## 1. The status of implementation (major achievements and problems in 2016)

- floats deployed and their performance

Most of the floats deployed by Germany are operated by BSH but additional funding has been acquired by various research institutes. BSH will have deployed 45 floats (21 APEX, 24 ARVOR) by the end of 2016, 5 floats purchased in 2016 will used for a deployment cruise early 2017. No floats have been deployed by GEOMAR and AWI this year. All of the German floats deployed in 2016 were standard TS floats. Deployment was carried on research vessels. The scientific research vessels comprised Canadian, German and UK ships. The deployment locations for 2016 are shown in Fig. 1.

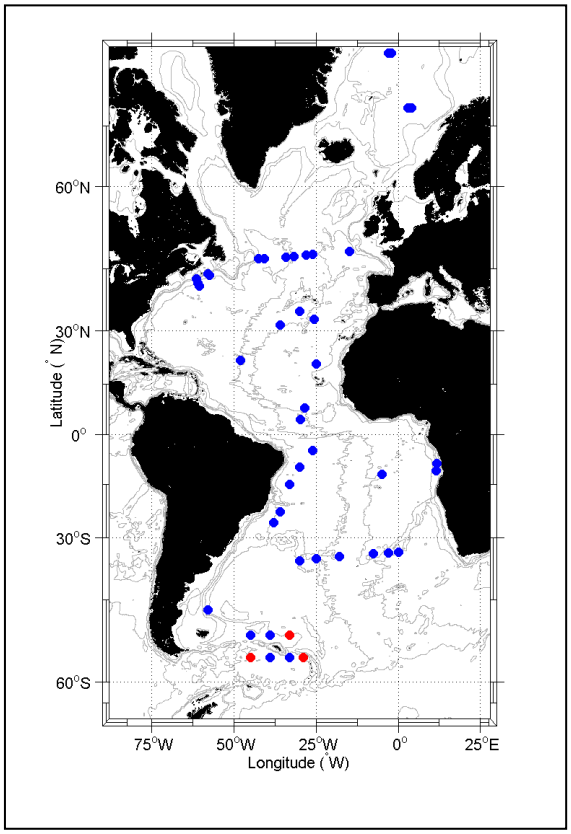



Fig. 1: Deployment positions for floats operated by BSH in 2016 in the Atlantic Ocean. At positions marked in blue the deployment has been carried out in 2016 and those in red will be achieved in the next few weeks.

Currently (February 10th, 2017) 143 German floats are active (Fig.2) and the total number of German floats deployed within the Argo program increased to 853. 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. TWR has provided 9 more floats during 2016 from the warranty agreement for lost floats. In total 34 floats were provided by TWR between 2014 and 2016 to replace floats suffering from battery flue. 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.

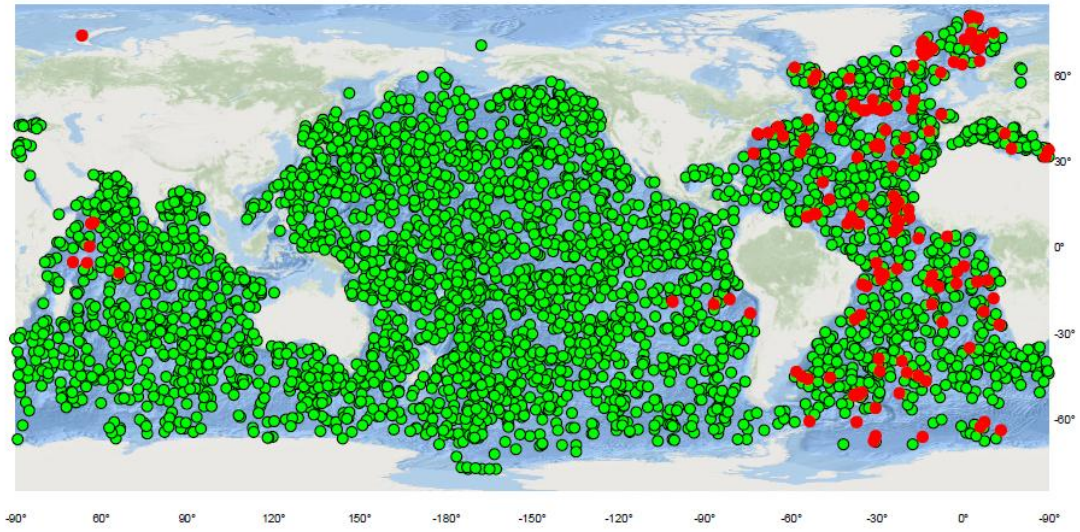



Fig. 2: Locations of active German floats (red) and active international floats (green) (Argo Information Centre, February 2017).

