EQUIPEX NAOS
WP5 : Deep oxygen floats in the North-Atlantic

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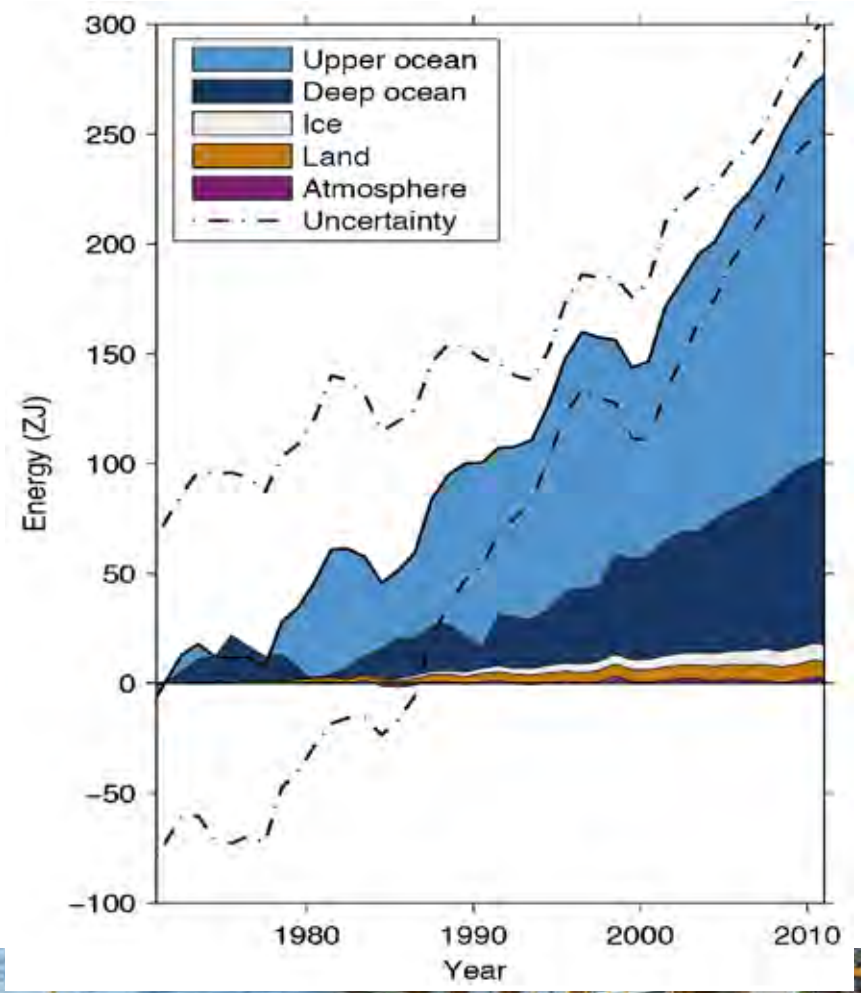
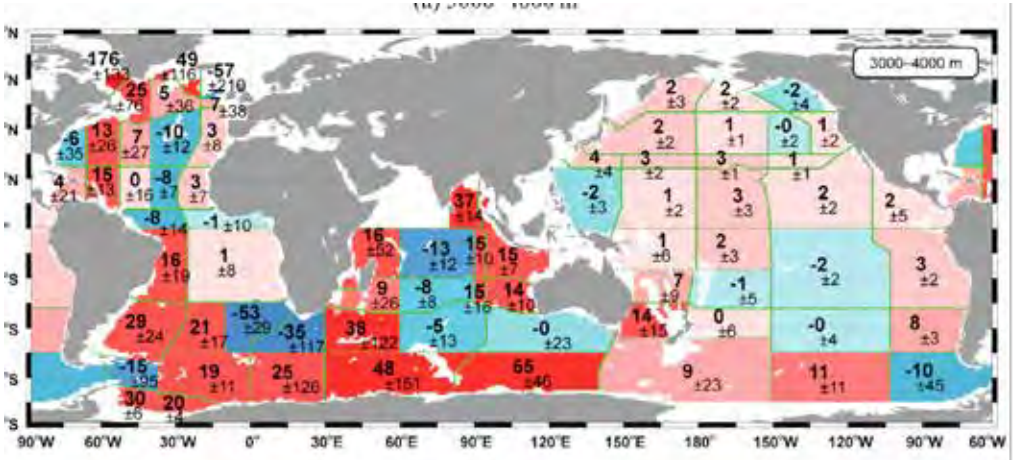
UMR 6523 CNRS / IFREMER / IRD / UBO–IUEM

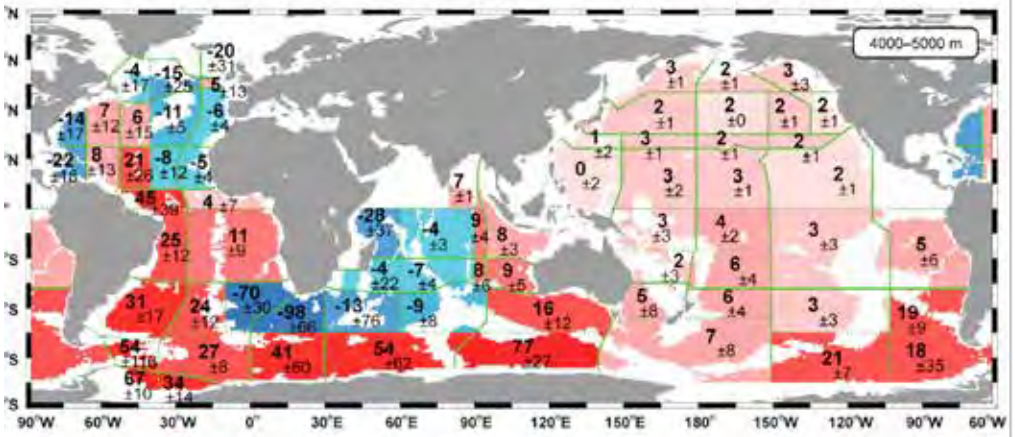
Change in Global Energy Inventory



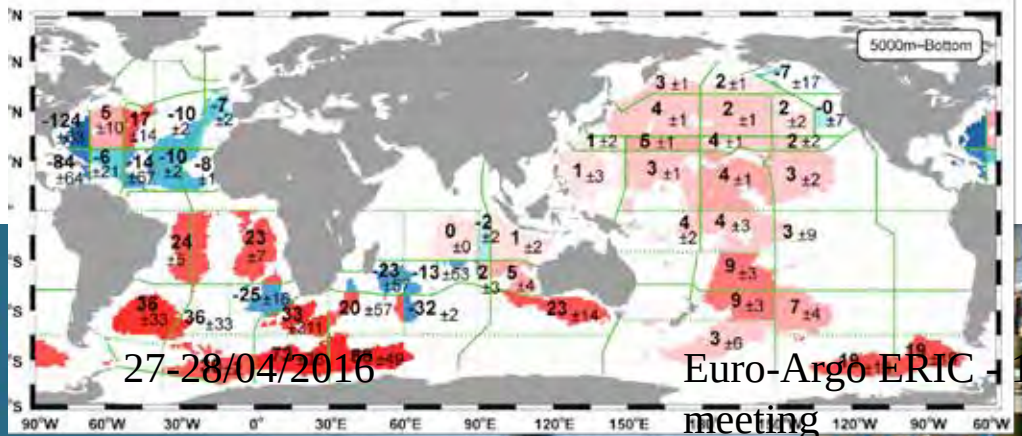
(IPCC, 2013)



(b) 4000–5000 m



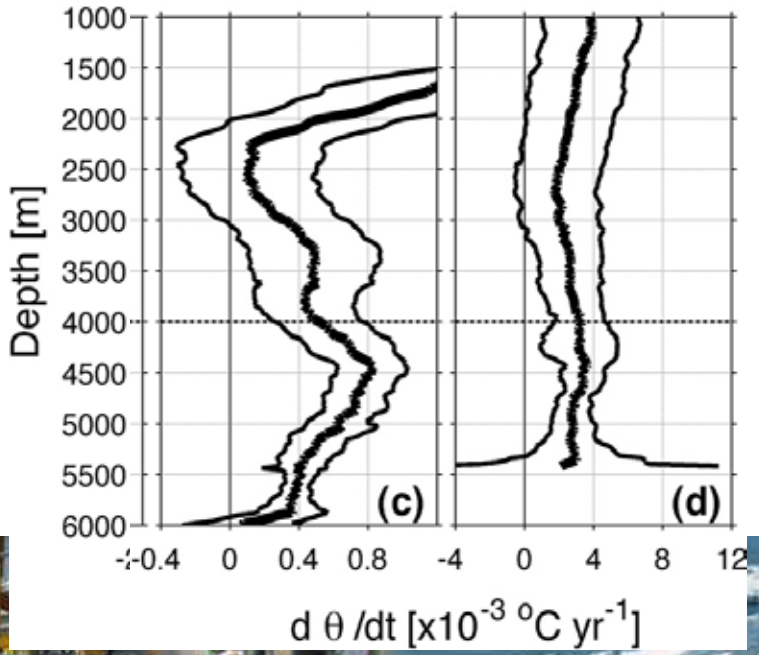
(c) 5000 m–bottom



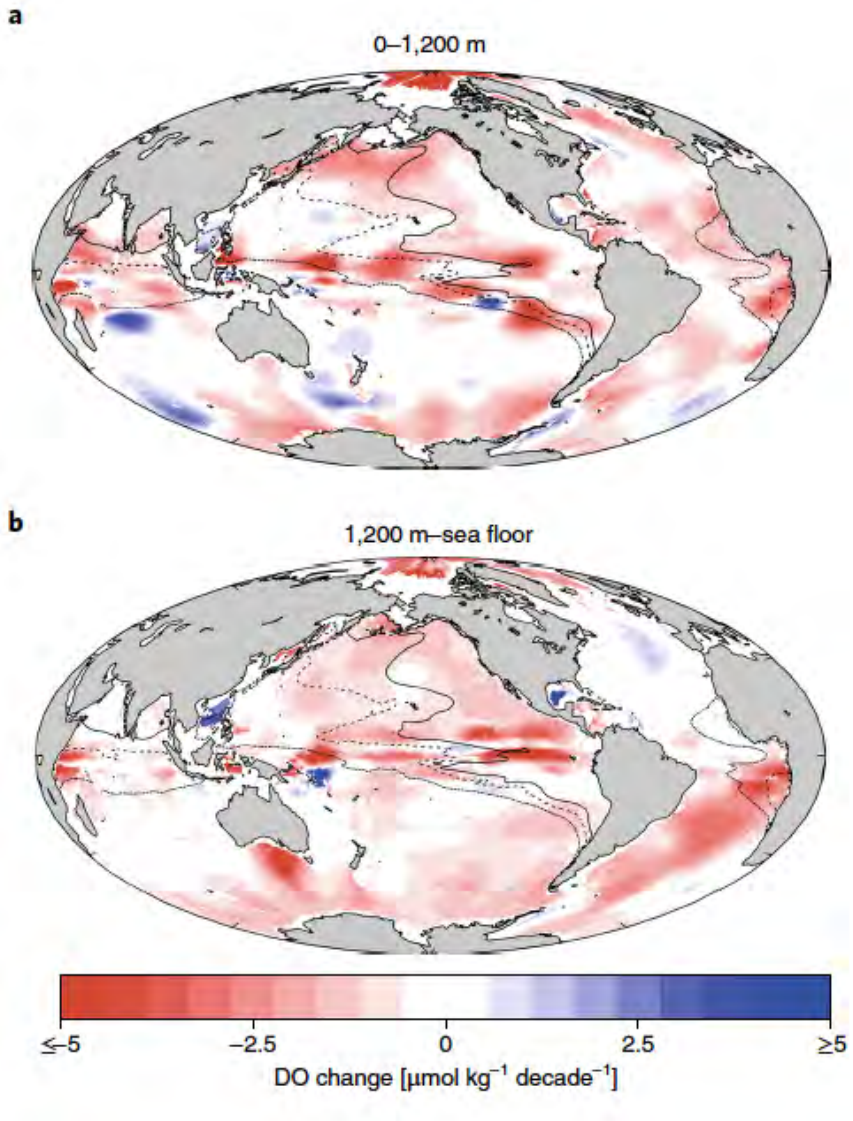
Temperature trends in m ° C/decade from the 1990s to the 2000s (Kouketsu et al, 2011; Purkey and Johnson, 2010)

