

# 4th Euro-Argo Science Meeting and Workshop

## Consistency checks of Delayed Mode analysis in the North Atlantic

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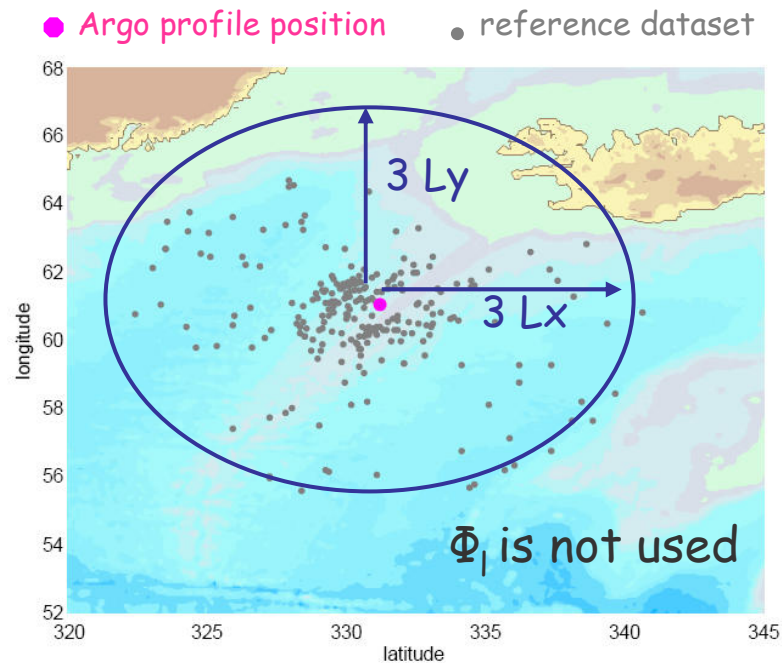
## Why consistency checks of delayed mode corrections are necessary?

Good and corrected data are crucial for scientific studies

Delayed mode (DM) PI's and operators agreed on a common method to correct salinity data (OW method, Owens and Wong, 2009)

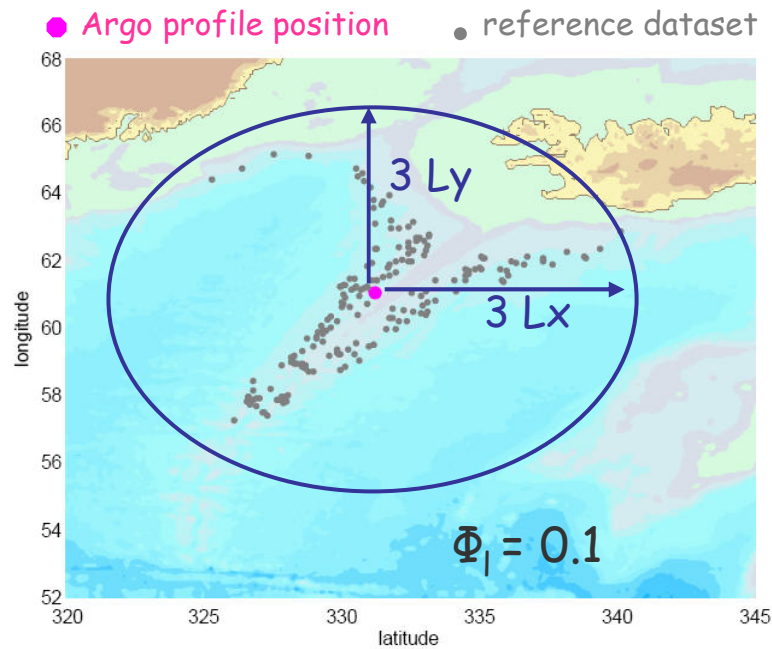
However this method can be difficult to apply and results can depend on the choice of the parameters, the knowledge of the region and the experience of the operator.

# Delayed mode analysis of the salinity: OW method



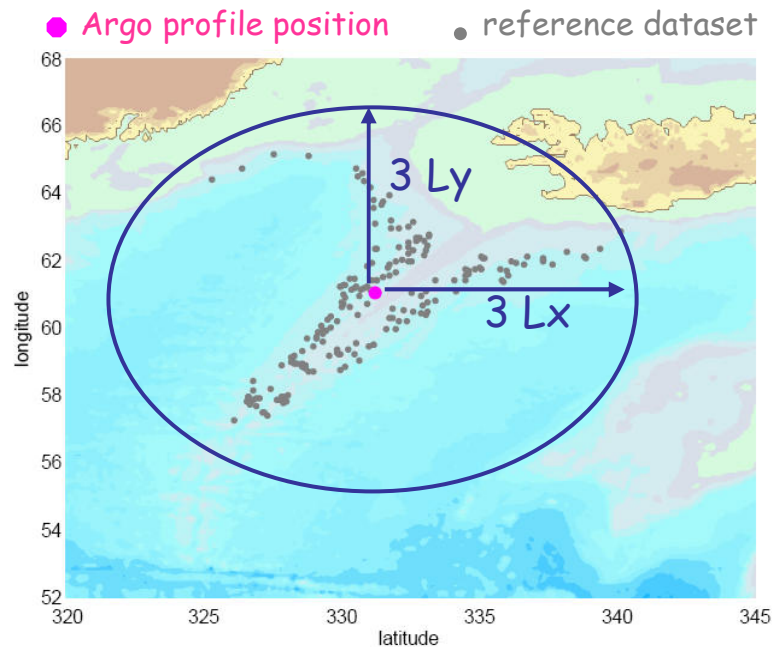
1. Selection of a reference dataset within the spatial **large scales**  $L_x$ ,  $L_y$  and  $\Phi_l$  (cross-isobaths scale)

# Delayed mode analysis of the salinity: OW method



1. Selection of a reference dataset within the spatial **large scales**  $Lx$ ,  $Ly$  and  $\Phi_l$  (cross-isobaths scale)

# Delayed mode analysis of the salinity: OW method



## 2. Two stages objective mapping:

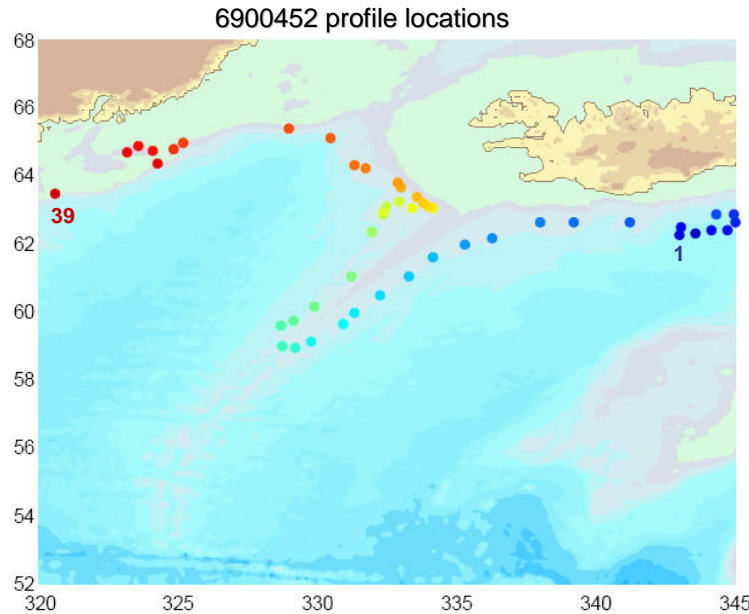
- Estimate the time-independent large scale field (Gaussian decay  $L_x, L_y, \Phi_l$ ) :  $\hat{S}_{large}$

