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WORLD OCEAN DATABASE 2013
USER'S MANUAL

Ocean Climate Laboratory
National Oceanographic Data Center

Silver Spring, Maryland
December 24, 2013

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Environmental Satellite Data and Information Service

National Oceanographic Data Center

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http://www.nodc.noaa.gov/OC5/WOD/wod_updates.html

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User's Manual

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The National Oceanographic Data Center/Ocean Climate Laboratory (NODC/OCL) is supported by the National Oceanic and Atmospheric Administration (NOAA) Climate and Global Change program, to produce scientifically quality-controlled oceanographic profile databases, to compile objectively analyzed global fields of oceanographic variables, 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 WOD13.

Special thanks to Dr. Reiner Schlitzer from the Alfred Wegener Institute in Germany, for the development and continuous support of the Ocean Data View software and for allowing us to make this software available as part of WOD13.

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I. INTRODUCTION

A. OVERVIEW

World Ocean Database 2013 (WOD13) is a scientifically quality-controlled database of selected historical *in-situ* surface and subsurface oceanographic measurements produced by the Ocean Climate Laboratory (OCL) at the National Oceanographic Data Center (NODC), Silver Spring, Maryland, USA. WOD13 updates and expands on an earlier version of our product, *World Ocean Database 2009* (WOD09) by adding additional data and also increasing the number of standard levels and depths from 40 to 137 (see Table 14 for the standard depths).

WOD13 provides quality-controlled data to calculate climatologies of temperature, salinity, oxygen, phosphate, silicate, and nitrate. These climatologies are used to produce the *World Ocean Atlas 2013* (WOA13). 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 WOA13 climatologies, quality control performed by the data submitters is included as originators' flags when available.

The WOA13 climatologies are calculated on standard 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 WOD13 and each has its own set of quality control flags. No data are removed from WOD13 if they fail WOD quality control checks; however, that fail objective and subjective tests are marked with quality control flags.

Data are provided compressed in our native World Ocean Database (WOD) format. 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 – 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 NODC/World Data Center for Oceanography, Silver Spring (WDC) have been received as a result of projects such as the Intergovernmental Oceanographic Commission (IOC)/NODC 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), and many others. The numbers in Table 1 show the increase in data holding from 1982 to 2013. A more detailed description of data in the WOD13 can be found in Boyer *et al*. (2013).

As Table 1 shows, the data holdings in the database have increased greatly 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. 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 WOD13, and additional errors are identified, they will be corrected. Some data flagged as "unrepresentative" may not deserve this designation and therefore could be reassessed.

Table 1. Comparison of the amount of data in WOD13 with previous versions of WOD

Dataset	NODC (1974)[1]	NODC (1991)[2]	WOA94	WOD98	WOD01	WOD05	WOD09	WOD13
OSD [3]	425,000	783,912	1,194,407	1,373,440	2,121,042	2,258,437	2,541,298	3,115,552
CTD [4]	na	66,450	89,000	189,555	311,943	443,953	641,845	848,911
MBT [5]	775,000	980,377	1,922,170	2,077,200	2,376,206	2,421,940	2,426,749	2,425,607
XBT	290,000	704,424	1,281,942	1,537,203	1,743,590	1,930,413	2,104,490	2,211,689
MRB	na	na	na	107,715	297,936	445,371	566,544	1,411,762
DRB	na	na	na	na	50,549	108,564	121,828	251,712
PFL	na	na	na	na	22,637	168,988	547,985	1,020,216
UOR	na	na	na	na	37,645	46,699	88,190	88,190
APB	na	na	na	na	75,665	75,665	88,583	1,713,132
GLD	na	na	na	na	na	338	5,857	103,798
Total Stations	**1,490,000**	**2,535,163**	**4,487,519**	**5,285,113**	**7,037,213**	**7,900,349**	**9,155,099**	**13,190,569**
Plankton	na	na	na	83,650	142,900	150,250	218,695	242,727
SUR [6]	na		na	na	4,743	9,178	9,178	9,289

[1] Based on statistics from *Climatological Atlas of the World Ocean* (1982).
[2] Based on NODC Temperature Profile CD-ROM.
[3] WOD13 OSD dataset includes data from 174,777 low-resolution CTD casts and 1,708 low-resolution XCTD casts.
[4] WOD13 CTD dataset includes data from 8,821 high-resolution XCTD casts.
[5] WOD13 MBT dataset includes data from 79,500 DBT profiles and 5,659 Micro-BT profiles.
[6] Surface data are represented differently from 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 OCL is actively seeking feedback from data contributers/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 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 database will be implemented and amended data will be placed online on a monthly basis. Monthly updates are available on the NODC website.

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. 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 WOD13 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 WOD13 and lead to an increase in the number of users who can benefit from this product would be appreciated. Updates will be posted on the NODC website.

B. DATA SOURCES

Data submitted to, or obtained by, NODC as of January 23, 2013 which contain subsurface measurements of one or more of the variables listed in Table 3 or plankton measurements were potential data sources for WOD13. Due to lack of time, not all submitted data were converted to a uniform format and quality controlled in time for inclusion in WOD13. All datasets found in WOD13 can be found in their original submitted form at NODC and are accessible, using the NODC accession number, through the NODC Ocean Archive System. In addition to the subsurface data, specific surface-only datasets submitted to NODC 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 WOD13 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 WOD13 Code Tables.

C. DEFINITIONS

A few terms which are important for understanding the data structure of WOD13 are: dataset, profile, cast, station, cruise, and accession number. Please refer to the Glossary for a more descriptive definition of these and other terms.

WOD13 Citation

The WOD13 should be cited as follows:

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D. DATASETS

The data in WOD13 are organized into eleven datasets that are briefly described in this section and listed in Table 2. A more detailed explanation of each dataset is provided in individual chapters of the *World Ocean Database 2013* NOAA Atlas NESDIS 72 (Boyer *et al.*, 2013).

Table 2. Datasets in the WOD13

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.

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 WOD13 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 WOD13 can be found in Appendix 2.21.

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 WOD13, 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 or TCO_2) 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 ISO country code (see code list in Appendix 1), 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 in Table 3 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.

Many of the meteorological variables have World Meteorological Organization (WMO) or NODC code tables associated with them. These code tables are grouped together in Appendix 2. 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 on the NODC website in the WOD code tables section. The WOD secondary header information is always in numeric format. A description of all WOD second headers is shown below.

Table 3. Depth-dependent primary variables present in WOD13

Code	Variable (nominal abbreviations)	WOD13 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 [O_2]	Milliliter per liter (ml l^{-1})	OSD, CTD, PFL, UOR, DRB
4	Phosphate [HPO_4^{-2}]	Micromole per liter (µM)	OSD
6	Silicate [$Si(OH)_4$]	Micromole per liter (µM)	OSD
8	Nitrate [NO_3^-] and Nitrate+Nitrite	Micromole per liter (µM)	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 [TALK] unless specified	Milliequivalent per liter (meq l^{-1})	OSD, SUR
20	Partial pressure of carbon dioxide [pCO_2]	Microatmosphere (µatm)	OSD, SUR
21	Dissolved Inorganic carbon [DIC]	Millimole per liter (mM)	OSD
24	Transmissivity (BAC)[1]	Per meter (m^{-1})	CTD, DRB
25	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[2]	Day	SUR, APB, UOR
33	Tritium [^3H]	Tritium Unit (TU)	OSD
34	Helium [He]	Nanomol per liter (nM)	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 [Ar]	Nanomol per liter (nM)	OSD
39	Neon [Ne]	Nanomol per liter (nM)	OSD
40	Chlorofluorocarbon 11 (CFC 11)	Picomole per liter (pM)	OSD
41	Chlorofluorocarbon 12 (CFC 12)	Picomole per liter (pM)	OSD
42	Chlorofluorocarbon 113 (CFC113)	Picomole per liter (pM)	OSD
43	Delta Oxygen-18 [$\Delta^{18}O$]	Per mille (‰)	OSD

[1] Beam Attenuation Coefficient

[2] Julian year-day is the decimal day for the year in which the observations were made (see Section I. F7)

Table 4. List of secondary header variables in WOD13

ID[1]	DESCRIPTION	App[2]	ID	DESCRIPTION	App[2]
1	NODC Accession Number	File	35	Digitization Method (NODC 0612)	2.15
2	NODC Project Code	File	36	Digitization Interval (NODC 0613)	2.16
3	WOD Platform Code	File	37	Data Treatment and Storage Method (NODC 0614)	2.17
4	NODC Institution Code	File	38	Trace Correction	
5	Cast/Tow number		39	Temperature Correction	
7	Originator's station number		40	Instrument for reference temperature (NODC 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 NODC 0110)	2.4	72	XBT Wait (code no longer used)	
17	Wave Height (WMO 1555 or NODC 0104)	2.5	73	XBT Frequency (code no longer used)	
18	Sea State (WMO 3700 or NODC 0109)	2.6	74	Oceanographic measuring vehicle	2.21
19	Wind Force (Beaufort scale or NODC 0052)	2.7	77	xCO_2 in atmosphere (ppm)	
20	Wave Period (WMO 3155 or NODC 0378)	2.8	84	ARGOS fix code	2.22
21	Wind Direction (WMO 0877 or NODC 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	2.23
26	Weather Conditions (WMO 4501/4677)	2.10	92	UKHO Bibliographic Reference Number	2.24
27	Cloud Type (WMO 0500 or NODC 0053)	2.11	93	Consecutive profile in a tow segment	
28	Cloud Cover (WMO 2700 or NODC 0105)	2.12	94	WMO Identification Code	
29	Probe Type	2.13	95	Originator's Depth unit	2.25
30	Calibration Depth		96	Originator's flags	2.26
31	Calibration Temperature		97	Water Sampler	2.27
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	
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 NODC website.

The following is an explanation of the secondary headers listed in Table 4. All individual 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 NODC accession number: a unique number assigned by NODC to each group of data received in the NODC Ocean Archive System (file: s_1_accession.pdf);
- Code 2 NODC 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 continous tow;
- Code 7 Originator's station number: numeric station number assigned by the data submittor 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 Statiaons 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 NODC 0378): description of codes in Appendix 2.8; note that NODC 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 (NODC 0612): description of codes in Appendix 2.15;
- Code 36 Digitization Interval (NODC 0613): description of codes in Appendix 2.16;
- Code 37 Data Treatment and Storage (NODC 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 submittor – in some cases the correction has already been applied;
- Code 40 Instrument for Reference Temperature (NODC 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: the 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 2.22;
- 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 2.23;
- 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 2.24;
- 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 2.25;
- Code 96 Originator's Flags: Appendix 2.26 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 2.27);
- 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.

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	DESCRIPTION	App	ID	DESCRIPTION	App
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	

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

- Code 1 NODC accession number: unique number assigned by NODC 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 WOD13;
- 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 submittor'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. Similar to the secondary header information, some description is provided by code lists.

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	DESCRIPTION	App	ID	DESCRIPTION	App
1	Water volume filtered (m^3)		14	Tow distance (meters)	
2	Sampling duration (minutes)		15	Average towing speed (knots)	
3	Mesh size (μm)		16	Sampling start time (GMT)	
4	Type of tow	4.1	18	Flowmeter type	4.3
5	Large removed volume (ml)		19	Flowmeter calibration	4.7
6	Large plankters removed	4.2	20	Counting institution	File
7	Gear code	4.3	21	Voucher Institution	File
8	Sampler volume (liters)		22	Wire angle start (degrees)	
9	Net mouth area (m^2)		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)		30	Accession number for the biology	File
13	Count method	4.6			

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, in 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: $\text{area} = \pi\,(0.5\ \text{diameter})^2$;
- 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 insititute 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: NODC dataset identification for the biological component of the current cast (file: b_30_accession.pdf).

6. Taxa-specific and Biomass Data

The typical plankton cast, as represented in WOD13, 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	DESCRIPTION	App	ID	DESCRIPTION	App
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)	5.8
5	Taxon lifestage	5.1	19	Size max (mm)	5.8
6	Taxon sex code	5.2	20	Originator's Unit	3.4
7	Taxon present	5.3	21	Taxon radius (μm)	
8	Taxon trophic mode	5.4	22	Taxon length (μm)	
9	Taxon realm	5.5	23	Taxon width (μm)	
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

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 WOD13 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 can not 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 WOD13. WOD13 negative taxa codes follow those laid out for the COPEPOD database (O'Brien 2007).

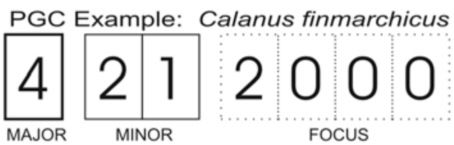
Table 8. Summary of Taxa Variable Number Codes

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	WOD13 Biomass Code (*e.g., All Biomass Types, Total Displacement Volume, Total Wet Mass, etc.)*
-1000 to -1999	WOD13 "Failed ITIS Review" Code *(ITIS was unable to verify its validity. Description may be non-existent, non-taxonomic, or unidentified)*
-5000 to -5999	WOD13 "Non-taxonomic Group" Code (*e.g., "gelatinous organisms")*
-6000 to -6999	WOD13 "Multiple taxa group" Code *(e.g., "Foraminifera & Radiolaria")*
-7000 to -9999	WOD13 "Pending ITIS Review" Code *(ITIS verification in-progress as of WOD13 release)*

In addition to the original plankton descriptions, each "Taxa-Record" also contains a supplemental WOD13 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 & Schwartz 1998). It places each taxon into broader groups (*e.g.*, "phytoplankton", "diatoms", "zooplankton", "copepods") which allows the WOD13 user access to hundreds of individual taxons by using a single PGC code. Appendix 6 lists the PGC groups and codes available in WOD13.

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. WOD13 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 4218000 2160000	10^{-6}	4 4 2	zooplankton zooplankton phytoplankton
MINOR GROUP	4212000 4218000 2160000	10^{-4}	421 421 216	crustacean crustacean diatoms
FOCUS GROUP	4212000 4218000	10^{-2}	42120 42180	copepods euphausiidae

Plankton numerical abundance and total biomass measurements are stored with the originator's units in WOD13 (*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 Table 14) 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

All files which contain observed and standard level data are 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 WOD13 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 format change between WOD09 and WOD13, and only for standard level data files. Since standard levels have changed for WOD13 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	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	NODC/WOD
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
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

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

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 "0" 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 WOD13
PROFILE DATA - all steps repeated based on number of levels **(L)** listed in the primary header			
1. Number depth significant digits	1	I1	if -> set "missing" values for level, proceed to next 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 repeated for each variable or **N** times
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 2.26)

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 a product offered for searching and retrieving WOD data. This 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 (native or ".csv").

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. WOD13 Data

The directory **WOD data** contains links for the user to retrieve data sorted geographically or sorted by year (time).

The geographically sorted data are organized by WMO 10-degree square. 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 WOD13 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). For a tutorial on how to use the data (*i.e*. import) in ODV see Section V.

3. WOD13 Documentation

The directory **WOD documentation** contains a copy of this document and other files necessary for accessing, reading, and using WOD13 data. All files are in PDF format.

Files in the directory **WOD documentation:**

WOD13 User's Manual	PDF version of this document;
WOD13 Tutorial	PDF tutorial describing how to access, read and use WOD13;
WOD13 Introduction	PDF describing in detailed all datasets available in WOD13.

4. WOD13 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 files except b_30_accession.pdf, s_1_accession.pdf, v_1_accession.pdf, s_2_project.pdf, v_2_project.pdf, b_20_institute.pdf, b_21_institute.pdf, s_4_institute.pdf, v_4_institute.pdf, s_3_platform.pdf, and t_1_taxa_list.txt are listed in the appendices of this document. All files in this directory are Portable Document Format (PDF) and Text (TXT) documents.

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, and primary_investigator_list.pdf)

5. WOD13 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 WOD13 data.

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 WOD13 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 WOD13

To decompress the WOD13 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. WOD13 Programs

The directory **WOD programs** contains sample programs, written in FORTRAN 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, or other graphical packages.

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

readFOR.txt	readme file describing wodFOR program
wodFOR.f	sample FORTRAN program for reading the data
sampFOR.txt	sample output data from wodFOR.f
readASC.txt	describes the use of wodASC program
wodASC.f	outputs a user-selected variable in either tabular- (columns) or comma-separated-values columns
wodASC.exe	executable for wodASC.f program
sampASC.txt	sample output data from wodASC.f
wodSUR.f	write the Surface format out into comma-separated-values (CSV) file
wodSUF.exe	executable for wodSUR program
sampSUR.txt	sample of output from wodSUR program
Instructions from WOD to csv	instructions to convert WOD format to ArcMap readable 'csv' format
csvfromwod.c	(β - version) C program to convert 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	describes the use of wodC program
wodC.c	sample C program for reading the data
wodC.exe	executable for C program for Microsoft Windows environment

7. WOD13 Masks

The following **WOD masks** are necessary for 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

The minimum hardware requirements for accessing data and information are:

- Using the Ocean Data View 4.5.7 software has additional requirements, which are addressed at the ODV web site.

III. QUALITY CONTROL PROCEDURES

Data received by the National Oceanographic Data Center's Ocean Climate Laboratory (NODC/OCL), through the Global Ocean Data Archeology and Rescue (GODAR) project, the Global Ocean Database project, the Global Temperature and Salinity Pilot Project (GTSPP), the US-NODC 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 WOD13 even though all the quality control steps were not applied. These are pCO_2, DIC (or TCO_2), geochemical tracers, plankton (we are in the process of building up the database and have insufficient data to date), oxygen from PFL; (data not 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.

The WOD includes quality control flags that are set during automatic and subjective quality control steps in the calculation of WOA09 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 2.26 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 NODC/OCL, the first step, after assigning a NODC 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 NODC/OCL 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 OCL 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 WOD13, 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.

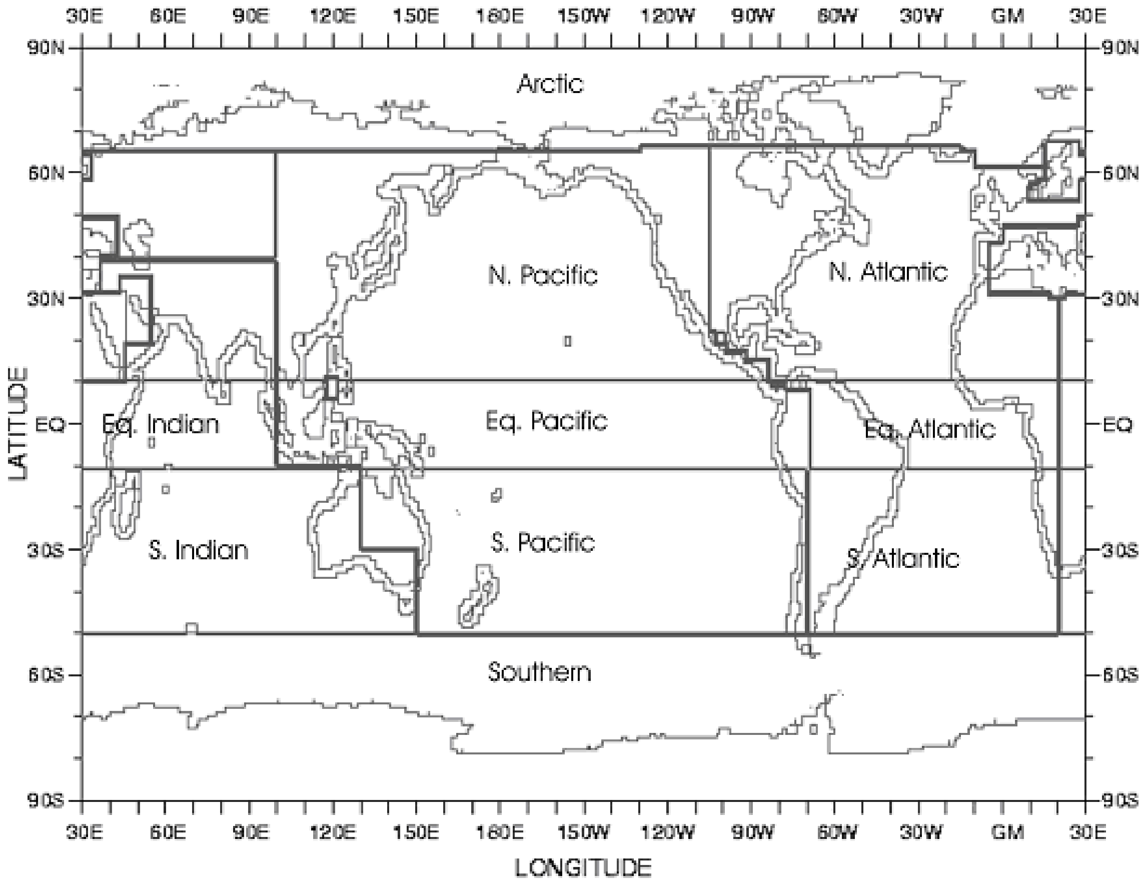


Figure 1. Geographic boundaries of ocean basin definitions in WOD13.

