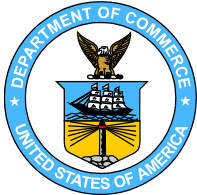


National Oceanographic Data Center Internal Report 17



# **WORLD OCEAN ATLAS 2001: Objective Analyses, Data Statistics, and Figures CD-ROM Documentation**

*Ocean Climate Laboratory*  
National Oceanographic Data Center

Silver Spring, MD  
September 2002

**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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**For updates on the data, documentation and additional information about WOA01 please refer to:**

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**click on: Ocean Climate Laboratory**  
**click on: Products**

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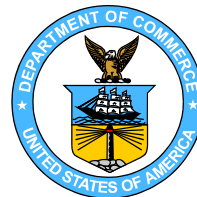
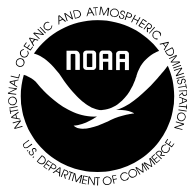
National Oceanographic Data Center Internal Report 17

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CD-ROM Documentation***

M. E. Conkright, R. A. Locarnini, H. E. Garcia, T. D. O'Brien,  
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## TABLE OF CONTENTS

1. INTRODUCTION .....	1
2. OVERVIEW .....	2
3. CONTENTS OF WOA01 .....	3
A. DATA CD-ROMs .....	3
B. FIGURES DVDs .....	5
4. DIRECTORY STRUCTURE .....	5
5. DATA FORMAT .....	8
6. FILE NAMING CONVENTION FOR ANALYZED DATA AND STATISTICS .....	9
7. util DIRECTORY .....	10
A. Installing gzip for the first time .....	10
B. Decompressing data from WOA01 .....	10
C. Removing carriage return-line feed: UNIX Users .....	11
8. REFERENCES ASSOCIATED WITH WORLD OCEAN ATLAS 2001 .....	16
A. NOAA Atlas NESDIS <i>World Ocean Atlas 2001</i> (WOA01) series .....	16
B. <i>World Ocean Database 2001</i> (WOD01) CD-ROM set .....	16
C. NOAA Atlas NESDIS <i>World Ocean Database 2001</i> (WOD01) Atlas series .....	16

## LIST OF TABLES

Table 1. Standard depth levels and corresponding depths (meters) .....	3
Table 2. Availability of objective analyses and statistics by climatological compositing periods for each ocean variable, and the maximum depth for which objective analyses and statistics were computed.. .....	4
Table 3. Basins defined for objective analysis and the shallowest standard depth level for which each basin is defined .....	12

## LIST OF FIGURES

Figure 1. Directory structure for the temperature data in WOA01-01 .....	13
Figure 2. One-degree horizontal coordinate system of the analyzed fields .....	14
Figure 3. Five-degree horizontal coordinate system of the analyzed fields .....	15

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# World Ocean Atlas 2001

## Objective Analyses, Data Statistics, and Figures

### CD-ROM Documentation

Ocean Climate Laboratory  
National Oceanographic Data Center  
September 2002

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## 1. INTRODUCTION

The *World Ocean Atlas 2001* (WOA01) Series consists of two sets of products. The first set of products consists of three **DATA** CD-ROMs containing global data statistics at standard depth levels by one-degree and five-degree squares of several commonly measured ocean variables, as well as objectively analyzed fields (on a one-degree grid) of these variables. These products are in ASCII format. The ocean variables included in this series are: *in-situ* temperature, salinity, oxygen (dissolved oxygen, apparent oxygen utilization (AOU), and percent oxygen saturation), dissolved inorganic nutrients (phosphate, nitrate, and silicate), and chlorophyll at standard depth levels, and plankton biomass sampled between 0 m and 200 m depth. The second set of products consists of three **FIGURE** DVDs containing PDF figures illustrating the fields found on the **DATA** CD-ROMs.

The WOA01 CD-ROM/DVD set is associated with the following series of products:

- NOAA Atlas NESDIS *World Ocean Atlas 2001* Series (Six volumes): The WOA01 atlas series describes the methods used to generate the various statistics and objectively analyzed fields for each variable and each climatological compositing periods: annual, seasonal, and monthly. It also includes figures at selected standard depth levels for all variables, except plankton biomass for which the figures represent values between the 0 - 200 meter depth layer.
- *World Ocean Database 2001* (WOD01) CD-ROM set: This set of CD-ROMs contains the observed and standard level data used to generate the WOA01 fields. WOD01 consists of eight CD-ROMs.
- *World Ocean Database 2001* Atlas (WOD01) Series (seven volumes): This series details the sources of the WOD01 data and shows distribution plots for each variable and instrument type as a function of year.

