Product Information Document (PIDoc)

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

SDC_BLS_DATA_TS_V2

HORIZON 2020

sdn-userdesk@seadatanet.org – www.seadatanet.org

SeaDataCloud - Further developing the pan-European infrastructure for marine and ocean data management

Grant Agreement Number: 730960

Product Name

SDC_BLS_DATA_TS_V2

Extended name

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

Product DOI

http://doi.org/10.12770/b90d7650-a0d7-409c-ba31-122a1f4f9c3f

Short description

The SeaDataCloud Temperature and Salinity Historical Data Collection for the Black Sea (Version 2) includes open access in situ data on temperature and salinity of water column in the Black Sea (and a little in the Sea of Azov) for period 1868 – 2019. The data were retrieved from the SeaDataNet infrastructure at the end of 2019. The dataset format is Ocean Data View (ODV) binary collection. 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 the elaborated by SeaDataNet2 and SeaDataCloud project QC procedures in conjunction with the visual expert check. Data duplicates have been identified and excluded from the dataset. The final number of the Temperature and Salinity profiles (stations) in the collection is 162626.

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Dissemination

Public

Copyright terms

How to Cite

History

Version	Authors	Date	Comments
1.0	V. Myroshnychenko	19/01/2020	

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Abstract

The SeaDataCloud Temperature and Salinity Historical Data Collection for the Black Sea (Version 2) (product name SDC_BLS_DATA_TS_V2) includes open access in situ data on temperature and salinity of water column in the Black Sea (and a little in the Sea of Azov) for period 1868 – 2019 retrieved from the SeaDataNet infrastructure at the end of 2019. The dataset format is Ocean Data View (ODV) binary collection. 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 the elaborated by SeaDataNet2 project and enhanced in SeaDataCloud project QC procedures in conjunction with the visual expert check. Data duplicates have been identified and excluded from the dataset. The final number of the Temperature and Salinity profiles (stations) in the collection is 162626.

Whenever SDC_BLS_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.

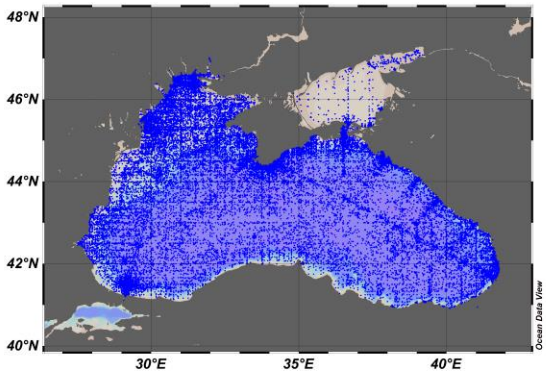
1. General description of the data collection

The SeaDataCloud Temperature and Salinity Historical Data Collection for the Black Sea (Version 2) (product name SDC_BLS_DATA_TS_V2) combines data from the SDC_BLS_DATA_TS_V1 collection (*Myroshnychenko et al. 2018*), based on the data harvested in Dec 2017, with the new data, that were added to the SeaDataNet infrastructure after Dec 2017 and retrieved at the end of 2019. The collection includes non-restricted data obtained from 44 data providers (originators and distributors) listed in Annex 2 – Data providers.

The collection was created, managed and quality controlled with Ocean Data View (ODV) software. The dataset format is ODV binary collection.

The collection covers period 1868 – 2019. All data in the collection have been quality controlled according to procedures described in chapter 2. The duplicates and bad data (e.g., stations on land, empty profiles i.e. those without Temperature and Salinity, and empty depth level) were excluded from the collection.

The collection contains data from two types of observations: 1) traditional ones done in one geographical point in one time moment – these include both vertical profiles single depth measurements (further in text just profiles), and 2) underway data, i.e. data from continuous sampling along the vessel trajectory. These trajectories are easily recognized at stations map. Spatial distribution



and data density are presented at

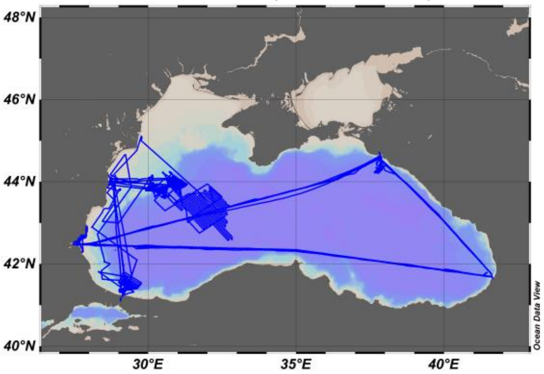
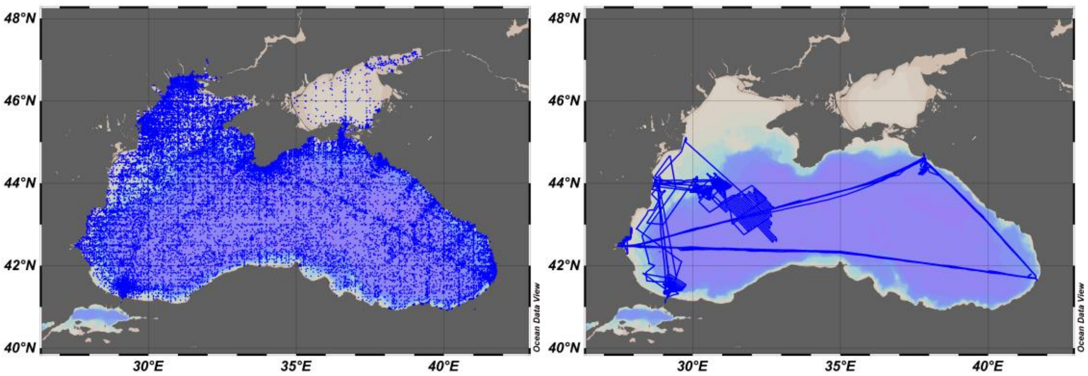
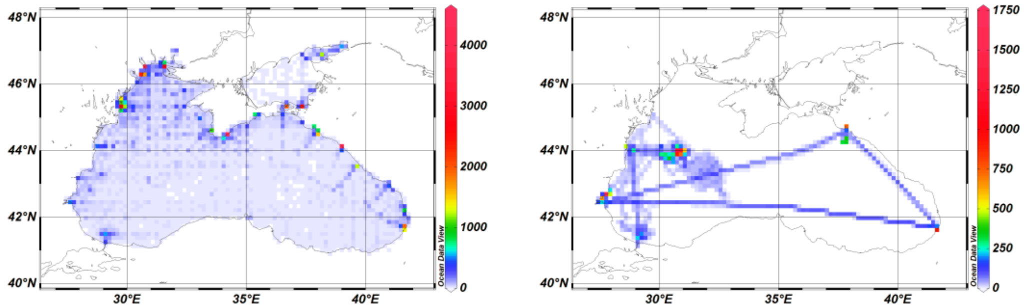