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 NODC 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:

$$gradient = \frac{v_2 - v_1}{z_2 - z_1} \quad (1)$$

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 WOD13

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 [O_2]	Milliliter per liter ($ml \cdot l^{-1}$)	9.3
4	Phosphate [HPO_4^{-2}]	Micromole per liter (µM·l)	9.4
6	Silicate [$Si(OH)_4$]	Micromole per liter (µM·l)	9.5
8	Nitrate [NO_3^-] and Nitrate+Nitrite	Micromole per liter (µM·l)	9.6
9	pH	Dimensionless	9.7
11	Total Chlorophyll [Chl] unless specified	Microgram per liter ($\mu g \cdot l^{-1}$)	9.8
17	Alkalinity [TALK]	Milliequivalent per liter ($meq \cdot l^{-1}$)	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 gradient and inversion factors used for WOD13

VARIABLE	MIV (Z<400m)	MGV (Z<400m)	MIV (Z>400m)	MGV (Z>400m)	ZSI
Temperature	0.300	0.700	0.300	0.700	5.00
Salinity	9.000	9.000[1]	0.050	0.050	5.00
Oxygen	checks not applicable				yes
Phosphate	1.000	1.000	0.500	0.500	2.50
Silicate	checks not applicable				yes
Nitrate	1.000	1.000	0.500	0.500	2.50
pH	0.400	0.400	0.200	0.200	2.00
Chlorophyll	checks not applicable				yes
Alkalinity	0.100	0.100	0.050	0.050	2.00

[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 Table 14). 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.

Table 14. Standard levels and depths (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		

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 Table 15. 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.

Table 15. 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 Depths	Acceptable depth differences for "inside values"	Acceptable depth differences for "outside values"
1	0	5	200
2	10	50	200
3	20	50	200
4	30	50	200
5	50	50	200
6	75	50	200
7	100	50	200
8	125	50	200
9	150	50	200
10	200	50	200
11	250	100	200
12	300	100	200
13	400	100	200
14	500	100	400
15	600	100	400
16	700	100	400
17	800	100	400
18	900	200	400
19	1000	200	400
20	1100	200	400
21	1200	200	400
22	1300	200	1000
23	1400	200	1000
24	1500	200	1000
25	1750	200	1000
26	2000	1000	1000
27	2500	1000	1000
28	3000	1000	1000
29	3500	1000	1000
30	4000	1000	1000
31	4500	1000	1000
32	5000	1000	1000
33+	5500+	1000	1000

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.

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):

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

where $\rho_0 = 1.02$ 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 NODC 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 WOD13 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 WOD13 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 WOD13 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 WOD13 was received at NODC 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 NODC 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 Appendix 2.20 (this document) or file s_54_needs_depth_fix.pdf for information on code table and how to correct depths.)

IMPORTANT: THE OBSERVED LEVEL XBT DATA IN WOD13 ARE THE SAME DATA AS SUBMITTED BY THE ORIGINATORS. IF YOU ARE USING OBSERVED LEVEL XBT DATA FROM WOD13, PLEASE USE SECONDARY HEADER 54 TO SEE WHETHER A DEPTH CORRECTION IS NECESSARY.

THE STANDARD LEVEL XBT DATA IN WOD13 WERE PREPARED, WHEN NEEDED AND POSSIBLE, USING A CORRECTED DEPTH-TIME EQUATION. IF YOU ARE USING STANDARD LEVEL XBT DATA FROM WOD13, 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 NODC 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. TUTORIAL: Importing WOD13 data into Ocean Data View

Ocean Data View (ODV) is used for visualization and analysis of oceanographic data by allowing the user to generate property-property plots, maps, and sections (transects). The software can be downloaded from ODV website.

What follows is a tutorial on how to use WOD13 data in Ocean Data View (ODV). The example shown will use a downloaded file from the geographical location (WMO square) option (file APBO7515.gz; where APB denotes Autonomous Pinniped Bathythermograph, O denotes observed level data; 7515 denotes the WMO code; and the extension gz denotes that the file is a gzip compressed file). To use this tutorial the user must have successfully installed ODV version 4.5.7 or higher. It is also important to add that this tutorial has been written for the Microsoft Windows XP and 2007 environment on personal computers. This document is not a substitute for the ODV User's Guide. Please refer to the ODV User's Guide for more information.

Reading the data using Ocean Data View: ODV will read (import) selected WOD13 data files in gzip compressed or decompressed format as well as offer options for displaying the data. Examples 1 and 2 below illustrate how to open a new collection and import single and multiple data files into ODV.

Example 1: Open a new data collection and import a single WOD13 data file (APBO7515.gz) into ODV.

Select and extract the Autonomous Pinniped Bathythermograph (APB) at observed depths with geographic coordinates between 50° and 60°N and between 150° and 160°W. Note the radio-buttons for selection among observed or standard depths are located above the WMO map.

The region of interest is located in WMO square number 7515 (North Pacific) as shown in Appendix 7. Click WMO square 7515 to get to the data page specific to this geographical region.

Selecting data by dataset type: On the data page for each ten-degree WMO square the data are organized by dataset. The file with the desired data is APBO7515.gz. Select and save APBO7515.gz to your work directory.

Opening a new data collection: In the upper menu bar of ODV click the **File** tab to open the file menu. Then click **New** to create a New_ODV_Collection in your working directory (otherwise, any existing collection can be used if available). ODV will then request a name for the new collection. In Example 1, enter **demo1s** (as for "demo 1 single file", or any other meaningful file name) in the File name window. Click **Save**. This will create the collection named **demo1s.odv**.

Figure 2 shows ODV when a new collection is created and prior to importing data. Since no data have been imported, the ODV internal number of stations is zero, shown in the bottom of the window as **0/0: DefaultView*** circled in red.

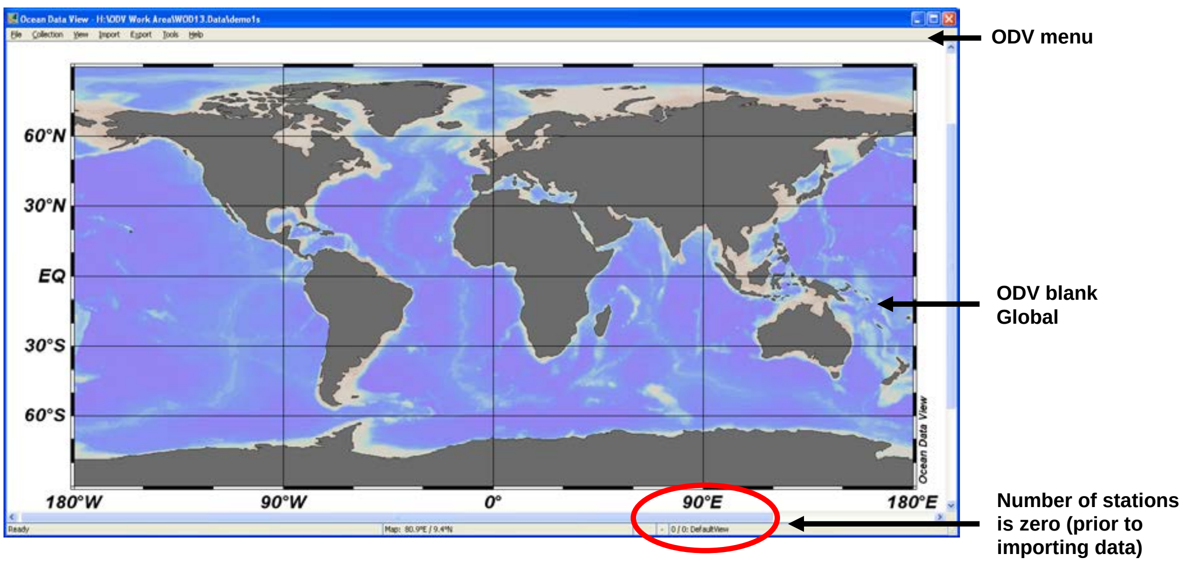


Figure 2. ODV screen after creating a new collection and prior to importing data.

Importing a single data file into the collection: The next step is to import data (APBO7515.gz). In the ODV File Menu select **Import** > **NODC Formats** > **World Ocean Database**. In the browser window point to the folder where you have placed the APBO7515.gz file.

Using the *Import Options* dialog box (Figure 3) you can associate the variables of the imported data with the variables already defined in the collection. Now look at the bottom portion of the box that hows window called Variable Association. All of the variables defined as the WOD13 data are preceded by asterisks. To keep this exercise simple, we will not make any changes to the *Source File* or *Target Collection*. Please refer to the ODV manual for detailed information about advanced ODV features. Highlight APBO7515.gz so that it shows in the File name window and select **Open** to continue.

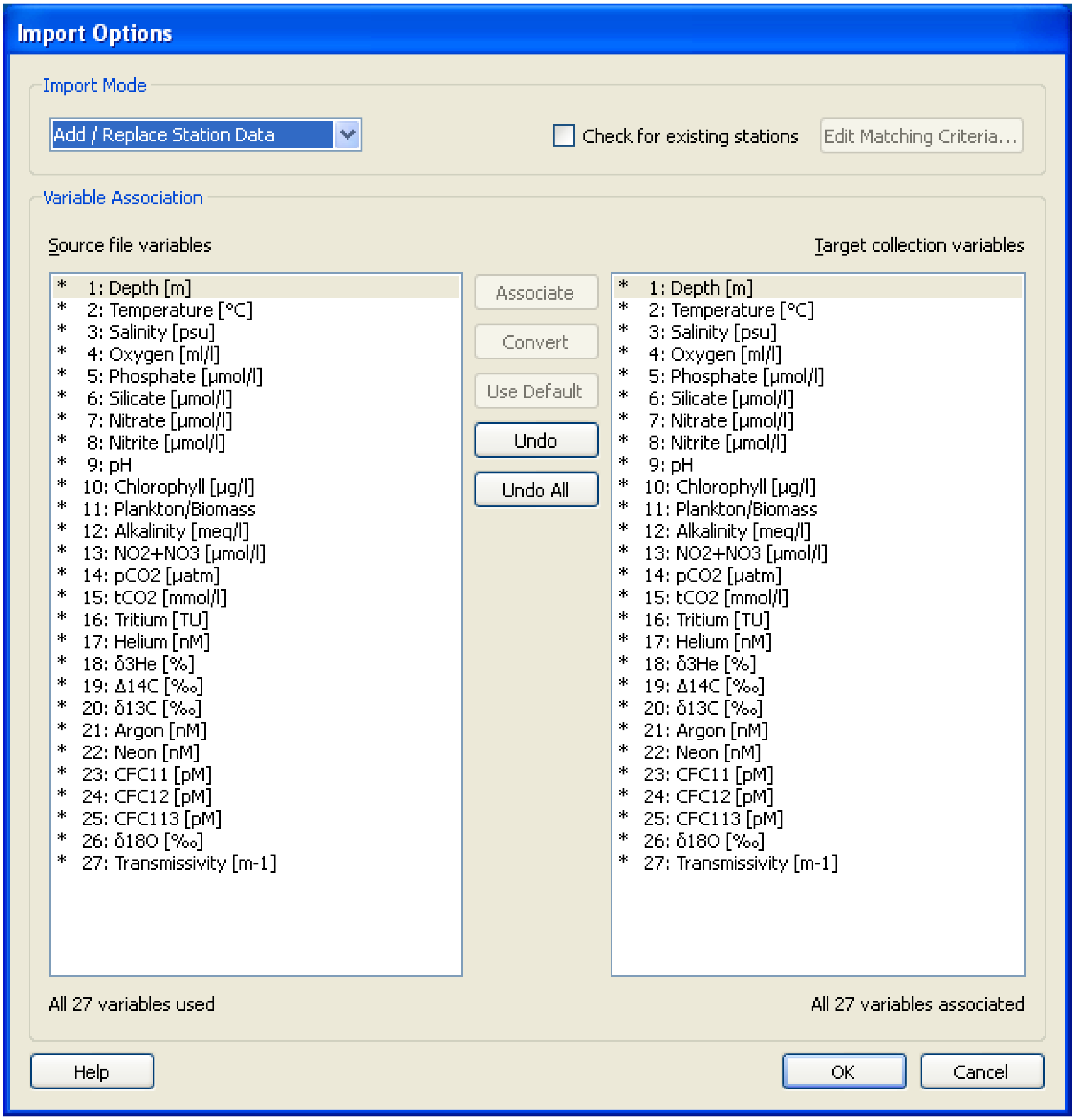


Figure 3. ODV Import Options.

A small dialog box (Figure 4) displays the total number of stations (**9943 stations**) imported from APBO7515 into the ODV Global Map. Click **OK** to continue.

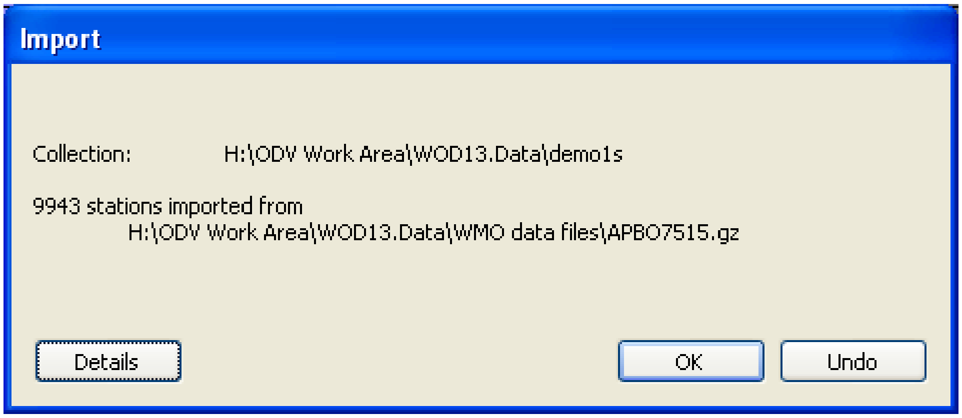


Figure 4. ODV Import Completion Dialog Box.

When the user selects **World Ocean Database** format, distribution of the imported data will appear in the Global Map. The ODV screen also displays all depth-dependent variables in WOD13 (see Table 3) and their values. A zoom of the information displayed to the right of the Global Map is shown in Figure 5. The station information changes accordingly, as you click a station in the distribution map. All the information corresponds to the WOD13 format unless specified otherwise. Some cast information such as profile bottom depth might not exist in all casts. Note that once a collection has been created, it is possible to import additional data files into the same collection.

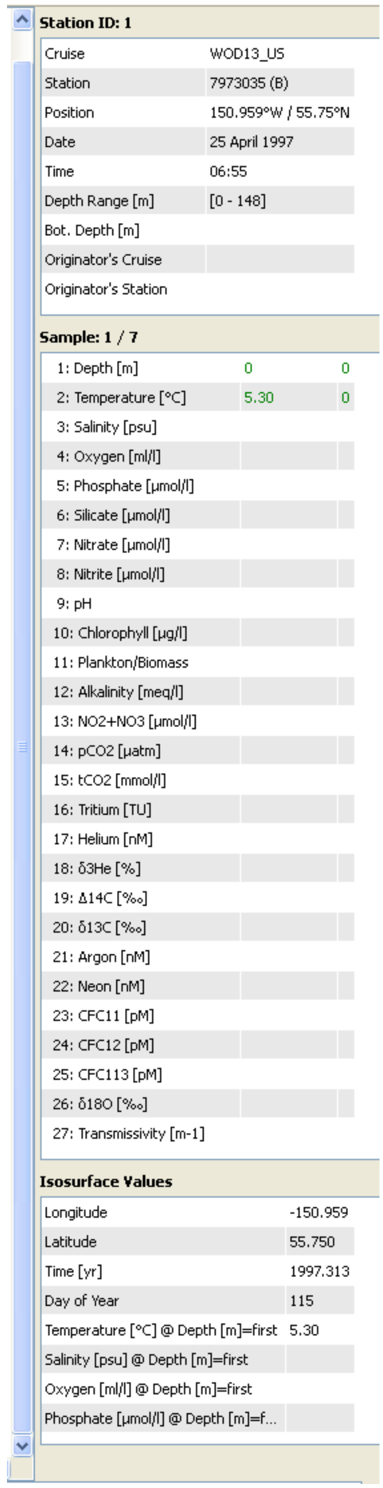


Figure 5. WOD13 cast information and profile data as displayed by Ocean Data View (ODV).

Example 2: Open a new collection and import several OSD data files into ODV.

Opening a new data collection: In the ODV menu bar click the **File** tab to open the File Menu. Click **New** to create a New_ODV_Collection in your working directory (or you can open any existing collection if one is available). ODV will then request a name for the new collection under File Name. Enter *demo2m* (*i.e.* demo 2 multiple files; or any other file name) in the File Name box and click **Save**. This will create the collection file named *demo2m.odv*.

Importing multiple data files into the collection: In the ODV File Menu bar, select **Import** > **NODC Formats** > **World Ocean Database**. In the browser window, select the folder where you have placed the files to import. Hold down the shift key to select all files in the folder, or hold down the control key to select certain files. Click **Open** to continue. When importing is completed, data distribution will appear in the Global Map. The **Importing ...** dialog box will show the number of imported stations. For this exercise, 13,675 stations where imported from files: OSDO7201.gz, OSDO7202.gz, and OSDO7203.gz, see dialog box shown in Figure 6.

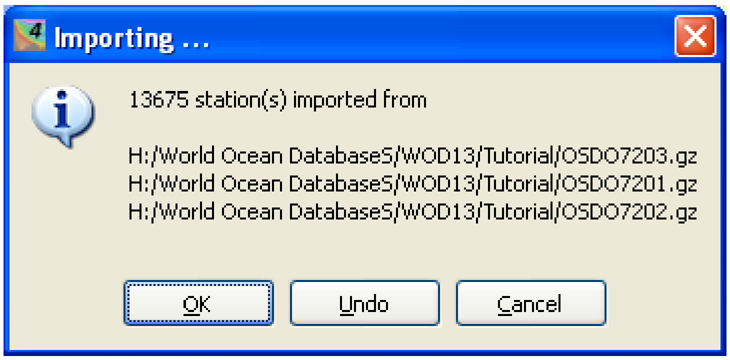


Figure 6. ODV Importing stations from multiple files.

Mapping of WOD variable quality flags: When a user creates a WOD collection using the WOD variables, ODV imports the original WOD quality flags and automatically maps these flags in the imported files to the ODV collection. The WOD variable quality flags are shown in Table 12. The WOD variables that received full quality control are: temperature, salinity, oxygen, phosphate, silicate, and nitrate. Other WOD13 variables received limited quality control such as basin data ranges for: pH, Chlorophyll, Alkalinity, Partial pressure of carbon dioxide, Dissolved Inorganic carbon, Tritium, Helium, Delta Helium-3, Delta Carbon-14, Delta Carbon-13, Argon, Neon, Chlorofluorocarbon 11, Chlorofluorocarbon 12, Chlorofluorocarbon 113, and Delta Oxygen-18.

Reporting data problems, suggestions, comments about WOD13: If any errors are found in the WOD13, please contact the Ocean Climate Laboratory at OCL.help@noaa.gov and the problems will be corrected. Comments or suggestions for improving WOD13 would be appreciated. Updates to the programs and changes to WOD13 will be posted in the NODC WOD Updates page.

VI. FREQUENTLY ASKED QUESTIONS

What follows are answers to basic users' questions about WOD13. They are included here to answer any questions that may arise as you read this document as well as work with the data.

Where do I get WOD13 data? The data are available online or on DVD.

DVD:
If the user requires all the data, or a large subset, ordering the DVD is the best option. The DVD can be ordered by sending E-mail to NODC.Services@noaa.gov or through the NODC online store at http://www.nodc.noaa.gov/General/getdata.html. Data on the DVD are sorted by year (time) only. The year-sorted data are provided in the DATA folder on the DVD.

Online: Geographically-sorted option:
http://www.nodc.noaa.gov/OC5/WOD13/data13geo.html - Data are sorted into 10° World Meteorological Organization (WMO) squares (Appendix 7). Within each 10° square, the data are sorted chronologically. There are separate files for each dataset for each 10° square for both observed and standard level data. Surface-only data are all contained in one file, regardless of geographic position.

Online: Chronologically-sorted option:
http://www.nodc.noaa.gov/cgi-bin/OC5/WOD/getyearlydata.pl?Go=TimeSorted - Data are sorted by year. Each year for each dataset has a separate file for both observed and standard level data. Surface-only data (SUR) are all contained in one file, regardless of year.

Online: User subset option:
http://www.nodc.noaa.gov/OC5/SELECT/dbsearch/dbsearch.html - This tool, called WOD*select*, allows the user to generate their own subset of data, based on a number of criteria, including geographic location, date, platform, project, institute, primary investigator (PI), measured variables, dataset, and quality-control flags. The data are available both in native format and in a comma-delimited (csv) format. The data can be separated by dataset or combined in one set of files. The number of files is based on the size of the subset requested and the maximum file size supported by the ftp site.

The data are compressed, how do I uncompress the data? The compression routine used on the files is gzip, denoted by the .gz file name extention. Many commercial software packages are able to decompress files compressed using gzip. If you are in a point and click environment, double click on the WOD file, and if your default decompression software recognizes the .gz extension, the decompression should proceed automatically, possibly with some user prompting, depending on software used.

