I-SEAMORE

D4.2 Preliminary Data Sets from UxVs & Copernicus

WP.4 I-SEAMORE
UxVs, Satellites &
Payloads

Integrated surveillance ecosystem for European Authorities responsible for Maritime Operations leveraged by reliable and enhanced aerial support

Co-funded by the European Union

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D4.2 Preliminary Data Sets form UxUv & Copernicus

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Abstract	This document will present the main activities performed within task 4.2. The main purpose of the document is to present the different data types that will feed the I-SEAMORE platform.

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DISCLAIMER

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EXECUTIVE SUMMARY

In the Task 4.2 (March 2023 – September 2023) the main activities performed are related with the principal data sets that are going to be used in the I-SEAMORE project. The consortium primarily concentrated its efforts on utilizing Copernicus satellite data and drone-generated information within the project.

In the document, primary guidelines have been outlined regarding how the data will be utilized for the subsequent phases of the project. Satellite images, primarily sourced from Sentinel-1 under the Copernicus Program, will encompass an area of approximately 500 square kilometers in the western region of the Troia Peninsula which is the envisaged demonstration area of the project. The Copernicus Data Spaces Ecosystem (an open ecosystem that provides free instant access to a wide range of data and services from Copernicus Sentinel missions) will serve as the primary provider of satellite data, as well as handling their processing, storage, and visualization. During the satellite data processing, the necessary steps will be followed to acquire a Spatio Temporal Asset Catalog (STAC) data catalog of the Analysis Ready Data variety. The resultant images will be directly employable across various operational contexts. Furthermore, within the annexes, an illustrative metadata model that will accompany each satellite product has been included.

Copernicus satellite data will be used as a foundational element in both case studies, in conjunction with data supplied by drones. The document also presents the data types (e.g., video images) and their characteristics. Within I-SEAMORE, at least three UxVS systems will be used: Inspector, Primoco 150 and Primoco 180, the systems being able to cover both sea and aerial space.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

ARD	Analysis Ready Data
AIS	Automatic Identification System
CEOS	Committee on Earth Observation Satellites
CIDL	Configuration Item Data List
CITE	Compliance Interoperability and Testing Evaluation (OGC)
COG	Cloud Optimized GeoTIFF
DATASPACE	Copernicus Data Space Ecosystem
DIAS	Data and Information Access Services
ECSS	European Cooperation for Space Standardization
EO	Earth Observation
EOC	Earth Observation Center
EOP	Earth Observation Profile (HMA metadata definition)
FTP	File Transfer Protocol
FEDEO	Federated Earth Observation mission access
GeoTIFF	A public domain standard for geo-tagging of TIFF images.
GIS	Geospatial Information System
ISO	International Standards Organization
JSON	JavaScript Object Notation
ODA	EO Online Data Access
OGC	Open Geospatial Consortium
OSEO	OpenSearch Extension for EO
STAC	Spatio Temporal Asset Catalogs
TEP	Thematic Exploitation Platform
TIFF	Tag Image File Format
UC	Use Case
UxVs	Unmanned Vehicles
WCS	Web Coverage Service
WCPS	Web Coverage Processing Service
WFS	Web Feature Service
WMS	Web Mapping Service
WPS	Web Processing Service

1 INTRODUCTION

1.1 Purpose of the document

This document describes the use of satellite and drone data within the I-SEAMORE project. The focus of the document will be on satellite data provided by Copernicus Programme. Also, within the document, it will be described the data provided by various UxVs system that are going to be used in the framework of the use cases developed in the project.

The document addresses the main data sources considered for the I-SEAMORE ecosystem in order to fulfill all the user requirements foreseen in the project proposal and in the users' requirements gathering phase of the project.

1.2 Overview

This document is built on two main categories:

- Earth Observation (EO)-data
- Non-EO data (drone data)

The document is organized into several sections as presented in the table of content.

- **Data needs for I-SEAMORE**: within this section, we explore the critical requirements and essential components needed for the development of border surveillance ARD. This part of the document sets the stage for a comprehensive exploration of the specific needs and challenges associated with this technology.
- **I-SEAMORE Product Family Specifications**: in the following section, we provide detailed specifications for the product family, encompassing both Earth Observation (EO) data and Non-EO Data.
- **I-SEAMORE ARD Production**: the document proceeds to discuss the setup of the ARD production pipeline.
- **I-SEAMORE EO ARD Workflow**: this section highlights the concept, data formats, data services, software technologies, and the advantages of employing this approach within the I-SEAMORE project.
- **UXVS Data Contribution**: here, we present a comprehensive overview of the data contributions from various sources, including USV Inspector, Primoco One 150 UAV, and IT180.

