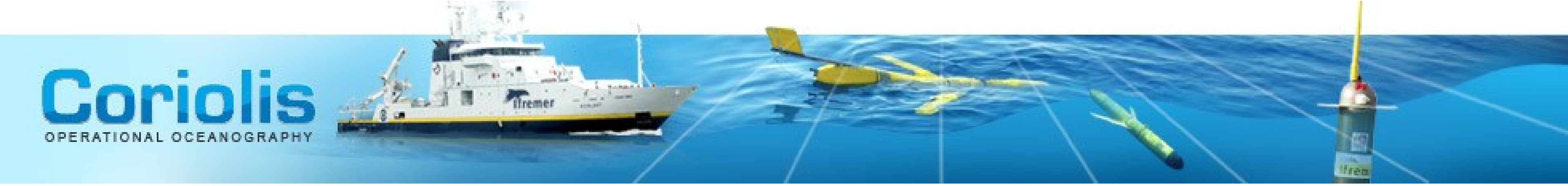
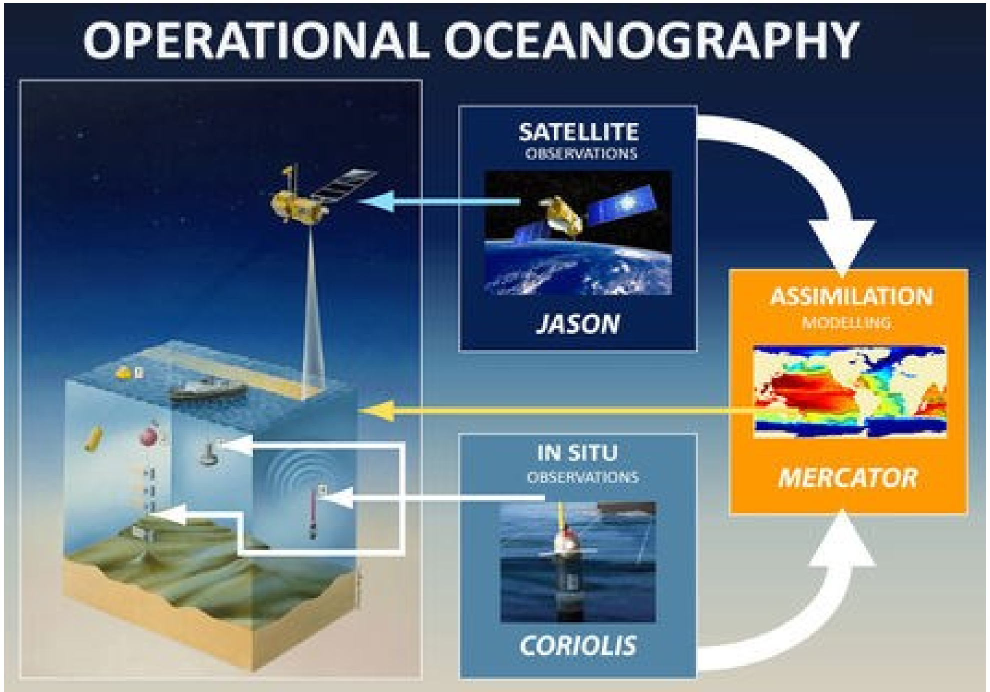


An In-Situ Service For Operational Oceanography

Goal: In-situ data portal for operational oceanography

Actors : 7 French institutes contributing to the French operational oceanography program for the in-situ observations

Role : Acquisition, collection, validation and dissemination of real-time and delayed mode in situ data for the global ocean.

