

Building climate resilience across **land-coast-sea** systems

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Executive summary

Coastal regions are increasingly exposed to interconnected climate risks, including sea-level rise, coastal erosion, flooding, biodiversity loss, water scarcity and increasing pressures on infrastructure, economic activities and local communities. While the European Union has established an ambitious policy framework for climate adaptation, biodiversity restoration and water resilience, implementation remains fragmented. Adaptation measures are frequently planned and delivered through separate sectoral policies, despite the ecological and socio-economic interdependencies that characterise coastal systems.

Experience from the Horizon Europe COAST-SCAPES project demonstrates that climate resilience is most effective when land, coastal and marine environments are managed as one interconnected system. Successful adaptation requires not only technical measures and Nature-based Solutions (NbS), but also integrated governance, sustained stakeholder engagement, science-based decision-making and long-term financing.

Evidence from diverse European coastal regions shows that systemic resilience approaches can strengthen adaptation planning, improve coordination across sectors and administrative levels, and increase the long-term effectiveness and replicability of resilience measures.



Key takeaways

European climate adaptation policies should move beyond fragmented sectoral approaches and promote integrated land-coast-sea governance supported by permanent science-policy collaboration, harmonised resilience assessments, and sustainable financing mechanisms.

Policy challenge

Despite significant progress in European climate policy, many coastal adaptation initiatives remain fragmented across sectors, institutions and administrative boundaries. Climate adaptation, biodiversity restoration, water management, spatial planning and economic development are often addressed independently, limiting the effectiveness of public investment and increasing the risk of maladaptation.

This fragmentation is particularly problematic because climate risks rarely occur in isolation. Sea-level rise, coastal erosion, flooding, ecosystem degradation and declining water quality interact across land, coastal and marine environments, generating cumulative impacts on ecosystems, infrastructure, economic activities and communities.

Existing governance structures often struggle to coordinate responses across these interconnected systems. In addition, adaptation measures frequently lack long-term maintenance strategies,

sustainable financing and mechanisms for transferring successful approaches between regions facing similar challenges.

Strengthening Europe's climate resilience therefore requires governance approaches that recognise the land-coast-sea continuum, integrate scientific knowledge into policy processes, and enable adaptation measures to be replicated and maintained beyond individual projects.

Evidence from COAST-SCAPES

The COAST-SCAPES project brings together coastal regions exposed to different climate pressures and governance contexts. Together, these case studies demonstrate that integrated resilience approaches can support more effective adaptation across diverse environmental and socio-economic conditions.

COAST-SCAPES is organised around three pilot triads that connect demonstration, replication and knowledge transfer across different coastal contexts. Each triad includes a Core Pilot, where resilience solutions are tested and assessed under present conditions, a Replicating Pilot, where approaches are adapted to a different setting, and a Transfer Pilot, where methods and lessons learned are conveyed to regions facing similar challenges. The three Core Pilots - Mar Menor (Spain), Venice Lagoon (Italy), and Wadden sea - Weser Estuary (Germany) - represent different coastal ecosystems, climate pressures, and governance contexts, providing the evidence base for the replication and transfer of resilience approaches. Their impact is further extended through the Networking Pilots, which promote knowledge exchange, mutual learning and the wider uptake of project outcomes across additional coastal regions.

The Core pilots in the triads cover three types of coastal climate vulnerability hotspots: Mediterranean lagoons affected by land-sea pressures and water quality degradation; Atlantic and North Sea estuaries exposed to infrastructure pressures and hydromorphological change; and coastal wetlands threatened by habitat loss, disrupted connectivity and sea-level rise. This structure makes it possible to evaluate not only the performance of resilience measures, but also the conditions under which they can be applied in other environmental, social and governance contexts.

Under the scope of COAST-SCAPES the Core pilots will provide:

Mar Menor Case Study

- Practical guidance for resilient coastal management. The Mar Menor Case Study will develop a set of practical guidance to promote the implementation of resilient solutions in coastal areas. This will include, among others, a guide for the transition towards more resilient agricultural systems in coastal regions and a methodological guide for developing integrated resilience indicators that combine environmental, social, economic and governance dimensions.



