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MOCCA

D4.3.2 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), Institute for Chemistry and Biology of the Marine Environment (ICBM)
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1.0	04.09.2019	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.

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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 D4.2.3 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:

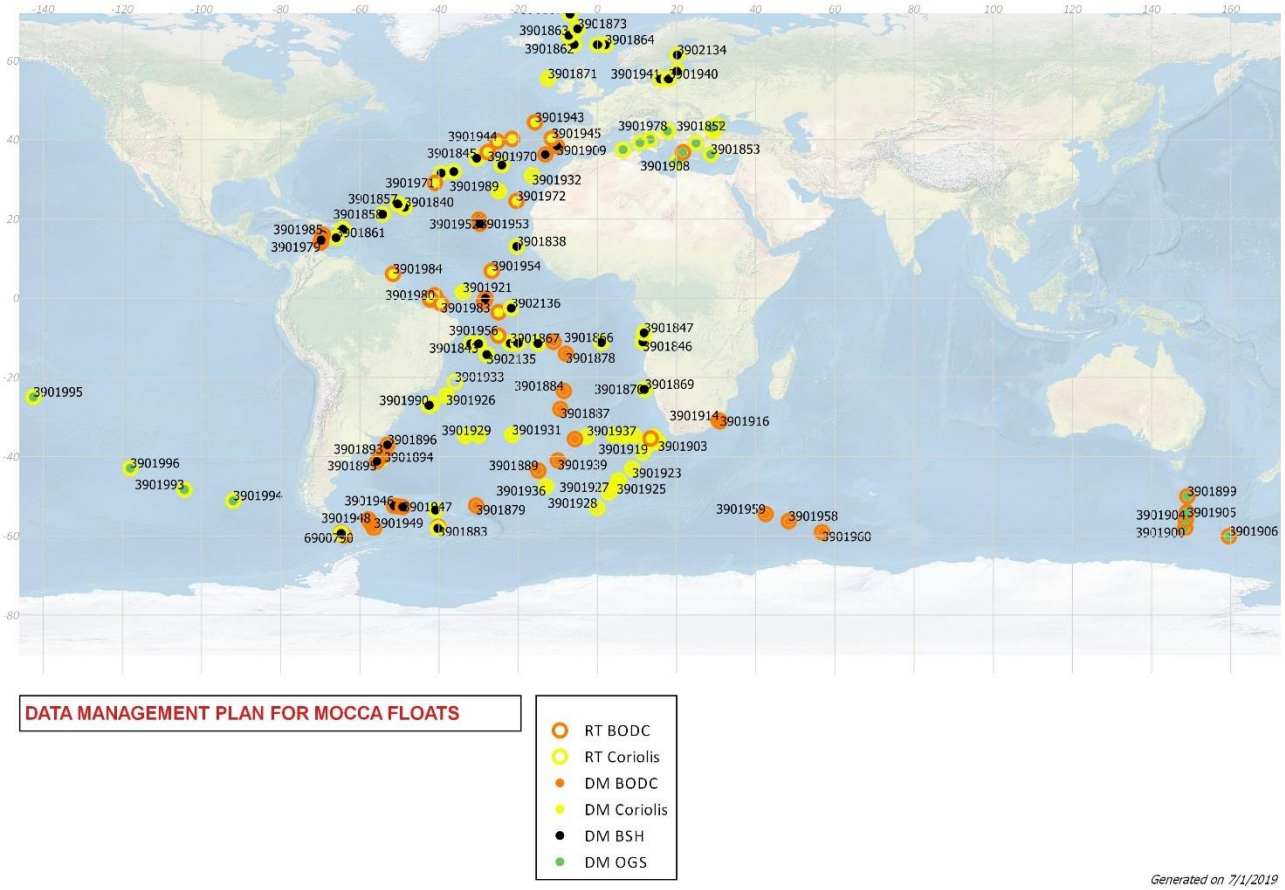


Figure 1: MOCCA data processing allocation between partners for Real-Time and Delayed-Mode. Points depict the Argo deployment positions.

2. METHODOLOGY

The DMQC of Argo floats follows guidelines provided by the Argo Data Management Team (ADMT), 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 quality controlled delayed-mode data is achieved by comparing Argo to other observations (climatology, altimetry, reference databases, deployment CTD, etc.) and visual 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 deep climatological reference deep CTD data (Figure 3) and objective analysis, we can estimate what salinity should be at float locations.

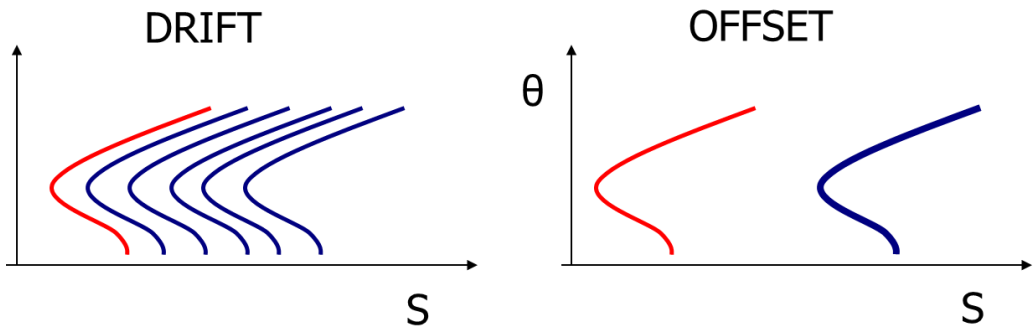


Figure 2: Example of drift or offset problems in the salinity time series. Red is the first collected profile and blues are the next ones.

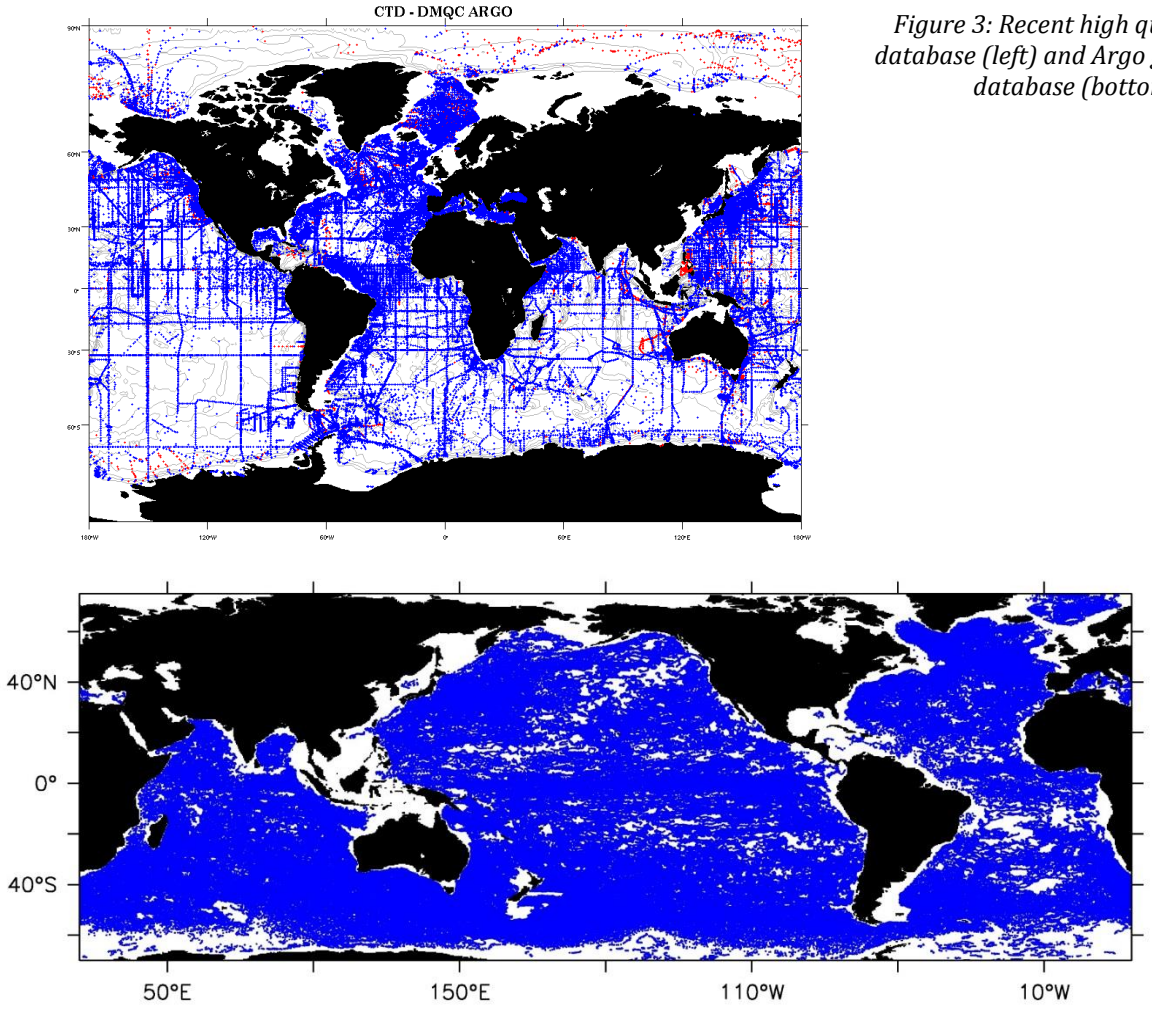


Figure 3: Recent high quality CTD database (left) and Argo good profile database (bottom).

