EUROPEAN CLIMATE RESILIENCE AND RISK MANAGEMENT - INTEGRATED FRAMEWORK

CALL FOR EVIDENCE

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The EGU Climate Hazards and Risk Task Force

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European climate resilience and risk management – integrated framework

Evidence-based insights for policymakers

Executive Summary

- For a framework to be comprehensive, it must include a multi-hazards approach that considers cascading and compound risks, as well as co-beneficial solutions, including risk reduction, adaptation and mitigation strategies that benefit multiple sectors over a long-time period.
- An all-encompassing approach must recognise that climate change impacts local communities and environments unequally; assessments must prioritize high risk regional 'hotspots'.
- Coherence between EU policies requires the use of common climate change reference scenarios, as well as indicators informed by earth observation systems, and which include non-economic health and cultural impacts.
- Public engagement should be strengthened through participation civil protection mechanisms and improved risk communication, including the integration of local and indigenous knowledge in assessment and implementation.

Summary of recommendations

1. Assess hazards and risks as interconnected, systemic events.
2. Identify regionally specific climate risk 'hotspots' and prioritise these for action.
3. Improve the integration of inter-state and multi-sectoral mechanisms by adopting common climate policies.
4. Achieve targets by identifying alignment and improving collaboration between international climate policies.
5. Implement solutions which benefit multiple issues over the long-term.
6. Strengthen citizen engagement through coordination between existing frameworks and public engagement.
7. Integrate Earth Observation, climate modelling, and other digital tools to monitor and improve Adaptation and Mitigation efforts.

The European Geosciences Union (EGU) Climate Hazards Task Force welcomes the ambitious initiative to develop n comprehensive assessment of climate-induced hazards across society and between sectors. The EU Preparedness Union Strategy, recently announced in March 2025, states 30 key actions for strengthening cross-sectoral co-operation and coherency; this is a positive response to the challenge posed by cascading and interconnected climate-induced risks. With the European Climate Adaptation Plan set to be presented in 2026, the development of a climate risk assessment founded in scientific evidence is necessary to ensure a strong and meaningful adaptation to climate change.

The call comes at a time when Europe is warming twice the global average and experiencing the intensifying effects of climate change faster than any other continent: the European State of the Climate Report (2024) stated that 2024 was Europe's warmest year on record. Its impacts are already being felt across multiple sectors, including public health, agriculture, water resources, and infrastructure, whilst greenhouse gas emissions continue to rise. Given the widespread and interconnected nature of climate change impacts, the assessment framework must consider the overlapping effects of multiple hazards and the co-beneficial results produced by solutions that integrate different sectors.

To ensure the EU's Climate Resilience and Risk Management framework achieves its objectives, the EGU Climate Hazard Task Force has outlined seven core recommendations that the strategy should consider based on the latest scientific evidence. It is hoped that these recommendations will inform the discussions of the European Parliament and the Council of the EU when developing a science-based climate risk assessment framework.

1. Assess hazards and risks as interconnected, systemic events

The frequency of individual, climate change-induced events is increasing: under 2.7°C of global warming with respect to pre-industrial temperatures. Of the estimated 120 million children born in 2020, 100 million will face unprecedented lifetime exposure to extreme heat, 30 million to crop failures, 15 million to river floods, 11 million to wildfires, and 8 million to droughts[1]. However, climate hazards in Europe are no longer isolated events: they are increasingly interconnected, with one hazard triggering or amplifying others[2].

The IPCC AR6 WG2 Chapter 13 identifies these compound and cascading risks as key threats to European cities, infrastructure, and health systems. These events often overwhelm local emergency services and have cascading effects on air quality, public health, and economic productivity, particularly in tourism and agriculture-dependent regions[3]. Whilst EU policy has highlighted the need for multi-hazard approaches to be included in climate risk assessments[4], implementation has continued to focus on individual hazards with a detrimental effect of adaptation efficacy[5].

The new legislation should address the interconnectedness between hazards, compounding vulnerabilities, and cascading impacts across geographies and sectors[6].

For example:

- Droughts reduce soil moisture and vegetation cover, increasing the risk of wildfires, which in turn degrade air quality and damage infrastructure[7].
- Heatwaves intensify urban heat island effects, strain energy systems, and exacerbate health inequalities, particularly in vulnerable population[6].
- Flooding following drought can lead to soil instability, mould growth, and infrastructure failure, especially in poorly maintained housing stock[8].

- Wildfires, increasingly frequent and intense across Southern and Central Europe, not only result from prolonged drought and heat but also trigger secondary hazards such as landslides, water contamination, and long-term ecosystem degradation[3].

