TRUSTED, Deliverable

The Copernicus FRM Metadata Gap Analysis and Implementation Plan

Reference :	CLS-TRUSTED-22-13
Nomenclature :	The Copernicus Fiducial Reference Measurement Metadata Gap Analysis and Implementation Plan
Version :	2. 0
Date :	22/11/2022

CLS (siège)
11 rue Hermès
Parc technologique du Canal
31520 Ramonville Saint-Agne
FRANCE

Tél. : +33 (0)5 61 39 47 00
Fax : +33 (0)5 61 75 10 14
Mél. : info@cls.fr
Web : www.cls.fr

CLS Brest Le Ponant
Avenue La Pérouse
29280 Plouzané
FRANCE

Tél. : +33 (0)2 98 05 76 80
Fax : +33 (0)2 98 05 76 90

Version History :

Version :	Date :	Version	Author
1.0	12/05/2022	Original version	M. Krieger
2.0	19/12/2022	Revision following Eumetsat feedback	M. Belbeoch

Document Approvals:

Written by (*) :	M. Krieger	Oceanops
Checked by par (*) :	M. Lucas	CLS, Project Manager
Approved by (*) :	A.OCarrol	EUMETSAT, Project Officer

Content

1. Scope of Document

This document presents the Metadata gap analysis and implementation plan for Copernicus Fiducial Reference Measurement (FRM) drifting buoys activities, organized within the project: Towards Fiducial Reference Measurements of Sea Surface Temperature (SST) by European Drifters (TRUSTED). The document gives an overview of the Metadata management performed by OceanOPS for Copernicus, presents the current status and analysis including the identification of gaps, details the implementation plan and finally summarises the next steps towards a full Quality Control (QC) and metadata specification for FRM drifting buoys.

2. Background

OceanOPS (https://www.ocean-ops.org) has developed an integrated metadata management system for all of Global Ocean Observing System (GOOS) Observations Coordination Group (OCG) networks, with standardised and harmonised references and vocabularies including an automatic allocation interface and Application Programming Interface (API) for unique identifiers of the World Meteorological Organization Integrated Global Observing System (WMO/WIGOS).

This metadata standard is gradually enriched based on network specifics and OceanOPS integrated requirements. This work, led by OceanOPS according to its 5-Year strategy (*Goal 2: "lead metadata standardization and integration across the global ocean observing networks"*), takes place within the OCG and Networks Data teams.

The metadata specification needed for Copernicus FRM activities identified through the TRUSTED project will progress DBCP/Global Drifter Array metadata advancements.

OceanOPS metadata resources and key features include:

- **Documentation**: https://www.ocean-ops.org/metadata/
  This documentation focuses for now on the "input" metadata as required by OceanOPS and networks.

- **Web Interface:** https://ocean-ops.org with specific boards for each Network, e.g. https://ocean-ops.org/board?t=dbcp for TRUSTED drifters.
  This interface enables the update of metadata through a wizard to guide users through bulk uploads and edits, and operate as a "file checker" to ensure content is harmonised. Records can also be edited individually.
  The search engine allows the definition of any sample of observing platform, exporting the metadata content, and the use of many charts and mapping functions available on the

dashboard. Dashboard and sample queries can be saved by users.

- **API:** https://ocean-ops.org/api available for machine-to-machine dialogue on a regular basis, with proper documentation.
  The API enables the export of metadata in .json and .xml (WMO Integrated Global Observing System Metadata Representation - WMDR compliant).
  It also allows the user to obtain unique identifiers.

- **OGC compliant web services:**
  https://www.ocean-ops.org/arcgis/rest/ based on ESRI ArcGIS server and API
  https://www.ocean-ops.org/arcgis/rest/services/DBCP

- **Daily CSV extractions:**
- https://ocean-ops.org/share/dbcp/status/dbcp_all.csv
- https://ocean-ops.org/share/dbcp/status/dbcp_operational.csv

Strict minimal metadata (eight attributes are mandatory) are provided by platform operators to OceanOPS autonomously via the web interface (or routinely if enabled), controlled by machine and experts, and enriched by the OceanOPS system from operations planning to platforms end of life. **This document particularly focusses on the input metadata requirements,** while output features are covered but not yet fully documented through an exhaustive list of attributes available. The OceanOPS system synchronises in real-time with data systems set up for each network, such as the Global Telecommunications Network (GTS) and global internet data nodes. The system handles individual observations, measured Essential Ocean and Climate Variables (EOVs/ECVs), statistics on timeliness and quality, and gathers feedback from users on data quality and channels it back to data producers. This section will be developed in a next version of the metadata standard documentation within the TRUSTED project.

