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Governance Challenges for the Adaptation to Sea-Level Rise in the Canary Islands: A Multilevel Approach

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Abstract

Island territories are particularly vulnerable to climate change due to their geographical isolation and environmental characteristics, as highlighted in the Intergovernmental Panel on Climate Change *Sixth Assessment Report*. In the Canary Islands, sea-level rise is a critical impact of climate change, affecting several coastal ecosystems, including beaches, dunes, and wetlands, as well as infrastructure and residential areas, which in turn significantly impacts tourism and housing. This study examines the existing climate change legislation and norms, focusing particularly on the islands' adaptation to sea-level rise as a socio-ecological system. It also analyses the intentionality and substantiality of these measures within a multilevel governance framework. Accordingly, this research provides an initial approach to constructing and studying the main governance network concerning sea-level rise in the Canary Islands through a combination of experiences, events, and mechanisms. Conflicts were identified between legislation and the implementation of adaptation measures, where the timescale for the latter is not aligned with the climate emergency. The study highlights coordination gaps that hinder effective adaptive management in the face of climate change. The findings emphasize the need for enhanced inter-institutional collaboration and propose mechanisms to harmonise policies, mitigate conflicts, and improve governance. Strengthening governance capacities in the Canary Islands could provide a model for other island territories facing similar challenges and contribute to global efforts to address the climate emergency and ensure sustainable development in vulnerable coastal regions. This is the first study to focus on the coastal governance in the Canary Islands in relation to sea-level rise.

Keywords
Canary Islands; climate change adaptation; coastal management; multilevel governance; ocean governance; sea-level rise

1. Introduction

Climate change represents one of the most important crises of the present century, with impacts on the environment, society, and economy. The Intergovernmental Panel on Climate Change (IPCC) has reported an increase in impacts such as global warming, extreme weather, ocean acidification, and rising sea-levels. These are all affecting ecosystems and human society (IPCC, 2023). These impacts are becoming more severe in island ecosystems, which are more vulnerable than continental ecosystems (Nurse et al., 2014), making adaptation essential (Betzold, 2015). This is due to their geographic isolation, limited territory size, dependence on external resources, and vulnerability to extreme weather events (Correa et al., 2025; Kelman & West, 2009; Mycoo et al., 2022). Rising sea-levels pose an especially serious threat to islands due to the increased risk of coastal flooding, saltwater intrusion into aquifers, and the loss of important ecosystems such as mangroves, wetlands, and beaches (Church et al., 2013; van den Hurk et al., 2024). However, other impacts are also considered to be of anthropogenic origin, such as reduced sediment supplies due to streamflow obstructions, urbanisation and habitat loss in exposed coastal areas, a lack of sustainable groundwater strategies, and ageing coastal infrastructure (van den Hurk et al., 2024). This is a common challenge for the entire EU, given the importance of its coasts for its growth (Tocco et al., 2024).

In this sense, the governance of coastal adaptation in the Canary Islands (the study area of the current research) poses a significant challenge due to the territory's unique characteristics. Located in the northeastern Atlantic, the Canary Islands are an outermost region of the EU and comprise eight islands with an area of around 515 km from east to west (Figure 1). The region covers an area of around 7,447 km^2, making it the largest in the Macaronesia region (Fernández-Palacios & Dias, 2001; Pérez-Chacón Espino et al., 2019), with around 52% of the territory under some form of protection. The trend of the impacts of

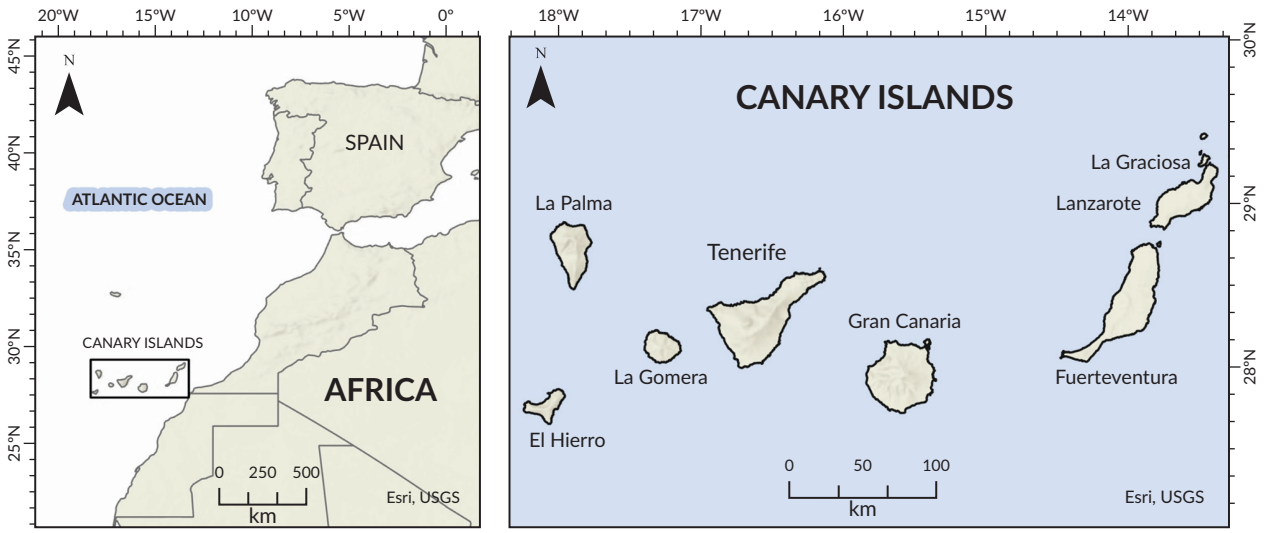

Figure 1. Study area: Location of the Canary Islands.

climate change has been studied there. Primary effects such as temperature (Correa et al., 2025) and ocean warming and acidification (González-Dávila & Santana-Casiano, 2023), for example, have been analysed for over 25 years, and there is clear evidence of these effects in the region. Other related impacts, such as tropical storms near the islands, precipitation, and tropical nights, have also been studied (Antequera et al., 2018; Correa et al., 2025; López-Díez et al., 2019). In fact, a climatic atlas (Söllheim et al., 2024) and projections (Carrillo et al., 2022; Expósito et al., 2015) under different scenarios have been developed to enhance understanding of potential future impacts in the Canary Islands.

Focusing on the sea-level rise in the Canary Islands, Vargas-Yáñez et al. (2023) reported an increase of 1.09 ± 0.14 mm yr^{-1} for the period between 1948 and 2019 using tide-gauge data and an increase of 2.7 ± 0.4 mm yr^{-1} from 1993 to 2019 using altimetry data. Additionally, Marrero-Betancort et al. (2022) reported the sea-level anomaly from 1993 to 2019 using satellite estimation, finding a total rise of approximately 8 cm during this period. This suggests that the increase will reach 18 cm by 2050, which will affect the islands' coastal environment and economy. The impacts also include dune systems, wetlands, and marine habitats (Peña-Alonso et al., 2018), as well as economic infrastructure such as ports, hotels, and residential developments. These are increasingly vulnerable to flooding, which could have severe economic consequences for the tourism industry and local livelihoods (García-Romero et al., 2023). Accordingly, projections of sea-level rise in the Canary Islands have been carried out (Gobierno de Canarias, 2022) to identify critical areas and infrastructures, the economic impact, and the number of people affected by the coastal flooding. The proposed solutions to mitigate this impact mainly focus on hard infrastructure (engineering) and nature-based solutions as proposed by Lise et al. (2025), which imply a transformation of the land–sea interface or a change in the maritime competencies. This is particularly pertinent in the context of the Canary Islands, where urban areas are highly affected (Gobierno de Canarias, 2022).