If you do not have commercial software, gzip decompression utility is freeware and it is available at http://www.gzip.org. The gzip utility is available in the UTILS folder on the DVD.

How do I work with the WOD data? The WOD native format is an ASCII format (Tables 10.1, 10.2, and 10.3) developed for compactness. As such, it appears in a text editor as a "B" followed by a string of numbers (see Appendix 8 for sample output). Despite increases in computer memory and bandwidth, compactness is a desirable attribute when downloading data. We have provided a number of choices for working with the data:

Constructing your own reading utility: A detailed format description for WOD is provided in Section II (this document) followed by the ASCII format listing. From this description you can create your own reading software in your preferred language.

Using the FORTRAN and C utilities provided by the Ocean Climate Laboratory: http://www.nodc.noaa.gov/OC5/WOD/wod_programs.html contains sample FORTRAN and C programs for reading the WOD native format. The basic programs are wodFOR.f and wodC.c. The user can add output routines to these programs to display the data in their preferred format. Executables compatible with Microsoft operating systems are also included. wodASC.f and wodSUR.f will read the WOD native format data and output the data in a comma or space delimited format. This format can be used in software such as MatLab and other. The utilities are also provided in the PROGRAMS folder on the DVD.

Importing into Ocean Data View: Ocean Data View (ODV) is freeware developed by Dr. Renier Schlitzer at the Alfred Wegener Institute. It is used for viewing oceanographic profile data with features such as property-property plots and ocean sections. ODV can be freely used and distributed for non-commercial research and teaching purposes. The software is made available in the ODV folder on the WOD13 DVD. The software can be downloaded from http://odv.awi.de/. If you use ODV for your scientific work, you must reference it in your publication as follows:

Schlitzer, R., Ocean Data View, http://odv.awi.de, 2013.

Commercial use of ODV: If you plan to use Ocean Data View or any of its components for commercial applications and products, you need to obtain a software license. Please contact the address below for further information:

© 1990 – 2013 Reiner Schlitzer, Alfred Wegener Institute
Columbusstrasse 27568 Bremerhaven, Germany
E-mail: Reiner.Schlitzer@awi.de

A brief tutorial on importing WOD data into ODV is available in Section V and on line at: http://www.nodc.noaa.gov/OC5/WOD13/docwod13.html.

***How do I use the WOD quality-control flags*?** WOD quality control flags are the flags set during automatic and subjective quality control steps in the calculation of WOA13 climatologies. There are separate flags for each profile in a cast (temperature, salinity, phosphate, *etc*.). There are three types of flags. Whole profile flags denote failed checks for an entire profile; these flags are the same for observed and standard level data. Observed level flags are flags for individual measurements in a profile. Standard level flags are flags for individual interpolated values on standard levels. A complete list of flags can be found in Table 12. A more detailed description of the quality-control procedures can be found in Section III. The flags are not broken down into good/questionable/bad. Each automatic or subjective check has its own flag value. The user can decide whether to use all flags, no flags, or only flags set by selected quality-control checks. Note that all data is included in WOD13 even if it appears to be of questionable quality. It is therefore advised that the included quality-control flags are used.

How do I use the originators quality-control flags? Quality-control flags are included in the data as received by NODC are often included with individual measurements. There are no 'whole profile' or 'standard level' originator's flags. Often, the data originator may have more knowledge of submitted data than NODC. The originator's flags are used to help identify possible unrepresentative data, but they are not always used to set WOD quality control flags. The user of the data may prefer to use the originator's quality control flags instead of the WOD quality control flags. If a cast has originators flags, second header 96 contains a code that will indicate which set of originator's flags was used. Appendix 2.26 gives a list of values for each set of originator's flags.

How do I report data problems in WOD13? Despite the large amount of time and efforts invested in quality control of WOD13, problems still exist. We encourage anyone who encounters a problem, or has a question, to contact us at OCL.help@noaa.gov.

How is the XBT fall-rate problem handled? As per the international agreement detailed in Hanawa (1994), all observed level XBT data are stored as we received them, without any type of depth correction. However, all necessary information needed to make depth corrections when necessary is available in the second header information of each XBT cast. For details on the XBT fall-rate problem and how to perform depth correction, see Section IV.

How do I access the plankton data in WOD13? The plankton data are included with the physical data in the same WOD native format. The description of the portion of the format devoted to plankton data is provided in Tables 10.2 and 10.3. Descriptions of all the codes used to describe the plankton data are on Appendices 4 through 6. A detailed description of the plankton database is described in Chapter 14 of the WOD13 (Boyer *et al*., 2009). Another alternative is to download the plankton data or a subset of plankton data using WOD*select*. The output can be requested in WOD native format, or in csv format. The later writes out all the code values found in the WOD native format as well as the codes themselves.

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

Note: all Internet links as shown were checked at the time of publication (spring 2006)

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
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
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NODC	National Oceanographic Data Center
OCL	Ocean Climate Laboratory
ODV	Ocean Data View
OMEX	Ocean Margin Exchange Project
OSD	Ocean Station Data dataset

OWS	Ocean Weather Station
P-ALACE	Profiling Autonomous Lagrangian Circulation Explorer
PFL	Profiling Float dataset
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
WDC	World Data Center for Oceanography, Silver Spring
WMO	World Meteorological Organization
XBT	Expendable Bathythermograph

VIII. 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. NODC/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 NODC. The final column contains the code description.

2.1. Ocean Weather Station (code 9)

Code table: s_9_weather_station

To date, OWS Mike is the only operational station. Actual locations of each station at any given time were generally within a 2° box centered at the nominal (assigned) location.

CODE	OWS	1942 - 1952[1]	1 Apr 1952 - 29 Feb 1956[1]	1 March 1956 – present[1]	Assigned location[2]	Country[2]
1	A	Able	Alpha	Alpha	62.0°N; 33.0°W	U.S./Netherlands/U.K.
2	B	Baker	Bravo	Bravo	56.5°N; 51.0°W	U.S./Canada
3	C	Charlie	Coca	Charlie	52.7°N; 35.5°W	U.S./FSU
4	D	Dog	Delta	Delta	44.0°N; 41.0°W	U.S.
5	E	Easy	Echo	Echo	35.0°N; 48°W	U.S.
6	F	Fox	Foxtrot	Foxtrot	36.0°N; 40.0°W[3]	U.S.[3]
7	G	George	Golf	Golf	46.0°N; 30.0°W[3]	U.S.[3]
8	H	How	Hotel	Hotel	36.0°N; 70.0°W[3]	U.S.[3]
9	I	Item	India	India	59.0°N; 19.0°W	U.K.
10	J	Jig	Juliet	Juliet	52.5°N; 20.0°W	U.K./Netherlands
11	K	King	Kilo	Kilo	45.0°N; 16.0°W	Belgium/France/Netherlands
12	L	Love	Lima	Lima	57.0°N; 20.0°W	U.K.
13	M	Mike	Metro	Mike	66.0°N; 2.0°W	Norway/Sweden/Netherlands
14	N	Nan	Nectar	November	30.0°N; 140.0°W	U.S.
15	O	Oboe	Oscar	Oscar		
16	P	Peter	Papa	Papa	50.0°N; 145.0°W	U.S./Canada
17	Q	Queen	Quebec	Quebec		

CODE	OWS	1942 - 1952[1]	1 Apr 1952 - 29 Feb 1956[1]	1 March 1956 – present[1]	Assigned location[2]	Country[2]
18	R	Roger	Romeo	Romeo	47.0°N; 17.0°W	France
19	S	Sugar	Sierra	Sierra		
21	U	Uncle	Union	Uniform		
22	V	Victor	Victor	Victor	34.0°N; 164.0°E	U.S.
23	W	William	Whiskey	Whiskey		
25	Y	Yoke	Yankee	Yankee		
26	Z	Zebra	Zulu	Zulu		

[1] Lumby and Saelen, 1957
[2] Diaz, H.F., C.S. Ramage, S.D. Woodruff, and T.S. Parker, 1987
[3] Frankcom, CEN. 1982

2.2. Cast Direction (code 12)

Code table: s_12_cast_direction

WOD CODE	DESCRIPTION
-1	Direction not recorded
0	Down
1	Up
2	Average of up and down casts

2.3. Water Color (code 14)

Code table: s_14_water_color; Code source: Extended Forel-Ule Scale

CODE	DESCRIPTION	Forel-Ule Scale
1	0% yellow	Forel-Ule Scale I
2	2% yellow	Forel-Ule Scale II
3	5% yellow	Forel-Ule Scale III
4	9% yellow	Forel-Ule Scale IV
5	14% yellow	Forel-Ule Scale V
6	20% yellow	Forel-Ule Scale VI
7	27% yellow	Forel-Ule Scale VII
8	35% yellow	Forel-Ule Scale VIII
9	44% yellow	Forel-Ule Scale IX
10	54% yellow	Forel-Ule Scale X
11	65% yellow, 0% brown	Forel-Ule Scale XI
12	2% brown	Forel-Ule Scale XII
13	5% brown	Forel-Ule Scale XIII
14	9% brown	Forel-Ule Scale XIV
15	14% brown	Forel-Ule Scale XV
16	20% brown	Forel-Ule Scale XVI
17	27% brown	Forel-Ule Scale XVII
18	35% brown	Forel-Ule Scale XVIII
19	44% brown	Forel-Ule Scale XIX
20	54% brown	Forel-Ule Scale XX
21	65% brown	Forel-Ule Scale XXI
31	Green	
32	Blue	
33	Grey	
34	Red	
35	Chalky	
36	Brown	
37	Luminescent	

2.4. Wave Direction (code 16)

Code table: s_16_wave_direction; Code source: WMO code 0877

CODE	DESCRIPTION	CODE	DESCRIPTION
0	Calm (no waves; no motion)	20	195° - 204°
1	5° - 14°	21	205° - 214°
2	15° - 24°	22	215° - 224°
3	25° - 34°	23	225° - 234°
4	35° - 44°	24	235° - 244°
5	45° - 54°	25	245° - 254°
6	55° - 64°	26	255° - 264°
7	65° - 74°	27	265° - 274°
8	75° - 84°	28	275° - 284°
9	85° - 94°	29	285° - 294°
10	95° - 104°	30	295° - 304°
11	105° - 114°	31	305° - 314°
12	115° - 124°	32	315° - 324°
13	125° - 134°	33	325° - 334°
14	135° - 144°	34	335° - 344°
15	145° - 154°	35	345° - 354°
16	155° - 164°	36	355° - 4°
17	165° - 174°	49	Waves confused, direction indeterminate (waves equal to or less than 4-3/4 meters)
18	175° - 184°	99	Waves confused, direction indeterminate (waves greater than 4-3/4 meters) winds variable, or all directions or unknown
19	185° - 194°		

2.5. Wave Height (code 17)

Code table: s_17_wave_height; Code source: WMO code 1555

CODE	DESCRIPTION
0	Calm
1	0.5 meter
2	1 meter
3	1.5 meter
4	2 meter
5	2.5 meter
6	3 meter
7	3.5 meter
8	4 meter
9	4.5 meter
10	5 meter
11	5.5 meter
12	6 meter
13	6.5 meter
14	7 meter
15	7.5 meter
16	8 meter
17	8.5 meter
18	9 meter
19	9.5 meter
20	10 meter
21	10.5 meter
22	11 meter
23	11.5 meter
24	12 meter
25	12.5 meter
26	13 meter
27	> 13 meters

2.6. Sea State (code 18)

Code table: s_18_sea_state; Code source: WMO code 3700

CODE	DESCRIPTION
0	Calm-Glassy 0 Ft (0 Meters)
1	Calm-Rippled 0 to 1/3 Ft (0 to 0.1 Meters)
2	Smooth-Wavelet 1/3 to 1-2/3 Ft (0.1 to 0.5 Meters)
3	Slight 1-2/3 to 4 Ft (0.5 to 1.25 Meters)
4	Moderate 4 to 8 Ft (1.25 to 2.50 Meters)
5	Rough 8 to 13 Ft (2.50 to 4.0 Meters)
6	Very Rough 13 to 20 Ft (4 to 6 Meters)
7	High 20 to 30 Ft (6 to 9 Meters)
8	Very High 30 to 45 Ft (9 to 14 Meters)
9	Phenomenal >45 Ft (>14 Meters)

2.7. Wind Force (code 19)

Code table: s_19_wind_force; Code source: Beaufort Scale

CODE	DESCRIPTION
0	Calm - Mean Velocity In: Knots <1; Meters/Sec 0 to 0.2; Km/H <1; MPH <1; Wave Ht < 0.25 Ft
1	Light Air - Mean Velocity In: Knots 1 to 3; Meters/Sec 0.3 to 1.5; Km/H 1 to 5; M.P.H. 1 to 3; Wave Ht = 0.25 Ft
2	Light Breeze - Mean Velocity In: Knots 4 to 6; Meters/Sec 1.6 to 3.3; Km/H 6 to 11; M.P.H. 4 to 7; Wave Ht = 0.5 Ft
3	Gentle Breeze - Mean Velocity In: Knots 7 to 10; Meters/Sec 3.4 to 5.4; Km/H 12 to 19; M.P.H. 8 to 12; Wave Ht = 2 Ft
4	Moderate Breeze - Mean Velocity In: Knots 11 to 16; Meters/Sec 5.5 to 7.9; Km/H 20 to 28; M.P.H. 13 to 18; Wave Ht = 4 Ft
5	Fresh Breeze - Mean Velocity In: Knots 17 to 21; Meters/Sec 8.0 to 10.7; Km/H 29 to 38; M.P.H. 19 to 24; Wave Ht = 6 Ft
6	Strong Breeze - Mean Velocity In: Knots 22 to 27; Meters/Sec 10.8 to 13.8; Km/H 39 to 49; M.P.H. 25 to 31; Wave Ht = 10 Ft
7	Near Gale - Mean Velocity In: Knots 28 to 33; Meters/Sec 13.9 to 17.1; Km/H 50 to 61; M.P.H. 32 to 38; Wave Ht = 14 Ft
8	Gale - Mean Velocity In: Knots 34 to 40; Meters/Sec 17.2 to 20.7; Km/H 62 to 74; M.P.H. 39 to 46; Wave Ht = 18 Ft
9	Strong Gale - Mean Velocity In: Knots 41 to 47; Meters/Sec 20.8 to 24.4; Km/H 75 to 88; M.P.H. 47 to 54; Wave Ht = 23 Ft
10	Storm
11	Violent Storm
12	Hurricane

2.8. Wave Period (code 20)

Code table: s_20_wave_period

NODC CODE 3155	
CODE	**DESCRIPTION**
0	20 or 21 seconds
1	over 21 seconds
2	5 seconds or less
3	6 or 7 seconds
4	8 or 9 seconds
5	10 or 11 seconds
6	12 or 13 seconds
7	14 or 15 seconds
8	16 or 17 seconds
9	18 or 19 seconds
10	calm or period not determined

2.9. Wind Direction (code 21)

Code table: s_21_wind_direction; Code source: WMO code 0877

CODE	DESCRIPTION	CODE	DESCRIPTION
0	Calm (no winds; no motion)	20	195° - 204°
1	5° - 14°	21	205° - 214°
2	15° - 24°	22	215° - 224°
3	25° - 34°	23	225° - 234°
4	35° - 44°	24	235° - 244°
5	45° - 54°	25	245° - 254°
6	55° - 64°	26	255° - 264°
7	65° - 74°	27	265° - 274°
8	75° - 84°	28	275° - 284°
9	85° - 94°	29	285° - 294°
10	95° - 104°	30	295° - 304°
11	105° - 114°	31	305° - 314°
12	115° - 124°	32	315° - 324°
13	125° - 134°	33	325° - 334°
14	135° - 144°	34	335° - 344°
15	145° - 154°	35	345° - 354°
16	155° - 164°	36	355° - 4°
17	165° - 174°	49	Waves confused, direction indeterminate (waves equal to or less than 4-3/4 meters)
18	175° - 184°	99	Waves confused, direction indeterminate
19	185° - 194°		

2.10. Weather Condition (code 26)

Code table: s_26_weather_condition; Code source: WMO code 4501 (if <=0) or WMO code 4677 (if >0)

CODE	DESCRIPTION
-9	Thunderstorm(s)
-8	Shower(s)
-7	Snow, or rain and snow mixed
-6	Rain
-5	Drizzle
-4	Fog, thick dust or haze
-3	Sandstorm, dust storm, or blowing snow
-2	Continuous layer(s) of cloud(s)
-1	Partly cloudy (scattered or broken)
0	Clear (no cloud at any level)
1	Clouds generally dissolving or becoming less developed. Change of state of sky during past hour.
2	State of sky on the whole unchanged. Change of the state of sky during the past hour
3	Clouds generally forming or developing. Change of the state of sky during the past hour
4	Visibility reduced by smoke, *e.g.* veldt of forest fires, industrial smoke or volcanic ashes
5	Haze
6	Widespread dust in suspension in the air, raised by wind at or near the station at time of observation
7	Dust or sand raised by wind at or near the station at the time of observation, but no well developed dust whirl(s) or sand whirl(s), and no dust storm or sandstorm seen
8	Well developed. Dust whirl(s) or sand whirl(s) seen at or near station during the preceding hour or at the time of observation, but no dust storm or sandstorm
9	Dust storm or sandstorm within sight at the time of observation, or at station during preceding hour
10	Mist
11	Patches of shallow fog or ice fog at the station, whether on land or sea, not deeper than about 2 meters on land or 10 meters at sea
12	More or less continuous shallow fog or ice fog at the station, whether on land or sea, not deeper than about 2 meters on land or 10 meters at sea
13	Lightning visible, no thunder heard
14	Precipitation within sight, not reaching the ground or the surface of the sea
15	Precipitation within sight, reaching the ground or the surface of the sea, but distant (*i.e.* Estimated to be more than 5 km) from the station
16	Precipitation within sight, reaching ground or surface of the sea, near to, but not at the station
17	Thunderstorm, but no precipitation at the time of observation
18	Squalls at or within sight of the station during the preceding hour or at time of observation
19	Funnel cloud(s) at or within sight of station during preceding hour or at the time of observation
20	Drizzle (not freezing) or snow grains - not falling as shower(s)
21	Rain (not freezing) - not falling as shower(s)
22	Snow - not falling as shower(s)
23	Rain and snow or ice pellets, type (a) - not falling as shower(s)
24	Freezing drizzle or freezing rain - not falling as shower(s)
25	Shower(s) of rain - not falling as shower(s)

CODE	DESCRIPTION
26	Shower(s) of snow, or of rain and snow - not falling as shower(s)
27	Shower(s) of hail, or of rain and hail - not falling as shower(s)
28	Fog or ice fog - not falling as shower(s)
29	Thunderstorm (with or without precipitation)
30	Slight or moderate dust storm or sandstorm - has decreased during the preceding hour
31	Slight or moderate dust storm or sandstorm - no appreciable change during the preceding hour
32	Slight or moderate dust storm or sandstorm - has begun or has increased during the preceding hour
33	Severe dust storm or sandstorm - has decreased during the preceding hour
34	Severe dust storm or sandstorm - no appreciable change during the preceding hour
35	Severe dust storm or sandstorm - has begun or has increased during the preceding hour
36	Slight or moderate blowing snow - generally low (below eye level)
37	Heavy drifting snow - generally low (below eye level)
38	Slight or moderate blowing snow - generally high (above eye level)
39	Heavy blowing snow - generally high (above eye level)
40	Fog or ice fog at a distance at time of observation, but not at the station during the preceding hour, the fog or ice fog extending to a level above that of the observer
41	Fog or ice fog in patches
42	Fog or ice fog, sky visible - has become thinner during the preceding hour
43	Fog or ice fog, sky invisible - has become thinner during the preceding hour
44	Fog or ice fog, sky visible - no appreciable change during the preceding hour
45	Fog or ice fog, sky invisible - no appreciable change during the preceding hour
46	Fog or ice fog, sky visible - has begun or has become thicker during the preceding hour
47	Fog or ice fog, sky invisible - has begun or has become thicker during the preceding hour
48	Fog, depositing rime, sky visible
49	Fog, depositing rime, sky invisible
50	Drizzle, not freezing, intermittent - slight at time of observation
51	Drizzle, not freezing, continuous - slight at time of observation
52	Drizzle, not freezing, intermittent - moderate at time of observation
53	Drizzle, not freezing, continuous - moderate at time of observation
54	Drizzle, not freezing, intermittent - heavy (dense) at time of observation
55	Drizzle, not freezing, continuous - heavy (dense) at time of observation
56	Drizzle, freezing, slight
57	Drizzle, freezing, moderate or heavy (dense)
58	Drizzle and rain, slight
59	Drizzle and rain, moderate or heavy
60	Rain, not freezing, intermittent - slight at time of observation
61	Rain, not freezing, continuous - slight at time of observation
62	Rain, not freezing, intermittent - moderate at time of observation
63	Rain, not freezing, continuous - moderate at time of observation
64	Rain, not freezing, intermittent - heavy at time of observation
65	Rain, not freezing, continuous - heavy at time of observation
66	Rain, freezing, slight

