

# Appendix II: Glossary

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This Glossary is based on the glossaries published in the IPCC Fourth Assessment Report.

The italics used have the following meaning: *Glossary word reference*; *Glossary secondary reference* (i.e., terms which are either contained in a glossary of the IPCC Working Group contributions to the AR4, or defined within the text of an entry of this glossary).

## A.

### Abrupt climate change

The nonlinearity of *the climate system* may lead to abrupt *climate change*, sometimes called *rapid climate change*, *abrupt events* or even *surprises*. The term *abrupt* often refers to time scales faster than the typical time scale of the responsible forcing. However, not all abrupt climate changes need be *externally forced*. Some possible abrupt events that have been proposed include a dramatic reorganisation of the thermohaline circulation, rapid deglaciation and massive melting of *permafrost* or increases in soil respiration leading to fast changes in the *carbon cycle*. Others may be truly unexpected, resulting from a strong, rapidly changing, forcing of a non-linear system.

### Active layer

The layer of ground that is subject to annual thawing and freezing in areas underlain by *permafrost*.

### Adaptation

Initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected *climate change* effects. Various types of adaptation exist, e.g., *anticipatory* and *reactive*, *private* and *public*, and *autonomous* and *planned*. Examples are raising river or coastal dikes, the substitution of more temperature-shock resistant plants for sensitive ones, etc.

### Adaptive capacity

The whole of capabilities, resources and institutions of a country or *region* to implement effective *adaptation* measures.

### Aerosols

A collection of airborne solid or liquid particles, with a typical size between 0.01 and 10 micrometre (a millionth of a metre) that reside in the atmosphere for at least several hours. Aerosols may be of either natural or *anthropogenic* origin. Aerosols may influence *climate* in several ways: directly through scattering

and *absorbing* radiation, and indirectly through acting as cloud condensation nuclei or modifying the optical properties and lifetime of clouds.

### Afforestation

Planting of new forests on lands that historically have not contained forests (for at least 50 years). For a discussion of the term *forest* and related terms such as afforestation, *reforestation*, and *deforestation* see the IPCC Report on Land Use, Land-Use Change and Forestry (IPCC, 2000).

### 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 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.

### 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.

### Annex I countries

The group of countries included in Annex I (as amended in 1998) to the *United Nations Framework Convention on Climate Change (UNFCCC)*, including all the OECD countries in the year 1990 and countries with economies in transition. Under Articles 4.2 (a) and 4.2 (b) of the Convention, Annex I countries committed themselves specifically to the aim of returning individually or jointly to their 1990 levels of *greenhouse gas* emissions by the year 2000. By default, the other countries are referred to as *non-Annex I countries*.

## Annex II countries

The group of countries included in Annex II to the *United Nations Framework Convention on Climate Change (UNFCCC)*, including all OECD countries in the year 1990. Under Article 4.2 (g) of the Convention, these countries are expected to provide financial resources to assist developing countries to comply with their obligations, such as preparing national reports. Annex II countries are also expected to promote the transfer of environmentally sound technologies to developing countries.

## Annex B countries

The countries included in Annex B to the *Kyoto Protocol* that have agreed to a target for their greenhouse-gas emissions, including all the *Annex I countries* (as amended in 1998) except for Turkey and Belarus. See *Kyoto Protocol*

## Annular modes

Preferred patterns of change in atmospheric circulation corresponding to changes in the zonally averaged mid-latitude westerlies. The *Northern Annular Mode* has a bias to the North Atlantic and has a large correlation with the *North Atlantic Oscillation*. The *Southern Annular Mode* occurs in the Southern Hemisphere. The variability of the mid-latitude westerlies has also been known as *zonal flow* (or *wind*) vacillation, and defined through a *zonal index*. [WGI Box 3.4]

## Anthropogenic

Resulting from or produced by human beings.

## 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.

## Arid region

A land region of low rainfall, where *low* is widely accepted to be less than 250 mm precipitation per year.

## Atlantic Multi-decadal Oscillation (AMO)

A multi-decadal (65 to 75 year) fluctuation in the North Atlantic, in which *sea surface temperatures* showed warm phases during roughly 1860 to 1880 and 1930 to 1960 and cool phases during 1905 to 1925 and 1970 to 1990 with a range of order 0.4° C.

