Product Information Document (PIDoc)

SeaDataCloud Temperature and Salinity Climatology for the Global Ocean (Version1)

SDC_GLO_CLIM_TS_V1

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_GLO_CLIM_TS_V1

Extended name

SeaDataCloud Temperature and Salinity Climatologies for the Global Ocean (Version 1)

Product DOI

http://dx.doix.org/10.12770/f632d0d4-3373-43a4-a6be-d2109ebe0177

Short description

The SDC_GLO_CLIM_TS_V1_1 and SDC_GLO_TS_V1_2 contain Temperature and Salinity climatology for global ocean including monthly fields for time period 1900 to 2017 and 2003 to 2017 respectively. The climatology was computed using the World Ocean Database (2013) and the analysis was carried out by the DIVAnd (Data Interpolating Variational Analysis) version 2.3.1.

Authors

Kanwal Shahzadi, Nadia Pinardi, Vladislav Lyubartsev, Marco Zavatarelli and S. Simoncelli

Dissemination	Copyright terms
Public	

How to Cite

Shahzadi, K., N.Pinardi, V.Lyubartsev, M.Zavatarelli and S. Simoncelli, 2019. Global Ocean Temperature and Salinity climatology from the World Ocean Data profiles, Version 1

History

Version	Authors	Date	Comments
1	Kanwal Shahzadi	June 14, 2019	First version
2	Nadia Pinardi	June 18, 2019	Comments and updates
3	Kanwal Shahzadi	June 22, 2019	All pictures included
4	Nadia Pinardi	June 26, 2019	Final comments
5	Kanwal Shahzadi	June 29, 2019	Formulas and results in section 5
6	Kanwal Shahzadi	July 9, 2019	Corrections in section 5 and 6
7	Simona Simoncelli	July 11, 2019	revision
8	Simona Simoncelli	July 28, 2019	final check

Table of contents

Abstract

The SDC_GLO_CLIM_TS_V1 product contains two different monthly climatology for temperature and salinity, SDC_GLO_CLIM_TS_V1_1 and SDC_GLO_CLIM_TS_V1_2 from the World Ocean Data (WOD) database. Only basic quality control flags from the WOD are used. The first climatology, V1_1, considers temperature and salinity profiles from Conductivity Depth Temperature (CTD), Ocean station data (OSD) and Moored buoy data (MRB) along with Profiling Floats (PFL) from 1900 to 2017. The second climatology, V1_2, utilizes only PFL data from 2003 to 2017. V1_1 considers depth layers from surface to 6000 m while V1_2 from 0 to 2000 m. The gridded fields are computed using DIVAnd (Data Interpolating Variational Analysis) version 2.3.1. Basic statistics for differences between the WOD gridded fields, so-called WOA, and the SDC_GLO analyses are computed and the two estimates are found to be consistent.

1. General description of the input data sets

The input database used for this first global SeaDataCloud climatology is the WOD 2013 V2 [1].

The first climatology (**SDC_GLO_CLIM_V1_1**) is estimated using profiles from Conductivity Depth Temperatures (**CTD)**, Profiling Floats (**PFL**), Ocean Station Data (**OSD**) and Moored buoy data (**MRB**) from 1900 to 2017. The second climatology (**SDC_GLO_CLIM_V1_2**) is estimated only using the **(PFL)** data set from 2003 to 2017. Table 1 summarizes the total number of stations and measurements per each climatology, while Table 2 reports the number of stations per each data type used to create SDC_GLO_CLIM_V1_1.

Product	**Total number of stations**	**Total number of samples (Temperature)**	**Total number of samples (Salinity)**
SDC_GLO_CLIM_V1_1	7,039,304	402,289,089	380,970,230
SDC_GLO_CLIM_V1_2	1,862,686	357,758,703	340,849,188

Table 1 Statistics of the data used for the product.

SDC_GLO_CLIM_V1_1	**Number of stations**
Profiling Floats (PFL)	1,862,686
Conductivity Depth Temperature (CTD)	1,034,402
Moored Buoy (MRB)	949,310
Ocean Station Data (OSD)	3,192,906
Total	7,039,304

Table 2 Statistics of the data sub-sets used for the products

In next sections, a general description about each data sub-set is briefly given.

1.1. Profiling Floats

The **PFL** dataset is a collection of data from different PFL platforms: Profiling Autonomous Langrangian Circulation Explorer (PACE), PROVOR (free drifting hydrographic profiler), SOLO (Sounding Oceanographic Langrangian Observer) and APEX (Autonomous Profiling Explorer) [1]. Most of the data in the PFL dataset come from the Argo project. PFL dataset has a well distributed observations on the global scale, number of casts used by PFL for this product are 186,2686 and number of observations are 357,758,703 for temperature and 340,849,188 for salinity.

Annual distribution of data in Figure 1(a and b) represents a gradual increase of data from 2003 to 2017. Month and depth wise distribution of data in Figure 1(c and d) shows nonuniform distribution of data for each depth layer because of the definition of depth layers (Table. 3). First 10 layers are defined at distance of 10 m while next 16 layers are at distance of 25 and 100 m while last 5 layers at distance of 200 m. In addition, spatial distribution of the observations from PFL shows a good coverage of data on a global scale (Figure 2).

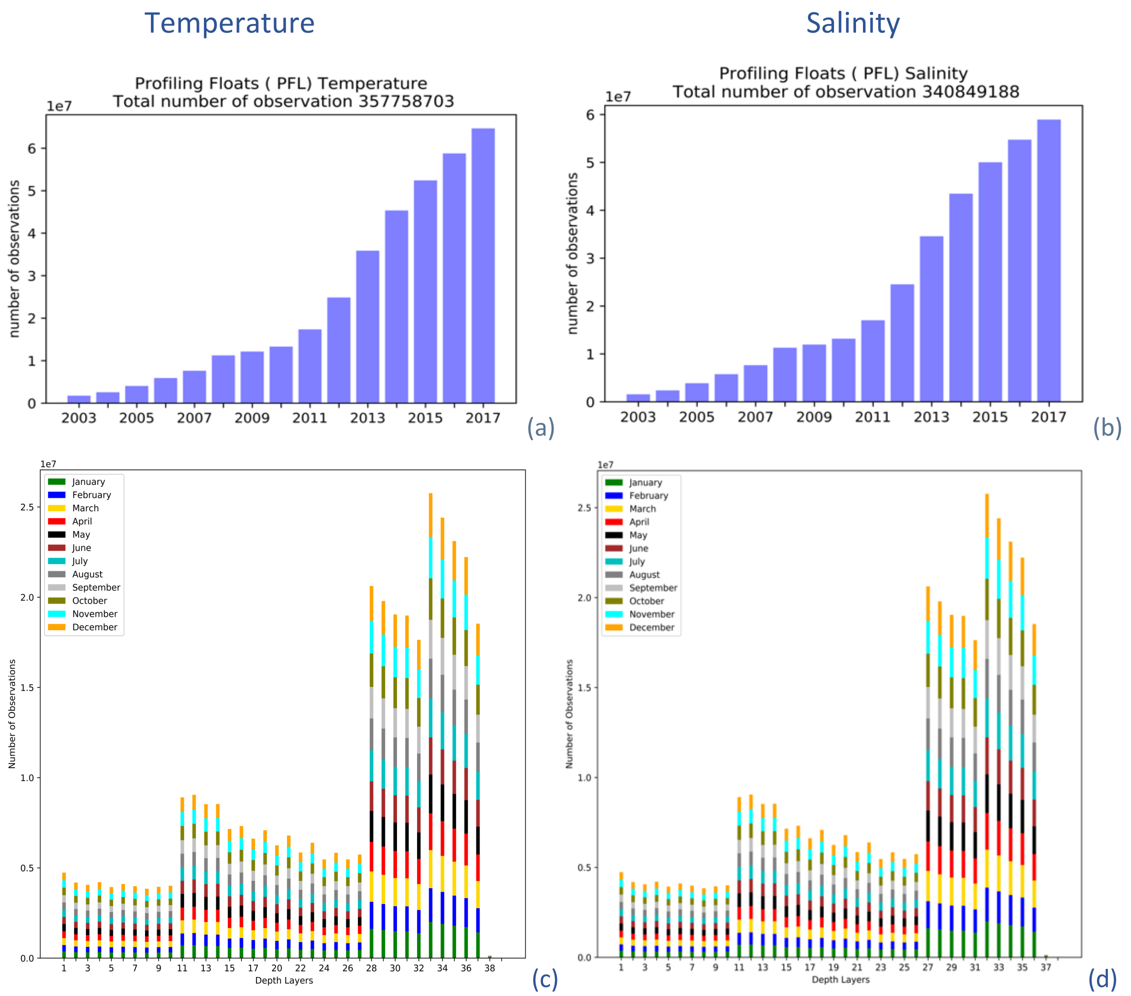


Figure 1 Total observations year wise (a &b) and depth and month wise (c &d) for temperature (left panels) and salinity (right panels).

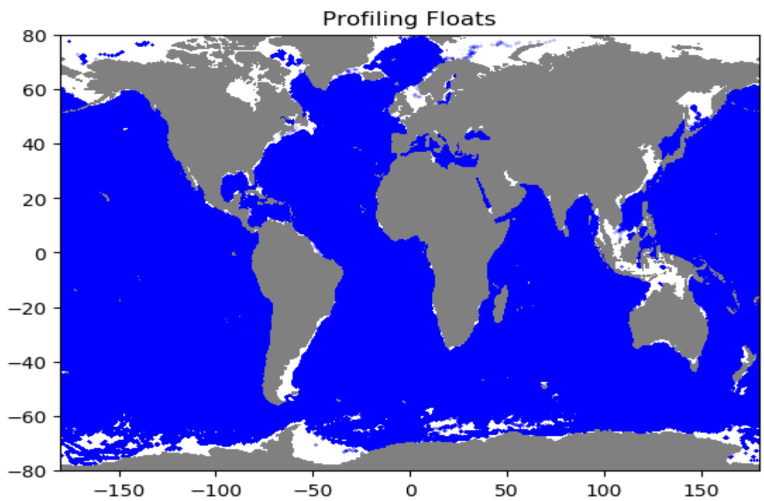


Figure 2 Spatial distribution of PFL profile.

1.2. Moored Buoy data

MRB dataset contains data from the Tropical Atmosphere-Ocean (TAO) buoy array (in the tropical Pacific), the TRITON buoy array (in the western tropical Pacific), the PIRATA buoy array (in the tropical Atlantic), the RAMA buoy array (in the tropical Indian Ocean), MARNET buoys and light-ships (in the North Sea and the Baltic Sea). Observations in MRB data set are located in the equatorial region from surface to 750 m deep (Figure 4). Annual distribution of data in Figure 3(a and b) shows increase in the data up to 2012 while less amount for the following years. Figure 3(c and d) shows there is minimum amount of data for 21st, 23rd and 25th depth layer. Total number of casts used from MRB dataset are 949,310 while number of observations are 8,324,740 for temperature and 2,043,497 for salinity.

