

Argo Germany National Report 2015

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1. The status of implementation (major achievements and problems in 2015)

Data acquired from floats:

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 66 floats by the end of 2015, 6 floats purchased in 2015 are kept in store to serve deployment cruises early 2016. No floats have been deployed by GEOMAR this year. Early in 2015 AWI has deployed 15 floats, but due to technical problems none of the floats is able to deliver its data. This gives a total of 66 German float deployments until the end of 2015.

Currently (February 24th, 2016) 129 German floats are active (Fig.1) and the total number of German floats deployed within the Argo program increased to 732. Due to the increased loss rate of APEX floats with alkaline batteries the number of German floats in the network is still at a low rate, but slowly increasing. Some of the under-ice floats deployed by AWI in the previous years are assumed to be still active under the ice. It is anticipated that about 20 floats should resurface again in the next austral summer and deliver their stored data.



Fig. 1: Locations of active German floats (red) with active international floats (green) (Argo Information Centre, February 2016).

In the past most of the German floats were APEX floats purchased from Webb Research, but a smaller amount of floats were manufactured by the German company OPTIMARE. The company has been working in close collaboration with the AWI and has developed a float type suitable for partially ice covered seas. These floats are equipped with an ice sensing algorithm which prevents the float from ascending to the surface under ice conditions and prevents it from being crushed. Float profiles are stored internally until they can be transmitted during ice free conditions. In the last year three manufacturers supplied the floats

purchased by BSH: ARVOR floats from NKE, NOVA floats from METOCEAN and APEX floats from TELEDYNE/WEBB. Additionally 11 APEX floats were supplied by TELEDYNE/WEBB as replacement for floats which had problems with their alkaline batteries.

We had discovered major technical problems with the alkaline batteries in our APEX floats deployed since 2010. Until September 2015 more than 60 floats 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. We had contacted TELEDYNE/WEBB about the problem and it was discovered that the floats were experiencing 'energy flue' because of a design change in the floats. As a possible fix against the premature fail of the entire battery pack due to failure of an individual alkaline battery a diode had been installed in the design in 2004, but was removed again in 2009/2010. WEBB/TELEDYNE had offered 14 floats in compensation for the malfunctioning floats in 2014 and 11 floats in 2015.

All of the German floats deployed in 2015 are standard TS floats. Deployment was carried out mostly on research vessels but also with the help of the German Navy in areas which are difficult to reach with research vessels such as the western Indian Ocean. The scientific research vessels comprised Canadian, German and UK ships. The deployment locations for 2015 are shown in Fig. 2a-b.

