WORLD OCEAN DATABASE 2018

USER'S MANUAL

pre-release

Ocean Climate Laboratory
National Centers for Environmental Information

Silver Spring, Maryland
February 12, 2019
Version 0.10

U.S. DEPARTMENT OF COMMERCE
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National Centers for Environmental Information
NOAA/NESDIS
SSMC III, 4th floor
1315 East-West Highway
Silver Spring, MD 20910-3282

Telephone: (301) 713-3277
Fax: (301) 713-3302
E-mail: NCEI.Services@noaa.gov
NODC URL: http://www.nodc.noaa.gov/

For updates on the data, documentation, and additional information about the WOD18 and other data products please refer to:

https://www.NCEI.noaa.gov/OC5/indprod.html

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User's Manual (prerelease)

Hernan E. Garcia, Tim P. Boyer, Ricardo A. Locarnini,
Olga K. Baranova, Melissa M. Zweng

Techical Editor Alexey V. Mishonov

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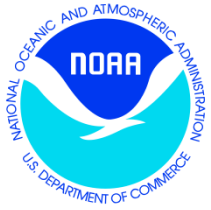

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National Environmental Satellite, Data and Information Service
Stephen Volz, Ph.D., Assistant Administrator

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WOD18 User's Manual
Version History

Description	Comments	Version # Date
WOD18 prerelease	Most tables and appendices link to World Ocean Database online web page	09/28/2018
WOD18 prerelease	Updated tables, netCDF format	02/12/2019

TABLE OF CONTENTS

ACKNOWLEDGMENTS

The National Centers for Environmental Information (NCEI) is supported by the National Oceanic and Atmospheric Administration (NOAA) Climate Program Office, to produce scientifically quality-controlled oceanographic profile databases, to compile objectively analyzed global fields of oceanographic variables (essential ocean variables, EOV), and to perform diagnostic studies of the world ocean based on these databases.

The Intergovernmental Oceanographic Commission (IOC) at the 17th IOC Assembly held in 1993 endorsed the Global Oceanographic Data Archaeology and Rescue (GODAR) project which has resulted in the rescue of vast amount of historical ocean data. These data are included in the *World Ocean Database 2018* (WOD18). The World Ocean Database is also a project of the International Oceanographic Data and Information Exchange (IODE) of IOC.

Thanks to the outstanding help from Carla Coleman and Alexandra Grodsky. We were able to improve on the quality of the data and metadata through their thoughtful examination of problems associated with doubtful or incomplete metadata from individual cruises, and their search on the Internet for missing information. In addition, they were part of the team rescuing data through manuscript digitization.

The World Ocean Database Team acknowledges the help received over the years from many of our NOAA colleagues. We also express our gratitude to all users of previous World Ocean Database series who have provided helpful comments and suggestions for improvement of this product. All errors that may remain in the *World Ocean Database 2018* are entirely ours.

World Ocean Database 2018 would not be possible without the tireless efforts of thousands of sea-going oceanographers, technicians, data analysts, and scientists who collected and submitted data to the National Oceanographic Data Centers and the World Data System (WDS) for Oceanography. Our most sincere gratitude extends to all of them. The IOC and the International Council of Science (ICSU) World Data Service for Oceanography have played major roles in facilitating the international exchange of oceanographic data. We acknowledge these institutions and their staff for this contribution.

I. INTRODUCTION

A. OVERVIEW

World Ocean Database 2018 (WOD18) **prerelease** is a scientifically quality-controlled database of selected historical *in-situ* surface and subsurface oceanographic measurements produced by the Center for Coasts, Oceans and Geophysics at NOAA's National Centers for Environmental Information (NCEI)[1], Silver Spring, Maryland, USA. The WOD18 prerelease was released on September 20, 1018 and updates and expands on the *World Ocean Database 2013* (WOD13) by adding additional data and data quality control (see Appendix 9 for the standard depths). WOD18 includes *in situ* measurements of temperature, salinity, dissolved oxygen, dissolved inorganic nutrients (phosphate, nitrate, nitrate+nitrite, nitrite, silicate), chlorophyll, alkalinity, pH, partial pressure of carbon dioxide (pCO_2), Dissolved Inorganic Carbon (DIC), Tritium, Δ^{13}Carbon, Δ^{14}Carbon, Δ^{18}Oxygen, Freons (CFC), Helium, Δ^{3}Helium, Neon, and plankton. We note that these are Global Ocean Observing System (GOOS) Essential Ocean Variables (EOV) for physics, biogeochemistry, and biology and ecosystems.

WOD18 provides quality-controlled data to calculate climatologies of temperature, salinity, dissolved oxygen (including apparent oxygen utilization and oxygen saturation), and dissolved inorganic nutrients (phosphate, silicate, and nitrate and nitrate+nitrite). These climatologies are used to produce the *World Ocean Atlas 2018* (WOA18). The variables for which climatologies were calculated have full quality control, except for the oxygen and chlorophyll data from the Conductivity-Temperature-Depth (CTD) probes and Undulating Oceanographic Recorder (UOR) probes. These data and data for other measured variables have a more limited set of quality control. More detailed information is provided in Section III, Quality Control Procedures.

In addition to quality control performed during calculation of WOA18 climatologies, quality control performed by the data submitters is included as originators' flags when available.In all cases, we have helped ensure visible data attribution in the data itself. Every cast contains (when supplied) information on the instrumentation, platform, project, institution, and provenance. We intend to include Digital Object Identifier (DOI) for each dataset received to document the different contributors and their role in the making of the given measurements.

The WOA18 climatologies are calculated on 102 standard depth levels. Since originators' data are sampled on various observed levels, the measurements in the profiles are interpolated to the appropriate standard levels. Both the original measurements (observed level data) and the interpolated measurements (standard level data) are available in WOD18 and each has its own set of quality control flags. No data are removed from WOD18 if they fail WOD quality control checks; however, that fail objective and subjective tests are marked with quality control flags.

The World Ocean Database data are provided compressed in several file formats. The data are stored in 11 datasets, each one representing a group of similar oceanographic probes: Ocean Station Data – OSD; High-resolution Conductivity-Temperature-Depth – CTD; Mechanical/ Digital/ Micro Bathythermograph – MBT; Expendable Bathythermograph – XBT; Surface – SUR; Autonomous Pinniped Bathythermograph – APB; Moored Buoy – MRB; Profiling Float – PFL; Drifting Buoy –

1 NCEI is part of NOAA's National Environmental Satellite, Data, and Information Service (NESDIS)

DRB; Undulating Oceanographic Recorder – UOR; and Glider – GLD. In the remainder of this document, the following terms OSD, CTD, MBT, XBT, SUR, APB, MRB, PFL, DRB, UOR, and GLD are used. More information can be found in the Datasets Section and the Glossary.

Over the past several years, a substantial number of datasets received at the NCEDI World Data Service for Oceanography (WDS; formerly World Data Center for Oceanography, Silver Spring, WDC) have been received as a result of projects such as the Intergovernmental Oceanographic Commission (IOC)/IODE Global Oceanographic Data Archaeology and Rescue project (GODAR) (Levitus *et al*., 1994, Levitus *et al*., 1998, Levitus *et al*., 2005), NODC Global Ocean Database project, IOC World Ocean Database project, Global Temperature-Salinity Profile Program (GTSPP), World Ocean Circulation Experiment (WOCE), Joint Global Ocean Flux Studies (JGOFS), Ocean Margin Experiment (OMEX), climate variability and predictability (CLIVAR), and many others. The numbers in Table 1 show the increase in data holding from 1982 to 2018. A more detailed description of data in the WOD18 can be found in Boyer *et al*. (2018).

As Table 1 shows, the data holdings in the database have increased substantially since 1974. The OCL has attempted to ensure that the conversion of data from originator to WOD format was accurate, that duplicates were removed, and that "unrepresentative" data were flagged during the quality control process using quality flags. This last task is an ongoing effort. Every effort was made to identify and correct errors in the database. As scientists and data managers utilize the WOD18, and additional errors are identified, they will be corrected. Some data flagged as "unrepresentative" may not deserve this designation and therefore could be reassessed.

We note that the former NOAA's national data centers (National Oceanographic Data Center, NODC; National Climatic Data Center, NCDC; and National Geophysical Data Centers, NGDC) were merged into the NOAA's National Centers for Environmental Information (NCEI). NCEI is part of NOAA's National Environmental Satellite, Data, and Information Service (NESDIS).

Table 1. Comparison of the number of oceanographic casts in WOD18 compared to previous WOD versions

Dataset	NCEI (1974)[1]	NCEI (1991)[2]	WOA94	WOD98	WOD01	WOD05	WOD09	WOD13	WOD18
OSD[3]	425,000	783,912	1,194,407	1,373,440	2,121,042	2,258,437	2,541,298	3,115,552	3,220,635
CTD[4]	na	66,450	89,000	189,555	311,943	443,953	641,845	848,911	1,029,231
MBT[5]	775,000	980,377	1,922,170	2,077,200	2,376,206	2,421,940	2,426,749	2,425,607	2,430,807
XBT	290,000	704,424	1,281,942	1,537,203	1,743,590	1,930,413	2,104,490	2,211,689	2,303,354
MRB	na	na	na	107,715	297,936	445,371	566,544	1,411,762	1,585,135
DRB	na	na	na	na	50,549	108,564	121,828	251,712	227,871
PFL	na	na	na	na	22,637	168,988	547,985	1,020,216	1,867,873
UOR	na	na	na	na	37,645	46,699	88,190	88,190	127,544
APB	na	na	na	na	75,665	75,665	88,583	1,713,132	1,804,605
GLD	na	na	na	na	na	338	5,857	103,798	1,148,669
Total casts	**1,490,000**	**2,535,163**	**4,487,519**	**5,285,113**	**7,037,213**	**7,900,368**	**9,155,099**	**13,190,569**	**15,861,868**
Plankton	na	na	na	83,650	142,900	150,250	218,695	242,727	245,059
SUR[6]	na		na	na	4,743	9,178	9,178	9,289	9,289

[1] Based on statistics from *Climatological Atlas of the World Ocean* (1982).
[2] Based on NCEI Temperature Profile CD-ROM.
[3] WOD18 OSD dataset includes data from 178,442 low-resolution CTD and 1,708 low-resolution XCTD casts.
[4] WOD18 CTD dataset includes data from 10,953 high-resolution XCTD casts.
[5] WOD18 MBT dataset includes data from: 2,339,471 MBT, 80,200 DBT and 11,136 Micro-BT casts.
[6] Surface data are represented differently from cast (profile) data in the database – all observations in a single cruise have been combined into one "cast" with zero depth, value(s) of variable(s) measured, latitude, longitude, and Julian year-day to identify data and position of individual observations.

The World Ocean Database Team is actively seeking feedback from data contributors/users in order to improve various aspects of quality control, and in particular to identify questionable data and properly flag them, as well as to remove flags from data that may have been erroneously flagged. We encourage data users to provide their comments and feedback through our E-mail address at OCL.help@noaa.gov. As we receive input from users, corrections to the World Ocean Database will be implemented and amended data will be placed online on a monthly basis. WOD quarterly updates are available on the NCEI website (https://www.ncei.noaa.gov/).

Should any errors be found, either in the data, its metadata, or in the flags assigned to the data, please contact the OCL at OCL.help@noaa.gov and these problems will be addressed as soon as practical. The OCL is committed to providing the U.S. and international scientific community with oceanographic data of the highest quality and will continue to pursue this goal.

As part of this WOD18 release there are several software utilities included that can be used as examples of how to read the data and output them into different formats; these utilities continue to be improved. Any comments and suggestions for additional software utilities that could improve the convenience of use of WOD18 and lead to an increase in the number of users who can benefit from this product would be appreciated. Data and metadata updates will be posted on the NCEI website.

B. DATA SOURCES

Data submitted to, or obtained by, NCEI as of January, 2018 which contain subsurface measurements of one or more of the variables listed in Table 3 in each corresponding probe (Table 2) or plankton measurements were potential data sources for WOD18. We note that most variables in WOD18 are also Essential Ocean Variables (EOV) for ocean physics, biogeochemistry, and biology and ecosystems as identified by the Global Ocean Observing System (GOOS) Expert Panels. Due to lack of time, not all submitted data were converted to a uniform format and quality controlled in time for inclusion in WOD18. All datasets found in WOD18 can be found in their original submitted form to NCEI and are accessible online without restrictions, using the NCEI accession number, through the Ocean Archive System data services. In addition to the subsurface data, specific surface-only datasets submitted to NCEI were included. These surface datasets were selected because they filled a time period where there are little subsurface data for measured variables, or contained measured variables of special interest. Many of the datasets included in WOD18 were gathered as a result of the IOC/IODE GODAR project, the NODC Global Ocean Database project, and the IOC World Ocean Database project. A list of the project names and codes are available in s_2_project.pdf in the WOD18 Code Tables.

C. DEFINITIONS

A few terms which are important for understanding the data structure of WOD18 are: dataset, profile, cast, station, cruise, and accession number (See Glossary).

WOD18 Citation: The World Ocean Database 2018 (WOD18) should be cited as follows:

Boyer, T. P., O. K. Baranova, C. Coleman, H. E. Garcia, A. Grodsky, R. A. Locarnini, A. V. Mishonov, C. R. Paver, J. R. Reagan, D. Seidov, I. V. Smolyar, K. W. Weathers, and M.M. Zweng (2018). World Ocean Database 2018. A.V. Mishonov, Technical Editor. *NOAA Atlas NESDIS 87*.

D. DATASETS

The data in WOD18 are organized into eleven datasets that are briefly described in this section and listed in Table 2 (see online). A more detailed explanation of each dataset is provided in individual chapters of the *World Ocean Database 2018* (Boyer *et al.*, 2018).

Table 2. Datasets in the WOD18 (See table online PDF)

DATASETS	DATASETS INCLUDES
OSD	Ocean Station Data, Low-resolution CTD/XCTD, Plankton data
CTD	High-resolution Conductivity-Temperature-Depth / XCTD data
MBT	Mechanical / Digital / Micro Bathythermograph data
XBT	Expendable Bathythermograph data
SUR	Surface-only data
APB	Autonomous Pinniped data
MRB	Moored buoy data
PFL	Profiling float data
DRB	Drifting buoy data
UOR	Undulating Oceanographic Recorder data
GLD	Glider data

1. Ocean Station Data (OSD)

Historically, Ocean Station Data (OSD) referred to measurements made from a stationary research ship using reversing thermometers to measure temperature and making measurements of other variables such as salinity, oxygen, nutrients, chlorophyll, *etc*. on seawater samples gathered using special bottles. The OSD dataset includes bottle data, low-resolution Conductivity-Temperature-Depth (CTD) data, Salinity- Temperature- Depth (STD), some surface-only data with specific characteristics, some low-resolution Expendable XCTDs, and plankton taxonomic and biomass measurements.

2. High-Resolution Conductivity-Temperature-Depth (CTD) Data

The CTD dataset contains data from Conductivity-Temperature-Depth instruments as well as STD data measured at high frequency *vs*. depth (pressure). CTD data are treated according to their resolution. All casts with a depth increment less than two meters are considered high-resolution CTD otherwise, the casts are considered as low-resolution CTD. The low-resolution CTD data reside within OSD dataset. High-resolution data collected by expendable Conductivity-Temperature-Depth (XCTD) instruments are also included in this dataset.

3. Mechanical/Digital/Micro Bathythermograph (MBT) Data

The MBT instrument was developed in its modern form around 1938 (Spilhaus, 1938). The instrument provides estimates of temperature as a function of depth in the upper water column. The

MBT dataset contains data on water temperature profiles obtained from MBTs, Digital Bathythermograph (DBT) and Micro Bathythermograph (micro BT) instruments.

4. Expendable Bathythermograph (XBT) Data

The XBT was first deployed around 1966 and replaced the MBT in most measurement programs. This electronic instrument has a thermistor which measures temperature *vs.* depth. Depth is calculated using the elapsed time of its free descent through the water column and fall-rate equation (See Section IV for information on XBT fall-rate error).

5. Surface (SUR) Only Data

The SUR dataset contains data collected by any *in-situ* means from the surface of the ocean. The majority of the SUR observations were performed along ship routes in the Atlantic and Pacific oceans. In the SUR dataset each cruise is stored in the same form as a cast for other datasets. Each measurement has an associated latitude, longitude, and Julian year-day.

6. Autonomous Pinniped (APB) Data

The APB dataset contains *in-situ* temperature data from time-temperature-depth recorders (TTDR) and temperature and salinity data from CTD sensors manually attached to marine mammals such as northern elephant seals (*Mirounga angustirostris*).

7. Moored Buoy (MRB) Data

The MRB dataset contains temperature and salinity measurements collected from moored buoys located in the Tropical Pacific, tropical Atlantic, Baltic and North Seas, and area around Japan. These include the major ongoing Equatorial buoy arrays, TAO/TRITON, PIRATA, and RAMA.

8. Profiling Float (PFL) Data

The PFL dataset contains temperature and salinity data collected from drifing profiling floats such as Profiling Autonomous Lagrangian Circulation Explorer (P-ALACE), PROVOR (free-drifting hydrographic profiler), SOLO (Sounding Oceanographic Lagrangian Observer), and APEX (Autonomous Profiling Explorer). The main source of the PFL data in WOD18 is the Argo project.

9. Drifting Buoy (DRB) Data

The DRB dataset contains data collected from surface drifting buoys and drifting floats with subsurface thermister chains. The major sources of this data include the GTSPP project and Arctic buoy projects.

10. Undulating Oceanographic Recorder (UOR)

The UOR dataset contains data collected from a Conductivity-Temperature-Depth probe mounted on a towed undulating vehicle. A description of the different types of UOR vehicles used for acquiring the data included in the WOD18 can be found online.

Table 3. Depth-dependent primary *in situ* measured variables present in WOD18

Code	Variable (nominal abbreviations)	WOD18 standard unit or scale (nominal abbreviation)	Dataset(s) where variable(s) is/are stored
1	Temperature	Degrees Celsius (°C)	OSD, CTD, MBT, XBT, SUR, APB, MRB, PFL, UOR, DRB, GLD
2	Salinity	Dimensionless (unitless)	OSD,CTD, SUR, MRB, PFL, UOR, DRB, GLD
3	Oxygen[2]	Micromole per kilogram (µmol kg^{-1})	OSD, CTD, PFL, UOR, DRB
4	Phosphate[3]	Micromole per kilogram (µmol kg^{-1})	OSD
6	Silicate[3]	Micromole per kilogram (µmol kg^{-1})	OSD
8	Nitrate[3] and Nitrate+Nitrite[3]	Micromole per kilogram (µmol kg^{-1})	OSD
9	pH	Dimensionless	OSD, SUR
11	Total Chlorophyll [Chl] unless specified	Microgram per liter (µg l^{-1})	OSD, CTD, SUR, UOR, DRB
17	Alkalinity	Milli-equivalent per liter (meq l^{-1})	OSD, SUR
20	Partial pressure of carbon dioxide [pCO_2]	Microatmosphere (µatm)	OSD, SUR
21	Dissolved Inorganic carbon	Millimole per liter (mmol l^{-1})	OSD
24	Transmissivity (Beam Attenuation Coefficient)	Per meter (m^{-1})	CTD
25	Water pressure	Decibar	OSD, CTD, UOR, GLD, PFL, DRB
26	Air temperature	Degree Celsius (°C)	SUR
27	CO_2warming	Degree Celsius (°C)	SUR
28	xCO_2atmosphere	Parts per million (ppm)	SUR
29	Air pressure	Millibar (mbar)	SUR
30	Latitude	Degrees	SUR, APB, UOR
31	Longitude	Degrees	SUR, APB, UOR
32	Julian year-day[1]	Day	SUR, APB, UOR
33	Tritium [^3H]	Tritium Unit (TU)	OSD
34	Helium[3] [He]	Nanomol per kilogram (nmol kg^{-1})	OSD
35	Delta Helium-3 [Δ^3He]	Percent (%)	OSD
36	Delta Carbon-14 [$\Delta^{14}C$]	Per mille (‰)	OSD
37	Delta Carbon-13 [$\Delta^{13}C$]	Per mille (‰)	OSD
38	Argon[3] [Ar]	Nanomol per kilogram (nmol kg^{-1})	OSD
39	Neon[3] [Ne]	Nanomol per kilogram (nmol kg^{-1})	OSD
40	Chlorofluorocarbon[3] 11	Picomole per kilogram (pmol kg^{-1})	OSD
41	Chlorofluorocarbon[3] 12	Picomole per kilogram (pmol kg^{-1})	OSD
42	Chlorofluorocarbon[3] 113	Picomole per kilogram (pmol kg^{-1})	OSD
43	Delta Oxygen-18 [$\Delta^{18}O$]	Per mille (‰)	OSD

[1] Julian year-day is the decimal day for the year the observations were made
[2] Dissolved oxygen in previous WOD versions were expressed in units of ml/l
[3] Previously expressed on a per-volume basis

11. Glider (GLD) Data

The GLD dataset contains data collected from reusable autonomous underwater vehicles (AUV) designed to glide from the ocean surface to a programmed depth and back while measuring temperature, salinity, depth-averaged current, and other quantities along a sawtoothed trajectory through the water.

E. CAST DESCRIPTION

In WOD18, a cast is comprised of as many as seven parts with the first five devoted to metadata holding:

(1) Primary Header: Information vital to the identification of an individual cast, such as date, time, location, ISO country code, cruise code, and a unique cast number.

(2) Secondary Header: Information such as meteorological data, sea floor depth, instrument, ship (platform), institute, and project.

(3) Variable-specific secondary header: Information specific to each individual measured variable such as originator's units, scales, and methods.

(4) Character Data: Originator's cruise codes, originator's cast codes, and Principal Investigator's code.

(5) Biological Header: Information necessary to understand how biological data were sampled. "Biological" data are defined as plankton biomass (weights or volumes) and taxa-specific observations.

(6) Taxa-specific and Biomass Data: Plankton weights, volumes, and/or concentrations, for an entire sample (biomass) or for individual groups of organisms (taxa-specific).

(7) Measured Variables: Temperature, salinity, oxygen, phosphate, silicate, nitrate, pH, chlorophyll, alkalinity, partial pressure of carbon dioxide (pCO_2) dissolved inorganic carbon (DIC), tracers, and pressure data *vs*. depth. In addition, the SUR, APB, and UOR datasets contain latitude, longitude, and Julian year-day with each set of measurements.

1. Primary Header

The primary header contains information about the number of bytes in the cast, a unique number which identifies each cast, the International Organization for Standardization ISO country code, a cruise number, date, time, position, and the number and type of variables in the cast. Please note that some data have been submitted with a day of zero (0) and we have kept these in the database as such. Time and location are all written in the same format:

a) number of significant digits
b) total digits
c) precision of measurement
d) data value

Total digits will be one more than significant digits if the value is a negative number. Total digits will also be different than significant digits if a value has been converted or identified as a trace value. The station type identifies whether the stored data are collected at observed depth levels (0) or interpolated to standard levels (1). The number and type of variables identifies the depth-dependent

variables in a cast. Depth-dependent variables are listed online with their numerical identification codes.

2. Secondary Header

The secondary header contains metadata (information about the data) and meteorological information associated with each cast. Table 4 lists the different types of secondary header data included for each cast, when such information is available (See WOD codes online).

Many of the meteorological variables have World Meteorological Organization (WMO) or NCEI code tables associated with them. The complete listings of accession numbers (secondary header 1), project codes (secondary header 2), platform codes (secondary header 3), and institution codes (secondary header 4) are quite large and therefore are placed in individual files. All files can be found in the WOD code tables section. The WOD secondary header information is always in numeric format.

The following is an explanation of the secondary headers listed in Table 4. All code tables and files can be found on our website on the WOD code tables page. Note: file names preceded by the letter "s" (*e.g.* s_1_accession.pdf) denotes a secondary header file.

- Code 1 NCEI accession number: a unique number assigned by NCEI to each group of data received in the NCEI Ocean Archive (file: s_1_accession.pdf);
- Code 2 NCEI project: identifies the project associated with the data (file: s_2_projects.pdf);
- Code 3 Platform: identifies the platform associated with the data (file: s_3_platform.pdf);
- Code 4 Institution: code identifies the institution which sampled the data (file: s_4_institute.pdf);
- Code 5 Cast/Tow Number: sequential number representing each over-the-side operation or discrete sampling at a cast or continuous tow;
- Code 7 Originator's station number: numeric station number assigned by the data submitter or data originator;
- Code 8 Depth Precision: precision of the depth field (number of digits to the right of the decimal);
- Code 9 Ocean Weather Station: identifies data from the various ocean weather stations; a list of Ocean Weather Stations are found in Appendix 2.1;
- Code 10 Bottom depth: depth from water surface to sediment-water interface, in meters;
- Code 11 Cast duration: duration of the cast, in hours;
- Code 12 Cast Direction: if a direction is not present, down is assumed, description of codes found in Appendix 2.2;
- Code 13 High-resolution pairs: unique cast number identifying where high-resolution CTD and low-resolution OSD data are both available;
- Code 14 Water Color: a modified Forel-Ule color scale is used, a description of codes in Appendix 2.3. Codes in the database and Appendix 2.3 include values that are not in the Forel-Ule Scale (values> 21);
- Code 15 Water transparency: Secchi disk visibility depth, in meters;
- Code 16 Wave Direction (WMO 0877): description of codes in Appendix 2.4;
- Code 17 Wave Height (WMO 1555): description of codes in Appendix 2.5;

- Code 18 Sea State (WMO 3700): description of codes in Appendix 2.6;
- Code 19 Wind Force (Beaufort Scale): description of codes in Appendix 2.7;
- Code 20 Wave Period (WMO 3155 or NCEI 0378): description of codes in Appendix 2.8; note that NCEI code 0378 is not equivalent to WMO 3155, therefore these data need to be used with caution unless the users can identify which code was reported;
- Code 21 Wind Direction (WMO 0877): description of codes in Appendix 2.9;
- Code 22 Wind speed: surface or near-surface wind speed, in knots;
- Code 23 Barometric pressure: the atmospheric pressure at sea level due to the gravitational force on the column of air above it (millibar);
- Code 24 Dry bulb temperature: identical to air temperature, in °C;
- Code 25 Wet bulb temperature: the temperature a parcel of air would have if it were cooled adiabatically with no heat transfer, in °C;
- Code 26 Weather Condition (WMO 4501 and WMO 4677): description of codes in Appendix 2.10;
- Code 27 Cloud Type (WMO 0500): description of codes in Appendix 2.11;
- Code 28 Cloud Cover (WMO 2700): description of codes in Appendix 2.12;
- Code 29 Probe Type: list of probe types; listing in Appendix 2.13;
- Code 30 Calibration Depth: deviation on a bathythermograph (BT) from the zero depth. This difference between points was used to adjust the profile when it was digitized;
- Code 31 Calibration Temperature: deviation on a BT from a 16.7°C reference point. This difference between points was used to adjust the profile when it was digitized;
- Code 32 Recorder Type (WMO 4770): description of codes in Appendix 2.14;
- Code 33 Depth Correction: a zero (0) is assigned if the original depth-time equation was used for the XBT data collected after a corrected depth-time equation was introduced; a one (1) is assigned if a corrected depth-time equation was used;
- Code 34 Bottom Hit: a one (1) is assigned if the probe hits the bottom;
- Code 35 Digitization Method (NCEI 0612): description of codes in Appendix 2.15;
- Code 36 Digitization Interval (NCEI 0613): description of codes in Appendix 2.16;
- Code 37 Data Treatment and Storage (NCEI 0614): description of codes in Appendix 2.17;
- Code 38 Trace Correction: average difference between the surface trace and the surface depth line of the grid for a BT;
- Code 39 Temperature Correction (°C): correction for difference between reference temperature and BT reading or correction to the original data by the submitter – in some cases the correction has already been applied;
- Code 40 Instrument for Reference Temperature (NCEI 0615): description of codes in Appendix 2.18;
- Code 41 Horizontal Visibility (WMO 4300): description of codes in Appendix 2.19;
- Code 45 Absolute Humidity ($g \cdot m^{-3}$): sometimes referred to as the vapor density, - the ratio of the mass of water vapor present to the volume occupied by the moist air mixture present in the atmosphere;
- Code 46 Reference/Sea Surface Temperature: temperature used to check the probe or a separate measure of sea surface temperature;
- Code 47 Sea Surface Salinity of the layer of sea water nearest to the atmosphere;
- Code 48 Year: in which probe was manufactured;

- Code 49 Speed: ship speed (knots) when probe was dropped;
- Code 54 Depth Fix: equation needed to calculate correct depth (file: s_54_needs_depth_fix.pdf, Appendix 2.20);
- Code 71 Real-time: identifies data received over the WMO Global Telecommunication System within 24 hours of measurement. Real-time data is identified with the number one (1);
- Code 72 XBT Wait: is the time difference between the launch of the probe and the time it begins recording data (NB: this code is no longer used);
- Code 73 XBT Frequency: is the sampling rate of the recorder (NB: this code is no longer used);
- Code 74 Oceanographic Measuring Vehicle: Appendix 2.21 lists the different types of vehicles which carry oceanographic instruments (file: s_74_ocean_vehicle.pdf);
- Code 77 xCO_2 in atmosphere (ppm): mole fraction of CO_2 in dry gas sample;
- Code 84 ARGOS Fix Code: ARGOS satellite fix and location accuracy, description of codes in Appendix 2.24;
- Code 85 ARGOS time (hours) from last fix: used to calculate position of APB;
- Code 86 ARGOS time (hours) to next fix: used to calculate position of APB;
- Code 87 Height (meters) of XBT launcher;
- Code 88 Depth of sea surface sensor (meters);
- Code 91 Database ID: Identifies source of data; description of codes in Appendix 2.25;
- Code 92 UKHO Bibliographic Reference number: source for digitized cards from the United Kingdom Hydrographic Office (vessels, institutes, sea area); description of codes in Appendix 2.26;
- Code 93 Consecutive profile in tow segment: used to identify one up or down half-cycle in underway data;
- Code 94 WMO Identification code: code assigned to buoys or profiling floats by WMO;
- Code 95 Originator's Depth Unit: units used by the data originator to report depth values. If code is absent, depths were reported in meters; description of codes in Appendix 2.27;
- Code 96 Originator's Flags: Appendix 2.28 lists the data quality flags submitted by the data originator. They are also listed in file s_96_origflagset.pdf. These flags are assigned only to the observed depth data. If this code is absent, there are no originator's flags.
- Code 97 Water Sampler: devices used to capture water sample (bucket, specific bottle type; Appendix 2.29);
- Code 98 ARGOS ID number: assigned by the ARGOS project office;
- Code 99 Time Stamp: in format YYYYJJJ (where YYYY=year, JJJ=Julian year day) time-stamp when the ASCII version of a cast was created.

Table 4. List of secondary header variables in WOD18

ID [1]	DESCRIPTION	App [2]	ID [1]	DESCRIPTION	App [2]
1	NCEI Accession Number	File	35	Digitization Method (NCEI 0612)	2.15
2	NCEI Project Code	File	36	Digitization Interval (NCEI 0613)	2.16
3	WOD Platform Code	File	37	Data Treatment and Storage Method (NCEI 0614)	2.17
4	NCEI Institution Code	File	38	Trace Correction	
5	Cast/Tow number		39	Temperature Correction	
7	Originator's station number		40	Instrument for reference temperature (NCEI 0615)	2.18
8	Depth Precision		41	Horizontal visibility (WMO Code 4300)	2.19
9	Ocean Weather Station	2.1	45	Absolute Humidity (g/m^3)	
10	Bottom Depth (meters)		46	Reference/Sea Surface Temperature	
11	Cast Duration (hours)		47	Sea Surface Salinity	
12	Cast Direction (down assumed)	2.2	48	Year in which probe was manufactured	
13	High-resolution pairs		49	Speed of ship (knots) when probe was dropped	
14	Water Color	2.3	54	Depth fix	2.20
15	Water Transparency (Secchi disk)		71	Real time	
16	Wave Direction (WMO 0877 or NCEI 0110)	2.4	72	XBT Wait (code no longer used)	
17	Wave Height (WMO 1555 or NCEI 0104)	2.5	73	XBT Frequency (code no longer used)	
18	Sea State (WMO 3700 or NCEI 0109)	2.6	74	Oceanographic measuring vehicle	2.21
19	Wind Force (Beaufort scale or NCEI 0052)	2.7	77	xCO_2 in atmosphere (ppm)	
20	Wave Period (WMO 3155 or NCEI 0378)	2.8	84	ARGOS fix code	2.24
21	Wind Direction (WMO 0877 or NCEI 0110)	2.9	85	ARGOS time (hours) from last fix	
22	Wind Speed (knots)		86	ARGOS time (hours) to next fix	
23	Barometric Pressure (millibars)		87	Height (meters) of XBT launch	
24	Dry Bulb Temperature (°C)		88	Depth of sea surface sensor	
25	Wet Bulb Temperature (°C)		91	Database ID	2.25
26	Weather Conditions (WMO 4501/4677)	2.10	92	UKHO Bibliographic Reference Number	2.26
27	Cloud Type (WMO 0500 or NCEI 0053)	2.11	93	Consecutive profile in a tow segment	
28	Cloud Cover (WMO 2700 or NCEI 0105)	2.12	94	WMO Identification Code	
29	Probe Type	2.13	95	Originator's Depth unit	2.27
30	Calibration Depth		96	Originator's flags	2.28
31	Calibration Temperature		97	Water Sampler	2.29
32	Recorder (WMO 4770)	2.14	98	ARGOS ID number	
33	Depth Correction		99	Time stamp (YYYYJJJ, Y=year, J= year day) to indicate when ASCII version of cast was	
34	Bottom Hit				

[1] "**ID**" column represents the code assigned to each secondary header

[2] "**App**" indicates the Appendix where the code list is found or if in a separate file (*e.g.* s_9_weather_station.pdf) available on line the WOD code tables page on the NCEI website.

3. Variable-Specific Secondary Header

The variable-specific secondary headers contain metadata specifically associated with each variable. Table 5 lists the different types of variable-specific secondary header information included for each cast, when such is available. The "App" Column indicates the Appendix where the code list is found; the "ID" column represents the code number assigned to each variable specific second header. All individual code tables and files can be found on our website in the WOD code tables page.