According to Tocco et al. (2024), the governance of coastal adaptation should include environmental, economic, social, and scientific information in order to address the challenges posed by sea-level rise, a global hazard. They proposed three recommendations to this end: "1) the effective implementation of EU marine and coastal legislation's fundamental principles related to an integrated approach; 2) the development of new governance mechanisms to enhance policy coordination, and 3) the development of collaborative governance processes" (Tocco et al., 2024). Moreover, multiple stakeholders must be involved in decision-making processes (Ferraro & Failler, 2024a). If coastal governance is considered the framework for compromising institutional, structural, and legal arrangements (Stephenson et al., 2019), then the confluence of heterogeneous management is mandatory when considering conflicts and difficult policy integration (Van Assche et al., 2020). This is particularly evident in the Canary Islands in relation to mainland Spain due to the confluence of legal competencies related to the decentralised structure between different administrations (from local to national level). Even though climate change governance has been in place for over 30 years, it is still in the process of being developed. Most efforts have focused on mitigation, but this is particularly true of adaptation, where political prioritisation and scientific development are needed because greenhouse gases remain in the atmosphere for a long time and their impacts will be felt for years. In addition, the science–policy interface for adaptation is still evolving, and governance structures are mainly reactive rather than anticipatory, although the impacts of climate change are well understood in many regions, including the Canary Islands. This global problem requires governments to reach credible agreements (Jordan et al., 2018), and, in terms of administrative systems, poses a significant challenge (Meadowcroft, 2009), primarily due to the inertia that hinders effective and timely responses.

When the focus is on a case like the Canary Islands, the coastal adaptation has to take into account the governments of European, national, regional, and island (cabildos, seven in total) levels, as well as the municipalities (88, of which 77 have coastal zones). The Regional Law on Climate Change and Energy Transition (2022) establishes a framework for climate mitigation and adaptation, addressing areas such as land use planning, infrastructure design standards, and risk assessment. Additionally, this law allocates certain responsibilities to cabildos and municipalities with regard to adaptation plans. Other sectoral laws are clearly related to adaptation strategies, such as those concerning coastal protection, urban development, and water management. Despite the importance of coastal areas to the Canary Islands' economy, there are no specific policies in place to integrate coastal and maritime management (García-Sanabria et al., 2011). This complexity highlights the need for analysis and recommendations to be implemented. To this end, the objectives of this article are:

- To examine existing laws, policies, and regulations in the Canary Islands that address climate change adaptation to sea-level rise.
- To analyse the intentionality and substantiality of legal policy and instruments at the multi-scale level (from European to municipal) associated with climate change adaptation in the context of sea-level rise.
- To identify governance challenges, including conflicts between legislation and the implementation of adaptation measures.
- To assess coordination gaps that hinder effective adaptive management, and to propose mechanisms for improved inter-institutional collaboration.

This research aims to enhance climate governance by shedding light on the unique challenges faced by highly vulnerable insular regions such as the Canary Islands.

2. Methodology

This study employs a multilevel policy analysis framework to assess governance structures responding to sea-level rise adaptation in the Canary Islands. For this purpose, we undertook a review of institutional instruments (e.g., policies, legislation, and plans) that are focused on climate change and sea-level rise. Our methods span content analysis of various policy documents with a structured evaluation framework developed using intentionality and substantiality based on the research of Elrick-Barr and Smith (2021) and built on the conceptualisation of Dupuis and Biesbroek (2013). This is the first study of this nature in the region.

2.1. Policy and Instruments Selection

We consider intentionality as the level to which the policy explicitly incorporates climate change adaptation, especially concerning sea-level rise, as a primary objective. In this case, intentionality demonstrates the design of a policy as a response to climate threats for coastal areas. We consider substantiality as the extent to which the policy includes solid, actionable, and enforceable measures to assist with adaptation efforts. This comprises the various implementation tools, measures of success, legally binding structures or enforceability, and operationalized plans.

The manuscript is organized as follows: (a) the current state of sea-level impacts in the region and their impacts on different sectors; (b) the description of the multilevel legal framework to attend the risk of sea-level rise, and the importance of the Law of Climate Change and Energy Transition (Comunidad Autónoma de Canarias, 2022) in the Canary Islands; (c) analysis the intentionality and substantiality of legal policy and instruments at the multi-scale level associated with climate change adaptation to sea-level rise; (d) the normative conflicts, institutional fragmentation, and barriers to effective adaptation in the Canary Islands; and eventually, (e) the recommendations for coastal adaptation governance in this case study. The study was conducted at four different scales, each of which has competence in the Canary Islands: national, regional, insular, and local.

2.2. Analysis

The current research has attempted to critically evaluate information in order to improve our understanding of public policy and make it better (Dunn, 2015; Vogel & Henstra, 2015). However, there is no universally accepted methodology for conducting policy analysis. Instead, the choice of method largely depends on the analysis's specific objectives, for example, whether the focus is on policy content or the policymaking process (Dunn, 2015). This analysis draws on the conceptual framework established by Dupuis and Biesbroek (2013) to help policy analysts assess the scope and intent of climate change adaptation policies. We have refined this framework by transitioning it from a purely conceptual model to an analytical tool. This has been achieved by introducing a rating system that evaluates policy instruments based on their degree of intentionality and substantiality, as defined by Elrick-Barr and Smith (2021), but adapted to three categories: low, moderate, and high (see Table 1). Intentionality, defined as the presence of a deliberate aim or plan, has its origins in psychological theory as an extension of causal models of behaviour (Turner, 2017). In a policy context, intentionality reflects the extent to which a policy deliberately targets a specific issue. Accordingly, instruments were considered intentional if coastal management constituted their primary objective. Integrated Coastal Zone Management, for instance, aims to sustain, restore, or enhance coastal ecosystems and the benefits that humans derive from them (Olsen, 2003). Therefore, a policy instrument was classified as intentional if it explicitly addressed coastal zone management and the preservation of coastal values.

To analyze both intentionality and substantiality, we applied a three-tier rating scale (Table 1): Low (1) = no or limited reference to adaptation in the context of sea-level rise; moderate (3) = partial or indirect reference to adaptation in the context of sea-level rise by including some relevant provisions; and high (5) = clearly and directly focused on adaptation in the context of sea-level rise with mechanisms or mandates for implementation. In this evaluation, we emphasize the climate adaptation component of each policy, regardless of whether adaptation was the initial or dominant objective. We recognize that some documents were meant to serve as strategic frameworks rather than operational plans; this distinction is considered in their substantiality ratings. In total, we reviewed 28 policies and plans at the five governance levels: International and EU—EU Strategy on Adaptation to Climate Change; national (Spain)—Law 7/2021, of 22 April, on Climate Change and Energy Transition; regional (Canary Islands)—Law 6/2022, of 2 November, on Climate Change and Energy Transition in the Canary Islands; island (Cabildos)—Island Spatial Plans (PIOs); and municipal—General Urban Development Plans (PGOUs).

For each policy we have documented, we recorded: legal and institutional coverage, intended objectives, types and strength of adaptation instruments, territorial coverage, and stage of operationalisation. In addition to scoring individual policies, we also considered barriers to effective adaptation by assessing the

Table 1. Intentionality and substantiality rating scale.

