



Data Management Plan

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1. Introduction

The purpose of this Data Management Plan (DMP) is to serve as a comprehensive guide to how data at PLOCAN are and will be managed at the institutional level, from collection to long-term preservation and accessibility for the broader scientific community and stakeholders.

PLOCAN is a research infrastructure dedicated to multidisciplinary ocean observations, technological development, and innovation. It integrates various platforms, including fixed and mobile observation systems, to collect high-quality oceanographic data. Given the diverse nature of data sources and formats, this DMP establishes a unified framework to ensure that data management practices align with the FAIR (Findable, Accessible, Interoperable, and Reusable) principles and international best practices.

This DMP is intended to be a living document, subject to regular updates as PLOCAN evolves and as new data management standards and technologies emerge and are implemented at the institution.

2. Infrastructure

PLOCAN's infrastructure consists of multiple specialized facilities designed to support marine and oceanographic research, technological development, and environmental monitoring. These facilities include the Oceanic Observatory, the Offshore Platform, the Test Site, VIMAS, and Onshore Facilities. Each of these components plays a critical role in advancing marine science and innovation.

Oceanic Observatory

The Oceanic Observatory is a multidisciplinary and permanent network of autonomous ocean observation platforms designed for marine environmental monitoring. It consists of two main nodes:

- **Coastal Node:**
 - **HF Radar:** Enables monitoring of surface marine currents.

- **Acoustic Doppler Current Profiler (ADCP):** Measures currents and wave patterns.
- **Hydrophones:** Allow for underwater noise monitoring.
- **Deep-Sea Node: The European Station for Time-Series in the Ocean Canary Islands (ESTOC)** is located 60 nautical miles north of Gran Canaria at a depth of 3,670 meters. It operates as a long-term meteorological and oceanographic time-series station in the Central-Eastern North Atlantic.

ESTOC is equipped with meteorological and oceanographic measurement systems, including:

- **Surface Buoy Sensors:**
 - Atmospheric sensors (temperature, humidity, ultrasonic and mechanical anemometers, pressure, PAR, and GPS)
 - Marine sensors (temperature, conductivity, dissolved oxygen, chlorophyll, turbidity, pH, and CO₂)
- **Mooring Line Sensors at Various Depths:**
 - CTD with dissolved oxygen sensors
 - Fluorometer
 - ADCP
 - Nitrate sensor
 - Current meter
 - Hydrophone
 - Sediment trap

Offshore Platform

The Offshore Platform is a seabed-supported facility located 1.5 km off the northeast coast of Gran Canaria at a depth of 30 meters. It includes:

- **Multidisciplinary laboratories** for bio-geochemical analyses of the water column.
- **Main deck area and hangar** for experimental operations, including material loading and unloading.
- **General-use facilities**, such as workshops, cranes, a gantry, and other equipment for operational support.
- **Environmental monitoring equipment**, including a LiDAR device, meteorological station, and air quality monitoring station.
- **Upcoming equipment**, including a **FerryBox** system that will measure parameters such as sea water temperature, salinity, chlorophyll, and carbon dioxide; and a

subaquatic camera system, which will enable continuous underwater monitoring and observation for research and environmental assessment purposes.

Test Site

The Test Site is a 23 km² marine testing area for various marine technologies. It provides access to a unique ecosystem that fosters sustainable and responsible marine research, aligned with the United Nations Sustainable Development Goals (SDGs). The site supports the development and validation of marine technologies under real conditions.

Key features include:

- **Electrical and communication infrastructure:** Two 5 MW medium-voltage submarine cables, each with a connection point, allowing renewable energy technologies to feed power into the island's electrical grid.
- **Competitive access:** The Test Site is managed through the **MARHIS** distributed ICTS network, facilitating fair and structured use of its facilities.

VIMAS (Vehicles, Instruments, and Submarine Machines)

The **VIMAS Base** hosts a fleet of cutting-edge autonomous ocean platforms and instruments. It serves as a permanent base for autonomous underwater and surface vehicles, as well as deep-sea visual observation vehicles.

Available equipment includes:

- **Gliders:**
 - Slocum Glider G3 (1000 m)
 - Slocum Glider G2 (1000 m)
 - Seaglider M1 (1000 m)
 - SeaExplorer (1000 m)
- **Autonomous Surface Vehicles (ASVs):**
 - Sailbuoy
 - AutoNaut (5m)
- **Remotely Operated Vehicles (ROVs):**
 - SeaBotix vLBV 950 (950 m)
 - BlueROV2 (100 m)

The VIMAS Base is also equipped with dedicated mechanical and electronic tools, workbenches, and a testing tank.

