Product Information Document (PIDoc)

SeaDataCloud Temperature and Salinity Historical Data Collection for the North Atlantic Ocean (Version 1)

SDC_NAT_DATA_TS_V1

HORIZON **2020**

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SeaDataCloud Temperature and Salinity Historical Data Collection for the North Atlantic Ocean (Version 1)

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Short description

The SeaDataCloud Temperature and Salinity Historical Data Collection for the North Atlantic Ocean includes open access in situ data on temperature and salinity of water column in the North Atlantic Ocean (from 10°N to 62°N for the east part and including the Labrador Sea for the west part) for period 1900 – 2017. The data were retrieved from the SeaDataNet infrastructure at the end of October 2017. The dataset format is ODV binary collections [1]. The quality control of the data has been performed with the help of ODV software. Data Quality Flags have been revised and set up using recommended QC procedures defined during SeaDataNet2 in conjunction with the visual expert check.

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V1	C. Coatanoan	23/02/2018	First version of the PIDoc
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V1.2	C. Coatanoan	24/04/2018	Additional dataset
V1.3	C. Coatanoan	14/05/2018	Add annex2 and update of quality control procedure

V1.4	S. Simoncelli	21/06/2018	Final revision

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Abstract

The SeaDataCloud Temperature and Salinity Historical Data Collection for the North Atlantic Ocean includes open access in situ data on temperature and salinity of water column in the North Atlantic Ocean (from 10°N to 62°N for the east part and including the Labrador Sea for the west part) for period 1900 – 2017. The data were retrieved from the SeaDataNet infrastructure at the end of October 2017. The dataset format is ODV binary collections [1]. The quality control of the data has been performed with the help of ODV software. Data Quality Flags have been revised and set up using recommended QC procedures defined during SeaDataNet2 in conjunction with the visual expert check.

Whenever SDC_NAT_DATA_TS_V1 product is used, this PIDoc should be cited in any publication. We also ask users to remember that hard-working scientists made these measurements, often under severe conditions. Further, the data providers normally possess insight on the quality and context of the data not always shared with the SeaDataCloud team. Hence, inviting data providers and product leaders to collaborate in scientific investigations that depend on their data and data products is considered good and fair practice. Importantly, this will promote further sharing of data and will be beneficial to science.

1. General description of the data collection

The historical data collection of the North Atlantic Ocean contains Temperature and Salinity observations between 10°N and 62°N of latitude for the east part, and including data into the Labrador Sea till 70°N and till gulf of Mexico for the west part. The spatial distribution and the data density maps of Temperature and Salinity observations from the entire data collection are shown in Figure 1(a) and (b). Data distribution maps show a good geographical spread with the best coverage on the eastern part of the domain, mainly close to the areas off Ireland and in the Bay of Biscay (Figure 1(b)). This higher coverage on the east part is also due to a large number of **thermosalinograph (TSG) measurements** (Figure 2), which are off the coast of Ireland and **represent almost 46% of the total dataset**. The North Atlantic Ocean historical data set contains just over 8108995 stations for the period 1890-2012 and 982778 stations for recent years (2013-2017). The data collection contains 6002 cruises for 9091773 stations.

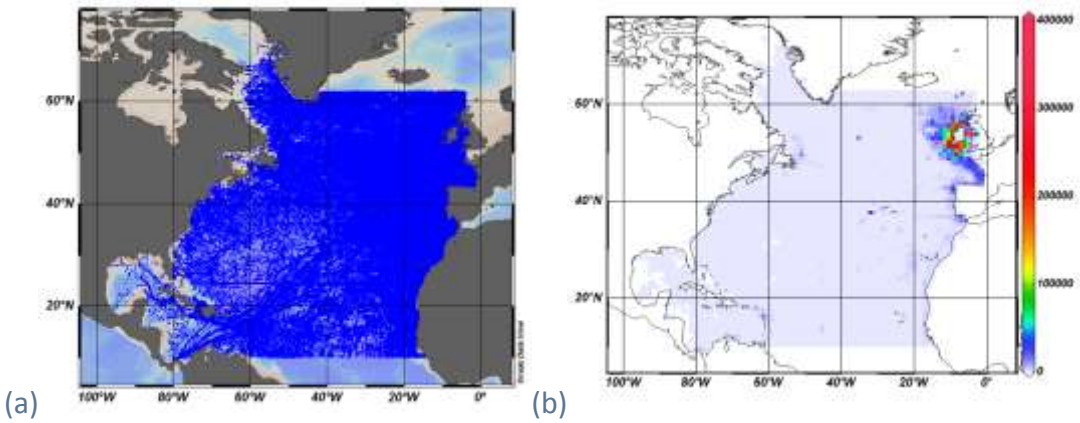


Figure 1. TS stations collection for the North Atlantic Ocean: (a) data distribution map; (b) data density plot showing where most values have been sampled.

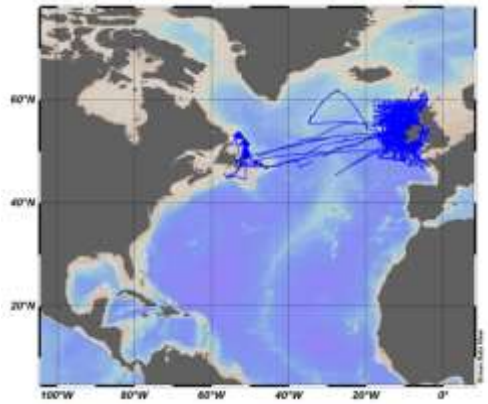


Figure 2. Thermosalinograph (TSG) distribution from the Marine Institute data center (4177186 stations).

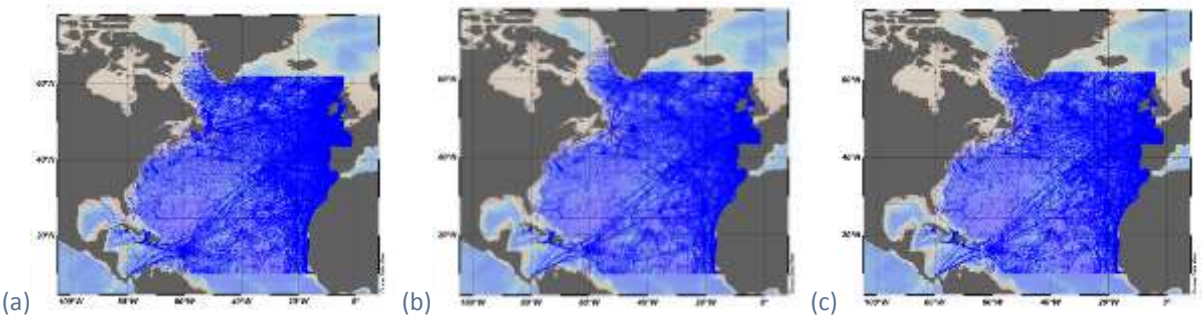
Table 1 shows in details the number of observed stations and its repartition in Temperature stations and Salinity stations and stations that sampled both T and S. Some profiles have Salinity measurements and no Temperature measurements; 3134 stations have only salinity

parameter. Only 39.25% of the observations have the couple TS that means that most of the data have only temperature observations (most of TSG observations).

PAR	#stations	%
All	9091773	
T	9074128	99.80%
S	3572113	39.29%
TS	3568979	39.25%
Z	9091756	

Table 1. Synthesis table with data statistics

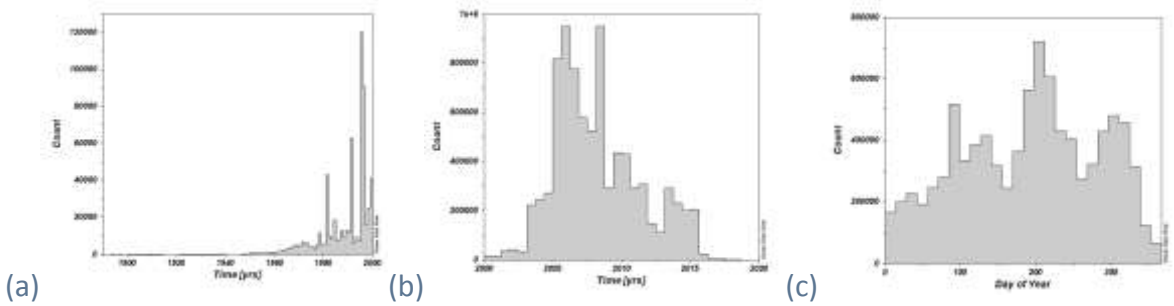
Figure 3 shows the distribution map by parameter (temperature, salinity and couple temperature/salinity). The stations with only temperature data are mainly in the northeast part of the map.