The following diagram, not exhaustive, summarises the different categories of metadata managed by OceanOPS.

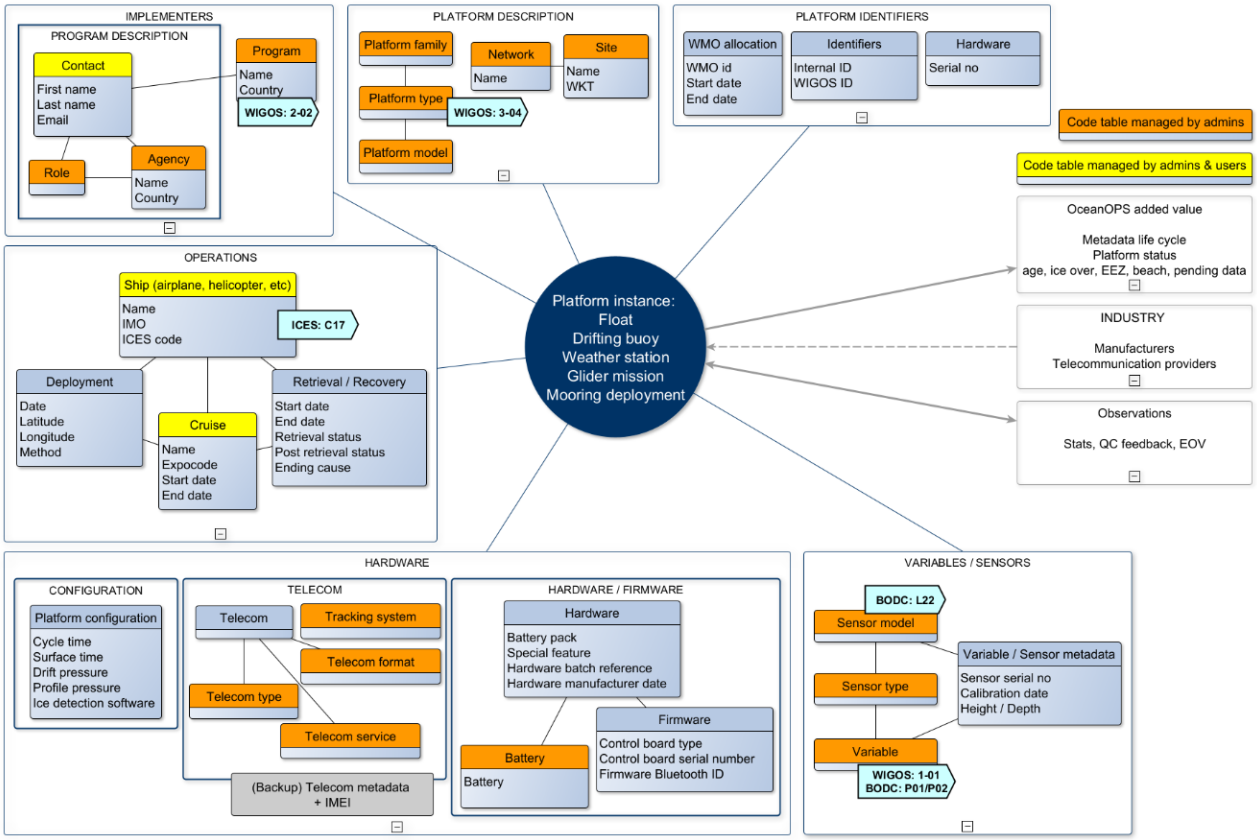

Figure 1 : OceanOPS metadata concepts overview https://www.ocean-ops.org/metadata/#concepts-%E2%80%93-detailed-entity-diagram

3. Copernicus FRM Metadata Management By Oceanops

A prerequisite to routine metadata management is to clearly identify the responsible entities and contact points behind each platform. This enables the proper structure of the contribution within GOOS, and within the Data Buoy Cooperation Panel (DBCP) and Global Drifter Array (GDA) network.

OceanOPS has created the PROGRAM "COPERNICUS HRSST FRM" with agencies involved (with unique EDMO codes), specific roles ("owning" agency e.g.), and contact points. The agencies and roles of the Program are applied to all platforms in the program but they can also be customized at the platform level, independently from the program definition.

