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MOCCA

D4.3.1 Report on Delayed-Mode processing on the MOCCA fleet

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The French Republic	Ifremer	Member	SHOM, INSU/CNRS, Meteo-France, IRD, IPEV
The Federal Republic of Germany	BSH	Member	GEOMAR, University of Hamburg, Alfred-Wegener-Institute for Polar and Marine Research (AWI)
The Hellenic Republic	HCMR	Member	N/A
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The Kingdom of the Netherlands	KNMI	Member	N/A
The Republic of Finland	FMI	Member	N/A
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0.1	01.01.2018	Draft	Initial document creation
0.2	14.11.2018	Draft	Revision
0.3	30.11.2018	QC	For internal quality control
1.0	07.01.2019	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.

Table of Contents

Table of Figures

1. INTRODUCTION

This document compiles the activities on Delayed-Mode Quality Control (DMQC) processing of the MOCCA fleet (Figure 1). Data processing for MOCCA floats is compliant and makes use of the Argo Data System.

The Real-Time (RT) processing of the MOCCA fleet is organised through Euro-Argo data centres, as described in the deliverable D4.2.2 Report on Real-Time processing of the MOCCA fleet.

The DMQC of MOCCA floats is performed by Euro-Argo MOCCA partners delayed-mode operators according to the area of deployment and taking into account their area of expertise. It is further described in the deliverable D4.1.1 Organization of Float Data Management among DAC and DM-operators.

The following map illustrates the repartition of RT and DM processing among MOCCA partners:

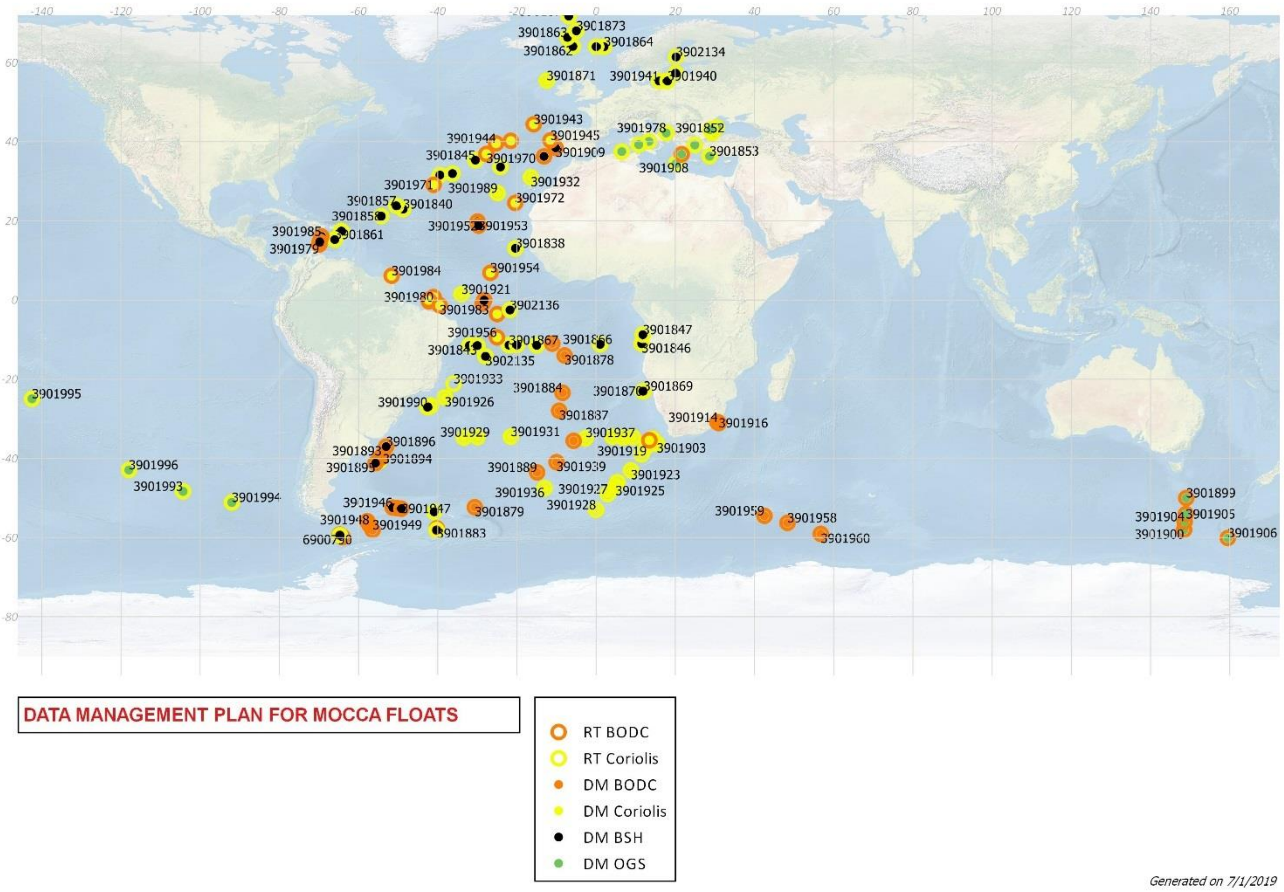


Figure 1: MOCCA data processing allocation between partners for Real-Time and Delayed-Mode.

2. METHODOLOGY

The DMQC of Argo floats follows guidelines provided by the Argo Data Management Team, and is documented in the following manuals:

- Argo user's manual V3.2 (*http://dx.doi.org/10.13155/29825*)
- Argo quality control manual for CTD and trajectory data, version 3.1 (*http://dx.doi.org/10.13155/33951*)

Each DM operator might use its own tools but by essence Argo data is corrected in delayed mode using agreed procedures. In the frame of the MOCCA project a **DMQC workshop** was organised in April 2018 by the Euro-Argo ERIC and the DMQC experts within Europe. Some of the key achievements were a review of the DMQC methodology among operators, sharing of tools or MATLAB codes, discussions about the reference databases to be used to control the data.

Information about the workshop can be accessed on the workshop webpage: *http://www.euro-argo.eu/News-Meetings/Meetings/Others/1st-European-Argo-Delayed-Mode-QC-Workshop*

Talks and practical work material may be downloaded from the cloud link: *https://cloud.ifremer.fr/index.php/s/ifgoDyTIDGkjr5E*

This report will not focus on the methodology of DMQC but rather on summarising the status of MOCCA float DMQC. **Detailed information about DMQC pathway is available from the manuals and presentations mentioned above.**

Nevertheless, a brief overview of the DMQC workflow is described hereafter.

2.1. DMQC workflow

RT processing is carried out by DACs (Data Assembly Centres). Procedures flag the gross errors in the data but some subtle errors may remain like sensor drift and or offset (Figure 2), float trajectory problems, etc. Elaborate procedures have been devised, based on statistical methods, and scientific expertise from principal investigators (PIs). The procedures are constantly assessed and updated as necessary. A minimum of 1 year of data is needed before the delayed mode processing can be performed.

The improvement of data quality from RT data to DMQC data is achieved by comparing Argo to other observations (climatology, altimetry, reference databases, deployment CTD, etc.) and viewing inspection by an operator. Pressure, temperature and salinity data are extensively analysed. Especially salinity data needs to be carefully examined since over time, the conductivity sensor can experience instrumental drift that gives salinity measurements an artificial trend. By using reference deep CTD data (Figure 3) and objective analysis, we can estimate what salinity should be at float locations.

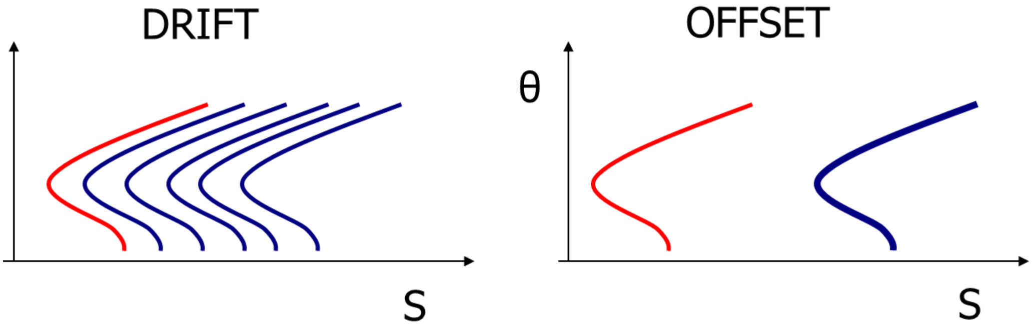


Figure 2: Example of drift or offset problems in the salinity time series.

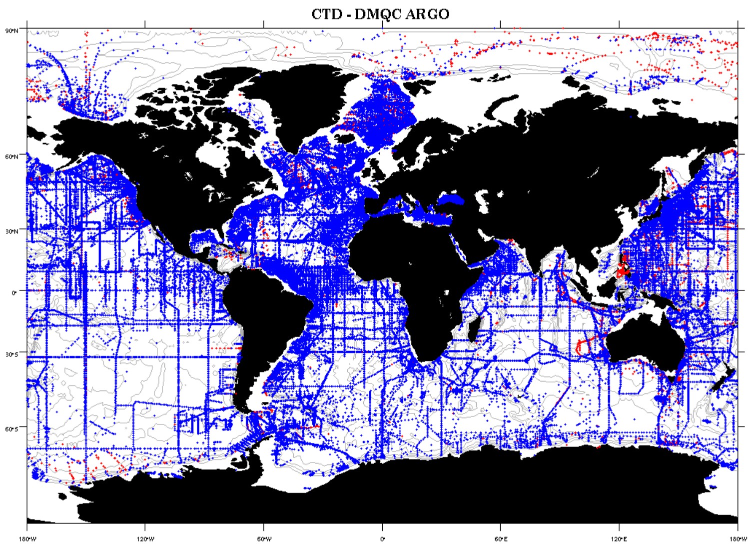
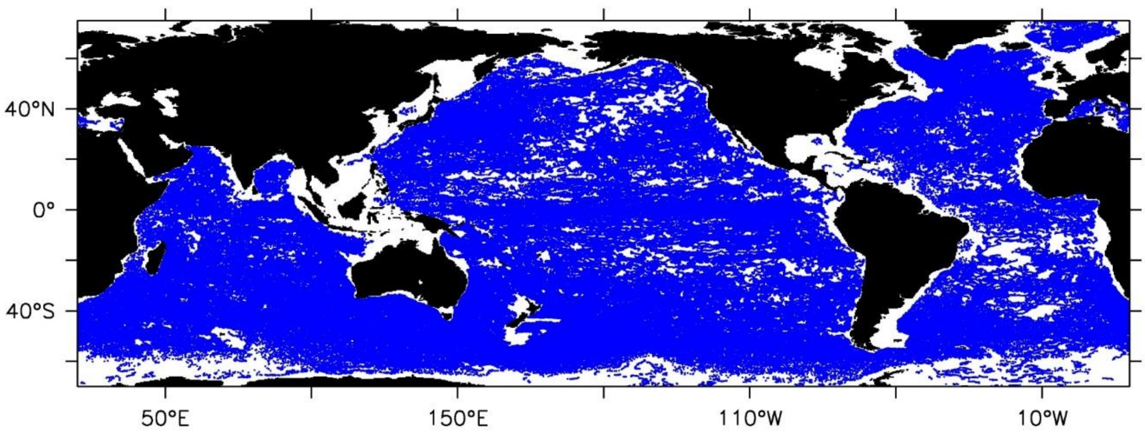


Figure 3: Recent high quality CTD database (left) and Argo good profile database (bottom).



A typical DMQC process includes:

- Look at the main float characteristics (cycle settings, mission number, etc.)
- Review of float trajectory, positions and dates, raw sections, raw theta/S diagrams
- Verification of RT QC flags
- Quality check on basic parameters (surface pressure, battery, etc.)
- Choice of reference CTDs and Argo profiles databases for comparison

- OW[3] method configuration and runs
- Comparison with deployment CTD profile (if available)
- Comparison with the closest (in time and space) CTD reference profiles and good Argo float profiles (if available)
- Look at sections based on the adjusted data and respective theta/S diagrams (above all the most uniform part of the curve)
- Analysis and decisions by the DM operator: changing QC flags, applying correction or calibration to one or more parameters
- Production and submission of D files[4] and submission to the relevant DAC

2.2. Timeline

Recommendations from ADMT are to complete the **first DMQC not later than one year after float deployment**. Indeed, the operator needs to look at a significant number of measurements to detect potential drifts in the dataset.

Then it is encouraged to **revisit the DMQC every two years**. If potential drifts or problems were identified during the first DMQC then the revisit should take place sooner.

Feedback from **Objective Analysis** (statistical tests performed monthly at Coriolis) and **Altimetry Test** (performed by CLS) are also part of the Argo Quality Control Process**. In case of warnings issued for a float that has not been quality controlled already, it is highly recommended that the DM operator** in charge of the float performs a **first DMQC even if the float is recently deployed.**

[3] Owens, W.B. and A.P.S. Wong, 2009. An improved calibration method for the drift of the conductivity sensor on autonomous CTD profiling floats by θ - S climatology. DeepSea Res. Part I, 56, 450-457. *https://doi.org/10.1016/j.dsr.2008.09.008*
[4] Argo netCDF profile file that has been through the delayed-mode process. It replaces the real-time file (R).

3. MOCCA FLOATS MAPS

More than **10 000 Argo CTD profiles have been collected by the MOCCA fleet** to date (14 November 2018), in Figure 4:

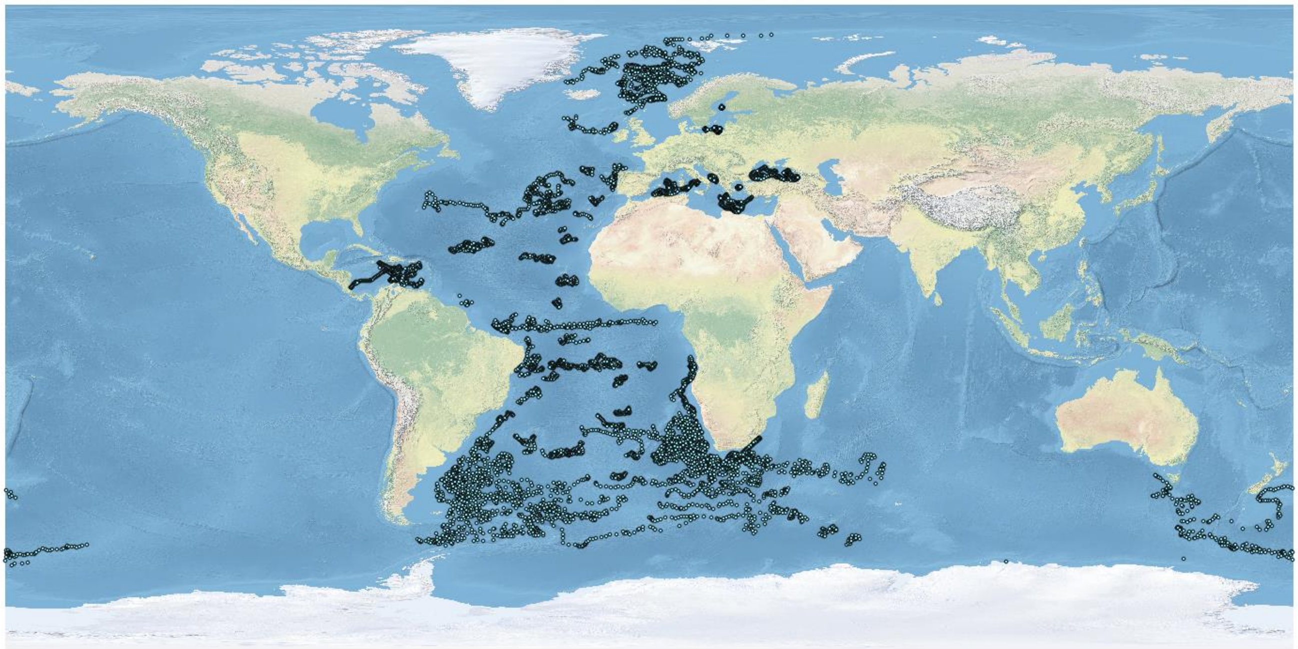


Figure 4 : MOCCA observations (1 blue point per CTD profile acquired).

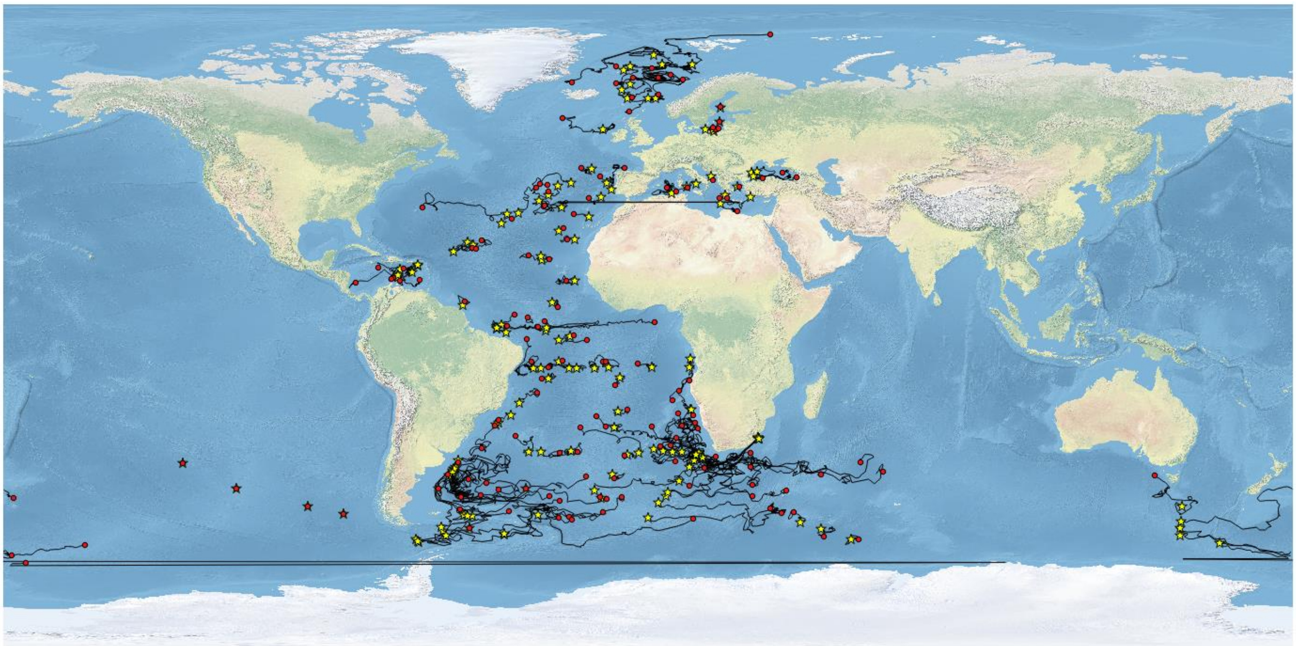


Figure 5: MOCCA deployment locations (yellow stars), latest locations (red circle) and trajectories of floats (black line).

The MOCCA deployment plan (Figure 5) provides a good coverage of European and Caribbean marginal seas, Nordic seas, South Atlantic and substantial measurements in the South Indian and South Pacific oceans.

4. MOCCA FLOATS DMQC STATUS

4.1. MOCCA floats table

Table 1 describes the MOCCA fleet with information about the WMO number of each float, its serial number, transmission type, ship and cruise of deployment, date and position of deployment, sub-MOCCA programme and partner allocation for RT and DM.

