Argo floats in Barents Sea

Missions and challenges

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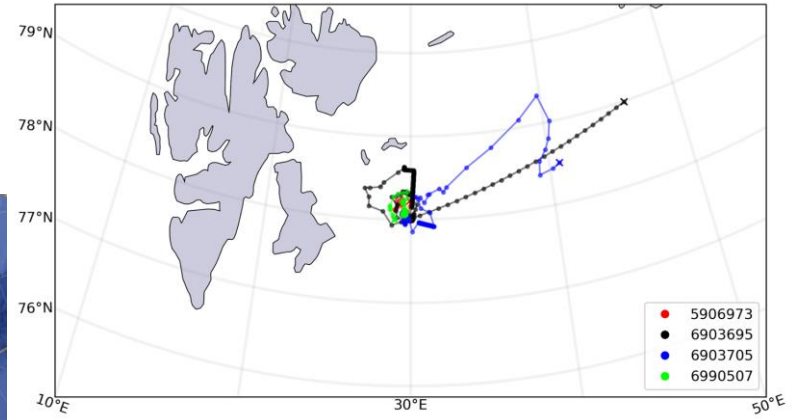
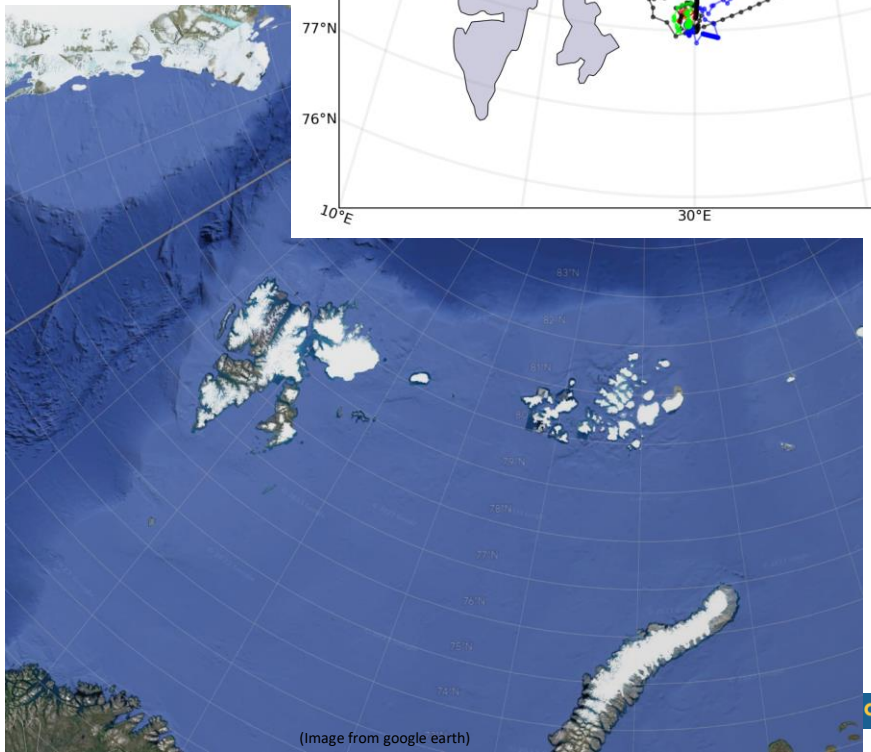
Marginal Seas Argo DMQC workshop, Sopot, Poland 18.04.2023-19.04.2023

FMI Missions In Barents Sea

FMI missions

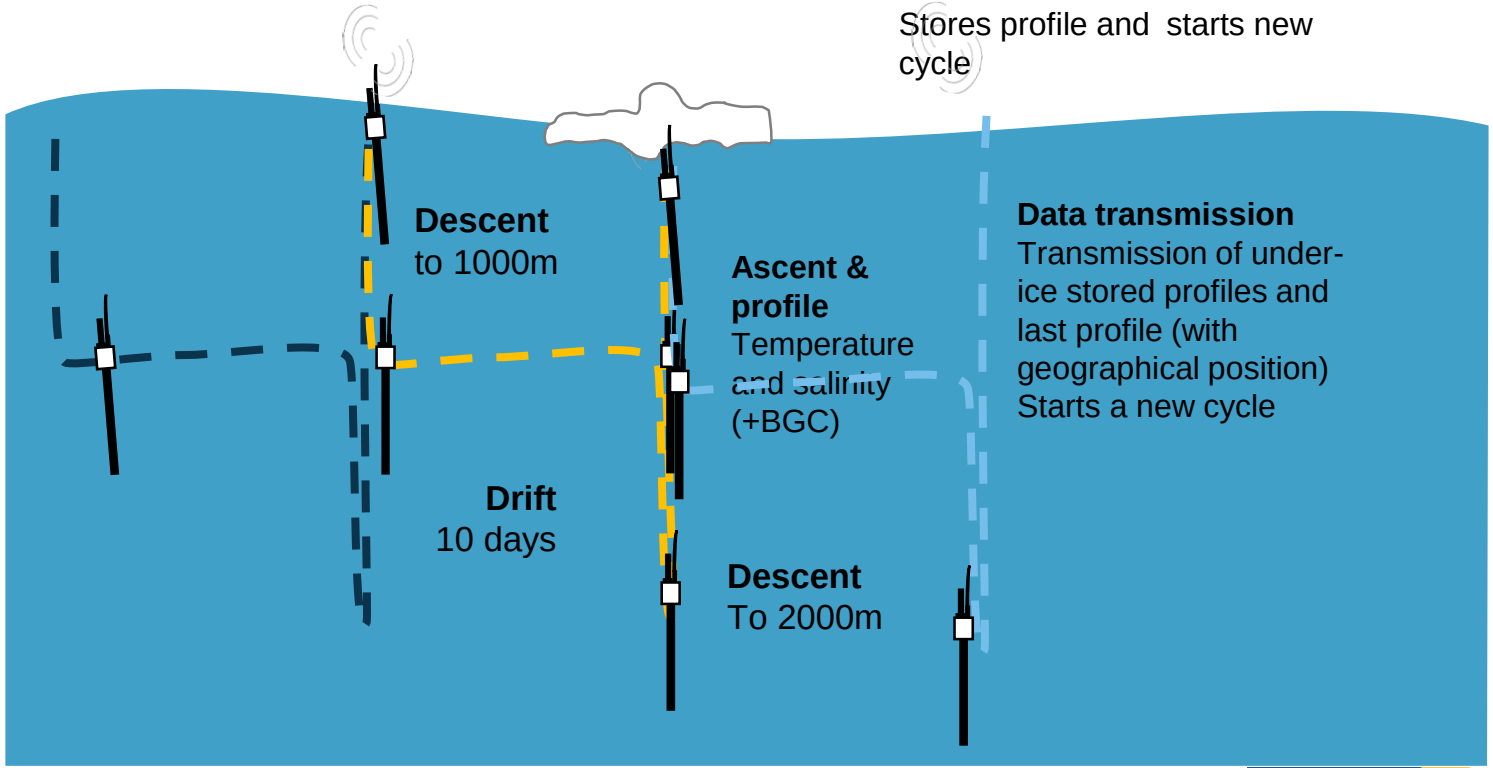
- 4 floats so far
  - 2018,2020, 2x2022
- CTD sensors
- **I**ce **S**ensing **A**lgorithm (ISA)
- 200 m depth
- Have spent months under ice