- technical problems encountered and solved

The major technical problems with the alkaline batteries in our APEX floats deployed since 2010 is slowly fading out. Until February 2017 more than 74 floats, deployed between 2010 and 2014, expired early with life cycles of about 700-800 days. The technical data send back from the floats indicate a sudden loss of battery voltage to values of around 7 volt during the last profile and increased battery consumption during the previous cycles due to 'energy flue'. WEBB/TELEDYNE has already replaced floats 34 floats in three batches (14 floats in 2014, 11 floats in 2015 and 9 floats in 2016). We expect to finish all warranty issues from that tender with TWR in 2017.

As has been reported in last year's national report the Canadian NOVA floats appear to have an extremely high early death rate. According to the analysis of the entire NOVA fleet in the Argo program the survival rate after 6 months was only 81%, i.e. 19% were lost in the first 6 months. In the smaller sample of 22 German NOVA floats 11 have died within the first year (<40 cycles) and 4 more before reaching 100 cycles. These floats are covered by our warranty agreement and we will work with the company to settle the issue. Additional to the high early failure rate the floats also show very noisy salinity profiles which have abundant spikes and inversion which are unstable in salinity.

- 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 will deploy deep-floats and bio-Argo floats within this project. Germany will be responsible in the framework of the ERIC for the delayed-mode quality

control of the ERIC floats in the Nordic Seas and at-sea monitoring of the fleet. Germany has adopted a few (9) of the orphaned US Navy floats and will provide quality control for these floats. Germany is also acting as delayed mode quality control for European contributions from Denmark, Finland, Norway, the Netherlands and Poland.

Birgit Klein has taken on duties from Ann Thresher on the standardization of the technical files. This is an ongoing issue as more names will be required for new float models and sensors. This work is carried out in cooperation with John Gilson and Esmee van Wijk to ensure consistency to the meta-files.

- status of delayed mode quality control process

The delayed mode processing is distributed between the various German institutions contributing to Argo, depending on their area of expertise. The Alfred-Wegener Institute is responsible for the Southern Ocean and GEOMAR is processing floats with oxygen data. 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. Delays in delayed-mode data processing have occurred in the last year at AWI due to changes in personal and delays in replacement. The processing of the RAFOS information on the under ice floats needs reformatting of the files to file format 3.1. The intermediary RAFOS amplitudes and time-of-arrival will be stored in the trajectory data. AWI is presently enhancing their decoders for the remaining NEMO floats to solve issues with the dating of under-ice profiles and will resubmit these data to Coriolis soon. These files will then be transformed to file format 3.1.

We are in continuous contact with Coriolis because the re-processing of APEX floats at Coriolis required a replacement of already existing D-files with files based on the new decoders and format conversion to V3.1. The process has been finished for most APEX float types and we hope it will be finished for NEMO floats in 2017.

The DMQC process is continuing, and delays have been encountered due to format issues with file format 3.1 and updates in hardware/software are resolved now. It is expected the number of delayed mode files submitted to Coriolis and the frequency of delayed-mode will go back to normal levels during 2017.

All delayed mode profiles from BSH have been sent to the Coriolis GDAC node. The total number of available profiles from German floats is 61086 (February 10$^{th}$, 2017), the number of DM profiles is 45589. The percentage of DM profiles with respect to the total number of profiles has increased to about 81%.

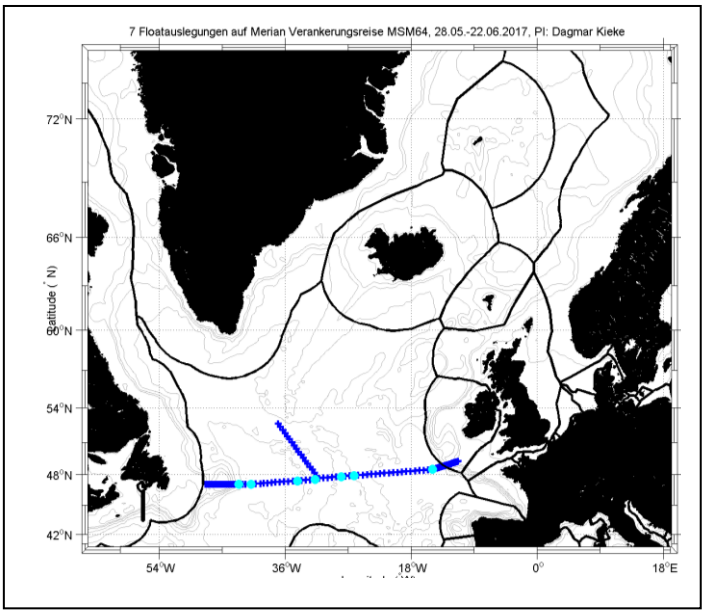
**2. Present level of and future prospects for national funding for Argo including a summary of the level of human resources devoted to Argo.**