2 REFERENCES

2.1 Applicable Documents

The following documents are related with the current deliverable in two ways:

- Input for this deliverable marked with [I1, I2, etc.]
- Output from this deliverable marked with [O1, O2, etc.]

I1 – Grant Agreement

I2 - Model based State-of-the-art (D3.1)

I3 - Plan for Co-Design and Co-Creation Processes Implementation (D3.2)

I4 -Operational concepts, KPIs and User Requirements (D3.3)

I5 - Assessment of I-SEAMORE UxVs and Payloads Capabilities (D4.1)

O1 – I-SEAMORE Interoperability Layer (D5.1)

O2 – I-SEAMORE Data Fusion Modules (D5.4)

2.2 Reference Documents

TABLE 1 - REFERENCE STANDARDS

Reference ID and Document Title	Document ID and Issue
[RD01] CEOS WGISS	http://ceos.org/ourwork/workinggroups/wgiss/
[RD02] Space Engineering Standard – Software	ECSS-E-ST-40C, 6 March 2009
[RD03] CEOS FDA	http://ceos.org/ourwork/ad-hoc-teams/fda/; http://ceos.org/document_management/Working_Gr oups/WGISS/Meetings/WGISS-46/1.%20Monday/CEOSS_WGISS_FDA_prova.pdf
[RD04] Open Geospatial Consortium (OGC)	http://www.opengeospatial.org/
[RD05] OGC OpenSearch Extension for Earth Observation (OpenSearch- EO)	http://www.opengeospatial.org/pressroom/pressrelea ses/2831

[RD06] [OGC 17-003] EO Product Metadata GeoJSON(-LD) Encoding	https://portal.opengeospatial.org/files/?artifact_id=77 652
[RD19] DIAS	https://www.copernicus.eu/en/upcoming-copernicus-data-and-information-access-services-dias
[RD08] TEP	https://tep.eo.esa.int/
[RD10] STAC	https://stacspec.org/
[RD11] OpenEO	https://openeo.org/
[RD12] Space Product Assurance Standard – Software Product Assurance	ECSS-Q-ST-80C 6 March 2009
[RD12] Copernicus Access to Data	https://www.copernicus.eu/en/access-data
[RD13] Copernicus Sentinels Satellites	https://www.copernicus.eu/en/about-copernicus/infrastructure/discover-our-satellites

3 BACKGROUND

The Copernicus Program represents an outstanding source of satellite data that must become one of the most ubiquitous data sources when it comes to environmental applications. In addition to the data policy that makes the data available under an open license, there are critical advantages to take into consideration: (1) long-term continuity of measurements (>20-years time series building on previous, observationally compatible missions), (2) global and generally frequent coverage, (3) careful calibration of the satellite sensors, (4) data delivery and archiving that meet the rigorous performance requirements of operational programs, and (5) a broad variety of sensing methods (optical and microwave, active and passive, etc.) (Berger et al., 2012).

The two main broad data categories considered by the I-SEAMORE are: EO data and non-EO data. The data plan will be served for the following I-SEAMORE use cases:

1. Irregular Migration
2. Smuggling of Drugs

These use cases primarily involve the collection and analysis of Earth Observation (EO) data, including satellite imagery and geospatial information. While EO data plays an important role in monitoring migration and smuggling patterns and environmental factors, non-EO data, provided by drones, offers critical insights into on-ground conditions, border surveillance, and potential irregular migration activities. This non-EO data from drones includes real-time imagery, videos, and sensor data, enhancing the overall understanding of real time conditions.