In the first phase of the project buoys were owned by Copernicus and in the second and subsequent phases by CLS. The OceanOPS metadata records track this properly.

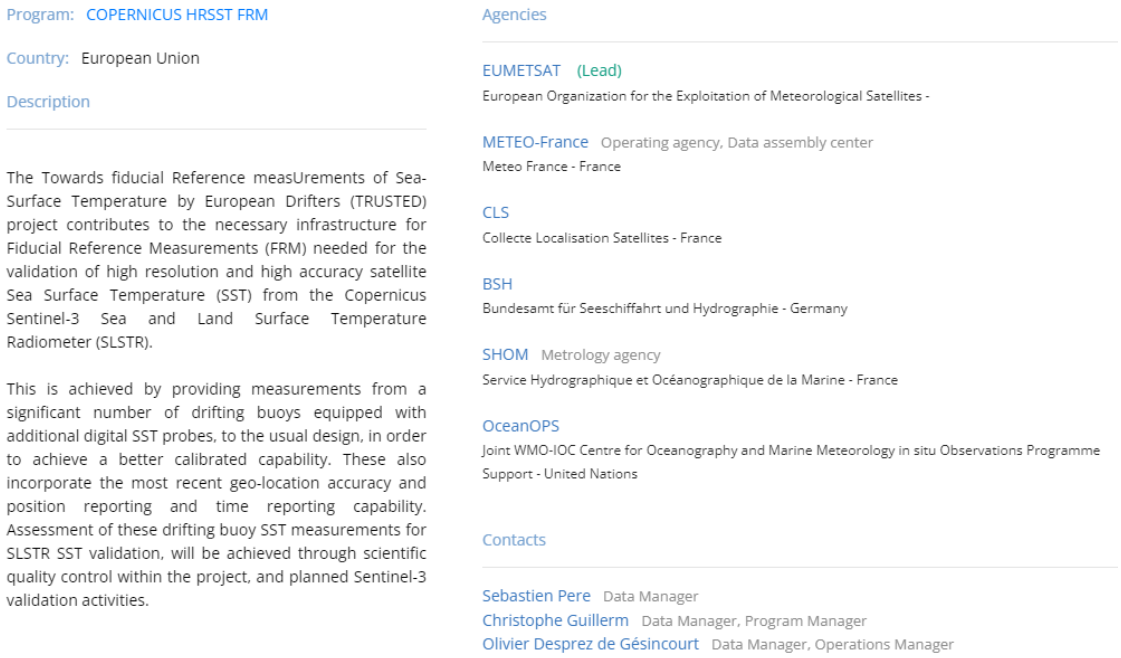

Figure 2 : OceanOPS website, COPERNICUS HRSST FRM program details

Once the structural elements are fixed for a contribution to the GOOS, we can update routinely its individual platforms metadata

The program key allows a quick access to the web based monitoring dashboard, tools and statistics.

The string "Copernicus" can be entered in the search feature of the dashboard e.g.

The OceanOPS internal system will add value to these metadata through connection to data nodes e.g.(see above), but also monitoring the "status" of the platforms in real-time.

To manage queries properly in the dashboard it is important to understand how the "status" attribute is managed dynamically by the machine:

status =probable: a deployment plan

status=confirmed: a deployment plan with a specific ship/cruise

status=registered: the deployment is officially registered (around the launch date) with feedback from the ship and all mandatory metadata. Real-time tracking is enabled

status=operational: data are flowing (at GDACs and on GTS)

status=inactive: data are not flowing since a given time (default a month for a drifter).

status = closed: data have not been flowing for a long time (default a year for drifters)

When this dynamic concept of status is understood users can generate any sample for platforms from the dashboard and access all metadata available.

Users should note as well that when it comes to display the platforms on the interactive map one can use different geographical concepts and data layers:

- Deployment locations
- Latest locations (in near real-time, from the observations made available)
- Trajectory and observations

The availability of all observations for all drifters is not yet enabled on the web for performance reasons and limited to 30 days.