CODE	DESCRIPTION
67	Rain, freezing, moderate or heavy
68	Rain or drizzle and snow, slight
69	Rain or drizzle and snow, moderate or heavy
70	Intermittent fall of snow flakes - slight at time of observation
71	Continuous fall of snow flakes - slight at time of observation
72	Intermittent fall of snow flakes - moderate at time of observation
73	Continuous fall of snow flakes - moderate at time of observation
74	Intermittent fall of snow flakes - heavy at time of observation
75	Continuous fall of snow flakes - heavy at time of observation
76	Ice prisms (with or without fog)
77	Snow grains (with of without fog)
78	Isolated star like snow crystals (with or without fog)
79	Ice pellets, type (a)
80	Rain shower(s), slight
81	Rain shower(s), moderate or heavy
82	Rain shower(s), violent
83	Shower(s) of rain and snow mixed, slight
84	Shower(s) of rain and snow mixed, moderate or heavy
85	Snow shower(s), slight
86	Show shower(s), moderate or heavy
87	Shower(s) of snow pellets or ice pellets, type(b), with or without rain and snow mixed - slight
88	Shower(s) of snow pellets or ice pellets, type(b), with or without rain or rain and snow mixed - moderate or heavy
89	Shower(s) of hail, with or without rain or rain and snow mixed, not associated with thunder - slight
90	Shower(s) of hail, with or without rain or rain and snow mixed, not associated with thunder - moderate or heavy
91	Slight rain at time of observation - thunderstorm during the preceding hour but not at time of observation
92	Moderate or heavy rain at time of observation - thunderstorm during preceding hour, but not at time of observation
93	Slight snow, or rain and snow mixed or hail at time of observation - thunderstorm during the preceding hour but not at time of observation
94	Moderate or heavy snow, or rain and snow mixed or hail at time of observation - thunderstorm during the preceding hour but not at time of observation
95	Thunderstorm, slight or moderate, without hail, but with rain and/or snow at time of observation - thunderstorm at time of observation
96	Thunderstorm, slight or moderate, with hail at time of observation - thunderstorm at time of observation
97	Thunderstorm, heavy, without hail, but with rain and/or snow at time of observation - thunderstorm at time of observation
98	Thunderstorm combined with dust storm or sandstorm at time of observation - thunderstorm at time of observation
99	Thunderstorm, heavy, with hail at time of observation - thunderstorm at time of observation

2.11. Cloud Type (code 27)

Code table: s_27_cloud_type; Code source: WMO code 0500

CODE	DESCRIPTION
0	Cirrus (CI)
1	Cirrocumulus (CC)
2	Cirrostratus (CS)
3	Altocumulus (AC)
4	Altostratus (AS)
5	Nimbostratus (NS)
6	Stratocumulus (SC)
7	Stratus (ST)
8	Cumulus (CU)
9	Cumulonimbus (CB)
10	Cloud not visible owing to darkness, fog, dust storm, sandstorm, or other analogous phenomena

2.12. Cloud Cover (code 28)

Code table: s_28_cloud_cover; Code source: WMO code 2700

CODE	DESCRIPTION
0	0 (Zero)
1	1 Okta or less, but not zero (1/10 or less, but not zero)
2	2 Oktas 2/10 to 3/10
3	3 Oktas 4/10
4	4 Oktas 5/10
5	5 Oktas 6/10
6	6 Oktas 7/10 to 8/10
7	7 Oktas or more, but not 8 Oktas (9/10 or more, but not 10/10)
8	8 Oktas 10/10
9	Sky obscured, or cloud amount cannot be estimated

2.13. Probe Type (code 29)

Code table: s_29_probe_type

CODE	DESCRIPTION
0	unknown
1	MBT
2	XBT
3	DBT
4	CTD
5	STD
6	XCTD
7	bottle/rossette/net
8	underway/intake
9	profiling float
10	moored buoy
11	drifting buoy
12	towed CTD
13	animal mounted
14	bucket
15	glider
16	microBT

2.14. Recorder (code 32)

Code table: s_32_recorder; Code source: WMO code 4770

CODE	DESCRIPTION
1	SIPPICAN STRIP Chart Recorder
2	SIPPICAN MK2A/SSQ-61
3	SIPPICAN MK-9
4	SIPPICAN AN/BHQ-7/MKS
5	SIPPICAN MK-12
6	SIPPICAN MK21
7	MK8 Linear Recorder
10	SPARTAN SOC-BT/SV Processor Model 100
20	ARGOS XBT-ST
21	CLS-ARGOS/PROTECNO XBT-ST MODEL 1
22	CLS-ARGOS/PROTECNO XBT-ST MODEL 2
30	BATHY SYSTEMS SA-810
31	SCRIPPS METROBYTE Controller
32	MURAYAMA DENKI Z-60-16 III
33	MURAYAMA DENKI Z-60-16 II
34	PROTECNO ETSM2
35	NAUTILUS MARINE SERVICE NMS-XBT
40	TSK MK-2A
41	TSK MK-2S
42	TSK MK-30
43	TSK MK-30N
45	TSK MK-100
46	TSK MK-130 compatible recorder for XBT and XCTD
47	TSK MK-130A XCTD recorder
48	TSK AXBT receiver MK-300
50	JMA ASTOS
60	P-ALACE float, ARGOS communications, sampling on up transit
61	P-ALACE float, ARGOS communications, sampling on down transit
62	P-ALACE float, Orbcomm communications, sampling on up transit
63	P-ALACE float, Orbcomm communications, sampling on down transit
70	CSIRO DEVIL-1 XBT Acquisition System
71	CSIRO DEVIL-2 XBT Acquisition System
72	SIPPICAN MK21
73	CSIRO DEVIL XBT ACQUISITION SYSTEM

2.15. Digitization Method (code 35)

Code table: s_35_digitization_method; Code source: NODC code 0612

CODE	DESCRIPTION
1	Manual
2	A-D conversion from original
3	A-D conversion from copies
4	Optical Scanning
5	Direct digital output unknown
6	Direct digital output BATHY
7	Direct digital output SUTRON
8	Direct digital output from SIPPICAN MARK 9

2.16. Digitization Interval (code 36)

Code table: s_36_digitization_interval; Code source: NODC code 0613
LE – less than or equal to (<=); LT – less than (<); GT – greater than (>)

CODE	DESCRIPTION
1	Fixed interval <= 0.1 meter and <= 0.1°C
2	Fixed interval > 1 meter but <= 3 meters and <= 0.1°C
3	Fixed interval > 3 meters but <= 6 meters and <= 0.1°C
4	Fixed interval > 6 meters and <= 0.1°C
11	Fixed interval <= 1 meter and <= 0.2°C
12	Fixed interval > 1 meter but <= 3 meters and <= 0.2°C
13	Fixed interval > 3 meters and <= 6 meters and <= 0.2°C
31	Variable interval - manually determined
32	Variable interval - statistically determined
33	Variable interval - physically determined
34	Fixed interval > 3 meters but < 6 meters and <= 0.2°C

2.17. Data Treatment and Storage (code 37)

Code table: s_37_data_storage; Code source: NODC code 0614

CODE	DESCRIPTION
1	Single digitization; stored as digitized
2	Single digitization; compression; fit within 0.05°C
3	Single digitization; compression; fit within 0.1°C
4	Single digitization; compression; fit within 0.2°C
5	Single digitization; compression; fit within 0.3°C
6	Single digitization; compression; fit within 0.7°C
7	Unknown
21	Dual digitization and averaging; stored as digitized
22	Dual digitization and averaging; compression; fit within 0.05°C
23	Dual digitization and averaging; compression; fit within 0.1°C
24	Dual digitization and averaging; compression; fit within 0.2°C
25	Dual digitization and averaging; compression; fit within 0.3°C
26	Dual digitization and averaging; compression; fit within 0.5°C
27	Data points at fixed intervals or selected intervals retained and stored

2.18. Reference Instrument (code 40)

Code table: s_40_ref_instrument; Code source: NODC code 0615

CODE	DESCRIPTION
1	Bucket
2	Injection, or unverified bucket notation, or unknown
3	Nansen cast (reversing thermometer)
4	Thermograph
5	Special calibration thermometer or equipment
6	BT
7	STD
9	Hull contact sensor
10	Engine intake

2.19. Horizontal Visibility (code 41)

Code table: s_41_visibility; Code source: WMO code 4300

CODE	DESCRIPTION
0	Less than 50 meters
1	50 to 200 meters
2	200 to 500 meters
3	500 to 1000 meters
4	1 to 2 km
5	2 to 4 km
6	4 to 10 km
7	10 to 20 km
8	20 to 50 km
9	50 km or more

2.20. Needs Depth Fix (code 54)

Code table: s_54_needs_depth_fix

CODE	DESCRIPTION
-1	insufficient information
0	no fix necessary
1	needs Hanawa *et al*., 1994 applied (XBT)
2	needs Kizu *et al*., 2005 applied (XBT)
3	Hanawa *et al*., 1994 applied (XBT)
4	Kizu *et al*., 2005 applied (XBT)
5	Levitus *et al*., 2009 applied (XBT/MBT)
6	Wijffels *et al*., 2008 Table 1 applied (XBT)
7	Wijffels *et al*., 2008 Table 2 applied (XBT)
8	Ishii and Kimoto, 2009 applied (XBT/MBT)
9	Gouretski and Reseghetti, 2010 applied (XBT/MBT)
10	Good 2011 applied (XBT)
11	Hamon *et al*., 2012 applied (XBT/MBT)
12	Gouretski 2012 applied (XBT)
103	needs Johnson, 1995 (XCTD)
104	needs Mizuno and Watanabe, 1998 applied (XCTD)

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)

Code table: s_74_ocean_vehicle

CODE	DESCRIPTION
1	Undulating Oceanographic Recorder
2	SeaSoar
3	Profiling Float
4	Surface Drifter
5	Net
6	Animal
302	PROVOR (free-drifting hydrographic profiler, IFREMER/MARTEC, France)
303	P-ALACE (Autonomous Lagrangian Circulation Explorer, Webb Research Corporation)
304	SOLO (Sounding Oceanographic Lagrangian Observer, SIO)
305	APEX (Autonomous Profiling Explorer, Webb Research Corporation)
306	R1 (Webb Research Corporation)
308	NINJA (New Profiling Float of Japan)
309	NEMO (Navigating European Marine Observer)
401	J-CAD (JAMSTEC Compact Arctic Drifter)
501	Ground Trawl Net
601	Elephant Seal

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)

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)

Code table: s_84_argos_fix

CODE	DESCRIPTION (km)
1	0.8
2	1.4
3	2.7
4	9.3
5	28.3
6	48.4

2.25. Database ID (code 91)

Code table: s_91_database_id

CODE	DESCRIPTION
1	NODC archive (1992)
2	GTSPP Project
3	GODAR Project
4	PMEL TAO/PIRATA database
5	MEDAR/MEDATLAS
6	MOODS (Master Oceanographic Observation Data Set)
7	US GODAE server (Argo)
8	JAMSTEC TRITON database
9	Carbon Dioxide in the Atlantic Ocean (CARINA)
10	WHO/CCHDO
11	Arctic Atlas 2004 (MMBI-OCL)
12	British Oceanographic Data Centre
13	COPEPOD (NMFS Coastal and Oceanic Plankton Ecology Production and Observation Database)

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

Code table: s_92_ukho_ref

CODE	REFERENCE
77 - 107	ICES (1902-1914, 1919-1937)
381 - 519	No information provided
522 - 530	Japan (1923-1941)
531 - 659	No information provided
2010 - 3265	No information provided
3260	ICES (1938-1939)
3520 - 6652	No information provided
6752	Danish Light Vessels (1932)
6790 - 6865	No information provided
6944	Danish Light Vessels (1938)
6945	Danish Light Vessels (1945)
6961 - 7065	No information provided
7110	No information provided
7138 - 7337	No information provided
7410	Danish Light Vessels (1946)
7635 - 7838	No information provided
8125	Danish Light Vessels (1947)
8313	No information provided
8470	Danish Light Vessels (1948)
8471	Danish Light Vessels (1949)
8517 - 8562	No information provided
8567	Danish Light Vessels (1950)
8568 - 8823	No Information Provided
8888	Danish Light Vessels (1951)
9349	No Information Provided
9357	No Information Provided
9448	Danish Light Vessels (1953)
9554	Danish Light Vessels (1952)
9580 -10383	No Information Provided
10477	Danish Light Vessels (1939)
10478	Danish Light Vessels (1940)
10777	No Information Provided
10816	Danish Light Vessels (1954)
10923 -10940	No Information Provided

2.26. continued

CODE	REFERENCE
-1	ICES Bulletin Hydrographique
-2	Norwegian Records
-3, -4	ERNEST HOLT (1949 - 1958)
-5	SMED
-6	Caspian Sea
-7	Canadian Oceanographic Data Center
-8	COEC
-9	EXPL. MER URSS
-10, -11	JOHAN HJORT (1900 - 1901)
-12, -13	DAMPIER (1965)
-14, -15	ALBATROSS (1948)
-16	GRAMPUS (1963)
-17	NARWHAL (1964)
-18	NC847
-19	VEIDING (1931)
-20	WMH
-21	Analysis De Hydrographique
-22	Northern Waters
-23	Bulletin Russian Hydrographic Institute
-24	ZUBOV
-25	F14
-26	BPMR
-27	PALLISES
-28	ROSNELL
-29	Ocean Weather Station E
-30	Ocean Weather Station
-31	RUSSELL
-32	0 or 00
-33	ELBE 1
-34	ELBF 1 / ELBF I
-35	ELSE 1
-36	ELBE 2
-37	WESER
-38	S2
-39	R74
-40	Ocean Weather Station J
-41	ONT

CODE	REFERENCE
-42	DUNKIR
-43	Q
-44	PRISSEL
-45	BORKUMR
-46	368C
-47	368A
-48	DISCOVERY II (1955 - 1956)
-49	BUYAYED
-50	100T
-51	*No information provided*

If the UKHO originator's code was not numeric (*e.g.* text string), the OCL assigned a negative numeric code

2.27. Originator's Depth Unit (code 95)

Code table: s_95_depth_unit

CODE	DESCRIPTION
83	Foot
86	Fathom

2.28. Originator Flag Set (code 96)

Code table: s_96_origflagset

WOD CODE	PROJECT/INSTITUTE OR ACCESSION #	DESCRIPTION
1	(1) WOCE Accessions: 0000841, 0000307; (analyst/sample collector flags) (2) Accessions: 0000192, 0000887, 0000888, 0000769, 0000889, 0000899, 0001029, 0001495, 0002190, 9900206, 9500152, 0001919, 0001334, 000907	**Water Sample Quality Flags** 2 - acceptable measurement 3 - questionable measurement 4 - bad measurement 6 - mean of replicate 7 - manual chromatographic peak measurement 8 - irregular digital chromatographic peak integration **Water Bottle Quality Flags** 2 - no problem noted 3 - leaking 4 - did not trip correctly 6 - significant discrepancy between Gerard and Niskin bottles 7 - unknown problem 8 - pair did not trip correctly **CTD Quality Flags** 2 - acceptable measurement 3 - questionable measurement 4 - bad measurement 6 - interpolated over >2 dbar interval 7 - despiked
3	GTSPP	1 - good quality 2 - "probably" good quality 3 - "probably" bad quality 4 - bad quality 5 - data changed
5	GEOSECS	1 - data taken from CTD down trace 2 - temperature calculated from unprotected thermometer 3 - depth calculated from wire out 4 - data extracted from CTD records 5 - data appears to be in error, but verified by other means 6 - thermometric data (normally measured by CTD) 7 - known error 8 - pretrip or postrip 9 - uncertain data
6	CalCOFI	6 - data okay, but from a CTD device 8 - suspect data 2 - data okay
7	Wilkes Land Expedition (1) Accession: 0000550 (CTD only) (2) Accession: 0000782	3 - unreliable data 4 - bad data 6 - interpolated data
8	OMEX & Accession 0001018	1 - improbable value
9	Accession: 0000440	1 - suspect value

WOD CODE	PROJECT/INSTITUTE OR ACCESSION #	DESCRIPTION
10	Accession: 0001086	3 - doubtful data 4 - bad data
11	PMEL TAO/PIRATA database	1 - highest quality 2 - default quality 3 - adjusted data 4 - lower quality 5 - sensor failed
12	ARGO profiling floats	0 - no quality control performed 1 - good data 2 - probably good data 3 - bad data that are potentially correctible 4 - bad data
13	LATEX (accession 0065693)	1 – bad data

2.29. Water Sampler (code 97)

Code table: s_97_sampler

WOD CODE	DESCRIPTION
7	Bottle, model and brand unknown
442	Zond-bathometer
445	Hydrozond
701	Bathometer (Russia)
702	Trace metal free bottle, model and brand unknown
703	Open bucket, model and brand unknown
705	WHOI-developed SEA SAMPLER (circa 1950 MBT On Bottle Rosette)
706	Van Dorn, model and brand unknown
716	Gerard-Ewing metal sampler
717	Niskin water sampler, model and brand unknown
718	Nansen water sampler, model and brand unknown
760	Sub-surface continuous water pump sampler, brand and model unknown
775	Hale apparatus with thermometer (Prestwich, 1875)
7001	Niskin water sampler, model unknown, 1.2-liter (General Oceanics, Inc.)
7010	Niskin water sampler, model unknown, 10-liter (Ocean Data Facility, SIO, UCSD)
7011	Niskin water sampler, model unknown, 10-liter (General Oceanics, Inc.)
7012	Niskin water sampler, model unknown, 12-liter (General Oceanics, Inc.)
7015	Fjarlie water sampler (Fjarlie, 1953)
7255	Niskin water sampler, model unknown, 2.5/5-liter (General Oceanics, Inc.)

APPENDIX 3. CODES FOR VARIABLE SPECIFIC SECONDARY HEADERS

The prefix ‘v’ in the following tables denotes variable specific header codes

3.1. Scale (code 3)

Code table: v_3_scale

CODE	DESCRIPTION
102	Temperature: T68 (IPTS-68)
103	Temperature: ITS-90
202	Salinity: PSS78
203	Salinity: unknown (pre-PSS78)
300	Chrlorofluorocarbon reported on SIO98 scale
1461	pH: SWS25
1462	pH: NBS25

3.2. Instrument Codes (code 5)

Code table: v_5_instrument

CODE	INSTRUMENT	DESCRIPTION
0	Unknown	Unknown
1	MBT	Type Unknown
2	XBT	Type Unknown
3	DBT	Type Unknown
4	CTD	Type Unknown
5	STD	Type Unknown
6	XCTD	Type Unknown
7	Bottle	Type Unknown
8	Underway	Underway Data Collection Instrument Type Unknown
101	MBT	GM-39 (Russia)
201	XBT	T7 (Unknown Brand)
202	XBT	T4 (Unknown Brand)
203	XBT	T6 (Unknown Brand)
204	XBT	T5 (Unknown Brand)
205	XBT	T10 (Unkown Brand)
206	XBT	T11 (Unknown Brand)
207	XBT	T7 (SIPPICAN)
208	XBT	T4 (SIPPICAN)
209	XBT	T6 (SIPPICAN)
210	XBT	T5 (SIPPICAN)
211	XBT	T10 (SIPPICAN)
212	XBT	T11 (SIPPICAN)
213	XBT	FAST DEEP (SIPPICAN)
214	XBT	DEEP BLUE (SIPPICAN)
215	XBT	T4 (TSK - TSURUMI SEIKI Co.)
216	XBT	T6 (TSK - TSURUMI SEIKI Co.)
217	XBT	T7 (TSK - TSURUMI SEIKI Co.)
218	XBT	MHI, Academy of Science, Ukraine)
219	XBT	T5 (TSK - TSURUMI SEIKI Co.)
220	XBT	T10 (TSK - TSURUMI SEIKI Co.)
221	XBT	XBT-1 (SPARTON)
222	XBT	XBT-3 (SPARTON)
223	XBT	XBT-4 (SPARTON)
224	XBT	XBT-5 (SPARTON)
225	XBT	XBT-5DB (SPARTON)
226	XBT	XBT-6 (SPARTON)
227	XBT	XBT-7 (SPARTON)