Table 5. List of Variable-Specific Secondary Headers

ID[1]	DESCRIPTION	App[2]	ID[1]	DESCRIPTION	App[2]
1	Accession number	File	11	Filter type and size	3.6
2	Project	File	12	Incubation time	3.7
3	Scale	3.1	13	CO_2 sea warming	
4	Institution	File	15	Analysis temperature	
5	Instrument	3.2	16	Uncalibrated	
6	Methods	3.3	17	Contains nitrite	
8	Originator's units	3.4	18	Normal Standard Seawater batch	
10	Equilibrator type	3.5	19	Adjustment	

[1] "**ID**" column represents the code assigned to each secondary header
[2] "**App**" indicates the Appendix where the code list is found or if in a separate file (*e.g.* s_9_weather_station.pdf) available on line the WOD code tables page on the NCEI website

Below is an explanation of the variable-specific secondary header codes (WOD code tables) shown in Table 5:

Below is an explanation of the variable-specific secondary header codes listed in Table 5:

- Code 1 NCEI accession number: unique number assigned by NCEI to each batch of data received (file: v_1_accession.pdf). Sometimes the variables for a cast are received at different times or from different sources and therefore may have different accession numbers. We have attempted to merge these casts together and kept the source information intact;
- Code 2 Project: identifies the research project associated with the data collection. See file: v_2_project.pdf for a list of projects in WOD18;
- Code 3 Scale: The units for temperature and salinity are based on the internationally agreed referenced measurement standards (*i.e.* ITS Temperature Scale, Practical Salinity Scale, and pH scales). Table 3 provides the detailed list of variables and units. Appendix 3.1 provides the list of scale codes.
- Code 4 Institution: identifies institution associated with the investigator who sampled the specific variable (file: v_4_institute.pdf);
- Code 5 Instrument: Appendix 3.2 provides a list of instrument used, also available in file v_5_instrument.pdf;
- Code 6 Methods: Appendix 3.3 lists the methods associated with each variable measured. This list represents the methods reported with the data submitted and is not a comprehensive list of variable methods. Also available in file: v_6_measure_method.pdf;
- Code 8 Originator's units: Appendix 3.4 identifies the submitter's original units. Also listed in

file: v_8_orig_units.pdf;

- Code 10 Equilibrator type: describes the design of the instrument used for equilibrating seawater with air in preparation for measuring CO_2 concentrations (Appendix 3.5);
- Code 11 Filter type and size (Appendix 3.6);
- Code 12 Incubation time: 25 is dawn to noon, 26 is noon to dusk; otherwise, value is in hours (Appendix 3.7);
- Code 13 CO_2 sea warming: temperature change in transporting water from the sea surface to the CO_2 analysis site;
- Code 15 Analysis temperature: temperature of seawater at the time of CO_2 analysis;
- Code 16 Uncalibrated: set to 1 if instrument is uncalibrated;
- Code 17 Contains nitrite: set to 1 if nitrate value is actually nitrate+nitrite;
- Code 18 Normal Standard Seawater batch: the code gives the IAPSO normal standard seawater batch number, P-Series, *i.e*. code 78 means normal standard seawater batch P78.
- Code 19 Adjustment: this is an adjustment (correction) value made to Argo profiling floats. The adjustment is a real value (*i.e*. decimal number) and is the mean difference between original (real-time) and adjusted (delayed-mode) profile of temperature, salinity, oxygen, or pressure for all values below 500 meters depth. If a profile has an adjustment value (even if this value is 0.0, it indicates that the profile has gone through additional quality control by the Argo project and is considered either adjusted real-time or delayed-mode data.

4. Character Data and Principal Investigator Code

Character data are used to report the originator's cruise identification and the originator's station identification, if provided, which could be in alphanumeric format. If the originator's code is purely numeric, it will be found in second header code 7.

The Principal Investigator (PI) is also identified by numeric code and by variable code. The PI is the person (or persons), responsible for data collection and this information is included whenever available. A list of the numeric codes associated with each PI can be found in the file: primary_investigator_list.pdf. For the purpose of assigning PI codes, plankton data are identified as variable 14 for all plankton, -5002 for zooplankton, and -5006 for phytoplankton.

5. Biological Header

The biological header section contains information on the sampling methods used for collecting taxonomic and biomass data. Table 6 lists the different types of biological header information included for each cast, if it was available.

All code tables are listed in Appendix 4 (the biological headers are listed in file Table 6). The "App" column indicates the Appendix of this document where the code list is found; the "ID" column represents the WOD code number assigned to each biological header entry.

Table 6. List of biological header variables

ID[1]	DESCRIPTION	App[2]	ID[1]	DESCRIPTION	App[2]
1	Water volume filtered (m^3)		14	Tow distance (meters)	
2	Sampling duration (minutes)		15	Average towing speed (knots)	
3	Mesh size (µm, micro-meter)		16	Sampling start time (GMT)	
4	Type of tow	4.1	18	Flowmeter type	4.3
5	Large removed volume (ml, milli-liter)		19	Flowmeter calibration	4.7
6	Large plankters removed	4.2	20	Counting institution	
7	Gear code	4.3	21	Voucher Institution	
8	Sampler volume (liters)		22	Wire angle start (degrees)	
9	Net mouth area (m^2, squared meter)		23	Wire angle end (degrees)	
10	Preservative	4.4	24	Depth determination method	4.8
11	Weight method	4.5	25	Volume method	4.9
12	Large removed length (cm, centimeter)		30	Accession number for the biology	
13	Count method	4.6			

[1] "**ID**" column represents the code assigned to each secondary header
[2] "**App**" indicates the Appendix where the code list is found or if in a separate file (*e.g.* s_9_weather_station.pdf) available on line the WOD code tables page on the NCEI website

The following is a description of the biological header codes listed in Table 6:

- Code 1 Water volume filtered: total volume of water filtered by the sampling gear (m^3)
- Code 2 Sampling duration: time over which the sampling gear was towed, in minutes;
- Code 3 Mesh size: pore size of the sampling device, in micrometers;
- Code 4 Type of tow: towing method used (*e.g.*, horizontal, vertical, oblique) – Appendix 4.1;
- Code 5 Large removed volume: the minimum volume criteria for removing large plankters, in ml, see also code 12;
- Code 6 Large plankters removed: if large plankters were specified as being removed (1) or not removed (2), this code is added. See codes 5 and 12 in Appendix 4.2;
- Code 7 Gear code: type of gear used (*e.g.*, plankton net, bottle, MOCNESS) – Appendix 4.3;
- Code 8 Sampler volume: internal volume of the sampling gear (*e.g.*, Niskin bottle), in liters;
- Code 9 Net mouth area: mouth or opening area of the sampling gear, in m^2. If mouth diameter was provided, area was calculated as: area = π (0.5 diameter)^2;
- Code 10 Preservative: type of preservative used to preserve the plankton sample (Appendix 4.4);
- Code 11 Weight method: method used for weighing the plankton sample (Appendix 4.5);
- Code 12 Large removed length: the minimum size/length criteria for removing large plankters, in cm, see also code 5;
- Code 13 Count method: method used for counting the plankton sample (Appendix 4.6);
- Code 14 Tow distance: distance over which sampling gear was towed, in meters;
- Code 15 Average tow speed: average speed used to tow the sampling gear, in knots;
- Code 16 Sampling start time: GMT;
- Code 18 Flowmeter type: the brand and/or model of the flowmeter used (Appendix 4.3);
- Code 19 Flowmeter calibration: the calibration frequency for the flowmeter (Appendix 4.7);
- Code 20 Counting Institution: the Institution responsible for identifying and counting the taxa-specific sample (file: b_21_institutes.pdf; see institute code);

- Code 21 Voucher Institution: the location (Institution) of the taxa-specific sample voucher (file: b_21_institutes.pdf; see institute code);
- Code 22 Wire angle start: wire angle of the towing apparatus at sampling start, in degrees;
- Code 23 Wire angle end: wire angle of the towing apparatus at sampling end, in degrees.
- Code 24 Depth determination method: a code indicating that depth was calculated from wire angle and length or a PI-specific "target depth" (Appendix 4.8);
- Code 25 Volume method: the method used for measuring the volume of the plankton sample (Appendix 4.9);
- Code 30 Accession number for biology: NCEI dataset identification for the biological component of the current cast (file: b_30_accession).

6. Taxa-specific and Biomass Data

The typical plankton cast, as represented in WOD18, stores taxon specific and/or biomass data in individual sets of unique observations, called "Taxa-Record". Each "Taxa-Record" contains a taxonomic description, depth range (the upper and lower depth) of observation, the original measurements (*e.g.*, abundance, biomass or volume), and all provided qualifiers (*e.g.*, lifestage, sex, size, etc.) required to represent that plankton observation.

Each unique taxonomic description, depth range, or measurement has its own "Taxa-Record". For example:

- Biomass (displacement volume) measured from 0-100m, and 200-500m, will have two "Taxa-Records", one for each depth range,
- Biomass (displacement volume and wet weight) measured from 0-250m will have two "Taxa-Records", one for each type of biomass measurement,
- A taxa-specific measurement of a single species, counted at five bottle depths, will have five "Taxa-Records", one for each depth,
- A taxa-specific measurement of ten species, counted at five bottle depths, will have 50 "Taxa-Records", five depths multiplied by ten species.

Note that taxa with different taxonomic descriptors (*e.g.*, life stage, sex code, *etc.*) are treated as different unique taxonomic descriptions, and are stored in different Taxa-Records. For example: *Calanus* eggs, *Calanus* juveniles, *Calanus* adults (male), and *Calanus* adults (female) would be stored as four separate observations, each with the same genus, but differing in their taxon life stage and/or taxon sex.

Table 7 lists the different types of taxa-specific and biomass data fields for each Taxa-Record, if the information is available. Each cast can have multiple Taxa-Records, and each Taxa-Record can contain any of the fields in Table 7. Similar to the biological header information, much of the information is represented by codes.

Code tables for these variables are listed in Appendices 3.4, 5.1 through 5.11, and 6. The "App" column indicates the Appendix where the code table is found; the "ID" column represents the code number assigned to each biomass and taxon-specific variable. "UNIT" refers to the originator's units (code 20).

Table 7. List of biomass and taxa-specific variables

ID[1]	DESCRIPTION	App[2]	ID[1]	DESCRIPTION	App[2]
1	Variable number (>0 ITIS taxon code, <0 WOD taxon or group code)	File	15	Taxon ash-free weight (mg or ng/UNIT)	none
2	Upper depth (meters)		16	Taxon feature	5.6
3	Lower depth (meters)		17	Taxon modifier	5.7
4	Biomass value		18	Size min (mm, milli-mter)	5.8
5	Taxon lifestage	5.1	19	Size max (mm, milli-mter)	5.8
6	Taxon sex code	5.2	20	Originator's Unit	3.4
7	Taxon present	5.3	21	Taxon radius (µm, micro-meter)	
8	Taxon trophic mode	5.4	22	Taxon length (µm, micro-meter)	
9	Taxon realm	5.5	23	Taxon width (µm, micro-meter)	
10	Taxon count (count of taxon/UNIT)		25	Taxon carbon content (mg or ng/UNIT)	
11	Sample-specific sample volume (m^3 or ml/UNIT)		26	Count method	5.9
12	Taxon volume (ml or pl/UNIT)		27	Common Base-unit Value (CBV)	5.10
13	Taxon wet weight (g or µg/UNIT)		28	CBV calculation method	5.11
14	Taxon dry weight (g or µg/UNIT)		30	Plankton Grouping Code (PGC)	6

[1] "**ID**" column represents the code assigned to each secondary header
[2] "**App**" indicates the Appendix where the code list is found or if in a separate file (*e.g.* s_9_weather_station.pdf) available on line the WOD code tables page on the NCEI website

The following is a description of biomass and taxa-specific variables listed in Table 7:

- Code 1 Variable number: identifies the type of taxon or biomass sampled. See Table 8 for a breakdown of these codes and complete numerically sorted taxonomic list available on-line (file t_1_taxa_list.txt);
- Code 2 Upper depth: the shallowest depth of the sample, in meters;
- Code 3 Lower depth: the deepest depth of the sample, in meters;
- Code 4 Biomass value: contains biomass value measured, units are specified by the biomass variable code (Table 8 and Appendix 5.8);
- Code 5 Taxon lifestage: a specific lifestage indicated for a taxonomic observation (*e.g.*, *Calanus finmarchicus*, nauplii) – Appendix 5.1;
- Code 6 Taxon sex code: a specific sex indicated for a taxonomic observation (*e.g.*, *Calanus finmarchicus*, female) – Appendix 5.2;
- Code 7 Taxon present: a non-numeric description of the relative abundance, presence indicator (*e.g.*, "rare", "common", "dominant") – Appendix 5.3;
- Code 8 Taxon trophic mode: a specific trophic description for a taxonomic observation (*e.g.*, autotrophic *picoplankton*) – Appendix 5.4;
- Code 9 Taxon realm: a specific realm description for a taxonomic observation (*e.g.* bathypelagic *fish*) – Appendix 5.5;
- Code 10 Taxon count: the number of an individual taxon counted, in count per unit (as specified by code 20);
- Code 11 Sample-specific sample volume: used only when each sample within a tow has a

different sample volume (*e.g.*, the different volumes filtered by each net of a MOCNESS net). If the value is >0, the units are "m^3 per UNIT". If the value is <0, the units are "ml per UNIT", where UNIT is specific by code 20;

- Code 12 Taxon volume: the volume of an individual taxon counted. If the value is >0, the units are "ml per UNIT". If the value is <0, the units are "nl per UNIT", where UNIT is specific by code 20;
- Code 13 Taxon wet weight: the wet weight of an individual taxon counted. If the value is >0, the units are "g per UNIT". If the value is <0, the units are "mg per UNIT", where UNIT is specified by code 20;
- Code 14 Taxon dry weight: the dry weight of an individual taxon counted. If the value is >0, the units are "g per UNIT". If the value is <0, the units are "mg per UNIT", where UNIT is specific by code 20;
- Code 15 Taxon ash-free dry weight: the ash-free dry weight of an individual taxon counted. If the value is >0, the units are "mg per UNIT". If the value is <0, the units are "ng per UNIT", where UNIT is specific by code 20;
- Code 16 Taxon feature: a specific feature or shape indicated in a taxonomic observations (*e.g.*, athecate *Dinoflagellate*) – Appendix 5.6;
- Code 17 Taxon modifier: a specific taxonomic identity description for a taxonomic observation (*e.g.*, *Calanus* spp., *Ceratium* sp. A, *Ceratium* sp. B, *Ceratium* spp., other) – Appendix 5.7;
- Code 18 Minimum size range description: the smaller size range used in a taxonomic description. If the value is >0, the units are "mm". If the value is <0, it is a code (-1 = small, -2 = medium, -3 = large, -4 = very small, as provided in the original taxonomic description (file t_18_size_min.pdf) – Appendix 5.8;
- Code 19 Maximum size range description: the larger size range used in a taxonomic description, in mm (on-line file t_19_size_max.pdf) – Appendix 5.8;
- Code 20 Originator's Unit: additional unit identifier for biomass and taxa-specific measurements (Appendix 3.4);
- Code 21 Taxon radius description: the radius (0.5 diameter) used in a taxonomic description, in µm;
- Code 22 Taxon length description: the length or height used in a taxonomic description, in µm;
- Code 23 Taxon width description: the width or shortest-dimension used in a taxonomic description, in µm;
- Code 25 Taxon carbon content: the carbon content of the individual taxon counted. If the value is >0, the units are "g per UNIT". If the value is <0, the units are "mg per UNIT", where UNIT is specific by code 20;
- Code 26 Count method: used only when multiple methods are used within a single measurement (*e.g.* to distinguish bacterial groups discerned and counted by different staining and/or fluorescent techniques within a single sample) – Appendix 5.9;
- Code 27 Common Base-unit Value (CBV): a "per-unit-volume" common base-unit value calculated from original value using sampling metadata (*e.g.*, towing distance, water volume filtered) – Appendix 5.10;
- Code 28 CBV calculation method: method used for calculating the CBV – Appendix 5.11;

- Code 30 Plankton Grouping Code (PGC): a Smart-Index (O'Brien 2007) indicates a plankton taxa's membership in up to four tiered groups – Appendix 6.

Scientific taxonomic names in the plankton description follow the Integrated Taxonomic Information System (ITIS) as an authority table, and are represented in WOD18 under the ITIS taxonomic serial number (on-line file t_1_taxa_list.pdf). This approach was not applied for all plankton descriptions. For example, non-scientific descriptions such as "gelatinous organisms", combinations of multiple species in a single description, and "total haul biomass" measurements cannot be represented using ITIS. Therefore, ancillary codes were developed to preserve these original descriptions. Table 8 provides a list of value ranges for all **Variable number** code values present in WOD18. WOD18 negative taxa codes follow those laid out for the COPEPOD database (O'Brien 2007).

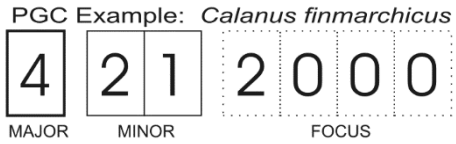
Table 8. Summary of Taxa Variable Number Codes

VARIABLE VALUE RANGE	DESCRIPTION
1 to 700000	Official ITIS Code (*Full taxonomic detail are available on the ITIS web site.)*
-400 to -405 -500 to -503	WOD18 Biomass Code (*e.g., All Biomass Types, Total Displacement Volume, Total Wet Mass, etc.)*
-1000 to -1999	WOD18 "Failed ITIS Review" Code *(ITIS was unable to verify its validity. Description may be non-existent, non-taxonomic, or unidentified)*
-5000 to -5999	WOD18 "Non-taxonomic Group" Code (*e.g., "gelatinous organisms")*
-6000 to -6999	WOD18 "Multiple taxa group" Code *(e.g., "Foraminifera & Radiolaria")*
-7000 to -9999	WOD18 "Pending ITIS Review" Code *(ITIS verification in-progress as of WOD18 release)*

In addition to the original plankton descriptions, each "Taxa-Record" also contains a supplemental WOD18 grouping index – **Plankton Grouping Code** (PGC) developed by O'Brien (2007), code 30.

The PGC code follows the taxonomic hierarchy presented in *The Five Kingdoms* (Margulis and Schwartz 1998). It places each taxon into broader groups (*e.g.,* "phytoplankton", "diatoms", "zooplankton", "copepods") which allows the WOD18 user access to hundreds of individual taxons by using a single PGC code. Appendix 6 lists the PGC groups and codes available in WOD18.

Earlier versions of the *World Ocean Database* (2005, 2001) used a PGC precursor index called the Biological Grouping Code (O'Brien *et al. 2001*). The PGC combines the BGC's separate "protist" grouping with the "phytoplankton" group. WOD18 has all BGC codes replaced with their corresponding PGC codes.



The PGC is a 7-digit code divided into Major (*e.g. Bacteria, Phytoplankton, Zooplankton*), Minor (*e.g. cyanobacteria, diatoms, crustaceans*), and Focus Groups (*e.g., copepods*). For example, the copepod *Calanus finmarchicus* has a PGC code of "4212000", specifying that it is in Major Group "4" (zooplankton), Minor Group "21" (crustaceans), and Focus Group "2000" (copepods). Using the PGC code requires the multiplication of the PGC code value, outlined in Table 9, to specify the

exact grouping level desired (*e.g., "all zooplankton", "all crustaceans", or "all copepods"*).

Table 9. Operational example of the Plankton Grouping Code

Desired Group	PGC Value	Multiply by	Result	PGC Equivalent (see Appendix 6)
MAJOR GROUP	4212000	10^{-6}	4	zooplankton
	4218000		4	zooplankton
	2160000		2	phytoplankton
MINOR GROUP	4212000	10^{-4}	421	crustacean
	4218000		421	crustacean
	2160000		216	diatoms
FOCUS GROUP	4212000	10^{-2}	42120	copepods
	4218000		42180	euphausiidae

Plankton numerical abundance and total biomass measurements are stored with the originator's units in WOD18 (*e.g., "number per m^3", "count per m^2", "count per haul", "count per ml", "displacement volume per haul"*). To make comparison of measurements provided in different units easier, each numerical abundance or biomass measurement has been recalculated into a common unit named **Common Base-unit Value** (CBV), code 27. The CBV value has a quality control flag associated with it (see Table 12 for a definition of the flags). The calculation method used to create the CBV is stored in the **CBV calculation method** field, code 28, and detailed in Appendix 5.11. The CBV unit is dependent on the major taxonomic group of the measurement, as classified in the **Plankton Grouping Code** for that observation. For example, bacteria and phytoplankton counts are units of "count per ml", whereas zooplankton and ichthyoplankton counts are in units of "count per m^3". The CBV units for taxonomic counts and various biomass measurements are detailed in Appendix 5.10.

7. Measured Variables

The number of variables, their type, as well as a quality control flag for each variable (if all values of that variable have been flagged for that cast) are identified in the primary header. Table 3 lists the variables and their identifying codes. Table 12 lists the types of quality flags assigned to each variable.

Casts with data on pressure surfaces have their depths computed, so depth is always present and the pressure value is stored as a variable. Some data were submitted with both depth and pressure values in which case both are stored. Some casts may be reported on standard depth levels (see Appendix 9) such as most of the Japanese and Former Soviet Union (FSU) data. It is uncertain whether these data were originally measured at standard levels or interpolated to standard depth levels.

The following three datasets are discussed in more detail since they include additional information so as to fit the WOD format.

7a. Surface-only Data (SUR)

Surface-only data are treated differently than profile data. For such data, each cruise is presented as a single cast with depth, latitude, longitude, and Julian year-day associated with each set of measured values. The Julian year-day 0.00 is defined as time 0.00 on January 1st of the year of the first measurement in the cruise. For cases in which the cruise spans 2 calendar years, the year-day is consecutive. For example, if the first measurement was taken at time 0:00 on 31 Dec. 1965 (not a leap

year), the year day for that observation is 365.00. If the last measurement on the same cruise was taken at time 12:00 on 1 January 1966, the year-day is 366.5. An example of data from a surface cast is shown below:

Longitude	Latitude	Year	Month	Day	Time	Cruise#	CC	Prof_#
-30.026	62.666	1991	9	3	20.33	9810	06	7819341

Num	Depth	Temp	Sal	pCO2	Lat	Lon	Jday
1	0.00	9.130	34.940	294.300	62.666	-30.026	245.847
2	0.00	9.300	34.930	303.400	62.660	-30.057	245.851
3	0.00	9.400	34.913	305.300	62.640	-30.151	245.861
4	0.00	9.370	34.927	307.900	62.655	-30.088	245.854
5	0.00	9.400	34.915	306.600	62.648	-30.120	245.858

cast continues with a total of 2097 observations

Access#	113
Platform	335
Institution	388

pCO2 Instrument	8.000
pCO2 Method	1233.000
pCO2 Orig_Units	81.000

Note that the primary header information contains the same longitude, latitude and date/time information as the first observation in the listing.

7b. Autonomous Pinniped Data (APB)

Autonomous Pinniped Data (APB) are the temperature (salinity) data recorded by temperature-depth recorders (TDRs) or conductivity-temperature-depth satellite relay data loggers (CTD-SRDLs) manually attached to large marine mammals (*e.g.* northern elephant seals).

Depth and temperature (salinity) are recorded by the TDR or CTD-SRDL as the mammal ascends and descends through the water column while swimming. When the mammal returns to the surface, its position is transmitted to the ARGOS unit. During the seals multi-month migration, the seals dive continuously, night and day, capturing thousands of profiles along their migration route (*e.g.*, Boehlert *et al*., 2001).

7c. Undulating Oceanographic Recorder (UOR)

Undulating Oceanographic Recorder (UOR) is the generic name given to towed vehicles carrying measuring devices (usually CTDs, plankton recorders, transmissometers, *etc*.) which ascend and descend through the water column in a more or less regular pattern, giving a two-dimensional view of the water column along the towing path.

UOR measurements are usually close together in time and space, and are continuous, from the near surface layer to a maximum depth of about 500 m. To fit this dataset into the WOD format, the undulations are broken into distinct up and down casts, and all the measurements between the breaks are averaged on a minimum pressure increment of 1.0 decibar. The latitude and longitude are also averaged for each measurement, as is the date/time (preserved as Julian year-day). This averaged

metadata value is kept with each measurement of the oceanographic variables. The coordinates stored in the cast header is the position of the portion of the tow when the vehicle is at the exact middle of its ascent or descent (based on the averaged decibar increments). Some of the data received was already processed to some extent by originators and did not include latitude, longitude, or Julian year-day.

A tow can be broken into either a few up or down segments or thousands of segments. The tow number (secondary header 5) along with the Segment Number (secondary header 93) can be used to follow the progression of a tow in time, as the segment numbers correspond to the sequence of up or down undulations.

II. FILE STRUCTURE/FORMAT

The World Ocean Database (WOD) officially archived version for observed and standard level data is provided in ragged array netCDF format which follows the Climate-Forecast (CF) conventions. The CF format for contiguous ragged array and profile data representation is optimal for WOD which aggregates oceanographic casts (collections of ocean profiles for one or more variables taken at the same date, time, geographic location, and depth or pressure). Different casts can have very different counts of depth/variable pairs for each profile (from 2 to 24,000 in the WOD), and from 1 to 26 variables with separate profiles in each cast. Appendix 12 provides additional description.

All files which contain observed and standard level data are also written as a series of 80 character length ASCII records. A detailed record layout for the data can be found in Table 10 (primary header format; character data, secondary and biological header; and integrated, taxonomic and profile). There is a carriage return code after each 80 bytes (CR-LF). Each cast begins on a new line. Starting with WOD01, the first byte in a cast is a character which identifies the World Ocean Database version. If the first byte is character "C", it refers to WOD18 format, a "B" refers to WOD09 or WOD05 format, and "A" refers to WOD01 format. If the first byte is numeric, it identifies WOD98. There is one ASCII format change between WOD09 and WOD18, and only for standard level data files. Since standard levels have changed for WOD13 and WOD18 compared to all previous releases, depths are now explicitly given for each depth level, rather than implicit as for previous WOD formats. Each section of a cast (*e.g.*, primary header and variable-specific second header, character data, secondary header, biological header) begins with the number representing a total byte count for that section. If there are no data for that section, the byte count is zero. If there are data for that section which are of no interest to the user, the byte count can be used to skip over this sections.

The header includes the ISO country code (see Appendix 1 for the complete list), cruise number, position, date, time, internal unique cast number, the number of observed or standard depth levels, an identifier for observed or standard level data, number of variables, variable codes, originator's flag for observed level data only, and a flag if all of a variable's data in that cast fails a quality control check (see Table 12 for a description of the flags).

Appendix 8 shows sample data output from Cast 67064 (using the program wodFOR.f) This sample output contains temperature, salinity, oxygen, phosphate, silicate, and taxonomic / biomass data ("f" denotes the flag assigned to the variable and "o" denotes the originator's quality flag); numbers in parenthesis represent the number of significant digits in the value; "VarFlag" identifies whole profile flags for each variable).

For compactness, each variable is written as follows: STPVVVVVV[F][O], where:

S = Number of significant digits in a value;

T = Total number of digits in a value. This is usually the same as [S], but can vary in cases of negative numbers, converted values, and data in which the values are reported with more precision than an instrument is capable of recording;

P = Precision of a variable (number of places to the right of the decimal point);

V = The actual value. This is read in using [T] and [P];

F = WOD quality control flag;

O = Originators flag.

For example: A salinity value, written as [5533389100] means that S = 5, T = 5, P = 3. Using this information, there are five bytes in the salinity reading, with a precision of three, so V(sal) = 33.891, F = 0, O = 0.

A missing value in this data format is always represented with an S = '-' (the minus character). That is, when the number of significant digits is read in, the character encountered will be a negative sign. This tells the user that no value was recorded and to skip to the next value.

Table 10.1. ASCII Format for Primary Header

FIELD	LENGTH	FORMAT	DESCRIPTION
1. **WOD Version identifier**	1	A1	WOD18=WOD13 = “C”; WOD09 = “B”; WOD05 = “B”; WOD01 = "A"; if field is numeric, format is for WOD98.
2. **Bytes** in next field	1	I1	
3. **Bytes** in profile	from (2)	Integer	
4. **Bytes** in next field	1	I1	
5. **WOD** unique **cast number**	from (4)	Integer	WOD cast identification
6. **Country Code**	2	A2	ISO country codes (App 1)
7. **Bytes** in next field	1	I1	
8. **Cruise Number**	from (7)	Integer	WOD cruise number identification
9. **Year**	4	I4	
10. **Month**	2	I2	
11. **Day**	2	I2	may have a zero value
12. **Time** - if time is missing it's denoted as (-) in the Significant digits field - if so, skip to (13)			
a. Significant digits	1	I1	“-“ if time missing
b. Total digits	1	I1	not present if (a) is negative
c. Precision	1	I1	not present if (a) is negative
d. Value	based on (b)	based on (a-c)	not present if (a) is negative
13. **Latitude** - if latitude is missing it's denoted as (-) in the Significant digits field - if so, skip to (14)			
a. Significant digits	1	I1	“-“ if missing
b. Total digits	1	I1	not present if (a) is negative
c. Precision	1	I1	not present if (a) is negative
d. Value	based on (b)	based on (a-c)	not present if (a) is negative
14. **Longitude** - if longitude is missing it's denoted as (-) in the Significant digits field, if so, skip to (15)			
a. Significant digits	1	I1	“-“ if missing
b. Total digits	1	I1	not present if (a) is negative

FIELD	LENGTH	FORMAT	DESCRIPTION
c. Precision	1	I1	not present if (a) is negative
d. Value	based on (b)	based on (a-c)	not present if (a) is negative
15. Bytes in next field	1	I1	
16. Number of Levels **(L)**	from (15)	Integer	Number of depths
17. Profile **type**	1	I1	"0" Observed "1" Standard level
18. # Variables in profile **(N)**	2	I2	
*Next section repeated based on number of variables in the profile (read fields 19-23 **N** times)*			
19. Bytes in next field	1	I1	read fields 19-23 N times
20. Variable code	from (19)	Integer	WOD variable codes (Table 3)
21. Quality control flag for variable	1	I1	see Table 12
22. Bytes in next field	1	I1	
*23. Number of Variable-specific metadata **(M)***	from (22)	Integer	if zero go to 19, otherwise read fields 24-25 **M** times
*Next section repeated based on number of variable specific metadata (read fields 24-25 **M** times for each variable **(N))***			
24. Bytes in next field	1	I1	if zero go to 19
25. Variable-specific code	from (24)	Integer	see Table 5
a. Significant digits	1	I1	"-" if missing
b. Total digits	1	I1	not present if (a) is negative
c. Precision	1	I1	not present if (a) is negative
d. Value	based on (b)	based on (a-c)	not present if (a) is negative

Table 10.2. ASCII Format for Character Data, Secondary, Biological Header

FIELD	LENGTH	FORMAT	DESCRIPTION
CHARACTER DATA AND PRINCIPAL INVESTIGATOR - entries 4-9 repeated based on number read in (3)			
1. Bytes in next field	1	I1	if "0" go to Second Header
2. Total bytes for character data	from (1)	Integer	
3. Number of entries **(C)**	1	I1	
IF FIELD (4) IS 1=Originators Cruise, OR 2=Originators station code (read fields 4-6 **C** times)			
4. Type of data	1	I1	"1" orig. cruise "2" orig. cast
5. Bytes in next field	2	I2	
6. Character data	from (5)	A	
IF FIELD (4) IS 3=Principal Investigator			
4. Type of data	1	I1	always "3"
5. Number of PI names **(P)**	2	I2	read fields 6-9 **P** times
6. Bytes next field	1	I1	
7. Variable code	from (6)	Integer	WOD code (see Table 3)
8. Bytes in next field	1	I1	
9. P.I. code	based on (8)	Integer	WOD code (see file: primary_investigator_list.pdf)
SECONDARY HEADER - entries 5-10 repeated based on number read in (4)			
1. Bytes in next field	1	I1	if "0" go to Biological Header
2. Total bytes for second headers	based on (1)	Integer	
3. Bytes in next field	1	I1	
4. Number of entries **(S)**	based on (3)	Integer	read fields 5-10 **S** times
5. Bytes in next field	1	I1	
6. Second header code	based on (5)	Integer	
7. Significant digits	1	I1	
8. Total digits	1	I1	
9. Precision of value	1	I1	
10. Value	based on (8)	based on (7-9)	
BIOLOGICAL HEADER - entries 5-10 repeated based on number read in (4)			
1. Bytes in next field	1	I1	if "0" go to Profile Data
2. Total bytes for biology	based on (1)	Integer	
3. Bytes in next field	1	I1	
4. Number of entries **(B)**	based on (3)	Integer	read 5-10 **B** times
5. Bytes in next field	1	I1	
6. Biological header code	based on (5)	Integer	WOD code (see Table 6)
7. Significant digits	1	I1	
8. Total digits	1	I1	
9. Precision of value	1	I1	
10. Value	based on (8)	based on (7-9)	

Table 10.3. ASCII Format for Integrated, Taxonomic, and Profile Data

FIELD	LENGTH	FORMAT	DESCRIPTION
TAXONOMIC DATASETS AND INTEGRATED PARAMETERS - entries 3-12 repeated based on number read in (2)			
1. Bytes in next field	1	I1	if "-" go to next to next section
2. Number of taxa sets **(T)**	based on (1)	Integer	
3. Bytes in next field	1	I1	read fields 3-12 **T** times
*4. Number of entries for each taxa set **(X)***	based on (3)	Integer	
5. Bytes in next field	1	I1	read fields 5-12 **X** times
6. Taxa or integrated parameter code	based on (5)	Integer	WOD code (see Table 7)
7. Significant digits	1	I1	
8. Total digits	1	I1	
9. Precision	1	I1	
10. Value	based on (5)	based on (7-9)	
11. Quality control flag for value	1	I1	see Table 12
12. Originator's flag	1	I1	always "0" in WOD18
PROFILE DATA - all steps repeated based on number of levels **(L)** listed in the primary header			
1. Number depth significant digits	1	I1	if "-", the entire standard level data is missing skip steps 2-12 for the given level.
2. Total digits in depth	1	I1	
3. Precision of depth value	1	I1	
4. Depth value	based on (2)	based on (1-3)	
5. Depth error code	1	I1	see Table 12
6. Originator's depth error flag	1	I1	see flags associated with project (App 2.25)
7. Value significant digits	1	I1	steps 7-12 are repeated for each variable or **N** times. If "-", the measured variable is missing from the level, skip steps 8-12 for the variable.
8. Total digits in value	1	I1	
9. Precision of value	1	I1	
10. Value	based on (8)	based on (7-9)	
11. Value quality control flag	1	I1	see Table 12
12. Originator's flag	1	I1	see flags associated with project (App 2.28)

A. DESCRIPTION OF THE INTERNET PAGES AND FILES

What follows are the Internet page names and the contents of each page:

- **WOD*select*** – contains the online version of data retrieval;
- **WOD data** - contains the geographically sorted and year sorted data;
- **WOD documentation** - contains the documentation;
- **WOD codes tables** - contains codes associated with the secondary header, variable specific header, biological header, and taxa data;
- **WOD utilities** - contains the utilities necessary to convert files from DOS to UNIX format and to decompress the data;
- **WOD programs** - contains sample FORTRAN and C programs for reading the data and allow the user to convert the data to the comma separated format so it can be read into Matlab (or any other tabular program); and
- **WOD masks** – contains masks necessary for the WOD.

