

Climate Change and the Great Barrier Reef

A Vulnerability Assessment

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Glossary of Terms

acclimation changes in tolerance under laboratory or other experimental conditions, generally over the short term

acclimatisation phenotypic changes by an organism to stresses in the natural environment that result in the re-adjustment of the organism's tolerance levels

adaptation an adjustment that moderates harm or exploits beneficial opportunities in natural or human systems in response to actual or expected climatic changes or their effects. A 'biological adaptation' is a phenotypic variant that results in highest fitness among a specific set of variants in a given environment; it occurs when the more vulnerable members of a population are eliminated by an environmental stress, leaving the more tolerant organisms to reproduce and recruit to available habitat

adaptive capacity the potential for a species or system to adapt to climate change (including changes in variability and extremes) so as to maximise fitness; moderate potential damages; or take advantage of opportunities, such as increased space availability

amphidromic a point within a tidal range where the tidal range is almost zero

arboreal relating to or resembling a tree

Argo global array of free-drifting profiling floats measuring temperature and salinity of the ocean

arthropods characterised by a segmented body, chitinous exoskeleton, paired, jointed limbs and in the class Crustacea

assemblage multiple species of plants and animals living in the same place and time

Atlantic meridional overturning circulation carries warm surface waters into far-northern latitudes and returns cold deep waters south across the Equator. Its heat transport makes a substantial contribution to the moderate climate of maritime and continental Europe, and any slowdown in the overturning circulation would have profound implications for climate

attribution the process of establishing cause and effect with some defined level of confidence

autotrophs produce sugars that are essential to consumers, in the pelagic environment, this is usually through photosynthesis (see *phytoplankton*). Autotrophs are the foundation of marine food chains

azooxanthellate organisms that do not contain microscopic single-celled algae called *zooxanthellae*, which are commonly found in soft and hard corals

biodiversity the number and relative abundance of different genes (genetic diversity), species, and ecosystems (biological communities) in a particular area

bioturbation the displacement and mixing of sediment layers by benthic plants and animals

bottom-up control refers to ecosystems in which the nutrient supply, productivity, and type of primary producers (plants and phytoplankton) control the ecosystem structure

broadcast spawning the simultaneous release of sperm and eggs into the water column. Many species of corals, fish and benthic invertebrates exhibit synchronised spawning in order to increase the chances of fertilization and maximise genetic diversity

Cephalopoda means 'head foot' and refers to a class of marine molluscs with well-developed senses and large brains, for example squid and octopi

chronostratigraphic a graphic display, with geologic time along the vertical axis and distance along the horizontal axis, to demonstrate the relative ages and geographic extent of *strata* in a given location (also known as a Wheeler diagram)

climate the 'average weather', or more rigorously, the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands of years. The classical period is 30 years, as defined by the World Meteorological Organization. These quantities are most often surface variables such as temperature, precipitation, and wind

climate change a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (United Nations Framework Convention on Climate Change) (see *climate variability*). The concept of increased emissions over time and gradual changes in climate is well accepted. Importantly though, fossil evidence clearly demonstrates that the Earth's climate can shift within a decade, establishing new patterns that can persist for decades to centuries. Climate change, therefore, can refer to either a gradual or abrupt change in climatic conditions

climate variability variations in the mean state and other statistics of the climate (such as standard deviations and the occurrence of extremes) on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability) (see also *climate change*)

CLIVAR a program run by the World Climate Research Program that works to describe and understand the physical processes responsible for climate variability and predictability on seasonal, interannual, decadal, and centennial time-scales, through the collection and analysis of observations and the development and application of models of the coupled climate system

connectivity natural links among reefs and neighbouring habitats, especially seagrass beds, mangroves and back-reef lagoons that provide dispersal and genetic replenishment. Also refers to linkages among coastal lands and adjacent catchments, which are sources of freshwater, sediments and pollutants. The mechanisms include ocean currents, terrestrial runoff and watercourses, larval dispersal, spawning patterns, and movements of adult fishes and other animals. Connectivity is an important process to ensure the productive function of the plant and animal species that contribute to the overall health of an ecosystem

copepod small pelagic crustaceans (0.3 to 5 mm long) that are important consumers of phytoplankton and some zooplankton, and form an important food source for higher trophic levels

coral bleaching the paling of corals and other animals with *zooxanthellae* resulting from a loss of these symbiotic algae. Bleaching occurs in response to physiological shock due primarily to periods of increased water temperature coincident with high levels of light (see *mass coral bleaching*). Bleaching can also be caused by changes in salinity or turbidity

