



# **WORLD OCEAN DATABASE 2009 TUTORIAL**

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**For updates on data, documentation, and additional information about the WOD09 please refer to:**

[http://www.nodc.noaa.gov/OC5/WOD/wod\\_updates.html](http://www.nodc.noaa.gov/OC5/WOD/wod_updates.html)

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## I. Introduction

The purpose of this informal tutorial is to introduce new users to the *World Ocean Database 2009* (WOD09), outline the WOD09 environment, and to provide step-by-step examples of: 1) how to select WOD09 online data by location (geographically sorted by World Meteorological Organization squares); 2) use programs (wodFOR.f and wodASC.f) to read and output ASCII data; and 3) decompress data files and read data using the Ocean Data View (ODV) software (<http://odv.awi.de/>). For more detailed information on WOD09 see Boyer *et al.*, 2009 and Johnson *et al.*, 2009 available at: [http://www.nodc.noaa.gov/OC5/WOD09/pr\\_wod09.html](http://www.nodc.noaa.gov/OC5/WOD09/pr_wod09.html).

It is important to mention an alternative way of obtaining data, namely using the *WODselect*, which is not described in this tutorial. *WODselect* is available at: <http://www.nodc.noaa.gov/OC5/SELECT/dbsearch/dbsearch.html>.

The WOD09 data are available in the Data Sets & Products page at [http://www.nodc.noaa.gov/OC5/WOD09/pr\\_wod09.html](http://www.nodc.noaa.gov/OC5/WOD09/pr_wod09.html).

Finally, this tutorial has been written for the Microsoft Windows XP and 2007 environment on personal computers.

## II. Examples of Extracting and Reading WOD Data

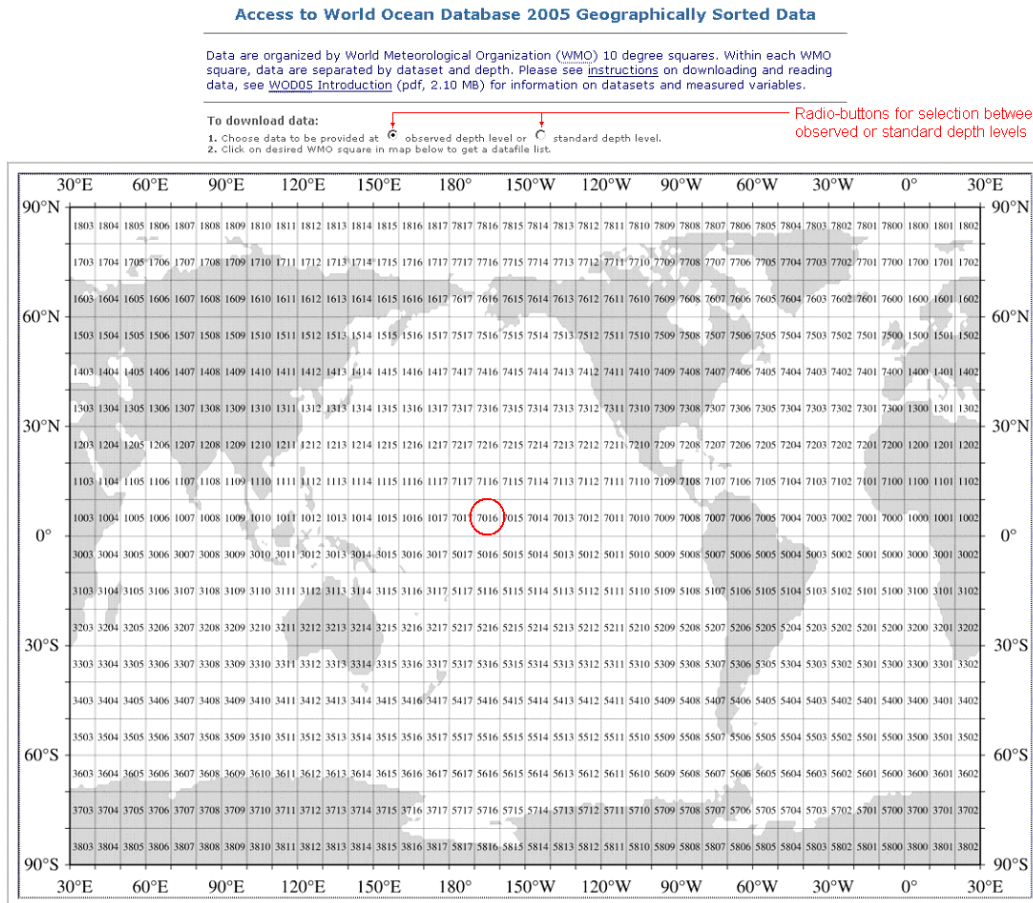
While this tutorial provides examples of several ways to use WOD09 data, it is important to point out that the DVD provides yearly (time) sorted data only. Since the time-sorted selection process is similar to the geographically sorted, we provide an example of extracting geographically sorted data only. Sections on reading data and importing data into ODV are relevant to the DVD.

**Geographically Sorted Data:** The geographically sorted data are organized by ten-degree latitude-longitude squares following the World Meteorological Organization (WMO) ten-degree square numbering scheme ([Figure 1](#)). This geographical location option allows the user to select data within the desired WMO square and download data at observed (O) or interpolated to standard (S) depths. [Table 1](#) shows the standard levels and their depths. After selecting observed or standard depths, the user can select the dataset (*i.e.* instrument type) of interest ([Figure 2](#)).

### **Example 1: Selecting and extracting Ocean Station Data**

Select and extract the Ocean Station Data (OSD) at observed depths with geographic coordinates between the 0°-10°N and between 160°-170°W. Note the radio-buttons for selection among observed or standard depths are located above the WMO map (see [Figure 1](#) or <http://www.nodc.noaa.gov/OC5/WOD09/data09geo.html>).

The region of interest is located in WMO square number 7016 (North Pacific) as shown in [Figure 1](#). Click square 7016, or any square, to download data for a specific geographical region.



**Figure 1. WOD09 Geographical Selection from WMO ten-degree squares**  
(see <http://www.nodc.noaa.gov/OC5/WOD09/data09geo.html>).

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 OSD07016.gz ([Figure 2](#)). The file-naming convention is as follows: OSD denotes instrument type; O denotes observed depth levels; 7016 denotes the WMO square number; filename extension .gz indicates that data file is compressed by gzip utility.

