

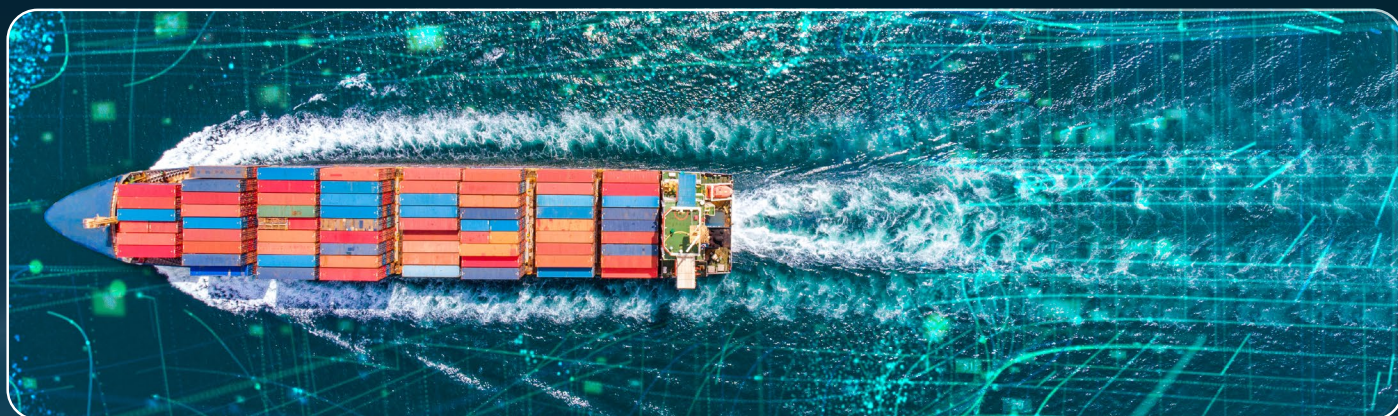
# EARTH OBSERVATION FOR THE MARITIME SECTOR: USE CASES AND COMMERCIAL OPPORTUNITIES

## Introduction to the maritime sector

The maritime sector plays a pivotal role in the global economy, **serving as a lifeline for international trade**, transportation, energy production, and as a vital source of food. Shipping remains the most cost-effective and efficient mode of transporting goods across long distances. Roughly 95% of global trade by volume is carried out through maritime routes, making ports and shipping lanes essential components of the global supply chain. The fisheries and aquaculture sector also plays a vital role in **providing food for millions of people worldwide**, especially in coastal regions and developing countries, where seafood often constitutes a primary source of animal protein. Moreover, the maritime industry provides numerous employment opportunities.

However, the industry is under increasing pressure to **reduce its environmental impact**. Issues such as air and water pollution,

greenhouse gas emissions, and oil spills pose significant challenges. Stricter regulations and demands for cleaner, more sustainable systems or methodologies are driving the industry to adopt greener technologies and practices. Growing global food demand which to some extent can clash with the sustainability and preservation of our seas is also resulting in increasing pressure for efficiency and digitalisation within the industry. Moreover, **geopolitical issues surrounding illegal maritime migration, border security, smuggling and piracy** are fast becoming a high priority for many governments. As a result of these challenges, Earth Observation-based services are becoming more and more accepted and adopted within the industry thanks, to their ability to address the sustainability and efficiency requirements of the sector.



### THE SECTOR IN NUMBERS

**95%**

of global trade by volume is transported and delivered by the shipping industry

**11 billion tons**

Cargo transported annually

**50,000**

Merchant vessels in operations globally

*Source for numbers*



## Zoom in on Europe

Europe is home to some of the world's busiest and most significant seaports, including Rotterdam, Antwerp, Hamburg, and Marseille. These ports serve as crucial gateways for international trade. Moreover, Europe is the home of many major shipping companies that operate globally. Greek, Danish, and Norwegian shipping companies, in particular, play a significant role in the international shipping market. Stakeholders across the European maritime landscape include several **maritime authorities** who are looking for new and more efficient ways to fulfil their mandates. Within the maritime Research and Innovation (R&I) ecosystem exciting innovations are being developed for application in challenging environments and service providers delivering value to the market with cutting-edge technologies for end users such as port authorities, national governments, shipping companies, fisheries, and construction companies.

