EuroGEO

MARINE

Analysing the pattern dynamics in Earth Observation Research & Innovation

#OneEuroGEO

COMBINE, COORDINATE, COOPERATE

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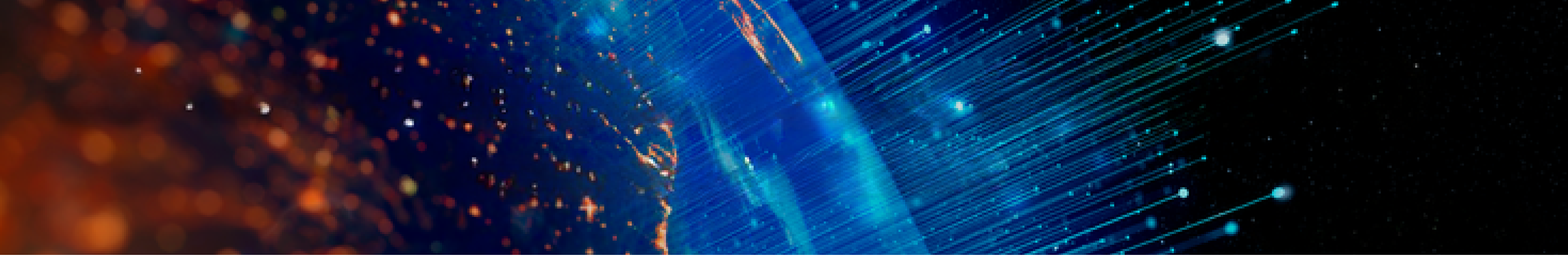


Introduction

In recent years, there has been an **increasing uptake of Earth Observation** (EO) as a tool in support of the implementation of various policies and the execution of a wide range of operational tasks. Users across the value chains of different sectors can utilise EO-based solutions in support of their work, **realising significant benefits** (economic, environmental, societal, etc.). Market demand for such solutions is driven by policies and sector-specific needs. Technological advances have the potential to enable solutions that match the specific needs.

EuroGEO, Europe's part of the Group on Earth Observation, stands at the intersection of research, policy, and markets. This **strategic position** allows it to identify and monitor relevant developments and trends, to engage stakeholders, and to assess the evolving EO landscape in Europe and beyond. Capturing insights relevant for the different stakeholders allows EuroGEO to document the current state of play of EO, its trajectory, and the required steps for broader adoption and increased benefits.

With the support of the ***EuroGEOSec* project**, and with the aim of **maximising the impact of Research and Innovation** (R&I), a dedicated effort has been made to establish the **R&I Observatory for Earth Observation** (RIO). This includes a team of analysts and an online tool to monitor and analyse past and ongoing R&I in EO in order to identify trends and support strategic decisions on future R&I activities. Relying on the RIO, the so-called **R&I State-of-Play Reports** are created presenting a concise overview of the policy context, technological perspectives, and market trends within the thematic areas covered by the EuroGEO Action Groups (AG). This present report focuses on analysing patterns in the **marine segment**. Research has been complemented by multiple other reports and studies, including studies performed by and for EuroGEO's Marine AG.

The aim of this report is to **support EuroGEO and its stakeholders in decision-making** regarding future work programmes and strategic innovation agendas (such as those of the Knowledge Centre on Earth Observation – KCEO), inform the review of the **EuroGEO Implementation Plan**, and contribute to the production of institutional outputs.

The following EuroGEO **Action Groups** develop application pilots/conduct other actions foreseen in the EuroGEO roadmap: Agriculture, Land Cover and Land Intelligence (LC&LI), Urban, Disaster Resilience and Health, Energy, Biodiversity, ecosystems and geodiversity (BEG), Marine, Climate, and Green Deal Data Spaces.

Methodology

The browser-based tool of the **R&I Observatory for Earth Observation** (RIO) allows retrieving relevant information from a variety of sources, including project information (e.g., descriptions, partners, budgets, results, timelines) for the majority of relevant European R&I programmes. Sources include information related to e.g., Horizon Europe (HE) and its predecessors, the LIFE programme, the Connecting Europe Facility, Eurostars, COSME, the European Defence Fund, and the European Defence Industrial Development Programme. Additional sources are being incorporated as part of the continuous development of the RIO.

The RIO structures the information into a standardised format for the uniform documentation of R&I activities. Functions of search, bookmarking, filtering, visualisation, and export allow the processing and analysis of the pre-curated information.

The focus of the analysis is on **mapping R&I efforts across segments** by analysing data on projects, core applications, budgets, and timelines. The full list of the analysed projects, filtered from the database of projects and mapped against segment-specific EO applications can be found in the original deliverable 🔗 . The segment's **core applications** have been identified and mapped based on the most prominent and important themes, as determined by the Action Group and tits leads. They are derived from **AG expert studies**🔗 and further validated by sector experts such as AG leads. See the classification below:

- Sargassum
- Marine litter / Debris / Plastic
- Shoreline Changes / Erosion
- Marine Flooding / Marine Inundation
- Fisheries and Aquaculture
- Eutrophication / Marine Nutrients
- Adaptation Planning / Climate Resilience

To address the research questions – i.e., to identify trends in EO-related R&I for marine applications and the drivers behind them – the following **limitations or simplifications** were applied:

Data Processing

- Project information sourced from the RIO (including acronym, title, coordinators, topic, programme, pillar, objectives, work programme, status, start and end dates, budget, grant, and links) has been filtered using segment-specific keywords to ensure that only relevant projects are included and no projects are overlooked. This relies on full-text search in existing descriptions and meta data, along with the use of consistent terminology. Where data might be missing or unexpected terminology is used, certain projects may have been missed.
- The filtered list of projects considered relevant has been extracted (i.e., exported into a spreadsheet) for processing.
- Data has been manually checked for relevance and further cleaned accordingly, then augmented by segment-specific categorisation for more detailed analysis.