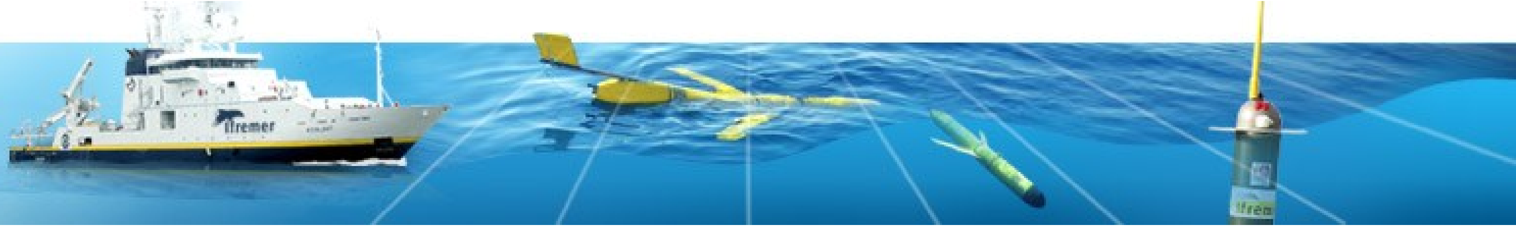


OPERATIONAL OCEANOGRAPHY

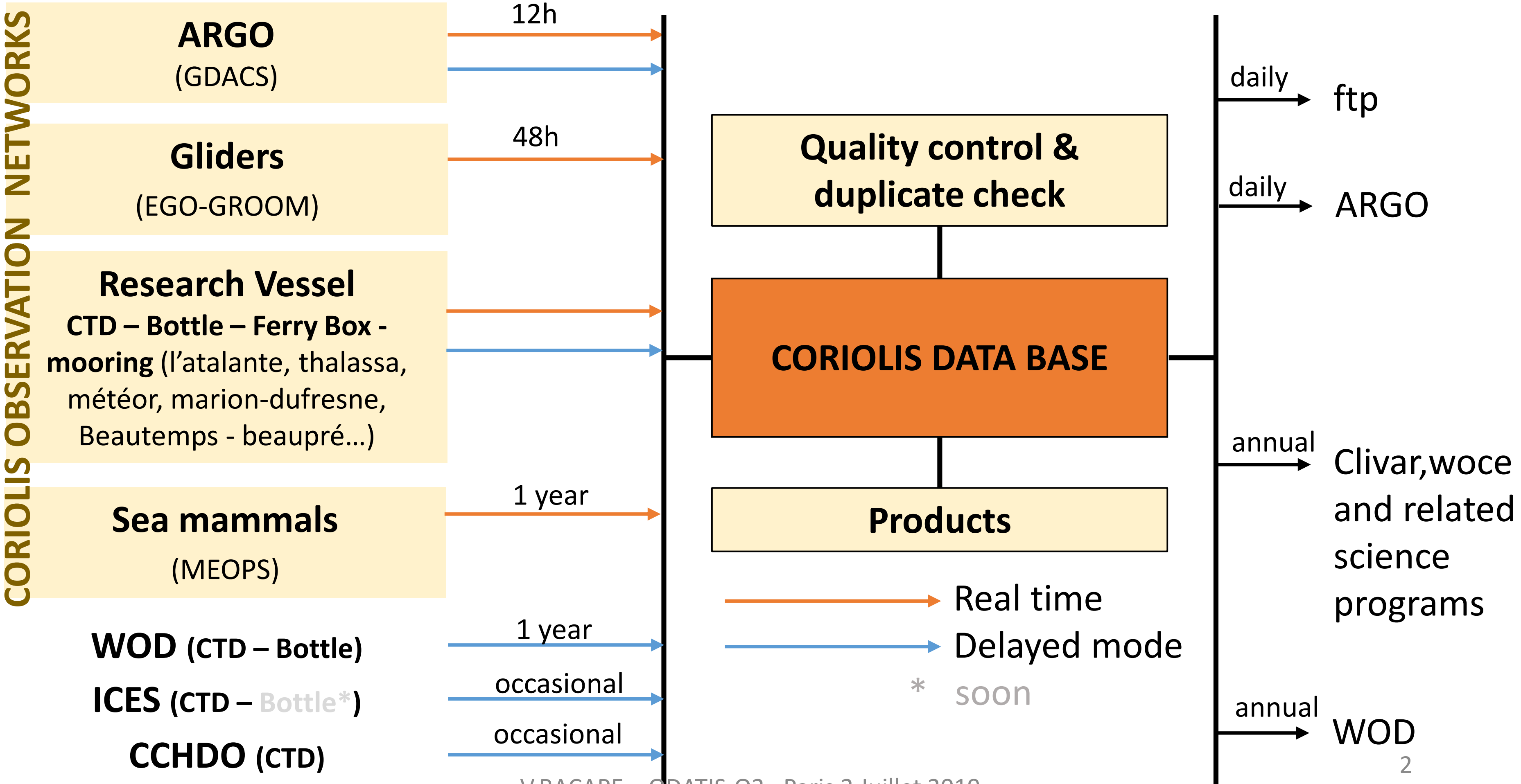
SATELLITE
OBSERVATIONS
JASON

ASSIMILATION
MODELLING
MERCATOR

IN SITU
OBSERVATIONS
CORIOLIS



O_2 flux throughout the Coriolis Data Center



CORIOLIS OBSERVATION NETWORKS

ARGO
(GDACS)
12h

Gliders
(EGO-GROOM)
48h

Research Vessel
CTD – Bottle – Ferry Box - mooring (l'atalante, thalassa, météor, marion-dufresne, Beautemps - beaupré…)

