

Coriolis Quality Control System

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OBSERVING SYSTEM

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RESEARCH **OR VOLUNTARY MERCHANT**

vessels acquire surface data during transit

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.

Anchored at a fixed location, they provide full depth time series of a wide variety of variables.

MOORED BUDYS

physical and biogeochemical measurements

SCIENTIFIC CRUISES provide accurate full depth

> DATA CENTRES Acquire the data in real-time by satellite transmission, process and distribute them to users

TIDE GAUGES

Provide sea level reference measurements

SURFACE DRIFTERS

While drifting at the surface they measure sea surface temperature, sea surface satinity, air pressure and surface currents.

ARGO PROFILING FLOATS

Mainly real-time temperature and salinity profiles from surface down to 2000 m every 10 days

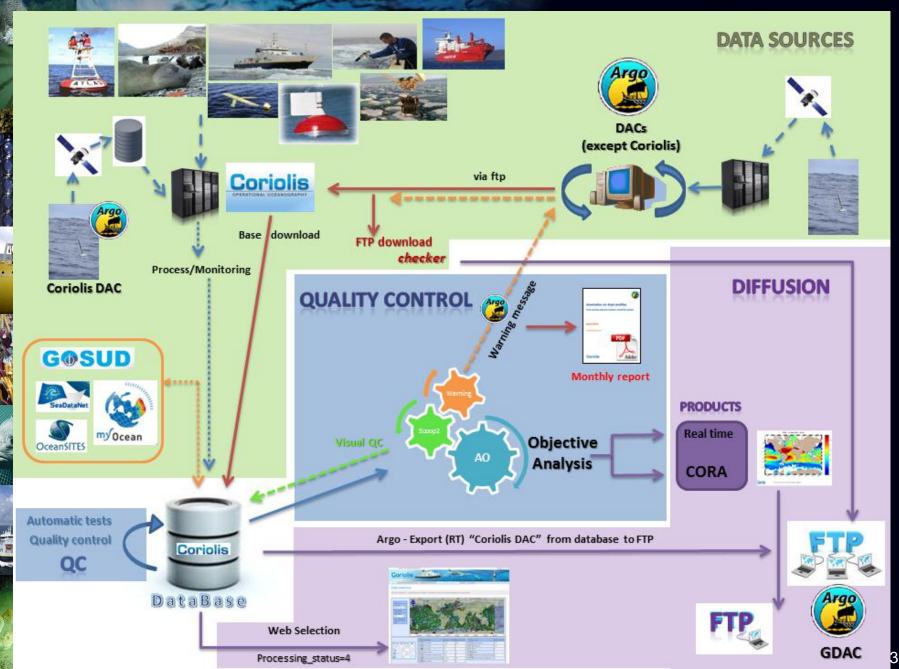
GLIDERS

while gliding from surface to about 1000m they provide real-time physical and biogeochemical data along their transit

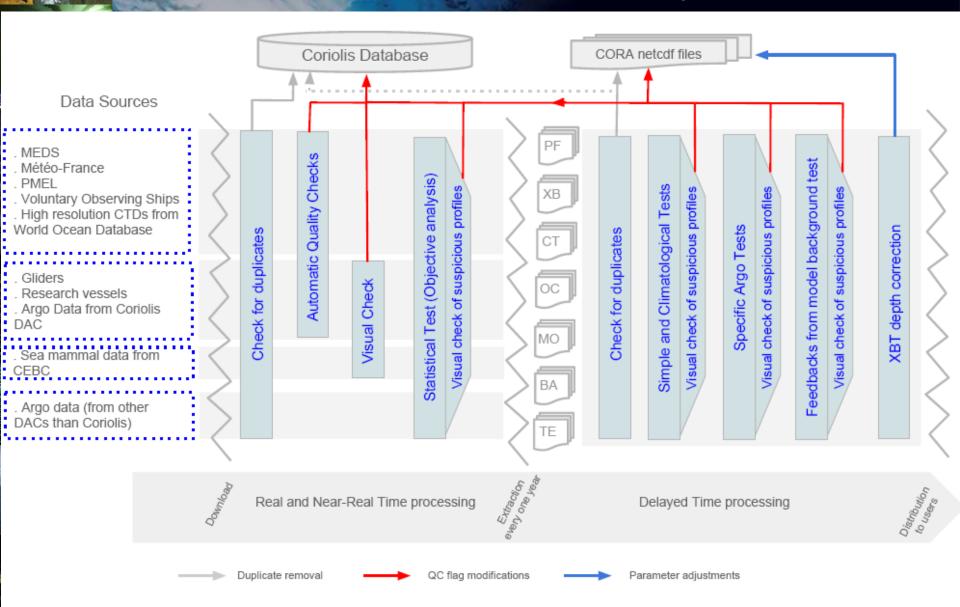
SEA MAMMALS

provide real time temperature and salinity in polar areas

Data flow in Coriolis database & Quality Control



From Real time to Delayed Mode



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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

- 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
- 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

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



<u>OA Output</u> = 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:

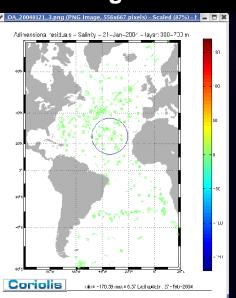
1/ additional calculation to define a new residual at each level, using 3 variables calculated by OA : residuals, errors coming from not resolute scales and errors on the parameter interpolation .

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.





