

Article

Not peer-reviewed version

Integrated Spatial Planning as a Framework for Climate Adaptation in Coastal and Marine Systems

[Francisco Javier Córdoba-Donado](#)*, [Vicente Negro-Valdecantos](#)*, Gregorio Gomez-Pina, [Juan J. Muñoz-Pérez](#), [Luis J. Moreno Blasco](#)

Posted Date: 16 March 2026

doi: 10.20944/preprints202603.1156.v1

Keywords: marine spatial planning (MSP); terrestrial spatial planning (TSP); environmental dynamics; resilience; climate change; blue economy; climate models; ocean multi-use; integrated spatial planning (ISP)



Preprints.org is a free multidisciplinary platform providing preprint service that is dedicated to making early versions of research outputs permanently available and citable. Preprints posted at Preprints.org appear in Web of Science, Crossref, Google Scholar, Scilit, Europe PMC.

Copyright: This open access article is published under a [Creative Commons CC BY 4.0 license](#), which permit the free download, distribution, and reuse, provided that the author and preprint are cited in any reuse.

Disclaimer/Publisher's Note: The statements, opinions, and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions, or products referred to in the content.

Article

Integrated Spatial Planning as a Framework for Climate Adaptation in Coastal and Marine Systems

Francisco Javier Córdoba-Donado ^{1,*}, Vicente Negro-Valdecantos ^{1,*}, Gregorio Gómez-Pina ², Juan J. Muñoz-Pérez ³ and Luis J. Moreno-Blasco ¹

¹ Environment, Coast and Ocean Research Laboratory (ECOREL). Escuela Técnica Superior de Ingenieros de Caminos, Canales y Puertos, Universidad Politécnica de Madrid, Spain

² Escuela Técnica Superior de Algeciras Av. Ramón Puyol, s/n, Algeciras, Cádiz, Spain

³ CASEM (Andalusian Centre for Maritime Studies), Universidad de Cadiz, 11510 Puerto Real, Spain

* Correspondence: fcordova@ciccp.es (F.J.C.-D.); vicente.negro@upm.es (V.N.-V.)

Abstract

Marine Spatial Planning (MSP) and Terrestrial Spatial Planning (TSP) have traditionally evolved as disconnected systems, limiting the capacity to address coastal dynamics under climate change. This article proposes Integrated Spatial Planning (ISP) as a governance and planning framework that links marine and terrestrial domains through a multi-level zoning structure operating from municipal to international scales. The approach explicitly incorporates climate change adaptation by aligning spatial planning instruments with marine climate drivers, hydrological processes, and environmental dynamics that shape coastal resilience. The methodology is applied to the Region of Murcia, Spain, a Mediterranean coastal system highly exposed to climate variability, sea level rise, and extreme runoff events. Despite the existence of multiple regulatory and strategic instruments, including urban plans, regional spatial law, basin-scale hydrological planning, climate strategies, and coastal management guidelines, planning remains fragmented across land and sea. The case study reveals critical gaps in the integration of climate projections, runoff and sediment dynamics, infrastructure planning, renewable energy deployment, and ecosystem-based adaptation, particularly in sensitive areas such as the Mar Menor lagoon. ISP addresses these challenges by establishing governance mechanisms that connect marine climate models, environmental dynamics, and spatial decision-making across administrative levels. The results demonstrate how ISP can improve coherence between climate adaptation strategies, ecosystem protection, and socio-economic development, offering a transferable framework for climate-informed coastal and marine spatial planning in vulnerable regions.

Keywords: marine spatial planning (MSP); terrestrial spatial planning (TSP); environmental dynamics; resilience; climate change; blue economy; climate models; ocean multi-use; integrated spatial planning (ISP)

1. Introduction

The oceans cover more than 70 percent of the Earth's surface [1] and provide essential resources and services that sustain human societies and global economies. Ensuring their long-term sustainability requires spatial planning approaches capable of balancing environmental protection with growing social and economic demands.

Marine Spatial Planning (MSP) [2] has emerged as a key policy instrument to organize uses of marine space, reduce conflicts, and support sustainable development objectives. Promoted at the international level by organizations such as IOC UNESCO [3] and DG MARE [4], MSP is closely aligned with the Sustainable Development Goals [5] and reinforced by global initiatives including the UN Decade of Ocean Science [6] and the High-Level Panel for a Sustainable Ocean Economy [7][8]. Through an ecosystem-based approach, it addresses fisheries, aquaculture, marine protected areas, renewable energy, climate change adaptation, and activities beyond national jurisdiction [9].

Coastal zones represent a critical interface between land and sea, concentrating nearly half of the world's population [10][11] and a large share of economic activity. These areas are among the most vulnerable to climate change impacts such as sea level rise, extreme weather events, flooding, and ecosystem degradation. Despite this vulnerability, terrestrial spatial planning frameworks often treat the sea as an external or marginal domain, limiting coordination to the public maritime domain or narrow coastal strips. As a consequence, MSP and Terrestrial Spatial Planning (TSP) have evolved largely as parallel systems, leading to fragmented governance, inconsistent policy objectives, and weak integration of climate adaptation measures across the land–sea system.

These challenges are particularly evident in the Mediterranean region, where national maritime zoning practices vary widely due to diverse legal traditions, administrative structures, and planning cultures. This heterogeneity complicates coordination between marine and terrestrial competences and highlights structural gaps in multilevel governance. Existing frameworks such as Integrated Coastal Zone Management (ICZM) [12] and national climate adaptation strategies have improved coordination in specific contexts, but they remain spatially limited, sector-specific, or strongly dependent on national policy settings. They do not fully resolve the need for a coherent planning framework that integrates marine and terrestrial systems across administrative levels and jurisdictional boundaries.

In this context, there is a clear need for a spatial planning methodology that overcomes the traditional separation between land and sea, incorporates climate and environmental dynamics, and supports coherent decision-making from local to international scales. The objective of this study is to address this gap by proposing Integrated Spatial Planning (ISP) as a unified framework that connects marine areas defined under the United Nations Convention on the Law of the Sea [13] with equivalent terrestrial planning units within shared governance structures. The novelty of the approach lies in its multilevel zoning logic, its explicit integration of climate change adaptation into spatial planning instruments, and its capacity to align marine and terrestrial policies within a single, transferable methodology. By doing so, the study offers a new contribution to coastal and marine governance, providing a replicable model for enhancing resilience, sustainability, and coherence in vulnerable coastal regions.



Figure 1. United Nations Sustainable Development Goals (SDGs) of the 2030 Agenda.

Visual representation of the 17 SDGs that frame the global strategy for environmental, social, and economic sustainability. These goals provide a transversal reference for the integration of marine and terrestrial spatial planning (MSP–TSP), particularly in contexts of urban adaptation to climate change and coastal governance.

2. Materials and Methods

This section reviews the conceptual and policy foundations that support the methodological approach of this study. By examining the evolution of Marine Spatial Planning (MSP) and Terrestrial Spatial Planning (TSP), it clarifies the institutional, legal, and governance frameworks that shape current land–sea planning practices. This background is essential to understand why Integrated Spatial Planning (ISP) is proposed as a unified framework capable of addressing the climate, environmental, and socio-economic dynamics described in the methodology.

2.1. State of the Art of Marine Spatial Planning

This subsection outlines the main international frameworks, definitions, and governance principles that have shaped Marine Spatial Planning (MSP). It highlights how MSP has evolved from sectoral ocean management to an ecosystem-based and climate-informed planning instrument. These elements provide the foundation upon which ISP extends MSP logic toward integrated land–sea governance.

The main international organizations driving ocean sustainability include IOC-UNESCO, which coordinates the UN Decade of Ocean Science and advances scientific cooperation to address climate, resource management, and pollution challenges [14][15][16]; the High Level Panel for a Sustainable Ocean Economy, a coalition of 19 states promoting a sustainable ocean economy through coherent policies, investments, and Marine Spatial Planning [17]; and the Global Partnership for Oceans, a broad alliance of more than 150 actors working to combat overfishing, pollution, and habitat degradation, supported by World Bank initiatives [18].

Basic Concepts of MSP

- Marine Spatial Planning (MSP) is conceived by IOC-UNESCO as an integrative framework to address ocean governance challenges and promote sustainability. Ocean governance refers to the way ocean affairs are managed by governments, communities, and stakeholders, based on law, customs, and institutions [19]. Key terminology is provided in the MSPglobal International Guide [20]:
- Coastal Zone: interface between land and sea, often managed through ICZM plans.
- Ocean Domain: three-dimensional ocean space (surface, water column, seabed).
- Maritime Boundaries: legal definitions under national and international law, covering territorial seas, EEZs, and continental shelves. Areas Beyond National Jurisdiction (ABNJ) remain without planning authority. MSP is also linked to zone-based planning under United Nations Convention on the Law of the Sea (UNCLOS) [21] and the agreement on biodiversity in ABNJ [22].

