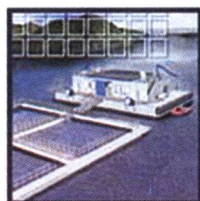
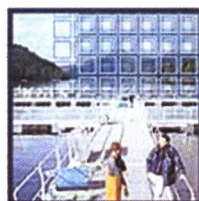
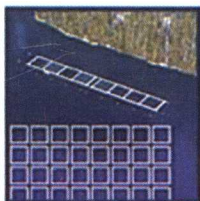
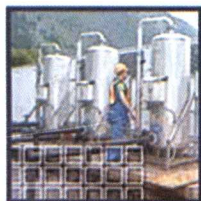
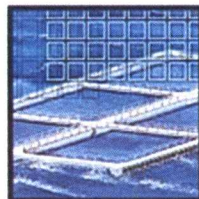
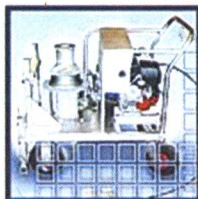




ENCYCLOPAEDIA OF MARINE TECHNOLOGY

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Preface

The aim of this encyclopaedia is to give definitions and details of terms that are of importance in Marine Technology. It is an encyclopaedia of Marine terms, written by specialists, partly for other specialists but more particularly for students. This Encyclopaedia includes various fields of Marine Technology such as PHYSICAL OCEANOGRAPHY, SONAR MARINE COMMUNICATION, SHIP BUILDING, MARINE ENGINEERING and much more.

Today's digital scholar can use this encyclopaedia as a tool to explore the vast parameters of the applications, problems, and solutions related to digital disciplines. The book has an extensive range of topics for the student who wants to discover and research other areas within the Marine Technology disciplines beyond their own.

Further to serve the needs of the teacher, student and worker in the field of Marine Science, as well as in related fields, a considerable number of terms have been included from the subject-areas bordering on Marine. The objective of editors and contributors has been the more modest one of providing a book useful as a general reference in Marine, helpful even to the specialist in regions outside of his domain of specialized knowledge.

The aim of this volume is to provide a concise repository of number of major concepts in this field. In preparation of this book, the author has freely consulted large number of books and journals so no authenticity is claimed. Author is especially thankful to M/S Anmol Publications for shaping this book in its final form. Suggestions for further improvement of this book are not only welcome but also greatly appreciated.

Author



A/B test A form of listening test in which two sounds are compared with each other in a rapid A/B fashion. Ideally, the listeners would not know the identity of the two products being compared.

A/D Converter A device that accepts an Analog signal at its input, and outputs a digital version of the signal.

A/V receiver Combines the following functions in one device: audio- and video-signal switcher; Surround Sound decoder; Multichannel amplifier; Preamplifier, including tone controls and other effects; and radio Tuner.

Abeam At right angles to, or beside, the boat

Aberration Deviation, Wandering away, The non-convergence of rays of light to one focus.

Abiotic Non-living. Abiotic factors include all aspects of climate, geology, and atmosphere that may affect living organisms.

Ablation The removal of mass from a glacier by the processes of surface melting, evaporation, and iceberg calving.

Ablation zone One of five glacier zones used to categorize areas on glaciers in terms of ice temperature and melting. The ablation zone is the area below the equilibrium line below which there is a net loss of ice over the year. The superimposed ice zone exists above this line.

ABP Abbreviation for Acoustic Backscatter Probes.

Abrasion The mechanical wearing away by rock material transported by wind or water

Abrasion platform A rock or clay platform which has been worn by the processes of abrasion.

Abroholos Violent squalls on the coast of Brazil that prevail from May to August.

Absolute humidity The ratio of the mass of water vapour in a sample of moist air to a unit volume of the sample. It is expressed in grams per cubic meter and also called the vapour concentration.

Absolute temperature Temperature measured on the Kelvin scale, whose base is absolute zero, i.e. 273°C; 0°C is expressed as 273K.

Absolute vorticity The sum of the relative vorticity and the planetary vorticity.

Absorptance In radiation transfer, the fraction of incoming radiation that is absorbed by a medium. The sum of this, the transmittance, and the reflectance must equal unity.

Absorption The removal of energy from a sonar beam as it propagates through the water. Absorption is one of the factors in limiting the range of a sonar system underwater. For lower side scan sonar frequencies, the chemical relaxation of magnesium sulfate in sea water is a major factor in absorption. The

higher frequencies are more affected by the physics of shear and viscosity.

Absorption band Wavelength interval within which electromagnetic radiation is absorbed by the atmosphere or by other substances.

Absorption coefficient The proportion of incident Sound that is absorbed by a surface. Usually this is expressed as a number between 0 and 1, or a percentage. In most materials, the amount of Absorption changes with the angle of incidence. The specification is normally a 'random incidence' measurement.

Absorption line In atmospheric radiative transfer, a discrete frequency at which an energy transition of an atmospheric gas occurs due to the absorption of incident solar radiation. The line width depends on broadening processes, the most important of which are natural, pressure (also known as collision), and Doppler broadening.

