

# Glossary

## Acidification

Change in the environment's natural chemical balance caused by an increase in the concentration of acidic elements. The main source of acidifying substances which include sulphur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), and ammonia (NH<sub>3</sub>) is emissions from fossil fuel combustion.

## Adaptation

Adjustment in natural or human systems over time to a new or changing environment, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation.

## Albedo

Fraction of solar radiation reflected by a surface or object, often expressed as a percentage. Snow-covered surfaces have a high albedo, the surface albedo of soils ranges from high to low, and vegetation-covered surfaces and oceans have a low albedo. The Earth's planetary albedo varies mainly through varying cloudiness, snow, ice, leaf area, and land cover changes.

## Albedo feedback

Climate feedback involving changes in the Earth's albedo. It usually refers to changes in the cryosphere, which has an albedo much larger (~0.8) than the average planetary albedo (~0.3). In a warming climate, it is anticipated that the cryosphere would shrink, and the Earth's overall albedo would decrease resulting in more solar radiation being absorbed and warming the Earth still further.

## Altimeter satellite

Device to measure the time that it takes for a radar pulse to travel from the satellite antenna to the surface and back to the satellite receiver. Combined with precise satellite location data, altimetry measurements can provide sea surface heights.

## Anthropogenic

Resulting from or produced by human beings.

## Aragonite

Calcium carbonate (limestone) mineral, used by shell- or skeleton-forming, calcifying organisms such as corals, some macro algae, pteropods (marine snails) and non-pteropod molluscs such as bivalves (e.g., clams, oysters), cephalopods (e.g., squids, octopuses). Aragonite is more sensitive to ocean acidification than calcite, also used by many marine organisms. See also Calcification and Ocean acidification.

## Arctic oscillation

An atmospheric circulation pattern in which the atmospheric pressure over the polar regions varies on timescales ranging from weeks to decades. The oscillation extends through the depth of the troposphere. From January through March, the Arctic Oscillation also referred to as the North Atlantic Oscillation, extends upward into the stratosphere where it modulates the strength of the westerly vortex that encircles the Arctic polar cap region.

## Arthropods

Any of numerous invertebrate animals of the phylum Arthropoda, characterized by an exoskeleton (hard shell). Arthropods include the insects, crustaceans, arachnids, myriapods, and extinct trilobites, and are the largest phylum in the animal kingdom.

## Atmosphere

Gaseous envelope surrounding the Earth. The dry atmosphere consists almost entirely of nitrogen and oxygen, together with trace gases such as carbon dioxide and ozone.

## Biochar

A type of charcoal resulting from the process of heating organic material in the absence of oxygen (pyrolysis).

## Biodiversity

The variability among living organisms from all sources such as terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. It encompasses diversity within species, between species and of ecosystems.

## Biophysics (also biological physics)

An interdisciplinary science that employs and develops theories and methods of the physical sciences for the investigation of biological systems. Studies included under the umbrella of biophysics span all levels of biological organization, from the molecular scale to whole organisms and ecosystems. Biophysics is closely related to biochemistry, nanotechnology, bioengineering, agrophysics and systems biology.

## Calcification

The process in which the mineral calcium builds up in soft tissue, causing it to harden. Calcification can be used for classification purposes based on the mineral balance and the location of the calcification.

## Calcium carbonate (CaCO<sub>3</sub>)

Chemical compound found as rock in all parts of the world and the main component of seashells and the shell of snails. Calcium carbonate is the active ingredient in agricultural lime.

## Calving

Process by which ice breaks off a glacier's terminus; usually the term is used for tidewater glaciers or glaciers that end in lakes, but can also refer to ice that falls from hanging glaciers.

## Carbon dioxide (CO<sub>2</sub>)

A naturally occurring gas and a by-product from burning fossil fuels or biomass, land-use changes or industrial processes. It is the principal anthropogenic greenhouse gas that affects Earth's radiative balance.

## Carbon sequestration

The process of increasing the carbon content of a reservoir other than the atmosphere (see Carbon sink).

