdown)	(years)	(years)	(m)	(years)	(m)	(m2)	Risk (euro/yr)
3									
4	Home	Netherlands	1	50	0.1	1000	4	55	435

Figure 2.4. *Overview of the REACT tool in Excel.*

The advanced approach allows for more tailoring by also including the building's actual value, climate change scenarios, building elevation level, adaptation actions taken on the building level. The REACT tool is flexible to its input data and can be used with all possible flood maps, this allows for an enhanced comparison between different data sources and promotes more transparency in the flood risk assessment. The technical documentation[32] gives guidelines in the exact implementation of all the input variables.

2.2 Towards an investment framework

The REACT tool offers an approach for real estate investors to get more insights into the climate risk they are facing. Besides direct physical damage to buildings, natural hazards can also cause indirect, second-order effects to global markets that affect the balance sheets and

[32] https://zenodo.org/doi/10.5281/zenodo.8333491

cash flows of banks, insurers, and pension funds[33,34]. For instance, flooding causes businesses to temporarily close, leading to revenue losses and potential liquidity problems for these firms (see *Background 5*). These liquidity problems may then affect the security of the rent payments to investors in commercial real estate.

Background 5. Flood impact on businesses (Endendijk et al., 2024a).

Endendijk et al. (2024) assessed the role of flooding on business interruption duration and interruption losses. They found that flooded firms in their sample experienced fifteen days of business interruption on average, while non-flooded firms had two days of business interruption. Large differences between economic sectors have been observed. The hospitality, health and manufacturing sectors were found to have the most prolonged business interruption when flooded. Inundation depth impacts the length of business interruption; one additional centimetre of self-reported inundation depth is associated with four hours of additional business interruption. In turn, on average, one day of business interruption duration costs a firm 0.5% of their annual revenue. This effect is stronger for firms with a weak connection to their region. A possible explanation for this effect is that customers return to firms with a strong connection to the region, while customers of less regionally connected firms seek substitutes. Additionally, it has been found that quick and straightforward insurance compensation reduces business interruption duration.

Moreover, there is evidence that climate risks are currently capitalized into property prices, but the property prices do not yet reflect climate risks to the full extent[35]. On top of that, property prices strongly drop after a flood event, only to return back to their original level within a couple of years[36,37,38]. These changes in property prices are currently not integrated in the risk assessments of real estate investors, although they significantly influence the value of the total capital on the balance sheet. Hence, there is ongoing work within the REACHOUT project to integrate such financial risks within a flood risk framework for banks and real estate investors[39]. This framework will focus on the assessment of portfolio depreciation, mortgage credit risk, capital requirements, and losses in return to investments.

[33] Hallegatte (2015).
[34] Zhou et al. (2023).
[35] Bernstein et al. (2022).
[36] Bin & Landry (2013).
[37] Atreya et al. (2013).
[38] Mutlu et al. (2023).
[39] Endendijk et al., (2024b)

3 Uptake & next steps

3.1 User uptake

The Real Estate Asset Climate Testing (REACT) Tool has been extensively tested by two organizations from the real estate sector. Both APG - one of the world's largest pension investors[40] - and AEW - one of the largest real estate investment managers globally[41] - have used the tool to analyse flood risk for their European portfolios. APG has already worked with various commercial providers of physical climate risk assessments but encountered difficulties in comparing results due to the use of 'black box 'methods. With the REACT tool, APG was able to independently conduct a AEW on the other hand used the REACT tool for a Research Perspective in 2023[42], investigating how to integrate both transition risk and physical climate risk into a single climate risk premium for each of their sector- and city-specific segments. Both testcases are described below.

The experience of APG

- In a recent application of the REACT tool, APG conducted an assessment of flood risk for a random sample set of European real estate assets using open-source flood and regional protection data as suggested in the REACT tool documentation.

-The tool's analysis uncovered intriguing nuances, including significant vulnerability shifts in specific regions and notable disparities among future time periods and scenarios.

-The outcome suggests a positive correlation between higher flood protection standards and lower flood risk increase. Countries with stronger protection standards tend to show more resilience.

-The results underscore the necessity for ongoing monitoring and adaptation to navigate the evolving landscape of climate-related risks. This tool contributes valuable insights to the broader effort of enhancing climate risk assessments within the real estate sector.

