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A

Ablation The action of removing and carrying away a superficial material; it primarily relates to the *sublimation*, melting and evaporation which remove snow and ice from the surface of a glacier or snowfield. It can also be applied to the wearing away of rock by water and the removal of salt or sand from a surface by the action of wind.

Ablation zone The region of a glacier that experiences net loss of mass throughout the year (i.e. ablation exceeds accumulation).

Absolute zero The temperature at which molecules have no internal energy and are at a complete rest. This is equivalent to zero kelvin or - 273.15 degrees Celsius.

Absorption bands Sections of the electromagnetic spectrum that interfere with the passage of radiation to the Earth's surface.

Abyssal plain The flat deep-sea floor extending seawards from the base of the continental slope and continental rise, reaching depths of 4-6 km between mid-ocean ridges and trenches.

Accumulation zone The region of a glacier that experiences net gain of mass throughout the year (i.e. accumulation of snow, *firn* and ice).

Across-track sensors Scanning instruments that collect data by directing the line of sight in a sweeping motion at right angles to the direction of travel by a rotating or oscillating mirror. These are also called whiskbroom scanners.

Active layer The thin top layer of the ground surface that is seasonally frozen and unfrozen above *permafrost*.

Adiabatic The expansion of a body of air without loss or gain of heat.

Adsorbed When a specific gas, liquid or substance in solution adheres to the exposed surface of a material with which it is in contact, usually a solid, e.g. the adsorption of anions to the surface of clay minerals by electrostatic attractions.

Adsorption Attachment of a substance in solution to a solid.

Advection The horizontal circulation of an ocean body or air mass.

Advective solution The process in which solutes are removed and transported through the soil in a flow of water (e.g. runoff and percolating water); it is very effective at removing solutes from near the surface; similar to leaching.

Aeolian Pertaining to the processes, Earth materials and landforms that involve the role of wind.

Aeration The ventilation of soil.

Aerosols Minute particles suspended in the atmosphere that interact with the Earth's radiation budget and climate.

Aggradation The raising of a surface caused by the accumulation of material deposited by various geomorphological agents (e.g. wind, water or wave).

Aggregate A grouping of soil particles adhered together and separated from surrounding aggregates by voids in the soil. Also known as *ped*.

Agronomy Subject of utilizing plant processes for crop growth.

Air mass An extensive body of air possessing relatively uniform conditions of temperature and moisture that is in contact with the ground.

Alas Small irregularly shaped lakes and depressions caused by the melting of massive ground ice.

Albedo The proportion of radiation reflected from a surface. Surfaces such as snow have a high albedo.

Alkaline A substance which has properties of an alkali, a pH greater than 7.

Alkalinity The capacity of water to neutralize acid, determined by the quantity of base *cations* (Na^+ , K^+ , Mg^{2+} , Ca^{2+}) in the substance. Measured by titration of the sample with a strong mineral acid.

Allelopathy A biological occurrence whereby one plant species can limit the growth of another through the release of inhibiting metabolic chemicals into the local environment.

Allochthonous A material or resource which is not indigenous to the location in which it is found and has therefore travelled to reach the said location.

Allogenic Pertaining to a change in system dynamics caused by the influence of an external environmental factor, i.e. in relation to river channel adjustment, an allogenic change involves a move away from equilibrium conditions in response to an alteration in the sediment and water regime of the river.

Alluvial fan A fan-shaped landform composed of alluvium, deposited where a tributary stream loses momentum on entering a more gently sloping valley.

Along-track sensors Scanning devices that collect data using a linear array of instruments oriented perpendicularly to the direction of travel covering one side of the *swath* to the other. These are also called pushbroom scanners.

Alpine permafrost Permafrost that occurs locally owing to low temperatures at high altitudes, e.g. the Rocky Mountains.

Alternative dispute resolution The process of settling an environmental dispute through mediation and arbitration (avoiding litigation); it avoids strict winners and losers by presenting a range of choices and encouraging *participatory analysis*.

Amictic Amictic comes from amixis, which means a lack of mixing. Amictic lakes are those which do not circulate, usually because they are covered in ice for the majority of the year and therefore wind is not able to mix the water; they are predominantly found in high-latitude and high-altitude locations.

Amhidrome Points in the oceans where there is zero tidal range due to cancelling out of tides. Tides radiate out from amphidromes.

Anaerobic Functioning in the absence of oxygen.

Anaerobic bacteria Microorganisms that survive in environments containing no free or dissolved oxygen; they obtain oxygen through the decomposition of chemical compounds, such as nitrates.

Analogue image An image composed of continuous tone.

Anastomosing Pertaining to the tendency for certain rivers to divide and reunite, producing a complex pattern of channels with large, stable islands between the channels.

Angle of repose The maximum slope gradient at which uncon-solidated material will remain stable without collapse.

Anions Negatively charged *ions*, i.e. an atom which has gained one or more negatively charged electrons, e.g. the chloride ion (Cl⁻).

Anoxic Depleted of oxygen; in water usually a result of bacterial oxygen consumption and other respiration in areas of restricted circulation.

Antarctic Bottom Water (ABW) A body of water formed along the edge of the Antarctic continent. Very dense water created by the very cold, saline conditions is forced to sink and flow north underneath the *North Atlantic Deep Water (NADW)*; together they power the *thermohaline circulation* of the world's oceans.

Anticyclogenesis A condition in which a zone of descending air results in high pressure at ground level and air to circulate slowly outwards from the descending zone. This results in anticyclonic conditions.

Anti-dune A type of small-scale cross-bedding feature formed from a sand deposit on a river bed. It develops from a 'normal' dune when the flow velocity increases in a highly loaded river; erosion from the downstream slope throws material into saltation and suspension more easily than it can be replenished from upstream, causing upstream migration of the bedform feature.

Aquifer A layer of rock with sufficient porosity to absorb and store water and permeable enough to allow water to pass freely through as groundwater.

Aquitard An *aquifer* which has been confined between impermeable rock layers and only open for recharge and discharge at certain locations.

Archimedes' principle Any object wholly or partially immersed in a fluid will experience a buoyant force (or upthrust) equal to the weight of the fluid displaced.

Arete A steep knife-edge ridge that divides the steep walls of two adjacent cirques in a mountainous region.

Argillic A term to describe a soil horizon characterized by clay accumulation.

Aridity A state of lacking in moisture, when evapotranspiration exceeds precipitation. It can be defined by the annual overall net negative moisture balance of a particular environment.

Armoured layer The coarser stoned surface layer of a mixed gravel-bed river, protecting the finer material beneath.

Artificial neural network (ANN) A type of parallel computing in which memory is distributed across a number of smaller processing units that process information in a parallel manner.

Aspiration The act of drawing air.

Asthenosphere The ductile layer of the Earth's mantle located 100-400 km below the surface, on which the rigid lithospheric plates glide.

Atmometer An instrument for taking direct measurements of evaporation; by connecting a water supply to a porous surface the amount of evaporation over a given time is measured by the change in water stored.

Atolls Coral reefs that surround a central lagoon; most are found in the Indian and Pacific Oceans.

Autochthonous A material or resource which is indigenous to the location in which it is found.

Autogenic Pertaining to a change in system dynamics caused by the influence of an internal, self-produced factor, i.e. in relation to river channel adjustments, an autogenic change involves a fluctuation about an equilibrium condition.

Autotrophs Those life forms that acquire their energy from the Sun via the process of photosynthesis. They form the first *trophic level* by creating a source of energy for other animals, birds and insects.

Available water The water available in soil for plant growth after excess water has drained owing to gravitational forces, i.e. the water retained between the states of *field capacity* and *wilting point*.

Avulsion The process whereby a channel shifts, abandoning its old course for a new course, and leaving an intervening area of floodplain intact.

B

Back-scar The upslope section of the wall from which a landslide has occurred, creating a scar.

Backscatter The return signal of a radiation pulse from an active remote sensor. This is also called the echo.

Backwash The seaward return pulse of water from a breaking wave along the shoreline, moving under the force of gravity.

Badlands A deeply eroded barren landscape characterized by very irregular topography with ridges, peaks and mesas resulting from wind and water erosion of sedimentary rock. Badlands originally referred to the heavily eroded arid region of south-west South Dakota and north-west Nebraska in the United States but is now a more generic term.

Balance velocity The flow velocity required by a glacier to maintain the ice in equilibrium; the mass transferred down the glacier should equal that lost by melting in the ablation zone.

Bank-full Condition when the river channel is full of water.

Bank-full discharge The level of discharge at which any more water would cause the river to spill out of the channel onto adjacent low-lying land.

Barchan dunes Isolated crescentic sand dunes with a shallow windward and a steep lee side whose horns point in the direction of dune movement (usually forming under conditions of limited sand supply).

Barrier beaches Elongated offshore banks of coarse granular debris (sand, gravel) lying parallel to the coastline that are not submerged by the tide (see *barriers*).

Barrier islands Elongated offshore islands of coarse granular material, lying parallel to the coastline, similar to barrier beaches but larger in scale and forming behind barrier beaches (see *barriers*).

Barriers Elements of a beach planform located just offshore that involve the accumulation of landward-migrating sand shoals running parallel to the coastline that achieve surface elevation as they roll inland (see *barrier beaches* and *barrier islands*).

Bars Ridges of coarse sediment deposited on a stream bed where the stream velocity drops, especially mid-stream and on the inside of meanders.

Base Pertaining to substances with a pH above 7 (notably calcium, magnesium, potassium and sodium) or substances that release hydroxide ions (OH⁻).

Base saturation The percentage of base cations that make up the total exchangeable cations in soil.

Base station A stationary *global positioning system* receiver positioned over a known point that continuously collects data from satellites used to correct the recorded positions of the roving global positioning system receivers.

Baseflow The stable portion of a river's discharge, contributed by *groundwater* transfers.

Batholith A large irregular shaped mass of *igneous rock*, often granite; it is formed through the intrusion of magma into the strata at depth, where it melts the strata. The igneous rock is then exposed when the less resistant overlying rock is eroded away over time.

Bathymetry The study and mapping of ocean floor topography.

Bay-head delta A delta at the head of an estuary or a bay into which a river discharges. They typically occur if the river carries large amounts of sediment, or where the coastline is being submerged.

Beach cusps Crescent-shaped accumulations of sand or shingle surrounding a depression on a beach; they are always found in combination and formed when outgoing *rip currents* and incoming waves combine to create circular water movements.

Beach nourishment A *soft engineering* technique implemented to reduce the impact of beach erosion. The method involves adding sediment to the beach to maintain the beach profile.

Beamwidth The width of a radar pulse in the direction of travel. A narrow beamwidth means higher resolution.

Bed load Sediment grains transported in water by rolling along the bed surface or through *saltation*.

Bed return flow The average return flow of water offshore near to the bed, after it has been brought onshore in the upper water column. Large amounts of beach material can be removed from the beach in the bed return flow.

Bed form A morphological feature developed by fluid flow across the surface of soft sediment, involving the entrainment or deposition of sediment.

Benthic Pertaining to organisms dwelling on the river or sea floor.

Benthos Benthic organisms (see *Benthic*).

Bergeron process The formation of precipitation described by the Bergeron-Findeison theory. Ice crystals fall from the upper part of a cloud, leading to aggregation of crystals and accretion of supercooled water. Ice crystals grow preferentially by *sublimation* at the expense of surrounding water droplets because the relative humidity above an ice surface is greater than a liquid surface and hence the saturation vapour pressure over water is greater than ice, causing a pressure gradient towards the ice.

Berm Prominent ridges at the back of a beach with a steep seaward face and flat top, marking the limit of the swash zone.

Best Management Practices (BMPs) Methods of minimizing diffuse pollution. BMPs consist of two types: structural, e.g. wetlands, and procedural, e.g. handling methods for polluting chemicals.

Bifurcation point Bifurcation theory is a branch of chaos theory, and the bifurcation point refers to an occurrence within this theory. The bifurcation point is the point of change in a non-linear system where there is a branching off into different paths, which can lead to differing outcomes. Along each branch of the system new influences will determine the eventual outcome which may result in feedback loops or descent into chaos. The bifurcation point marks a sudden change as opposed to a slow one which would allow for gradual evolution.

Bimodal distribution A statistical term signifying that the frequency curve of a distribution of data has two maxima (two modal classes).

Binge-purge model A model of ice sheet development related to inherent instabilities of large ice sheets; ice loading due to the growth of an ice sheet increases basal pressure causing substrate failure and greater meltwater production, thereby increasing ice flow velocity and ice rafting. The release of this excess ice would then stabilize the ice sheet again. Proposed as a possible cause of *Heinrich events*.

Bioaccumulation The accumulation of toxins in specific parts of the ecosystem (usually at the higher levels of food chains) due to the greater ability of some chemicals to accumulate in zones where they become bioavailable, and are taken up and stored by producers and consumers. The materials must be stored in those parts of the individual that will be consumed. It may result in severe adverse effects on an ecosystem once a threshold level of toxin storage is reached.

Biochemical oxygen demand (BOD) A measure of the amount of biochemically degradable organic matter in water that is widely used in water pollution assessments.

Bioconcentration The level of concentration of accumulated toxins found in plant or animal tissues (via the process of *bioaccumulation*) compared with background natural levels.

Biodiversity The number and variety of taxonomic groups (usually species) of plants and animals at a site or within a region.

Biogenous Pertaining to material derived from organisms.

Biogeochemical Pertaining to the chemical relationships between the geology of an area and its plant and animal life.

Biogeochemical cycles These cycles are the pathways through which the elements necessary for life travel in the biotic and abiotic environment. Along these pathways there are changes in the fluxes of the element depending on the residence time in varying reservoirs and the transformations of the elements which occur.

Bioherm An ancient mass of rock formed by sedentary organisms, such as corals.

Biological sediments Sediments derived from organic materials, either remains of dead organisms (e.g. shells, plants) or framework organisms (e.g. coral reefs).

Biomass The total dry weight of living organic matter, usually measured per unit area over a particular time interval. Tends to include dead parts of organisms when referring to soils.

Biome A coarse unit of ecosystem classification based on what the land cover and ecosystems look like.

Bioregional theory A concept first put forward by Brunckhorst (1995) as a framework for regional planning based on a firm understanding of the sustainable and interconnected elements of both the geophysical and the cultural indicators that unify an *ecosystem*, therefore valuing both the natural *landscape ecology* and the conservation values developed from local cultural beliefs.

Biosphere All the organisms on the planet, viewed as a system of interacting components making a thin film on the planet's surface, and including parts of the atmosphere, hydrosphere and *lithosphere*.

Biostratigraphic Pertaining to the division of sedimentary deposits based upon their fossil evidence, each biostratigraphic unit having a distinctive fossil assemblage, e.g. the use of fossilized pollen assemblages for studying European *interglacial intervals*.

Bit scale Refers to the number of colours used to quantify brightness values in a digital image.

Black body An ideal body or surface that absorbs and emits all radiant energy dependent on its absolute temperature.

Black smokers Hydrothermal springs lying along the rift valley of *mid-ocean ridges*. Seawater that seeps into fissures in the basaltic lava becomes superheated and chemically interacts with the basaltic rock to create a black precipitate of metal sulphides.

Blockfield A continuous spread of angular rock fragments across a high mountain or plateau in a periglacial environment; formed *in situ* by frost shattering (occasionally transported and deposited by saturated material in *gelifluction*).

Bond cycles A grouping of *Dansgaard-Oeschger (D-O) events* together into a larger cycle with a long cooling trend followed by an abrupt warming.

Bottomset beds Horizontally layered sediment beds deposited in front of a delta as it progrades seawards. They become covered and end up at the bottom of a stack of deltaic sediments (below the *foreset beds* and *topset beds*).

Boudins Bands of connected debris-rich ice lenses in a glacier, once connected but broken under pressure (forming a sausage shape; *boudin* is French for sausage).

Boulder-controlled slope A scree slope at the base of a cliff in which the scree material is removed as quickly as new material is added to it by rockfall creating a thin covering maintained at the angle of repose. The landform (cliff and boulder-controlled slope) retreats at an almost constant ratio.

