SeaDataCloud

Product Information Document (PIDoc)

SeaDataCloud Temperature and Salinity Historical Data Collection for the Mediterranean Sea (Version 2)

SDC_MED_DATA_TS_V2

HORIZON **2020**

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Short description

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V1	S. Simoncelli	08/10/2020	first draft
	V. Myroshnychenko	26/10/2020	revision
	S. Simoncelli	26/10/2020	final version

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Abstract

The second release of SeaDataCloud Temperature and Salinity Historical Data Collection for the Mediterranean Sea (SDC_MED_DATA_TS_V1) includes open access in situ data of water column temperature and salinity between -9.25 and 37 degrees of longitude, thus including an Atlantic box and the Marmara Sea. The collection has been obtained harvesting all measurements contained within SeaDataNet infrastructure at the end of July 2019 belonging to **30 data providers** (distributors) **124 data originators**. The dataset format is Ocean Data View (ODV) binary collection. The quality control of the data has been performed using ODV 5.3.0 software. Data Quality Flags have been revised following SeaDataNet2 project QC procedures in conjunction with the visual expert check. The number of the Temperature and Salinity profiles (stations) in the collection is 1003259.

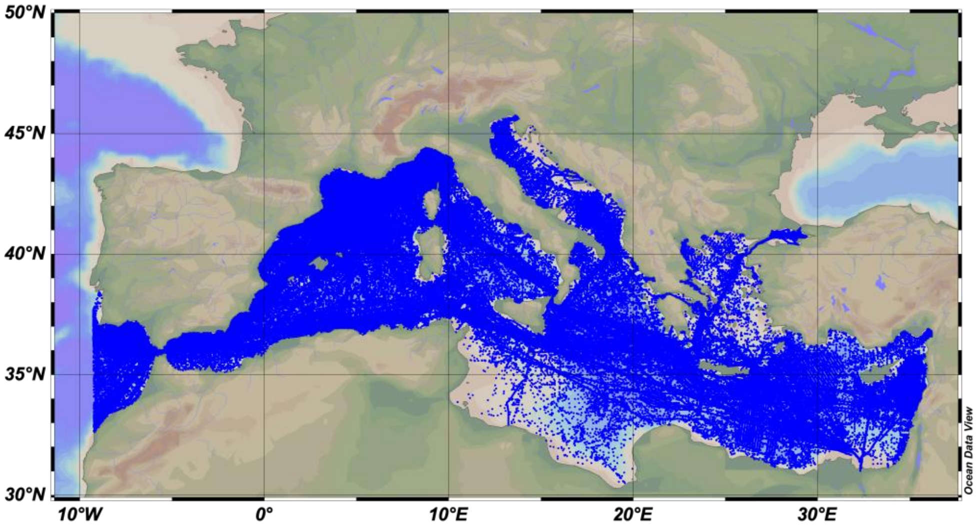
Whenever SDC_MED_DATA_TS_V2 product is used, this PIDoc should be cited in any publication. We also ask users to remember that hard-working scientists made these measurements, often under severe conditions. Further, the data providers normally possess insight on the quality and context of the data not 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

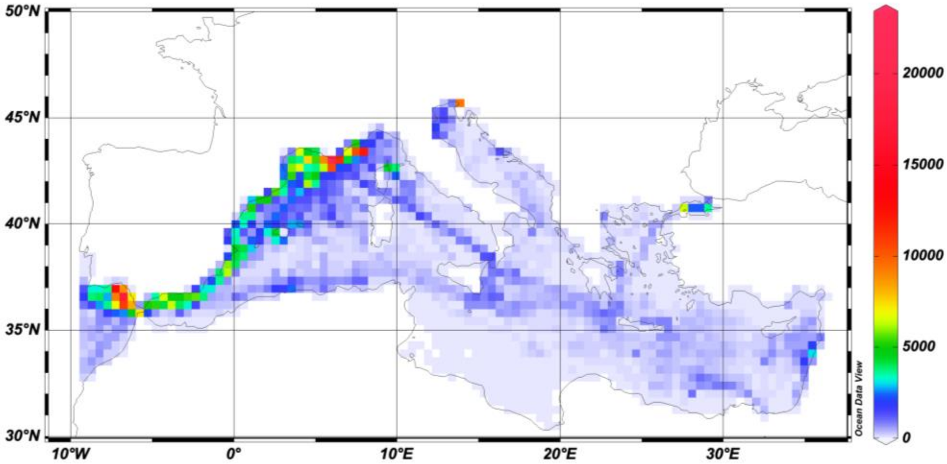
The historical data collection of the Mediterranean Sea contains temperature and salinity observations between -9.25 and 37 degrees of longitude, thus including an Atlantic box and the Marmara Sea.

SDC_MED_DATA_TS_V2 collection has been obtained harvesting all new and updated measurements contained within SeaDataNet infrastructure between the end of October 2017 (harvesting of the SDC_MED_DATA_TS_V1 dataset) and the end of July 2019. This data sub-set of new and updated CDIs have been merged with SDC_MED_DATA_TS_V1, substituting the updated profiles and removing the deleted CDIs. The data contained within this temperature and salinity data collection belong to **30 data providers** (distributors) listed in **Annex 2** and **124 data originators** listed in **Annex 3**.

The spatial distribution and the data density of measurement stations are shown in Figure 1. The spatial distribution of data (Figure 1a) presents a good data coverage in the Western Mediterranean basin and the Atlantic box, while in the Eastern Mediterranean still many areas are characterized by few and sparse data, like the coastal areas of Tunisia, Libya, Egypt, Turkey and Croatia. Data density map (Figure 1b) highlights that observations are more concentrated along the coastal areas of Spain, France and Italy (Ligurian Sea and Northern Adriatic Sea). In the eastern part of the Basin, maximum data concentration is along the Israeli and the Greek coasts. Data density is high also in the Marmara Sea.



(a)



(b)

Figure 1 Temperature and Salinity data collection for the Mediterranean Sea in the time period 1900-2017: (a) Data distribution map; (b) Data density map.

Temporal distributions of data are in Figure 2 and Figure 3. Annual distributions (Figure 2a and Figure 3) prove that data are very sparse before 1950 and their number start to increase systematically from the sixties and concentrate mostly in the noughties, due to the advent of new data types (Argo, thermosalinograph). The data availability is lacking in the recent years (after 2015), due to the time lag that characterizes the delay mode databases (Figure 3b). This must be taken into consideration during climatological data analysis.

Seasonal distribution of data (Figure 2b) presents a good coverage all year long. A peak in number of data is present at the end of summer beginning of autumn (September, October) and this might be due to surveys dedicated to monitor particular events. This is another aspect to consider carefully for climatological analysis or other applications.

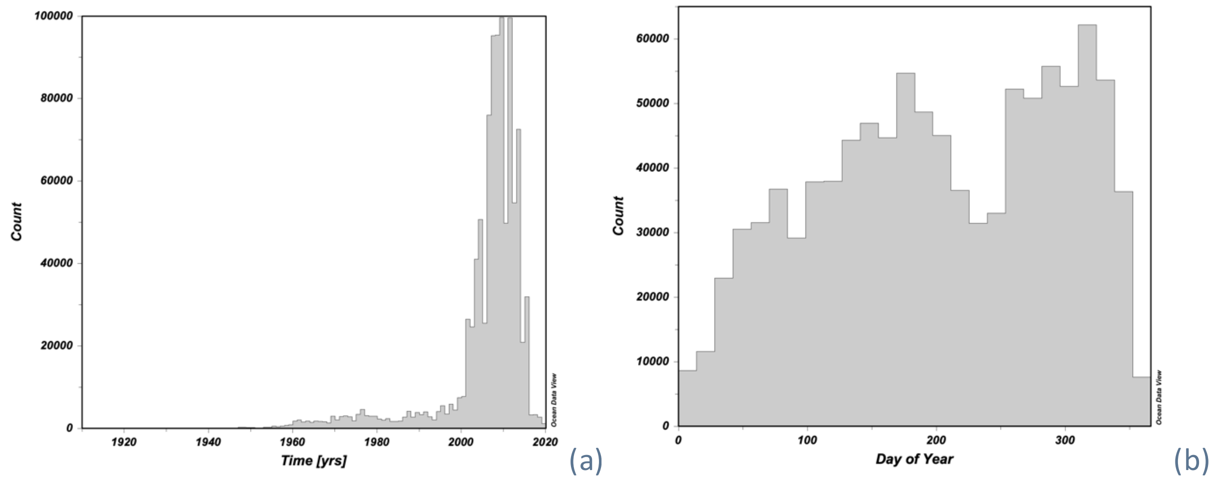


Figure 2 Temporal data distribution over the time period 1900-2019 in the Mediterranean Sea: (a) annual, and (b) seasonal.

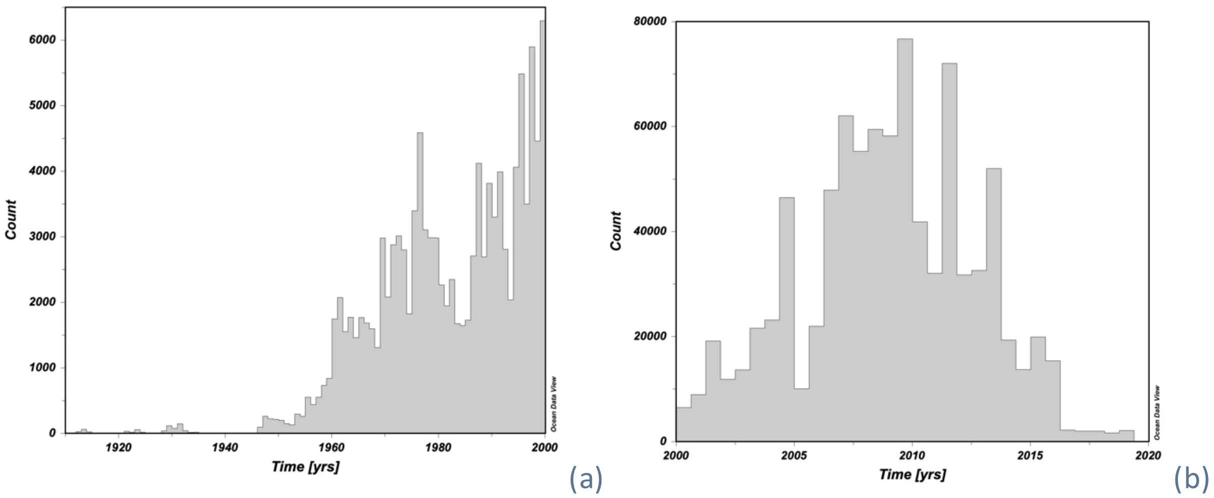


Figure 3 Temporal data distribution over the time periods: (a) 1900-1999 (119900 stations) (b) 2000-2019 (883359 stations, mainly thermosalinographs data).

Table 1 summarizes the number of observed temperature and salinity stations and stations having both measurements in SDC_MED_DATA_TS_V2 collection. Temperature stations represent 99.4% of total stations, salinity stations represent 92,8% of total stations while measurements containing both temperature and salinity are 92,3% In terms of number of samples it should be noticed the increased difference among temperature and salinity monitoring system.

Table 1 Number of stations and samples for temperature and salinity and TS measurements contained in SDC_MED_DATA_TS_V2 collection and their relative percentages.

par	# stations	%	# samples
total	1003259		44423115
T	997255	99,4%	43626555
S	931350	92,8%	31458014
TS	926223	92,3%	30880568

Figure 4 shows Temperature (a), Salinity (b) and Temperature and Salinity (TS) collocated profiles data distribution. Salinity observations are less and sparser than temperature ones. Both maps show the presence of data along ship tracks, along coastal transects, and regular monitoring arrays.