A complete list of publications associated with WOD01 and WOA01 is presented in section 8.

## 2. OVERVIEW

For clarity we begin by presenting definitions and explanations of the products contained in this atlas and CD-ROM series which are described in this documentation.

As with previous works, we have vertically interpolated ocean profile data from "observed" depth levels to standard depth levels. We define 33 standard depth levels extending from the sea surface to 5500 m depth as given in Table 1. Several statistics are then computed, by one-degree and five-degree squares, for the world ocean at each standard depth level and for various climatological, all-data, compositing periods as documented in Table 2. The statistics computed include:

- the **number of observations** of each variable in each one-degree and five-degree square of the world ocean at each standard depth level,
- the arithmetic mean (referred to as "**unanalyzed mean**") of each variables in each one-degree square and five-degree of the world ocean at each standard depth level,
- the **standard deviation** about the arithmetic mean of each variable in each one-degree and five-degree square of the world ocean at each standard depth level,
- the **standard error of the mean** of each variable in each one-degree and five-degree square of the world ocean at each standard depth level,

The above one-degree and five-degree global fields are referred to as "**unanalyzed fields**".

The fields of unanalyzed one-degree square means at each standard depth level were objectively analyzed to fill in one-degree squares that do not contain any data, through a process of interpolation and smoothing as outlined in the *World Ocean Atlas 2001: Volume 1* (Stephens *et al.* 2002).. The resulting fields are referred to as "**analyzed fields**".

"**Differences fields**", computed at each standard depth level, are defined as the difference between the monthly or seasonal analyzed field of a variable and the corresponding analyzed annual mean field of the variable. An analyzed annual mean field is defined as the average of the twelve monthly (where available) or four seasonal analyzed mean fields.

The number of one-degree square grid point values used to compute the analyzed value at each grid point was also computed and presented in the form of one-degree fields. This field is referred to as a "**grid point**" field.

The difference between each "unanalyzed" field and the corresponding "analyzed" field at standard depth levels for each one-degree square, wherever data exists in the "unanalyzed" field, is referred to as the "**interpolation error**".

### 3. CONTENTS OF WOA01

#### A. DATA CD-ROMs

The DATA CD-ROMs (WOA01-01 through WOA01-03) contain objectively analyzed fields (one-degree grid) and statistics (unanalyzed) for one-degree squares and five-degree squares at standard depth levels (Table 1) for all ocean variables, and for the 0 - 200 meter layer for the plankton biomass values.

**Table 1.** Standard depth levels and corresponding depths (meters).

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

The maximum depth for which objective analyses and statistics were computed for each variable and for each climatological compositing periods is shown in Table 2.

**Table 2.** Availability of objective analyses and statistics by climatological compositing periods for each ocean variable, and the maximum depth for which objective analyses and statistics were computed. A dash character "-" indicates these products were not computed for the specified variable and climatological time period.

<b>Variable</b>	<b>Annual</b>	<b>Seasonal</b>	<b>Monthly</b>
Temperature	5500	5500	1500
Salinity	5500	5500	1500
Dissolved oxygen	5500	5500	1500
Apparent oxygen utilization	5500	5500	1500
Percent oxygen saturation	5500	5500	1500
Phosphate	5500	500	500
Nitrate	5500	500	500
Silicate	5500	500	500
Chlorophyll	100	surface	-
Total Plankton Biomass: All biomass types <sup>1</sup> Calculated Carbon Mass	0-200 <sup>2</sup> 0-200 <sup>2</sup>	- 0-200 <sup>2</sup>	- -

<sup>1</sup> Includes Displacement Volume, Settled Volume, Wet Mass, Dry Mass, and Ash-free Dry Mass.

<sup>2</sup> Plankton Biomass is a mean of net tows covering 0 - 200 meters.

Objectively analyzed fields (one-degree grid) and difference from the annual mean fields are available for all the variables listed in Table 2. The statistics (for one-degree and five degree squares) for all variables listed in Table 2 (except plankton biomass) include:

- number of observations;
- arithmetic mean;
- standard deviation about the arithmetic mean;
- standard error of the mean.

In addition to the above statistics and objective analyses, additional fields were computed and are available. These include:



- the number of grid points which contain data within the radius of influence surrounding each grid box by one-degree squares (grid point fields);
- annual and seasonal fields of unanalyzed means minus objectively analyzed means by one-degree squares for each one-degree square that contains data (interpolation error);
- land-sea mask used in the analysis at standard depth levels;
- definition of basins used in the analysis at standard depth levels.