Boulton-Menzies theory A theory of *drumlin* formation suggesting drumlins are formed by deposition in the lee of a slowly moving obstacle in the deforming layer of a glacier, therefore streamlining the deposition.

Boundary conditions The physical conditions at the boundaries of a system. They are particularly used in modelling work and for example would refer to the impermeable nature of the floor of an aquifer in the model.

Boundary roughness The roughness of the river channel bed and the submerged bank.

Braided channel A river channel consisting of separate, but interlinked, migrating channels flowing either side of active unvegetated bars that change position owing to bed load transport.

Breakwater A coastal management feature in which a submerged artificial barrier offshore acts to break incoming waves or create new diffraction patterns, protecting the shoreline from wave action in the process.

Bulk density The weight per unit volume of a solid particulate as it is normally packed (including solids and pore spaces). Usually expressed as lb/ft^3 or g cm^{-3} .

C

Calcareous ooze Fine-grained deep-ocean *biogenous* sediment containing at least 30% skeletal remains of marine organisms based on calcium carbonate (CaCO_3).

Calcrete A *duricrust* composed mainly of calcium carbonate.

Caldera A large, steep-sided, land surface depression containing volcanic vents. Formed by large-scale subsidence as the parent magma chamber cools and contracts following a major volcanic eruption.

Calibre The size of sediment particles.

Candle ice Ice consisting of vertically orientated crystals often over 1 m in length.

Capillarity Also known as capillary action. It is the process whereby a liquid can act against the force of gravity and flow upwards in a narrow tube such as those found in a porous material. It is dependent upon the surface tension of the liquid and the adhesion of the molecules.

Capillary water Water that remains in small pores in the soil against the forces of gravity; the major source of water available for plant uptake.

Carbon sequestration The uptake of carbon by a system. Carbon dioxide can be absorbed by plants from the atmosphere and then this is converted into solid plant material. The carbon is then part of the terrestrial system and has been 'taken up' from the atmosphere.

Carnivores Organisms (usually an animal) that consume meat and therefore occupy a high *trophic level* in the *ecosystem*.

Catastrophe theory A theory in which non-linear interactions within a system cause a threshold to be crossed which then leads to a sudden and dramatic change to a new stable model of operation. Before the threshold is crossed changes may be slow and barely noticeable.

Catchment An open system defined as the area of land drained by a particular stream or river; it represents a fundamental unit in hydrology and is usually topographically well defined. A catchment may be composed of a series of subcatchments.

Catena The sequence of soils occupying a slope transect from the topographical divide to the bottom of the adjacent valley that have developed from similar parent material but vary in profile characteristics owing to the differing topographical and drainage conditions under which they formed.

Cation exchange The process of interchange between a *cation* in soil solution and another on the surface of a soil colloid.

Cation exchange capacity (CEC) The overall net negative charge of clay minerals per unit mass of soil, usually expressed as milliequivalents (meq) per kg of oven-dried soil.

Cations Positively charged *ions*, e.g. the sodium ion (Na^+).

Causal inference The process in which a cause is linked to observations under the assumption that every event must have a cause. It is a key element in the scientific method.

Cavitation A process of fluvial erosion, characteristic of waterfalls and rapids. Constriction of channel flow raises the flow velocity, thereby reducing water pressure and leading to the formation of air bubbles. As the stream widens again and the velocity decreases the air bubbles collapse and the shock waves place considerable stress on the channel walls.

Channel planform The form of channels when viewed from above.

Channel sinuosity A measure of the degree of curvature in channels with meandering *channel planforms*.

Channelization The artificial modification of natural river channels for the purposes of flood alleviation, land drainage or relocation. It may involve channel widening, deepening, straightening, stabilizing (using concrete or piling) or embanking.

Chatter marks Microscale erosional features that appear as crescentic scars.

Chelates A stable compound formed between organic molecules and metallic cations in which more than one bond links the two components (also see *complex*). Chelates are especially important for the behaviour of aluminium and iron in the soil.

Chelation The process whereby *chelates* are formed.

Chemical mixing model A chemical mass balance model in which it is assumed that the concentration of an *ion* in solution consists of the mixture of concentrations and flows from different sources.

Chemical sediments Sediments produced by chemical processes, formed predominantly as a result of precipitation of minerals directly from a water body.

Chinook A warm, dry local wind that blows east down the lee slopes of the Rocky Mountains. The wind is subject to warming by adiabatic compression on descent and is warmer in absolute terms at any given altitude than on its windward ascent.

Chroma A measurable variable of soil colour describing the purity or strength of the colour (a chroma of 0 is natural grey).

Clastic sediments Sediments composed of grains of rock which have been weathered and eroded from a pre-existing bedrock material; they are dominated by those grains most resistant to weathering.

Clay A soil mineral particle within the *fine earth* fraction, having an upper limit of 2 μm (two-millionths of a metre) in diameter; very important in determining soil properties.

Clay skin A thin film of clay which has lined an area of soil.

Climax communities A community of plants and animals in steady-state equilibrium with prevailing conditions in the physical environment, seen as the self-perpetuating terminal stages of *ecological succession*.

Coefficient of friction The ratio of the frictional force between two surfaces sliding across one another to the normal force acting perpendicular to the surfaces; it depends primarily on the nature of both surfaces in contact.

Coefficient of thermal expansion When heated, most substances will expand and on cooling will contract. It is the response of the substance to this alteration in temperature which is the coefficient of thermal expansion.

Cohesion The force by which a homogeneous substance is held together owing to attraction between like molecules.

Cold glacier A glacier in which ice remains at very low temperatures, tens of degrees below freezing, with no appreciable surface melting. The absence of meltwater causes the glacier to remain largely frozen to the underlying substrate.

Coleoptera A large and important order of insects, distinguished by anterior wings converted into hard sheaths covering the other pair when not in use, i.e. beetles.

Collector-fitterers These organisms exist in the water column and feed by filtering out fine particulate organic matter in the water column.

Collector-gatherers These organisms can be found in the slower flowing areas of a river, they are more likely to feed from the bottom of the water column as they wait until the fine particulate organic matter has fallen out of the water column due to the reduced energy in the water flow and then gather it up to feed on.

Colloid A substance in which very small particles (0.1-10 μm (millionths of a metre) in diameter) are held in a state midway between a solution and a suspension.

Colour palette Colour reference table for displaying the *digital number* of an image.

Community (in ecological terms) The total living biotic component of an ecosystem (plants, animals and microbes).

Competition (in ecological terms) Negative interaction between organisms caused by the need for a common resource such as light, water or nutrients.

Complex A compound formed between organic molecules and metallic cations by a single bond (also see *chelates*).

Compressive stress The action of a force pushing inwards to the centre of an object along its cross-sectional axis.

Concentration The mass of substance of interest per unit volume, for solutes normally expressed as mg L^{-1} .

Conditionally unstable Instability in the atmosphere that is conditional upon an air parcel becoming saturated, which leads to a shift from cooling via the dry adiabatic lapse rate to the saturated adiabatic lapse rate. This causes the air to become warmer than the surrounding air and ascend more rapidly, leading to strong upward convection.

Conduction Transfer of energy between two bodies in contact.

Congruent dissolution This is the process whereby a whole solid dissolves into its constituent elements and there is no secondary solid phase. An example of such a process is the dissolution of calcite into calcium, water and carbon dioxide.

Continental shelf The zone bordering a continent extending from the line of permanent immersion to the depth at which there is a marked increase in the downward slope which descends to the deep-ocean floor.

Continental shield The ancient, stable, low-relief interior of continents; composed primarily of Precambrian crystalline rocks, some as old as 2 to 3 billion years.

Continuous permafrost zone A region in which *permafrost* occurs everywhere in the ground surface except beneath large bodies of water or ice.

Contour scaling This often occurs on urban stone and is associated with salt crystallisation in subsurface layers of the stone. The result is a layer of stone up to several centimetres thick blistering and then completely falling away.

Control A single test performed within a larger set of experiments, whereby no variables are altered from the norm; it acts to monitor the quality of the experimentation and ensure that no unaccounted variables are influencing the results.

Convection Transfer of energy through a fluid (liquid or gas) by molecular motions.

Convergent plate boundary The boundary between two litho-spheric plates in which one plate descends below the other, resulting in the consumption of *lithosphere* via the process of *subduction*.

Coping strategies Strategies used to reduce stress by mitigating the influences of an event/situation as opposed to attempting to change the situation.

Coriolis effect As a result of the Earth's rotation any moving object or fluid is deflected towards the right in the northern hemisphere and to the left in the southern hemisphere.

Corrasion The mechanical breakdown of rock due to wearing and grinding caused by material carried in transport across the rock surface.

Corries Basins excavated into a mountainside by the erosive power of a cirque glacier possessing defining features: steep retaining rock walls, a gently inclined rock basin, abundant signs of glacial scour and a terminal moraine. Also known as cirques.

Corrosion A weathering process involving the breakdown of solid rock by means of chemical reactions.

Cosmogenous Pertaining to material that originated extraterrestrially, e.g. meteor fragments and cosmic dust.

Coversands An extensive sand sheet (generally thin and lacking bedforms), formed by wind action in an unvegetated periglacial environment adjacent to an ice sheet. Similar to *loess* but coarser grained.

Crag and tail A streamlined ridge consisting of a resistant rock mass (the 'crag') with an elongated body of less resistant glacial till (the 'tail') on the lee side; a result of preferential erosion around a ridge below a glacier.

Crescentric gouges Crescentric fractures formed by irregular rolling of boulders carried at the base of a glacier; similar to *chatter marks* but larger in scale and less repetitive.

Crevasse-fill ridge A short, linear ridge of glaciofluvial material deposited as meltwater debris in a crevasse of a previous glacier (similar to an *esker* but shorter and less sinuous).

Critical rationalism A form of *positivism* involving the use of *deductive* reasoning. A theory is first adopted, leading to the formation of a hypothesis; this hypothesis is then tested in an attempt to falsify it.

Crusting The process in which a crust (a hard coating) is formed on the ground surface, caused either by concentration of minerals in surface layers due to high evaporative rates, or through high-intensity raindrop impact. It is most common in dryland environments.

Cryptozoic Pertaining to organisms which seek shelter as the preferred ecological niche.

Cultural landscape A landscape fashioned by human intervention, normally over a long period. Typically, a cultural landscape will be dominated by vegetation whose structure and species composition is different from what would be expected under pristine conditions. An obvious example would be farmland; a less obvious example might be a moorland created by felling a forest and maintained by grazing by sheep.

Curie point The temperature above which a metal is no longer attracted to a magnet.

Current ripples Small unidirectional ridges (up to 5 cm in height and 30 cm in wavelength) formed on a beach or on a sandy river bed by the motion of water.

Cyclogenesis A condition in which high-level air divergence is greater than low-level convergence such that air is able to rise. This results in low pressure and the development of cyclonic conditions.

D

Dansgaard-Oeschger (D-O) events *Interstadial* episodes during the Quaternary lasting no more than 500-2000 years involving an abrupt change in temperature of the order of 5-8°C as quickly as a few decades (gradual cooling followed by rapid warming). Large differences are also recorded in atmospheric dust content, ice accumulation rate, methane concentration and CO₂ concentrations. They are interpreted to be the response of internal feedback mechanisms.

Darcy's law A physical law to determine the flow of water through the matrix of a porous medium (e.g. groundwater through an aquifer). The relationship holds only for laminar (non-turbulent) flow of fluids in homogeneous porous media and does not hold well for well-jointed limestone with numerous fissures. According to Darcy's law the discharge of water through permeable material is equal to the cross-sectional area times the slope of the water surface times the coefficient of permeability.

Daviesian cycles of erosion A theoretical sequence of 'wear-down' processes and forms that occur between the initial uplift of a land mass and its erosion to a *peneplain* (first codified by William Davis in 1899). Its utility within real situations has often been challenged, particularly in relation to the effect of frequent global climatic changes that render any simple sequence of forms improbable.

de Geer moraine An arc-shaped ridge of glaciofluvial material (2-15 m in height) formed transverse to flow at the margin of a retreating glacier where the ice mass borders a glacial lake.

Debris avalanche A type of sudden and very rapid mass movement common on steep mountain slopes mobilized by gravity and commonly originating from a rockslide. It is composed of an unsorted mass of rock and soil that disintegrates during movement into a range of fragment sizes. Movement is characterized by flowage in a dry or wet state; momentum is maintained by a bouncing layer of grain-to-grain collisions at the ground surface.

Debris flow A highly destructive mass wasting process involving a slurry-like flow composed of rock grains, sediment and water with a wide range of sediment size grades and little internal stratification on deposition.

Deductive Pertaining to the process of drawing a conclusion via observational and measurement testing of a principle/ hypothesis that is already assumed, i.e. inference by reasoning from general laws to particular instances (opposed to *inductive*).

Degrees of freedom Pertaining to the capability of variation within a system. The number of degrees of freedom in a particular system refers to the number of independent variables that can be freely changed to bring the system to a new equilibrium without altering the phases of the system.

Delta A sedimentary landform where the mouth of a river reaches another water body such as an ocean or lake.

Delta front The limit of the accumulation zone of a delta; it forms from the settling of finer-grained sediment carried furthest into the basin by the decelerating currents.

Delta plain The flat surface of the delta over which the river channel migrates and channel sands accumulate.

Delta switching The process whereby the position of a river delta changes from one site to another. This can occur when the delta becomes so infilled with sediment that the river changes its course dramatically to allow the water to drain more freely into the ocean.

Dendrochronology The study of annual growth rings in certain tree species for dating of the recent past.

Dendroecology The study of tree rings to understand ecological processes.

Denitrification The process whereby nitrate is reduced to produce nitric oxide to then produce nitrous oxide to then produce nitrogen. It occurs in anaerobic conditions where the microbes use nitrate for respiration in place of oxygen during the decomposition process. The result of denitrification is the loss of nitrogen into the atmosphere.

Denudation chronology The process of attempting to determine the history of a landscape by establishing which stage of the *Daviesian cycles of erosion* it represents.

Desert varnish A tough dark layer covering *scree slopes* found in arid areas, produced by weathering of the interior of the scree slope boulders.

Desertification The spread of desert-like conditions and land degradation in arid and semi-arid environments as a result of mainly human influence or climatic change.

Detritivore An organism that feeds off litter breaking down dead plants and animals or their waste.

Detritus Waste from living organisms, including dead organisms and cast-off fragments.

Deuterium A stable isotope of hydrogen containing two neutrons in the nucleus.

Diagenesis Minor, non-destructive changes in the mechanical or chemical properties of rock shortly after deposition, particularly cementation and compaction (associated with the final stages of lithification (see *lithified*)).

Diapause A phenomenon which is often associated with insects; it is a period in the life cycle of an insect where its development is suspended. It can be instigated by environmental conditions.

Diapositives A positive photograph developed on plastic or glass with high dimensional stability, rather than on paper, to minimize distortions with shrinkage or expansion of the photographic media.

Diatoms Microscopic single-celled marine or freshwater plants with silica skeletons that contribute to the formation of sedimentary deposits when they die.

Differential GPS A global positioning system that uses one or more roving receivers along with one stationary global positioning system receiver positioned over a known point that continuously collects data from the satellites. This information can be used to correct errors in the global positioning system signals received by the rovers to produce high-quality positional measurements.

Differentials Those species present as a subtype of an ecosystem community that is dominated by another species.

Diffuse pollution The release of contaminants over a large area, e.g. leaching of nitrates from cultivated fields, wash off of oil from highway surfaces.

Diffuse reflection The redirection of radiation off a rough surface such that the radiation is redirected in many random directions.

Digital elevation model (DEM) A digital representation of a three-dimensional surface, where pixel *digital numbers* represent elevation rather than brightness.

Digital image An image composed of an array of discrete pixels with a numerical assignment to define its tone.

Digital number (DN) The numerical value assigned to a pixel in a digital image, the range of which is defined by the image depth or *bit scale*.

Dilation In general terms, the expansion of material.

Dimictic Dimictic lakes are those which have two mixing periods per year. During summer and winter the lake is likely to be stratified due to thermal differences at the top and bottom of the lake. The mixing periods are likely to be in the spring and autumn when the temperature of the lake is the same throughout.

