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MOCCA

D3.3.2 Description of the at sea monitoring procedure (revised)

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Document History

Version[2]	Issue Date	Stage	Content and Changes
0.1	01.03.2017	Draft	Initial document creation
0.2	29.06.2017	Draft	Revision
0.3	01.08.2017	QC	For internal quality control
1.0	01.10.2017	Final	Final version for submission

[1] As indicated in the "Technical and Scientific description of the Euro-Argo ERIC" July 2013 attached to the Euro-Argo Statutes.

[2] Integers correspond to submitted versions.

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1. INTRODUCTION

This document defines MOCCA at sea monitoring procedures defined in order to follow the 150 floats bought through the project, and that will be used to monitor the European fleet.

Monitoring of floats after they are deployed is coordinated by the ERIC with the support of national float experts. In June 2016, a review of existing at-sea monitoring tools was presented to the Euro-Argo Management Board and a monitoring flow for the float life cycle was designed:

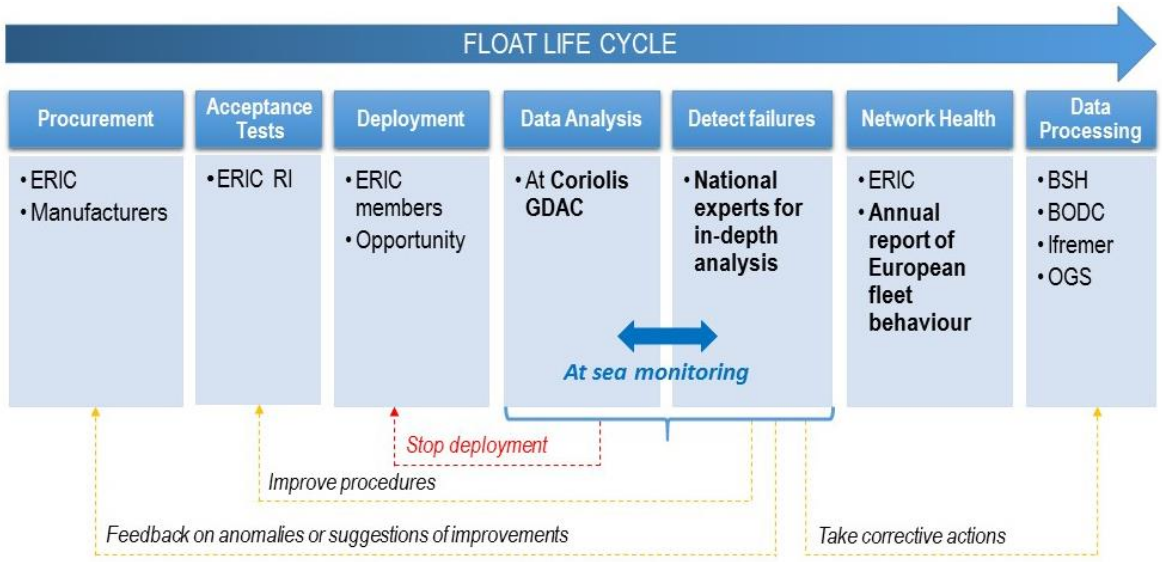


Figure 1: At sea monitoring workflow

Discussions highlighted the fact that it is important to know what are the questions we want to answer when reporting on fleet status, so the ERIC issued a questionnaire that was filled by Euro-Argo partners and associated institutions, providing feedback on the current needs and where to put efforts. Survey results showed that there is a strong requirement to report on status, performance and technical aspects.

This phase took much time than expected and thus delayed slightly the initial schedule of Annex I of the Grant Agreement for defining comprehensive at sea monitoring procedures. It was decided that ERIC would work jointly with the **AIC for deriving global statistics** (age distribution, life expectancy, deployment maps etc.) and that existing **tools at Coriolis will be enhanced in 2017 to monitor the European fleet, especially considering technical aspects**: reports on the cases of early failures of individual floats, for known issues the current status of floats and finally the monitoring of critical technical parameters defined by partners (battery voltage, last transmission date etc.) through a web interface with dashboards/status tables.

The present document is describing the major revision of Coriolis webpages performed in 2017, that now fulfil the monitoring objectives of Euro-Argo for the MOCCA fleet.

2. TIMELINE

A **review of existing at sea monitoring tools was presented to the Euro-Argo Management board in June 2016**, collecting examples of websites or in-house procedures used by some Argo floats communities to follow-on their floats after deployment. It was described in the first version of this deliverable and thus not repeated here.

Then **user requirements concerning technical monitoring** were collected from questionnaire and meetings (2016). It was decided at the Management Board in October 2016 to **enhance the Coriolis existing tools** for at sea monitoring.

At the beginning of 2017 the ERIC technical team organised a **review of actions with Coriolis** Data Centre, and a **proof of concept** was presented to the Management Board in March 2017. During spring 2017 a massive work was undertaken by the **computer team at Ifremer for both visualisation and programming**, driven by the **specifications** of ERIC team. Corrections of existing alerts were made, new alerts were defined and implemented into the data flow.

In June 2017, a **first version of the new at sea monitoring website was released**, addressing many new features and allowing effective monitoring of the MOCCA fleet. **The tool will be presented at the Euro-Argo User Meeting in Paris in July 2017**, and feedbacks will be collected for further improvements.

Some corrections and evolutions are currently implemented and another website release is planned in December 2017 and early 2018.

The tool is available at *http://www.ifremer.fr/argoMonitoring/*

NOTE: the tool has been specially designed and tested for MOCCA fleet (NKE Arvor floats 2016); some of the functionalities will work for other float versions, other not. It is scheduled under Euro-Argo coordination to extend the tool to all the European floats.

3. DESCRIPTION OF THE TOOL

The Coriolis tool for at sea monitoring of Argo floats is first displaying the list of WMO numbers of active (or all) floats. The tool is divided into 2 parts:

- a **platform** webpage that details a single float, with metadata, data graphs, a map and plots of main technical parameters,
- a **dashboard** that allows the monitoring of a set of floats.

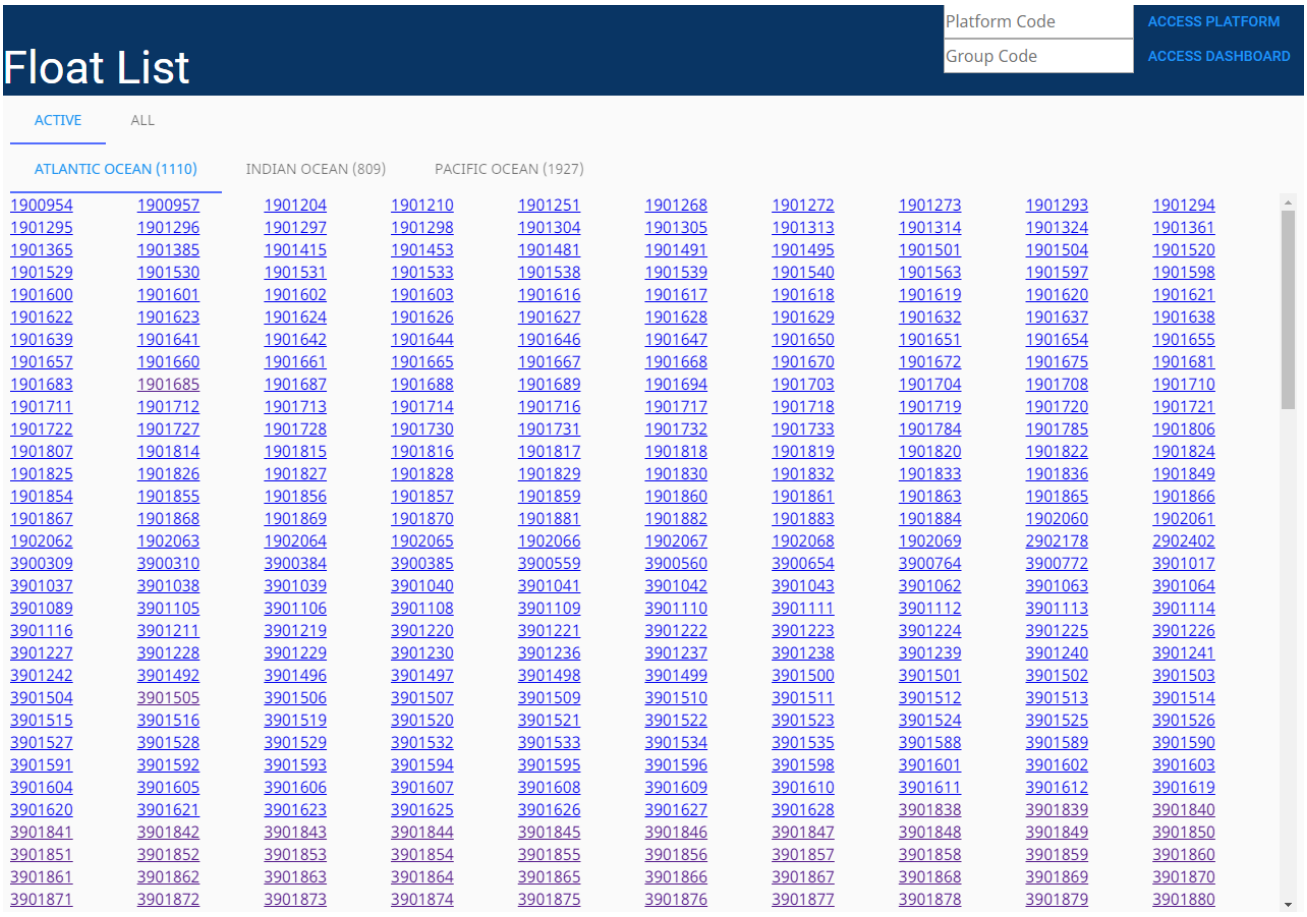


Figure 2: List of active Argo floats and access to platform or dashboard webpages.

The tool is using the **Coriolis database** managed by the Coriolis DAC.

3.1. Access platform

One can access a specific platform (Argo float) webpage by clicking on its WMO (e.g. 3901864) number from the main page or through the following address: http://www.ifremer.fr/argoMonitoring/float/3901864

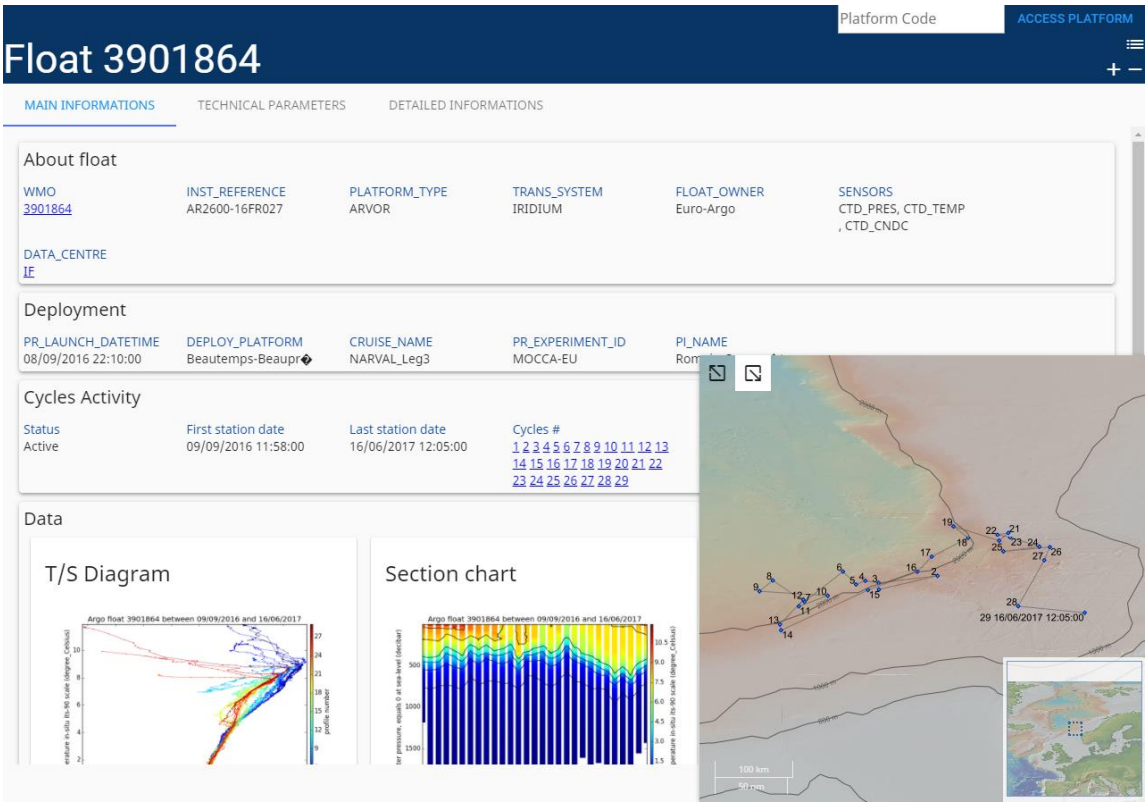


Figure 3: Float webpage - main tab with basic metadata, data graphs and map.

3.1.1. Main information

The “main information” tab displays the most important float metadata with:

- WMO number and link to the JCOMMOPS/AIC webpage http://www.jcommops.org/board/wa/InspectPtfModule?ref=3901864
- Float serial number, type of float, transmission system, owner and sensors available
- Deployment information
- Float stations and cycles performed

The map inset can be displayed or not, and shows the float stations positions with cycle number and date. The bathymetry and coastline layers are available on the background.

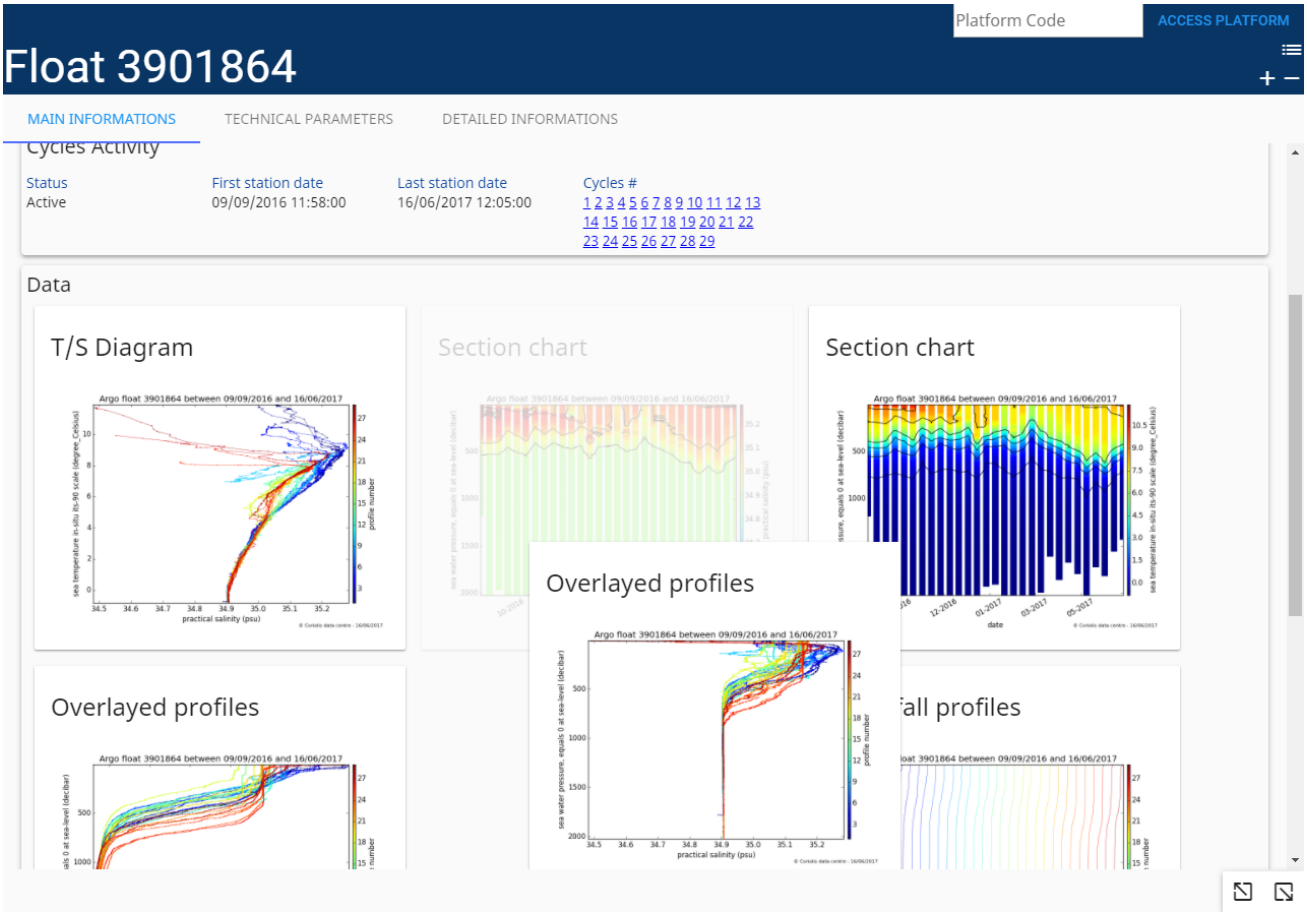


Figure 4: Float webpage - main tab with map inset folded and reorganisation of data graphs.

