Argo under-ice in the northern latitudes

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Motivation (Euro-Argo Strategy - EA-RISE)

- Strengthening Europe's role in and contribution to the global Argo Programme
- Supporting the implementation of the EU Marine Policy through the development and subsequent incorporation of biogeochemical sensors into the programme
- **Extending spatially the observations into the European and Polar Seas**, as well as into the abyssal parts of the oceans
- **Further developing the existing data management system**
- Maximising the relevant knowledge of the Seas and Oceans, e.g. their role in a changing climate.

Outline

- How to operate floats in the Arctic and Baltic (recommendations)
- How to do quality control in the Arctic and Baltic (recommendations)
- European fleet performance in the Arctic
- Conclusions

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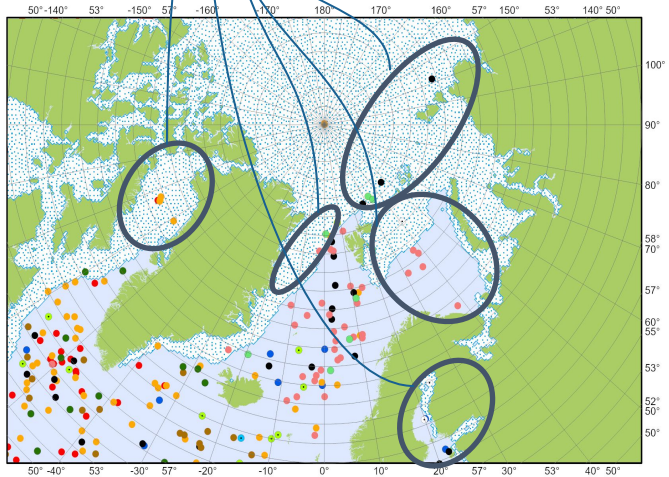
Operating floats in the Arctic and the Baltic - Recommendations

Case studies

- Baffin Bay
- Baltic Sea
- Barents Sea
- East Greenland Current
- Nansen Basin



Deployment and under-ice operation:

• Identify the ice free months on the target area. The float deployment should take place during that period.

• Make sure that the floats have an ISA algorithm available.

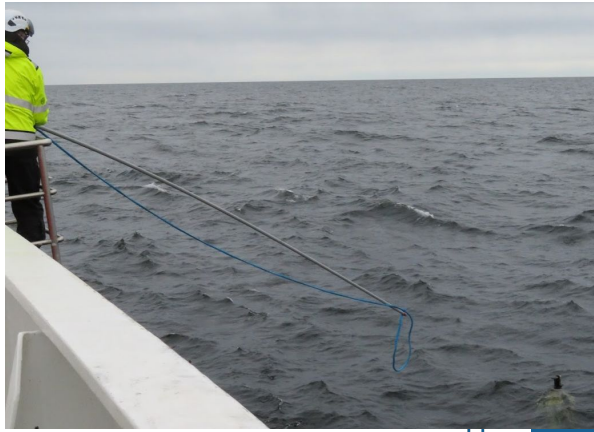
• Review D 5.1 for the previous experiences and parametrisations: temperature, trigger depths

• Ensure that the battery/memory lasts through the under-ice period.

• Overcautious ISA algorithm can cause unneeded loss of location info and upper layer data. Operators may keep ISA manually off as long as the region is free of sea ice based on satellite data.

Float requirements to consider:

• Internal memory
• Enough battery to last through expected ice season
• Buoyancy engine capable to overcome the typical haloclines present in the region
• Software-based ice detection methods, including ISA.
• Two-way Iridium communication



Further details in D 5.1, tools: https://github.com/euroargodev

DMQC in the Arctic and the Baltic -Recommendations

Arctic

- Use OWC* as in Nordic Seas, but longer time scales
- Carefully inspect OWC proposed fits for unreliable data due to gaps in reference data distribution
- Compare float with buddy dataset to check for internal consistency
- Make efforts to engage with the Arctic observational community to expand the CTD reference database with new data
- Perform a thorough detailed quality control of the profiles in the reference database with assistance of the experts in Arctic oceanography.
- Perform a CTD cast at deployment whenever possible to assist the DMQC
- Continue to test the interpolation methods for the estimation of under-ice positions.

Baltic Sea

- Disable the digit rollover and stuck values tests for the Baltic.
- Continue to use a threshold of 0.03 kg/m3 for density inversions in the Baltic and apply thermal lag corrections in delayed-mode.
- Add a regional real time test for Baltic to catch excessively high surface salinities. The proposed test would look at salinities at depth of 10-25 m and assign a QC of 3 to the entire profiles if these are larger than a regionally varying threshold.
- Communicate and discuss the proposed new set of rules at the next ADMT. If these are endorsed, then communicate with the GDAC/DAC about the reprocessing of all Baltic floats, for implementation.
- Explore if the implementation of the min/max near real-time quality control is appropriate for the Baltic.