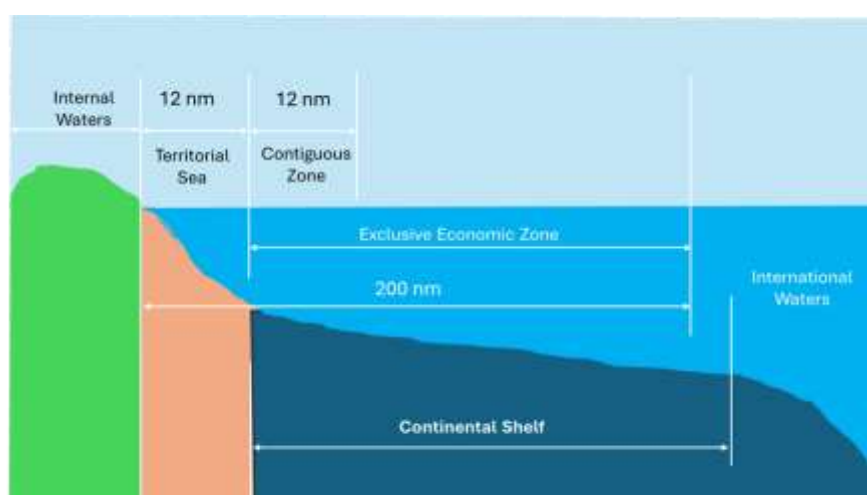


Figure 2. Legal Boundaries of the Oceans and Airspace [23].

Diagram illustrating the maritime zones defined by the United Nations Convention on the Law of the Sea (UNCLOS), including internal waters, territorial sea, contiguous zone, exclusive economic zone (EEZ), continental shelf, and international waters. These spatial boundaries establish the legal framework for coastal state jurisdiction and are essential for understanding the regulatory scope of marine spatial planning (MSP) in relation to terrestrial planning (TSP) and climate adaptation strategies. Definitions of MSP.

IOC-UNESCO (2009) defines MSP as a public process for allocating human activities in marine areas to achieve ecological, economic, and social objectives. The U.S. National Ocean Council (2013) emphasizes science-based planning for multiple uses [24], while Directive 2014/89/EU establishes a framework for Member States to organize maritime activities for sustainable development [25]. While all three definitions emphasize governance, stakeholder participation, and the balance between economic growth and conservation, they differ in scope and legal framing: IOC-UNESCO promotes a global, voluntary framework; the US National Ocean Council emphasizes domestic coordination and ecosystem services; and Directive 2014/89/EU establishes binding legal instruments for EU Member States, with a focus on cross-border coherence and integration with terrestrial planning.

- Blue Economy

The ocean economy encompasses established sectors (fisheries, transport, tourism) and emerging ones (renewable energy, aquaculture, biotechnology). Growth is “brown” if unsustainable and “blue” when aligned with sustainability (Patil et al., 2018). MSP is considered a key enabler of the blue economy.

- Ocean Multi-Use

Multi-use refers to intentional sharing of ocean space/resources across spatial, temporal, provisioning, or functional dimensions. It can be: polyvalent (independent uses), symbiotic (mutually beneficial), coexistence/co-location (simultaneous or alternating), or subsequent/re-use (sequential use of space/resources).

- Marine Management

Sectoral regulation of activities at sea, including quotas, technical rules, transport regulations, and environmental protection measures.

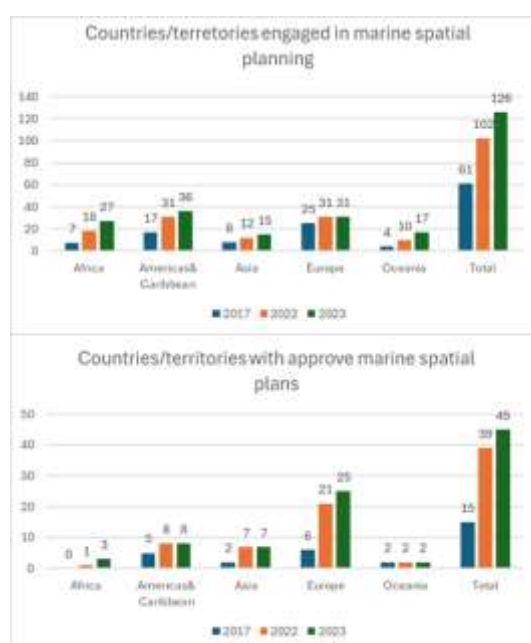


Figure 3. IOC-UNESCO assessments about marine spatial planning status around the world: a. Number of countries/territories engaged in MSP; and b. Number of countries/territories with approved marine spatial plans at national, subnational and/or local level. Source: IOC-UNESCO.

Sustainable Ocean Planning (SOP)

IOC-UNESCO defines SOP as a strategic framework guiding responsible management of marine areas, balancing economic, social, and environmental sustainability [26]. SOP is characterized by inclusivity, integration, adaptability, place-based and ecosystem-based approaches, knowledge support, political backing, long-term financing, and adequate capacity.

SOP Program in the Ocean Decade [27]

Launched to achieve 100% sustainable ocean planning, the program supports nations with tools, knowledge, and capacity development, emphasizing mission-oriented, collaborative, and equitable approaches. It fosters a global community of practice, particularly benefiting Small Island Developing States (SIDS) and Least Developed Countries (LDCs).

Relationship Between MSP and Climate Change. Climate-Smart MSP [28]

The integration of strategic climate objectives into general sustainable development and environmental policies related to the marine realm can be achieved through the use of a climate-smart and inclusive Marine Spatial Planning (MSP) as a common framework to establish meaningful and effective actions across all regions. This can be facilitated by establishing interdisciplinary MSP networks to develop climate-smart and inclusive design frameworks for ocean planning.

IOC-UNESCO's Strategy on Sustainable Ocean Planning and Management [29]

The importance of integrated ocean management is recognized in major international commitments, including the UN Sustainable Development Goals (especially Goal 14), the UNCLOS agreement on biodiversity in areas beyond national jurisdiction (BBNJ), the UN Decade of Ocean Science, the UNFCCC and Paris Agreement, the High-Level Panel for a Sustainable Ocean Economy, and the Lisbon Declaration.

In response, IOC-UNESCO is developing a Strategy for Sustainable Ocean Planning and Management (SOPM) in consultation with member states and stakeholders. The Strategy seeks a unified approach to ocean governance, fostering cross-sector dialogue and alignment with global initiatives. It will build on and expand existing IOC programs such as MSPglobal, the Global Ocean Observing System (GOOS), and the International Oceanographic Data and Information Exchange (IODE), alongside ocean science and tsunami initiatives.

The SOPM will serve as a guiding framework for IOC activities, supporting future observation, data management, early warning services, assessments, and the creation of innovative tools, knowledge products, and capacity-building initiatives tailored to sustainable ocean planning needs.

Relationship Between MSP and Climate Change. Climate-Smart MSP [30]

Marine Spatial Planning (MSP) is increasingly recognized as a climate-smart framework that integrates strategic climate objectives into sustainable development and marine environmental policies. By fostering interdisciplinary networks, MSP can design inclusive and adaptive approaches that strengthen resilience across regions.

As illustrated in Figure 5, the impacts of climate change on marine and coastal systems—such as ocean acidification, oxygen loss, and sea level rise—are projected to intensify significantly under a +2.0 °C scenario compared to +1.5 °C. These changes threaten both ecological integrity and human settlements, particularly in island states and megacities located in low-lying coastal zones. The figure underscores the urgency of embedding climate adaptation into spatial planning instruments across the land–sea interface.

Integrated Spatial Planning (ISP) builds on the climate-smart potential of MSP by extending its logic into terrestrial domains, enabling coherent governance across administrative levels. By aligning

marine and terrestrial instruments, ISP ensures that climate resilience measures are not only designed but also implemented through binding, cross-sectoral planning frameworks.


THE IMPACT OF CLIMATE CHANGE ON THE OCEAN AND CRYOSPHERE		
+1.5 °C scenario	Key projections for 2100	+2.0 °C scenario
+70-90%	Coral reefs are projected to decline by	
~ 1.8%	Oxygen loss is projected to decrease by	~ 3.45%
+~ 0.43 cm	Sea level rise is expected to increase	~ 0.84 cm
~ 0.039 pH units	Ocean acidification is expected to decrease by	~ 0.288 pH units
Island states threatened by rising sea level		Megacities threatened by rising sea level
Kiribati Tuvalu Maldives in the tropical western Pacific rates up four times the global average		New York City Tokyo Jakarta Mumbai Shanghai Lagos Cairo
IPCC special report statements		
- The ocean and the cryosphere play a critical role for life on Earth. A total of 670 million people in high mountain region and 680 million people in low lying coastal zones depend directly on these systems		
- It is virtually certain that the global ocean has warmed unabated since 1970 and has taken up more than 90% of the excess heat in the climate system. Ocean warming dominates the global energy change inventory. Since 1993, the rate of ocean warming has more than doubled		
- The ocean has taken up between 20-30% of total anthropogenic CO2 emissions since the 1980s causing ocean acidification		

Figure 4. Climate projections for 2100 under +1.5 °C and 2.0 °C scenarios.