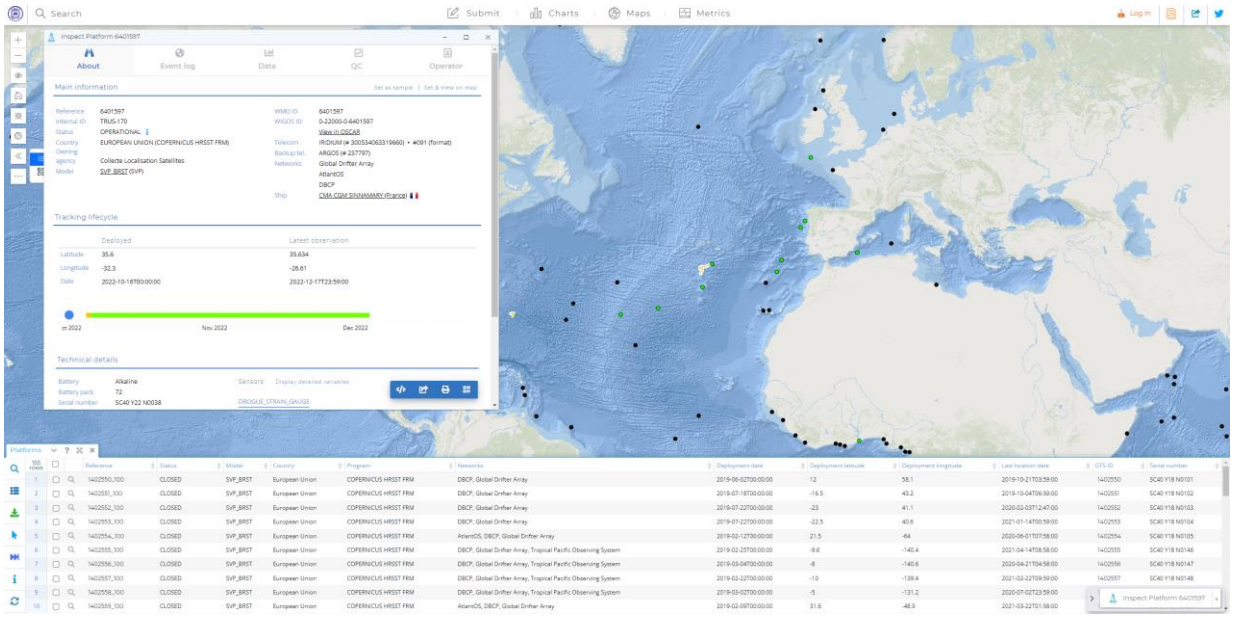

Figure 3 : OceanOPS dashboard monitoring "COPERNICUS HRSST FRM", with interactive map, table of platforms metadata (exportable/customizable) and detail page of a specific buoy

On a monthly basis, the Copernicus metadata are sent by Meteo-France to OceanOPS. Upon reception of the file, the Copernicus metadata are updated manually in the OceanOPS system, by comparing the content of the last two received files, and correcting and checking a few elements. This additional manual check of the metadata allows enhancing the metadata quality.

This could be operationalised if the format and content of the file was compliant with OceanOPS format.

Metadata provided by the operator Meteo-France should cover the full life cycle of the platforms, from planning to end of operations

Some of the metadata attributes values (vocabulary) required by OceanOPS are managed via reference tables (the model of the buoy/platform, the batteries, the telecom type, sensor models,

etc.). For some of them, OceanOPS uses existing standards (e.g. the ICES codes for the ships, and the L22 BODC code table for the sensor models).

Further reference tables can be used for GTS data distribution, and for the WIGOS metadata standard

OceanOPS has the role to organize the convergence of code tables between current oceanographic standards and WMO ones.

The web-based processing of these files (bulk upload with file checker) allows OceanOPS to update Copernicus metadata while linking to the code tables mentioned above. But the way to manage these metadata would be much more efficient and reliable by using the OceanOPS metadata format (https://www.ocean-ops.org/metadata). An export in the OceanOPS format of the Copernicus buoy metadata has been sent to Meteo-France, and shall be used for future updates. (OceanOPS export/import metadata format are compatible)

Figures 4 below illustrate some details available on the OceanOPS website. The GUI is very convenient to quickly update metadata. A routine file upload is more operational, and feasible only if content is robust. The Copernicus partners should use the interface routinely to verify and keep the content up to date, so that the monitoring of project activities and performance is accurate and up to date.

