D2.4 PROTOTYPE IDENTIFICATION (DRAFT)

EO-FIN

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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 (final)	1
[RD9]	D2.3	EO-FIN-Workshop-2 summary report	1

Acronyms

Acronym	Definition
EO	Earth Observation
ESA	European Space Agency
FM	Financial Management
EARSC	European Association of Remote Sensing Companies
ESG	Environmental, Social, and Governance
FAPAR	Fraction of Absorbed Photosynthetically Active Radiation
SMA	Soil Moisture Anomaly
LST	Land Surface Temperature
GLASS	Global Land Surface Satellite
GFM	Global Flood Monitoring
CDI	Combined Drought Indicator
SPI	Standardised Precipitation Index
GLASS	Global Land Surface Satellite
CGLS	Copernicus Global Land Services
UN	User need

1. INTRODUCTION

This report describes the identification of the Earth Observation (EO) service case to prototype in response to geo-information requirements of the Financial Management (FM). Following the consolidation of the geo-information requirements targeting the FM sector (documented in D1.2 Geo-Information Requirements report), 38 mature and validated EO capabilities EO products identified (documented in D2.1 Current EO Capabilities) to address the geospatial needs of the FM sector in four domains including investment management, insurance management, and green finance, and risk analysis.

The EO-FIN team engaged the Stakeholder's Board (SB) members, experts in the FM sector, in the process of selecting the EO service. This selection was carried out through a series of one-to-one interviews. The primary objective of these interviews was to pinpoint an EO service, along with its technical specifications, that can effectively meet and address genuine needs within FM institutions.

The selected EO service will be prototyped on a virtual platform, therefore, these interviews included also asking the SB members about the functionalities they need on the virtual platform to interact with the data, derive products, and integrate the outcomes in their business protocols. This contributes to one of the aims of the EOFIN project which is to increase the awareness of the advantages of accessing geoinformation services through a virtual platform.

To narrow down the options and choose the EO service, we put some determinants of the service which should:

- address stakeholders' requirements that could be met with mature and validated EO capabilities with known, documented performances and constraints.
- address requirements that have gathered high consensus among the stakeholders.
- address requirements having a significant influence on the success of the stakeholders' business processes.
- maximise the number of stakeholders interested in using the prototype.
- rely as much as possible on open-source data (EO and non-EO).
- work in a region where regions where EO-derived information offers superior relevance/accuracy over other sources of information.
- demonstrate the synergy of EO and non-EO data, specifically of sector-specific data, and among satellite and in situ EO data.
- optimize the benefits for FM stakeholders and have the potential to become a business case.
- match with the project resources.

1.1. PROJECT OVERVIEW

The activity "Best EO practices to support financial management (EO-FIN)" is an ESA-fully funded project aiming to understand the current, and short-term future, EO capabilities that can support the FM sector. This project studies EO best practices meeting the best responses to the FM sector's needs and requirements. The best EO practices are expected to lead to better products, greater trust from the customers, and a more competitive position in the market.

1.2. PURPOSE

The goal of this activity can be broken down into the following objectives:

1. Identify and consolidate the geoinformation needs and priorities within the domains of concern: Investment Management, Green Finance, Risk Analysis, and Insurance Management.
2. Identify and characterise EO-based products and services meeting the needs of the domains of concern by assessing the gaps between these and what EO can offer, now and in the near future.
3. Implement and test on a Virtual Platform at least one prototype of an identified EO-based service.

4. Define a roadmap for building EO industry guidelines for the commonly accepted best-practice use of EO-based information by companies within the FM sector.
5. Disseminate the analysis results via key international associations and bodies representing the sector, like EARSC (on the EO side).