WMO	S/N	Transmission	Ship	Cruise	Deployment	Latitude	Longitude	Program	RT	DM
3901838	AR2600-16FR001	IRIDIUM	FS METEOR	M129	23/08/2016	13.0717	-20.3583	MOCCA-GER	Coriolis	BSH
3901839	AR2600-16FR002	IRIDIUM	FS METEOR	M127	25/06/2016	31.9500	-36.2800	MOCCA-GER	Coriolis	BSH
3901840	AR2600-16FR003	IRIDIUM	FS METEOR	M127	29/05/2016	22.9700	-48.7300	MOCCA-GER	Coriolis	BSH
3901841	AR2600-16FR004	IRIDIUM	FS METEOR	M129	31/07/2016	33.62	-24.15	MOCCA-GER	Coriolis	BSH
3901842	AR2600-16FR005	IRIDIUM	FS METEOR	M131	08/10/2016	-11.5013	-32.0005	MOCCA-GER	Coriolis	BSH
3901843	AR2600-16FR006	IRIDIUM	FS METEOR	M131	09/10/2016	-11.4827	-30.0008	MOCCA-GER	Coriolis	BSH
3901844	AR2600-16FR007	IRIDIUM	FS METEOR	M131	13/10/2016	-11.434	-14.9992	MOCCA-GER	Coriolis	BSH
3901845	AR2600-16FR008	IRIDIUM	FS METEOR	M127	26/06/2016	35.3400	-30.4900	MOCCA-GER	Coriolis	BSH
3901846	AR2600-16FR009	IRIDIUM	FS METEOR	M131	20/10/2016	-11.0175	11.4998	MOCCA-GER	Coriolis	BSH
3901847	AR2600-16FR010	IRIDIUM	FS METEOR	M131	22/10/2016	-8.7505	11.8	MOCCA-GER	Coriolis	BSH
3901848	AR2600-16FR011	OFF	BELLE POULE	MED	04/06/2016	40.0800	13.3400	MOCCA-IT	Coriolis	OGS
3901849	AR2600-16FR012	IRIDIUM	BELLE POULE	MED	05/06/2016	39.2600	10.7700	MOCCA-IT	Coriolis	OGS
3901850	AR2600-16FR013	IRIDIUM	OCEANIA	AREX2016	24/06/2016	73.5100	12.2400	MOCCA-POL	Coriolis	BSH
3901851	AR2600-16FR014	IRIDIUM	OCEANIA	AREX2016	25/06/2016	73.5300	4.0400	MOCCA-POL	Coriolis	BSH
3901852	AI2600-16FR015	IRIDIUM	TURKEY	BLACK SEA	06/12/2016	42.1844	29.3343	MOCCA-EU	Coriolis	OGS
3901853	AI2600-16FR016	IRIDIUM	TURKEY	CILICIAN BASIN	28/10/2016	36.3468	28.657	MOCCA-EU	Coriolis	OGS
3901854	AI2600-16FR017	IRIDIUM	ROMANIA	BLACK SEA	02/11/2016	43.5752	30.4416	MOCCA-EU	Coriolis	OGS
3901855	AI2600-16FR018	IRIDIUM	BULGARIA	BLACK SEA	22/10/2016	43.1053	28.8788	MOCCA-EU	Coriolis	OGS
3901856	AR2600-16FR019	IRIDIUM	PELAGIA	PELAGIA_TR	09/08/2016	31.573	-39.459	MOCCA-EU	Coriolis	BSH
3901857	AR2600-16FR020	IRIDIUM	PELAGIA	PELAGIA_TR	12/08/2016	23.804	-50.4702	MOCCA-EU	Coriolis	BSH
3901858	AR2600-16FR021	IRIDIUM	PELAGIA	PELAGIA_TR	14/08/2016	21.1817	-54.2483	MOCCA-EU	Coriolis	BSH
3901859	AR2600-16FR022	IRIDIUM	PELAGIA	64PE614	01/09/2016	17.45	-64.381	MOCCA-EU	Coriolis	BSH
3901860	AR2600-16FR023	IRIDIUM	PELAGIA	64PE614	05/09/2016	17.3467	-64.235	MOCCA-EU	Coriolis	BSH
3901861	AR2600-16FR024	IRIDIUM	PELAGIA	64PE614	06/09/2016	15.2817	-65.9983	MOCCA-EU	Coriolis	BSH
3901862	AR2600-16FR025	IRIDIUM	Beautemps-Beaupré	NARVAL	11/08/2016	64.0744	-5.8695	MOCCA-EU	Coriolis	BSH
3901863	AR2600-16FR026	IRIDIUM	Beautemps-Beaupré	NARVAL	12/08/2016	66.33	-7.22	MOCCA-EU	Coriolis	BSH
3901864	AR2600-16FR027	IRIDIUM	Beautemps-Beaupré	NARVAL	08/09/2016	63.9797	1.9976	MOCCA-EU	Coriolis	BSH
3901865	AR2600-16FR028	IRIDIUM	Beautemps-Beaupré	NARVAL	08/09/2016	64	0	MOCCA-EU	Coriolis	BSH
3901866	AR2600-16FR029	IRIDIUM	FS METEOR	M131	17/10/2016	-11.1852	1.0013	MOCCA-EU	Coriolis	BSH
3901867	AR2600-16FR030	IRIDIUM	FS METEOR	M131	11/10/2016	-11.3833	-22	MOCCA-EU	Coriolis	BSH
3901868	AR2600-16FR031	IRIDIUM	FS METEOR	M131	12/10/2016	-11.3648	-19.9973	MOCCA-EU	Coriolis	BSH
3901869	AR2600-16FR032	IRIDIUM	FS METEOR	EEZ	10/11/2016	-23	12	MOCCA-EU	Coriolis	BSH
3901870	AR2600-16FR033	IRIDIUM	FS METEOR	EEZ	10/11/2016	-23.0007	11.7487	MOCCA-EU	Coriolis	BSH
3901871	AR2600-16FR034	IRIDIUM	CELTIC VOYAGER	CV16030	29/08/2016	55.4133	-12.475	MOCCA-EU	Coriolis	Coriolis
3901872	AR2600-16FR035	IRIDIUM	HAAKON MOSBY	2016618	23/08/2016	71.7229	-6.913	MOCCA-EU	Coriolis	BSH

3901873	AR2600-16FR036	IRIDIUM	HAAKON MOSBY	2016618	04/09/2016	67.9926	-4.9936	MOCCA-EU	Coriolis	BSH
3901874	AR2600-16FR037	IRIDIUM	HAAKON MOSBY	2016618	22/08/2016	75.96	1.56	MOCCA-EU	Coriolis	BSH
3901875	AR2600-16FR038	IRIDIUM	HAAKON MOSBY	2016618	23/08/2016	72.9994	-5.0001	MOCCA-EU	Coriolis	BSH
3901876	AI2600-16FR039	IRIDIUM	PLANCIUS	KNMI	17/10/2016	-26.6633	-41.71	MOCCA-NETH	Coriolis	BSH
3901877	AI2600-16FR040	IRIDIUM	PLANCIUS	KNMI	21/10/2016	-40.6317	-54.7167	MOCCA-NETH	Coriolis	BSH
3901878	AI2600-16FR041	IRIDIUM	PLANCIUS	KNMI	19/04/2017	-13.9917	-7.9583	MOCCA-NETH	BODC	BODC
3901879	AI2600-16FR042	IRIDIUM	PLANCIUS	KNMI	03/04/2017	-52.3133	-30.64	MOCCA-NETH	BODC	BODC
3901880	AI2600-16FR043	IRIDIUM	PLANCIUS	KNMI	20/04/2017	-10.9983	-11.9983	MOCCA-NETH	BODC	BODC
3901881	AI2600-16FR044	IRIDIUM	PLANCIUS	KNMI	22/01/2017	-52.5314	-50.2682	MOCCA-NETH	BODC	BODC
3901882	AI2600-16FR045	IRIDIUM	PLANCIUS	KNMI	04/03/2017	-59.7346	-64.1988	MOCCA-NETH	BODC	BODC
3901883	AI2600-16FR046	IRIDIUM	PLANCIUS	KNMI	28/01/2017	-57.8178	-40.2158	MOCCA-NETH	BODC	BODC
3901884	AI2600-16FR047	IRIDIUM	PLANCIUS	KNMI	14/04/2017	-23.4183	-8.4783	MOCCA-NETH	BODC	BODC
3901885	AI2600-16FR048	IRIDIUM	PLANCIUS	KNMI	19/12/2016	-59.8805	-64.0436	MOCCA-NETH	BODC	BODC
3901886	AI2600-16FR049	IRIDIUM	PLANCIUS	KNMI	24/03/2017	-59.2467	-64.76	MOCCA-NETH	BODC	BODC
3901887	AI2600-16FR050	IRIDIUM	PLANCIUS	KNMI	13/04/2017	-27.95	-9.3517	MOCCA-NETH	BODC	BODC
3901888	AI2600-16FR051	IRIDIUM	PLANCIUS	KNMI	25/02/2017	-57.6815	-40.2235	MOCCA-NETH	BODC	BODC
3901889	AI2600-16FR052	IRIDIUM	PLANCIUS	KNMI	06/04/2017	-43.5233	-14.905	MOCCA-NETH	BODC	BODC
3901890	AI2600-16FR053	IRIDIUM	POSEIDON	AEGEAN	03/04/2017	39.1633	24.928	MOCCA-EU	Coriolis	OGS
3901891	AI2600-16FR054	IRIDIUM	HESPERIDES	RETRO-BMC	14/04/2017	-39.8803	-54.4889	MOCCA-EU	BODC	BODC
3901892	AI2600-16FR055	IRIDIUM	HESPERIDES	RETRO-BMC	14/04/2017	-39.5867	-54.2867	MOCCA-EU	BODC	BODC
3901893	AI2600-16FR056	IRIDIUM	HESPERIDES	RETRO-BMC	15/04/2017	-39.3758	-54.116	MOCCA-EU	BODC	BODC
3901894	AI2600-16FR057	IRIDIUM	HESPERIDES	RETRO-BMC	15/04/2017	-39.001	-53.8722	MOCCA-EU	BODC	BODC
3901895	AI2600-16FR058	IRIDIUM	HESPERIDES	HESPERIDES_TR	14/04/2017	-41.1893	-55.713	MOCCA-EU	BODC	BSH
3901896	AI2600-16FR059	IRIDIUM	HESPERIDES	HESPERIDES_TR	24/04/2017	-36.9977	-53.0213	MOCCA-EU	BODC	BSH
3901897	AI2600-16FR060	IRIDIUM	HESPERIDES	HESPERIDES_TR	10/05/2017	-0.8742	-28.6443	MOCCA-EU	BODC	BSH
3901898	AI2600-16FR061	IRIDIUM	HESPERIDES	HESPERIDES_TR	10/05/2017	0	-28.258	MOCCA-EU	BODC	BSH
3901899	AI2600-16FR062	IRIDIUM	OGS EXPLORA	Tasmania - Ross Sea	22/01/2017	-50.0037	149.0205	MOCCA-EU	BODC	OGS
3901900	AI2600-16FR063	IRIDIUM	OGS EXPLORA	Tasmania - Ross Sea	24/01/2017	-58.0117	148.4747	MOCCA-EU	BODC	OGS
3901901	AI2600-16FR064	IRIDIUM	METEOR	M133	16/12/2016	-36.2335	15.326	MOCCA-EU	Coriolis	Coriolis
3901902	AI2600-16FR065	IRIDIUM	METEOR	M133	16/12/2016	-36.2328	15.3282	MOCCA-EU	Coriolis	Coriolis
3901903	AI2600-16FR066	IRIDIUM	METEOR	M133	16/12/2016	-36.2317	15.331	MOCCA-EU	Coriolis	Coriolis
3901904	AI2600-16FR067	IRIDIUM	OGS EXPLORA	Tasmania - Ross Sea	24/01/2017	-55.985	148.6202	MOCCA-EU	BODC	OGS
3901905	AI2600-16FR068	IRIDIUM	OGS EXPLORA	Tasmania - Ross Sea	23/01/2017	-54.0553	148.9278	MOCCA-EU	BODC	OGS
3901906	AI2600-16FR069	IRIDIUM	OGS EXPLORA	Tasmania - Ross Sea	10/03/2017	-60.1	159.52	MOCCA-EU	BODC	OGS
3901907	AI2600-16FR070	IRIDIUM	BTBP	PROTEUS	21/01/2017	37.4865	6.4797	MOCCA-IT	Coriolis	OGS
3901908	AI2600-16FR071	IRIDIUM	BTBP	PROTEUS	25/01/2017	34.5008	20.2458	MOCCA-IT	Coriolis	OGS
3901909	AI2600-16FR072	IRIDIUM	NORUEGA	IPMA	29/12/2016	38.4407	-10.2171	MOCCA-EU	BODC	BSH
3901910	AI2600-16FR073	IRIDIUM	OCEANIA	AREX2017	29/06/2017	73.5008	12.2253	MOCCA-POL	Coriolis	BSH
3901911	AI2600-16FR074	IRIDIUM	OCEANIA	AREX2017	27/06/2017	73.5102	4.0647	MOCCA-POL	Coriolis	BSH
3901912	AI2600-16FR075	IRIDIUM	ALGOA	ASCA	10/08/2017	-30.8776	30.6909	MOCCA-EU	BODC	BODC
3901913	AI2600-16FR076	IRIDIUM	ALGOA	ASCA	10/08/2017	-31.0101	30.9068	MOCCA-EU	BODC	BODC
3901914	AI2600-16FR077	IRIDIUM	ALGOA	ASCA	10/08/2017	-30.9172	30.7555	MOCCA-EU	BODC	BODC
3901915	AI2600-16FR078	IRIDIUM	ALGOA	ASCA	10/08/2017	-30.9656	30.832	MOCCA-EU	BODC	BODC
3901916	AI2600-16FR079	IRIDIUM	ALGOA	ASCA	10/08/2017	-31.0609	30.9813	MOCCA-EU	BODC	BODC
3901917	AI2600-16FR080	IRIDIUM	ALGOA	ASCA	10/08/2017	-30.83456	30.62351	MOCCA-EU	BODC	BODC
3901918	AL2500-16FR016	ARGOS	SA Agulhas II	SANAE	01/12/2016	-35	14.25	MOCCA-EU	Coriolis	Coriolis

3901919	AL2500-16FR017	ARGOS	SA Agulhas II	SANAE	01/12/2016	-37	12.7915	MOCCA-EU	Coriolis	Coriolis
3901920	AL2500-16FR018	ARGOS	SA Agulhas II	SANAE	02/12/2016	-39	11.49	MOCCA-EU	Coriolis	Coriolis
3901921	AL2500-16FR019	ARGOS	HESPERIDES	HESPERIDES_TR	19/05/2018	1.45	-34.01	MOCCA-EU	Coriolis	Coriolis
3901922	AL2500-16FR020	ARGOS	SA Agulhas II	GOUGH	07/10/2017	-34.9197	-2.6788	MOCCA-EU	Coriolis	Coriolis
3901923	AL2500-16FR021	ARGOS	SA Agulhas II	SANAE	03/12/2016	-43	8.7793	MOCCA-EU	Coriolis	Coriolis
3901924	AL2500-16FR022	ARGOS	SA Agulhas II	SANAE	04/12/2016	-46	5.403	MOCCA-EU	Coriolis	Coriolis
3901925	AL2500-16FR023	ARGOS	SA Agulhas II	SANAE	04/12/2016	-47.02	4.9	MOCCA-EU	Coriolis	Coriolis
3901926	AL2500-16FR024	ARGOS	PLANCIUS	PLANCIUS_TR	31/10/2017	-24.5917	-38.2258	MOCCA-EU	Coriolis	Coriolis
3901927	AL2500-16FR025	ARGOS	SA Agulhas II	SANAE	05/12/2016	-49.01	2.9458	MOCCA-EU	Coriolis	Coriolis
3901928	AL2500-16FR026	ARGOS	SA Agulhas II	SANAE	06/12/2016	-53	0	MOCCA-EU	Coriolis	Coriolis
3901929	AL2500-16FR027	ARGOS	MARIA S MERIAN	MSM60	22/01/2017	-34.6283	-29.9508	MOCCA-EU	Coriolis	Coriolis
3901930	AL2500-16FR028	ARGOS	MARIA S MERIAN	MSM60	24/01/2017	-34.7572	-33.4006	MOCCA-EU	Coriolis	Coriolis
3901931	AL2500-16FR029	ARGOS	MARIA S MERIAN	MSM60	19/01/2017	-34.5019	-21.5253	MOCCA-EU	Coriolis	Coriolis
3901932	AL2500-16FR030	ARGOS	HESPERIDES	HESPERIDES_TR	08/06/2018	31	-16.4875	MOCCA-EU	Coriolis	Coriolis
3901933	AL2500-16FR031	ARGOS	PLANCIUS	PLANCIUS_TR	31/10/2017	-21.16	-35.9996	MOCCA-EU	Coriolis	coriolis
3901934	AL2500-16FR032	ARGOS	MARIA S MERIAN	MSM60	10/01/2017	-34.5069	4.1219	MOCCA-EU	Coriolis	Coriolis
3901935	AL2500-16FR033	ARGOS	MARIA S MERIAN	MSM60	08/01/2017	-34.6839	9.3347	MOCCA-EU	Coriolis	Coriolis
3901936	AL2500-16FR034	ARGOS	SA Agulhas II	GOUGH	20/09/2017	-47.5	-13	MOCCA-EU	Coriolis	Coriolis
3901937	AL2500-16FR035	ARGOS	MARIA S MERIAN	MSM60	09/01/2017	-34.7525	6.76	MOCCA-EU	Coriolis	Coriolis
3901938	AI2600-16FR081	IRIDIUM	SA Agulhas II	GOUGH	06/10/2017	-35.5436	-5.6777	MOCCA-EU	BODC	BODC
3901939	AI2600-16FR082	IRIDIUM	SA Agulhas II	GOUGH	18/09/2017	-40.94	-10	MOCCA-EU	BODC	BODC
3901941	AI2600-16FR084	IRIDIUM	OCEANIA	BALTIC	21/09/2017	55.3338	15.916	MOCCA-EU	Coriolis	BSH
3901942	AI2600-16FR085	IRIDIUM	TAMOURE	MARTIN	20/09/2017	36.2983	-13.1633	MOCCA-EU	BODC	BSH
3901943	AI2600-16FR086	IRIDIUM	PIERRE DE FERMAT	ORANGE MARINE	20/09/2017	44.39	-15.7633	MOCCA-EU	BODC	Coriolis
3901944	AI2600-16FR087	IRIDIUM	PIERRE DE FERMAT	ORANGE MARINE	22/09/2017	39.5676	-25.2586	MOCCA-EU	BODC	Coriolis
3901945	AI2600-16FR088	IRIDIUM	PIERRE DE FERMAT	ORANGE MARINE	04/11/2017	40.3248	-11.5367	MOCCA-EU	BODC	Coriolis
3901946	AI2600-16FR089	IRIDIUM	PLANCIUS	PLANCIUS_TR	23/01/2018	-52.42	-51.3817	MOCCA-EU	BODC	BSH
3901947	AI2600-16FR090	IRIDIUM	PLANCIUS	PLANCIUS_TR	23/01/2018	-52.6833	-49.175	MOCCA-EU	BODC	BSH
3901948	AI2600-16FR091	IRIDIUM	RRS James Clark Ross	JR17001	17/12/2017	-56.78335	-57.23179	MOCCA-EU	BODC	BODC
3901949	AI2600-16FR092	IRIDIUM	RRS James Clark Ross	JR17001	16/12/2017	-58.04956	-56.44746	MOCCA-EU	BODC	BODC
3901950	AI2600-16FR093	IRIDIUM	RRS James Clark Ross	JR17001	18/12/2017	-55.83342	-57.82059	MOCCA-EU	BODC	BODC
3901951	AI2600-16FR094	IRIDIUM	RSS DISCOVERY	AMT27	28/09/2017	40.2173	-21.5348	MOCCA-EU	BODC	Coriolis
3901952	AI2600-16FR095	IRIDIUM	RSS DISCOVERY	AMT27	05/10/2017	19.8383	-29.9343	MOCCA-EU	BODC	BSH
3901953	AI2600-16FR096	IRIDIUM	RSS DISCOVERY	AMT27	05/10/2017	18.7857	-29.6822	MOCCA-EU	BODC	BSH
3901954	AI2600-16FR097	IRIDIUM	RSS DISCOVERY	AMT27	09/10/2017	6.8803	-26.686	MOCCA-EU	BODC	Coriolis
3901955	AI2600-16FR098	IRIDIUM	RSS DISCOVERY	AMT27	13/10/2017	-3.5392	-24.994	MOCCA-EU	BODC	Coriolis
3901956	AI2600-16FR099	IRIDIUM	RSS DISCOVERY	AMT27	15/10/2017	-9.4225	-25.0287	MOCCA-EU	BODC	Coriolis
3901957	AI2600-16FR100	IRIDIUM	R/V AEGEO	DIMITRIS	20/05/2018	36.838	21.6072	MOCCA-EU	BODC	OGS
3901958	AI2600-16FR101	IRIDIUM	Katharsis II	ANTARCTIC CIRCLE	03/01/2018	-56.2767	48.3305	MOCCA-EU	BODC	BODC
3901959	AI2600-16FR102	IRIDIUM	Katharsis II	ANTARCTIC CIRCLE	02/01/2018	-54.4942	42.5025	MOCCA-EU	BODC	BODC
3901960	AI2600-16FR103	IRIDIUM	Katharsis II	ANTARCTIC CIRCLE	05/01/2018	-59.0596	56.7322	MOCCA-EU	BODC	BODC
3901964	AI2600-16FR107	IRIDIUM	SA Agulhas II	SEAmester Cruise	25/07/2017	-35.4178	13.4487	MOCCA-EU	BODC	Coriolis
3901965	AI2600-16FR108	IRIDIUM	SA Agulhas II	SEAmester Cruise	25/07/2017	-35.4178	13.4487	MOCCA-EU	BODC	Coriolis
3901970	AI2600-16FR113	IRIDIUM	PIERRE DE FERMAT	ORANGE MARINE	20/07/2018	36.9044	-27.7112	MOCCA-EU	BODC	Coriolis
3901971	AI2600-16FR114	IRIDIUM	PIERRE DE FERMAT	ORANGE MARINE	23/07/2018	29.106	-41.0321	MOCCA-EU	BODC	Coriolis
3901972	AI2600-16FR115	IRIDIUM	FS SONNE	SO259-3	25/12/2017	24.5326	-20.426	MOCCA-EU	BODC	Coriolis