Methodology

Timeframe

In order to restrict the analysis to relevant activities while drawing from a significant enough sample size, a (roughly) **10-year timeframe** is used, covering the period **from 2014 to 2024** (i.e., only projects that have started before 2025 and have not ended before 2014 have been analysed). This timeframe is used to capture long-term trends, technological developments, and measurable outcomes of concluded projects. It also ensures that typical project lifecycles, such as those in Horizon Europe, are included. It coincides with the launch of the first Sentinel-1 satellite in 2014, the free and open data of Copernicus being considered as one driver of EO-related R&I, which has been attempted to confirm through the analysis.

Sample Size

The sample data is limited to the sources **currently included in the RIO**, expected to cover relevant European R&I projects to a large extent, but with further potentially relevant projects not included in the analysis where the data source has not been included yet. It is further limited to the keywords and queries applied (see data processing above) and timeframe selected (see timeframe above).

Budget allocations per application

Breaking down budgets of projects that address more than one segment-specific application and dividing them across these applications has been done following a simplified approach assuming an (unlikely) even distribution. Therefore, budget sizes per application can only **reflect trends** and may not be fully accurate.

To interpret and complement the findings from the RIO tool, **desk research** has been conducted across reports and studies, including:

- European Space Agency (ESA) application or industry articles
- European Commission (EC) documents, e.g., Climate factsheets, Reports on uptake barriers of EU space services
- EUSPA EO and Global Navigation Satellite System (GNSS) 2024 Market Report
- Stocktaking Reports from related Group on Earth Observations (GEO) initiatives
- Horizon Europe's Strategic Research and Innovation Agendas
- Segment-specific as well as EO-related strategic research and innovation agendas including outcomes of the Horizon 2020 (H2020) project *FIRE*
- EuroGEO Workshop Reports
- 🔗**EuroGEO Marine AG Expert Study**

These **sources** were carefully reviewed to extract relevant content that addressed the questions raised during the analysis. They were particularly useful in identifying gaps and barriers in each segment, as well as R&I trends and technologies that are (or can be) applied to address these issues.

Marine Overview

Over the years, Earth Observation (EO) has become increasingly valuable to **marine research** due to its **cost-effective** and **large-scale** monitoring capabilities. EO improves data **availability** and **integration**, supporting **ocean temperature** and **sea level** monitoring, **ecosystem health**, **resource planning**, **environmental risk assessment**, and **maritime spatial** planning, while also informing policies.

More specifically, the spatial and temporal resolution of marine data has been enhanced through the increased deployment of **in-situ observation platforms** (e.g., Argo floats, gliders, high-frequency radar systems) among the research community. **Satellite observations**, while valuable, rely on in-situ measurements for validation. However, the lack of international ownership in coordinating these efforts has resulted in a fragmented system of sensors and floats, limiting research progress. Technological innovations, such as **AI-based fish classification systems**, continue to support biodiversity and food monitoring.

The main marine EO applications relevant to the scope of this report include the detection of **plastic slicks**, **algal blooms**, **sediment transport**, and **fish stock modelling**. From a market perspective, they also extend to **IUU** (illegal, unregulated, and underreported) **fishing**, **catch optimisation**, and **aquaculture**. EO supports monitoring marine pollution, including **oil spills**, **sargassum**, **shoreline changes**, **erosion**, and marine **flooding**. Additionally, it plays a crucial role in addressing **eutrophication** and tracking environmental factors such as **ocean temperatures** and **heat**.

Despite the significant presence of remote sensing in marine applications, the European Ocean Observing Community (EOOC) still identifies **data and knowledge gaps** – particularly in in-situ data, inefficient management of marine resources, weak **international coordination**, and limited **public engagement** as key challenges for marine researchers.
The Marine Action Group (MAG) aims to bridge such gaps in order to improve **ocean management**, support **climate resilience**, and enable sustainable management of marine resources such as **fisheries**, **aquaculture**, and **coastal ecosystems**. These priorities effectively align with MAG's core application areas and key domains outlined in the Methodology section.

Policy Context

EO can address marine challenges such as monitoring ocean health, tracking marine pollution, supporting sustainable fisheries, observing coastal erosion, and assessing the impacts of climate change on marine ecosystems by providing **accurate, timely, global and transparent data** that can generate **actionable insights**. In this context, policies are increasingly promoting the use of EO data, products, and services to support marine management, conservation practices, and reporting obligations. The growing integration of EO in the marine domain is also reflected in **rising investment** in relevant research and innovation activities, as shown in the graph on the right, generated with the help of the RIO.