This figure highlights key oceanic and coastal impacts of global warming, including oxygen loss, acidification, and sea level rise. It identifies vulnerable island states and megacities, reinforcing the need for Integrated Spatial Planning (ISP) to address land–sea interactions and enhance climate resilience. Source: IPCC Special Report on the Ocean and Cryosphere.

Challenges in Incorporating Climate Change Impacts into MSP

Climate change affects marine and coastal systems through multiple, interacting processes that challenge the effectiveness of Marine Spatial Planning (MSP). Although MSP increasingly incorporates climate-smart approaches, several structural limitations still hinder its capacity to anticipate and manage long-term impacts. The following challenges summarize the main scientific, institutional, and governance barriers identified in the literature, providing the basis for understanding why Integrated Spatial Planning (ISP) is needed to strengthen land–sea climate adaptation

- Variable impacts: Climate change affects sectors, geographies, and scales differently, with cumulative effects from human activities [31].
- Knowledge gaps: Despite efforts to integrate climate change into spatial scenarios [30], uncertainties remain due to complex processes [32]. Studies must incorporate temporal evolution and scenarios [33].
- Uneven national responses: Adaptation capacities differ widely between developed and developing countries.

These limitations highlight the need for planning frameworks capable of integrating climate projections, land–sea interactions, and multi-level governance structures, elements that are central to the ISP approach developed in this study.

Climate-Smart MSP and Adaptive Capacity

A climate-smart MSP requires robust data on ecosystem impacts and human uses, combined with climate literacy and stakeholder knowledge. Inclusive design approaches [34] enable dynamic

governance. Crucially, integrated MSP–TSP planning strengthens adaptive capacity by linking land and sea management:

Flooding: Joint zoning of terrestrial and marine areas allows coordinated defenses (wetlands, dunes, breakwaters) that reduce flood risks.

Coastal erosion: Integrated planning aligns terrestrial land-use restrictions with marine ecosystem restoration, preventing maladaptive urban expansion.

Extreme events: Shared governance frameworks improve early warning systems and evacuation routes by connecting terrestrial infrastructure with marine hazard monitoring.

Recommendations for Action

Knowledge: Expand evidence on vulnerable uses and integrate relocation scenarios into MSP.

Policy: Embed climate objectives into sustainable development policies through climate-smart MSP and interdisciplinary networks.

Policy Actions in Europe and Spain

As an example of the political actions that have contributed to consolidating Marine Spatial Planning (MSP), some of the initiatives that have been carried out in Europe and also in Spain will be presented [35]

The EU Directive 2014/89/EU [35] established a framework for maritime spatial planning, transposed in Spain via Royal Decree 363/2017 [37] under Law 41/2010 [38]. This decree approved five maritime spatial plans, aligned with the European Green Deal [38], Paris Agreement [40], EU Climate Change Adaptation Strategy [41], and EU Biodiversity Strategy to 2030 [42]. Plans were developed with inter-administrative coordination and stakeholder participation.

Spain consolidated MSP with Royal Decree 150/2023 [43], covering five marine regions (North Atlantic, South Atlantic, Strait and Alboran, Levantine-Balearic, Canary Islands) as defined in Law 41/2010 [44]. These frameworks ensure sustainability of human activities at sea while directly supporting climate adaptation and risk reduction.



Figure 5. The five marine regions defined by Spain’s Maritime Spatial Planning Plans (POEM).

Spatial delineation of the five marine regions established under the POEM framework: Noratlántica, Sudatlántica, Canaria, Levantino-Balear, and Estrecho-Alborán. These regions reflect ecological, socio-economic, and administrative criteria, and serve as the operational basis for implementing MSP in Spain. Their definition is critical for coordinating marine and terrestrial planning processes in the context of climate adaptation and integrated coastal governance. Source: Executive Summary of the POEM. Ministry for the Ecological Transition and the Demographic Challenge.

2.2. State of the Art of land planning

This subsection summarizes the main characteristics of terrestrial spatial planning (TSP), emphasizing its legal foundations, governance structures, and planning instruments across European contexts. Understanding these elements is essential because ISP requires bridging two traditionally separate systems—marine and terrestrial—whose differences in competencies, scales, and planning cultures have historically limited coherent land–sea governance.

Description of Land Planning

Land spatial planning is structured through instruments at national, regional, and local levels, depending on the scale of space being organized. While marine and land planning are based on state-specific legislation, here the focus is on common global aspects.

Definition of Territory

Unlike marine space, often public domain, land is predominantly private, especially in cities. Public space is reserved for infrastructures and services. Territory can be defined as a resource whose use requires programming and structuring under legal supervision [45]. Planning is therefore organized around legal, political, economic, and social criteria.

Planning, Management, and Implementation

Urban growth, non-urban space planning, infrastructure integration, real estate development, and land market regulation are managed through scientific and technical criteria, forming the basis of urbanism and land planning.

Terrestrial Spatial Planning (TSP)

Land planning emerged as state policy in the 1930s, consolidating as a scientific discipline by the 1960s [46]. In the U.S., the Tennessee Valley Authority's Integrated Management Plan (1933) [47,48] exemplified early comprehensive planning, addressing natural resources, energy, flood control, housing, and urban development. In Europe, land planning developed alongside urban planning: the UK, USSR, and France focused on large housing complexes, while Switzerland and Alpine countries prioritized accessibility and connectivity.

Land Planning in Europe

The European Charter for Territorial Planning (1983) established guiding principles: balanced regional development, improved quality of life and infrastructure, responsible resource management, and rational land use. Bengoetxea [49] identifies different levels of planning based on territorial scope and approach. Land use planning is integrative, similar to MSP, addressing environmental, social, economic, infrastructural, and service-related issues. As Serrano (2001) notes, systemic management of space appropriation is essential to promote equity and sustainability, in line with the European Spatial Planning Charter.

Table 1. Land Planning. Scope and Approach in Europe. Overview of the hierarchical distribution of land planning responsibilities across governance levels in the European context. The table highlights the macro-level guidelines set by the European Union, the sectoral and infrastructural criteria defined by Member States, and the operational planning frameworks implemented by Autonomous Communities and Local Entities. This structure is essential for understanding the vertical coordination required in terrestrial spatial planning (TSP) and its integration with marine spatial planning (MSP). Source: Bengoetxea, 2000.

SCOPE	APPROACH
European Union	Macro land planning: General criteria and guidelines
Member State	Regional policy: Infrastructure of general interest, sectorial criteria
Autonomous Community	Land Planning
Local Entities	Urbanism (Subject to approval by Autonomous Communities)

Land Use Planning Models in Europe [50]

European land use planning reflects the political and administrative structures of each Member State, but shares common principles of sustainability and territorial balance.

United Kingdom: A unitary state with responsibilities divided among central government, counties, and municipalities. Since the 1990 Spatial Planning Act, planning emphasizes territorial balance and sustainability.

France: A unitary republic with decentralized powers since the 1980s. Regions, Departments, and Municipalities share responsibilities, with urban planning ultimately managed locally but integrated into broader frameworks [51].

Germany: A federal state of sixteen Länder. Territorial planning is conducted at the federal level, implemented by states, and supported by municipalities and districts. Germany has been active in European territorial policy, contributing to the Leipzig Principles and the European Territorial Strategy [52].

Spain: A unitary parliamentary monarchy with strong decentralization into 17 Autonomous Communities. The State retains authority over national laws and major infrastructures, while regions and municipalities manage planning. Coastal responsibilities are increasingly transferred to autonomous communities.

Italy: A unitary republic with strong regional decentralization. Regions hold exclusive competencies in land and urban planning, while the State retains authority over infrastructures of general interest, cultural heritage, and the environment [53].

Conclusions on Land Use Management in the EU

The European Union has established guiding instruments: the European Spatial Planning Charter (1983), the European Territorial Strategy (1999) [54,55], and the Guiding Principles for Sustainable Development (2005) [54]. These emphasize territorial balance, sustainability, and environmental protection.

The European Regional Development Fund (ERDF) [56], created in 1975, addresses disparities among Member States, reflecting the coexistence of highly developed regions, developing regions, and Eastern Europe. Integration of efforts —such as the single currency and removal of internal borders— aim to strengthen territorial cohesion and competitiveness.

The European Spatial Planning Commission defines land use planning as the spatial expression of economic, social, cultural, and ecological policies, conceived as an interdisciplinary and holistic approach (Parejo, 2003). Overall, the EU approach is integrative, ensuring legal security, sustainability, and territorial balance.

Systematics in land use planning

Land use planning is structured through a hierarchy of instruments that operate at different levels (state, regional, municipal), ensuring systematic territorial organization [57].

Territorial Development Plans: Regional or municipal strategies that set objectives and frameworks for spatial organization.

Coordination Programs: Align actions of public administrations with significant territorial impact.

