CONSULTATION PAPER: ASSESSMENT OF THE PRUDENTIAL TREATMENT UNDER SOLVENCY II OF ADAPTATION MEASURES IN NATCAT INSURANCE

EIOPA REGULAR USE
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1. RESPONDING TO THIS PAPER

1.1. EIOPA welcomes comments on the prudential treatment under Solvency II (SII)of adaptation measures in NatCat insurance consultation paper.

1.2. Comments are most helpful if they:

- respond to the question stated, where applicable;
- contain a clear rationale; and
- describe any alternatives EIOPA should consider.

Please send your comments to EIOPA by [17 April 2026] by responding to the questions in the survey under the following link:

[Link to EU Survey]

Contributions not provided using the survey or submitted after the deadline will not be processed.

PUBLICATION OF RESPONSES

1.3. Contributions received will be published on EIOPA's public website unless you request otherwise in the respective field in the survey. A standard confidentiality statement in an email message will not be treated as a request for non-disclosure.

1.4. Please note that EIOPA is subject to Regulation (EC) No 1049/2001 regarding public access to documents (EC, 2001) and EIOPA's rules on public access to documents (EIOPA, 2021). Contributions will be made available at the end of the public consultation period.

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2. INTRODUCTION

2.1. Insurance coverage plays an important role in protecting households, businesses and governments from the impacts of natural-related disasters ([1]). However, there is a significant natural catastrophe (NatCat) insurance protection gap ([2]), where only part of the losses from extreme events are insured today. Climate change is expected to increase the frequency and/or intensity of a range of climate-related (weather) perils and could potentially limit the availability of affordable insurance in the future, contributing to the widening of the already existing protection gap. Risk reduction through adaptation and mitigation of climate change ([3]) will be the only sustainable mean to limit the expected increase in future climate damages and losses and potential disruptions to insurance markets and the wider economy.

2.2. EIOPA has previously worked on the prudential treatment of sustainability risks (EIOPA, 2024). In this work, EIOPA focused on non-life premium risk and found some moderate evidence of a risk reduction impact of adaptation measures ([4]). At that time, EIOPA suggested an extension of the prudential analysis of adaptation measures to the Solvency Capital Requirements (SCR) for natural catastrophe.

2.3. EIOPA also highlights the key role of the (re)insurance sector to contribute to climate change adaptation via the concept of “impact underwriting” (EIOPA, 2023). Micro ([5]) adaptation measures, such as anti-flood barriers and windows, can reduce the policyholder’s physical risk exposures and insured losses. Therefore, they can be a key tool to maintain the future

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[1] In this context, a disaster is a serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts (UNDRR, 2017).

[2] With a protection gap, we mean the uninsured economic losses, or the difference between the insured and total economic losses due to extreme events. Here we mainly focus on property insurance gap. It is important to note that even if all households and businesses were insured against NatCat risk, there would still be a gap between total economic and insured costs due to costs that can’t be insured by individuals such as infrastructure repairs.

[3] Mitigation measures are measures to reduce the release of CO_2 and other greenhouse gasses into the atmosphere as these a driving climate change. Adaptation measures are those interventions that – when they happen – reduce the impact of extreme events on the economy, society and environment. Both are necessary as without mitigation measures global warming and related weather extremes and variability will reach a state where adaptation measures can no longer reduce the impact to a level where economies, societies and the environment are resilient. Adaptation measures are a necessity as even without additional releases of greenhouse gasses, long-term effects (e.g. in ocean heating and acidification) will increase extreme weather events compared to present. While this paper only focusses on the adaptation against extreme weather events (like disaster risk management does), climate change adaptation also deals with gradual changes of the climate like changes in average temperatures, sea level rise, changing wind patterns etc.

[4] As the input for the premium risks is using premium data, adaptation measure could be directly reflected in the input data which would not be the case for the natural catastrophe module (where the input is based on sum insured data).

[5] Some adaptation measures can be taken by individual owners (here called “micro measures”) while other measures are there to protect a certain area (here called “macro measures”).

availability and affordability of non-life insurance products providing coverage against natural catastrophes. Ultimately, adaptation measures can help to reduce the insurance protection gap in Europe. While progress is being made in how insurance undertakings are adapting their non-life underwriting practices to climate change, EIOPA's report shows that the EU insurance market overall appears to be at a relatively early stage ([6]). EIOPA sees further room for improvement to include micro adaptation at the core of insurance products. A more recent assessment of available data to EIOPA ([7]) shows that for the vast majority of the amount of written premiums for natural catastrophe insurance, the product design makes some allowance for risk-prevention measures. From these data, it is however unclear which types of risk prevention measures (macro or micro measures for example) are allowed and to which degree these are implemented, something that cannot be derived from the existing QRT reporting.

2.4. In addition, this paper will also consider the impact of macro adaptation measures as they should also be taken into consideration by insurers. Indeed, best results can be unlocked when micro adaptation measures are supported and guided by meso- and macro-level policies that ensure equity, manage systemic risks, and prevent maladaptive outcomes. It is therefore critical that integration actions across all levels are contemplated to ensure effective resilience (Adger, Arnell, & Tompkins, 2005). Insurers play a role to for example help leveraging its claims experience and risk analytics, where the insurance sector can provide expertise to individual policyholders or wider communities on adaptation and risk reduction measures that can provide effective protection against climate perils.

2.5. EIOPA also recently published the reassessment of the natural catastrophe risk standard formula (SF) capital charges (EIOPA, 2025). An increase in several parameters has been proposed. As part of its mandate, EIOPA regularly reviews these NatCat parameters, which could also help better reflect adaptation measures in the future.

2.6. This paper aims to assess if a dedicated treatment is justified under SII for better reflecting adaptation measures in the NatCat SF module beyond the regular calibration of the SF parameters. This work will also consider proportionality to ensure that the SF strikes a balance between being risk sensitive and 'limited' complexity.

2.7. The consultation paper starts with addressing the manner in which the prudential framework reflects the impact of adaptation measures where these are part of the NatCat component of insurance products (i.e. is the framework risk-sensitive enough or is itself an obstacle to the

[6] As mentioned in OECD (2023), there are more and more examples of insurance companies providing risk information and risk reduction advice to corporate policyholders. For example, FM Global provides "Climate Risk Reports" that provide risk information on specific locations by peril as well as information on potential mitigation actions. Similarly, AXA Climate Consulting Services provides asset-by-asset climate risk assessment and adaptation advice to businesses on a consulting basis. Zurich Insurance has a business unit (Zurich Resilience Solutions) that supports corporate policyholders in reducing risk.

[7] Based on the assessment of the Quantitative Reporting Template (QRT) S.14.02.01 on non-life business – policy and customer information.

expansion of impact underwriting) (Chapter 4). A second step considers the materiality from a SF perspective (Chapter 5). Chapter 6 elaborates on options for a dedicated prudential treatment. Chapter 7 provides a quantitative assessment on adaptation measures on the SF parameters.

2.8. This work was performed in close collaboration with the EU NCAs and EIOPA's Technical Expert Network on Catastrophe Risks (Annex 1).

RELEVANCE OF ADAPTATION MEASURES

2.9. A lack of adaptation action is costly, but also difficult to quantify exactly (Alberti, 2024). Between 1981 and 2023, natural catastrophe-related extreme events caused around €900 billion in direct economic losses in the EU, with more than a fifth of the losses occurring in the last three years (EIOPA & ECB, 2024) (Figure 1). Without adaptation, the EU risks escalating costs and irreversible damage to ecosystems, infrastructure, and human health. According to the European Parliament (EP, 2024), this not only requires a strengthening of the EU's Civil Protection Mechanism but also of the EU Solidarity Fund to be "commensurate to the increasing number and severity of natural disasters in Europe". In the long-term, the resolution calls for more EU investment in regional and local resilience and demands the future EU cohesion policy focus even more on climate change mitigation and adaptation.

2.10. Assessing the benefits of adaptation measures requires taking into account not only the reduced impact of natural hazards but also their contribution to overall economic development. Assessments also need to consider ancillary benefits to biodiversity, air quality, water management, greenhouse gas emission reductions, health and well-being.

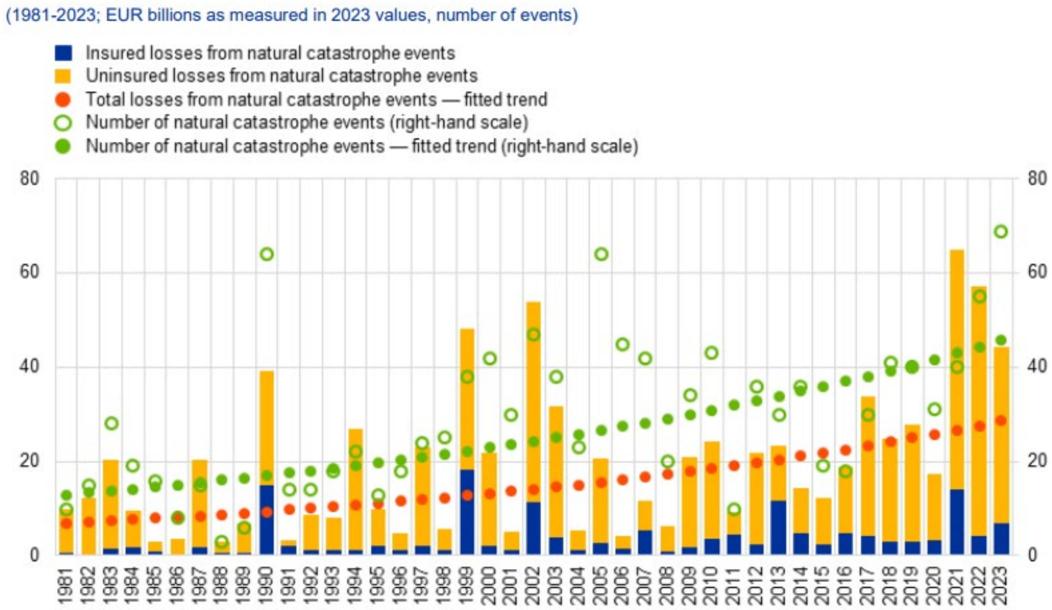
2.11. When societies fail to invest in climate adaptation and mitigation, the frequency and severity of climate-related disasters increase, leading to higher economic losses (the increased cost of inaction). These losses might exceed the capacity provided by insurance, widening the protection gap. Without adequate adaptation measures, the increased financial burden will fall heavily on governments and public authorities, businesses and citizens, exacerbating economic strain and social inequality.

2.12. The protection gap, expressed as the share of the insured losses over the total losses can be narrowed by enhanced insurance mechanisms. However, without adaptation measures, costs from weather- and climate-related extremes will increase and insurance premiums will have to rise to cover the increased risks or these may become uninsurable. The role of adaptation measures is to limit the total economic losses, while the insured losses will be proportionally affected ([8]). The aim is to narrow the absolute difference between the total and insured

[8] Not necessarily in a linear way.

economic losses and to provide conditions where assets remain insurable and a functioning market can thrive, while reducing the financial vulnerability of public authorities, businesses and citizens (a necessity to have economic growth).

Figure 1 - Economic losses and number of natural catastrophes in the EU.



Source: EIOPA & ECB (2024), based on CATDAT (RiskLayer GmbH – Europe Climate related impact Analysis Project), EIOPA's Dashboard on insurance protection gap for natural catastrophes and EM-DAT.

Notes: The two fitted trends depict exponential trends fitted to the annual time series of the number of and the total losses (insured and uninsured) from natural catastrophe events. (Initially, two types of linear regressions were fitted, one for the original data and one for logs of the original data: since better fits – as measured by R-squared – were obtained for the logs of the original data, the estimated coefficients from these regressions were used to depict the exponential trends). The trend fitted to total losses remains upward-sloping when total losses are scaled by GDP. Natural catastrophes include both geological catastrophe events (e.g. earthquakes, volcanic eruptions) and climate-related catastrophe events (droughts, extreme temperatures, floods, mass movements, storms and wildfires). The frequency of geological catastrophe events (as opposed to that of most natural catastrophe events or climate-related catastrophe events) is not upward-trending.

ADAPTATION AND THE INSURANCE SECTOR

2.13. Climate-related adaptation measures, for example water-resistant walls or floors in the case of flood risks, reduce the policyholder's physical risk exposures and insured losses, and can be a key tool to maintain the future supply of non-life insurance products covering climate-related hazards. Adaptation measures can therefore help to reduce the potential losses in Europe.

2.14. The insurance industry, as risk managers, plays an important and unique role in raising the resilience of the society and real economy. Insurance products pricing risks and compensating financial losses caused by extreme events help to protect economic wealth and social welfare. However, due to the expected growth in physical risk exposures related to climate change, risk-based premium levels are expected to increase as well over time, potentially impairing the mid- to long-term affordability and availability of insurance products with coverage against climate-related hazards. This could reduce the level of insurance uptake, reducing insured losses and increasing the protection gap both in relative and absolute values.

2.15. In the past ([9]), only around a quarter of the total losses caused by extreme events across Europe was insured ([10]), with material differences in the scope of the protection gaps across countries and perils (EIOPA, 2025). Given the current trajectories of climate change, these insurance protection gaps are expected to become even wider in the future, as more frequent and severe natural disasters are likely to occur and insurance becomes less accessible and less affordable. Adaptation measures that are implemented ex-ante to a loss event, reduce the policyholder's physical risk exposure and insured losses. As such, adaptation measures can be a key tool to stabilize risk-based premium levels and insurance coverage in light of climate change and to maintain the future availability and affordability of insurance products with coverage against climate-related hazards.

2.16. Figure 2 gives ranges of the benefit cost ratio and the return timeframe for different adaptation actions at micro or individual asset level, mainly retrofitting initiatives. While the uncertainty is significant, the benefits are significantly larger than the costs and the average time to return the investment is significantly smaller than the lifetime of the asset.

2.17. In this regard, EIOPA introduced the concept of impact underwriting, capturing the ability of insurance undertakings, consistent with actuarial risk-based principles, to contribute to the adaptation of the society and real economy to climate change by means of their underwriting practices in terms of data, risk assessment and expertise, thereby promoting and incentivizing policyholders to take up adaptation measures (EIOPA, 2021).

2.18. EIOPA's previous study (2023) showed that while progress is being made in how insurance undertakings are adapting their non-life underwriting practices to climate change, the EU insurance market overall appears to be at a relatively early stage to for example recognize micro adaptation measures in insurance products ([11]). EIOPA sees further room for improvement especially in terms of standardising the implementation of climate-related adaptation measures in insurance contracts, for instance through dedicated risk-based certificates and

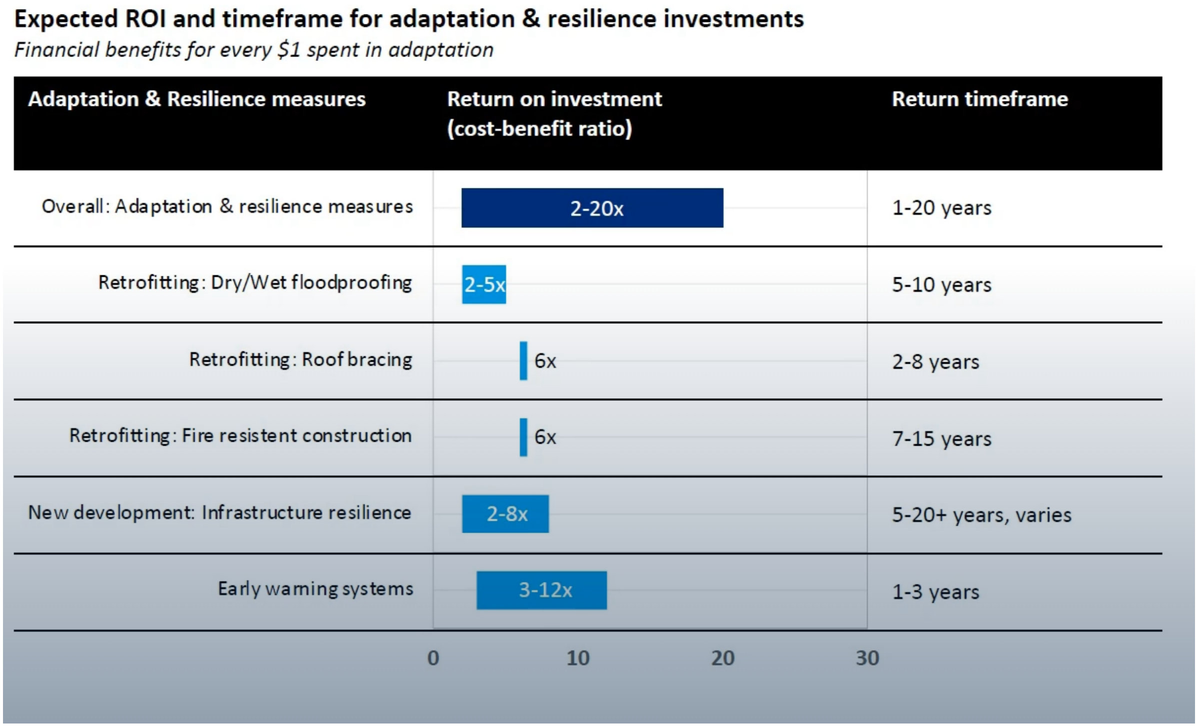
[9] Since 1980. The situation in recent years might differ in some countries and for certain perils.

