# Baltic Sea workshop report

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# EXECUTIVE SUMMARY

Argo floats are designed to study the open ocean. Near-real time ocean measurements from the float network that covers the world's ocean have opened a new era in studying the ocean, its state and its changes. The next step in using Argo technology was the use of floats in marginal seas. One of the specific objectives of EA-RISE project is: *'investigate the potential of Argo profiling floats in shelf areas to close the gap between open-ocean and shallow waters'.* These goals are included, inter alia, in Work Package 6: Extension to Marginal Seas. One of the tools for the implementation of this program was the organization of workshops on marginal seas and the Arctic. Two workshops (Baltic Sea and Arctic) were planned to be held in Sopot, Poland. Delays caused by the development of the COVID-19 pandemic forced the organizers to conduct both meetings as online events.

This report is about the Baltic Sea workshop.

So far, only two Baltic countries - Finland and Poland, regularly use Argo floats in the Baltic Sea. The Germans deploy a large number of floats, but mostly in the open ocean. This spring the first German floats were deployed in the Baltic. The other Baltic states do not use Argo floats.

The aim of the Baltic Sea workshop was to gather oceanographers from the Baltic countries at one workshop, familiarize them with the Argo technology, show the potential of floats working in shelf seas, the possibility of using Argo data in scientific works and in environmental monitoring.

We expect that the result of the reported workshop and other activities in WP6.3 will be encouraging institutions from other Baltic states to launch Argo floats in the Baltic Sea, enlarging the Argo-users community and increasing the number of members of the Euro-Argo ERIC infrastructure.

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# 1. Introduction

WP6 of the Euro-Argo RISE project concerns European Marginal Seas. The main aim of the WP6 is the extension of Argo measurements at a regional level, in particular in shallow areas taking into account the specificity of each European Marginal Sea. This goal can be achieved by enlarging the regional Argo community - involving new scientists, countries, organizations in the Argo world through different actions (workshops and political events organization, participations in activities, instrument donations).

In this way, Euro-Argo ERIC wants to transfer the revolution in world oceanographic measurements, which was undoubtedly caused by the implementation of Argo floats and the maintenance of a measurement matrix to the Marginal Seas. We have three such seas in Europe: the Mediterranean Sea, the Baltic Sea and the Black Sea. Each of them has a different specificity, therefore in WP6 separate tasks are assigned to them. The Mediterranean Sea, being the largest and deepest, has been the launching site of Argo floats for a long time. The Black Sea is also deep, but has a different specificity than the Mediterranean Sea. The Baltic Sea differs completely from these two.

The Baltic Sea is small (400,000 km2) and shallow (average depth 55 m). The salinity of the Baltic Sea is much lower than typical ocean salinity. Its specificity are strong gradients of salinity and other properties - both horizontal and vertical.

Therefore, due to these specific characteristics, it seemed that Argo operations in the Baltic Sea were impossible. After all, Argo floats were designed for moderately deep-water ocean measurements. The shallow sea and the proximity to the shore are factors that make measurements very difficult and increase the risk of losing the floats. Moreover, heavy vessel traffic and increased fishing activity pose additional threats. Despite this, Euro-Argo ERIC objectives for 2014-2019 was '*To provide additional coverage in the European regional seas*'.

The efforts of Finnish oceanographers who first deployed Argo in the Baltic Sea in 2011 (Purokoski et al., 2013), and later the works of Polish oceanographers who launched Argo floats in the southern Baltic in 2016 (Walczowski et al., 2020) have brought results. We have proved that Argo floats can work in such extreme conditions and that they can be a very valuable source of oceanographic data. That is why the Finnish and Polish oceanographers were entrusted with the implementation of Task 6.3: '*Extension activities in the Baltic Sea*' and the organization of the Baltic Sea workshop. The organization of a dedicated workshop gave the opportunity to share experiences with a wider group of potential users of Argo data, and perhaps also to interest them in launching their own floats.

# 2. Conference preparations

Several goals of the conference were set. The most important of them were:

- Gather together oceanographers from the Baltic countries;
- Familiarize them with the Argo technology;
- Present the problems related to the operation of floats in the specific conditions of a shallow shelf sea;
- Present the results obtained from floats working in the Baltic Sea;
- Show possibility of using the results in scientific work and monitoring activities;
- Highlight legal problems and the need for international cooperation.

The aspect of interest of the Baltic states in the cooperation related to the use of Argo floats was also important. The entire Baltic Sea is divided into Exclusive Economic Zones and the legal problems related to the use of Argo floats are not entirely clear.