Rating	Intentionality	Substantiality
Low (1)	No intent to address coastal issues or values	Does not address values, threats, or actions
	Coastal issues and values are incidental to the focus of the instrument	Addresses one of three in part
Moderate (3)	Coastal issues are noted, values are not reported, and other issues (beyond coastal) are of greater focus	Addresses two of three in part; or one comprehensively
	Coastal issues are a partial focus; values are partially (e.g., indirectly addressed) or not addressed	Addresses three in part; or one comprehensively and one in part
High (5)	Coastal issues are a key focus, values are considered (perhaps indirectly), and the coast receives equal or greater attention than other issues	Addresses one comprehensively, two in part; or two comprehensively
	Coastal issues and values are a major (but not sole) focus of the instrument	Addresses two comprehensively, one in part
	The absolute intent of the instrument is on coastal issues and values	Addresses values, threats, and actions comprehensively

degree of fragmentation, failure in coordination, and time-lag between impacts of climate change and planning cycles. The types of barriers were determined from a grounded approach and literature (e.g., Ferraro & Failler, 2024a; Meadowcroft, 2009) and then analysed in the context of the multilevel governance system of the Canary Islands.

3. Results and Discussion

3.1. High-Level Risk in the Canary Islands due to the Sea-Level Rise

Before presenting results, we provide a contextual summary of the biophysical and socio-economic exposure of the Canary Islands to sea-level rise. To the Plan de Impulso al Medio Ambiente (PIMA), specifically the PIMA Adapta Costas in the Canary Islands (Gobierno de Canarias, 2022). This study is one of the most effective ways of highlighting the socio-economic areas that will be affected by rising sea-levels. Understanding the potential impacts of different climate scenarios enables the development of targeted public policies and the analysis of the regulatory framework, thereby enhancing governance in coastal adaptation in the Canary Islands.

These studies, which were carried out throughout Spain, form part of the National Plan for Adaptation to Climate Change (PNACC) and aim to provide a more precise regional analysis of the impact of rising sea-levels on coastal areas. The risk of sea-level rise was studied in relation to the population, infrastructure, productive sectors, tourist beaches, cultural and natural heritage, and coastal ecosystems. The number of people affected could range from 558 people (representative concentration pathways [RCP] 4.5, the most favourable scenario) to over 46,000 (RCP 4.5 and a return period of 500 years). Of these people, 55% would be directly affected, and the remaining 45% indirectly. In terms of critical infrastructure, hospitals, airports,

motorways, water treatment, and supply stand out as particularly affected. A total of 127 infrastructures will be affected, of which 23 show the least favourable scenario (Figure 2a, high critical level) and 104 present the most favourable scenario (Figure 2a, critical level), mainly on the island of Gran Canaria. Beach erosion is another major consequence of sea-level rise in a region where sun and beach tourism dominate.

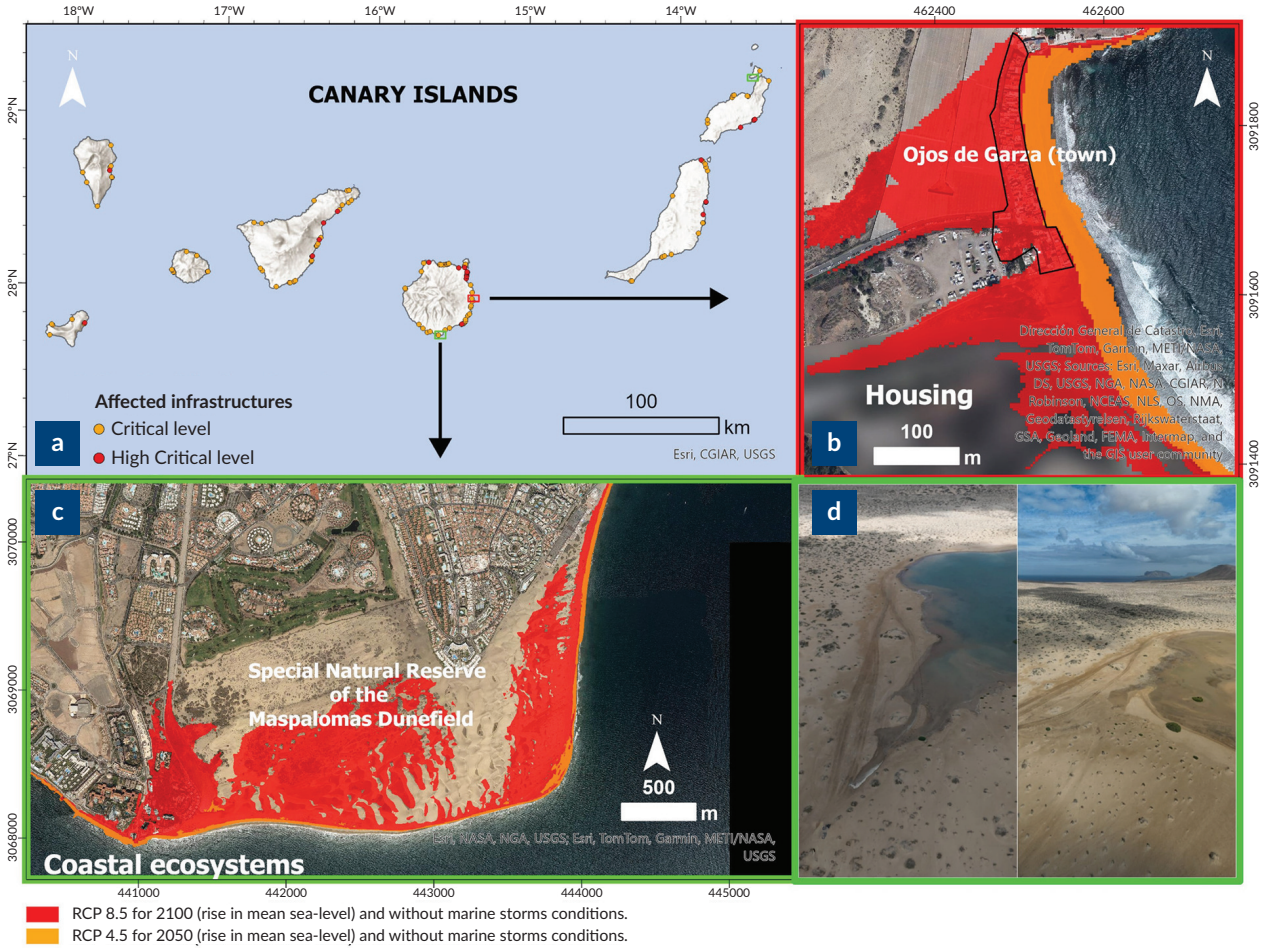

Figure 2. Results obtained through PIMA Adapta Costas in the Canary Islands Project: (a) location of the infrastructures affected by sea-level rise; (b) example of a residential area (housing) affected by sea-level rise with RCP 4.5 and 8.5 projections; (c) example of a coastal ecosystem that will be flooded and eroded by sea-level rise; (d) coastal ecosystem flooded currently when marine storms and equinoctial tides are produced in La Graciosa Island.

According to this study, the global surface area of tourist beaches could shrink by between 29.5% and 45.2%, which equates to the loss of up to 150 beaches in the RCP 4.5 scenario and 153 beaches in the RCP 8.5 scenario. This equates to an annual loss of capital related to beaches ranging from 2,940,324,000 euros per year in RCP 4.5 to 4,520,910,000 euros per year in RCP 8.5. This equates to approximately 10% of the islands' GDP. Within the framework of PIMA Adapta Costa in the Canary Islands (Gobierno de Canarias, 2022), 47 areas of high accumulated risk have also been identified that require urgent attention. This vulnerability is exacerbated by a dense, tourism-driven urban footprint, limited available land for retreat, and complex jurisdictional arrangements across five levels of government.

