



Strategic Research and Innovation Agenda (SRIA)

Version reviewed in 2020, in connection with the Implementation Plan
and the Euro-Mediterranean context development



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Authors & Institutes Acronyms		Erasmia Kastanidi, Popi Pagou, Nikos Papandroulakis, HCMR Andrea Barbanti, Margherita Cappelletto, Elena Ciappi, Fabio Trincardi, CNR José de Lara Rey, Cluster Marítimo Guy Herrouin, PMM Abraham Trujillo Quintela, AEI	
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INTRODUCTION

The **BlueMed** Initiative offers a shared strategic framework for working towards a healthy, productive and resilient Mediterranean Sea that is better known and valued. It is designed to tap the full potential of the marine and maritime sectors, structuring transnational cooperation to create new 'blue' jobs and to improve social wellbeing, sustainable prosperity and the environmental status of the region and its surroundings.

Acknowledging the importance of a shared vision of the Mediterranean Sea as a common resource, to promote security, safety and prosperity of present and future generations, Mediterranean countries are willing to coordinate and integrate efforts to implement the BlueMed Initiative.

To ensure flourishing of the blue economy and to dignify the Mediterranean environment and its inhabitants conflicting uses of the sea resources need to be overcome, taking full account of extant anthropogenic impacts occurring over the last decades in total unawareness of the complexity and fragility of this ecosystem.

Joint efforts of Mediterranean countries, with the support of the European Commission, have been carried out since 2014 and resulted in the launch of the BlueMed Strategic Research and Innovation Agenda (SRIA), calling for aligned research and innovation strategies, programmes and activities.

Synergies and complementarities among all involved stakeholders will maximise existing and future opportunities and the use of the most appropriate instruments, thus structuring cooperation for advancing the Strategic Research and Innovation Agenda for Blue Growth in the Euro-Mediterranean Region. The BlueMed Initiative supports and facilitates cooperation and coordination among all the Mediterranean countries, in order to promote the alignment of programmes and pooling of resources and investments to address the challenges identified in the BlueMed SRIA. Coordination with two relevant initiatives targeting the Mediterranean Basin at sub-regional level, namely WESTMED – Towards a Sustainable Blue Economy Initiative for the Western Mediterranean, and EUSAIR – European Strategy for Adriatic-Ionian Region, will enhance the efficiency of the actions, as well as investments in marine and maritime research, innovation and technology and also reduce fragmentation and duplication of efforts. At the same time, connection with the Regional Smart Specialization Strategies will enhance the Blue Growth perspective in the coastal/maritime and insular regions/countries.

The **BlueMed Strategic Research and Innovation Agenda (SRIA)** is a living document designing a shared pattern to foster blue growth in the Mediterranean area. It targets multiple stakeholders and end-users, involving all relevant players in the consolidation process, national ministries, regional authorities, research organizations, research infrastructures, academia, the private sector, non-governmental and international organizations and the public, thus engaging the quadruple helix.

The BlueMed SRIA addresses the crucial aspect of multilevel governance, bottom-up and horizontal (interregional and transnational), which must be taken into account when implementing its goals. The related Implementation Plan¹ allows for different types of actions to be undertaken according to a sub-set of priorities at different levels, with respect to geographical coverage, critical mass, joint funding, coordination of national/regional efforts or the use of EU instruments.

¹ www.blueded-initiative.eu/wp-content/uploads/2020/07/blueded-preliminary-implementation-plan_version-complete.pdf

WHY BLUEMED

28 % of endemic species, 7.5% of the world's marine fauna and 18% of the world's marine flora are in the Mediterranean which is representing only the 0.7% of the global ocean surface

30 % of global sea-borne trade by volume

450 ports and terminals

A quarter of worldwide sea-borne oil traffic

World's **second-largest** market for cruise ships

A coastal population of **150 million** that more than doubles during the tourist season

400 UNESCO sites

236 Marine Protected Areas

Unique culture as regard food and environmental healthy life stile

Among all seas surrounding Europe, the Mediterranean is unique when it comes to biodiversity and the links between human activities and the environment and is changing fast, in response to both natural and anthropogenic pressures. Climate change, growing maritime traffic and pollution, mass tourism, overexploitation of fish stocks and invasions of alien species are among the stressors placing the region at risk. At the same time, the Mediterranean's unique features provide major local opportunities for blue growth and jobs, ranging from fisheries to sustainable tourism.

The region's geopolitical complexity may represent a constraint on implementing framework conditions favourable to blue economic growth. Joint efforts are required to successfully address present and future challenges. A global perspective, along with more vigorous transnational and international cooperation, is essential to implement effectively and efficiently tailored actions that are conducive to safe, secure and sustainable development for all, by taking into account national priorities.

THE PROCESS

The BlueMed Initiative was set up in May 2014 in the framework of the European Strategy on Blue Growth. Technically, the process started with the endorsement of the BlueMed Vision Document² at the EU Competitiveness Council in December 2014. The work carried out by nine European countries (Cyprus, Croatia, France, Greece, Italy, Malta, Portugal, Slovenia and Spain) with the support of the European Commission, led in October 2015 to the signature of the Venice declaration on Mediterranean Sea Cooperation - Launching a Strategic Research Marine and Maritime Research and Innovation Agenda for Blue Growth, the BlueMed SRIA first version³. The Union for Mediterranean Declaration on the Blue Economy, inviting non-EU countries to join the BlueMed Initiative, was adopted in November 2015.

The BlueMed Coordination and Support Action was a project funded by the EC to support the BlueMed Initiative, which started in October 2016. As an operative tool, the project set up the BlueMed platforms on “Knowledge”, “Economy”, “Technology”, and “Policy”, which were four transversal thematic fora where country representatives, the National Pivots, met and interact. Established to ensure broad consultation and constant dialogue at Mediterranean and national level, the platforms enhanced virtuous relationships among different stakeholders in order to consolidate the SRIA towards the selection of key priorities and the definition of the Implementation Plan.

In April 2017, the BlueMed high-level conference “A Basin of Research and Innovation for sustainable growth” held in Malta marked a key milestone towards the endorsement, by the Union for the Mediterranean (UfM) and EU Member States, of the Valletta Declaration⁴ on strengthening Euro-Mediterranean cooperation through Research and Innovation in May 2017.

Since February 2018, the Group of Senior Officials BlueMed Working Group composed by delegates officially appointed by EU and non-EU countries is the BlueMed Initiative steering body.

Following the update of the SRIA⁵ in December 2018, the agreement on key priority actions and the final publication of the Implementation Plan in January 2020, the BlueMed CSA releases this document as a final and refined version.

² www.bluedmed-initiative.eu/wp-content/uploads/2017/10/BLUEMED_Vision.pdf

³ www.bluedmed-initiative.eu/wp-content/uploads/2016/12/Bluedmed-SRIA_A4.pdf

⁴ www.bluedmed-initiative.eu/wp-content/uploads/2017/05/Declaration_EuroMed-Cooperation-in-RI_1772.pdf

⁵ www.bluedmed-initiative.eu/wp-content/uploads/2018/12/BlueMed-SRIA_Update_2018.pdf

VISION

The geopolitical complexity of the Mediterranean area, whose countries from three different continents strongly depend on blue activities, challenges the sustainability of the marine environment. Multiple stakeholders with diverse and often contrasting interests compete for the use of the same resource and space.