(a) (b) (c)

Figure 3. Spatial distribution of: (a) temperature observations; (b) salinity observations; (c) temperature and salinity observations.

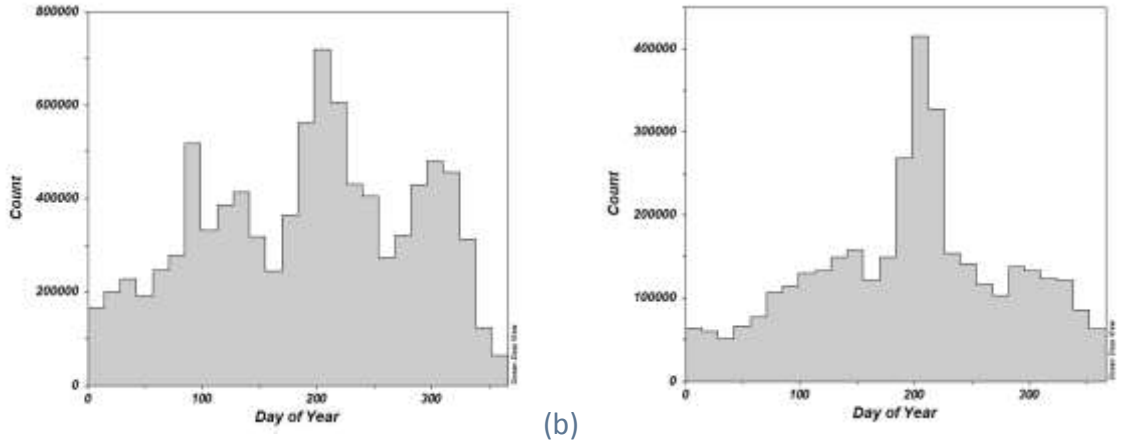
Temporal data distribution is shown in Figure 4a. The distribution in time is poor for the first 80 years, it increases somewhat after 1980 until around end of 1990s where it further increases. In the latest years there is a decrease in data which is caused by a natural time lag between sampling and until data becomes available in the SeaDataCloud system. Figure 4b shows the seasonal distribution of data. Most of the data have been collected during spring, summer and autumn, with a larger peak during summer.



(a) (b) (c)

Figure 4. Time distribution for the period 1890-1999 (a) and 2000-2017 (b), and seasonal distribution over the year (c) for the entire data set.

Splitting the temporal distribution by parameter (Figure 5) shows a sampling of salinity data mainly during the summer.



(a) (b)

Figure 5. Seasonal distribution for temperature (a) and salinity (b).

In terms of **instrument types (**Table 2**), 83 versions have been detected in the data collection** for the profiles for a total of 9421968. Some versions are very similar and differ by only one sensor.

altimeters;CTD;dissolved gas sensors;fluorometers;optical backscatter sensors;radiometers;salinity sensor;transmissometers;water temperature sensor	49
altimeters;CTD;dissolved gas sensors;fluorometers;optical backscatter sensors;salinity sensor;transmissometers;water pressure sensors;water temperature sensor	9
altimeters;CTD;dissolved gas sensors;fluorometers;optical backscatter sensors;salinity sensor;transmissometers;water temperature sensor	229
altimeters;CTD;dissolved gas sensors;fluorometers;salinity sensor;transmissometers;water temperature sensor	84
altimeters;CTD;fluorometers;optical backscatter sensors;salinity sensor;transmissometers;water temperature sensor	29
altimeters;dissolved gas sensors;fluorometers;optical backscatter sensors;radiometers;salinity sensor;transmissometers;water pressure sensors;water temperature sensor	65

anemometers;fluorometers;meteorological packages;NAVSTAR Global Positioning System receivers;platform attitude sensors;radiometers;salinity sensor;single-beam echosounders;thermosalinographs;transmissometers;water temperature sensor	13722
autoanalysers;colorimeters	1359
autoanalysers;colorimeters;Decca Navigator System main chain receivers;fluorometers;salinity sensor;thermosalinographs;transmissometers;water temperature sensor	774
autoanalysers;colorimeters;dissolved gas sensors;fluorometers;metal analysers;NAVSTAR Global Positioning System receivers;salinity sensor;thermosalinographs;transmissometers;water temperature sensor	4547
autoanalysers;colorimeters;fluorometers;metal analysers;NAVSTAR Global Positioning System receivers;salinity sensor;thermosalinographs;transmissometers;water temperature sensor	2627
autoanalysers;colorimeters;fluorometers;NAVSTAR Global Positioning System receivers;salinity sensor;thermosalinographs;transmissometers;water temperature sensor	4686
bathythermographs	88897
bathythermographs;water temperature sensor	498
CTD	52308
CTD;discrete water samplers	14484
CTD;discrete water samplers;fluorometers;optical backscatter sensors;salinity sensor;water pressure sensors;water temperature sensor	141
CTD;discrete water samplers;transmissometers	2
CTD;dissolved gas sensors;fluorometers;in-situ particle sizers;radiometers;salinity sensor;transmissometers;water temperature sensor	1198
CTD;dissolved gas sensors;fluorometers;nutrient analysers;radiometers;salinity sensor;transmissometers;water temperature sensor	143
CTD;dissolved gas sensors;fluorometers;optical backscatter sensors;radiometers;salinity sensor;water temperature sensor	16
CTD;dissolved gas sensors;fluorometers;optical backscatter sensors;radiometers;salinity sensor;transmissometers;water temperature sensor	69
CTD;dissolved gas sensors;fluorometers;optical backscatter sensors;salinity sensor;transmissometers;water pressure sensors;water temperature sensor	51
CTD;dissolved gas sensors;fluorometers;optical backscatter sensors;salinity sensor;transmissometers;water temperature sensor	346
CTD;dissolved gas sensors;fluorometers;optical backscatter sensors;salinity sensor;water temperature sensor	1
CTD;dissolved gas sensors;fluorometers;radiometers;salinity sensor;transmissometers;water pressure sensors;water temperature sensor	83
CTD;dissolved gas sensors;fluorometers;radiometers;salinity sensor;transmissometers;water temperature sensor	1789