3.2. Multilevel Legal Framework for Sea-Level Rise Risk Management in the Canary Islands

The legal framework for adapting to sea-level rise in the Canary Islands is organised as a complex, multilevel governance system that defines the powers of the state, regions, islands, and local authorities. This legal system underpins the planning, administration, and decision-making processes intended to reduce the territories' susceptibility to coastal hazards. For example, the Canary Islands' climate change and energy transition law clearly identifies the role of the other administrations, such as cabildos and municipalities, which also have their own plans and regulations that interact with the legal framework in terms of climate adaptation, as shown above. This cascading legal influence affects planning decisions and infrastructure, as well as shaping how local risks are assessed and managed. Figure 3 illustrates the multilevel governance structure concerning sea-level rise adaptation in the Canary Islands. It schematically identifies the different administrative levels and their roles; however, it does not reflect the intensity, quality, or effectiveness of coordination mechanisms between these levels. These dimensions are further analysed in Section 3.5 on institutional fragmentation and coordination gaps. This current research examines several important legal tools pertinent to climate change and sea-level rise in the Canary Islands, ranging from national to insular levels. One of the primary obstacles to climate management in remote areas such as the Canary Islands is the overlapping powers of different administrative entities, which can result in divided government, implementation delays, and difficulties in achieving horizontal and vertical coordination. Table 2 shows the different laws and plans, and the administration responsible for them. Regarding climate adaptation and risks in the Canary Islands, the table shows the legal tools and the need for integration across scales to ensure adaptive, responsive, and effective multilevel governance.

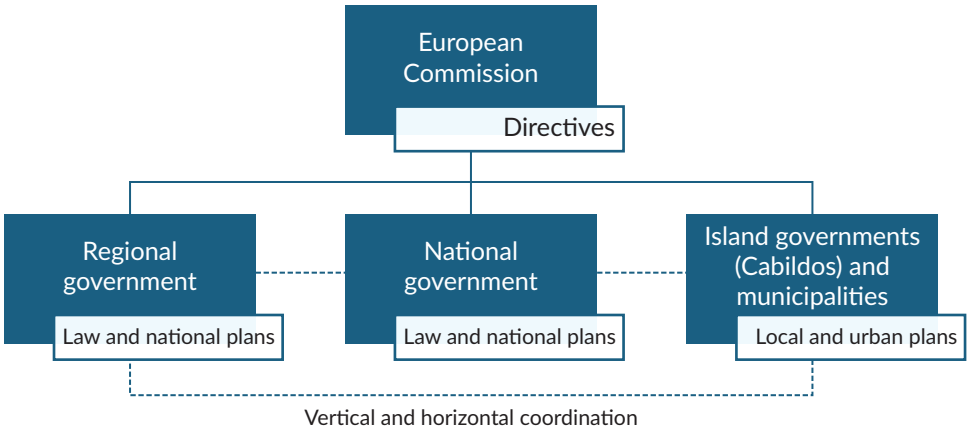

Figure 3. Schematic governance structure for the sea-level rise in the Canary Islands.

At the international level, the EU has worked towards a comprehensive framework for coastal action, recognising the importance of coasts in the different countries. Examples include the UN 2030 Agenda for Sustainable Development, the UNCLOS, and the Integrated Coastal Zone Management. The European Commission's Cabildo maritime spatial planning and 2008 Maritime Strategy Framework Directives are also important as they affect the reorganisation of coastal zones in relation to climate change. In direct relation to climate change, the EU adopted the EU Strategy on Adaptation to Climate Change in 2021, which recognises the urgent need for member countries to take action on rising sea-levels.

At a national level (Table 2), Spain's Coastal Law (Law 22/1988 of 28 July) plays a central role in controlling, protecting, and planning the use of the public maritime-terrestrial domain. Given the identified impacts in the Canary Islands, it is sensible for the organization of coastal uses to be addressed. In addition, the implementation of adaptation policies is required, such as restricting construction or urban planning in regions vulnerable to sea-level rise. This law actually defines servitudes and coastal protection zones. In terms of climate change, some articles must be highlighted. Management of the public maritime-terrestrial domain must guarantee climate change adaptation measures (Article 2). Article 44 requires project planning to include assessments of the effects of climate change. Regarding concessions, Article 66 stipulates that project durations must reflect authorised government initiatives for beach regeneration and erosion control. According to Article 76, concessions must take steps dictated by the government to adapt to sea-level rise and other environmental impacts. Article 116 clarifies inter-administrative connections by requiring data sharing, cooperation, and coordination at all levels of government.

Table 2. Summary of legal instruments analysed in the current investigation.

Policy/Instrument	Level of governance
UN 2030 Agenda for Sustainable Development	European
UNCLOS	
The Maritime Spatial Planning Directive (2014/89/EU)	
The Maritime Strategy Framework Directive (2008/56/EC)	
EU strategy on Adaptation to Climate Change 2021	
Law 22/1988, of 28 July 1988, on Coasts	National
Law 2/2013, of 29 May, on the protection and sustainable use of the coast and modification of Law 22/1988, of 28 July, on Coasts	
Law 26/2007, of 23 October 2007, on Environmental Liability	
Law 21/2013 of 9 December 2013 on environmental assessment	
Organic Law 1/2018, of 5 November, on the reform of the Statute of Autonomy of the Canary Islands	
Law 7/2021 of 20 May on climate change and energy transition	
PNACC 2021–2030	
Law 14/2014 of 26 December 2014 on Harmonisation and Simplification in the Protection of the Territory and Natural Resources	Regional
Law 4/2017, of 13 July, on the Land and Protected Natural Spaces of the Canaries	
Law 6/2022, of 27 December, on climate change and energy transition in the Canary Islands	
Decree-Law 5/2024 (Amendment of Law 6/2022)	
Canary Islands Climate Action Strategy 2030	
Canary Islands Climate Action Plan	
PIOs	Island
PGOUs	Municipalities

Following the introduction of Law 2/2013 on 29 May regarding the protection and sustainable use of the coastline, this legislation was revised to impose stricter limits on urban development in areas susceptible to coastal erosion. Another significant piece of national legislation is the Environmental Liability Law

(Law 26/2007 of 23 October), which establishes the groundwork for preventing and restoring environmental damage. Although it does not explicitly mention climate change, the increasing sea-levels that contribute to ecosystem destruction must be considered, along with the related obligations of public officials and commercial enterprises.

The Environmental Assessment Law (Law 21/2013 of 9 December) is essential for adaptation measures. This law requires impact evaluations for developments likely to cause significant damage to coastal areas prone to sea-level rise. The significance of incorporating climate change into tactical and technical reports is emphasized in Articles 18 and 24. Article 3 of the law also emphasises cooperation between the national administration and independent communities, thereby underlining the need for vertical coordination in its opening remarks and Article 2.

The regional government (Table 2) has certain responsibilities relating to coastal management, environmental protection, and land use planning under the Statute of Autonomy of the Canary Islands (Organic Law 1/2018). This provides the regional government with the legislative and administrative capacity to develop environmental adaptation measures. The Canary Islands Land and Protected Natural Areas Law (Law 4/2017) provides tools that enable sustainability and climate adaptation requirements to be integrated into spatial planning. This enables territorial planning to encourage risk management and impose land use limitations in susceptible regions. Article 102 assigns the island councils, cabildos, the task of creating and ratifying PIOs, provided that they can consider possible environmental effects, including those related to climate change. Although the Territorial Planning Law (Law 9/1999) does not explicitly refer to climate change, it governs land usage in the Canary Islands and includes clauses for planning in coastal areas subject to risk. This law also addresses sea-level rise and flooding.