A typical DMQC process includes:

- Visual inspection of 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
- 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 at minimum 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 **15 000 Argo CTD profiles have been collected by the MOCCA fleet** to date (July 2019), in Figure 4:

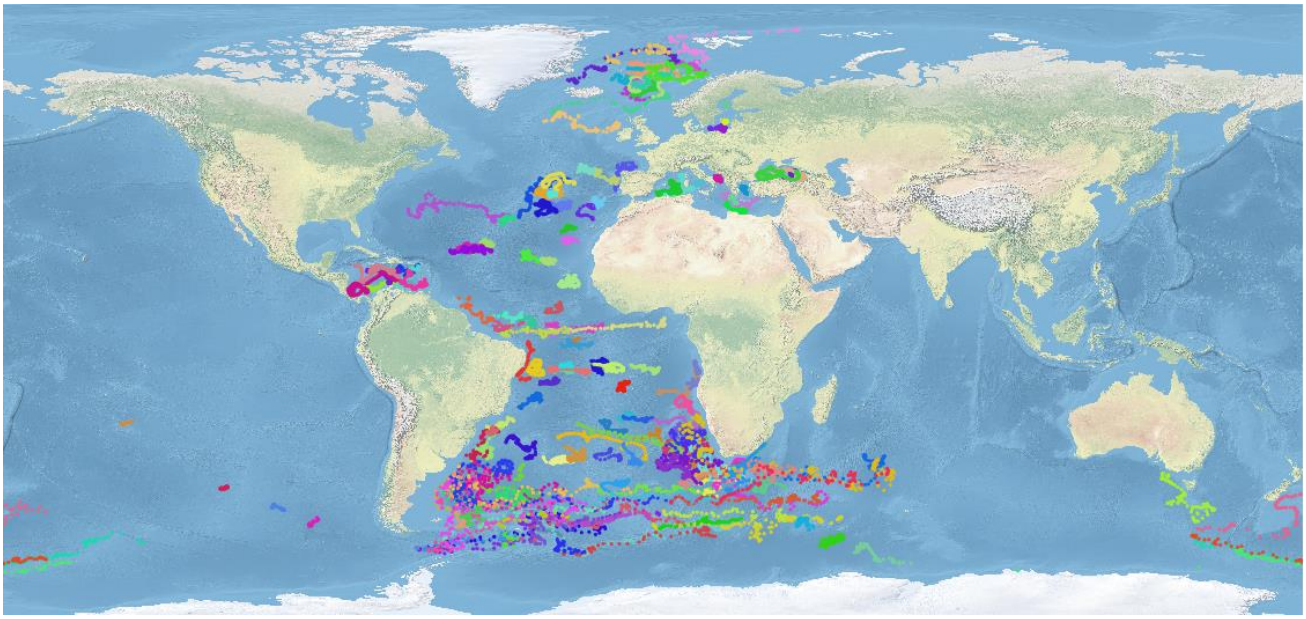


Figure 4 : MOCCA observations locations (1 colour per float).

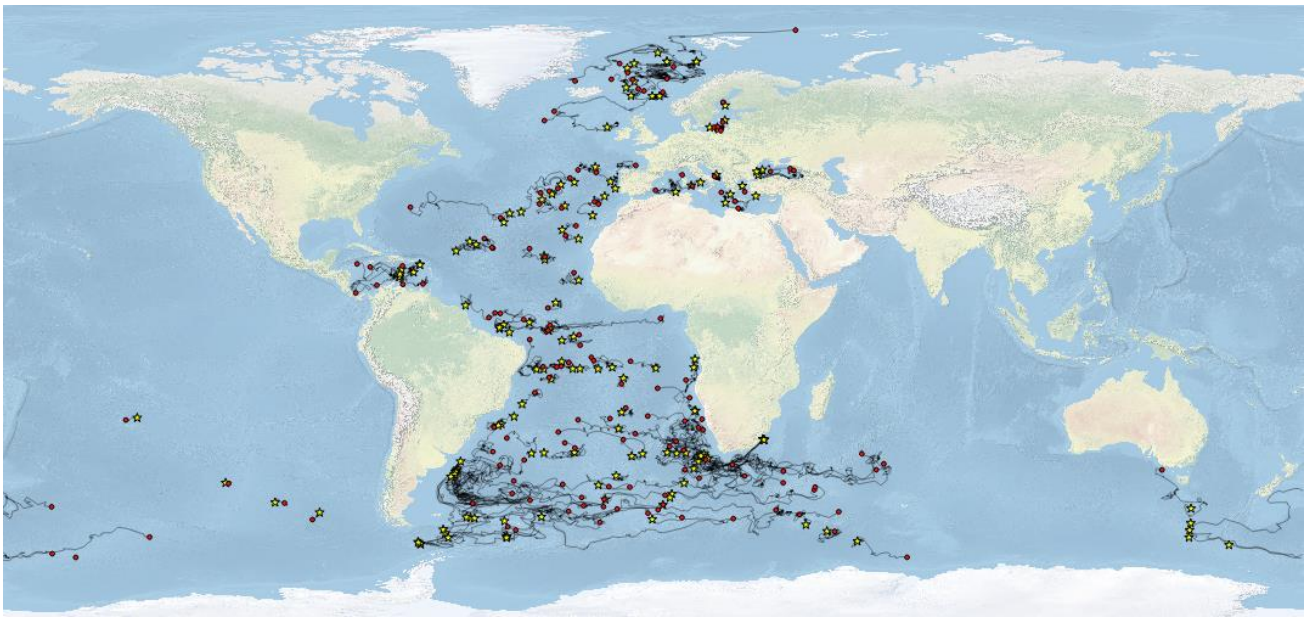


Figure 5: MOCCA deployment locations (yellow stars), latest locations (red circle) and trajectories of floats (black line).

The MOCCA deployments and subsequent trajectories (Figure 5) provides a good coverage of European and Caribbean marginal seas, Nordic seas, South Atlantic and substantial measurements along the ACC (Antarctic Circumpolar Current) 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 (July 2019), **D files have been submitted for 127** floats. 140 floats have been deployed more than 1 year ago so in theory are eligible for DMQC (Figure 6).

WMO	RT	DM	first_cycle_date	DM_done	float_age (days)	float_more1year	greylist	obs_number
3901971	BODC	Coriolis	20180725162730	0	369	1	0	38
3901970	BODC	Coriolis	20180722162930	0	372	1	0	39
3901932	Coriolis	Coriolis	20180610053100	0	415	1	0	43
3901957	BODC	OGS	20180521085130	0	435	1	0	91
3901921	Coriolis	Coriolis	20180521054400	0	435	1	0	45
3901980	BODC	Coriolis	20180509030030	0	447	1	0	69
3901982	BODC	Coriolis	20180503025400	0	453	1	0	66
3901983	BODC	Coriolis	20180430025430	0	456	1	0	69
3902133	Coriolis	BSH	20171108090000	0	629	1	0	630

3901954	BODC	Coriolis	20171011174830	0	656	1	0	67
3901941	Coriolis	BSH	20170923090800	0	675	1	0	673
3901940	Coriolis	BSH	20170922090500	0	676	1	0	12
3901913	BODC	BODC	20170811055520	0	718	1	1	126
3901890	Coriolis	OGS	20170405025300	0	846	1	0	171

Table 2: MOCCA floats eligible to DMQC.

Among the 14 floats eligible that have not been DMQC, 6 are quite old (deployed more than 2 years ago) and the other are more recent and will be DMQCed soon.

Three of these 6 older floats are in the Baltic Sea where the DMQC methodology has not yet been defined for such shallow environment. As part of WP4 Data Management, activities are planned until the end the MOCCA project to **develop a strategy for the DMQC in the Baltic Sea**. Some of the envisaged approaches include:

- organising the recovery of the floats and send the CTD heads back to SBE (in the USA) for post-calibration in the laboratory and possible retrospective corrections of offset/drift;
- plan collocated CTD measurements from ships (or other observation networks) to compare the float data to other reference data and quality assessment;
- a mix of solutions 1 and 2, providing feedback on whether or not collocated measurements are sufficient for quality assessment or a post-calibration is needed.

This will be envisaged with the collaboration of Polish and Finnish partners, with a cruise happening in the end of September 2019.

DM operators of the oldest eligible floats have been contacted to inform them about the need to undertake DM control in short notice.

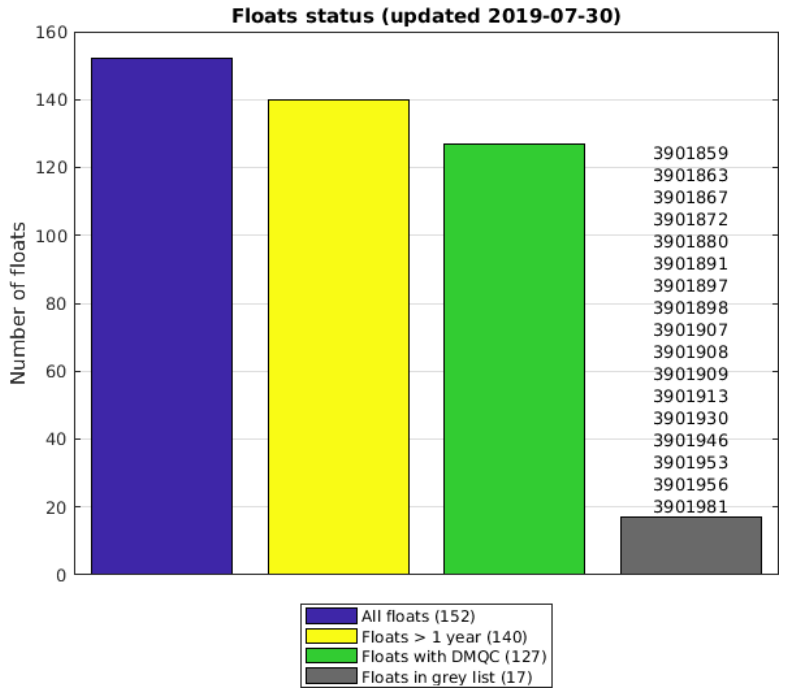


Figure 6: MOCCA DMQC progress: number of floats that have been quality controlled.

60% of MOCCA observations have already been quality controlled, and **88% of observations aged more than 1 year have already been quality controlled** (Figure 8)**.**

DMQC is well advanced for every partner (Figure 7 and Figure 8).