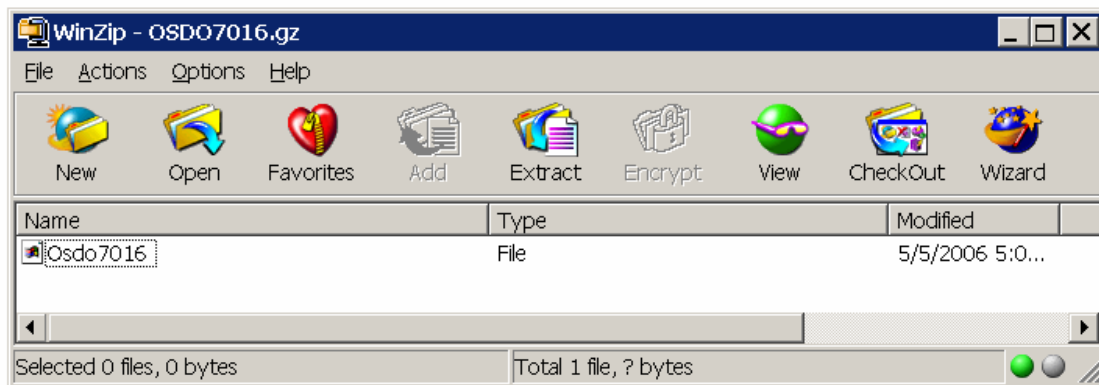
Select and save OSD07016.gz to your work directory.

**WMO 7016 - Observed Depth Data**  
Please see [information](#) on downloading and reading data

Dataset		File Name (size)
<b>OSD</b>	Bottle, low resolution CTD and XCTD, and plankton data	<a href="#">OSDO7016.gz</a> (0.1 MB)
<b>MBT</b>	MBT, DBT, and Micro BT data	<a href="#">MBTO7016.gz</a> (0.5 MB)
<b>CTD</b>	High resolution CTD data	<a href="#">CTDO7016.gz</a> (2.4 MB)
<b>XBT</b>	Expendable bathythermograph data	<a href="#">XBTO7016.gz</a> (5.4 MB)
<b>PFL</b>	Profiling float data	<a href="#">PFLO7016.gz</a> (0.1 MB)
<b>MRB</b>	Moored buoy data	<a href="#">MRBO7016.gz</a> (0.2 MB)
<b>DRB</b>	Drifting buoy data	no data in selected WMO
<b>APB</b>	Autonomous Pinniped Bathythermograph data	no data in selected WMO
<b>UOR</b>	Undulating Oceanographic Recorder data	no data in selected WMO
<b>GLD</b>	Glider data	no data in selected WMO
<b>SUR</b>	Surface data are not geographically sorted. The entire dataset is available in a single file	<a href="#">SURF_ALL.gz</a> (21.6 MB)

**Figure 2. WOD09 Download screen of WMO square 7016 observed data.**

If you have WinZip installed on your machine, the *WinZip* dialog box will appear ([Figure 3](#)) which allows decompression of OSD07016.gz. To decompress OSD07016.gz highlight the file, click **Extract** and select the desired location for the data file. Close the *WinZip* dialog after decompression.



**Figure 3. WinZip dialog box used for file extraction.**

**Decompressing data:** An alternative to WinZip is gzip. This is freeware that we have provided on the **utilities** page at: [http://www.nodc.noaa.gov/OC5/WOD09/wod\\_utils.html](http://www.nodc.noaa.gov/OC5/WOD09/wod_utils.html). The **utilities** page contains utilities used for decompressing data for DOS and UNIX environments. To decompress OSD07016.gz, use the following command: `gzip -nd OSD07016.gz`. (Refer to the **utilities** page or the gzip site at: <http://www.gzip.org>.) The data are now ready for use.

### **Example 2: Using WOD programs**

The **programs** page ([http://www.nodc.noaa.gov/OC5/WOD09/wod\\_programs.html](http://www.nodc.noaa.gov/OC5/WOD09/wod_programs.html)) contains sample programs written in FORTRAN and C for reading the WOD09 data.

The below FORTRAN program wodFOR.f shows how to read select WOD09 data from a file. This program is interactive in the sense that it prompts the user for the incoming file name (*e.g.*, OSD07016) and number of stations to be displayed. The program can read data from any dataset at observed or standard depths. First, copy wodFOR.f to your working directory and make (compile) an executable or use the existing compiled wodFOR.exe. It is assumed that the user is familiar with compiling FORTRAN programs (*e.g.*, UNIX environment: `g77 -o <executable_file> <program_file.f>`). The data should be decompressed by either WinZip, gzip, or other compression utility prior to running wodFOR.exe.

Suppose that the name of the executable is wodFOR.exe (or any other name). To execute wodFOR.exe, type: wodFOR.exe. The program prompts the user for the data file name as input. Enter the file name: **OSDO7016**. The next prompt is to enter the number of desired casts. For Example 2, since the casts are displayed on your screen, enter the number **5**. The program displays the user-selected number of casts in the OSD07016 data file. [Table 2](#) shows the first cast in OSD07016.

Each dataset contains different variables. For example, OSD datasets (files) include chemical, physical, and biological variables ([Table 3](#)). The sample output from wodFOR.exe shows that the WOD09 cast number 159608 contains six variables (1=temperature, 2=salinity, 3=oxygen, 4=phosphate, 6=silicate, and 9=pH) as a function of depth (refer to [Table 3](#) for codes). Each cast includes variable-specific and secondary header codes denoting meteorological data, originator's methods and instruments, ship and cruise name, *etc.* (Refer to **codes table** page ([http://www.nodc.noaa.gov/OC5/WOD09/wod\\_codes.html](http://www.nodc.noaa.gov/OC5/WOD09/wod_codes.html)) for codes.)

A note on other sample programs: Any of the FORTRAN or C programs can read WOD09 data from any dataset shown in [Figure 2](#). The FORTRAN program wodASC.f reads the WOD09 data from a user-selected file and outputs a user-selected variable as a function of depth in either tab-separated or comma-separated format. The output from wodC.c is the same as wodFOR.f. The user can modify these programs according to specific needs.

### **Example 3: Reading data using 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 <http://odv.awi.de/>. ODV will read (import) selected WOD09 data files in both gzip compressed or decompressed format. Example 3 illustrates how to open a new collection and import single and/or multiple data files into ODV. To use this tutorial, ODV version 4.1 or higher must be installed. This document is not a substitute for the ODV User's Guide available at:

[http://odv.awi.de/fileadmin/user\\_upload/odv/misc/odv4Guide.pdf](http://odv.awi.de/fileadmin/user_upload/odv/misc/odv4Guide.pdf).