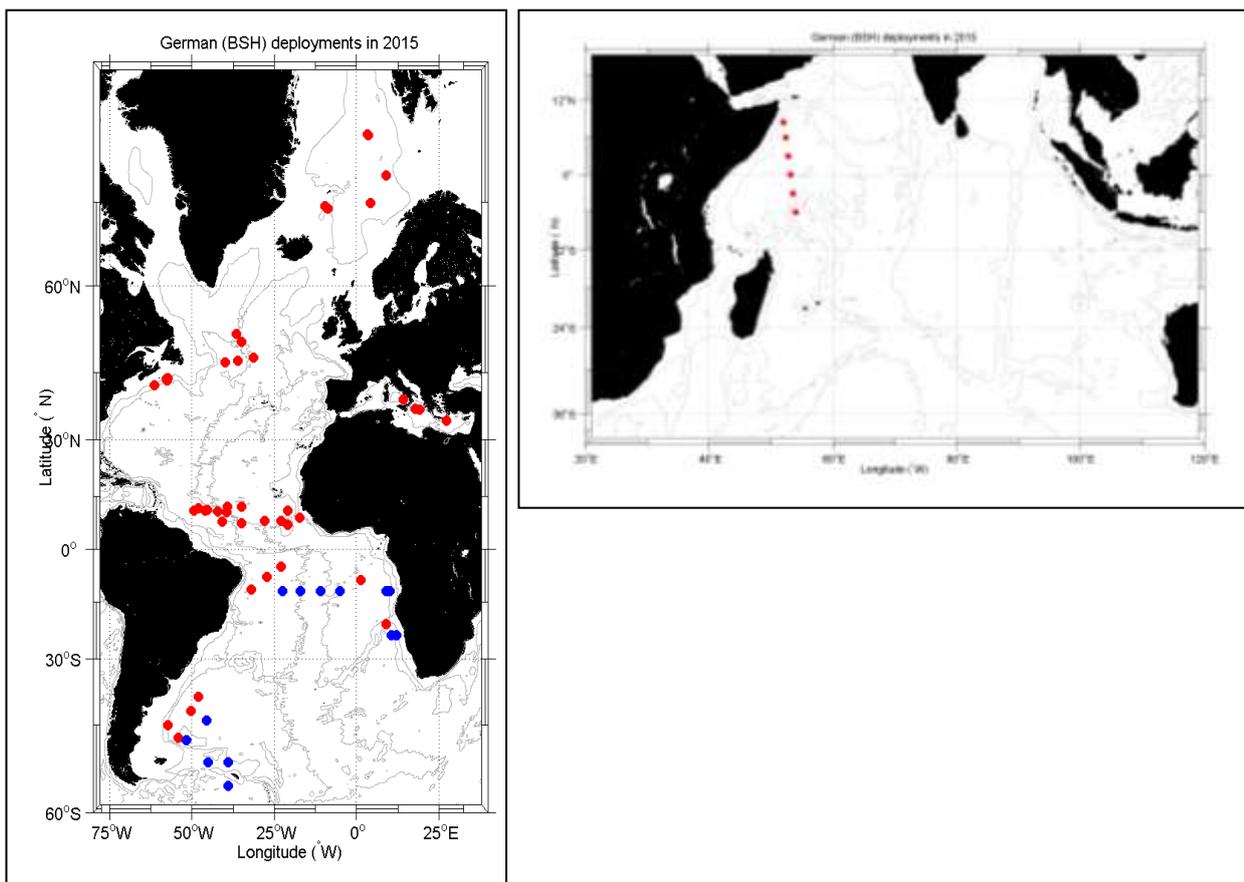


Fig. 2a-b: Deployment positions in 2015 in the Atlantic (left) and the Indian Ocean (right). At positions marked in red the deployment has already been carried out and those in blue will be achieved until the end of the year.

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). It is planned to coordinate the deployments for 2016 at the European level and this could invoke changes to the proposed plans. GEOMAR and AWI are members of the EU-funded ATLANTOS project and will deploy deep-floats and bio-Argo floats within this project.

2. Deployment plan for 2016

The deployment plans for 2016 will comprise at present about 53 floats from BSH in the Atlantic, the Nordic Seas, Indian Ocean and the Southern Ocean and consists of floats purchased already in 2015, funds from 2016 and warranty floats (Fig. 3a-e and Fig. 4a-e). The priority of our deployments is grid completion and extension of the core Argo array into the seasonally ice covered oceans in the Nordic Seas and the Southern Ocean. We have received 9 additional replacements by WEBB/TELEDYNE for floats which died of energy flue in 2015. Contacts with researchers on potential deployment cruises have been established and agreement has been reached on the possibility to deploy floats. The German Navy has been contacted again about potential deployments in the Indian Ocean during their regular survey operations. The AWI is planning to deploy about 22 floats during the Polarstern cruise PS103 in December 2016-February 2017. No deployments are planned yet for 2016 by GEOMAR. But GEOMAR is partner in the ATLANTOS consortium and will be involved in the deployment of deep floats as part of the pilot study in the Atlantic.