- Compute the residuals (data - large scale field) and estimate the smaller features and time dependence from the residuals :  $\hat{S}_{small}$   
(Gaussian decay  $l_x, l_y, \Phi_s$  and  $\tau$ )

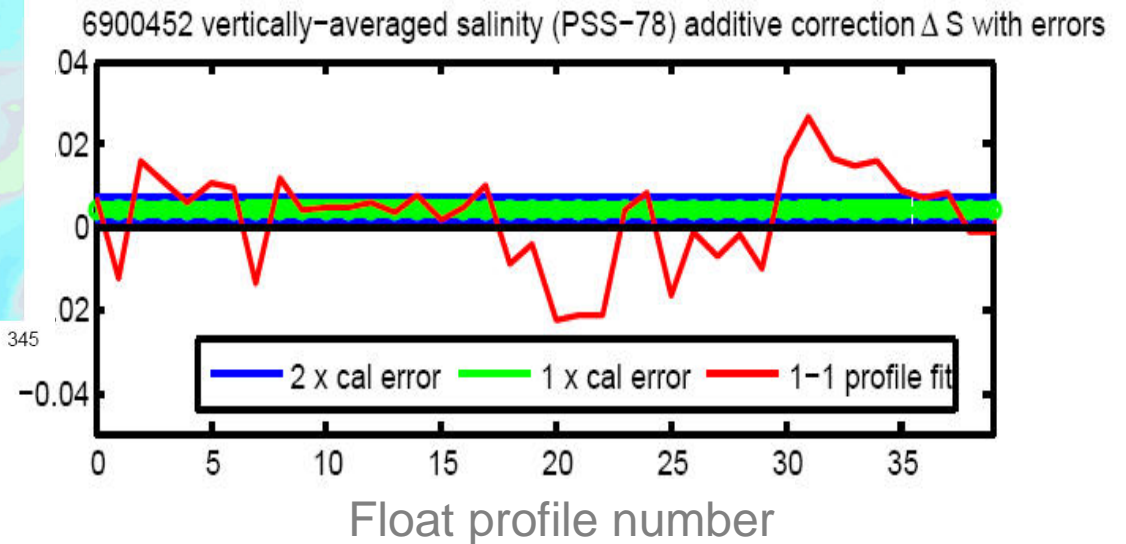
⇒ Mapped salinities ( $\hat{S}_{large} + \hat{S}_{small}$ ) on float  $\theta$  levels

Parameters (spatial and time scales) for the North Atlantic region:  
Böhme and Send 2005

# Delayed mode analysis of the salinity: OW method



## 3. Best fit over the whole float time series



Corrections are computed by comparing mapped salinities to the floats salinity measurements

## Test of the OW method in the subpolar Gyre region:

We have selected 343 floats whose salinity does not need to be corrected in delayed mode according to the PI decision.

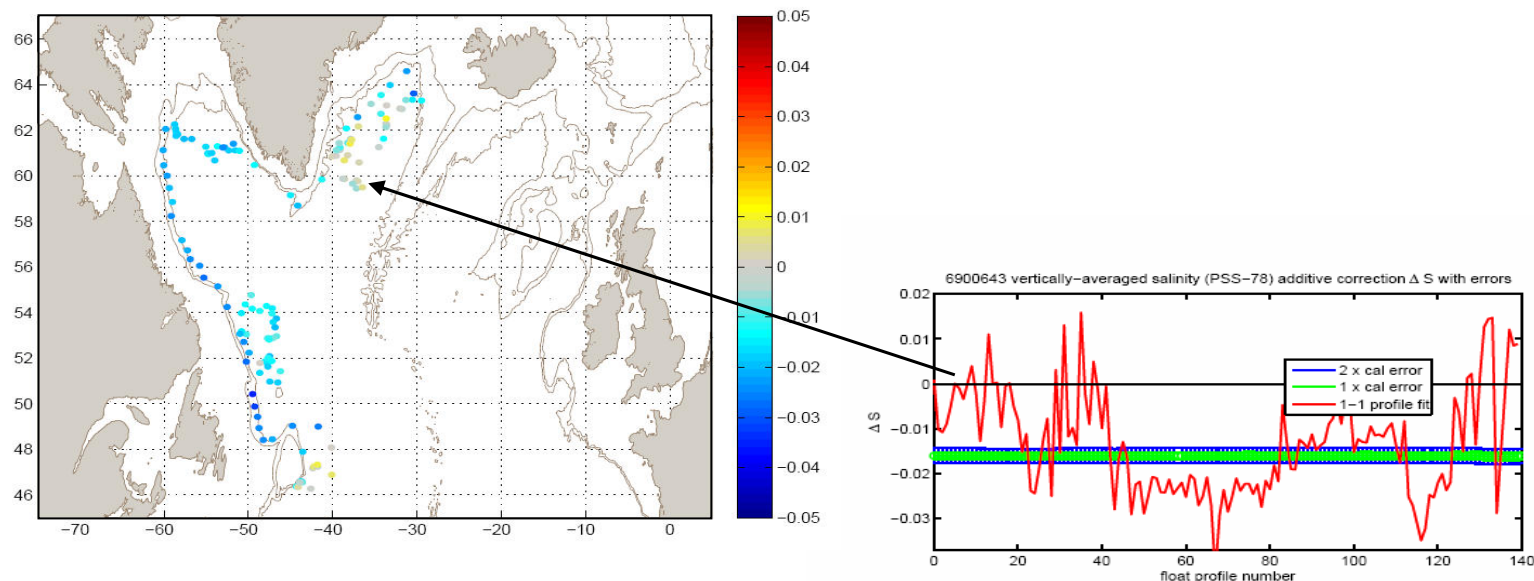
We have run the OW method for these 343 floats  
(configuration parameters for the North Atlantic - Böhme and Send 2005- and historical CTDs as the reference dataset)

