St3TART-FO

FRM for Sentinel-3 Land Altimetry

St3TART FOLLOW-ON: FIDUCIAL REFERENCE MEASUREMENTS (FRM) - S3 LAND ALTIMETRY

FRM Data Hub User Guide (TD-17), v1.1

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Issue	**Revision**	**Date**	**Reason for the revision**
1	0	18/11/2024	Initial version
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Issue	Rev	Status *	Modified pages	Reason for the modification
1	1	I, M	All document	The document has been updated with the latest screenshots from the most recent version of the FRM Data Hub.

*   *I = Inserted   D = Deleted   M = Modified*

Acronyms

AEM	Airborne ElectroMagnetic
ALS	Airborne Laser Scanner
AO	Announcement of Opportunity
API	Application Programming Interface
AWI	Alfred Wegener Institute
AWS	Automatic Weather Stations
Cal/Val	Calibration/Validation
CCI	Climate Change Initiative
CCR	Contract Close-out Review
CLS	Collecte Localisation Satellites
CIMR	Copernicus Imaging Microwave Radiometer
CO	Contract Officer
CRISTAL	Copernicus polaR Ice and Snow Topography ALtimeter
CS-2	CryoSat-2 mission
CSV	Comma-Separated Values
DOI	Digital Object Identifier
DSM	Digital Surface Models
DTU	Denmark's Technical University
EASE	Equal Area Scalable Earth
EEA	European Environmental Agency
eLTER	European Long-Term Ecosystem Research
EO	Earth Observation
ESA	European Space Agency
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
FAQ	Frequently Asked Questions
FF	Fully Focused

FFP	Firm Fixed Price
FO	Follow On
FR	Final Review
FRM	Fiducial Reference Measurement
FRM-CC	FRM Collaborative Campaign
GCOS	Global Climate Observing System
GCP	Ground Control Point
GIS	Geographic Information System
GNSS	Global Navigation Satellite Systems
GPS	Global Positioning System
GRDC	Global Runoff Data Center
IMBIE	Ice sheet Mass Balance Intercomparison Exercise
IPS	Ice Profiling Sonar
ITT	Invitation To Tender
KO	Kick Off
LEGOS	Laboratoire d'Etudes en Géophysique et Océanographie Spatiales (literally : Laboratory of Space Geophysical and Oceanographic Studies)
LiDAR	Light Detection And Ranging
LOCEAN	Laboratoire d'Océanographie et du Climat: Expérimentations et Approches Numériques (literally : Laboratory of Oceanography and Climate: Experimentations and Numerical Approaches)
MoM	Minutes of Meeting
MPC	Mission Performance Cluster
NetCDF	Network Common Data Form
NORCE	Norwegian Research Center
NSIDC	National Snow and Ice Data Center
NPI	Norwegian Polar Institute
OLCI	Ocean and Land Colour Instrument
ORR	Operation Readiness Review

OZCAR	Observatoires de la Zone Critique, Applications et Recherches (literally: Critical Zone Observatories, Applications and Research)
PM	Progress Meeting
POCA	Point of Closest Approach
PPP	Precise Point Positioning
PR	Progress Review
PVR	Product Validation Report
QA4EO	Quality Assurance framework for Earth Observation
QGIS	Quantum Geographic Information System
QWG	Quality Working Group
RB	Requirements Baseline
REMA	Reference Elevation Model of Antarctica
S3	Sentinel-3
S3VT	Sentinel-3 Validation Team
SAR	Synthetic Aperture Radar
SBLA	Single Point Laser Altimeter
ScalSIT	Super Cal/Val Site Identifier Tool
SfM	Structure-from-Motion
SI	Système International d'unités (literally: International System of Units)
SIMS	Sea Ice Measurement System
SIN'XS	Sea Ice thickness product intercomparison exercise
SLSTR	Sea and Land Surface Temperature Radiometer
SMB	Surface Mass Balance
SNO-GLACIOCLIM	Service National d'Observation GLACIOlogique et CLIMatologique des régions de montagne (literally: National Glaciological and Climatological Observation Service for Mountain Regions)
SoW	Statement of Work
SPR	Set-up Phase Review
SWOT	Surface Water and Ocean Topography

St3TART	Sentinel-3 Topography mission Assessment through Reference Techniques (contract between 2021 and 2023)
St3TART-FO	St3TART Follow-On
STM	Surface Topography Mission
TBD	To Be Defined
TDP	Thematic Data Products
TO	Technical Officer
UAV	Unmanned Aerial Vehicles
UN	UNfocused
WP	Work Package

