

Appendix I: Glossary

Notes:

1. This glossary defines some specific terms as the lead authors intend them to be interpreted in the context of this Report.
2. Words in italic indicate that the following term is also contained in this glossary.

Acclimatisation

The physiological *adaptation* to climatic variations.

Active layer

The top layer of soil or rock in *permafrost* that is subjected to seasonal freezing and thawing.

Adaptability

See *adaptive capacity*.

Adaptation

Adjustment in natural or *human systems* in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation:

Anticipatory adaptation – Adaptation that takes place before impacts of *climate change* are observed. Also referred to as proactive adaptation.

Autonomous adaptation – Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or *welfare* changes in *human systems*. Also referred to as spontaneous adaptation.

Planned adaptation – Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.

Adaptation assessment

The practice of identifying options to adapt to *climate change* and evaluating them in terms of criteria such as availability, benefits, costs, effectiveness, efficiency and feasibility.

Adaptation benefits

The avoided damage costs or the accrued benefits following the adoption and implementation of *adaptation* measures.

Adaptation costs

Costs of planning, preparing for, facilitating, and implementing *adaptation* measures, including transition costs.

Adaptive capacity (in relation to climate change impacts)

The ability of a system to adjust to *climate change* (including *climate variability* and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

Aerosols

A collection of air-borne solid or liquid particles, with a typical size between 0.01 and 10 μm , that reside in the *atmosphere* for at least several hours. Aerosols may be of either natural or *anthropogenic* origin. Aerosols may influence *climate* in two ways: directly through scattering and absorbing radiation, and indirectly through acting as condensation nuclei for cloud formation or modifying the optical properties and lifetime of clouds.

Afforestation

Direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources. See also *reforestation* and *deforestation*. For a discussion of the term *forest* and related terms such as *afforestation*, *reforestation* and *deforestation*, see the IPCC Special Report on Land Use, Land-Use Change, and Forestry (IPCC, 2000).

Aggregate impacts

Total *impacts* integrated across sectors and/or regions. The aggregation of impacts requires knowledge of (or assumptions about) the relative importance of impacts in different sectors and regions. Measures of aggregate impacts include, for example, the total number of people affected, or the total economic costs.

Albedo

The fraction of solar radiation reflected by a surface or object, often expressed as a percentage. Snow-covered surfaces have a

high albedo; the albedo of soils ranges from high to low; vegetation-covered surfaces and oceans have a low albedo. The Earth's albedo varies mainly through varying cloudiness, snow, ice, leaf area, and land-cover changes.

Algae

Photosynthetic, often microscopic and *planktonic*, organisms occurring in marine and freshwater *ecosystems*.

Algal bloom

A reproductive explosion of *algae* in a lake, river or ocean.

Alpine

The biogeographic zone made up of slopes above the *tree line* characterised by the presence of rosette-forming *herbaceous* plants and low, shrubby, slow-growing woody plants.

Anthropogenic

Resulting from or produced by human beings.

AOGCM

See *climate model*.

Aquaculture

The managed cultivation of aquatic plants or animals such as salmon or shellfish held in captivity for the purpose of harvesting.

Aquifer

A stratum of permeable rock that bears water. An unconfined aquifer is recharged directly by local rainfall, rivers and lakes, and the rate of recharge will be influenced by the permeability of the overlying rocks and soils.

Aragonite

A calcium carbonate (limestone) mineral, used by shell- or skeleton-forming, calcifying organisms such as *corals* (warm- and cold-water corals), some macroalgae, *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 *calcite* and *ocean acidification*.

Arbovirus

Any of various viruses transmitted by blood-sucking arthropods (e.g., mosquitoes, ticks, etc.) and including the causative agents of *dengue fever*, yellow fever, and some types of encephalitis.

Arid region

A land region of low rainfall, where 'low' is widely accepted to be <250 mm precipitation per year.

Atmosphere

The gaseous envelope surrounding the Earth. The dry atmosphere consists almost entirely of nitrogen and oxygen, together with trace gases including *carbon dioxide* and *ozone*.

Attribution

See *Detection and attribution*

Baseline/reference

The baseline (or reference) is the state against which change is measured. It might be a 'current baseline', in which case it represents observable, present-day conditions. It might also be a 'future baseline', which is a projected future set of conditions excluding the driving factor of interest. Alternative interpretations of the reference conditions can give rise to multiple baselines.

Basin

The drainage area of a stream, river or lake.

Benthic community

The community of organisms living on or near the bottom of a water body such as a river, a lake or an ocean.

Biodiversity

The total diversity of all organisms and *ecosystems* at various spatial scales (from genes to entire *biomes*).

Biofuel

A fuel produced from organic matter or combustible oils produced by plants. Examples of biofuel include alcohol, black liquor from the paper-manufacturing process, wood, and soybean oil.

Biomass

The total mass of living organisms in a given area or volume; recently dead plant material is often included as dead biomass. The quantity of biomass is expressed as a dry weight or as the energy, carbon or nitrogen content.

Biome

Major and distinct regional element of the *biosphere*, typically consisting of several *ecosystems* (e.g., forests, rivers, ponds, swamps) within a region of similar *climate*. Biomes are characterised by typical communities of plants and animals.

Biosphere

The part of the Earth system comprising all *ecosystems* and living organisms in the *atmosphere*, on land (terrestrial biosphere), or in the oceans (marine biosphere), including derived dead organic matter, such as litter, soil organic matter, and oceanic detritus.

Biota

All living organisms of an area; the flora and fauna considered as a unit.

Bog

Peat-accumulating acidic wetland.

Boreal forest

Forests of pine, spruce, fir and larch stretching from the east coast of Canada westward to Alaska and continuing from Siberia

westward across the entire extent of Russia to the European Plain. The climate is continental, with long, very cold winters (up to 6 months with mean temperatures below freezing), and short, cool summers (50 to 100 frost-free days). Precipitation increases during summer months, although annual precipitation is still small. Low *evaporation* rates can make this a humid climate. See *taiga*.

Breakwater

A hard engineering structure built in the sea which, by breaking waves, protects a harbour, anchorage, beach or shore area. A breakwater can be attached to the coast or lie offshore.

C₃ plants

Plants that produce a three-carbon compound during *photosynthesis*, including most trees and agricultural crops such as rice, wheat, soybeans, potatoes and vegetables.

C₄ plants

Plants, mainly of tropical origin, that produce a four-carbon compound during *photosynthesis*, including many grasses and the agriculturally important crops maize, sugar cane, millet and sorghum.

Calcareous organisms

A large and diverse group of organisms, many marine, that use *calcite* or *aragonite* to form shells or skeletons. See *calcite*, *aragonite* and *ocean acidification*.

Calcite

A calcium carbonate (limestone) mineral, used by shell- or skeleton-forming, calcifying organisms such as foraminifera, some macroalgae, lobsters, crabs, sea urchins and starfish. Calcite is less sensitive to *ocean acidification* than *aragonite*, also used by many marine organisms. See also *aragonite* and *ocean acidification*.

Capacity building

In the context of *climate change*, capacity building is developing the technical skills and institutional capabilities in developing countries and economies in transition to enable their participation in all aspects of *adaptation* to, *mitigation* of, and research on *climate change*, and in the implementation of the Kyoto Mechanisms, etc.

Carbon cycle

The term used to describe the flow of carbon (in various forms, e.g., *carbon dioxide*) through the *atmosphere*, ocean, terrestrial *biosphere* and lithosphere.

Carbon dioxide (CO₂)

A naturally occurring gas fixed by *photosynthesis* into organic matter. A by-product of fossil fuel combustion and *biomass* burning, it is also emitted from land-use changes and other industrial processes. It is the principal *anthropogenic greenhouse gas* that affects the Earth's radiative balance. It is the reference gas against which other greenhouse gases are measured, thus having a Global Warming Potential of 1.

