D4.1 BEST PRACTICES ROADMAP REPORT

EO-FIN

Prepared by:	London Economincs (Clio von Petersdorff)
	GMV (Rahman Momeni and Enes Hisam)
Approved by:	Rasmus Flytkjaer
Authorised by:	Rahman Momeni

Code:	D4.1
Version:	1.0
Date:	04/07/2024
Internal code:	GMV 24178/24 V1/24

DOCUMENT STATUS SHEET

Version	Date	Pages	Changes
1.0	07/05/2024	27	

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

REFERENCE DOCUMENTS

The following documents, although not part of this document, amplify or clarify its contents. Reference documents are those not applicable and referenced within this document. They are referenced in this document with footnotes which further use notation in the form [RDx].

Table 1-1 - Reference Documents

Ref.	Document ID.	Title	Rev.
[RD1]	Proposal	Proposal "EO-FIN Best Practice for Financial Management Support"	
[RD2]	PMP	The project management plan	
[RD3]	D1.1	Workshop-1 summary report	1
[RD4]	D1.2	EO-FIN-Geoinformation requirements report (draft)	0.1
[RD5]	D1.2	EO-FIN-Geoinformation requirements report (final)	1
[RD6]	D2.1	EO-FIN Current EO Capabilities Report (draft)	0.1
[RD7]	D2.2	EO-FIN-Current EO Capabilities Report (final)	1
[RD8]	D2.2	EO-FIN-Gap analysis report	
[RD9]	D2.3	EO-FIN-Workshop-2 summary report	
[RD10]	D3.1	EO-FIN-Prototype identification (draft)	0.1
[RD11]	D3.1	EO-FIN-Prototype identification (final)	1
[RD12]	D3.2	EO-FIN- User feedback/lessons learned report	

ACRONYMS

Acronyms used in this document and needing a definition are included in the following table:

Table 1-2 - Acronyms

Acronym	Definition
AI	Artificial Intelligence
CGLS	Copernicus Global Land Services
CHIME	Copernicus Hyperspectral Imaging Mission for the Environment
CO2M	Carbon Dioxide Monitoring
DLR	German Aerospace Centre
ECB	European Central Bank
ECMWF	European Centre for Medium-Range Weather Forecasts
EO	Earth Observation
EO-FIN	Project title for the current work
ERA5-land	ECMWF Reanalysis
ESA	European Space Agency
ESG	Environment, Social, Governance factors
FM	Financial Management
GHG	Greenhouse Gas
GNSS	Global Navigation Satellite System
LSTM	Copernicus Land Surface Temperature Monitoring
MAIA	NASA Multi-Angle Imager for Aerosols
MODIS	Moderate Resolution Imaging Spectroradiometer
NASA	National Aeronautics and Space Association
NISAR	NASA-Indian Space Research Organisation Synthetic Aperture Radar
R&D	Research and Development
ROI	Return on Investment
ROSE-L	Radar Observing System in L-band
UX	User Experience

1. EXECUTIVE SUMMARY

This report presents a roadmap for increasing the adoption of the Earth Observation (EO) technology into the financial management (FM) sector. This roadmap builds upon all previous deliverables within the EO-FIN project and as such highlights current applications of EO in the FM sector, as well as the future outlook of EO in the FM sector.

The current environment section details the present use of EO in the sector, the state of EO technology, including sensors and satellite products, and the key challenges such as high costs, a lack of geospatial skills, and complex IT system integration. The future outlook section offers a gap analysis, lessons learned from recent EO advancements, and potential future developments.

The future outlook section conducts a gap analysis to identify areas needing improvement and shares lessons learned from recent advancements in EO capabilities. It explores the potential future developments in EO technology that could further benefit FM.

The roadmap outlines suggested activities to address the identified gaps and challenges, providing a detailed plan for the adoption and integration of EO technology. Crucially the roadmap suggests activities for a variety of stakeholders, including the EO industry, Public sector and FM firms, to foster cross-sector collaboration. The suggested activities identified within this report are:

- **Define the Vision for Collaboration**: Establish a comprehensive vision for EO-FM integration through stakeholder consultations and strategic roadmap development.
- **Identify and Address Regulatory Barriers**: Conduct regulatory assessments, engage with authorities, and develop strategies to mitigate regulatory hurdles and promote EO data compliance.
- **Explore the Use of Artificial Intelligence (AI)**: Identify pain points and develop pilot projects to integrate AI with EO data, enhancing processing and decision support.
- **Increase Visibility of EO for FM Products**: Raise awareness of EO data's value through workshops, conferences, and other events.
- **Increase Uptake of EO Data Use in Public Sector**: Develop EO products tailored to public sector needs and collaborate with public institutions to promote adoption.
- **Develop Products for Non-Technical Users**: Create user-friendly EO tools and dashboards, involving end-users in the development process to ensure usability.
- **Provide Training and Support for EO and FM Professionals**: Develop training programs to enhance understanding and skills in both sectors, fostering innovation and collaboration.
- **Greenhouse Gas (GHG) Emissions Monitoring R&D**: Support R&D initiatives for EO-based GHG monitoring, collaborating with environmental agencies and research institutions to improve technology.

2. INTRODUCTION

The EO Best Practice for FM (EO-FIN) project is a collaborative initiative bridging the Earth Observation (EO) and Financial Management (FM) sectors. The main aim of the EO-FIN project is to understand the FM sector's requirements for geospatial information and what the current and near future capabilities of EO are to support the FM sector's needs for Geospatial services. The project involved a collaboration between GMV and London Economics, as well as drawing from many experts in both sectors through surveys, workshops, and one-to-one interviews.

Through these efforts, EO-FIN collected and consolidated the geospatial needs of the FM sector (D1.2 Geo-Information Requirements report [RD5]), identified and consolidated corresponding EO capabilities (D2.1 Current EO Capability report [RD7]), and highlighted gaps hindering the FM sector's utilisation of EO capabilities (D2.2 Gap Analysis report [RD8]). EO-FIN seeks to identify the best practices allowing the EO industry to respond to these requirements through high-quality, standardised, EO products and services. This final report consolidated all evidence that has been collected to define a roadmap for the implantation of EO best practices.

Within this study, the FM sector includes Investment Management, Risk management, Insurance Management, and Green Finance.

- **Investment Management**: services including asset allocation, stock allocation, monitoring of existing investments, and portfolio strategy and implementation.
- **Risk Analysis**: the process of identifying, assessing, and managing financial, legal, strategic, and security risks to an organisation's capital, operations, and earnings.
- **Insurance Management**: services including the provision of insurance contracts, underwriting, ongoing and post-event asset evaluation, and claims against policies.
- **Green Finance**: financial activities that support the development of a greener future, and/or mitigate negative impacts that arise from environmental pollution and climate change.

2.1. INTRODUCTION TO THE ROADMAP

One of the key objectives of the EO-FIN project was to establish a roadmap for the use of EO data by the FM sector. To meet this objective, it was necessary to fully understand the needs and requirements of the FM sector. As part of the project, already existing technologies and capabilities which address these needs were identified. However, some EO products may need some refinement to fully meet the needs of the insurance sector and make it a suitable support for financial products. This might be due to missing technologies and methodologies or rather just finding the right format and combination of suitable EO products to fit into the existing daily workflows of the FM sector.

With all the information collected to date, further steps are needed to support the EO and FM industries. A roadmap serves as a strategic blueprint, delineating the necessary activities to achieve specific outcomes. The roadmap presented in Section 5. provides a detailed outline of activities required to achieve the objectives of the EO-FIN project, and to close the gaps between the EO and FM sectors.

2.2. HOW EO CAN BENEFIT THE FINANCIAL MANAGEMENT SECTOR

Each of the four domains within the scope of this project has an inherent need for accurate, timely, and comprehensive data to make informed decisions, manage risks, and ensure regulatory compliance. Geoinformation is increasingly viewed as one source of alternate data to drive further improvements across these domains. Real-time and historical data derived from EO satellites has the potential to meet many of the sector's needs as it provides a unique spatial perspective, offering insights into physical assets, infrastructure, and environmental conditions that directly impact financial operations. It can enable financial professionals to make well-informed decisions and enhance risk assessments and asset valuations. Moreover, EO data contributes to monitoring and predicting economic trends by analysing factors such as agricultural production, commodity supply chains, and urban development.

