



PORTODIMARE

geoPORTal of TOols & Data for sustainable Management of coAstal and maRine Environment (ADRION205)

**DT2.8.3 Action plan on the testing area
of Emilia-Romagna Region (Italy)**

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List of abbreviations

AIS	Automatic Identification System
AIR	Adriatic-Ionian Region, as defined by the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions concerning the European Union Strategy for the Adriatic and Ionian Region COM(2014) 357 final
API	application programming interface
AZA	Module supporting Allocated Zone to Aquaculture Identification integrated into the GAIR
BPZ	Zone of Biological Protection
CEA	Module for Cumulative Effects Assessment integrated into the GAIR
CNR	Consiglio Nazionale delle Ricerche
CS	Case study
CSW	Catalogue Service for the Web
EEZ	exclusive economic zone, as defined by the United Nations Convention on the Law of the Sea
EU	European Union
EUSAIR	Strategy for the Adriatic and Ionian Region COM(2014) 357 final
GAIR	Geoportal of Adriatic-Ionian Region (the main output of PORTODIMARE project)
GUI	graphical user interface
ICZM	Integrated Coastal Zone Management, as defined by the Protocol on Integrated Coastal Zone Management to the Barcelona Convention (Council Decision 2010/631/EU)
LSI	Land-sea interaction(s)
MCDA	Multi-Criteria Decision Analysis
MSF	Medium Scale Fishery Footprint
MSP	Maritime Spatial Planning, as defined by Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning
MSPKC	Maritime Spatial Planning Knowledge Catalogue
MUC	Module on Maritime Use Synergy and Conflict Analysis, integrated into the GAIR
NTC	National Technical Committee, established in Italy for the governance of the MSP process
PARTRAC	Module for supporting particles and contaminants dispersion tracking, integrated into the GAIR
PU	planning units
OGC	Open Geospatial Consortium
SO	specific objects



SQL	Structured Query Language
UNIVE	University of Venice
WAC	Western Adriatic Coastal Current
VMS	Vessel Monitoring System
WGS	World Geodetic System
WP	Work Package of PORTODIMARE project (as described in the Application Form)

1 PORTODIMARE PROJECT

Almost all coastal and marine areas are under pressure by different human activities that try to fulfil all the demands modern society has. Climate changes and hazards, both manmade and natural, are impacting marine and coastal resources and ecosystems even more. The Adriatic and Ionian seas are, because of their shallowness and semi-enclosed nature, particularly vulnerable to such threats. That is why the PORTODIMARE project is aimed at tackling environmental vulnerability, fragmentation, and the safeguarding of ecosystems in the Adriatic-Ionian Region (AIR). Efficient planning and management of the coastal and marine spaces in the AIR need to be done transnationally to avoid conflicts and support sustainable growth while preserving the ecosystem for the upcoming generations. PORTODIMARE project is in full compliance with the Integrated Coastal Zone Management (ICZM) and Maritime Spatial Planning (MSP) principles and policies and supports the implementation of the EUSAIR Action Plan.

The main output of the PORTODIMARE project is the Geoportal of Adriatic-Ionian Region (GAIR), which integrates and further develops existing databases, portals and tools that were developed within the previous European project and other initiatives. In such a way, most of the available knowledge and resources are efficiently organized and made accessible through a single virtual space. The main components of the GAIR are described in chapter 1.1 and following.

The project implemented a set of Tools for MSP, (modules) used for analytical purposes, mainly to provide information for coastal and marine planning. The intended users' groups include experts and decision makers either from spatial planning and environmental agencies or from public authorities as well as operators such as fishery managers and potential investors. Moreover, research groups and students are invited particularly to build a knowledge base, which could be offered to other users via the GAIR. The use of GAIR and its modules was tested in six pilot sites as a support for the development of action plans for four Countries: Croatia, Greece, Italy, and Slovenia.

PORTODIMARE project includes the following activities: preparation, management, implementation, and communication of the GAIR. The implementation is divided in two parts. The first part encompasses the design and development of the architecture and main components of the GAIR and its tools for MSP. The second part encompasses efforts on the coordination of the training, the testing activities, and the elaboration of the GAIR maintenance and transferability plan, GAIR Practical Guide and Action plans for the countries.

The former one is elaborated in this document. It describes COUNTRY specific action plan as a contribution of the Portodimare project to national/regional MSP process. As well as for the maintenance of the Geoportal datasets and tools and transfer the use of its modules to target groups within its pilot area and in the country as a whole.

1.1 The GAIR development

The GAIR Report on system architecture and design (DT.1.4.1), describes the system architecture that was used to develop the GAIR. Some of the main purposes of the GAIR are: to guarantee an operational use to public administrations, as well as to scientific and research bodies and civil society; to develop an effective and integrated environment between data and tools; to be well connected to other sources of information; to integrate data and information that are adequately controlled and validated; to be user-friendly for non-technical experts, etc. GAIR follows the MSP implementation process and modular approach that means that GAIR implements multiple modules (tools for MSP) that will enable integrated and sectorial geospatial modelling. Each of the modules has single or multiple objectives and is spatially scalable, that is, they are applicable on local, regional, and on the scale of the Adriatic-Ionian Region. GAIR is based on free and open-source software approach, it is targeting the multi-level community, ranging from students, open public, research/academics, sectorial actors, planners, and decision-makers. The results of each module run will be available within the GAIR, thus allowing sharing knowledge within the community.

The GAIR MSP-driven approach consists of six steps that ensure full support to planning and iteration:

1. definition of the goals of the tool application
2. definition of which module (Tool for MSP) to use for the analysis;
3. definition of the spatial extent of the study area;
4. definition of the module workflow with present or/and future conditions;
5. valuation of module results by analysis of the result summary on the user's personal computer and GIS software;
6. sharing the results with the PORTODIMARE community through GAIR.

Module run can be based on geospatial layers that are already incorporated in the GAIR and also on multiple geospatial layers that can be uploaded by users.

The content of the GAIR is coming from different sources which include links to existing data already published or accessible through standard OGC web services, geographical datasets that partners have uploaded directly through the Geoportal interface, and geographical datasets that are part of deliverables of past projects (Figure 1).

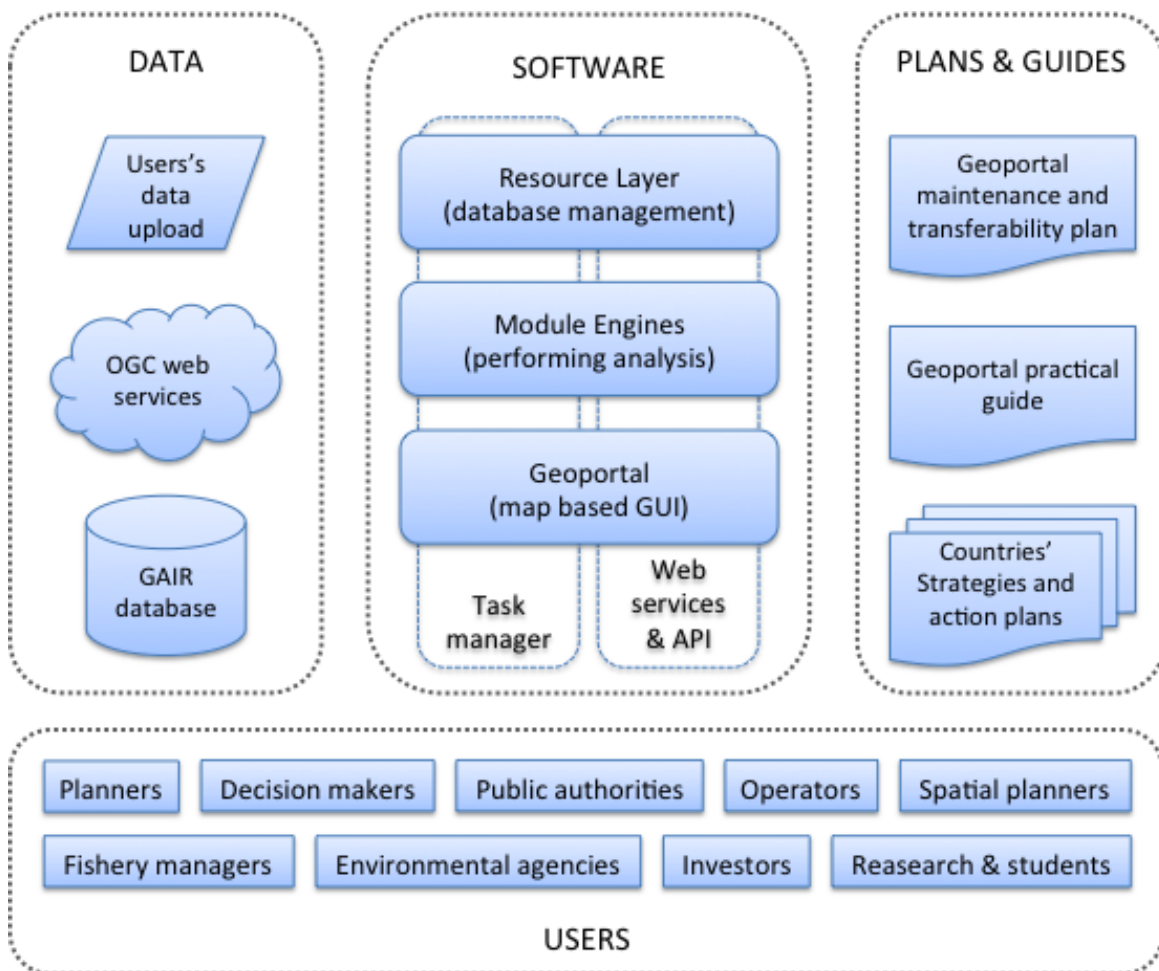


Figure 1 - Components of the Geoportal of Adriatic-Ionian Region (GAIR)

GAIR is based on the GeoNode platform. PORTODIMARE specific applications were built in Django, Python web development framework. Other software solutions that have been used to build GAIR include PostgreSQL with PostGIS, GeoServer, Swagger, Celery, GeoExt, OpenLayers, Leaflet, Wagtail, and others.

The GAIR system architecture consists of five main components (Figure 1):

1. Resource Layer (database management systems and facilities to store datasets, information, metadata, and other resources);
2. Module Engines (for performing module/tool analysis);
3. Task Manager middleware (for orchestrating the GAIR tasks and processes);
4. Web services and API (for publishing the API and for the web services for interaction with resources);
5. the Geoportal (graphical user interface, tools to search, visualize, explore, and analyse resources, and for downloading geospatial layers, maps, and PORTODIMARE model outputs).

Different user profiles with different, hierarchically organized, privileges are defined within GAIR. The authentication layer supports a single sign-on mechanism and is equipped with security precautions, such as automatic password expiring after 180 days.

1.2 GAIR -Tools for MSP (modules)

The PORTODIMARE project implemented seven modules. They differ according to the programming languages (Python and R), user interaction level, and level of long-term support perspective. Because of these differences, two different module integration patterns have been designed:

- direct integration (GAIR API directly execute the module engine) and
- API-based integration (GAIR API performs machine-to-machine communication with an external module/tool).

Module T1.10 does not require real-time analysis and users can use pre-processed layers and pre-configured maps. Interfaces are input forms, characterized by different components and options that can be defined, or are map-based. Graphical user interfaces for the output of each module are map-based, where the main part of the interface is a map on which the output layer is loaded (Figure 2). Other results, like graphs and links to reports, are shown in a side panel.

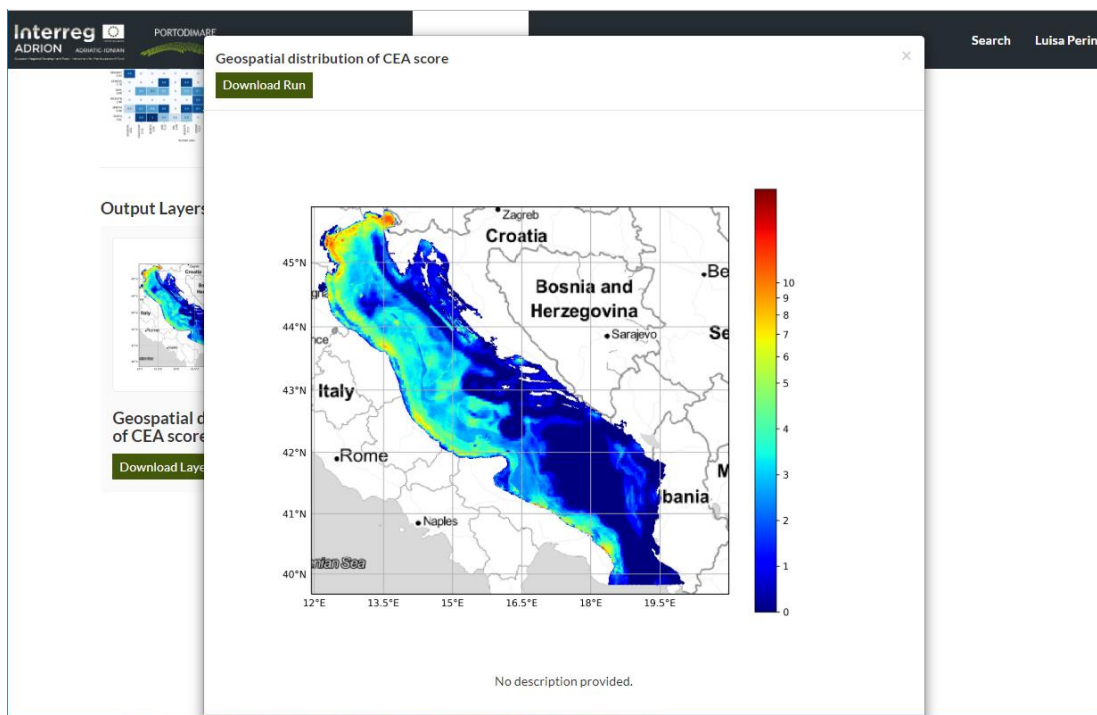


Figure 2 - Example of GAIR - module's graphical interface

1.2.1 Module: Maritime Use Synergy and Conflict Analysis Tool (MUC)

Because of the strong human influence on the Adriatic-Ionian Sea region, geospatial tools that are enabling the analysis of the multi-sector interactions are needed to support Blue Growth and planning strategies and scenarios for conflict mitigation (Depellegrin et al., 2018). MUC tool allows the assessment and mapping of maritime use conflicts (constraints that are creating disadvantages to maritime activities) and synergies (multi-use potentials).

Planners and planning teams, decision-makers, environmental agencies, and research institutions can use MUC. Module inputs are the study area boundary and raster layers about human activities. Module outputs are 1 spatial raster layer and one summary graph and table.

1.2.2 Module: Cumulative Effects Assessment (CEA)

To reach ecological targets in the Adriatic-Ionian Sea region, sustainability goals can only be reached through smart and efficient allocation of the sea space. Geospatial tools supported by the Cumulative Effects Assessment (CEA) can help decision-makers in sea space to choose from different planning options and drive ecosystem-based management (Menegon *et al.*, 2018). CEA is a tool for analysing and mapping the effects of single or multiple human activities on the sea space.

Planners and planning teams, decision-makers, environmental agencies, and research institutions can use this module. Module inputs are the study area boundary, a set of spatial raster datasets about human activities, and a set of spatial raster datasets about environmental components. Module outputs are 3 spatial raster datasets and 4 summary graphs and tables.

1.2.3 Module: Supporting Allocated Zone to Aquaculture (AZA) identification

EU Blue Growth initiative identified aquaculture as one of the key sectors with high potential for sustainable jobs and growth. This module implements the Spatial Multi-Criteria Evaluation (SMCE) methodology for identifying Allocated Zones to Aquaculture (AZA), i.e. marine areas where the development of aquaculture has priority before other uses.

This module is intended for public authorities, current operators, and investors. Module inputs are the user-defined location or area on the map, the optimal growth model, and about 10-30 geospatial remotely sensed and site-specific datasets about constraints, socio-economic and environmental data. Outputs are three geospatial layers (criteria map, constraints, and suitability map), four raw datasets, and one report.

1.2.4 Module: Particle/conservative contaminants dispersion (PARTRAC)

This module is a tool that can be used to calculate the area of influence of a source of contamination by simulating the dispersion of particles. Users can select location, intensity, and inner behaviour of the particles. It is also possible to characterize the particles by a decay time, life duration, and sinking velocity (Ghezzi *et al.*, 2018).

Planners and planning teams, decision-makers, environmental agencies, and research institutions can use this module. Module inputs are the user-defined location or area on the map and hydrodynamic field model targeted for the area of interest and/or season. Outputs are dispersion simulation, influence area map, and summary report warnings and information about reliability of the results.

1.2.5 Module: Coastal Oil Spill Vulnerability Assessment

One of the major risk factor in the Adriatic-Ionian Sea is represented by the transit of the tanker ships that are carrying hydrocarbons and toxic substances. The pollution of the coastline caused by the spilling of the

substances that are being transported would cause environmental and economic damage (Caputo & Natrella, 2018). This module can perform oil spill simulations in any area of the Adriatic-Ionian Sea to understand the risk scenarios and conduct a risk assessment.

The module is intended for institutions that deal with the management policies of economic, commercial, or tourism activities in the Adriatic-Ionian Region, emergency management institutions, and citizens and students. Inputs are a user-defined area of interest, geospatial layers about coastal vulnerability, a simplified hydrodynamic field, and data about ships and weather. Module outputs are 3-5 geospatial layers, one animation of oil spill simulation, and 1-5 plots with statistical analysis.

1.2.6 Module: Small Scale Fishery (SSF) Footprint

Most of the professional fishing vessels are not equipped with location monitoring systems (VMS - Vessel Monitoring System or AIS - Automatic Identification System) so it is not possible to map their footprints using those systems (Kavadas et al., 2018). The module for Small Scale Fishery (SSF) Footprint implements an MCDA (Multi-Criterial Decision Analysis) to assess and map fisheries' spatial footprint for SSF and a tool for their visualization.

Users of this module can be fishery managers, scientists, spatial planning managers, and scientific groups. Inputs are up to 9 geospatial layers and weights assigned by the user or by default. Outputs are two geospatial layers and a summary report.

1.2.7 Module: Medium Scale Fishery (MSF) Footprint and Cumulative Effects Assessment on SSF and MSF

This module implements a tool for visualization of fisheries' spatial footprint for MSD, including trawlers, and purse seines. It also includes the estimation of the cumulative additive fishing pressure index (SSF+MSF). Medium scale fisheries are, unlike the small-scale fisheries, usually equipped with VMS and AIS monitoring systems that allow mapping their footprints. In cases where VMS and/or AIS are not available for all spatial and temporal scales, GIS-MCDA based approach is employed.

This module is intended for fishery managers, researchers, spatial planning managers, and scientific groups. As input, the module uses up to 10 geospatial layers that are already stored in the GAIR. Outputs are three geospatial layers, summary reports, and raw data.

2 MARITIME SPATIAL PLANNING (MSP) AND INTEGRATED COASTAL ZONE MANAGEMENT (ICZM) PROCESS AND PLANNING STEPS

2.1 Objectives and principles

Today, the increasing demand for coastal and maritime space for different human activities, and as a consequence, the increasing pressures on the coastal and maritime ecosystems and resources, require an integrated planning and management approach. There are several pillars on which such planning and management should be developed. From the EU Integrated Maritime Policy for the European Union, proposed methodologies such as the UNEP/MAP conceptual framework for marine spatial planning (UN Environment/MAP, 2018) to technical tools developed by several projects such as the GAIR tool developed by the PORTODIMARE project.

The chapter briefly elaborates the main legal documents on which integrated coastal and maritime planning and management are based: the Protocol on Integrated Coastal Zone Management in the Mediterranean (hereinafter ICZM Protocol) (UNEP/MAP/PAP, 2008) and Directive 2014/89/EU establishing a framework for maritime spatial planning (Directive 2014/89/EU). Considering the nature of coastal zones and seas, planning and management processes should take into account land-sea interactions, but also cooperation among countries sharing the same coastal and sea ecosystems. Thus, two more issues are elaborated briefly: a land-sea interaction and a transnational cooperation.

2.1.1 The ICZM Protocol

As an international legal document, the ICZM Protocol drives the Mediterranean Countries to better manage and protect their coastal zones. It complements the existing set of Protocols of the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean. 'Integrated coastal zone management' means a sustainable management and use of coastal zones. Coastal zone is defined as the geomorphologic area either side of the seashore on which the interaction between the marine and land parts occurs. For the management purposes, the coastal zone is defined as the external limit of the territorial waters and with the land limit of the administrative coastal units.

The objectives of the ICZM are to:

- Facilitate, through the rational planning of activities, the sustainable development of coastal zones by ensuring that the environment and landscapes are taken into account in harmony with economic, social and cultural development;
- Preserve coastal zones for the benefit of current and future generations;
- Ensure the sustainable use of natural resources, particularly with regard to water use;
- Ensure preservation of the integrity of coastal ecosystems, landscapes and geomorphology;
- Prevent and/or reduce the effects of natural hazards and in particular of climate change, which can be induced by natural or human activities; and
- Achieve coherence between public and private initiatives and between all decisions by the public authorities, at the national, regional and local levels, which affect the use of the coastal zone.

In the process of implementing, the several principles should be considered:

- The terrestrial and maritime part of the coastal zone should be considered as a single entity;
- All the coastal elements (hydrological, geomorphological, climatic, ecological, socio-economic, cultural systems) shall be taken into account in an integrated manner;
- The ecosystem-based approach shall be applied (taking into account all the coastal elements but also their continuous interactions);
- Appropriate governance allowing participation of stakeholders shall be ensured;
- Cross-sector institutional coordination shall be required;
- Development of land use strategies, plans and programmes shall be required;
- The multiplicity and diversity of activities in coastal zones shall be taken into account, and priority shall be given, where necessary, to public services and activities requiring, in terms of use and location, the immediate proximity of the sea;
- The allocation of uses/activities in coastal zones should be balanced and unnecessary concentration and urban sprawl should be avoided;
- Preliminary assessments shall be made of the risks posted on coastal zones; and
- Damage to the coastal environment shall be prevented, and where it occurs, appropriately restored.

Some other considerations proposed by the ICZM Protocol are as follow. Economic activities in the coastal zones that are highlighted are: agriculture and industry; fishing; aquaculture; tourism, sporting and recreational activities; utilization of natural resources; infrastructure, energy, ports and maritime works and structures; and maritime activities. The specific coastal systems to be protected are wetlands and estuaries and marine habitats. Also, special consideration to protection shall be given to coastal landscapes, islands and cultural heritage. As coastal zones are contiguous and stretches across national boundaries, national strategies shall be coordinated with the neighbouring ones. Finally, as ICZM instruments, the ICZM Protocol envisage monitoring and observation activities, national and regional strategies and actions plans for ICZM, environmental assessments, as well as definition of indicators in order to evaluate the effectiveness of ICZM strategies and plans.

To implement the ICZM Protocol, the ICZM Process is designed and is intended to guide the implementation of the ICZM Protocol (PAP/RAC, 2012). There are 5 key stages further structured into key tasks for each stage as follows:

1. Establishment	Establishing Coordination Mechanisms Defining Territorial Scope Defining Governance Context Scoping, Engaging Stakeholders Proposing a Vision, Deciding on Strategic Environmental Assessment
2. Analysis and futures	Building the Evidence Identifying Futures
3. Setting the vision	Building Consensus Setting the Direction Measuring Success

4. Designing the future	Formulating ICZM Strategies Plans or Programmes Establishing Management Structure Embedding
5. Realising the vision	Implementing Acting Monitoring and Reviewing

The working outputs of the ICZM Process are: Inception Report, The Work Plan, Scoping Report, Communication Strategy, Diagnostic Report, Alternative Scenarios and Vision Statement. The final and main output is an ICZM Integrated Plan accompanied with an Implementation Programme/Roadmap. While ICZM Integrated Plan sets the objectives that shall be achieved together with long-term governance and implementation structures, the Programme/Roadmap aims at securing the materialisation of the Plan by definition of actions, responsibilities, costs, timeframes etc. The ICZM plans and programmes are either self-standing documents or integrated in other plans and programmes. They could provide support to the spatial planning process by giving recommendations for policies and the instruments for monitoring and evaluation.

Some examples could be found on the following link:

Coastal Plan for the Šibenik-Knin County (PAP/RAC, 2015)

<http://iczmplatform.org//storage/documents/pEoju2FqfXjzPoYBLsKZiD3o6ONBXxJ44RTWFt7P.pdf>

2.1.2 Maritime spatial planning (Directive 2014/89/EU)

Maritime spatial planning (MSP) is defined as “a process by which the relevant authorities analyse and organise human activities in marine areas to achieve ecological, economic and social objectives“ (Directive, 2014). It is enforced across the EU countries by the Directive 2014/89/EU defining a framework for MSP and obligations to EU countries to establish a maritime planning process. MSP results in a maritime spatial plan. Responsibilities for designing the formats and contents of such plans, including institutional arrangements and allocation of maritime activities, are left to European Member States. In other Mediterranean Countries, non-EU States, the UNEP/MAP Conceptual framework for marine spatial planning is a tool/instrument for the implementation of MSP, is considered as a tool of the ICZM Protocol.

The main MSP objective is to promote sustainable development and growth in the maritime sector considering economic, social, and environmental aspects as well as long-term changes due to climate change. Today, main economic sectors at sea include energy, maritime transport, fisheries, aquaculture and tourism sectors. MSP should manage spatial uses and conflicts in marine areas and encourage multi-purpose uses.

The minimum requirements for MSP are the following:

- To take into account land-sea interactions;
- To take into account environmental, economic and social aspects, as well as safety aspects;
- To promote coherence between maritime spatial planning and the resulting plan and other processes, such as integrated coastal management or equivalent formal or informal practices;
- To ensure the involvement of stakeholders;
- To organize the use of the best available data;
- To ensure trans-boundary cooperation between Member States; and
- To promote cooperation with third countries in accordance.

The Directive stresses the application of the ecosystem-based approach aiming at the sustainable development of the maritime and coastal activities but also ensuring the sustainable use of marine and coastal resources.