3901978	AI2600-16FR121	IRIDIUM	Nase More	Adriatique	05/07/2017	42.212	17.7096	MOCCA-IT	Coriolis	OGS
3901979	AI2600-16FR122	IRIDIUM	PELAGIA	NICO	06/02/2018	14.0497	-69.9363	MOCCA-EU	BODC	BSH
3901980	AI2600-16FR123	IRIDIUM	HESPERIDES	RETRO-EZR	08/05/2018	0.7678	-41.0492	MOCCA-EU	BODC	Coriolis
3901981	AI2600-16FR124	IRIDIUM	HESPERIDES	RETRO-EZR	04/05/2018	-0.3295	-42.2318	MOCCA-EU	BODC	Coriolis
3901982	AI2600-16FR125	IRIDIUM	HESPERIDES	RETRO-EZR	02/05/2018	0.034	-42.2935	MOCCA-EU	BODC	Coriolis
3901983	AI2600-16FR126	IRIDIUM	HESPERIDES	RETRO-EZR	29/04/2018	-1.3168	-39.5186	MOCCA-EU	BODC	Coriolis
3901984	AI2600-16FR127	IRIDIUM	PIERRE DE FERMAT	ORANGE MARINE	26/08/2018	6.145	-51.6417	MOCCA-EU	BODC	Coriolis
3901985	AI2600-16FR128	IRIDIUM	PELAGIA	NICO	07/02/2018	16.067	-69.3668	MOCCA-EU	BODC	BSH
3901986	AI2600-16FR129	IRIDIUM	PELAGIA	NICO	06/02/2018	14.0507	-69.9365	MOCCA-EU	BODC	BSH
3901987	AI2600-16FR130	IRIDIUM	PELAGIA	NICO	06/02/2018	14.73333	-69.7933	MOCCA-EU	BODC	BSH
3901940	AI2600-16FR083	IRIDIUM	OCEANIA	BALTIC	20/09/2017	55.3333	18.0133	MOCCA-EU	Coriolis	BSH
3902133	AI2600-16FR083	IRIDIUM	OCEANIA	BALTIC	20/09/2017	55.3333	18.0133	MOCCA-EU	Coriolis	BSH
6900790	AR2600-16FR026	IRIDIUM	PLANCIUS	PLA-21	21/11/2018	-59.3917	-64.7067	MOCCA-EU	Coriolis	BSH
3902134	AI2600-17EU010	IRIDIUM		BALTIC BOTHNIAN	04/10/2018	61.4	20.1833	MOCCA-EU	Coriolis	BSH
3902135	AI2600-17EU011	IRIDIUM	SONNE	SO259-3	01/01/2018	-14.2138	-27.9402	MOCCA-EU	Coriolis	BSH
3902136	AI2600-17EU012	IRIDIUM	SONNE	SO259-3	30/12/2017	-2.5008	-21.7597	MOCCA-EU	Coriolis	BSH
3902137	AI2600-17EU013	IRIDIUM		BALTIC GOTLAND DEEP	09/11/2018	57.3137	20.0725	MOCCA-EU	Coriolis	BSH
3901989	AI2600-17EU014	IRIDIUM	VAYA	LA LONGUE ROUTE	08/09/2018	26.9996	-24.8784	MOCCA-EU	Coriolis	Coriolis
3901990	AI2600-17EU015	IRIDIUM	PLANCIUS		25/10/2018	-27.0583	-42.5800	MOCCA-EU	Coriolis	BSH
3901991	AI2600-17EU016	IRIDIUM	PLANCIUS		13/12/2018	-58.0970	-40.2962	MOCCA-EU	Coriolis	BSH
3901992	AI2600-17EU017	IRIDIUM	PLANCIUS		27/12/2018	-53.4850	-40.8967	MOCCA-EU	Coriolis	BSH
3901993	AI2600-17EU018	IRIDIUM	DESCARTES	ORANGE MARINE	28/12/2018	-48.3200	-104.3133	MOCCA-EU	Coriolis	OGS
3901994	AI2600-17EU019	IRIDIUM	DESCARTES	ORANGE MARINE	30/12/2018	-51.1117	-91.9917	MOCCA-EU	Coriolis	OGS
3901995	AI2600-17EU020	IRIDIUM	DESCARTES	ORANGE MARINE	20/12/2018	-24.9333	-142.4600	MOCCA-EU	Coriolis	OGS
3901996	AI2600-17EU021	IRIDIUM	DESCARTES	ORANGE MARINE	26/12/2018	-42.9195	-117.9937	MOCCA-EU	Coriolis	OGS

Table 1: MOCCA detailed deployment information

4.2. MOCCA floats DMQC progress

The progress made for the DMQC of the MOCCA fleet is shown from Figure 6 to Figure 8. The detailed index file on the GDAC (*ftp://ftp.ifremer.fr/ifremer/argo/etc/argo_profile_detailled_index.txt*) is used to make the analysis.

To date (7 January 2019), **D files have been submitted for 101 floats**. 123 floats have been deployed more than 1 year ago so in theory are eligible for DMQC. **60% of MOCCA observations have already been quality controlled**, and **88% of observations aged more than 1 year have already been quality controlled.**

DMQC is well advanced for floats attributed to BSH. It is well underway for BODC, Coriolis and OGS.

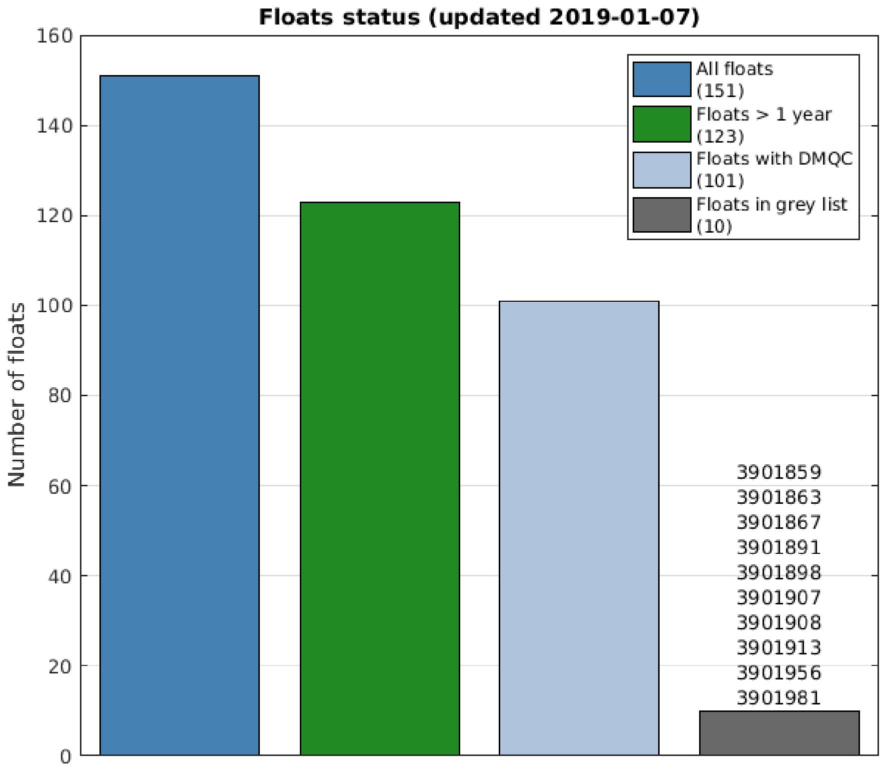


Figure 6: MOCCA DMQC progress: number of floats that have been quality controlled.

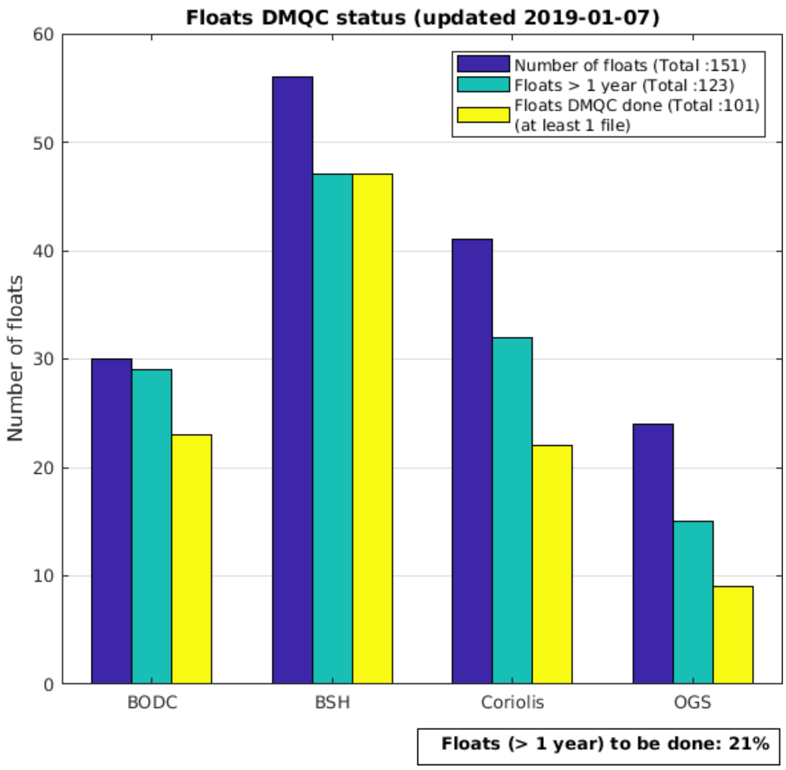


Figure 7: MOCCA DMQC progress: for each DM operator, number of floats allocated, number of floats eligible to DMQC, number of floats that have been quality controlled at least once.

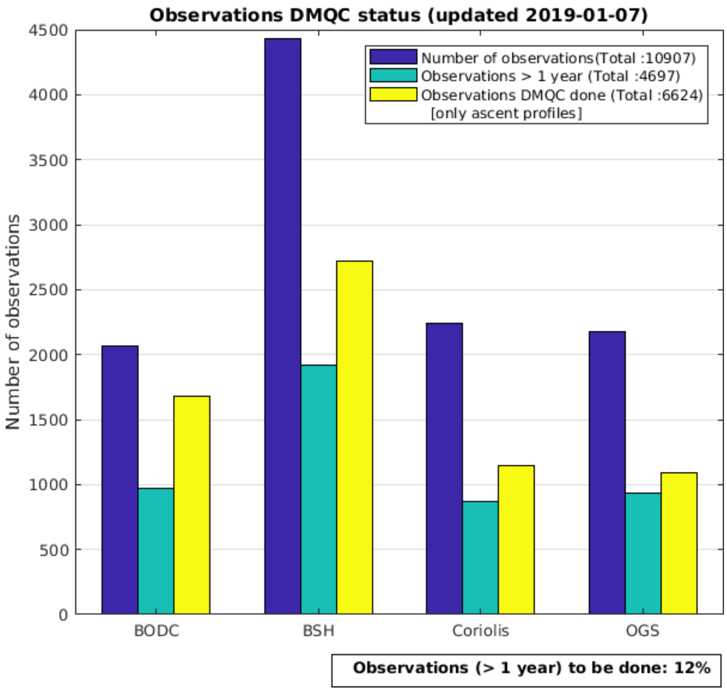


Figure 8: MOCCA DMQC progress: for each DM operator, number of observations available for allocated floats, number of observations eligible to DMQC, number of observations that have been quality controlled at least once.

4.3. MOCCA floats on the Grey list

The **Grey list** file available on the GDAC (*ftp://ftp.ifremer.fr/ifremer/argo/ar_greylist.txt*) is implemented in the Argo data stream to **stop the real-time distribution** on the GTS of measurements from a sensor that is not working correctly.

The decision to insert a float parameter in the grey list comes from the PI or the delayed-mode operator. A float parameter should be put in the grey list when sensor drift is too big to be corrected adequately in real time, or when the sensor is judged to be not working correctly.

Currently **10 MOCCA floats are on the Grey list** (Table 2):

PLATFORM_CODE	PARAMETER_NAME	START_DATE	END_DATE	QUALITY_CODE	COMMENT	DAC
3901859	PSAL	20181122		3	DD drift	IF
3901863	PSAL	20160812		4	CL 20160928	IF
3901863	TEMP	20160812		4	CL 20160928	IF
3901867	PSAL	20181122		3	DD drift	IF
3901891	PSAL	20180521		4	Salinity sensor providing routinely spikey data	BO
3901913	PSAL	20180706		3	Drifting salinity sensor potentially correctable in DMQC	BO
3901907	PSAL	20180525		3	CP 20181016 Drift	IF
3901908	PSAL	20171208		3	CC 20171211 Drift on salinity	IF
3901898	PSAL	20181003		4	Sensor problem	BO
3901956	PSAL	20180415		4	Sensor problem	BO
3901981	PSAL	20180514		4	CTD plugs accidentally left on so the salinity is spurious	BO

Table 2: MOCCA floats on the Grey list

5. MOCCA FLOATS DMQC RESULTS

5.1. Argo quality control flags and profile quality flags

A **quality flag** indicates the quality of an observation. The flags are assigned in real time or delayed mode according to the Argo quality control manual (Table 3).

n	Meaning	Real-time comment	Delayed-mode comment
0	No QC was performed	No QC was performed.	No QC was performed.
1	Good data	All Argo real-time QC tests passed.	The adjusted value is statistically consistent and a statistical error estimate is supplied.
2	Probably good data	Not used in real-time.	Probably good data.
3	Bad data that are potentially correctable	Test 15 or Test 16 or Test 17 failed and all other real-time QC tests passed. These data are not to be used without scientific correction. A flag '3' may be assigned by an operator during additional visual QC for bad data that may be corrected in delayed mode.	An adjustment has been applied, but the value may still be bad.
4	Bad data	Data have failed one or more of the real-time QC tests, excluding Test 16. A flag '4' may be assigned by an operator during additional visual QC for bad data that are not correctable.	Bad data. Not adjustable.
5	Value changed	Value changed	Value changed
6	Not used	Not used	Not used
7	Not used	Not used	Not used
8	Estimated value	Estimated value (interpolated, extrapolated or other estimation).	Estimated value (interpolated, extrapolated or other estimation).
9	Missing value	Missing value	Missing value

Table 3: Argo QC flags

In the Argo data system, the **quality of a whole CTD profile** is also used and defined as the **percentage of levels** (in the CTD profile) **that contains good data** (Table 4). Good data is viewed as QC 1, 2, 5 or 8 from the table above.

n	Meaning
" "	No QC performed
A	***N*** = 100%; All profile levels contain good data.
B	75% <= ***N*** < 100%
C	50% <= ***N*** < 75%
D	25% <= ***N*** < 50%
E	0% < ***N*** < 25%
F	***N*** = 0%; No profile levels have good data.

Table 4: Argo profile quality flags

The following plots (Figure 9 and Figure 10) give an indication of the data quality of the observations collected by the MOCCA fleet. About 90% of the profiles contain 100% good data. 9% of the profiles contains at least 1 level flagged as bad data. Considering that MOCCA Iridium floats collect about 800 to 1000 levels for each Argo profile collected, that is not very significant. **Less than 2% of the MOCCA Argo profiles contains only bad data that should not be used by operational services and scientific users**. These concerns mainly the floats placed on the Grey list.

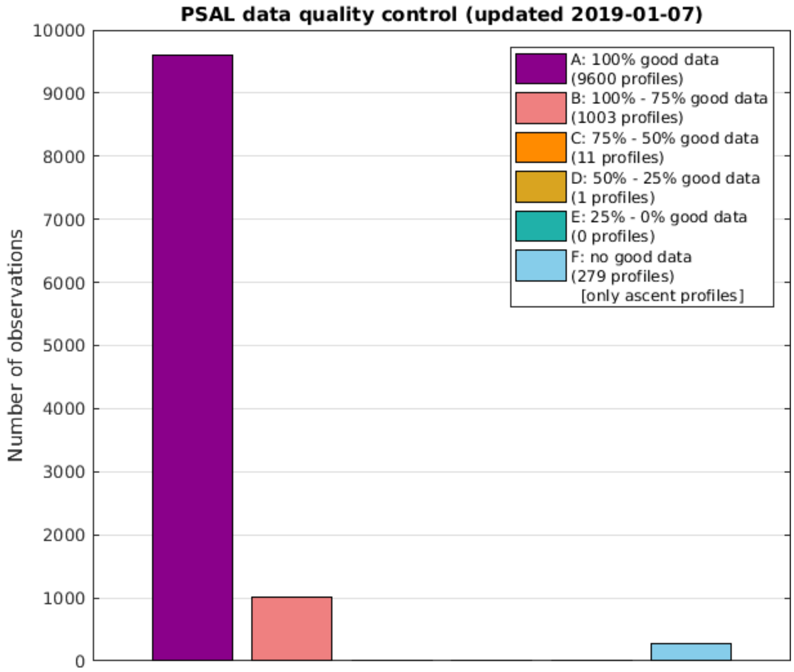
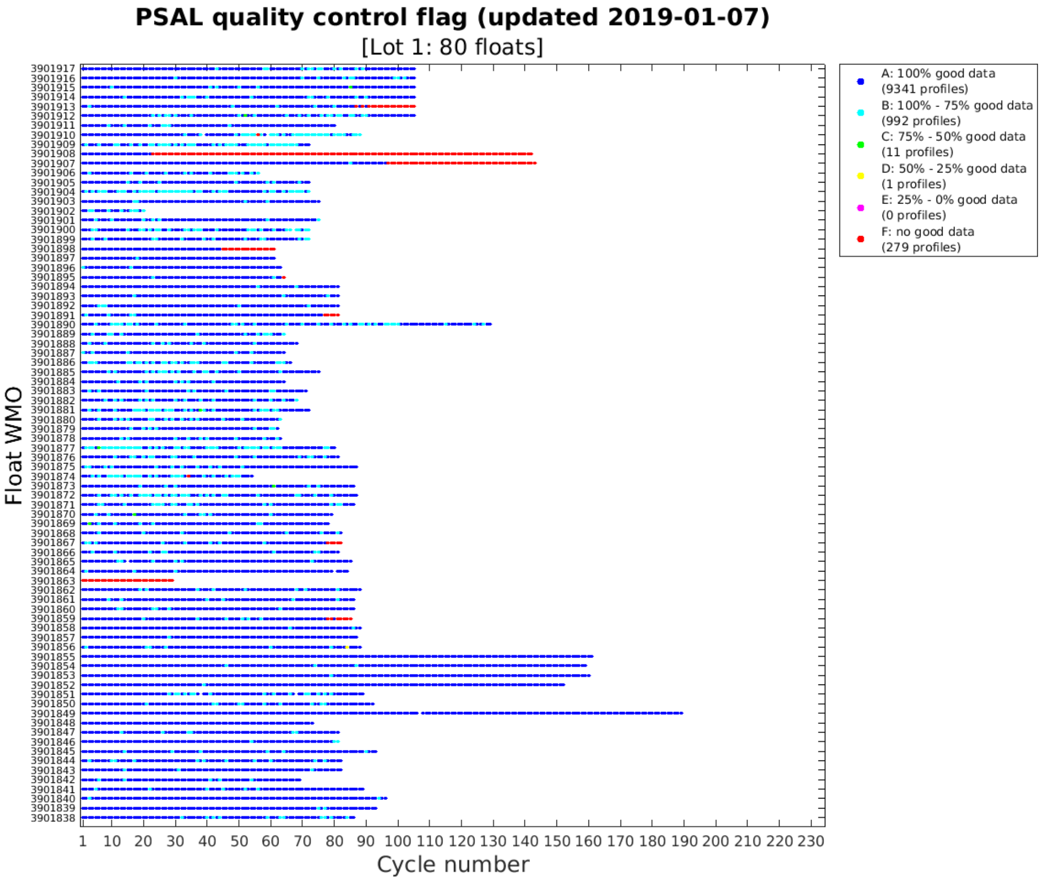


Figure 9: MOCCA Argo profiles quality flag for salinity.