Sopot (Poland) was chosen as the place of organization of this workshop, and it is the seat of the Institute of Oceanology of the Polish Academy of Sciences (IOPAN).

The Scientific Programme Committee included the following experts:

- Laura Tuomi, (FMI, Finland)
- Waldemar Walczowski (IOPAN. Poland)
- Ingrid Angel-Benavides (BSH, Germany)
- Siiriä Simo-Matti (FMI, Finland)
- Malgorzata Merchel, (IOPAN, Poland)
- Birgit Klein (BSH, Germany)
- Giulio Notarstefano (OGS, Italy)
- Claire Gourcuff (Euro-Argo ERIC office, France)
- Sylvie Pouliquen (Euro-Argo ERIC office, France)

The practical organisations were conducted by Estérine Evrard, Francine Loubrieu and Romain Cancouët (Euro-Argo ERIC office, France).

Sopot was selected for several reasons:

- Good communication with other Baltic states;
- Good logistic conditions for the workshop at IOPAN;
- IOPAN is well recognized among Baltic and Arctic researchers;
- IOPAN's experience in organizing scientific conferences;
- Relatively low cost of accommodation;
- Good contacts between IOPAN oceanographers and Russian oceanographers.

In order to maximize the impact of the conference and gather more participants, it was decided to combine the Baltic Workshop with the Arctic Workshop, also organized in Sopot as part of Euro-Argo RISE WP5. For this reason, a 3-day meeting has been planned: the 'Baltic' day, the general day on the Argo technique and the 'Arctic' day. September 2020 was selected as the date of the workshop organization. An extensive information campaign was carried out, the conference advertisements were posted on many internet platforms of the ocean observing community, and many participants and speakers were acquired. Baltic Sea organisations such as Baltic Earth and BOOS, as well as Euro-Argo and global Argo organisations were involved in the workshop preparation and declared affiliation. Unfortunately, the situation related to the development of the COVID-19 pandemic did not allow the workshop to be carried out on the scheduled date.

Initially, it was decided to postpone the meeting in spring 2021. Unfortunately, the further development of the situation forced the organizers to change their plans again. Finally, it was decided to conduct the meeting remotely, together with the Mediterranean and Black Sea workshop. The length and complexity of the workshop was revisited to get the highest outcomes possible considering the pandemic situation. Virtual format with shorter sessions was chosen to keep things to the point and discussions interactive.

# 3. Workshop

The Arctic and Baltic User Workshop was held on 8 - 9th April 2021. Information about the planned workshop has been placed on the Euro-Argo ERIC website:

https://www.euro-argo.eu/News-Meetings/Meetings/Others/Arctic-and-Baltic-users-workshop

The first day began with a general session on Argo in the European Marginal Seas (Table 1, Annex). It was the first ever organized session on this subject. The session dedicated to the Baltic Sea was held in the afternoon of April 8th. The Baltic Sea session was also the first event of this type to be organized.

The workshop included presentations about the current status of the Argo floats in the Baltic Sea, how the data are used and how they can be used. In addition to the presentation, a panel discussion was held including experts on Baltic Sea environmental monitoring, measurement techniques and operational oceanography. The final agenda of the workshop included four presentations and a discussion panel (Table 2, Annex). The workshop was chaired by Laura Tuomi, Task 6.3 leader and WP5 leader. The presentations were conducted by three oceanographers from the Finish Meteorological Institute (FMI) and one from the Institute of Oceanology of the Polish Academy of Sciences. Presentations covered the most important topics with which it was planned to familiarize the participants:

- The specificity of the Argo operation in the Baltic Sea was presented by prof. Waldemar Walczowski from IOPAN;
- Dr Simo Siiriä from FMI referred Argo activities at the Baltic Sea;
- Possibilities and examples of using Argo data were presented by Dr Petra Roiha from FMI ;
- Plans for enhancing and prospects for cooperation in the Baltic Sea were presented by Dr Laura Tuomi (FMI).

The formula was a 15 minute PowerPoint presentation and 5 minutes for questions. To take advantage of the online format of the workshop, presentations were targeted to a 15-minute time slot to keep messages focused.

The first speaker, Argo-Poland coordinator, in the talk ‘Operating in Baltic Sea’ presented specific conditions of the Baltic Sea that make the use of Argo floats in the shallow Baltic Sea different from operating in the open ocean. He drew special attention to the small size and low water depth, strong stratification and heavy vessel traffic in the Baltic Sea. Then he presented examples of Argo measurements performed in the Baltic Sea. An important part of the speech was the presentation of legal problems and ambiguities related to the exploitation of the Argo in conditions of a small sea divided into Exclusive Economic Zones. In the conclusions, he stressed the importance of international cooperation in the Baltic Sea research with the use of Argo floats.