CTD data graphs (static) are presented, with for instance sections charts of Temperature and Salinity over time and pressure, overlayed profiles or T/S diagram. Plots of individual profiles open in a popup when clicking of the cycle number.

Desirable evolutions in December 2017 or 2018:

➔ CTD data graphs for drifting phases of the float

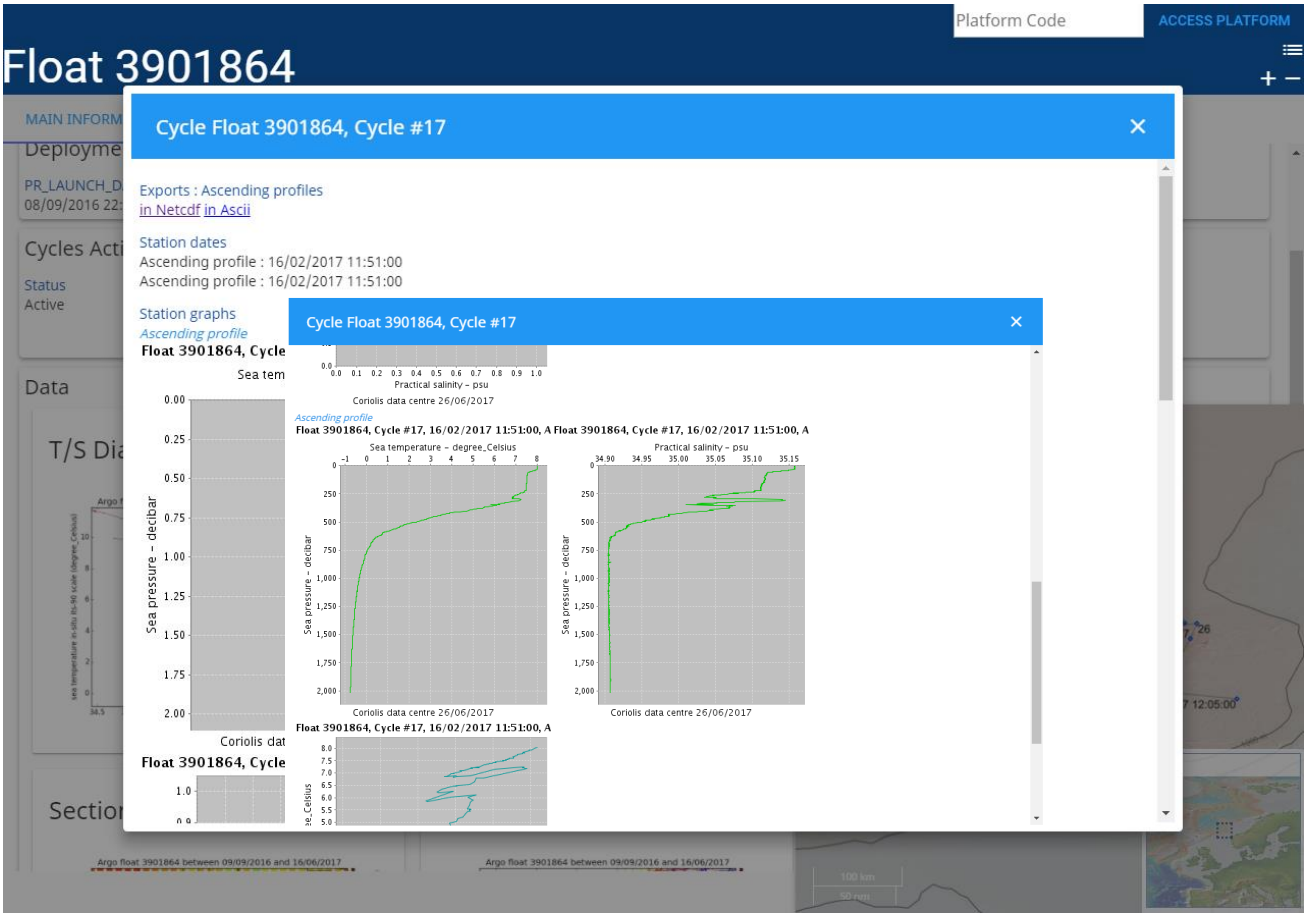


Figure 5: Plot of CTD profiles of a specific cycle and data export.

3.1.2. Detailed information

The "detailed information" tab displays the all the metadata available. It is hierarchized with categories:

- **Float** that contains general information and identification fields,
- **Deployment** information,
- **Float configuration** at the beginning of the mission, and now also the settings that have changed across float life with for instance iridium commands.
- **Activity** that shows the cycle data and plots of each individual technical parameter.

Each category is divided into sub-categories with for instance Mission Configuration or Mission Technical parameters. One can unfold any sub-category to display the desired information.

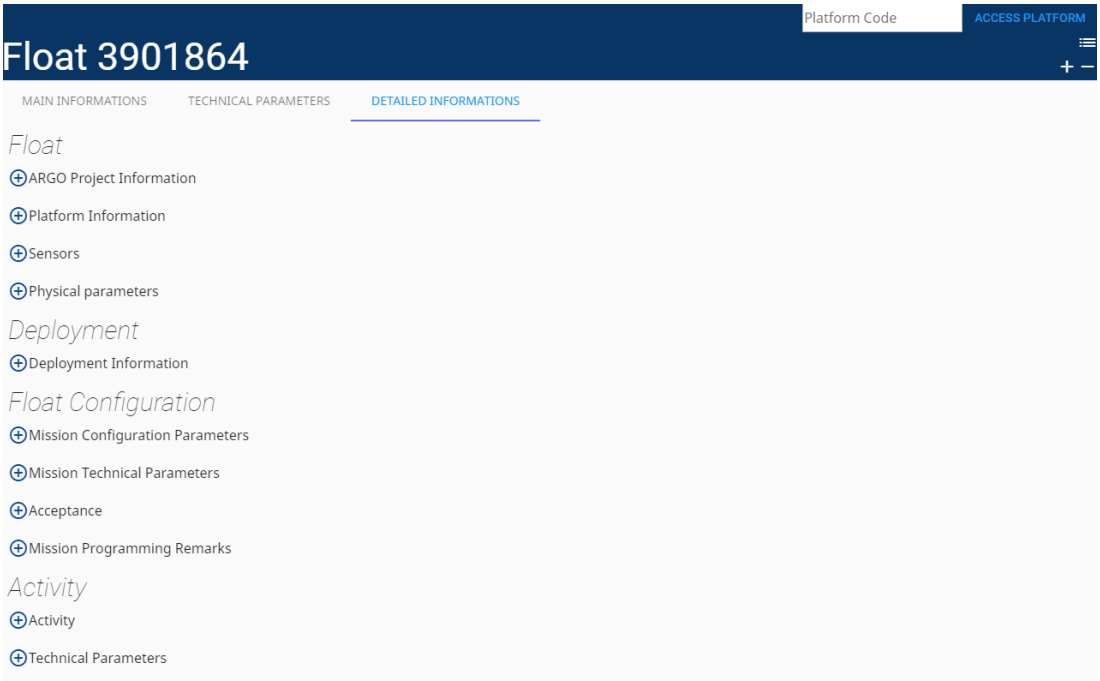


Figure 6: Float webpage – detailed information tab with all metadata organised into categories.

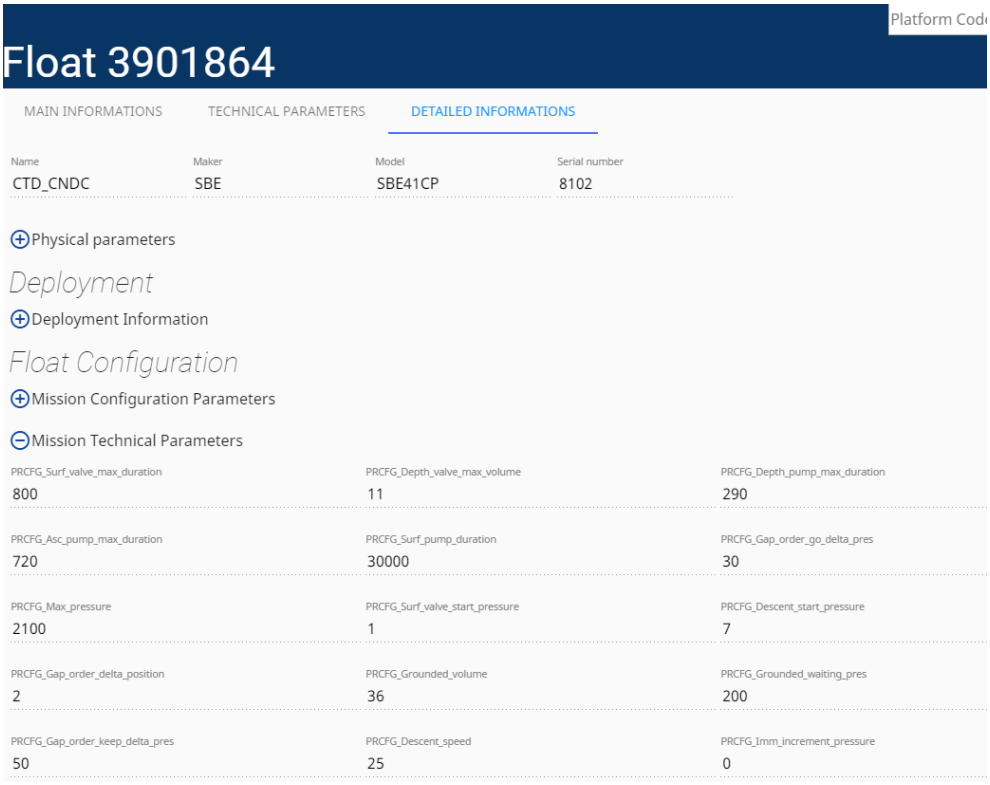
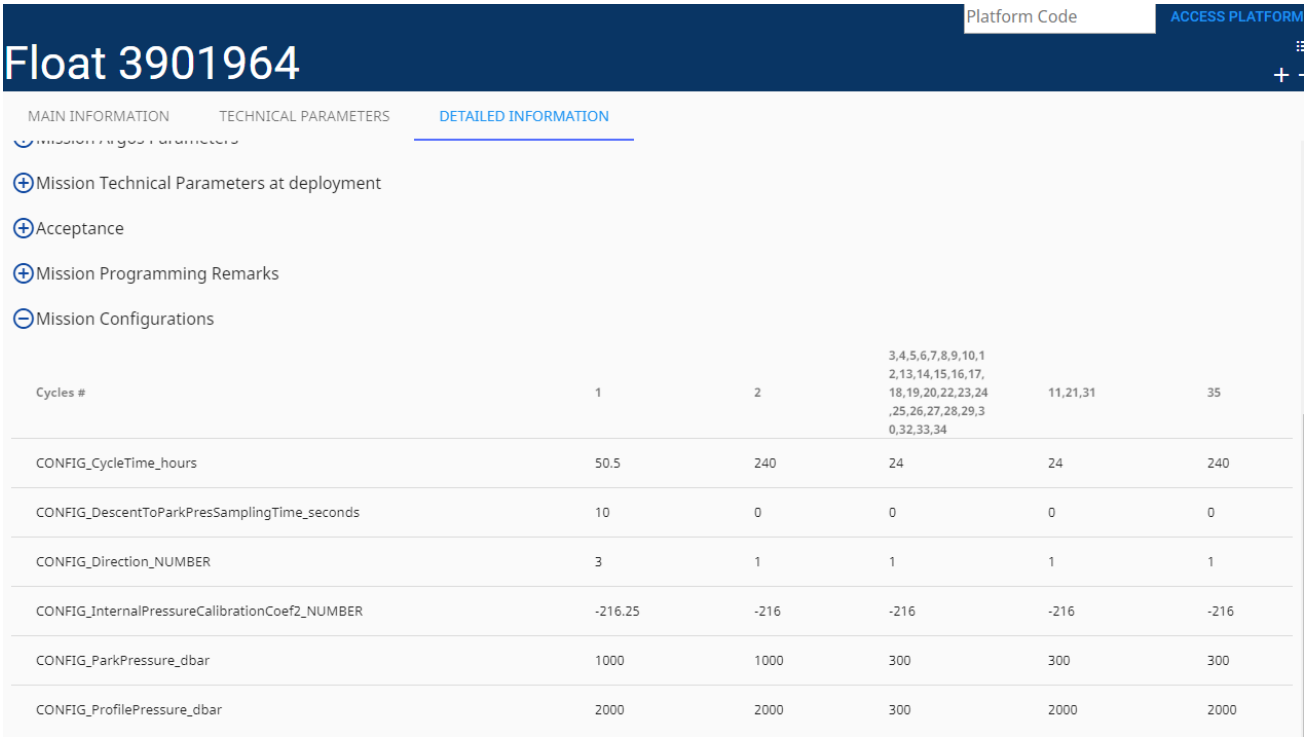


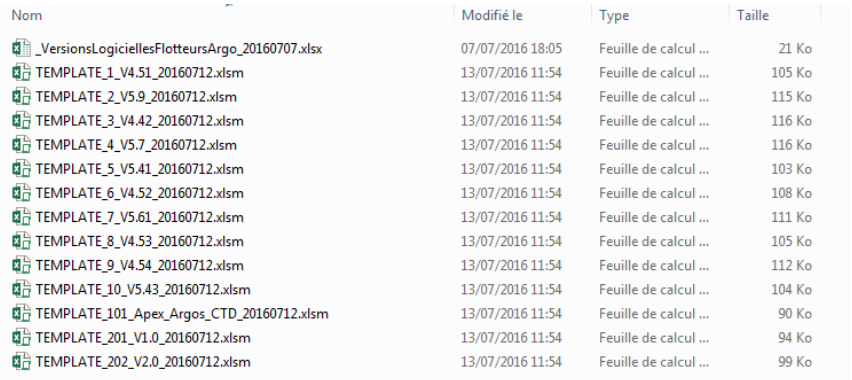
Figure 7: Float webpage – detailed information tab with some metadata sub-categories unfolded. The standardized metadata field is described on mouse-over.



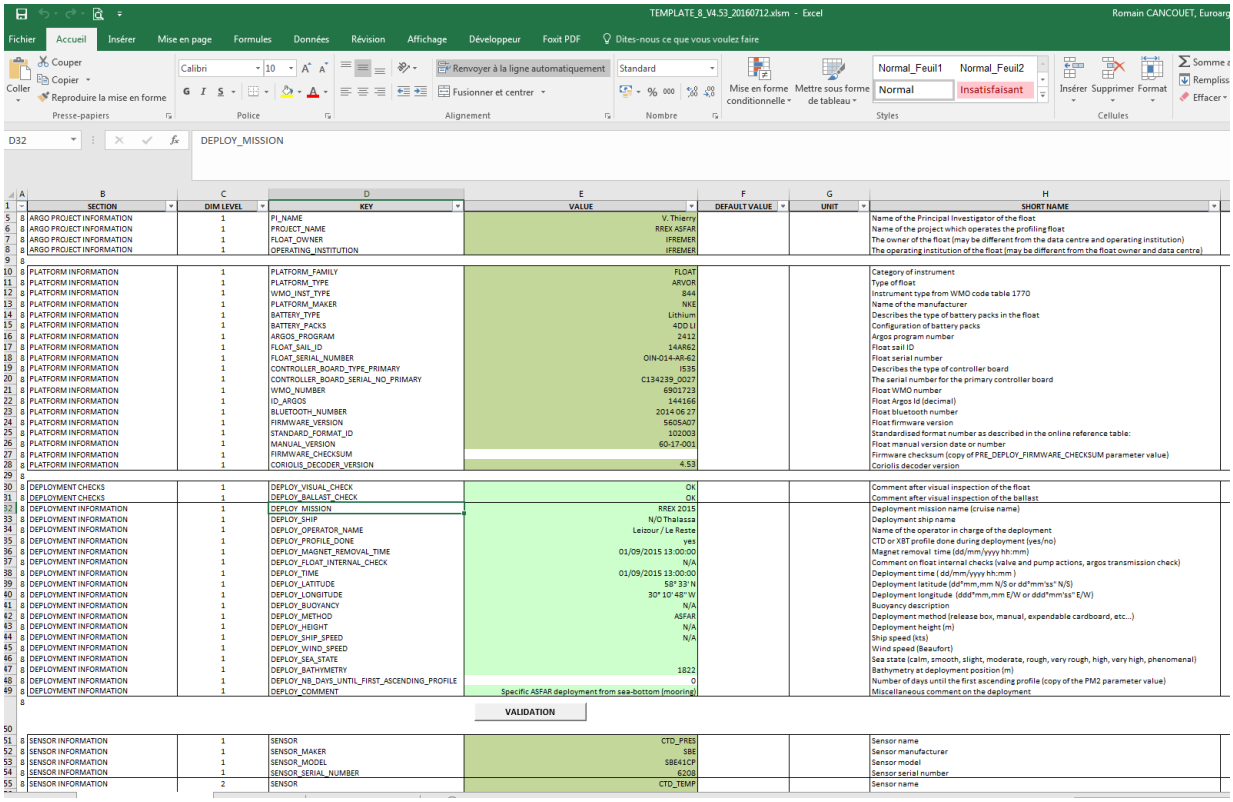
Cycles #	1	2	3,4,5,6,7,8,9,10,12,13,14,15,16,17,18,19,20,22,23,24,25,26,27,28,29,30,32,33,34	11,21,31	35
CONFIG_CycleTime_hours	50.5	240	24	24	240
CONFIG_DescentToParkPresSamplingTime_seconds	10	0	0	0	0
CONFIG_Direction_NUMBER	3	1	1	1	1
CONFIG_InternalPressureCalibrationCoef2_NUMBER	-216.25	-216	-216	-216	-216
CONFIG_ParkPressure_dbar	1000	1000	300	300	300
CONFIG_ProfilePressure_dbar	2000	2000	300	2000	2000

Figure 8: Float webpage – detailed information tab with mission configurations. Each parameter that has changed across float life is listed in the table (row), and the corresponding value for each cycle or group or cycles (first row) is displayed (column).