Live Access Server Longitude : Layers :	Alerte 21/01/2004					
	Baver: 0-10	0 Raver: 100-300	Daver: 300-700	flaver: 700-1000	flaver: 1000-1600	Daver: 1600-200
	m]	[m]	m]	m]	m]	m]
Residu sans dim :	4.1878	NaN	0.17662	-1.0418	-1.6344	NaN
Residu dim :	0.54409	NaN	0.012394	-0.052313	-0.081722	NaN
identifiant de la plateforme : l	1900244					
Date :	05-Jan-200	4 10:56:00				
Identifiant Station :	1604985					
Type d'instrument :		iling Float 00207				
Latitude :	25.40					
Longitude :	-33.96					
Layers :	layer: 0-10	0 (layer: 100-300	[layer: 300-700	[layer: 700-1000 m]	[layer: 1000-1600 m]	[layer: 1600-200 m]
	m	lui				
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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

Alert definition

naut

- □ 1: standardization (test to the standard deviation failed)
- □ 2: analysis failed inexistent
- □ 3: red analysis (residuals / threshold)
- 4: undefined analysis

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- 5: spike/offset climatology
- \square 6: white analysis no visual control, for the delayed mode study

Visual cont SCOOP

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13 / 2013 Valider 6901776 - PROVOR-II Profiling Float 🔻

2 35439210 15/03/2014 14:06:00 lat: 43,13055; lon : 7,46835

Annual and the Labor tent / 488.00
 Annual Annual

lat: 42,80326; lon: 8,07824 provençai

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Infos vis

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Graphs et carte

690177 Nom de la plateforme PROVOR-II Profiling Float - NAOS Nom du Pl Herve CLAUSTRE

-

-Données

Accueil

Accueil

-

ode plateform

Numéro de cycle Station ID Date sition

Bathymétrie

	Code plateforme	6901776	n -
control	Nom de la plateforme	PROVOR-II Profiling Float - NAOS	
control :	Nom du Pl	Herve CLAUSTRE	
	Numéro de cycle	2	
Fr parts -	Station ID	35439210	DENS ()/PRES (decibar)
where is a second second	Date	15/03/2014 14:06:00 1	TEMP (degree_Celsius)/PRES (decibar)
	Position	lat: 43,13055; lon: 7,46835	
and the second sec	Bathymétrie	2576	PSAL (psu)/PRES (decibar)
areas and the second se	Processing status	4	DENS ()/PRES (decibar)
and the second sec	Format code	PF	DOWNWELLING_PAR (micromol m-2 s-1)/PRES (decibar)
A subject to the second second	Direction	D	_CPHL_ADJUSTED (milligram/m3)/PRES (decibar)
the state of the second s	Code inst. (Station)	3599 - LOV, Laboratoire Océanographiq	CPHL (milligram/m3)/PRES (decibar)
	Code inst. (Ptf)	3599 - LOV, Laboratoire Océanographiq	DOWN_IRRADIANCE412 (W m-2 nm-1)/PRES (decibar)
	Digitization code	8 - Digitized at profile inflexion points.	DOWN_IRRADIANCE380 (W m-2 nm-1)/PRES (decibar)
	Prob inst. code	839 - PROVOR¿II, SBE conductivity sen	
	Rec inst. code	99 - Unknown recording system	小
Contraction of the Contract of the Contract	Plateforme type	45 - BUOY/MOORING: SUBSURFACE, V	
	Data state	2B - temps réel	
	Sampling scheme	Primary sampling: averaged [2sec sam	
Station courante 🖌 🗰 0 3 8 🦙 🦳 👘 📰 🎉	Fichier chargé	MR6901776_002D.nc - 03/08/2016 21:50	
Annuler Rejouer Annuler Table Historique Station	Dernière MàJ	03/08/2016 21:51:10	
ualisées Mode de la souris Annuler / Rejouer Table Historique	Dernière history date	20/07/2016 15:40:05	
TEMP (degree_Celsius)/PRES (decibar)	4	PSAL (psu)/PRES (decibar)	DENS ()PRES (decibar)
10,00 11,17 12,33 13,50 14,67 15,83	17,00 38,00 38,67	37,33 38,00 38,67 39,33 40,0	0 28,000 28,33 29,667 30,001
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300	300 .	$\sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{i=1}^{n} \sum_{i=1}^{n} \sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{i=1}^{n} \sum_{i$	300 .
350 -	350 _		380 -
400	400	↓ /	400
		1 1	
450	450 _		460
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sso _	550 _		500 -
500 J	600 -		800
650	650 _		eco .
700	700 -		700
750	750		760
800	800 -		800
390	850 -	1 1	
900	900 .	1 1	800
950 -	950 .		960 -
1000	1000	i 🖁	1000
1060	▼ 1080		1080
PRES:14.4, TEMP:13,537, PSAL:38,16, DENS:28,731	101 Ja 21	P	75 / 989 MB
			2101000 HB



OCL temperature profiles analysis

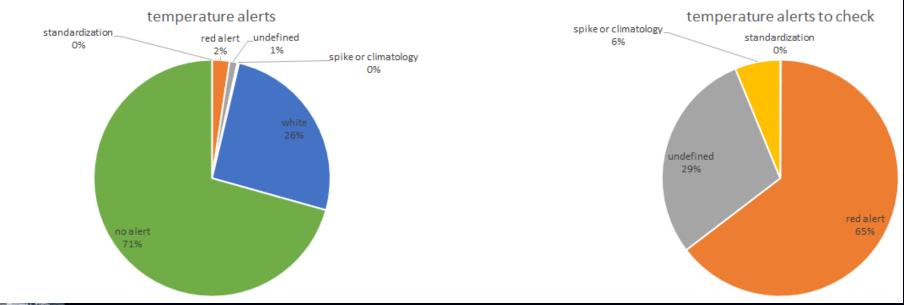
A total of 5492 OCL csv files (*.XBT*.csv, *.CTD*.csv)