#### Example 4: Creating a new data collection and importing a file

Example 4 walks you through creating a new data collection and importing a single WOD09 data file (**OSDO7016**) into ODV.

Opening a new data collection: Start the ODV software by double clicking the ODV icon. 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 (otherwise, any existing collection can be used if available). ODV will then request a name for the new collection. 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**.

In the “**Creating collection ...**” window, ([Figure 4](#)) select “**World Ocean Database variables**” from the list of “**Definition of collection variables**” and click **OK**.

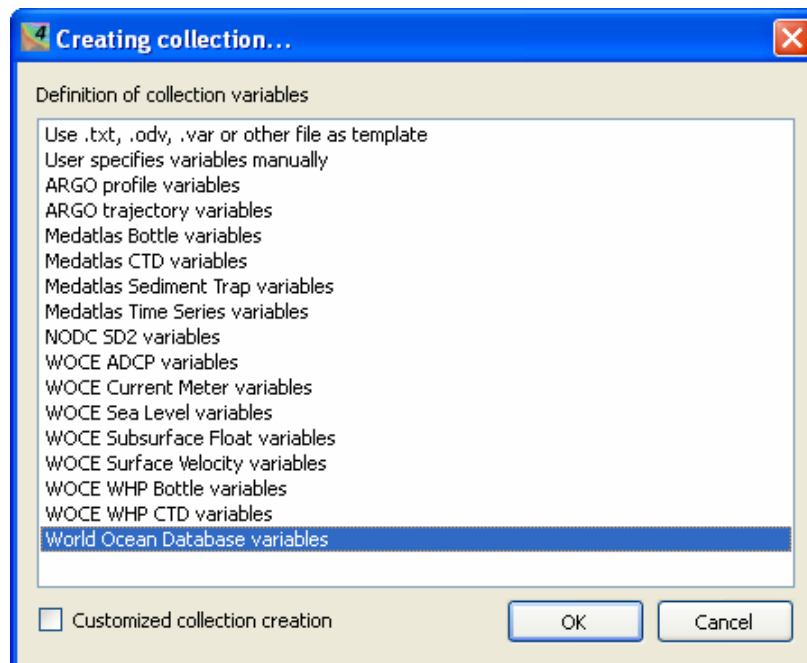


Figure 4. Creating a new ODV collection (New\_ODV\_Collection.odv)

The next window displayed is the Global Map ([Figure 5](#)). Since this is a “new” collection, just created and prior to importing data, no data are displayed in the map. Since no data have been imported yet, the ODV internal number of stations is zero, shown in the bottom of the window as **0/0: DefaultView\*** circled in red.



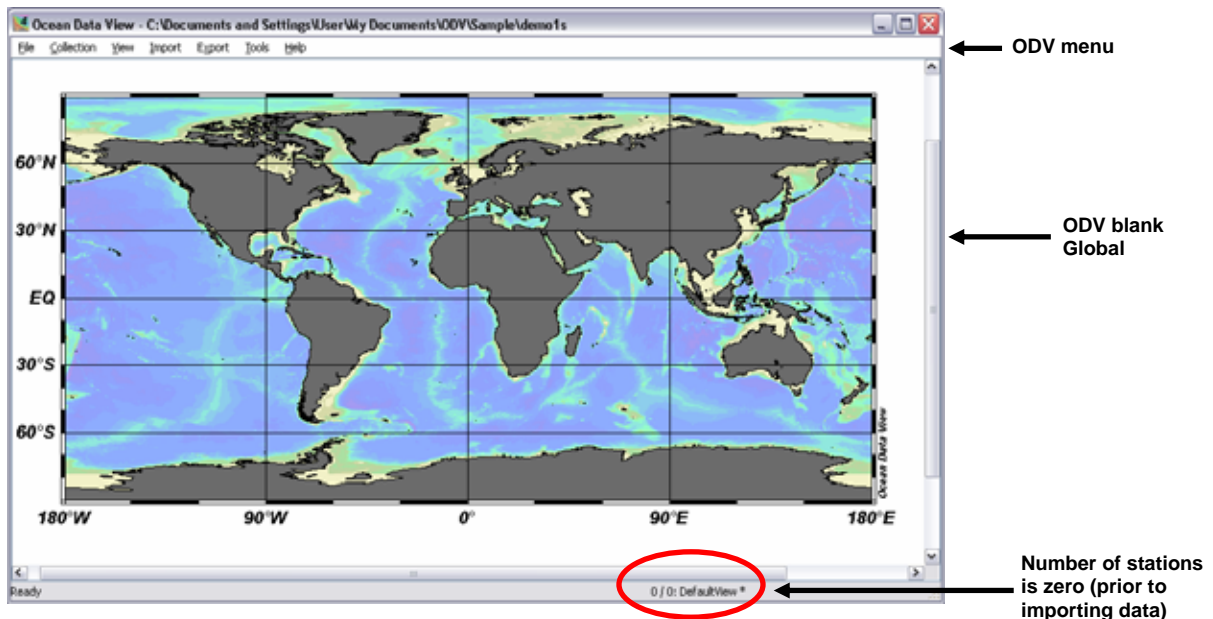


Figure 5. ODV screen after creating a new collection and prior to importing data.

Importing a single data file into the collection: The next step is to import data (OSDO7016.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 OSD07016.gz file.

Using the *Import Options* dialog box (Figure 6) 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 shows window called Variable Association. All of the variables defined as the WOD09 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 OSD07016.gz so that it shows in the File name window and select **Open** to continue.