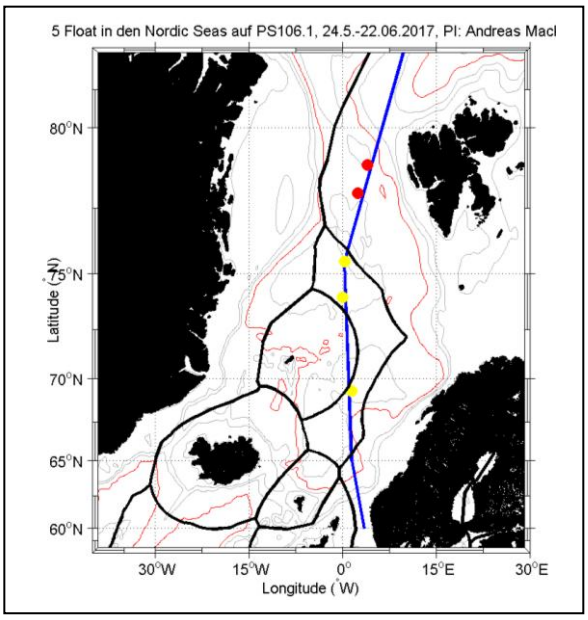
The present level of national funding for Argo has remained at flat levels during the last years, but we hope for an increase in funding in 2018 which would allow us to increase the number of floats purchased per year from ~40 back to 50 as originally envisioned.

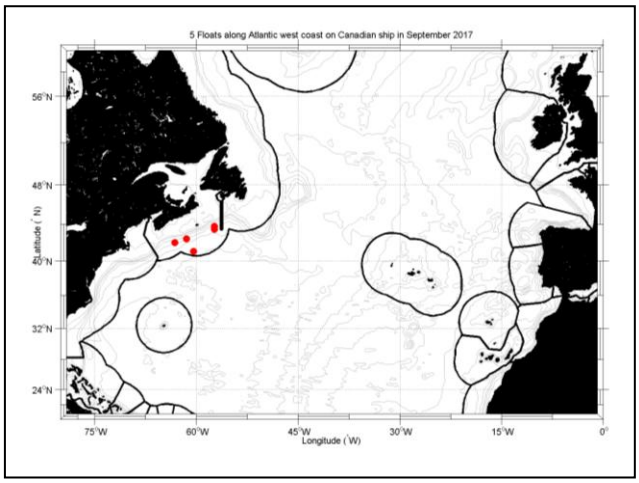
At BSH three staff members (Birgit Klein, Jan-Hinrich Reissmann and Anja Schneehorst) are involved in the Argo project and cover all activity areas from purchase, deployment to data quality control and representation in national and international teams. As part of our Euro-Argo activities Hartmut Heinrich and Bernd Brügge are involved as Council and Management Board members. Birgit Klein is member of the Scientific and Technical Advisory Group.

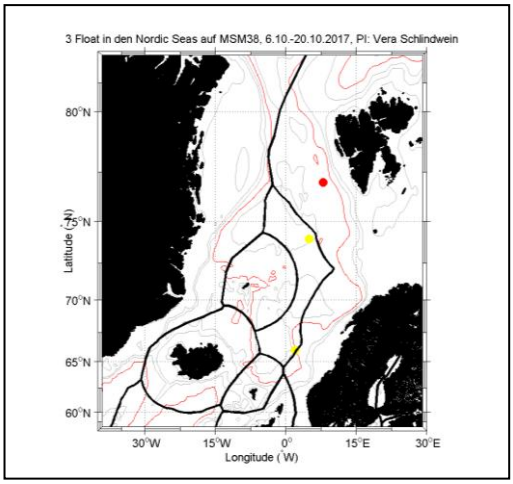
**3. Summary of deployment plans (level of commitment, areas of float Deployment, low or high resolution profiles, Argo extensions) and other commitments to Argo (data management) for the upcoming year and beyond where possible.**