Metadata information is hierarchised according to the relevant deployment sheet (available at Coriolis) **for a specific float version**. To date a dozen of deployment sheets are available for most recent float versions of Arvor, Apex and Nova floats.



Nom	Modifié le	Type	Taille
_VersionsLogicielsFlotteursArgo_20160707.xlsx	07/07/2016 18:05	Feuille de calcul ...	21 Ko
TEMPLATE_1_V4.51_20160712.xlsm	13/07/2016 11:54	Feuille de calcul ...	105 Ko
TEMPLATE_2_V5.9_20160712.xlsm	13/07/2016 11:54	Feuille de calcul ...	115 Ko
TEMPLATE_3_V4.42_20160712.xlsm	13/07/2016 11:54	Feuille de calcul ...	116 Ko
TEMPLATE_4_V5.7_20160712.xlsm	13/07/2016 11:54	Feuille de calcul ...	116 Ko
TEMPLATE_5_V5.41_20160712.xlsm	13/07/2016 11:54	Feuille de calcul ...	103 Ko
TEMPLATE_6_V4.52_20160712.xlsm	13/07/2016 11:54	Feuille de calcul ...	108 Ko
TEMPLATE_7_V5.61_20160712.xlsm	13/07/2016 11:54	Feuille de calcul ...	111 Ko
TEMPLATE_8_V4.53_20160712.xlsm	13/07/2016 11:54	Feuille de calcul ...	105 Ko
TEMPLATE_9_V4.54_20160712.xlsm	13/07/2016 11:54	Feuille de calcul ...	112 Ko
TEMPLATE_10_V5.43_20160712.xlsm	13/07/2016 11:54	Feuille de calcul ...	104 Ko
TEMPLATE_101_Apex_Argos_CTD_20160712.xlsm	13/07/2016 11:54	Feuille de calcul ...	90 Ko
TEMPLATE_201_V1.0_20160712.xlsm	13/07/2016 11:54	Feuille de calcul ...	94 Ko
TEMPLATE_202_V2.0_20160712.xlsm	13/07/2016 11:54	Feuille de calcul ...	99 Ko



	A	B	C	D	E	F	G	H
1		SECTION	DIM LEVEL	KEY	VALUE	DEFAULT VALUE	UNIT	SHORT NAME
5	8	ARGO PROJECT INFORMATION	1	PI_NAME	V. Thierry			Name of the Principal Investigator of the float
6	8	ARGO PROJECT INFORMATION	1	PROJECT_NAME	RREX ASFAR			Name of the project which operates the profiling float
7	8	ARGO PROJECT INFORMATION	1	FLOAT_OWNER	IFREMER			The owner of the float (may be different from the data centre and operating institution)
8	8	ARGO PROJECT INFORMATION	1	OPERATING_INSTITUTION	IFREMER			The operating institution of the float (may be different from the float owner and data centre)
9	8							
10	8	PLATFORM INFORMATION	1	PLATFORM_FAMILY	FLOAT			Category of instrument
11	8	PLATFORM INFORMATION	1	PLATFORM_TYPE	ARVOR			Type of float
12	8	PLATFORM INFORMATION	1	WMO_INST_TYPE	844			Instrument type from WMO code table 1770
13	8	PLATFORM INFORMATION	1	PLATFORM_MAKER	NKE			Name of the manufacturer
14	8	PLATFORM INFORMATION	1	BATTERY_TYPE	Lithium			Describes the type of battery packs in the float
15	8	PLATFORM INFORMATION	1	BATTERY_PACKS	4DD LI			Configuration of battery packs
16	8	PLATFORM INFORMATION	1	ARGOS_PROGRAM	2412			Argos program number
17	8	PLATFORM INFORMATION	1	FLOAT_SAIL_ID	14AR62			Float sail ID
18	8	PLATFORM INFORMATION	1	FLOAT_SERIAL_NUMBER	OIN-014-AR-62			Float serial number
19	8	PLATFORM INFORMATION	1	CONTROLLER_BOARD_TYPE_PRIMARY	I535			Describes the type of controller board
20	8	PLATFORM INFORMATION	1	CONTROLLER_BOARD_SERIAL_NO_PRIMARY	C134239_0027			The serial number for the primary controller board
21	8	PLATFORM INFORMATION	1	WMO_NUMBER	6901723			Float WMO number
22	8	PLATFORM INFORMATION	1	ID_ARGOS	144166			Float Argos Id (decimal)
23	8	PLATFORM INFORMATION	1	BLUETOOTH_NUMBER	2014 06 27			Float bluetooth number
24	8	PLATFORM INFORMATION	1	FIRMWARE_VERSION	5605A07			Float firmware version
25	8	PLATFORM INFORMATION	1	STANDARD_FORMAT_ID	102003			Standardised format number as described in the online reference table:
26	8	PLATFORM INFORMATION	1	MANUAL_VERSION	60-17-001			Float manual version date or number
27	8	PLATFORM INFORMATION	1	FIRMWARE_CHECKSUM				Firmware checksum (copy of FRE_DEPLOY_FIRMWARE_CHECKSUM parameter value)
28	8	PLATFORM INFORMATION	1	CORIOLIS_DECODER_VERSION	4.53			Coriolis decoder version
29	8							
30	8	DEPLOYMENT CHECKS	1	DEPLOY_VISUAL_CHECK	OK			Comment after visual inspection of the float
31	8	DEPLOYMENT CHECKS	1	DEPLOY_BALLAST_CHECK	OK			Comment after visual inspection of the ballast
32	8	DEPLOYMENT INFORMATION	1	DEPLOY_MISSION	RREX 2015			Deployment mission name (cruise name)
33	8	DEPLOYMENT INFORMATION	1	DEPLOY_SHIP	N/O Thalassa			Deployment ship name
34	8	DEPLOYMENT INFORMATION	1	DEPLOY_OPERATOR_NAME	Leizour / Le Reste			Name of the operator in charge of the deployment
35	8	DEPLOYMENT INFORMATION	1	DEPLOY_PROFILE_DONE	yes			CTD or XBT profile done during deployment (yes/no)
36	8	DEPLOYMENT INFORMATION	1	DEPLOY_MAGNET_REMOVAL_TIME	01/09/2015 13:00:00			Magnet removal time (dd/mm/yyyy hh:mm)
37	8	DEPLOYMENT INFORMATION	1	DEPLOY_FLOAT_INTERNAL_CHECK	N/A			Comment on float internal checks (valve and pump actions, argos transmission check)
38	8	DEPLOYMENT INFORMATION	1	DEPLOY_TIME	01/09/2015 13:00:00			Deployment time (dd/mm/yyyy hh:mm)
39	8	DEPLOYMENT INFORMATION	1	DEPLOY_LATITUDE	58° 33' N			Deployment latitude (dd°mm,mm N/S or dd°mm'ss" N/S)
40	8	DEPLOYMENT INFORMATION	1	DEPLOY_LONGITUDE	30° 10' 48" W			Deployment longitude (ddd°mm,mm E/W or ddd°mm'ss" E/W)
41	8	DEPLOYMENT INFORMATION	1	DEPLOY_BUOYANCY	N/A			Buoyancy description
42	8	DEPLOYMENT INFORMATION	1	DEPLOY_METHOD	ASFAR			Deployment method (release box, manual, expendable cardboard, etc...)
43	8	DEPLOYMENT INFORMATION	1	DEPLOY_HEIGHT	N/A			Deployment height (m)
44	8	DEPLOYMENT INFORMATION	1	DEPLOY_SHIP_SPEED	N/A			Ship speed (kts)
45	8	DEPLOYMENT INFORMATION	1	DEPLOY_WIND_SPEED				Wind speed (Beaufort)
46	8	DEPLOYMENT INFORMATION	1	DEPLOY_SEA_STATE				Sea state (calm, smooth, slight, moderate, rough, very rough, high, very high, phenomenal)
47	8	DEPLOYMENT INFORMATION	1	DEPLOY_BATHYMETRY	1822			Bathymetry at deployment position (m)
48	8	DEPLOYMENT INFORMATION	1	DEPLOY_NB_DAYS_UNTIL_FIRST_ASCENDING_PROFILE	0			Number of days until the first ascending profile (copy of the PM2 parameter value)
49	8	DEPLOYMENT INFORMATION	1	DEPLOY_COMMENT	Specific ASFAR deployment from sea-bottom (mooring)			Miscellaneous comment on the deployment
	8				VALIDATION			
50								
51	8	SENSOR INFORMATION	1	SENSOR	CTD_PRES			Sensor name
52	8	SENSOR INFORMATION	1	SENSOR_MAKER	SBE			Sensor manufacturer
53	8	SENSOR INFORMATION	1	SENSOR_MODEL	SBE41CP			Sensor model
54	8	SENSOR INFORMATION	1	SENSOR_SERIAL_NUMBER	6208			Sensor serial number
55	8	SENSOR INFORMATION	2	SENSOR	CTD_TEMP			Sensor name

Figure 9: Existing deployment sheet versions at Coriolis data centre (top) and example of a MOCCA Arvor iridium deployment sheet with metadata categories (bottom).

3.1.3. Technical parameters

The "technical parameters" tab is a brand-new feature of Coriolis website enhancement that shows a set of graphs dedicated to the technical monitoring of a float. Again, it was specifically designed for MOCCA Arvor float versions but could be extended to other float types with specifications from the technical experts.

The main technical parameters for the monitoring of MOCCA floats were defined by the ERIC Office, Coriolis deployment and data centre teams and Ifremer engineering department that have a great knowledge of NKE Arvor floats behaviour.

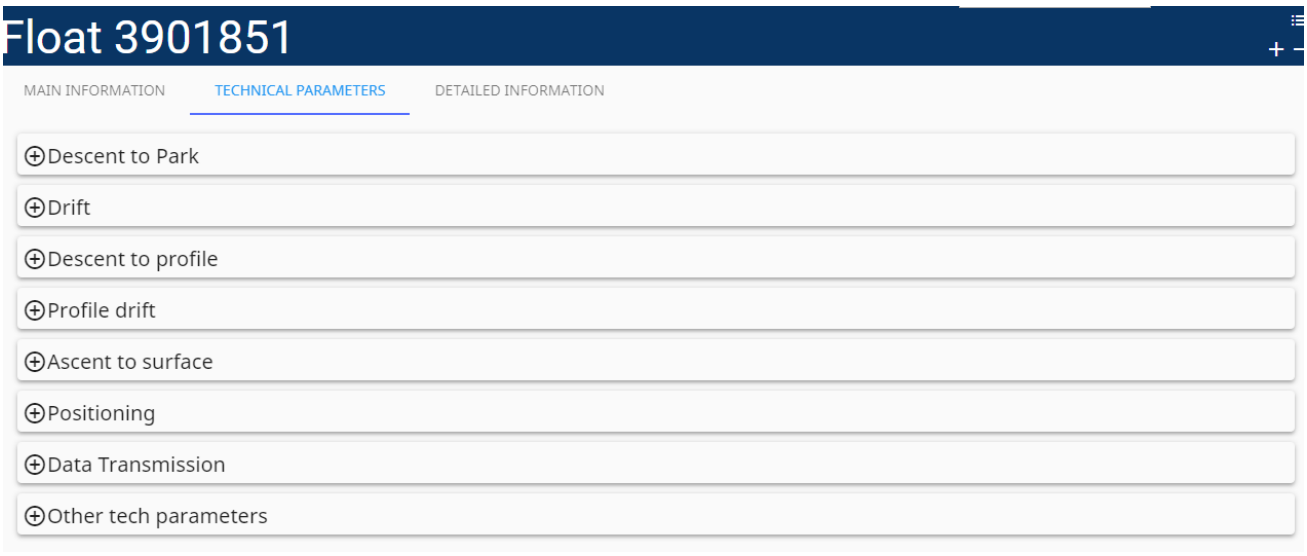


Figure 10: Float webpage – technical parameters tab.

It concerns:

- **Float hydraulic and repositioning behaviour** with for instance number of pump or solenoid valve actions during the different phases of float cycle (descent to park, drift etc.),
- **Data transmission**
- **Positioning**
- **Battery voltage**
- **Surface pressure offset corrections**

The graphs are displayed into categories corresponding to the different phases of float cycle:

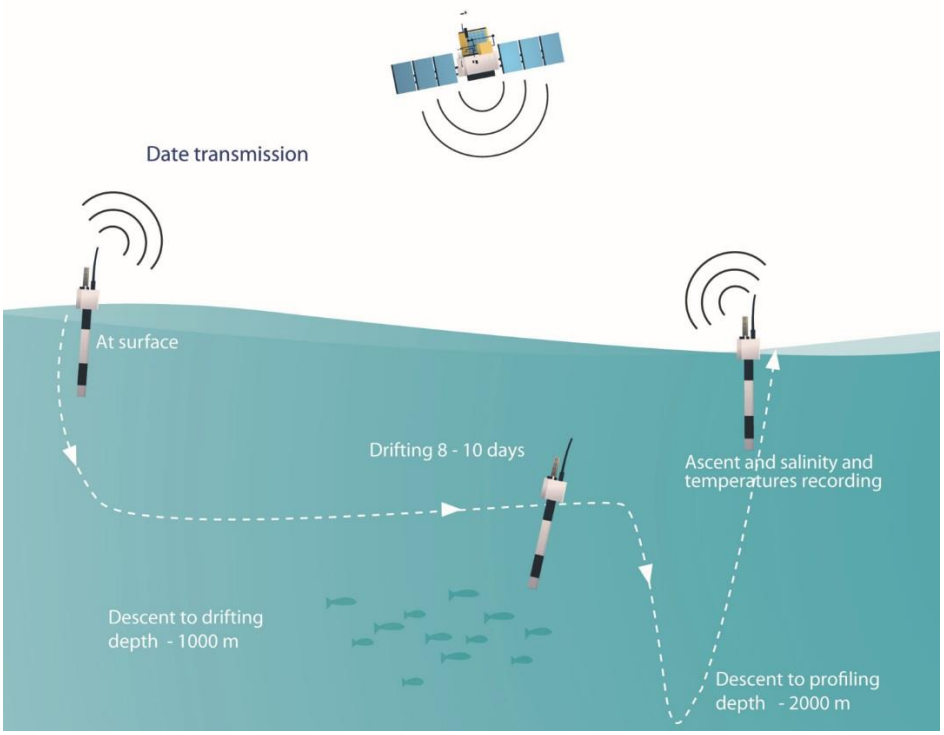


Figure 11: Standard Argo mission cycle phases.

On the technical graphs, the x-axis represents always the cycle number of the float and the y-axis one or several technical parameters values for each cycle. Each parameter can be selected or unselected and the related values are displayed on mouse-over.

Descent to Park

The graphs display the maximum pressure values reached during this float phase, together with the number of pump and valve actions. Usually the float does not need to start the pump during this phase. The number of valve actions performed at surface to make the float sink is also represented, and we can see on Figure 12 that it is higher for the first 2 cycles and then the float "learns" about its buoyancy behaviour in the water column and adjust this number more closely.

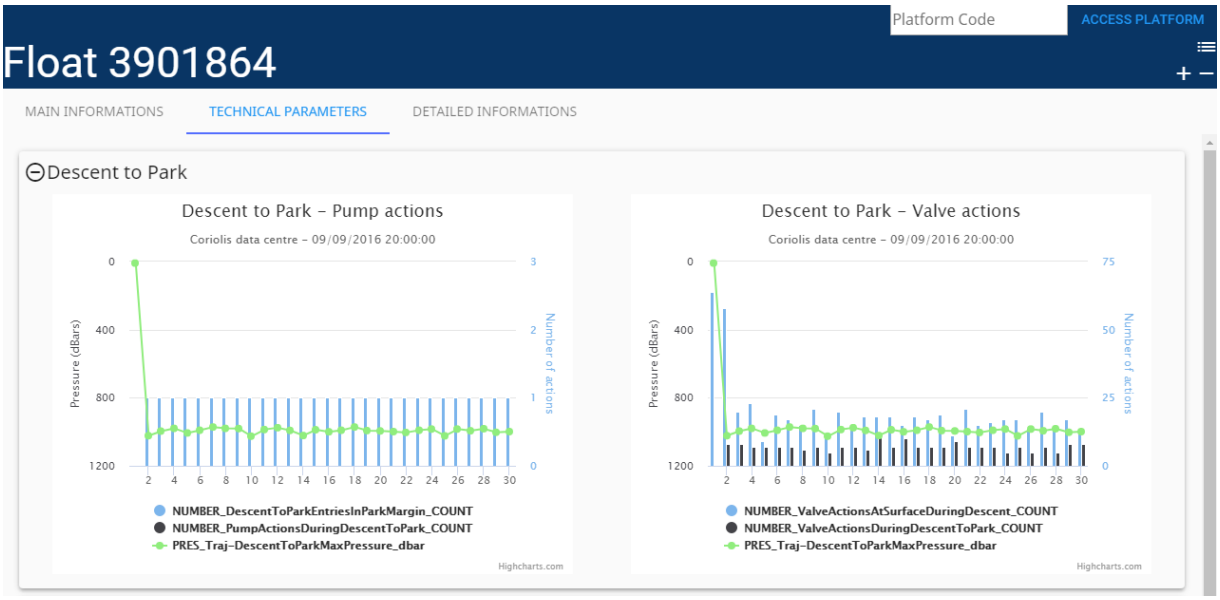


Figure 12: Float webpage – technical parameters tab with Descent to Park graphs unfolded.

