About the WOA Data Files

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The http://joa.ucsd.edu/data web site includes collections of regional and section-oriented files extracted from the World Ocean Atlas (WOA) statistical-mean gridded data produced by Syd Levitus and colleagues at the NOAA National Oceanographic Data Center (NODC; now called NCEI, for National Centers for Environmental Information). The WOA files are quality-controlled mean temperature, salinity, dissolved oxygen, and nutrient data on standard level surfaces (see list below), originally produced level-by-level on a 1-degree positional grid for the World Ocean. We have converted these to vertical profile data on the same grid. They are useful for exploring the large scale, mean distributions of seawater characteristics in the World Ocean. We do not yet have these data in WHP-Exchange ASCII format (although it may be feasible at some point for us to do that). Some of the data are available in JOA ascii spreadsheet format (.jos); others are in JOA binary format (.joa). In addition to the annual means (all months), we include seasonal mean WOA data to facilitate examination of the large-scale seasonal cycle in the oceans (JFM, AMJ, JAS, and OND). [Note that in the seasonal WOA files there are no nutrient data below 800 meters.] It is recommended that the annual average WOA files be used except when there is a need to examine seasonal phenomena.

NODC/NCEI WOA standard levels used in WOA98, WOA05, WOA09, and WOA13 (depths in meters):

0, 10, 20, 30, 50, 72, 100, 125, 150, 200, 250, 300, 400, 500, 600, 700, 800, 900, 1000, 1100, 1200, 1300, 1400, 1500, 1750, 2000, 2500, 3000, 3500, 4000, 4500, 5000, 5500.

NODC/NCEI used 102 standard levels in preparing the WOA18 data files (depths in meters):

0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 125, 150, 175, 200, 225, 250, 275, 300, 325, 350, 375, 400, 425, 450, 475, 500, 550, 600, 650, 700, 750, 800, 850, 900, 950, 1000, 1050, 1100, 1150, 1200, 1250, 1300, 1350, 1400, 1450, 1500, 1550, 1600, 1650, 1700, 1750, 1800, 1850, 1900, 1950, 2000, 2100, 2200, 2300, 2400, 2500, 2600, 2700, 2800, 2900, 3000, 3100, 3200, 3300, 3400, 3500, 3600, 3700, 3800, 3900, 4000, 4100, 4200, 4300, 4400, 4500, 4600, 4700, 4800, 4900, 5000, 5100, 5200, 5300, 5400, 5500.

Codes used in WOA file names on the JOA/data site (some key codes are highlighted):

(WOA)98, 05, 09	The year NODC released the World Ocean Atlas version used for the data file; each new WOA release year includes the data from previous WOA release years plus additional data, such as newer data and more recently recovered older data, plus additional QC updates
annual	annual mean (all months)
winter JFM 13	North Hemisphere winter (January - March) [Southern Hemisphere summer]
spring AMJ 14	North Hemisphere spring (April - June) [Southern Hemisphere fall]

summer JAS 15	North Hemisphere summer (July - September) [Southern Hemisphere winter]
autumn OND 16	North Hemisphere autumn (October - December) [Southern Hemisphere spring]
an	objectively analyzed mean (JHS prefers this over the raw statistical means)
mn	raw statistical mean (not used by JHS)
decimated	grid points (longitudes only) were progressively removed from the equator to the poles in recognition that the 1-degree grid spacing in the original WOA files was not realistic in terms of real-data horizontal resolution (also reduces file size) (there is no decimation in the WOA section files)
vol	the oxygen and nutrient data are in volume units, i.e. ml/l and µm/l, respectively (these are the original units as received in the WOA files)
mass	the oxygen and nutrient data are in mass units, i.e. µm/kg (in pre-WOA18 files these were converted from NCEI's volume units for increased compatibility with present community preferences for oxygen and nutrient units)
NPAC	North Pacific Ocean - from Bering Strait to the equator, including all marginal seas
SPAC	South Pacific Ocean - from the equator to Antarctica, including all marginal seas; west limit south of Australia ca. Tasmania; east limit from the tip of the Antarctic Peninsula to the tip of South America
ATL	Atlantic Ocean - from the Greenland-Spitsbergen passage on the north to Antarctica on the south, including all marginal seas; in the north the east limit lies in the western Barents Sea and the west limit includes Baffin Bay; in the south the west limit extends from the tip of the Antarctic Peninsula to the tip of South America, and the east limit was drawn straight south a few degrees east of the tip of South Africa
IND	Indian Ocean - from Asia to Antarctica, including all marginal seas; the west limit was drawn straight south a few degrees east of the tip of South Africa; the east limit was drawn straight south of Australia from ca. Tasmania
sections	global vertical sections at 5 degree intervals of latitude and 10 degree intervals of longitude, extracted from the WOA data
surface	sea surface-only data
.jos	Java OceanAtlas ascii spreadsheet data format
.joa	Java OceanAtlas binary data format

Note about oxygen and nutrient units in the WOA data files

Until approximately the 1990s, most physical oceanographers, when they worked with data for dissolved oxygen or nutrients, used data in "volume units" - milliliters per liter (ml/l) for dissolved oxygen and micro-moles per liter (µm/l) for nutrients. In the 1990s, ocean geochemists convinced the physical oceanographers to switch to "mass units" for dissolved oxygen and nutrients - micro-moles per kilogram. Over the long haul, all the data and plots may be in mass units, but for now, there are many data sets in volume units and many in mass units.

In the original WOA files the dissolved oxygen and nutrient data are in volume units. But most of the more recent WOCE, CLIVAR repeat hydrography, and GO-SHIP vertical section oxygen and nutrient data are in mass units.

Therefore one must be careful not to confuse units for dissolved oxygen or nutrients. In most cases it is easy to distinguish the units used for dissolved oxygen: in volume units the numerical range is about 0-8 (or so) and in mass units about 0-360 (or so). But for nutrients there is only a roughly 3% difference, so be careful!

To convert from O2 in ml/l to O2 in µmol/kg multiply by 44.660 and divide by density in CGS. (There is a small issue regarding what density to use, but it gets buried in the decimal place weeds. It is best to use sigma-0, i.e. (1000 + sigma0)/1000 in CGS.) To go from nutrients in µmol/l to µmol/kg divide by density in CGS. Use sigma-0 for the nutrient conversion. [In other words, if the calculated sigma-0 associated with a given dissolved oxygen value or nutrient value were 26.523, use density 1.026523 (gm/cm^3) for the conversion.]

In JOA, one can first calculate sigma-0 and then set up a sequence of calculations via the JOA Custom Calculations dialog box to do the conversions.