Temperature Salinity

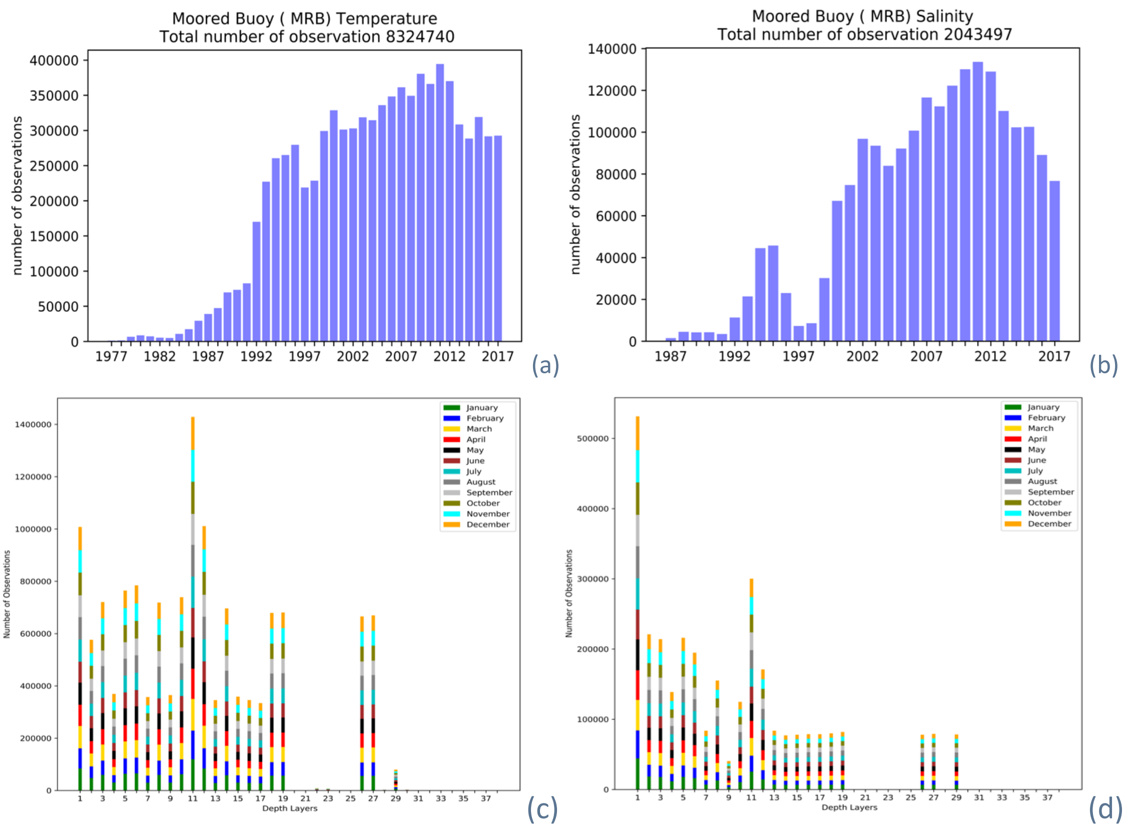


Figure 3 Total observations year wise (a &b) and depth and month wise (c &d) for temperature (left panels) and salinity (right panels).

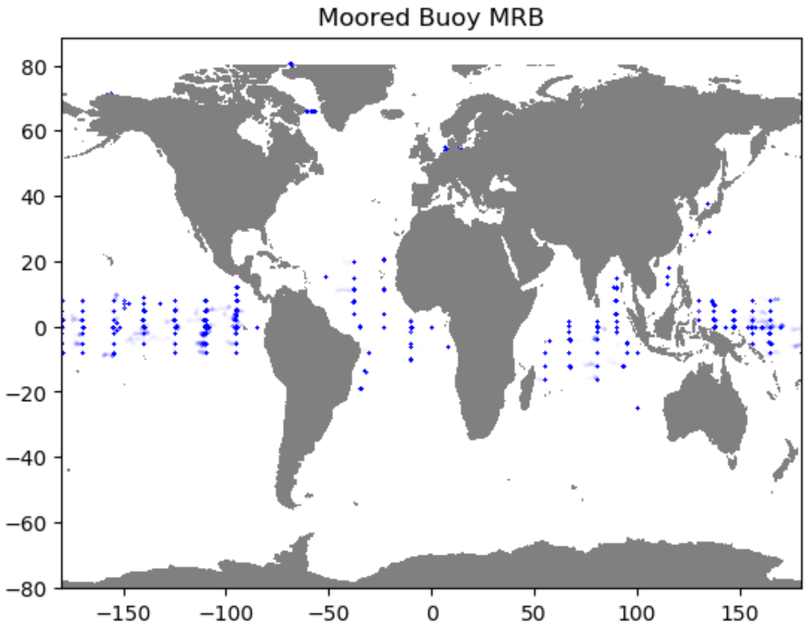
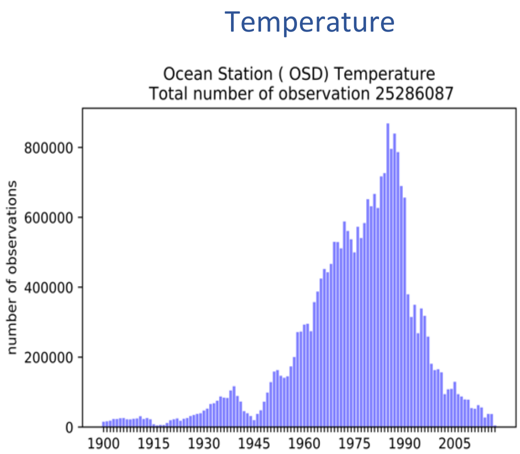


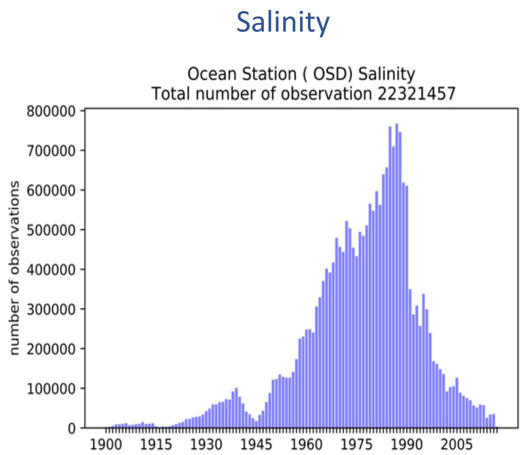
Figure 4 Spatial distribution of MRB observations

1.3. Ocean Station Data

OSD dataset contains data collected from stationary research ships using reversing thermometers, bottles equipped with STD (Salinity Temperature Depth) and CTD (Conductivity Temperature Depth) tipped at depths of interest in water column [1]. Measurements made in this method have both high- and low-resolution measurement with respect to depth. Low resolution data resides in OSD and high resolution are kept in a separate dataset called as CTD. Total number of OSD casts used for this product are 3,192,906, while total observations are 25,286,087 for temperature and 22,321,457 for salinity, distributed as in Figure 6.



(a)



(b)

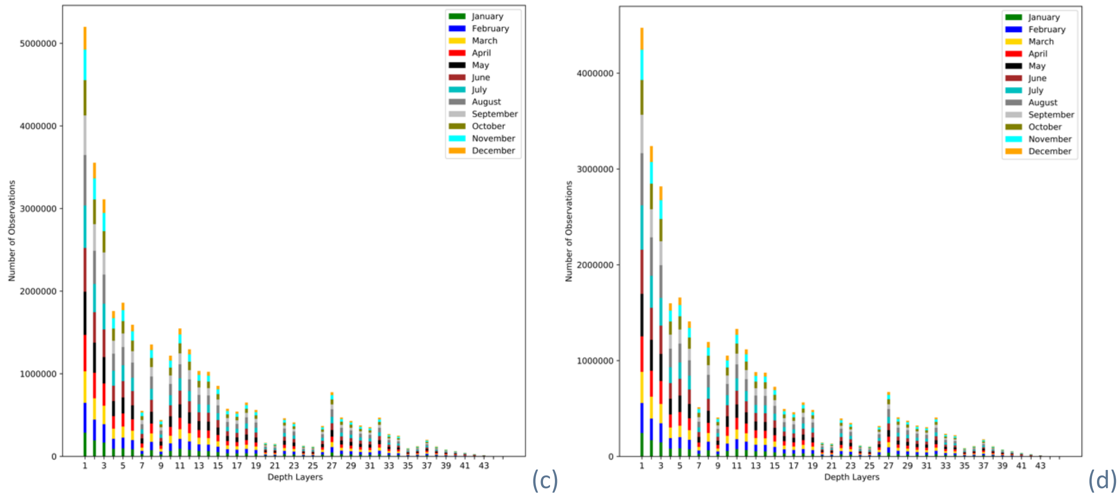


Figure 5 Total observations year wise (a &b) and depth and month wise (c &d) for temperature (left panels) and salinity (right panels).

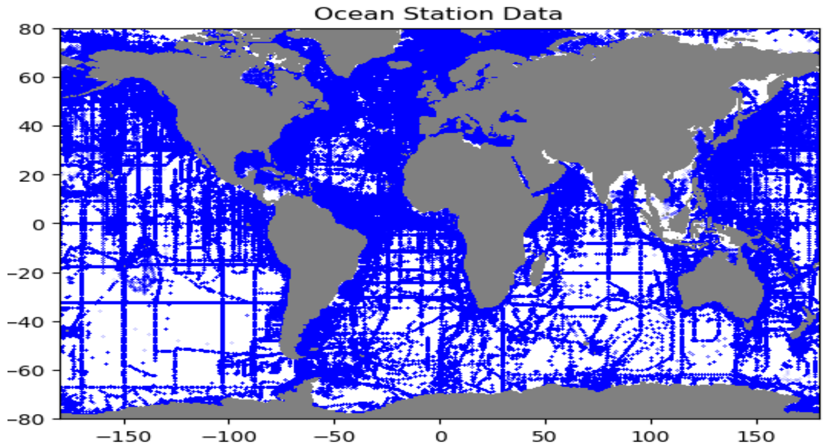


Figure 6 Spatial distribution of OSD observations

1.4. Conductivity Temperature Depth

Total number of **CTD** casts used for this product are 1,034,402, while total observations are 368,678,262 for temperature and 356,605,276 for salinity. Observations in both dataset OSD and CTD are distributed well on the globe scale. Annual distribution of data by OSD in Figure 5 and CTD in Figure 7(a and b) show gradual increase of data from 1945 to 1990 and a steep decrease from 1990 to 2017. OSD have maximum amount of data for initial depths (Figure 5c and d)that decreases abruptly for deeper layers while depth distribution of data for CTD is highly irregular (Figure 7c and d).