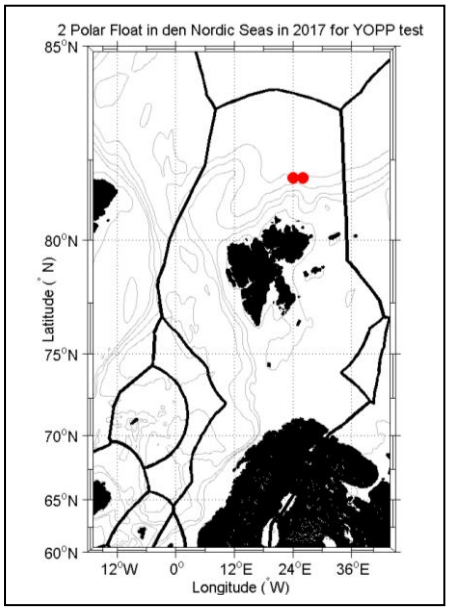
Purpose is gapping filling in the Atlantic, main focus areas are southern ocean and Nordic Seas from the priority list of the ERIC. A minimum deployment of 39 floats is planned, 5 from these have purchased in 2016. A maximum of 56 float deployments is planned if more funds become available (warranty floats).

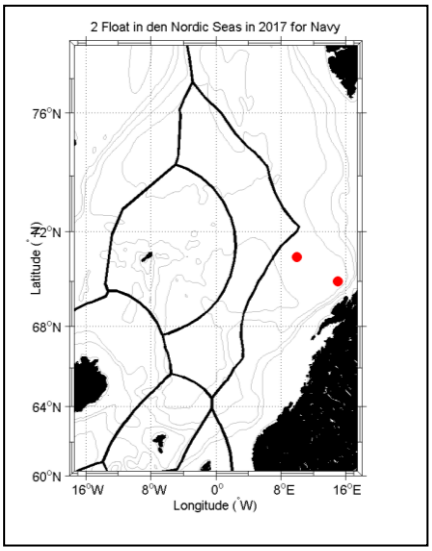


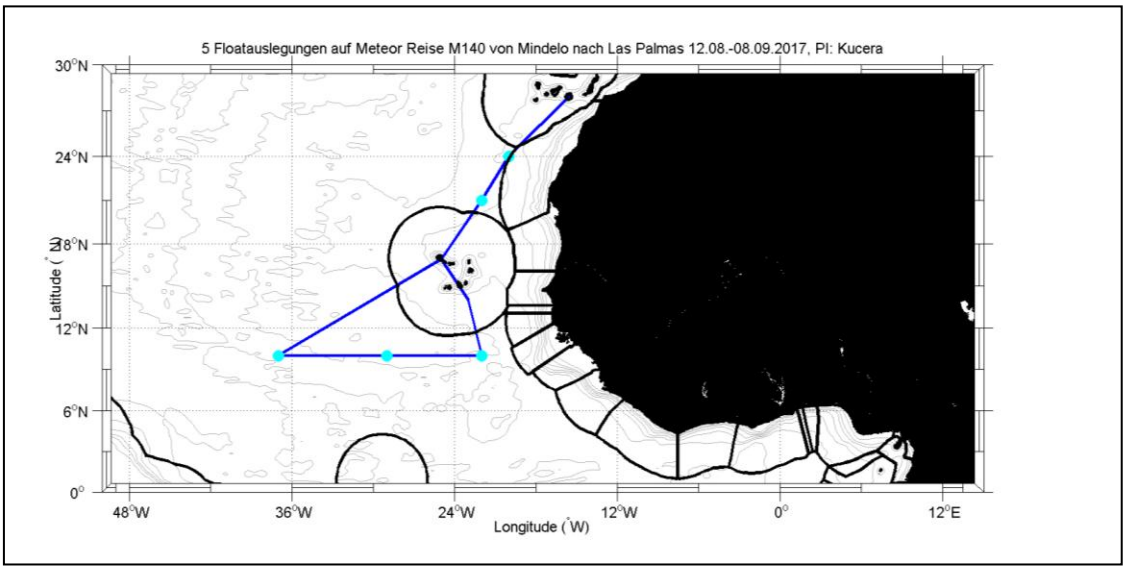



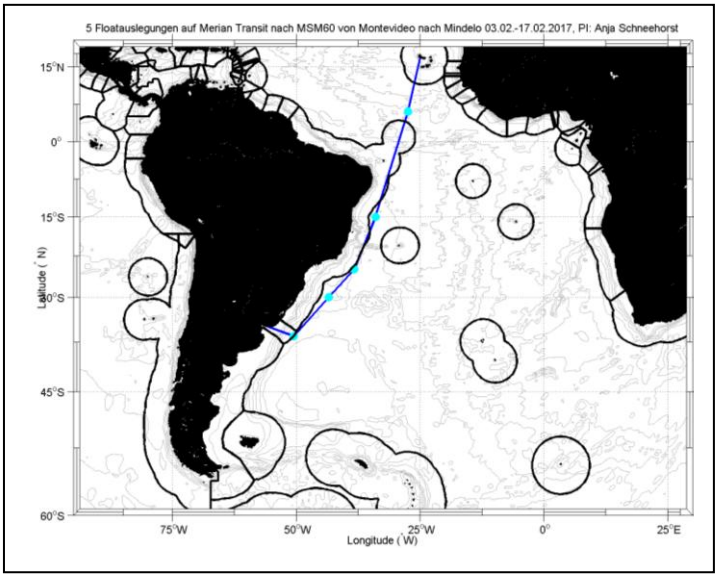