Sea mammals
(MEOPS)
1 year

WOD (CTD – Bottle)
1 year

ICES (CTD – Bottle*)
occasional

CCHDO (CTD)
occasional

Quality control & duplicate check

CORIOLIS DATA BASE

Products

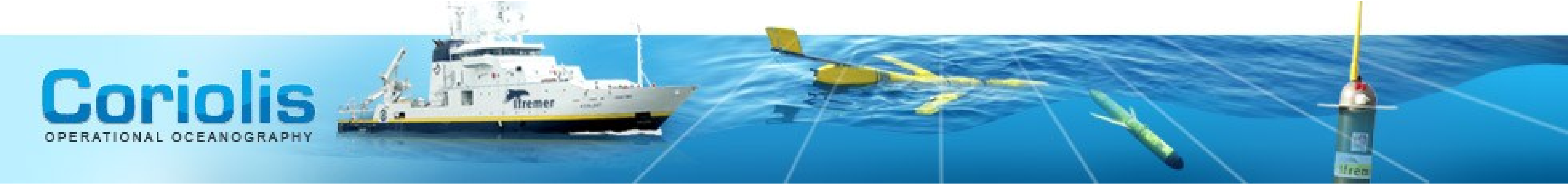
Real time
Delayed mode
* soon

daily ftp

daily ARGO

annual Clivar,woce and related science programs

annual WOD

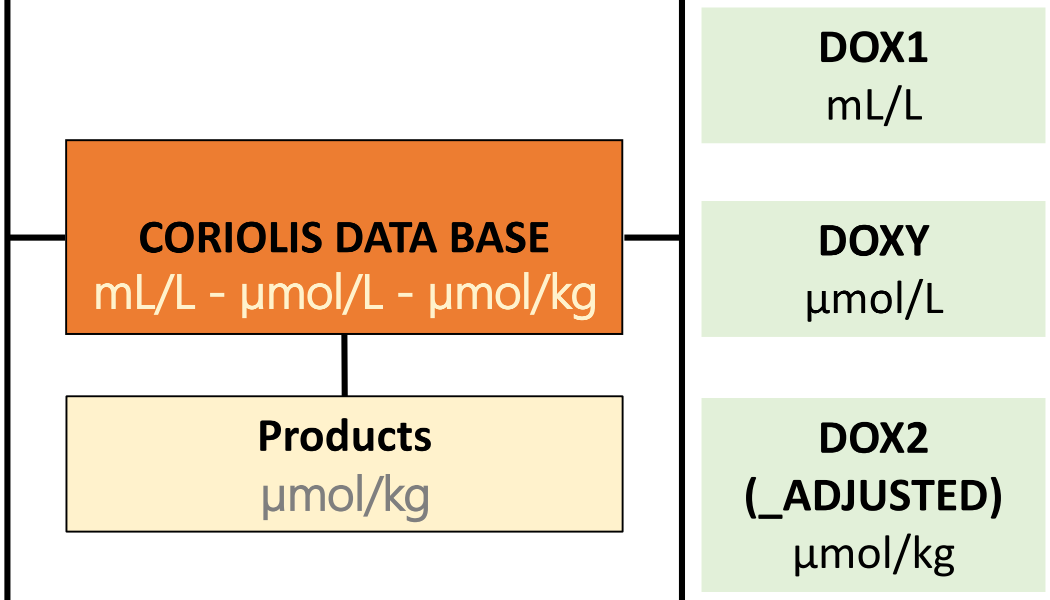


QC code and O_2 units in the Coriolis Data Base

QC CODE

Code	Meaning
0	No QC was performed
1	Good data
2	Probably good data
3	Bad data that are potentially correctable
4	Bad data
5	Value changed
6	Not used
7	Not used
8	Interpolated value
9	Missing value