Abyss The bottom of the deep ocean below the continental shelf, usually deeper than 6,000 feet (1,755 m), where temperatures average 32 - 36°F (0-2°C) and salinity is about 35 percent.

Abyssal hill Small hills found only in the deep sea which rise from the ocean basin floor with heights ranging from 10 to over 500 feet and widths from a few hundred feet to a few miles. They are found along the seaward margin of most abyssal plains and originate from the spreading of mid-ocean ridges. As such, they usually form two strips parallel to mid-ocean ridges. They generally decrease in height as one traverses away from the ridges as they gradually become covered with sediment and are replaced by abyssal plains.

Abyssal Ocean depths greater than 4000 meters. The floor of the deep ocean, from 4000-6000 meters, is called the abyssal plain.

Abyssal plain Flat areas of the ocean basin floor which slope less than 1 part in 1000. These were formed by turbidity currents which covered the preexisting topography. Most abyssal plains are located between the base of the continental rise and the abyssal hills. The remainder are trench abyssal plains that

lie in the bottom of deep-sea trenches. This latter type traps all sediment from turbidity currents and prevents abyssal plains from forming further seaward, e.g. much of the Pacific Ocean floor.

Abyssal zone This originally meant (before the mid-1800s) the entire depth area beyond the reach of fisherman, but later investigations led to its use being restricted to the deepest regions with a uniform fauna and low temperatures. Thus it was distinguished from the overlying bathyal or archibenthal zone with more varied fauna and higher temperatures. Eventually an underlying hadal zone was defined for areas in trenches and deeps below 6000-7000 m depth. The upper boundary of the abyssal zone ranges between 1000-3000 m, with the position of the 4°C isotherm generally considered the demarcation line. It is the world's largest ecological unit, with depths exceeding 2000 m comprising over three-quarters of the world ocean.

Abyssopelagic zone One of five vertical ecological zones into which the deep sea is sometimes divided. There is a pronounced drop in the number of species and the quantity of animals as one passes into this zone. It is separated from the overlying bathypelagic zone by the 4°C isotherm and from the underlying hadopelagic zone at about 6000 meters. The distinction between pelagic and benthic species can be difficult to ascertain in this zone.

Acclimation Given a change of a single parameter, a readjustment of the physiology of an organism, reaching a new steady state

Accommodation ladder Stairs slung at the gangway.

Accretion May be either natural or artificial. Natural accretion is the buildup of land, solely by the action of the forces of nature, on a beach by deposition of water- or airborne material. Artificial accretion is a similar buildup of land by reason of an act of man, such as the accretion formed by a Groin, Breakwater, or beach fill deposited by mechanical means. Also Aggradation.

Accumulation mode One of three categories used to summarize the distribution of atmospheric aerosols in terms of production mechanism and particle size, the others being the nucleation and coarse particle modes. The accumulation mode ranges in size from 0.1 to 1 μ m in diameter and its production mechanism is by coagulation and heterogeneous condensation.

Accuracy The degree of freedom from error. The total error compared to a theoretically true value.

ACE Aerosol Characterisation Experiment is a study of the processing of gases and aerosols through hill cap clouds on Tenerife and sub-tropical marine stratocumulus. Also Autumn Circulation Experiment that took place between October 1987 and March 1988 in the North Sea.

Achromat A lens corrected for chromatic aberration (colour fringing) at two wavelengths in the visible spectrum. Most modern camera lenses are achromats.

Achromatic doublet A lens in which achromatic correction is achieved by cementing together two lenses made from different types of glass.

Achromatic vision The perception by the human eye of changes in brightness, often used to describe the perception of monochrome or black and white scenes.

Acid A proton donor. A compound containing hydrogen which dissociates in aqueous solution producing positively charged hydrogen ions (H^+). An acidic solution has a pH less than 7.0

Acid rain The deposition on land and water of strong acids (H_2SO_4 , HNO_3) in the form of rain, snow, fog, cloud water, and dry deposition. These acids are formed by the oxidation of SO and NO emitted to the atmosphere during the combustion of fossil fuels.

ACME Abbreviation for Advisory Committee on the Marine Environment, an ICES committee.

Acme biozone In biostratigraphy, a type of biozone that relies for definition on the

recognition of a maximum occurrence of a fossil that might otherwise range both higher and lower in the succession.

ACMP Abbreviation for Advisory Committee on Marine Pollution, an ICES committee.

ACMRR Abbreviation for Advisory Committee of Experts on Marine Resources Research, a FAO committee.

ACMSU Abbreviation for the Atmospheric Chemistry Modeling Support Unit, a part of UGAMP located at the Centre for Atmospheric Science at Cambridge, U.K. The ACMSU is responsible for provision of the chemical data and codes to the rest of UGAMP.

ACOH Abbreviation for Advisory Committee for Operational Hydrology, a WMO committee.

ACOMR Abbreviation for Advisory Committee on Oceanic Meteorological Research, an WMO committee.

ACOPS Abbreviation for Advisory Committee on Protection of the Sea.