Simo Siiriä presented history and statistics of Argo floats missions in the Baltic Sea in a talk entitled ‘Baltic Argo activities’. Finnish, Polish and German missions were presented. Next, he discussed float types used in these missions. An important part of the presentation was the demonstration of innovative works such as Ice Avoidance Algorithms testing, the use of new RBR CTD sensors and tests of Ramses Irradiance sensor. He also presented plans of SUNA Nitrate sensors testing in Gotland Deep. In conclusion, he underlined that Argo floats provide an important addition to the monitoring efforts on the Baltic Sea, but still there is a lot of room to grow and improve.

Petra Roiha in a presentation entitled ‘“Use cases” of Argo Data in the Baltic Sea’ focused on showing how Argo data can be used. First, she discussed existing and potential user groups such as the Energy

sector, Environment sector, Aquaculture, Operational oceanography, EU 'Green Deal'. Later she showed various possibilities of using Argo data, such as scientific and operational use cases, model validation and data assimilation.

In the presentation entitled 'Enhancing cooperation in Baltic' Laura Tuomi presented possibilities and plans of cooperation between the Baltic Sea countries and organisations. She pointed to organisations, projects and services such as: BOOS, Baltic Earth, HELCOM and CMEMS BAL MFC. Cooperation in deployment and recovery floats in planned scientific cruises, deployment and recovery from small vessels and sailing yachts are important. In BOOS, cooperation between gliders and Argo groups has been established. Concluding, she showed that the amount of data is increasing both, spatially and temporally, and we should discuss where and which parameters should be measured.

The slides of the presentations are available at:

https://drive.google.com/drive/folders/1Pw-D43G7EkaJNs_73z1xGuoqwBrXwooC?usp=sharing

A discussion panel took place after the presentations. Baltic Sea research specialists were invited to participate in it:

- Dr Henry Bittig from Leibniz Institute for Baltic Sea Research (IOW), Warnemünde, Germany;
- Professor Urmas Lips from Tallinn University of Technology, Department of Marine Systems (TTU-MSI), Estonia.
- Dr Jun She from Danish Meteorological Institute (DMI).

The Panel Discussion was moderated by Dr Ingrid Angel-Benavides from Federal Maritime and Hydrographic Agency (BSH), Germany. Two questions for each panellist were asked by the moderator. The questions targeted the future possibilities and potential challenges in using Argo data in the different Baltic Sea applications. After that, questions and comments from meeting participants were discussed. The general conclusion of the discussion was the statement that Argo is very suitable for the study of the Baltic Sea because it is an efficient and cheap tool. 7-10 still operating floats should be enough to cover all the Baltic Sea deep basins. However, it was highlighted that it is not easy to convince conservative organizations and researchers to use new research methods and therefore more outreach and training support would be necessary to support this transition to autonomous platforms. The need for international cooperation as well as cooperation between various institutions, organizations and groups of researchers was emphasized.

# 4. Workshop participants

Despite the changed formula and postponement in time, representatives of most Baltic countries and other European countries participated in the workshop. In total, 68 people from 15 countries participated in this on-line meeting (Figure 1&2). They represented 32 various organisations as universities and research institutes, ministries, international scientific organisations, equipment manufacturers (Table 1).