References

[RD1]	ESA-EOPG-EOPGMQ-SOW-80, Issue 1 Rev. 0 – 24/11/2023, Statement of Work - H2.2/2023/001 - FIDUCIAL REFERENCE MEASUREMENTS (FRM) - S3 LAND ALTIMETRY ST3TART (FOLLOW-ON)
[RD2]	NOV-FE-1464-PR-004, Detailed Proposal
[RD3]	ESA Contract No. 4000144565/24/I-KE, ESA Contract – H2.2/2023/001 - FIDUCIAL REFERENCE MEASUREMENTS (FRM) - S3 LAND ALTIMETRY ST3TART (FOLLOW-ON)
[RD4]	NOV-FE-1464-NT-036, FRM Data Product Description Document

Table of contents

1 Introduction

1.1 Purpose and Scope

The purpose of this FRM Data Hub User Guide is to provide a detailed, step-by-step guide to help users navigate the various features and functionalities of the St3TART FRM Data Hub. The tool has been developed as part of the St3TART project and its follow-on activities, which focus on collecting and distributing Fiducial Reference Measurements (FRMs) to validate the Copernicus Sentinel-3 satellite mission. These reference measurements are critical in ensuring the accuracy of satellite-derived data for inland waters, sea ice, and land ice domains.

This guide will walk you through the various aspects of using the FRM Data Hub, including accessing the platform, understanding the available tools and filters, downloading and uploading data, and utilizing advanced features such as time series visualization and metadata exploration. Additionally, this guide provides troubleshooting tips and support resources for any issues users may encounter while using the platform.

By the end of this guide, users should be able to confidently use the FRM Data Hub to support their specific needs.

1.2 Overview of this Document

This " FRM data hub user guide " document includes the following chapters in addition to this Introduction:

- ▲ Chapter 2: Overview of the FRM Data Hub
- ▲ Chapter 3: Getting Started
- ▲ Chapter 4: Using the FRM Data Hub
- ▲ Chapter 5: Example Use Cases
- ▲ Chapter 6: Help and Support

2 Overview of the FRM Data Hub

2.1 What is the FRM Data Hub?

The FRM Data Hub is a web-based, fully operational platform designed as a centralized repository for Fiducial Reference Measurements (FRMs) collected in the St3TART-FO project. This project focuses on delivering FRMs in support of the validation activities of the Sentinel-3 radar altimeter covering various surfaces of interest. These include inland water bodies – such as lakes, reservoirs, rivers including estuarian areas – as well as sea ice and land ice areas, including ice caps and mountain glaciers.

The FRM Data Hub provides centralized, free access to these fully characterized FRMs, along with a suite of analytical tools. Measurements are sourced from various platforms and sensors across the surfaces. The data is available for download in the standardized NetCDF format.

2.2 Key Features

The FRM Data Hub is equipped with a variety of features to allow users to explore, analyze, and download data most relevant to their needs. Additionally, it includes a submission feature to enable user contributions.
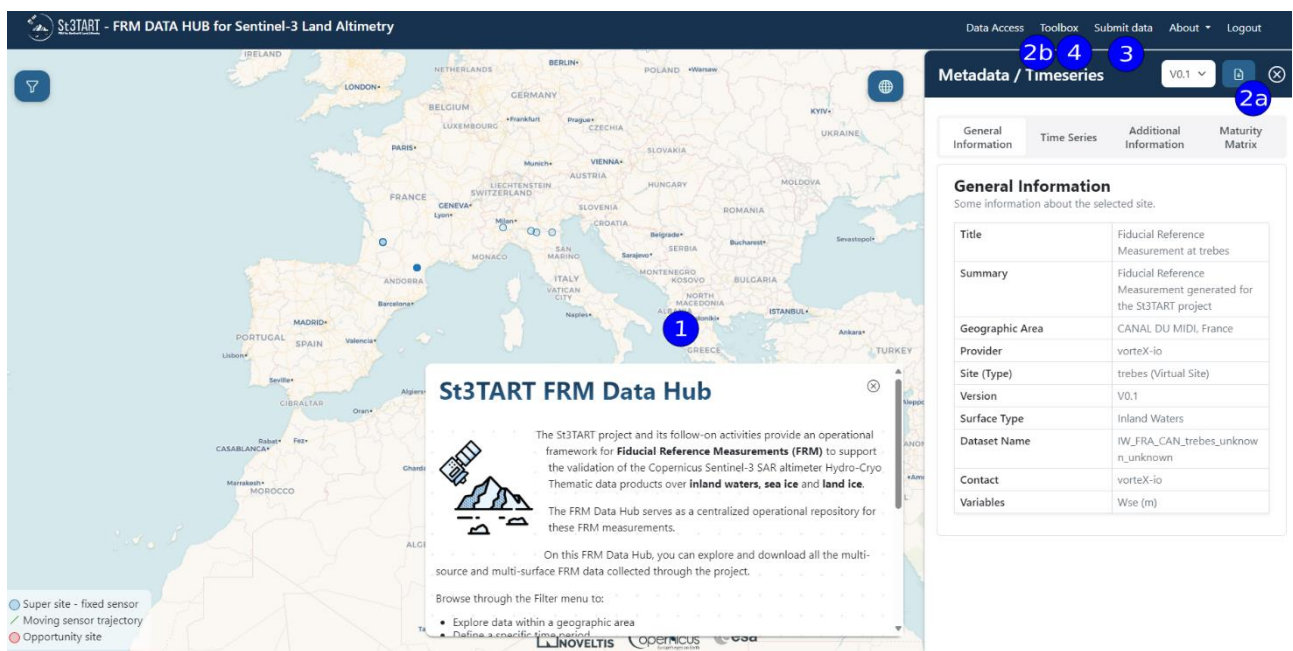