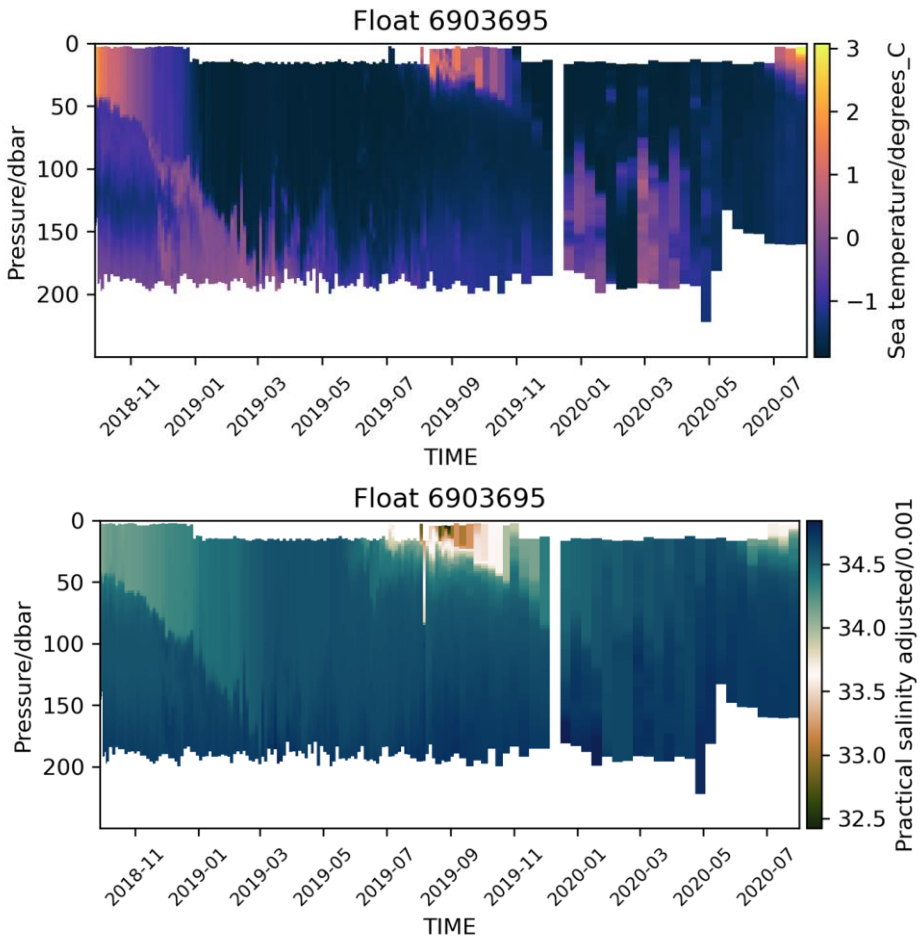


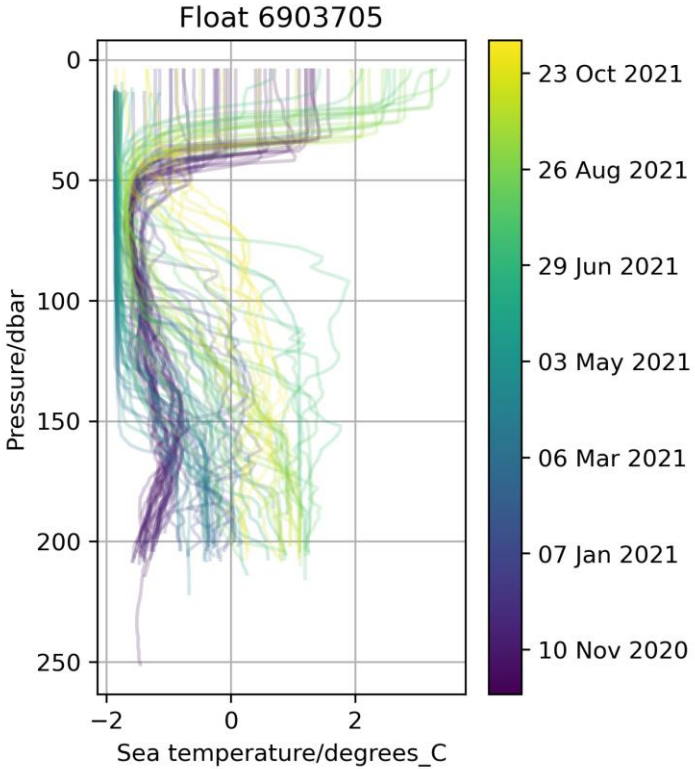
Ice Sensing Algorithms

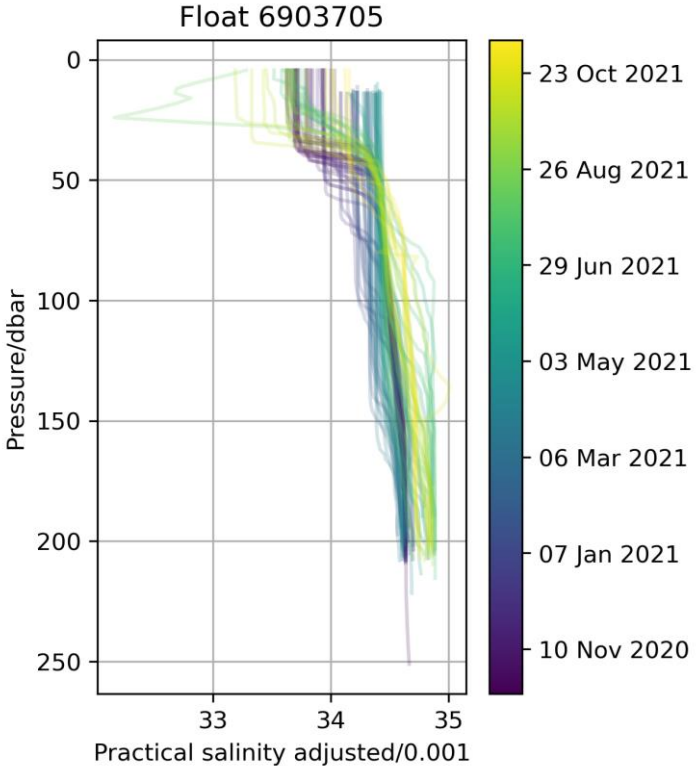
Encounters sea ice
No geographical position
No data transmission
Stores profile and starts new cycle



Sample dataset




Float 6903705
Pressure/dbar
Sea temperature/degrees_C
23 Oct 2021
26 Aug 2021
29 Jun 2021
03 May 2021
06 Mar 2021
07 Jan 2021
10 Nov 2020


Float 6903705
Pressure/dbar
Practical salinity adjusted/0.001
23 Oct 2021
26 Aug 2021
29 Jun 2021
03 May 2021
06 Mar 2021
07 Jan 2021
10 Nov 2020

Challenges in geolocation

- No GPS under ice
- Float can travel long distances, so exact location is unknown

- Some ideas for remedying this reviewed in EA-Rise project
  - Linear interpolation in potential vorticity (PV) coordinates: Interpolation in PV space using along-PV and across-PV axes. *Chamberlain et al. (2018)*

  - Bathymetry constrained interpolation using profiles depth from floats groundings: Bathymetry measured by the float is used to constrain the possible under-ice positions. *Wallace et al.(2020)*

  - Bathymetry following interpolation: Interpolation of missing positions following bathymetry contours, with an option to include float grounding depth information *Yamazaki et al. (2020)*