The available fields for plankton biomass include:

- annual and seasonal number of observations by one-degree square in the 0 - 200 meter layer;
- annual and seasonal fields of the unanalyzed means by one-degree in the 0 - 200 meter layer;

## **B. FIGURES DVDS**

The DVD section of this product contains PDF images of the fields described in the previous section:

- annual, seasonal, and monthly global data statistics of observed, unanalyzed data for one-degree and five-degree squares at standard depth levels (see Table 1). The following statistics for each grid box are included: 1) number of observations, 2) arithmetic mean, 3) standard deviation, 4) standard error of the mean, 5) "interpolation error" of the objectively analyzed fields defined as fields of unanalyzed means minus objectively analyzed means of one-degree squares at standard depth levels.
- annual, seasonal, and monthly objectively analyzed mean fields by one-degree squares at standard depth levels.
- seasonal and monthly objectively analyzed fields minus annual mean objectively analyzed fields by one-degree squares at standard depth levels.

For the purpose of this product, the seasons are defined based on the Northern Hemisphere as Winter (January-March), Spring (April-June), Summer (July-September), and Fall (October-December). Table 2 lists the maximum depths and available fields for each variable in WOA01.

## **4. DIRECTORY STRUCTURE**

The objectively analyzed fields and associated statistics for temperature, salinity, oxygen, dissolved inorganic nutrients, chlorophyll, and plankton biomass are on three CD-ROMs:

- |          |  |
|----------|--|
| WOA01-01 | annual, seasonal, and monthly fields for temperature and salinity  |
| WOA01-02 | annual, seasonal, and monthly fields for dissolved oxygen and the calculated variables apparent oxygen utilization (AOU) and percent oxygen saturation |

WOA01-03      annual, seasonal, and monthly fields for phosphate, nitrate, silicate, and annual and seasonal fields for chlorophyll and plankton biomass

There are several directories within each CD-ROM: **masks**, **programs**, **utils**, and a data directory identified by the **variable** (temperature, salinity, *etc.*) name. Figure 1 shows an example of the directory structure for temperature on WOA01-01. The *readme.pdf* file contain a PDF version of this documentation, and is included in each CD-ROM.

**masks** directory:

- basin.msk* - definition of basins used in the objective analysis . Table 3 lists the numeric value which identifies each basin (columns 1 and 4), the basin name, and the shallowest standard depth level for which each basin is defined (columns 3 and 6). The basin mask has 33 levels.
- landsea.msk* - bottom depth (standard levels given in Table 1) assigned to each one-degree latitude by one-degree longitude square. There are additional standard levels in the land-sea mask corresponding to areas where the bottom depth is greater than 5500 m (additional seven levels starting at 6000 and incrementing by 500 m to a depth of 9000 m).

**programs** directory:

- analysis.for* - FORTRAN program to print out a 10x10 degree latitude-longitude area from a user requested file
- analysis.c* - C program to print out a 10x10 degree latitude-longitude area from a user requested file
- analysis.exe* - DOS executable version of the "analysis.for" program
- anlyxyz.for* - FORTRAN program which writes the entire 360x180 degree latitude-longitude grid into a comma-separated-value output file
- anlyxyz.exe* - DOS executable version of the "anlyxyz.for" program

**utils** directory:

**gzip** directory

- gzip124.exe* - self-extracting DOS executable
- gzip124.tar* - tar'd file containing gzip source code for UNIX users

<b>temperat</b> directory	(WOA01-01)
<b>salinity</b> directory	(WOA01-01)
<b>oxygen</b> directory - Dissolved oxygen data	(WOA01-02)
<b>o2sat</b> directory - Percent oxygen saturation data	(WOA01-02)
<b>aou</b> directory - Apparent oxygen utilization data	(WOA01-02)
<b>phosph</b> directory	(WOA01-03)
<b>nitrate</b> directory	(WOA01-03)
<b>silicate</b> directory	(WOA01-03)
<b>chloroph</b> directory	(WOA01-03)
<b>plankton</b> directory	(WOA01-03)

Each variable directory in WOA01-01 and WOA01-02 contains three subdirectories:

- annual** directory - annual analyses and statistics for 33 standard depth levels
- seasonal** directory - seasonal analyses and statistics for 33 standard depth levels
- monthly** directory - monthly analyses and statistics for 24 standard depth levels

Each variable directory in WOA01-03 contains three subdirectories:

- annual** directory - annual analyses and statistics for 33 standard depth levels for dissolved inorganic nutrients, annual analyses and statistics for 7 standard depth levels for chlorophyll, and annual analyses and statistics for plankton biomass in the 0 - 200 meter layer
- seasonal** directory - seasonal analyses and statistics for 14 standard depth levels for nutrients, seasonal analyses and statistics for 1 standard depth level for chlorophyll, and seasonal analyses and statistics for plankton biomass in the 0 - 200 meter layer
- monthly** directory - monthly analyses and statistics for 14 standard depth levels for nutrients

The following file types are contained within the **annual**, **seasonal**, and **monthly** directories:

- A. *Analyzed fields (an)* - One-degree all-data objectively analyzed mean. For all variables, the annual analyzed field is the average of the twelve monthly fields for each standard level for which monthly fields exist - see Table 2. Below the deepest standard level for which a monthly field exists for a variable (from the surface layer for chlorophyll and plankton biomass), the annual field is the average of the four seasonal analyzed fields for each standard level for which seasonal fields exist. Below the deepest standard level for which seasonal fields exist for a variable, the annual field is the objectively analyzed mean field of all data. Similarly, the seasonal analyzed field is the average of the corresponding three monthly fields for each standard level for which monthly fields exist. Below the deepest standard level for which monthly fields exist, the seasonal field is the objectively analyzed mean field of all available data taken in the corresponding season. Monthly fields are the objectively analyzed mean fields of all data taken in the corresponding month.
- B. *Difference fields (ma)* - One-degree seasonal and monthly analyzed mean minus annual analyzed fields
- C. *Grid point fields (gp)* - One-degree number of grid points which contain data within the radius of influence for each grid box
- D. *Number of observations (dd)* - One-degree and five-degree geographic distribution of data used in analysis
- E. *Standard deviation (sd)* - One-degree and five-degree standard deviation from the mean

- F. *Standard error of the mean (se)* - One-degree and five-degree standard error of the mean
- G. *Means (mn)* - One-degree and five-degree unanalyzed means for all data used in analysis
- H. *Interpolation error fields (oa)* - One-degree analyzed field subtracted from one-degree unanalyzed (raw) means

## 5. DATA FORMAT

Each individual datum is stored in one of two ways:

- For *gp* (grid point), *dd* (number of observations), and *msk* files, the value is stored as a seven digit numeral followed by a decimal point (FORTRAN f8.0). The value "-100." indicates landmass or the seafloor in the *gp*, *dd*, and *basin.msk* files; the value "1." indicate landmass in the *landsea.msk* file.
- For all other files (*an*, *se*, *sd*, *mn*, *ma*, *oa*), the value is stored as a seven digit real with 4 places to the right of the decimal (FORTRAN f8.4). The value "-99.9999" indicates landmass, the sea floor, or no data.

For both cases, there are 10 values per line, followed by a return.

The first value in a one-degree square file corresponds to the grid box centered at latitude 89.5°S and longitude 0.5°E (grid box 1,1). The first 360 values are incremented eastward in longitude, constant in latitude. The 361<sup>st</sup> value in the file is for the grid square centered at latitude 88.5°S and longitude 0.5°E (grid square 2,1). Figure 2 shows the one-degree coordinate system of the analyzed fields. The five-degree square files follow the same pattern, listing 72x36 values. Figure 3 shows the five-degree coordinate system.

The program *analysis.for* and *analysis.c* are sample FORTRAN and C programs which can be used for reading in data, *analysis.exe* is a DOS executable version of *analysis.for*. These programs read in a single WOA01 one-degree or five-degree data file, request a single latitude and longitude coordinate from the user, and return a 10x10 degree latitude-longitude grid of values centered on that coordinate: this is only written to the screen. The user should modify these programs according to specific needs.

The program *anlyxyz.for* is a sample FORTRAN program which reads in a single WOA01 data file and writes out the entire 360x180 degree latitude-longitude grid values into an output file. The output file is in comma-separated-value (CSV) format, of the form "latitude, longitude, value", and uses the original file name, with an extension of ".###", where "###" is the standard depth level extracted (e.g. ".005" for standard level 5, or 50 meters - see Table 1). The program can extract a single depth level or all available levels (e.g. 1 to 33). "*anlyxyz.exe*" is the DOS executable of this program. This program works with WOA01 and WOA98 data files, and can read one-degree and five-degree formats.