Drift

The graphs display the minimum, maximum and representative pressure values reached during this float phase, together with the number of pump and valve actions (during drift phase) and the number of float repositions. One can see on Figure 13 a yellow background for cycle 2, that corresponds to an alert defined when the float is repositioning during the drift phase. Alerts will be detailed later on in this document on section 4.

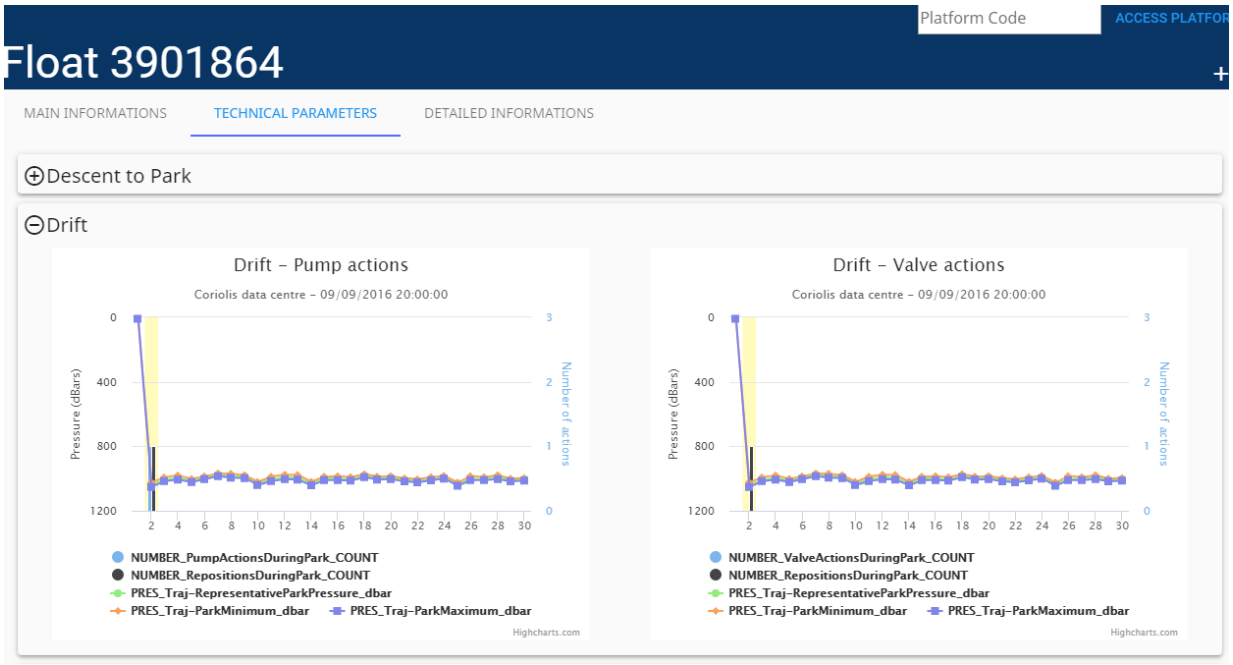


Figure 13: Float webpage – technical parameters tab with Drift graphs unfolded.

Descent to Profile

The graphs display the maximum pressure values reached by the float during this phase, together with the number of pump and valve actions. Usually the float does not need to start the pump during this phase. One can see on Figure 14 that the information "Grounded" is also shown when the float declared itself as stranded for this cycle.

Figure 14: Float webpage – technical parameters tab with Descent to Profile graphs unfolded.

Profile drift

The graph displays the number of repositions, valve/pump actions and minimum/maximum pressure values.

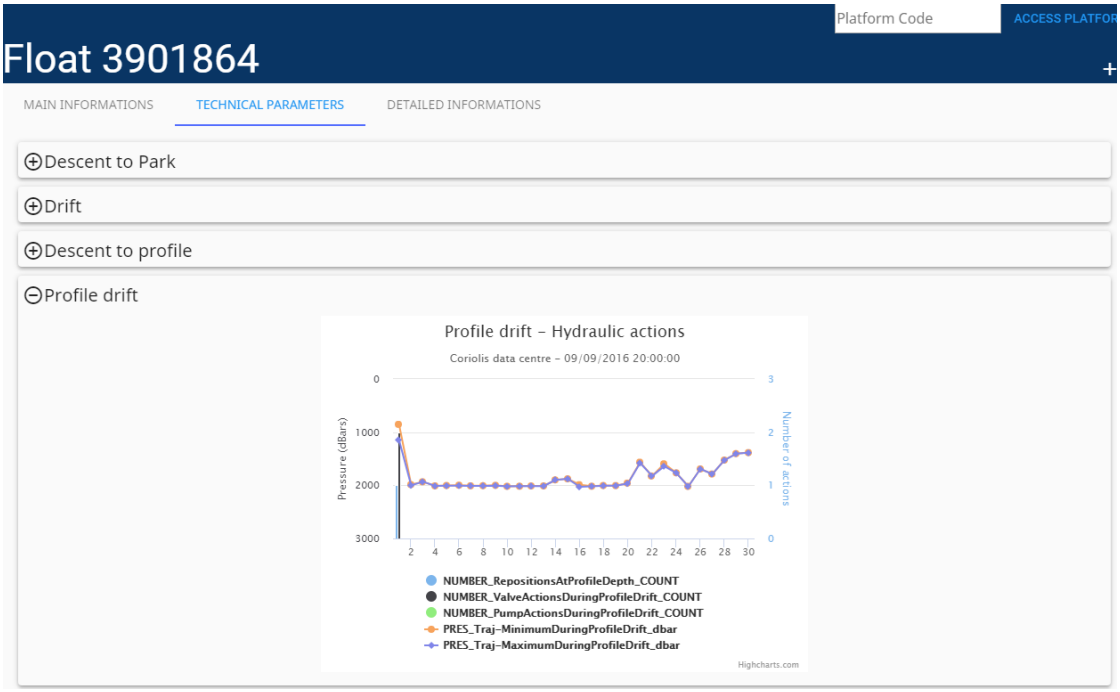


Figure 15: Float webpage – technical parameters tab with Profile Drift graph unfolded.

Ascent to surface

The graph displays the minimum and maximum pressure values together with the number of pump actions required to reach the surface from the profile pressure.

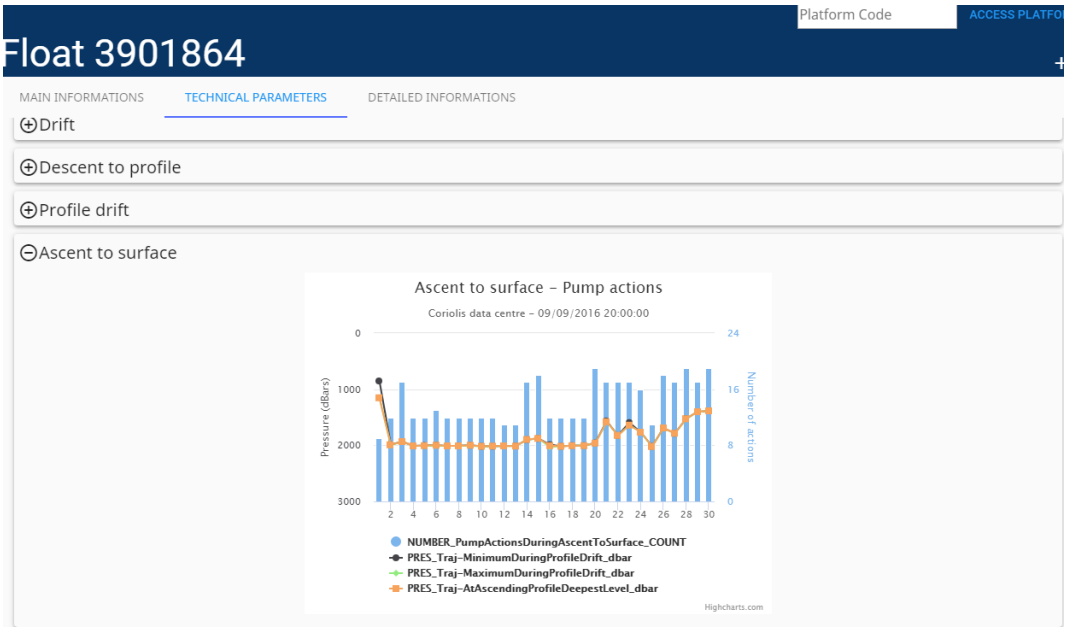


Figure 16: Float webpage – technical parameters tab with Ascent to surface graph unfolded

Other tech parameters

The **surface pressure offset correction** and the **battery voltage** when the pump is started at the profile pressure are represented. Jumps and drifts can thus be monitored easily.

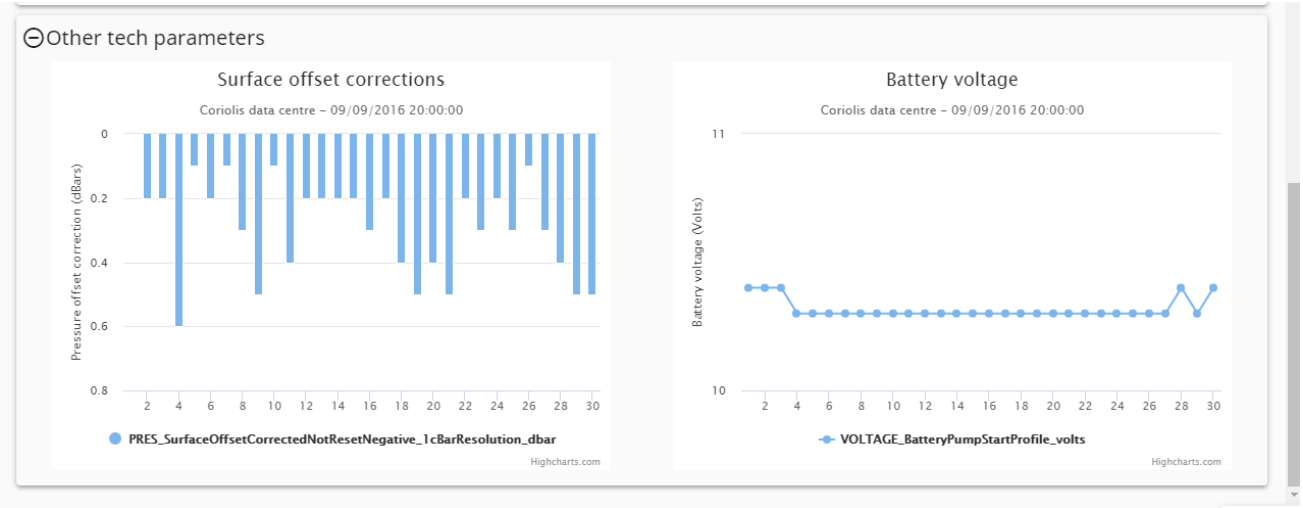


Figure 17: Float webpage – technical parameters tab with surface pressure offset correction and battery voltage.

Data transmission

The data transmission graphs are different depending on the transmission system used: Argos or iridium. For iridium new technical parameters had to be defined, decoded by the Coriolis data centre and implemented in the TECH_AUX part of the data flow.

- The **completeness of the transmission** for CTD data and parameter, hydraulic and technical messages can be monitored. As a general rule of thumb, the number of frames or messages emitted by the float is compared to the number of frames or messages received by the data centre. The CTD messages are divided into specific measuring phases (descending profile, park, ascending profile, near surface, in air etc.) of the float if applicable. The number and names of parameter, hydraulic and technical messages are likewise specific to a float version.

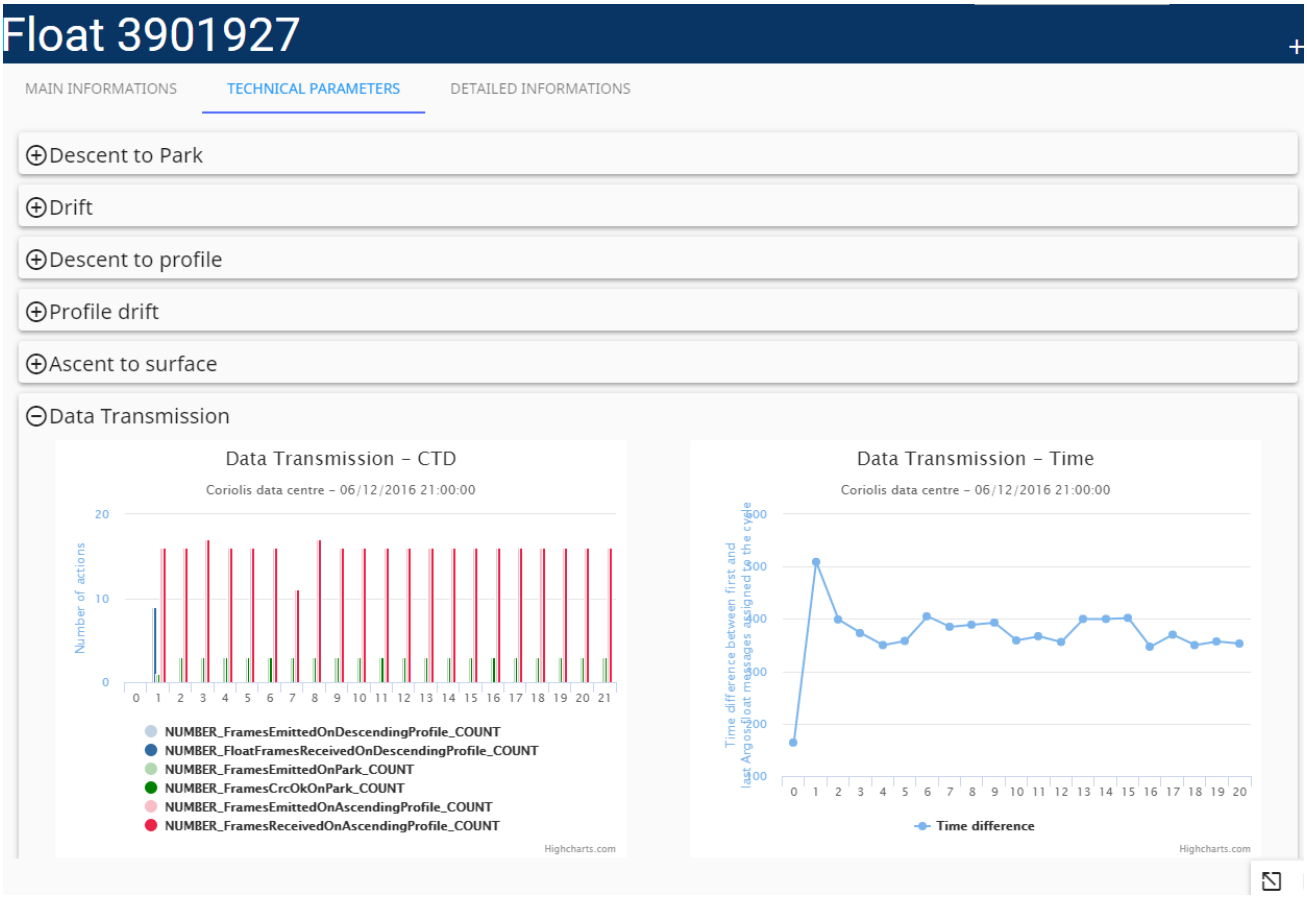


Figure 18: Float webpage – technical parameters tab for data transmission. Example for a MOCCA Argos transmission with the comparison between emitted and received frames (left) for different measuring phases. The transmission time on surface for each cycle is also monitored (right).

- The **surface transmission time** (defined as the time difference between first and last transmitted float messages assigned to the cycle) is plotted to monitor potential variations across float life.

- The **data transmission quality (ARGOS only)** can be assessed by the ratio between the number of messages received and the number of these messages that pass the CRC (cyclic redundancy check). It gives an indication on the presence of electronic noise for ARGOS transmission.

- The **satellite coverage** (number of messages received per time unit) will also be monitored for ARGOS.

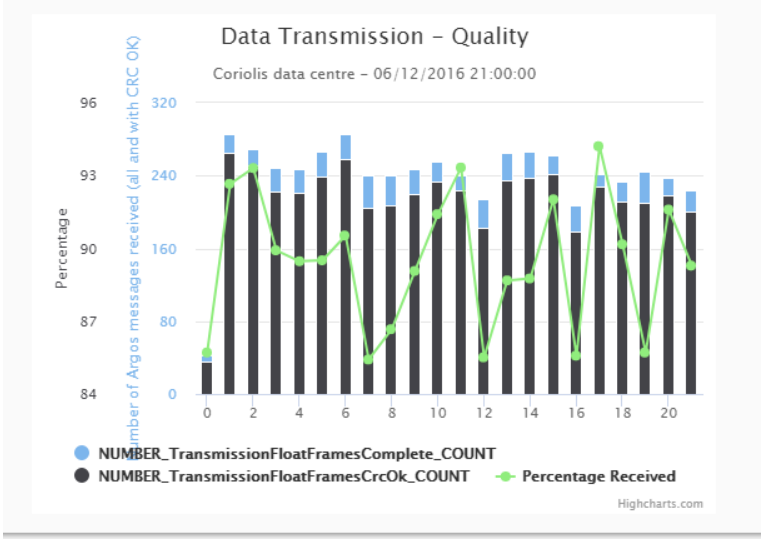


Figure 19: Float webpage – technical parameters tab for data transmission. Example for a MOCCA Argos transmission with the ratio between the number of received messages and the number of received messages that have a good CRC.