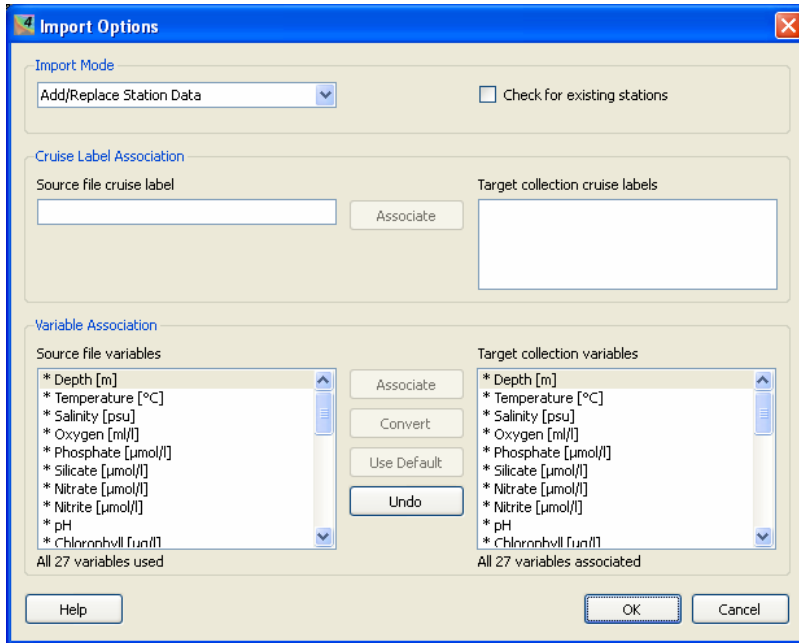


Figure 6. ODV Import Options.

A small dialog box (Figure 7) displays the total number of stations (**501 stations**) imported from OSD07016 into the ODV Global Map. Click **OK** to continue.

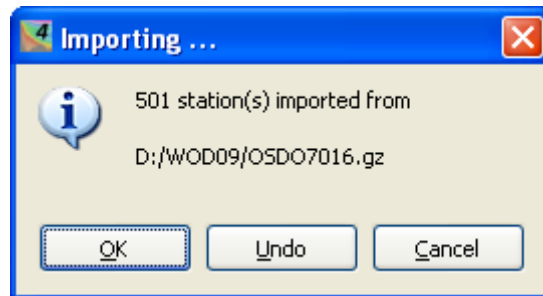
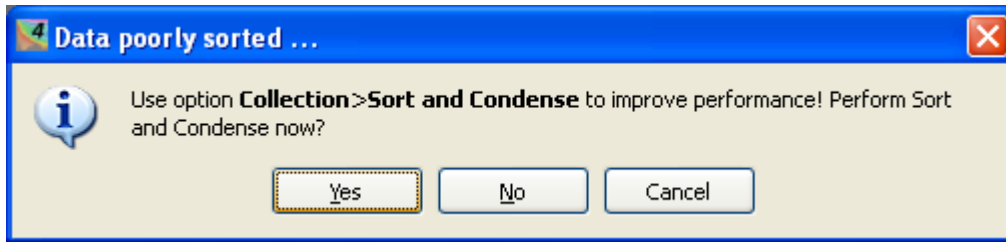


Figure 7. ODV Import Completion Dialog Box.

The next dialog box (Figure 8) allows you to improve sorting and condensing performance on the data just imported. Refer to the ODV User's Guide for detailed information on this option. To keep this exercise simply, Click **No** to continue.



**Figure 8. ODV Sort and Condense Dialog Box.**

When the user selects **World Ocean Database** format, distribution of the imported data will appear in the Global Map. To the right of the Global Map, is a display of all depth-dependent variables in WOD09 (see [Table 3](#)) and their values. A zoom of the information displayed is shown in [Figure 9](#). The station information changes accordingly, as you click a station in the distribution map. All the information corresponds to the WOD09 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.

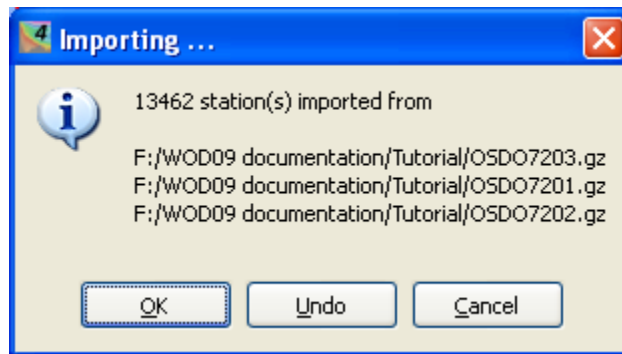
Station ID: 1		
Cruise	WOD05_09	
Station	362156 (B)	
Position	163.28°W / 6.17°N	
Date	16 September 1961	
Time	23:36	
Depth Range [m]	[0 - 1795]	
Bot. Depth [m]	4572	
Sample: 1 / 14		
Depth [m]	0	0
Temperature [°C]	28.46	0
Salinity [psu]	34.230	0
Oxygen [ml/l]	4.44	0
Phosphate [ $\mu\text{mol/l}$ ]	0.14	0
Silicate [ $\mu\text{mol/l}$ ]		
Nitrate [ $\mu\text{mol/l}$ ]	0.0	0
Nitrite [ $\mu\text{mol/l}$ ]		
pH		
Chlorophyll [ $\mu\text{g/l}$ ]		
Plankton/Biomass		
Alkalinity [meq/l]		
NO <sub>2</sub> +NO <sub>3</sub> [ $\mu\text{mol/l}$ ]		
pCO <sub>2</sub> [ $\mu\text{atm}$ ]		
tCO <sub>2</sub> [mmol/l]		
Tritium [TU]		
Helium [nM]		
$\delta^3\text{He}$ [%]		
$\Delta^{14}\text{C}$ [‰]		
$\delta^{13}\text{C}$ [‰]		
Argon [nM]		
Neon [nM]		
CFC11 [pM]		
CFC12 [pM]		
CFC113 [pM]		
$\delta^{18}\text{O}$ [‰]		
Transmissivity [m <sup>-1</sup> ]		
Isosurface Values		
Projected Longitude	-163.280	
Projected Latitude	6.170	
Time [yr]	1961.710	
Day of Year	259	
Temperature [°C] @ Depth [m]=first	28.46	
Salinity [psu] @ Depth [m]=first	34.230	
Oxygen [ml/l] @ Depth [m]=first	4.44	
Phosphate [ $\mu\text{mol/l}$ ] @ Depth [m]=...	0.14	

Figure 9. WOD09 cast information and profile data as displayed by ODV.

**Example 5: 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 on the Global Map. The **Importing ...** dialog box will show the number of imported stations. For this exercise, 13,462 stations were imported from files: OSD07201.gz, OSD07202.gz, and OSD07203.gz, see dialog box shown in [Figure 10](#).



**Figure 10. 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 4](#). The WOD variables that received full quality control are: temperature, salinity, oxygen, phosphate, silicate, and nitrate. Other WOD09 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.