Coriolis effect the apparent deflection of objects from a straight path when the objects are viewed from a rotating frame of reference. The best example is the deflection of winds moving along the surface of the Earth to the right of the direction of travel in the Northern Hemisphere and to the left in the Southern Hemisphere. This effect is caused by the rotation of the Earth and is responsible for the direction of tropical storms and cyclones

cryptofauna animals that are difficult to see when making cursory observations of a habitat. They are usually small and in most cases, highly dependent on their habitats for shelter and food. In the marine environment, these are *demersal* animals

demersal dwelling at or near the bottom of a body of water

detection the process of demonstrating that an observed change is significantly different (in a statistical sense) than can be explained by natural variability

East Australian Current (EAC) a current that originates in the Coral Sea and flows southward along the east coast of Australia

echinoderms radially symmetrical invertebrates of the phylum Echinodermata that have an internal calcareous skeleton and are often covered with spines, for example starfish and sea cucumbers

ecosystem a community of organisms, interacting with one another and the environment in which they live. Such a system includes all abiotic components such as mineral ions, organic compounds, and the climatic regime

ectotherm having a body temperature that varies with the temperature of the surrounding environment

Effective Juvenile Habitats (EJH) habitats that have a greater than average overall contribution to adult populations

Ekman transport process by which each layer of water in the ocean drags with it the layer beneath. Thus, the movement of each layer of water is affected by the movement of the layer above

emissions scenario scenarios describing how greenhouse gas emissions could progress between 2000 and 2100, depending on various hypotheses about human societies and behaviour. As there are an infinite number of possibilities to describe future emissions, scenarios are necessarily conventional with each reflecting a plausible state of the future world. The IPCC has published 40 scenarios grouped into four types (A1, A2, B1, B2) with each representing a different evolution of humanity and associated rates of energy consumption and food production

endemic native to or confined to a certain geographical region

endogenous originating or produced from within an organism, tissue or cell

enhanced greenhouse effect increasing concentrations of greenhouse gases in the atmosphere trap more heat and raise the Earth's surface temperature

El Niño-Southern Oscillation (ENSO) widespread two to seven year oscillations in atmospheric pressure, ocean temperatures and rainfall associated with El Niño (the warming of the oceans in the equatorial eastern and central Pacific) and its opposite, La Niña. Over much of Australia, La Niña brings above average rain, and El Niño brings drought. A common measure of ENSO is the Southern Oscillation Index (SOI), which is the normalised mean sea level pressure difference between Tahiti and Darwin. The SOI is positive during La Niña events and negative during El Niño events

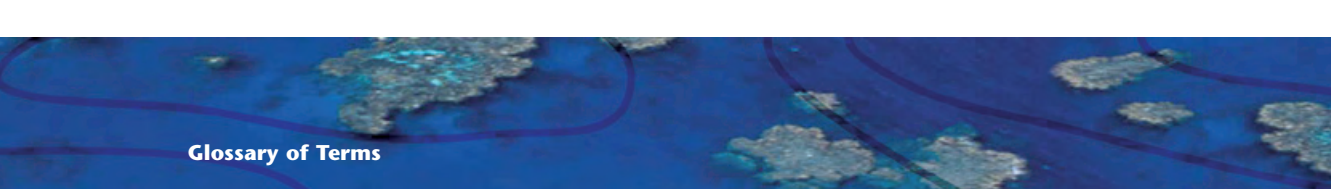
euphotic zone the depth of water that is exposed to sufficient sunlight for photosynthesis to occur

eutrophic nutrient-rich waters

eutrophication the increase in dissolved nutrients and decrease in dissolved oxygen in a (usually shallow) body of water, caused by either natural processes or pollution