## Carbon sink

Pool or reservoir that absorbs or takes up released carbon from another part of the carbon cycle. The 4 sinks are the atmosphere, terrestrial biosphere (usually including freshwater systems), oceans, and sediments.

## Carbonate (CO<sub>3</sub>)

A salt or ester of carbonic acid. Also used as a verb, to describe carbonation (to carbonate), which is the process of raising the concentrations of carbonate and bicarbonate ions in water to produce carbonated water and other carbonated beverages by adding carbon dioxide.

## Catchment

An area that collects and drains rainwater.

## Circulation patterns

General geometric configuration of atmospheric circulation usually applied in synoptic meteorology to large-scale features of synoptic charts and mean charts.

## Circumpolar circulation

Deep ocean currents that transport deep and intermediate water between the oceans. For example, the Antarctic Circumpolar Current is an important feature of the ocean's deep circulation because it contributes to the deep circulation between the Atlantic, Indian, and Pacific Oceans.

## Climate

'Average weather' described in terms of the mean and variability of relevant quantities such as temperature, precipitation and wind over a period of time ranging from months to thousands or millions of years. Climate can also be used to describe the state, including a statistical description, of the climate system. The classical period of time is 30 years, as defined by the World Meteorological Organization (WMO).

## Climate change

Alternations in the state of the climate system over time due to natural variability or as a result of human activity. The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural variability observed over comparable time periods."

## Climate threshold

The point at which external forcing of the climate system triggers a significant climatic or environmental event which is considered unalterable, or recoverable only on very long timescales. For example, widespread bleaching of corals or a collapse of oceanic circulation systems as a result of increasing atmospheric concentration of greenhouse gases in the atmosphere.

## Climatology

The scientific study of climate conditions averaged over a period of time on a local, regional or global scale to enable understanding of the periodicity, frequency, and trends of patterns. Recorded average climate is used as a standard against which to measure changes due to natural or human-induced factors.

## Coral reef

Rock-like limestone structures along ocean coasts (fringing reefs) or on top of shallow, submerged banks or shelves (barrier reefs, atolls), often found in tropical and subtropical oceans.

## Coral bleaching

The paling in colour of the coral which occurs if a coral loses its symbiotic, energy-providing organisms.

## Coralline algae

A simple non-flowering type of plant. Coralline algae are red algae in the family Corallinaceae of the order Corallinales. These algae are most typically pink, or some other shade of red and some species can be purple, yellow, blue, white or grey-green in colour and found in tropical marine waters all over the world.

## Corals

Common name for the Order Scleractinia, all members of which have hard limestone skeletons, and which are divided into reef-building and non-reef-building, or cold- and warm-water corals.

## Crustaceans

A large group of arthropods, comprising almost 52,000 known species. They include various familiar animals, such as crabs, lobsters, crayfish, shrimp, krill and barnacles. The majority of them are aquatic, living in either marine or fresh water environments, but a few groups have adapted to life on land, such as terrestrial crabs, terrestrial hermit crabs and woodlice.

## Cryosphere

Component of the climate system consisting of all snow, ice, frozen ground and permafrost on and beneath the surface of the Earth and ocean. See also Glacier.

## Desertification

Degradation of land in arid, semi-arid and dry sub-humid areas resulting from various factors including human activities and climatic variations. Often used as an example of a threshold beyond which

the underpinning ecosystem cannot restore itself, but requires ever-greater external resources for recovery.

## Disappearing climate

The complete disappearance of an extant climate. Disappearing climates are projected to be concentrated in tropical montane regions and the poleward portions of continents.

## Drought

Prolonged absence or marked deficiency of precipitation that causes a serious hydrological imbalance. Agricultural drought relates to moisture deficits in the topmost one metre or so of soil (the root zone) that affects crops. Meteorological drought is mainly a prolonged deficit of precipitation, and hydrologic drought is related to below-normal stream flow, lake and groundwater levels.