Onshore Facilities

PLOCAN's land-based headquarters includes **workshops, laboratories, testing areas, and support infrastructure** for marine research and technology development. The main facilities include:

- **Workshops:** 400 m² of fully equipped spaces for electronics, mechanical integration, repair, storage, and logistics.
- **Multipurpose Laboratories:** 500 m² of laboratories for physical, chemical, biological, and geological research.
- **Oceanographic Laboratories:** Ten fully equipped multipurpose laboratories with workspaces, storage, seawater access, and compressed air.
- **Dry and Wet Laboratories:** Including a saltwater tank for the preparation, maintenance, and preliminary testing of underwater vehicles (e.g., gliders, ROVs, ASVs), as well as dedicated workshops and a control room for testing and repairs.
- **Operational Control Room:** A real-time pilot, monitoring, and control center for marine operations, including visualization of live data from observation platforms and equipment. It is also used for specialized training.
- **ICT Demonstration Center (CDTIC):** Equipped with desktop and laptop computers, projection equipment, satellite communications, radio systems, and digital workspaces.
- **Sensor Laboratory:** A 100 m² workspace for sensor and electronics research, including 3D printers, PC workstations, electronic design software, a meeting area, and storage space.
- **Technical Hall:** Dedicated to the preparation, adaptation, and preliminary testing of various marine research elements, such as renewable energy devices, meteoro-oceanographic buoys, sensors, and moorings. This space is also available for training courses.
- **Dock and Confined Waters Access in Taliarte Port:** A floating dock and controlled waters area for testing marine research equipment before deployment in open waters.
- **Harshlab 0.5:** A marine material testing facility accessible year-round, consisting of two metal structures installed in the Taliarte Dock, with a capacity for up to 140 test samples.

PLOCAN's infrastructure offers comprehensive support for scientific research, technology testing, and innovation in the marine environment. These facilities contribute to advancing knowledge, sustainability, and the responsible use of marine resources. Furthermore, this infrastructure plays a key role in data collection, storage, and accessibility, ensuring high-

quality data management that supports long-term oceanographic research and technological innovation.

3. Data Sources and Variables

The data collected by PLOCAN comes from a variety of sources, each with its specific platform and location. These data sources are crucial for monitoring oceanographic, meteorological, and environmental conditions across various sites. The data management plan for these sources will ensure that data is organized, accessible, and aligned with best practices for data sharing and preservation.

Below is a table summarizing the identified data sources, their locations, relevant variables, and the formats in which the data is stored.

Data Source	Location(s)	Variables Measured	Format
LiDAR	Offshore Platform	Wind Direction, Horizontal Wind Speed and Vertical Wind Speed at several heights	.csv
ADCP Moorings	Test Site	Significant Wave Height Peak Period Peak Direction Current Velocity Current Direction	.000, .a1, .a2, .a3, .sen, .v1, .v2, .v3
HF Radar	Taliarte Las Palmas Port	Wave height Wave period Wave Direction Wind Direction Surface Current Velocity Surface Current Direction	.wls, .ruv
Air Quality Station	Offshore Platform	European Air Quality Index Dew Point Heat Index Humidity Pressure Temperature CO, O ₃ , SO ₂ NO, NO ₂ , NO _x PM1, PM10, PM2.5, PM4 Total Particle Counter Total Suspended Particles Wind Speed Average	.csv

		Wind Speed Max Wind Vane Average	
Meteorological Station	Offshore Platform Onshore facilities	PAR UV radiation Wind Direction Wind Speed Humidity Air Temperature Pressure Rain amount Rain duration Rain intensity Rain peak	.dat
Oceanographic Station	Taliarte Port	Oxygen Concentration Oxygen Saturation Sea Water Temperature Conductivity Salinity	.dat
Surface buoy (meteorological + oceanographic station)	ESTOC	Air Pressure Air Temperature PAR Relative Humidity Wind Speed Wind Direction Turbidity Dissolved Oxygen Chlorophyll Temperature Conductivity Salinity pH pCO ₂	.nc
Mooring Watercolumn	ESTOC	Turbidity Dissolved Oxygen Chlorophyll Temperature Conductivity Salinity Current Velocity Current Direction	.nc
Hydrophones	Test Site ESTOC	Ocean Sound	.wav
Gliders	Test Site ESTOC	Pressure Temperature	multiple

		Conductivity Dissolved Oxygen Chlorophyll a Turbidity	
Wave Buoy	Test Site	Significant wave height Maximum wave height Peak wave period Mean wave period Average wave period Maximum wave period Peak wave direction Mean wave direction Peak directional spreading Mean directional spreading	.csv
Oceanographic Campaigns	Test Site ESTOC	Temperature Conductivity Salinity Oxygen Chlorophyll a Turbidity	.xlsx, .nc

The diversity of data sources and variables presented in the table highlights the broad scope of PLOCAN’s observational capabilities. Ensuring consistency in data collection, formatting, and storage across these sources is essential for maintaining data quality and facilitating interoperability. The data management plan will establish protocols for metadata documentation, standardization, and long-term accessibility to support scientific research and technological innovation.