A total of 2 081 876 temperature profiles analysed

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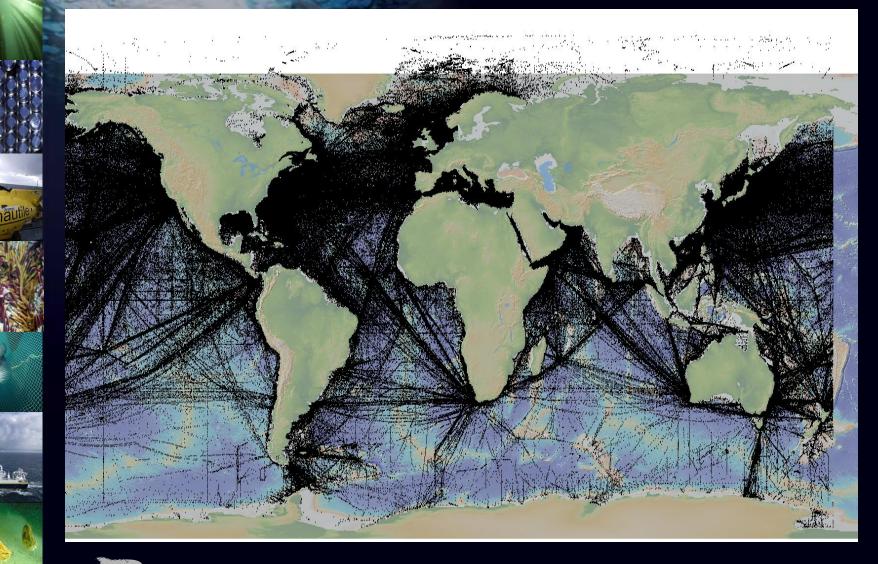
OCL temperature profiles analysis

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



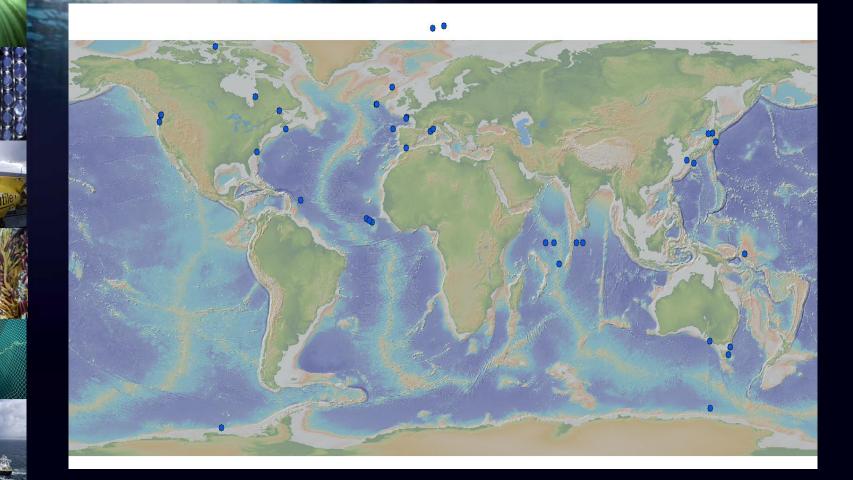


OCL ISAS 6.2 no alert



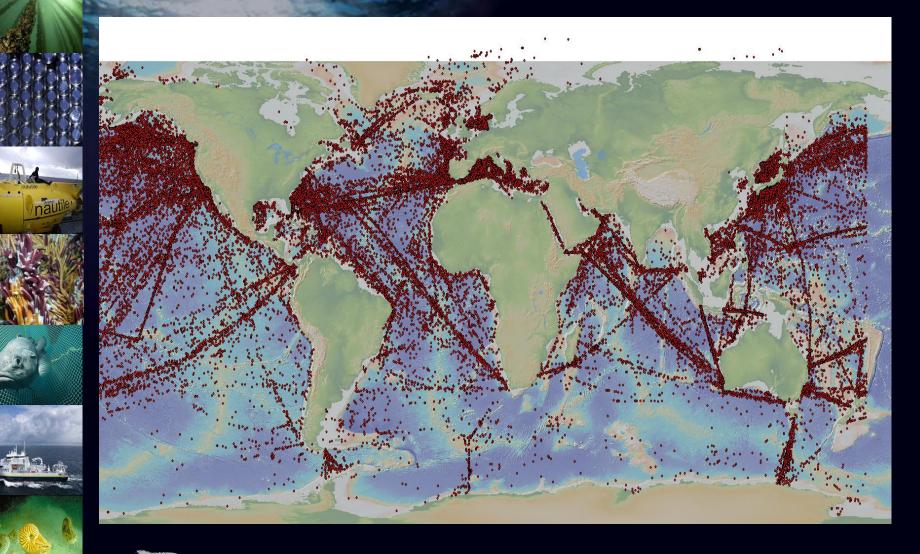


OCL ISAS 6.2 standardization alerts (blue)