## 6. FILE NAMING CONVENTION FOR ANALYZED DATA AND STATISTICS

All files in the directories containing the data have the following naming convention:

[v][tp][ft][g]/xx/.gz

where:

[v] = variable:

t = temperature  
s = salinity  
o = dissolved oxygen  
x = percent oxygen saturation  
a = apparent oxygen utilization  
p = phosphate  
n = nitrate  
i = silicate  
c = chlorophyll  
z = zooplankton biomass

[tp] = time period:

00 = all data annual  
13 - 16 = seasons (starting with 13 = Winter (Jan-Mar))  
01 - 12 = months (starting with 01 = January)

[ft] = file type:

an = all-data objectively analyzed mean  
ma = seasonal or monthly difference fields  
dd = number of observations  
sd = standard deviation of data  
se = standard error of the mean of data  
mn = unanalyzed mean of data  
oa = interpolation error fields  
gp = number of grid points containing data within the radius of influence around present grid point

[g] = grid size:

1 = one-degree square file  
5 = five-degree square file

[xx] = plankton type identifier: **Only present in the plankton data files**

dv = zooplankton displacement volume (ml/m<sup>3</sup>)  
sv = zooplankton settled volume (ml/m<sup>3</sup>)  
wm = zooplankton wet mass (mg/m<sup>3</sup>)  
dm = zooplankton dry mass (mg/m<sup>3</sup>)  
am = zooplankton ash-free dry mass (mg/m<sup>3</sup>)  
cc = calculated zooplankton Carbon content (mg-C/m<sup>3</sup>)

Examples:

*t14se1.gz* = temperature (*t*) spring (*14*) standard error (*se*) for one-degree square (*1*) compressed file (*.gz*).

*z00mn1wm.gz* = zooplankton (*z*) annual (*00*) unanalyzed mean (*mn*) for one-degree (*1*) wet mass (*wm*) compressed file (*.gz*)

## 7. util DIRECTORY

Within the **utils** directory of each CD-ROM there is a **gzip** directory which contains two files used for decompressing the data on the WOA01 CD-ROMs. 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 drive. Run *gzip124.exe* and use the file *gzip.exe* to uncompress data as described in section B.

UNIX Users:

Copy *gzip124.tar* to your UNIX system.

Run the following command: `tar -xvf gzip124.tar`

This commands will create a directory named *gzip-1.2.4* which include the *gzip* source code and documentation on copyrights, compression methods and how to compile and install the *gzip* code. Read through the README file and when ready to build the *gzip* executable, follow the instructions in the INSTALL file.

### B. Decompressing data from WOA01

To decompress the WOA01 files, it is recommended to first copy the data files to a 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 (e.g. *gzip -h*); additional information may be found at [www.gzip.org](http://www.gzip.org).

To decompress a single file:

```
gzip -nd <filename>
```

To decompress the contents of a directory and all of its subdirectories:

```
gzip -ndr <directoryname>
```

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

### **C. Removing carriage return-line feed: UNIX Users**

The DOS CR-LF (Carriage Return-Line Feed) indicates the end of a record and may cause problems when working in a UNIX environment. Many systems have a program which removes these characters from an ASCII file. Files can also be converted by transferring from DOS/WINDOWS using FTP (File Transfer Protocol). The UNIX "tr" or "perl" utilities will also remove the CR-LF.

a. *To use the UNIX translate utility, "tr":*

```
tr -d '\r' < original_filename > new_filename
```

(Note that the "<" and ">" must be typed for this command to work).

b. *To use the UNIX perl utility:*

```
perl -pi -e 's/\r\n/\n/g' filename
```

**Table 3.** Basins defined for objective analysis and the shallowest standard depth level for which each basin is defined.