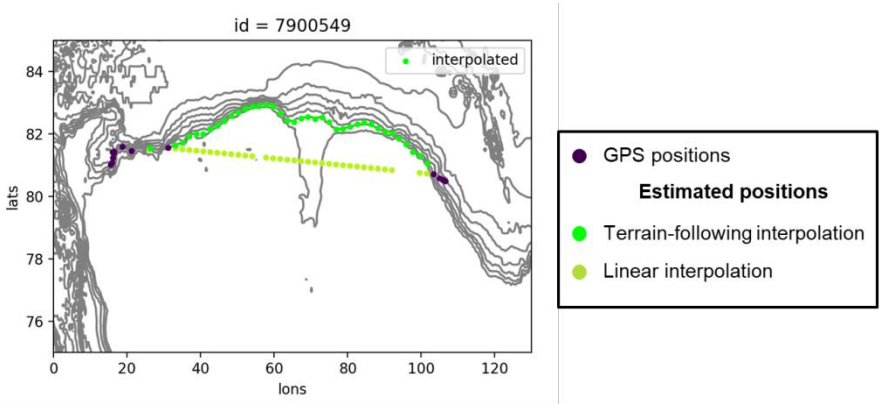


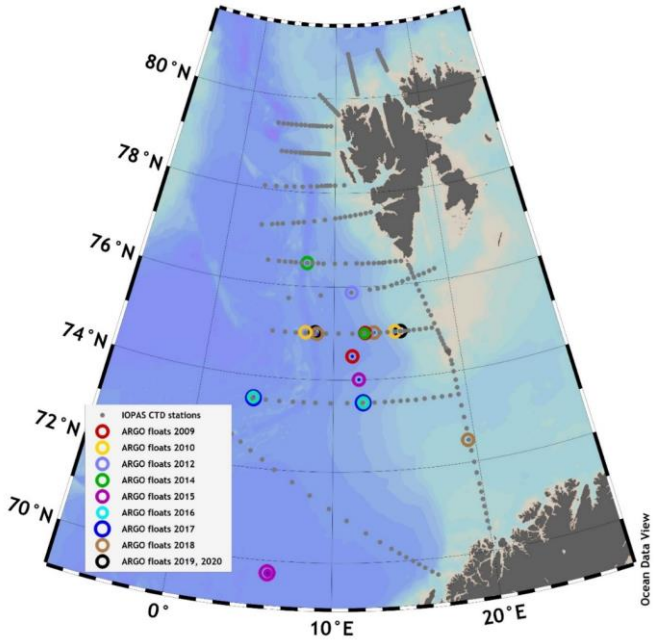
Image from Euro-Argo RISE project Deliverable 5.1, Figure 17.
https://www.euro-argo.eu/content/download/159327/file/D5_1_V1.0.pdf

Chamberlain, P. M., Talley, L. D., Mazloff, M. R., Riser, S. C., Speer, K., Gray, A. R., and Schwartzman, A. (2018). Observing the ice-covered weddell gyre with profiling floats: Position uncertainties and correlation statistics. Journal of Geophysical Research: Oceans, 123(11):8383–8410.

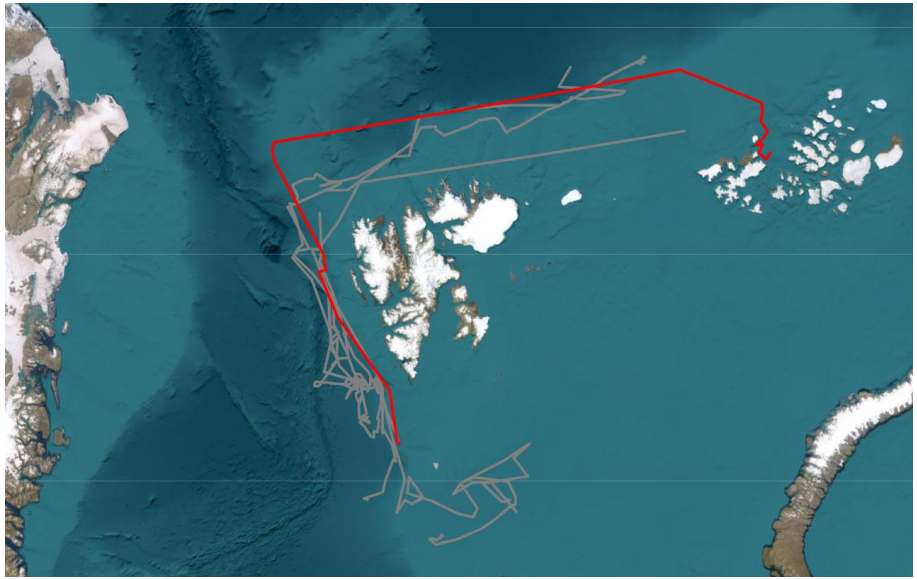
Wallace, L. O., van Wijk, E. M., Rintoul, S. R., and Hally, B. (2020). Bathymetry-constrained navigation of argo floats under sea ice on the antarctic continental shelf. Geophysical Research Letters, 47(11):e2020GL087019. e2020GL087019 2020GL087019.

Yamazaki, K., Aoki, S., Shimada, K., Kobayashi, T., and Kitade, Y. (2020). Structure of the subpolar gyre in the australian-antarctic basin derived from argo floats. Journal of Geophysical Research: Oceans, 125(8):e2019JC015406. e2019JC015406 2019JC015406.

IOPAN has been deploying Argo floats in the Arctic since 2009. Every year we launch 2-3 floats in this area, one of the floats is deployed in the core of the West Spitsbergen Current, the other in the western branch of the WSC. We assume that the float deployed on the eastern side will drift towards the Fram Strait and further with the current of the Svalbard Branch, along the border of the shelf to the east.



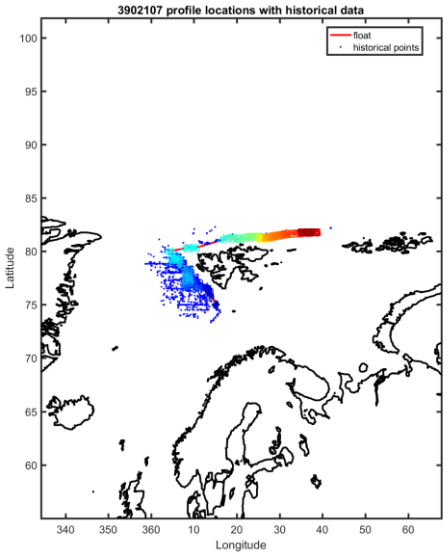
Deployment sites of the Arctic floats and standard grid of CTD stations repeated annually by IOPAN.



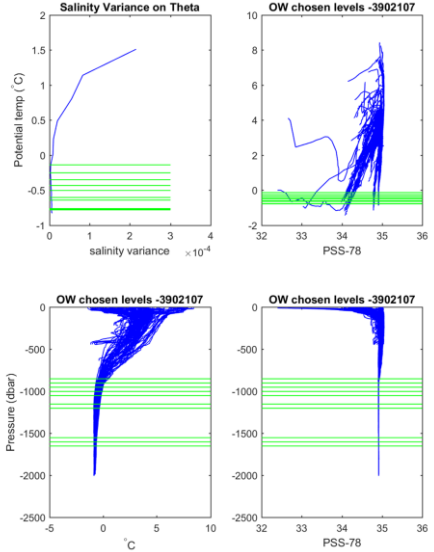
Trajectories of floats deployed by IOPAN in the core of the West Spitsbergen Current.

In some cases, we can use the standard OWC package to perform the DMQC on data from the Arctic floats. If some of the data is from the deep region and the data looks good, we can assume that the rest of the data from the shallow region is also good.

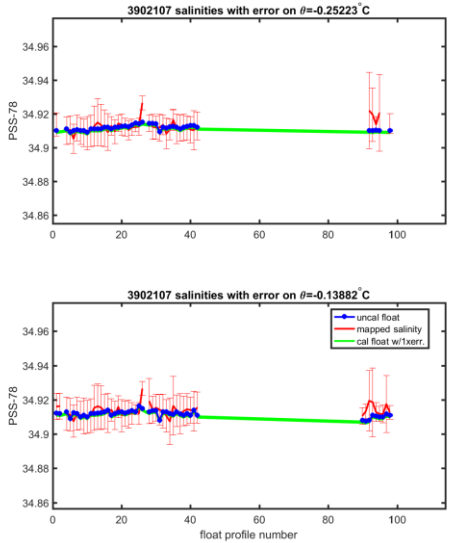
Figures from the OWC package used for calibrating profiling float conductivity sensor drift.



Location of the float profiles and the reference data selected for mapping (blue dots) (Figure 1 from OWC).



The ten most stable float θ levels used to compute the fit are displayed in green (Figure 8 from OWC).



Evolution of salinity with time along two selected θ levels with minimum salinity variance (Figure 6 from OWC).

