



# EURO-ARGO

A European Research Infrastructure Consortium for observing the Ocean

## *Argo floats – an important element of oceanographic observations in the Southern Baltic Sea*

*Waldemar Walczowski,*

*Ilona Goszczko, Małgorzata Merchel, Piotr Wieczorek, Daniel Rak*



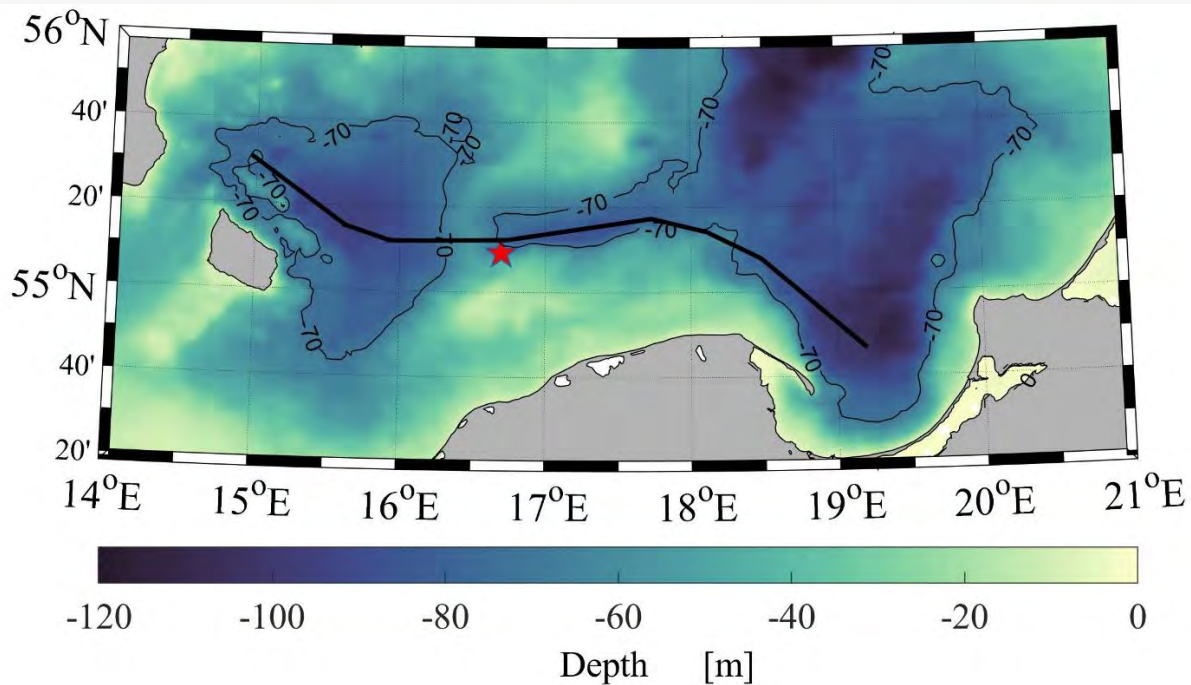
**INSTITUTE OF OCEANOLOGY**  
**POLISH ACADEMY OF SCIENCES**



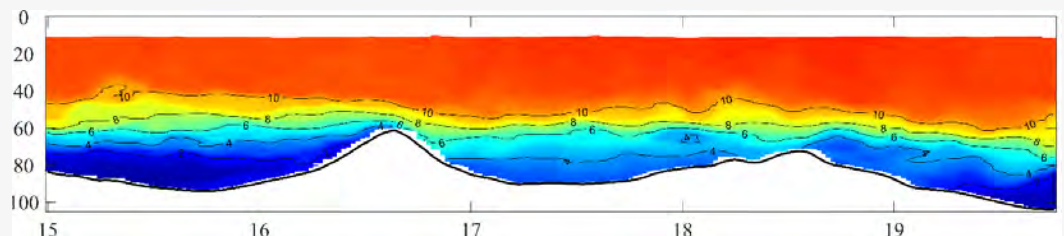
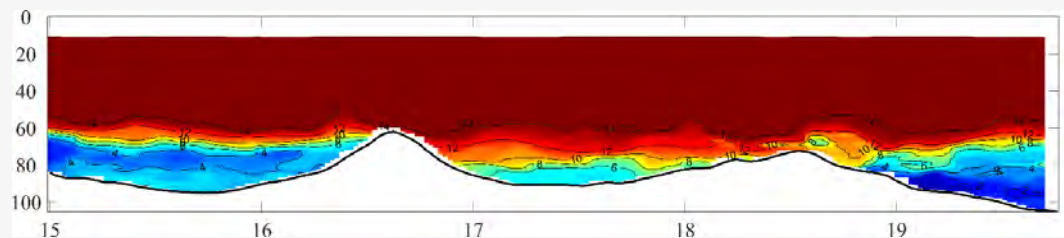
## This is a detailed topographical map of the Baltic Sea region. The map shows the coastline of several European countries, including Norway to the northwest, Sweden to the west, Finland to the north, Denmark to the southwest, Germany to the south, Poland to the southeast, Lithuania, Latvia, and Estonia to the east, and Russia to the northeast. Major cities are labeled in yellow text, including Oslo, Stockholm, Helsinki, Tallinn, Riga, Vilnius, Gdansk, Copenhagen, and Hamburg. The Baltic Sea itself is shown in dark blue, with various gulfs and straits labeled in blue text, such as the Gulf of Bothnia and the Gulf of Gdansk. The landmasses are depicted in shades of green and brown, indicating different elevations and vegetation. The map also shows some islands, such as Gotland and Åland. The overall orientation is with North at the top.

- *Baltic is a small, shallow sea surrounded by land*
- *Limited water exchange with world's ocean*
- *Two-layer water column structure*
- *High vertical water properties gradients*
- *High horizontal water properties gradients*
- *Intensive fisheries*
- *High vessel traffic*
- *Decreasing inflows volume*
- *Eutrophication*
- *Anoxic zones*





*Monthly distributions  
of dissolved oxygen  
along the main  
section.  
April and November*

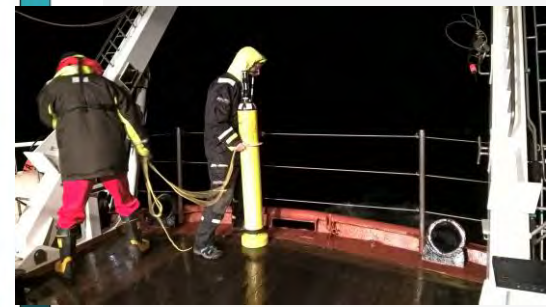
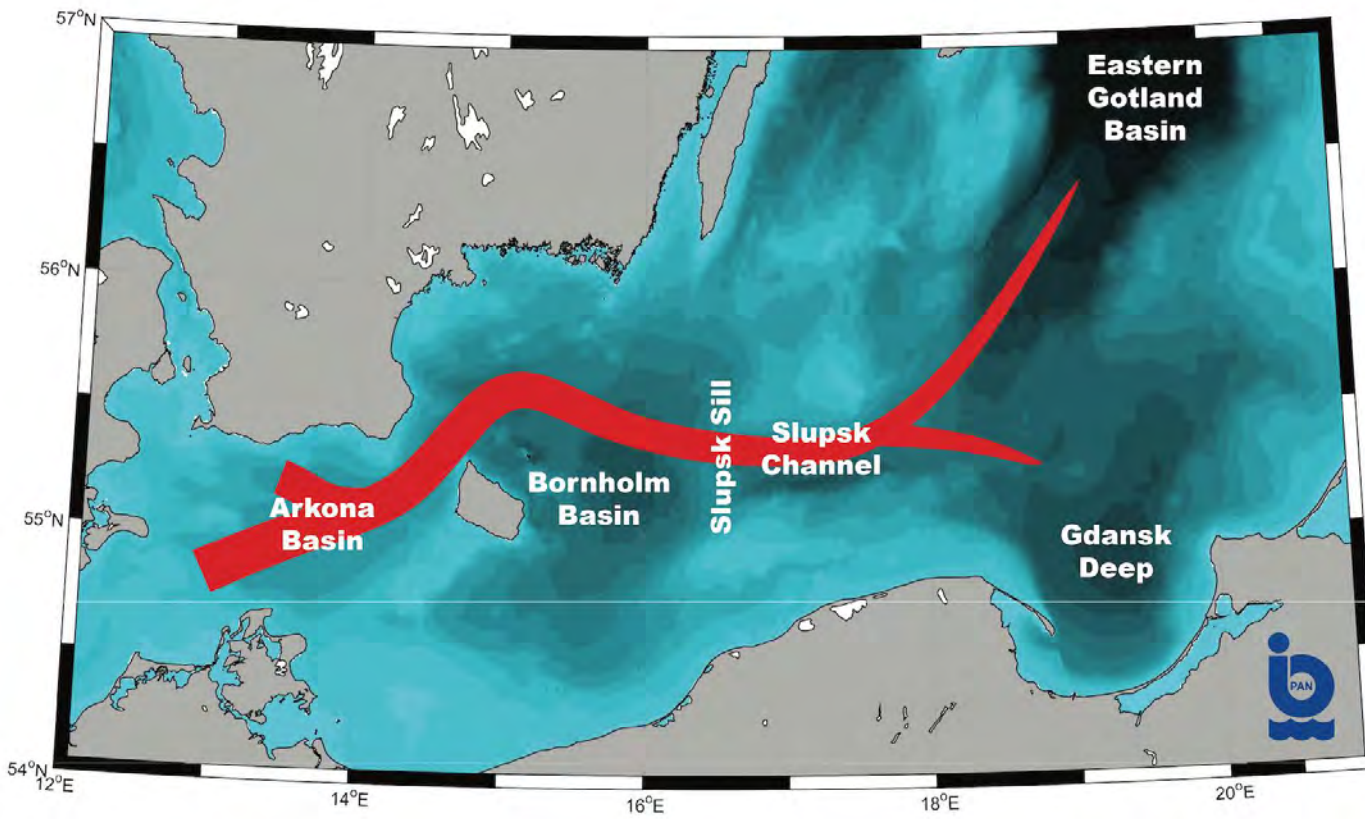


