0.21 W

WADIC Acronym for Wave Direction Measurement Calibration Project, a program held in the vicinity of the Edda platform in the Ekofisk field in the North Sea during winter 1985–1986. Several wave buoys, platforms and wave staffs were intercalibrated in this project. See Allender et al. [1989].

Walker circulation A name coined by Bjerknes for two circulation cells in the equatorial atmosphere, one over the Pacific and one over the Indian Ocean. Schematically these are longitudinal cells where, on one side of the ocean, convection and the associated release of latent heat in the air above lifts isobaric surfaces upward in the upper troposphere and creates a high pressure region there. The lack or lesser degree of the same process on the other side of the ocean results in lower pressure there, and a longitudinal pressure gradient is established which, being on the equator, cannot be balanced by the Coriolis force. Thus a direct zonal circulation is driven in the equatorial plane with countervailing winds at the surface and in the upper troposphere, with concomitant rising and sinking branches on the appropriate sides of the ocean.

The normal Walker circulation in the Pacific consists of air rising over Indonesia, west winds in the upper troposphere, sinking air off the west coast of South America, and east winds near the surface. A reversed but weaker Walker circulation (and an enhanced Hadley circulation occurs during ENSO years. In the Indian ocean the circulation cell proceeds in the opposite sense (to the normal Pacific Walker cell), with sinking air over cold waters off the Somali coast and a low-level acceleration from west to east along the equator in the lower atmosphere. See Henderson-Sellers and Robinson [1986] and Kraus and Businger [1994].

Walvis Basin See Cape Basin.

WAMDI Acronym for Wave Model Development and Implementation group, an organization created to advanced sea surface state models. See Group [1988].

WAMEX Acronym for the West African Monsoon Experiment, a component of FGGE designed to study monsoonal circulations. See WAMEX [1990].

Warm Deep Water See Antarctic Circumpolar Water.

WASA Acronym for Waves And Storms in the North Atlantic, a project whose goal is to verify or falsify the hypothesis of a worsening storm and wave climate in the Northeast Atlantic and its adjacent seas in the 20th century. The main conclusion of the project is that the storm- and wave–climate in most of the Northeast Atlantic and in the North Sea has undergone significant variations on times scales of decades, that is has indeed roughened in the past decades, but that the present intensity seems to cmopare with the intensity at the beginning of the century. Part of the variability was found to be related to the North Atlantic Oscillation. See WASA [1998].

`[http://www.knmi.nl/onderzk/oceano/special/wasa/index-en.html]`

WAT-BEE Acronym for WOCE/Atlantic/Tropical–Boundary Eastern Equatorial.

water mass In physical oceanography, a body of water with a common formation history. A water mass is identified through relationships on a T-S diagram, although additional information about the degree of spatial and temporal variability during its formation as expressed by a standard deviation is almost always needed as well. A single T-S point, i.e. a water type, along with its standard deviation, may be sufficient for identification (especially with deep water masses), although generally a set of T-S combinations, i.e. a function in T-S space, is needed along with a standard deviation envelope. Generally the standard deviation decreases with depth. In practice not enough data is usually available to calculate a standard deviation, so a point or line in T-S space is specified around which the water mass properties are presumed to vary. See Emery and Meincke [1986a].

Examples include AAIW, AASW, SAMW, SAUW, AACW, WDW, AABW, ABW, GSDW, ASW, PDW, SIW, WSPCW, ESPCW, WNPCW, ENPCW, NPEW, SPEW, JSMW, JSPW, IDW, PGW, ICW, AAMW, BBW, LSW, EMW, AIW, SACW, NACW, MMW, MDW, AW, and LIW.

See Emery and Meincke [1986b] and Wright and Worthington [1970].

water mass analysis A technique introduced by Jacobsen [1927] as a graphical method for determining mixing coefficients in a T–S diagram. It was extended by Wüst in 1935 who developed his core layer method. This was further extended by Tomczak [1981] who developed a multi–parameter analysis technique by adding oxygen and nutrients as additional quasi–conservative parameters. This idea was further developed into what is currently known as Optimum Multiparameter Analysis (OMP). See Rees and Aiken [1995].

water mass assembly From Bâcle et al. [2002]:

> In the following discussion we distinguish between terms that describe water masses (based on straight theta-S diagrams and origins) and those that describe the structure of the water column that comprises these water masses (based on theta and S profiles, sections and maps, e.g., haloclines, layers, mode waters). Following McLaughlin et al. [1996], the term water-mass assembly is used to describe the basic arrangement or vertical stacking of water masses within the region, recognising that components within an assembly can vary spatially.