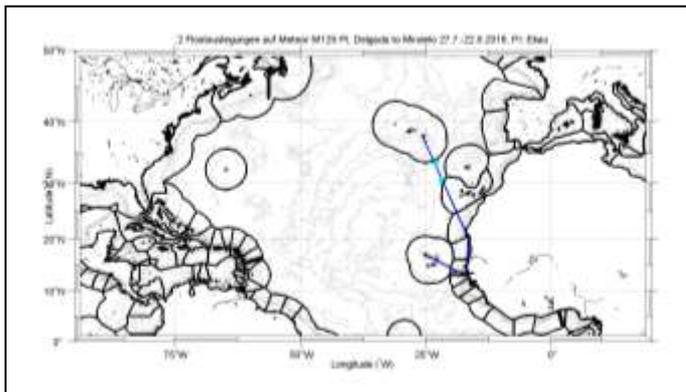
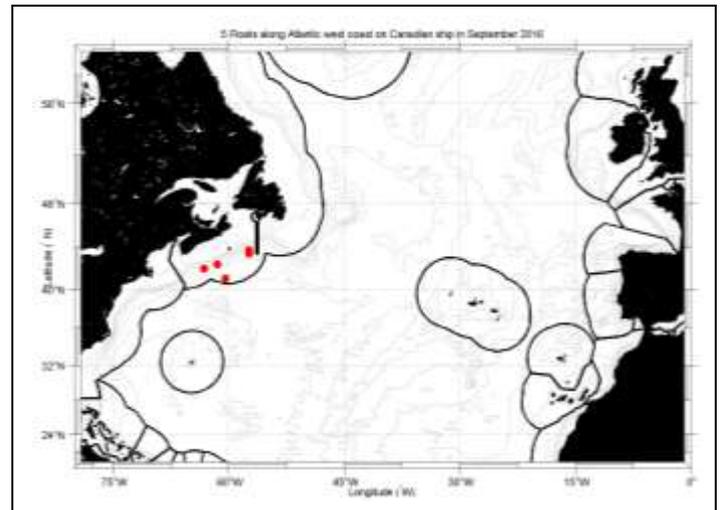
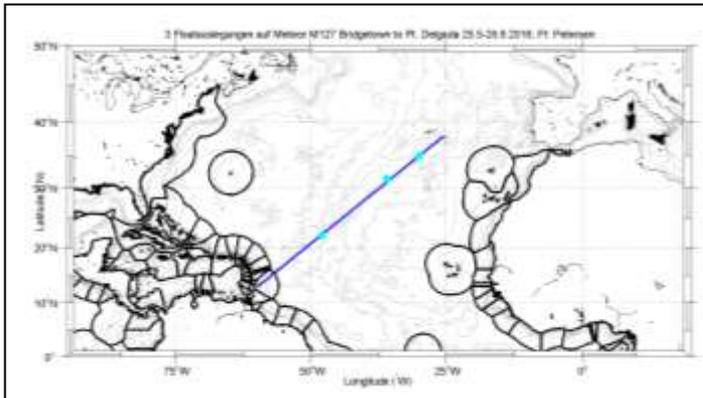
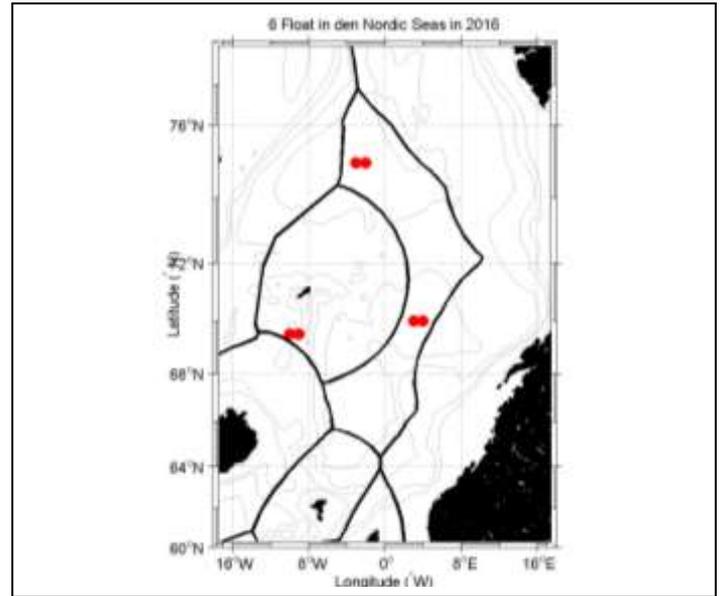
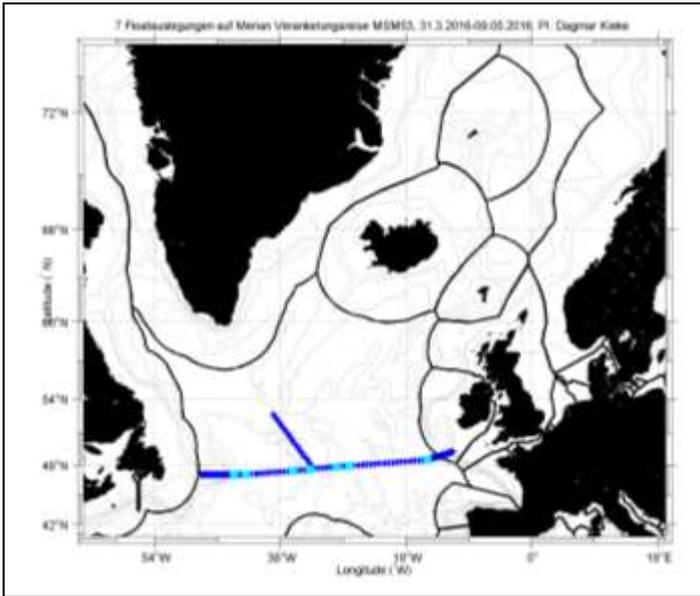