Investment Management

Investment Management is defined relatively broadly for the purposes of this study. The industry is highly diversified, with capital allocated across a wide range of asset classes and investment

strategies. Capital is entrusted to investment managers who invest on a client's behalf to deliver a return, mitigate risk, and/or deploy capital in line with particular principles/ethical frameworks.

EO capabilities can provide valuable information for commodity trading for industries heavily reliant on commodity prices, such as agriculture, energy, and mining. In particular, as EO capabilities can track agricultural activities, land use changes, and weather patterns, financial professionals can anticipate crop yields, assess potential disruptions, and make informed decisions about commodity investments.

Satellite imagery can also provide real-time data on construction projects, transportation networks, energy facilities, and other critical infrastructure. This information enables financial institutions and investors to gauge the progress of large-scale projects and make more accurate investment decisions.

EO products can also contribute to the evaluation of real estate markets. By providing information about urban development and population density, satellite imagery and geospatial data aids in property valuation and urban planning decisions.

Constraints which take into account environmental, social, or governance (ESG) considerations are increasingly common. These constraints may be accompanied by associated due diligence and reporting requirements which increase the operational cost of investment management. Given these cost drivers, as well as increasing regulatory, political, and social pressure for investment managers to respond to ESG issues such as climate change and ethical supply chains, the adoption of new technology may be of critical interest to this competitive industry. Tools such as satellite-based Earth Observation and associated analytics may offer new insights into prospective assets or streamline compliance with certain ethical frameworks. Through enhanced insight, cost savings over other in-situ measurements, or improved timeliness, geoinformation-based insights may enhance an investment manager's product offering.

Green Finance

For this study, Green Finance includes structured financial activities, products, or services, that have been created to support environmental objectives, encourage the development of green projects or minimise the climate impact of projects. These products seek to foster the development of greener business practices, operating models, and a sustainable economy as a whole. For example, green bonds can be obtained to finance projects aimed at energy efficiency, pollution prevention, sustainable agriculture, fishery and forestry, the protection of aquatic and terrestrial ecosystems, clean transportation, clean water, and sustainable water management. They also finance the cultivation of environmentally friendly technologies and the mitigation of climate change.

There is scope for EO and geospatial data to be utilised by green finance, as these data sources provide valuable information and insights that can enhance decision-making processes related to environmental sustainability, climate change mitigation, and green investments. Some ways in which the green finance sector can leverage EO and geospatial data include:

- **Due Diligence**: EO data can be used to monitor land-use changes, deforestation rates, water availability, and other indicators relevant to climate-related risks. This information helps financial institutions and investors evaluate potential projects' environmental impact and sustainability.
- **Impact Monitoring and Reporting**: EO data can enable the monitoring of projects funded through green finance mechanisms, including tracking carbon emissions, conservation efforts and renewable energy generation. Transparent and accurate impact reporting is crucial for demonstrating the effectiveness of green investments and ensuring accountability.
- **Monitoring carbon offsetting**: EO data can be used to monitor carbon offsetting projects and provide metrics for voluntary carbon markets. This can lead to greater confidence in these markets.

Risk Analysis

Risk Analysis, in this study, includes the process of identifying, assessing, and managing financial, legal, strategic and security risks to an organisation's capital, operations, and earnings. Financial institutions typically have a Risk Management function to ensure they identify and manage these risks in order to mitigate exposure and impact. These functions typically focus on "material risks", which have the potential to significantly impact the institution financially.

EO capabilities offer insights into environmental factors that can impact businesses and financial assets. For instance, monitoring natural disasters, climate change effects, and environmental regulations help financial institutions assess the physical risks their investments might face. This data can guide the development of risk models and influence lending, insurance, and investment strategies.

Insurance Management

For this study, the Insurance Management industry is defined as the section of the finance industry that provides risk management solutions in the form of insurance contracts. Insurance contracts serve as a hedge against uncertain or contingent losses to assets or occurrences which may impact business operations. The contract, or insurance policy, details the conditions and circumstances under which the insurer will compensate the policyholder or their designated beneficiary.

Geoinformation can add value across the full range of insurance industry activities. For example, geoinformation can be used in the following ways:

- **Validating self-reports**: Insured assets can often be observed through satellite-based EO-provided geoinformation. Self-reported asset inventories and states can then be validated against remotely captured data on the asset's condition.
- **Assess claims against policies**: Pre- and post-claim geoinformation can be used to rapidly assess the extent of insurance pay-out required, enabling a faster, more accurate, and less costly claims process.
- **Parametric insurance products**: Insurance policies that automatically pay based on measurable events (e.g. storms, earthquakes, crop damage) can be directly supported by geoinformation, and are particularly advantageous in cases where other data is often poor or unavailable, such as rural or less developed (or both) regions.
- **Expanding coverage**: The ability to remotely monitor assets, and hence add value through validation, assessing, and creating new financial products can mean satellite-provided EO geoinformation allows expansion of coverage to areas previously deemed too remote or unprofitable.

2.3. PROJECT BREAKDOWN STRUCTURE

Error! Reference source not found. shows the EO-FIN project breakdown structure by describing the entire scope of the EO-FIN project, and the distribution of the work among the three teams that form part of the consortium: GMV-NSL, London Economics, and GMV AD. Overall, there are five WPs defined, namely:

- WP1. Collection of geoinformation requirements and associated constraints (corresponding to Task 1 in the SoW)
- WP2. Definition of current EO capabilities and use (corresponding to Task 2 in the SoW)
- WP3. Development of a service prototype (corresponding to Task 3 in the SoW)
- WP4. Development of a best practice roadmap (corresponding to Task 4 in the SoW)
- WP5. Overall management