Units



CORIOLIS DATA BASE
mL/L - µmol/L - µmol/kg

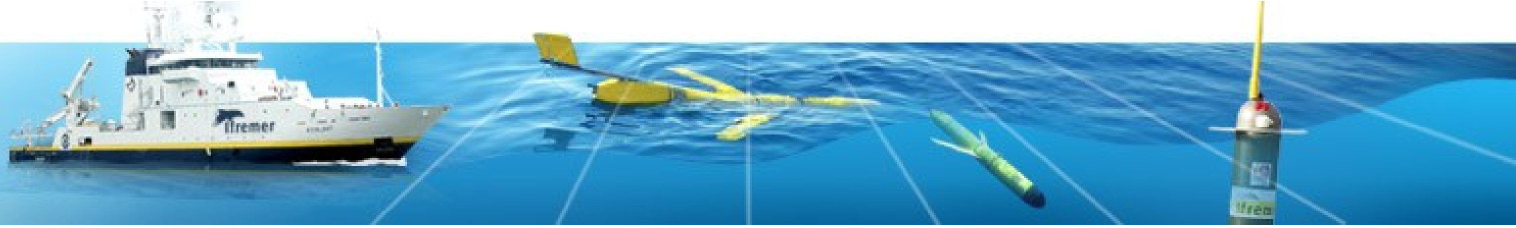
Products
µmol/kg

Variables

DOX1
mL/L

DOXY
µmol/L

DOX2 (_ADJUSTED)
µmol/kg



Duplicate check by Coriolis R&D

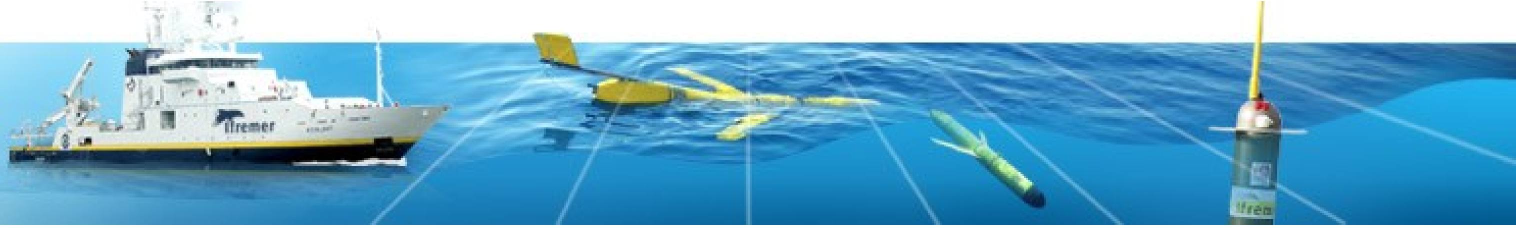
- All profiles with Δt and Δ(x,y) < 15' are considered as a duplicate *Automatic Query*
  - Performed on all profiles in the coriolis data base
  - Statut undistributed (like quarantine) up to human decision →
  - *Inconvenient* : require good metadata / doesn't take into consideration parameter values
- Frozen profiles test *return alert for human decision*
  - Performed on platform files
  - Test that complets previous query

Nota Bene

In the Coriolis data base, 1 **profile** is defined by **x,y,z,t,n parameters**

Human decision
1/ priority for data coming from french source 2/ priority to profile with the greatest number of parameters, to profile with original parameters…

Coriolis dissemination **by platform** = 1 file with all profiles from the same platform



First O_2 Quality Control by Coriolis R&D

Automatic Queries → ***As soon as data is loaded*** *(WOD,ICES,CCHDO,MEOP*)*

- **Check potential unit inversion**
- **Negative Pressure Test**
  DOX#_QC = 4 if and only if PRES/DEPH < 0 dbar/m
- **P&T&S QC Test*** *Only for µmol/kg*
  DOX#_QC = 4/3/4 if and only if PRES_QC **or** TEMP_QC **or** PSAL_QC = 4/3/Filled Value
- **Regional Range Test***
  Any QC modification due to this test will be controlled later by an operator

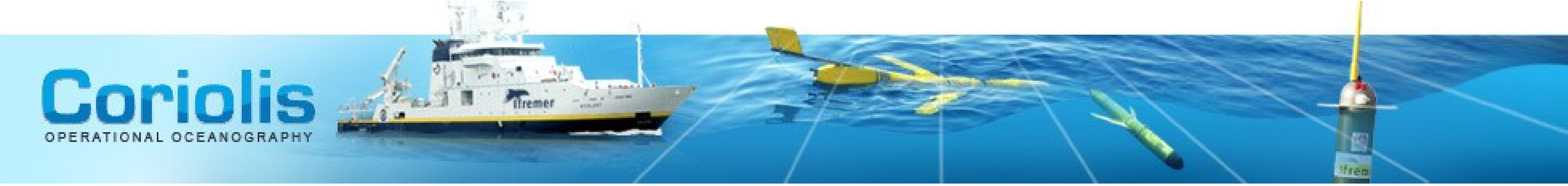
In progress

Alert controlled by an operator *(all sources / their application depend on the profile type)*

- **Check** :
  1/ Unit number and their relationships
  2/ data&QC association / QC=0?
- **P&T&S QC test** for data in µmol/kg
- **Negative pressure test**