4 DATA NEEDS FOR I-SEAMORE

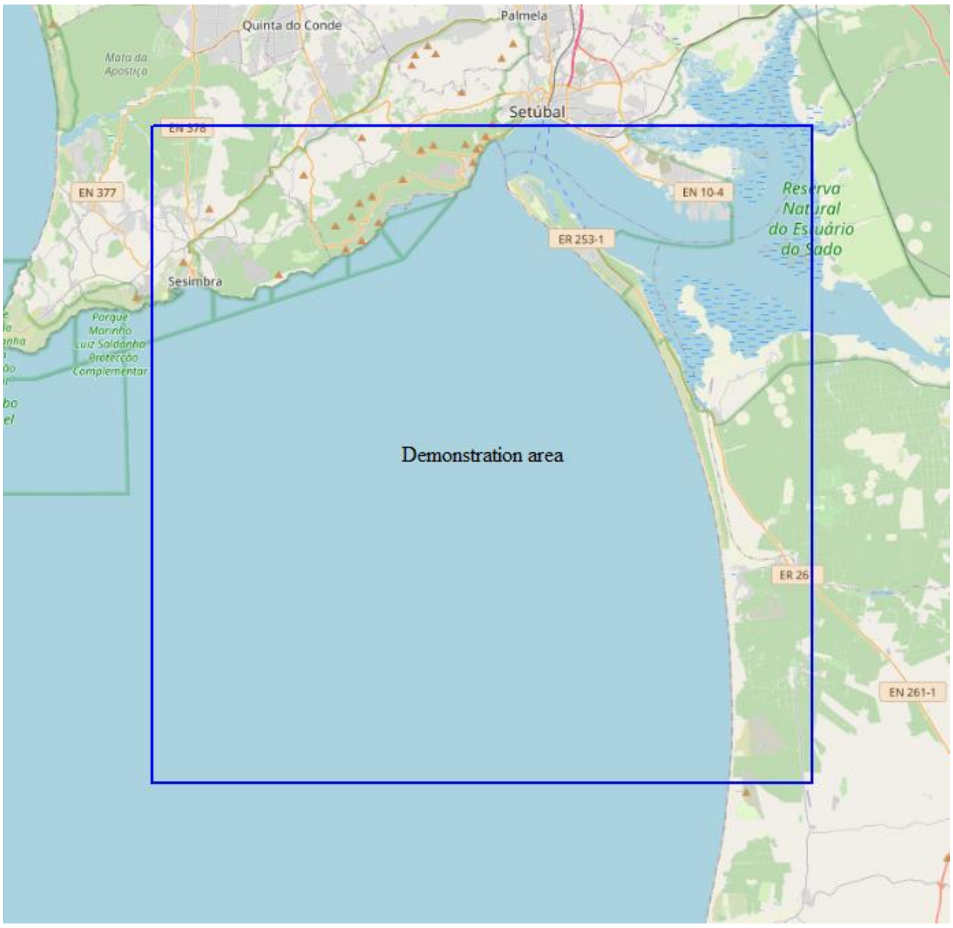
The main inputs for this task are provided by WP3 I-SEAMORE Co-Creation & Co-Design Phases. Within T3.1 Model based analysis of State-of-the-Art concepts and capabilities for Maritime Surveillance inputs for satellite data are collected. Task 3.3 defines the Use Cases and paved the way for the specific requirements regarding the pilots.

Analysis Ready Data (ARD) is processed satellite data that is readily available for specific applications without the need for further preprocessing by the end-user. Based on the documents that serve as an input for this deliverable, the following user requirements are clear. These requirements are relevant for both I-SEAMORE use cases: Irregular Migration and Smuggling of Drugs. The use cases pilots will be demonstrated, see Figure 1 bellow, in the proximity of Troia Peninsula, south of Lisbon & Setubal, in the Atlantic Ocean.

1. Geographical coverage
    - Data covering specific border areas, possibly with overlapping regions for comprehensive monitoring.
2. Temporal resolution
    - Because of the nature of the border activities, generally, users require frequent updates. Manny need daily updates (impossible at lower latitudes with Copernicus data), while others are fine with weekly or monthly observations. The time-series by design characteristic of ARD satellite data helped with catalogue systems like STAC facilitate the data consumption by I-SEAMORE users.
3. Spatial resolution
    - Some small-scale activities, like illicit crossings or smuggling operations, require high spatial resolution for proper detection, which is also not possible with Copernicus data. However, this can be achieved by fusion Copernicus data with high resolution commercial satellite data and/or data captured by drones.
4. Authorization & credentials
    - Proper identification and validation of the entity or individual requesting the data.
    - Appropriate security clearance or permission, especially for sensitive border surveillance activities.
5. Data security & privacy
    - Ensuring that data access and transmission are secure.
    - Mechanisms to protect sensitive information, especially if the ARD is used in conjunction with other data sources that may contain private or classified information.
6. Interoperability
    - The data should be compatible with other datasets and surveillance tools used by border security agencies and other data providers like meteorological agencies and Automatic Identification System (AIS) (e.g., the use of OGC standard services and/or the new cloud native formats can achieve technical ARD data interoperability).
7. Data formats
    - Data should be available in standard formats (e.g., GeoTIFF/COG, NetCDF) that are compatible with common analysis tools.
8. Preprocessing Requirement
    - Atmospheric correction to remove distortions caused by the atmosphere.