## Drunken forests

An area of trees displaced from their normal vertical alignment. Most commonly occurs in northern subarctic taiga forests of black spruce (*Picea mariana*) when discontinuous permafrost or ice wedges melt away, causing trees to tilt at various angles. Tilted trees may also be caused by frost heaving, and subsequent pals development, hummocks, earthflows, forested active rock glaciers, landslides, or earthquakes.

## Earth System Science

An interdisciplinary field of study of the behaviour of Earth Systems' components, with an emphasis on observing, understanding and predicting global environmental changes involving interactions between land, atmosphere, water, ice, biosphere, societies, technologies and economies.

## Ecosystem

A dynamic and complex system of living organisms and their physical environment interacting with each other as a functional unit. The extent of an ecosystem may range from very small spatial scales to the entire Earth.

## Ecosystem services

The benefits derived from ecosystems. These include provisioning services such as food and water, regulating services such as flood and disease control, cultural services, such as spiritual, recreational and cultural benefits, and supporting services, such as nutrient cycling, that maintain the conditions for life on Earth. Also referred to as ecosystem goods-and-services.

## El Niño Southern Oscillation

Systematic and re-occurring weather patterns of the ocean-atmosphere system in the tropical Pacific having important consequences for weather around the globe.

## Endemic species

Species whose natural occurrence is confined to a certain region and whose distribution is relatively limited.

## Erosion

Process of gradual destruction or removal and transport of soil and rock by weathering, mass wasting by streams, glaciers, waves, winds and underground water.

## Eustatic sea-level rise

See Sea-level rise.

## Evapotranspiration

The transport of water into the atmosphere from surfaces, for example from soil evaporation and vegetation transpiration. The process of evapotranspiration is one of the main consumers of solar energy at the Earth's surface. Apart from precipitation, evapotranspiration is one of the most significant components of the water cycle.

## Genotype

The specific genetic makeup of an organism.

**Geoengineering**

Technological options to achieve a deliberate manipulation of the Earth's climate to produce a planetary cooling effect in order to mitigate the impact of global warming from greenhouse gas emissions.

**Glacial retreat**

Net movement of the glacier terminus upvalley. Retreat results when the glacier is ablating at a rate faster than its movement downvalley. Retreating termini are usually concave in shape.

**Glacier**

Mass of land ice flowing downhill (by internal deformation and sliding at the base) and constrained by the surrounding topography such as the sides of a valley or surrounding peaks. A glacier is maintained by accumulation of snow at high altitudes, balanced by melting at low altitudes or discharge into the sea.

**Glaciologists**

Ice experts and specialists in the scientific study of glaciers and their effects on the landscape and our climate.

**Global warming**

Gradual increase, observed or projected, in global surface temperature, referred to as the global temperature, as one of the consequences of the enhanced greenhouse effect, which is induced by anthropogenic emissions of greenhouse gases into the atmosphere.

**Greenhouse gas (GHG)**

Gaseous constituents such as water vapour (H<sub>2</sub>O), carbon dioxide (CO<sub>2</sub>), nitrous oxide (N<sub>2</sub>O), methane (CH<sub>4</sub>) and ozone (O<sub>3</sub>) in the atmosphere. These gases, both natural and anthropogenic, can absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, the atmosphere, and by clouds causing the warming greenhouse effect.

**Groundwater**

Water beneath the Earth's surface, often between saturated soil and rock, that supplies wells and springs.

**Groundwater recharge**

The process by which external water is added to the zone of saturation of an aquifer, either directly into a formation or indirectly by way of another formation.

**Headwaters**

The source of a river or a stream and the place from which the water in the river or stream originates.

**Hydrographic event**

An incident that alters the state or current of waters in oceans, rivers or lakes.

**Hydrology**

Scientific study of water which seeks to understand the complex water system of the Earth and help solve water problems.

**Ice cap**

A dome-shaped ice mass, usually covering a highland area, which is considerably smaller in extent than an ice sheet.

**Ice shelf**

A floating slab of ice of considerable thickness extending from the coast (usually of great horizontal extent with a level or gently sloping surface), often filling embayments in the coastline of the ice sheets.

**Iceberg**

A large block of freshwater ice that has broken off from a snow-formed glacier or ice shelf and is floating in open water.