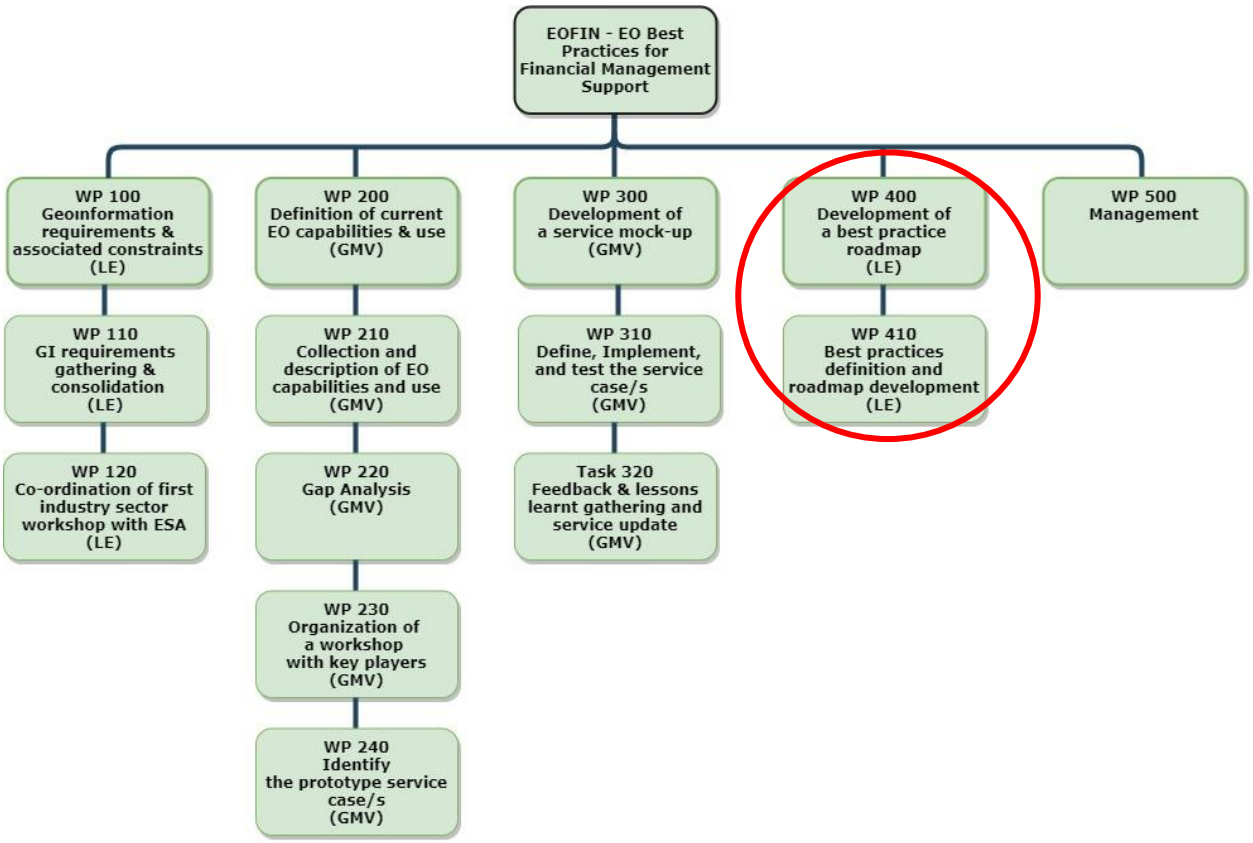

Figure 1. EO-FIN work breakdown structure.

3. CURRENT ENVIRONMENT

This section provides an overview of current EO data utilisation within the FM sector. It begins with a discussion on the current applications and benefits of EO data in FM operations, including examples of its use. Subsequently, it provides an overview of the existing state of EO technology relevant to FM, drawing insights from the *D2.1 Current EO capability* report [RD7]. Additionally, the section identifies key challenges and requirements faced by the FM industry in harnessing EO technology, based on findings from the *D2.2 Gap Analysis* report [RD8].

3.1. HOW IS EO CURRENTLY BEING USED IN FINANCIAL MANAGEMENT?

Many FM organisations currently use or are considering incorporating, geospatial data into their decisions. Based on stakeholder engagement during this project, the reported use of geospatial data was highest for individuals working in Risk Analysis, with 47% of participants' organisations currently using or considering incorporating geospatial data. Across the remaining three domains, between 28% - 36% of participants' organisations use or are considering incorporating geospatial data into their activities.

The desk-based review identified several macro drivers for geospatial data use cases across financial services activities. These macro drivers are:

- **Demand from un- and underserved markets**: In many markets demand for new or existing financial products is not met. Not all demand can be met – sometimes this is simply a case of willingness to pay and cost not intersecting, leaving communities unserved for banking, insurance, or savings products, other times financial institutions lack information to appropriately evaluate and price risks and due to these frictions do not enter these markets. EO data can and is already enabling the expansion of an existing market. For example, Descartes Insurance developed the first product to insure solar installation owners against damages from hail. This has been possible by using satellite data in two parts of the process. First, Descartes Labs developed a machine learning approach relying on a combination of EO data and computer vision methods to locate all solar plants worldwide.[1] Second, they utilised EO data in estimating future hail patterns used to define pay events and payouts as part of a parametric insurance product.[2]
- **The rise of voluntary and mandatory environment, social, and governance (ESG) frameworks**: A rise in regulatory initiatives targeting action on climate change, sustainable development, as well as ESG goals has created new data needs for businesses everywhere. The financial sector in particular is singled out by regulators worldwide as a key avenue to realising a shift to economies that operate sustainably. As the mediator of large financial flows into all corners of the global economy, the financial sector is a centrepiece of these agendas. Disclosure frameworks are key drivers of demand for geoinformation in the finance sector. Disclosure frameworks require financial sector companies to understand the specific climate, nature, and ESG characteristics of their investee or loan portfolios, which have often not been assessed before and for which data is not readily available. As many of the disclosure requirements require data to be monitored at the asset and sub-asset level this introduces geolocation data requirements. Some provide strong applications for the space sector, for example, the provision of granular physical climate risk data, hazard vulnerability, deforestation, or biodiversity data. As disclosure frameworks are adopted by more companies and across more jurisdictions, these geoinformation needs will only increase over time.
- **Initiatives to green the financial system:** The financial sector plays a large role in determining the direction and composition of the economy by directing financial flows. Where these financial flows go also determines the stability of the economy overall, demonstrated by the fallout from the 2008 global financial crisis. Climate change is another source of risk that could systematically threaten the long-term stability of the financial system. To manage the risk climate change poses, central bankers are increasingly seeking to understand the implications of climate change for financial stability. For example, in 2021 the European Central Bank (ECB) performed an economy-wide climate stress test exercise, covering climate transition and physical risks. The ECB modelled common risk types for approximately 4 million European firms using geolocated risk scores,

[1] Kruitwagen et al (2020) A global inventory of photovoltaic solar energy generating units. Nature, 598:604-610.
[2] https://descartesunderwriting.com/whitepaper/parametric-hail-insurance-white-paper/

drawing heavily on EO data to model different physical hazards including floods, sea-level rise, wildfire, water stress, heat stress, and hurricanes and typhoons.

3.2. WHAT IS THE CURRENT STATE OF EO TEHCNOLOGY?

The current state of EO technology for the FM sector includes diverse sensors and satellite data sources such as ESA's Copernicus programme and commercial providers like Planet Labs, offering high-resolution data. These technologies, along with satellite-based products like ERA5-land and Copernicus Global Land Services (CGLS), provide detailed climate, land cover, and vegetation information, aligning with FM sector needs.

A full discussion of the consolidated EO capabilities that respond to the FM geo-information needs can be found in the D1.2 *Geo-Information Requirements* report [RD5]. In the following subsections, we summarise these current EO capabilities with regard to relevant EO sensors, satellite-based and reanalysis products, and EO products and services.

3.2.1. SUMMARY OF RELEVANT EO SENSORS

EO sensors are essential for collecting data from Earth's surface and atmosphere. This data forms the foundational input for generating EO products and services. At present, a variety of EO satellites, both freely accessible and commercially viable, are applicable and well-suited for the creation of EO products suitable for the FM sector. The subsequent overview outlines several commonly utilised EO sensors in this regard.

- ESA provides a range of different EO sensors as part of the Copernicus program, those sensors provide freely available satellite imagery with appropriate spatial resolution and revisit time. Sentinel-2 provides fine details about land cover, vegetation health, urban expansion, and natural resources. Sentinel-2 enables monitoring for many applications at the asset level due to its 10 m spatial resolution and revisit time every 5-6 days. Whereas Sentinel-3 is used for broader scale landscape and ocean monitoring with 300 m spatial resolution and 1-2 days revisit time. There is also Sentinel-1 equipped with a radar sensor which enables observation regardless of the cloud coverage or weather conditions.
- Since 1972, NASA's Landsat mission has offered the most extensive archive of satellite data with appropriate spatial resolution based on optical observations. The latest sensor is Landsat-9.
- In addition, commercial satellite operators like Planet Labs (offering PlanetScope, RapidEve, and Skysat), Deimos Imaging (DEIMOS-2), ICEYE, TerraSAR-X and TanDEM-X from the German Aerospace Center (DLR) and Airbus (providing Pléiades 1A/1B, SPOT 6/7) make very high-resolution data accessible. These data are vital to capture very tiny details of the earth’s surface like buildings, vessels, and individual trees.

3.2.2. SUMMARY OF RELEVANT SATELLITE-BASED AND REANALYSIS PRODUCTS

Satellite-based products offer a comprehensive view of Earth's dynamics on a global scale, providing detailed imagery, maps, and measurements of Earth's surface and atmosphere. **Reanalysis products** integrate historical observational data with numerical models to create consistent and reliable datasets for climate and environmental studies. These products are vital for understanding long-term trends and monitoring changes. The satellite-based and reanalysis products provide valuable information about various atmospheric and surface variables. They are widely used as input data for a wide range of applications including meteorology, climate research, and environmental studies. Below are several examples of popular satellite-based and reanalysis products described in detail.