CODE	INSTRUMENT	DESCRIPTION
228	XBT	XBT-7DB (SPARTON)
229	XBT	XBT-10 (SPARTON)
230	XBT	XBT-20 (SPARTON)
231	XBT	XBT-20DB (SPARTON)
232	XBT	DEEP BLUE (TSK - TSURUMI SEIKI Co.)
233	XBT	AXBT (TSK - TSURUMI SEIKI Co.)
234	XBT	AXBT (Unknown Brand and Type)
235	XBT	DEEP BLUE, Unknown Brand
236	XBT	FAST DEEP, Unknown Brand
237	XBT	Submarine-launched Expendable Bathythermograph (SSXBT) (SIPPICAN)
238	XBT	AXBT 536 (SPARTON)
301	DBT	BRANCKER RBR XL-200 mBT (Micro BT)
302	DBT	SBE 39 Temperature (& Pressure) Recorder (Sea-Bird Electronics Inc.)
401	CTD	SBE 9 (Deep ocean precision CTD Sea-Bird Electronics Inc.)
402	CTD	ISTOK-4 (Russia)
403	CTD	EG&G MARK III (EG&G Ocean products)
404	CTD	NEIL BROWN MARK IIIB
405	CTD	SEACAT Type Unknown (Sea-Bird Electronics Inc.)
406	CTD	GUILDLINE Model Unknown
407	CTD	(MHI, Academy of Science, Ukraine)
408	CTD	(Institute Oceanography; Academy of Science, Russia)
409	CTD	KROSSBIM STD ROSETTES
410	CTD	Sea-Bird Electronics Model Unknown
411	CTD	SBE 911plus (Sea-Bird Electronics Inc.)
412	CTD	BISSETT-BERMAN Model Unknown
413	CTD	JASUS (by M. Du Chaffaut and T. Labadie)
414	CTD	PLESSEY 9040
415	CTD	PLESSEY 9400
416	CTD	PLESSEY 9041
417	CTD	PLESSEY 9060
418	CTD	NEIL BROWN MARK III
419	CTD	HYDRO PRODUCTS 612/912S
420	CTD	NEIL BROWN SMART CTD
421	CTD	PLESSEY Model Unknown
422	CTD	PLESSEY/GRUNDY Model Unknown (Notice: Grundy is new Plessey name)
423	CTD	NEIL BROWN DRCM
424	CTD	SBE 102 (Sea-Bird Electronics Inc.)
425	CTD	SBE 911 (Sea-Bird Electronics Inc.)
426	CTD	OCEAN CASSETTE
427	CTD	NEIL BROWN Model Unknown

CODE	INSTRUMENT	DESCRIPTION
428	CTD	BECKMAN RS5-3
429	CTD	SBE 19 SEACAT profiler (Sea-Bird Electronics Inc.)
430	CTD	GUILDLINE 8700 (aka MARK II)
431	CTD	GUILDLINE 8701 (analog CTD)
432	CTD	GUILDLINE 8701 MODIFIED
433	CTD	GUILDLINE 8705
434	CTD	GUILDLINE 8706
435	CTD	GUILDLINE 8709 (portable)
436	CTD	GUILDLINE 8755
437	CTD	GUILDLINE 8770 (portable)
438	CTD	GUILDLINE 8737 "WOCE" (WOCE-specifications)
439	CTD	FSI CTD (Falmouth Scientific Inc.)
440	CTD	BISSETT-BERMAN 9006
441	CTD	BISSETT-BERMAN 9040-2A
442	CTD	ZOND-BATHOMETER
443	CTD	OCEAN SENSORS OS200
444	CTD	CHELSEA INSTRUMENTS, Model Unknown
445	CTD	HYDROZOND
446	CTD	SBE 25 SEALOGGER (Sea-Bird Electronics Inc.)
447	CTD	NEIL BROWN MARK IV
448	CTD	NEIL BROWN MARK II
449	CTD	HYDROPOLYTESTER/NEPHELOMETER ZULLIG
450	CTD	MEERESTECHNIK OTS-1200
451	CTD	SBE 9s (Sea-Bird Electronics Inc.)
452	CTD	MODIFIED NEIL BROWN PACODF CTD-O2
453	CTD	NEIL BROWN MARK V
454	CTD	CHELSEA INSTRUMENTS AQUALINK
455	CTD	OCEAN DATA EQUIPMENT (ODE) 302 CSTD
456	CTD	SBE 41CP (Sea-Bird CTD Module for ALACE)
457	CTD	FSI CTPS-202-D (Falmouth Scientific, Inc.)
458	CTD	AIST (Russia)
459	CTD	FSI ICTD Profiler (Falmouth Scientific Inc.)
460	CTD	OM-87 (Institut fuer Meereskunde Warnemuende Germany)
461	CTD	NEIL BROWN/GENERAL OCEANICS MARK IIIC
462	CTD	TSK-original CTD sensor (TSK - TSURUMI SEIKI Co.)
463	CTD	SBE 16 SEACAT C-T Recorder (Sea-Bird Electronics Inc.)
464	CTD	SBE 37-IM MicroCAT (Sea-Bird Electronics Inc.)
465	CTD	Fluorometer: Turner; model unknown
466	CTD	Fluorometer: Instrument manufacturer and model unknown
467	CTD	Fluorometer: Aiken (1981)

CODE	INSTRUMENT	DESCRIPTION
468	CTD	Transmissometer: SeaTech 25-cm pathlength 660 nm wavelength
469	CTD	Transmissometer: Instrument manufacturer and model unknown
470	CTD	SBE 19plus SEACAT profiler (Sea-Bird Electronics, Inc.)
471	CTD	MEERESTECHNIK ELEKTRONIK
472	CTD	Transmissometer: Chelsea Alpha tracka Mk II 25-cm pathlength 660-nm wavelength
473	CTD	CTD 90M - Multiparameter Memory Probe (Sea & Sun Technology GmbH/LTD)
474	CTD	Transmissometer: C-Star 25-cm pathlength 660 nm wavelength (Beam Cp, WET Labs, USA)
475	CTD	ISTOK-3 (MHI, Ukraine
476	CTD	ISTOK-5 (MHI, Ukraine)
477	CTD	ISTOK-7 (MHI, Ukraine)
478	CTD	KATRAN-4S (Shirshov IO, Russia)
479	CTD	OCEAN-2 (Shirshov IO, Russia)
480	CTD	OCEAN-3 (Shirshov IO, Russia)
481	CTD	OLT profiler (MHI, Ukraine)
482	CTD	ShIK-01 (MHI, Ukraine)
483	CTD	ShIK-02 (MHI, Ukraine)
484	CTD	GUILDLINE MARK IV
501	STD	PLESSEY 9006
502	STD	PLESSEY 8400
503	STD	PLESSEY 9040
504	STD	PLESSEY 9041
505	STD	ED 9071
506	STD	APMCRO 12
507	STD	Hydrolab *in-situ* salinometer (circa 1960's)
508	STD	AML STD-12 (aka AML CTD-12)
509	STD	BISSETT-BERMAN 9040
510	STD	SALINOMETER GM 65
511	STD	HYTECH MODEL 9006
512	STD	APPLIED MICROSYSTEMS 12 PLUS
513	STD	Submarine Oceanographic Digital Data System (U.S. NAVY)
514	STD	InterOcean Systems, Inc. Model 513-10 CSTD
515	STD	9040 STD (Unknown Brand)
516	STD	9040 STD-SV (Unknown Brand)
517	STD	9060 STD (Unknown Brand)
518	STD	InterOcean Systems, Inc. T-S Bridge
601	XCTD	STANDARD (SIPPICAN)
602	XCTD	DEEP (SIPPICAN)
603	XCTD	AXCTD (SIPPICAN)
604	XCTD	SSXCTD (SIPPICAN)

CODE	INSTRUMENT	DESCRIPTION
605	XCTD	Unknown (SIPPICAN)
606	XCTD	XCTD (TSK - TSURUMI SEIKI Co. 1000 meter max)
607	XCTD	AXCTD (TSK - TSURUMI SEIKI Co.)
608	XCTD	XCTD-2 (TSK - TSURUMI SEIKI Co.)
609	XCTD	XCTD-2F (TSK - TSURUMI SEIKI Co.)
610	XCTD	XCTD-1 (TSK - TSURUMI SEIKI Co.)
701	Bottle	BATHOMETER (Russia)
702	Bottle	TRACE METAL FREE BOTTLE
703	Bottle	Open Bucket
704		THERMISTER CHAIN
705	Bottle	WHOI-developed SEA SAMPLER (circa 1950 MBT ON BOTTLE ROSETTE)
706	Bottle	VAN DORN
707	Bottle	Salinometer brand/model unknown (generic)
708	Bottle	Guildline Autosal (model unknown)
709	Bottle	Guildline model 8400 Autosal
710	Bottle	Guildline model 8400A Autosal
711	Bottle	Guildline model 8400B Autosal
712	Bottle	Guildline model 8410 Portasal
713	Bottle	Guildline model 8410A Portasal
714	Bottle	Salinometer Kahlsico R-10
715	Bottle	Salinometer AGE Minisal 2100
716	Bottle	GERARD-EWING SAMPLER
717	Bottle	Autolab Inductive Salinometer
718	Bottle	Nansen water sampler, unknown brand and model
719	In-Situ	Automated dissolved oxygen sensor: brand and model unknown
720	In-Situ	Automated dissolved oxygen sensor: Beckman polarographic; model unknown
721	In-Situ	Automated dissolved oxygen sensor: SBE 43 dissolved oxygen sensor Clark polarographic membrane
722	Bottle	Continuous Flow Autoanalyzer (CFA): Instrument manufacturer and model unknown
723	Bottle	Continuous Flow Autoanalyzer (CFA): Technicon; model unknown
724	Bottle	Autoanalyzer: Sumigraph analyzer; model unknown
725	Bottle	Continuous Flow Autoanalyzer (CFA): Alpkem; model unknown
726	Bottle	Continuous Flow Autoanalyzer (CFA): Skalar; model unknown
727	Bottle	Autoanalyzer: CEC Elemental Analyzer [BATS: gf/f (0.7 µm)]
728	Bottle	Autoanalyzer: Perkin Elmer Model 240B Elemental Analyzer [CEAREX: gf/f]
729	Bottle	Autoanalyzer: Yanagimoto CHN Analyzer [KH754: Type C gf/f]
730	Bottle	Autoanalyzer: Perkin Elmer Model 2400 Elemental Analyzer [FRONTS]
731	Bottle	Continuous Flow Autoanalyzer (CFA): Technicon AAII
732	Bottle	Continuous Flow Autoanalyzer (CFA): ChemLab AAII
733	Bottle	Continuous Flow Autoanalyzer (CFA): Bran+Luebbe trAAcs; model unknown

CODE	INSTRUMENT	DESCRIPTION
734	Bottle	HPLC: High Performance Liquid Chromatography; model unknown
735	Bottle	Automated titration: type unknown
736	Bottle	Methrohm Dosimat 665 automatic buret
737	Bottle	Radiometer reference pH meter PHM-93; PHC-2085
738	Bottle	Hirama Riken laboratory photometric titrater (ART-3 D0-1)
739	Bottle	Klehn 50100 auto-titrator (Friederich *et al*; 1991)
740	Bottle	Continuous Flow Autoanalyzer (CFA): Bran+Luebbe trAAcs 800
741	Bottle	Continuous Flow Autoanalyzer (CFA): Chemlab
745	Bottle	Continuous Flow Autoanalyzer (CFA): Bran+Luebbe III
750	Bottle	Fluorometer, TD-700
755	Bottle	Autoanalyzer: Perkin+Elmer PE2400 CHNS elemental analyzer
760	Bottle	Sub-surface continuous water pump sampler, brand and model unknown
765	Bottle	Beckman pH meter Model G
766	Bottle	pH meter manufactured by the Chesapeake Bay Institute, John Hopkins University (model unknown)
767	Bottle	Horiba pH meter - Automatic Temperature Compensation (model unknown)
768	Bottle	Induction conductivity and temperature instrument (Schiemer and Pritchard, 1961)
769	Bottle	Utopia Instruments Corp. (UIC) model 5011 Coulometer
770	Bottle	Skalar Sanplus Autoanalyzer (CFA)
771	Bottle	Radiometer automatic titrator TTT80 & dual platinum electrode
772	Bottle	Fluorometer, Turner Designs, model unknown
773	Bottle	Fluorometer, Turner Designs, model 10-005 R
774	Bottle	Fluorometer, Turner Designs, model 10-AU-005-CE
775	Bottle	Hale apparatus with thermometer (Prestwich, 1875)
776	Bottle	Ionometer electrolyte analyzer (Brand: Unknown; Model: EV 74)
777	Bottle	AKEA autoanalyzer
778	Bottle	Dissolved organic carbon (DOC) Shimadzu Total Organic Carbon Analyzer
7013	Bottle	Beckman DU II spectrophotometer
7014	Bottle	Spectronic 20 spectrophotometer
7016	Bottle	Beckman pH meter model G-2 or GS
7017	Bottle	Beckman pH meter model unknown
7018	Bottle	Klett-Summerson photo-electric colorimeter (Garver, 1951)
7019	Bottle	Photo-electric colorimeter (Brand: Unknown; Model FEK 60)
7020	Bottle	Gas chromatograph (GC) with electron capture detector (ECD), model unknown
7050	Bottle	Kahlisco induction salinometer, model unknown
7060	Bottle	Generic glass reversing thermometers (protected/unprotected)
801	Underway	MK3 data recording tag (Wildlife Computers) mounted on elephant seal
802	Underway	Thermosalinograph unknown brand & model
803	Underway	SEACAT Thermosalinograph SBE 21 (Sea-Bird Electronics Inc.)

3.3. Methods (code 6)

Code table: v_6_methods

CODE	DESCRIPTION
201	Titration (Knudsen 1902)
202	PSAL78
203	UNESCO (Cox *et al.,* 1967)
204	Fofonoff *et al.*, 1974
205	Perkin and Walker, 1972
206	Bennett , 1976
207	Ribe and Howe, 1975
208	Federov, 1971
209	Other salinity methods
300	Winkler method (unknown)
301	Winkler automated oxygen titration; whole bottle method (Carpenter, 1965)
302	Winkler method (Radiometer automated titrator)
303	Winkler automated oxygen titration: amperometric end-detection (Culberson, 1991)
304	Winkler automated oxygen titration: photometric end-detection
305	Winkler manual oxygen titration: visual end-point (Strickland and Parsons, 1972)
306	Winkler manual oxygen titration: visual end-point (Carpenter 1965, Anderson, 1971)
307	Winkler automated oxygen titration; whole bottle method & photometric end-detection (Jones 1992; Levy *et al*., 1977)
308	Winkler manual oxygen titration: visual end-point
321	Beckman polarographic oxygen sensor (CTD)
322	Beckman polarographic oxygen sensor (Owens and Millard, 1985)
323	SBE 43 Dissolved Oxygen Sensor; Clark polarographic membrane
340	Chromatography
360	Spectrophotometric (Shibala method)
400	Spectrophotometric
401	Spectrophotometric single solution method (Strickland and Parsons, 19XX)
402	Spectrophotometric stannous chloride reduction
403	Spectrophotometric persulphate oxidation (Menzel and Corwin, 1965)
404	Spectrophotometric perchloric acid digestion)
405	Spectrophotometric reduced beta silico-molybdate (Strickland and Parsons, 1972)
406	Spectrophotometric reduced alpha silico-molybdate (Grasshof, 1964)
407	Cadmium reduction (Morris and Riley 1963; Wood *et al.,* 1967)
408	Strychnidine method (Rochford, 1947)
409	Spectrophotometric phenolhypochlorite method (Solorzano, 1969)
410	Spectrophotometric (Richards and Thompson 1952)
411	Spectrophotometric (SCOR/UNESCO, 1966)
412	Spectrophotometric (Parsons and Strickland, 1963)
413	Spectrophotometric (Jeffrey and Humphery, 1975)
500	Autoanalyzer, model and brand unknown

CODE	DESCRIPTION
501	Technicon Autoanalyzer (Murphy and Riley, 1962)
502	Continuous flow autoanalyzer (CFA) colorimetric
503	Continuous Flow Analyzer (Bendschneider and Robinson, 1952)
504	Continuous Flow Analyzer (CFA) Indophenol blue (Berthelot's reaction)
505	Nitrate+Nitrite - autoanalyzer
506	A Modification of colorimetric determination of silicic acid (Alimarin and Zverev, 1937
507	Continuous flow autoanalyzer (CFA) (Alpkem)
508	Continuous flow autoanalyzer (CFA) (Skalar instrument)
509	Silicic acid concentration in water (Dienert and Wandenbulcke, 1923)
600	Fluoroscence
601	Fluoroscence *in-situ* Turner fluorometer (Strickland and Parsons, 1972)
602	Fluoroscence *in-vivo* underway (Lorenzen, 1966)
603	Fluorometer *in-situ* CTD
604	Fluorometer (Aiken, 1981)
605	Fluorometric chl-a assay acetone extraction
606	Fluorometric chl-a assay methanol extraction
607	Fluorometric chl-a assay acetone extraction; Turner fluorometer (Yentsch and Menzel, 1963; Holm-Hansen *et al*., 1965)
700	HPLC (High Performance Liquid Chromatography)
701	HPLC (normal phase High Performance Liquid Chromatography)
702	HPLC (reverse phase High Performance Liquid Chromatography
800	14C *in-situ* incubation
801	Carbon-14 (14C) simulated *in-situ* or deck incubation
802	Carbon-14 (14C) artificial light incubation
803	Sorokin's method
804	artificial light incubation (Hawaii method)
805	artificial light incubation (Australian method)
806	*in-situ* light incubation (Hawaii method)
807	*in-situ* light incubation (Australian method)
808	Carbon-14 (14C) simulated *in-situ* or deck incubation (Steeman Nielsen 1952; Doty and Oguri, 1958)
860	Van Dorn (Japanese)
901	Modified Gran titration (Brewer *et al*., 1986)
910	Ruppin's method (Zubov, 1937)
920	Coulometric (Johnson *et al.,* 1985)
921	Coulometric (HOTS) Single operator multi-param metabolic analyzer (SOMMA)
922	Coulometric; Single Operator Multi-Metabolic Analyzer (SOMMA) [Johnson *et al.,* 1993; 1998]
923	Coulometric (Johnson *et al.,* 1993b)
924	Potentiometric titration (Mintrop *et al.,* 2000)
942	Spectroscopic pH (25 degrees Celcius) and coulometric TCO2 using the carbonic acid dissociation constants of Mehrbach *et al*., 1973 as refit after Dickson and Millero,1987
1000	C/N analyzer - GF/F filter

CODE	DESCRIPTION
1001	BATS GF/F (0.7 um) CEC Elemental Analyzer
1002	BOFS 200pm pre-filter then GF/F Europa Roboprep Analyzera
1003	CEAREX: GF/F; Perkin Elmer Model 240B Elemental Analyzer
1004	KH754: Type C GF/F; Yanagimoto CHN Analyzer
1050	Spectrophotometric wet oxidation with dichromate (Strickland and Parsons, 1972)
1100	High Temperature Catalytic Oxidation (HTCO) (Sugimura and Suzuki, 19XX)
1101	Ultraviolet (UV) oxidation
1102	Wet oxidation (*i.e.* persulphate)
1103	High Temperature Catalytic Oxidation (HTCO) ionics catalytic oxidation with IR CO2 detection
1104	High Temperature Catalytic Oxidation (HTCO) Shimadzu catalytic oxidation with IR CO2 detection
1200	Gas chromatography
1201	Gas chromatography (Weiss, 1981)
1202	Gas chromatography xCO2 at analysis temperature
1203	Gas chromatography (Bulsiewicz *et al.,* 1998)
1205	Gas chromatography pCO2 at analysis temperature
1231	Infrared spectrometry
1233	Infrared spectrometry pCO2
1261	Nondispersive Infrared spectrometry (NDIR)
1262	Nondispersive Infrared spectrometry (NDIR) xCO2 at analysis temperature
1300	pH meter (potentiometric)
1340	Coulometric
1343	Coulometric (manual operation)
1344	Coulometric; automated operation; single-operator multiparameter metabolic analyzer (SOMMA)
1450	pH; spectrophotometry
1460	pH value determined manually using a pH color chart (Buch, 1937)
1461	pH scale SWS25
1462	pH scale NBS25
1463	pH determined spectrophotometrically using the indicator m-cresol purple following Tupas *et al.*, 1993 [Hawaii Time Series]
1464	Total (titration) alkalinity determined using the modified Gran titration method as described in Tupas *et al*., 1997 [Hawaii Time Series]
4001	Freon gas extraction (Bullister and Weiss, 1988)
4054	Winkler automated oxygen titration: whole-bottle method; photometric end-detection (Culberson, 1991)
4056	Winkler automated oxygen titration: amperometric end-detection (Knapp *et al*., 1989)
4057	Winkler automated oxygen titration: amperometric end-detection
4058	Winkler automated oxygen titration: potentiometric and photometric end-detection (Culberson, 1991; Culberson *et al*., 1991; Dickson, 1994)
4059	Winkler automated oxygen titration: whole-bottle method; photometric end-detection (Culberson 1992; Carpenter 1969; Friederich *et al*., 1991)
4061	Winkler automated oxygen titration: whole-bottle method; amperometric end-detection (Culberson and Huang, 1987)
4062	Gran-linearized potentiometric Winkler titration (Anderson *et al.,* 1992)