The vertical distributions of observations in Figure 5ab show how measurements diminish with depth with very few observations below 3000m. Temperature measurements (~4 millions) are more numerous than salinity measurements (~ 3 millions) near the surface. Temperature values (Figure 5ce) range mainly between 10°C and 20°C degrees and peak at about 13-14°C. Salinity values (Figure 5df) present a bimodal distribution, due to the different Atlantic (fresher) and Mediterranean (saltier) water masses characteristics.

The statistics related to data quality flags are summarized in **Table 2**. The percentage of data not checked by data providers (QF=0) is about 0.7-0.8% and it substantially diminished if compared with the previous data set (SDC_MED_DATA_TS_V1) in which it was about 3.0-4.5%. The 98.5% of temperature and 99% of depth records are flagged as good (QF=1) or probably good (QF=2), while for salinity the percentage is equal to 98.2. Bad (QF=4) or probably bad (QF=3) data range from 0.2% to 1.1%. The samples with flags from 5 to 9 are almost absent.

Table 2 Quality Flag statistics related to depth, Temperature and Salinity parameter expressed in percentages.

	QF0	QF12	QF34	other
Depth	0,8%	99,0%	0,2%	0,0%
Temp	0,8%	98,5%	0,8%	0,0%
Salt	0,7%	98,2%	1,1%	0,0%
T&S	0,7%	98,1%	0,3%	0,0%

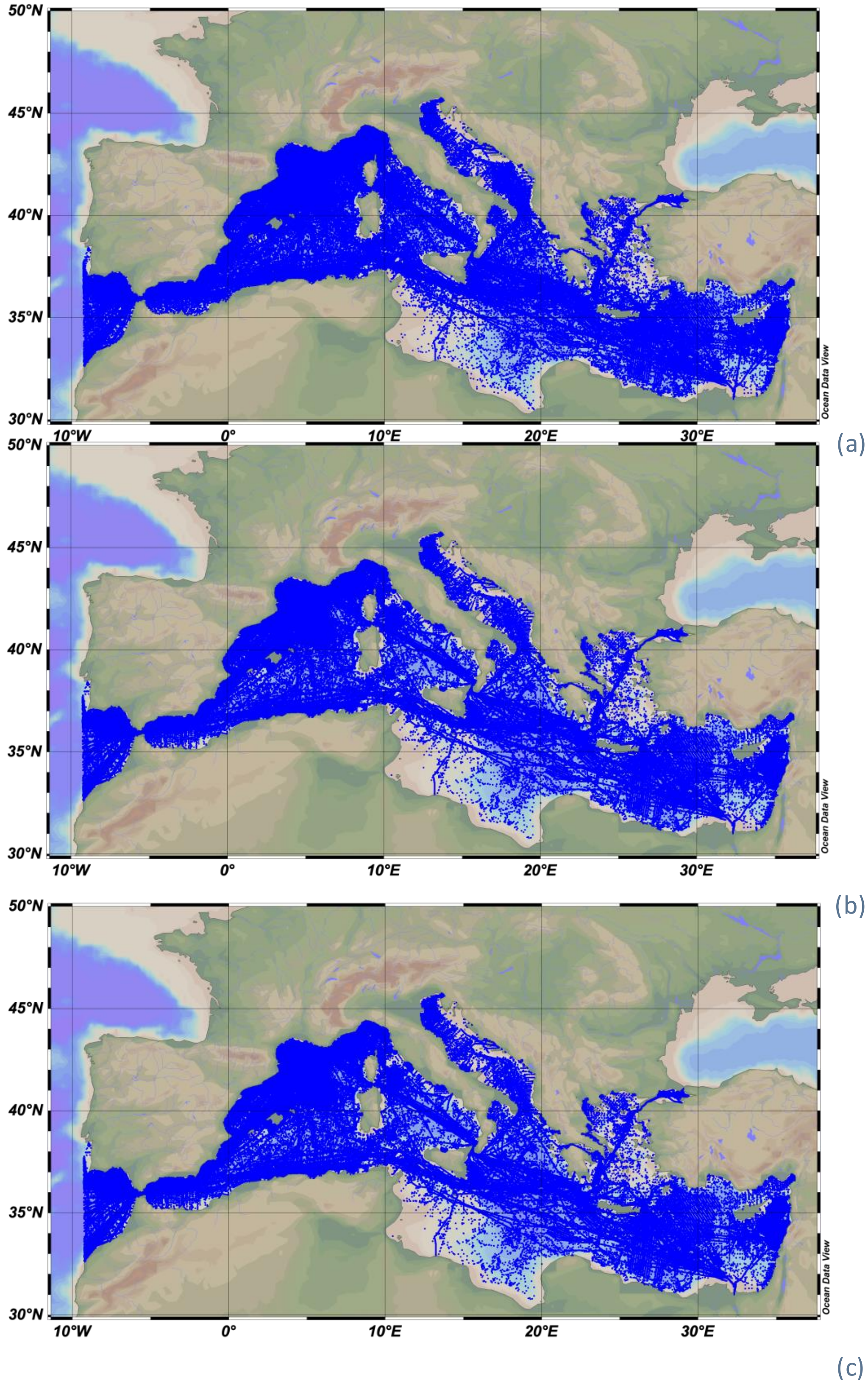


Figure 4 Station distribution map for the Mediterranean Sea 1900-2019: (a) Temperature; (b) Salinity; (c) Temperature and Salinity collocated profiles.

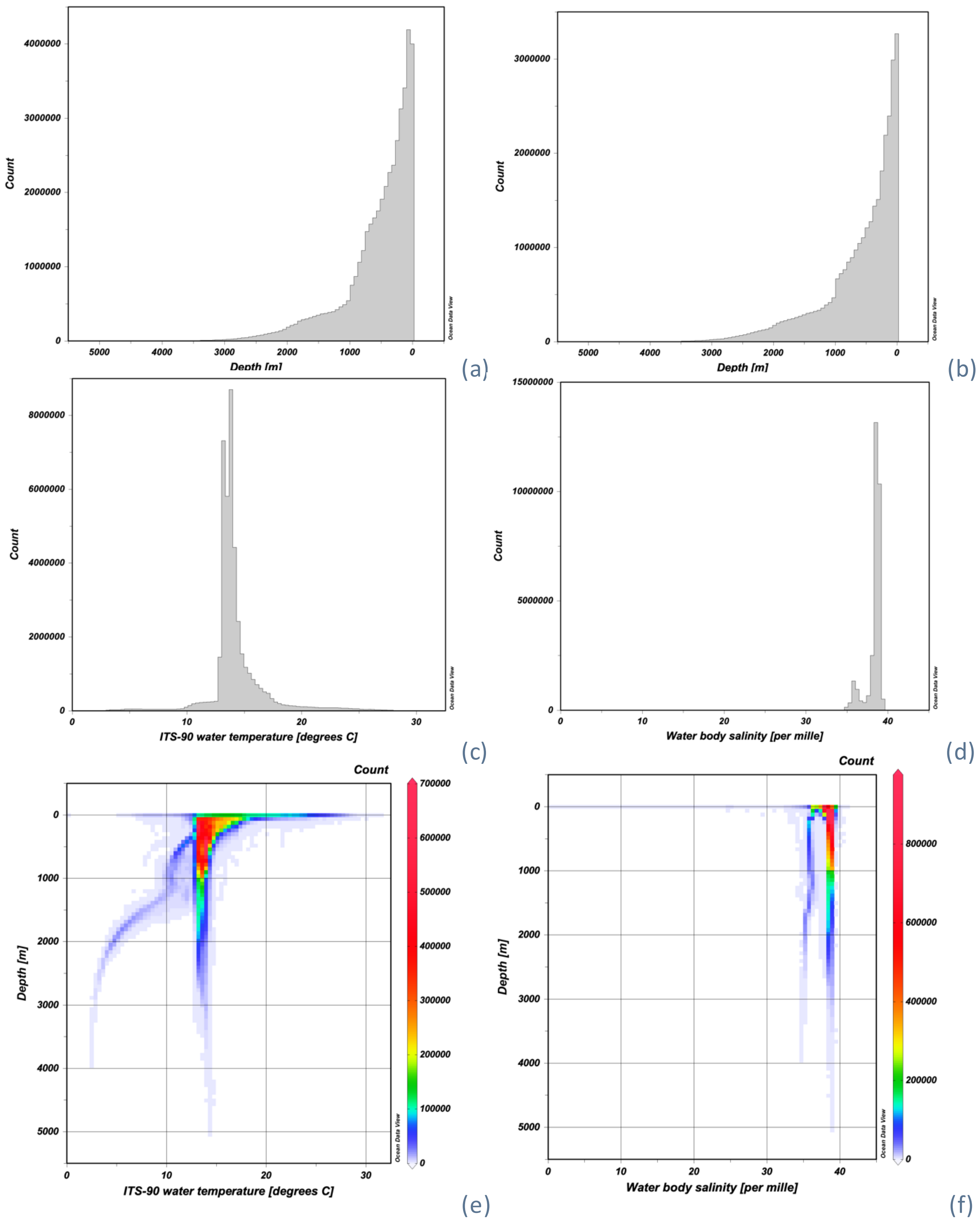


Figure 5 Vertical distribution of (a) Temperature, (b) Salinity observations. Temperature (c) and Salinity (d) data distributions. Temperature (e) and Salinity (f) data density along the water column.

2. Quality Control Procedure

The quality check (QC) analysis has been performed following the QC guidelines in Annex 1 and the SeaDataNet Quality Flags schema at http://vocab.nerc.ac.uk/collection/L20/current/.

The first steps were dedicated to correct data anomalies from specific EDMO_CODE (data providers):

- EDMO_CODE 486 → measurements flagged 0 were quality assessed assigning 2 to probably good data, 3 to probably bad data. MEDOC cruises are characterized by bad depth values (many equal depth values with different temperature and salinity measurements) and salinity measurements flagged as 0.

- EDMO_CODE 840 → all measurements with temperature and salinity values equal to 0 were wrongly flagged 0, thus the corresponding QF were set to 4. This was done in V1 version.

The second phase of analysis was dedicated to the data with QC=0. The adopted strategy was to substitute 0 with 2 (probably good). Data with QF=1 and 2 are then analyzed to detect data anomalies starting from a gross range check and spikes detection by visual inspection. Vertical profiles with depth parameters with QF=0 but having their relative temperature and salinity parameters with QF=1 have been flagged as 2.

Temperature

→ range check T<2°C and T> 33°C assigned to QF=4;

→ identification of spikes assigned to QF=4;

Salinity

→ range check S>42 assigned to QF=4;

→ identification of spikes assigned to QF=4.

2.1. QC analysis per sea regions

In order to detect data anomalies more efficiently by visual inspection the data domain has been subdivided in 17 regions according to the definition in Figure 6 adopted by the CMEMS MED-MFS for evaluating the Mediterranean Forecasting System (http://marine.copernicus.eu/documents/QUID/CMEMS-MED-QUID-006-013.pdf). The Marmara Sea has been analyzed separately as region 18.

The number of stations per region (Figure 7) first highlights that the northwest Mediterranean (region 3) is the region with the highest number of stations. While regions 7 (Sicily

Channel/Tunisian waters), 10 (Southern Adriatic Sea), 14 (northern Levantine basin) are the ones characterized by the smallest number of temperature and salinity profiles.