Mean temperature trend

Global Southern Ocean

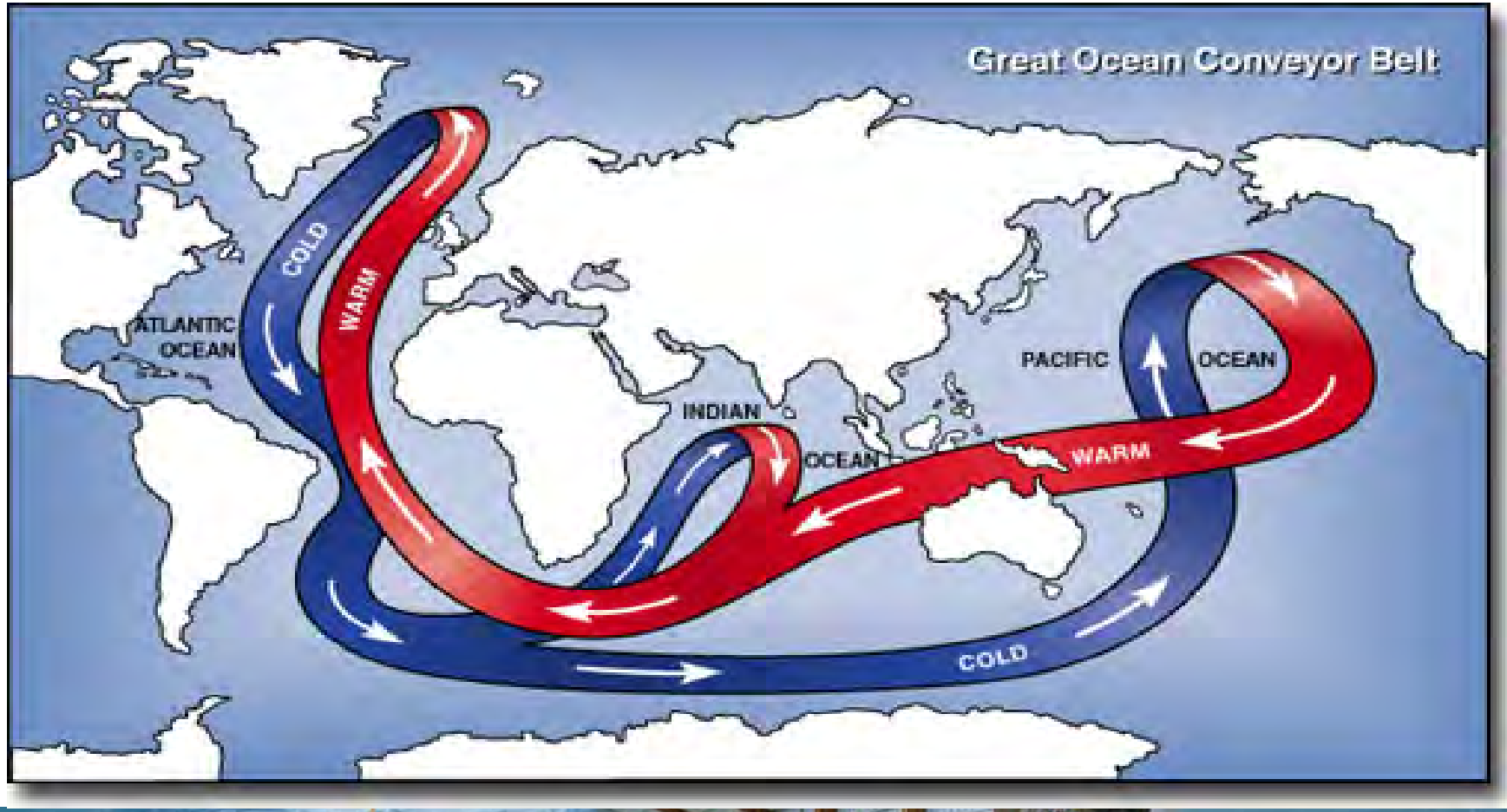


Observational estimate of the 50-year (1960 to 2010) oxygen change



Oschlies et al 2018

Meridional Overturning Cell



Scientific and technological objectives

- **Deployment of 23 Deep-Arvor floats with oxygen sensor in the North-Atlantic Ocean**

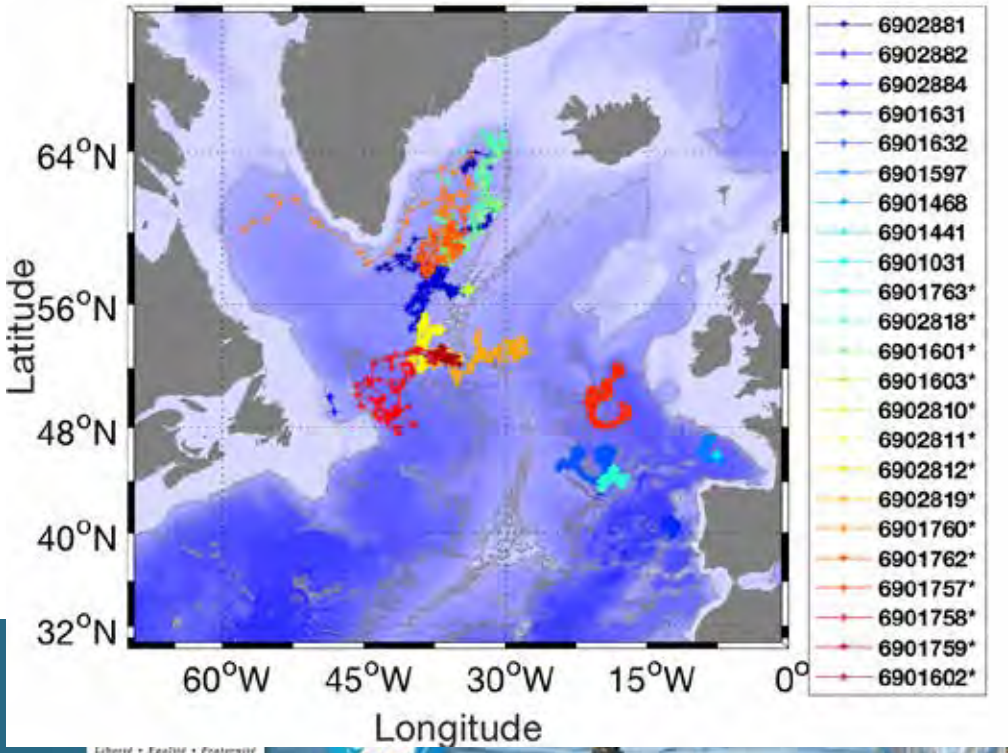
- **Implement a pilot experiment for O2 and deep data**
  - Implement the corresponding data stream at international level
  - Prepare the future international Deep-Argo and Argo-O2 array

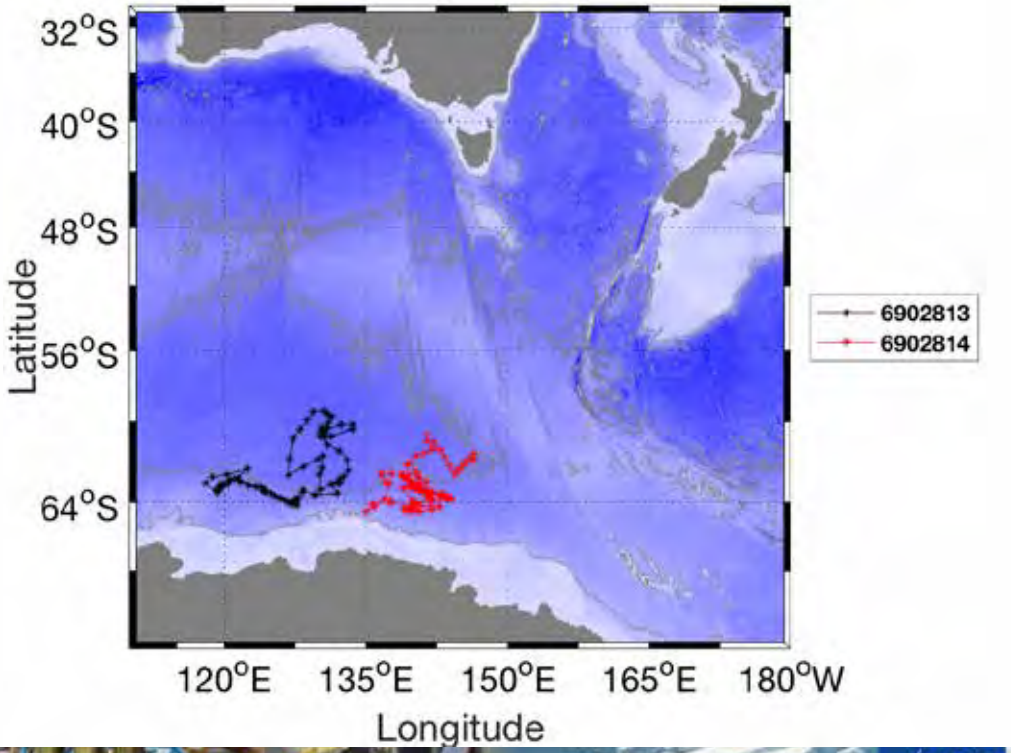
- **Technological objective:** Demonstrate the capacity of the Deep-Arvor float at acquiring deep (below 2000m depth) and oxygen data of high-quality

- **Scientific objective** : Investigate deep convection and deep water mass circulation and mixxing in order to investigate the input and propagation of climatic anomalies within the ocean interior

Implementation and floats performances

- The NAOS Deep-Arvor floats were deployed in the North-Atlantic Ocean, in complement to other deployments
- 2 floats were deployed in the Southern Ocean