Positioning

Information on **GPS performances** (so only for floats equipped with it, e.g. MOCCA Arvor iridium) will be collected: the time required to obtain a GPS fix and the validity of this fix.

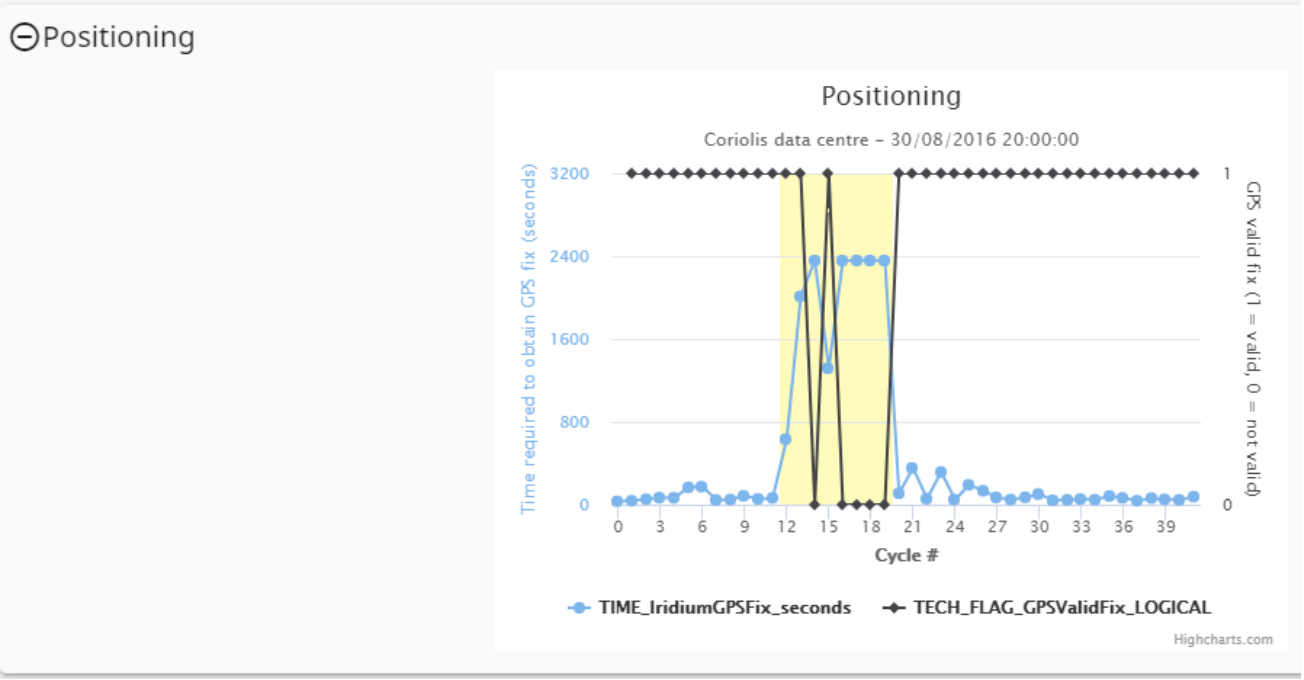


Figure 20: Float webpage– technical parameters tab for GPS positioning.

Alerts

Alerts are defined by the technical team monitoring the floats, based on thresholds, trends etc. on one or combination of these technical parameters. This will be further detailed in section 4 of the document.

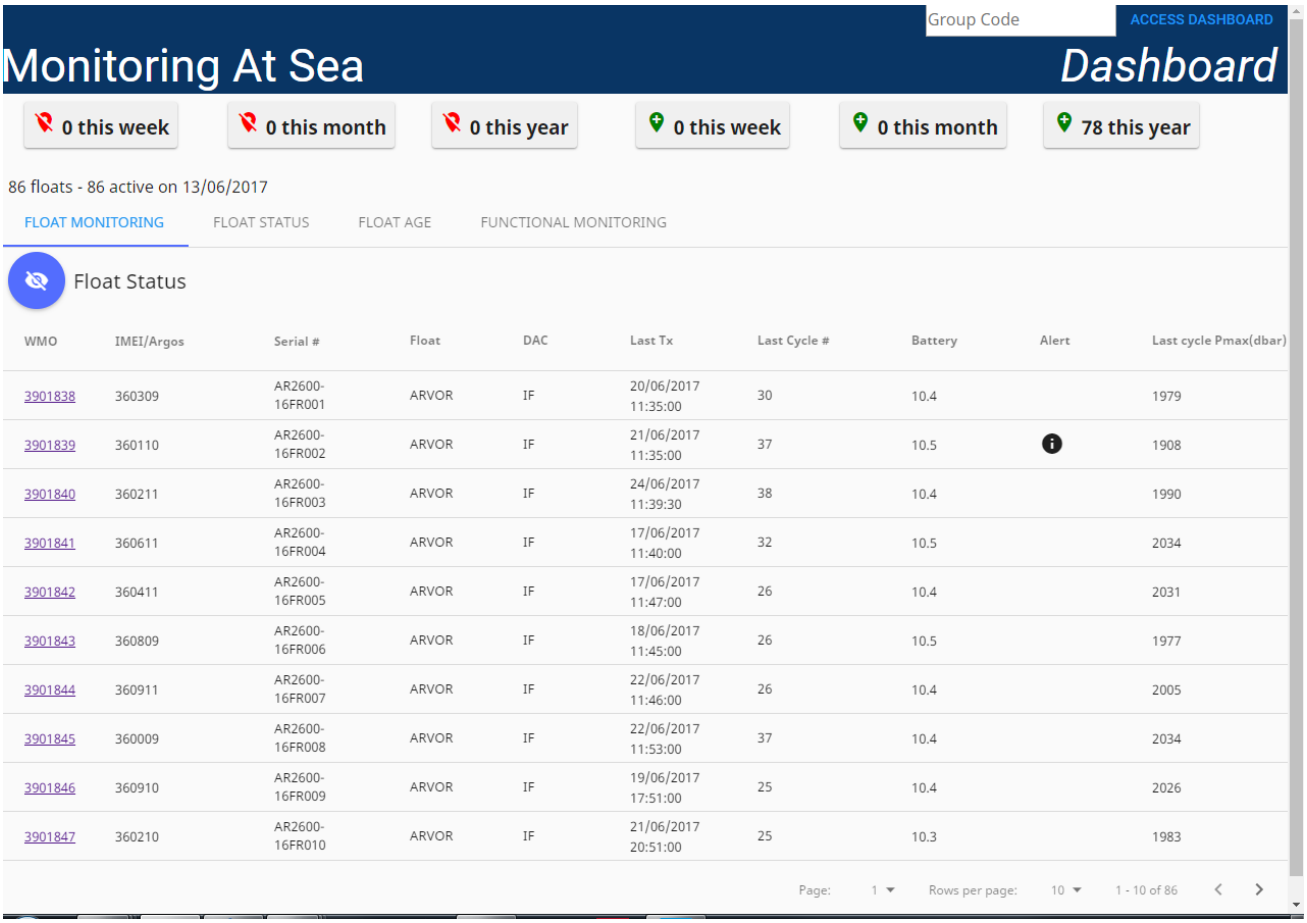
3.2. Access dashboard

The other part of the Coriolis website concerns the monitoring of a fleet, i.e. a group of floats. Currently a fleet is identified by its "group code", which in Coriolis database regroups a list of floats identified by their WMO number.

The group code of MOCCA fleet (130 NKE Arvor iridium and 20 NKE Arvor Argos) is 632.

3.2.1. Active floats table

The first tab of the dashboard is a **listing of all active floats** in a specific group code. A link to each individual float webpage (see section 3.1) is provided. **Basic float information** (serial number, transmission identification, float version, data centre) and **key information of the last cycle decoded** is presented. Column fields can be user-selected.



WMO	IMEI/Argos	Serial #	Float	DAC	Last Tx	Last Cycle #	Battery	Alert	Last cycle Pmax(dbar)
3901838	360309	AR2600-16FR001	ARVOR	IF	20/06/2017 11:35:00	30	10.4		1979
3901839	360110	AR2600-16FR002	ARVOR	IF	21/06/2017 11:35:00	37	10.5		1908
3901840	360211	AR2600-16FR003	ARVOR	IF	24/06/2017 11:39:30	38	10.4		1990
3901841	360611	AR2600-16FR004	ARVOR	IF	17/06/2017 11:40:00	32	10.5		2034
3901842	360411	AR2600-16FR005	ARVOR	IF	17/06/2017 11:47:00	26	10.4		2031
3901843	360809	AR2600-16FR006	ARVOR	IF	18/06/2017 11:45:00	26	10.5		1977
3901844	360911	AR2600-16FR007	ARVOR	IF	22/06/2017 11:46:00	26	10.4		2005
3901845	360009	AR2600-16FR008	ARVOR	IF	22/06/2017 11:53:00	37	10.4		2034
3901846	360910	AR2600-16FR009	ARVOR	IF	19/06/2017 17:51:00	25	10.4		2026
3901847	360210	AR2600-16FR010	ARVOR	IF	21/06/2017 20:51:00	25	10.3		1983

Page: 1 Rows per page: 10 1 - 10 of 86

Figure 21: Fleet dashboard – listing

These key parameters have been defined by the deployment team and from the answers to the questionnaire issued in 2016:

- date, time and number of the last cycle decoded
- battery voltage
- maximum pressure of the last profile
- grounding flag for the last cycle
- alert flags for the last cycle

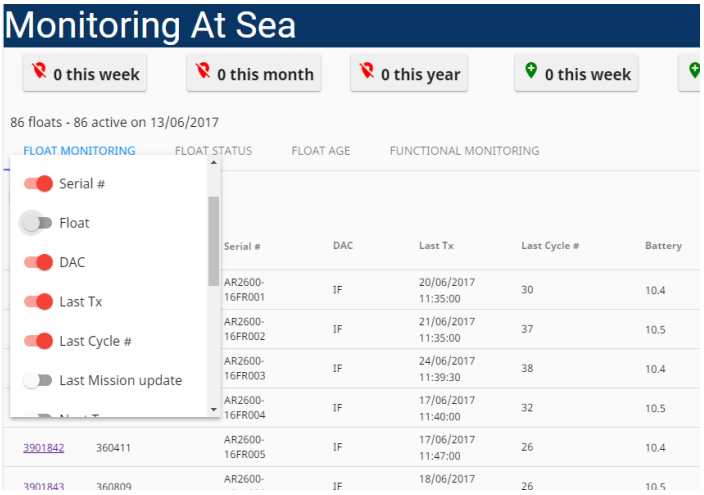


Figure 22: Fleet dashboard – listing: selection of column fields

One can sort the floats by any column, allowing to see the floats that have low battery voltages or that grounded during last cycle. Some alerts have been defined on key parameters. The float row is then coloured in red (alert) or orange (warning), or an info mark is displayed.

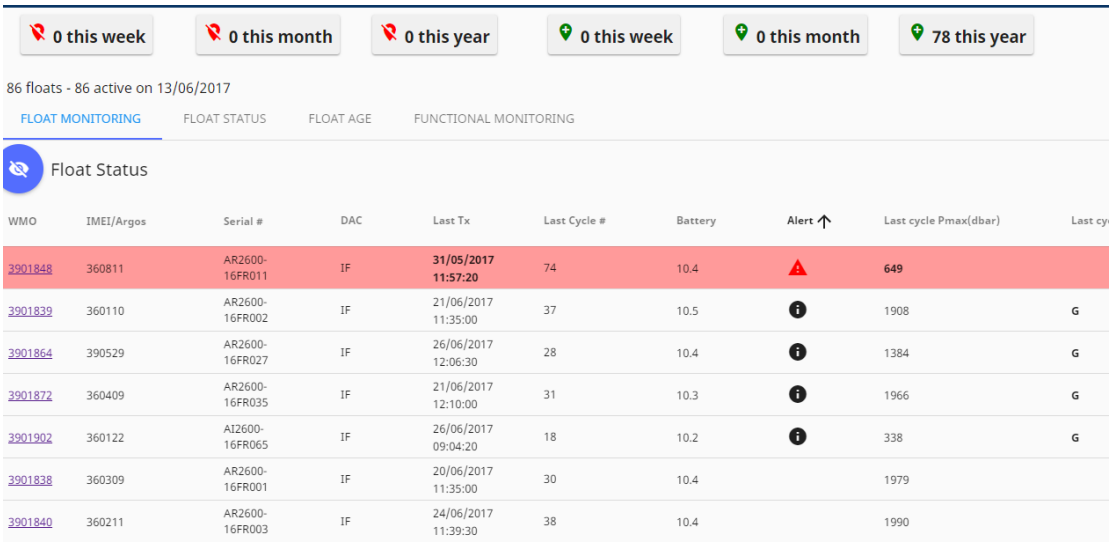


Figure 23: Fleet dashboard – listing with alerts

Specification of alerts in the dashboard listing

- Row coloured with the colour of the most serious alert,
- Bold font for the fields that trigged the alerts,
- For a complete description of the alerts, see section 4.

Basically, an **alert** is triggered if the float has no decoded data since more than its cycle period (i.e. the float is not on surface as expected), or the battery is usually low, or the float is in end-of-life mode.

A **warning** is trigged if the float has not reached its target profile pressure or is declared as grounded but it is doubtful given the bathymetry in the area.

An **info** is trigged if the float was grounded.

Field	Alert (colour red)	Warning (colour orange)	Info (no colour)
Last Tx	If **FLAG_MissingVerticalProfile_LOGICAL = 1**		
Last cycle Pmax (dbar)		If **FLAG_ProfileMaxPressureAnomaly_LOGICAL = 1**	
Last cycle minV (volts)	If **FLAG_VoltageDrop_LOGICAL = 1**		
End of life	EOL		
Last cycle grounded		G (grounded) if **FLAG_Traj-Grounded_LOGICAL = 1 & FLAG_FalseGrounding_LOGICAL = 1**	G (grounded) if **FLAG_Traj-Grounded_LOGICAL = 1**

Table 1: Specification of alerts in the dashboard listing. See flags description is section 4 of the document.

This table allows the day-to-day monitoring of a fleet, with possible major alerts encountered.

3.2.2. All floats table

This table is an index of all floats present in the fleet. It gather main metadata (identification, last transmission date, launch date, DAC etc.) and the status (active in green, dead in red) of each float:

Figure 24: Fleet index table with basic metadata and active/dead status.

3.2.3. Dead and deployed floats

The top banner of the page presents the number of dead (in red) or deployed (in green) floats within the fleet during last week, month and year. The WMO numbers of the concerned floats (and link to individual float page) is provided on mouse-over.

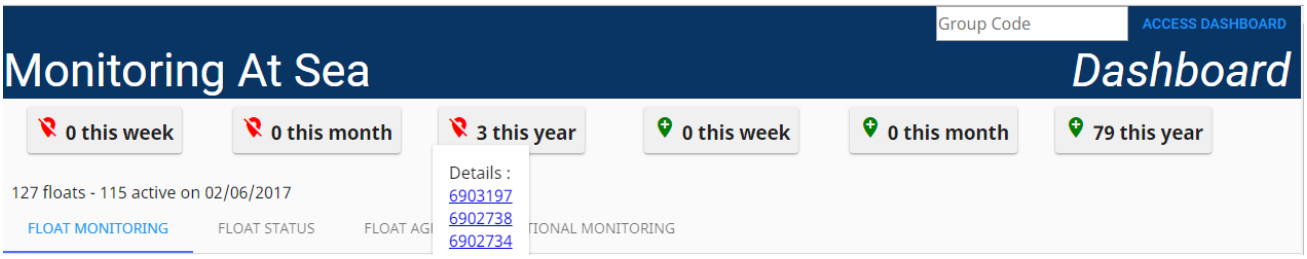


Figure 25: Fleet dashboard – number of deployed and dead floats in a timeline.

3.2.4. Fleet status

The status page is presenting the percentage of active and inactive floats within the fleet.