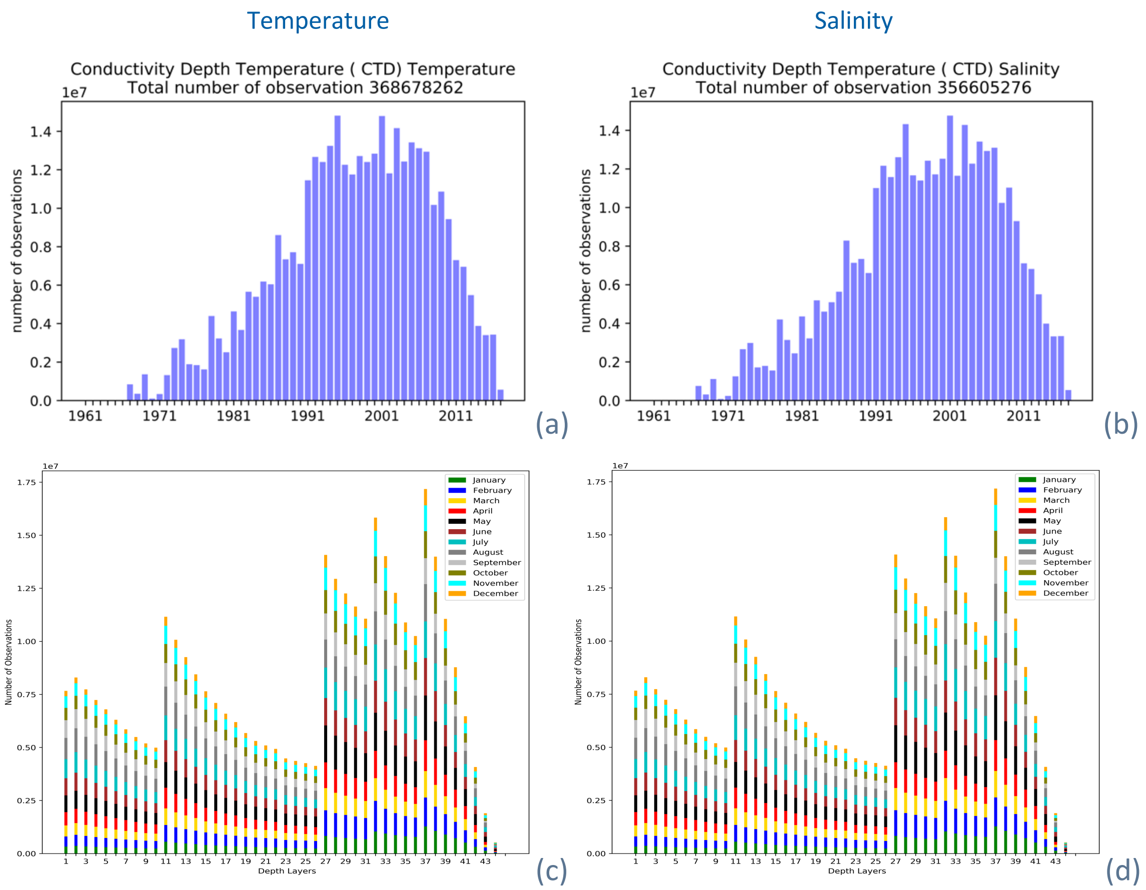


Figure 7 Total observations year wise (a &b) and depth and month wise (c &d) for temperature (left panels) and salinity (right panels).

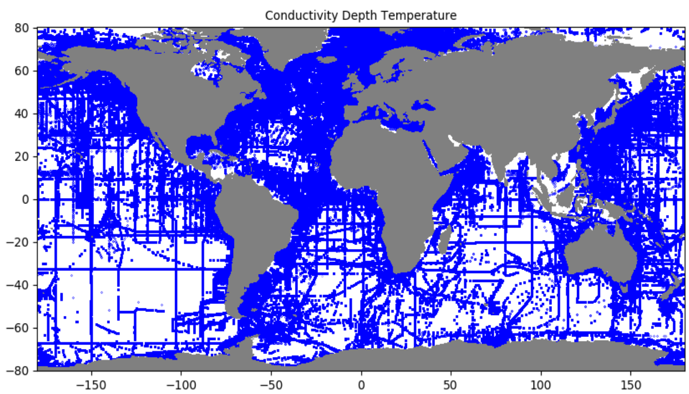


Figure 8 Spatial distribution of CTD observations

2. Methodology

2.1. Data Quality Control

Quality control (QC) is an essential step to exclude anomalous data before doing the analysis. In this product, the WOD quality flags (QF) have been considered. There are three types of QFs in the WOD:

1-Orginator Flag (Oflag)

2-World Ocean database observed value flag (WODf)

3-World Ocean database profile flag (WODpf)

In this analysis, only the observations with WODf flags value **"0" (Accepted)** and WODpf flag value **"0" (Accepted)** have been used.

2.2. DIVA implementation and settings

Data Interpolating Variational analysis (DIVA) is a tool to estimate continuous field from in-situ (observational) data. It is based on Variational inverse method that works with minimization of the cost function allowing the choice of analyzed field fitting at best the data set [3]. The computation of this climatology is done by DIVAnd 2.3.1. DIVAnd is available as a package in the programming language Julia (https://github.com/gher-ulg/DIVAnd.jl) and is used in conjunction with the jupyter notebook (https://jupyter.org/).

To compute an analysis, **diva3d** requires the input of arrays consisting of (longitude, latitude, observations, depth, time). The domain for the analysis is global (**0 to 360** longitude and **-80 to 80** latitude) for 37 (surface to 2000m) and 44 (surface to 6000 m) non-uniform depth layers respectively for SDC_GLO_CLIM_V2 and SDC_GLO_CLIM_V1. We consider "layers", thus all profile data fitting in the specified layer thickness are used to calculate a climatology nominally located at the center of the layer without any interpolation. The layers are listed in Table 3. The temporal resolution is monthly, and the spatial resolution is 0.25°.

Layers	Depth (m)	Layers	Depth (m)	Layers	Depth (m)	Layers	Depth (m)
1	0-10	12	125-150	23	400-425	34	1400-1600
2	10-20	13	150-175	24	425-450	35	1600-1800
3	20-30	14	175-200	25	450-475	36	1800-2000

4	30-40	15	200-225	26	475-500	**37**	**2000-2500**
5	40-50	16	225-250	27	500-600	38	2500-3000
6	50-60	17	250-275	28	600-700	39	3000-3500
7	60-70	18	275-300	29	700-800	40	3500-4000
8	70-80	19	300-325	30	800-900	41	4000-4500
9	80-90	20	325-350	31	900-1000	42	4500-5000
10	90-100	21	350-375	32	1000-1200	43	5000-5500
11	100-125	22	375-400	33	1200-1400	**44**	**5500-6000**

Table 3 Depth Layers for the first SeaDataCloud Global Climatology

2.3. DIVAnd Settings

Bathymetry: In this product, **Gebco 30 sec bathymetry** is used [4]. Land-sea mask used in the global climatology for different depth layers is given in Figure 9 below.

Correlation length: The correlation length "L" gives an indication of the distance over which a given data point influences its neighborhood. The **correlation length for these analyses is 200km in both zonal and meridional direction**. Instead of using vertical correlation length, a "layer" discretization has been used (Table 3), thus all profile data fitting in the specified layer thickness are used.

Error variance Epsilon2: "Epsilon2" is the error variance of the observations (normalized by the error variance of the background field). It can be a scalar, vector or a matrix depending upon the error covariance of the observation and correlation of the error and in case of a scalar it is the *inverse of the signal-to-noise ratio* [4]. **Error variance (Epsilon2) for these analyses is 0.9**.

Background Field: The background field is the first guess to the analysis. The default background field of diva3d is used in this analysis. **In case of default background field, diva3D computes the spatial mean of the observations for each layer**. The resulting profiles are shown in Figure 10 and Figure 11 and are used for this analysis. The difference at depth between the vertical profiles could be due to the different number of profiles between months. We note in fact that PFL floats are not present below 2000 m.