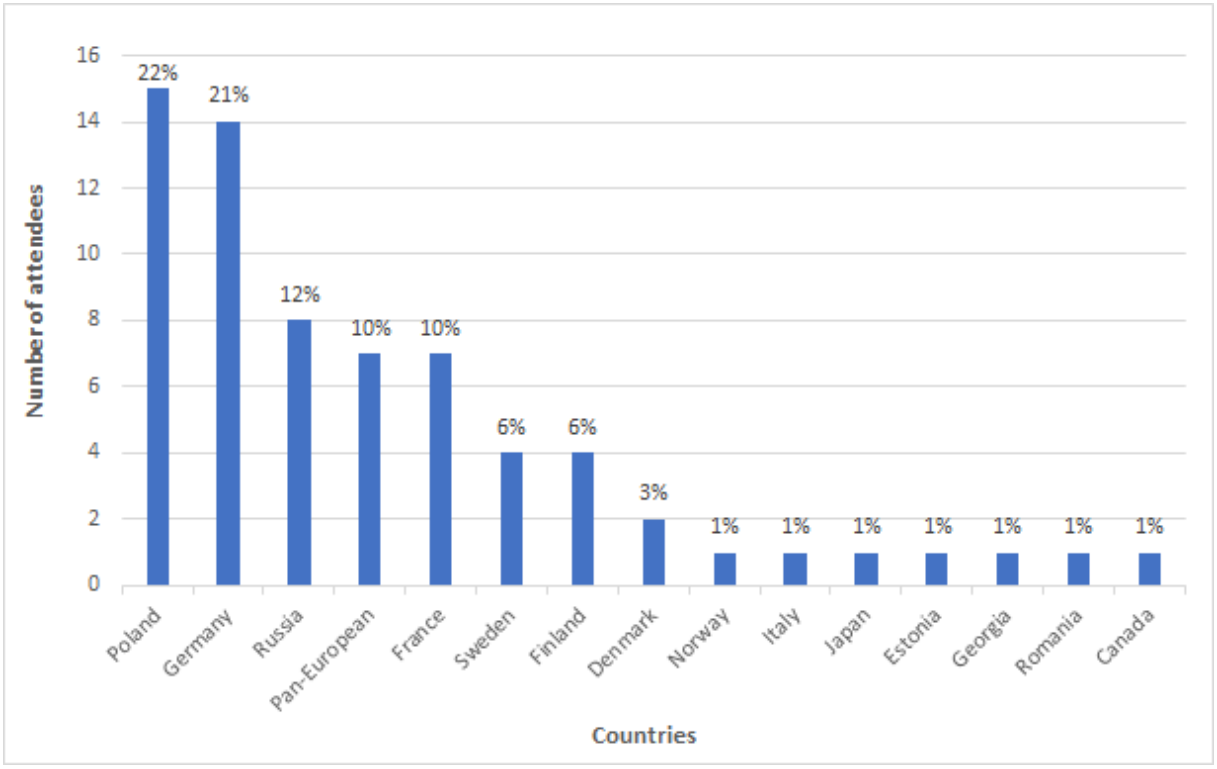


Figure 1: Distribution of participants by country for the Baltic Sea session. The percentage of attendance per country is indicated above each country bar.

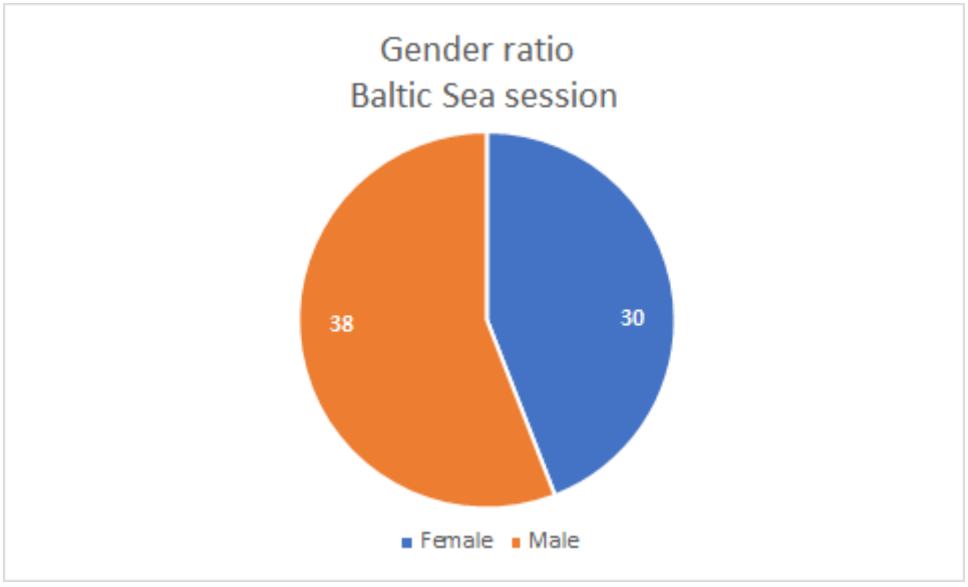


Figure 2: Gender ration for the Baltic Sea session.