Various authorities and public agencies such as the **International Maritime Organization (IMO)**, the **European Maritime Safety Agency (EMSA)**, the **Directorate-General for Maritime Affairs**

and **Fisheries (DG MARE)**, the **European Fisheries Control Agency (EFCA)** and several national agencies including the UK's **Maritime and Coastguard Agency** are all concerned with guiding how the maritime sector is managed. These entities drive many initiatives and regulations such as the **International Convention for the Safety of Life at Sea (SOLAS)**, the **European Union Maritime Security Strategy (EUMSS)**, and the **Common Fisheries Policy (CFP)**. Numerous industry associations also play a vital role in **making sure the voice of the industry is heard at political/international levels**. They routinely promote and advance the common interests of businesses and promote the proliferation of common industry standards.

Europe has many entities involved in highly sophisticated R&I in the maritime sector. Numerous institutions and universities across the continent are looking into issues facing the maritime sector, such as the **optimisation of port operations, wave energy, dark vessel monitoring, autonomous shipping, and harmful algal blooms (HABs)**.

## Critical challenges facing the maritime sector

**Illegal maritime migration in Europe is at its highest level since 2016.** In 2022, the number of irregular border crossings into Europe via the Central Mediterranean route rose to over 100,000 and the number of people crossing the English Channel rose to over 70,000, accounting for a 51% and 37% increase on the previous year respectively<sup>1</sup>.

**Maritime safety incidents are also on the rise.** A large part of these increases can be attributed to a post-pandemic increase in seaborne trade. Machine damage or failure has been the main driver of this surge in safety incidents, increasing by 24% in 2021 and 13% in 2022. It is also possible that an improved approach to incident reporting drove these numbers up<sup>2</sup>. Digitalisation (AI, machine learning and cloud connectivity) is enabling real-time processing of data, leading to actionable insights and more reliable decision-making for the maritime security/safety stakeholders. **However, adequate training, awareness, and accountability among the workforce are still crucial** in minimising human errors and ensuring safe usage of digital systems<sup>8</sup>.

**Demand for sustainable seafood is also a strong and growing trend from consumers.** The number of Marine Stewardship Council (MSC) certified fisheries and supply chain organisations are increasing year on year, with 550 fisheries in 2023, up from 539 the previous year. The MSC is the international not-for-profit organisation responsible for the world's most widely used sustainable seafood ecolabel<sup>3</sup>.

At European level, maritime transport represents **3 to 4% of the EU's total CO<sub>2</sub> emissions, or over 124 million tonnes of CO<sub>2</sub> in 2021**. There is increasing pressure on the sector to reduce its emissions, hence the forthcoming introduction of the maritime sector to the **EU Emissions Trading System**<sup>4</sup>.



1. EU'S EXTERNAL BORDERS IN 2022...
2. WHAT ARE THE LATEST MARITIME SAFETY TRENDS...
3. CELEBRATING SUSTAINABLE SEAFOOD...
4. EU EMISSIONS TRADING SYSTEM (EU ETS) POLICY\_EU\_ETS...





# How space adds value for the maritime sector

Space technologies play a crucial role in enhancing various aspects of the maritime sector. The integration of satellite-based technologies and space-derived data has significantly improved the efficiency, safety, and sustainability of maritime activities. Earth Observation (EO) data can help monitor **weather patterns, sea conditions, and environmental changes**. This data is invaluable in helping maritime operators make informed decisions about routes, avoiding storms, and ensuring the safety of vessels. Satellites also help monitor and manage fisheries by **tracking vessel movements, identifying illegal fishing activities, monitoring maritime pollution such as oil spills or CO2 emissions, and assessing the health of marine ecosystems**.

Given the huge focus on maritime security, EO is proving invaluable by providing continuous surveillance of maritime areas. Satellite imagery assists in **monitoring shipping routes, detecting suspicious activities, and preventing illegal activities such as piracy, illegal fishing and smuggling**. Space technologies also enable connectivity for autonomous and remotely-operated ships. Satellite communications ensures continuous data exchange, navigation updates, and remote control capabilities for smart shipping applications. For this application in particular, EO better enables the acquisition of

essential information such as sea and weather conditions, and when in colder regions, enables safe navigation around sea ice. Offshore renewable energy project developers and investors can use EO to **identify the most suitable areas for the exploitation** of renewable energy sources, plan their development and monitor their integrity/status.