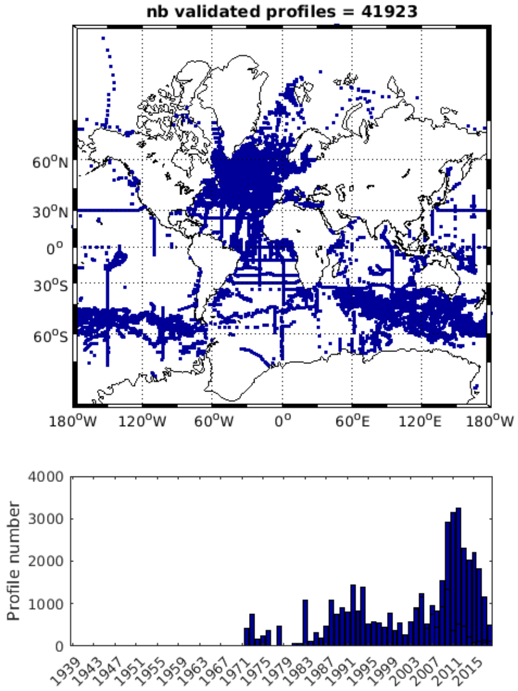
- **Regional Range Test**
- **Frozen Value test**
- **Spike test**
- **Frozen profile test** (for profile only)