Fig. 3: a-e: Planned deployments of 24 floats in the North Atlantic

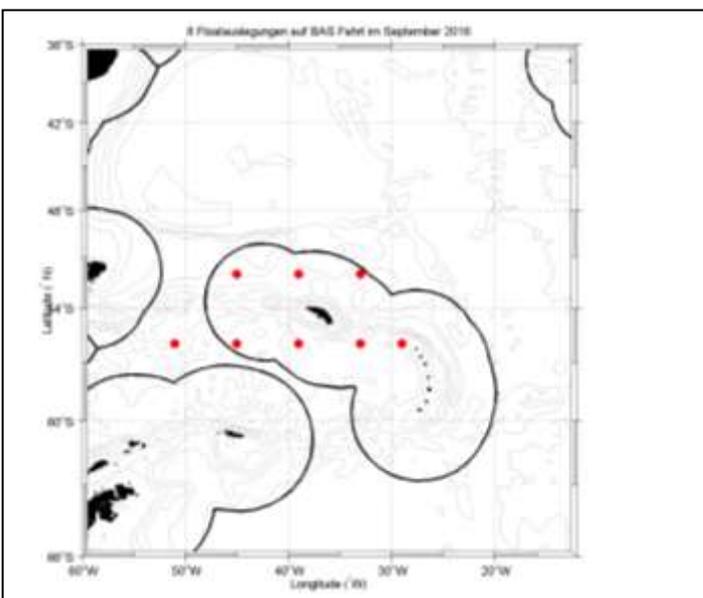
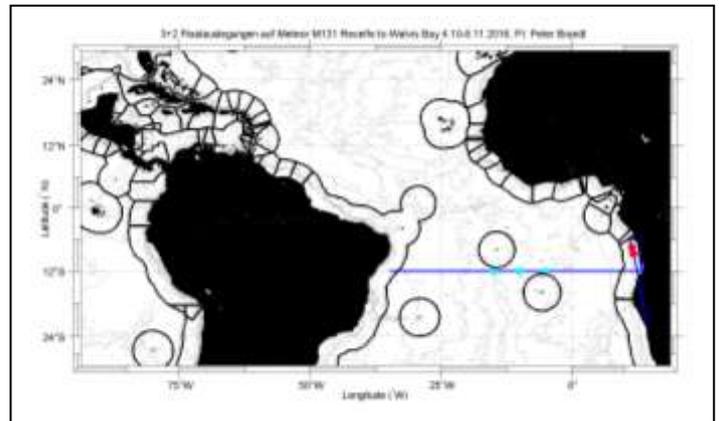