EO-enabled marine surveying and mapping of the seabed and coastal areas is important in **determining prospective infrastructure sites**. It also helps construction companies in continuously monitoring the progress achieved on construction sites and in reporting on this progress to their clients (e.g., infrastructure owners / operators). Maritime insurers, investors and asset managers all rely on **evaluating the levels of risk exposure**, using probabilistic approaches of the events, exploiting historical data, and performing climate reanalyses over several years. Again, EO can aid in all of this.

In support to EO, it should be noted that **Global Navigation Satellite Systems (GNSS) and Satellite Communications** are extremely useful to for the maritime sector by as they provide accurate and reliable positioning information as well as connectivity for safety, business critical and operational services.

## Some space related initiatives in Europe

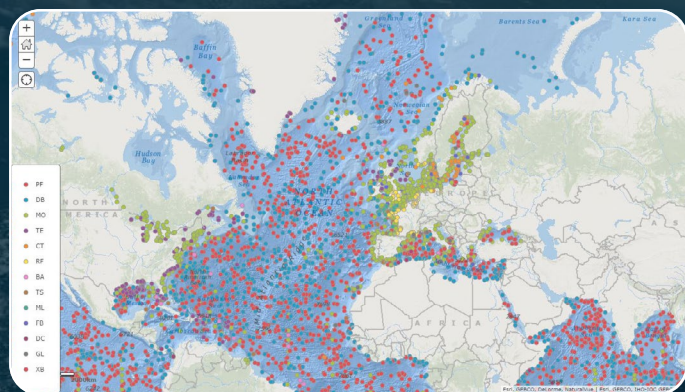
A major anticipated trend in the industry is the proliferation of **Maritime Autonomous Surface Ships (MASS)**. There is currently a lot of regulatory work being developed at IMO level on this topic. The non-mandatory MASS code is expected by 2024 and, based on the application of the non-mandatory MASS Code at an initial stage, the mandatory MASS Code is expected to come into force on 1 January 2028. **EMSA is currently in the process of developing a risk-based assessment tool (RBAT)<sup>6</sup> for the evaluation of new Maritime Autonomous Surface Ships (MASS) projects**. It is expected to be finalised in 2023 and results will be shared with relevant stakeholders. The regulatory and technical impact of MASS technology in the shipping industry is expected to be transformative with EO and GNSS both considered important data sources for this initiative.

An important development in the sector is the incorporation of the shipping industry's emissions into the EU **Emissions Trading System<sup>7</sup>** in 2024. This will open opportunities for EO companies **to aid in the monitoring, reporting and verification of emissions** coming from the shipping industry.

The **Copernicus Marine Service (CMEMS)<sup>8</sup>**, is one of the six services provided by the EU's Earth Observation and Monitoring programme and is dedicated to providing accurate information on the global and regional marine environment. Other EU initiatives include the **European Marine Observation and Data Network (EMODnet)<sup>9</sup>** and the **European Spatial Planning Platform (MSP)<sup>10</sup>** which are respectively enhancing access to marine

data, data products, services and projects to better understand European and oceans as well as advancing the use of EO in maritime spatial planning.

The **European Space Agency (ESA)** is involved in several projects aimed at supporting the maritime sector using EO and other advanced technologies.



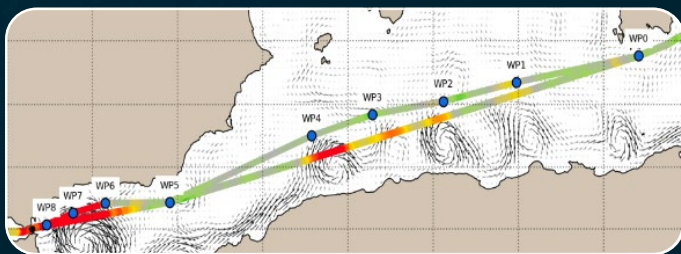
*In situ observing platforms in global CMEMS*

5. AUTONOMOUS SHIPPING...
6. MARITIME AUTONOMOUS SURFACE SHIPS (MASS)...
7. REDUCING EMISSIONS FROM THE SHIPPING SECTOR...
8. COPERNICUS MARINE SERVICE...
9. EUROPEAN MARINE OBSERVATION AND DATA NETWORK...
10. THE EUROPEAN MARITIME SPATIAL PLANNING PLATFORM...