CTD;dissolved gas sensors;fluorometers;radiometers;salinity sensor;water temperature sensor	38
CTD;dissolved gas sensors;fluorometers;radiometers;salinity sensor;water pressure sensors;water temperature sensor	35
CTD;dissolved gas sensors;fluorometers;salinity sensor;transmissometers;water pressure sensors;water temperature sensor	179
CTD;dissolved gas sensors;fluorometers;salinity sensor;transmissometers;water temperature sensor	3503
CTD;dissolved gas sensors;fluorometers;salinity sensor;water pressure sensors;water temperature sensor	23
CTD;dissolved gas sensors;fluorometers;salinity sensor;water temperature sensor	437828
CTD;dissolved gas sensors;radiometers;salinity sensor;transmissometers;water temperature sensor	11
CTD;dissolved gas sensors;salinity sensor;transmissometers;water temperature sensor	726
CTD;dissolved gas sensors;salinity sensor;water temperature sensor	4587
CTD;fluorometers;NAVSTAR Global Positioning System receivers;salinity sensor;single-beam echosounders;water temperature sensor	23234
CTD;fluorometers;NAVSTAR Global Positioning System receivers;salinity sensor;water temperature sensor	179984
CTD;fluorometers;optical backscatter sensors;salinity sensor;water pressure sensors;water temperature sensor	55
CTD;fluorometers;optical backscatter sensors;salinity sensor;transmissometers;water temperature sensor	29
CTD;fluorometers;optical backscatter sensors;salinity sensor;water temperature sensor	151
CTD;fluorometers;radiometers;salinity sensor;transmissometers;water pressure sensors;water temperature sensor	55
CTD;fluorometers;radiometers;salinity sensor;transmissometers;water temperature sensor	136
CTD;fluorometers;radiometers;salinity sensor;water pressure sensors;water temperature sensor	15
CTD;fluorometers;salinity sensor;transmissometers;water pressure sensors;water temperature sensor	3
CTD;fluorometers;salinity sensor;transmissometers;water temperature sensor	952
CTD;fluorometers;salinity sensor;water pressure sensors;water temperature sensor	19
CTD;fluorometers;salinity sensor;water temperature sensor	455
CTD;radiometers;salinity sensor;transmissometers;water temperature sensor	40
CTD;fluorometers;salinity sensor;water temperature sensor	9
CTD;pH sensors;Physical oceanographic models;salinometers;sieves and filters;titrators;water temperature sensor	321
CTD;salinity sensor;transmissometers;water pressure sensors;water temperature sensor	14
CTD;salinity sensor;water pressure sensors;water temperature sensor	1

CTD;salinity sensor;water temperature sensor	15655
CTD;transmissometers	2
continuous water samplers	8552
Differential Global Positioning System receivers;fluorometers;NAVSTAR Global Positioning System receivers;salinity sensor;transmissometers;water temperature sensor	29246
Differential Global Positioning System receivers;fluorometers;salinity sensor;thermosalinographs;water temperature sensor	40886
discrete water samplers	94879
dissolved gas sensors;fluorometers;NAVSTAR Global Positioning System receivers;optical backscatter sensors;salinity sensor;thermosalinographs;water temperature sensor	768025
dissolved gas sensors;fluorometers;NAVSTAR Global Positioning System receivers;salinity sensor;thermosalinographs;water temperature sensor	334581
dissolved gas sensors;fluorometers;optical backscatter sensors;radiometers;salinity sensor;transmissometers;water pressure sensors;water temperature sensor	40
dissolved gas sensors;fluorometers;optical backscatter sensors;salinity sensor;transmissometers;water pressure sensors;water temperature sensor	5
dissolved gas sensors;fluorometers;radiometers;salinity sensor;water pressure sensors;water temperature sensor	4
dissolved gas sensors;fluorometers;salinity sensor;transmissometers;water temperature sensor	73
dissolved gas sensors;fluorometers;salinity sensor;water temperature sensor	2089
dissolved gas sensors;salinity sensor;water temperature sensor	6175
expendable CTDs;salinity sensor;water temperature sensor	32
fluorometers;NAVSTAR Global Positioning System receivers;optical backscatter sensors;salinity sensor;thermosalinographs;water temperature sensor	155002
fluorometers;salinity sensor;thermosalinographs;transmissometers;water temperature sensor	45555
fluorometers;salinity sensor;transmissometers;water temperature sensor	19902
fluorometers;salinity sensor;water temperature sensor	17346
fluorometers;thermosalinographs	125338
platform attitude sensors;water temperature sensor	814
salinity sensor	6158
salinity sensor;satellite tracking system;water temperature sensor	15
salinity sensor;water temperature sensor	73889
thermistor chains	402

thermistor chains;water temperature sensor	295272
thermosalinographs	5524806
thermosalinographs;water temperature sensor	134105
transmissometers	1
water temperature sensor	882435
unknown	75

Table 2. Numbers of stations sampled by the instrument/gear type.

Just looking at the **numbers of data by type of instruments**, the **thermosalinographs and the water temperature sensors are the most representative**.

2. Quality Control Procedure

After a general description of the historical data set a visual control of all observations allowed to assess their quality and to identify the principal criticalities for possible future applications and users. But the large variability of both salinity and temperature for the North Atlantic Ocean makes the quality control difficult, thus the data set has been split into sub-sets for the QC visualization, either in time or in space (sub-regions) or both combined, with a smaller variation than the whole dataset. The data set has been split into 6 sub-regions for the QC visualization (Figure 6) following the water masses characteristics, with similar hydrodynamic. In some sub-region, a new selection has been applied to take into account some time periods to decrease the number of stations to quality check.

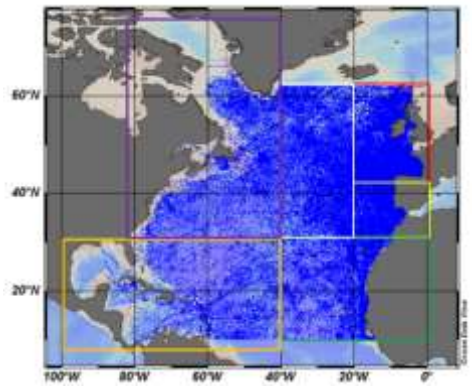


Figure 6. Regional subsets to individually check the QC on the data.

Another data selection by EDMO_CODE had also been used to focus on some anomalies (the same QC procedure has been applied per data centre to detect their eventual systematic errors and data anomalies).

Considering the data, the density was calculated and plotted to find unstable profiles. Displaying the θS plot with ispoycnals can also help to identify problems with the data. Visual inspection was the most used practice to identify the outliers, spike, unstable profiles and stations on land. The same procedure was applied for all data, considering only the quality flag 0, 1 and 2; since it is well known that quality controlled data still can contain errors. Some checks concerning the QF on the missing data have also been investigated.

Checking bottom water is a bit easier because it is not affected by the seasonal temperature cycles and it has stable salinity concentrations.

The quality control work followed the best practices that were defined during the project SeaDataNet 2:

- **Checks of the data coverage, by sub-region when necessary** (distribution for T, S, TS couples), by time periods, by layers (distinction between surface, intermediate and bottom layers);
- TS scatter plots of the entire dataset: T versus Z, S versus Z, θS diagram with isopycnal levels for all the QF<3 (check the outliers and change the QF to 4); sometimes the outliers were the missing data values with not appropriate QF;
- By sub-region, scatter plot of observations with QF=1 (good) with a secondary plot showing the density;
- By sub-region, scatter plot of observations with QF=2 (probably good) with a secondary plot showing the density;
- Scatter plot observations with QF=0 (no quality check): only change the bad data with QF4;
- Identification of stations falling on land;
- Identification of stations having unreal depth (depth values<0);

The most useful and powerful quality control used was visual inspection of subsets of data in ODV to discover spikes, outliers, unstable profiles and stations on land.

ODV is also used to check with the surface plots (on depth or potential density anomaly), the quality of the data. The distribution of the data on a defined depth or density allows showing point with strange value (Figure 7 and Figure 8).

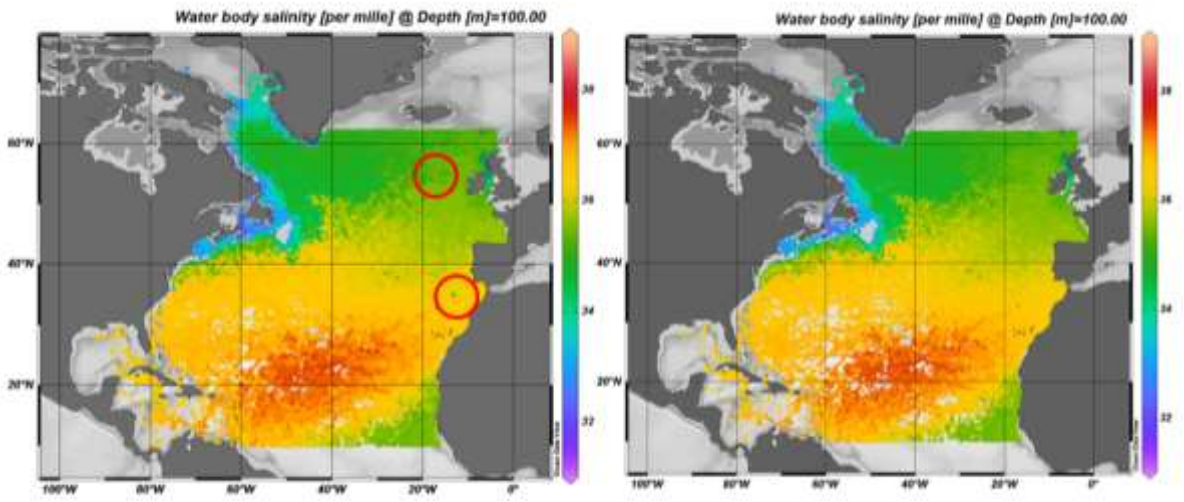


Figure 7. Salinity distribution (QC 0-1-2) on the depth 100m before and after correction.