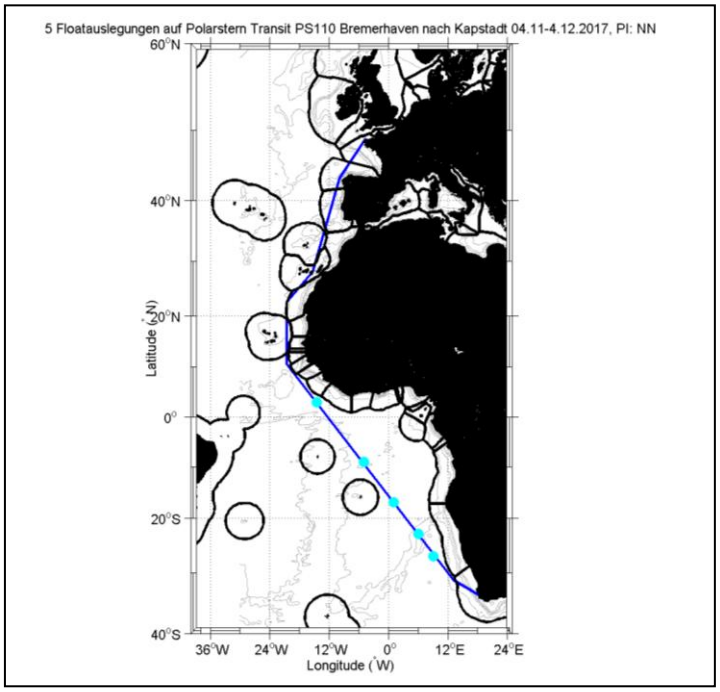



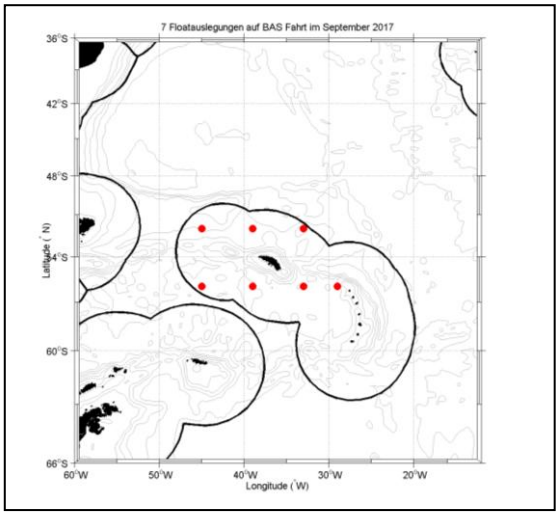




Additional floats will be deployed in the tropical Atlantic and 2 floats are reserved for the German Navy for the Nordic Seas. The field phase of the YOPP is postponed until 2018, testing of 2 polar floats could be carried out in 2017, positions and times for floats not yet clear, potentially in the Norwegian EEZ to avoid problems with requiring permits for Russian territory.