CODE	DESCRIPTION
4063	Continuous Flow Analyzer (CFA) (Gordon *et al*., 1993)
4064	Modified gran approach (Dickson *et al.,* 2003)
4065	Alkalinity method of Perez and Fraga, 1987)
4100	Winkler automated oxygen titration; Williams and Jenkinson 1982; Friederich *et al*., 1991
4101	Winkler automated oxygen titration; whole bottle method; end-detection
4102	Winkler automated oxygen titration: Rosenberg *et al.,* 1995
4103	Continuous Flow Analyzer (CFA); Technicon Autoanalyzer model unknwon (Armstrong *et al*., 1967)
4104	Continuous Flow Analyzer (CFA); Technicon Autoanalyzer (Bernhardt and Wilhelms, 1967)
4105	Continuous Flow Analyzer (CFA); Technicon Autoanalyzer model unknown (Friedrich and Whitledge,1972)
4106	Continuous Flow Analyzer (CFA); Murphy and Riley, 1962)
4107	Continuous Flow Analyzer (CFA); Raimbault *et al.*,1990
4108	Continuous Flow Analyzer (CFA); Fanning and Pilson, 1973
4109	Fluoroscence in vivo underway (Kerouel and Aminot, 1997)
4110	Dissolved inorganic nutrients (Armstrong, 1967)
4111	Dissolved inorganic nutrients (Grasshoff 1965,1984)
4112	Dissolved inorganic nutrients (Strickland and Parsons, 1968)
4113	Winkler manual oxygen titration: visual end-point (Strickland and Parsons, 1968)
4114	Winkler manual oxygen titration: visual end-point, whole bottle method (Carpenter, 1965)
4115	Manual volumetric titration
4116	Spectrophometric following method of Robinson and Thompson (1948)
4117	Continuous Flow Analyzer (CFA); Kirkwood, 1995
4118	Salinity computed from Chlorinity data (Tcyrikova and Shylgina, 1964)
4119	Dissolved inorganic nutrients (Whitledge *et al.,* 1981)
4120	Salinity computed from Chlorinity data calculated from conductivity (Schiemer and Pritchard, 1961)

3.4. Originator's Units (code 8)

Code table: v_8_orig_units

CODE	DESCRIPTION
7	μg-at·l^{-1} (NB: μg-at·l^{-1} = mmol·m^{-3} = μmol·l^{-1} = μM = μmol·dm^{-3})
9	m·s^{-1}
11	percent
16	mg·m^{-3}
23	mgC·m^{-3}·incubation t^{-1}
24	mgC·m^{-2}·incubation t^{-1}
29	μmol·kg^{-1}
32	mg·l^{-1} (NB: mg·l^{-1} = ppm = μg·g^{-1} = μg·ml^{-1} = μl·l^{-1} = g·m^{-3})
33	μg·kg^{-1}
34	μeq·kg^{-1} (NB: use μmol·kg^{-1} for alkalinity ONLY)
36	μg·l^{-1} (NB: μg·l^{-1} = mg·m^{-3} = ppb = g·0.001·m^{-3}
37	mg-at·l^{-1}
39	ng·l^{-1} (NB: ng·l^{-1} = μg·m^{-3})
40	mgC·m^{-3}·hr^{-1}
42	mgC·m^{-3}·day^{-1} (NB: mgC·m^{-3}·day^{-1} = μgC·l^{-1}·day^{-1})
48	μ-atm
49	gC·m^{-2}·day^{-1}
50	gC·m^{-2}·hr^{-1}
51	μeq·l^{-1} (NB: use μmol·l^{-1} for alkalinity ONLY)
54	meq·kg^{-1}
56	mgC·m^{-2}·day^{-1}
57	mgC·m^{-2}·hr^{-1}
58	mg-at·kg^{-1}
59	mg·kg^{-1}
61	mmol·kg^{-1}
62	mmol·l^{-1}
66	ng·kg^{-1}
64	molesC·m^{-2}·day^{-1}
65	molesC·m^{-2}·hr^{-1}
68	per sample
69	per m^2
70	per m^3
71	per individual
72	per ml
73	mg/Chl-a·m^{-3}
74	ml·kg^{-1}

CODE	DESCRIPTION
75	μgC·m^{-3}
76	S·m^{-1}
78	per liter
81	parts per million
82	Degrees Fahrenheit
83	Foot
84	per microliter
85	mg·m^{-2}
86	Fathom
87	millimeter
136	μg·l^{-1} (NB: alternate nutrient conversion - use instead of #36)
107	μmol·l^{-1} (NB: alternate oxygen conversion - use instead of #7)
200	Tritium Unit (TU)
210	nanomol per liter (nmol·l^{-1})
211	picomol per liter (pmol·l^{-1})
212	per mille
213	nanomol per kilogram (nmol·kg^{-1})
214	picomol per kilogram (pmol·kg^{-1})
215	μmol·l^{-1} (NB: use only for CFCs)
216	volts (*i.e.*, Flurometer units)
217	Relative unit (*i.e.*, Flurometer units)

3.5. Equilibrator Type (code 10)

Code table: v_10_equilibrator_type

CODE	DESCRIPTION
1600	Showerhead design
1601	Showerhead, large volume >10L
1602	Showerhead, small volume <10L
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

3.6. Filter Type and Size (code 11)

Code table: v_11_filter_type_and_size

CODE	DESCRIPTION
100	Glass-Fiber Filter Fine Mesh (gf/f)
101	Reeve Angel gf/f 984H
102	Whatman gf/f 25
103	Whatman gf/f 47 mm
104	Gelman gf/f 0.45 µ
105	Gelman gf/f 0.8 µ
106	Glass-Fiber Filter Coarse Mesh (gf/c)
107	Whatman gf/f 0.8 to 1.2 µ
200	Millipore
201	HA Millipore 47 mm (pore size = 0.45 µ)
300	Nucleopore
301	Nucleopore >10 micron
302	Nucleopore 2 to 10 micron
303	Nucleopore <2 micron
400	Paper Filter
500	Unspecified Filter-Type
501	>10 micron (unspecified type)
502	2 to 10 micron (unspecified type)
503	<2 micron (unspecified type)
900	Combination Filter-Types
901	Whatman gf/c and HA Millipore

3.7. Incubation Time (code 12)

Code table: v_12_incubation_time

CODE	DESCRIPTION
0 to 24	Incubation time in hours
25	dawn – noon
26	noon – dusk

APPENDIX 4. BIOLOGICAL HEADER CODE TABLES

The prefix ‘b’ in the following tables denotes biological header codes

4.1. Type of Tow (code 4)

Code table: b_4_type_tow

CODE	DESCRIPTION
1	Horizontal Tow
2	Vertical Tow
3	Other Type (Oblique, Double Oblique, *etc.*)
4	Depth Strat (Depth Stratified (*e.g.* Mocness, *etc.*)

4.2. Large Removed (code 6)

Code table: b_6_large_removed

CODE	DESCRIPTION
1	yes
2	no

4.3. Gear and Flowmeter (code 7 and code 18)

Code table: b_7_gear_and_flowmeter_codes

CODE	DESCRIPTION	CODE	DESCRIPTION
101	NORPAC Net	144	BOTTLE: Van Dorn
102	Plankton Net (Muslin)	145	Flowmeter: GOM 2030
103	Plankton Net (Silk)	145	Flowmeter: GOM 2030
104	Marutoku B Net	146	POFI Net
105	Juday Net (Tropical or Large)	147	Micro Net (Unspecified)
106	Juday Net (Oceanic or JOM)	148	Open Net (Unspecified)
107	Ring Net	149	Closing Net (Unspecified)
108	Gulf IA Sampler	150	HIGH Speed Net (Unspecified)
109	Gulf III Sampler	151	Plankton Trap (Unspecified)
110	Gulf II (on-Board CPR)	152	NORPAC Net - Petersen (Closing)
111	Rectangular Midwater Trawl (RMT)	153	NORPAC Net - Improved
112	Plankton Net (Type Unknown)	154	Flowmeter: RGS (Unknown Model)
113	Be= Multiple Plankton Sampler (MPS)	155	Flowmeter: Type and Model Unknown
114	Bathypelagic Plankton Sampler (BPS)	156	6-FT IKMT; Isaacs Kidd Medwater Trawl
115	Indian Ocean Standard Net (IOSN)	157	10-FT IKMT; Isaacs Kidd Midwater Trawl
116	Clarke-Bumpus Sampler	158	Flowmeter: Atlas
117	Neuston Net	159	TUBE HAI: 200ms
118	Bongo Net	160	Continuous Plankton Sampler (Type Unspecified)
119	Water Pump	161	Double Net (Inner)
120	MOCNESS Net	162	Double Net (Outer)
121	BR 80/113 Net	163	Jeddi Net (Typo of Juday Net)
122	Continuous Plankton Recorder (Longhurst-Hardy)	164	IMKT+EMPS (IKMT with Electric Multi-Layer Plankton Samplers)
123	Isaacs-Kidd Midwater Trawl (IKMT), Depressor Dimension Unspecified	165	VMPS
124	Midwater Trawl	166	Tucker Trawl 3-Net Opening/Closing
125	ORI Net	167	Manta Net (Neuston Sampler)
126	Kitahara Net	168	Double Bongo (Combined as one Sample)
127	BOTTLE: (Type Unspecified)	169	Ceppelin
128	BOTTLE: Niskin	170	Cory Net
129	Marutoku Net (Type Unspecified)	171	Plankton Net (Gas)
130	BOTTLE: (Go-FLOS)	172	Flowmeter: Rgs-236
131	CALCOFI Net	172	Flowmeter: Rgs-236
132	WP-2 (UNESCO Working Party 2)	173	Flowmeter: Rgs-633
133	Nansen Surface Net	174	NIO (National Institute of OCG) NET
134	Heron Tranter Net	175	Vertical Closing Ringnet
135	N70 Net	176	Tucker Trawl
136	Organdie Net	177	Sameoto Neuston Sampler
137	75M25 Net	178	0.5 X 1 M MARMAP Neuston Net
138	Flowmeter: TSK (Model Unknown)	179	Epibenthic Sled with 2 Tucker Trawls
139	Hensen Egg Net	180	Tucker Trawl (2 Nets)
140	Beam Trawl	181	English Umbrella Net
141	Marushi Net	182	Gulf V Sampler (Modified Gulf III, High Speed)

CODE	DESCRIPTION	CODE	DESCRIPTION
142	Foredeck Net	183	Plummet Net
143	Motoda MTD Net	184	Pull Sled
185	Miller High-Speed Sampler (Model Unspecified)	224	Bongo net + Multinet
186	Apstein Opening-Closing Mesh Net (APNET)	225	Water Pump + Niskin Bottle
187	Longhurst-Hardy Plankton Recorder (LHPR)	226	Flow-meter: RGS-432
188	Autosampling And Recording Instrument Environmental Sampling System (ARIES NET)	227	Plankton Net (Nylon)
189	Special BONGO (Double WP-2 Nets Mounted on Bongo Frame)	228	Flow-meter: General Oceanics 2030
190	Marine Lab Aberdeen Pupnet (PUPNET)	229	Bogorov Net
191	SAHFOS Continuous Plankton Recorder (CPR)	230	Apstein Surface Net
192	Special HYDRO-Bios Multinet: Five Sets of Double HYDRO-Bios Multinets (64 µM Mesh for Taxa/200µM Mesh for Biomass)	231	Juday Plankton Net small (model 963)
193	UTOW (like a SAHFOS CPR, with T,S and Flow Rate also Measured)	232	Nansen Bottle
194	Bucket (On A Rope)	233	Phytoplankton net (mesh 75 micron)
195	Flowmeter: RGS-233	234	Miller Net (mesh 239 micron)
196	Free-Fall Plankton Net	235	1-meter (Diameter) Plankton net
197	Double MOCNESS	236	1x2m Neuston net
198	Flowmeter: General Oceanics Model 2030R	237	CalCOFI standard 1-meter net (1951-1978)
199	HYDRO-Bios Multinet (64 µM Mesh for Taxa/200 µM Mesh for Biomass)	238	CalCOFI standard bongo net (1978-present)
200	BIONESS (10-Net Opening & Closing Net	239	Nansen Closing Plankton Net
201	N70V Vertical Closing Net (Kemp, Hardy & Mackintosh 1929)	240	Scoop Net
202	Kiel MultiNet	241	Nansen Closing Pelagic Net
203	Flow-meter: RGS-952	242	Closing Pelagic Net (name unknown)
204	Nakai Fish Larvae Net	243	Petersen Swimming Trawl
212	Multinet (150 µM mesh)	244	Swimming Trawl (name unknown)
213	Flow-meter: General Oceanics (model unspecified)	245	Hatch Trawl
214	Juday38 Net (569 µM no. 38 mesh)	246	Midwater Plankton Net
215	NANSEN15 NET	247	Helgoland Larva Net
216	K100 (100 cm diameter 3 different no. mesh: 9; 15; 23 or 38)	248	Triple WP-2 net (stepped-deployment)
217	BOGOROV-RASS	249	EQUALANT plankton net
218	NANSEN2 NET (0.5 m diameter; no. 2 mesh upper; no 10 mesh lower)	250	ICITA plankton net
219	HT NET (mouth area 0.25 m2 and mesh width 0.3 mm)	246	Midwater Plankton Net
220	Plankton Net (type unspecified)	247	Helgoland Larva Net
221	Sipre Ice Corer	248	Triple WP-2 net (stepped-deployment)
222	Unspecified Water Pump	249	EQUALANT plankton net
223	Juday Net + Melnikov's trawl + Bottle	250	ICITA plankton net

4.4. Preservation Method (code 10)

Code table: b_10_preservative_method

CODE	DESCRIPTION
1	4-5% formalin, unbuffered
2	4-5% formalin, hexamine buffered
3	4-5% formalin, borax or borate buffered
4	10% formalin, seawater, buffered
5	4-5% formalin,seawater(buffered/unbuffered unspecified)
6	4-5% formalin, no ref. to water-type or buffering
7	4-5% formalin, buffered, (buffer unspecified)
8	10% filtered paraformaldehyde
9	2-10% formalin, seawater, buffered(buffer unspecified)
10	5-10% formalin, seawater, buffered,buffer unspecified)
11	1% formalin, buffered (buffer unspecified)
12	2% formalin, buffered (buffer unspecified)
13	3-5% formalin, seawater, unbuffered
14	5% formalin, seawater, borax buffered
15	4-5% formalin, seawater, sodium bicarbonate
16	liquid nitrogen
17	Lugol's Solution ("acidified Lugol's iodine")
18	formalin, no info on: %,buffering,water type
19	preservative used, no additional information provided
20	10% buffered formalin
21	Formol-hexamine (5% concentraction)
22	20% buffered formalin
23	20% buffered formalin + strontium chloride
24	1%-paraform + deep freeze (frozen in liquid nitrogen at -85°C)
25	1%-glutaraldehyde + deep freeze (frozen in liquid nitrogen at -85°C)
26	3% formalin, seawater, (buffered/unbuffered unspecified)
27	2% formalin, no ref. to water-type or buffering
29	10% formalin, no ref. to water-type or buffering
31	90% Acetone
32	2% Glutaraldehyde
33	N-dimethylfloramide
34	Lugol+Formalin,fixed by Lugol's solution after sample blooming by 40% formaldehyde
35	3-4% buffered Formaldehyde (buffering agent not specified)
37	70% Ethanol
38	95% Ethanol

4.5. Weight Method (code 11)

Code table: b_11_weight_method

CODE	DESCRIPTION	REFERENCE
1	TOTAL CATCH (wet weight of the total catch)	Bogorov, 1951. Trans. Inst. Oce. Acad. Sci. USSR 5:54-62 (Russian)
2	BOFS Mesoplankton Biomass Protocol	BOFS mesomass ash free dry weight protocol
3	ZOOPLANKTON CALCULATED (Individual weight of organisms calculated from body length using tables of Standard Weights)	(Kanaeva 1962; Shmeleva 1963; Kryilov 1968; Gruzov 1970) or nomograms (Chislenko 1968)
4	PHYTOPLANKTON CALCULATED	Biomass of phytoplankton algae were calculated considering cells[1] volumes by equating real or average volumes of cells to corresponding geometric figures 1001, PRIME (“carbon”); No other information available

4.6. Count Method (code 13)

Code table: b_13_count_method

CODE	DESCRIPTION
1	COUNTING CHAMBER; counting chamber method
2	ACID LUGOLS STAIN; stained (acid Lugols) and counted
3	AUTOFLUORESCE;autoflourescing/counted under microscope
4	DAPI; stained/counted using epifluorescence microscopy
5	MUD (or MPN); Method of Ultimate Dilution
6	MICROSCOPE; counted under a microscope
7	COMPLETE ENUMERATION; complete enumeration
8	FOLSOM SPLITTER; complete enumeration using Folsom Spl
9	EPIFLUOR MICROSCOPIC; staining unspecified
10	CENTRIFUGE METHOD; centrifuge method (Gran, 1932)
11	ALIQUOT AND FULL; counted aliquout, then counted FULL
12	COULTER COUNTER; counted with a coulter counter
13	INVERTED MICROSCOPE
14	BACTERIA Epiflour microscopy - Acrodine Orange stained
15	CELL CYTOMETRY
16	BACTERIA Epiflour microscopy - unspecified stained
17	OPTICAL PLANKTON COUNTER (OPC)
18	OPTICAL MICROSCOPY with correction for cell lose during fixation
19	FMIAS; Flourescence microscope image analysis system
20	Monger & Landry cytometry via "Monger & Landry, 1993"
21	Olson & Sosik split beam cytometry (range 1-40 µm)
22	Replicate aliquots were counted and averaged
23	Perez IMECOCAL; Folsom splitter to 1/8-1/16 (~ 800-900 individuals) then stereoscopic microscope
24	SEDIMENTATION AND INVERTED MICROSCOPE
25	RELATIVE ABUNDANCE

4.7. Flowmeter Calibration (code 19)

Code table: b_19_flowmeter_calibration

CODE	DESCRIPTION
1	Cruise Start And End
2	By Manufacturer
3	Single Calibration Tow

4.8. Depth Determination (code 24)

Code table: b_24_depth_determined

CODE	DESCRIPTION
1	OCL CALCULATED (Calculated by OCL from wire out and wire angle)
2	FIXED (One target depth reported by originator for all samples)

4.9. Volume Method (code 25)

Code table: b_25_volume_method

CODE	DESCRIPTION	SOURCE
1	IOSD; IOSD 1991 (stored in 5% formalin solution/ measured several months later after initial shrinkage occured)	IOSD data
2	WICKSTEAD (1965)	Indonesian Data Reports
3	24 hrs/50; Settle 24hrs in 50 ml grad. cylinder	Indonesian Data Reports
4	CENTRIFUGE; Centrifuge and measure all plankton together	IMARPE data

APPENDIX 5. TAXONOMIC DATA

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

5.1. Lifestage (code 5)

Code table: t_5_taxon_lifestage; TSN = taxonomic serial number

CODE	DESCRIPTION	
1	EGG/OVA	code “gametes” below
2	NAUPLIUS/NAUPLII	default TSN = 83677 CRUSTACEA
3	ZOEA	default TSN = 83677 CRUSTACEA
4	MEGALOPA	default TSN = 98276 BRACHYURA
5	VELIGER	default TSN = 69459 GASTROPODA
6	LARVA	
7	JUVENILE	
8	ADULT	
9	LARVA+JUV+ADULTS	equals LARVAL + POST-LARVAL (Codes 6+7+8) equals LARVAL + JUVENILE
10	C5: COPEPODITE V	
11	POSTLARVAE/SUB-ADULT	Codes 7+8
12	CYPHONAUTES larva	default TSN = 155469 BRYOZOA
13	PHYLLOSOMA larva	default TSN = 97646 PALINURIDAE
14	PILIDIUM larva	default TSN = 57411 NEMERTEA (NEMERTINEA)
15	TORNARIA larva	default TSN = 158617 ENTEROPNEUSTA
16	TROCHOPHORE larva	default TSN = -5002 ZOOPLANKTON
17	ARACHNACTIS larva	def 51985 CERIANTHIDAE (also genus 51998)
18	ACTINOTROCHA larva	def 155457 PHORONIDAE
19	EMBRYO	example: sea urchin embryo
20	CYPRIS larva	default TSN = 89433 CIRRIPEDIA (barnacle)
21	BIPINNARIA larva	default TSN = 156862 ASTEROIDEA
22	OPHIOPLUTEUS larva	default TSN = 157325 OPHIUROIDEA
23	ECHINOPLUTEUS larva	default TSN = 157821 ECHINOIDEA
24	hypnospores	refers to “resting stages”, “cysts”, etc.
25	C1: COPEPODITE I	
26	C2: COPEPODITE II	
27	C3: COPEPODITE III	
28	C4: COPEPODITE IV	
29	COPEPODITE	without stage information; sum of various (unspecified) copepodite stages
30	CALYPTOPIS	default TSN = 95496 EUPHAUSIACEA
31	FURCILIA	default TSN = 95496 EUPHAUSIACEA
32	N1: NAUPLIUS I	default TSN = 85257 COPEPODA
33	N2: NAUPLIUS II	default TSN = 85257 COPEPODA
34	N3: NAUPLIUS III	default TSN = 85257 COPEPODA
35	N4: NAUPLIUS IV	default TSN = 85257 COPEPODA
36	N5: NAUPLIUS V	default TSN = 85257 COPEPODA
37	METANAUPLIUS	default TSN = 85257 COPEPODA
38	POLYP	refers to Anthozoa, Scyphozoa, or Hydrozoa
39	MEDUSAE	
40	INDETERMINABLE	
41	GAMETES	

