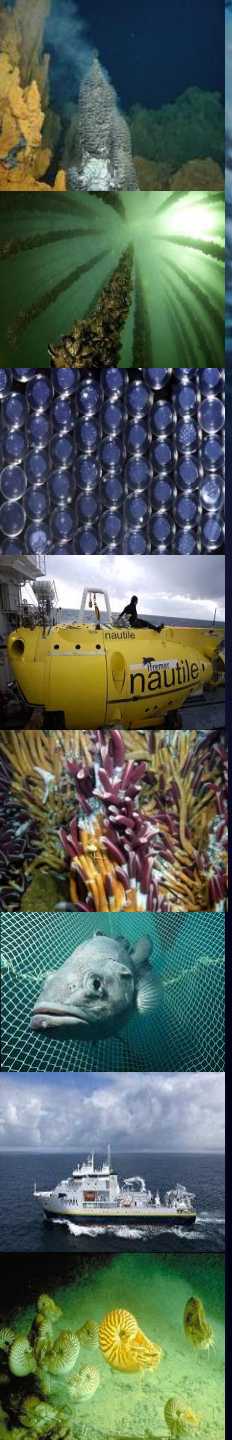
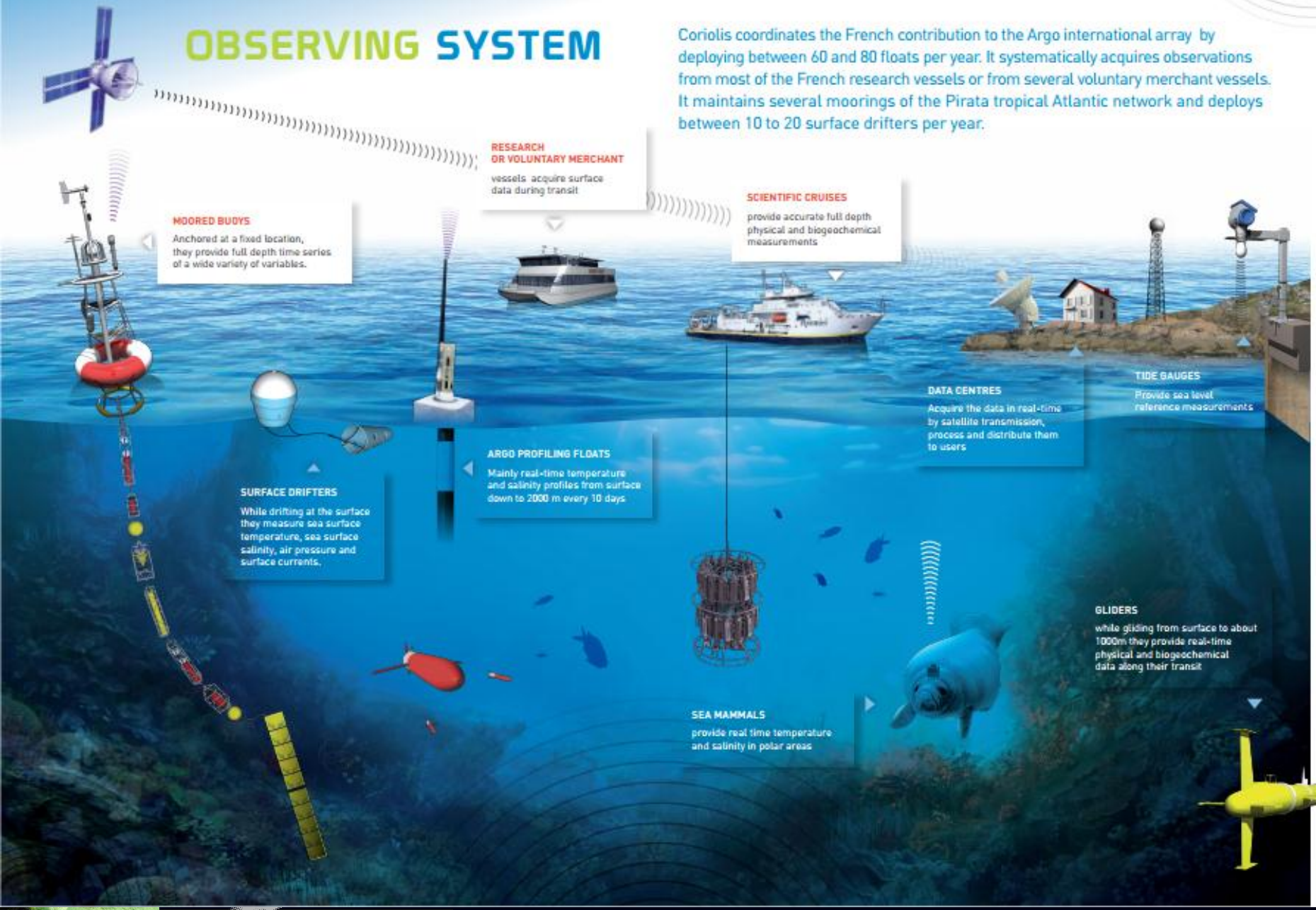


Coriolis Quality Control System

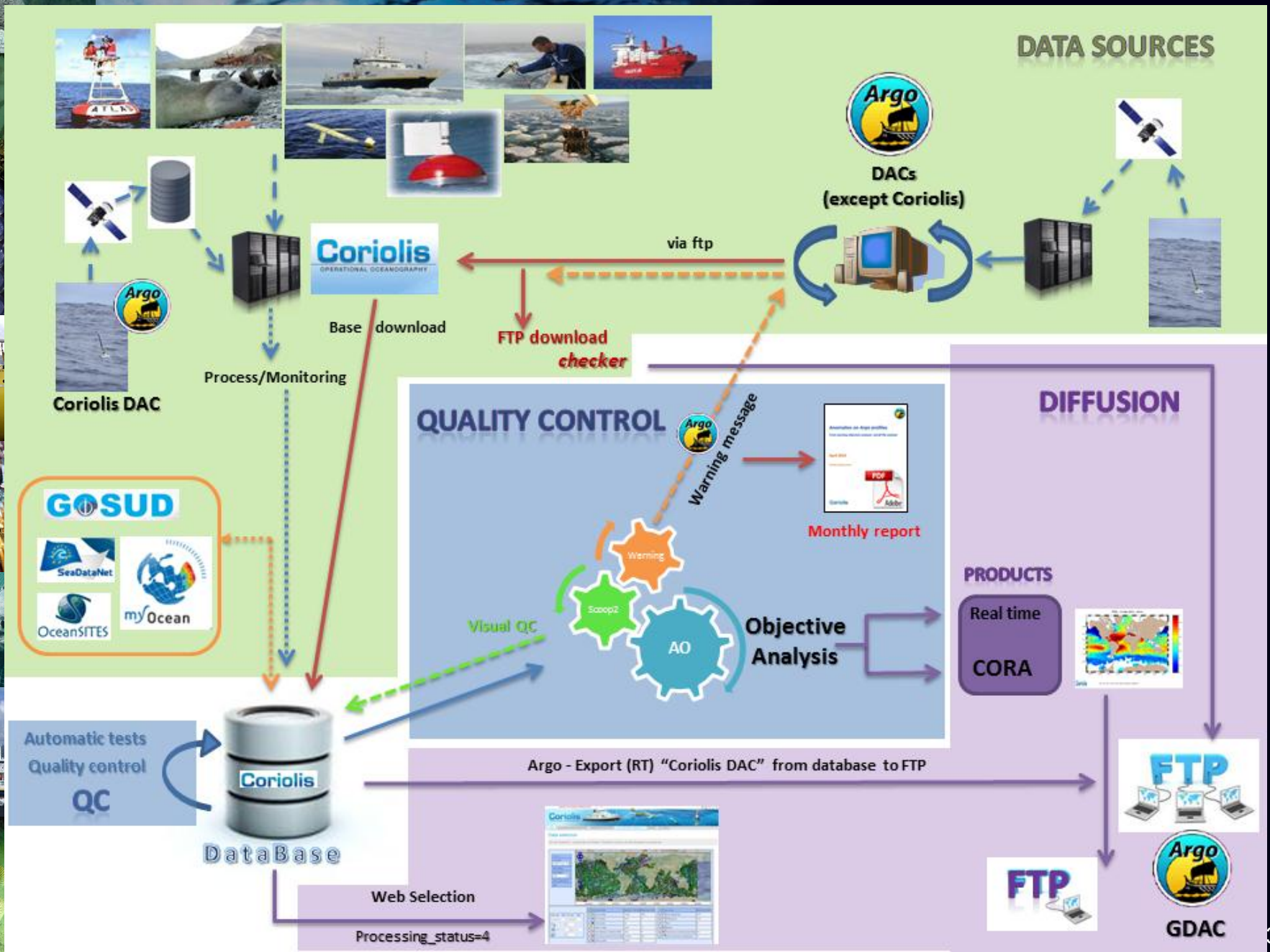
Christine Coatanoan, Thierry Carval
& Coriolis Team
Christine.Coatanoan@ifremer.fr

OBSERVING SYSTEM

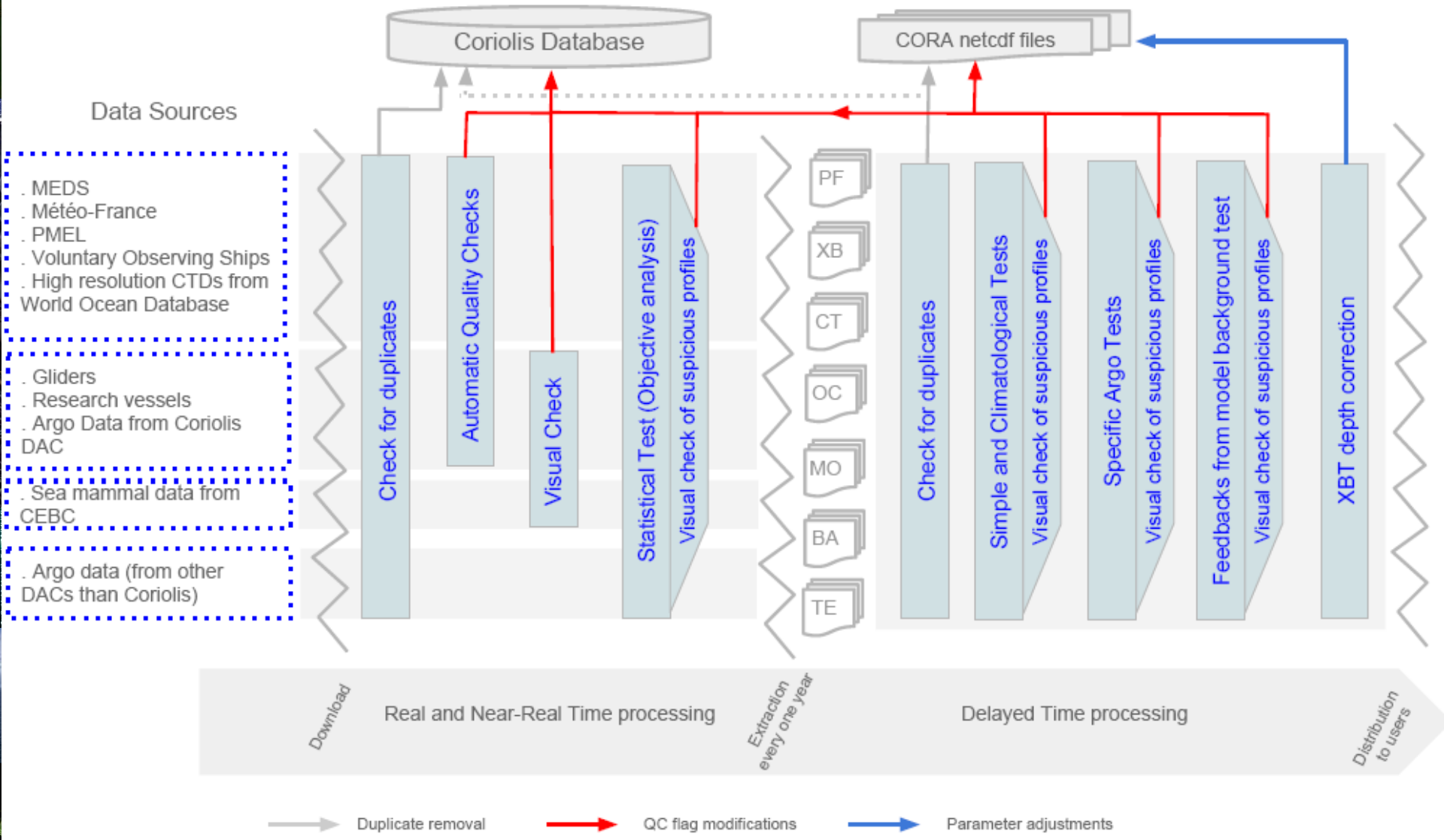
Coriolis coordinates the French contribution to the Argo international array by deploying between 60 and 80 floats per year. It systematically acquires observations from most of the French research vessels or from several voluntary merchant vessels. It maintains several moorings of the Pirata tropical Atlantic network and deploys between 10 to 20 surface drifters per year.