1. WOD*select*

WOD*select* is an online interface which allows a user to search the World Ocean Database using a variety of user-specified search criteria. The search criteria will provide a distribution map, cast, count, and the option for selecting output format of the data files (WOD native ASCII format, Comma Delimited Value (CSV) format, or netCDF format).

In this section the user builds a data retrieval request based on their choce of criteria such as geographic coordinates, observations datasets, dataset (*e.g.* OSD, CTD, XBT), measured variables (*e.g.* temperature, salinity, nutrients), biology (*e.g.* phytoplankton, zooplankton), deepest measurement, country, platform, project, institute, and data exclusion using WOD quality control flags.

2. WOD18 Data

The WOD web page contains links for the user to retrieve WOD data sorted geographically or sorted by year (time). The geographically sorted data are organized by WMO 10-degree squares. A world map with the WMO codes in each 10-degree square is provided in Appendix 7. Data chronologically sorted by year are available in the WOD18 Data directory.

In both the geographically sorted and the year sorted data subdirectories the user has the option to retrieve data by observed (O) or standard (S) level and by dataset (see Table 2 for the complete list of datasets).

3. WOD18 Documentation

The WOD documentation contains introductory and user manual (this document) documentation for accessing, reading, and using WOD18 data. All files are in Portable Document Format (PDF) format. For any questions about this product, please e-mail OCL.help@noaa.gov.

4. WOD18 Code Tables

The directory WOD code tables contain all files describing the metadata in secondary header, variable specific header, biological header, and taxa data. All code code file links are listed in the

appendices of this document. All files in this directory are Portable Document Format (PDF) and Text (TXT) documents (actually, Comma Delimited Value, CSV format).

File structure is as follows:

- Secondary Header Files are prefixed with the letter "s"
- Variable Secondary Header Files are prefixed with the letter "v"
- Biological Header files have the prefix "b"
- Taxonomic files have the prefix "t"
- All other files are given their unique names (*e.g.* country_list.pdf)

5. WOD18 Utilities

The WOD utilities directory contains the utilities necessary to convert files from DOS to UNIX format and to decompress the data. It contains two **GZIP** files needed for decompressing the WOD18 data. **GZIP** is a single-file/stream lossless data compression utility, where the resulting compressed file generally has the suffix .gz (See GNU Gzip). **GZIP** can be found on the main GNU ftp server via HTTP and via FTP. It can also be found on the GNU mirrors; please use a mirror if possible.

GZIP:

There are two utilities used for decompressing the zipped data files. The first (gzip124.exe) is a self-extracting DOS executable and the second (gzip124.tar) is a tar'd file containing source code for UNIX users.

*a. Installing **gzip** For the First Time*

DOS Users: The file gzip124.exe is a self-extracting DOS executable. Copy gzip124.exe to your hard disk; preferably into a directory listed in your path. Run gzip124.exe and use the file gzip.exe to uncompress WOD18 data as described below.

UNIX Users: Copy gzip124.tar to your UNIX system and run the following commands: tar xvf gzip124.tar

These commands will create a directory named gzip124 which include the gzip source code and documentation on copyrights, compression methods, and how to compile and install the **gzip** code. The readme file contains instruction on how to execute **gzip**.

b. Decompressing Data from WOD18

To decompress the WOD18 files, it is easier to copy the files to the hard disk. Use **gzip** to decompress selected files or a directory and all subdirectories with one command.

gzip has a limited help menu accessible with the -h option (*i.e.*, **gzip** -h)

To decompress a single file: gzip -nd <filename>

To decompress the contents of a directory and all subdirectories: gzip -dr <directoryname>

If an older version of **gzip** is used, the -n option is required in order to preserve the correct file names.

6. WOD18 Programs

The directory WOD programs contains sample programs, written in FORTRAN (Formula Translation general-purpose programming language) and C, for reading the data (wodFOR.f, wodC.c). Another FORTRAN program (wodASC.f) has an option to output the sample data in either tabular column or comma separated columns (also known as comma separated values, csv) format which can be read by MatLab, GRAPHER, Generic Mapping Tools (GMT), or other graphical packages.

The following are sample converters from the WOD format to other formats.

Program converter	Description
wod_nc.f	sample FORTRAN program for reading WOD ragged array netCDF files
readFOR.txt	readme file describing wodFOR program
sampFOR.txt	sample of output from wodFOR.f
readASC.txt	describes the use of wodASC.f
wodASC.f	outputs a user selected variable in either tabular or comma separated columns
wodASC.exe	executable for wodASC.f program
sampASC.txt	sample output data from wodASC.f
wodSUR.f	writes surface-only data out in a comma-separated-value (CSV) format
wodSUR.exe	DOS-compatible executable for wodSUR.f
sampSUR.txt	sample of output from wodSUR.exe
instructions from WOD to csv	instructions to convert WOD format to ArcMap readable 'csv' format
csvfromwod.c (β-version)	C program for convertion data from WOD format to ArcMap readable 'csv' format
csvfromwod.exe	executable for C program
ArcGIS tutorial	tutorial to convert 'csv' files in to shapefiles and upload it in ArcMap
readC.txt	readme file describing the wodC program
wodC.c	sample C program for reading the data
wodC.exe	executable for C program
wodtodepthmatrix_info.txt	info file describing the wodtodepthmatrix.c program
wodtodepthmatrix.c	sample C program for reading the data
wodtodepthmatrix.exe	executable for wodtodepthmatrix.exe program (for Windows 64bit system)

7. WOD18 Masks

The following WOD masks are used as part of the WOD.

range_area.msk	ocean areas for each set of variable min/max ranges
range_basin_list.msk	range basins list
sd_multiplier.msk	5-degree standard deviation multiplier

B. SYSTEM REQUIREMENTS

- No specific requirements.
- Using the Ocean Data View (ODV) software has additional requirements, which are addressed at the ODV web site. The latest ODV version at the time of this writing is ODV 5.1.2 (released October 02, 2018).

III. QUALITY CONTROL PROCEDURES

Data received by NCEI, through the IODE Global Ocean Data Archeology and Rescue (GODAR) project, the Global Ocean Database project, the Global Temperature and Salinity Pilot Project (GTSPP), the NCEI data archives, or other sources, are put through a set of quality control procedures to ensure that 1) the data are converted to the WOD format correctly, 2) the data format provided with the data is correct and the data have not been corrupted in transmission, 3) only one copy of data at each cast is retained in the WOD format, and 4) the data, as initially collected and processed, are of good quality.

The OCL continues to quality control the data and requests input from the users as to possible problems identified when using the data. As these problems are corrected, the updated casts will be placed online and the changes documented.

Some data are included in WOD18 even though all the quality control steps were not fully applied. These are pCO_2, DIC, geochemical tracers, plankton (we are in the process of building up the database and have insufficient data to date), oxygen from PFL (data not presently used in the objective analysis), chlorophyll from CTDs, and UORs. In addition, nitrite was excluded from the database since the data were not examined to ensure their quality. Air pressure, Julian year-day, latitude, and longitude, included as variables for the sole purpose of identifying the surface-only, APB and UOR data, were not quality controlled beyond basic range checks.

WOD includes quality control flags that are set during automatic and subjective quality control steps in the calculation of WOA18 climatologies. There are quality control flags with each measurement and for each profile. A complete list of WOD quality control flags and their definitions is provided in Table 12.

In addition to the WOD quality control flags, there are quality control flags provided by data submittors (*i.e.*, originator's flags). The only datasets with included originator's flags are those associated with the GTSPP, WOCE, CalCOFI (all data since August 1996), PMEL TAO and PIRATA

data, Argo, OMEX, and GEOSECS projects, as well as some smaller datasets (Appendix 2.28 lists the originators flags and their associated project or accession number). The originator's flags were included with the observed level data only.

A. QUALITY CONTROL OF OBSERVED LEVEL DATA

1. Format conversion

When data are received at the NCEI/OCL, the first step, after assigning a NCEI accession number, is to convert the data into the OCL internal format. Some of the checks during format conversion include calculation of the number of significant digits, identification of time zone used (GMT or local), and checking the consistency of the originator's data format. Additionally, where originator's data units differ from the standard WOD units, data are converted to the standard WOD units (Table 3). After conversion to WOD format, data are checked and compared with the original data for accuracy in the data conversion. If/when problems with data are noted, the data originator is contacted when possible.

2. Check cast position/date/time

Converted data are checked for metadata integrity - incorrect/missing latitudes, longitudes, time, and dates. Questionable values are compared with the original data to make sure that problems are not introduced during the conversion process. If the incorrect datum is found in the original data, the data submittor is notified of the error and a correction is requested when possible.

3. Assignment of cruise and cast numbers

Once cast positions and dates are checked, unique cruise numbers are assigned. In some cases, data cannot be clearly identified as having been collected on a single cruise (*e.g.* data collected by a single ship over a prolonged period of time). In these cases, cruises are defined by OCL data scientists (if/when not provided on request by the data originator). A general definition is that a cruise is comprised of casts for which the time difference between any two casts is <20 days. This definition is a guideline, as some datasets necessitate a smaller break period, and others a longer period. Some data which have nonspecific platforms (*e.g.* airplane or ice-camp) are not amenable to this treatment. If no platform or primary investigator information is provided, a cruise number of zero (0) is assigned to denote the absence of cruise information.

All submitted casts are assigned a sequential number which is unique to that cast. This unique cast number allows the OCL to identify and record any changes made to the cast, as well as cast deletion. Note, this internal unique cast number is not the originator's cast number. The originator's cast number is kept in its original form.

4. Speed check

Following assignment of cruise numbers, the entire cruise is mapped out and the speed between casts is calculated. If the speed between adjoining casts is unrealistic, the date/time may be in error, the position may be wrong, or the cast may not belong to this cruise/platform. These problems, when encountered, are noted and the submittor contacted to decide on a course of action. Due to lack of time and resources, not every single cruise was checked and therefore some groupings of casts may not represent a cruise as defined here.

5. Duplicate cast checks

Upon completion of these preliminary quality control checks, extensive duplicate checks are performed – first internal to the new dataset, and then the data is checked against the existing WOD databases. Duplicates are a continuous problem with any historical database. While exact duplicate profiles are easy to identify and remove, "near" duplicates are more difficult to detect. Such duplicates can result from receiving the same data from different sources, where key metadata variables such as latitude, longitude, or date/time were treated differently. As the procedures for identifying duplicate casts improve, more of these "near" duplicate casts continue to be identified and eliminated.

Duplicate checks involve identifying casts with:

- same position/date/time
- position/date/time within some small offset
- same originator's cast numbers within a cruise
- same profile data
- same taxonomic data

Below are the general types of duplicates which were found to occur:

Identical or nearly identical profiles – two or more profiles which contain the same variable with identical values at each depth. Frequently, positions or times of such profiles may be slightly different (depending on the accuracy to which latitude/longitude/time were provided in the original data submissions). Sometimes larger differences in time (up to a one day offset) may also take place when time is provided in GMT in one dataset and in local time for the other.

Identical casts – two or more casts from the same location, date and time, but with different variables or different values. When values are different, the casts may contain identical profiles that were handled differently by an intermediate data center or investigator (*e.g.* using different storage criteria with XBT's or CTD's, or interpolating the observed data to standard levels). When variables are different between two casts which are otherwise identical, this may be due to cases in which data were submitted separately. Therefore variables from these casts are combined (see *Special Case: merging profiles* below).

Overlapping Cruises – two or more cruises with the same platform code that overlaps in their starting and ending dates. In most cases, the overlapping cruises are duplicated and have already been detected by the previous two checks. In others cases, the difference in positions is so great that the standard position check does not detect the duplicated casts (*e.g.* a missing "+/-" for latitude would give two casts (or set of casts), collected from the same platform with the same times and data values, in both the northern/southern or eastern/western hemispheres).

When duplicates are found, the "better" cast is retained within the database, and the other cast is marked for removal. In general, the retaining (*i.e.* "better") cast has more depth levels, additional variables, or data at a higher precision. Preference is given to the original observed level data over interpolated. As a rule, data obtained directly from the originator have preference over data that have passed through many users/processors, and possibly lost/changed precision or other information along the way.

Special Case: merging profiles within the same cast

In some cases, different variables from the same oceanographic cast have been submitted to

the NCEI at different times or from different sources. The most common example of this is when biological data (*e.g.*, pigments, plankton measurements) are submitted for previously processed ocean cast data, which already loaded into WOD databases. Through the efforts of the GODAR project and the Global Ocean Database project, many casts containing chlorophyll, nutrient, and plankton data have been acquired from the source Institutions and/or digitized, and combined with existing data in WOD.

Information such as date, position, time, platform, and originator's cast number and/or cruise identifier is used to match up incoming casts with existing casts. Frequently, the match-up is obvious (*e.g.* the same ship is in the exact position on the same day, and the depth levels of the existing data correspond exactly to the incoming data). When the match-up is less obvious, efforts are made to determine whether this match is appropriate or not by reviewing the documentation, comparing cruise tracks, or contacting the data originator, if possible.

When an appropriate match is made, the data are merged into one single cast which has all of the data and metadata of the previous two casts. When a match is uncertain, but platform, position and dates are very close, the casts are left separate and assigned the same WOD cruise number so the data will at least remain grouped by cruise number.

6. Depth inversion and depth duplication checks

Depth inversions and duplication of depths were found in some profiles. A depth inversion occurs when an observation has a shallower depth than the observation directly preceding it. A depth duplicate is a reading which has the same depth as the reading immediately before it. In either case the second observation was always flagged, rather than trying to evaluate the data. Table 12 lists the flags assigned to the data. If, after an inversion or duplication, the next two depth observations were still shallower than the first reading, this observation and all subsequent observations were flagged. This usually occurred when two or more profiles have been sequentially entered together into a digital file with no separating header information between them. After this check, casts submitted with depths in reverse order (deeper depth first) were sorted so shallowest depth will appear first.

Depth error flags are assigned if:

a) The second of two successive depths is shallower than the first (a depth inversion), the second depth will be marked with a flag value = 1.
b) Three successive depths are shallower than the first depth, every depth reading in the profile following the first will be marked with a flag value = 1.
c) Two successive depth readings are equal, the second reading will be marked with a flag value = 1.

All correct depths are marked with a flag value = 0.

7. High-resolution pairs check

The high-resolution pairs check is implemented to ensure whether or not any incoming data have matches in the existing bottle (OSD) and/or high-resolution (CTD) datasets. This check is performed to link the data acquired during the oceanographic cast when bottle samples and CTD data taken at the exact same time and location. The check is done on incoming OSD or CTD data with temperature, salinity, and/or oxygen. The measured parameters itself are not checked. If there are

high-resolution pairs found, the necessary secondary header code for “High-Res Pair” (see Table 4, code 13) is placed in both OSD and CTD datasets for paired casts.

8. Range checks on observed level data

Range checks are used to screen the data for extreme values. Broad ranges have been established as a function of depth and oceanic basins (shown in Figure 1) for each variable. The range for a variable, in each region, is set large enough to encompass variations for all seasons and years. Ranges were determined using frequency distributions, statistical analysis, literature values, and atlases (*e.g.* GEOSECS (Bainbridge, 1980; Craig *et al.*, 1981, Spencer *et al.*, 1982), Southern Ocean Atlas (Gordon *et al.*, 1982, Wyrtki, 1971)). Observed level data were compared with these ranges, and outliers were flagged with a range outlier flag. Table 11 lists the variables contained in the WOD18, the standard WOD units, and the Appendices containing the ranges set for these variables. The ranges in these appendices do not represent the minimum and maximum values in the basins, but rather indicates extent of values beyond which the data are believed to be erroneous.

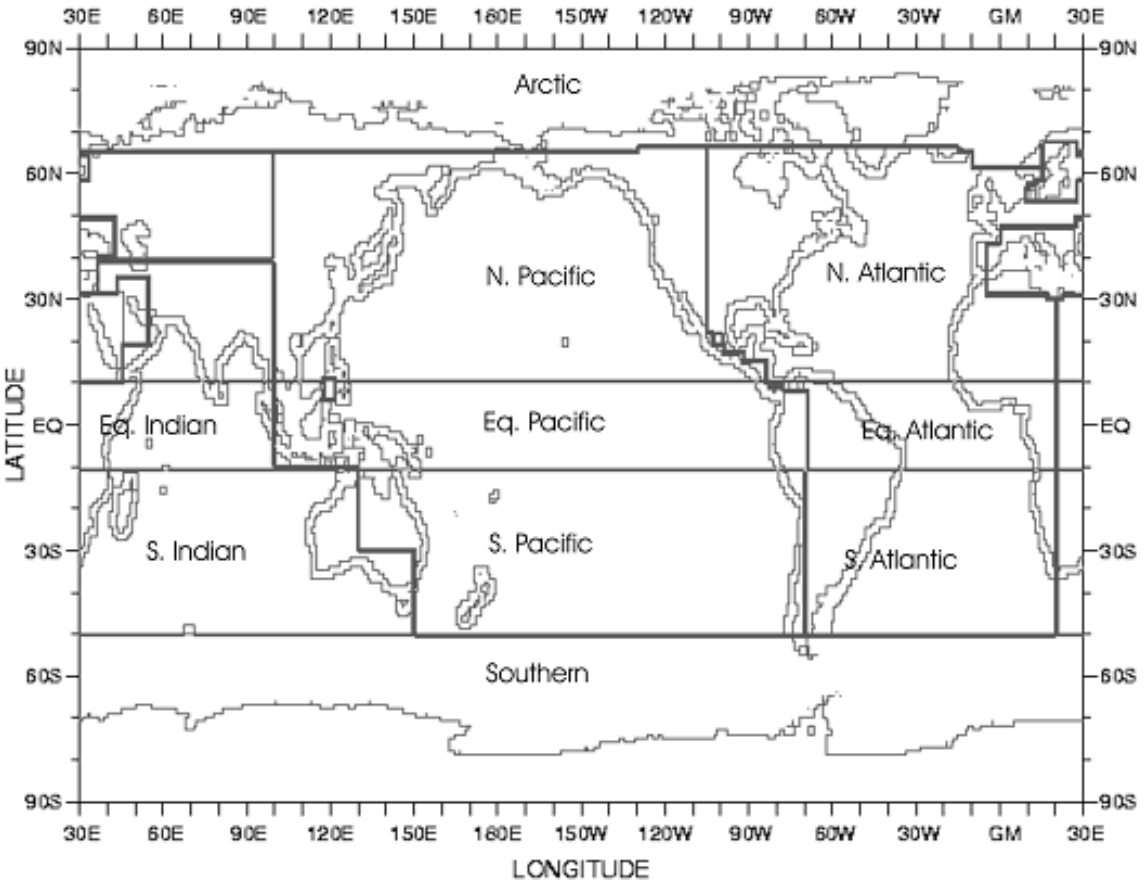


Figure 1. Geographic boundaries of ocean basin definitions in WOD18.

The range area mask (range_area.msk) and range basin list (range_basin_list.msk) area available as ASCII text files on the WOD masks page on the WOD website.

9. Excessive gradient checks

For each variable in Table 11, a check was made for "excessive decreases and increases in a value over a depth range", or excessive gradients. A gradient was defined as:

$$gradient = \frac{v_2 - v_1}{z_2 - z_1} \qquad \text{(Equation 1)}$$

where

v_1 = the value of the variable at the current depth level
v_2 = the value of the variable at the next depth level
z_1 = the depth (meters) of the current depth level
z_2 = the depth (meters) of the next depth level

Table 11. Data Ranges for Quality Control Individual Variables in WOD18

Code	Variable (nominal abbreviations)	Standard unit or scale (nominal abbreviation)	Appendix
1	Temperature	Degree Celsius (°C)	9.1
2	Salinity	Dimensionless (unitless)	9.2
3	Oxygen	Micromole per kg (µmol kg^{-1})	9.3
4	Phosphate	Micromole per kg (µmol kg^{-1})	9.4
6	Silicate	Micromole per kg (µmol kg^{-1})	9.5
8	Nitrate and Nitrate+Nitrite	Micromole per kg (µmol kg^{-1})	9.6
9	pH	Dimensionless	9.7
11	Total Chlorophyll [Chl] unless specified	Microgram per liter (µg·l^{-1})	9.8
17	Alkalinity [TALK]	Micromole per kg (µmol kg^{-1})	9.9

Two types of gradients were checked, and marked as follows:

- Excessive Gradients - a negative gradient, *i.e.* an excessive decrease in the value over depth. The criteria used to define "excessive" for each variable are listed in Table 13. Any value which exceeded this "maximum gradient value" (MGV) was marked with a gradient flag.
- Excessive Inversions - a positive gradient, *i.e.* an excessive increase in value over depth. These criteria are presented in Table 13. Data which exceeded the "maximum inversion value" (MIV), were marked with an inversion flag.

MGV/MIVs were determined from literature and/or by objectively reviewing the trends of the variable within the data. To better accommodate the differences in gradient ranges between surface and deep water (*e.g.* due to physical or biochemical influence), a different set of MIV/MGVs were used for depths above and below 400 meters. When dealing with high-resolution instruments (*e.g.* HCTD, XBT), a minimum depth difference of 3.0 meters was used when calculating the gradients (Equation 1).

Table 12. Definition of WOD Quality Flags

(1) FLAGS FOR ENTIRE CAST (AS A FUNCTION OF VARIABLE)	
0	accepted cast
1	failed annual standard deviation check
2	two or more density inversions (Levitus, 1982 criteria)
3	flagged cruise
4	failed seasonal standard deviation check
5	failed monthly standard deviation check
6	failed annual and seasonal standard deviation check
7	bullseye from standard level data or failed annual and monthly standard deviation check
8	failed seasonal and monthly standard deviation check
9	failed annual, seasonal and monthly standard deviation check
(2) FLAGS ON INDIVIDUAL OBSERVATIONS	
(a) Depth Flags	
0	accepted value
1	duplicates or inversions in recorded depth (same or less than previous depth)
2	density inversion
(b) Observed Level Flags	
0	accepted value
1	range outlier (outside of broad range check)
2	failed inversion check
3	failed gradient check
4	observed level “bullseye” flag and zero gradient check
5	combined gradient and inversion checks
6	failed range and inversion checks
7	failed range and gradient checks
8	failed range and questionable data checks
9	failed range and combined gradient and inversion checks
(c) Standard Level Flags	
0	accepted value
1	bullseye marker
2	density inversion
3	failed annual standard deviation check
4	failed seasonal standard deviation check
5	failed monthly standard deviation check
6	failed annual and seasonal standard deviation check
7	failed annual and monthly standard deviation check
8	failed seasonal and monthly standard deviation check
9	failed annual, seasonal and monthly standard deviation check
(d) Biological data flags (applied only to Comparable Biological Value - CBV Taxa code 27)	
0	accepted value
1	range outlier (outside of broad range check)
2	questionable value (“bullseye flag”)
3	group was not reviewed
4	failed annual standard deviation check

Table 13. Maximum depth gradient and inversion factors used for WOD18

VARIABLE	MIV (Z<400m)	MGV (Z<400m)	MIV (Z>400m)	MGV (Z>400m)	ZSI
Temperature	0.300	0.700	0.300	0.700	5.000
Salinity	9.000	9.000[1]	0.050	0.050	5.000
Oxygen	43.570	43.570	32.677	32.677	87.140
Phosphate	0.967	0.967	0.488	0.488	2.439
Silicate	4.878	4.878	3.415	3.415	2.927
Nitrate	0.976	0.976	0.488	0.488	2.439
pH	0.400	0.400	0.200	0.200	2.000
Chlorophyll	1.000	1.000	0..250	0.250	2.000
Alkalinity	0.300	0.100	0.050	0.050	2.000
NO_2NO_3	0.976	0.976	0.488	0.488	2.439

[1]For all variables, the MGV/MIV ranges (Z<400m), where Z denotes depth, were set high enough to exclude only values which are grossly incorrect. For salinity, these ranges are so large as to be nearly irrelevant for these checks.

In addition, data were checked to distinguish *zero as a value* versus *zero as a missing-value- indicator*, particularly in the historical nutrient data. The zero sensitivity check will flag a zero value if a gradient decreases to zero at a rate greater than the MGV * ZSI (zero sensitivity indicator). For example, if ZSI is 2.00, the gradient must be twice as large as the MGV for that depth range. These values were assigned a flag = 4, equivalent to an observed level flag.

10. Observed level density checks

Density checks were run on the observed level data to locate density inversions. This check was not used to flag temperature and salinity data from subsequent quality control, but was used to get an estimate of data quality prior to interpolation to standard levels. The check is the same as described in Section B.12, *Standard level density check*, except the values are divided by the depth difference between adjacent levels unless the difference is less than 3 meters, in which case a difference of 3 meters is used.

11. Vertical interpolation method

Prior to the next step in the quality control procedure, the data are interpolated from observed levels to standard depth levels (listed in Appendix 9). Any data flagged as range outliers, excessive gradients, inversions, or depth errors were not used during interpolation to standard levels. This was applied when possibly during interpolation to standard levels.

The interpolation scheme used is a modification from that described by Reiniger and Ross (1968) and noted by UNESCO (1991) as being in common usage. This scheme uses four observed values surrounding the standard level in question – the two closest shallower values and the two closest deeper values. The closest shallower and deep values ("inside" values) and the two farthest shallow and deep values ("outside" values) must be within the depth difference criteria shown in Appendix 10. The first set of depths in this table is the maximum distance between the depths of the "inside values". The second set of depths applies to the maximum distance between the depths of the “outside values”. This interpolation scheme has the advantage over three point Lagrangian interpolation of being less susceptible to extremes when a large gradient is encountered since two

separate three-point Lagrangian interpolations are averaged and then fit to a reference curve.

If all the above criteria are met, the variable value at the standard depth level is set by the Reiniger and Ross (1968) interpolation method. If there are not enough surrounding values within acceptable distances, three point Lagrangian interpolation is performed on the value above and two values below the level in question, or on the two values above and one value below depending on the number of observations above or below the selected depth.

Modifications to the Reiniger and Ross (1968) method are the following:

a) If the Reiniger and Ross interpolated value does not fall between the observed values directly above and below it, linear interpolation is substituted;

b) If any observed value is recorded within 5 meters of the sea surface, this value is used as the surface value;

Direct substitution (observed level depth equals the standard level depth) and the Reiniger and Ross (1968) interpolation account for most of the standard level values.

B. QUALITY CONTROL OF STANDARD LEVEL DATA

12. Standard level density check

A standard level density check was used to eliminate spurious inversions due to interpolation (Levitus *et al.*, 1994). Each profile was checked for static stability using Hesselberg and Sverdrup's (1914) definition. The computation is a local one in the sense that adiabatic displacements between adjacent temperature-salinity measurements in the vertical are considered rather than displacements to the sea surface. The procedure for stability (E) computation follows that used by Lynn and Reid (1968):

$$E = \lim_{\delta z \to 0} \frac{1}{\rho_0} \frac{\delta \rho}{\delta z}, \qquad \text{(Equation 2)}$$

where ρ_0 = 1.02 g·cm^{-3} and z is depth in meters. As noted by Lynn and Reid (1968) the term is "the individual density gradient defined by vertical displacement of a water parcel". For discrete samples, the density difference ($\delta\rho$) between two samples is taken after the deeper sample is adiabatically displaced to the standard level of the shallower depth. $\delta\rho$ is then simply the displaced sample's density minus the shallower sample's density. Densities were calculated using the IGOSS standard density equation (Fofonoff *et al*., 1983) on interpolated temperature and salinity data. An inversion was defined as anywhere the $\delta\rho$ was less than zero. For observations with a deeper sampling depth of 30 meters or less, an inversion of 3×10^{-5} g·cm^{-3} was considered an indication of a problem with the data. The temperature and salinity at both of these depths were flagged. For observations with a deeper sampling depth between 50 and 400 meters an inversion of 2×10^{-5} g·cm^{-3} was considered excessive. For depths greater than 400 meters any inversion greater than 10^{-6} g·cm^{-3} was considered excessive. If two or more such density inversion were found in one profile, all temperature and salinity values were flagged as unusable for this profile.

13. Statistical analysis of data at standard depth levels

Observed level data were interpolated to standard levels, averaged by five-degree-squares,

and simple statistics (mean, standard deviation, and number of observations) were computed for each depth level. Each five-degree square box was designated coastal, near coastal, or open ocean, depending on the number of one-degree by one-degree latitude-longitude grid boxes in the five-degree box which were land areas. The five-degree standard deviation multiplier file (sd_multiplier.msk) is available on the WOD masks page of the WOD website.

Standard level data were flagged as follows:

a) Coastal: The standard level data value exceeds 5 standard deviations computed within the 5x5 grid in the upper 50 m;
b) Near-coastal: The standard level data value exceeds 4 standard deviations computed for 5x5 the grid in the upper 50 m;
c) Open ocean: The standard level data value exceeds three standard deviations computed for the 5x5 grid, except when a profile was at or below the average depth level for the one-degree box in which it was contained, or any of the adjacent one degree boxes, then 4 standard deviations were used;
d) If a cast contains four or more standard deviation failures, the whole cast is flagged.

The reason for varying the standard deviation criterion is the expected high variability in shallow coastal areas due to river runoff and other factors. Also, high variability within a five-degree box near the ocean bottom can occur if the five-degree square box contains portions of two basins, *e.g.*, the mid-Atlantic ridge separating east and west Atlantic waters. This check was only performed if there were five or more observations at this depth in the grid box. The standard deviation check was applied twice to the data and then new five-degree square statistics were computed to produce a new "clean" dataset.

14. Objective analysis

Following the statistical check, standard level data were averaged by one-degree squares for input to the objective analysis (Boyer *et al.*, 1998). The initial objective analyses for each variable at standard depth levels usually contained some large-scale gradients over a small area, or so-called “bullseyes”. These unrealistic features generally occurred because of the difficulty in identifying non-representative values in data sparse areas. “Bullseyes” and other questionable features are investigated and are flagged by identifying the profile or individual data points that created each unrealistic feature. In some extreme cases, entire cruises were flagged. These flags were applied to both the observed and standard level data. “Bullseyes” were investigated using property-property plots (*e.g.* temperature against dissolved oxygen), or variable as a function of depth and season within regional basins.

IV. XBT DEPTH-TIME EQUATION

Since the XBT system does not measure depth directly, the accuracy of the depth associated with each temperature measurement is dependent on the equation that converts to depth the time elapsed since the probe enters the water. Unfortunately, problems have been found in various depth-time equations used since the introduction of the XBT system.

The original depth-time equation developed by Sippican for their T-4, T-6, T-7, and Deep Blue models underestimates the probe's fall rate. At a given elapsed time, the falling probe is actually deeper than indicated by the original equation. Thus, the water temperatures are associated by the original equation with depths that are shallower than the actual depths at which they are measured. The error, first documented by Flierl and Robinson (1977), increases with increasing elapsed time reaching 21 meters, or about a 2.5% error, for depths around 800 meters. Sippican's original equation was used by TSK for their T-4, T-6, T-7, and Deep Blue models, and by Sparton for their XBT-4, XBT-6, XBT-7, XBT-7DB, XBT-20, and XBT-20DB models. Although 2.5% in depth seems a small error, it can lead to overestimates of as much as 6% when calculating ocean heat content (Willis, 2004).

In 1994, Hanawa *et al*. published an International Oceanographic Commission (IOC, 1994) report detailing a large study of XBT fall rates using different probes manufactured by Sippican and TSK and dropped in different geographic locations. A new depth-time equation, the Hanawa *et al*. equation, was given, as well as an algorithm for correcting depths for existing data collected using the original equation. The report emphasized the need to continue to archive existing data with the original depth equation only, applying the correction when necessary for scientific research.

Sparton XBT-7 probes were studied by Rual *et al*., (1995, 1996). It was determined that the Hanawa *et al*. equation was suitable for use with these probes.

Thadathil *et al*. (2002), however, suggest that the Hanawa *et al*. equation is not valid for measurements in high-latitude low temperature waters.

Following the IOC 1994 report of Hanawa *et al*. (1994), TSK altered their software between January and March 1996 to make the Hanawa *et al*. equation the default equation (Greg Ferguson, personal commmunication). Sippican did the same around August 1996, (James Hannon, personal communication). However, a universal switch to the new software has not been made. As of mid-2005, data from XBT drops are recorded using both the original and Hanawa *et al*. depth-time equations.

Kizu *et al*. (2005) published a new depth-time equation for the TSK T-5 probes, but no software has been released with their equation.

Corrections to the depth-time equations for air dropped XBT probes (AXBT) manufactured by Sippican and Sparton were calculated by Boyd (1987) and Boyd and Linzell (1993b) respectively.

More recently, Gouretski and Koltermann (2007) found that using the Hanawa equation still left a time and depth dependent bias, largest in the 1970s, smallest in the late 1980s-early 1990s, when most of the tests used by Hanawa were performed. Levitus *et al*. (2009) refined Gouretski and Koltermann (2007) statistics for the XBT bias and extended them through 2012

CORRECTIONS TO XBT DEPTH-TIME EQUATION ERRORS

Before the various depth-time equations errors were widely known, a significant amount of data were recorded and archived without notation of what type of expendable probe was used. Approximately 55% of XBT temperature profiles in WOD18 have an instrument code of "XBT, type unknown". Of these, most are positively identified as coming from shipboard drops. The remaining casts were dropped from unknown platforms. These missing ancillary metadata make it very hard to know whether the reported depths for a particular XBT profile were obtained with an incorrect depth-time equation.

In the present, many XBT data are still recorded and archived with no indication of the depth-time equation used. This is particularly critical now, since there is more than one depth-time equation in use for many XBT types.

The XBT data in the WOD18 at observed levels retain the depths received from the data submitter. For pre-1996 data, if second header code 33 has a value of "1", the submitter corrected the depths based on a recalculated depth-time equation, otherwise second header 33 is absent. For XBT profiles taken on or after Jan. 1, 1996, second header 33 will be set to "0" if the depths were calculated using the original manufacturers depth-time equation, a "1" if the Hanawa *et al*. (1994) depth-time equation was used to calculate the depths. Second header code 33 is not present if the depth-time equation used is unknown for all data taken on or after Jan. 1, 1996.

The XBT data in the WOD18 interpolated to standard levels uses the appropriate corrected depth equation when possible and the appropriate bias correction from Levitus *et al*. (2009). Since more than half of all XBT profiles are of type unknown, a test was applied to these data to see if a depth correction was necessary. If the greatest reported depth is less than 840 meters, the largest realistic depth for the probes with underestimated fall rates, the depths were corrected using the Hanawa *et al*. equation. It was assumed that, following the IOC recommendation, data available in the WOD18 was received at NCEI with depths calculated using the original equations unless otherwise noted.