# Argo at the Baltic Sea ?

**First Argo deployment – Finland, Bothnian Sea, 2012**

**Argo Poland November 2016, Apex float**

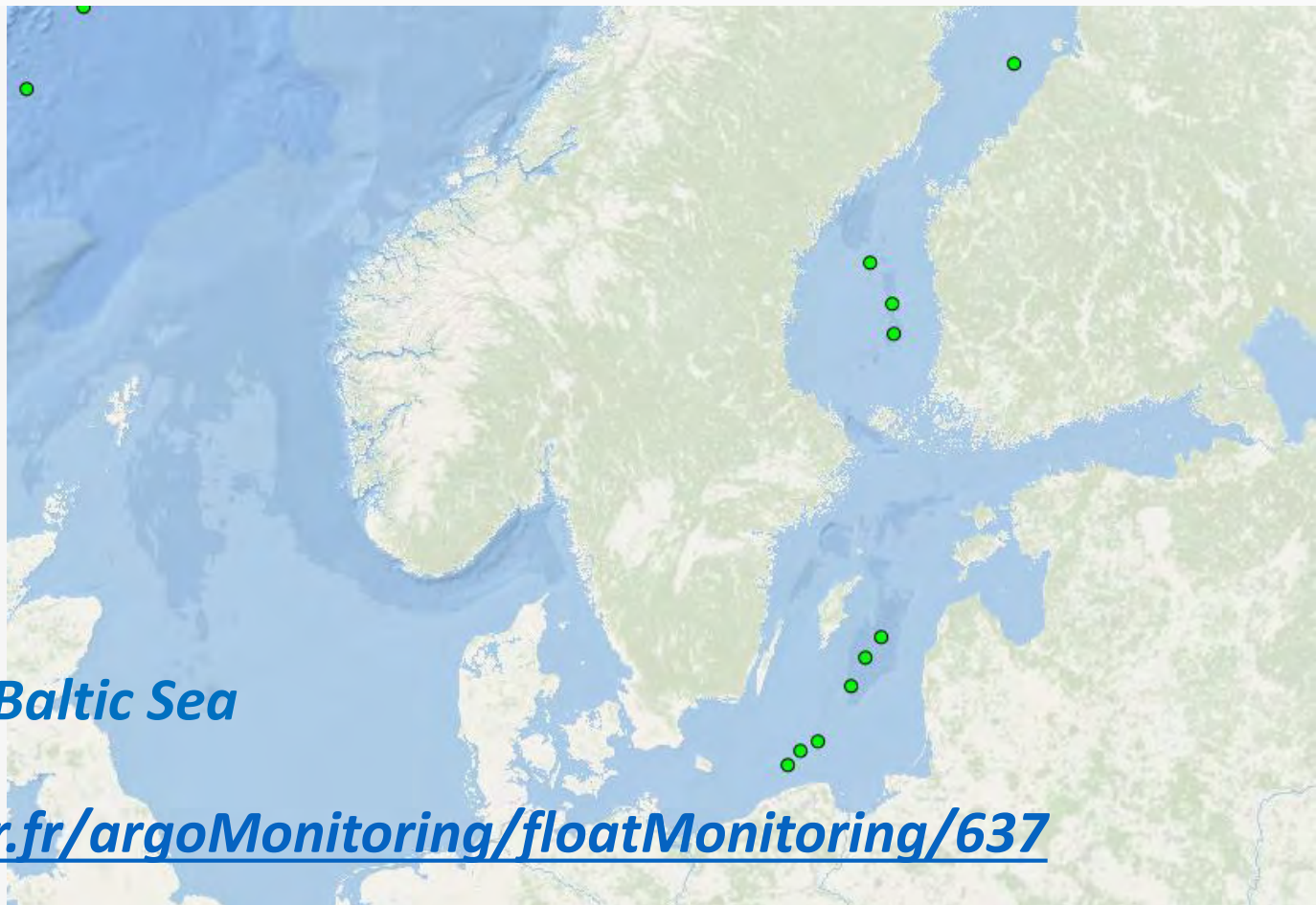
- **Monitoring of the Baltic deeps including oxygen behaviour (anoxic zones);**
- **Investigation of seasonal thermocline dynamics, mixed surface layer;**
- **Investigation of permanent halocline dynamics (mixing);**
- **Monitoring of the inflow events;**
- **Investigations of the water dynamics (currents).**





WMO	PTT	Serial #	Float	DAC	Last Tx	Last Cycle	Launch Date	Last cycle Pmax(dbar)	Last cycle Grounded	EOL	Ship
<a href="#">3901941</a>	360622	AI2600-16FR084	ARVOR	IF	06/08/2019 10:21:00	340	21/09/2017 02:34:00	76	<b>G</b>		RV OCEANIA
<a href="#">3902101</a>	596921	AI2632-17EU025	ARVOR	IF	07/08/2019 09:16:30	272	06/02/2018 04:24:00	116			R/V OCEANIA
<a href="#">3902106</a>	596903	AI2632-18EU005	ARVOR	IF	07/08/2019 09:29:30	172	11/09/2018 13:02:00	49	<b>G</b>		R/V OCEANIA
<a href="#">3902133</a>	360324	AI2600-16FR083	ARVOR	IF	06/08/2019 10:07:30	315	03/11/2017 15:27:00	74	<b>G</b>		RV OCEANIA
<a href="#">3902134</a>	586940	AI2600-17EU010	ARVOR	IF	08/08/2019 04:29:30	202	04/10/2018 14:20:00	104			Coast Guard Vessel
<a href="#">3902137</a>	515157	AI2600-17EU013	ARVOR	IF	07/08/2019 09:23:30	165	09/11/2018 14:25:00	120	<b>G</b>		R/V Aranda
<a href="#">6903697</a>	9568	7191	APEX	IF	06/08/2019 01:33:30	55	15/10/2018 14:00:00				RV Aranda