[10] There are large differences in between countries, from 3% or less in countries such as Bulgaria, Croatia and Romania to over 40% in countries such as Denmark, France, Luxembourg, the Netherlands and Norway. In addition, there are large differences between the types of events (EIOPA, 2025). For meteorological events, over one-third of the losses were insured. It was less than 15% for hydrological events and slightly over 10% for all climatological events, including heatwaves, droughts and forest fires (EEA, 2025). Lastly, these are averages over a period of over 4 decades and therefore the result for a country and/or a type might be impacted by major events further away in the past and no longer describing the current insurance landscape.

[11] This is in particular true for retail or other standardized products (e.g. for SMEs), but not necessarily for larger corporate and commercial policies, where risk prevention has been a key element for decades.

programs. In addition, EIOPA also believes that it is of crucial importance for the insurance sector to help to develop macro adaptation measures.

Figure 2 - From risk to resilience: Financing risk and adaptation in a changing climate.



Source: Climate X (in a presentation), based on WEF Alliance of CEO Climate Leaders, OECD, WRI, Science Direct, SwissRe, Standard Chartered and other.

2.19. In Italy, for example, taken the importance of NatCat risks for the country, IVASS has focused on the risks of natural catastrophes carried out on the Italian insurers. Climate adaptation initiatives are increasingly becoming an integral part of both insurance product design and innovative coverage solutions in Italy (Table 1). Innovations consist of increased customization of cover (at the customer's request) and the provision of additional services for claims management (e.g. with dedicated teams, networks of specialized partners and mobile units to promptly assist customers affected by damage) (IVASS, 2025).

2.20. In addition, new insurance products are developed to take into account efforts to mitigate risks. For example, the Nature Conservancy and Willis, a business of Willis Towers Watson PLC announced an insurance policy that considers efforts to mitigate fire risk. The wildfire resilience insurance policy was developed and placed to demonstrate lower premium pricing and improved availability where ecological forest practices have taken place (TNC, 2025). These developments are crucial to ensure the sustainability of natural catastrophe insurance.

Table 1 - Introduction of innovations in product design and insurance coverage in Italy (% of companies underwriting natural hazards)

		2022	2023
1 Product design	Premiums take into account preventive measures taken by the policyholder	41,5%	45,8%
	Distribution strategies provide information to policyholders about the importance of preventive measures and their effect on contract conditions	13,2%	18,8%
2 Innovative solutions	The insurance products offered provide coverage for weather events if the customer requests it	47,2%	63,5%
	Customization of products according to customer needs	41,5%	47,1%
3 Data Sharing	Data on insured losses is made available free of charge to public authorities for research purposes	52,0%	45,7%
4 Post-catastrophe solution	High level of service in post-disaster situation (claims are processed in a fair and timely manner)	75,5%	76,6%

Note: % = number of non-life insurers/ total non-life insurers

DEFINITION OF ADAPTATION MEASURES

DEFINING RISK

2.21. Risk as a term is widely used amongst different professions, but the number of different concepts, definitions and perceptions is large (see e.g. Vlek & Keren (1992) for an overview). Therefore, it is important to define risk in the context of this paper. Risk, as typically defined in a context of disaster risk reduction and climate change adaptation is the combination of hazard, exposure and vulnerability. This is e.g. the concept in the risk propellor of the Intergovernmental Panel on Climate Change or the NAIC risk triangle (Annex 4: Defining risk for details). Notwithstanding the common wording, there are differences between these approaches.

2.22. For this paper, the intention is to stay as close as possible to the understanding of risk in the European insurance sector with

- the hazard covers the local intensity of the event and the conditions of the event footprint;
- the vulnerability quantifies the expected damage based on asset characteristics, mostly using damage functions ([12]);
- the exposure which consists of exposed assets (or people) and may be represented by datasets providing the location together with risk characteristics and economic and insured values.

MACRO VERSUS MICRO ADAPTATION MEASURES

2.23. The European Environment Agency developed a detailed taxonomy for adaptation measures (Annex 5: Defining adaptation). Some adaptation measures can be taken by individual owners (here called micro measures) while other measures are there to protect a certain area (here called macro measures). In most cases, only the micro measures are under the control of the individual owner or policy holder while the macro measures are decided, planned and implemented by a public authority ([13]). Macro measures are part of a wider planning approach, where as a result all the assets within that area have a reduced risk through reduced hazard, exposure and/or vulnerability.

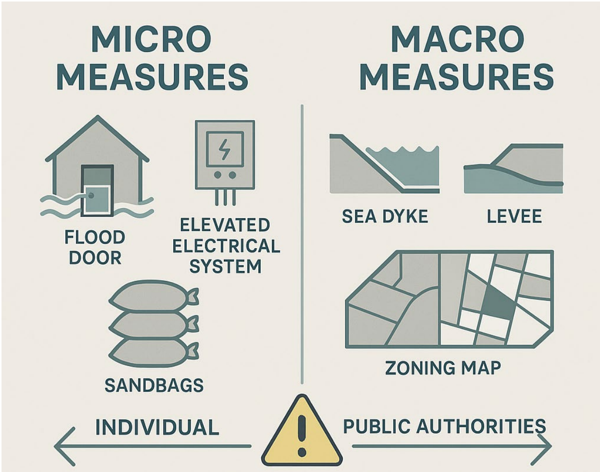
2.24. In general, most micro measures (e.g. flood door) reduce the risk by focussing on the 'more frequent less severe' events compared to macro measures (e.g. sea dykes) focus on the tail of the distribution (less frequent more severe events). Which measures, or which combination of micro and macro measures, is most cost-effective and cost-efficient is different for different perils and in different locations (Figure 3).

2.25. Certain micro measures that are beneficial from an individual perspective might become counterproductive when applied on a large scale. For example, micro measures like heightening certain parts of the property (garden) or having a fence acting as a wall (e.g. with concrete panels) might take away necessary volume in the floodplain that then causes additional risks downstream.

[12] Damage functions are essentially equations that are used to compute the amount of expected damage for a given hazard intensity (such as windspeeds) based on characteristics (e.g., construction, occupancy, building height) of the property at risk (NAIC, 2025).

[13] In Sweden, discussion is ongoing about a shared-responsibility model for climate adaptation, especially in flood-prone areas. In projects like the PoCoClim initiative, co-financing models are encouraged where property owners contribute to on-site adaptation measures (e.g. flood barriers or drainage upgrades) or share infrastructure (e.g. levees or retention basins) with neighbouring owners. The model reflects a policy shift: instead of solely relying on public funding, private actors are expected to invest in resilience, especially when their assets benefit directly. This is due to rising costs to protect properties from flooding, but also a pressure from the insurance sector as higher premiums and reduced coverage in high-risk zones are stimulating private owners to act pre-emptively. See e.g. RISE (2025) and Ecogain (2024) for more information).

Figure 3 - Examples of micro and macro measures.



Source: EIOPA.

Reducing the risk by reducing the hazard, exposure or vulnerability

2.26. Without techniques like weather engineering ([14]), the hazard can mainly be reduced ([15]) for the perils flood and wildfire.

2.27. For fluvial and coastal flooding, this can mainly be done via macro measures, e.g. via physical and nature-based solutions as dykes, controlled overflow zones, reduced tidal areas, stilling wave basins, groynes or changes to the foreshore and beach profile.

2.28. For pluvial flooding, combined micro and macro measures can be used to reduce the hazards, e.g. by sustainable urban drainage systems, increased infiltration options in the public and private domain, well-managed rainwater tanks or green roofs.

2.29. For wildfires, one way to reduce the hazard is by reducing the fuel by forest management measures, both near-term (e.g. removal of deadwood) and long-term (e.g. species composition) ([16]). Depending on the size of the individual ownership, these kinds of measures can be taken by the individual (and be seen as a micro measure) or require public intervention. Also in a build-up environment prone to wildfires, reducing the possibility of fire to move from one place to another is a measure that can be taken at micro level (e.g. spacing between

[14] E.g. weather modifications like cloud seeding with the goal of increasing local water supply (increasing rainfall or snow) or of preventing damaging weather (e.g. hail) from occurring.

[15] In general, climate change mitigation and CO_2 reduction are the most important action to reduce the additional impact on frequency and intensity of weather- and climate-related extremes due to climate change. These are outside the scope of this paper.

[16] The biodiversity of the forest can also be a protection method against wildfires. While monoculture spruce forests are an old adaptation to pulp industry era, climate change adaptation today is to use more blended forest, not burning so easily and being less prone also to secondary damages.

housing and fire-prone material, removal of deadwood ([17]), forest road network by individual owners) as well as on macro-level for larger forests in the vicinity of houses ([18]).

2.30. For other perils, including storms, drought, heatwaves and earthquakes, management plans can be made with a focus on reducing the exposure and the vulnerability, e.g. by planning the location of (future) assets, building codes, …

2.31. In the remaining part of this paper, focus will be on physical interventions (both nature-based solutions and grey options ([19])). It will therefore not in detail describe policy and economic enabling measures and neither the knowledge nor behavioural ones (Annex 5: Defining adaptation for a detailed description of these categories). For example, on building codes, the focus in this paper is on the houses constructed according to a certain building code rather than on the process to create and enforce these building codes.

[17] While the objective to increase biodiversity might include leaving deadwood in the forests, removing it might be a measure to prevent wildfires. While there are multiple synergies between the different climate and environment-related objectives, there are also cases where there is a trade-off between them. Both climate change adaptation and biodiversity are the most context specific of the climate and environment-related objectives, meaning there is no general best approach but a case by case evaluation needed.

[18] E.g. in Finland, the adaptation to wildfires is a century old project as the country relied on forestry, pulp and paper industry. The macro measures used include;

- aerial surveillance systems,
- covering forest road network (by the state, and servicing both forestry and fire extinguishing) and
- voluntary fire brigades (from National Fire Protection Fund which in turn is funded with the fire protection premium that is collected from all the fire insurances).

[19] Grey measures typically involve technical or engineering oriented responses.

3. SCOPE OF THIS PAPER

SOLVENCY CAPITAL REQUIREMENT (SCR) MODULE CONSIDERED

3.1. The prudential requirements for non-life underwriting risks in SII's SF comprise three main modules:

i. the premium and reserve risk module,

ii. the catastrophe module, and

iii. the lapse risk module.

Lapse risk may be impacted by catastrophe or climate change, though indirectly. Extreme events and economic disruptions may indeed influence policyholder behaviour, leading to unexpected lapses or surrenders. The first two modules are more directly sensitive to extreme event. The premium and reserve risk module assesses the risk that premiums are insufficient, or reserves are inadequate to cover future claims. More frequent and severe natural disasters (e.g., floods, wildfires, storms) lead to higher claim volumes and costs. The catastrophe module is clearly impacted by extreme events as per its own definition it is the risk of extreme or rare events causing large-scale claims. As the input for the premium risks is using premium data, adaptation measure could be directly reflected in the SF with the input data (premium data)([20]). This would not be the case for the natural catastrophe module (where the input is based on sum insured data). This paper therefore focuses on the NatCat catastrophe module of the SF.

3.2. In addition, for the NatCat SF module, if a policyholder invests in physical adaptation measures that lower the impact of storm or flood to their property, the sum insured would potentially increase as the value of the property is increasing (e.g. as cost to rebuild to the same standard is more expensive). So, in that sense the risk charge might increase for NatCat through some forms of adaptation. One might therefore also argue, that in such cases consideration it would be even more important to account for adaptation measures in the risk-based SF parameters to avoid perverse incentives in the framework that would actually act as obstacles to the implementation of adaptation measures by policyholders.

3.3. Traditional protection measures should typically lower claims cost. If the claims are frequent the protection measures' effects are immediate. The profit/loss effect is sufficient to introduce traditional measures. With climate change it may take 10-15 years before the actual benefit of adaptation method is seen. Nevertheless, the risk distribution is changing and undertakings

[20] This was analysed previously in EIOPA (2024).

should react. That is why the SCR should show this loss absorbing capacity ex ante. It would require that the undertaking is able to the satisfaction of the supervisor present the adaptation measures with impact assessments and not to double count any (macro-)measures that are already noted in the country coefficients.

COUNTRIES CONSIDERED

3.4. The current methodology covers the exposures and perils inside the European Economic Area (EEA), UK and Switzerland. The SF also includes a calibration methodology for non-EEA NatCat hazards, but it is not widely used. Indeed, it is assumed that insurance undertakings with material non-EEA exposure will generally use an internal model. In order to verify this assumption EIOPA had a look at the data that is available for floods and windstorms on a quarterly basis. According to this information, non-EEA NatCat SCR calculated using the SF represents only 11% of the NatCat SCR calculated with the SF for floods and windstorms. Since the exposure is not material for this work, it is appropriate that the focus of the SF for this paper is on exposures and perils inside the EEA, UK and Switzerland.

PERILS CONSIDERED

3.5. The SII NatCat SF covers the following natural perils:

- earthquake;
- flood;
- hail;
- subsidence;
- windstorm.

3.6. In order to understand how adaptation is/should be reflected in the SF, it is important to consider the specificities of each peril.

SF PARAMETERS CONSIDERED

3.7. The scope covers the parameters for country ([21]) factors, zonal relativities and correlations as well as the country correlations (for the definition of these parameters please see EIOPA (2021).

[21] Note that the regions considered in the SF correspond to countries.

4. HOW THE PRUDENTIAL FRAMEWORK CURRENTLY REFLETS THE IMPACT OF ADAPTATION MEASURES

HOW ARE SF PARAMETERS CALCULATED?

4.1. A number of steps are needed to obtain the SF parameters in the NatCat module (EIOPA, 2025). The assessment usually starts with the country factors (200 Occurrence Exceedance Probability ([22]) year Return Period Loss (RPL)/Total Insured Value (TIV)) because of their high impact on a (re)insurance undertaking's SCR for a given scenario. In the latest assessment of the NatCat parameters, EIOPA worked with the main NatCat model vendors. The TIV are provided by these model vendors, who used their own Industry Exposure Database (IED). IEDs contain all insurable properties and their respective replacement values for a given country, along with information about the occupancy and the physical characteristics of the structures, such as construction type and height classification. Even information pertaining to standard industry policy conditions, such as limits and deductibles, is incorporated into a country's IED. For some countries, in addition to the modeller's own IEDs, some modellers also provided the results using Perils' IED (PERILS, s.d.).

4.2. The 200-year RPL (Gross Loss) was modelled using commercial catastrophe models. In order to identify a final proposal for a single country factor the following process is carried out (referred to as the "mini-Delphi method"):

- Available models for a given scenario are run and the values calculated and collected. In those cases where models are not available for a given scenario expert judgement is provided, using publicly available or sharable proprietary information.
- The input values are then anonymized and circulated to the experts. The experts comment on the values and give a vote either to increase or to decrease the value further (or keep it as it is).
- A comparison and subsequent consolidation of recommendations are carried out and comments to a "dominant set" of proposals are provided and re-circulated to the experts.

4.3. The process is repeated until a single value was identified as the final proposal.

4.4. For the (re)assessment of risk zone weights, aggregation matrices and country correlations relevant models are determined and industry exposure data collected. The relevant model(s) are then run and a vector of raw risk zone weights and an aggregation matrix are generated. Experts comment on potential inconsistencies/peculiarities they discover when assessing the

[22] The Occurrence Exceedance Probability (OEP) is the probability that the largest loss in a year exceeds a certain amount of loss.

appropriateness of each parameter (set). Finally, experts receive the output of the previous step for final consistency checks.

HOW DOES A CATASTROPHE MODEL WORK?

4.5. As explained above, catastrophe models are a central part to assess the SF parameters for the NatCat module (see also Annex 4: Defining risk).

4.6. Catastrophe models are used to quantify the financial impact from a range of potential disasters, looking beyond limited historical loss data and using latest scientific research regarding current and near-term environmental conditions.

4.7. Basic components underpinning a probabilistic catastrophe model include hazard, vulnerability, exposure and financial. The first three components are based on the widely known concept of 'Risk Triangle' (NAIC, 2025). Depending on the source, these modules' names can slightly vary, but the underlying function of the modules remains the same.

Exposure data

- Portfolio data such as location-specific information (building's location along with type of material construction, occupancy, number of stories and age, insured values, insurance policy terms and conditions such as deductibles, limits)...

Hazard module

This module contains a large catalogue of simulated events representing a wide range of plausible scenarios. Event catalogue provides information on how frequently events of certain size are likely to occur, as well as the extent and severity of such events. Each event in the event catalogue is characterized by a specific strength or size, location, or path, and annual probability of occurrence.

Vulnerability Module

The vulnerability module quantifies the expected damage for the exposures from an event based on the building characteristics and local event intensity using vulnerability functions. These functions are essentially equations that are used to compute the expected damage for a given hazard intensity (such as windspeeds) based on characteristics (e.g., construction, building height) of the property.

Financial Module

In a first step, the financial module calculates the overall financial loss for each event scenario that the underlying exposure is exposed to. Insured loss estimates are generated based on policy conditions, such as deductibles, limits, attachment points as well as applicable reinsurance. The overall loss from all the event scenarios are combined to create a loss probability distribution. Loss distribution is used to derive expected losses as well as the likelihood of different loss levels.