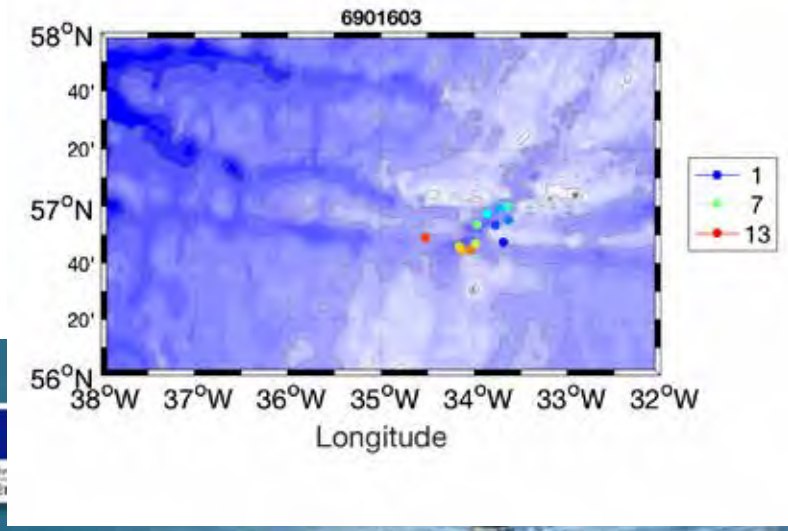




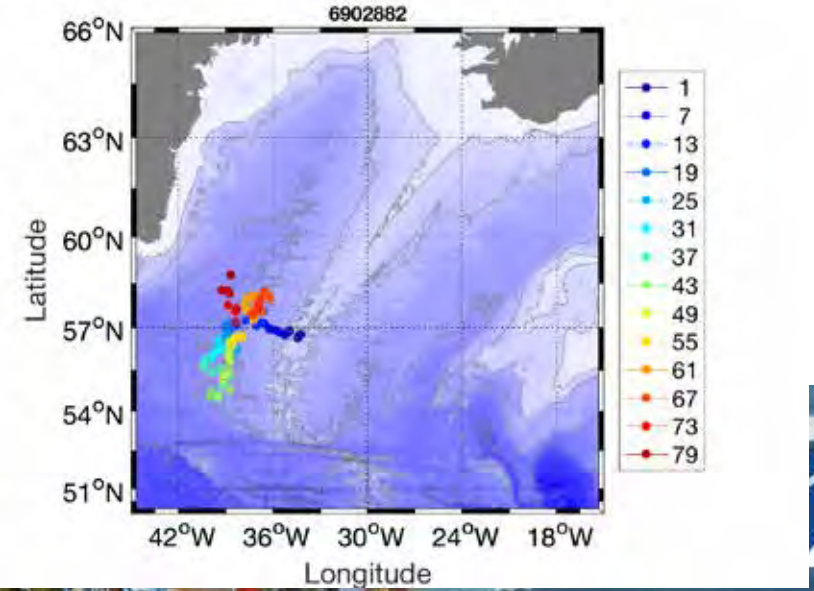
Implementation and floats performances

- **Back and forth between at sea experiments and improved technology**
- **Improvments of both platforms and software over the duration of the project**
  - Mean life time of 47 cycles (about 120 expected) for the first batch of float deployed before 2018
  - Floats deployed since 2018 are still active and have already exceed the mean life time of the first batch.

First batch (deployed in 2017)



Second batch (deployed in 2018)



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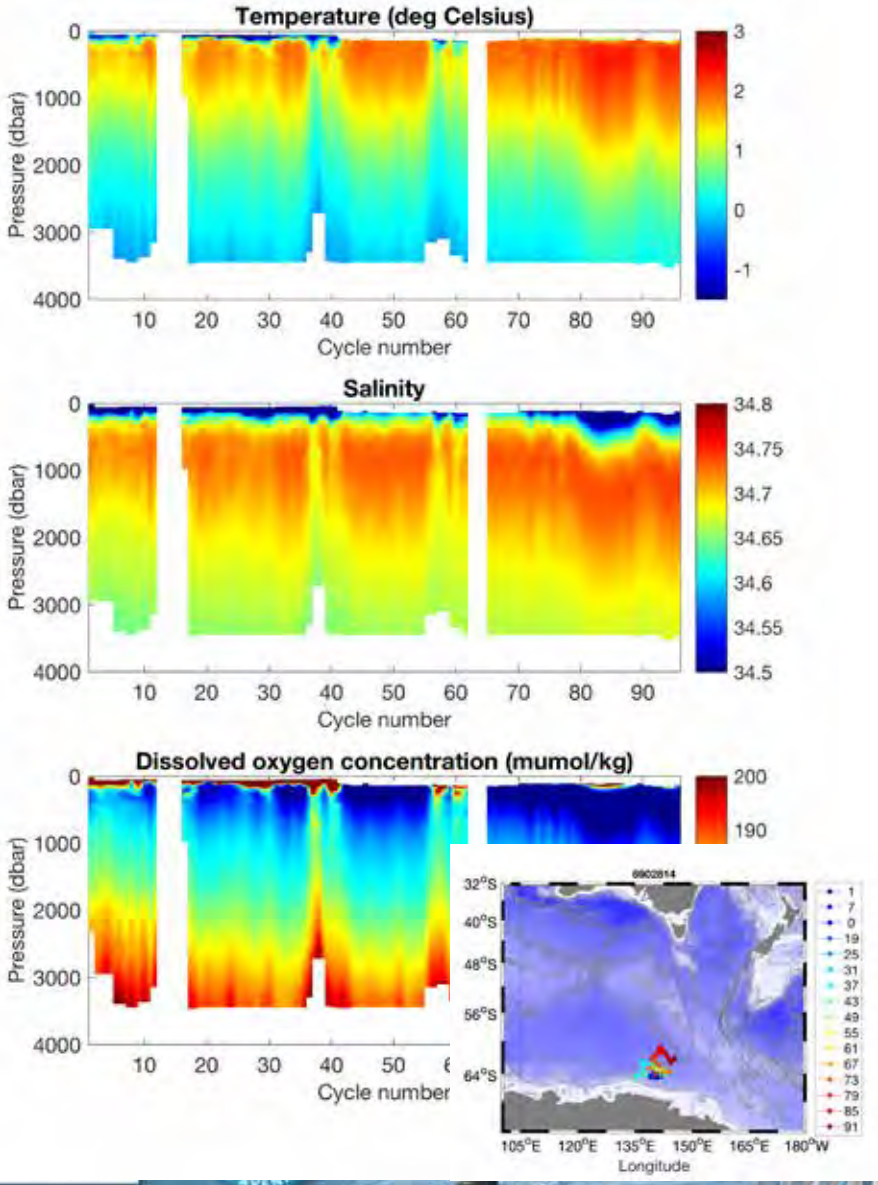

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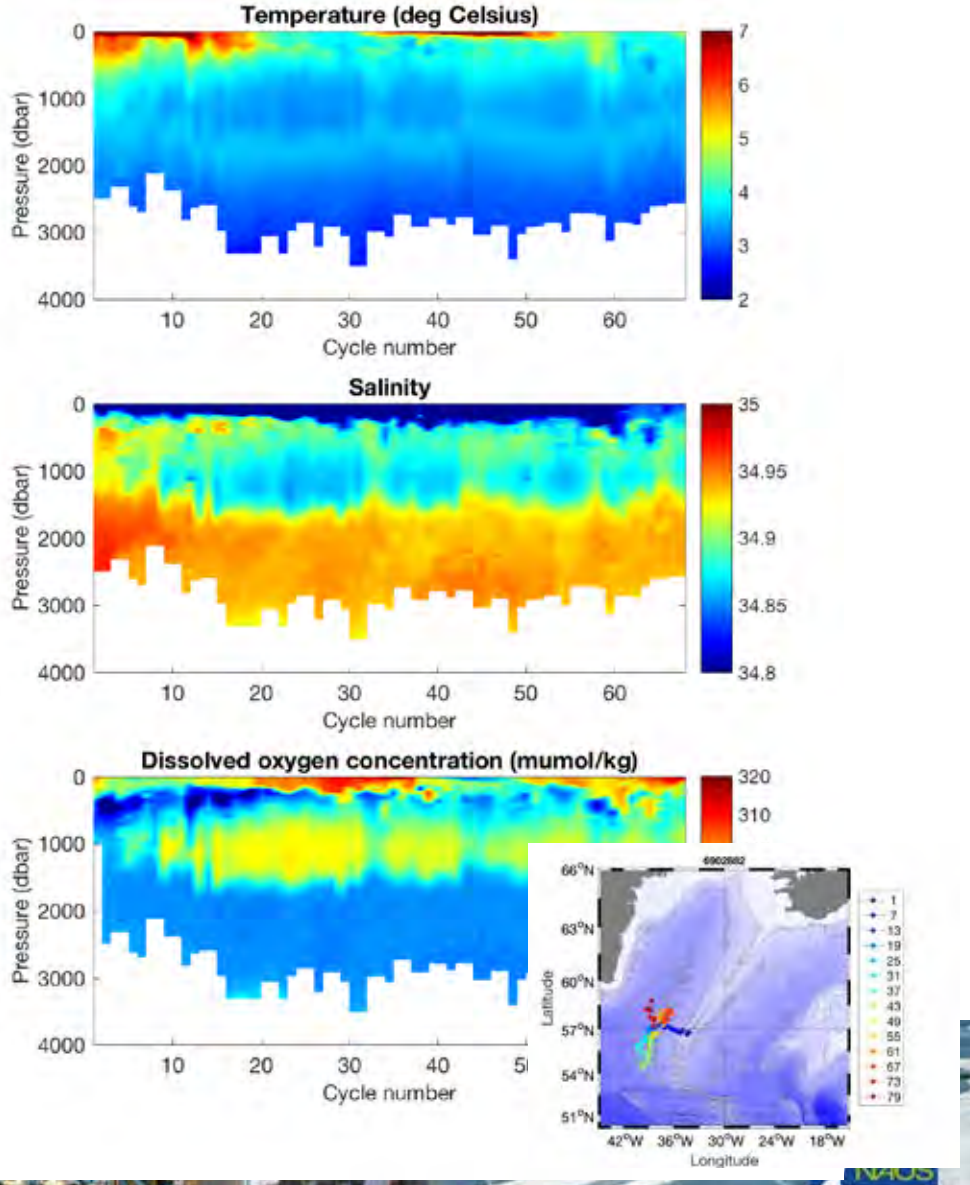
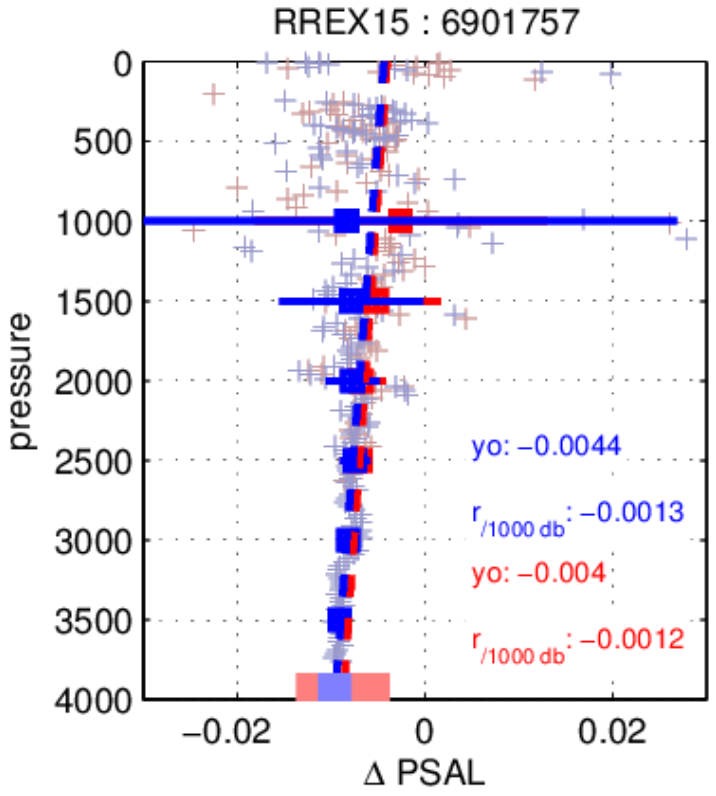


Data management and qualification: Investigation of the quality of the conductivity/salinity data

- **Comparaison of the first float profile with a calibrated reference CTD case**



Salinity difference between Argo and the reference profile as function of pressure