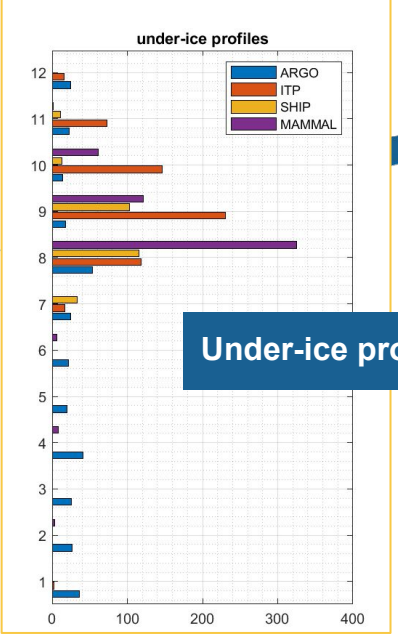
* description of OWC: https://www.sciencedirect.com/science/article/pii/S0967063708002021
implementation: https://github.com/ArgoDMQC/matlab_owc

For further info see Deliverable 2.7:
A report on the adaptation of existing DMQC methods to marginal seas
https://www.euro-argo.eu/EU-Projects/Euro-Argo-RISE-2019-2022/Deliverables

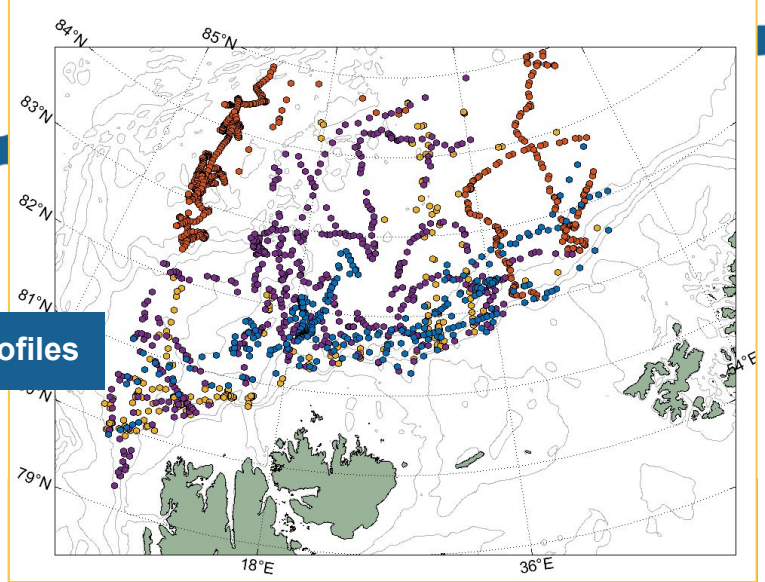
Nansen Basin (Arctic)

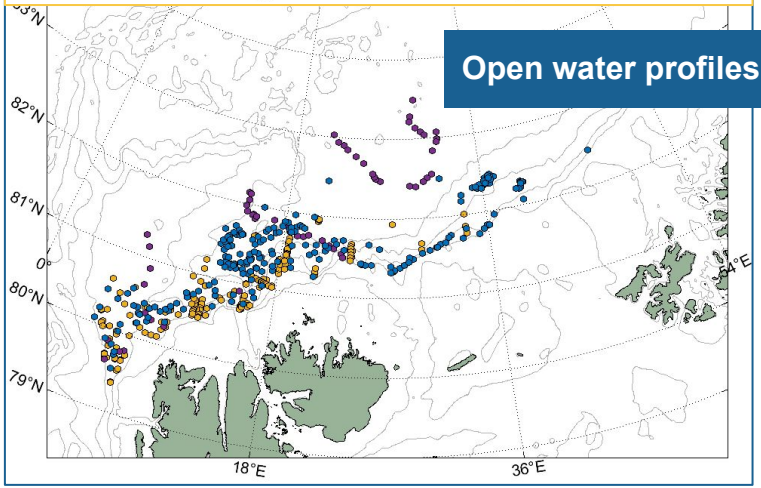
Datasets:

- Ship and ITP CTD data from the ICES and UDASH databases (2006 to 2019).
- Marine mammals data from the MEOP database (2008 to 2012)
- Argo data (2016 to 2022) - 568 profiles. 19 floats

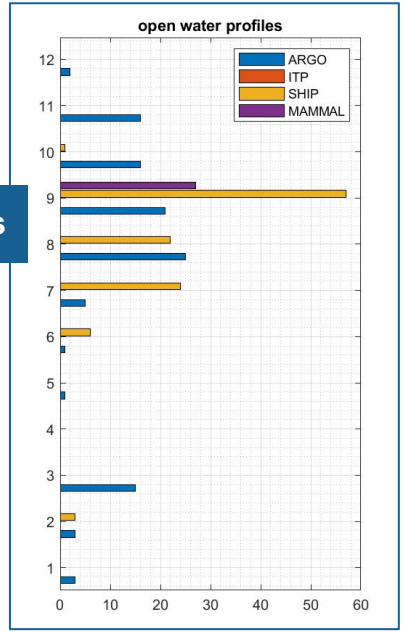


Under-ice profiles





Open water profiles



Float status	N
Active	3
first under ice season	4
second under ice season	2
no data this summer	5
lost under ice	5

Most observations (also under ice) are between July and December

Argo samples throughout the year. Mostly close to the boundary current

Conclusions

- Recent efforts to sample the Arctic and the Baltic have we have improved coverage. In the Arctic, Argo provides coverage from January to June, when almost no other measurements available.
- The lessons learned for floats operating under ice in different regions are in D5.1
- The recommendations for doing DMQC on these regions are in D2.7
- We will continue to analyze data to improve the performance of the fleet.

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