

German National Report on Argo - 2018

1. The status of implementation (major achievements and problems in 2018)

- floats deployed and their performance

All of the floats deployed by Germany in 2018 are operated by BSH, but in other years additional funding had been acquired by various research institutes. BSH has deployed 51 floats (16 APEX, 35 ARVOR) by the end of 2018. No floats have been deployed by GEOMAR and AWI in 2018. 49 of the German floats deployed in 2018 were standard TS floats, 3 floats deployed in the Labrador Sea carried pH/O_2 sensors. Deployment was carried out on research vessels which comprised Canadian, German and UK ships. The deployment locations for 2018 are shown in Fig. 1.

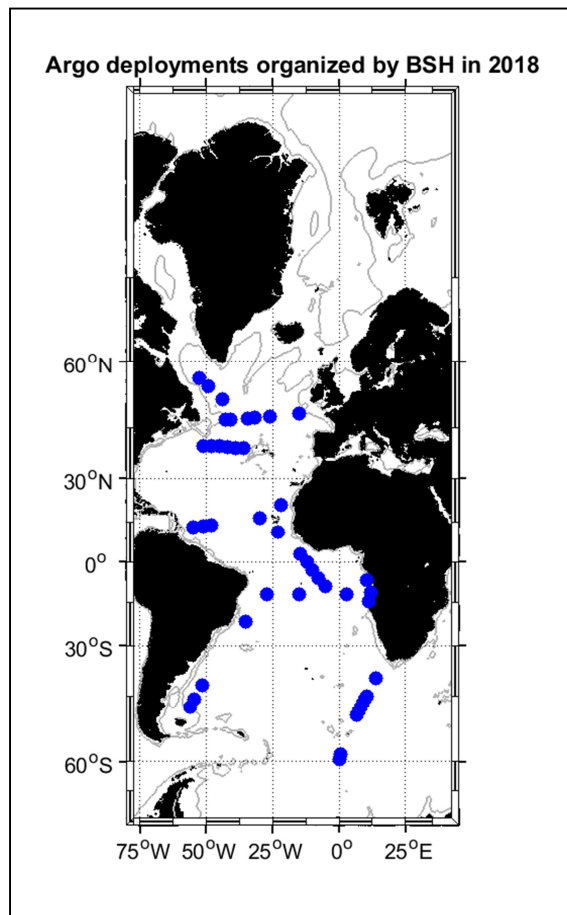


Fig. 1: Deployment positions for floats operated by BSH in 2018 in the Atlantic Ocean.

Currently (February 15th, 2019) 154 German floats are active (Fig.2) and the total number of German floats deployed within the Argo program increased to 866. The number of German floats in the network is stiller lower than anticipated due to the loss rate of APEX floats in the previous years. Some of the under-ice floats deployed by AWI in the previous years are assumed to be still active under the ice and could resurface again in the next austral summer and deliver their stored data.