Fig. 1: Evolution of EO R&I Marine Budget (€M) and Key Policy Shifts

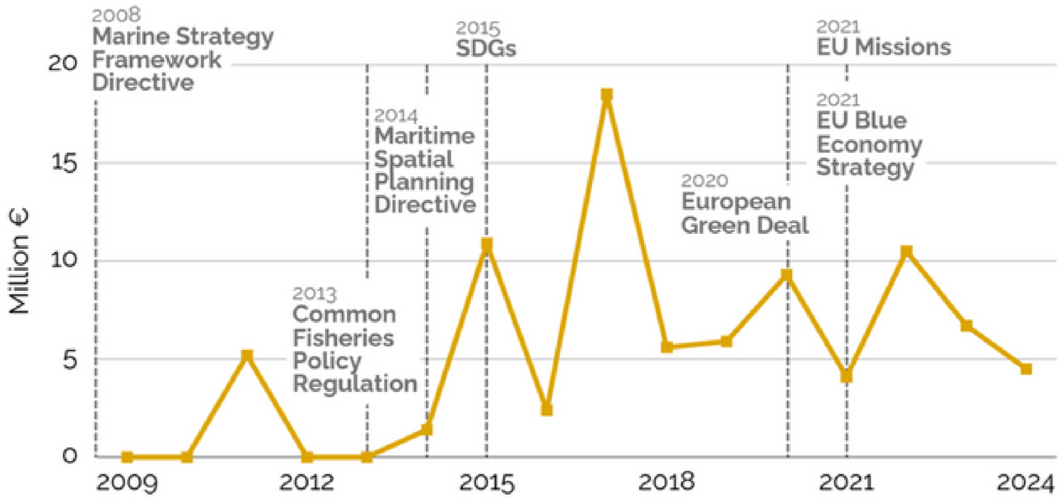


Figure 1 depicts the fluctuations in budgets for EO-related R&I efforts in the marine segment, generated with the sampled data of 42 projects extracted from the R&I Observatory. This data has been mapped against specific EO marine applications (see **Methodology** section) and complemented with annotations of relevant policy implementations or changes to analyse the potential correlation between the two. There is evidence of increasing investment over time, with a fluctuating trend and notable peaks, such as in 2017. However, it remains unclear which policy correlates with this peak, and the dip in 2024 raises further questions.

Frameworks such as the **European Green Deal** (EGD), the United Nations (UN) **Sustainable Development Goals** (SDGs) and the **UN Decade of Ocean Science for Sustainable Development** are also shaping the future of sustainable marine management and climate-resilient coastal regions. The EGD, the EU's overarching strategy to achieve climate neutrality by 2050, reinforces the protection and sustainable use of marine and coastal ecosystems through initiatives that promote biodiversity conservation, reduce **pollution**, support **adaptation to climate change**, and foster a **sustainable blue economy**. In this context, EO plays a critical role in delivering the high-resolution data needed to monitor and assess marine environmental conditions in real time and over the long term. This is also reflected by ongoing EO R&I efforts, where for the area of **climate change adaptation and resilience** in a marine context **18 projects** were identified for the analysed period, with a **combined budget of ca. €33M** for such applications.

As part of the EGD, policies such as the **EU Biodiversity Strategy for 2030** and the **Zero Pollution Action Plan** call for a significant reduction in pressures on marine biodiversity and habitats, coming from e.g., ship pollution, plastic, debris, or marine litter. Additionally, the EU's **Natura 2000** restoration network and **Nature Restoration Regulation** include provisions that will positively impact the marine environment. These goals have driven the launch of multiple EO-based R&I projects focused on **marine litter** detection, plastic debris transport modelling, or pollution hotspot identification. For the analysed period, **12 projects** have been identified that have been funded with **combined budgets of ca. €32.5M** for such applications specifically, aimed at improving marine water quality monitoring and supporting evidence-based policy implementation across EU Member States.

Further EU initiatives align closely with the EGD in driving the uptake of EO in marine contexts: The **EU Missions in Horizon Europe** (HE), specifically the **Adaptation to Climate Change** and **Restore our Oceans and Waters** missions, are funding solutions for e.g. coastal zone management, **marine flooding** prediction, and **shoreline change** monitoring. These Missions promote partnerships between different marine/maritime stakeholders to pilot and scale new solutions, including EO-based approaches. For the analysed period, **13 projects** have been identified that address shoreline changes with a **combined budget of ca. €27.5M**. A further **two projects** target marine inundation with **combined budgets of ca. €1.9M**. EO-based data also enables forecasts for parameters such as sea level, salinity, ocean currents, or wave dynamics. Such data supports the objectives of the **EU Marine Strategy Framework Directive** (MSFD), which requires regular environmental assessments to help EU countries achieve a good environmental status (GES).

Policy Context

EO data supports measurement of MSFD indicators such as eutrophication, marine litter, biodiversity, seafloor integrity, or hydrographic conditions. **Eight projects** have been identified for the analysed period that address **eutrophication** with **combined budgets of ca. €10.4M** to support such applications. Complementing this, the **Maritime Spatial Planning (MSP) Directive** , formally known as Directive 2014/89/EU, aims to promote sustainable growth of maritime economies, sustainable development of marine areas, and the sustainable use of marine resources.

Regulation (EU) No 1380/2013, adopted in 2013, is the foundational document for the European Union's **Common Fisheries Policy** (CFP). It outlines the rules for managing fisheries to ensure **sustainable exploitation** of marine resources, economic viability of the fishing industry, and **availability** of **food supplies**. The **CFP** and the **EU Blue Economy Strategy** emphasise sustainable resource use and ecosystem-based management. EO is increasingly used to track fishing vessel activity to e.g. assess spawning grounds, monitor aquaculture sites, and ensure compliance with sustainable fisheries regulations. This is reflected by **15 EO-related R&I projects** in the area of **fisheries and aquaculture**, ongoing during the analysed period with **combined budgets of ca. €30M**. Supporting the EGD's objectives, financial instruments such as the **European Maritime, Fisheries and Aquaculture Fund** (EMFAF) and **EU Cohesion Policy** funds also include dedicated funding streams for marine sustainability, research, and innovation.