A comprehensive guide how to put MSP in practice could be found in a document “A Step-by-Step Approach Toward Ecosystem-Based Management” published by UNESCO (Ehler and Douvere, 2009). The guide identifies ten steps and describes their tasks and outputs, together with lessons learned from already developed maritime spatial plans. Another guiding reference, intended to be short and easy-to-use, is the ‘Conceptual framework for MSP in the Mediterranean’ (UN Environment/MAP, 2018). The document elaborates common principles to be used in the maritime spatial planning process:

<u>Adaptive approach</u>	MSP is a continuing iterative process that adapts over time: plans are developed and implemented, conditions monitored, results evaluated, and plans improved, and so on in the planning cycles.
<u>Multi-scale approach</u>	MSP includes Mediterranean, regional, national, and local scales, combining top-down and bottom-up perspectives.
<u>Integration</u>	Integration among themes, sectors, vertical-horizontal cooperation, marine and land-based planning.
<u>Land-sea interactions</u>	Land-sea interaction could be related to land-sea natural processes, among land-sea uses and activities and among land-sea planning and management processes.
<u>Four dimensions of MSP</u>	Maritime space comprises sea surface, water columns and seabed, thus tridimensional space. Activities could share the same space but in different time, thus the fourth dimension is necessary to enable temporal zoning.
<u>Knowledge based project</u>	MSP must be based on high-quality data and best available knowledge.
<u>Suitability and spatial efficiency</u>	Key guiding concepts to achieve sustainability of marine resources, minimize conflicts, maximize synergies.
<u>Connectivity</u>	Connections between elements should be considered such as shipping lines, areas of similar uses, between protected habitats forming a network, among MSP participants in terms of knowledge sharing and cooperation.
<u>Cross-border cooperation</u>	An essential principle to ensure coherent and coordinated MSP plans across the seas, implying cooperation at the methodological, strategic and implementation levels.

The same document proposes the following steps in the development of maritime spatial plans:

1. Starting the process and getting organized;
2. Assessing the context and defining a vision;
3. Analysing existing conditions;
4. Analysing future conditions;
5. Identifying key issues;
6. Design phase
 - a. Elaboration of MSP plans;
 - b. Strategic Environmental Assessment;
7. Adopting the plan and organizing the implementation;
8. Implementing, monitoring and evaluating the plan; and
9. Cross-step activity: stakeholder consultation.

The above steps need to be tailored to the specifics of the marine area and the specific objectives of the maritime plan.

Main MSP output is a comprehensive spatial management plan for a marine area including zoning, priorities in time and space and covering a 10 to 20 years' time horizon. The plan could include a zoning map and a permit system, to be used as management measures (e.g. permits for fisheries or tourism are issued based on the plan and zoning map).

Some examples can be found on the following link: <https://www.msp-platform.eu>

2.2 Importance of land-sea interactions (LSI)

Land-sea interaction (LSI) is highlighted by the ICZM Protocol, EU MSP Directive and other MSP documents as an essential aspect that should be taken into account when planning and managing coastal and marine areas. LSI is defined “as a complex phenomenon that involves both natural processes across the land-sea interface, as well as the impact of socio-economic human activities that take place in the coastal zone” (EC DG MARE, 2017) and could have double direction: land toward sea or sea toward land. Planning maritime space implies allocation of land space to some maritime activities while planning land-use implies allocation of maritime space to some land-based activities.

LSI could be classified into the following groups:

Land-sea natural processes	e.g. flow of water and movement of organisms between land and sea ecosystems.
Land and sea uses and activities	Almost all maritime uses need supporting structures on land (e.g. ports for ships) while some of the land uses need sea such (e.g. tourism).
Land and sea planning and management processes	Land and sea activities should be planned in harmonized manner considering the land-sea continuum - implying alignment of the methodologies used
Land-sea socioeconomic interactions	People living at the coast are driving land-sea processes; furthermore, people exchange their experiences, knowledge, and culture.

All these interactions shall be identified and assessed in order to include them into the planning and management processes, either in planning maritime space or land space. LSI analysis is necessary for a harmonized planning and management of the coastal zone, its maritime and land parts.

An example of identified LSI-s among land and sea uses is given in Figure 3.

Coastal land uses	Sea spatial uses																						
	Bathing waters	Coastal fishing	Open sea fishing	Pound nets	Underwater cables	Shipping routes and navigation	Dumping sites	Dredging	Anchorage sites	Yachting tourism	Water sports (windsurfing, etc.)	Engine water sports	Diving	Underwater cultural heritage	Military practice areas	Intake waters	Waste water discharges	Bottom trawling	Protected areas	Concession areas	Research monitoring stations	Research hydrographic equipment	
Beaches and dunes																							
Tourism activities																							
Residential areas																							
Industrial areas																							
Port terrestrial areas																							
Waste water discharges																							
Roads and railways																							
Electrical grid																							
Airport																							
Natural gas pipelines																							
Oil pipelines																							
Tailings dams																							
Fish boat landing sites																							
Coastal protection/nourishment																							
Nationally protected areas and NATURA 2000 areas																							
Cultural historical sites and landscape																							

Figure 3 - Matrix of land-sea interactions among uses for Burgas study area (Ramieri *et al.*, 2019)

To integrate LSI into any planning process, three phases are proposed (see LSI document):

1. Scoping (setting the context),
2. Analysis (evaluating LSI using selected methodology), and
3. Incorporating into plans.

Within MSP, the above phases are elaborated in more details forming a guideline to perform LSI as follow (Ramieri *et al.*, 2019):

<p>1. Scoping LSI interaction stocktaking</p>	<p>Define the spatial domain Identify interactions Localize interactions Describe and qualify interactions Identify key policy - legislative - planning aspects Identify key governance aspects Identify and engage stakeholders)</p>
<p>2. Analysis LSI interaction in-depth analysis</p>	<p>Pathways of interactions Spatialize interactions Quantify interactions Analyse temporal dimension</p>
<p>3. Incorporating into plan Inform the plan about LSI analysis outcomes</p>	<p>Identify LSI hot-spot areas Identify key messages from LSI analysis.</p>

Some examples could be found on the following links:

<http://iczmplatform.org//storage/documents/taFUAsAqp9pOnvq8F4zQmNIhMWBTEvocP0qncF2C.pdf>

https://www.msp-platform.eu/sites/default/files/marsplan-bs-burgas_lsi.pdf

2.3 GAIR - a tool supporting MSP processes

Summarizing the above explained concepts involved in the MSP, Figure 4 explains their relations. While Ecosystem-based approach represents a management methodology that takes into account all the system's elements but also their continuous interactions, ICZM Protocol legally enforces but also proposes specific methodological guidelines for integrated coastal zone planning and management. MSP could be seen as an instrument for the implementation of the coastal zone management, for its maritime part. Land-sea interactions, their identification and analysis are a prerequisite for coherent land and maritime spatial planning and thus a required part of both. Finally, the GAIR is a tool supporting the MSP processes including land-sea interactions analysis. What are the MSP's requirements and steps that the GAIR supports?

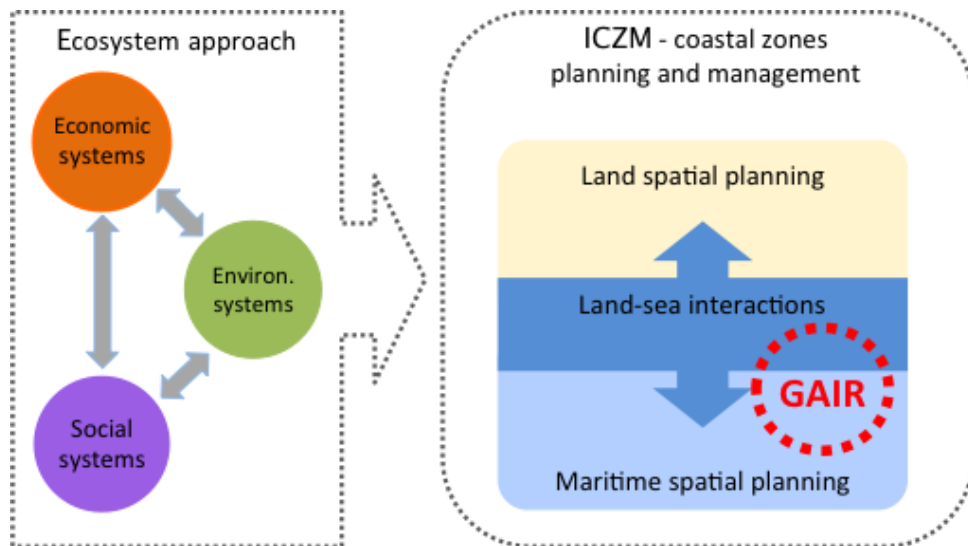


Figure 4 - The support of GAIR in managing coastal and maritime spaces

MSP should ensure several requirements as stated in the previous sub-chapter. The GAIR offers support to all of them. Namely, the GAIR Resource layer ensures the use and organisation of data across the borders and stakeholders, the Module engines provide analytical tools for land-sea interactions' analysis and other analytical tasks such as modelling and development of scenarios, and the Geoportal facilitates stakeholders participation and trans-boundary cooperation (Figure 4).

Regarding MSP steps, Table 1 points out the supporting functions of the GAIR.

Table 1: the GAIR supporting function to MSP steps

MSP steps	The GAIR support
1. Starting the process and getting organized	Resource layer (data collection and management - OGC services and data import functions)
2. Assessing the context and defining a vision	Geoportal (visualising data on maps, tables and charts)
3. Analyzing existing conditions	Module engines (various spatial analysis)
4. Analyzing future conditions	Module engines (various spatial analysis)
5. Identifying key issues	Geoportal (visualising data on maps, tables and charts)
6a. Design phase - Elaboration of MSP plans	Module engines (various spatial analysis) Geoportal (visualising data on maps, tables and charts)
6b. Design phase - Strategic Environmental Assessment	Module engines (various spatial analysis) Geoportal (visualising data on maps, tables and charts)
7. Adopting the plan and organizing the implementation	Resource layer (OGC web services and data export functions) Geoportal (visualising data on maps, tables and charts)
8. Implementing, monitoring and evaluating the plan	Resource layer (data management, OGC web services) Module engines (various spatial analysis) Geoportal (visualising data on maps, tables and charts)
9. Cross-step activity: stakeholder consultation	Geoportal (visualising data on maps, tables and charts)

2.4 Transnational cooperation

The MSP Directive (2014/89/EU) recognises the necessity for cross-border cooperation between Countries, as a part of the planning and management process. The aim is to ensure a coherent and coordinated management across the marine regions.

The cross-border cooperation shall be established among EU Member States and with neighbouring third Countries, hereafter called transnational cooperation because such cooperation should take into account issues of transnational nature. The EUSAIR is a mechanism that supports and enables such cooperation between the AI countries, as one of the four main sub-regions of the Mediterranean.

The MSP Directive stipulates that each EU Member State shall designate the authority responsible for the implementation of the Directive including the responsibility for transnational cooperation. The forms of cooperation are not prescribed into details, but the Directive suggests the following cooperation approaches through the following:

- Existing regional institutional cooperation structures such as Regional Sea Conventions (Barcelona Convention in the case of AIR);
- Networks or structures of Member States' competent authorities;
- Any other method, for example in the context of sea-basin strategies (EUSAIR).

Today, Countries are preparing national and sub-national maritime spatial plans, covering the sea space under their jurisdiction and governed by national laws and regulations. The MSP development process includes the consultation among Countries that share a maritime border (consulting maritime activities and spatial plans of neighbouring Countries and negotiate across borders), but finally, the maritime space is governed by different set of rules.

Although EU Member States are cooperating via international sectorial agreements, there is a need for some supra-national instrument (such as EUSAIR) or body dealing with cross-border aspects of MSP. This is particularly important in Europe, where seas are increasingly congested. There are several MSP instruments that should enhance transnational MSP; among the others, the ones in line with the EUSAIR Action Plan are the following:

- Creation of macro-regional or regional actions as the starting point for successful transnational MSP practices (such as the EUSAIR Action Plan, in the case of the Adriatic-Ionian Region);
- Creation of international/regional sea basins serving as the basis for transnational cooperation (analogue to river basins and sub-basins introduced by Directive 2000/60/EC - Water Framework Directive), and
- Creation of a forum, i.e. a place to discuss and develop approaches to the management of maritime activities in the sea basins (such as the EU MSP Forum¹).

One of the GAIR tool 's achievements is providing support to transnational cooperation in the Adriatic-Ionian Region. It is realised through enabling data and knowledge sharing and applying the same methodologies and analytical tools among the Countries.

¹ <https://www.msp-platform.eu/type-event/forum>

3 MSP AND ICZM IN EMILIA-ROMAGNA - ITALY

3.1 Legal framework, competent authorities and stakeholders

The Protocol on Integrated Coastal Zone Management (ICZM), signed in Madrid on 21 January 2008, and entered in force on 24 March 2011, have been signed by Italy but the ratification is still pending. On the other hand, following the “Recommendation of the European Parliament and the relative Council to the performance of the integrated management of the coastal zones in Europe” - Adopted by the Council and the European Parliament on 30 May 2002 (2002/413/CE), the Emilia-Romagna Regional Council adopted the ICZM Guidelines, by Act n. 645 of 20th January 2005, following the Regional Government’s proposal n. 2406 of 29th November 2004.

For what concern the EU MSP Directive (2014/89/EU), Italy transposed it through the legislative decree n.201 in October 2016 (D. Lgs. 201/2016), establishing a national framework for maritime spatial planning².

In Italy MSP competences are shared among different institutions; the **Competent Authority** for MSP (hereinafter CA), as per Art. 8 of D. Lgs. 201/2016, is the Ministry for Infrastructures and Transport (Ministero delle Infrastrutture e dei trasporti, MIT), within whom a **National Technical Committee** was established (NTC) with the main task to elaborating the maritime spatial plans.

An **inter-ministerial coordination board** (Tavolo Interministeriale di Coordinamento, hereinafter TIC) was established (as per Art. 6 of D. Lgs. 201/2016) within the Department for European Policies of the Presidency of the Council of Ministries. The TIC includes the Ministries for: Infrastructures and Transport, Environment and Land and Sea Protection, Agriculture Food and Forestry, Economic Development, Cultural Heritage and Tourism, Foreign Affairs and International Cooperation, Education and Scientific Research, Defence, Health, Employment and Social Policies, Economy and Finances, Department for Regional Affairs and Autonomies of the Council Presidency and of the Agency for the Douane and Monopolies.

The TIC elaborated the **Guidelines** for the preparation of maritime space management plans (hereinafter Guidelines), published in the official journal n. 19, year 159, of 24 January 2018³. The TIC also defined the **three reference maritime areas**, for whom the maritime spatial plans must be elaborated. Such areas can be reconducted to the three subregions defined in Art. 4 of Directive 2008/56/EU (the Marine Strategy Framework Directive):

- 1) West Mediterranean Sea (involving the Regions of: Liguria, Toscana, Lazio, Campania, Basilicata, Calabria, Sicilia, Sardegna)
- 2) Adriatic Sea (involving the Regions of: Friuli Venezia Giulia, Veneto, Emilia Romagna, Marche, Abruzzo, Molise, Puglia)
- 3) Ionian Sea and Central Mediterranean Sea (involving the Regions of: Puglia, Basilicata, Calabria, Sicilia).

As per Art. 7 of D. Lgs. 201/2016, the NTC is composed by the representatives of: the MIT, the Ministry for Environment and Land and Sea Protection, the Ministry for Agriculture Food and Forestry, the Ministry for Economic Development, the Ministry for Cultural Heritage and Tourism, and by the representatives of all the Regions included in the above mentioned reference maritime areas identified by the Guidelines.

² DECRETO LEGISLATIVO 17 ottobre 2016, n. 201 Attuazione della direttiva 2014/89/UE che istituisce un quadro per la pianificazione dello spazio marittimo <https://www.gazzettaufficiale.it/eli/id/2016/11/07/16G00215/sg>

³ Linee guida per la gestione dello Spazio marittimo, https://www.gazzettaufficiale.it/atto/serie_generale/caricaDettaglioAtto/originario?atto.dataPubblicazioneGazzetta=2018-01-24&atto.codiceRedazionale=18A00392

To be operational, and in accordance to the Guidelines, three Sub-Committees were instituted, one for each of the maritime areas, whose main task is to work directly to the plan of the related maritime area and the sub-areas included in it. Furthermore, a **sub-Technical Committee** was set up to focus on the gathering and management of the data needed for the maritime spatial plan's elaboration.

Emilia-Romagna Region is represented in the NTC, in the Sub-Committee for the Adriatic Sea and in the Sub-Committee dedicated to data management. The Region has also established an **internal 'working group for MSP'**, involving representatives of all those regional departments dealing with sectors of interest for the MSP process, with the aim of gathering all the necessary contributions to the elaboration of the plan for the sub-area of Emilia-Romagna.

Starting from January 2020, the CA involved a **scientific pole** composed by experts in MSP coming from several institutions, including CNR-Ismar and IUAV, that are associates of CORILA (PORTODIMARE project partner n. 02 and leader of Work Package T1). This scientific pole is concretely supporting the CA in organizing the activities, in elaborating the analysis and in the development of the plans themselves.

3.2 Preparation of maritime spatial plans

According to D. Lgs. 201/2016, the maritime spatial plans must be concluded by the end of 2020 in order to be submitted to the European Commission within March 2021. Due to the current emergency caused by the COVID-19 pandemic, however, a slight postponement of such deadlines is foreseen.

Following the Italian MSP guidelines, the scientific pole proposed an operational methodology and a workplan that was approved by the NTC at the beginning of 2020. Such methodology aims at producing a strategic plan, which has the role of providing guidance on how the sea should be used.

The planning phases and main contents of the methodology are the following:

Phase 1 - Initial assessment and current / expected trends

Phase 2 - Analysis of interactions (conflicts and synergies) among uses and impacts on environmental components

Phase 3 - Vision and strategic objectives

Phase 4 - Planning: vocations, specific objectives, specific measures (by areas and by sectors)

Phase 5 - Methodology and indicators for monitoring and adapting the Plan

Phase 6 - Activities for the consolidation, implementation and updating of the Plan.

The Adriatic Sea Maritime Area (as defined in Art. 4 of Directive 2008/56/EC) is divided, for the scope of MSP, into sub-areas (see Figure 5); in each sub-area, a medium-long term vision is defined, and specific planning objectives have been settled.

The criteria and elements to be considered for the definition of the sub-areas, through their optimal combination and expert judgment, are the following:

- national and international legal and administrative limits.
- zoning already existing and used for sectoral planning and management activities.
- Marine Reporting Unit MSFD.
- morphological and oceanographic characteristics.
- existing peculiar or prevalent uses of the sea.

The limits of the sub-areas must be considered as permeable limits, from the point of view of uses, from the point of view of the environment ecosystem and from the point of view of the governance system, in order to guarantee maximum coherence with respect to the planning of a large area and neighbouring sub-areas.

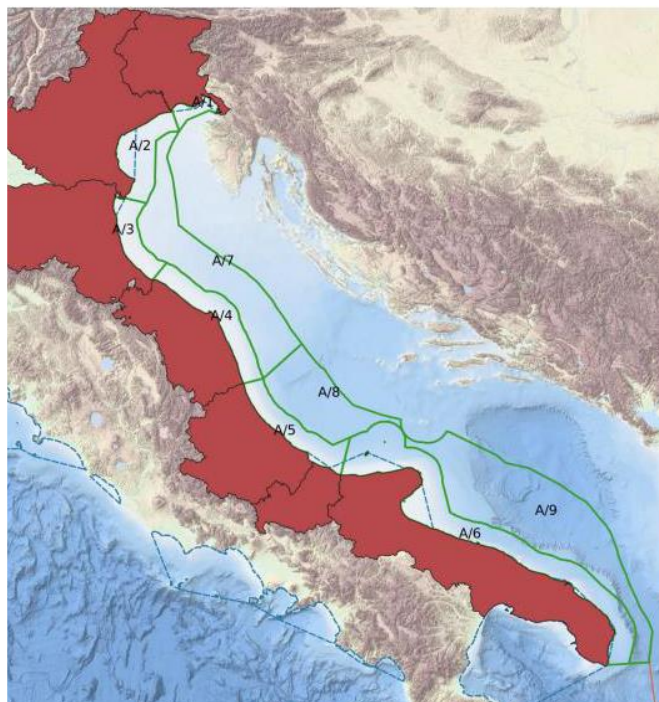


Figure 5 - The Adriatic Sea maritime area and related sub-areas.

The 9 Adriatic sub-areas are characterised as follows:

- 6 areas within the 12 NM
- 3 area, extending from the limit of the territorial waters (i.e. 12 NM) to the boundary dividing the continental shelf as set by the decree of the President of the Republic of Italy n. 830, of 22 May 1969, ratifying the agreement between Italy and Yugoslavia⁴, then transposed by Croatia, Montenegro and Slovenia.

Emilia-Romagna Region is currently working on the elaboration of the plan for the sub-area A 3 (see details in the following Figure 6), in front of the regional coastline, and is cooperating to the development of the plan for sub-area A7 as well as contributing to the knowledge framework for the whole maritime area of the Adriatic Sea.

The elaboration of the plans is work in progress in all the three reference maritime areas and in the related sub-areas, although not with the same level of progress. The activities almost completed are the ones belonging to phases 1 and 2. Locally (for example in Emilia-Romagna) also phases 3 and 4 are at an advanced state of implementation. This was possible thanks to the earlier activities carried out within the flagship project RITMARE⁵ (Barbanti and Perini, 2018) and then those implemented within PORTODIMARE. Recently a specific ‘working group’ has been created to support planning activity at regional level

The consultation process at national level is not yet started due to the COVID-19 pandemic. Nevertheless, it will soon benefit of a dedicated European project (i.e. MSP-MED) whose partnership includes the Italian MSP CA and the scientific pole.

⁴ <https://unmig.mise.gov.it/index.php/it/234-normativa-di-settore/fonti-secondarie/506-decreto-del-presidente-della-repubblica-22-maggio-1969-n-830>

⁵ <http://www.ritmare.it/>

4 TESTING AREA

The general aim of the Emilia-Romagna case study (i.e. PORTODIMARE activity T2.3) is to test the Geoportal of Adriatic-Ionian Region (GAIR) and its Tools for MSP in a context of a real MSP process, so that to provide management and planning options for the present and future activities at sea in the area in front of the regional coastline aimed at enhancing the sustainability of sea uses and the environmental quality of the maritime area.

Since the Region is involved both in PORTODIMARE and in the national MSP process, overlapping temporally and in contents, Emilia-Romagna decided to focus the case study T2.3 on the testing of GAIR both for the analyses expected by the project implementation, and for the outcomes foreseen by the methodology of analysis and planning decided at national level.

The case study (described in detail into the report T.2.3.1) included:

- implementation of the GAIR with regional and more extensive information, in particular with all dataset needed for the use of the Tools for MSP run and those finalized at creating a suitable **knowledge framework concerning sea uses and land sea interaction**;
- testing of the **Tools for MSP, in the present and in managed scenarios**;
- drawing of a managed scenario basing on a set of strategic objectives that has been defined
- an example of maritime spatial plan for Emilia-Romagna area proposal, defining planning units, possible strategies and measures oriented at reducing conflicts among uses, pressures on the environment, at increasing knowledge, and at preparing the basis for a sustainable blue growth .

4.1 Presentation of the testing area

The study site is the marine area facing the Emilia-Romagna Region, located in the Northern Adriatic Sea (Figure 6). It extends around 70 km from the coastline to the limits of the Italian continental shelf. The northern and southern limits fit with the boundaries of the 8° Maritime Rescue Sub Centre of Ravenna (Direzione Marittima). The total water surface is of 5256 km², and is characterized by three different jurisdictional zones: 8% inner water (from the shoreline to the baseline); 40% territorial water (within the 12 Nautical Miles); 52% high seas. With reference to the Adriatic Sea maritime sub-areas, it covers sub-area A3 and, partially, sub-area A7 (see Figure 6).

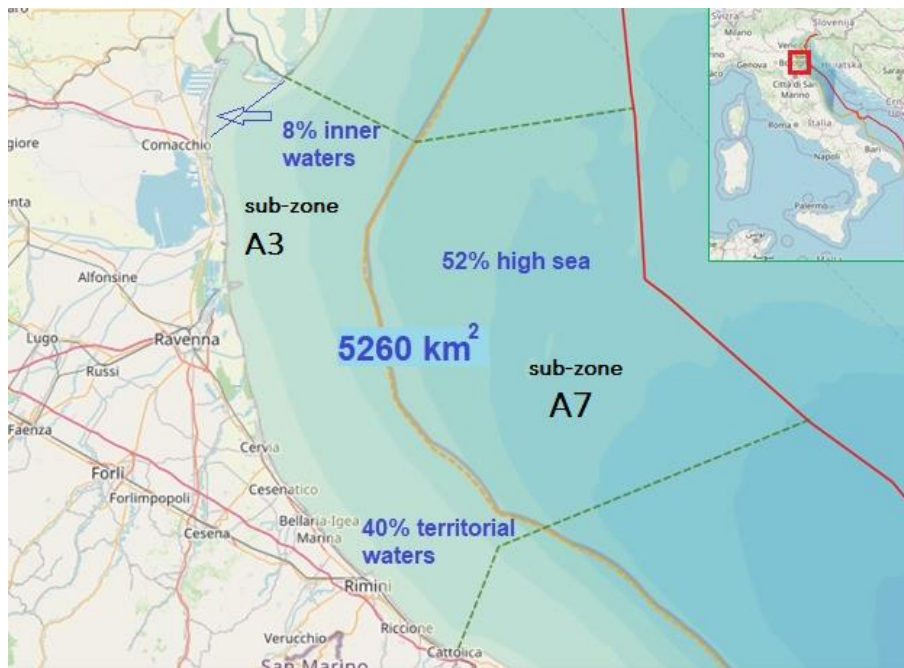


Figure 6 - Case Study area.

The Emilia-Romagna coastal and marine zone is of strategic importance to all the regional territory. Here several key economies are well developed, both on land and at sea, and hence many human activities coexist in a very delicate equilibrium.



Figure 7 - Example of main coastal and sea uses.

The regional coastline extends around 140 km from the Po di Goro river mouth (including the sand-spit) to the southern boundary of the region represented by the Tavollo river, that flows below the headland of Gabicce. South of the actual Po delta, the coast is a long arcuate low and sandy line, broken only by minor Apennines rivers and by the jetties of several harbours. In some parts, the beach is over 200 metres wide, while other sectors are completely eroded and have been replaced by seawalls. Behind the coastal system there are vast reclaimed areas, which lie below the medium sea level and partly consist of wetlands (Bertuzzi Valley, Comacchio Valleys, Ravenna Piallasse): they are home to natural ecosystems of inestimable value.