HOW ARE ADAPTATION MEASURES REFLECTED IN CATASTROPHE MODELS?

4.8. As NatCat SF parameters are calibrated using catastrophe models, it is important to understand how these model capture adaptation measures. This can take place at multiple steps ([23]):

- **Hazard Modification**: Adaptation measures can alter the impact frequency or severity of the hazard at specific locations ([24]). For example, a sea wall might reduce the impact of storm surge, or improved forest management might reduce the severity of a wildfire. Models need to account for these modifications to have an accurate simulation in the hazard module.
- **Exposure description**: The parameters describing the properties and assets at risk can be adjusted to reflect the presence of adaptation measures.
- **Vulnerability Functions**: With adaptation measures in place, the vulnerability of assets may be reduced. Catastrophe models can incorporate these changes into their vulnerability functions. The description of the adaptation measures would be found in the exposure description.

WINDSTORM

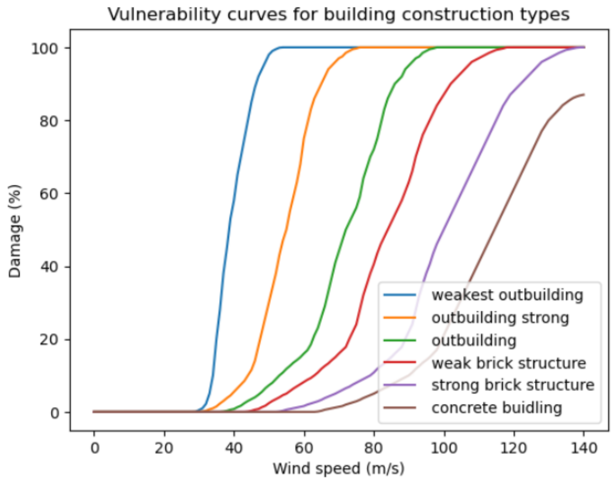
4.9. For windstorm it is generally not possible to change directly the area impacted by the hazard ([25]). Adaptation measures would be reflected in the exposure description and the associated vulnerability curves. For example, as shown in Figure 4, for a concrete building, winds of around 80m/s would cause less than 10% damage to the house. For a weak brick structure, the same wind speed would cause a 50% damage to the house.

[23] It is important to note that NatCat models are probabilistic, this means they not only model the impact of risk mitigation measures, but also the uncertainty around that performance. It is important to account for uncertainty.

[24] Or, in the context of the IPCC, the adaptation measures alter the exposed area. See Annex 4: Defining risk for details about these differences.

[25] But some initiatives could for example plan paths in cities where wind can more easily pass.

Figure 4 - Vulnerability curves for building construction types.

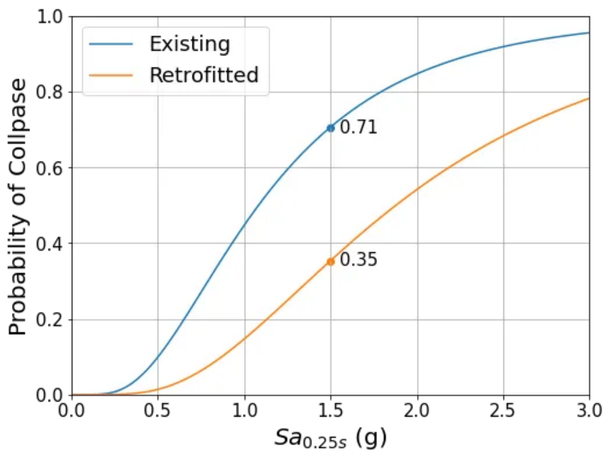


Source: based on Feuerstein et al. (2011)

EARTHQUAKE

4.10. For earthquake, it is not possible to modify the area impacted by the hazard directly ([26]). Adaptation measure would rather be reflected in the way buildings are built. The information about how buildings are built would be provided in the exposure data. The way buildings are built would influence the vulnerability function. For example, as shown in Figure 5, for the building which has been retrofitted, the damage is smaller for the same earthquake intensity.

Figure 5 - Fragility curve of an existing and retrofitted example building.

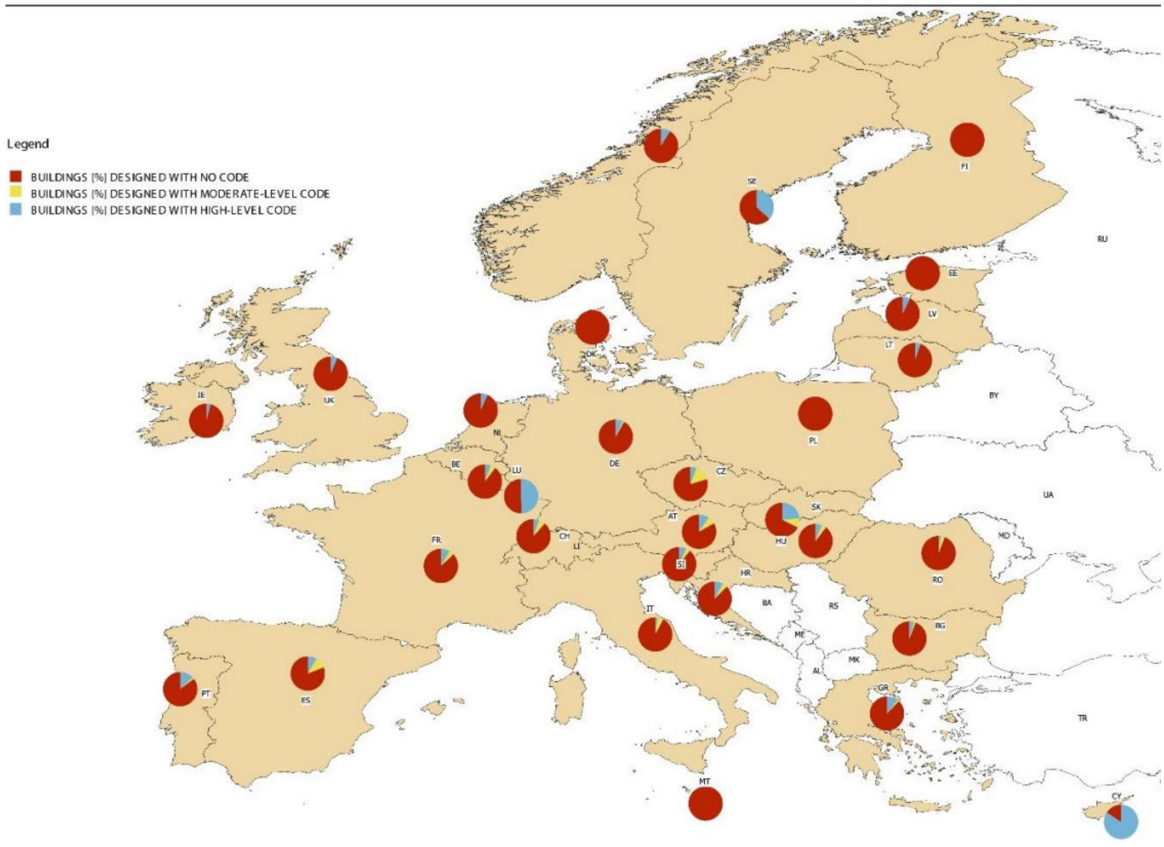


Source: Yi et al. (2020)

[26] It might be possible to modify local site conditions to diminish the risk of liquefaction.

4.11. For Europe, Figure 6 shows that the building stock is old and that the large majority of buildings across Europe was constructed before the date of entry into force of the first building codes with rules for seismic design. This will strongly impact the potential earthquake losses ([27]).

Figure 6 - Percentage of buildings designed without provisions for earthquake resistance and with moderate or high-level seismic code.



Source: Palermo et al. (2018)**.**

Note: Percentage of buildings designed without provisions for earthquake resistance (no code), moderate level and high-level seismic code. In some countries buildings are built with no code (shown in red) but this could be justified as there is minimal earthquake risk.

FLOOD

4.12. A number of prevention measures can be taken by policyholders to lower potential flood impacts (Hudson, Botzen, Feyen, & Aerts, 2016; Endendijk, et al., 2023). These measures fall into two categories (CIRIA, 2025):

- Resistance measures, which aim to prevent the ingress of water into the property (sometimes referred to as dry flood proofing);

[27] It is however important to note that in Europe not all countries have high earthquake risk so a high-level design of building code might not be relevant for all countries.

- Resilience measures, which aim to limit the potential damage once the water has entered a building (known as wet flood-proofing).

4.13. Preparedness measures can also be taken by governments / local authorities (e.g. physical permanent measures such as flood defences and polders; planned temporary measures such as demountable defences; and ad hoc measures such as sand bags) (The Flood Hub, 2019). Governments are usually responsible for permanent structures such as permanent flood defences, building codes, planning regulations ([28]).

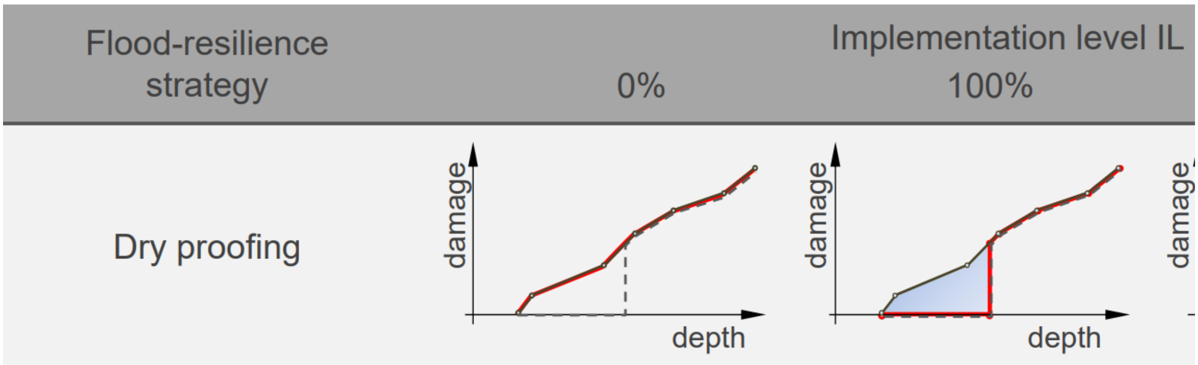
4.14. Flood models can reflect adaptation measures in a number of ways:

1. Micro: Adjustments to exposure descriptors and damage functions to reflect resilience and resistance measures such as flood barriers on doors, non-return valves, air brick covers, dry treatment, flood-resistant materials, and raised electrics.
2. Macro: Incorporation of flood prevention measures such as permanent physical flood defences, temporary barriers, flood management schemes and detention basins in the hazard module so as to account for changes to flood severity and frequency across a number of protected properties.

4.15. Finding information describing property-level measures in place, either in analysed portfolios or from external data sources, is a common limitation on the ability of flood models to account for such measures.

4.16. An illustrative example of damage reduction when dry flood-proofing has been implemented is shown in Figure 7. Each of these measures will have different costs (Aerts, 2018) and effectiveness.

Figure 7 - Damage as a function of flood depth.



Source: adapted from Schinke et al. (2016).

Note: Qualitative effects of the implementation level (IL) as damage dominating attributes depending on selected flood-resilience strategies. Continuous red line: weighted function result; Continuous grey line: implementation level 0%; Dashed grey line: implementation level 100%; Light-blue area: reduced damage as the effect of flood-resilience technologies.

[28] i.e. governments may define where properties may be constructed given flood risk.

HAIL (SCS)

4.17. In substance, this is the same issue like for wind, the exposed area to the hazard cannot be modified and adaptation measures need to act on vulnerability. This is 1) using more recent certified material, while being careful with recent energy efficient materials that are very damageable and 2) educate people, e.g. do close your shutters if a hailstorm is about to hit, or secure your garden values, etc.). For motor (e.g. presence of garages, or hail nets for manufactures or dealers) and agriculture (e.g. impact-resistant materials like reinforced glass or roofing for greenhouses), this is also relevant.

SUBSIDENCE

4.18. In France, on the hazard side, adaptation measures to address *Retrait-Gonflement des Argiles* (RGA) focus on evaluating the local characteristics, including slope, prior vegetation, and nearby water sources. Effective water management is essential, with regulated groundwater use, proper drainage systems like sealed gutters and peripheral drains to limit moisture fluctuations near foundations. Proper land use planning is needed to avoid overloading of vulnerable surfaces. Monitoring systems and geotechnical assessments also play a key role in identifying risk zones and informing long-term adaptation strategies.

4.19. Structural resilience (vulnerability) is enhanced by assessing foundation depth, building rigidity, and construction quality. Vegetation should be managed by maintaining safe distances or installing root barriers. Lastly, raising homeowner awareness and encouraging regular maintenance are key to preventing future damage.

COMMON PREVENTION MEASURES

Natural catastrophe models considers number of adaptation measures as shown in Table 2.

Table 2 - Examples of adaptation measures for different perils and the module where these are reflected.

Peril	Adaptation measures + short description	In which part of the model / module is it reflected
Flood	Permanent physical flood defences, temporary barriers, catchment management (macro measures).	Hazard module
Flood	Flood barriers, non-return valves, air brick covers, flood-resistant materials, dry treatment, and raised electrics (micro measures).	Vulnerability module
Wind	Shape and properties of roof, presence of chimney, types of wall cladding, proximity to trees (micro measures).	Vulnerability module
Hail	Shape and properties of roof, types of wall cladding, presence of solar panels etc. (micro measures). Motor: garages and hail nets (auto dealers).	Vulnerability module
Earthquake	Site effect modification, e.g. liquefaction (macro measures).	Hazard module
Earthquake	Enforcement of building codes, retrofit of existing buildings (micro measures).	Vulnerability module

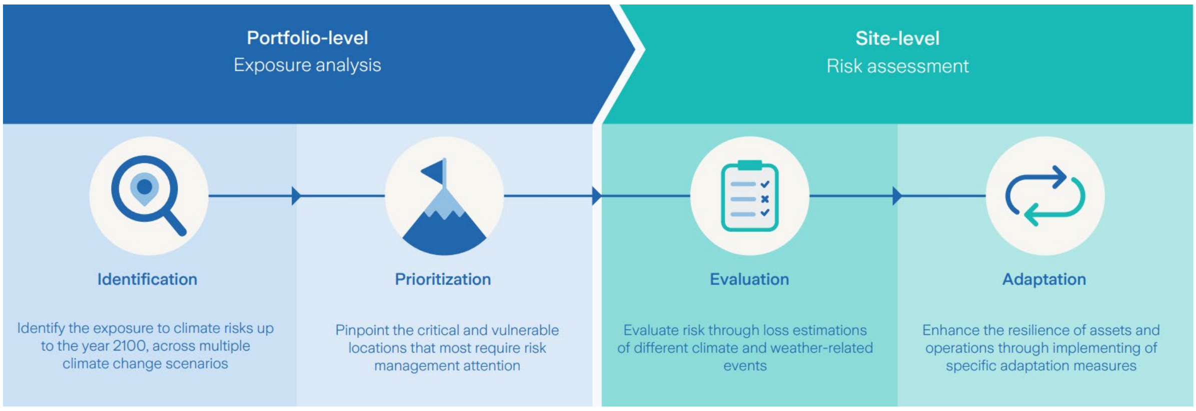
Adaptation measures considered by insurance sector/brokers

4.20. As mentioned above, a number of adaptation measures can be accounted for in catastrophe models. From the insurance sector perspective, the consideration of adaptation measures is under development. EIOPA observes that more focus is currently given to the consideration of adaptation in the insurance business.

4.21. A strategy on adaptation and resilience in the insurance industry which seems to emerge for customers is to warn and inform policyholder. For example, insurers are creating apps to send policyholders a warning message on mobile phone, mainly for hail, wind and flood events. In addition, tools are also created to provide interested individuals access to hazard information at their location of interest and download further information on major perils and ways to protect their property from negative impacts ([29]).

4.22. Commercial clients on the other hand can have properties which are multi location and often multinational. Insurers typically provides services which can be additional to the insurance cover and in-depth risk assessment are often required (see for example Figure 8). While such an in depth study is not possible for all contracts, more cost effective approaches could be taken which are beneficial to the policyholder e.g. taking into account adaptation measures by reducing the deductibles when a claim is submitted.

Figure 8 – Example of an Insurer's approach toward resilience for large commercial client.



Source: Zurich Resilience Solution ([30]).