At the island level (cabildos, see Table 2), the PIOs have become strategic instruments for long-term territorial management. Some cabildos have started to include environmental risk evaluations, flood modelling, and projections of coastal retreat for 2050 and 2100. Several coastal municipalities are adding land-use regulations based on exposure to coastal risk to their local urban development plans. Such updates support the precautionary principle and align with local legislation aimed at ensuring regional safety and preserving natural and cultural heritage. Using Gran Canaria as an example, the PIO must account for local hazards, including sea-level rise. It is a vital tool for managing regions prone to flooding. The Flood Risk Management Plan for Gran Canaria also identifies sensitive areas and proposes measures to minimise damage, which is highly relevant for planning coastal housing developments.

This picture of laws and norms could be improved if the impact of rising sea-levels on essential infrastructure were taken into account, as reported by the PIMA Adapta Costas (Gobierno de Canarias, 2022). This includes airports, water infrastructure, and transportation networks, for example:

- Particularly under Articles 92–104 of the Water Law (Royal Legislative Decree 1/2001, of 20 July), the safeguarding of water infrastructure is governed.
- Hydrological plans based on the EU Water Framework Directive (2000/60/EC) must include measures for water security and climate adaptation.
- The Critical Infrastructure Protection Law (April 28, 2011) provides strategic responses to natural hazards.

- Many of the roads affected by extreme weather events linked to climate change are covered by the National Roads Act (Law 37/2015) and the Canary Islands Roads Act (Law 9/2003), which govern road planning, construction, and management.

The Canary Islands have a sophisticated legal framework for managing coastal risks and adapting to climate change. However, the multiple levels of administrative complexity make it challenging. Efficient coordination and rapid response are hampered by overlapping duties and legal dispersion. Creating a robust governance system capable of handling the growing threat of sea-level rise requires institutional collaboration at all levels, from vertical to horizontal.

3.3. Climate Change Laws and Sea-Level Rise in Spain and the Canary Islands

In addition to the various legal frameworks relating to the impact of climate change on coastal areas, recent climate change legislation must be considered and analysed at the national and regional levels to find solutions for coastal management governance.

At the national level, Law 7/2021 on Climate Change and Energy Transition is the main legal framework for tackling climate-related issues in Spain. It includes guidelines for adapting to the impacts of climate change, such as sea-level rise, and requires all levels of government (national, regional, and local) to incorporate these risks into their policy frameworks. Regarding coastal planning, Law 7/2021 supplements Spain's Coastal Law by introducing the concept of "non-regression in environmental protection" and encouraging nature-based solutions for coastal defence. It particularly supports the restoration of coastal ecosystems, such as dunes, wetlands, and marshes, as a key strategy to enhance resilience and safeguard people and property from sea-level rise. However, its failure to provide for island territories, including the Canary Islands, makes enforcement of this law difficult. Here, aggressive coastal urbanisation, high tourism pressure, and geomorphological vulnerability require more targeted adjustment policies with committed and sustained financial resources.

The National Climate Change Adaptation Plan 2021–2030 is one of the most important tools for tackling sea-level rise. It is legally binding and is explicitly mentioned in Article 17 of Law 7/2021. According to the Plan, coastal regions are among the most sensitive sectors to climate change due to threats such as shoreline erosion, saltwater intrusion, permanent or occasional flooding, and loss of ecosystem products and services. The first priority is to improve early warning systems for marine risks, followed by incorporating sea-level projections into urban and territorial planning, and creating local adaptation plans for sensitive coastal areas. However, effective implementation in small regions such as the Canary Islands still requires locally appropriate strategies, including guaranteed funding and improved technical and administrative capabilities. Despite the national plan's recognition of increased sea-level hazards, its effectiveness will depend heavily on the adoption of regulations at the local, island, and municipal levels. Furthermore, pertinent for successful policy translation will be the creation of operational metrics and instruments tailored to extreme regional circumstances will be pertinent for successful policy translation. Due to the cross-cutting nature of climate change policy, the law also requires institutional coordination, emphasising inter-administrative cooperation as set out in Articles 2 and 17, among others.

At the regional level, Law 6/2022, on Climate Change and Energy Transition in the Canary Islands, which was developed by the government of the Canary Islands, is the archipelago's first comprehensive legal

framework aimed at establishing a structured governance system to address climate change. Partially amended and extended by Decree-Law 5/2024, the legislation incorporates mitigation and adaptation measures that take into account the unique territorial, social, and economic characteristics of the islands. Its main objectives include defending coastal areas and marine-coastal ecosystems against the effects of climate change, particularly rising sea-levels, which the Law identifies as one of the main long-term risks to territorial security. The Law incorporates the principles of ecosystem-based adaptation and precaution in the face of climate change. It requires all levels of Canary Islands administration and each Cabildo to incorporate climate change projections into spatial, environmental, and infrastructure planning processes. The Law will be implemented through two tools: the Climate Action Strategy and the Climate Action Plan. The Climate Action Strategy encourages collaborative planning at many levels, bringing together the government, cabildos, and municipalities, and inviting people to contribute, particularly in relation to areas of the coastline at risk of change or relocation. The Climate Action Plan will serve as the operational framework for implementing sectoral adaptation measures. It is expected to explicitly identify the coastal zones that are most vulnerable to sea-level rise, including: risk maps, projections of the impact on critical infrastructure (e.g., roads, ports, and sewage systems), and island-specific strategies. Decree-Law 5/2024 reinforces the obligation for island and municipal administrations to incorporate climate vulnerability assessments into spatial and sectoral planning instruments. This addition strengthens the legal mandate for evidence-based territorial governance in response to climate threats. However, funding from Spain and Europe is required for this to work. Additionally, local stakeholders are required to ensure the preservation of traditions and heritage. This is why the Climate Action Strategy states that islands and municipalities must be prepared with training courses, risk and vulnerability maps, and coastal adaptation measures. However, one of the key challenges is integrating the current climate governance into the existing interdisciplinary legislation, such as that relating to biodiversity and infrastructures. Climate change impacts must be considered holistically and in isolation.

3.4. Analysis of the Intentionality and Substantiality of Legal Policy and Instruments at the Multi-Scale Level

Table 3 provides a comparative assessment of five international and EU-level governance instruments, based on their level of intention and substance with regard to adapting to sea-level rise. The UN 2030 Agenda and UNCLOS demonstrate limited direct action, with moderate and low intentionality, respectively, reflecting their broad or outdated scope. In this sense, they include climate goals without obligations or implementation pathways for sea-level rise, resulting in a moderate or low intentionality and low substantiality. The Maritime Spatial Planning Directive and the Marine Strategy Framework Directive demonstrate moderate levels of both criteria, explicitly incorporating climate change considerations, albeit not as central mandates. The EU Strategy on Adaptation to Climate Change (2021) stands out due to its high level of intentionality, as it explicitly prioritises resilience and sectoral adaptation. However, its level of substantiality remains moderate due to implementation challenges.

Table 4 analyses the intentionality and substantiality of key Spanish national and regional governance instruments concerning sea-level rise adaptation. Although laws such as Law 22/1988 and Law 2/2013 demonstrate a high level of intentionality with regard to coastal protection, their substantiality is moderate due to outdated frameworks or uneven implementation. Instruments such as the Environmental Liability Law and the Environmental Assessment Law have moderate relevance and limited direct application to

Table 3. Analysis of intentionality and substantiality of the legal policy and instruments at the European level in current research.