1.3. PROJECT BREAKDOWN STRUCTURE

Figure 1 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

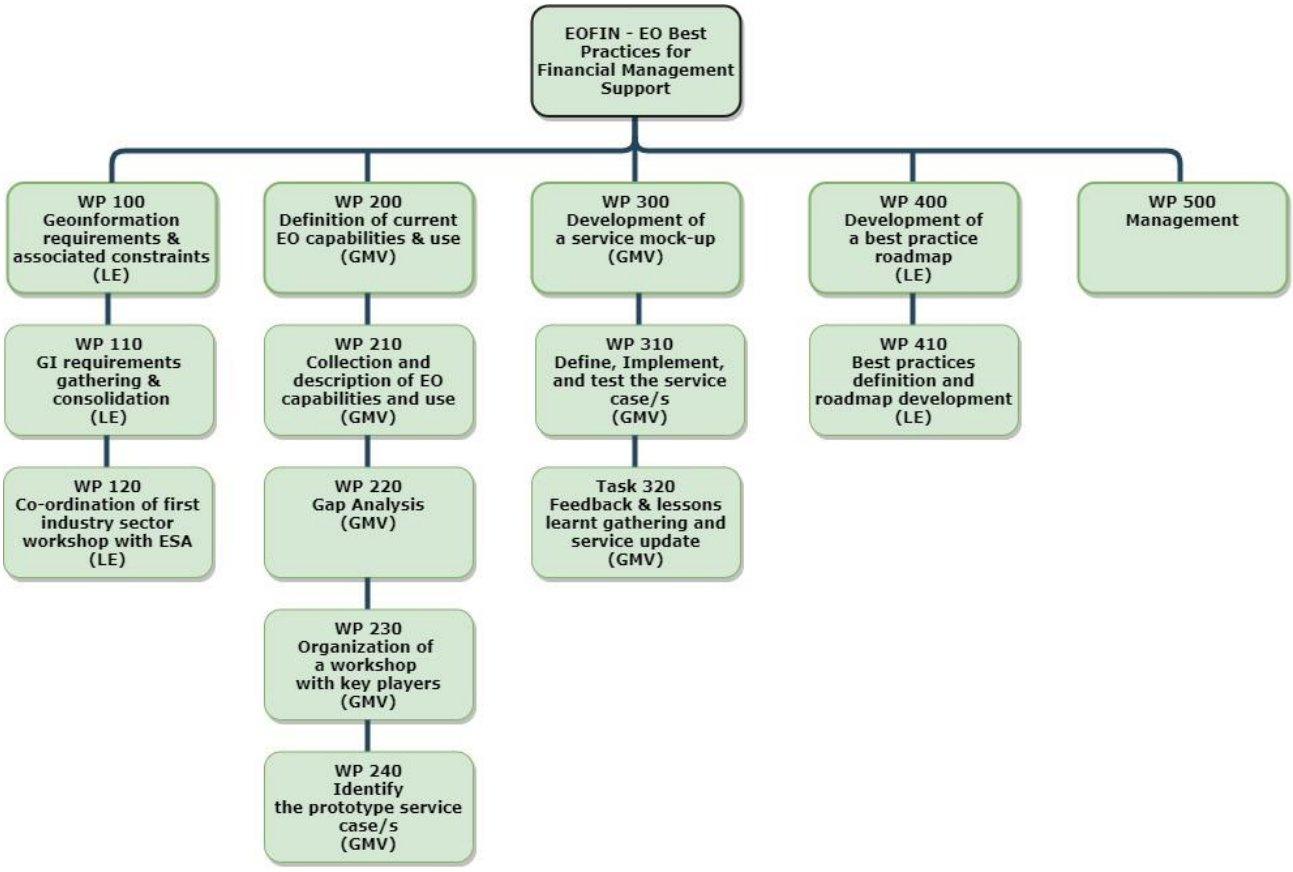

Figure 1. EO-FIN work breakdown structure.

1.4. SCOPE OF THE PRESENT REPORT AND TARGET AUDIENCE

This report outlines the process of identification and selection of an EO service case by the EO-FIN Team, to be a prototype for the FM sector and describes its specifications ad characteristics.

The selected EO service will undergo prototyping on a virtual platform, facilitating the involvement of FM stakeholders in utilizing and processing the service. The target audience of this report is the EO service providers and FM stakeholders.

2. SELECTION OF EO SERVICES CASES TO BE THE PROTOTYPE

The selection of the prototype for the EO service case considers both the anticipated impact it will have on addressing the FM sector's geo-information needs and the effort required for its development. The approach to defining a fully fit-per-purpose prototype involves weighing the resources, time, and expertise dedicated to developing the prototype against the potential positive outcomes it is expected to deliver for FM stakeholders. Striking a balance between effort and impact ensures that the selected prototype not only showcases technical proficiency but also maximizes its effectiveness in meeting the genuine requirements of the FM sector.

Different activities were conducted to evaluate both **impact and effort**.

The activities to evaluate the impact included:

- Analysis of the demand levels of the consolidated FM geo-information requirements which were documented in the D2.2 Gap Analysis report. The demand level describes the degree of interest, enthusiasm, and recognition expressed by stakeholders or potential users regarding a specific geospatial user need.
- Analysis of the utilization and capability levels of the consolidated EO products which were also documented in the D2.2 Gap Analysis report. Utilization level refers to the degree of utilization of the EO product by the FM sector. Capability level refers to the EO product's ability to meet the relevant FM user needs.
- Prioritise 38 consolidated EO products based on their impact on the Finance industry through members of the Stakeholder Board (SB) feedback.
- Conduct a series of one-to-one interviews with SB members to further assess the impacts of the EO products by considering the technical specifications of the products and the detailed functionalities expected on the virtual platform.