The above assumption is not always valid for data collected since new depth-time equations became available on recording software released by each XBT manufacturer. For data collected since January 1996, if the depth-time equation used was not noted, the data were not corrected when interpolating to standard levels and were marked so as not to be used for depth sensitive calculations. Of a total of 300,434 XBT drops during the relevant time periods, there are 78,494 drops without depth-time equation information.

An attempt to ascertain the depth-time equation information was made by contacting the data originators. Most of the data originators are large data centers and the information could not be recovered. The actual values of the reported depths can be used to recognize the depth-time equation used, when the full depth trace is reported (Donald Scott, personal communication). Although most data received at NCEI comes with only selected depth levels, when possible, this technique was used.

Secondary header 54 contains information on our decision as to whether the depths need correction for each XBT given the criteria listed above. This secondary header also carries information on exactly which corrected depth-time equation should be used to recalculate the reported depth values. Second header 54 is set to "-1" if there is not enough information to know whether a correction is necessary, "0" if no correction is necessary, and a positive value denotes which depth

correction needs to be applied to the given observed depths. (See file s_54_needs_depth_fix.pdf for information on code table and how to correct depths.)

IMPORTANT: THE OBSERVED LEVEL XBT DATA IN WOD18 ARE THE SAME DATA AS SUBMITTED BY THE ORIGINATORS. IF YOU ARE USING OBSERVED LEVEL XBT DATA FROM WOD18, PLEASE USE SECONDARY HEADER 54 TO SEE WHETHER A DEPTH CORRECTION IS NECESSARY.

THE STANDARD LEVEL XBT DATA IN WOD18 WERE PREPARED, WHEN NEEDED AND POSSIBLE, USING A CORRECTED DEPTH-TIME EQUATION. IF YOU ARE USING STANDARD LEVEL XBT DATA FROM WOD18, PLEASE USE SECONDARY HEADER 54 TO SEE WHETHER A CORRECTED DEPTH-TIME EQUATION WAS USED, A CORRECTION WAS NOT NEEDED, OR A CORRECTION COULD BE NEEDED BUT THERE WAS NOT ENOUGH INFORMATION.

THE XBT AND MBT DATA AT STANDARD LEVELS WERE ALSO CORRECTED FOR TEMPERATURE BIAS, AFTER LEVITUS *ET AL.* (2009). THE CORRECTIONS ARE YEAR AND DEPTH DEPENDENT AND ARE SHOWN ON THE XBT BIAS DEPTH AND TEMPERATURE CORRECTIONS PAGE AND THE MBT BIAS DEPTH AND TEMPERATURE CORRECTIONS PAGE OF THE NCEI WOD/OCL PRODUCTS WEB PAGES. THERE ARE A NUMBER OF DIFFERENT XBT CORRECTIONS IN THE PUBLISHED CORRECTIONS ASIDE FROM THE LEVITUS CORRECTIONS. WODselect ALLOWS DOWNLOAD OF DATA USING EACH OF THE CORRECTIONS DETAILED IN THE ABOVE PAGE FOR OBSERVED LEVEL DATA. NO BIAS CORRECTIONS WERE MADE TO OBSERVED LEVEL DAT IN THE YEARLY OR GEOGRAPHICALLY SORTED DATA.

V. FREQUENTLY ASKED QUESTIONS

Answers to commonly asked questions about the World Ocean Datbase are found on our WOD FAQ web page.

VI. LIST OF ACRONYMS AND WEB LINKS USED IN THE DOCUMENTATION

Note: all Internet links as shown were checked at the time of publication (September 2018)

APB	Autonomous Pinniped Bathythermograph
APEX	Autonomous Profiling Explorer
Argos DCS	Argos Data Collection System
Argo PFLs	Argo profiling floats
BT	Bathythermograph
BODC	British Oceanographic Data Center
CalCOFI	California Cooperative Oceanic Fisheries Investigation
CTD	Conductivity, Temperature, Depth probe
DBT	Digital Bathythermograph
DOI	Digital Object Identifier
DRB	WOD designation for drifting buoy data
ESDIM	Environmental Science Data and Information Management
FSU	Former Soviet Union
GODAR	Global Oceanographic Data Archaeology and Rescue Project
GTSPP	Global Temperature-Salinity Profile Project
ICES	International Council for the Exploration of the Seas
IGOSS	Integrated Global Ocean Services System
IOC	Intergovernmental Oceanographic Commission
IODE	International Ocean Data Exchange
ITIS	Integrated Taxonomic Information System
JAMSTEC	Japan Agency for Marine-Earth Science and Technology
JGOFS	Joint Global Ocean Flux Studies
MARNET	Marine Environmental Monitoring Network in the North and Baltic Seas
MRB	WOD designation for moored buoy data
MBT	Mechanical Bathythermograph
NCAR	National Center for Atmospheric Research
NCEI	National Centers for Environment Information
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NODC	National Oceanographic Data Center (now part of NCEI)
OCL	Ocean Climate Laboratory
ODV	Ocean Data View
OMEX	Ocean Margin Exchange Project
OSD	WOD designation for Ocean Station Data

OWS	Ocean Weather Station
P-ALACE	Profiling Autonomous Lagrangian Circulation Explorer
PFL	WOD designation for Profiling Float data
PIRATA	Moored Buoy Array in Tropical Atlantic
PMEL	Pacific Marine Environmental Laboratory
PRIME	Plankton Reactivity in the Marine Environment
PSS	Practical Salinity Scale
TAO	Tropical Atmosphere-Ocean
TSN	Taxonomic Serial Number
TOGA	Tropical Ocean-Global Atmosphere
TRITON	Triangle Trans-Ocean Buoy Network
SOLO	Sounding Oceanographic Lagrangian Observer (Profling Float)
STD	Salinity/Temperature with Depth
TAO	Tropical Atmosphere-Ocean
UCAR	University Corporation for Atmospheric Research
UKHO	United Kingdom Hydrographic Office
UOR	Undulating Oceanographic Recorder dataset
WOA94	World Ocean Atlas, 1994
WOCE	World Ocean Circulation Experiment
WOD98	World Ocean Database 1998
WOD01	World Ocean Database 2001
WOD05	World Ocean Database 2005
WOD09	World Ocean Database 2009
WOD13	World Ocean Database 2013
WOD18	World Ocean Database 2018
WDS	World Data Servise for Oceanography, USA
WMO	World Meteorological Organization
XBT	Expendable Bathythermograph

VII. REFERENCES AND FURTHER READING LIST

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APPENDIX 1. ISO COUNTRY CODES

CODE	COUNTRY NAME	CODE	COUNTRY NAME
DE	GERMANY	PT	PORTUGAL
DU	EAST GERMANY	RO	ROMANIA
AR	ARGENTINA	GB	GREAT BRITAIN
AU	AUSTRALIA	CN	CHINA
AT	AUSTRIA	SE	SWEDEN
BE	BELGIUM	TH	THAILAND
BR	BRAZIL	TN	TUNISIA
BG	BULGARIA	TR	TURKEY
CA	CANADA	SU	SOVIET UNION
CL	CHILE	ZA	SOUTH AFRICA
TW	TAIWAN	UY	URUGUAY
CO	COLOMBIA	VE	VENEZUELA
KR	KOREA; REPUBLIC OF	YU	YUGOSLAVIA
DK	DENMARK	99	UNKNOWN
EG	EGYPT	AG	ANTIGUA
EC	ECUADOR	DZ	ALGERIA
ES	SPAIN	AO	ANGOLA
US	UNITED STATES	BB	BARBADOS
FI	FINLAND	BS	BAHAMAS
FR	FRANCE	CR	COSTA RICA
GR	GREECE	CU	CUBA
IN	INDIA	CY	CYPRUS
ID	INDONESIA	EE	ESTONIA
IE	IRELAND	FJ	FIJI
IS	ICELAND	GH	GHANA
IL	ISRAEL	HN	HONDURAS
IT	ITALY	HK	HONG KONG
JP	JAPAN	CI	COTE D'IVOIRE
LB	LEBANON	KW	KUWAIT
LR	LIBERIA	LV	LATVIA
MG	MADAGASCAR	LT	LITHUANIA
MA	MOROCCO	MU	MAURITIUS
MX	MEXICO	MT	MALTA
NO	NORWAY	MC	MONACO
NC	NEW CALEDONIA	MY	MALAYSIA
NZ	NEW ZEALAND	MR	MAURITANIA
PK	PAKISTAN	NG	NIGERIA
NL	NETHERLANDS	PA	PANAMA
PE	PERU	CD	CONGO; THE DEMOCRATIC REPUBLIC OF THE
PH	PHILIPPINES	RU	RUSSIAN FEDERATION
PL	POLAND	SA	SAUDI ARABIA

APPENDIX 1. ISO COUNTRY CODES (continued)

CODE	COUNTRY NAME	CODE	COUNTRY NAME
SC	SEYCHELLES		
SN	SENEGAL		
SG	SINGAPORE		
SL	SIERRA LEONE		
VC	SAINT VINCENT AND THEN GRENADINES		
TO	TONGA		
TT	TRINIDAD AND TOBAGO		
UA	UKRAINE		
WS	SAMOA; WESTERN		
YE	YEMEN		
ZZ	MISCELLANEOUS ORGANIZATION		
MH	MARSHALL ISLANDS		
HR	CROATIA		
EU	EUROPEAN UNION		

Data from Russia include data from USSR (the FSU). Data from Germany include the Federal Republic and the Democratic Republic.

APPENDIX 2. NCEI/WOD SECONDARY HEADER CODE TABLES

The prefix ‘s’ in front of the following tables in Appendix 2 denotes secondary header code tables. The first column in the tables contains the code used by the WOD to identify the variable. Sometimes, the second column contains the code used by NCEI. The final column contains the code description.

2.1. Ocean Weather Station (code 9): ***Code table: s_9_weather_station***

2.2. Cast Direction (code 12): ***s_12_cast_direction***

2.3. Water Color (code 14): ***s_14_water_color; Source: Extended Forel-Ule Scale***

2.4. Wave Direction (code 16): ***s_16_wave_direction; Source: WMO code 0877***

2.5. Wave Height (code 17): ***s_17_wave_height; Source: WMO code 1555***

2.6. Sea State (code 18): ***s_18_sea_state; Source: WMO code 3700***

2.7. Wind Force (code 19): ***s_19_wind_force; Source: Beaufort Scale***

2.8. Wave Period (code 20): ***s_20_wave_period***

2.9. Wind Direction (code 21): ***s_21_wind_direction; Source: WMO code 0877***

2.10. Weather Condition (code 26): ***s_26_weather_condition; Source: WMO code 4501 (if <=0) or WMO code 4677 (if >0)***

2.11. Cloud Type (code 27): ***Code table: s_27_cloud_type; Source: WMO code 0500***

2.12. Cloud Cover (code 28): ***Code table: s_28_cloud_cover; Source: WMO code 2700***

2.13. Probe Type (code 29): ***Code table: s_29_probe_type***

2.14. Recorder (code 32): ***Code table: s_32_recorder; Source: WMO code 4770***

2.15. Digitization Method (code 35): ***s_35_digitization_method; Source: NCEI code 0612***

2.16. Digitization Interval (code 36): ***s_36_digitization_interval; Source: NCEI code 0613***

2.17. Data Treatment and Storage (code 37): ***s_37_data_storage; Source: NCEI code 0614***

2.18. Reference Instrument (code 40): ***s_40_ref_instrument; Source: NCEI code 0615***

2.19. Horizontal Visibility (code 41): ***s_41_visibility; Source: WMO code 4300***

2.20. Needs Depth Fix (code 54): ***s_54_needs_depth_fix. Note: Values 3-12 are only available through WODselect. In addition, values 1, 2, 103, 104, have corrections applied (ignore 'needs').***

2.21. Ocean Vehicle (code 74): ***s_74_ocean_vehicle***

2.22. pCO2 Calculation Method (code 81): ***Code table s_81_calc_method***

CODE	DESCRIPTION
1500	Warming (°C), or temperature of analysis (°C)
1520	Standard atmospheric pressure used in calculations, or measured
1540	Warming correction method
1541	Warming correction method Weiss *et al.* (1982)
1542	Warming correction method Takahashi *et al.* (1993)
1543	Warming correction method Goyet *et al.* (1993)
1544	Warming correction method Copin-Montegut (1988)
1545	Warming correction method Gordon

2.23. pCO2 Equilibrator Type (code 82): *S_82_equilibrat_type*

Code table s_82_equilibrat_type

CODE	DESCRIPTION
1600	Showerhead design
1601	Showerhead, large volume >10 L
1602	Showerhead, small volume <10 L
1630	Laminar flow design
1640	Rotating disk design
1650	Bubbling design
1660	Tandem design (combined showerhead and bubbling)
1670	Membrane design
1680	Aspirator design
1690	Discrete sample closed loop equilibration

2.24. ARGOS Fix (code 84): *s_84_argos_fix*

2.25. Database ID (code 91): *s_91_database_id*

2.26. United Kingdom Hydrographic Office Profile Data Reference (code 92): *s_92_ukho_ref*

2.27. Originator's Depth Unit (code 95): *s_95_depth_unit*

2.28. Originator Flag Set (code 96): *s_96_origflagset*

2.29. Water Sampler (code 97): *s_97_sampler*

APPENDIX 3. CODES FOR VARIABLE SPECIFIC SECONDARY HEADERS

The prefix 'v' in the following tables denotes variable specific header codes (see WOD codes online)

3.1. Scale (code 3): ***v_3_scale***

3.2. Instrument Codes (code 5): ***Code table: v_5_instrument***

3.3. Methods (code 6): ***v_6_methods***

3.4. Originator's Units (code 8): ***v_8_orig_units***

3.5. Equilibrator Type (code 10): ***v_10_equilibrator_type***

3.6. Filter Type and Size (code 11): ***v_11_filter_type_and_size***

3.7. Incubation Time (code 12): ***v_12_incubation_time***

APPENDIX 4. BIOLOGICAL HEADER CODE TABLES

The prefix 'b' in the following tables denotes biological header codes

4.1. Type of Tow (code 4): ***b_4_type_tow***

4.2. Large Removed (code 6): ***b_6_large_removed***

4.3. Gear and Flowmeter (code 7 and code 18): ***b_7_gear_and_flowmeter_codes***

4.4. Preservation Method (code 10): ***b_10_preservative_method***

4.5. Weight Method (code 11): ***b_11_weight_method***

4.6. Count Method (code 13): ***b_13_count_method***

4.7. Flowmeter Calibration (code 19): ***b_19_flowmeter_calibration***

4.8. Depth Determination (code 24): ***b_24_depth_determined***

4.9. Volume Method (code 25): ***b_25_volume_method***

APPENDIX 5. TAXONOMIC DATA

The prefix 't' in the following tables denotes taxonomic data codes.

5.1. Lifestage (code 5): ***t_5_taxon_lifestage; TSN = taxonomic serial number***

5.2. Gender (code 6): ***t_6_taxon_sex_code***

5.3. Presence/abundance (code 7): ***t_7_taxon_presence_abundance_codes***

5.4. Trophic Mode (code 8): ***t_8_taxon_trophic_mode***

5.5. Realm (code 9): ***t_9_taxon_realm***

5.6. Features (code 16): ***t_16_taxon_features***

5.7. Modifier (code 17): ***t_17_taxon_modifier***

5.8. Size (codes 18 and 19): ***t_18_size_min*** ***and*** ***t_19_size_max***

5.9. Count Method (code 26): ***t_26_count_method***

5.10. Commmon Base-Unit Value (code 27): ***t_27_cbv_value***

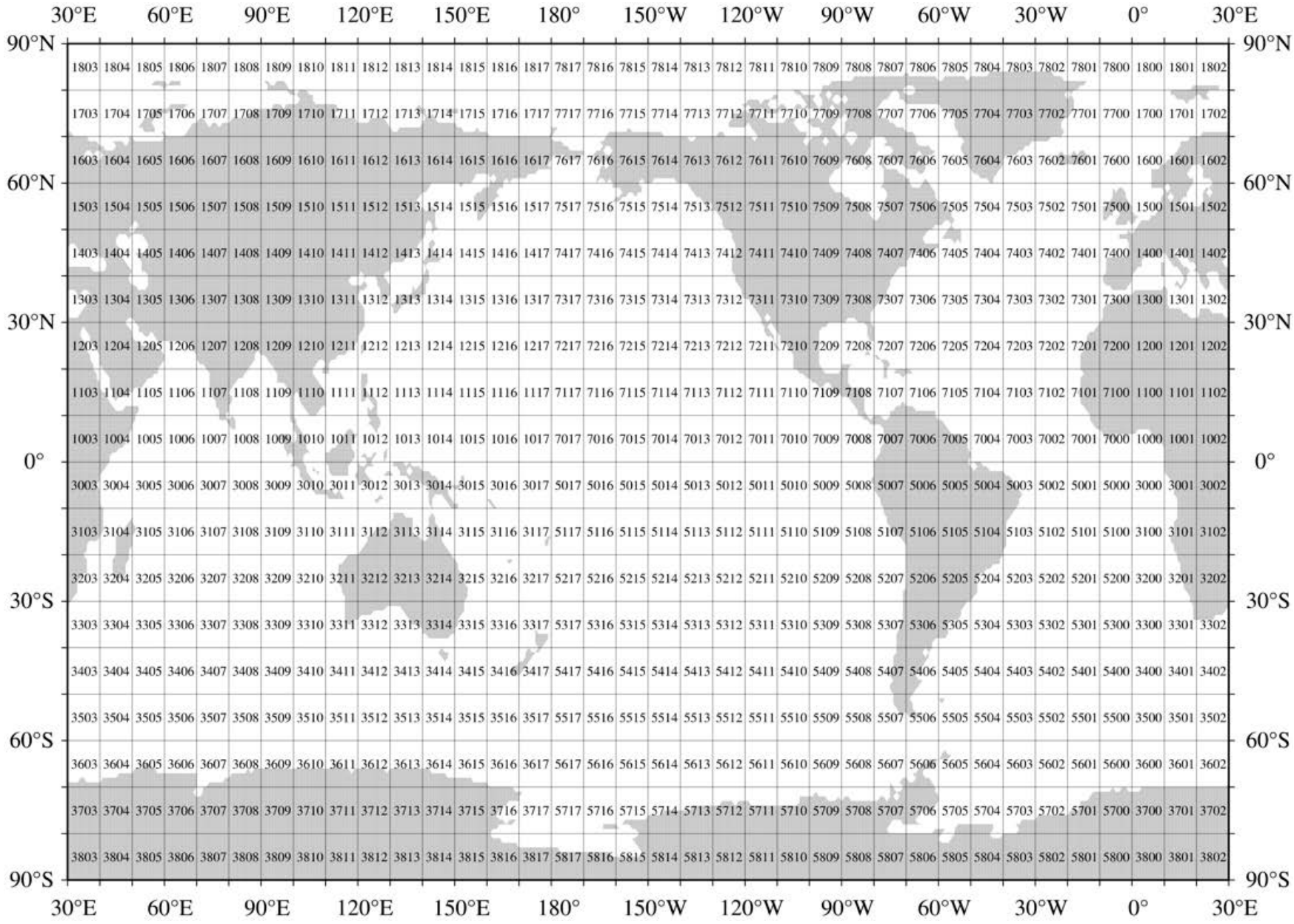
5.11. Common Base-Unit Value Calculation Method (code 28): ***t_28_cbv_calculation_method***

APPENDIX 6. PLANKTON GROUPING CODES

CODE	DESCRIPTION
1000000	**BACTERIA** (*all sub-groups*)
1050000	Cyanobacteria
2000000	**PHYTOPLANKTON** (*all sub-groups*)
2030000	Amoebida
2040000	Granuloreticulosa (Foraminifera)
2070000	Dinomastigota (Dinoflagellata)
2080000	Ciliophora (ciliates)
2100000	Haptomonada (Coccolithophorids)
2110000	Cryptomonada (Chrytophyta)
2120000	Discomitochondria
2130000	Chrysomonada (Chrysophyta)
2160000	Diatoms (Bacillariophyta)
2270000	Actinopoda (amoeba)
2280000	Chlorophyta (green algae)
2300000	Ebriida
4000000	**ZOOPLANKTON** (*all sub-groups*)
4020000	Porifera
4030000	Cnidaria (coelenterates)
4032000	Hydrozoa
4036000	Stauromedusae
4038000	Antipatharia
4040000	Ctenophora (comb jellies)
4050000	Platyhelminthes (flat worms)
4090000	Nemertina (ribbon worms)
4100000	Nematoda
4130000	Rotifera (rotifers)
4180000	Entoprocta
4190000	Arthropoda: Chelicerata
4200000	Arthropoda: Mandibulata ("insects")
4210000	Arthropoda: Crustacea (*all sub-groups*)
4211000	*Crustacea*: Ostracoda
4212000	*Crustacea*: Copepoda
4213000	*Crustacea*: Cirripedia (barnacles)
4214000	*Crustacea*: Mysidacea
4216000	*Crustacea*: Isopoda
4217000	*Crustacea*: Amphipoda
4218000	*Crustacea*: Euphausiacea
4219000	*Crustacea*: Decapoda
4220000	Annelida (segmented worms)
4230000	Sipuncula
4260000	Mollusca (*all sub-groups*)
4262500	*Mollusca*: Gastropoda (snails & slugs)
4265000	*Mollusca*: Bivalvia (bivalve molluscs)
4266000	*Mollusca*: Scaphopoda (tusk shell)

4267500	*Mollusca*: Cephalopoda
4300000	Brachiopoda (lamp shells)
4310000	Phoronida
4320000	Chaetognatha (arrow worms)
4330000	Hemichordata
4340000	Echinodermata
4350000	Urochordata (*all sub-groups*)
4352500	*Urochordata*: Ascidiacea (sea squirts)
4355000	*Urochordata*: Thaliacea (salps & doliolids)
4357500	*Urochordata*: Larvacea / Appendicularia
4360000	Cephalochordata / Leptocardia
5000000	**ICHTHYOPLANKTON**

APPENDIX 7. WMO SQUARES



APPENDIX 8. SAMPLE OUTPUT FOR OBSERVED LEVEL DATA

FROM *WOD18/DATA/NPAC/OSDO7617.gz* CAST 67064

C41303567064US5112031934 8 744210374426193562-17227140 611010120101301118220581 4
011182202916011182202919010247218STOCS85A3 41032151032165-500632175-50023218273
181177095001101344014271433039317220762102206022911072911103299770201330238461 81
244218001322076141102173301031922205213220112164421037230770950011018181155085 27
200121100001333125000210110600220220680022722148302284426840002307704212000001 91
155079118001211000013331250001511050021033022700220220680022744118163022844268 40
002307704265000001911550694590012110000133312500015110500210330113002202206800 22
733190430228442684000230770426200000191166015966800121100001333125000210220160 02
171101002202206800227331128302284426840002307704357000001811550888030012110000 13
331250002102201600220220680022733112830228442684000230770421200000191155088803 00
121100001333125000151102002103305350022022068002274414280302284426840002307704 21
200000191155088803001211000013331250001522043002102203200220220680022733125630 22
844268400023077042120000019115508537100121100001333125000151102002102201600220 22
068002273311283022844268400023077042120000011000033289600442309000332675002226 50
033120500332810002201000332895004423090003326700022271003311230033281000220250 02
229000442319100332862002229000331154003328100022050003 42-123004423241003327280 03
321170033125600332805 00

OUTPUT FROM wodFOR.f for Cast 67064

Output from ASCII file, cast# 273

CC	cruise	Latitde	Longitde	YYYY	MM	DD	Time	Cast	#levels
US	11203	61.930	-172.270	1934	8	7	10.37	67064	4

Number of variables in this cast: 6

Originators Cruise Code: STOCS85A

Primary Investigator: 215 ... for variable #: 0
Primary Investigator: 216 ... for variable #: 0
Primary Investigator: 217 ... for variable #: -5006
Primary Investigator: 218 ... for variable #: -5007

z	fo	1	fo	2	fo	3	fo	4	fo	6	fo	9	fo
0.0	00	8.960 (3)	00	30.900 (4)	00	6.750 (3)	00	0.650 (2)	00	20.500 (3)	00	8.100 (3)	00
10.0	00	8.950 (3)	00	30.900 (4)	00	6.700 (3)	00	0.710 (2)	00	12.300 (3)	00	8.100 (3)	00
25.0	00	0.900 (2)	00	31.910 (4)	00	8.620 (3)	00	0.900 (2)	00	15.400 (3)	00	8.100 (3)	00
50.0	00	-1.230 (3)	00	32.410 (4)	00	7.280 (3)	00	1.170 (3)	00	25.600 (3)	00	8.050 (3)	00

VarFlag: 0 0 0 0 0 0

Secondary header # 1 9500110. (7)
Secondary header # 3 1427. (4)
Secondary header # 4 393. (3)
Secondary header # 7 76. (2)
Secondary header # 10 60. (2)
Secondary header # 29 7. (1)
Secondary header # 91 3. (1)
Secondary header # 99 2013302. (7)

Measured Variable # 3 Information Code # 8 58. (2)
Measured Variable # 4 Information Code # 8 29. (2)
Measured Variable # 6 Information Code # 8 29. (2)
Biological header # 2 18.000 (4)
Biological header # 3 76.000 (2)
Biological header # 4 2.000 (1)
Biological header # 7 103.000 (3)
Biological header # 9 0.050 (2)
Biological header # 13 11.000 (2)
Biological header # 16 10.370 (4)
Biological header # 30 9500110.000 (7)

Taxa-set 1 : Taxonomic Code [1]# 85272 (5)
Code # 2 0.000 (1) 00
Code # 3 25.000 (3) 00
Code # 10 6.000 (1) 00
Code # 20 68.000 (2) 00
Code # 27 4.800 (2) 30
Code # 28 68.400 (4) 00
Code # 30 4212000.000 (7) 00

Taxa-set 2 : Taxonomic Code [1]# 79118 (5)
Code # 2 0.000 (1) 00
Code # 3 25.000 (3) 00
Code # 5 5.000 (1) 00
Code # 10 227.000 (3) 00
Code # 20 68.000 (2) 00
Code # 27 181.600 (4) 30
Code # 28 68.400 (4) 00
Code # 30 4265000.000 (7) 00

Taxa-set 3 : Taxonomic Code [1]# 69459 (5)
Code # 2 0.000 (1) 00
Code # 3 25.000 (3) 00
Code # 5 5.000 (1) 00
Code # 10 113.000 (3) 00
Code # 20 68.000 (2) 00
Code # 27 90.400 (3) 30
Code # 28 68.400 (4) 00
Code # 30 4262000.000 (7) 00

Taxa-set 4 : Taxonomic Code [1]# 159668 (6)
Code # 2 0.000 (1) 00
Code # 3 25.000 (3) 00
Code # 10 16.000 (2) 00
Code # 17 1.000 (1) 00
Code # 20 68.000 (2) 00
Code # 27 12.800 (3) 30
Code # 28 68.400 (4) 00
Code # 30 4357000.000 (7) 00

Taxa-set 5 : Taxonomic Code [1]# 88803 (5)
Code # 2 0.000 (1) 00
Code # 3 25.000 (3) 00
Code # 10 16.000 (2) 00
Code # 20 68.000 (2) 00
Code # 27 12.800 (3) 30
Code # 28 68.400 (4) 00
Code # 30 4212000.000 (7) 00

Taxa-set 6 : Taxonomic Code [1]# 88803 (5)
Code # 2 0.000 (1) 00
Code # 3 25.000 (3) 00
Code # 5 2.000 (1) 00
Code # 10 535.000 (3) 00
Code # 20 68.000 (2) 00
Code # 27 428.000 (4) 30
Code # 28 68.400 (4) 00
Code # 30 4212000.000 (7) 00

Taxa-set 7 : Taxonomic Code [1]# 88803 (5)
Code # 2 0.000 (1) 00
Code # 3 25.000 (3) 00
Code # 5 43.000 (2) 00
Code # 10 32.000 (2) 00
Code # 20 68.000 (2) 00
Code # 27 25.600 (3) 30

Code # 28 68.400 (4) 00
Code # 30 4212000.000 (7) 00

Taxa-set 8 : Taxonomic Code [1]# 85371 (5)
Code # 2 0.000 (1) 00
Code # 3 25.000 (3) 00
Code # 5 2.000 (1) 00
Code # 10 16.000 (2) 00
Code # 20 68.000 (2) 00
Code # 27 12.800 (3) 30
Code # 28 68.400 (4) 00
Code # 30 4212000.000 (7) 00

APPENDIX 9. STANDARD VERTICAL LEVELS AND DEPTH (METERS)

Depth	Level #	Depth	Level #	Depth	Level #	Depth	Level #
0	1	475	36	2400	71	5900	106
5	2	500	37	2500	72	6000	107
10	3	550	38	2600	73	6100	108
15	4	600	39	2700	74	6200	109
20	5	650	40	2800	75	6300	110
25	6	700	41	2900	76	6400	111
30	7	750	42	3000	77	6500	112
35	8	800	43	3100	78	6600	113
40	9	850	44	3200	79	6700	114
45	10	900	45	3300	80	6800	115
50	11	950	46	3400	81	6900	116
55	12	1000	47	3500	82	7000	117
60	13	1050	48	3600	83	7100	118
65	14	1100	49	3700	84	7200	119
70	15	1150	50	3800	85	7300	120
75	16	1200	51	3900	86	7400	121
80	17	1250	52	4000	87	7500	122
85	18	1300	53	4100	88	7600	123
90	19	1350	54	4200	89	7700	124
95	20	1400	55	4300	90	7800	125
100	21	1450	56	4400	91	7900	126
125	22	1500	57	4500	92	8000	127
150	23	1550	58	4600	93	8100	128
175	24	1600	59	4700	94	8200	129
200	25	1650	60	4800	95	8300	130
225	26	1700	61	4900	96	8400	131
250	27	1750	62	5000	97	8500	132
275	28	1800	63	5100	98	8600	133
300	29	1850	64	5200	99	8700	134
325	30	1900	65	5300	100	8800	135
350	31	1950	66	5400	101	8900	136
375	32	2000	67	5500	102	9000	137
400	33	2100	68	5600	103		
425	34	2200	69	5700	104		
450	35	2300	70	5800	105		

APPENDIX 10. Acceptable depth differences for "inside" and "outside" values used in the Reiniger-Ross scheme for interpolating observed level data to standard levels

Standard Levels	Standard Depth	Acceptable depth differences for "inside values"	Acceptable depth differences for "outside values"	Standard Levels	Standard Depth	Acceptable depth differences for "inside values"	Acceptable depth differences for "outside values"
1	0	5	200	22	125	50	200
2	5	50	200	23	150	50	200
3	10	50	200	24	175	50	200
4	15	50	200	25	200	50	200
5	20	50	200	26	225	50	200
6	25	50	200	27	250	100	200
7	30	50	200	28	275	100	200
8	35	50	200	29	300	100	200
9	40	50	200	30	325	100	200
10	45	50	200	31	350	100	200
11	50	50	200	32	375	100	200
12	55	50	200	33	400	100	200
13	60	50	200	34	425	100	200
14	65	50	200	35	450	100	200
15	70	50	200	36	475	100	200
16	75	50	200	37	500	100	400
17	80	50	200	38	550	100	400
18	85	50	200	39	600	100	400
19	90	50	200	40	650	100	400
20	95	50	200	41	700	100	400
21	100	50	200	42	750	100	400

Note: Since many XBT data were reported only at “inflection points” (depth at which temperature changed by a specified amount from previous recorded value) interpolation limits were not used for XBTs.

APPENDIX 10. (continued 1)

Standard Levels	Standard Depth	Acceptable depth differences for "inside values"	Acceptable depth differences for "outside values"	Standard Levels	Standard Depth	Acceptable depth differences for "inside values"	Acceptable depth differences for "outside values"
43	800	100	400	64	1850	200	1000
44	850	100	400	65	1900	200	1000
45	900	200	400	66	1950	200	1000
46	950	200	400	67	2000	1000	1000
47	1000	200	400	68	2100	1000	1000
48	1050	200	400	69	2200	1000	1000
49	1100	200	400	70	2300	1000	1000
50	1150	200	400	71	2400	1000	1000
51	1200	200	400	72	2500	1000	1000
52	1250	200	400	73	2600	1000	1000
53	1300	200	1000	74	2700	1000	1000
54	1350	200	1000	75	2800	1000	1000
55	1400	200	1000	76	2900	1000	1000
56	1450	200	1000	77	3000	1000	1000
57	1500	200	1000	78	3100	1000	1000
58	1550	200	1000	79	3200	1000	1000
59	1600	200	1000	80	3300	1000	1000
60	1650	200	1000	81	3400	1000	1000
61	1700	200	1000	82	3500	1000	1000
62	1750	200	1000	83	3600	1000	1000
63	1800	200	1000	84	3700	1000	1000

APPENDIX 10. (continued 2)

Standard Levels	Standard Depth	Acceptable depth differences for "inside values"	Acceptable depth differences for "outside values"	Standard Levels	Standard Depth	Acceptable depth differences for "inside values"	Acceptable depth differences for "outside values"
85	3800	1000	1000	106	5900	1000	1000
86	3900	1000	1000	107	6000	1000	1000
87	4000	1000	1000	108	6100	1000	1000
88	4100	1000	1000	109	6200	1000	1000
89	4200	1000	1000	110	6300	1000	1000
90	4300	1000	1000	111	6400	1000	1000
91	4400	1000	1000	112	6500	1000	1000
92	4500	1000	1000	113	6600	1000	1000
93	4600	1000	1000	114	6700	1000	1000
94	4700	1000	1000	115	6800	1000	1000
95	4800	1000	1000	116	6900	1000	1000
96	4900	1000	1000	117	7000	1000	1000
97	5000	1000	1000	118	7100	1000	1000
98	5100	1000	1000	119	7200	1000	1000
99	5200	1000	1000	120	7300	1000	1000
100	5300	1000	1000	121	7400	1000	1000
101	5400	1000	1000	122	7500	1000	1000
102	5500	1000	1000	123	7600	1000	1000
103	5600	1000	1000	124	7700	1000	1000
104	5700	1000	1000	125	7800	1000	1000
105	5800	1000	1000	126	7900	1000	1000

APPENDIX 10. (continued 3)

Standard Levels	Standard Depth	Acceptable depth differences for "inside values"	Acceptable depth differences for "outside values"	Standard Levels	Standard Depth	Acceptable depth differences for "inside values"	Acceptable depth differences for "outside values"
127	8000	1000	1000	133	8600	1000	1000
128	8100	1000	1000	134	8700	1000	1000
129	8200	1000	1000	135	8800	1000	1000
130	8300	1000	1000	136	8900	1000	1000
131	8400	1000	1000	137	9000	1000	1000
132	8500	1000	1000				

APPENDIX 11. ACCEPTABLE RANGES OF OBSERVED VARIABLES AS A FUNCTION OF DEPTH, BY BASIN

The range values provided has range values for temperature, salinity, oxygen, phosphate, silicate, nitrate, pH, chlorophyll, and alkalinity. The range values in the tables are used to help identify the most obvious questionable values for these variables. For simplicity, please note that ranges are given on 33 standard levels (+ one for depths deeper than 5500 m). All standard depths in between given standard depths have the same values as the nearest standard depth shown (for example, 90m standard depth uses 100m range values. If a standard depth is equidistance between two shown standard depths, the ranges values will be the same as the shallower shown standard depth (i.e. 5 m range values will be the same as 0 m shown values, not 10 m shown values).