Natural and Rural Land Use Plans: Protect and enhance areas of ecological, agricultural, or landscape value; in coastal regions, specific coastal land use plans regulate beaches and maritime fronts.

Regional Interest Actions: Exceptional instruments for urgent or strategic development.

Municipal Land Use Plans: Local strategic plans integrated into regional frameworks, ensuring coherence across scales.

Territorial Impacts of Sectoral Legislation Sectoral laws (coasts, water, forests, protected areas, roads, railways, airports, energy transport) [García-Ayllón, 2014] have hierarchical precedence over urban planning laws, requiring integration into territorial planning.

Urban Planning Instruments at Municipal Level Municipalities apply General Urban Planning Plans, classifying land as non-urbanizable, urbanizable (sectorized/non-sectorized), or urban (consolidated/non-consolidated/special). Development tools include:

General Urban Planning Plan

Development Planning

Partial Plans (zoning, land uses, building typologies)

Special Plans and Detail Studies (specific regulations)

Urbanization projects (infrastructure, mobility, green areas)

This system ensures territorial organization balances strategic development with ecological, social, and infrastructural considerations.

2.3. Methodology

Marine Spatial Planning is widely recognized as a key instrument for organizing human activities in marine environments while ensuring the protection of ecosystems and the sustainable use of ocean resources. International guidance, particularly from IOC-UNESCO, frames MSP within the broader concept of ocean governance, understood as the set of legal, institutional, and participatory arrangements through which marine spaces and resources are managed. MSP operates within the legal boundaries established by UNCLOS, which define internal waters, territorial seas, contiguous zones, exclusive economic zones, and international waters. These maritime zones establish the spatial and jurisdictional framework within which planning competences are exercised and coordinated.

Across different institutional contexts, MSP is consistently defined as a public and science-based process aimed at allocating marine space to achieve environmental, economic, and social objectives. While international frameworks emphasize adaptive and voluntary cooperation, regional instruments such as the EU Directive 2014/89/EU provide binding obligations for Member States, particularly regarding cross-border coordination and coherence with terrestrial planning systems. MSP also plays a central role in supporting the development of the blue economy by organizing both traditional maritime sectors and emerging uses, and by facilitating forms of ocean multi-use that require careful spatial and temporal coordination.

Climate change has increasingly been incorporated into MSP through the concept of climate-smart planning. This approach integrates climate projections, ecosystem vulnerability, and socio-economic exposure into spatial decision-making, allowing marine plans to address sea level rise, coastal flooding, ocean warming, acidification, and extreme events. International initiatives linked to the UN Decade of Ocean Science and Sustainable Ocean Planning promote adaptive, ecosystem-based, and knowledge-driven planning processes. Nevertheless, the integration of climate

considerations into MSP remains uneven, often constrained by uncertainties in long-term projections, data limitations, and differences in institutional capacity among countries.

In parallel, terrestrial spatial planning has developed as a long-standing policy domain, structured through legally binding instruments at national, regional, and municipal levels. Land planning systems regulate land use, urban development, infrastructure, and environmental protection within predominantly private property regimes. In Europe, these systems are guided by shared principles of sustainability, territorial balance, and cohesion, but are implemented through diverse administrative models, ranging from centralized to highly decentralized structures. Despite conceptual similarities with MSP, terrestrial planning operates through different legal traditions, planning cultures, and implementation mechanisms.

The separation between marine and terrestrial planning becomes particularly problematic in coastal areas, where land–sea interactions are most pronounced. Environmental processes such as sediment transport, runoff, coastal erosion, flooding, and nutrient exchanges operate across administrative and jurisdictional boundaries. At the same time, socio-economic activities such as ports, tourism, fisheries, aquaculture, and coastal infrastructure depend on coordinated planning across land and sea [58–60]. Literature offers multiple definitions, but all converge on the idea of complex, evolving interconnections between socio-ecological systems and governance frameworks [61–64]. Existing approaches, including ICZM, have improved coordination in specific coastal contexts, but often remain limited in spatial scope or lack strong integration with statutory planning instruments [65–68].

To address these limitations, the methodology adopted in this study is based on the systematic integration of Marine Spatial Planning and Terrestrial Spatial Planning through a shared spatial and governance structure. The core of the methodology is a multi-level zoning framework that aligns marine zones defined under UNCLOS with corresponding terrestrial planning levels. Four marine zones are distinguished according to distance from the baseline: internal waters and territorial sea, contiguous zone, exclusive economic zone, and international waters. Each of these zones is linked to a specific level of governance, respectively municipal, regional, national, and international, ensuring consistency between spatial jurisdiction and administrative responsibility.



Figure 6. The Cerdà Plan in Barcelona. Historical map of Barcelona and its surroundings, illustrating the urban layout proposed by Ildefonso Cerdà in the mid-19th century. Despite his background as a Civil, Canal and Port Engineer, Cerdà's visionary plan for the city was conceived with limited integration of the coastal interface, reflecting a historical disconnection between urban development and maritime spatial considerations. Source: City History Museum, Barcelona.

This zoning framework serves as the basis for integrating planning instruments across land and sea. At the municipal level, local urban and land-use plans are coordinated with planning provisions applicable to adjacent internal waters and territorial seas, allowing issues such as coastal development, flood risk, and public access to be addressed coherently. At the regional level, territorial strategies and sectoral plans are aligned with planning objectives in the contiguous zone, supporting integrated management of infrastructures, ecosystems, and economic activities. At the national level, maritime spatial plans for the exclusive economic zone relate to national territorial,

energy, and climate policies. At the international level, cooperation mechanisms address transboundary marine areas and interactions with international waters.

Methodologically, the integration process involves the identification of relevant planning instruments at each governance level, the analysis of their spatial scope and regulatory content, and the assessment of overlaps, gaps, and inconsistencies between marine and terrestrial frameworks. Particular attention is given to climate-related drivers and impacts, such as flood risk, erosion, sea level rise, and extreme events, which require coordinated responses across the land–sea interface. Environmental and socio-economic interactions are mapped to support decision-making, and planning objectives are aligned to ensure coherence between ecosystem protection, risk reduction, and development strategies.

Through this structured approach, the methodology provides an operational framework for addressing land–sea interactions in a coordinated manner. It supports the alignment of governance responsibilities, enhances the capacity to incorporate climate adaptation into spatial planning, and facilitates the coherent management of coastal and marine systems across multiple administrative levels.

3. Results

The application of Integrated Spatial Planning is structured through a top-down logic in which coordination is established from the most general spatial scale to the most specific. At the international level, corresponding to international waters (Zone 4), Marine Spatial Planning is guided by IOC UNESCO frameworks. Planning at this scale focuses on organizing maritime routes, submarine cables, offshore energy extraction, and deep-sea mining within sustainability constraints. These activities rely increasingly on international monitoring systems, observation networks, and predictive models supported by advanced data analytics and artificial intelligence, allowing cumulative impacts and transboundary pressures to be assessed.

Within the Exclusive Economic Zone (Zone 3), responsibility lies with national administrations. Integration at this level requires the consolidation of Marine Spatial Planning with state-level terrestrial planning instruments into a single coherent framework. National transport corridors, port systems, energy transmission networks, and communication infrastructures are addressed jointly across land and sea. Environmental monitoring and climate adaptation methodologies are applied consistently, ensuring that terrestrial policies and marine spatial allocations respond to shared climate risks and environmental dynamics.

At the regional scale (Zone 2), integration operates through territorial strategies, coastal plans, and sectoral programs that incorporate marine spatial provisions. This scale is critical for coordinating supra-municipal infrastructures, managing cumulative environmental effects, and aligning land-based activities such as agriculture or industry with adjacent marine uses. Regional planning thus becomes the hinge between national marine strategies and local land-use regulation.

At the municipal scale (Zone 1), results indicate the need for General Urban Development Plans to extend into the maritime domain up to 12 nautical miles. Municipal planning instruments incorporate ICZM documents and Marine Spatial Planning guidelines, allowing direct management of land–sea interactions. Temporal dynamics are explicitly included, requiring urban development and coastal uses to be conditioned by climate scenarios related to sea level rise, shoreline retreat, and extreme events. This leads to adaptive planning models in which municipal development rights evolve in response to changing coastal configurations.

Beyond the municipal domain, the ISP framework clarifies that each subsequent zone does not replace or spatially displace the previous one, but rather encompasses it through broader governance scales, planning instruments, and functional mandates. The zoning structure is therefore cumulative and nested: regional, national, and international levels operate over the same physical land–sea continuum while adding distinct competencies, temporal horizons, and strategic objectives. This multilevel configuration ensures that local adaptive measures remain coherent with wider territorial

planning, sectoral policies, and climate commitments, reinforcing vertical integration across the entire coastal and marine system.

The results confirm that the integration of marine and terrestrial planning is primarily a governance challenge rather than a purely technical one. Effective territorial governance depends on vertical coherence across administrative levels. Municipal authorities regulate urban growth, discharges, and coastal uses. Regional administrations coordinate infrastructures, environmental protection, and sectoral strategies. National governments manage activities within the EEZ and define strategic maritime priorities, as well as manage National transport corridors, port systems, energy transmission networks and communications infrastructures across land and sea. When these responsibilities remain disconnected, planning fragmentation leads to inefficiencies, regulatory conflicts, and reduced adaptive capacity.