Figure 1: FRM Data Hub Core Features: (1) Data Visualization and Access, (2) Download Options, (3) Data Submission and (4) Toolbox Access

1. **Data Visualization and Access via Interactive Map:** At the heart of the FRM Data Hub is an interactive map, which displays various data points representing FRM datasets. The map allows users to visualize Sentinel-3 satellite tracks, super sites, opportunity sites, and calculated FRM points under satellite tracks. On the left side of the screen, users can apply filters based on parameters such as surface type (e.g., inland waters, sea ice, land ice), geographic area (using latitude and longitude coordinates), time period, data type, sensor type, platform, and FRM provider.

2. **Download Options:** The FRM Data Hub offers flexible download options that cater to different data access needs. Users can download data directly from the map (see 2a in Figure 1) by selecting a specific data point and accessing its metadata window. Alternatively, users needing programmatic access can download data through the API in the Toolbox (see 2b in Figure 1), which allows for automated data retrieval based on filters such as time range, geographic area, and sensor type. This dual approach ensures that users can efficiently access data for one-time exploration or ongoing analysis.

3. **Submit Data:** The FRM Data Hub encourages contributions from the community, allowing users to submit their own FRM datasets to expand the available data. Users can upload data through the "Submit Data" page by providing their name, organization, and a brief description of the data. Uploaded data undergoes a validation process by the FRM Data Hub team to ensure quality and compatibility. Once validated, the new data is integrated into the hub and made accessible to the community, fostering a collaborative environment for satellite calibration and validation.

4. **Toolbox:** The platform also features a toolbox with advanced tools: Jupyter Hub, API, ScalSIT, etc. These tools ensure that users can perform in-depth analyses, access data through the API, and enhance their workflows directly within the FRM Data Hub.

3 Getting Started

3.1 Accessing the FRM Data Hub

To begin using the FRM Data Hub, you first need to create an account by registering on the platform. The registration process requires basic information such as your first name, last name, email address, and organization. Once registered, you will receive an activation email with a link to confirm your account. Additionally, it is possible to reset your password directly from the login popup on the platform.

After confirming your account, you can log in to access the full range of features offered by the FRM Data Hub.
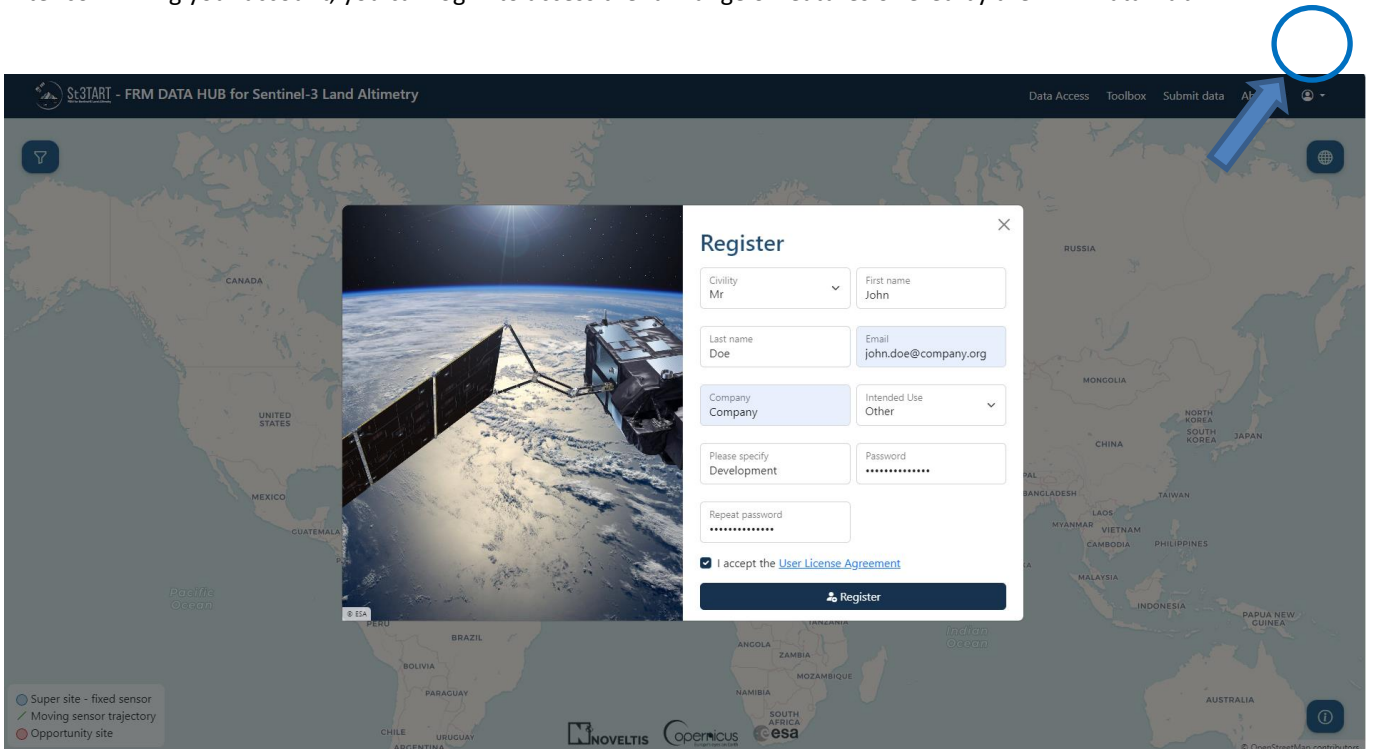