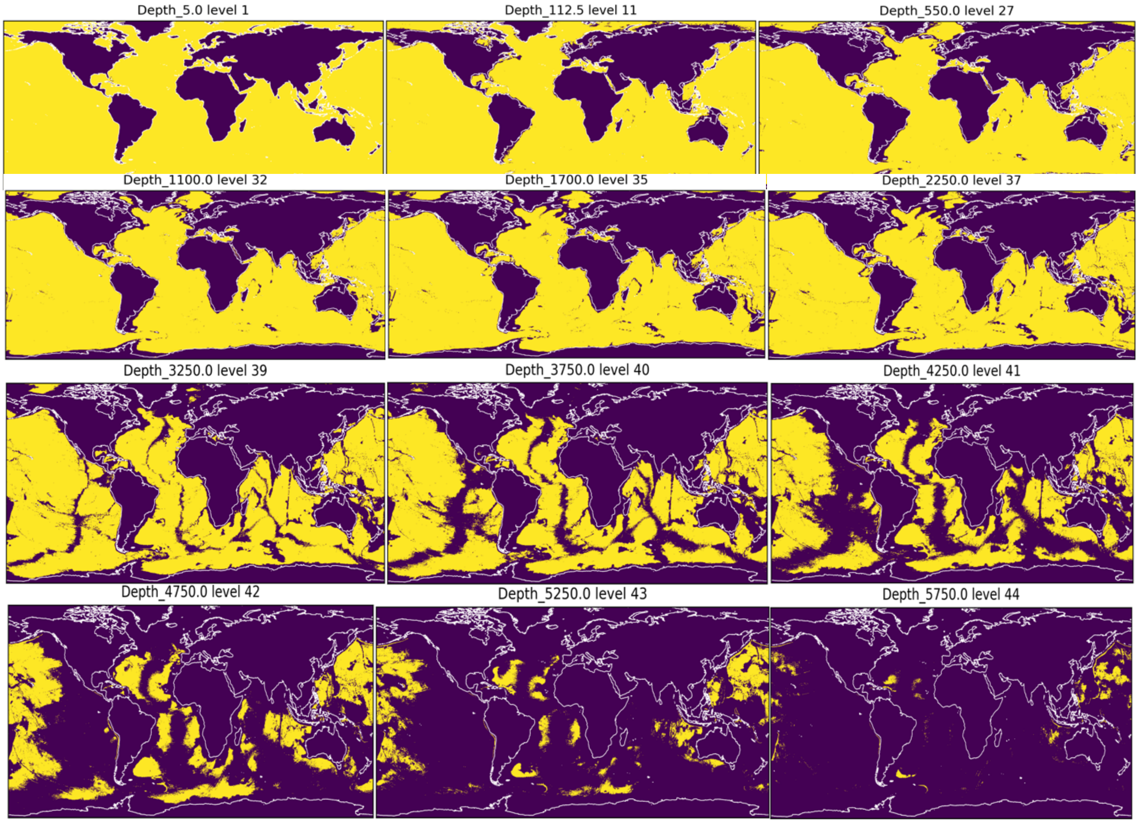


Figure 9 Land Sea mask at different depth of climatology

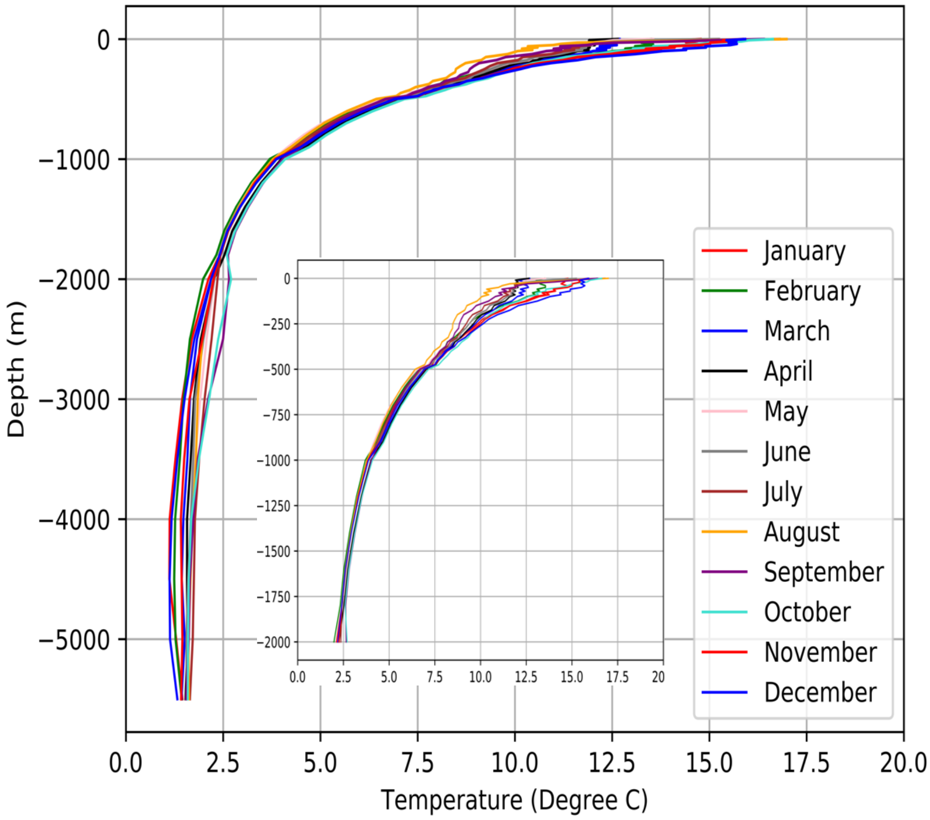


Figure 10 Vertical Profile of the temperature background field

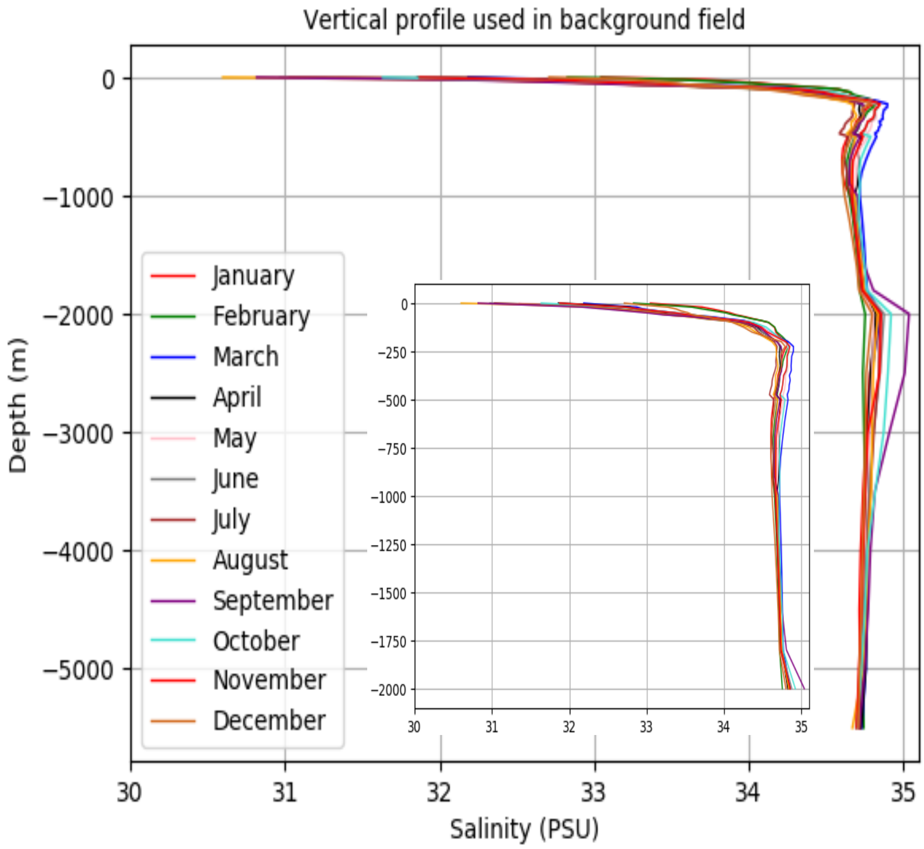


Figure 11 Vertical profile of the salinity background field.

3. Climatology

Temperature and Salinity climatology for both fields (V1_1 and V1_2) were computed by DIVAnd using the parameters given in section 3.1. Moreover, the fields are masked by error field i.e. error values greater than 30% (relative to field standard deviation).

In next section, temperature and salinity field for January and August at surface, 950 m and 3750 m are shown with concluding remarks.

3.1. Temperature

Temperature climatology for (V1_1) computed by DIVAnd and masked by 30% error field for January and August for surface, 950 m and 3750m is shown in Figure 12 and Figure 13. Temperature climatology for (V1_2) for January and August for surface and 950 m is displayed in Figure 14 and Figure 15. In January, there is less data in Artic region that results to a blank gridded field and similar is the case for August in Antarctic region and at depth 3750.

Both V1_1 and V1_2 climatology shows consistent features in spite of using different datasets. In January, temperature is high for equatorial regions and decreases toward poles. At 950 m, Mediterranean, Black sea, north left part of Indian ocean and part of north Atlantic are the warmest.

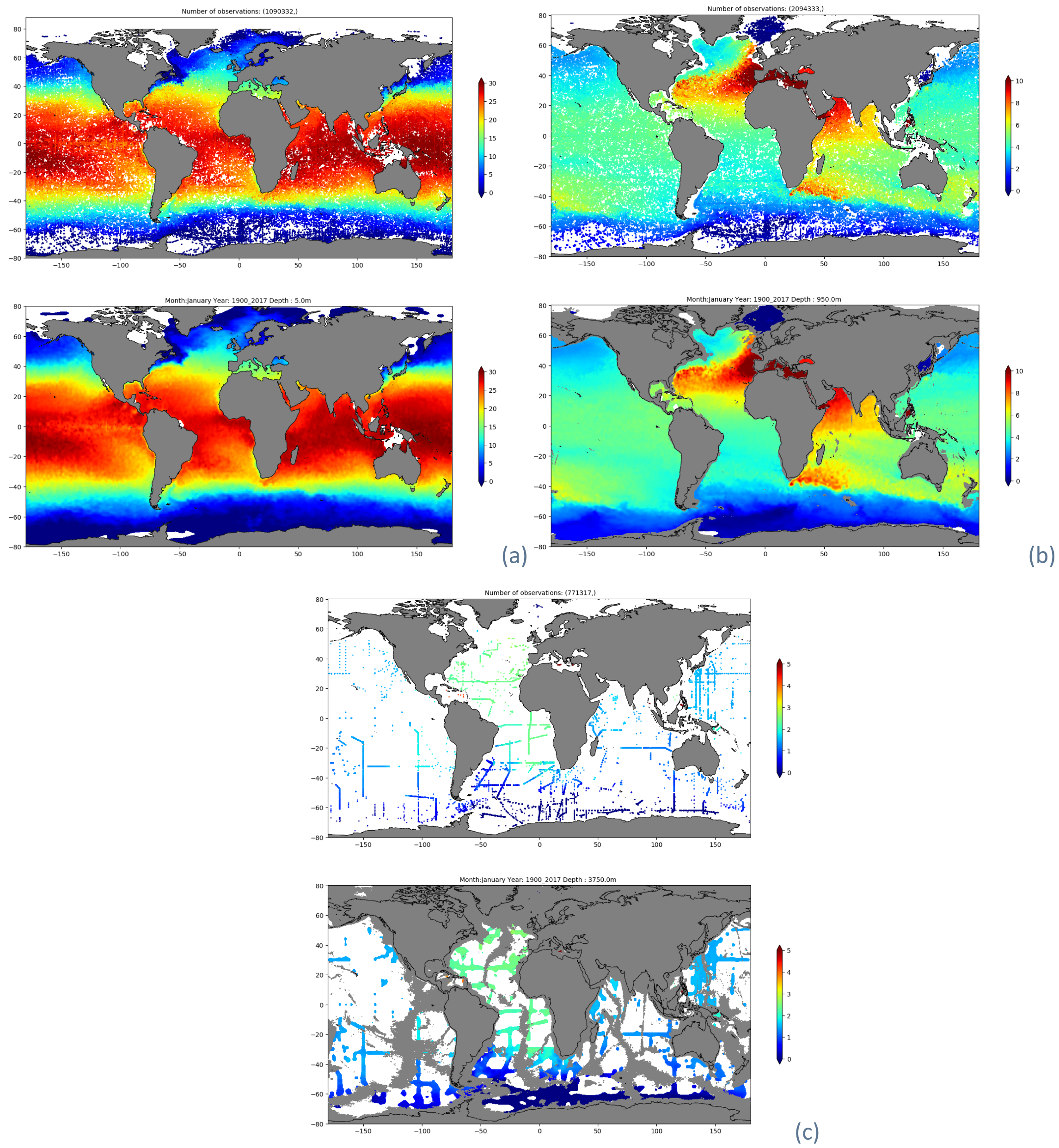


Figure 12 SDC_GLO_CLIM_V1_1 January temperature field in Degree C: a) surface; b) at 950 m; c) at 3750 m.