Policy/Instrument	Intentionality	Substantiality	Analysis
UN 2030 Agenda for Sustainable Development	Moderate	Low	While it sets broad goals like SDG 13 ("climate action"), it lacks specific mandates for sea-level rise adaptation
UNCLOS	Low	Low	UNCLOS does not explicitly address sea-level rise, leading to legal ambiguities regarding maritime boundaries
Maritime Spatial Planning Directive (2014/89/EU)	Moderate	Moderate	Encourages consideration of climate change impacts, including sea-level rise, in maritime spatial plans. Needed for the zonification of coastal areas and industrial uses
Marine Strategy Framework Directive (2008/56/EC)	Moderate	Moderate	Aims for a good environmental status of marine waters, indirectly supporting adaptation through ecosystem-based approaches
EU Strategy on Adaptation to Climate Change (2021)	High	Moderate	Sets out a comprehensive framework for climate resilience, emphasizing adaptation across sectors, including coastal areas. It is the basis for the climate change laws at the national level

Table 4. Analysis of intentionality and substantiality of the legal policy and instruments at the Spanish (national) level in current research.

Policy/Instrument	Intentionality	Substantiality	Analysis
Law 22/1988, of 28 July 1988, on Coasts	High	Moderate	Establishes coastal protection zones but predates current climate change challenges. Actions at the coastal level have to be in agreement with this law
Law 2/2013, of 29 May, on the protection and sustainable use of the coast and modification of Law 22/1988, of 28 July, on Coasts	High	Moderate	Updates the 1988 Law, incorporating sustainable use principles, yet vertically coordinated implementation
Law 26/2007, of 23 October 2007, on Environmental Liability	Moderate	Low	Focuses on environmental damage prevention and remediation, with limited direct application to sea-level rise
Law 21/2013 of 9 December 2013 on environmental assessment	Moderate	Moderate	Requires environmental assessments for plans and projects, potentially integrating sea-level rise considerations
Law 7/2021 of 20 May on climate change and energy transition	High	Moderate	Establishes a framework for climate action, including adaptation measures relevant to coastal areas. It highlights the necessity of horizontal and vertical coordination
PNACC 2021–2030	High	High	Provides a strategic approach to adaptation, identifying coastal zones as priority areas. The national base product is later applied to local regions

Table 4. (Cont.) Analysis of intentionality and substantiality of the legal policy and instruments at the Spanish (national) level in current research.

Policy/Instrument	Intentionality	Substantiality	Analysis
Organic Law 1/2018, of 5 November, on the reform of the Statute of Autonomy of the Canary Islands	Moderate	Moderate	Provides the Canary Islands with the legal and institutional framework to design and implement adaptive policies to vulnerabilities of the region's coastal zones

sea-level rise. While Law 7/2021 and PNACC 2021–2030 have relatively high intentionality scores because they specifically mention climate change adaptation and identify sea-level rise as a national priority, there are only moderate substantiality scores due to implementation relying heavily on subnational entities and especially weak enforcement mechanisms in outermost regions, including the Canary Islands. While the Coastal Law (22/1988) recognizes high intentionality in protecting the littoral, its age and partial updates mean it does not apply adaptation tools evenly, hence moderate substantiality. The Organic Law 1/2018 strengthens the Canary Islands' regional autonomy, enabling them to develop localised adaptation strategies.

Table 5 presents a systematic evaluation of regional legislative and strategic instruments in the Canary Islands concerning their intentionality and substantiality in addressing sea-level rise adaptation. Organic Law 1/2018 and other legislation, such as Law 14/2014 and Law 4/2017, while not particular to climate issues, grant the Canary Islands autonomy to legislate on environmental issues, show moderate levels in both elements, and provide institutional competencies and regulatory frameworks to indirectly assist in adaptation processes. In contrast, Law 6/2022 and this policy's amendment through Decree-Law 5/2024 provide high levels of policy intentionality and substantiality as they specifically include climate change adaptation, especially for coastal impacts, into the regional legal framework and require the inclusion of climate projections in spatial planning. These features explain its high intentionality and substantiality. Additionally, both the Canary Islands Climate Action Strategy 2030 and the Climate Action Plan operationalise long-term resilience objectives through actionable, evidence-based measures, including ecosystem-based adaptation and infrastructure planning. Collectively, show an evolutionary shift towards a more integrated and adaptive model of governance in the subnational and local context. They excel in both dimensions of the score due to their implementation orientation and being multilevel instruments.

Finally, Table 6 evaluates the effectiveness of local-level planning instruments in Gran Canaria in adapting to sea-level rise. PIOs exhibit moderate intentionality and substantiality, offering a structural framework for land use that can incorporate adaptive strategies. Similarly, PGOUs are also moderately intentional and substantial, though their effectiveness varies based on local governance capacity and commitment. Overall, while these instruments provide entry points for adaptation, their implementation remains context-dependent and uneven.

A comparative analysis of international, national, regional, and local governance instruments reveals an evolving yet fragmented framework for adapting to sea-level rise. At the international and EU levels (Table 3 and Figure 4), instruments such as the UN 2030 Agenda and UNCLOS demonstrate limited direct action, reflecting either broad developmental scope or outdated priorities. In contrast, while the EU Strategy on Adaptation to Climate Change (2021) demonstrates high intentionality, it faces moderate substantiality due to implementation challenges. This is consistent with the observations of Elrick-Barr and Smith (2021) that "policy is rarely intentional or substantial for coastal issues."

Table 5. Analysis of intentionality and substantiality of the legal policy and instruments at the Canary Islands (regional) level in current research.

Policy/Instrument	Intentionality	Substantiality	Analysis
Organic Law 1/2018 on the Statute of Autonomy of the Canary Islands	Moderate	Moderate	Grants the region competencies that can be leveraged for climate adaptation policies
Law 14/2014 of 26 December 2014 on Harmonisation and Simplification in the Protection of the Territory and Natural Resources	Moderate	Moderate	Aims to streamline environmental protection, offering tools for coastal adaptation. The Canary Islands are highly protected, and it has to be considered for climate action
Law 4/2017, of 13 July, on the Land and Protected Natural Spaces of the Canaries	Moderate	Moderate	Regulates land use, including coastal zones, facilitating adaptation measures. The Canary Islands are highly protected, and it has to be considered for climate action
Law 6/2022, of 27 December, on climate change and energy transition in the Canary Islands	High	High	Specifically addresses climate adaptation, including sea-level rise, with actionable measures. It has a high grade of coordination (horizontal and vertical)
Decree-Law 5/2024 (Amendment of Law 6/2022)	High	High	Strengthens the regional climate framework, enhancing adaptation strategies. It is a modification of the law of climate change and energy in the Canary Islands
Canary Islands Climate Action Strategy 2030	High	High	Sets long-term goals for climate resilience, emphasizing coastal adaptation. The strategy is focused on adaptation and reflects the need for harmonization between different legal tools
Canary Islands Climate Action Plan	High	High	Details specific actions for adaptation, including infrastructure and ecosystem-based approaches

Table 6. Analysis of intentionality and substantiality of the legal policy and instruments at the island and municipal level in current research.