Carbon dioxide fertilisation

The stimulation of plant *photosynthesis* due to elevated CO₂ concentrations, leading to either enhanced productivity and/or efficiency of *primary production*. In general, C₃ plants show a larger response to elevated CO₂ than C₄ plants.

Carbon sequestration

The process of increasing the carbon content of a *reservoir*/pool other than the *atmosphere*.

Catchment

An area that collects and drains rainwater.

CDM (Clean Development Mechanism)

The CDM allows *greenhouse gas* emission reduction projects to take place in countries that have no emission targets under the *United Nations Framework Convention on Climate Change (UNFCCC) Kyoto Protocol*, yet are signatories.

Chagas' disease

A parasitic disease caused by the *Trypanosoma cruzi* and transmitted by triatomine bugs in the Americas, with two clinical periods: acute (fever, swelling of the spleen, oedemas) and chronic (digestive syndrome, potentially fatal heart condition).

Cholera

A water-borne intestinal infection caused by a bacterium (*Vibrio cholerae*) that results in frequent watery stools, cramping abdominal pain, and eventual collapse from dehydration and shock.

Climate

Climate in a narrow sense is usually defined as the 'average weather', or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is 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

Climate change refers to any change in *climate* over time, whether due to natural variability or as a result of human activity. This usage differs from that in the *United Nations Framework Convention on Climate Change (UNFCCC)*, which 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 climate variability observed over comparable time periods'. See also *climate variability*.

Climate change commitment

Due to the thermal inertia of the ocean and slow processes in the *biosphere*, the *cryosphere* and land surfaces, the climate would continue to change even if the atmospheric composition was held fixed at today's values. Past change in atmospheric com-

position leads to a ‘committed’ *climate change* which continues for as long as a radiative imbalance persists and until all components of the *climate system* have adjusted to a new state. The further change in temperature after the composition of the *atmosphere* is held constant is referred to as the committed warming or warming commitment. Climate change commitment includes other future changes, for example in the hydrological cycle, in *extreme weather events*, and in *sea-level rise*.

Climate model

A numerical representation of the *climate system* based on the physical, chemical, and biological properties of its components, their interactions and *feedback* processes, and accounting for all or some of its known properties. The climate system can be represented by models of varying complexity (i.e., for any one component or combination of components a hierarchy of models can be identified, differing in such aspects as the number of spatial dimensions, the extent to which physical, chemical, or biological processes are explicitly represented, or the level at which empirical parameterisations are involved. Coupled *atmosphere/ocean/sea-ice General Circulation Models* (AOGCMs) provide a comprehensive representation of the climate system. More complex models include active chemistry and biology. Climate models are applied, as a research tool, to study and simulate the climate, but also for operational purposes, including monthly, seasonal, and interannual *climate predictions*.

Climate prediction

A climate prediction or climate forecast is the result of an attempt to produce an estimate of the actual evolution of the climate in the future, e.g., at seasonal, interannual or long-term time scales. See also *climate projection* and *climate (change) scenario*.

Climate projection

The calculated response of the *climate system* to *emissions* or concentration *scenarios* of *greenhouse gases* and *aerosols*, or *radiative forcing scenarios*, often based on simulations by *climate models*. Climate projections are distinguished from *climate predictions*, in that the former critically depend on the emissions/concentration/*radiative forcing* scenario used, and therefore on highly uncertain assumptions of future socio-economic and technological development.

Climate (change) scenario

A plausible and often simplified representation of the future *climate*, based on an internally consistent set of climatological relationships and assumptions of *radiative forcing*, typically constructed for explicit use as input to climate change impact models. A ‘climate change scenario’ is the difference between a climate *scenario* and the current climate.

Climate sensitivity

The equilibrium temperature rise that would occur for a doubling of CO₂ concentration above *pre-industrial* levels.

Climate system

The climate system is defined by the dynamics and interactions

of five major components: *atmosphere*, hydrosphere, *cryosphere*, land surface, and *biosphere*. Climate system dynamics are driven by both internal and external forcing, such as volcanic eruptions, solar variations, or human-induced modifications to the planetary radiative balance, for instance via *anthropogenic emissions* of *greenhouse gases* and/or land-use changes.

Climate threshold

The point at which external forcing of the *climate system*, such as the increasing atmospheric concentration of *greenhouse gases*, triggers a significant climatic or environmental event which is considered unalterable, or recoverable only on very long time-scales, such as widespread bleaching of *corals* or a collapse of oceanic circulation systems.

Climate variability

Climate variability refers to variations in the mean state and other statistics (such as standard deviations, statistics of extremes, etc.) of the *climate* 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*.

CO₂ fertilisation

See *carbon dioxide fertilisation*.

Coastal squeeze

The squeeze of coastal *ecosystems* (e.g., salt marshes, mangroves and mud and sand flats) between rising sea levels and naturally or artificially fixed shorelines, including hard engineering defences (see Chapter 6).

Coccolithophores

Single-celled microscopic *phytoplankton algae* which construct shell-like structures from *calcite* (a form of calcium carbonate). See also *calcite* and *ocean acidification*.

Committed to extinction

This term describes a species with dwindling population that is in the process of inescapably becoming extinct in the absence of human intervention. See also *extinction*.

Communicable disease

An *infectious disease* caused by transmission of an infective biological agent (virus, bacterium, protozoan, or multicellular macroparasite).

Confidence

In this Report, the level of confidence in a statement is expressed using a standard terminology defined in the Introduction. See also *uncertainty*.

Control run

A model run carried out to provide a ‘*baseline*’ for comparison with climate-change experiments. The control run uses constant values for the *radiative forcing* due to *greenhouse gases* and *anthropogenic aerosols* appropriate to *pre-industrial* conditions.

Coral

The term ‘coral’ has several meanings, but is usually the 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.

Coral bleaching

The paling in colour which results if a *coral* loses its symbiotic, energy-providing, organisms.

Coral reefs

Rock-like limestone (calcium carbonate) structures built by *corals* along ocean coasts (fringing reefs) or on top of shallow, submerged banks or shelves (barrier reefs, atolls), most conspicuous in tropical and sub-tropical oceans.

Cryosphere

The component of the *climate system* consisting of all snow and ice (including *permafrost*) on and beneath the surface of the Earth and ocean.

Cryptogams

An outdated but still-used term, denoting a group of diverse and taxonomically unrelated organisms, including fungi and lower plants such as *algae*, lichens, hornworts, liverworts, mosses and ferns.

Deforestation

Natural or *anthropogenic* process that converts forest land to non-forest. See *afforestation* and *reforestation*.

Dengue fever

An *infectious* viral *disease* spread by mosquitoes, often called breakbone fever because it is characterised by severe pain in the joints and back. Subsequent infections of the virus may lead to dengue haemorrhagic fever (DHF) and dengue shock syndrome (DSS), which may be fatal.

Desert

A region of very low rainfall, where ‘very low’ is widely accepted to be <100 mm per year.

Desertification

Land degradation in arid, semi-arid, and dry sub-humid areas resulting from various factors, including climatic variations and human activities. Further, the United Nations Convention to Combat Desertification (UNCCD) defines land degradation as a reduction or loss in arid, semi-arid, and dry sub-humid areas of the biological or economic productivity and complexity of rain-fed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including those arising from human activities and habitation patterns, such as: (i) soil *erosion* caused by wind and/or water; (ii) deterioration of the physical, chemical, and biological or economic properties of soil; and (iii) long-term loss of natural vegetation.

Detection and attribution

Detection of change in a system (natural or human) is the process of demonstrating that the system has changed in some defined statistical sense, without providing a reason for that change.