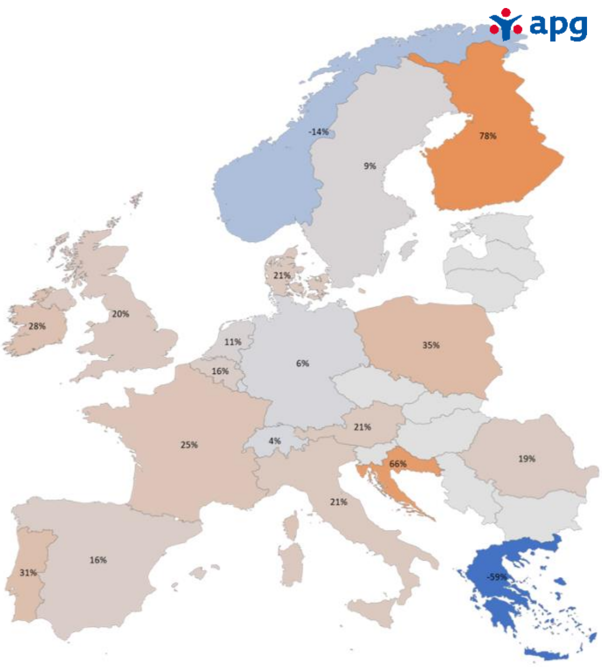

Figure 3.1*. Overview of projected increase in flood risk for a selection of the APG assets (2030-2080) under RCP8.5 scenario. Not representative of APG's real estate portfolio). Hazard data retrieved from WRI's Aqueduct Floods Tool, 2023.*

-APG remains committed to refining its existing methodologies and collaborating with industry stakeholders to advance the understanding and management of climate-induced risks in real estate portfolios.

It is important to note that the results presented in this analysis pertain to the specific locations of real estate assets rather than providing a comprehensive overview of the entire country's increase in flood risk. The sample set utilized for this analysis is for illustrative purposes and does not represent APG's real estate portfolio.

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40 https://apg.nl/en/about-apg/asset-management/
41 https://www.aew.com/eu
42 https://www.aew.com/research/real-estate-climate-risk-premium

The experience of AEW

- As part of its market-level climate impact research report series, the AEW research & strategy team used the REACT beta tool from the Institute for Environmental Studies (VU- IVM) in September 2023 to estimate flood risk.

- This open-source tool was applied on a sample of 3.303 buildings from the AEW portfolio in 51 European cities to overlap as much as possible with its 196 market segment universe and the previous year's report-based area (i.e. not building-level) sampling using a leading commercial source. It should be noted that the sample portfolio's buildings are meant to reflect prime market segments for which AEW research also estimates climate transition risk – but are not managed by AEW.

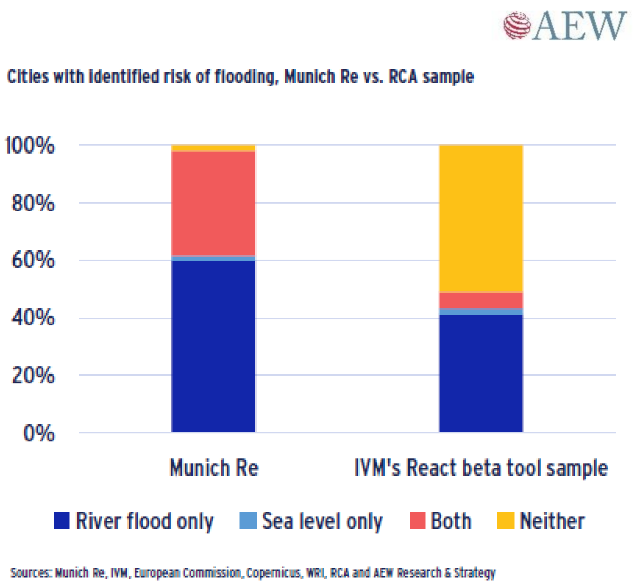

***Figure 3.2**. Cities in the AEW portfolio with identified risk of flooding according to Munich Re and the REACT tool.*

-The REACT tool enabled the research team to identify and quantify river flood risk for properties located in 21 of 51 cities, sea level rise risk only in one city, and both risks in three cities -- leaving 26 of 51 cities with no building level flood risk. This was much lower than in last year's results, raising a number of interesting follow-up questions.

-Given the growing interest in climate-related physical climate risks from our real estate investor clients, the next phase could be to perform a technical analysis on the tool's underlying data and benchmark them with our current tools and others available in the market.

-Science-based, open-source tools, like the REACT tool are particularly interesting for our market-level research. Our in-house Socially Responsible Investment (SRI) team verifies their preferred tools independently and was not yet involved in this initial application. AEW Research is keen to collaborate to further improve these tools for our clients, ourselves, and the broader market.