exogenous derived or developed outside the body; to originate externally

- exposure** the nature and degree to which a system or species is exposed to significant climate variations. In a climate change context, it captures the important weather events and patterns that affect the system. Exposure represents the background climate conditions against which a system or species operates, and any changes in those conditions
- fissiparous** reproducing by biological fission, a process in which the organism breaks into parts
- genotype** the genetic makeup, as distinguished from the physical appearance, of an organism or a group of organisms
- geostrophic current** the current that results from the forces associated with horizontal changes in density being compensated by accelerations arising from fluid motion on a rotating Earth
- global temperature** usually referring to the surface temperature, this is an area-weighted average of temperatures recorded at ground- and sea-surface-based observation sites around the globe, supplemented by satellite-based or model-based records in remote regions
- global warming** an increase in global average surface temperature due to natural or anthropogenic *climate change*
- gravity wave** in fluid dynamics these waves can be generated in a fluid medium or at the interface between two mediums (eg the atmosphere and ocean) and have the restoring force of gravity, which often results in the wave oscillating around an equilibrium
- Great Barrier Reef (GBR)** tropical marine ecosystem on the northeast coast of Australia that comprises of reef, seagrass, inter-reef, pelagic, shoals and mangrove habitats and includes the islands, cays and coastal areas that are connected physically and biologically
- greenhouse gases** any of the atmospheric gases that contribute to the greenhouse effect. Naturally occurring greenhouse gases include water vapour, carbon dioxide, methane, nitrous oxide and ozone. Certain human activities, such as the burning of fossil fuels, add to the concentration of these naturally occurring gases in the atmosphere
- greenhouse effect** greenhouse gases that are present naturally in the Earth's atmosphere trap heat from the sun to maintain the Earth's surface temperature at a habitable level
- heterotrophs** consumers that cannot synthesise their food and must consume other plants or animals, for example zooplankton and nekton
- impacts** the adverse effect resulting from a threat acting on a vulnerability. Can be described in terms of loss or degradation of any, or a combination of any, ecological, social or economic features
- insolation** a measure of incoming solar radiation incident on a unit horizontal surface at a specific level
- Intergovernmental Panel on Climate Change (IPCC)** an organisation set up in 1988 by the World Meteorological Organization and the United Nations Environment Program to advise governments on the latest science of climate change, its impacts and possible adaptation and mitigation. It involves panels of climate and other relevant experts who assess climate change-related information and prepare reports, which are then critically reviewed by researchers and governments from member countries around the world
- iteroparous** to produce offspring across multiple seasons or years
- larval phase** the early developmental life phase of an animal that is usually different to its adult form. In the marine environment, larvae are often pelagic. In the case of benthic organisms, settlement to the bottom marks the end of this phase (other terms include pre-settlement phase and pelagic larval duration). For pelagic species, growth into a juvenile is the end of the larval phase
- latent heat** the heat released or absorbed per unit mass by a system in a reversible isobaric-isothermal change of phase. In tropical oceanography, the latent heat of evaporation (or condensation) is of importance
- lecithotrophic** describing larvae that do not feed during their planktonic phase but rather derive nutrition from yolk
- longwave radiation** heat radiation with wavelengths greater than 4 micrometres (infra-red)
- Madden-Julian Oscillation (MJO)** an atmospheric cycle characterised by the eastward movement of large regions of both enhanced and suppressed tropical rainfall, observed mainly over the Indian Ocean and Pacific Ocean. Cycles last between 30 to 60 days.
- marine snow** a continuous shower of mostly organic detritus falling from the upper layers of the water column, including dead or dying animals and plants, faecal matter, sand, soot and other inorganic dust. As sunlight cannot reach them, deep-sea organisms rely heavily on marine snow as a source of energy
- mass coral bleaching** coral bleaching extending over large areas (often affecting reef systems spanning tens to hundreds of kilometres) as a result of anomalously high water temperatures (see also *coral bleaching*)
- mesograzers** organisms able to use individual seaweeds as both habitat and food. Mesograzers can acquire enemy-free space by inhabiting and consuming seaweeds that are chemically defended against larger, more mobile consumers.
- mitigation** mitigation of climate change refers to those responses that reduce the sources of greenhouse gas emissions into the atmosphere or enhance their sinks. Targets are usually set with respect to a baseline scenario, thus avoiding exceeding the adaptive capacity of natural systems and human societies
- molluscs** a phylum in which organisms are characterised by a shell-secreting organ, the mantle, and a radula, a food-rasping organ located in the forward area of the mouth