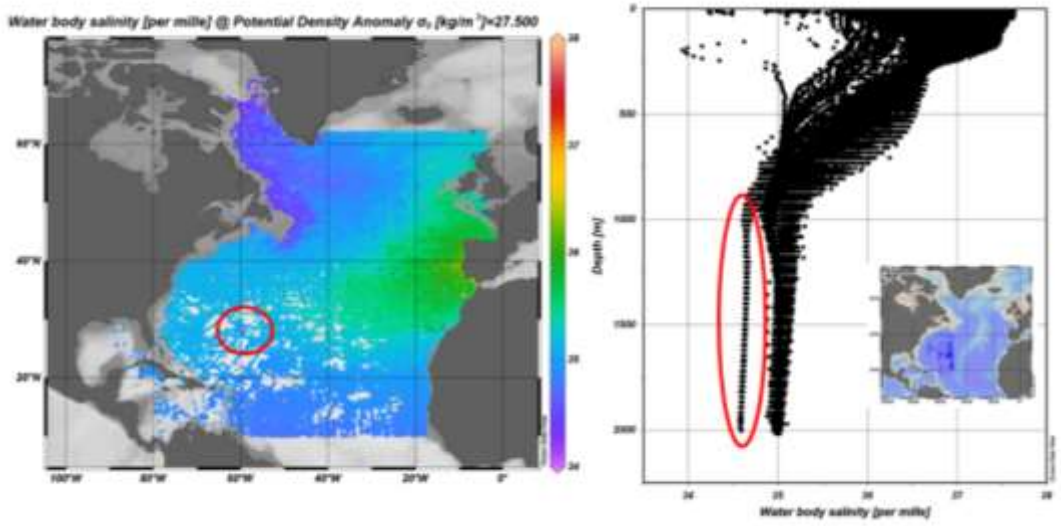


Figure 8. Salinity distribution on the density 27.5 on left and corresponding bad salinity on right.

3. Quality assessment results

All data have been quality controlled according to the criteria defined in chapter 2. Around **12703 salinity values and 7770 temperature values were flagged as suspicious/bad**, flag 3 and 4. This is about 0.024% of the total amount of salinity values and 0.011% of the total amount of temperature values, further details can be seen below in Table 3 and Table 4.

The suspicious values consist mainly of spikes, outliers and unstable density profiles, but there are also some other problems:

- Some profiles appear to be more salty, due to wrong position.

- Few values have negative depths (Argo profiles).

- Some measurements contain values 0; corresponding certainly of missing values (the QC 1 has been updated to 4).

- Some salinity measurements contain QF0 but it is due to a wrong QC mix between psal and ssal measurements during aggregation. Those data have been checked to determine wrong value (QF changed to 4 in this case) but QF0 has been kept and will be used to produce the climatology.

- Few measurements appear to be “on land”, or close to rivers.

The list of the QC changes will be included in the quality control feedback that will be sent to the different SeaDataCloud partners.

PAR	TOT	QF0	QF1	QF2	QF3-9
T	70139531	65237	69642822	69641	361831
%		0.09	99.30	0.09	0.52
S	53549152	1274601	51080353	122079	1072119
%		2.38	95.39	0.23	2.00

Table 3. Quality Flags statistics for the initial data collection (without QC procedure).

PAR	TOT	QF0	QF1	QF2	QF3-9
T	69921467	61640	69421176	69046	369601
		0.09	99.29	0.09	0.53
S	53331088	1274555	50850255	121456	1084822
		2.39	95.34	0.24	2.03

Table 4. Quality Flags statistics after the quality check procedure.

The following figures show the distribution of the parameters versus depth. Figure 9 shows the temperature versus depth scatter plots before quality control for all the QF, for the QF1 and QF0.

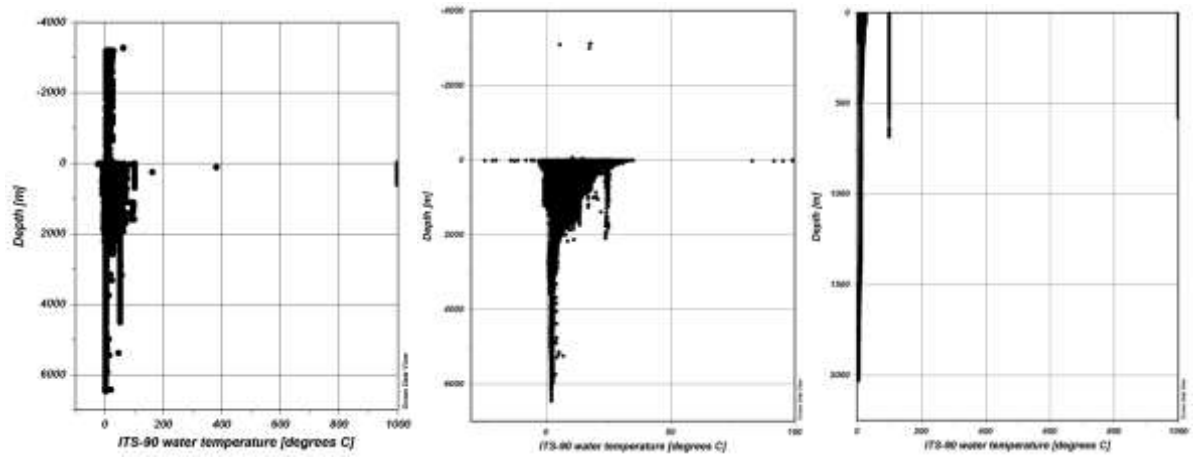


Figure 9. Temperature versus depth scatter plot of the North Atlantic data collection covering the time period 1900-2017: (a) all data Quality Flags; (b) QF=1; (c) QF = 0 (no quality control).

Figure 10 shows the salinity versus scatter plots before quality control for all the QF, for the QF1 and QF0.