Dinoflagellate Unicellular organisms which exhibit a great diversity of form; the most dramatic effect on surrounding life is in marine ecosystems during 'bloom' periods.

Dipterocarp A family of large tropical trees that dominate South-East Asian rainforest ecosystems.

Discontinuous permafrost zone A region in which frozen ground occurs but is not laterally continuous.

Disjunct When two related groups of organisms are separated geographically by a large distance.

Dispersive grain stress A force acting to lift particles in a debris avalanche, caused by grain-to-grain collisions which bounce the particles along the base of the flow.

Displacement flow The method in which soil water at the bottom of a slope is rapidly pushed out of the soil by new infiltrating water entering at the top of a slope, contributing directly to storm hydrographs.

Dissipative beaches This type of beach is also known as a high-energy beach. Due to the energetic waves sediment is transported offshore. The resultant beach is flat with a wide surf zone. On these beaches most of the wave energy is lost in the surf zone.

Distributaries Separate river channels that are created when a river splits and does not rejoin the main channel.

Divergent plate boundaries The boundary between two litho-spheric plates which are moving apart, resulting in the formation of new *lithosphere*.

Domestication The process whereby the evolution of a plant or animal species becomes controlled by humans. The deliberate breeding of dogs from their tamed wolf ancestors is an example.

Drainage basin That part of the landscape which is drained by a unitary river system.

Drainage density The measure of total stream channel length per unit area of drainage basin (stream length divided by drainage area).

Drainage divide The perimeter boundary of a *drainage basin*.

Drumlin A depositional bedform characterized by elongated accumulations of till streamlined in the direction of ice flow (they can reach 1 km in length, 500 m in width and 50 m in height). Debate exists as to the process of their formation; most accept they are deposited when the competence of a glacier overloaded with sediment reduces.

Dry adiabatic lapse rate The rate at which rising air is cooled as it expands when no condensation is occurring: $9.8^{\circ}\text{C km}^{-1}$.

Dry-snow zone A zone within the accumulation zone of a glacier in which there is no surface melt, even in summer.

Dump moraines Ridges formed at the margin of a glacier from material delivered by the ice flow; they lie transverse to the flow direction.

Dunes Migrating ridges of sediment, either as terrestrial deposits of sand formed by aeolian processes, or as small stream bed deposits of sand and clay common in streams of high velocity. The steeper front of the dune is termed the 'stoss' side and the gentler the 'lee' side.

Duricrust A hard, crystalline crust found on arid land surfaces. Evaporation and limited flushing by rains can lead to the accumulation of minerals on the surface or subsurface as capillary action transports minerals from underlying soils and rocks towards the surface.

E

Eccentricity of orbit The shape of the Earth's orbit around the Sun changes from more circular to more elliptical and back again over a 100 000 year period owing to gravitational forces. An increase in eccentricity causes the seasons in one hemisphere to become more intense while the seasons in the other are moderated.

Ecocline A biogeographical term introduced by Whittaker (1953) to describe the combination of environmental factors changing together through space along a gradient, e.g. the simultaneous change in temperature, exposure and soil type resulting from a change in altitude.

Ecological succession The mixture of processes that produce a gradual directional change in ecosystem structure and community at a given site over time, involving progressive habitat modification. Clements (1916) first described ecological succession as a sequence of plant communities characterized by increasing complexity of life form.

Ecosystem An organized open system consisting of biotic (plants and animals) and abiotic (environmental) components interconnected through flows of energy and materials.

Ecotone A zone of transition between two plant communities that is generally characterized by plant competition and can have special significance for more mobile animals due to edge effects.

Edaphic Pertaining to the characteristics of soil, i.e. those environmental conditions influencing a terrestrial ecosystem that are determined by the physical, chemical and biological properties of the soil.

Eh-pH stability field A plot showing the Eh-pH conditions in which the aqueous species of an element occur in a system at equilibrium (see also *redox potential*).

El Nino Southern Oscillation (ENSO) A reduction in the trade wind strength over the equatorial Pacific Ocean causes the westward-driven equatorial ocean current to falter. This leads to the cessation of the typical upwelling of cold deep water off the South American Pacific. The result is the appearance of unusually warm weather and the disturbance of pressure and precipitation systems throughout the southern hemisphere. Literally, 'The Christ Child' for its periodic occurrence every few years commencing during the Christmas season.

Elastic creep Deformation caused by strain forces; the method of movement of solid mantle rocks.

Elastic limit This is the limit to which a material can be

stretched without irreversible alterations being made to the dimensions and form of the material.

Electrical conductivity The degree to which a substance conducts an electric current.

Electromagnetic energy/radiation A type of energy in transit (or radiation) in which electric and magnetic fields vary simultaneously.

Electromagnetic spectrum The continuum comprising the entire range of wavelengths of electromagnetic energy.

Electrons Within an atom electrons are the negatively charged particles; as a whole these electrons create a negative charge which is balanced by the positively charged protons. Electrons can be found on the shells surrounding the nucleus of an atom. Electrons are a key feature in the bonds which exist between atoms.

Eluviation The removal of solid or dissolved material from one soil horizon.

Emissivity The rate of emission of energy from a surface per degree of temperature difference between the surface and surrounding substances.

Encapsulated countryside A type of urban ecosystem that is likely to suffer ecosystem degradation in the absence of human management, either ancient habitats or previously managed land.

Endemic Referring to a plant or animal species that is indigenous to one particular location or region, i.e. a consequence of geological isolation and allopatric (populations become more isolated from one another) *speciation*.

Endoreic Pertaining to an inland drainage system which does not terminate at the coastline; predominantly found in dryland environments ending in salt pans or *playas*.

Englacial Inside a glacier between the surface and the bed.

Entrainment The process in which small sediment particles are mobilized from a bed surface and transported in fluid suspension.

Entropy The degree of disorder or uncertainty in a system.

Environmental economics A branch of economics that involves the analysis and expression of the impacts of an activity on the environment in monetary values in order to promote communication with decision-makers and providing a more straightforward view of the impacts.

Environmental gradient The change in an environmental variable that acts as a control on plant and animal communities along a transect from one location to another, e.g. altitude, moisture, temperature, soil acidity. Environmental gradients vary in steepness, direction and the severity of their influence upon the community; they can lead to evolutionary branching and hence *speciation*.

Environmental impact assessment (EIA) An evaluation designed to identify and predict the impact of proposed action or project on the environment in order to ensure all possible impacts *are* considered before implementation. They are legally required in many countries.

Environmental lapse rate The actual rate at which temperature falls with increasing altitude in the local atmosphere.

Environmental technology assessment An evaluation designed to identify and predict the potential environmental, economic and social impacts of a new technology.

Ephemeral Short-lived.

Epilimnion The surface layer of water in a water body which is warmer and less dense than the water layer below which remains trapped as it is cooler and more dense than the water above.

Epiphyte A plant growing above the ground surface that is not rooted in the soil but uses other plants for support; commonly associated with tropical rainforests.

Epoch In geological nomenclature, an epoch is a division of geological time. Two or more epochs make up a *period*.

Equifinality This is the argument with respect to open systems that the end point, the formation of a landscape for example, can be achieved by a number of processes and it is not possible to attribute the outcome to just one input. Different processes may achieve the same end point.

Equilibrium line The boundary between the *accumulation zone* and the *ablation zone* of a glacier where the net mass balance is zero.

Ergodic method Studying the development of a process or object over time (i.e. the sequence of landforms) by evaluating areas that represent different stages of advance in the process, therefore substituting space for time. For example, the sequence of successional stages of a salt marsh over time can be observed by studying a horizontal transect through the marsh from the youngest to the oldest section.

Erqs Another term for *sand seas*.

Esker A narrow winding ridge of glaciofluvial sand and gravel deposited by a meltwater stream flowing at the bed of a glacier.

Essential elements Elements found in the soil without which, or in the wrong proportions, green plants cannot grow normally. There are 16 essential elements consisting of *micronutrients* and *macronutrients*.

Estuary The mouth of a river where it broadens into the sea and within which the tide ebbs and flows, leading to an intermixing of freshwater and seawater. Estuaries are usually sites of deposition, especially if the river carries more sediment than can be removed by the tidal current or wave action.

Eustasy Global change in ocean water level due to change in the volume of water in the oceans.

Eustatic sea level The mean global sea level.

Eutrophic zone The upper layer of water where there is enough light penetration for photosynthesis.

Eutrophication Enrichment of freshwater and marine water bodies with plant nutrients to the extent that plants in the water bloom at the expense of other aquatic organisms.

Evaporite A mineral or sedimentary rock composed of soluble salts resulting from the evaporation of a body of water.

Evapotranspiration The transfer of liquid water from the Earth's surface to water vapour in the atmosphere by means of evaporation and plant *transpiration*.

Exchangeable cations Cations attracted to the surface of clay minerals and adsorbed by electrostatic attractions which can be displaced by cations in the soil solution through *cation exchange*.

F

Fabric The orientation of particles within a rock or sediment.

Falling limb The section of a storm hydrograph depicting the decrease in river discharge after rainfall has ceased following a storm event.

Fatigue failure This is the result of low-magnitude stresses being applied to a material frequently over a prolonged period. There is often not any evidence of the stress occurring but it is the accumulation of the impacts of the stress which can cause the failure.

Fecundity The faculty of reproduction. An organism has a high fecundity if it reproduces quickly and in large numbers and can therefore recover its population quickly after a problem.

Feeder-seeder mechanism A type of *orographic* enhancement of precipitation. Adiabatic cooling of air forced to rise over mountains causes saturation of water vapour and cloud formation. The water vapour of this 'feeder' cloud is swept into the precipitation of a frontal 'seeder' cloud aloft, increasing the overall precipitation on the mountain.

Fiducial marks Marks exposed on imagery that act as a frame of reference for the x, y coordinate system of the image.

Field capacity A term to describe the state of the soil when all *gravitational water* has drained away, leaving only the *capillary water*.

Field drains Subsurface drainage system installed under agricultural land to reduce the soil moisture content.

Fine earth The fine fraction of soil mineral particles consisting of sand, silt and clay, less than 2 mm in diameter.

Firn Compacted granular snow with interconnecting air spaces in at least its second accumulation season, in the process of being transformed into glacier ice (with a density usually greater than 0.4 but less than 0.8 kg m⁻³).

Fjord A long, deep basin, previously excavated by a glacier, and has since become inundated by the sea as a result of sea-level rise during deglaciation.

Flashy regime A term used to describe a stream with a fast hydrological response to precipitation events involving a rapid rise in channel water levels.

Flow duration curve A graphically plotted curve used in the analysis of river flow frequency. The frequency distribution of the mean flow of a river at a particular site is calculated and the percentage of time any particular discharge rate is reached and exceeded is then plotted. The slope of the curve indicates the magnitude of the flow.

Flow traction A type of wash process that involves the transport of sediment along the ground surface due to the stress applied by rainwater flowing downslope and the friction maintaining the rolling and bumping of particles within the moving water; a type of *rillwash*.

Flows A type of rapid mass movement in which different parts of the mass move over each other with differential levels of movement; see *debris flow*.

Fluidization The process in which water detaches an entire fine-grained sediment deposit and converts it into a mixture of water and sediment that takes on most of the properties of a fluid.

Flute An elongated ridge formed by the infilling of cavities on the downstream side of obstacles in the bed (more elongated than drumlins); the depositional equivalent of crag and tail features.

Fohn wind The European equivalent of the *Chinook* wind.

Footprint The area on the ground 'seen' by a sensor at an instantaneous moment in time.

Foraminifera An order of Rhizopoda: small, single-celled marine organisms with a shell of calcium carbonate.

Foredune ridge A ridge of sand on the seaward side of a dune system where several smaller dunes which are forming have coalesced.

Foreset bed A seaward-sloping sediment bed deposited at the advancing edge of a growing delta; the sediment accumulates underwater and constitutes the bulk of the delta (overlain by the *topset bed*).

Form drag A drag force that slows and curves a flow path over surface topography, e.g. the slowing of glacier flow due to obstacles on the glacier bed, or the slowing of air flow over a mountain range.

Frequency distribution A method of plotting numerical data to show the number of times different values of a variable occur within a sample.

Friction cracks A variety of rock fractures caused by the action of glacier ice passing over bedrock (including *crescentic gouges*).

Frictional drag The retarding drag force associated with the interaction between a particle moving across the surface of another particle.

Frost blisters Small ice-cored mounds that develop over a single winter as a result of *frost heave*.

Frost creep The slow downslope creep of the *active layer* on a slope due to freezing of the soil causing it to expand normal to the surface; subsequent thawing then permits the vertical settlement of the soil, resulting in a net downward movement.

Frost heave The vertical lifting of the soil surface into doming frost hillocks as a result of pressures caused by the freezing of groundwater under periglacial conditions.

Fundamental niche A *niche* containing the ideal conditions for the species requirements, only realized in simple situations where no other competitors for any of the resources exist.

G

Gabbro A type of intrusive igneous rock that crystallizes slowly at depth; its minerals (plagioclases and pyroxenes) are large and visible to the naked eye.

Gabions Wire rock-filled cages used to prevent river bank erosion and stabilize slumping hillsides.

Gaia A conceptual theory developed by James Lovelock (1979) that proposes that the Earth maintains conditions suitable for life by self-regulation and feedback mechanisms whereby all elements of the Earth are interlinked at all scales; the Earth acts almost as a conscious biological organism.

Gas hydrate An ice-like crystalline solid formed from a mixture of water and a gas, often methane.

Gelifluction A type of *solifluction* only occurring in areas of permafrost. When seasonally frozen soil in the *active layer* thaws during spring, water cannot percolate down owing to lower layers of permafrost, thereby creating a lubricating effect for the slow downslope creep of the water-saturated material.

Genetic classification A term used in association with the classification of sediment types by the mode of their deposition.

Geographical information system A system of hardware, software and procedures designed to support the capture, management, manipulation, analysis, modelling and display of spatially referenced geographical data for solving complex planning and management problems.

Geomaterials This is the cumulative name given to rocks and regoliths, materials which are derived from a geologic source.

Georeferencing Correcting a remote sensing image to remove geometric distortions caused by the motion of the sensor or by the motion of the Earth beneath the sensor so that objects in the image correspond to their positions on the ground.

Geostrophic wind High-level wind blowing parallel to isobars, in which the pressure gradient and Coriolis force are in balance.

Geothermal heat Energy derived from the heat in the interior of the Earth. This energy is found everywhere beneath the Earth's surface, although the highest temperatures are concentrated in regions of active or geologically young volcanoes.

Geothermal heat flux The amount of heat given off by the Earth's crust; generated by radioactive decay, chemical processes and friction at plate boundaries.

Glacial intervals An extended cold phase during the Quaternary in which ice sheets and glaciers extended widely from the poles to lower latitudes.

Glen's law A physical law referring to the rate of deformation of glacier ice due to shear stress; fundamental in the understanding of glacier flow.

Gleying The formation of a gley soil; a blue-grey soil or soil layer caused by the reduction of iron and manganese compounds in stagnant saturated conditions.

Global positioning system (GPS) A system consisting of a constellation of orbiting satellites and one or more global positioning system receivers on the ground (or in an air- or watercraft) that are used for precise positioning.

Gondwanaland A large ancient continent of the southern hemisphere made up of present-day South America, Africa, Australia and Antarctica.

Graben A structural rock mass that is downdropped by parallel faults on both sides, often forming a structural valley.

Grain roundness A textural property of sediments associated with the degree of angularity/roundness that provides environmental information, e.g. very rounded grains are formed via considerable abrasion and are likely to have undergone extended transport.

Granular disaggregation A process associated with salt weathering; as a result grains of the rock can become loose and lead to a rough uneven surface on the rock.

Gravitational water The water that drains from *macropores* in the soil following a period of soil saturation due to gravitational forces and is replaced by air.

Grazers (or scrapers) Organisms which feed on algae attached to stones in the water column by scraping or grazing from the surface of the stone. The abundance of these organisms in the river is dependent on the extent of light penetration which in turn determines algae production.

Greenhouse effect - enhanced Human disturbance within the last few centuries has caused the concentration of the major greenhouse gases to increase. Thus, the presence of higher concentrations of such gases may enhance the greenhouse effect, making the planet warmer. The Earth's average global temperature has been estimated to have risen by 0.3-0.6°C in the past 100 years, as a result of human influence.