Le Traon et al, 2020

Data management and qualification: Investigation of the quality of the conductivity/salinity data

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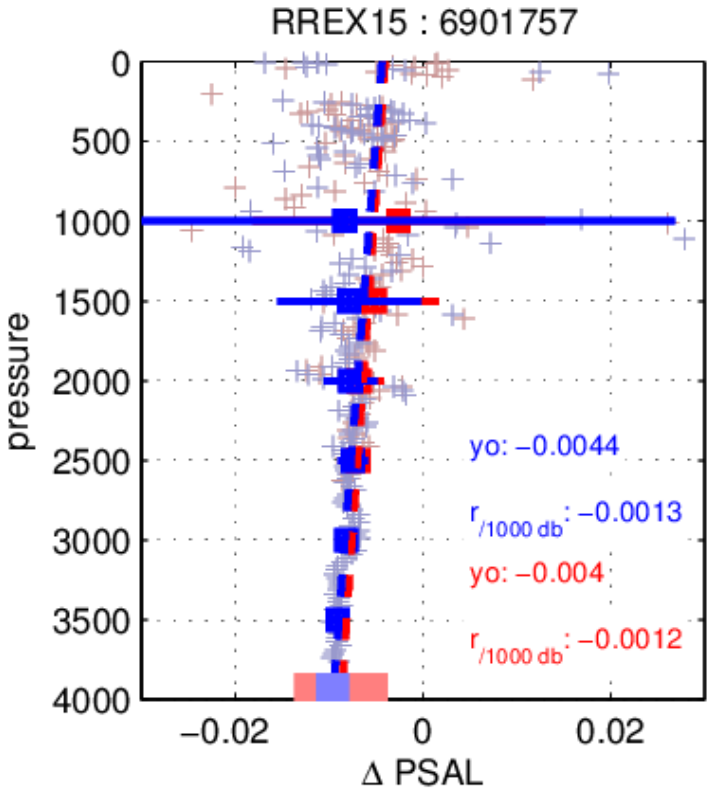
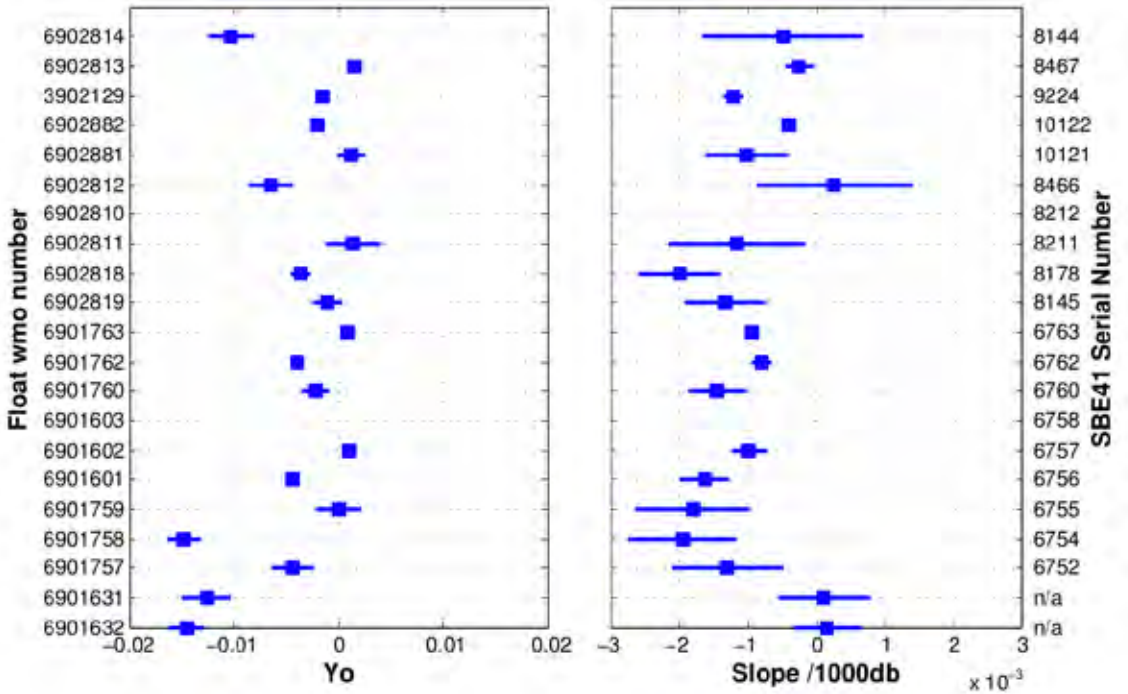


Offset

Slope



Le Traon et al, 2020

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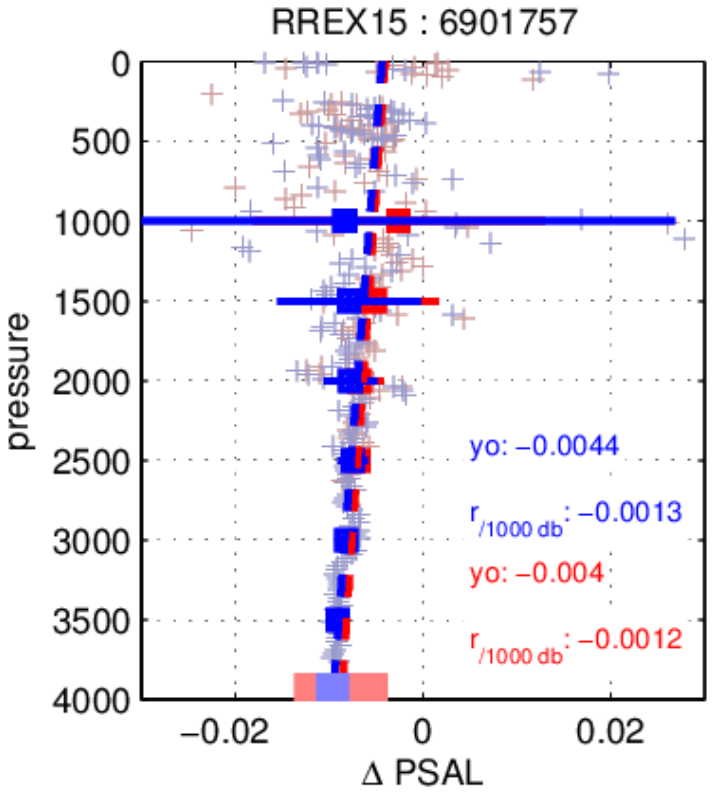

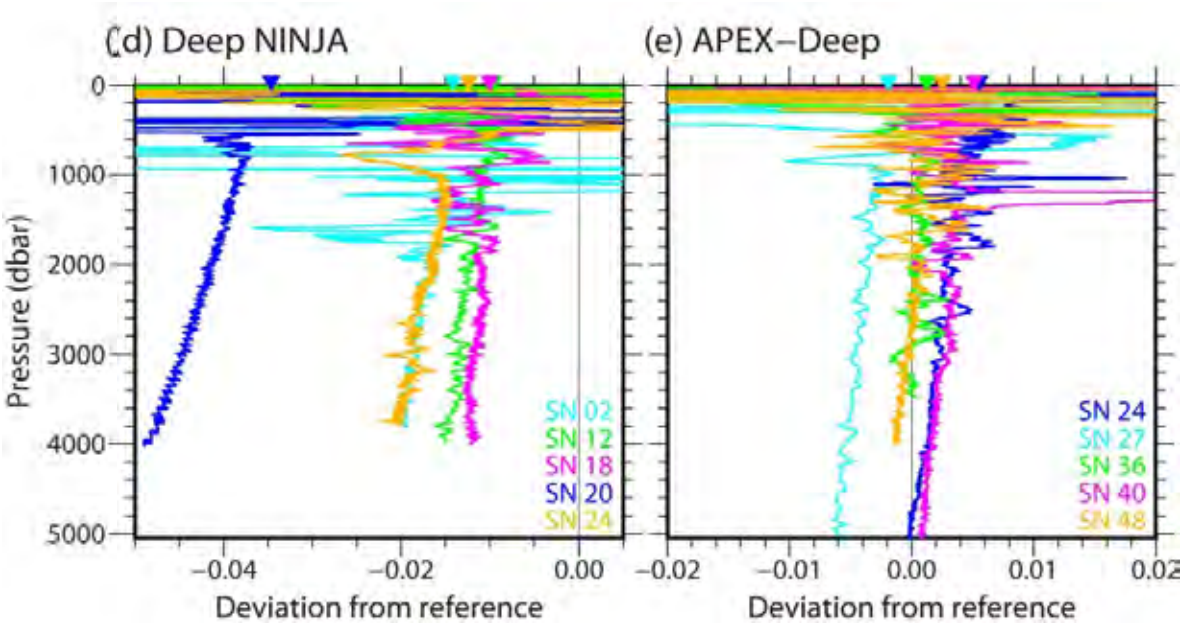

Kobayashi, Sato, and King (submitted)

Le Traon et al, 2020

Data management and qualification: Investigation of the quality of the conductivity/salinity data

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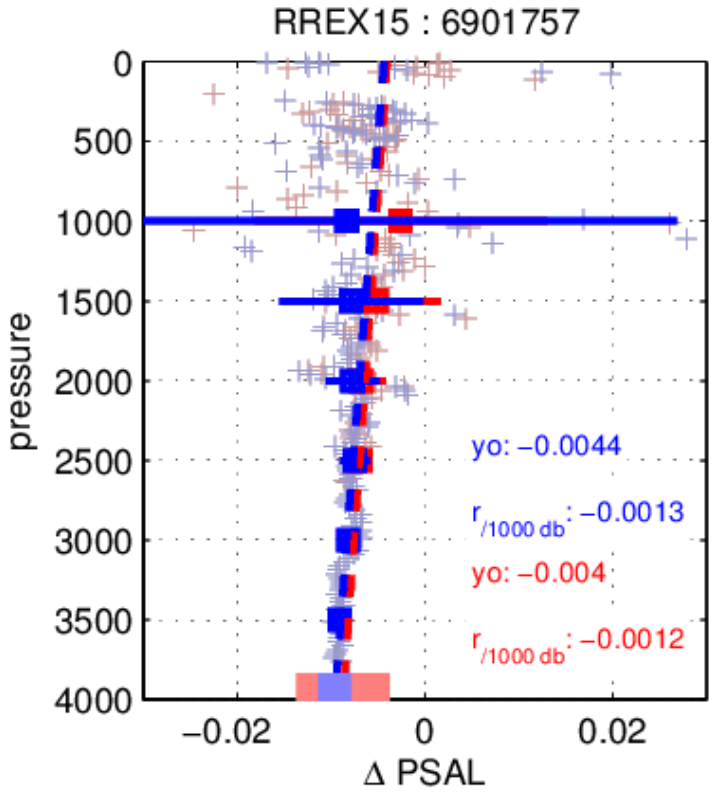
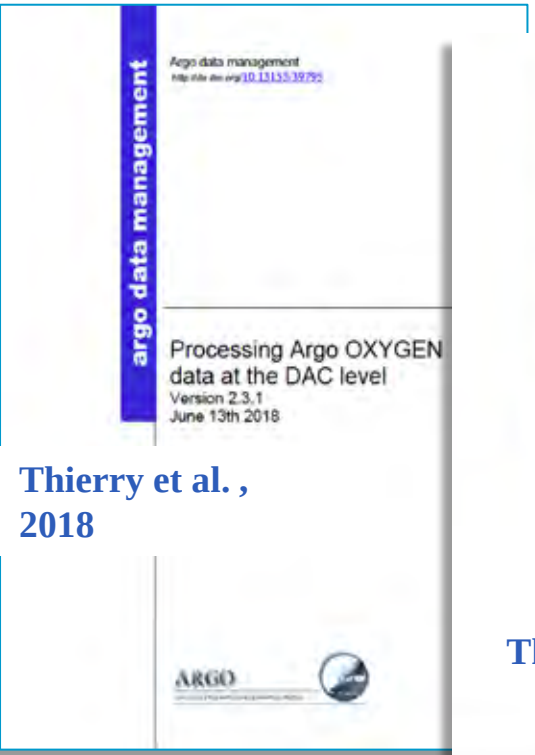


- Attributed to an incorrect value of the compressibility conductivity cell coefficient (Cpcorr) in Seabird equation
- NAOS team is included in the international working group that addresses this issue. The team suggests a new Cpcorr of about -13.5 e-08 (the current value is -9.57e-08).