To ensure a sustainable future, it is crucial to:

- reduce fragmentation and facilitate cooperation between people;
- engage EU and non-EU countries for a global Mediterranean Basin;
- foster innovative multidisciplinary research and innovation activities addressing the relevant Mediterranean challenges;
- coordinate planning and programming of relevant research and innovation activities;
- connect research investments and public policies at regional, national, European and Mediterranean level;
- provide knowledge-based support for the implementation of relevant policies;
- develop innovative marine-based technologies, methodologies and approaches with a view to boosting the sustainable economic growth of the European maritime sectors and the conservation and upgrading of the marine environment, resources and cultural heritage;
- advocate public understanding of the value of the blue economy;
- create an interoperable, fully integrated observing and forecasting system based on open data structures;
- train a new generation of scientists, professionals, technicians and entrepreneurs thus creating new and qualified 'sea-based' jobs.

HOW

1. Identify needs of marine and maritime communities and align relevant programmes;
2. Increase the accessibility to information, opportunities, funding and facilities;
3. Develop joint actions by aligning, planning and programming research and innovation activities at multiple level;
4. Engage different stakeholders;
5. Fine-tune data, knowledge, capacities and projects;
6. Maximise leverage effects of research investments and their influence on public policy;
7. Raise awareness on the impacts to the Mediterranean that have been caused by a not-sustainable economic growth on land and at sea.

KEY CHALLENGES

BlueMed identifies a set of challenges under three pillars, (i) 'key enabling knowledge', (ii) 'key sectoral enablers', and (iii) 'enabling technology and capacity creation' characterized by tight horizontal synergies deemed necessary for sketching economy-driven trajectories. It also highlights cross-cutting themes.

Cross-cutting enablers for Blue Jobs and Blue Growth

Key enabling knowledge for the Mediterranean >> Knowledge enablers

- A. Mediterranean Sea ecosystems: characterize present dynamics, services, resources, vulnerability and resilience to natural and anthropogenic pressures
- B. Mediterranean Sea: forecast changes of the basin under climate and anthropogenic pressures and develop services in the field of sustainable adaptation to climate change and plans for mitigation
- C. Hazards and protection of coastal areas and open sea in the Mediterranean
- D. Innovative blue growth trajectories: biotechnologies, food, and the deep sea and offshore resources

Key sectoral enablers in the Mediterranean >> Economy enablers

- A. Innovative businesses based on marine bio-resources in the Mediterranean
- B. Ecosystem-based management of Mediterranean aquaculture and fisheries
- C. Sustainable tourism and cultural heritage in the Mediterranean
- D. Maritime clusters in the Mediterranean
- E. Governance of maritime space and marine resources in the Mediterranean

Enabling technology and capacity creation for the Mediterranean >> Technology enablers

- A. Smart, greener and safer maritime transport and facilities in the Mediterranean
 - B. Observing systems and operational oceanography capacities in the Mediterranean
 - C. Innovative offshore industrial platforms including marine renewable energy and co-use
 - D. Marine and coastal natural and cultural heritage in the Mediterranean: discovering, protecting and valuing
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KNOWLEDGE ENABLERS

CHALLENGE A. Mediterranean Sea ecosystems: characterize present dynamics, services, resources, vulnerability and resilience to natural and anthropogenic pressures	
GOAL	ACTION
A1. Understanding the functioning of the Mediterranean Sea ecosystem	A1.1 Develop theoretical and operational tools for data analytics towards an end-to-end conceptual and numerical model
	A1.2 Identify the origins of invasive or alien species (including microbes) and the routes of invasions, the environmental conditions conducive to invasions and their main effects and impacts on local habitats, species and ecosystems and study natural connectivity patterns from basin open boundaries and commercial maritime routes
	A1.3 Assess inputs from atmosphere-land-sea nexus and the effects of natural events and historical and on-going anthropogenic pressures leading to change in marine and coastal ecosystems
	A1.4 Fill gaps in understanding the Mediterranean Sea dynamics, biogeographic patterns, biodiversity (including cryptic and microbial), and ecosystem functions (including fishing resources) using novel monitoring, e.g. satellite, marine drones, molecular/genetic tools to develop new end-to-end models forecasting the carrying capacity of the Mediterranean ecosystems
	A1.5 Identify the services supported and the management scales (e.g. regional inter-boundary) towards sustainable exploitation of resources
	A1.6 Describe the deep sea “landscape”, mapping the topography of seabed, characterizing the geomorphology and substrate types, identifying geo-habitats and sensitive habitats, with an open access inventory of their baseline biodiversity, as well as essential fish habitats and anthropogenic alterations for sustainable exploitation and preservation of deep sea resources
A2. Understanding Pollution Impacts, Mitigation, and Remediation in the Mediterranean Sea	A2.1 Develop coastal and marine potential hazard/pollution sources maps (exploiting Earth Observations and linking to pollutant dispersion models) for identification of hot spots and areas that are particularly exposed to the impact of multiple stressors and propose possible solutions
	A2.2 Implement coordination/cooperation schemes and comparable risk assessment procedures (integrating biological and chemical techniques) of the effects of multiple anthropogenic pressures at different depths, including deep-sea areas

CHALLENGE A. Mediterranean Sea ecosystems: characterize present dynamics, services, resources, vulnerability and resilience to natural and anthropogenic pressures

A2.3 Conduct in situ measurements and develop modelling (including Big-Data modelling) tools to understand the distribution, intensity and sources of underwater noise, as well as its effect on marine species

A2.4 Measure and identify emerging chemical compounds (e.g. pharmaceuticals, synthetic drugs) from terrestrial sources, determining contaminant dispersal in all marine matrices; characterize sources, pathways and effects on marine ecosystems; develop early warning tools

A2.5 Define distribution, concentration and provenance (when possible) of all forms of garbage at sea (including plastic and microplastic debris) at the sea surface, within the water column, the sea floor and the coastal-estuarine environments; rise awareness through literacy and citizen science initiatives

A2.6 Explore and propose solutions to reduce the input of pollutants from atmosphere, land and sea:

- Obtain marine eco-toxicological data for contaminants in marine waters and sediments, at different levels of biological organization; Develop environmental criteria (baseline and thresholds) for alert/intervention and early warning tools (e.g. using novel biomarkers)
- Develop and test (bio)remediation measures in diverse areas, considering re-use and recycling of hazardous materials to promote sustainable redevelopment of aquatic contaminated sites
- Develop new generation techniques for identification of molecules; in situ sensors (and biosensors) for a large-scale view of their distribution; mechanisms of transfer and bio-magnification and modelling of the food web
- Identify sources of chemical pollution from sunken shipwrecks and containers thrown at sea, inventory of critical hazards and risk assessment of leak impacts in space and time; identify possible genetic pollution from aquaculture animals to natural populations and effects to the ecosystem
- Improve wastewater treatment processes and recycling to prevent the impact of pollution in coastal areas

CHALLENGE B. Mediterranean Sea: forecast changes of the basin under climate and anthropogenic pressures and develop services in the field of sustainable adaptation to climate change and plans for mitigation