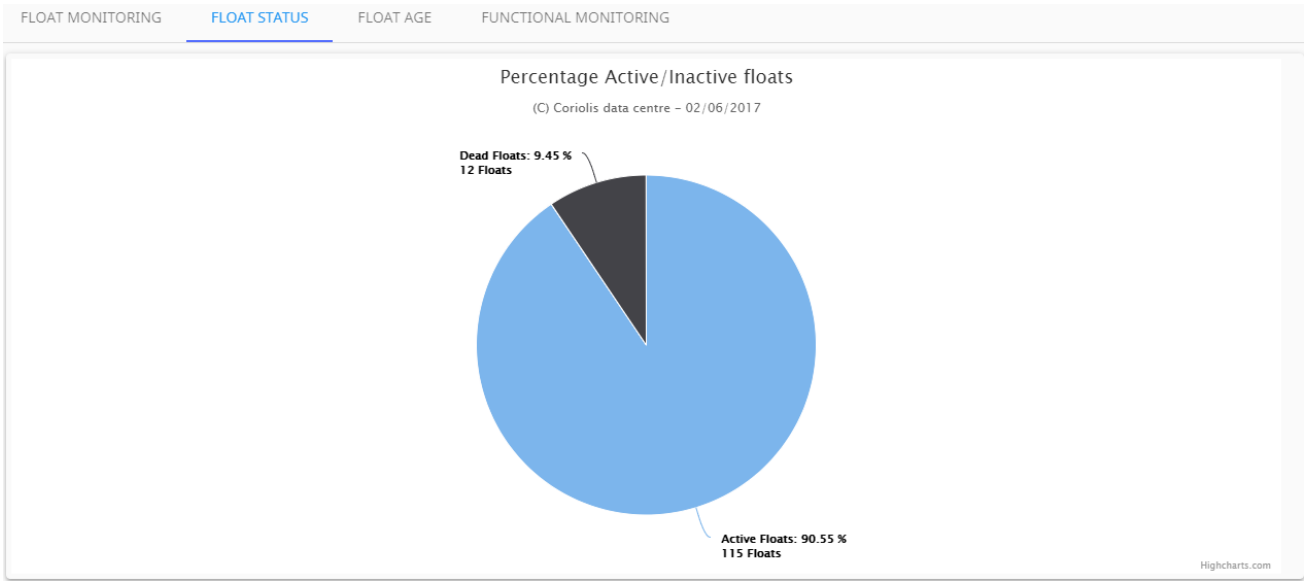


Figure 26: Fleet dashboard – status

The JCOMMOPS/AIC website if offering a lot of general statistics so this tab will not be much more developed to avoid the duplication of information.

Desirable evolutions in December 2017 or 2018:

- ➔ Small table with basic statistics: number of performed profiles, float with maximum number of profiles
- ➔ Pie chart with composition of the fleet by float type or version or satellite transmission etc.

3.2.5. Fleet age

The age tab is presenting a histogram of the number of floats that achieved a certain amount of cycles. Dead (in red) and active (in green) floats are distinguished.

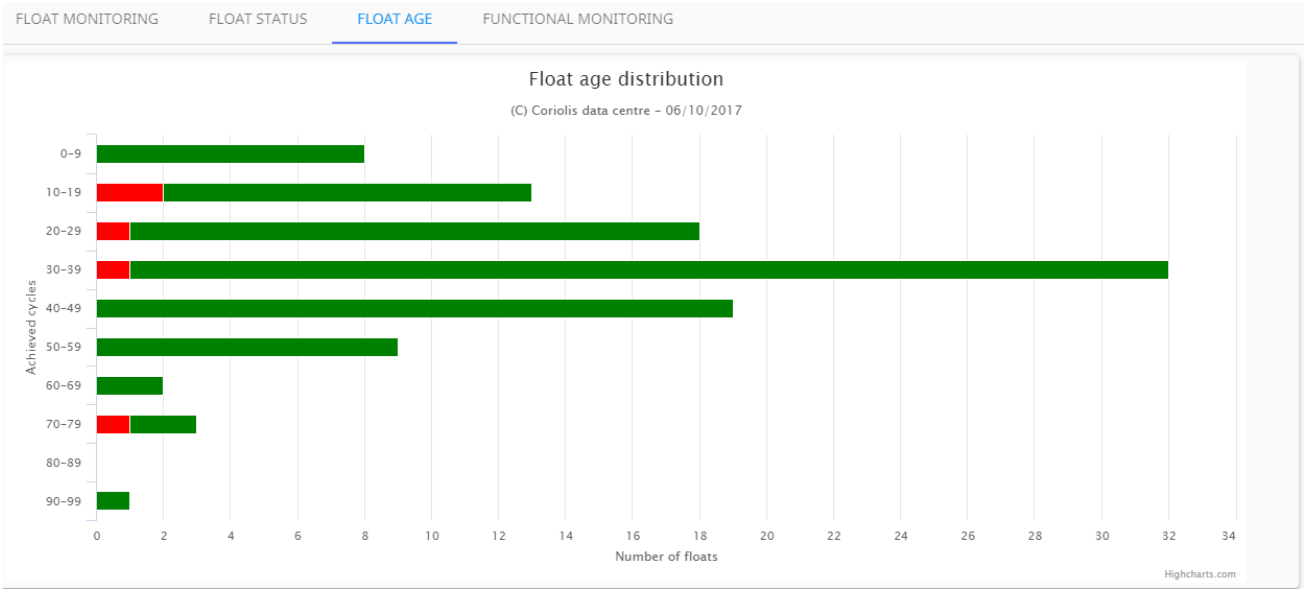


Figure 27: Fleet dashboard – age distribution

The percentage of floats that achieved a certain amount of cycles is presented in the following graph. Active (green) and dead (red) floats are presented in two curves, together with the total (all).

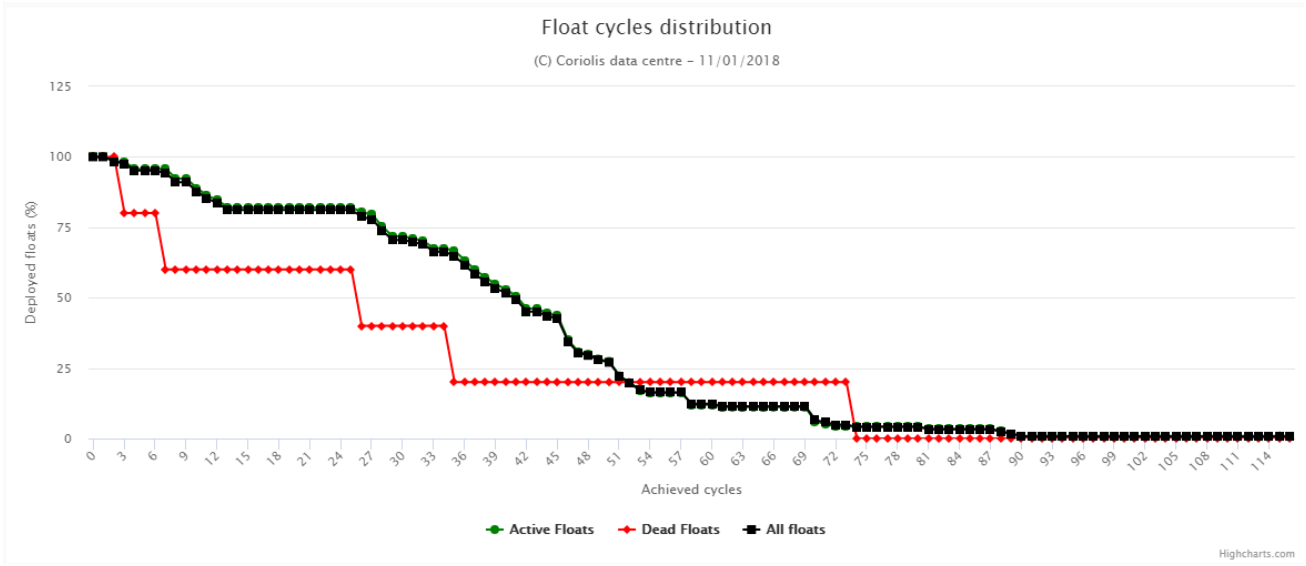


Figure 28: Fleet dashboard – cycle distribution

Then we have the distribution of floats according to length classes. Each length class represents the vertical distances of all profiles measured by the float.

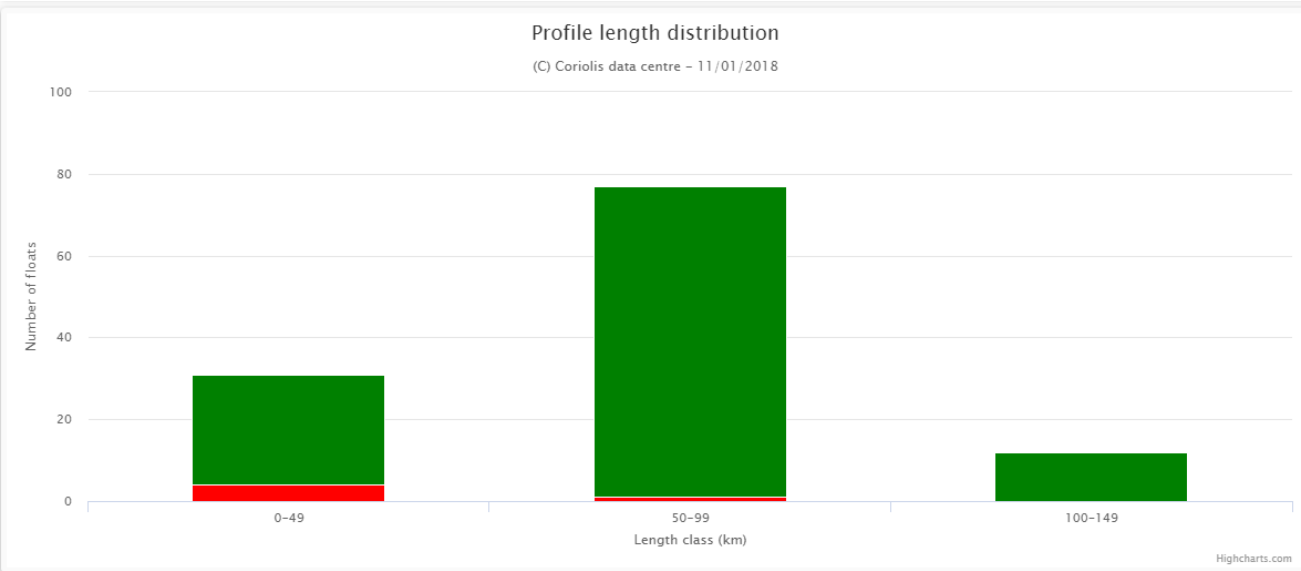
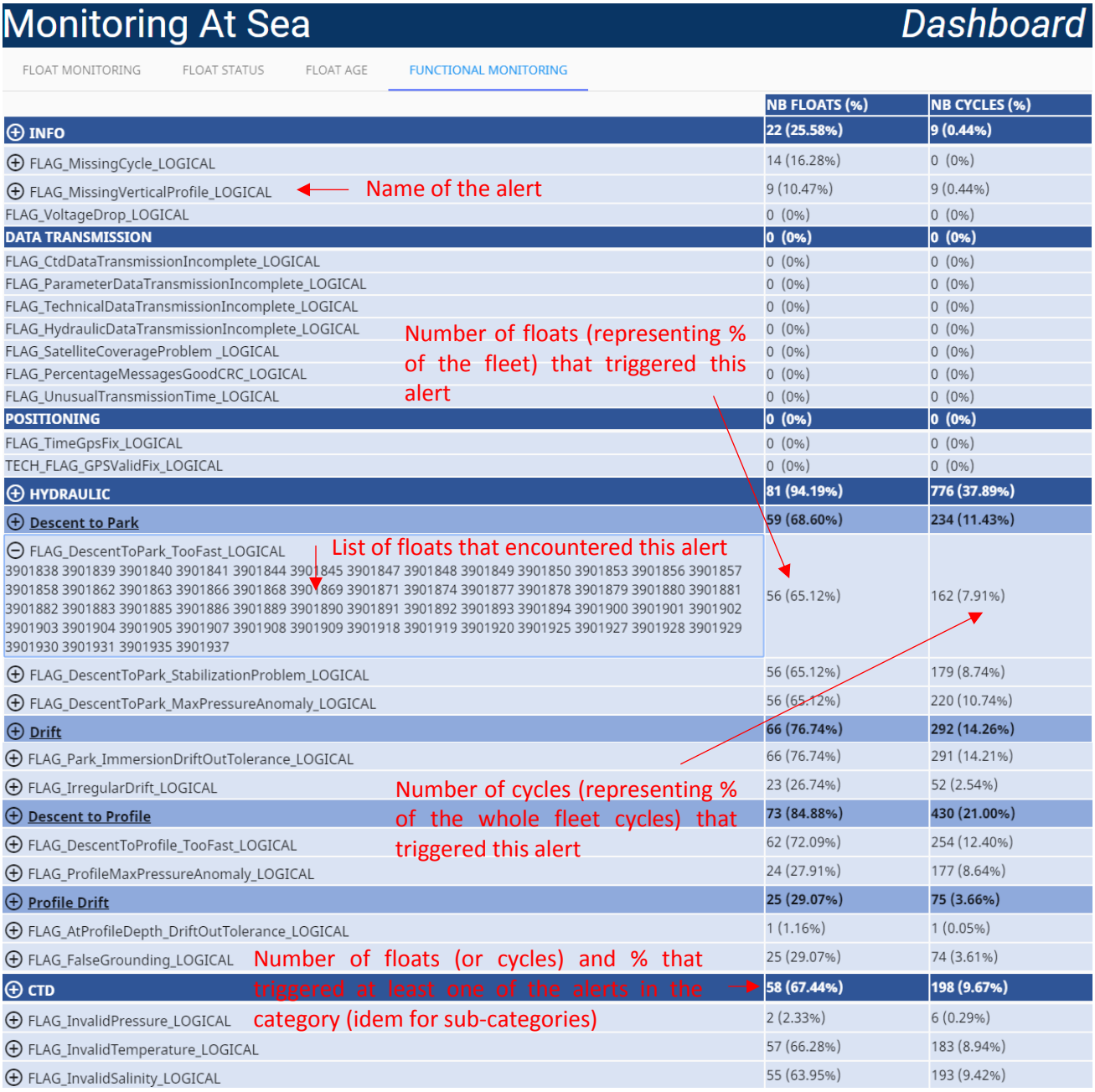


Figure 29: Fleet dashboard - Profile length distribution

3.2.6. Functional monitoring

This tab is designed for **monitoring the set of floats according to predefined alerts**. First at **table** is summarizing all alerts encountered within the fleet, sorted by categories and sub-categories. These alerts are the ones that were also visible on the technical graphs (yellow background) of a float webpage (see section 3.1.3). It concerns hydraulic behaviour of the float, data transmission, positioning or CTD flags. Alerts are **divided in categories**, and for hydraulic in sub-categories according to different float cycle phases.

In this table on can click on the alert name to see the WMO numbers (and link to float webpage) of the floats that are subjected to the alert. There is also a **counter** that gives the **number of floats** (within the fleet) and associated percentage that presented the alert. The counter gives also the **number of cycles** and **percentage** within the fleet that are subjected to the alert.



	NB FLOATS (%)	NB CYCLES (%)
⊕ INFO	22 (25.58%)	9 (0.44%)
⊕ FLAG_MissingCycle_LOGICAL	14 (16.28%)	0 (0%)
⊕ FLAG_MissingVerticalProfile_LOGICAL	9 (10.47%)	9 (0.44%)
FLAG_VoltageDrop_LOGICAL	0 (0%)	0 (0%)
DATA TRANSMISSION	0 (0%)	0 (0%)
FLAG_CtdDataTransmissionIncomplete_LOGICAL	0 (0%)	0 (0%)
FLAG_ParameterDataTransmissionIncomplete_LOGICAL	0 (0%)	0 (0%)
FLAG_TechnicalDataTransmissionIncomplete_LOGICAL	0 (0%)	0 (0%)
FLAG_HydraulicDataTransmissionIncomplete_LOGICAL	0 (0%)	0 (0%)
FLAG_SatelliteCoverageProblem _LOGICAL	0 (0%)	0 (0%)
FLAG_PercentageMessagesGoodCRC_LOGICAL	0 (0%)	0 (0%)
FLAG_UnusualTransmissionTime_LOGICAL	0 (0%)	0 (0%)
POSITIONING	0 (0%)	0 (0%)
FLAG_TimeGpsFix_LOGICAL	0 (0%)	0 (0%)
TECH_FLAG_GPSValidFix_LOGICAL	0 (0%)	0 (0%)
⊕ HYDRAULIC	81 (94.19%)	776 (37.89%)
⊕ Descent to Park	59 (68.60%)	234 (11.43%)
⊖ FLAG_DescentToPark_TooFast_LOGICAL 3901838 3901839 3901840 3901841 3901844 3901845 3901847 3901848 3901849 3901850 3901853 3901856 3901857 3901858 3901862 3901863 3901866 3901868 3901869 3901871 3901874 3901877 3901878 3901879 3901880 3901881 3901882 3901883 3901885 3901886 3901889 3901890 3901891 3901892 3901893 3901894 3901900 3901901 3901902 3901903 3901904 3901905 3901907 3901908 3901909 3901918 3901919 3901920 3901925 3901927 3901928 3901929 3901930 3901931 3901935 3901937	56 (65.12%)	162 (7.91%)
⊕ FLAG_DescentToPark_StabilizationProblem_LOGICAL	56 (65.12%)	179 (8.74%)
⊕ FLAG_DescentToPark_MaxPressureAnomaly_LOGICAL	56 (65.12%)	220 (10.74%)
⊕ Drift	66 (76.74%)	292 (14.26%)
⊕ FLAG_Park_ImmersionDriftOutTolerance_LOGICAL	66 (76.74%)	291 (14.21%)
⊕ FLAG_IrregularDrift_LOGICAL	23 (26.74%)	52 (2.54%)
⊕ Descent to Profile	73 (84.88%)	430 (21.00%)
⊕ FLAG_DescentToProfile_TooFast_LOGICAL	62 (72.09%)	254 (12.40%)
⊕ FLAG_ProfileMaxPressureAnomaly_LOGICAL	24 (27.91%)	177 (8.64%)
⊕ Profile Drift	25 (29.07%)	75 (3.66%)
⊕ FLAG_AtProfileDepth_DriftOutTolerance_LOGICAL	1 (1.16%)	1 (0.05%)
⊕ FLAG_FalseGrounding_LOGICAL	25 (29.07%)	74 (3.61%)
⊕ CTD	58 (67.44%)	198 (9.67%)
⊕ FLAG_InvalidPressure_LOGICAL	2 (2.33%)	6 (0.29%)
⊕ FLAG_InvalidTemperature_LOGICAL	57 (66.28%)	183 (8.94%)
⊕ FLAG_InvalidSalinity_LOGICAL	55 (63.95%)	193 (9.42%)

Figure 30: Fleet dashboard – functional monitoring table

Below the table a **Gantt-like chart displays a synoptic view of the alerts for the whole fleet**. The y-axis represents the WMO float number and the x-axis the cycle numbers. A **colour-coded round indicates if the float triggered one or several alerts for a specific cycle**. The platform number, cycle number and names of triggered alerts are displayed on mouse-over.