Data flow in Coriolis database & Quality Control



From Real time to Delayed Mode



Quality control in Coriolis data

Real Time - Automatic tests (based on the ARGO project)

- - test 1: Platform Identification
- - test 2: Impossible Date Test
- - test 3: Impossible Location Test
- - test 4: Position on Land Test
- - test 5: Impossible Speed Test
- - test 6: Global Range Test
- - test 7: Regional Global Parameter Test for Red Sea and Mediterranean Sea
- - test 8: Pressure Increasing Test
- - test 9: Spike Test
- - test 10: Top and Bottom Spike Test
- - test 11: Gradient Test
- - test 12: Digit Rollover Test
- - test 13: Stuck Value Test
- - test 14: Density Inversion
- - test 15: Grey List
- - test 16: Gross salinity or temperature sensor drift

CODE	SIGNIFICATION
0	NOT CONTROLLED VALUE
1	CORRECT VALUE
2	VALUE INCONSISTENT WITH STATISTICS
3	DOUBTFUL VALUE (Gradient,...)
4	FALSE VALUE (Out of scale, constant profile, vertical instability
5	VALUE MODIFIED DURING QC (interpolation location or date)
6-8	Not USED
9	MISSING VALUE

Visual control: for some data types

Global controls: residuals from objective analysis detect anomalies (& visual control)

Objective Analysis ISAS

(F.Gaillard, LPO, Ifremer)

The operational analysis system set up by the IN SITU TAC Global component operated by CORIOLIS data center. It produces temperature and salinity gridded fields. The system is based on an statistical estimation method (objective analysis). This system allows presenting a synthesis and a validation of the dataset, providing a support for localized experience (cruises), providing a validation source for operational models, observing seasonal cycle and inter-annual variability. It is the In Situ Objective analysis operational nominal product for the Global Ocean. The dataset contains data from different types of instruments: mainly Argo floats, XBT, CTD and XCTD, and Mooring. The data are stored in 7 files types: PF, XB, CT, OC, MO, BA, TE.

This system is operated by the IN SITU TAC on different time scales :

REAL-TIME OBJECTIVE ANALYSIS

NEAR-REAL TIME OBJECTIVE ANALYSIS

DELAYED MODE OBJECTIVE ANALYSIS

OA Output = gridded field & for each profile using for analysis : calculated residuals from analysis of the day *(ISAS method - F. Gaillard (LPO-Ifremer))*.

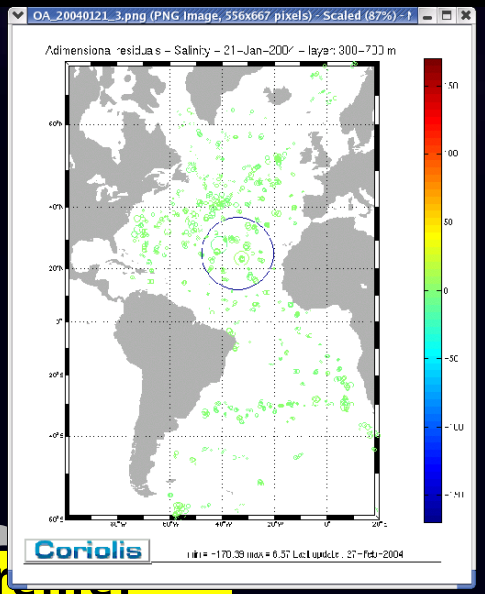
At the data center:

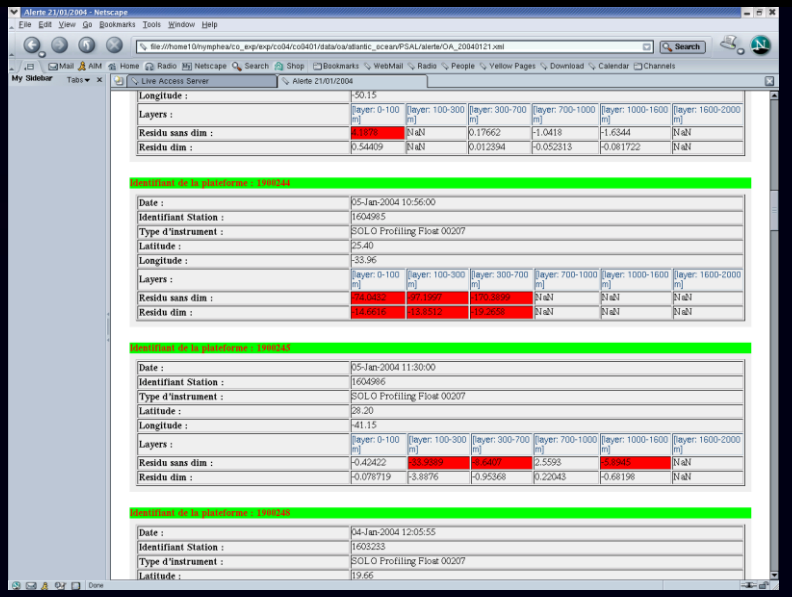
1/ additional calculation to define a new residual at each level, using 3 variables calculated by OA : residuals, errors coming from not resolute scales and errors on the parameter interpolation .

2/ calculation of the mean for the new residuals for 6 layers of depth (0-100m, 100-300m, ...).

3/ comparison of the 6 mean values and values calculated for each profile at each level with customizable thresholds.

If one of those residuals is higher than defined “red” threshold (4 for residuals means on 6 depth layers and 8 for residuals at each level), the profile is in warning to be check by an operator.





OBJECTIVE ANALYSIS ALERT/ANOMALIES

Daily : RT Objective analysis (version 6.2)

Detection on anomalies => alert in the database in the historical field of the stations (QCTEST)

Station with alert => (RTQCGL01) to be controlled visually

When QC is changed in our database, information sent to the DAC

2014 : QCTEST IN (1,2,3,4,5,6) – OA version < 6.2

End of 2014 – April 2015 : QCTEST IN (1,2,3,4)

Since May 2015 : QCTEST IN (1,2,3,4,5)

Alert definition

- 1: standardization (test to the standard deviation failed)
- 2: analysis failed - inexistent
- 3: red analysis (residuals / threshold)
- 4: undefined analysis
- 5: spike/offset climatology
- 6: white analysis - no visual control, for the delayed mode study

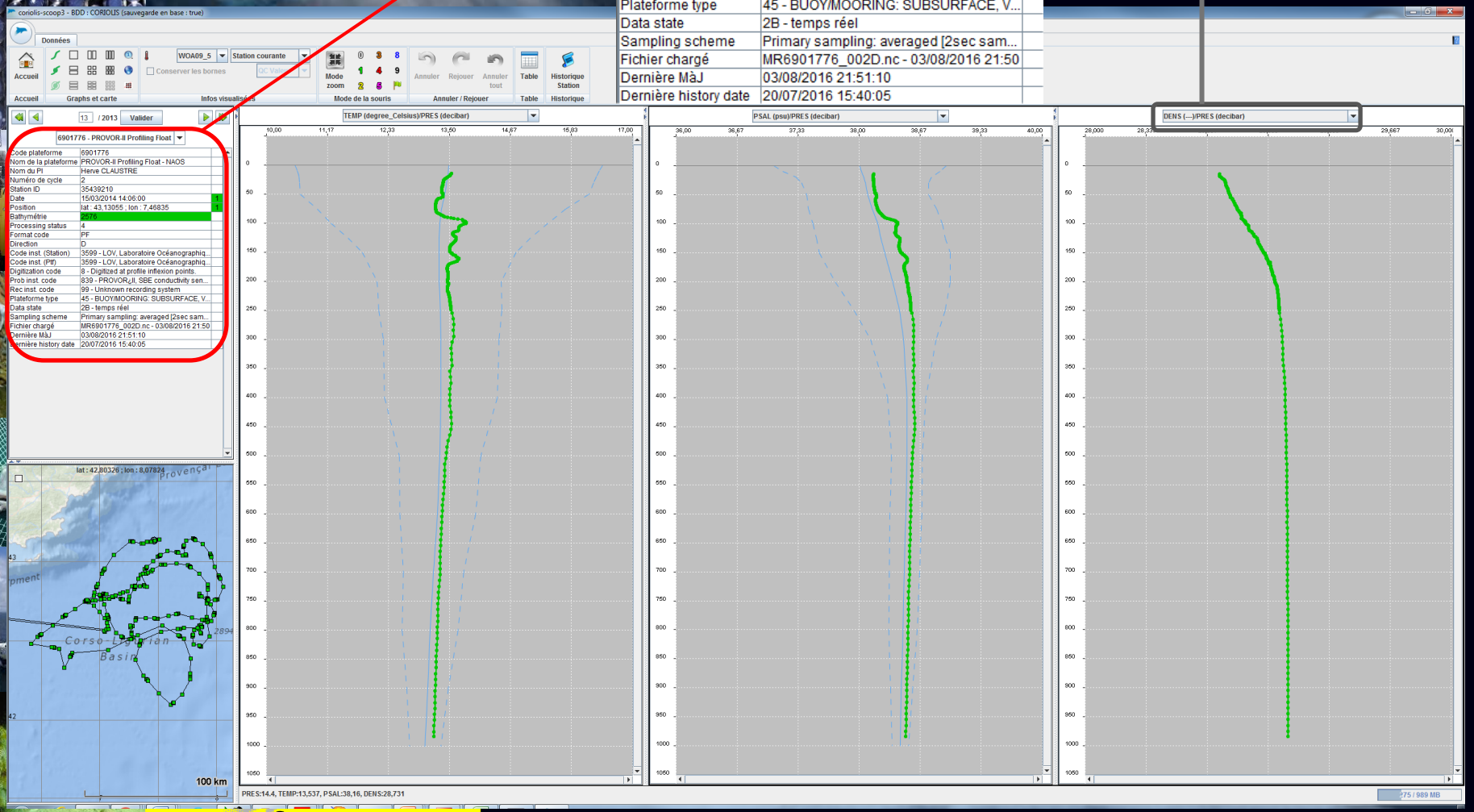
Ifremer

Visual control : SCOOP

Code plateforme	6901776	
Nom de la plateforme	PROVOR-II Profiling Float - NAOS	
Nom du PI	Herve CLAUSTRE	
Numéro de cycle	2	
Station ID	35439210	
Date	15/03/2014 14:06:00	1
Position	lat : 43,13055 ; lon : 7,46835	1
Bathymétrie	2576	
Processing status	4	
Format code	PF	
Direction	D	
Code inst. (Station)	3599 - LOV, Laboratoire Océanographiq...	
Code inst. (Ptf)	3599 - LOV, Laboratoire Océanographiq...	
Digitization code	8 - Digitized at profile inflexion points.	
Prob inst. code	839 - PROVOR¿II, SBE conductivity sen...	
Rec inst. code	99 - Unknown recording system	
Plateforme type	45 - BUOY/MOORING: SUBSURFACE, V...	
Data state	2B - temps réel	
Sampling scheme	Primary sampling: averaged [2sec sam...	
Fichier chargé	MR6901776_002D.nc - 03/08/2016 21:50	
Dernière MàJ	03/08/2016 21:51:10	
Dernière history date	20/07/2016 15:40:05	

DENS (---)/PRES (decibar)

- TEMP (degree_Celsius)/PRES (decibar)
- PSAL (psu)/PRES (decibar)
- DENS (---)/PRES (decibar)
- DOWNWELLING_PAR (micromol m-2 s-1)/PRES (decibar)
- CPHL_ADJUSTED (milligram/m3)/PRES (decibar)
- CPHL (milligram/m3)/PRES (decibar)
- DOWN_IRRADIANCE412 (W m-2 nm-1)/PRES (decibar)
- DOWN_IRRADIANCE380 (W m-2 nm-1)/PRES (decibar)



Ifremer

OCL temperature profiles analysis

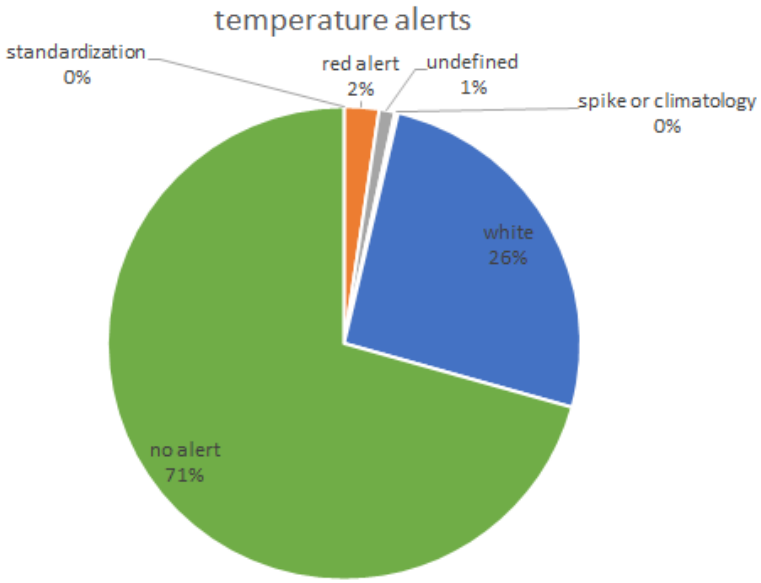
A total of 5492 OCL csv files (*.XBT*.csv, *.CTD*.csv)

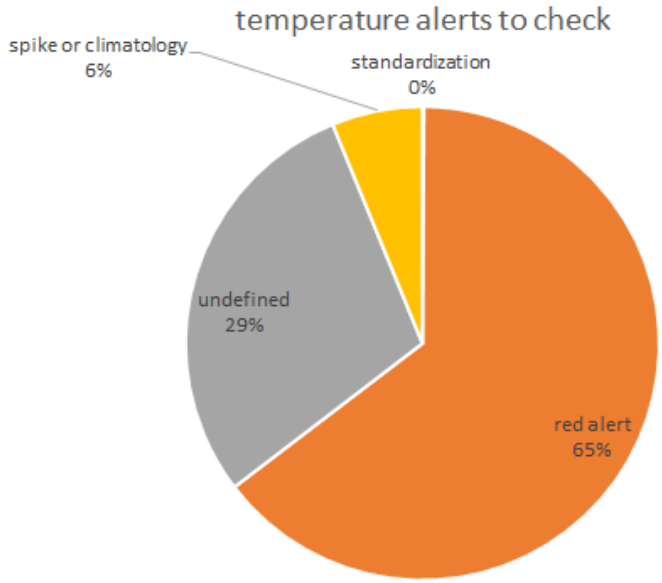
A total of 2 081 876 temperature profiles analysed