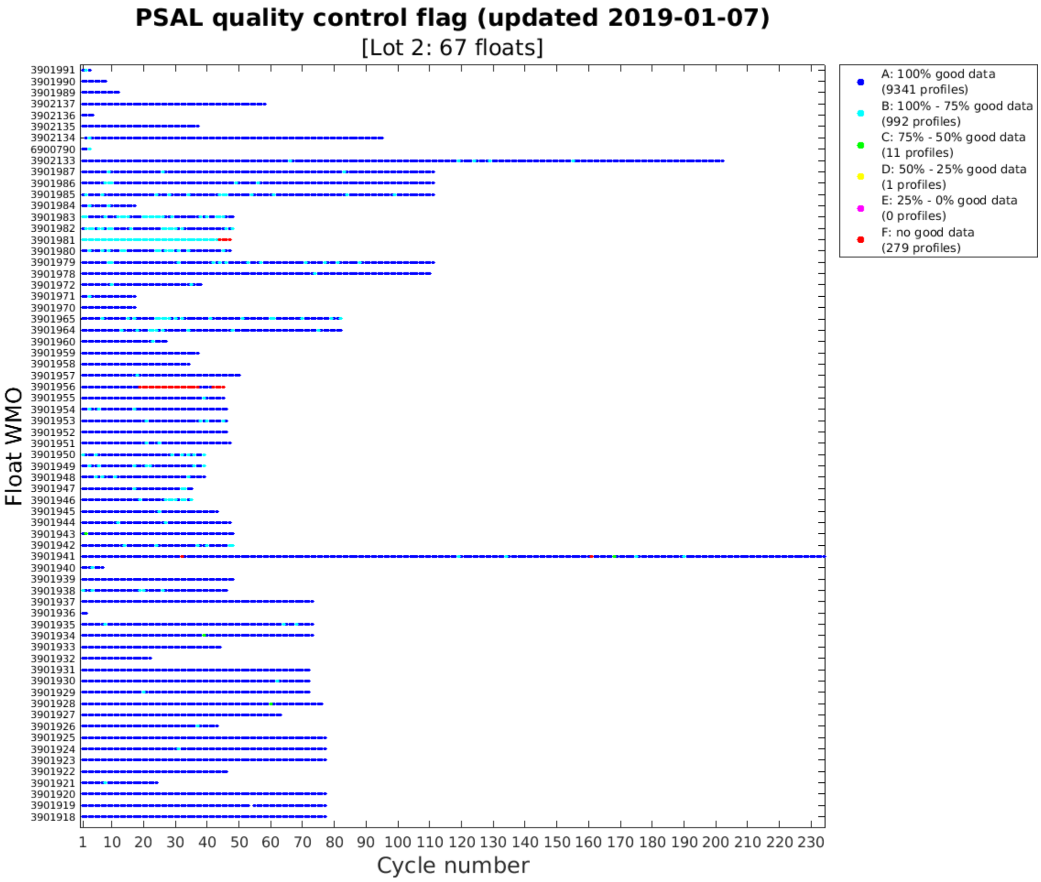
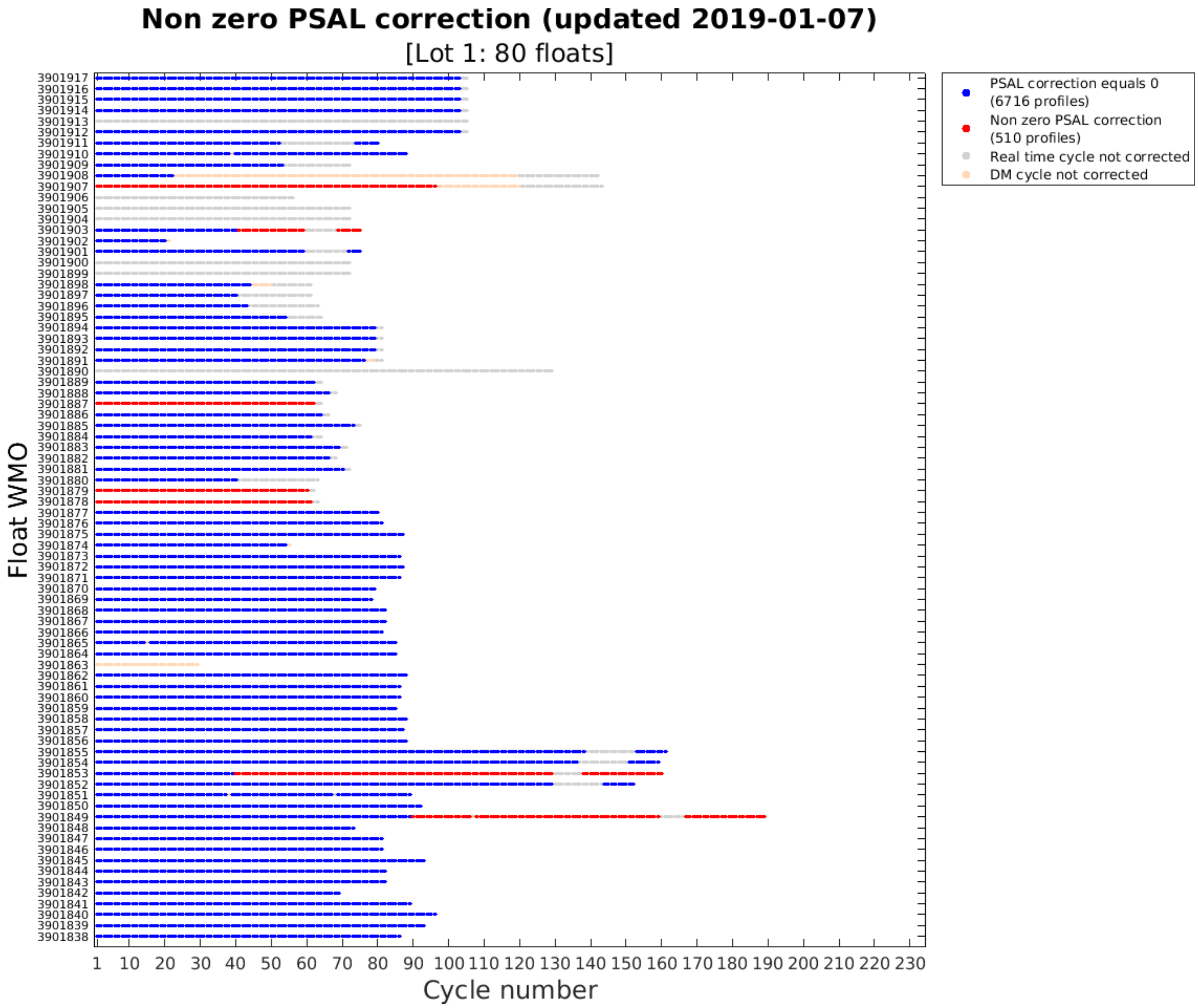


Figure 10: MOCCA Argo profiles quality flag for salinity, view cycle by cycle.

5.2. DMQC mean salinity adjustment

Salinity is the main parameter studied for the DMQC, specifically for checking sensor drifts and offsets. **One output of the DMQC is the decision taken by the operator to adjust or not float salinity values**. **When severe offsets or drifts are identified, the operator usually decides not to adjust the data and flag them as bad. When it is adjustable, a correction is applied.** This can be checked in Figure 11 that illustrates the decision of the DMQC operator to adjust or not the PSAL data:



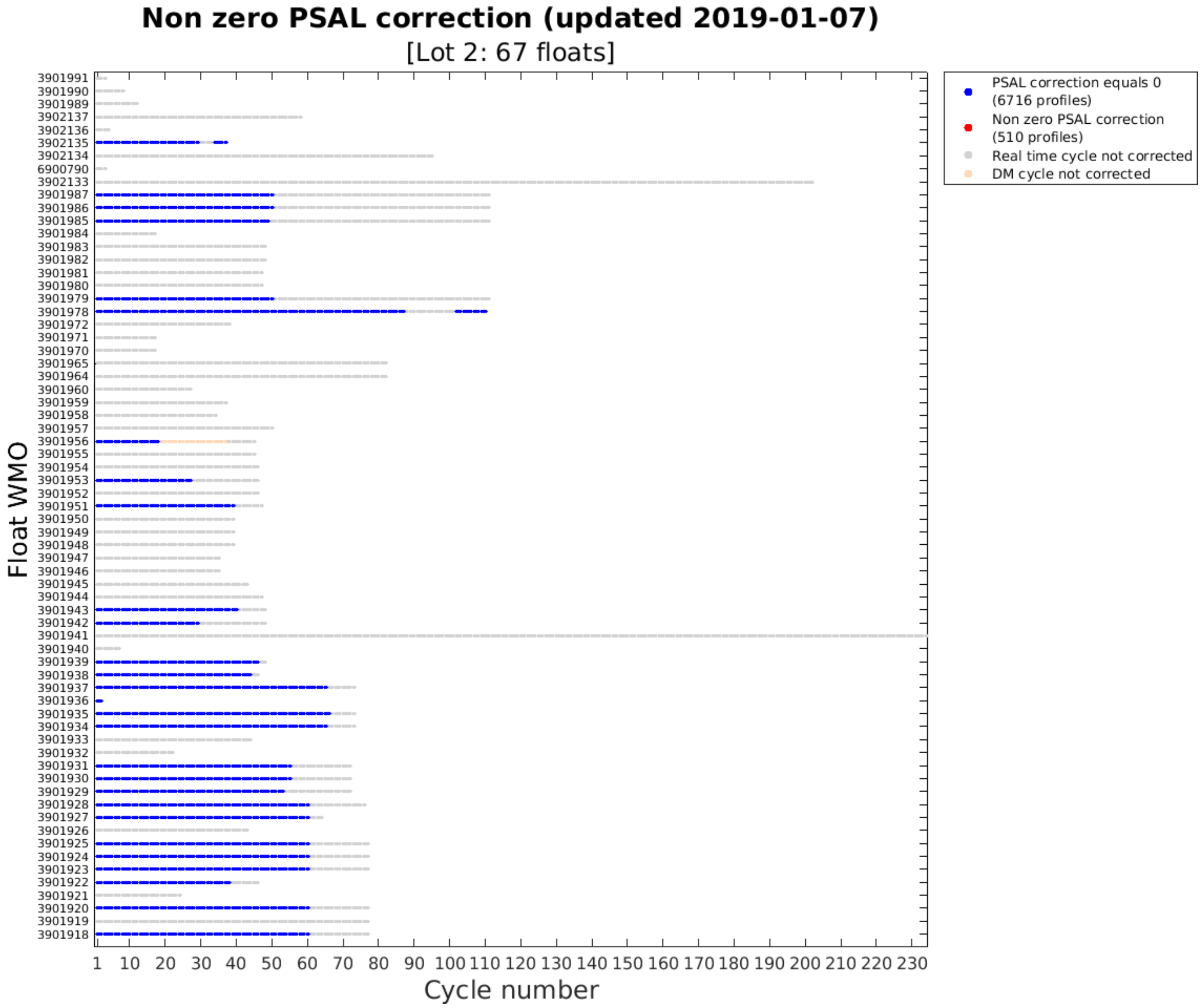


Figure 11: Status of the PSAL correction (null or not null) of the MOCCA floats.

Figure 12 depicts the mean salinity adjustments (as a result of the DMQC, when the DMQC operator decided to apply a correction to the PSAL data) for each of the adjusted MOCCA Argo profiles:

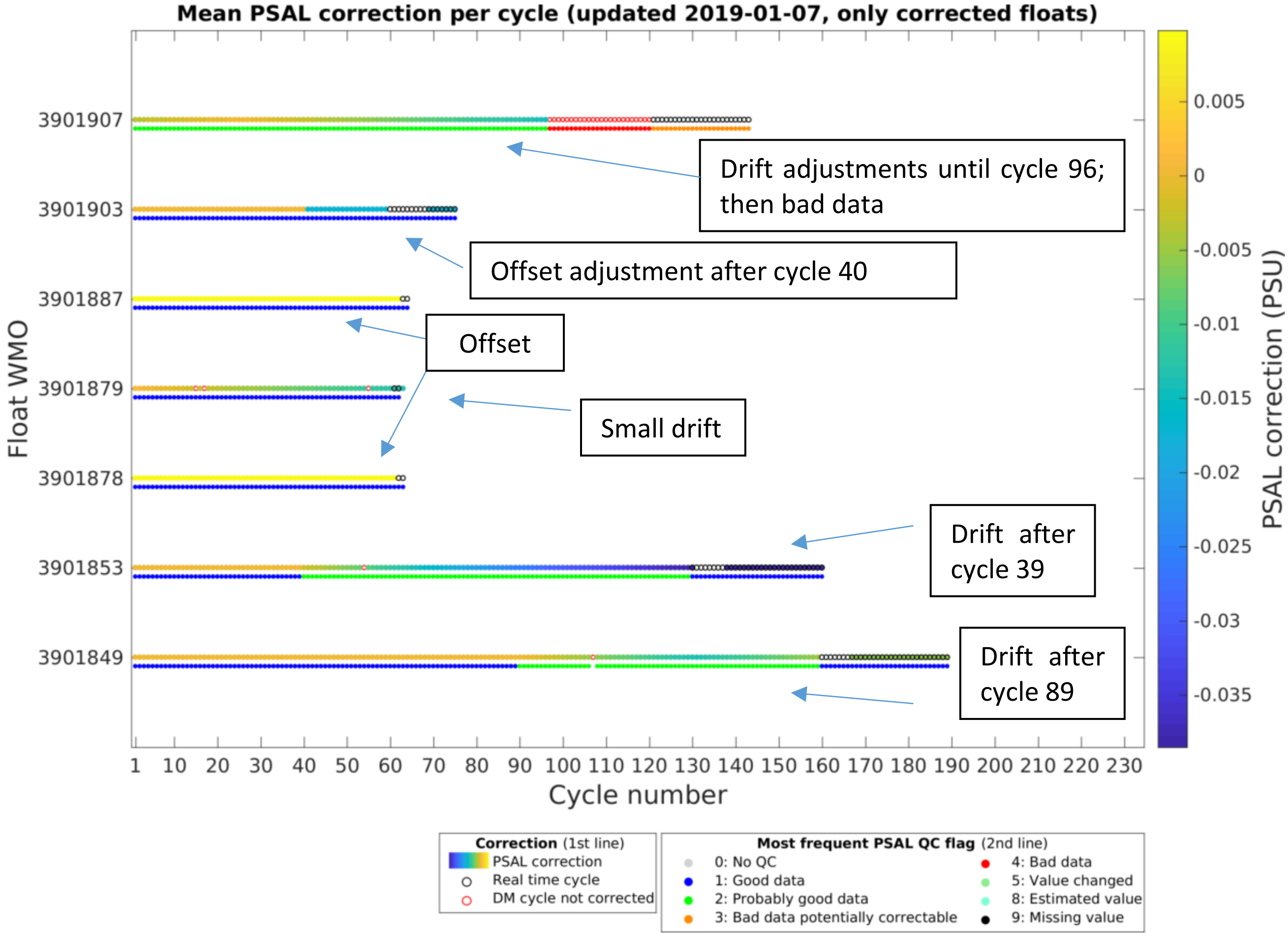


Figure 12: Mean salinity correction applied in delayed-mode to adjusted MOCCA Argo profiles, view cycle by cycle.

Figure 12 gives an indication of the level of correction applied to the salinity profiles in delayed-mode for the MOCCA fleet. The detailed summary of the DMQC analysis performed by each partner for each float is presented hereafter. Each partner has provided diagnostic plots or reports for each float.

An example of a complete report with diagnostic plots and analysis is provided in AnnexE: report on DMQC of MOCCA float WMO 3901849.

5.3. DMQC BSH

Status: 06.11.2018

WMO_ID		Float type	Deployment Date	Number of cycles	Date of last DMQC Files controlled	Date of next DMQC	Result of DMQC
3901838		Arvor	2016/08/23	1-81	D2 (05/2018) 1-64	Dec. 2018	No correction needed
3901839		Arvor	2016/06/25	1-87	D2 (06/2018) 1-72	Jan. 2019	High natural variability, no correction needed now
3901840		Arvor	2016/05/29	1-89	D3 (06/2018) 1-76	Jan. 2019	No correction needed
3901841		Arvor	2016/07/31	1-83	D2 (06/2018) 1-69	Jan. 2019	No correction needed now, tendency at end
3901842		Arvor	2016/10/09	1-71	D2 (06/2018) 1-61	Jan. 2019	No correction needed
3901843		Arvor	2016/10/13	1-76	D2 (06/2018) 1-62	Jan. 2019	No correction needed
3901844		Arvor	2016/10/13	1-76	D2 (06/2017) 1-61	Jan. 2019	No correction needed
3901845		Arvor	2016/06/26	1-87	D2 (06/2018) 1-72	Jan. 2019	No correction needed, high natural variability
3901846		Arvor	2016/06/25	1-75	D2 (05/2018) 1-58	Dec. 2018	No correction needed, little reference data
3901847		Arvor	2016/05/29	1-75	D2 (05/2017) 1-58	Dec. 2018	No correction needed, little reference data
3901850		Arvor	2016/06/24	1-87	D2 (06/2018) 1-72	Jan. 2019	No correction needed, S very noisy
3901851		Arvor	2016/06/25	1-87	D2 (06/2017) 1-72	Jan. 2019	No correction needed
3901856		Arvor	2016/08/09	1-82	D2 (06/2018) 1-68	Jan. 2019	No correction needed
3901857		Arvor	2016/08/12	1-82	D2 (06/2018) 1-68	Jan. 2019	No correction needed
3901858		Arvor	2016/08/14	1-82	D2 (06/2018) 1-68	Jan. 2019	No correction needed
3901859		Arvor	2016/09/01	1-80	D2 (06/2018) 1-66	Jan. 2019	No correction needed
3901860		Arvor	2016/09/05	1-80	D2 (06/2018) 1-66	Jan. 2019	No correction needed
3901861		Arvor	2017/09/06	1-79	D2 (06/2018) 1-65	Jan. 2019	No correction needed
3901862		Arvor	2016/08/11	1-82	D2 (06/2018) 1-68	Jan. 2019	No correction needed, S very noisy
3901863		Arvor	2016/08/12	1-34†	D1 (11/2017) 1-34	------------	All data are bad, no need for formal dmqc
3901864		Arvor	2016/08/09	1-79	D2 (06/2018) 1-65	Jan. 2019	No correction needed
3901865		Arvor	2016/08/09	1-79	D2 (06/2018) 1-65	Jan. 2019	No correction needed
3901866		Arvor	2016/10/17	1-75	D2 (06/2018) 1-62	Jan. 2019	No correction needed, little reference data
3901867		Arvor	2016/10/11	1-76	D2 (04/2018) 1-55	Dec. 2018	No correction needed, little reference data
3901868		Arvor	2016/10/12	1-76	D2 (04/2018) 1-55	Dec. 2018	No correction needed, little reference data
3901869		Arvor	2016/11/10	1-73	D2 (06/2018) 1-59	Jan. 2019	No correction needed
3901870		Arvor	2016/11/10	1-73	D2 (06/2018) 1-59	Jan. 2019	No correction needed
3901872		Arvor	2016/08/29	1-81	D2 (06/2018) 1-67	Jan. 2019	No correction needed
3901873		Arvor	2016/08/23	1-80	D2 (06/2018) 1-66	Jan. 2019	No correction needed, S noisy
3901874		Arvor	2016/08/22	1-58†	D2 (06/2018) 1-58	--------------	No correction needed
3901875		Arvor	2016/08/23	1-81	D2 (06/2018) 1-67	Jan. 2019	No correction needed, S noisy
3901876		Arvor	2016/10/17	1-75	D2 (06/2018) 1-62	Jan. 2019	No correction needed, higher natural variability
3901877		Arvor	2016/10/21	1-75	D2 (06/2018) 1-61	Jan. 2019	No correction needed now, higher natural variability, offset unclear
3901895	BODC	Arvor	2017/04/14	1-57	D1 (10/2018) 1-54	Apr. 2019	No correction needed now, higher natural variability
3901896	BODC	Arvor	2017/04/24	1-56	D1 (06/2018) 1-43	Jan. 2019	No correction needed
3901897	BODC	Arvor	2017/05/10	1-55	D2 (06/2018) 1-41	Jan. 2019	No correction needed
3901898	BODC	Arvor	2017/05/10	1-55	D3 (09/2018) 1-50	Jan. 2019	No correction needed now, strong tendency at end
3901909	BODC	Arvor	2016/12/29	1-68	D1 (07/2018) 1-55	Feb. 2019	No correction needed now, little reference data, unclear behaviour
3901910		Arvor	2017/06/29	1-71	D2 (06/2018) 1-50	Jan. 2019	No correction needed
3901911		Arvor	2017/06/27	1-71	D1 (06/2018) 1-52	Jan. 2019	No correction needed
3901940		Arvor	2017/09/20	1-7AD†	Baltic	Dec. 2018	Pending until after ADMT-19
3901941		Arvor	2017/09/21	1-207AD	Baltic	Dec. 2018	Pending until after ADMT-19
3901942	BODC	Arvor	2017/09/20	1-41	D1 (07/2018) 1-29	Feb. 2019	No correction needed
3901946	BODC	Arvor	2018/01/23	1-29	D1 (09/2018) 1-21	Mar. 2019	No correction needed
3901947	BODC	Arvor	2018/01/23	1-29	D1 (09/2018) 1-21	Mar. 2019	No correction needed
3901952	BODC	Arvor	2017/10/05	1-40	D0 (07/2018) 1-28	Feb. 2019	No D-files submitted because of unclear behaviour
3901953	BODC	Arvor	2017/10/05	1-40	D1 (07/2018) 1-27	Feb. 2019	No correction needed, high natural variability
3901979	BODC	Arvor	2018/02/06	1-91	D1 (07/2018) 1-50	Feb. 2019	No correction needed, 3 day cycle
3901985	BODC	Arvor	2018/02/07	1-90	D1 (07/2018) 1-49	Feb. 2019	No correction needed, 3 day cycle
3901986	BODC	Arvor	2018/02/06	1-91	D1 (07/2018) 1-50	Feb. 2019	No correction needed, 3 day cycle
3901987	BODC	Arvor	2018/02/06	1-91	D1 (07/2018) 1-50	Feb. 2019	No correction needed, 3 day cycle
3902133 former 3901940		Arvor	2017/11/03	1-182AD	Baltic	Dec. 2018	Pending until after ADMT-19
3901966	BODC	Arvor	2018/04/07	1-22		Dec. 2018	----
3901967	BODC	Arvor	2018/04/16	1-21		Dec. 2018	----
3901968	BODC	Arvor	2017/11/02	1-37	D1 (10/2018) 1-35	Apr. 2019	No correction needed, little reference data