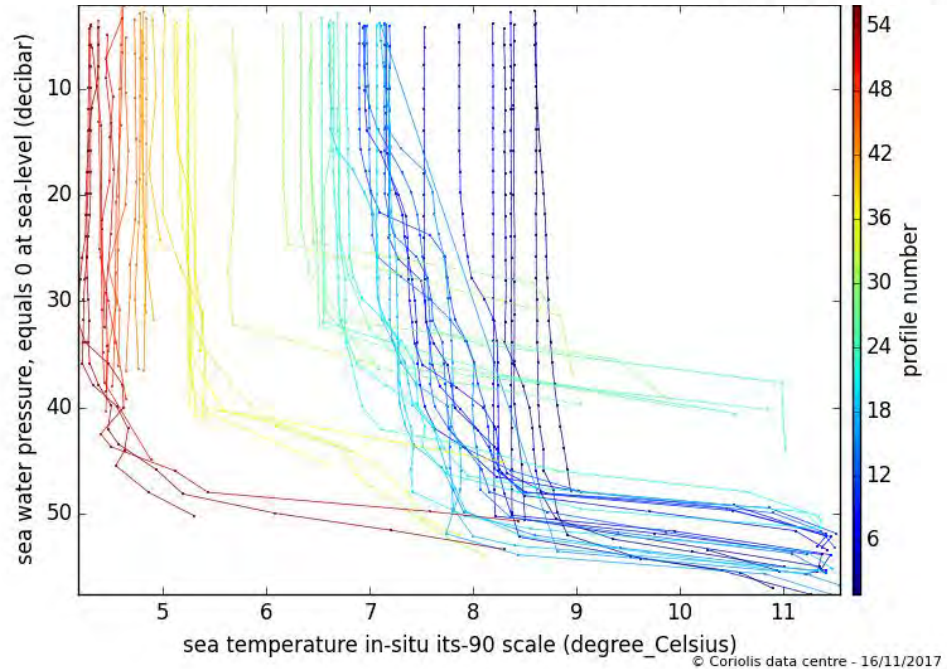
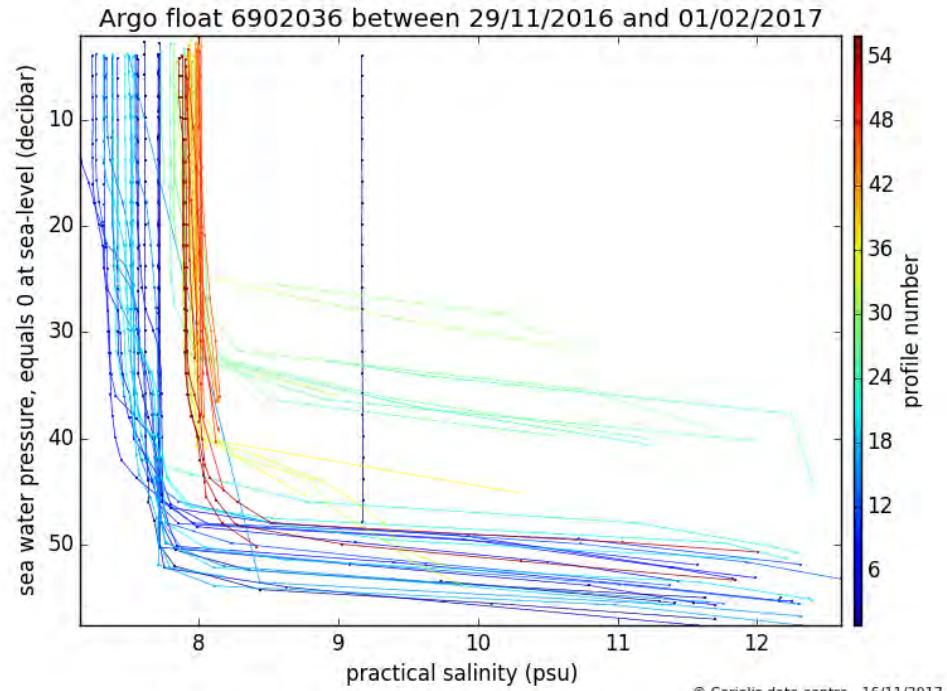
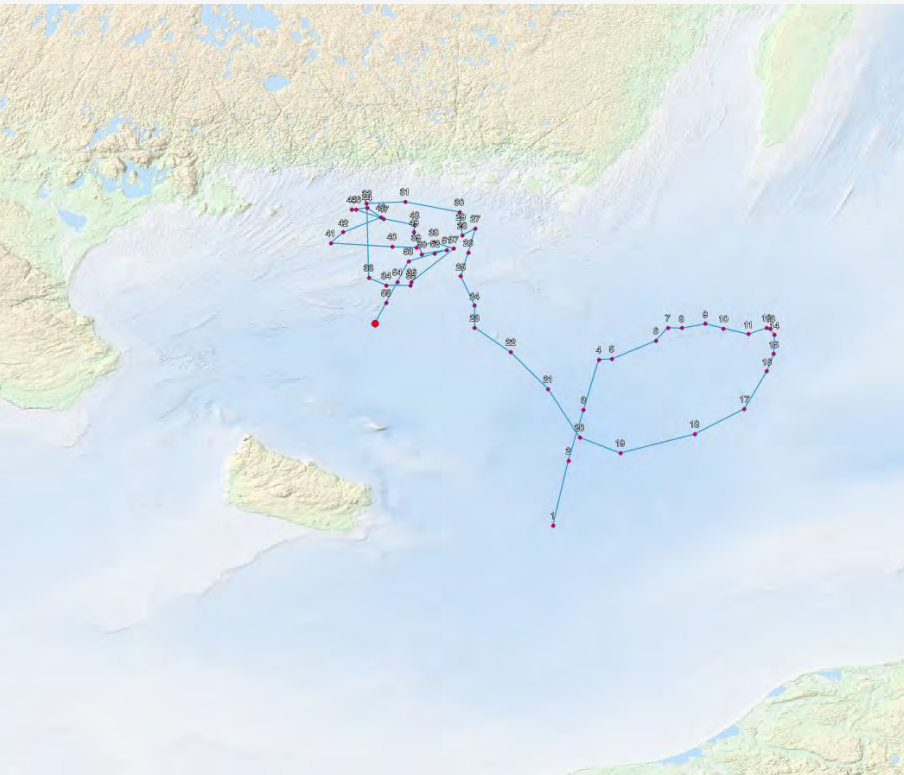
*28 floars deployed  
7 floats active*



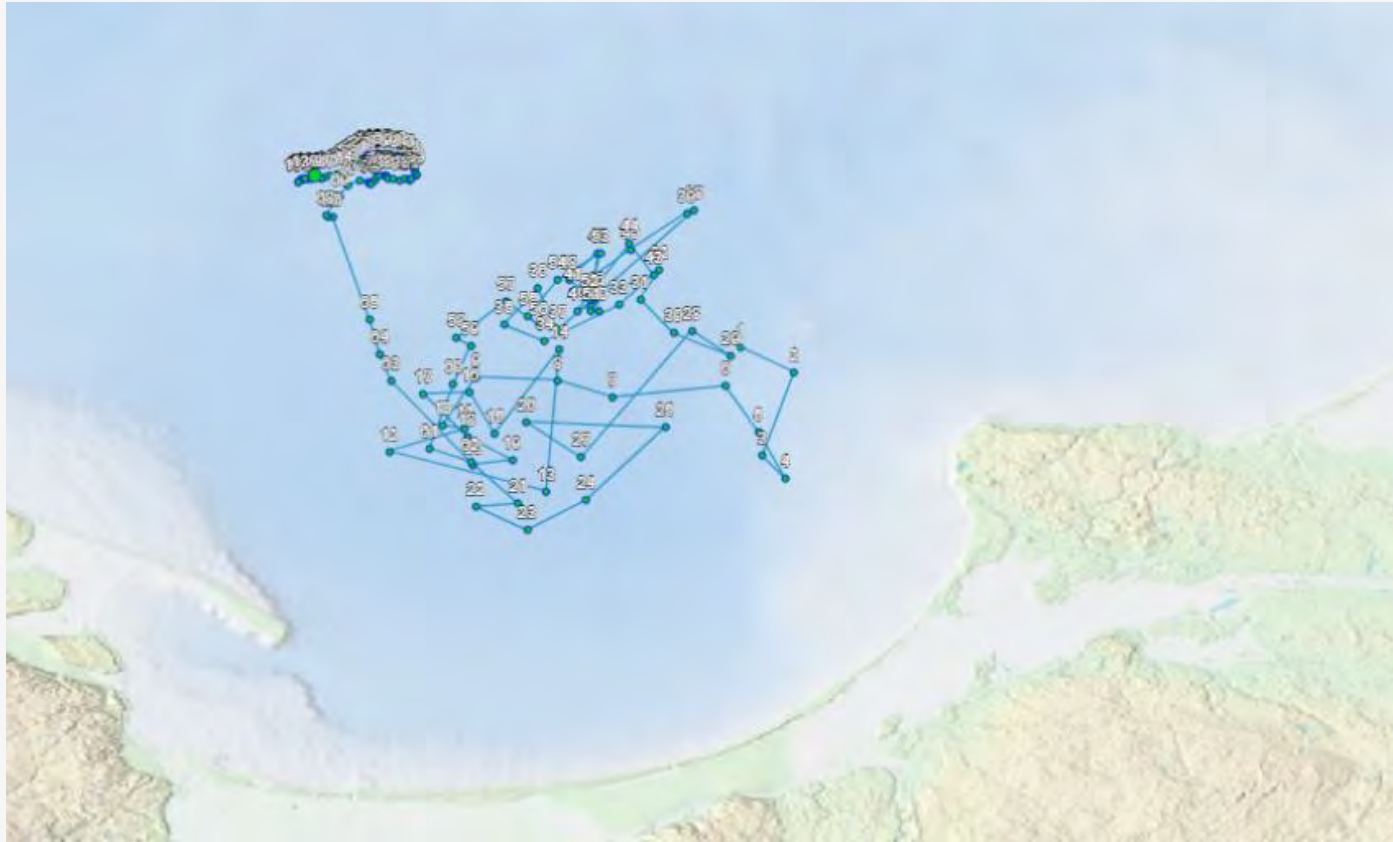
*Active floats at the Baltic Sea  
01.08.2019*