4. Data Documentation and Metadata

The following points outline the procedure we follow at PLOCAN to manage the data we produce, ensuring proper documentation, standardized file naming, and the creation of comprehensive metadata. This process allows us to maintain a structured record of our data, facilitating its organization and accessibility:

1. Data Registration Form

- a. This form will be used by project leaders and data generators to register newly generated and existing datasets, including both raw data and processed datasets.
- b. Users will provide key information about each dataset, such as:
 - i. Dataset name

- ii. Type of data measured
- iii. Platform/Sensor type
- iv. Date of data collection
- v. Geographic coordinates
- vi. Depth/Height of data collection
- vii. Processing level
- viii. Project funding the dataset
- ix. How the data is stored
- x. File format
- xi. Other relevant details

2. Metadata and File Preparation for Data Sharing

- a. To facilitate data sharing with the scientific community, a metadata file is required for each dataset. This metadata file must be provided in .json format.
- b. Datasets are encouraged to follow the .csv format, with the ultimate goal of converting them into NetCDF files by merging the metadata .json file and the .csv data file. However, exceptions exist for certain data types that follow specific formats widely accepted within the scientific community, such as hydrophone data.
- c. A metadata template has been developed for PLOCAN following these established standards:
 - i. [EMSO Metadata Specifications](#)
 - ii. [OceanSITES Data Format Reference Manual](#)
 - iii. [CF Conventions](#)
 - iv. [Attribute Convention for Dataset Discovery \(ACDD\)](#)
 - v. [EGO Gliders NetCDF Format Reference Manual](#)
- d. Variable naming conventions and units are established according to standardized vocabularies described in:
 - i. [CF Standard Names](#)
 - ii. [OceanSITES Data Format Reference Manual](#)
 - iii. [SeaDataNet Parameter Discovery Vocabulary](#)
 - iv. [Copernicus Marine In Situ TAC - physical parameters list](#)
- e. Quality flags follow the standards defined in:
 - i. [OceanSITES Data Format Reference Manual](#)
 - ii. [Argo real-time quality control measurement flags](#)
 - iii. [Argo delayed-mode quality control measurement flags](#)
- f. A Python script is being developed in the scope of the DELTA project to automate metadata validation and ensure compliance with these standards.

Once finalized, this tool will be integrated into PLOCAN's data management workflow.

3. File Name Convention

- a. Datasets must be named following a specific standard based on the file name convention described in the OceanSITES Data Format Reference Manual.
- b. This standard ensures that datasets can be easily identified, classified, and traced back to their collection date and associated project. By following a structured format, filenames provide essential metadata at a glance, facilitating dataset organization, retrieval, and integration into broader research initiatives.

This protocol is a living document that will be updated regularly based on feedback from its users, including researchers, technicians, project managers, and other stakeholders. Continuous improvements will be made to ensure that the protocol remains aligned with evolving data management needs, best practices, and technological advancements.

5. Data Storage and Backup

At PLOCAN, the resilience of our technological infrastructure is a priority. We have two interconnected data centers (CPDs) with redundant optical fiber and multiple alternative routes, ensuring business continuity in the event of any incident. PLOCAN's Disaster Recovery Plan defines the strategies, policies, and procedures for recovery and operational continuity, ensuring the availability of critical data and the proper functioning of the infrastructure. The plan covers the following aspect, among others:

1. Components of PLOCAN's technological infrastructure:

a. Data Centers (CPDs):

- i. Two interconnected CPDs, with redundant power supply (UPS) and temperature and humidity control via dedicated air conditioning systems for CPDs.
- ii. Redundant interconnection via optical fiber and multiple routes to ensure connectivity.

b. Network Infrastructure:

- i. Network equipment with orchestrated redundancy at the Layer 3 Firewall (FW) level.
- ii. VLAN segmentation to isolate and protect different network segments.

c. Virtualization and Storage Platform:

- i. Virtualization cluster with redundant storage arrays in each CPD.
- ii. Daily backups of both data and virtual machines, ensuring data integrity and availability.

d. Security Systems:

- i. Access control based on user rules and two-factor authentication.
- ii. Cloud collaboration platform with version control and file change tracking.
- iii. Next-generation endpoint protection with event monitoring.
- iv. Email security filters and systems: reputation analysis, sandboxing, anti-phishing, anti-fraud, link analysis, and AI-driven security intelligence.