The activities to evaluate the effort included:

- The EO-FIN Team internally evaluated to determine the time and resources required to develop each of the potential mature EO products with high priority from the SB members.

2.1. IMPACT SELECTION CRITERIA

2.1.1.1. DEMAND, CAPABILITY AND UTILIZATION SCORES

The uniformity in the project workflow held significant importance for the EO-FIN team. Consequently, the results of prior deliveries were to be employed as inputs for subsequent stages. As described in D2.1 and D2.2 reports, the consortium assessed the current EO capabilities for the FM sector based on three elements including demand, capability, and utilization.

To derive the demands score per EO product, firstly a score of interest was given to each User Need (UN) based on the information we acquired during geoinformation gathering including one-to-one interview with end users. As, each EO product responds to single of a group of the UNs, the demand level for each EO products derived from its UN's demand level. On the other hand, utilization scores were derived from the questionnaire targeting the FM sector and the capability scores were obtained from feedback from the EO industry.

These derived scores and the related comments received from both the FM and the EO sectors were helpful in better identifying the EO products. For example, EO products were prioritised according to high demand scores from the FM sector, and on the other hand, EO products with high capability scores were prioritised based on response levels to their associated user needs. The utilization scores and related comments are used to identify barriers that prevent financial institutions from using the EO product in their practices. Understanding those challenges and limitations can better define the specifications and functionalities of the prototype.

2.1.1.2. DISCUSSIONS WITH FINANCIAL MANAGEMENT STAKEHOLDERS

A list of 38 EO products that were consolidated through previous activities of EOFIN with the description of each of them was sent to experts in the FM sector. These experts from different

countries and diverse fields such as banking, insurance, and asset management, were initially tasked with prioritizing 10 top EO products according to the interests of their respective institutions. Also, they were requested to rank these chosen 10 products in descending order based on priority. The objective of this activity was to guide us in the selection of high-priority EO that fit in purpose of supporting the business process based on real needs within the FM sector.

Subsequently, a series of one-to-one interviews were conducted with each of the FM experts. It is worth noting that most of the selected products/services are mature and can thematically fit the FM's needs, however, this does not mean that the products/services already fit into the workflows of financial institutions.

These one-to-one interviews aim to understand the specifications and key elements required for the prototype service which is not only mature but also can fit into the workflow of the financial institutions. This means, the questions did not only target the technical specifications of the service but also considered other aspects. The structure of the questions for each prioritized EO product comes as 7 groups of questions as follows:

1. **Impact of the EO product in the FM sector** with questions about:
   a. Who are the target customers for these EO products?
   b. Why there is a need for this EO product in your organisation?
   c. Which FM domain can mostly benefit from these EO products?
   d. What types of financial institutions would be interested in these EO products?
2. **EO related** with questions about:
   a. Which EO application(s) would you group your highly prioritised EO products?
   b. What regions do you suggest developing the prototype for?
3. **Product technical specifications** with questions about:
   a. What would be the ideal size of the target area for each of your highly prioritised EO products?
   b. What would be the ideal target feature size for each of your highly prioritised EO products?
   c. What would be the ideal Spatial resolution for each of your highly prioritised EO products?
   d. What would be the ideal Spatial resolution for each of your highly prioritised EO products?
   e. How frequently you would like to have your highly prioritised EO products?
   f. What would be the ideal output format (i.e., vector (shp), raster (GeoTIFF), and tabular (CSV)) for each of your highly prioritised EO products?
   g. What would be an accuracy expectation for each of your highly prioritised EO products?
4. **Previous experience with your highly prioritised EO products** with questions like:
   a. Do you have any previous experience in using your highly prioritised EO products in your practices? If the answer is yes, we continue with other questions.
   b. Do you rely on an EO product or prefer in-situ data instead?
   c. What barriers prevent such a product from being fit into their workflow?
   d. What are the improvements derivers need to consider in which the EO product fits well into your workflow?
5. **Web platform features and characteristics** with questions about:
   a. Would you prefer to have the visualization features for each of your highly prioritised EO products?
   b. What functionalities do you suggest the web platform to have?
   c. What parameters do users have to define for operating prototypes on the web platform?
   d. Do you prefer online processing over offline and why?
6. **Prototype users** with questions about:

   a. What elements to consider facilitating the FM sector using this prototype?
   b. How important assisting users of the prototype in your organisation to analyse and extract target information or indicators?