Attribution of such an observed change in a system to *anthropogenic climate change* is usually a two-stage process. First, the observed change in the system must be demonstrated to be associated with an observed regional climate change with a specified degree of *confidence*. Second, a measurable portion of the observed regional climate change, or the associated observed change in the system, must be attributed to *anthropogenic* climate forcing with a similar degree of confidence.

Confidence in such *joint attribution* statements must be lower than the confidence in either of the individual attribution steps alone due to the combination of two separate statistical assessments.

Diadromous

Fish that travel between salt water and freshwater.

Discount rate

The degree to which consumption now is preferred to consumption one year hence, with prices held constant, but average incomes rising in line with *GDP* per capita.

Disturbance regime

Frequency, intensity, and types of disturbances, such as fires, insect or pest outbreaks, floods and *droughts*.

Downscaling

A method that derives local- to regional-scale (10 to 100 km) information from larger-scale models or data analyses.

Drought

The phenomenon that exists when precipitation is significantly below normal recorded levels, causing serious hydrological imbalances that often adversely affect land resources and production systems.

Dyke

A human-made wall or embankment along a shore to prevent flooding of low-lying land.

Dynamic global vegetation model (DGVM)

Models that simulate vegetation development and dynamics through space and time, as driven by *climate* and other environmental changes.

Ecological community

A community of plants and animals characterised by a typical assemblage of species and their abundances. See also *ecosystem*.

Ecological corridor

A thin strip of vegetation used by wildlife, potentially allowing movement of biotic factors between two areas.

Ecophysiological process

Individual organisms respond to environmental variability, such as *climate change*, through ecophysiological processes which operate continuously, generally at a microscopic or sub-organism scale. Ecophysiological mechanisms underpin individual organism's tolerance to environmental stress, and comprise a broad range of responses defining the absolute tolerance limits of individuals to environmental conditions. Ecophysiological responses may scale up to control species geographic ranges.

Ecosystem

The interactive system formed from all living organisms and their abiotic (physical and chemical) environment within a given area. Ecosystems cover a hierarchy of spatial scales and can comprise the entire globe, *biomes* at the continental scale or small, well-circumscribed systems such as a small pond.

Ecosystem approach

The ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. An ecosystem approach is based on the application of appropriate scientific methodologies focused on levels of biological organisation, which encompass the essential structure, processes, functions and interactions among organisms and their environment. It recognises that humans, with their cultural diversity, are an integral component of many *ecosystems*. The ecosystem approach requires adaptive management to deal with the complex and dynamic nature of ecosystems and the absence of complete knowledge or understanding of their functioning. Priority targets are conservation of *biodiversity* and of the ecosystem structure and functioning, in order to maintain ecosystem services.

Ecosystem services

Ecological processes or functions having monetary or non-monetary value to individuals or society at large. There are (i) supporting services such as productivity or *biodiversity* maintenance, (ii) provisioning services such as food, fibre, or fish, (iii) regulating services such as climate regulation or *carbon sequestration*, and (iv) cultural services such as tourism or spiritual and aesthetic appreciation.

Ecotone

Transition area between adjacent *ecological communities* (e.g., between forests and grasslands).

El Niño-Southern Oscillation (ENSO)

El Niño, in its original sense, is a warm-water current that periodically flows along the coast of Ecuador and Peru, disrupting the local fishery. This oceanic event is associated with a fluctuation of the inter-tropical surface pressure pattern and circulation in the Indian and Pacific Oceans, called the Southern Oscillation. This coupled atmosphere-ocean phenomenon is collectively known as El Niño-Southern Oscillation. During an El Niño event, the prevailing trade winds weaken and the equatorial countercurrent strengthens, causing warm surface waters in the Indonesian area to flow eastward to overlies the cold waters of the Peru current. This event has great impact on the wind, sea surface temperature, and precip-

itation patterns in the tropical Pacific. It has climatic effects throughout the Pacific region and in many other parts of the world. The opposite of an El Niño event is called *La Niña*.

Emissions scenario

A plausible representation of the future development of emissions of substances that are potentially radiatively active (e.g., *greenhouse gases*, *aerosols*), based on a coherent and internally consistent set of assumptions about driving forces (such as demographic and socio-economic development, technological change) and their key relationships. In 1992, the IPCC presented a set of emissions scenarios that were used as a basis for the *climate projections* in the Second Assessment Report. These emissions scenarios are referred to as the IS92 *scenarios*. In the IPCC Special Report on Emissions Scenarios (*SRES*) (Nakićenović et al., 2000), new emissions scenarios – the so-called SRES scenarios – were published.

Endemic

Restricted or peculiar to a locality or region. With regard to human health, endemic can refer to a disease or agent present or usually prevalent in a population or geographical area at all times.

Ensemble

A group of parallel model simulations used for *climate projections*. Variation of the results across the ensemble members gives an estimate of *uncertainty*. Ensembles made with the same model but different initial conditions only characterise the uncertainty associated with internal *climate variability*, whereas multi-model ensembles including simulations by several models also include the impact of model differences.

Epidemic

Occurring suddenly in incidence rates clearly in excess of normal expectancy, applied especially to *infectious diseases* but may also refer to any disease, injury, or other health-related event occurring in such outbreaks.

Erosion

The process of removal and transport of soil and rock by weathering, mass wasting, and the action of streams, *glaciers*, waves, winds and underground water.

Eustatic sea-level rise

See *sea-level rise*.

Eutrophication

The process by which a body of water (often shallow) becomes (either naturally or by pollution) rich in dissolved nutrients, with a seasonal deficiency in dissolved oxygen.

Evaporation

The transition process from liquid to gaseous state.

Evapotranspiration

The combined process of water *evaporation* from the Earth's surface and *transpiration* from vegetation.

Externalities

Occur when a change in the production or consumption of one individual or firm affects indirectly the well-being of another individual or firm. Externalities can be positive or negative. The impacts of pollution on *ecosystems*, water courses or air quality represent classic cases of negative externality.

Extinction

The global disappearance of an entire species.

Extirpation

The disappearance of a species from part of its range; local *extinction*.

Extreme weather event

An event that is rare within its statistical reference distribution at a particular place. Definitions of 'rare' vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile. By definition, the characteristics of what is called 'extreme weather' may vary from place to place. Extreme weather events may typically include floods and *droughts*.

Feedback

An interaction mechanism between processes is called a feedback. When the result of an initial process triggers changes in a second process and that in turn influences the initial one. A positive feedback intensifies the original process, and a negative feedback reduces it.

Food chain

The chain of *trophic relationships* formed if several species feed on each other. See *food web* and *trophic level*.

Food security

A situation that exists when people have secure access to sufficient amounts of safe and nutritious food for normal growth, development and an active and healthy life. Food insecurity may be caused by the unavailability of food, insufficient purchasing power, inappropriate distribution, or inadequate use of food at the household level.

Food web

The network of *trophic relationships* within an *ecological community* involving several interconnected *food chains*.

Forecast

See *climate prediction* and *climate projection*.

Forest limit/line

The upper elevational or latitudinal limit beyond which natural tree regeneration cannot develop into a closed forest stand. It is typically at a lower elevation or more distant from the poles than the *tree line*.

Freshwater lens

A lenticular fresh groundwater body that underlies an oceanic island. It is underlain by saline water.

Functional extinction

This term defines a species which has lost its capacity to persist and to recover because its populations have declined to below a minimum size. See *committed to extinction*.

General Circulation Model (GCM)

See *climate model*.

Generalist

A species that can tolerate a wide range of environmental conditions.

Glacier

A mass of land ice flowing downhill (by internal deformation and sliding at the base) and constrained by the surrounding topography (e.g., 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.

Globalisation

The growing integration and interdependence of countries worldwide through the increasing volume and variety of cross-border transactions in goods and services, free international capital flows, and the more rapid and widespread diffusion of technology, information and culture.