OceanOPS manages also the events related to a platform (beaching, iced over) or related to the data quality. It relays the feedback (a blacklist e.g.) from data users to data producers. It logs the information, and relay it properly through notifications. These extra metadata should also be made available to users (see Fig. 5)

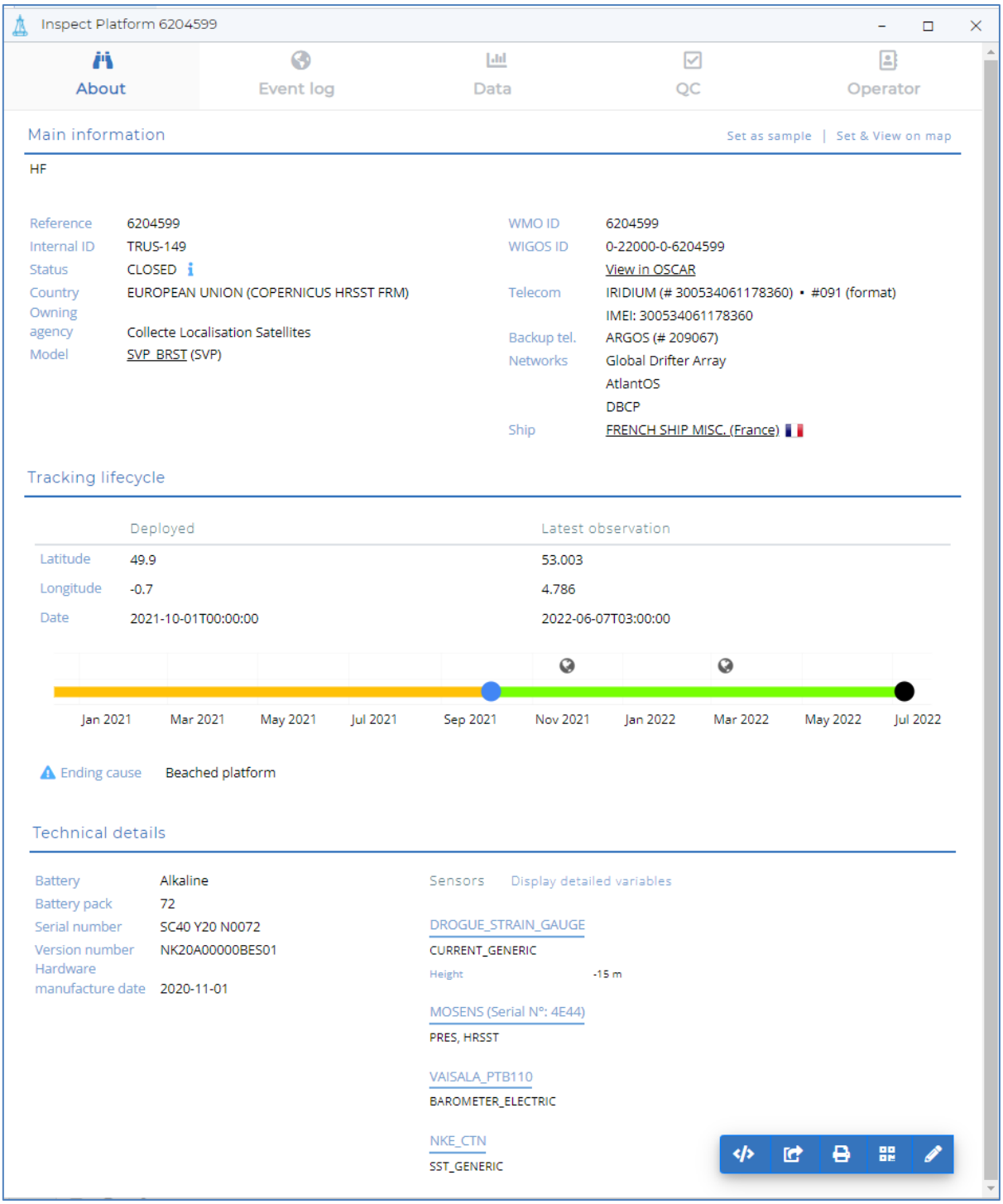

Figure 4: OceanOPS website with Copernicus FRM buoy description

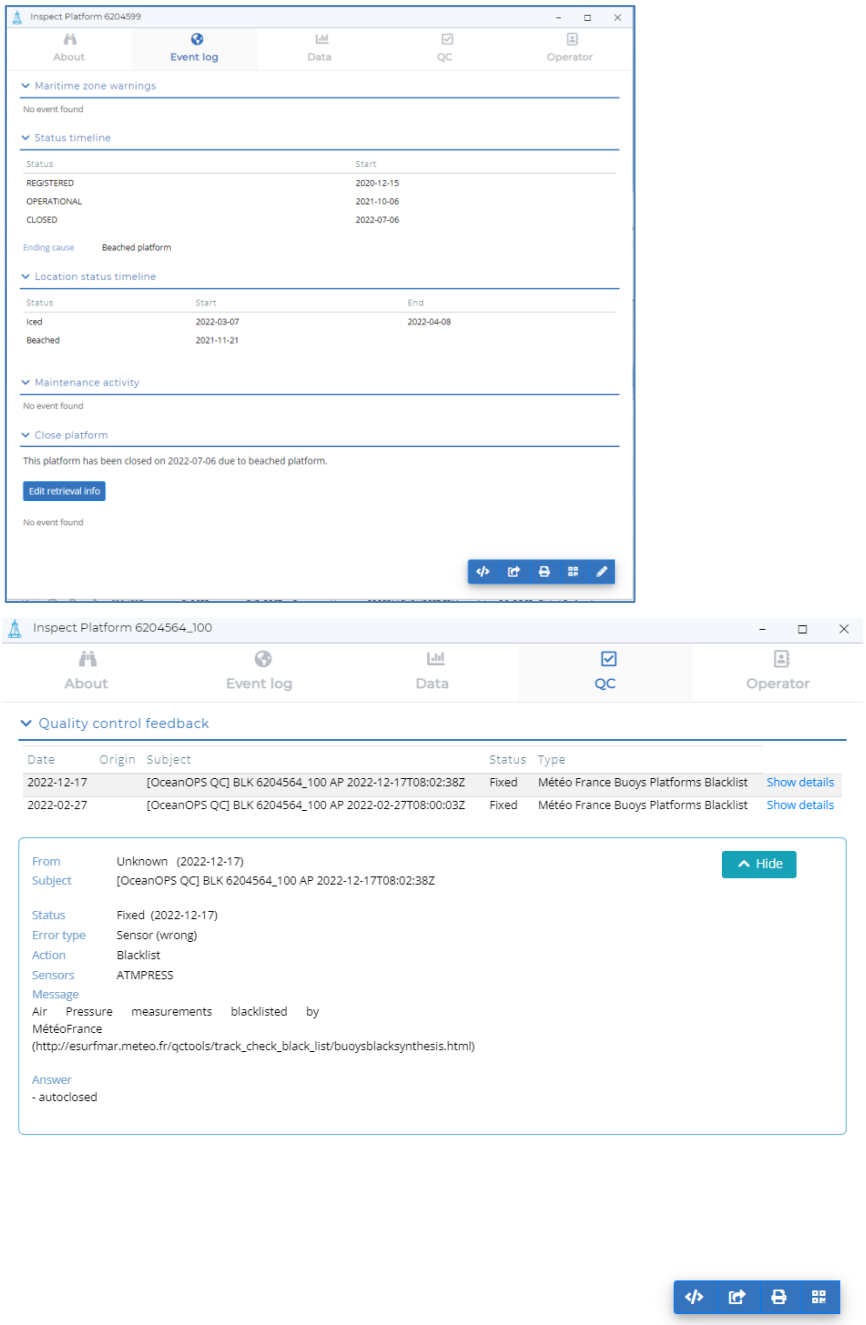

Figure 5 : OceanOPS website, Copernicus FRM buoy event log and quality control feedback archiving/notification tool