#	BASIN	STANDARD DEPTH LEVEL	#	BASIN	STANDARD DEPTH LEVEL
1	Atlantic Ocean	1	30	North American Basin	29
2	Pacific Ocean	1	31	West European Basin	29
3	Indian Ocean	1	32	Southeast Indian Basin	29
4	Mediterranean Sea	1	33	Coral Sea	29
5	Baltic Sea	1	34	East Indian Basin	29
6	Black Sea	1	35	Central Indian Basin	29
7	Red Sea	1	36	Southwest Atlantic Basin	29
8	Persian Gulf	1	37	Southeast Atlantic Basin	29
9	Hudson Bay	1	38	Southeast Pacific Basin	29
10	Southern Ocean	1	39	Guatemala Basin	29
11	Arctic Ocean	1	40	East Caroline Basin	30
12	Sea of Japan	1	41	Marianas Basin	30
13	Kara Sea	8	42	Philippine Sea	30
14	Sulu Sea	10	43	Arabian Sea	30
15	Baffin Bay	14	44	Chile Basin	30
16	East Mediterranean	16	45	Somali Basin	30
17	West Mediterranean	19	46	Mascarene Basin	30
18	Sea of Okhotsk	19	47	Crosat Basin	30
19	Banda Sea	23	48	Guinea Basin	30
20	Caribbean Sea	23	49	Brazil Basin	31
21	Andaman Basin	25	50	Argentine Basin	31
22	North Caribbean	26	51	Tasman Sea	30
23	Gulf of Mexico	26	52	Atlantic Indian Basin	31
24	Beaufort Sea	28	53	Caspian Sea	1
25	South China Sea	28	54	Sulu Sea II	14
26	Barents Sea	28	55	Venezuela Basin	14
27	Celebes Sea	25	56	Bay of Bengal	1
28	Aleutian Basin	28	57	Java Sea	6
29	Fiji Basin	29	58	East Indian Atlantic Basin	32



**Figure 1.** Directory structure for the temperature data in WOA01-01. Bold denotes directories, italics denotes file names. “xx” denotes time period, 13-16 for the seasons (13 = Winter), and 01-12 for the monthly files (01 = January).

*readme.pdf*

**programs**

*analysis.for*  
*analysis.c*  
*analysis.exe*  
*anlyxyz.for*  
*anlyxyz.exe*

**mask**

*basin.msk*  
*landsea.msk*

**temperat**

**annual**

*t00an1.gz*  
*t00dd1.gz*  
*t00dd5.gz*  
*t00gp1.gz*  
*t00mn1.gz*  
*t00mn5.gz*  
*t00oa1.gz*  
*t00sd1.gz*  
*t00sd5.gz*  
*t00se1.gz*  
*t00se5.gz*

**seasonal**

*txxan1.gz*  
*txxdd1.gz*  
*txxdd5.gz*  
*txxgp1.gz*  
*txxmn1.gz*  
*txxmn5.gz*  
*txxoa1.gz*  
*txxsd1.gz*  
*txxsd5.gz*  
*txxse1.gz*  
*txxse5.gz*  
*txxma1.gz*

**monthly**

*txxan1.gz*  
*txxdd1.gz*  
*txxdd5.gz*  
*txxgp1.gz*  
*txxmn1.gz*  
*txxmn5.gz*  
*txxoa1.gz*  
*txxsd1.gz*  
*txxsd5.gz*  
*txxse1.gz*  
*txxse5.gz*  
*txxma1.gz*

*an1=one-degree analyzed field*  
*dd1=one-degree data distribution*  
*dd5=five-degree data distribution*  
*gp1=one-degree grid points*  
*mn1=unanalyzed one-degree mean*  
*mn5=unanalyzed five-degree mean*  
*oa1=observed mean minus analyzed*  
*sd1=one-degree standard deviation*  
*sd5=five-degree standard deviation*  
*se1=one-degree standard error*  
*se5=five-degree standard error*  
*ma1=seasonal/monthly minus annual fields*