Ifremer

OCL temperature profiles analysis

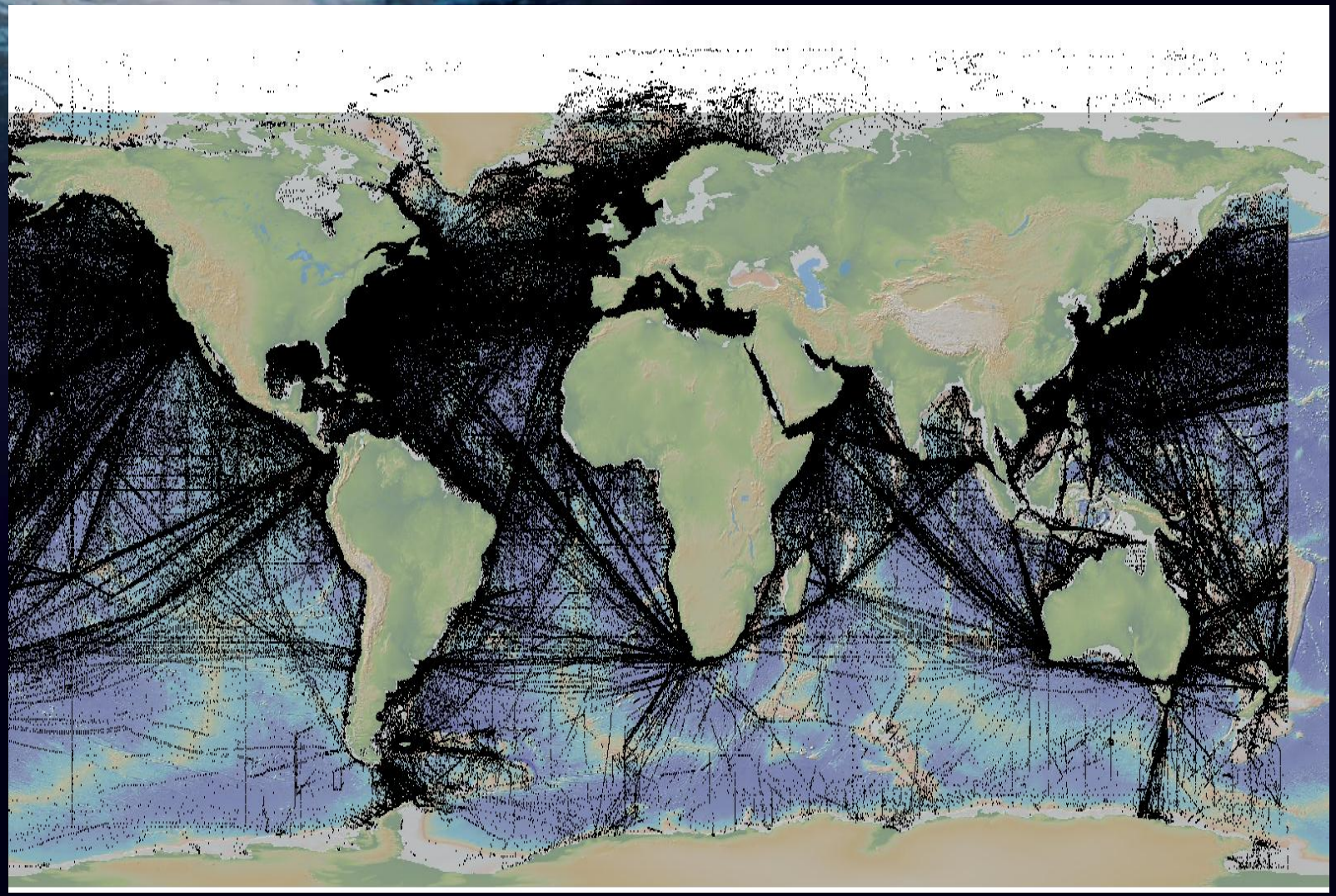
parameter	alert	alert label	nb profiles
TEMP	1	standardization	75
TEMP	3	red alert	49 419
TEMP	4	undefined	22 355
TEMP	5	spike or climatology	4 746
TEMP	6	white	534 389
TEMP		no alert	1 470 892



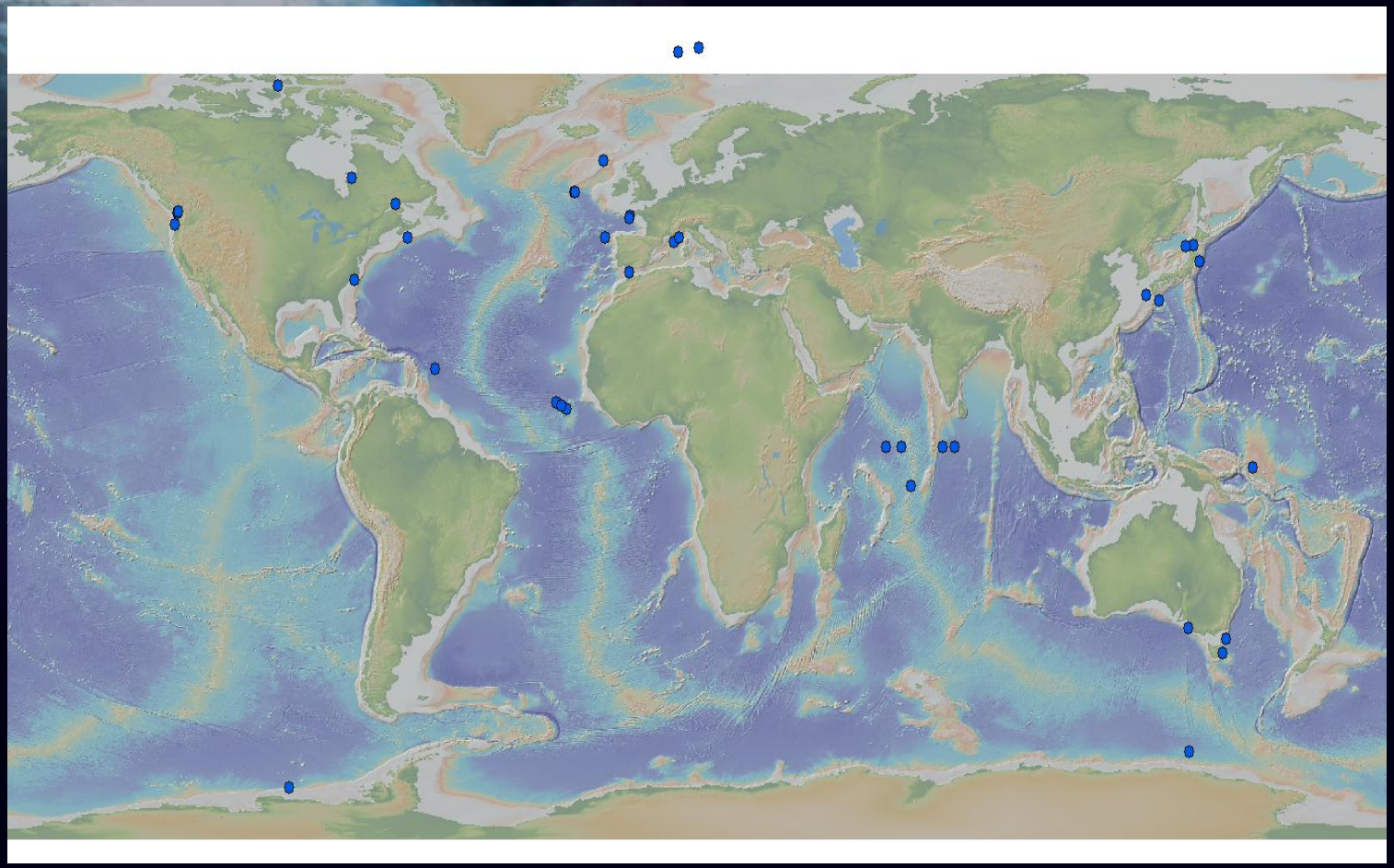


Ifremer

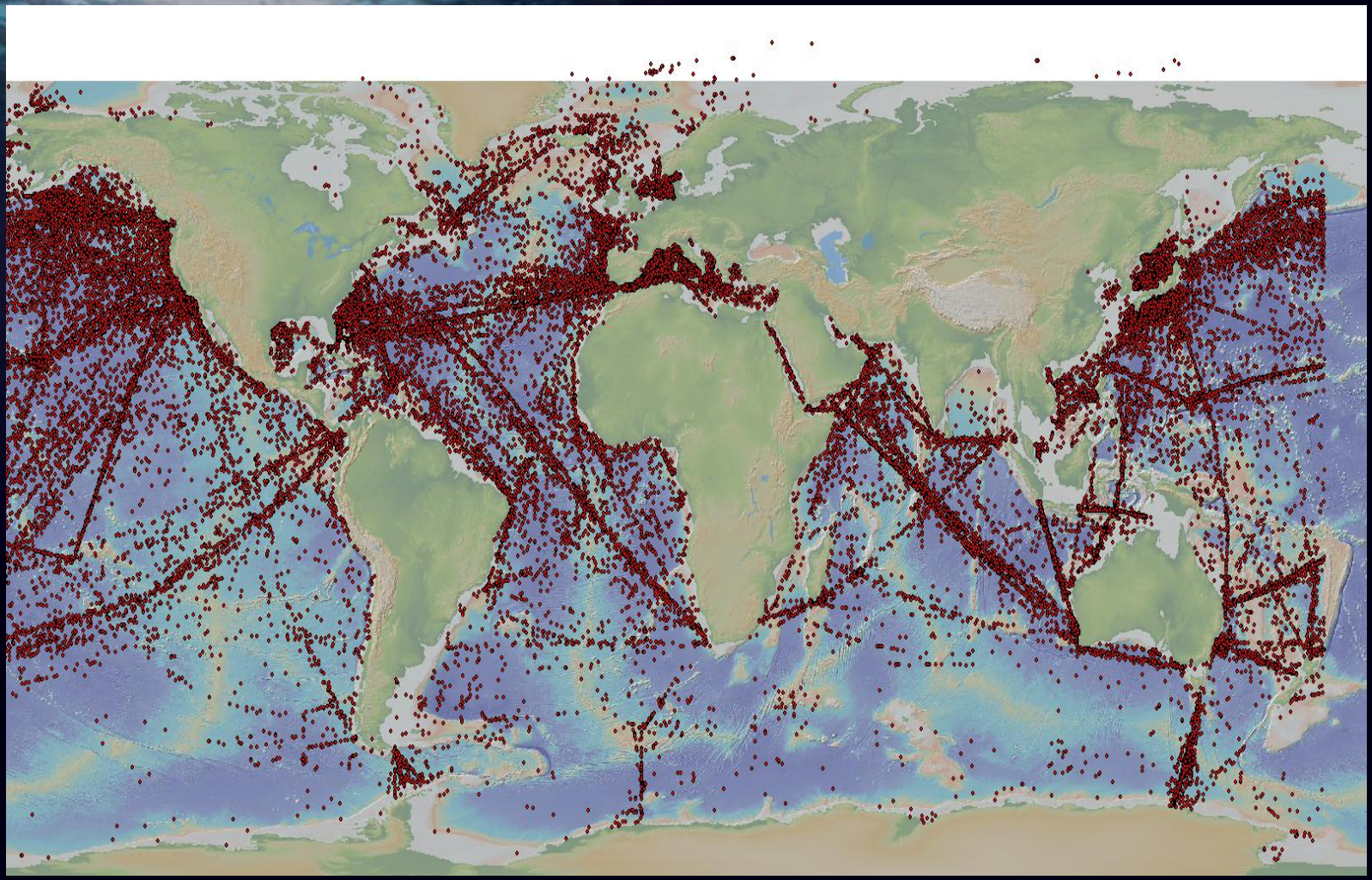
OCL ISAS 6.2 no alert

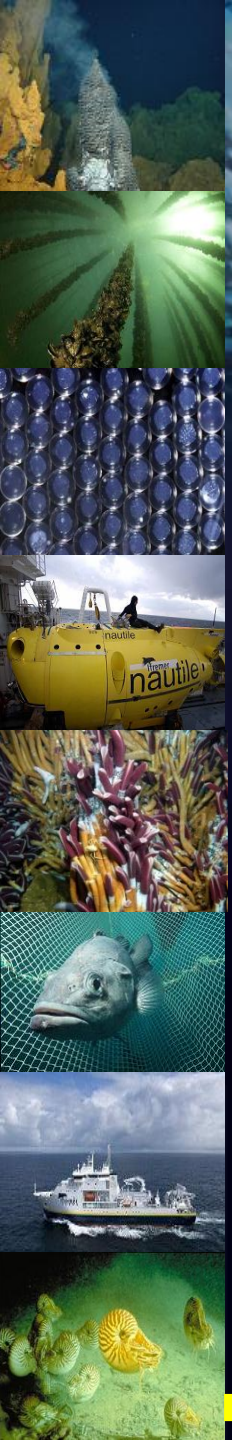


OCL ISAS 6.2 standardization alerts (blue)