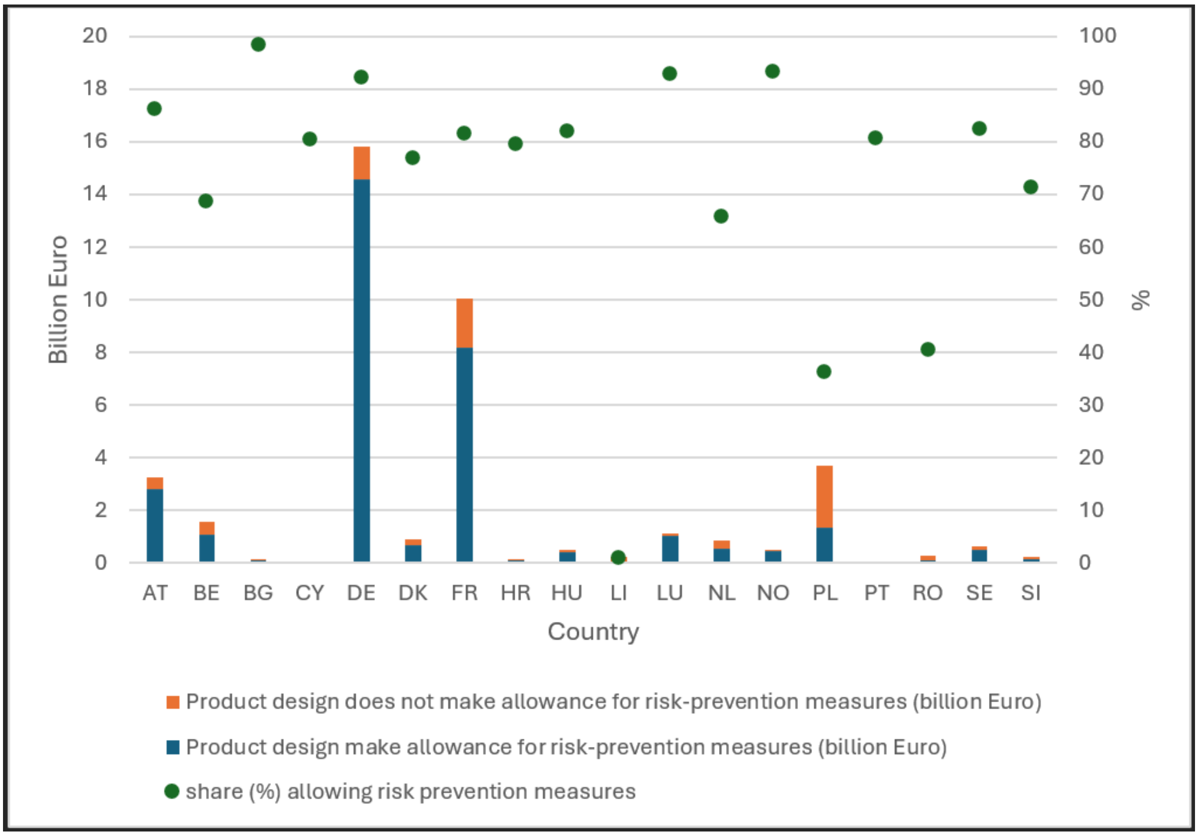
4.23. Assessment of available data ([31]) shows that for the vast majority (81%) of the amount of written premiums for natural catastrophe insurance (Figure 9), the product design make allowance for risk-prevention measures. It is however unclear which types of risk prevention measures are allowed and to which degree these are implemented, something that cannot be derived from the existing reporting.

[29] Allianz – presentation for EIOPA's Climate roundtable "Adaptation and Resilience in Insurance Industry Allianz Perspective".

[30] Zurich Resilience Solution – presentation for EIOPA's Climate roundtable "Creating a resilient future".

[31] Based on the assessment of the Quantitative Reporting Template (QRT) S.14.02.01 on non-life business – policy and customer information.

Figure 9 - Total amount of written premiums allowing or not for risk prevention measures.



Note: Based on QRT S.14.02.01 reporting, using Annual Solvency II reporting solo information. Data are available for 18 EU and EFTA countries. All non-life and composite undertakings were selected and for the lines of business 1) Fire and other damage to property insurance, 2) Marine, aviation and transport insurance, 3) Motor vehicle liability insurance and 4) Other motor insurance and the product category “Natural catastrophe insurance”. In addition to the countries in this figure, Malta and Iceland reported QRT S.14.02.01 data for 2023 but no records had the selected characteristics.

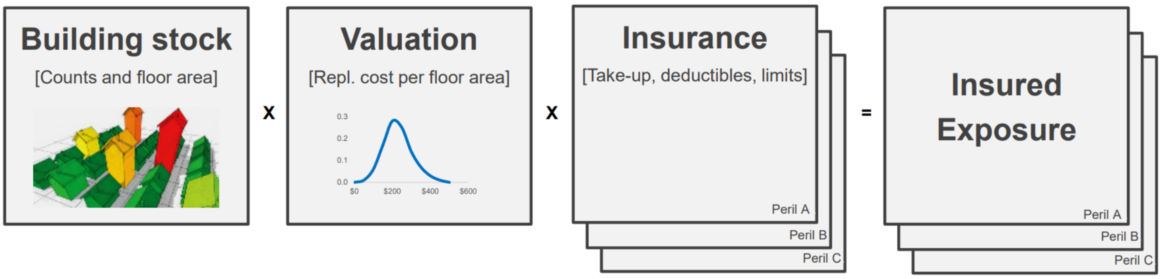
EXPOSURE DATA

4.24. Catastrophe models need information which describes the insured assets as input. This is called “exposure” data (see also Annex 4: Defining risk).

4.25. In the SF calibration process average IEDs are used by the modellers which could deviate from the portfolio of specific companies ([32]). The IED typically considers information such as location, building codes and standards, year of construction, value of the asset and occupancy and usage (Figure 10).

[32] This is consistent with the overall approach used in the SF as all elements of the calibration involve a level of averaging.

Figure 10 - Description of the elements considered in the Industry Exposure Database

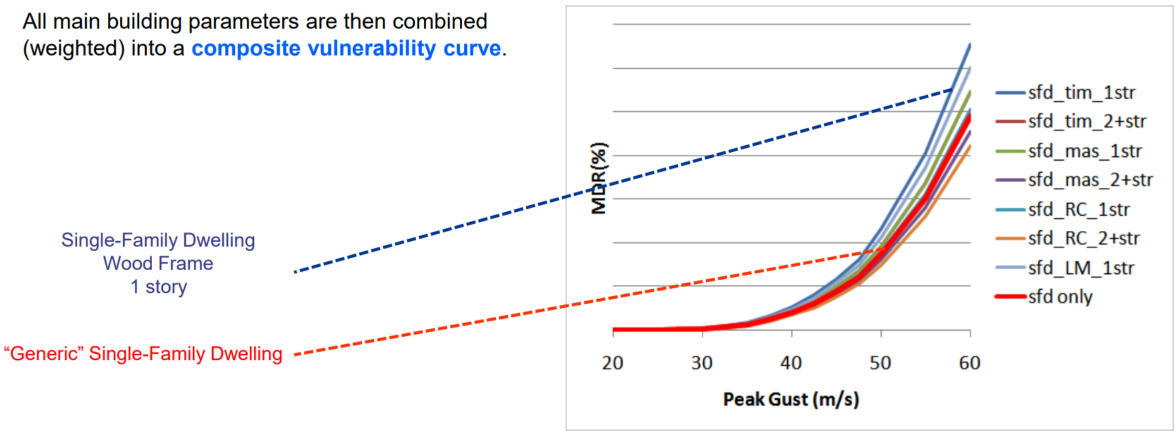


Source: Moody's.

4.26. For the calibration process of the SF, modellers would typically set the building characteristics to "unknown". If the building characteristic is set to unknown, the models are using building inventory, which assume an average mix of construction type typical for a certain region.

4.27. The average mix of building characteristics in a specific region is used to determine a so-called composite vulnerability curve which would be used in the modelling of the SF parameters (Figure 11).

Figure 11 - Composite vulnerability curve.



Source: Moody's.

Building codes

4.28. Building codes are used to describe the building characteristics (this is inferred via the "year built" information).

4.29. In Europe, building codes exist to mitigate the risks associated with various perils (see Annex 6: Building codes). Some of the key perils addressed by building codes in Europe and/or their national annexes include:

- Seismic activity (Earthquakes): Building codes in earthquake-prone areas, such as Greece, Italy, and Portugal, are designed to ensure that structures can withstand seismic forces and minimize damage.
- Wind: Building codes in coastal areas, such as the UK, Netherlands, and Denmark, address wind loads and ensure that structures can resist high winds, including those from storms and hurricanes. They include provisions for secure roofing and cladding.
- Floods: Building codes in flood-prone areas, such as the Netherlands, UK, and Germany, require structures to be designed and constructed to withstand flooding, including provisions for flood-resistant materials and construction techniques.
- Fire: Building codes across Europe address fire safety, including requirements for fire-resistant materials, fire alarms, and emergency evacuation routes.
- Snow loads: Building codes in countries with significant snowfall, such as Norway, Sweden, and Switzerland, ensure that structures can withstand snow loads and minimize the risk of collapse.

4.30. Examples of national building codes and standards that address these perils include:

- ΕΛΟΤ EN 1998-1 (Greece) defines seismic zones Z1, Z2, and Z3 (based on peak ground acceleration (PGA) thresholds), based on the Greek Seismic Code (EAK 2003);
- UNI EN 1998-1 (Italy), integrated into NTC 2018 (Norme Tecniche per le Costruzioni) for seismic hazard defined by PGA maps for different return periods;
- NEN-EN 1997-1 (Netherlands) focuses on hydraulic structures, polder systems, and dike safety and integrates with Dutch flood defence frameworks like the Water Safety Assessment Instrument;
- BS EN 1991-1-4 (UK) providing wind velocity maps depending on location and terrain, including altitude correction, directional factors, and seasonal adjustments;
- NEN-EN 1991-1-4 (Netherlands) defines basic wind velocity zones across the country and integrates with Dutch Building Code and flood defence standards;
- DS/EN 1991-1-4 (Denmark) specifies wind zones and design wind speeds for Danish regions, including orography and roughness factors for terrain modelling.

4.31. Note that building codes and standards can vary significantly between countries and regions, and this list is not exhaustive.

DISCUSSION

4.32. As discussed in the previous section, catastrophe models can reflect adaptation measures, but the extent of this can vary. Catastrophe models can capture adaptation measures at multiple steps, including hazard modification, exposure data or vulnerability module.

4.33. However, the reflection of adaptation measures in cat models is not always straightforward, and there are limitations and challenges to consider. For instance, for macro measures, it may not be possible to modify the hazard directly for windstorms or earthquakes. For flood, macro measures are reflected but it might also be challenging to have access to the data describing the flood defences. Micro adaptation measures need to be reflected in the exposure description and as well as in the associated vulnerability curves. Here also the access to the right data can be a challenge. Overall, while cat models can reflect adaptation measures, there is room for improvement in terms of capturing the impact of adaptation measures on natural catastrophe risks and also to ensure that the right data are collected to be able to reflect these measures.

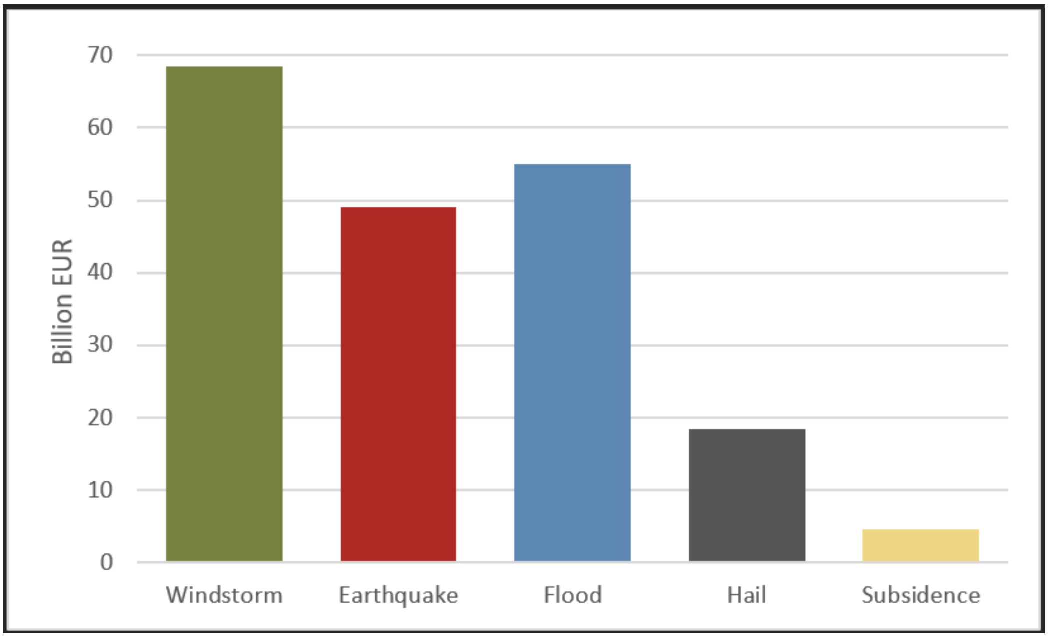
5. DISCUSSION OF MATERIALITY OF DIFFERENT PERIL/REGION IN THE SF

5.1. As mentioned in the introduction of this paper, certain adaptation measures are always relevant, for all regions, for all relevant perils that affect the region. However, in the context of the SF and this particular paper, a consideration is given in this section to discuss the materiality for specific perils/regions to consider specific adaptation considerations in the SF.

5.2. The aim of this section is to determine whether macro/micro adaptation measures should be considered/whether they are already considered and what countries should be considered for the application of adaptation measure consideration from a SF perspective.

5.3. The work hereafter focuses on the perils that have the greatest impact on the insurance sector. Since hail and subsidence affect relatively few(er) countries and contribute less to the total SCR (Figure 12), it is reasonable to exclude them and to focus on wind, earthquake and flood in this chapter.

Figure 12 - SCR before risk mitigation.



Note: based on QRT S.27.01 reporting Frequency Group Name Annual solo for reference year 2023, non-life and composite undertakings are selected, and for the Solvency II Capital Requirement non-life, health and non-similar to life techniques catastrophe risk, the 5 perils from the SF are selected: windstorm, earthquake, flood, hail and subsidence. Data are reported for 30 countries (EU-27 + EFTA). Based on C0010/R0020-R0060 SCR before risk mitigation – Natural catastrophe risk perils This is the total capital requirement before risk mitigation per natural catastrophe peril, taking into consideration the diversification effect between zones and regions. Per natural peril this amount is equal to the Catastrophe Risk Charge before risk mitigation.

WINDSTORM

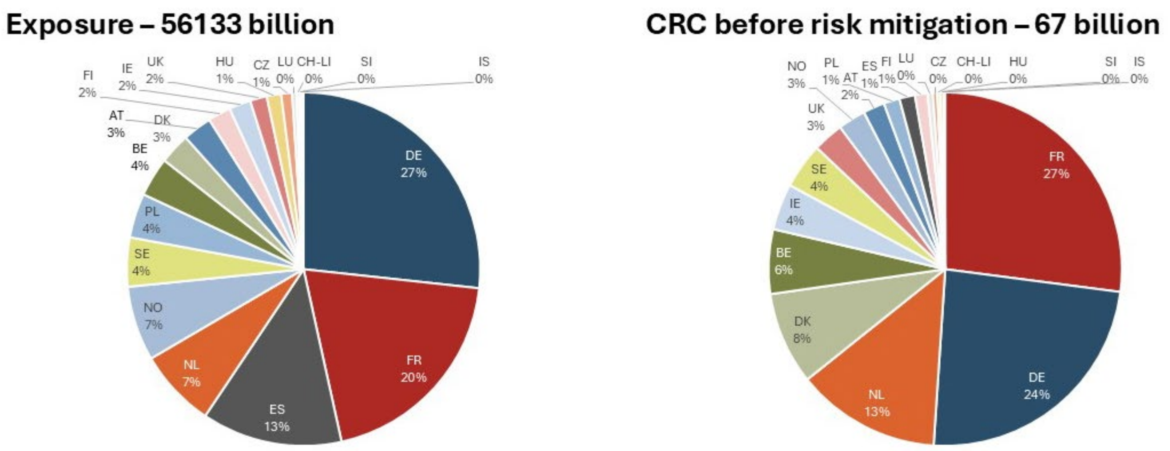
MACRO AND MICRO

5.4. As mentioned in Chapter 4 "How are adaptation measures reflected in catastrophe models? ", it is not possible/very common to modify the hazard module directly for windstorms. (Physical) Macro adaptation measures ([33]) for windstorms are therefore not reflected in the SF parameters.

5.5. Regarding micro measures, it might be of interest to consider the alignment with specific building codes of an insurer's portfolio. Indeed, the potential losses vary significantly depending on the construction type of a building.

DISCUSSION AT COUNTRY LEVEL FOR WINDSTORM RISKS

Figure 13 – Windstorm - Exposure and Catastrophe risk charge ([34]) before risk mitigation ([35]) - share by Country Natural Catastrophe Risk ([36])



Note: based on QRT S.27.01.02 (windstorm) reporting Frequency Group Name Annual Solo for reference year 2023, non-life and composite undertakings are selected. C0050 Exposure (EUR) and C0090 Catastrophe risk charge (CRC) before risk mitigation (EUR) are mapped per country (Natural catastrophe risk ID 6-21 recoded to ISO-2 letter country codes. Data are reported for EU-27 + EFTA + UK. In the assessment per Country Natural Catastrophe Risk, only those countries with a country factor for windstorm in the SF appear.

[33] For all perils, focus is on the physical measures, excluding governance and institutional measures like planning, technological measures like extreme weather warning tools and or measures focusing on awareness raising and behavioural change. Those are enabling adaptation measures but in the context of this paper out of scope due to their lower relevance for the SF and capital requirements in the insurance sector.

[34] Catastrophe Risk Charge (CRC), as reported in the QRT S.27.01.02-S.27.01.06 and refers to the NatCat specific SCR.