2. Identify regionally-specific climate risk 'hotspots' and prioritise these for action

Some regions are more at risk to the impacts of climate change. The Mediterranean Basin, in particular, is a well-recognized hotspot for cascading climate risks, facing the convergence of sea-level rise, water scarcity, heat extremes, and coastal erosion. The MedEC (Mediterranean Experts on Climate and environmental Change) Special Report on Coastal Risks (2024) highlights that one-third of the Mediterranean population lives near the coast, where infrastructure, livelihoods, and ecosystems are highly exposed to these interacting hazards.

Alongside the Mediterranean Basin, the polar regions are warming over three times the global average. They are losing ice, and their oceans are changing rapidly. The consequences of the changing polar regions extends to the whole planet, and affect people in multiple ways, affecting the livelihoods of local communities[9]. Citizens living in Europe's Arctic regions are vulnerable to the impacts of climate change due to the compound effect of remoteness, extreme weather, and rapid-environmental change relative to the rest of the continent. This, as well as the developing strategic and geopolitical importance of the region, means it is essential to adopt multi-sectoral and multidisciplinary approaches to risk reduction, preparedness, and adaptation that are inclusive, innovative, and aimed at reducing vulnerability. Participatory processes that engage diverse societal actors play a critical role in this endeavour, as they foster trust, enhance legitimacy, and improve the uptake of adaptation measures, thereby strengthening collective responses to climate risks[10].

Despite the severity of such compound risks, current EU adaptation legislation does not sufficiently prioritise region-specific compound risk assessments or develop tailored adaptation pathways for such hotspots[8].

The new framework should:

- Recognise climate-vulnerable territories as strategic laboratories for resilience, including supporting place-based adaptation informed by regional science and the full participation of indigenous and local communties[11].
- Promote co-creation with communities in climate hotspots to foster a whole-of-society approach, ensuring socially acceptable and context-sensitive adaptation solutions.

3. Improve the integration of inter-state and multi-sectoral mechanisms by adopting common climate policies

Current policies often treat water, energy, housing, and health in silos, missing the systemic nature of cascading risk. Previous legislation, such as the EU Adaptation Strategy (2021) and the Water Resilience Strategy (2025) provide important foundations: however, they fall short in several areas: a lack of policy integration across sectors hampers adaptation effectiveness, as there is no EU-wide mechanism to evaluate whether adaptation measures are reducing vulnerability over time and to what extent and cost[12]. Additionally, despite the deployment of valuable EU-funded projects and policies, insufficient harmonization between EU-level and local-level strategies limits the scaling-up and replicability of solutions. This is compounded by a lack of access to integrated high-resolution data and guidance on how to assess and respond to compound hazards[13].

Climate risk assessments often focus on direct financial impacts, neglecting to include equity-focused indicators, such as health, cultural loss, and societal burden[14]. Classed as non-economic losses, these factors directly impact the ability of communities to recover. For instance, the 2021 floods in Germany showed that psychological burden due to flood experience reduced health-related quality of life and functioning, with recovery influenced by income, reconstruction progress, and insurance support[15]. Non-economic losses are deeply intertwined with a tangible, cultural heritage whose deterioration exacerbates economic losses; social and cultural damages in turn reshape cultural practices and beliefs to threaten human health and social cohesion[14]. However, the inclusion of climate-induced impacts on cultural heritage is sparse in the EU's grey literature, with awareness limited at both member-state and EU-level[16]. Guidance on the assessment and response to compound hazards should include also include non-economic indicators for the assessment to be comprehensive.

For adaptation strategies to be adopted, they must acknowledge and work with cultural identities of their target communities: indigenous and local knowledge systems offer unique, place-based, longitudinal insights and ethical frameworks, including knowledge of the local environment and sustainable solutions rooted in traditional practices. However, climate policies that do not account for cultural heritage can themselves induce damage, in turn, reducing our own capacity to adapt with the loss of traditional knowledge. This risk can be reduced by engaging communities throughout the entire process of policy planning and implementation; assessments considering the effective implementation of adaptation strategies require the meaningful participation of informed and consenting Indigenous and local communities[11] .

We must underscore that climate action and just transition pathways are fundamentally interlinked rather than separate initiatives, highlighting the need for integrated planning and implementation.

Assessment should improve inter-sectoral and societal integration by:

- Assessing cross-sectoral governance and data interoperability, and promoted integration by establishing common climate reference scenarios and multi-hazard indicators.
- Embed monitoring and evaluation systems that track adaptation outcomes, not just outputs.
- Develop comprehensive, systemic metrics for multi-hazard risk quantification, which include non-economic risks; health impacts, and recovery trajectories should be explicitly integrated as part of multi-hazard risk assessment frameworks[14].
- Indigenous and local knowledge should be incorporated to develop more equitable, appropriate, and sustainable responses to climate change[17]. Indigenous and local communities should be engaged throughout the assessment process, such as through public consultation, and creating positions for community members in decision-making process.
- Explicitly link climate resilience planning with disaster risk reduction (DRR), in line with the Sendai Framework for Disaster Risk Reduction and the EU Disaster Resilience Goals.