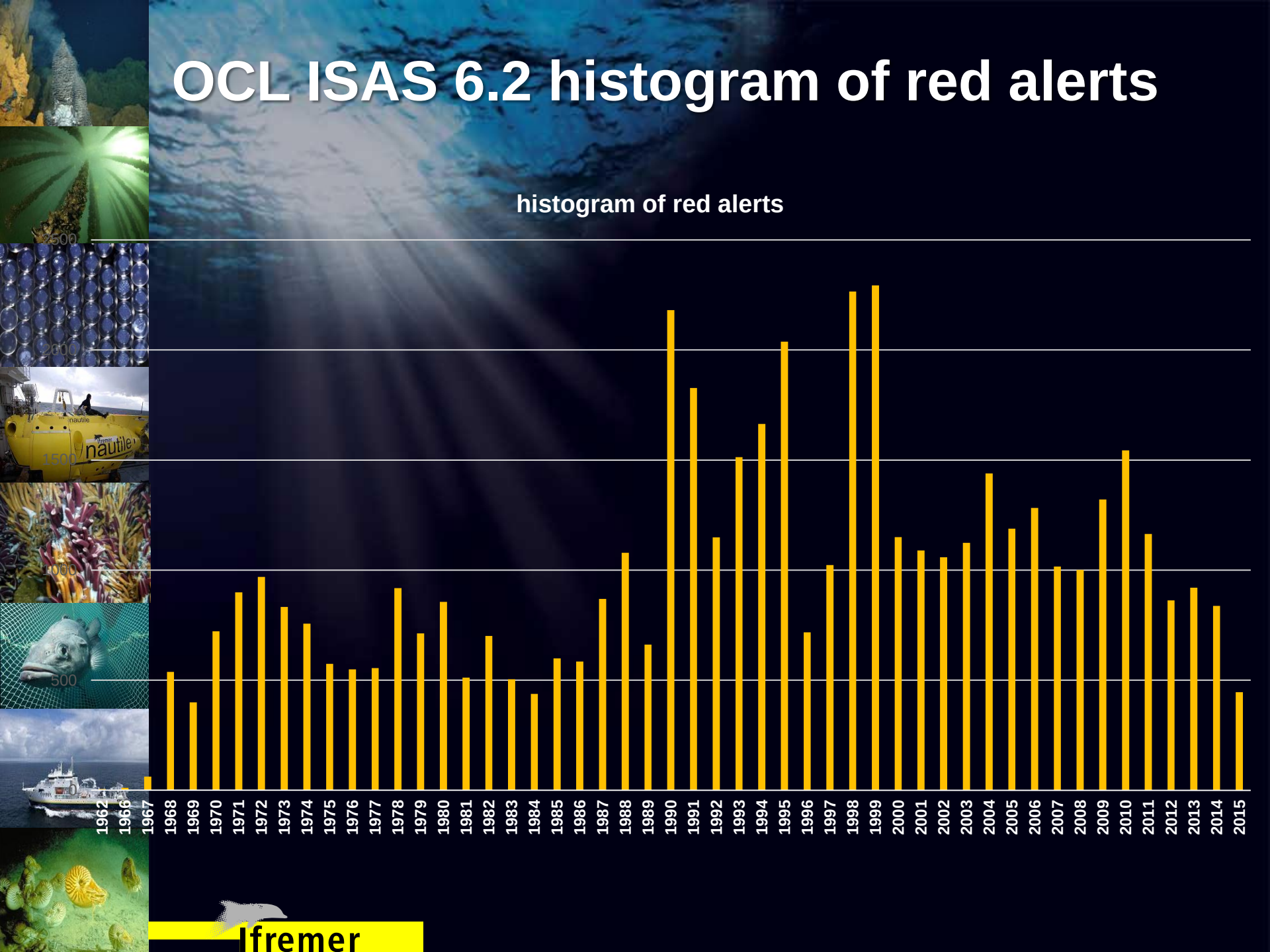
OCL ISAS 6.2 red alerts





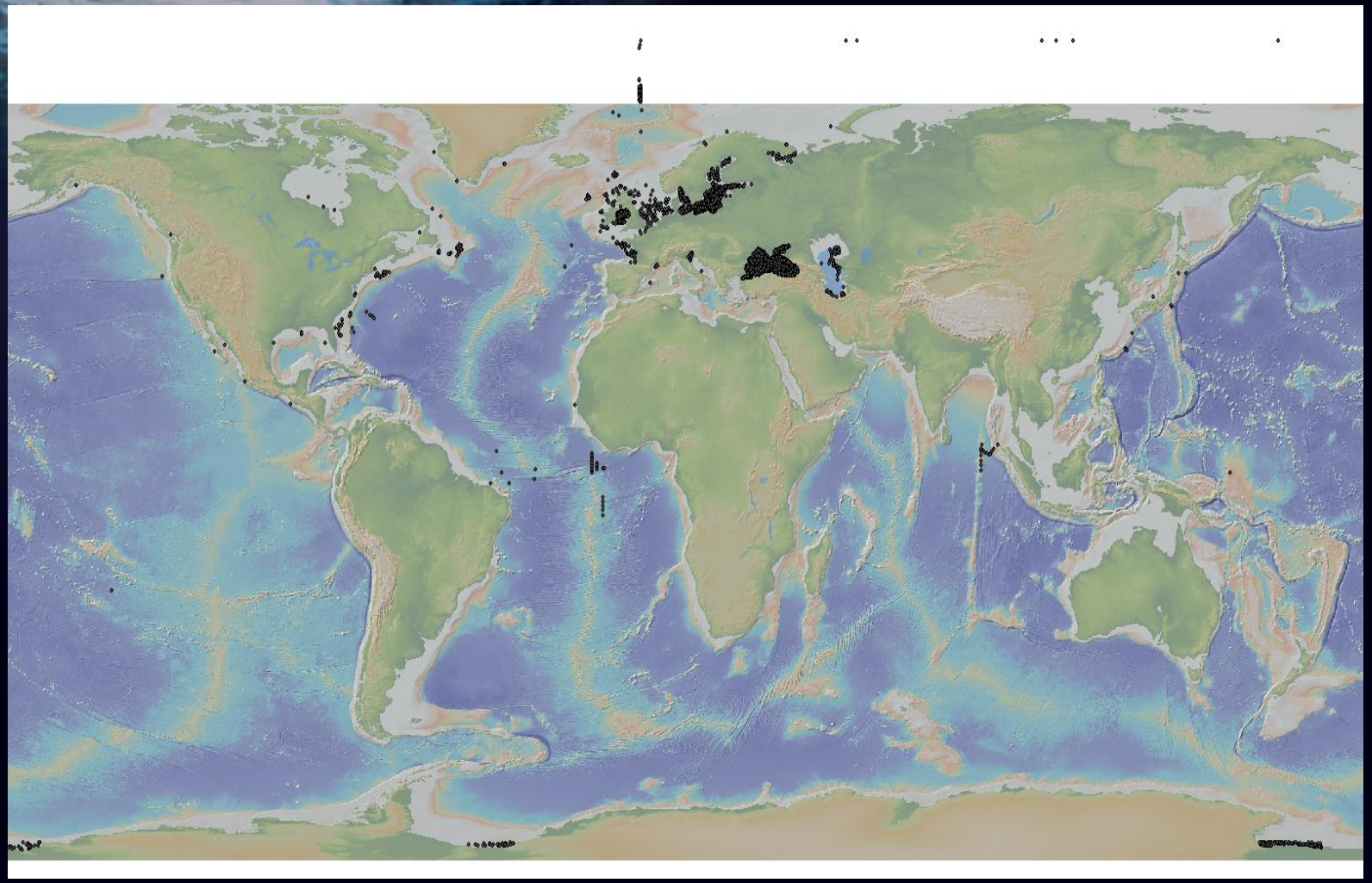
Ifremer

OCL ISAS 6.2 histogram of red alerts



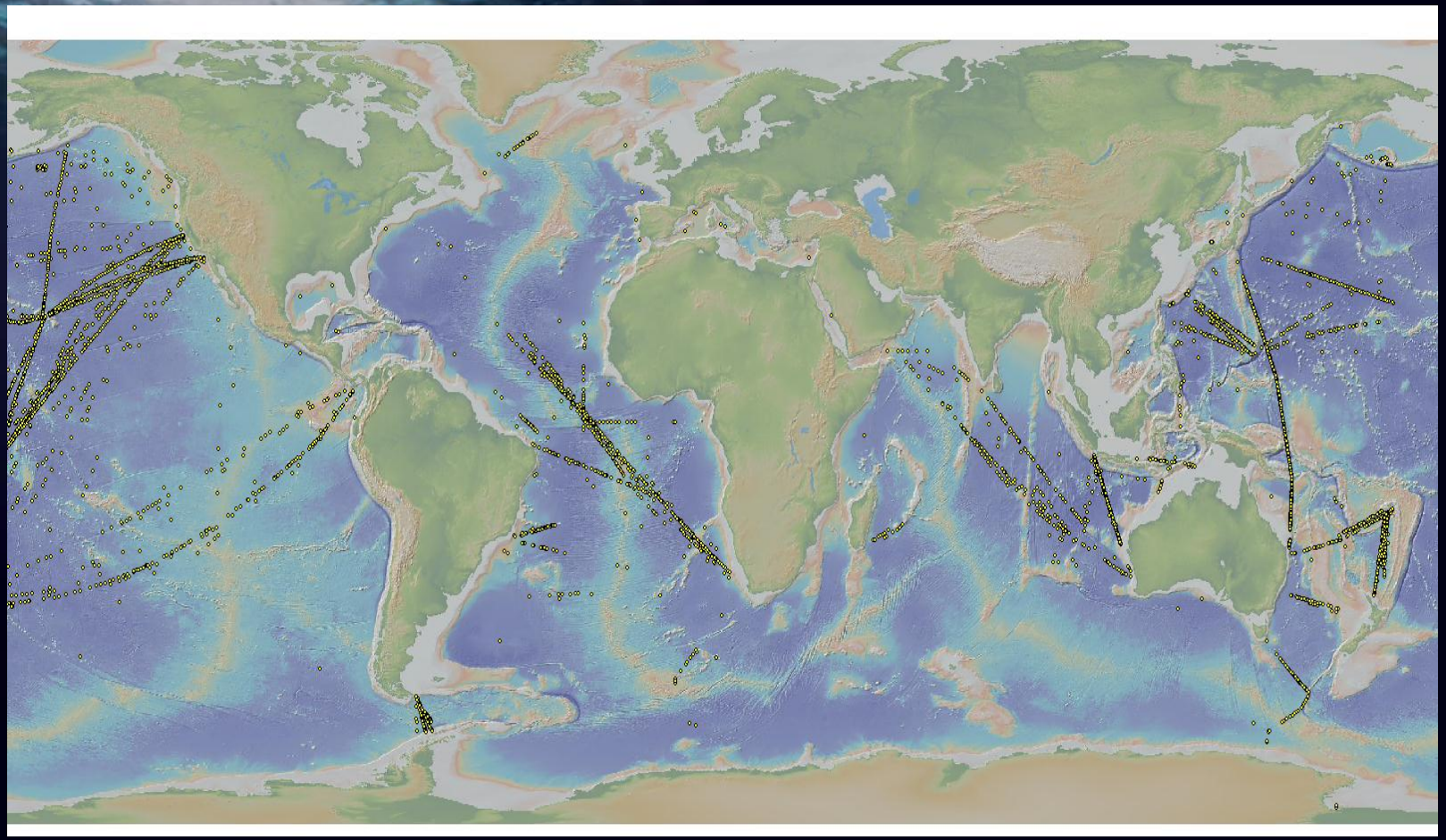
Ifremer

OCL ISAS 6.2 undefined alerts (dark grey)

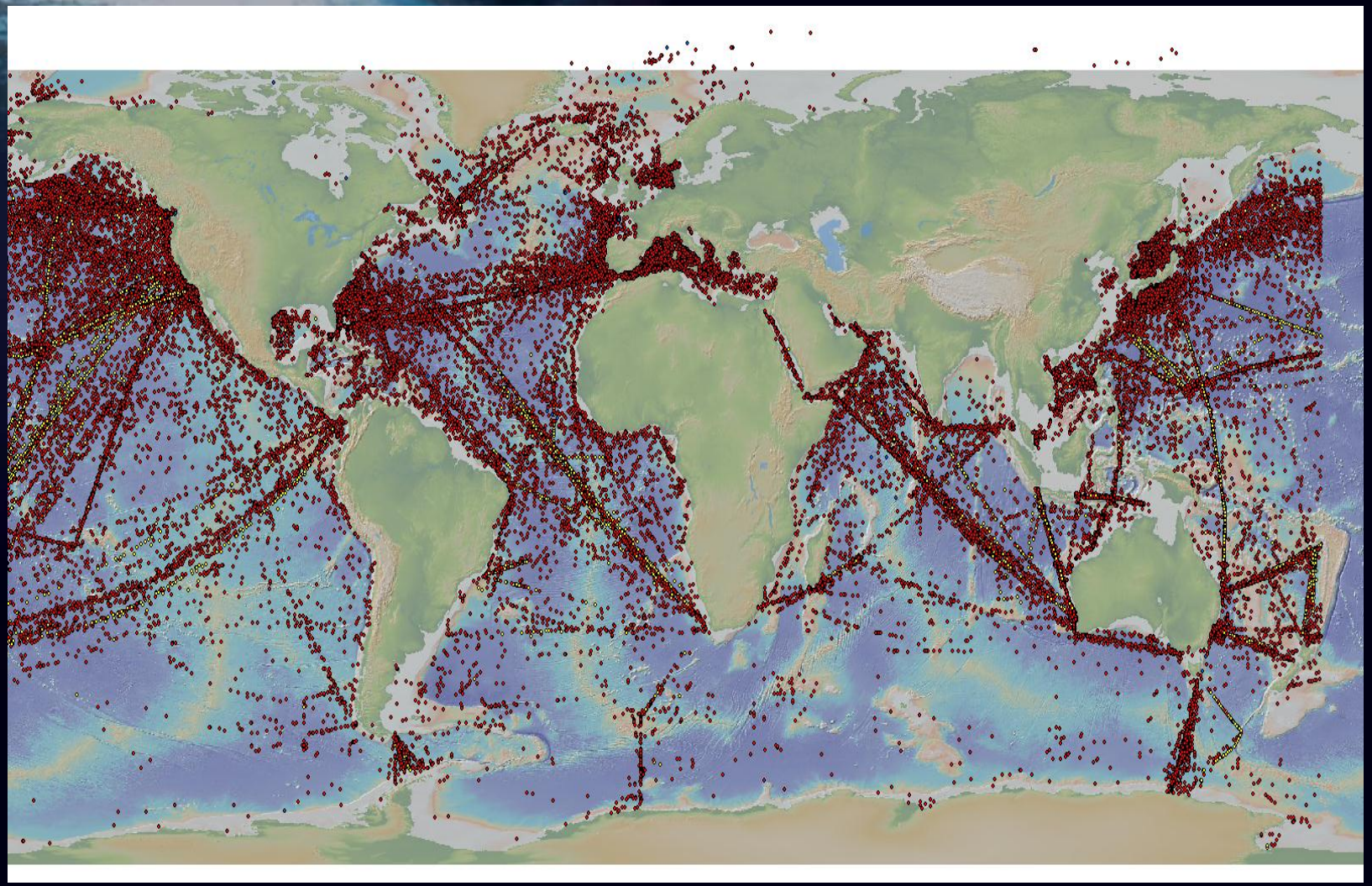


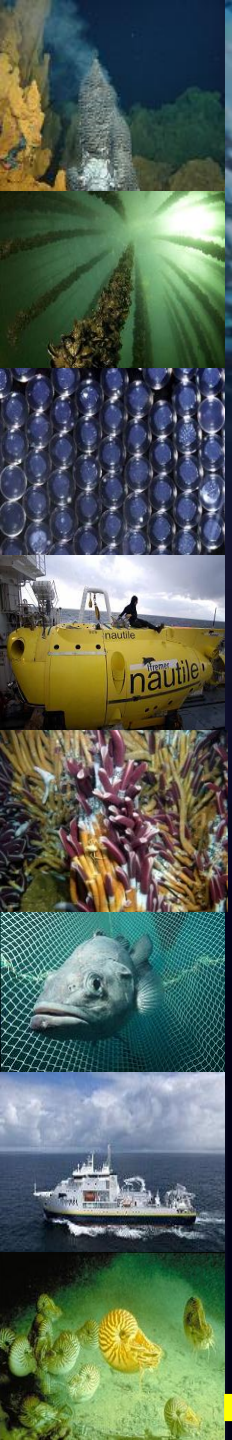
Ifremer

OCL ISAS 6.2 spike or climatology alerts (yellow)