**utils**

**gzip**

*gzip124.exe*  
*gzip124.tar*

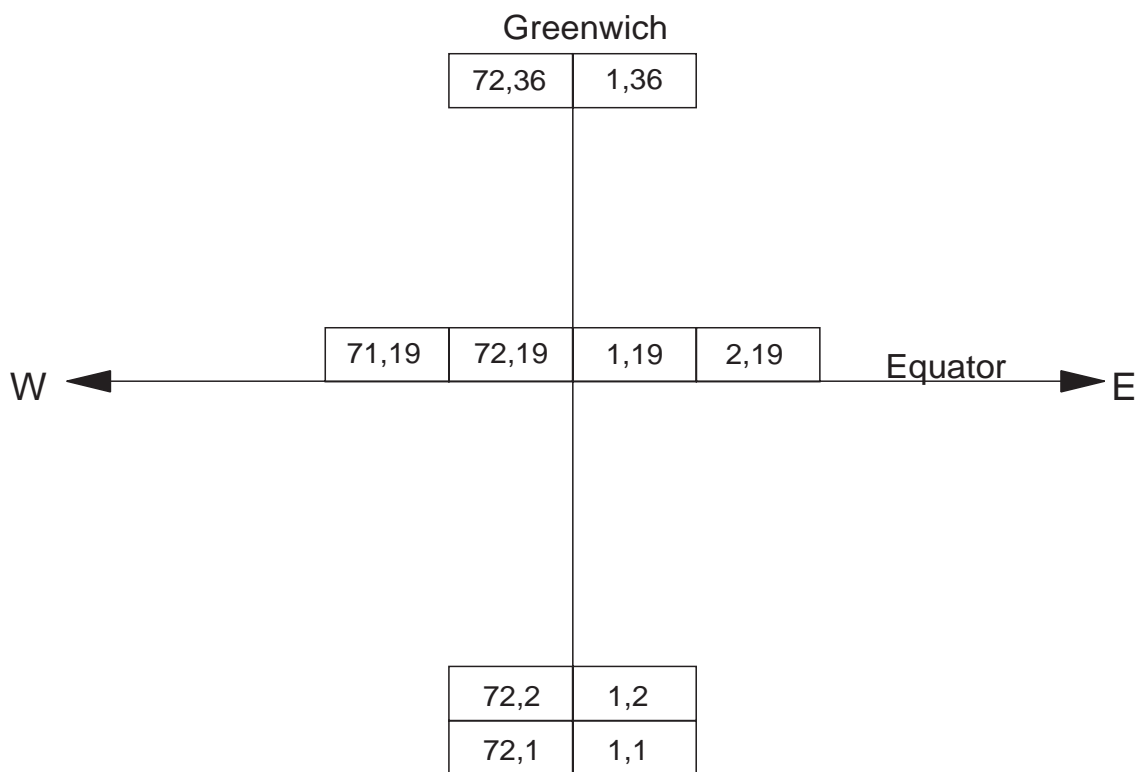


**Figure 3.** Five-degree horizontal coordinate system of the analyzed fields

Each element  $F(i,j)$  of an analyzed field  $F$ , where  $F$  is dimensioned  $F(72,36)$ , is considered to represent the value at the center of a five-degree latitude longitude square

Longitude denoted by the variable "i", varies from 1 at  $2.5^\circ\text{E}$  to 72 at  $2.5^\circ\text{W}$

Latitude denoted by the variable "j", varies from 1 at  $87.5^\circ\text{S}$  to 36 at  $87.5^\circ\text{N}$



## **8. REFERENCES ASSOCIATED WITH WORLD OCEAN ATLAS 2001**

### **A. NOAA Atlas NESDIS *World Ocean Atlas 2001* (WOA01) series:**

Stephens, C., J. I. Antonov, T. P. Boyer, M. E. Conkright, R. A. Locarnini, T. D. O'Brien, H. E. Garcia, 2002: *World Ocean Atlas 2001, Volume 1: Temperature*. S. Levitus, Ed., NOAA Atlas NESDIS 49, U.S. Government Printing Office, Wash., D.C., 167 pp., CD-ROMs.

Boyer, T. P., Stephens, C., J. I. Antonov, M. E. Conkright, R. A. Locarnini, T. D. O'Brien, H. E. Garcia, 2002: *World Ocean Atlas 2001, Volume 2: Salinity*. S. Levitus, Ed., NOAA Atlas NESDIS 50, U.S. Government Printing Office, Wash., D.C., 165 pp., CD-ROMs.

Locarnini, R. A., T. D. O'Brien, H. E. Garcia, J. I. Antonov, T. P. Boyer, M. E. Conkright, C. Stephens, 2002: *World Ocean Atlas 2001, Volume 3: Oxygen*. S. Levitus, Ed., NOAA Atlas NESDIS 51, U.S. Government Printing Office, Wash., D.C., 286 pp., CD-ROMs.

Conkright, M. E., H. E. Garcia, T. D. O'Brien, R. A. Locarnini, T. P. Boyer, C. Stephens J. I. Antonov, 2002: *World Ocean Atlas 2001, Volume 4: Nutrients*. S. Levitus, Ed., NOAA Atlas NESDIS 52, U.S. Government Printing Office, Wash., D.C., 392 pp., CD-ROMs.

O'Brien, T. D., M. E. Conkright, T. P. Boyer, C. Stephens, J. I. Antonov, R. A. Locarnini, H. E. Garcia, 2002: *World Ocean Atlas 2001, Volume 5: Plankton*. S. Levitus, Ed., NOAA Atlas NESDIS 53, U.S. Government Printing Office, Wash., D.C., 95 pp., CD-ROMs.

Conkright, M. E., T. D. O'Brien, C. Stephens, R. A. Locarnini, H. E. Garcia, T. P. Boyer, J. I. Antonov, 2002: *World Ocean Atlas 2001, Volume 6: Chlorophyll*. S. Levitus, Ed., NOAA Atlas NESDIS 52, U.S. Government Printing Office, Wash., D.C., 46 pp., CD-ROMs.