See McLaughlin et al. [1996] and Bâcle et al. [2002].

water mass characteristics A property value or, more often, range of property values by which a water mass can be identified and tracked through the ocean. The most commonly used are temperature, potential temperature, salinity, potential density or the density referenced to a particular depth or pressure. Less often used by still quite valuable for certain applications are oxygen, nitrate, phosphate, silicate, chlorofluorocarbon, carbon 14 and tritium. See also the entry on ocean tracers.

water type In physical oceanography, a point on a T-S diagram.

water vapor feedback A positive feedback loop in the atmosphere wherein an increase in temperature increases the water holding capacity. This will lead to an increase in the amount of atmospheric water vapor which, being a greenhouse gas, will in turn lead to another temperature increase. This process is better understood in the lower troposphere where there is reasonable certainty as to the feedback process. The upper atmosphere, while not as well understood in this regard, has a preponderance of evidence pointing to this. The temperature change is not uniform with height and the resulting changes in the vertical temperature gradient can partially compensate for the water vapor feedback.

water vapor mixing ratio The ratio of the mass of water vapor to the mass of dry air in a specified volume as expressed in grams per kilogram.

water vapor pressure The part of atmospheric pressure due to the water vapor in the atmosphere.

WATOX Acronym for Western Atlantic Ocean Experiment. See Ray et al. [1990].

WATTS Acronym for Western Atlantic Thermohaline Transport Study.

wave action See Andrews and McIntyre [1978].

wave climate The general condition of sea state at a particular location, the principal elements of which are the wave height, period parameters, and the wave direction. The significant wave height is usually used as the heighter parameter with the period parameter either the significant wave period as determined from time-series analysis, the period corresponding to the spectral peak frequency, or the mean wave period from time-series or spectral analysis. The wave direction is usually expressed with the 16-point bearing system (i.e. NNE, WSW, etc.). The wave climate is described in terms of months, seasons and years. See Goda [1990].

wave–current interaction See Peregrine [1976] and Johsson [1990].

wave forecasting Predicting the development and characteristics of ocean surface gravity waves via semiempirical methods. These methods use some theory in their foundation but require basic data for the evaluation of various constants and coefficients. Advances in the state-of-the-art are usually a matter of collecting a larger database of winds and the wave they generate. The two main approaches to wave forecasting are the significant wave method and the wave spectrum method. See Komar [1976] and Bates [1949].

wave model A general term for numerical models designed to simulate the generation, propagation, shoaling, interaction, refraction, reflection, etc. of wind waves. These are used to predict wave fields for complicated wave fields and bathymetry.

First generation wave models include:

- SOWM
- ODGP (Reece and Cardone [1982])
- GSOWM

Second generation models include:

- SAIL (Greenwood et al. [1985])
- NOW
- WINCH
- ODGP-2

Third generation models include:

- CSOWM (Khandekar et al. [1994])
- SWAN
- WAVEWATCH

`[http://www.oceanweather.com/owiwav.html]`

wave set-down See wave set-up.

wave set-up A phenomenon local to the surf zone wherein wave breaking causes a stress or a landward push of the water which causes it to pile up against the shore until the seaward slope of this set-up is sufficient to oppose the wave stresses. This is called wave set-up to distinguish it from storm set-up or storm surge and from wind set-up, both of which occur over a larger scale. Wave set-up can range from 17-50% of the incident wave height on natural beaches which can give values of up to 1 m during large storms, which can result in a shoreward indundation of 50 m on a beach with a 1:50 slope. A related wave set-down is found in the vicinity of the wave breaking point in the surf zone, while the set-up occurs shoreward of this. of the wave breaking point on the beach profile, with a small set-down also found at The mechanism by which waves can exert a stress on the fluid in which they propagate is via a phenomenon called radiation stress. See Holman [1990].

wave spectrum A method for describing the characteristics of irregular waves in which parameterized formulae are developed by spectral analysis of measured wave data. Several wave spectra have been developed including:

- Pierson–Moskowitz spectrum
- JONSWAP spectrum
- TMA spectrum

See Komen et al. [1996].

wave spectrum method A method of wave forecasting that describes the waves generated by storms in terms of a complete spectrum of periods and energies rather than in terms of a single significant wave height or period. An example of a wave spectrum method is the P-N-J method, while a significant wave method is the S-M-B method. See Komar [1976].

WAVEWATCH A series of wavemodels, i.e.

- WAVEWATCH I, developed at Delft University (Tolman [1991]),
- WAVEWATCH II, developed at NASA GSFC (Tolman [1992]), and
- WAVEWATCH III, developed at NOAA/NCEP.

WAVEWATCH III is a third–generation wave model that solves the spectral action density balance equation for wavenumber–direction spectra. It is implicitly assumed that the medium (i.e. depth and current) as well as the wave field vary on time and space scales much larger than the corresponding scales of a single wave. The source code and complete documentation are available for WAVEWATCH III.

`[http://polar.wwb.noaa.gov/waves/wavewatch/wavewatch.html]`

WBC Abbreviation for western boundary current.