[35] meaning it assumes "no reinsurance or other risk transfer mechanisms" have been applied yet.

[36] The exposure as well as the catastrophe risk charge before risk mitigation are calculated based on the location of the risk. These templates in S.27.01 specifically allow summarising the information per country where the risk takes place instead of the country where the physical risk takes place.

5.6. In Annex 7 is a discussion on potential relevance of the reflection in the SF of micro measures for windstorm for each country ([37])(Table 9). The analysis was made considering the exposure, the resulting SCR ([38]), the country factor, the relevance of the peril for a specific country and other elements such as national schemes in place or current developments.

Questions to stakeholders:

Q1a: Do you have any comments about the discussion for windstorm? (yes/no)

Q1b: Please explain.

EARTHQUAKE

MACRO AND MICRO

5.7. As mentioned in Chapter 4, it is not possible/very common to the exposed area directly for earthquakes in the hazard module of a cat model. Macro adaptation measures for earthquake are therefore not reflected in the SF parameters.

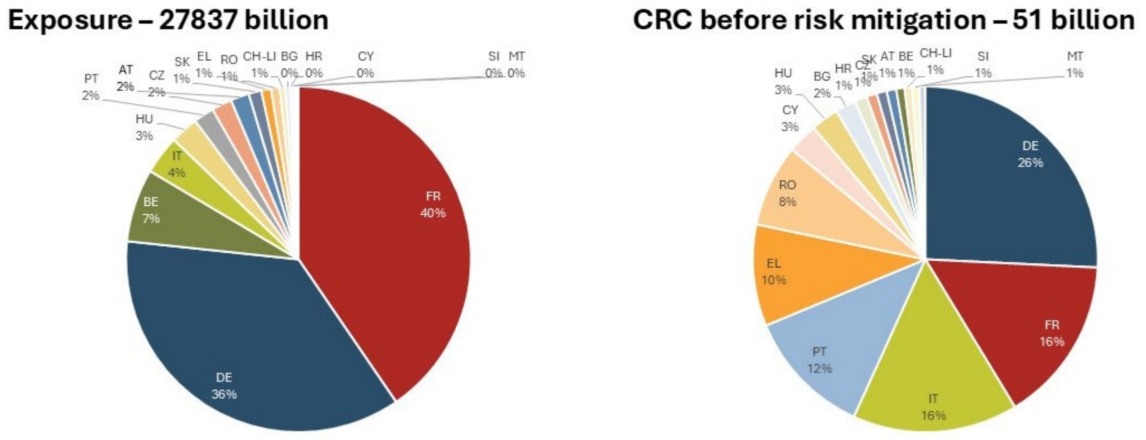
5.8. Regarding micro measures, it might be of interest to consider the building type coding of an insurer’s portfolio (which would be described in the exposure data). Indeed, the potential losses vary significantly depending on the construction type of a building.

[37] Adaptation measures are always relevant but here countries are prioritised from a SF perspective.

[38] Specifically, *C0090/R0400– R0590 Catastrophe Risk Charge before risk mitigation — specified Region Capital requirement before risk mitigation arising from Windstorm for each of the 23 specified Regions corresponding to the larger of scenario A or B* is used in the figures as this is how the reporting fields are named in QRT S.27.01.02. However, as capital requirement is more common term than catastrophe risk charge, SCR is used as a synonym for CRC in the discussion in this section.

DISCUSSION AT COUNTRY LEVEL FOR EARTHQUAKE RISKS

Figure 14 - Earthquake - Exposure and Catastrophe Risk Charge before risk mitigation - share by Country Natural Catastrophe Risk



Note: based on QRT S.27.01.03 (earthquake) reporting for Frequency Group Name Annual Solo for reference year 2023, non-life and composite undertakings are selected. C0140 Exposure (EUR) and C0170 Catastrophe risk charge (CRC) before risk mitigation (EUR) are mapped per Country Natural Catastrophe Risk (Natural catastrophe risk ID 49-65 and 175, recoded to ISO-2 letter country codes. Data are reported for EU-27 + EFTA. In the assessment per Country Natural Catastrophe Risk, only those countries with a country factor for windstorm in the SF appear.

5.9. In Annex 7 is a discussion on potential relevance of the reflection in the SF of micro measures for earthquake for each country (Table 10). The analysis was made considering the exposure, the resulting SCR ([39]), the country factor, the relevance of the peril for a specific country and other elements such as national schemes in place or current developments.

Questions to stakeholders:

Q2a: Do you have any comments about the discussion for earthquake? (yes/no)

Q2b: Please explain.

[39] Specifically, *C0170/R0830– R1020 Catastrophe Risk Charge before risk mitigation — specified Region Capital requirement before risk mitigation arising from earthquakes in each of the 20 specified Regions* is used in the figures as this is how the reporting fields are named in QRT S.27.01.03. However, as capital requirement is more common term than catastrophe risk charge, SCR is used as a synonym for CRC in the discussion in this section.

FLOOD

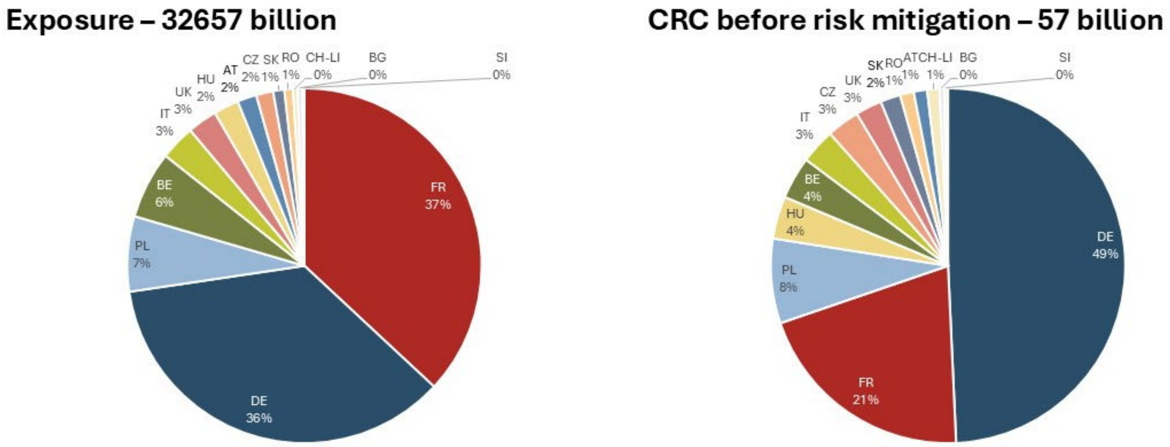
MACRO AND MICRO

5.10. For flood, the hazard can be significantly impacted by infrastructure, such as having flood defences, its level of maintenance, and by water management strategies. It is therefore important to ensure that the macro prevention measures in place are well reflected in the models used to calibrate the SF.

5.11. As discussed in Chapter 4, for flood, it is also possible to take micro adaptation measures which would decrease the potential flood risk (such as flood barriers for example).

DISCUSSION AT COUNTRY LEVEL FOR FLOOD RISKS

Figure 15 - Flood - Exposure and Catastrophe risk charge before risk mitigation - share by Country Natural Catastrophe Risk



Note: based on QRT S.27.01.04 (flood) reporting for Frequency Group Name Annual Solo for reference year 2023, non-life and composite undertakings are selected. C0220 Exposure (EUR) and C0260 Catastrophe risk charge (CRC) before risk mitigation (EUR) are mapped per country (Natural catastrophe risk ID 92-105 and 176, recoded to ISO-2 letter country codes. Data are reported for EU-27 + EFTA. In the assessment per Country Natural Catastrophe Risk, only those countries with a country factor for windstorm in the SF appear.

5.12. In Annex 7 is a discussion on potential relevance of the reflection in the SF of micro measures for flood for each country ([40]) (Table 11). The analysis was made considering the exposure, the resulting SCR ([41]), the country factor, the relevance of the peril for a specific country and other elements such as national schemes in place or current developments.

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[40] Adaptation measures are always relevant but here countries are prioritised from a SF perspective.

[41] Specifically, *C0260/R1260– R1390 Catastrophe Risk Charge before risk mitigation – specified Region Capital requirement before risk mitigation arising from Floods in each of the 14 specified Regions, corresponding to the larger of scenario A or B* is used in the figures as this is how the reporting fields are named in QRT S.27.01.03. However, as capital requirement is more common term than catastrophe risk charge, SCR is used as a synonym for CRC in the discussion in this section.

Questions to stakeholders:

Q3a: Do you have any comments about the discussion for floods? (yes/no)

Q3b: Please explain.

6. DISCUSSION ON A DEDICATED TREATMENT ON ADAPTATION

6.1. This chapter assesses the challenges and opportunities of reflecting adaptation measures into the SII SF considering different options.

OPTIONS WHERE THE PRUDENTIAL FRAMEWORK COULD BE MODIFIED TO BETTER REFLECT ADAPTATION MEASURES

OPTION A: EXPLICITLY CONSIDER ADAPTATION IN THE REGULAR (RE)ASSESSMENT/RECALIBRATION OF THE SF

6.2. EIOPA has a mandate to perform regular (re)assessment of the NatCat parameters of the SF. In the regular exercise, it would be possible for EIOPA to add a specific step in the (re)assessment exercise to better reflect adaptation measures.

6.3. What would these step be?

- Ensure that macro measures are properly accounted for in the cat models.
- Ensure that the exposure data used in the (re)assessment exercise are up to date to reflect the latest (or regularly updated) status of the building stock to account for micro measures.
- Propose an expert judgement view – for example working together with EIOPA's network on catastrophe risks - on the estimated parameters if the two points above cannot be achieved.

Pros and cons

Pros	Cons
- Process already exists and could include these questions/requests. - Less need for USPs/(P)IMs for individual insurance companies to reflect adaptation since it is automatically included in the SF. - Adaptation would be reflected for all.	- (Re)assessment/recalibration process might be too late for modellers to be able to better reflect adaptation measures adequately. - Could add volatility in the SF parameters. - incentive to perform well on adaptation as SF country factors are the same for all insurance companies in a geographical area might not work well to reflect micro measures.

Questions to stakeholders:

Q4a: Do you think that considering adaptation in the reassessment process is a valuable option? (yes/no)

Q4b: Which other pros do you see from this option? Please explain.

Q4c: Which other cons do you see from this option? Please explain.

OPTION B: USE SF UNDERTAKING SPECIFIC PARAMETERS (USP) TO REFLECT ADAPTATION MEASURES

6.4. For certain submodules and specific risk factors the SF can be replaced by USPs which are estimated with undertaking-specific data. The application of USP in the SF calculation requires a prior supervisory approval by the corresponding national supervisory authority.

6.5. The potential use of USP is currently limited to some underwriting risk modules in the SF, including the non-life premium and reserve risk, the Non-Similar to Life Techniques (NSLT) premium and reserve risk module and the life revision risk submodule.

6.6. Most USP applications relate to the Non-Life and NSLT premium and reserve risk modules. Thus, the following considerations mainly relate to USP application for the premium and reserve risk module. Undertakings aiming for an USP application for the premium and reserve risk module need to specify which of the parameters of Art. 218-220 Delegated Regulation (EU, 2015) they want to replace with their USP application. While for the premium risk undertakings can choose between three parameters, for the reserve risk submodule only one parameter can be replaced. More specifically the undertakings need to specify if they want to apply USP for both premium and reserve risk, or just one type of risk and for what segments in Annex II and Annex XIV they want to apply USP.

6.7. The methodologies to estimate the USP parameters are specified in EU (2015), for the premium and reserve risk submodule ([42]) the methodologies are included in Annex XVII. It is worthwhile to emphasize that the undertakings cannot apply other than the specified set of methodologies in the Delegated Regulation. Moreover, it is important to note that the USP methodologies are exactly the same methodologies that have been used in the calibration of the corresponding SF parameters. For the premium risk there is exactly one methodology for each subset of parameters, while for the reserve risk undertakings are allowed to choose between two methodologies. For reserve risk they need to demonstrate that they are using the more appropriate methodology.

[42] if insurers are already allowing for adaptation measures then they will have lower premiums and claims and implicitly therefore have a lower capital charge. So, a further adaptation parameter would be a double count.

6.8. From an economic and actuarial perspective, the USP application enables undertakings to calculate the volatility of the economic best estimate combined ratio (premium risk) and/or the volatility of the economic best estimate runoff ratio (reserve risk) using undertaking-specific data. The overall premium and reserve risk charge after USP is calculated by including the estimated USP, the undertaking-specific volume measures (earned premiums for premium risk and net claims provision for reserve risk) and other parameters following the formula-based calculation from Art. 116 and Art. 147 respectively (EU, 2015).

USP for NatCat risk

6.9. What could USP for NatCat risks look like and could they help to better account for adaptation measures? To answer to this question, we could follow what define USP.

Subset of NatCat standard parameters

6.10. We need first to define the subset of NatCat standard parameters that may be replaced by USP. Looking at the NatCat SF in Art. 121 to 125 ([43]) of the Delegated regulation (EU, 2015), the parameters used in the formulas are:

1. $W_{(\text{NatCat risk}, r,i)}$: the risk weight for NatCat risk in risk zone i of region r
2. $Q_{(\text{NatCat}, r)}$: the NatCat risk factor for region r

6.11. Those risk factors are specific for the regions set out in the annexes of the Delegated Regulation (EU, 2015) and all risk zones of those regions ([44]).

Data criteria

6.12. Data used to calculate undertaking-specific parameters shall only be considered to be complete, accurate and appropriate where they satisfy to the criteria set out in Art. 219 of EU (2015). The regulation also allows under certain conditions to use external data. Specific data criteria may be developed to ensure the completeness, accuracy and appropriateness of the data used for the NatCat parameters.

Standardised methods to calculate the USP.

6.13. Where insurance and reinsurance undertakings calculate USP they shall use, for each parameter, the standardised methods define in EU (2015).

[43] 121 – Windstorm Risk Sub-Module, 122 – Earthquake Risk Sub-Module, 123 – Flood Risk Sub-Module, 124 – Hail Risk Sub-Module, 125 – Subsidence Risk Sub-Module

[44] Annex V for windstorm; Annex VI for earthquake, Annex VII for flood, Annex VIII for hail and Annex X for risk weights for catastrophe risk zones.

Pros and cons

Pros	Cons
- Incentivize adaptation as undertakings can reflect own portfolio. - Push to improve the availability of better data to reflect adaptation measures. - Insurers already select risks today. E.g. they could for example improve the risk of their motor portfolios by increasing premiums of riskier drivers, when profitability of the as a whole is jeopardised. Adding the possibility to better reflect adaptation measures could ensure that the risks are not "simply" taken out of a portfolio but that other options are considered to mitigate the risk.	- It might be difficult for undertakings to have the data, and this would require insurers to be certain that the measures are implemented. - The calibration of the NatCat parameters for the SF used the mini-Delphi method based on the results of the different NatCat models available for a certain region. It is not a simple formula to apply but instead use modelling techniques. - There is a risk of selection by the insurers of the more protected houses only, excluding less protected and more exposed houses from insurance, and increasing protection gap. A decrease in the risk might come from an exclusion policy put in place by the insurer.

Questions to stakeholders:

Q5a: Do you think that considering USP to better reflect adaptation measures is a valuable option? (yes/no)

Q5b: Which other pros do you see from this option? Please explain.

Q5c: Which other cons do you see from this option? Please explain.

OPTION C: USE THE RISK MITIGATION IN SOLVENCY II TO REFLECT ADAPTATION MEASURES

6.14. The objective of adaptation measures is to mitigate underwriting risks. The question in place is if adaptation measures can be considered as having an impact equivalent to a risk-mitigation technique.

6.15. The SII framework considers in general the term risk-mitigation techniques for all risk-transfer instruments whose risk-mitigating effect can potentially be recognized in the SCR calculation of the SF. For underwriting risk, the main risk mitigation technique are reinsurance arrangements. In order to recognize the risk-mitigation impact in the SF risk-mitigation techniques need to satisfy the qualitative requirements in Art. 208-215 (EU, 2015). The criteria particularly include requirements concerning effective risk transfer including no material basis risks, credit quality (rating) or SCR requirements for reinsurers etc. Moreover, only those risk-mitigation techniques can be recognized, which are captured under the counterparty default risk of the SF. If one of the conditions on risk-mitigation techniques is not sufficiently satisfied, the risk mitigating effect of a risk-mitigation technique cannot be recognized in the SCR calculation.

6.16. Although adaptation measures and risk mitigation in the SII context might have in common that they intend to reduce risk from an insurer portfolio perspective ([45]), it is important to note that adaptation measures are in general structurally different from risk-mitigation techniques. An adaptation measure does not transfer risk – it eliminates/reduces risk for everyone.

Pros and cons

Pros	**Cons**
- Adaptation measures and "risk mitigation techniques" (SII context) might have in common that they intend to reduce risk from an insurer portfolio perspective.	- Risk mitigation in the SF corresponds to mitigation through reinsurance. Reinsurance keeps the risk as it is, it is just carried by someone else. But as such, the risk is still the same while adaptation measures do actually change the risk.