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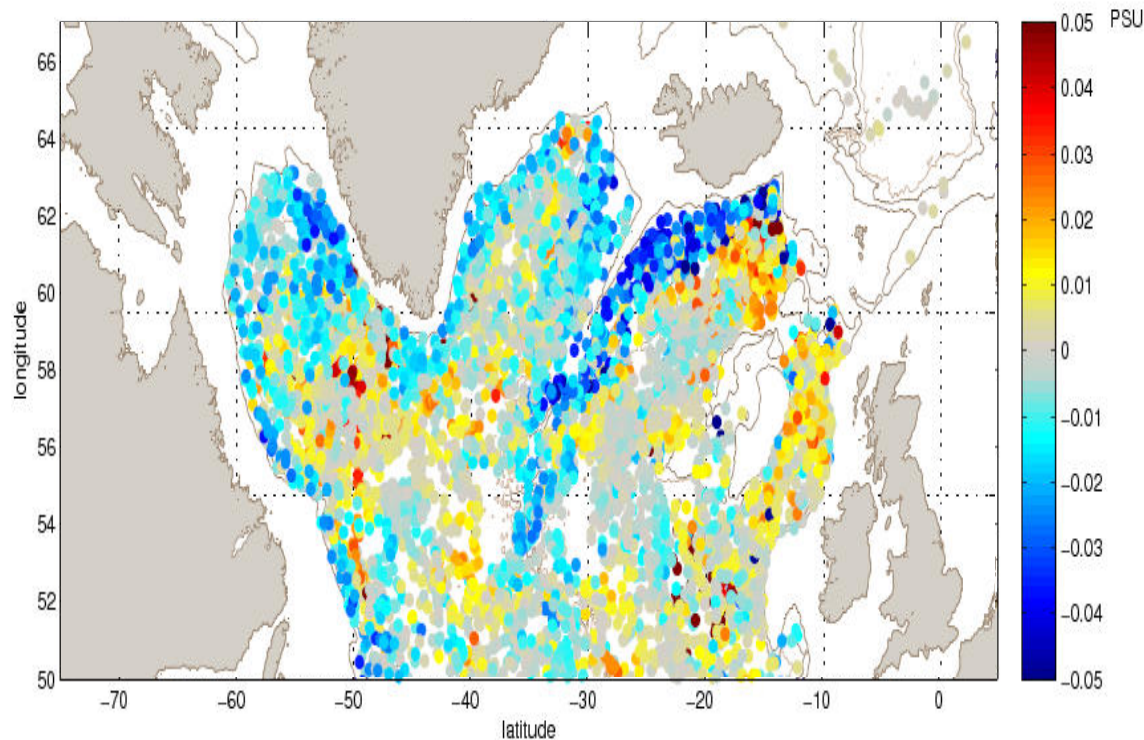
Salinity corrections (PSU)  
for the float 6900643





We have used more than 300 floats that do not need to be corrected in DM to test the OW method in the Subpolar Gyre region

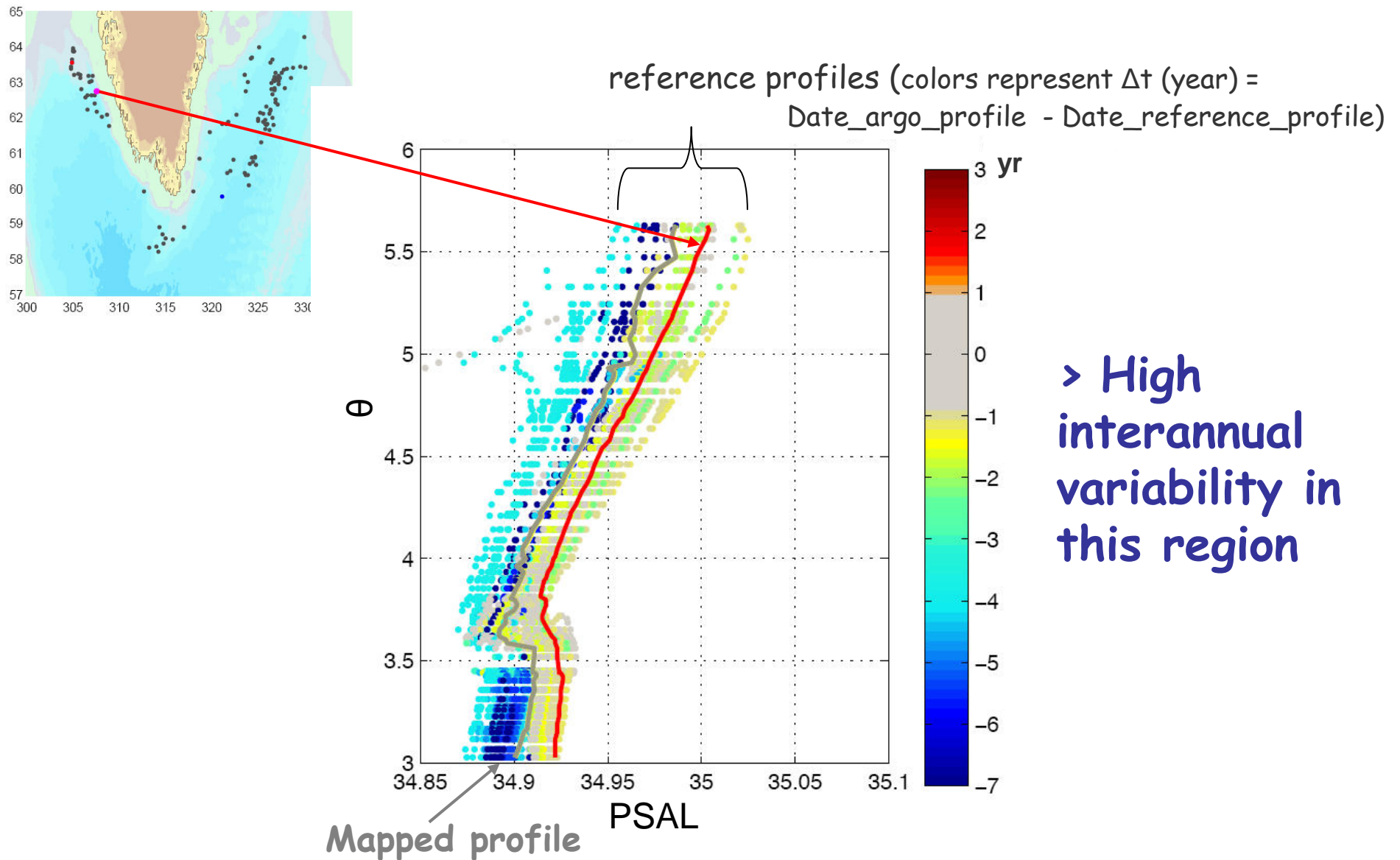
CTD reference database is used



Corrections proposed by OW method

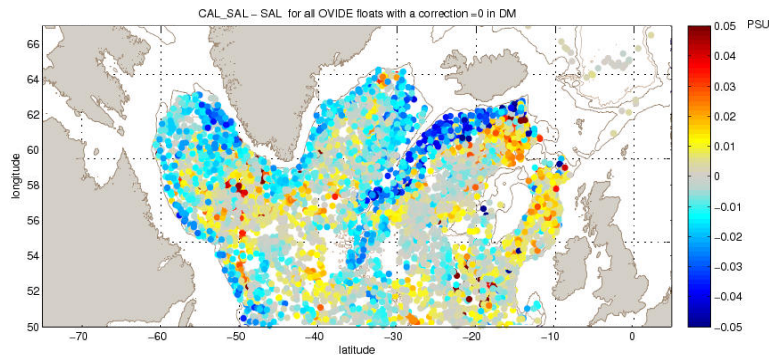
Systematic negative corrections of 0.02-0.03 PSU are proposed by the OW method along the ridge and the topography in the Irminger and Labrador seas

One profile of the float 6900492 plotted against reference profiles...