**Table 1**: List of scientific institutions and organisations for the Baltic session

| **Institutes** | **Countries** |
|---|---|
| BSH | Germany |
| AARI | Russia |
| Black Sea Commission ICZM Advisory Group Member and NFP | Georgia |
| CNRS | France |
| DMI | Denmark |
| Euro-Argo ERIC | Pan-European |
| EuroGOOS | Pan-European |
| FMI | Finland |
| Fraunhofer IOSB | Germany |
| GEOMAR | Germany |
| German Development Institute | Germany |
| IFREMER | France |
| IMGW-PIB | Poland |
| IMR | Norway |
| Institute of Geophysics PAS | Poland |
| IOPAN | Poland |
| JAMSTEC | Japan |

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|---|---|
| Joint GeoMETOC Suppport Center | Denmark |
| Leibniz Institute for Baltic Sea Research Warnemünde (IOW) | Germany |
| Ministry of Education and Science | Poland |
| Ministry of infrastructure | Poland |
| National Institute for Research and Development on Marine Geology and Geo-ecology – GeoEcoMar | Romania |
| NKE instrumentation | France |
| OGS - National Institute of Oceanography and Applied Geophysics | Italy |
| Rockland Scientific | Canada |
| Shirshov Institute of Oceanology, Russian Academy of Sciences | Russia |
| SMHI, Swedish Meteorological and Hydrological Institute | Sweden |
| Tallinn University of Technology | Estonia |
| University Gothenburg | Sweden |
| University of Gdańsk | Poland |
| University of Oldenburg - Institute for Chemistry and Biology of the Marine Environment (ICBM) | Germany |
| VOTO (Voice of the Ocean) | Sweden |

# 5. Questionnaire

To obtain knowledge about the existing and potential use of Argo data within the Arctic&Baltic User workshop participants we made a questionnaire, which was available for the participants before and during the workshop.

From the 118 participants 37 answered the questionnaire. The answers represented 11 countries and mostly Public sector organisations or Universities (Figure 3). Different maritime sectors were also represented, the majority was involved with Marine environmental monitoring and Public Research (Figure 4).

Of those who answered the questionnaire 66% had not used Argo data before the workshop. The present and possible future use of Argo data was divided quite evenly between the different fields of oceanography (Figure 5). Slightly higher percentage of answers included hydrographic studies or operational oceanography. For the areas of interest most participants mentioned either the Baltic Sea, the Nordic Seas or the Arctic Ocean. 39% found the Argo data coverage sufficient for their study and study area and 37% too sparse. Few of those, who found the current coverage sufficient, remarked that it applies to Core Argo. For the BGC Argo, the coverage is yet too sparse. Others either had no prior experience or knowledge about the data coverage in their area of interest.