WDC Abbreviation for World Data Center, a system of facilities established within the framework of the IOC IODE program to receive oceanographic data and inventories from NODCs, RNODCs, marine science organizations, and individual scientists. The data are collected and submitted voluntarily from national programs or arise from international cooperative ventures. The WDCs are also responsbile for monitoring the performance of the international data exchange system. See the See the IODE Web site[168].

WDW See Warm Deep Water.

Weber number A dimensionless number that relates the inertial force to the surface tension force. It is given by

$$W = \frac{\nu^2 l \rho}{\sigma}$$

where ν is the kinematic viscosity, l a characteristic length scale, ρ the fluid density and σ the surface tension. It is generally used in momentum transfer calculations such as bubble/droplet formation and breakage of liquid jets.

[168] http://www.unesco.org/ioc/oceserv/iodestr.htm

WECOMA See Barber [1992] and other papers therein.

Weddell Gyre See Deacon [1979], Orsi et al. [1993] and Schröder and Fahrbach [1999].

Weddell Gyre Boundary See Continental Water Boundary.

Weddell Sea More about which later.

Weddell-Scotia Confluence The zone separating the waters of the Weddell Sea from those of the Scotia Sea in the Southern Ocean. This is a line extending from the South Shetland Islands near the Antarctic Peninsula in a northeastward direction across the southern Scotia Sea to as far as 30° E. The deep waters on either side of the boundary are distinguishable on the basis of their temperature and salinity properties, with those to the north of the line (from the southeast Pacific) being warmer and slightly saltier.

The water column in the western WSC itself is nearly homogenuous due to vertical mixing that is active to one degree or another throughout the year. As one proceeds eastward lateral mixing processes gradually mix this homogenous water with the stratified waters to the north and south until such stratification is restored on the WSC is no longer in evidence. The complex bathymetry in the region is thought to play a major part in inducing the lateral mixing processes. See Patterson and Sievers [1980].

Weddell Sea Bottom Water (WSBW) A type of water found in the seas surrounding Antarctica with temperatures ranging from -1.4 to 0.8° C and salinities of 34.65 ppt. It underlies Antarctic Bottom Water (AABW) and is found on the slopes and southern and western ages of the Weddell Sea basin.

Weddell Deep Water (WDW) In physical oceanography, a water mass type formed in the Weddell Sea by surface cooling and subsequent convection in the polyna. This water has stable properties with a potential temperature between 0.4-0.7° C. WDW mixes with water above the continental slope in the Weddell Sea to serve as one source for Antarctic Bottom Water. See Gordon [1982] and Tomczak and Godfrey [1994].

Wedderburn number A dimensionless number expressing a balance between surface wind stress and the pressure gradient resulting from the slope of the interface. It is given by:

$$W_n = \frac{g'h}{U_*^2}\frac{h}{L}$$

where h is the depth of the thermocline, L is the fetch length (the length of the reservoir at the thermocline in the direction of the wind), U_* is the surface friction velocity, and g' is the reduced gravity. U_* is given by:

$$U_* = C_d \frac{\rho_a}{\rho_0}^{1/2} U_{10}$$

where U_{10} is the wind velocity at 10 meters, ρ_a is the density of the air, and C_d is the drag coefficient. Meanings for various values of the Wedderburn number have been defined:

- $W_n >> 1$ - the buoyancy force is greater than the applied wind stress, i.e. there is strong vertical stratification with very little horizontal variation;
- $W_n \sim 1$ - wind stress and buoyancy forcing are nearly equal, and therefore horizontal mixing is important;
- $W_n << 1$ - the time scale for vertical mixing is small compared to horizontal advection.

well mixed estuary One of four principal types of estuaries as distinguished by prevailing flow conditions. In this type the water column is (as you might have guessed) well mixed with essentially no variation in salinity in a vertical column. The Thames estuary is an example of this type.

WENPEX Acronym for Western North Pacific Experiment, a Japanese program taking place on the Hakuho Maru from Jan. 11–Feb. 5, 1991. See Fujiyoshi et al. [1995].

WEPOCS Acronym for Western Equatorial Pacific Ocean Circulation Study, a program taking place from 1985–1988 to examine the complex current structures in a relatively poorly explored part of the tropics. See Lindstrom et al. [1987] and Lukas et al. [1991].

WEPOLEX Acronym for the U.S.-U.S.S.R. Weddell Polynya Expedition of 1981 aboard the Soviet ice-breaker SOMOV. See Chen [1982].

[http://cdiac.esd.ornl.gov/oceans/ndp_028/ndp028.html]

West African Trough See Guinea Basin.

West Europe Basin An ocean basin located in the eastern North Atlantic Ocean off the west coast of Europe (and also called the Northeastern Atlantic Basin). This includes the Porcupine Abyssal Plain west of Britain, the Biscay Abyssal Plain, and is connected to the Iberia Basin to the south by the Theta Gap. See Fairbridge [1966].