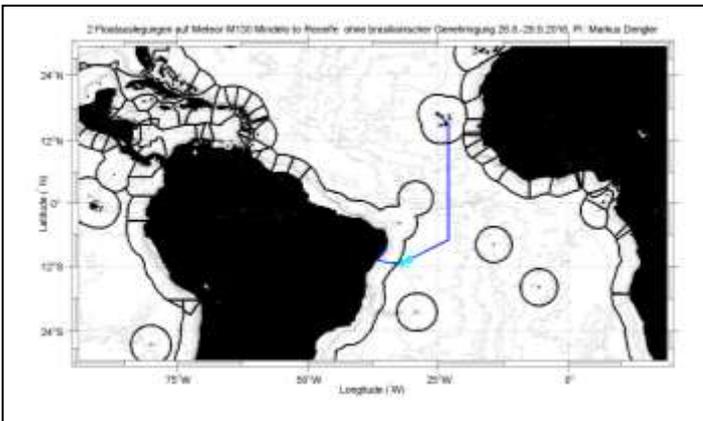
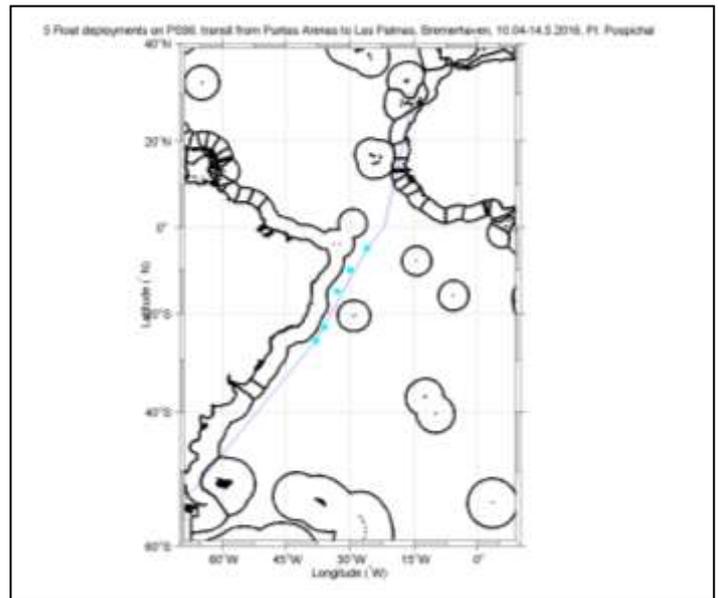
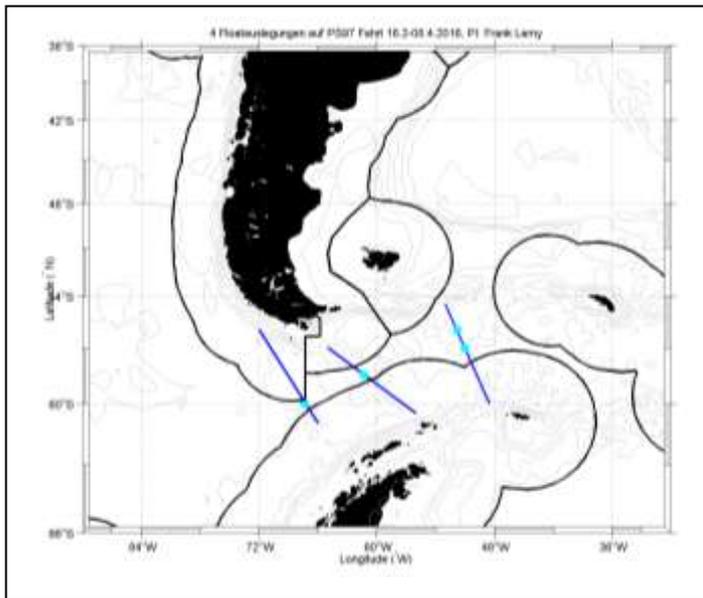


