Argo-Poland National Report 2023

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1. The status of implementation of the new global, full-depth, multidisciplinary Argo array (major achievements and problems in 2023)

Argo-Poland is carried out by the Institute of Oceanology of the Polish Academy of Sciences (IOPAN). Since 2009 the Institute has deployed forty-one floats. Twenty-three of them were launched in the Nordic Seas from the board of *r/v Oceania* and three in the same region aboard *r/v Horyzont II.* Since November 2016, also aboard *r/v Oceania*, IOPAN has launched fifteen floats in the Baltic Sea.

a. floats deployed and their performance

In 2023 Poland launched 6 floats from the board of Institute of Oceanology Polish Academy of Sciences (IO PAN) vessel *r/v Oceania*. Five floats were deployed under the Argo-Poland program, which is Polish contribution to the Euro-Argo ERIC infrastructure, one float was deployed under the EU MOCCA project.

Two Argo floats (WMO 3902119, 3902118) were deployed in the Nordic Seas at the end of June 2023 at positions 75.00 °N, 08.44 °E and 75.00 °N, 15.42 °E respectively (Figure 1). Both instruments are the NKE manufactured ARVOR floats with Iridium transmission system and ice avoidance algorithms. The parking depth was set at 1000 dbars and the profiling depth at 2000 dbars. The floats have cycles of 10 days. In addition to standard CTD measurements, the floats also have taken measurements of dissolved oxygen. The first float (WMO 3902119) was operated for the whole of 2023 and has sent 19 complete sets of hydrographic data (CTD, O_2) by the end of the year. The second float (WMO 3902118) stopped sending data on October 18. Most likely, the float drifted under the sea ice.