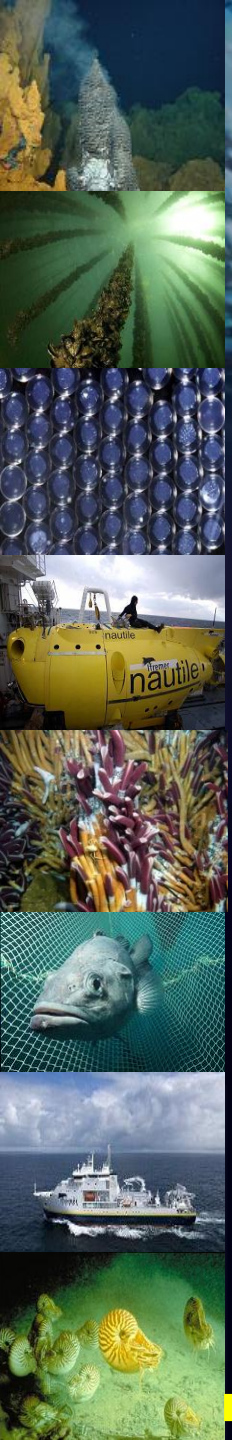
OCL ISAS 6.2 with significant alerts (red, blue, yellow)

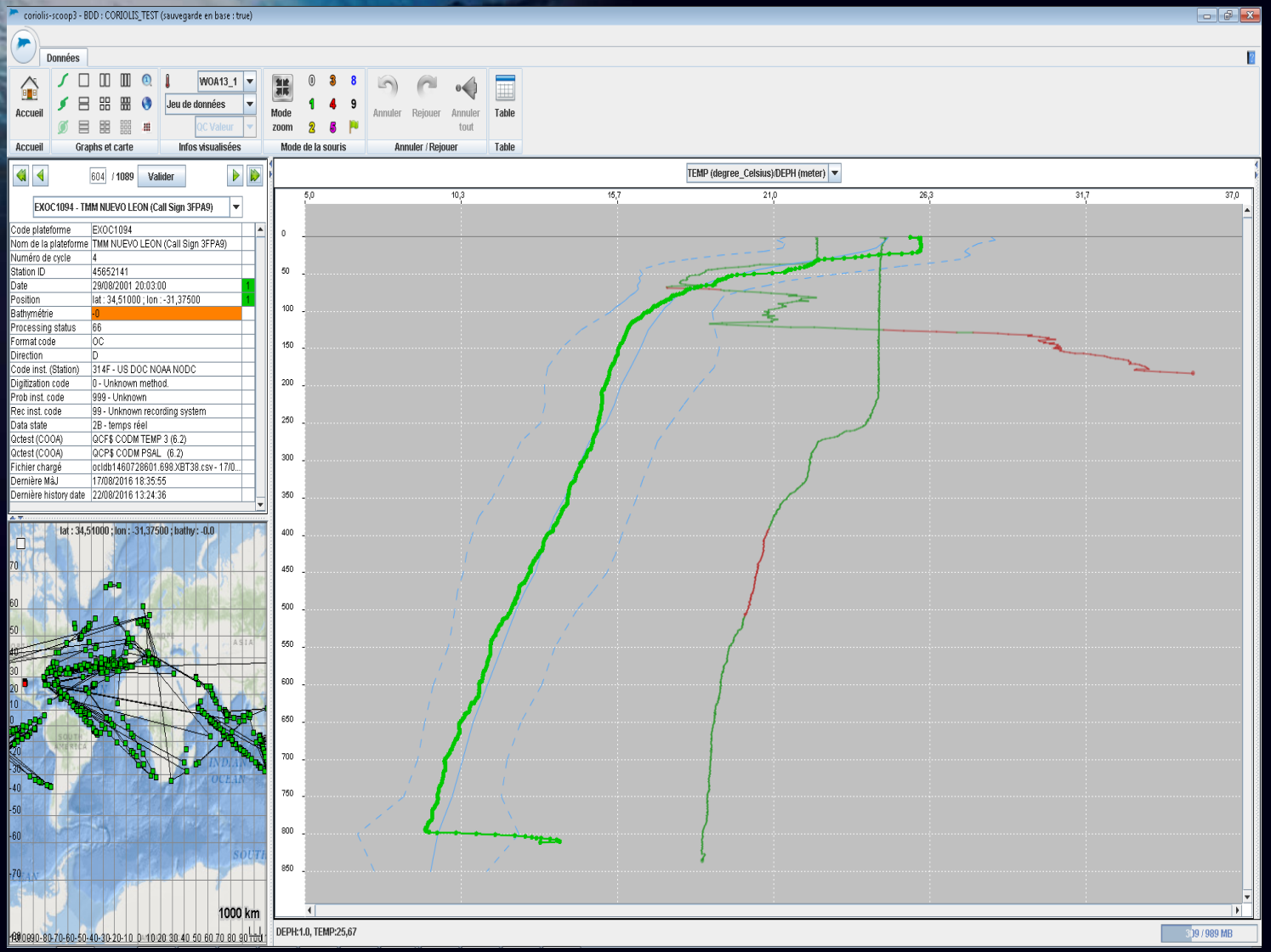




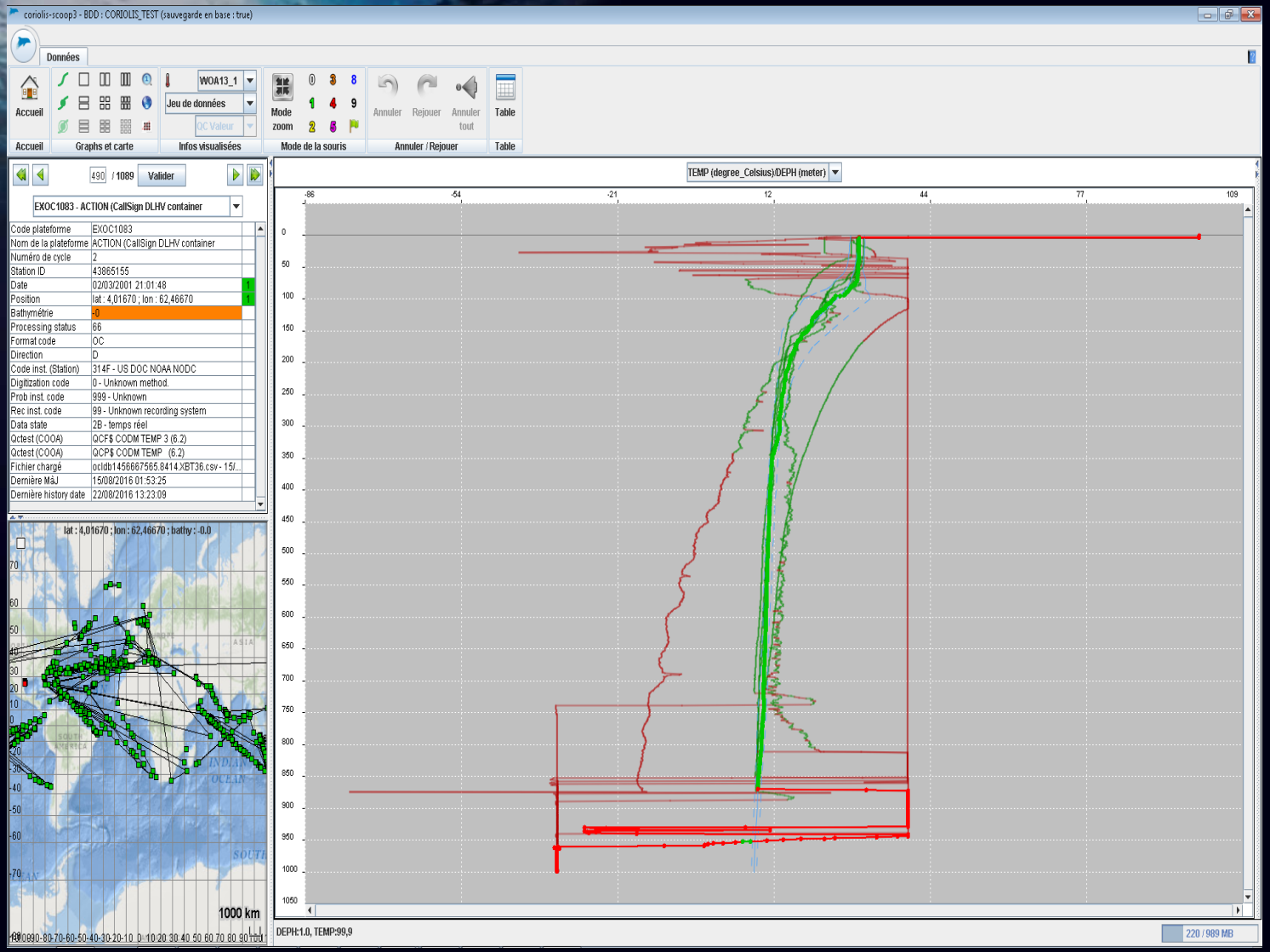
Ifremer

Ex. of anomalies : OCL anomalies year 2001

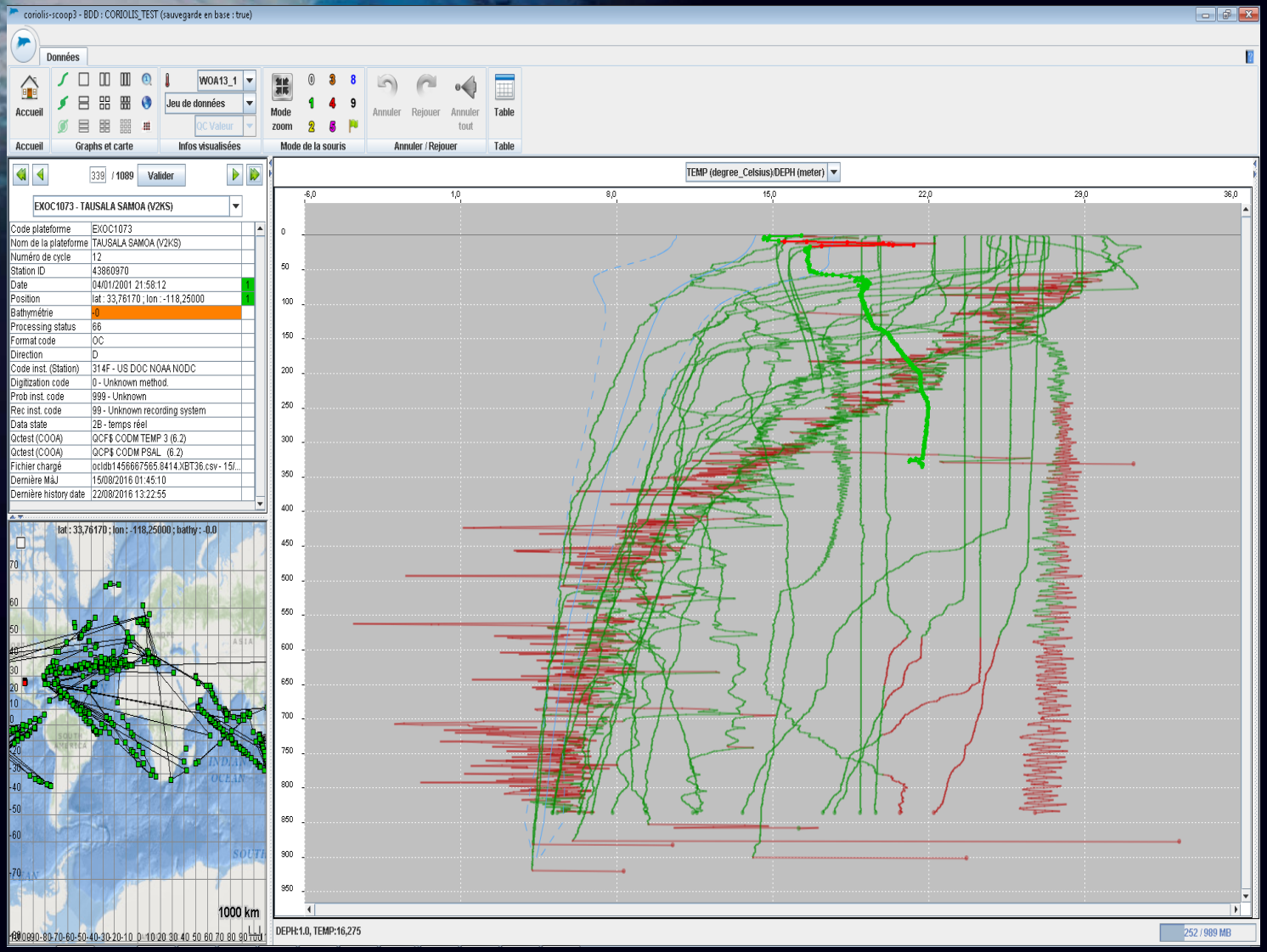




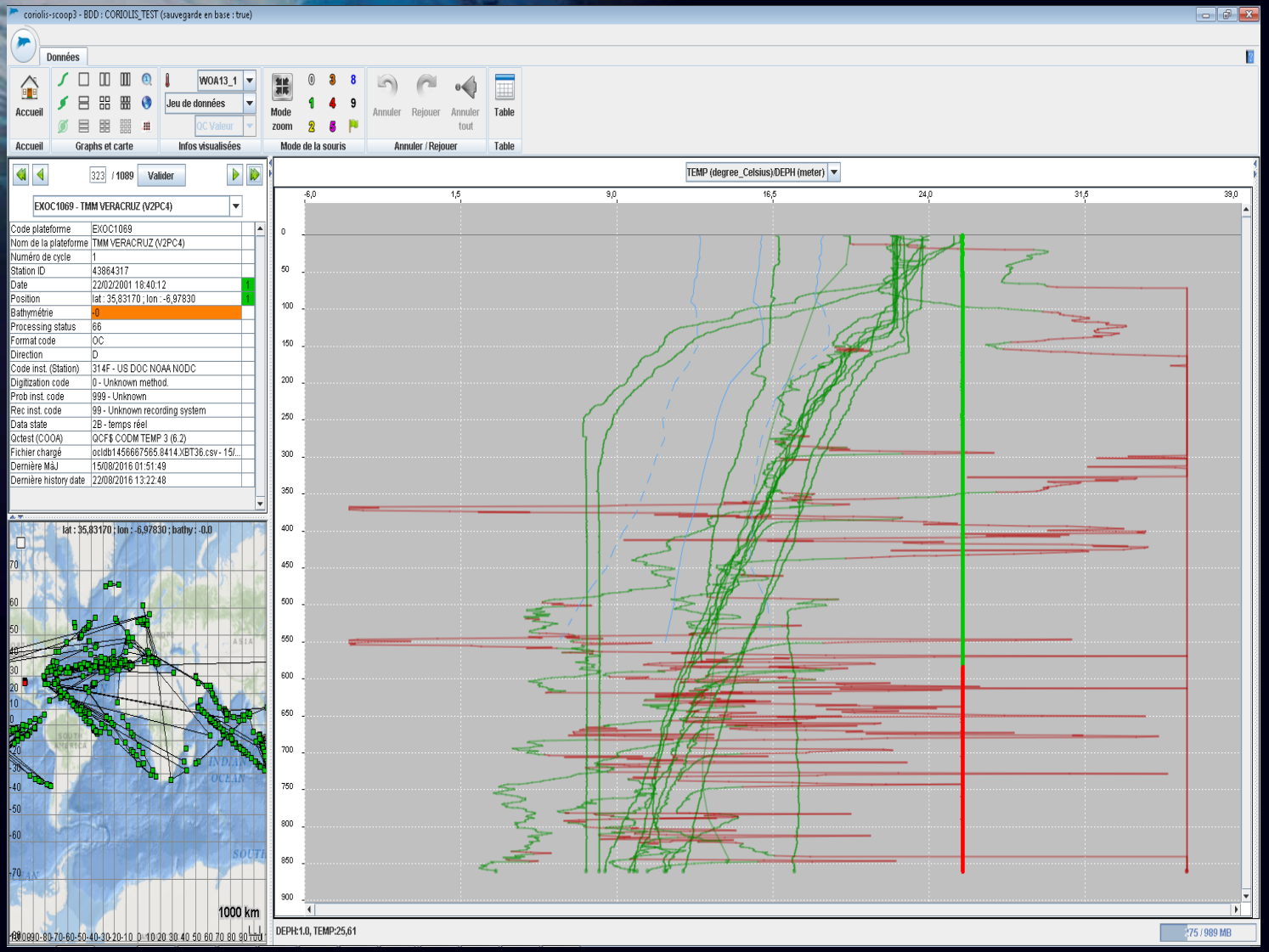
Ex. of anomalies : OCL anomalies year 2001



Ex. of anomalies : OCL anomalies year 2001

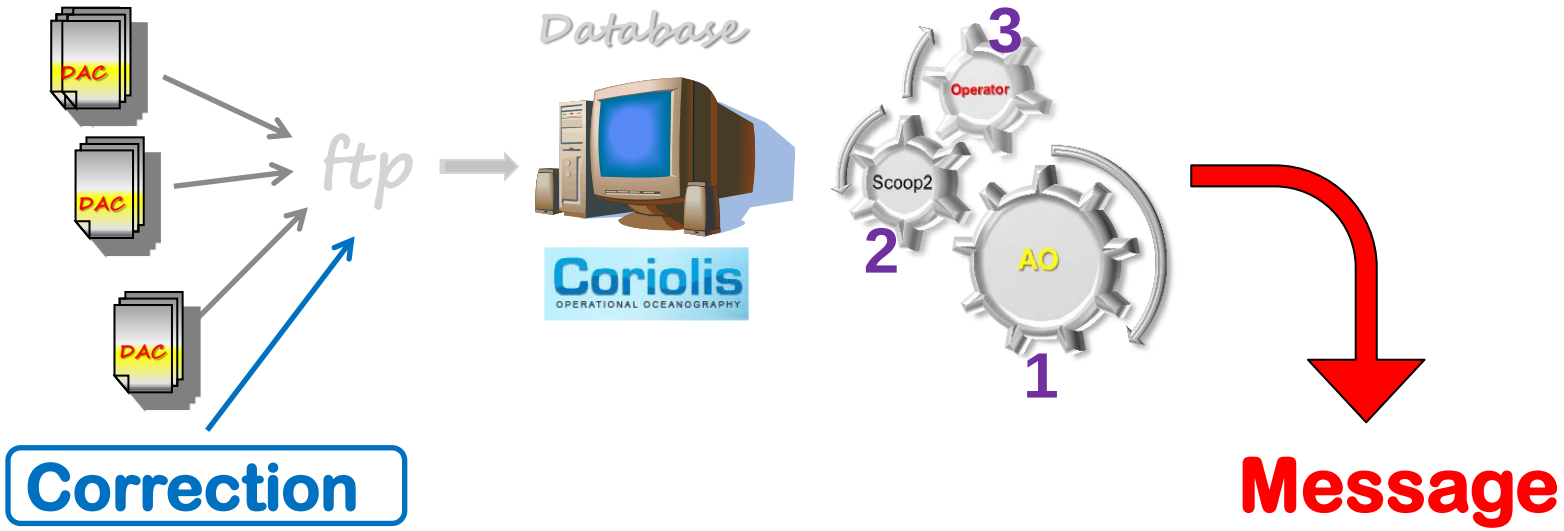


Ex. of anomalies : OCL anomalies year 2001



Feedback from OA

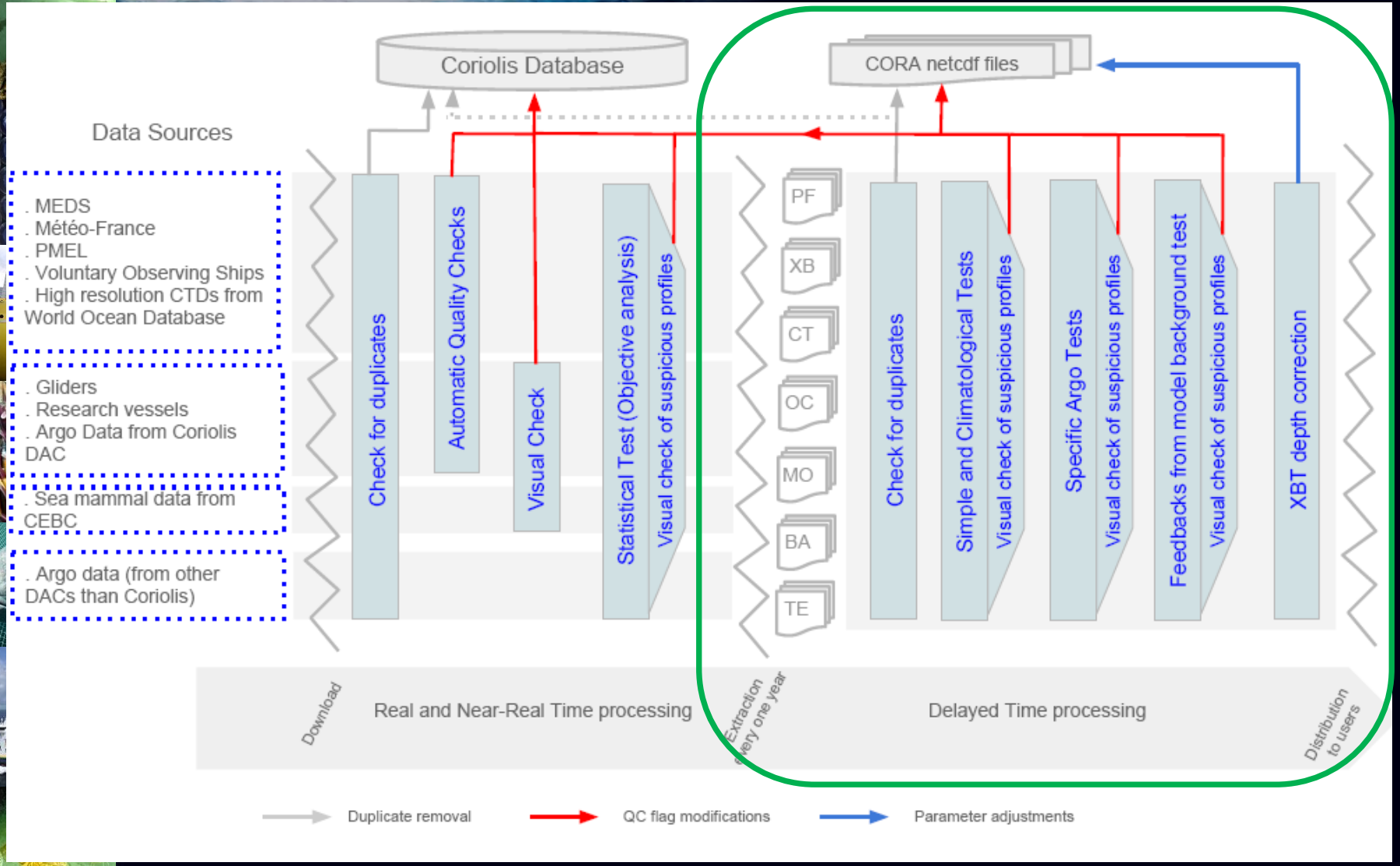