In progress

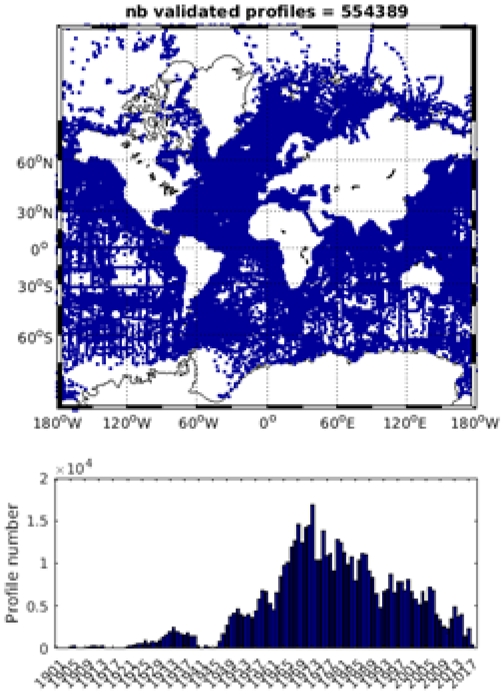


O_2 VALIDATED PROFILES IN THE CORIOLIS DATA BASE

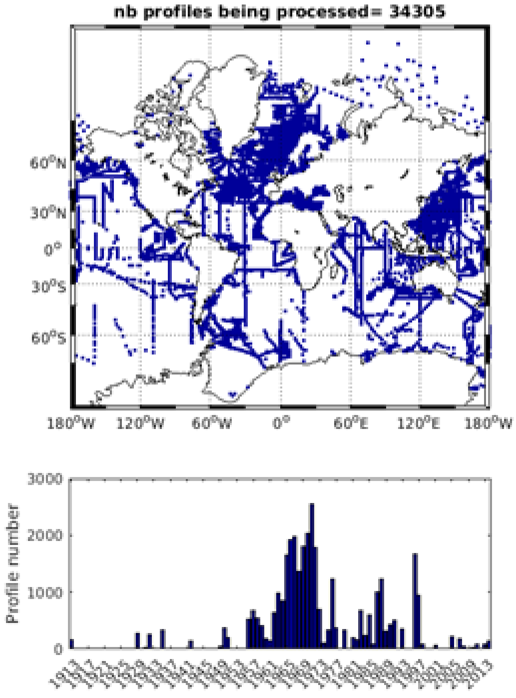
Work in progress

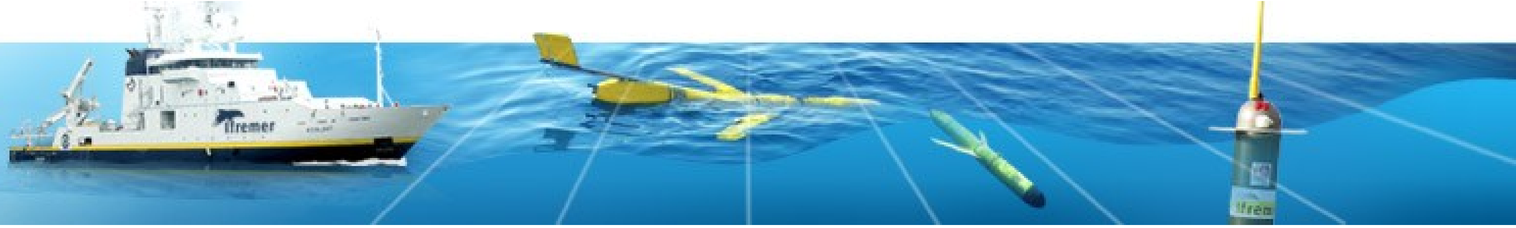


Including Argo float in DM



Including WOD CTD&BO

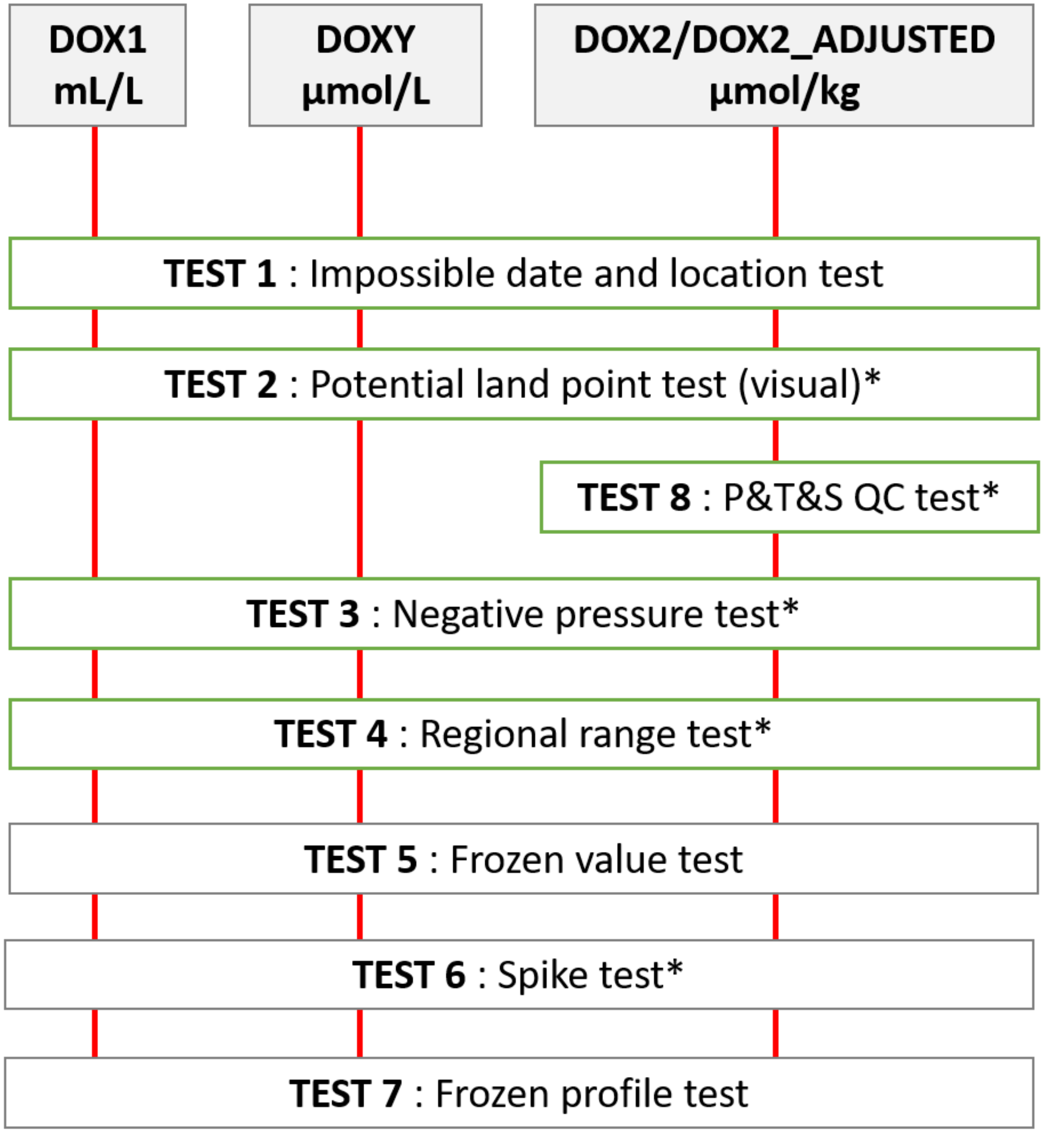




O_2 Products
Work in progress

- **INSITU_GLO_REP_OBSERVATIONS_013_046**
  Product of Copernicus Marine Environment Monitoring Service (http://www.marineinsitu.eu/)
  Availability : September 2019
  Content : All vertical profiles (CTD-BO-PF-SM-ML) validated by the first O_2 QC procedure
  (including ARGO floats in DM only)
  Validation : First O_2 QC procedure
  Saturation Test
  Comparison with WOD18
  Unit : µmol/kg

