Background document – ESA Blue Worlds Initiative

An ESA cross-disciplinary programme of activities for bodies of water and their ecosystems (social, economic, and environmental)

Rationale

ESA Member States (MS) collectively possess the largest maritime Exclusive Economic Zone (EEZ) worldwide. In Europe the 'blue economy' represents roughly 5.4 million jobs and a gross added value of almost €500 billion a year, generating great potential for further growth and diversification.

The safeguarding of economic, environmental and geopolitical interests, as well as safety and security, depend on the ability to monitor, control, defend, connect and exploit the maritime territory, its resources and its pathways. Global situational awareness of maritime spaces is also a key element.

For many years, ESA has devoted a number of initiatives to the oceans and to the blue economy. Individual Member States participate in these initiatives whilst having their own strategy and activities. ESA runs a number of successful programmes that are part of the required critical infrastructure, and also provide key data, information and services for the maritime world.

A mapping of the current and planned ESA activities relevant to maritime has been consolidated. A Blue Worlds Task Force (BWTF) has been established with representatives from all interested ESA Member States with the support of ESA experts from all Directorates and Services.

In the frame of the activities of the BWTF, and in order to better understand the needs of the maritime users, it has been decided to launch a questionnaire. The analysis of the answers will help with identifying how space is used today and determining the main challenges faced by maritime communities. This will be used to prepare future ESA programmes that meet the wishes and interests of Member States, as well as the needs of potential users.

Context

Knowledge of seas and oceans is proving increasingly important in solving the issues of climate modelling and future climate predictions. Environmental protection and climate adaptation and resilience are already strategic topics for the Atlantic and maritime regions, and for sub-areas or smaller water bodies in Europe – such as the North Sea, Baltic Sea or Black Sea – that are very sensitive to climate change. The use of space technology, in particular all types of Earth observation data and applications, is an essential element for the development of activities and research in this area. From an environmental point of view, oceans and seas are key areas for monitoring and understanding climate change and their balance is under significant threat from pollution.

From an economic point of view, 'blue worlds' are important as their conditions impact the transport, energy and food sectors. As a source of limited (and often threatened) resources subject to exploration interests from many parties, a fair allocation and oversight can be achieved with proper monitoring and inspection mechanisms in place. Tourism related to maritime activities is also expected to grow, with a challenge to keep it eco-friendly.

From a safety and security (including crisis management) point of view, autonomous shipping, piracy and smuggling are all important elements, as are maritime security, protecting the borders of European states and providing system alerts for threats such as tsunamis and other extreme weather conditions that can endanger coastlines and recreational navigation. For the latter, services associated with search and rescue are expected to be in higher demand and include more sophistication and interoperability between space and terrestrial/maritime systems. Again, cooperation and synergy with existing infrastructure and initiatives will be sought.

The total value of the services produced by marine and coastal ecosystems is valued at USD 29.5 trillion per year. But ocean and sea health is more than wealth.

Blue Worlds – Areas and Themes of Action

The following strategic blue world/geographical areas are considered:

- **The Atlantic Ocean and its sub-areas, such as:**
    - **The High North, for example, Greenland and the Nordic Seas**
    - **The North Sea**
    - **The Baltic Sea**
- **The Black Sea**
- **The Mediterranean Sea**

as well as all waters under the jurisdiction of any ESA Member or Associate State.

The following main themes are part of the reflections:

1. **COASTAL IMPACT** (i.e., Natural processes and climate change, anthropogenic impacts), for instance coastal flood hazards and risks. This may also include morphological (physical) change as well as ecological (biological) change and their interactions (bio-physical).
2. **BAY and ESTUARINE AREAS including COASTAL ECOSYSTEMS and PROCESSES and SUSTAINABLE FOOD PRODUCTION** – to promote the sustainable development of major urban and coastal ecosystems in bay and estuarine areas and mangroves; to improve land management systems and land productivity and promote new food value chains with sustainable off-shore aquaculture; to improve water management together with sustainable energy usage in coastal regions; and to reduce the impact of floods and sea level rise in major coastal areas.
3. **LIFE BELOW WATER** – marine and coastal biodiversity, status and trends – to support the management and protection of biodiversity; to support the estimation of underwater marine biodiversity and environment, including blue carbon potential (e.g., reed belts, macro algae) and EBVs; to improve estimation of marine litter and land-based sources, tracking plastic littering,