2. Risk Analysis and Impact Assessment

a. Threat Identification:

- i. **Cyberattacks:** Ransomware, malware, intrusions, and targeted network attacks.
- ii. **Hardware/software failures:** Incidents affecting CPDs, the virtualization cluster, or storage arrays.
- iii. **Physical disasters:** Events impacting CPD infrastructure, mitigated by power and climate redundancies.
- iv. **Operational errors:** Human errors in system configuration or management, mitigated through access controls and two-factor authentication.

b. Impact Assessment:

- i. **Business continuity:** Impact on production operations and observatory activities.
- ii. **Associated costs:** Data loss, downtime, and potential legal consequences.
- iii. **Reputation:** Trust of users and clients.

3. Backup and Recovery Strategy

a. Backup Policy:

i. Frequency and Coverage:

- Daily backups covering both data and virtual machines, allowing full environment restoration.
- Separation of production and observatory data to prevent cross-contamination or errors.

ii. Backup Storage Locations:

- Backups performed in both CPDs and cloud platforms, ensuring redundancy and recovery in case of failure in one CPD.

iii. Backup Methods:

- Use of incremental and differential backup strategies, complemented by periodic full backups to ensure integrity and availability.

b. Replication and High Availability Technologies:

i. Network Infrastructure:

- Connectivity redundancy via optical fiber and alternative routes.
- Orchestrated device control via Layer 3 FW and VLAN segmentation.

ii. **Virtualization and Storage Platform:**

- Virtualization cluster enabling automatic failover and migration in case of failure.
- Redundant storage arrays in each CPD, ensuring continuous data access and backup availability.

The Disaster Recovery Plan at PLOCAN is directly linked to its data management strategy, ensuring the resilience, availability, and integrity of critical data. This plan not only safeguards operational and observational data but also enhances compliance with data management principles, supporting long-term accessibility and reliability.

6. Data Sharing and Accessibility

PLOCAN offers two main types of data access:

1. **Open Data:** Oceanographic data collected by PLOCAN's observational infrastructure is made openly available to users through its data servers. Users can visualize and download historical data via the [PLOCAN THREDDS server](#), [Siboy](#), [Obsplatform](#), and [ERDDAP server](#). PLOCAN's ERDDAP server will soon be federated with EMSO ERIC, enhancing interoperability and accessibility of oceanographic data within the European research infrastructure.

Additionally, an Open Data Portal is in development, based on a hybrid solution hosted on Microsoft Azure's public cloud. This portal is expected to be operational in 2025, providing enhanced access to oceanographic data generated at PLOCAN. It will allow users to directly visualize and download data, improving accessibility while also enabling the tracking of user statistics. The portal will also include an option to request access to non-public data through an *on-demand data request* feature, described in the following section.

2. **On-Demand Data Requests:** Users can request specific datasets that are not openly available but can be provided upon request. These requests are handled based on availability and feasibility, ensuring that researchers and stakeholders can access tailored oceanographic information obtained through PLOCAN's resources.

These data services support scientific research, technological development, and informed decision-making in marine and oceanographic studies.

7. Roles and Responsibilities

To ensure effective data management, the following roles and responsibilities are assigned:

1. Data Manager(s):

- **Responsibilities:**

- a. Oversee the implementation of the Data Management Plan.
- b. Ensure data is properly stored, organized, and archived.
- c. Coordinate data sharing and access within and outside of PLOCAN.
- d. Monitor data quality and ensure compliance with relevant standards and protocols.

2. Data Steward:

- **Responsibilities:**

- a. Ensure that data quality control procedures are properly implemented.
- b. Maintain metadata accuracy and completeness.
- c. Verify compliance with data standards and formats.
- d. Facilitate data interoperability and adherence to FAIR principles.
- e. Assist in defining and refining data management policies.

3. Data Producers (e.g., researchers, platform operators):

- **Responsibilities:**

- a. Collect and generate data following defined protocols.
- b. Ensure that the data is accurate, complete, and well-documented.
- c. Provide metadata to describe data accurately and ensure consistency.
- d. Submit data to the data repository in a timely manner.

4. IT/Technical Support:

- **Responsibilities:**

- a. Ensure the proper functioning of data storage systems, databases, and infrastructure.
- b. Implement data security measures to protect sensitive information.
- c. Assist with troubleshooting and technical issues related to data management tools and systems.

5. Data Users (e.g., researchers, external collaborators):

- **Responsibilities:**

- a. Access and use data according to established policies and guidelines.

- b. Provide feedback on data quality and usability to inform future data management practices.
- c. Acknowledge data sources when using or publishing data.

6. External Partners (if applicable):

- **Responsibilities:**

- a. Contribute to data collection and provide data to PLOCAN as per agreements.
- b. Follow the data management guidelines set by PLOCAN to ensure consistency and compatibility with other datasets.

8. Monitoring and Reviewing

The Data Management Plan will undergo a review every six months to ensure it remains up-to-date. This review will incorporate feedback from users, reflect any changes in PLOCAN's operations, and account for advancements in data management practices and relevant technological developments.