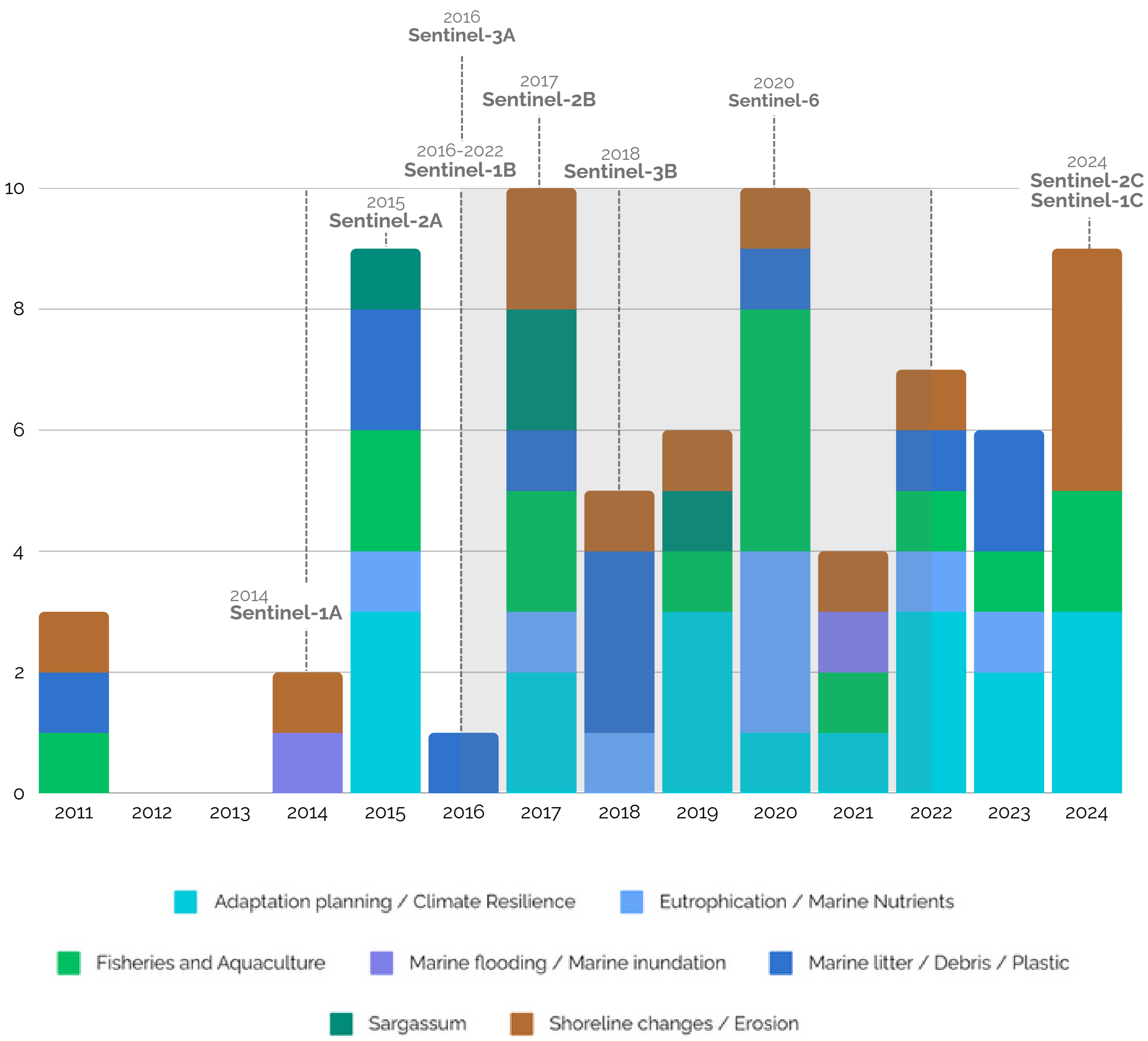
With links to climate change, **sargassum** influxes are an issue to be addressed at the intersection of most of the aforementioned policies. EO solutions can play a crucial role in monitoring, forecasting, and managing sargassum, supporting sustainable blue economy goals and enhancing resilience. In the analysed period, **four EO-related projects** were identified to address algae bloom or sargassum specifically, with a **combined budget of ca. €9M**.

Beyond the legislation of the EU, SDGs remain a key reference also for marine policy. **SDG 14: Life Below Water** sets targets for the sustainable use and protection of oceans and marine resources. Here, EO data is crucial to monitor indicators related to targets such as sustainable fishing, reduced pollution, or the conservation of coastal areas and ecosystems. **SDG 13: Climate Action** reinforces the need to monitor ocean-climate interactions such as ocean acidification, warming, and sea level rise, but also extreme weather events that affect coasts. Likewise, with oceans playing a key role in global food systems, **SDG 2: Zero Hunger** implies the need to monitor the oceans in support of food security. Other international frameworks such as the **UN Convention on the Law of the Sea** (UNCLOS), the **International Convention for the Prevention of Pollution from Ships** (MARPOL), or the **UN Decade of Ocean Science for Sustainable Development** also impose obligations to monitor, report, and act upon changes in marine environmental conditions.