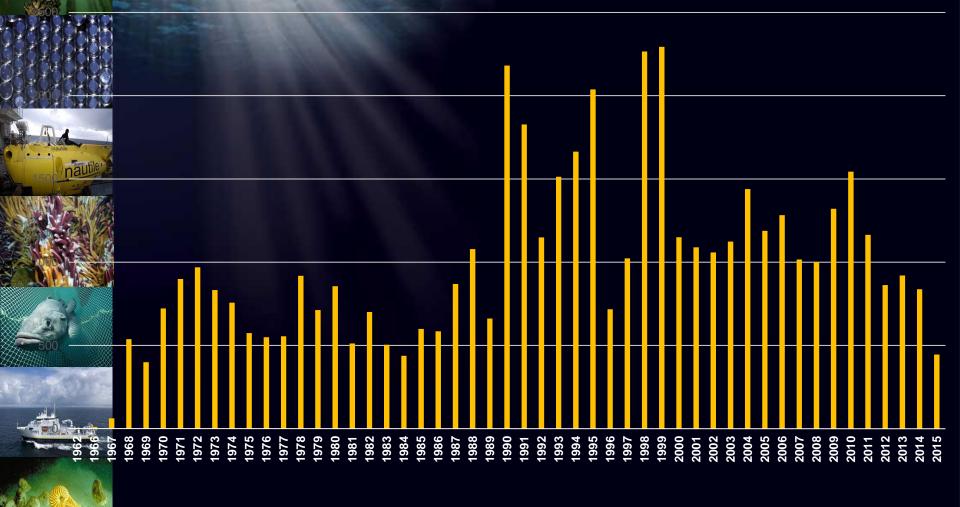
OCL ISAS 6.2 red alerts





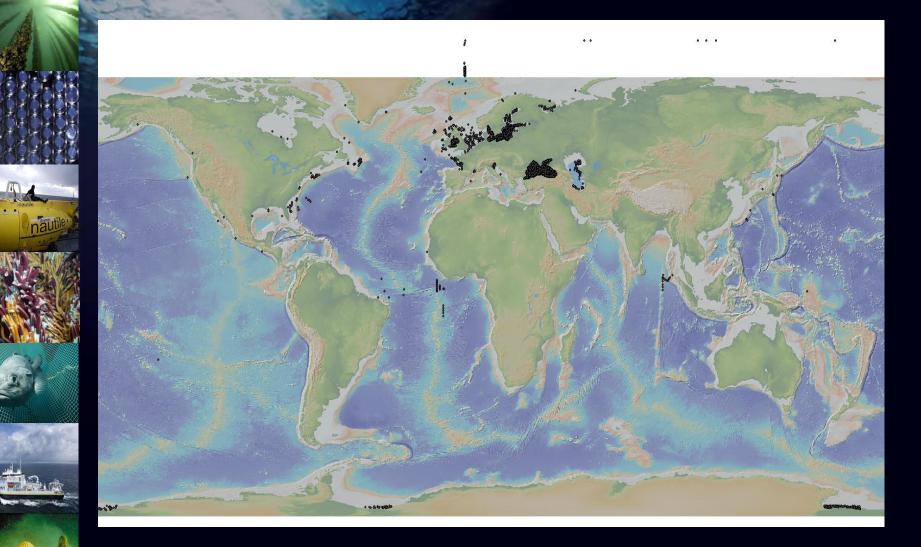
OCL ISAS 6.2 histogram of red alerts

histogram of red alerts



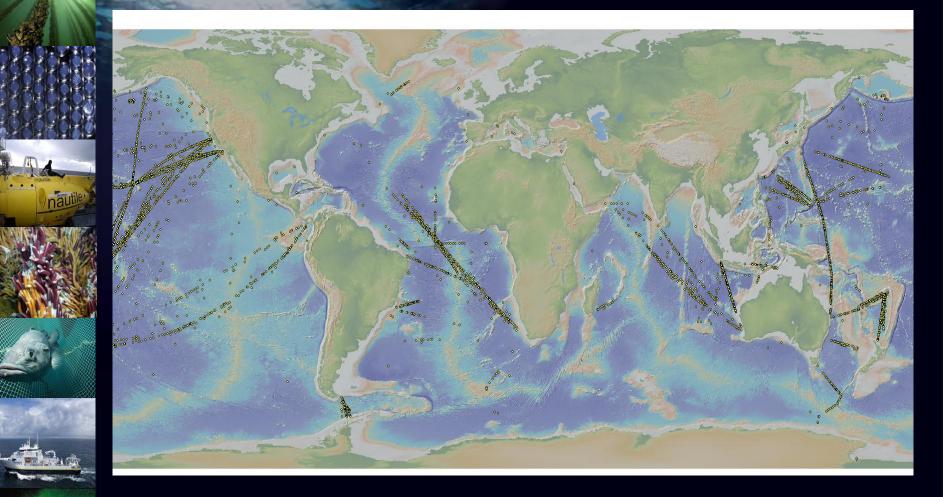
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OCL ISAS 6.2 undefined alerts (dark grey)