Questions to stakeholders:

Q6a: Do you think that considering Risk Mitigation to better reflect adaptation in the SF is a valuable option? (yes/no)

Q6b: Which other pros do you see from this option? Please explain.

Q6c: Which other cons do you see from this option? Please explain.

OPTION D: ADD NEW PARAMETERS IN THE SF PARAMETERS

6.17. It could be possible for the country factor in the SF to be updated to reflect a changing risk profile; for example, the factor for earthquake could be adapted if a portfolio had a higher

[45] SII risk mitigation refers to reinsurance. Reinsurance keeps the risk as it is, it is just carried by someone else who has benefits from diversification and the ceding insurer gets more counterparty risk. But as such, the risk is still the same while adaptation measures do actually change the risk.

proportion of buildings designed with high-level code than the proportion considered in the calibration of the SF parameters. For example, a parameters "Adaptation_factor" could be added as shown in the equation below which would be calibrated by EIOPA as currently done for the other SII parameters. This factor would be equal to 1 by default. If an insurer's portfolio is "better"[46] than the average portfolio used to calibrate the parameters, it could be possible use a lower "Adaptation_factor" (Figure 16) which would be pre-defined in the SII parameters. Consideration should include where the portfolio of the insurer is significantly worse than the average portfolio used to calibrate the SF parameters. In that case, an increase in the "Adaptation_factor" would be required.

Figure 16 - Adaptation factor.

$$L_{(earthquake,r)} = Adaptation\_factor * Q_{(earthquake,r)} \sqrt{\sum_{(i,j)} Corr_{(earthquake,r,i,j)} WSI_{(earthquake,r,i)} WSI_{earthquake,r,j)}}$$

6.18. The practice to have different factors based on adaptation measures has been already applied but mainly on defining the premiums and not the capital requirement ([47]) (both are risk-based).

Example from the Turkish Catastrophe Insurance Pool

6.19. To calculate the earthquake premium, the insurance amount (guarantee amount), which determines the highest limit received after the earthquake is needed. The premium is equal to the guaranteed amount multiplied by the tariff. There are 14 tariffs determined based on seven risk groups and two different building types (DASK, s.d.).

Table 3 - Tariffs depending on building characteristics and earthquake risk zone.

Ratios on a regional basis by type of building (‰)	1st group	2nd group	3rd group	4th group	5th group	6th group	7th group
A - reinforced concrete	2,56	2,28	1,94	1,82	1,32	0,97	0,66
B - Other	4,51	3,86	3,39	3,17	2,54	1,69	0,99

Source: DASK (s.d.)

[46] For example, if an insurer has many building with high-level design building codes.

[47] Note that the input data for the SF in the NatCat module in scope are sum insured so there is no issue of double counting.

Note: Earthquake risk groups are determined using the Turkey Earthquake Zones Map, ground conditions and building characteristics and are published on the Turkish Catastrophe Insurance Pool's website.
The definition of the building characteristics specified in the above tariff is as follows:
A - Reinforced concrete: These structures use steel or reinforced concrete structures;
B - Other: They are structures that do not fall into the above groups.

Example on premium discounts for covered properties with documented windstorm mitigation

6.20. In 2005, the Florida legislature passed a law requiring all residential property insurance companies to file with the Office of Insurance Regulation (Office) a range of premium discounts they offer to customers who live in homes of certain construction types or who apply loss mitigation devices (like shutters) to their homes (FLOIR, 2025).

6.21. In December 2006, the Office required all property insurers to provide to the Office higher discounts in their insurance rates for policyholders who had recognized loss mitigation devices on their homes. The Rule requires insurers to send a list of those discounts (FLOIR, 2025).

Table 4 - Example of windstorm loss reduction credit depending on the adaptation measure

WINDSTORM LOSS REDUCTION CREDITS SECTION 627.0629(1), F.S. WIND PREMIUM CREDITS FOR EXISTING CONSTRUCTION – SINGLE FAMILY HOMES											
				TERRIAN B – 2% DEDUCTIBLE				TERRIAN C – 2% DEDUCTIBLE			
				FRAME, MASONRY, OR REINFORCED MASONRY							
				ROOF SHAPE				ROOF SHAPE			
				OTHER		HIP		OTHER		HIP	
ROOF COVER	ROOF DECK ATTACHMENT	ROOF-WALL CONNECTION	OPENING PROTECTION	NO SWR	SWR	NO SWR	SWR	NO SWR	SWR	NO SWR	SWR
			None	0.00	0.06	0.47	0.50	0.00	0.07	0.28	0.32
		TOE NAILS	Basic – Windows or All	0.35	0.42	0.62	0.65	0.29	0.38	0.56	0.62
			Hurricane – Windows or All	0.44	0.51	0.66	0.70	0.39	0.48	0.64	0.72
			None	0.35	0.42	0.62	0.66	0.18	0.26	0.44	0.51
		CLIPS	Basic – Windows or All	0.47	0.54	0.68	0.73	0.38	0.48	0.64	0.72
NON - FBC	A		Hurricane – Windows or All	0.50	0.57	0.70	0.74	0.44	0.54	0.68	0.76
EQUIVALENT	(6d @ 6" / 12")		None	0.35	0.43	0.62	0.67	0.20	0.28	0.45	0.51
		SINGLE WRAPS	Basic – Windows or All	0.47	0.55	0.68	0.73	0.39	0.49	0.64	0.72
			Hurricane – Windows or All	0.50	0.58	0.70	0.74	0.44	0.54	0.68	0.76
			None	0.35	0.43	0.62	0.66	0.21	0.28	0.45	0.51
		DOUBLE WRAPS	Basic – Windows or All	0.47	0.55	0.68	0.73	0.39	0.49	0.64	0.72
			Hurricane – Windows or All	0.50	0.58	0.70	0.74	0.44	0.54	0.68	0.76

Source: THIG (2025).

Pros and cons

Pros	Cons
- Give reward and incentivize the recognition of adaptation measures. - Motivation to calculate premiums more accurately which would be fairer for the customers since the premium is mainly risk-based. Companies who are early adopters of this method may also be able to be more profitable since they could offer a lower premium to "better" (= generate less claims) customers.	- Challenging to calculate the adaptation factor; adding risk mitigation factors would require insurers to be certain that the policyholders implement concrete prevention measures. - It might be hard to keep up and include all adaptation measures as quickly as the insurance companies would like which might generate a lot of discussion. - Many insurance companies may not get detailed enough data so even if they want

- Push to improve the availability of better data to reflect adaptation measures. - capital charges reductions driven by climate related adaptation measures, which should reduce frequency and intensity of claims. - As based on a risk-based principle, where risks are reduced or effectively transferred, a capital benefit should be obtained. However, no regime explicitly recognizes how pre-emptive measures can be considered as risk mitigation techniques, and standardized approaches setting capital requirements for underwriting risks lack the appropriate level of granularity to recognize that where adaptation measures (pre-emption) have been taken, there is a reduction of risk. - Push to improve the availability of better data to reflect adaptation measures. - capital charges reductions driven by climate related adaptation measures, which should reduce frequency and intensity of claims. - As based on a risk-based principle, where risks are reduced or effectively transferred, a capital benefit should be obtained. However, no regime explicitly recognizes how pre-emptive measures can be considered as risk mitigation techniques, and standardized approaches setting capital requirements for underwriting risks lack the appropriate level of granularity to recognize that where adaptation measures (pre-emption) have been taken, there is a reduction of risk.	to do this, they may not be able to, at least not to begin with. - Would need to get access to the average inventory mix used by the model vendors which is currently not disclosed. - Comparing the level of adaptation measures to the “average” portfolio might be ineffective and inappropriate. The differences in the level of risk between the two portfolios could result in other factors than adaptation measures. - There is a risk of selection by the insurers of the more protected houses only, excluding less protected and more exposed houses from insurance, and increasing protection gap. - In a risk-based and personalized approach, wider characteristics than only specific NatCat adaptation measures would have to be taken into account. Indeed, other parameters, such as “primary components” (e.g., buildings age and materials) may have more impact than secondary components and are also taken into account (by default) on average.

Questions to stakeholders:

Q7a: Do you think that considering new parameters to better reflect adaptation measures is a valuable option? (yes/no)

Q7b: Which other pros do you see from this option? Please explain.

Q7c: Which other cons do you see from this option? Please explain.

OPTION E: CONSIDER HOW ADAPTATION MEASURES ARE REFLECTED IN INTERNAL MODELS

6.22. The options above (A-D) consider changes related to the SF. In addition to these options, consideration could also be given to Internal Models (IM) or Partial Internal Models (PIM). Companies can also use IM or PIM to assess their SCR. They are complex, company-specific models that aim to replicate the insurer's risk profile, business lines, and management strategies and calculate the capital needed to cover potential losses.

How well are prevention measures captured in IM or PIM?

6.23. For calculating natural catastrophe risks, IM typically use outputs from catastrophe models. From a macro measure perspective, similar points as discussed in Chapter 4 “How are adaptation measures reflected in catastrophe models? “How are adaptation measures reflected in catastrophe models?” should be considered. This would also require undertakings to ensure a proper understanding of the insured properties with regard to micro adaptation measures.

Pros and cons

Pros	Cons
- In theory, a wide range of adaptation measures can be reflected in the (P)IM. - Companies can also adjust commercial cat models if they feel that adaptation measures are not adequately reflected. - Give reward and incentivize the recognition of adaptation measures. - Motivation to calculate premiums more accurately which would be fairer for the customers since they should pay premium based on their risk. Companies who are early adopters of this method may also be able to be more profitable since they could	- IM/PIM require resource. - Undertakings might not have sufficient information/details on the insured properties to describe the adaptation measures. Plus, this would require insurers to be certain that the policyholders implement concrete prevention measures. - There is a risk of selection by the insurers of the more protected houses only, excluding less protected and more exposed houses from insurance, and increasing protection gap. A decrease in the risk might come from an exclusion policy put in place by the insurer.

offer a lower premium to “better” (= generate less claims) customers. - Push to improve the availability of better data to reflect adaptation measures.	- Not all cat models necessarily capture sufficiently the macro measures. - Not easy to reflect adaptation changes on top of existing commercial models.

Questions to stakeholders:

Q8a: Do you agree that considering IM to better capture adaptation measures is a valuable option? (yes/no)

Q8b: Which other pros do you see from this option? Please explain.

Q8c: Which other cons do you see from this option? Please explain.

Q9a: Do you see other valuable options to better capture adaptation measures? (yes/no)

Q9b: Please explain.

7. ASSESSMENT OF FURTHER DEVELOPMENT OF ADAPTATION MEASURES

7.1. This section analyses the sensitivity of the NatCat SF parameters to various adaptation measures on top of what would be currently captured in the SF. Using the commercial catastrophe models described in Chapter 4, we compared the outcomes of these models accounting for adaptation measures to assess the sensitivity of the county factors for different perils and countries. The perils and countries considered in this section were selected based on the assessment presented in Chapter 5 and Annex 7, which identified specific regions and perils that may require tailored adaptation considerations in the SF.

WINDSTORM

MICRO

7.2. In the USA, analyses were looking at the impact of adaptation measures. For example, by comparing different standard, two-story, single-family homes near the south Florida Coast – one constructed in the early 1990s and the other constructed in 2022 – clear differences emerge in expected extreme wind damages between the two homes ([48]). Notably, building codes between the 1990s and present day have progressed to include advanced construction techniques and materials to enhance wind resistance. More recently, Florida building codes have placed greater emphasis on the use of impact-resistant windows, reinforced doors, enhanced roof coverings, and stronger connections between structural elements, such as hurricane straps or clips. These new construction adaptations lower expected hurricane damage costs associated with intense winds and are effective at reducing Average Annual Damage, as shown in Table 5.

[48] Windstorm risk in Florida means Hurricanes (Tropical Cyclones). This is not the case for Europe (except for some French overseas departments and territories), where Windstorm risk derives from extra tropical storms, which are different in nature and in their effects. The benefits of adaptation measures could be different if calculated for extra tropical storms.

Table 5 - Present Day Wind Derived Average Annual Damage

Building Code Era	
1990s	2022
$28,448	$4,603

Source: Moody's (2023).

7.3. Considering the scope of this paper which is on EEA countries, the modellers could unfortunately not provide an assessment for windstorm due to the lack of detailed information in the exposure data which could describe adaptation measures for windstorms.

Questions to stakeholders:

Q10a: Do you have any comments on the assessment of micro adaptation measures for windstorm? (yes/no)

Q10b: Please explain.

EARTHQUAKE

MICRO

7.4. A recent study by the Pacific Earthquake Engineering Research Center estimated potential savings of $10,000 to $200,000 or more after a major earthquake depending on factors like the construction material, number of stories, exterior siding type, or how near a house is to the earthquake fault. That is as much as 20-40% of the replacement value of many California homes (PEER, 2020; CRMP, s.d.).

7.5. For this paper, the catastrophes models were run for three countries (Greece, Cyprus and Italy) (Annex 7). Two different level of prevention measures were assumed:

- Year built considered as 2024 for all exposures – which means that all buildings have the latest earthquake mitigation standards in place.
- buildings constructed according to low seismic design codes are reinforced to meet moderate code standards, and those built to moderate codes are upgraded to high code standards. This approach acknowledges budget constraints and the practical challenges of retrofitting large numbers of buildings.

7.6. The first approach provided the most significant decreases in the related country factors for all three considered countries. The impact of retrofitted houses is significant and can allow for a decrease in the country factor of up to 80% (comparing the output of a cat model using average exposure parameters which is used to calibrate the SF and improved adaptation measures as described in the two scenarios). For both options, Italy was the country with the most significant decrease in country factor.

Questions to stakeholders:

Q11a: Do you have any comments on the assessment of micro adaptation measures for earthquake? (yes/no)

Q11b: Please explain.

FLOOD

MACRO

7.7. In the past model vendors have performed analyses on the impact of micro adaptation measures on flood risks (see also Annex in EIOPA (2024). These specific case studies show the impact of macro flood measures on the flood risk.

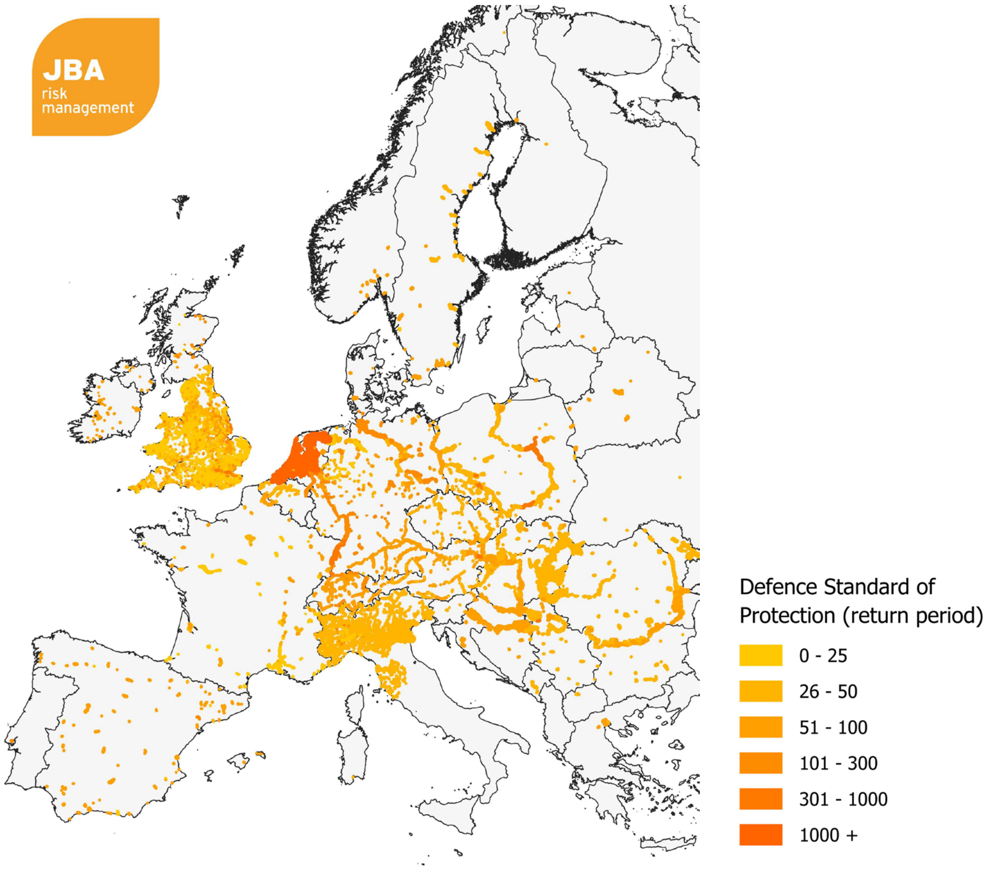
7.8. For example, Verisk analysed flood risk reduction across 1006 postal codes in western Germany impacted by the July 2021 floods. Two mitigation scenarios were tested: increasing protection return periods by 25% and implementing a 200-year minimum standard. Scenario 1 yielded up to 15% local risk reduction and 6% overall average annual loss (AAL) decrease; Scenario 2 achieved up to 35% local reduction, amounting to an overall AAL reduction of 7%. Moderate overall gains stemmed from already existing high protection and residual risks from pluvial/off-plain flooding. However, this highlights that the cost versus benefit relationship of additional protection investments can be favourable and how modelling tools can support such analyses.