Venice Lagoon Case Study

- Stakeholder engagement guideline. The RES-Plat activities will ensure continuity between REST-COAST and COAST-SCAPES projects in the effort of creating a stronger link between researchers, authorities and stakeholders to build trust and ensure a long-term collaboration. This effort aims at building a legacy that ensures that project activities are taken up and further developed after the project conclusion.
- Toolkit and assessments. Within the Venice Lagoon Case Study, modelling of water quality dynamics in current and future scenarios driven by climate change, land use and land cover change and solutions aimed at reducing risk and increasing resilience will be developed.



The chosen indicators and outcomes will be designed to support European Policies such as the Water Framework Directive and the Water Resilience Strategy in the form of risk and resilience assessments. These will identify risk hotspots and risk drivers together with solutions aimed at increasing resilience, directly informing authorities and decision-makers.

- Business planning and financing approaches. Building on previous experience, the Venice Lagoon Case Study will develop and test business planning approaches to support the long-term financing, implementation and maintenance of resilience measures. The resulting framework will help identify sustainable public financing and private investment opportunities and provide practical guidance for the wider uptake of Nature-based Solutions in coastal areas.

Wadden sea - Weser Estuary

- Within the Wadden Sea Case Study, modelling of coupled wave-hydro-morphodynamics as well as water quality dynamics in current and future scenarios driven by climate change and additional eutrophication scenarios (e.g. resembling land use and land cover change) will be undertaken. (Nature-Based) Solutions aimed at reducing risk and increasing resilience will be developed. Likewise, the chosen indicators and outcomes will be designed to support European Policies such as the Water Framework Directive and the Water Resilience Strategy in the form of risk and resilience assessments. These will identify risk hotspots, pathways and risk drivers together with solutions aimed at increasing resilience in formats suitable for directly informing authorities and decision-makers.
- The COAST-SCAPES RES-Plat activities will further develop and go beyond foundational steps laid in REST-COAST in close exchange with the authorities and stakeholders to ensure the inclusion of stakeholder perspectives and policy needs for a successful long-term collaboration.



COAST-SCAPES assesses climate and other environmental and socio-economic-driven risks, as well as the resilience under present conditions and future scenarios and policy options across interconnected land-coast-sea systems, taking into account the socio-economic and governance frameworks. By combining scientific analyses with stakeholder knowledge, the project identifies critical vulnerabilities, adaptation limits, synergies and trade-offs that influence resilience planning and implementation. The resulting evidence supports the co-design of adaptation pathways, resilience measures and governance arrangements, while addressing the gap between planning and implementation through Resilience Platforms (RES-plats), which bring together public authorities, scientists, businesses and civil society to co-design, implement and support long-term resilience measures, complemented by resilience indicators and financing approaches tailored to different coastal contexts.

Key lessons emerging from the project

- **Climate resilience depends on integrated planning**

Climate adaptation is most effective when land, coastal and marine environments are managed together as one interconnected system rather than through separate sectoral policies. Integrated planning reduces trade-offs between climate adaptation, biodiversity conservation, water management and regional development while increasing co-benefits across multiple policy objectives.

- **Nature-based Solutions require enabling governance**

Resilient coastal regions require more than technical solutions. Nature-based Solutions achieve sustainable impact when governance arrangements ensure stakeholder participation, institutional coordination, observation and monitoring for scientific evidence and sustained financing for continuity.

- **Science-policy collaboration improves decision-making**

The project demonstrates the value of permanent science-policy interfaces that connect researchers, public authorities, businesses and civil society throughout adaptation planning and implementation. Such collaboration improves the legitimacy, transparency and effectiveness of climate adaptation decisions.

- **Common assessment frameworks support replication**

Harmonised resilience indicators, integrated climate-risk assessments and scenario-based planning provide a common evidence base that enables adaptation approaches to be transferred and adapted across regions with similar climate challenges.