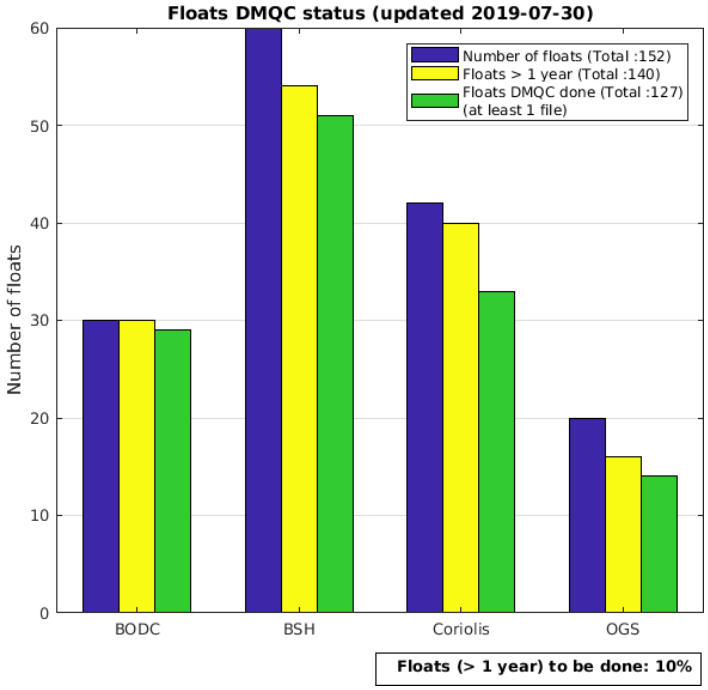


Figure 7: MOCCA DMQC progress: for each DM operator, number of floats allocated, number of floats eligible to DMQC, number of floats that have been quality controlled at least once.

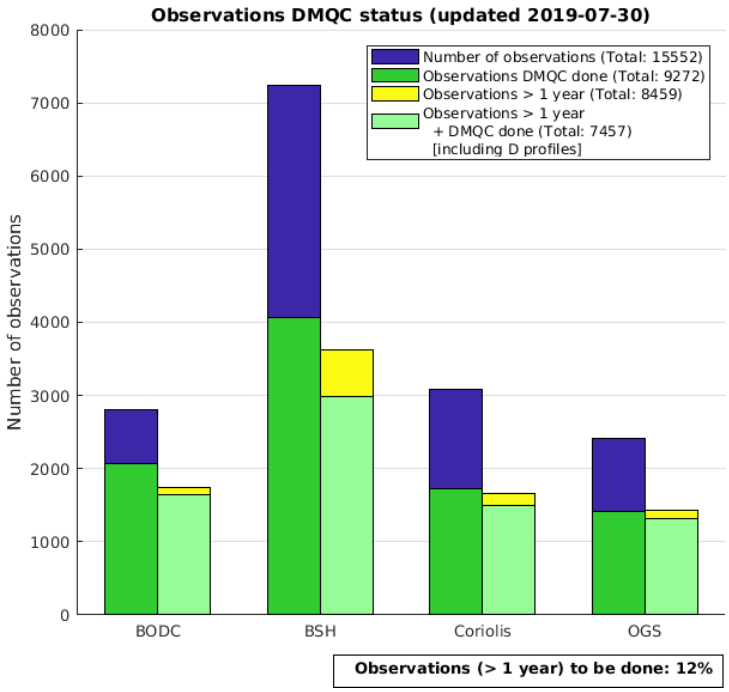


Figure 8: MOCCA DMQC progress: for each DM operator, number of observations available for allocated floats (left bars, blue) and number of observations that have been already quality controlled (left bars, green); number of observations eligible (i.e. > 1 year) to DMQC (right bars, yellow) and number of eligible observations that have been already quality controlled (right bars, light green).

Looking at Figure 9 we can see that the oldest observations from 2016 have all been quality controlled, as well as most of the ones from 2017. Figure 10 shows the age distribution of observations that are not yet quality controlled: most of them are younger that the usual target of 1 year defined to start the DMQC.

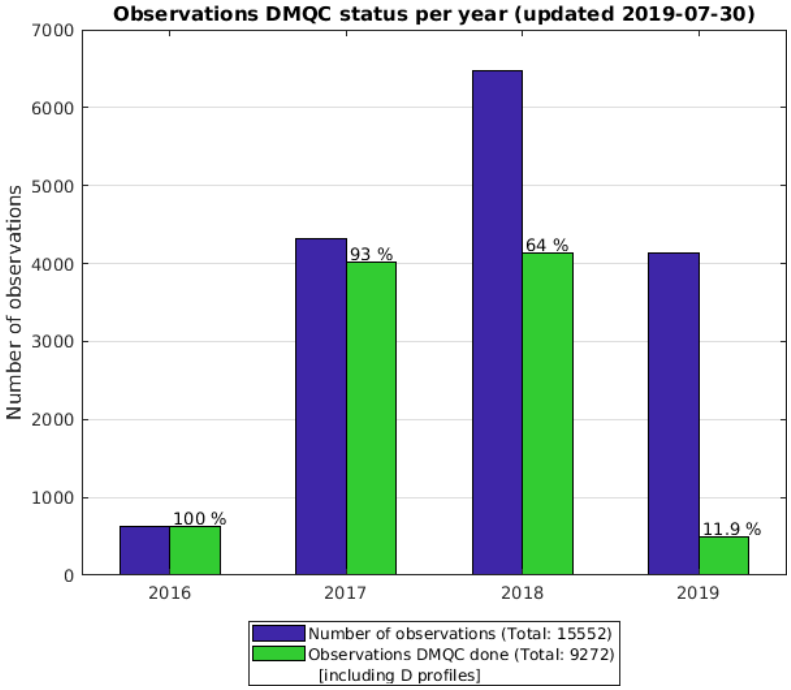


Figure 9: Number of available MOCCA observations per year and their processing status.

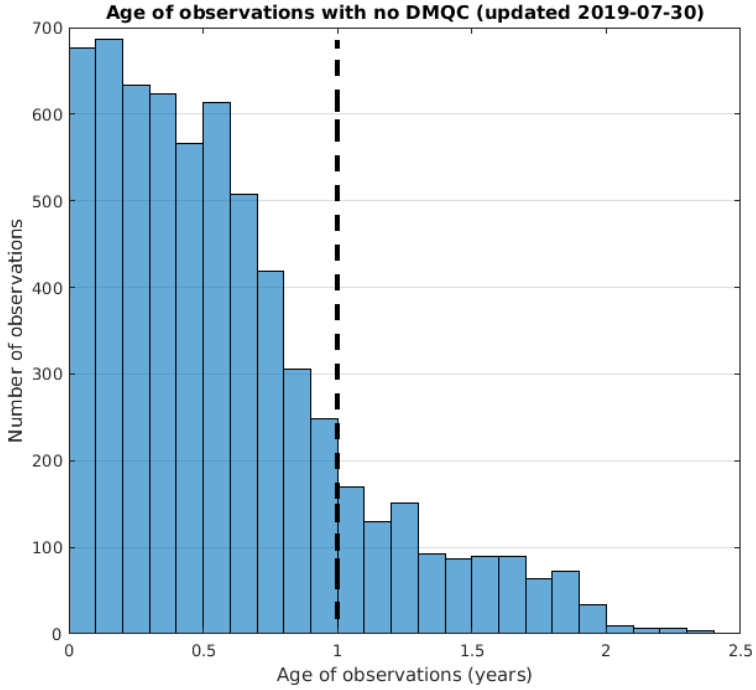


Figure 10: Age of MOCCA observations that have not been quality controlled yet.

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 **17 MOCCA floats are on the Grey list** (Table 3):

PLATFORM_CODE	PARAMETER_NAME	START_DATE	END_DATE	QUALITY_CODE	COMMENT	DAC
3901859	PSAL	20181122		4	DD (20190408): drift not rescuable (OWC Birgit)	IF
3901863	PSAL	20160812		4	CL 20160928	IF
	TEMP					
3901867	PSAL	20181122	20190220	3	DD (20190405): drift	IF
		20190220		4	DD (20190405): hard drift	IF
3901872	PSAL	20181223		3	DD: drift	IF
3901880	PSAL	20180527		3	Severe PSAL drift to be revisited in DMQC	BO
3901891	PSAL	20180521		4	Salinity sensor providing routinely spikey data	BO
3901897	PSAL	20181113		4	Cell failure after cycle 56	BO
3901898	PSAL	20181003		4	sensor problem	BO
3901907	PSAL	20180525		3	CP 20181016 Drift	IF
3901908	PSAL	20171208		3	CC 20171211 Drift on salinity	IF
3901909	PSAL	20180415		4	likely salinity drift from cycle 48	BO
3901913	PSAL	20180706		3	Drifting salinity sensor potentially correctable in DMQC	BO
3901930	TEMP	20190317		3	DD (20190607): sensor failure	IF
	PSAL					
3901946	PSAL	20181018		3	Unusual behaviour and unable to resolve in DMQC as of 08/03/2019	BO
3901953	PSAL	20180616		3	Alimeter warnings suggesting salinity drift from cycle 26 onwards	BO
3901956	PSAL	20180415		4	Sensor problem	BO
3901981	PSAL	20180514		4	CTD plugs accidentally left on so the salinity is spurious	BO

Table 3: MOCCA floats on the Grey list.

Out of these 17 floats, 2 have problems that are not related to a standard CTD drift: float 3901863 has a temperature probe issue and has been recovered, 3901981 has been deployed with the CTD plugs left on so the salinity measurements are not correct.

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 4).

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 4: 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 5). 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 5: Argo profile quality flags

The following plots (Figure 11 and Figure 12) give an indication of the data quality of the observations collected by the MOCCA fleet. **About 87% of the profiles contain 100% good data**. 8% 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 5% 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.

There is also float 3902136 dead after 6 cycles for which the DMQC has been completed and the data deemed unreliable.