Figure 2: Registration Popup

Upon logging in, you will be greeted by the main interface of the FRM Data Hub, which consists of an interactive map, filter panel, and navigation bar. The map displays data points representing FRM datasets, and the filter panel on the left allows you to refine your search criteria.
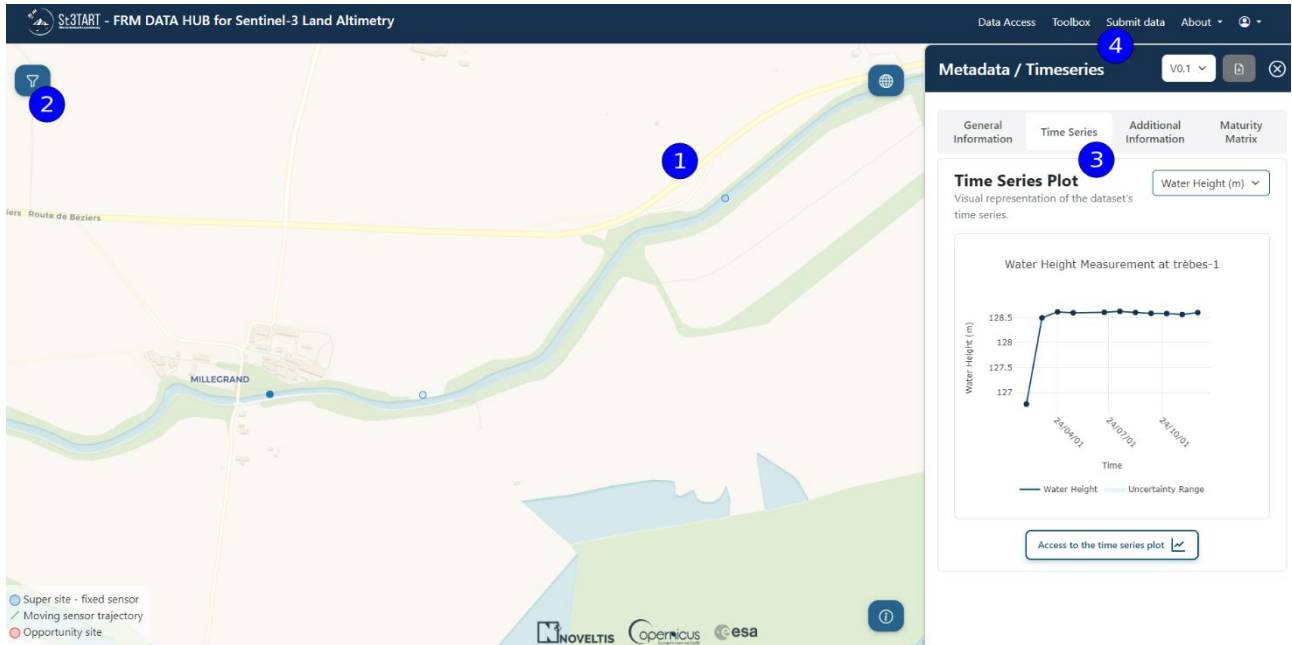

Figure 3: Dynamic Map with Metadata Example

The key sections of the platform include:

1. **Interactive Map**: This is the primary tool for visualizing FRM datasets. Each data point on the map corresponds to a specific dataset, and clicking on a point brings up a detailed metadata window. You can interact with the map to zoom in or out, pan across regions, and select various layers such as Sentinel-3 satellite tracks. You can also choose to display super sites and/or opportunity sites exclusively.

2. **Filter Panel**: Located on the left side of the screen, the filter panel enables users to define their search criteria. You can filter by geographic area (by entering latitude and longitude coordinates), surface type, time period, sensor type, platform, and more. Once you apply the filters, the map will refresh to display only the relevant datasets. See section 4.1 for more details.