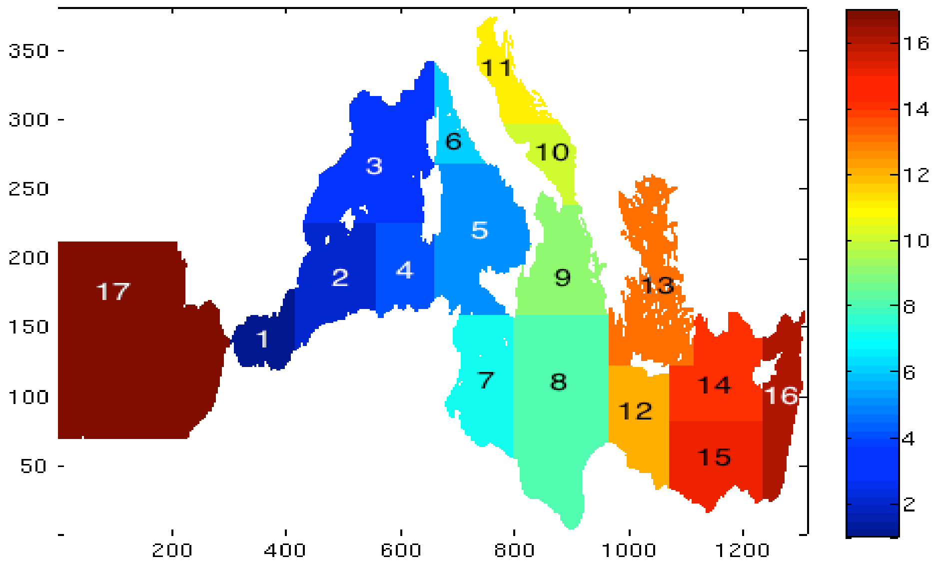


Figure 6 The Mediterranean Sea sub-regions subdivision.

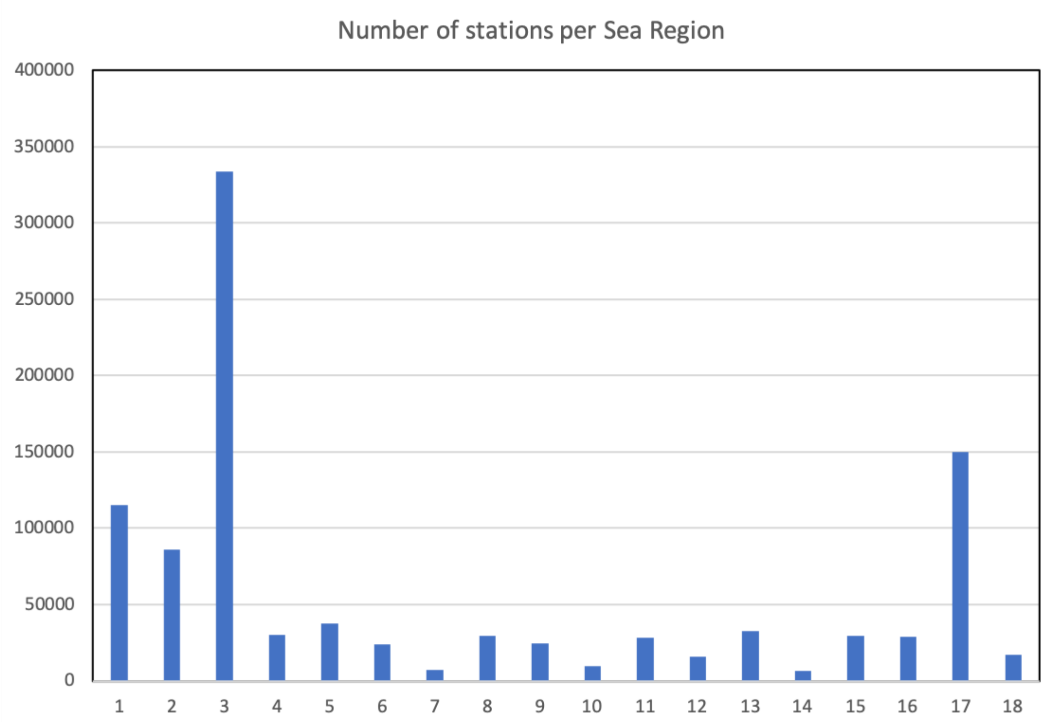


Figure 7 Number of stations per sub-region (Figure 6).

2.2. QC analysis per depth layer

The QC analysis has been conducted also per depth layer according to the layers definition: 0-30, 30-150, 150-300, 300-600, 600-1000, 1000-2000, 2000-3000, 3000-4000, 4000-5500[m]. In particular the TS diagrams per each layer have been analyzed to detect data anomalies, the results are presented in Section 3.

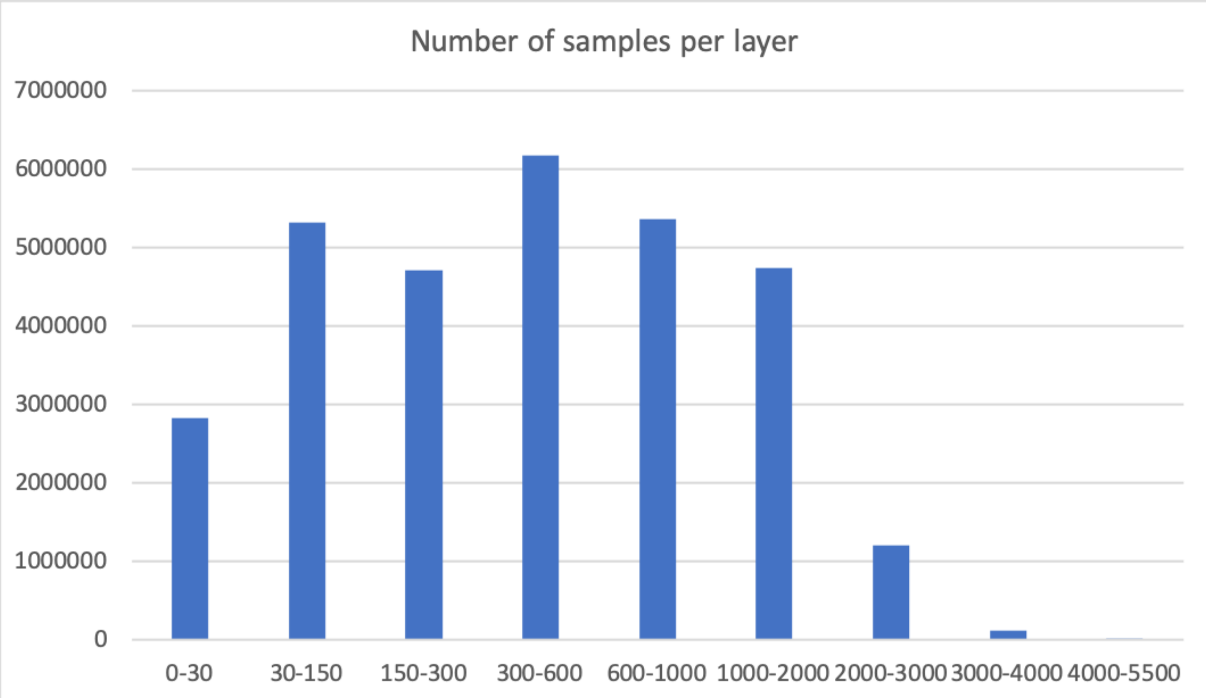


Figure 8 Number of samples per each vertical layer: 0-30m, 30-150m, 150-300m, 300-600m, 600-1000m, 1000-2000m, 2000-3000m, 3000-4000m, 4000-5500m.

2.3. Instrument type analysis

The QC analysis was performed also by instrument type in order to study their monitoring space-time coverage. Table 3 summarizes the number of stations per instrument type according to the analysis of metadata associated to the data. The 3% of data was missing the instrument type information in V1 dataset (Simoncelli et al. 2018), while in V2 this percentage reduced to almost nil. It follows an analysis of space-time distribution of the data from the principal instrument types: thermosalinographs, bathythermographs, CTDs.

Table 3 Number of stations divided by instrument/gear type.

Instrument/Gear Type	V1	%	V2	%
CTD	52031	7	70036	7
bathythermograph	56558	8	59574	6
discrete water sampler	32258	4	37485	4
thermosalinograph	555269	75	808364	81
thermistor chains	22	0	22	0

continuous water sampler	1577	0	1654	0
salinity sensor; water temperature sensor	19852	3	25445	3
salinometers	100	0	131	0
none info	21973	3	374	0
	739640		1003085	

Thermosalinograph (TSG) data have been sampled in 808364 stations distributed in space as in Figure 9. Data density is maximum in the north-western Mediterranean and the Atlantic Box. The data temporal distribution (Figure 10) shows the start of underway data in 2001 with maximum number of stations in fall season. This data type represents the 81% of the entire data set in terms of number of stations, because each sample (lon,lat,depth and variable) constitutes a station, as it is managed by ODV.

SDC_MED_DATA_TS_V2 contains 70036 **CTD** stations distributed as in Figure 11. CTD data are sparse in the Tyrrhenian Sea, the Ionian Sea, the Croatian and the North African coastal areas. The highest data availability is in late nineties and early 2000s, during the summertime (Figure 12).

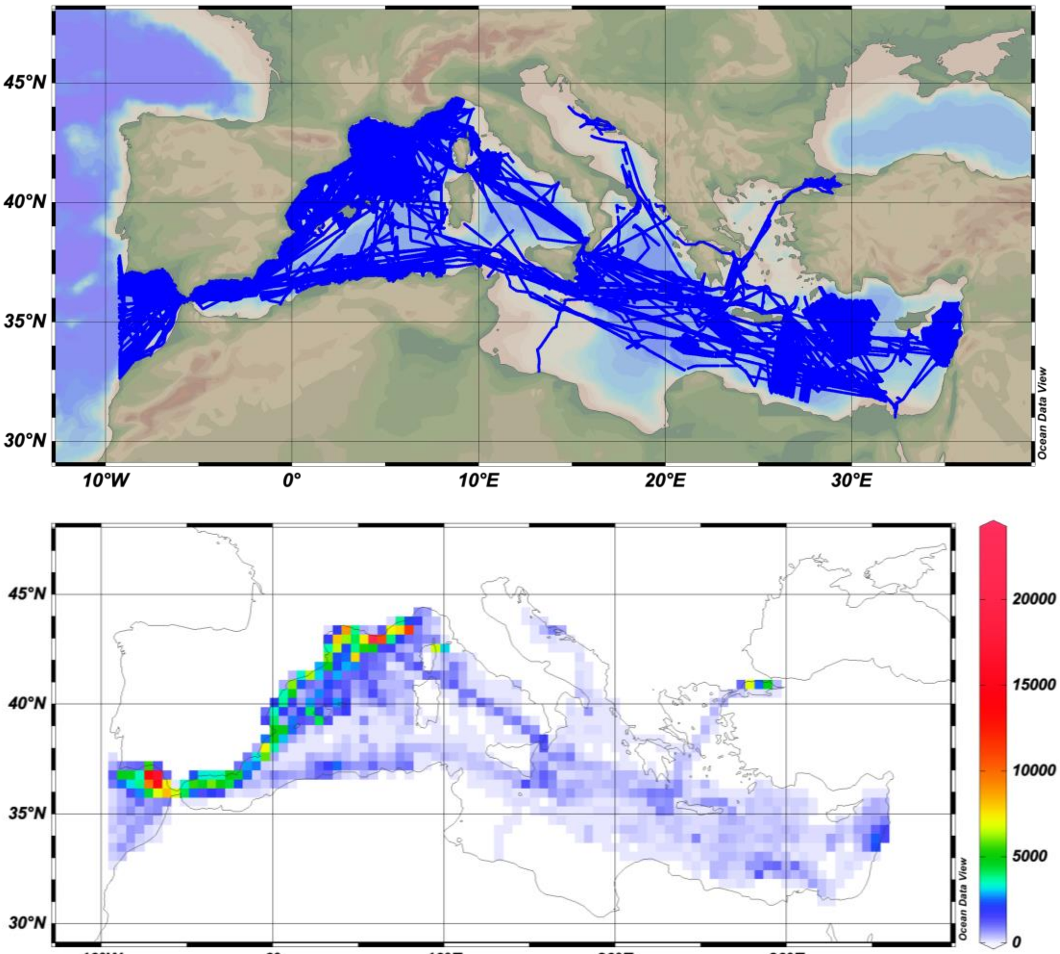


Figure 9 Thermosalinographs (TSG) stations contained in the SDC_MED_DATA_TS_V2 data collection.