4 NorARGO floats in the Barents Sea: Trajectories from BSO to St. Anna Trough

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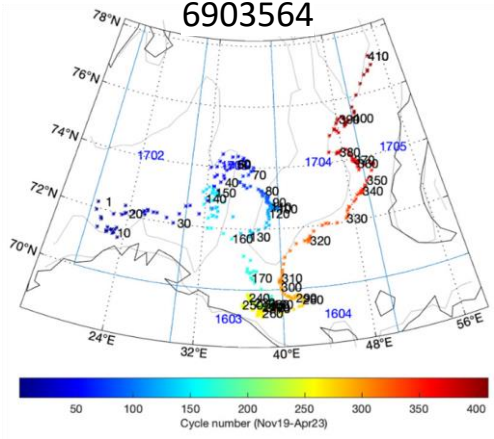

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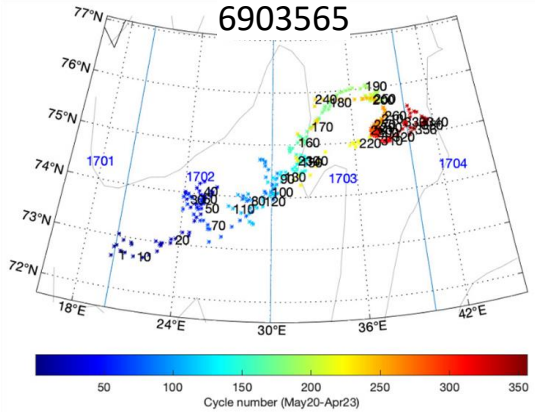

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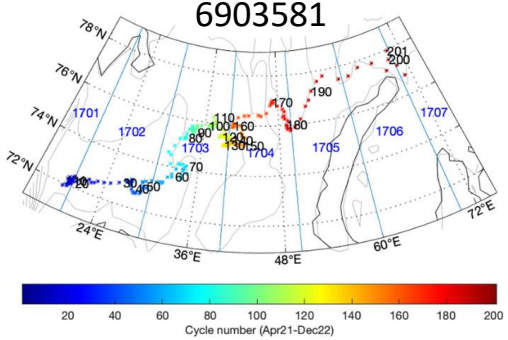

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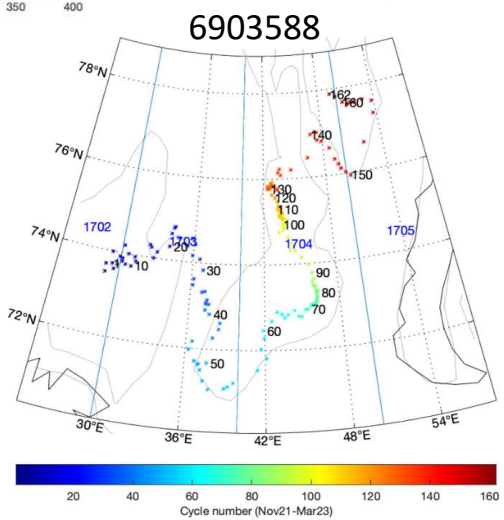
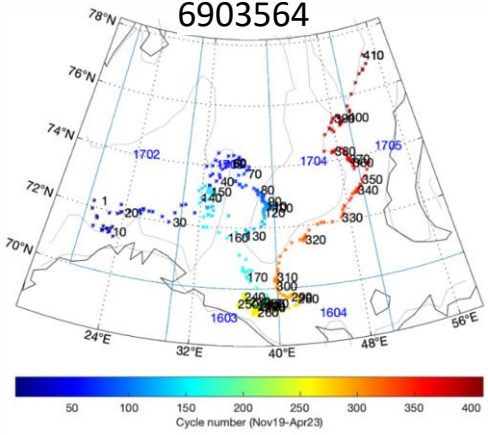
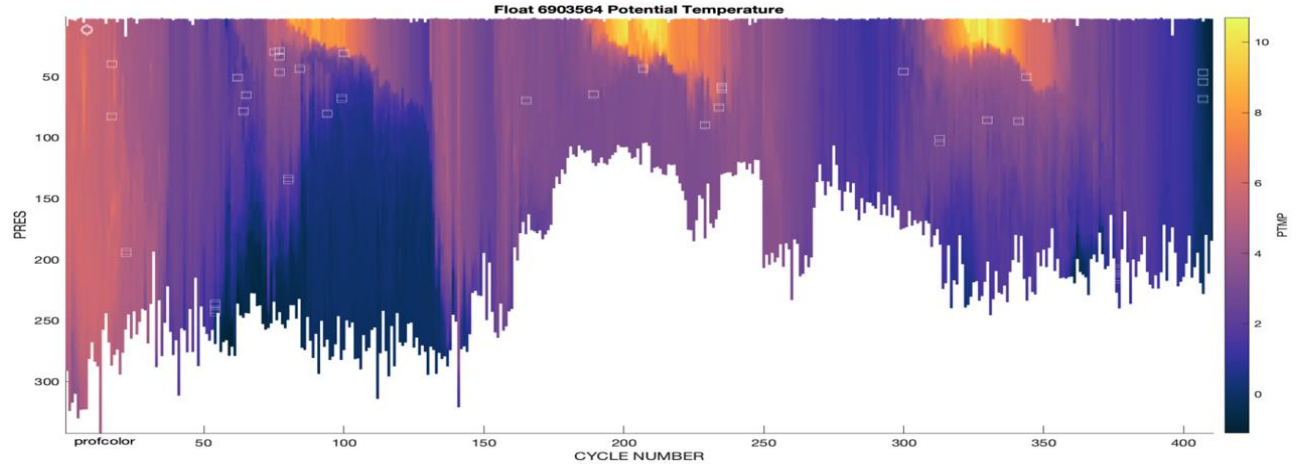
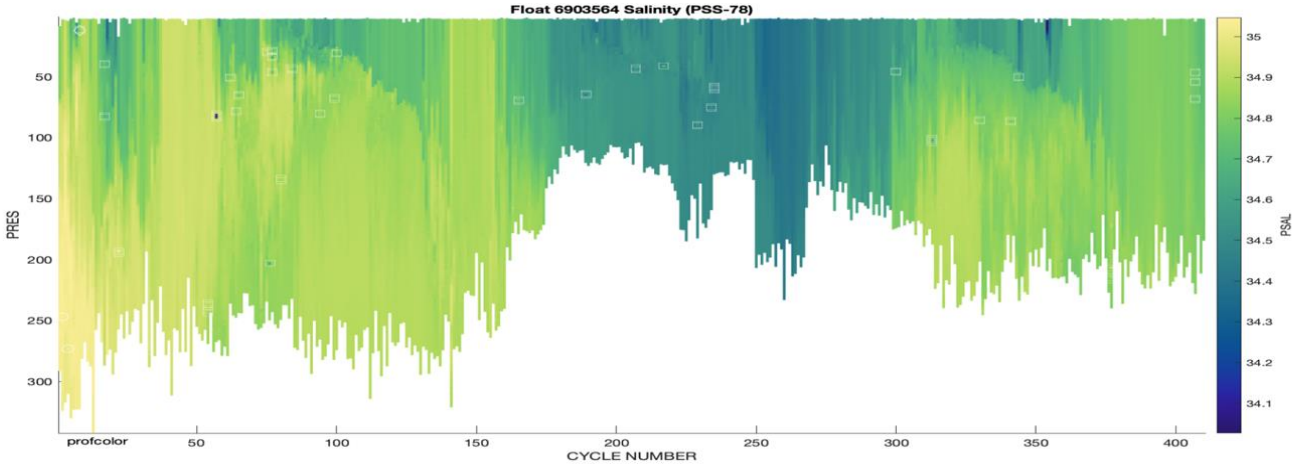
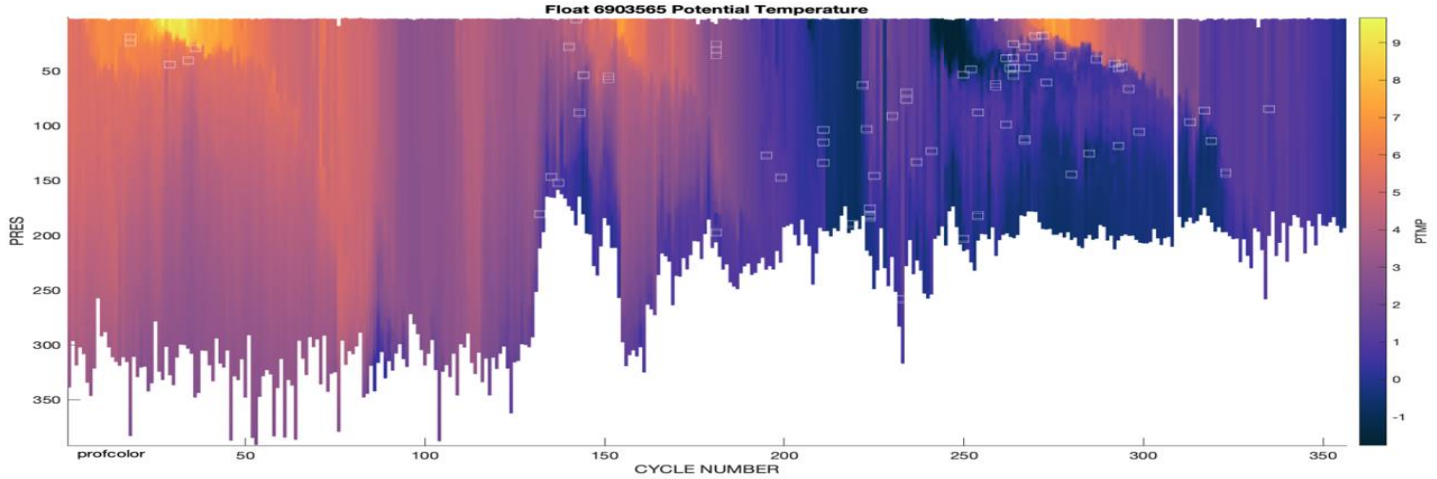