Scale	Policy/Instrument	Intentionality	Substantiality	Analysis
Island	PIOs	Moderate	Moderate	Provide a framework for land use, with potential to integrate sea-level rise adaptation
Municipal	PGOUs	Moderate	Moderate	Implementation of adaptation measures varies across municipalities, depending on local priorities and resources

Figure 4 shows the distributions of intentionality and substantiality ratings (the total number of assessments rated) for each level of governance. The figure shows that at the regional level (Canary Islands), there have been more instances of high ratings than nationally (EU, member state) or locally (municipal, city, etc.). This

suggests that the regional level, in this case, seems more in line with adaptation objectives. It is important to note that the figure does not represent functional linkages or coordination mechanisms between these policies; this aspect is discussed in the subsequent section. According to Figure 4, older frameworks such as Law 22/1988 are still limited by outdated mechanisms or inconsistent implementation. At the regional scale of the Canary Islands (Table 5), recent legislation, such as Law 6/2022 and the Canary Islands Climate Action Plan, reflects a shift toward comprehensive and strategic responses, integrating ecosystem-based and infrastructural measures. Local instruments (Table 6), including PIOs and PGOUs, provide planning frameworks, though these lack uniformity in application due to variability in municipal resources and priorities.

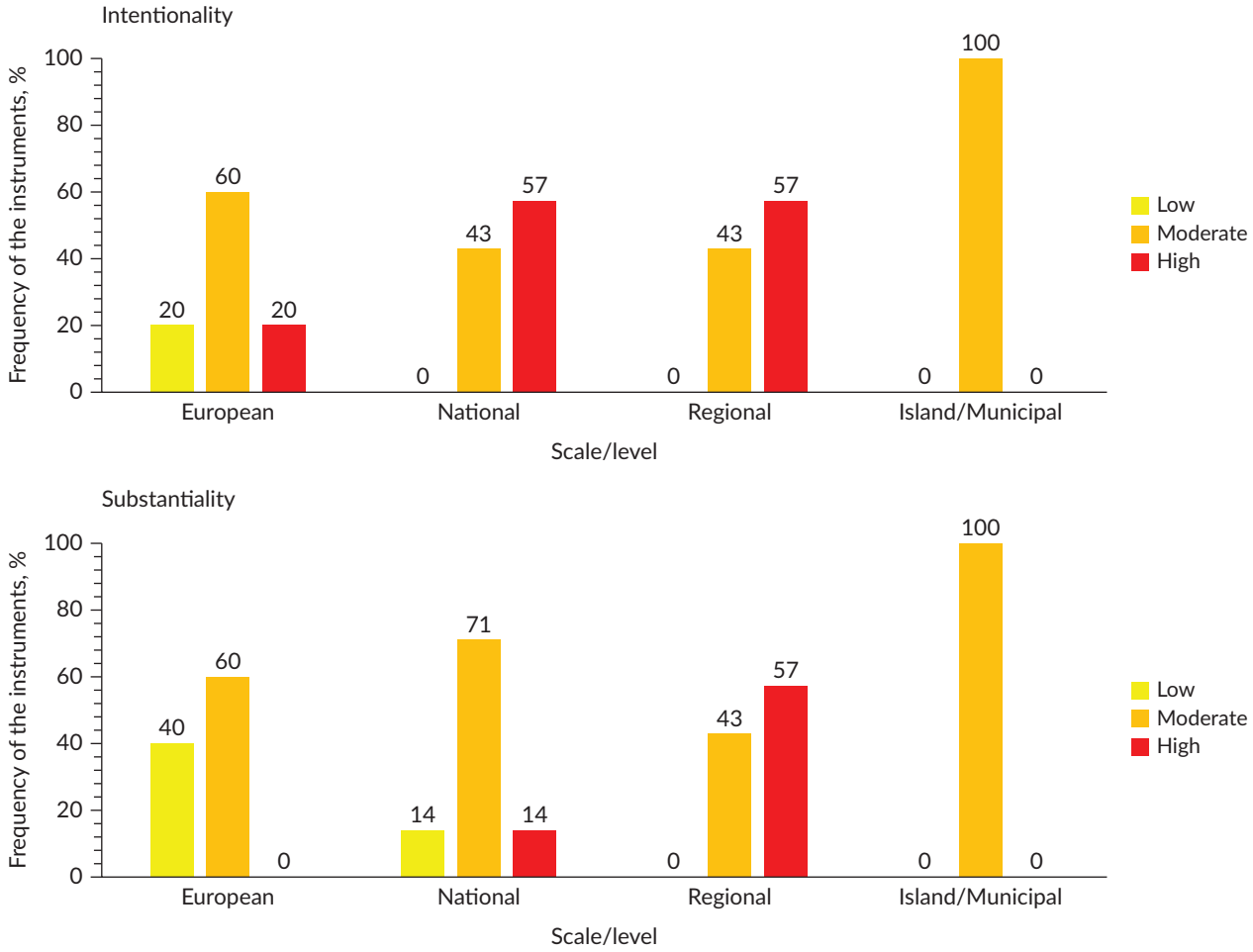

Figure 4. Distribution (frequency, %) of the intentionality and substantiality rating scale of the legal policy/instruments at the multilevel (from European to municipal) for the case of the Canary Islands.

At the island/municipal level (Figure 4), it shows that all instruments are rated as moderate in both intentionality and substantiality, reflecting a uniform but limited commitment likely due to constrained local capacities. At the regional level, over half of the instruments exhibit high intentionality (57.14%), alongside a balanced presence of moderate and high substantiality. This aligns with the discussion on Canary Islands legislation, such as Law 6/2022 and the Climate Action Plan. At the national level, the distribution is more mixed: intentionality is split between moderate (57.14%) and high (42.86%), while substantiality leans towards moderate (71.43%). This supports the finding that, although intentions are strong (e.g., the PNACC), implementation remains uneven. European-level instruments are largely moderate in intent (60%) and

substance (60%); they still lack high-substantiality policies, which reaffirms the claim that "broad or outdated scopes" limit direct action (e.g., UNCLOS and UN Agenda). Thus, the figure confirms that, while intentionality improves from the international to the regional scales, substantiality lags behind. This echoes the observations of Elrick-Barr and Smith (2021) that policy is rarely both intentional and substantial in coastal contexts.

This multilevel governance analysis underscores that while adaptation intent is increasingly embedded in policy frameworks, substantial, enforceable measures are uneven and are often hindered by institutional fragmentation or limited local capacity (see Supplementary File, for information related to the aims of the policy and instruments used in this analysis, the governance tools, and the expected outcomes).

3.5. Normative Conflicts, Institutional Fragmentation, and Barriers to Effective Adaptation in the Canary Islands

Although Figures 3 and 4 illustrate the existence of multiple governance levels and variable policy strength, they do not visualise specific forms of coordination or non-coordination, across levels. Our analysis suggests that although there are legal opportunities for multilevel coordination (e.g., Climate Action Network), coordination remains largely procedural and fragmented. In practice, we found that horizontal coordination (e.g., between cabildos and municipalities) is often weak or unspecified, while vertical linkages are shaped predominantly by the individual capacity of administration and political will.

According to Van Den Hurk et al. (2024), the coastal adaptation decision-making is complex, involving many stakeholders. It requires long-term implications, flexibility to adopt new decision processes, and monitoring the progress to achieve the established goals. However, the legal framework previously detailed demonstrated that there are no solutions from a single administration. This means that the presence of coordination instruments must be implemented and maintained in the long term (Ferraro & Failler, 2024b). Conversely, the complexity of the legal framework also shows that solutions must be found to address the timescale of the climate emergency (Bazant-Fabre et al., 2022). In the Canary Islands, the legal framework indicates a solid commitment to coastal governance, despite the absence of a defined strategy. However, this does not necessarily guarantee effective coastal adaptation governance. It is urgent that we consider the timescale of climate action. Although many laws, regulations, and plans include actions relating to emergency or general interest, unfortunately, this is not applied in the case of climate adaptation. Such solutions would improve the timescale of responses. In the case of the Canary Islands, the response to sea-level rise is hindered by a complex and fragmented legal framework. The mismatch between the timeframes of policies and the immediacy of climate risks creates a structural barrier to effective adaptation. The current legal framework includes the National Climate Change Law (Law 7/2021), coastal legislation (Coastal Law 22/1988 and the 2013 amendment), and regional and municipal competencies regarding spatial planning. This is complemented by the Canary Islands' Law 14/2014 on Harmonisation and Simplification of Territorial and Natural Resource Protection, which is a key instrument in land-use and environmental planning. Jurisdictional clashes, overlapping and conflicting competences, and procedural constraints in planning instruments hinder the effective implementation of environmental law.