3. **Metadata and Time Series Window**: Clicking on a data point will open a metadata window with multiple tabs for detailed exploration of the dataset. This window provides all the essential information about the dataset, along with tools for visualizing time series data. More details can be found in section 4.1.

4. **Navigation Bar**: At the top of the screen, the navigation bar provides quick access to additional features, including the Toolbox, Documentation, and Submit Data sections.

4 Using the FRM Data Hub

4.1 Searching for FRM Data

The FRM Data Hub offers a search functionality through the filter panel located on the left side of the screen. To search for FRM data, you can:

- ▲ Define a geographic area by entering the coordinates of the top-left and bottom-right corners of the bounding box or by using the "Start Drawing" tool to select an area on the map.
- ▲ Specify a time period by entering a date range.
- ▲ Choose a specific surface type, such as inland waters, sea ice, or land ice.
- ▲ Select a site or campaign.
- ▲ Filter by FRM provider or display opportunity sites if available.
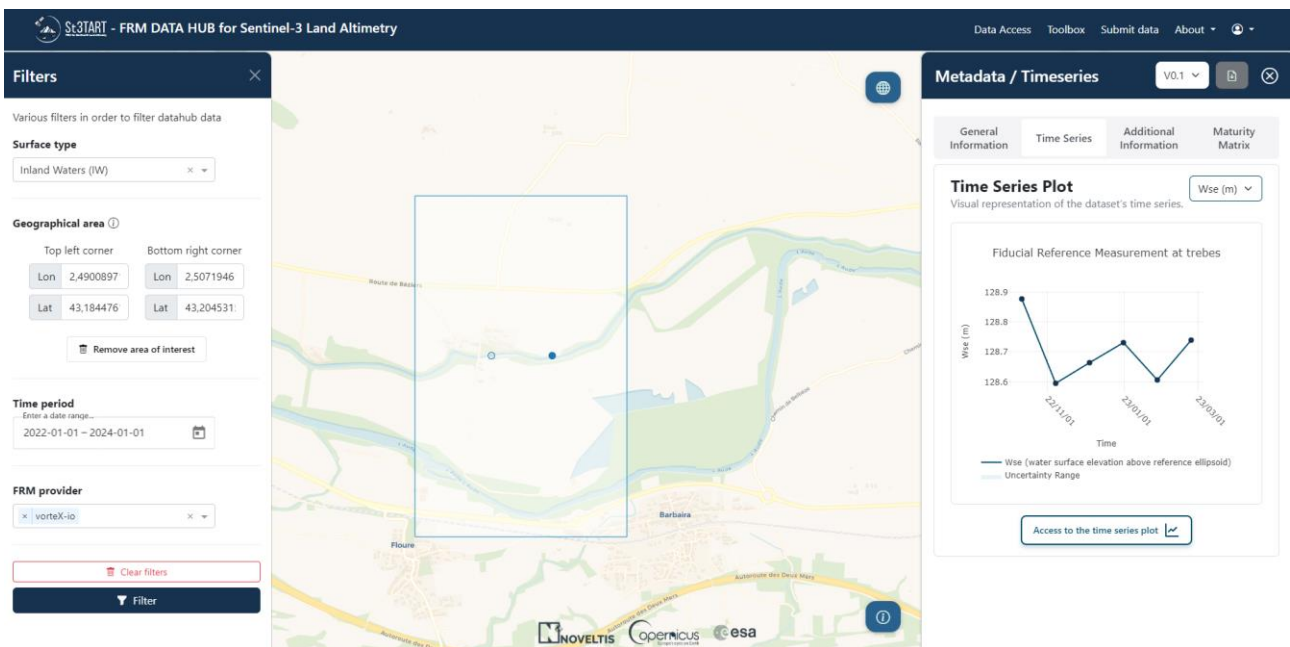