### **B. *World Ocean Database 2001* (WOD01) CD-ROM set:**

Conkright, M. E., T. D. O'Brien, T. P. Boyer, C. Stephens, R. A. Locarnini, H. E. Garcia, P. P. Murphy, D. Johnson, O. Baranova, J. I. Antonov, R. Tatusko, R. Gelfeld, I. Smolyar, 2000: *World Ocean Database 2001, CD-ROM Data Set Documentation*. National Oceanographic Data Center, Silver Spring, MD, 137 pp.

### **C. NOAA Atlas NESDIS *World Ocean Database 2001* (WOD01) Atlas series:**

Conkright, M. E., J. I. Antonov, O. K. Baranova, T. P. Boyer, H. E. Garcia, R. Gelfeld, D. Johnson, R. A. Locarnini, P. P. Murphy, T. O'Brien, I. Smolyar, C. Stephens, 2002: *World Ocean Database 2001, Volume 1: Introduction*. S. Levitus, Ed. NOAA Atlas NESDIS 42, U.S. Government Printing Office, Wash., D.C., 159 pp., CD-ROMs.

- Boyer, T. P., M. E. Conkright, J. I. Antonov, O. K. Baranova, H. E. Garcia, R. Gelfeld, D. Johnson, R. A. Locarnini, P. P. Murphy, T. O'Brien, I. Smolyar, C. Stephens, 2002: ***World Ocean Database 2001, Volume 2: Temporal Distribution of Bathythermograph Profiles***. S. Levitus, Ed., NOAA Atlas NESDIS 43, U.S. Government Printing Office, Wash., D.C., 119 pp., CD-ROMs.
- Stephens, C., M. E. Conkright, T. P. Boyer, J. I. Antonov, O. K. Baranova, H. E. Garcia, R. Gelfeld, D. Johnson, R. A. Locarnini, P. P. Murphy, T. D. O'Brien, I. Smolyar, 2002: ***World Ocean Database 2001, Volume 3: Temporal Distribution of Conductivity-Temperature-Depth (Pressure) Profiles***. S. Levitus, Ed., NOAA Atlas NESDIS 44, U.S. Government Printing Office, Wash., D.C., 47 pp., CD-ROMs.
- Locarnini, R. A., M. E. Conkright, T. P. Boyer, J. I. Antonov, O. K. Baranova, H. E. Garcia, R. Gelfeld, D. Johnson, P. P. Murphy, T. D. O'Brien, I. Smolyar, 2002: ***World Ocean Database 2001, Volume 4: Temporal Distribution of Temperature, Salinity, and Oxygen Profiles***. S. Levitus, Ed., NOAA Atlas NESDIS 45, U.S. Government Printing Office, Wash., D.C., 332 pp., CD-ROMs.
- Conkright, M. E., T. P. Boyer, J. I. Antonov, O. K. Baranova, H. E. Garcia, R. Gelfeld, D. Johnson, R. A. Locarnini, P. P. Murphy, T. D. O'Brien, I. Smolyar, C. Stephens, 2002: ***World Ocean Database 2001, Volume 5: Temporal Distribution of Nutrient Profiles***. S. Levitus, Ed., NOAA Atlas NESDIS 46, U.S. Government Printing Office, Wash., D.C., 286 pp., CD-ROMs.
- Murphy, P. P., Conkright, M. E., T. P. Boyer, J. I. Antonov, O. K. Baranova, H. E. Garcia, R. Gelfeld, D. Johnson, R. A. Locarnini, T. D. O'Brien, I. Smolyar, C. Stephens, 2002: ***World Ocean Database 2001, Volume 6: Temporal Distribution of pH, Alkalinity, pCO<sub>2</sub>, and tCO<sub>2</sub> Data***. S. Levitus, Ed., NOAA Atlas NESDIS 47, U.S. Government Printing Office, Wash., D.C., 235 pp., CD-ROMs.
- O'Brien, T. D., P. P. Murphy, M. E. Conkright, T. P. Boyer, J. I. Antonov, O. K. Baranova, H. E. Garcia, R. Gelfeld, D. Johnson, R. A. Locarnini, I. Smolyar, C. Stephens, 2002: ***World Ocean Database 2001, Volume 7: Temporal Distribution of Chlorophyll and Plankton Data***. S. Levitus, Ed., NOAA Atlas NESDIS 48, U.S. Government Printing Office, Wash., D.C., 219 pp., CD-ROMs.