3.2 Scientific dissemination

The scientific findings from the Amsterdam city hub within the REACHOUT project are primarily disseminated through five research articles published in peer-reviewed scientific journals[43]. By publishing in scientific journals, the research ensures rigorous scrutiny and validation by the academic community. Establishing credibility, transparency, and facilitating further discourse and advancement in the field is especially important when trying to overcome the issue of 'black box' methodologies. The scientific work and its further applications to the financial sector have furthermore been presented at multiple academic conferences, including the fields of earth sciences (EGU2023 & EGU2024), economics (DEARE2023), and finance (FECS2024).

3.3 Knowledge agenda for improving this work

The REACT tool currently empowers data analysts at real estate investors to do their own flood risk assessments. There are three main ways forward regarding the use and uptake of the REACT tool.

[43] Endendijk et al. (2023a; 2023b; 2024a); Zhou et al. (2023); De Wolf et al. (2024).

The first way forward is extending the technical documentation to create a step-by-step guide to download and process all input data for the tool. The current technical documentation already includes a detailed description of the use of the tool and how the data can be inserted into the tool. To facilitate the uptake of the tool, a guide for downloading and handling the different input data can be useful. Moreover, a sample code to upscale the tool to entire investment portfolios can promote the tool's use.

Next, the tool can be made more user-friendly compared to the tool currently provided in Excel. The current approach in Excel is aimed at improving the transparency of the tool by displaying how the different input data sources are used to determine the flood risk for each property. However, a user-friendly interface that loads in different types of input data and lets the user freely choose and play around with the tool can also promote the uptake of the tool. Care should be taken here to balance a user-friendly interface, but avoiding becoming a 'black box' tool itself through continuing to empower users to gain insight into the risk of their portfolio and how that is determined.

Finally, the tool can be extended to other hazards. For now, the tool is only applied to different types of flooding. The tool is flexible in its use and by adjusting the hazard input and vulnerability functions, it would be possible to also include hazards such as earthquakes, hurricanes, or wildfires into the tool.

3.4 Next steps

The REACHOUT partners are committed to addressing and improving the issue of 'black box' approaches in EU-level climate risk assessments, by facilitating knowledge exchange between scientists and real estate organizations. We want to explore the possibility of partnering with a wider network of European organizations, with three objectives:

1. Sharing knowledge and experiences from practitioners working in the financial and real estate sectors, concerning EU-level physical climate risk.
2. Providing updates on ongoing scientific research on different climate hazards that can be assessed at EU-level.
3. Developing a roadmap to establish an EU-scale approach to physical climate risk assessment for real estate portfolios, covering all relevant hazards mentioned in the EU Taxonomy, empowering informed decision-making in addressing climate change-induced risks.

In light of these goals, the REACHOUT partners have successfully organized two Science-Practice Labs. In December 2022 and 2023, APG hosted two live events that facilitated knowledge exchange between scientists and financial parties. Some of the main takeaways from these events:

1. The starting point of physical climate risk assessments in science is not the same as in practice. The experience from the practice side shows struggles with interpretation of data and the need to make decisions based on these data (e.g., related to climate scenarios). Further interpretation of data into 'base maps' by the researchers, as well as supporting corporate decision making under climate uncertainty, can help towards levelling the starting point.
2. From this starting point of physical climate risk, we can further improve towards financial climate risk. Improving our understanding of building vulnerability is key.
3. Besides the current probabilistic way of calculating likelihoods and risk, there is an opportunity to look at individual events to better understand ripple effects. Developing a narrative can improve the understanding of climate risk.

4. We need to build a community of practitioners. Therefore, it is needed to engage international organizations with extensive networks within the real estate sector, such as ULI[44], INREV[45] and the Green Building Councils[46].
5. There is a need for an overview of the best available national-level data (e.g., BAT-ADAPT[47], GIS-ImmoRisk[48], Dutch Climate Impact Atlas[49]). A tailored overview specific to the real estate sector would be invaluable.
6. Colleagues expressed a desire to reduce dependence on ‘black box’ providers, highlighting the necessity for open access approaches and in-house capacity on physical climate risk.

The REACHOUT partners are now preparing for a final event in 2024, tentatively scheduled in November, to further expand the coalition of interested parties. This event is aimed to be organized in Paris, in order to connect to French organizations and further scale up the ideas from the REACHOUT project within Europe.

44 https://uli.org/
45 https://www.inrev.org/
46 https://worldgbc.org/
47 https://r4re.resilience-for-real-estate.com/resilience/analysis
48 https://www.gisimmorisknaturgefahren.de/immorisk.html
49 https://www.klimaateffectatlas.nl/en/

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