42	ORTHONAUPLIUS	
43	C1-5: COPEPODITE I-V	all stages (1-5) were counted in one group
44	DEAD or non-viable	
45	LIVING or viable	
46	MULLERS LARVA	default TSN = 53964 TURBELLARIA (class)
47	EGGS + LARVAE	codes 1+6
48	N6: NAUPLIUS VI	could be metanauplius
49	PLUTEUS Larva	default TSN = 156857 ECHINODERMATA
50	C3-4: COPEPODITE 3-4	stages (3-4) were counted in one group
51	C5-6: COPEPODITE 5-6	stages (5-6) were counted in one group
52	C6: COPEPODITE VI	
53	N2-3: NAUPLII 2 - 3	
54	N3-4: NAUPLII 3 - 4	
55	N4-5: NAUPLII 4 - 5	
56	N5-6: NAUPLII 5 - 6	
57	C4-5: COPEPODITE 4 - 5	
58	N3-5: NAUPII 3 - 5	
59	C1-2: COPEPODITE 1 - 2	
60	C2-3: COPEPODITE 2 - 3	
61	PUPA	
62	NYMPH	
63	PROTOZOEA	
64	MYSIS	
65	GLAUCOTHOE	
66	POLYGASTRIC PHASE	
67	EUDOXID PHASE	
71	MOLT STAGE 1	(decapods)
72	MOLT STAGE 2	(decapods)
73	MOLT STAGE 3	(decapods)
74	MOLT STAGE 4	(decapods)
75	MOLT STAGE 5	(decapods)
76	MOLT STAGE 6	(decapods)
77	MOLT STAGE 7	(decapods)
78	MOLT STAGE 8	(decapods)
79	MOLT STAGE 9	(decapods)
80	C1-4: COPEPODITE 1 - 4	
81	C1-6: COPEPODITE 1 - 6	
82	N1-6: NAUPLII 1 - 6	
83	ECHINOSPIRA	veliger larva of Lamellaria persicua
84	MASTIGOPUS	“first post-larval stage” of Shrimp (+crabs)
85	EPHYRA	life stage of genus Aurelia
86	C1-3: COPEPODITE 1 - 3	stages (1-3) were counted in one group
87	IMMATURE	developed many but not all adult characteristic, is not sexually mature
89	OOTHECA	firm-walled and distinctive egg sack
90	EXUVIA	remains of an exoskeleton that are left after crustacean have moulted
91	C1-2,4	stages (1-2 + 4) were counted in one group

92	C4-6: COPEPODITE 4 - 6	stages (4 - 6) were counted in one group
93	C3-5: COPEPODITE 3 - 5	stages (3 - 5) were counted in one group
94	OOTHECA + CYSTAE	life stages counted in one group
95	LARVAE 1	Bivalvia larval stage
96	LARVAE 2	Bivalvia larval stage
97	LARVAE 3	Bivalvia larval stage
98	ZOEA I	Decapoda zoeal stage
99	ZOEA II	Decapoda zoeal stage
100	AURICULARIA	Larval form of ECHINODERMATA
101	OPHIOPLUTEUS 1	Larval form of ECHINODERMATA
102	OPHIOPLUTEUS 2	Larval form of ECHINODERMATA
103	OPHIOPLUTEUS 3	Larval form of ECHINODERMATA
104	JUVENILE + COP 1	life stages counted in one group
105	JUVENILE + COP 2	life stages counted in one group
106	JUVENILE + COP 3	life stages counted in one group
107	MITRARIA larva	Polychaeta (Owenia) larva

5.2. Gender (code 6)

Code table: t_6_taxon_sex_code

CODE	DESCRIPTION
1	Male
2	Female
3	Hermaphrodite
4	Transitional
5	Grouped, Both Sexes Present
6	Hermaphroditic, Functional Female
7	Hermaphroditic, Functional Male
8	Indeterminable
9	Sexual Generation
10	Asexual Generation

5.3. Presence/abundance (code 7)

Code table: t_7_taxon_presence_abundance_codes

CODE	DESCRIPTION	EQUIVALENTS
1	PRESENT	(Present; +; some; also used for body parts, *e.g.,* spicules)
2	ABSENT	(Absent; not found; -; not observed)
3	COMMON	(C; ++; many)
4	ABUNDANT	(CC)
5	VERY ABUNDANT	(CCC; +++)
6	PREDOMINANT	(CCCC)
7	RARE	(R; LITTLE)
8	VERY RARE	(VR; RR)
9	HIGHLY RARE	(RRR)
10	EXTREMELY RARE	(RRRR)
11	RED TIDE	(bloom)
12	EXCLUSIVELY	
13	X	from JGOFS ANT X/6 (exact translation unknown)
14	XX	from JGOFS ANT X/6
15	XXX	from JGOFS ANT X/6
16	O	from JGOFS ANT X/6
17	OO	from JGOFS ANT X/6
18	OOO	from JGOFS ANT X/6
19	FEW	
20	SEVERAL	
21	A LOT	
22	AVERAGE	
31	WDC1	Present in aliquot
32	WDC2	Present in sample but not in aliquot
33	WDC3	Searched for but not found in sample

5.4. Trophic Mode (code 8)

Code tabe: t_8_taxon_trophic_mode

CODE	DESCRIPTION	
1	AUTOTROPH (unspecified)	also "holophytic"
2	AUTOTROPH-CHEMO	
3	AUTOTROPH-PHOTO	
4	HETEROTROPH (unspecified)	also "holozoic"
5	HETEROTROPH-PARASITIC	
6	HETEROTROPH-SAPROPHYTIC	obtains food by absorbing dissolved organics (decay)
7	PLASTIDIC	has plastids
8	NON-PLASTIDIC	does not have plastids
9	OLIGOTROPH	

5.5. Realm (code 9)

Code table: t_9_taxon_realm

CODE	DESCRIPTION	
1	BENTHIC	
2	EPIBIONT	EPIZOIC, EPIPHYTIC, ...
3	ENDOBIONT	Intestinal, ENDOZOIC, ...
4	MEROPLANKTONIC	Adults are benthic or nektonic
5	BATHYPELAGIC	

5.6. Features (code 16)

Code table: t_16_taxon_features

CODE	DESCRIPTION	
1	SPHERICAL/COCCOID	ball-shaped; 1-dimension; radius
2	ELLIPSOID	ellipsoid; 2-dimensions; long = length, short = radius
3	BACILLUS/ROD-SHAPED	long circular-column: 2-dimensions; long = length, short = radius
4	LENS-LIKE	lentil-shaped: 2-dimensions; long = radius, short = length (thickness)
5	SPINDLE-LIKE	needle-shaped; 2-3 dimensions; long = length, remaining = radius/width
6	TRUNCATED-CONICAL	trunc-cone; 2 dimensions; usually long = length, short = radius
7	ARMORED/THECATE	armoured, e.g., dinoflagellates
8	UNARMORED/ATHECATE	unarmoured, e.g., naked dinoflagellates
9	HOLOCOCCOLITH-IC	coccoliths made of same size/shape crystals
10	HETEROCOCCOLITH-IC	coccoliths made of different size/shape crystals
11	FILAMENT	algal filaments (rather than individual cells) the unit used
12	PAIRED SPHERE/COCCOID	paired ball-shaped; 1-dimension; radius
13	SINGLE CHLOROPLAST	Has only one chloroplast, versus multiple
14	ARMOURED/ARMORED	Has armor
15	UNARMOURED/UNARMORED	Without armor
16	DOUBLE CONE	
17	EUKARYOTE	Has nucleus
18	PROKARYOTE	Do not has nucleus
19	LORICATE	Has lorica
20	NON-LORICATE	Having no lorica
21	COCCOID RODS	
22	CURVED RODS	
23	VIBRIO-LIKE	
24	GOLD AUTOFLUORESCING	
25	GREEN AUTOFLUORESCING	
26	RED AUTOFLUORESCING	
27	GOLD AUTOFLUORESCING + ROD-SHAPED	double-feature properties
28	COLONY	As in a radiolarian colony

5.7. Modifier (code 17)

Code table: t_17_taxon_modifier

CODE	DESCRIPTION
1	sp. (single species)
2	spp. (multiple species)
3	other / unidentified / residue
4	sp. 1
5	sp. 2
6	sp. A or sp. 3
7	sp. B or sp. 4
8	sp. C or sp. 5
9	sp. D or sp. 6
10	sp. E or sp. 7
11	sp. F or sp. 8
12	sp. G or sp. 9
13	sp. H or sp. 10
15	TOTAL (indicated taxa group is a sum of all members)
16	SAHFOS-CPR "traverse count" TOTAL
17	SAHFOS-CPR "eye count" TOTAL
18	Empty Diatom (shell)
19	sp. I or sp. 11
20	sp. J or sp. 12
21	sp. K or sp. 13
22	sp. L or sp. 14
23	sp. M or sp. 15
24	sp. N or sp. 16
25	sp. O or sp. 17
26	sp. P or sp. 18
27	sp. Q or sp. 19
28	sp. R or sp. 20
29	sp. S or sp. 21
30	sp. T or sp. 22
31	Spicules
32	Casts
33	retained non-targetted

5.8. Size (codes 18 and 19)

Code table: t_18_size_min

CODE	DESCRIPTION
-1	Small
-2	Medium
-3	Large
-4	Very small

Code table: t_19_size_max

CODE	DESCRIPTION
-1	Small
-2	Medium
-3	Large
-4	Very small

Units: if value is <0 use description from this code table, otherwise value presented in mm

5.9. Count Method (code 26)

Code table: t_26_count_method

CODE	COUNT METHOD	
1	COUNTING CHAMBER	counting chamber method
2	ACID LUGOLS STAIN	stained (acid Lugols) and counted
3	AUTOFLUORESCE	autoflourescing/counted under microscope
4	DAPI	stained/counted using epifluorescence microscopy
5	MUD (or MPN)	Method of Ultimate Dilution
6	MICROSCOPE	counted under a microscope
7	COMPLETE ENUMERATION	complete enumeration
8	FOLSOM SPLITTER	complete enumeration using Folsom Splitter
9	EPIFLUOR MICROSCOPIC	staining unspecified using epifluorescence microscopy
10	CENTRIFUGE METHOD	centrifuge method (Gran, 1932)
11	ALIQUOT AND FULL	counted aliquout, then counted FULL sample (for less frequent forms)
12	COULTER COUNTER	counted with a coulter counter
13	INVERTED MICROSCOPE	
14	BACTERIA - AO Epiflour microscopy	Acrodine Orange stained and counted using epifluorescence microscopy
15	CELL CYTOMETRY	
16	BACTERIA Epiflour microscopy	Epiflour microscopy - unspecified stained
17	OPC	Optical Plankton Counter
18	OPTICAL MICROSCOPY	with correction for cell lose during fixation
19	FMIAS	Flourescence microscope image analysis system
20	Monger & Landry cytometry	Cytometry via "Monger & Landry, 1993"
21	Olson & Sosik cytometry	Split beam cytometry (range 1-40 um)
22	Average of Rep Aliquots	Replicate aliquots were counted and averaged
23	Perez IMECOCAL	Folsom splitter to 1/8-1/16 (~ 800-900 individuals) then stereoscopic microscope
24	SEDIMENTATION AND INVERTED MICROSCOPE	
25	RELATIVE ABUNDANCE	

5.10. Commmon Base-Unit Value (code 27)

Code table: t_27_cbv_value

PGC[1]	DESCRIPTION	COMMON UNITS
	Counts	
1000000	Bacterioplankton Counts	$\# \cdot \mu l^{-1}$
2000000	Phytoplankton Counts	$\# \cdot ml^{-1}$
4000000	Zooplankton Counts	$\# \cdot m^{-3}$
5000000	Ichthyoplankton Counts	$\# \cdot m^{-3}$
	Biomass	
-400	All Biomass Types (excluding ichthyoplankton)	$ml \cdot m^{-3}$
-401	Total Displacement Volume	$ml \cdot m^{-3}$
-402	Total Settled Volume	$ml \cdot m^{-3}$
-403	Total Wet Weight	$mg \cdot m^{-3}$
-404	Total Dry Weight	$mg \cdot m^{-3}$
-405	Total Ashfree Dry Weight	$mg \cdot m^{-3}$
-500	All Ichthyoplankton Biomass Types	$mg \cdot m^{-3}$
-501	Ichthyoplankton Total Displacement Volume	$mg \cdot m^{-3}$
-503	Ichthyoplankton Total Wet Weight	$kg \cdot m^{-3}$

[1]PGC – “Plankton Grouping Code”, see Appendix 6

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

Code table: t_28_cbv_calculation_method

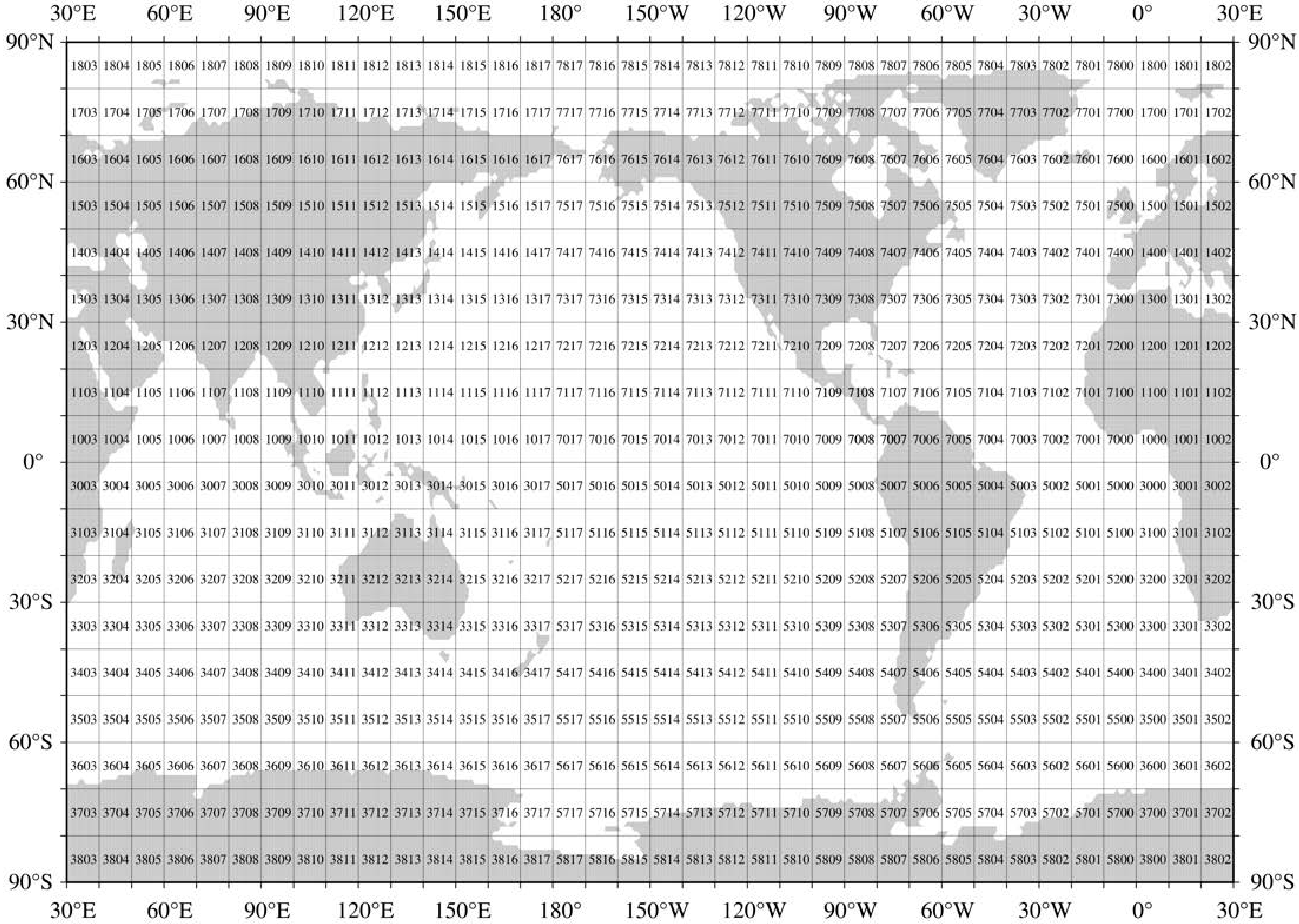
CODE	DESCRIPTION
Original measurement in units *(simple multiplication or division by 1000 or 1000000)*	
70	Original measurement in units of “per m^3"
72	Original measurement in units of “per ml"
78	Original measurement in units of “per liter"
84	Original measurement in units of “per µl"
Original measurement in units of “per m^2" *(must divide by Atowing distance (in meters) to get “per m^3”)*	
69.1	Vertical Tow: use (lower depth - upper depth) for “towing distance”
69.2	Horizontal Tow: use (tow distance) for “towing distance”
69.3	Horizontal Tow: use (tow speed * tow time) for “towing distance”
69.6	Other Tow: use (tow distance) for “towing distance”
69.7	Other Tow: use (tow speed * tow time) for “towing distance”
69.8	Other Tow: use (lower depth - upper depth) as “towing distance” * used only with careful consideration
-69	**Insufficient metadata available to convert “per haul” to “per m^3”**
Original measurement in units of “per haul”, “per sample”, or “per tow” *(must divide by “volume filtered (in m^3) to get “per m^3”)*	
68.1	Volume filtered used for “volume filtered”
68.2	Horizontal Tow: use (tow distance * mouth area) for “volume filtered”
68.3	Horizontal Tow: use (tow speed * tow time * mouth area) for “volume filtered”
68.4	Vertical Tow: use ((lower depth - upper depth) * mouth area) for “volume filtered”
68.5	Other Tow: use (tow distance * mouth area) for “volume filtered”
68.6	Other Tow: use (tow speed * tow time * mouth area) for “volume filtered”
68.7	Other Tow: use ((lower depth - upper depth) * mouth area) for “volume filtered” * used only with careful consideration
-68	**Insufficient metadata available to convert “per haul” to “per m^3”**