Greenhouse effect

The process in which the absorption of infrared radiation by the *atmosphere* warms the Earth.

In common parlance, the term 'greenhouse effect' may be used to refer either to the natural greenhouse effect, due to naturally occurring *greenhouse gases*, or to the enhanced (*anthropogenic*) greenhouse effect, which results from gases emitted as a result of human activities.

Greenhouse gas

Greenhouse gases are those gaseous constituents of the *atmosphere*, both natural and *anthropogenic*, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds. This property causes the *greenhouse effect*. Water vapour (H₂O), *carbon dioxide* (CO₂), nitrous oxide (N₂O), methane (CH₄) and *ozone* (O₃) are the primary greenhouse gases in the Earth's atmosphere. As well as CO₂, N₂O, and CH₄, the *Kyoto Protocol* deals with the greenhouse gases sulphur hexafluoride (SF₆), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

Gross Domestic Product

Gross Domestic Product (GDP) is the monetary value of all goods and services produced within a nation.

Gross National Product

Gross National Product (GNP) is the monetary value of all goods and services produced in a nation's economy, including income generated abroad by domestic residents, but without income generated by foreigners.

Gross primary production

The total carbon fixed by plant through *photosynthesis*.

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.

Groyne

A low, narrow jetty, usually extending roughly perpendicular to the shoreline, designed to protect the shore from *erosion* by currents, tides or waves, by trapping sand for the purpose of replenishing or making a beach.

Habitat

The locality or natural home in which a particular plant, animal, or group of closely associated organisms lives.

Hantavirus

A virus in the family *Bunyaviridae* that causes a type of haemorrhagic fever. It is thought that humans catch the disease mainly from infected rodents, either through direct contact with the animals or by inhaling or ingesting dust that contains aerosolised viral particles from their dried urine and other secretions.

Heat island

An urban area characterised by ambient temperatures higher than those of the surrounding non-urban area. The cause is a higher absorption of solar energy by materials of the urban fabric such as asphalt.

Herbaceous

Flowering, non-woody.

Human system

Any system in which human organisations play a major role. Often, but not always, the term is synonymous with ‘society’ or ‘social system’ e.g., agricultural system, political system, technological system, economic system; all are human systems in the sense applied in the AR4.

Hydrographic events

Events that alter the state or current of waters in oceans, rivers or lakes.

Hydrological systems

The systems involved in movement, distribution, and quality of water throughout the Earth, including both the hydrologic cycle and water resources.

Hypolimnetic

Referring to the part of a lake below the *thermocline* made up of water that is stagnant and of essentially uniform temperature except during the period of overturn.

Hypoxic events

Events that lead to a deficiency of oxygen.

Ice cap

A dome-shaped ice mass covering a highland area that is considerably smaller in extent than an *ice sheet*.

Ice sheet

A mass of land ice that is sufficiently deep to cover most of the underlying bedrock topography. An ice sheet flows outwards from a high central plateau with a small average surface slope. The margins slope steeply, and the ice is discharged through fast-flowing ice streams or outlet *glaciers*, in some cases into the sea or into *ice shelves* floating on the sea. There are only two large ice sheets in the modern world – on Greenland and Antarctica, the Antarctic ice sheet being divided into east and west by the Transantarctic Mountains; during glacial periods there were others.

Ice shelf

A floating *ice sheet* of considerable thickness attached to a coast (usually of great horizontal extent with a level or gently undulating surface); often a seaward extension of ice sheets. Nearly all ice shelves are in Antarctica.

(climate change) Impact assessment

The practice of identifying and evaluating, in monetary and/or non-monetary terms, the effects of *climate change* on natural and *human systems*.

(climate change) Impacts

The effects of *climate change* on natural and *human systems*. Depending on the consideration of *adaptation*, one can distinguish between potential impacts and residual impacts:

Potential impacts: all impacts that may occur given a projected change in climate, without considering adaptation.

Residual impacts: the impacts of climate change that would occur after adaptation. See also *aggregate impacts*, *market impacts*, and *non-market impacts*.

Indigenous peoples

No internationally accepted definition of indigenous peoples exists. Common characteristics often applied under international law, and by United Nations agencies to distinguish indigenous peoples include: residence within or attachment to geographically distinct traditional *habitats*, ancestral territories, and their natural resources; maintenance of cultural and social identities, and social, economic, cultural and political institutions separate from mainstream or dominant societies and cultures; descent from population groups present in a given area, most frequently before modern states or territories were created and current borders defined; and self-identification as being part of a distinct indigenous cultural group, and the desire to preserve that cultural identity.

Industrial revolution

A period of rapid industrial growth with far-reaching social and economic consequences, beginning in England during the second half of the 18th century and spreading to Europe and later to other countries including the USA. The industrial revolution marks the beginning of a strong increase in combustion of fos-

sil fuels and related emissions of *carbon dioxide*. In the AR4, the term ‘*pre-industrial*’ refers, somewhat arbitrarily, to the period before 1750.

Infectious disease

Any disease caused by microbial agents that can be transmitted from one person to another or from animals to people. This may occur by direct physical contact, by handling of an object that has picked up infective organisms, through a disease carrier, via contaminated water, or by the spread of infected droplets coughed or exhaled into the air.

Infrastructure

The basic equipment, utilities, productive enterprises, installations and services essential for the development, operation and growth of an organisation, city or nation.

Integrated assessment

An interdisciplinary process of combining, interpreting and communicating knowledge from diverse scientific disciplines so that all relevant aspects of a complex societal issue can be evaluated and considered for the benefit of decision-making.

Integrated water resources management (IWRM)

The prevailing concept for water management which, however, has not been defined unambiguously. IWRM is based on four principles that were formulated by the International Conference on Water and the Environment in Dublin, 1992: (1) fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment; (2) water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels; (3) women play a central part in the provision, management and safeguarding of water; (4) water has an economic value in all its competing uses and should be recognised as an economic good.

Invasive species and invasive alien species (IAS)

A species aggressively expanding its range and population density into a region in which it is not native, often through out-competing or otherwise dominating native species.

Irrigation water-use efficiency

Irrigation *water-use efficiency* is the amount of *biomass* or seed yield produced per unit irrigation water applied, typically about 1 tonne of dry matter per 100 mm water applied.

Isohyet

A line on a map connecting locations that receive the same amount of rainfall.

Joint attribution

Involves both *attribution* of observed changes to regional *climate change* and attribution of a measurable portion of either regional climate change or the associated observed changes in the system to *anthropogenic* causes, beyond natural variability. This process involves statistically linking climate-change simulations from *climate models* with the observed responses in the natural or managed system. *Confidence* in joint attribution state-

ments must be lower than the confidence in either of the individual attribution steps alone due to the combination of two separate statistical assessments.

Keystone species

A species that has a central servicing role affecting many other organisms and whose demise is likely to result in the loss of a number of species and lead to major changes in *ecosystem* function.

Kyoto Protocol

The Kyoto Protocol was adopted at the Third Session of the Conference of the Parties (COP) to the *UN Framework Convention on Climate Change (UNFCCC)* in 1997 in Kyoto, Japan. It contains legally binding commitments, in addition to those included in the UNFCCC. Countries included in Annex B of the Protocol (most member countries of the Organisation for Economic Cooperation and Development (OECD) and those with economies in transition) agreed to reduce their *anthropogenic greenhouse gas* emissions (CO₂, CH₄, N₂O, HFCs, PFCs, and SF₆) by at least 5% below 1990 levels in the commitment period 2008 to 2012. The Kyoto Protocol entered into force on 16 February 2005.

La Niña

See *El Niño-Southern Oscillation (ENSO)*.