Greenhouse effect - natural The atmosphere traps heat energy at the Earth's surface and within the atmosphere by absorbing and re-emitting long-wave radiation; 90% of long-wave radiation emitted back to space is intercepted and absorbed by greenhouse gases such as carbon dioxide and water vapour. Without the greenhouse effect the Earth's average global temperature would be -18 grade C.

Ground control points Points on the ground of known coordinates that can be identified in the imagery and can be used to remove distortions in a process called geocorrection.

Ground diffusivity Pertaining to the ability of the soil to propagate fluctuations in surface temperature to greater depths in the ground.

Ground-penetrating radar A geophysical technique involving the propagation of high-frequency electromagnetic waves into the ground which are then reflected back to the surface from boundaries at which there are electrical property contrasts. It allows high-resolution mapping of subsurface features such as soil pipes, bedrock and other geophysical anomalies.

Groundwater The portion of subsurface water stored in both soils and aquifer rocks below the water table (in the *saturated zone*).

Groynes Artificial structures positioned across a beach at right angles to the shore to trap sediment being transported by longshore currents, therefore inhibiting loss of sediment by longshore drift.

Gypcrete A *duricrust* composed of calcium sulphate.

Gypsum An *evaporite* mineral composed of calcium sulphate with water.

Gyre A large circular movement of water. It usually refers to the large oceanic gyres in the subtropical high-pressure zones where geostrophic currents rotate clockwise in the northern hemisphere and counterclockwise in the southern hemisphere.

H

Halocline A layer of water in which the salinity (saltiness) changes rapidly with depth.

Hanging valley A tributary valley which, at convergence with the trunk valley, has a higher ground level, resulting in a sharp drop in elevation (the result of glacial activity in the main valley).

Hard engineering Pertaining to coastal management practices that involve the construction of large-scale structures to protect the coastline (e.g. sea walls, breakwaters and *groynes*); most hard engineering practices change the local sediment dynamics.

Health impact assessment (HIA) An evaluation designed to identify and predict the health impacts on society of a proposed activity.

Heinrich events Referring to events occurring during the coldest points of *Bond cycles* in which vast amounts of icebergs were discharged into the North Atlantic, immediately followed by abrupt warming.

Helicoidal flow A process by which water flows in an outward direction when approaching a meander bend, causing water levels on the outside of meander bends to become super-elevated. Water then flows inwards along the channel bed as a return flow. This results in individual water molecules corkscrewing around the meander bend.

Herbivore An organism that feeds off plants (primary producers) and therefore occupies the second *trophic level*.

Heterotrophs Organisms that cannot photosynthesize and therefore feed directly on *autotrophs* and other heterotrophs for their energy supply. They are described as first-order consumers and form the second *trophic level*.

Histogram A column diagram where values are divided into equal parts and the frequency of occurrences within each subdivision is summed and plotted.

Hjulstrom curve An empirical curve defining the threshold flow velocities (i) to initiate motion of sediment grains of different sizes on a stream bed, (ii) necessary to keep the sediment grains in transport and (iii) the depositional velocity.

Holocene The second epoch of the Quaternary, in which we live now, preceded by the *Pleistocene*. It began approximately 10 000 years ago. The Holocene is an interglacial period.

Holomictic This is a group of lakes which mix completely, which means that during the year there will be a time when the temperature of the lake is the same at the top as it is at the bottom and therefore mixing is possible. Holomictic lakes can be divided into four subgroups: monomictic, dimictic, polymictic and oligomictic.

Horizontal interception Formation of water droplets by condensation of atmospheric moisture on vegetation surfaces, contributing significantly to catchment precipitation inputs under vegetation canopies in conditions of high atmospheric humidity.

Horn A high, spire-shaped mountain summit with steep sides formed by the convergence of intersecting walls of several cirques.

Horticulture Subject of using plant processes for the purposes of garden development.

Hot spots A centre of volcanic activity and igneous rock production located away from plate margins, thought to be positioned over a rising mantle plume and related to convection processes which originate at the core-mantle boundary deep in the Earth.

Hue A measurable variable of soil colour that describes the dominant colour of the pure spectrum (usually redness or yellowness).

Hummocky moraine A type of *moraine* characterized by considerably undulating terrain; caused by deposition from meltout of *supraglacial* and *englacial* material in *kettle holes* and crevasses.

Humus A type of soil organic matter which is very resistant to decomposition.

Hydrates A compound which contains water but which can dissociate into water and another compound. This process is reversible and therefore the compound and the water can combine again.

Hydraulic geometry Referring to the river flow characteristics of a channel (such as discharge, depth, width and velocity) and their relationship to one another.

Hydraulic radius The ratio of the cross-sectional *area* of water flowing through a channel to the length of the *wetted perimeter*; it represents a measure of the efficiency of the channel at conveying water and the proportion of water subject to bed surface friction.

Hydraulic sorting The process by which particles of river bed material are sorted into sections of near uniform particle size due to the change in river competence throughout its journey from source to mouth.

Hydrogenous Pertaining to sediments derived from *ions* in sea-water through geochemical processes, e.g. metal ions of iron and manganese are released from hydrothermal vents and oxidize or combine with silica to form metal-rich sediments.

Hydrograph A graph showing river discharge plotted against time for a point on the river channel network, displaying a characteristic shape during rainfall events.

Hydrophyte A plant that has adapted to grow in wet or waterlogged conditions.

Hygroscopic water Soil water held as a tight film around individual soil particles and unavailable to plants because of the very strong attraction between the water and soil particle.

Hyper-arid Pertaining to extremely dry areas ('true deserts') that may go as long as 12 months without rainfall (e.g. central Sahara).

Hyper-concentrated flow Similar to a debris flow but with a higher water content, acting more like a liquid and with less viscosity; these flows behave like a sediment-rich stream maintained by forces of turbulence.

Hyperspectral scanners Scanning remote sensing instruments that record digital images using multiple narrow bands. Similar to *multispectral scanners* but with higher spectral resolution. These are also called imaging spectrometers

Hypolimnion A cooler, lower layer of water in a water body which does not readily mix with the upper warmer layer as it is more dense and hence remains below the warmer, less dense layer.

Hyporheic zone This is the zone under a river channel where there is a mixing of channel water and groundwater. It exists where the river channel flows over a permeable substrate.

Hysteresis A process whose progress is determined by the direction in which the reaction is occurring. It is normally described by a bivariate plot in which the value of one variable is dependent on whether the other variable is increasing or decreasing.

I

Ice creep A slow, continuous movement of ice involving non-recoverable deformation of the ice owing to intergranular motion caused by internal pressure and the force of gravity.

Ice rafting The process by which glacially eroded debris is transported by floating ice (ice floes or icebergs); it may be transported great distances and deposited either on the sea floor when the ice melts or on beaches.

Ice segregation The formation of layers of ice in rocks or soils where there has been a movement of water into gaps which has then frozen.

Ice shelves Thick floating sheets of ice extending over the sea from a landward ice sheet, fed by the ice sheet and snow accumulation.

Ice streams Fast-flowing 'rivers' of ice within more slowly moving ice sheet walls.

Ice wedge polygons *Ice wedges* that have joined together owing to the annual reopening and expansion of the ice wedge.

Ice wedges V-shaped bodies of ground ice that extend into *permafrost* (up to 1.5 m in width and 3-4 m in depth). Under very low temperatures frozen ground contracts as it is further cooled, causing it to crack; water enters during spring and summer and then freezes into an ice wedge.

Iceberg calving The process in which a large mass of floating ice breaks away from an ice shelf; a major method in which mass is lost from ice sheets.

Ice-pushed ridge A ridge of material accumulated by the ploughing action of a glacier but composed of material that is not glacially derived (i.e. similar to a *push moraine* but not consisting of glacially derived debris).

Igneous rock Rock that has originated from a molten state such as lava from a volcano.

Illumination The degree to which a scene or object is lit, in this case by the Sun.

Illuviation The deposition of solid or dissolved material into a soil horizon.

Image mosaic A composite of remote sensing images to produce an image of greater coverage.

Image orientation The direction in which a sensor is pointed to capture an image. Images can be orientated vertically, horizontally or obliquely.

Imaging spectrometers Another term for *hyperspectral scanners*.

Imbrication The wedging of particles among others. Often small particles become trapped by larger ones so that even though the flow is great enough to entrain them, they cannot move until the larger particles are entrained.

Incremental methods Techniques for estimating the age of deposits based on the measurements of regular accumulations of sediment or biological matter through time, e.g. *dendrochronology*, analysis of *varves* and ice cores.

Indentation hardness The resistance of a material to deformation as a result of the application of compressive stress from a sharp object. The indentation hardness of a material can be determined by the amount of compressive force required to make an indentation to a certain depth or by the size of an indentation left as a result of a fixed size of compressive force.

Inductive Pertaining to the process of inferring a general law or principle from the observation of particular instances; by classifying and ordering unordered knowledge, regularities may be identified and general laws discovered (opposed to *deductive*).

Indurated Pertaining to soils and sedimentary rocks which have become hardened and compacted by post-depositional chemical and physical alterations.

Industrial Revolution A major shift of technological and cultural practices in the late eighteenth century and early nineteenth century in some western countries. It began in Britain and spread throughout the world and consisted of an engagement with energy generation through fossil fuel burning, construction, invention and mass transport systems.

Infiltration capacity The maximum rate at which water can enter soil under specified conditions.

Infiltration-excess overland flow A form of *overland flow* occurring when rainfall intensity exceeds the infiltration capacity and excess water is stored and transported on the surface (also known as Hortonian overland flow).

Infiltration rates The volume of water passing into the soil per unit area per unit time (i.e. the rate at which water added to the surface enters the soil).

Integrated coastal zone management A management approach where all parties concerned in coastal protection and development are involved; it considers the socio-economic and environmental issues which are present to achieve a sustainable outcome. Planning should be based on shared knowledge and long-term goals need to be identified.

Interception The process by which precipitation is prevented from reaching the ground, by the vegetation layer.

Interception storage The storage of water on leaves and tree trunks when precipitation has been intercepted by vegetation en route to the ground surface.

Interference The fading, disturbance or degradation of a signal (in this case surface reflectance) caused by signals from unwanted sources (i.e. the atmosphere).

Interglacial intervals A long, distinct warm phase between glacial stages during the Quaternary; the Earth's glaciers become severely diminished owing to climatic amelioration (restricted to very limited locations with sufficient conditions).

Intermediate beaches This type of beach falls between the extremes of the high-energy (*dissipative*) and low-energy (*reflective*) beaches. They often feature near shore bars which dissipate some of the wave energy which reaches the beach. The upper part of an intermediate beach can be steep, however, and show characteristics of a *reflective beach*. Intermediate beaches can be dynamic and change their morphology.

Interstadial A short period of climatic amelioration and ice retreat within a glacial stage, less pronounced than an *interglacial interval*.

Interstices This is a small or narrow space between particles or objects.

Interstitial ice Ice crystals (individual or fused together) occupying the pore spaces of a soil or rock.

Intertropical convergence zone (ITCZ) The zone where the north-east trade winds from the northern hemisphere and the south-east trade winds from the southern hemisphere come together over the equatorial region. This zone is characterized by cloud bands which illustrate rising air yet it is not a continuous band around the Earth. The ITCZ migrates northwards and southwards across the equator with the seasons, so that it resides in the hemisphere which is experiencing summer.

Involutions Features caused by the deformation of unconsolidated surface materials (i.e. disruption to the sedimentary structure and soil profile) due to thawing of ice-rich ground; often used as a diagnostic for past permafrost conditions.

Ionic diffusion The upward movement of ions through the soil without the aid of water, due to the difference in concentration of ions from the base to the surface of the soil. The close proximity to parent material at the bottom of the soil profile results in a greater quantity of ions; the random movements of the ions will then form a general upward movement to an area of fewer ions.

Ions Positively or negatively charged atoms.

Island biogeography The study of the distribution and evolution of organisms on islands or even 'virtual islands' (resulting from some barrier other than the sea). More narrowly, island biogeography is the examination of MacArthur and Wilson's (1967) equilibrium theory of *speciation* in geographically isolated areas, whereby a relationship is identified between the species richness of an island and its size and isolation, among other characteristics.

Isobars Lines on a map joining points of equal atmospheric pressure.

Isohyets Contour lines connecting points of equal rainfall.

Isomorphous substitution During the formation of a clay mineral, the process in which one atom in the crystal lattice is replaced by another of similar size without disrupting the crystal structure. The replacing ion is generally of a lower positive charge, causing the clay mineral to become electrically negative.

Isostasy The principle by which the Earth's crust 'floats' upon the denser *mantle*, following Archimedes' law of hydrostatics. The thicker, more buoyant crust (continental regions) stands topographically higher than the thinner, denser crust (under the oceans) to create an equilibrium situation.

Isostatic rebound The process whereby, after a heavy weight (such as an ice cap) is removed, the Earth's lithosphere slowly relaxes and the surface rises to a new equilibrium level.

Isovels Contour lines connecting points of equal velocity.

J

Jet streams High-speed long, narrow winds in the upper atmosphere. These currents meander and reach speeds of 400 km h^{-1} .

Jetties *Hard engineering* coastal management structures built along the banks of a tidal inlet at a river mouth in order to stabilize unpredictable shifting channels for navigation purposes.

K

Kames Steep-sided isolated conical hills of bedded glaciofluvial materials deposited by meltwater along the sides or margins of a glacier.

Karst Referring to the ground surface depressions and extensive underground drainage network created by limestone solution.

Katabatic drainage Radiative cooling at night causes the air close to the ground to cool; this cooler air is slightly denser and slowly moves downslope to lower ground and into depressions. It is greatest in cloud-free and dry conditions with light winds (limited mechanical mixing of the air).

Kettle hole A closed depression found in glacial till deposits, formed by the melting of a large mass of ice that became incorporated and preserved in glacial till.

Keystone species Species that are highly connected to the entire food web; their loss may result in *ecosystem* collapse and huge loss of biodiversity.

Kinematic viscosity The ratio between the density and viscosity of a fluid.

L

Lagoon A coastal bay totally or partially enclosed and cut off from the open sea by a *barrier beach*, *spit*, shingle ridge or an offshore reef.

Lahars Flows of loose soil, rock, ash and water following a volcanic eruption.

Laminar flow One of the two ways in which water can flow; it involves all water molecules flowing in the same direction parallel to one another resulting in no mixing of water.

Landscape corridors Narrow strips of land that differ from the *landscape matrix* existing on either side; the key characteristic relates to their function in connecting different environments and the often sharp microclimatic and soil gradients from one side of a corridor to another.

Landscape ecology A concept used in exploring regional and small-scale biogeographical distributions. It refers to the analysis of the cause-effect relationships between the living community and the immediate environmental conditions, which have created the specific landscape pattern observed. The theory suggests the landscape consists of a matrix of patches and corridors providing oases and pathways for species dispersal and movement.

Landscape matrix The element of the landscape that contains within it other landscape components (patches and corridors) into a complex system that controls the local biogeography. The stability of the matrix is dependent upon the extent and development of *landscapes patches* and *landscape corridors*.

Landscape patches Distinctive elements within the wider landscape, such as ponds, woods or towns. Their analysis involves the influence of patch characteristics (shape, frequency, origin and stability) upon the local ecosystem. The community of a landscape patch may vary substantially to the surrounding landscape and be very vulnerable to its influences, thus having particular relevance to conservation ecology.

Landslides A mass movement process whereby a large coherent mass of material moves down a slope under the influence of gravity, remaining undeformed.

Lapse rate Rate at which temperature decreases with altitudinal increase.

Latent heat The amount of heat required to change the state of a substance, e.g. from a liquid to a gas, or vice versa.

Lateral moraine A ridge of glacial debris lying parallel to the sides of a glacier or lying along the sides of a valley formerly occupied by a glacier, consisting of dumped material and frost-shattered material from the valley walls.

Lateralization The process in which high temperatures and heavy rainfall cause intense weathering and leaching of the soil, producing horizons depleted in base cations and enriched in silica and oxides of aluminium and iron.