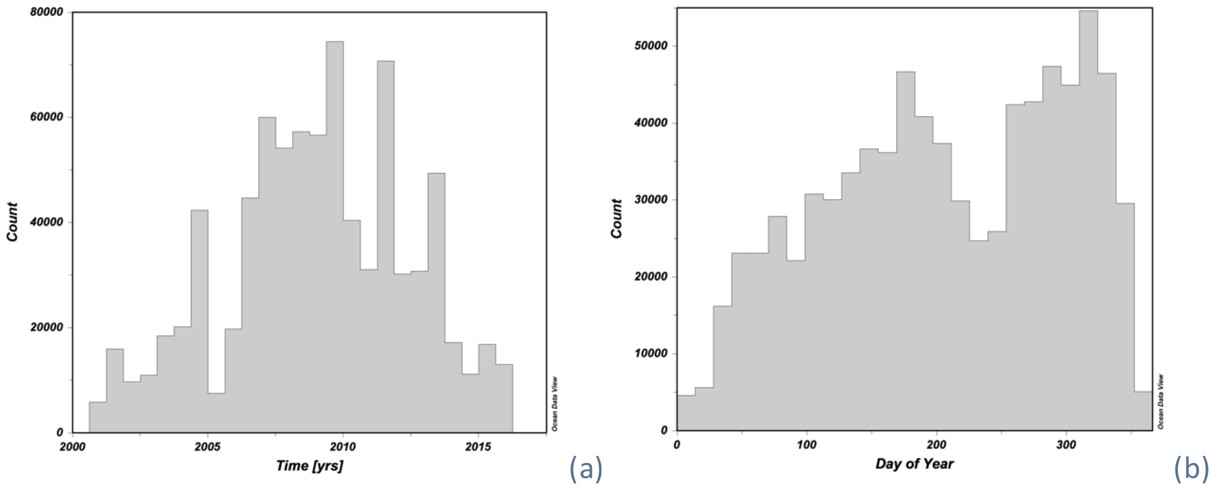


Figure 10 Time distributions of thermosalinographs (TSG) stations in the SDC_MED_DATA_TS_V2 collection: (a) annual and (b) seasonal.

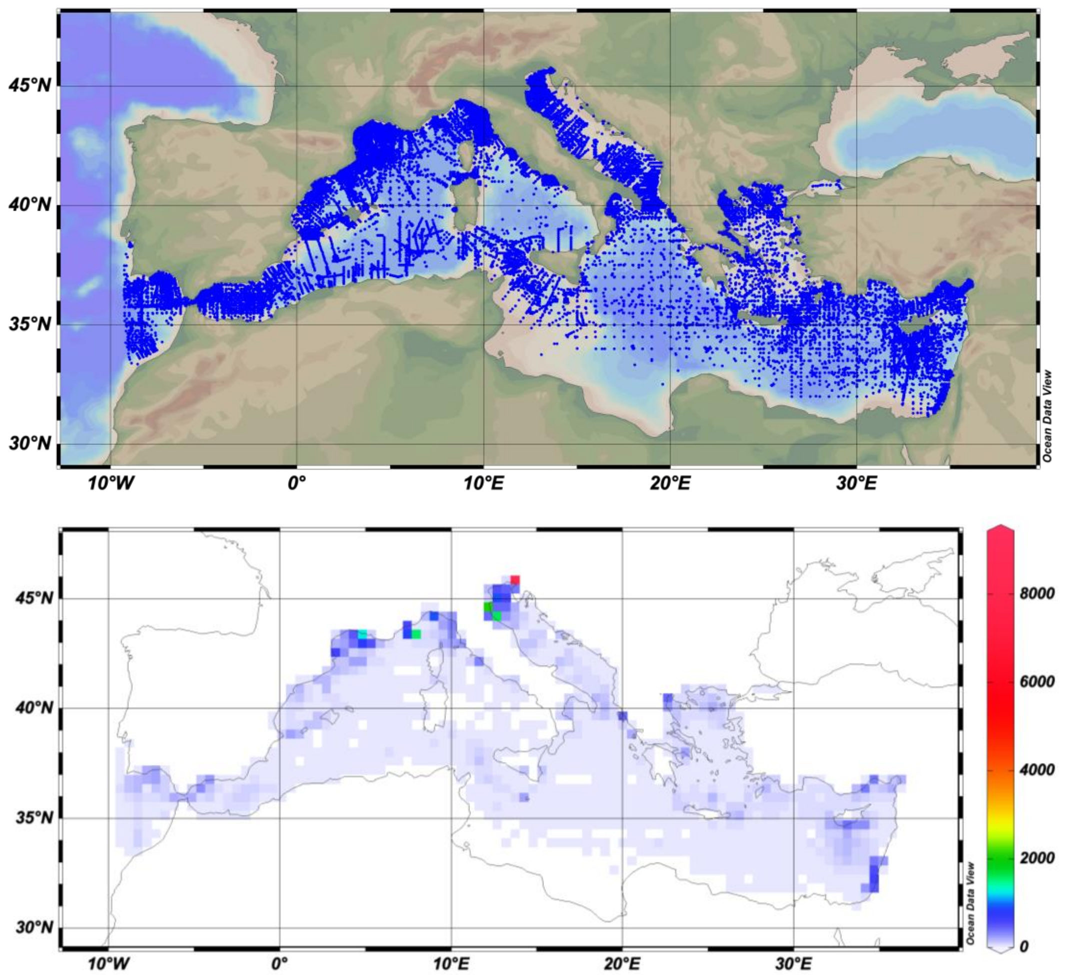
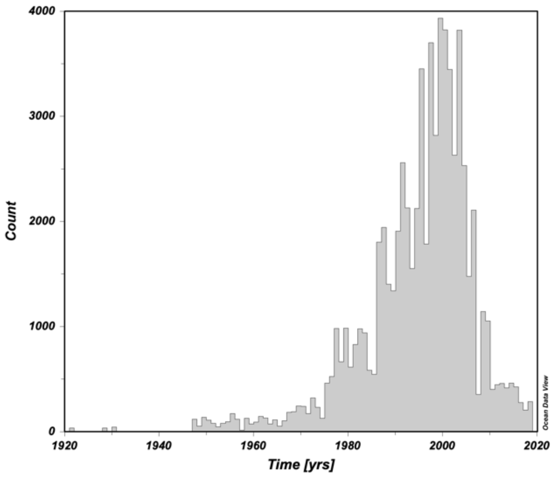


Figure 11 Spatial distribution and data density map of CTD stations contained in the SDC_MED_DATA_TS_V2 collection.



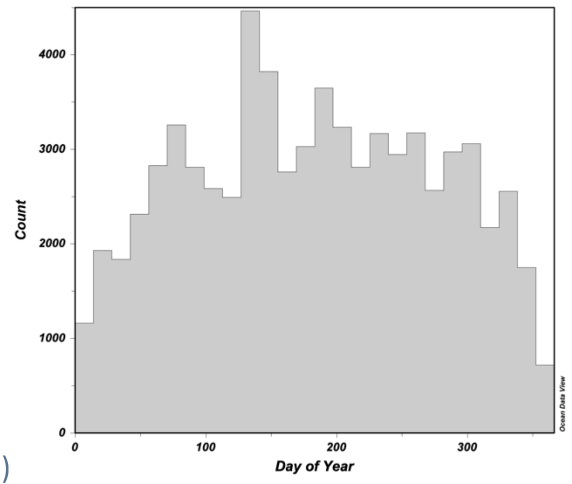
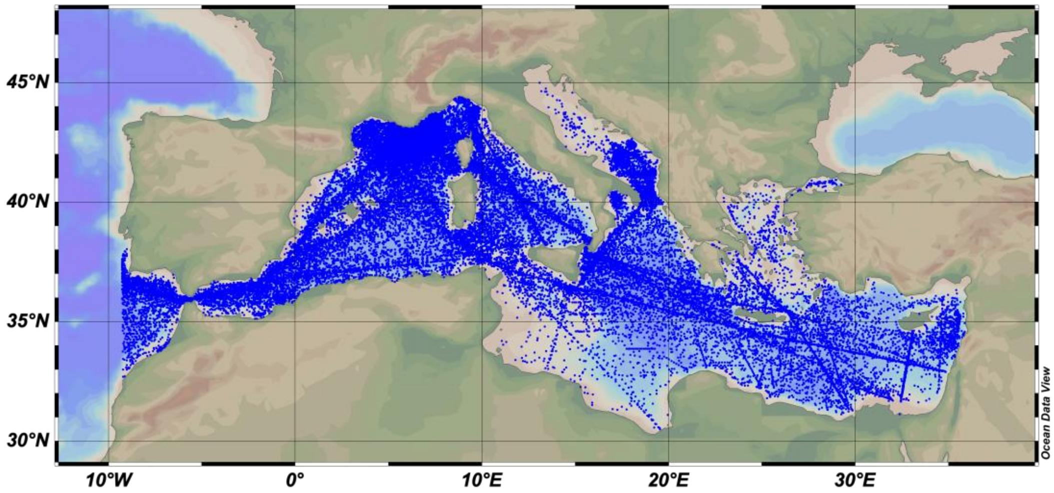


Figure 12 Time distributions of CTD stations in the SDC_MED_DATA_TS_V2 collection: (a) annual and (b) seasonal.

59574 stations have been monitored by **bathythermographs** and their location is shown in Figure 13. 7326 stations are classified as *"Expendable bathythermographs"* (XBTs), 11255 stations are classified as *"Mechanical bathythermographs"* (MBTs), while the remaining 40709 are still labeled as *"bathythermographs"*. Actions to specify the data type, probe type an fall rate equations are ongoing. The data density map shows the main ships of opportunity (VOS) routes along with bathythermograph measurements have been performed in the framework of MFSPP and MFSTEP projects (*Pinardi et al., 2003; Pinardi and Coppini 2010, Manzella et al. 2007*). The maximum data concentration is in the north western Mediterranean (Ligurian Sea and Gulf of Lion), the Tyrrhenian Sea, along the Spanish coast towards Gibraltar Strait, from Sicily to the Southern Adriatic. In the Levantine basin the data are sparser than in the western Mediterranean. The time distributions of bathythermograph stations (Figure 14) presents the first monitored stations from the fifties until early eighties, when the availability of these type of measurements reduces in this dataset and then it restarts in middle nineties. The seasonal distribution displays a minimum number of measurements during the summer time.