*<http://www.ifremer.fr/argoMonitoring/floatMonitoring/637>*

***APEX first tests at the  
Southern Baltic  
29/11/2016 - 01/02/2017  
56 CTD profiles***



# MOCCA float trajectory and settings



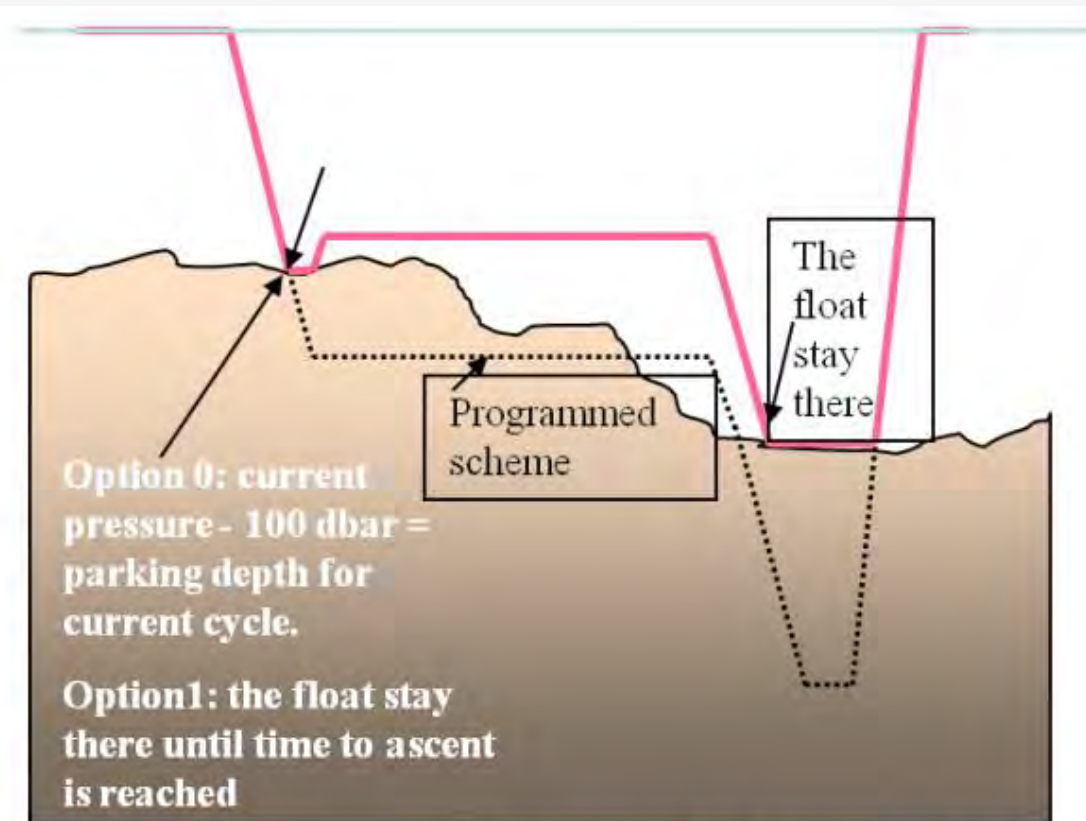
Float settings	MC/TC on recent ARVOR software versions	Values 3902133
Park Pressure(dbar)	MC11	100 then 110 (cycles > #99)
Profile Pressure (dbar)	MC12	105 then 200 (cycles > #6)
Grounding mode (0=pressure switch 1=stay grounded)	MC24	0
Pressure decreased on grounding (dbar)	MC25	25 then 15 (cycles > #6)
Pressure Delta for positioning (+/-) (dbar)	TC5	10
Pressure delta during drift (+/-) (dbar)	TC12	20
Grounding pressure (dbar)	TC11	50
Max volume before detecting grounding (cm3)	TC10	36 then 50 (cycles > #6)



# Arvor float grounding scheme at the Baltic Sea

*After changes in the 'behaviour' of the float in case of grounding we have obtained satisfying results:*

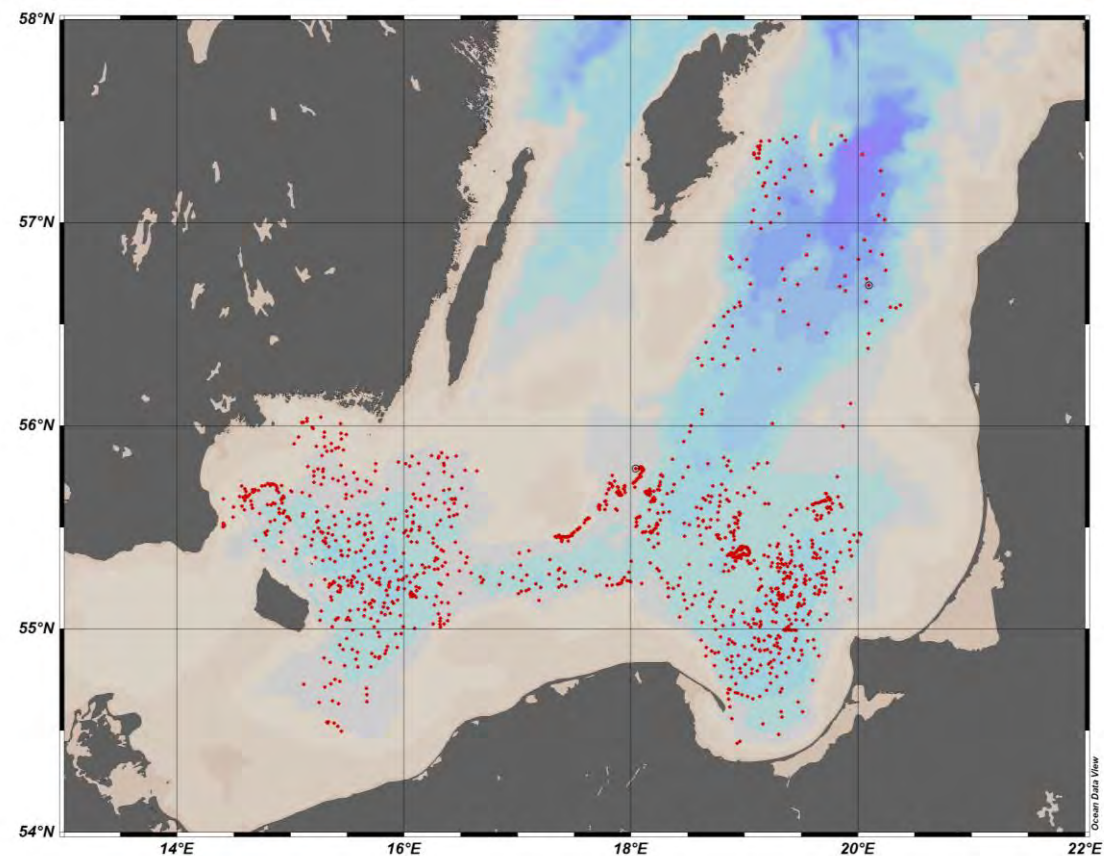
- Float is able to reach the bottom even in case of very strong pycnocline*
- There is no tendency for the float to get stuck in the bottom*