Acoustic backscatter This shows how much of a transmitted acoustic signal is bounced back to a transducer.

Acoustic doppler current profiler (ADCP) Instrument that obtains water velocity profiles by transmitting sound of known frequency into the water and measuring the Doppler shift of reflections from plankton, suspended sediment, and bubbles, assumed to be moving with the water.

Many ADCPs are compatible with the SBE 44 Underwater Inductive Modem, making it possible to integrate the ADCP with other instruments that communicate via Sea-Bird's inductive modem telemetry system.

Anti-foulant device Material used to reduce biological fouling. In a conductivity sensor, a very thin coating of biological fouling can change the conductivity cell geometry, having a large effect on the conductivity measurement.

Sea-Bird's AF24173 Anti-Foulant Device is an expendable device that is installed on each

end of the conductivity cell, so that any water that enters the cell is treated. The active ingredient in the anti-foulant device is TBTO. AF24173 is registered with the U.S. Environmental Protection Agency (EPA), and approved for use with conductivity sensors.

Anti-Foulant Devices are supplied with moored CTDs (SBE 16, 16plus, 16plus-IM, 37-IM, 37-IMP, 37-SM, 37-SMP, 37-SI, 37-SIP, 52-MP), thermosalinographs (SBE 21 and 45), and drifters (SBE 41/41CP ALACE floats), and may be provided with other instruments (SBE 4M, 19plus, 26plus, 49, 53). Useful life varies, depending on several factors. We recommend that customers consider more frequent anti-foulant replacement when high biological activity and strong current flow (greater dilution of the anti-foulant concentration) are present. Moored instruments in high growth and strong dilution environments have been known to obtain a few months of quality data, while drifters that operate in non-photoc, less turbid deep ocean environments may achieve years of quality data. Experience may be the strongest determining factor in specific deployment environments. recommends that you keep track of how long the devices have been deployed, to allow you to purchase and replace the devices when needed.

For handling information, refer to the instrument manual, and to the Material Safety Data Sheet on our MSDS page. AF24173 Anti-Foulant Device is not classified by the U.S. DOT or IATA as hazardous material.

Acoustic echo A pressure (or its representation in voltage) signal that results from the scattering of sound from an acoustic impedance discontinuity (target) in the medium in which the sound is propagating (e.g., an "echo" from a zooplankter or a school of fish).

Acoustic scattering models A mathematical expression used to describe the sound scattering process from "targets" (e.g., marine organisms). Models range in complexity from empirically based linear regressions of acoustic scattering on size for a particular acoustic frequency, to complex expressions

based on first principles of physics, the acoustic frequency, and the organism's shape, size, morphology, physical structure, compressibility, and density contrasts with the surrounding medium and the target's relative orientation with respect to the acoustic sensor.

Acoustic suspension A closed box Loudspeaker Enclosure in which the Compliance (spring) of the air inside the box is a substantial portion of the total Compliance of the system, including the mechanical Suspension of the Woofer. See: Suspension, Compliance

Acoustic tag These devices, which are typically attached to fish, have also been used to detect and track whales and crabs. They come in at least two types. One is an instrument that periodically transmits a sound, allowing one to detect that sound at a remote location, determining the presence of the animal and its direction. The transponding acoustic tag makes a sound only when interrogated, thereby saving battery power in the tag and extending the tag life. By using the time delay between the interrogating signal and the reception of the acoustic response, the range to the animal can be estimated as well as its direction. Information about the animal, such as its depth or heart rate, can be encoded into the signal on either the simple or transponding tag.

Acoustic technology A technology that utilizes sound in the ocean to "see" underwater. Sound travels through water in waves, with different sizes and frequencies being created by different sounds. A large selection of different acoustic tools are used by scientists, generally involving the emission of sound (from a research vessel or other source) and the recording of its reflection off different surfaces (the ocean floor, fish schools, etc.) in its path. This acoustic technology, commonly used to track submarines, has advanced in recent years and has become a primary tool for oceanographers, both for mapping the physical shape of the ocean floor and for tracking and counting marine animals of all sizes. Applied with other technologies,

acoustics are a critical tool for Census scientists.

Acoustic tomography The inference of the state of the ocean from precise measurements of the properties of sound waves passing through it. This technique takes advantage of the facts that the properties of sound in the ocean are functions of temperature, water velocity and other salient oceanographic properties and that the ocean is nearly transparent to low-frequency sound waves. These felicitous circumstances combine to allow signals transmitted over hundreds to thousands of kilometers to be processed with inverse methods to obtain estimates of large-scale fields of ocean properties. An especially advantageous feature of this method is that, given the 3000 knot speed of sound in the ocean, reasonably synoptic fields can be constructed. The chief problems presently encountered in this field are those related to engineering sufficiently accurate transmitters and receivers for the task.

Acoustic window A covering for the hull-side opening of a sea chest that is transparent to sound. A vessel mounted ADCP is typically mounted in a sea chest and the acoustic window helps to isolate it from biofouling organisms and also the flow noise generated by the vessel.