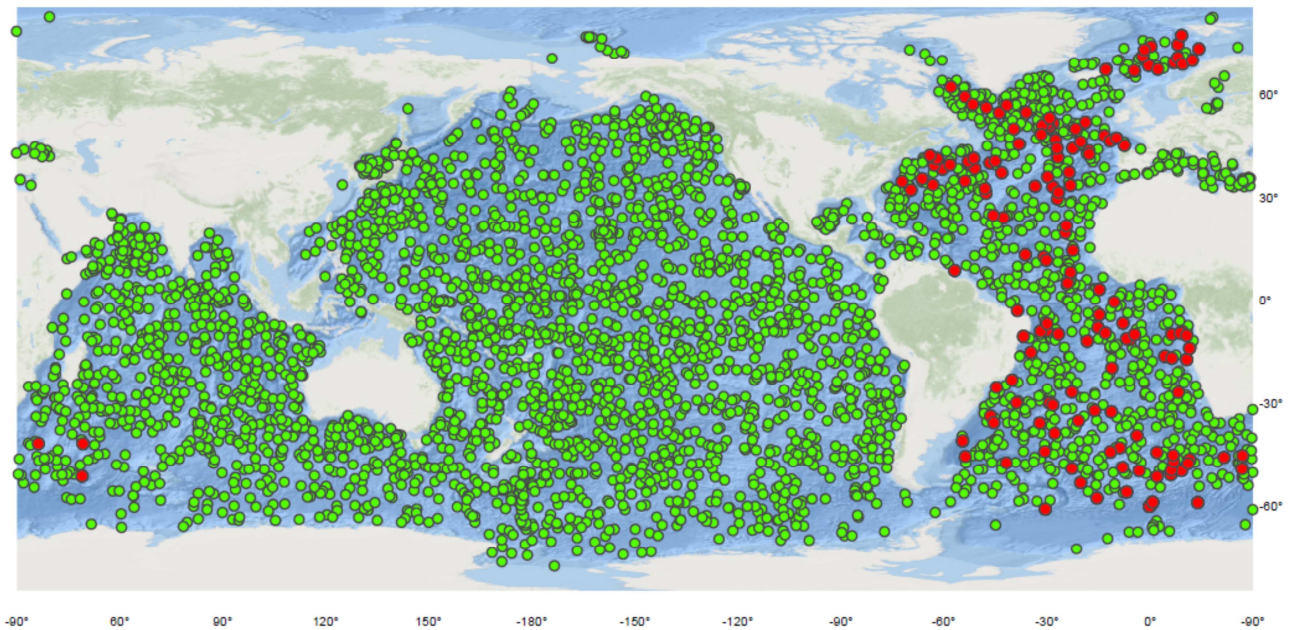


Fig. 2: Locations of active German floats (red) and active international floats (green) (Argo Information Centre, February 2019).

- technical problems encountered and solved

The major technical problem with the alkaline batteries in our APEX floats deployed between 2010-2014 has faded out. We are still experiencing problems with the new APF-11 controller boards provided by TWR and some of the missions settings needed to be changed in extensive interaction with TWR. One of the three APEX floats equipped with ph- and O2-sensor is malfunctioning due to a defect pressure sensor. A replacement for this float has been offered and we are in contact with our colleagues from Bedford Institute in Canada in an effort to retrieve the float from the central Labrador Sea.

After the audit by John Gilson on availability of SBE serial numbers in the meta files, efforts were taken to provide Coriolis with missing information and check the proper assignment of serial numbers to individual sensors.

Special attention has been given to floats in the SN range 6000-7100, all floats have been through dmqc and have been corrected if necessary.

Sudden salty drift is also detected for more recent SNs and some of the floats show depth dependent corrections. Contact with Kim Martini from SBE has been established to understand the behavior.

- status of contributions to Argo data management (including status of conversion to V3 file formats, pressure corrections, etc.)

Germany has continued to work in the new European Research Infrastructure Consortium EURO-ARGO-ERIC which was established in July 2014 in Brussel by 9 founding countries (France, Germany, United Kingdom, Italy, Netherlands, Norway, Greece, Poland and Finland). GEOMAR and AWI are

members of the EU-funded ATLANTOS project and have deployed deep-floats and bio-Argo floats within this project. Germany is responsible in the framework of the MOCCA project (coordinated by the ERIC) for the delayed-mode quality control of about 50 MOCCA floats, in the Nordic Seas, the subpolar gyre and Southern Ocean and contributes to the at-sea monitoring of the fleet. Within MOCCA an ice-algorithm has been developed for the Arctic ocean from a combination of quality controlled hydrographic data and ice-edge information. At present we are starting to process all the Argo data in the Nordic Seas, trying to eliminate small biases in the data set and will also work on updating the CTD reference data set for the Nordic Seas and Arctic.

Germany has adopted a few of the orphaned US Navy floats and has provided quality control for these floats, as well as for some floats belonging to the University of Maine. Germany is also acting as delayed mode quality control operator for European contributions from Denmark, Finland, Norway, the Netherlands and Poland.

Coriolis is still in the process of reformatting older floats into V3.1, with priority on floats carrying BGC parameters. This leads to changes of existing D-files into R-files and needs additional work on dmqc. The amount of floats to be processed is decreasing and most floats concerned have been reformatted by now.