- **ERA5-land:** ERA5-Land is a specialised dataset developed by re-examining the land-based segment of the ECMWF ERA5 climate reanalysis. This dataset offers an intricate and refined perspective of various land-related climate variables, spanning factors such as temperature, precipitation, soil moisture, and vegetation dynamics. By utilising advanced modelling techniques, ERA5-Land provides a comprehensive and accurate portrayal of historical climate and environmental conditions over the land areas since 1950, enhancing our understanding of long-term weather trends and their impacts on ecosystems and societies.

- **Copernicus Global Land Services (CGLS):** CGLS is an integral component of the broader Copernicus Earth Observation Program. This service focuses on delivering precise and up-to-date geospatial information related to land and its various attributes. Leveraging a combination of satellite observations, ground-based data, and advanced processing techniques, CGLS offers a wealth of information about land cover, land use, changes in vegetation, soil moisture, and other essential parameters. With a commitment to providing high-quality, reliable, and accessible data, CGLS supports a wide range of applications across diverse sectors such as environmental monitoring, agriculture, urban planning, and disaster management.
- **MODIS products:** MODIS, which stands for Moderate Resolution Imaging Spectroradiometer has provided a wealth of EO data since 1999, generating a variety of products that are valuable for a wide range of scientific, environmental, and societal applications. These products are categorised into atmosphere, land, cryosphere, and ocean products.

3.2.3. EO PRODUCTS AND SERVICES

EO products and services are used to process, analyse, and interpret EO sensor and satellite-derived data. They transform raw data into actionable insights and information products tailored for specific applications.

The *D2.1 Current EO Capabilities* report [RD7] identified 38 EO products and 18 EO services that correspond to the consolidated geo-information requirements of the FM sector. These products are currently available and well-validated with documented performances and constraints. The report includes a description and use case for each of the 38 EO products.

It was found that almost all the user needs can be potentially addressed by currently available EO products and services. While some requirements could be fulfilled by a single EO product, others necessitate a service incorporating a blend of EO products. However, there was only UN17: 'Need near real-time tracking of marine vessels to understand their routes and estimate fuel usage' without a mature EO product. The main constraint arises from the limitations of the frequency of revisit time by current and near-future Greenhouse Gas monitoring missions, which hinders the ability to track ships effectively. Additionally, another limitation is associated with the spatial resolution of these missions, further impacting their ability to capture and monitor ship-related Greenhouse Gas emissions.

It is worth noting that while most of these products/services are mature and can thematically fit the FM sector's needs, this does not mean that the products/services already fit into the workflows of individual companies. This roadmap is therefore important to ensure that EO capabilities are adaptable to the FM workflows.

In the process of consolidating EO products for the FM sector, we found that. However, there are some limitations and challenges that should be considered to increase the capability of the EO products to fully respond to user needs. one of UNs that we did not find a mature EO product in the industry, despite the need for it by the FM institutions. This user need was **UN17: 'Need near real-time tracking of marine vessels to understand their routes and estimate fuel usage'.** In the context of this user need, the FM stakeholders outlined that this information is a crucial input to estimate the marine vessel's GHG emissions, which are identified by professionals as increasingly important data. However, we did not find a product in the EO market that responds to this user need due to the limitation of the current EO capabilities. The main constraint arises from the limitations of the frequency of revisit time by current and near-future GHG monitoring missions, which hinders the ability to track ships effectively. Additionally, another limitation is associated with the spatial resolution of these missions, further impacting their ability to capture and monitor ship-related GHG emissions.

3.3. KEY CHALLENGES FACED BY THE FINANCIAL MANAGEMENT INDUSTRY IN LEVERAGING EO TECHNOLOGY

There are several perceived barriers that may hinder the use of geo-information within the FM sector. Chief among these are the start-up costs of training staff, purchasing or collecting the geo-information data itself, and developing new methodologies to utilise the data. There is also a lack of uniformity in terms of the product offering of data suppliers (e.g. asset classifications, degree of pre-processing, language support), which increases the complexity of integrating geo-information into business

processes. These complications only further increase the perceived start-up costs in the minds of senior staff who allocate budgets.

FM organisations remain sceptical of the value of integrating geo-information into existing models and processes which is also blocker to further uptake. Demonstrating this value without concrete use cases or proof-of-concepts, makes it all the more difficult to secure resources to build new services on top of geo-information. While many use cases exist, they are often highly specific to organisations or projects and/or confidential; it is perhaps unsurprising that public examples of sufficiently similar projects are rare.

Regulation has the potential to be a significant driver or challenge for the wider use of geo-information. Across all four FM domains, stakeholders expressed frustration at **regulatory barriers** to implementing EO solutions. For example, within the Green Finance domain it was related that the organisations that set voluntary standards do "not yet recognise EO as a [credible] source" of information on green activities. This means that organisational interest does not translate to large enough resource investments in incorporating geoinformation into business processes. Within the Insurance Management domain, one participant highlighted that "in the US" it is currently against federal regulation "to incorporate satellite EO for crop insurance". It was further noted that geospatial solutions do not fit with regulatory requirements more generally and that therefore many companies maintain protocols and data governance rules that prevent their adoption.

Despite these challenges, stakeholders in the FM sector mentioned major opportunities from further integration of geo-information into FM processes, including:

- **Granularity –** higher precision insights into key model parameters
- **Visibility & accountability** – the objectivity of data creates opportunities for trust-driven markets to grow and develop in new ways.
- **Automation** – a repeatable data generation process creates an opportunity to automate tasks relating to monitoring and forecasting within the financial sector.
- **Wider applicability** – interviewees felt it was highly likely that processes developed for one geographic region or market could be readily adapted and deployed in different situations.

Beyond those specific opportunities, FM stakeholders related plans to work with geo-information in a number of ways. These included the **integration of such data with more data types and layers**, the explicit linking of project financing to geo-information-derived monitoring processes, and monitoring sites for greenhouse gas (GHG) emissions.

4. FUTURE OUTLOOK

The EO-FIN project aims to foster growth in the space/EO sector while promoting sustainability and supporting the green transition by increasing the uptake and utilisation of Earth Observation (EO) products and services within the FM sector. Building upon the identification of challenges outlined in the *D2.2 Gap Analysis* report [RD8], this section delves into the hurdles faced by the EO/FM sector that hinder the effective utilisation of EO data in FM practices. Furthermore, the section explores the future capabilities of EO in FM, delving into potential advancements and innovations that could address existing gaps and challenges.

4.1. GAP ANALYSIS

The geo-information requirements of FM professionals were collected through several distinct activities: an extensive desktop review to study geospatial data in finance, a workshop to gather feedback and contacts, and one-to-one interviews with stakeholders across public, private and third sectors to understand geospatial challenges and opportunities. Finally, the information was synthesised to create a consolidated user requirements database.

A comprehensive gap analysis was then conducted by comparing the consolidated 32 FM geo-information needs (documented in the *D1.2 Geo-Information Requirements* report [RD5]) with the consolidated 38 EO products to address these needs (*D2.1 Current EO Capabilities* report [RD7]). Three distinct types of gaps were identified during this analysis: Guideline gaps, Utilisation gaps, and Research and Development (R&D) gaps.

Table 4-1 – Types of gaps

Type of gap	Description
Guideline gap	There is an EO product/service that can address a requirement from the FM, however, the financial sector is not aware of it.
Utilisation gap	FM sector is aware of the EO product/service, however, there is limited uptake. This could be due to cost, reliability of the product, etc.
R&D gap	There is a demand in the FM sector for an EO product/service, but the existing EO capabilities are unable to deliver a product or service of the desired/necessary quality.