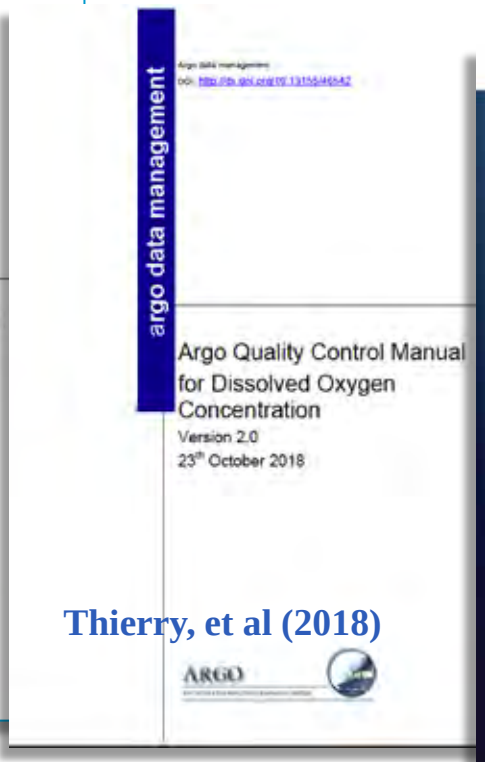
Le Traon et al, 2020

Data management and qualification

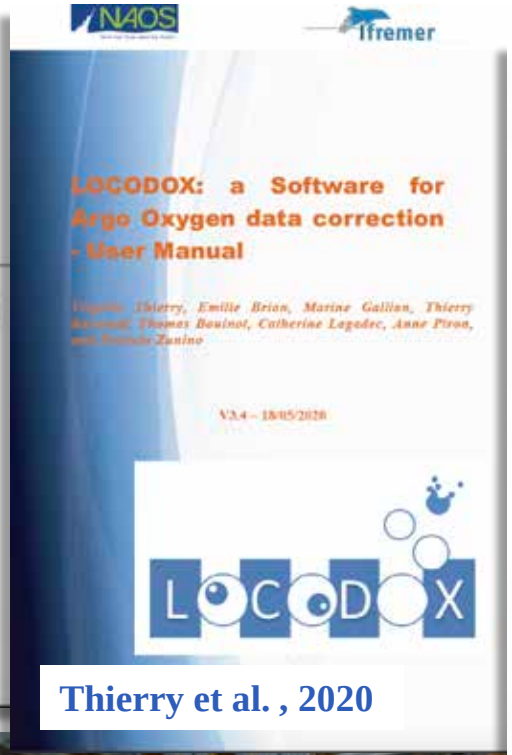
- One major contribution of the NAOS project is its implementation of the procedure for managing oxygen data in the Argo data stream



Thierry et al. , 2018



Thierry, et al (2018)

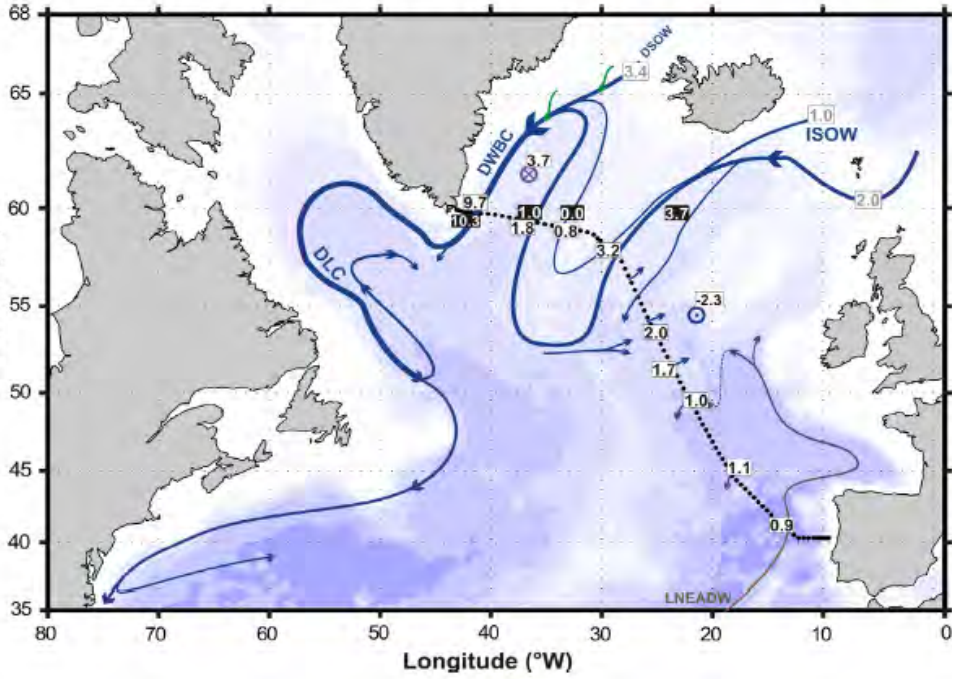


Thierry et al. , 2020

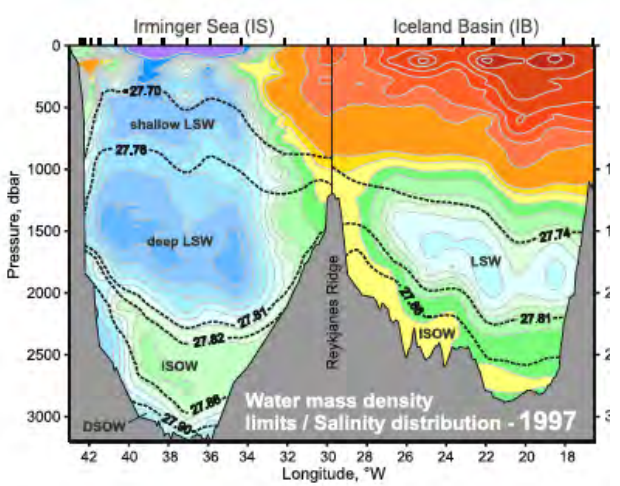
Bittig, et al (2018).

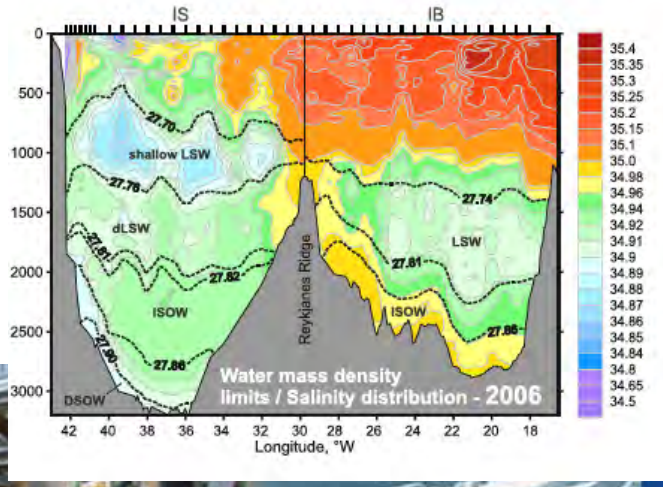
Scientific analyses
Investigate ISOW pathways, mixing and variability with Deep-Arvor floats