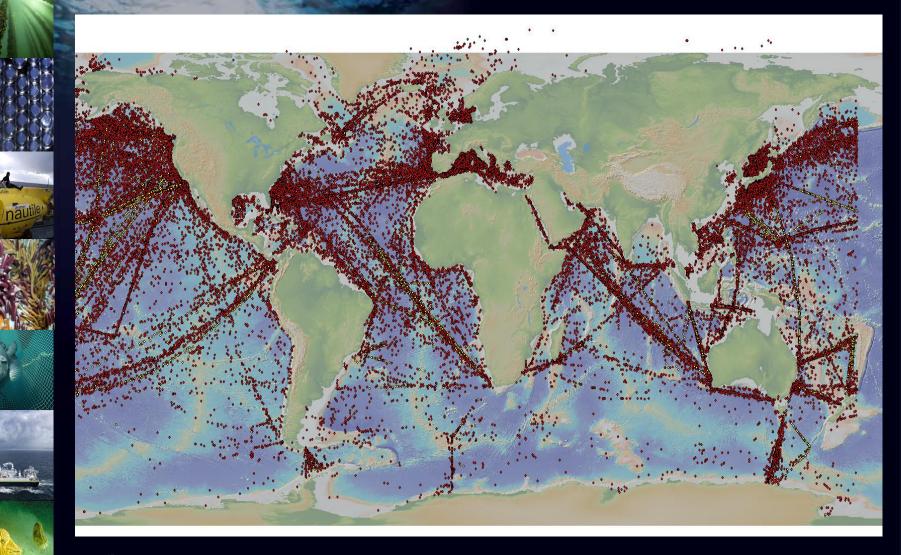


OCL ISAS 6.2 spike or climatology alerts (yellow)

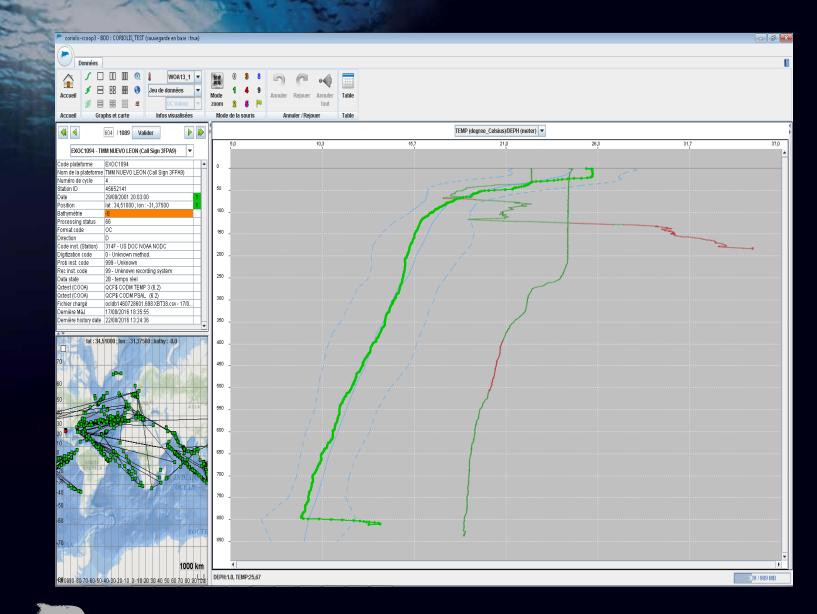




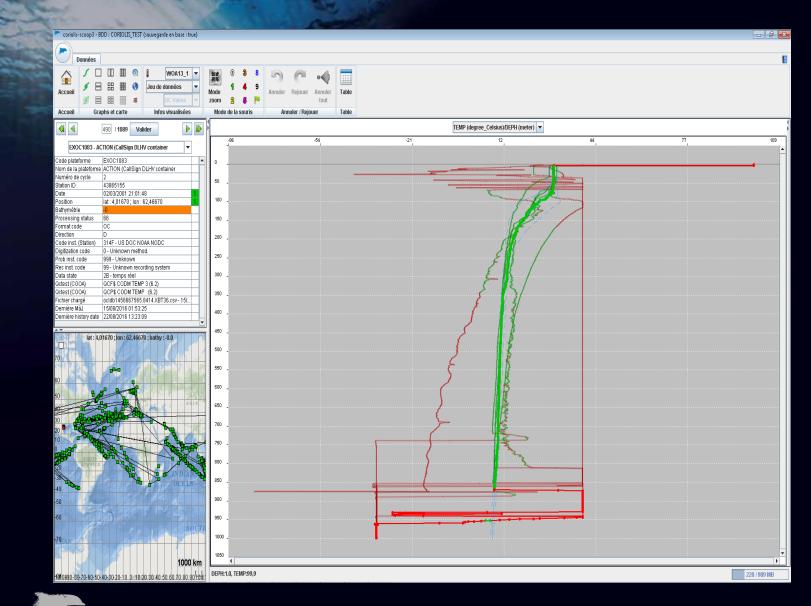
OCL ISAS 6.2 with significant alerts (red, blue, yellow)