Institutional overlap emerges as one of the main barriers to integration. Sectoral legislation on coasts, water, energy, or transport frequently has precedence over urban and territorial planning, generating inconsistencies across instruments. Decentralization processes further complicated coordination, as competences are unevenly distributed among levels of government. The results point to the importance of integrated governance arrangements, including permanent inter-administrative coordination mechanisms, harmonized legal instruments that align sectoral regulations, shared geospatial platforms, and structured stakeholder participation. Empirical evidence from recent studies supports these findings, showing that governance fragmentation remains a central obstacle to effective Marine Spatial Planning implementation on a global scale.

Integrated planning also proves to be a key mechanism for strengthening climate resilience. Flooding, erosion, and extreme events cannot be addressed effectively when land and sea are planned separately. Coordinated nature-based and engineered solutions, such as wetlands, dunes, and breakwaters, require joint land–sea planning. Similarly, early warning systems and risk management strategies depend on the integration of terrestrial and marine data streams. The results align with recent literature emphasizing that overcoming spatial segmentation is essential to reduce vulnerability in coastal regions.



Figure 7. Example of the PATRICOVA cartographic viewer [69]. Screenshot of the digital cartography platform developed by the Generalitat Valenciana, displaying territorial layers related to urban planning, climate change exposure, and coastal dynamics. In addition to fluvial flood risk, the viewer integrates spatial analysis of extreme maritime storm events and the coastal inundation they produce. This tool exemplifies the use of geospatial platforms to support integrated land planning and climate adaptation strategies in vulnerable coastal zones. Source [https://mediambient.gva.es/es/web/planificacion-territorial-e-infraestructura-verde/cartografia-del-patricova].

4. Discussion and Analysis of the Case Study in the Spanish Mediterranean: The Region of Murcia

The integration of MSP and TSP is not merely a technical exercise; it is fundamentally a matter of governance. Effective territorial governance requires coherence across scales: municipal authorities

must manage urban growth and coastal discharges; regional administrations must coordinate infrastructures and environmental strategies; and national governments must regulate state-level uses within the EEZ. Without integration, responsibilities are fragmented, leading to inefficiencies and conflicts.

Governance and institutional challenges

Institutional overlaps are among the most significant barriers. Sectoral legislations—covering coasts, water, energy, or transport—often have hierarchical precedence over urban planning laws, creating inconsistencies. Political barriers also arise from decentralization processes, where competences are distributed unevenly among levels of government. To address these challenges, integrated governance mechanisms are required: Inter-administrative coordination mechanisms (mixed land–sea committees).

Inter-administrative committees that bring together municipal, regional, and national authorities.

Unified legal instruments that harmonize sectoral regulations within integrated spatial plans.

Shared GIS platforms for transparency and cooperation.

Stakeholder participation to legitimize decisions and reduce conflicts.

Recent studies confirm that governance fragmentation and institutional segmentation remain critical obstacles for MSP implementation worldwide, reinforcing the need for integrative frameworks that bridge terrestrial and marine competences [70,71].

Climate resilience

Integrated planning is also a tool for climate resilience. Flooding, erosion, and extreme events cannot be managed effectively if land and sea are treated separately. Joint defences—such as wetlands, dunes, and breakwaters—must be coordinated with marine ecosystem restoration. Early warning systems must integrate terrestrial and marine data, providing comprehensive risk management [72,73] & [74]. The integration of climate adaptation measures into binding spatial instruments is consistent with recent findings that emphasize the importance of overcoming spatial segmentation to reduce vulnerability in coastal regions [75].

The Region of Murcia provides a representative example of how ISP can be applied in a complex Mediterranean coastal context. The region combines a densely urbanized coastline, intensive agricultural systems in its hinterland, and highly sensitive marine and coastal ecosystems, most notably the Mar Menor. This combination of pressures and vulnerabilities exposes the structural limitations of sector-based planning approaches and highlights the need for coordinated governance across the land–sea interface.

At present, Murcia is regulated through a broad set of planning and management instruments operating at different administrative levels. Terrestrial spatial planning is structured through the Regional Land and Urban Planning Law [76], municipal General Urban Development Plans [77], and the Territorial Strategy of Murcia [78], which together define land use, urban growth management, and supra-municipal coordination. Marine uses are governed by Mar Menor Integrated Management Plan [79] which specifically addresses the ecological crisis of Europe's largest coastal lagoon and the Levantine-Balear Maritime Spatial Plan (POEM) [80], which allocates space for navigation, fisheries, aquaculture, and offshore renewable energy. In parallel, sectoral instruments address climate adaptation, hydrological management, coastal erosion, and ecosystem protection, including the Regional Climate Change Strategy [81], the Segura River Basin Hydrological Plan, the Mar Menor Integrated Management Plan [82], and the Regional Coastal Adaptation Guidelines [83]. Although this framework is complete, the analysis shows that it functions in a fragmented manner, with limited cross-referencing between instruments and weak institutional coordination across land and sea.

Several critical gaps emerge from this fragmentation. Governance remains divided at the maritime-terrestrial boundary, leaving the first 12 nautical miles subject to overlapping but poorly coordinated competences between municipal, regional, and national authorities. Agricultural runoff management under the Segura River Basin Plan is not systematically linked to marine ecosystem objectives defined in the Maritime Spatial Plan, contributing to persistent nutrient inputs and

eutrophication processes in the Mar Menor. Port development and coastal defense projects are planned through separate terrestrial and marine frameworks, which limit the assessment of cumulative impacts on sediment dynamics, coastal erosion, and biodiversity. Similarly, offshore renewable energy allocations identified in the Maritime Spatial Plan are not fully coordinated with regional land-use strategies or municipal planning instruments, generating uncertainty regarding grid connections, infrastructure corridors, and social acceptance. Climate adaptation measures, while well-articulated in strategic and technical documents, are not consistently embedded into binding spatial plans, reducing their effectiveness in guiding development and investment decisions.

Table 2. Comparative MSP vs TSP and Integrated Spatial Planning (ISP) in Murcia. Synthesis of key dimensions across marine spatial planning (MSP), terrestrial spatial planning (TSP), and an integrated approach (ISP) in the Region of Murcia. The table compares scale, transformation intensity, time horizon, governance structures, climate resilience strategies, and applied case examples. It highlights the potential for coordinated land–sea planning to enhance adaptive capacity and regulatory coherence in coastal territories.

Dimension	Terrestrial Spatial	Marine Spatial	Integrated Approach
Scale	Multi-level(national, regional, municipal)	Mostly regional/state level	Unified across Zones 1-3
Transformation	Deep (infrastructure,urbanization)	Moderate (uses, zoning)	Balanced, coordinated land-sea
Time horizon	Long-and short-term instruments	Strategic long-term	Adaptative scenarios (climate change)
Governance	Municipal, regional, national	National, international	Multi-level integration (PGOU,POEM, Territorial Planning)
Climate resilience	Flood defenses, land-use restrictions	Marine ecosystem protection	Joint defenses, restoration, early warning
Case Murcia examples	PGOU Cartagena Segura Basin Plan	POEM South Mediterranean	Mar Menor Plan, Climate Strategy, Coastal Guidelines

The application of ISP offers a structured response to these shortcomings. At the municipal level, General Urban Development Plans can be extended seaward to manage discharges, coastal defenses, tourism uses, and lagoon restoration in a coherent manner. This would allow urban growth and coastal activities to be aligned with the ecological objectives of the Mar Menor and with coastal adaptation guidelines. At the regional level, territorial strategies can explicitly integrate marine uses defined in the Maritime Spatial Plan, enabling coordination between agricultural policies, water management, coastal protection, and offshore activities. At the national level, planning within the Exclusive Economic Zone can be linked to terrestrial infrastructure strategies, ensuring that offshore renewable energy developments are coordinated with onshore transmission networks and environmental safeguards. Across all administrative levels, climate adaptation strategies would become enforceable components of spatial planning rather than advisory guidelines, strengthening their operational impact.

From a governance perspective, the results indicate that implementing ISP in Murcia does not require the replacement of existing institutions but rather their functional reconfiguration. Municipal competences would extend into the nearshore marine domain under regional and national oversight, enabling local authorities to address land–sea interactions more effectively. Regional authorities would assume a stronger coordinating role, aligning terrestrial strategies with marine allocations and sectoral policies. National administrations would reinforce inter-administrative coordination mechanisms to ensure that state-level infrastructures and maritime uses are consistent with regional and local priorities. European and international frameworks would be systematically embedded into binding regional and municipal instruments, reinforcing coherence with broader sustainability and climate objectives.