7. **EO service or EO product** with questions like:
   a. Do you think individual EO products fit for purpose or service by a combination of a series of products?
   b. If you prefer a service, what EO products would like to group them as a service?

3. SUMMARY OF FINDINGS

Based on the prioritized EO products and the one-to-one interviews with financial end users, it has been noted that there are series of EO products that are highly interested, and they can be grouped into two services such as multi-physical risk observations and Green House Gas (GHG) emissions monitoring.

- **Multi-physical risk observations**. We realized that big financial institutions are very interested in having historical data on physical risks, they need those long-term data to be used as inputs for their statistical models to calculate risk factors. They prefer to have these historical data rather than have a risk factor product provided by EO providers. The reason is that they have their models which they trust and would not share with the EO providers. In addition, we found that financial institutions are struggling to access data on different physical risks. And it would be great for them to access different physical risk layers in one platform. The physical risk products that they were interested in included:
    - Agricultural drought observations at the asset level, which is very important for the agricultural sector as well as real estate for mortgage and estimation of house and land prices.
    - Post wildfires assessment (area and severity), which is important in regions prone to wildfires like southern Europe.
    - Identification of past flood events, which can be used for assessing and determining the regions that are susceptible to flooding. It was also crucial for the stakeholders to know the type of flood (like surface, river, sea, or groundwater floods), which helps the financial institutions with risk mitigation strategies.
    - Identification of trends related to shifts in rainfall patterns, which is used to determine the probability of occurrence of extreme rainfall events over a specific region.
    - Heat hazard maps, that are used to identify areas prone to extreme heat events. These maps utilize satellite imagery to visualize temperature variations and heatwave patterns across a region.
    - Impact of increased temperatures on soil moisture and vegetation condition, this product along with heat hazard maps is very useful to assess the impact of temperature increases on the agricultural sector, country GDP, and inflation.
- **Green House Gas (GHG) emissions monitoring** which is important for financial institutions to assess the impact of climate change mitigation/transition policies. They are also of great importance to validate self-reported disclosures of emissions. Those products include:
    - GHG emissions monitoring focuses on continuous monitoring of GHGs such as Co2, No2, and CH4.
    - Estimation of above-ground carbon stocks in forests which focuses on the measurement of gains and losses of carbon associated with forest growth, loss, and degradation.

According to demand, capability, and utilization scores, the current EO products for GHG emissions monitoring are not capable of responding to the FM needs mainly due to the low spatial resolution of existing products which cannot enable the monitoring of emissions over asset levels. This gap was classified as a critical R&D gap on the scope of the D2.2 Gap Analysis report. Also, the resources needed for developing the product of estimation of 'above-ground carbon stocks in forests' are not available within the EO-FIN project as it requires LIDAR data to train a machine learning model. Also, there was a higher interest from the FM stakeholders in the multi-physical risk observations service over the current EO products for GHG emissions.

Therefore, when it comes to choosing which services to select as the use case for the prototype service, the **multi-physical risks observations service** is more of interest to the FM sector by providing a comprehensive and holistic view of various physical risks, allowing financial institutions to assess and mitigate potential threats to their assets and investments. A multi-physical risk observation service is proposed for the selection of the EO-FIN use case service. According to feedback from FM stakeholders gathered through interviews, there is a recognized need for historical data on various hazards. Here are some important characteristics of the anticipated service that are provided in the following table.

Table 1. Characteristics of the anticipated prototype service.

Feature	Related information
Target audience	Big financial institutions
Targeted FM domain	Investment management firms
Regions of interest	Not region-specific: it is based on risk and opportunity.
Expected output	They prefer raw output that can be used as input to other statistical models.
Target time frame	Historical monitoring
Output format	The end users prefer to have different output formats and choose among them, like: • Geospatial formats: raster and vector files • Tabular data
Accuracy expectation	High accuracy is not crucial for investment management.
Functionalities on the platform	• Allow end users to upload information. • Integrate EO data with companies' information. • Download raw data based on area of interest and time range. • Aggregate data to different geographical levels such as districts, municipalities, cities, and country levels.
Visualization features on the platform	Downloading digital raw data is more appealing than visualization of the information platform.