## Atmosphere

The gaseous envelope surrounding the Earth. The dry atmosphere consists almost entirely of nitrogen (78.1% volume mixing ratio) and oxygen (20.9% volume mixing ratio), together with a number of trace gases, such as argon (0.93% volume mixing ratio), helium and radiatively active greenhouse gases such as *carbon dioxide* (0.035% volume mixing ratio) and *ozone*. In

addition, the atmosphere contains the greenhouse gas water vapour, whose amounts are highly variable but typically around 1% volume mixing ratio. The atmosphere also contains clouds and *aerosols*.

## Atmospheric boundary layer

The atmospheric layer adjacent to the Earth's surface that is affected by friction against that boundary surface, and possibly by transport of heat and other variables across that surface (AMS, 2000). The lowest 10 metres or so of the boundary layer, where mechanical generation of turbulence is dominant, is called the *surface boundary layer* or *surface layer*.

## Attribution

See *Detection and attribution*.

## B.

### Barrier

Any obstacle to reaching a goal, *adaptation* or *mitigation* potential that can be overcome or attenuated by a policy, programme, or measure. *Barrier removal* includes correcting market failures directly or reducing the transactions costs in the public and private sectors by e.g., improving institutional capacity, reducing risk and uncertainty, facilitating market transactions, and enforcing regulatory policies.

### Baseline

Reference for measurable quantities from which an alternative outcome can be measured, e.g., a non-intervention *scenario* used as a reference in the analysis of intervention scenarios.

### Basin

The drainage area of a stream, river, or lake.

### Biodiversity

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

### Bioenergy

Energy derived from biomass.

### 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

A 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 (terrestrial and marine)**

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.

**Black carbon**

Operationally defined *aerosol* species based on measurement of light absorption and chemical reactivity and/or thermal stability; consists of soot, charcoal and/or possible light absorbing refractory organic matter.

**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.

**Boundary layer**

See *Atmospheric boundary layer*.

**C.****C<sub>3</sub> plants**

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

**C<sub>4</sub> 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.

**Carbon (dioxide) capture and storage (CCS)**

A process consisting of separation of *carbon dioxide* from industrial and energy-related sources, transport to a storage location, and long-term isolation from the *atmosphere*.

**Carbon cycle**

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

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

A naturally occurring gas, also a by-product of burning fossil fuels from fossil carbon deposits, such as oil, gas and coal, of burning *biomass* and of *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 and

therefore has a *Global Warming Potential* of 1.

**Carbon dioxide (CO<sub>2</sub>) enrichment**

See *Carbon dioxide (CO<sub>2</sub>) fertilisation*.

**Carbon dioxide (CO<sub>2</sub>) fertilisation**

The enhancement of the growth of plants as a result of increased atmospheric *carbon dioxide* (CO<sub>2</sub>) concentration. Depending on their mechanism of *photosynthesis*, certain types of plants are more sensitive to changes in atmospheric CO<sub>2</sub> concentration.

**Carbon sequestration**

The uptake of carbon containing substances, in particular *carbon dioxide*. See *Sequestration*.

**Catchment**

An area that collects and drains rainwater.

**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.

**Clean Development Mechanism (CDM)**

Defined in Article 12 of the *Kyoto Protocol*, the CDM is intended to meet two objectives: (1) to assist parties not included in *Annex I* in achieving *sustainable development* and in contributing to the ultimate objective of the Convention; and (2) to assist parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments. Certified Emission Reduction Units from CDM projects undertaken in non-Annex I countries that limit or reduce greenhouse gas emissions, when certified by operational entities designated by Conference of the Parties/Meeting of the Parties, can be accrued to the investor (government or industry) from parties in *Annex B*. A share of the proceeds from the certified project activities is used to cover administrative expenses as well as to assist developing country parties that are particularly vulnerable to the adverse effects of *climate change* to meet the costs of *adaptation*.

**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. The classical period for averaging these variables is 30 years, as defined by the World Meteorological Organization. The relevant 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*.