- Cloud masking to exclude or highlight cloud-covered areas (for optical data).
- Image normalization to maintain consistency across different dates and sensors.

FIGURE 1 - I-SEAMORE DEMONSTRATION AREA



5 I-SEAMORE PRODUCT FAMILY SPECIFICATIONS

The I-SEAMORE ecosystem will derive advantages from two primary categories of data: Earth Observation (EO) data and Non-Earth Observation (Non-EO) data.

5.1 Earth Observation (EO) Data

The main source of satellite data for the project will be Copernicus Programme. From the Sentinel constellation, Sentinel-1 is envisaged to be the primary resource for EO data. Besides Sentinel-1, The project can also have access to Sentinel-2 and Sentine-3 through Copernicus Data Spaces Ecosystem. All satellite data that is going to be used in I-SEAMORE project will cover the area of interest (AOI) presented in Figure 1.

The following key information provides insight into its Copernicus Sentinel missions that can be used within the project.

Sentinel 1:[1]

- Launched On - End of Service: Ap. 03, 2014 – present
- Observation period at equator (average). (*): 12 days(**)
- Satellite Sensor Data Source: C-SAR (C-band Synthetic Aperture Radar)
- Resolution: 5m - 40m (depending on sensor mode)
- Data source: Copernicus Data Spaces Ecosystem
- Description/Metadata link: https://dataspace.copernicus.eu/explore-data/data-collections/sentinel-data/sentinel-1
- Format: SENTINEL-SAFE/GeoTIFF
- Access type: HTTP, S3, API
- Access policy: open data

Sentinel 2:

- Launched On - End of Service: 23, June, 2014 – present
- Observation period at equator (average). (*): 9 days(**)
- Satellite Sensor Data Source: MSI (Multi Spectral Instrument). Optical: 443nm - 2190nm.
- Resolution: 10m - 60m (depending on wavelength)
- Data source: Copernicus Data Spaces Ecosystem
- Description/Metadata link: https://dataspace.copernicus.eu/explore-data/data-collections/sentinel-data/sentinel-2
- Format: SENTINEL-SAFE/JPEG2000
- Access type: HTTP, S3, API
- Access policy: open data

[1] https://sentinel.esa.int/web/sentinel/user-guides

Sentinel 3:

- Launched On - End of Service: Feb. 16, 2016 – present
- Observation period at equator (average). (*):4 days (OLCI).(**); 2 days (SLSTR).(**)
- Satellite Sensor Data Source: OLCI (Ocean and Land Colour Instrument) optical med-res: 400nm -
- 1200nm. SLSTR (Sea and Land Surface Temperature Radiometer) thermal SRAL (SAR Altimeter) Auxiliary Instruments
- Resolution: 500m (OLCI) - 1000m (SLSTR)
- Data source: Copernicus Data Spaces Ecosystem
- Description/Metadata link: https://dataspace.copernicus.eu/explore-data/data-collections/sentinel-data/sentinel-3
- Format: SENTINEL-SAFE/NetCDF4
- Access type: HTTP, S3, API
- Access policy: open data

5.2 Non-EO Data

Non-EO data category is produced or collected as non-space-born data with a geographic dimension.

Within I-SEAMORE project, two main categories will be produced:

1. Provided by air-borne sensors: aerial photography, 3D lidar data, Ku band SAR, video.
2. Provided by sea-borne sensors:
    - above water: lidar, radar and optical images
    - bellow water: lidar, radar, optical images, obstacle detection and various sea water parameters (e.g., turbidity, depth)

6 I-SEAMORE ARD PRODUCTION

6.1 ARD production Infrastructure

The I-SEAMORE project team will consider mainly Sentinel-1 data but will also take into consideration Sentinel-2 and 3 data for the ARD data cube creation.