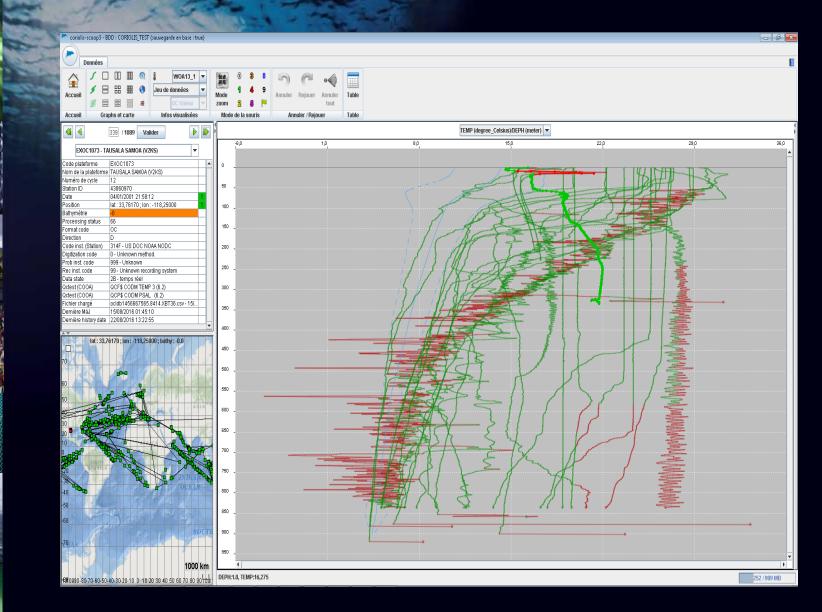




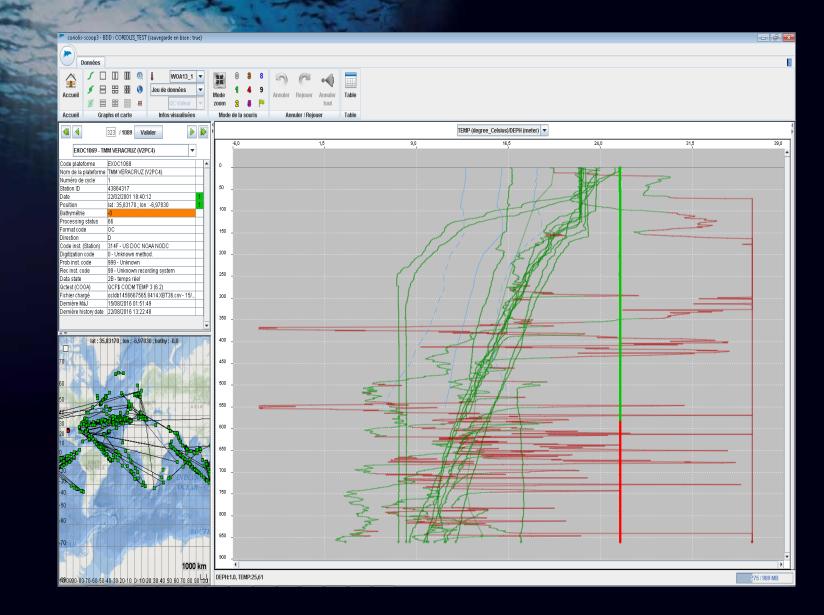
Ifremer



Ifremer



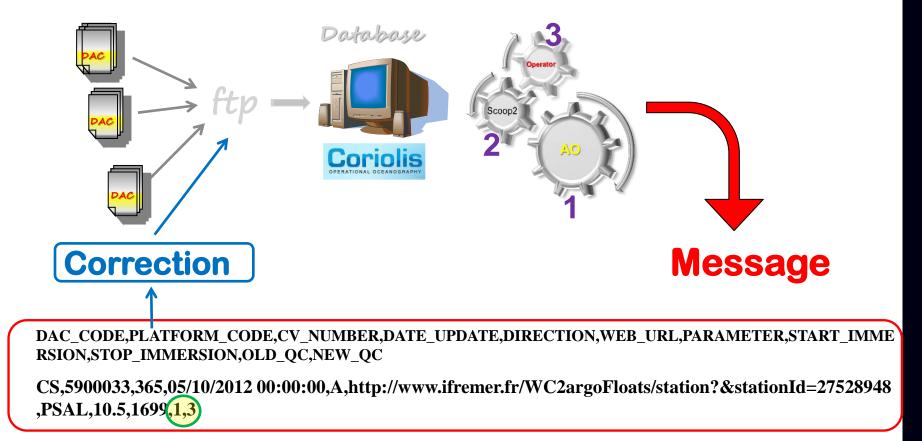




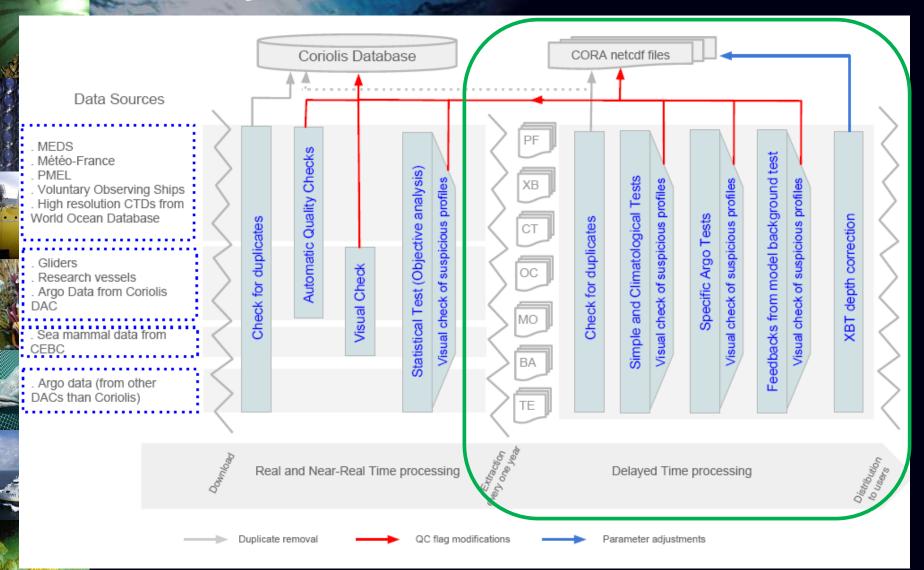
Ifremer

Feedback from OA

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



Using objective analysis for QC in delayed mode : CORA

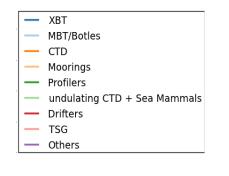


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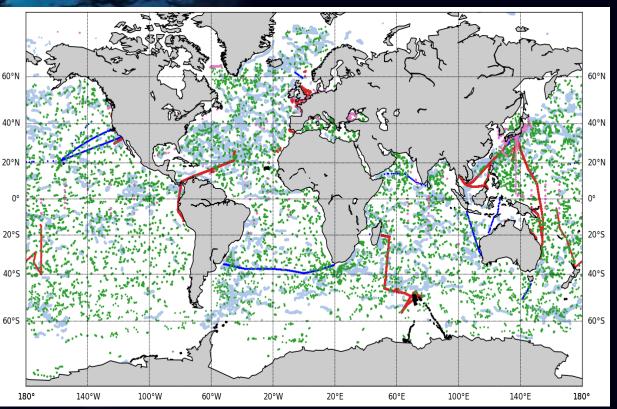
24

CORA 4.2 – COriolis dataset for ReAnalysis

Temperature and Salinity dataset 1950-2014 Global ocean Delayed mode validated profiles Numerous instrument types:

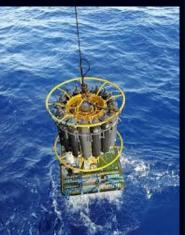


And also 2500000 profiles from SHOM