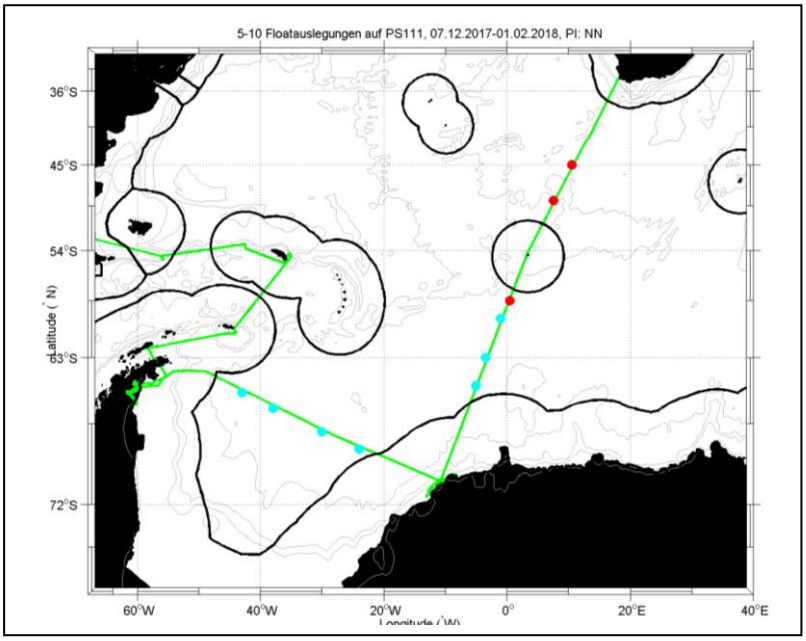
Gap filling in the Southern Ocean:




Gap filling in the Weddell Gyre:



**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. The URL for the Argo Germany is:

http://www.german-argo.de/

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 held on 22.06.2016 at BSH was attended by a mixed group; it included users from the modelling community and users performing observational studies. The three institutions contributing floats to the German program outside of BSH were also represented.

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.

**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:

Merian cruises MSM-39, MSM-43 and MSM53 were provided by Uni Bremen (PI: Dagmar Kieke)

Meteor cruises M130 and M131 were provided by GEOMAR (PI: Peter Brandt)

**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.**
**There is also the thesis citation list (http://www.argo.ucsd.edu/argo_thesis.html). If you know of any doctorate theses published in your country that are missing from the list, please let me know.**
Finally, if you haven't already sent me a list of Argo PIs in your country, please do so to help improve the statistics on how many papers are published including an Argo PI vs no Argo PIs.

Stendardo, I., M. Rhein, and R. Hollmann (2016), A high resolution salinity time series 1993-2012 in the North Atlantic from Argo and altimeter data, J. Geophys. Res., 121, 2523-2551, doi:10.1002/2015JC011439.

Burmeister, K., P. Brandt, and J. F. Lübbecke (2016), Revisiting the cause of the eastern equatorial Atlantic cold event in 2009, J. Geophys. Res. Oceans , 121 , 4777–4789, doi:10.1002/2016JC011719.

Schütte, F., Brandt, P. und Karstensen, J. (2016) Occurrence and characteristics of mesoscale eddies in the tropical northeast Atlantic Ocean Ocean Science, 12 (3). pp. 663-685. DOI 10.5194/os-12-663-2016.

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Stammer, D.; Balmaseda, M.; Heimbach, P.; Köhl, A.; Weaver, A.. “Ocean Data Assimilation in Support of Climate Applications: Status and Perspectives”. Annual Review of Marine Science 8. (2016): S. 491-518. doi: 10.1146/annurev-marine-122414-034113

Jochumsen, K.; Schnurr, S.M.; Quadfasel, D.. “Bottom temperature and salinity distribution and its variability around Iceland”. Deep Sea Research Part I: Oceanographic Research Papers 111. (2016): S. 79-90. doi: 10.1016/j.dsr.2016.02.009

K. Latarius, D. Quadfasel: Water mass transformation in the deep basins of the Nordic Seas: Analyses of heat and freshwater budgets, Deep_Sea Research I, 114 (2016): 23-42, http://dx.doi.org/10.1016/j.dsr.2016.04.012

Myriel Horn (2015), Frontal analysis on the shelf region of the western North Atlantic, M.Sc. Marine Environmental Sciences, University of Oldenburg