Fig. 4: a-e: Planned deployments of 22 floats in the South Atlantic

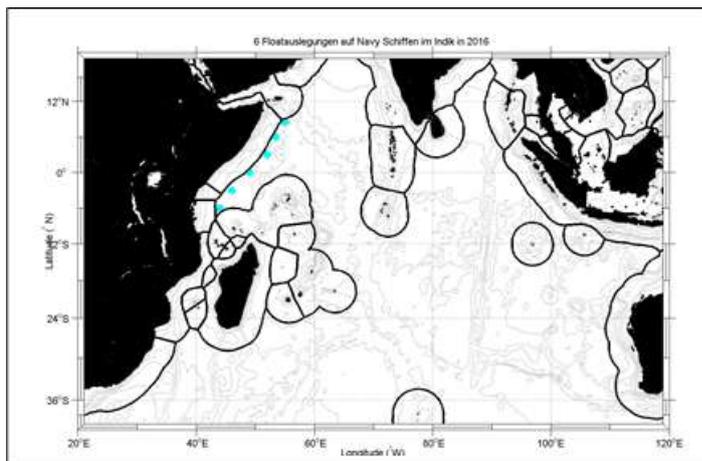


Fig. 5a: Planned deployments of 6 floats by the German Navy in the Indian Ocean.

3. Commitments to Argo data management

Data issued to GTS

The profiles for all German floats are processed by Coriolis and are distributed on the GTS by way of Meteo-France.

Data issued to GDACs after real-time QC

The real-time data processing for all German floats is performed at the Coriolis Center in France. Data processing follows the procedures set up by the Argo Data Management Team.

Data issued for delayed QC

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 the Pacific floats. 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. BSH has also adopted some European floats which did not have a DMQC operator assigned to them, such as national Argo programs from the Netherlands, Denmark, Norway, Finland and Poland. All German institutions have been working in close collaboration with Coriolis and delayed mode data have been provided on a 6 monthly basis. Delays in delayed-mode data processing have occurred occasionally due to changes in personal and delay in data transmission in the Southern Ocean due to ice coverage. The

processing of the RAFOS information on the under ice floats has yet to be started, it is planned for the second half of 2016. Delayed-mode data processing follows the rules set up by the Data Management Team. The DMQC process is well underway and no major delays have been encountered.

Delayed mode data send to GDACs

All delayed mode profiles from BSH have been sent to the Coriolis GDAC node. The total number of available profiles from German floats is 54082 (February 24th, 2016), the number of DM profiles is 44236. The percentage of DM profiles with respect to the total number of profiles is about 87%. Early in 2015 the delayed mode quality control for the Dutch float has been performed by BSH and a 100% of all eligible floats are now available in delayed mode.

4. Summary of national research and operational uses of Argo data

Web pages

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.

Statistics of Argo data usage

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 data for the Northwest European Shelf. Argo data are routine assimilated in the GECCO reanalysis, which is used for the initialisation the decadal prediction system MiKlip

Publications based on Argo:

Czeschel, R., Stramma, L., Weller, R. A. and Fischer, T. (2015) Circulation, eddies, oxygen and nutrient changes in the eastern tropical South Pacific Ocean, *Ocean Science*, 11, pp. 455-470. DOI 10.5194/os-11-455-2015.