Figure **1.1** and Figure 1.2 below. The total number of stations in the collection is 162626.



a) b)

Figure 1.1 Spatial distribution of observations: profiles (a) and underway data (b)



a) b)

Figure 1.2 Data density of observations: profiles (a) and underway data (b)

The underway data are being collected in Black Sea relatively recently – in past two decades in just several cruise. Since the underway data are obtained with high frequency (e.g., 1 measurements per minute), the number of data points per cruise can be large. In ODV every such point is considered as a separate station, therefore the number of underway stations in the collection is relatively large compared to traditional stations, while the temporal and spatial coverage is very irregular (Figure 1.1 b)). For better understanding of the collection content the data statistics further will be provided for profiles data, for underway data and for totals.

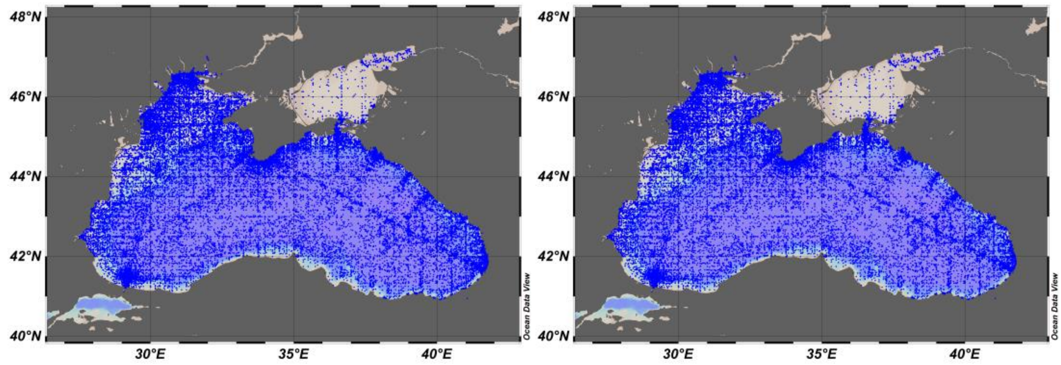
Table 1.1 Data Statistics: total numbers.

	Cruises			Stations			Values		
	Profiles	Underway	Total	Profiles	Underway	Total	Profiles	Underway	Total
All data	2342	69	2411	123897	38759	162656	5091585	38759	5130344
Temperature	2334	69	2403	123511	38759	162270	5089418	38759	5128177
Salinity	2186	69	2255	115804	37349	153153	4932861	37349	4970210
T+S	2178	69	2247	115418	37349	152767	4930694	37349	4968043

The data distribution in Black Sea is rather uneven: the higher concentration of measurements can be observed in areas of intensive navigation and along the standard oceanographic transects, while the interior of the sea, the areas along southern coast and along the central part of the western coast are covered rather poor. About 7% of stations in the collection belong to the Sea of Azov, however most of them are kind of time series from several coastal stations while the interior of the sea is covered poorly.

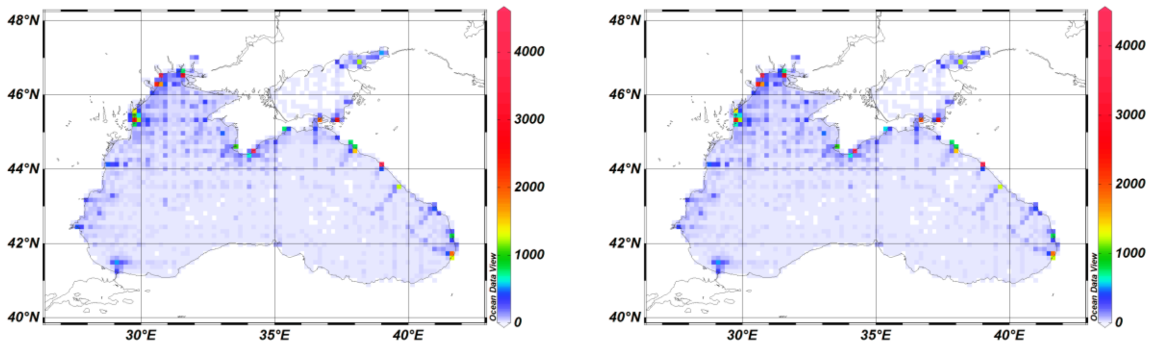
Spatial distribution of Temperature and Salinity data is practically identical. The small difference in spatial coverage can be only noticed for profiles along the eastern coastline and at the north-western shelf (

Figure 1.**3** and Figure 1.4).



a) b)

Figure 1.3 Spatial distribution of Temperature (a) and Salinity (b) profiles



a) b)

Figure 1.4 Data density of Temperature (a) and Salinity (b) profiles

Temporal distributions of observation is presented at Figure 1.5.