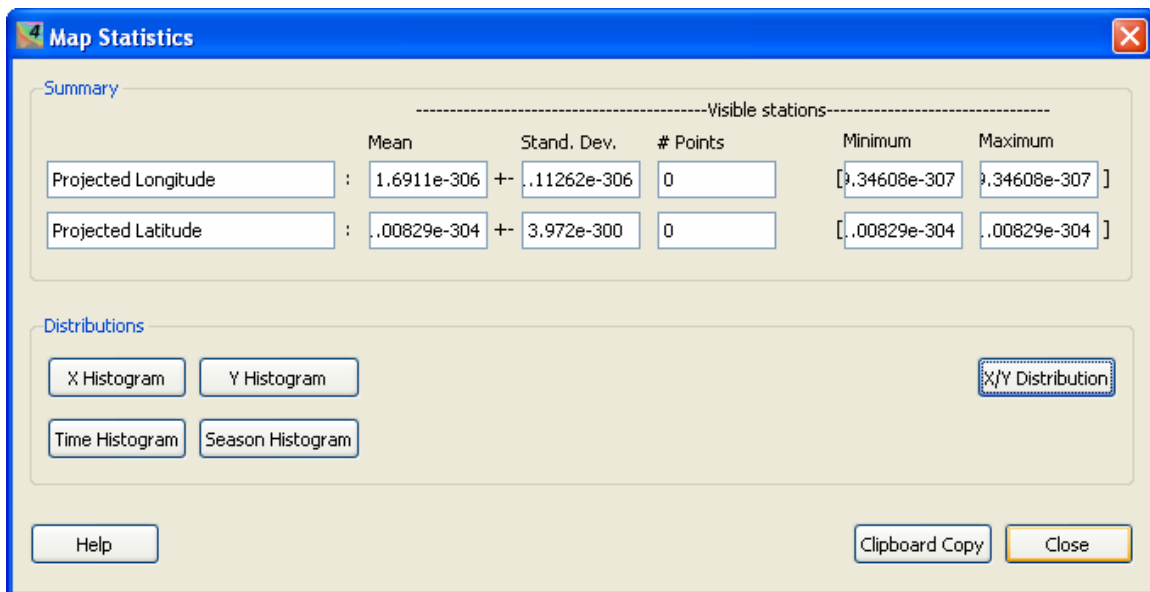
### III. ODV Function (F) Keys

What follows are a few function keys used as shortcut keys for ODV layouts. For more detailed information on the functions keys, please refer to the ODV User's Guide.

**F1 – Opens ODV User's Guide in a browser**

**F4 – Shows data statistics of the window containing the mouse**

The dialog box for data statistics is shown in [Figure 11](#).



**Figure 11. ODV Data Statistics.**

**F5 – Redraws the entire canvas or the window containing the mouse**

**F8 – Switches to full-screen map layout**

The dialog box shown in [Figure 12](#) is the ODV Glob Map in full-screen layout.

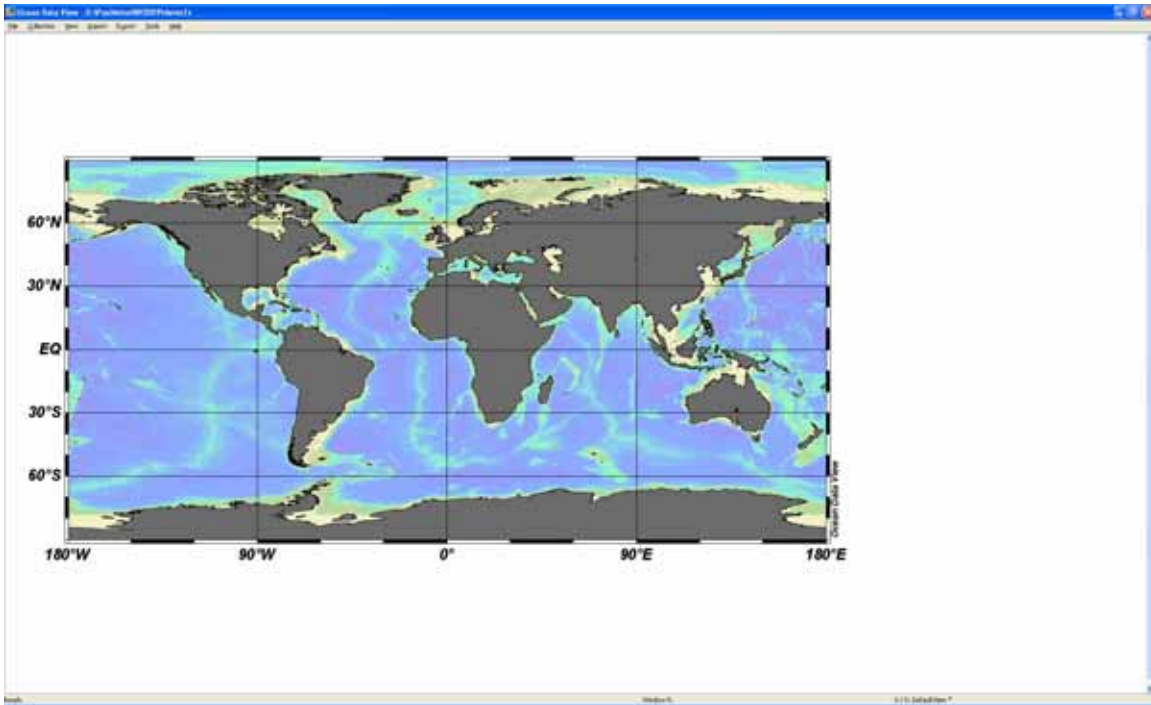


Figure 12. ODV full-screen layout.

### F9 – Switches to six STATION window layout

The dialog box in [Figure 13](#) shows the six station window layout. The user can delete and/or move any desired station window from the layout.