Landslide

A mass of material that has slipped downhill by gravity, often assisted by water when the material is saturated; the rapid movement of a mass of soil, rock or debris down a slope.

Large-scale singularities

Abrupt and dramatic changes in the state of given systems, in response to gradual changes in driving forces. For example, a gradual increase in atmospheric *greenhouse gas* concentrations may lead to such large-scale singularities as slowdown or collapse of the *thermohaline circulation* or collapse of the West Antarctic *ice sheet*. The occurrence, magnitude, and timing of large-scale singularities are difficult to predict.

Last Glacial Maximum

The Last Glacial Maximum refers to the time of maximum extent of the *ice sheets* during the last glaciation, approximately 21,000 years ago.

Leaching

The removal of soil elements or applied chemicals by water movement through the soil.

Leaf area index (LAI)

The ratio between the total leaf surface area of a plant and the ground area covered by its leaves.

Legume

Plants that fix nitrogen from the air through a symbiotic relationship with bacteria in their soil and root systems (e.g., soybean, peas, beans, lucerne, clovers).

Likelihood

The likelihood of an occurrence, an outcome or a result, where this can be estimated probabilistically, is expressed in this Report using a standard terminology, defined in the Introduction. See also *uncertainty* and *confidence*.

Limnology

Study of lakes and their *biota*.

Littoral zone

A coastal region; the zone between high and low watermarks.

Malaria

Endemic or *epidemic* parasitic disease caused by species of the genus *Plasmodium* (Protozoa) and transmitted by mosquitoes of the genus *Anopheles*; produces bouts of high fever and systemic disorders, affects about 300 million and kills approximately 2 million people worldwide every year.

Market impacts

Impacts that can be quantified in monetary terms, and directly affect *Gross Domestic Product* – e.g., changes in the price of agricultural inputs and/or goods. See also *non-market impacts*.

Meningitis

Inflammation of the meninges (part of the covering of the brain), usually caused by bacteria, viruses or fungi.

Meridional overturning circulation (MOC)

See *thermohaline circulation (THC)*.

Microclimate

Local climate at or near the Earth's surface. See also *climate*.

Millennium Development Goals (MDGs)

A list of ten goals, including eradicating extreme poverty and hunger, improving maternal health, and ensuring environmental sustainability, adopted in 2000 by the UN General Assembly, i.e., 191 States, to be reached by 2015. The MDGs commit the international community to an expanded vision of development, and have been commonly accepted as a framework for measuring development progress.

Mires

Peat-accumulating wetlands. See *bog*.

Mitigation

An *anthropogenic* intervention to reduce the anthropogenic forcing of the *climate system*; it includes strategies to reduce *greenhouse gas sources* and emissions and enhancing *greenhouse gas sinks*.

Mixed layer

The upper region of the ocean, well mixed by interaction with the overlying *atmosphere*.

Monsoon

A monsoon is a tropical and sub-tropical seasonal reversal in

both the surface winds and associated precipitation.

Montane

The biogeographic zone made up of relatively moist, cool upland slopes below the *sub-alpine* zone that is characterised by the presence of mixed deciduous at lower and coniferous evergreen forests at higher elevations.

Morbidity

Rate of occurrence of disease or other health disorders within a population, taking account of the age-specific morbidity rates. Morbidity indicators include chronic disease incidence/prevalence, rates of hospitalisation, primary care consultations, disability-days (i.e., days of absence from work), and prevalence of symptoms.

Morphology

The form and structure of an organism or land-form, or any of its parts.

Mortality

Rate of occurrence of death within a population; calculation of mortality takes account of age-specific death rates, and can thus yield measures of life expectancy and the extent of premature death.

Net biome production (NBP)

Net biome production is the *net ecosystem production (NEP)* minus carbon losses resulting from disturbances such as fire or insect defoliation.

Net ecosystem production (NEP)

Net ecosystem production is the difference between *net primary production (NPP)* and heterotrophic *respiration* (mostly decomposition of dead organic matter) of that *ecosystem* over the same area (see also *net biome production (NBP)*).

Net primary production (NPP)

Net primary production is the *gross primary production* minus autotrophic *respiration*, i.e., the sum of metabolic processes for plant growth and maintenance, over the same area.

Nitrogen oxides (NO_x)

Any of several oxides of nitrogen.

No regrets policy

A policy that would generate net social and/or economic benefits irrespective of whether or not *anthropogenic climate change* occurs.

Non-linearity

A process is called 'non-linear' when there is no simple proportional relation between cause and effect.

Non-market impacts

Impacts that affect *ecosystems* or human *welfare*, but that are not easily expressed in monetary terms, e.g., an increased risk of premature death, or increases in the number of people at risk of hunger. See also *market impacts*.

Normalised difference vegetation index (NDVI)

A satellite-based remotely sensed measure of the 'greenness' of the vegetation cover.

North Atlantic Oscillation (NAO)

The North Atlantic Oscillation (NAO) consists of opposing variations of barometric pressure near Iceland and near the Azores. It is the dominant mode of winter *climate variability* in the North Atlantic region.

Ocean acidification

Increased concentrations of CO₂ in sea water causing a measurable increase in acidity (i.e., a reduction in ocean pH). This may lead to reduced calcification rates of calcifying organisms such as *corals*, molluscs, *algae* and crustacea.

Ombrotrophic bog

An acidic *peat*-accumulating *wetland* that is rainwater (instead of groundwater) fed and thus particularly poor in nutrients.

Opportunity costs

The cost of an economic activity forgone through the choice of another activity.

Ozone

The triatomic form of oxygen (O₃), a gaseous atmospheric constituent. In the *troposphere*, it is created both naturally and by photochemical reactions involving gases resulting from human activities (*photochemical smog*). In high concentrations, tropospheric ozone can be harmful to many living organisms. Tropospheric ozone acts as a *greenhouse gas*. In the *stratosphere*, ozone is created by the interaction between solar ultraviolet radiation and molecular oxygen (O₂). Depletion of stratospheric ozone, due to chemical reactions that may be enhanced by *climate change*, results in an increased ground-level flux of ultraviolet (UV) B radiation.

Paludification

The process of transforming land into a *wetland* such as a marsh, a swamp or a *bog*.

Particulates

Very small solid exhaust particles emitted during the combustion of fossil and biomass fuels. Particulates may consist of a wide variety of substances. Of greatest concern for health are particulates of less than or equal to 10 nm in diameter, usually designated as PM₁₀.

Peat

Peat is formed from dead plants, typically *Sphagnum* mosses, which are only partially decomposed due to the permanent submergence in water and the presence of conserving substances such as humic acids.

Peatland

Typically a *wetland* such as a *mire* slowly accumulating *peat*.

Pelagic community

The community of organisms living in the open waters of a river, a lake or an ocean (in contrast to *benthic communities* living on or near the bottom of a water body).

Permafrost

Perennially frozen ground that occurs where the temperature remains below 0°C for several years.

Phenology

The study of natural phenomena that recur periodically (e.g., development stages, migration) and their relation to climate and seasonal changes.

Photochemical smog

A mix of photochemical oxidant air pollutants produced by the reaction of sunlight with primary air pollutants, especially hydrocarbons.

Photosynthesis

The synthesis by plants, *algae* and some bacteria of sugar from sunlight, *carbon dioxide* and water, with oxygen as the waste product. See also *carbon dioxide fertilisation*, *C₃ plants* and *C₄ plants*.

Physiographic

Of, relating to, or employing a description of nature or natural phenomena.

Phytoplankton

The plant forms of *plankton*. Phytoplankton are the dominant plants in the sea, and are the basis of the entire marine *food web*. These single-celled organisms are the principal agents of photosynthetic carbon fixation in the ocean. See also *zooplankton*.

Plankton

Microscopic aquatic organisms that drift or swim weakly. See also *phytoplankton* and *zooplankton*.