From an administrative point of view, the coast is managed by 4 provinces (Ferrara, Ravenna, Forlì-Cesena and Rimini) and by 14 coastal municipalities. There are 5 regional ports (Cattolica, Rimini, Cesenatico, Porto Garibaldi e Goro, as shown in Figure 8), 4 municipal harbours (Riccione, Bellaria, Cervia and Gorino) and 27 marinas, some of them built-in in the mentioned harbours. All the ports perform a series of functions (fishing, tourism, commerce, etc.) often superimposed and connected to the territorial context in which they are inserted (tertiary and residential). The cargo sector also includes the commercial transport along the 'Padano-Veneto waterway system' that is part of the "Mediterranean" corridor 3.

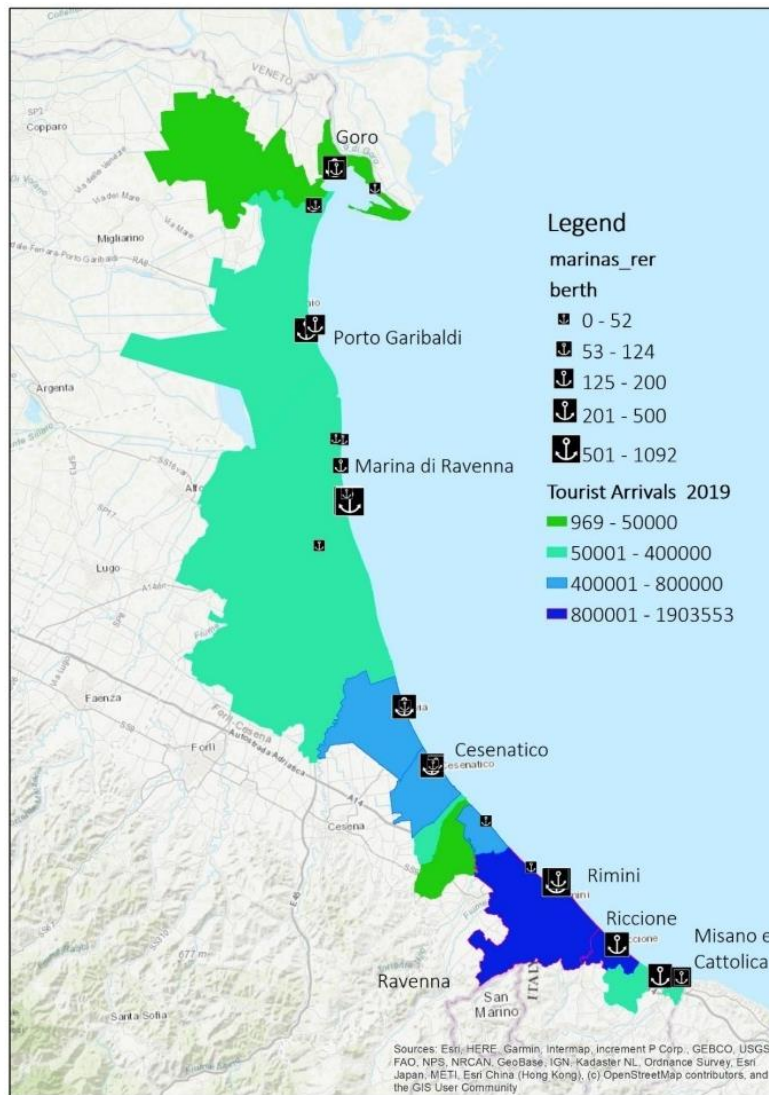


Figure 8 - Tourist arrivals 2019 and marinas

The Emilia-Romagna coastal zone represents **one of the biggest tourist attractions in Europe**, especially in the southern part of the region (e.g. Cesenatico, Rimini, Riccione). Here, the urban fabric is almost uninterrupted and hence this zone is known as the 'linear city'. Towns, villages and many touristic infrastructures have been built along the coastline especially after the second World War, so the urban sprawl reached the 400% in the period 1943- 2008, with reference to a coastal strip wide 1.5 km from the shoreline (Lorito et al 2010). Such exploitation, particularly focused in the southern and central part of the region, caused significant impacts to the coastal morphologies such as coastal dunes, that have been dramatically smoothed to leave space for buildings and beach resorts. Tourism attraction primarily concern beach activities, shipping, fishing, and diving, even if sites visits to the rich cultural heritage (such as Ravenna, Comacchio, Rimini cities) and green tourism become more and more attractive by the time. The northern sector of the region, indeed, hosts large protected areas such as the Delta Po Man & Biosphere site by UNESCO, which are an attraction for the naturalistic tourism.

Data published by the National Institute of Statistics (ISTAT-2020) shows that coastal tourism is constantly increasing and, during 2019, the total arrivals in the 14 coastal municipalities amount to 5.864.630 units, the 32% of which in Rimini (Figure 8).

The main criticalities of the territory are: coastal erosion, sea flooding, subsidence and salt water intrusion into the coastal phreatic and confined aquifers. Moreover, the wide extension of low land areas, located immediately behind the beach system, can exacerbate the possible consequences of the climate change effects, and in particular of the sea-level rise. **Coastal defence** therefore represents a strategic issue for Emilia-Romagna, with a double purpose: protecting people and infrastructures from the sea-storms and preserving the 'beach system', being it a very important ecosystem and the first resource for tourism business. Considering the coastline between Cattolica and the Po di Volano river mouth, extending 108 km, the 36% of it shows a high susceptibility to coastal erosion phenomena (as shown in Figure 9) and the 35% to sea-flooding. Furthermore, around the 40% of beaches (the portion free from buildings) has a critical width lower than 50 meters, and more than 80% of them has an average elevation below 1.5 meters (Perini *et al.*, 2019). It is therefore clear why the 60% of the coast has been hardly protected during last century by using several types of defence structures (mainly breakwaters, groynes, embankments). In addition, the whole Goro Lagoon has been protected since the early '900 by sea-walls to contrast the overwash effects of sea storms. Nevertheless, the analysis conducted under the Flood Directive 2007/60 shows that, out of the total 78 km² of coastline that are at risk of flooding, 22 km² insist in the urban zones (Perini *et al.* 2015).

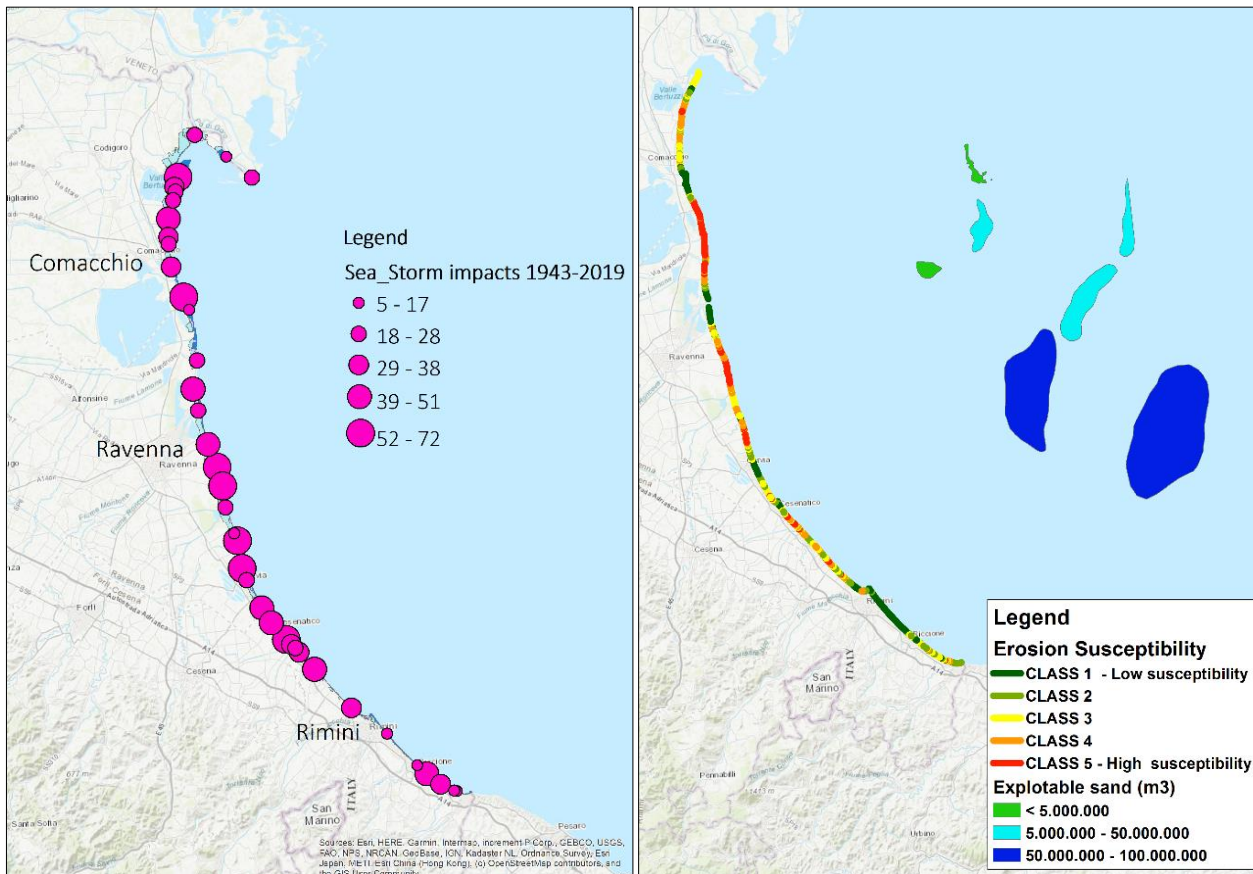


Figure 9 - Coastal risks: on the left, number of sea-storms impacting events since 1946; on the right classification of coastal erosion susceptibility and of the offshore sand stocks.

A recent monitoring conducted by Emilia-Romagna Region through its agency for environmental protection (ARPAE) highlighted that the 18% of littorals (i.e. 21 out of the 120 km monitored) is affected by beach erosion (ARPAE 2020). Such value is greatly mitigated thanks to massive beach nourishments realised in the last years by the regional government and by the coastal Municipalities (the so-called Progettone 3, dated 2016). Indeed, subtracting such contributions would result in a situation where about the 26% of the coastline would be in erosion and a further 21% in a precarious state. Therefore, sand delivery is of utmost

importance for beach maintenance, as it happened with the 'Progettone 3', when about 1.3 million m³ of sand were delivered in 7 different areas along the coastline. Sand was dredged from the ancient coastal deposits discovered offshore of Emilia-Romagna.

The sea space facing the coast of Emilia-Romagna between the Po delta to Cattolica shoreline up to the limit of Italian-Croatian territorial waters (Italian continental platform ~65 km) is characterized by a uniform morphology, with a low axial gradient (0.02°) and a maximum of 60 metres depth in the south-eastern portions. The tidal excursions are of ±0,85 m. The most intense sea-storms are related to the Bora winds blowing from the NE, while the storms aroused by the Scirocco wind (blowing from the SE) are often associated to storm surges (Perini *et al.* 2011). The significant wave heights can reach 3,3 m (return time 1 year), 4.7 m (return time 10 years) and 5.9 m (return time 100 years) (Idroser, 1996). The surface waters circulation is from north to south (Western Adriatic Coastal Current - WACC), dominated by seasonal variations and influenced by Bora winds in the winter months. The WACC has more energy in the winter months than during summer and rules the dispersion and deposition of the fine sediments brought into the sea by the Po river. Moreover, a longshore circulation from south to north has been recorded, responsible of the northward sands belt transfer. In the overflow side of piers and groynes sediment accumulation is evident, whereas in the underflow side erosion processes occurs.

The abiotic characteristics of the sea in this area are strongly influenced by the Po River, whose fresh waters decrease the salinity of the coastal waters and bring along a large input of nutrients, especially during the river floods, with a consequent increase of the sea ecosystem productiveness and of the eutrophication processes that seasonally affects the coast of Emilia-Romagna and cause strong negative impacts on the benthic ecosystem, on fishery and on the quality of bathing waters.

The area is part of the EBSA (Ecologically or Biologically Significant Marine Areas of North Adriatic - Unep/MAP/RAC-SPA). The biotic characteristics of the area are interlinked to the nature of the seabed. With reference to the EUNIS (European Nature Information System) habitat classification, developed by the European Biodiversity Thematic Centre (ETC/BD) for the Agency European Environmental (EEA) (shown in Figure 10), we can observe that the study area is characterized by 5 zones,, longitudinal to the shore line: Infralittoral fine sand, circalittoral muddy sands, circalittoral muddy sand, circalittoral sandy mud, circalittoral fine mud (see Figure 10).

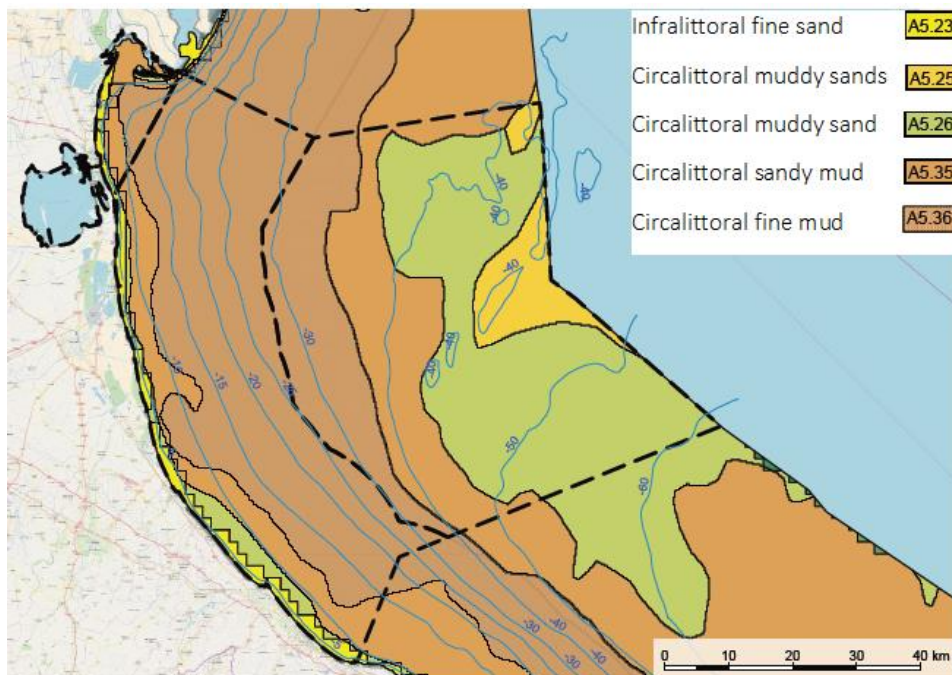


Figure 10 - EUNIS classification of the seabed.

Besides the input by the rivers, other major pressures on sea environment are related to the presence of multiple sea uses, the most relevant of which are:

- **Aquaculture.** Emilia-Romagna boasts the highest regional production in Italy, with 40,000 tons/year catch (about 45% of the national production) in 2013. With reference to the production of mussels and clams, together with Veneto Region, Emilia-Romagna reaches about the 66% of the national shellfish farming (MIPAAF, 2015). Aquaculture consists of breeding of the 'Voracious clam of Asian origin' (*Tapes philippinarum*) and of Mediterranean mussel (*Mytilus galloprovincialis*). The fish breeding farms in cages, instead, are less widespread and concentrated mainly in the Comacchio lagoon areas. The total amount of aquaculture licences is 165, of which 114 spread inside and the immediate outside of the Sacca di Goro lagoon (which extends around 4900 hectares) (Figure 9). They are specifically dedicated to the breeding of the 'vongola verace' (*Venerupis decussata*).
- **Fishing.** The prevailing activities are small-scale fishery (SFF or artisanal fishing), and bottom trawler fishing, even though the trend of the fishing sector in the Emilia-Romagna region is steadily decreasing, as in the whole of the Upper Adriatic. In recent years, in fact, the maritime fleet of Emilia-Romagna has undergone a general and continuous reduction, both in the number of boats and in the engines power, a trend in line with the one recorded at national level and monitored at EU level. The fishing fleet in the Emilia-Romagna Region is composed of about 840 boats, most of which are used for small coastal fishing, followed by those practicing the towing, and the hydraulic dredges. The SSF boats have length under 12 m, using passive fishing gears, such as gillnets, trammel nets and traps. The firsts are used for the capture of target species like the *Solea solea* and the shrimp. The traps, such as pots and 'cogolli', are used in catching cuttlefish (*Sepia officinalis*) while 'baskets' are used for catching sea snails (*Tritia mutabilis*). All these artisanal fishing activities are predominantly exercised close to the coast, seldom exceeding the limit of 6-7 nautical miles. Bottom trawling relates to demersal species, it is practiced with bottom trawls or bottom traps. The latter are active fixed-mouth tools for benthic species such as *Solea* and *Pectinidae* (*Pecten jacobaeus* and *Aequipecten opercularis*). In addition, it is also common the trawling for pelagic species, mainly anchovies and sardines (*Engraulis encrasicolus* and *Sardina pilchardus*): this activity is carried out by single boats or by two boats in parallel (pair trawling). The current rules forbid any type of trawling activity within the 3 nautical miles from the coast and set the minimum catch sizes for several commercial species.
- **Oil & Gas.** The offshore extraction compartment developed in Italy in the 60s starting from Emilia-Romagna Region. Although gas production has been significantly decreasing since the 2000s, in the offshore of the Emilia-Romagna Region there still are several active permits and wells. Only considering the area from the shoreline to the 12 Nm (territorial waters- sub-area A3) there still are 19 oil and gas permissions, six of them no longer in exercise; another 9 permissions are present in areas A7. The two largest gas-fields are Garibaldi and Agostino, located in front of Ravenna at 8-13 nautical miles (NM) from the coast. Both have been exploited since 1970, and their total production reaches around 86 billion standard cubic meters (Sm³ - gas volume in m³ in standard conditions of pressure and temperature), which represent about 30% of the total regional production. In the whole sea area, 61 platforms are still present, 4 of which are as support and 1 is not in exercise. Most of them, 51, are distributed within the 12 NM (Figure 11).



Figure 11 - Oil and gas permissions, platforms, and pipelines

- Maritime transport.** The maritime compartment, represented by the passengers and cargo, is mainly connected to the National Port of Ravenna, which has been strongly enlarging and developing during the last years. Indeed, it boasts connections all over the world, especially through the Mediterranean and Black seas. Moreover, there are 5 regional ports (Cattolica, Rimini, Cesenatico, Porto Garibaldi e Goro), 4 municipal harbours (Riccione, Bellaria, Cervia and Gorino) and 27 marinas, some of them built-in inside the mentioned harbours. All the ports perform a series of functions (fishing, tourism, commerce, etc.) often superimposed and connected to the territorial context in which they are inserted (tertiary and residential). The cargo sector also includes the commercial transport along the 'Padano-Veneto waterway system' that is part of the "Mediterranean" corridor 3. Within Emilia-Romagna Region the Waterway of Ferrara offers the opportunity to reach the Adriatic Sea by following the Po up to Ferrara, and then navigating the 70-km-long Waterway of Ferrara to Porto Garibaldi. From there, following the coastline, it is possible to connect with the port of Ravenna
- Military training areas.** The Emilia-Romagna coastal zone and marine area is site of **two military zones**. The first one is located at the Reno River mouth (ECHO 346) and is the biggest land-sea shooting site in Italy. It includes zones permanently forbidden to anchoring and fishing activities (by Ordinance of the Maritime District of Ravenna) and areas temporarily barred from sailing and fishing during shooting exercises. The second is an area in front of Riccione coast (ECHO 345) and is not currently in use

4.2 GAIR - tools for MSP (Modules) tested

The sea zone in front of the regional coast is characterized by the presence of multiple anthropogenic uses insisting on the subsoil (e.g. oil and gas extraction), on the seafloor (e.g. trawling, pipelines, sand dredging), on the water column and water surface (maritime transport, aquaculture, etc), as already discussed in the presentation of the testing area and shown in Figure 12. Such sea uses often conflict among them and/or impact the marine habitat and the coastal zone, affecting one of the most valuable resource for tourism, the beach. Likewise, land-based activities can significantly impact on sea environment and marine resources (e.g. fish).

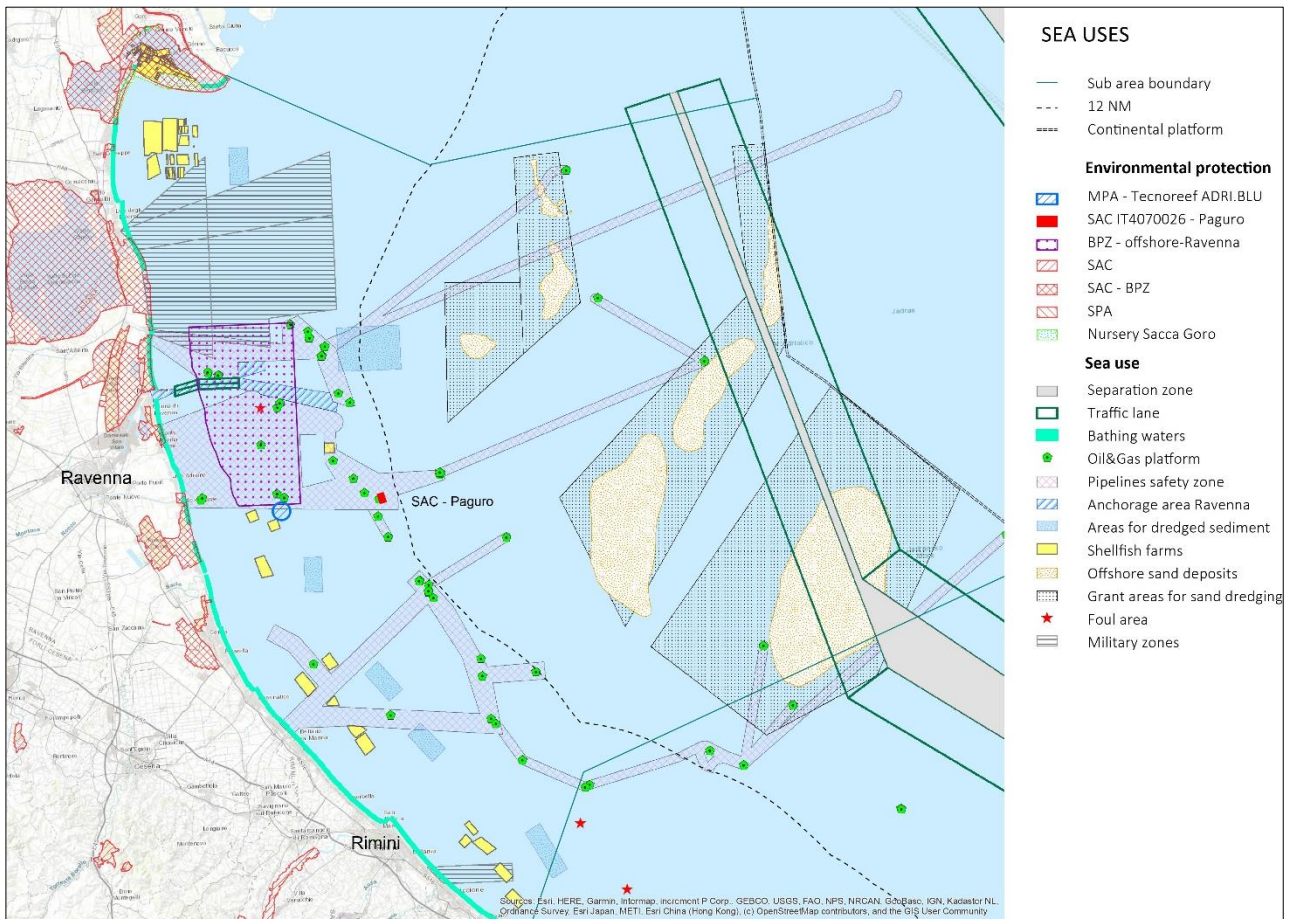


Figure 12 - Multiple sea uses offshore Emilia-Romagna.

For this reason, a detailed analysis of the co-existing sea uses, their mutual conflicts and pressures induced become a priority when developing the maritime spatial plan of the area. Moreover, once a ‘preliminary plan’ is designed, the following step is to verify the ‘proposed managed scenario’. For doing this, suitable and updated spatial data are needed, as well as analytical methodologies and tools.

The opportunity offered by PORTODIMARE project, indeed, is the testing of several decisional support tools, some developed by previous projects (e.g. Tools4MSP from ADRIPLAN and Ritmare) and now further implemented, other developed *ex-novo* in PORTODIMARE (i.e. AZA and PARTRAC). All the tools for MSP are now integrated into the GAIR, that represents itself an essential device for the research, consultation, analysis and processing of the data collected.

Such processing tools, integrated with dedicated models, provide assessment outputs that may significantly improve analysis, thanks to the quantitative approaches used in the different steps of the MSP process.

The added value of such tools for MSP is linked to the fact that they allow to:

- perform quicker, more detailed and quantitative analysis;
- obtain spatial results, whose resolution depends on the accuracy of the input data;
- provide an integrated and cumulative evaluation of uses interactions and effects/impacts;
- re-run the analysis in different scenarios or whenever a more detailed information is available;
- support the scenario building, analysis and fine tuning, also through evidence-supported participatory processes.

As extensively discussed into the PORTODIMARE report DT2.3.1, the Emilia-Romagna case study focused on the testing of the GAIR and of the following tools for MSP (modules):

- CEA: Geospatial tools for Cumulative Effects Assessment; it is dedicated to the analysis and mapping the effects of single or multiple human activities on the sea space.
- MUC: Geospatial tools for Maritime Use Synergy and Conflict Analysis; it allows the assessment and mapping of maritime use conflicts (constraints that are creating disadvantages to maritime activities) and synergies (multi-use potential).
- PARTRAC: Geospatial tools for Particle Tracking simulation. It can be used to calculate the area of influence of a source of contamination by simulating the dispersion of particle. This analysis was not foreseen by the application form.
- AZA: Geospatial tools for identifying Allocated Zones for Aquaculture. This analysis was not foreseen in the application form of the project.

MUC and CEA modules were tested to evaluate both the current 'status' and the possible response of the 'suggested measures' in a managed scenario.

AZA e PARTRAC modules were tested in order to analyse specific issues related to MSP. In particular: where to plan new areas for aquaculture and the possible impacting areas for marine litter produced by aquaculture farms.