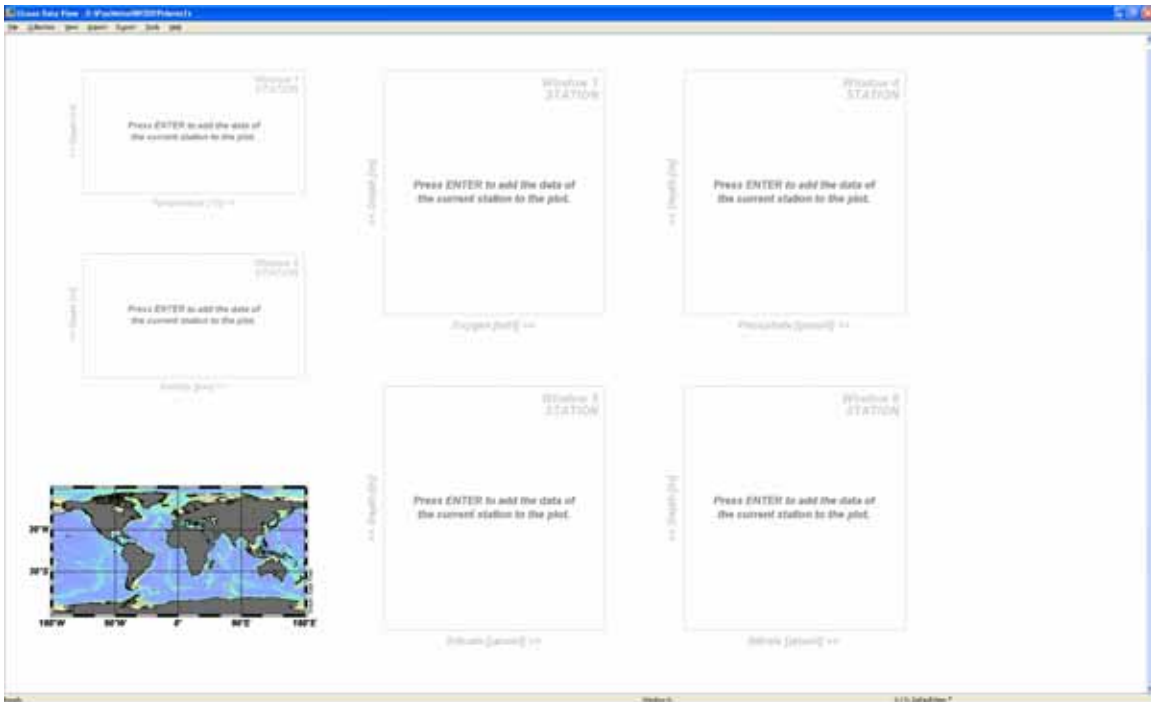


Figure 13. ODV six station window layout.

## F10 – Switches to two SCATTER window layout

The dialog box in [Figure 14](#) shows salinity (top left) and temperature (right) scatter plots. Also shown in Figure 14 are the data distribution in the global map (bottom) and the cruise metadata (far right) of the dialog box.

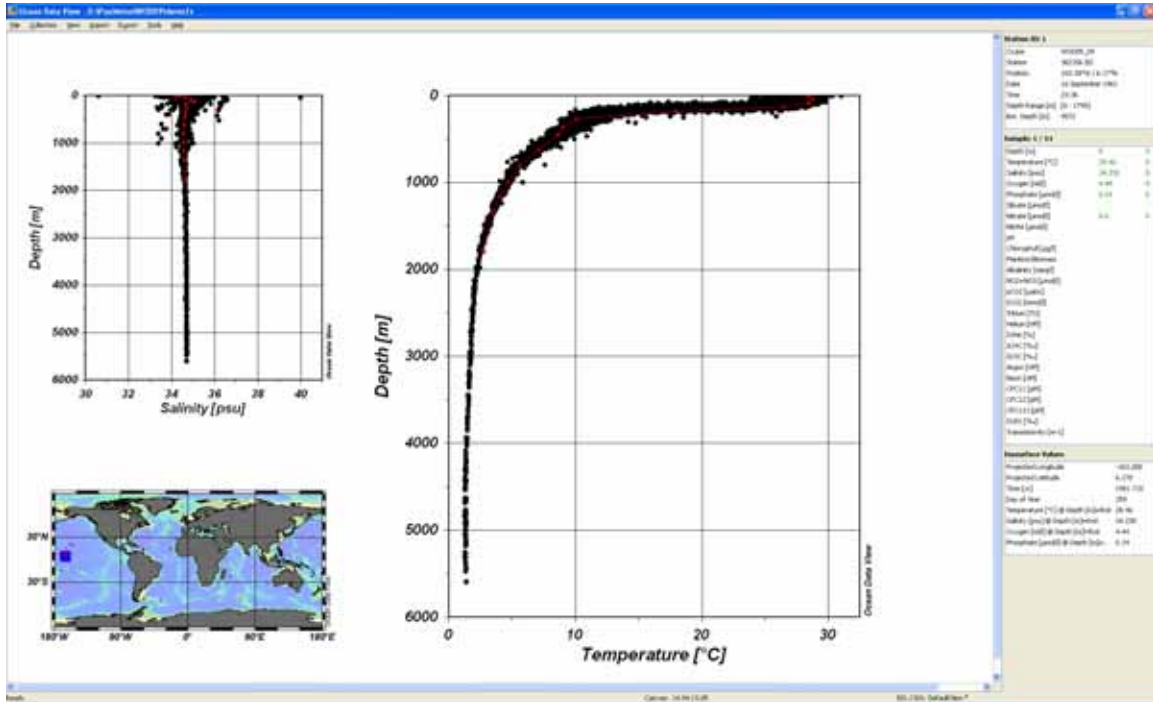


Figure 14. ODV salinity and temperature scatter plots.



## F11 – Switches to three SECTION window layout

The dialog box shown in [Figure 15](#) is the layout for the three section layout. The user can delete and/or move any desired section window from the layout.