West Spitsbergen Current A current flowing offshore of West Spitsbergen Island in the eastern part of Fram Strait. This current carries comparatively warm water from the Atlantic into the Arctic Ocean. See Perkin and Lewis [1984], Swift [1986], Pfirman et al. [1994] and Richez [1998].

western boundary current (WBC) The intensification of the western limb of an oceanic circulation gyre. This is inevitable given a rotating earth, a meridional boundary, and a zonal wind stress pattern that reverses direction at some latitude as was shown using a simple dynamical model in the classic paper of Stommel [1948]. Common features of such currents include their flowing as swift narrow streams along the western continental rise of ocean basins, their extension to great depth well below the thermocline, and their separation from the coast at some point and continuation into the open ocean as narrow jets that develop instabilities along their paths. The most well-known western boundary currents are the Gulf Stream and the Kuroshio Current. See Hogg and Johns [1995].

Western Mediterranean Circulation Experiment (WMCE) A program to study the circulation of the western Mediterranean Sea from the Strait of Sicily to the Strait of Gibraltar using scales ranging from basin size to 1 km and depths from the surface to the deepest layers. The specific goals were to study the major features of the circulation and their variation in space and time, the physical forcing mechanisms, the affects of the circulation on the chemical, biological and optical properties of the western Mediterranean, and to implement the knowledge gained into numerical models.

The field study began in November 1985 and ended in March 1987, and consisted of the placement of long-term current meter moorings as well as campaigns for procuring measurements from aircraft. The field campaigns ran concurrently with those of two other experiments: POEM and the Gibraltar Experiment, with some effort being expended to make the three campaigns complementary to each other. See La Violette [1990].

[http://sit.iuav.unive.it/mednet/ocean/WMCE.html]

Western Mediterranean Deep Water (WMDW) See Perkins and Pistek [1990].

Western North Atlantic Central Water (WNACW) See Poole and Tomczak [1999].

Western North Atlantic Water (WNAW) A water mass defined by Iselin [1936] and Pollard et al. [1991] to define water found in the North Atlantic Current. The WNAW definition can be subsumed into the broader definition of North Atlantic Subpolar Mode Water, and thus can be seen as a variety of the latter. Se Read [2001].

Western North Pacific Central Water (WNPCW) In physical oceanography, the dominant water mass in the northern subtropical gyre, formed and subducted in the northern STC. This is fresher than NPEW at all temperatures and saltier than ENPCW except at temperatures above about 17° C (the upper thermocline). It is separated to the east from ENPCW at around 170° W and to the south from NPEW at around 12-15° N. See Tomczak and Godfrey [1994], p. 165.

Western Pacific Warm Pool (WPWP) An ENSO-related phenomenon conventionally defined as SSTs greater than or equal to 28 °C. It is a large area of heat accumulation in the global ocean and related to the development of El Nino. See Ho et al. [1995].

Western South Atlantic Central Water (WSACW) See Poole and Tomczak [1999].

Western South Pacific Central Water (WSPCW) In physical oceanography, a water mass which is one of six distinguishable Central Water masses in the Pacific Ocean. Its T-S properties are almost indistinguishable from those of ICW and SACW, indicative of similar atmospheric conditions during formation. It is formed and subducted in the STC between Tasmania and New Zealand, and is geographically restricted by that and Australia at 150° W. It is separated to the east from the fresher ESPCW in a broad transition zone between 145 and 100° W, and to the north from SPEW, fresher above 8° C and saltier below, at around 15° S. See Tomczak and Godfrey [1994], p. 164.

Western Tropical Atlantic Experiment (WESTRAX) An international field program conducted during 1989–1991 in the western boundary region of the tropical Atlantic between 0° and 10° N. Moored current meter observations were collected in the North Brazil Current (NBC) near the equator, near 4° N, and near 6° N to investigate the structure and variability of the NBC. See Brown et al. [1992].

WESTRAX Acronym for Western Tropical Atlantic Experiment.

WESTROPAC A 1982 cruise in the western tropical South Pacific Ocean whose goal was to reassess the regional distribution of the water masses in the area, to identify possible fronts in the region, and to get some idea of the frequency of occurrence of water mass layering, intrusions or interleaving. WESTROPAC was performed using the R. V. *Sprightly* of the CSIRO. It consisted of three individual cruises identified as *Sprightly* cruises Sp9/82 (from Sydney to Honiara), Sp10/82 (from Honiara to Nouméa), and Sp11/82 (from Nouméa to Sydney). See Tomczak and Gu [1987].

wet-bulb temperature The temperature obtained by covering the bulb of a dry-bulb thermometer with a silk or cotton wick saturated with distilled water and drawing air over it at a velocity not less than 1000 ft/min. This is often accomplished by swinging the covered thermometer on the end of a string or rope. If the atmosphere is saturated with water vapor, the water in the wick will not evaporate and the dry and wet bulb temperatures will be the same. If the atmosphere is not completely saturated, the water will evaporate from the wick at a rate depedent upon the degree of saturation. The evaporation will cool the bulb and lower the temperature reading over that of the dry-bulb temperature to that of the wet-bulb temperature.

white noise Noise that results in a spectrum where all frequency components have the same amount of energy. This can also refer the the resulting spectrum as well as the process. Compare to red noise.