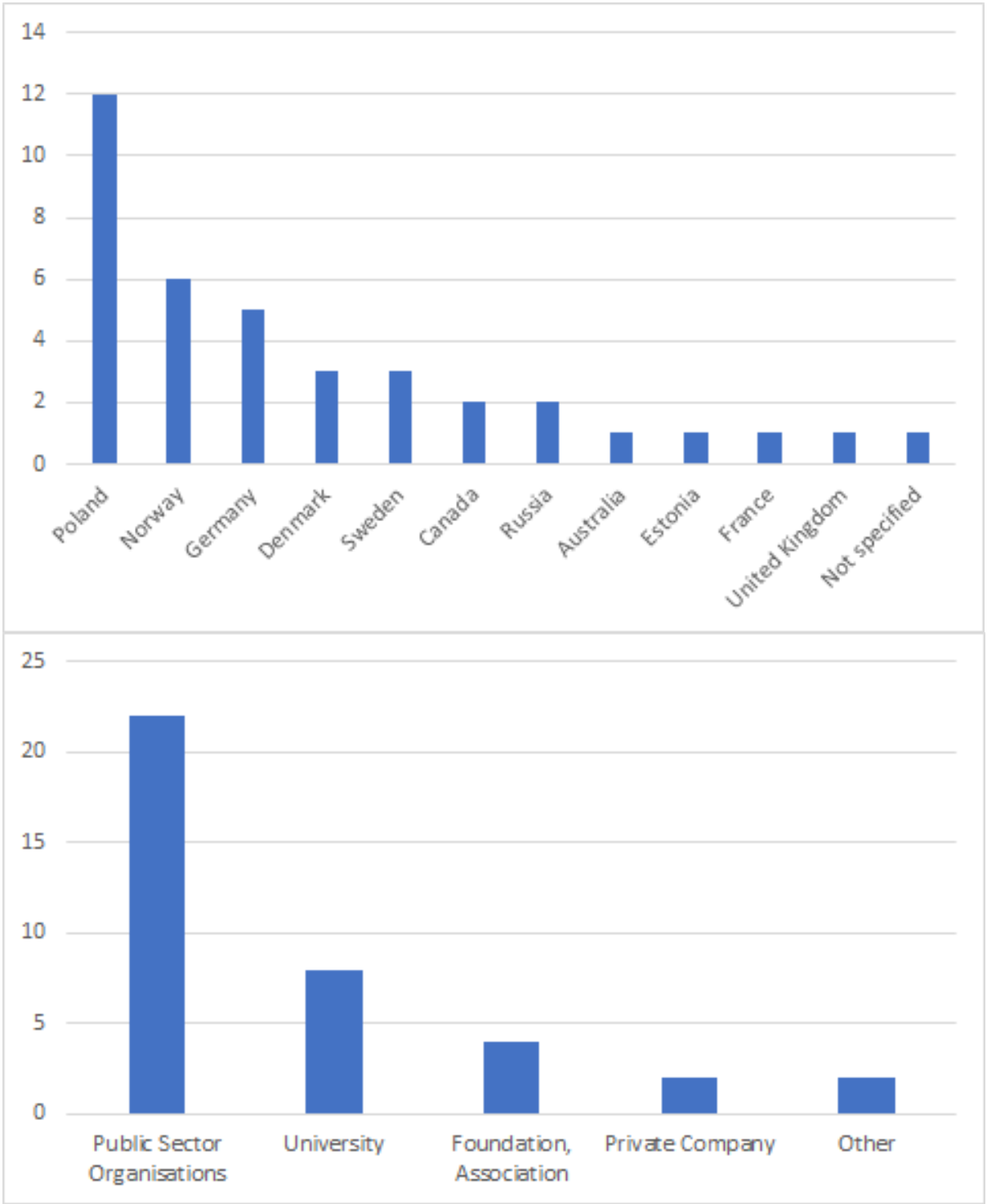


Figure 3. Distribution of answers by country (upper) and by type of organisation (lower).