In summary, European and international marine policies are **powerful enablers of EO adoption**. They demand robust, evidence-based decision-making for marine management, and EO data are uniquely positioned to fulfil this demand. As policies continue to evolve, they are expected to drive even greater investment and innovation in EO solutions that support a sustainable and climate-resilient ocean future.

Technological Perspectives

Fig. 2: Marine Project Count Timelines by Application & Sentinel Missions



The **Copernicus Marine Environment Monitoring Service** (CMEMS), which is the marine component of the Copernicus Programme of the European Union, exploits EO technologies by **integrating satellite and in-situ data** with advanced **numerical models** for improved marine environment predictions as well as real-time tracking. Notably, CMEMS and dedicated **EO platforms** such as those seen in *e-shape* pilots, aid in sargassum, aquaculture, and fisheries monitoring. CMEMS works closely with **EMODnet**, the European Marine Observation and Data Network, coordinating their work at various levels, including operational level, to provide the necessary and complementary open-access, free data to the stakeholders.

Focusing on the marine component of the Copernicus programme, **Sentinels-1, -2, -3 and -6** are relevant to our analysis.

The most prominent marine applications for **Sentinel-1**, further filtered by our core areas of interest, include **marine wave and wind** monitoring, **flood** monitoring and **oil pollution** monitoring. Sentinel-1 ocean products and **global ocean wave models** determine wave direction and height, which supports in **weather forecasting**. What's more, **Ocean Wind Field** (OWI) **products** aid in coastal area monitoring by providing wind speed and direction measurements. **Synthetic Aperture Radar** (SAR) facilitates flood monitoring by observing through cloud cover with frequent revisits. In areas where elevation data are incomplete, high-resolution **digital elevation models** (DEMs) generated using **Synthetic Aperture Radar Interferometry** (InSAR) from Sentinel-1 are used to monitor terrain changes and for flood modelling. Looking at Figure 2, a sizeable increase in R&I projects tackling **shoreline changes** and **climate resilience applications** is observed since the launch of Sentinel-1. The *AtlantOS* project (2015-2019) integrated CMEMS satellite data with in-situ observations to develop innovative observing systems, improving marine monitoring and supporting to climate resilience efforts.

Technological Perspectives

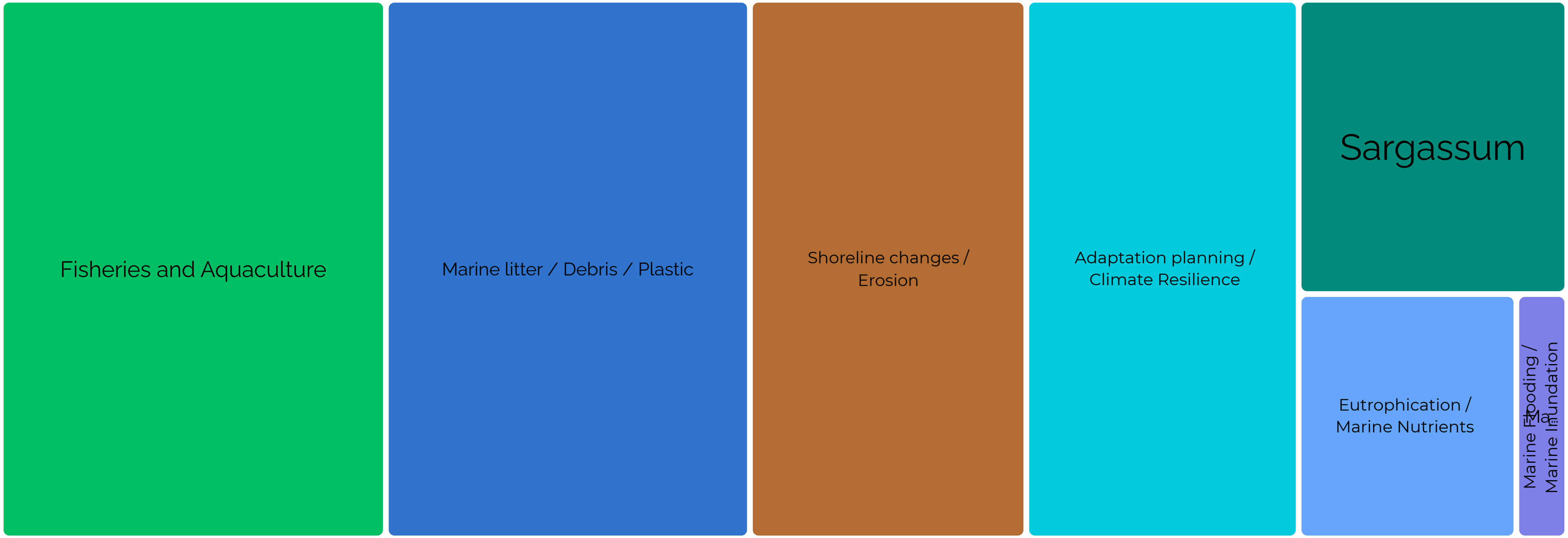
Emergency management, including dealing with marine inundation and marine litter tracking, are key applications of **Sentinel-2**. Sentinel-2 uses **multispectral imagery** in combination with **Artificial intelligence** (AI) and **supercomputer automation** to detect marine litter slicks or "litter windows" across the Mediterranean Sea. There is an uptake in marine debris-related projects from 2015 onwards, when Sentinel-2 was launched. The *AMAre* project (2016-2020) developed geospatial tools to monitor Marine Protected Areas (MPAs) in the Mediterranean, focusing on marine litter modelling and plastic source identification.