Glossary of Terms

Morphoedaphic Index (MEI) the total dissolved solids in mg/litre divided by mean depth in metres. The MEI was first developed by Richard A. Ryder in the mid-1960s as an estimator of potential fish yield in lakes, and can be used to predict both fish harvest and standing crop

nekton aquatic organisms that are self-propelled (ie not at the whim of the currents) and are large consumers that include squid, fishes, turtles and whales

neogastropods an order of gastropods that contains the most highly developed snails whereby respiration is performed by means of ctenidia, the nervous system is concentrated, an operculum is present, and the sexes are separate

nutrient-phytoplankton-zooplankton models models that describe the relative interactions of nutrients, phytoplankton and zooplankton in an environment. These can range in complexity, depending on the environment in question, and/or the focus of the research

octocorals commonly called 'soft corals', they are not close relatives of the Scleractinia, or 'hard corals' that have hexaradial symmetry. Octocorals have eightfold radial symmetry, and are made up of colonial polyps, which, in some, perform specialised functions. Excepting the 'blue coral' and 'organ-pipe' corals, few produce substantial calcium carbonate skeletons while some produce calcified holdfast structures

oligotrophic nutrient-poor waters

ontogenetic the origin and development of an individual organism from embryo to adult

osmoregulation maintenance of an optimal, constant fluid pressure in the body of a living organism

oviparous to produce eggs that hatch outside the body

Pacific Decadal Oscillation (PDO) a long-lived El Niño like climate pattern with the same spatial implications for climate but lasting from 20 to 30 years rather than the six to 18 months seen in the *El-Niño-Southern Oscillation*

panmictic random mating within a breeding population

pelagic living in open water (from plankton to whales)

phenology the scientific study of periodic/seasonal biological phenomena, such as flowering, breeding and migration, as they relate to climate conditions

phenotype the observable physical or biochemical characteristics of an organism, as determined by both genetic makeup and environmental influences

phenotypic plasticity the ability of an organism with a given genetic makeup to change its *phenotype* in response to changes in the environment

photoinhibition reduction in photosynthetic capacity following damage to the light-harvesting reactions of the photosynthetic apparatus caused by excess light energy

photoprotection the use of compounds to minimise the harmful effects of excess light energy

photorespiration oxidation of carbohydrates in plants with the release of carbon dioxide during photosynthesis, which lowers the efficiency of photosynthesis

photosensitise to make an organism, cell or substance sensitive to light

photosynthesis the process in which plants, and some bacteria and protists convert sunlight energy, carbon dioxide and water into sugars and starch. It is a highly complex process beginning with the capture of sunlight by the green pigment chlorophyll and the release of oxygen from water

photosynthetically active radiation the spectral range of solar light from 400 to 700 nanometres that is used in the process of *photosynthesis*. Light energy at shorter wavelengths tends to be so energetic that it can damage cells and tissues, though most are filtered out by the ozone layer. Light energy at longer wavelengths does not carry enough energy to allow photosynthesis to take place

phytoplankton plant plankton that require light to photosynthesise; they are essential to higher trophic level consumers, such as zooplankton

plankton all organisms that are considered 'wanderers' or 'drifters'. Plankton includes viruses, autotrophs and heterotrophs, phytoplankton and zooplankton

planktotrophic larvae that feed on plankton

pneumatophores erect roots in swamp dwelling plants such mangroves that are an extension of the underground root system. Since these roots are exposed at least part of the day to the air and not submerged underwater, the root system can obtain oxygen in an otherwise anaerobic substrate, for example mangrove sediments

poikilothermic having a body temperature that varies with the temperature of the surrounding environment (eg a fish or reptile); an *ectotherm*

polyplacophorans refers to chitons, an order of molluscs distinguished by an elliptical body with a dorsal shell comprised of eight overlapping calcareous plates