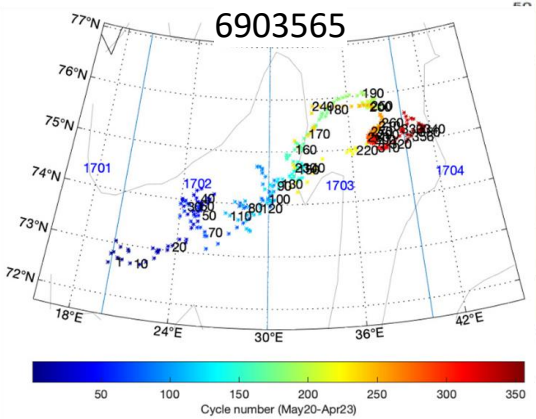
2019.11–now ; 410 cycles à 3 days
2020.05–now ; 356 cycles à 3 days
2021.04–2022.12; 201 cycles à 3 days
2021.11–2023.03; 162 cycles à 3 days

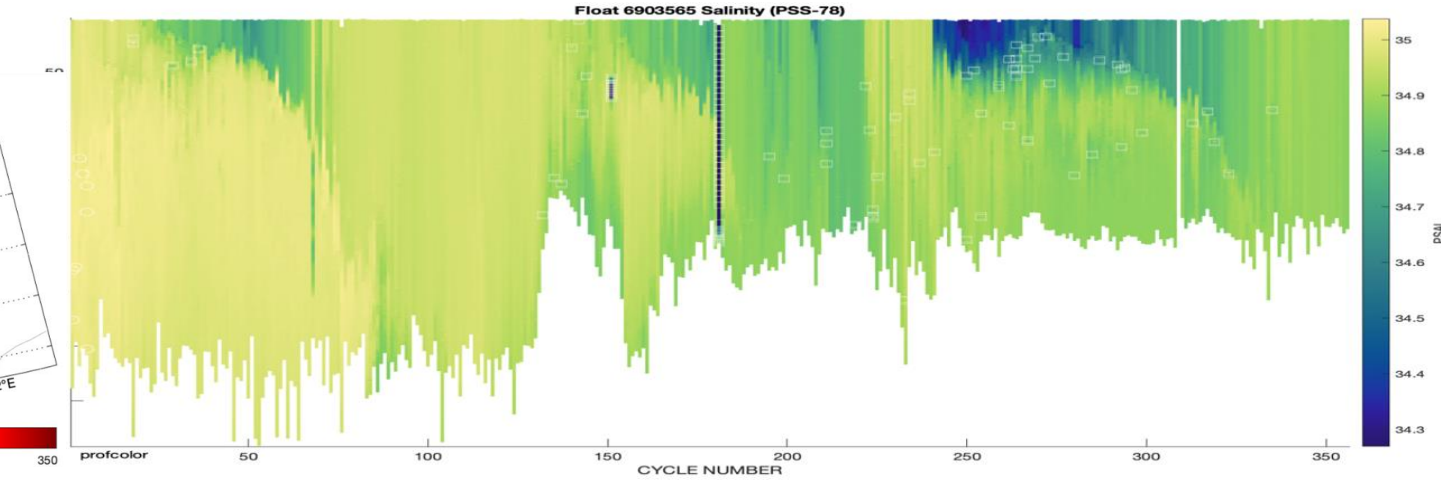

6903564
78°N
76°N
74°N
72°N
70°N
24°E
32°E
40°E
48°E
56°E
1702
1704
1705
1603
1604
50
100
150
200
250
300
350
400
Cycle number (Nov19-Apr23)