11.1. Variable: Temperature
Standard unit or scale: Degrees Celcius or centigrade (°C)

Depth (m)	North Atlantic		Coastal N. Atlantic		Equatorial Atlantic		Coastal Eq. Atlantic		South Atlantic		Coastal S. Atlantic		North Pacific		Coastal N. Pacific		Equatorial Pacific		Coastal Eq. Pacific	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
0	-2.10	35.00	-2.10	35.00	5.00	35.00	5.00	35.00	0.00	32.00	-2.10	35.00	-2.10	35.00	-2.10	35.00	5.00	35.00	5.00	35.00
10	-2.10	35.00	-2.10	35.00	5.00	35.00	5.00	35.00	0.00	32.00	-2.10	35.00	-2.10	35.00	-2.10	35.00	5.00	35.00	5.00	35.00
20	-2.10	32.00	-2.10	35.00	5.00	35.00	5.00	35.00	0.00	32.00	-2.10	35.00	-2.10	35.00	-2.10	35.00	5.00	35.00	5.00	35.00
30	-2.10	32.00	-2.10	35.00	5.00	35.00	5.00	35.00	0.00	32.00	-2.10	35.00	-2.10	35.00	-2.10	35.00	5.00	35.00	5.00	35.00
50	-2.10	32.00	-2.10	35.00	5.00	35.00	5.00	35.00	0.00	32.00	-2.10	35.00	-2.10	35.00	-2.10	35.00	5.00	35.00	5.00	35.00
75	-2.00	30.00	-2.10	35.00	5.00	35.00	5.00	35.00	0.00	32.00	-2.10	35.00	-2.10	35.00	-2.10	35.00	5.00	35.00	5.00	35.00
100	-2.00	30.00	-2.10	30.00	5.00	30.00	5.00	30.00	0.00	32.00	-2.10	30.00	-2.10	30.00	-2.10	30.00	5.00	30.00	5.00	30.00
125	-2.00	28.00	-2.10	30.00	5.00	30.00	5.00	30.00	-1.50	30.00	-2.10	30.00	-2.10	30.00	-2.10	30.00	3.00	30.00	3.00	30.00
150	-2.00	28.00	-2.10	30.00	5.00	30.00	5.00	30.00	-1.50	30.00	-2.10	30.00	-2.10	30.00	-2.10	30.00	3.00	30.00	3.00	30.00
200	-2.00	28.00	-2.10	30.00	5.00	30.00	5.00	30.00	-1.50	30.00	-2.10	30.00	-2.10	30.00	-2.10	30.00	3.00	30.00	3.00	30.00
250	-1.70	28.00	-2.10	28.00	5.00	28.00	0.00	28.00	-1.50	28.00	-2.10	28.00	-2.10	28.00	-2.10	28.00	3.00	28.00	3.00	28.00
300	-1.70	28.00	-2.10	28.00	3.00	28.00	0.00	28.00	-1.50	28.00	-2.10	28.00	-2.10	28.00	-2.10	28.00	3.00	28.00	3.00	28.00
400	-1.50	20.00	-2.10	28.00	3.00	28.00	0.00	28.00	-1.50	28.00	-2.10	28.00	-2.10	28.00	-2.10	28.00	3.00	28.00	3.00	28.00
500	-1.50	20.00	-2.10	28.00	3.00	28.00	0.00	28.00	-1.50	28.00	-2.10	28.00	-2.10	28.00	-2.10	28.00	0.00	28.00	0.00	28.00
600	-1.50	20.00	-2.10	20.00	3.00	20.00	0.00	20.00	-1.50	20.00	-2.10	20.00	-2.10	20.00	-2.10	20.00	0.00	20.00	0.00	20.00
700	-1.50	20.00	-2.10	20.00	3.00	20.00	0.00	20.00	-1.50	20.00	-2.10	20.00	-2.10	20.00	-2.10	20.00	0.00	20.00	0.00	20.00
800	-1.50	20.00	-2.10	20.00	-0.50	20.00	0.00	20.00	-1.50	20.00	-2.10	20.00	-2.10	20.00	-2.10	20.00	0.00	20.00	0.00	20.00
900	-1.50	20.00	-2.10	20.00	-0.50	20.00	0.00	20.00	-1.50	20.00	-2.10	20.00	-2.10	20.00	-2.10	20.00	0.00	20.00	0.00	20.00
1000	-1.50	18.00	-2.10	18.00	-0.50	18.00	0.00	18.00	-1.50	18.00	-2.10	18.00	-2.10	18.00	-2.10	18.00	0.00	18.00	0.00	18.00
1100	-1.50	18.00	-2.10	18.00	-0.50	18.00	0.00	18.00	-1.50	18.00	-2.10	18.00	-2.10	18.00	-2.10	18.00	0.00	18.00	0.00	18.00
1200	-1.50	18.00	-2.10	18.00	-0.50	18.00	0.00	18.00	-1.50	18.00	-2.10	18.00	-2.10	18.00	-2.10	18.00	0.00	18.00	0.00	18.00
1300	-1.50	18.00	-2.10	18.00	-0.50	18.00	0.00	18.00	-1.50	18.00	-2.10	18.00	-2.10	18.00	-2.10	18.00	0.00	18.00	0.00	18.00
1400	-1.50	18.00	-2.10	18.00	-0.50	18.00	0.00	18.00	-1.50	18.00	-2.10	18.00	-2.10	18.00	-2.10	18.00	0.00	18.00	0.00	18.00
1500	-1.50	18.00	-2.10	18.00	-0.50	18.00	0.00	18.00	-1.50	18.00	-2.10	18.00	-2.10	18.00	-2.10	18.00	0.00	18.00	0.00	18.00
1750	-1.50	13.00	-2.10	13.00	-0.50	13.00	0.00	13.00	-1.50	13.00	-2.10	13.00	-2.10	13.00	-2.10	13.00	0.00	13.00	0.00	13.00
2000	-1.50	13.00	-2.10	13.00	-0.50	13.00	0.00	13.00	-1.50	13.00	-2.10	13.00	-2.10	13.00	-2.10	13.00	0.00	13.00	0.00	13.00
2500	-1.50	13.00	-2.10	13.00	-0.50	13.00	-1.00	13.00	-1.50	13.00	-2.10	13.00	-2.10	13.00	-2.10	13.00	0.00	13.00	0.00	13.00
3000	-1.50	7.00	-2.10	7.00	-0.50	7.00	-1.00	7.00	-1.50	7.00	-2.10	7.00	-2.10	7.00	-2.10	7.00	0.00	7.00	0.00	7.00
3500	-1.50	7.00	-2.10	7.00	-0.50	7.00	-1.00	7.00	-1.50	7.00	-2.10	7.00	-2.10	7.00	-2.10	7.00	0.00	7.00	0.00	7.00
4000	-1.50	7.00	-1.50	7.00	-0.50	7.00	-1.00	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00
4500	-1.50	7.00	-1.50	7.00	-0.50	7.00	-1.00	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00
5000	-1.50	7.00	-1.50	7.00	-0.50	7.00	-1.00	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00
5500+	-1.50	5.00	-1.50	3.00	-0.50	3.00	-1.00	3.00	-1.50	3.00	-1.50	3.00	-1.50	3.00	-1.50	3.00	-1.50	3.00	-1.50	3.00

11.1. Temperature (continued 1)
Standard unit or scale: Degrees Celcius or centigrade (°C)

Depth (m)	South Pacific		Coastal S. Pacific		North Indian		Coastal N. Indian		Equatorial Indian		Coastal Eq. Indian		South Indian		Coastal S. Indian		Antarctic		Arctic	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
0	-2.00	32.00	-2.10	35.00	3.00	35.00	-2.10	35.00	5.00	35.00	5.00	35.00	0.00	35.00	-2.10	35.00	-2.40	15.00	-3.00	20.00
10	-2.00	32.00	-2.10	35.00	3.00	35.00	-2.10	35.00	5.00	35.00	5.00	35.00	0.00	35.00	-2.10	35.00	-2.40	15.00	-3.00	20.00
20	-2.00	32.00	-2.10	35.00	3.00	35.00	-2.10	35.00	5.00	35.00	5.00	35.00	0.00	35.00	-2.10	35.00	-2.40	15.00	-3.00	20.00
30	-2.00	32.00	-2.10	35.00	3.00	35.00	-2.10	35.00	5.00	35.00	5.00	35.00	0.00	35.00	-2.10	35.00	-2.40	15.00	-3.00	14.00
50	-2.00	32.00	-2.10	35.00	3.00	35.00	-2.10	35.00	5.00	35.00	5.00	35.00	0.00	35.00	-2.10	35.00	-2.40	15.00	-3.00	14.00
75	-2.00	32.00	-2.10	35.00	3.00	35.00	-2.10	35.00	5.00	35.00	5.00	35.00	0.00	35.00	-2.10	35.00	-2.40	15.00	-3.00	14.00
100	-2.00	30.00	-2.10	30.00	3.00	30.00	-2.10	30.00	5.00	30.00	5.00	30.00	0.00	30.00	-2.10	30.00	-2.40	15.00	-3.00	14.00
125	-2.00	30.00	-2.10	30.00	3.00	30.00	-2.10	30.00	3.00	30.00	3.00	30.00	0.00	30.00	-2.10	30.00	-2.40	15.00	-3.00	14.00
150	-2.00	30.00	-2.10	30.00	3.00	30.00	-2.10	30.00	3.00	30.00	3.00	30.00	0.00	30.00	-2.10	30.00	-2.40	15.00	-3.00	10.00
200	-2.00	30.00	-2.10	30.00	3.00	30.00	-2.10	30.00	3.00	30.00	3.00	30.00	0.00	30.00	-2.10	30.00	-2.40	15.00	-3.00	10.00
250	-2.00	28.00	-2.10	28.00	3.00	28.00	-2.10	28.00	3.00	28.00	3.00	28.00	0.00	28.00	-2.10	28.00	-2.40	15.00	-3.00	10.00
300	-2.00	28.00	-2.10	28.00	3.00	28.00	-2.10	28.00	3.00	28.00	3.00	28.00	0.00	28.00	-2.10	28.00	-2.40	15.00	-3.00	10.00
400	-2.00	28.00	-2.10	28.00	3.00	28.00	-2.10	28.00	3.00	28.00	3.00	28.00	0.00	28.00	-2.10	28.00	-2.40	15.00	-3.00	10.00
500	-2.00	28.00	-2.10	28.00	3.00	28.00	-2.10	28.00	0.00	28.00	0.00	28.00	0.00	28.00	-2.10	28.00	-2.40	15.00	-3.00	10.00
600	-2.00	20.00	-2.10	20.00	0.00	20.00	-2.10	20.00	0.00	20.00	0.00	20.00	0.00	20.00	-2.10	20.00	-2.40	10.00	-3.00	9.00
700	-2.00	20.00	-2.10	20.00	0.00	20.00	-2.10	20.00	0.00	20.00	0.00	20.00	0.00	20.00	-2.10	20.00	-2.40	10.00	-3.00	9.00
800	-2.00	20.00	-2.10	20.00	0.00	20.00	-2.10	20.00	0.00	20.00	0.00	20.00	0.00	20.00	-2.10	20.00	-2.40	10.00	-3.00	9.00
900	-2.00	20.00	-2.10	20.00	0.00	20.00	-2.10	20.00	0.00	20.00	0.00	20.00	0.00	20.00	-2.10	20.00	-2.40	10.00	-3.00	9.00
1000	-2.00	18.00	-2.10	18.00	0.00	18.00	-2.10	18.00	0.00	18.00	0.00	18.00	0.00	18.00	-2.10	18.00	-2.40	10.00	-3.00	8.00
1100	-2.00	18.00	-2.10	18.00	0.00	18.00	-2.10	18.00	0.00	18.00	0.00	18.00	0.00	18.00	-2.10	18.00	-2.40	10.00	-3.00	8.00
1200	-2.00	18.00	-2.10	18.00	0.00	18.00	-2.10	18.00	0.00	18.00	0.00	18.00	0.00	18.00	-2.10	18.00	-2.40	7.00	-3.00	8.00
1300	-2.00	18.00	-2.10	18.00	0.00	18.00	-2.10	18.00	0.00	18.00	0.00	18.00	0.00	18.00	-2.10	18.00	-2.40	7.00	-3.00	8.00
1400	-2.00	18.00	-2.10	18.00	0.00	18.00	-2.10	18.00	0.00	18.00	0.00	18.00	0.00	18.00	-2.10	18.00	-2.40	7.00	-3.00	8.00
1500	-2.00	18.00	-2.10	18.00	0.00	18.00	-2.10	18.00	0.00	18.00	0.00	18.00	0.00	18.00	-2.10	18.00	-2.40	7.00	-3.00	8.00
1750	-2.00	13.00	-2.10	13.00	0.00	13.00	-2.10	13.00	0.00	13.00	0.00	13.00	0.00	13.00	-2.10	13.00	-2.40	7.00	-3.00	8.00
2000	-2.00	13.00	-2.10	13.00	0.00	13.00	-2.10	13.00	0.00	13.00	0.00	13.00	0.00	13.00	-2.10	13.00	-2.40	7.00	-3.00	8.00
2500	-2.00	13.00	-2.10	13.00	0.00	13.00	-2.10	13.00	0.00	13.00	0.00	13.00	0.00	13.00	-2.10	13.00	-2.40	3.00	-3.00	8.00
3000	-2.00	7.00	-2.10	7.00	0.00	7.00	-2.10	7.00	0.00	7.00	0.00	7.00	0.00	7.00	-2.10	7.00	-2.40	3.00	-3.00	7.00
3500	-2.00	7.00	-2.10	7.00	0.00	7.00	-2.10	7.00	0.00	7.00	0.00	7.00	0.00	7.00	-2.10	7.00	-2.40	3.00	-3.00	7.00
4000	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	3.00	-1.50	7.00
4500	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	3.00	-1.50	7.00
5000	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	3.00	-1.50	7.00
5500+	-1.50	3.00	-1.50	3.00	-1.50	3.00	-1.50	3.00	-1.50	3.00	-1.50	3.00	-1.50	3.00	-1.50	3.00	-1.50	3.00	-1.50	3.00

11.1. Temperature (continued 2)
Standard unit or scale: Degrees Celcius or centigrade (°C)

Depth (m)	Mediterranean		Black Sea		Baltic Sea		Persian Gulf		Red Sea		Sulu Sea		NW Pacific		Yellow Sea		Sea of Japan		Seto Inland Sea	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
0	0.00	34.00	0.00	27.00	-2.00	25.00	-3.00	35.00	14.00	35.00	0.00	35.00	-3.00	33.00	-2.00	32.00	-3.00	32.00	3.00	32.00
10	0.00	34.00	0.00	27.00	-2.00	25.00	-3.00	35.00	14.00	35.00	0.00	35.00	-3.00	33.00	-2.00	31.50	-3.00	31.00	3.50	30.00
20	0.00	34.00	0.00	27.00	-2.00	25.00	-3.00	35.00	14.00	34.00	0.00	35.00	-3.00	33.00	-2.00	31.00	-3.00	30.00	4.00	29.00
30	3.00	30.00	0.00	27.00	-2.00	25.00	-3.00	35.00	14.00	34.00	0.00	35.00	-3.00	32.00	-2.00	30.50	-3.00	29.00	4.50	28.00
50	3.00	30.00	3.00	30.00	-2.00	25.00	-3.00	35.00	13.00	32.00	0.00	35.00	-3.00	30.00	-2.00	30.00	-3.00	29.00	5.00	27.00
75	3.00	28.00	3.00	30.00	-2.00	25.00	-3.00	35.00	13.00	30.00	0.00	35.00	-2.00	29.00	0.00	29.00	-3.00	25.00	7.50	25.00
100	3.00	26.00	3.00	30.00	-2.00	25.00	-3.00	32.00	13.00	30.00	0.00	30.00	-1.00	28.00	3.00	28.00	-3.00	23.00	10.00	24.00
125	3.00	26.00	3.00	30.00	-2.00	25.00	-3.00	32.00	13.00	30.00	0.00	30.00	0.00	27.00	3.00	26.50	-2.00	21.00	10.00	22.00
150	3.00	26.00	5.00	30.00	-2.00	25.00	-3.00	32.00	13.00	30.00	0.00	30.00	0.00	26.00	3.00	25.00	-1.00	18.00	10.00	20.00
200	3.00	22.00	5.00	30.00	-2.00	16.00	-3.00	32.00	13.00	28.00	0.00	30.00	0.00	24.50	3.00	24.00	-1.00	14.00	8.00	17.00
250	3.00	22.00	5.00	25.00	-2.00	16.00	-3.00	32.00	13.00	28.00	0.00	28.00	0.00	23.00	5.00	22.50	-1.00	12.00	7.00	14.00
300	3.00	22.00	5.00	25.00	-2.00	16.00	-3.00	32.00	10.00	28.00	0.00	28.00	0.00	21.50	7.00	21.00	-1.00	10.00	6.00	11.00
400	3.00	20.00	5.00	20.00	-2.00	16.00	-3.00	32.00	10.00	28.00	0.00	28.00	0.00	20.00	6.00	18.00	-1.00	3.00	5.00	10.00
500	3.00	20.00	5.00	20.00	-2.00	16.00	-3.00	32.00	10.00	28.00	0.00	28.00	1.00	19.00	5.50	15.00	0.00	1.10	5.00	10.00
600	3.00	20.00	5.00	17.00	-2.00	16.00	-3.00	32.00	10.00	26.00	0.00	20.00	1.80	16.50	5.00	12.50	0.00	1.00	5.00	10.00
700	3.00	20.00	5.00	17.00	-2.00	16.00	-3.00	32.00	10.00	26.00	0.00	20.00	2.00	14.00	4.50	10.00	0.00	0.80	5.00	10.00
800	3.00	20.00	5.00	17.00	-2.00	16.00	-3.00	32.00	10.00	26.00	0.00	20.00	2.00	11.00	4.00	7.60	0.00	0.62	5.00	10.00
900	3.00	20.00	5.00	16.00	-2.00	16.00	-3.00	32.00	10.00	26.00	0.00	20.00	2.00	8.00	3.70	7.30	0.00	0.52	5.00	10.00
1000	3.00	20.00	5.00	16.00	-2.00	16.00	-3.00	32.00	10.00	23.00	0.00	18.00	2.00	6.50	3.50	7.00	0.00	0.44	5.00	10.00
1100	3.00	20.00	5.00	16.00	-2.00	16.00	-3.00	32.00	10.00	23.00	0.00	18.00	2.00	5.30	3.40	6.00	0.00	0.40	5.00	10.00
1200	3.00	18.00	5.00	16.00	-2.00	16.00	-3.00	32.00	10.00	23.00	0.00	18.00	1.95	4.70	3.30	5.00	0.00	0.37	5.00	10.00
1300	3.00	18.00	5.00	16.00	-2.00	16.00	-3.00	32.00	10.00	23.00	0.00	18.00	1.90	4.10	3.20	4.90	0.00	0.34	5.00	10.00
1400	3.00	18.00	5.00	16.00	-2.00	16.00	-3.00	32.00	10.00	23.00	0.00	18.00	1.85	3.70	3.10	4.60	0.00	0.31	5.00	10.00
1500	3.00	18.00	5.00	16.00	-2.00	16.00	-3.00	32.00	10.00	23.00	0.00	18.00	1.80	3.50	3.00	4.50	0.00	0.28	5.00	10.00
1750	3.00	16.00	5.00	16.00	-2.00	16.00	-3.00	32.00	10.00	34.00	0.00	13.00	1.60	3.10	3.00	4.50	0.03	0.25	5.00	10.00
2000	3.00	16.00	5.00	16.00	-2.00	16.00	-3.00	32.00	10.00	34.00	0.00	13.00	1.40	2.60	3.00	4.50	0.05	0.25	5.00	10.00
2500	3.00	16.00	5.00	16.00	-2.00	16.00	-3.00	32.00	10.00	34.00	0.00	13.00	1.30	2.10	3.00	4.50	0.10	0.30	5.00	10.00
3000	3.00	16.00	5.00	16.00	-2.00	16.00	-3.00	13.00	10.00	34.00	0.00	12.00	1.25	1.90	3.00	4.50	0.15	0.35	5.00	10.00
3500	3.00	16.00	5.00	16.00	-2.00	16.00	-3.00	13.00	10.00	20.00	0.00	12.00	1.20	1.80	3.00	4.50	0.20	0.40	5.00	10.00
4000	3.00	16.00	5.00	16.00	-2.00	16.00	-1.50	7.00	10.00	20.00	-1.50	12.00	1.20	1.80	3.00	4.50	0.30	0.45	5.00	10.00
4500	3.00	16.00	5.00	16.00	-2.00	16.00	-1.50	7.00	10.00	20.00	-1.50	12.00	1.25	1.85	3.00	4.50	0.30	0.45	5.00	10.00
5000	3.00	16.00	5.00	16.00	-2.00	16.00	-1.50	7.00	10.00	20.00	-1.50	12.00	1.30	1.90	3.00	4.50	0.30	0.45	5.00	10.00
5500+	3.00	16.00	5.00	16.00	-2.00	16.00	-1.50	7.00	10.00	20.00	-1.50	12.00	1.40	2.00	3.00	4.50	0.30	0.45	5.00	10.00

11.2. Variable: Salinity
Standard unit or scale: unitless

Depth (m)	North Atlantic		Coastal N. Atlantic		Equatorial Atlantic		Coastal Eq. Atlantic		South Atlantic		Coastal S. Atlantic		North Pacific		Coastal N. Pacific		Equatorial Pacific		Coastal Eq. Pacific	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
0	5.00	40.00	0.00	40.00	5.00	40.00	0.00	40.00	5.00	40.00	0.00	40.00	5.00	40.00	0.00	40.00	5.00	40.00	0.00	40.00
10	27.00	38.20	0.00	40.00	20.00	37.60	0.00	40.00	28.00	38.50	0.00	40.00	25.00	37.00	0.00	40.00	28.60	37.00	0.00	40.00
20	28.30	38.20	0.00	40.00	28.00	37.40	0.00	40.00	28.00	38.00	0.00	40.00	30.00	36.50	0.00	40.00	29.00	37.00	0.00	40.00
30	28.50	38.20	0.00	40.00	31.00	37.40	0.00	40.00	30.60	38.00	0.00	40.00	30.00	36.50	0.00	40.00	29.60	37.00	0.00	40.00
50	28.90	38.00	20.00	40.00	31.40	37.40	20.00	40.00	31.00	38.00	20.00	40.00	31.00	36.00	20.00	40.00	30.20	37.00	20.00	40.00
75	28.90	38.00	20.00	40.00	31.80	37.40	20.00	40.00	31.20	38.00	20.00	40.00	31.00	36.00	20.00	40.00	31.00	37.00	20.00	40.00
100	29.40	38.00	20.00	40.00	31.80	37.40	20.00	40.00	31.40	38.00	20.00	40.00	31.50	36.00	26.00	40.00	31.50	37.00	30.00	40.00
125	29.40	38.00	20.00	40.00	31.80	37.40	20.00	40.00	31.40	37.80	20.00	40.00	31.50	36.00	26.00	40.00	31.50	36.80	30.00	40.00
150	29.60	37.60	20.00	40.00	31.80	37.20	20.00	40.00	31.40	37.40	20.00	40.00	32.00	35.80	26.00	40.00	31.50	36.80	30.00	40.00
200	29.90	37.40	20.00	40.00	31.80	37.00	30.00	40.00	31.40	36.60	30.00	40.00	32.00	35.80	26.00	40.00	31.50	36.70	30.00	40.00
250	30.30	37.10	30.00	40.00	32.00	37.00	30.00	40.00	31.40	36.20	30.00	40.00	32.00	35.80	26.00	40.00	31.80	36.30	30.00	40.00
300	30.80	36.80	30.00	40.00	32.20	36.80	30.00	40.00	31.60	36.00	30.00	40.00	32.00	35.80	30.00	40.00	31.80	36.30	30.00	40.00
400	30.80	36.70	33.00	40.00	32.40	36.60	33.00	40.00	32.00	35.80	33.00	40.00	32.20	35.50	30.00	40.00	31.80	36.20	33.00	40.00
500	31.20	36.60	33.00	40.00	33.70	36.50	33.00	40.00	34.00	35.50	33.00	40.00	32.40	35.25	30.50	40.00	32.75	36.10	33.00	40.00
600	32.20	36.60	33.00	40.00	33.70	36.00	33.00	40.00	34.10	35.10	33.00	40.00	32.60	35.25	30.50	40.00	33.00	36.00	33.00	40.00
700	33.00	36.60	33.00	40.00	33.60	35.80	33.00	40.00	34.10	35.10	33.00	40.00	32.60	35.25	32.00	40.00	33.00	35.90	33.00	40.00
800	33.00	36.60	33.00	40.00	33.60	35.60	33.00	40.00	34.10	35.00	33.00	40.00	33.20	35.25	33.00	40.00	33.75	35.80	33.00	40.00
900	33.00	36.60	33.00	40.00	33.60	35.60	33.00	40.00	34.10	34.90	33.00	40.00	33.60	35.25	33.00	40.00	33.80	35.50	33.00	40.00
1000	33.00	36.60	33.00	40.00	33.60	35.40	33.00	40.00	34.20	34.90	33.00	40.00	33.70	35.15	33.00	40.00	34.20	35.30	33.00	40.00
1100	33.00	36.60	33.00	38.00	33.60	35.40	33.00	38.00	34.20	34.90	33.00	38.00	33.70	35.15	33.00	38.00	34.20	35.30	33.00	38.00
1200	33.00	36.60	33.00	38.00	33.60	35.40	33.00	38.00	34.20	34.90	33.00	38.00	33.70	35.15	33.00	38.00	34.20	35.30	33.00	38.00
1300	33.00	36.60	33.00	38.00	33.60	35.40	33.00	38.00	34.30	34.90	33.00	38.00	33.70	35.15	33.00	38.00	34.20	35.30	33.00	38.00
1400	33.00	36.60	33.00	38.00	33.60	35.40	33.00	38.00	34.30	35.00	33.00	38.00	33.70	35.15	33.00	38.00	34.20	35.20	33.00	38.00
1500	33.00	36.60	33.00	38.00	33.80	35.40	33.00	38.00	34.40	35.00	33.00	38.00	33.80	35.00	33.00	38.00	34.40	35.20	33.00	38.00
1750	33.00	36.60	33.00	38.00	34.60	35.20	33.00	38.00	34.50	35.00	33.00	38.00	33.80	35.00	33.00	38.00	34.40	35.20	33.00	38.00
2000	33.00	36.00	33.00	38.00	34.70	35.15	33.00	38.00	34.60	35.00	33.00	38.00	34.00	35.00	33.00	38.00	34.40	35.10	33.00	38.00
2500	34.70	35.50	33.00	35.50	34.80	35.10	33.00	35.50	34.60	35.00	33.00	35.50	34.00	35.00	33.00	35.50	34.40	35.10	33.00	35.50
3000	34.80	35.40	33.00	35.50	34.80	35.10	33.00	35.50	34.66	35.00	33.00	35.50	34.00	35.00	33.00	35.50	34.20	35.10	33.00	35.50
3500	34.80	35.40	33.00	35.50	34.70	35.10	33.00	35.50	34.64	35.00	33.00	35.50	34.00	35.00	33.00	35.50	34.00	35.10	33.00	35.50
4000	34.80	35.40	33.00	35.50	34.50	35.10	33.00	35.50	34.62	35.00	33.00	35.50	34.00	35.00	33.00	35.50	34.00	35.50	33.00	35.50
4500	34.80	35.40	33.00	35.50	34.50	35.10	33.00	35.50	34.62	35.00	33.00	35.50	34.00	35.00	33.00	35.50	34.00	35.50	33.00	35.50
5000	34.80	35.40	33.00	35.50	34.50	35.10	33.00	35.50	34.62	35.00	33.00	35.50	34.00	35.00	33.00	35.50	34.00	35.50	33.00	35.50
5500+	34.80	35.40	34.30	35.50	34.50	35.10	34.30	35.50	34.62	35.00	34.30	35.50	34.00	35.00	34.30	35.50	34.00	35.50	34.30	35.50

11.2. Salinity (continued 1)
Standard unit or scale: unitless

Depth (m)	South Pacific		Coastal S. Pacific		North Indian		Coastal N. Indian		Equatorial Indian		Coastal Eq. Indian		South Indian		Coastal S. Indian		Antarctic		Arctic	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
0	5.00	40.00	0.00	40.00	5.00	40.00	0.00	40.00	5.00	40.00	0.00	40.00	5.00	40.00	0.00	40.00	0.00	40.00	0.00	40.00
10	28.00	37.00	0.00	40.00	28.00	38.00	0.00	40.00	26.00	38.00	0.00	40.00	30.00	36.40	0.00	40.00	26.00	36.75	0.00	40.00
20	28.00	37.00	0.00	40.00	29.80	38.00	0.00	40.00	31.00	37.40	0.00	40.00	31.40	36.40	0.00	40.00	28.00	36.75	0.00	40.00
30	29.00	37.00	0.00	40.00	30.20	38.00	0.00	40.00	31.20	37.00	0.00	40.00	31.60	36.40	0.00	40.00	29.00	36.50	0.00	40.00
50	30.00	36.70	20.00	40.00	31.20	38.00	20.00	40.00	31.60	36.80	20.00	40.00	31.90	36.30	20.00	40.00	30.00	36.50	0.00	40.00
75	31.00	36.70	20.00	40.00	32.20	38.00	20.00	40.00	31.60	36.80	20.00	40.00	32.00	36.30	20.00	40.00	30.50	36.50	0.00	40.00
100	31.00	36.70	30.00	40.00	32.40	37.00	30.00	40.00	31.80	36.60	20.00	40.00	32.00	36.20	30.00	40.00	30.50	36.50	26.00	38.00
125	31.00	36.70	30.00	40.00	32.40	37.00	30.00	40.00	31.80	36.50	20.00	40.00	32.00	36.20	30.00	40.00	30.50	36.50	26.00	38.00
150	31.00	36.70	30.00	40.00	32.60	37.00	30.00	40.00	31.80	36.40	20.00	40.00	32.00	36.10	30.00	40.00	31.00	36.50	26.00	38.00
200	31.20	36.00	30.00	40.00	33.40	37.00	30.00	40.00	31.80	36.40	30.00	40.00	32.00	36.00	30.00	40.00	31.00	36.25	26.00	38.00
250	31.50	36.00	30.00	40.00	33.60	37.00	30.00	40.00	32.00	36.30	30.00	40.00	32.20	36.00	30.00	40.00	31.00	36.00	26.00	38.00
300	32.00	36.00	30.00	40.00	33.70	37.00	30.00	40.00	32.00	36.20	30.00	40.00	32.20	35.80	30.00	40.00	31.00	36.00	30.00	38.00
400	32.00	36.00	33.00	40.00	34.00	36.50	33.00	40.00	32.40	36.20	33.00	40.00	32.40	35.60	33.00	40.00	31.50	35.75	33.00	37.00
500	34.20	35.50	33.00	40.00	34.60	36.50	33.00	40.00	34.30	36.00	33.00	40.00	34.10	35.40	33.00	40.00	32.00	35.50	33.00	37.00
600	34.20	35.25	33.00	40.00	34.85	36.30	33.00	40.00	34.40	36.00	33.00	40.00	34.15	35.30	33.00	40.00	33.00	35.50	33.00	37.00
700	34.20	35.00	33.00	40.00	34.85	36.30	33.00	40.00	34.40	35.75	33.00	40.00	34.20	35.20	33.00	40.00	33.80	35.25	33.00	37.00
800	34.20	35.00	33.00	40.00	34.85	36.20	33.00	40.00	34.45	35.75	33.00	40.00	34.20	35.00	33.00	40.00	33.80	35.00	33.00	37.00
900	34.20	35.00	33.00	40.00	34.85	36.00	33.00	40.00	34.45	35.75	33.00	40.00	34.20	35.00	33.00	40.00	34.00	35.00	33.00	37.00
1000	34.20	35.00	33.00	40.00	34.85	36.00	33.00	40.00	34.50	35.75	33.00	40.00	34.25	34.90	33.00	40.00	34.00	35.00	33.00	37.00
1100	34.30	35.00	33.00	38.00	34.80	35.90	33.00	38.00	34.50	35.75	33.00	38.00	34.25	34.90	33.00	38.00	34.00	35.00	33.00	36.00
1200	34.30	34.70	33.00	38.00	34.80	35.80	33.00	38.00	34.50	35.75	33.00	38.00	34.25	34.90	33.00	38.00	34.00	35.00	33.00	36.00
1300	34.30	34.70	33.00	38.00	34.80	35.60	33.00	38.00	34.55	35.60	33.00	38.00	34.30	34.90	33.00	38.00	34.00	34.90	33.00	36.00
1400	34.40	34.70	33.00	38.00	34.80	35.60	33.00	38.00	34.55	35.30	33.00	38.00	34.30	34.90	33.00	38.00	34.30	34.90	33.00	36.00
1500	34.40	34.80	33.00	38.00	34.75	35.60	33.00	38.00	34.55	35.20	33.00	38.00	34.35	34.90	33.00	38.00	34.30	34.90	33.00	36.00
1750	34.40	34.80	33.00	38.00	34.75	35.50	33.00	38.00	34.57	35.10	33.00	38.00	34.45	34.90	33.00	38.00	34.40	34.90	33.00	36.00
2000	34.40	34.80	33.00	38.00	34.70	35.40	33.00	38.00	34.60	35.00	33.00	38.00	34.55	34.90	33.00	38.00	34.40	34.90	33.00	36.00
2500	34.50	34.80	33.00	35.50	34.65	35.40	33.00	35.50	34.60	35.00	33.00	35.50	34.60	34.90	33.00	35.50	34.40	34.90	33.00	35.50
3000	34.50	34.80	33.00	35.50	34.65	35.40	33.00	35.50	34.60	35.00	33.00	35.50	34.60	34.90	33.00	35.50	34.40	34.90	33.00	35.50
3500	34.60	34.80	33.00	35.50	34.60	35.40	33.00	35.50	34.60	35.00	33.00	35.50	34.60	34.90	33.00	35.50	34.40	34.90	33.00	35.50
4000	34.60	34.80	33.00	35.50	34.60	35.40	33.00	35.50	34.60	35.00	33.00	35.50	34.60	34.90	33.00	35.50	34.40	34.90	33.00	35.50
4500	34.60	34.80	33.00	35.50	34.60	35.40	33.00	35.50	34.60	35.00	33.00	35.50	34.60	34.90	33.00	35.50	34.40	34.90	33.00	35.50
5000	34.60	34.80	33.00	35.50	34.60	35.40	33.00	35.50	34.60	35.00	33.00	35.50	34.60	34.90	33.00	35.50	34.40	34.90	33.00	35.50
5500+	34.60	34.80	34.30	35.50	34.60	35.40	34.30	35.50	34.60	35.00	34.30	35.50	34.60	34.90	34.30	35.50	34.40	34.90	34.30	35.50