From Tanguy Szekely (Coriolis R&D)

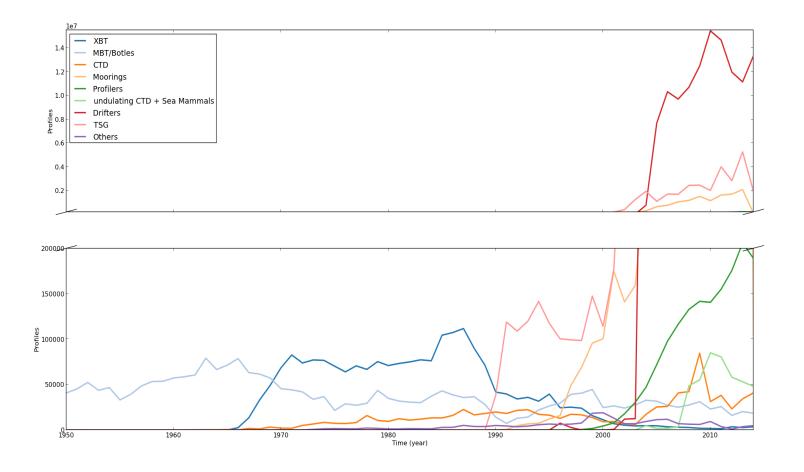




CORA4.2 dataset description

Instrument types:

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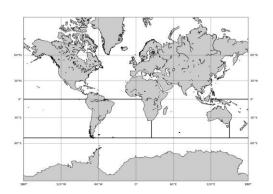


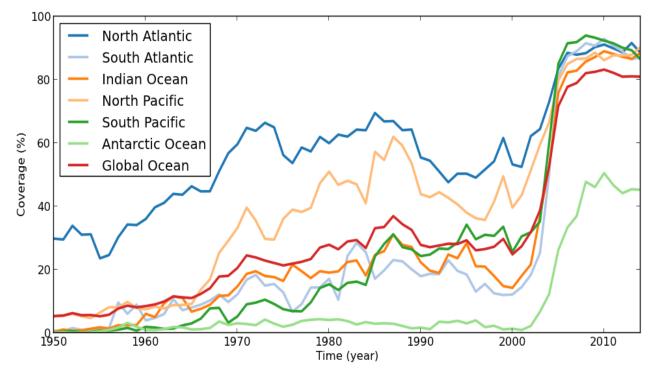
Updates from CORA 4.1 : Over 4 million new delayed time validated profiles.

CORA4.2 dataset description

Ocean basin sampling rates

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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	$0.001 \mu S cm^{-1f}$	

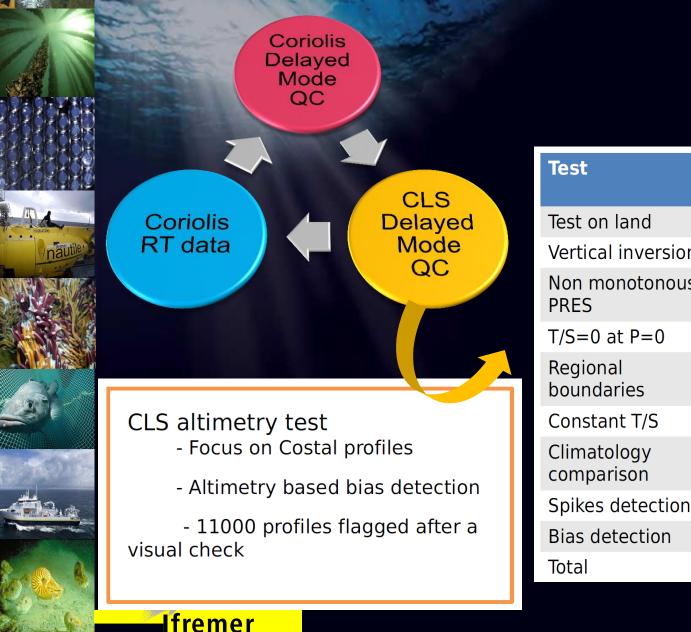
^a World Ocean Database, 2009, Boyer et al. (2009); ^b Johnson (1995); ^c nominal accuracy, Boehme and Send (2005);