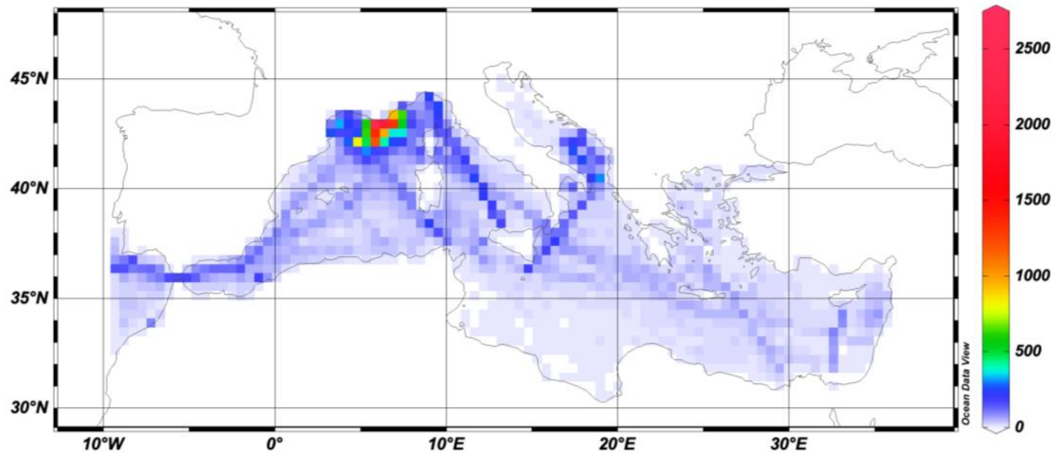
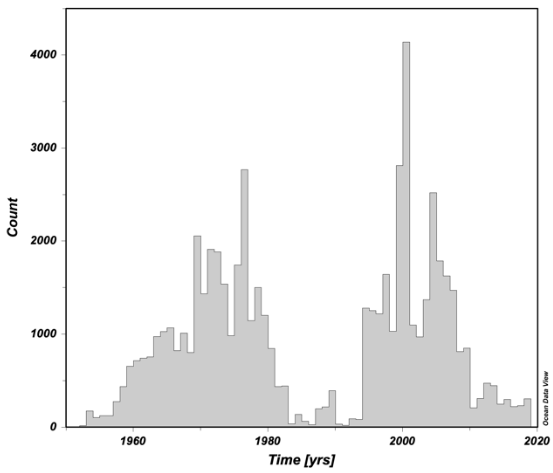
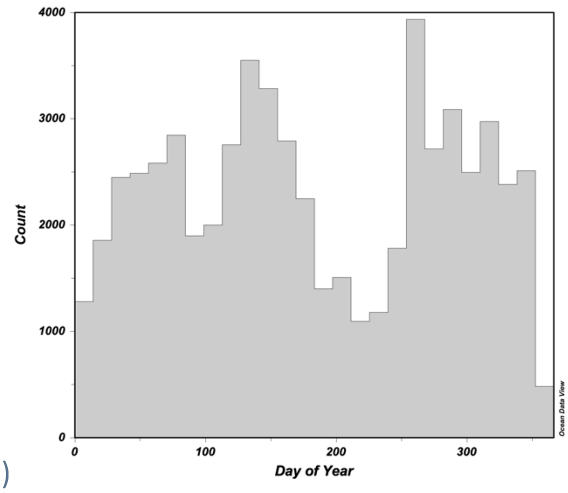


Figure 13 Bathythermograph stations contained in the SDC_MED_DATA_TS_V2 collection: (top) data distribution map; (bottom) data density map.



(a)



(b)

Figure 14 Time distributions of bathythermograph stations in the SDC_MED_DATA_TS_V2 collection: (a) annual and (b) seasonal.

In Figure 15 are displayed the 37485 stations measured by **discrete water samplers** (bottles), mainly sampled starting from late forties but with the highest data availability between the sixties and the nineties (Figure 16).

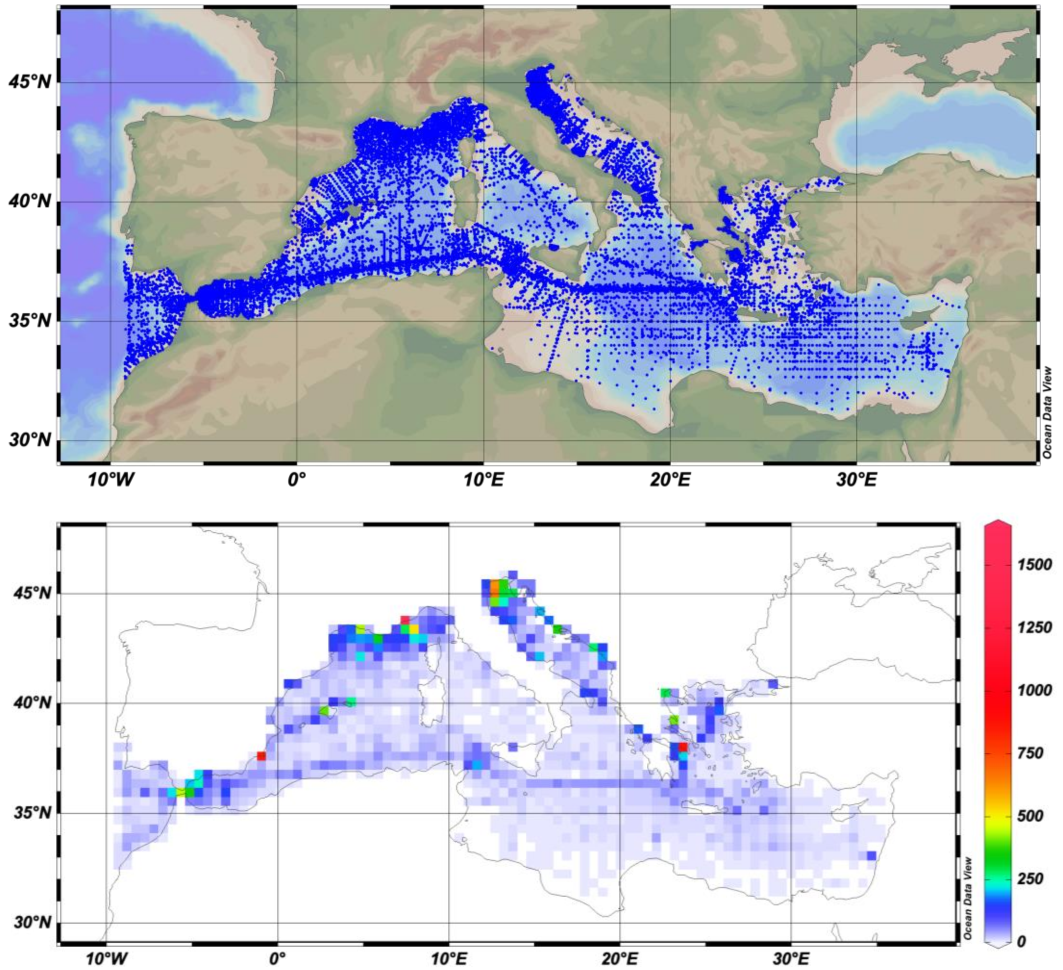
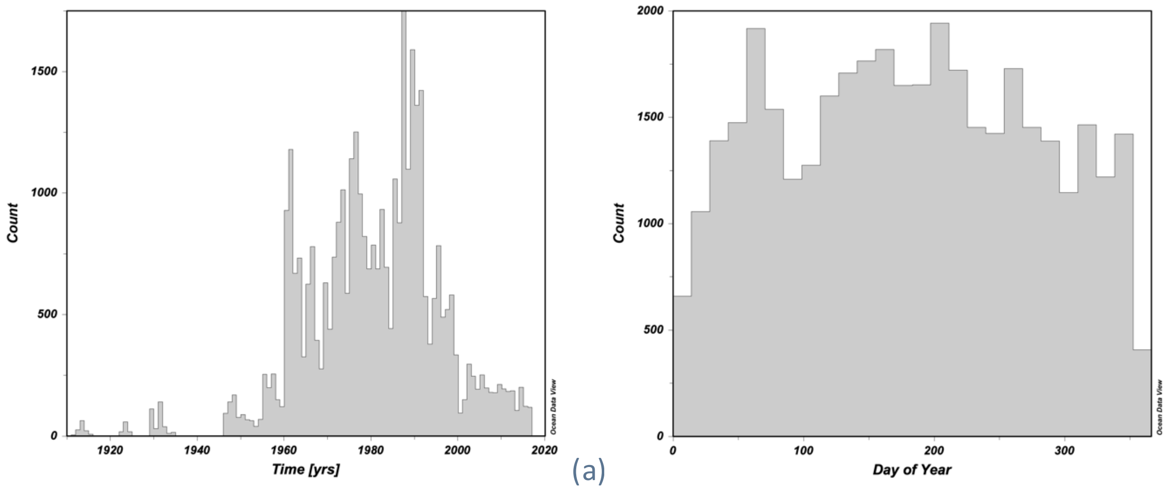


Figure 15 Stations contained in the SDC_MED_DATA_TS_V1 collection measured by discrete water samplers: (top) data distribution map; (bottom) data density map.



(a) (b)

Figure 16 Time distributions of stations measured by discrete water samplers (bottles) in the SDC_MED_DATA_TS_V2 collection: (a) annual and (b) seasonal.

3. Quality assessment results

Figure 17 presents the TS diagrams per each sub-region (Figure 6) after the QC analysis, the colors indicates the measurement's depth.

Region 1 (**Alboran Sea**) shows temperature ranging between 12 and 28°C and salinity values comprise between 35 and 39.

In the **South West Mediterranean** (western part region2) temperatures range between 12 and 28°C and salinities between 36 and 39. In the **South West Mediterranean** (eastern part, region 4), range between 12 and 28°C and salinities between 36.5 and 39.

In the **North West Mediterranean** (region 3) the variability of temperatures (7-29°C) and salinity (0-39) is larger due to the atmospheric forcing and the riverine influence.

The **Tyrrhenian Sea** (region 5) presents salinities mainly ranging between 37 and 39 and temperatures between 10 and 30°C, while in the **Ligurian Sea** (region 6) the salinity can reach 30 due to the riverine influence.

The **Adriatic Sea** presents very low salinities in its northern part (region 11) under the influence of Po River and other minor rivers. Temperatures as well have a large range of variability from 5 to 29°C. In the Southern Adriatic (region 10) salinities are larger than 30, but mainly goes from 36 to 39, while temperature are higher than 7°C.

The northern **Ionian Sea** (region 9) presents temperature and salinity characteristics similar to region 10, but very low salinities are present due to the samples along the Greek coastal area. In the Southern Ionian (region 8) temperatures are warmer than 10°C and salinity is higher than 37.

Region 7 shows a larger number of measurements along the Sicily Channel than the Tunisian coast, the temperatures range between 12 and 29°C and salinity values between 37 and 39.

The **Aegean Sea** (region 13) presents low salinities (20-35) due to the inflow of waters coming from the Black Sea through the Dardanelles.

The water entering the **Levantine Sea** (region 12-Cretan Passage and region 15-central southern part) presents increasing salinities from 37.5 to 40. In its eastern part (region 16) low salinity values appear along the Turkish coast.

The **Atlantic box** (region 17) diagram shows temperatures ranging from 2 to 27 degrees. The lowest temperature values are measured below 2500m. Salinity ranges approximately from 34 to 38.5. Bottom salinity is about 35. At the surface some low salinity value is due to the sample location close to river mouths along the Spanish coast. Surface salinity values are among 36 and 37.

In the **Marmara Sea** (region 18) both temperature and salinity are characterized by a large variability. Low salinity waters (20-25) flow at the surface from the Black Sea towards the Aegean Sea while salty Mediterranean waters enters the Dardanelles flowing below 120-150m of depth (halocline).