Acoustical interference When two or more sounds arriving from different directions combine at a point in space, e.g. at an ear or microphone, those components which are in step with each other (in phase) will add (constructive interference) and those that are Out-of-phase will subtract, or cancel each other (destructive interference). See: In Phase, Out-of-phase, Comb Filter.

Acoustics The study of sound and sound waves. Ocean scientists use acoustic technology to determine their position, map the sea floor, and to track marine animals.

Acquisition The process of detecting and recognizing a seabed anomaly using sonar. Detection is a function of sonar design and acoustical physics while recognition is highly

dependent upon the eye-brain interface and operator experience.

Acrylic Poly methyl methacrylate. A clear plastic with good optical properties and very high transparency. Trade names Perspex, Plexiglass, Lucite. Acrylic is attacked by chlorinated organic solvents. Stressed (i.e., shaped or moulded) acrylic will shatter in contact with alcohols, so be very careful about what you put on it if you want to clean it (mild detergent and water is preferred). Wiping with 60-80 petrol (cigarette lighter fluid) can be used to remove severe non-water-soluble adhesions.

Acrylonitrile butadiene styrene co polymer (ABS) A cross between plastic and rubber with excellent engineering properties, used to make underwater housings, cabinets for electronic equipment, solvent-weld plumbing fittings, etc.. ABS is attacked by many industrial cleaning agents, especially chlorinated solvents, ketones (e.g., MEK), and furans (e.g., THF). Cleaning with agents other than mild detergent and water is not recommended.

Actinic flux Name given to spherical spectral radiant flux density in the atmospheric photochemistry community. It is the photochemically effective flux and the units are photons/cm²/s/nm over a series of narrow wavelength intervals. No instruments are available to measure this, and it is usually approximated using chemical actinometry techniques.

Active acoustics A subdiscipline of the branch of physics that deals with the man-made generation, propagation, and scattering of sound projected into a medium (e.g., air, water or the earth) by an investigator for the purpose of remotely determining some characteristic of the transmission medium along the propagation path.

Active continental margin A continental margin that is characterized by tectonic activity, which results from the collision of two tectonic plates, for example, the subduction of an oceanic plate under a continental plate.

Active crossover An Analog or digital device performing high-pass, low-pass and Bandpass functions ahead of Power amplifiers driving the transducers in a Loudspeaker.

Active loudspeaker A Loudspeaker which has a built-in Power Amplifier for at least one Driver, usually the Woofer or Subwoofer. It may also have amplifiers for mid and high Frequency drivers.

ADCP Abbreviation for Acoustic Doppler Current Profiler, an instrument used to measure ocean currents. It transmits high frequency acoustic signals which are backscattered from plankton, suspended sediment, and bubbles, all of which are assumed to be traveling with the mean speed of the water. The Doppler shift in the backscatter echo allows the water velocity to be determined. Further processing of the received signals allows a profile of current speed and direction to be determined. The ADCP measures the ocean current velocity continuously over the upper 300 m of the water column, usually in 8 m depth increments. It is also used to estimate the abundance and distribution of biological scatterers over the same depth range and in the same depth increments. ADCP data collection requires that four instruments work together. These are the ADCP itself, the ship's gyrocompass, a GPS receiver, and a GPS Attitude Determination Unit (ADU).

ADEOS Acronym for the Advanced Earth Observing Satellite to be launched by Japan in February 1996. It will be launched into a solar-synchronous sub-recurrent orbit in a recurrent period of 41 days at an altitude of about 800 km. The goal is to collect data appropriate for monitoring environmental changes such as global warming, ozone layer depletion, decrease in tropical rain forests, unusual weather occurrences, etc. The instruments ADEOS will carry include AVNIR, ILAS, IMG, NSCAT, OCTS, POLDER, RIS, and TOMS.

Adhemar, Joseph Alphonse A French mathematician who was the first to suggest

that the prime causal mechanism of the ice ages might be variations in the way the earth moves around the sun. He published this suggestion in a book entitled *Revolutions of the Sea* in 1842. He reasoned that the precession of the equinoxes, presently causing the southern hemisphere to have more hours of darkness per year than daylight, was what caused and maintained the ice sheet on Antarctica. He then theorized that the cycle of the precession of the equinoxes would cause whatever hemisphere was having the longer winter to have an ice age.

It is now well known that the centring of the large Antarctic land mass over the South Pole shields any ice or snow that forms there from the moderating effects of the ocean and, combined with the process of ice-albedo feedback, keeps the continent cold enough to form an ice sheet. It is also now known that the total amount of heat received by a hemisphere during the year is the same for both. Although Adhemar was wrong about the details, he did correctly identify orbital variations as a possible cause of ice ages, prompting others to follow him with better and more complete theories of the effects of orbital variations on the climate of the earth.

Adriatic sea A part of the eastern basin of the Mediterranean Sea located between Italy and the Balkan Peninsula. It is landlocked on the north, east and west, and terminates at the Otranto Strait to the south. This is one of the two regions within the Mediterranean where freshwater input exceeds evaporation (the other being the Black Sea), a situation caused by outflow from the Po River.