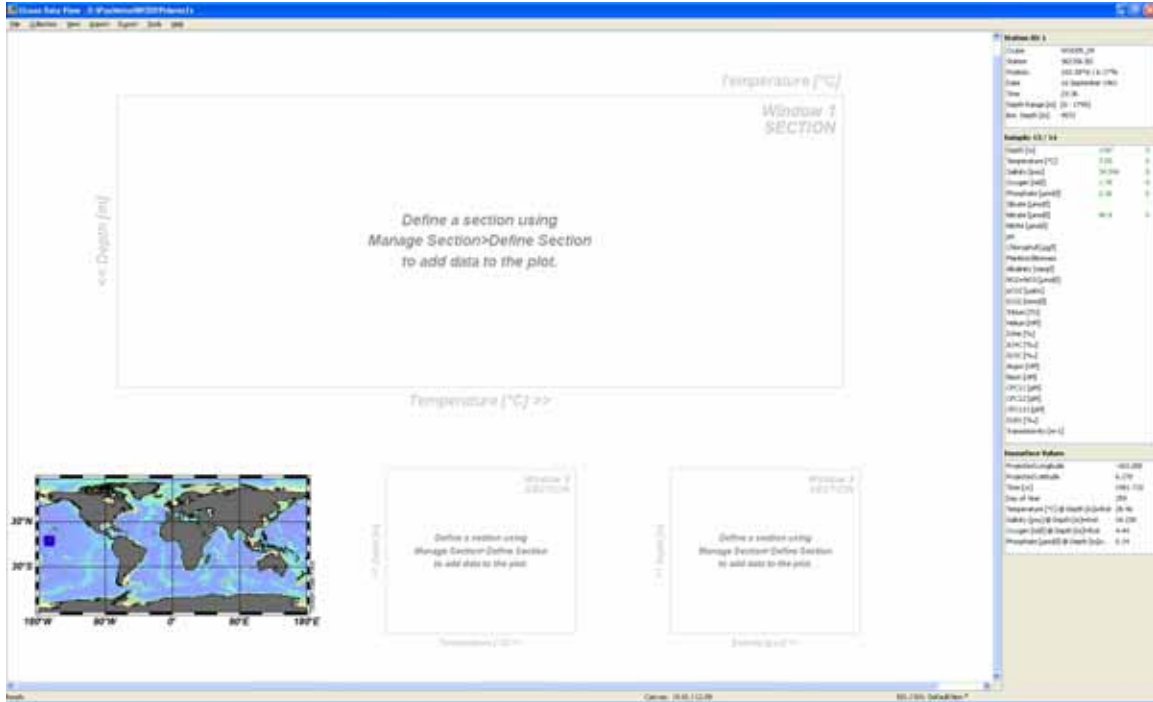


Figure 15. ODV three section window layout.

## F12 – Switches to one SURFACE window layout

The dialog box in [Figure 16](#) shows the appearance of the data in surface layout mode (right image).

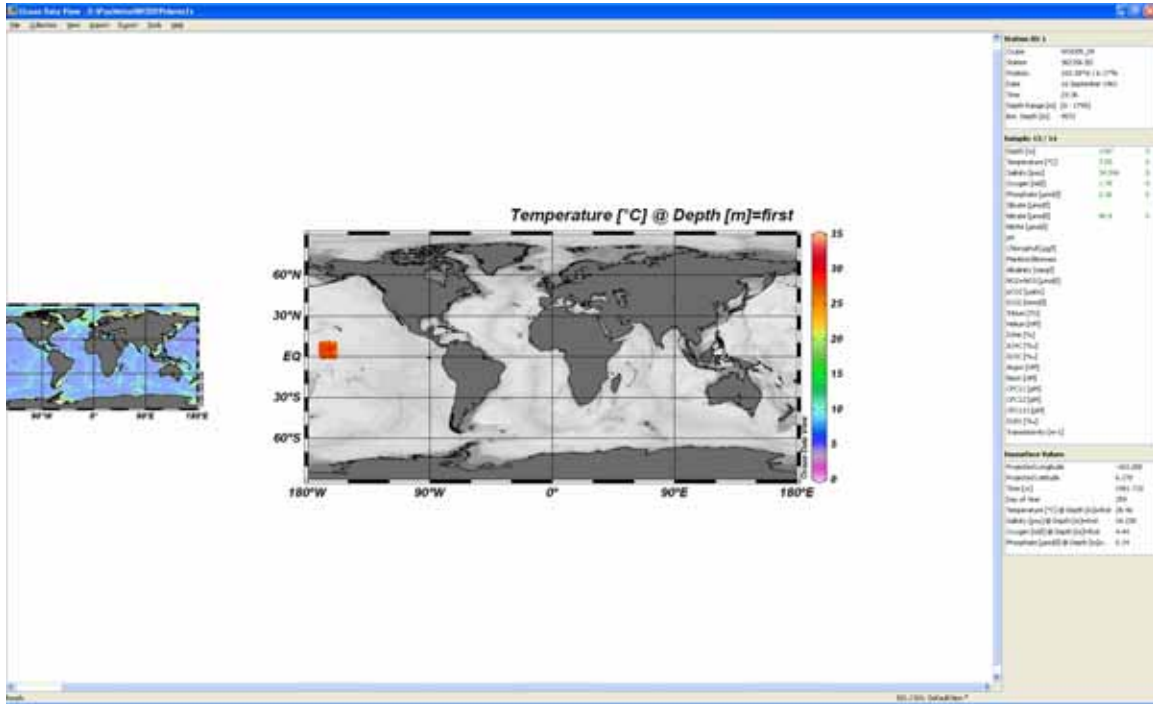


Figure 16. ODV surface window layout.

## **IV. Reporting Data Problems, Suggestions and Comments about WOD09**

If any errors are found in WOD09, please contact the Ocean Climate Laboratory (OCL) at [OCL.help@noaa.gov](mailto:OCL.help@noaa.gov) and the problems will be corrected. Comments or suggestions for improving WOD09 would be greatly appreciated. Updates to programs and changes to WOD09 will be posted on the National Oceanographic Data Center/OCL Web site at: <http://www.nodc.noaa.gov/OC5>.

## V. References

- Boyer, T.P., J.I. Antonov , O.K. Baranova, H.E. Garcia, D.R. Johnson, R.A. Locarnini, A.V. Mishonov, T.D. O'Brien, D. Seidov, I.V. Smolyar, M.M. Zweng, 2009. *World Ocean Database 2009*. Edited by Sydney Levitus, NOAA Atlas NESDIS 66, U.S. Gov. Printing Office, Wash., D.C., 206 pp., DVDs.
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- Schlitzer, R., 2009. Ocean Data View, <http://odv.awi.de/>.

**Table 1.** Standard levels and their depths.

<b>Depth (m)</b>	<b>Level #</b>	<b>Depth (m)</b>	<b>Level #</b>	<b>Depth (m)</b>	<b>Level #</b>	<b>Depth (m)</b>	<b>Level #</b>
0	1	250	11	1200	21	4500	31
10	2	300	12	1300	22	5000	32
20	3	400	13	1400	23	5500	33
30	4	500	14	1500	24	6000	34
50	5	600	15	1750	25	6500	35
75	6	700	16	2000	26	7000	36
100	7	800	17	2500	27	7500	37
125	8	900	18	3000	28	8000	38
150	9	1000	19	3500	29	8500	39
200	10	1100	20	4000	30	9000	40