Integrated Spatial Planning (ISP) could generate multiple benefits. For example, it could enhance ecological restoration by reducing nutrient inflows into the Mar Menor and supporting the recovery of its ecosystems. It could also improve infrastructure coherence, ensuring that ports, coastal

defenses, and renewable energy projects are planned within a unified framework that minimizes cumulative impacts. Governance efficiency would increase by reducing conflicts and delays arising from overlaps among municipal, regional, and national competences. Climate resilience would be strengthened by enhancing Murcia's capacity to withstand flooding, erosion, and sea-level rise through binding adaptation measures. Moreover, farmers, fishers, tourism operators, and energy developers would benefit from transparent and integrated planning processes.

Overall, the Region of Murcia illustrates both the constraints imposed by fragmented planning systems and the practical benefits of integration. The case study demonstrates that aligning spatial scales, administrative competences, and climate adaptation objectives within a single planning framework can enhance governance efficiency, reduce environmental pressures, and improve resilience in vulnerable coastal territories. In this sense, Murcia provides a clear example of how ISP can be operationalized in the Spanish Mediterranean and in other coastal regions facing similar land–sea challenges.

5. Conclusions

The sustainable management of terrestrial and marine spaces constitutes one of the central challenges of contemporary spatial governance. TSP has historically developed robust and detailed instruments to regulate land use and urban development, whereas MSP, as a more recent discipline, still lacks equivalent fine-scale tools and remains weakly connected to terrestrial planning frameworks. This structural separation has contributed to fragmented governance, limited policy effectiveness, and partial responses to environmental and socio-economic challenges that transcend the land–sea boundary.

The ISP methodology proposed in this study responds to these limitations by providing a coherent framework that links Marine and Terrestrial Spatial Planning across administrative levels. ISP operates as a multi-scale system, from international waters guided by IOC-UNESCO principles to national EEZs, regional territories, and municipal jurisdictions. By incorporating the temporal dimension associated with climate change, the framework enables spatial plans to address long-term adaptation, ecosystem dynamics, and resilience in a systematic and enforceable manner.

The application of ISP to the Region of Murcia demonstrates its practical relevance in a complex coastal context. Although the region is governed by a wide range of planning and management instruments, including municipal plans, regional territorial laws, marine spatial plans, hydrological planning, and climate strategies, their lack of integration has reduced overall effectiveness. The continued degradation of the Mar Menor, the disconnection between port and coastal infrastructure planning, the limited coordination of renewable energy development, and the weak incorporation of climate adaptation measures into binding plans illustrate the consequences of this fragmentation.

Within an ISP framework, these deficiencies can be addressed through coordinated action across governance levels. Municipal planning instruments can be extended into the maritime domain to manage land–sea interactions more effectively. Regional authorities can align terrestrial strategies with marine uses and sectoral policies. National infrastructures can be planned in coherence with regional and local priorities through structured inter-administrative coordination. At the same time, European and international frameworks can be systematically embedded into binding spatial instruments, strengthening regulatory coherence and implementation capacity.

The expected outcomes of such integration include improved ecological protection and restoration, greater coherence in infrastructure and energy planning, increased efficiency in governance processes, enhanced resilience to climate change, and higher levels of stakeholder confidence. More broadly, the Murcia case shows that ISP is not limited to conceptual or strategic discourse but can function as an operational approach to spatial governance.

In conclusion, ISP represents a necessary evolution in the management of coastal and marine territories. By treating land and sea as a single, interconnected system, it clarifies institutional responsibilities, strengthens adaptive capacity, and supports sustainable development under conditions of increasing environmental and socio-economic pressure. Bridging the divide between

Marine and Terrestrial Spatial Planning, ISP provides a coherent and transferable framework for adaptive governance in Mediterranean and global coastal regions.

Author Contributions: F.J.C.D contributed to the work described in this paper by carrying out the analysis and evolution of Marine Spatial Planning (MSP) throughout the history. Comparing current standards followed by the experts in international organization for developing Marine Spatial Planning and the common characteristics of Terrestrial Spatial Planning in different countries and proposing a methodology for the integration of both: Marine (MSP) and Terrestrial Spatial Planning (TSP). V.N.V contributed organizing the development of the article, clarifying specialized concepts and introducing the relationships between climate change and the Spatial Planning, both marine and terrestrial. G.G.P, J.J.M and L.J.M.B. contributed with knowledgeable discussion and suggestion.

Abbreviations

The following abbreviations are used in this manuscript, in order of appearance:

MSP	Marine Spatial Planning
TSP	Terrestrial Spatial Planning
ECOREL	Environment, Coast and Ocean Research Laboratory
CASEM	Andalusian Centre for Maritime Studies
ISP	Integrated Spatial Planning
IOC	Intergovernmental Ocean Commission
UNESCO	United Nations Educational, Scientific and Cultural Organization
OCEAN PANEL	High-Level Panel for a Sustainable Ocean Economy
GPO	Global Partnership for Oceans
DG MARE	Directorate-General for Maritime Affairs and Fisheries
SDG	Sustainable Development Goals
OCEAN DECADE	United Nations Decade of Ocean Science for Sustainable Development
ABNJ	Areas Beyond National Jurisdiction
IPCC	Intergovernmental Panel on Climate Change
GDP	Gross Development Product
SOP	Sustainable Ocean Planning
SIDS	Small Island Developing States
LCDs	Least Developed Countries
BBNJ	Biodiversity in areas Beyond National Jurisdiction
UNFCCC	United Nations Framework Convention on Climate Change
SOPM	Sustainable Ocean Planning and Management
GOOS	Global Ocean Observing System
IODE	International Oceanographic Data and Information Exchange
EEZ	Exclusive Economic Zones
UNEP	United Nations Environmental Program
PAP/RAC	Priority Actions Program/ Regional Activity Centre
ESPON	European Observation Network for Territorial Development and Cohesion
ICZM	Integrated Coastal Zone Management
GIS	Geographic Information System

References

1. Corporate author: Ministry for the Ecological Transition and the Demographic Challenge (MITECO), National Center for Environmental Education (CENEAM). ABC del mar – Principle 1. Available at: <https://www.miteco.gob.es/es/ceneam/recursos/mini-portales-tematicos/reeducamar/abc-mar-principio1.html>. Accessed 25 November 2025.
2. Corporate author: Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO). Marine Spatial Planning. Available at: <https://www.ioc.unesco.org/en/marine-spatial-planning>. Accessed 25 November 2025.
3. Corporate author: Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO). IOC-UNESCO Main Page. Available at: <https://www.ioc.unesco.org/en>. Accessed 25 November 2025.
4. Corporate author: European Commission, Directorate-General for Maritime Affairs and Fisheries (DG MARE). Maritime Affairs and Fisheries – Main Page. Available at: https://commission.europa.eu/about/departments-and-executive-agencies/maritime-affairs-and-fisheries_en. Accessed 25 November 2025.
5. Corporate author: United Nations. 2030 Agenda for Sustainable Development. Available at: <https://sdgs.un.org/2030agenda>. Accessed 25 November 2025.
6. Corporate author: UNESCO. United Nations Decade of Ocean Science for Sustainable Development (2021–2030). Available at: <https://www.unesco.org/en/decades/ocean-decade>. Accessed 07 January 2026.
7. Corporate author: High Level Panel for a Sustainable Ocean Economy (Ocean Panel). Ocean Panel – Main Page. Available at: <https://oceanpanel.org/>. Accessed 07 January 2026.
8. Corporate author: High Level Panel for a Sustainable Ocean Economy (Ocean Panel). Call to Action. Available at: <https://oceanpanel.org/call-to-action/>. Accessed 07 January 2026.
9. Corporate author: European Commission, Directorate-General for Research and Innovation. Restore Our Ocean and Waters by 2030 – Implementation Plan. Available at: https://research-and-innovation.ec.europa.eu/system/files/2021-09/ocean_and_waters_implementation_plan_for_publication.pdf. Accessed 07 January 2026.
10. Corporate author: Intergovernmental Panel on Climate Change (IPCC). IPCC – Main Page. Available at: <https://www.ipcc.ch>. Accessed 07 January 2026.
11. Corporate author: Ministry for the Ecological Transition and the Demographic Challenge (MITECO). Executive Summary – Evaluation Report of the Spanish National Climate Change Adaptation Plan (PNACC). Available at: https://www.miteco.gob.es/content/dam/miteco/es/cambio-climatico/temas/impactos-vulnerabilidad-y-adaptacion/executivesummary_informeevaluacionpnacc_tcm30-499189.pdf. Accessed 07 January 2026.
12. Corporate author: European Parliament and the Council of the European Union. Recommendation concerning the implementation of Integrated Coastal Zone Management in Europe (2002/413/EC). Official Journal L 148, 6 June 2002, pp. 24–27. Accessed 07 January 2026.
13. Corporate author: United Nations. United Nations Convention on the Law of the Sea (UNCLOS). Available at: https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf. Accessed 07 January 2026.
14. Corporate author: UNESCO. UNESCO in Brief. Available at: <https://www.unesco.org/en/brief>. Accessed 07 January 2026.
15. Corporate author: Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO). Statutes of the Intergovernmental Oceanographic Commission. Document code: IOC/INF/1148; SC.2000/WS/57; 2000. Available at: <https://unesdoc.unesco.org/ark:/48223/pf0000124367.locale=en>. Accessed 07 January 2026.
16. Corporate author: Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO). IOC Brochure 2016/4. Document code: IOC/BRO/2016/4 REV; 2016. Available at: <https://unesdoc.unesco.org/ark:/48223/pf0000246085>. Accessed 07 January 2026.
17. Corporate author: High Level Panel for a Sustainable Ocean Economy (Ocean Panel). The Journey – Progress Report. Available at: <https://oceanpanel.org/progress-report/the-journey>. Accessed 07 January 2026.