11.2. Salinity (continued 2)
Standard unit or scale: unitless

Depth (m)	Mediterranean		Black Sea		Baltic Sea		Persian Gulf		Red Sea		Sulu Sea		NW Pacific		Yellow Sea		Sea of Japan		Seto Inland_Sea	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
0	0.00	40.00	0.00	25.00	0.00	35.00	0.00	42.00	0.00	44.00	0.00	40.00	27.00	35.30	2.00	35.05	27.00	35.00	2.00	35.00
10	0.00	40.00	0.00	25.00	0.00	35.00	0.00	42.00	0.00	44.00	0.00	40.00	27.50	35.30	6.00	35.05	28.00	35.00	12.00	35.00
20	0.00	40.00	0.00	25.00	0.00	35.00	0.00	42.00	0.00	44.00	0.00	40.00	28.00	35.30	20.00	35.05	29.00	35.00	22.00	35.00
30	0.00	40.00	0.00	25.00	0.00	35.00	0.00	42.00	0.00	44.00	0.00	40.00	29.00	35.30	25.00	35.05	30.00	35.00	25.00	35.00
50	12.00	40.00	10.00	40.00	0.00	35.00	20.00	42.00	20.00	43.00	20.00	40.00	31.00	35.30	30.00	35.05	32.50	35.00	31.00	34.90
75	12.00	40.00	10.00	40.00	0.00	35.00	20.00	42.00	20.00	43.00	20.00	40.00	31.50	35.30	31.00	35.05	33.00	35.00	32.00	34.85
100	31.00	40.00	12.00	40.00	0.00	35.00	30.00	42.00	30.00	43.00	30.00	40.00	32.00	35.30	32.00	35.05	33.50	34.90	33.00	34.85
125	31.00	40.00	12.00	40.00	0.00	35.00	30.00	42.00	30.00	43.00	30.00	40.00	32.25	35.30	33.50	35.05	33.50	34.80	34.00	34.80
150	31.00	40.00	12.00	40.00	0.00	35.00	30.00	42.00	30.00	43.00	30.00	40.00	32.50	35.30	34.00	35.05	33.50	34.70	34.00	34.80
200	31.00	40.00	12.00	40.00	1.00	25.00	30.00	42.00	30.00	43.00	30.00	40.00	33.00	35.30	34.10	35.00	33.50	34.50	34.00	34.75
250	31.00	40.00	12.00	40.00	1.00	25.00	30.00	42.00	30.00	43.00	30.00	40.00	33.05	35.30	34.10	34.95	33.60	34.50	34.00	34.70
300	31.00	40.00	12.00	35.00	1.00	25.00	30.00	42.00	30.00	43.00	30.00	40.00	33.10	35.25	34.10	34.90	33.70	34.50	34.00	34.70
400	31.00	40.00	12.00	33.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	40.00	33.20	35.20	34.10	34.70	33.80	34.30	34.00	34.70
500	31.00	40.00	12.00	30.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	40.00	33.30	35.15	34.10	34.60	33.96	34.25	34.00	34.70
600	33.00	40.00	12.00	30.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	40.00	33.50	35.10	34.10	34.59	33.97	34.24	34.00	34.70
700	33.00	40.00	15.00	30.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	40.00	33.70	35.05	34.10	34.58	33.97	34.23	34.00	34.70
800	33.00	40.00	15.00	28.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	40.00	33.80	35.00	34.15	34.57	33.98	34.22	34.00	34.70
900	33.00	40.00	15.00	28.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	40.00	33.90	34.90	34.20	34.56	33.98	34.21	34.00	34.70
1000	33.00	40.00	15.00	28.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	40.00	33.95	34.90	34.30	34.55	33.99	34.20	34.00	34.70
1100	33.00	40.00	18.00	25.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	38.00	34.00	34.90	34.32	34.55	33.99	34.19	34.00	34.70
1200	33.00	40.00	18.00	25.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	38.00	34.05	34.85	34.33	34.55	34.00	34.18	34.00	34.70
1300	33.00	40.00	18.00	25.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	38.00	34.10	34.80	34.34	34.55	34.00	34.17	34.00	34.70
1400	33.00	40.00	18.00	25.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	38.00	34.15	34.80	34.35	34.55	34.01	34.16	34.00	34.70
1500	33.00	40.00	18.00	25.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	38.00	34.20	34.80	34.35	34.55	34.01	34.15	34.00	34.70
1750	33.00	40.00	18.00	25.00	1.00	25.00	33.00	42.00	33.00	50.00	33.00	38.00	34.30	34.80	34.35	34.55	34.02	34.14	34.00	34.70
2000	33.00	40.00	18.00	25.00	1.00	25.00	33.00	42.00	33.00	50.00	33.00	38.00	34.40	34.80	34.35	34.55	34.03	34.13	34.00	34.70
2500	33.00	40.00	18.00	25.00	1.00	25.00	33.00	42.00	33.00	50.00	33.00	35.50	34.55	34.77	34.35	34.55	34.04	34.12	34.00	34.70
3000	33.00	40.00	18.00	25.00	1.00	25.00	33.00	42.00	33.00	50.00	33.00	35.50	34.58	34.75	34.35	34.55	34.05	34.11	34.00	34.70
3500	33.00	40.00	18.00	25.00	1.00	25.00	33.00	35.50	33.00	50.00	33.00	35.50	34.60	34.75	34.35	34.55	34.05	34.11	34.00	34.70
4000	33.00	40.00	18.00	25.00	1.00	25.00	33.00	35.50	33.00	50.00	33.00	35.50	34.61	34.75	34.35	34.55	34.05	34.11	34.00	34.70
4500	33.00	40.00	18.00	25.00	1.00	25.00	33.00	35.50	33.00	50.00	33.00	35.50	34.63	34.73	34.35	34.55	34.05	34.11	34.00	34.70
5000	33.00	40.00	18.00	25.00	1.00	25.00	33.00	35.50	33.00	50.00	33.00	35.50	34.63	34.73	34.35	34.55	34.05	34.11	34.00	34.70
5500+	34.30	40.00	18.00	25.00	1.00	25.00	34.30	35.50	34.30	50.00	34.30	35.50	34.63	34.73	34.35	34.55	34.05	34.11	34.00	34.70

11.3. Variable: Dissolved Oxygen
Standard unit or scale: micromole per kilogram (µmol kg^{-1})

Depth (m)	North Atlantic		Coastal N. Atlantic		Equatorial Atlantic		Coastal Eq. Atlantic		South Atlantic		Coastal S. Atlantic		North Pacific		Coastal N. Pacific		Equatorial Pacific		Coastal Eq. Pacific	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
0	0	479	0	436	0	305	0	392	0	392	0	392	0	436	0	436	0	349	0	305
10	0	479	0	436	0	305	0	392	0	392	0	392	0	436	0	436	0	349	0	305
20	0	479	0	436	0	305	0	392	0	392	0	392	0	436	0	436	0	349	0	305
30	0	479	0	436	0	305	0	392	0	392	0	392	0	436	0	436	0	349	0	305
50	0	479	0	392	0	261	0	392	0	392	0	349	0	436	0	349	0	349	0	261
75	0	479	0	392	0	261	0	261	0	392	0	349	0	392	0	349	0	349	0	261
100	0	436	0	392	0	261	0	261	0	349	0	349	0	392	0	349	0	261	0	261
125	0	436	0	392	0	261	0	261	0	349	0	349	0	392	0	349	0	261	0	261
150	0	436	0	392	0	261	0	261	0	349	0	349	0	349	0	349	0	261	0	218
200	0	436	0	392	0	261	0	261	0	349	0	349	0	349	0	349	0	218	0	218
250	0	436	0	349	0	261	0	261	0	349	0	349	0	349	0	349	0	218	0	218
300	0	392	0	349	0	218	0	261	0	349	0	305	0	305	0	349	0	218	0	218
400	0	392	0	349	0	218	0	261	0	349	0	305	0	305	0	349	0	218	0	218
500	0	392	0	349	0	218	0	261	0	349	0	305	0	305	0	349	0	218	0	218
600	0	392	0	349	0	218	0	305	0	305	0	305	0	305	0	305	0	218	0	218
700	0	392	0	349	0	218	0	305	0	305	0	305	0	261	0	305	0	218	0	218
800	0	392	0	349	0	218	0	305	0	305	0	305	0	261	0	305	0	218	0	218
900	0	392	0	349	0	218	0	305	0	305	0	305	0	261	0	305	0	218	0	218
1000	0	392	0	349	0	261	0	305	0	305	0	305	0	261	0	305	0	218	0	218
1100	0	392	0	349	0	261	0	305	0	305	0	305	0	261	0	305	0	218	0	218
1200	0	392	0	349	0	261	0	305	0	305	0	305	0	261	0	305	0	218	0	218
1300	0	392	0	349	0	261	0	305	0	305	0	305	0	261	0	305	0	218	0	218
1400	0	392	0	349	0	305	0	305	0	305	0	305	0	261	0	305	0	218	0	218
1500	131	392	0	349	0	305	0	305	0	305	0	305	0	261	0	305	0	218	0	218
1750	131	392	0	305	0	305	0	305	0	305	0	305	0	261	0	305	0	218	0	218
2000	131	392	0	305	0	305	0	305	0	305	0	305	0	261	0	305	0	218	0	218
2500	131	349	0	305	0	305	0	305	0	305	0	305	0	261	0	305	0	218	0	218
3000	131	349	0	305	0	305	0	305	0	305	0	305	0	261	0	305	0	218	0	174
3500	131	349	0	305	0	305	0	305	0	305	0	305	0	261	0	305	0	218	0	174
4000	131	349	0	305	0	305	0	305	0	261	0	305	0	261	0	218	0	218	0	174
4500	131	349	0	305	0	261	0	305	0	261	0	305	0	261	0	218	0	218	0	174
5000	131	349	0	305	0	261	0	305	0	261	0	305	0	261	0	218	0	218	0	174
5500+	131	349	0	305	0	261	0	305	0	261	0	305	0	261	0	218	0	218	0	174

11.3. Dissolved Oxygen (continued 1)
Standard unit or scale: micromole per kilogram (µmol kg^{-1})

Depth (m)	South Pacific		Coastal S. Pacific		North Indian		Coastal N. Indian		Equatorial Indian		Coastal Eq. Indian		South Indian		Coastal S. Indian		Antarctic		Arctic	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
0	0	349	0	349	0	305	0	305	0	436	0	261	0	436	0	392	229	479	0	**479**
10	0	349	0	349	0	305	0	305	0	436	0	261	0	436	0	392	229	457	0	**479**
20	0	349	0	349	0	305	0	305	0	436	0	261	0	436	0	392	229	436	0	**479**
30	0	349	0	349	0	305	0	305	0	436	0	261	0	436	0	392	218	436	0	**479**
50	0	349	0	305	0	305	0	305	0	436	0	261	0	436	0	392	174	436	0	**479**
75	0	349	0	305	0	305	0	305	0	436	0	261	0	349	0	392	163	414	0	**436**
100	0	349	0	305	0	305	0	305	0	305	0	261	0	349	0	392	152	403	0	**436**
125	0	349	0	305	0	218	0	218	0	305	0	218	0	349	0	392	152	392	0	**436**
150	0	349	0	305	0	218	0	218	0	305	0	218	0	349	0	392	152	381	0	**436**
200	0	305	0	305	0	218	0	218	0	218	0	218	0	349	0	392	152	370	0	**436**
250	0	305	0	305	0	218	0	218	0	218	0	218	0	349	0	305	152	370	0	**436**
300	0	305	0	305	0	218	0	174	0	218	0	218	0	305	0	305	152	359	0	**436**
400	0	305	0	305	0	218	0	174	0	218	0	218	0	305	0	305	152	349	0	**436**
500	0	305	0	305	0	218	0	174	0	218	0	218	0	305	0	305	152	349	0	**436**
600	0	305	0	305	0	218	0	174	0	218	0	218	0	305	0	261	152	338	0	**392**
700	0	305	0	261	0	218	0	174	0	218	0	218	0	305	0	261	152	338	0	**392**
800	0	305	0	261	0	218	0	174	0	218	0	131	0	261	0	261	152	338	0	**392**
900	0	305	0	261	0	218	0	174	0	218	0	131	0	261	0	261	152	327	0	**392**
1000	0	261	0	261	0	218	0	174	0	218	0	131	0	261	0	261	152	327	0	**392**
1100	0	261	0	218	0	218	0	174	0	218	0	131	0	261	0	261	142	327	0	**392**
1200	0	261	0	218	0	218	0	174	0	218	0	131	0	261	0	261	142	327	0	**392**
1300	0	261	0	218	0	218	0	174	0	218	0	131	0	261	0	261	131	327	0	**392**
1400	0	261	0	218	0	218	0	174	0	218	0	218	0	261	0	261	131	327	0	**392**
1500	0	218	0	218	0	218	0	174	0	218	0	218	0	261	0	261	131	316	0	**392**
1750	0	218	0	218	0	218	0	174	0	218	0	218	0	261	0	261	131	316	0	**392**
2000	0	218	0	218	0	218	0	174	0	218	0	218	0	261	0	261	131	316	0	**392**
2500	0	218	0	218	0	218	0	174	0	218	0	218	0	261	0	261	142	316	0	**392**
3000	0	218	0	218	0	218	0	174	0	218	0	218	0	261	0	261	152	316	0	**392**
3500	0	218	0	218	0	218	0	174	0	218	0	218	0	261	0	261	163	305	0	**392**
4000	0	218	0	218	0	218	0	174	0	218	0	218	0	261	0	261	174	283	0	**392**
4500	0	218	0	218	0	218	0	174	0	218	0	218	0	261	0	261	174	283	0	**392**
5000	0	218	0	218	0	218	0	174	0	218	0	218	0	261	0	261	185	283	0	**392**
5500+	0	218	0	218	0	218	0	174	0	218	0	218	0	261	0	261	196	283	0	**392**

11.3. Dissolved Oxygen (continued 2)
Standard unit or scale: micromole per kilogram (µmol kg^{-1})

Depth (m)	Mediterranean		Black Sea		Baltic Sea		Persian Gulf		Red Sea		Sulu Sea		NW Pacific		Yellow Sea		Se of Japan		Seto Inland_Sea	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
0	0	349	0	436	0	523	0	523	0	523	0	218	0	436	0	436	0	436	0	436
10	0	349	0	436	0	523	0	523	0	523	0	218	0	436	0	436	0	436	0	436
20	0	349	0	436	0	523	0	523	0	523	0	218	0	436	0	436	0	436	0	436
30	0	349	0	436	0	523	0	523	0	523	0	218	0	436	0	436	0	436	0	436
50	0	349	0	436	0	523	0	523	0	523	0	218	0	436	0	436	0	436	0	436
75	0	305	0	349	0	414	0	414	0	414	0	218	0	392	0	392	0	392	0	392
100	0	305	0	349	0	414	0	414	0	414	0	174	0	392	0	392	0	392	0	392
125	0	305	0	349	0	414	0	414	0	414	0	174	0	392	0	392	0	392	0	392
150	0	305	0	349	0	414	0	414	0	414	0	174	0	349	0	349	0	349	0	349
200	0	305	0	218	0	392	0	392	0	392	0	131	0	349	0	349	0	349	0	349
250	0	305	0	218	0	392	0	392	0	392	0	131	0	349	0	349	0	349	0	349
300	0	305	0	218	0	349	0	349	0	349	0	131	0	305	0	305	0	305	0	305
400	0	305	0	87	0	349	0	349	0	349	0	131	0	305	0	305	0	305	0	305
500	0	305	0	87	0	349	0	349	0	349	0	131	0	305	0	305	0	305	0	305
600	0	305	0	87	0	309	0	309	0	309	0	131	0	305	0	305	0	305	0	305
700	0	305	0	87	0	309	0	309	0	309	0	131	0	261	0	261	0	261	0	261
800	0	305	0	87	0	309	0	309	0	309	0	131	0	261	0	261	0	261	0	261
900	0	305	0	87	0	309	0	309	0	309	0	131	0	261	0	261	0	261	0	261
1000	0	261	0	87	0	309	0	309	0	309	0	131	0	261	0	261	0	261	0	261
1100	0	261	0	87	0	309	0	309	0	309	0	131	0	261	0	261	0	261	0	261
1200	0	261	0	87	0	309	0	309	0	309	0	87	0	261	0	261	0	261	0	261
1300	0	261	0	87	0	309	0	309	0	309	0	87	0	261	0	261	0	261	0	261
1400	0	261	0	87	0	309	0	309	0	309	0	87	0	261	0	261	0	261	0	261
1500	0	261	0	87	0	309	0	309	0	309	0	87	0	261	0	261	0	261	0	261
1750	0	261	0	87	0	309	0	309	0	309	0	87	0	261	0	261	0	261	0	261
2000	0	261	0	87	0	309	0	309	0	309	0	87	0	261	0	261	0	261	0	261
2500	0	261	0	87	0	309	0	309	0	309	0	87	0	261	0	261	0	261	0	261
3000	0	261	0	87	0	309	0	309	0	309	0	87	0	261	0	261	0	261	0	261
3500	0	261	0	87	0	309	0	309	0	309	0	87	0	261	0	261	0	261	0	261
4000	0	261	0	87	0	309	0	309	0	309	0	87	0	261	0	261	0	261	0	261
4500	0	261	0	87	0	261	0	261	0	261	0	87	0	261	0	261	0	261	0	261
5000	0	261	0	87	0	261	0	261	0	261	0	87	0	261	0	261	0	261	0	261
5500+	0	261	0	87	0	261	0	261	0	261	0	87	0	261	0	261	0	261	0	261

11.4. Variable: Phosphate
Standard unit or scale: micromole per kilogram (µmol kg^{-1})

Depth (m)	North Atlantic		Coastal N. Atlantic		Equatorial Atlantic		Coastal Eq. Atlantic		South Atlantic		Coastal S. Atlantic		North Pacific		Coastal N. Pacific		Equatorial Pacific		Coastal Eq. Pacific	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
0	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
10	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
20	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
30	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
75	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
100	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
125	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
150	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
200	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
250	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
300	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
400	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
500	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
600	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
700	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
800	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
900	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
1000	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
1100	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
1200	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
1300	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
1400	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
1500	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
1750	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
2000	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
2500	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
3000	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
3500	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
4000	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
4500	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
5000	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
5500+	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50

11.4. Phosphate (continued 1)
Standard unit or scale: micromole per kilogram (µmol kg^{-1})

Depth (m)	South Pacific		Coastal S. Pacific		North Indian		Coastal N. Indian		Equatorial Indian		Coastal Eq. Indian		South Indian		Coastal S. Indian		Antarctic		Arctic	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
0	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
10	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
20	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
30	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
75	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
100	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
125	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
150	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
200	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
250	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
300	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
400	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
500	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00	4.50
600	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
700	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
800	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
900	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
1000	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
1100	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
1200	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
1300	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
1400	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
1500	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
1750	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
2000	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
2500	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
3000	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
3500	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
4000	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
4500	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
5000	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50
5500+	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50	0.01	4.50

11.4. Phosphate (continued 2)
Standard unit or scale: micromole per kilogram (µmol kg^{-1})

Depth (m)	Mediterranean		Black Sea		Baltic Sea		Persian Gulf		Red Sea		Sulu Sea		NW Pacific		Yellow Sea		Se of Japan		Seto Inland_Sea	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
0	0.00	30.00	0.00	30.00	0.00	60.00	0.00	1.50	0.00	4.50	0.00	2.75	0.00	2.75	0.00	2.75	0.00	2.75	0.00	2.75
10	0.00	30.00	0.00	30.00	0.00	60.00	0.00	1.50	0.00	4.50	0.00	2.75	0.00	2.75	0.00	2.75	0.00	2.75	0.00	2.75
20	0.00	30.00	0.00	30.00	0.00	60.00	0.00	1.50	0.00	4.50	0.00	2.75	0.00	2.75	0.00	2.75	0.00	2.75	0.00	2.75
30	0.00	30.00	0.00	30.00	0.00	60.00	0.00	1.50	0.00	4.50	0.00	2.75	0.00	2.75	0.00	2.75	0.00	2.75	0.00	2.75
50	0.00	30.00	0.00	30.00	0.00	60.00	0.00	1.50	0.00	4.50	0.00	2.75	0.00	2.75	0.00	2.75	0.00	2.75	0.00	2.75
75	0.00	5.00	0.00	15.00	0.00	60.00	0.02	1.50	0.00	4.50	0.00	2.75	0.00	2.75	0.00	2.75	0.00	2.75	0.00	2.75
100	0.00	5.00	0.00	15.00	0.00	20.00	0.02	1.50	0.00	4.50	0.00	2.75	0.00	2.75	0.00	2.75	0.00	2.75	0.00	2.75
125	0.00	5.00	0.00	15.00	0.00	20.00	0.02	1.50	0.00	4.50	0.00	2.75	0.00	2.75	0.00	2.75	0.00	2.75	0.00	2.75
150	0.00	5.00	0.00	15.00	0.00	20.00	0.02	1.50	0.00	4.50	0.00	2.75	0.00	2.75	0.00	2.75	0.00	2.75	0.00	2.75
200	0.00	5.00	0.00	15.00	0.00	20.00	0.02	1.50	0.00	4.50	0.00	2.75	0.00	2.75	0.00	2.75	0.00	2.75	0.00	2.75
250	0.00	2.50	0.00	15.00	0.00	20.00	0.02	1.50	0.00	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75
300	0.00	2.50	0.00	15.00	0.00	20.00	0.02	1.50	0.00	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75
400	0.00	2.50	0.00	15.00	0.00	20.00	0.02	1.50	0.00	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75
500	0.00	2.50	0.00	15.00	0.00	20.00	0.02	1.50	0.10	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75
600	0.01	2.50	0.01	15.00	0.01	20.00	0.02	1.50	0.10	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75
700	0.01	2.50	0.01	15.00	0.01	20.00	0.02	1.50	0.10	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75
800	0.01	2.50	0.01	15.00	0.01	20.00	0.02	1.50	0.10	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75
900	0.01	2.50	0.01	15.00	0.01	20.00	0.02	1.50	0.10	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75
1000	0.01	2.50	0.01	15.00	0.01	20.00	0.02	1.50	0.10	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75
1100	0.01	2.50	0.01	15.00	0.01	20.00	0.02	1.50	0.10	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75
1200	0.01	2.50	0.01	15.00	0.01	20.00	0.02	1.50	0.10	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75
1300	0.01	2.50	0.01	15.00	0.01	20.00	0.02	1.50	0.10	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75
1400	0.01	2.50	0.01	15.00	0.01	20.00	0.02	1.50	0.10	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75
1500	0.01	2.50	0.01	15.00	0.01	20.00	0.02	1.50	0.10	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75
1750	0.01	2.50	0.01	15.00	0.01	20.00	0.02	1.50	0.10	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75
2000	0.01	2.50	0.01	15.00	0.01	20.00	0.02	1.50	0.10	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75
2500	0.01	2.50	0.01	4.50	0.01	20.00	0.02	1.50	0.10	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75
3000	0.01	2.50	0.01	4.50	0.01	20.00	0.02	1.50	0.10	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75
3500	0.01	2.50	0.01	4.50	0.01	20.00	0.02	1.50	0.10	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75
4000	0.01	2.50	0.01	4.50	0.01	20.00	0.02	1.50	0.10	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75
4500	0.01	2.50	0.01	4.50	0.01	20.00	0.02	1.50	0.10	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75
5000	0.01	2.50	0.01	4.50	0.01	20.00	0.02	1.50	0.10	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75
5500+	0.01	2.50	0.01	4.50	0.01	20.00	0.02	1.50	0.10	4.50	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75	0.50	2.75

11.5. Variable: Silicate
Standard unit or scale: micromole per kilogram (µmol kg^{-1})

Depth (m)	North Atlantic		Coastal N. Atlantic		Equatorial Atlantic		Coastal Eq. Atlantic		South Atlantic		Coastal S. Atlantic		North Pacific		Coastal N. Pacific		Equatorial Pacific		Coastal Eq. Pacific	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
0	0.00	150.00	0.00	250.00	0.00	80.00	0.00	250.00	0.00	150.00	0.00	250.00	0.00	100.00	0.00	250.00	0.00	150.00	0.00	250.00
10	0.00	150.00	0.00	250.00	0.00	80.00	0.00	250.00	0.00	150.00	0.00	250.00	0.00	100.00	0.00	250.00	0.00	150.00	0.00	250.00
20	0.00	150.00	0.00	250.00	0.00	80.00	0.00	250.00	0.00	150.00	0.00	250.00	0.00	100.00	0.00	250.00	0.00	150.00	0.00	250.00
30	0.00	150.00	0.00	250.00	0.00	80.00	0.00	250.00	0.00	150.00	0.00	250.00	0.00	100.00	0.00	250.00	0.00	150.00	0.00	250.00
50	0.00	150.00	0.00	250.00	0.00	80.00	0.00	250.00	0.00	150.00	0.00	250.00	0.00	100.00	0.00	250.00	0.00	150.00	0.00	250.00
75	0.00	150.00	0.00	250.00	0.00	80.00	0.00	250.00	0.00	150.00	0.00	250.00	0.00	100.00	0.00	250.00	0.00	150.00	0.00	250.00
100	0.00	150.00	0.00	250.00	0.00	80.00	0.00	250.00	0.00	150.00	0.00	250.00	0.00	100.00	0.00	250.00	0.00	150.00	0.00	250.00
125	0.00	150.00	0.00	250.00	0.00	80.00	0.00	250.00	0.00	150.00	0.00	250.00	0.00	100.00	0.00	250.00	0.00	150.00	0.00	250.00
150	0.00	150.00	0.00	250.00	0.00	80.00	0.00	250.00	0.00	150.00	0.00	250.00	0.00	110.00	0.00	250.00	0.00	150.00	0.00	250.00
200	0.01	150.00	0.01	250.00	0.01	80.00	0.01	250.00	0.01	150.00	0.01	250.00	0.01	120.00	0.01	250.00	0.00	150.00	0.01	250.00
250	0.01	150.00	0.01	250.00	0.01	80.00	0.01	250.00	0.01	150.00	0.01	250.00	0.01	125.00	0.01	250.00	0.01	150.00	0.01	250.00
300	0.01	150.00	0.01	250.00	0.01	80.00	0.01	250.00	0.01	150.00	0.01	250.00	0.01	130.00	0.01	250.00	0.01	150.00	0.01	250.00
400	0.01	150.00	0.01	250.00	0.01	80.00	0.01	250.00	0.01	150.00	0.01	250.00	0.01	140.00	0.01	250.00	0.01	150.00	0.01	250.00
500	0.01	150.00	0.01	250.00	0.50	80.00	0.01	250.00	0.50	150.00	0.01	250.00	0.50	150.00	0.01	250.00	0.50	150.00	0.01	250.00
600	0.01	150.00	0.01	250.00	1.00	80.00	0.01	250.00	2.50	150.00	0.01	250.00	5.00	160.00	0.01	250.00	2.00	150.00	0.01	250.00
700	0.01	150.00	0.01	250.00	2.00	80.00	0.01	250.00	5.00	150.00	0.01	250.00	5.00	165.00	0.01	250.00	5.00	150.00	0.01	250.00
800	0.01	150.00	0.01	250.00	2.00	80.00	0.01	250.00	5.00	150.00	0.01	250.00	5.00	170.00	0.01	250.00	5.00	155.00	0.01	250.00
900	0.01	150.00	0.01	250.00	5.00	80.00	0.01	250.00	10.00	150.00	0.01	250.00	10.00	175.00	0.01	250.00	5.00	160.00	0.01	250.00
1000	2.50	150.00	1.00	250.00	5.00	80.00	1.00	250.00	10.00	150.00	1.00	250.00	10.00	180.00	1.00	250.00	5.00	165.00	1.00	250.00
1100	2.50	150.00	1.00	250.00	5.00	80.00	1.00	250.00	10.00	150.00	1.00	250.00	10.00	190.00	1.00	250.00	10.00	165.00	1.00	250.00
1200	2.50	150.00	1.00	250.00	5.00	80.00	1.00	250.00	10.00	150.00	1.00	250.00	20.00	200.00	1.00	250.00	10.00	170.00	1.00	250.00
1300	2.50	150.00	1.00	250.00	5.00	80.00	1.00	250.00	10.00	150.00	1.00	250.00	20.00	200.00	1.00	250.00	10.00	170.00	1.00	250.00
1400	2.50	150.00	1.00	250.00	5.00	80.00	1.00	250.00	10.00	150.00	1.00	250.00	20.00	200.00	1.00	250.00	10.00	170.00	1.00	250.00
1500	5.00	150.00	1.00	250.00	5.00	80.00	1.00	250.00	10.00	150.00	1.00	250.00	20.00	225.00	1.00	250.00	10.00	175.00	1.00	250.00
1750	5.00	150.00	1.00	250.00	5.00	80.00	1.00	250.00	10.00	150.00	1.00	250.00	20.00	225.00	1.00	250.00	10.00	180.00	1.00	250.00
2000	5.00	150.00	1.00	250.00	10.00	80.00	1.00	250.00	10.00	150.00	1.00	250.00	20.00	250.00	1.00	250.00	10.00	200.00	1.00	250.00
2500	5.00	150.00	1.00	250.00	10.00	80.00	1.00	250.00	10.00	150.00	1.00	250.00	20.00	250.00	1.00	250.00	10.00	200.00	1.00	250.00
3000	5.00	150.00	1.00	250.00	10.00	80.00	1.00	250.00	10.00	150.00	1.00	250.00	20.00	250.00	1.00	250.00	10.00	200.00	1.00	250.00
3500	5.00	150.00	1.00	250.00	10.00	150.00	1.00	250.00	10.00	150.00	1.00	250.00	20.00	250.00	1.00	250.00	10.00	200.00	1.00	250.00
4000	5.00	150.00	1.00	250.00	10.00	150.00	1.00	250.00	10.00	150.00	1.00	250.00	20.00	200.00	1.00	250.00	10.00	200.00	1.00	250.00
4500	10.00	150.00	1.00	250.00	10.00	150.00	1.00	250.00	10.00	150.00	1.00	250.00	20.00	200.00	1.00	250.00	10.00	200.00	1.00	250.00
5000	10.00	150.00	1.00	250.00	10.00	150.00	1.00	250.00	10.00	150.00	1.00	250.00	20.00	190.00	1.00	250.00	10.00	200.00	1.00	250.00
5500+	15.00	150.00	1.00	250.00	10.00	150.00	1.00	250.00	10.00	150.00	1.00	250.00	20.00	180.00	1.00	250.00	10.00	200.00	1.00	250.00

11.5. Silicate (continued 1)
Standard unit or scale: micromole per kilogram (µmol kg^{-1})

Depth (m)	South Pacific		Coastal S. Pacific		North Indian		Coastal N. Indian		Equatorial Indian		Coastal Eq. Indian		South Indian		Coastal S. Indian		Antarctic		Arctic	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
0	0.00	140.00	0.00	250.00	0.00	180.00	0.00	250.00	0.00	200.00	0.00	250.00	0.00	180.00	0.00	250.00	0.00	200.00	0.00	200.00
10	0.00	140.00	0.00	250.00	0.00	180.00	0.00	250.00	0.00	200.00	0.00	250.00	0.00	180.00	0.00	250.00	0.00	200.00	0.00	200.00
20	0.00	140.00	0.00	250.00	0.00	180.00	0.00	250.00	0.00	200.00	0.00	250.00	0.00	180.00	0.00	250.00	0.00	200.00	0.00	200.00
30	0.00	140.00	0.00	250.00	0.00	180.00	0.00	250.00	0.00	200.00	0.00	250.00	0.00	180.00	0.00	250.00	0.00	200.00	0.00	200.00
50	0.00	140.00	0.00	250.00	0.00	180.00	0.00	250.00	0.00	200.00	0.00	250.00	0.00	180.00	0.00	250.00	0.00	200.00	0.00	200.00
75	0.00	140.00	0.00	250.00	0.00	180.00	0.00	250.00	0.00	200.00	0.00	250.00	0.00	180.00	0.00	250.00	0.00	200.00	0.00	200.00
100	0.00	140.00	0.00	250.00	0.00	180.00	0.00	250.00	0.00	200.00	0.00	250.00	0.00	180.00	0.00	250.00	0.00	200.00	0.00	200.00
125	0.00	140.00	0.00	250.00	0.00	180.00	0.00	250.00	0.00	200.00	0.00	250.00	0.00	180.00	0.00	250.00	0.00	200.00	0.00	200.00
150	0.00	140.00	0.00	250.00	0.00	180.00	0.00	250.00	0.00	200.00	0.00	250.00	0.00	180.00	0.00	250.00	0.00	200.00	0.00	200.00
200	0.01	140.00	0.01	250.00	0.01	180.00	0.01	250.00	0.01	200.00	0.01	250.00	0.01	180.00	0.01	250.00	0.01	200.00	0.01	200.00
250	0.01	140.00	0.01	250.00	0.01	180.00	0.01	250.00	0.01	200.00	0.01	250.00	0.01	180.00	0.01	250.00	0.01	200.00	0.01	200.00
300	0.01	140.00	0.01	250.00	0.01	180.00	0.01	250.00	0.01	200.00	0.01	250.00	0.01	180.00	0.01	250.00	0.01	200.00	0.01	200.00
400	0.50	140.00	0.01	250.00	0.01	180.00	0.01	250.00	0.01	200.00	0.01	250.00	0.01	180.00	0.01	250.00	0.01	200.00	0.01	200.00
500	2.00	140.00	0.01	250.00	0.01	180.00	0.01	250.00	0.01	200.00	0.01	250.00	0.01	180.00	0.01	250.00	0.01	200.00	0.01	200.00
600	3.00	140.00	0.01	250.00	0.01	180.00	0.01	250.00	0.01	200.00	0.01	250.00	0.01	180.00	0.01	250.00	0.01	200.00	0.01	200.00
700	4.00	140.00	0.01	250.00	0.01	180.00	0.01	250.00	0.01	200.00	0.01	250.00	0.01	180.00	0.01	250.00	0.01	200.00	0.01	200.00
800	5.00	140.00	0.01	250.00	0.01	180.00	0.01	250.00	0.01	200.00	0.01	250.00	0.01	180.00	0.01	250.00	1.00	200.00	0.01	200.00
900	7.00	140.00	0.01	250.00	0.01	180.00	0.01	250.00	0.01	200.00	0.01	250.00	0.01	180.00	0.01	250.00	1.00	200.00	0.01	200.00
1000	10.00	150.00	1.00	250.00	1.00	180.00	1.00	250.00	1.00	200.00	1.00	250.00	1.00	180.00	1.00	250.00	1.00	200.00	0.01	200.00
1100	20.00	150.00	1.00	250.00	1.00	180.00	1.00	250.00	1.00	200.00	1.00	250.00	1.00	180.00	1.00	250.00	10.00	200.00	0.01	200.00
1200	25.00	150.00	1.00	250.00	1.00	180.00	1.00	250.00	1.00	200.00	1.00	250.00	1.00	180.00	1.00	250.00	10.00	200.00	0.01	200.00
1300	30.00	155.00	1.00	250.00	1.00	180.00	1.00	250.00	1.00	200.00	1.00	250.00	5.00	180.00	1.00	250.00	10.00	200.00	0.01	200.00
1400	35.00	160.00	1.00	250.00	5.00	180.00	1.00	250.00	1.00	200.00	1.00	250.00	5.00	180.00	1.00	250.00	10.00	200.00	0.01	200.00
1500	40.00	165.00	1.00	250.00	5.00	180.00	1.00	250.00	1.00	200.00	1.00	250.00	5.00	180.00	1.00	250.00	10.00	200.00	0.01	200.00
1750	50.00	165.00	1.00	250.00	10.00	180.00	1.00	250.00	1.00	200.00	1.00	250.00	5.00	180.00	1.00	250.00	10.00	200.00	0.01	200.00
2000	60.00	170.00	1.00	250.00	10.00	180.00	1.00	250.00	1.00	200.00	1.00	250.00	5.00	180.00	1.00	250.00	10.00	200.00	0.01	200.00
2500	65.00	170.00	1.00	250.00	10.00	180.00	1.00	250.00	1.00	200.00	1.00	250.00	5.00	180.00	1.00	250.00	10.00	200.00	0.01	200.00
3000	75.00	170.00	1.00	250.00	10.00	180.00	1.00	250.00	1.00	200.00	1.00	250.00	5.00	180.00	1.00	250.00	10.00	200.00	0.01	200.00
3500	80.00	170.00	1.00	250.00	10.00	180.00	1.00	250.00	1.00	200.00	1.00	250.00	5.00	180.00	1.00	250.00	10.00	200.00	0.01	200.00
4000	85.00	170.00	1.00	250.00	10.00	180.00	1.00	250.00	1.00	200.00	1.00	250.00	5.00	180.00	1.00	250.00	10.00	200.00	0.01	200.00
4500	90.00	170.00	1.00	250.00	10.00	180.00	1.00	250.00	1.00	200.00	1.00	250.00	5.00	180.00	1.00	250.00	10.00	200.00	0.01	200.00
5000	100.00	170.00	1.00	250.00	10.00	180.00	1.00	250.00	1.00	200.00	1.00	250.00	5.00	180.00	1.00	250.00	10.00	200.00	0.01	200.00
5500+	100.00	170.00	1.00	250.00	10.00	180.00	1.00	250.00	1.00	200.00	1.00	250.00	5.00	180.00	1.00	250.00	10.00	200.00	0.01	200.00

11.5. Silicate (continued 2)

Standard unit or scale: micromole per kilogram (µmol kg^{-1}).