- status of delayed mode quality control process

In the past the delayed mode processing had been distributed between the various German institutions contributing to Argo, depending on their area of expertise. The Alfred-Wegener Institute had been responsible for the Southern Ocean and GEOMAR was processing floats in the Pacific with oxygen data. The DMQC for the core Argo parameters is now performed by BSH, including the AWI floats. Reprocessing of these has been finished by Coriolis and the floats are on the priority list for DMQC. DMQC on oxygen will still be performed at PI level and work is carried out by GEOMAR respectively Henry Bittig now at IOW. The processing of the ph-data is carried out by Arne Körtzinger's group at GEOMAR.

BSH is also processing the German/Finnish/Norwegian floats in the Nordic Sea, and is covering the tropical, subtropical and subpolar Atlantic. German floats in the Mediterranean on the other hand are processed by MEDARGO. The sharing of delayed-mode data processing will be continued in the coming years, but BSH will cover all German floats which have not been assigned to a PI.

All German institutions have been working in close collaboration with Coriolis and delayed mode data have been provided on a regular basis (6 month). The processing of the RAFOS information on the under ice floats needs to be performed by AWI experts, the intermediary RAFOS amplitudes and time-of-arrival are stored in the in the aux-files directory.

The DMQC process for German floats is continuing, and the frequency of delayed-mode visits has increased during 2017 and continues at these levels in 2018. The total number of available profiles from German floats is 72758 (February 28th, 2019), the number of DM profiles is 62976. The percentage of DM profiles with respect to the total number of profiles has at about 87% in 2018. The main delays remain with the floats in the Southern Ocean owned by AWI, for the other float programmes managed by BSH the delayed mode is at 91%. All delayed mode profiles have been sent to the Coriolis GDAC node.

The table below lists the status of dmqc efforts for the various national and adopted international programs.

Program Name	Number of profiles	Number of D-files	D-files pending	Comments
Argo BSH	47394	42405	1624	
Argo AWI	7388	3597	3791	Are on priority list
Argo GEOMAR	13490	12552	928	Due to reprocessing
Argo U. HH	3331	3096	235	
Argo Poland	1907	744	312	Baltic floats mostly
Argo Finland	2756	795	1576	Baltic floats mostly
Argo Denmark	360	360	0	Old floats associated with U. HH
Argo Netherlands	10194	9656	226	
Argo Norway	4140	2232	1489	Due to reprocessing

2. Present level of and future prospects for national funding for Argo including a summary of the level of human resources devoted to Argo.

The present level of national funding for Argo had remained at flat levels during the last years, but in negotiations with the ministry we have received an increase in funding for the floats in 2019 which allows us to increase the number of floats purchased per year from ~35 back to 50, as originally envisioned. The human resources remain at the same level as before and Birgit Klein, Jan-Hinrich Reissman, Anja Schreehorst and Simon Tewes cover activities such as purchase, technical inspection, deployment, data quality control and representation in national and international teams. As part of our Euro-Argo activities Birgit Klein and Bernd Brügge are involved as management board and council.

Funding for complementary oxygen and ph-sensors has been provided by the science ministry (BMBF) and three floats equipped with these sensors have been deployed in the Labrador Sea in 2018. One float is malfunctioning due to a defect in the pressure sensor, but will be replaced in 2019 by compensation of Webb Research. The University of Oldenburg has received funds from BMBF to buy 6 BGC floats and test new hyperspectral sensors. Three of the floats will be deployed in 2019.

3. Summary of deployment plans (level of commitment, areas of float Deployment, low or high resolution profiles, Argo extensions) and other commitments to Argo (data management) for the upcoming year and beyond where possible.

Purpose is gapping filling in the Atlantic, main focus areas are southern ocean and gaps in the subtropical/subpolar areas from the priority list of the ERIC (see maps below). A maximum number of 55 will be deployed in 2019. 3 floats with BGC sensors are contributed by the University of Oldenburg and are financed by the ministry of research (BMBF). All profiles will be high resolution profiles.