In the *D2.2 Gap Analysis* report [RD8], we have discussed and analysed different types of gaps that prevent the FM sector from leveraging EO technologies. Among those gaps, we have highlighted critical gaps, knowing the critical gaps will be greatly beneficial to the FM sector and EO industry to take urgent actions and decisions. Those critical gaps were identified based on the correlation between the EO products and the corresponding FM needs. The following table illustrates the identified critical guideline, utilisation, and R&D gaps.

Table 4-2 – Critical gaps for EO products in relation to user needs

Investment Management domain		
EO product	**Corresponding user need(s)**	**Type of critical gap**
Lithology and surficial geology mapping	UN9: Understanding stock levels and monitoring supply chains	Utilisation
Land use maps	UN11: Realistic assessment of accessibility to assets	Guideline
Mapping travel times to assets	UN11: Realistic assessment of accessibility to assets	Guideline
Land cover maps	UN11: Realistic assessment of accessibility to assets	Guideline
Satellite-derived bathymetry for port and coastal monitoring	UN12: Analysis of potential risks in specific regions	Utilisation
GHG emissions monitoring	UN15: Need to monitor carbon intensity of portfolio assets	R&D
Ship detection and categorisation	UN17: Need near real-time tracking of marine vessels to understand their routes and estimate fuel usage.	Utilisation
Crop type and acreage mapping	UN18: Need to monitor crop productivity	Guideline
Crop phenology, rotation, and number of seasons	UN18: Need to monitor crop productivity	Guideline
Tillage and crop residue cover practices	UN18: Need to monitor crop productivity	Guideline

Green biomass and yield estimation	UN18: Need to monitor crop productivity	Guideline
Green Finance domain		
GHG emissions monitoring	UN26: Need to monitor GHG emissions of projects funded	R&D
Land Cover Maps	UN27: Need to assess historical trends and baseline of natural assets.	Guideline
Crop health (diseases and pests detection)	UN30: Need for monitoring with accurate measurement of the growth and health of trees	Guideline
Estimation of above-ground carbon stocks in forests	UN30: Need for monitoring with accurate measurements of the growth and health of trees UN32: Need to periodically estimate the growth of above-ground carbon stocks (in forests)	Utilisation
Trees counting	UN31: Need to link tree planting parcels to estimate the number of trees planted	Utilisation
Risk Analysis domain		
Monitor slow-moving subsidence	UN37: Projection of risk to portfolio assets into the future	Guideline
Monitoring highway and railway networks	UN37: Projection of risk to portfolio assets into the future	Guideline
Dams' Safety	UN37: Projection of risk to portfolio assets into the future	Guideline
Surveillance of Oil and Gas Pipelines for Geohazard and Ground Subsidence Vulnerabilities	UN37: Projection of risk to portfolio assets into the future	Guideline
Crop health (diseases and pests detection)	UN37: Projection of risk to portfolio assets into the future	Guideline
Vegetation height estimation	UN37: Projection of risk to portfolio assets into the future	Guideline
Identification of flood hazard areas	UN37: Projection of risk to portfolio assets into the future	Guideline
Drought monitoring at the assets level	UN37: Projection of risk to portfolio assets into the future UN42: Need to monitor the impact of droughts on assets	Guideline
Land cover	UN38: Need for trustworthy time series of reliable data on assets	Utilisation
Monitoring reforestation and deforestation activities	UN39: Need to assess the potential impact of business activities or investments on ecosystems and biodiversity	Guideline
Oil spill detection	UN39: Need to assess the potential impact of business activities or investments on ecosystems and biodiversity	Guideline
Impact of increased temperatures on soil moisture and vegetation condition	UN41: Need to monitor the impact of increased temperatures on assets	Guideline
Heat hazard maps	UN41: Need to monitor the impact of increased temperatures on assets	Guideline
Post wildfires monitoring (area and severity)	UN45: Need to measure the area affected by wildfires after the fact. UN46: Need to measure the intensity of wildfires (level of damage to assets).	Guideline
Building inventory	UN47: Need up-to-date geospatial data on residential and industrial infrastructure locations.	Utilisation
Insurance Management domain		
Crop health (diseases and pests detection)	UN55: Detecting crop damage at the level of individual farms/fields	Utilisation
Land use maps	UN56: Need to detect changes in land use (at the level of individual buildings)	Guideline
WorldPop – Population Counts	UN57: Automatically update changes in population density estimates based on observable land use changes.	Guideline

4.2. LESSONS LEARNED FROM NEWLY-DEVELOPED EO CAPABILITIES

GMV developed a prototype of an EO multi-natural hazard web platform as part of this project and engaged with the FM industry to receive user feedback. This section describes a summary of the lessons learned from the development and beta-testing of the prototype. Further details on the lessons learned can be obtained from *D2.3 User Feedback/Lessons Learned Report* [RD12].

Some high-level barriers that prevent financial institutions from using commercial EO products were identified through this process:

1. **Cost Considerations**: High costs associated with EO products, including data acquisition, processing, and analysis, pose a barrier to financial institutions. This barrier could be reduced by leveraging public-private partnerships and open data policies.
2. **Lack of Direct Communication**: The absence of direct channels between EO service providers and financial professionals hampers effective collaboration and customization of products. This barrier could be addressed by establishing robust communication channels through workshops and webinars which can help tailor EO data to financial applications.
3. **Geospatial Skills Gap**: Financial institutions often lack the geospatial expertise needed to effectively use EO products. Targeted training programs could enhance geospatial skills among financial managers.
4. **Complex IT Systems**: Integrating EO data into existing complex and regulated financial IT systems is challenging and time-consuming. EO product teams should simplifying IT system integration through standardised data formats, APIs, and cloud-based services can further facilitate adoption.

The commercialisation of Earth Observation (EO) services in the FM sector holds significant potential, however, realising this potential involves overcoming these barriers. Demonstrating EO-derived solutions' value through concrete examples, pilot projects, and quantifiable metrics like cost savings and improved decision accuracy can encourage financial institutions to invest in these technologies, thereby driving innovation and scalability in FM solutions.

4.2.1. FEEDBACK ON THE NEWLY-DEVELOPED EO PLATFORM

Overall, the EO multi-natural hazard web platform service received positive feedback for its user-friendly interface and ease of product selection, ordering, and downloading. Users appreciated the platform's simplicity and ability to handle varying experience levels, although they provided suggestions for further improvement.

Users emphasized the need for improved features in the web platform, including:

- **AOI Identification**: Users require more robust features for selecting AOIs. They suggested the ability to select AOIs as points in addition to polygons, and the option to upload shapefiles (.shp) or CSV files containing AOI information. Adding buffers to points for better coverage of surrounding areas was also recommended.
- **Formats of EO-derived Products**: To cater to users with varying levels of geospatial expertise, it is crucial to offer EO products in a variety of formats. For example, it was found that advanced users prefer TIFF and SHP formats for detailed geospatial analysis, while general users benefit from more accessible formats like PDF for viewing and sharing, CSV for exporting data to Excel, and PNG/JPG for visual representation in presentations.
- **GIS Visualization**: For users who prefer using GIS software like QGIS and ArcMap, providing specific GIS styles (such as symbology, colour ramps, and labelling) for each EO product is beneficial. Customized visualizations enhance clarity, consistency, and ease of data interpretation.
- **Metadata**: Detailed metadata is essential for informed decision-making during the EO product selection process. Users need access to comprehensive metadata and product samples during the selection process to assess the suitability, accuracy, and relevance of EO products for their use-case.
- **Visualization Before Purchase**: Users highlighted the importance of being able to visualize EO products before purchasing. Ideally, a web-based GIS view for interactive presentation is preferred, but PNG previews can also suffice for evaluating product suitability.

Additionally, users expressed the need for a **wide range of EO-derived hazard products** to support both private asset management and public investment strategies. Historical risk data is particularly valuable for making informed decisions based on past events. Stakeholders appreciated the centralization of all risk hazard data on a single platform for streamlined decision-making.