Depth (m)	Mediterranean		Black Sea		Baltic Sea		Persian Gulf		Red Sea		Sulu Sea		NW Pacific		Yellow Sea		Se of Japan		Seto Inland_Sea	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
0	0.00	80.00	0.00	360.00	0.00	200.00	0.00	25.00	0.00	150.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
10	0.00	80.00	0.00	355.00	0.00	200.00	0.00	25.00	0.00	150.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
20	0.00	80.00	0.00	355.00	0.00	200.00	0.00	25.00	0.00	150.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
30	0.00	80.00	0.00	350.00	0.00	200.00	0.00	25.00	0.00	150.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
50	0.00	80.00	0.00	350.00	0.00	200.00	0.00	25.00	0.00	150.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
75	0.00	80.00	0.00	340.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
100	0.00	80.00	0.00	330.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
125	0.00	40.00	0.00	320.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
150	0.00	40.00	1.00	315.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
200	0.00	40.00	1.00	305.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
250	0.00	40.00	3.00	295.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
300	0.00	40.00	3.00	295.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
400	0.00	40.00	10.00	195.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
500	0.00	40.00	20.00	205.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
600	0.00	40.00	90.00	205.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
700	0.00	20.00	100.00	240.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
800	0.00	20.00	105.00	250.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
900	0.00	20.00	110.00	270.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
1000	0.00	20.00	110.00	270.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
1100	0.00	20.00	135.00	270.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00
1200	0.00	20.00	135.00	270.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00
1300	0.00	20.00	150.00	270.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00
1400	0.00	20.00	150.00	270.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00
1500	0.00	20.00	150.00	270.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00
1750	0.00	20.00	150.00	270.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00
2000	0.00	20.00	150.00	270.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00
2500	0.00	20.00	150.00	270.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00
3000	0.00	20.00	150.00	270.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00
3500	0.00	20.00	150.00	270.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00
4000	0.00	20.00	150.00	270.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00
4500	0.00	20.00	150.00	270.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00
5000	0.00	20.00	150.00	270.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00
5500+	0.00	20.00	150.00	270.00	0.00	150.00	0.00	25.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00	0.00	150.00

11.6. Variable: Nitrate and Nitrate+Nitrite
Standard unit or scale: micromole per kilogram (µmol kg^{-1})

Depth (m)	North Atlantic		Coastal N. Atlantic		Equatorial Atlantic		Coastal Eq. Atlantic		South Atlantic		Coastal S. Atlantic		North Pacific		Coastal N. Pacific		Equatorial Pacific		Coastal Eq. Pacific	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
0	0.00	18.00	0.00	500.00	0.00	18.00	0.00	30.00	0.00	22.00	0.00	60.00	0.00	26.00	0.00	50.00	0.00	22.00	0.00	100.00
10	0.00	18.00	0.00	500.00	0.00	18.00	0.00	30.00	0.00	26.00	0.00	60.00	0.00	26.00	0.00	50.00	0.00	22.00	0.00	100.00
20	0.00	18.00	0.00	500.00	0.00	18.00	0.00	30.00	0.00	26.00	0.00	60.00	0.00	26.00	0.00	50.00	0.00	22.00	0.00	100.00
30	0.00	18.00	0.00	500.00	0.00	18.00	0.00	30.00	0.00	30.00	0.00	60.00	0.00	30.00	0.00	50.00	0.00	26.00	0.00	100.00
50	0.00	26.00	0.00	500.00	0.00	26.00	0.00	30.00	0.00	30.00	0.00	60.00	0.00	30.00	0.00	50.00	0.00	34.00	0.00	100.00
75	0.00	30.00	0.00	500.00	0.00	30.00	0.00	30.00	0.00	34.00	0.00	60.00	0.00	34.00	0.00	50.00	0.00	34.00	0.00	100.00
100	0.00	30.00	0.00	500.00	0.00	30.00	0.00	30.00	0.00	34.00	0.00	60.00	0.00	34.00	0.00	50.00	0.00	34.00	0.00	100.00
125	0.00	30.00	0.00	500.00	0.00	30.00	0.00	40.00	0.00	34.00	0.00	60.00	0.00	42.00	0.00	50.00	0.00	34.00	0.00	100.00
150	0.00	30.00	0.00	500.00	0.00	30.00	0.00	40.00	0.00	34.00	0.00	60.00	0.00	42.00	0.00	50.00	0.00	38.00	0.00	100.00
200	0.00	30.00	0.00	500.00	0.00	30.00	0.00	40.00	0.00	38.00	0.00	60.00	0.00	46.00	0.00	50.00	0.00	38.00	0.00	100.00
250	0.00	34.00	0.00	500.00	0.00	34.00	0.00	45.00	0.00	38.00	0.00	60.00	0.00	46.00	0.00	75.00	0.00	42.00	0.00	100.00
300	0.00	34.00	0.00	500.00	0.00	34.00	0.00	45.00	0.00	38.00	0.00	60.00	0.00	46.00	0.00	75.00	0.00	42.00	0.00	100.00
400	0.00	42.00	0.00	500.00	0.00	42.00	0.00	45.00	2.00	42.00	0.00	60.00	2.00	46.00	0.00	75.00	2.00	42.00	0.00	100.00
500	0.00	42.00	0.00	500.00	0.00	42.00	0.00	45.00	2.00	46.00	0.00	60.00	2.00	46.00	0.00	75.00	2.00	46.00	0.00	100.00
600	0.00	42.00	0.00	500.00	0.00	42.00	0.00	45.00	2.00	46.00	0.00	60.00	2.00	50.00	0.00	75.00	2.00	46.00	0.00	100.00
700	6.00	46.00	0.00	500.00	0.00	46.00	0.00	45.00	2.00	46.00	0.00	60.00	2.00	50.00	0.00	75.00	2.00	50.00	0.00	75.00
800	6.00	46.00	0.00	500.00	0.00	46.00	0.00	45.00	2.00	46.00	0.00	60.00	2.00	54.00	0.00	75.00	2.00	56.00	0.00	75.00
900	6.00	46.00	0.00	500.00	0.00	46.00	0.00	45.00	2.00	46.00	0.00	60.00	2.00	54.00	0.00	75.00	2.00	56.00	0.00	75.00
1000	6.00	46.00	0.00	500.00	0.00	46.00	0.00	40.00	2.00	46.00	0.00	60.00	2.00	54.00	0.00	75.00	2.00	56.00	0.00	75.00
1100	6.00	46.00	0.00	500.00	0.00	46.00	0.00	40.00	2.00	46.00	0.00	60.00	2.00	54.00	0.00	75.00	2.00	56.00	0.00	75.00
1200	6.00	48.00	0.00	500.00	0.00	48.00	0.00	40.00	6.00	42.00	0.00	60.00	2.00	54.00	0.00	75.00	2.00	56.00	0.00	75.00
1300	6.00	48.00	0.00	500.00	0.00	48.00	0.00	40.00	6.00	42.00	0.00	60.00	2.00	54.00	0.00	75.00	2.00	50.00	0.00	75.00
1400	6.00	48.00	0.00	500.00	6.00	48.00	0.00	40.00	6.00	42.00	0.00	60.00	2.00	54.00	0.00	75.00	2.00	50.00	0.00	75.00
1500	6.00	48.00	0.00	500.00	6.00	48.00	0.00	40.00	6.00	42.00	0.00	60.00	2.00	54.00	0.00	75.00	2.00	50.00	0.00	75.00
1750	6.00	48.00	0.00	500.00	6.00	48.00	0.00	40.00	6.00	42.00	0.00	60.00	2.00	54.00	0.00	75.00	2.00	50.00	0.00	75.00
2000	6.00	48.00	0.00	500.00	6.00	48.00	0.00	40.00	6.00	42.00	0.00	60.00	2.00	54.00	0.00	75.00	2.00	50.00	0.00	75.00
2500	6.00	48.00	0.00	500.00	6.00	48.00	0.00	40.00	6.00	42.00	0.00	60.00	2.00	54.00	0.00	75.00	2.00	50.00	0.00	75.00
3000	6.00	48.00	0.00	500.00	6.00	48.00	0.00	40.00	6.00	42.00	0.00	60.00	2.00	50.00	0.00	75.00	2.00	46.00	0.00	75.00
3500	10.00	48.00	0.00	500.00	10.00	48.00	0.00	40.00	6.00	42.00	0.00	60.00	2.00	46.00	0.00	75.00	2.00	46.00	0.00	75.00
4000	10.00	48.00	0.00	500.00	10.00	48.00	0.00	40.00	6.00	42.00	0.00	60.00	2.00	46.00	0.00	75.00	2.00	46.00	0.00	75.00
4500	10.00	46.00	0.00	500.00	10.00	46.00	0.00	40.00	6.00	42.00	0.00	60.00	2.00	42.00	0.00	75.00	2.00	46.00	0.00	75.00
5000	10.00	44.00	0.00	500.00	10.00	44.00	0.00	40.00	10.00	42.00	0.00	60.00	10.00	42.00	0.00	75.00	2.00	46.00	0.00	75.00
5500+	14.00	42.00	0.00	500.00	14.00	42.00	0.00	40.00	14.00	34.00	0.00	60.00	14.00	42.00	0.00	75.00	2.00	46.00	0.00	75.00

11.6. Nitrate and Nitrate+Nitrite (continued 1)
Standard unit or scale: micromole per kilogram (µmol kg^{-1})

Depth (m)	South Pacific		Coastal S. Pacific		North Indian		Coastal N. Indian		Equatorial Indian		Coastal Eq. Indian		South Indian		Coastal S. Indian		Antarctic		Arctic	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
0	0.00	18.00	0.00	40.00	0.00	14.00	0.00	30.00	0.00	4.00	0.00	35.00	0.00	18.00	0.00	50.00	0.00	46.00	0.00	18.00
10	0.00	18.00	0.00	40.00	0.00	18.00	0.00	30.00	0.00	6.00	0.00	35.00	0.00	18.00	0.00	50.00	0.00	46.00	0.00	18.00
20	0.00	18.00	0.00	40.00	0.00	18.00	0.00	30.00	0.00	6.00	0.00	35.00	0.00	18.00	0.00	50.00	0.00	46.00	0.00	18.00
30	0.00	22.00	0.00	40.00	0.00	18.00	0.00	30.00	0.00	14.00	0.00	35.00	0.00	18.00	0.00	50.00	0.00	46.00	0.00	18.00
50	0.00	26.00	0.00	40.00	0.00	30.00	0.00	30.00	0.00	18.00	0.00	35.00	0.00	18.00	0.00	50.00	0.00	46.00	0.00	18.00
75	0.00	30.00	0.00	40.00	0.00	30.00	0.00	40.00	0.00	26.00	0.00	35.00	0.00	22.00	0.00	50.00	0.00	46.00	0.00	18.00
100	0.00	30.00	0.00	40.00	0.00	30.00	0.00	40.00	0.00	30.00	0.00	45.00	0.00	22.00	0.00	50.00	0.00	46.00	0.00	22.00
125	0.00	30.00	0.00	40.00	0.00	42.00	0.00	40.00	0.00	34.00	0.00	45.00	0.00	26.00	0.00	50.00	0.00	46.00	0.00	22.00
150	0.00	30.00	0.00	40.00	0.00	42.00	0.00	40.00	0.00	34.00	0.00	45.00	0.00	30.00	0.00	50.00	0.00	46.00	0.00	22.00
200	0.00	38.00	0.00	40.00	0.00	42.00	0.00	40.00	0.00	38.00	0.00	45.00	0.00	30.00	0.00	50.00	0.00	46.00	0.00	26.00
250	0.00	38.00	0.00	40.00	2.00	42.00	0.00	40.00	2.00	38.00	0.00	50.00	0.00	30.00	0.00	50.00	0.00	46.00	0.00	26.00
300	0.00	38.00	0.00	60.00	2.00	50.00	0.00	40.00	2.00	46.00	0.00	50.00	0.00	30.00	0.00	50.00	0.00	46.00	0.00	26.00
400	4.00	42.00	0.00	60.00	2.00	50.00	0.00	40.00	2.00	46.00	0.00	50.00	0.00	34.00	0.00	50.00	4.00	46.00	0.00	28.00
500	6.00	46.00	0.00	60.00	2.00	50.00	0.00	40.00	2.00	46.00	0.00	50.00	0.00	34.00	0.00	50.00	6.00	46.00	0.00	28.00
600	6.00	50.00	0.00	60.00	2.00	50.00	0.00	40.00	2.00	46.00	0.00	50.00	0.00	38.00	0.00	50.00	6.00	46.00	0.00	32.00
700	6.00	50.00	0.00	60.00	2.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	0.00	46.00	0.00	50.00	6.00	46.00	0.00	32.00
800	10.00	50.00	0.00	60.00	2.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	0.00	46.00	0.00	50.00	14.00	46.00	0.00	42.00
900	10.00	50.00	0.00	60.00	2.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	0.00	46.00	0.00	50.00	14.00	46.00	0.00	42.00
1000	10.00	50.00	0.00	60.00	2.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	0.00	46.00	0.00	50.00	14.00	50.00	0.00	46.00
1100	10.00	50.00	0.00	60.00	2.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	0.00	46.00	0.00	50.00	14.00	50.00	0.00	46.00
1200	10.00	54.00	0.00	60.00	2.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	0.00	46.00	0.00	50.00	14.00	50.00	0.00	46.00
1300	10.00	54.00	0.00	60.00	2.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	0.00	46.00	0.00	50.00	14.00	50.00	0.00	50.00
1400	10.00	54.00	0.00	60.00	2.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	0.00	46.00	0.00	50.00	14.00	50.00	0.00	50.00
1500	10.00	54.00	0.00	60.00	20.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	2.00	46.00	0.00	50.00	14.00	50.00	0.00	50.00
1750	10.00	54.00	0.00	60.00	20.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	2.00	46.00	0.00	50.00	14.00	50.00	0.00	50.00
2000	10.00	54.00	0.00	60.00	20.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	2.00	46.00	0.00	50.00	14.00	50.00	0.00	54.00
2500	10.00	54.00	0.00	60.00	20.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	2.00	46.00	0.00	50.00	14.00	50.00	0.00	54.00
3000	10.00	54.00	0.00	60.00	20.00	54.00	0.00	40.00	2.00	46.00	0.00	50.00	2.00	46.00	0.00	50.00	14.00	50.00	0.00	54.00
3500	10.00	54.00	0.00	60.00	20.00	46.00	0.00	40.00	2.00	46.00	0.00	50.00	2.00	46.00	0.00	50.00	14.00	46.00	2.00	54.00
4000	10.00	54.00	0.00	60.00	20.00	46.00	0.00	40.00	2.00	46.00	0.00	50.00	2.00	46.00	0.00	50.00	14.00	46.00	2.00	46.00
4500	10.00	42.00	0.00	60.00	20.00	46.00	0.00	40.00	2.00	46.00	0.00	50.00	2.00	46.00	0.00	50.00	14.00	42.00	2.00	46.00
5000	10.00	38.00	0.00	60.00	20.00	46.00	0.00	40.00	2.00	46.00	0.00	50.00	2.00	46.00	0.00	50.00	14.00	42.00	2.00	46.00
5500+	14.00	38.00	0.00	60.00	20.00	46.00	0.00	40.00	2.00	46.00	0.00	50.00	10.00	46.00	0.00	50.00	18.00	42.00	2.00	46.00

11.6. Nitrate and Nitrate+Nitrite (continued 2)
Standard unit or scale: micromole per kilogram (µmol kg^{-1})

Depth (m)	Mediterranean		Black Sea		Baltic Sea		Persian Gulf		Red Sea		Sulu Sea		NW Pacific		Yellow Sea		Se of Japan		Seto Inland_Sea	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
0	0.00	30.00	0.00	125.00	0.00	50.00	0.00	10.00	0.00	35.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00
10	0.00	30.00	0.00	125.00	0.00	50.00	0.00	10.00	0.00	35.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00
20	0.00	30.00	0.00	75.00	0.00	50.00	0.00	10.00	0.00	35.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00
30	0.00	30.00	0.00	75.00	0.00	50.00	0.00	10.00	0.00	35.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00
50	0.00	30.00	0.00	50.00	0.00	50.00	0.00	10.00	0.00	35.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00
75	0.00	30.00	0.00	35.00	0.00	30.00	0.00	10.00	0.00	35.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00
100	0.00	30.00	0.00	35.00	0.00	30.00	0.00	10.00	0.00	35.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00
125	0.00	20.00	0.00	35.00	0.01	20.00	0.00	10.00	0.00	35.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00
150	0.00	20.00	0.00	35.00	0.01	20.00	0.00	10.00	0.00	35.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00
200	0.00	20.00	0.00	30.00	0.01	20.00	0.00	10.00	0.00	35.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00
250	0.00	20.00	0.00	15.00	0.01	20.00	0.00	10.00	0.01	35.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00
300	0.00	20.00	0.00	15.00	0.01	20.00	0.00	10.00	0.01	35.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00
400	0.00	20.00	0.00	5.00	0.01	20.00	0.00	10.00	0.01	35.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00
500	0.00	20.00	0.00	5.00	0.01	20.00	0.00	10.00	0.01	35.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00	0.00	45.00
600	0.00	20.00	0.00	2.50	0.01	15.00	0.00	10.00	0.01	40.00	5.00	45.00	5.00	45.00	5.00	45.00	5.00	45.00	5.00	45.00
700	0.00	20.00	0.00	2.50	0.01	15.00	0.00	10.00	0.01	40.00	5.00	45.00	5.00	45.00	5.00	45.00	5.00	45.00	5.00	45.00
800	0.00	20.00	0.00	2.50	0.01	15.00	0.00	10.00	0.01	40.00	5.00	45.00	5.00	45.00	5.00	45.00	5.00	45.00	5.00	45.00
900	0.00	20.00	0.00	2.50	0.01	15.00	0.00	10.00	0.01	40.00	5.00	45.00	5.00	45.00	5.00	45.00	5.00	45.00	5.00	45.00
1000	0.00	20.00	0.00	2.50	0.01	15.00	0.00	10.00	0.01	40.00	5.00	45.00	5.00	45.00	5.00	45.00	5.00	45.00	5.00	45.00
1100	0.01	15.00	0.00	2.50	0.01	15.00	0.00	10.00	0.01	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00
1200	0.01	15.00	0.00	2.50	0.01	15.00	0.00	10.00	0.01	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00
1300	0.01	15.00	0.00	2.50	0.01	15.00	0.00	10.00	0.01	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00
1400	0.01	15.00	0.00	2.50	0.01	15.00	0.00	10.00	0.01	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00
1500	0.01	15.00	0.00	2.50	0.01	15.00	0.00	10.00	0.01	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00
1750	0.01	15.00	0.00	2.50	0.01	15.00	0.00	10.00	0.01	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00
2000	0.01	15.00	0.00	2.50	0.01	15.00	0.00	10.00	0.01	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00
2500	0.01	15.00	0.00	2.50	0.01	15.00	0.00	10.00	0.01	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00
3000	0.01	15.00	0.00	2.50	0.01	15.00	0.00	10.00	0.01	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00
3500	0.01	15.00	0.00	2.50	0.01	15.00	0.00	10.00	0.01	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00
4000	0.01	15.00	0.00	2.50	0.01	15.00	0.00	10.00	0.01	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00
4500	0.01	15.00	0.00	2.50	0.01	15.00	0.00	10.00	0.01	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00
5000	0.01	15.00	0.00	2.50	0.01	15.00	0.00	10.00	0.01	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00
5500+	0.01	15.00	0.00	2.50	0.01	15.00	0.00	10.00	0.01	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00	5.00	40.00

11.7. Variable: pH
Standard unit or scale: unitless

Depth (m)	North Atlantic		Coastal N. Atlantic		Equatorial Atlantic		Coastal Eq. Atlantic		South Atlantic		Coastal S. Atlantic		North Pacific		Coastal N. Pacific		Equatorial Pacific		Coastal Eq. Pacific	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	7.50	8.70	6.30	9.20	7.30	8.50	6.20	8.70	7.40	8.50	7.10	8.80	7.30	8.60	7.00	8.90	7.30	8.60	6.00	8.80
10	7.50	8.70	6.60	9.00	7.30	8.50	6.20	8.70	7.40	8.50	7.10	8.80	7.30	8.60	7.00	8.80	7.30	8.60	6.00	8.90
20	7.50	8.70	6.80	9.00	7.30	8.50	6.60	8.70	7.40	8.50	7.10	8.80	7.30	8.60	7.00	8.80	7.30	8.60	6.00	9.00
30	7.50	8.70	6.80	9.00	7.30	8.50	6.60	8.70	7.40	8.50	7.10	8.80	7.30	8.60	7.00	8.80	7.30	8.60	6.00	9.00
50	7.50	8.70	6.80	9.00	7.30	8.50	7.20	8.70	7.40	8.50	7.10	8.80	7.30	8.60	7.00	8.80	7.30	8.60	6.00	9.00
75	7.50	8.70	7.00	9.00	7.30	8.50	7.40	8.70	7.40	8.50	7.10	8.80	7.30	8.60	7.00	8.80	7.30	8.60	6.00	9.00
100	7.50	8.70	7.00	8.80	7.30	8.50	7.40	8.70	7.40	8.50	7.10	8.80	7.30	8.60	7.00	8.80	7.30	8.60	6.00	9.00
125	7.50	8.70	7.00	8.80	7.30	8.50	7.40	8.70	7.40	8.50	7.10	8.80	7.30	8.60	7.00	8.80	7.30	8.60	7.00	8.70
150	7.50	8.70	7.00	8.80	7.30	8.50	7.40	8.70	7.40	8.50	7.20	8.80	7.30	8.60	7.00	8.70	7.30	8.60	7.00	8.70
200	7.50	8.70	7.00	8.80	7.30	8.50	7.50	8.70	7.40	8.50	7.30	8.80	7.30	8.60	7.00	8.60	7.30	8.60	7.00	8.70
250	7.50	8.70	7.00	8.80	7.30	8.50	7.50	8.70	7.40	8.50	7.40	8.80	7.30	8.60	7.00	8.60	7.30	8.60	7.00	8.70
300	7.50	8.70	7.00	8.80	7.30	8.50	7.50	8.70	7.40	8.50	7.40	8.80	7.30	8.60	7.00	8.50	7.30	8.60	7.00	8.70
400	7.50	8.70	7.10	8.80	7.30	8.50	7.50	8.70	7.40	8.50	7.40	8.80	7.30	8.60	7.00	8.50	7.30	8.60	7.00	8.50
500	7.30	8.50	7.10	8.80	7.20	8.40	7.50	8.70	7.30	8.40	7.40	8.60	7.20	8.50	7.00	8.50	7.20	8.30	7.00	8.50
600	7.30	8.50	7.10	8.80	7.20	8.40	7.50	8.70	7.30	8.40	7.40	8.60	7.20	8.50	7.00	8.50	7.20	8.30	7.00	8.50
700	7.30	8.50	7.20	8.80	7.20	8.40	7.50	8.70	7.30	8.40	7.40	8.60	7.20	8.50	7.00	8.50	7.20	8.30	7.00	8.40
800	7.30	8.50	7.20	8.80	7.20	8.40	7.60	8.70	7.30	8.40	7.40	8.60	7.20	8.50	7.10	8.50	7.20	8.30	7.00	8.40
900	7.30	8.50	7.20	8.80	7.20	8.40	7.60	8.70	7.30	8.40	7.40	8.50	7.20	8.50	7.20	8.50	7.20	8.30	7.00	8.40
1000	7.30	8.50	7.20	8.60	7.20	8.40	7.60	8.70	7.30	8.40	7.50	8.50	7.20	8.50	7.20	8.50	7.20	8.30	7.00	8.40
1100	7.30	8.50	7.20	8.60	7.20	8.40	7.60	8.70	7.30	8.40	7.50	8.40	7.20	8.50	7.20	8.40	7.20	8.30	7.10	8.40
1200	7.30	8.50	7.20	8.50	7.20	8.40	7.60	8.70	7.30	8.40	7.50	8.40	7.20	8.50	7.20	8.40	7.20	8.30	7.10	8.30
1300	7.30	8.50	7.70	8.50	7.20	8.40	7.60	8.70	7.30	8.40	7.50	8.40	7.20	8.50	7.20	8.20	7.20	8.30	7.10	8.30
1400	7.30	8.50	7.70	8.50	7.20	8.40	7.60	8.70	7.30	8.40	7.50	8.40	7.20	8.50	7.20	8.20	7.20	8.30	7.20	8.30
1500	7.30	8.50	7.70	8.50	7.20	8.40	7.60	8.70	7.30	8.40	7.50	8.40	7.20	8.50	7.20	8.20	7.20	8.30	7.20	8.30
1750	7.30	8.50	7.70	8.50	7.20	8.40	7.60	8.70	7.30	8.40	7.50	8.40	7.20	8.50	7.20	8.20	7.20	8.30	7.30	8.30
2000	7.30	8.50	7.70	8.50	7.20	8.40	7.60	8.70	7.30	8.40	7.50	8.40	7.20	8.50	7.40	8.20	7.20	8.30	7.40	8.30
2500	7.30	8.50	7.80	8.50	7.20	8.40	7.60	8.70	7.30	8.40	7.50	8.40	7.20	8.50	7.40	8.20	7.20	8.30	7.40	8.30
3000	7.30	8.50	7.80	8.40	7.20	8.40	7.60	8.70	7.30	8.40	7.50	8.40	7.20	8.50	7.40	8.20	7.20	8.30	7.40	8.30
3500	7.30	8.50	7.80	8.30	7.20	8.40	7.60	8.70	7.30	8.40	7.50	8.40	7.20	8.50	7.40	8.20	7.20	8.30	7.40	8.30
4000	7.30	8.50	7.80	8.30	7.20	8.40	7.60	8.70	7.30	8.40	7.50	8.40	7.20	8.50	7.40	8.20	7.20	8.30	7.40	8.30
4500	7.30	8.50	7.80	8.30	7.20	8.40	7.60	8.70	7.30	8.40	7.50	8.40	7.20	8.50	7.40	8.20	7.20	8.30	7.40	8.30
5000	7.30	8.50	7.80	8.30	7.20	8.40	7.60	8.70	7.30	8.40	7.50	8.40	7.20	8.50	7.40	8.20	7.20	8.30	7.40	8.30
5500+	7.30	8.50	7.80	8.30	7.20	8.40	7.60	8.70	7.30	8.40	7.50	8.40	7.20	8.50	7.40	8.20	7.20	8.30	7.40	8.30

11.7. pH (continued 1)
Standard unit or scale: unitless

Depth (m)	South Pacific		Coastal S. Pacific		North Indian		Coastal N. Indian		Equatorial Indian		Coastal Eq. Indian		South Indian		Coastal S. Indian		Antarctic		Arctic	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	7.30	8.60	7.30	9.00	7.30	8.60	7.10	8.80	7.50	8.50	7.20	8.90	7.30	8.40	7.30	8.50	7.30	8.40	7.20	8.60
10	7.30	8.60	7.30	9.00	7.30	8.60	7.10	8.80	7.50	8.50	7.20	8.90	7.30	8.40	7.30	8.50	7.30	8.40	7.20	8.60
20	7.30	8.60	7.30	9.00	7.30	8.60	7.10	8.80	7.50	8.50	7.20	8.80	7.30	8.40	7.30	8.50	7.30	8.40	7.20	8.60
30	7.30	8.60	7.30	9.00	7.30	8.60	7.10	8.80	7.50	8.50	7.20	8.60	7.30	8.40	7.30	8.50	7.30	8.40	7.20	8.60
50	7.30	8.60	7.30	9.00	7.30	8.60	7.10	8.70	7.50	8.50	7.20	8.60	7.30	8.40	7.40	8.50	7.30	8.40	7.20	8.60
75	7.30	8.60	7.30	8.90	7.30	8.60	7.10	8.70	7.50	8.50	7.20	8.50	7.30	8.40	7.40	8.50	7.30	8.40	7.20	8.60
100	7.30	8.60	7.30	8.90	7.30	8.60	7.10	8.60	7.50	8.50	7.20	8.50	7.30	8.40	7.40	8.50	7.30	8.40	7.20	8.60
125	7.30	8.60	7.30	8.90	7.30	8.60	7.10	8.40	7.50	8.50	7.20	8.40	7.30	8.40	7.40	8.50	7.30	8.40	7.20	8.60
150	7.30	8.60	7.30	8.90	7.30	8.60	7.10	8.40	7.50	8.50	7.20	8.30	7.30	8.40	7.40	8.50	7.30	8.40	7.20	8.60
200	7.30	8.60	7.30	8.70	7.30	8.60	7.10	8.40	7.50	8.50	7.20	8.30	7.30	8.40	7.40	8.50	7.30	8.40	7.20	8.60
250	7.30	8.60	7.30	8.70	7.30	8.60	7.10	8.40	7.50	8.50	7.20	8.30	7.30	8.40	7.40	8.50	7.30	8.40	7.20	8.60
300	7.30	8.60	7.30	8.70	7.30	8.60	7.10	8.40	7.50	8.50	7.20	8.30	7.30	8.40	7.40	8.50	7.30	8.40	7.20	8.60
400	7.30	8.60	7.30	8.70	7.30	8.60	7.10	8.40	7.50	8.50	7.20	8.30	7.30	8.40	7.40	8.50	7.30	8.40	7.20	8.60
500	7.20	8.40	7.40	8.60	7.20	8.30	7.10	8.30	7.40	8.40	7.40	8.30	7.20	8.30	7.60	8.40	7.20	8.30	7.50	8.30
600	7.20	8.40	7.50	8.60	7.20	8.30	7.10	8.30	7.40	8.40	7.40	8.30	7.20	8.30	7.60	8.40	7.20	8.30	7.50	8.30
700	7.20	8.40	7.50	8.50	7.20	8.30	7.10	8.30	7.40	8.40	7.40	8.30	7.20	8.30	7.60	8.40	7.20	8.30	7.50	8.30
800	7.20	8.40	7.50	8.50	7.20	8.30	7.10	8.30	7.40	8.40	7.40	8.30	7.20	8.30	7.60	8.30	7.20	8.30	7.50	8.30
900	7.20	8.40	7.50	8.50	7.20	8.30	7.30	8.30	7.40	8.40	7.50	8.30	7.20	8.30	7.60	8.30	7.20	8.30	7.50	8.30
1000	7.20	8.40	7.50	8.40	7.20	8.30	7.30	8.30	7.40	8.40	7.50	8.30	7.20	8.30	7.60	8.30	7.20	8.30	7.50	8.30
1100	7.20	8.40	7.50	8.40	7.20	8.30	7.30	8.30	7.40	8.40	7.50	8.30	7.20	8.30	7.60	8.30	7.20	8.30	7.50	8.30
1200	7.20	8.40	7.50	8.30	7.20	8.30	7.40	8.30	7.40	8.40	7.50	8.30	7.20	8.30	7.60	8.30	7.20	8.30	7.50	8.30
1300	7.20	8.40	7.50	8.30	7.20	8.30	7.40	8.30	7.40	8.40	7.60	8.30	7.20	8.30	7.60	8.30	7.20	8.30	7.50	8.30
1400	7.20	8.40	7.50	8.30	7.20	8.30	7.40	8.30	7.40	8.40	7.60	8.30	7.20	8.30	7.60	8.30	7.20	8.30	7.50	8.30
1500	7.20	8.40	7.60	8.30	7.20	8.30	7.40	8.30	7.40	8.40	7.60	8.30	7.20	8.30	7.60	8.30	7.20	8.30	7.50	8.30
1750	7.20	8.40	7.60	8.30	7.20	8.30	7.40	8.30	7.40	8.40	7.60	8.30	7.20	8.30	7.60	8.30	7.20	8.30	7.50	8.30
2000	7.20	8.40	7.60	8.30	7.20	8.30	7.40	8.30	7.40	8.40	7.60	8.30	7.20	8.30	7.60	8.30	7.20	8.30	7.50	8.30
2500	7.20	8.40	7.60	8.30	7.20	8.30	7.60	8.30	7.40	8.40	7.60	8.30	7.20	8.30	7.60	8.30	7.20	8.30	7.50	8.30
3000	7.20	8.40	7.60	8.30	7.20	8.30	7.60	8.30	7.40	8.40	7.60	8.30	7.20	8.30	7.60	8.30	7.20	8.30	7.50	8.30
3500	7.20	8.40	7.60	8.30	7.20	8.30	7.60	8.30	7.40	8.40	7.60	8.30	7.20	8.30	7.60	8.30	7.20	8.30	7.50	8.30
4000	7.20	8.40	7.60	8.30	7.20	8.30	7.60	8.30	7.40	8.40	7.60	8.30	7.20	8.30	7.60	8.30	7.20	8.30	7.50	8.30
4500	7.20	8.40	7.60	8.30	7.20	8.30	7.60	8.30	7.40	8.40	7.60	8.30	7.20	8.30	7.60	8.30	7.20	8.30	7.50	8.30
5000	7.20	8.40	7.60	8.30	7.20	8.30	7.60	8.30	7.40	8.40	7.60	8.30	7.20	8.30	7.60	8.30	7.20	8.30	7.50	8.30
5500+	7.20	8.40	7.60	8.30	7.20	8.30	7.60	8.30	7.40	8.40	7.60	8.30	7.20	8.30	7.60	8.30	7.20	8.30	7.50	8.30