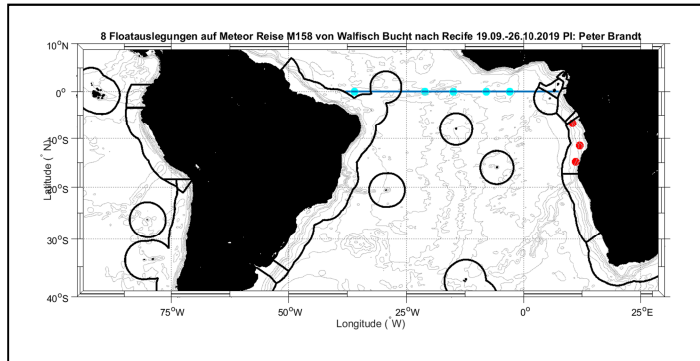
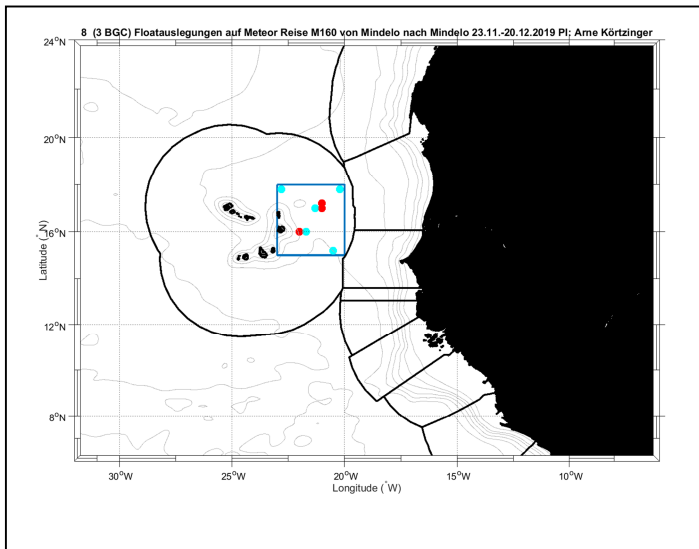
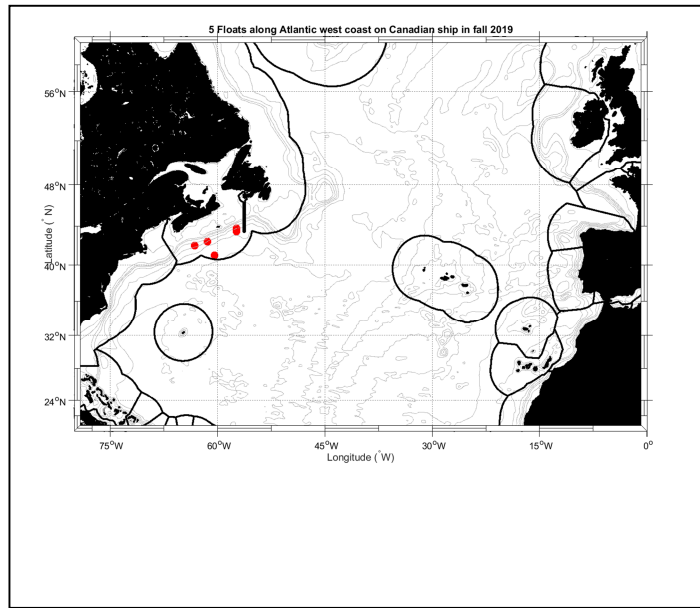
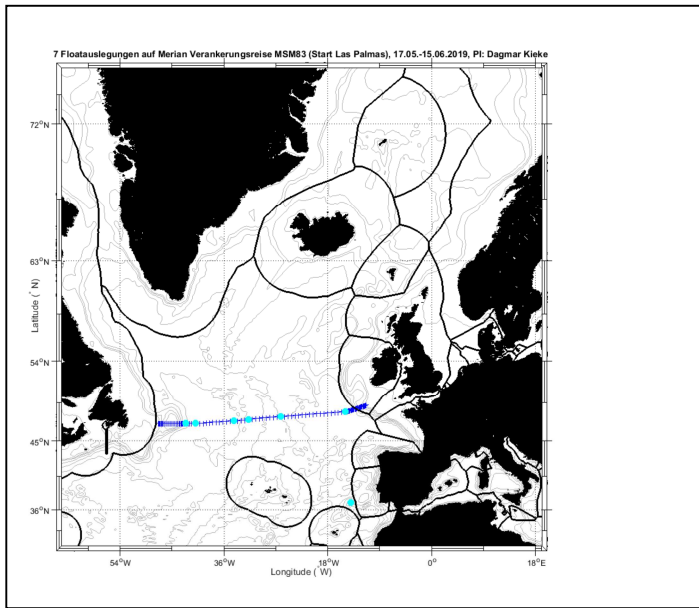