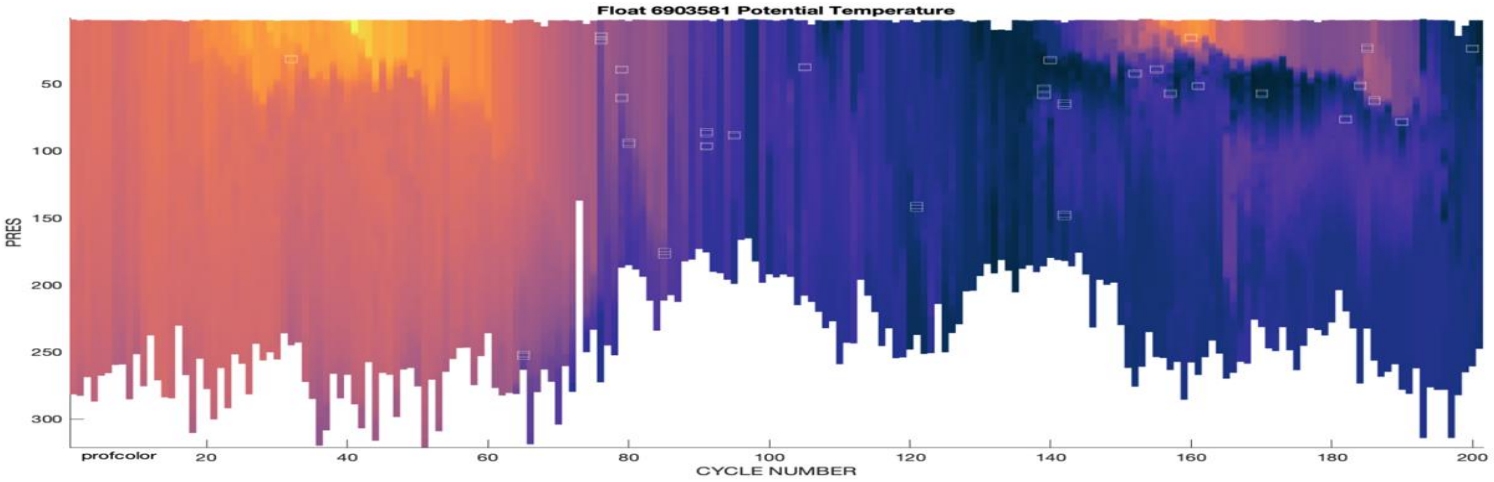

Float 6903564 Potential Temperature
PRES
CYCLE NUMBER
profcolor
PTMP


Float 6903564 Salinity (PSS-78)
PRES
CYCLE NUMBER
profcolor
PSAL

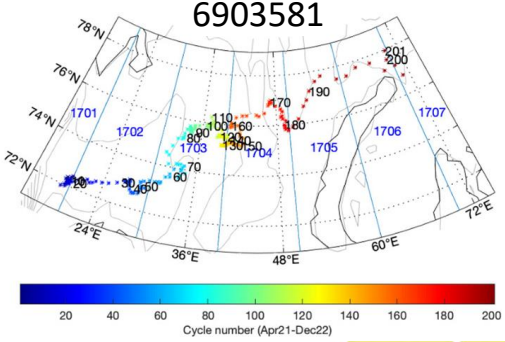

Float 6903565 Potential Temperature
PRES
PTMP
profcolor
CYCLE NUMBER

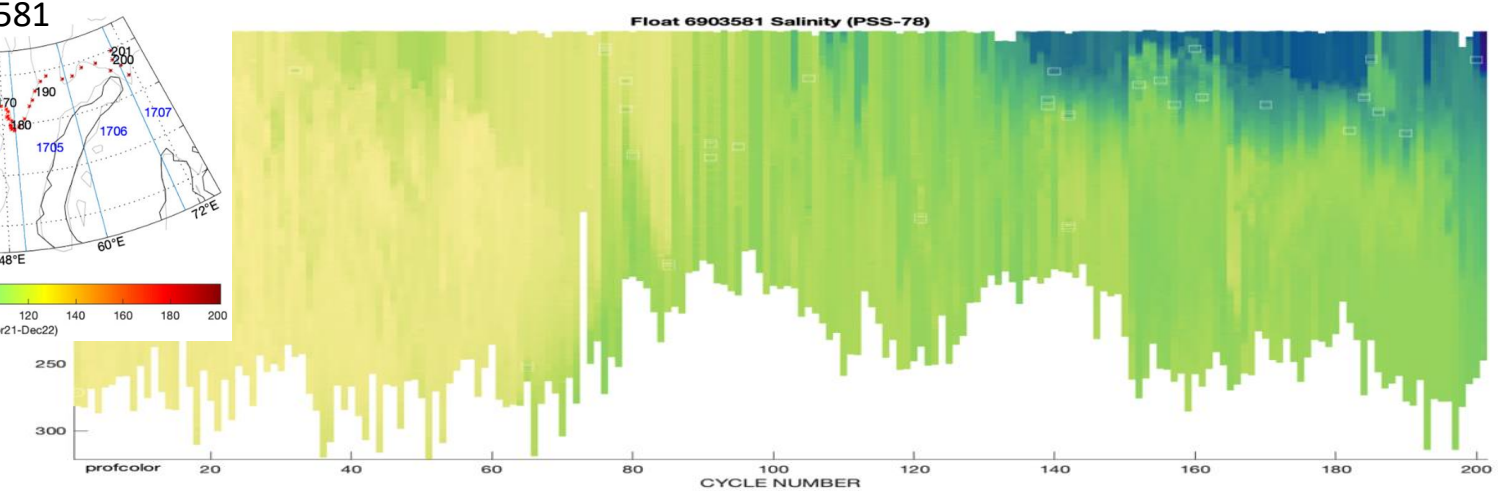

6903565
77°N
76°N
75°N
74°N
73°N
72°N
18°E
24°E
30°E
36°E
42°E
1701
1702
1703
1704
Cycle number (May20-Apr23)


Float 6903565 Salinity (PSS-78)
PSAL
profcolor
CYCLE NUMBER


Float 6903581 Potential Temperature
PRES
CYCLE NUMBER
PTMP
profcolor

6903581


78°N
76°N
74°N
72°N
24°E
36°E
48°E
60°E
72°E
1701
1702
1703
1704
1705
1706
1707
Cycle number (Apr21-Dec22)


Float 6903581 Salinity (PSS-78)
PRES
CYCLE NUMBER
PSAL
profcolor

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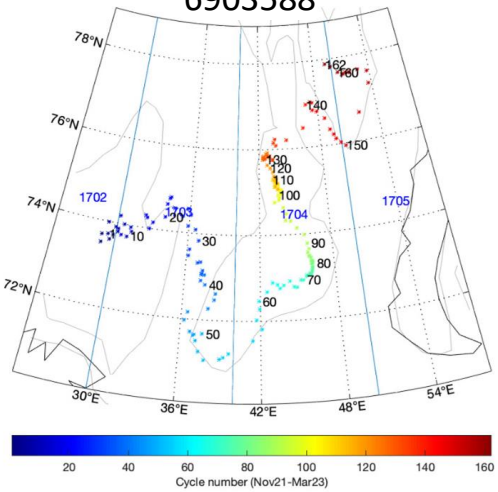
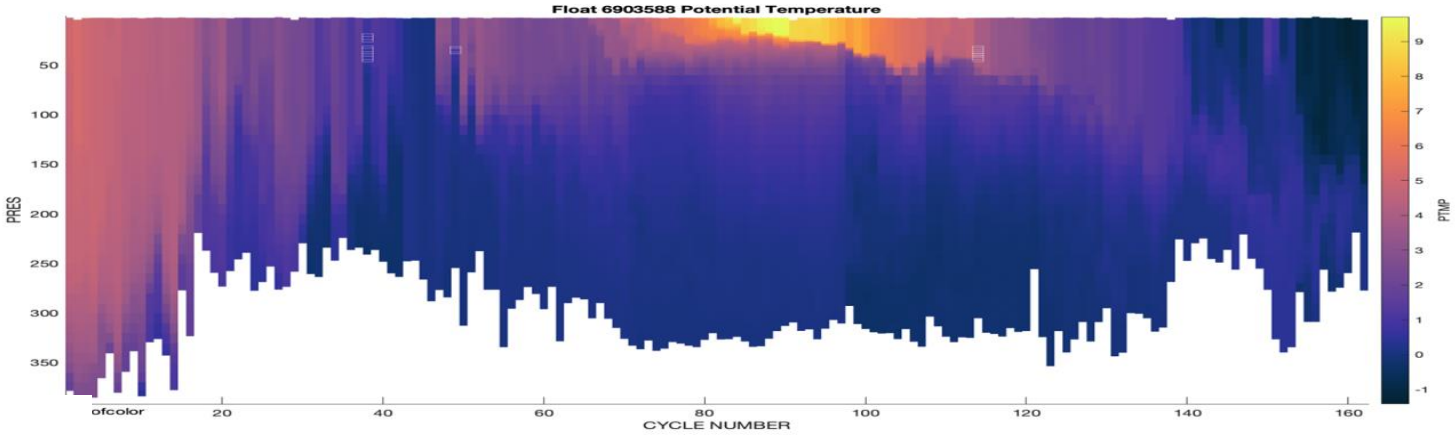
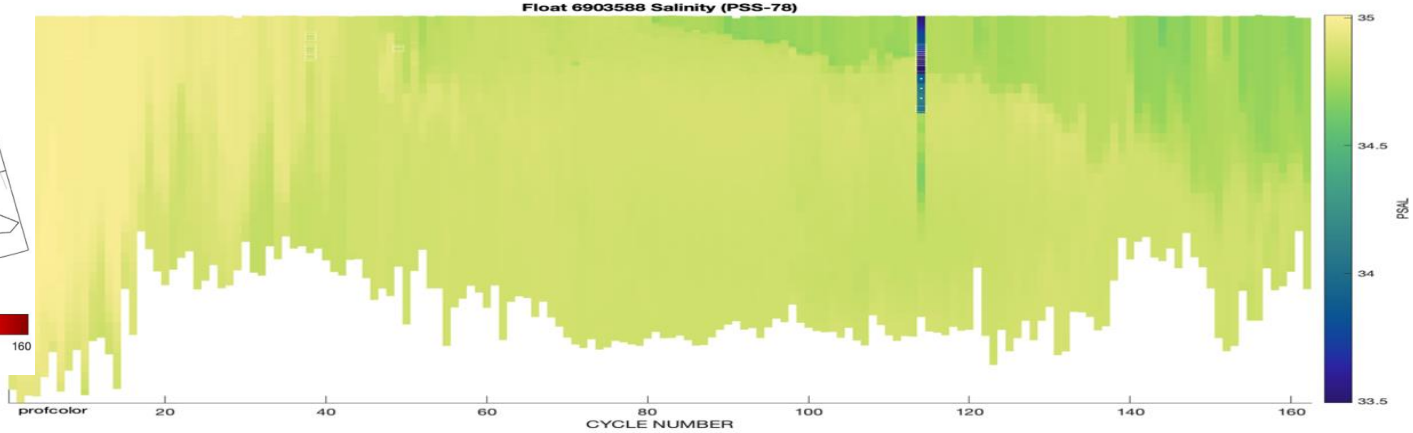
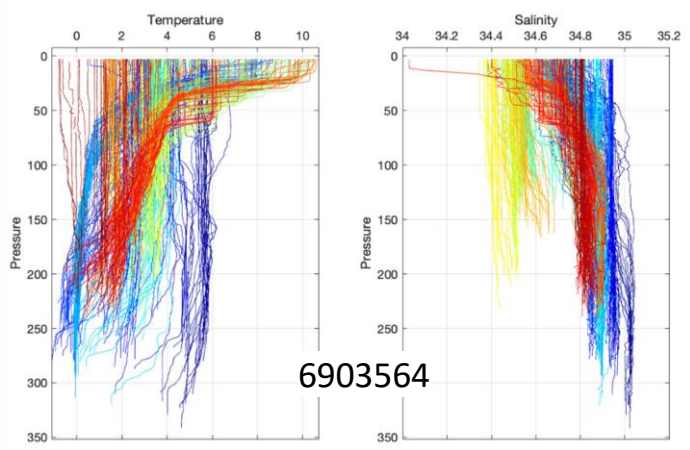