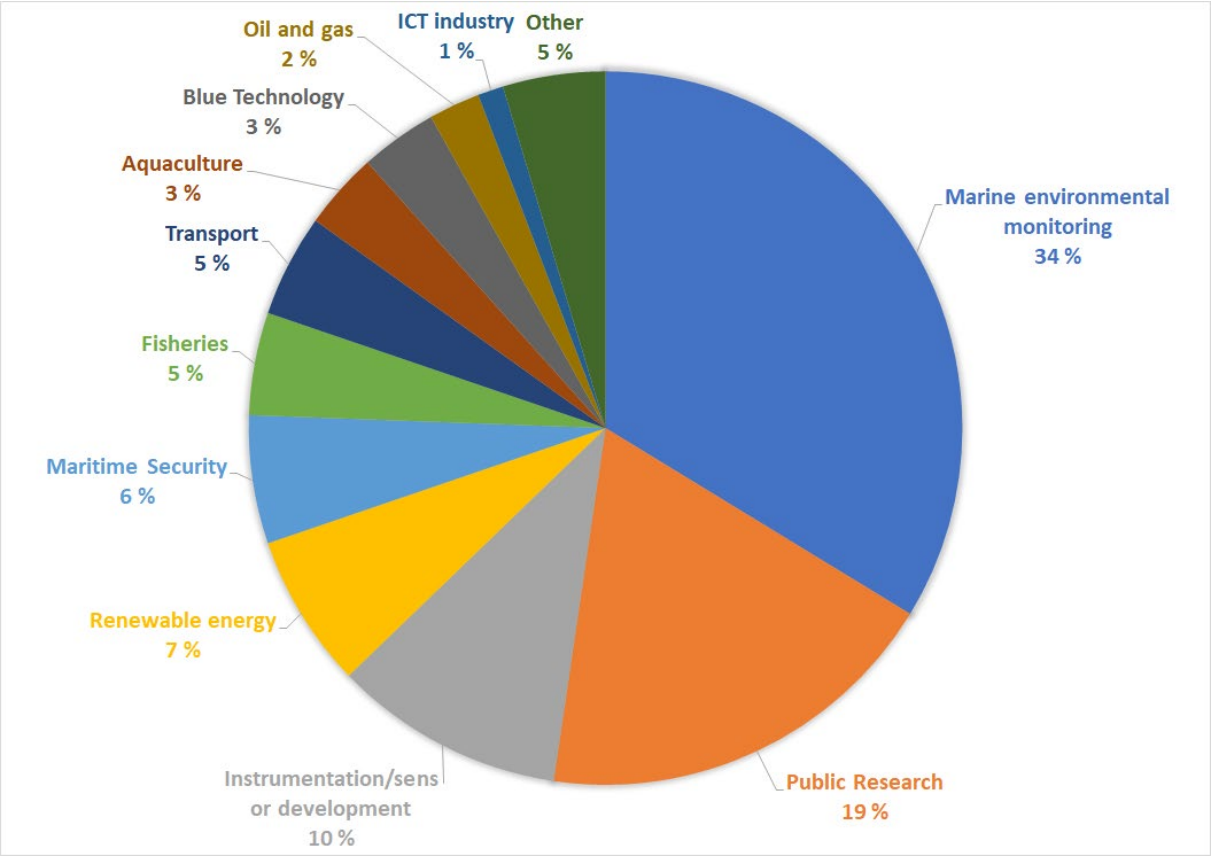


Figure 4. The different marine sectors the answers represent (multiple selection of sectors was possible in the questionnaire).

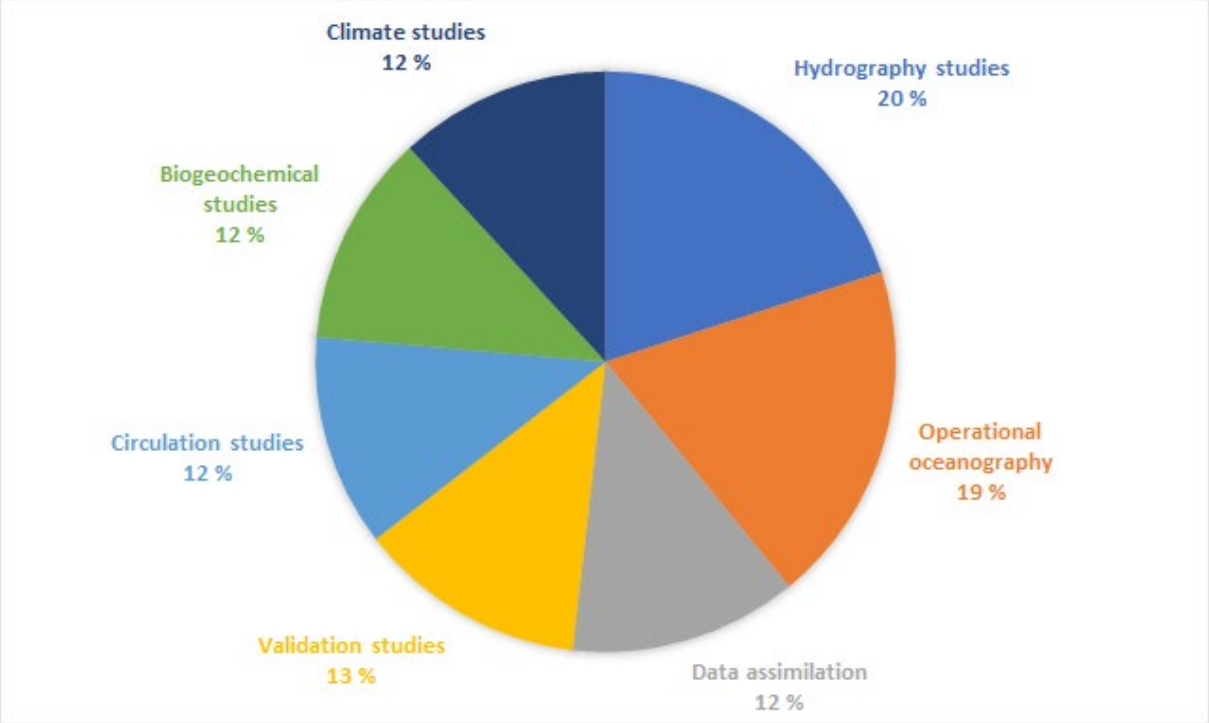


Figure 5. Distribution of use of Argo data in different oceanographic fields regarding the present and possible future use of Argo data by the participants.

## 6. Outcome

Despite the online form, the conference gathered a sufficient number of participants. It was attended by oceanographers, politicians, representatives of industry and technology. During the presentations it was proven that Argo operations in the Baltic Sea are possible and profitable. Possibilities and examples of using Argo data in the Baltic Sea were also presented. These examples encouraged the attendees of the conference to participate in the discussion panel. Both technical, organizational, political and legal matters were discussed in the panel.

The conference was attended by oceanographers from most of the Baltic Riparian countries. Only representatives from Lithuania and Latvia were missing. From Russia, the conference was attended by representatives of three centres: from Moscow, St. Petersburg and Kaliningrad.