^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

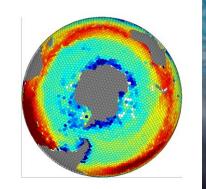


CORA 4.2 – Delayed Mode Validation



est	Corrected profiles
est on land	33
ertical inversion	161
on monotonous RES	969
/S=0 at P=0	58
egional oundaries	265
onstant T/S	91
limatology omparison	3310
pikes detection	68
ias detection	6023
otal	10979

Minmax test description

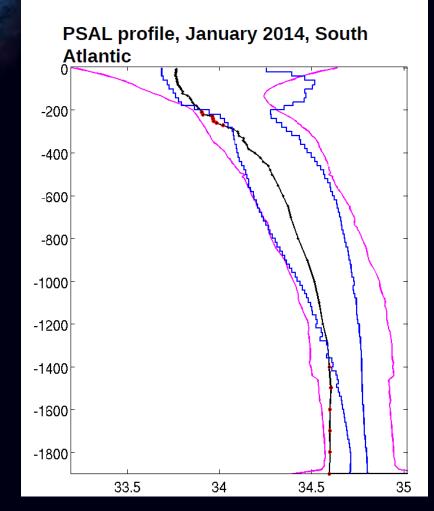


Reference field of the minimum and maximum observed temperature in 120km wide hexagonal cells

 Based on ARGO, CTD and sea mammals profiles.

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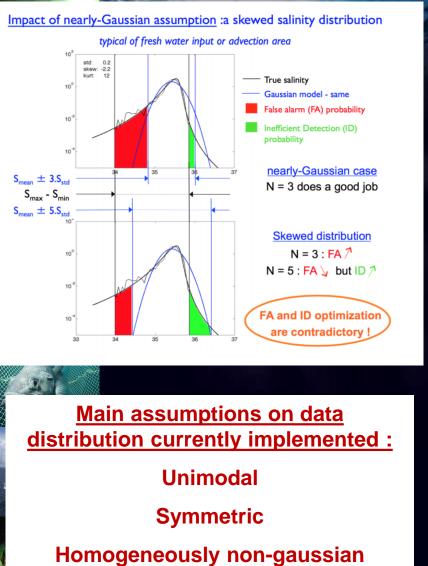
- Very efficient to find biased profiles
- Lower wrong detection rate
- Accurate in the deep ocean



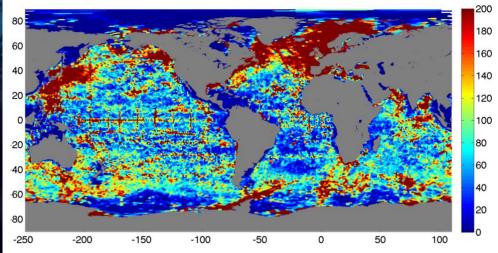
Jérôme Gourrion et al, poster session OD14C-2440:

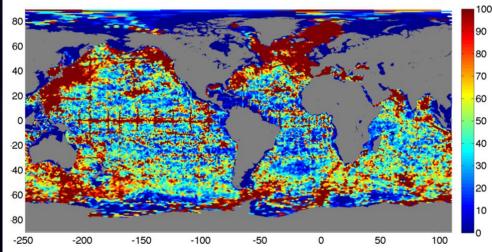
Improved Statistical Method for Hydrographic Climatic Record Quality Control

Minmax test description



Ifremer



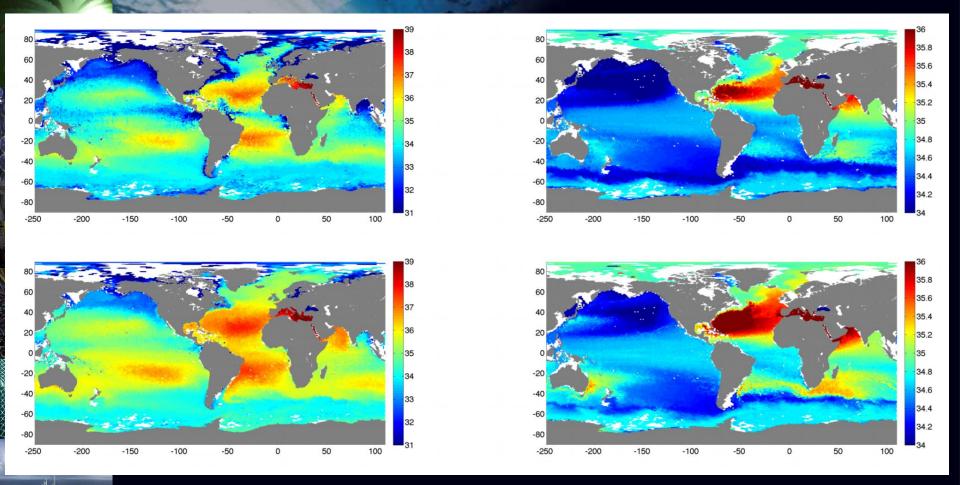


Number of samples per grid cell.

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

Minmax test description

Ifremer



Upper panels: minimum salinity value. Bottom: maximum salinity value. Left (right) column corresponds to the 0-10 db (500-510 db) layer.