7.9. Reliable information on flood protection levels is crucial for a correct estimation of river flood risk. In Europe, detailed descriptions of protection structures (i.e. type, location, geometry, design parameters) are usually available only for limited areas, while information on the design level of protection can be found for a few countries and urban areas (Dottori, et al., 2017) .

7.10. Flood defences are variable by country (Figure 17). Information which is typically available about flood defences are their location and the standard of protection. However, typically the maintenance regime or current state, the area protected or the construction type (related to the probability of failure) is not an information which is readily available.

7.11. As seen in Figure 17, countries like Netherlands, Austria, Hungary, and parts of Germany show high protection levels, often exceeding 100-year return periods. Some eastern European and Baltic countries (e.g., Estonia, Latvia, Lithuania, Bulgaria) have lower protection levels, often below 50-year return periods. These areas also suffer from limited data availability.

Figure 17 - Distribution of flood protection levels, expressed as maximum return period of the design flood (in years).



Source: JBA Risk Management.

7.12. For this paper, an analysis on the level of protection was run for three countries (Germany, Hungary and Poland) (Annex 7) to estimate the impact on the SF country factor. Table 6 shows that not everybody living in a 200-year return period ([49]) (RP200) floodplain is protected (actually a large portion of the population at risk seems to be unprotected ~65%). The trend observed shows similarities between Germany, Hungary and Poland. However, it is important to note that a defence with a standard of protection of RP50 will reduce the overtopping flow from a RP200 flood down to an effective RP12.5 footprint. This dramatically reduces the extent

[49] A floodplain area that, in any given year, has a 0.5% probability a flood occurs.

and depths of the resulting event, meaning a significant number of properties are actually protected to some extent from the 1-in-200-year flood.

Table 6 - Potential relevance of the reflection of macro measures in the SF for flood per country.

Country	% of population at risk (RP200 floodplain)	% of population at risk protected at RP200
Germany	8.0%	34.3%
Poland	9.0%	30.9%
Hungary	6.5%	37.7%

Source: JBA Risk Management, JBA Europe Flood Model, 2025

Questions to stakeholders:

Q12a: Do you have any comments on the assessment of macro adaptation measures for flood? (yes/no)

Q12b: Please explain.

MICRO

7.13. In the past model vendors had performed analyses on the impact of micro adaptation measures on flood risks for example for the UK, Switzerland and the USA (see also Annex in EIOPA (2024). These specific case studies show that measures on property can indeed have an impact on the flood risk.

7.14. For example, Moody's modelled the impact of many different property flood resilience (PFR) measures such as sandbags, floodwalls, raised ground floors, dry- and wet-proofing, etc.:

- Assessed the impact of flood protection measures at the property level, as opposed to the impact of investments in large river protection measures (e.g. heightening of dams and levees);
- Analysed the effects of installing a 0.5 meter floodwall (a PFR measure) at every commercial property in the city of Zurich because the largest portion of the potential losses are from commercial buildings;
- Did not apply any adaptation measures to residential and industrial properties.

7.15. Implementing the specific adaptation measure at the property level, the floodwall, reduced today's flood risk by almost 30 percent.

7.16. In addition, some examples of mitigation measures that can be modelled at this time in available models from Verisk include “wet flood-proofing” of structural components of a building and raising or protecting service equipment (e.g. heating, electrical, or plumbing).

7.17. Using a sample exposure in the United States, consisting of 250,000 locations exposed to various levels of flood hazard and consisting of a typical exposure mix of commercial, residential and industrial locations, Verisk examined impacts by looking at differences in flood risk metrics after implementing various levels of service equipment protection and wet flood-proofing (up to 1 m)([50]).

7.18. The combined impact of wet flood-proofing and high service equipment protection (up to 1 m elevation) typically ranges from an AAL reduction for individual buildings of 6% to 15% (25% and 75% quantiles) and in the most impactful scenarios, AAL reduction of up to nearly 30% was achieved.

7.19. For this paper, the catastrophes models were run for three countries (Germany, Hungary and Poland) as identified in Annex 7 to estimate the impact on the SF country factor. The following level of prevention measures was assumed:

- individual households will implement property-level measures, such as the use of local mobile door barriers, to further reduce their vulnerability.

7.20. The impact of adaptations on the country factor varied from -5% to -20% depending on the country. The potential issue identified with PFR measures could also be that some might be mobile and there is uncertainty if they would be implemented when the event occurs.

Questions to stakeholders:

Q13a: Do you have any comments on the assessment of micro adaptation measures for flood? (yes/no)

Q13b: Please explain.

DISCUSSION

7.21. The perils and countries considered in this section are examples and were selected based on the assessment presented in Chapter 5 and Annex 7, which identified specific regions and perils that may require tailored adaptation considerations in the SF. This selection is not exhaustive, neither geographically nor in terms of perils.

[50] It is important to note that the residential building stock is quite different in the US compared to Europe, not least because of use of the Base Flood Elevation for building design in flood-prone areas. This means that the impact of PFR measures in the USA could have a different impact to those in Europe.

ANNEX 1: ORGANISATIONS WHICH ARE MEMBERS OF THE TECHNICAL EXPERT NETWORK ON CATASTROPHE RISKS

Please see below the list of organisations with whom the members of the Technical Expert Network on Catastrophe Risks are affiliated. The inputs provided in the consultation paper is based on each individual members' expertise and contribution.

Achmea	Impact Forecasting
AON	JBA Risk Management
AVIVA	Liberty Mutual
CMCC (Euro-Mediterranean Centre on Climate Change)	Moody's
Consorcio de Compensacion de Seguros	MSK Meyerthole Siems Kohlruss
CoreLogic	Munich Re
Deloitte	ORTEC
EEA (European Environment Agency)	PERILS
Gallagher Re	Siriuspoint
Guy Carpenter	SwissRe
Hannover Re	Verisk
HDI	

ANNEX 2: LIST OF ACRONYMS

AAL:	Average Annual Loss
CRC:	Catastrophe Risk Charge
EEA:	European Economic Area
GDP:	Gross Domestic Product
IED:	Industry Exposure Database
IM:	Internal Model
IPCC:	Intergovernmental Panel on Climate Change
NatCat:	Natural Catastrophe
NCA:	National Competent Authority
NSLT:	Non-Similar to Life Techniques
PFR:	Property Flood Resilience
PIM:	Partial Internal Model
QRT:	Quantitative Reporting Templates
RP:	Return Period
RPL:	Return Period Loss
SCR:	Solvency Capital Requirement
SCS:	Severe Convective Storms
SF:	Standard Formula
SII:	Solvency II
TIV:	Total Insured Value
USP:	Undertaking Specific Parameter

ANNEX 3: DEFINITION OF PERILS

SF Peril name	Type of disaster	SF
Earthquake	Geophysical	Includes ground movement, but neither tsunami nor fire following.
Flood	Hydrological	Includes riverine (or fluvial) floods and floods that result from rainfall (pluvial, or surface water, floods). Storm surge is not included. Flash floods, which can be part fluvial and part pluvial, are included.
Windstorm	Meteorological	Includes cyclonic storms (both extra-tropical and tropical cyclones). Storm surge is not a separate peril, but – where material - combined with windstorm due to the inherently coupled nature. Convective storms are not part of the windstorm peril.
Hail	Meteorological	The SF includes in particular hail as the dominant sub-peril, but also other sub-perils of severe convective storms, such as tornadoes and lightning,
Subsidence	Geophysical	Subsidence is part of the SF in France and refers to a swelling or shrinking of clay soils.

ANNEX 4: DEFINING RISK

"Risk" is contextual, and its understanding the result of different cultural and professional influences. Risk as a term is widely used amongst different professions, but the number of different concepts, definitions and perceptions is large (Vlek & Keren, 1992). Therefore, it is important to define risk in the context of this paper. Risk, as typically defined in a context of disaster risk reduction and climate change adaptation is the combination of hazard, exposure and vulnerability.

Both in climate science and in commercial NatCat models, risk is a central concept defined as a combination of a hazard, exposure and vulnerability.

RISK IN THE IPCC CONTEXT

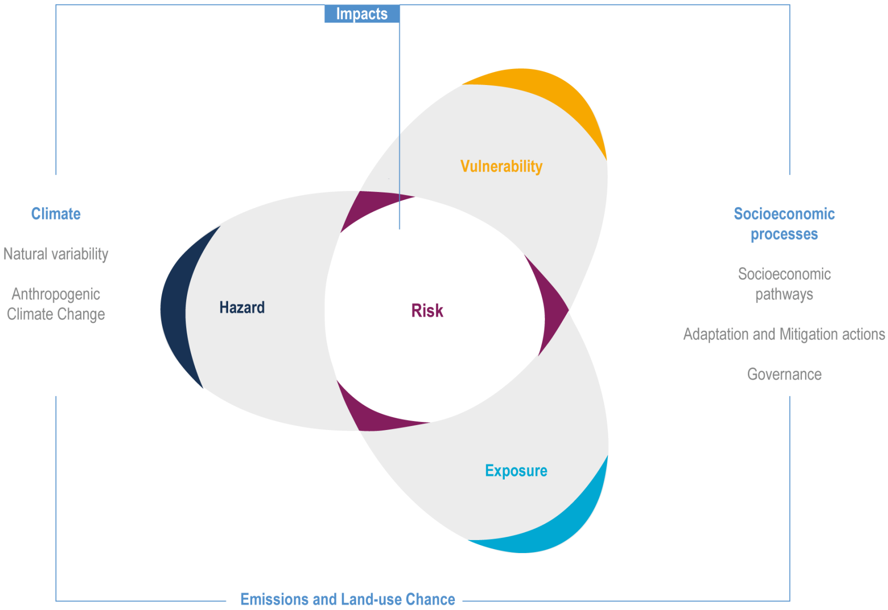
In climate sciences, the Intergovernmental Panel on Climate Change (IPCC) is an authoritative voice. The IPCC allocated a full guidance document to the concept of risk in its 6th assessment report (IPCC, 2020), and risk is defined as:

The **potential** for **adverse consequences** for human or ecological systems, recognising the diversity of values and objectives associated with such systems. In the context of *climate change*, risks can arise from potential *impacts* of climate change as well as human responses to climate change. […([51])] In the context of climate change impacts, risks result from **dynamic interactions between** climate-related ***hazards*** with the ***exposure* and *vulnerability*** of the affected human or ecological system to the hazards.

Climate-related risks in this context are generally an assessment from the 'additional' risk due to climate change and not of the total risk of a system (IPCC, 2023). As the risk from climate change may depend on the current and future non-climatic stressors, these assumptions are to be made explicit to avoid confusion (IPCC, 2020).

[51] Bold by EIOPA, the remaining parts of the definition are not that relevant for the scope of this document.

Figure 18 - Risk propellor



Source: IPCC (2023).

Note: "Risk propellor" from the Summary for Policymakers, referring to the risk concept in the fifth assessment report. See also the final report of the Climate Resilience Dialogue (2024) for a more detailed discussion on risk reduction measures.

The 3 components of risk are defined as follows (IPCC, 2023):

- Hazard: The potential occurrence of a natural or human-induced **physical event or trend** that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources.
- Exposure: The **presence** of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets **in places and settings that could be adversely affected**.
- Vulnerability: The **propensity or predisposition to be adversely affected**. Vulnerability encompasses a variety of concepts and elements, including sensitivity ([52]) or susceptibility to harm and lack of capacity to cope and adapt.

A natural hazard causing significant harm can be called a catastrophe but **not** called a "natural catastrophe".

When applied to flood risk:

- The hazard is the physical flooding event, including frequency, intensity and duration.

[52] Defined as the degree to which a system or species is affected […].

- The exposure is the presence of people, infrastructure and ecosystems in areas that could be affected by flooding and includes the geographical distribution and value of the assets at risk.
- The vulnerability is the susceptibility of the exposed elements to harm, influenced by factors like building quality, preparedness and adaptive capacity.

Notwithstanding a common terminology in IPCC and NatCat commercial models, the content of each of the elements is slightly different when it comes to details.

RISK IN NATCAT MODELS

In NatCat models, risk is defined as potential financial losses due to natural catastrophes. While there are differences in the models for each peril, in general the different components of a catastrophe model to result in insured property loss metrics are (American Academy of Actuaries, 2018; NAIC, 2025) (Figure 19):

- Hazard: **local intensity** of the event and the conditions of the event footprint, based on a large catalogue of **simulated events representing a wide range of plausible scenarios**. For example, inundation depth for flooding, wind speed for winter storms or ground movement acceleration for earthquakes.
- Vulnerability: quantification of how the local intensity impacts the structure and its contents, **quantifying the expected damage based on building characteristics** using damage functions ([53]). Most engineering parameters and structure characteristics are peril specific.
- Exposure: **portfolio data** such as location together with risk characteristics and insured values. This module also includes information about **insurance policy terms and conditions** such as deductibles, limits, and any applicable reinsurance.
- Financial analysis or insurance: describing how the **loss is allocated among those responsible for payment** for all the event scenarios. Applies the insurance contract terms to the loss, assigning portions of the amount to policy holders (via deductibles), insurance and reinsurance to generate insured loss estimates. The losses from all the event scenarios are aggregated to create a **loss probability distribution**. Loss distribution is used to derive expected losses as well as the likelihood of different loss levels.

[53] Damage functions are essentially equations that are used to compute the amount of expected damage for a given hazard intensity (such as windspeeds) based on characteristics (e.g., construction, occupancy, building height) of the property at risk (NAIC, 2025).

Figure 19 - Risk Triangle

Source: NAIC (2025), based on the "Risk Triangle" (Crichton, 1999)

The modelling framework in general ([54]) consist of

- event module: the stochastic event set, scenarios characterised by their strength, location and probability;
- hazard module: assessing the physical hazards in a geographic area;
- vulnerability module: assessing the degree to which insured properties are likely to be damaged;
- financial module: translating the expected physical damage into monetary losses and estimates the responsible for paying.

> There are significant differences in between climate change models and NatCat models when it comes to hazard, exposure and vulnerability and even more when it comes to the information in the different modules of the commercial NatCat models.
>
> For example, large scale flood defences in climate change models will impact the exposure component of the risk while these will be incorporated in the hazard module of a NatCat model.
>
> Similarly, some of the hazard information from a climate model will be in the event module of a NatCat model.
>
> As there is no separate exposure module, the exposure information from NatCat models is distributed over the hazard, vulnerability and even the financial module.

[54] Wording might differ, here taken from Moody's (2025).

In the context of the IPCC, climate change mitigation covers all efforts to reduce emissions of greenhouse gasses.

In the context of the SII framework risk mitigation techniques are all risk transfer instruments with a risk reducing effect that can potentially be recognised in the calculations of the SCR. For underwriting risk, the main risk mitigation technique is reinsurance.

Some terminology confusion might occur. In this note, different measures to mitigate (read: reduce) the risk are grouped as adaptation measures. When adaptation measures are discussed, they are described as reducing the overall risk from natural hazards and not only the increased risk due to climate change, covers the whole disaster risk management cycle (with a focus on prevention and preparedness). In this context, the focus is on (changes in the) climate related extremes as those are the most relevant for property and infrastructure insurance ([55]).

In this note, we will use the term adaptation measures instead of risk mitigation measures to avoid confusion with climate change mitigation measures. Adaptation, in the broadest sense, is acting to reduce or limit any of the risk components. However, in practice, most adaptation measures focus on reducing the vulnerability and to a less extent on the exposure (RMS, 2008).

DIFFERENCES AND SIMILARITIES

Common characteristics:

- Both focus on the negative consequences, opportunities are mentioned separately.
- Both have risk consisting of a hazards, exposure and vulnerability component.

Significant differences:

- The IPCC, and climate change adaptation in general, focuses on a wider human-ecological-economic system, while commercial NatCat models focus on the financial impact and insured assets.
- The purpose of both concepts is different: the IPCC aims to inform policy and the development of (multi-sectoral) climate change adaptation strategies, while NatCat models aim to assess and price insurance risk.

[55] Climate change adaptation looks at the changes in the extreme events as well as changes to the averages. The later can be relevant for agriculture and to gradually adapt to climate change. In this context, we look at the extreme events, or at least at the peak events and their evolution as those are the ones driving losses and damages. Changes to the average wind-speed are less relevant in this context than changes in storm frequency and magnitude, changes to average winter precipitation are less relevant here than changes to peak rainfall events over different time intervals, etc.

- While risk definitions include the same elements, the IPCC puts emphasis on adaptive capacity and sensitivity, while commercial models emphasize financial valuation and damage ratios.
- Climate sciences focus mainly on the changes in the hazard model, often keeping other developments, like economic and demographic evolutions constant, while catastrophe models can change the catalogue of events but also variate exposure and vulnerability properties.

ANNEX 5: DEFINING ADAPTATION MEASURES

HISTORIC EVOLUTION

Adaptation refers to the process of adjusting to a changing environment or situation in order to survive, thrive, or maintain a certain level of performance. In the context of climate change, adaptation measures are actions taken to reduce the vulnerability of natural and human systems to the impacts of climate change, such as sea-level rise, increased frequency of extreme weather events, and changes in temperature and precipitation patterns. Adaptation options are strategies and measures that are available and appropriate for addressing climate change adaptation (IPCC, 2023). In this paper, measures to mitigate earthquake risks will also be considered as earthquake is a significant risk in some European regions. In addition, the adaptation measures are not only dealing with the additional impact due to climate change of certain perils but instead focus on lessening or minimizing the adverse impact of the hazardous event as a whole, in line with disaster risk management practices.