Coordination is another major issue that needs to be addressed. In the Canary Islands, Law 6/2022 will introduce governance tools such as the Canary Islands Climate Action Network, a permanent multilevel

governance platform, and the Canary Islands Climate Action Office. The latter will provide technical advice on adaptation planning to all administrative levels, including cabildos and municipalities. These tools aim to promote coordination among institutions and to integrate climate action within the archipelago. However, they are still in the process of formation. Although Law 7/2021 mandates the development of sectoral adaptation plans, their implementation in the Canary Islands is hindered by institutional coordination gaps and limited integration into spatial and urban planning frameworks. Thus, while this national legislation provides an advanced legal framework, its effectiveness in insular contexts depends on its articulation with regional and local regulations, as well as governance mechanisms that ensure compliance in the face of escalating climate risks. Additionally, coordinating climate actions across different administrations requires more human resources to address all areas of responsibility. This issue could be resolved through the digitalisation of public administration.

The recent processing and approval by the City Council of Las Palmas de Gran Canaria of a climate action project promoted by the Regional Ministry of Ecological Transition and Energy of the Government of the Canary Islands is a representative example of the gaps in competencies and the lack of inter-administrative coordination in climate governance in the Canary Islands. According to the local newspaper *La Provincia*, the project was approved during a City Council plenary session due to a mistake by one of the council members (Villullas, 2025). The article contains statements from several city government members, who describe the proposal by the Regional Ministry as nonsensical and assert that they were neither sent the technical project nor officially invited to collaborate on the document.

This situation has arisen despite the regional legal framework being reinforced through Decree Law 5/2024, which actively promotes governance mechanisms and explicitly states that the proposed objectives cannot be achieved through unilateral public management. In the draft document of the Canary Islands Climate Action Plan, the governance mechanisms section states that an inter-administrative technical working group must be established to support administrative cooperation and accelerate joint efforts across the different levels of government involved in implementing action. Moreover, this information should be made public to encourage citizens, organisations, and social movements to participate in developing the planned measures.

This case study highlights that governance mechanisms rely not only on legal design and regulatory effectiveness, but also on the capacity of public administrations to execute, coordinate, and allocate resources. It reveals an operational gap in multilevel coordination: while the legal framework anticipates collaboration, participation, and policy coherence, however, fragmentation and the corresponding change in institutional levels create ambiguities in political agendas and coastal competences, particularly in strategic areas such as the urban coastline of the capital, the Canary Islands.

One of the key conflicts identified is the asymmetry between the pace of spatial and urban planning and the urgent need for adaptive decisions, especially in highly exposed coastal areas. Many PGOUs, for example, have not been updated to reflect new sea-level rise projections, despite available scientific evidence (e.g., PIMA Adapta Costas) and existing legal obligations to incorporate climate risk. Without this integration, the implementation of structural measures such as planned retreat or the prohibition of new development in high-risk zones is blocked.

Another critical issue is the lack of effective coordination between different levels of government. As highlighted throughout this paper, several laws emphasize the urgent need for horizontal and vertical

administrative cooperation in climate governance. Although cabildos hold key competencies in spatial planning through the PIOs, their alignment with regional strategies—such as the Canary Islands Climate Action Strategy 2030—remains incipient. At the same time, municipalities are burdened with many responsibilities but often lack the technical and financial capacity to implement recommendations stemming from vulnerability assessments, such as PIMA Adapta Costas. This results in territorial disparities in the application of adaptation measures across territories, revealing a structural weakness in adaptive governance where planning rarely translates into action.

In this sense, a key point of contention in the environmental governance of the Maspalomas Dunes Special Natural Reserve (Figure 2) is the differing roles and actions of the Cabildo of Gran Canaria and the San Bartolomé de Tirajana City Council, particularly with regard to rising sea-levels. As the managing authority, the Cabildo has initiated science-driven restoration projects such as MASDUNAS, which have successfully reintroduced over 60,000 m^3 of sand and increased native vegetation by 75% in order to stabilise the dunes (Cabildo de Gran Canaria, n.d.). In contrast, the City Council has been criticised for using tractors and scrapers to smooth the sand for tourism purposes. This practice harms dune vegetation and accelerates erosion by smoothing the dunes and removing a small amount of sand every day (Pinardo-Barco et al., 2023). The conflicting actions of the Cabildo, which pushes for ecological recovery, and the municipality, which enables tourism-driven maintenance, underscore a serious governance rift over who holds responsibility, how urgently action should be taken, and which should prevail: environmental integrity or tourist infrastructure.

4. Conclusions and Recommendations

This is the first study to address the legal framework for mitigating and adapting to sea-level rise in the Canary Islands, as well as the conflicts and barriers to improving coastal adaptation governance, and possible recommendations for doing so. Sea-level rise is one of the most pressing impacts of climate change in this region. Despite the existence of a relatively comprehensive legal framework, significant challenges persist due to the fragmentation of responsibilities among different levels of government (e.g., state, regional, island, and municipal). Furthermore, there is a significant discrepancy between the urgency of adaptation measures and the timeframes for implementing various laws.

Against this backdrop, there is an urgent need for prompt and effective multilevel coordination mechanisms to enhance climate governance in the Canary Islands. A key recommendation is to establish the Climate Action Office and the Climate Action Network in the Canary Islands immediately, so that they can encourage the formation of climate adaptation committees at the island level. These committees should involve participants from national, regional, island, and local governments, and should be complemented by the establishment of a Coastal Observatory for the Canary Islands, whose remit would be to provide advice on integrating climate scenarios into planning instruments and on biodiversity. In terms of human resources, building institutional capacity is also fundamental. To this end, it is recommended that the technical expertise of local staff be enhanced. The timescale of climate actions must be addressed by implementing projects of general interest, thereby reducing the time for action, mainly in terms of adaptation. Furthermore, the link between climate adaptation and administrative effectiveness can be strengthened via digitalisation, bearing in mind that the public administrations must invest in human resources to be able to achieve the goals established in the various climate laws.

It is essential to strengthen public engagement further so that it becomes a key factor in co-governance in climate planning processes, especially for adaptation measures. Such participation must formalise the citizens' involvement in decision-making through participatory structures that further embed strategic planning tools. Also, regulatory harmonisation is necessary to keep the mechanisms agile and functional. Legal policy and instruments must be aligned and adapted to the current climate emergency in order to prevent slowdowns, jurisdictional disputes, and operational inefficiencies.

For all these reasons, there is a need to generate methodologies for monitoring the health of the sea and coastal areas within the identified management objectives. We propose adaptive management through tools that evolve periodically to incorporate new processes into the monitoring model via multidisciplinary work networks. This generates a living model that can adapt to systemic variations resulting from social and environmental changes in highly dynamic coastal and open ocean environments.

Improving climate governance in the Canary Islands is essential not only for the archipelago's resilience but also as a replicable model for other island territories, particularly those with high population density and economic dependence on coastal areas. The Canary Islands' experience can meaningfully contribute to designing differentiated climate policies for island contexts that align with the Paris Agreement and the Sustainable Development Goals commitments.

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Conflict of Interests

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