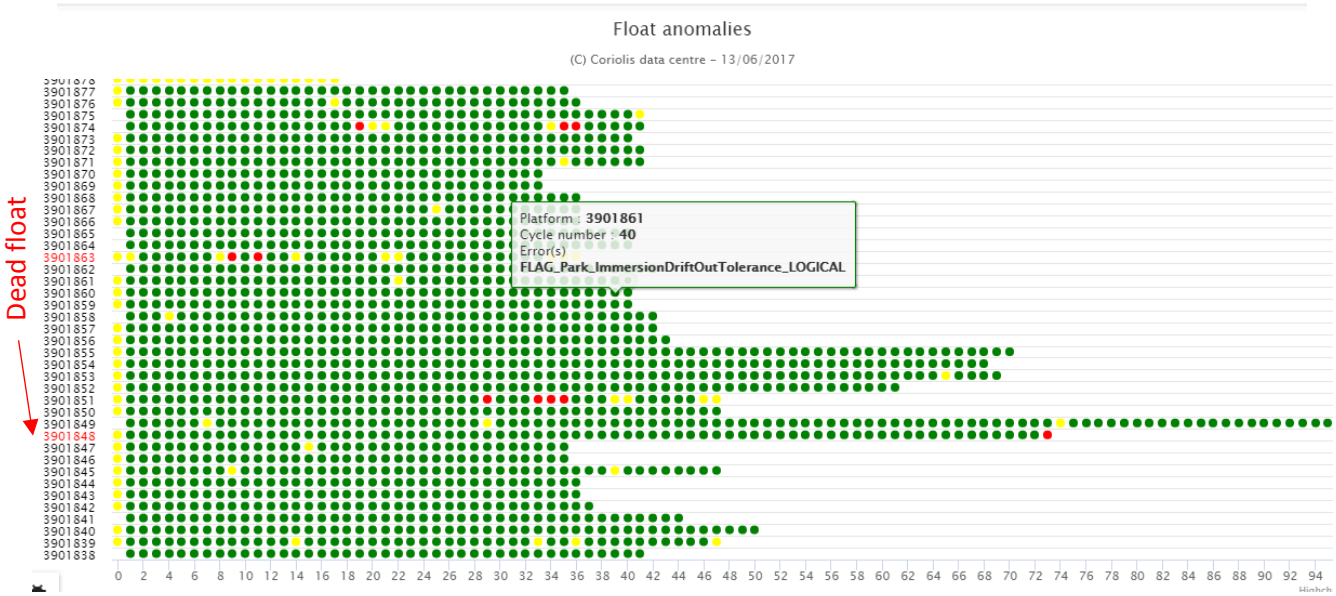


Figure 31: Fleet dashboard – Gantt chart with main alerts.

The following colours are applied to the round, depending on the gravity of the alerts:

- Green: no or minor alerts triggered
- Yellow: “warning” triggered
- Red: “alert” triggered

In case there are several alerts, the round is in the colour of the most “serious” alert. The name, description and type of every predefined alert is described in the next section.

NOTE: following the presentation of the tool to partners in July 2017 and taking into account feedbacks, the Gantt chart is now only presenting major alerts for better readability.

4. TECHNICAL ALERTS

4.1. Summary

The following table summarizes the alerts defined for the Coriolis at sea monitoring website. Alerts are sorted by categories and sub-categories. They have been specifically designed for the MOCCA fleet but some could be used to other float versions.

Alert name	Description	Alert Warning Info
INFO		
FLAG_MissingCycle_LOGICAL	*A cycle is missing*	Alert
FLAG_MissingVerticalProfile_LOGICAL	*Float ascent time was later than expected*	Alert
FLAG_VoltageDrop_LOGICAL	*The float experienced a voltage drop*	Alert
DATA TRANSMISSION		
FLAG_CtdDataTransmissionIncomplete_LOGICAL	*All CTD data have not been received*	Warning
FLAG_ParameterDataTransmissionIncomplete_LOGICAL	*All parameter messages have not been received*	Warning
FLAG_TechnicalDataTransmissionIncomplete_LOGICAL	*All technical messages have not been received*	Warning
FLAG_HydraulicDataTransmissionIncomplete_LOGICAL	*All hydraulic data have not been received*	Warning
FLAG_SatelliteCoverageProblem _LOGICAL	*Jump in number of Argos messages received per time span*	Warning
FLAG_ PercentageMessagesGoodCRC_LOGICAL	*Percentage of Argos messages received with good CRC is less than a threshold*	Warning
FLAG_UnusualTransmissionTime_LOGICAL	*Transmission time more than a threshold or with sudden jump*	Warning
POSITIONING		
FLAG_ TimeGpsFix_LOGICAL	*Time required to obtain a GPS fix is more than a threshold*	Warning
TECH_FLAG_GPSValidFix_LOGICAL	*No GPS valid fix*	Alert
HYDRAULIC		
Descent to Park		
FLAG_DescentToPark_TooFast_LOGICAL	*The float started the pump (more than a threshold) during its descent*	Warning
FLAG_DescentToPark_StabilizationProblem_LOGICAL	*The float experienced a stabilization defect during this phase*	Warning
FLAG_DescentToPark_MaxPressureAnomaly_LOGICAL	*The float did not reach the target park pressure*	Warning
Drift		
FLAG_Park_ImmersionDriftOutTolerance_LOGICAL	*The float measured out of the target pressure ranges for this phase*	Warning
FLAG_IrregularDrift_LOGICAL	*The float repositioned itself during this phase (more than a threshold)*	Warning
Descent to Profile		
FLAG_DescentToProfile_TooFast_LOGICAL	*The float started the pump (more than a threshold) during its descent*	Warning
FLAG_ProfileMaxPressureAnomaly_LOGICAL	*The float did not reach the target profile pressure*	Warning

	Profile drift	
FLAG_AtProfileDepth_DriftOutTolerance_LOGICAL	*The float repositioned itself during this phase (more than a threshold)*	Warning
FLAG_FalseGrounding_LOGICAL	*The float detected a grounding which is suspicious given the bathymetry in the area (more than a threshold)*	Warning
	CTD	
FLAG_InvalidPressure_LOGICAL	*The percentage of good pressure values in the profile in less than a threshold*	Info
FLAG_InvalidTemperature_LOGICAL	*The percentage of good temperature values in the profile in less than a threshold*	Info
FLAG_InvalidSalinity_LOGICAL	*The percentage of good salinity values in the profile in less than a threshold*	Info

Table 2: Description of alerts for MOCCA at sea monitoring.

These alerts are used in the functional monitoring tab of the dashboard (see section 3.2.6), with the alert table counters, and in the Gantt-like chart with colour-coded rounds for each specific cycle of a float. They are also used in the technical graphs of a float webpage (see section 3.1.3), with a **yellow/red background displayed in the graph corresponding to the alert definition**, when possible.

4.2. Configuration file for alerts

The alerts defined above are computed based on technical parameters of Argo float data, on external parameters such as bathymetry, or on data produced by the Coriolis DAC. They are **stored in the Coriolis database** alongside the technical data of each float.

Some of the alerts are trigged based on a threshold or are using an input parameter. In order to allow flexibility in the computation of alerts, Coriolis at sea monitoring is using a **configuration file** that can be modified easily. Each threshold or input needed in the computation of an alert can be **edited for a specific float type and specific decoder version** (Coriolis data centre info). For instance, MOCCA Argos floats (PROVOR_4.52) may have **different thresholds** than MOCCA iridium floats (PROVOR_5.43) or APEX etc. There is always a default value. These can be enhanced with inputs from float type experts within Euro-Argo.

Here is an example of the configuration file (ASCII text file) for some alerts:

```
#* FLAG_DescentToPark_TooFast_LOGICAL
our %NUMBER_PUMP_ACTIONS_DURING_DESCENT_TO_PARK_LIMIT =(
#                       "PROVOR_4.52" =>2,
#                       "PROVOR_5.43" =>2,
#                       "PROVOR_5.44" =>2,
                        "default" =>2);

#* FLAG_DescentToPark_StabilizationProblem_LOGICAL
our %NUMBER_DESCENT_TO_PARK_ENTRIES_IN_PARK_MARGIN_LIMIT  =(
#                       "PROVOR_4.52" =>3,
#                       "PROVOR_5.43" =>3,
#                       "PROVOR_5.44" =>3,
                        "default" =>3);

#* FLAG_DescentToPark_MaxPressureAnomaly_LOGICAL

#*FLAG_TechnicalDataTransmissionIncomplete_LOGICAL
our %FLOAT_VERSION_TECHNICAL_DATA_TRANSMISSION  =
("PROVOR_4.52"
=>["TECH_NUMBER_TechnicalMessage1Received_COUNT","TECH_NUMBER_TechnicalMessage2Received_COUNT"]),
("PROVOR_5.33"
=>["TECH_NUMBER_TechnicalMessage1Received_COUNT","TECH_NUMBER_TechnicalMessage2Received_COUNT"]),
("PROVOR_5.34"
=>["TECH_NUMBER_TechnicalMessage1Received_COUNT","TECH_NUMBER_TechnicalMessage2Received_COUNT"]);
```

4.3. Example of alerts triggered for MOCCA floats

We detailed below some examples of alerts triggered for the MOCCA fleet. It is more understandable to see the alerts on the respective technical graph of the float webpage.

FLAG_MissingCycle_LOGICAL
A red background is present on all graphs for cycle 19 since the float skip this cycle: it was under ice.

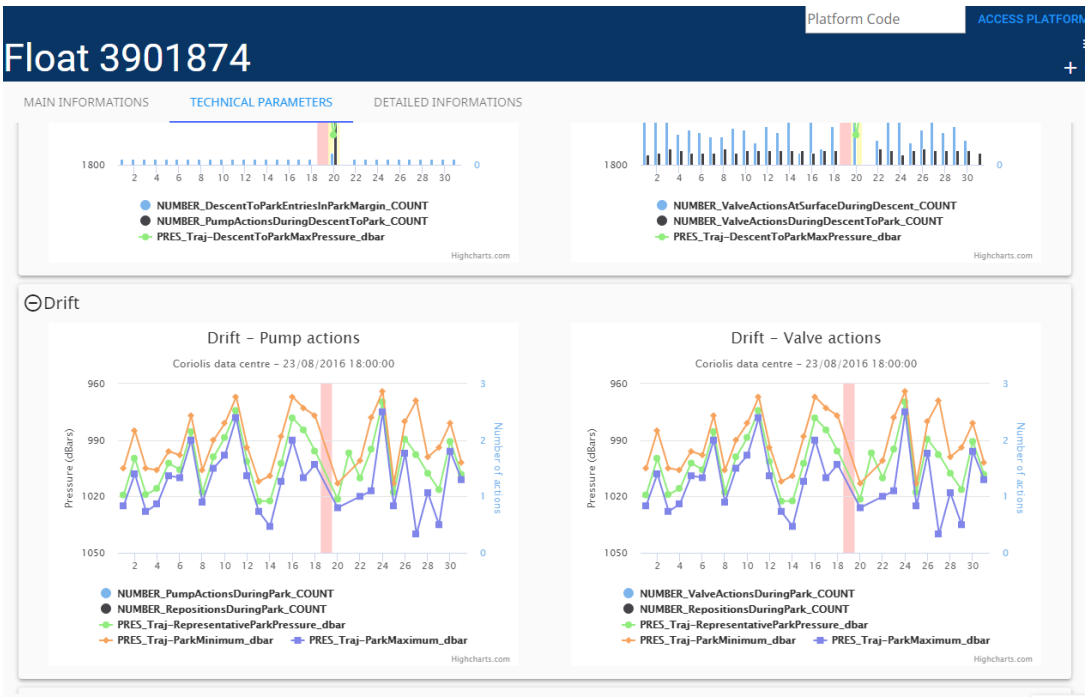


Figure 32: FLAG_MissingCycle_LOGICAL alert.

FLAG_MissingVerticalProfile_LOGICAL
This alert is visible in the dashboard with a red row. The float has no decoded data since 31/05/2017. This float is considered as dead.

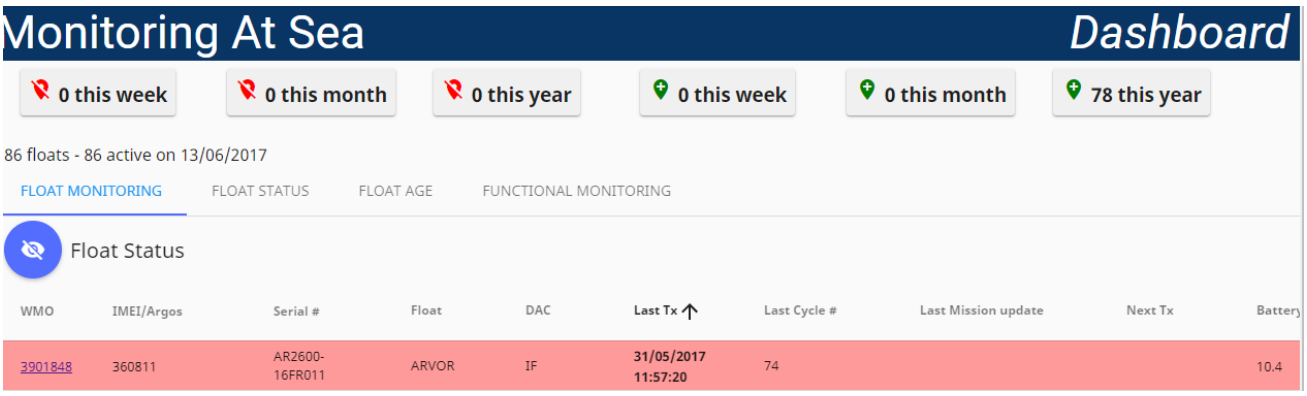


Figure 33: FLAG_MissingVerticalProfile_LOGICAL alert.

FLAG_VoltageDrop_LOGICAL
This alert will be visible in the dashboard status table and on the battery voltage graph of the concerned floats. We do not have example for now.

FLAG_DescentToPark_TooFast_LOGICAL
This alert is triggered when the float performs more than 1 (user selectable) pump actions during the descent to park phase. It means that the float sunk too fast.

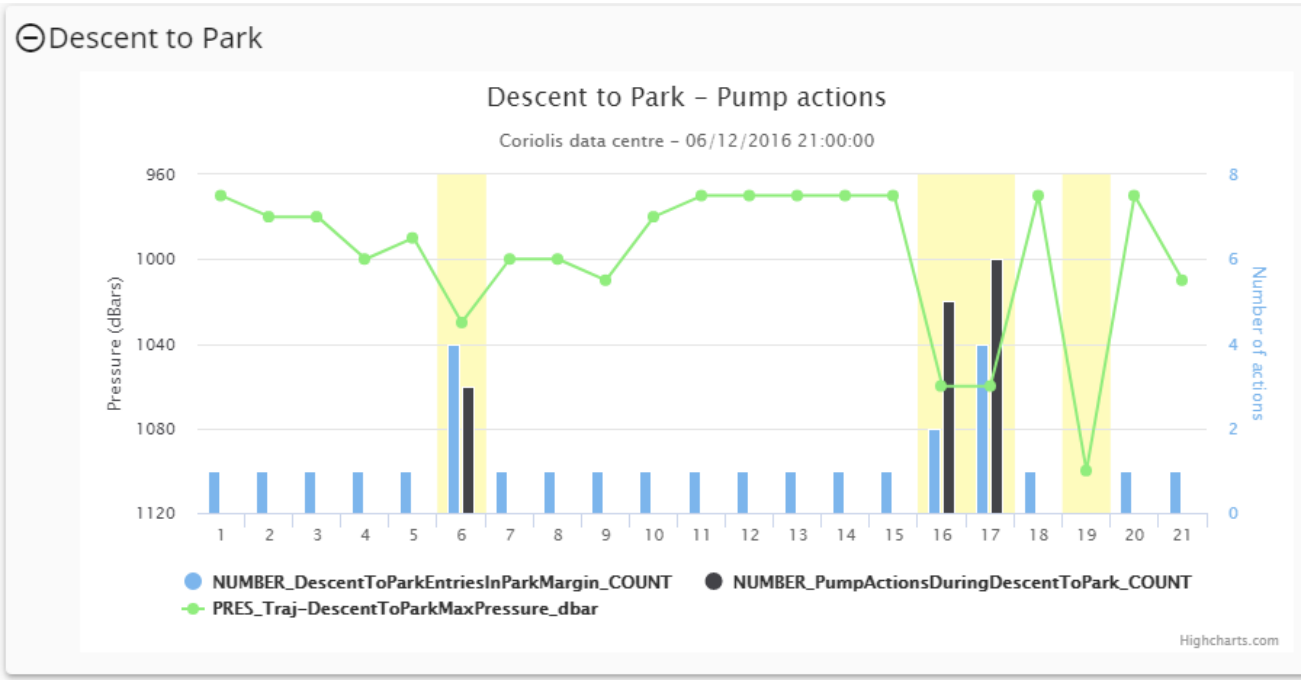


Figure 34: FLAG_DescentToPark_TooFast_LOGICAL, FLAG_DescentToPark_StabilizationProblem_LOGICAL and FLAG_DescentToPark_MaxPressureAnomaly_LOGICAL alerts.