GOAL	ACTION
B1. Forecasting the Mediterranean Sea dynamics and climate	B1.1 Sustain and improve ocean observing systems for physical, biogeochemical, and ecosystem parameters by expanding their scope and establishing quality assurance in order to improve modelling and forecasting of system dynamics, and estimates of trends and indicators
	B1.2 Provide numerical modelling, forecasting, indicators to identify diverse trends as well as abrupt shifts in the Mediterranean environmental conditions supported by long-term monitoring, considering land-sea-air interaction processes, with a focus on coastal dynamics
	B1.3 Improve understanding of the hydrodynamics interaction between the Mediterranean Sea and the Atlantic Ocean.
	B1.4 Implement downscaling models of climate change for the Mediterranean Sea and its sub-basins; assess impacts on marine ecosystems and their resources, from regional to local scales
B2. Preparing to climate change and define adaptation/mitigation measures	B2.1 Make a comprehensive assessment of climate and anthropogenic related risks and opportunities in the Mediterranean Sea ecosystems and human environments from the coastal zone to the deep ocean, including extreme climate events, acidification, sea level rise, flooding and invasive species.
	B2.2 Develop, enhance and deliver user-friendly tools for disseminating climate information related to Mediterranean atmosphere, coastal and deep ocean areas.
	B2.3 Climate Change and Blue Growth: Develop climate adaptation and mitigation strategies.
	B2.4 Explore links and positive feedbacks between increased flooding and desertification vulnerabilities with escalating coastal subsidence, salt wedge penetration and increasing fresh water consumption.
	B2.5 Launch a pan-Mediterranean program on coastal fresh water reserves: quantification of reservoirs, state of the water (quality, contaminants, depth beneath surface), level of exploitation and frames for sustainable use of this good. Promote innovative desalinization practices in areas with lack of fresh water minimizing negative impacts on shallow marine ecosystems.

CHALLENGE C. Hazards and protection of coastal areas and open sea in the Mediterranean

GOAL	ACTION
C1. Reducing the coastal risk of disasters and their effects	C1.1 Define geological features located nearshore and offshore (slides, volcanoes, fault, diapirs, mud volcanoes, fluid escape features, sand boils and seismicity) potentially generating geo-hazards that cause risk to coastal and offshore infrastructures and population
	C1.2 Improve assessment and knowledge sharing on the recurrence of marine geo-hazards, from paleo records (inferred paleo seismicity, recurrence of sediment failure, historical volcanic activity), through deep coring/drilling accompanied by mechanical characterization of submarine terrains (sediments or rocks)
	C1.3 Implement high-resolution swath bathymetry mapping and geophysical surveys to reveal detailed morphology of the seafloor, locate active geological features and study the morphological land and sea floor changes to build predictive models
	C1.4 Fill gaps in understanding coastal morphodynamics at regional and local level including a focus on coastal erosion and on anthropogenically induced erosion processes (e.g. erosion due to maritime transport in near-shore areas next to ports, especially those close to natural protected areas; rockfall of coastal cliffs...)
	C1.5 Develop operational observing platforms, early warning systems and decision matrices to address natural marine disasters such as tsunami events, coastal slides, storms, while assessing and controlling progressive coastal and geological processes such as erosion, habitat destruction, landslides
	C1.6 Study coastal urbanization trends and related pressures to improve protection of coastline ecosystems
	C1.7 Identify risks introduced by anthropogenic features such as ports, oil terminals, offshore platforms, aquaculture plants and map the relevant information defining and assessing possible mitigation scenarios
C2. Protecting Maritime Cultural Heritage	C2.1 Exploit large-scale seabed mapping databases to locate shipwrecks, as well as drowned building remains, pavements (e.g. roman centuriation) or infrastructures, and target areas for high-resolution seabed mapping
	C2.2 Explore and protect underwater natural and cultural heritage through multidisciplinary approaches, combining efforts from national programmes for stocktaking

CHALLENGE D. Innovative blue growth trajectories: biotechnologies, food, and the deep sea resources

GOAL	ACTION
D1. Exploring the potential of blue-biotech	D1.1 Infer and analyse metabolic pathways of marine organisms with biotech and bioremediation potential
	D1.2 Explore the potential of genetically modified organisms, within constraints imposed by precautionary principles, to produce metabolites useful for nutraceuticals, biofuel and pharmacology as well as bioremediation
	D1.3 Develop individual base, mechanistic models of simulating the biology of model species; carry on -omics and -metaomics analyses with a bioprospecting purpose
	D1.4 Analyse and enhance defence strategies against pathogens and parasites of organisms in coastal-transitional waters and marine environments
	D1.5 Find solutions for culturing marine extremophiles with biotech potential
	D1.6 Develop tools for characterization of unknown genes of marine organisms
	D1.7 Characterize signalling and interactions among marine organisms to be considered in the set-up of artificial systems
	D1.8 Exploring the potential of blue-biotech for paints and antifouling products.
D2. Support solutions for sustainable food production	D2.1 Identify marine biota as a new source of protein for human consumption
	D2.2 Characterize ecological niches of target species to improve their preservation and to reduce the frequency of extinctions
	D2.3 Increase knowledge on biological and ecological aspects of habitat-forming species.
	D2.4 Develop Mediterranean aquaculture: new management tools, ecosystem-based approach, tackling pathogens; develop conceptual models for Integrated Multi Trophic aquaculture (IMTA)
D3. Exploiting the Deep Sea	D3.1 Improve knowledge base (including technology development) for sustainable exploitation of shelf to deep-sea biotic and abiotic resources, including sand borrowing sites, mining for minerals and ore deposits and identifying molecules of potential industrial interest

ECONOMY ENABLERS

CHALLENGE A. Innovative businesses based on marine bio-resources in the Mediterranean	
GOAL	ACTION
A1. Developing new methodologies and tools	A1.1 Evaluate the means necessary to promote engineering and new business models based on new robust micro-algae species and other microbial communities and strains for biorefinery schemes, including aquaculture feeding and for greening the chemical and agroindustry
	A1.2 Develop biotechnological chains on an industrial scale to boost biotechnological applications and patent deposits such as health, cosmetics and food sector
	A1.3 Analyse and assess the exploitation potential of newly discovered invertebrates for human consumption, biomedicine or ecosystem engineering considering the economic viability and technological sustainability
	A1.4 Optimize cultivation and metabolic/production using omics techniques of known and new marine microbial species as well as their industrial up-scale, complying with relevant regulations
	A1.5 Develop standardize methodologies to quantify the socio-economic value of natural bio-assets
A2. Generating new products and services	A2.1 Identify and assess potentials of marine resources for new products and services
	A2.2 Evaluate the potential reuse of marine litter
	A2.3 Develop methods and tools to sustainably exploit and extract submarine bio-resources
	A2.4 Develop biomaterials to replace non-environmentally friendly materials
	A2.5 Promote new market opportunities for Mediterranean-labelled products from marine bio-resources
	A2.6 Promote aggregation of companies and investors from key sectors to increase Mediterranean competitiveness on a global scale