- Objective Analysis unsing ISAS-O2
  Content : All vertical profiles (CTD-BO-PF-SM) validated by the first O_2 QC procedure
  (including ARGO floats in DM only)
  First guest : WOD / home first guest using bottle from Glodap_v2
  Starting September 2019
  Unit : µmol/kg



DOX1
mL/L

DOXY
µmol/L

DOX2/DOX2_ADJUSTED
µmol/kg

TEST 1 : Impossible date and location test

TEST 2 : Potential land point test (visual)*

TEST 8 : P&T&S QC test*

TEST 3 : Negative pressure test*

TEST 4 : Regional range test*

TEST 5 : Frozen value test

TEST 6 : Spike test*

TEST 7 : Frozen profile test

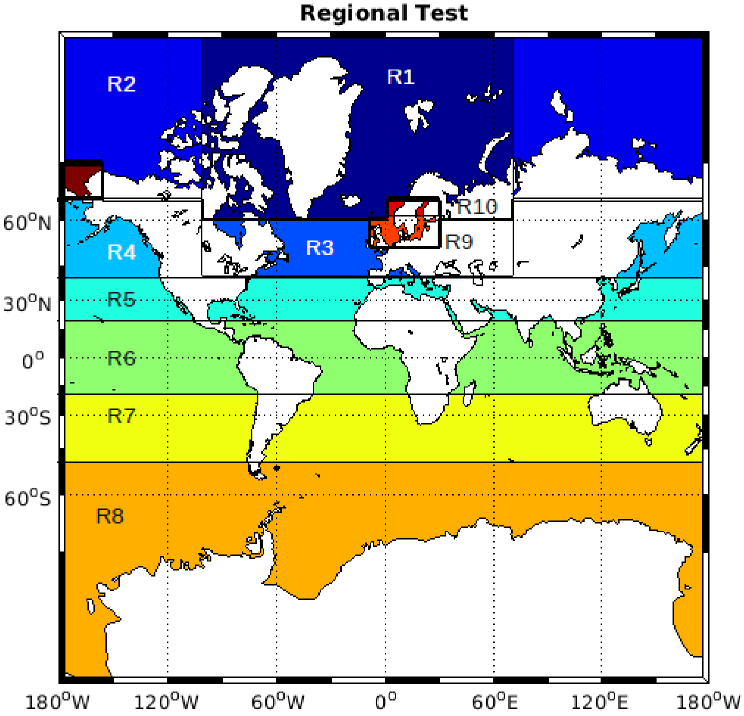
→ Profiles (CT, SM, ML and MO)

☐ Isolated Samples (BO)

* Tests applied in addition to ARGO recommendation (PF)

Regional Range Test

<u>Definition of the thresholds for the NRT-regional range test</u> (conversion using mean(rho) = 1.025 kg/L and V(O2) 44.6596 µmol/ml (SCOR 142)



Global Basin

<u>R1 : 60°N to 90°N - 100°W to 70°E (ARCT-ATL)</u>

40 to 600 µmol/kg | 41 to 615 µmol/L | 0.9 to 13.8 mL/L

<u>R2 : 65°N to 90°N - 70°E to 100°W (ARTC – PAC)</u>

40 to 600 µmol/kg | 41 to 615 µmol/L | 0.9 to 13.8 mL/L

<u>R3 : 40°N to 60°N - 100°W to 70°E (ARCT-ATL)</u>

-5 to 600 µmol/kg | -5 to 615 µmol/L | -0.1 to 13.8 mL/L

<u>R4 : 40°N to 65°N - 70°E to 100°W (ARTC – PAC)</u>

-5 to 600 µmol/kg | -5 to 615 µmol/L | -0.1 to 13.8 mL/L

<u>R5 : 20°N to 40°N</u>

-5 to 500 µmol/kg | -5 to 512.5 µmol/L | -0.1 to 11.5 mL/L

<u>R6 : 20°S to 20°N</u>

-5 to 400 µmol/kg | -5 to 410 µmol/L | -0.1 to 9.20 mL/L

<u>R7 : 50°S to 20°S</u>

-5 to 500 µmol/kg | -5 to 512.5 µmol/L | -0.1 to 11.5 mL/L

<u>R8 : 90°S to 50°S</u>

50 to 600 µmol/kg | 51.25 to 615 µmol/L |1.15 to 13.8 mL/L

Baltic Sea and north seas

<u>R9 : 52°N to 60°N / 8°W to 30.34°E</u>

-5 to 27 mL/

<u>R10 : 60°N to 65.84°N / 1.3°E to 30.34°E</u>

-5 to 567 µmol/kg | -5 to 581 µmol/L | -0.1 to 13 mL/L

Chukchi sea

<u>R11 : 65°N to 73°N / 180°W to 155°W</u>

-5 to 780 µmol/KG | -5 to 800 µmol/L | -0.1 to 18 mL/L

A method testing the statistical entropy change caused by the instrument

Based on a 2 step estimation of the modified Akaike information criterion (UEDA, 2009):