The **accuracy of EO-derived products** is a critical factor for their adoption in the FM sector. Financial institutions, especially banks, require a validation process to ensure that EO data meets the necessary standards. An accuracy level above 80% is considered satisfactory for historical data, while predictive data may have lower expected accuracy due to the complexities of climate modelling.

To address the varying levels of expertise within the **FM sector**, the platform must offer different formats and levels of data complexity. Larger institutions with in-house forecasting teams can handle more sophisticated data, while smaller institutions may rely on simpler outputs and external services.

Recommended features of EO web platform

- compatible with a wide range of formats and types of Areas of Interest (AoI).
- offers a full package of natural hazard products.
- offers product visualisation (e.g., in PNG format) before purchasing and ordering.
- provides detailed metadata and samples of products.
- Offers Various Format of the products according to the level of users.
- Expands the EO products in the probability of occurrence, forecasting, and projection of specific climate risks (climate risk scenarios).
- Providing further statistics including pixel counting and maximum to the current features including mean, median, and standard deviation at district and province levels.

4.3. FUTURE OF EO FOR FINANCIAL MANAGEMENT

The future outlook of EO in the FM sector appears promising overall, with stakeholders indicating ongoing efforts to develop in-house capabilities across organisations. This trend is complemented by the anticipated rise of AI-based techniques, which are expected to automate the integration of geo-information into business processes seamlessly. This convergence of AI and geospatial technologies has the potential to streamline data workflows, enhance decision-making processes, and unlock new opportunities for leveraging EO data within financial institutions.

Furthermore, increasing regulatory pressure on businesses to collect and publicly report data across various activities is seen as a significant driver for the future richness of datasets. This trend is expected to result in far more comprehensive and detailed datasets, creating synergies for combining geo-information with other data types such as financial, operational, and environmental data. The integration of these diverse datasets holds the potential to provide deeper insights, improve risk assessment models, and enable more informed strategic planning within the FM sector.

Stakeholders also expressed a growing belief that geo-information will gain greater acceptance as a reliable and objective source of information among senior decision-makers in the future. This shift in perception is crucial as it signifies a broader recognition of the value and credibility of geospatial data in validating and augmenting other data sources. As geo-information becomes increasingly integrated into analytical frameworks and decision support systems, it is poised to play a pivotal role in driving innovation, transparency, and efficiency across various facets of FM practices.

4.3.1. FUTURE EO CAPABILITIES

Several EO satellite missions that will be launched in the coming 5 years have been identified as potentially important and relevant to the FM geo-information requirements and are described below. More information on these missions, including a description of the missions, space agency launcher, planned launch date, design end-of-life date, measurement detailed/sensor instruments, spatial resolution, revisit time, and whether the data will be open access or commercial, is available in *D2.2 Gap Analysis* report [RD8]. Table 4-3 describes the contributions of the future EO missions to the FM.

- The **BIOMASS mission** uses a novel P-band synthetic aperture radar to provide comprehensive measurements of global forest biomass. It aims to provide critical data to better understand the distribution, composition, and dynamics of forests worldwide. The mission is poised to significantly

enhance our knowledge of how forests contribute to the global carbon cycle and, consequently, aid in climate change mitigation efforts.

- The **Fluorescence Explorer (Flex) mission** will provide data about the health of global vegetation. This data will be employed to enhance our knowledge of the flow of carbon between plants and the atmosphere, as well as the impact of photosynthesis on carbon and water cycles. Furthermore, this has significance not just in comprehending the worldwide carbon cycle but also in terms of agricultural administration and ensuring food security.
- **Copernicus Land Surface Temperature Monitoring (LSTM)** will carry a high spatial-temporal thermal-infrared sensor to deliver observations of land-surface temperature. This mission's primary goal is to address the urgent needs of the agricultural community in enhancing sustainable crop production in a world facing growing water scarcity and climatic fluctuations. It relies on the measurement of land-surface temperature and evapotranspiration to gain crucial insights into and respond to climate variations, optimise water resource management for agriculture, predict droughts, and tackle issues such as land degradation, natural disasters like fires and volcanic eruptions, as well as managing water resources in coastal and inland areas and mitigating urban heat island effects.
- **Copernicus Hyperspectral Imaging Mission for the Environment (CHIME**) will be equipped with a unique spectrometer that covers the visible to shortwave infrared range. It will provide regular hyperspectral observations to support improved services for sustainable agricultural practices, biodiversity management, and the characterisation of soil properties. The mission will complement Copernicus Sentinel-2, particularly for tasks such as land-cover mapping.
- **Radar Observing System in L-band (ROSE-L)'s** objectives include geohazard monitoring, the tracking of land use, agriculture, and forestry, the provision of high-resolution soil moisture information, and the surveillance of the Arctic and cryosphere. ROSE-L will reinforce the capabilities of current Copernicus C-band SAR systems. Furthermore, it will improve imaging performance in regions densely covered by vegetation, thanks to its longer wavelength L-band radio that can penetrate through the canopy.
- The objective of **Carbon Dioxide Monitoring (CO2M)** is to quantify the amount of carbon dioxide being emitted into the atmosphere, with a specific focus on emissions caused by human activities.
- **Carbon Mapper** aims to offer a comprehensive initiative to assist in understanding and mitigating worldwide emissions of methane and carbon dioxide in our atmosphere. This program will provide 30-meter resolution satellite imagery and tackle the pressing concerns of greenhouse gas emissions and climate change on a global scale. Additionally, Carbon Mapper will supply over 25 other environmental and carbon-related indicators to help address and reduce emissions in both our atmosphere and ecosystems.
- **NASA Multi-Angle Imager for Aerosols (MAIA)** provides information about the sizes, compositions, and quantities of particulate matter in air pollution. As a component of the MAIA investigation, scientists will integrate MAIA data with population health records to enhance their understanding of the links between aerosol pollutants and health issues, including negative birth outcomes, cardiovascular and respiratory diseases, and untimely mortality.
- The **NASA-Indian Space Research Organisation (ISRO) Synthetic Aperture Radar (NISAR)** satellite is equipped with advanced radar imaging technology that will offer an unprecedented, intricate perspective of Earth. Its purpose is to monitor and collect data on some of the planet's most intricate phenomena, including disruptions in ecosystems, the disintegration of ice sheets, sea level rise, groundwater, and natural hazards such as earthquakes, volcanic activity, coastal sinking, and landslides.

Table 4-3. Contribution of future missions in the following 5 years to the FM geo-information needs.

Mission	User needs that can benefit from the mission				Contribution of the mission to the user needs
	Investment Management	Green Finance	Risk Analysis	Insurance Management	
BIOMASS		**UN30:** Need for monitoring with accurate measurements of the growth and health of trees and verifying the sustainability of forest management practices. **UN32**: Need to periodically estimate the growth of above-ground and soil carbon stocks (in forests).	**UN39:** Need to assess the potential impact of business activities or investments on ecosystems and biodiversity		• BIOMASS provides global coverage. • Frequent and consistent measurements over time • Easy access to the data without a need to obtain and analyse raw data, which reduces time and cost.
Flex	**UN18:** Need to monitor crop productivity	**UN28:** Need to classify the types of crops being grown in order to assess the Sustainability and Environmental impact of agricultural investments. **UN30:** Need for monitoring with accurate measurements of the growth and health of trees and verifying the sustainability of forest management practices.	**UN39:** Need to assess the potential impact of business activities or investments on ecosystems and biodiversity.	**UN55:** Detecting crop damage at the level of individual farms/fields	• Complementary to Sentinel-2 by adding a new dimension by measuring fluorescence, which offers complementary information for agriculture, ecology, and land management. • FLEX data can enhance the monitoring of crop health and stress. • It aids in understanding the responses of different ecosystems to environmental changes and human impacts.
LSTM	**UN12:** Analysis of potential risks in specific regions		**UN41:** Need to monitor the impact of increased temperatures on assets		Higher spatial resolution and revisit time for land surface temperature compared to currently available data
CHIME	**UN18:** Need to monitor crop productivity. **UN19:** Identifying types of crops being grown is essential	**UN28:** Need to classify the types of crops being grown in order to assess the Sustainability and	**UN39:** Need to assess the potential impact of business activities or investments on ecosystems and biodiversity.	**UN55:** Detecting crop damage at the level of individual farms/fields.	• Complementing Sentinel-2, as hyperspectral data at appropriate spatial resolution and revisit time will add value in agricultural activities. This will enhance crop type and disease classification.

