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

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click on: Products

This publication should be cited as:

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

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Silver Spring, MD
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).

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

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.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Annual</th>
<th>Seasonal</th>
<th>Monthly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>5500</td>
<td>5500</td>
<td>1500</td>
</tr>
<tr>
<td>Salinity</td>
<td>5500</td>
<td>5500</td>
<td>1500</td>
</tr>
<tr>
<td>Dissolved oxygen</td>
<td>5500</td>
<td>5500</td>
<td>1500</td>
</tr>
<tr>
<td>Apparent oxygen utilization</td>
<td>5500</td>
<td>5500</td>
<td>1500</td>
</tr>
<tr>
<td>Percent oxygen saturation</td>
<td>5500</td>
<td>5500</td>
<td>1500</td>
</tr>
<tr>
<td>Phosphate</td>
<td>5500</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Nitrate</td>
<td>5500</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Silicate</td>
<td>5500</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Chlorophyll</td>
<td>100</td>
<td>surface</td>
<td>-</td>
</tr>
<tr>
<td>Total Plankton Biomass:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All biomass types&lt;sup&gt;1&lt;/sup&gt;</td>
<td>0-200&lt;sup&gt;2&lt;/sup&gt;</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Calculated Carbon Mass</td>
<td>0-200&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0-200&lt;sup&gt;2&lt;/sup&gt;</td>
<td>-</td>
</tr>
</tbody>
</table>

<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

**temperat** directory (WOA01-01)
**salinity** directory (WOA01-01)
**oxygen** directory - Dissolved oxygen data (WOA01-02)
**o2sat** directory - Percent oxygen saturation data (WOA01-02)
**aou** directory - Apparent oxygen utilization data (WOA01-02)
**phosph** directory (WOA01-03)
**nitrate** directory (WOA01-03)
**silicate** directory (WOA01-03)
**chloroph** directory (WOA01-03)
**plankton** 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 361st 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/m³)
  - sv = zooplankton settled volume (ml/m³)
  - wm = zooplankton wet mass (mg/m³)
  - dm = zooplankton dry mass (mg/m³)
  - am = zooplankton ash-free dry mass (mg/m³)
  - cc = calculated zooplankton Carbon content (mg-C/m³)
Examples:

\texttt{t14se1.gz} = temperature (\textit{t}) spring (14) standard error (\textit{se}) for one-degree square (1) compressed file (.\texttt{gz}).

\texttt{z00mn1wm.gz} = zooplankton (\textit{z}) annual (\textbf{00}) unanalyzed mean (\textit{mn}) for one-degree (1) wet mass (\textit{wm}) compressed file (.\texttt{gz})

7. util DIRECTORY

Within the \texttt{utils} directory of each CD-ROM there is a \texttt{gzip} directory which contains two files used for decompressing the data on the WOA01 CD-ROMs. The first, \texttt{gzip124.exe}, is a self-extracting DOS executable, and the second, \texttt{gzip124.tar}, is a tar'd file containing source code for UNIX users.

A. Installing gzip for the first time

DOS Users:

The file \texttt{gzip124.exe} is a self-extracting DOS executable. Copy \texttt{gzip124.exe} to your hard drive. Run \texttt{gzip124.exe} and use the file \texttt{gzip.exe} to uncompress data as described in section B.

UNIX Users:

Copy \texttt{gzip124.tar} to your UNIX system.

Run the following command: \texttt{tar -xvf gzip124.tar}

This command will create a directory named \texttt{gzip-1.2.4} which includes 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.
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.

<table>
<thead>
<tr>
<th>#</th>
<th>BASIN</th>
<th>STANDARD DEPTH LEVEL</th>
<th>#</th>
<th>BASIN</th>
<th>STANDARD DEPTH LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Atlantic Ocean</td>
<td>1</td>
<td>30</td>
<td>North American Basin</td>
<td>29</td>
</tr>
<tr>
<td>2</td>
<td>Pacific Ocean</td>
<td>1</td>
<td>31</td>
<td>West European Basin</td>
<td>29</td>
</tr>
<tr>
<td>3</td>
<td>Indian Ocean</td>
<td>1</td>
<td>32</td>
<td>Southeast Indian Basin</td>
<td>29</td>
</tr>
<tr>
<td>4</td>
<td>Mediterranean Sea</td>
<td>1</td>
<td>33</td>
<td>Coral Sea</td>
<td>29</td>
</tr>
<tr>
<td>5</td>
<td>Baltic Sea</td>
<td>1</td>
<td>34</td>
<td>East Indian Basin</td>
<td>29</td>
</tr>
<tr>
<td>6</td>
<td>Black Sea</td>
<td>1</td>
<td>35</td>
<td>Central Indian Basin</td>
<td>29</td>
</tr>
<tr>
<td>7</td>
<td>Red Sea</td>
<td>1</td>
<td>36</td>
<td>Southwest Atlantic Basin</td>
<td>29</td>
</tr>
<tr>
<td>8</td>
<td>Persian Gulf</td>
<td>1</td>
<td>37</td>
<td>Southeast Atlantic Basin</td>
<td>29</td>
</tr>
<tr>
<td>9</td>
<td>Hudson Bay</td>
<td>1</td>
<td>38</td>
<td>Southeast Pacific Basin</td>
<td>29</td>
</tr>
<tr>
<td>10</td>
<td>Southern Ocean</td>
<td>1</td>
<td>39</td>
<td>Guatemala Basin</td>
<td>29</td>
</tr>
<tr>
<td>11</td>
<td>Arctic Ocean</td>
<td>1</td>
<td>40</td>
<td>East Caroline Basin</td>
<td>30</td>
</tr>
<tr>
<td>12</td>
<td>Sea of Japan</td>
<td>1</td>
<td>41</td>
<td>Marianas Basin</td>
<td>30</td>
</tr>
<tr>
<td>13</td>
<td>Kara Sea</td>
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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

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anl=one-degree analyzed field
ddl=one-degree data distribution
dd5=five-degree data distribution
gpl=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
Each element $F(i,j)$ of an analyzed field $F$, where $F$ is dimensioned $F(360,180)$, is considered to represent the value at the center of a one-degree latitude longitude square.

Longitude denoted by the variable "i", varies from 1 at 0.5°E to 360 at 0.5°W

Latitude denoted by the variable "j", varies from 1 at 89.5°S to 180 at 89.5°N

The point $F(1,1)$ is the value at 0.5°E, 89.5°S

The point $F(218,20)$ is the value at 142.5°W, 70.5°S

The point $F(360,91)$ is the value at 0.5°W, 0.5°N
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°E to 72 at 2.5°W.

Latitude denoted by the variable "j", varies from 1 at 87.5°S to 36 at 87.5°N.

![Figure 3. Five-degree horizontal coordinate system of the analyzed fields](image-url)
8. REFERENCES ASSOCIATED WITH WORLD OCEAN ATLAS 2001

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


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


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