Circulation scheme in the deep layers (σ0=27.8),



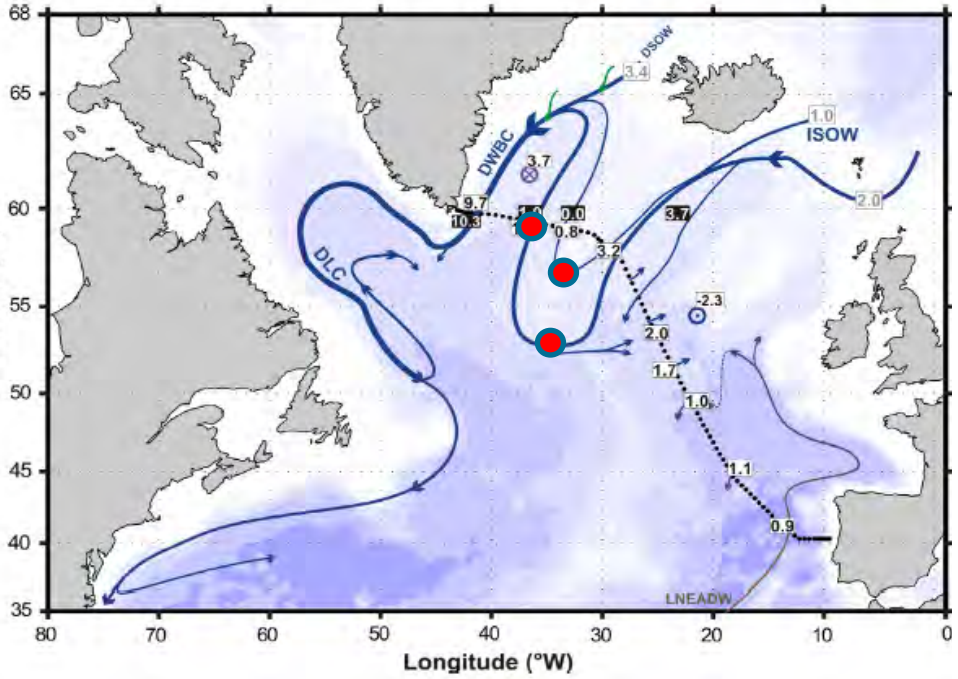
Daniault et al. 2016

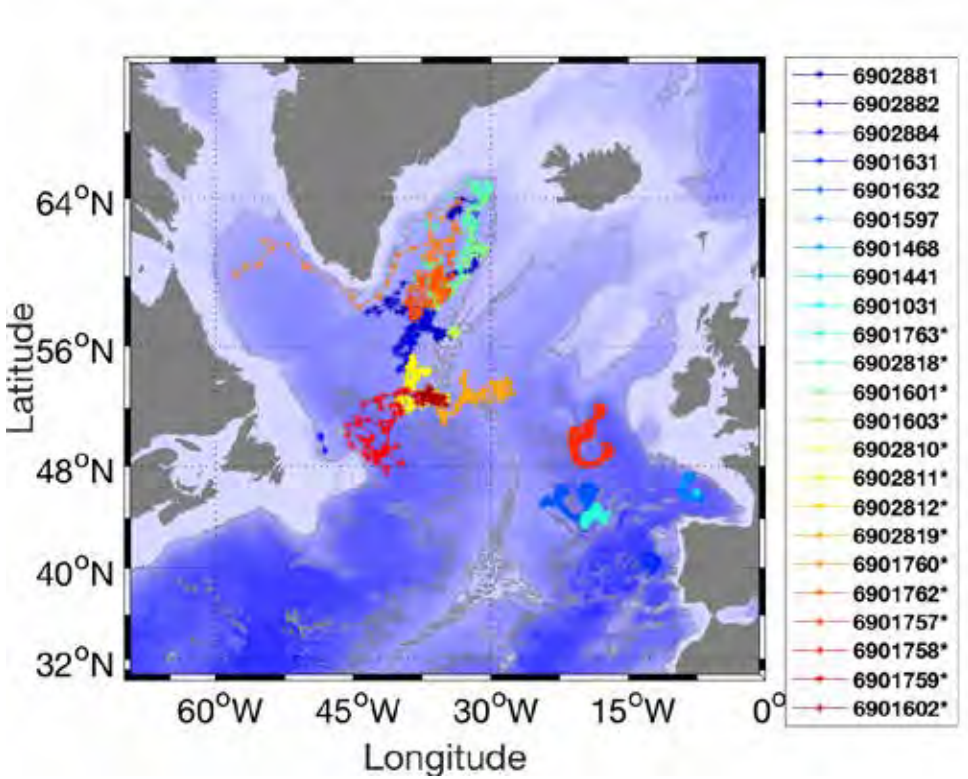




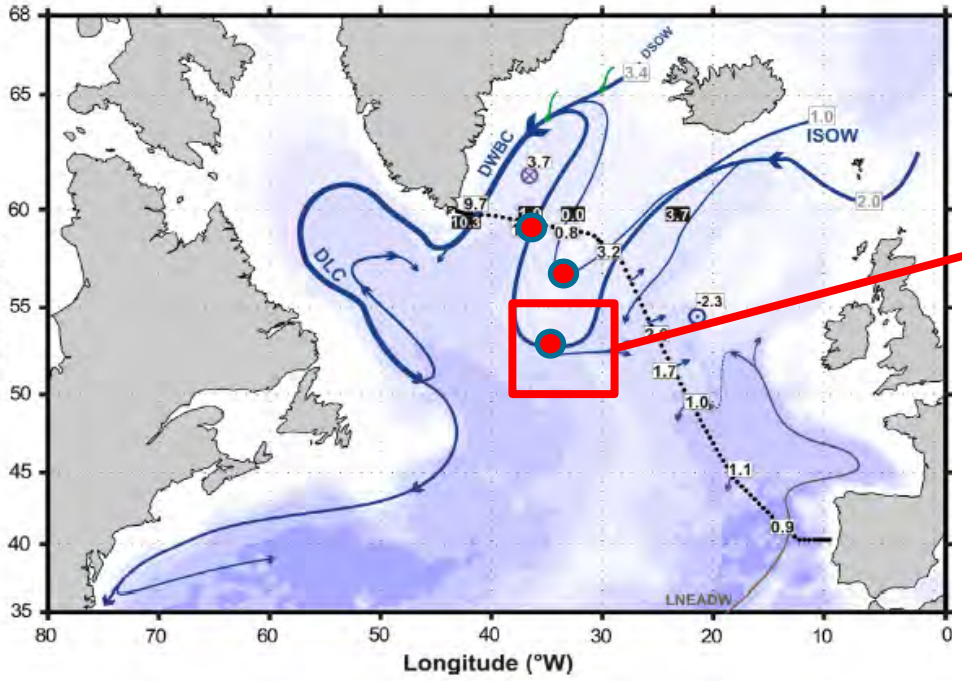
Sarafanov et al, 2007

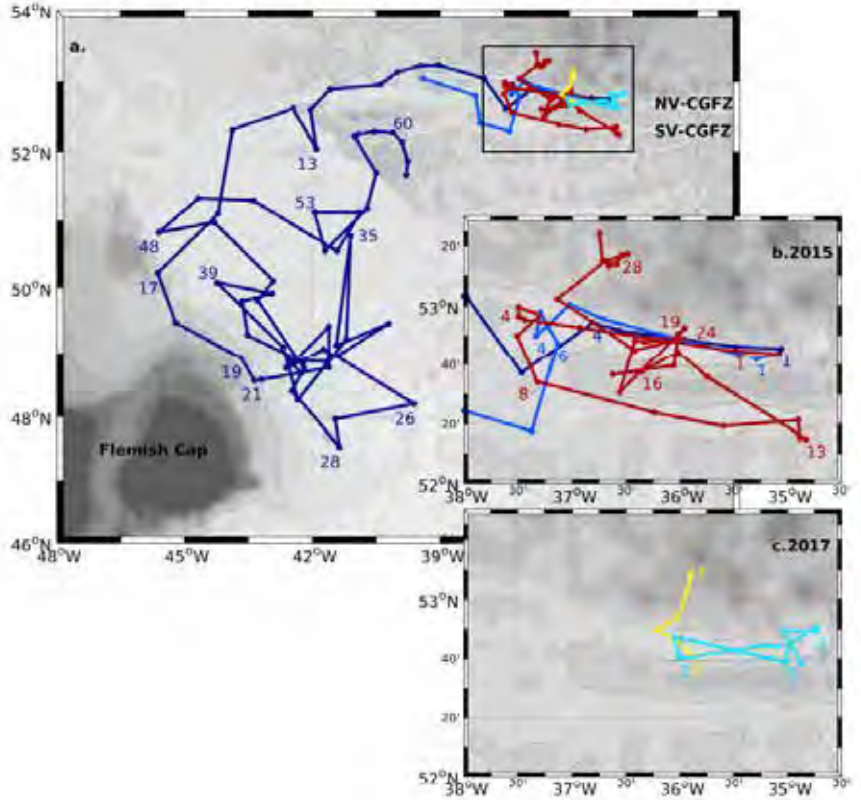
Scientific analyses
Investigate ISOW pathways, mixing and variability with Deep-Arvor floats





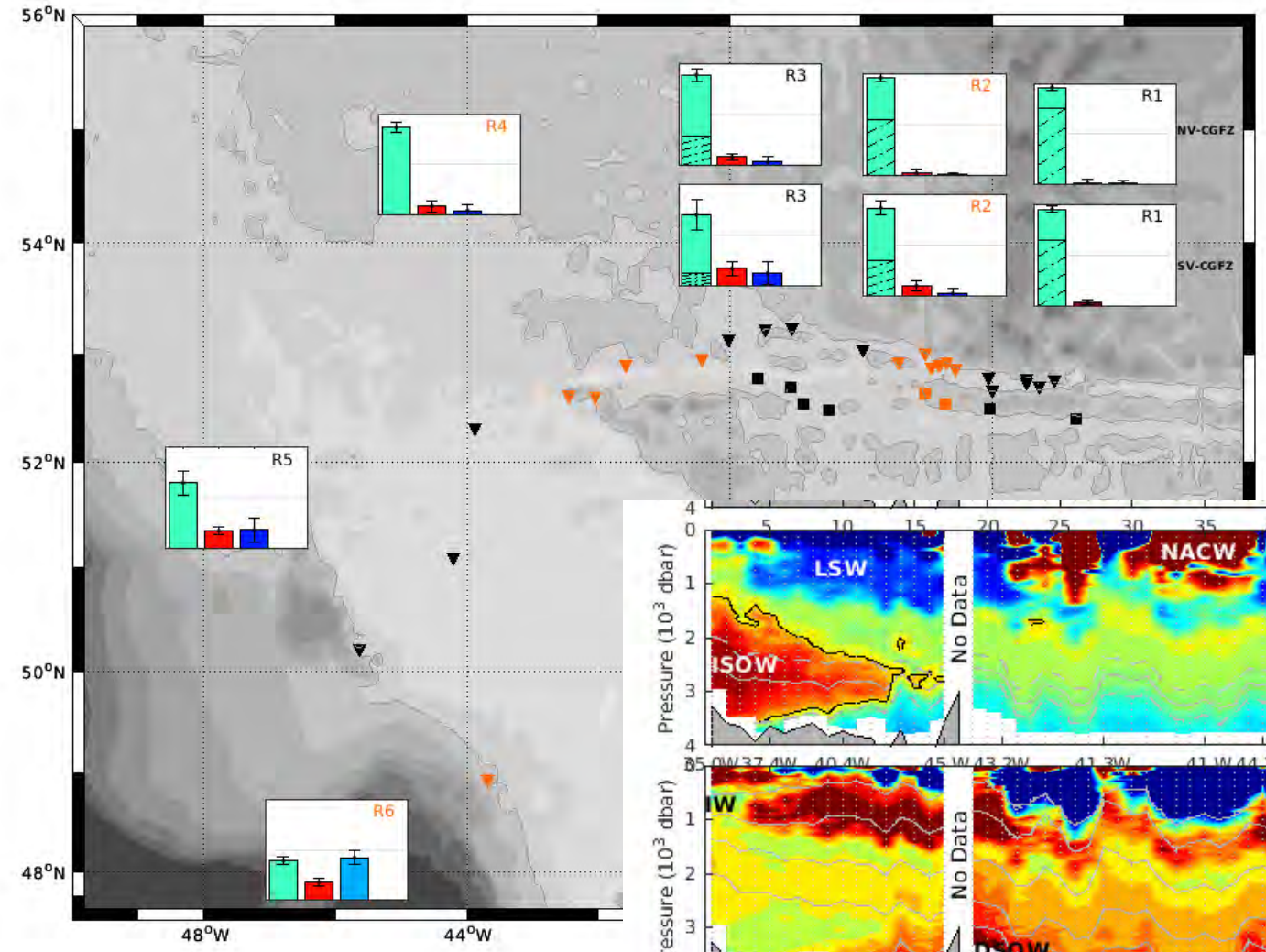
Investigate ISOW pathways downstream of Charlie-Gibbs Fracture Zone