3901969	BODC	Arvor	2018/04/14	1-21		Dec. 2018	----
3902135		Arvor	2018/01/01	1-31	D1(10/2018)1-29	Apr. 2019	No correction needed, little reference data
3902136		Arvor	2017/12/30	1-4†		Dec. 2018	----

5.4. DMQC BODC

5.4.1. Summary

BODC is responsible for the DMQC of 30 floats as part of the MOCCA project. This first batch of DMQC was performed based on floats that were greater than 1 year old as of 30/11/2018, and therefore eligible for DMQC. The summary of the DMQC assessment is:

- 21 floats required no correction;
- 1 float required no correction up to profile 40, after which a significant drift developed and the files have been left in R-mode until more data is available;
- 6 floats were not yet eligible for DMQC;
- 2 floats were corrected for small offsets in salinity of around 0.01;
- 1 float was corrected for a small drift in salinity;
- 1 float has a large and variable drift which will need further review at a future date.

5.4.2. Individual Float Assessment

WMO	Status	No. of cycles	Ocean features (in order)	Correction on salinity	Other
3901878	Active	60	SAG	Offset = + 0.0095 Drift = 0; Error: +/- 0.01	None
3901879	Active	59	ACC, WG	Offset = 0; Drift = -0.014929 overall (-0.00024079 per cycle); Error = +/- 0.01; insufficient CTD reference data, relied on Argo only	None
3901880	Active	60	SAG	No correction needed up to cycle 40 - significant sensor drift from cycle 41 onwards, revisit in future review	None
3901881	Active	69	ACC, SAG	No correction needed, high natural variability from Sub-Antarctic Front	None
3901882	Active	65	ACC	No correction needed	None
3901883	Active	69	ACC	No correction needed	None
3901884	Active	61	SAG	No correction needed, although CTD reference and Argo reference give contradictory recommendations	None
3901885	Active	73	ACC	No correction needed, little CTD reference data, relied on Argo only	None
3901886	Active	63	ACC, SAG	No correction needed, little CTD reference data, relied on Argo only	None
3901887	Active	61	SAG	Offset = 0.0098; Drift = 0; Error = +/- 0.01	None
3901888	Active	66	ACC	No correction needed, little CTD reference data, relied on Argo only	None
3901889	Active	62	ACC	No correction needed, high natural variability from Sub-Antarctic Front	None
3901891	Active	78	ACC, SAG	No correction needed, high natural variability from Sub-Antarctic Front, little CTD reference data, relied on Argo only	Grey list for salinity
3901892	Active	78	ACC, SAG	No correction needed	None
3901893	Active	78	SAG	No correction needed	None
3901894	Active	78	ACC	No correction needed	None
3901912	Active	102	AC, AR	No correction needed, high natural variability from Agulhas Retroflection	None
3901913	Active	102	AC, AR, ACC	Large variable drift, deemed unreliable - requires further review	Grey list for salinity
3901914	Active	102	AC, AR, ACC	No correction needed, high natural variability from Agulhas Retroflection	None

3901915	Active	102	AC, AR, BC	No correction needed, high natural variability from Agulhas Retroflection	None
3901916	Active	102	AC, AR, ACC	No correction needed, high natural variability from Agulhas Retroflection	None
3901917	Active	102	AC, AR	No correction needed, high natural variability from Agulhas Retroflection	None
3901938	Active	43	SAG	No correction needed	None
3901939	Active	45	SAG	No correction needed	None
3901948	Active	36	ACC	Float not yet 1-year old	None
3901949	Active	36	ACC	Float not yet 1-year old	None
3901950	Active	36	ACC	Float not yet 1-year old	None
3901958	Active	31	ACC/WG	Float not yet 1-year old	None
3901959	Active	35	ACC/WG	Float not yet 1-year old	None
3901960	Under-ice	27	ACC/WG	Float not yet 1-year old	None

5.4.3. Oceanographic feature acronyms:

The large-scale oceanographic circulation features in which the floats have drifted are noted in the table to aid with characterising the float:

- AC = Agulhas Current
- ACC = Antarctic Circumpolar Current
- AR = Agulhas Retroflection
- BC = Benguela Current
- SAG = South Atlantic Gyre
- WG = Weddell Gyre

5.4.4. Under-ice floats

Floats with a status listed as under-ice have not reported profiles some a significant period of time, but may well return from under-ice at a later date. As a result, the number of profiles is less than expected compared to floats of a similar age.

5.4.5. DMQC Operator

The operator for this batch of DMQC was Matt Donnelly, BODC-NOC (matdon@bodc.ac.uk).

5.5. DMQC Ifremer

5.5.1. 2016 Deployments

Summary

WMO Number	DM Salinity correction
3901871	No correction
3901901	No correction
3901902	No correction
3901903	No correction[1:40] OWC[41:59]
3901918	No correction
3901919	No correction
3901920	No correction
3901923	No correction
3901924	No correction
3901925	No correction
3901927	No correction
3901928	No correction

Real Time QC flags were verified and modified if necessary. Table 3 gives the list of flags that have been modified during the delayed mode process.

WMO Number	Cycle	Param	Old flag	New flag	Levels	Date of modification
3901871	007A	PSAL	1	4	111.2 : 112.1	18/09/2018
	060A	PSAL	1	4	619.9 : 619.9	18/09/2018
3901901	020A	PSAL	1	4	1299.9 : 1990.4	01/10/2018
3901902	016A	PSAL	1	4	92.4 : 92.4	18/09/2018
	018A	PSAL	1	4	165.9 : 165.9	18/09/2018
	020A	PSAL	1	4	234.4 : 234.4	18/09/2018
3901928	060A	PSAL	1	4	6 : 6	08/08/2018

Table 3: Modified flags during DM analysis

WMO Number	Calibration: Comparison with the reference CTD cast	Calibration: Correction from OWC method (CTD ref)	Correction applied in the D files
3901903	na	-0.0014 $\pm$ 0.0121 [1:40] -0.0168 $\pm$ 0.0135 [41:59] (config. 129)	No correction[1:40] OWC[41:59]

5.5.1. 2017 Deployments

WMO Number	DM Salinity correction
3901929	No correction
3901930	No correction
3901931	No correction
3901956	No Correction[1:18] Unusable data[19:37]

Table 1: Salinity Correction applied in delayed mode for each float

WMO Number	Cycle	Param	Old flag	New flag	Levels	Date of modification
3901930	013A	PSAL	1	4	1713 : 1976	17/10/2018
		TEMP	1	4	1713 : 1976	17/10/2018
		PSAL	1	4	1588 : 1688	17/10/2018
		TEMP	1	4	1588 : 1688	17/10/2018
3901956	019A	PSAL	1	4	3.1 : 1975.5	18/10/2018
	020A	PSAL	1	4	3.9 : 1975.9	18/10/2018
	021A	PSAL	1	4	2.9 : 1987.1	18/10/2018
	022A	PSAL	1	4	3 : 1976.5	18/10/2018
	023A	PSAL	1	4	3.5 : 1990.8	18/10/2018
	024A	PSAL	1	4	3.6 : 1997.4	18/10/2018
	025A	PSAL	1	4	3.1 : 2011.6	18/10/2018
	026A	PSAL	1	4	2.9 : 2021.7	18/10/2018
	027A	PSAL	1	4	3 : 1992	18/10/2018
	028A	PSAL	1	4	2.9 : 1982.4	18/10/2018
	029A	PSAL	1	4	2.9 : 1986.8	18/10/2018
	030A	PSAL	1	4	3.8 : 2006.2	18/10/2018
	031A	PSAL	1	4	3.2 : 1996.5	18/10/2018
	032A	PSAL	1	4	3 : 1992.6	18/10/2018
	033A	PSAL	1	4	3.2 : 2003.2	18/10/2018
	034A	PSAL	1	4	3.9 : 1985.6	18/10/2018
	035A	PSAL	1	4	3.7 : 1977	18/10/2018
	036A	PSAL	1	4	2.9 : 1982.3	18/10/2018
	037A	PSAL	1	4	3.3 : 1980.9	18/10/2018

Table 3: Modified flags during DM analysis

WMO Number	Calibration		Correction applied in the D files
	Comparison with the reference CTD cast	Correction from OWC method (CTD ref)	
3901929	na	-0.0068 ± 0.0149 (config. 129)	No correction
3901930	na	-0.0031 ± 0.01 (config. 129)	No correction
3901931	na	-0.01 ± 0.0139 (config. 129)	No correction
3901956	na	-0.0095 ± 0.0121 [1:18] -0.016*t + -0.052 ± 0.009 [19:37] (config. 129)	No Correction[1:18] Unusable data[19:37]

Table 5: Salinity corrections for the floats proposed by the OWC method or by comparison with a shipboard CTD reference profile. Uncertainties are the statistical uncertainties from the OW method.

5.6. DMQC OGS

Float WMO	Status	Correction on salinity	Flag applied to PSAL_ADJUSTED	Pressure	Other
3901907	Active	YES, drift detected, OW applied	Profile 1 to 96 → flag 2 Profile 97 to 120 → flag 4	Autocorrecting	Grey list for salinity (real time)
3901849	Active	YES, drift detected, OW applied	Profile 1 to 89 → flag 1 Profile 90 to 159 → flag 2	Autocorrecting	none
3901848	Inactive	NO	Profile 1 to 73 → flag 1	Autocorrecting	none
3901978	Active	NO	Profile 1 to 87 → flag 1	Autocorrecting	none
3901853	Active	YES, drift detected, OW applied	Profile 1 to 39 → flag 1 Profile 40 to 130 → flag 2	Autocorrecting	none
3901908	Active	Drift detected, unadjustable	Profile 1 to 22 → flag 1 Profile 23 to 119 → flag 4	Autocorrecting	Grey list for salinity (real time)
3901855	Active	NO	Profile 1 to 138 → flag 1	Autocorrecting	none
3901852	Active	NO	Profile 1 to 129 → flag 1	Autocorrecting	none
3901854	Active	NO	Profile 1 to 136 → flag 1	Autocorrecting	none

6. CONCLUSION

DMQC of the MOCCA fleet is underway. No particular difficulties are anticipated.

7. ANNEXE: REPORT ON DMQC OF MOCCA FLOAT WMO 3901849

Report from Giulio

DELAYED MODE QUALITY CONTROL OF THE MOCCA ARGO FLOAT WMO 3901849 IN THE MEDITERRANEAN SEA

G. Notarstefano

Produced by the Mediterranean Argo Regional Centre (MedArgo), OGS, Trieste, Italy

October, 2018

1. Float data

The float data were downloaded in September 2018 from the Coriolis Global Data Assembly Centre (GDAC), based in Brest, France, in NetDCF format. The data were converted in MatLab binary files.

2. Status of the float

The float was deployed in the Central Mediterranean (Thyrrhenian sub-basin) in June 2016 (Figure 1) and performed 159 cycles at the moment of this analysis (Table 1). The salinity, potential temperature and potential density profiles are depicted in Figures 2, 3 and 4, respectively.

Model	WMO	Deploy Date	Lat	Lon	Cycle	Last Date	Lat	Lon	Status
Arvor	3901849	5-Jun-2016 11:43	39.26	10.77	159	5-Aug-2018 11:57	37.88	3.50	Alive

Table 1. Status of the float.

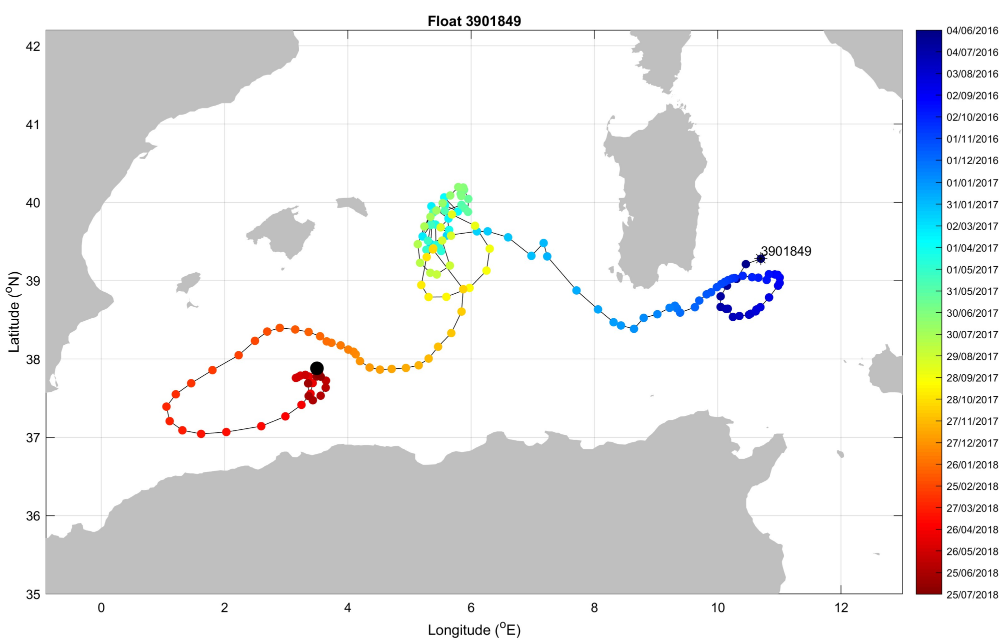
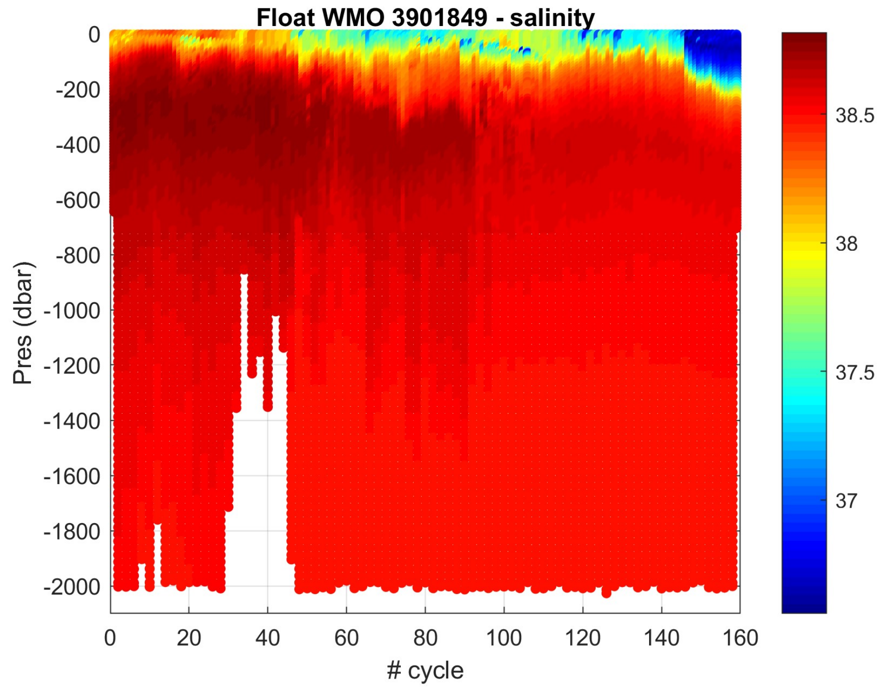


Figure 1. Float trajectory color-coded per time (the black dot represents the last float position).



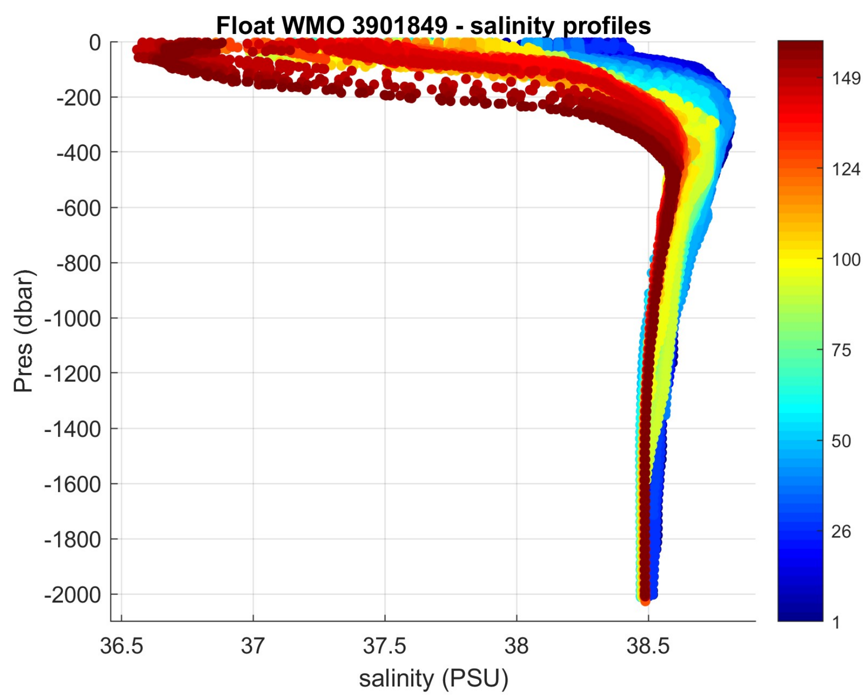
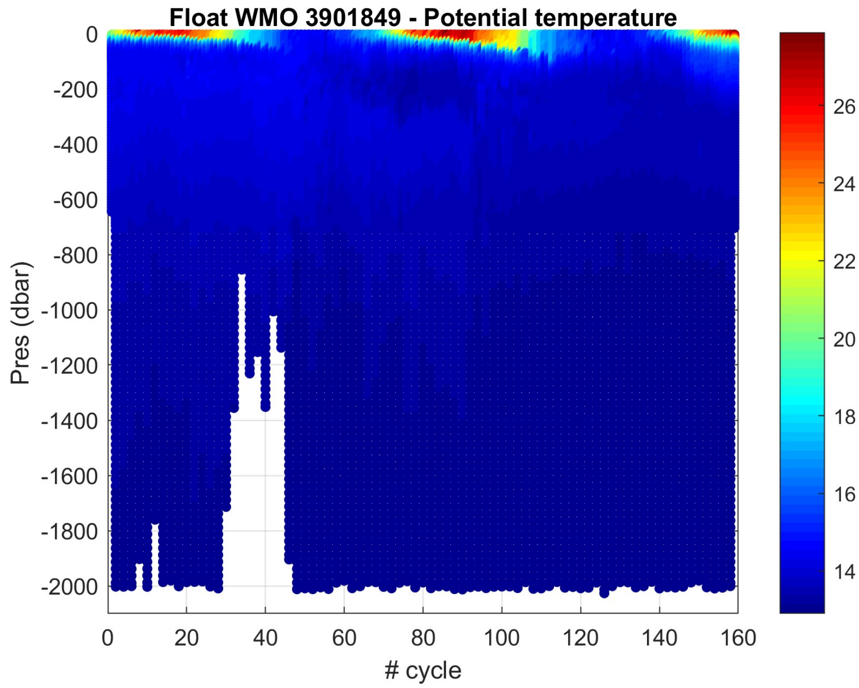


Figure 2. Salinity section along the float trajectory (upper panel) and salinity profiles color-coded per cycle number (bottom panel).