Source:  
Arvor deployments in the Baltic Sea  
Euro-Argo ERIC  
Romain Cancouet

**Schematic representation of a ARVOR-I's behaviour in case of grounding**





## ***Southern Baltic***

***29/11/2016 - 12/08/2019***

***1622 CTD ascending profiles***

***including***

***760 dissolved oxygen profiles***

***+***

***descending profiles***

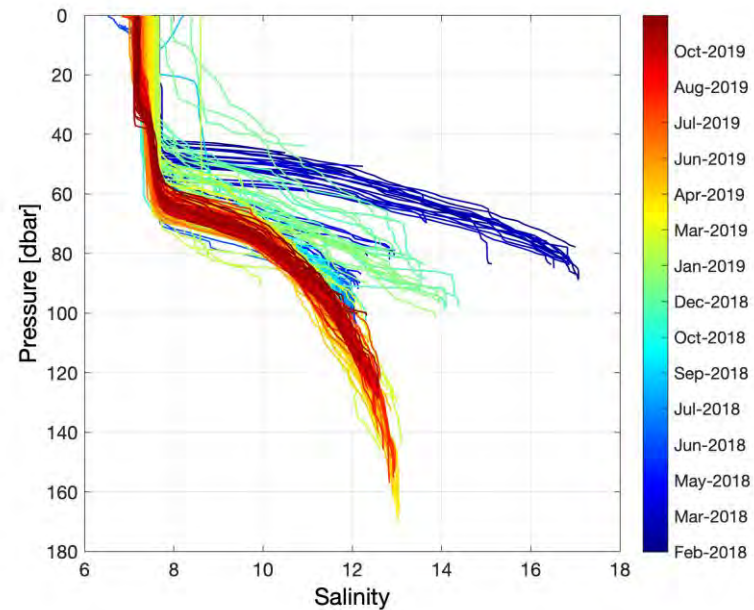
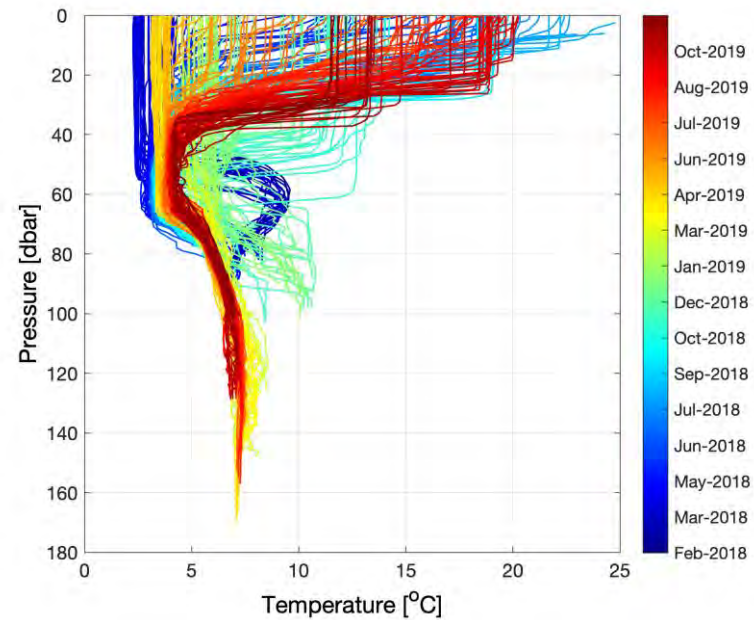
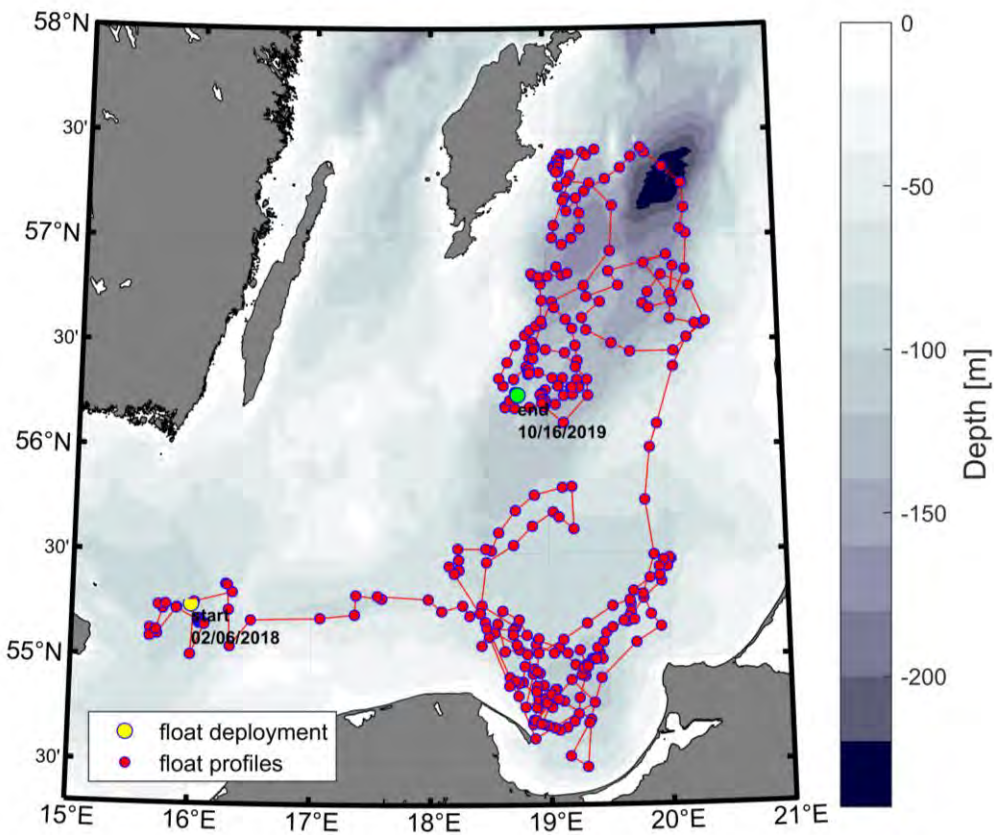
***+***

***data from parking drift***

Float	Project	Type	Sensors	Start	End	Cycles	Comments
6902036	Argo Poland	Apex	CTD	29/11/2016	01/02/2017	56	found by fishermen in 2019
2902100	Argo Poland	Apex	CTD	15/03/2017	07/01/2018	234	
3902101	Argo Poland	Arvor	CTD/O <sub>2</sub>	06/02/2018		310	active
3902104	Argo Poland	Arvor	CTD/O <sub>2</sub>	01/06/2018	10/09/2018	53	recovered
3902106	Argo Poland	Arvor	CTD/O <sub>2</sub>	11/09/2018		200	Active, redeployment of 3902104
3901940	MOCCA	Arvor	CT	20/09/2017	04/10/2017	7	recovered
3901940	MOCCA	Arvor	CT	21/09/2017		347	Non active
3902133	MOCCA	Arvor	CT	06/11/2017		322	Active redeployment of 3901940

Examples of Argo data, float 3902101  
February 2018-October 2019  
310 CTD/O<sub>2</sub> profiles