11.7. pH (continued 2)
Standard unit or scale: unitless

Depth (m)	Mediterranean		Black Sea		Baltic Sea		Persian Gulf		Red Sea		Sulu Sea	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	7.40	8.70	7.00	9.00	6.70	9.20	6.00	9.30	7.40	8.50	7.60	8.40
10	7.40	8.70	7.00	8.90	6.70	9.20	6.00	9.30	7.40	8.50	7.60	8.40
20	7.40	8.70	7.00	8.90	6.70	9.20	6.00	9.30	7.40	8.50	7.60	8.40
30	7.40	8.70	7.10	8.90	6.70	9.20	6.00	9.30	7.40	8.50	7.60	8.40
50	7.40	8.70	7.10	8.80	6.70	9.20	6.00	9.30	7.40	8.50	7.60	8.40
75	7.40	8.70	7.10	8.50	6.70	9.00	6.00	9.30	7.40	8.50	7.60	8.40
100	7.40	8.70	7.10	8.50	6.70	8.60	6.00	9.30	7.40	8.50	7.60	8.40
125	7.40	8.60	7.10	8.40	6.70	8.60	6.00	8.60	7.40	8.50	7.60	8.40
150	7.40	8.60	7.10	8.40	6.70	8.60	6.00	8.60	7.40	8.40	7.60	8.40
200	7.40	8.60	7.10	8.30	6.70	8.40	6.00	8.60	7.40	8.40	7.60	8.40
250	7.40	8.60	7.20	8.30	6.70	8.40	6.70	8.20	7.40	8.40	7.60	8.40
300	7.40	8.60	7.20	8.30	6.70	8.40	6.70	8.20	7.40	8.40	7.60	8.40
400	7.40	8.60	7.20	8.30	6.70	8.40	6.70	8.20	7.40	8.40	7.60	8.40
500	7.40	8.60	7.20	8.30	7.50	8.40	6.70	8.20	7.40	8.40	7.60	8.40
600	7.40	8.60	7.20	8.30	7.50	8.40	7.50	8.40	7.40	8.40	7.60	8.40
700	7.40	8.50	7.20	8.30	7.50	8.40	7.50	8.40	7.40	8.40	7.60	8.40
800	7.40	8.50	7.20	8.30	7.50	8.40	7.50	8.40	7.40	8.40	7.60	8.40
900	7.40	8.50	7.20	8.30	7.50	8.40	7.50	8.40	7.40	8.40	7.60	8.40
1000	7.40	8.50	7.20	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.60	8.40
1100	7.40	8.50	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.60	8.40
1200	7.40	8.50	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.60	8.40
1300	7.40	8.50	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.60	8.40
1400	7.40	8.50	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.60	8.40
1500	7.40	8.50	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.60	8.40
1750	7.40	8.50	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.60	8.40
2000	7.40	8.40	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.60	8.20
2500	7.40	8.40	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.70	8.20
3000	7.40	8.40	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.70	8.20
3500	7.40	8.30	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.70	8.20
4000	7.40	8.30	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.70	8.20
4500	7.40	8.30	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.70	8.20
5000	7.40	8.30	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.70	8.20
5500+	7.40	8.30	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.70	8.20

11.8. Variable: Chlorophyll
Standard unit or scale: micro-gram per liter (µg l^{-1})

Depth (m)	North Atlantic		Coastal N. Atlantic		Equatorial Atlantic		Coastal Eq. Atlantic		South Atlantic		Coastal S. Atlantic		North Pacific		Coastal N. Pacific		Equatorial Pacific		Coastal Eq. Pacific	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	0.00	3.00	0.00	50.00	0.00	1.50	0.00	50.00	0.00	1.00	0.00	50.00	0.00	1.50	0.00	50.00	0.00	1.00	0.00	50.00
10	0.00	3.00	0.00	50.00	0.00	1.00	0.00	50.00	0.00	1.00	0.00	50.00	0.00	1.50	0.00	50.00	0.00	1.00	0.00	50.00
20	0.00	3.00	0.00	50.00	0.00	1.00	0.00	50.00	0.00	1.00	0.00	50.00	0.00	1.50	0.00	50.00	0.00	1.00	0.00	50.00
30	0.00	2.50	0.00	50.00	0.00	1.00	0.00	50.00	0.00	0.80	0.00	50.00	0.00	1.50	0.00	50.00	0.00	1.00	0.00	50.00
50	0.00	2.00	0.00	50.00	0.00	1.00	0.00	50.00	0.00	0.80	0.00	50.00	0.00	1.00	0.00	50.00	0.00	0.75	0.00	50.00
75	0.00	1.50	0.00	50.00	0.00	0.80	0.00	50.00	0.00	0.50	0.00	50.00	0.00	1.00	0.00	50.00	0.00	0.60	0.00	50.00
100	0.00	1.00	0.00	50.00	0.00	0.60	0.00	50.00	0.00	0.50	0.00	50.00	0.00	1.00	0.00	50.00	0.00	0.50	0.00	50.00
125	0.00	0.50	0.00	50.00	0.00	0.40	0.00	50.00	0.00	0.50	0.00	50.00	0.00	0.75	0.00	50.00	0.00	0.40	0.00	50.00
150	0.00	0.50	0.00	50.00	0.00	0.20	0.00	50.00	0.00	0.40	0.00	50.00	0.00	0.75	0.00	50.00	0.00	0.40	0.00	50.00
200	0.00	0.50	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.50	0.00	50.00	0.00	0.40	0.00	50.00
250	0.00	0.50	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.50	0.00	50.00	0.00	0.10	0.00	50.00
300	0.00	0.40	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.40	0.00	50.00	0.00	0.10	0.00	50.00
400	0.00	0.40	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.40	0.00	50.00	0.00	0.10	0.00	50.00
500	0.00	0.40	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.20	0.00	50.00	0.00	0.05	0.00	50.00
600	0.00	0.40	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.20	0.00	50.00	0.00	0.05	0.00	50.00
700	0.00	0.40	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.20	0.00	50.00	0.00	0.05	0.00	50.00
800	0.00	0.40	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00
900	0.00	0.40	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00
1000	0.00	0.40	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00
1100	0.00	0.40	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00
1200	0.00	0.40	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00
1300	0.00	0.40	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00
1400	0.00	0.40	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00
1500	0.00	0.40	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00
1750	0.00	0.40	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00
2000	0.00	0.40	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00
2500	0.00	0.40	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00
3000	0.00	0.30	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00
3500	0.00	0.30	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00
4000	0.00	0.30	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00
4500	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00
5000	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00
5500+	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00

11.8. Chlorophyll (continued 1)
Standard unit or scale: micro-gram per liter (µg l^{-1})

Depth (m)	South Pacific		Coastal S. Pacific		North Indian		Coastal N. Indian		Equatorial Indian		Coastal Eq. Indian		South Indian		Coastal S. Indian		Antarctic		Arctic	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	0.00	0.80	0.00	50.00	0.00	1.00	0.00	50.00	0.00	1.00	0.00	50.00	0.00	0.50	0.00	50.00	0.00	4.50	0.00	15.00
10	0.00	0.50	0.00	50.00	0.00	1.00	0.00	50.00	0.00	1.00	0.00	50.00	0.00	0.50	0.00	50.00	0.00	4.50	0.00	15.00
20	0.00	0.50	0.00	50.00	0.00	1.00	0.00	50.00	0.00	1.00	0.00	50.00	0.00	0.50	0.00	50.00	0.00	4.50	0.00	15.00
30	0.00	0.50	0.00	50.00	0.00	1.00	0.00	50.00	0.00	1.00	0.00	50.00	0.00	0.50	0.00	50.00	0.00	4.50	0.00	15.00
50	0.00	0.50	0.00	50.00	0.00	1.00	0.00	50.00	0.00	1.00	0.00	50.00	0.00	0.50	0.00	50.00	0.00	4.50	0.00	15.00
75	0.00	0.50	0.00	50.00	0.00	1.00	0.00	50.00	0.00	1.00	0.00	50.00	0.00	0.50	0.00	50.00	0.00	2.00	0.00	15.00
100	0.00	0.50	0.00	50.00	0.00	0.50	0.00	50.00	0.00	0.75	0.00	50.00	0.00	0.50	0.00	50.00	0.00	0.50	0.00	15.00
125	0.00	0.40	0.00	50.00	0.00	0.50	0.00	50.00	0.00	0.50	0.00	50.00	0.00	0.40	0.00	50.00	0.00	0.50	0.00	4.00
150	0.00	0.30	0.00	50.00	0.00	0.40	0.00	50.00	0.00	0.30	0.00	50.00	0.00	0.40	0.00	50.00	0.00	0.50	0.00	4.00
200	0.00	0.20	0.00	50.00	0.00	0.40	0.00	50.00	0.00	0.20	0.00	50.00	0.00	0.40	0.00	50.00	0.00	0.50	0.00	4.00
250	0.00	0.10	0.00	50.00	0.00	0.40	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.20	0.00	50.00	0.00	0.50	0.00	4.00
300	0.00	0.10	0.00	50.00	0.00	0.40	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.20	0.00	50.00	0.00	0.50	0.00	4.00
400	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.20	0.00	50.00	0.00	0.50	0.00	4.00
500	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.20	0.00	50.00	0.00	0.50	0.00	4.00
600	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
700	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
800	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
900	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
1000	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
1100	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
1200	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
1300	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
1400	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
1500	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
1750	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
2000	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
2500	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
3000	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
3500	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
4000	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
4500	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
5000	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
5500+	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00

11.8. Chlorophyll (continued 2)
Standard unit or scale: micro-gram per liter (µg l^{-1})

Depth (m)	Mediterranean		Black Sea		Baltic Sea		Persian Gulf		Red Sea		Sulu Sea	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	0.00	5.00	0.00	5.00	0.00	12.00	0.00	5.00	0.00	5.00	0.00	5.00
10	0.00	5.00	0.00	5.00	0.00	12.00	0.00	5.00	0.00	5.00	0.00	5.00
20	0.00	5.00	0.00	5.00	0.00	12.00	0.00	5.00	0.00	5.00	0.00	5.00
30	0.00	5.00	0.00	5.00	0.00	8.00	0.00	5.00	0.00	5.00	0.00	5.00
50	0.00	5.00	0.00	5.00	0.00	8.00	0.00	5.00	0.00	5.00	0.00	5.00
75	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
100	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
125	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
150	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
200	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
250	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
300	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
400	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
500	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
600	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
700	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
800	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
900	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
1000	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
1100	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
1200	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
1300	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
1400	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
1500	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
1750	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
2000	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
2500	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
3000	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
3500	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
4000	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
4500	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
5000	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
5500+	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00

11.9. Variable: Alkalinity
Standard unit or scale: millimole per kilogram (mmol kg^{-1})

Depth (m)	South Pacific		Coastal S. Pacific		North Indian		Coastal N. Indian		Equatorial Indian		Coastal Eq. Indian		South Indian		Coastal S. Indian		Antarctic		Arctic	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	2.00	2.80	0.00	2.80	1.80	2.80	0.00	2.80	2.00	2.80	0.00	2.80	1.80	2.80	0.00	2.80	2.00	2.80	0.00	2.80
10	2.00	2.80	0.00	2.80	1.80	2.80	0.00	2.80	2.00	2.80	0.00	2.80	1.80	2.80	0.00	2.80	2.00	2.80	0.00	2.80
20	2.00	2.80	0.00	2.80	1.80	2.80	0.00	2.80	2.00	2.80	0.00	2.80	1.80	2.80	0.00	2.80	2.00	2.80	0.00	2.80
30	2.00	2.80	0.00	2.80	1.80	2.80	0.00	2.80	2.00	2.80	0.00	2.80	1.80	2.80	0.00	2.80	2.00	2.80	0.00	2.80
50	2.00	2.80	0.00	2.80	1.80	2.80	0.00	2.80	2.00	2.80	0.00	2.80	1.80	2.80	0.00	2.80	2.00	2.80	0.00	2.80
75	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	2.00	2.80	1.80	2.80	1.60	2.80	2.00	2.80	1.60	2.80
100	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	2.00	2.80	1.80	2.80	1.60	2.80	2.00	2.80	1.60	2.80
125	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	2.00	2.80	1.80	2.80	1.60	2.80	2.00	2.80	1.60	2.80
150	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	2.00	2.80	1.80	2.80	1.60	2.80	2.00	2.80	1.60	2.80
200	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	2.00	2.80	1.80	2.80	1.60	2.80	2.00	2.80	1.60	2.80
250	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	2.00	2.80	1.80	2.80	1.60	2.80	2.00	2.80	1.60	2.80
300	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	2.00	2.80	1.80	2.80	1.60	2.80	2.00	2.80	1.60	2.80
400	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	2.00	2.80	1.80	2.80	1.60	2.80	2.00	2.80	1.60	2.80
500	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	2.00	2.80	1.80	2.80	1.60	2.80	2.00	2.80	1.60	2.80
600	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
700	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
800	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
900	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
1000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
1100	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
1200	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
1300	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
1400	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
1500	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
1750	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
2000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
2500	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
3000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
3500	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
4000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
4500	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
5000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
5500+	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80

11.9. Alkalinity (continued 1)
Standard unit or scale: millimole per kilogram (mmol kg^{-1})

Depth (m)	South Pacific		Coastal S. Pacific		North Indian		Coastal N. Indian		Equatorial Indian		Coastal Eq. Indian		South Indian		Coastal S. Indian		Antarctic		Arctic	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	2.00	2.80	0.00	2.80	2.00	2.80	0.00	2.80	2.00	2.80	0.00	2.80	2.00	2.80	0.00	2.80	2.00	2.80	0.40	2.60
10	2.00	2.80	0.00	2.80	2.00	2.80	0.00	2.80	2.00	2.80	0.00	2.80	2.00	2.80	0.00	2.80	2.00	2.80	0.40	2.60
20	2.00	2.80	0.00	2.80	2.00	2.80	0.00	2.80	2.00	2.80	0.00	2.80	2.00	2.80	0.00	2.80	2.00	2.80	0.40	2.60
30	2.00	2.80	0.00	2.80	2.00	2.80	0.00	2.80	2.00	2.80	0.00	2.80	2.00	2.80	0.00	2.80	2.00	2.80	0.40	2.60
50	2.00	2.80	0.00	2.80	2.00	2.80	0.00	2.80	2.00	2.80	0.00	2.80	2.00	2.80	0.00	2.80	2.00	2.80	0.40	2.60
75	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.40	2.80
100	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.40	2.80
125	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.40	2.80
150	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.40	2.80
200	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.40	2.80
250	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.40	2.80
300	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.40	2.80
400	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.40	2.80
500	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.60	2.80	2.00	2.80	1.40	2.80
600	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.80	2.80
700	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.80	2.80
800	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.80	2.80
900	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.80	2.80
1000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.80	2.80
1100	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.80	2.80
1200	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.80	2.80
1300	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.80	2.80
1400	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.80	2.80
1500	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.80	2.80
1750	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.80	2.80
2000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.80	2.80
2500	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.80	2.80
3000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.80	2.80
3500	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.80	2.80
4000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.80	2.80
4500	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.80	2.80
5000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.80	2.80
5500+	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.80	2.80

11.9. Alkalinity (continued 2)
Standard unit or scale: millimole per kilogram (mmol kg^{-1})

Depth (m)	Mediterranean		Black Sea		Baltic Sea		Persian Gulf		Red Sea		Sulu Sea	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	1.80	3.10	0.00	2.80	0.40	2.80	2.00	2.80	2.00	2.80	0.40	2.80
10	1.80	3.10	0.00	2.80	0.40	2.80	2.00	2.80	2.00	2.80	0.40	2.80
20	1.80	3.10	0.00	2.80	0.40	2.80	2.00	2.80	2.00	2.80	0.40	2.80
30	1.80	3.10	0.00	2.80	0.40	2.80	2.00	2.80	2.00	2.80	0.40	2.80
50	1.80	3.10	0.00	2.80	0.40	2.80	2.00	2.80	2.00	2.80	0.40	2.80
75	2.00	3.10	0.00	2.80	0.40	2.80	2.00	2.80	2.00	2.80	0.40	2.80
100	2.00	3.10	0.00	2.80	0.40	2.80	2.00	2.80	2.00	2.80	0.40	2.80
125	2.00	3.10	0.00	2.80	0.40	2.80	2.00	2.80	2.00	2.80	0.40	2.80
150	2.00	3.10	0.00	2.80	0.40	2.80	2.00	2.80	2.00	2.80	0.40	2.80
200	2.00	3.10	0.00	2.80	0.40	2.80	2.00	2.80	2.00	2.80	0.40	2.80
250	2.00	3.10	0.00	2.80	0.40	2.80	2.00	2.80	2.00	2.80	0.40	2.80
300	2.00	3.10	0.00	2.80	0.40	2.80	2.00	2.80	2.00	2.80	0.40	2.80
400	2.00	3.10	0.00	2.80	0.40	2.80	2.00	2.80	2.00	2.80	0.40	2.80
500	2.00	3.10	0.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	1.70	2.80
600	2.00	3.10	0.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	1.70	2.80
700	2.00	3.10	0.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	1.70	2.80
800	2.00	3.10	0.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	1.70	2.80
900	2.00	3.10	0.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	1.70	2.80
1000	2.00	3.10	0.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	1.70	2.80
1100	2.00	3.10	0.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	1.70	2.80
1200	2.00	3.10	0.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	1.70	2.80
1300	2.00	3.10	0.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	1.70	2.80
1400	2.00	3.10	0.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	1.70	2.80
1500	2.00	3.10	0.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	1.70	2.80
1750	2.00	3.10	0.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	1.70	2.80
2000	2.00	3.10	0.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	1.70	2.80
2500	2.00	3.10	0.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	1.70	2.80
3000	2.00	3.10	0.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
3500	2.00	3.10	0.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
4000	2.00	3.10	0.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
4500	2.00	3.10	0.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
5000	2.00	3.10	0.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
5500+	2.00	3.10	0.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80

APPENDIX 12. World Ocean Database ragged array

netCDF format description

The World Ocean Database (WOD) officially archived version for observed and standard level data is provided in ragged arrayNetwork Common Data Form netCDF format which follows the Climate-Forecast (CF) conventions. The CF format for contiguous ragged array and profile data representation is optimal for WOD which aggregates oceanographic casts (collections of ocean profiles for one or more variables taken at the same date, time, geographic location, and depth or pressure). Different casts can have very different counts of depth/variable pairs for each profile (from 2 to 24,000 in the WOD), and from 1 to 26 variables with separate profiles in each cast. This renders standard array representation (max_depth_count x max_variable_count x number_of_casts) inefficient for oceanographic casts. Ragged array form has single dimension arrays for each profile variable which contain all the measurements for the given variable.

Ragged array form has a second array, a counting array (called VAR_row_size where VAR is the variable name), which gives the number of variable measurements for each cast. To get to the variable measurements for cast N, the (N-1) VAR_row_size counts are summed, and the pointer in array VAR is moved to this element position. The next VAR_row_size(N) elements in array VAR are the variable measurements for cast N. Note that variable z (depth) is always present and the indexed variable measurements for a particular cast are always associate with the same index for depth.

A trivial example: A file contains five oceanographic casts, each of which has profiles of depth/temperature and depth/salinity, one of which contains a profile of depth/oxygen. Only the fourth cast contains a profile of oxygen. The file has the following:

```
 netcdf wod_example {
dimensions:
        casts = 5 ;
        z_obs = 25 ;
        Temperature_obs = 25 ;
        Salinity_obs = 25 ;
        Oxygen_obs = 5 ;

: : : : : : : : : :
variables:
     float lat(casts) ;
      float lon(casts) ;
       double time(casts) ;
        float z(z_obs) ;
        int z_row_size(casts) ;
        float Temperature(Temperature_obs) ;
        int Temperature_row_size(casts) ;
        float Salinity(Salinity_obs) ;
         int Salinity_row_size(casts) ;
        float Oxygen(Oxygen_obs) ;
```

int Oxygen_row_size(casts) ;

: : : : : : : : : : : :

z_row_size = 5, 5, 5, 5, 5 ;
Temperature_row_size = 5, 5, 5, 5, 5 ;
Salinity_row_size = 5, 5, 5, 5, 5 ;
Oxygen_row_size = _, _, _, 5, _ ;

Note that '_' for VAR_row_size is a missing value. Fill value is set to zero (0).
To read in the fourth cast (N=4), skip the first 15 elements in variables z, Temperature, and Salinity. (N-1)=3, VAR_row_size(1)+VAR_row_size(2)+VAR_row_size(3)=5+5+5=15 for VAR=z,Temperature,Salinity. For Oxygen, Oxygen_row_size(1)=Oxygen_row_size(2)=Oxygen_row_size(3)=0, so read from the first value in array Oxygen (position 0 in the array). For all variables, VAR_row_size(4)=5, so the next 5 values are read from each VAR array (elements 16-20 in arrays z,Temperature,Salinity; elements 1-5 in array Oxygen). VAR_row_size(N) will always be either equal to z_row_size(N) or equal to 0, the latter only in cases where the particular variable was not measured in cast N. All variables present in a cast will have a one-to-one correspondence with the depth (z) for that cast: z(cast=4,element=1) corresponds to Temperature(cast=4,element=1), Salinity(cast=4,element=1), Oxygen(cast=4,element=1). In the ragged array representation then, z(16) corresponds to Temperature(16), Salinity(16), Oxygen(1) – the separate VAR_row_size must be accounted for.

Oceanographic casts are complex. Describing the ocean environment requires multiple profile variables associated with depth (z). But all profile variable elements must be associated not only with depth (z), but with cast specific variables such as latitude, longitude, date/time. Further, other cast specific measurements such as bottom depth, wave height, wind speed, etc. help to contextualize the ocean profile variables to describe the ocean environment. Other information, such as ship name, primary investigator, cruise identifier, etc. are important to identify and assess the ocean profile data. It is important to keep all of this information together for each cast and so for the aggregate oceanographic cast file provided to users. It is also important, even with today's system capacities to minimize file size when possible. This is the reason behind using a ragged array format. It is also important to use accepted standards in order to make sure the data are widely accessible. This is why the CF standard has been followed. Two points of the CF standard for contiguous ragged array netCDF are problematic for the efficient arrangement of oceanographic cast, file size, and inclusion of all necessary variables together and are not followed. The first is that all ocean profile variables do not have the same array size, each ocean profile variable has an array size (VAR_obs) commensurate with the number of measurements of the variable itself (VAR). All variables are still associated with the cast depth through the VAR_row_size counter. The second is that there are arrays of variables – both ocean profile and other ocean environment descriptors with different axes. For instance, the ocean profile variables are arranged along the depth axis (and the cast axis) while ocean state variables are arranged only along the cast axis.

Glossary

Accession Number – A group of stations received and archived at the U.S. NCEI. Each dataset submitted to NCEI is given a unique accession number. Using this number, a user can get the original data from NCEI as well as information about the data itself. Cruises are not always subsets of accession numbers, as data from the same cruise may come from multiple accession numbers. Each station has an accession number (with a few exceptions). If a station is replaced by higher quality data, the accession number will reflect the new source of the data while the unique station number will remain unchanged. If a profile for a variable not previously stored with a station becomes available, the profile will be added to the existing station, and a profile specific accession number will be added to the station to record the source of the new profile.

Accuracy – ability of a measuring instrument to give responses close to a true value.

ASCII data format – Native format used in the World Ocean Data series.
APB – Autonomous pinniped bathythermograph is the name given to temperature data recorded by time-temperature-depth recorders (TTDR) and ARGOS position transmitters attached to pinnipeds (*e.g*. northern elephant seals).
See http://www.marinemammalcenter.org/education/marine-mammal-information/pinnipeds/ for information on the different pinniped species.

Bathythermograph (BT) data – Temperature profile data from mechanical bathythermographs (MBT), and expendable bathythermographs (XBT).

Biological header – The biological header section contains information on the sampling methods used for collecting taxonomic and biomass measurements.

Bullseyes – Bullseyes are unrealistic features found during the intial objective analyses for each variable at standard depth levels and usually contain some large-scale gradients over a small area. The data causing these features are investigated and flagged.

Calibration – A set of operations that establish, under specified conditions, the relationship between the values of quantities indicated by a measuring instrument or measuring system and the corresponding values realized by standards.

Cast – A set of profiles (or a single profile) taken concurrently. Meteorological and ocean condition information are also included for a cast if measurements were taken concurrently with the profile(s). Observations and measurements of plankton from net-tows are included if taken concurrently or in close time proximity to profiles. If there are no profiles in close proximity, a net-tow by itself will constitute a cast. Each cast in the WOD18 is assigned a unique cast number. If the cast is subsequently replaced by higher quality data, the unique cast number remains the same. If any alteration is made to a cast, this information is noted online, referenced by the unique cast number. For surface-only data in dataset SUR, a cast is defined as a collection of concurrent profiles of surface measurements at discrete latitudes and longitudes over an entire cruise (see definition of cruise below). Profiles of latitude, longitude and Julian year-day are included with profiles of measured oceanographic variables.

Cast/Tow Number – Sequential number representing each over-the-side operation or discrete sampling at a station or section or a cast of a tow.

Character Data – Includes originator's cruise codes, originator's cast codes, and principal investigator integer code.

Comma Separated Value (CSV) – Also known as "common-delimited" is a text file or flat file format allowing portability of files into any database.

Country code – A two-character code assigned to each country. Each code is unique to a country and is assigned by NCEI. See Appendix 1 for the complete list of country codes.

Cruise – A set of casts is grouped together if they fit the cruise definition. A cruise is defined as a specific deployment of a unique platform for the purposes of a coherent oceanographic investigation. For an oceanographic research vessel, this deployment is usually well defined with a unique set of scientific investigators collecting data for a specific project or set of projects. In some cases different legs of a deployment with the same equipment and investigators are assigned different cruise numbers, as per the investigators designation. In the case of merchant ships of opportunity, a cruise is usually defined as the time between major port calls. Profiling floats, moored buoys, and drifting buoys are assigned the same cruise number for the life of the platform. For surface-only data in dataset SUR, a cast and cruise are the same, except for 27 cruises which were split into 2 casts each due to the large number of sets of measurement (> 24,000).

In WOD18, a cruise identifier consists of two parts, the ISO 3166-1 country code and the unique cruise number. The unique cruise number is only unique with respect to the country code. The country code is usually assigned based on the flag under which the ship from which the data were measured operates. If the platform from which data were measured was not a ship, (e.g. profiling float, moored buoy), the country of the primary investigator or institute which operates or releases the platform is used. For data for which no information on country is present, a country code of 99 is used. For data for which there is no way to identify a specific cruise, a cruise number of zero (0) is used.

The present cruise identifier definition is slightly changed from previous releases of the World Ocean Database. Previously, bathythermograph (BT) data were assigned unique cruise numbers without regard to country in keeping with prior convention at the US NCEI. This made assigning the same cruise number to BT data and other data collected on the same cruise impossible. Now BT cruises are assigned in the same manner as other datasets. To facilitate this change, approximately 5,300 Mechanical Bathythermograph (MBT) cruise numbers were reassigned, along with 22 Expendable bathythermographs (XBT) cruise numbers.

Now, all data for a cruise should be listed under one unique country code/unique cruise number combination. It should be possible to get all bottle, high-resolution CTD, BT, and towed-CTD data for a cruise using one unique cruise identifier. However, this is not yet the case for all BT data. It is an ongoing project to match the BT data with the correct bottle and high-resolution CTD data.

Cruise Code – A unique code assigned to all casts completed in the same cruise. It is formed by a country code and a number.

CTD – Conductivity-Temperature-Depth. Data contains physical-chemical oceanographic data at discrete pressure levels.

Dataset – All casts from similar instruments with similar resolution. For instance, all bathythermographs (BTs) which are dropped over the side of a ship on a winch and recovered are in dataset MBT, all CTD data stored at high-resolution (small depth increments or large number of measurements) are stored in CTD. A list of all datasets for WOD18 is found in Table 2. For convenience, data from each dataset are stored in separate files in WOD18.

DRB – Drifting Buoy Data

g77 compiler – g77 is a GNU Fortran compiler that was initially designed to replace the UNIX f77 command, a UNIX compiler. See http://gcc.gnu.org/onlinedocs/gcc-3.4.1/g77/ as well as http://www-rocq.inria.fr/~kern/G77/g77.html for more information.

GLD – Glider Data

Institute code – A unique numerical code assigned to each institute which sampled the data.

ISO – International Organization for Standardization. It is a widely used coding system and is the largest developer and publisher of International Standards in the world. We see it used everyday: 1) used to ID the Internet country code Top-Level Domains like ".fr", ".jp", ".ru", 2) representation for currencies & funds (United States dollar, Japanese Yen, Euro, Russian Rubble, *etc*.). See http://www.iso.org/iso/home.htm for more information.

MBT – Mechanical Bathythermograph. The data contains temperature-depth profile obtained at discrete depths to a maximum depth less than 300 meters.

Measured Variables – Temperature, salinity, oxygen, phosphate, silicate, nitrate, pH, chlorophyll, alkalinity, PCO_2, DIC, Nitrate+Nitrite, and pressure data versus depth.

Meq – Milli-equivalents

MRB – Moored Buoy Data

µM – Micromolar (micromol per liter)

Observed level/depth – The depth or pressure at which an *in-situ* measurement was collected as reported by the originator of the data.

Ocean Archive System – The Ocean Archive System contains metadata of all of the data received and accessed at the National Oceanographic Data Center (NCEI). It assigns unique accession numbers, maintains internal data management information and it maintains a control vocabulary (Principal Investigators, Projects, Institutions, Platforms, etc.).

Originator's Cast Number – Numeric cast number assigned by the data submittor or data originator.

Originator's unit(s) – Units which the data were reported to NCEI.

OSD – Ocean Station Data (also known as Bottle Data). The data contain physical-chemical-biological oceanographic data recorded at discrete depth (or pressure) levels.

PFL – Profiling Float Data

Platform Code – *See Ship code.*

Principal Investigator – Lead scientist or engineer for a particular research cruise or project.

Probe type – OSD, MBT, XBT including XCTD, CTD including STD, SUR, UOR, APB, PFL, DRB, MRB GLD. They correspond to the databases within the WOD main database. Some of the probes are named after the instruments that collected the data.

Profile – A set of measurements for a single variable (temperature, salinity, etc.) at discrete depths taken as an instrument drops or rises vertically in the water column. For surface-only data, the profile consists of measurements taken along a horizontal path. For moored buoys and drifting buoys, the instrument does not move vertically in the water column, so a profile is a discrete set of concurrent measurements from the instruments at different depths attached to the buoy.

Precision – number of digits to the right of the decimal point.

Primary headers – The primary header contains information about the number of bytes in the cast, a unique WOD number which identifies each cast, the ISO country code, a cruise number, date, time, position, and the number and type of variables in the cast.

Quality Control – Data received by NCEI/OCL are put through a set of quality control procedures to ensure that: 1) the data are converted to the WOD format correctly, 2) the data format provided with the data is correct and the data itself have not been corrupted in transmission, 3) only one copy of data at each cast is retained in the WOD format, 4) the data are of good quality.

Secondary Header – Contains information such as meteorological data, water column characteristics (i.e. depth to bottom), information about the instrument used, ship, institute, and project.

Ship Code – A unique code which identifies the ships associated with the data. Also called platform code.

Significant digits – The total number of digits stored in a WOD parameter value.

Standard level/depth – A depth below the sea surface at which water properties should be measured and reported, either directly or by interpolation, according to the proposal by the *International Association of Physical Oceanography* in 1936.

Station – Data from one or more casts at one geographic location.

SUR – Surface data are surface-only variables which are treated differently from profile data in the database. For surface-only data, each cruise is treated as though it were a single cast with depth, latitude, longitude, and Julian year-day associated with each measurement value.

Taxa-specific and biomass data – Contains plankton weights, volume, and/or concentrations, for an entire sample (biomass) or for individual groups of organisms (taxa-specific).

Unique Cast Number – A number assigned by the WOD database to a cast. This number remains unique to that cast.

UOR – Undulating oceanographic recorder is the generic name given to towed vehicles carrying measuring devices (usually CTDs) which ascend and descend through the water column in a more or less regular pattern, giving a two-dimensional view of the water column along the path in which the vehicle is towed.

Variable – Physical-chemical-biological measurements (e.g. temperature, salinity, oxygen, phosphate, nitrate, etc.) as well as latitude, longitude, julian-day, etc. See Table 3 for a complete list of variables.

Variable specific secondary header – Contains information specific to each individual variable such as original units and methods for a given cast.

WOD – World Ocean Database

WMO – World Meteorological Organization of the Untied Nations, Geneva, Switzerland. The WMO Code is an international nomenclature adopted by the World Meteorolgoical Organization based on 10-degree squares.

XBT – Expendable Bathythermograph. It is the successor of the MBT instrument. The data contains temperature-depth profiles taken at discrete depths. Standard XBTs normally obtain profiles to depths of 450 and 760 meters. Other expendable baththermographs reach a depth of 1830 meters.

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