4.3 Methodology

The general methodology adopted for the elaboration of the Emilia-Romagna case study (detailed into the report DT2.3.1) integrates the approach proposed by the scientific pole within the National Technical Committee (NTC), and the PORTODIMARE commitments. In particular, the work has been organised in 5 consecutive operational steps, articulated in several actions (see table below). The testing of GAIR and its tools for MSP were object of steps 1, 2 and 4, whereas steps 3 and 5 concern planning actions.

Step 1: Testing the GAIR to create a knowledge framework: it includes the updating of necessary data and metadata; processing of thematic maps required for MSP analysis within Portodimare and those necessary to support the Adriatic-MSP Plan according to D.Lgs. 201/2016

Step 2: Testing the MSP tools, in the present condition. In particular, the following analysis have been performed: analysis of cumulative effects assessment using CEA Module; multi-use synergies and conflicts analysis using MUC tools; research of suitable new zones for aquaculture, by testing AZA tool; finally it was tested the application of PARTRAC tool, to simulate the dispersion of particles from a source of waste

Step 3: Set up of a **planning vision and objectives:** starting from results of previous studies, such as Ritmare project; a **common and long-term vision** for coastal and marine areas must be drawn, as well as specific objects declined to the 'planning sub-units', into which the CS area has been split, with reference to the planning methodology approved by the NTC

Step 4: Testing the **MSP tools, in the managed scenario.** With reference to the strategic objectives and the derived planning units, and considering possible new sea uses, it has been performed a new analysis of the cumulative effects assessment (CEA Module) and of multi-use synergies and conflicts analysis using MUC tools

Step 5: Elaboration of **Indication for MSP plan in the Emilia-Romagna sea zone;** defining a set of possible Strategies and Measures oriented to reduce conflicts among uses, pressures on the environment, to increase knowledge, and prepare the basis for a sustainable 'blue growth'.

Going through the most technical aspects, the adopted procedure is synthesized by the activities in the following chapters.

4.3.1 Case study area: identification of sea uses, environmental factors and regulatory aspects

The major sea uses and environmental aspects to be considered in the case study area are:

- Environment protection in the maritime and coastal areas
- Tourism features and facilities (presence; bathing waters - recreational and cultural uses)
- Fishing (e.g. efforts, fleets)
- Aquaculture (e.g. farms -licences)
- Maritime transport (e.g. Ports & harbour - Shipping routes and density)
- Oil& Gas (Offshore infrastructures, Pipelines and Cables - permissions)
- Coastal defence
- Offshore - Sand deposits
- Military zones (restrictions)
- Waste dumping
- EFH (essential fish habitats)
- Protected species (e.g. mammals and turtles).

4.3.2 Collecting and Managing data

This activity was mainly conducted within WPT1, though the elaboration of specific reports concerning data needs and existing portals where detailed information is accessible (PORTODIMARE activities T.1.1 and T1.2). In particular, the project report DT1.2.1 offered a complete list of category, subcategory, and specific layers necessary to correctly implement the ICZM/MSP analysis. Moreover, within the project activities from T1.6 to T.12, a detailed analysis of the required and available information to implement the 'Case studies' was performed.

For the Case study AT.2.3 assigned to Emilia-Romagna, the above-mentioned guidelines were followed, and a lot of information layers were uploaded into the GAIR. Some of them are capitalized from previous projects (e.g. SHAPE); others, deriving from more recent surveys and/or monitoring activities, were processed by testing specific functionalities of the GAIR: uploading, processing of data and styles, processing of metadata (see an example in Figure 13), permission setting.

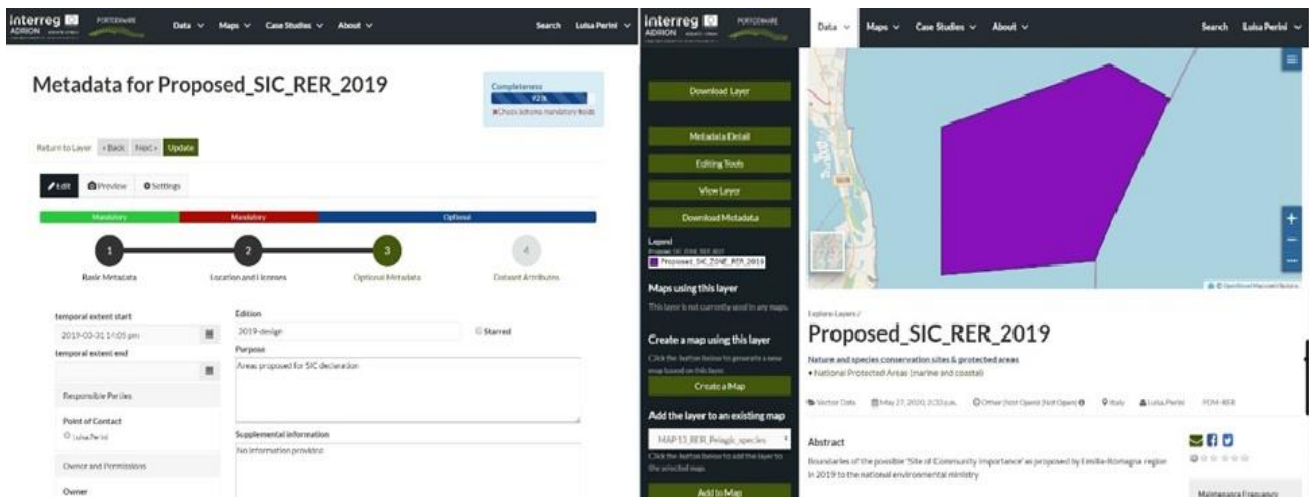


Figure 13 - Example of data and metadata editing.

4.3.3 Maps elaboration

The very innovative side offered by the GAIR, compared to other portals dedicated to the MSP topic, is the possibility to process cartographies and therefore to perform multilayer spatial analysis, essential for the planning process.

Within the Case study AT2.3, a specific task was dedicated to the elaboration of the twelve maps, included in the list of maps required by the National MSP process, done by following the methodology approved by the Italian MSP Technical Committee. The list of maps is shown in the following table.

N°	Title	layers	Direct url within GAIR
1	Emilia-Romagna CS Boundaries - Map 1	Coastline, territorial waters, continental platforms; other significative boundaries	https://www.portodimare.eu/maps_ext/2607#/
2	Emilia-Romagna CS_MAP2_Transport	Besides CS boundaries; traffic density 2017; Ports and Harbours; Anchorage areas	https://www.portodimare.eu/maps_ext/2738#/
3	Emilia-Romagna CS_MAP3_Energy	Besides CS boundaries; energy resources in the area: oil & gas permits, platforms, cables and pipelines	https://www.portodimare.eu/maps_ext/2743#/
4	Emilia-Romagna CS_MAP4_Aquaculture	Besides CS boundaries; Aquaculture permits - farms - nursery zones - ports	https://www.portodimare.eu/maps/2744/edit#/
5	Emilia-Romagna CS_MAP5_Fishing	Besides CS boundaries, it contains information on fishing fleets, small scale fishery; 3 nautical miles and fishing efforts (OTB-TBB)	https://www.portodimare.eu/maps_ext/2734#/
6	Emilia-Romagna CS_MAP6_Coastal risks	Besides CS boundaries, it contains information on coastal risks and Offshore sand deposits exploited for beach nourishment	https://www.portodimare.eu/maps_ext/2735#/
7	Emilia-Romagna CS_MAP7_Tourism	Besides CS boundaries, it contains: Tourist presence for coastal Municipality (2019); marinas; bathing waters quality	https://www.portodimare.eu/maps_ext/2737#/

N°	Title	layers	Direct url within GAIR
8	Emilia-Romagna CS_MAP8_Protected Areas	Besides CS boundaries, it contains: Coastal and marine protected areas (SIC-Natura2000-ATB)	https://www.portodimare.eu/maps_ext/2747#/
9	Emilia-Romagna CS_MAP9_Protected Areas	It should contain main forecasts of landscape plans and areas of archaeological interest	Waiting for data from National level
10	Emilia-Romagna CS_MAP10_Military	Besides CS boundaries, it contains: Permanent and temporary military areas; danger zone; foul areas; wasted disposal dumped munitions	https://www.portodimare.eu/maps_ext/2748#/
11	Emilia-Romagna CS_MAP11_Research	Besides CS boundaries, it contains: position of the sea state control stations: wave buoy and platforms where sea-level gauges are installed	https://www.portodimare.eu/maps_ext/2753#/
12	Emilia-Romagna CS_MAP12_Habitat	Besides CS boundaries, it contains: EUNIS classification and Habitat	https://www.portodimare.eu/maps_ext/2754#/
13	Emilia-Romagna CS_MAP13_Pelagic species	Besides CS boundaries, it contains: predicted presence of Tursiops and Caretta_Caretta; and Tursiops sighting 2018	https://www.portodimare.eu/maps_ext/2749#/
14	Emilia-Romagna CS_MAP14_Indicators of contaminated waters sources	Distribution of synthetic indicators relating to the state of water contamination	Still missing information

Table 2 - List of maps for MSP, with reference to Emilia-Romagna sea, implemented into the GAIR.

4.3.4 CEA module run: description of methods and main results

Objectives

As above mentioned, the CEA module, as well as MUC, has been tested to evaluate both the current ‘status’ and the possible response of the ‘suggested measures’ in a managed scenario. Of course, the managed scenario was drawn after the definition of the planning vision and of the ‘Specific Objectives’ described into the report T2.3.2 and in following chapter 5.

Within Step 2 of the case study, indeed, the CEA analysis was performed to inform the planning process on the present propagation of the pressures generated by one or multiple anthropogenic uses, and to assess the spatial distribution of the impacts exerted by one or multiple pressures on one or multiple environmental receptors (**CS1: present status**).

Then, within step 4, the CEA analysis was re-run to test the possible effects of the proposed management measures. (**CS2: managed scenario**).

The CEA module approach incorporates a key aspect of the environmental risk assessment discipline which is the explicit identification and understanding of the source-pressure-pathway-receptor linkages (Judd *et al.*, 2015; Stelzenmüller *et al.*, 2018). More in detail, the linkages are modelled through two independent but concatenate tasks:

- **pressures assessment:** from human uses to pressures. It estimates the propagation of pressures generated by one or multiple anthropogenic uses.
- **effects/impacts assessment:** from pressures to impacts. It allows to spatially assess the spatial distribution of impact exerted by one or multiple pressures on one or multiple environmental receptors.

According to the general method adopted by PORTODIMARE Geoportal, the CEA analysis has been conducted by following a Case Study-driven approach, where the “Case Study” is a coherent and harmonized set of rasterized geospatial layers (and other documentation) available at different geospatial scales (in this case at regional scale) and resolutions.

The two default Case Studies (CEA-Emilia-Romagna) elaborated into the action AT2.3 are described in detail into the report DT.2.3.1, and are directly available within the GAIR:

- T2.3 Emilia-Romagna Case Study 1 ‘present status’ <https://www.portodimare.eu/casestudies/34/>
- T2.3 Emilia-Romagna Case Study 2 ‘managed scenario’ <https://www.portodimare.eu/casestudies/128/>

As input to the CEA Module 11 spatial raster datasets about human activities, previously created within the GAIR using the Geodatabuilder function, are considered as well as 4 spatial raster datasets about environmental components. Regarding the “Pressures assessment”, in total 15 pressures are taken into consideration according to the MSFD Annex III (2017/845/EU).

The effects/impacts assessment task is based on sensitivity/vulnerability scores which represent the “likelihood of change when a pressure is applied to a feature (receptor) and is a function of the ability of the feature to tolerate or resist change (resistance) and its ability to recover from impact (resilience)” (Tillin *et al.*, 2010). Similarly to buffer weights and pressure distances, the sensitivities scores are expert-based, and they are derived from stakeholder engagement. In Figure 14 the sensitivity matrix for each combination of different pressures and environmental components is presented.

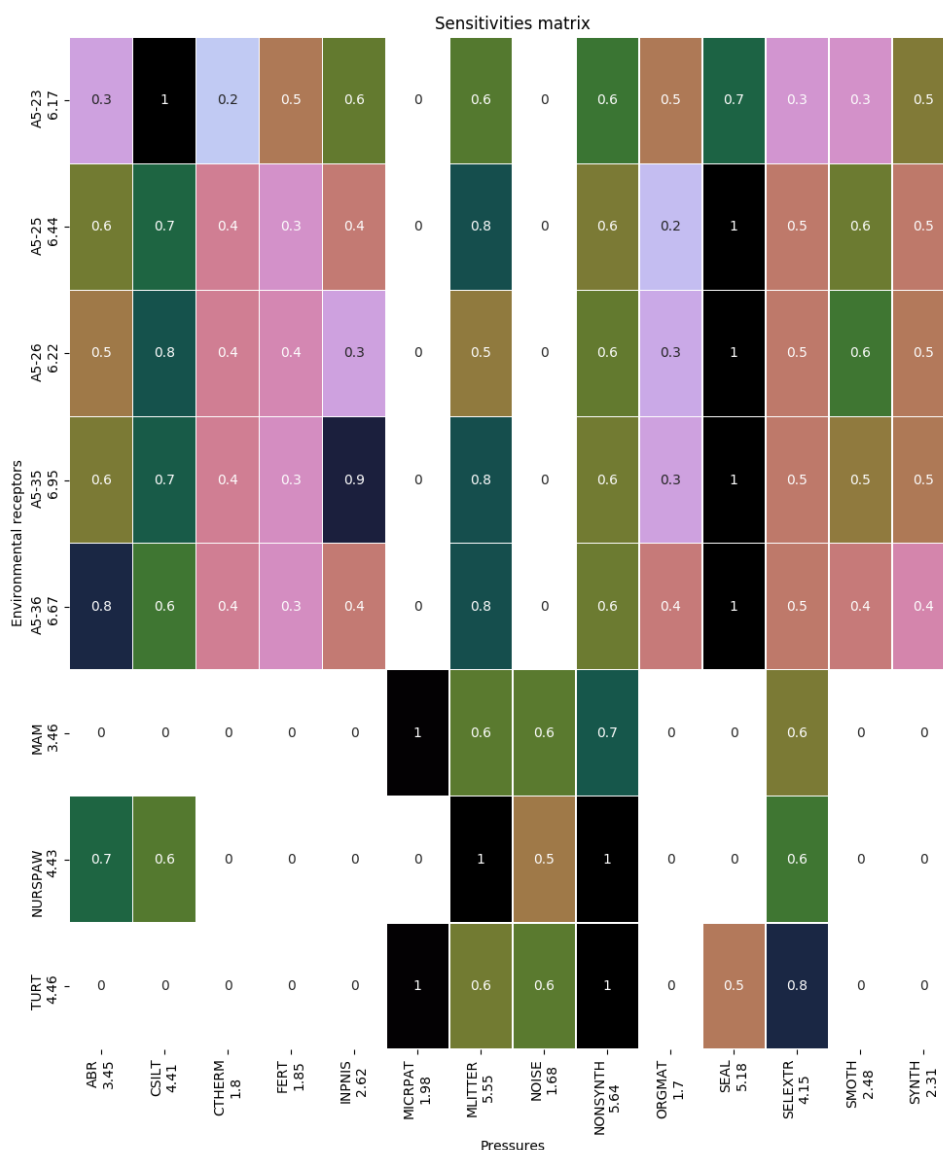


Figure 14 - Sensitivity scores for each pressure -environmental receptor combination.

The main output of the CEA module is the geospatial distribution of CEA score (CEAScore), a 2-dimension GeoTIFF raster file representing the overall Cumulative Effects score in each raster grid cell. Furthermore, three additional geospatial outputs are generated were the overall CEA is split according to the MSFD pressure classification:

- CEA score exerted by MSFD Substances, litter and energy pressures (MAPCEA-MSFDSUB): Inputs of fertilisers and other nitrogen and phosphorus-rich substances, Inputs of organic matter, Introduction of non-synthetic substances and compounds, Introduction of other substances, Introduction of radio-nuclides, Introduction of synthetic compounds, Marine litter, Underwater noise.
- CEA score exerted by MSFD Biological pressures (MAPCEA-MSFDBIO): Food availability, Introduction of microbial pathogens, Introduction of non-indigenous species and translocations, Selective extraction of species, including incidental non-target catches.
- CEA score exerted by MSFD Physical pressures (MAPCEA-MSFDPHY): Abrasion (surface, light, heavy), Changes in siltation, Heat effect (due to cabling), Removal of substratum (extraction), Sealing, Significant changes in electromagnetic field, Significant changes in salinity regime, Significant changes in thermal regime, Smothering

In order to ease the interpretation of results, other outputs are made available by the module:

- Barplot of CEA score for Human Use (BARCEAUSE). A table/barplot representing the contribution (in percentage) of human uses (U) to the overall CEA score for the whole area of analysis.
- Barplot of CEA score for Environmental Receptor (BARCEAENV). A table/barplot representing the contribution (in percentage) of environmental receptors (E) to the overall CEA score for the whole area of analysis.
- Barplot of CEA score for exerted pressure (BAPRESCORE). A table/barplot representing the contribution (in percentage) of exerted pressure (P) to the overall CEA score for the whole area of analysis.
- CEA score for each U-E combination (HEATUSEENVCEA). A table/matrix representing the contribution (in percentage) of the single pairwise combination of human use (U) and environmental receptor (E) to the total CEA score (for the whole area of analysis).
- CEA score for each P-E combination (HEATPREENVCEA). A table/matrix representing the contribution (in percentage) of the single pairwise combination of pressure (P) and environmental receptor (E) to the total CEA score (for the whole area of analysis).
- Heatmap of Pressure scores due to human uses (HEATUSEPRESCORE). A table/matrix representing the contribution (in percentage) of the single pairwise combination of human use (U) and pressure (P) to the total CEA score (for the whole area of analysis).
- Distribution of CEA score (HISTCEAScore). A table/histogram representing the number of grid cells for each class of CEA score.

Finally, the graphical user interface allows the users to individually select the layers (human uses or environmental receptors) to incorporate into the analysis.

Figure 15, 16, 17 show the spatial distribution of scores and the histogram generated by the CEA module, both in present and in managed scenario.

CEA Present Scenario

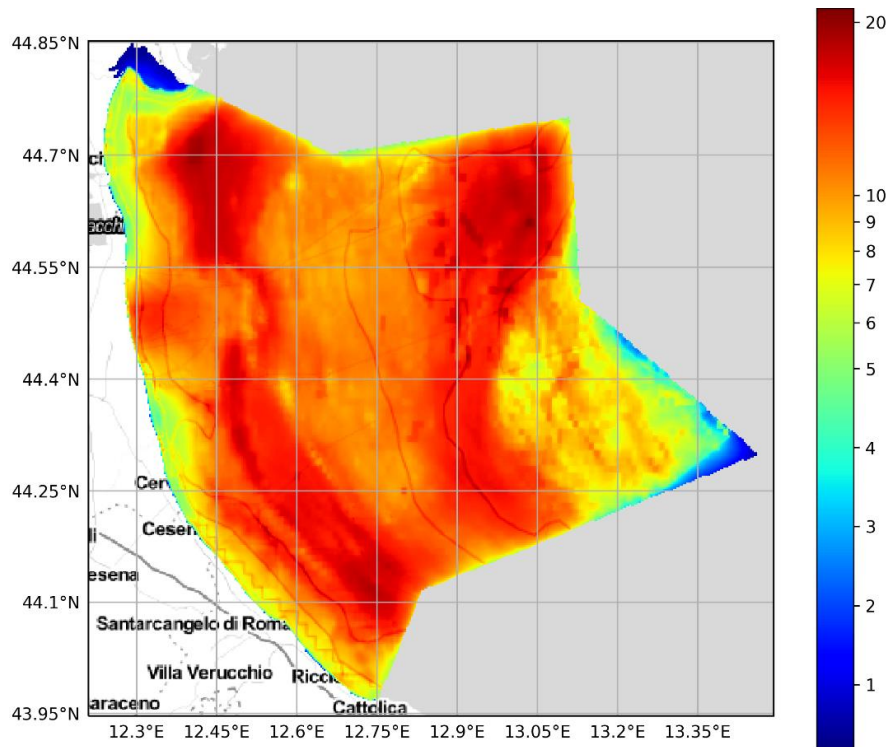


Figure 15 - Spatial distribution of CEA scores (present scenario).

The CEA scores in Figure 15 show a pattern that is linked to high traffic densities and trawling related pressures. The highest scores (14-21) are located in the whole CS area between 3 and 12 NM offshore, in a wide area of the International waters (approximately 20 NM offshore) and in proximity of the port of Ravenna. Such scores indeed are in correspondence to intense maritime traffic areas, ground of intense trawler fishing, hot spots of species of conservation interest (i.e. marine turtles and mammals) and Essential Fish Habitats (EFH). Areas showing medium-high scores (7-14) are largely distributed along the entire CS area (see Figures 15 and 16), mainly due to maritime traffic and trawling activities, while lower CEA scores (<7) cover coastal areas far from ports and marinas and within the 3 NM, where trawling fisheries are banned, and touristic activities, small scale fisheries are exerted mainly on seabed essential fish habitats.

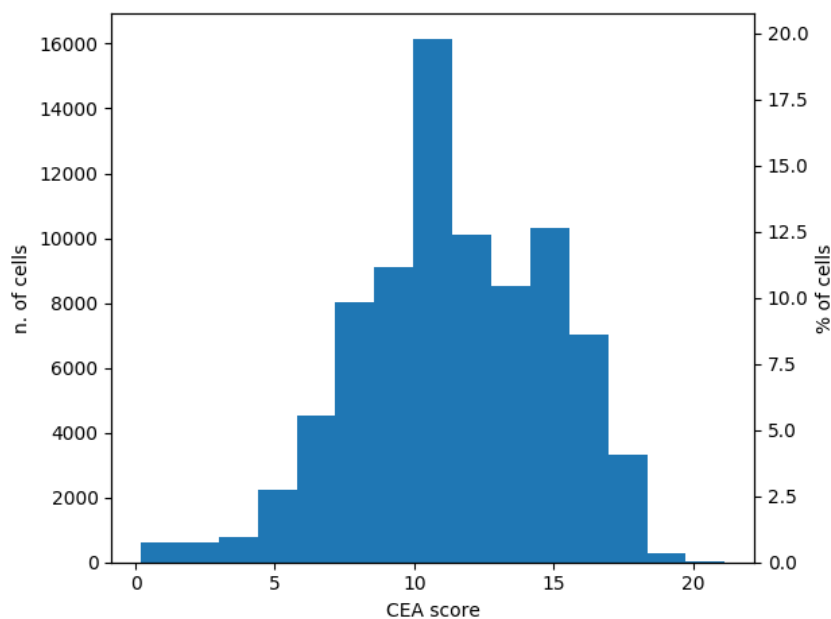


Figure 16 - Histogram representing the number of grid cells (left axis) and the percentage over the total cells (right axis) for each class of CEA score (present scenario).

CEA Managed Scenario

Compared to the present scenario, for the CEA analysis of the managed scenario the spatial distributions of 6 human uses were modified to consider a hypothesis of expansion in the aquaculture sector, the introduction of bans/regulations in fishing activities (Small Scale Fishery, Mid-water pelagic trawling, Trawling OTB and Trawling TBB) and the increase of sand extraction from offshore sand deposits.

In addition, two new uses have been introduced:

- Offshore Wind Farm: to reflect the increasing interest in wind farm development
- Trawling OTB-BRD: to identify/characterize the Trawling OTB with selective devices (BRD - bycatch reduction device). Different values of pressure weights have been assigned to OTB-BRD in respect to standard OTB.

On the other hand, it was assumed that the spatial distribution of environmental receptors remain the same as in the current scenario.

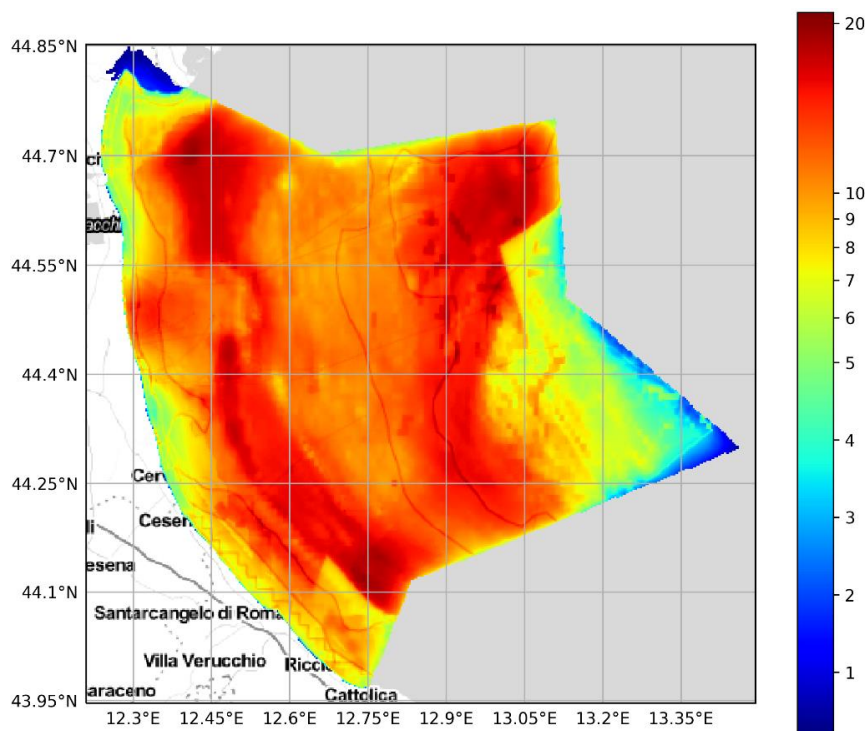


Figure 17 - Spatial distribution of CEA scores (managed scenario).

The CEA scores shown in Figure 17, concerning managed scenario, confirm a pattern linked to high traffic densities and trawling related pressures. As a matter of fact, the highest scores (14-21) are still located in the whole CS area, between 3 and 12 NM offshore, in a wide area of the International waters (approximately 20 NM offshore) and in proximity of the port of Ravenna. Medium-high scores (7-14) remain the more representatives along the entire region, while lower CEA scores (<7) are located mainly within the 3 NM.

The differences between the CEA scores after the application of the managing measures (Figure 18) and before (Figure 18) highlight the importance of role that a possible BPZ would play in limiting all the trawling fisheries pressures on the seabed and on the Essential Fish habitats, together with the effects of the possible “Sole sanctuary” implementation in reducing the impacts over the Essential Fish habitats, the marine Mammals and Turtles hotspots. On the other hand, the managed scenario evidences the potential increase of impacts caused by the possible new infrastructures (i.e. offshore wind farms) and the aquaculture facilities. The following figures 18-19 show explicit differences between the “managed” and “present condition” CEA scores.