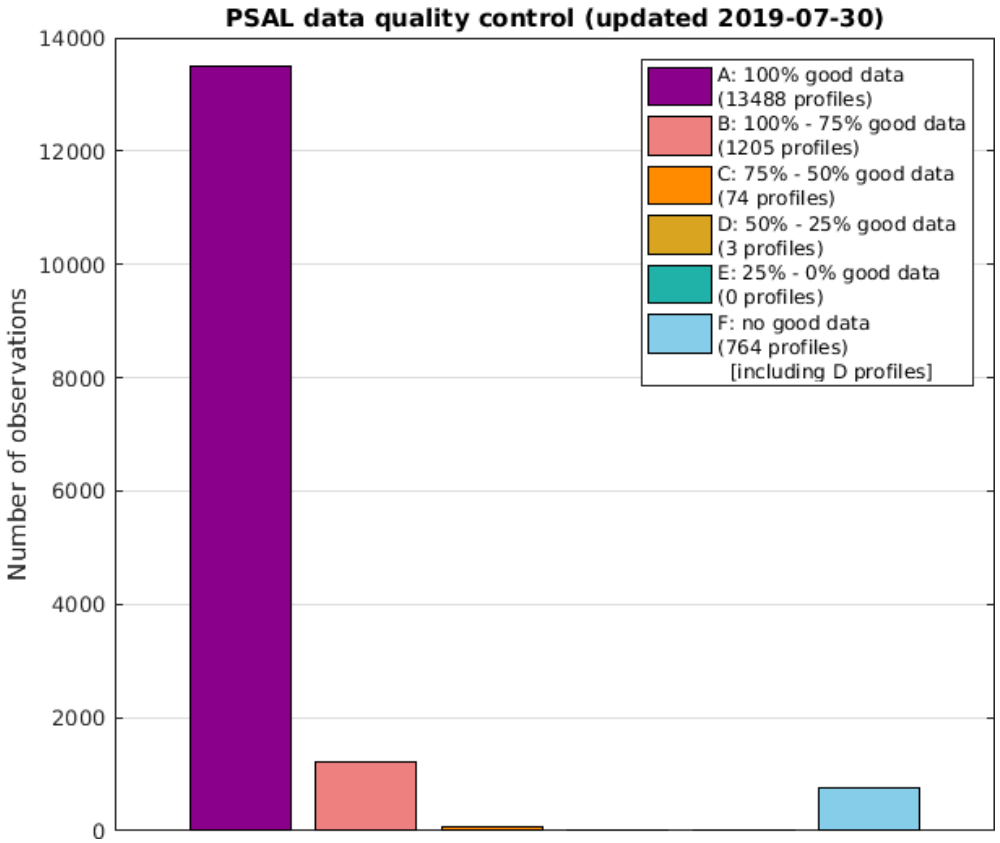
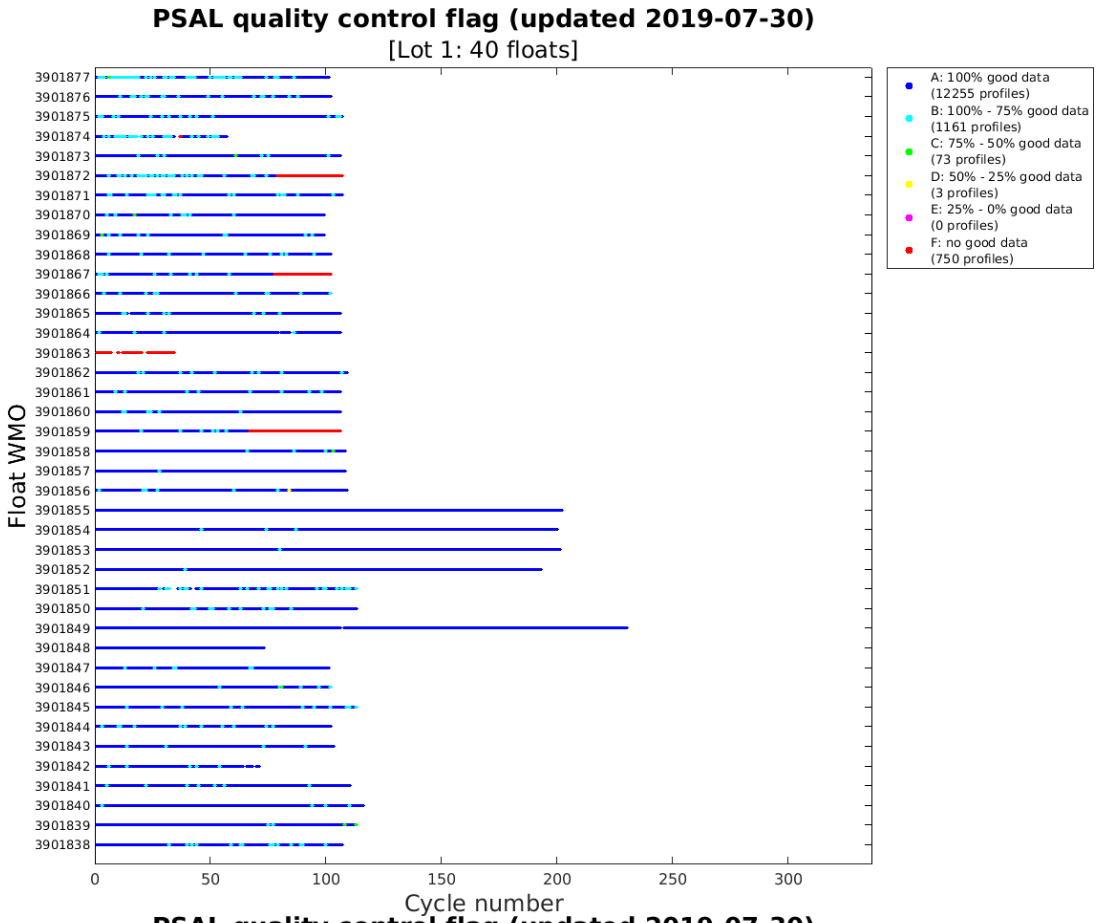


Figure 11: MOCCA Argo profiles quality flags for salinity.