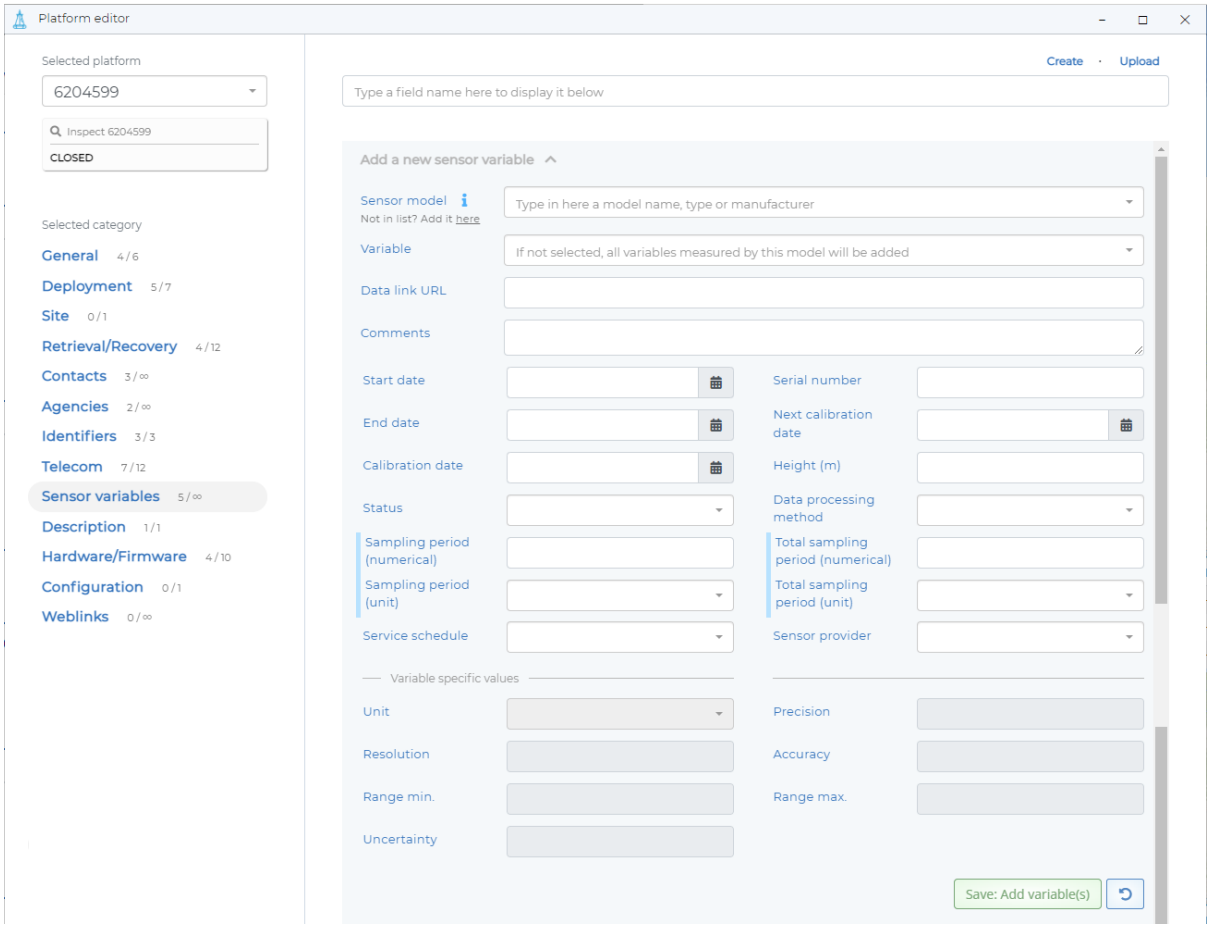

Figure 6 : OceanOPS platform editor and zoom on the sensor webform

4. Oceanops Metadata Gap Analysis

To analyze the completeness of metadata for the project, OceanOPS has organized a number of meetings with project managers, platform operators, manufacturer, data users. These reviews will continue in 2023 with a focus on manufacturer (NKE), metrology experts (SHOM) and the global data distribution centre (Coriolis/Ifremer).

Overall analysis confirms that OceanOPS system manages most of the metadata requirements by users, and more, with a few small adjustments required. However more information could be managed related to the quality of sensors and data. Eventually a complete documentation of the overall "output metadata" will be made available as OceanOPS focused first on the "input metadata" required from operators.

The input from the operators (e.g. Meteo-France for these Copernicus activities) should evolve to fully meet the OceanOPS operational requirements and ease the machine-to-machine updates. Any update inserted into the exchange format will overwrite the previous versions. This file can also be submitted through the web dashboard, with a file checker and comparison tools. This can be used in a transition period from a manual to a fully operational exchange system.
It is recalled that the deployment plans should also be listed in such file, so that first key metadata (such as the unique WMO id) can be fixed early in the project. This enable also tracking and reporting tools for the project management. The deployment plans have not been yet inserted for the second phase of the project. The same metadata file can be used to add the plans and complete them as planning develop. It is recalled the many tools (GIS based) on OceanOPS website that enable and facilitate deployment planning (checking the overall density of the drifter array, the Copernicus service status, cruise plans e.g.).
In addition OceanOPS coordinates together with MeteoFrance a number of deployments (with sailing races e.g) hence the information and plans need to be formally registered for all partners involved.