Copernicus Data Spaces Ecosystem will be the cloud infrastructure used for discovering, accessing, processing and delivery of the ARD data cube derived from Copernicus satellite data.

As a hub to the entire Copernicus Program, Copernicus Data Spaces Ecosystem can provide also various types of non-EO data from the contributing missions (e.g., whether conditions, sea conditions (waves, currents etc.)).

The non-EO data provided by air and sea borne vehicles collected in the project will be provided by EXAIL and Primoco partners. For sea-borne deployed sensors Interceptor 90, Interceptor 125 and DriX will be used, and for the air-borne ones, the team will use Primoco ONE 150 UAS.

6.2 EO ARD data cubes

Data cubes in the context of Earth Observation (EO) data refer to a multidimensional array structure used for organizing and analyzing large amounts of EO data. This concept allows for the efficient retrieval, processing, and analysis of data collected from satellites or other earth observation platforms.

6.2.1 The concept

Data cubes organize EO data into multidimensional arrays where each dimension represents a different aspect such as time, spatial location (latitude, longitude), and various spectral bands. This organization mimics the natural structure of EO data, making it intuitive and efficient for analysis. The organization within data cubes ensures that data is stored in a manner that mirrors its inherent multidimensional nature. This structure allows for efficient querying and analysis, enabling users to extract meaningful insights from large datasets. Each element in the data cube, often referred to as a pixel, carries information across various dimensions. This allows for in-depth pixel-based analysis, which can be crucial for understanding changes in land use, marine traffic and other earth observation parameters over time and space. Data cubes facilitate layer stacking, where different layers of data such as various spectral bands or datasets from different time periods can be stacked together for comparative analysis. This stacking enables a more comprehensive understanding of the observed phenomena. The temporal dimension in data cubes allows for time-series analysis. This is particularly useful in monitoring changes over time, which is a core part of many EO applications. Data cubes support standardized data processing workflows. This standardization ensures consistency in data handling, processing, and analysis, which is essential for accurate and reliable insights and a very important matter for the fusion and integration with the other data sources of I-SEAMORE.

6.2.2 Data formats and data services for Copernicus ARD

Several data formats are foreseen to be used by the I-SEAMORE, both in terms of input and output products. These are listed and briefly described below.

- GeoTIFF[2] is an OGC (Open Geospatial Consortium) Implementation Standard. It represents one of the most popular and used raster formats in the geospatial industry. It is based on the TIFF format and is used as an interchange for georeferenced raster imagery. All of the software solutions envisaged to be used in I-SEAMORE offer support for the read and write of GeoTIFF products.
- Cloud Optimized GeoTIFF (COG)[3] format was designed in order to make GeoTIFF files adapted to be hosted on a HTTP file server. The main advantage is given by the internal storage capability which offers more efficient workflow on the cloud. More specifically, users can retrieve just parts of the file they need, instead of getting the entire product.
- Sentinel SAFE[4] format is a container specifically designed for the distribution of Sentinel based products. For Sentinel-2 it includes the images in a JPEG2000 format. The SAFE format wraps a folder containing image data in a binary data format and product metadata in XML. This flexibility allows the format to be scalable enough to represent all levels of SENTINEL products.
- NetDCF (Network Common Data Form)[5] is mainly used to store and retrieve data in the form of arrays. There are several versions of the format, each with particularities. The one to be used for output data is the NetDCF-4 implementation. Sentinel-3 OLCI data and CMEMS products are distributed, for example, as NetDCF files.
- Shapefile[6] format is the most used method to store geospatial vector data to be used with Geographic Information System (GIS) software. Shapefiles can describe points, lines or polygons and have associated one or multiple attributes that describe the geometric features.
- GeoPackage (GPKG)[7] is an open, non-proprietary data format for storing vector information. GPKG is built up as an extended SQLite 3 database file (*.gpkg) containing data and metadata tables with specified definitions, integrity assertions, format limitations and content constraints. Thus, it represents an SQLite container. It became more and more popular in the last years, due to some advantages it brings compared to the old format, such as shapefile (e.g., can store more than one type of graphical elements in the same file).
- FlatGeobuf[8] is a performant binary encoding for geographic data based on flatbuffers that can hold a collection of Simple Features including circular interpolations as defined by SQL-MM Part 3.
- GeoParquet[9] Apache Parquet is a powerful column-oriented data format, built from the ground up to as a modern alternative to CSV files. GeoParquet is an incubating Open Geospatial Consortium (OGC) standard that adds interoperable geospatial types (Point, Line, Polygon) to Parquet.
- Web Map Service Interface Standard (WMS)[10] provides a simple HTTP interface for requesting geo-registered map images from one or more distributed geospatial databases. A WMS request defines the geographic layer(s) and area of interest to be processed. The response to the request is one or more geo-registered map images (returned as JPEG, PNG, etc) that can be displayed in a browser application. The interface also supports the ability to specify whether the returned images should be transparent so that layers from multiple servers can be combined or not.