4. Achieve targets by identifying alignment and improving collaboration between international climate policies

There are limits in global warming above pre-industrial temperatures beyond which adaptation becomes extremely difficult, both in terms of human health (for example, survival beyond deadly humid heat as recently demonstrated in the 2025 Indian heat wave) and reaching potential climate tipping points. It is projected that beyond °C of global warming, the risk of the collapse of the Greenland and West Antarctic ice sheets significantly increases. This collapse would induce meters of global sea level rise and the possible slow- or shutdown of global ocean circulation, with

implications for global ocean heat transport and balance. Meanwhile, the Amazon Rainforest, a major sink of carbon, could undergo rapid decline[18]. Adapting to such drastic ecological and environmental changes would be incredibly difficult and costly: the current climatic trends underscore the urgent need to include and emphasise mitigation practices as part of our adaptation strategy rather than separate to it, such as accelerating decarbonisation. Rapid reductions in emissions are essential to avoid breaching the 1.5°C threshold and to mitigate cascading risks to ecosystems and economies.

Further alignment is needed in the following:

- Align measures with complementary strategies such as the UNFCCC Global Goal on Adaptation (GGA), by supporting sub-national monitoring and transparent reporting, the EU Water Resilience Strategy, by integrating water scarcity indicators and promoting water-smart infrastructure[12], and the EU Green Deal, by ensuring that adaptation and mitigation are pursued hand-in-hand, not in isolation[7].
- Strengthen synergies with existing global and EU frameworks, including: ensuring alignment with just transition pathways for achieving the goals of the Paris Agreement, ensuring that adaptation strategies address equity, justice, and livelihoods—particularly for vulnerable groups and regions most affected by climate change[19].
- Governments must fully recognize the rights of Indigenous Peoples, provide them with direct access to climate finance and capacity building, and integrate Indigenous knowledge into climate policy[11].

5. Implement solutions which benefit multiple issues over the long-term

The IPCC and MedECC both stress the need for transformational adaptation in the face of cascading risks and interconnected hazards that can span across decadal timescales. Integrating climate adaptation across multiple sectors allows for otherwise disconnected strategies to co-benefit. For example, decarbonisation is a strategic investment in Europe's resilience, prosperity, and leadership in the global climate transition. Including mitigation measures are necessary to reduce the burden of adaptation; integrating decarbonisation as an assessment criteria avoids significantly higher adaptation costs in the future whilst providing an economic opportunity the European Green Deal estimates that investment achieving net-zero by 2050 could boost EU GDP by up to 1.5%[20], annually, however the European Environment Agency (EEA) has estimated that annual climate-related damages could reach €240–300 billion by 2050 in the absence of strong mitigation and adaptation measures. Adopting strategies that provide co-beneficial outcomes improves adaptation outcomes by connecting disaster risk reduction with environmental, social, and economic needs whilst improving efficiency[21].

The EU framework should explicitly support robust, durable and systemic adaptation, moving beyond short-term fixes to facilitate long-term resilience pathways[22]. This includes:

- Investing in clean energy, energy efficiency, and nature-based solutions can generate millions of new jobs, reduce healthcare costs linked to pollution, and enhance energy security.
- Reforming urban and land-use design to reduce exposure and increase preparedness, by planning to withstand multiple hazards and an increase in demands for adaptation measures, such as effective cooling.
- Mainstreaming nature-based solutions that offer co-benefits for water retention, cooling, and biodiversity, as well as restoring ecosystems that represent essential carbon sinks[6,8].

- Building back better post-disaster in recovery, rehabilitation, and reconstruction to strengthen recovery by addressing existing and developing vulnerabilities to climate hazards such as floods, storms, heatwaves, droughts, etc. It also anticipates emerging risks from climate change, including slow-onset events like sea level rise, which occur over a long time commitment[23].

6. Strengthen citizen engagement through coordination between existing frameworks and public engagement

The increasing frequency and complexity of climate-related disasters, particularly multi-hazard and cascading events, highlight the urgent need to consolidate and harmonize the EU's civil protection architecture, and its visibility and authority to EU citizens and local stakeholders[24]. Despite trust in public authorities on this matter, many EU citizens do not feel sufficiently informed about disasters, and express a need for more accessible information and training.

There is a momentum to offer UCPM a strong operational capacity to train and inform EU citizens about disasters, particularly as social media is a significant and consistent source of information in this context[25], and that misinformation risk amplifying the cascading effects of disasters[26]. For example: while the Union Civil Protection Mechanism (UCPM) has improved coordination across Member States and Participating States, it remain little known to citizens, and too little involved in proactive training and communication to EU citizens. Its mandate should be strengthened. This should lead to increased visibility and perceived legitimacy to European citizens.