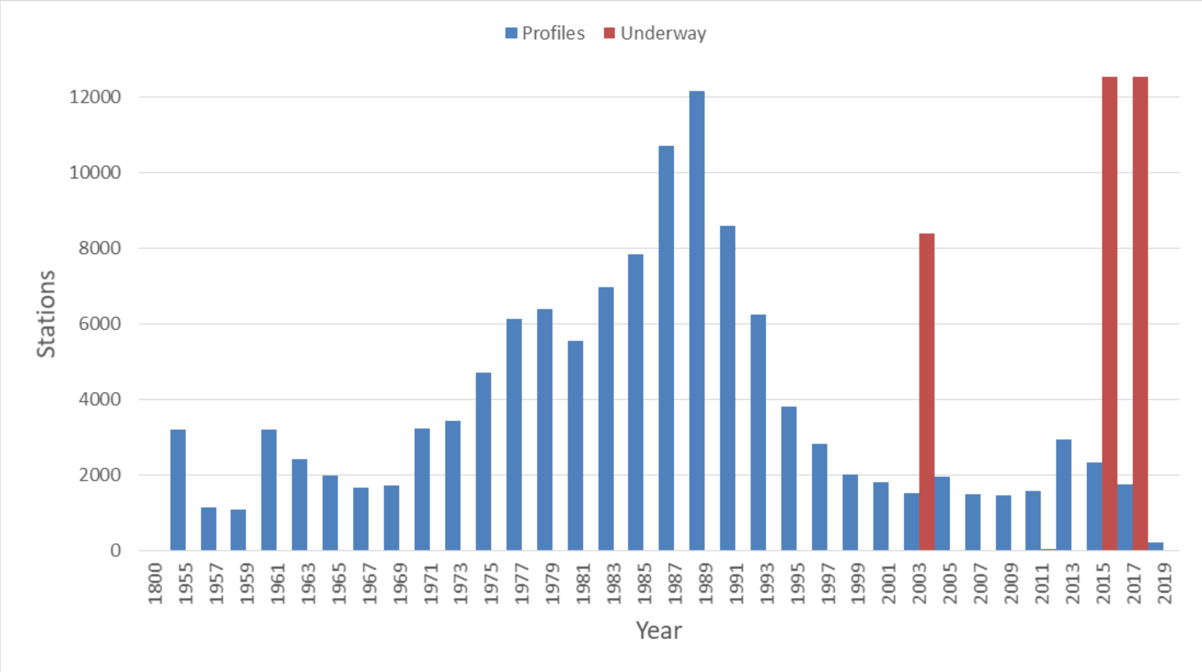


Figure 1.5 Temporal distribution of observations

Though the first oceanographic measurements in Black Sea date from 1868, the total number of observations before 1955 is rather small – slightly above 3000. The most intensive oceanographic observations were performed in Black Sea in period 1970 – 1995. The first available underway observations in Black Sea are dated by 2002.

Temporal distributions of observation separately for Temperature and Salinity are presented at Figure 1.6, Figure 1.7 and at Figure 1.8, Figure 1.9 below. The distributions are practically identical except the small difference in annual distributions in 1960-s, when there were less Salinity observations compared to Temperature.

The number of in profiles in recent years (2017 - 2019) is small - 1000 stations annually. This could due to overall decrease of observations in Black Sea or due to time lag between sampling and data submission to SeaDataNet or because the recent data have status "restricted" or "moratorium" and therefore could not be included in the current collection. On the other hand, there is significant increase of underway data.

Monthly and seasonal distributions of profiles, as expected, have dome-like shape with maximum in summer (more observations) and minimum in winter (less observations), while underway data are distributed irregularly.

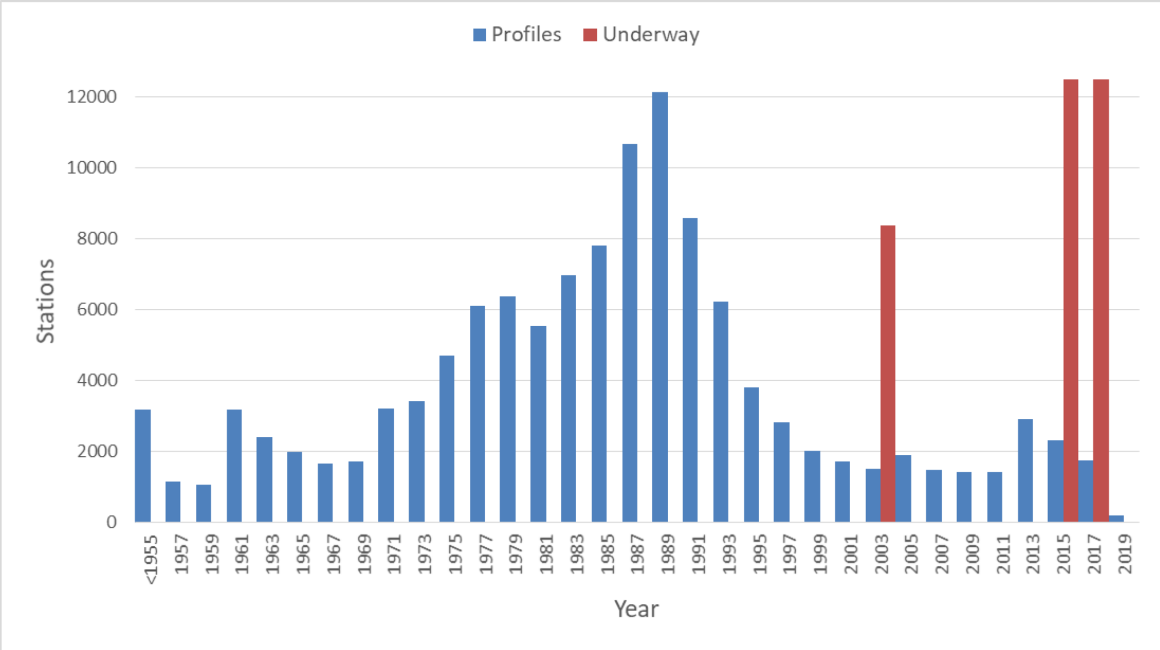
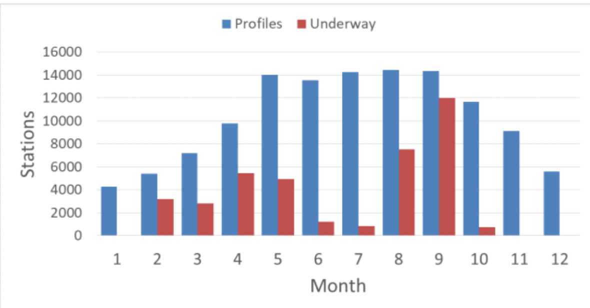
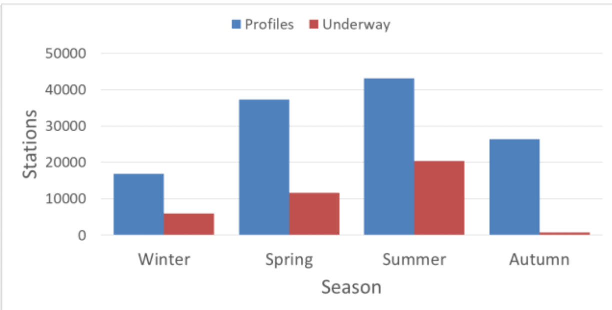