78°N
76°N
74°N
72°N
30°E
36°E
42°E
48°E
54°E
1702
1703
1704
1705
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
162
180
20
40
60
80
100
120
140
160
Cycle number (Nov21-Mar23)


Float 6903588 Potential Temperature
PRES
50
100
150
200
250
300
350
ofcolor
20
40
60
80
100
120
140
160
CYCLE NUMBER
PTMP
9
8
7
6
5
4
3
2
1
0
-1


Float 6903588 Salinity (PSS-78)
profcolor
20
40
60
80
100
120
140
160
CYCLE NUMBER
PSAL
35
34.5
34
33.5

Large changes across the Barents Sea



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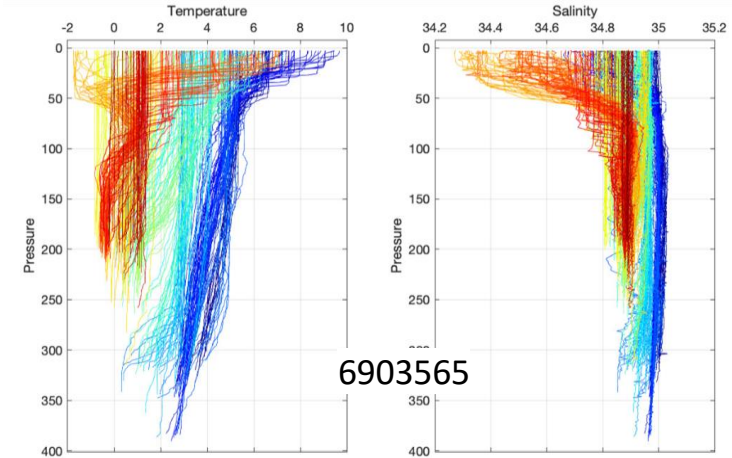

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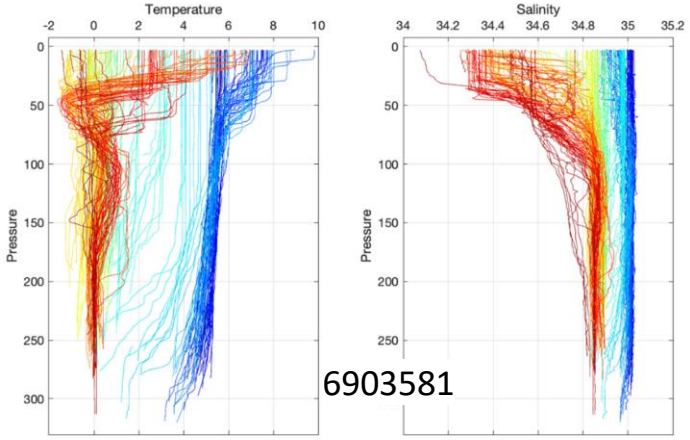

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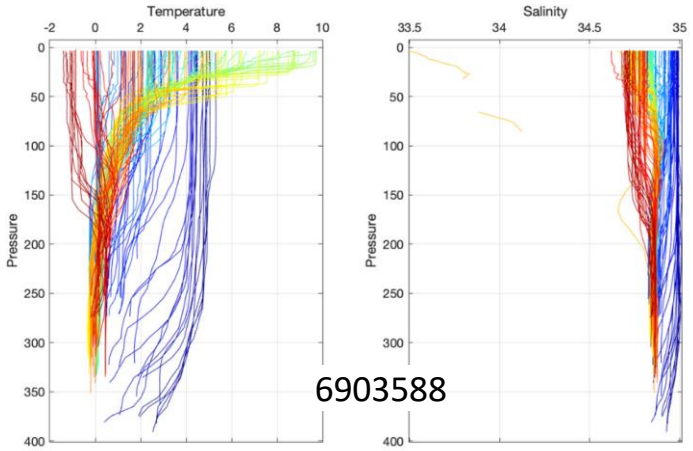

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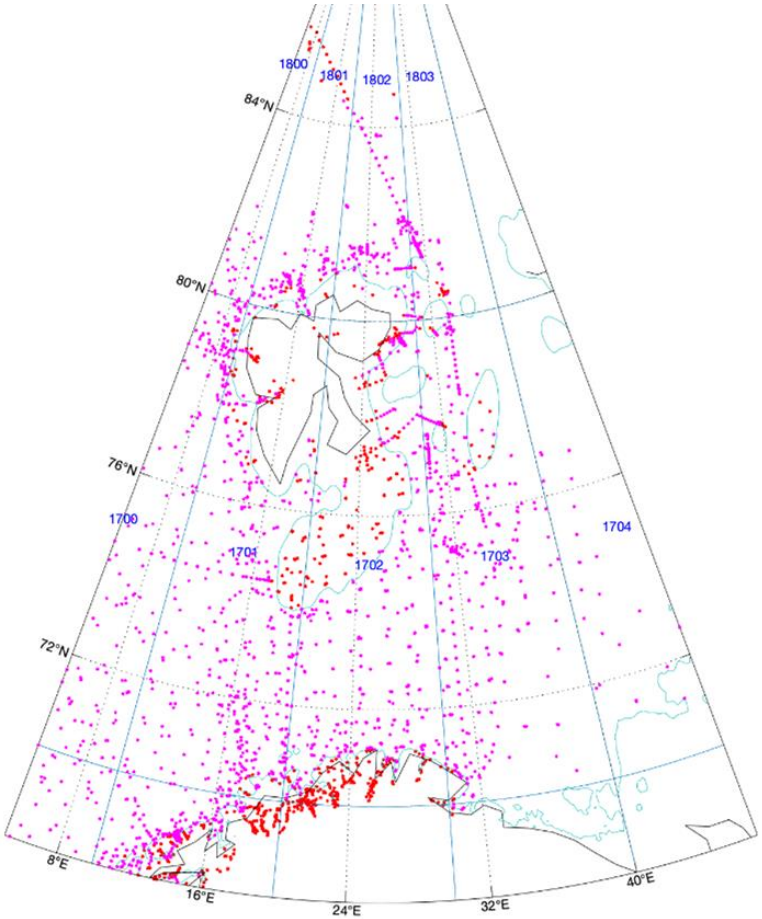
No Argo RDB in Barents Sea ; New reference data added from IMR

- IMR data from 2019-2022
- Shallow waters excluded
- Ingested into (my copy of) Argo RDB
- But only first half of trajectories covered in any way (<40E)