White Sea One of the seas found on the Siberian shelf in the Arctic Mediterranean Sea. It is located to the west of the Barents Sea and is otherwise landlocked. See Zenkevitch [1963].

WHOI Abbreviation for Woods Hole Oceanographic Institution.

WHPO Abbreviation for WOCE Hydrographic Program Office. See the WOCE entry.

[http://whpo.ucsd.edu/]

WHYCOS Acronym for World Hydrological Cycle Observing System.

WIBP Abbreviation for Western Iberian Buoyant Plume. See Peliz et al. [2002].

Wilkes, Charles (1798–1877) See Peterson et al. [1996], p. 72.

williwaw A violent squall in the Straits of Magellan. This is a region where the winds are almost constantly strong and westerly.

wind chill temperature The hypothetical air temperature in calm conditions that would cause the same heat flux from the skin as occurs for the true winds and the true air temperature.

wind scatterometry A method wherein a specialized radar called a scatterometer is used to measure the near–surface wind speed and direction. The technique is indirect, i.e. the instrument tranasmits microwave pulses and receives backscattered power from the ocean surface. Changes in wind velocity cause changes in ocean surface roughness, modifying the radar cross–section of the ocean and the magnitude of backscattered power. This backscattered power is measured by scatterometers to obtain an estimate of the normalized radar cross–section of the sea surface. The cross–section varies with both wind speed and direction when measured at moderate incidence angles, allowing the development of a transfer function called a geophysical model function relating the former to the latter. Multiple, collocated, nearly simultaneous cross–section measurements acquired from several directions can be used to simultaneously solve for wind speed and direction. See Naderi et al. [1991].

[http://www.ee.byu.edu/ee/mers/Ocean-1.html]

wind stress The dominant driving source for the surface layer of the world's oceans. The wind stress τ represents a complex interfacial momentum exchange process between the wind and the underlying wind waves and surface currents. Historically, the measurement of the wind stress has been a problematic task. It is usually measured above the sea surface from fixed towers, ships or low–flying aircraft. The most direct approach is a technique called the eddy correlation method wherein the directional components of the near–surface turbulent stress covariance in the atmospheric boundary layer are measured.

A popular alternative technique for measuring the magnitude of the wind stress is based on equilibrium turbulent boundary layer modeling. The vertical wind profile is taken to have the form:

$$U(z) = \frac{u^*}{\kappa}\left[\ln\left(\frac{z}{z_0}\right) - \psi_m\left(\frac{z}{L}\right)\right]$$

where $U(z)$ is the wind speed at height z meters above the surface, u^* is the surface wind friction velocity given by $(\tau/\rho_a)^{1/2}$, ρ_a is the density of air, z_0 is the aerodynamic roughness length, $\kappa =$ 4 is the von Kármán constant, ψ_m is a thermal stratification function given for unstable conditions $(z/L < 0)$ by:

$$\psi_m\left(\frac{z}{L}\right) = \ln\left[\left(\frac{1+x^2}{2}\right)\left(\frac{1+x}{2}\right)^2\right] - 2\arctan x + \frac{\pi}{2}$$

where $x = (1-16z/L)^{1/4}$, and for stable conditions $(z/L > 0)$ by:

$$\psi_m\left(\frac{z}{L}\right) = -5\frac{z}{L}$$

. L is the Monin–Obukhov stability length scale defined by:

$$L = \frac{-T_\nu u_*^3}{g\kappa \overline{wT_\nu}}$$

where T_ν is the virtual temperature and g the gravitational acceleration. The associated drag coefficient is:

$$C_d = \frac{u_*^2}{U_{10}^2}$$

where U_{10} is the wind speed 10 meters above the sea surface.

The roughness length varies according to conditions. At low wind speeds with aerodynamically smooth flow over the surface it is given by:

$$z_0 = 0.11\nu/u_*$$

where ν is the kinematic viscosity of the air. As the winds grow stronger, the roughness length is given by:

$$z_0 = \alpha u_*^2/g$$

where α is known as the Charnock coefficient, which ranges from 0.011 for well–developed ocean conditions to 0.0145–0.018 for coastal sites with less mature waves. High variability among various measurements led to a proposed extension of the Charnock relation in which the roughness length is a function of the wave age, i.e.

$$z_0 = \frac{u_*^2}{g} f(c_p/u^*)$$

where c_p is the phase speed of the spectral peak waves. Several forms for this function have been proposed.