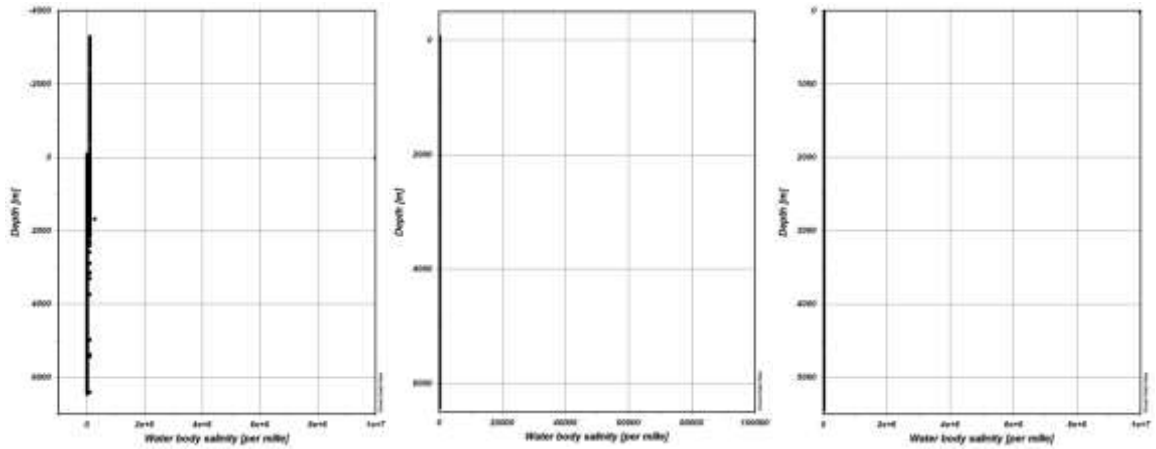
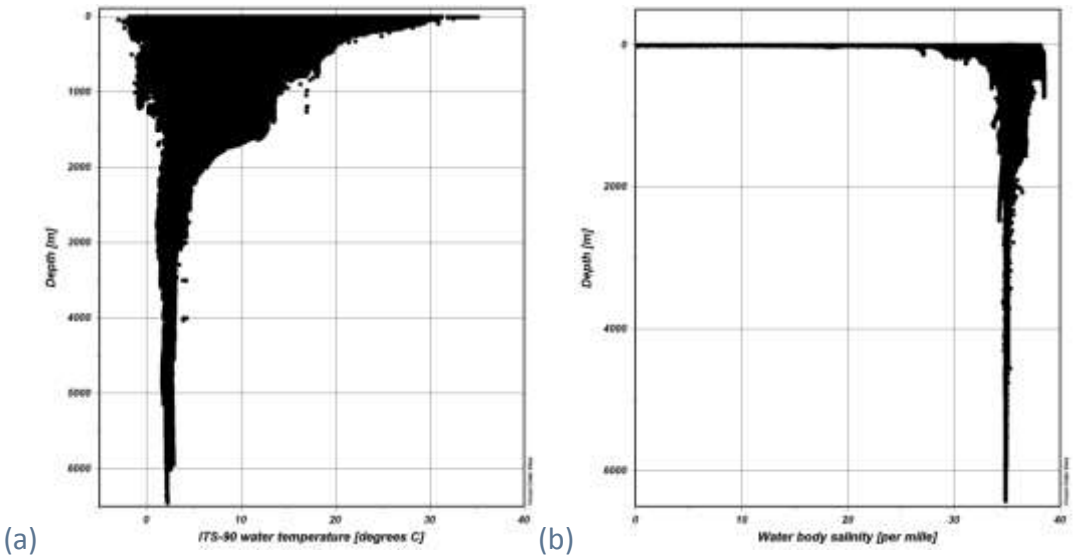


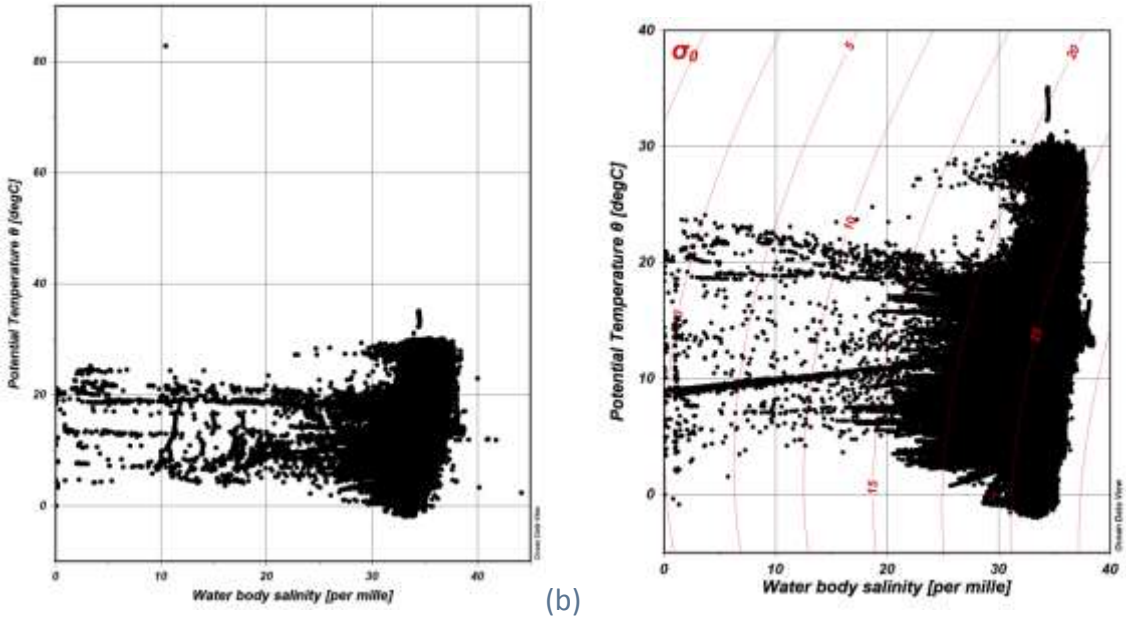
Figure 10. Salinity versus depth scatter plot of the North Atlantic data collection covering the time period 1900-2017: (a) all data Quality Flags; (b) QF=1; (c) QF = 0 (no quality control).

Plots in Figure 9 and Figure 10 show that among data with good quality flag (QF=1) there are still some wrong values that need to be updated with a QF4. Some obvious outliers were easy to detect and remove from the good dataset. Figure 11 displays the parameters versus depth of good quality data after QC analysis. Figure 12 presents the θS diagram plots and Figure 13 shows the vertical distribution of the potential density anomaly before and after the quality control procedure.



(a) (b)

Figure 11. North Atlantic data collection (1890-2017) considering only data with QF = 1 (good): (a) Temperature versus depth; (b) Salinity versus depth.



(a) (b)

Figure 12. North Atlantic data collection: θS diagram (QF=1) showing data before (a) and after (b) quality control.

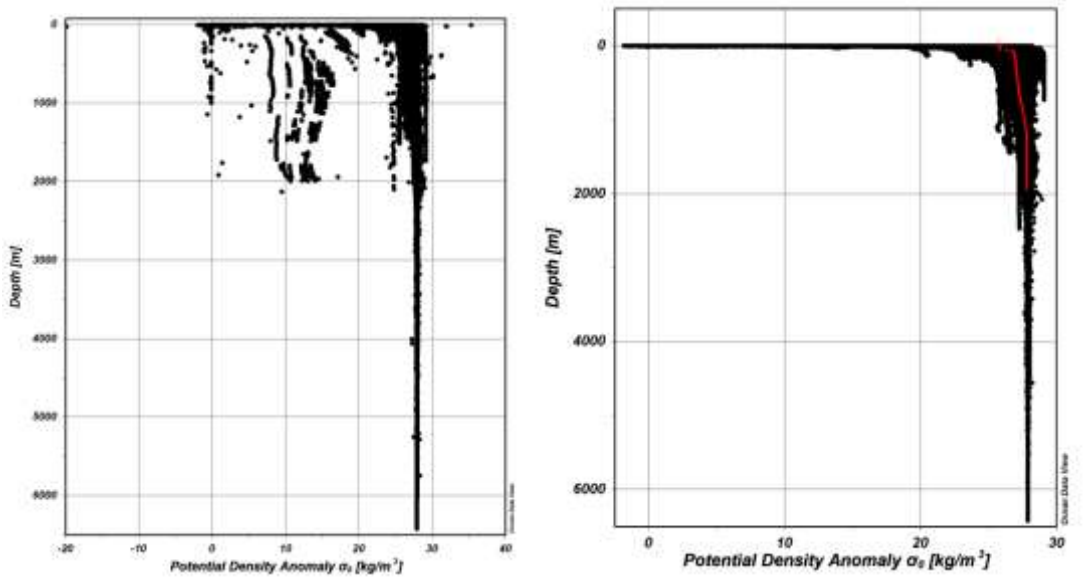


Figure 13. North Atlantic data collection considering only data with QF = 1 (good). Potential Density Anomaly: (a) before correction and (b) after correction.

4. Technical Specifications

Product Format

Ocean Data View (ODV) collection.

Data Policy

No limitation on usage; however for data access the registration is required at http://www.marine-id.org/.