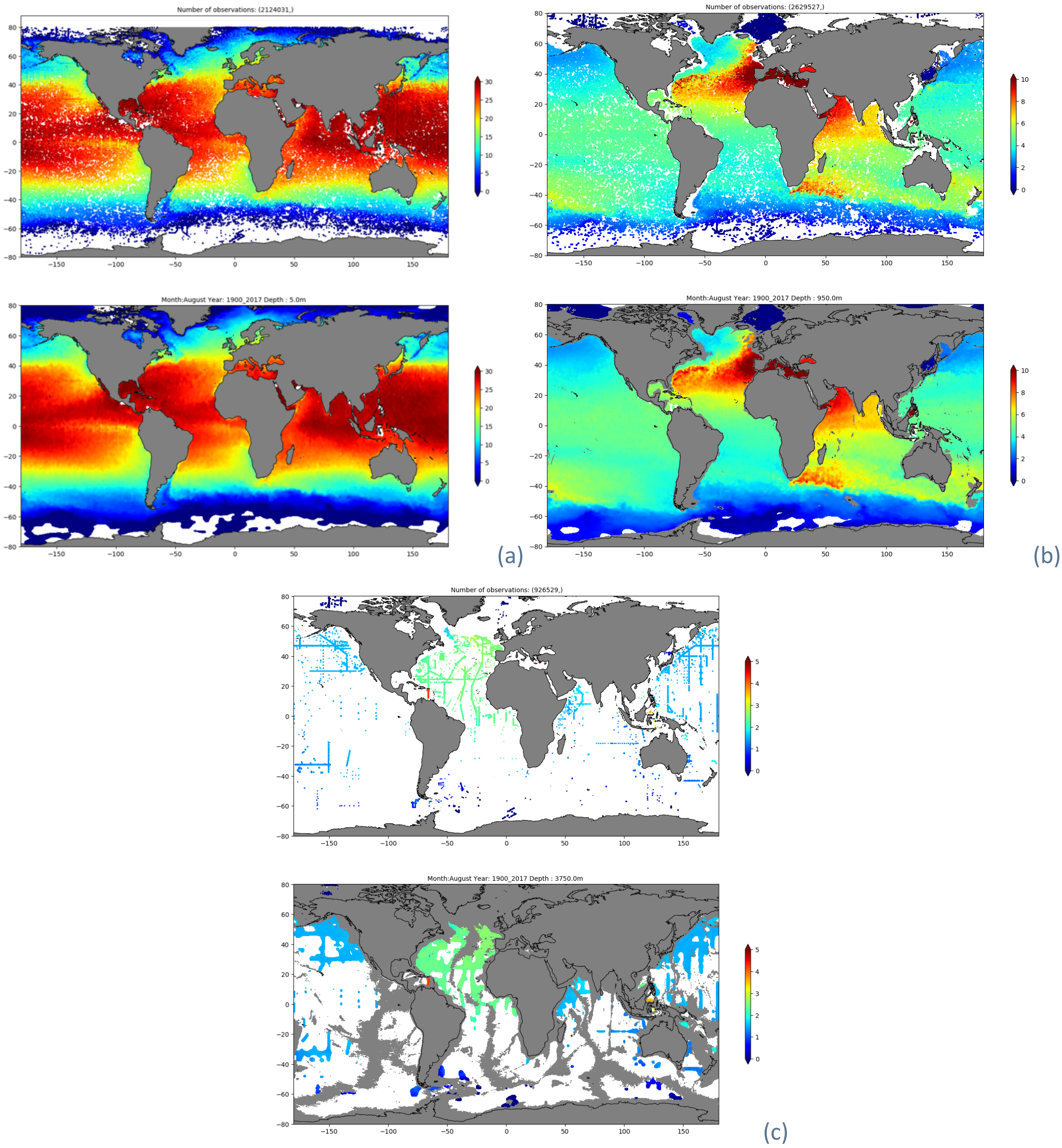


Figure 13 SDC_GLO_CLIM_V1_1 August temperature field in Degree C: a) surface; b) at 950 m; c) at 3750 m.

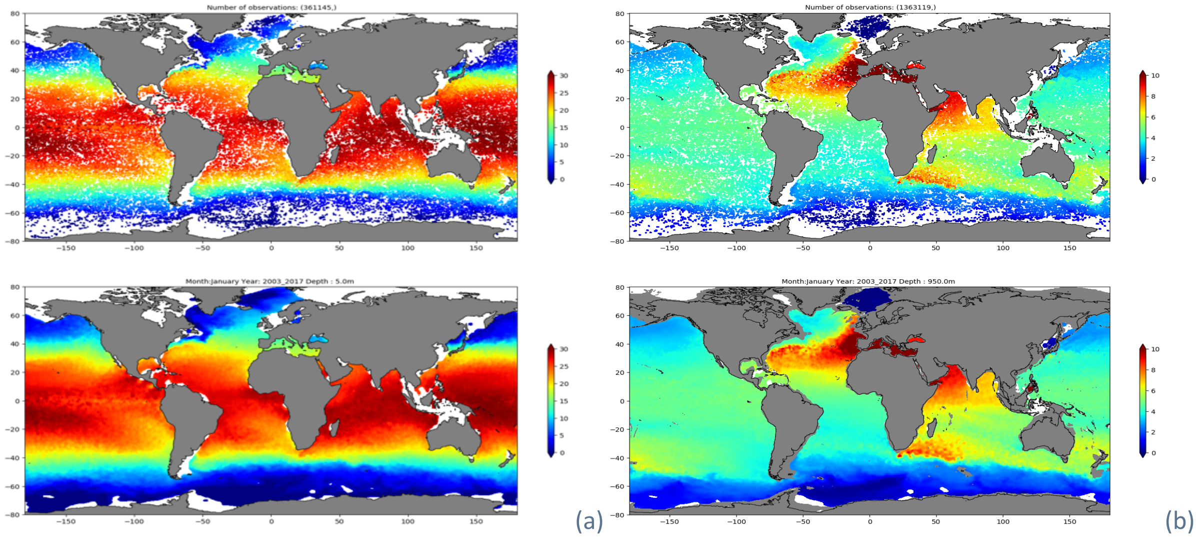


Figure 14 SDC_GLO_CLIM_V1_2 January Temperature field in Degree C: a) at surface; b) at 950 m.

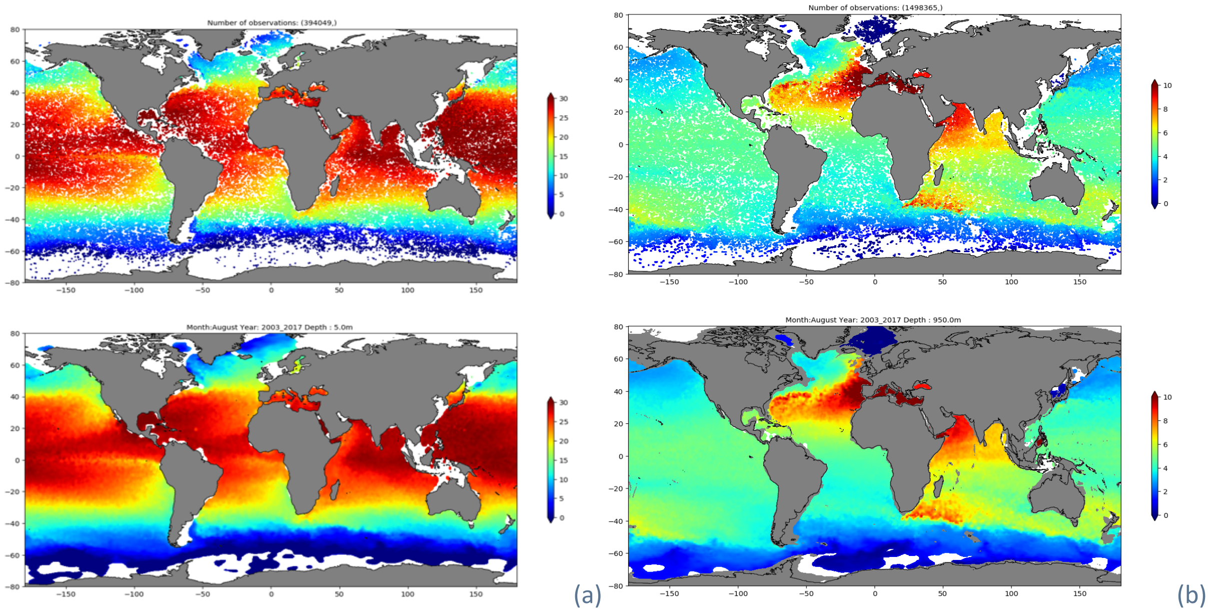


Figure 15 SDC_GLO_CLIM_V1_2 August Temperature field in Degree C: a) at surface; b) at 950 m.

3.2. Salinity

Salinity climatology (V1_1) computed by DIVAnd and masked by 30% error field for January and August for surface, 950 m and 3750m is shown in Figure 16 (January) and Figure 17 (August). Salinity climatology (V1_2) is displayed in Figure 18 (January) and Figure 19 (August). The anomalous features, more prominent for the surface layer, are due to bad quality of data even using the available quality flags of WOD.

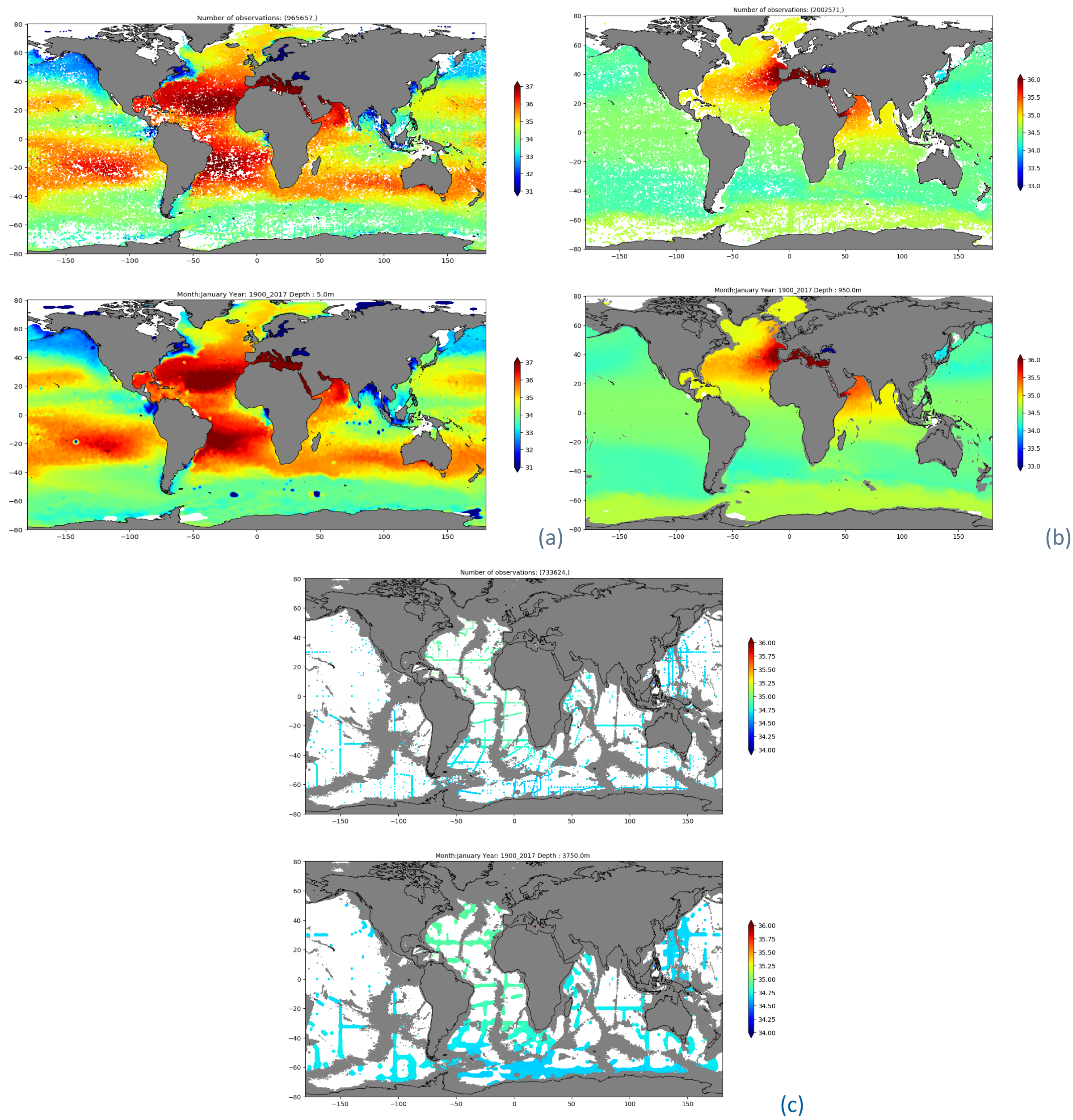


Figure 16 SDC_GLO_CLIM_V1_1 January Salinity Climatology in PSU: a) at surface; b) at 950 m, and c) at 3750.