To effectively inform about compound risks such as heatwaves followed by wildfires, or flooding that disrupts energy and health systems, the EU must:

- Increasing the public visibility of UCPM through communication campaigns at local and regional levels, under the guiding principle of leaving no one behind, is crucial for strengthening public awareness, ensuring inclusiveness, and fostering community resilience.
- Provide clear, general audience disaster information via a trusted digital platform with an emphasis on countering misinformation.
- Expand UCPM's mandate to cover an operational role in citizen engagement, ensuring it is not only a coordination tool but also a direct informational and training resource to EU citizens that provides clear, general audience disaster information via a multi-channel strategy, tailored to the different needs of stakeholders, with an emphasis on countering misinformation.
- Promote "impact-based forecasting", early warning systems, which translates hazard predictions into anticipated effects on people, assets, and services, provides a forward-looking dimension to risk metrics[27] [28].
- Increase investment in cross-border early warning systems, including impact-based forecasting, and strengthen joint training and exercises to better prepare for cascading scenarios.
- Integrate climate risk intelligence into civil protection planning, using shared data platforms and AI-enhanced forecasting.

7. Integrate Earth Observation, climate modelling, and other coordination tools to monitor and improve Adaptation and Mitigation efforts

Earth observation (EO) systems play a critical role in enhancing readiness for managing climate change impacts by providing timely, accurate, and continuous data on the Earth's atmosphere, land, and oceans. By integrating satellite observations with ground-based and airborne measurements, Earth Observation enables the monitoring of key climate indicators such as temperature trends, sea-level rise, land use changes, extreme weather events, and ecosystem health[29]. Ensuring readiness involves not only advancing Earth Observation technologies but also improving data accessibility, capacity building, and international collaboration, so that stakeholders at all levels can translate Earth Observation insights into effective climate action[30].

To implement adapted solutions to the current and future impacts of climate change, the EU should develop and sustain Earth Observation knowledge and readiness:

- Earth Observation supported evidence-based decision-making, early warning systems, and adaptive management strategies that strengthen resilience across sectors such as agriculture (e,g, high precision agriculture), water resources, disaster risk reduction, and urban planning.
- Earth Observation readiness involves not only advancing Earth Observation technologies but also improving data accessibility, capacity building, and international collaboration, so that stakeholders at all levels can translate Earth Observation insights into effective climate action.
- Support research into digital tools, such as high resolution models, that can be integrated into digital user platforms like the Destination Earth Digital twins on Climate Extremes and Adaptation. For example, UrClim, a physical model that can provide temperature statistics down to a few hundred metres can provide a powerful framework to develop locally-specific adaptation solutions.
- Improve monitoring coherence between sectors by using cross-platform data from pre-existing in-situ, airborne, and satellite motoring systems.
- Continued support of coordinated efforts such as the Global Climate Observing System (GCOS), which provides an international framework to identify essential climate variables and ensures that Earth Observation data respects FAIR requirements for climate monitoring and adaptation.

Summary

The EGU Climate Risk and Hazards Task Force is an active member within Europe's scientific community and supports evidence-informed policymaking in Europe. The Task Force acknowledges the complexity exhibited by the risk assessment framework, particularly due to the high level of interconnection between different hazards, regions, sectors and communities. However, it is because of the nuanced interplay that the role of scientific evidence cannot be understated in both bringing clarity to these complex policy discussions and when considering the potential outcomes of policy decisions. Evidence shows that the improved integration and recognition of interconnected hazards, monitoring approaches, and citizen engagement have the potential to significantly improve climate adaptation through the deployment of solutions, that target benefit multiple sectors and result in cascading environmental, social, and economic benefits.

About the EGU Climate Hazards and Risk Task Force

The European Geosciences Union (EGU) is the leading organisation for Earth, planetary, and space science research in Europe. Together with our partner organisations worldwide, we foster fundamental geoscience research, alongside applied research that addresses key societal and environmental challenges. Our vision is to help realise a sustainable and just future for humanity and for the planet. The expertise of our 19,000 members spans key scientific disciplines relevant to the EU's climate resilience and risk management goals, including natural hazards, climate change, hydrology, biogeoscience, planetary protection and ocean sciences.

As Europe's largest geoscience society, the EGU is uniquely positioned to facilitate the transfer of knowledge from research into practice and to connect policymakers to the most relevant geoscience experts. In early 2025, EGU's Science for Policy Working Group created the EGU Climate Hazards and Risk Task Force, a selection of ten scientists with expertise spanning a range of climate-related fields as well as skills in science communication, outreach, and policy. The Task Force's mission is to bridge the gap between science and policy, delivering scientific information and expertise to where it is most needed. For further information, please contact policy@egu.eu.

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