FLAG_DescentToPark_StabilizationProblem_LOGICAL
This alert is quite similar to FLAG_DescentToPark_TooFast_LOGICAL, but is using the number of entries in park margin given by the float. It reflects a default of stabilization at the end of its descent to park pressure.

FLAG_DescentToPark_MaxPressureAnomaly_LOGICAL
This alert is not using the technical messages of the float but the maximum depth of the trajectory data for the descent to park phase. This depth must be in the range of the target park pressure (usually 1000 m) +/- 30 dbar (technical threshold of the float). One can see that it is triggered at cycle 19 in Figure 34.

FLAG_Park_ImmersionDriftOutTolerance_LOGICAL
This alert is visible in the 2 graphs of the drift phase. It is triggered when the minimum or maximum park pressure of the trajectory data is not within the range of the target park pressure (usually 1000m) +/- 50 dbar (technical threshold of the float).

FLAG_IrregularDrift_LOGICAL
This alert is triggered when the float performs more than 1 (user selectable) repositioning during the drift phase. One can see on Figure 35 that the float started the pump and valve on cycle 12, and only the pump on cycles 2 and 5 (because the float was too deep).

Figure 35: FLAG_Park_ImmersionDriftOutTolerance_LOGICAL and FLAG_IrregularDrift_LOGICAL alerts.

FLAG_DescentToProfile_TooFast_LOGICAL

This alert is visible when the float started the pump during the descent to profile pressure. It means the descent was too fast. This alert is triggered several times on the left graph of Figure 36.

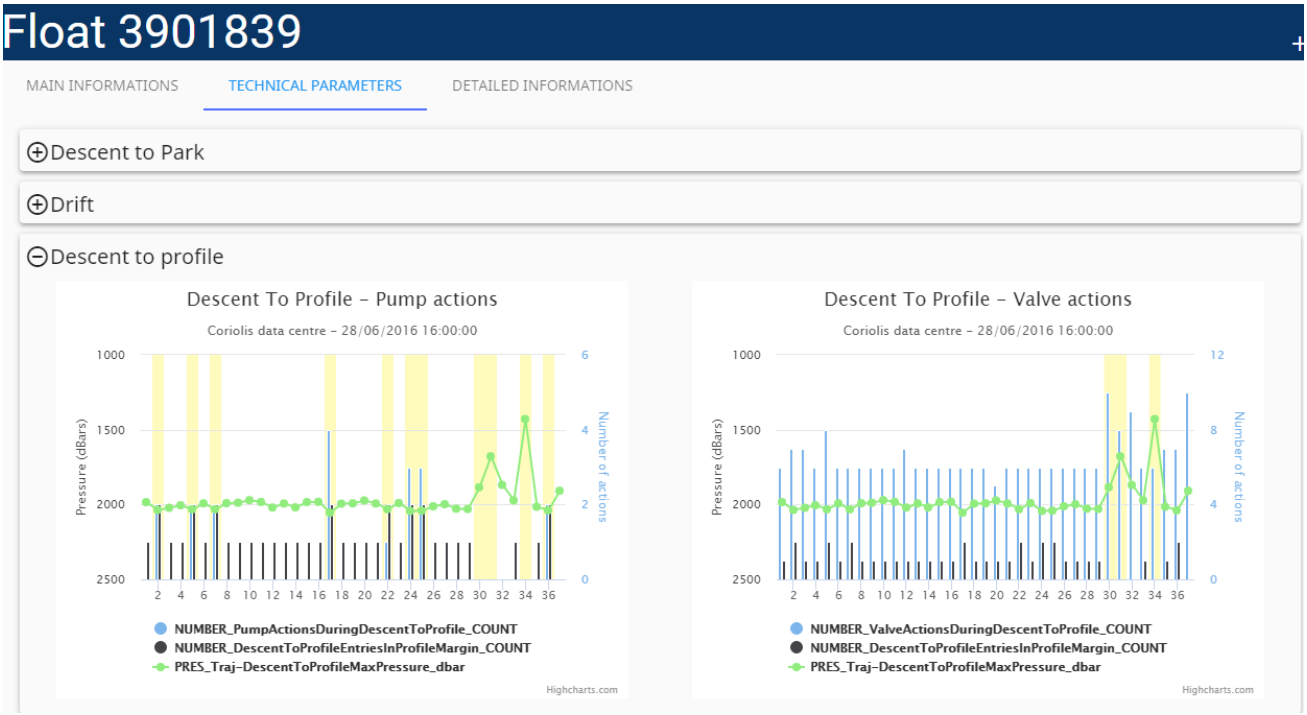


Figure 36: FLAG_DescentToProfile_TooFast_LOGICAL and FLAG_ProfileMaxPressureAnomaly_LOGICAL alerts.

FLAG_ProfileMaxPressureAnomaly_LOGICAL

The alert is triggered when the maximum pressure of the descent to profile trajectory data is not within the range of the target profile pressure (usually 2000 m) +/- 30 dbar (technical threshold of the float). It is visible on the 2 graphs of Figure 36 for cycles 31 and 34.

FLAG_AtProfileDepth_DriftOutTolerance_LOGICAL

The alert is triggered when the float performed depth corrections during the profile drift, waiting for ascent.

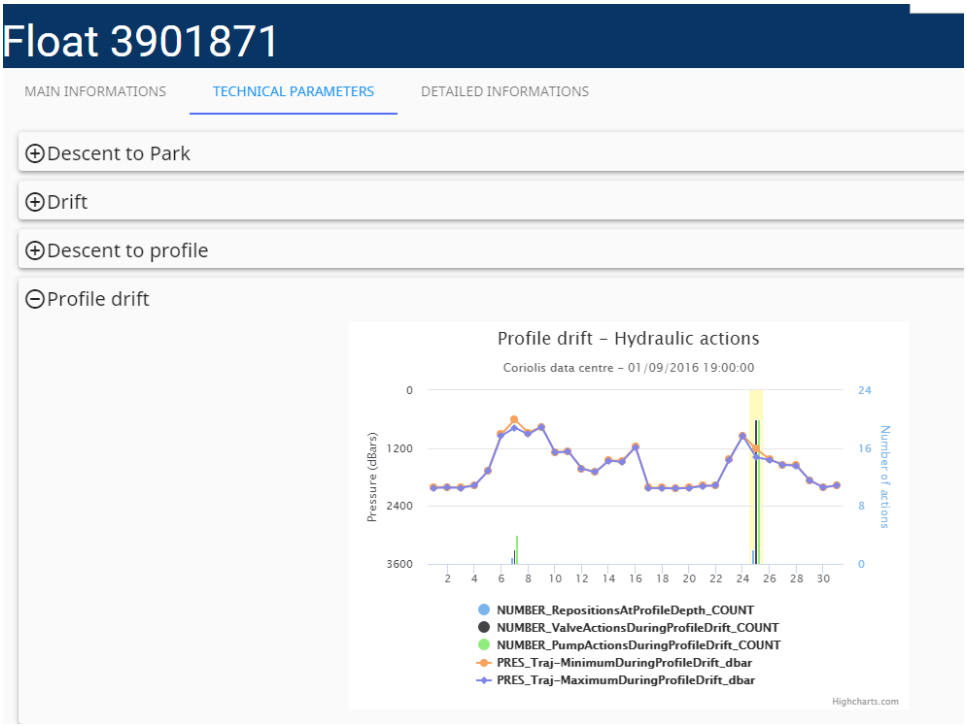


Figure 37: FLAG_AtProfileDepth_DriftOutTolerance_LOGICAL alert.

FLAG_FalseGrounding_LOGICAL

The alert false grounding concerns cycles where the float declares itself (in the technical message) as grounded, but bathymetry in the area is deeper that the maximum pressure of the profile trajectory data. A threshold of 100 m is taken but is probably too low given the poor accuracy of the bathymetry file and the approximation of the geographic position of the float when drifting. It will be raised to 300 m.

Moreover, the label "**Grounded" is placed under the maximum pressure data of each float phase if the float declared itself as grounded during this particular phase**. The label is red in case alert false grounding is raised.

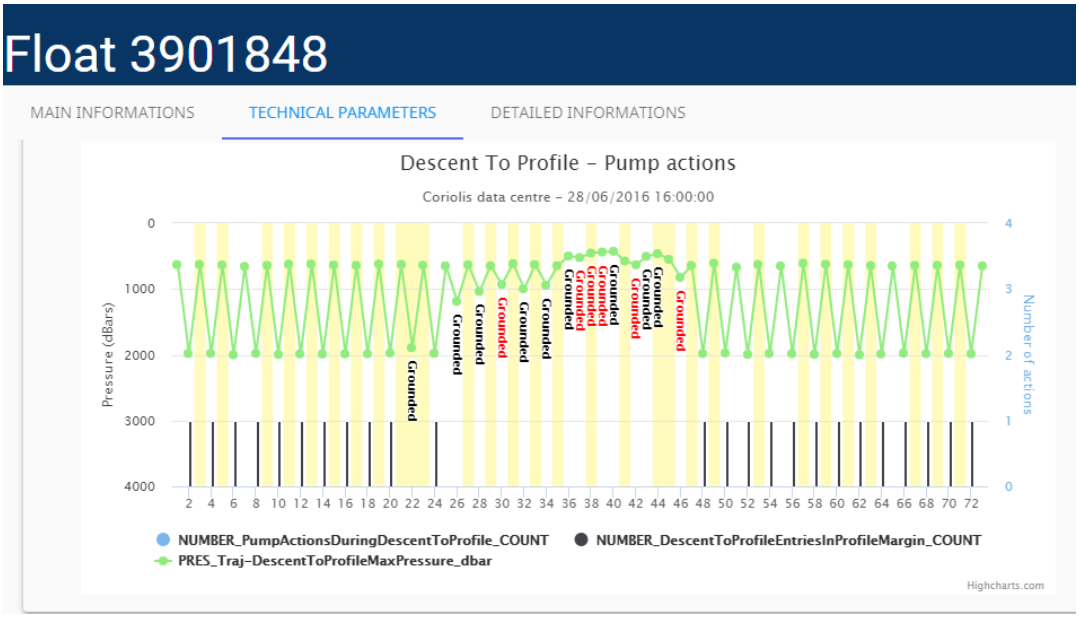


Figure 38: FLAG_FalseGrounding_LOGICAL alert.

FLAG_InvalidPressure_LOGICAL, FLAG_InvalidTemperature_LOGICAL and FLAG_InvalidSalinity_LOGICAL

We do not have example for the moment.

5. ROADMAP

The needs for **global statistics are well-addressed by JCOMMOPS on the AIC** website. Within MOCCA, ERIC is willing to work with AIC to propose new KPIs whenever new requirements arise. ERIC will also work with AIC to improve accuracy of statistics: for instance, to reflect true float life (recoveries, different cycle schemes etc.).

There was a strong need for enhancing available tools for **technical and functional monitoring of the floats**. The major **update of Coriolis at sea monitoring website within MOCCA** in June 2017 covers almost all requirements identified by the questionnaire and during meetings with Euro-Argo partners. For the moment, it is specifically dedicated to the MOCCA fleet but many functionalities will work for the remaining of the European fleet.

The tool now enables:

- Presentation of essential float metadata
- Detail on all float metadata classified into understandable categories
- Visualisation of main technical parameters with predefined alerts on the graphs. This is a major improvement and will facilitate the analysis of float behaviour and the identification of failures if any. In the past, a lot of data preparation and formatting was needed to be able to understand the float status concerning main technical parameters.
- Warning/notification system if mal-function is detected
- Detect early failures
- Corrective actions from deployment teams
- Implementation of dashboards/status tables for the whole fleet

The AIC and the Coriolis at sea monitoring tool will be used to quickly:

- Report on the case of early failure of a float
- Report on the behaviour of a fleet

A generic monthly report on the fleet could be issued and in-depth analysis of the end-of-life could be performed once a float is dead.

The tool has been presented at the Euro-Argo meetings (Management Board, User Workshop etc.) in July 2017, Paris. Feedbacks were collected and will drive further developments of the tool to enhance functionalities and monitor the European fleet.

Desirable features have been already identified:

- Access to data improvement
- All (BGC, APEX etc.) floats handling
- Use of external information: observations colocalised with more accurate bathymetry and weather conditions at that time
- Corrections and minor evolutions of the current version of the website

5.1. Bug report

In order to facilitate feedbacks from users, or report on bugs, a button enables the notification of a message to the technical people developing the website and the ERIC Office.

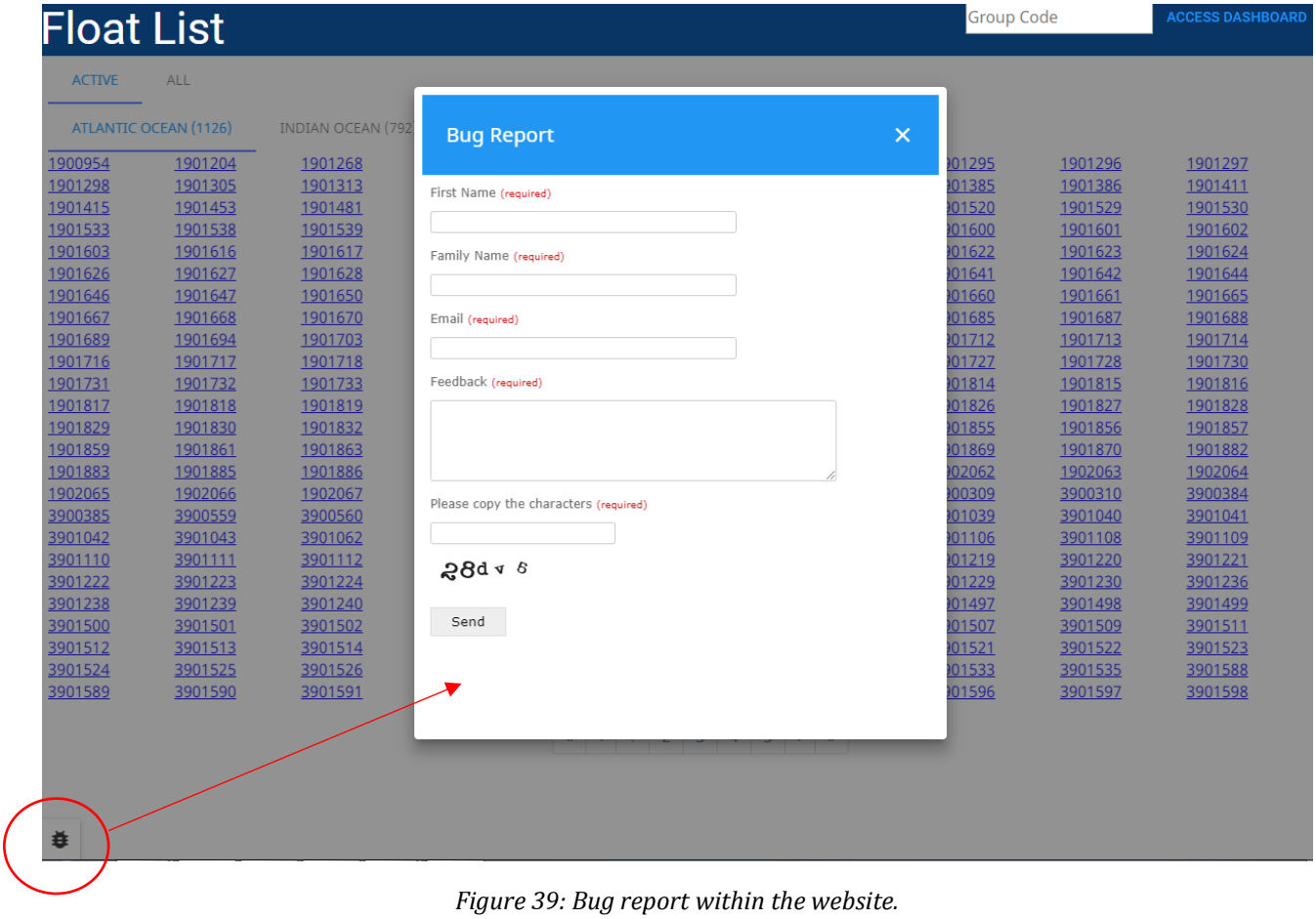


Figure 39: Bug report within the website.