- prediction** a statement that something will happen in the future, based on known conditions at the time the prediction is made, and assumptions as to the physical or other processes that will lead to change. Since present conditions are often not known precisely, and the processes affecting the future are not perfectly understood, such predictions are seldom certain, and are often best expressed as probabilities
- primary productivity** rate at which light energy is used by producers to form organic substances that become food for consumers
- projection** a set of future conditions, or consequences, derived on the basis of explicit assumptions, such as scenarios. Even for a given scenario or set of assumptions, projections introduce further uncertainties due to the use of inexact rules or 'models' connecting the scenario conditions to the projected outcomes
- radiation** emission or transfer of energy in the form of electromagnetic waves
- refuges** place where species and/or communities survive environmental changes. Species may remain restricted to the vicinity of a refuge or disperse from a refuge thus recolonising wider areas following further environmental changes. Past refuges might include places where species have survived glacial periods
- resilience** the ability of system to absorb shocks, resist phase shifts and regenerate and reorganise so as to maintain key functions and processes without collapsing into a qualitatively different state that is controlled by a different set of processes
- risk** probability that a situation will produce harm under specified conditions. It is a combination of two factors the probability that an adverse event will occur; and the consequences of the adverse event. Risk encompasses impacts on human and natural systems, and arises from exposure and hazard. Hazard is determined by whether a particular situation or event has the potential to cause harmful effects
- sea surface temperature** the temperature of ocean water at the surface. In practical terms, this will vary depending on the method of measurement used. Infrared radiometers attached to orbiting satellites typically measure the temperature in the top ten microns of the water column while drifting or moored buoys take temperature readings from the top 1 metre
- scaphopods** predatory molluscs with a tubular and, generally, curved shell having openings at both ends
- scenario** a coherent, internally consistent and plausible description of a possible future state of the climate. Similarly, an emissions scenario is a possible storyline regarding future emissions of greenhouse gases. Scenarios are used to investigate the potential impacts of climate change; emissions scenarios serve as input to climate models
- schema** the organization of experience in the mind or brain that includes a particular organised way of perceiving and responding to situations and stimuli
- sensible heat** the heat absorbed or transmitted by a substance during a change of temperature which is not accompanied by a change of state. Used in contrast to latent heat
- sensitivity** the degree to which a system is affected, either adversely or beneficially, by climate related stimuli, including average climate characteristics, climate variability and the frequency and magnitude of extremes
- sensu** (in *sensu stricto*) in a narrow or strict sense
- shortwave radiation** radiation in the visible and near-visible portions of the electromagnetic spectrum (roughly 0.4 to 4.0 micrometres in wavelength)
- sink reefs** reefs that receive larvae via ocean currents. Some reefs may be sinks at one time of year and sources at another time, where monsoonal currents reverse in different seasons
- social-ecological** collective term for the natural and human components of the Great Barrier Reef; that is, the ecosystem and the industries and communities that interact with it
- socioeconomic** the study of the relationship between economic activity and social life. This is a multidisciplinary field using theories and methods from sociology, economics, history, and psychology
- source reefs** reefs that have the potential to supply larvae to other reefs via ocean currents. Some reefs may be sinks at one time of year and sources at another time, where monsoonal currents reverse in different seasons
- Southern Annular Mode (SAM)** a ring of climate variability that encircles the South Pole and extends out to New Zealand, and involves alternating changes in wind and storm activity
- Southern Equatorial Current (SEC)** a broad, westward flowing current that extends from the surface to a nominal depth of 100 metres. Its northern boundary is usually near 4° N, while the southern boundary is usually found between 15 and 25° S
- Southwest Pacific Circulation and Climate Experiment (SPICE)** a multi-organisational experiment working to observe, model and understand the role of the southwest Pacific ocean circulation in the large-scale, low-frequency modulation of climate from the Tasman Sea to the equator, as well as the generation of local climate signatures
- spermatogenic** formation and development of spermatozoa by meiosis and spermiogenesis
- spongin** a sulfur-containing protein related to keratin that forms the skeletal structure of certain classes of sponges