CHALLENGE B. Ecosystem-based management of Mediterranean aquaculture and fisheries

GOAL	ACTION
B1. Develop optimal fishing strategies, technologies and practices	B1.1 Introduce new/adapt fishing gear and detection technologies to reduce discards and by-catch, fuel consumption, and direct impact on seabed
	B1.2 Develop best methods to integrate the use of by-products and by-catch from fisheries and aquaculture in the production chain
	B1.3 Develop innovative methods and tools for monitoring and governing Mediterranean aquaculture and fisheries, in line with existing policies
	B1.4 Develop innovative and efficient maritime monitoring, control and surveillance systems for fisheries.
	B1.5 : Ensure better valorisation of fisheries products through, inter alia, the promotion of research and development in matter of innovative post-harvest conservation and preservation systems
B2. Develop optimal aquaculture strategies, technologies and practices	B2.1 Develop innovative solutions adapted to confront economic and ecological exploitation constraints for offshore aquaculture.
	B2.2 Define methods to reduce fishmeal/fishoil use in the aquaculture industry
	B2.3 Develop and implement effective processes using existing and innovative technologies to improve husbandry, biosecurity, control escapes, towards economic sustainability
	B2.4 Develop aquaculture practices adapted to multipurpose maritime facilities
	B2.5 Foster studies to support non-carnivorous species aquaculture, reducing the demand for fishmeal.
	B2.6 Study and evaluate the best processes to adapt and diversify aquaculture activities (species and systems) and capacities in a changing environment, including for small and medium-scale farms
	B2.7 Determination of food safety hazards of harvested fish and bivalves at Mediterranean level
	B2.8 Improve health and welfare in marine aquaculture

CHALLENGE C. Sustainable tourism and cultural heritage in the Mediterranean

GOAL	ACTION
C1. Linking tourism, tourists and environment	C1.0 Monitoring marine communities' shift (as related with external environmental variables) threatening tourism
	C1.1 Promote synergies between tourism and other productive activities (e.g. fishing tourism, marine mammals watching, aquaculture and tourism), encouraging networking with other economic sectors (agriculture, crafts, culture, fishing, etc.) and between destinations in order to enlarge the tourism offers
	C1.2 Design solutions to increase sustainability, adaptability and resilience of coastal infrastructures fostering tourism industry
	C1.3 Develop new quality tourist products fostered by Marine Protected Areas and green transportation (biking, hiking, bird watching, canoeing)
	C1.4 Establish tools to promote an integrated approach to distribute tourist flows to coastal areas and inland
	C1.5 Develop economic strategies to use tourism as a vehicle to educate people through a "Lifelong learning" approach, implementing new interactive tools and multi-devices based on modern technologies
	C1.6 Expand opportunities offered by a sustainable cruise tourism to favour up market and targets, high quality and tailor made services and to strengthen the relationship with cruise companies and intermediaries
	C1.7 Develop monitoring and evaluation systems of tourism (economic, social and environmental), assessing carrying capacities of destinations, in support of an efficient management of tourism flows and impacts leading to an effective governance of tourism development
	C1.8 Implement evaluation measures and methods to address the development of a greener and sustainable tourism industry

CHALLENGE C. Sustainable tourism and cultural heritage in the Mediterranean

	C1.9 Develop methodologies, tools and systems for assessing environmental impacts of tourism and its drivers in the Mediterranean area
C2. Increase the economic impact of the Mediterranean natural and cultural heritage	C2.1 Create a sustainable and integrated range of tourist services, sustainably exploiting the Mediterranean's cultural heritage
	C2.2 Take advantage of retrieved data and information to create a Virtual Museum of Mediterranean Submarine Archaeology
	C2.3 Valorise traditions and customs for tourism purposes
	C2.4 Launch "tourists through history" initiatives with the use of ancient and modern digitised maps documenting coastal evolution due to human activities and climate change
	C2.5 Promote the digitalization of tourism practices and innovative products (e.g. smart moorings, serious games, augmented reality, scripting on smartphone, underwater trails...) to develop citizen science services and participative and "savoir-faire" tourism

CHALLENGE D. Maritime clusters in the Mediterranean

GOAL	ACTION
D1. From traditional maritime economic to blue growth activities	D1.1 Establish strategies to encourage and facilitate cluster development in the Mediterranean, particularly addressing innovative green technologies, through cooperation between local small and medium enterprises, large companies, scientific institutes and innovative players, integrating them (from an economic and productive point of view) within the broader supply chain
	D1.2 Promote public-private partnerships to overcome the obstacles against the flourishing of new activities. for example in emerging markets, such as, offshore wind, mineral resources in the high seas, biotechnologies, coastal ecological engineering, satellite data services among others through the federation of actors in research and industry, increasing visibility, and international representation

CHALLENGE D. Maritime clusters in the Mediterranean

	D1.3 Develop economic studies to identify the specialization of different areas and regional clusters and highlight more productive and sustainable activities
	D1.4 Establish innovative methodologies to assess the impacts of different programmes and actions on the evolution of maritime sectors and economy
	D1.5 Encourage existing structured maritime clusters to prioritize activities, generating blue growth outputs
D2. Mediterranean Blue start-ups	D2.1 Favour incubators and connect start-ups, investors, accelerators, entrepreneurs, corporate networks, universities for increasing innovative blue ecosystems

CHALLENGE E. Governance of maritime space and marine resources in the Mediterranean

GOAL	ACTION
E1. Strengthen synergies among science, industry, policy-makers and society	E1.1 Develop participatory approaches to take decisions by improving the dialogue with civil society, considering its importance (e.g. awareness, inputs, transparency, participation, consensus and support) and its specific technicalities (e.g. engagement at local level, language, ambassadors)
	E1.2 Support Maritime Spatial Planning and Integrated Coastal Zone Management through research on multi-level governance and management of multi-stakeholder processes, improving the dialogue with civil society
	E1.3 Take full consideration of long-lasting effects of historical human interventions on coastal systems including river diversions, digging of canals, construction of hard structures for coastal defence, landfills with toxic materials and spread pollution through time (now buried in sediment column)
	E1.4 Provide scenarios of environmental change, investigating the impacts on biodiversity and ecosystems goods and services, of alternative socioeconomic development pathways, policy options and blue growth scenarios
E2. Effective maritime spatial planning	E2.1 Improve the knowledge on the land-sea nexus to properly address planning, considering co-existence

CHALLENGE E. Governance of maritime space and marine resources in the Mediterranean

in the Mediterranean.

of coast and sea uses and environmental objectives; particular emphasis should be placed on substantially improving the connection between marine traffic with port location/activities and the main supply chains on land (train and free-way networks as well as water ways, where appropriate)

E2.2 Develop coastal ecological engineering solutions and measures taking into account also pressures derived from economical drivers on land.

E2.3 Define and study approaches and tools to identify the trade-offs between ecological dynamics and socio-economic needs, taking into account marine ecosystems goods and services and their environmental, economic and social value, in order to inform and improve adaptive planning and management scenarios

E2.4 Use integrated decision tools to select appropriate sites for offshore installations, to ensure that they meet energy and environmental requirements

E2.5 Address transboundary maritime spatial planning issues to understand problems and opportunities (social, economic, environmental) and strengthen knowledge on environmental pressures across borders

E2.6 Develop tools/software to assess the cumulative impacts of human activities, including the role of land-based stressors, to ensure an eco-sustainable exploitation of marine resources, considering social and economic aspects.