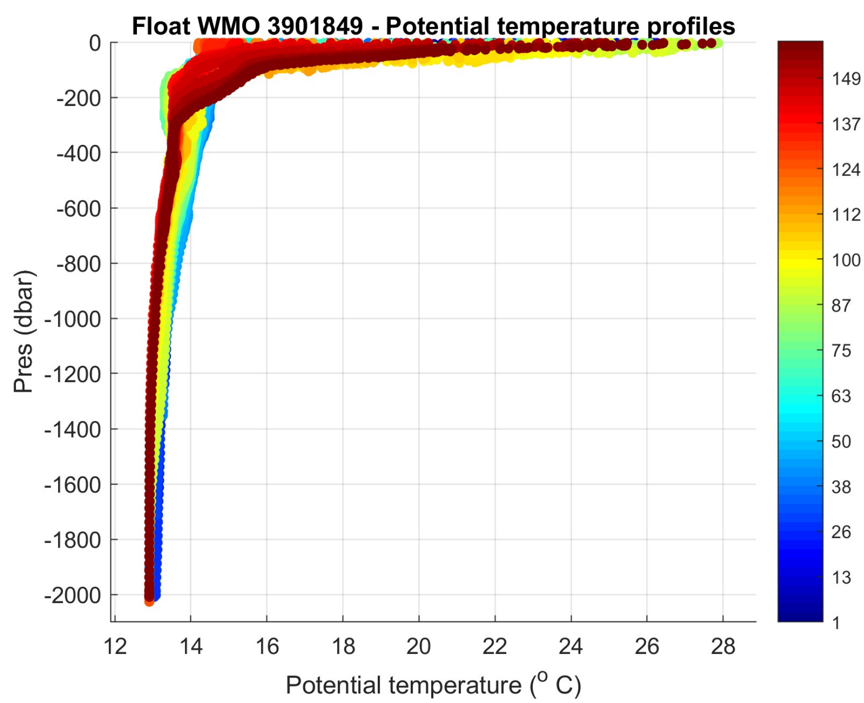


Figure 3. Potential temperature (°C) section along the float trajectory (upper panel) and potential temperature profiles color-coded per cycle number (bottom panel).

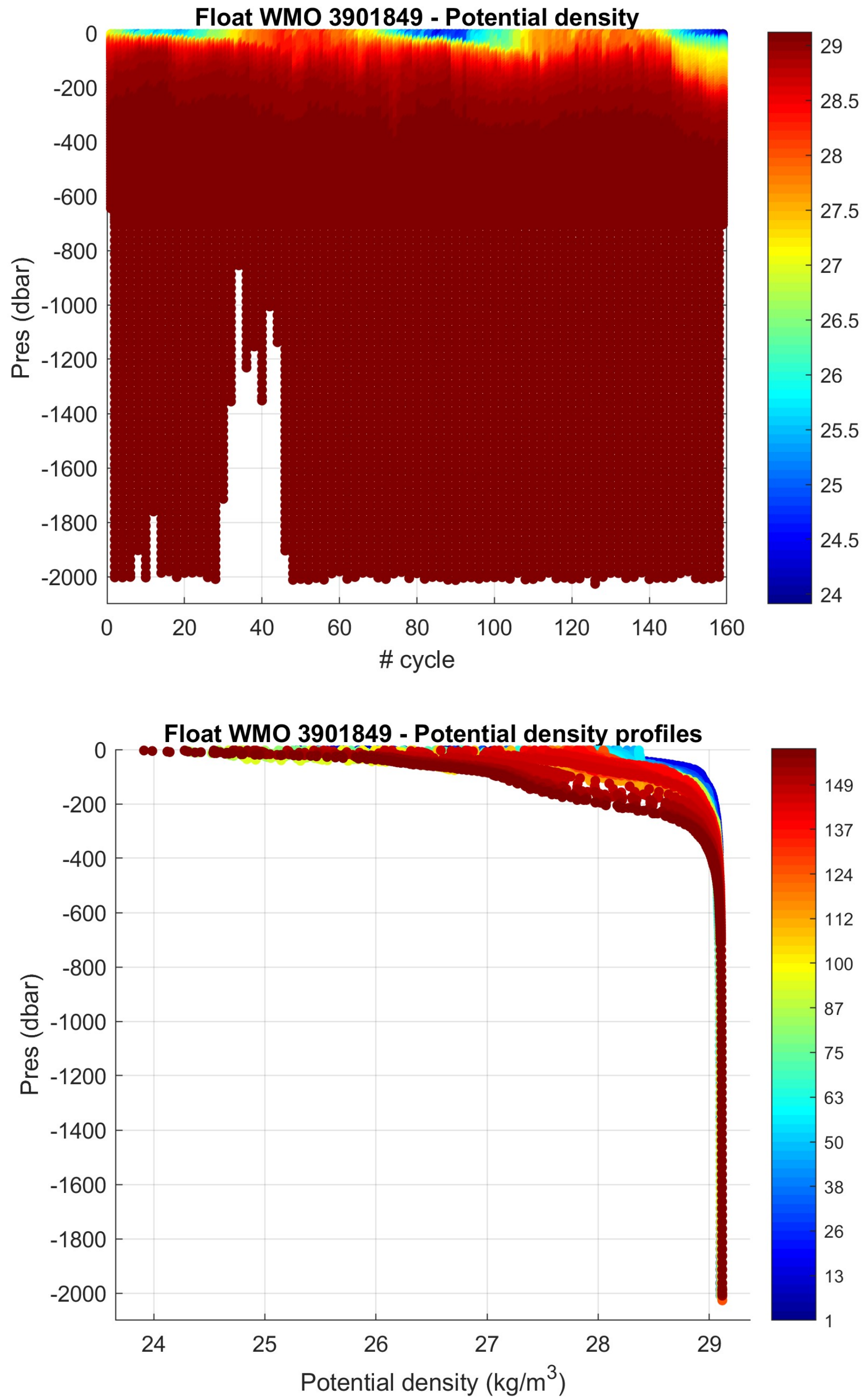


Figure 4. Potential density (kg/m^3) section along the float trajectory (upper panel) and potential density profiles color-coded per cycle number (bottom panel).

3. Surface pressure

The adjusted surface pressure is plotted in Figure 5. Surface pressure is extracted from the Argo technical file: the variable name is "PRES_SurfaceOffsetCorrectedNotResetNegative_1cBar Resolution_dbar". No adjustment of the CTD pressure profiles is required because the data is auto-corrected on board the float.

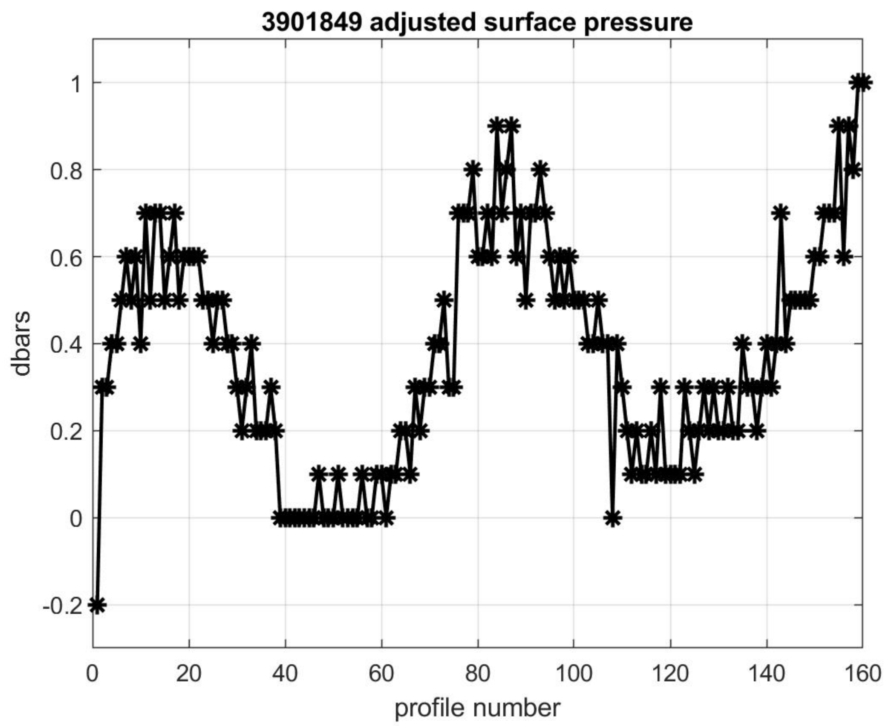
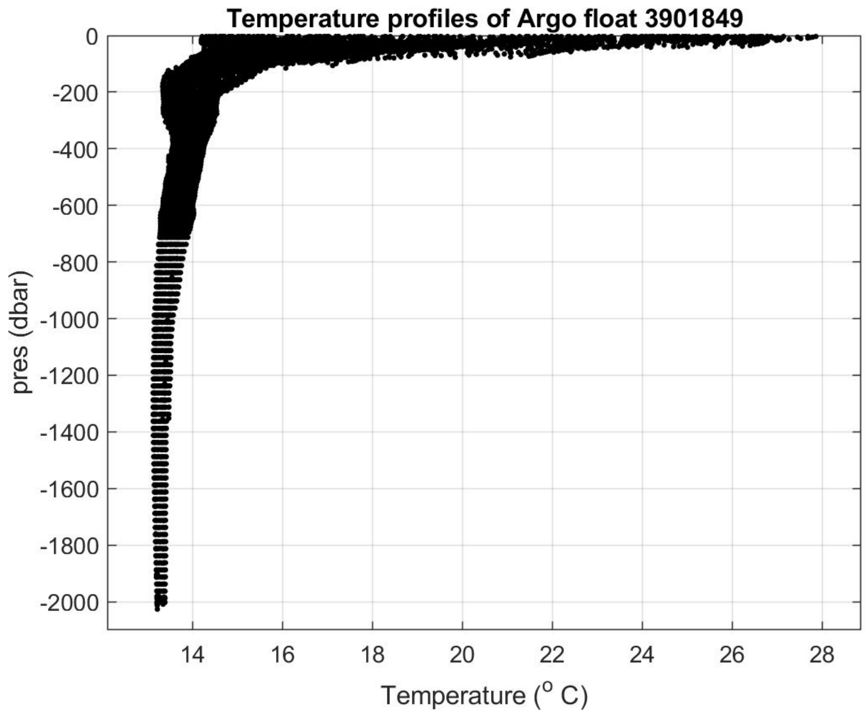


Figure 5. Adjusted surface pressure values versus profile number.

4. Manual inspection and identification of major spikes in temperature and salinity

No major spikes in temperature and salinity were found (Figures 6 and 7).



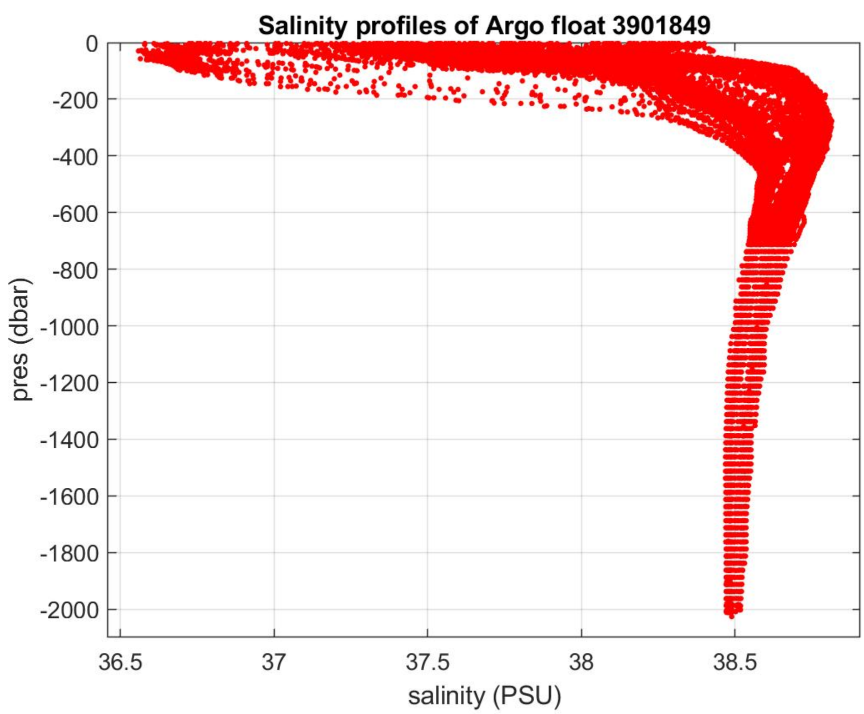


Figure 6. Temperature (upper panel) and salinity (bottom panel) profiles as they are in real time correction mode.

5. Reference dataset

The reference dataset used in the delayed mode quality control (DMQC) method, as of September 2018, is composed of the following CTD and Argo historical datasets: the profiles locations are plotted in Figures 7 and 9 and the yearly distribution in Figures 8 and 10.

CTD:

- CMEMS: INSITU_MED_TS_REP_OBSERVATIONS_013_041
- CMEMS: INSITU_BS_TS_REP_OBSERVATIONS_013_042
- Coriolis: CTD_for_DMQC_2018V01
- Historical CTD profiles provided through personal contact

Argo:

- ARGO_for_DMQC_2018V01

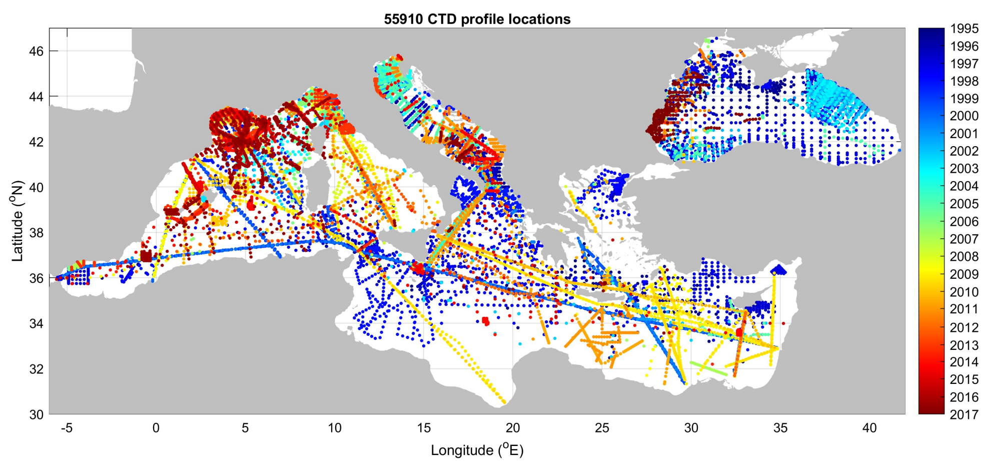


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Figure 7. Location of the historical CTD data, up to 2017, used in the DMQC analysis.

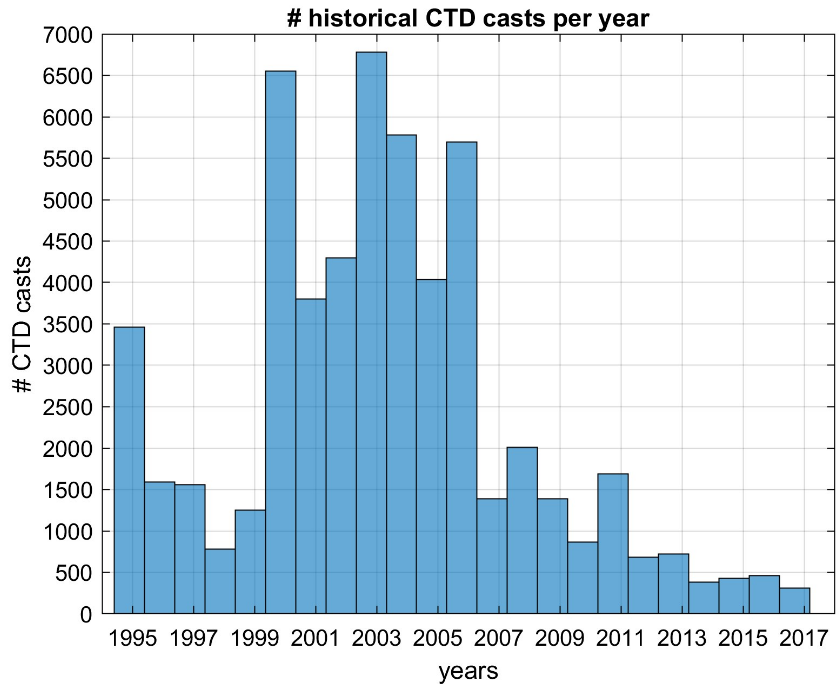


Figure 8. Yearly distribution of the historical CTD data, up to 2017, used in the DMQC analysis.

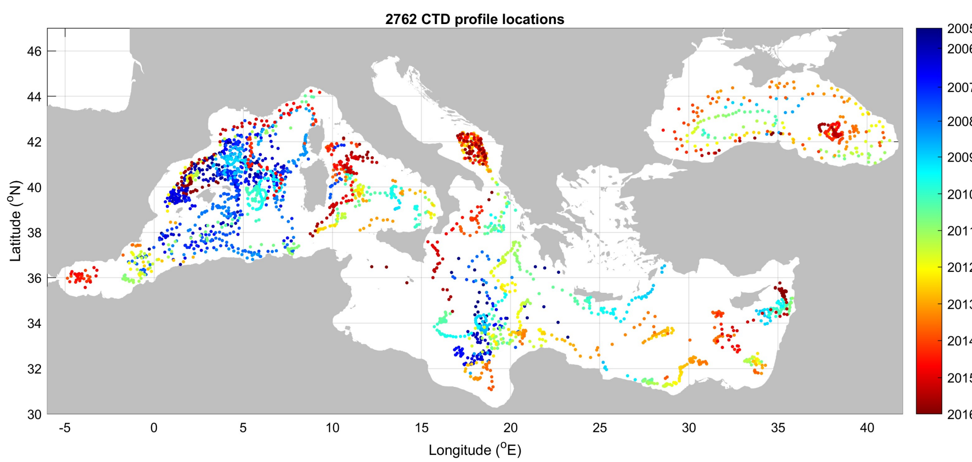


Figure 9. Location of the historical Argo data, up to 2017, used in the DMQC analysis.