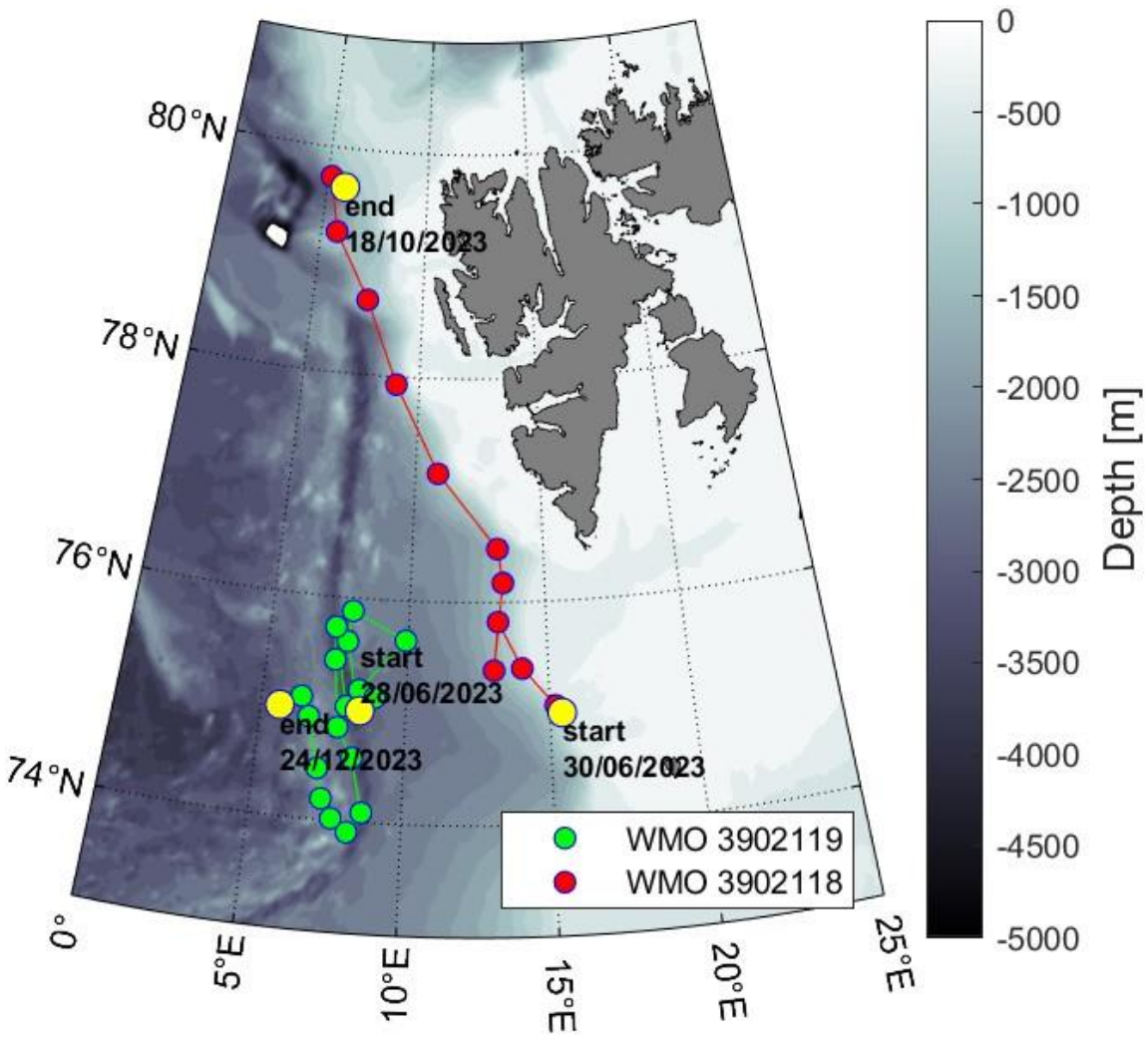

Figure 1. Positions of deployment and trajectories of two Argo floats deployed in the Nordic Seas by Argo-Poland program in June 2023.

Four Argo floats were deployed in the Baltic Sea from the board of *r/v Oceania* in 2023. In February 2023, during a standard hydrodynamic cruise, IO PAN recovered the Argo float (WMO 3902115) from the area of the Slupsk Furrow. After recovering, the float was transported to the Bornholm Basin, assigned a new WMO 3902117 number, and redeployed at position 55.23 °N, 16.04 °E (Figure 2). The float was operated for the whole of 2023 and has sent 280 complete sets of hydrographic data (CTD, O_2) by the end of the year. The second Baltic float (WMO 7901091) was launched in the Gdansk Deep (54.83 °N, 19.33 °E) in May 2023 (Figure 2). The device is the ARVOR type with the Iridium transmission system and performs standard CTD measurements. In 2023 it transmitted 53 complete CTD data sets. The float was deployed under the EU MOCCA project.