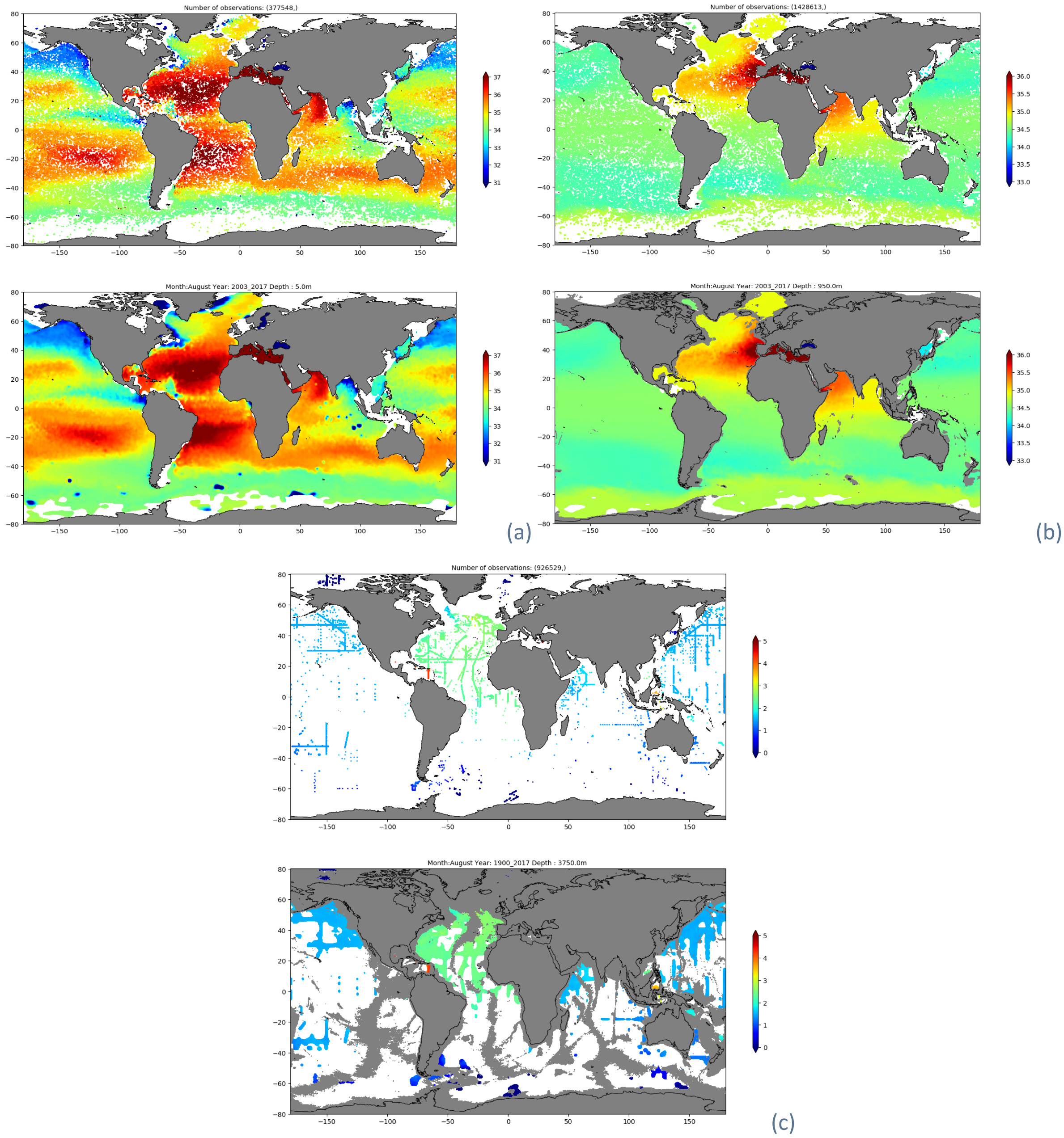


Figure 17 SDC_GLO_CLIM_V1_1 August Salinity Climatology in PSU: a) at surface; b) at 950 m, and c) at 3750.

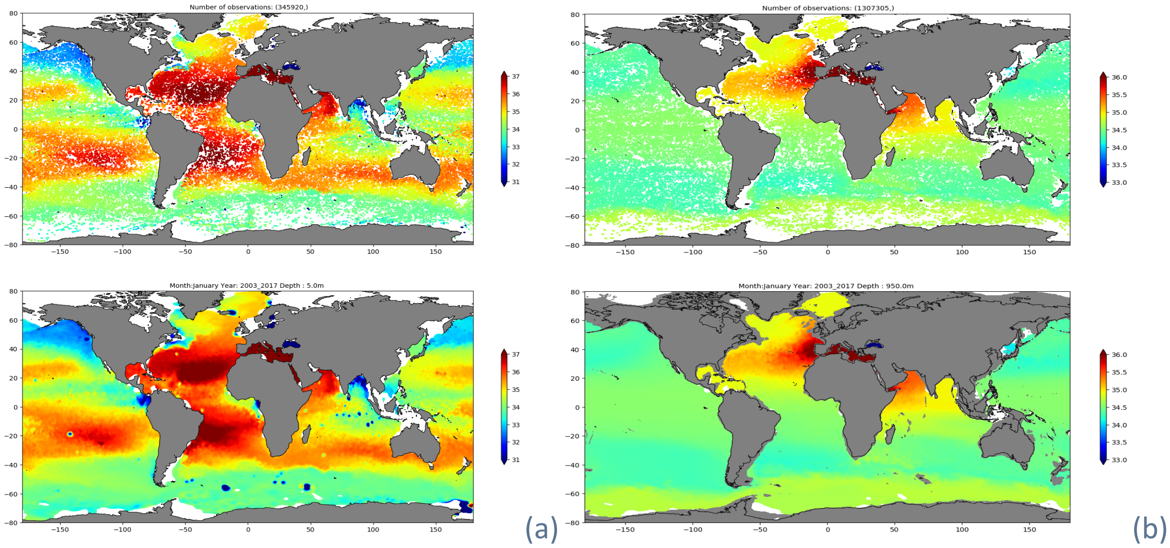


Figure 18 SDC_GLO_CLIM_V1_2 January Salinity field in PSU: a) at the surface; b) at 950m.

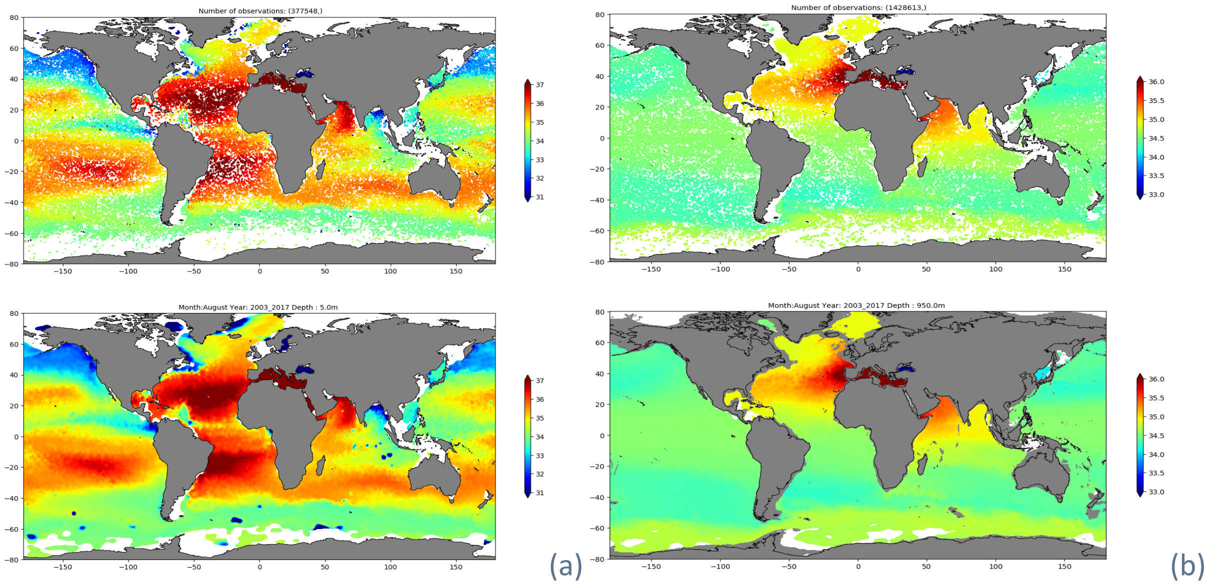


Figure 19 SDC_GLO_CLIM_V1_2 August Salinity field in PSU: a) at the surface; b) at 950m.

4. Consistency analysis

The validation of the analysis is an essential step in order to have an indication of the reliability of the results. In this regard, gridded climatology for temperature and salinity computed with DIVA is compared with World Ocean Atlas (**WOA-18**) for 57 depth level for each month (Table 4).

Table 4 **Depth layers used in WOA.**

Level	Depth(m)	Level	Depth (m)	Level	Depth (m)	Level	Depth (m)
1	0	16	75	31	350	46	950
2	5	17	80	32	375	47	1000
3	10	18	85	33	400	48	1050
4	15	19	90	34	425	49	1100
5	20	20	95	35	450	50	1150
6	25	21	100	36	475	51	1200
7	30	22	125	37	500	52	1250
8	35	23	150	38	550	53	1300
9	40	24	175	39	600	54	1350
10	45	25	200	40	650	55	1400
11	50	26	225	41	700	56	1450
12	55	27	250	42	750	57	1500
13	60	28	275	43	800		
14	65	29	300	44	850		
15	70	30	325	45	900		

The data from WOA for comparison is an average of objectively analyzed climatologies at 0.25° for six decades i.e. 1955-1964, 1965-1974, 1975-1984, 1985-1994, 1995-2004 and 2005-2012 [6]. The grid of WOA is (-89.785 to 89.785) for latitude and (-179.875 to 179.875) for longitude. To compute the difference between the climatologies, WOA fields were interpolated on the DIVA analysis grid using linear interpolation (phyton library).

The differences between the interpolated WOA and SDC_GLO_CLIM_TS_V1, for both salinity and temperature are shown in Fig. (16-19).