18. Corporate author: World Bank. Global Partnership for Oceans (GPO). Available at: <http://documents.worldbank.org/curated/en/737341637821958000/Global-Partnership-for-Oceans-GPO>. Accessed 07 January 2026.
19. BORGESSE, ELISABETH MANN. Ocean Governance. Halifax (Canada): International Ocean Institute, 2001.
20. Corporate author: Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO) and Directorate-General for Maritime Affairs and Fisheries of the European Commission. MSPglobal International Guide on Marine/Maritime Spatial Planning. IOC Manuals and Guides, 89. Document code: IOC/2021/MG/89. ISBN: 978-84-09-33197-0; 2021. Available at: <https://unesdoc.unesco.org/ark:/48223/pf0000379196>. Accessed 07 January 2026.
21. Corporate author: United Nations. United Nations Convention on the Law of the Sea (UNCLOS). Available at: https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf. Accessed 07 January 2026.
22. Corporate author: European Union. Decision (EU) 2024/1830 of 19 July 2024. Official Journal of the European Union, L 1962, pp. 1–45. Available at: <https://eur-lex.europa.eu/eli/dec/2024/1830/oj/eng>. Accessed 07 January 2026.
23. Corporate author: ResearchGate. Governing the Global Commons: Challenges and Opportunities for US–Japan Cooperation – Figure Resource. Available at: https://www.researchgate.net/publication/366986362_Governing_the_Global_Commons_Challenges_and_Opportunities_for_US-Japan_Cooperation/figure. Accessed 07 January 2026.
24. Corporate author: Executive Office of the President of the United States. Final Marine Planning Handbook. Available at: https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/final_marine_planning_handbook.pdf. Accessed 07 January 2026.
25. Corporate author: European Union. Directive 2014/89/EU establishing a framework for maritime spatial planning. Available at: <https://eur-lex.europa.eu/eli/dir/2014/89/oj/eng>. Accessed 07 January 2026.
26. Corporate author: Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO). Sustainable Ocean Planning. Available at: <https://www.ioc.unesco.org/en/sustainable-ocean-planning>. Accessed 07 January 2026.
27. Corporate author: United Nations Decade of Ocean Science for Sustainable Development. Ocean Decade Programme on Sustainable Ocean Planning. Available at: <https://oceandecade.org/actions/ocean-decade-programme-on-sustainable-ocean-planning/>. Accessed 07 January 2026.
28. VASSILOPOULOU, VASSILIKI. IOC Policy Brief. Licence type: CC BY-SA 3.0 IGO; 2021. Available at: <https://oceanexpert.org>. Accessed 07 January 2026.
29. Corporate author: Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO). Draft IOC-Wide Strategy on Sustainable Ocean Planning and Management. Document code: IOC/EC-57/4.3 Doc(1) Rev. Paris, 3 June 2024. Available at: <https://unesdoc.unesco.org/ark:/48223/pf0000375721>. Accessed 07 January 2026.
30. QIANG, H.; SILLIMAN, B. R. Climate Change, Human Impacts, and Coastal Ecosystems in the Anthropocene. *Current Biology*, Vol. 29, Issue 19, 2019, pp. R1021–R1035. Available at: <https://doi.org/10.1016/j.cub.2019.08.042>. Accessed 07 January 2026.
31. FRAZAO-SANTOS, C.; et al. Integrating climate change in ocean planning. *Nature Sustainability*, 3, 2020, pp. 505–506. Available at: <https://doi.org/10.1038/s41893-020-0513-x>. Accessed 07 January 2026.
32. RILOV, G.; et al. A fast-moving target: achieving marine conservation goals under shifting climate and policies. *Ecological Applications*, 30(1), 2020. Available at: <https://doi.org/10.1002/eap.2009>. Accessed 07 January 2026.
33. NEGRO, VICENTE; et al. Action Strategy for Studying Marine and Coastal Works with Climate Change on the Horizon. *Journal of Coastal Research*, Special Issue No. 85, 2018, pp. 506–510.
34. Corporate author: TENNET. Stakeholder consultation and nature inclusive design of the offshore grid. 2019. Available at: http://ecoadapt.org/data/documents/EcoAdapt_USFS_SoCal_Webinars_Mar2017_small.pdf. Accessed 07 January 2026.

35. CORDOBA-DONADO, F. J.; et al. Integration of Marine Spatial Planning and Terrestrial Spatial Planning and its implementation in Spain. *JSM Environmental Science and Ecology*, Vol. 12, Issue 2, 2024. SciMedCentral. Available at: <https://www.jscimedcentral.com/journal-article-info/JSM-Environmental-Science-and-Ecology/Integration-of-Marine-Spatial-Planning-and-Terrestrial-Spatial-Planning-and-its-implementation-in-Spain-11855#>. Accessed 07 January 2026.
36. Corporate author: European Union. Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning.
37. Corporate author: Government of Spain. Royal Decree 363/2017, of April 8th, which establishes a framework for maritime spatial planning and ordered the approval of five maritime space management plans, one for each of the Spanish marine regions.
38. Corporate author: Government of Spain. Law 41/2010, of December 29th, on the protection of the marine environment.
39. Corporate author: European Commission. The European Green Deal (EGD), approved in 2020 – policy initiatives to make the European Union climate neutral by 2050.
40. Corporate author: United Nations. The Paris Agreement, signed on April 22nd, 2016 – agreement under the UNFCCC to reduce greenhouse gas emissions and limit global temperature increase.
41. Corporate author: European Commission. 2050 long-term strategy – Striving to become the world's first climate-neutral continent by 2050. Available at: https://climate.ec.europa.eu/eu-action/climate-strategies-targets/2050-long-term-strategy_en. Accessed 07 January 2026.
42. Corporate author: European Commission. EU Biodiversity Strategy for 2030. Available at: https://environment.ec.europa.eu/strategy/biodiversity-strategy-2030_en. Accessed 07 January 2026.
43. Corporate author: Government of Spain. Royal Decree 150/2023, of February 28th, 2023, approving the maritime spatial management plans of the five Spanish marine regions.
44. Corporate author: Ministerio para la Transición Ecológica y el Reto Demográfico (MITECO). Executive Summary of the POEM. Available at: https://www.miteco.gob.es/content/dam/miteco/es/costas/temas/proteccion-medio-marino/4resumenejecutivopoem_tcm30-552786.pdf. Accessed 07 January 2026.
45. GARCÍA-AYLLÓN VEINTIMILLA, SALVADOR. Urbanismo y ordenación del territorio. Manual de teoría. Escuela Universitaria de Ingenieros de Caminos, Canales y Puertos, Universidad Politécnica de Cartagena, 2014.
46. SANÁBRIA-PEREZ, SOLEDAD. La ordenación del territorio: origen y significado. *Terra Nueva Etapa*, Vol. XXX, No. 47, 2014, pp. 13–32. Universidad Central de Venezuela, Caracas. Available at: <http://www.redalyc.org/articulo.oa?id=72132516003>. Accessed 07 January 2026.
47. PALANCAR, M. La Autoridad del Valle de Tennessee. (n.d.).
48. BOISIER, S. Postscriptum sobre desarrollo regional: modelos reales y modelos mentales. *Revista Anales de Geografía*, Vol. 18, 1998, pp. 18–35.
49. BENGOTXEA, J. Principios jurídicos para la ordenación del territorio. *Azkoaga*, Vol. 8, 2000, pp. 79–101.
50. SERRANO, A. Hacia un desarrollo territorial más sostenible. ¿Una nueva forma de planificación? Universidad Politécnica de Valencia, Asociación Interprofesional de Ordenación del Territorio, FUNDICOT, Valencia, 2001, pp. 2–11. Available at: <http://www.cebem.org/biblioteca/fundicot/serrano.pdf>. Accessed 07 January 2026.
51. HILDENBRAND, A. Política de ordenación del territorio en Europa. *Revista Estudios Regionales*, No. 47, 1997, pp. 205–210. Available at: <http://www.revistaestudiosregionales.com/pdfs/pdf977.pdf>. Accessed 07 January 2026.
52. PAREJO, T. La estrategia territorial europea. Doctoral Thesis, Universidad Carlos III de Madrid, 2003. Available at: <http://e-archivo.uc3m.es/dspace/handle/10016/562>. Accessed 07 January 2026.
53. Corporate author: Council of Europe. 6th European Conference of Ministers Responsible for Regional Planning (CEMAT). Available at: <https://rm.coe.int/6th-european-conference-of-ministers-responsible-for-regional-planning/168076dd93>. Accessed 07 January 2026.
54. Corporate author: European Commission. 1999 Strategy Paper. Available at: https://enlargement.ec.europa.eu/strategy-paper-1999_en. Accessed 07 January 2026.