Fig.3: Planned deployments in the North Atlantic in 2019

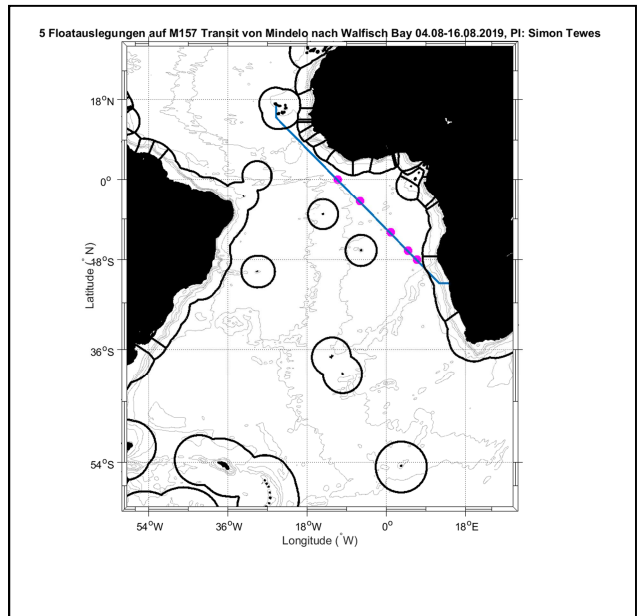
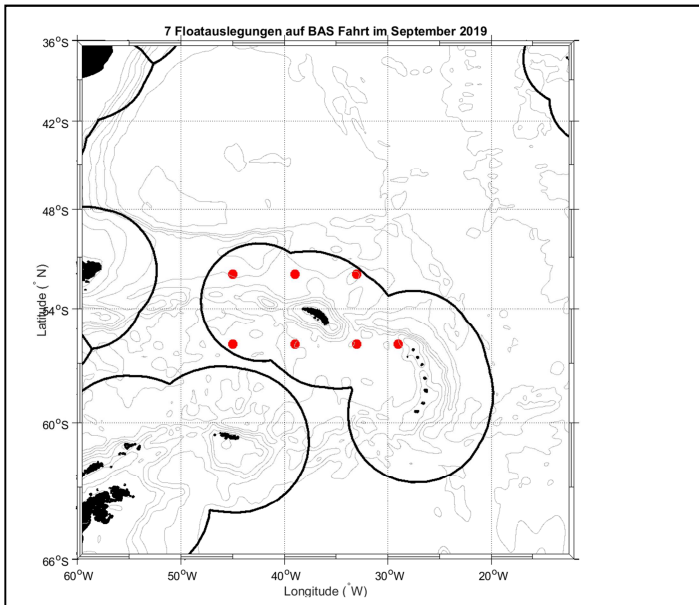
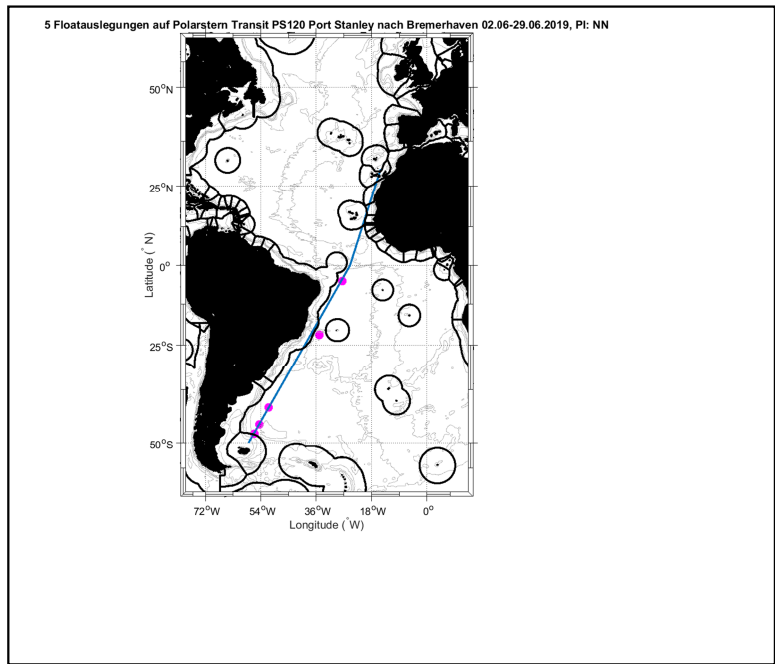
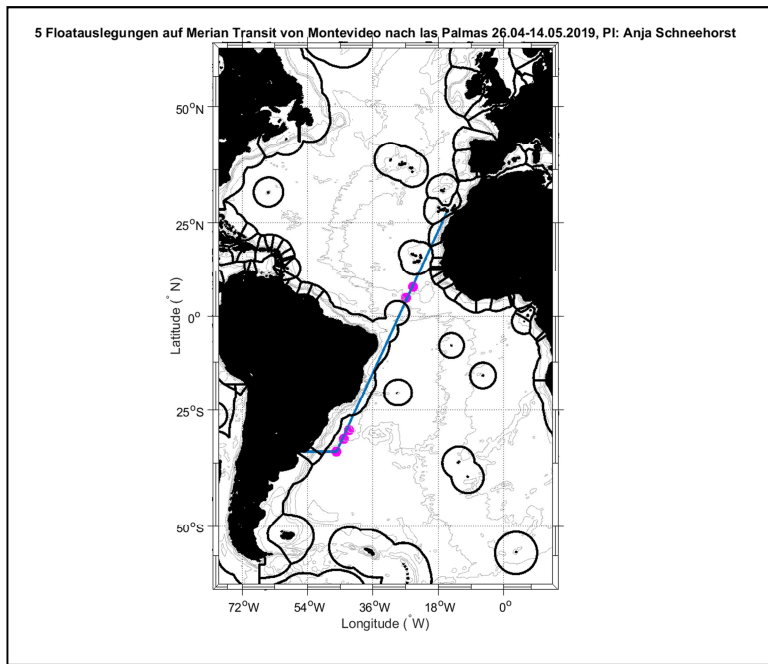