E2.7 Promote innovative technologies and services for a sustainable management and resulting protection of coastal areas from coastal erosion, flooding and pollution.

E2.8 Implement managing solutions and conservation plans, including networks of Marine Protected Areas and their surroundings, for coastal to deep-sea ecosystems, taking into account their relationship with natural and anthropogenic changes (such as artificial reefs) in the environment while ensuring and promoting ecosystem services; best practices on adaptation and resilience

E2.9 Develop best practices for deep-sea adaptive management based on open data from diverse stakeholders and a common/shared and long-term vision

CHALLENGE E. Governance of maritime space and marine resources in the Mediterranean

E3. Promote the role of Marine Renewable Energies (MRE) in the energy transition phase.

E3.1 Develop tools to evaluate and select optimal zones for the implementation of MREs farms with a multi-criteria approach (e.g. wind/solar/currents/energy potential, characteristics of seabed, interaction with other marine activities, environmental impacts, ...) also evaluating the possible re-use of some of the oil and gas platforms that are being decommissioned.

E3.2 Develop MRE sub-systems for energy transition and identify guidelines for their sustainable operation involving both submarine (benthic) and sub-aerial environmental/ecological impacts.

E3.3 Develop large demonstration projects to sustain commercial MREs development, including Floating Offshore Wind Turbine which is particularly relevant in the Mediterranean.

TECHNOLOGY ENABLERS

CHALLENGE A. Smart, greener and safer maritime transport and facilities in the Mediterranean	
GOAL	ACTION
A1. Greening vessels, facilities and services	A1.1 Implement multidisciplinary integrated methodologies to evaluate the impact of ships and harbours on the environment at transnational level, in the light of the specific characteristics of the Mediterranean basin
	A1.2 Develop new vessel concepts, i.e. flexible, modular and high efficient ships, using new materials (e.g. high strength, lightweight, smart and others) and advanced design and production techniques, with lower manufacturing, construction, installation, dismantling and recycling costs from the perspective of the circular economy
	A1.3 Low emission alternative fuels: support the design of LNG-fuelled ships and appropriate inland, coastal and offshore infrastructures, and the research on biofuels and hydrogen
	A1.4 Exploit new technologies and tools to monitor pollution from ships on route coast and in harbours.
	A1.5 Towards shipping electrification: support research on cold ironing from renewable resources, batteries and fuel cells and internal combustion engines in particular for fishing boats
	A1.6 Design and develop innovative green infrastructure solutions and tailored software to improve the sustainability of logistics and ports, with special reference to energy efficiency and externalities related to the surrounding built environment
	A1.7 Develop innovative design and management solutions for eco-friendly vessels, e.g. antifouling, greener propulsion for transport, leisure and fishing boats, fuel saving and noise reduction materials for vessel-water interface
	A1.8. Zero emission fuels: support the design and implementation of module-based hydrogen fuel cells and internal combustion engines for propulsion and power generation of ferries and other types of ships and vessels and appropriate infrastructures for producing the hydrogen from wind renewable energy doing a paradigm shift towards entirely emissions-free maritime transport
A2. Safer maritime transport	A2.1 Develop a new generation of Decision Support System tools and low-cost expendable instruments for

CHALLENGE A. Smart, greener and safer maritime transport and facilities in the Mediterranean

	emergency response to marine pollution and oil-spills from accidents, including analysis of the state of damaged platforms, carriers, and shipwrecks and managing on-board emergency situations
	A2.2 Develop ship detection and classification tools to interpret satellite images (relying on European Maritime Safety Agency as data provider)
	A2.3 Develop innovative technologies for safer vessels, with real-time structural monitoring, the ability to navigate in sub-optimal conditions (safe return to port) and the ships' continued capacity to sail. Operate in extreme environmental situations (resilient ships) and sensitive areas, which may involve using the European Global Navigation Satellite System
	A2.4 Boost technology to speed up corpse identification and recovery in case of disasters at sea
	A2.5 Develop innovative ship inspection technologies, such as drone and augmented reality also to reduce illegal practices (fraud fishing, discharge at sea of containers with toxic content along navigation routes)
A3. Connected and automated transport	A3.1 Towards autonomous ships and digital shipping (i.e. from sensors and Internet of Things, to big data analytics)
	A3.2 Towards efficient Motorways of the Sea (MoS) and their connections among Ports: develop feasibility studies, identifying main obstacles, and innovative methodologies/tools for the efficient functioning of the existing MoS and the establishment of new ones
	A3.3 Develop the concepts of industry 4.0 on ports and innovate the current global supply chains, using the new concepts of "Physical Internet", "Smart Ports" and "Mobile Harbours", in a green environment that uses tailor made sensors (AUV, USV, gliders with novel sensors, etc.) to help monitor the emissions

CHALLENGE B. Observing systems and operational oceanography capacities in the Mediterranean

GOAL	ACTION
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CHALLENGE B. Observing systems and operational oceanography capacities in the Mediterranean

B1. Towards an observing system of systems	B1.1 Develop technologies towards an integrated Mediterranean observing system, capitalizing on existing networks and consortia, including European Strategy Forum on Research Infrastructures, and national/regional/local infrastructures, in line with the overall European contribution to global observing systems, such as in the Common Information Sharing Environment (CISE) approach
	B1.2 Support long term and long-time series observing systems for climate change impact evaluation
	B1.3 Implement ICT, Big Data Analysis and Cloud Services Platforms to take advantage of multi-sectoral data management and sharing opportunities for the Mediterranean
	B1.4 Standardize and expand coastline monitoring systems across the Mediterranean region to maintain updated data and information on erosion phenomena and coastal risks (e.g. monitor coastal dunes, wetlands, coastal forest and underwater meadows, coral and coralligenous colonies)
	B1.5 Develop appropriate systems to foster Citizen Science initiatives and protocols to complement environmental and ecosystem monitoring
	B1.6 Widen the use of ship of opportunity to improve environmental monitoring (sea state, wave height, traffic, visible pollution such as garbage patches, and early detection of disasters such as oil spills)
B2. Tailor-made sensors and platforms	B2.1 Develop Autonomous Unmanned Vehicles and related infrastructure to extend actions on deep sea environments - for different types of operations minimizing the presence or cost of support vessels and ensuring minimal environmental impact
	B2.2 Develop submarine networks using sensors fibre optic arrays also for deep sea observatories, to monitor geohazards (gas seepage or venting, slope instability, submarine volcanoes, earthquakes) measuring ground acceleration, gas emissions, earthquakes in all water depths including the deep sea
	B2.3 Use state-of-the-art knowledge and infrastructure/sensors (AUV, USV, UAS, gliders with novel sensors, etc.) to improve monitoring of, particles flux, energy and mass transfer rates and processes
	B2.4 Develop new products relevant for monitoring the global change of the Mediterranean Sea: horizontal and vertical hydrodynamic circulation, T increase, pH reduction, changing biogeochemical cycles, trophic levels and abrupt regime shifts in marine communities