**ALongRoute**<sup>11</sup>, supported by ESA BIC Greece, focuses on leveraging AI-powered ocean forecasts to guide vessels efficiently, ensuring smoother, greener, safer, and more cost-efficient maritime transport. The project's high-precision data is instrumental in enabling marine management software companies to optimise shipping performance significantly. The groundbreaking AI models employed can generate marine weather forecasts with exceptional accuracy and resolution.

**Amphitrite**<sup>12</sup>, another ESA-supported project, contributes by providing innovative, reliable, and accurate ocean data necessary for informed decision-making at sea. Recognising the uncertainties in operational ocean models, Amphitrite employs artificial intelligence to merge multiple satellite and in-situ data. This approach ensures the delivery of reliable information tailored to the specific needs of maritime actors, addressing the complexities associated with decision-making in maritime operations.



Short term optimal routing

**Skytek**<sup>13</sup>, a recipient of ESA ARTES programme funding, developed a demonstrator titled 'Next Generation – Recognised Maritime Picture' (NG-RMP). The project utilises emerging Satellite Automatic Identification System (AIS) vessel position technology to create a dynamic and improved Recognised Maritime Picture. This enhanced capability aids the Irish Naval Service in identifying 'vessels of interest' and provides real-time aggregated information on vessels for the insurance industry. The system was further enhanced by the integration of high-resolution EO datasets, SAR and machine learning. This provided insurance organisations at major ports worldwide with the capability to detect dark activities on vessels, calculate the value of cargo and make calculated risk assumptions regarding the vessels.

Under the support of ESA BIC Finland and ESA's **Business Applications and Space Solutions (BASS) program**, **Awake.AI**<sup>14</sup> has developed the Marketplace platform to enhance transparency and streamline operations in ports. This platform allows port service providers to effortlessly create and manage orders for various services, whether linked to a vessel port call or not. The Marketplace represents a significant step towards optimising port operations and fostering efficient communication within the maritime industry. A wide range of datasets are used including EO as well as vessel AIS and GNSS to make the marketplace smarter and provide added value.

Finally, more specifically in the field of communications, ESA also supports the **Sternula**<sup>15</sup> project, which aims to establish global maritime IoT satellite connectivity for safety and navigation. This initiative focuses on enhancing the communication infrastructure to enable seamless and secure data exchange in the maritime domain.

It is clear to see that there are numerous synergies between the space and maritime sectors and ESA, with its range of support programmes, is committed to continuing its collaboration with the maritime sector.

The BASS programme will launch its Space for Maritime Task Force beginning this year which aims to contribute to sustainability in the sector by exploiting digital and space technologies. Furthermore, a workshop was organised with EMSA to discuss WHF Data Exchange Systems (VDES) (December 2023)<sup>16</sup> as well as a "Space for Blue" workshop exploring synergies and challenges for stakeholders around the North and Baltic Seas (February 2024)<sup>17</sup>. In addition, ESA's Earth Observation programme InCubed has recently launched its call focusing on developing innovative and commercially viable products and services using space borne Earth observation in the maritime domain<sup>18</sup>. Finally, the second edition of the ESA Commercialisation Days on Transportation had a dedicated session in discussing space and maritime synergies (November 2023)<sup>19</sup>.

ESA continues to be an active partner for a wide range of organisations and activities across the maritime sector, helping them to harness space technologies to improve life on Earth. Funding and technical support is available to organisations directly or indirectly involved in the sector, from support for start-ups via the ESA BIC network<sup>20</sup> to the development of science, technical and commercial projects through the BASS<sup>21</sup> and InCubed<sup>22</sup> programmes.



11. ESA COMMERCIALISATION DAYS: TRANSPORTATION EVENT...
12. ESA COMMERCIALISATION DAYS: TRANSPORTATION EVENT...
13. EMERGING SATELLITE AIS TECHNOLOGY TO GENERATE...
14. AWAKE.AI MARKETPLACE: REVOLUTIONISING THE MARITIME...
15. ESA COMMERCIALISATION DAYS: TRANSPORTATION EVENT...
16. JOINT EMSA-ESA WORKSHOP ON VDES...
17. "SPACE FOR BLUE" EVENT TO BE HELD IN FEBRUARY...
18. INCUBED – MARITIME THEMATIC CALL...
19. ESA COMMERCIALISATION DAYS: TRANSPORTATION EVENT...
20. ESA BUSINESS INCUBATION CENTRES...
21. YOUR BUSINESS POWERED BY SPACE...
22. INCUBED IS AN ESA PROGRAMME MANAGED...