**Icefield**

Large sheet of ice which covers an area of land or water.

**Interglacial stage**

Period of warmer climate that separates two glacial periods. Mid-latitude interglacials are identified by a characteristic sequence of vegetation change from tundra to boreal forest and subsequently deciduous forest.

**Inter-tidal zone**

An area of the foreshore and seabed that is exposed to the air at low tide and submerged at high tide, or the area between tide marks. Also referred to as the littoral zone.

**Logarithmic scale**

A measurement that uses the logarithm of a physical quantity instead of the quantity itself.

**Magnesium calcite**

Carbonate mineral and the most stable polymorph of calcium carbonate (CaCO<sub>3</sub>). Calcite is often the primary constituent of the shells of marine organisms, e.g. plankton (such as coccoliths and planktic foraminifera), the hard parts of red algae, some sponges, brachiopoda, echinoderms, most bryozoa, and parts of the shells of some bivalves, such as oysters and rudists.

**Mangroves**

Shrubs and trees of the families Rhizophoraceae, Acanthaceae, Lythraceae, and Arecaceae (palm) or the subfamily Pellicieraceae (family Tetrameristaceae) that grow in dense thickets or forests along tidal estuaries, in salt marshes, and on muddy coasts.

**Mega drought**

Long drawn out, pervasive and prolonged absence or marked deficiency of precipitation that causes a serious hydrological imbalance lasting much longer than normal, usually a decade or more.

**Mesoscale convective system**

Cluster of thunderstorms which becomes organized on a scale larger than the individual thunderstorms, and normally persists for several hours or more. Mesoscale convective systems may be round or linear in shape, and include other systems such as tropical cyclones.

**Mitigation**

A human intervention to reduce the sources or enhance the sinks of greenhouse gases.

**Moraine**

Glacially formed accumulation of unconsolidated glacial debris (soil and rock) which can occur in currently glaciated and formerly glaciated regions. Moraines may be composed of debris ranging in size from silt-like glacial flour to large boulders. The debris is typically sub-angular to rounded in shape. Moraines may be on the surface of a glacier or deposited as piles or sheets of debris where the glacier has melted. Moraines may also occur when glacier- or iceberg-transported rocks fall into the sea as the ice melts.

**Novel climate**

Future climate lacking a modern analogue, characterized by high seasonality of temperature, warmer than any present climate globally, with spatially variable shifts in precipitation, and increase in the risk of species reshuffling into future no-analog communities. Novel climates are projected to develop primarily in the tropics and subtropics.

**Ocean acidification**

A decrease in the pH of seawater due to the uptake of anthropogenic carbon dioxide.

**Oceanography**

Scientific study of the oceans using science and mathematics to explain the complex interactions between seawater, fresh water, polar ice caps, the atmosphere and the biosphere.

**Outburst floods**

An incident taking place when a lake contained by a glacier bursts. Floods happen due to erosion, a build-up of water pressure, an avalanche of rock or heavy snow, an earthquake or cryoseism, volcanic eruptions under the ice, or if a large enough portion of a glacier breaks off and massively displaces the waters in a glacial lake at its base.

**Outlet glaciers**

A stream of ice from an ice cap to the sea.

**Oxygen isotope ratio**

Cyclical variations in the ratio of the mass of oxygen with an atomic weight of 18 to the mass of oxygen with an atomic weight of 16 present in some substances, such as polar ice or calcite in ocean core samples. The ratio is linked to water temperature of ancient oceans, which in turn reflects ancient climates. Cycles in the ratio mirror climate changes in geologic history.

**Ozone (O<sub>3</sub>)**

A gaseous atmospheric constituent created naturally and by photochemical reactions involving gases resulting from human activities (e.g. smog) in the troposphere. Tropospheric ozone acts as a greenhouse gas. In the stratosphere, it is created by the interaction between solar ultraviolet radiation and molecular oxygen (O<sub>2</sub>). Stratospheric ozone plays a dominant role in the stratospheric radiative balance. Its concentration is highest in the ozone layer.