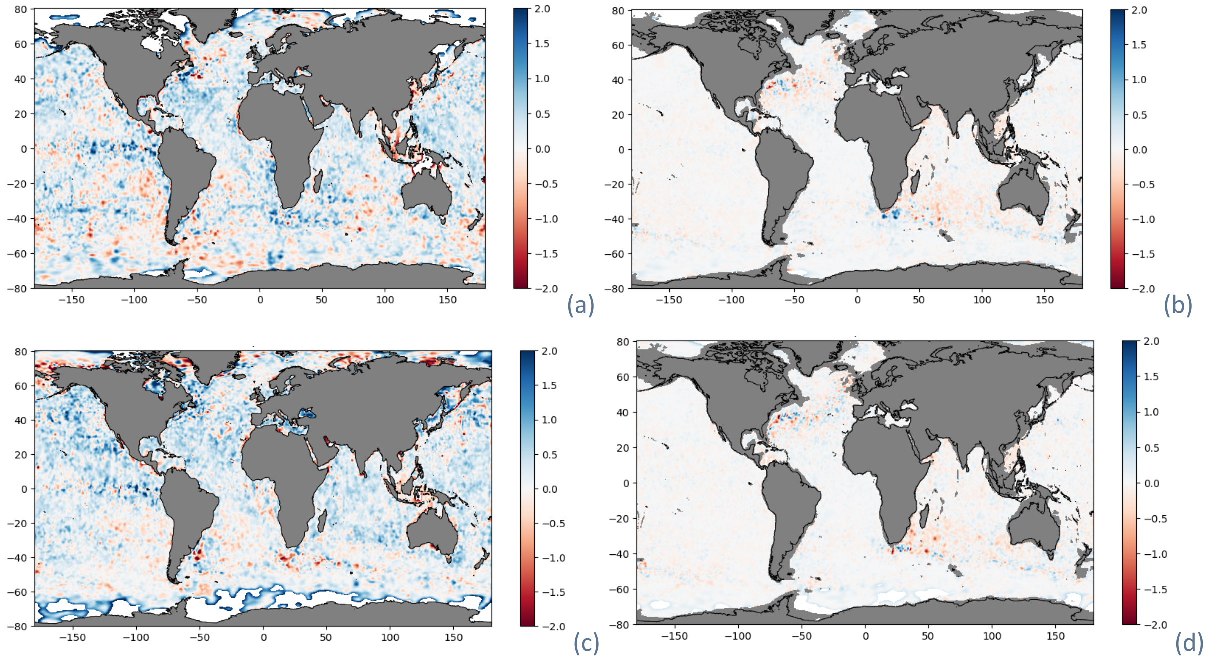


Figure 20 Difference field (WOA-SDC_GLO_CLIM_V1_1) for Temperature: a) January at the surface; b) January at 950m; c) August at the surface, and d) August at 950m.

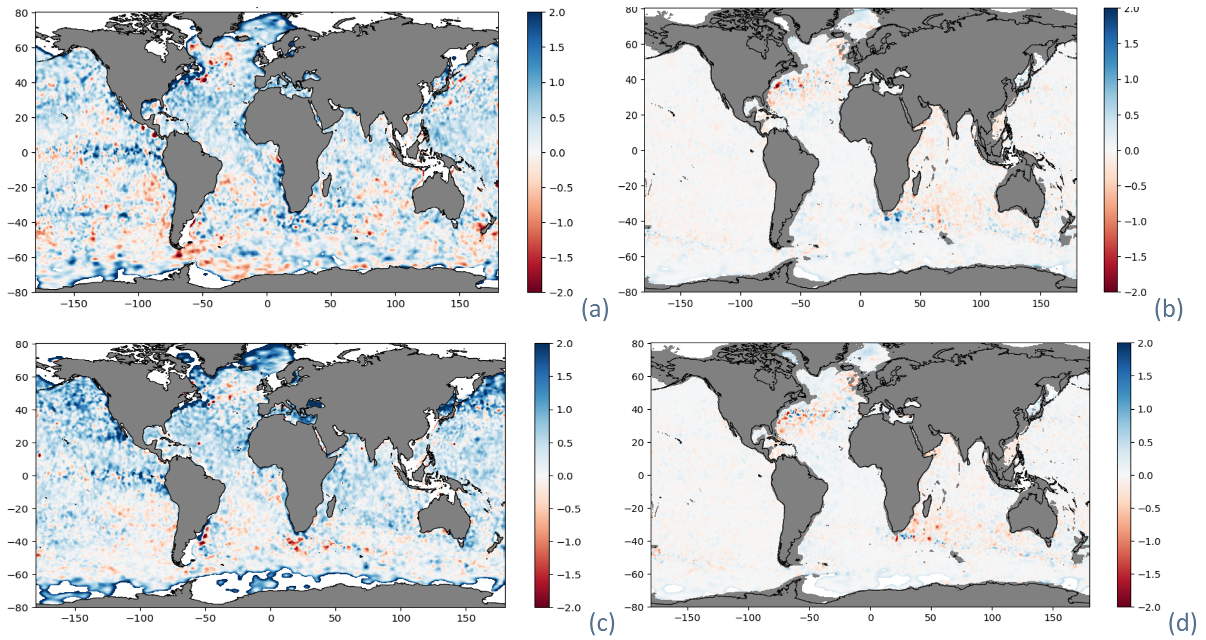


Figure 21 Difference field (WOA-SDC_GLO_CLIM_V1_2) for Temperature: a) January at the surface; b) January at 950m; c) August at the surface, and d) August at 950m.

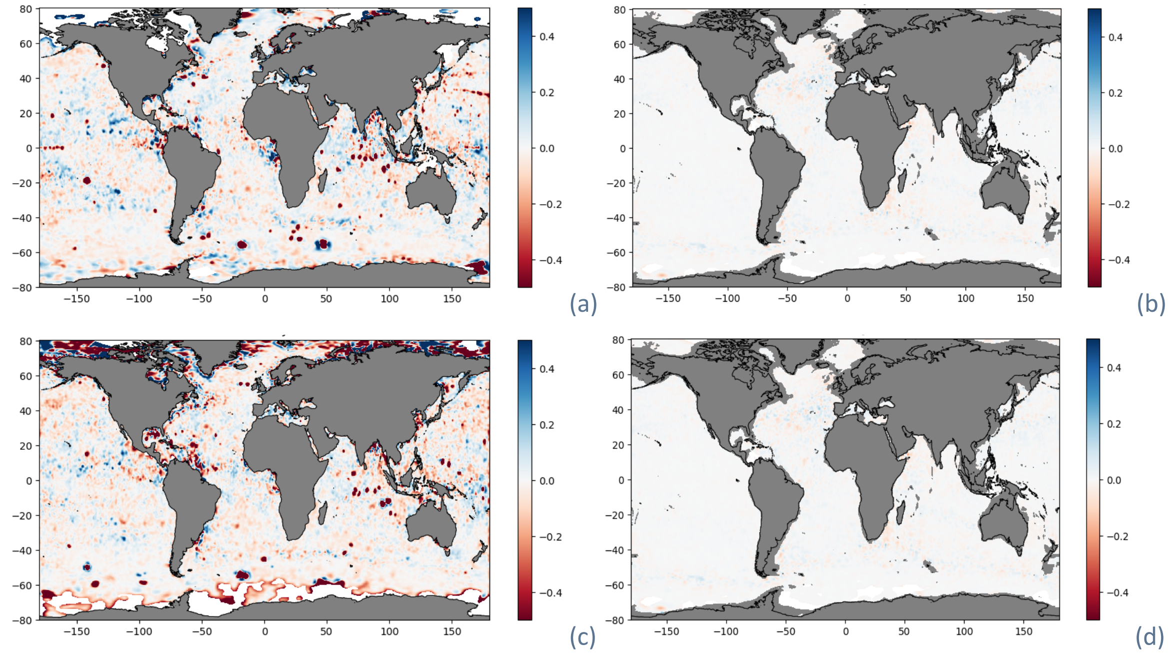


Figure 22 Difference field (WOA-SDC_GLO_CLIM_V1_1) for Salinity: a) January at the surface; b) January at 950m; c) August at the surface, and d) August at 950m.

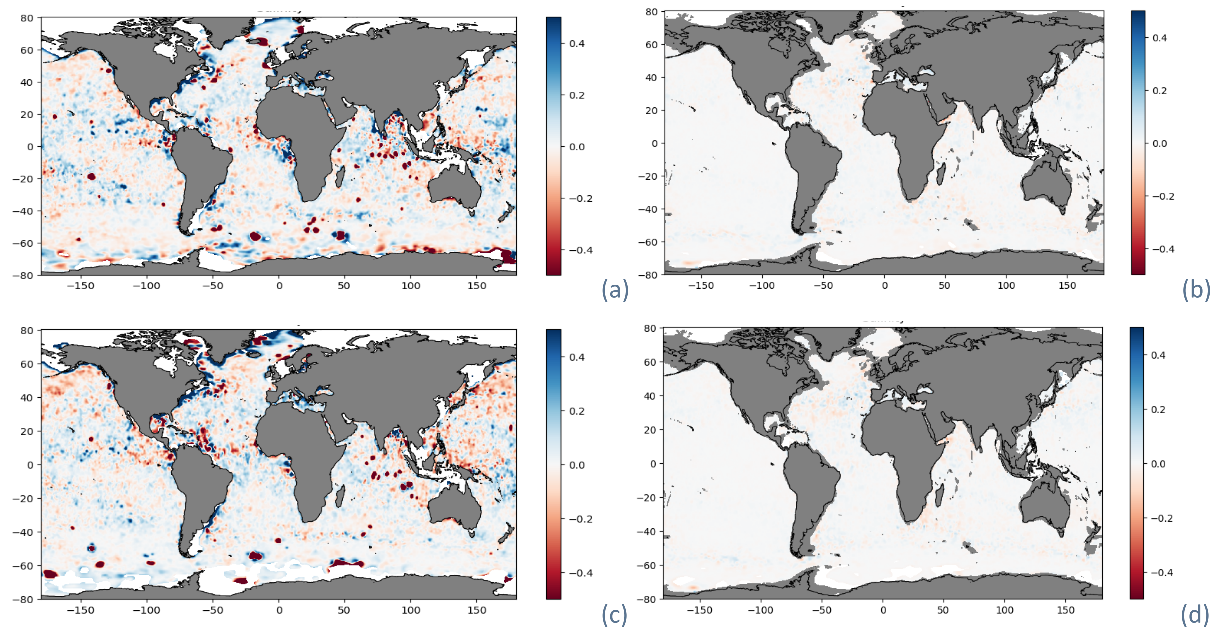


Figure 23 Difference field (WOA-SDC_GLO_CLIM_V1_2) for Salinity: a) January at the surface; b) January at 950m; c) August at the surface, and d) August at 950m.

Overall both SDC_GLO_CLIM V1_1 and SDC_GLO_CLIM V1_2 climatologic fields are consistent with WOA estimates. In order to have a better estimate quality index, Root Mean Square Difference (RMSD), Bias and Percentage root Mean Square Difference (PRMSD) are computed and is explained in next section.

4.1. Quality indices

The quality indices calculated are Root Mean Square Difference (RMSD), Bias and Percentage Root Mean Square Difference (PRMSD) and corresponding formulas used are as follow:

$$RMSD = \sqrt{\frac{1}{N}\sum(x-y)^2}, \qquad (1)$$

where

$$x = WOA\ climatology,$$

$$y = SDC\ climatology.$$

$$Bias = \frac{1}{N}\sum(x-y), \qquad (2)$$

and

$$PRMSD = \frac{RMSD}{REF}, \qquad (3)$$

$$REF = \sqrt{\frac{1}{N}\sum(x-\bar{x})^2}\ . \qquad (4)$$

where *REF* is the standard deviation of the WOA monthly climatology and N are the number of points of the SDC analysis grid.

$$\bar{x} = \frac{1}{N}\sum x$$

RMSD, Bias and PRMSD are calculated from Eq. (1), (2) and (3) for surface, 950m and 1500m for all months and is summarized for both temperature and salinity fields in Table 5 for V1_1 and in Table 6 for V1_2.