The flow between the Adriatic and the greater Mediterranean through the Otranto Strait is that of a typical dilution basin wherein low salinity water exits near the surface and high salinity water enters at depth. There is an additional outflow layer beneath the incoming Levantine Intermediate Water (LIW) that results from the surface water in the very shallow (less than 200 m) northern Adriatic being greatly cooled by outbreaks of strong and cold winter winds called bora. This

gives the deep outflow water, whose characteristics are a temperature of 13 C and a salinity of 38.6, a density greater than that of the overlying LIW.

Advance-10K Acronym for Analysis of Dendrochronological Variability and Natural Climates in Eurasia: The Last 10,000 Years, an EU project in which the absolute dating control and seasonal growth of long tree-ring chronologies will be used to reconstruct a range of climate variables in different regions of northern Eurasia to enhance knowledge of natural climate variability on a range of timescales within the last 10,000 years and to advance understanding of the mechanisms and forcings that generated this variability.

Advanced very high resolution radiometer (AVHRR) Crosstrack multispectral scanner on a NOAA polar orbiting satellite that acquires five spectral bands of data (0.55 to 12.50µm) with a ground resolution cell of 1.1 by 1.1 km.

Advection Changes in a sea water property (salinity, temperature, oxygen content, etc.) that take place in the presence of currents. Also, changes in atmospheric properties in the earth's atmosphere.

Advice Acronym for Annual to Decadal Variability in Climate in Europe, a project whose goals are: 1. to characterize as fully as possible the variability of climate over greater Europe, including Iceland, the Near East, and parts of North Africa, over the last 215 years; and

2. To reconstruct the climate during the Late Maunder Minimum (from 1675-1715).

AEDD Abbreviation for Arctic Environmental Data Directory, a repository for information on the Arctic in support of the Arctic Research and Policy Act of 1984. It contains descriptions of data on global change studies, environmental interactions, earth sciences, social sciences, and policy and management.

AEPS Abbreviation for Arctic Environmental Protection Strategy, a programme adopted by the governments of the eight circumpolar nations at the First Arctic Ministerial

Conference in Rovaniemi, Finland in June 1991. The objectives of the AEPS are to protect the Arctic ecosystems; provide for the protection, enhancement, and restoration of natural resources; recognize and seek to accommodate the traditional and cultural needs of the indigenous peoples; regularly review the state of the Arctic environment; and identify, reduce, and, finally, to eliminate pollution. The programmes established to meet these objectives include AMAP, PAME, EPPR, CAFE, and SDU.

AERI Acronym for Atmospheric Emitted Radiance Interferometer, a Ground Based High Resolution Interferometer Sounder (GB-HIS) which measures the downwelling atmospheric emitted radiance at 0.5 cm spectral resolution in the spectral range 3-18 µm. It measures vertical temperature and water vapour profiles, sea surface temperatures, and cloud optical properties.

Aerial magnetic survey Survey that records variations in the earth's magnetic field.

AEROCE Acronym for Atmosphere/Ocean Chemistry Experiment.

Aeronomy laboratory (AL) A part of the ERL component of NOAA that conducts research on chemical and physical processes of the earth's atmosphere to advance the capability to observe, predict, and protect the quality of the atmosphere.

Aeronomy The study of the atmosphere above about 50 km where dissociation and ionization are prevalent processes.

Aerosols These are the non-gaseous microscopic particles and droplets floating in the atmosphere that have a climate forcing effect just as do the greenhouse gases. They come from natural and artificial sources, with the most abundant ones being particles of mineral dust, sulfuric acid, ammonium sulfate, biological material-like pollens, and carbon or soot. Aerosols provide forcing in a couple of ways, the first being providing the nuclei around which larger drops of water can condense and release latent heat into the atmosphere. They can also absorb or reflect

energy radiated from the Sun or Earth. It is not known at present whether their net effect is to heat or cool the Earth.

AESOP Acronym for Airborne Experiment to Study Ozone Photochemistry, an airborne chemistry study performed during the summer of 1994 by the Tropospheric Chemistry group of the NOAA ERL Aeronomy Laboratory (AL). The NOAA Orion P-3, a midsize aircraft capable of measuring through the planetary boundary layer (PBL) and the lower and middle free troposphere, flew over the Denver and Nashville metropolitan areas to make measurements needed to understand the processes and sources of the ozone precursors that shape the distribution of ozone. The compounds and quantities measured were O₃, NO, NO₂, PAN, NO_x, NO/O₃, CO, SO₂ and aerosols (with the latter measured using the ASSP and FSSP instruments).