4. **MARITIME INFRASTRUCTURE and NAVIGATION** – to promote the evolution of secure maritime infrastructure, including ports, harbours, ships, waterways, routeing measures, aids to navigation, etc., towards more autonomous and resilient systems allowing the smart operation of vessels for safe, sustainable and efficient traffic flow comprising all types of marine vehicles and assisted and coordinated by enhanced shore-based services; sustainable use of Arctic waters.
5. **SAFETY AND SECURITY – to develop, test and implement connected systems** and cooperative services to increase the safety, integrity and security of data, infrastructure and end-users, from maritime, communication, fishing, etc. (also through satellites placed in specific orbits such as HEO) – this should include commercial vessel traffic (SOLAS ships and fishery) and smaller marine vehicles (Non-SOLAS, fishery and leisure crafts) either conventionally, automated or autonomously navigating (mixed traffic scenarios); support to global maritime traffic.
6. **LOW-COST SENSORS AND INFORMATION SYSTEMS** – to develop, test and implement/roll out user-friendly, low-cost sensors and integrated information systems, making use of mini- and micro-satellite data, together with Earth observation systems integrated with artificial intelligence and other related data processing systems.
7. **DATA PROCESSING POWER, ANALYTIC CAPACITY AND AI** – a large emphasis should be put on the capacity at space agency level to invest in infrastructure, processing power and analytic/algorithm development to process the large datasets that will be arriving in the future. This would aid in the possibility of real-time/near real-time data products for monitoring and control. Advanced cloud processing and AI possibilities to maximise the use of existing and new satellite missions. Big/smart data management should be a major focus in the report, alongside regional needs.
8. **CLIMATE CHANGE** – studying the role of oceans and seas for monitoring and understanding climate change and the impact of climate change on the conditions of oceanic and smaller water bodies.

The sectors and users targeted include, but are not limited to: shipping, fishing, port authorities, conservation managers, shipping administration, logistics brokers, environmental and infrastructure public authorities, energy, food, rescue and regulatory bodies.

https://www.esa.int/Enabling_Support/Preparing_for_the_Future/Space_for_Earth/Blue_worlds

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Annex

Benefits for Non-Space Sectors, Possible Topics to be Addressed and Partnerships

Sector/Domain	Possible Aspects/Themes of Interest	Users/Potential Partners
Environmental aspects	• Pollution – plastics, oil spills from platforms as well from tankers • Water supply • Essential Climate Variables and aspects linked to the ocean – salinity, currents, sea levels, surface roughness, depth and coastline • Biodiversity, species protection and sea flora • Seismology and volcanology • Pelagic fish stocks • Essential Biodiversity Variables (EBVs) • Weather forecasting	• Labs and research institutes (e.g. AIR Centre) • Institutes for oceans/seas and atmosphere • Ministry of Environment, National Hydrographic Offices • Ministry of Internal Affairs • Companies investing in 'clean energy' and low environmental impact
Transportation/ Mobility sector	• Augmented GNSS services • Weather services • Real-time situational awareness services for conventional shipping • Autonomous shipping and connected and autonomous driving • Currents, surface conditions • Maritime communication • GERROS • Ship Fairways (AIS) • High-resolution Bathymetry	• Public organisations • Big shipping companies and ship manufacturers • Shipyards and ship technology / ICT companies • Logistics brokers • Traffic control • Port authorities • National Hydrographic Offices

Electronic communications sector	• New generation of satellite systems and technologies • Integration with terrestrial systems – 5G • Big data in future SATCOM networks • Govsatcom • Optical and quantic communications • Machine learning and artificial intelligence for satellite communications • IoT technologies and applications ubiquitous broadband access	• EMSA • Public organisations • Ministry of Internal Affairs • Ministry of Defence • Ministry of Infrastructures • Labs and research institutes (e.g., AIR Centre) • Universities • Electronic communications industry and service providers • Regulatory authorities
Food sector	• (See elements for the above two sectors) • Management of fish shoals • Inspection of fishing quotas	• Fishing industry • Regulatory bodies
Energy sector	• Wind • Currents • Traffic of fuel • Infrastructures	• Local governments • Companies investing in renewable energy sources • Ministry of Economics • Ministry of Environment
Safety and security	• Search and rescue for ships and planes • Piracy • Smuggling • Illegal fishing • Migration • Surveillance and tactical support • Threat alerts (swell conditions, harbour sea ground changes, etc.) • Maritime search and rescue • Dark ships (no AIS ID)	• EMSA • Ministry of Defence • Ministry of Internal Affairs • Rescue services • Port authorities • Cybersecurity centres
Downstream activities	• Map platforms (real digital twin of the environment) • Artificial intelligence for forecasts and anomaly spotting • Data dissemination • Big Data • Spin in, spin off • Open data	• SAP