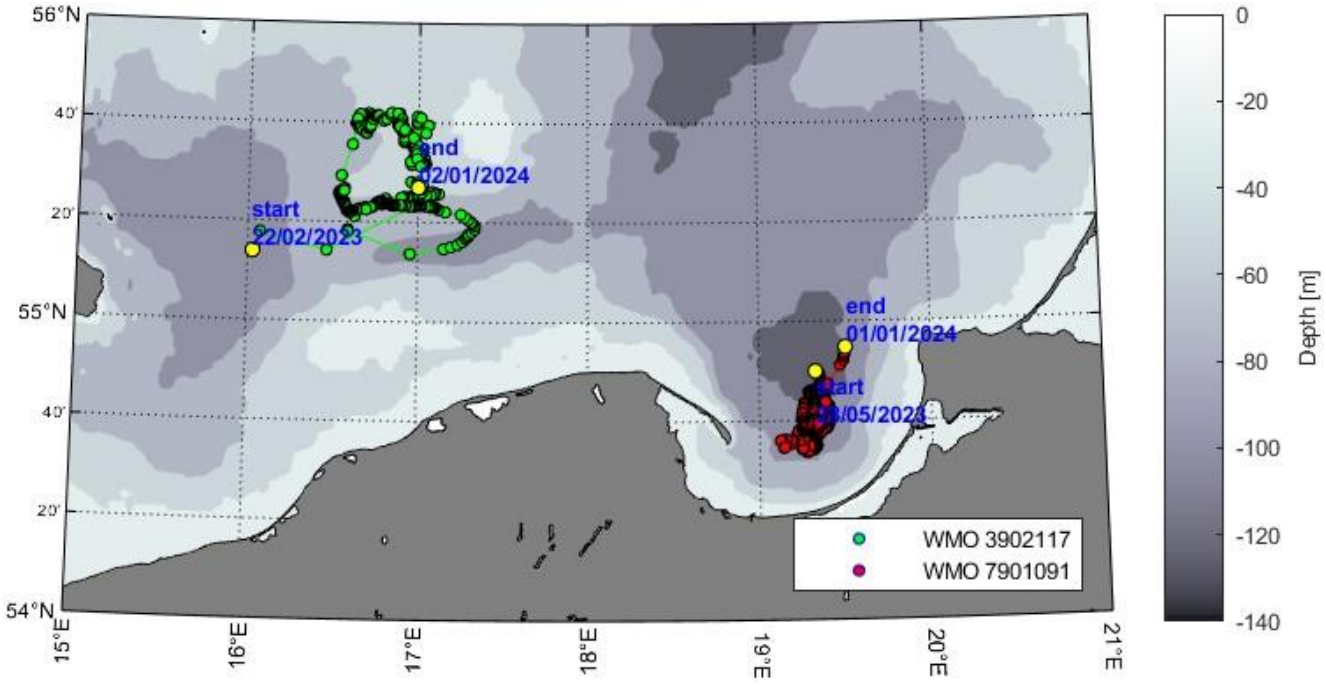

Figure 2. Positions of deployment and trajectories of two Argo floats deployed in the Baltic Sea by Argo-Poland program in February and May 2023.

Two more Baltic floats were launched in September 2023. On September 22, the Argo float (WMO 1902682) was deployed in the Bornholm Deep (55.22 °N, 15.90 °E) (Figure 3). The float is the ARVOR type with an Iridium data transmission system. In addition to standard CTD measurements, the float will also measure dissolved oxygen content in the water. By the end of the year the device has sent 53 complete sets of hydrographic data (CTD, O_2). On September 24, the Argo-Poland consortium deployed Biogeochemical Argo (BGC Argo) (WMO 1902683) for the first time. In addition to standard CTD measurements, our BGC Argo measures four additional seawater properties: dissolved oxygen concentration, chlorophyll-a concentration, irradiance and CDOM. The float was deployed in the Gdansk Deep at the position 54.85 °N, 19.23 °E (Figure 3). The device is the PROVOR type with the Iridium data transmission system. The float was operated for the whole of 2023 and has sent 82 complete sets of BGC data by the end of the year. All four Baltic floats have been working in 1- or 2-day cycles. In all devices, the parking depth has been set deeper than the bottom depth to keep the floats in a limited area and use them as a virtual moorings.