		Environmental impact of agricultural investments.			• It will add value to biodiversity management and the characterization of soil properties.
ROSE-L			**UN37:** Projection of risk to portfolio assets into the future.		ROSE-L will reinforce the capabilities of current Copernicus C-band SAR systems as it will improve imaging performance in regions densely covered by vegetation, thanks to its longer wavelength L-band radio that can penetrate through the canopy.
CO2M	**UN15:** Need to monitor carbon intensity of portfolio assets	**UN26:** Need to monitor GHG emissions of projects funded			Global Carbon Monitoring at appropriate spatial resolution (2 km) and revisit time (11 days) at a global scale.
Carbon mapper	**UN15:** Need to monitor carbon intensity of portfolio assets	**UN26:** Need to monitor GHG emissions of projects funded			The relatively high resolution (30 m) and revisit time (1-7 days) for GHG monitoring at a global scale.
MAIA			**UN37:** Projection of risk to portfolio assets into the future. **UN39:** Need to assess the potential impact of business activities or investments on ecosystems and biodiversity.		• Provides global information about the sizes, compositions, and quantities of particulate matter in air pollution with appropriate spatial resolution (1km, and 300 m over some regions) and revisit time (≤ 1 day). • Integrate MAIA data with population health records
NISAR			**UN37:** Projection of risk to portfolio assets into the future.		Using both L-band and S-band with appropriate spatial resolution and revisit time.

5. ROADMAP

A roadmap serves as a strategic blueprint, delineating the necessary activities to achieve specific outcomes. Within the context of the EO-FIN project, the roadmap provides a detailed outline of activities required to achieve the objectives of the EO-FIN project, and to close the gaps between the EO and FM sectors described in *D2.2 Gap Analysis* report [RD8].

5.1. OVERVIEW OF SUGGESTED ACTIVITIES

Define the vision for collaboration of EO and FM sectors

This activity aims to establish a comprehensive vision for integrating Earth Observation (EO) data into the FM sector. The key objective is to outline the strategic direction, long-term benefits, and goals of EO-FIN collaboration. Tasks involved include conducting stakeholder consultations, gathering industry insights, analysing market trends, and drafting a strategic roadmap highlighting key milestones, targets, and actionable strategies for achieving the envisioned integration.

Identify and address regulatory barriers

This project has uncovered instances where regulatory barriers impede the integration of EO data into the FM sector. For instance, different regulations across jurisdictions can make it difficult for EO products in the insurance sector to scale. At the same time, financial regulation has the potential to become a driver for the uptake of EO data products and services as environmental monitoring and climate risk monitoring is increasingly expected from investors, regulators, and the public. By including EO data in regulation as a compliant data source for these monitoring purposes, many more FM organisations may be more inclined to integrate it. The objective of this activity is to identify and mitigate regulatory hurdles that hinder the integration of EO data, as well as to identify opportunities where sensible new or updated regulations can increase the uptake of EO data products and services while achieving other goals.

Tasks within this activity include conducting regulatory assessments, engaging with regulatory authorities and policymakers, analysing compliance requirements, developing advocacy strategies, and fostering collaborations to create an enabling regulatory environment for EO data usage.

Explore the use of Artificial Intelligence (AI)

AI advances have the potential to enhance EO data processing, integration, and decision support capabilities. Harnessing AI can also improve the efficiency, accuracy, and scalability in handling geospatial data.

This activity will include exploring specific pain-points within EO and FM companies where EO-data is difficult to integrate into existing FM workflows. Following this, existing AI platforms and tools will be explored in order to identify potential partners or technologies that can be integrated into EO data pipelines. This activity will then need to bring together firms from the EO and FM sector to develop pilot projects that can demonstrate AI's effectiveness in integrating EO data.

Increase visibility of EO for FM products

Through engaging with FM stakeholder during this project it was discovered that many individuals are either unaware or sceptical of the potential value of EO data within their sector. Increasing visibility and awareness of EO data's value proposition within the financial sector is crucial for driving adoption, investment, and collaboration in EO-FIN initiatives. To increase adoption of EO data in this sector, it will be necessary to showcase the relevance, applications, success stories, and potential ROI of EO data in developing innovative financial products, risk management strategies, and market intelligence tools.

Visibility of EO for FM products can be raised through workshops, conferences, webinars, and other events to showcase the benefits of EO data for financial applications. An effective option for increasing visibility may be to engage with existing conferences relevant to one or more of the four FM domains within the project scope and engaging directly with FM stakeholders.

Increase uptake of EO data use in public sector

Many of the FM professionals are unable to share information regarding their use of EO products on account of internal corporate policies regarding sharing information, analysis methods, and projects to improve business processes. Corporate secrets, especially those from which a company derives a significant benefit, are jealously guarded. Institutional organisations, such as central banks and

financial regulators, are more open in this regard. This project found that while it is likely that private firms are already incorporating EO data into their investment strategies to some extent, public sector institutions may be lagging behind. Addressing the public sector's lag in EO data adoption is crucial as many of the FM organisations that they are regulating may already be using EO data.

The goal of this activity is therefore to empower public finance institutions and regulatory bodies with valuable geospatial information for better decision-making, policy formulation, and regulatory oversight. Tasks include developing ready-to-use EO products or services tailored to public sector needs, such as regulatory compliance or monitoring, and collaborate with public institutions to understand their requirements and promote EO solutions.

Develop products for non-technical users

Designing user-friendly EO products for non-technical users is essential to democratise access to EO data and insights. It enables a wider audience, including policymakers, business executives, and community leaders, to leverage geospatial information effectively in their decision-making processes. This in turn should help to foster data literacy, inclusivity, and stakeholder engagement.

To increase the accessibility and usability of EO data for non-technical users it will be important to focus on developing user-friendly tools, dashboards, APIs, or reports that provide insights directly relevant to financial decision-making. End-users should be involved throughout the product development process to ensure that products are adequately meeting their needs. The products developed should aim to enhance user experience and usability through intuitive interfaces, data visualisation techniques, and personalised insights tailored to non-technical user needs and preferences.

Provide training and support for EO and FM professionals

Building capacity and skills among both EO and FM professionals is essential for bridging the gap between EO and FM. FM professionals need to be sufficiently equipped with tools and resources required to leverage geospatial data, and realise its value for their businesses. At the same time, EO professionals need to improve their understanding of the workflows and challenges within the FM sector in order to develop tools and services that can create commercial value within this sector. Providing training and support for professionals in both sectors will drive innovation and effective collaboration between FM and EO sectors, and enable both the development and the successful integration of new EO products and services.

The tasks within this activity include developing tailored training programs that enhance EO professionals' understanding of FM needs, and awareness raising and technical skills training for FM professionals to effectively use geospatial data in their workflows.

Greenhouse Gas (GHG) emissions monitoring Research & Development (R&D)

There is a demand in the FM sector for an EO product that allows for accurate and reliable GHG emissions monitoring, however, the existing EO capabilities were found to be unable to deliver a product or service of the desired/necessary quality.

The goal of this activity is to support R&D initiatives focused on developing EO-based techniques for accurate and timely monitoring of emissions, enabling firms to track and manage their environmental impact more effectively. To achieve this, it will be necessary to collaborate with environmental agencies, industry stakeholders, and research institutions to develop and validate new technology.

5.2. DETAILED DESCRIPTION OF SUGGESTED ACTIVITIES

This section provides a more detailed overview of several key elements of each activity. These elements are described Table 5-1 below.