Laurasia A large ancient continent of the northern hemisphere made up of present-day North America, Europe and Asia.

Law of limiting factors Pertaining to a species, the necessity for all the environmental factors that control its survival to be maintained within a range that the organism can tolerate; if just one of these controlling variables falls outside of the tolerance range the organism will not survive.

Laws of thermodynamics Laws pertaining to the conservation of energy. The first law of thermodynamics states that energy cannot be created or destroyed, only transformed from one form into another; thus energy is conserved. The second law of thermodynamics states that isolated systems become more disorganized over time.

Leaching Downward transport of soluble soil material in solution through the soil profile by percolating surplus water, depositing some in lower layers but removing the most soluble entirely.

Least-squares adjustment A mathematical method for fitting a model to data so as to minimize error between the observed values and the estimated values.

Lentic Term used to refer to things which are related to or inhabit still water bodies such as ponds and lakes.

Liana A woody vine supported on the trunk or branch of trees, usually tropical.

Life-cycle analysis (LCA) The evaluation of all the environmental impacts of a product from the time the raw materials are taken from the Earth to the time the product is thrown away and added to the ecosystem (including its manufacture, use and disposal).

Linear wave theory Main theory of ocean surface waves used in ocean and coastal engineering from which important equations are derived.

Lithified Pertaining to the transformation of unconsolidated sediments into a cohesive sedimentary rock mass through cementation, compaction and crystallization (lithification).

Lithogenous Pertaining to material derived from the physical and chemical breakdown of rocks and minerals.

Lithosphere The rigid outermost layer of the Earth, consisting of the crust and upper section of the mantle above the asthenosphere; characterized by brittle behaviour.

Litter A type of soil organic matter consisting of decomposing residues of plant and animal debris.

Littoral drift The transport of beach material along the coast, sometimes referred to as *longshore drift*. Waves surging along the beach at an oblique angle transport sediment up and along the beach in the *swash* followed by transport more perpendicular to the coast in the *backwash* (creating a zig-zag movement of sediment along the beach).

Littoral zone The part of the lake which is closest to the shoreline. It occurs in both shallow and deep lakes and is where light can penetrate to the bottom thereby allowing for a diverse array of plants and algae to grow.

Lobate Characterized by having a tongue-like shape, e.g. the ice lobe of an alpine glacier.

Loess A fine-grained (less than 50 μm (fifty-millionths of a metre), commonly non-stratified and unconsolidated sediment. It is composed of quartz, feldspar, carbonate and clay minerals that have been transported by wind from arid land surfaces and deposited elsewhere, sometimes thousands of kilometres away.

Logical positivism A form of *positivism* in which *inductive* reasoning is used to form theory and acquire knowledge from experimentation.

Long profile A graphical curve displaying the longitudinal altitude profile of a river from source to mouth (height of the river plotted against distance from stream source). It illustrates the change in river gradient downstream.

Longshore currents A net movement of water parallel to a coastline. This occurs because waves surging along beaches at oblique angles are followed by more perpendicular transport out to sea resulting in a net water movement along the coastline.

Longshore drift Another term for *littoral drift*.

Long-wave radiation Radiation that has been emitted by a surface at a longer wavelength than its solar source. It is also called terrestrial radiation.

Lotic Term used to refer to things which are related to or inhabit fast-moving water bodies such as rivers.

Lumped model A catchment model in which catchment characteristics are assumed to be uniform across space.

Luvisols A group of soils produced by clay *eluviation* (also known as acid brown earths).

Lysimeter An instrument for taking direct measurements of *evapotranspiration*; by isolating a block of soil (with its vegetation cover), the weight of the block can be used to represent the quantity of water and its change over time can be calculated.

M

Macrogelivation The process whereby rocks are broken up into clast-size debris through the utilization of existing fractures and fissures in the rock.

Macroinvertebrates These are organisms which live in the water column and are greater than half a millimetre in size; they live in varying locations in the water column including on rocks and in aquatic plants.

Macronutrients The group of *essential elements* found in high concentration in plants (carbon, oxygen, hydrogen, nitrogen, phosphorus, sulphur, calcium, magnesium, potassium and chlorides).

Macropore Infrequent large opening or void in the soil (greater than 0.1 mm in diameter) that can promote rapid, preferential transport of water and chemicals, formed by structural cracks and fissures or by biological activity, e.g. earthworms, burrowing creatures and plant roots.

Macropore flow The movement of water through the soil within larger pores (*macropores*).

Magnetometer An instrument for measuring the strength of the Earth's magnetic field.

Main stream length The distance of the main river channel in a catchment from source to mouth (equating to the length of the *long profile*). Given in kilometres.

Mangroves A term applying to the variety of trees and shrubs which grow on saline mudflats in tropical coastal areas to form a dense swamp forest. Their roots trap silt which accumulates to form a swamp.

Mantle The zone within the Earth's interior lying between the partially molten core and the thin surface crust, containing 70% of the earth's total mass and composed principally of magnesium-iron silicates.

Mass balance The difference between the total accumulation and *ablation* of a glacier with time, i.e. a positive mass balance exists when accumulation exceeds ablation for a given period.

Mass movement The downslope movement of sediment, soil and rock material as a single unit (the individual fragments are in close contact); a number of mass movement processes can be identified including *debris flows*, *debris avalanches*, *slumping* and *landslides*.

Mass wasting The spontaneous downhill movement of surface materials (soil, *regolith* and bedrock) under the influence of gravity, without the active aid of fluid agents.

Massive ice Very thick bands of *segregated ice*, up to several metres thick.

Matrix flow The movement of water through the soil within very fine pores.

Meandering rivers Sinuous river channels that migrate downstream owing to river bank erosion on the outside of meander bends and deposition of bed material on the inner bank. Excessive meandering leads to oxbow lake formation.

Meromictic Derived from meromixis, this is where there is an incomplete mixing of a lake. Deep lakes are meromictic as their depth prevents a complete overturning circulation. Lakes which also have inflows of different density water can be meromictic as stratification can occur owing to the different densities.

Mesohabitats The smaller units which combine to define a reach of a river. Each mesohabitat within a river reach is determined by similar characteristics such as deeper, slower flowing pools and shallower, faster riffle sections.

Mesophyte A plant that requires a moderate climate in terms of temperature and precipitation in order to survive.

Metalimnion A thin layer of water in a lake or ocean where there is a zone of rapid temperature change with depth.

Metamorphic rock Rock which has altered its form through structural and mineralogical change due to heat and pressure from the surrounding conditions.

Metamorphosis (metamorphism) (biological) A change in the form, function or habits of a living organism by a natural process of growth or development, e.g. the change of a caterpillar into a butterfly.

Microgelivation The occurrence of ice crystallization within pores and fissures of a rock at the scale of grains and crystals can result in the formation of fine rock fragments.

Microhabitats The smallest area in an ecosystem which is home to an individual array of organisms and vegetation, micro-habitats can include clumps of grass or fallen trees.

Micronutrients The group of *essential elements* found in small concentration in plants (iron, manganese, zinc, copper, boron and molybdenum).

Micropores Very small pores in the soil that can hold soil water (less than 0.1 mm in diameter).

Mid-ocean ridges The zones in which oceanic lithosphere is created by the spreading of *divergent plate boundaries*. The relative buoyancy of the newly formed oceanic crust causes the topography to be raised, creating a high-relief ridge.

Mie scattering The wavelength-dependent redirection or scattering of electromagnetic radiation at wavelengths of about the same magnitude as the size of the particles.

Milankovitch theory A hypothesis formalized by Milutin Milankovitch describing the external driving force behind the glacial cycles of the Quaternary. The amount of solar radiation reaching different parts of the Earth from the Sun varies as the eccentricity of the Earth's orbit, the obliquity of the axis of rotation and the precession of the equinoxes change over time in a regular and predictable way.

Mineralization The process of forming a mineral by combination of a metal with another element.

Mohorovicic discontinuity (Moho) The contact surface between the crust and the mantle; the zone in which seismic waves are significantly modified.

Mole The quantity of a substance that contains the same number of chemical units as there are atoms in exactly 12.000 grams of carbon-12.

Molten rock Rock in a state of a liquid; the rock has melted and flows as any liquid.

Monoclimax A theory of vegetation requiring that all sequences of *ecological succession* within a given climatic region converge on a single uniform stable climax community depending solely on regional climate.

Monomictic With respect to lakes, these lakes only have one season of overturning and mixing in a year.

Monsoon A system of winds that switch direction from ocean-continent to continent-ocean between summer and winter in response to the northerly and southerly movements of the intertropical convergence zone (ITCZ). The characteristics of a monsoon climate are most apparent in India and South-East Asia; the *jet stream* reverses from westerly to easterly, causing the north-east and south-west monsoon seasons that *are* responsible for the majority of inter-annual climatic change in the region.

Montmorillonite A soft mineral that forms as very small plate-shaped crystals. Two silicon tetrahedral sheets enclose an aluminium octahedral sheet in the structure. Considerable expansion can occur when water moves between the silica sheets.

Moraine An accumulation of glacial till that has been transported and deposited by a glacier or ice sheet; classifications of moraines are usually based on the mode of their formation: see *de Geer moraine*, *dump moraines*, *hummocky moraine*, *lateral moraine*, *push moraine* and *rogen moraine*.

Moulin A rounded vertical or steeply inclined hole within a glacier down which meltwater travels.

Multispectral scanners Scanning remote sensing instruments that record digital images using several, moderately narrow bands, typically between the ultraviolet and infrared portions of the spectrum. Similar to *hyperspectral scanners* but with lower spectral resolution.

Munsell colour chart A standard system for the description of soil colour based on three measurable variables (*hue*, *value* and *chroma*).

Mycorrhizal Pertaining to the nature of mycorrhiza, a fungus growing in or on a plant root involving a symbiotic relationship between the two.

N

Nadir The point below a point of observation. The nadir will be the point in the centre of an aerial photograph that is perfectly vertical.

Neap tide A tide that occurs at the first and third quarters of the Moon when the gravitational force of the Moon is opposed to that of the Sun, thereby producing a relatively small tidal range, and causing lower than average high tides and higher than average low tides. The velocity of tidal currents is slowed at this time.

Nearshore A process-based term for the area comprising the swash, surf and breaker zone; the area in which waves *are* forced to break owing to the shallowing of water closer to the shoreline.

Negative feedback An event or process resulting from another event that counteracts its effects.

Nekton A nektonic organism (see *nektonic*).

Nektonic The collective name for organisms which are active in the water column and move around in it rather than being restricted to the top or the bottom.

Net primary productivity (NPP) The amount of energy (carbohydrate) fixed by plants during photosynthesis subtracting that used in respiration; it represents the growth of the plant/ecosystem, measured in unit area per unit time.

Net radiation The difference between the total incoming radiation and the total outgoing radiation.

Neuston The name given to a group of organisms which exist mainly on the surface of the water or just below the surface.

Niche The position or role of an animal or plant species within its community in relation to its specific requirement of habitat resources and microclimatic conditions (i.e. climate, shelter, food, water). No two species with identical resource requirements can occupy the same niche (the principle of competitive exclusion applies).

Nitrification The process whereby ammonium is oxidized to produce nitrite which is then oxidized to form nitrate. In the natural environment the process is carried out by nitrifying bacteria which are able to gain energy through the oxidation of the compounds. Nitrification is an aerobic process which means it requires oxygen to occur.

Nitrifying bacteria Bacteria that oxidize ammonium to nitrite and thence to nitrate.

Nitrogen fixation Nitrogen in the form N_2 is not accessible to plants to use for their growth. Nitrogen fixation is the process whereby bacteria which exist in the soil or in nodules on the roots of plants (symbiotic relationship) are able to reduce nitrogen to ammonium thereby making it accessible to plants.

Nivation Localized erosion of a slope caused by the combination of frost action, *gelifluction*, *frost creep* and meltwater flow at the edges and beneath a snowpack; accentuated in permafrost-free zones during periodic freezing and thawing of constantly moistened ground.

Nivometric coefficient The percentage of precipitation falling as snow within a given area.

Non-selective scattering The wavelength-independent redirection or scattering of electromagnetic radiation caused by atmospheric particles that are much larger than the wavelengths of the light they scatter.

North Atlantic Deep Water (NADW) A body of water formed in the North Atlantic Ocean. Relatively saline water from the Gulf Stream cools when it moves rapidly north into the Norwegian Sea; it becomes denser and sinks, flowing back south to form a major component of the *thermohaline circulation* of the oceans.

Nuee ardente A cloud of superheated gas-charged ash that develops into a pyroclastic gravity flow following a very explosive volcanic eruption.

O

Occluded front The process in which a cold front of a depression overtakes a warm front. The occluded front is classified as warm or cold depending on whether the air ahead of the warm front is colder or warmer than the air following the cold front.

Occult deposition The occurrence where the contact of mist or fog with buildings or vegetation can result in the deposition of pollutants on these surfaces.

Offshore A morphological term for the area below the wave base, just beyond the shoreline and foreshore.

Oligomictic With reference to lakes, these lakes may be permanently stratified unless there is some perturbation to induce mixing, such as a storm event.

Omnivore Organism that feeds on both plants and animals.

Ophiolites A layer of oceanic crust created at mid-oceanic ridges and uplifted at convergent plate boundaries, now lying exposed above the water at continental margins.

Options analysis The identification of key criteria through which to evaluate management options when dealing with an environmental issue.

Organic Pertaining to any compound containing carbon, except simple compounds such as oxides and carbonates (which are considered inorganic).

Orogeny The process of mountain building, it is particularly related to the growth of mountains which occurs as a result of the deformation of the Earth's crust through folding actions and compressional forces.

Orographic Pertaining to mountains; for example, orographic precipitation is caused by the forced ascent of air over high ground/mountain barrier.

Oscillatory flow Currents that oscillate backwards and forwards such as wave currents.

Overland flow The motion of a surface layer of water as sheet flow (unchannelled).

Oxidation A chemical weathering process involving the combination of free oxygen with minerals to form oxides with a positive electrical charge.

Oxidation state The electronic state of an atom in a particular compound; equal to the difference between the number of electrons it has compared with a free atom, e.g. in calcium chloride (CaCl_2), calcium has the oxidation state of +2 (Ca^{2+}) and chlorine has the state -1 (Cl^-).

Oxisols A soil order found in the tropics consisting of old, extremely weathered soils which have been highly leached and consequently become infertile with a low base status.

P

Palaeo- Spelt 'Paleo-' in American English, derived from the Greek for 'old', and often used as a prefix to mean 'past'. Thus 'palaeoecology' is the ecology of the past; 'palaeoclimatology' is the study of past climates; etc.

Palaeoecology The study of ancient plant and animal distributions and processes.

Palaeomagnetism The study of the magnetism of igneous rock; the strongly magnetic particles of magnetite in igneous rock become permanently orientated in the direction of the Earth's magnetic field at the time of the lava cooling.

Paisas Low permafrost-cored mounds, 1-10 m high, formed in peat of both continuous and discontinuous permafrost zones; caused by differential frost heaving linked to the thermal conductivity of peat.

Palynology The branch of science concerned with the study of living or fossil pollen and spores; often used in the reconstruction of palaeoenvironments via analysis of pollen types preserved in peat, organic soils and lake muds.

Panchromatic Sensitive to all colours of the visible spectrum.

Pangaea The Earth's most recent supercontinent formed during the Permian by the coalescence of most continental plates (Gondwanaland and Laurasia, among other smaller continents) and rifted apart in the Jurassic.

Paraglacial geomorphology The study of landscape features which owe their existence to the presence of ice, albeit indirectly and often in the past.

Parallax The apparent change in position of a stationary object when viewed from two different positions.

Parent material The material upon which soil is developed and constitutes the main input of soil material through the process of weathering. It may be the weathered surface of exposed unconsolidated *in situ* rock surfaces, or unconsolidated superficial material transported and deposited by gravity, water, ice and wind.

Partial contributing area concept The idea that *infiltration-excess overland flow* will often occur only in spatially localized parts of the hillslope as opposed to the entire catchment (as originally postulated by Horton).