Another technique for estimating the wind stress is the inertial dissipation method, which depends on an assumed dependent on the friction velocity u^* in the spectral level of the inertial subrange of the turbulence spectrum. See Banner et al. [1999].

Winter Intermediate Water (WIW) A water mass ... See Perkins and Pistek [1990].

Winter Water See Antarctic Surface Water (AASW).

Winter Weddell Sea Experiment An experiment taking place in 1986.

WITS Acronym for Wave Identification and Tracking System, a collection of tools for wave spectral partitioning with automated swell tracking and storm source identification capabilities. The WITS spectral partitioning steps are:

1. Peak isolation via identifying the paths of steepest ascent leading to each peak in the spectral matrix.
2. Identification and combination of wind sea peaks.
3. Combination of mutual swell peaks.
4. Removal of partitions whose total energy is below a given threshold.
5. Calculation of partition statistics.

Swell-tracking is a two step process, with the first being the formation of preliminary groups of swell partitions likely to have been generated by the same source. Next, specific swell events are located within the preliminary groups. Distinct swell source times and locations are calculated from each specific group of swell partitions. See Hanson and Phillips [2001].

WIW Abbreviation for Winter Intermediate Water.

WKB approximation More later.

WMCE Abbreviation for Western Mediterranean Circulation Experiment.

WMDW Abbreviation for Western Mediterranean Deep Water.

WMONEX Acronym for Winter Monsoon Experiment, a program taking place from Dec. 1, 1978 to Mar. 5, 1979 in the Indian Ocean, the western part of the Pacific Ocean, and in adjacent continental areas.

[http://www.meteo.ru/fund/inter.html]

WNACW Abbreviation for Western North Atlantic Central Water.

WNPCW See Western North Pacific Central Water.

WOCE Acronym for the World Ocean Circulation Experiment program, a component of the WCRP that is a cooperative scientific effort by more than 30 nations to provide essential strategic research on ocean circulation. The primary goals of WOCE are (1) to develop models useful for predicting climate change and to collect the data necessary to test them and (2) to determine the representativeness of the specific WOCE data sets for the long–term behavior of the ocean, and to find methods for determining long–term changes on time scales from ten to one hundred years. The field phase of the program is from 1990 to 1997 and the analysis, interpretation, modeling and synthesis (AIMS) phase continues until the year 2002. Some WOCE observations will be continued by the CLIVAR program. For more information see the U.S. WOCE Office Web site[169], the WOCE International Project Office (IPO)[170], the WOCE Hydrographic Program Office (WHP)[171], or the WOCE Data Information Unit (DIU)[172].

Woods Hole Oceanographic Institution (WHOI) See the WHOI Web site[173].

WOCE cruises WOCE sponsored many hydrographic programs, most of which were given abbreviations based on geographic location and latitude or longitude. The Pacific cruises included:

- P1
- P2
- P6
- P9
- P10
- P12
- P13
- P14C
- P14N
- P15N
- P16C

[169] http://www-ocean.tamu.edu/WOCE/uswoce.html
[170] http://www.soc.soton.ac.uk/OTHERS/woceipo/ipo.html
[171] http://whpo.whoi.edu/
[172] http://diu.cms.udel.edu/personnel/wdiu.html
[173] http://www.whoi.edu

- P16N
- P16S
- P17C
- P17E
- P17N
- P17S
- P18
- P19A - 11/01/92 to 12/08/92, *James Clark Ross*
- P19C - 2/22/93 to 4/13/93, *Knorr*
- P19S - 12/04/92 to 1/22/93, *Knorr*
- P21
- P31
- S04P - 2/14/92 to 4/6/92, *Akademik Ioffe*
  `[http://whpo.ucsd.edu/data/onetime/southern/s04/s04p/s04pdo.txt]`
- S4
- SR4
- T10
- T24
- T47
- TEW

`[http://whpo.ucsd.edu/]`
`[http://sam.ucsd.edu/pacwoce/]`

WOMARS According to Povinec [2003]:

> [T]he research programme on Worldwide Marine Radioactivity Studies (WOMARS) [was] carried out by the IAEA's Marine Environment Laboratory in Monaco in collaboration with over 30 research institutes. The primary objective of the project was to develop an understanding of the present open-ocean distribution of radionuclides in the water column and sediment and thus predict the radiological impact to be addressed, and to encourage and support marine radioactivity studies by methodological assistance and analytical quality management. The programme was designed with the intention of reviewing and contributing to scientific knowledge of the processes that affect radionuclide distributions and the sources that have introduced radionuclides to the world's oceans. Three anthropogenic radionuclides – 90Sr, 137Cs and 239,240Pu – have been chosen as the most representative of anthropogenic radioactivity in the marine environment, comprising beta, gamma and alpha-emitters, which have the highest potential contribution to radiation doses to humans via seafood consumption.
>
> The specific objectives of the project were to: identify the major sources of anthropogenic radionuclides in the world's oceans; develop present knowledge of the distributions of key radionuclides (90Sr, 137Cs and 239,240Pu) in water and sediment of the world's oceans; and study the development of radionuclide concentrations in water with time using good quality historical data and new comprehensive data sets.