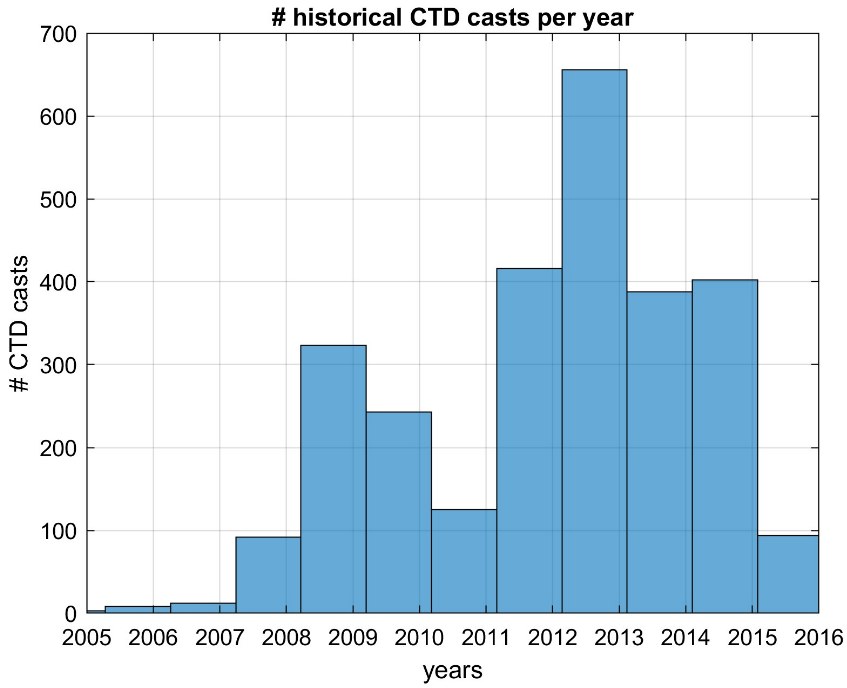


Figure 10. Yearly distribution of the historical Argo data, up to 2017, used in the DMQC analysis.

6. Analysis before the OW approach

Before running the Owens and Wong method, referred to as OW hereafter, the theta-salinity (θ-S) diagram of the float is analyzed (Figure 11) and in particular the area where the θ-S relationship is the tightest (Figure 12). The analysis of this portion of the θ-S curve can help in detecting sensor salinity anomalies. A positive salinity drift is observed after about profile 90.

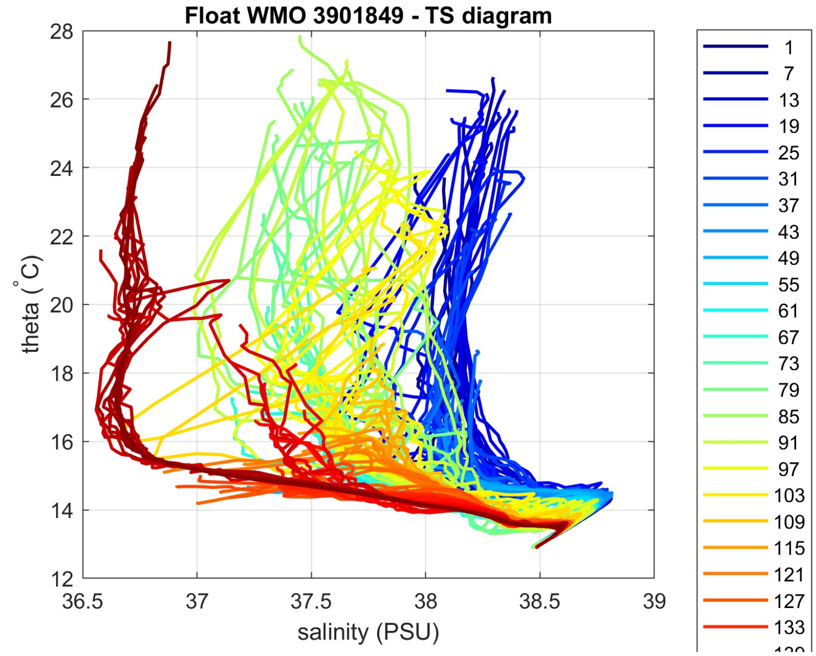


Figure 11. θ-S diagram color-coded per cycle number.

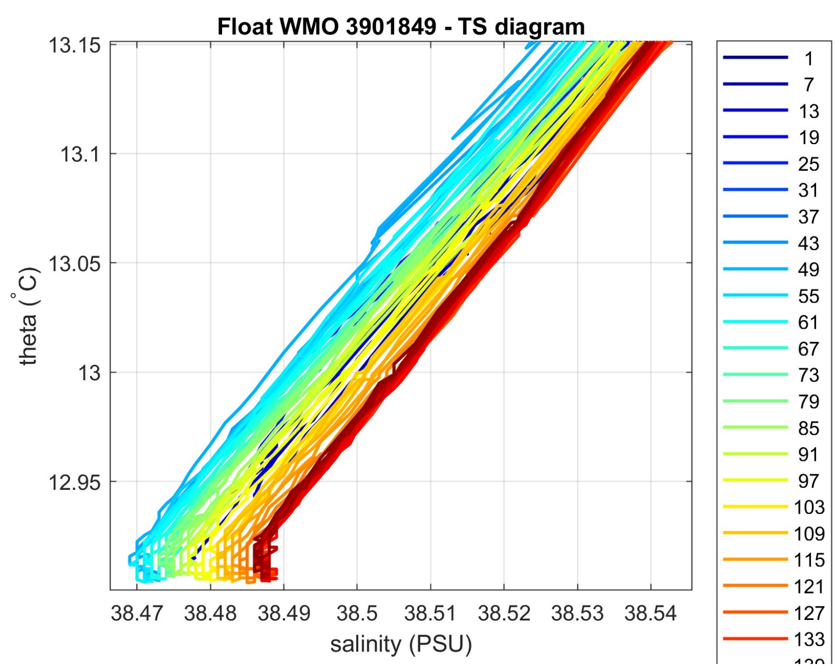


Figure 12. Area of the θ-S diagram (color-coded per cycle number) where the θ-S relationship is more uniform.

Three salinity float profiles are selected to perform a comparison (in time and space) with the historical data. The salinity float profile is depicted in black while other colours represent the salinity reference profiles in Figures 13, 14, 15. The red colour means that the historical data are more recent with respect to the float ones, while magenta states that the float data are more recent than the historical ones (the maximal difference is 3 years). A time difference between 3 and 6, 6 and 9 and larger than 9 years is depicted in green, cyan and blue, respectively.

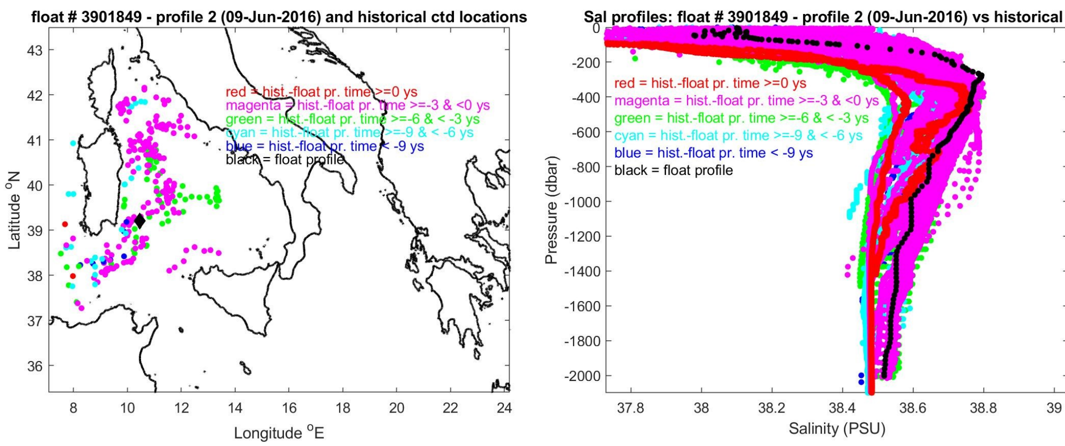


Figure 13. Locations of the salinity float profile number 2 and historical CTD data (right panel) and the respective salinity profiles (left panel).

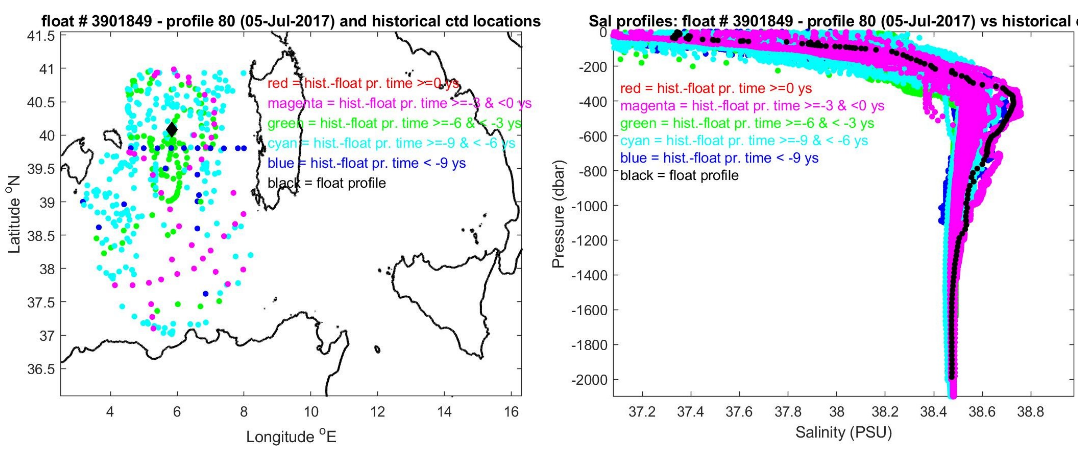


Figure 14. Locations of the salinity float profile number 80 and historical CTD data (right panel) and the respective salinity profiles (left panel).

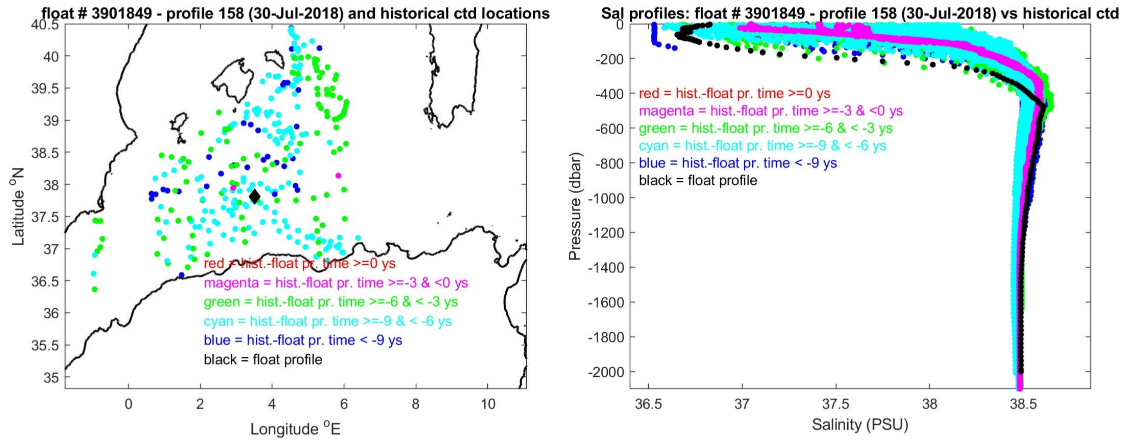


Figure 15. Locations of the salinity float profile number 158 and historical CTD data (right panel) and the respective salinity profiles (left panel).

The comparison of these 3 selected salinity float profiles with the closest (in space and time) salinity reference profile in shown in Figures from 16 to 18. The temporal difference between the two datasets is about one year for profiles number 2 and 158, whilst it is about one month for profiles 80. The agreement between the float salinity profiles and the historical salinity profiles is good for profile 2 and 80, whilst a small difference is observed for profile 158 in the intermediate and deeper layers, where the water column is more stable.

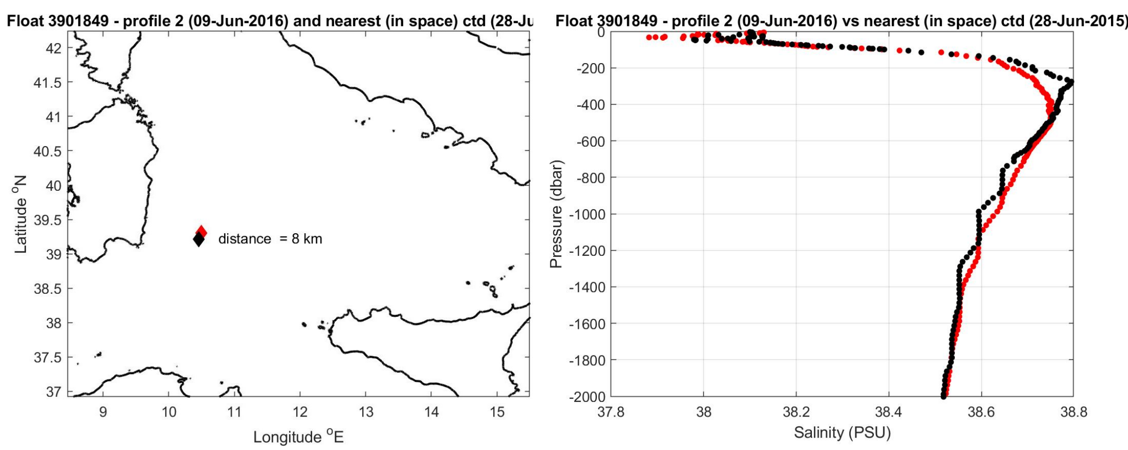


Figure 16. The salinity float profile number 2 (black dots in right panel) are compared to the nearest in space reference profile (red dots in right panel). The locations of the two profiles and their distance is given in the left panel.

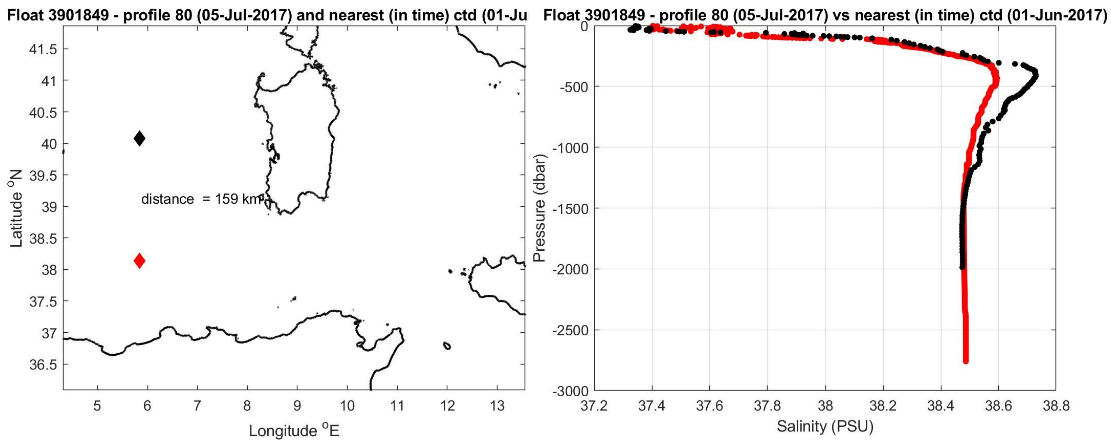


Figure 17. The salinity float profile number 80 (black dots in right panel) are compared to the nearest in time reference profile (red dots in right panel). The locations of the two profiles and their distance is given in the left panel.

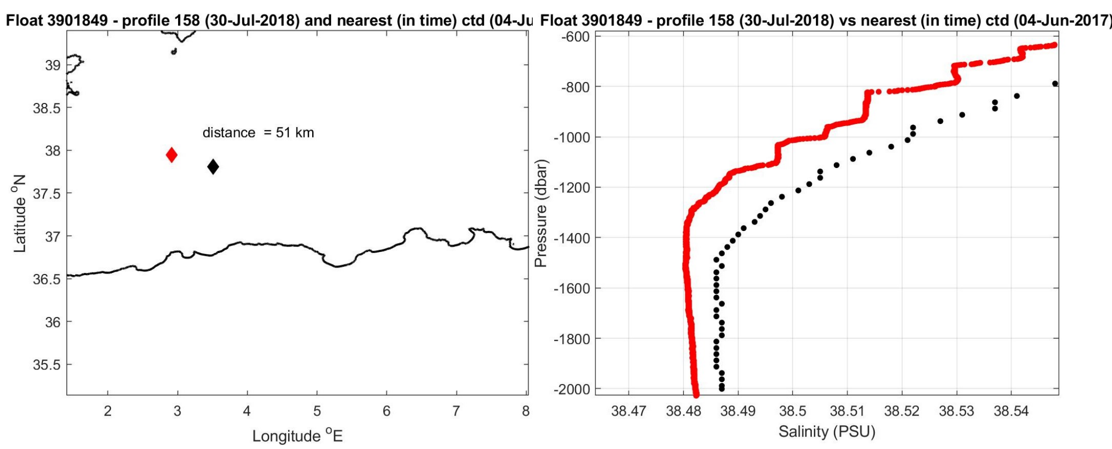


Figure 18. The salinity float profile number 158 (black dots in right panel) are compared to the nearest in time reference profile (red dots in right panel). The locations of the two profiles and their distance is given in the left panel.

A comparison with other two floats deployed in the same area is also performed. The θ-S diagrams of the floats WMO 6900316 and 6901476 is superimposed to the one of the Argo float WMO 3901849 in Figure 19. A slight positive salinity drift of float WMO 3901849 seems to be confirmed after about the first 90 profiles.

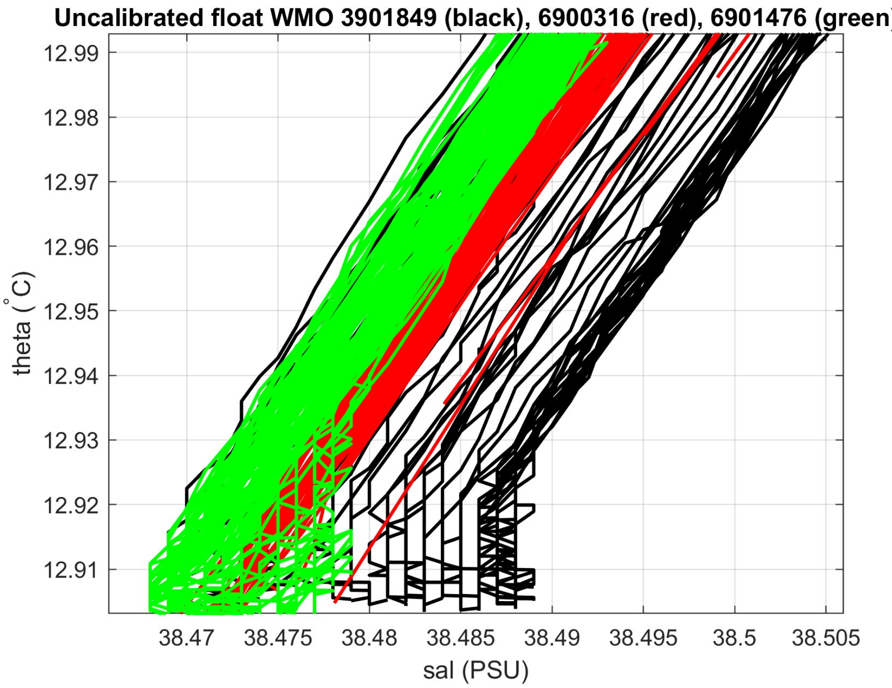


Figure 19. The θ-S diagram of the uncalibrated float WMO 3901849 (black lines) compared to the floats WMO 6901476 (green lines) and 6900316 (red lines).

7. DMQC: configuration and results

We applied the OW DMQC method to the float WMO 3901849 operating in the Mediterranean Sea. The parameters used for the objective mapping are listed in Table 2. A maximum of 4 break points is allowed in the piece-wise linear fit.

Parameters	Value
CONFIG_MAX_CASTS	300
MAP_USE_PV	1
MAP_USE_SAF	0
MAPSCALE_LONGITUDE_LARGE	4
MAPSCALE_LONGITUDE_SMALL	1.33
MAPSCALE_LATITUDE_LARGE	4
MAPSCALE_LATITUDE_SMALL	1.33
MAPSCALE_PHI_LARGE	0.5
MAPSCALE_PHI_SMALL	0.1

MAPSCALE_AGE	10
MAP_P_EXCLUDE	700
MAP_P_DELTA	250

Table 2. Objective mapping parameters of the OW method.

In Figure 20 the float trajectory and the historical CTD locations selected by the OW method are shown.

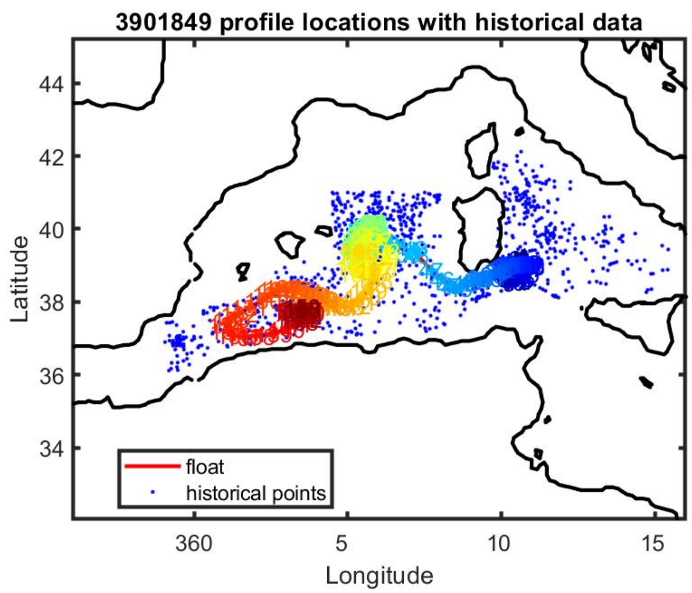


Figure 20. Float trajectory (color-coded per cycle number) and locations of the historical CTD data (blue dots).