- Stomatopoda** an order of crustacean containing four families of narrow and elongate-bodied mantis shrimps
- strata** a bed or layer of rock or soil with internally consistent characteristics that distinguishes it from contiguous layers
- sublittoral** lying between the low tide line and the landward edge of the continental shelf
- superspecies** a grouping of very closely related species with common ancestry that have developed into true species due to their geographical location
- sustainability** activities that meet the needs of the present without having a negative impact on future generations. A concept associated with sustainability is triple bottom line accounting, taking into account environmental, social and economic costs
- teleconnection** linkage between changes in atmospheric circulation occurring in widely separated parts of the globe
- terrigenous** of or derived from the land and often used to describe sediments that enter the marine environment by erosive action
- thalassinideans** a group of thin-shelled decapod crustaceans that live in burrows in the muddy bottoms of the world's oceans
- thermocline** the region of transition between the warmer surface waters and colder deep oceanic water
- thermoregulation** maintaining a constant internal body temperature independent of the surrounding environmental temperature
- threshold** any level in a natural or *socioeconomic* system beyond which a defined or marked change occurs. Gradual climate change may force a system beyond such a threshold. Biophysical thresholds represent a distinct change in conditions, such as the drying of a wetland. Climatic thresholds include frost, snow and monsoon onset. Ecological thresholds include breeding events, local to global extinction or the removal of specific conditions for survival
- top-down control** biomass at different levels of the food chain is controlled from the top, for example fisheries take fish that consume zooplankton, this allows the abundance of phytoplankton to increase (see *bottom-up control*)
- trophic focusing** the biomass of organisms is aggregated in certain regions of abrupt topography (eg a seamount). It generally results in biomass (and diversity) decreasing further offshore and deeper. This is because *primary productivity* is highest closest to the ocean surface and close to coastlines
- uncertainty** the degree to which a value is unknown, expressed quantitatively (eg a range of temperatures calculated by different models) or qualitatively (eg the judgement by a team of experts on the likelihood of the West Antarctic Ice Sheet collapsing). Uncertainty in climate projections is primarily introduced by the range of projections of human behaviour which determine emissions of greenhouse gases, and the range of results from climate models for any given greenhouse gas
- upwelling** process whereby cold, often nutrient-rich waters from the ocean depths rise to the surface
- vermivorous** to feed on worms, grubs, or insect vermin
- vitellogenic** formation of the yolk of an egg
- viviparous** in animals giving birth to living offspring that develop within the mother's body; in plants producing seeds that germinate before becoming detached from the parent plant, for example some mangroves
- vulnerability** the degree to which a system or species is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system or species is exposed, its *sensitivity*, and its *adaptive capacity*
- West Pacific Warm Pool (WPWP)** a body of water, which spans the western waters of the equatorial Pacific to the eastern Indian Ocean and holds the warmest seawater in the world
- zoogeographic species concept** closely related species with common ancestry that have developed into true species due to their geographical location
- zooplankton** animal plankton that range in size from a few microns to metres, for example some jellyfish
- zooxanthellae** microscopic single-celled algae (usually dinoflagellates) that form symbiotic relationships with corals, sea anemones, molluscs and several other types of marine invertebrates and provide photosynthetic products (ie energy) to the host animal in return for shelter

Symbol Glossary

ANIMALS




















 Branching coral	 Pelagic tunicates	 Crown-of-thorns starfish
 Plate coral	 Butterflyfish	 Hermit crab
 Massive coral	 Rabbitfish	 Brittle star
 Anenome	 Coral trout	 Squid
 Soft coral	 Parrotfish	 Nudibranch
 Gorgonian	 Damselfishes	 Bivalve/burrowing
 Sponge	 Goby	 Snail
 Sponge larvae	 Barramundi	 Burrowing worms
 Coral larvae	 Trevally	 Feather duster worm
 Copepods	 Whiting	 Prawn
 Juvenile fish	 Flyingfish	 Crab
 Sea birds	 Black marlin	 Polychaete worm
 Noddy	 Eel	 Christmas tree worm
 Sooty oystercatcher	 Baitfish	 Feather star
 Crested tern	 Bull shark	 Stingray
 Pied imperial pigeon	 Mako shark	 Chimaera
 Bar-tailed godwit	 Hammerhead shark	 Dolphin
 Capricorn white-eye	 Sawfish	 Turtle
 Jellyfish	 Blacktip reef shark	 Koala
		 Frog

Symbol Glossary
































ENVIRONMENT

 Sun	 Calcareous sand	 Temperature - cool/warm/hot
 Rain - high/low	 Silicious sand	 pH - alkaline/acidic
 Cyclone/wind	 Mud	 Reef rubble
		 Dead coral

PLANTS

 Mangroves	 Wetland vegetation	 Phytoplankton - diatoms
 Seagrass	 Terrestrial vegetation	 Phytoplankton - dinoflagellates
 Seagrass seeds	 Island vegetation	 Phytoplankton - mixed
 Fleshy macroalgae	 Casuarina	 Trichodesmium
 Turf algae	 Argusia	 Heath vegetation
 Crustose coralline algae	 Rare terrestrial plant	 Grasslands
		 Terrestrial weed

PROCESSES

 Elevated temperature	 Coral recruitment - good/poor	 Flux - low/high
 Nutrients - pulsed input	 Upwelling	 Limitation - carbon
 Freshwater - pulsed input	 Desiccation	 CO ₂ concentration - low/high
 Sediment - pulsed input	 Nutrient uptake	 HCO ₃ ⁻ concentration - low/high
 Sediment scouring	 Flux - in/out	 Salinity - low/high
 Sediment - burial	 Currents	 Decomposition
 Sediment resuspension	 Flushing - poor/good	 Growth
 Light attenuation/extinction	 Mixing	 Coral growth - slow/rapid
 Loss	 Wave energy	 Timing altered
 Flood plume	 Sea level rise	 Shoreward migration/barrier
		 Reef substrate bioerosion

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