Figure 4: Dynamic Map with Metadata Example and Filters Box

Once the filters are applied, the map will update to show only the data points that match your criteria. You can click on any data point to open the metadata window and explore further details about the dataset.
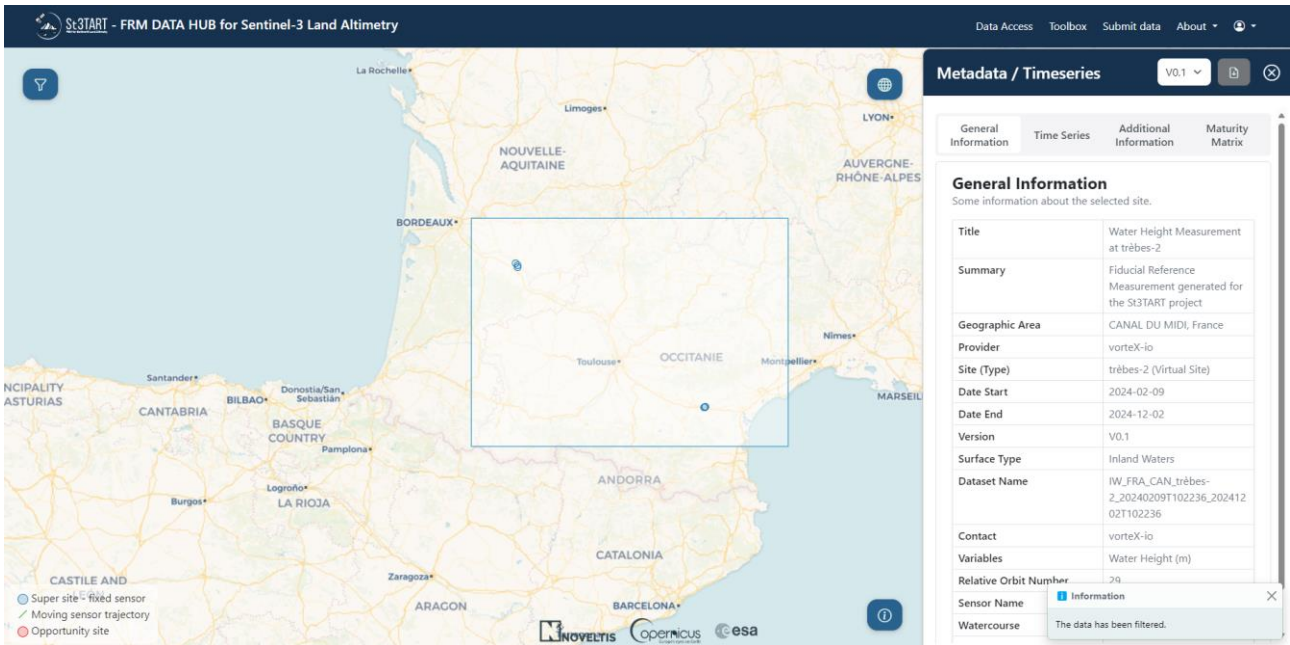
Figure 5: Dynamic Map with Search Zone

By clicking on any data point, users can open a detailed metadata window that contains several tabs:

▲ **General Information**: This tab provides a high-level summary of the dataset, including the geographic area, site or campaign, date range, and measured variables.

▲ **Time Series**: The Time Series tab presents a visual representation of the dataset's time series data. Users can view quick plots and enlarge them for better visualization, with access to tools that allow for zooming, panning, and filtering by date range and data type. Additionally, users can select specific variables to plot and view an Uncertainty Range, providing insights into the data's precision and potential variability.
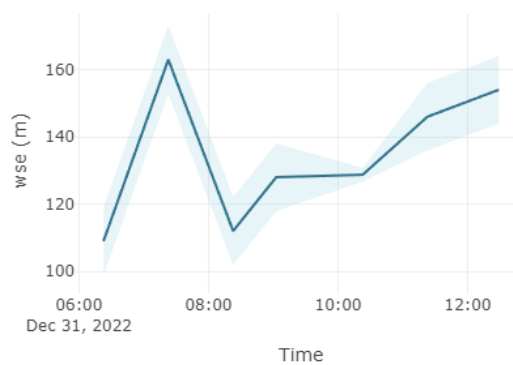

Figure 6: Example of Uncertainly Range

▲ **Additional Information**: Here, users will find supplementary information that might not be covered in the general information tab. For instance, links to lower-level products can be found here, or to additional documentation.

▲ **Maturity Matrix**: This tab displays the dataset's maturity level based on the CEOS-FRM framework.
  o For more details on the Maturity Matrix, please refer to section 2.6.5 in the FRM Data Product Description Document [RD4].

Figure 7: Example of Maturity Matrix

4.2 Downloading FRM Data

After identifying the desired dataset, downloading the data is simple.

There are two ways to download data in NetCDF format:

▲ **Option 1: Downloading via the Map**
When users interact with the map and click on a data point, a metadata window opens, displaying detailed information about the dataset. At the top of this window, users will see download options that allow them to directly retrieve the dataset in NetCDF format.
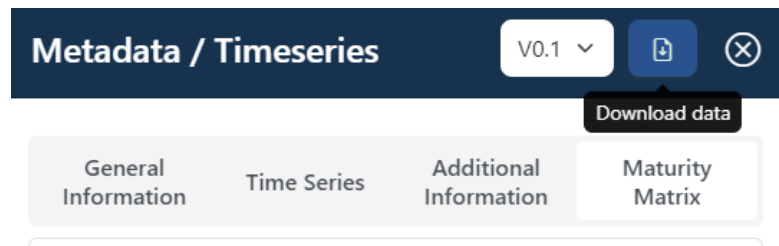