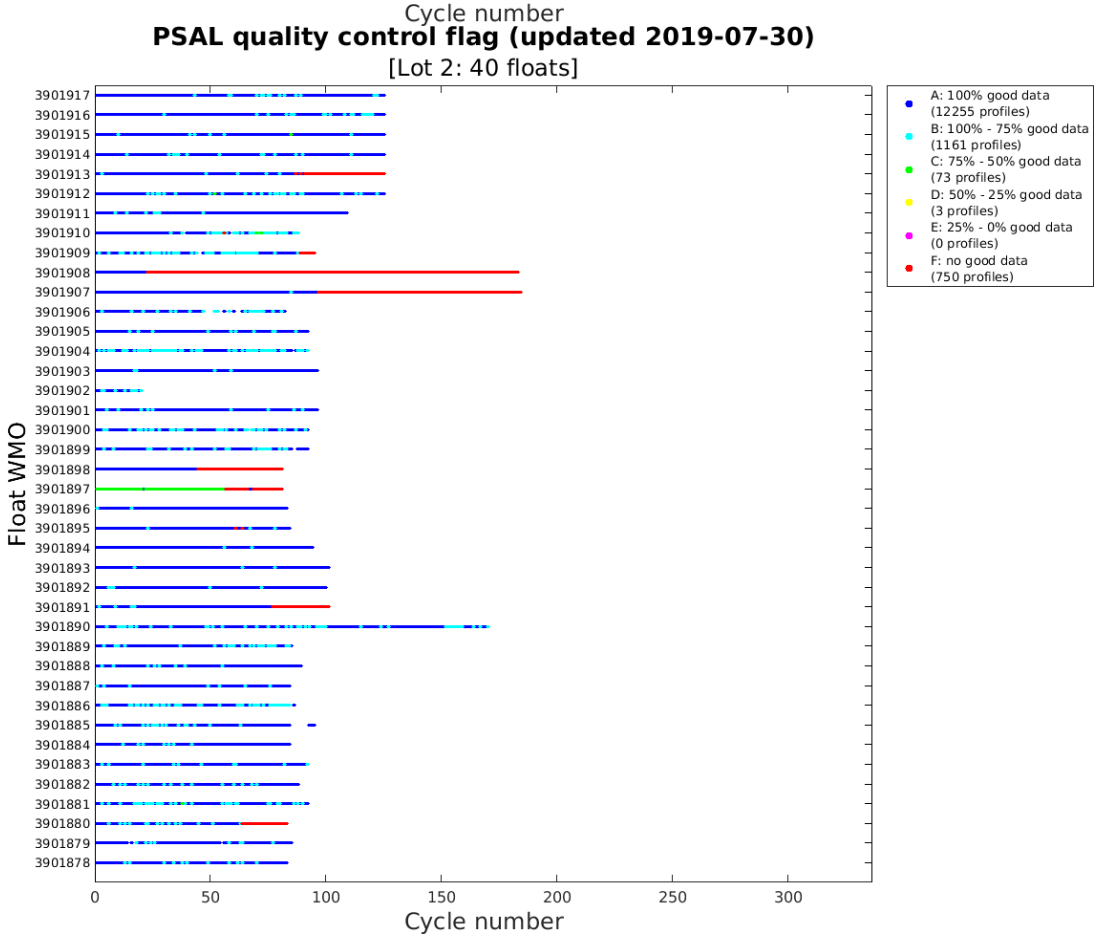
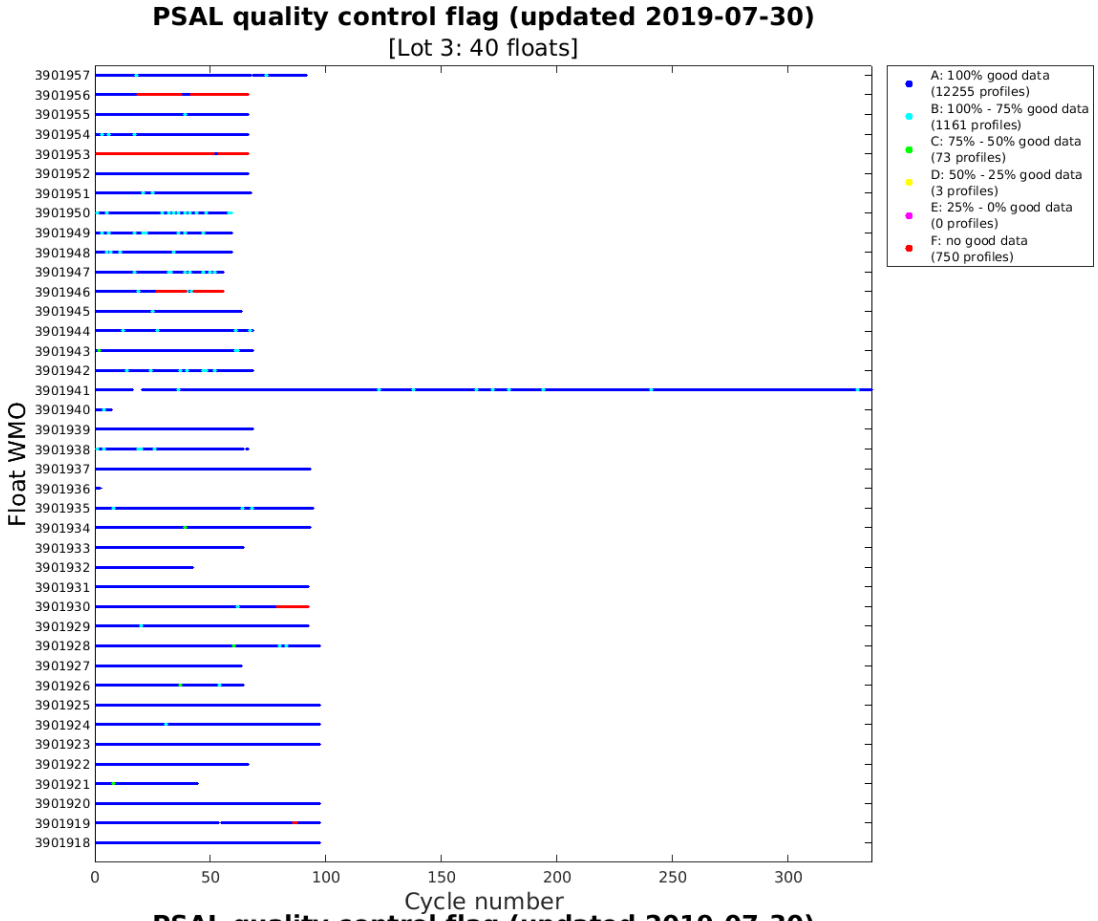
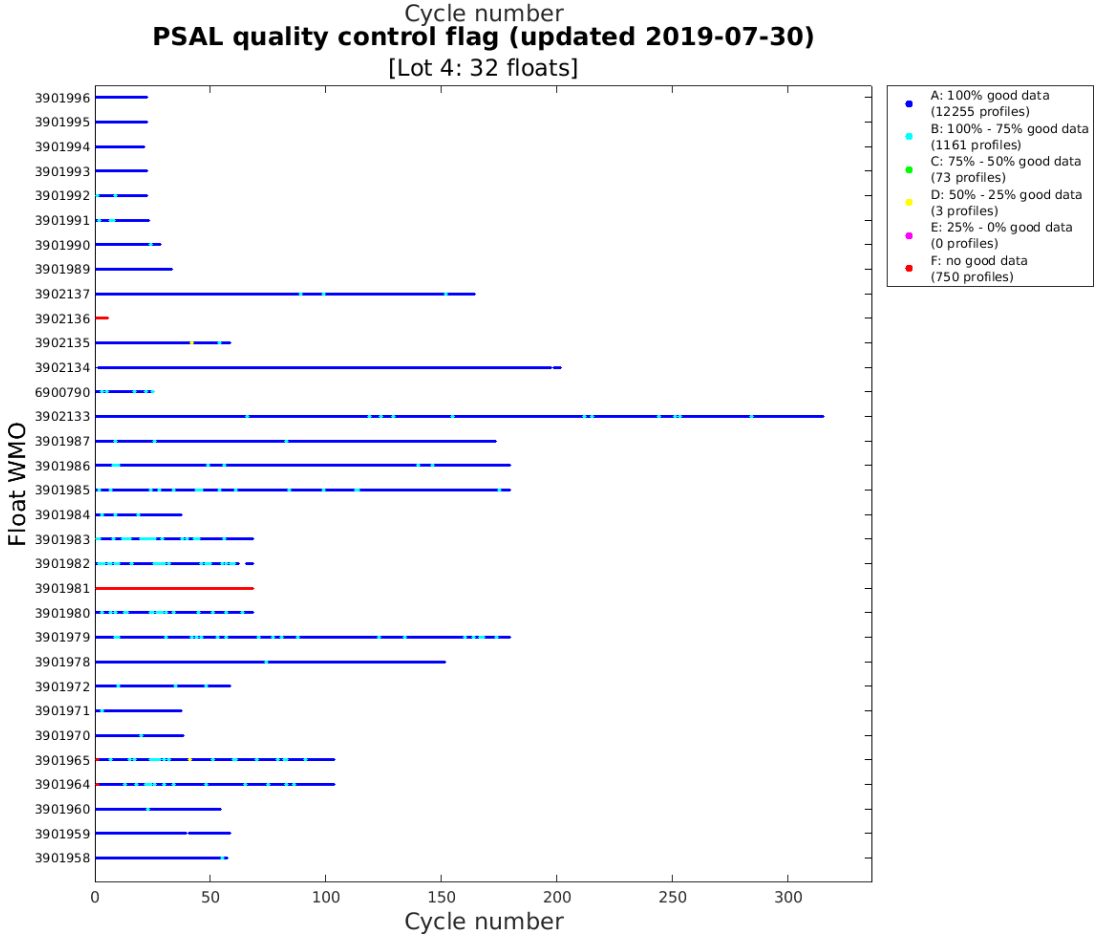


Figure 12: MOCCA Argo profiles quality flags for salinity, view cycle by cycle.


PSAL quality control flag (updated 2019-07-30)
[Lot 3: 40 floats]
Float WMO
Cycle number
A: 100% good data (12255 profiles)
B: 100% - 75% good data (1161 profiles)
C: 75% - 50% good data (73 profiles)
D: 50% - 25% good data (3 profiles)
E: 25% - 0% good data (0 profiles)
F: no good data (750 profiles)


PSAL quality control flag (updated 2019-07-30)
[Lot 4: 32 floats]
Float WMO
Cycle number
A: 100% good data (12255 profiles)
B: 100% - 75% good data (1161 profiles)
C: 75% - 50% good data (73 profiles)
D: 50% - 25% good data (3 profiles)
E: 25% - 0% good data (0 profiles)
F: no good data (750 profiles)

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 the plots Figure 13 that illustrate the decision of the DMQC operator to adjust or not the PSAL data.