CHALLENGE B. Observing systems and operational oceanography capacities in the Mediterranean

	B2.5 Support R&D on eco-acoustics to assess the overall health of the ecosystem
B3. Security and safety services and technologies in the Mediterranean supporting the Blue Growth	B3.1 Integrate the Information Communication Technologies-ICT (Big Data, IOT-connected objects, Deep Learning, etc.) in the development of observing systems to deliver high-tech products and services for traditional and emerging sectors such as fisheries, aquaculture, MRE, etc.
	B3.2 Develop new cybersecurity-based solutions for securing data and communications in complex and critical maritime systems such as ports and vessels (positioning systems, communication systems, access control systems, ...)
	B3.3 Design and implement new on-board systems for security of passengers and crew, based on the integration of multi-sensorial surveillance and monitoring technologies (biometry, computer vision systems, radar,...) supervised by ICT architectures
	B3.4 Develop integrated solutions based on autonomous and unmanned (marine and air) drones/robots for surveillance around the vessel and in port areas, enhanced by advanced (surface and underwater) target detection and tracking systems
	B3.5 Develop advanced Alert Management Systems able to provide a continuously updated situational awareness about the safety and security conditions of a vessel and improve crisis management , in line with international standards in the subject matter, particularly those stipulated by The International Maritime Organisation instruments
	B3.6 Develop advanced space systems (optical, radar) for sea monitoring and surveillance exploiting Copernicus and new satellite constellations, as well as the future opportunities offered by geostationary platforms for continuous observation
	B3.7 Smart data fusion of terrestrial and Automatic Identification System data for improved Vessel Tracking
	B3.8 Develop systems for security of ports based on the integration of sensing technologies from multi-observational platforms (airborne, drones, on-ground, surface water and underwater) for the control of the persons and goods (containers, vehicles, ...)
	B3.9: Strengthen and reinforce maritime search and rescue cooperation and coordination in the Mediterranean

CHALLENGE B. Observing systems and operational oceanography capacities in the Mediterranean

B3.10: Examine the possibility of developing regional directives regarding the safety of fishing ships and the protection from marine pollution generated by these units.

CHALLENGE C. Innovative offshore industrial platforms including marine renewable energy and co-use

GOAL	ACTION
C1. Changing the rationale: one platform, multiple uses and activities	C1.1 Develop offshore fixed and mobile infrastructure for the purpose of environmental monitoring from the coast to the high seas, including surface weather conditions, water column and seabed monitoring
	C1.2 Develop Platforms' Multi-Criteria Analysis (MCA) tools allowing to assess different technological options from safety, social, economic and environmental points of view, and regulatory framework at all stages of development from construction to decommissioning, addressing risk analysis (safety and security) during their lifecycle
	C1.3 Autonomous operations to support aquaculture, desalination, services of yachts in platforms
C2. Increase the fraction of installed marine renewable energy power plants	C2.1 Develop site characterization tools and methods with spatialised information, measurement and modelling (including Big-Data modelling) of extreme events (including sea state) and characterization of sedimentary transport
	C2.2 Identify and strengthen potential synergies between coastal and offshore energy infrastructures and other activities/threats (e.g. aquaculture, protected areas, coastal erosion prevention, etc.)
	C2.3 Develop technology design tools for MRE: impact of biofouling on components, behaviour of structures/components in fatigue, innovative monitoring strategies, anchoring
	C2.4 Tool development farm architecture and integration with electric networks and energy storage (Hydrogen, ...)
	C2.5 Environmental and socio-economic impacts: Develop digital tools to characterize and analyse interactions between all stakeholders and the environment, habitat modification, characterization and

CHALLENGE C. Innovative offshore industrial platforms including marine renewable energy and co-use

	modelling of biofouling, contextualization of impacts related to MRE
	C2.6 Develop appropriate methods to manage and exploit bio-resources in the vicinity of MREs plants
	C2.7 Study and improve the acceptability of MRE projects through an enhanced knowledge of their environmental interactions and a thorough multidisciplinary evaluation including socio-economic dimension

CHALLENGE D. Marine and coastal natural and cultural heritage in the Mediterranean: discovering, protecting and valuing

GOAL	ACTION
D1. Technology solutions for the Mediterranean natural and cultural heritage	D1.1 Develop systems for monitoring of cultural heritage in coastal areas (underwater or partially emerged assets), based on the integration of multi-sensing and multi-observation platforms (satellite, ROV, UAV, on-ground, underwater)
	D1.2 Assimilation of sensed data in advanced modelling for the definition of mitigation actions against climate change and multi-risk scenarios
	D1.3 Technologies and innovations to strengthen sustainable development policies, more efficient use of natural resources and cultural heritage in coastal and marine areas such as: <ul style="list-style-type: none"> - 3D virtual diving with applications for smartphones, for the promotion of natural and cultural heritage; - Ecological engineering: artificial reefs for diving sites, underwater trails, preservation of biodiversity; - Eco-yachting: ecological moorings
	D1.4 Promote innovative devices for and approaches to limit coastal erosion and pollution and to favour beach stabilization
	D1.5 Blue marinas with nature-based solutions. Design and develop innovative integrated solutions using clean technologies to improve the sustainability and management of infrastructures

CHALLENGE D. Marine and coastal natural and cultural heritage in the Mediterranean: discovering, protecting and valuing

D1.6 Develop a strategy focusing on new ICT technologies and services for sustainable tourism (integrating coast and inland waterways) to de-seasonalise and differentiate tourism products

D1.7 Marine litter: development and testing of new marine litter removal techniques (sea bottom removal, floating litter removal, fishing-for-litter good practices). Include citizen science approach when appropriate

CROSS-CUTTING ENABLERS

A number of key cross-cutting actions could be useful to facilitate the implementation process to assure effectiveness of Knowledge, Economy and Technology actions and their transfer into Blue Growth sectors and value chains. Most of these cross-cutting actions are policy driven and require policy decisions for their implementation. Therefore, such actions must be regarded as potential areas of investigation and do not commit the contributors.

CHALLENGE A. Cross-cutting enablers for Blue Jobs and Blue Growth	
GOAL	ACTION
A1. Open data, open science, open innovation	A1.1 Promote and regulate transparency with regard to the results of research conducted or 'owned' by public/private companies and institutions, and public authorities, and take action to make them more readily available to the society
	A1.2 Create a "Blue Cloud" for Marine data accumulation (e.g. oceanographic, biooptical, genomics, -omics, and -metaomics) at Mediterranean level
	A1.3 Support planning and management activities by improving access to marine data (connecting to the Blue Cloud) and including economic, social and environmental information
	A1.4 Promote standardization and interoperability of technological solutions with specific reference to the maritime field with innovate "guides to the use" explaining what diverse sets of data are available, standardized sampling and analyses methodologies. Linking all "guides" to their corresponding Blue Cloud database
	A1.5 Create a common disclosure and data sharing policy on Maritime Cultural Heritage including the preservation of ancient cartography and its digitization and translation into GIS georeferenced mapping systems
A2. International Cooperation and Coordinated Transboundary Networks	A2.1 Promote appropriate investments, homogeneous legislation and capacity building throughout the Mediterranean, together with a sound sense of ownership in order to ensure full participation from all stakeholders
	A2.2 Promote Maritime Domain Awareness through a strategic framework based on voluntary contributions provided within flexible and inclusive institutionalized structures
	A2.3 Establish a coordinated network of marine institutes, universities, stations, observatories and public and