Fig. 4: Planned deployments in the South Atlantic in 2019

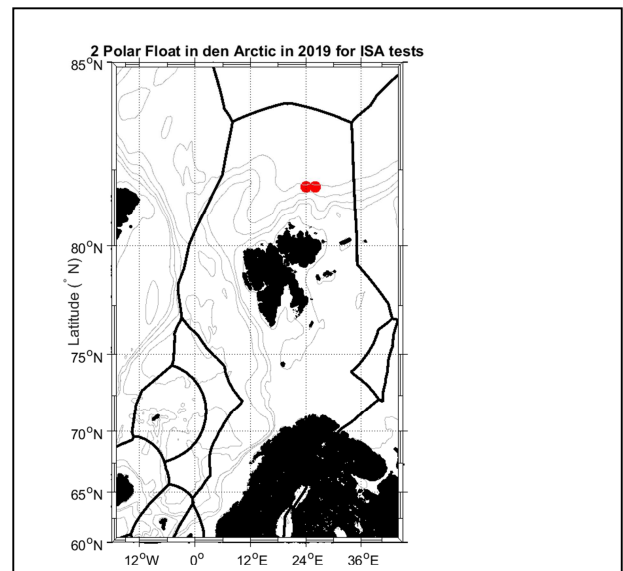
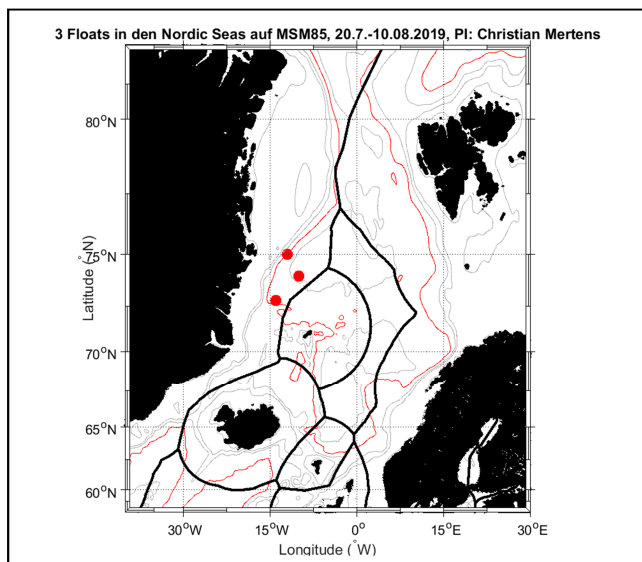