Figure 1.6 Annual distribution of Temperature observations





a) b)

Figure 1.7 Monthly (a) and seasonal (b) distribution of Temperature observations

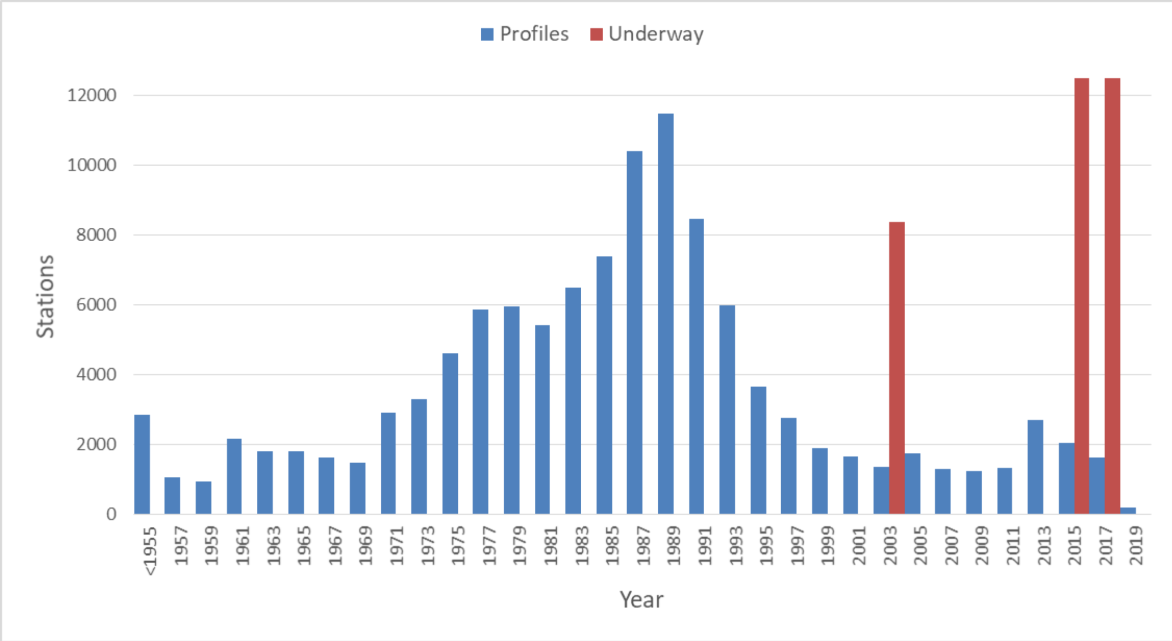
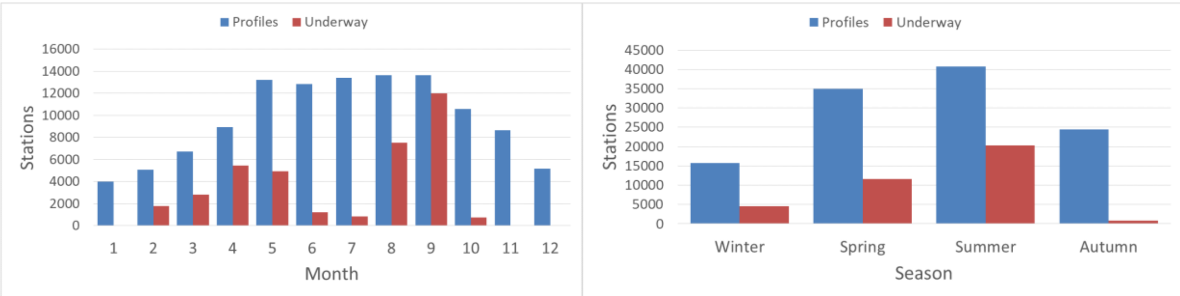


Figure 1.8 Annual distribution of Salinity observations excluding underway data



a) b)

Figure 1.9 Monthly (a) and seasonal (b) distribution of Salinity observations

Vertical distribution of observations (Figure 1.10) shows that data availability drastically decreases with depth. The underway measurements contribute only in two upper depth levels – surface and 5m. As the significant part of historical data was obtained with bottles at standard levels, there are also data gaps in between, e.g. at 15, 40, and 125 m.