Product Usability

The collection contains unique large array of QC-ed data on Temperature and Salinity for the North Atlantic Ocean for periods 1890-2017. This dataset can be used as to support the general oceanographic studies, such as investigation of variability of physical properties as well as applications, such as circulation models. For the north/northeast limits, it will be useful to take into account the North Sea and Artic collections for better investigations on the water masses circulation on those oceanic areas. Please consider that the SDC_NAT_DATA_TS_V1 data set contains:

- underway data at reduced resolution, since only one sample over seven have been included in this data collection. New releases will keep the original data resolution.
- XBT data without any depth correction.

Whenever SDC_NAT_DATA_TS_V1 product is used, this PIDoc should be cited in any publication. We also ask users to remember that hard-working scientists made these measurements, often under severe conditions. Further, the data providers normally possess insight on the quality and context of the data not always shared with the SeaDataCloud team. Hence, inviting data providers and product leaders to collaborate in scientific investigations that depend on their data and data products is considered good and fair practice. Importantly, this will promote further sharing of data and will be beneficial to science.

Changes since previous version

The previous version of the product (SDN2_V2) was released at the end of 2015 in the framework of the SeaDataNet2 project and it is available at SEXTANT Catalogue (http://sextant.ifremer.fr/en/web/seadatanet) under the name “North Atlantic Ocean - Temperature and salinity observation collection V2”.

Comparing the SDC_NAT_DATA_TS_V1 to the SDN2_V2 collection over the same spatial domain but time period from 1900-2014 to 1890-2017 in Table 4 it shows a large data increase (+403%), mainly for temperature measurements (435.7% of increase). This increase is mainly due to the large data ingestion from the Marine Institute (Ireland). Most of their data have only temperature measurements (and most are from thermosalinograph instrument type), explaining the large increase for this parameter between SDN2_V2 and SDC_V1.

Moreover, the data aggregation for SDC_V1 contains underway data imported at reduced resolution, only one sample over seven have been included in this data collection.

#stations	Total	T	S	TS
SDN2_V2	1807266	1693840	785476	784015
SDC_V1	9091773	9074128	3572113	3568979
% of increase	+403%	+435.7%	+354.7%	+38.1%

Table 4. Data statistics of previous (SDN2_V2) and current (SDV_V1) version of the North Atlantic Ocean historical data collections.

Annex 1 - QC Best Practices

- The basic QC analysis steps applied during SeaDataNet2 Project using ODV were:
- **Data coverage**;
- **Data distribution maps** per Temperature, Salinity and TS couples;
- **Data density maps** (domain binning);
- **Time coverage and time distribution** → histograms with annual, seasonal and monthly data distribution;
- TS scatter plots of the entire dataset;
- Scatter plot of observations with QF=1 (good) and QF=2 (probably good);
- Scatter plot observations with QF=0 (no quality check);
- **Gross range check** to detect observations with temperature and salinity out of reasonable values;
- Visual control of scatter-plots to identify wrong profiles (outliers);
- Identification of stations falling on land;
- Identification of stations having unreal depth;
- Identification of wrong or missing data;
- Stability check on density

Additional checks are advisable per specific:

- **areas** with similar hydrodynamic characteristics;
- **layers** (surface, intermediate, bottom);
- **time periods** (decades, or specific periods i.e. Eastern Mediterranean Transient, Western Mediterranean Transition, Norther Ionian Reversal);
- **Instrument type** → consistency issue of historical data;

Duplicate Check is another important step when performing SDC data integration with external data sources for climatologies and new data products generation.

Table 5 lists the Quality Flags (QF) adopted by SeaDataNet and their definition. QF assigned by the data centers are modified by the regional products' leaders when/if a data anomaly is detected. The data anomaly is reported to the data center asking for correction in the central CDI.

Key	Entry Term	Abbreviated term	Term definition
0	no quality control	none	No quality control procedures have been applied to the data value. This is the initial status for all data values entering the working archive.
1	good value	good	Good quality data value that is not part of any identified malfunction and has been verified as consistent with real phenomena during the quality control process.
2	probably good value	probably_good	Data value that is probably consistent with real phenomena but this is unconfirmed or data value forming part of a malfunction that is considered too small to affect the overall quality of the data object of which it is a part.
3	probably bad value	probably_bad	Data value recognised as unusual during quality control that forms part of a feature that is probably inconsistent with real phenomena.
4	bad value	bad	An obviously erroneous data value.
5	changed value	changed	Data value adjusted during quality control. Best practice strongly recommends that the value before the change be preserved in the data or its accompanying metadata.
6	value below detection	BD	The level of the measured phenomenon was too small to be quantified by the technique employed to measure it. The accompanying value is the detection limit for the technique or zero if that value is unknown.
7	value in excess	excess	The level of the measured phenomenon was too large to be quantified by the technique employed to measure it. The accompanying value is the measurement limit for the technique.
8	interpolated value	interpolated	This value has been derived by interpolation from other values in the data object.
9	missing value	missing	The data value is missing. Any accompanying value will be a magic number representing absent data.
A	value phenomenon uncertain	ID_uncertain	There is uncertainty in the description of the measured phenomenon associated with the value such as chemical species or biological entity.

Table 5 List of SeaDataNet Quality Flags (QF) used to describe the data value; no changes are made to the original data values.

https://www.seadatanet.org/content/download/596/3118/file/SeaDataNet_QC_procedures_V2_%28May_2010%29.pdf?version=1

Annex 2 – Data providers

Edmo code	DATA_ORIGINATOR	CDIs & Stations
396	Marine Institute (396)	4938369
486	IFREMER / IDM / SISMER - Scientific Information Systems for the SEA (486)	1228646
48	Proudman Oceanographic Laboratory (48)	1078000
2133	Proudman Oceanographic Laboratory (2133)	359273
2424	National Oceanography Centre, Liverpool (2424)	293966
2489	Marine Technology Unit. Mediterranean Marine and Environmental Research Centre (2489)	181144
540	Shom (540)	176124
44	Scottish Association for Marine Science (44)	129395
2091	Scottish Office Agriculture and Fisheries Department - Aberdeen Marine Laboratory (2091)	63961
20	University of Wales, School of Ocean Sciences (20)	52275
47	Plymouth Marine Laboratory (47)	48746
6	University of East Anglia, School of Environmental Sciences (6)	44212
2002	Southampton Oceanography Centre (2002)	40369
353	IEO/Spanish Oceanographic Institute (353)	39178
931	Odessa Branch of SOI (State Oceanographic Institute) (931)	38832
17	National Oceanography Centre, Southampton (17)	33350
1054	IFREMER (1054)	30606
1850	Federal Maritime and Hydrographic Agency (1850)	23525
2	University of Cambridge Department of Earth Sciences (2)	16044
43	British Oceanographic Data Centre (43)	12489
919	Polar Scientific Research Institute of Fishery and Oceanography (919)	9772
682	Atlantic Scientific Research Institute for Marine Fishery and Oceanography (682)	8852
2117	Institute of Oceanographic Sciences Deacon Laboratory (2117)	7457
1160	Institute for Marine Science (IFM), University of Kiel (1160)	6389
490	LABORATORY OF OCEANOGRAPHY of VILLEFRANCHE (LOV) / OOV (490)	5981
2118	Institute of Oceanographic Sciences Wormley Laboratory (2118)	4899
38	Fisheries Research Services, Aberdeen Marine Laboratory (38)	4754
2134	Institute of Oceanographic Sciences, Bidston Laboratory (2134)	4431