Fig. 5: Planned deployments in the ice covered areas

Summary of deployment plans by area and float type and sensor additions

GER	2019						
	Total	T/S Core	T/S/O2	BGC	Bio	Deep	
Nordic Seas	3	3					
Mediterranean Sea							
Black Sea							
Baltic Sea							
Southern Ocean							
Arctic Ocean	2	2					
Global Ocean	50	47		3			
Total	55	52		3			

GER	2020						
	Total	T/S Core	T/S/O2	BGC	Bio	Deep	
Nordic Seas	3	3					
Mediterranean Sea							
Black Sea							
Baltic Sea							
Southern Ocean	10		10				
Arctic Ocean	2	2					
Global Ocean	48	45		3			
Total	63	50	10	3			

Deployment plans for 2019/2020

4. Summary of national research and operational uses of Argo data as well as contributions to Argo Regional Centers. Please also include any links to national program Argo web pages to update links on the AST and AIC websites.

BSH is maintaining the Argo Germany Web site. We have recently moved our updated webpage to our institutional page and have added content.

https://www.bsh.de/DE/THEMEN/Beobachtungssysteme/ARGO/argo_node.html

It provides information about the international Argo Program, German contribution to Argo, Argo array status, data access and deployment plans. It also provides links to the original sources of information.

Currently no statistics of Argo data usage are available. The German Navy uses Argo data on a regular basis for the operational support of the fleet and uses their liaison officer at BSH to communicate their needs. The SeaDataNet portal uses German Argo data operationally for the Northwest European Shelf. Argo data are routinely assimilated in the GECCO reanalysis, which is used for the initialisation the decadal prediction system MiKlip. At BSH the data are used within several projects such as KLIWAS, RACE, MiKlip, ICDC and Expertennetzwerk BMVI.

The user workshop was held in 29.06.2018. It was well attended. It provided a good forum for users to share their scientific work and methods.

A key aspect of the use of Argo data at BSH is to develop a data base for climate analysis, to provide operational products for interpretation of local changes and to provide data for research applications for BSH related projects (KLIWAS, RACE, MiKlip, ICDC and Expertennetzwerk BMVI).

Argo data are being used by many researchers in Germany to improve the understanding of ocean variability (e.g. circulation, heat storage and budget, and convection), climate monitoring and application in ocean models.

Germany contributes to the NAARC and also recently joined the SOARC. Researchers from German institutions have continued to contribute recent CTD data to the Argo climatology. Within the MOCCA project we are presently working on an ARC for the Nordic Seas.

5. Issues that your country wishes to be considered and resolved by the Argo Steering Team regarding the international operation of Argo. These might include tasks performed by the AIC, the coordination of activities at an international level and the performance of the Argo data system. If you have specific comments, please include them in your national report.

6. To continue improving the quality and quantity of CTD cruise data being added to the reference database by Argo PIs, it is requested that you include any CTD station data that was taken at the time of float deployments this year. Additionally, please list CTD data (calibrated with bottle data) taken by your country in the past year that may be added to the reference database. These cruises could be ones designated for Argo calibration purposes only or could be cruises that are open to

the public. To help CCHDO track down this data, please list the dates of the cruise and the PI to contact about the data.