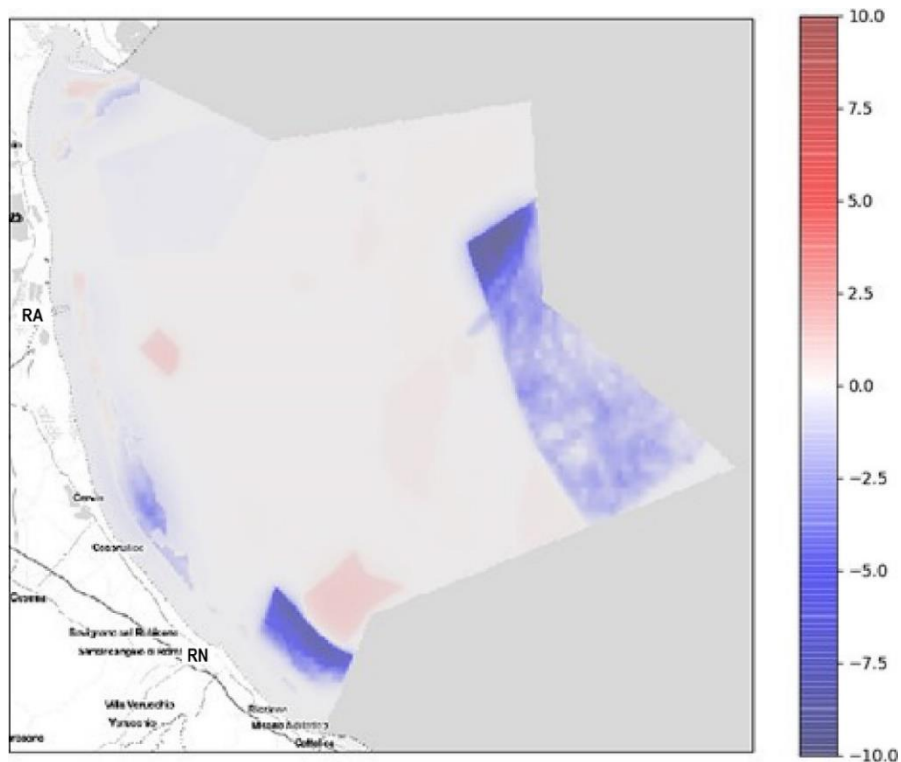


Figure 18 - Spatial explicit differences between the “managed” and “present condition” CEA scores.

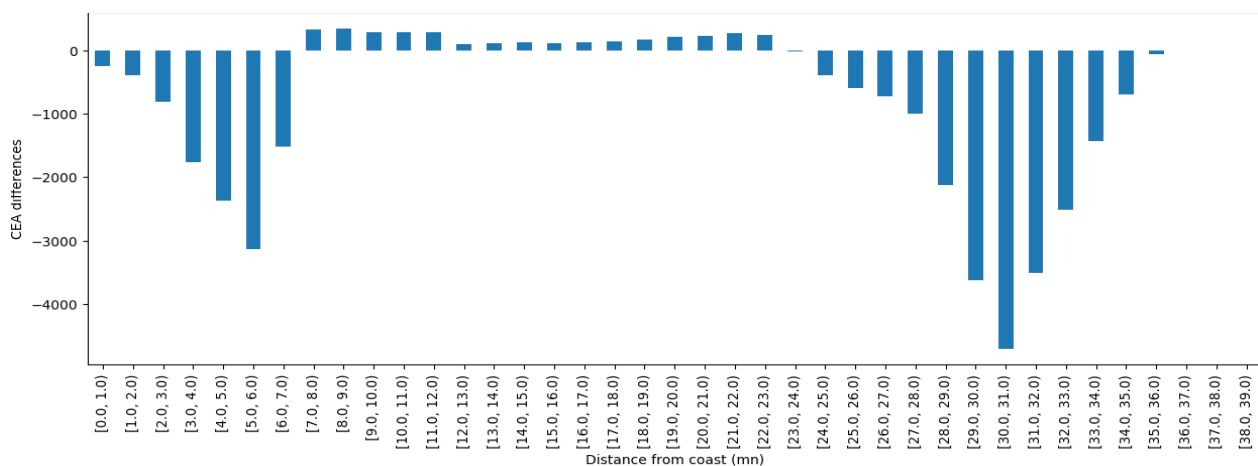


Figure 19 - Histogram representing the distribution of CEA scores' differences by the distance from the coast in nautical miles (NM).

The full set of trawling activities reaches a higher total CEA score in respect to the one generated by the maritime transport: bottom otter trawlers (OTB), mid-water pelagic (PTM) and “rapido” beam trawlers (TBB) impact the area mainly by generating seabed abrasion, change in siltation, smothering and selective extraction of species.

An important reduction in CEA scores is evident in the sea areas facing Rimini within the 12NM (and offshore close to the limit of eastern boundary of the study area). This is produced by the total trawling ban within, respectively, the proposed Zone of Biological Protection (BPZ) and the proposed “Sole sanctuary”. The latter is a spatial measure suggested within the DORY Project (final report 2019), assuming the results of previous research, also published into the report STECF 2019, in the section on the ‘Multi-Annual Plans for the fisheries exploiting demersal stocks in the Adriatic Sea’. Moreover, the same measures have been considered into the SUPREME project - Adriatic CS, after discussion with the GFCM (General Fisheries Commission for the Mediterranean).

The proposed Natura 2000 SCI for the protection of *Caretta caretta* and *Tursiop truncatus* in the marine waters facing the Po Delta could foresee, among the managing measures, the application of Bycatch Exclusion Devices (BRDs) on trawling nets. The BRDs are widely used to reduce the mortality of marine turtles when accidentally caught within the trawling nets, together with other good practices (e.g. increase nets stability with technological improvements). The effect hypothesized for these measures is the reduction of the OTB pressure on *C. caretta*, decreasing by 30% the specific weight in generating the pressure "selective extraction of species, including incidental non-target catches", with a substantial reduction of the overall CEA score in the area and an evident effect on the influenced environmental components (especially marine turtles).

Important increases in human-related pressures are evident locally, where the new wind farms are planned; these are mainly due to physical pressures (e.g. sealing, see Figure 20). Differently, the additional impact exerted by the possible new aquaculture installations is partially balanced by the consequent reduction of other activities (e.g. trawling, shipping).

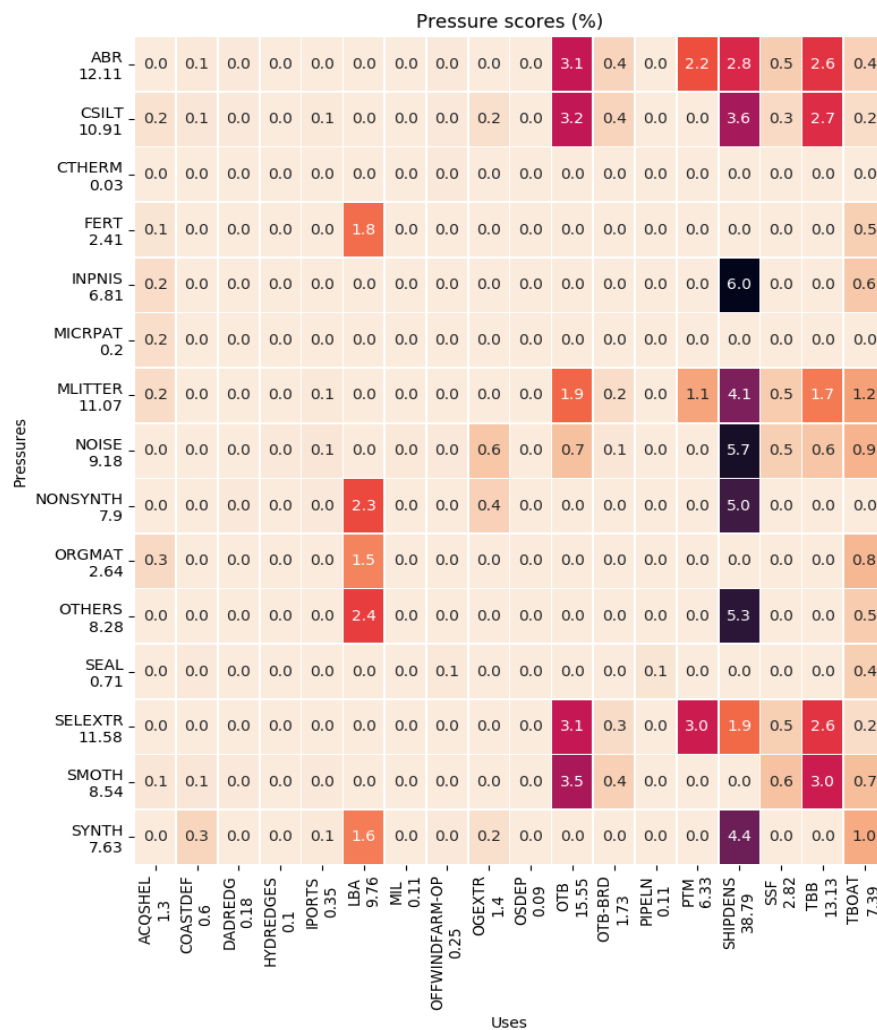


Figure 20 - Matrix representing the contribution (in %) of the single pairwise combination of human use (U) and pressure (P) to the total CEA score (for the whole area of analysis).

The application of specific bans and measures for trawling fisheries could allow a substantial reduction of the pressures on habitats and species. Key nursery and spawning areas of species of commercial interest for fisheries (EFHs) and seabed habitats are still, among the components, the most exposed to anthropogenic pressures (e.g. abrasion, pollution, marine litter), even if with clear reductions of the score where trawling bans are applied.

Marine mammals and turtles also benefit from the increased sustainability of fisheries, even if only in the areas where management measures are proposed.

4.3.5 MUC module run: description of methods and main results

Objectives

The Maritime Use Conflict analysis (MUC) has been performed in two steps of the methodology.

Within the Step 2, the Maritime Use Conflict analysis (MUC) has been performed to identify the current interactions between human uses in terms of conflicts (**CS1-MUC: present status**).

Within step 4, the Maritime Use Conflict analysis (MUC) has been performed in order to inform the planning process on the possible effects of the proposed management measures, investigating how the proposed allocation of new human activities (aquaculture, offshore wind farm installations) and new areas of environmental protection (BPZ and Sole sanctuary) overlap/conflict with activities currently present in the area (**CS2-MUC: managed scenario**).

Like for the CEA module described above, the PORTODIMARE Geoportal allows to perform the Maritime Use Conflict analysis (MUC) that derive from the Tools4MSP-MUC that was based on the methodology developed within the COEXIST Project - Interaction in European coastal waters: a roadmap to sustainable integration of aquaculture and fisheries (COEXIST, 2013; Gramolini *et al.* 2010). The methodology enables the identification of current and potential human uses and assesses their interaction in terms of conflicts. The MUC score on a single grid of analysis is calculated by summarizing the potential conflict score between each combination of uses which are present in that cell. According to the original methodology, the potential conflict score between two uses is expert-based and can vary from 0 to 6. Figure 21 shows the potential conflict score related to the Adriatic Sea.

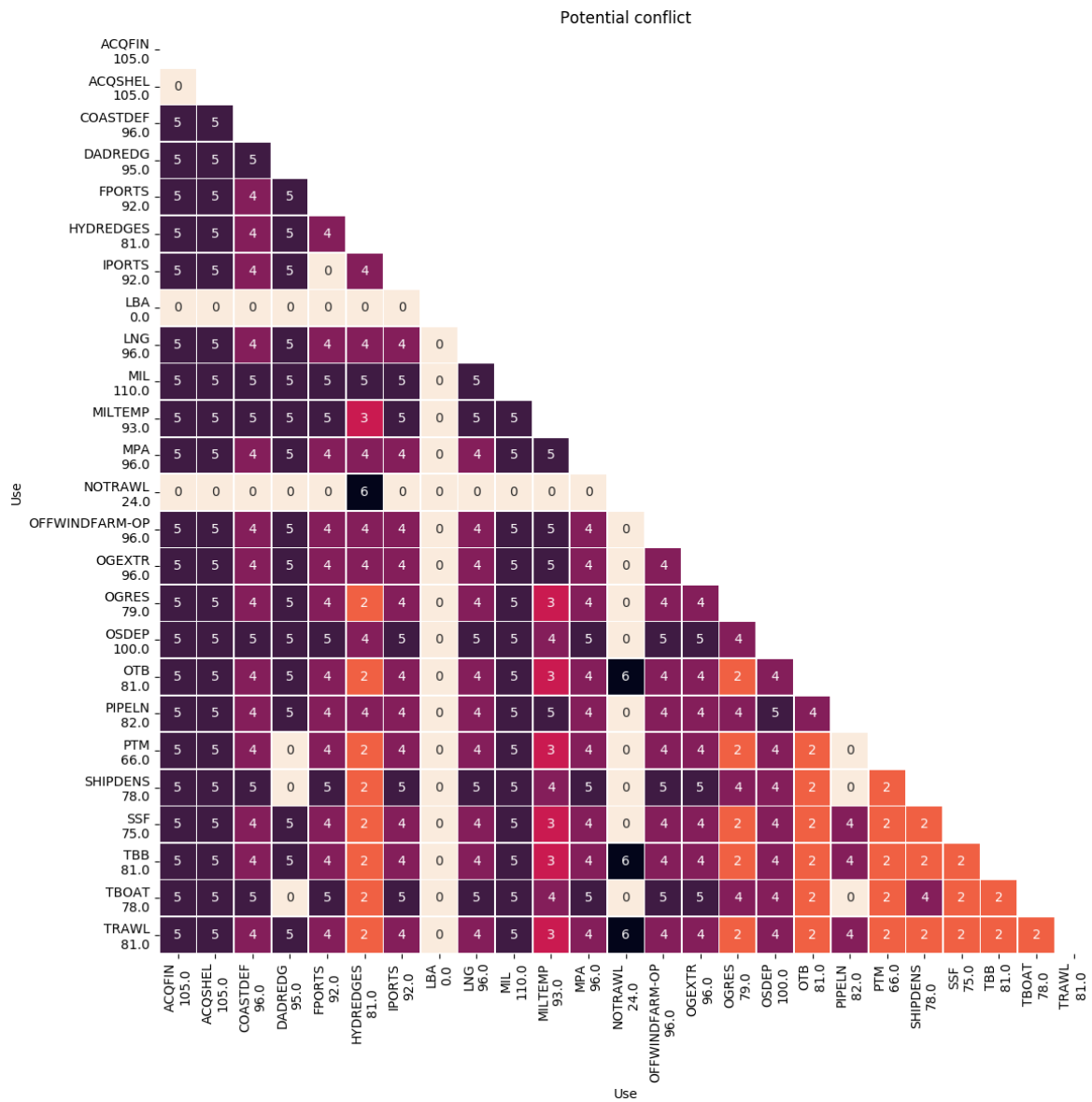


Figure 21 - potential conflict score between use-use combination. For a more detailed description (e.g. equations) of the MUC assessment we refer to Menegon et al. (2018b) and the Tools4MSP MUC online documentation⁶.

As for CEA the default Case Study **CS1-MUC: present status** and **CS2-MUC: managed scenario**, they both are directly available within the GAIR:

- **CS1-MUC: present status** ; T2.3 Emilia-Romagna Case Study <https://www.portodimare.eu/casestudies/121/>
- **CS2-MUC: managed scenario** T2.3 Emilia-Romagna Case Study; <https://www.portodimare.eu/casestudies/129/>

⁶ <http://docs.tools4msp.eu/modules/muc/index.html>

All datasets needed for the analysis were rasterized in a regular grid with cell resolution of 250 x 250 m. However, differently from the CEA analysis, the MUC model considers only the presence/absence distribution of human uses (it does not support intensity). Hence, a binary classification (0/1) based on discriminant threshold has been applied to the intensity-represented use layers (e.g. Maritime transport, Fishery).

The following table describes the human uses in the study area, including the references to the layer published through the PORTODIMARE and the discriminant threshold.

Human use	Description	Unit/Threshold	Source
Aquaculture	Aquaculture (RER - 2020)	P/A	2020 shellfish farms in Emilia-Romagna (IT)
Cables and Pipelines	Submarine pipelines and safety zones around the pipelines	P/A	Pipelines (Emilia-Romagna Region) SAFETY ZONE - around pipelines
Coastal and Maritime Tourism	Bathing waters	P/A	Bathing waters monitoring network
	Marinas - Italy	Nr of berth threshold 40%	Marinas - Italy - Published 2014
Marine Protected Areas	ADRI-BLU TECNOREEF and wreck of Paguro platform	P/A	Protected marine habitat (Emilia-Romagna Region)
Maritime Transport	Adriatic traffic density (July 2014-June 2015)	Ship passages/cell threshold 10%	Adriatic traffic density July 2014 - June 2015
Naval base activities	Cruise Ports data (year 2015)	Nr of cruises threshold 40%	Cruise Ports - Italy 2015
	Main Ports (Total shipped goods, year 2016)	Tons threshold 40%	Main Ports Stats 2015-2016
No trawling areas	Trawling restrictions in Emilia-Romagna	P/A	No-trawling areas in Emilia-Romagna marine area
Offshore sand deposits	Offshore sand dredged and offshore sand deposits	P/A	Localisation and volume of dredged sands offshore (Emilia-Romagna Region) Offshore sand deposit (Emilia-Romagna Region)
Oil & Gas extraction	EMODNET Hydrocarbon Extraction - Offshore Installations and safety zones around the platforms	P/A	O&G extraction platforms - Italy Oil and gas marine terminals Emilia-Romagna (IT) Safety zones around platforms

Human use	Description	Unit/Threshold	Source
Small scale fishery	Small scale fisheries (e.g. Set gillnets, purse seines, traps, etc.)	Total operations threshold 10%	Small scale fisheries (It RER VEN FVG) GNS - Reti a imbrotto - 2015 (It RER VEN FVG) PS - Circonazione - 2015 (It RER VEN FVG)
Mid-water pelagic trawling	Mid-water pair trawl from AIS data (year 2015)	Swept area (km ²) threshold 10%	PTM - Volanti - 2015
Trawling OTB	Bottom otter trawl from AIS data (year 2015)	Swept area (km ²) threshold 10%	OTB - Bottom otter trawl - 2015
Trawling TBB	Beam trawl from AIS data (year 2015)	Swept area (km ²) threshold 10%	TBB - Rapidi - 2015

Table 3- Human uses included in the MUC analysis.

The main outputs of the Tools MUC module are:

- geospatial distribution of conflict score (MUCSCORE). A 2-D GeoTIFF raster file representing the overall conflict score in each raster grid cell.
- MUC score for each U-U combination (HEATUSEMUC). A table/matrix representing the contribution (in percentage) of the single pairwise combinations to the total MUC score (for the whole area of Main results).

CS1-MUC: present status

Figure 22 shows the results from marine use conflict analysis. The analysis evidence that within national waters (12 nm) are present the highest MUC scores, especially in the coastal areas of the military area Echo 346 and the port of Ravenna, while offshore conflicts are mainly linked to trawling fisheries, maritime traffic and extractive activities (both hydrocarbons and sands) and related cables and infrastructures.

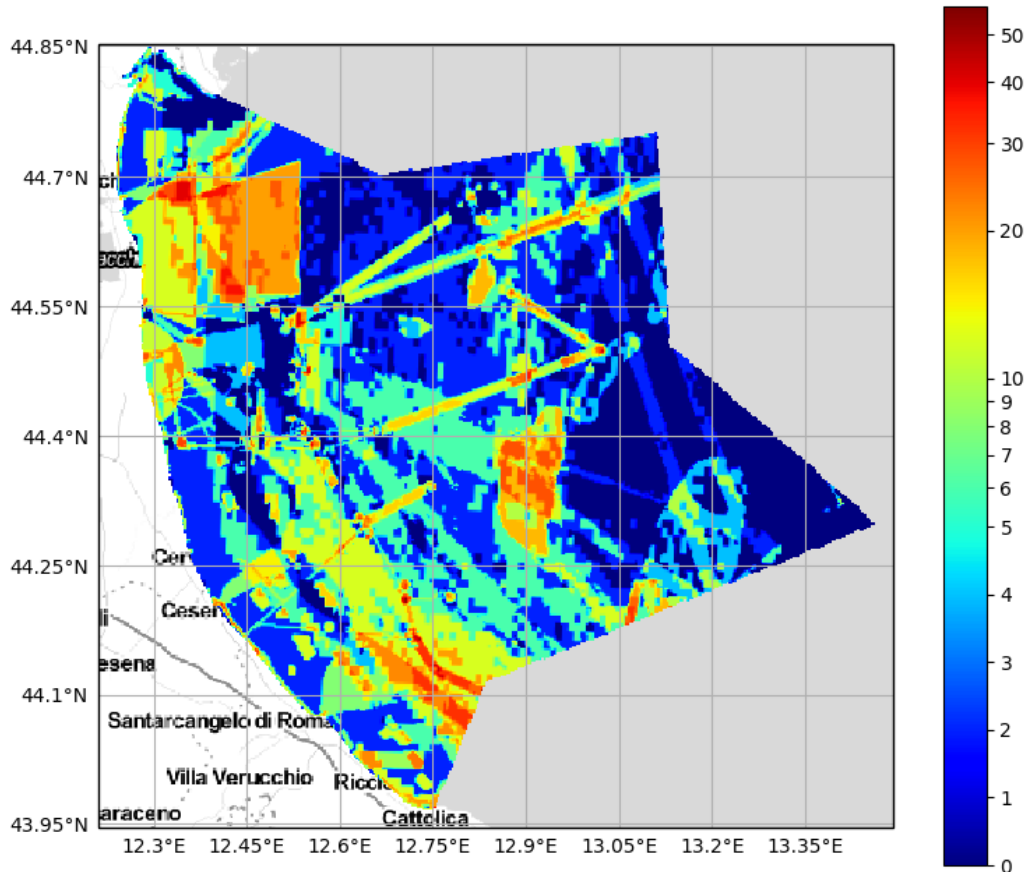


Figure 22 - Spatial distribution of MUC scores (present scenario).

A Detailed analysis of the interactions between sea-uses that generate the MUC scores are shown in Figure 23. The higher scores are linked to the interactions between the extensive no trawling zones (due to other human activities such as military areas and oil & gas extraction and/or environmental protection and fishery management) and trawling fisheries, sand extraction and trawling fisheries, maritime traffic and trawling fisheries and between different trawling fleets (TBB, PTM and OTB).

Other relevant potential conflicts are those between small scale fisheries and military areas, coastal and maritime tourism with maritime transport, coastal and maritime tourism with small scale fisheries, and trawling fisheries and small-scale fisheries.

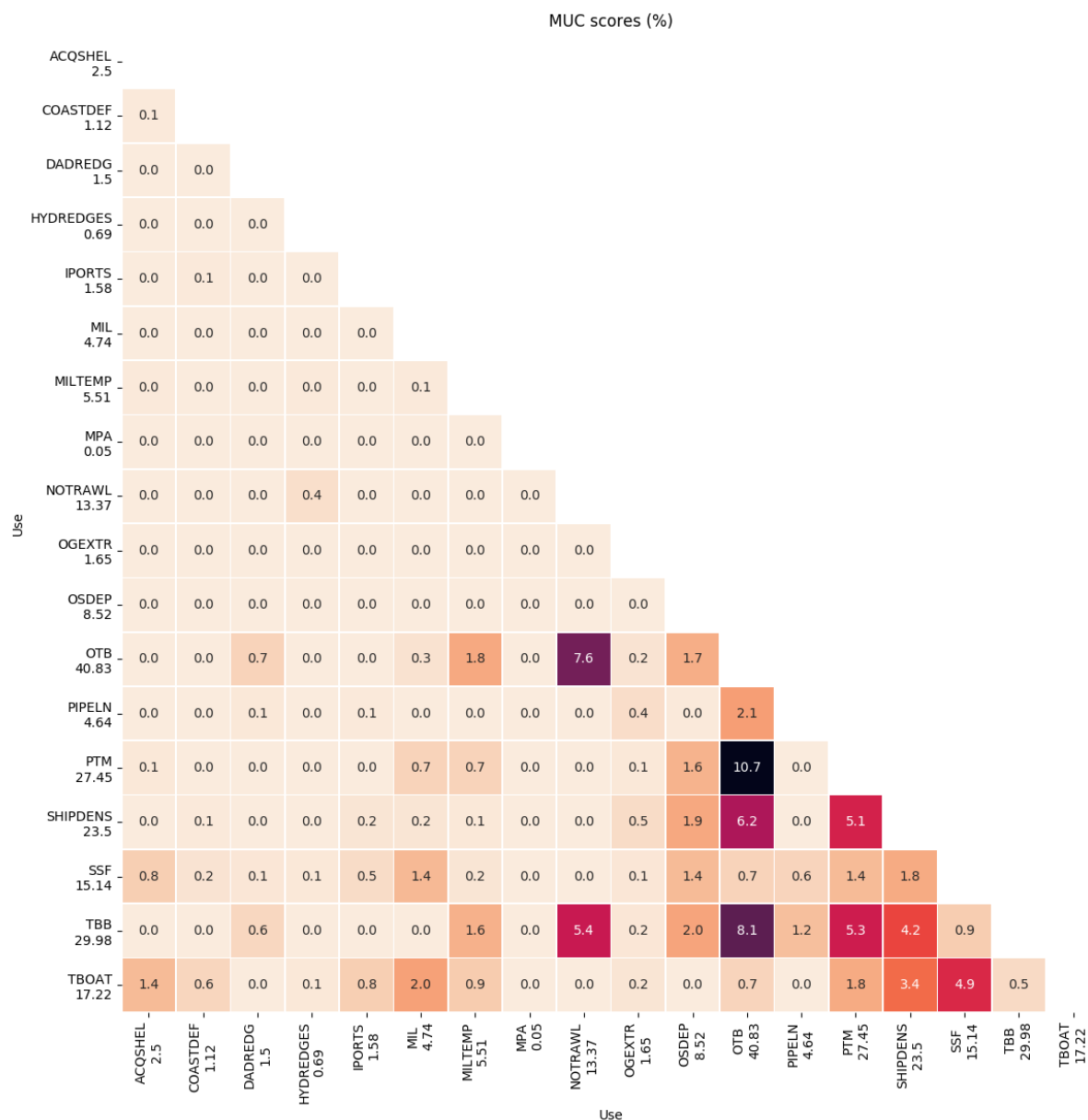


Figure 23 - Matrix representing the contribution (in percentage) of the single pairwise combinations to the total MUC score (for the whole area of analysis).