Temperature and salinity profiles



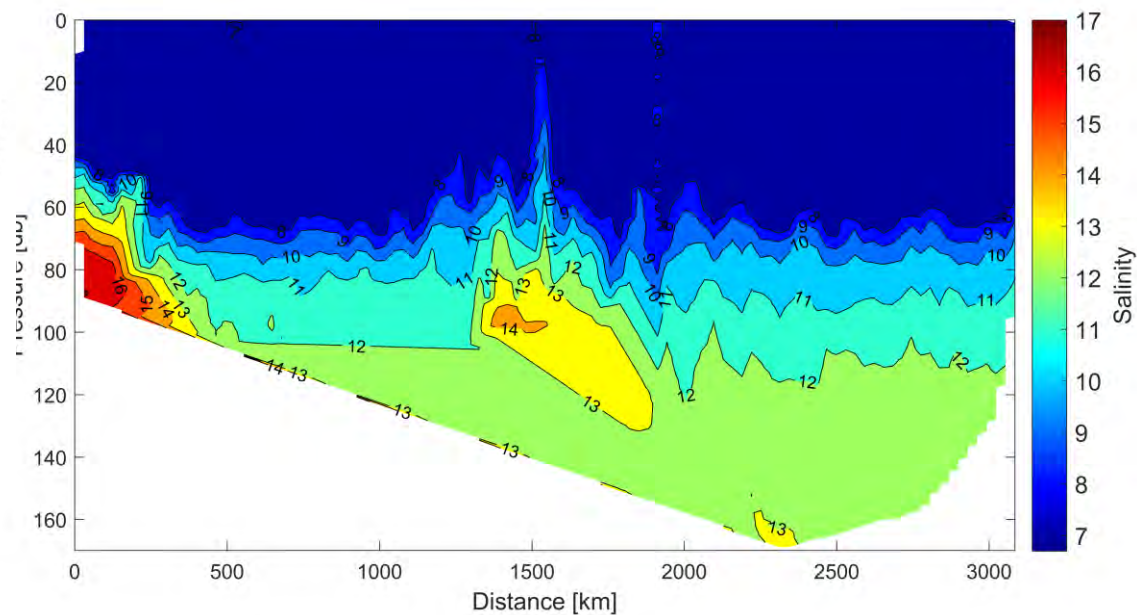
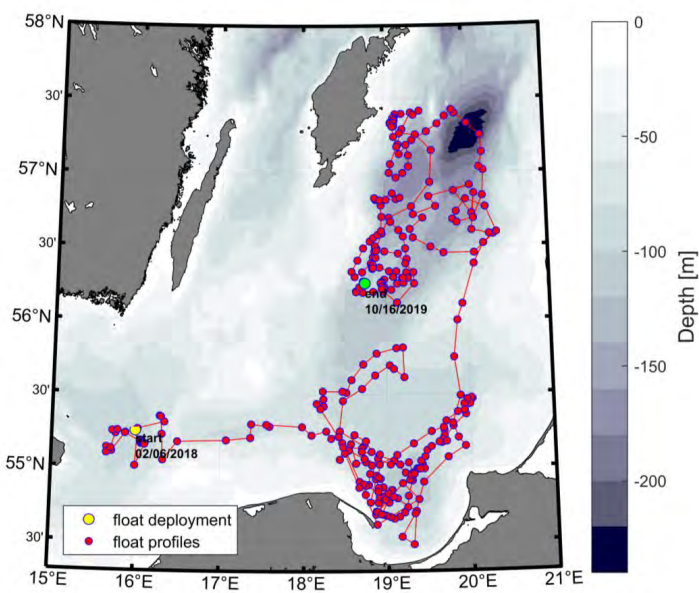
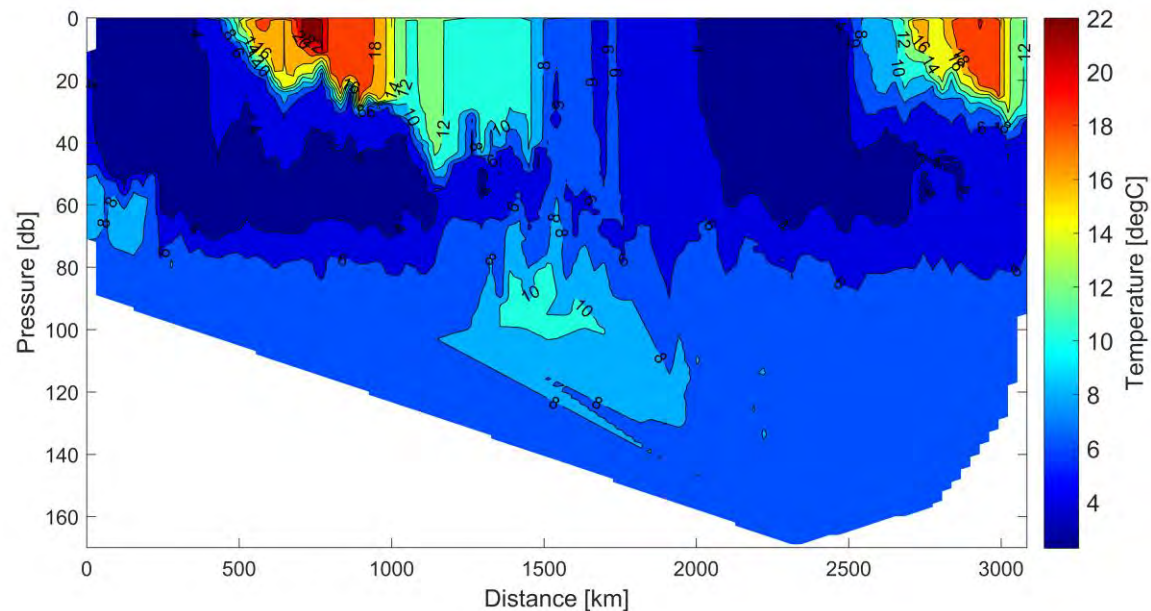


# Float 3902101

February 2018-  
October 2019

310 CTD/O<sub>2</sub> profiles

Temperature and salinity  
sections

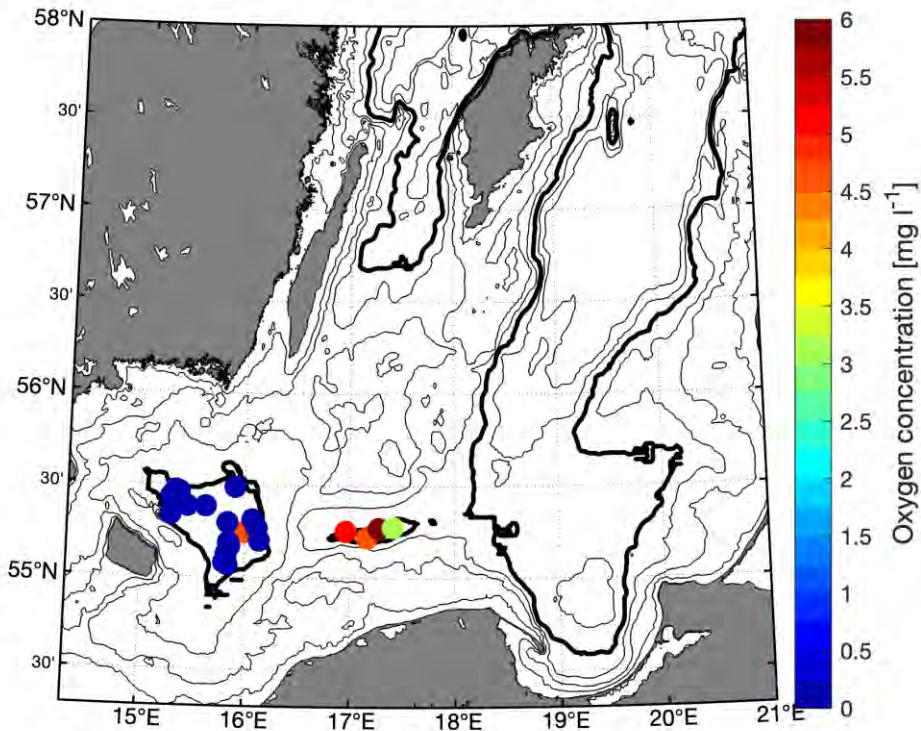


# *Dissolved oxygen concentration for regions deeper than 80 m Bottom layer*

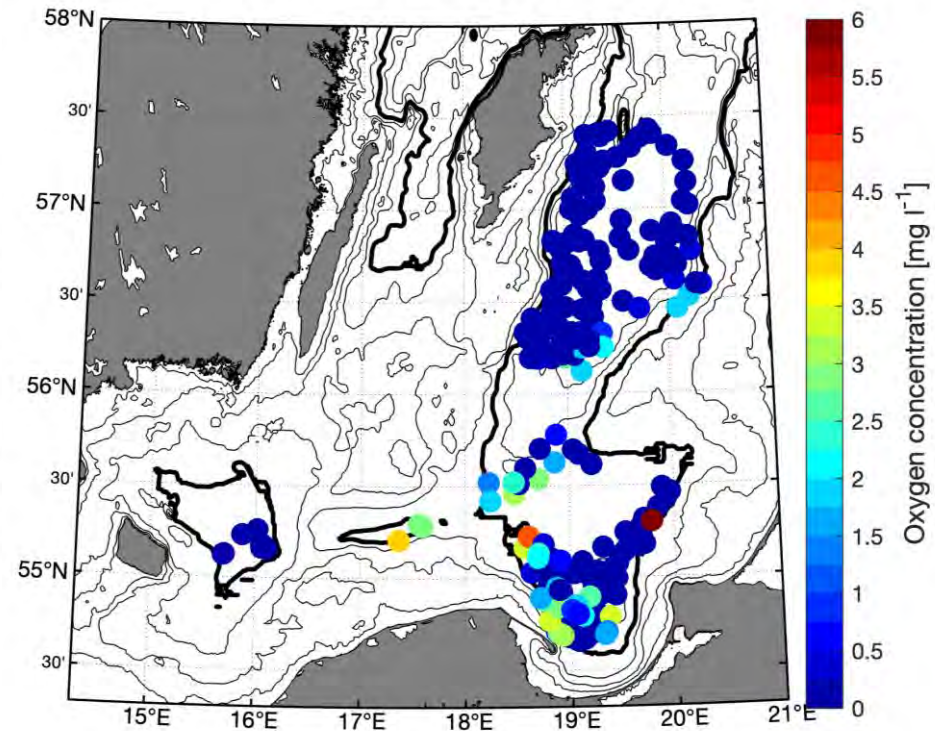
*Float 3902106  
September 2018 - October 2019*