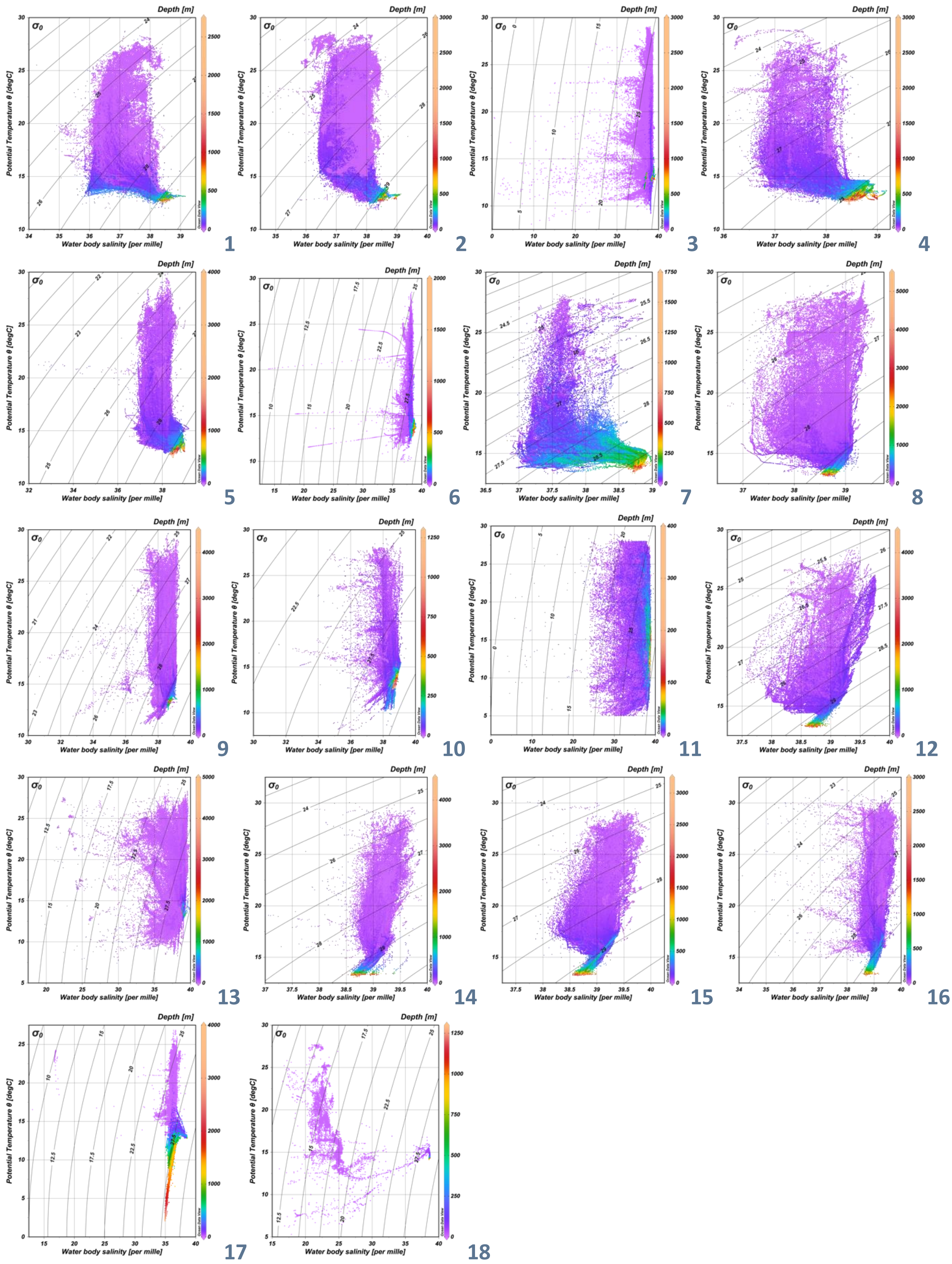


Figure 17 TS diagrams per each region of the Mediterranean Sea (as defined in Figure 6) with isopycnals and the colorbar indicating the depth of each measurement,.

Figure 18 presents the TS diagrams over the entire Mediterranean region per vertical layer. Below 300m (panel d) the Atlantic and Mediterranean waters are distinct, with Atlantic waters colder and fresher than the Mediterranean ones. Very low salinity values are present above 30m of depth (layer a) due to the river influence along the coasts.

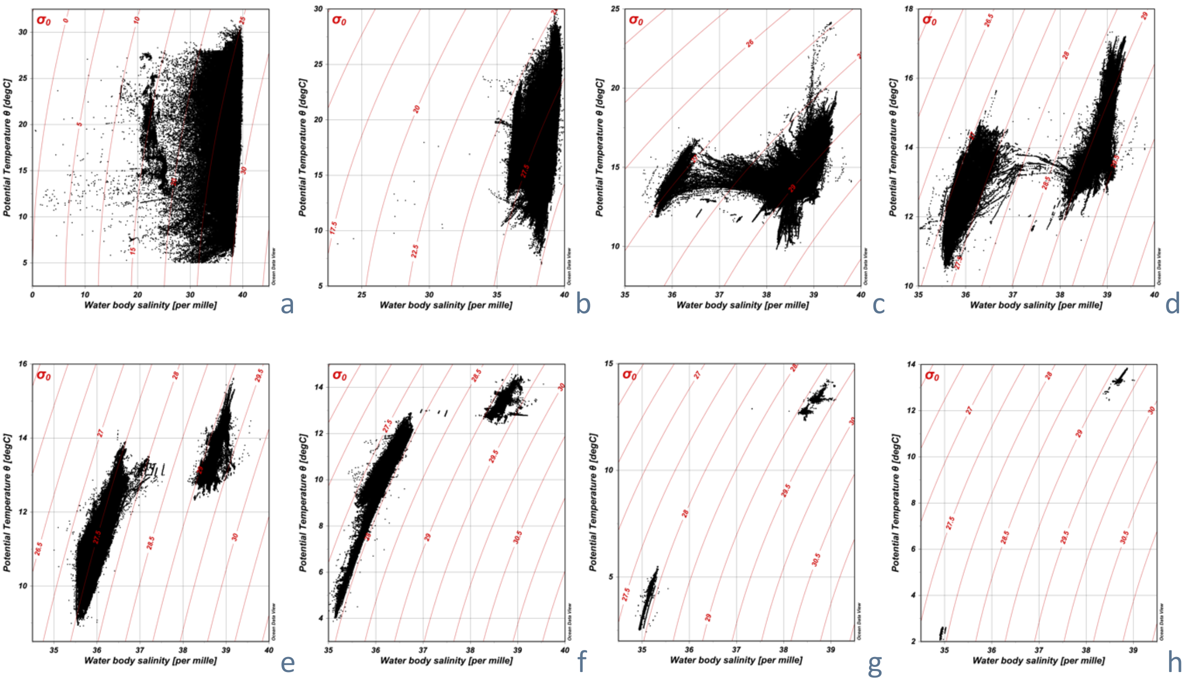


Figure 18 TS diagrams of data with QF=1,2 per each vertical layer: a) 0-30m; b) 30-150m; c) 150-300m; d) 300-600; e) 600-1000; f) 1000-2000; g) 2000-3000m; h) 3000-4000m.

Temperature and salinity observations at specific depth levels (30, 150, 300, 600, 1000, 2000, 3000m) are displayed in Figure 19 and Figure 20 respectively. The number of observations reduces going deeper, with very few observations at 4000m. Temperature is colder and salinity is fresher in the Western Mediterranean than in the Eastern Basin, due to the influence of incoming Atlantic Waters and the effect of strong evaporation in the Eastern Mediterranean. Some data anomalies are present both in temperature and salinity fields but further investigation is needed before discarding them because the Eastern Mediterranean Transient (1992-1993) and the Western Mediterranean Transition (2005-2006) changed the main water mass properties.

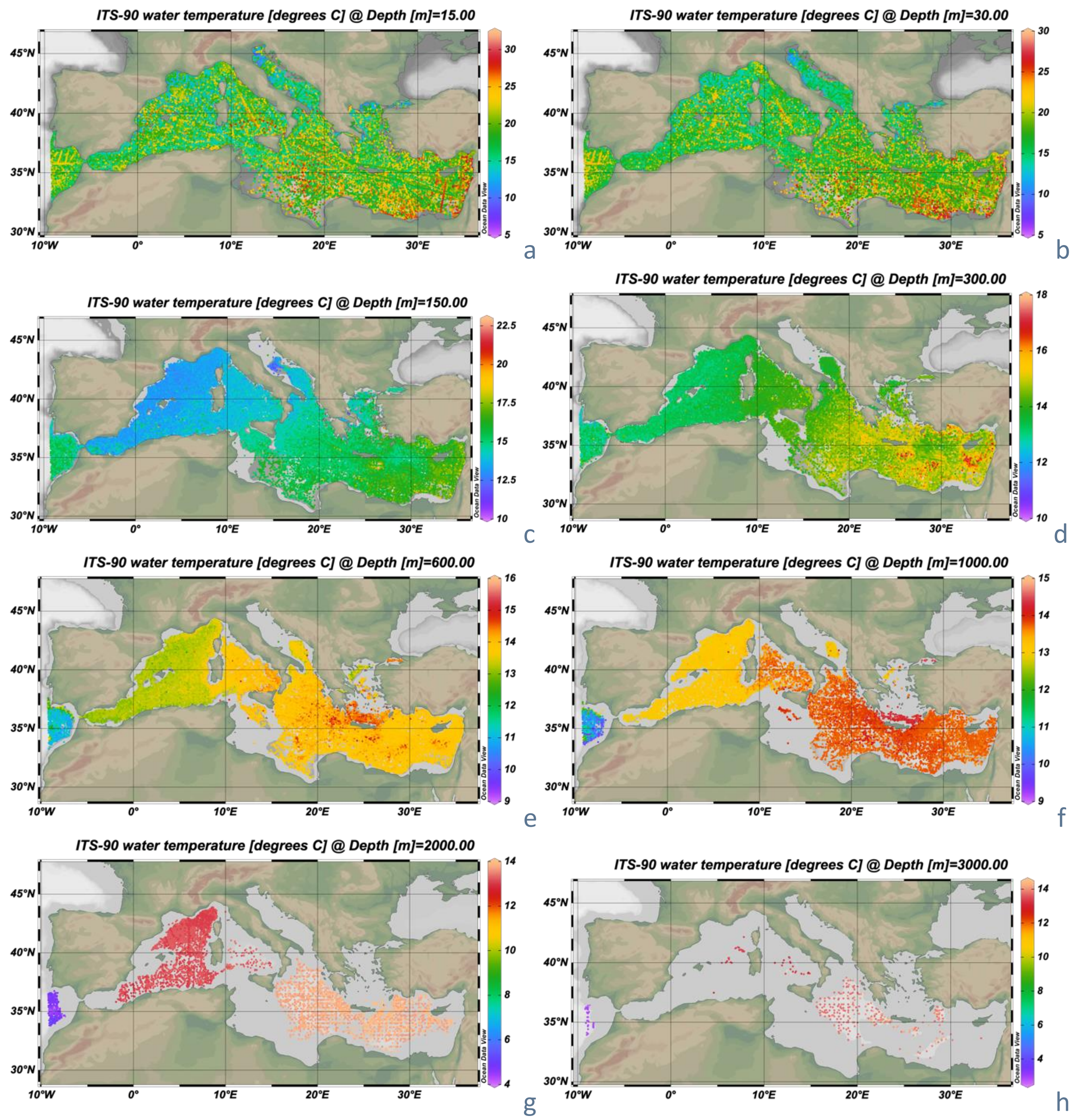


Figure 19 Temperature values with QF=1,2 at specific depths: a) 15m; b) 30m c) 150m; d) 300m; e) 600m; f) 1000m; g) 2000m; h) 3000m.