Due to the division of the Baltic Sea into economic zones, broadly understood international cooperation in the use of Argo floats in this reservoir is essential. That is why Russia's involvement in this project is very important. This conference has made an important step in this direction. We also managed to encourage other countries to become interested in the Argo program, to use Argo data and possibly join Euro-Argo ERIC in the future.

The Arctic and Baltic Workshops took place in a formula different from that originally planned. Despite it, we believe that they have been successful. A great help in the preparation of the meeting was provided by the Euro-Argo office, both technical and organizational. The Euro-Argo website was used to post announcements, register participants, and finally arrange the meeting agenda. Euro-Argo office's help was also very valuable in organizing the questionnaire. We would like to express our special thanks to Estérine Evrard.

# 7. Next steps

Even though the meeting was a success, we did not resign from organizing the meeting in Sopot. Perhaps it will not have the formula of a large workshop, but only meetings of interested parties. In our opinion such a meeting can bring very positive results, especially as it allows us to provide participants hands-on training about how to download, process and use the Baltic Sea Argo data.

To continue the engagement of new users and enhance cooperation in the Baltic, a BOOS cooperation group for Argo floats and gliders in the Baltic was established. The first meeting of this group was arranged after the Arctic&Baltic users workshop in April. Participants from several Baltic institutes were present and possibilities for cooperation were discussed. The already existing collaboration in deploying and recovering Argo floats was further enhanced by sharing information about the planned research and monitoring cruises in the Baltic. Also, joint glider operations were discussed. It was agreed that the group would meet at least once a year during the BOOS annual meeting. In addition to that, dedicated workshops will be arranged around specific topics.

**References:**

Purokoski, T. , Aro, E. , Nummelin, A. , 2013. First long-term deploy- ment of Argo float in Baltic Sea Argo's inaugural operation in shallow, low-salinity water. Sea Technol. 54, 41—44 .

Walczowski W., Merchel M., Rak D., Wieczorek P., Goszczko I., 2020. Argo floats in the southern Baltic Sea, Oceanologia, https://doi.org/10.1016/j.oceano.2020.07.001 .

# 8. Annexes

**Table 1. Agenda of the General session**
**Thursday 8.4. – Argo in the European Marginal Seas (09:15-12:30)**
Chair: Sylvie POULIQUEN, Euro-Argo ERIC

| Time | Topic | Speaker |
|---|---|---|
| **09:15-09:30** | Welcome and overview of the organisation | Estérine EVRARD (Euro-Argo ERIC) |
| **09:30-09:45** | Argo, Euro-Argo research infrastructure and Euro-Argo RISE project | Sylvie POULIQUEN and Estérine EVRARD (Euro-Argo ERIC) |
| **09:45-10:15** | Argo float and at sea activities | Atanas PALAZOV (IOBAS), Dimitris KASSIS (HCMR), Vincent TAILLANDIER (SU) |
| **10:15-10:30** | Parameters acquired (core + BGC) | Petra ROIHA (FMI) |
| **10:30-10:45** | **Coffee break** | |
| **10:45-11:00** | Data availability/usage, Data flow and QC | Claire GOURCUFF (Euro-Argo ERIC) |
| **11:00-11:15** | Cooperation activities | Victor TURPIN (IOC/OceanOPS) |
| **11:15-11:45** | Synergies and cooperation between Marine RIs | Richard SANDERS (ICOS); Adrian STANICA (DANUBIUS-RI); Nadia LO BUE (EMSO) |
| **11:45-12:30** | General discussion | Moderator :<br>Claire GOURCUFF (Euro-Argo ERIC) |

**Table 2. Agenda of the Baltic Sea Users workshop**
**Thursday 8.4. – Baltic Sea session (14:30-16:30)**
Chair: Laura TUOMI, FMI

| Time | Topic | Speaker |
|---|---|---|
| **14:30-14:40** | Welcome and introduction to WP6 activities | Laura TUOMI (FMI) |
| **14:40-15:00** | Operating in Baltic Sea | Waldemar WALCZOWSKI (IOPAN) |
| **15 :00-15 :20** | Baltic Argo activities | Simo SIIRIÄ (FMI) |
| **15 :20-15 :40** | Use cases of Argo data in Baltic Sea | Petra ROIHA (FMI) |
| **15 :40-16 :00** | Enhancing cooperation in Baltic | Laura TUOMI (FMI) |
| **16:00-16:30** | Panel discussion / General discussion | Moderator: Ingrid A. BENAVIDES<br>**Panelists:**<br>Henry BITTIG (IOW)<br>Urmas LIPS (TTU-MSI)<br>Jun SHE (DMI) |