CS2-MUC: managed scenario

Compared to MUC Analysis of the present conflicts, the spatial distribution of human uses has been modified to incorporate new aquaculture areas and new offshore wind farm installations, as suggested by specific objectives described in chapter 5. In addition, the proposed new environmental protection areas (where trawling activities are banned) have been directly incorporated into the “No-trawling area” layer (see Table below).

Human use	Criteria type	Criteria for reviewing spatial distribution	Additional sources
Aquaculture	Use expansion	Add new shellfish farms assuming it will be distributed on areas with a high level of suitability (suitability ≥ 0.75 ; cfr. cap7.d) and overlapping the areas with a high vocation for mussel farming	suitability constraints
Offshore Wind Farm	New use type	Add of the two areas of interest for wind farm development located in the offshore Ravenna and Rimini.	WF_OffS_Rimini Ritmare_RER_Measure 4_WF1
No-trawling areas	Use expansion	Extend no-trawling areas layer to incorporate BPZ	Ritmare_RER_Measure 9_ZTB_RN RER - MSP planning units Sole sanctuary

Table 4: list of the reviews in human uses spatial distributions to incorporate managed scenario proposal.

Figure 24 shows the results from marine use conflict analysis incorporating the above-mentioned new uses of a managed scenario proposal.

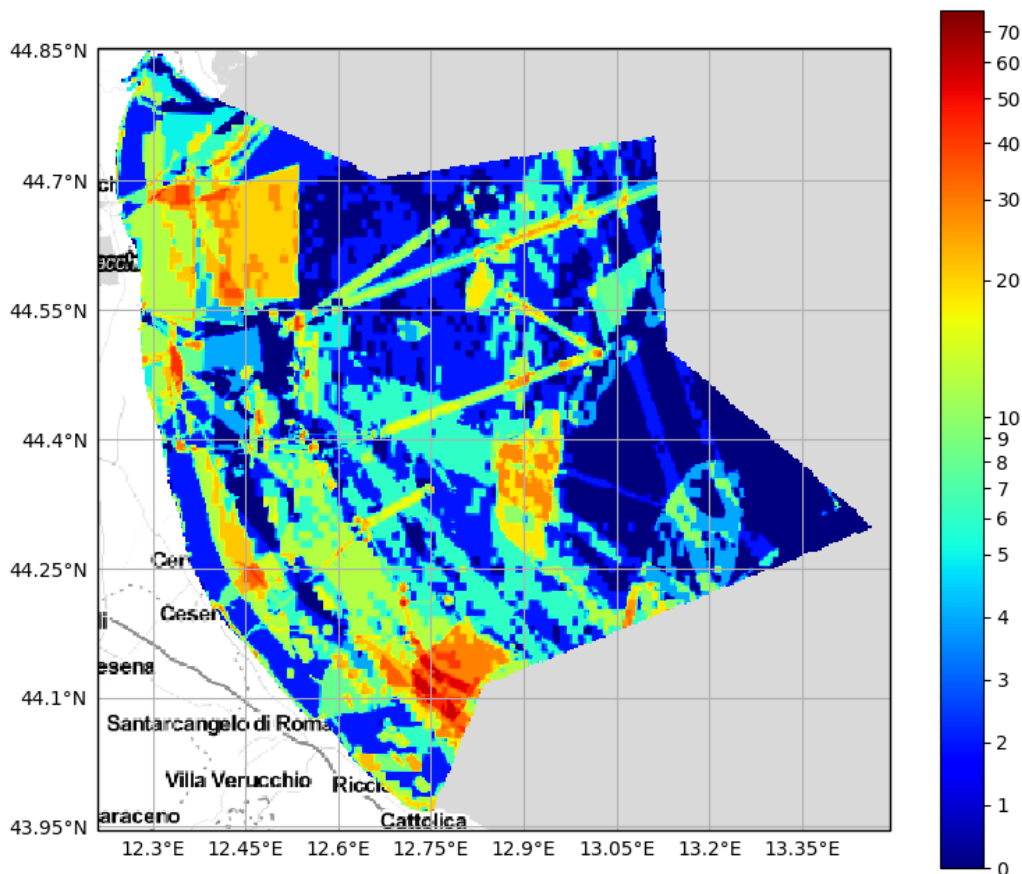


Figure 24 - Spatial distribution of MUC scores (managed scenario).

In Figure 25 the differences between the managed and the present scenarios are illustrated. The map shows the evidence of the increase of conflicts derived from the proposed institution of a new managed area as the BPZ offshore Rimini (4 to 6 NM), from the possible expansion of aquaculture (mainly with SSF) (parallel to the coastline 3 to 6 NM) and for the presence of the new offshore wind farms, with both trawling fisheries and maritime traffic, within 7 to 12 NM (Figures 24 and 25). In addition, an increase in MUC scores is also evident offshore, close to the eastern Case Study boundary, overlapping the “Sola sanctuary”, where a ban for trawling activities has been proposed.

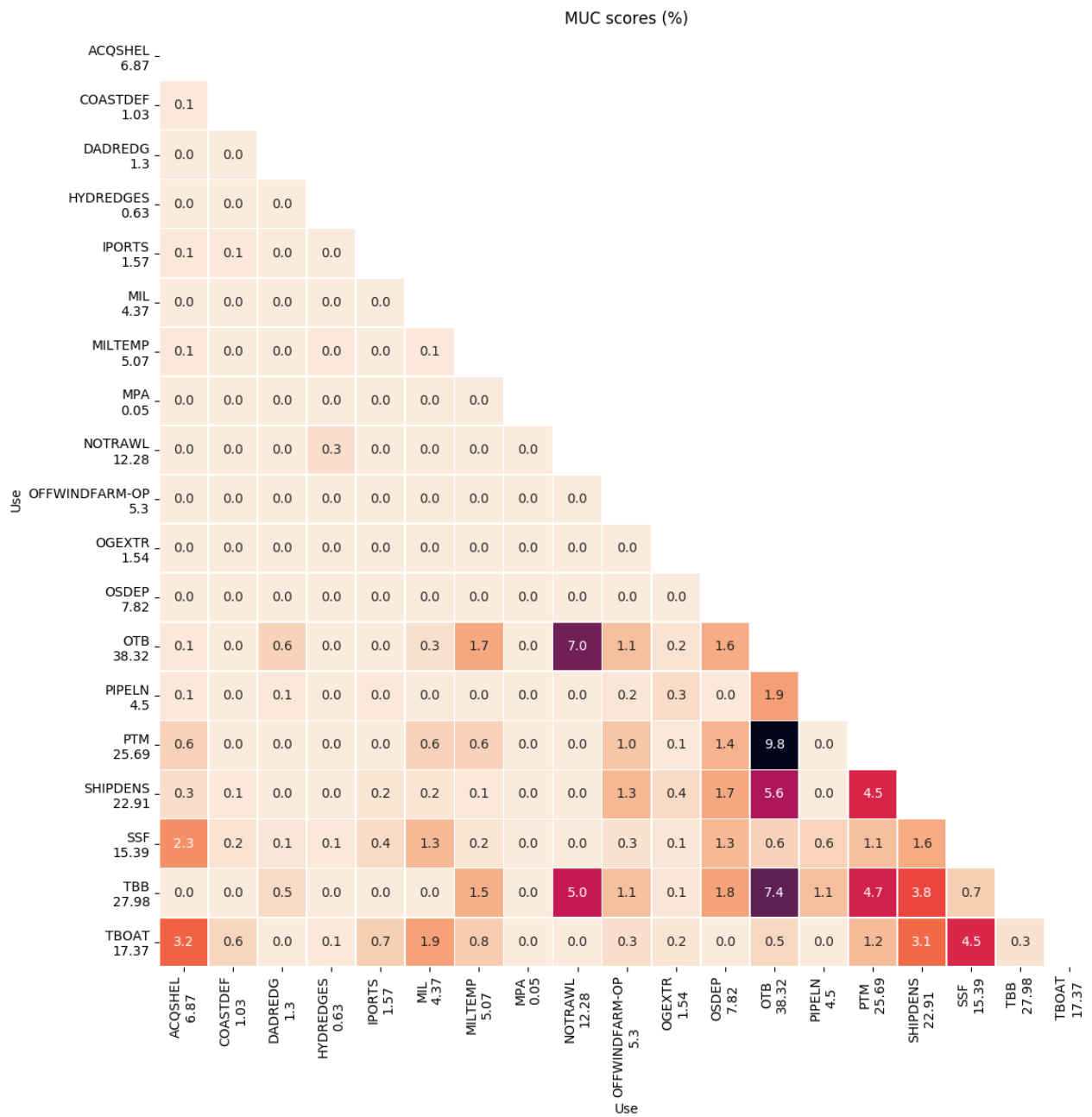


Figure 27 - Matrix representing the contribution (in percentage) of the single pairwise combinations to the total MUC score (for the whole area of analysis).

4.3.6 PARTRAC Module run: description of methods and main results

Objectives

The particle tracking module (PARTRAC) allows to assess the dispersion of particles released in the Adriatic Sea. The module could simulate, indeed, particles released on the surface or through the whole water column. The PARTRAC module produces outputs in terms of the positions of the released particles at daily time intervals. In this way, it is possible to follow the particles concentration at daily frequency, computed on a regular grid of 500 m².

In Emilia-Romagna Case Study AT2.3, the module was used to simulate the trajectories of the floating marine litter deriving from aquaculture activities (e.g. mussel farming plastic nets and growing ropes) (https://www.portodimare.eu/layers_ext/geonode:2019_shellfish_farms_in_eztyo#/) in both continuous and impulsive dispersion scenarios, over a maximum period of 10 days.

The main results of the PARTRAC module run are shown in Figures 28 and 29.

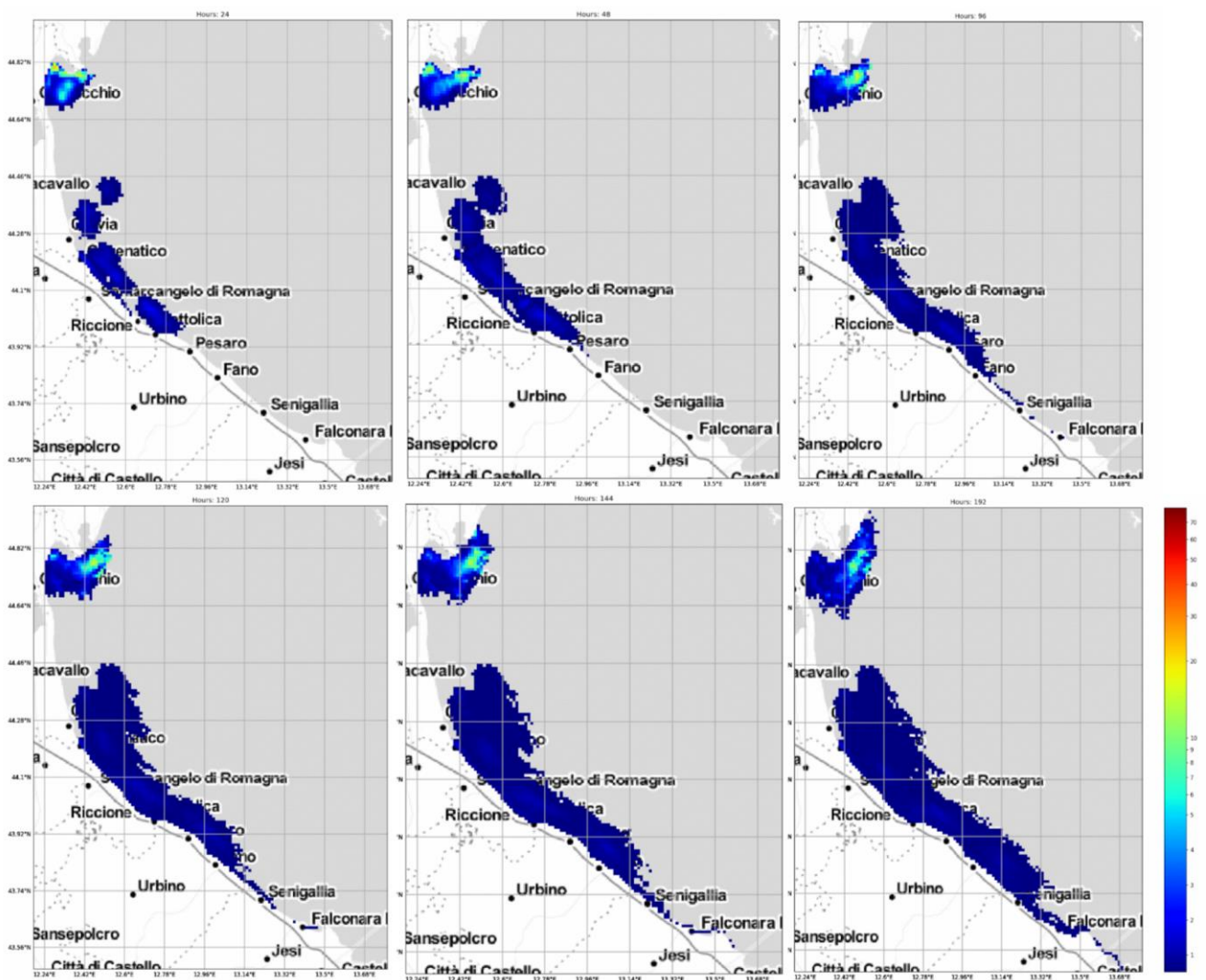


Figure 28 - Particles concentration at daily frequency considering an impulsive release from farms.

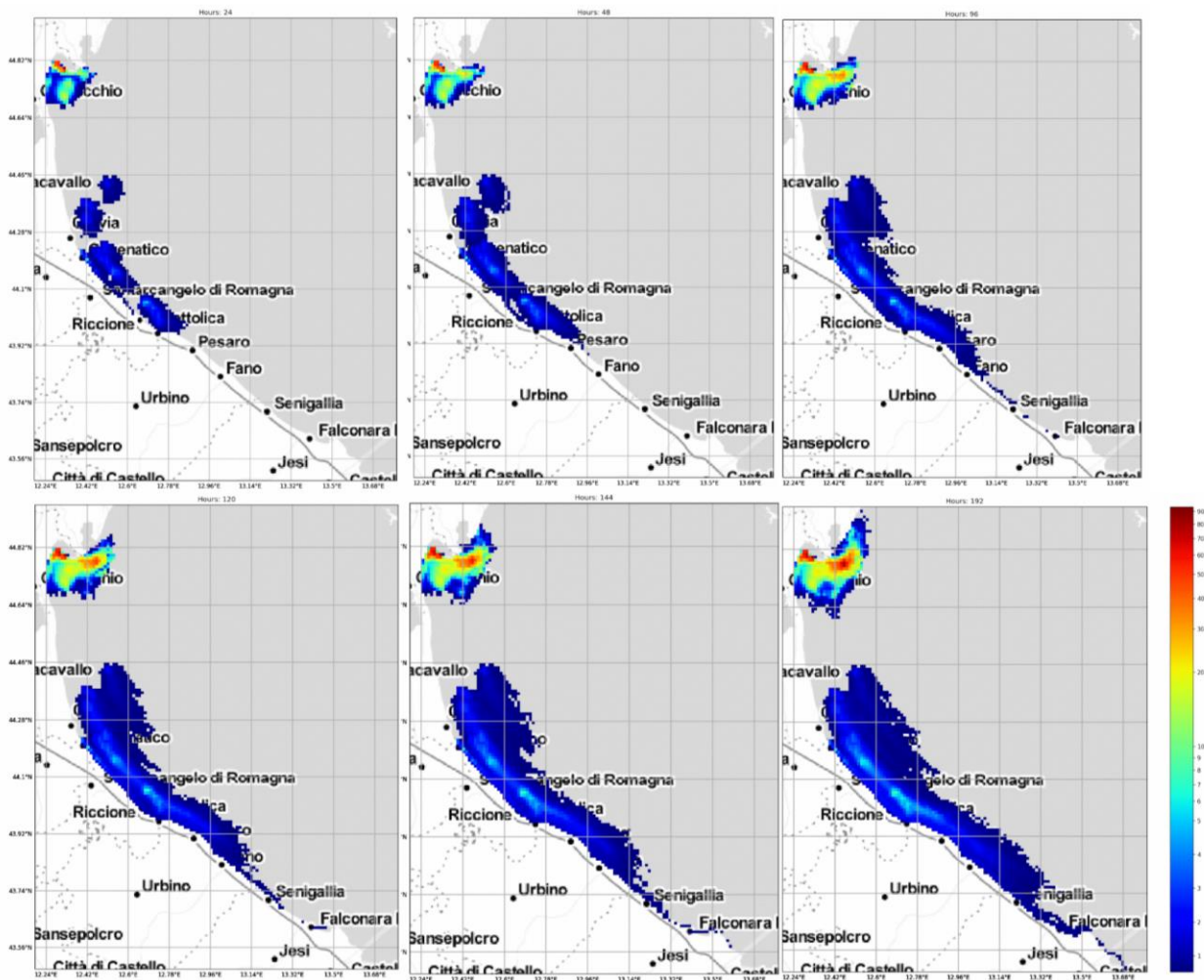


Figure 29 - Particles concentration at daily frequency considering a continuous release from farms.

In both scenarios, the relevant effect of the potential loss/release of floating litter from mussel farms is evident after few days from the hypothetical sporadic and/or frequent events, as most of the E-R coasts would be subject to the potential beaching of the plastic garbage (e.g. mussel farming plastic nets and growing ropes). This could have relevant effects on the good environmental status of coastal habitats and generate potential damage to other priority uses of the regional coasts (e.g. bathing tourism), fostering the need for the adoption of good practices and new technologies (e.g. non-plastic and degradable mussel nets and ropes) to avoid accidental releases at sea.

4.3.7 AZA MODULE run: description of methods and main results

Objectives:

Promoting the sustainable development of aquaculture activities in synergy with the other uses, researching new areas for aquaculture development

The AZA (Allocated Zones for Aquaculture) module implemented a spatially explicit Multi-Criteria methodology, namely SMCE (Spatial Multi-Criteria Evaluation) for identifying Allocated Zones for Aquaculture (AZAs), i.e. marine areas where the development of aquaculture is prior to other uses.

The AZA module has been tested in the Emilia-Romagna case study for the most important marine aquaculture typology for the region, mussel farming (*Mytilus galloprovincialis*).

The SMCE applied for the AZA module was carried out following the framework developed in Brigolin *et al.* (2017) throughout three steps: i) criteria normalization; ii) weight assignment to each criterion; iii) suitability index calculation.

The Suitability Index (SI) was calculated by applying the weighted linear combination using the following equation:

$$SI = \sum w_i x_i$$

Where w_i = weight of the assigned to factor i | x_i = criterion score of factor i

SI values ranged from 0 to 1, where values close to 1 indicate the highest suitability. In this application four criteria were used: (i) optimal growth, (ii) significant wave height, (iii) potential environmental impact and (iv) distance to harbour. Major details are described into the report T2.3.1

Such criteria, shown in Figure 30, evidenced that the coastal areas are those able to ensure faster mussel growth), especially in the central and northern part of the region, in presence of less intense and potentially hazardous waves and, clearly, closer to ports.

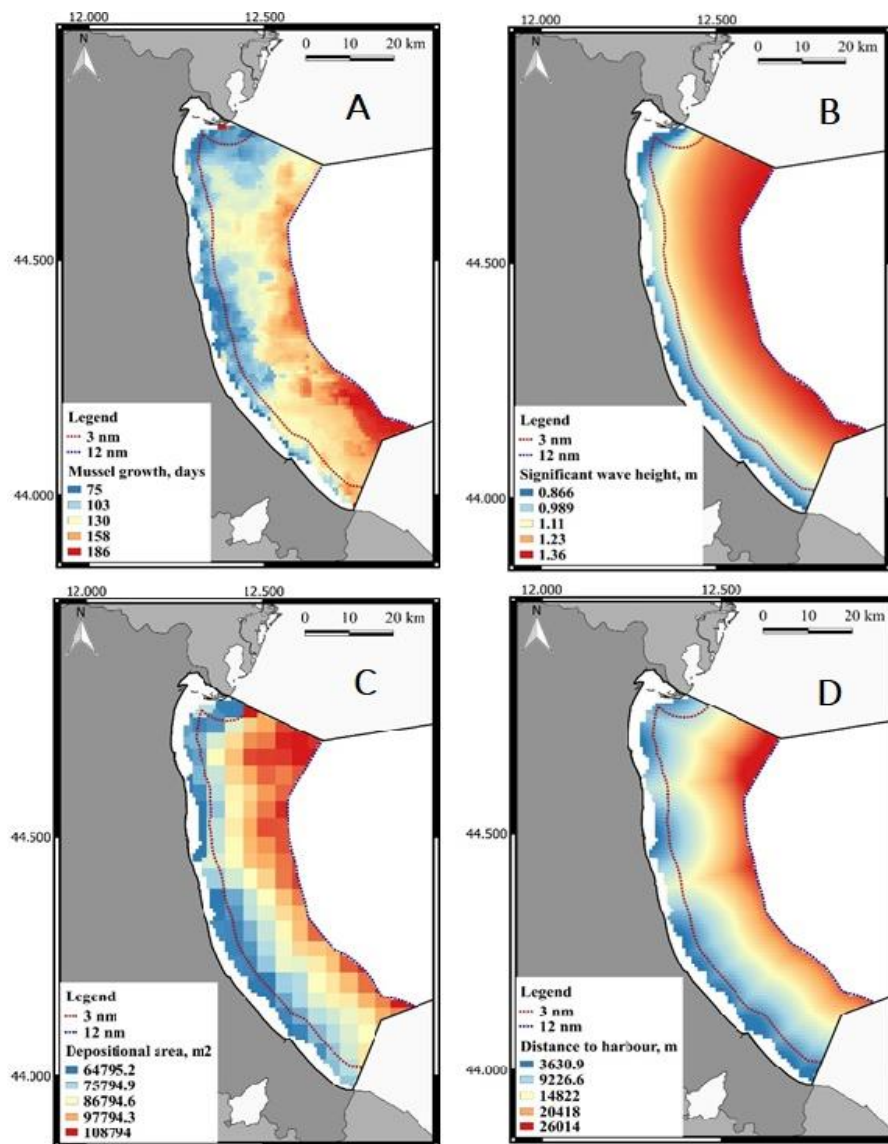


Figure 30 - criteria used to define new AZA: A - mussel growth criterion (days for optimal mussel growth); B - significant wave height criterion; C - environmental impact criterion; D - distance to harbour criterion.

The AZA module was applied in the study areas and the suitability to farming activities was estimated. In Figure 31 the Aquaculture Suitability Index for shellfish farm estimated applying the SMCE Methodology is shown.

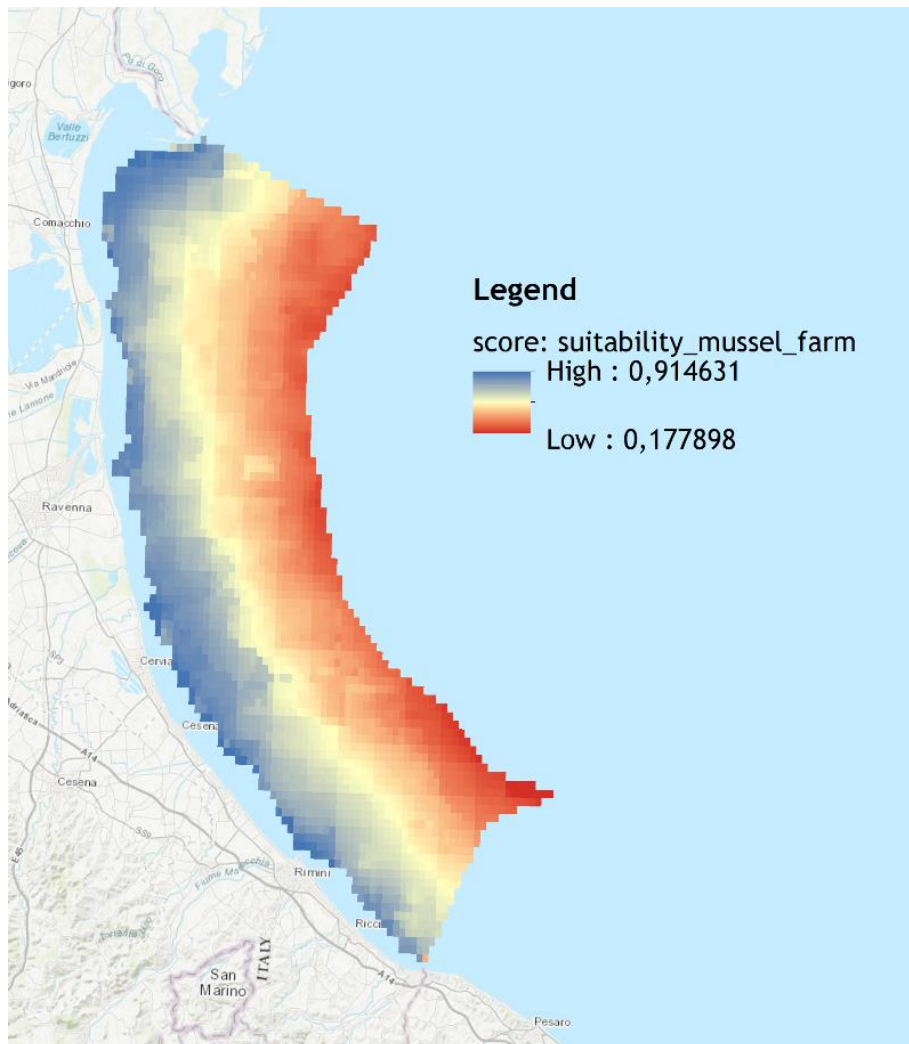


Figure 31 - spatial distribution of the Aquaculture Suitability Index scores for mussel farming (from blue: high suitability to red: low suitability).

The SI index highlights how extensive coastal areas within the 3 NM offshore may ensure the proper and most suitable location for mussel farming development. However, for a proper use of the module outputs to foster.