Table 5-1 – Key elements of each activity

Tasks	The main tasks which need to be performed to pursue the activity.
Risks & mitigations	Potential risks associated with implementing the roadmap are identified and described. Potential mitigation strategies are also provided to address technical challenges, regulatory constraints, stakeholder engagement issues, and other risk factors.
Stakeholders	Main stakeholders that will need to be involved for the successful execution of each activity.

Timeline / Time frame	The expected time required to complete the activity. Expected time frames are categorised as follows: - SHORT TERM: < 6 months - MEDIUM TERM: 6-12 months - LONG TERM: > 12 months
Cost estimate	The expected cost estimates required to complete the activity. The expected cost frames are categorised as follows: - LOW COST: < EUR 100,000 - MEDIUM COST: EUR 100,000 – EUR 500,000 - HIGH COST: > EUR 500,000

By encompassing these elements, the roadmap in Table 5-2 provides a structured and comprehensive framework for navigating the complexities of integrating EO data into FM practices. It serves as a dynamic guide that adapts to evolving challenges and opportunities, driving the project towards successful outcomes and impactful results.

Table 5-2 – Detailed overview of suggested activities

Activity	Tasks	Risks and mitigations	Stakeholders	Timeframe / Cost indicator
Define the vision for EO-FIN sector	■ Collaborate with key stakeholders to develop a detailed roadmap outlining milestones and targets for EO-FIN integration. ■ Conduct workshops and focus groups to gather insights on challenges and opportunities, ensuring alignment with industry needs and advancements. ■ Clearly articulate the long-term benefits and strategic goals of integrating EO data into FM practices. ■ Establish a shared understanding among stakeholders regarding the potential impact and value proposition of EO-FIN sector collaboration.	Risks: ■ Lack of stakeholder alignment leads to conflicting priorities and goals. ■ Incomplete or inaccurate data during the visioning process owing to its sensitive nature and 'trade secrets' in the financial sector. Mitigations: ■ Conduct regular feedback sessions to ensure alignment. ■ Validate data sources and assumptions through independent reviews or expert consultations.	Government agencies, Financial institutions, EO providers and tech companies, Industry associations and trade organisations, Research institutions and think tanks specialising in finance and geospatial technologies.	Short term / Low cost
Identify and address regulatory barriers	■ Conduct a comprehensive assessment of existing regulatory frameworks for the FM sector. ■ Identify regulatory hurdles, constraints, or ambiguities that impede the adoption and integration of EO data. ■ Identify opportunities within regulatory frameworks for EO data to be used in place of/in addition to other data sources. ■ Develop strategies and advocacy efforts to address regulatory challenges. ■ Collaborate with regulatory authorities and industry stakeholders to address and mitigate regulatory barriers.	Risks: ■ Changing the regulatory landscape may make identifying and addressing appropriate financial regulation difficult. ■ Resistance or lack of cooperation from regulatory authorities. Mitigations: ■ Build partnerships and alliances with industry associations or advocacy groups to strengthen advocacy efforts and maintain close communication on regulatory issues.	ESA, Financial Regulators, Central banks, Industry compliance and legal teams, Government policy-makers and legislators	Short term / Medium cost
Explore the use of AI	■ Evaluate existing AI platforms and tools to identify potential partners or technologies that can be integrated into EO data processing pipelines.	Risks: ■ Low engagement from FM companies ■ Ethical considerations and biases in AI	ESA, AI technology providers and developers, EO companies, FM	Medium term / Medium cost

	▪ Develop pilot projects or proofs of concept to demonstrate the efficacy and scalability of AI in integrating EO data into existing workflows and systems. ▪ Establish a cross-functional AI task force comprising data scientists, domain experts, and IT professionals to oversee the implementation and scaling of AI-driven solutions for EO-FIN applications.	algorithms affecting decision-making outcomes. Mitigations: ▪ Conduct thorough feasibility studies and pilot tests to identify and address integration challenges early in the process. ▪ Implement ethical guidelines and validation processes for AI algorithms to ensure fairness, transparency, and accountability in decision-making.	companies, Potential investors and venture capital firms focusing on fintech and geospatial sectors.	
Increase the visibility of EO for FM products	▪ Enhance marketing and communication strategies to raise awareness and promote the benefits of EO data for FM products and services and to increase understanding of FM challenges within the EO sector. ▪ Engage with industry stakeholders, conferences, and forums to showcase successful use cases and applications of EO data within the FM sector.	Risks: ▪ Limited understanding or scepticism within the financial sector regarding the use/value of EO data. Mitigation: ▪ Develop targeted case studies to inform FM stakeholders about EO data's tangible benefits and ROI.	ESA, Marketing and communications teams within financial institutions, EO technology providers and solution vendors.	Medium term / Low cost
Increase uptake of EO data use in public financial institutions	▪ Identify key public sector agencies, institutions, and decision-makers that can benefit from integrating EO data into their operations. ▪ Develop tailored awareness campaigns and training workshops to demonstrate the value of EO data within public financial institutions. ▪ Develop tailored EO solutions and services that address the specific needs and challenges faced by those institutions. ▪ Advocate for capacity-building programs to encourage the adoption and utilisation of EO data across public sector domains.	Risks: ▪ Resistance to change among public sector decision-makers. ▪ Budget constraints or competing priorities within public sector agencies. Mitigation: ▪ Awareness campaigns and training workshops should be tailored to specific institutions to showcase the value and impact of EO data on public policy and service delivery.	ESA, Regulatory bodies, Central banks, EO industry	Medium term / Medium cost
Developing products for non-technical users	▪ Design user-friendly EO products and tools that require minimal technical expertise, catering to the needs of non-technical users in the financial and public sectors. ▪ Incorporate intuitive interfaces, data visualisation techniques, and actionable insights to empower users in making informed decisions based on EO-derived information. ▪ Conduct user feedback sessions, usability tests, and iterative design processes to refine and optimise product features for enhanced user experience and adoption.	Risk: ▪ Complexity or technical jargon in product design, leads to user confusion. Mitigation: ▪ Conduct user testing and feedback iterations throughout the product development lifecycle to ensure user-friendliness and address usability issues proactively.	Product development teams within EO sector, User experience (UX) designers and interface developers.	Medium term / Medium cost

Training and Support	■ Offer training programmes and workshops to upskill EO professionals on FM concepts, terminology, and industry best practices. ■ Offer training modules and resources for FM professionals to understand EO technologies, data sources, and analytical methods relevant to their roles. ■ Establish ongoing support mechanisms and knowledge-sharing platforms to facilitate continuous learning, collaboration, and problem-solving within the EO-FIN community.	Risk: ■ Lack of ongoing support or follow-up mechanisms, hindering effective knowledge retention and application. Mitigation: ■ Establish a collaborative industry-wide knowledge-sharing platform or consortium dedicated to EO-FIN sector training and professional development. This could include an online learning portal with courses and webinars that are kept up to date.	ESA, EO technology vendors offering training and certification programs, Regulatory bodies and industry associations offering compliance training.	Long term / Medium cost
R&D for GHG emissions monitoring	■ Establish partnerships between leading research institutions and environmental agencies to collaborate on R&D projects aimed at developing advanced EO-based methodologies for real-time GHG emissions monitoring. ■ Collaborate with environmental agencies, research institutions, and industry partners to Conduct field trials or validation studies to validate and refine EO-derived GHG monitoring techniques and algorithms. ■ Publish research findings, technical reports, and best practices guides based on R&D outcomes.	Risks: ■ Technical challenges in developing accurate and scalable EO-based monitoring technologies. ■ Data quality issues or limitations in accessing relevant GHG emission data for research and validation purposes. Mitigation: ■ Ensure engagement with research institutions and industry experts from diverse fields to leverage collective expertise and resources. ■ Invest in data quality assurance measures, calibration/validation procedures, and cross-validation studies to ensure the accuracy and reliability of EO-based GHG monitoring technologies.	Environmental agencies and regulatory bodies responsible for emissions monitoring, Research institutions and academia specialising in environmental science and remote sensing, the EO sector, R&D funding programmes.	Long term / High cost

END OF DOCUMENT