Partially mixed estuaries Estuaries that are highly influenced by tidal currents, causing greater mixing (*advection* and *diffusion*) of fresh- and saltwater and a more gradual salinity gradient in the water column.

Participatory analysis The process of encouraging all stakeholders to take an active part in the decision-making process when deciding on an environmental management strategy where conflicting interests are involved.

Particle movement The physical transportation of material down a hillslope where grains move one, or a few, at a time and do not significantly interact with one another, as opposed to a *mass movement*.

Peat A type of predominantly dark organic soil derived from partially decomposed compacted plant materials that accumulate under waterlogged conditions.

Pedogenesis The process of soil formation.

Peds Clumps or structural units of soil separated by small natural voids.

Pelagic sedimentation Sediments formed in an open-ocean environment by the slow background sedimentation of fine-grained material (usually marine organisms and red clays) falling through the water column to the seabed.

Pelagic zone The zone at the top of the water column where light abundance allows for photosynthesis to take place; it is also related to open-water areas and is therefore only found away from the banks of a water body (*littoral zone*).

Peneplain A low-relief plain that is the theoretical end product of erosion in the absence of tectonic activity (following *Daviesian cycles of erosion*).

Perennating system A group of plants that persist for several years, usually with new growth from a perennating part of the plant, e.g. bulbs, *rhizomes* or tubers.

Period In geological terms, a period is a formal division of geological time. The Quaternary is an example of a geological period. Two or more periods make up an era.

Permafrost A condition existing below the ground surface, in which the soil or bedrock material remains perennially frozen, below 0°C for a minimum of two years. Currently permafrost affects approximately 26% of the Earth's surface.

Phanerophytes Woody perennials (trees and shrubs) with visible buds on upright perennial stems high above the ground, e.g. the palm family.

Phenological Pertaining to the timing of recurring natural phenomena, such as the timing of events such as leaf fall and buds appearing on plants.

Phenology The study of the timing of natural phenomena in relation to climate. For example, the appearance of the first flower of spring.

Photic zone The layer of the surface ocean which receives enough sunlight to enable photosynthesis to occur. Also known as the euphotic zone.

Photochemical oxidation A process which occurs in the presence of light and results in the chemical change of a substance through the loss of electrons.

Photon A quantum of electromagnetic radiation. Units of light or other electromagnetic radiation, the energy of which is proportional to the frequency of the radiation.

Photoreduction Chemical reduction of a substance caused by ultraviolet radiation, e.g. in sunlight.

Photosynthesis The process of converting light energy to chemical energy and storing it as sugar. This process occurs in plants and some bacteria and algae. Plants need only light energy, and to make sugar.

Photosynthetic bacteria Bacteria that are able to carry out *photosynthesis* (light is absorbed by bacteriochlorophyll), e.g. blue-green algae.

Phytoplankton Photosynthesizing plants, often microscopic, that live in saline and freshwaters and are the foundation for the aquatic food chain.

Pillow lava The name for lava that erupts from vents underwater and cools rapidly forming rounded structures surrounding the vent.

Pingo An ice-cored mound (up to 55 m high and 500 m long) found in permafrost areas; derived from an Inuit word meaning 'hill'.

Pingo scar A relict periglacial feature formed by the melting of the ice core of a *pingo*, leaving a central surface depression with sediment ramparts.

Pipeflow The movement of water through the soil within *soil pipes*.

Pixel A contraction of 'picture element' that refers to the smallest unit of a *digital image*.

Planktonic A group of organisms which reside in the water column in suspension and move through drifting and floating.

Plant physiology The study of the functioning of plants, and this includes the response of plants to their environment and the acquisition of resources by plants. **Platform** The stationary (i.e. gantry) or moving (i.e. aircraft) position on which remote sensors are mounted.

Playa A depression in the centre of an inland desert basin; the site of occasional temporary lakes; high levels of evaporation often create alluvial flats of saline mud.

Pleistocene The first epoch of the Quaternary, preceded by the Pliocene and succeeded by the *Holocene*. Lasting from approximately 1.8 million to 10 000 years before the present (when the Earth was most extensively glaciated).

Ploughing boulders Boulders found on periglacial slopes that slowly move downslope owing to different thermal conditions beneath the boulder compared with the surroundings. They leave a trough upslope and form a sediment prow downslope.

Point source pollution Release of contaminants from a clearly identified point, e.g. a pipe from a factory.

Polar front The surface of contact between a cold polar air mass and a warm tropical air mass.

Polar permafrost Extensive *permafrost* that occurs owing to low temperatures in high-latitude areas, e.g. Alaska.

Polder Land reclaimed from the sea via the development of embankments.

Polyclimaxes A theory of vegetation allowing the co-existence of several final *climax communities* for a given type of area, all of which rank equally rather than being subordinate to a single climatic climax community (as required by *the monoclimax* theory). Instead of total convergence into a single community type, succession therefore produces partial convergence to a mosaic of different stable communities in different habitats.

Polycrystalline Referring to a crystalline structure in which there is a random variation in the orientation of different parts.

Polymictic With reference to lakes, polymictic lakes tend to be shallow and are predominantly continually circulating. They have limited stability although there may be a point in each day where thermal stratification is able to occur.

Polythermal glacier A glacier composed of both warm and cold ice.

Pore spaces The voids between solid soil particles.

Pore water pressure The pressure exerted by water in the pores of soil and aquifer rocks which may force particles apart during saturated conditions.

Porosity The pore space of a substrate (i.e. the factor controlling soil and rock permeability).

Positive feedback An event or process resulting from another event or process which exacerbates or magnifies the original effect.

Positivism A traditional philosophy of science, originally attempting to distinguish science from religion by ensuring the application of a unitary scientific method of observation, involving direct and repeatable experimentation on which to base theory. The underlying premise is that a firm empirical basis will lead to the identification of scientific laws which become progressively unified into a system of knowledge and 'absolute truth' about the natural world.

Potential evapotranspiration The *evapotranspiration* that would occur from a vegetated surface with an unlimited water supply.

Potholes Circular depressions found on bedrock surfaces. In reference to rivers they are scoured out by the effect of a pebble rotating in an eddy.

Precautionary principle An approach to decision-making which states that where there are threats of serious or irreversible damage, lack of scientific certainty should not be used as an excuse to preclude preventative action. Action should be taken at an early stage before victims or negative impacts occur; 'better safe than sorry'.

Precession of the equinoxes The gravitational pull exerted by the Sun and the Moon cause the Earth to wobble on its axis like a spinning top, determining where in the orbit the seasons occur, and the season when the Earth is closest to the Sun.

Precipitation The deposition of water in a solid or liquid form on the Earth's surface from atmospheric sources (including dew, drizzle, hail, rain, sleet and snow).

Precipitation deficits The lack of precipitation in a water balance when considering the losses in the form of evaporation or losses through gravity-driven movement of water to riverflow or groundwater.

Predators Carnivorous organisms which exist by preying and feeding on other organisms.

Primary endemism When a species occurrence is unique to one specific area alone and unknown to any other region, e.g. Australian marsupials.

Primary minerals Minerals that have not changed from their original state since they were formed in magma (e.g. quartz, feldspars and micas).

Primary productivity The amount of biological material (biomass) produced by photosynthesis per unit area and unit time by plants.

Primary succession *Ecological succession* beginning on a newly constructed substrate previously devoid of vegetation (e.g. a new volcanic island); the recently exposed land is colonized by animals and plants.

Pro-delta The shelf area offshore of a river mouth which marks the intersection between the delta sediments and the adjacent basin.

Profundal zone A deep zone of water, usually in an ocean or lake where there is reduced light penetration. It is often found below the *thermocline* and due to the lack of light there is reduced biological diversity in this zone.

Pronival ramparts Another name for *protalus ramparts*.

Protalus ramparts Linear ridges of coarse sediment found a small distance away from a slope base, formed from the accumulation of frost-shattered debris that, once fallen from a backwall, slides down a snowpack to its lower margin.

Push moraine A ridge of material accumulated at the glacier margin by the bulldozing action of a glacier front and consisting of glacially derived material.

R

'r' and 'K' selection A theory of two life strategies to cope with competition and stress. Natural selection may favour either individuals with high reproductive rates and rapid development ('r' selection) or individuals with low reproductive rates and better competitive ability ('K' selection).

Radiation Emitted electromagnetic energy.

Radiometric Of or pertaining to the measurement or representation of radiation.

Radiometric methods Techniques for estimating the age of deposits based on the time-dependent radioactive decay of particular radioactive isotopes found in sediments.

Raindrop impact The force exerted by a falling raindrop on a soil surface. The impact of the raindrop causes a shock wave which detaches grains of soil or small aggregates up to 10 mm in diameter and projects them into the air in all directions; the rate of detachment is roughly proportional to the square of rainfall intensity.

Rainflow In shallow overland flow, the transport of water resulting from a combination of detachment by raindrop impact and transportation by rainwater flowing downhill.

Rainsplash A type of soil erosion caused by *raindrop impact* in which sediment is transported through the air.

Rainwash The erosion of soil by overland flow processes; normally occurs in concert with *rainsplash*.

Raised beach A step-like feature along a coastline which marks the former position of the high tides and which once used to be a beach. Often, raised beaches are created by isostatic rebound, which lifts the beach out of reach of the waves.

Random errors Non-systematic errors that are unpredictable and cannot be removed from data and can only be estimated.

Rating equation An equation used to infer river discharge values from measured water levels at particular points along a river. The known discharges of the river at various different water levels are plotted and the equation for the line of best fit is calculated; the discharge at any water height can then be inferred (although there are inevitable errors in this process).

Rayleigh scattering The wavelength-dependent redirection or scattering of *electromagnetic radiation* caused by atmospheric particles that are much smaller than the wavelengths of the light they scatter.

Reaches (river) Sections of a river which show uniform characteristics such as flow depth, slope and area. This could be found between two morphological features such as debris dams or boulders. They are usually observed at a scale of up to 10 m.

Reagent A substance or compound which is added to another substance to initiate a chemical reaction or to determine whether a reaction will occur.

Realized niche A term to describe the *niche* more commonly utilized by most species whereby competitive interaction between several species attracted to the same resource has inhibited attainment of the *fundamental niche*.

Rebound hardness The hardness of a substance as measured by a hammer or other object which bounces off it. The height of the bounce from a given drop height is compared from substance to substance.

Recharge Replenishment of groundwater stores.

Redox potential The reducing or oxidizing intensity of a system, measured with an inert platinum half-cell and a reference half-cell calibrated against the hydrogen electrode. A measurement conducted in this manner is known as the Eh.

Reduction A chemical weathering process in which oxygen is dissociated from minerals creating a negative electrical charge; it usually occurs in anaerobic conditions.

Reductionist The assumption that the system under study is 'closed', i.e. all other variables within the system are held constant, allowing the direct relationship between two variables to be ascertained, and thereby eliminating reference to the potential influence of extraneous variables (e.g. *positivism* is reductionist).

Reflection The process by which a wave approaching a vertical or near-vertical object (e.g. sea cliff or sea wall) is rebounded from the object. If the angle of wave approach is parallel to the object, the wave will be reflected in the opposite direction to the line of approach. If the wave strikes at an angle of incidence other than parallel the wave is reflected in the tangent to the angle of approach.

Reflective beaches Also termed low-wave energy beaches, they often form in protected pockets on the lee side of rocks and can be identified by steep narrow beaches of coarse sand and a narrow surf zone.

Reflectivity The ability of a body to return energy.

Refraction The process by which a wave front bends and changes direction owing to a reduction in velocity as the wave enters shallow water.

Refugia Isolated habitats with distinctive ecological, geological, geomorphological or microclimatic characteristics that allow formerly widespread species to survive following a period of climatic change.

Regelation A two-fold process involving the melting of ice under pressure (the melting point of ice under pressure is lower than 0°C) and its subsequent transport and refreezing where the pressure is reduced; a major factor in the mechanism of downslope movement of a glacier.

Regime The seasonal variation in river flow which tends to be repeated each year is the river regime.

Regolith(s) The basal layer of soil overlying the bedrock composed of loose, unconsolidated weathered rock and gravel debris; it is the raw material from which soils are developed.

Regressive barriers Large mounds of sediment that have developed under the influence of a falling sea level and/or excess sediment supply. Landward sediments are deposited on top of more seaward ones.

Relative sea level Level of the sea relative to the land determined by *eustasy* and *isostasy*.

Relaxation time The amount of time that an environment/ landscape takes to recover from a major event (e.g. a flood or landslide).

Relay floristics A concept relating to species invasion and disappearance from a local community; it suggests that as one group of species establishes itself it is replaced by another which is then replaced until a stable state is achieved.

Renaissance A period of change in culture in Europe when classical art and learning was re-examined and embraced. It began in the late fifteenth century in Italy and then spread to other European countries.

Reptation A method of sand transport in which grains are set into a low motion due to the high-velocity impact of a descending saltating grain.

Residence times The period of time a substance, e.g. nutrients, remains in a single location.

Residual tidal current Net movement of water due to tides occurring over long time periods. Tidal movements do not necessarily balance out over time thereby creating an overall water movement in a particular direction.

Resilience The ability of a system to recover from an event, change or shock.

Resolution Describes the ability of a system to separate a scene into constituent parts whether these parts be spatial, temporal or spectral.

Return flow Subsurface flow in the soil, either throughflow or macropore flow, that encounters a zone of soil saturation or lower hydraulic conductivity and is forced up through the soil profile to flow over the ground surface.

Rhizomes The underground lateral stems of certain plants that send up the new shoots (the rootstock).

Rhizosphere A zone approximately 1 mm wide surrounding the roots of a plant. The chemistry and biology of the soil in this zone are influenced by the plant root as a result of plant uptake and exudates.

Riffle A *bar* deposit found on the bed of river channels, usually spaced between 5 and 10 times the channel width apart. The height above the average bed surface causes fast-flowing, shallow and broken water under low- and medium-flow conditions.

Rill A small channel, formed by the merging of sheet wash into channelized flow, that acts as a conduit for water and sediment and is liable to collapse and change location between each runoff event.

Rillwash A hillslope erosion process that occurs when rainflow is deeper than 6 mm (generally in small channels carved out of the hillslope), rendering raindrop detachment ineffective; sediment detachment occurs when the downslope component of gravity and fluid flow traction overcome the frictional resistance of the soil.

Rip currents A strong seaward-directed current associated with water returning to the sea after being brought onshore by wave-breaking activity; an accumulation of water develops which pushes down the beach via a line of least resistance.

Riparian zone A region on either side of a stream or river which is characterized by vegetation which differs from that outside of the riparian zone due to soil conditions found in the region. Riparian zones can provide a number of ecosystem services including acting as filters for overland runoff, providing habitats and also producing *allochthonous* resources for river ecosystems.

Rising limb The increase in river discharge in response to a rainfall event, as depicted in a storm hydrograph.

River reach See *Reaches (river)*.

River segments These are sections of a river which are the length of the river between two bends. They are usually studied at the scale of approximately 100 m.

Roche moutonnees Small *stoss-and-lee* forms.

Rock flour Fine-grained rock particles pulverized by glacial erosion.

Rock glacier A tongue-like body of angular debris resembling a small glacier but with no ice evident at the surface and only *interstitial ice* in the pore spaces between the debris. Their movement downvalley is very slow and many appear stagnant.

Rock shelters Shallow, sheltered niches in a hillside, smaller and less pronounced than a *cave*. Ancient human occupation often results in rich archaeological findings, in addition to other deposits indicative of past environmental conditions.

Rockfall A mass-wasting process whereby consolidated material falls and breaks up into a jumble of material at the base of a cliff or steep slope.

Rogen moraine A moraine characterized by a series of ribs of sediments lying transverse to the direction of ice advance, approximately 10-30 m in height.

Rossby waves Upper-air waves that undulate horizontally in the flow path of the jet streams and the westerlies.

Roughness length An indicator of the roughness of the ground surface and its impact upon surface winds, i.e. an urban surface has a much greater roughness length (up to 10 m for tall buildings) than agricultural crops (approximately 5-20 cm).

Rover A non-stationary global positioning system receiver that is used to collect three-dimensional position data over an area.

Ruderal Pertaining to species with a good colonizing ability, capable of growing on new or disturbed sites, e.g. weeds (also described as 'r' strategists).