**Permafrost**

The surface layer of soil, sediment and rock that remains at or below 0 degrees Celsius for at least two consecutive years.

**Photosynthesis**

The process by which plants take carbon dioxide from the air (or bicarbonate in water) to build carbohydrates, releasing oxygen in the process. There are several pathways of photosynthesis with different responses to atmospheric CO<sub>2</sub> concentrations.

**Pyrolysis**

A thermal decomposition process of organic material at high temperature in the absence of oxygen.

**Radiative forcing**

The change in the net, downward minus upward, irradiance (expressed in W m<sup>-2</sup>) at the tropopause due to a change in an external driver of climate change, for example, a change in the concentration of carbon dioxide or the output of the Sun. Radiative forcing is computed with all tropospheric properties held fixed at their unperturbed values, and after allowing for stratospheric temperatures, if perturbed, to readjust to radiative-dynamical equilibrium.

**Savanna**

Tropical or sub-tropical grassland or woodland biomes with scattered shrubs, individual trees or a very open canopy of trees, all characterized by a dry (arid, semi-arid or semi-humid) climate.

**Salinity**

The presence of soluble salts in soils or waters such as sodium chloride, magnesium and calcium sulfates and bicarbonates. It usually results from water tables rising to, or close to, the ground surface.

**Sea-level rise**

Increase in the mean level of the ocean. Eustatic sea-level rise is a change in global average sea level brought about by an increase in the volume of the world ocean. Relative sea-level rise occurs where there is a local increase in the level of the ocean relative to the land, which might be due to ocean rise and/or land level subsidence. In areas subject to rapid land-level uplift, relative sea level can fall.

**Sediment respiration**

Process whereby living organisms convert organic matter to carbon dioxide and methane, releasing energy and consuming molecular oxygen.

**Small ice cap instability**

Behaviour of ice lines caused by variations in temperature, gradient, and amplitude of the seasonal cycle affecting the strength of the albedo feedback. Small ice cap instability may be a possible mechanism for the formation of the Antarctic ice sheet.

**Stratosphere**

The highly stratified region of the atmosphere above the troposphere extending from about 10 km (ranging from 9 km at high latitudes to 16 km in the tropics on average) to about 50 km altitude.

**Symbiotic relationship**

A close ecological relationship between the individuals of two or more different species. Sometimes a symbiotic relationship benefits both species, sometimes one species benefits at the other's expense, and in other cases neither species benefits.

**Talik**

An unfrozen section of ground found above, below, or within a layer of discontinuous permafrost. These layers can also be found beneath water bodies in a layer of continuous permafrost.

**Terrestrial ecosystems**

A community of organisms and their environment that occurs on the landmasses of continents and islands.

**Thermal expansion**

An increase in volume (and decrease in density) that results from warming water. For example, warming of the ocean leads to an expansion of the ocean volume and hence an increase in sea level.

**Thermodynamic equilibrium**

A condition in a system where the distribution of mass and energy moves towards maximum entropy.

**Thermohaline convection (THC)**

Large-scale, density-driven circulation in the ocean, caused by differences in temperature and salinity. In the North Atlantic, the thermohaline circulation consists of warm surface water flowing northward and cold deepwater flowing southward, resulting in a net poleward transport of heat. The surface water sinks in highly restricted regions located in high latitudes. Also called Meridional Overturning Circulation (MOC).

**Threshold**

The level of magnitude of a system process at which sudden or rapid change occurs. A point or level at which new properties emerge in an ecological, economic or other system, invalidating predictions based on mathematical relationships that apply at lower levels.

**Topography**

The relief and shape exhibited by a surface.

**Tsunami**

A large wave produced by a submarine earthquake, landslide or volcanic eruption.

**Westerlies**

Dominant winds of the mid-latitudes. These winds move from the subtropical highs to the subpolar lows from west to east.

**Wetland**

The transitional, regularly waterlogged area of poorly drained soils, often between an aquatic and a terrestrial ecosystem, fed from rain, surface water or groundwater. Wetlands are characterized by a prevalence of vegetation adapted for life in saturated soil conditions.