Figure 8: Download button on the metadata window

▲ **Option 2: Downloading via the API in the Toolbox**
For users needing to automate data retrieval or integrate the FRM Data Hub into other applications, the API provides a flexible and powerful alternative. Available in the Toolbox, the API allows users to:
  o Define specific parameters and filters, such as time range, geographic area, data type, and provider – to retrieve exactly the data needed.
  o Set up automated scripts to download regularly updated data or datasets that match criteria, without manual interaction.
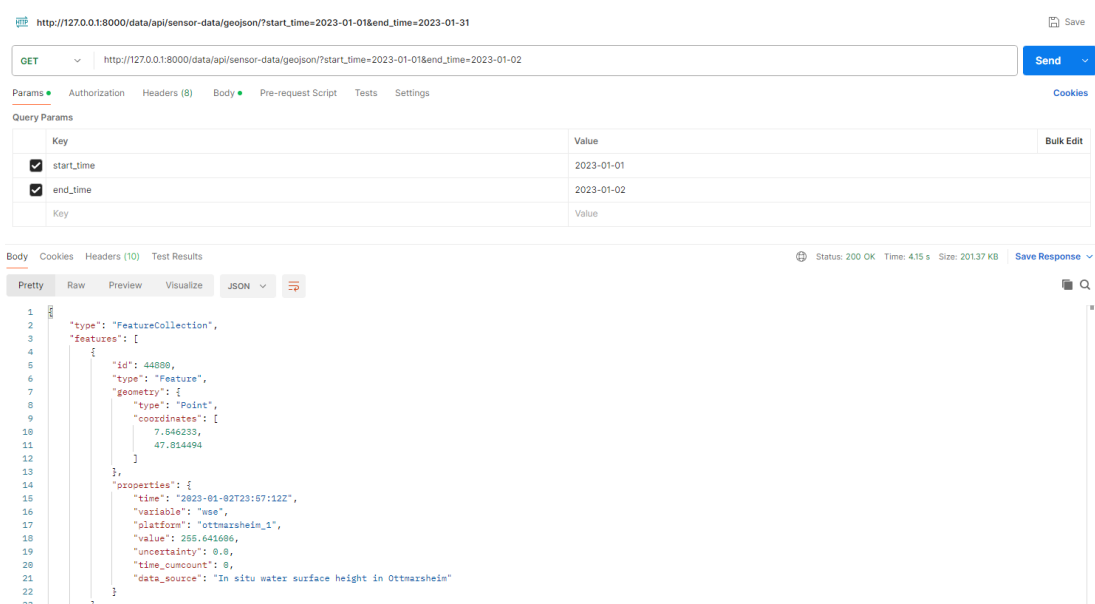

Figure 9: Extract of the API Interface

Both methods ensure that users can access FRM data efficiently and in the format that best suits their needs, whether for single-point exploration on the map or for large-scale, automated data collection via the API.

4.3 Uploading FRM Data

The FRM Data Hub also allows users to contribute their own data to the platform. If you have valuable FRM data that could benefit the community, you can submit it through the "Submit Data" section in the navigation bar. The submission process requires you to provide your name, email, and a brief description of the data being submitted. You can also contact the St3TART-FO team directly for further assistance in integrating your data into the platform.
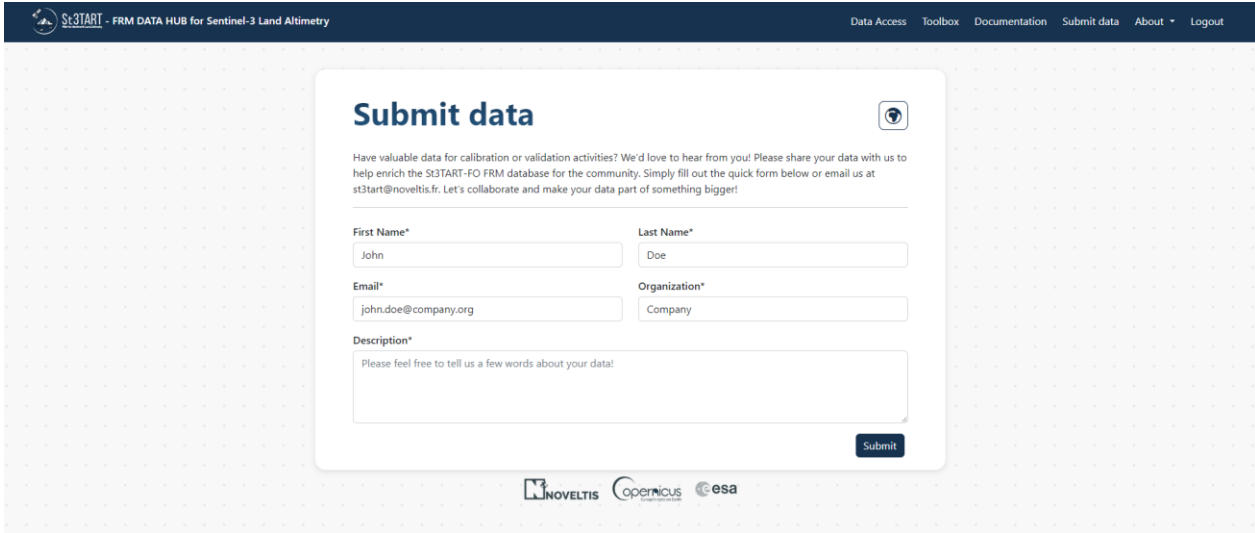

Figure 10: Submit Data Form

4.4 Toolbox

The Toolbox section provides users access to advanced tools such as:

▲ **JupyterHub**: This Python-based environment allows users to run scripts for processing, analyzing, and visualizing FRM data.