**Climate change**

Climate change refers to a change in the state of the *climate* that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for

an extended period, typically decades or longer. *Climate change* may be due to natural internal processes or *external forcings*, or to persistent *anthropogenic* changes in the composition of the *atmosphere* or in *land use*. Note that the *United Nations Framework Convention on Climate Change (UNFCCC)*, in its Article 1, 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’. The UNFCCC thus makes a distinction between climate change attributable to human activities altering the atmospheric composition, and climate variability attributable to natural causes. See also *Climate variability; Detection and attribution*.

### Climate feedback

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

### 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, that is, for any one component or combination of components a spectrum or 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 general circulation models (AOGCMs) provide a representation of the climate system that is near the most comprehensive end of the spectrum currently available. There is an evolution towards more complex models with interactive chemistry and biology (see WGI Chapter 8). Climate models are applied as a research tool to study and simulate the *climate*, and for operational purposes, including monthly, seasonal and interannual climate predictions.

### Climate projection

A *projection* of the response of the *climate system* to *emissions* or concentration *scenarios* of *greenhouse gases* and *aerosols*, or *radiative forcing* scenarios, often based upon simulations by *climate models*. Climate projections are distinguished from climate predictions in order to emphasise that climate projections depend upon the emission/concentration/radiative forcing scenario used, which are based on assumptions concerning, for example, future socioeconomic and technological developments that may or may not be realised and are therefore subject to substantial *uncertainty*.

### Climate scenario

A plausible and often simplified representation of the future *climate*, based on an internally consistent set of climatological relationships that has been constructed for explicit use in

investigating the potential consequences of *anthropogenic climate change*, often serving as input to impact models. *Climate projections* often serve as the raw material for constructing climate scenarios, but climate scenarios usually require additional information such as about the observed current climate. A *climate change scenario* is the difference between a climate scenario and the current climate.

### Climate system

The climate system is the highly complex system consisting of five major components: the *atmosphere*, the *hydrosphere*, the *cryosphere*, the land surface and the *biosphere*, and the interactions between them. The climate system evolves in time under the influence of its own internal dynamics and because of *external forcings* such as volcanic eruptions, solar variations and *anthropogenic* forcings such as the changing composition of the atmosphere and *land-use change*.

### Climate variability

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

### CO<sub>2</sub>

See *Carbon dioxide*.

### CO<sub>2</sub>-fertilisation

See *Carbon dioxide fertilisation*.

### Confidence

The level of confidence in the correctness of a result is expressed in this Technical Paper using a standard terminology defined in Box 1.1. See also *Likelihood; 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*, appropriate to present-day or *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. See *Coral reefs*

### Coral reefs

Rock-like limestone 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 subtropical oceans.

### Cost

The consumption of resources such as labour time, capital,

materials, fuels, etc. as a consequence of an action. In economics all resources are valued at their *opportunity cost*, being the value of the most valuable alternative use of the resources. Costs are defined in a variety of ways and under a variety of assumptions that affect their value. Cost types include: *administrative costs*, *damage costs* (to ecosystems, people and economies due to negative effects from *climate change*), and *implementation costs* of changing existing rules and regulation, capacity building efforts, information, training and education, etc. *Private costs* are carried by individuals, companies or other private entities that undertake the action, whereas *social costs* include also the external costs on the environment and on society as a whole. The negative of costs are benefits (also sometimes called *negative costs*). Costs minus benefits are *net costs*.

### Cryosphere

The component of the *climate system* consisting of all snow, ice and *frozen ground* (including *permafrost*) on and beneath the surface of the Earth and ocean. See also *Glacier*; *Ice sheet*.

### D. Deforestation

Conversion of forest to non-forest. For a discussion of the term *forest* and related terms such as *afforestation*, *reforestation*, and deforestation see the IPCC Report on Land Use, Land-Use Change and Forestry (IPCC, 2000).

### 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 less than 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

*Climate* varies continually on all time scales. *Detection* of *climate change* is the process of demonstrating that climate has changed in some defined statistical sense, without providing a reason for that change. *Attribution* of causes of climate change

is the process of establishing the most likely causes for the detected change with some defined level of *confidence*.

### Development path or pathway

An evolution based on an array of technological, economic, social, institutional, cultural, and biophysical characteristics that determine the interactions between natural and *human systems*, including production and consumption patterns in all countries, over time at a particular scale. *Alternative development paths* refer to different possible trajectories of development, the continuation of current trends being just one of the many paths.