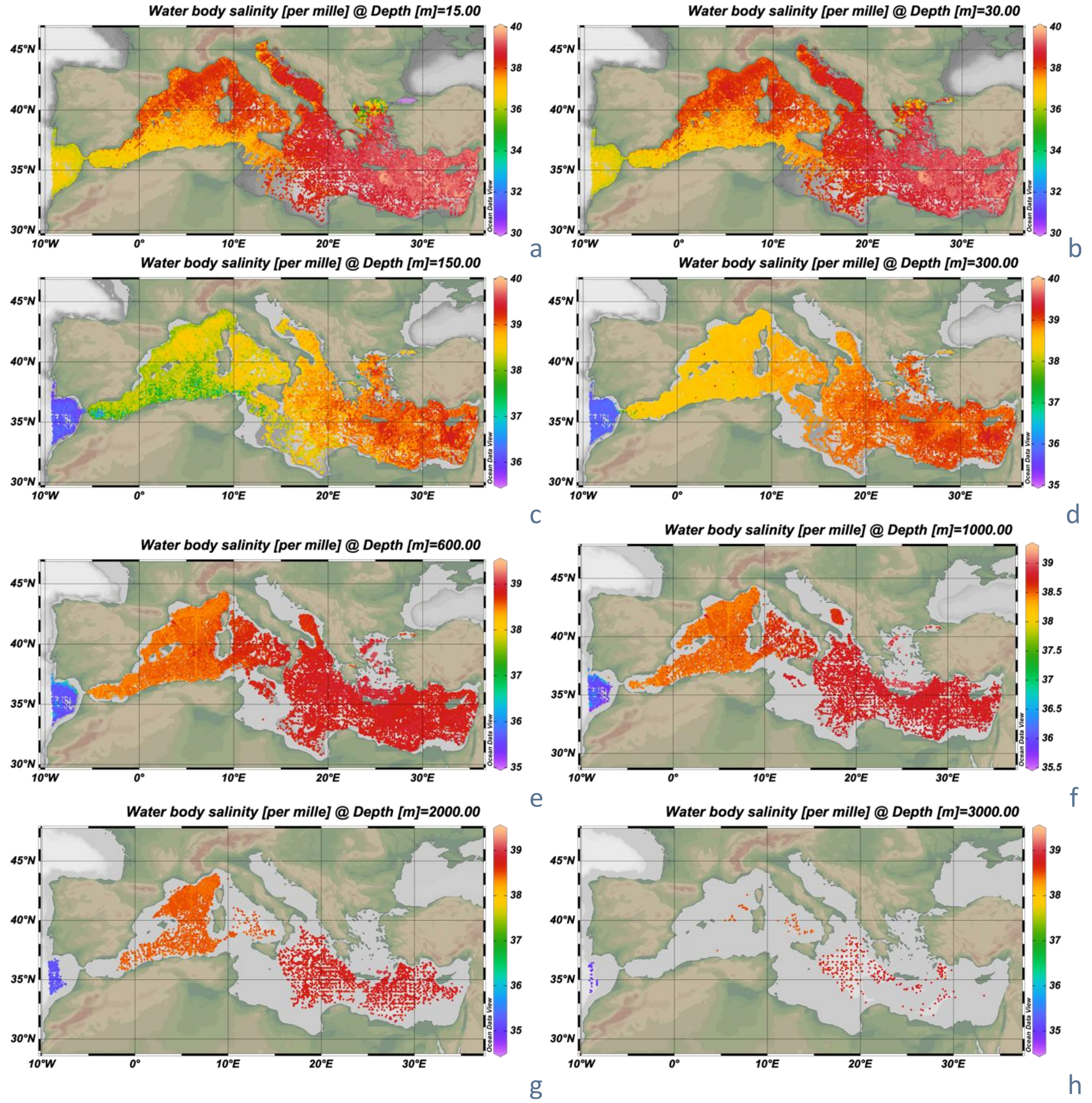


Figure 20 Salinity values with QF=1,2 at specific depths: a) 15m; b) 30m c) 150m; d) 300m; e) 600m; f) 1000m; g) 2000m; h) 3000m.

Figure 21 displays the scatter plots of SDC_MED_DATA_TS_V2 temperature and salinity measurements with QF equal to 1 and 2 . Some data appear still out of the data cloud but they have not been identified as obvious anomalies, they might have been sampled near the coast, during particular events or in peculiar circulation features.

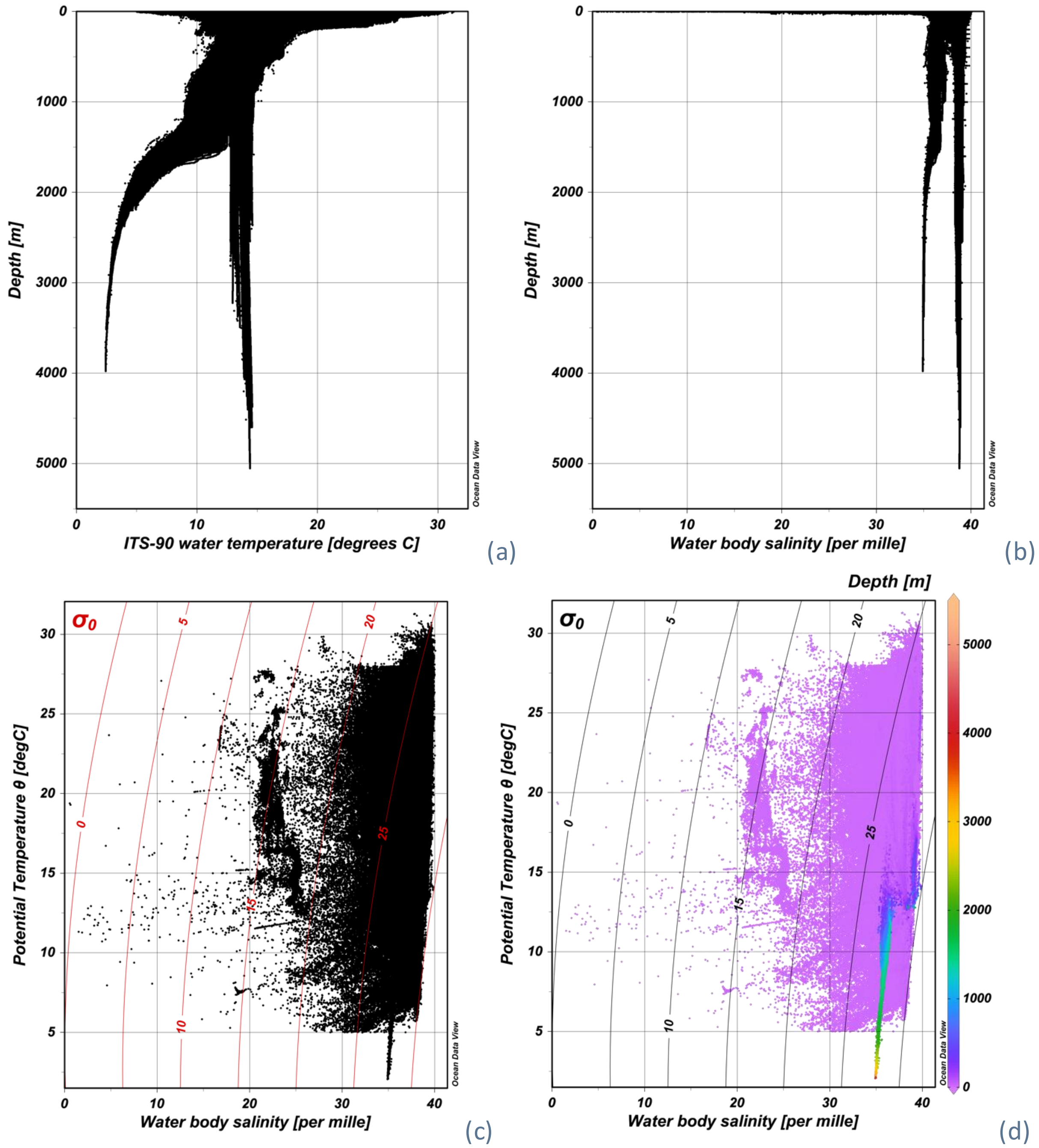


Figure 21 Scatter plots of good (QF=1, 2) observations after QC: (a) temperature versus depth; (b) salinity versus dept; (c) TS scatter plot, and (d) TS scatter plot with the colour indicating the depth value in meters of each measurement.

In conclusion, the results of QC analysis of SDC_MED_DATA_TS_V2 data set are summarized in Table 4. Data with QF=0 (not checked) have been inspected and validated thus their percentage became nil, consequently both good/probably good data (QF12) and bad/probably bad data (QF34) percentages slightly increased.

Table 4 Quality Flags statistics before and after the QC analysis.

	QF0		QF12		QF34	
	before QC	after QC	before QC	after QC	before QC	after QC
Depth	0,8%	0,0%	99,0%	99,7%	0,2%	0,3%
Temperature	0,8%	0,0%	98,5%	99,2%	0,8%	0,8%
Salinity	0,7%	0,0%	98,2%	98,8%	1,1%	1,2%
T&S	0,7%	0.0%	98,1%	98,7%	0,3%	0,3%

4. Technical Specifications

4.1. Product Format

Ocean Data View (ODV) collection.

4.2. Data Policy

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

4.3. Product Usability

The collection contains a unique and validated data set of Temperature and Salinity for the Mediterranean Sea sampled with different instruments. Data consistency among different data types should be kept in mind for any long term study or climatology computation. Data gaps are present and they must be considered for any application. Please consider that the SDC_MED_DATA_TS_V2 data set contains:

- underway data at reduced resolution, since only one sample over seven has been included in this data collection.
- XBT data are without any depth correction.

This data set can be used to support:

- the analysis of the variability of the basin hydrodynamic properties;
- operational oceanography modelling activities, data assimilation, model validation and model initialization.

Whenever SDC_MED_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.

4.4. Changes since previous version

The previous version of the product (SDC_V1) was released in June 2018 and it is available at SEXTANT Catalogue (http://sextant.ifremer.fr/en/web/seadatanet) under the name "Mediterranean Sea - Temperature and salinity Historical Data Collection SeaDataCloud V1" (*Simoncelli et al. 2018*).

Table 5 compares the number of stations in SDC_MED_DATA_TS_V1 and SDC_MED_DATA_TS_V2 collections over the same spatial domain. There is an increase in the number of stations of 36%, with the highest value for salinity (+40%). In terms of samples their availability increased of a 6% for temperature and 10% for salinity (Table 6). The encouraging increase in data availability in the Mediterranean region would allow to ameliorate the quality of the deriving data products.

Table 5 Stations in SDC_MED_DATA_TS_V1 and SDC_MED_DATA_TS_V2, and the percentage of increase of stations .

stations	SDC_V1	SDC_V1	Total increase (%)
Total	739784	1003258	+36%
T	737102	997255	+35%
S	667232	931350	+40%
T&S	665388	926223	+39%

Table 6 Samples in SDC_MED_DATA_TS_V1 and SDC_MED_DATA_TS_V2 and the percentage of increase from SDN2_V2 to SDC_V1.

samples	SDN2_V1	SDC_V2	Total increase (%)
T	41223938	43627275	+6%
S	28518744	31458072	+10%
T&S	28119926	30895352	+10%

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 7 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 7 List of SeaDataNet Quality Flags. Quality flags are 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

It follows the list of 27 data centres that provide data in the Mediterranean domain, with their relative **EDMO code** (https://www.seadatanet.org/Metadata/EDMO-Organisations).