*Float 3902101  
February 2018 - October 2019*

Dept>80m. Date 16-Oct-2019



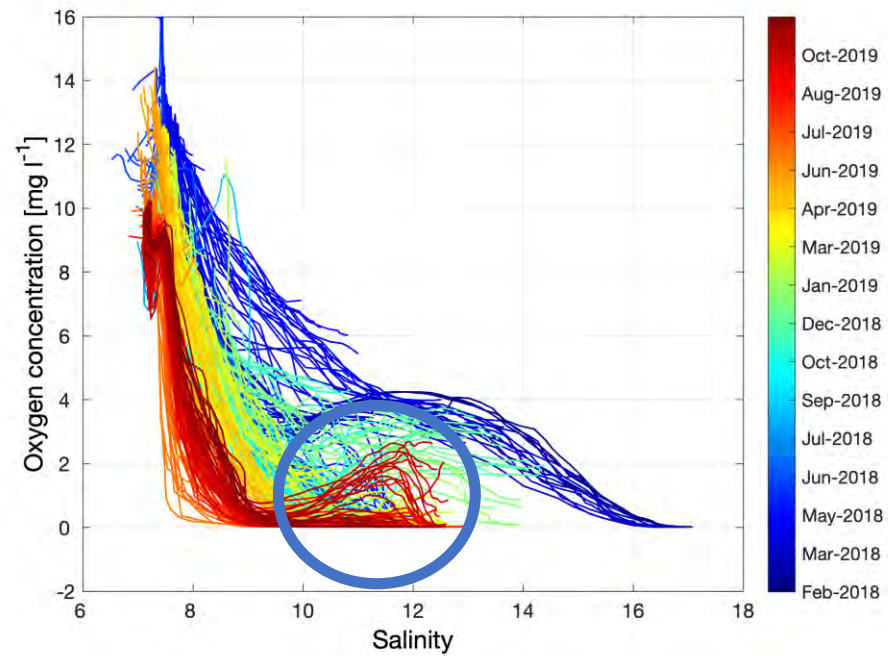
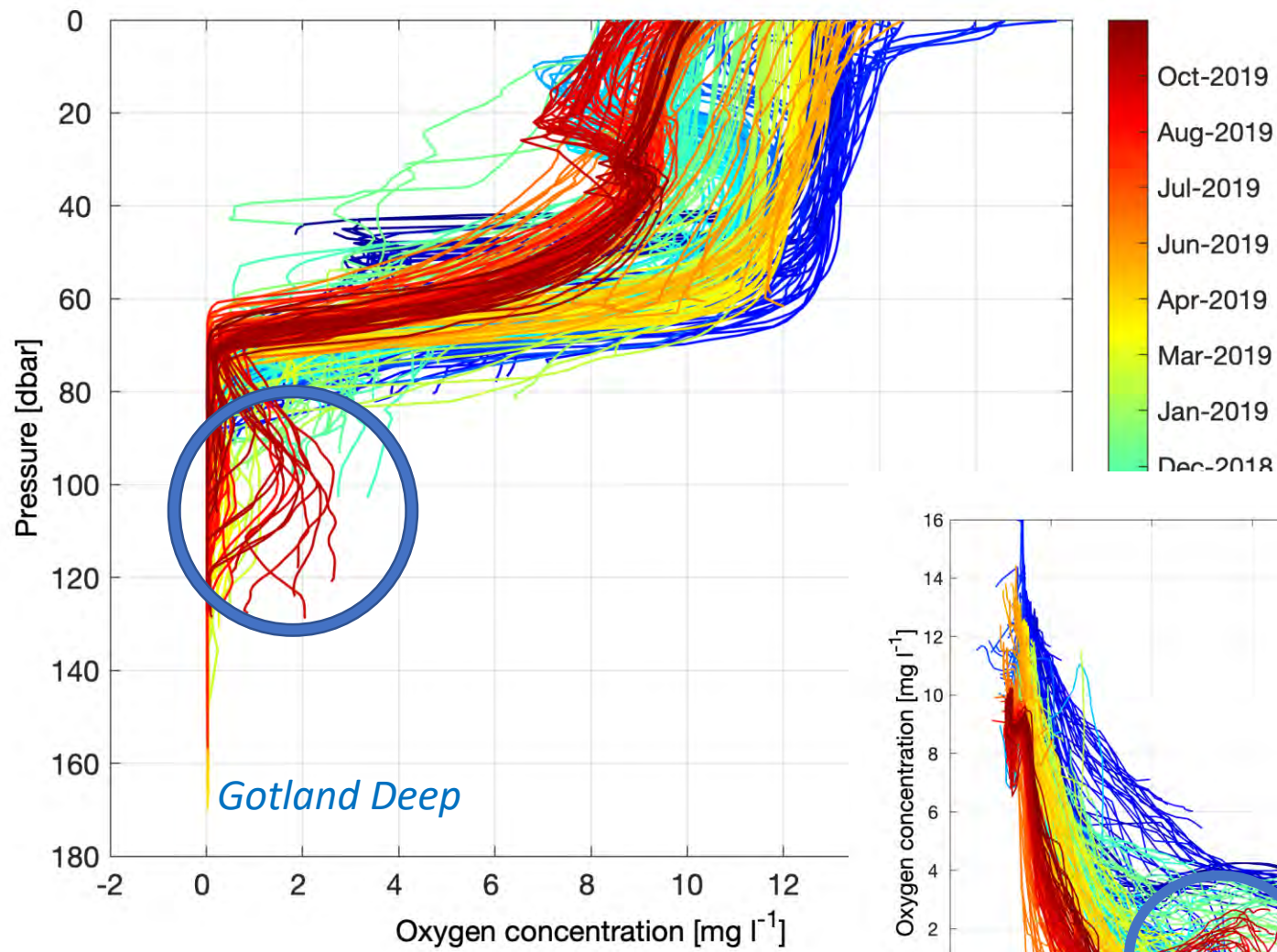
Dept>80m. Date 16-Oct-2019





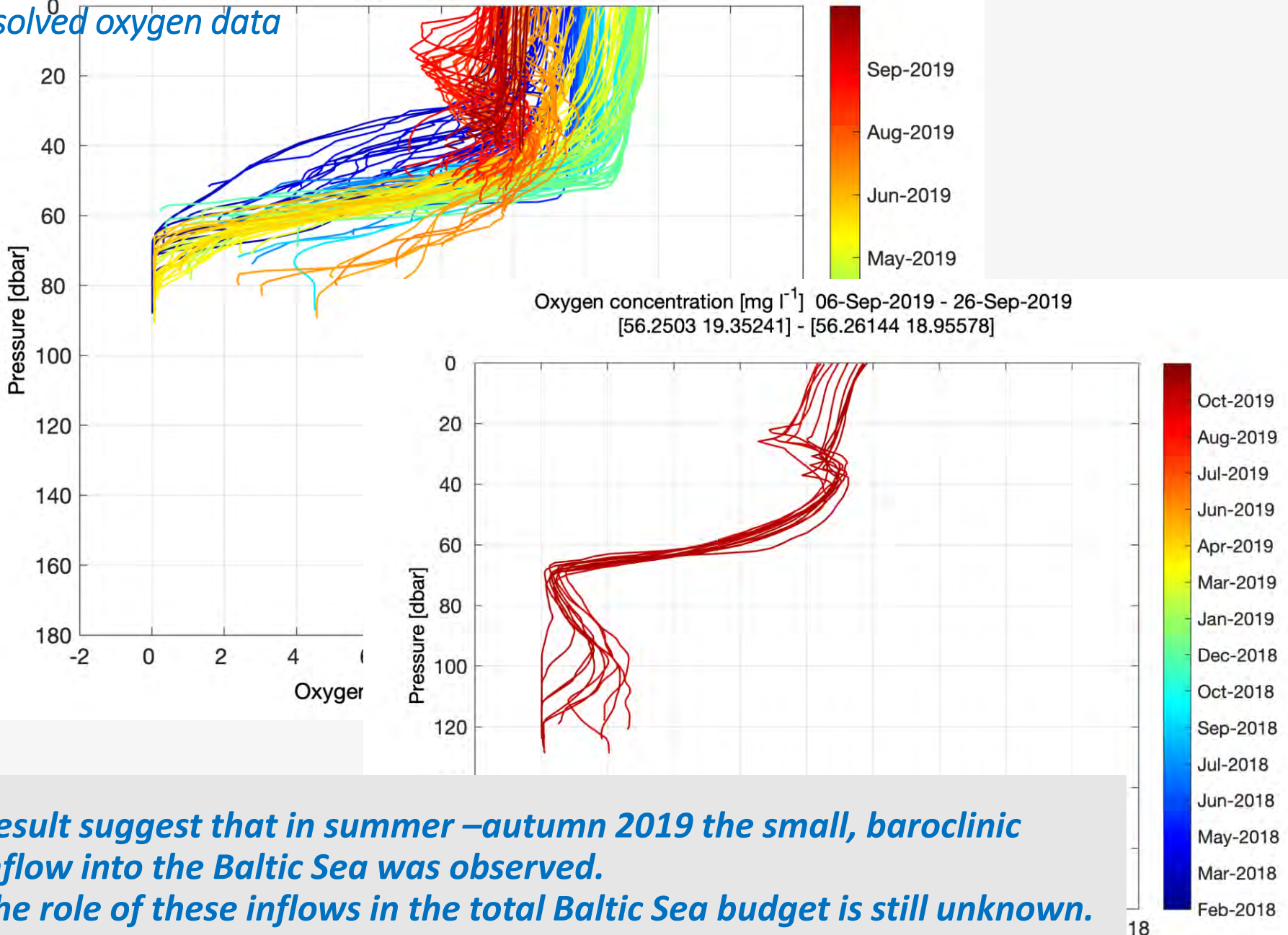
# Float 3902101, February 2018-October 2019