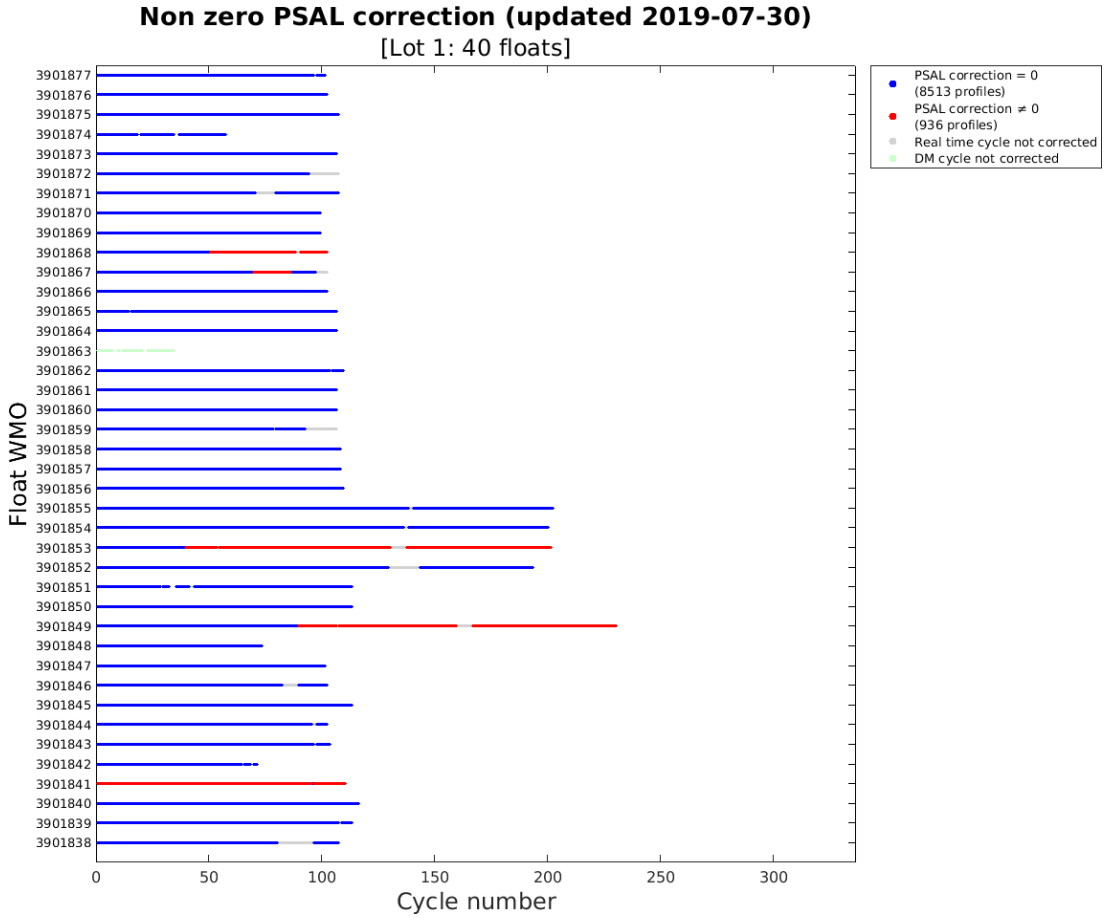
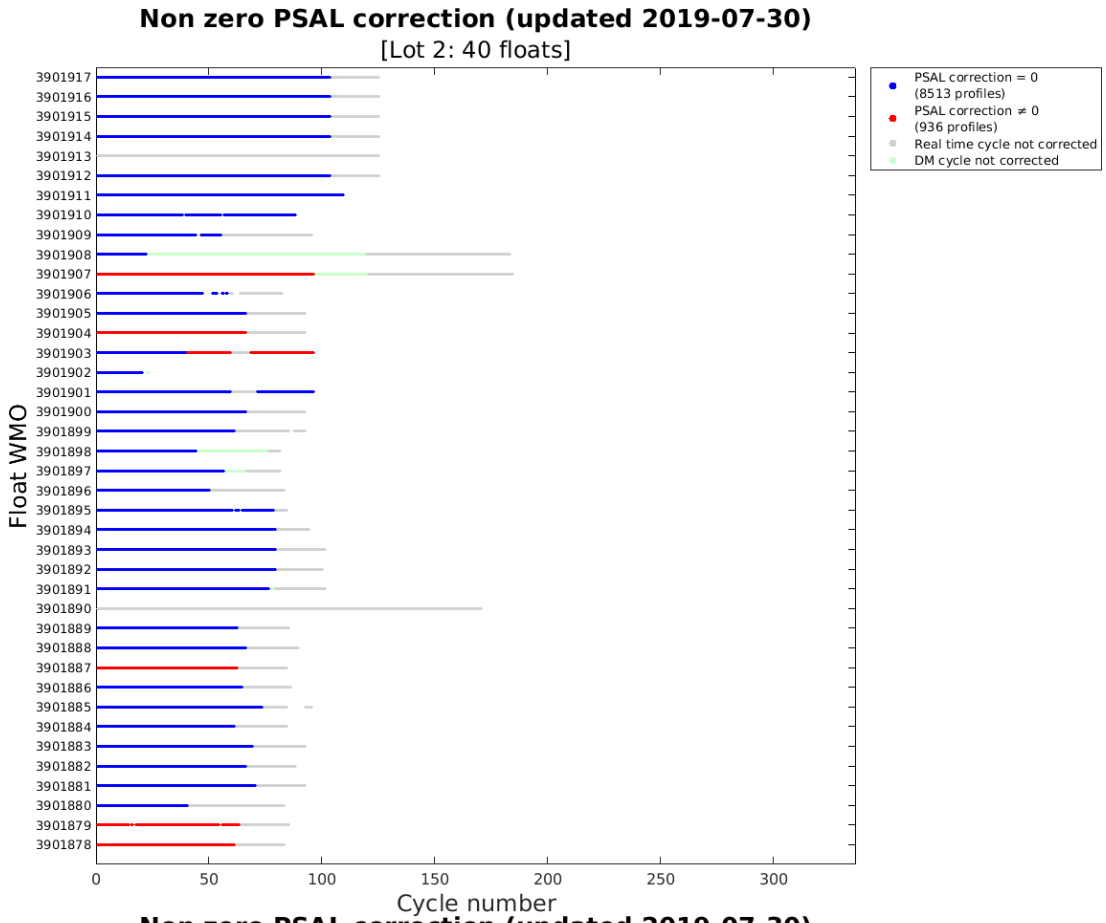
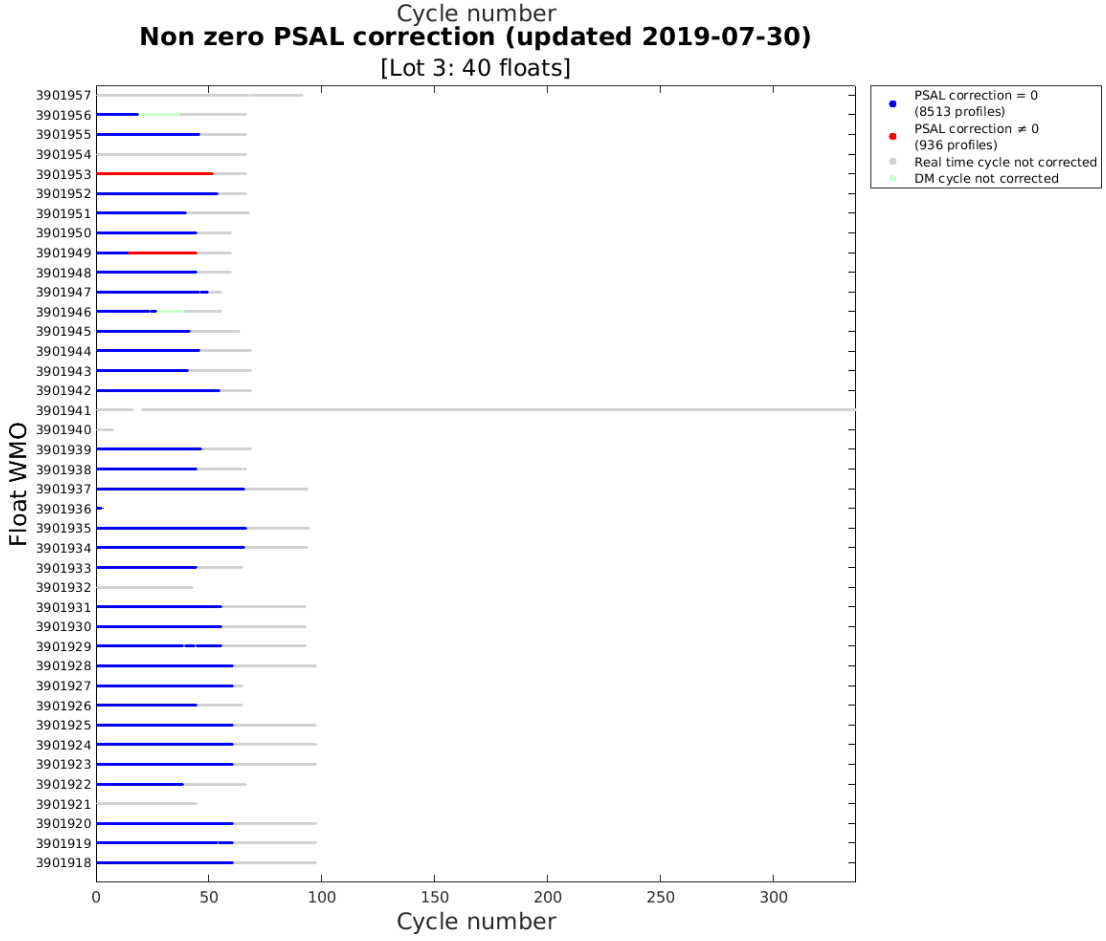


Figure 13: Presence or absence of a PSAL correction for the MOCCA floats.

13 MOCCA floats have received (at least for part of their cycles) a salinity correction.


Non zero PSAL correction (updated 2019-07-30)
[Lot 2: 40 floats]
PSAL correction = 0
(8513 profiles)
PSAL correction ≠ 0
(936 profiles)
Real time cycle not corrected
DM cycle not corrected
Float WMO
Cycle number
0
50
100
150
200
250
300


Non zero PSAL correction (updated 2019-07-30)
[Lot 3: 40 floats]
PSAL correction = 0
(8513 profiles)
PSAL correction ≠ 0
(936 profiles)
Real time cycle not corrected
DM cycle not corrected
Float WMO
Cycle number
0
50
100
150
200
250
300

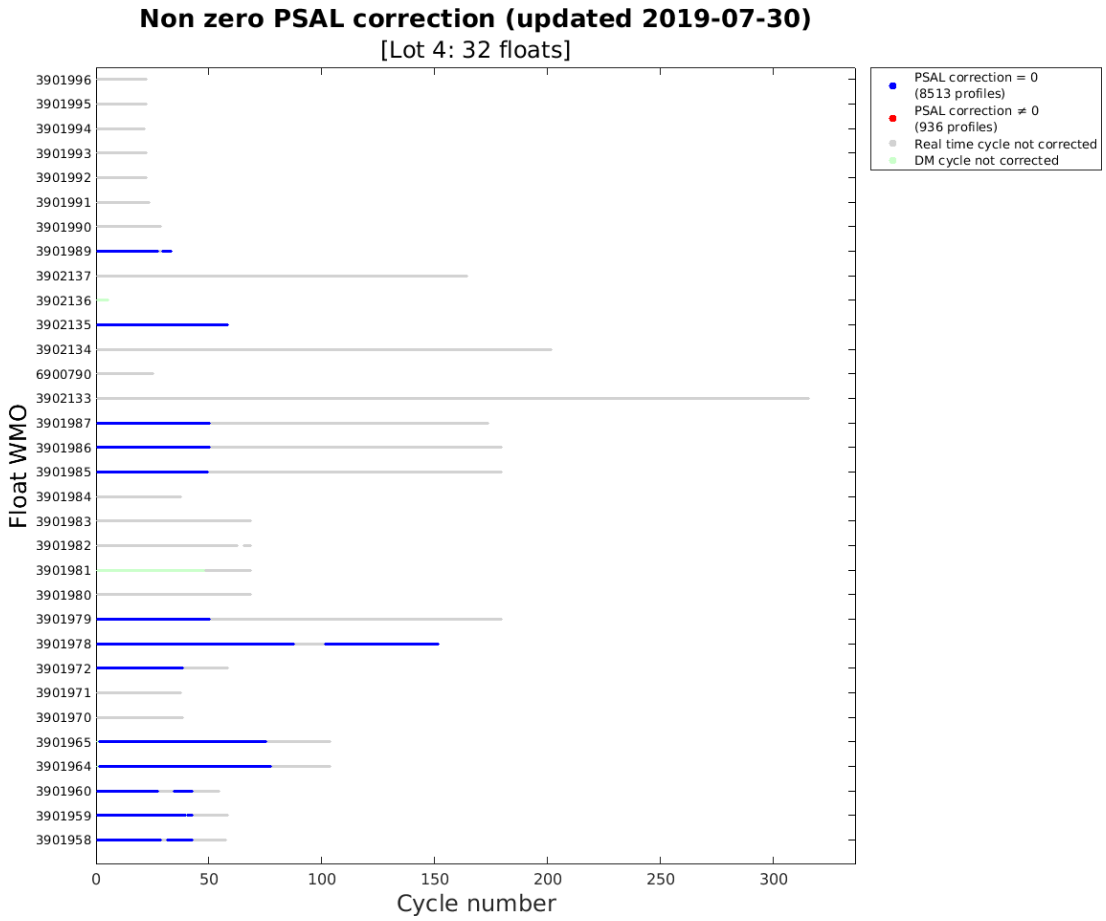


Figure 14 depicts the mean salinity adjustments (as a result of the DMQC, when the DMQC operator decided to apply a correction to the PSAL data) for each of the 13 adjusted MOCCA Argo profiles:

The corrections made are either offset (for 3 floats) or drift (10 floats).