Corrections proposed by the OW method for all the 343 Argo whose salinity does not need to be corrected in DM.

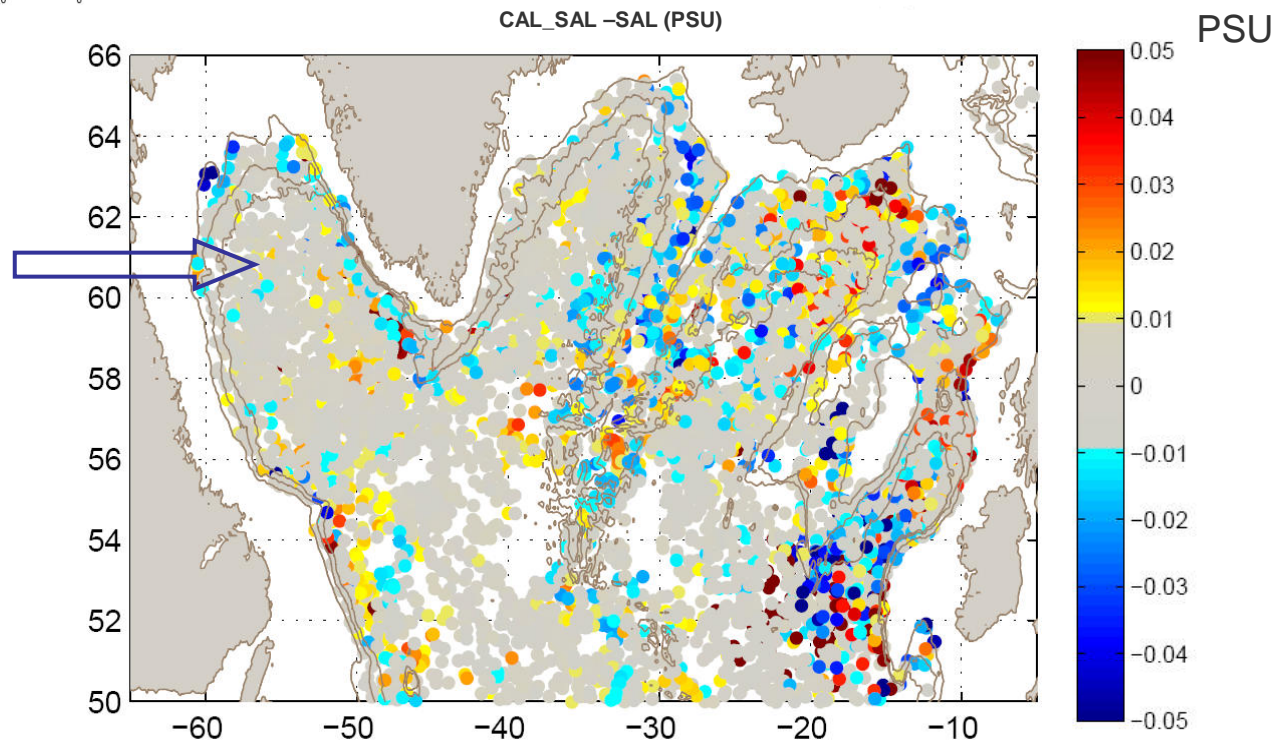
CTD reference database is used



Corrections proposed by OW method

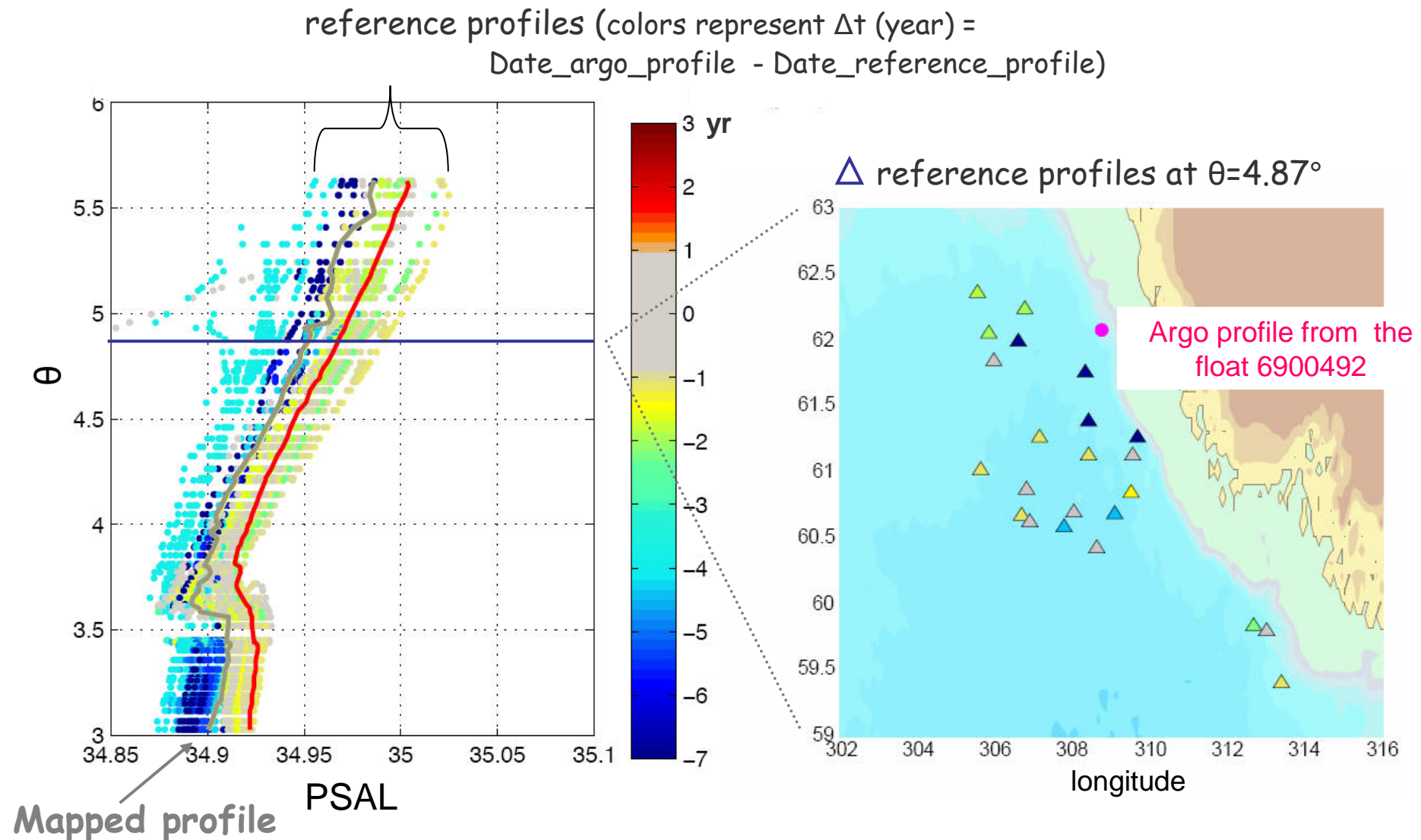
Argo +CTD reference databases are used

Using only reference data **within +/- 2yr** from the date of the profile

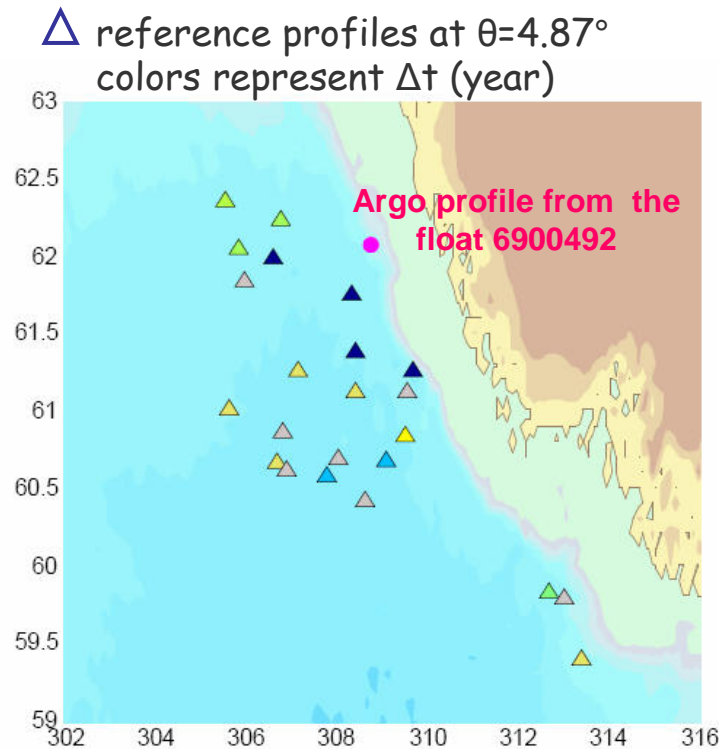




We have tried to understand why OW does not take into account this interannual variability...



# Delayed mode analysis of the salinity: OW method



Two stages objective mapping:

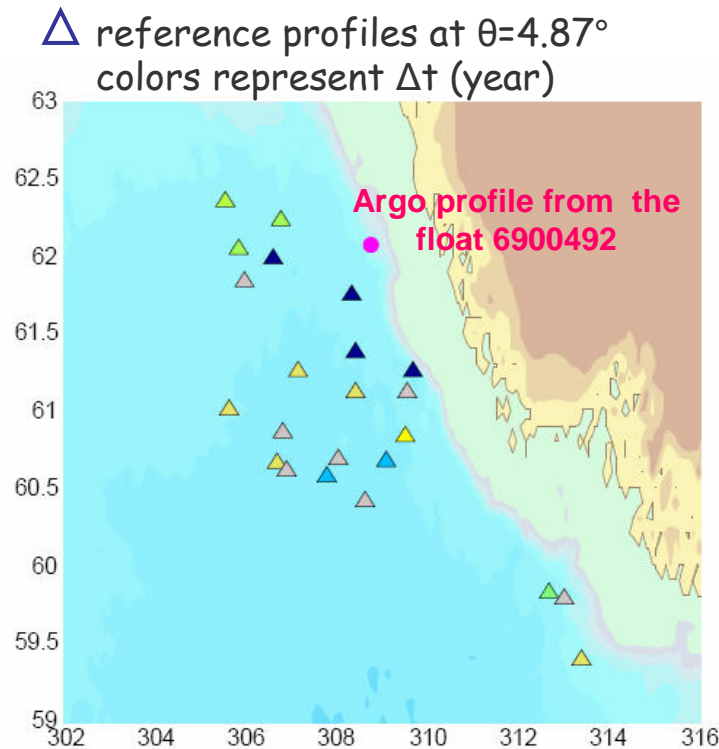
- Estimate the time-independent large scale field  $\hat{S}_{\text{large}}$   
 (Gaussian decay  $L_x, L_y, \Phi_l$ )  
 $3.2^\circ, 2^\circ, 0.5$

- Estimate the smaller features and time dependence from the residuals :  $\hat{S}_{\text{small}}$   
 (Gaussian decay  $l_x, l_y, \Phi_s$  and  $\tau$ )  