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[2] https://www.ogc.org/standard/geotiff/

[3] https://www.cogeo.org/in-depth.html

[4] https://sentinels.copernicus.eu/web/sentinel/user-guides/sentinel-2-msi/data-formats

[5] https://www.ogc.org/standard/netcdf/

[6] https://desktop.arcgis.com/en/arcmap/latest/manage-data/shapefiles/what-is-a-shapefile.htm

[7] https://www.ogc.org/standard/geopackage/

[8] https://docs.rs/flatgeobuf/latest/flatgeobuf/

[9] https://geoparquet.org/

[10] https://www.ogc.org/standard/wms/

- Web Map Tile Service (WMTS)[11] offers scalable, high-performance services for distribution of maps on the web.
- Web Coverage Service (WCS)[12] offers multi-dimensional coverage data for access over the Internet. WCS Core specifies a core set of requirements that a WCS implementation must fulfill.
- Web Feature Service (WFS)[13] represents a change in the way geographic information is created, modified and exchanged on the Internet. Rather than sharing geographic information at the file level using File Transfer Protocol (FTP), for example, the WFS offers direct fine-grained access to geographic information at the feature and feature property level.

6.2.3 Software Technologies

Given the large volume of EO data, big data/ cloud native technologies are essential for processing and analyzing data cubes efficiently. For I-SEAMORE purpose we plan to use the following technologies to develop our EO data cube:

- Spatial Temporal Asset Catalog (STAC)[14] is a standard that helps in cataloging and discovering spatial and temporal assets, aiding in the organization and retrieval of EO data within data cubes.
- Zarr[15] is a format for the storage of multidimensional arrays, which will be used for creating and managing EO data cubes, ensuring efficient data access and manipulation.
- Geospatial Data Abstraction Library (GDAL) [16]is a key technology for reading, writing, and manipulating EO data in data cube formats, providing a wide range of tools for geospatial data processing.
- Rasterio[17] is a library for reading and writing geospatial raster data, and can be used alongside data cube technologies for handling EO data, ensuring the integrity and accuracy of data manipulations.
- Geospatial servers - technologies like GeoServer or MapServer will be used to serve the I-SEAMORE data cube for online analysis and visualization, facilitating broader accessibility and utilization of EO data.
- Containerization and orchestration - tools like Docker and Kubernetes will be employed to containerize and orchestrate data cube services, ensuring scalable, and reliable operations.

6.2.4 Benefits

The utilization of a I-SEAMORE dedicated data cube in EO data management significantly augments the ability to derive meaningful insights from large and complex datasets. This, in turn, translates to better decision-making, more effective resource allocation. The main benefits are:

- Efficient data retrieval. The multidimensional array structure of the I-SEAMORE data cube, combined with technologies like COG and STAC, will facilitate fast and efficient data retrieval,

[11] https://www.ogc.org/standard/wmts/

[12] https://www.ogc.org/standard/wcs/

[13] https://www.ogc.org/standard/wfs/

[14] https://stacspec.org/en/about/stac-spec/

[15] https://zarr.dev/

[16] https://gdal.org/index.html

[17] https://rasterio.readthedocs.io/en/stable/

which is indispensable when dealing with large EO datasets and with the fusion with other kind of data (e.g. drones).

- Improved analysis. I-SEAMORE data cube enhances multidimensional analysis, aiding in better understanding and interpretation of EO data. This is crucial for deriving meaningful insights for the project purposes.
- Scalability. I-SEAMORE EO data cube is inherently scalable and can accommodate the growing volume of EO data and other sources of geospatial data.
- Data fusion and interoperability. The standardized structure of I-SEAMORE data cube facilitates data fusion from various sources and ensures interoperability among different systems considered within the project.
- Time-series analysis. I-SEAMORE EO data cube will provide the ability to conduct time-series analysis allows for monitoring changes over time, which is essential for many of I-SEAMORE applications.