CHALLENGE A. Cross-cutting enablers for Blue Jobs and Blue Growth

	private companies
	A2.4 Promote transnational pilot studies to develop and implement methodologies and practices
	A2.5 Improve coordination and cooperation among Member States and non-EU countries to achieve the Good Environmental Status by developing standard methodologies to implement the Marine Strategy Framework Directive and the UNEP-MAP Ecosystem Approach in shared waters
	A2.6 Establish a network for collaboration between marine and archaeological institutions to share data, locate shipwrecks and target areas for high-resolution seabed mapping
	A2.7 Implement coordinated methods and approach, to achieve a dedicated science-to-policy network on hazards in the Mediterranean
	A2.8 Develop new concepts and protocols with private companies and maritime operators to maximize the use of infrastructure, ships and platforms for scientific and environmental monitoring, safety and security purposes
A3. Interaction between scientists, stakeholders, policy and decision makers, civil society	A3.1 Enhance awareness at both civil and political levels that the degradation of the marine environment presents crucial security challenges in terms of disruption of national economies, displacement of people, degeneration of national identities, loss of lives
	A3.2 Include citizens' science in monitoring and sampling strategies while increasing awareness on the biases intrinsically related to citizen's science, which is hindered for example beyond the visible horizon or in dark deep water
	A3.3 Coordinated approach addressing coastal management and conservation of anthropogenic villages/ecosystems involving local communities
A4. Building capacity, blue skills and blue professionals	A4.1 Develop a network of training research centres to train new professionals on sampling, recording and working at marine level for environmental, engineering and scientific studies
	A4.2 Align high education curricula, establish joint MSc, PhD programs, short term scientific exchanges, to prepare the next generation of blue-economy scientists, technologist and entrepreneurs.
	A4.3 Develop an electronic platform for e-mentoring of young start-uppers in blue growth acting like a virtual

CHALLENGE A. Cross-cutting enablers for Blue Jobs and Blue Growth

	incubator to create a lively ecosystem of entrepreneurs of innovation
	A4.4 Co-develop training courses and knowledge exchange activities to improve the level of institutional, technical and human capacities at national level for the implementation of Maritime Spatial Planning and Maritime Governance
	A4.6 Improve Mediterranean training centres and capabilities to carry out projects for safety in oil & gas offshore operations, including environmental risk and new technologies
	A4.7 Develop new modalities of security operators training exploiting the opportunities offered by the augmented reality techniques
	A4.8 Exploit new digital technologies for training purposes, solutions based on Virtual Reality or Augmented Reality
	A4.9 Promote capacity building to increase resilience to disasters of Mediterranean countries
	A4.10 Train a new generation of marine technicians/scientists to conduct research on the protection of the marine cultural heritage
A5. Promoting and implementing strategies and action plans	A5.1 Analyse socio-economic and geopolitical dynamics of the Mediterranean area as the context/ constraint to implement the actions above and common policies
	A5.2 Develop environmental decision support modelling systems to sustain policy strategies, including adaptation and mitigation, for preserving the socioeconomic and environmental sustainability of marine species and habitats
	A5.3 Develop adaptive strategies for events, even of low recurrence but potentially devastating, preparing people for such a possibility, including impact scenarios
	A5.4 Provide scientific support to legal controls on littering and waste abandonment on river beds, unprotected shores and offshore

Moreover, a list of recommendations for triggering policy actions has been identified.

R.1 Promote Circular Economy associated to the sea and to coastal development and analyse solutions for implementing circular economy procedures.

- R.2** Support the social part of de-contamination activities (e.g. plastic strategy) and the policy part by implementing the MFSD in Mediterranean Sea.
- R.3** Review and harmonize Mediterranean countries' action plans on hazards and protection of coastal areas.
- R.4** Develop economic strategies to test and promote safe natural products of marine origin.
- R.5** Reduce administrative costs, promoting investments in best technologies to support sustainable aquaculture.
- R.6** Carry out awareness campaigns among consumers to improve the image of Mediterranean aquaculture products and to enhance the related economic value.
- R.7** Improve transport systems for smart, safe mobility in coastal zones, lagoons and restricted areas.
- R.8** Provide incentives for the use of Vessel Monitoring Systems (VMS).
- R.9** Explore opportunities for cooperation among Mediterranean Coastal States in order to ensure smooth functioning of Motorways of the Sea's connections in the region.
- R.10** Create the legislative, technological and infrastructural conditions to promote a highly connected and automated sea transportation system to improve safety and efficiency of shipping.
- R.11** Review and reinforce policies dedicated to the maritime security to achieve relevant sustainability goals and socio-economic advantages.
- R.12** Define a strategic plan and an action priority schema for maritime security supporting the Blue Growth and critical infrastructures monitoring.
- R.13** Facilitate fishing boats that bring ashore chemical containers, weapons/bombs or other undefined and potentially harmful material found offshore (in most countries today these boats risk to remain sequestered for weeks in port with major damage to the workers and owners), through adequate measures (e.g. legislative, administrative, economic, infrastructural, training, etc.)
- R.14** Improvement of fish trades and explore of the development of additional legislation for food control at Mediterranean level.
- R.15** Reinforce the frequency and the extent of participation in joint exercises carried out, in matters of maritime search and rescue and marine pollution response

POLICY RELEVANCE AND EXPECTED IMPACTS

The BlueMed SRIA and the derived BlueMed Implementation Plan are policy-driven and policy-oriented instruments aimed at informing, supporting and impacting a wide range of International and EU policy instruments and processes. The following list presents an overview of such relevance for each challenge of Knowledge, Economy and Technology enablers. The cross-cutting enablers are considered *per se* as policy actions.

- EC R&I Framework Programme 2021-2027 Horizon Europe and specifically the Mission Area on Healthy oceans, seas, coastal and inland waters and the candidate Partnership 'A climate neutral, sustainable and productive blue economy'.
- The Mediterranean component of the UN Decade of Ocean Science for Sustainable Development 2021-2030.
- Sustainable Development Goals of the UN 2030 Agenda, focusing on SDG14-Life below Water but also targeting SDG12- Sustainable Consumption and Production and SDG17-Partnerships for Sustainable Development.
- The new EU Green Deal proposed by the Commission and the EU strategy on adaptation to climate change.
- The UN Convention on Biological Diversity and the EU Biodiversity Strategy for 2030.
- The Ocean Governance policies and conventions and in particular the Maritime Spatial Planning EU Directive and UNEP Regional Framework on MSP and ICZM.
- Regional and Territorial Frameworks, Strategies and Initiatives (e.g. Barcelona Convention, WestMED, EUSAIR, UfM WG on Blue Economy and Climate, CPMR).
- The EU Integrated Maritime Policy, the Blue Growth Strategy and the Roadmap in preparation on sustainable blue economy in the EU.
- The EU Circular Economy Package adopted in 2015 and the specific strategy adopted on plastics in a circular economy perspective in 2018.
- The EU R&I initiative FOOD2030, on Food and Nutrition Security (FNS), the broader EU strategy "from Farm to Fork", and to the FAO-GFCM Initiatives MedFish4Ever and FishForum.
- The EU Offshore Renewable Energy Strategy.