Figure 14 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 Annex E: report on DMQC of MOCCA float WMO 3901849.

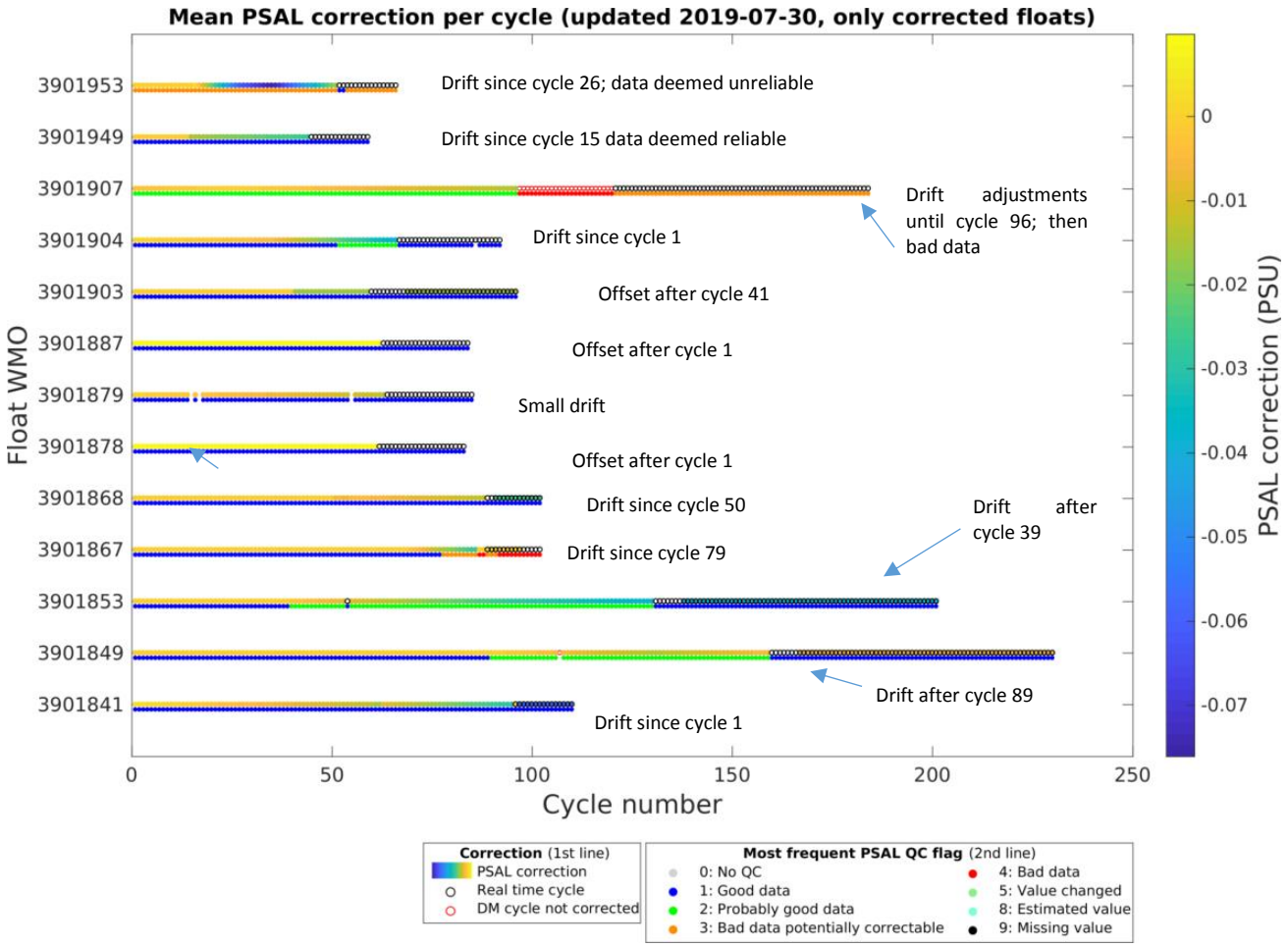


Figure 14: Mean salinity corrections applied in delayed-mode to adjusted MOCCA Argo profiles, view cycle by cycle.

5.3. Synthesis of MOCCA floats highlighted by the DM process

Information coming from the Greylist, GDAC index file, Altimetry QC and comments from the DMQC operators have been assembled in Table 6.

It follows that **33 MOCCA floats have been spotted by the DM process**. 14 floats received at least one Altimetry QC and 17 are on the Grey list.

Drift problems were identified for 23 floats and corrections were possible for 10 floats for part, or all (7 floats) of their cycles. The drift was deemed unadjustable after a certain point for 6 floats. The others need further review, meaning that the DM operator could not at this stage determine the seriousness of the drift.

Offset problems were identified for 4 floats, and corrections possible for 3 floats. The other float, lost after 5 cycles is considered as unreliable.

Other problems were identified for 3 floats, including 2 floats for which the data is unreliable for all their cycles (1 recovered, 1 deployed with the CTD plugs left on).

Spike problems were identified for 3 floats.

Altogether 754 profiles have been flagged as bad (F) for these 33 floats. This represents less than 5% of all MOCCA profiles. So, one can say that MOCCA dataset is for the time being of good quality.

In September 2018, a *message* to all Argo users was sent by the Argo Steering Team (AST) about a larger than normal number of Sea-Bird Scientific (SBE) CTD cells used in Argo, which developed a high salinity bias within 2 years of deployment. MOCCA floats are equipped with these sensors, so huge efforts have been spent on analysing as much float data as possible to detect any potential affected float and stop the real-time distribution to operational communities. In January 2019, 101 floats were checked and DMQC files submitted to the GDAC. Remaining floats will be examined in the next reporting period (at least 1 year of data is needed to start DMQC activities on a float) to be able to identify possible defects on sensors. It should be noted that corrections are difficult to decide until SBE tells the community more about the cell behaviour.

WMO and type of problem detected		PSAL correction ≠ 0	Altimetry QC	GREY LIST	Number of bad profiles (F flag)	% bad profiles (F flag)	Conclusion
Drift	**23**	**10**	**10**	**12**	**576**		
3901841		X					Drift correctable
3901849		X					Drift correctable
3901853		X					Drift correctable
3901859				X	40	37%	Drift unadjustable after cycle 66
3901867		X		X	25	24%	Drift unadjustable after cycle 87
3901868		X					Drift correctable
3901872				X	29	27%	Drift unadjustable after cycle 79
3901879		X					Drift correctable
3901880				X	20	24%	Needs further review
3901883			X				Needs further review
3901889			X				Needs further review
3901897			X	X	23	28%	Needs further review
3901898			X	X	37	45%	Drift unadjustable after cycle 44
3901904		X	X				Drift correctable
3901907		X		X	88	48%	Drift unadjustable after cycle 97
3901908				X	161	88%	Drift unadjustable after cycle 23
3901909				X	7	7%	Needs further review
3901913			X	X	37	29%	Needs further review
3901949		X					Drift correctable
3901952			X				Needs further review
3901953		X	X	X	65	97%	Needs further review
3901954			X				Needs further review
3901956			X	X	44	66%	Needs further review
Offset	**4**	**3**	**2**		**6**		
3901878		X	X				Offset correctable
3901887		X	X				Offset correctable
3901903		X					Offset correctable
3902136					6	100%	Data unusable
Other	**3**			**3**	**121**		
3901863				X	38	100%	Data unusable (recovered)
3901930				X	14	15%	Needs further review
3901981				X	69	100%	Salinity data unusable (plugs on the sensor)
Spike	**3**		**2**	**2**	**51**		
3901888			X				Needs further review
3901891				X	25	21%	Salinity sensor providing routinely spikey data
3901946			X	X	26	46%	Needs further review
Total	**33**	**13**	**14**	**17**	**754**		

Table 6: Synthetic view of the floats that have been corrected or flagged with bad data as part of the DM processing.