*Source: UNEP 2007, IPCC 2007a, IPCC 2007b, IPCC 2007c, MA 2005*

# Acronyms and Abbreviations

ACC	Antarctic Circumpolar Current	IPCC AR4	Intergovernmental Panel on Climate Change, The Fourth Assessment Report
AGRA	Alliance for a Green Revolution in Africa	IPCC AR5	Intergovernmental Panel on Climate Change, The Fifth Assessment Report
AMS	American Meteorological Society	IPCC WG2	Intergovernmental Panel on Climate Change, Working Group 2
AR4	Fourth Assessment Report	IPY	International Polar Year
AWC	Advanced Wood Combustion	masl	Metres above sea level
BAS	British Antarctic Survey	mm	Millimetre
Ca	Calcium	MOC	Meridional Overturning Circulation
CAA	Canadian Arctic Archipelago	MPA	Marine Protected Areas
CaCO <sub>3</sub>	Calcium carbonate	MYI	Multi Year Ice
CCS	Carbon Capture and Storage	N <sub>2</sub> O	Nitrous oxide
CDR	Carbon Dioxide Removal	NAM	Northern Annular Mode
CCSP	Climate Change Science Program	NASA	National Aeronautics and Space Administration
CDIAC	Carbon Dioxide Information Analysis Centre	NASA/JPL	National Aeronautics and Space Administration/Jet Propulsion Laboratory
CH <sub>4</sub>	Methane	NASA/GSFC	National Aeronautics and Space Administration / Goddard Space Flight Center
CO <sub>2</sub>	Carbon dioxide	NOAA	National Oceanic and Atmospheric Administration
CO <sub>3</sub>	Carbonate	NOAA-ESRL	National Oceanic and Atmospheric Administration-Earth System Research Laboratory
CO <sub>3</sub> <sup>-2</sup>	Carbonate ion	NPI	Norwegian Polar Institute
CSIRO	Commonwealth Scientific and Industrial Research Organisation	NSIDC	National Snow and Ice Data Center
DAMOCLES	Developing Arctic Modeling and Observing Capabilities for Long-term Environmental Studies	Pg	10 <sup>15</sup> grams, Billion tonnes
DSWC	Dense Shelf Water Cascades	ppm	parts per million
ENSO	El Niño Southern Oscillation	REDD	Reducing Emissions from Deforestation and Forest Degradation
ERHIN	Estudio de los Recursos Hídricos procedentes de la In-nivación	SCOPE	Scientific Committee on Problems of the Environment
ESA	European Space Agency	SEG	Scientific Expert Group
FAO	Food and Agriculture Organization	SIO	Scripps Institution of Oceanography
FYI	First Year Ice	SLR	Sea-level rise
GCOS	Global Climate Observing System	SMD	Seasonal Melt Departure
GHG	Greenhouse gas	SO <sub>2</sub>	Sulphur dioxide
GISS	Goddard Institute for Space Studies	SRM	Solar Radiation Management
GMT	Global Mean Temperature	SST	Sea surface temperature
GRACE	Gravity Recovery and Climate Experiment	TAR	Third Assessment Report
GTOS	Global Terrestrial Observing System	THC	Thermohaline circulation
H <sup>+</sup>	Hydrogen	UN	United Nations
H <sub>2</sub> CO <sub>3</sub>	Carbonic acid	UNEP	United Nations Environment Programme
H <sub>2</sub> O	Water	UNFCCC	United Nations Framework Convention on Climate Change
HCO <sub>3</sub> <sup>-1</sup>	Bicarbonate ion	USGS	United States Geological Survey
IAASTD	International Assessment of Agricultural Knowledge, Science and Technology for Development	WCMC	World Conservation Monitoring Centre
ICIMOD	International Centre for Integrated Mountain Development	WCRP	World Climate Research Programme
IEA	International Energy Agency	WGMS	World Glacier Monitoring Service
IGBP	International Geosphere-Biosphere Programme		
IGY	International Geophysical Year		
IMO	International Maritime Organization		
IPCC	Intergovernmental Panel on Climate Change		