Originally, adaptation measures or risk reduction measures were split into (1) structural adaptation, being all build infrastructure and further distinguishing grey measures from green measures ([56]) and (2) non-structural adaptation (sometimes called 'soft measures'), being anything else. Such a split was largely insufficient and in IPCC (2014) the 5th Assessment report included a two-tier classification system:

- Structural and physical options, further split into (a) ecosystem-based adaptation options, (b) engineering and built environment options, (c) service options and (d) technological options.
- Social options, further split into (a) behavioural, (b) educational and (c) informal options.
- Institutional options, further split into (a) economic options, (b) government policies and programmes and (c) laws and regulations.

Over the last decade, many projects and organisations selected groups of measures based on their need or audience. Most of them structure measures at one level and certain types of measures remained uncovered, hampering a proper exchange of knowledge and comparability of the information.

[56] Grey measures typically involve technical or engineering oriented responses while green measures are nature-based solutions.

TAXONOMY OF ADAPTATION MEASURES

The European Environment Agency (EEA) developed a taxonomy for key adaptation measures in the context of the Regulation on the Governance of the Energy Union and Climate Action (EU, 2018), where countries have to report on their national adaptation actions. To understand progress throughout the whole climate change adaptation policy cycle ([57]) (or in this case the disaster risk management cycle), the EEA added voluntary questions to the EU Member States on their planned and implemented measures.

While some level of detail was inevitably lost, a common set of key types of measures (KTMs, Table 7) for adaptation was necessary ([58]) to summarize and structure the information at European level. Therefore, in 2020, the EEA created a taxonomy with 3 levels: 5 KTMs, 11 sub-KTMs and 25 specifications (ETC/CCA, 2020; 2021). For the exercise covered in this document, only the levels of the KTMs and sub-KTMs are of relevance.

As an individual policyholder and as an insurance undertaking, it is normally not possible to have a direct impact on the Governance and institutional measures (KTM A). However, information providing, consulting and even co-creation might happen (depending on the local context and topic) when spatial planning plans are developed or changing ([59]), mandatory public consultation of the flood risk management plans takes place or building codes are developed/adapted (Eurocodes and EU standards as well as national and local requirements). These are relevant as context, e.g. when NatCat products mandatory cluster certain perils, or when a public system is set up to cover the losses from a certain peril, for one or more business lines.

Similarly, the economic and finance measures (KTM B) are mostly outside of the control of an individual policyholder. Nevertheless, also these are relevant as context, e.g. when tax reduction is provided for certain insurance products or when subsidies are provided at national, regional or local level for certain solutions at individual level. Also, volume purchases to get a better price can fall under this group of measures.

[57] For details, see the Adaptation support tool on Climate-ADAPT.

[58] A practice the European Commission also used for the measures reported under e.g. the Policies and Measures (PaMs) for climate change mitigation (reported under the (EU, 2018)), the Water Framework Directive or the Common Agricultural Policy.

[59] After all, one of the most important adaptation measures is the location of the assets: where do you build (and where do you rebuild). It applies to all hazards, but in particular for earthquake and flood this is an important measure to prevent potential future losses.

Table 7 - Key types of measures for climate change adaptation

KTM	Sub-KTM
A: Governance and Institutional	A1: Policy instruments
	A2: Management and planning
	A3: Coordination, cooperation and networks
B: Economic and finance	B1: Financing and incentive instruments
	B2: Insurance and risk sharing instruments
C: Physical and technological measures	C1: Grey options
	C2: Technological options
D: Nature-based solutions and ecosystem-based approaches	D1: Green options
	D2: Blue options
E: Knowledge and Behavioural change	E1: Information and awareness raising
	E2: Capacity building, empowering and lifestyle practices

Source: ETC/CCA (2021)

Physical and technological measures (KTM C) are the type of solutions that most people commonly associate with adaptation when they first think about it. Nevertheless, there are important differences between the grey options (KTM C1) and the Technological options (KTM C2). The physical grey measures consist of a wide variety of actions that individuals can take, ranging from reinforcing roof structure against storms, raising electrical outlets to prevent flood damage, and installing flood doors, to using to extra-strong glass in to withstand hail. KTM C1 also includes a range of large-scale measures implemented by authorities at different levels and to protect entire areas - particularly against flooding - such as separate urban drainage systems for wastewater and rainwater discharge, quay walls, controlled overflow zones along rivers, sea dykes and stilling wave basins for coastal protection.

Technological options (KTM C2) include measures that can be implemented by individual property owners, such as small weather stations that automatically close glass panels in greenhouses (agricultural and otherwise) when precipitation or high wind speeds are detected, automatic valves and pumps directing (waste)waterflow, or roller shutters that automatically close and serve as flood barrier for windows. Some technological measures, while theoretically feasible at the individual level—since they do not directly affect other properties or the surrounding territory—are in practice only effective when implemented across a broader area. These include specialised forecasting apps, early warning systems, the preventive lowering of water levels in certain basins, or the coordinated management of weirs and bulkheads along rivers based on forecast data. For these forecasting and early warning models, individual owners act primarily as is end users of the information, with no ability to implement the measure themselves, and must rely on subscribing to services developed and operated by others (see KTM E) ([60]).

For KTM D, which encompasses nature-based solutions and ecosystem-based approaches, a variety of concepts and terminology are used across climate change adaptation, disaster risk reduction, and related policy fields. However, in practice, the measures associated with these concepts are often interchangeable (EEA, 2021). Within the disaster risk reduction and civil protection communities, the term "Ecosystem-based disaster risk reduction" (Eco-DRR) is more commonly used. Blue nature-based solutions (KTM D2) focus on water management and storage, addressing both water excess (to prevent flooding) and shortage of water (to reduce drought impacts). Examples of such measures at the individual levels are rainwater gardens, permeable pavements in both private and public spaces, and green roofs or walls. Green nature-based solutions (KTM D1), on the other hand, target other types of hazards beyond 'water-related' risks—such as using urban trees to reduce urban heat island effects, or implementing buffer strips, soil conservation practices and green cover on agricultural land to prevent erosion, landslides or soil loss during storms.

The last group of measures covers aspects related to knowledge and behavioural change (KTM E). On information and awareness raising, individual owners can be considered at the receiving end of the communication chain, where they can be more or less knowledgeable or open to new information but do (in general) not have the possibility to initiate new research and innovations (KTM E1). However, the insurance sector is one of the actors executing a lot of these activities and having a role in the communication and dissemination of options and solutions on risk management and adaptation solutions. The last group, on capacity building and lifestyle practices (KTM E2) has almost

[60] For all measures, but in particular for those under KTM C and D, it is important to keep in mind the lifetime of the measures (and the expected lifetime of the asset) versus the future climate scenarios. Some measures will work well now but might become less effective when climate change becomes more extreme. This is the concept of Adaptation pathways where cost- effectiveness and cost-efficiency of measures is evaluated over time. Adaptation pathways help to avoid lock-in where certain measures prevent further upgrading if climate change aggravates. A flood protection door might be able to prevent damage until flooding becomes too extreme and elevating the house is more effective. The costs of both options are considerably different. See also Werners et al. (2021) and Muccione et al. (2024). Two well-known examples where this is applied are the Room for the River programme in the Netherlands and the Thames estuary and barrier in the UK.

by definition an active role for the individual when it comes to behavioural change, but these practices and behaviours and their evolution are hard to quantify. Capacity building and the sharing of good practices is also part of this sub-KTM and as is an adaptation solution that to some level can be done by individual owners, but again difficult to measure or model. However, the sharing of good practices on risk management and the whole knowledge transfer is again something by many seen as part of the societal role and social capital of the insurance industry.

ANNEX 6: BUILDING CODES

EU-level building standards are known as Eurocodes and the 10 standards EN 1990 – EN 1999 ([61]) are covering the structural and geotechnical design for building and civil engineering constructions. They are developed by the European Committee for Standardisation (CEN) at the request of the European Commission and set minimum design requirements and harmonized calculation methods. Each country can issue a National Annex to adapt parameters to local conditions (e.g. climate, seismic activity).

Each of these standards is further divided into parts that address specific design aspects. For example, EN 1991 includes wind, snow, and thermal actions, while EN 1997 covers soil mechanics and foundation design.

A major update, aiming to improve clarity and climate resilience in construction works, is expected by March 2026.

Table 8 gives an overview of the different Eurocodes and their relevance for the different perils from the standard formula. While wind, earthquake, flood and subsidence are all handled in one or more of the Eurocodes, Eurocode EN1991 specifically looks at storms, EN1998 at earthquakes while floods and subsidence are mainly handles in EN1997.

EN1991 also handles snow loads while structural fire design is primarily covered in the material specific design codes (EN1992-1996 and EN1999).

[61] Eurocodes Homepage | Eurocodes.

Table 8 - Eurocodes and the perils of the SF

Code	Title	Perils	Notes
EN1990	*Basis of Structural Design*	• Wind • Earthquake • Flood • Subsidence	Includes the general principles.
EN1991	*Actions on Structures*	• **Wind** • (Flood)	In particular relevant for wind (EN1991-1-4), flood effects considered through environmental actions.
EN1992 **EN1993** **EN1994** **EN1995** **EN1996** **EN1999**	*Material specific design, respectively for:* • *Concrete Structures* • *Steel Structures* • *Composite Structures* • *Timber Structures* • *Masonry Structures* • *Aluminium Structures*	• (Wind) • (Earthquake) • (Flood) • (Subsidence)	Relies on EN1991 for environmental actions. Include seismic and structural detailing, incl. material durability and resistance to water exposure
EN1997	*Geotechnical Design*	• Earthquake • **Flood** • **Subsidence**	Considers flood-related effects like groundwater and hydraulic actions, as well as ground movement settlement, soil instability and seismic soil-structure interaction.
EN1998	*Design of Structures for Earthquake Resistance*	• (Wind) • **Earthquake**	Core standard for seismic design. Includes wind actions in load combinations.

Note: hail is not explicitly addressed in any of the Eurocodes.

ANNEX 7: MATERIALITY ANALYSES

Table 9 - Potential relevance of the reflection of micro measures in the SF for windstorm per country

Country	Country factor (%) ([62])	Comment
Belgium	0.16	The country factor for windstorm is relatively large compared to other countries. The proportion of the SCR is larger than the proportion of the exposure (Figure 13). Proportion of the SCR is amongst the highest (based on the available data).
Denmark	0.25	The country factor for windstorm for Denmark is higher than for other countries. Proportion of the SCR is amongst highest (for the data available) and the proportion of the SCR is higher than the proportion of the exposure.
Netherlands	0.18	The country factor for windstorm is one of the largest. Proportion of the exposure and SCR is in the top 5 of all countries (based on the data available, Figure 13) and the proportion of the SCR is larger than the proportion of the exposure.
France	0.12	The country factor for windstorm is relatively large compared to other countries. Based on the available data, it is the country with the second largest exposure and largest SCR and the proportion of the SCR is larger than the proportion of the exposure (Figure 13).

[62] The paper uses the country factors from the Delegated Regulation (EU, 2015) in place at the time of writing instead of those from the Opinion on the 2023/2024 Reassessment of the NatCat SF (EIOPA, 2025).

Ireland	0.22	The country factor is the second largest of all countries. Based on the available data, the proportion of the SCR is larger than the proportion of the exposure (Figure 13).
Austria	0.06	The country factor for these countries is small and the proportion of the exposure (by country natural catastrophe risk and for the data available, see Figure 13) is larger than the resulting SCR and/or less than 2% for both the proportion of the exposure and the of the SCR.
Czechia	0.04	
Finland	0.04	
Hungary	0.02	
Iceland	0.03	
Norway	0.08	
Poland	0.04	
Slovenia	0.04	
Sweden	0.09	
Germany	0.07	Although being the country with the largest proportion of the exposure and the second largest proportion of the SCR (from the countries where data per NCA country are available), the country factor is relatively low, the proportion of the SCR smaller than the proportion of the exposure.
Luxembourg	0.12	Although the country factor is medium compared to other countries, both the proportion of the exposure and of the SCR (from the countries where data per NCA country are available) is small. Specifically for Luxembourg, the data on exposure and SCR per NCA are much larger than the data for the physical risk in Luxembourg.

Spain	0.01	Based on the available data, the proportion of the exposure is much larger than the proportion of the SCR. In addition, gusts of wind above 120 km/h are included in the extraordinary risk insurance cover by the Consorcio de Compensacion de Seguros.
Switzerland	0.09	No information reported by Swiss-based underwriters. The Country Natural Catastrophe Risk covers both Switzerland and Liechtenstein. And for CH, windstorm risks could also be covered in the Swiss Natural Hazard Pool. Only for Liechtenstein, data per NCA Country are reported.

Note: only countries with a SF country factor for windstorm are included in the table.

Table 10 - Potential relevance of the reflection of micro measures in the SF for earthquake per country

Country	Country factor (%)	Comment
Cyprus	2.12	Cyprus has the highest country factor for earthquake. The proportion of the SCR is larger than the proportion of the exposure (based on the available data, Figure 14).
Greece	1.85	Greece has the second highest country factor for earthquake. Based on the available data (Figure 14), the proportion of the SCR is significantly larger than the proportion of the exposure (almost 10 percentage points). In addition, legislative changes are making NatCat insurance coverage mandatory for commercial lines going forward.
	1.7	Romania has the third highest country factor for earthquake. Based on the available data, the proportion of the SCR is significantly higher than the proportion of the exposure (more than 5 percentage points) and the proportion of the SCR is the 6th largest overall (Figure 14).

Italy	0.8	Notwithstanding a country factor lower than in the records above, the country has the 3rd highest SCR before risk mitigation (Figure 14) and the proportion of the SCR is significantly higher than the proportion of the exposure (based on the available data). The country has a substantial earthquake risk and legislative changes are making NatCat insurance coverage mandatory for commercial lines going forward.
Portugal	1.2	The Portuguese country factor for earthquake is relatively high. From the available data (Figure 14), the proportion the SCR is significantly bigger than the proportion of the exposures (10 percentage points).
Bulgaria	1.6	Bulgaria and/or Croatia have a rather high-country factor. However, based on the available data, both the proportion of the SCR and of the exposure are small (Figure 14).
Croatia	1.6	
Austria	0.1	The country factor for earthquake for these countries is small and (based on the available data, Figure 14) both the proportion of the exposure and of the SCR are small (≤ 3%).
Czechia	0.1	
Hungary	0.2	
Slovakia	0.15	
Belgium	0.02	The country factor is small and the proportion of the exposure is significantly larger than the proportion of the SCR (more than 5 percentage points different, based on the available data (Figure 14)).
France	0.06	Although France and Germany have the biggest exposure and SCR before risk mitigation for earthquake (based on the available data, Figure 14), the proportion of the exposure is larger than the proportion of the SCR before risk mitigation (more than 10 percentage points). The country factor for earthquake is low.
Germany	0.1	

Slovenia	1	The country has a medium to high country factor compared to other countries. While the proportion of the SCR is larger than the proportion of the exposure, both are very small (based on the available data, Figure 14)

Note: only countries with a SF country factor for earthquake are included in the table.

Table 11 - Potential relevance of the reflection of micro measures in the SF for flood per country

Country	Country factor	Comment
Germany	0.2	The country has a high country factor for flood compared to other countries. From the countries data are available for (Figure 15) it has the highest proportion of the SCR and the second highest proportion of the exposure. The proportion of the exposure is significantly higher (more than 10 percentage point difference) than the one for the exposure.
Hungary	0.25	The country has a high country factor for flood compared to other countries. Based on the available data (Figure 15), the proportion of the SCR (4th largest share) is larger than the proportion of the exposure.
Czechia	0.3	Czechia has the second highest country factor for flood. Althpough rather small based on the available data (Figure 15), the proportion of the SCR is slightly bigger than the proportion of the exposure.
Poland	0.16	Poland has a relatively high country factor. In addition, it has the third highest proportion of the SCR and of the exposure (based on the available data, Figure 15) and the proportion of the SCR is larger than the proportion of the exposure.

Slovakia	0.35	Slovakia has the highest country factor for flood. Figure 15 shows that, based on the available data, the proportion of both the SCR and the exposure are small (where the proportion of the SCR is slightly larger than that of the exposure).
Austria	0.13	Notwithstanding the “medium” country factors compared to other countries, the proportion of both the exposure and the SCR are small (AT, BG, IT) and/or the proportion of the exposure is larger than the one of the SCR (AT, BE, FR) based on the available data (Figure 15). In particular for France, this difference is over 15 percentage points. In addition, for Italy, it might be more relevant to look at earthquakes (see subsection Earthquake).
Belgium	0.1	
Bulgaria	0.15	
France	0.12	
Italy	0.15	
Romania	0.3	Notwithstanding a high country factor for flood for RO and SI, the proportion in the exposure and the SCR is small (Figure 15), based on the available data In addition, for RO, the main focus might be on earthquake (see subsection Earthquake).
Slovenia	0.3	

Note: only countries with a SF country factor for flood are included in the table.

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