6. FEEDBACK FROM DMQC PARTNERS

6.1. DMQC BSH

WMO_ID	DAC	Deployment Date	Number of cycles	Date of last DMQC Cycles checked	Date of next DMQC	Result of DMQC
3901838	Coriolis	23.08.2016	1-111	D3 (03/2019) 1-93	September 2019	No correction needed
3901839	Coriolis	25.06.2016	1-117	D3 (06/2019) 1-107	December 2019	No correction needed
3901840	Coriolis	29.05.2016	1-120	D4 (06/2019) 1-110	December 2019	No correction needed
3901841	Coriolis	31.07.2016	1-113	D3 (03/2019) 1-95	September 2019	Fast salty drift starts in cycle 40, ΔS from -0.0075 to -0.0572
3901842	Coriolis	09.10.2016	1-71†	D3 (06/2019) 1-71	----------	No correction needed
3901843	Coriolis	09.10.2016	1-106	D3 (06/2019) 1-96	December 2019	No correction needed
3901844	Coriolis	13.10.2016	1-106	D3 (06/2019) 1-96	December 2019	No correction needed Few reference data
3901845	Coriolis	26.06.2016	1-117	D3 (06/2019) 1-107	December 2019	No correction needed
3901846	Coriolis	25.06.2016	1-105	D3 (03/2019) 1-87	September 2019	No correction needed
3901847	Coriolis	29.05.2016	1-105	D3 (03/2019) 1-87	September 2019	No correction needed Few reference data
3901850	Coriolis	24.06.2016	1-117	D3 (06/2019) 1-108	January 2020	No correction needed
3901851	Coriolis	25.06.2016	1-117	D3 (06/2019) 1-108	January 2020	No correction needed
3901856	Coriolis	09.08.2016	1-112	D3 (06/2019) 1-103	December 2019	No correction needed
3901857	Coriolis	12.08.2016	1-112	D2 (06/2018) 1-68	September 2019	No correction needed
3901858	Coriolis	14.08.2016	1-112	D3 (06/2019) 1-103	Dezember 2019	No correction needed
3901859	Coriolis	01.09.2016	1-110	D3 (03/2019) 1-92	September 2019	All data after cycle 66 are bad and not correctable
3901860	Coriolis	05.09.2016	1-110	D3 (06/2019) 1-100	January 2020	No correction needed But few reference data in eastern Caribbean
3901861	Coriolis	06.09.2016	1-109	D3 (06/2019) 1-100	January 2020	No correction needed But few reference data in eastern Caribbean
3901862	Coriolis	11.08.2016	1-112	D3 (06/2019) 1-103	December 2019	No correction needed
3901863	Coriolis	12.08.2016	1-34†	D1 (11/2017) 1-34	--------	All data are bad
3901864	Coriolis	08.09.2016	1-109	D3 (06/2019) 1-100	December 2019	No correction needed
3901865	Coriolis	08.09.2016	1-109	D3 (06/2019) 1-100	December2019	No correction needed
3901866	Coriolis	17.10.2016	1-105	D3 (06/2019) 1-96	December 2019	No correction needed, few reference data
3901867	Coriolis	11.10.2016	1-106	D3 (03/2019) 1-88	December 2019	Fast salty drift starts in cycle 70, ΔS from -0.0051 to -0.0549 in cycle 86, afterwards not correctable
3901868	Coriolis	12.10.2016	1-106	D3 (03/2019) 1-88	December 2019	Fast salty drift starts in cycle 51, ΔS from -0.0051 to -0.0252
3901869	Coriolis	10.11.2016	1-103	D3 (03/2019) 1-80	September 2019	No correction needed now, but tendency at end for higher salinities
3901870	Coriolis	10.11.2016	1-103	D3 (03/2019) 1-85	September 2019	No correction needed
3901872	Coriolis	29.08.2016	1-111	D3 (03/2019) 1-93	September2019	Fast salty drift starts abruptly in cycle 79, data are not correctable and all flagged bad
3901873	Coriolis	23.08.2016	1-110	D3 (06/2019) 1-100	January 2020	No correction needed, Slightly noisy salinities

3901874	Coriolis	22.08.2016	1-58†	D2 (06/2018) 1-58	----------	No correction needed
3901875	Coriolis	23.08.2016	1-111	D3 (03/2019) 1-93	October 2019	No correction needed, Slightly noisy salinities
3901876	Coriolis	17.10.2016	1-105	D3 (06/2019) 1-96	January 2020	No correction needed
3901877	Coriolis	21.10.2016	1-105	D3 (06/2019) 1-96	January 2020	No correction needed, High natural variability in Zapiola Eddy
3901895	BODC	14.04.2017	1-88	D2 (06/2019) 1-78	December 2019	No correction needed, High natural variability in Zapiola Eddy
3901896	BODC	24.04.2017	1-86	D4 (08/2019) 1-78	April 2020	Fast salty drift during entire life, ΔS from +0.002 to -0.0265 in cycle 73, all later cycles are not correctable
3901897	BODC	10.05.2017	1-85	D3 (02/2019) 1-66	September 2019	Highly variable and large positive corrections, all data after cycle 56 are not correctable.
3901898	BODC	10.05.2017	1-85	D4 (06/2019) 1-76	January 2020	Fast salty drift starts abruptly in cycle 45, data are not correctable and all flagged bad
3901909	BODC	29.12.2016	1-98	D3 (03/2019) 1-81	September 2019	Fast salty drift starts in cycle 48, ΔS from -0.0109 to -0.0325.
3901910	Coriolis	29.06.2017	1-88†	D3 (06/2019) 1-88	----------	No correction needed
3901911	Coriolis	27.06.2017	1-114	D2 (05/2019) 1-99	November 2019	No correction needed
3901940	Coriolis	20.09.2017	1-7AD†	Baltic	End of 2019	
3901941	Coriolis	21.09.2017	1-357AD	Baltic	End of 2019	
3901942	BODC	20.09.2017	1-69	D2 (03/2019) 1-54	September 2019	No correction needed
3901946	BODC	23.01.2018	1-59	D2 (03/2019) 1-39	September 2019	No correction needed until cycle 27, afterwards malfunction of the sensor and no correction possible
3901947	BODC	23.01.2018	1-59	D2 (05/2019) 1-49	November 2019	No correction needed
3901952	BODC	05.10.2017	1-70	D2 (03/2019) 1-53	September 2019	No correction needed, but tendency for drift at end
3901953	BODC	05.10.2017	1-80	D2 (02/2019) 1-51	September 2019	Highly variable and negative corrections since cycle 17, questionable if data are correctable.
3901979	BODC	06.02.2018	1-191	D1 (07/2018) 1-50	February 2020	Float in Caribbean with 3-day cycles, no reference data after cycle 100. DMQC pending
3901985	BODC	07.02.2018	1-179	D1 (07/2018) 1-49	Februar 2020	Float in Caribbean with 3-day cycles, no reference data after cycle 90. DMQC pending
3901986	BODC	06.02.2018	1-191	D1 (07/2018) 1-50	Februar 2020	Float in Caribbean with 3-day cycles, no reference data after cycle 60. DMQC pending

3901987	BODC	06.02.2018	1-173	D1 (07/2018) 1-50	Februar 2020	Float in Caribbean with 3-day cycles, no reference data after cycle 50. DMQC pending
3902133 Ehemals 3901940		03.11.2017	1-332AD	Baltic	End of 2019	
3901966	BODC	07.04.2018	1—52	D1 (06/2019) 1-43	December 2019	No correction needed
3901967	BODC	16.04.2018	1-41†	D1 (06/2019) 1-41	----------	No correction needed
3901968	BODC	02.11.2017	1-67	D2 (06/2019) 1-58	December 2019	No correction needed
3901969	BODC	14.04.2018	1-51	D1 (06/2019) 1-42	December 2019	No correction needed
6900790	Coriolis	21.11.2018	1-27		September 2019	
3902134	Coriolis	04.10.2018	1-219AD	Baltic	End of 2019	
3902135	Coriolis	01.01.2018	1-52	D2 (06/2019) 1-52	December 2019	No correction needed
3902136	Coriolis	30.12.2017	1-5†	D1 (06/2019) 1-5	----------	Malfunctioned from start, no good data
3902137	Coriolis	09.11.2018	1-182AD	Baltic	End of 2019	
3901989	Coriolis	08.09.2018	1-36	D1 (06/2019) 1-27	December 2019	No correction needed
3901991	Coriolis	13.12.2018	1-27		September 2019	
3901992	Coriolis	27.12.2018	1-25		September 2019	

Status is 03.09.2019

6.2. DMQC BODC

6.2.1. 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.

6.2.2. 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

6.2.3. 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

6.2.4. 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.

6.2.5. DMQC Operator

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

6.3. DMQC Ifremer

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

6.3.2. 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: Comparison with the reference CTD cast	Calibration: Correction from OWC method (CTD ref)	Correction applied in the D files
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.

Summary

WMO Number	DM Salinity correction
3901922	No correction
3901934	No correction
3901935	No correction
3901936	No correction
3901937	No correction
3901943	No correction
3901951	No correction
3901965	No correction
3901964	No correction
3901945	No correction
3901955	No correction
3901944	No correction
3901926	No correction
3901933	No correction
3901972	No correction

6.3.3. 2018 Deployments

Summary

WMO Number	DM Salinity Correction
3901971	No correction
3901970	No correction
3901980	No correction
3901982	No correction
3901983	No correction
3901954	OWC correction applied
3901984	No correction
3901921	No correction
3901932	No correction

WMO Number	Calibration: Comparison with the reference CTD cast	Calibration: Correction from OWC method	Correction applied in the D files
3901971	na	linear drift (0.015/yr) (config. 1491)	No correction
3901970	na	0.006 ± 0.014 (config. 1491)	No correction
3901980	na	0.006 ± 0.025 and small drift (1 break point) after cycle 25 (config. 1493)	No correction
3901982	na	0.002 ± 0.022 and 0 ± 0.003 after cycle 25 (config. 1493)	No correction
3901983	na	0.005 ± 0.015 and linear drift (0.003/yr) after cycle 25 (config. 1493)	No correction
3901954	na	linear drift (-0.024/yr) up to cycle 45 and strong drift afterward (config. 1293)	OWC correction applied
3901984	na	0.005 ± 0.003 (config. 1493)	No correction
3901921	na	0.005 ± 0.003 (config. 1493)	No correction
3901932	na	0.007 ± 0.005 (config. 1491)	No correction

6.4. 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

7. CONCLUSION

Here is the synthesis of the status of Delayed-Mode processing of the MOCCA fleet:

- 127 floats have been DMQC'ed at least once
- 60% of MOCCA observations have already been quality controlled and 88% of observations aged more than 1 year have already been quality controlled
- 17 floats are on the Grey list and that prevents their real-time distribution to operational centres
- 18 floats (including the 17 on the Grey list) have most of their profiles flagged as bad data
- 87% of the MOCCA profiles contain 100% good data and less than 5% contains only bad data

Information coming from the Greylist, GDAC index file, Altimetry QC and comments from the DMQC operators have been assembled in Table 6 and provide a consolidated view of the status of floats highlighted by the DM process.

It follows that 33 MOCCA floats have been highlighted by the DM process. 14 floats received at least one Altimetry QC and 17 are on the Grey list.

Salinity drift problems were identified for 23 floats and corrections were possible for 10 floats for part, or all (7 floats) of their cycles. The drift was deemed unadjustable after a certain point for 6 floats. The others need further review, meaning that the DM operator could not at this stage determine the seriousness of the drift.

Offset problems were identified for 4 floats, and corrections applied for 3 floats. The other float, lost after 5 cycles is considered as unreliable.

Other problems were identified for 3 floats, including 2 floats for which the data are unreliable for all their cycles (1 recovered, 1 deployed with the CTD plugs left on).

Spike problems were identified for 3 floats.

Altogether 754 profiles have been flagged as bad (F) for these 33 floats. This represents less than 5% of all MOCCA profiles. So, one can say that MOCCA dataset is for the time being of good quality.

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

Report from Giulio