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 *WOD13/DATA/NPAC/OSDO7617.gz* CAST 67064

```
C41303567064US5112031934 8 744210374426193562-17227140 61101012010130111822205814
011182202916011182202919010224721 8STOCS85A3 41032151032165-500632175-50023218273
18117709500110134401427143303931722076210220602291107291110329977020133023846181
24421800132207614110217330103192220521322011216442103723077095001101818115508527
20012110000133312500021011060022022068002272214830228442684000230770421200000191
15507911800121100001333125000151105002103302270022022068002274411816302284426840
00230770426500000191155069459001211000013331250001511050021033011300220220680022
73319043022844268400023077042620000019116601596680012110000133312500021022016002
17110100220220680022733112830228442684000230770435700000181155088803001211000013
33125000210220160022022068002273311283022844268400023077042120000019115508880300
12110000133312500015110200210330535002202206800227441428030228442684000230770421
20000019115508880300121100001333125000152204300210220320022022068002273312563022
84426840002307704212000001911550853710012110000133312500015110200210220160022022
06800227331128302284426840002307704212000001100003328960044230900033267500222650
03312050033281000220100033289500442309000332670002227100331123003328100022025002
22900044231910033286200222900033115400332810002205000342-123004423241003327280003
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. 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. 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).

9.1. Temperature
Standard unit or scale: °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	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	-3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	32.00	-3.00	35.00	-3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00
10	-3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	32.00	-3.00	35.00	-3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00
20	-3.00	32.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	32.00	-3.00	35.00	-3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00
30	-3.00	32.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	32.00	-3.00	35.00	-3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00
50	-3.00	32.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	32.00	-3.00	35.00	-3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00
75	-2.00	30.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	32.00	-3.00	35.00	-3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00
100	-2.00	30.00	-3.00	30.00	5.00	30.00	5.00	30.00	0.00	32.00	-3.00	30.00	-3.00	30.00	-3.00	30.00	5.00	30.00	5.00	30.00
125	-2.00	28.00	-3.00	30.00	5.00	30.00	5.00	30.00	-1.50	30.00	-3.00	30.00	-3.00	30.00	-3.00	30.00	3.00	30.00	3.00	30.00
150	-2.00	28.00	-3.00	30.00	5.00	30.00	5.00	30.00	-1.50	30.00	-3.00	30.00	-3.00	30.00	-3.00	30.00	3.00	30.00	3.00	30.00
200	-2.00	28.00	-3.00	30.00	5.00	30.00	5.00	30.00	-1.50	30.00	-3.00	30.00	-3.00	30.00	-3.00	30.00	3.00	30.00	3.00	30.00
250	-1.70	28.00	-3.00	28.00	5.00	28.00	0.00	28.00	-1.50	28.00	-3.00	28.00	-3.00	28.00	-3.00	28.00	3.00	28.00	3.00	28.00
300	-1.70	28.00	-3.00	28.00	3.00	28.00	0.00	28.00	-1.50	28.00	-3.00	28.00	-3.00	28.00	-3.00	28.00	3.00	28.00	3.00	28.00
400	-1.50	20.00	-3.00	28.00	3.00	28.00	0.00	28.00	-1.50	28.00	-3.00	28.00	-3.00	28.00	-3.00	28.00	3.00	28.00	3.00	28.00
500	-1.50	20.00	-3.00	28.00	3.00	28.00	0.00	28.00	-1.50	28.00	-3.00	28.00	-3.00	28.00	-3.00	28.00	0.00	28.00	0.00	28.00
600	-1.50	20.00	-3.00	20.00	3.00	20.00	0.00	20.00	-1.50	20.00	-3.00	20.00	-3.00	20.00	-3.00	20.00	0.00	20.00	0.00	20.00
700	-1.50	20.00	-3.00	20.00	3.00	20.00	0.00	20.00	-1.50	20.00	-3.00	20.00	-3.00	20.00	-3.00	20.00	0.00	20.00	0.00	20.00
800	-1.50	20.00	-3.00	20.00	-0.50	20.00	0.00	20.00	-1.50	20.00	-3.00	20.00	-3.00	20.00	-3.00	20.00	0.00	20.00	0.00	20.00
900	-1.50	20.00	-3.00	20.00	-0.50	20.00	0.00	20.00	-1.50	20.00	-3.00	20.00	-3.00	20.00	-3.00	20.00	0.00	20.00	0.00	20.00
1000	-1.50	18.00	-3.00	18.00	-0.50	18.00	0.00	18.00	-1.50	18.00	-3.00	18.00	-3.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.00
1100	-1.50	18.00	-3.00	18.00	-0.50	18.00	0.00	18.00	-1.50	18.00	-3.00	18.00	-3.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.00
1200	-1.50	18.00	-3.00	18.00	-0.50	18.00	0.00	18.00	-1.50	18.00	-3.00	18.00	-3.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.00
1300	-1.50	18.00	-3.00	18.00	-0.50	18.00	0.00	18.00	-1.50	18.00	-3.00	18.00	-3.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.00
1400	-1.50	18.00	-3.00	18.00	-0.50	18.00	0.00	18.00	-1.50	18.00	-3.00	18.00	-3.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.00
1500	-1.50	18.00	-3.00	18.00	-0.50	18.00	0.00	18.00	-1.50	18.00	-3.00	18.00	-3.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.00
1750	-1.50	13.00	-3.00	13.00	-0.50	13.00	0.00	13.00	-1.50	13.00	-3.00	13.00	-3.00	13.00	-3.00	13.00	0.00	13.00	0.00	13.00
2000	-1.50	13.00	-3.00	13.00	-0.50	13.00	0.00	13.00	-1.50	13.00	-3.00	13.00	-3.00	13.00	-3.00	13.00	0.00	13.00	0.00	13.00
2500	-1.50	13.00	-3.00	13.00	-0.50	13.00	-1.00	13.00	-1.50	13.00	-3.00	13.00	-3.00	13.00	-3.00	13.00	0.00	13.00	0.00	13.00
3000	-1.50	7.00	-3.00	7.00	-0.50	7.00	-1.00	7.00	-1.50	7.00	-3.00	7.00	-3.00	7.00	-3.00	7.00	0.00	7.00	0.00	7.00
3500	-1.50	7.00	-3.00	7.00	-0.50	7.00	-1.00	7.00	-1.50	7.00	-3.00	7.00	-3.00	7.00	-3.00	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

9.1. Temperature (continued 1)
Standard unit or scale: °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	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	-2.00	32.00	-3.00	35.00	3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	35.00	-3.00	35.00	-3.00	15.00	-3.00	20.00
10	-2.00	32.00	-3.00	35.00	3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	35.00	-3.00	35.00	-3.00	15.00	-3.00	20.00
20	-2.00	32.00	-3.00	35.00	3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	35.00	-3.00	35.00	-3.00	15.00	-3.00	20.00
30	-2.00	32.00	-3.00	35.00	3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	35.00	-3.00	35.00	-3.00	15.00	-3.00	14.00
50	-2.00	32.00	-3.00	35.00	3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	35.00	-3.00	35.00	-3.00	15.00	-3.00	14.00
75	-2.00	32.00	-3.00	35.00	3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	35.00	-3.00	35.00	-3.00	15.00	-3.00	14.00
100	-2.00	30.00	-3.00	30.00	3.00	30.00	-3.00	30.00	5.00	30.00	5.00	30.00	0.00	30.00	-3.00	30.00	-3.00	15.00	-3.00	14.00
125	-2.00	30.00	-3.00	30.00	3.00	30.00	-3.00	30.00	3.00	30.00	3.00	30.00	0.00	30.00	-3.00	30.00	-3.00	15.00	-3.00	14.00
150	-2.00	30.00	-3.00	30.00	3.00	30.00	-3.00	30.00	3.00	30.00	3.00	30.00	0.00	30.00	-3.00	30.00	-3.00	15.00	-3.00	10.00
200	-2.00	30.00	-3.00	30.00	3.00	30.00	-3.00	30.00	3.00	30.00	3.00	30.00	0.00	30.00	-3.00	30.00	-3.00	15.00	-3.00	10.00
250	-2.00	28.00	-3.00	28.00	3.00	28.00	-3.00	28.00	3.00	28.00	3.00	28.00	0.00	28.00	-3.00	28.00	-3.00	15.00	-3.00	10.00
300	-2.00	28.00	-3.00	28.00	3.00	28.00	-3.00	28.00	3.00	28.00	3.00	28.00	0.00	28.00	-3.00	28.00	-3.00	15.00	-3.00	10.00
400	-2.00	28.00	-3.00	28.00	3.00	28.00	-3.00	28.00	3.00	28.00	3.00	28.00	0.00	28.00	-3.00	28.00	-3.00	15.00	-3.00	10.00
500	-2.00	28.00	-3.00	28.00	3.00	28.00	-3.00	28.00	0.00	28.00	0.00	28.00	0.00	28.00	-3.00	28.00	-3.00	15.00	-3.00	10.00
600	-2.00	20.00	-3.00	20.00	0.00	20.00	-3.00	20.00	0.00	20.00	0.00	20.00	0.00	20.00	-3.00	20.00	-3.00	10.00	-3.00	9.00
700	-2.00	20.00	-3.00	20.00	0.00	20.00	-3.00	20.00	0.00	20.00	0.00	20.00	0.00	20.00	-3.00	20.00	-3.00	10.00	-3.00	9.00
800	-2.00	20.00	-3.00	20.00	0.00	20.00	-3.00	20.00	0.00	20.00	0.00	20.00	0.00	20.00	-3.00	20.00	-3.00	10.00	-3.00	9.00
900	-2.00	20.00	-3.00	20.00	0.00	20.00	-3.00	20.00	0.00	20.00	0.00	20.00	0.00	20.00	-3.00	20.00	-3.00	10.00	-3.00	9.00
1000	-2.00	18.00	-3.00	18.00	0.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	-3.00	18.00	-3.00	10.00	-3.00	8.00
1100	-2.00	18.00	-3.00	18.00	0.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	-3.00	18.00	-3.00	10.00	-3.00	8.00
1200	-2.00	18.00	-3.00	18.00	0.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	-3.00	18.00	-3.00	7.00	-3.00	8.00
1300	-2.00	18.00	-3.00	18.00	0.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	-3.00	18.00	-3.00	7.00	-3.00	8.00
1400	-2.00	18.00	-3.00	18.00	0.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	-3.00	18.00	-3.00	7.00	-3.00	8.00
1500	-2.00	18.00	-3.00	18.00	0.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	-3.00	18.00	-3.00	7.00	-3.00	8.00
1750	-2.00	13.00	-3.00	13.00	0.00	13.00	-3.00	13.00	0.00	13.00	0.00	13.00	0.00	13.00	-3.00	13.00	-3.00	7.00	-3.00	8.00
2000	-2.00	13.00	-3.00	13.00	0.00	13.00	-3.00	13.00	0.00	13.00	0.00	13.00	0.00	13.00	-3.00	13.00	-3.00	7.00	-3.00	8.00
2500	-2.00	13.00	-3.00	13.00	0.00	13.00	-3.00	13.00	0.00	13.00	0.00	13.00	0.00	13.00	-3.00	13.00	-3.00	3.00	-3.00	8.00
3000	-2.00	7.00	-3.00	7.00	0.00	7.00	-3.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	-3.00	7.00	-3.00	3.00	-3.00	7.00
3500	-2.00	7.00	-3.00	7.00	0.00	7.00	-3.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	-3.00	7.00	-3.00	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

9.1. Temperature (continued 2)
Standard unit or scale: °C

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	34.00	0.00	27.00	-2.00	25.00	-3.00	35.00	14.00	35.00	0.00	35.00
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

9.2. 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	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	0.00	40.00	0.00	40.00	0.00	40.00	0.00	40.00	0.00	40.00	0.00	40.00	0.00	40.00	0.00	40.00	0.00	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

9.2. 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	
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
0	0.00	40.00	0.00	40.00	0.00	40.00	0.00	40.00	0.00	40.00	0.00	40.00	0.00	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

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

Depth	Mediterranean		Black Sea		Baltic Sea		Persian Gulf		Red Sea		Sulu Sea	
(m)	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

9.3. Oxygen
Standard unit or scale: $ml \cdot l^{-1}$

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	11.00	0.00	10.00	0.00	7.00	0.00	9.00	0.00	9.00	0.00	9.00	0.00	10.00	0.00	10.00	0.00	8.00	0.00	7.00
10	0.00	11.00	0.00	10.00	0.00	7.00	0.00	9.00	0.00	9.00	0.00	9.00	0.00	10.00	0.00	10.00	0.00	8.00	0.00	7.00
20	0.00	11.00	0.00	10.00	0.00	7.00	0.00	9.00	0.00	9.00	0.00	9.00	0.00	10.00	0.00	10.00	0.00	8.00	0.00	7.00
30	0.00	11.00	0.00	10.00	0.00	7.00	0.00	9.00	0.00	9.00	0.00	9.00	0.00	10.00	0.00	10.00	0.00	8.00	0.00	7.00
50	0.00	11.00	0.00	9.00	0.00	6.00	0.00	9.00	0.00	9.00	0.00	8.00	0.00	10.00	0.00	8.00	0.00	8.00	0.00	6.00
75	0.00	11.00	0.00	9.00	0.00	6.00	0.00	6.00	0.00	9.00	0.00	8.00	0.00	9.00	0.00	8.00	0.00	8.00	0.00	6.00
100	0.00	10.00	0.00	9.00	0.00	6.00	0.00	6.00	0.00	8.00	0.00	8.00	0.00	9.00	0.00	8.00	0.00	6.00	0.00	6.00
125	0.00	10.00	0.00	9.00	0.00	6.00	0.00	6.00	0.00	8.00	0.00	8.00	0.00	9.00	0.00	8.00	0.00	6.00	0.00	6.00
150	0.00	10.00	0.00	9.00	0.00	6.00	0.00	6.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	6.00	0.00	5.00
200	0.00	10.00	0.00	9.00	0.00	6.00	0.00	6.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	5.00	0.00	5.00
250	0.00	10.00	0.00	8.00	0.00	6.00	0.00	6.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	5.00	0.00	5.00
300	0.00	9.00	0.00	8.00	0.00	5.00	0.00	6.00	0.00	8.00	0.00	7.00	0.00	7.00	0.00	8.00	0.00	5.00	0.00	5.00
400	0.00	9.00	0.00	8.00	0.00	5.00	0.00	6.00	0.00	8.00	0.00	7.00	0.00	7.00	0.00	8.00	0.00	5.00	0.00	5.00
500	0.00	9.00	0.00	8.00	0.00	5.00	0.00	6.00	0.00	8.00	0.00	7.00	0.00	7.00	0.00	8.00	0.00	5.00	0.00	5.00
600	0.00	9.00	0.00	8.00	0.00	5.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	5.00	0.00	5.00
700	0.00	9.00	0.00	8.00	0.00	5.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
800	0.00	9.00	0.00	8.00	0.00	5.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
900	0.00	9.00	0.00	8.00	0.00	5.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
1000	0.00	9.00	0.00	8.00	0.00	6.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
1100	0.00	9.00	0.00	8.00	0.00	6.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
1200	0.00	9.00	0.00	8.00	0.00	6.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
1300	0.00	9.00	0.00	8.00	0.00	6.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
1400	0.00	9.00	0.00	8.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
1500	3.00	9.00	0.00	8.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
1750	3.00	9.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
2000	3.00	9.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
2500	3.00	8.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
3000	3.00	8.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	4.00
3500	3.00	8.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	4.00
4000	3.00	8.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	6.00	0.00	5.00	0.00	5.00	0.00	4.00
4500	3.00	8.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	6.00	0.00	5.00	0.00	5.00	0.00	4.00
5000	3.00	8.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	6.00	0.00	5.00	0.00	5.00	0.00	4.00
5500+	3.00	8.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	6.00	0.00	5.00	0.00	5.00	0.00	4.00

9.3. Oxygen (continued 1)
Standard unit or scale: $ml \cdot l^{-1}$

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	8.00	0.00	8.00	0.00	7.00	0.00	7.00	0.00	10.00	0.00	6.00	0.00	10.00	0.00	9.00	5.25	11.00	0.00	11.00
10	0.00	8.00	0.00	8.00	0.00	7.00	0.00	7.00	0.00	10.00	0.00	6.00	0.00	10.00	0.00	9.00	5.25	10.50	0.00	11.00
20	0.00	8.00	0.00	8.00	0.00	7.00	0.00	7.00	0.00	10.00	0.00	6.00	0.00	10.00	0.00	9.00	5.25	10.00	0.00	11.00
30	0.00	8.00	0.00	8.00	0.00	7.00	0.00	7.00	0.00	10.00	0.00	6.00	0.00	10.00	0.00	9.00	5.00	10.00	0.00	11.00
50	0.00	8.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	10.00	0.00	6.00	0.00	10.00	0.00	9.00	4.00	10.00	0.00	11.00
75	0.00	8.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	10.00	0.00	6.00	0.00	8.00	0.00	9.00	3.75	9.50	0.00	10.00
100	0.00	8.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	8.00	0.00	9.00	3.50	9.25	0.00	10.00
125	0.00	8.00	0.00	7.00	0.00	5.00	0.00	5.00	0.00	7.00	0.00	5.00	0.00	8.00	0.00	9.00	3.50	9.00	0.00	10.00
150	0.00	8.00	0.00	7.00	0.00	5.00	0.00	5.00	0.00	7.00	0.00	5.00	0.00	8.00	0.00	9.00	3.50	8.75	0.00	10.00
200	0.00	7.00	0.00	7.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	8.00	0.00	9.00	3.50	8.50	0.00	10.00
250	0.00	7.00	0.00	7.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	8.00	0.00	7.00	3.50	8.50	0.00	10.00
300	0.00	7.00	0.00	7.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	7.00	0.00	7.00	3.50	8.25	0.00	10.00
400	0.00	7.00	0.00	7.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	7.00	0.00	7.00	3.50	8.00	0.00	10.00
500	0.00	7.00	0.00	7.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	7.00	0.00	7.00	3.50	8.00	0.00	10.00
600	0.00	7.00	0.00	7.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	7.00	0.00	6.00	3.50	7.75	0.00	9.00
700	0.00	7.00	0.00	6.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	7.00	0.00	6.00	3.50	7.75	0.00	9.00
800	0.00	7.00	0.00	6.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	3.00	0.00	6.00	0.00	6.00	3.50	7.75	0.00	9.00
900	0.00	7.00	0.00	6.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	3.00	0.00	6.00	0.00	6.00	3.50	7.50	0.00	9.00
1000	0.00	6.00	0.00	6.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	3.00	0.00	6.00	0.00	6.00	3.50	7.50	0.00	9.00
1100	0.00	6.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	3.00	0.00	6.00	0.00	6.00	3.25	7.50	0.00	9.00
1200	0.00	6.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	3.00	0.00	6.00	0.00	6.00	3.25	7.50	0.00	9.00
1300	0.00	6.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	3.00	0.00	6.00	0.00	6.00	3.00	7.50	0.00	9.00
1400	0.00	6.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	3.00	7.50	0.00	9.00
1500	0.00	5.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	3.00	7.25	0.00	9.00
1750	0.00	5.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	3.00	7.25	0.00	9.00
2000	0.00	5.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	3.00	7.25	0.00	9.00
2500	0.00	5.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	3.25	7.25	0.00	9.00
3000	0.00	5.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	3.50	7.25	0.00	9.00
3500	0.00	5.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	3.75	7.00	0.00	9.00
4000	0.00	5.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	4.00	6.50	0.00	9.00
4500	0.00	5.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	4.00	6.50	0.00	9.00
5000	0.00	5.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	4.25	6.50	0.00	9.00
5500+	0.00	5.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	4.50	6.50	0.00	9.00

9.3. Oxygen (continued 2)
Standard unit or scale: $ml \cdot l^{-1}$

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	8.00	0.00	10.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	5.00
10	0.00	8.00	0.00	10.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	5.00
20	0.00	8.00	0.00	10.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	5.00
30	0.00	8.00	0.00	10.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	5.00
50	0.00	8.00	0.00	10.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	5.00
75	0.00	7.00	0.00	8.00	0.00	9.50	0.00	9.50	0.00	9.50	0.00	5.00
100	0.00	7.00	0.00	8.00	0.00	9.50	0.00	9.50	0.00	9.50	0.00	4.00
125	0.00	7.00	0.00	8.00	0.00	9.50	0.00	9.50	0.00	9.50	0.00	4.00
150	0.00	7.00	0.00	8.00	0.00	9.50	0.00	9.50	0.00	9.50	0.00	4.00
200	0.00	7.00	0.00	5.00	0.00	9.00	0.00	9.00	0.00	9.00	0.00	3.00
250	0.00	7.00	0.00	5.00	0.00	9.00	0.00	9.00	0.00	9.00	0.00	3.00
300	0.00	7.00	0.00	5.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	3.00
400	0.00	7.00	0.00	2.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	3.00
500	0.00	7.00	0.00	2.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	3.00
600	0.00	7.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	3.00
700	0.00	7.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	3.00
800	0.00	7.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	3.00
900	0.00	7.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	3.00
1000	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	3.00
1100	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	3.00
1200	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	2.00
1300	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	2.00
1400	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	2.00
1500	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	2.00
1750	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	2.00
2000	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	2.00
2500	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	2.00
3000	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	2.00
3500	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	2.00
4000	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	2.00
4500	0.00	6.00	0.00	2.00	0.00	6.00	0.00	6.00	0.00	6.00	0.00	2.00
5000	0.00	6.00	0.00	2.00	0.00	6.00	0.00	6.00	0.00	6.00	0.00	2.00
5500+	0.00	6.00	0.00	2.00	0.00	6.00	0.00	6.00	0.00	6.00	0.00	2.00

9.4. Phosphate
Standard unit or scale: μM

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	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

9.4. Phosphate (continued 1)
Standard unit or scale: μM

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	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

9.4. Phosphate (continued 2)
Standard unit or scale: μM

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	30.00	0.00	30.00	0.00	60.00	0.00	1.50	0.00	4.50	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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

9.5. Silicate
Standard unit or scale: μM

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	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

9.5. Silicate (continued 1)
Standard unit or scale: μM

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	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

9.5. Silicate (continued 2)
Standard unit or scale: μM

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	200.00	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00
10	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00
20	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00
30	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00
50	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00
75	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00
100	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00
125	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00
150	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00	0.00	200.00
200	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00
250	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00
300	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00
400	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00
500	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00
600	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00
700	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00
800	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00
900	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00	0.01	200.00
1000	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00
1100	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00
1200	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00
1300	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00
1400	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00
1500	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00
1750	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00
2000	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00
2500	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00
3000	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00
3500	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00
4000	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00
4500	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00
5000	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00
5500+	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00	1.00	200.00

Note: A slightly different set of Silicate ranges were used in creating the World Ocean Atlas 2009 for the following basins: Mediterranean, Black, Baltic, Persian Gulf, Red and Sulu Seas.

9.6. Nitrate
Standard unit or scale: μM

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	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

9.6. Nitrate (continued 1)
Standard unit or scale: μM

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	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

9.6. Nitrate (continued 2)
Standard unit or scale: µM

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	30.00	0.00	125.00	0.00	50.00	0.00	10.00	0.00	35.00	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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

9.7. 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

9.7. 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

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

Depth	Mediterranean		Black Sea		Baltic Sea		Persian Gulf		Red Sea		Sulu Sea	
(m)	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

9.8. Chlorophyll
Standard unit or scale: 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

9.8. Chlorophyll (continued 1)
Standard unit or scale: $\mu g \cdot l^{-1}$

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

9.8. Chlorophyll (continued 2)
Standard unit or scale: $\mu g \cdot l^{-1}$

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

9.9. Alkalinity
Standard unit or scale: meq·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	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

9.9. Alkalinity (continued 1)
Standard unit or scale: meq·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	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

9.9. Alkalinity (continued 2)
Standard unit or scale: meq·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	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

Glossary

Accession Number – A group of stations received and archived at the U.S. NODC. Each dataset submitted to NODC is given a unique accession number. Using this number, a user can get the original data from NODC 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.imma.org/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 WOD13 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 – 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 NODC. 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 WOD13, 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 NODC. 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 WOD13 is found in Table 2. For convenience, data from each dataset are stored in separate files in WOD13.

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 (US 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

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 (NODC). 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) – These are the units under which the data were reported to NODC.

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 – Principal Investigator is …

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 NODC/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.