 $0.8^\circ, 0.5^\circ, 0.1$  and  $0.69 \text{ y}$

=> Mapped salinity at the position of the Argo profile at  $\theta=4.87^\circ$

$$\hat{S} = \hat{S}_{\text{large}} + \hat{S}_{\text{small}} = 34.9872 + 0.0002$$

# Delayed mode analysis of the salinity: OW method



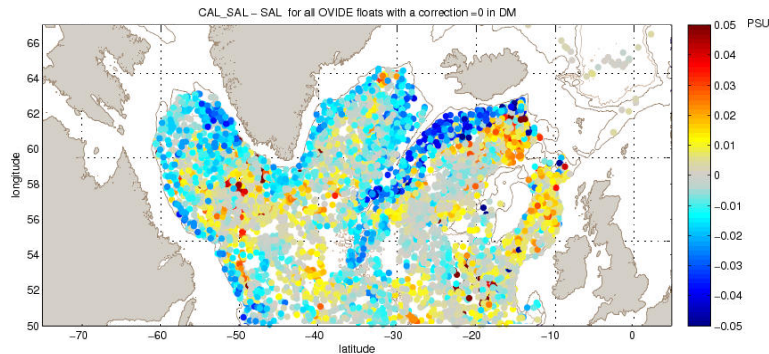
Two stages objective mapping:

- Estimate the **time-dependent** large scale field  $\hat{S}_{\text{large}}$   
(Gaussian decay  $L_x$ ,  $L_y$ ,  $\Phi_l$  and  **$T=2\text{yrs}$** )  
 $3.2^\circ, 2^\circ, 0.5$
- Estimate the smaller features and time dependence from the residuals  $\hat{S}_{\text{small}}$   
(Gaussian decay  $l_x$ ,  $l_y$ ,  $\Phi_s$  and  $\tau$ )  
 $0.8^\circ, 0.5^\circ, 0.1$  and  $0.69\text{ y}$

=> Add a Gaussian decay with a time scale  **$T=2\text{years}$**  when mapping the large scale field

Corrections proposed by the OW method for all the 343 Argo whose salinity does not need to be corrected in DM.