### Disturbance regime

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

### Downscaling

Downscaling is a method that derives local-to-regional-scale (10 to 100km) information from larger-scale models or data analyses. Two main methods are distinguished: *dynamical downscaling* and *empirical/statistical downscaling*. The dynamical method uses the output of regional *climate models*, global models with variable spatial resolution or high-resolution global models. The empirical/statistical methods develop statistical relationships that link the large-scale atmospheric variables with local/regional climate variables. In all cases, the quality of the downscaled product depends on the quality of the driving model.

### Drought

In general terms, drought is a ‘prolonged absence or marked deficiency of precipitation’, a ‘deficiency that results in water shortage for some activity or for some group’, or a ‘period of abnormally dry weather sufficiently prolonged for the lack of precipitation to cause a serious hydrological imbalance’ (Heim, 2002). Drought has been defined in a number of ways. *Agricultural drought* relates to moisture deficits in the topmost 1 metre or so of soil (the root zone) that affect crops, *meteorological drought* is mainly a prolonged deficit of precipitation, and *hydrologic drought* is related to below-normal streamflow, lake and groundwater levels. A *megadrought* is a longdrawn out and pervasive drought, lasting much longer than normal, usually a decade or more.

### 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.

### Dynamical ice discharge

Discharge of ice from *ice sheets* or *ice caps* caused by the dynamics of the ice sheet or ice cap (e.g., in the form of *glacier* flow, ice streams and calving icebergs) rather than by melt or *runoff*.

**E.****Ecological community**

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

**Ecosystem**

A system of living organisms interacting with each other and their physical environment. The boundaries of what could be called an ecosystem are somewhat arbitrary, depending on the focus of interest or study. Thus, the extent of an ecosystem may range from very small spatial scales to, ultimately, the entire Earth.

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

The term *El Niño* was initially used to describe a warm-water current that periodically flows along the coast of Ecuador and Perú, disrupting the local fishery. It has since become identified with a basinwide warming of the tropical Pacific east of the dateline. This oceanic event is associated with a fluctuation of a global-scale tropical and subtropical surface pressure pattern called the *Southern Oscillation*. This coupled *atmosphere*-ocean phenomenon, with preferred time scales of two to about seven years, is collectively known as *El Niño-Southern Oscillation*, or *ENSO*. It is often measured by the surface pressure anomaly difference between Darwin and Tahiti and the sea surface temperatures in the central and eastern equatorial Pacific. During an ENSO event, the prevailing trade winds weaken, reducing upwelling and altering ocean currents such that the sea surface temperatures warm, further weakening the trade winds. This event has a great impact on the wind, sea surface temperature and precipitation patterns in the tropical Pacific. It has climatic effects throughout the Pacific *region* and in many other parts of the world, through global teleconnections. The cold phase of ENSO 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 socioeconomic development, technological change) and their key relationships. *Concentration scenarios*, derived from emission scenarios, are used as input to a *climate model* to compute *climate projections*. See *SRES scenarios*.

**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.

**Energy**

The amount of work or heat delivered. Energy is classified in a variety of types and becomes useful to human ends when it flows from one place to another or is converted from one type into another. *Primary energy* (also referred to as *energy sources*) is the energy embodied in natural resources (e.g., coal, crude oil,

natural gas, uranium) that has not undergone any anthropogenic conversion. This primary energy needs to be converted and transported to become *usable energy* (e.g., light). *Renewable energy* is obtained from the continuing or repetitive currents of energy occurring in the natural environment, and includes non-carbon technologies such as solar energy, hydropower, wind, tide and waves, and geothermal heat, as well as carbon neutral technologies such as biomass. *Embodied energy* is the energy used to produce a material substance (such as processed metals, or building materials), taking into account energy used at the manufacturing facility (zero order), energy used in producing the materials that are used in the manufacturing facility (first order), and so on.

**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. Perturbed-parameter ensembles, in which model parameters are varied in a systematic manner, aim to produce a more objective estimate of modelling uncertainty than is possible with traditional multi-model ensembles.