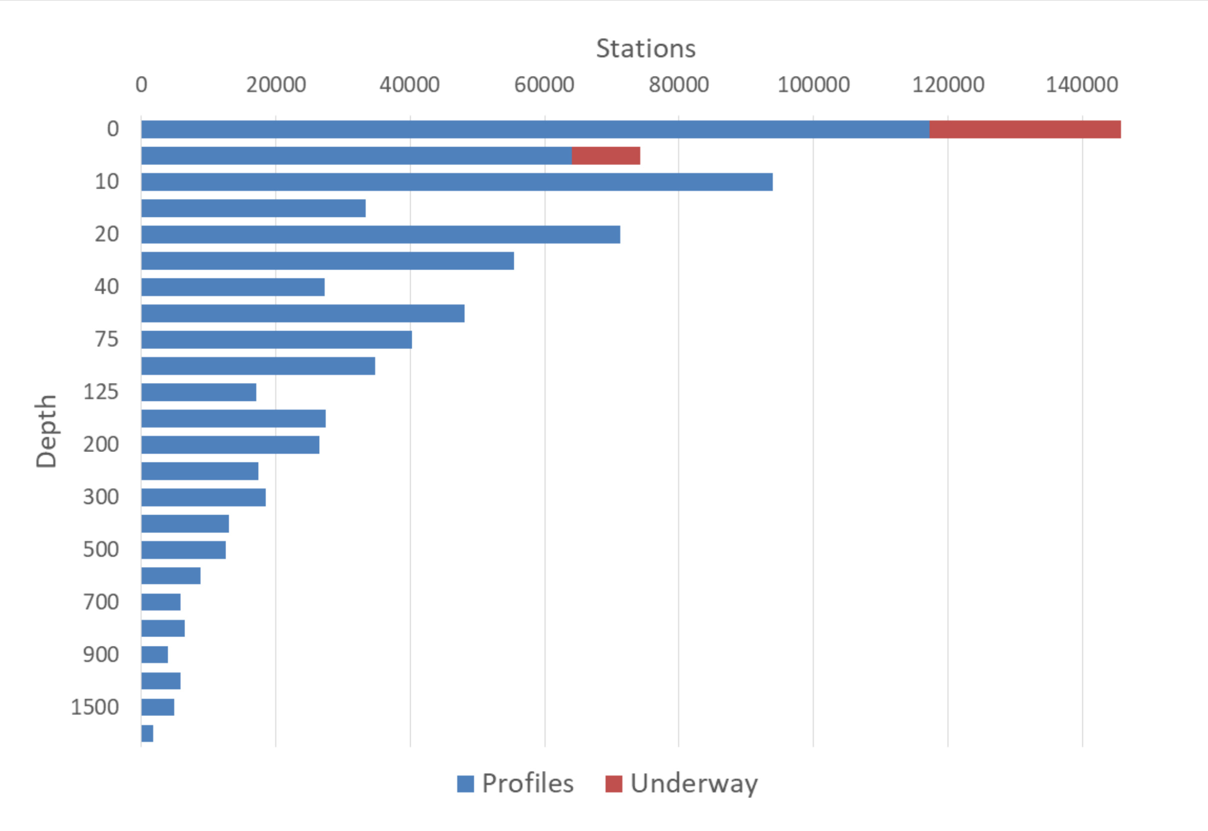


Figure 1.10 Vertical distribution of observations

Instrument usage statistics (Table 1.2) shows the relatively small part of data is acquired with modern instruments such as CTD profilers and thermosalinographs.

Table 1.2 Instruments usage statistics

Instrument	**Stations #**
thermistor chains	49164
discrete water samplers	30312
salinity sensor;water temperature sensor	21969
CTD	21608
thermosalinographs	18632
salinometers;thermistor chains	14436
bathythermographs	3206
water temperature sensor	1651
continuous water samplers	534
none info	258
salinometers;water temperature sensor	441
salinity sensor	228
unknown	217
Total	162656

2. Quality Control Procedure

As it was explained in Chapter 1, the SDC_BLS_DATA_TS_V2 collection combines data from the SDC_BLS_DATA_TS_V1 collection with the new data retrieved at the end of 2019. Since the SDC_BLS_DATA_TS_V1 was already quality controlled, it was necessary to apply QC procedures only to the new data, preliminary eliminating duplicates if any. Indeed, it appeared that the duplicates, that have been already identified and excluded from the SDC_BLS_DATA_TS_V1, still were found in the 2919 sub-set because, unfortunately, data providers still did not remove the reported duplicates from the SeaDataNet infrastructure. (As far as these duplicates persist in the SeaDataNet infrastructure they will be always identified as new data because not being present in the collection). Upon excluding duplicates, the number of new stations to be QC-ed is 24933, from which only 4767 are profiles while the rest are underway.

The quality control of the Temperature and Salinity data was performed following the guidelines in Annex 1 to this document and taking into account peculiarities of the Black Sea water masses such as permanent halocline and a two-layered structure of the waters, presence of **Cold intermediate Layer (CIL)**, conservativeness of properties of deep water layer (below 200 m), etc. The physical properties of the Black Sea water masses remain the same practically through the whole basin except the North-Western shelf, which is under influence of inflow from large rivers, and area of “Bosporus plume”, where saline Mediterranean waters flow to the Black Sea.

The following simple range check procedures were applied to the whole data array, allowing to identify and flag obviously erroneous data:

- Depth < 0,
- Temperature < 0 and QF<>4,
- Temperature > 30 and QF<>4,
- Salinity < 0 and QF<>4,
- Salinity S > 39 and QF<>4,
- Salinity > 23 out of “Bosporus plume” area (28.8<Longitude<29.3, Latitude <41.6),
- Temperature < 6 at depth > 200,
- Temperature > 10 at depth > 200.

Further the profiles were analysed for spikes (using both gradient plots and visual checks), and for stability with the help of plots of density derivative. The underway data were analysed for spikes by visual check of time plots.

The profiles with more or less correct shape but having deeper part going out of range, highly likely were missing the depth corrections, therefore their Depth values were flagged as “probably good” or “probably bad” depending on deviation. In cases, when both Temperature and Salinity were present and the T-S curve was correct, the Depth values in such profiles were flagged as “probably bad”.

Following metadata checks were performed for informing data providers about found mistakes and requesting for corrections:

- Identification of stations with Bottom Depth < 0,
- Identification of stations with profile depth > Bottom Depth,
- Identification of stations with wrong date,
- Identification of stations with missing time.

Station positions were analysed vs the most detailed Black Sea coastline available in ODV package. The special metadata variable Position_QF was added to the station metadata in order to mark stations that fall on land. Position_QF was set to 3 for station that are on land but close to the coastline (perhaps their coordinates were given with low precision). Position_QF was set to 4 for stations being located on land far away from coastline and for stations on land having maximum depth greater 15 m (because it is unlikely that these are coastal stations). The rest of stations have Position_QF=1.

The collection contains some amount of stations located in river estuaries. The values of Temperature and Salinity at such stations can vary beyond the ranges that are typical for Black Sea.