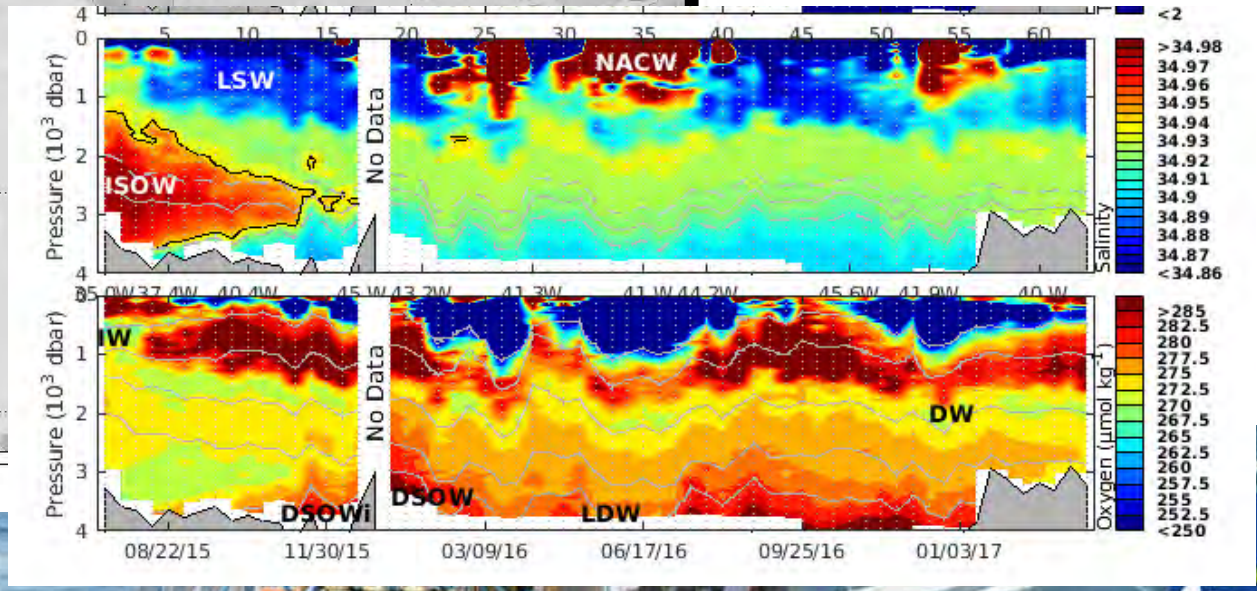




Racapé et al, 2019

Investigate ISOW pathways downstream of Charlie-Gibbs Fracture Zone

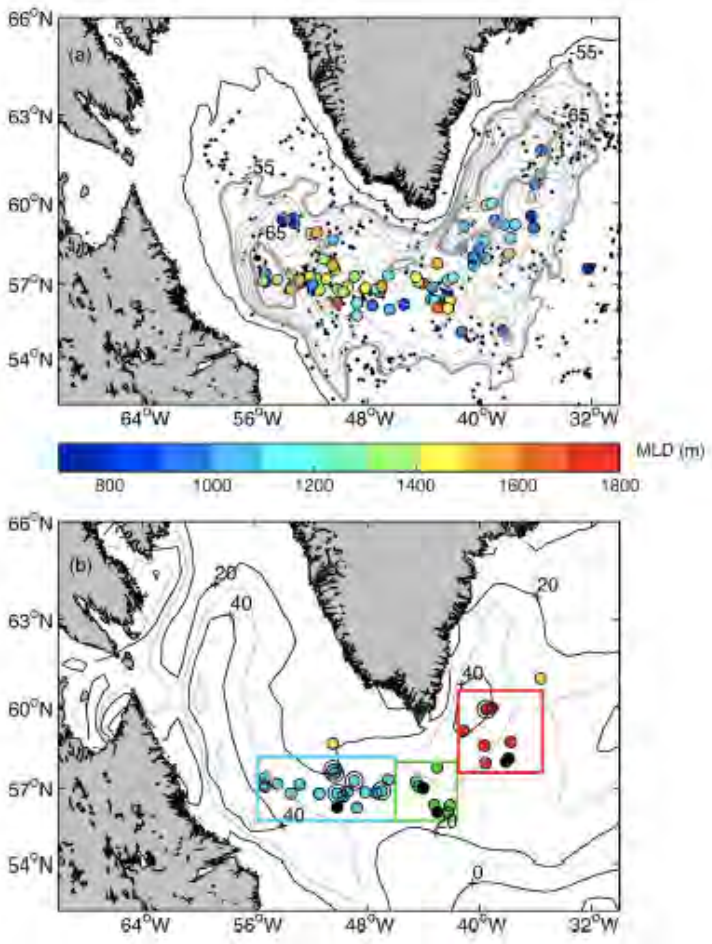


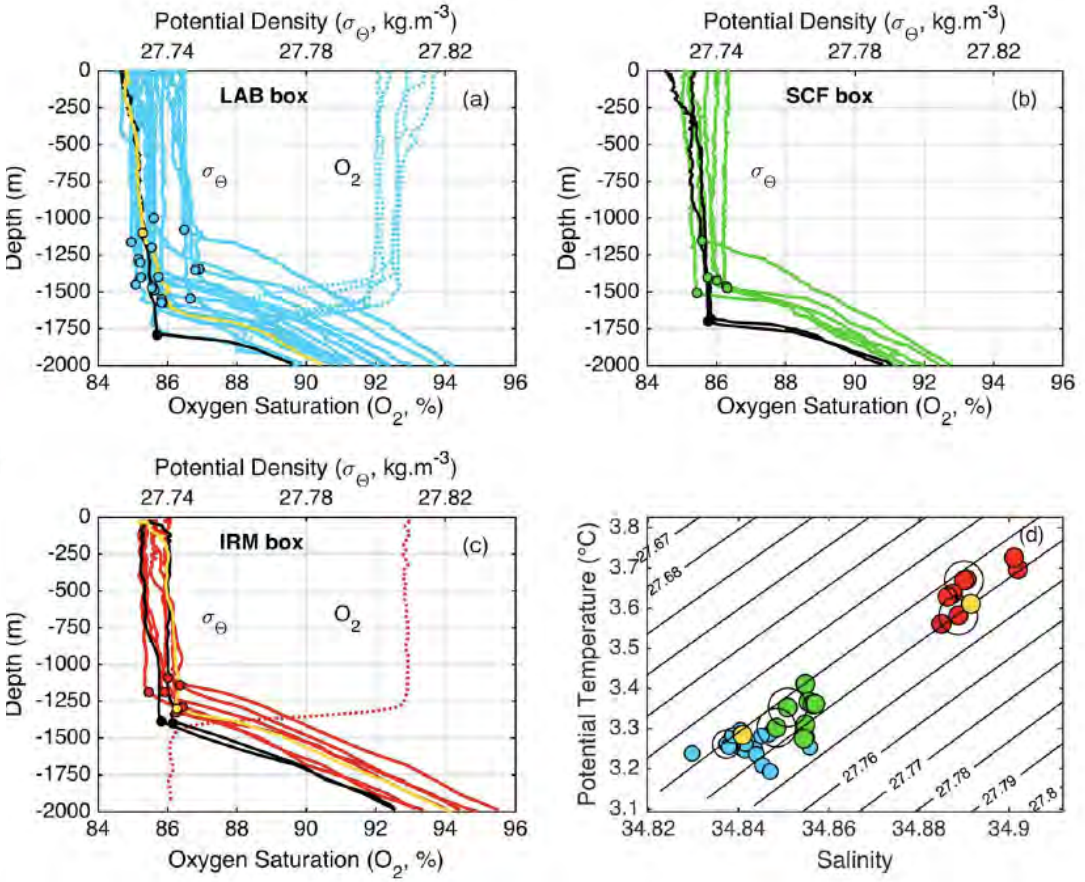


Racapé et al, 2019

Deep convection in the Irminger and Labrador Sea

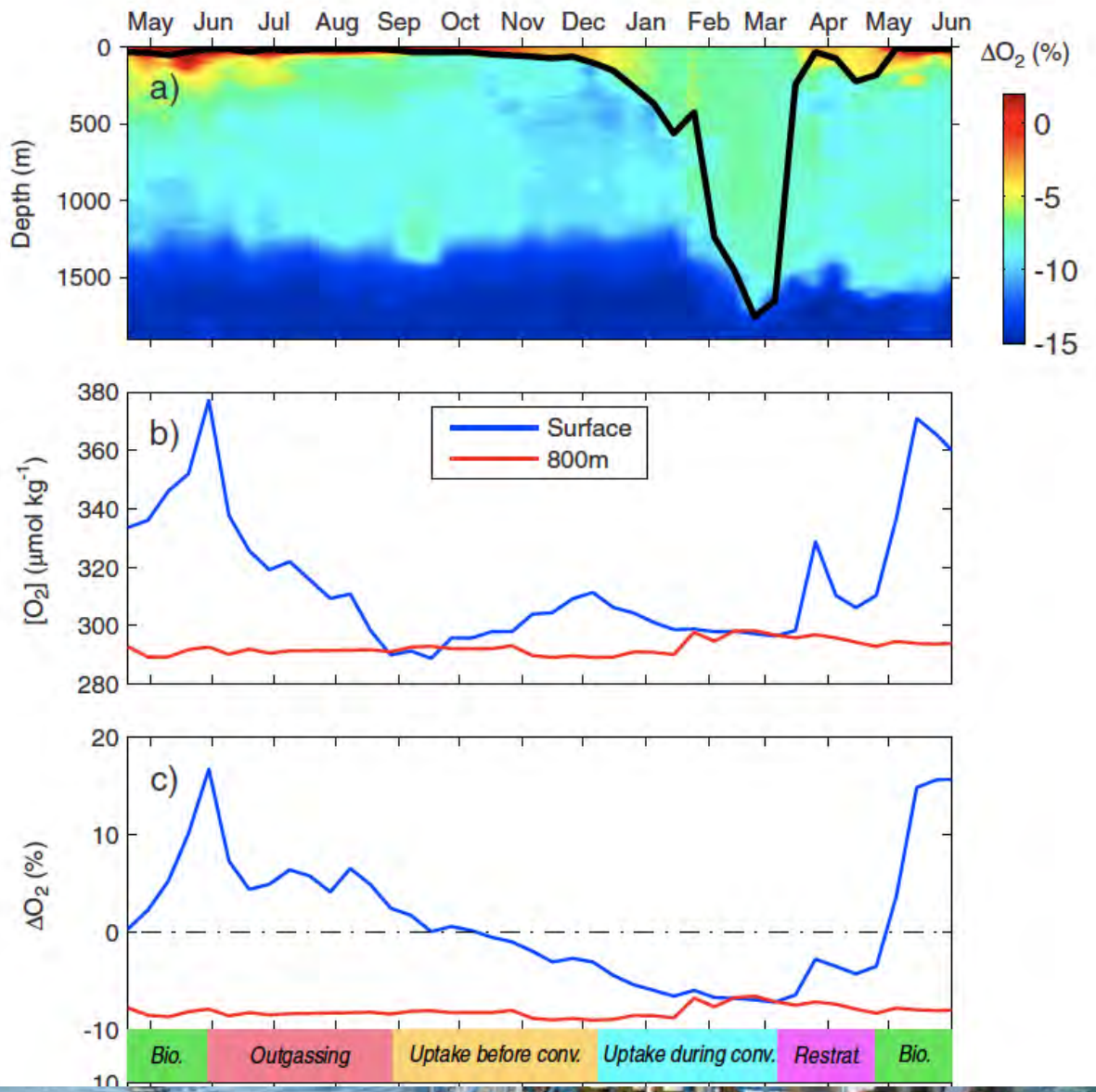
Winter 2014-2015 MLD





Piron et al, 2017

Labrador Sea would be a net sink for atmospheric oxygen



Wolf et al, 2018

Conclusions and perspectives: Data quality

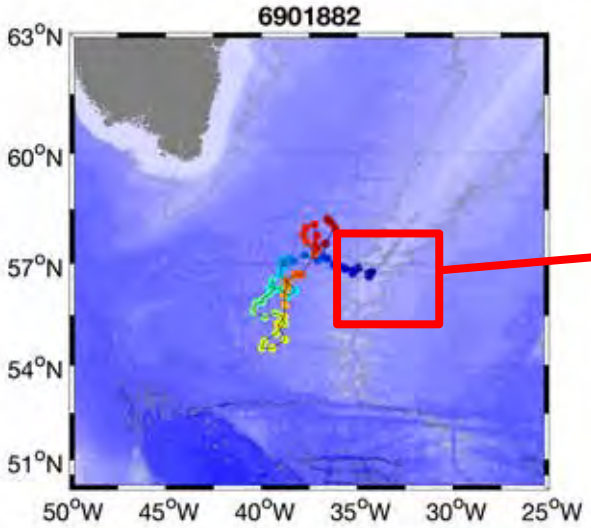
- **We demonstrated the value of the Deep-Argo data**
- **To go further, we designed the three-head Deep-Arvor floats**
  - Sensors intercomparison
  - Long-term stability
  - Two three-head Deep-Arvor floats should be deployed in 2020/2021 (H2020 Euro-Argo RISE project)