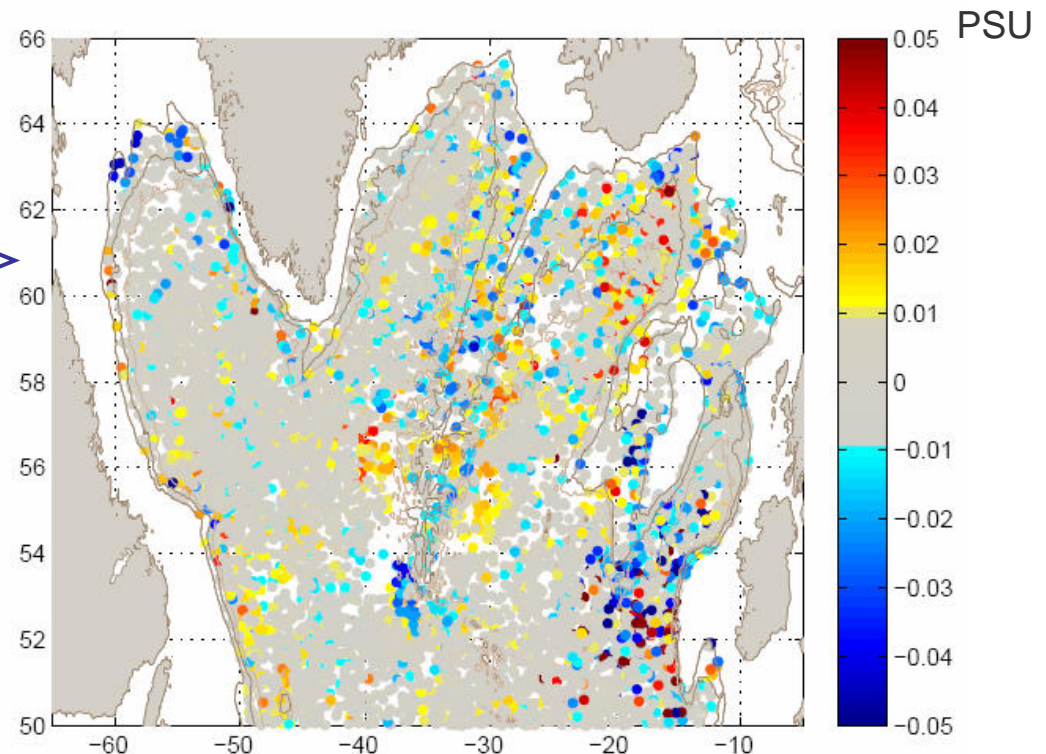
CTD reference database is used



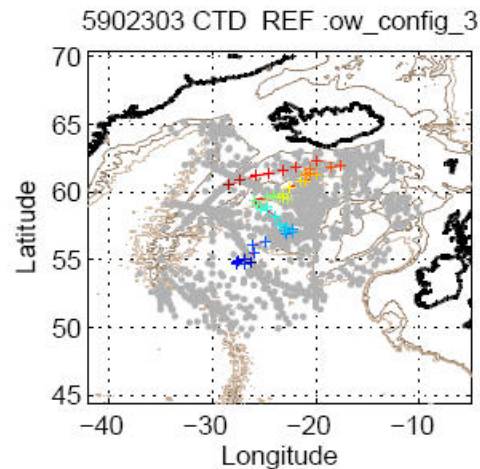
Corrections proposed by OW method

Argo + CTD reference databases are used

A Gaussian decay with a time scale  $T = 2\text{ years}$  is added when mapping the large scale field

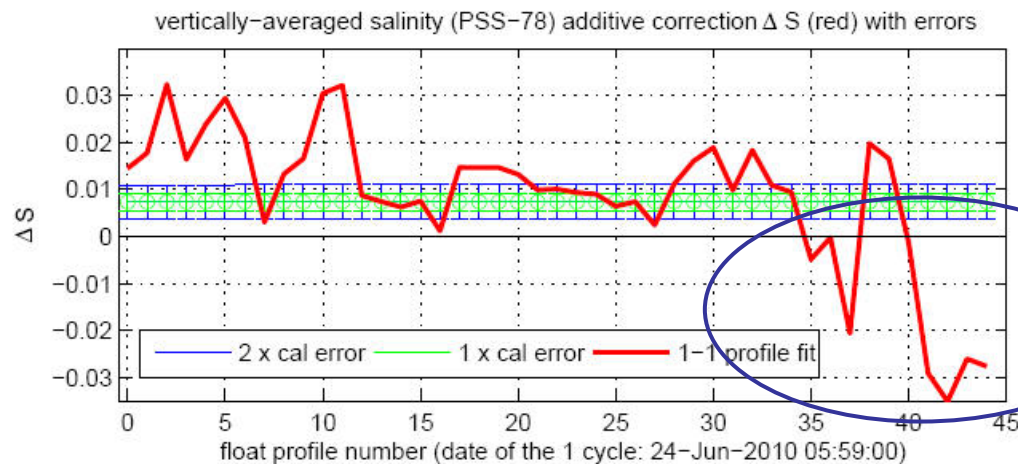


## Example of Delayed mode correction for the float 5902303



Historical CTD reference dataset

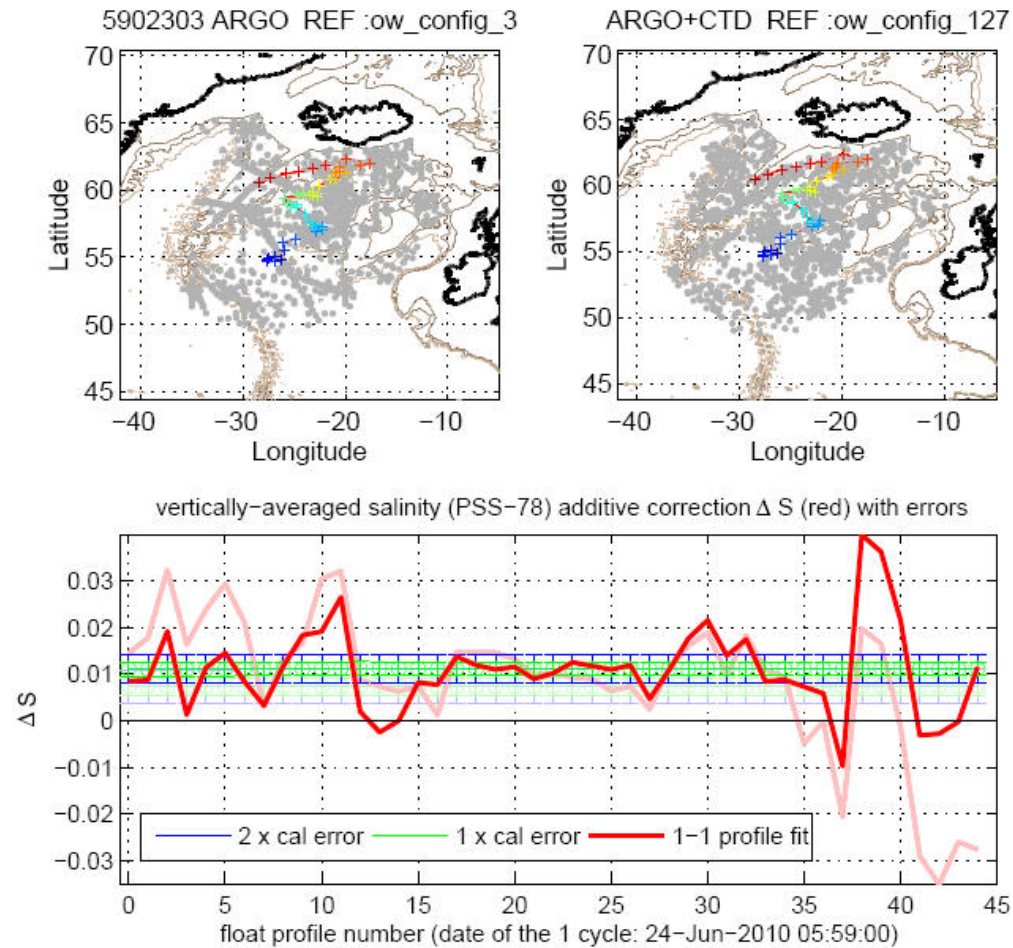
Time dependence: only when mapping the small scales