Hummels, R., P. Brandt, M. Dengler, J. Fischer, M. Araujo, D. Veleda, and J. V. Durgadoo, Interannual to decadal changes in the western boundary circulation in the Atlantic at 11°S, *Geophys. Res. Lett.*, 42, doi:10.1002/2015GL065254, 2015.

Karstensen, J., B. Fiedler, F. Schütte, P. Brandt, A. Körtzinger, G. Fischer, R. Zantopp, J. Hahn, M. Visbeck, and D. Wallace, Open ocean dead zones in the tropical North Atlantic Ocean, *Biogeosciences*, 12, 2597-2605, doi:10.5194/bg-12-2597-2015, 2015.

Meredith, M. P., Mazloff, M., Sallee, J. B., Newman, L., Wahlin, A., Williams, M. J. M., Garabato, A. C. N., Swart, S., Monteiro, P., Mata, M. M. und Schmidtko, S.

- (2015) *The Southern Ocean Observing System (SOOS)*, *Bulletin of the American Meteorological Society*, 96 (7), S157-S160
- Schmidtko, S., Heywood, K. J., Thompson, A. F. und Aoki, S. (2014) *Multidecadal warming of Antarctic waters*, *Science*, 346 (6214). pp. 1227-1231. DOI [10.1126/science.1256117](https://doi.org/10.1126/science.1256117).
- Schütte, F., Brandt, P. and Karstensen J. (2015) Occurrence and characteristics of mesoscale eddies in the tropical northeast Atlantic Ocean, *Ocean Science*
- Stramma, L., Czeschel, R., Tanhua, T., Brandt, P., Visbeck, M. und Giese, B. S. (2015) *The flow field of the upper hypoxic Eastern Tropical North Atlantic oxygen minimum zone*, *Ocean Science Discussions*, 12 (5). pp. 2147-2187. DOI [10.5194/osd-12-2147-2015](https://doi.org/10.5194/osd-12-2147-2015).
- Burmeister, K., Tropical Atlantic SST variability with focus on the extreme events in 2009, Master thesis, Christian-Albrechts-Universität, Kiel, 71 pp., 2015.
- Bittig, Henry C. (2014). Towards a Quantum Leap in Oceanic Oxygen Observation - From Oxygen Optode Characterization to Autonomous Observation of Gas Exchange and Net Community Production, Dissertation, Christian Albrecht University Kiel.
- Bittig, H.C., B. Fiedler, R. Scholz, G. Krahnemann, and A. Körtzinger (2014). Time response of oxygen optodes on profiling platforms: Dependence on flow speed and temperature and recommendations for field applications. *Limnol. Oceanogr.: Methods* 12, 617-636, doi: 10.4319/lom.2014.12.617.
- Ronja Eisner, Die Entwicklung der Deckschicht im Islandbecken und ihr Beitrag zum Nordatlantischen Tiefenwasser, Bachelor Thesis, 52 pp., University of Hamburg, 2012.
- Kieke, D., und I. Yashayaev (2015), Studies of Labrador Sea Water formation and variability in the subpolar North Atlantic in the light of international partnership and collaboration, *Prog. Oceanogr.*, 132, [doi:10.1016/j.pocean.2014.12.010](https://doi.org/10.1016/j.pocean.2014.12.010).
- Katrin Latarius, Über die Wassermassentransformation im Europäischen Nordmeer - Prozess-Studien und Budgets, Dissertation, Universität Hamburg, Department Geowissenschaften, Hamburg, 176 pp, 2013. <http://ediss.sub.uni-hamburg.de/volltexte/2013/6088/>

Products generated from Argo data

A key aspect of the German Argo program is to develop a data base for climate analysis from Argo data, to provide operational products for interpretation of local changes and to provide data for research applications.

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 NARC and contributes recent CTD data to the Argo climatology.

CTD data submitted to Reference data base:

M120 by Markus Dengler