4. DESCRIPTION OF THE USER CASE SERVICETO BE A PROTOTYPE

The EO-FIN prototype is designed to meet the needs of the FM sector, particularly large investment firms like banks for investment management in areas like risk assessment and mitigation, insurance strategies, and ensuring compliance with environmental, social, and governance (ESG) regulatory standards. The prototype offers an EO multi-physical risk observation service with a focus on past events. The prototype is formed by different types of physical risk layers with the highest impact on the sector.

The output of this service offers financial institutions the data they require to be used as inputs to their models to make more informed, resilient, and sustainable investment decisions, ultimately contributing to better risk management and long-term financial success.

To develop the service user case, the team will combine a series of EO products that are publicly available at a global scale with performing some required post-processing steps to meet end users' needs. In addition, for some products that are not globally available, the GMV team will use input data with algorithms to generate them, utilizing the Python language for implementation.

Therefore, the prototype can be developed over any region of the world as all the data of the service have global coverage. However, in the context of the EO-FIN project, an area of interest will be selected over a developing country where the EO data offers superior relevance/accuracy compared to other sources of information like in-situ data.

In the context of developing the prototype, four physical risks based EO products were chosen as follows:

1. Agricultural drought observations: to be developed by the GMV team.
2. Wildfires burned area observations: using publicly available EO products.
3. Flood extent mapping: using publicly available EO products.
4. Heat hazard map: to be developed by the GMV team.

The proposed EO user case service can offer the major financial institutions numerous benefits such as:

1. Applicable globally: The user case service can be applied to any location as its methodology is spatially independent and there is no limitation on spatial transferability. This would enable financial institutions to make informed investment decisions for any region in the world.
2. Convenience of having several hazard layers in one service: One of the limitations stakeholders raised was encountering challenges in collecting physical risk datasets from diverse sources in a suitable format, leading to difficulties in the collection process. The proposed EO service provides multi-physical risk datasets in a single package offering them the option to select the type of physical risk layer.
3. User-friendly post-processing functionalities: The financial institutions are not experts in dealing with EO products, therefore it is very important to facilitate the post-processing steps such as spatial and temporal aggregations to make the service easily go through the workflow of the financial institutions.

4.1. POTENTIAL FUTURE STEPS

There are potential future enhancements for the prototype that could further align it with the geo-information requirements of the financial management sector. Those improvements include but are not restricted to:

- Add observations of other physical risks such as identification of trends related to shifts in rainfall patterns and the impact of increased temperature on soil moisture and vegetation condition.
- Possibility of aligning with financial institutions' data: In the subsequent phases of development, the prototype can be expanded to enable end-users to input asset locations for evaluating historical

physical risks. This feature holds significant value for both major financial institutions and investment consultants, facilitating informed advice to clients interested in investing in specific companies.

4.2. DATA USED WITH SPECIFICATIONS

As highlighted earlier, the EO products that are utilized to generate the prototype service can be categorized into two groups: publicly available EO products and products that will be developed by the GMV team. Table 2 provides details regarding the specifications of the publicly accessible products, while Table 3 presents information about the specification of data employed in the development of the second set of products.

Table 2. Publicly available products used for the development of the prototype.

Product Name	Product output	Provider	Spatial resolution	Temporal frequency	Latency	Archive length	Spatial coverage	Output format	Access
Wildfires burned area observations	Fire burned area: pixel product	Copernicus	250-300 m	Monthly	Annual	2001-present	Global	NetCDF	Link
Flood extent mapping	Flood extent	Copernicus	20 m	~ 6days	~ 8 hours	2015-present	Global	Tiff	Link

Table 3. Products with input data specifications are to be developed by the EOFIN team.

Product Name	Product output	Data used	Provider	Spatial resolution	Temporal frequency	Latency	Archive length	Spatial coverage	Output format	Access
Agricultural drought observations	Combined Drought Indicator (CDI)	FAPAR	Copernicus	300 m	10 days	5 days	2014-present	Global	Tiff/NetCDF	Link
		FAPAR	GLASS	250 m	8 days	Archive	2000-2021	Global	HDF	Link
		Precipitation from ERA5-land monthly averaged data	Copernicus	0.1°	Hourly	~ 3 months	1950-present	Global	NetCDF	Link
		SMA	Copernicus	0.1°	10 days	10 days	2001-present	Global	Tiff/NetCDF	Link
Heat hazard map	Heat hazard map	LST	Copernicus	5 km	10 days	~ 2 days	2017-present	Global	Tiff/NetCDF	Link

FAPAR: Fraction of Absorbed Photosynthetically Active Radiation; SMA: Soil Moisture Anomaly; LST: Land Surface Temperature, GLASS: Global Land Surface Satellite.

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TEMPLATE 23/11/2020