Possibility to send files with correction done on profiles as provided for the Argo dataset



DAC_CODE,PLATFORM_CODE,CV_NUMBER,DATE_UPDATE,DIRECTION,WEB_URL,PARAMETER,START_IMMERSION,STOP_IMMERSION,OLD_QC,NEW_QC

CS,5900033,365,05/10/2012 00:00:00,A,http://www.ifremer.fr/WC2argoFloats/station?&stationId=27528948,PSAL,10.5,1699,1,3

Using objective analysis for QC in delayed mode : CORA



CORA 4.2 – COriolis dataset for ReAnalysis

Temperature and Salinity dataset

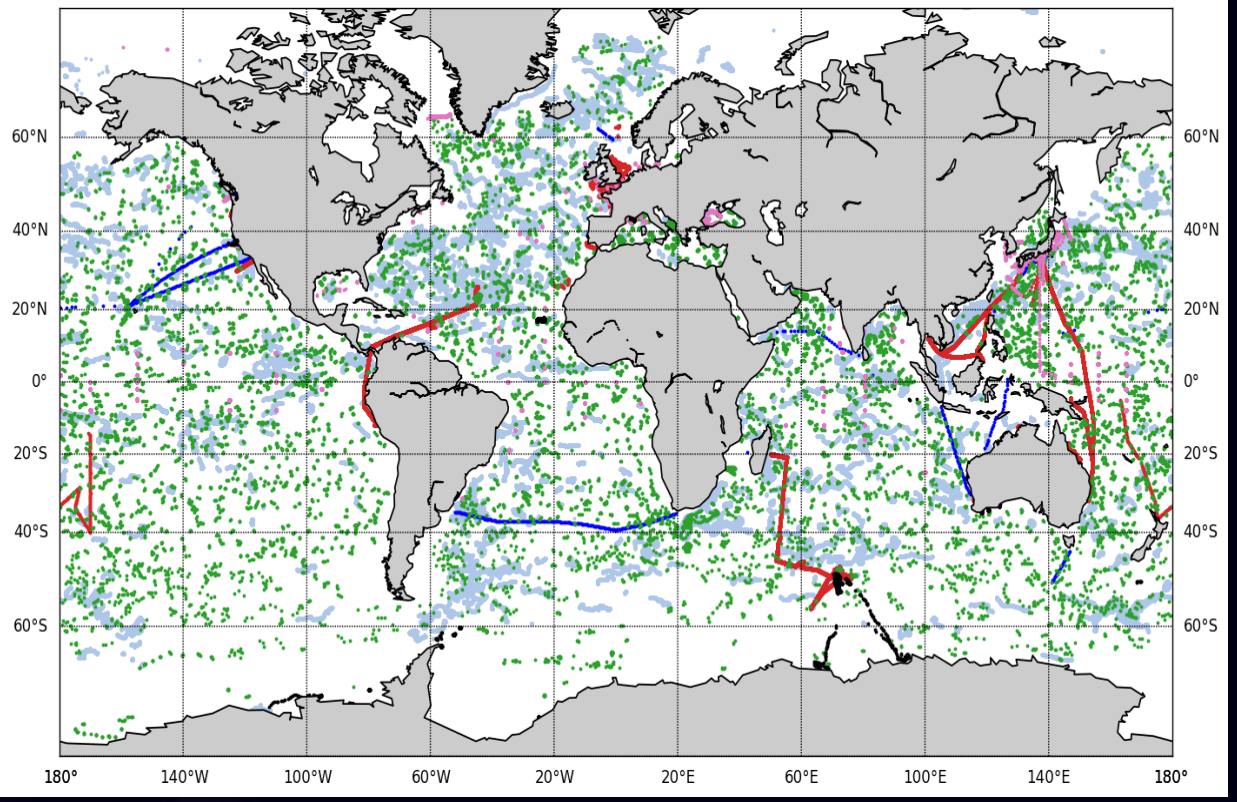
1950-2014 Global ocean

Delayed mode validated profiles

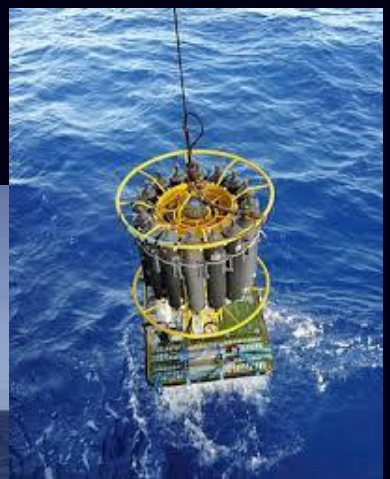
Numerous instrument types:

- XBT
- MBT/Botles
- CTD
- Moorings
- Profilers
- undulating CTD + Sea Mammals
- Drifters
- TSG
- Others

And also 2500000 profiles from SHOM

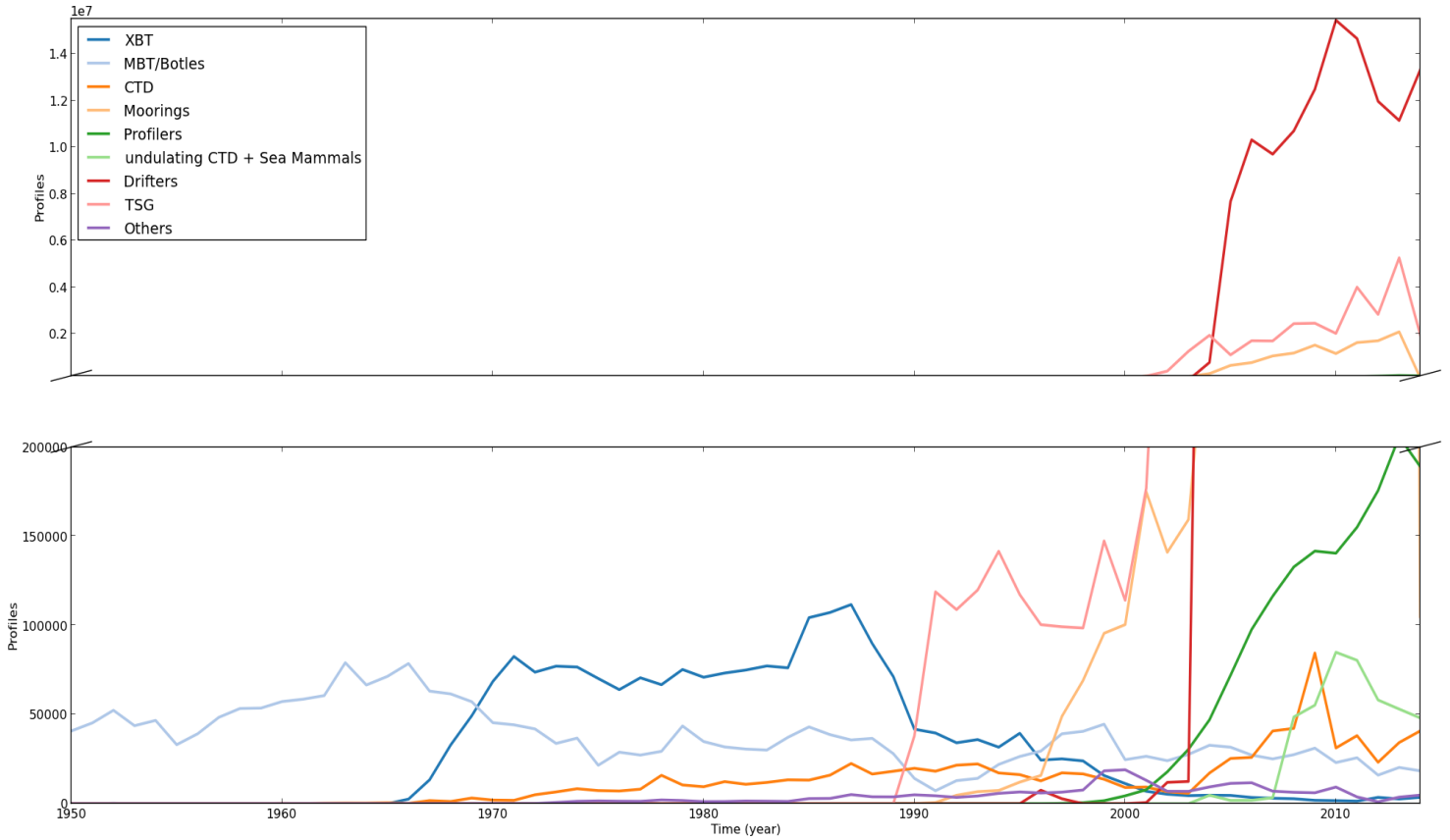


From Tanguy Szekely (Coriolis R&D)



CORA4.2 dataset description

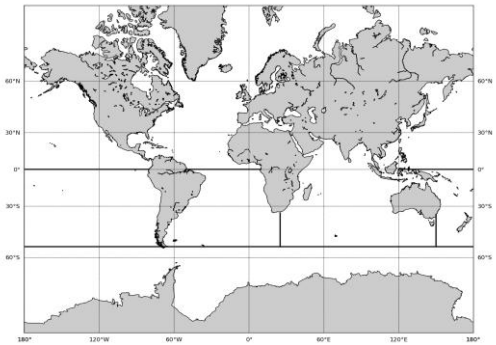
Instrument types:



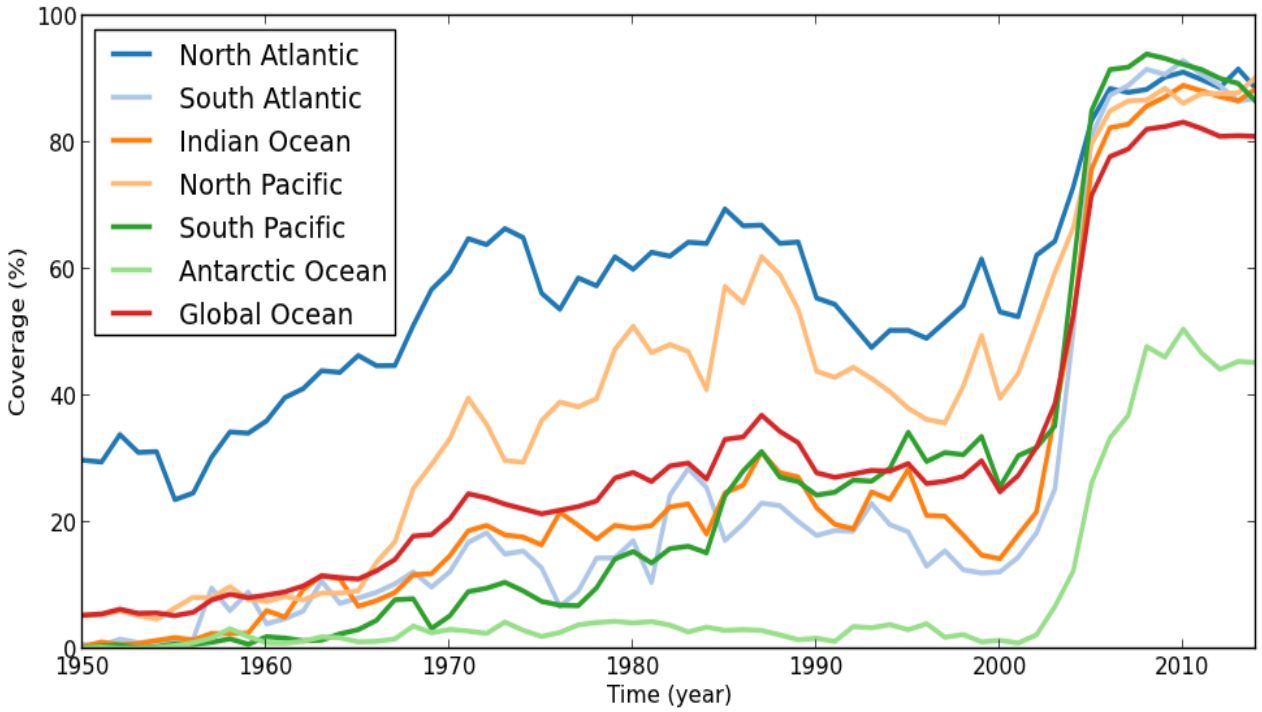
Updates from CORA 4.1 : Over 4 million new delayed time validated profiles.

Ifremer

CORA4.2 dataset description



Ocean basin sampling rates



Ifremer

CORA4.2 dataset uncertainties

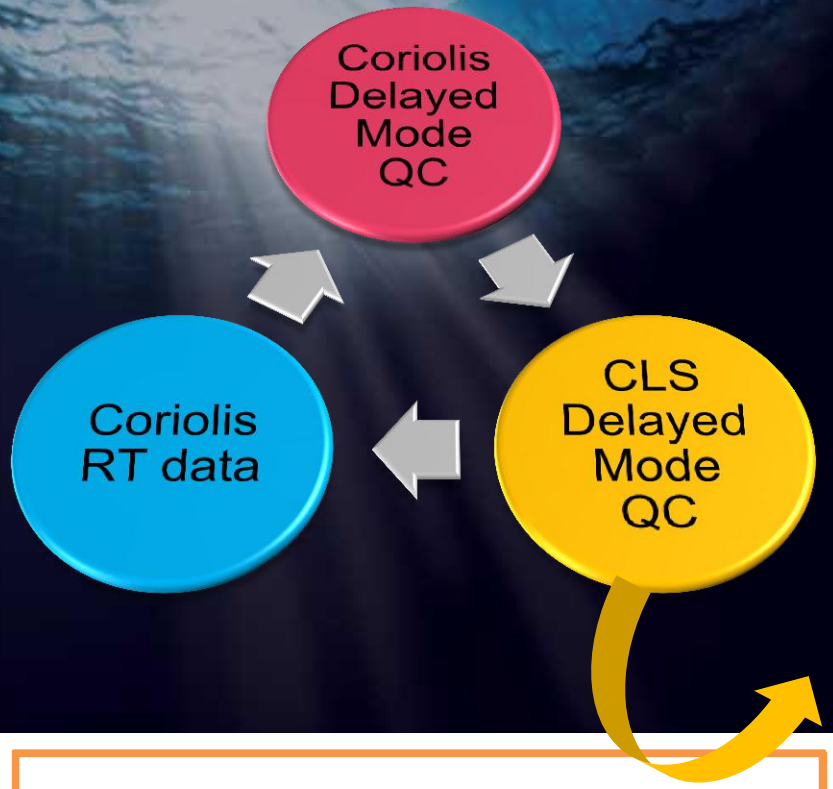
Table 1. Accuracies of the different data types included in CORA3. The type of netcdf files where each data type can be found is also listed (in italic for the most frequent occurrences). Note that data received from the GTS are not full resolution: data are truncated two places after the decimal point for the TESAC (TE) type and one place after the decimal point for the BATHY (BA) type.

"Probe types" (and the associated codes)	Type of files	Temperature accuracy	Salinity accuracy	Pressure or depth accuracy
XBT (10)	*XB*, BA, TE	0.03–0.01 °C[a]		2 %[a]
CTD (20)	*OC*, TE, BA, CT	0.001 °C –0.005 °C[a]	0.02–0.003[a]	0.015–0.08 %[a]
XCTD (30)	*BA, TE*, OC, XB, CT	0.02 °C[a]	0.05–0.08[b]	2 %[a]
Argo Floats (40)	*PF*, TE	0.01 °C[c]	0.01[c]	2.4 db[c]
TAO/TRITON, PIRATA, RAMA (51)	*TE*, MO, BA	Standard ATLAS: 0003–0.03 °C (SST) 0.003–0.09 °C (subsurface) Next Gen. ATLAS 0.003–0.02 °C[d]	0.02[d]	1 db[d]
Gliders (60)	*CT*, TE	0.001 °C –0.005 °C[a]	0.02–0.003[a]	
Sea mammals (70)	*TE*, CT	0.01 °C[e]	0.02[e]	
Drifting buoys (80)	*TE*, BA	0.002–0.01 °C[a]	0.003–0.01[a]	
Coastal (52) and other moorings (50)	*TE*, BA	Nominal 1 °C (Achieved 0.08 °C)[f]	0.001 µS cm^{-1}[f]	

[a] World Ocean Database, 2009, Boyer et al. (2009); [b] Johnson (1995); [c] nominal accuracy, Boehme and Send (2005);
[d] see http://www.pmel.noaa.gov/tao/proj_over/sensors.shtml and references therein; [e] Boehme et al. (2009); [e] for NDBC buoys, Conlee and Moersdorf (2005).