S

Sabkha A salt-encrusted tidal flat environment; evaporation of groundwater draws in seawater which upon evaporation precipitates *gypsum* (e.g. the coasts of the Persian Gulf).

Safety factor The ratio of the sum of forces resisting movement to the sum of forces promoting movement of material down a slope; a value below 1 means movement will begin.

Salcrete A *duricrust* predominantly composed of sodium chloride (rock salt), a halite.

Salinization A process involving the accumulation of soluble salts of sodium, magnesium and calcium in the soil to the extent that the soil fertility is severely reduced.

Salt marshes Coastal marshes that develop on low-lying sheltered sections of coastlines (primarily in a lagoon, behind a spit or in an estuary). Specialized salt-tolerant vegetation (halophytes) traps silt particles and consolidates the environment through processes of vegetation succession.

Saltation A mechanism of sediment transport involving sediment grains being bounced along a bed surface.

Sand Sediment particles between 0.06 and 2 mm in diameter.

Sand seas Large areas of sand accumulations characterized by sand sheets and dunes; sediment grains are well rounded and typically quartz (e.g. the Sahara and Namibian Deserts). Also known as *ergs*.

Saprolite A soft, clay-rich, disintegrating rock found in its original place, formed by chemical weathering of igneous or metamorphic rock in humid, tropical or subtropical climates.

Saprovores An organism that survives on dead organic matter.

Saturated A term to describe the state of the soil when all soil pores are filled with water.

Saturated adiabatic lapse rate The rate at which temperature decreases in a rising parcel of saturated air.

Saturated hydraulic conductivity The rate of water movement through a porous medium when it is saturated (calculated using *Darcy's law*).

Saturated zone The zone under the surface, which lies beneath the water *table*, in which all pores of the aquifer rock or soil are filled with groundwater (i.e. saturated).

Saturation-excess overland flow A form of overland flow that occurs when all available soil pore spaces become full (i.e. the soil is saturated). Excess water is forced to flow over the surface.

Scale Describes the linear relationship between a linear distance on an image and the corresponding distance on the ground which determines how much detail is captured in the image.

Sclerophyllous Refers to plants with small, tough evergreen leaves which maintain a rigid structure at low water potentials thereby avoiding wilting. They are usually found in low-rainfall areas since the tough leaves help to reduce water loss.

Scrapers Another name for grazers.

Scratch hardness The resistance of a material, such as stone, to scratching by another known material. These known materials are assembled into a standard scale which is known as Moh's scale of minerals.

Scree Loose, angular, rocky material that has been loosened from a slope through weathering and deposited further down the slope.

Scree slope The area at the base of a hillside where loose angular sediment (*scree*) accumulates.

Sea walls Massive concrete, steel or timber structures built along the coastline, with a vertical or sometimes curved face. A *hard engineering* coastal management technique employed to protect local infrastructure from flooding or erosion.

Seamounts Individual volcanoes on the ocean floor whose origin is distinct from the plate boundary volcanic system of mid-ocean ridges or subduction zones, i.e. usually formed as a plate moves over a *hot spot*.

Sea-salt events Enrichment of precipitation with sea salts incorporated from sea spray in windy conditions.

Seasonal icings Mounds of ice formed in winter in topographic lows where groundwater reaches the surface, i.e. in areas where *return flow* occurs and freezes.

Secondary endemic A species becomes endemic through the extinction of those species occurring in other places where they once survived (e.g. mammals of the West Indies).

Secondary minerals Minerals formed by the breakdown and chemical weathering of less resistant primary minerals (e.g. clays and oxides of iron and aluminium).

Secondary succession *Ecological succession* beginning on a previously vegetated site that has been recently disturbed by natural agents (e.g. fire, flood and hurricanes) or by human activities (e.g. deforestation). Remnant seed banks and root systems may influence the character of the resulting community.

Sediment budget An account of the inputs, outputs and stores of sediment for a given system.

Sediment yield The amount of sediment, both in suspension and transported as bed load, that is lost from a catchment. Usually measured as tonnes per year or tonnes per year per unit catchment area.

Sedimentary rock Rock which has formed by the gradual accumulation of sediment through time which has then solidified.

Sedimentation The process in which sediment is deposited leading to its accumulation (e.g. at deltas).

Segregated ice Very large lenses of ice that have slowly built up in frozen soil as a result of the migration of water to the freezing front (typically only in the upper 5-6 m of ground).

Seif dunes Linear dunes formed where two dominant wind directions are present at approximately right angles to each other.

Sensible heat Heat that can be measured by a thermometer and felt by humans.

Serai stage A stage within the process of *ecological succession* which is characterized by a particular biotic community. A series of serai stages (and their associated biotic communities) successively follow one another in the path to the climax community; each community creates conditions more favourable for a succeeding community.

Sesquioxides An oxide containing three atoms of oxygen to two atoms (or radicals) of some other substance.

Sessile A term to describe benthic organisms attached to a substrate and hence immobile (fixed to the ocean bottom).

Shadow dunes Small wind-blown dunes that develop in coastal or dryland areas around obstacles such as driftwood, a rock or a dead animal.

Shear A condition or force causing two contacting layers to slide past each other in opposite directions parallel to their plane of contact.

Shear stress A stress that acts upon a particle in the same plane as the surface the particle is resting upon (i.e. opposed to normal stress acting in the direction of gravity), resulting in either movement or strain of the particle, in the context of river systems, shear stress is the velocity of flowing water; when a critical flow velocity (and hence a critical shear stress) is reached, frictional forces may be overcome and a particle lifted from the bed.

Shield areas Technically stable areas of exposed rock which date back to the Precambrian era, these areas are relatively flat and show limited evidence of tectonic activity such as mountain building which is more evident at the margins of shield areas.

Shield volcanoes Large, dome-like rarely explosive volcanoes with gentle slopes of 6-12° formed by alternate layers of runny basalt, e.g. the Hawaiian shield volcanoes.

Shifting cultivation A form of plant cultivation in which seeds are planted in the fertile soil prepared by cutting and burning the natural growth. Relatively short periods of cultivation are followed by longer periods of fallow to allow soil rejuvenation, returning to the site years later.

Shoaling A gradual shallowing of the seabed.

Shore The land bordering the sea between the water's edge at low tide and the upper limit of effective wave action.

Shoreline The water's edge where the shore and the water meet; it varies over time.

Shore platform An erosional surface of horizontal or gently sloping rock in the intertidal zone that has developed following erosion of a rocky coast.

Short-wave radiation Incoming radiation whose wavelength is unchanged from its solar source.

Shredders Organisms which feed on coarse particulate organic matter, breaking it down into fine particulate organic matter. These organisms are considered most important in temperate river systems and are predominantly found in forest streams where there is much plant and leaf litter.

Significant wave height The mean height of the top tenth of all wave heights recorded at a given location (used as an approximate measure of wave energy for that location).

Silcrete A *duricrust* predominantly composed of silicates.

Silt Sediment particles between 0.004 and 0.06 mm in diameter.

Silviculture Subject of utilizing plant processes to grow trees for harvesting.

Sinusoidal The mathematical shape of a curve of sines, i.e. a wave consists of a simple sinusoidal form.

Slaking A process that involves raindrops striking a soil surface and water being forced into a soil aggregate therefore compressing the air inside and causing the aggregate to explode into its constituent grains.

Slantwise convection Convection (vertical rise in an air parcel) is inhibited when the prevailing lapse rate is less than the appropriate adiabatic lapse rate. However, a poleward horizontal movement of an air mass may bring the air parcel into an environment denser than itself, thereby allowing the air parcel to rise through slantwise convection.

Slide *Mass movements* which involve a large mass of earth or rock essentially moving as a block as opposed to *flows*.

Slumping A mass movement process whereby saturated slope material moves downslope under the force of gravity and deforms upon movement.

Smelting The process of extracting a metal from its ores by heating.

Snowline The altitude marking the lower limit of permanent snow in upland or high-latitude areas, i.e. the line where the winter snowfall exceeds the amount removed by summer melting and evaporation.

Social ecology The study of the dynamics and diversity of social behaviour and social systems of animals; social ecological variables include measures of group composition, inter-male competition and habitat preference.

Social impact assessment An evaluation of the impact of a proposed activity on all the social aspects of the environment including: people's *coping strategies* (economic, social and cultural); use of the natural environment; the way communities are organized through social and cultural institutions; and the identity and cultural character of a community. It involves characterizing the existing state of these aspects of the social environment in addition to predicting how they might change.

Soft engineering Pertaining to more 'sensitive' management practices that involve methods more closely associated with geomorphological processes and local sediment dynamics; large '*hard engineering*' types of structures are avoided.

Soil A complex medium consisting of inorganic materials, organic matter (living and dead), and water and air variously organized and subject to dynamic processes and interactions. It forms the natural terrestrial surface layer that is the supporting medium for the growth of plants.

Soil biomass The living component of soil organic matter, it is the term given to a mass of organisms in a specified mass of soil. It is often used as an indicator of soil quality and includes organisms such as bacteria and earthworms.

Soil colloid Very small mineral particles (less than 0.002 mm in diameter) that stay suspended in water, the most important being clay minerals capable of remaining suspended in water indefinitely.

Soil colour A visible characteristic of the soil that allows the determination of soil properties such as organic matter content, iron content, soil drainage and soil aeration.

Soil creep The very slow, imperceptible, movement of material downslope under the force of gravity.

Soil horizons Distinctive horizontal layers within a *soil profile*, created primarily by the translocation of materials with water moving through the soil.

Soil organic matter Predominantly consists of carbon, but is also made up of other elements including nitrogen, phosphorus, oxygen and sulphur. It can be split into three groups - litter, humus and biomass - and is an important component of a healthy and productive soil. It has a number of functions including retaining moisture and organic pollutants and providing food for soil biomass.

Soil pipes Horizontal tube-like subsurface cavities within the soil; special forms of macropores greater than 1 mm in diameter. They are continuous in length such that they can transmit water, sediment and solutes through the soil and bypass the soil matrix.

Soil profile A vertical section through' the soil from the ground surface down to the parent material; the profile characteristics determine the soil type.

Soil solution The water held in the soil pores that contains dissolved organic and inorganic substances and hence is not pure.

Soil structure The shape, size and distinctiveness of soil *aggregates*, divided into four principal types (blocky, spherical, platy and prismatic).

Soil texture The relative proportions of sand, silt and clay-sized fractions of a soil.

Solifluction Form of slow mass movement in environments that experience freeze-thaw action or highly variable warming and cooling of the surface. This results in a slow movement of soil material downslope.

Solum The portion of the soil where soil-forming processes are active and plant and animal life are mostly confined; the A, E and B horizons.

Solute load The total mass of material transported in solution by a flow.

Solvent A substance which dissolves another substance to produce a solution.

Sorting A measure of the spread, or standard deviation, of grain sizes within a sediment. In general the further a sediment deposit has been transported from its source, the greater the sorting of grains.

Speciation The evolution of new species involving the relatively gradual change in the characteristics of successive generations of an organism, ultimately giving rise to species different from the common ancestor. Most biologists accept Darwin's basic hypothesis of speciation from a common ancestor as a result of natural selection of those attributes best suited to survival in a given habitat with limited resources. Speciation can take a number of forms, whether sympatric (populations overlapping) or allopatric (populations become isolated from one another).

Specific conductance The ability of water to conduct an electric current, dependent on the concentration of ions in solution.

Specific heat The energy required to change the temperature of 1 gram of a substance by 1 degree Celsius. Water has a higher specific heat than air, requiring more energy to be absorbed for any given temperature change.

Spectral band A division of the electromagnetic spectrum that groups energy according to similarities.

Spectral signature Describes the reflectance characteristics of a surface across the electromagnetic spectrum.

Specular reflection The redirection of radiation off a smooth surface such that the radiation is otherwise unchanged.

Speleothems Structures formed in a cave by the deposition of minerals from water, e.g. a stalactite, stalagmite. They are primarily composed of calcium carbonate precipitated from groundwater percolating through carbonate rock, e.g. limestone.

Spits Narrow and elongated accumulations of sand and shingle projecting into the sea, usually with a curved seaward end caused by wave action. They grow out from the coastline when the shore orientation changes but longshore currents do not deviate and continue to transport and deposit along a projected coastline, e.g. at the mouth of an estuary.

Spring tides A tide that occurs at or near the new moon and full moon when the gravitational pull of the Sun reinforces that of the Moon producing a large tidal range, causing higher than average high tides and lower than average low tides.

Stable isotope Isotopes of an element possess the same number of protons in their nuclei but have different numbers of neutrons. A stable isotope does not break down by radioactive decay. For example, ^{12}C is a stable isotope and the most widespread form of carbon in the environment, but the radioactive isotope ^{14}C and the stable isotope ^{13}C also occur.

Stadial A short period of climatic deterioration within an interglacial period; glaciers advanced and periglacial conditions extended but in a less pronounced way than during a *glacial interval*.

Stakeholders A person or group who can affect or is affected by an action and therefore has a vested interest in the outcomes. Responsible decision-making requires consideration of the effects on all stakeholders.

Stand An area of more or less homogeneous vegetation.

Standard deviation A measure of how spread out the data are around the mean.

Stellate dunes Star-shaped dunes formed under conditions of variable wind direction with no one prevailing wind direction. These dunes do not migrate.

Stemflow The flow of water down the trunk of a tree or stems of other vegetation allowing water to reach the hillslope.

Stereo images Aerial photographs that have been obtained such that each photo overlaps another by a prescribed amount. Overlapping coverage provides two points of observation to provide *parallax* required for *digital elevation model* generation.

Stochastic A model that contains some random element in the operation or input data so that more than one, and usually a very large number of, outcomes are possible.

Stone pavements Accumulations of flat-lying boulders in a mosaic pattern at the ground surface in periglacial environments. Some argue they are formed by aeolian removal of fine surface particles, but it is more commonly argued they are displaced upwards as small particles fall into ground cracks created during freeze-thaw cycles while the larger boulders cannot.

Stormflow The peak flow that occurs during or immediately following a rainfall event occurring as a result of overland flow and rapid subsurface flow (e.g. pipeflow contributions may also be high).

Storm surge barriers A *hard engineering* technique with a main function to protect low-lying and coastal areas from flooding during storm events which can be exacerbated by the occurrence of rising sea levels.

Stoss-and-lee forms Streamlined elongated rock exposure formed by the sliding of debris-rich basal ice over the bedrock surface under a glacier; characterized by a gently sloping glacially smoothed upstream side and a steeper plucked downstream side (centimetres to metres in length).

Strain history The amount of deformation of a substance that has occurred owing to previous stress impact; it can affect present and future stress-strain relationships.

Strain rate The amount of deformation occurring over time for a given material (i.e. the rate of deformation). For glaciers, the strain rate for a given shear stress is determined by *Glen's law*.

Stratification (stratify) Division of water in deep lakes, reservoirs and stable water bodies into layers of differing density.

Stratified estuaries Estuaries with limited saltwater and freshwater mixing (via *advection* and *diffusion*) causing a lower layer of denser and saltier water with an upper layer of less dense freshwater; a salt wedge develops.

Stratigraphy The layering of sediments.

Stratosphere A layer of the atmosphere lying above the *troposphere* about 50 km above the Earth's surface.

Stratotype A particular stratigraphic unit with clear and well-recorded characteristics and boundaries. This site can become the point of reference for comparison with a more poorly preserved record. Also known as typesite.

Stream competence The maximum particle size a stream can transport.

Stream order Numbering of the drainage network according to the number of tributaries and stream network linkages.

Stream power The rate of energy supply in a river that is available for work to be done at the stream bed, measured in W m^{-2} .

Stress The force per unit area acting on a plane within a body due to application of an external load; six values are required to characterize the stress at a point completely (three normal components and three shear components).

Striations Microscale erosional features on rock surfaces, resembling a scratch.

Sub-aerial An object or a process which exists or occurs near to or on the surface of the Earth.

Subduction The process in which one lithospheric plate descends beneath another into the asthenosphere when the two plates converge.

Subglacial Pertaining to the environment at the base of a glacier.

Sublimate A change in the physical state of a substance directly from solid to gaseous form.