UEDA, T. 2009. A simple method for the detection of outliers. Electronic Journal of Applied Statistical Analysis, 67-76

A vertical sliding window of 5 data
centered on 1 potential outlier [x_{i-2} x_{i-1} x x_{i+1} x_{i+2}]
constrained by distance between 2 samples
[$\Delta Z < 5$db for $Z > 10$db] [$\Delta Z < 50$bd for $10<Z<100$]
[$\Delta Z < 200$dbar for $100<Z<998$] [$\Delta Z<500$dbar for $Z>998$dbar]

$$Ut=\frac{1}{2}AIC=ng\square\log(sigma+1)-term2$$

$$term2=nb-\frac{\log(n!)}{n}\square\sqrt{\,}$$

$$sigma=\sqrt{\frac{\sum_{2}(x_i-x)}{ng}}$$

First step (Ut_1) = without the outlier [x_{i-2} x_{i-1} x_{i+1} x_{i+2}]
n(total)=4 , ng(good data)=4, nb(bad data)=0

Second Step (Ut_2) = **with the outlier** [x_{i-2} x_{i-1} **x** x_{i+1} x_{i+2}]
n(total)=5, ng=4, nb=1

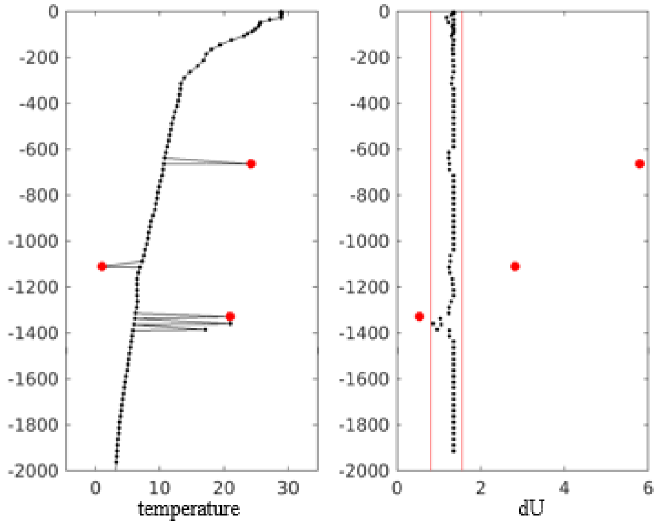
dU=abs(Ut1)-Ut2)
~
Δlog(sigma+1) - term2

X is an outlier if dU>dUcrit

How to estimate dUcrit ?
depending on parameter (accuracy),
on vertical region (natural variability)

T&S dUcrit-pos = 1,15*98th percentil of dU
dUcrit-neg = 0,85*98th percentil of dU

O_2 window extension to 7 data (variability)
dUcrit = 1,75*98th percentil of dU



(example for 100 data and 2 potential outliers)

A method based on vertical median and standard deviation
By D. Dobbler

Based on human eye visual work:

where normally should the points be?

A vertical **sliding median** is computed with its sliding window expressed in [dbar] and depending on vertical layers

If less than 5 points to compute median, the sliding window is extended to cover 5 points in the limitation of 500 dbar extension.

Depths [dbar]	Sliding window [dbar]
< 500	50
500 – 1200	200
> 1200	300

what's the variability of my data, depending on the vertical layer?

- **Standard deviation** is computed on different vertical layers (**one value per layer**)
- The result is bounded by a given domain :

Pressions [dbar]	TEMP_std range [°C]	PSAL_std range [PSU]	DOXY_std range [micromole/kg]
< 10	= 8	=1.1	= 70
10 - 500	[0.5 6]	[0.1 0.9]	[2.5 50]
500 - 1200	[0.5 2]	[0.07 0.3]	[2.5 25]
> 1200	[0.5 2]	[0.07 0.3]	[2.5 25]

Is my point out of what I expect to see (i.e. : out of normal location +/- the variability) ?

Test_value= (PARAM – PARAM_med > n_std * PARAM_std) in the following n_std=1