## Dissolved oxygen data



Float 3902101, February 2018-October 2019

Dissolved oxygen data



*Result suggest that in summer –autumn 2019 the small, baroclinic inflow into the Baltic Sea was observed. The role of these inflows in the total Baltic Sea budget is still unknown. Argo floats may be good tool for these inflows monitoring*



<https://www.iopan.pl/hydrodynamics/po/Argo/argo.html>

<http://www.ifremer.fr/argoMonitoring/floatMonitoring/637>

## ARGO POLAND



### *Initiative*

#### ARGO POLAND

ARCTIC

BALTIC

ARGO LINKS

ARGO MATERIALS

ARGO DATABASE

ARGO NEWS

RESEARCH BUOY

The Argo Poland is a component of global array of temperature/salinity profiling Argo floats.

The Argo array amounts to 4000 floats at present. About 800 new floats are deployed per year (including circa 250 in frame of the Euro-Argo).

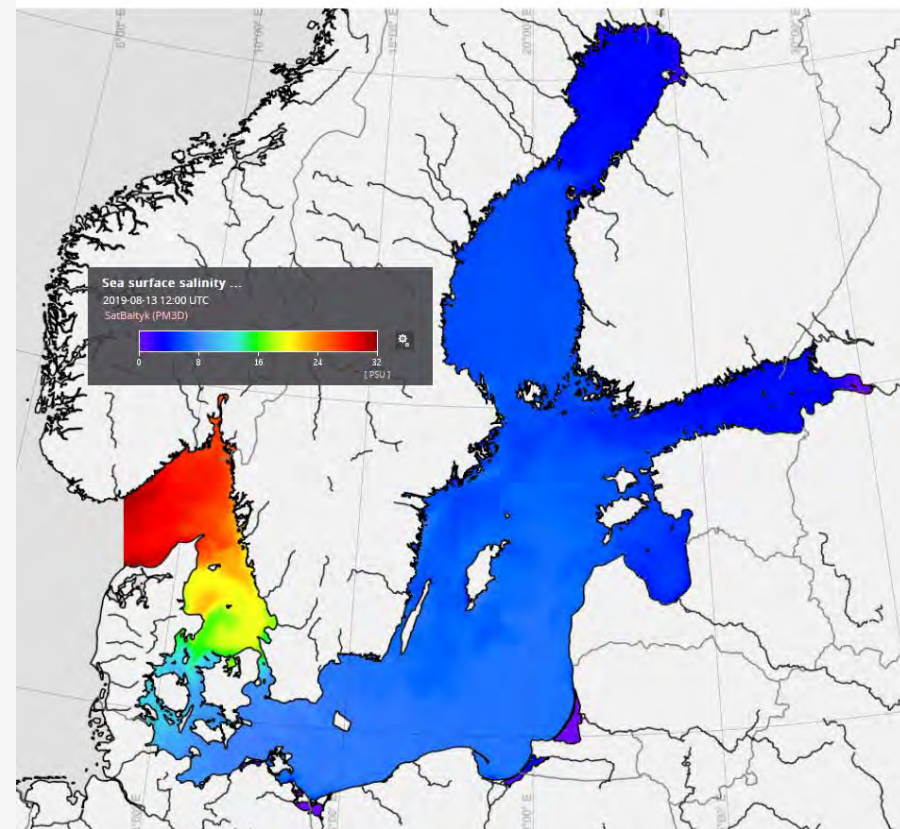
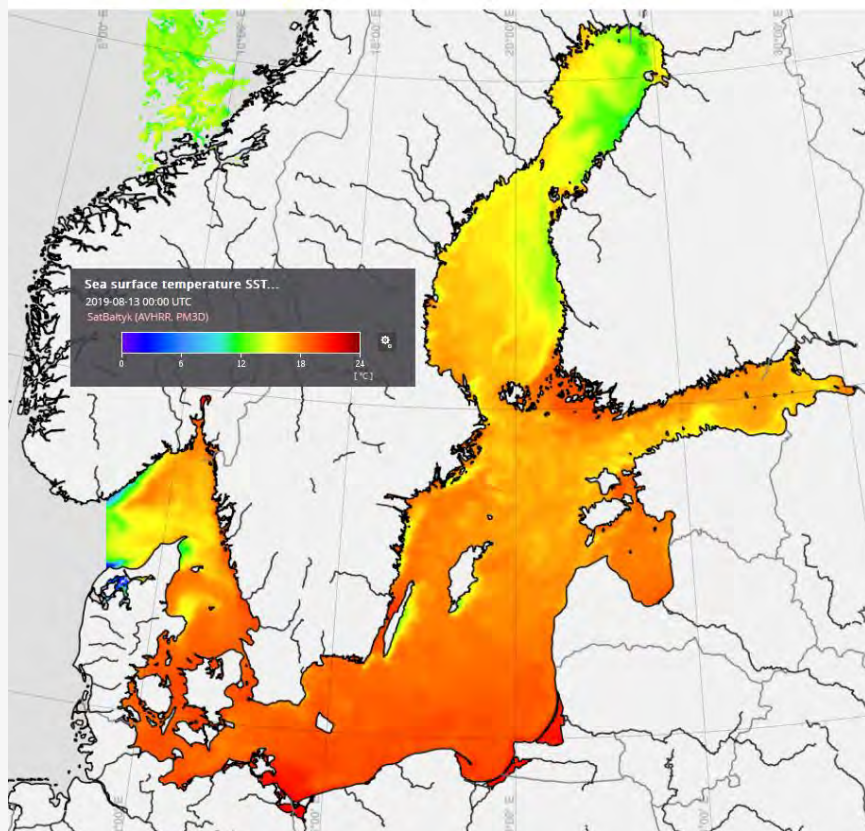
The data come from battery-powered autonomous floats that spend most of their life drifting at depth where they are stabilised by being neutrally buoyant at the "parking depth" pressure by having a density equal to the ambient pressure and a compressibility that is less than that of sea water. Satellites determine the position of the floats when they come to surface, and receive the data transmitted by the floats.

The Polish Argo programme is carried out by the Institute of Oceanology Polish Academy of Sciences (IOPAN). Since 2009 our Institute has deployed twenty-one floats. Fourteen 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 four floats in the Baltic Sea.

Data received from the IOPAN floats and another Argo data sets were used to construct the mean hydrographic fields in the West Spitsbergen Current (WSC) for a comparison with the WSC structure obtained from the shipborne hydrographic measurements.



*Data from Argo floats in the Southern Baltic are delivered in NRT to the SatBaltyk system:  
Satellite Environment Control of Baltic Sea system  
(<http://www.satbaltyk.pl/en/>)*



*Examples of surface temperature and salinity distribution on August 12, 2019*



# *Biogeochemical Argo (BGC Argo)*

## *Measured variables*

- *Oxygen concentration*
- *Nitrate concentration*
- *pH*
- *Chlorophyll a concentration*
- *Suspended particles*
- *Downwelling irradiance*



# Conclusions

- *The importance of autonomous devices in oceanographic measurements is increasing;*
- *Argo floats are the reliable and cheap sources of oceanographic real time data;*
- *Argo array is well organised and maintained;*
- *Practice shows that shallow shelf seas can also be explored using Argo floats;*
- *Contact with the bottom (grounding), proximity to the shore, collisions with vessel are not as dangerous for the float as it seemed before;*
- *Small seas as Baltic Sea gives opportunity of floats recovery and redeployment;*
- *Various sources of data as Argo floats, cruises and moorings provide extensive, complementary data set for better monitoring of the Baltic Sea, improvement of numerical models and validation of satellite observation;*
- *In the near future, in addition to standard CTD floats, the number and importance of BGC floats will increase;*
- *International collaboration in Argo projects at the Baltic Sea is very needed*





- ***Euro-Argo RISE project organise workshop devoted Argo at the Baltic Sea***
- ***The likely timing - end of September 2020***
- ***Certain place - Sopot, Poland***

**WELCOME**



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**POLISH ACADEMY OF SCIENCES**



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A European Research Infrastructure Consortium for observing the Ocean

**M****CCA**



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Maritime and Fisheries Fund