The main mission of **Sentinel-3** is to provide a multi-instrument capability to support the accurate parameterisation of topics such as Ocean Colour (OC), Sea Surface Height (SSH) and Sea Surface Temperature (SST). Together with SST, OC can be used to support the accurate estimation of oceanic carbon fluxes. The **altimetry instrument** on board Sentinel-3 will support marine applications such as **oceanography**. Some other Sentinel-3 marine monitoring applications include **coastal zone management**, **algal bloom** monitoring, and **climate change** assessment.

The threat of sea-level rise to coastal communities due to climate variability led to the launch of **Sentinel-6** in 2020, a mission that will be complemented by the launch of its second satellite in 2025. Sentinel-6's one-year tandem flight with satellite **Jason-3**, using **radar altimetry**, will ensure continuity with **simultaneous low- and high-resolution** measurements. There has been a noticeable increase in research projects dealing with **coastal change** and **adaptation planning**. The *CoastObs* project (2017-2021) used EO and Sentinel technologies to develop a service platform for coastal water monitoring with the aim of establishing sustainable supply chains.

The research community is increasing the accuracy of fish stock forecasts by integrating **AI**, **Big Data**, and **autonomous robotics** (Remotely Operated Vehicles – ROVs, Autonomous Underwater Vehicles – AUVs). These technologies are also invaluable for analysing water quality and ensuring the traceability of fish stocks. *FORCOAST4*, *HiSea*, and *CERTO* are just a few examples of **EO-driven platforms** supporting water quality and eutrophication monitoring for an improved aquaculture planning and nutrient load mapping. Moreover, the monitoring of marine habitats, sediment transport, and coastal changes is further improved through the use of **Digital Twins** and **predictive modelling tools**. Finally, it is crucial to mention technological innovations such as **environmental DNA** (eDNA), **metabarcoding** and **AI-based classification systems**, as these play a key role in transforming biological monitoring.

Fig. 3: Budget Distribution for EO-Related R&I in Marine



With accelerating **climate change**, **pollution**, and **overexploitation of marine resources**, optimising ocean monitoring and management is essential for ensuring sustainable use while minimising environmental impact. EO plays a crucial role in tackling critical challenges such as declining **fish stocks**, **habitat degradation**, **marine pollution**, and the impacts of ocean warming and acidification.

Marine environments are a primary source of biodiversity and food, crucial in mitigating the effects of climate change and play a major role in the global economy and its various sectors. Global revenues from EO data and service sales for fisheries and aquaculture alone are expected to increase from about €50M in 2023 to more than €100M in 2033🔗. The marine market is dominated by applications such as **water quality monitoring**, support for **fisheries and aquaculture**, **coastal zone management**, or oceanographic and **climate studies**. This is confirmed by the analysed EO-related R&I activities, where projects active during the past 10 years amounted to at least **18** related to **adaptation planning and climate resilience** with combined budgets of close to **€33M**, **15** addressing **fisheries and aquaculture** with combined budgets of more than **€30M**, **12** projects related to **marine litter and pollution** with combined budgets of nearly **€33M**, and **13** projects with a focus on **shoreline changes and erosion** and a combined budget of close to **€28M**. The *FORCOAST* project (2019-2022)🔗 addressed fisheries and coastal management applications with the integrated use of Copernicus Observation products with local patterns and diverse data sources in eight European pilot sites.

The growing global demand for seafood, alongside challenges like **overfishing** (as well as **illegal, unreported and unregulated fishing** – IUU), **habitat degradation**, and climate-driven ocean changes, is accelerating the need for precision approaches in **fisheries and aquaculture**. EO technologies enable operators to monitor **water quality**, track **fish movements**, and assess **marine ecosystems** remotely and in near real-time. This supports **sustainable harvests** and improved resource management while reducing environmental impact. Applications such as **site selection**, IUU detection, or aquaculture operations optimisation already represent significant market potential.

Market Trends

The increased threat of **marine litter**, **pollution**, and **debris** – caused by increasing coastal activity, plastic use, and inadequate waste management – drives the need for **monitoring** solutions. EO enables the **detection, tracking, and assessment of pollutants** across marine environments, including floating debris, oil spills, and nutrient runoffs. This enhances response efforts, informs policy, and supports mitigation strategies while reducing long-term ecological damage. EO solutions improve situational awareness, guide clean-up operations, and contribute to healthier marine ecosystems.