4.1.1. Indices for SDC_GLO_CLIM_T_V1_1

The RMSD for SDC_GLO_CLIM_T_V1_1 varies from 0.43 to 0.51°C for the surface layer, 0.13 to 0.14°C for the 950m layer and 0.05 to 0.07°C for the 1500m layer. Similarly, the Bias for surface layer ranges from -0.14 to -0.21°C, -0.01 to 0.003°C for the 950 m layer and -0.01°C for the layer at 1500m. The PRMSD at the surface is about 5-6%, at 950m is 8-9% and at 1500m is 6-7%.

4.1.2. Indices for SDC_GLO_CLIM_S_V1_1

The RMSD for SDC_GLO_CLIM_S_V1_1 varies from 0.38 to 0.67 PSU for the surface layer, varies from 0.0012 to 0.01 PSU at 950m layer and 0.008 to 0.009 PSU for 1500 layer. Similarly, the Bias for surface layer ranges from -0.27 to -0.4 PSU, -0.02 PSU at 950 m layer and -0.01 PSU at 1500m. The PRMSD value for surface is 22% to 34%, at 950m is 3% to 4% and at 1500m is 3%. The reason for greater value of PRMSD is anomalous values in data that results as sharp gradients in the gridded field (Figure 16 and Figure 17).

Table 5 Quality indices for SDC_GLO_CLIM_TS_V1_1 temperature and salinity climatology

SDC_GLO_CLIM_TS_V1_1	RMSD	BIAS	PRMSD
Temperature [°C]			
surface	from 0.43 to 0.51	from -0.14 to -0.21	5-6%
950m	from 0.13 to 0.14	from -0.01 to 0.003	8-9%
1500m	from 0.05 to 0.07	-0.01	6-7%
Salinity [PSU]			
surface	from 0.38 to 0.67	from -0.27 to -0.4	22-34%
950m	from 0.0012 to 0.01	-0.02	3-4%
1500m	from 0.008 to 0.009	-0.01	3%

4.1.1. Indices for SDC_GLO_CLIM_T_V1_2

The RMSD for SDC_GLO_CLIM_T_V1_2 varies from 0.6 to 0.7°C for the surface layer, 0.10 to 0.12°C for 950m layer and 0.06 to 0.07°C for 1500m layer. Similarly, the Bias for surface layer ranges from -0.27 to -0.4°C, -0.02°C at 950 m layer and -0.01°C at 1500m layer. The PRMSD value at the surface is about 7-8%, at 950m is 8-9% and at 1500m is 6- 8%.

4.1.2. Indices for SDC_GLO_CLIM_S_V1_2

The RMSD for SDC_GLO_CLIM_T_V1_2 varies from 0.39 to 0.82 PSU for surface layer, varies from 0.013 to 0.01 PSU for layers at 950m and 0.008 to 0.009 PSU for 1500m layer. Similarly, Bias for surface layer ranges from 0.01 to 0.06, -2e-4 to 1.75 PSU for layer at 950 m and at is 2e-4 to 5e-4 PSU for 1500m layer. The PRMSD value for surface is 18% to 67%, at 950m is 3% to 9% and for layer at 1500m is 3% to 6%. The reason for greater value of PRMSD is anomalous values in data that results as sharp gradients in the gridded field (Figure 18 and Figure 19).

Table 6 Quality indices for SDC_GLO_CLIM_TS_V1_1 temperature and salinity climatology

SDC_GLO_CLIM_TS_V1_2	RMSD	BIAS	PRMSD
Temperature [°C]			
surface	from 0.6 to 0.7	from -0.27 to -0.40	7-8%
950m	from 0.10 to 0.12	-0.02	8-9%
1500m	from 0.06 to 0.07	-0.01	6-8%
Salinity [PSU]			
surface	from 0.39 to 0.82	from 0.01 to -0.06	18-67%
950m	from 0.013 to 0.01	from -0.0004 to 1.75	3-9%
1500m	from 0.008 to 0.009	from 0.0002 to 0.0005	3-6%

5. Technical Specifications

5.1. Product Format

The product is delivered in 48 files in NetCDF format. Each .nc file contains 3d array (longitude, latitude, depth) and month is fixed for each file. Parameters of the file are named as follow:

- *Parameter_Name*: 3d array (longitude, latitude, depth)
- *Parameter_Name_L1*: parameter masked using error threshold 0.3,
- *Parameter_Name_L2*: parameter masked using error threshold 0.5,
- *Parameter_Name_relerr*: relative error of parameter.

The names of NetCDF files are:

SDC_GLO_CLIM_T_V1_1_1900_2017_025_January.nc

SDC_GLO_CLIM_T_V1_1_1900_2017_025_February.nc

SDC_GLO_CLIM_T_V1_1_1900_2017_025_March.nc

SDC_GLO_CLIM_T_V1_1_1900_2017_025_April.nc

SDC_GLO_CLIM_T_V1_1_1900_2017_025_May.nc

SDC_GLO_CLIM_T_V1_1_1900_2017_025_June.nc

SDC_GLO_CLIM_T_V1_1_1900_2017_025_July.nc

SDC_GLO_CLIM_T_V1_1_1900_2017_025_August.nc

SDC_GLO_CLIM_T_V1_1_1900_2017_025_September.nc

SDC_GLO_CLIM_T_V1_1_1900_2017_025_October.nc

SDC_GLO_CLIM_T_V1_1_1900_2017_025_November.nc

SDC_GLO_CLIM_T_V1_1_1900_2017_025_December.nc

SDC_GLO_CLIM_S_V1_1_1900_2017_025_January.nc

SDC_GLO_CLIM_S_V1_1_1900_2017_025_February.nc

SDC_GLO_CLIM_S_V1_1_1900_2017_025_March.nc

SDC_GLO_CLIM_S_V1_1_1900_2017_025_April.nc

SDC_GLO_CLIM_S_V1_1_1900_2017_025_May.nc

SDC_GLO_CLIM_S_V1_1_1900_2017_025_June.nc

SDC_GLO_CLIM_S_V1_1_1900_2017_025_July.nc

SDC_GLO_CLIM_S_V1_1_1900_2017_025_August.nc

SDC_GLO_CLIM_S_V1_1_1900_2017_025_September.nc

SDC_GLO_CLIM_S_V1_1_1900_2017_025_October.nc

SDC_GLO_CLIM_S_V1_1_1900_2017_025_November.nc

SDC_GLO_CLIM_S_V1_1_1900_2017_025_December.nc

SDC_GLO_CLIM_T_V1_2_2013_2017_025_January.nc

SDC_GLO_CLIM_T_V1_2_2013_2017_025_February.nc

SDC_GLO_CLIM_T_V1_2_2013_2017_025_March.nc

SDC_GLO_CLIM_T_V1_2_2013_2017_025_April.nc

SDC_GLO_CLIM_T_V1_2_2013_2017_025_May.nc

SDC_GLO_CLIM_T_V1_2_2013_2017_025_June.nc

SDC_GLO_CLIM_T_V1_2_2013_2017_025_July.nc

SDC_GLO_CLIM_T_V1_2_2013_2017_025_August.nc

SDC_GLO_CLIM_T_V1_2_2013_2017_025_September.nc

SDC_GLO_CLIM_T_V1_2_2013_2017_025_October.nc

SDC_GLO_CLIM_T_V1_2_2013_2017_025_November.nc

SDC_GLO_CLIM_T_V1_2_2013_2017_025_December.nc

SDC_GLO_CLIM_S_V1_2_1900_2013_025_January.nc

SDC_GLO_CLIM_S_V1_2_1900_2013_025_February.nc

SDC_GLO_CLIM_S_V1_2_1900_2013_025_March.nc

SDC_GLO_CLIM_S_V1_2_1900_2013_025_April.nc

SDC_GLO_CLIM_S_V1_2_1900_2013_025_May.nc

SDC_GLO_CLIM_S_V1_2_1900_2013_025_June.nc

SDC_GLO_CLIM_S_V1_2_1900_2013_025_July.nc

SDC_GLO_CLIM_S_V1_2_1900_2013_025_August.nc

SDC_GLO_CLIM_S_V1_2_1900_2013_025_September.nc

SDC_GLO_CLIM_S_V1_2_1900_2013_025_October.nc

SDC_GLO_CLIM_S_V1_2_1900_2013_025_November.nc

SDC_GLO_CLIM_S_V1_2_1900_2013_025_December.nc

5.2. Product Usability

Climatologies are the basis for quality control of ocean forecasts and modelling studies. In general, they can be used also for detection of extremes as anomalies from the given climatology. Normally, climatologies are used to initialize numerical ocean models.

The are some outstanding problems with the present version of the climatology:

1) The global climatology is affected by the low quality of the historical data that requires more advanced automatic quality control procedures to eliminate spurious values. Such advanced procedures are under development;
2) Using a layer representation of the vertical ocean structure might be too coarse for specific users;
3) The present background fields are too simple and there is a need for further refinement of the global background for T and S.

Notwithstanding all these problems, the SDC global climatology is consistent with the WOA gridded fields.

For the above reasons, it is advisable to consult the producer before using this climatology for any application.

References

1- Boyer, T.P., J. I. Antonov, O. K. Baranova, C. Coleman, H. E. Garcia, A. Grodsky, D. R. Johnson, R. A. Locarnini, A. V. Mishonov, T.D. O'Brien, C.R. Paver, J.R. Reagan, D. Seidov, I. V. Smolyar, and M. M. Zweng, 2013: World Ocean Database 2013, ***NOAA Atlas NESDIS 72,*** S. Levitus, Ed., A. Mishonov, Technical Ed.; Silver Spring, MD, 209 pp.

2- Data Interpolating Variational Analysis, User Guide, C. Troupin, S. Watelet, M. Ouberdous, D. Sirjacobs, A. Alvera-Azcárate, A. Barth, M.-E. Toussaint & J.-M. Beckers, 2018.

3- DIVAnd.jldocumentation,https://gher-ulg.github.io/DIVAnd.jl/latest/#DIVAnd.jl-documentation-1

4- The GEBCO Digital Atlas published by the British Oceanographic Data Centre on behalf of IOC and IHO, 2003, https://www.bodc.ac.uk/data/published_data_library/catalogue/10.5285/836f016a-33be-6ddc-e053-6c86abc0788e/

5- Locarnini, R. A., A. V. Mishonov, J. I. Antonov, T. P. Boyer, H. E. Garcia, O. K. Baranova, M. M. Zweng, C. R. Paver, J. R. Reagan, D. R. Johnson, M. Hamilton, and D. Seidov, 2013. *World Ocean Atlas 2013, Volume 1: Temperature.* S. Levitus, Ed., A. Mishonov Technical Ed.; NOAA Atlas NESDIS 73, 40 pp.

6- Zweng, M.M, J.R. Reagan, J.I. Antonov, R.A. Locarnini, A.V. Mishonov, T.P. Boyer, H.E. Garcia, O.K. Baranova, D.R. Johnson, D.Seidov, M.M. Biddle, 2013. *World Ocean Atlas 2013, Volume 2: Salinity.* S. Levitus, Ed., A. Mishonov Technical Ed.; NOAA Atlas NESDIS 74, 39 pp.

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