▲ **SCalSIT Tool**: This QGIS plugin is particularly useful for identifying new hydrology supersites by intersecting satellite tracks with water surfaces. The tool provides a straightforward way to locate optimal points for future calibration and validation activities.

▲ **Copernicus Data Space Ecosystem (CDSE)**: This portal provides access to Sentinel data through an interactive graphical user interface.

▲ **API**: The FRM Data Hub API allows users to programmatically access and retrieve FRM datasets based on specific filters such as time period, geographic area, site, and campaign. This is especially useful for automating data downloads or integrating the FRM data into external applications and workflows. The API supports data retrieval in NetCDF format, ensuring compatibility with a wide range of analysis tools and software.

5 Example Use Cases

The FRM Data Hub can be applied in various real-world calibration and validation activities, as well as for many scientific studies. Below are some examples of how different users might leverage the platform.

5.1 Sentinel-3 MPC

The Sentinel-3 Mission Performance Cluster (MPC S3) for Inland Waters is responsible for ensuring the quality and performance of Sentinel-3 Hydrology Thematic Products through routine monitoring and in-depth analysis.

Routine activities include generating Cyclic Performance Reports every 5 days, comparing Sentinel-3 Hydro Products to in-situ measurements, which include FRM data. To facilitate this, the MPC requires regular access to the latest Inland Waters FRM data.

To automate data collection, the MPC utilizes the FRM Data Hub API to set up a script that retrieves specific datasets based on geographic location and variables.

5.2 Scientific uses

Example 1: A researcher working on hydrological studies focuses on inland water bodies and wants to analyze water surface height data collected by fixed sensors. He uses the geographic filter to select a region in Europe, then applies a time filter to focus on data collected between January and April 2023. After selecting a data point in the Tiber River region, the researcher inspects the metadata and downloads the dataset in NetCDF format for further analysis in Python.

Example 2: A scientist working on satellite calibration uses the SCalSIT tool to find new potential supersites for future validation campaigns. By intersecting satellite tracks with large water surfaces, he identifies locations where future in-situ measurements could be taken to improve the accuracy of Sentinel-3 satellite data.

6 Help and Support

6.1 FAQ

▲ **How do I register for the FRM Data Hub?**
Visit the homepage and click on the user icon on the top right of the screen. Fill in the required information, including your name, email address, and organization, and submit the form. Once your account is created, you can log in to access all the platform features.

▲ **What data formats are supported?**
The platform supports data downloads in NetCDF format, which is a format widely used in scientific research and GIS applications.

▲ **How can I submit my data to the FRM Data Hub?**
Navigate to the "Submit Data" section of the platform, fill in your details and a description of your data, and submit the form. Alternatively, you can email your data directly to the St3TART team at st3tart@noveltis.fr.

▲ **What do I do if I have forgotten my password?**
If you have forgotten your password, click on the "Forgot Password" link on the login page. You will be prompted to enter your registered email address, and instructions to reset your password will be sent to you. Follow the link provided in the email to create a new password.

▲ **Why can't I see any data points on the map after applying filters?**
If no data points are visible on the map after applying filters, check the following:
  ○ Verify that your filter settings (geographical area, time range, surface type, etc.) are correct.
  ○ Try broadening your filter criteria (e.g., expanding the date range or geographic area).
  ○ Ensure you have a stable internet connection. If the problem persists, try refreshing the page or clearing your browser's cache. If none of these solutions work, contact support for further assistance.

▲ **How can I visualize time series data?**
After selecting a data point on the map, a metadata window will open. Navigate to the "Time Series" tab, where you can view a quick plot of the data. If you want to enlarge the plot, click the "Access to the time series plot" button to open a more detailed view with additional tools for zooming and adjusting visualization parameters.

▲ **How can I delete my account?**
To delete your account, please contact our support team. See section 6.2 Getting Help.

▲ **How does the FRM Data Hub comply with GDPR?**
We are committed to protecting your privacy and complying with the General Data Protection Regulation (GDPR). Please refer to our User License Agreement for more details on Personal Data.

If you have any questions or concerns about your data privacy, please contact contact our support team. See section 6.2 Getting Help.

6.2 Getting Help

For additional help and support, users can refer to the About section of the platform, which provides detailed information about the St3TART-FO project and the FRM Data Hub. If further assistance is required, users can contact the St3TART support team via email at st3tart@noveltis.fr, or use the contact form available on the platform.