Plant functional type (PFT)

An idealised vegetation class typically used in *dynamic global vegetation models (DGVM)*.

Polynya

Areas of permanently unfrozen sea water resulting from warmer local water currents in otherwise sea-ice covered oceans. They are biological hotspots, since they serve as breathing holes or refuges for marine mammals such as whales and seals, and fish-hunting birds.

Population system

An ecological system (not *ecosystem*) determined by the dynamics of a particular *vagile* species that typically cuts across several *ecological communities* and even entire *biomes*. An example is migratory birds that seasonally inhabit forests as well as grasslands and visit *wetlands* on their migratory routes.

Potential production

Estimated crop productivity under non-limiting soil, nutrient and water conditions.

Pre-industrial

See *industrial revolution*.

Primary production

All forms of production accomplished by plants, also called primary producers. See *GPP*, *NPP*, *NEP* and *NBP*.

Projection

The potential evolution of a quality or set of quantities, often computed with the aid of a model. Projections are distinguished from predictions in order to emphasise that projections involve assumptions – concerning, for example, future socio-economic and technological developments, that may or may not be realised – and are therefore subject to substantial *uncertainty*. See also *climate projection* and *climate prediction*.

Pteropods

Planktonic, small marine snails with swimming organs resembling wings.

Pure rate of time preference

The degree to which consumption now is preferred to consumption one year later, with prices and incomes held constant, which is one component of the *discount rate*.

Radiative forcing

Radiative forcing is the change in the net vertical irradiance (expressed in Watts per square metre; Wm^{-2}) at the tropopause due to an internal or external change in the forcing of the *climate system*, such as a change in the concentration of CO_2 or the output of the Sun.

Rangeland

Unmanaged grasslands, shrublands, *savannas* and *tundra*.

Recalcitrant

Recalcitrant organic material or recalcitrant carbon stocks resist decomposition.

Reference scenario

See *baseline/reference*.

Reforestation

Planting of forests on lands that have previously contained forests but that have been converted to some other use. For a discussion of the term *forest* and related terms such as *afforestation*, *reforestation* and *deforestation*, see the IPCC Special Report on Land Use, Land-Use Change, and Forestry (IPCC, 2000).

Reid's paradox

This refers to the apparent contradiction between inferences of high plant migration rates as suggested in the palaeo-record (particularly after the last Ice Age), and the low potential rates of

migration that can be inferred through studying the seed dispersal of the plants involved, e.g., in wind-tunnel experiments.

Reinsurance

The transfer of a portion of primary insurance risks to a secondary tier of insurers (reinsurers); essentially 'insurance for insurers'.

Relative sea-level rise

See *sea-level rise*.

Reservoir

A component of the *climate system*, other than the *atmosphere*, that has the capacity to store, accumulate or release a substance of concern (e.g., carbon or a *greenhouse gas*). Oceans, soils, and forests are examples of carbon reservoirs. The term also means an artificial or natural storage place for water, such as a lake, pond or *aquifer*, from which the water may be withdrawn for such purposes as irrigation or water supply.

Resilience

The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change.

Respiration

The process whereby living organisms convert organic matter to *carbon dioxide*, releasing energy and consuming oxygen.

Riparian

Relating to or living or located on the bank of a natural watercourse (such as a river) or sometimes of a lake or a tidewater.

River discharge

Water flow within a river channel, for example expressed in m^3/s . A synonym for *streamflow*.

Runoff

That part of precipitation that does not *evaporate* and is not *transpired*.

Salinisation

The accumulation of salts in soils.

Salt-water intrusion / encroachment

Displacement of fresh surface water or groundwater by the advance of salt water due to its greater density. This usually occurs in coastal and estuarine areas due to reducing land-based influence (e.g., either from reduced *runoff* and associated *groundwater recharge*, or from excessive water withdrawals from *aquifers*) or increasing marine influence (e.g., *relative sea-level rise*).

Savanna

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

Scenario

A plausible and often simplified description of how the future may develop, based on a coherent and internally consistent set of assumptions about driving forces and key relationships. Scenarios may be derived from *projections*, but are often based on additional information from other sources, sometimes combined with a ‘narrative storyline’. See also *climate (change) scenario*, *emissions scenario* and *SRES*.

Sea-ice biome

The *biome* formed by all marine organisms living within or on the floating sea ice (frozen sea water) of the polar oceans.)

Sea-level rise

An 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.

Sea wall

A human-made wall or embankment along a shore to prevent wave *erosion*.

Semi-arid regions

Regions of moderately low rainfall, which are not highly productive and are usually classified as *rangelands*. ‘Moderately low’ is widely accepted as between 100 and 250 mm precipitation per year. See also *arid region*.

Sensitivity

Sensitivity is the degree to which a system is affected, either adversely or beneficially, by *climate variability* or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to *sea-level rise*).

Sequestration

See *carbon sequestration*.

Silviculture

Cultivation, development and care of forests.

Sink

Any process, activity, or mechanism that removes a *greenhouse gas*, an *aerosol*, or a precursor of a greenhouse gas or aerosol from the *atmosphere*.

Snow water equivalent

The equivalent volume/mass of water that would be produced if a particular body of snow or ice was melted.

Snowpack

A seasonal accumulation of slow-melting snow.

Social cost of carbon

The value of the *climate change impacts* from 1 tonne of carbon emitted today as CO₂, aggregated over time and discounted back to the present day; sometimes also expressed as value per tonne of *carbon dioxide*.

Socio-economic scenarios

Scenarios concerning future conditions in terms of population, *Gross Domestic Product* and other socio-economic factors relevant to understanding the implications of *climate change*. See *SRES* (source: Chapter 6).

SRES

The storylines and associated population, *GDP* and *emissions scenarios* associated with the Special Report on Emissions Scenarios (SRES) (Nakićenović et al., 2000), and the resulting *climate change* and *sea-level rise scenarios*. Four families of *socio-economic scenario* (A1, A2, B1 and B2) represent different world futures in two distinct dimensions: a focus on economic versus environmental concerns, and global versus regional development patterns.

Stakeholder

A person or an organisation that has a legitimate interest in a project or entity, or would be affected by a particular action or policy.

Stock

See *reservoir*.

Stratosphere

Highly stratified region of *atmosphere* above the *troposphere* extending from about 10 km (ranging from 9 km in high latitudes to 16 km in the tropics) to about 50 km.

Streamflow

Water flow within a river channel, for example, expressed in m³/s. A synonym for *river discharge*.

Sub-alpine

The biogeographic zone below the *tree line* and above the *montane* zone that is characterised by the presence of coniferous forest and trees.

Succulent

Succulent plants, e.g., cactuses, possessing organs that store water, thus facilitating survival during *drought* conditions.

Surface runoff

The water that travels over the land surface to the nearest surface stream; *runoff* of a drainage *basin* that has not passed beneath the surface since precipitation.

Sustainable development

Development that meets the cultural, social, political and economic needs of the present generation without compromising the ability of future generations to meet their own needs.

Taiga

The northernmost belt of *boreal forest* adjacent to the Arctic *tundra*.

Thermal expansion

In connection with *sea-level rise*, this refers to the increase in volume (and decrease in density) that results from warming water. A warming of the ocean leads to an expansion of the ocean volume and hence an increase in sea level.

Thermocline

The region in the world's ocean, typically at a depth of 1 km, where temperature decreases rapidly with depth and which marks the boundary between the surface and the ocean.

Thermohaline circulation (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)*.

Thermokarst

A ragged landscape full of shallow pits, hummocks and depressions often filled with water (ponds), which results from thawing of ground ice or *permafrost*. Thermokarst processes are the processes driven by warming that lead to the formation of thermokarst.

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.

Transpiration

The *evaporation* of water vapour from the surfaces of leaves through stomata.