The success of the project was due to the active collaboration with participating institutions as well as with other numerous marine institutions that provided radionuclide data for the IAEA's Global Marine Radioactivity Database (GLOMARD). The IAEA would like to express its gratitude for the information provided and for most fruitful collaboration.

The results obtained in the framework of the WOMARS project provide (after the GEOSECS (Geochemical Ocean Sections Programme) carried out during the 1970s) the most complete data set available on levels of radionuclides in the world's ocean. The results will be used as the international reference source on the average levels of anthropogenic radionuclides in the marine environment so that any further contributions from nuclear reprocessing plants, radioactive waste dumping sites, nuclear bomb test sites, and possible nuclear accidents can be identified.

WOTAN Acronym for Wind Observations Through Ambient Noise, an oceanographic instrument for the determination of wind stress from measurements of ambient noise. See Vakkayil et al. [1996].

WPWP Abbreviation for Western Pacific Warm Pool.

WRINCLE The Warm Ring Inertial Circle Layer Experiment took place in March 1990 in the northwest Atlantic between 37–45° N and 75–60° W. The goal of the experiment was to investigate the rates and types of mixing associated with a Gulf Stream warm core ring. A high resolution profiler (HRP) was used to complete 78 profiles in and around one warm core ring during a 21 day cruise, with the complete depth of the ring resolved by profiling to 1000 m. The HRP measurements were accompanied by 26 CTD profiles, 55 expendable current profiler (XCP) profiles, a Richardson Number float deployment, and two XBT surveys to precisely define the position of the ring. See Kunze et al. [1995] and Schmitt and Montgomery [1991].

WSACW Abbreviation for Western South Atlantic Central Water.

WSBW See Weddell Sea Bottom Water.

WSDW See Weddell Sea Deep Water.

WSPCW See Western South Pacific Central Water.

WW See Winter Water.

Wust, Georg More later.

WWSP Abbreviation for Winter Weddell Sea Project.

Wyrtki, Klaus More later.

[http://www.soest.hawaii.edu/Wyrtki/]

Wyrtki Center for Climate Research and Prediction (WCCRP) A research center established at JIMAR whose mission is to conduct research on the predictability of the coupled ocean–atmosphere–land system, to develop the methods for making predictions of the evolution of this system, and to make experimental predictions to determine their usefulness. The focus of WCCRP is on the Asian–Australian Monsoon system and its interactions with ENSO. See the WCCRP Web site[174].

Wyville–Thomson Ridge See Greenland–Scotland Ridge.

[174] http://www.soest.hawaii.edu/WCCRP/

0.22 X

XBT Abbreviation for expendable bathythermograph. The accuracy of modern XBT probes is about 0.05° C and most used are rated to 760 m depth.

XCP Abbreviation for Expendable Current Profiler, an instrument developed at the APL. These use electric field measurements to estimate horizontal velocity relative to an unknown offset. They typically cost 40 times more than an XBT.

XCTD Abbreviation for eXpendable Conductivity, Temperature and Depth instrument. The accuracy of XCTD probes is 0.02° C in temperature and 0.03 psu in salinity, and they are rated to about 1000 m depth. They typically cost 20 times more than an XBT.

0.23 Y

Yanai wave An equatorially trapped wave that behaves like a mixture of gravity and Rossby waves. Yanai waves exhibit an eastward group velocity at all wave numbers k, although for large positive k is behaves like a Rossby wave and for large negative k like a gravity wave. For the case k=0 it is a standing wave for which the surface moves sinusoidally up and down with opposite sign on opposite sides of the equator. Fluid particles move anticyclonically around elliptical orbits. with eastward motion when the surface is elevated and westward motion when it is depressed. To be completed. See Hendershott [1981], p. 306 and Gill [1982].

Yellow Sea A marginal sea centered at around 124° E and 37° N in the western Pacific Ocean that is distinguished traditionally although not hydrographically from the adjoining East China Sea to the south. It is also called the Huanghai Sea. The name comes from huge quantities of sediment discharged into the Bohai Gulf by the Yellow River in China. The traditional demarcation line between the Yellow and East China Seas varies but usually lies somewhere around 33° N. The Yellow Sea can be separated into a northern part, the aforementioned Bohai Bay, and the Yellow Sea proper to the south and east of Bohai Bay. The average depth of the Yellow Sea is 44 m. A shallow trough runs through it and can be traced south to the northern end of the Okinawa Trough in the East China Sea.