A variety of CTD data sets from recent research groups were provided to Coriolis, mostly reference profiles from floats deployments from various cruises of Merian, Meteor and Polarstern. Additionally all data from Merian cruise MSM73 were provided by Uni Bremen (143 stations).

7. Keeping the Argo bibliography (<http://www.argo.ucsd.edu/Bibliography.html>) up to date and accurate is an important part of the Argo website. This document helps demonstrate the value of Argo and can possibly help countries when applying for continued Argo funding. To help me with this effort, please include a list of all papers published by scientists within your country in the past year using Argo data, including non-English publications.

Fischer, J., Karstensen, J., Oltmanns, M., and Schmidtko, S.: Mean circulation and EKE distribution in the Labrador Sea Water level of the subpolar North Atlantic, *Ocean Sci.*, 14, 1167-1183, <https://doi.org/10.5194/os-14-1167-2018>, 2018.

Oltmanns, M., J. Karstensen, J. Fischer. Increased risk of a shutdown of ocean convection posed by warm North Atlantic summers. *Nature Climate Change*, <http://dx.doi.org/10.1038/s41558-018-0105-1>, 2018.

Testor, P., Bosse, A., Houpert, L., Margirier, F., Mortier, L., Legoff, H., Dausse, D., Labaste, M., Karstensen, J., Hayes, D., ... Conan, P. Multiscale observations of deep convection in the northwestern Mediterranean Sea During winter 2012–2013 using multiple platforms. *J. of Geophysical Research: Oceans*, 123, 1745–1776. doi.org/10.1002/2016JC012671, 2018.

Tchupalanga, P.C.M., M. Dengler, P. Brandt, R. Kopte, M. Macuéria, , P. Coelho, M. Ostrowski and N. S. Keenlyside (2018) Eastern boundary circulation and hydrography off Angola – building Angolan oceanographic capacities, *Bulletin of American Meteorological Society*, 8, 1589-1605, doi: 10.1175/BAMS-D-17-0197.1.

Lübbecke, J. F., P. Brandt, M. Dengler, R. Kopte, J. Lüdke, I. Richter, M. S. Martins, P. C. M. Tchupalanga (2018) Causes and evolution of the southeastern tropical Atlantic warm event in early 2016, *Clim. Dyn.*, published online Dec. 8, 2018, doi: 10.1007/s00382-018-4582-8.

Czeschel, R., Schütte, F., Weller, R. A., Stramma, L. (2018) Transport, properties, and life cycles of mesoscale eddies in the eastern tropical South Pacific, *Ocean Science*, 14, 731-750, <https://doi.org/10.5194/os-14-731-2018>.

Keppler, L., Cravatte, S., Chaigneau, A., Pegliasco, C., Gourdeau, L., & Singh, A. (2018). Observed characteristics and vertical structure of mesoscale eddies in the southwest tropical Pacific. *Journal of Geophysical Research: Oceans*, 123, 2731–2756. doi.org/10.1002/2017JC013712

Featured also in the Euro-Argo Newsbrief (Science & Technology Highlights): <https://www.euro-argo.eu/Activities/Data-Use-and-Applications/Scientific-Results/Global-core-Argo/Observed-Characteristics-and-Vertical-Structure-of-Mesoscale-Eddies-in-the-SouthWest-Tropical-Pacific>

Kieke, D, W. Böke, S. Büttner, K. Bulsiewicz, C. Danek, T. Hempel, D. Khordakova, B. Mirau, A. Rochner, A. Roessler, N. Rohlf, A. Schneeorst, R. Steinfeldt, P. Sültenfuß, H.-H. Uhde, S. Wett, K. Wiegand, F. Wischnewski (2018), Subpolar Gyre Variability, Cruise No. MSM53, March 31 - May 09, 2016, Kiel (Germany) - St. John's (Canada). *MARIA S. MERIAN-Berichte*, DFG-Senatskommission für Ozeanographie, doi:10.2312/cr_msm53