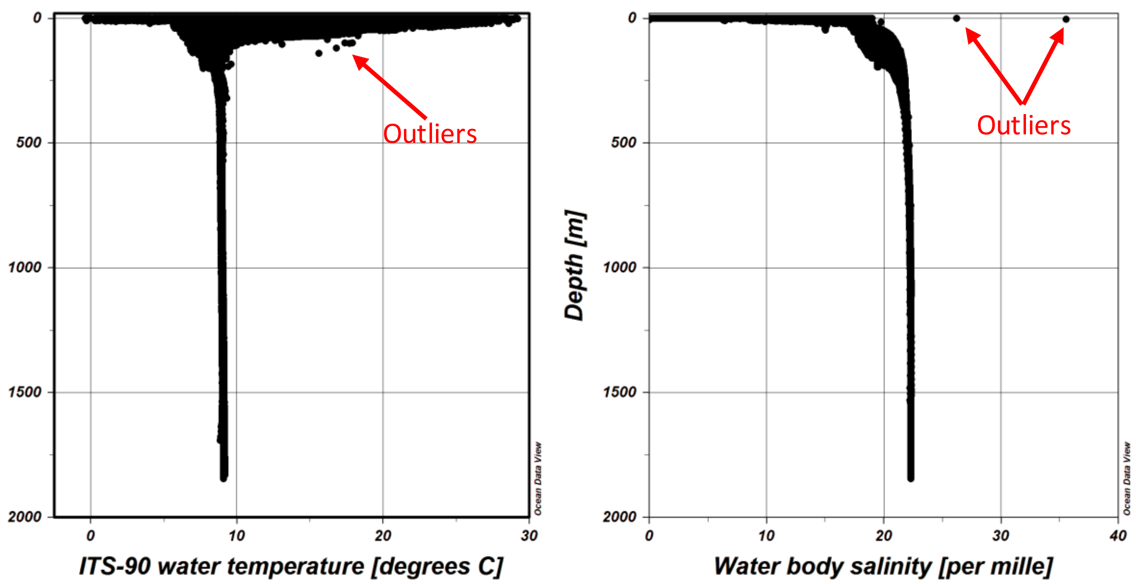
3. Quality assessment results

Statistics of the initial data quality flagging in the 2919 sub-set is provided in Table 3.1.

Table 3.1 Initial data quality flagging statistics in the 2919 sub-set

QF	0	1	2	1-2	3	4	3-4	Total
	not checked	good	probably good		probably bad	bad		
Depth	626135	297656	541	298197	151	23	174	924526
	67.72%	32.20%	0.06%	32.25%	0.02%	0.00%	0.02%	100.00%
Temperature	626072	277203	2175	279378	1034	778	1812	907262
	69.01%	30.55%	0.24%	30.79%	0.11%	0.09%	0.20%	100.00%
Salinity	629312	259680	1846	261526	997	443	1440	892278
	70.53%	29.10%	0.21%	29.31%	0.11%	0.05%	0.16%	100.00%

Though about 70% of new data were not quality controlled the overall quality of data appeared to be satisfactory with rather small amount of outliers as can be seen at the respective scatter plots (Figure 3.1).



a) b)

Figure 3.1 Scatter plots of Temperature (a) and Salinity (b) in 2919 sub-set before quality control

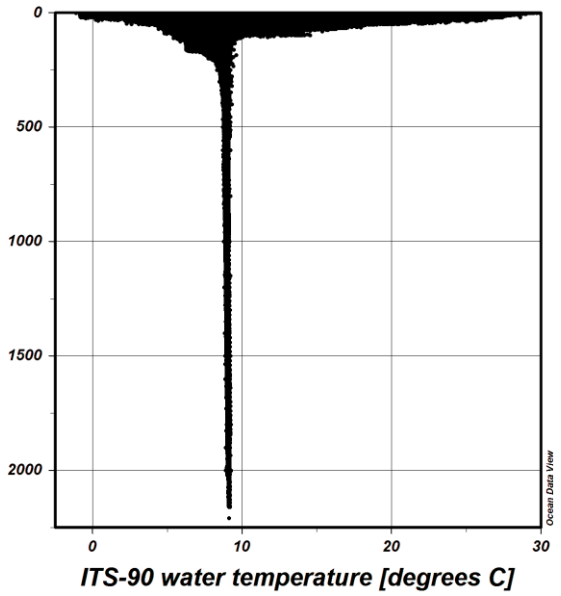
Mode detailed analysis revealed a number of stations with vertical instability (density inversions) due to presence of erroneous values of Temperature or Salinity. The “probably bad” or “bad” were assigned to such values except the special case of “AQUALOG” dataset of P.P.Shirshov Institute of Oceanology, RAS. The dataset contains raw data, i.e. data that did not undergo typical CTD post processing such as filtering, alignment, loop-edit, bin-averaging etc. According to the description of Aqualog, “the profiler makes repeated round trips up and down a taut mooring wire between the subsurface flotation and the anchor”. Judging from the data the profiler stays for a while at the end points of its vertical trips generating large amount of data at slightly changing depth. When imported to ODV these data are automatically sorted by depth and data points at top and bottom of profile are getting mixed up. Because of that, the test of profile for stability fails. These data, since they just slightly fluctuate around an average value for the respective water layer, were not flagged as bad except the obvious outliers.

Upon performing QC and merging with SDC_BLS_DATA_TS_V1 the final collection contains more than **5,130,344 Temperature and Salinity values at 162656 stations from 2342 cruises**. The quality flagging statistics for the final collection is provided in Table 3.2. About 98% of data in the final collection are flagged as "good" (96%) and probably good (2%) and be considered as valid for usage in different studies and applications.