6.3 I-SEAMORE EO ARD workflow

The creation of I-SEAMORE EO ARD data cube involves several steps to transform raw satellite observations into data that are ready for analysis. These steps will involve the following activities that will be done with the technologies mentioned above:

- Access the raw data. The I-SEAMORE team will create a dedicated account on the Copernicus Data Spaces Ecosystem and formally start a commercial agreement with the hub operators in order to provision the infrastructure resources needed for ARD production, discovery and processing.
- Pre-processing. Before the data becomes ARD, several preprocessing steps are necessary, depending on the products family:
    - Radiometric calibration: Convert digital numbers (DN) in the image to physical units, typically radiance or reflectance. This ensures consistency in the data and makes it comparable across different times and sensors.
    - Atmospheric correction. Remove the effects of the atmosphere to obtain the surface reflectance. Methods like Sen2Cor/MAJA (for Sentinel-2 data) or ATCOR will be used for this.
    - Geometric Correction. Adjust the satellite images to ensure they are correctly aligned to geographic coordinates. This step removes distortions caused by sensor and satellite movement.
    - Cloud Masking. Identify and mask clouds, shadows, and possibly snow/ice, which can interfere with the analysis.
- Resampling. Resample the data to a consistent spatial resolution will be considered especially for merging data from different sensors.
- Stacking & mosaicking: For temporal analysis, the stack of multiple images (from different dates) into a single data cube will be done. Tiles from multiple scenes will be mosaicked together.
- Quality assessment. Check the quality flags and metadata associated with the data to ensure its reliability. Discard or be wary of data that doesn't meet quality standards.
- Data formatting. Convert the processed data into a format suitable for I-SEAMORE analysis needs, like GeoTIFF/COG.
- Metadata compilation. Ensure the ARD is accompanied by comprehensive metadata that provides details about the processing steps, data sources, quality flags, and other relevant information.

- Store & management. Manage the ARD efficiently using appropriate Copernicus Data Spaces Ecosystem data storage and management practices.
- Analysis. With ARD ready, I-SEAMORE specific analyses can pe triggered (e.g., ship detection, ship parameters estimation – length, bearing).

7 UXVS DATA CONTRIBUTION

The UxVs will be an important contributor to the data collection of the I-SEAMORE system. With their mobility and quick deployment, they can provide real-time precise data. UxVs stream live video-data, but they also each provide additional data they collect through their specific sensors.

7.1 USV Inspector

The USV Inspector provides four different kinds of data:

- Live video data
- AIS Data
- Drone status information
- Tracking information

7.1.1 Live Video data

The Inspector relays the video captures from its different video payloads. In the specific configuration of I-SEAMORE, the main video stream available will be from the Infra-red camera.

The video stream will be provided with meta data according to STANAG 4609.

The video stream is provided through MPEG-TS as H264 video data.

7.1.2 AIS DATA

The Inspector will provide the captured AIS data to the I-SEAMORE system. It will transfer raw as specified in the NMEA0183 standard.

7.1.3 Drone status information

The Inspector will update the ISEAMORE System (see the parameters in Table 2) with its status through UDP messages at a rate up to 1Hz. These messages will contain at least:

TABLE 2 - USV INSPECTOR STATUS INFORMATION

Value	Description	Unit	Type
ID	Drone ID		String
Position Lat/Lon	Drone position	In decimal degrees on a WGS84 ellipsoid	Double
Speed over ground	Speed Over Ground (will be negative for non-confirmed tracks)	m/s	Double
Course over ground	Course Over Ground (will be negative for non-confirmed tracks).	Degree w.r.t north	Double

7.1.4 Tracking Data

The Inspector has its own tracking capabilities (see the parameters in Table 3) and, in addition to the raw data provided, it will provide pre-process tracking data. The tracking data will be provided as UDP messages, one for each track update at a rate up to 1Hz. These messages will contain at least the following data:

TABLE 3 – USV INSPECTOR DATA MESSAGE

Value	Description	Unit	Type
ID	A unique track ID. This in an integer that start at 0		string
Lat/Lon	Track position	In decimal degrees on a WGS84 ellipsoid	double
Speed over ground	Speed Over Ground (will be negative for non-confirmed tracks)	m/s	double
Course over ground	Course Over Ground (will be negative for non-confirmed tracks).	Degree w.r.t north	double
confirmed_track			bool
MMSI	If the track is associated to an AIS observation, the corresponding MMSI will be filled.		String
Length	The length given by an AIS observation. Or roughly estimated by IR observation (if an IR camera is present on the system).	Meters	double
sources	List of sensors that have detected this track.		String

7.2 Primoco One 150 UAV

The Primoco One 150 UAV provides multiple levels of data:

- Positioning data of the UAV
- On-board systems parameters (readable by the proprietary UAV Ground control station only
- Live imaginery data

7.2.1 Positioning data

The Primoco One 150 UAV provides a continuous text format of the WGS84-standardized text file with continuously calculated position of the UAV. Those may be further used for the UAV tracking. Those data can be further augmented by the open-source data streams such as Flightradar and others presenting position of the UAV with use of ADSB-In/Out Mode S traffic transponder.

7.2.2 Positioning data

The Primoco One 150 UAV provides over 120 parameters of the on-board systems (temperatures on engine cylinders, on-board systems status, fuel flow, fuel pressure, voltage etc.). Those are used for UAV control only and are in a proprietary format readable by the Ground control station only.

1.2.3. Live imaginery data

Primoco One 150 UAV relays the video feed from its payload in the form of the EO/IR gimbal (both day RGB camera and/or MWIR thermal camera). Both may be blended in PiP format for quick check.

The video stream will be provided with meta data according to STANAG 4609 or may be alternatively provided with metadata embedded in the video file.

The video stream is provided through MPEG compression format with pre-set level of compression.

7.2.3 Drone status information

The Primoco One 150 UAV will update the ISEAMORE System (see the parameters in Table 4) with its status through data messages at a selected rate up to 1Hz. These messages will contain at least:

TABLE 4 - PRIMOCO ONE 150 STATUS INFORMATION

Value	Description	Unit	Type
ID	Drone ID		string
Position Lat/Lon	Drone position	In decimal degrees on a WGS84 ellipsoid	double
Speed over ground	Speed Over Ground (will be negative for non-confirmed tracks)	m/s	double
Course over ground	Course Over Ground (will be negative for non-confirmed tracks).	Degree w.r.t north	double

7.3 Primoco One IT180

The IT180 provides two different kinds of data:

- Live video data
- Drone status information

7.3.1 Live Video data

The IT180 relays the video captures from its different video payloads. In the specific configuration of ISEAMORE, the main video stream available will be from an EO/IR camera.

The video stream will be provided with meta data according to STANAG 4609.

The video stream is provided through MPEG-TS as MJPEG compression format.

7.3.2 Drone status information

The IT180 will update the ISEAMORE System (see the parameters in Table 5) with its status through UDP messages at a rate up to 1Hz.. These messages will contain at least:

TABLE 5 - PRIMOCO ONE ITI 180 STATUS INFORMATION

Value	Description	Unit	Type
ID	Drone ID		string

Position Lat/Lon	Drone position	In decimal degrees on a WGS84 ellipsoid	double
Speed over ground	Speed Over Ground (will be negative for non-confirmed tracks)	m/s	double
Course over ground	Course Over Ground (will be negative for non-confirmed tracks).	Degree w.r.t north	double

8 CONCLUSIONS

In this document, we have addressed the main satellite and UxVs datasets to be used in I-SEAMORE platform. To commence, we mapped satellite and UxUv resources during the initial phase, enabling us to gain a comprehensive understanding of the available assets. Simultaneously, we conducted a thorough assessment of various cloud infrastructure providers, ultimately opting for the Copernicus Data Spaces Ecosystem after careful deliberation. This choice seamlessly aligns with our objectives, ensuring the presence of a robust platform for the efficient management and utilization of data.

A key element of our project centers on the deployment of an ARD STAC data cube within the I-SEAMORE platform. This equips us with the essential tools and resources necessary for proficient data processing and analysis. The integration of satellite data, UxVs resources, and state-of-the-art cloud infrastructure solutions forms the foundation for a successful undertaking.

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APPENDIX A

Below is presented as a truncated example the content of a metadata file for a Sentinel-1 satellite image that is processed as an ARD STAC.


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