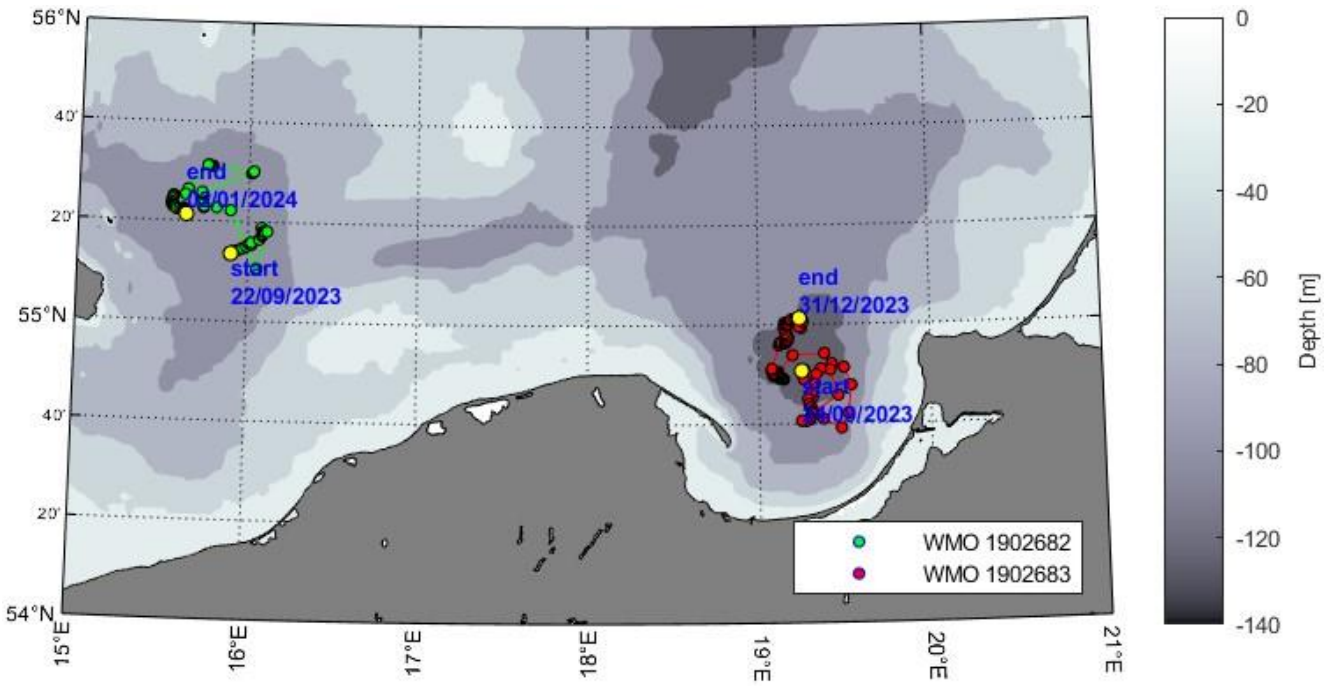

Figure 3. Positions of deployment and trajectories of two Argo floats deployed in the Baltic Sea by Argo-Poland program in September 2023.

b. technical problems encountered and solved

The Arctic and Baltic floats were deployed by the Institute of Oceanology Polish Academy of Sciences (IO PAN) from the board of the Institute research vessel 'Oceania'. There were no technical problems with the floats.

c. status of contributions to Argo data management.

Data from the Arctic floats were provided to the Ifremer Argo Center and processed in the Center. All data are available online. IO PAN provided CTD data collected by *r/v Oceania* during AREX cruises in the Nordic Seas (2000-2018) and the Baltic Sea (2016-2021) to the Argo references database.

d. status of delayed mode quality control process

IOPAN has been performing delayed mode quality control (DMQC) on data from Arctic floats deployed since 2018. Argo Poland also actively participates in the creation of DMQC procedures

for data from Argo floats launched in the Baltic Sea. DMQC on the data from Arctic floats deployed before 2018 is performed by BSH (Hamburg, Germany).

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

In 2021, the Institute of Oceanology of the Polish Academy of Sciences applied to the Ministry of Science and Education for funding the Argo-Poland consortium. The members of the consortium are the Institute of Oceanology PAN, the Institute of Geophysics PAN and the Polish Naval Academy. In 2022, we received funding from the Polish Ministry for the next five years.

3. **Summary of deployment plans.**

Argo-Poland plans to deploy at least 3 floats per year. Two floats will be deployed in the European Arctic and at least one float in the Baltic Sea.

4. **Summary of national research and operational uses of Argo data as well as contributions to Argo Regional Centers.**

IO PAN runs the long-term Nordic Seas observation program AREX. Argo floats are a valuable source of data complementing the measurement data obtained by *r/v Oceania*. This applies in particular to the variability of the seasonal properties of water masses (cruises are conducted only in summer) and sea currents pathways in the Svalbard region.
https://old.iopan.pl/hydrodynamics/po/Argo/argo.html

At the Baltic Sea Argo floats data are used to monitor the inflow of salty waters from the North Sea. Also, data on the oxygen content in the depths of the Baltic Sea and current pathways are especially valuable. Argo data are also used for the modelling in the SatBaltyk project.
http://www.satbaltyk.pl/en/

Also, project SufMix (Turbulent Mixing in the Slupsk Furrow) uses Argo data.

5. **Issues that your country wishes to be considered and resolved by the Argo Steering Team regarding the international operation of Argo.**

   No issues.

6. **CTD stations**

   In 2023 two Polish floats were deployed during IOPAN Arctic cruise AREX, when about 200 CTD profiles have been done. Four floats were launched in the Baltic Sea, during the Baltic cruises. The CTD stations were also performed just before the floats deployment. IOPAN can provide the data from this six stations to compare it with Argo floats.

Rest of the data from the Nordic Seas and the Baltic Sea will be available via IOPAN database. Contact point: Waldemar Walczowski, walczows@iopan.pl.

7. **Argo blibliography**

Merchel M., Walczowski W., Rak D., Wieczorek P., 2024, The use of Argo floats as virtual moorings for monitoring the South Baltic Sea, Oceanologia, in press.

Two other scientific papers using data from Argo floats are in preparation.

8. **How has COVID-19 impacted your National Program's ability to implement Argo in the past year?**

No problems with floats deployment and recovery.

9. **Does your National Program have any deployment plans for RBR floats in the next couple years?**

There are plans to buy one RBR float if it has an oxygen sensor.