- **Long-term resilience requires sustainable implementation**

Adaptation measures deliver lasting benefits when supported by permanent science-policy collaboration, inclusive governance structures, maintenance planning and financing mechanisms that extend beyond project lifecycles.

Policy Implications and Recommendations

Priority 1. Establish permanent science-policy interfaces

Create mechanisms to ensure a living and permanent science-policy interface providing the best available knowledge to support both short-term (management) and long-term (planning) decisions.

The governance bodies established in the Mar Menor pilot, including scientific and participatory advisory structures, illustrate how institutionalised dialogue can improve the legitimacy, transparency and effectiveness of climate adaptation decisions.¹

Expected benefits

- Better-informed policy decisions
- Greater public trust and transparency
- Improved adaptation effectiveness

Priority 2. Require integrated land-coast-sea planning

Ensure that climate adaptation, biodiversity restoration, water management, land-use planning and coastal development are planned together using integrated land-coast-sea approaches.

The Priority Actions Plan developed in the Mar Menor provides an example of this integrated approach,² while the Venice Lagoon pilot demonstrates the value of combining integrated observation systems, scenario-based modelling and stakeholder engagement to support decision-making across the land-coast-sea continuum.³

Expected benefits

- Reduced policy conflicts and maladaptation
- Improved ecosystem resilience
- Greater efficiency of public investment

¹ <https://www.miteco.gob.es/es/prensa/ultimas-noticias/2025/febrero/aprobado-el-real-decreto-que-regula-los-organos-de-representacio.html>; <https://canalmarmenor.carm.es/ciencia/comite-de-asesoramiento-cientifico/>

² <https://miteco-map.gob.es/marmenor>

³ <https://www.sciencedirect.com/science/article/abs/pii/S0272771425003312?via%3Dihub>

Priority 3. Mainstream Nature-based Solutions into adaptation policy

Promote ecosystem restoration and Nature-based Solutions as core adaptation measures while supporting long-term maintenance, monitoring and adaptive management. The ecological collapse of the Mar Menor demonstrates how the environmental, social and economic costs of ecosystem degradation can far exceed the investments needed to protect and restore natural systems, highlighting the importance of communicating the value of ecosystem services. In the Wadden Sea case, saltmarshes are already an integral part of a nature-based coastal protection strategy; However, their future effectiveness will depend on sustainable management and maintenance strategies that enable them to adapt to changing climate conditions.

Expected benefits

- Reduced climate risks
- Enhanced biodiversity
- Sustained ecosystem services supporting communities and local economies

Priority 4. Strengthen resilience assessment frameworks

Develop harmonised climate-risk and resilience assessment methods that enable decision-making participatory processes, as well as comparison, observation, monitoring and replication of successful adaptation approaches across regions. Engaging public authorities, stakeholders and local communities, together with the use of harmonised indicators and scenario-based assessments, can improve the evaluation of climate risks, adaptation options and resilience outcomes. The Venice Lagoon pilot demonstrates how integrated modelling under present and future scenarios can support evidence-based planning in complex coastal systems.

Expected benefits

- More consistent evidence for decision-making
- Faster uptake of successful practices
- Improved policy evaluation

Priority 5. Support long-term financing for climate resilience

Complement project-based funding with financing mechanisms that support the implementation, maintenance and scaling of adaptation measures beyond individual funding cycles.

Expected benefits

- Greater durability of adaptation investments
- Increased private-sector participation
- Improved long-term resilience

Priority 6. Promote knowledge transfer between regions

Support structured knowledge exchange, peer learning and replication mechanisms that enable regions to adapt successful resilience approaches to their own environmental and governance contexts.

Expected benefits

- Faster implementation of effective adaptation measures
- Reduced duplication of effort
- Greater European added value from research investments

Project information

Project	rethinking COASTal landSCAPES with climate-resilient interventions: systemic land-to-sea solutions (COAST-SCAPES)
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Programme	Horizon Europe – Mission Adaptation to Climate Change
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