Cabanes, C., A. Grouazel, K. von Schuckmann, M. Hamon, V. Turpin, C. Coatanoan, F. Paris, S. Guinehut, C. Boone, N. Ferry, C. de Boyer Montégut, T. Carval, G. Reverdin, S. Pouliquen, and P. Y. Le Traon, 2013: The CORA dataset: validation and diagnostics of in-situ ocean temperature and salinity measurements. Ocean Science, 9, 1-18, http://www.ocean-sci.net/9/1/2013/os-9-1-2013.html, doi:10.5194/os-9-1-2013

CORA 4.2 – Delayed Mode Validation

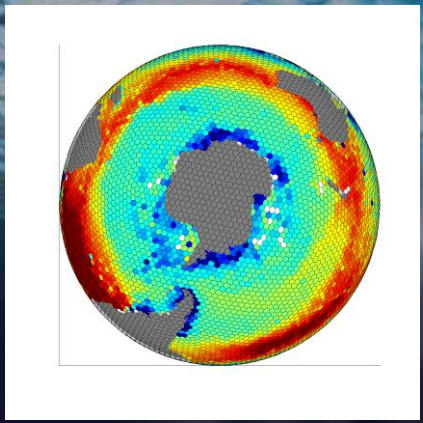


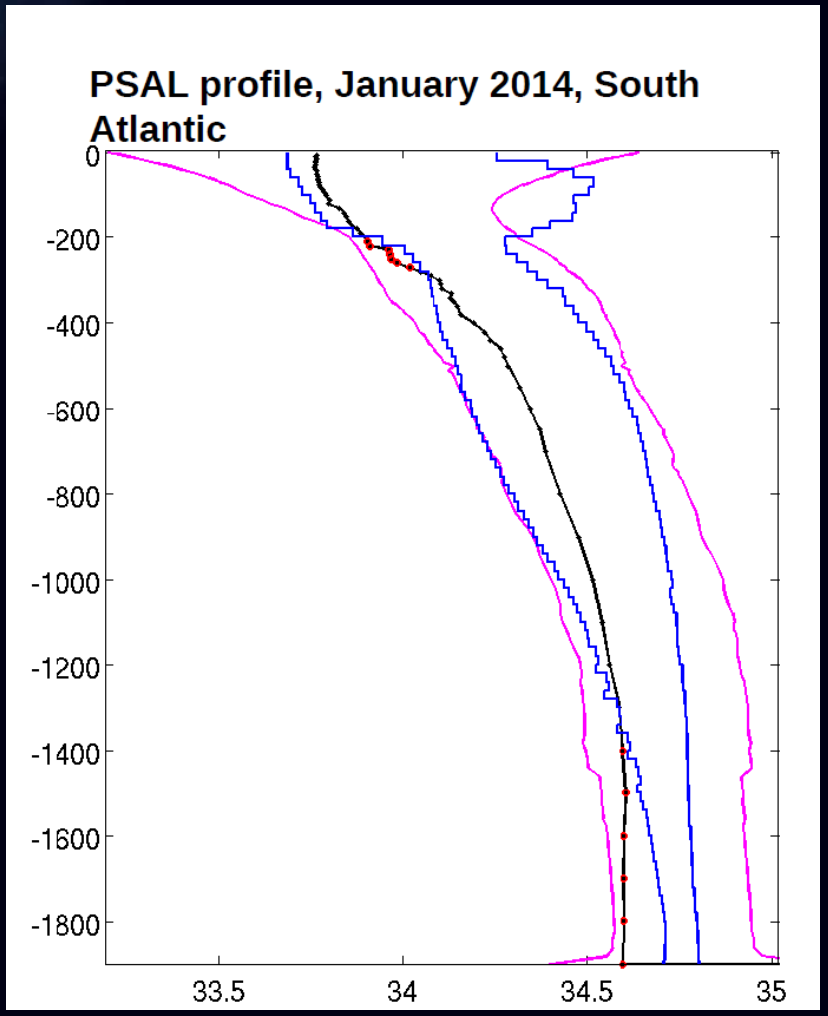
CLS altimetry test

- Focus on Costal profiles
- Altimetry based bias detection
- 11000 profiles flagged after a visual check

Test	Corrected profiles
Test on land	33
Vertical inversion	161
Non monotonous PRES	969
T/S=0 at P=0	58
Regional boundaries	265
Constant T/S	91
Climatology comparison	3310
Spikes detection	68
Bias detection	6023
Total	10979

Minmax test description





Reference field of the minimum and maximum observed temperature in 120km wide hexagonal cells

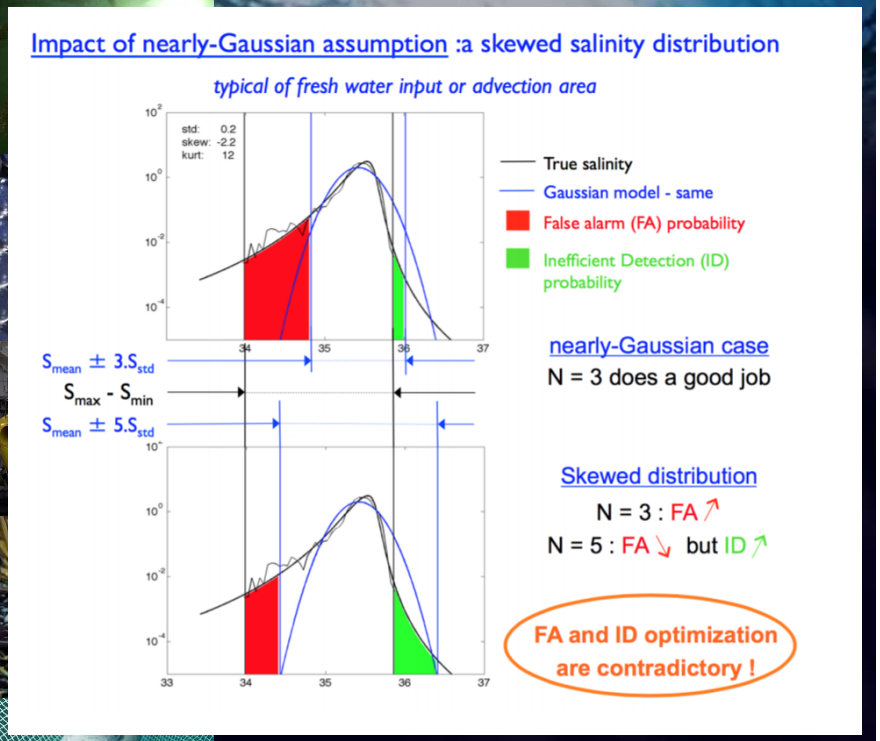
- Based on ARGO, CTD and sea mammals profiles.
- Very efficient to find biased profiles
- Lower wrong detection rate
- Accurate in the deep ocean

Jérôme Gourrion et al, poster session OD14C-2440:

Improved Statistical Method for Hydrographic Climatic Record Quality Control

Ifremer

Minmax test description

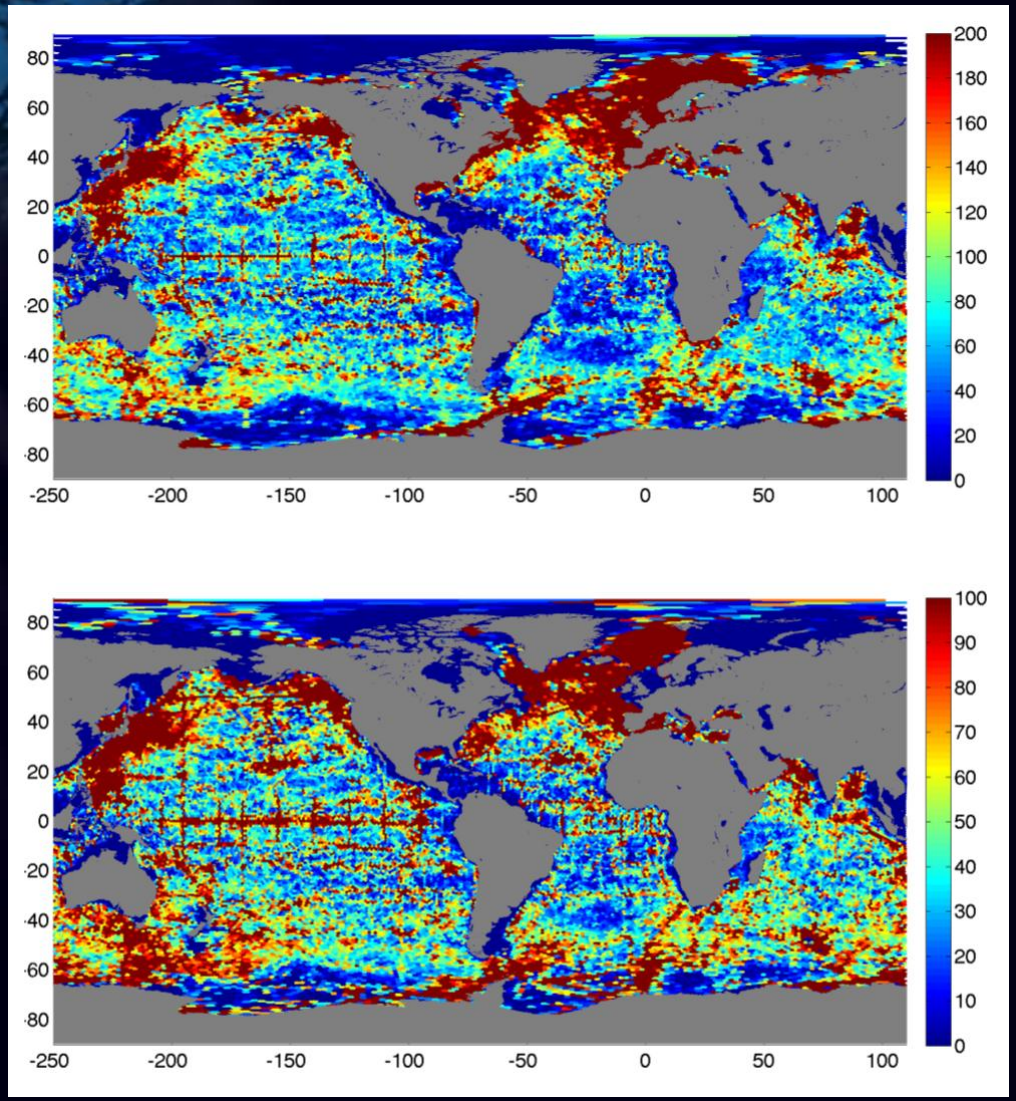


Main assumptions on data distribution currently implemented :

Unimodal

Symmetric

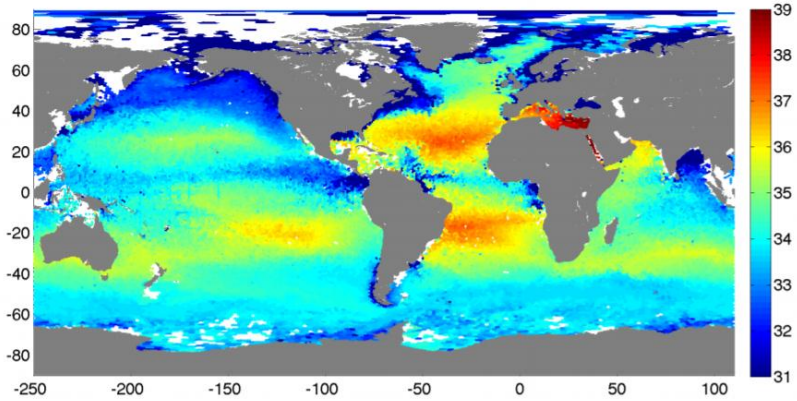
Homogeneously non-gaussian

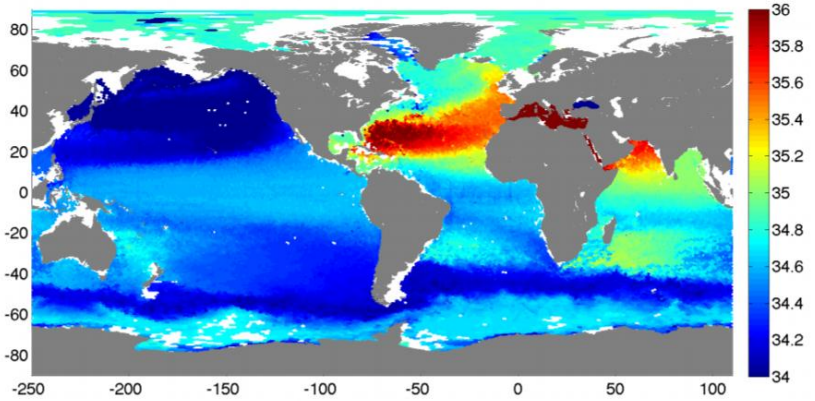


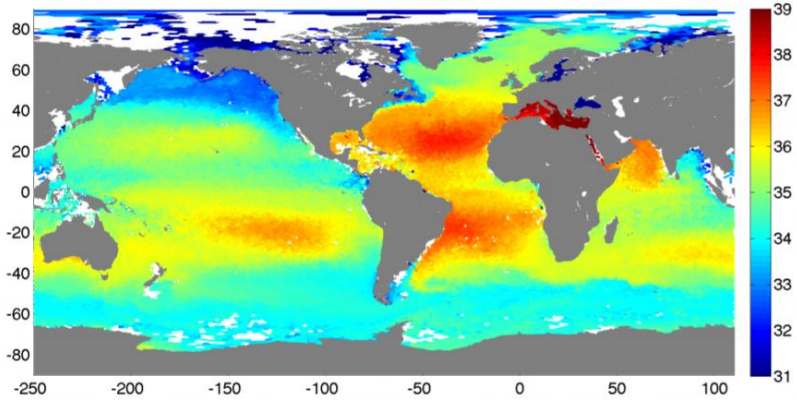
Number of samples per grid cell.

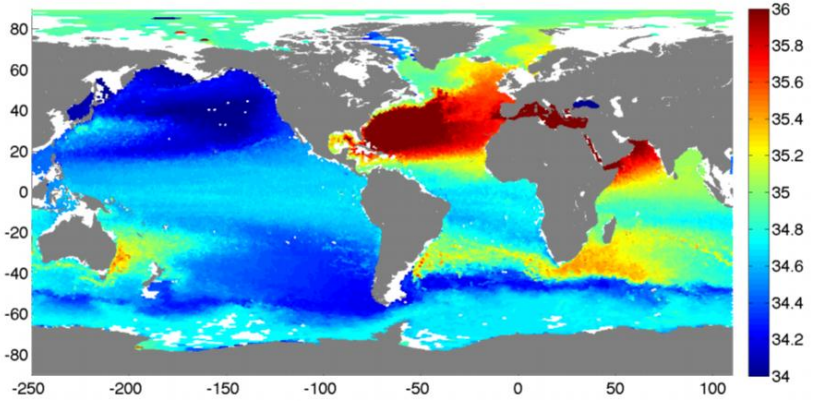
Top: the 0-10 db layer. Bottom: 500-510 db layer.

Minmax test description









Upper panels: minimum salinity value. Bottom: maximum salinity value.

Left (right) column corresponds to the 0-10 db (500-510 db) layer.