African waves A prominent meteorological phenomena wherein waves originate over central and western Africa and propagate westward into the eastern Atlantic Ocean. They have wavelengths of around 2500 km, periods of about 3.5 days and move with a westward speed of around 8 m/s. Their genesis begins with strong surface heating over the Sahara during the northern summer combining with cooling of the sea water over the Gulf of Guinea to the south to establish a north-south temperature gradient over central and western Africa. This gradient maintains the mid-tropospheric easterly jet stream because of the associated easterly thermal wind. The upper tropospheric jet easterly jet stream and the southward extension of the mid-latitude westerlies at the upper troposphere sit above this. This combination causes the north-south gradient of the absolute vorticity of the mean zonal wind to change sign in the mid-tropospheric area that contains the African Waves. This sign change is a necessary condition for baroclinic instability which provides a preferable environment for African Wave genesis.

After hatchway The hatchway nearest the stern.

After peak A compartment just forward of the stern post. It is generally almost entirely below the load water line.

Age and area theory A theory advanced by the British ecologist J. C. Willis to explain how the area occupied by a species is related to its population as a whole. It is simply stated as: statistically speaking, the area occupied by a species is directly proportional to its age as a species, i.e. the longer it has had time to spread, the further it will go. The practical applications of this theory apparently leave something to be desired since, according to Collinson (1988), "this is an excellent example of a logically satisfying theory which, unfortunately, so rarely fits the facts that it cannot be supported in its original form."

Age of tide The delay, usually a day or two, between full and new moons (when the equilibrium semi-diurnal tide is maximum) and the following spring tides. This terminology was first used to refer to this phenomenon by Whewell in 1883, although Defant referred to it as "spring retardation" in 1961 and Wood later (in 1978) used the terms "age of the phase inequality" and "age of the diurnal equality" to refer to, respectively, the ages of the semi-diurnal and diurnal tides. This delay is caused by frictional energy dissipation in coastal seas, although a localized increase in the age of tide is also a good indication of resonances at that location.

Agnath A superclass of the subphylum Vertebrata of the phylum Chordata. This has replaced the former class Cyclostomata and includes primitive, jawless vertebrates. Examples are lampreys, hagfish and many fossil forms. This class is also known as Marsipobranchii.

Agua je A condition observed annually in the coast water off Peru in which the water is discolored red or yellow and there is a significant loss of marine life. It typically occurs from April through June and is probably caused by an increase in water temperatures via the importation of warmer

waters by ocean currents. This causes the death of temperature sensitive marine organisms such as dinoflagellates, which may in turn kill other organisms via the release of toxins. The annual nature of this phenomenon makes it distinct from the El Nino phenomenon occurring in the same region. This is also known as *salgaso* or *aqua enferma*.

Agulhas current The branch of the western boundary current in the Indian Ocean south of 30 S. This is one of the strongest currents in the world ocean with mean speeds of 1.6 m/s throughout the year and peak speeds in excess of 2.5 m/s. It carries 95-135 Sv as it reaches the Agulhas Bank near 35 S. When it encounters the ACC while rounding the Cap of Good Hope, most of its transport turns back into the Indian Ocean in a phenomenon known as the Agulhas retroflection. This is largely due to the current developing instabilities and shedding the eddies that result.

AIDJEX Acronym for Arctic Ice Dynamics Joint Experiment, a programme that took place in two phases in 1975-1976. In summer 1975 four manned camps were maintained on ice floes in the Arctic Ocean to measure surface and geostrophic winds, ocean current velocities, and ice floe position. In April of 1976 the submarine USS Gurnard traversed 777 nautical miles along three tracklines in the Beaufort Sea, collecting ice thickness data from upward-looking acoustical soundings.

Air base Ground distance between optical centres of successive overlapping aerial photographs.

Air-blast injection Form of injection generally used on the larger early compression ignition engines. The charge of fuel was injected into the cylinder by compressed air which necessitated a compressor run by a second engine or by the engine itself. The technology was superseded by solid / mechanical injection, as generally used today.

Air casing A ring-shaped plate coaming surrounding the stack and fitted at the upper deck, just below the umbrella. It protects the

deck structure from heat and helps ventilate the fire room.

Air filter The disposable air filter is of the dry type with a filter element of folded paper. Industrial engines are fitted with a pressure drop indicator which shows a red indicator when the filter is clogged and needs replacing.

Air mass In meteorology, a contiguous and widespread body of air that has been stagnant over a surface for a sufficient length of time to have been modified by the surface. An example would be a maritime air mass that develops with high humidity over an ocean. The formation of air masses is favoured in regions of surface high pressure regions due to the ambient light winds allowing the long residence time necessary for modification. Given the prevailing global circulation patterns, warm air mass formation is favoured at 30 latitude and cold air mass formation at 90 latitude, with the boundary between these two regions being known as the polar front.

Air port An opening in the vessel's side or deck house for ventilation.

Air resources laboratory (ARL) A part of the NOAA ERL network that performs studies related to climate and air quality with research focused on turbulence and diffusion in the atmosphere, global transport of pollutants, meteorology of air pollution, air-surface exchange, and global climate change.

Airborne imaging spectrometer (AIS) Along track multispectral scanner with spectral bandwidth of 0.01 m.

Airborne visible and infrared imaging spectrometer (AVIRIS) Experimental airborne along track multispectral scanner under development at JPL to acquire 224 images in the spectral region from 0.4 to 2.4m.