Tree line

The upper limit of tree growth in mountains or high latitudes. It is more elevated or more poleward than the *forest line*.

Trophic level

The position that an organism occupies in a *food chain*.

Trophic relationship

The ecological relationship which results when one species feeds on another.

Troposphere

The lowest part of the *atmosphere* from the surface to about 10 km in altitude in mid-latitudes (ranging from 9 km in high latitudes to 16 km in the tropics on average) where clouds and 'weather' phenomena occur. In the troposphere, temperatures generally decrease with height.

Tsunami

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

Tundra

A treeless, level, or gently undulating plain characteristic of the Arctic and sub-Arctic regions characterised by low temperatures and short growing seasons.

Uncertainty

An expression of the degree to which a value (e.g., the future state of the *climate system*) is unknown. Uncertainty can result from lack of information or from disagreement about what is known or even knowable. It may have many types of sources, from quantifiable errors in the data to ambiguously defined concepts or terminology, or uncertain *projections* of human behaviour. Uncertainty can therefore be represented by quantitative measures (e.g., a range of values calculated by various models) or by qualitative statements (e.g., reflecting the judgement of a team of experts). See also *confidence* and *likelihood*.

Undernutrition

The temporary or chronic state resulting from intake of lower than recommended daily dietary energy and/or protein requirements, through either insufficient food intake, poor absorption, and/or poor biological use of nutrients consumed.

Ungulate

A hoofed, typically herbivorous, quadruped mammal (including ruminants, swine, camel, hippopotamus, horse, rhinoceros and elephant).

United Nations Framework Convention on Climate Change (UNFCCC)

The Convention was adopted on 9 May 1992, in New York, and signed at the 1992 Earth Summit in Rio de Janeiro by more than 150 countries and the European Community. Its ultimate objective is the 'stabilisation of *greenhouse gas* concentrations in the *atmosphere* at a level that would prevent dangerous *anthropogenic* interference with the *climate system*'. It contains commitments for all Parties. Under the Convention, Parties included in Annex I aim to return greenhouse gas emissions not controlled by the Montreal Protocol to 1990 levels by the year 2000. The Convention entered in force in March 1994. See also *Kyoto Protocol*.

Upwelling region

A region of an ocean where cold, typically nutrient-rich waters from the bottom of the ocean surface.

Urbanisation

The conversion of land from a natural state or managed natural state (such as agriculture) to cities; a process driven by net rural-to-urban migration through which an increasing percentage of the population in any nation or region come to live in settlements that are defined as 'urban centres'.

Vagile

Able to migrate.

Vascular plants

Higher plants with vascular, i.e., sap-transporting, tissues.

Vector

A blood-sucking organism, such as an insect, that transmits a pathogen from one host to another. See also *vector-borne diseases*.

Vector-borne diseases

Disease that are transmitted between hosts by a *vector* organism (such as a mosquito or tick); e.g., *malaria*, *dengue fever* and *leishmaniasis*.

Vernalisation

The biological requirements of certain crops, such as winter cereals, which need periods of extreme cold temperatures before emergence and/or during early vegetative stages, in order to flower and produce seeds. By extension, the act or process of hastening the flowering and fruiting of plants by treating seeds, bulbs or seedlings with cold temperatures, so as to induce a shortening of the vegetative period.

Vulnerability

Vulnerability is the degree to which a system is susceptible to, and 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 change and variation to which a system is exposed, its *sensitivity*, and its adaptive capacity.

Water consumption

Amount of extracted water irretrievably lost during its use (by *evaporation* and goods production). Water consumption is equal to water withdrawal minus return flow.

Water productivity

The ratio of crop seed produced per unit water applied. In the case of irrigation, see *irrigation water-use efficiency*. For rain-fed crops, water productivity is typically 1 t/100 mm.

Water stress

A country is water-stressed if the available freshwater supply relative to water withdrawals acts as an important constraint on development. Withdrawals exceeding 20% of renewable water supply have been used as an indicator of water stress. A crop is water-stressed if soil-available water, and thus actual *evapotranspiration*, is less than potential evapotranspiration demands.

Water-use efficiency

Carbon gain in *photosynthesis* per unit water lost in *evapotranspiration*. It can be expressed on a short-term basis as the ratio of photosynthetic carbon gain per unit transpirational water loss, or on a seasonal basis as the ratio of *net primary production* or agricultural yield to the amount of available water.

Welfare

An economic term used to describe the state of well-being of humans on an individual or collective basis. The constituents of well-being are commonly considered to include materials to satisfy basic needs, freedom and choice, health, good social relations, and security.

Wetland

A 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 characterised by a prevalence of vegetation adapted for life in saturated soil conditions.

Yedoma

Ancient organic material trapped in *permafrost* that is hardly decomposed.

Zoonoses

Diseases and infections which are naturally transmitted between vertebrate animals and people.

Zooplankton

The animal forms of *plankton*. They consume *phytoplankton* or other zooplankton.

References

IPCC, 2000: *Land Use, Land-Use Change, and Forestry: A Special Report of the IPCC*, R.T. Watson, I.R. Noble, B. Bolin, N.H. Ravindranath, D.J. Verardo and D.J. Dokken, Eds., Cambridge University Press, Cambridge, and New York, 377 pp.

Nakićenović, N., J. Alcamo, G. Davis, B. de Vries, J. Fenhann, S. Gaffin, K. Gregory, A. Grübler, T.Y. Jung, T. Kram, E.L. La Rovere, L. Michaelis, S. Mori, T. Morita, W. Pepper, H. Pitcher, L. Price, K. Raihi, A. Roehrl, H.-H. Rogner, A. Sankovski, M. Schlesinger, P. Shukla, S. Smith, R. Swart, S. van Rooijen, N. Victor and Z. Dadi, 2000: *Emissions Scenarios: A Special Report of Working Group III of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, and New York, 599 pp.

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Appendix IV: Acronyms

[CO ₂]	Concentration of carbon dioxide	CGE	Computable general equilibrium (model)
AAO	Antarctic Oscillation	CIESIN	Center for International Earth Science Information Network
ABM	Agent-based models	CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
AC	Air-conditioning	CMAQ	Community multiscale air quality (model)
ACIA	Arctic Climate Impact Assessment	COP	Conference of the Parties (to the UNFCCC)
AEJ	African Easterly Jet	CPPS	Comisión Permanente del Pacífico Sur (Permanent Commission of the South Pacific)
AEZ	Agro-ecological zone	CRID	Centro Regional de Información sobre Desastres (Regional Disaster Information Centre – Latin America and the Caribbean)
AGCM	Atmospheric General Circulation Model	CSIRO	Commonwealth Scientific and Industrial Research Organisation
AGO	Australian Greenhouse Office		
AIACC	Assessments of Impacts and Adaptations to Climate Change in Multiple Regions and Sectors		
AIDS	Acquired Immune Deficiency Syndrome		
AO	Arctic Oscillation		
AOGCM	Atmosphere–Ocean General Circulation Model		
APF	Adaptation Policy Framework		
AR4	Fourth Assessment Report	DAC	Development Assistance Committee
Aus	Australia	DAI	Dangerous anthropogenic interference
AVHRR	Advanced Very High Resolution Radiometer	DALY	Disability adjusted life year
		DDC	Data Distribution Centre (of the IPCC)
		Defra	Department for Environment, Food and Rural Affairs (of the UK Government)
BAU	Business-as-usual scenario	DGVM	Dynamic global vegetation model
BSATs	Brazilian semi-arid tropics	DIC	Dissolved inorganic carbon
CAA	Canadian Arctic archipelago	DJF	December, January, February
CAPRADE	Comité Andino para la Prevención y Atención de Desastres (Andean Committee for Disaster Prevention and Assistance)	DMS	Dimethyl sulphide
		DOC	Dissolved organic carbon
		DPSIR	Drivers–pressures–state–impacts–response
CBA	Cost-benefit analysis	DWC	Dialogue on Water and Climate
CBD	Convention on Biological Diversity		
CC	Climate change	ECCP	European Climate Change Programme
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources	ECLAC	Economic Commission for Latin America and the Caribbean
CCD	(United Nations) Convention to Combat Desertification	EF	Ecological footprint
CCIAV	Climate change impacts, adaptation and vulnerability	EIA	Environmental Impact Assessment
		EMIC	Earth-system model of intermediate complexity
CCN	Cloud condensation nuclei	ENSO	El Niño–Southern Oscillation
CDF	Conditional damage function	EPA	Environmental Protection Agency
CDM	Clean Development Mechanism	EPOC	Environment Policy Committee
CEE	Central and Eastern Europe	EPPA	Anthropogenic emission prediction and policy analysis
CFP	Common Fisheries Policy		