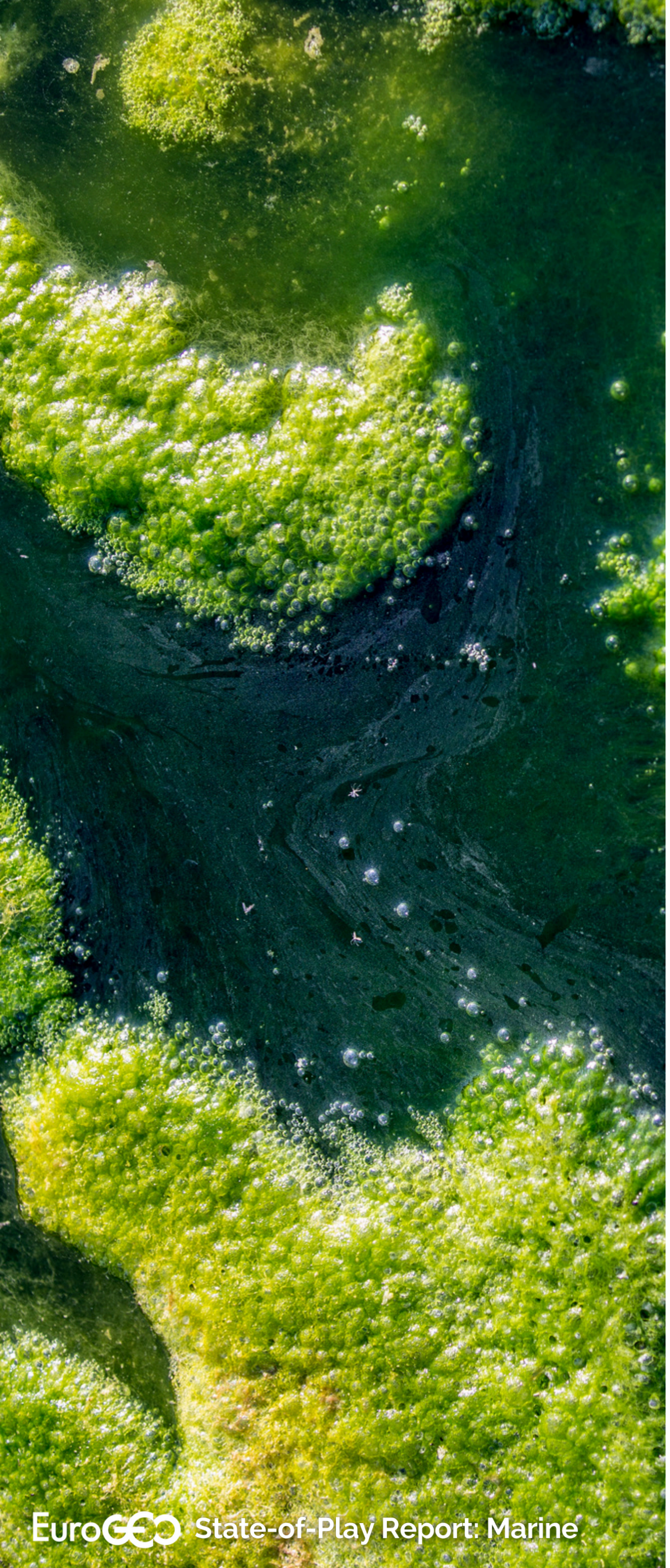
Rising sea levels, extreme weather events, and coastal development activities are accelerating **shoreline changes and erosion**, putting infrastructure, ecosystems, and communities at risk. EO provides tools for **monitoring** coastal dynamics, detecting erosion patterns, and assessing shoreline retreat over time, supporting coastal **planning**, **risk mitigation**, and **adaptation** strategies. Applications such as historical shoreline mapping, real-time erosion monitoring, and predictive modelling of coastal changes are becoming increasingly vital.

Marine flooding and coastal inundation are a threat to coastal populations, ecosystems, and infrastructure. EO enables monitoring **flood risks**, mapping **vulnerable zones**, and **assessing impacts** during and after inundation events. This supports **early warning**, **emergency response**, and **resilience planning** with applications such as **flood mapping**, storm surge modelling, and the analysis of trends in historical inundation data. Only **two** projects have been identified for the analysed period, that have combined budgets of **€1.9M**. The *ECFAS* project (2021-2022)🔗 used satellite and sensor data to create advanced tools and applications for enhanced flood monitoring. It developed a proof of concept for a European Coastal Flood Awareness System to improve preparedness and recovery in coastal areas.

Beyond coastal areas, climate change is reshaping whole marine environments, driving demand for solutions related to **adaptation planning** and enhanced **climate resilience**. EO delivers data to **assess vulnerabilities**, monitor ecosystem shifts, and support scenario modelling, enabling evidence-based resilience strategies. Key applications include habitat vulnerability assessments, sea level trend analysis, and climate risk mapping for infrastructure and communities.

Influxes of **sargassum** in coastal and open ocean regions have become a growing environmental, economic, and public health concern, impacting fisheries, tourism, and marine ecosystems. EO technologies enable **detecting**, **tracking**, and **forecasting** sargassum blooms. This allows for **early warning** and timely **mitigation** responses. Applications include sargassum **density mapping**, **drift trajectory** modelling, and **hotspot** identification. For the analysed period, only **four** projects have been identified that addressed sargassum specifically through core activities, with a combined budget of about **€9M**.

By integrating EO data with other advanced technologies, the marine sector can shift toward more sustainable, resilient, and informed management of ocean and coastal resources. As global initiatives and policies increasingly prioritise ocean health, climate adaptation, and sustainable blue economy development, EO will be a key enabler of their implementation.



Projections

Looking ahead, and aligned with the goals of the EU Biodiversity Strategy for 2030, the use of **EO-dedicated sensors** for **detecting marine plastics** and **improving** the **identification** of **1m-sized floating debris** is highly anticipated. Current sensors are not yet specifically designed to detect plastic, but the detection capability would be significantly enhanced by deploying observation technology tailored for ocean plastics and floating objects into orbit.

Further, Earth Observation technologies are expected to advance the monitoring of **climate impacts** on **eutrophication**, **marine flooding risks**, **shoreline dynamics** (e.g., erosion and sediment transport), and **habitat changes**. EO's accuracy and real-time nature will lead to more effective decision-making and policy development. These projections are reinforced by the priorities of the EGD and the UN's SDGs.

The **European Digital Twin of the Ocean** (EDITO) initiative will transform marine forecasting and ecosystem modelling with the creation of a digital replica of the ocean. By integrating real-time and historical data with advanced models, EDITO will enable precise simulations of future ocean scenarios.