Airy wave A theory of waves of small amplitude in water of arbitrary depth that is also known as linear wave theory. The derivation of the theory, given the assumptions of small wave slope () and a depth much greater than the wave height (), gives the expression for the water surface elevation where H is the wave height, k the wave number, and the wave

frequency. An expression for the wave length has also been developed, although it must be solved iteratively. Simpler expressions are available for the limiting cases of deep and shallow water, with deep water being the case where (where h is the depth and the deep water wavelength) and shallow water the case where. The particles move generally in closed elliptical orbits that decrease in diameter with depth, reducing to limiting cases of circles and straight lines in, respectively, deep and shallow water.

Aisle width The distance between two rack sections, allowing for the forklift truck to turn while carrying a boat. Larger boats require larger aisles and larger turning radii.

Aitken counter A small expansion chamber used to measure the concentration of CCN in the atmosphere.

Akroyd Stuart, Herbert (1864-1927) Although the invention of the compression ignition engine is commonly attributed to Dr Rudolph Diesel, the principles of this type of engine were first described in Akroyd Stuart's patent of 1890, two years before Diesel's patent. By 1892 Akroyd Stuart's engines were being built by Richard Hornsby & Sons Ltd of Grantham and marketed as Hornsby-Akroyds. Had the course of history run differently, we might now talk about Akroyds or Akroyd Stuarts rather than diesels!

Aland sea A part of the Baltic Sea bordered by the Gulf of Bothnia to the north, the Gulf of Finland to the east, and the main part of the Baltic Sea to the south.

Alaska current The eastern limb of the counterclockwise-flowing subpolar gyre in the North Pacific. This current is concentrated on the shelf region by the freshwater input from Alaskan rivers which enhances the pressure gradient across it. It is strongest in winter with current speeds around 0.3 m/s and weakest in July and August when prevailing winds tend to oppose its flow. This current may or may not be distinguished from a western boundary current flowing along the Aleutian Islands and called the Alaskan

Stream. Both have previously gone by the name of Aleutian Current. Whether or not the nomenclature makes a distinction, the Alaskan Stream and Current do have distinguishing characteristics. The Current is shallow and highly variable while the Stream is steadier and reaches to the ocean floor. The more barotropic nature of the latter is evidence that it is indeed a product of western boundary current dynamics while the former is in an eastern boundary regime.

Albedo The proportion of incident radiation reflected by a surface. About 30% of the incoming solar energy is reflected back to space from the earth, of which 25% is reflected by clouds and 5% by the surface or by atmospheric molecules or suspended particles. The clouds and atmospheric gases and particles absorb 25% of the incident radiation with the remainder absorbed at the surface.

Albian The last of six ages in the Early Cretaceous epoch, lasting from 113 to 97.5 Ma. It is preceded by the Aptian age and followed by the Cenomanian age of the Late Cretaceous Epoch.

Alboran sea A part of the western basin of the Mediterranean Sea that extends from the Gibraltar Strait in the west eastward to the Alboran Islands at about 3° W. It abuts the Balearic Sea to the east.

ALE/GAGE/AGAGE Abbreviation for Atmospheric Lifetime Experiment/Global Atmospheric Gases Experiment/Advanced GAGE. This is a programme in which continuous high frequency gas chromatographic measurements of two biogenic/anthropogenic gases (methane and nitrous oxide) and five anthropogenic gases (chlorofluorocarbons (3 types), methyl chloroform, carbon tetrachloride) are carried out at globally distributed sites. The programme began in 1978 and is divided into three parts associated with changes in instrumentation: 1. the ALE part which used HP5840 gas chromatographs;

2. the GAGE part which used HP5880 gas chromatographs; and

3. the AGAGE part which uses a full automated system containing a custom-designed sample module and HP5890 and Carle Instruments gas chromatographic components. The ALE/GAGE/AGAGE data are available via CDIAC.

Aleutian low A centre of action centred over the Aleutian Islands between the east coast of the Siberian Kamchatka Peninsula and the Gulf of Alaska at about 50 N. It is prominent in the winter and disappears in summer, with the average central pressure below 1000 mb in January.

ALEX Acronym for AIDJEX Lead Experiment, which took place Feb. 23 through Apr. 10, 1974 and investigated small-scale meteorological and oceanographic processes associated with leads in pack ice near Barrow, Alaska. The experiment plan called for rapid deployment of five instrumental huts, measuring equipment and personnel by helicopters and fixed-wing aircraft. The processes of primary interest were sensible, latent, and radiant heat loss to the atmosphere as well as the sinking of convective plumes of saline water formed by freezing and brine rejection at the surface. Logistical problems limited the success of the experiment, with the helicopter range limiting deployment to within 30 miles of Barrow and a dearth of suitable leads in that area.

Alfred Wegener institute (AWI) The German national research centre for polar and marine research. The Institute was founded in 1980 and named after the geophysicist and polar researcher Alfred Wegener. The mandate of the AWI includes fundamental scientific research in the polar regions, national coordination of polar research projects, and logistic support of polar expeditions from other German institutes. The Institute uses the RV Polarstern to perform research at sea.