900	Administration Of Fish Searching And Research Fleet for the Western Basin (900)	4163
2530	Scottish Marine Biological Association (2530)	4062
13	University of Plymouth, Institute of Marine Studies (13)	3845
541	IFREMER / EMH-DEPARTEMENT ECOLOGIE ET MODELES POUR L'HALIEUTIQUE (541)	3671
727	Marine Hydrophysical Institute (727)	3386
1404	IEO/ Vigo Oeanographic Centre (1404)	2823
1351	Institute of Marine Research (1351)	2738
487	LABORATORY of PHYSICAL OCEANOGRAPHY (LPO) UMR 6523 CNRS-IFREMER-IRD-UBO (487)	2508
630	NIOZ Royal Netherlands Institute for Sea Research (630)	2407
684	Arctic and Antarctic Research Institute, Roshydromet (Saint-Petersburg) (684)	2280
2092	Department of Agriculture and Fisheries for Scotland - Aberdeen Marine Laboratory (2092)	2145
2195	DTU Aqua - National Institute of Aquatic Resources, Technical University of Denmark (2195)	2059
590	IHPT, Hydrographic Institute (590)	1984
1401	IEO/ Santander Oceanographic Centre (1401)	1940
2529	Dunstaffnage Marine Laboratory (2529)	1689
494	Laboratory of Oceanography and Climate : Experiments and numerical Approaches - UMR 7159 (494)	1606
837	Laboratory of Physical Oceanography/ UNIVERSITE DE BRETAGNE OCCIDENTALE (UBO) (837)	1592
2135	Marine Scotland Science (2135)	1505
4024	Complete Laboratory Solutions (4024)	1280
903	Murmansk Hydrometeorological Administration of Roshydromet (903)	1189
1068	ISTPM (IFREMER NANTES) (1068)	1140
440	IRD /CENTRE DE BRETAGNE (440)	960
838	EPOC - Geology and Oceanography Department (838)	944
848	IFREMER / CENTRE DE BRETAGNE (848)	916
1772	University of Liverpool Department of Oceanography (1772)	723
188	LABO ATMOSPHEREs, MILIEUX, OBSERVATIONS SPATIALES (LATMOS) (188)	722
1403	IEO/ La Coruna Oceanographic Centre (1403)	722
1056	IFREMER / STATION DE LA TREMBLADE (1056)	519

1625	IFREMER / STATION DE LORIENT (1625)	515
2090	Scottish Office Agriculture Environment and Fisheries Department - Aberdeen Marine Laboratory (2090)	451
1016	IFREMER / DYNECO- Coastal Environment Dynamics department (1016)	426
1880	Ifremer / Crela (1880)	425
518	IFREMER STATION DE LA ROCHELLE-L'HOUMEAU (518)	421
1145	IRD / CENTRE OF ABIDJAN (1145)	403
2947	GEOMAR Helmholtz Centre for Ocean Research Kiel (2947)	392
28	Centre for Environment, Fisheries and Aquaculture Science, Lowestoft Laboratory (28)	323
520	IRD CENTRE DE NOUMEA (520)	284
24	Defence Evaluation Research Agency (24)	255
4554	Scottish Environment Protection Agency, Angus Smith Building (4554)	247
549	CEA / Laboratory of climatolocical and environmental Sciences(LSCE) (549)	231
513	COM - Physical and Biogeochemical Oceanography Laboratory (LUMINY) (513)	221
1548	Napier University School of Life Sciences (1548)	201
1570	Thünen-Institute of Sea Fisheries (TI-SF) (1570)	200
1066	IRD / CENTRE DE PAPEETE (1066)	189
441	IFREMER / DYNECO/PELAGOS-LABORATOIRE D'ECOLOGIE PELAGIQUE (441)	179
421	University of Liege, Laboratory of Oceanology (421)	170
501	MUSEUM NATIONAL D'HISTOIRE NATURELLE / LABORATOIRE D'OCEANOGRAPHIE PHYSIQUE (501)	157
484	IFREMER / EEP / LEP-DEEP ENVIRONMENT LABORATORY (484)	151
556	UNIVERSITE DE BRETAGNE OCCIDENTALE (UBO) / LAB. D'OCEANO. CHIMIQUE LOC - IUEM (556)	150
821	Roscoff Marine Station, Sorbonne UniversitÃ©s, UPMC Univ Paris 06 and CNRS (521)	146
3272	Scottish Environment Protection Agency, Edinburgh Office (3272)	146
309	Canary Institute of Marine Sciences (309)	140
756	Far Eastern Regional Hydrometeorological Research Institute (756)	139
4517	Department of Agriculture, Environment and Rural Affairs (4517);	139
1804	University of Southampton Department of Oceanography (1804)	133
539	IFREMER / STH/LBP-LABORATOIRE BIOLOGIE DES PECHERIES (539)	131
519	Institute of Earth Physics of Paris (519)	119

795	IFREMER / Dpt Technologicals Research and Development (795)	117
510	IFREMER / DYNECO / PHYSED -LABO PHYSIQUE HYDRODYNAMIQUE ET SEDIMENTAIRE (510)	110
1385	Agri-Food and Biosciences Institute (1385)	107
920	Primorsky Territorial Office on Hydrometeorology and Environmental Monitoring of Roshydromet (920)	105
1002	Aquitaine Observatory of Sciences of the Universe - University of Bordeaux (OASU) (1002)	105
691	National Institute of Fisheries Research (INRH) (691)	102
1427	Queen's University Belfast School of Biological Sciences (1427)	101
1801	University of Southampton School of Ocean and Earth Science (1801)	101
4614	ERIC Euro-Argo (4614)	101
1406	IEO/ Cadiz Oceanographic Centre (1406)	98
1015	Oceanologic Observatory of Banyuls (University of Paris VI) / OSU (1015)	96
1065	IRD / CENTRE DE MONTPELLIER (1065)	89
907	Navy Main Administration of Navigation and Oceanography, Ministry of Defence (907)	88
685	P.P.Shirshov Institute of Oceanology, RAS (685)	85
1902	University of Bordeaux I / Laboratory for Physical and Toxico Chemistry (ISM) (1902)	83
1039	CEA / INSTITUT DE RADIOPROTECTION ET DE SURETE NUCLEAIRE (1039)	82
532	CNRS / Microbiology, Geochemistry and Marine Ecology Laboratory (532)	81
791	IFREMER / STH-DEPARTEMENT SCIENCES ET TECHNOLOGIES HALIEUTIQUES (791)	77
240	Université Libre de Bruxelles, Laboratory of Chemical Oceanography and Water Geochemistry (240)	75
430	Vrije Universiteit Brussels, Faculty of Sciences, Department of Chemistry, Laboratory of Analytical and Environmental Chemistry (430)	74
1147	IRD / CENTRE OF HANN (1147)	74
279	Institute of Marine Research (IIM-CSIC) (279)	71
1001	IFREMER / STATION D'ARCACHON (1001)	71
298	IEO/ Oceanographic Centre of Canary Island (298)	67
1063	IRD / CENTRE DE LA MARTINIQUE (1063)	67
527	IFREMER / RBE Department / Biogeochimical end Ecotoxicological Resarch Unit (Nantes) (527)	61
533	IFREMER / STATION DE LA TRINITE (533)	52

721	IFREMER / STATION DE SETE (721)	52
1380	Woods Hole Oceanographic Institution: Department of Physical Oceanography (1380)	52
1571	Thünen-Institute of Fisheries Ecology (TI-FI) (1571)	50
1780	Faroese Fisheries Laboratory (1780)	50
1398	Las Palmas University. Sciences of the Sea Faculty (1398)	49
1925	Universite de Pau / IPREM multidisciplinary research institute for the environment and materials (1925)	48
990	Federal Research Centre for Fisheries (Hamburg) (990)	47
1803	University of Southampton Department of Oceanography (1803)	46
1715	University of Rostock, Institute of Biosciences (1715)	45
1915	Universite D'Angers / Laboratoire Des Bio-Indicateurs Actuels Et Fossiles (Biaf) (1915)	39
1405	IEO/ Malaga Oceanographic Centre (1405)	38
1802	University of Southampton School of Ocean and Earth Science (1802)	38
4548	Environment Agency North West Regional Office (4548)	34
1094	UNIVERSITE DE PAU / LAB.CHIMIE BIO INORGANIQUE & ENVIRONNEMENT (1094)	33
1077	University of Bordeaux I / Marine Biology Institut (1077)	27
1167	Ukrainian scientific center of Ecology of Sea (UkrSCES) (1167)	27
992	The Leibniz Institute of Marine Sciences at the University of Kiel (IFM-GEOMAR) (992)	25
1075	University of Bordeaux I / IGBA Talence (1075)	24
545	Swedish Meteorological and Hydrological Institute (545)	22
946	V.I. Il'ichevs Pacific Oceanological Institute, Far Eastern Branch, Russian Academy of Sciences (946)	20
1368	Alfred-Wegener-Institute for Polar- and Marine Research (1368)	20
7	University of Edinburgh, Department of Geology and Geophysics (7)	19
1771	University of Liverpool Department of Earth Sciences (1771)	18
1811	Bedford Institute of Oceanography (1811)	18
120	OGS (Istituto Nazionale di Oceanografia e di Geofisica Sperimentale), Division of Oceanography (120)	17
2120	James Rennell Centre for Ocean Circulation (2120)	17
1568	Marum - Center for Marine Environmental Sciences, University of Bremen (1568)	16
836	IRD ANTENNE INSTITUT OCEANOGRAPHIQUE (IRD) (836)	15