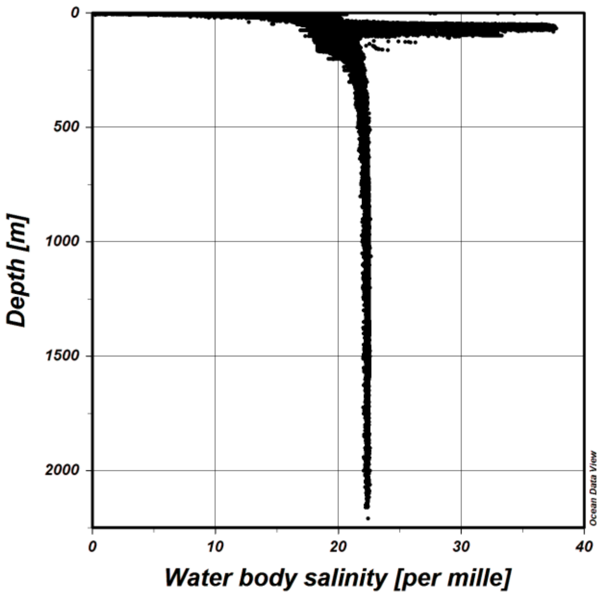
Table 3.2 Data quality flagging statistics in the final QC-ed collection

QF	1	2	1-2	3	4	3-4	Total
	good	probably good		probably bad	bad		
Depth	4964554	72298	5036852	93158	334	93492	5130344
	96.77%	1.41%	98.18%	1.82%	0.01%	1.82%	100.00%
Temperature	4945101	128131	5073232	48785	6160	54945	5128177
	96.43%	2.50%	98.93%	0.95%	0.12%	1.07%	100.00%
Salinity	4786277	87925	4874202	88298	7710	96008	4970210
	96.30%	1.77%	98.07%	1.78%	0.16%	1.93%	100.00%

The scatter plots of Temperature, Salinity and T-S diagrams for QC-ed data are presented at Figure 3.2 and Figure 3.3.



a)



b)

Figure 3.2 Scatter plots of Temperature (a) and Salinity (b) in the final collection

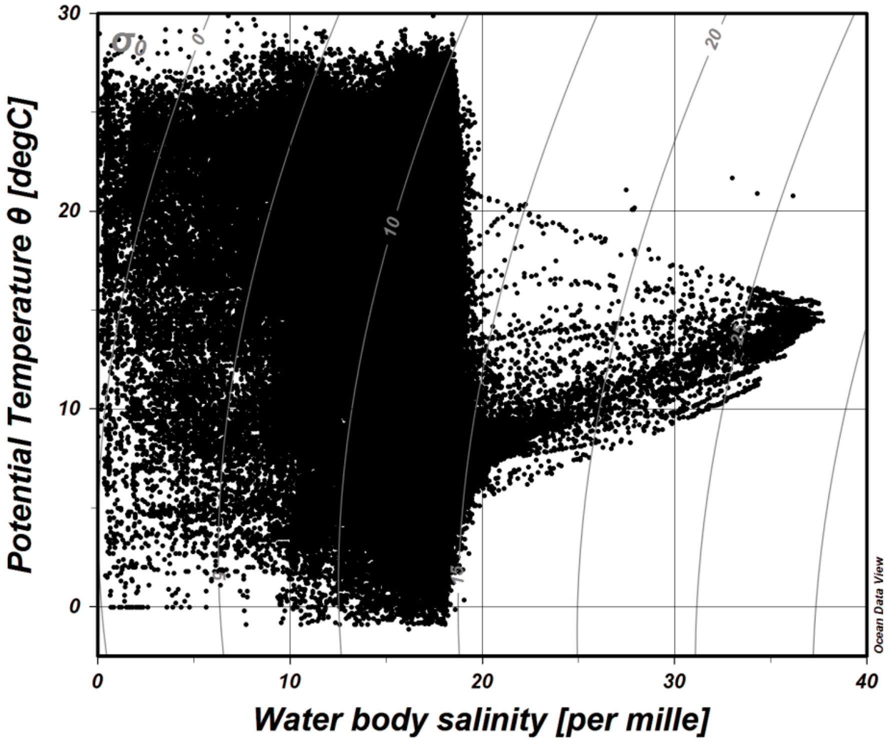


Figure 3.3 Scatter plot of TS diagram in the final collection

4. Technical Specifications

Product Format

Ocean Data View (ODV) collection.

Data Policy

No limitations 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 of Black Sea waters for period 1868 – 2017 that 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. The collection contains a number of data from observations done in river estuaries, firths and ports. Such data should be used with precaution in a certain cases, for example in climatic studies.

Please consider that the SDC_BLS_DATA_TS_V2 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_BLS_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.

Changes since previous version

The previous version of the product was released in 2018 and available at SEXTANT Catalogue (http://sextant.ifremer.fr/en/web/seadatanet) under the name "Black Sea - Temperature and salinity Historical Data Collection SeaDataCloud V1". Compared to *SDC_BLS_DATA_TS_V1* increase in terms of stations and values is in average 20% (Table 4.1). The underway data gave major increase of station (20196 from 24933 or 81%) while CTD profiles contributed 98% to increase of data. The number of cruises increased only on 5.5%, which means that modern instruments produce more data per cruise.

Table 4.1 Data statistics of previous (SDC_V1) and current (SDC_V2) versions of collection.

Cruises			Stations			Values (data)		
SDC_V1	SDC_V2	±%	SDC_V1	SDC_V2	±%	SDC_V1	SDC_V2	±%
2284	2411	5.56%	137723	162656	18.10%	4240346	5130344	20.99%

The statistics on data quality of two collections are very similar, therefore the comparison is not provided hereby - please see the **Erreur ! Source du renvoi introuvable.** instead.