Algae The common name for a division of primitive marine plants in which the body shows little or no differentiation of the vegetative organs, i.e. no true root, stem, or leaf. Algae also have no true vascular system.

This category includes seaweeds as well as unicellular and filamentous organisms. The study of algae is known as either algology or phycology.

Algerian current A current that flows eastward along the Algerian coast in the Mediterranean Sea. It flows as a narrow, easily distinguished current for around 300 km from about 0 to 4 E with a width of less than 30 km, average and maximum velocities of 0.4 and 0.8 m/s, respectively, and a transport of about 0.5 Sv. This is a continuation of the current associated with the Almeria-Oran Front that is itself a continuation of the flow of Atlantic Ocean water entering through the Gibraltar Strait.

Algorithm A step-by-step procedure for solving a problem or accomplishing a task, usually by using a microprocessor or DSP. In digital audio, algorithms are often used for Sound processing, data Compression and Surround Sound en-/decoding.

Aliasing A phenomenon encountered when sampling a continuous function to produce values at discrete points. If the sampling frequency isn't high enough to resolve the highest frequency signal present in the continuous function, then the high frequency information above the sampling frequency will appear as a false enhancement of (or, equivalently, be aliased onto) a related lower frequency in the computed power spectrum.

Alignment The course along which the centre line of a channel, canal or drain is located.

ALIPOR Acronym for Autonomous Lander Instrumentation Packages for Oceanographic Research, a project funded by MAST III to create a European fleet of lander vehicles that can operate together in joint research projects. Lander vehicles will be built to carry out a variety of experiments ranging from sediment probes to fish tracking. Three facets of lander technology are to be addressed: 1. the development of techniques to launch a fleet of landers from a single ship;

2. The development of new sensors for examining processes in the water of the deep benthic boundary layer at depths ranging from 200 to 5000 meters; and

3. The design and construction of two new types of landers, i.e. one that can carry several sensing devices and another compact one that can be operated from a small vessel.

Alkaline battery A battery which uses an aqueous alkaline solution for its electrolyte.

Alkalinity A property of sea water operationally defined as the excess positive charge to be balanced by CO_3 and HCO_3 ions. The carbonate ion content of any unit of sea water is equal to its alkalinity (i.e. excess positive charge) minus its total dissolved carbon content.

Allen's rule An ecogeographical rule, also known as the proportional rule, extends Bergman's Rule to include protruding parts of the body such as necks, legs, tails, ears and bills, i.e. such parts are shorter in animals that dwell in cooler regions. This was established by Joel A. Allen in 1877.

Allerod oscillation A post-LGM European climate regime. This refers to a period of general warmth between 10,000 and 9000 BC. It was preceded by the Bolling oscillation and followed by the Younger Dryas.

Allometry The relationship between size and shape in an organism or object. In heterochrony, if a particular structure increases in size relative to the whole organism during ontogeny, then the growth is said to show positive allometry; if it decreases in relative size, then it shows negative allometry. Increasing/decreasing the degree of allometry is called peramorphosis/paedomorphosis.

Allopatric speciation The differentiation of geographically isolated populations into distinct species

Allotropy The existence of the same state of more than one form of the same element with different properties.

Allozyme A variant of an enzyme type. These may be variants of a specific enzyme (e.g., cytochrome c) that are the products of a single genetic locus.

Alluvial Of or pertaining to an unconsolidated, stratified deposit laid down by running water.

Occasionally applied only to fine sediments (e.g. silt and clay), but more generally referring to coarser sediments such as sand and gravel as well.

Alluvial deposits Detrital material which is transported by a river and deposited – usually temporarily – at points along the flood plain of a river. Commonly composed of sands and gravels.

Almeria-Oran front A front and an associated current that separate the fresher water flowing in from the Atlantic Ocean via the Gibraltar Strait from the saltier Mediterranean Sea water to the west. The incoming water flows eastward as a jet, breaks into one or two large eddies of around 150 km diameter, and then is deflected to the right (the south) by the Coriolis force where it encounters the African coast and continues flowing eastward as the Algerian Current.

Almost intransitive In dynamical systems theory, a system is said to be almost intransitive if it mimics transitive behaviour for an indeterminate period of time and then switches to an alternative resultant state in the manner of an intransitive system. Thus, different initial conditions may not only lead to different resultant states, but also to eventual transitions between different resultant states.

Along track The dimension of the seabed or data record in a direction parallel to the track of the towfish (transverse). This is the opposite of the cross-track dimension. These two terms are used to describe sonar phenomena and dimensional corrections.

Along Track Scanner Scanner with a linear array of detectors oriented normal to flight path. The IFOV of each detector sweeps a path parallel with the flight direction.

Alongshore Parallel to and near the shoreline; Longshore.

Alteration Changes in color and mineralogy of rocks surrounding a mineral deposit that are caused by the solutions that formed the deposit. Suites of alteration minerals commonly occur in zones.