EDITORS

Andrea Barbanti, National Research Council, Italy - Policy Platform Coordinator

Elena Ciappi, National Research Council, Italy - BlueMed CSA

Erasmia Kastanidi, Hellenic Center for Marine Research, Greece - Knowledge Platform Coordinator

Fabio Trincardi, National Research Council, Italy - BlueMed CSA Coordinator

Guy Herrouin, Pôle Mer Méditerranée, France - Technology Platform Coordinator

José de Lara Rey, Cluster Marítimo, Spain - Economy Platform Coordinator

Margherita Cappelletto, National Research Council, Italy - BlueMed CSA

Nikos Papandroulakis, Hellenic Center for Marine Research, Greece - Knowledge Platform Coordinator

CONTRIBUTORS

Abraham Trujillo Quintela, State Research Agency, Spain - BlueMed CSA

Alan Deidun, University of Malta, Malta - National Pivot, Economy Platform

Albert Palanques, Spanish National Research Council, Spain - National Pivot, Knowledge Platform

Aldo Drago, University of Malta, Malta - National Pivot, Technology Platform

Alexandros Josephides, Cyprus Shipping Chamber, Cyprus - National Pivot, Economy Platform

Baris Salihoglu, Middle East Technical University, Institute of Marine Sciences, Turkey, GSO BlueMed WG Delegate

Carlos García Soto, Spanish Oceanographic Institute, Spain - BlueMed CSA

Charlotte Restiff, National Center for Scientific Research, France - BlueMed CSA

Cherif Sammari, INSTM, Tunisia, National Pivot

Christos Aspris, Directorate General for European Programmes, Coordination and Development, Cyprus - National Pivot, Policy Platform

Claire De Marco, University of Malta, Malta - National Pivot, Knowledge Platform

Claude Wohrer, General Secretariat for the Sea, France - National Pivot, Policy Platform

Claudiane Chevalier, Research Institute for Sea Resource Exploitation, France - BlueMed CSA

Conceição Santos, Directorate General for Sea Policy, Portugal - National Pivot, Policy Platform

Damir Sedlar, University of Split, Croatia - National Pivot, Technology Platform

Daniel Hayes, University of Cyprus, Cyprus - National Pivot, Knowledge Platform

David González, Ministry of Economy, Industry and Competitiveness, Spain - BlueMed CSA

Diofantos Hadjimitsis, Cyprus University of Technology, Cyprus - National Pivot, Technology Platform

Dori Edelist, University of Haifa, Israel, National Pivot

Elen Twrdy, University of Ljubljana, Slovenia - National Pivot, Technology Platform

Elena Sultana, Malta Council for Science & Technology, Malta - BlueMed CSA and Policy Platform

Eleni Hatziyanni, Region of Crete, Greece - National Pivot, Policy Platform

Emil Juvan, University of Primorska, Slovenia - National Pivot, Economy Platform

Esther Chacón Campollo, State Research Agency, Spain - BlueMed CSA

Estrella Fernández García, State Research Agency, Spain - BlueMed CSA

Ezgi SAHIN, Middle East Technical University, Institute of Marine Sciences, Turkey, National Pivot

Federica Mastracci, e-Geos, Italy - National Pivot, Technology Platform

Francesco Soldovieri, National Research Council, Italy - BlueMed CSA

Francisco Beirão, Fórum Oceano, Portugal - National Pivot, Economy Platform

Ian Gauci Borda, Malta Council for Science & Technology, Malta - National Pivot, Policy Platform

Ivica Vilibić, Institute of Oceanography and Fisheries, Croatia - BlueMed CSA

Iztok Skerlic, Public Agency for entrepreneurship promotion and project development, Municipality of Izola, Slovenia - National Pivot, Policy Platform

Jean-François Cadiou, French Research Institute for Exploitation of the Sea, France - BlueMed CSA

José Ventura de Sousa, Association of Naval Associations, Portugal - National Pivot, Technology Platform

Kalliopi Pagou, Hellenic Center for Marine Research, Greece - BlueMed CSA

Konstantinos Topouzelis, University of Aegean, Greece - National Pivot, Knowledge Platform

Kristina Pikelj, University of Zagreb, Croatia - National Pivot, Knowledge Platform

Krstina Mislov, Mišlov Ltd, Croatia - National Pivot, Economy Platform

Laura Yuste, Ministry of Economy, Industry and Competitiveness, Spain - National Pivot, Policy Platform

Leda Skoufari, Research Promotion Foundation, Cyprus - BlueMed CSA

Mahmoud Abuhussein, Higher Council for Science and Technology, Jordan, National Pivot

Mara Manente, International Center of Studies on the Tourist Economy, University Ca' Foscari of Venice, Italy - National Pivot, Economy Platform

Maria Angelucci, e-Geos, Italy - National Pivot, Technology Platform

Maria Snoussi, Mohammed V University, Morocco, National Pivot

Marisa Fernández, Centro Tecnológico del Mar - CETMAR Foundation, Spain - National Pivot, Economy Platform

Marta March Almela, Ministry of Economy, Industry and Competitiveness, Spain - National Pivot, Policy Platform

Maurizio Ribera D'Alcalà, Stazione Zoologica Anton Dohrn, Italy - National Pivot, Knowledge Platform

Mustafa Yucel, Middle East Technical University, **Institute of Marine Sciences**, Turkey, National Pivot

Nabil Anwari, Ministry of Agriculture, Fisheries, Rural Development, Water and Forests, Morocco, National Pivot

Nayrah Shaltout, National Institute of Oceanography and Fisheries, Egypt, National Pivot

Nicolas Arnaud, National Centre for Scientific Research, France - BlueMed CSA

Nikos Themelis, Regulatory Division of the Hellenic Register of Shipping, Greece - National Pivot, Technology Platform

Patrick Baraona, Pôle Mer Méditerranée, France - National Pivot, Economy Platform

Paulo Machado, Directorate General for Sea Policy, Portugal - BlueMed CSA

Phoebe Koundouri, Athens University of Economics and Business, Greece - National Pivot, Economy Platform

Richard Sempere, Mediterranean Institute of Oceanography, France - National Pivot, Knowledge Platform

Silvia Grandi, Ministry for Economic Development, Italy - National Pivot, Policy Platform

Sofia Cordeiro, Foundation for Science and Technology, Portugal - National Pivot, Knowledge Platform

Staša Skenžić, Ministry of Science and Education, Croatia - National Pivot, Policy Platform

Stella Tsani, ICRE8, Greece – National Pivot, Economy Platform

Victor Espinosa Roselló, Polytechnic University of Valencia, Spain - National Pivot, Technology Platform

Vincent Rigaud, French Research Institute for Exploitation of the Sea, France - National Pivot, Technology Platform

Vlado Malačič, National Institute for Biology, Slovenia - BlueMed CSA and National Pivot, Knowledge Platform



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