Saline bias along the ridge

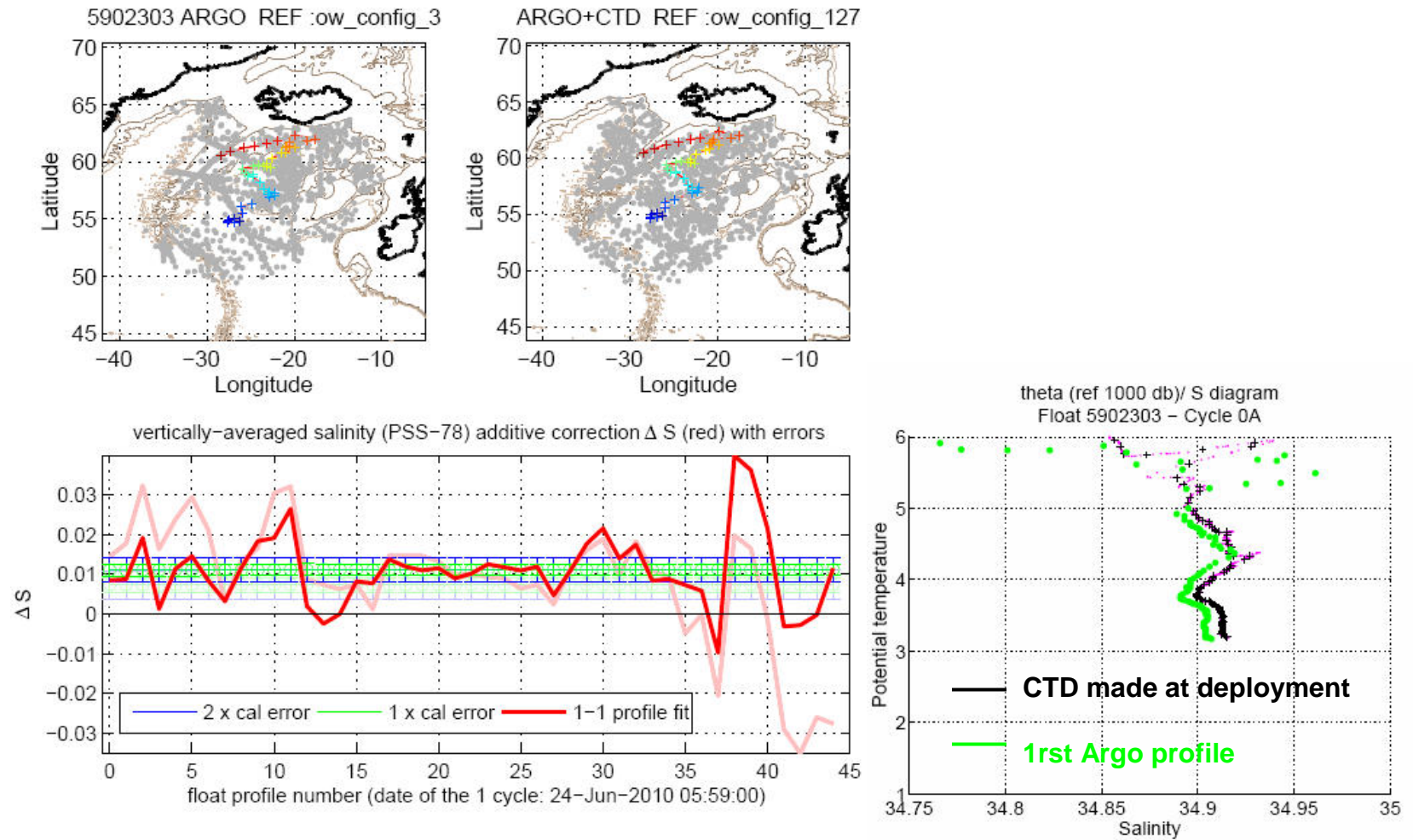


## Example of Delayed mode correction for the float 5902303



A Gaussian decay  
with a time scale  
 $T = 2$  years is added  
when mapping the  
large scale field

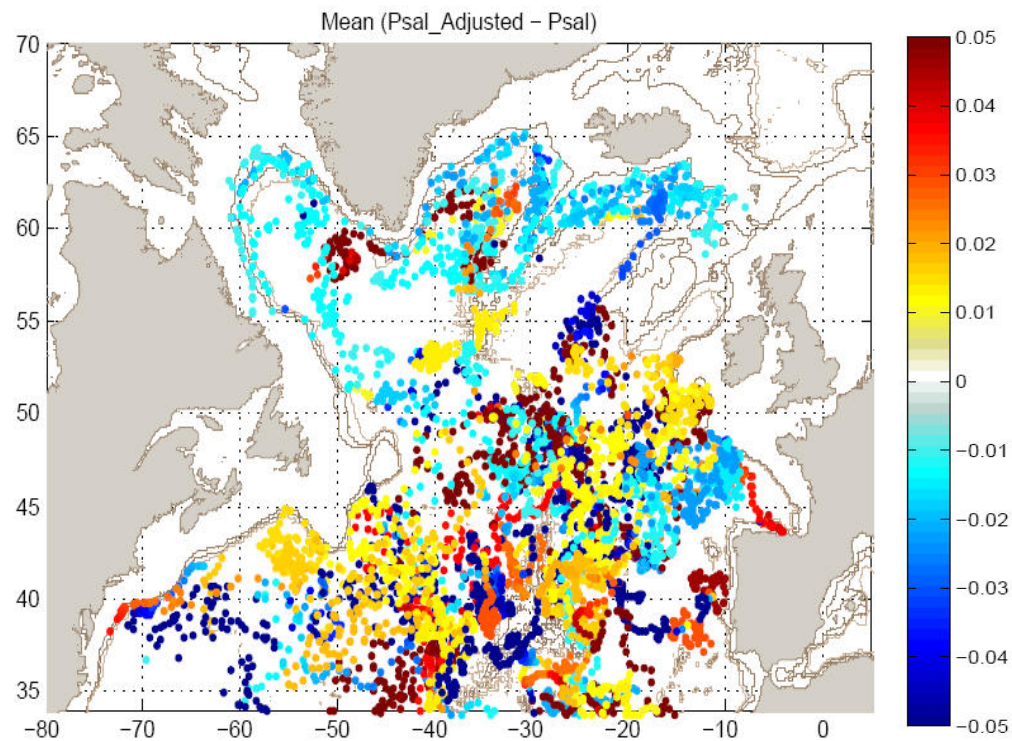
# Example of Delayed mode correction for the float 5902303