The results of the OW method are presented in Figures from 21 to 24. The 10 θ-levels chosen for the correction are reported in Figure 21. The corrected and uncorrected float salinity and the mapped salinity on two selected θ-levels are depicted in Figure 22. The float salinity data corrected by the OW method are presented in Figure 23. The correction proposed (Figure 24) is between -0.01 and 0.01; the correction term ***r*** is computed by the piece-wise liner fit and the additive correction ***ΔS*** is calculated using:

$$\Delta S = (r-1) \cdot C_0 + (r-1) \cdot C'$$

where C_0 is the vertical mean conductivity and C' is the variation around C_0.

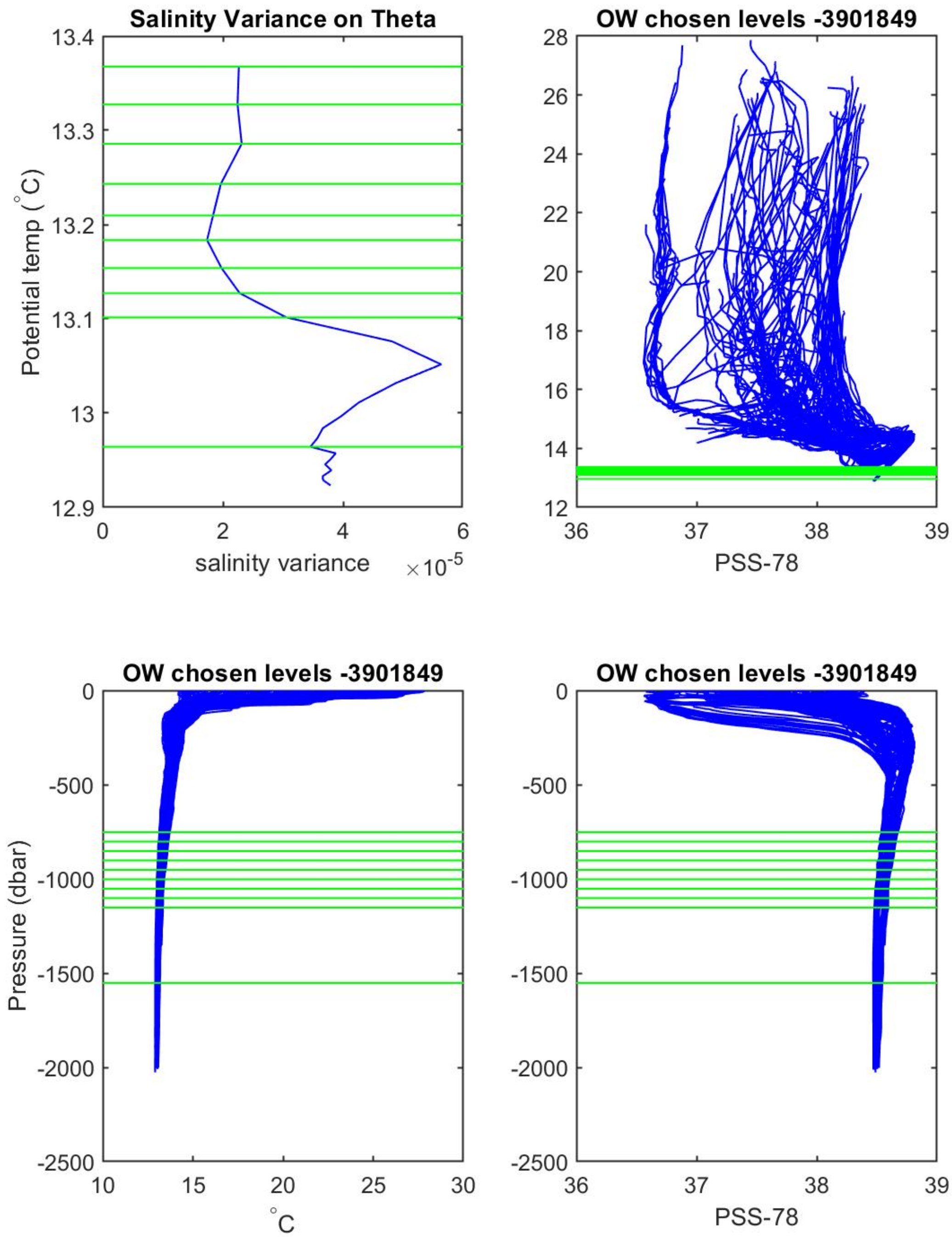
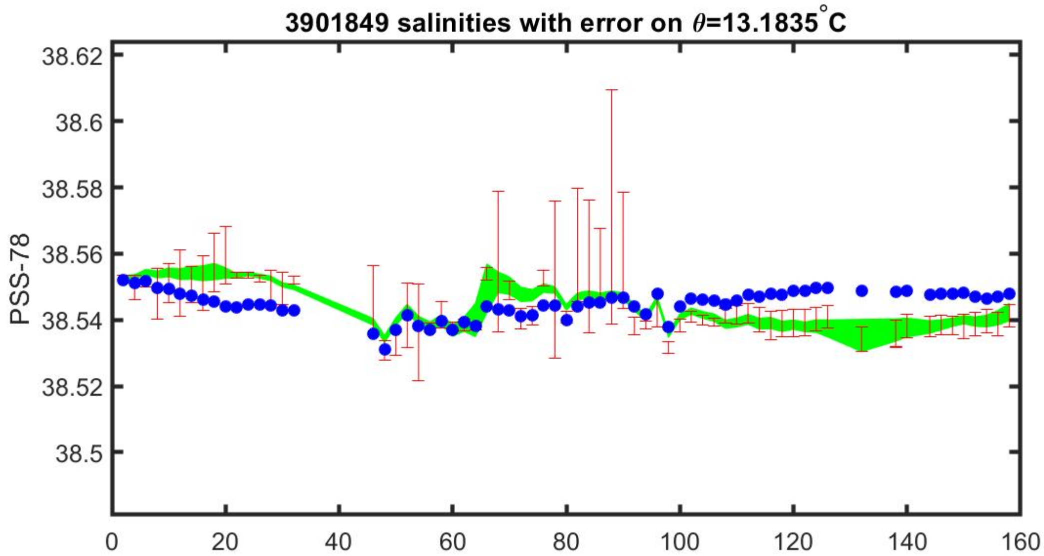


Figure 21. The 10 θ-levels chosen for the correction.



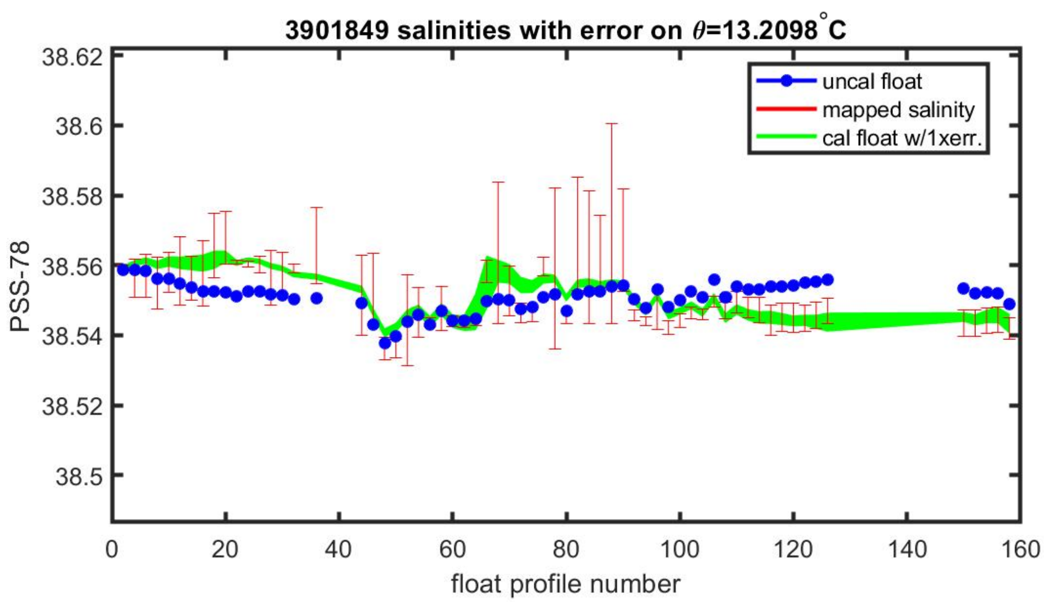


Figure 22. Comparison between the float salinity data and the mapped salinity, on θ-levels.

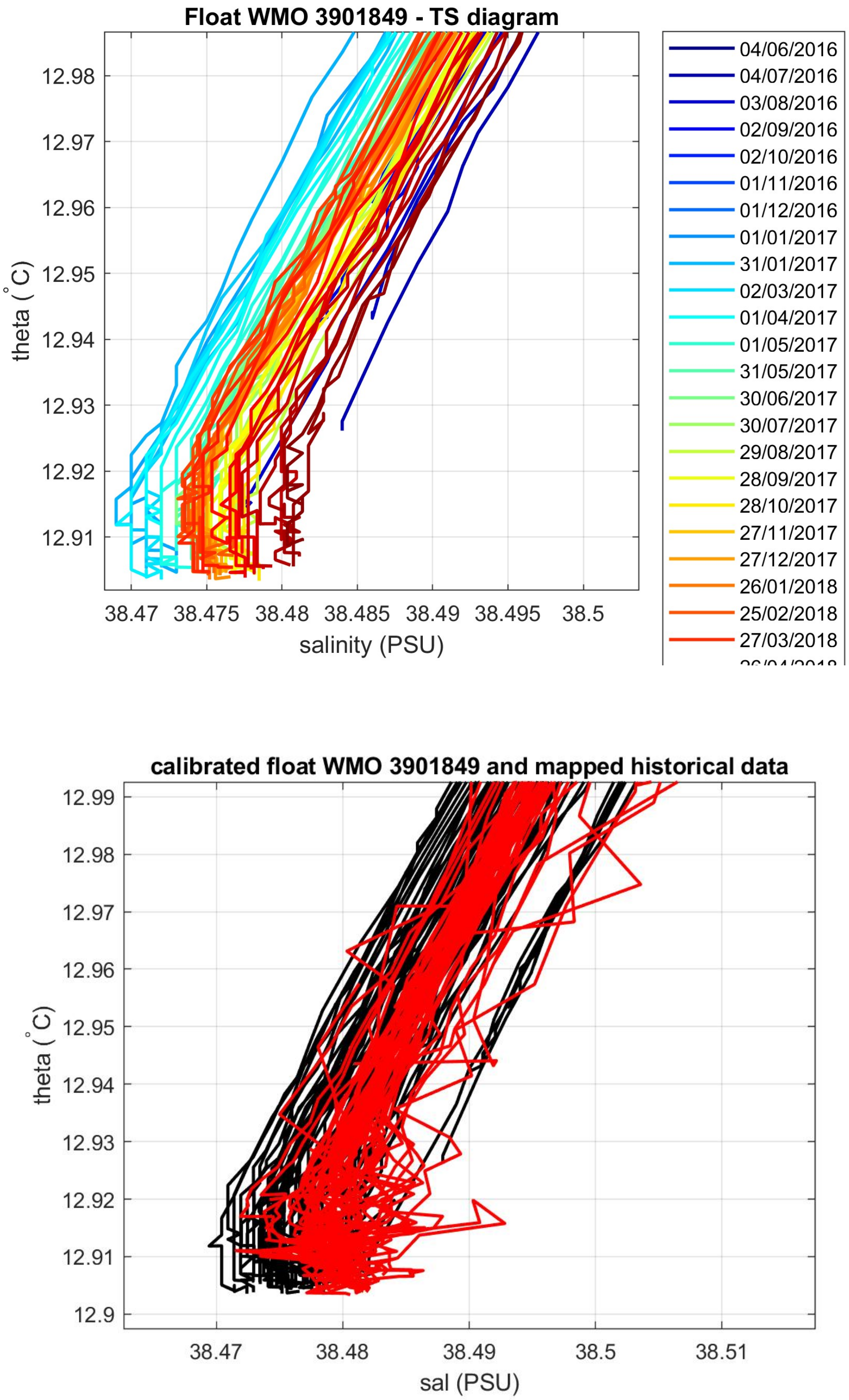


Figure 23. θ-S diagram of the corrected salinity data (color-coded per time in the upper panel and with the mapped data in red superimposed in the bottom panel).

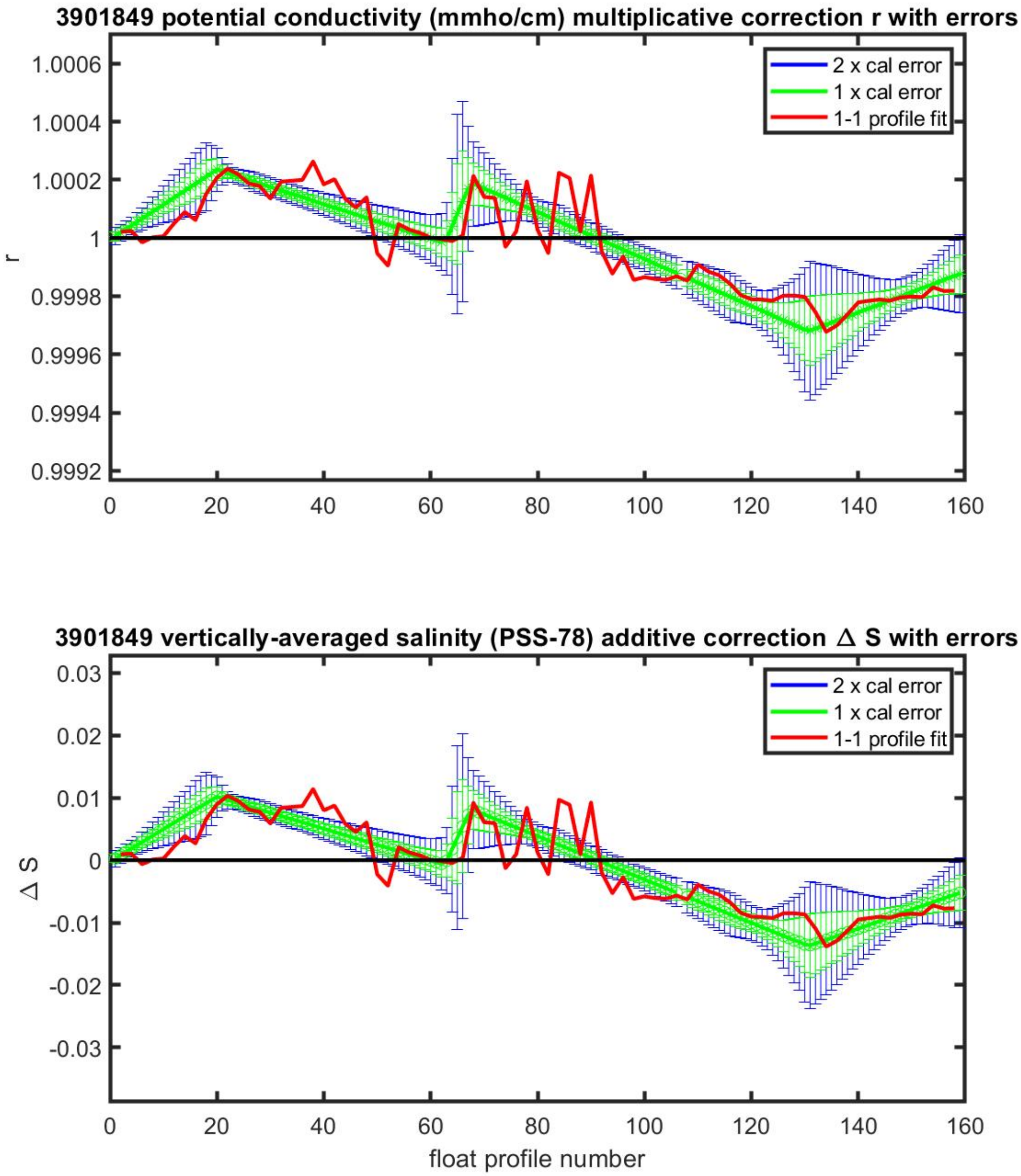


Figure 24. Correction proposed by the OW method.

The analysis of the θ-S diagram of profile segments deeper than 700 dbar (Figure 25) shows that the OW method was run where the θ-S relationship is the tightest. The mapped historical data are depicted as red lines in Figure 25, whilst the uncalibrated float data as black lines.

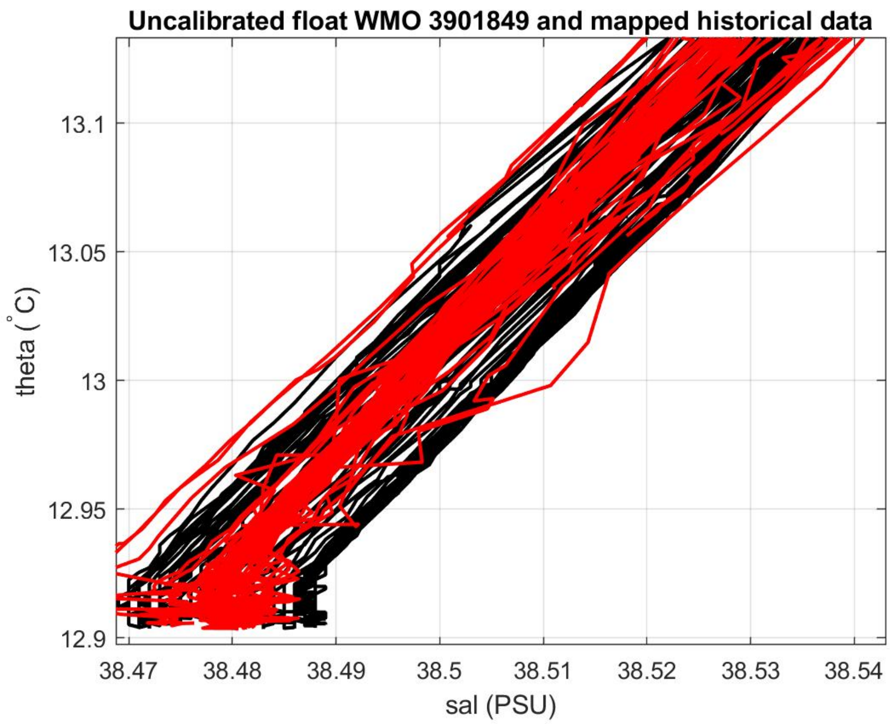


Figure 25. Uncalibrated float salinity profiles (black lines) and mapped historical data (red lines) in the most uniform part of the θ-S curve.

8. Conclusions

The correction proposed (Figure 24) is positive for the first half of profiles and then it is negative and it ranges about between 0.01 and -0.01. However, observation of the red line in Figure 24 reveals that the least square fit could have uncertainties. Figure 22 shows that the mapping error is quite large up to about profile number 90 and hence the objective estimates can be quite unrealistic. In the most uniform section of the θ-S curve (Figure 12 and 25) the variability of the float salinity is not very large (less than 0.02) and a systematic salinity offset in time is observed only after the first half of the float’s life (Figure 12). The comparison between selected float salinity profiles and the historical profiles (Figures from 16 to 18) shows the lowering of the conductivity sensor stability after profile number 80. The conductivity measurements drift in the second part of the float's life is also observed by comparing the θ-S curve of the float to the ones of floats 6901473 and 6900316 (Figure 19) that are quite close in space. We can conclude that there is an evidence of a salinity drift in the float measurements after profile number 90. Hence, the salinity data of Float WMO 3901849 need a delayed mode correction, that is the following:

PSAL_ADJUSTED=PSAL+ ΔS from cycle 90 to 159

The quality flags applied are the following:

PSAL_ADJUSTED_QC='2' from cycle 90 to 159

The delayed-mode files (Dfiles) have been created accordingly and sent to the Coriolis GDAC.