4.4 General Results

The Case Study AT2.3, described into the PORTODIMARE report DT2.3.1, tested the Geoportal of Adriatic-Ionian Region and the Tools for MSP, and offered the opportunity to update the analysis of conflicts and synergies existing among sea uses and to evaluate their cumulative impacts on the marine area in front of Emilia-Romagna Region, corresponding to the sub-areas A3 and partially A7 of the ongoing Adriatic maritime spatial plan (see chapter below). Both analyses have been done with respect to the present conditions and to a possible managed scenario in which new sea uses and potential measures have been considered according to the specific objectives declared in chapter 5. Indeed, the temporal coincidence between the PORTODIMARE project activity and the implementation of the MSP process in Italy allowed to take into account the actual vision and strategic objectives that are being considered in the Adriatic maritime spatial plan for the sub-area in front of Emilia-Romagna.

The most relevant results, described in previous chapters, can be synthesised in the following topics:

- The marine area in front of the regional coast is characterized by significant human pressures, which affect the water column, the seabed and the subsoil, due to the coexistence of multiple sea-uses (maritime transport, aquaculture, fishing, fossil energy, exploitation of the off-shore sands deposits, coastal defence, ports, military uses). Besides, in the near future new sea-uses are planned, which must be carefully assessed as part of the marine space planning, together with the implementation of cogent environmental measures.
- The results of the CEA module run (Figures 15-16) show how the higher CEA scores are related to the maritime traffic density and to the trawling activities, which affect the whole CS area between 3 and 12 NM off-shore, a wide area of the International waters (approximately 20 NM offshore) and the proximity of the Ravenna harbour (the latter for what concerns traffic). These results are still confirmed in the hypothetical managed scenario, even though, in some areas, a consistent reduction in the CEA scores are observed (Figure 17) due to the simulated introduction of bans/regulations on Small Scale Fishery, Mid-water pelagic trawling, bottom otter trawlers (OTB) and “rapido” beam trawlers (TBB). This is particularly evident in the area offshore Rimini, where a biological protected zone is proposed, and eastward, close to the territorial water boundary, where the scenario simulated the hypothesis of the institution of the “Sole sanctuary”. Besides, the proposed Natura 2000 SCI for the protection of *Caretta caretta* and *Tursiop truncatus* in the marine waters facing the Po Delta, that could foresee the application of Bycatch Exclusion Devices (BRDs) on trawling nets, could really bring to a substantial reduction of the overall CEA score in the area, and have an evident effect on the concerned environmental components (especially marine turtles).
- On the other hand, significant increases in the human-related pressures are evident locally where the new wind farms are planned, mainly due to physical pressures (e.g. sealing). However, the additional impact exerted by new aquaculture installations would be partially balanced by the consequent reduction of other activities in the same zones (e.g. trawling, shipping).
- If we compare such results with those coming from the MUC module analysis in the managed scenario (Figures 24 and 25), it is evident how an increase in conflicts could derive from the proposed institution of a new managed area as the BPZ (located 4 to 6 NM), from the possible expansion of aquaculture (mainly with SSF) and from the presence of new offshore wind farms: these three factors would indeed conflict with trawling fisheries and maritime traffic, within 7 and 12 NM. In addition, an increase in MUC scores is also evident in the eastern side of the CS area, due to the overlapping with the “Sola sanctuary”, even if a ban for trawling activities has been proposed.

- Thanks to the testing of the PARTRAC Module, originally not foreseen in the Case Study, it was possible to analyse the relevant effects of the potential loss/release of floating litter from mussel farms. It is evident that, after few days from the hypothetical sporadic and/or frequent events, most of the regional coast would be subject to the potential beaching of the plastic garbage (e.g. mussel farming plastic nets and growing ropes). This could have relevant impacts on the good environmental status of coastal habitats and also generate potential damage to other priority uses insisting on the regional coast (e.g. bathing tourism). Such results must be considered in the planning process by fostering the need for the adoption of good practices and innovative technologies (e.g. non-plastic and degradable mussel nets and ropes) to avoid accidental plastic releases at sea.
- Finally, Thanks to the application of the AZA (Allocated Zones for Aquaculture) module, it was possible to identify the most suitable areas for new possible farming activities. The SI index highlights how extensive coastal areas within the 3 NM offshore may ensure the proper and most suitable location for mussel farming development (Figure 29).

5 ACTION PLAN FOR MARITIME SPATIAL PLANNING

The planning process here discussed, to which the GAIR and its Tools for MSP (modules) are contributing, has a long history. It started from the capitalisation of those activities carried out in the area during the last two decades aimed at elaborating ICZM strategies and plans. As above mentioned, this process has an important milestone in the approval of the Regional ICZM Guidelines in 2005⁷.

The European projects SHAPE funded by IPA Adriatic CBC (Regione Emilia-Romagna, 2014) and ADRIPLAN funded by DG Mare (Barbanti *et al.*, 2015) represent two other important milestones, because they focused on the assessing of maritime and coastal uses and impacts, on identifying key MSP and ICZM issues in the area and also addressed some planning solutions at a strategic level.

Furthermore, a specific Research Line of RITMARE (a national flagship project on marine and maritime research topics coordinated by CNR), titled "ICM-MSP in the Adriatic Ionian Region", had the objective to develop a concrete exercise of MSP on the Emilia-Romagna coast and its marine area, by defining a vision, the objectives and a portfolio of coherent planning measures (Barbanti & Perini, 2018; Barbanti *et al.*, 2017a, b). Such activity has been carried out by CNR-ISMAR in collaboration with the Emilia Romagna Region (Land and Environmental Directorate General), as part of an Institutional Collaboration Agreement for study and research activities aimed at supporting the planning and management of the coastal zone of the Emilia-Romagna Region and its marine waters (DG 2274/2016). During both ADRIPLAN and RITMARE the modules MUC and CEA, although at a less developed stage, have been used to support the analysis and the planning phases.

The significant contribution of PORTODIMARE project, besides the integration of such tools for MSP and others into the GAIR geoportal, and the creation of a dedicated platform for ICZM-MSP in the Adriatic-Ionian Seas, is to carry out real planning experiences, thus concretely contributing to the ongoing process according to Directive 2014 /89EU and providing action plans to be applied and transferred to other areas.

As widely discussed in the DT2.3.1 report, the exercise performed by Emilia-Romagna Region is strictly connected to the ongoing elaboration of the maritime spatial plans in the Italian seas. For this reason, it was decided to work as far as possible in parallel, by combining the objectives and by testing both the operational methodologies foreseen by NTC and by PORTODIMARE application form. In particular, the work has been organised in subsequent operational steps (described in chapter 4.3). Some of them are common to both processes, such as the data recovery, the knowledge framework and the definition of objectives and planning units, while the steps dedicated to the testing of tools for MSP are only subject of PORTODIMARE project.

The present Action Plan, can thus integrate the best practices outcoming from the two processes and will significantly support the ongoing national maritime spatial plan, especially for what concerns the approach that other regions have to undertake and the steps to be followed. As already mentioned, indeed, Italian Regions are directly involved into the national process, being responsible for the proposal of a planning draft for the territorial waters in front of their coast.

Before going through the methodology it is important to emphasize that the ongoing 'Italian MSP plan', will be a strategic planning, providing address and guidelines for the maritime zone and for the sub-areas, to be used as a reference for other planning actions (thematic or at local level) and for the establishment of specific regulatory frameworks. It takes into account the characteristics of the different maritime areas and sub-areas, of the level of deepening and the complexity of the strategic and specific objectives, and considers the overall picture of the information available and the requests of the stakeholders involved.

⁷ (Regione Emilia-Romagna, 2005. Linee Guida per la Gestione Integrata Zone Costiere. Delibera C.R. 20 gennaio 2005, n.645)

5.1 Planning approach and methodology

As mentioned in chapter 3.2, the national MSP process foresees 6 phases for the planning implementation:

Phase 1 - Initial assessment and current / expected trends in the area

Phase 2 - Analysis of interactions (conflicts and synergies) among existing uses and impacts on environmental components.

Phase 3 - Definition of a vision and strategic objectives

Phase 4 - Planning: definition of 'planning units' based on the vocations, specific objectives, specific measures (by areas and by sectors)

Phase 5 - Methodology and indicators for monitoring and adapting the Plan

Phase 6 - Activities for the consolidation, implementation and updating of the Plan

Such phases are below described in detail with reference to Emilia-Romagna Case Study area (sub-areas A3 and part of A7 of the Adriatic Maritime zone), at least for what concerns the phases from 1 to 4. Phase 5 and 6, on the contrary, are only described with reference to the national guideline.

5.2 Phase 1: initial assessment and current/expected trends in the area

This phase basically corresponds to the knowledge framework creation. Its goal is to provide a synthetical but comprehensive description of the environmental system and of the sea-uses existing in the area, and has to be supported by cartography. Within the Italian MSP process it was decided to consider, for what concerns maritime and coastal activities and trends, the following aspects listed with reference to Directive 2017/845/EU -Annex III, Table 2b:

- Physical restructuring of rivers, coastline or seabed (water management)
- Extraction of non-living resources
- Production of Energy
- Extracting of living resources
- Cultivation of living resources
- Transport
- Urban and industrial uses
- Tourism and leisure
- Security/Defence
- Education and research

The same national process set a list of 14 'essential maps' to be provided, that were also processed within the Emilia-Romagna Case Study, as described in report T2.3.1 and synthesized in the present report in chapter 4.3.3. Besides, description of main physical and environmental characteristics of the area, of the sea uses criticalities and of the trends are summarized in chapter 4.1.

Thanks to the GAIR development, indeed, the initial assessment of Emilia-Romagna Case Study has been conducted directly by accessing the geoportal previously implemented with all the needed information layers, starting from the geographical boundaries passing to the sea uses (Figure 32) up to the environmental data.

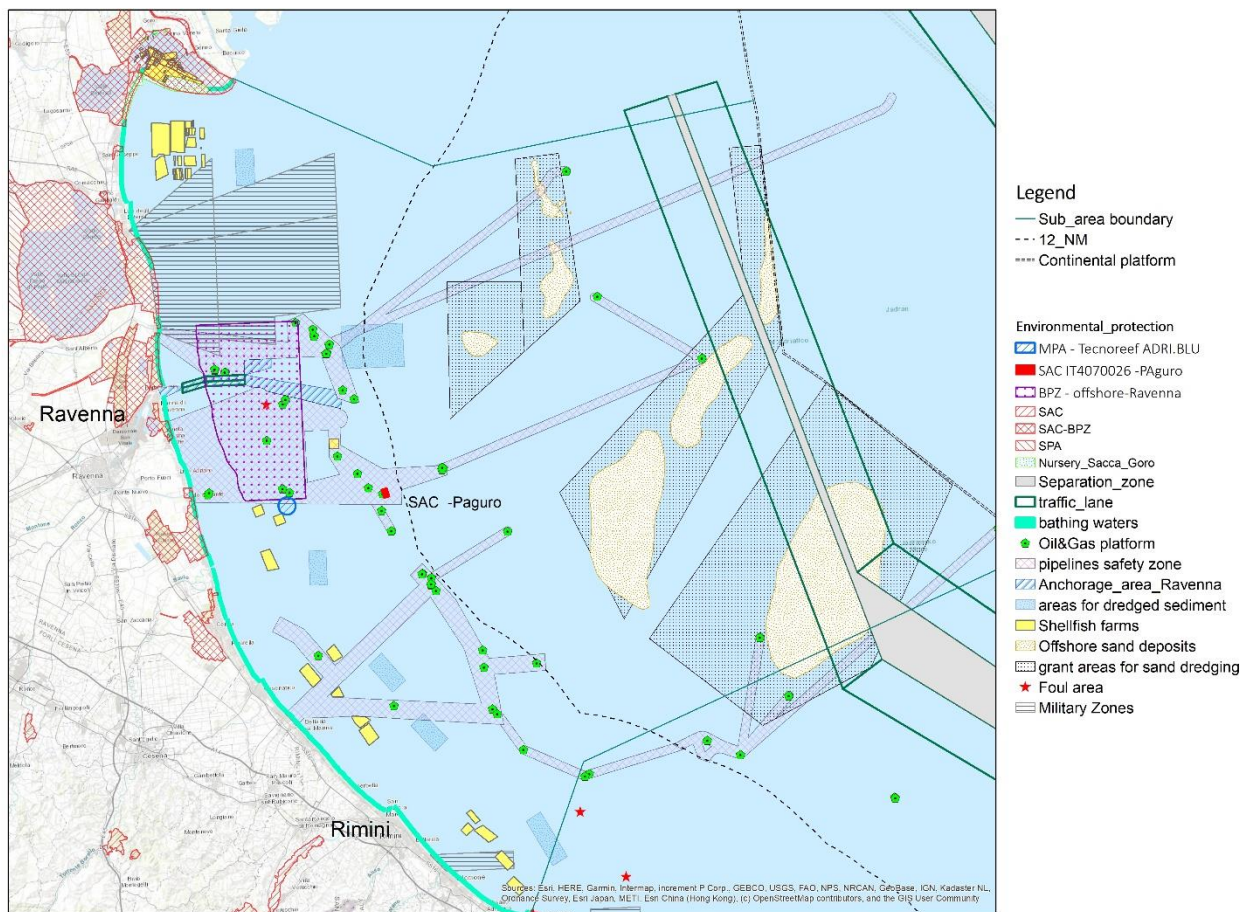


Figure 32 - complexity of the sea-uses in the Emilia-Romagna case study area.

Another relevant aspect of phase 1 is the analysis of land sea interactions (LSI). The general Framework developed by EC DG MARE describes “LSI as a complex phenomenon that involves both natural processes across the land-sea interface, as well as the impact of socio-economic human activities that take place in the coastal zone” (EC DG MARE, 2017). In Fact, there are several aspects that bind the land and marine components, both as regards to the anthropic uses of the coast and the sea, and as regards to the natural dynamics, which are often accelerated or worsened by the anthropic impact.

LSI could be classified into the following groups:

- **Land-sea natural processes:** often influenced/accelerated by human activities: flow of water and movement of organisms between land and sea ecosystems; loss of coastal /marine ecosystems; coastal erosion and sea flooding processes, sea level rise, the subsidence of the coastal plains; reduction of sediment input by the river, etc.
- **Land and sea uses and activities:** almost all maritime uses need supporting structures on land (e.g. ports for ships) while some of the land uses need structures at sea such (e.g. tourism); moreover some activities at sea impact the coastline and vice versa (e.g. oil and gas production accelerate land lowering of the coast).
- **Land and sea planning and management processes;** land and sea activities should be planned in a harmonized manner considering the land-sea continuum, thus implying the alignment of the general objectives and the methodologies used.
- **Land-sea socioeconomic interactions;** people living along the coast benefit from coastal and marine resources, operate in the economic sectors that develop both on land and at sea, thus driving land-sea processes; furthermore, people exchange their experiences, knowledge and culture with the neighbouring Countries.

It therefore becomes essential within the MSP process to focus on the regional hot-spots and on the dynamics underway: this is one of the driving points of the methodologies approved by the Italian NTC.

Basing on the above mentioned concepts and following the national Guidelines for Maritime Spatial Planning (Decree of the Presidency of the Council of Ministries of 1 December 2017), the NTC identified the most relevant areas in terms of land-sea interactions, which are:

- **river basins** relevant on the basis of their identification according to the Water Framework Directive (decree 152/2006);
- **terrestrial and marine protected areas**, including SCIs (Sites of Community importance), SACs (Special Areas of Conservation), and SPAs (Special Protection Areas) of the Natura 2000 network;
- **UNESCO sites**;
- **coastal areas** with high landscape/marine value;
- areas with important coastal maritime **infrastructures** (e.g. ports).

For what concerns Emilia-Romagna territory, two main hot spots have been identified (see Figure 33):

- the **Po delta** (mostly located in the Veneto Region): it is characterized by a high environmental and historical value, and it has been recognized as a site of the UNESCO MAB (Man & Biosphere reserve). Main human activities in this area concern agriculture, aquaculture, fishing, and tourism. Here, natural and human-induced processes (such as anthropic subsidence) strongly influence land and ecosystems loss. It is an area relevant for the river outflow in terms of water, sediment, and pollutants.
- the **Ravenna harbour and surrounding zone**: it is characterized by the presence of environmental protected areas and by particularly important historical heritages, which represent an attraction to the coastal tourism. Unfortunately, both these elements are remarkably close to the industrial zone of Ravenna harbour, which is one of the biggest in Italy. The off-shore area still hosts several oil and gas wells, very close to the shoreline (e.g. Angela-Angelina platform), which influence both the local subsidence, that reaches some of the higher rates in the Region, and the coastal erosion.

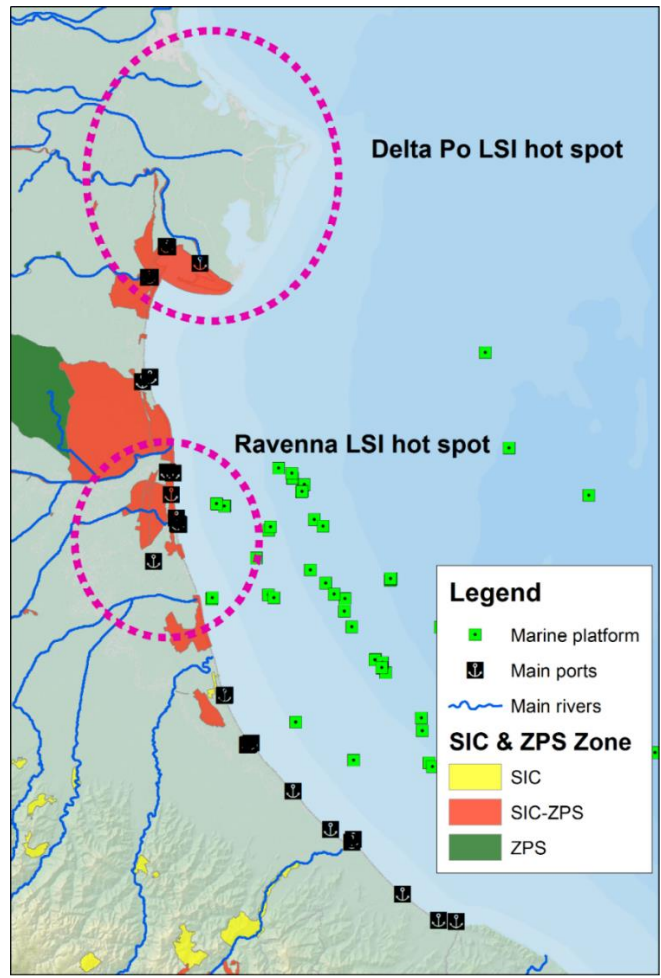


Figure 33 - Land-sea interaction hotspots in Emilia-Romagna.

5.3 Phase 2: analysis of interactions (conflicts and synergies) among uses and impacts on environmental components

The main contribution of the Portodimare project is in the development of this phase of the planning process. Indeed, analysis of the interaction among sea-uses here has been carried out with the support of quantitative and spatially explicit Tools for MSP, instead of using simplified methodology as the approach proposed by Ehler and Douvere (2009) (Figure 34).

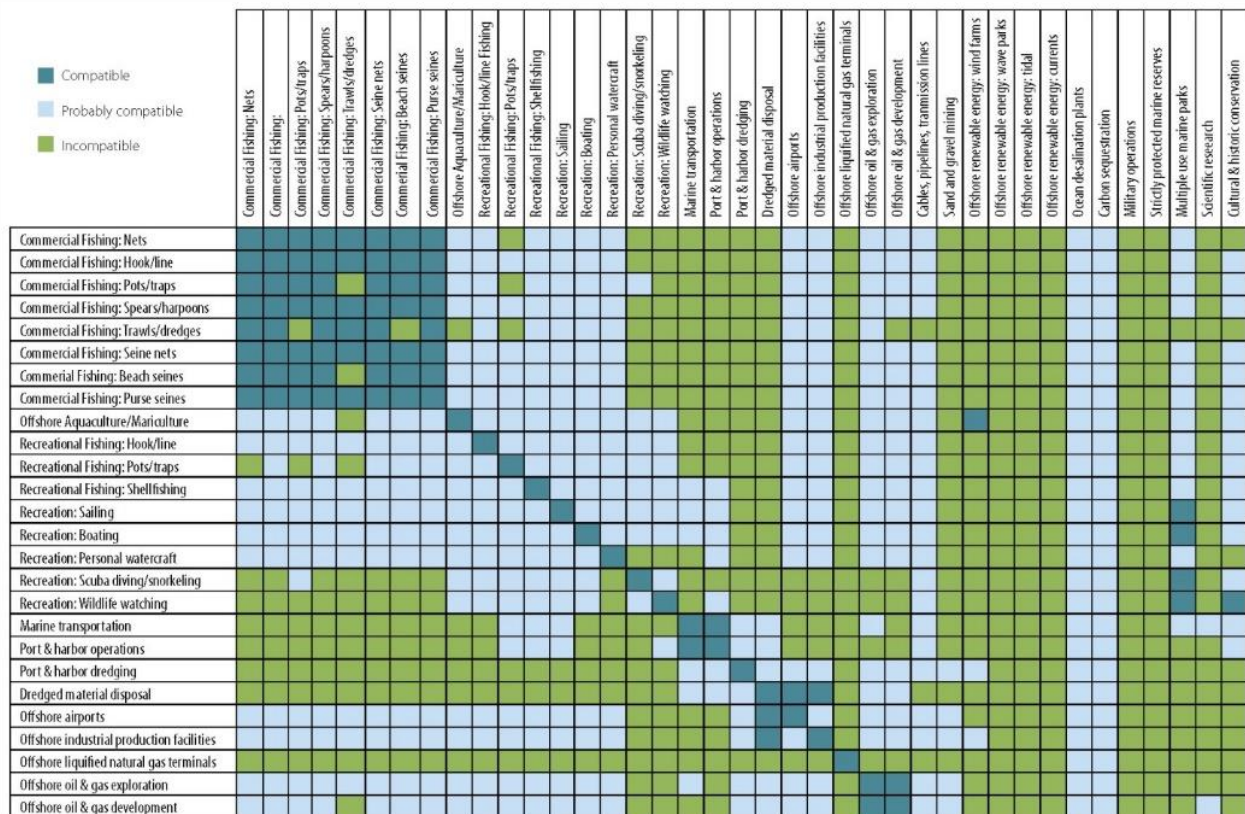


Figure 34 - Example of Conflict and Compatibility Matrix (Ehler & Douvere, 2009).

As described in detail in PORTODIMARE report T2.3.1 and synthesized in the present report at CHAPTER 4.3.4 and 4.3.5, the analysis of conflicts and synergies was performed by using the Tools for MSP - CEA and MUC in the current status.

In particular, the Cumulative Effects Assessment (CEA) analysis has been carried out in order to inform the planning process on the present propagation of pressures generated by one or multiple anthropogenic uses, and to assess the spatial distribution of impacts exerted by one or multiple pressures on one or multiple environmental receptors. The Maritime Use Conflict analysis (MUC) was conducted to identify the current interactions between human uses in terms of conflicts.

The Cumulative Effects Assessment (CEA) analysis, indeed, gives some fundamental information for planning, highlighting the areas of major impact and identifying the typology of sea uses responsible for those impacts. On such areas the most relevant management measures should be concentrated. The main results of the analysis, described in previous chapters and re-shown in Figure 35, prove that the higher CEA scores (14-21) are located between 3 and 12 NM off-shore, and in a wide area of the International waters (approximately 20 NM offshore); such scores are related to the maritime traffic density and to the trawling activities, and in the proximity of the Ravenna harbour (the latter for what concern traffic).

5.4 Phase 3: vision and strategic objectives

In order to apply a forward-looking approach and prevent potential conflicts in the future, a maritime vision must be developed as part of the MSP process. The vision can also help in communicating the benefits of an MSP process, in increasing the awareness on future trends, in defining the priorities for the maritime space and in ensuring the commitment to those actions needed to reach a desired future. A vision helps to clarify the focus of MSP and may also provide the basis to derive jointly agreed S.M.A.R.T. goals (specific, measurable, achievable, relevant, time-bound), towards which an MSP process should lead.

Thanks to the result of the analysis carried out in PORTODIMARE by using the GAIR and the modules MUC and CEA, it was possible to update and basically confirm the 'Vision' and the correlated strategic objectives for the area previously expressed for the Emilia-Romagna case study in Barbanti & Perini (2018).

Such 'Vision' is that **coastal and maritime tourism, and the related value chain, is the pivotal use for the area. Descending from such vision, the following actions must be pursued:**

- **Tourism infrastructures and activities shall respect natural coastal dynamics and the needs of other uses, for a balanced and long-term co-evolution.**
- **Coexisting uses shall not compromise the resources on which tourism is based (e.g. nature, water quality, landscape), but look for all the possible synergies.**

5.5 Phase 4: planning. Specific objectives, vocations, specific measures

As described in chapter 3.2, the Emilia-Romagna Case Study focuses on the sub-area A/3 and part of sub-area A/7 of the Adriatic maritime area (see Figure 5).

Within the Case Study a number of **specific planning objectives** (SO), deriving from the 'Vision' itself, have been defined. They consider, in an integrated way, the system of existing uses and their current trends together with the environmental characteristics and issues of the study area. Such objectives are summarized in Table 5 and mainly concern, in single or combined way, six sectors and uses of the sea/coast:

- Tourism
- Energy
- Fishing and aquaculture
- Environmental Protection
- Coastal defence
- Landscape and cultural heritage protection
- Military uses.

Sectors	Specific Objectives (SO)
Coastal tourism - Coastal defense	SO.1 - Safeguarding the tourist use of the coasts (seaside tourism) by defending against flooding and counteracting erosion.
Energy - Tourism - Aquaculture - Environmental protection	SO.2 - Allowing the exploitation over time of the methane deposits already authorized in a safe way for humans and the environment, reducing conflicts and increasing synergies with other sectors of sea economy.
	SO.3 - Promoting the exploitation of marine renewable energies, with particular reference to wind power.
Fisheries	SO.4 - Promoting the sustainable and regulated expansion of small-scale fisheries;
	SO.5 - Reviewing the regulation of bottom trawling, also considering the effects on the seabed and on areas with EFHs and the sustainability of stocks exploitation.
Aquaculture	SO.6 - Promoting the sustainable development of aquaculture activities in synergy with the other uses in the area.
Environmental protection - Tourism	SO.7 - Consolidating the system of protected areas and existing conservation measures, within a framework of overall ecological coherence and in synergy with other present uses.
	SO.8 - Maintain/achieve the environmental objectives of WFD, MSFD and H&BD.
Military uses - Traffic - Fisheries and Aquaculture	SO.9 - Allow the maintenance of the military uses of some areas, reducing their conflicts with other existing uses.