We have checked the corrections made on Argo profiles on the GDac

Take all the floats corrected in DM and for which salinity corrections > 0.01 PSU

Vertically-averaged (PSAL\_ADJUSTED – PSAL)

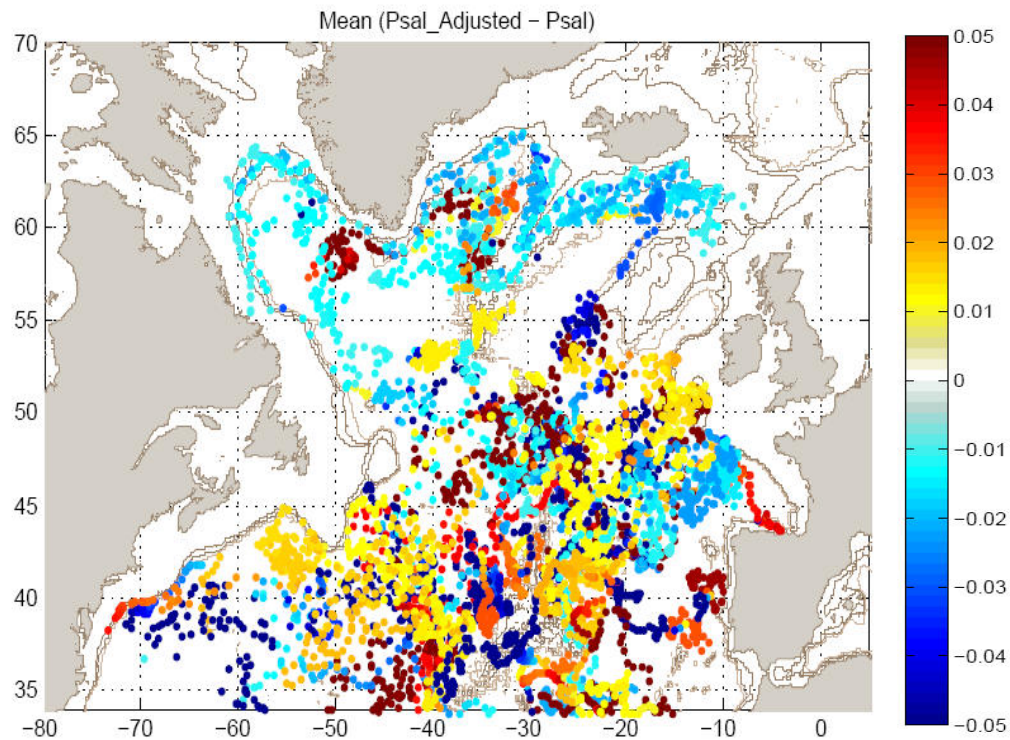




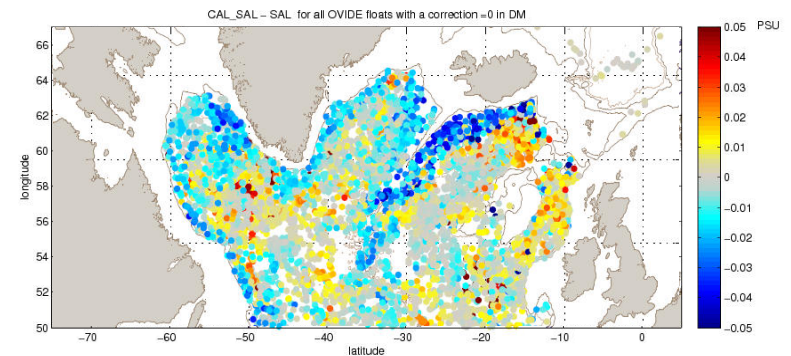
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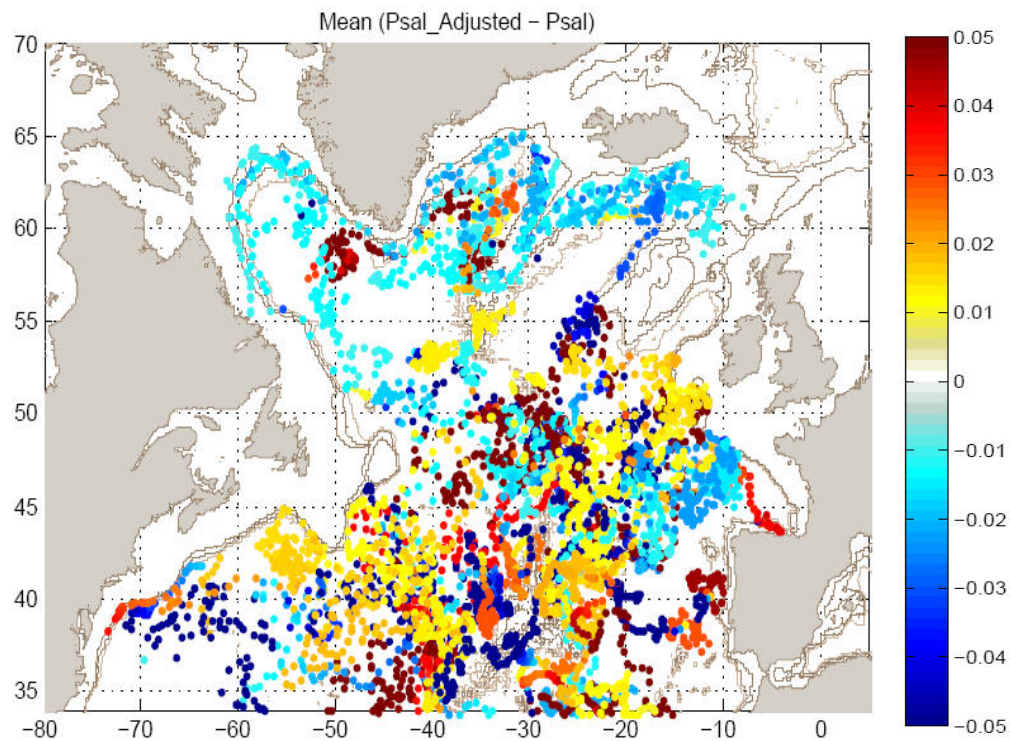
CTD reference database is used



We have checked the corrections made on Argo profiles on the GDac

Take all the floats corrected in DM and for which salinity corrections > 0.01 PSU

Vertically-averaged (PSAL\_ADJUSTED – PSAL)



Some floats (8) in the subpolar gyre may have been over-corrected

Pi's or DM operators have been contacted and the floats have been checked again

# Conclusions

- We have used more than 300 floats that do not need to be corrected in DM to test the OW method in the Subpolar Gyre region
- OW method used with the CTD reference database often proposed negative salinity corrections along the ridge and the topography in the Labrador and Irminger seas.
- We have shown that it is necessary to introduce a Gaussian decay with a time scale  $T \sim 2$  years when mapping the large scale field.
- Next, we plan to refine the estimate of the time scale  $T$  using Argo and CTD data.

**Thank you !**