As for all contributions to GOOS, the content of metadata is primarily under operator responsibility even if OceanOPS perform regular checking and support functions

Further information is needed from the buoy manufacturers on drifters and sensors specifications so that reference records can be completed as needed (sensor resolution, accuracy, manufacturer,metrology steps, etc.).

The OceanOPS standard should include as well the quality control procedures achieved in real-time or delayed mode related metadata, and the quality feedback logs channeled from users to operators and data managers. This will require discussions with the drifter GDAC (Coriolis/Ifremer).

The following gaps in the OceanOPS metadata have been identified and will be addressed in the next steps of the project:

- **Operator shall send the metadata to OceanOPS** according to the suggested format (http://www.ocean-ops.org/metadata). This shall be organized as a permanent location for routine access by OceanOPS. Operator can also self-maintain the information through the many tools available (a drag and drop of the exchange file on the website works well to update metadata, finalize deployment plans, etc).
- Operator will also create metadata records for deployment plans, even with approximate date and position and update it gradually as logistics are confirmed.
- **Manufacturer will share the latest buoy and sensor specification sheets** with OceanOPS.
- Further information is needed on FRM specific metadata, such as additional calibration activities, and to capture relevant metadata and confirming FRM quality. Meetings will be organised as required.
- Further metadata on the management of events can be shared (operational or data quality related), e.g.: beaching, trapped by ice, blacklisted for some sensor data, rejected by some models, etc.
- Further metadata are available on individual observations through the synchronization of OceanOPS and GTS/GDACs (quality flags, timeliness, etc). It is to be discussed on how these can be made available together with platform metadata.
- **OceanOPS will add these hardware, FRM specifications, events and data quality controls and feedback logs** to the metadata set.
- **OceanOPS will make** small adjustments required to the metadata management web interface, file import/export features and API.
- **OceanOPS will document the full "output metadata" enabled though its system and complete its standard http://www.ocean-ops.org/metadata accordingly.**
- **OceanOPS will ensure that these metadata will reach Copernicus users through discussion with data producers and aggregators.**

5. QR code metadata pilot

OceanOPS has been working on introducing a unique QR code on buoy stickers. Its web-based information system generates codes on demand, to be then sent to the printing company to complete the sticker. This part is completed and will be implemented in the coming months.

A second step is to review the workflow of updates that could be made in the metadata flow through QR code flashing, and develop the web-based interface (and responsive for mobiles) to perform the necessary actions, e.g.:

- get a unique WMO id at first flash, confirm core manufacturer metadata (serial number e.g.) set the buoy ready for shipping

- pre-deployment check and extra calibration if any done, buoy ready for shipping to port/ship
- buoy loaded on ship and ready for deployment
- buoy deployed
- buoy beached (extra mean for public to warn OceanOPS)

All along these potential steps, the GPS would capture the lat/lon and date, and interface could offer some simple metadata updates. This would ease the updates, reduce human errors. OceanOPS will further develop the concept and make the based developments required by a POC.

Further activities to support the QR code pilot are:

- Printing of specific stickers with QR codes.
- OceanOPS to develop the specifications for QR code handling functions
- OceanOPS to enrich the specifications through exchange with partners
- OceanOPS to develop basic web/mobile functions to run the pilot if 2023 budget allows.

The latter is depending on the capacity of OceanOPS to fund web developments (regularly outsourced) in 2023 which is at the moment of writing this report constrained by budget limitations.

Figure 7 : OceanOPS sticker for Copernicus FRM drifting buoy measurements with QR code

6. Implementation Plan

2023 will see the metadata gap analysis results addressed through a set of actions identified in annex A by the first semester.

By Q1 2023, all consultations with partners will be completed to improve the standard and Meteo France will deliver the standard metadata required by OceanOPS routinely (or at least autonomously), and including the deployment planning information.

By Q2 2023, the full metadata output potential will be documented and relevant tools updated (web, import/export, API, etc).

The QR code pilot specifications will be written and needs for further developments dimensioned.

Q3/Q4 2023 will enable a more robust and complete metadata exchange system, facilitating to the maximum the inputs required by operators, minimizing the error and manual steps, and maximizing the overall metadata made available to users.

Some of these metadata (not to say all) should be made available to users through the promotion of specific services (API access) or through the update of the netCDF format used by Copernicus users.

To conclude this document, the main efforts in 2023 will have to be made on operator side (to operationalize their metadata submission), and on OceanOPS side to complete the output metadata set, tools and documentation and make sure these are available to Copernicus users.