Sublimation The chemical process in which a solid changes directly into a gas.

Subsea permafrost *Permafrost* found beneath the sea; sometimes due to low temperatures at the bed, more usually a remnant of past colder temperatures and rising sea levels (drowning frozen ground).

Subsurface flow Pertaining to *throughflow* that occurs through *micropores*, *macropores* and *soil pipes*.

Succession Changes over time in the structure or composition of an ecological community. These changes often follow a predictable pattern.

Sun-synchronous orbit The orbit of a satellite travelling around the Earth which is timed such that it passes over any given latitude at the same time at each pass so as to ensure that illumination conditions remain constant between subsequent images.

Super-adiabatic A term used for localized steep *lapse rates* that are greater than even the *dry adiabatic lapse rate* causing rapid local convection, e.g. strong radiational heating of the ground surface.

Superimposed ice The ice formed when water from melting snow comes into contact with the cold surface ice of a glacier at the base of the snowpack and refreezes.

Supply limited A transport process that is limited by the lack of sediment supply, not the capacity to transport sediment since more force is available than is being utilized. For example, rockfalls are limited by the amount of material that is loose enough to fall.

Supraglacial Pertaining to the environment at the surface of a glacier.

Surf zone A process-based term for the area within the *nearshore* zone where breaking waves approach the shore usually over a wide, low gradient.

Surface boundary layer A layer extending upwards from the Earth to a height that ranges anywhere between 100 and 3000 m. Here, almost all interactions between the atmosphere and humans take place.

Surface tension The resistance of the surface of a material to external forces. It is determined by the cohesive energy between the molecules which form the surface of the object. Molecules in the middle of an object are subject to equal forces on all sides whereas forces acting on the surface molecules are not in balance, however.

Suspended load The sediment transported in water when lifted from the bed surface and kept in suspension by turbulent fluid flow.

Sustainable development Development (any form of development from an action, project, strategy or legislation) that meets the needs of people today without compromising the ability of future generations to meet their own needs.

Swash The thin sheet of water that travels up the beach following the breaking of a wave.

Swash zone Process-based term for the area within the *near-shore* zone where broken waves travel up the beach as *swash* and return as *backwash*.

Swath The area on the ground covered by the motion of a remote sensing instrument.

Symbiotic Living together in a mutually beneficial relationship.

Systematic errors Predictable errors that can be modelled and removed from the data.

T

Tafoni These are cavities in a rock face which are the result of weathering. They are elliptical in shape and are most commonly found on vertical and sloping rock faces. They usually exist in honeycomb-like groups and can be found on a variety of rock types.

Talik A Siberian word for an unfrozen pocket within permafrost; for example, beneath a lake or warm-bedded glacier.

Talus An accumulation of angular rock debris from rockfalls found at the base of a slope.

Tarn A depression located at the site of a melted *corrie* glacier; a lake usually forms in the centre.

Taxonomy The study, description and systematic classification of living organisms (plant and animal) into groups based on similarities of structure or origin. Synonymous with systematics.

Telemetry The process of obtaining measurements in one place and relaying them for recording or display at a different site.

Temperate glacier A glacier formed in temperate climates where the temperature of the entire glacier is at the pressure melting point except for the surface 10-20 m (which fluctuates with the season); considerable quantities of meltwater are generated causing high rates of glacier movement and erosion.

Temperature inversion A reversal of the normal environmental temperature *lapse rate*; air temperature increases with altitude.

Tensile strengths The amount of force which is required to pull an object to the point of fracture.

Tensile stress The action of a force pulling an object along its cross-sectional axes in an outwards motion from its centre.

Terminal mode The final form of a particle of glacial sediment in which the particle will not break down into a finer form even with prolonged transport in the glacial system.

Terminal velocity The velocity at which the frictional drag forces acting on a falling object are equal to the driving forces of gravity, resulting in a constant fall rate (neither accelerating nor slowing down).

Thalweg The line of maximum water velocity down the path of a river.

Thermal conductivity The degree to which a substance transmits heat.

Thermal scanner A remote sensing instrument similar to a *multispectral scanner* but that can only sense radiation in the thermal infrared portion of the spectrum.

Thermocline The depth at which the temperature gradient of the water column rapidly changes in the vertical dimension, marking the contact zone between water masses of markedly different temperatures. Also known as the metalimnion.

Thermohaline circulation Large-scale circulation of the world's oceans, involving the vertical movement of large bodies of water, driven by water density differences. Cold, salty water sinks in 'downwelling zones', particularly at high latitudes in the North Atlantic, and flows slowly southward along the bottom of the Atlantic and into the Pacific, where it rises again mainly in an 'upwelling' zone of western South and Central America. It then flows back as a surface current. The thermohaline circulation is estimated to take 2000 years to complete one revolution. It is very important in transporting heat through the Earth system.

Thermokarst A term referring to the ground surface depressions which are created by the thawing of ground ice (and subsequent water erosion) in periglacial areas, e.g. p/ngos.

Thermoluminescent Pertaining to luminescence (an emission of light) resulting from exposure to high temperature; used as a means of dating ancient material.

Thiessen polygon The spatial influence of a particular data point calculated using arithmetic spatial averaging techniques on a network of data points.

Thixotropic Pertaining to the property of becoming fluid when agitated but recovering its original condition upon standing; viscosity decreases as the rate of shear (relative movement) increases.

Throughfall Water reaching the ground surface after dripping or bouncing off overlying vegetation.

Throughflow The downslope movement of water draining through the soil.

Through-wash A wash process involving the movement of regolith particles through the pores between grains in the regolith; the particles must be at least 10 times smaller than the grains they are passing between, and the process is therefore only significant in washing silt and clay out of clean sands.

Tidal currents Currents produced by the rise and fall of the tide; either the movement in and out of an estuary or bay, or the movement of water between two points affected by different tidal regimes (especially common in straits).

Tidal prism The volume of water that moves in or out of an area such as an estuary during a tidal cycle.

Tidal range The difference in water level between high and low water during a tide.

Till The generic term for sediment deposited directly by glacier ice.

Tillage erosion An anthropogenic soil erosion process (similar to creep) which is the result of ploughing either up- and downslope or along the contour. The turning over of soil produces a direct downhill movement. Whatever the ploughing direction, the process is faster than natural soil creep.

Tilt of the Earth The Earth's axis lies at an angle that varies from approximately 21° to 24° and back again in a 41 000 year cycle. The greater the tilt, the more intense the seasons in both hemispheres become.

Topset bed A horizontal bed of coarse sediment deposited by braided streams crossing a *delta plain*; it represents the sub-aerial part of the delta.

Topsoil The upper section of the soil that is most important for plant growth (usually the A horizon or plough horizon).

Total stream length The combined length (km) of all components of the channel network.

Trade winds The prevailing winds in the tropics blowing from high pressure at the tropics to low pressure at the equator. The winds do not blow directly north-south because the rotation of the Earth deflects them to the left in the southern hemisphere and to the right in the northern hemisphere.

Tragedy of the commons A term coined by Garret Harding in 1968 that refers to the excessive exploitation of a communal resource to a point of degradation due to the selfish nature of rational people who will use more than their fair share of the resource; no one person will take responsibility for something owned by all. It is often used to demonstrate the mistake in allowing a growing population to increase steadily its exploitation of the ecosystem which supports it.

Transform faults Major strike-slip faults occurring where two plates slide past each other in the horizontal plane. They are capable of causing major destructive earthquakes, e.g. the San Andreas Fault.

Transgressive barriers Accumulations of sediment just offshore running parallel to the coastline which have formed under the influence of rising sea level and/or a negative sediment budget. They tend to consist mainly of tidal delta and/or washover deposits, and are underlain by estuarine or lagoonal deposits. In this instance sediments deposited in seaward environments end up on top of sediment that originated in more landward environments.

Translocation The transport of dissolved ions and small particles through the soil within the *soil solution*, to surface water and groundwater.

Transmission bands Sections of the electromagnetic spectrum that allow radiation to pass unobstructed. These are also called atmospheric windows.

Transpiration The loss of water to the atmosphere through the process of evaporation from leaf pores and plants.

Transport limited A transport processes that can only move material a limited distance from the source despite the plentiful supply of material, e.g. rainsplash.

Transporting capacity The maximum amount of material which the transport process can carry.

Transverse dunes Linear dunes with a shallow windward side and steep lee slope (similar in structure to dunes and ripples formed below water).

Treatments A single test within a larger experiment where a single variable has been altered from the control situation by a known quantity and applied to the principal substrate in order to ascertain its effect.

Treeline The altitudinal upper limit of tree growth; affected by latitude and local factors such as slope, soil, aspect and exposure.

Trophic level A functional or process category describing the position of an organism or group of organisms in a food chain. Primary producers are at the first trophic level, those that feed on primary producers are at the second trophic level.

Tropopause The boundary between the *troposphere* and the *stratosphere*.

Troposphere The lowermost layer of the atmosphere extending to approximately 11 km above the Earth's surface.

Truncated spur A valley side spur that has been abruptly cut off and steepened *at* its lower end by the erosive action of a glacier.

Tsunami A large sea wave generated by submarine seismic activity (earthquakes, slides, volcanic activity) or meteor impact in the ocean. These waves can be extremely destructive, especially in the Pacific Rim, contributing to the coastline development of these areas.

Turbidite current A density current involving mixtures of sediment and water which, owing to their increased density relative to seawater, flow down and along the bottom of the oceans transporting sand and clay-sized sediment from shelf slopes to deeper oceanic environments.

Turbulent flow One of the two ways in which water can flow. It involves water molecules moving in many directions, with an overall net flow in one direction; as a result the flow is well mixed.

U

Undertow See *bed return flow*.

Unidirectional flow Currents flowing in one dominant direction (e.g. rivers and wind).

Uniformitarianism A practical principle of modern science concerning the method in which scientists explain phenomena; it advocates the use of the simplest explanation which is consistent with both evidence and known scientific laws. It is primarily related to James Hutton's demonstration in 1788 that the simplest explanation of the development of the Earth's landscape is through the observed processes of erosion and uplift acting gradually over time, rather than catastrophic landform development through divine intervention.

Urban boundary layer The section of the atmosphere directly overlying the *urban canopy layer*, subject to *urban heat island* effects through the entrainment of air from the urban canopy layer and anthropogenic heat from roofs and chimneys.

Urban canopy layer The section of the atmosphere immediately overlying an urban area, subject to heavy localized *urban heat island* effects, including greater daytime heat storage, anthropogenic heat release from buildings and decreased evaporation.

Urban heat island Urban landscapes adjust the local micro-climatic processes, resulting in an 'island' of warmer air surrounded by cooler rural air; two distinct regions of atmospheric modification are observed (the *urban canopy layer* and the *urban boundary layer*). The effect is most apparent at night, owing to slower cooling of the urban landscape, and during light winds.

U-shaped valley A wide valley with steep sides formed by glacial erosion of a V-shaped valley, involving the formation of truncated spurs during the valley straightening.

V

Valent A substance which has valence, often used to refer to the potential of an atom to combine with another atom. This is dependent on the number of atoms which can be shared, lost or gained through combining.

Value A measurable variable of soil colour describing the degree of darkness or lightness of the colour (a value of 0 represents black).

Variable source area concept The idea that the area of a catchment that produces *saturation-excess overland flow* will vary through time, i.e. during a rainfall event a greater proportion of the catchment will begin to contribute saturation-excess overland flow as time progresses, and the catchment becomes more saturated.

Varve A thin laminar bed of glacial sediment deposited by a proglacial stream in a repetitive annual sequence; coarse particles are deposited in summer and the finer particles progressively throughout the year.

Ventifacts The smoothed surfaces of individual stones eroded by sand and dust particles entrained in the wind.

Venturi effect Wind forced to funnel between two buildings causes the local wind speed to increase.

Vital attributes The critical physical characteristics of plants that determine their ability to survive disturbance, including their methods of persistence, conditions for establishment and timing of life stages.

W

Wadati-Benioff zone The band of rock (20 km thick) which dips from the trench region under an overlying plate in a subduction zone. It is the location of earthquake foci that are associated with descending lithospheric plates.

Wandering gravel-bed river A gravel-bed river channel characterized by an irregularly sinuous thalweg that is frequently split around vegetated islands and low-order braiding within complex bar deposits where the river is laterally unstable.

Water balance Pertaining to the cyclical movements of volumes of water within a drainage basin per unit time. It relates to the various inputs, storage and outputs of water within the drainage basin system and controls the nature of river discharge.

Water table The upper boundary of the zone of groundwater saturation (the *saturated zone*). Its level varies with the amount of precipitation, evapotranspiration and percolation.

Watershed Another name for *catchment*.

Wave asymmetry The nature of waves that is not symmetrical on either side of the wave crest. As waves enter shallower water they develop peaked crests and flat troughs, in addition to the asymmetrical shape, the water flow velocities also become asymmetric with the onshore side of the wave being stronger but of shorter duration than the offshore side of the wave.

Wave base The point of a wave below which there is no orbital movement of water.

Wave breaking The destruction of a wave when it becomes too steep and disintegrates.

Wave convergence The focusing of wave rays so that they come together increasing in energy and height.

Wave crest The peak of the curve of a wave.

Wave divergence The separation of wave rays so that waves move apart. Typically waves will become shorter and less energetic.

Wave energy flux The rate of transfer of energy by waves.

Wave frequency The number of *wave crests* which pass a fixed point over a set timescale.

Wave height The vertical distance between the *wave trough* and the wave crest.

Wave period A measure of wave speed; the time taken for two successive *wave crests* to pass a fixed point.

Wave set-up Wave breaking results in water piling up against the shore. This results in a slope of water with higher water pushed nearer the shore and this 'set-up' is sufficient to oppose the shoreward wave stresses.

Wave steepness Wave height divided by wavelength.

Wave trough The base of the curve of a wavelength.

Wavelength The distance between a *wave crest* to the next wave crest, or between trough to trough.

Weathering The breakdown of rocks and minerals by the physical and chemical processes of erosion.

Well-mixed estuary An estuary in which mixing is so effective that the salinity gradient in the vertical direction vanishes entirely. If the estuary is wide enough then the Coriolis force pushes the flow of the outflowing river to the margin of the estuary and may result in a horizontal separation of riverwater and seawater.

Wet-snow zone The region of a glacier in which the entire snowpack becomes saturated at the end of the summer.

Wetted perimeter The contact area between the channel bed and water when viewed in cross-section. Bank-full wetted perimeter is calculated as the estimated contact zone when the channel is completely full with water.

Whaleback A streamlined elongated rock exposure formed by the basal sliding action of a glacier; similar in shape to *stoss-and-lee forms* but the steep side faces upstream and the tapered end downstream.

Whole-life costing Expressing the results of *life-cycle analysis* in financial terms, i.e. placing a monetary value on all the environmental impacts of a product from its manufacture to disposal.

Wilting point The condition of a soil when plants cannot withdraw the necessary water for growth as the only remaining soil water is that held tightly to soil particles by hygroscopic forces and is unavailable for plant use.

Wind shear A change in wind speed or direction with altitude in the atmosphere.

X

Xeromorphic The possession, by a plant, of features adapted to conditions of limited moisture availability.

Xerophyte A plant that has adapted to grow in very arid conditions with restricted water availability by minimizing water loss and maximizing water efficiency.

Xerophytic Pertaining to having the character of a *xerophyte*, i.e. an organism adapted to growth in conditions of limited water availability.

Y

Yardangs Large-scale dryland features; the erosive power of dust carried in the wind leads to the smoothing of entire hills streamlined in the direction of sediment transport.

Yield strength The stress at which a material exhibits a deviation from the proportionality of stress to strain, to produce a specified amount of plastic deformation, i.e. below the yield strength the material acts as an elastic and above as a viscous material.

Young's modulus Also known as the modulus of elasticity, it is a measure of the rate of change of stress in a material as a result of the strain applied, often in the form of compressional forces. On a stress-strain diagram it is the straight-line part of the graph.

Z

Zooplankton Microscopic organisms which consume other plankton. Zooplankton exist in a variety of forms including larval, immature stages of larger animals, single-celled organisms and tiny crustaceans.