Overall comparison reference data and float profiles

Large variability within regions

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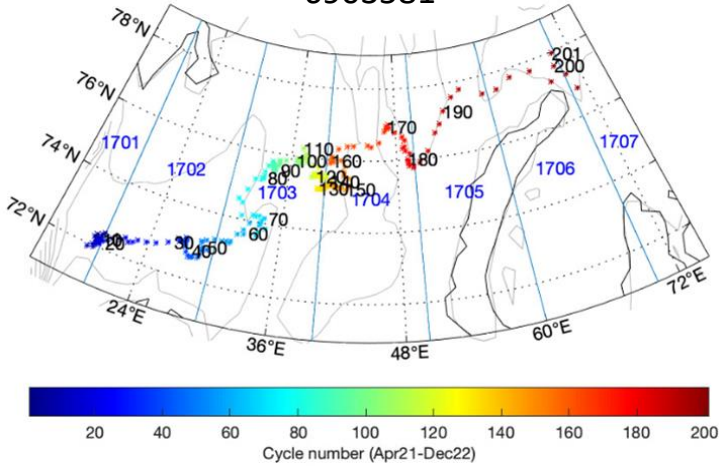
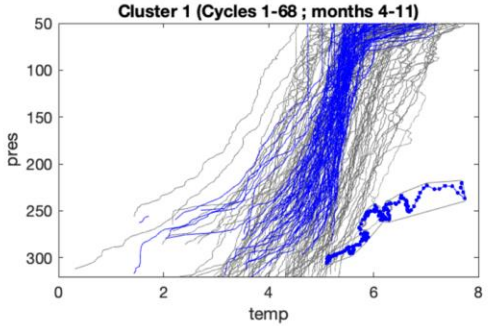
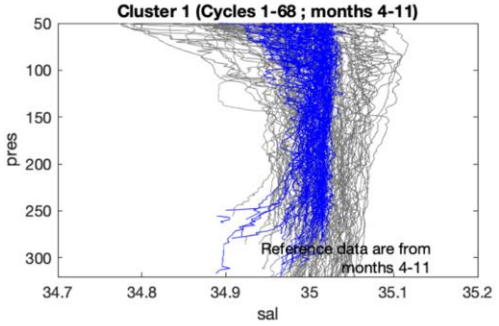
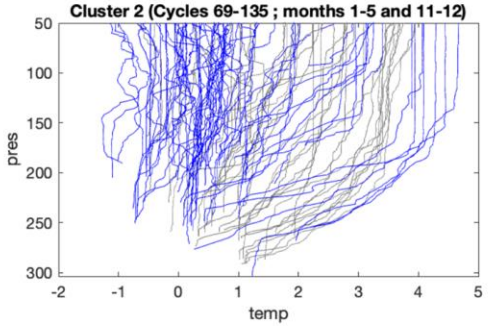
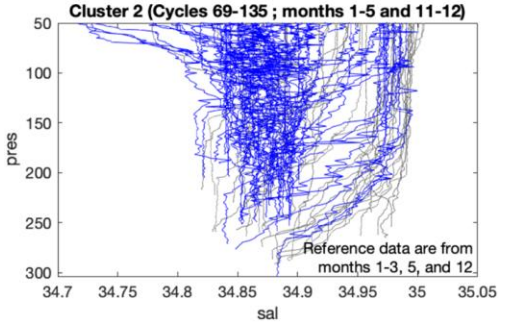
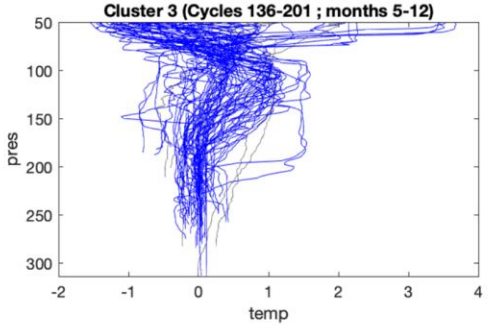


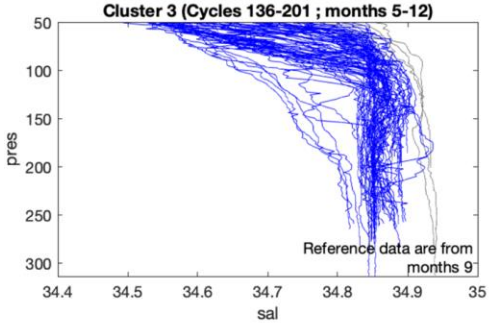






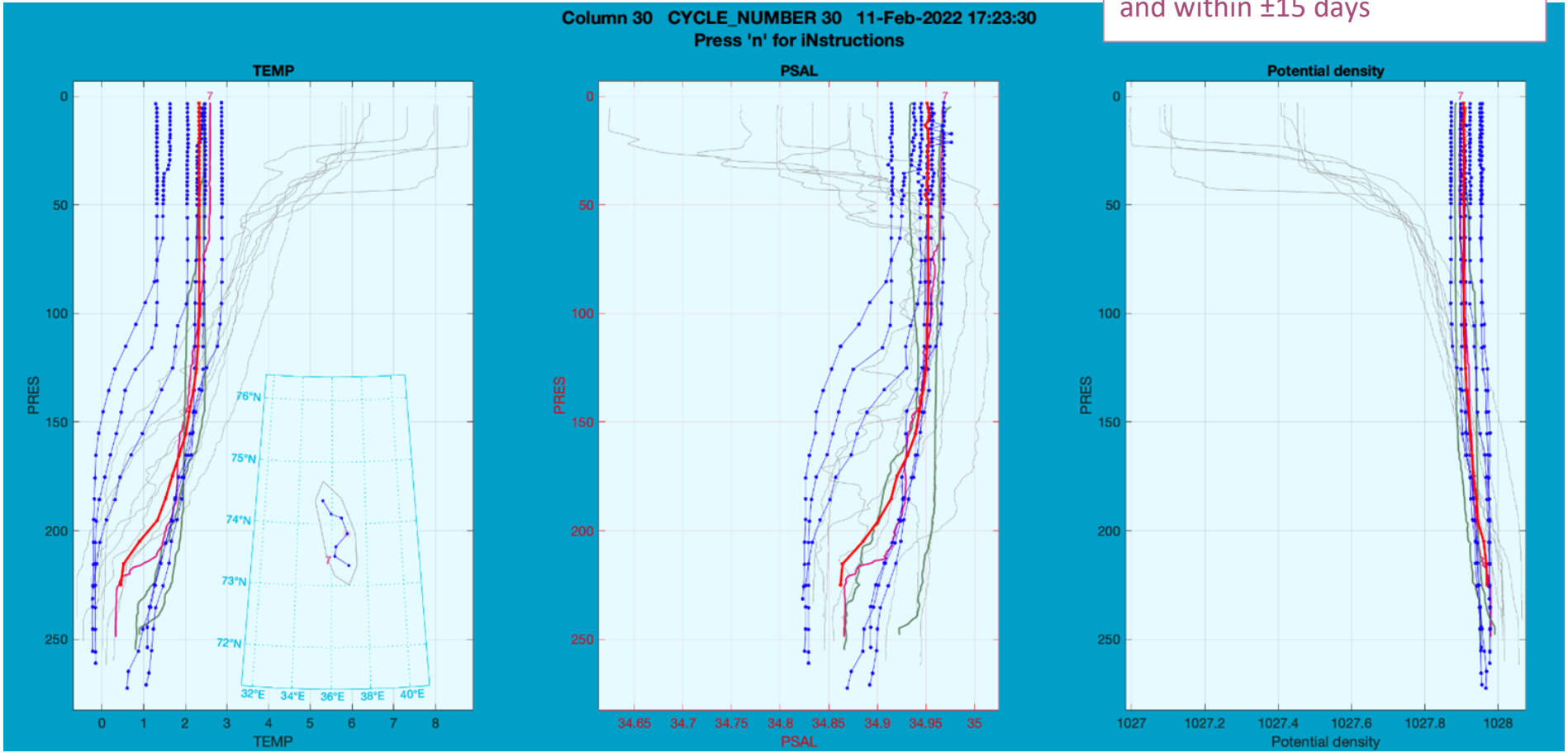






Need coinciding profiles

For float 6903588 this is 1 of only 2 cases with refdata close and within ±15 days



Thanks!

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contact@euro-argo.eu

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