Although these practices are already pivotal, further growth of **service platforms that integrate EO**, **in-situ data**, **AI**, **robotics**, and **citizen science** is expected as well as essential to meet marine governance and biodiversity goals.

Sentinel Expansion missions are being developed to address EU policy and Copernicus user needs, enhancing the Copernicus Space Component. Key missions include CHIME and LSTM for coastal and water monitoring, and Rose-L for maritime safety. Additionally, the *AQUA SUP* project integrates and leverages CHIME and LSTM data to improve water quality monitoring, including marine ecosystems like seagrass and algae.

Though largely beyond this report's scope, the following near-future considerations directly impact its applications. Based on insights from the 2024 Marine User Days, the **prioritisation of offshore marine energy and maritime security** is expected to push other maritime activities to secondary importance. Additionally, the need for ships to re-route and analyse marine data for fuel efficiency is driving efforts towards significant improvements in **operational efficiency**.

Overall, the projected advancements in marine technology present substantial opportunities for the EuroGEO community to shape new regulatory frameworks, refine predictive analytics for ocean management, and strengthen resilience planning for coastal zones.

EuroGEO Contribution

Increasing the impact and involvement in research and innovation is a key priority for the Marine AG, achievable through **facilitating connections** for increased **knowledge sharing** within the EOOC. Beyond interactions within the research community, the MAG allows for **cross-sector collaboration** and **policy alignment**. Leveraging the **GEO Knowledge Hub** open-source repository, EuroGEO can contribute to the centralisation of ocean observation data by addressing the **gaps in data stream compatibility**, ultimately improving accessibility for sustainable governance. There is currently a need to further promote **coordination between the Action Groups**, which could be done by organising annual summits (beyond the time they meet annually for the EuroGEO workshops), inviting only EuroGEO AG members to brainstorm and organise sessions with members of different AGs in the same workshop, which is not currently the case. Some benefits for participants could be cross-sectoral awareness of their institutions and organisations through networking activities and poster sessions.

Some *e-shape* pilots effectively addressed and contributed to relevant EuroGEO MAG areas, e.g., sargassum, fisheries, aquaculture, illustrating EuroGEO's interest and support for **downstream innovation** in marine EO services. This could be achieved through targeted webinars for the different stakeholders (i.e., policymakers and practitioners of any origin, whether from industry, service providers, or researchers).

EuroGEO's MAG aims to continue **aligning EU EO initiatives with GEO's global objectives** and **supporting Copernicus evolution** through stakeholder co-design. This is extremely valuable for bridging EU-funded projects with EuroGEO/GEO activities in order to stimulate new developments. Such activities typically take place in global forums or yearly workshops of the GEO and EuroGEO caucus.

At a higher level and to strengthen project and team commitments, the MAG could play a role in **collaborative frameworks** where these are defined and have a formal structure, such as a dedicated secretariat or, at GEO level, the GEO Working Groups. Moreover, EuroGEO will continue to invest in ongoing efforts to act as catalyst for funding synergies and capacity building among stakeholders and thematic experts. Given a formal structure for the group, such efforts could be harnessed through **targeted marine core application-specific meetings**, capitalising on the diversity in the roles and expertise of MAG Members. Coordinating the infrastructure of EuroGEO and GEO with the **EDITO** initiative would also be of great value.

In conclusion, for R&I in the marine sector, EuroGEO's priorities should align with the most in-demand applications, such as **fisheries and aquaculture** and **marine litter**. These application areas also align closely with the key objectives of the EU Biodiversity Strategy for 2030 and the EU Blue Economy Strategy. At the same time, they are also on the rise in terms of R&I budget allocation.

Glossary

InSAR	Synthetic Aperture Radar Interferometry
IUU	Illegal, unreported and unregulated fishing
KCEO	Knowledge Centre on Earth Observation
MAG	Marine Action Group
MARPOL	International Convention for the Prevention of Pollution from Ships
ML	Machine Learning
MPAs	Marine Protected Areas
MSFD	Marine Strategy Framework Directive
MSP	Maritime Spatial Planning Directive
OC	Ocean Colour
OWI	Ocean Wind Field
R&I	Research and Innovation
RIO	R&I Observatory for Earth Observation
ROVs	Remotely Operated Vehicles
SAR	Synthetic Aperture Radar
SDGs	Sustainable Development Goals
SoP	State of Play
SSH	Sea Surface Height
SST	Sea Surface Temperature
UN	United Nations
UNCLOS	UN Convention on the Law of the Sea
WP	Work Package

AG	Action Group
AI	Artificial Intelligence
AUVs	Autonomous Underwater Vehicles
CFP	Common Fisheries Policy
CMEMS	Copernicus Marine Environment Monitoring Service
DEMs	Digital Elevation Models
eDNA	Environmental DNA
EEA	European Environment Agency
EGD	European Green Deal
EMFAF	European Maritime, Fisheries and Aquaculture Fund
EMODnet	European Marine Observation and Data Network
EO	Earth Observation
EOOC	European Ocean Observing Community
ESA	European Space Agency
EuroGEO	Europe’s part of the Group on Earth Observations (GEO)
EUSPA	European Union Agency for the Space Programme
GES	Good Environmental Status
HE	Horizon Europe
HPC	High-Performance Computing

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Disclaimer: This report is submitted as a final version for deadline purposes but remains **pending review by the Marine Action Group**. Revisions may follow based on their expert feedback.

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