Table 5: Specific planning objectives for the study area - Emilia-Romagna T.2.3

Basing on these specific planning objectives (SO), the "Planning Units" (PU) were defined. PU are those areas to which specific usage vocations have been assigned, with the aim of regulating and re-directing their use and evolution. Ten PU were identified in the sub-area A/3 (territorial waters) and three PU in the part of sub-area A/7 considered (continental shelf).

The identification of the Planning Units, as well as the subsequent phase of definition of the planning measures, was carried out by taking into account, among other things, the Programme of Measures adopted according to Art. 13 of the Marine Strategy Framework Directive. In fact, in the MSP process, the ecosystem-based approach underlies the entire activity of defining the planning units and identifying the related vocations of use. In this sense, those elements that are relevant for the protection and conservation of species and habitats are transversal and valid for all the Planning Units. Similarly, the needs for the conservation and improvement of landscape quality and for the protection of cultural heritage are considered as cross-cutting issues and valid for most of the Planning Units.

As defined by the NTC procedure, each PU must be codified into the following four classes and then graphically represented (as shown in Figure 37):

- G = Generic Use

Areas where all uses are generally permitted, with specific and mutual regulation mechanisms defined or to be defined in the context of national and international standards or sector plans, in order to guarantee safety, reduce and control environmental impacts and favour coexistence between uses.

- P = Priority Use

Areas for which the Plan provides indications of priority of use and development, also indicating the other uses to be guaranteed or allowed through mutual adjustments and with the identified priority use.

- L = Limited Use

Areas for which a prevalent use is indicated, with other uses that may be present, with or without specific limitations, if and insofar as they are compatible with the prevalent use.

- R = Reserved Use

Areas reserved for a specific use. Other uses are permitted exclusively for the needs of reserved use or except for exceptions and concessions by the person responsible or manager of the reserved use.

This coding, as it is or with any adjustments, may also be suitable for the use at basin scale (e.g., Western Mediterranean, Eastern Mediterranean, Adriatic-Ionian Region) with the aim of having a harmonized representation of the Plans in different States (in this regard examples are offered by the Baltic Sea through the HELCOM Secretariat).

The definition of the PU in each sub-area by expert judgment takes into account a series of criteria:

- Current status of uses and environmental components;
- Current trend, both of the physical and environmental system and of the use system;
- Developments of the system of uses to be promoted, based on the vision and objectives stated in the Plan;
- Requirements for conservation and improvement of environmental conditions, as also defined in the Plan objectives;
- Competence framework and governance system;
- Marine Reporting Unit MSFD;
- Standards and plans in place, with particular reference to environmental, landscape and cultural heritage standards.

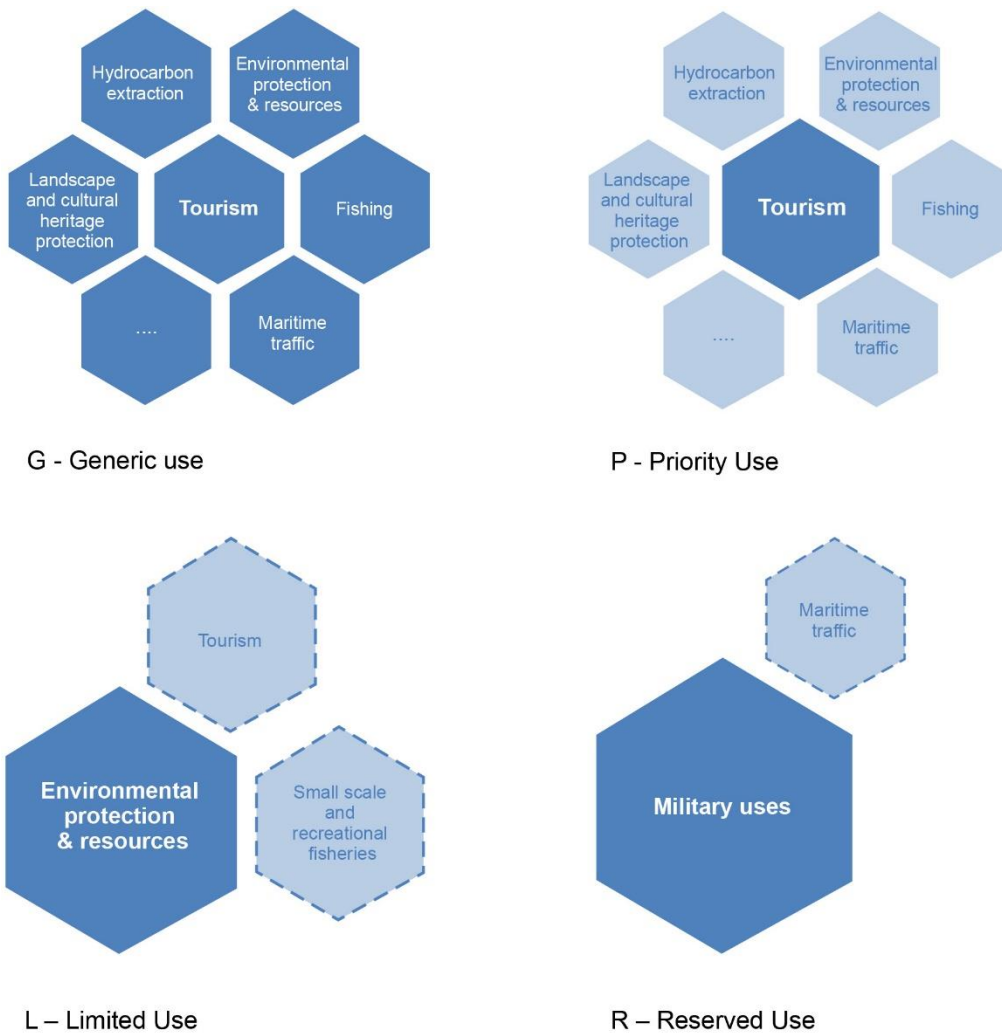


Figure 37 - Graphical representation of the four typologies to be attributed to Planning Units.

The PU identified in the Emilia-Romagna CS are shown in Figure 38 and thoroughly described in Table 6. They belong mainly to the "Priority Use" (P) type (9 out of 13), although from the point of view of extension, also the "General Use" areas (G) are quantitatively significant.

It is useful to point out the presence of a "Reserved Use" (R) type area, which corresponds to the permanent area of the Foce Reno military area, and of a "Limited Use" type area (L), located in correspondence of the Natura 2000 Site SIC IT4070026 "Wreck of the Paguro platform".

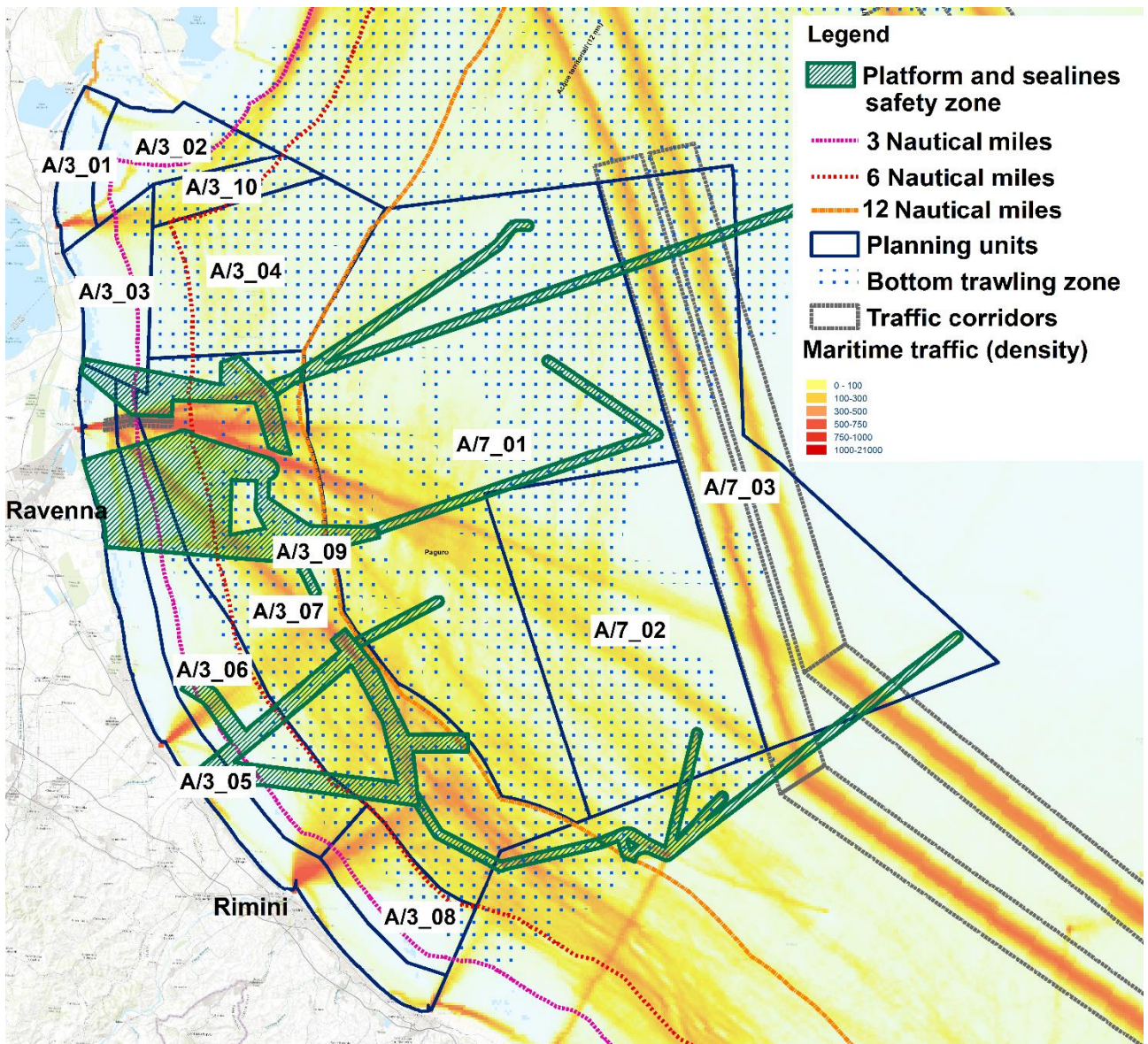


Figure 38 - Planning Units identified in the area and their vocation.

PU CODE	Typology	Generic (G), Priority (P), Limited (L), Reserved (R)	Reason for typology	Other uses	Particular consideration
A/3_01	P(t)	Priority Use (P): tourism (t)	Area with a high tourism vocation (bathing, leisure boating). Attention to landscape aspects is particularly important. Potential development of experiential and eco-tourism due to the presence of coastal Natura 2000 sites and the Po Delta Park.	<ul style="list-style-type: none"> • Aquaculture • Fisheries • Maritime transport • Environmental protection 	Potential for aquaculture and harvesting of bivalve molluscs from natural schools (A.T.B. Sacca di Goro). Harvesting of molluscs with hydraulic dredger according to current legislation.
A/3_02	P(a)	Priority Use (P): aquaculture (a)	Area with a high vocation for mussel farming. Presence of concession areas for mussel farming and harvesting of bivalve molluscs from natural schools (A.T.B. Sacca di Goro).	<ul style="list-style-type: none"> • Fisheries • Maritime transport • Environmental protection • Tourism 	Fishing activities with gears and towed gears allowed in compliance with current legislation outside the areas intended for priority use.
A/3_03	R(d)	Reserved Use (R): defense (d)	Reserved use for national defence (Military training area Echo 346)		Transit allowed according to specific provisions and ordinances.
A/3_04	P(n,d)	Priority Use (P): - nature (n) - defense (d)	Priority on environmental protection for high naturalistic value. Proposal under finalization for the creation of a SCI (Habitat Directive) site for the protection of species of high naturalistic value (<i>Caretta caretta</i> and <i>Tursiops truncatus</i>). Area of interest for national defence (Echo 346 military exercise area) according to ordinances and temporary provisions.	<ul style="list-style-type: none"> • Fisheries • Maritime transport • Tourism 	Fishing activities allowed in compliance with current legislation and according to the requirements determined by the priority uses. Tourism / recreational activities with naturalistic orientation (according to the established measures).
A/3_05	P(t)	Priority Use (P): - tourism (t)	Area with a high tourism vocation (bathing, leisure boating). Attention to landscape aspects is particularly important. Presence of artificial reefs with potential for underwater and eco-tourism development.	<ul style="list-style-type: none"> • Aquaculture • Fisheries • Maritime transport • Environmental protection • Oil & Gas exploitation 	Presence of concession areas for mussel farming with potential development of the sector. Small scale fisheries allowed according to current legislation. Harvesting of molluscs with hydraulic dredger according to current legislation. Commercial / passenger maritime traffic (Port of Ravenna) and intense leisure boating. High ecological value: area of reproduction and growth of commercial fishery species. Presence of Oil & Gas concessions and Oil & Gas activities with potential for the reuse of decommissioned platforms.

PU CODE	Typology	Generic (G), Priority (P), Limited (L), Reserved (R)	Reason for typology	Other uses	Particular consideration
A/3_06	P(a)	Priority Use (P): - aquaculture (a)	Area with a high vocation for mussel farming. Presence of concession areas for mussel farming with potential development of the sector.	<ul style="list-style-type: none"> • Fisheries • Maritime transport • Environmental protection • Oil & Gas exploitation 	<p>Commercial / passenger maritime traffic (Port of Ravenna) and intense leisure boating.</p> <p>Fishing activities with gears and towed gears allowed in compliance with current legislation outside the areas intended for priority use.</p> <p>Presence of Oil & Gas concessions, Oil & Gas activities, marine terminals and infrastructures operating according to current legislation, with potential for the reuse of platforms that are soon to be decommissioned.</p>
A/3_07	P(e)	Priority Use (P): - energy (e)	<p>High presence of hydrocarbon extraction platforms, support structures, subsea pipelines and marine terminals operating according to current legislation. Potential for the reuse of decommissioned platforms.</p> <p>Within the area, areas of interest for possible wind farms and other renewable sources (solar, wave motion) have been identified.</p> <p>Need to consider the effects of the possible installation of these infrastructures on the coastal landscape.</p>	<ul style="list-style-type: none"> • Aquaculture • Fisheries • Maritime transport • Environmental protection 	<p>High ecological value: area of reproduction and growth of fish species of commercial interest (Presence of the Biological Protection Area "Outside Ravenna", Tecnoreef ADRI.BLU Area).</p> <p>Fishing activities with gears and towed gears allowed in compliance with current legislation outside the areas intended for priority use.</p> <p>Commercial / passenger maritime traffic (Port of Ravenna) and intense leisure boating.</p> <p>Limited presence of concession areas for mussel farming with potential development of the sector.</p>
A/3_08	P(a, t, n)	Priority Use (P): - aquaculture (a) - tourism (t) - nature (n)	<p>Area ad elevata vocazione per la mitilicoltura. Presenza di aree in concessione per la mitilicoltura con potenziale sviluppo del settore.</p> <p>Area ad elevata vocazione turistica (nautica da diporto, presenza di reef artificiali, eventualmente ampliabili, con potenziale sviluppo turismo subacqueo e naturalistico).</p> <p>Elevata valenza naturalistica: area di riproduzione e accrescimento specie alieutiche di interesse commerciale (potenziale istituzione nuova Z.T.B.).</p>	<ul style="list-style-type: none"> • Fisheries • Maritime transport 	<p>Fishing activities with gears and towed gears allowed in compliance with current legislation outside the areas intended for priority uses.</p> <p>Heavy maritime traffic.</p> <p>Collection of molluscs with hydraulic dredger according to current legislation.</p>
A/3_09	L(n)	Limited Use (L): - nature (n)	High ecological value with presence of SAC - Wreck of the Paguro platform (IT4070026).	<ul style="list-style-type: none"> • Tourism 	<p>Area with a high vocation for underwater and eco-tourism.</p> <p>Leisure boating traffic regulated by a management plan.</p>

PU CODE	Typology	Generic (G), Priority (P), Limited (L), Reserved (R)	Reason for typology	Other uses	Particular consideration
A/3_10	G	Generic Use (G)	Various uses that share the same space in compliance with the specific rules of each use and rules of coexistence between uses.	<ul style="list-style-type: none"> -Aquaculture -Fisheries -Maritime transport - Environmental protection 	<p>Potential for aquaculture and bivalve shellfish harvesting.</p> <p>Fishing activities with gears and towed gears allowed in compliance with current legislation.</p> <p>High ecological value: presence of protected species (Annex II Habitat Directive - <i>Caretta caretta</i> and <i>Tursiops truncatus</i>).</p>
A/7_01	G	Generic Use (G)	Various uses that share the same space in compliance with the specific rules of each use and rules of coexistence between uses.	<ul style="list-style-type: none"> • Fisheries • Maritime transport • Environmental protection • Oil & Gas exploitation • Renewable energies • Relict sands extraction 	<p>Fishing activities with gears and towed gears allowed in compliance with current legislation, with potential closure to towing gears within the area called "Sanctuary of the sole".</p> <p>Oil & Gas concessions and Oil & Gas activities.</p> <p>Presence of submarine deposits of relict sands.</p> <p>High ecological value: presence of protected species (Annex II Habitat Directive - <i>Caretta caretta</i> and <i>Tursiops truncatus</i>), in particular in the northern part of the Planning Unit.</p>
A/7_02	P(n, sa)	Priority Use (P): - Relict sand extraction (sa)	<p>High ecological value: area of reproduction and growth of commercial fish species. A small portion of the area falls within the proposed "Sole sanctuary" (Fishery Restricted Area -FRA), an action that would also help to reduce the impacts of fishing (e.g. accidental catches) on cetaceans and turtles.</p> <p>Presence of significant deposits of relict sands (ancient coastal deposits), which are source for beach nourishment</p>	<ul style="list-style-type: none"> • Fisheries • Maritime transport • Oil & Gas exploitation 	<p>Fishing activities with fixed and towed gears allowed in compliance with current legislation, with possible further restrictions due to the possible institution of the FRA.</p> <p>Oil & Gas concessions and Oil & Gas activities should avoid infrastructures above the 'relict sand deposits.</p>
A/7_03	P(tm)	Priority Use (P): - maritime transport (tm) - nature (n)	<p>Area with high density of maritime traffic, transit corridors and IMO maritime traffic separation schemes.</p> <p>A significant portion of the area falls within the proposed "Sole sanctuary" (Fishery Restricted Area -FRA), an action that would also help to reduce the impacts of fishing (e.g. accidental catches) on cetaceans and turtles.</p>	<ul style="list-style-type: none"> • Fisheries • Relict sands extraction 	<p>Fishing activities with fixed and towed gears allowed in compliance with current legislation, with possible further restrictions due to the possible institution of the FRA.</p> <p>Presence of submarine deposits of relict sands, with exploitation methods to be agreed to limit conflicts with navigation and guarantee safety.</p>

Table 6: Planning Units and their main characteristics.

The final planning activity is to identify and test management measures to be applied to each PU in order to achieved the declared specific objectives. As suggested by the NTC procedure, the range of measures to be potentially used in the plan are:

- Spatial measures
- Temporal measure
- Behavioural measures
- Measures oriented to Technical and Ecological improvements (T&E improv.)
- Knowledge Measures
- Monitoring, control and surveillance measures
- Multi-level governance
- Regulations and administration measures
- Economic and financial measures
- Entrepreneurial development and marketing (Ent. Dev. Mark.)
- Training and engagement of operators and the public

To define most of the measures it is necessary, once more, to have a detailed knowledge and to carry out specific analysis, like the ones conducted in the Emilia-Romagna Case Study by using the tools for MSP in the managed scenario.

The CEA and MUC analysis of the present conditions, indeed, highlighted specific criticalities that could be solved, mitigated, or managed though dedicated measures. As previously illustrated, such measures were modelled using the tools in a 'managed scenario mode', by analysing, in a quantitative way, their possible benefits or troubles. This was partially done during the 'Step 4' of the CS (with reference to the project report T2.3.1) and is illustrated in this report in chapters 4.3.4 and 4.3.5.

Finally, the managed scenario tested during PORTODIMARE does not introduce any radical variation in the use of the marine space in front of the coast of the Region, in line with the proposed vision that substantially repeats and defines a current vocation. However, the tested scenario rather suggests a series of important innovations and optimizations aimed at:

- Allowing the sustainable development of certain uses, i.e. promoting the Blue Growth, solving existing problems and fostering opportunities that are not currently exploited, as well as safeguarding the existing uses (e.g. aquaculture and MRE).
- Managing the conflicts and increasing the synergies among uses.
- Reducing the environmental impacts and increasing the level of protection of relevant habitats and species (e.g. new TZB near Rimini, use of OTB-BRD, gillnet mesh size).

Even if these measures could be implemented independently and reflect specific sectorial needs, they have been conceived and tested by considering the mutual connections and the explicit elements of synergy, consistently with a general planning and non-sectorial vision.

Examples of such kind of measures are listed in table 7.

Measures types	SEA USES						
	tourism	Aquaculture	fishery	Environment protection	traffic	military defence	Oil & gas
spatial measures		Detailed setting of new allocated zone for aquaculture (AZA)	Encourage the progressive movement of trawling out of 4 nautical miles	Encourage measures to reduce impacts on nursery areas and target species;		Limitations to other sea uses during military exercise	Encourage the offshore moving of extraction sites to reduce coastal subsidence
temporal measures			extending the biological lock for tools with high impact on the bottom		reduce speed of vessels in the periods of higher density of protected species (e.g. Tursiops, sea turtles).		
behavioural measures		Co-managed measures - to limit loss of tools and waste and reducing environmental impacts (e.g. use of biodegradable materials		Adoption of right practices for waste management from anthropogenic activities	good practices reducing potential impacts of recreational boating		
T&E improv. measures		Testing new biodegradable materials and highly sustainable and productive mussel farming techniques	use bycatch reduction tools (e.g. UV lamps, acoustic bollards) on fishing nets and mesh increase (72 mm)		New technology aimed at reducing underwater noise and emissions		
Knowledge measures		research of new species to be bred		Identify gaps and promote actions to improve ecological knowledge; identify pressures	R&D aimed at reducing the impact of ports on the surrounding environment (CO2)		Improve studies on decommissioning and re-use
Enterpren. Development Marketing	Develop multi-use tests (fishing / tourism) creating clusters of operators from different sectors						
training	for new professionals						

Table 7: Some example of measures

5.6 Methodology and indicators to monitor and adapt the Plan

The monitoring phase allows to evaluate the effectiveness of the plan in achieving the defined objectives through the application of dedicated measures.

This phase was not developed within the PORTODIMARE Case study, but it is important to schedule it in the plan.

The monitoring represents, indeed, the opportunity to further increase the knowledge needed to improve the Plan, by conducting the acquisition of new data and developing synergies with the monitoring plans related to other directives (e.g. MSFD, WFD, HBD).

The monitoring phase is based on a set of indicators, also linked to the Environmental Assessment Review process, which concern: environmental, socio-economic and efficiency of the governance aspects.

Furthermore, the MSP monitoring assumes:

- a series of repeated observations in the same site, over a long period of time;
- a quantification of the levels and types of uses/activities in the area and any changes occurred

The general steps can be identified as follows:

- Establishing a monitoring plan
- Analysis and evaluation of the monitoring data.
- Periodic reports on the evaluation of the plan addressed to the competent authorities, to the stakeholders and to civil community carriers.

All this activities can be better developed and managed if proper tools, such as the GAIR is, are available.

5.7 Activities for the consolidation, implementation and updating of the Plan

This stage of the plan (consolidation and updating of the plan) requires proper tools and methodology which are:

- Knowledge improvement, organization, and integration:
 - dedicated Geoportal
 - Integration of key gaps (data and knowledge)
- Deepening of analyses and definition of plan choices
 - using decisional support systems, tools for MSP (e.g. MUC and CEA)
 - comparative scenario evaluation
 - dedicated tools for assessments of the socio-economic effects of plan choices
- Detailing of analyses and definition of plan choices
 - spatial resolution improvement
 - detailing measures: from vocations to decisions on the use of space and resources
 - relationships between Plans and Climate Change (influence on plans and influence of CC Plans), emerging sectors and technologies (e.g. renewable energy from the sea, biotechnology, offshore aquaculture, green maritime transport)
- Coherence with other planning processes
 - addressing local plans (municipality plans, protected areas)
 - linking and harmonization with other rules and plans (e.g., MSFD, WFD, Flood Directive, Common Fisheries Policy)
- Multi-level governance
 - development and maintenance over time of consultation processes with the 'stakeholders'
 - checking evolution of the situation of maritime areas and areas in jurisdiction
 - refining multi-level governance mechanisms
 - financing the plan
- Adaptation of the plan
 - based on the level of achievement of the objectives set and the real effectiveness of the proposed/implemented measures
 - make transparent the link between management objectives and actions identifying missing data and knowledge, and thus bringing out the new knowledge needed to guide research and data collection action
 - feedback from stakeholders should be collected.

These activities must be implemented progressively, during and after the approval process of the Plans.

6 FINAL CONSIDERATIONS

The Maritime Spatial Planning exercise carried out in the Case Study area of the Emilia-Romagna Region (AT2.3), offers a practical guide that can be capitalized in other areas of the Adriatic-Ionian Region (AIR).

The main technical steps illustrated in this report are based on the application of the GAIR, as a source of the most relevant information for MSP in the Adriatic-Ionian sea basin, and on the testing of the integrated tools for MSP: CEA, MUC, PARTRAC and AZA. To this end, it is important to underline that almost the entire domain of the Case Study is covered by the most relevant dataset for MSP at an adequate scale. Nevertheless, in order to carry out detailed analysis at regional or County level, more detailed information is requested.

Moreover, the MUC and CEA simulations are already available within the GAIR at the scale of Adriatic Sea, offering a resolution grid of 1000x1000 m. And once more, for a more accurate analysis, as the ones performed within AT2.3, higher resolution datasets are required.

Nevertheless, already available data allow to create maps on the base of which it is possible to conduct some preliminary analysis (initial assessment) of sea-uses, which are the fundamental step for the definition of the planning Vision and of the related 'specific objectives'. Such components of the plan, however, need to be matched with a coordinated and constant dialogue with the government level and with stakeholders. The creation of interdisciplinary working groups, as the one established in Emilia-Romagna, may be a useful suggestion to this purpose.

Finally, the needed negotiations between governance levels and between different sectors can only be based on a solid and undoubted knowledge basis, which allows to address reliable analyses on more and more accurate planning scenarios.

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