485	IFREMER / GM-MARINE GEOSCIENCES (485)	13
33	Environment Agency Wales (33)	12
1879	Universite de la Rochelle / Litoral Environnement et Societe (LIENSS) - UMR 7266 (1879)	12
1495	AWI - Biological Institute Helgoland (1495)	10
560	CEREGE (560)	8
1041	CNEVA / LAB. PATHOLOGIE ANIMAUX AQUATIQUES (1041)	7
542	IFREMER / HMMN-DEPARTEMENT HALIEUTIQUE DE MANCHE-MER DU NORD (542)	6
583	Marine Research Institute (583)	4
136	ENEA Centro Ricerche Ambiente Marino - La Spezia (136)	1
628	Finnish Institute of Marine Research (FIMR) (628)	1
858	Instituto Geologico e Mineiro (858)	1
1849	German Hydrographic Institute (1849)	1
3781	Polar Oceans Research Group (3781)	1
1051	*Unknown*	*7155*
	Empty	*11*

Below, the pie charts for the data providers having more than 1000 stations in the dataset (Figure 14) and between 500 and 999 stations (Figure 15) :

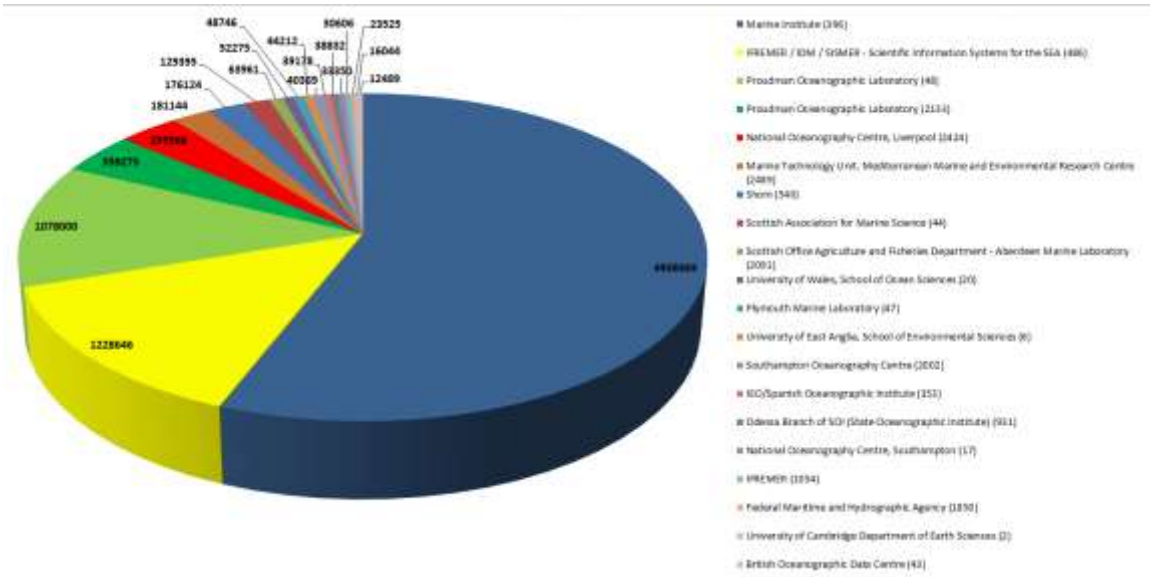


Figure 14. Data originators with more than 1000 stations in the dataset.

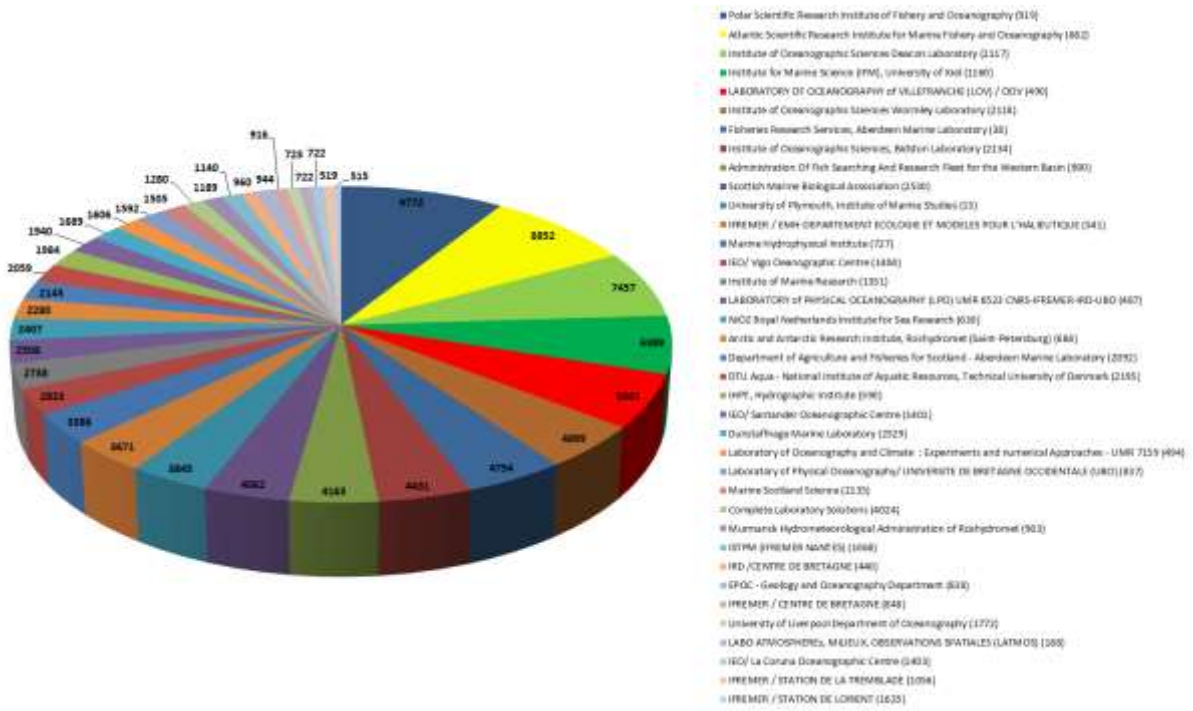


Figure 15. Data originators with number between 500 and 999 stations.

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List of acronyms

Acronym	Definition
ARC	Arctic ocean
BAL	Baltic Sea
BLS	Black Sea
CDI	Common Data Index
CLIM	Climatology
CMEMS	Copernicus Marine Environment Monitoring Service
DATA	Aggregated Dataset
DIVA	Data-Interpolating Variational Analysis (software)
DOI	Digital Object Identifier
EC	European Commission
EDMO	European Directory of Marine Organisations (SeaDataNet catalogue)
GLO	GLobal Ocean
IOC	Intergovernmental Oceanographic Commission
IODE	International Oceanographic Data and Information Exchange (IOC)
MED	Mediterranean Sea
NAT	North Atlantic Ocean
NWS	North West Shelf
ODV	Ocean Data View Software
QC	Quality Checks
QF	Quality Flags
SDC	SeaDataCloud
SDN	SeaDataNet
TS	Temperature and Salinity
WOA	World Ocean Atlas
WP	Work Package