IFREMER / IDM / SISMER - Scientific Information Systems for the SEA (486)
IEO/ Spanish Oceanographic Institute (353)
OGS (Istituto Nazionale di Oceanografia e di Geofisica Sperimentale), Division of Oceanography (120)
Shom (540)
IEO/Spanish Oceanographic Institute (353)
Hellenic Centre for Marine Research, Hellenic National Oceanographic Data Centre (HCMR/HNODC) (269)
ENEA Centro Ricerche Ambiente Marino - La Spezia (136)
All-Russia Research Institute of Hydrometeorological Information - World Data Centre (RIHMI-WDC) National Oceanographic Data Centre (NODC) (681)
Israel Oceanographic and Limnological Research (IOLR) (963)
Institute of Marine Sciences, Middle East Technical University (696)
ORION (4537)
Institute of Oceanography and Fisheries (700)
Institute of Biology of the Southern Seas, NAS of Ukraine (840)
CNR, Institute of Atmospheric Sciences and Climate (ISAC) (Rome) (149)
IHPT, Hydrographic Institute (590)
Institute of Marine Biology (IMBK) (2432)
NIOZ Royal Netherlands Institute for Sea Research (630)
British Oceanographic Data Centre (43)
International Ocean Institute - Malta Operational Centre (University Of Malta) / Physical Oceanography Unit (708)
Israel Marine Data Center (ISRAMAR) (710)
Department of Navigation and Hydrography and Oceanography, Turkish Navy (731)
International Council for the Exploration of the Sea (ICES) (730)
PANGAEA - Data Publisher for Earth & Environmental Science (3234)
National Institute of Fisheries Research (INRH) (691)
Marine Institute (396)
Marine Hydrophysical Institute (727)
Istanbul University, Institute of Marine Science and Management (802)
CNR, Institute of Marine Science (ISMAR) - Ancona (144)
Institut National des Sciences et Technologies de la Mer – INSTM (1232)
CNR, Institute of Marine Sciences S.S. of Lerici (SP) (134)

Annex 3 – Data Originators

It follows the list of **data originators** with the relative EDMO code (https://www.seadatanet.org/Metadata/EDMO-Organisations.

IFREMER / IDM / SISMER - Scientific Information Systems for the SEA (486)
IEO/ Spanish Oceanographic Institute (353)
Shom (540)
Marine Technology Unit. Mediterranean Marine and Environmental Research Centre (2489)
OGS (Istituto Nazionale di Oceanografia e di Geofisica Sperimentale), Division of Oceanography (120)
Laboratory of Oceanography of Villefranche (LOV) / IMEV (490)
UNKNOWN (1051)
IFREMER (1054)
ENEA Centro Ricerche Ambiente Marino - La Spezia (136)
Hellenic Centre for Marine Research, Institute of Oceanography (HCMR/IO) (164)
UNIVERSITE DE PARIS VI / GEOSCIENCES AZUR - SITE DE VILLEFRANCHE / OOV (511)
Odessa Branch of SOI (State Oceanographic Institute) (931)
Israel Oceanographic and Limnological Research (IOLR) (963)
CSIC-UTM/ Marine Technology Unit (2489)
Italian Hydrographic Institute (1338)
Institute of Marine Sciences, Middle East Technical University (696)
CNR, Istituto di Scienze Marine (Sezione di Venezia - ex IBM) (108)
ARPA Emilia-Romagna - Struttura Oceanografica Daphne (1130)
Cyprus Oceanography Center (711)
Federal Maritime and Hydrographic Agency (1850)
CSIC-ICM/ Institute of Marine Sciences (280)
CNR, Institute of Marine Sciences S.S. of Lerici (SP) (134)
Institute of Biology of the Southern Seas, NAS of Ukraine (840)
Oceanologic Observatory of Banyuls (University of Paris VI) / OSU (1015)
CNR, Institute of Marine Science (ISMAR) - Ancona (144)
CNR, Institute of Marine Science (ISMAR) (Trieste) (127)
UNIVERSITY OF PERPIGNAN / CEFREM (515)
Laboratory of Oceanography and Climate : Experiments and numerical Approaches - UMR 7159 (494)
COM - Physical and Biogeochemical Oceanography Laboratory (LUMINY) (513)
Institute of Oceanography and Fisheries (700)
MUSEUM NATIONAL D'HISTOIRE NATURELLE / LABORATOIRE D'OCEANOGRAPHIE PHYSIQUE (501)
IEO/ Murcia Oceanographic Centre (1407)
CNR, Institute of Atmospheric Sciences and Climate (ISAC) (Rome) (149)
Università degli Studi di Napoli 'Parthenope' - Istituto di Meteorologia e Oceanografia (234)

IHPT, Hydrographic Institute (590)
IEO/ Malaga Oceanographic Centre (1405)
IFREMER / STATION DE SETE (721)
Institute of Marine Biology (IMBK) (2432)
ERIC Euro-Argo (4614)
Center for marine research - Rudjer Boskovic Institute (702)
Hellenic Centre for Marine Research (HCMR) (3051)
CNRS / Center of Oceanology of Marseille (COM) La-Seyne-Sur-Mer (1941)
Marine Biology Laboratory of Trieste (238)
Stazione Zoologica Anton Dohrn of Naples (237)
CNRS / COM - Physical and Biogeochemical Oceanography Laboratory (Toulon) (1020)
SACLANT Undersea Research Centre (SACLANTCEN) (126)
COM - Physical and Biogeochemical Oceanography Laboratory (Endoume) (1043)
IRD /CENTRE DE BRETAGNE (440)
NIOZ Royal Netherlands Institute for Sea Research (630)
Institut polaire francais Paul-Emile Victor (IPEV) (1363)
UIB/ Baleares Islands University. Environmental Biology Department. (334)
IEO/ Balearic Islands Oceanographic Centre (1409)
Hellenic Navy Hydrographic Service (HNHS) (1004)
Proudman Oceanographic Laboratory (48)
IEO/Spanish Oceanographic Institute (353)
Department of Navigation and Hydrography and Oceanography, Turkish Navy (731)
Oceanological Observatory of Villefranche sur Mer (3928)
Atlantic Scientific Research Institute for Marine Fishery and Oceanography (682)
CNRS / Microbiology, Geochemistry and Marine Ecology Laboratory (532)
P.P.Shirshov Institute of Oceanology, RAS (685)
National Institute of Fisheries Research (INRH) (691)
CEA / Laboratory of climatolocical and environmental Sciences(LSCE) (549)
IMEDEA-UIB-CSIC/ Mediterranean Institute for Advanced Studies (957)
IEO/ La Coruna Oceanographic Centre (1403)
Marine Institute (396)
International Ocean Institute - Malta Operational Centre (University Of Malta) / Physical Oceanography Unit (708)
Marine Hydrophysical Institute (727)
LABORATORY of PHYSICAL OCEANOGRAPHY (LPO) UMR 6523 CNRS-IFREMER-IRD-UBO (487)
CNR, Institute of Marine Science (ISMAR) - Bologna (145)
Ukrainian scientific center of Ecology of Sea (UkrSCES) (1167)
British Oceanographic Data Centre (43)
Moscow State University, Geography Department (902)
CSIC-CEAB/ Centre for Advanced Studies of Blanes (1393)

Malta Centre for Fisheries Sciences (709)
UNIVERSITE DE LA MEDITERRANNEE (U2) / CENTRE D'OCEANOLOGIE DE MARSEILLE (1084)
UNIVERSITY OF MONTPELLIER / GEOSCIENCES MONTPELLIER UMR 5243 CNRS/UM2 (1088)
DTU Aqua – National Institute of Aquatic Resources, Technical University of Denmark (2195)
Commissione Permanente per lo Studio dell'Adriatico, Venezia (1339)
IEO/ Cadiz Oceanographic Centre (1406)
LABORATORY OF OCEANOGRAPHY of VILLEFRANCHE (LOV) / OOV (490)
OGS (Istituto Nazionale di Oceanografia e di Geofisica Sperimentale), Department of Biological Oceanography (2431)
Istanbul University, Institute of Marine Science and Management (802)
CNR, Istituto per lo Studio della Dinamica delle Grandi Masse (128)
Institut National des Sciences et Technologies de la Mer – INSTM (1232)
Administration Of Fish Searching And Research Fleet for the Western Basin (900)
CNRS / Laboratory of of studies on Spatial Geophysics and Oceanography (LEGOS) (552)
Developmental Biology Research Laboratory (529)
Murmansk Hydrometeorological Administration of Roshydromet (903)
Mediterranean Institute of Oceanography - LUMINY (MIO) - UMR 7294 / 235 / 110 (3078)
Societe ACRI S.A. (1017)
Water Services Corporation (4750)
IFREMER / GM-MARINE GEOSCIENCES (485)
University of Genova - Laboratory of Marine Geology and Sedimentology, Dpt for the Study of the Territory and Resources (138)
IFREMER / CENTRE DE TOULON (819)
Southampton Oceanography Centre (2002)
ORION (4537)
Universite D'Angers / Laboratoire Des Bio-Indicateurs Actuels Et Fossiles (Biaf) (1915)
IFREMER / LERPAC - Toulon (4606)
ISTPM (IFREMER NANTES) (1068)
CEREGE (560)
Far Eastern Regional Hydrometeorological Research Institute (756)
GEOMAR Helmholtz Centre for Ocean Research Kiel (2947)
National Oceanography Centre, Southampton (17)
IFREMER / RBE / Biogeochimical end Ecotoxicological Resarch Unit (Brest) (1888)
IFREMER / RBE Department / Biogeochimical end Ecotoxicological Resarch Unit (Nantes) (527)
University of Athens, Department of Chemistry, Division of Inorganic and Environmental Chemistry, Environmental and Marine Chemistry Group (EMCG/UATH) (302)
IFREMER / DYNECO- Coastal Environment Dynamics department (1016)
IRDN / LERCM - Toulon (1842)
IRD / CENTRE OF ABIDJAN (1145)
V.I. Il'ichevs Pacific Oceanological Institute, Far Eastern Branch, Russian Academy of Sciences (946)

EPOC - Geology and Oceanography Department (838)
IFREMER / EEP / LEP-DEEP ENVIRONMENT LABORATORY (484)
IFREMER / GENAVIR BREST (1052)
Universite de Toulon / Lab. De Sondages Electromagnetiques (Lseet) (1942)
German Hydrographic Institute (1849)
IFREMER / CENTRE DE BRETAGNE (848)
Italian Navy Hydrographic Office (1338)
Plymouth Marine Laboratory (47)
UIB/ Balearic Islands University. Sciences Faculty (2146)
UNIVERSITE DE BRETAGNE OCCIDENTALE (UBO) /Ocean Geoscience Laboratory (LGO) (1079)
University of Rostock, Institute of Biosciences (1715)
IFREMER / Dpt Technologicals Research and Development (795)
IRD CENTRE DE NOUMEA (520)
Primorsky Territorial Office on Hydrometeorology and Environmental Monitoring of Roshydromet (920)

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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 Organizations (SeaDataNet catalogue)
GLO	Global Ocean
IOC	Intergovernmental Oceanographic Commission
IODE	International Oceanographic Data and Information Exchange (IOC)
MED	Mediterranean Sea
MFC	Monitoring and Forecasting System
NAT	North Atlantic Ocean
NWS	North West Shelf
ODV	Ocean Data View Software
QC	Quality Check
QF	Quality Flag
SDC	SeaDataCloud
SDN	SeaDataNet
TS	Temperature and Salinity
WOA	World Ocean Atlas
WP	Work Package