55. Corporate author: European Commission. Communication COM(2005) 218 – Cohesion Policy in Support of Growth and Jobs. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52005DC0218>. Accessed 07 January 2026.
56. Corporate author: European Commission. European Regional Development Fund (ERDF) – Main Page. Available at: https://ec.europa.eu/regional_policy/funding/erdf_en. Accessed 07 January 2026.
57. Corporate author: Comunidad de Madrid. Orden 2024/12/27 del Boletín Oficial de la Comunidad de Madrid. Available at: https://www.bocm.es/boletin/CM_Orden_BOCM/2024/12/27/BOCM-20241227-1.PDF. Accessed 07 January 2026.
58. Corporate author: United Nations Environment Programme (UNEP). World Water Quality Assessment Report. Available at: https://wesi.unep.org/media/docs/assessments/unep_wwqa_report_web.pdf. Accessed 07 January 2026.
59. Corporate author: United Nations Environment Programme (UNEP). Programme of Work – Draft, 29 September 2015. Available at: http://www.pnuma.org/forodeministros/20-reunion-intersesional/documentos/UNEA2/PoW_draft_29_Sept_2015.pdf. Accessed 07 January 2026.
60. Corporate author: European Commission – Maritime Spatial Planning Platform. Land-Sea Interactions Final Report (2018). Available at: https://maritime-spatial-planning.ec.europa.eu/sites/default/files/lis_final20180417_digital5.pdf. Accessed 07 January 2026.
61. KIDD, S.; ELLIS, G. From the land to sea and back again? Using terrestrial planning to understand the process of marine spatial planning. *Journal of Environmental Policy & Planning*, Vol. 14, No. 1, 2012, pp. 49–66. Available at: <https://doi.org/10.1080/1523908X.2012.662382>. Accessed 07 January 2026.
62. Corporate author: Priority Actions Programme Regional Activity Centre (PAP/RAC). Main Page. Available at: <https://paprac.org/>. Accessed 07 January 2026.
63. Corporate author: ESPON Programme. Main Page. Available at: <https://www.espon.eu/>. Accessed 07 January 2026.
64. Corporate author: MSPglobal Initiative. MSPglobal Flyer – Land-Sea Interactions. Available at: https://www.mspglobal2030.org/wp-content/uploads/2020/05/MSPglobal_Flyer_LSI_EN.pdf. Accessed 07 January 2026.
65. Corporate author: Priority Actions Programme Regional Activity Centre (PAP/RAC). Progress Report 2018–2019. Available at: https://paprac.org/storage/app/media/Progress%20Reports/Progress%20Report%202018_2019.pdf. Accessed 07 January 2026.
66. Corporate author: ESPON Programme. MSP-LSI – Maritime Spatial Planning and Land-Sea Interactions Project. Available at: <https://www.espon.eu/projects/msp-lsi-maritime-spatial-planning-maritime-spatial-planning-and-land-sea-interactions>. Accessed 07 January 2026.
67. MORF, A. (ed.); CEDERGREN, E.; GEE, K.; KULL, M.; ELIASSEN, S. *Lessons, Stories and Ideas on How to Integrate Land-Sea Interactions into MSP*. Stockholm, Nordregio, 2019.
68. KIDD, S.; GEE, K. Taking account of land-sea interactions in marine spatial planning. In: ZAUCHA, J.; GEE, K. (eds.). *Marine Spatial Planning: Past, Present, Future*. Cham, Palgrave Macmillan, 2019.
69. Corporate author: Generalitat Valenciana. PATRICOVA Cartographic Viewer – Territorial Action Plan for Flood Risk Prevention in the Valencian Community. Available at: <https://mediambient.gva.es/es/web/planificacion-territorial-e-infraestructura-verde/patricova-plan-de-accion-territorial-de-caracter-sectorial-sobre-prevencion-del-riesgo-de-inundacion-en-la-comunitat-valenciana>. Accessed 07 January 2026.
70. CHALASTANI, V. I.; TSOUKALA, V. K.; COCCOSSIS, H.; DUARTE, C. M. A bibliometric assessment of progress in marine spatial planning. *Marine Policy*, 127, 2021, 104329. Available at: <https://doi.org/10.1016/j.marpol.2020.104329>. Accessed 07 January 2026.
71. TSAIMOU, C. N.; PAPADIMITRIOU, A.; CHALASTANI, V. I.; SARTAMPAKOS, P.; CHONDROS, M.; TSOUKALA, V. K. Impact of spatial segmentation on the assessment of coastal vulnerability – Insights and practical recommendations. *Journal of Marine Science and Engineering*, 11(9), 2023, 1675. Available at: <https://doi.org/10.3390/jmse11091675>. Accessed 07 January 2026.

72. GÓMEZ PINA, GREGORIO. ¿Qué es un tsunami?: importancia de la educación ciudadana. In: El riesgo de maremotos en la Península Ibérica a la luz de la catástrofe del 1 de noviembre de 1755. IERD, 2015.
73. GONZÁLEZ RODRÍGUEZ, MAURICIO. Desarrollo de metodologías para el cálculo del riesgo por tsunami y aplicación para el caso de Cádiz. In: El riesgo de maremotos en la Península Ibérica a la luz de la catástrofe del 1 de noviembre de 1755. IERD, 2015.
74. PRIETO, J. M.; ALMORZA, D.; AMOR-ESTEBAN, V.; MUÑOZ-PÉREZ, J. J.; JIGENA-ANTELO, B. Identification of Risk Patterns by Type of Ship Through Correspondence Analysis of Port State Control: A Differentiated Approach to Inspection to Enhance Maritime Safety and Pollution Prevention. *Oceans*, 6(1), 2025, p. 15. MDPI.
75. CRUZ-RAMÍREZ, C. J.; CHÁVEZ, V.; SILVA, R.; MUÑOZ-PÉREZ, J. J.; RIVERA-ARRIAGA, E. Coastal Management: A Review of Key Elements for Vulnerability Assessment. *Journal of Marine Science and Engineering*, 12, 2024, 386. Available at: <https://www.mdpi.com/journal/jmse>. Accessed 07 January 2026.
76. Corporate author: Comunidad Autónoma de la Región de Murcia. Ley 13/2015, de 30 de marzo, de ordenación territorial y urbanística de la Región de Murcia. Available at: <https://www.boe.es/eli/es-mc/l/2015/03/30/13/con>. Accessed 07 January 2026.
77. Corporate author: Ayuntamiento de Cartagena. Plan General de Ordenación Urbana (PGOU). Available at: <https://urbanismo.cartagena.es/urbanismo4/asp/pln/plan.aspx?IDClave=2008-0001>. Accessed 07 January 2026.
78. Corporate author: Comunidad Autónoma de la Región de Murcia. Plan Estratégico de la Región de Murcia 2014–2020. Available at: <https://transparencia.carm.es/-/plan-estrategico-de-la-region-de-murcia-2014-2020>. Accessed 07 January 2026.
79. Corporate author: Ministerio para la Transición Ecológica y el Reto Demográfico (MITECO). Marco de Actuaciones Prioritarias para la Recuperación del Mar Menor. Available at: <https://www.miteco.gob.es/es/ministerio/planes-estrategias/mar-menor/marco-actuaciones-prioritarias-2024.html>. Accessed 07 January 2026.
80. Corporate author: Ministerio para la Transición Ecológica y el Reto Demográfico (MITECO). POEM Levantine Balear Marine Spatial Plan. Available at: <https://www.miteco.gob.es/es/costas/temas/proteccion-medio-marino/ordenacion-del-espacio-maritimo>. Accessed 07 January 2026.
81. Corporate author: Comunidad Autónoma de la Región de Murcia. Estrategia Regional de Mitigación y Adaptación al Cambio Climático. Available at: <https://transparencia.carm.es/-/estrategia-regional-de-mitigacion-y-adaptacion-al-cambio-climatico>. Accessed 07 January 2026.
82. Corporate author: Confederación Hidrográfica del Segura. Plan Hidrológico de la Cuenca del Río Segura 2022–2027. Available at: <https://www.chsegura.es/es/cuenca/planificacion/planificacion-2022-2027/plan-hidrologico-2022-2027>. Accessed 07 January 2026.
83. Corporate author: Ministerio para la Transición Ecológica y el Reto Demográfico (MITECO). Estrategia para el Cambio Climático de la Costa Española. Available at: https://www.miteco.gob.es/content/dam/miteco/es/costas/temas/proteccion-costa/estrategiaadaptacionccaprobada_tcm30-420088.pdf. Accessed 07 January 2026.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.