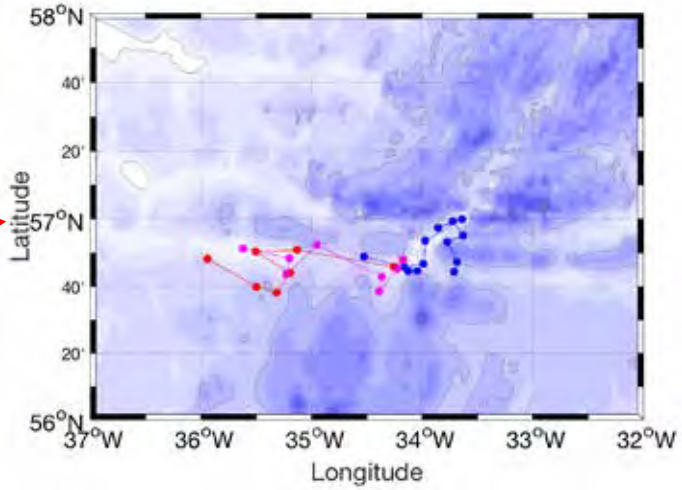
Conclusions and perspectives: Scientific results

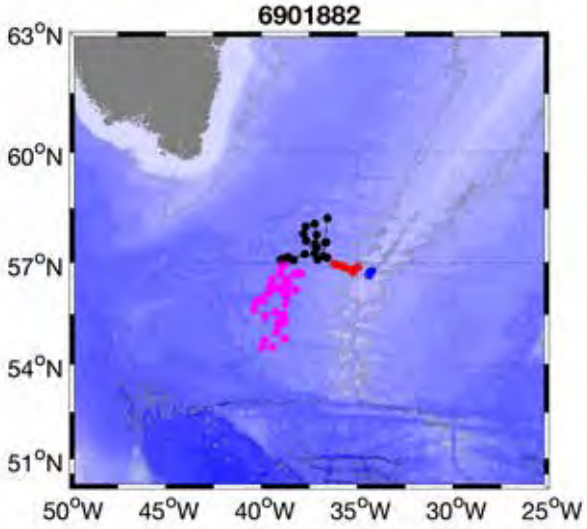
- Piron et al, DSR, 2016
- Le Reste et al, JAOT, 2016
- Piron et al.,GRL,2017
- Wolf et al, GBC, 2018
- Racapé et al., JGR, 2019
- Roemmich et al., FMS, 2019
- Bittig et al., FMS, 2019
- Zunino et al., OS, 2020
- Le Traon et al., FMS 2020

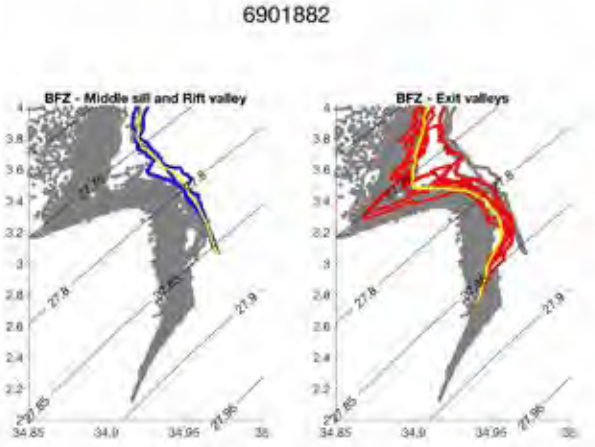
Investigate ISOW pathways downstream of Bight Fracture Zone

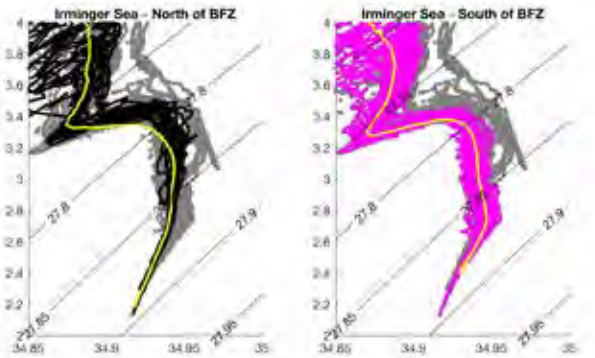
T. Petit, V. Thierry, H. Mercier





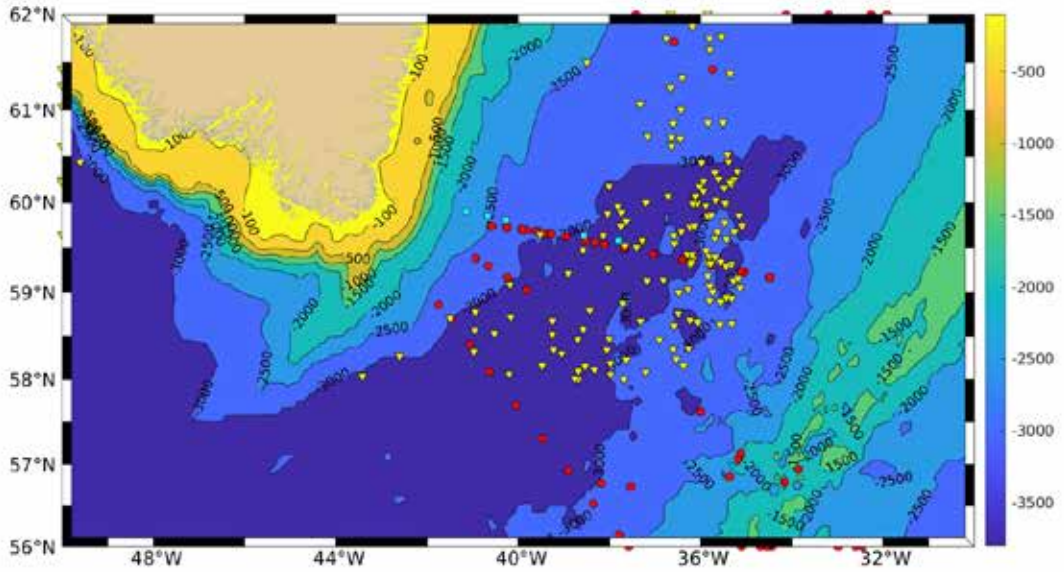


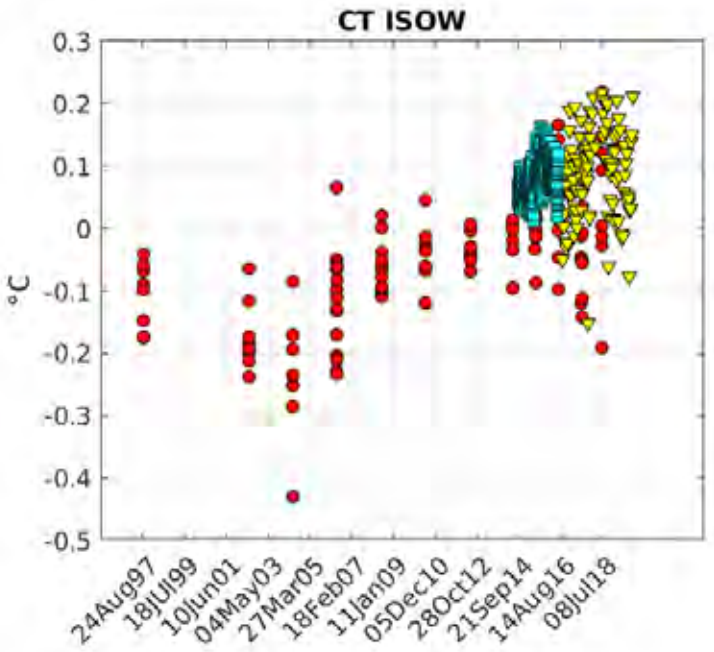




Interannual and decadal variability of ISOW

E. Pietro-Bravo, D. Desbruyères, V. Thierry





Hydrography (OVIDE, RREX) + Deep Argo + OSNAP moorings

post-doc Eva Pietro Bravo, H2020 Euro-Argo RISE

Conclusions and perspectives: Towards a sustain Deep-Argo array

- Results gained from NAOS where shared among the international communities
- They contributed at defining the new Argo program that is now global in extent, full depth and multi-disciplinary (Roemmich et al., 2019) and the European strategy
- Deep Argo component : 1250 active Deep Argo floats at 5 ° x5 ° spacing (Johnson et al., 2015) and cycling every 10 days
- Mixture of 4000 m and 6000 m floats to monitor, in a cost-effective manner, both the deep layer (2000-4000 m) and the abyssal layer (> 4000m)


Deep Argo Implementation Workshop 13-15th May 2019

Report on the 2nd Deep Argo Implementation Workshop

Hobart, May 13-15th 2019

The Deep Argo workshop committee: Nathalie Zilberman, Brian King, Sarah Purkey, Virginie Thierry, and Dean Roemmich

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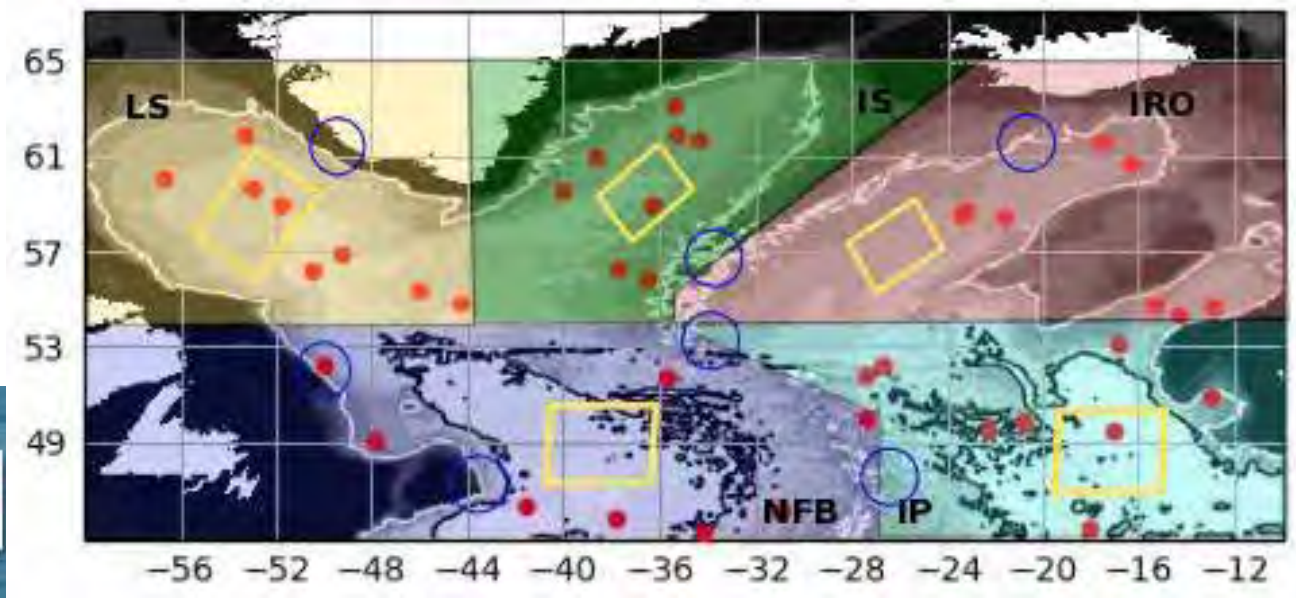
Towards a sustain Deep-Argo array

- **The transition from regional pilot array to global array :**
  - § maintenance and expansion of the spatial domain of the existing regional pilot array;
  - § initiation of new regional arrays, starting with areas where the deep layers are believed to undergo substantial decadal changes, seasonal cycles, or other variability, and that are close to deep-water and bottom-water formation sites.

- **France will follow those principles**
  - § Maintain the Deep-Argo array in the North-Atlantic and extends it southward
  - - Contribute in other locations (eg. Southern Ocean)



Le Traon et al, 2020