**Table 2.** Sample data output (Cast No. 159608) from the OSD07016 using wodFOR.f. The output shows six variables as a function of depth; quality flags; and secondary header codes. Letters “f” and “o” denote WOD09 and originator’s quality flags, respectively; numbers in parenthesis indicate significant digits; “VarFlag” indicates whole profile quality flag; missing values are denoted as -999.990.

```

Input File Name:

Enter number of casts to view (0=view entire file)
-----
Output from ASCII file, cast# 159608
-----

CC  cruise Latitude Longitude YYYY MM DD    Time    Cast #levels
77  1232   8.670  -169.470  1947 12 20   22.00   159608    13

Number of variables in this cast:  6

Originators Cruise Code: 77470418

      z  fo    1          fo    2          fo    3          fo    4          fo    6          fo    9          fo
0.0 00  27.500 (4) 00  34.270 (4) 00  4.830 (3) 00  0.290 (2) 00  5.000 (1) 00  8.130 (3) 00
24.0 00  27.510 (4) 00 -999.990 (0) 00 -999.990 (0) 00 -999.990 (0) 00 -999.990 (0) 00 -999.990 (0) 00
48.0 00  27.490 (4) 00  34.350 (4) 00  4.810 (3) 00  0.260 (2) 00  6.000 (1) 00  8.140 (3) 00
72.0 00  26.330 (4) 00  35.010 (4) 00  4.430 (3) 00  0.420 (2) 00  9.000 (1) 00  8.110 (3) 00
96.0 00  21.160 (4) 00  34.880 (4) 00  3.810 (3) 00  0.650 (2) 00  9.000 (1) 00  8.050 (3) 00
144.0 00  13.990 (4) 00  34.560 (4) 00  2.780 (3) 00  1.550 (3) 00  21.000 (2) 00  7.910 (3) 00
194.0 00  11.100 (4) 00  34.650 (4) 00  0.750 (2) 00  2.520 (3) 00  32.000 (2) 00  7.730 (3) 00
293.0 00  9.720 (3) 00  34.700 (4) 00  0.570 (2) 00  2.520 (3) 00  41.000 (2) 00  7.710 (3) 00
392.0 00  8.960 (3) 00  34.660 (4) 00  0.540 (2) 00  2.810 (3) 00  49.000 (2) 00  7.660 (3) 00
491.0 00  8.140 (3) 00  34.620 (4) 00  0.630 (2) 00  2.900 (3) 00  56.000 (2) 00  7.670 (3) 00
587.0 00  6.310 (3) 00  34.560 (4) 00  0.450 (2) 00  3.120 (3) 00  68.000 (2) 00  7.640 (3) 00
779.0 00  5.460 (3) 00  34.560 (4) 00  0.960 (2) 00  3.040 (3) 00  86.000 (2) 00  7.630 (3) 00
971.0 00  4.590 (3) 00  34.580 (4) 00  1.470 (3) 00  3.060 (3) 00  98.000 (2) 00  7.710 (3) 00

VarFlag:          0          4          0          3          3          0
Secondary header # 1      126. (3)
Secondary header # 3      6185. (4)
Secondary header # 7      130. (3)
Secondary header # 10     5450. (4)
Secondary header # 18      3. (1)
Secondary header # 19      9. (1)
Secondary header # 21      4. (1)
Secondary header # 29      7. (1)
Secondary header # 99     2006124. (7)

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**Table 3.** Depth-dependent variables in WOD09.

Code	Parameter (nominal abbreviations)	WOD09 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 <sub>2</sub> ]	Milliliter per liter (ml l <sup>-1</sup> )	OSD, CTD, PFL, UOR
4	Phosphate [HPO <sub>4</sub> <sup>-2</sup> ]	Micromole per liter (µM)	OSD
6	Silicate [Si(OH) <sub>4</sub> ]	Micromole per liter (µM)	OSD
8	Nitrate [NO <sub>3</sub> ] and Nitrate+Nitrite	Micromole per liter (µM)	OSD
9	pH	Dimensionless	OSD, SUR
11	Total Chlorophyll [Chl] unless specified	Microgram per liter (µg l <sup>-1</sup> )	OSD, CTD, SUR, UOR
17	Alkalinity [TALK] unless specified	Milliequivalent per liter (meq l <sup>-1</sup> )	OSD, SUR
20	Partial pressure of carbon dioxide [pCO <sub>2</sub> ]	Microatmosphere (µatm)	OSD, SUR
21	Dissolved Inorganic carbon [DIC]	Millimole per liter (mM)	OSD
24	Transmissivity (BAC) <sup>1</sup>	Per meter (m <sup>-1</sup> )	CTD
25	Pressure	Decibar	OSD, CTD, UOR, GLD, PFL
26	Air temperature	Degree Celsius (°C)	SUR
27	CO <sub>2</sub> warming	Degree Celsius (°C)	SUR
28	xCO <sub>2</sub> atmosphere	Parts per million (ppm)	SUR
29	Air pressure	Millibar (mbar)	SUR
30	Latitude <sup>3</sup>	Degrees	SUR, APB, UOR
31	Longitude <sup>3</sup>	Degrees	SUR, APB, UOR
32	Julian year-day <sup>2,3</sup>	Day	SUR, APB, UOR
33	Tritium [ <sup>3</sup> H]	Tritium Unit (TU)	OSD
34	Helium [He]	Nanomol per liter (nM)	OSD
35	Delta Helium-3 [Δ <sup>3</sup> He]	Percent (%)	OSD
36	Delta Carbon-14 [Δ <sup>14</sup> C]	Per mille (‰)	OSD
37	Delta Carbon-13 [Δ <sup>13</sup> 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 [Δ <sup>18</sup> O]	Per mille (‰)	OSD

<sup>1</sup> Beam Attenuation Coefficient

<sup>2</sup> Julian year-day is the decimal day for the year in which the observations were made (see Section I. F7)

<sup>3</sup> Codes: 30, 31, and 32 (latitude, longitude, and Julian year-day respectively) are not depth-dependent variables and are not in WODselect.

**Table 4.** Definition of WOD09 Quality Flags

<b>(1) FLAGS FOR ENTIRE CAST (AS A FUNCTION OF VARIABLE)</b>	
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
<b>(2) FLAGS ON INDIVIDUAL OBSERVATIONS</b>	
<b>(a) Depth Flags</b>	
0	accepted value
1	duplicates or inversions in recorded depth ( same or less than previous depth )
2	density inversion
<b>(b) Observed Level Flags</b>	
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
<b>(c) Standard Level Flags</b>	
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
<b>(d) Biological data flags (applied only to Comparable Biological Value - CBV Taxa code 27)</b>	
0	accepted value
1	range outlier ( outside of broad range check )
2	questionable value ("bullseye flag" )