EPPA-HHL	The EPPA high-emissions scenario	IOCARIBE-GOOS	Intergovernmental Oceanographic Commission Regional Sub-Commission for the Caribbean and Adjacent Regions
EPPA-LLH	The EPPA low-emissions scenario		Global Ocean Observing System
ET	Evapotranspiration		
EU	European Union	IOD	Indian Ocean Dipole
EU15	The 15 countries in the European Union before the expansion on 1 May 2004	IPCC	Intergovernmental Panel on Climate Change
EU25	The 25 countries in the European Union after the expansion on 1 May 2004, but prior to 1 January 2007	IPO	Inter-decadal Pacific Oscillation
EWS	Early-warning systems	IRRI	International Rice Research Institute
FACE	Free-air carbon dioxide enrichment	ITCZ	Intertropical Convergence Zone
FAO	Food and Agriculture Organization	ITTO	International Tropical Timber Organization
FFF	Food, fibre and forestry	IUCN	International Union for the Conservation of Nature and Natural Resources (World Conservation Union)
FFFF	Food, fibre, forestry and fishery		
GBR	Great Barrier Reef	JFM	January, February, March
GCM	General Circulation Model	JJA	June, July, August
GDP	Gross domestic product	LA	Latin America
GEF	Global Environment Facility	LAI	Leaf-area index
GEOSS	Global Earth Observation System of Systems	LBA	Large Scale Biosphere-Atmosphere (experiment)
GHG	Greenhouse gas(es)	LDC	Less/Least Developed Countries
GIMMS	Global Inventory Modeling and Mapping Studies	LGA	Local government authority (Chapter 11)
GIS	Geographic information system	LGM	Last Glacial Maximum
GISS	Goddard Institute for Space Studies	LGP	Length of growing period
GLOF	Glacial lake outburst flood	LIA	Little Ice Age
GMAT	Global mean annual temperature	LPJ	Lund-Potsdam-Jena (model)
GMT	Global mean temperature	LULUCF	Land use, land-use change and forestry
GNP	Gross national product	M&E	Monitoring and evaluation
GPP	Gross primary production	MA	Millennium Ecosystem Assessment
GPS	Global Positioning System	MACC	Mainstreaming Adaptation to Climate Change in the Caribbean
GWP	Global Water Partnership	MAMJ	March, April, May, June
HABs	Harmful algal blooms	MARA/ARMA	Mapping Malaria Risk in Africa/Atlas du Risque de la Malaria en Afrique
HANPP	Human appropriation of net primary productivity	MASL	Metres above sea level
HIV	Human immunodeficiency virus	MDB	Murray-Darling Basin
HPS	Hantavirus pulmonary syndrome	MDGs	Millennium Development Goals
HYV	High-yield varieties	MEA	Multilateral environmental agreement
IAM	Integrated assessment model	MER	Market exchange rates
IAS	Invasive alien species	MJO	Madden-Julian Oscillation
ICLIPS	Integrated Assessment of Climate Protection Strategies	MOC	Meridional overturning circulation
ICM	Integrated coastal management	MTE	Mediterranean-type ecosystems
ICZM	Integrated coastal zone management	NAH	North Atlantic Sub-tropical High
IFRCRC	International Federation of Red Cross and Red Crescent Societies	NAO	North Atlantic Oscillation
IGBP	International Geosphere-Biosphere Programme	NAPA	National Adaptation Programme of Action
IHDP	International Human Dimensions Programme	NBP	Net biome productivity
IIASA	International Institute for Applied Systems Analysis	NC	National Communication
INAP	Integrated National Pilot Adaptation Plan	NCAR PCM	National Center for Atmospheric Research Parallel Climate Model
		NDVI	Normalised Difference Vegetation Index
		NEP	Net ecosystem productivity
		NEPAD	New Partnership for Africa's Development
		NGO	Non-governmental organisation

NHT	Northern Hemisphere temperature	SLR	Sea-level rise
NPP	Net primary productivity	SM	Supplementary material
NSW	New South Wales	SoCAB	South Coast Air Basin (California)
NT	Northern Territory	SON	September, October, November
NTFP	Non-timber forest products	SPCZ	South Pacific Convergence Zone
NWMP	National Water Management Plan	SRES	Special Report on Emissions Scenarios
NZ	New Zealand	SST	Sea surface temperature
		SWE	Snow water equivalent
ODA	Official Development Assistance		
OECD	Organisation for Economic Co-operation and Development	TAR	Third Assessment Report (of the IPCC)
		TBE	Tick-borne encephalitis
OND	October, November, December	TEJ	Tropical Easterly Jet
		TEK	Traditional ecological knowledge
PAHO	Pan-American Health Organization	TGICA	Task Group on Data and Scenario Support for Impact and Climate Analysis
PAL	Pathfinder AVHRR Land		
PDF	Probability density function	THC	Thermohaline circulation
PDI	Power dissipation index	TOGA	Tropical Ocean-Global Atmosphere
PDO	Pacific Decadal Oscillation	TOPEX	Ocean Topography Experiment
PDSI	Palmer Drought Severity Index	TWA	Tolerable windows approach
P-E	Precipitation-evaporation		
PEAC	Pacific ENSO Applications Center	UHI	Urban heat-island
PFT	Plant functional types	UK	United Kingdom
PIA	Participatory integrated assessment	UKCIP	United Kingdom Climate Impacts Programme
PI-GCOS	Pacific Islands Global Climate Observing System	UNDP	United Nations Development Programme
P-IND	Pre-industrial	UNFCCC	United Nations Framework Convention on Climate Change
PM	Particulate matter		
ppb	Parts per billion	US	United States (of America)
ppm	Parts per million	USEPA	United States Environmental Protection Agency
PPP	Purchasing power parity		
PRA	Participatory rural appraisal	UVR	Ultraviolet radiation
Qld	Queensland	VBD	Vector-borne disease
		VOC	Volatile organic compound
RCM	Regional Climate Model		
RRA	Rapid rural appraisal	WA	Western Australia
RSLR	Relative sea-level rise	WAIS	West Antarctic ice sheet
		WAMU	West African Monetary Union
SACZ	South Atlantic Convergence Zone	WBD	Water-borne disease
SAP	Structural adjustment programme	WCRP	World Climate Research Programme
SAS	Storyline and simulation	WE	Western Europe
SBW	Spruce bud worm	WG	Working Group (of the IPCC)
SCAPE	Soft Cliff and Platform Erosion (model)	WHO	World Health Organization
SD	Statistical downscaling	WMO	World Meteorological Organization
SDSM	Statistical downscaling model	WNV	West Nile virus
SEAFRAME	Sea-level fine resolution acoustic measuring equipment	WTO	World Trade Organization
		WWW	World Weather Watch
SIDS	Small Island Developing States		

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