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 2 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 2 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	Stations	CDIs
841	Ukrainian Hydrometeorological Institute - Marine Branch	35752	35752
727	Marine Hydrophysical Institute	22435	22435
688	Southern Scientific Research Institute of Marine Fisheries and Oceanography	21905	21905
692	Bulgarian National Oceanographic Data Centre(BGODC), Institute of Oceanology	18951	2390
486	IFREMER / IDM / SISMER - Scientific Information Systems for the SEA	18632	2
910	North-Caucasus Regional Administration of Hydrometeorology of Roshydromet	7809	7809
1167	Ukrainian scientific center of Ecology of Sea (UkrSCES)	6340	6340
931	Odessa Branch of SOI (State Oceanographic Institute)	5696	5696
696	Institute of Marine Sciences, Middle East Technical University	4817	4817
4727	NGO MARINE SOUND	3553	54
697	National Institute for Marine Research and Development "Grigore Antipa"	2996	2996
914	Odessa branch of IBSS (Institute of Biology of Southern Seas)	2412	2412
685	P.P.Shirshov Institute of Oceanology, RAS	2042	2042
891	Kuban offing station, North-Caucasus HMS	1694	1694
871	Donskaya offing station North-Caucasus HMS	1207	1207
840	Institute of Biology of the Southern Seas, NAS of Ukraine	1417	1417
192	Laboratory of Marine Ecology-Central Laboratory of General Ecology	660	593
731	Department of Navigation and Hydrography and Oceanography, Turkish Navy	644	644
4614	ERIC Euro-Argo	381	381
540	Shom	354	354
120	OGS (Istituto Nazionale di Oceanografia e di Geofisica Sperimentale), Division of Oceanography	335	335
733	Sinop University, Fisheries Faculty	330	330
907	Navy Main Administration of Navigation and Oceanography, Ministry of Defence	304	304
1054	IFREMER	289	289
191	Institute of Fishery Resources	275	275
942	Tuapse Hydrometeorological Bureau, North-Caucasus Centre	209	209
1265	Scientific - Research Firm "GAMMA"	199	199
913	Nothern Regional Administration of Hydrometeorology of Roshydromet	189	189
2121	Georgian Institute of Hydrometeorology of Georgian Technical University	177	70
2267	National Environmental Agency of the Ministry of Environment Protection and Natural Resources	151	151
164	Hellenic Centre for Marine Research, Institute of Oceanography (HCMR/IO)	105	105
2122	Georgian Institute of Water Management of Georgian Technical University	92	92
693	Iv.Javakhishvili Tbilisi State University, Centre of Relations with UNESCO Oceanological Research Centre and GeoDNA (UNESCO)	52	52

EDMO code	Data Originator	Stations	CDIs
1680	State Oceanographic Institute, Sebastopol Branch (SB SOI)	48	48
802	Istanbul University, Institute of Marine Science and Management	40	40
2187	Zoological Institute of the Russian Academy of Sciences	36	36
732	Karadeniz Technical University, Faculty of Marine Sciences	25	25
901	Mariupol Marine Hydrometeorological Station, Ukrainian HMS	25	25
1169	Odessa National I.I.Mechnikov University	24	24
2176	Ankara University	23	23
1051	UNKNOWN	20	20
485	IFREMER / GM-MARINE GEOSCIENCES	7	7
756	Far Eastern Regional Hydrometeorological Research Institute	3	3
353	IEO/ Spanish Oceanographic Institute	1	1
	Total	162656	123792

EDMO code	Data Distributor	Stations	CDIs
727	Marine Hydrophysical Institute	75844	75844
692	Bulgarian National Oceanographic Data Centre(BGODC), Institute of Oceanology	20057	2414
486	IFREMER / IDM / SISMER - Scientific Information Systems for the SEA	19329	699
681	All-Russia Research Institute of Hydrometeorological Information - World Data Centre (RIHMI-WDC) National Oceanographic Data Centre	17730	17730
841	Ukrainian Hydrometeorological Institute - Marine Branch	9192	9192
696	Institute of Marine Sciences, Middle East Technical University	4817	4817
1167	Ukrainian scientific center of Ecology of Sea (UkrSCES)	3649	3649
697	National Institute for Marine Research and Development "Grigore Antipa"	2996	2996
4727	NGO MARINE SOUND	2447	30
685	P.P.Shirshov Institute of Oceanology, RAS	1792	1792
840	Institute of Biology of the Southern Seas, NAS of Ukraine	1316	1316
961	Laboratory of Marine Ecology-Central Laboratory of General Ecology	658	591
731	Department of Navigation and Hydrography and Oceanography, Turkish Navy	644	644
540	Shom	354	354
120	OGS (Istituto Nazionale di Oceanografia e di Geofisica Sperimentale), Division of Oceanography	335	335
733	Sinop University, Fisheries Faculty	330	330
693	Iv.Javakhishvili Tbilisi State University, Centre of Relations with UNESCO Oceanological Research Centre and GeoDNA (UNESCO)	325	218
191	Institute of Fishery Resources	275	275
1265	Scientific - Research Firm "GAMMA"	195	195
2267	National Environmental Agency of the Ministry of Environment Protection and Natural Resources	151	151
269	Hellenic Centre for Marine Research, Hellenic National Oceanographic Data Centre (HCMR/HNODC)	105	105
802	Istanbul University, Institute of Marine Science and Management	40	40
732	Karadeniz Technical University, Faculty of Marine Sciences	25	25
1169	Odessa National I.I.Mechnikov University	24	24
2176	Ankara University	23	23
192	National Institute of Meteorology and Hydrology, Bulgarian Academy of Sciences	2	2
353	IEO/ Spanish Oceanographic Institute	1	1
	Total	162656	123792

References

1. SeaDataCloud project (2016-2020), grant agreement 730960, EU H2020 programme, www.seadatanet.org/About-us/SeaDataCloud
2. Seadatanet 2 project (2011-2015), grant agreement 283607, EU Seventh Framework Programme, https://www.seadatanet.org/About-us/SeaDataNet-2
3. Schlitzer, R., Ocean Data View, odv.awi.de, 2017
4. Simoncelli S., Coatanoan C., Myroshnychenko V., Sagen H., Bäck Ö., Scory S., Grandi A., Schlitzer R., Fichaut M. (2015). **Second release of the SeaDataNet aggregated data sets products**. WP10 Fourth Year Report - DELIVERABLE D10.4. http://doi.org/10.13155/50382
5. Volodymyr Myroshnychenko, Dick Schaap, Reiner Schlitzer (2018). Black Sea - Temperature and salinity Historical Data Collection SeaDataCloud V1. https://doi.org/10.12770/2287615d-1977-479f-8d5b-439960bcb21a
6. V.S. Tuzhilkin, Thermohaline Structure of the Sea, pp. 217-254. In: Kostianoy A., Kosarev A. (eds) The Black Sea environment. The Handbook of Environmental Chemistry, V5Q. Springer, Berlin/Heidelberg/New, 2008. — 460 p.

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