The hydrographic and circulation properties of both the Yellow and East China Seas are controlled by their proximity to the Kuroshio Current and the seasonal variation of the monsoon winds. The chief currents are a northwest trending branch of the Kuroshio called the Yellow Sea Current (or Yellow Sea Warm Current), the southward flowing China Coastal Current, and an unnamed current flowing southward along the west coast of Korea that carries low salinity water from the Bohai Gulf. Frontal regions separate the currents in this alternating flow pattern which is identifiable through the year, although the flow strength of the individual currents varies seasonally with the monsoons.

In the winter, strong northerly winds and cold, dry continental air vertically homogenize most of the Yellow and Bohai Seas. The winds also excite subtidal sea level fluctuations that propagate southward along the west coast of the sea all the way to the South China Sea. In the summer, solar forcing and weak wind mxing warm the upper part of the water column, leaving a conspicuous bottom pool of cold water called the Yellow Sea Cold Water, which is formed from the remnant winter water. The stratification usually appears in April and disappears in November. See Tomczak and Godfrey [1994], Guan [1994], Hu [1994], Jilan [1998] and Teague et al. [1998].

Yellow Sea Current A northwestward flowing current in the central Yellow Sea that brings warm water from the Kuroshio Current with velocities that are a maximum of about 0.2 m/s at the surface and decrease rapidly with depth. This keeps the central waters several degrees warmer than those near the coast. The is also known as the Yellow Sea Warm Current. See Teague and Jacobs [2000].

Yellow Sea Warm Current See Yellow Sea Current.

Yoshida jet See Gill [1982], p. 460.

Younger Dryas A post-LGM European climate regime where the retreat of the ice was reversed. The evidence for this event, which started at about 9000 BC, is strongest for the North Atlantic Basin, although there is some evidence for it in other parts of the world. The most probable hypothesis as to the cause of this involves the significant amount of glacial meltwater inducing changes in the atmosphere-ocean circulation, i.e. the outflow of low-salinity water into the subpolar North Atlantic may have affected the rate of deep-sea mixing and thus the production rate of North Atlantic Deep Water. It was preceded by the Allerod oscillation and followed by the Pre-Boreal period. See Crowley and North [1991], Broecker [1988] and Lamb [1985], pp. 371.

young ice A type of sea ice defined by the WMO as:

> Ice in the transition stage between nilas and first–year ice, 10–30 cm in thickness. This may be subdivided into grey ice and grey–white ice.

See WMO [1970].

0.24 Z

zero velocity surface A reference level at which the horizontal velocities are thought to be practically zero.

Zimmerman, W. F. A. (1797–1864) See Peterson et al. [1996], p. 91.

zonal mean wind The distribution of the zonal mean of the eastward component of the wind through latitude and height. This is westerly through most of the troposphere, and peaks at speeds exceeding 30 m/s in the subtropical jet stream. Near the surface the zonal mean winds are westerly at most latitudes between 30 and 70°, with easterly winds prevailing a latitudes less than 30°. See Hartmann [1994].

zooplankton One of two groups into which plankton are divided, the other being phytoplankton. Zooplankton are a large group of micro- and macroscopic animals ranging in size from a fraction of a millimeter to 30–50 millimeters, with a few, such a certain jellyfish, being up to a meter in diameter. Some plankton, called permanent plankton or holoplankton, are adapted to a pelagic mode of existence and remain floating or feebly swimming throughout their entire life cycle. Others, called temporary plankton, are the transitory floating stages such as eggs, larvae, and juveniles of the benthos and nekton. This latter category is usually seasonal in occurrence and the abundance is primarily neritic since it derives from the benthos and nekton of shallow areas.

According to Rigby and Milsom [2000]:

> Members of the zooplankton have the widest geographical spread and greatest numerical abundance of any animals. Modern zooplankton are important contributors to global biomass and to the chemistry of the oceans, a dominant means of flux to the seabed, and a source of food for many large animals. The microzooplankton are dominated by flagellate protists, including some dinoflagellates and zooflagellates, and by amoebae such as foraminifera and radiolarians. Planktic ciliates are common, although the major group of these, the tintinnids, have proteinaceous tests and leave little record in the sediment. The macrozooplankton include a wide range of solitary and colonial cnidarians, chaetognath and polychaete worms, and holoplanktic gastropods. Crustaceans are among the most common macrozooplankton, with copepods, euphausiids, amphipods, ostracodes, and decapods all abundant and diverse. Urochordates are widespread with two planktic groups, appendicularians and salps. Larval stages of invertebrates and fish make up a significant proportion of the heterotrophic plankton in the modern ocean, remaining as part of the plankton for periods ranging from minutes to years.

See Johnson [1957], Riley and Chester [1971] and Rigby and Milsom [2000].

Zoppritz, Karl A German fluid dynamicist who was a pioneer in applying modern fluid dynamical methods to questions of the large–scale oceanic circulation. See Peterson et al. [1996], p. 98.

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