**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.

**Equilibrium line**

The boundary between the region on a *glacier* where there is a net annual loss of ice mass (ablation area) and that where there is a net annual gain (accumulation area). The altitude of this boundary is referred to as *equilibrium line altitude*.

**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.

**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.

**External forcing**

External forcing refers to a forcing agent outside the *climate*

*system* causing a change in the climate system. Volcanic eruptions, solar variations and *anthropogenic* changes in the composition of the *atmosphere* and *land-use change* are external forcings.

### Extinction

The complete disappearance of an entire biological species.

### Extirpation

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

### Extreme weather event

An event that is rare at a particular place and time of year. Definitions of “rare” vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile of the observed probability density function. By definition, the characteristics of what is called *extreme weather* may vary from place to place in an absolute sense. Single extreme events cannot be simply and directly attributed to *anthropogenic climate change*, as there is always a finite chance the event in question might have occurred naturally. When a pattern of extreme weather persists for some time, such as a season, it may be classed as an *extreme climate event*, especially if it yields an average or total that is itself extreme (e.g., *drought* or heavy rainfall over a season).

## F.

### Feedback

See *Climate feedback*.

### Food chain

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

### 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*.

### Forcing

See *External forcing*.

### Forest

A vegetation type dominated by trees. Many definitions of the term forest are in use throughout the world, reflecting wide differences in biogeophysical conditions, social structure, and economics. Particular criteria apply under the *Kyoto Protocol*. 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).

### Fossil fuels

Carbon-based fuels from fossil hydrocarbon deposits, including coal, peat, oil, and natural gas.

### Framework Convention on Climate Change

See *United Nations Framework Convention on Climate Change (UNFCCC)*.

### Freshwater lens

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

### Frozen ground

Soil or rock in which part or all of the pore water is frozen. Frozen ground includes *permafrost*. Ground that freezes and thaws annually is called *seasonally frozen ground*.

## G.

### General circulation model

See *Climate model*.

### Glacial lake

A lake formed by *glacier* meltwater, located either at the front of a glacier (known as a *proglacial lake*), on the surface of a glacier (*supraglacial lake*), within the glacier (*englacial lake*) or at the glacier bed (*subglacial lake*).

### Glacier

A mass of land ice which flows downhill under gravity (through internal deformation and/or sliding at the base) and is constrained by internal stress and friction at the base and sides. A glacier is maintained by accumulation of snow at high altitudes, balanced by melting at low altitudes or discharge into the sea. See *Mass balance*.

### Global warming

Global warming refers to the gradual increase, observed or projected, in global average surface temperature, as one of the consequences of radiative forcing caused by anthropogenic emissions.

### 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.

### Governance

The way government is understood has changed in response to social, economic and technological changes over recent decades. There is a corresponding shift from government defined strictly by the nation-state to a more inclusive concept of governance, recognising the contributions of various levels of government (global, international, regional, local) and the roles of the private sector, of non-governmental actors and of civil society.

**Greenhouse effect**

*Greenhouse gases* effectively absorb thermal infrared radiation, emitted by the Earth's surface, by the *atmosphere* itself due to the same gases, and by clouds. Atmospheric radiation is emitted to all sides, including downward to the Earth's surface. Thus greenhouse gases trap heat within the surface-*troposphere* system. This is called the *greenhouse effect*. Thermal infrared radiation in the troposphere is strongly coupled to the temperature of the atmosphere at the altitude at which it is emitted. In the troposphere, the temperature generally decreases with height. Effectively, infrared radiation emitted to space originates from an altitude with a temperature of, on average,  $-19^{\circ}\text{C}$ , in balance with the net incoming solar radiation, whereas the Earth's surface is kept at a much higher temperature of, on average,  $+14^{\circ}\text{C}$ . An increase in the concentration of greenhouse gases leads to an increased infrared opacity of the atmosphere, and therefore to an effective radiation into space from a higher altitude at a lower temperature. This causes a *radiative forcing* that leads to an enhancement of the greenhouse effect, the so-called *enhanced greenhouse effect*.

**Greenhouse gas (GHG)**

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 thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. This property causes the *greenhouse effect*. Water vapour ( $\text{H}_2\text{O}$ ), *carbon dioxide* ( $\text{CO}_2$ ), *nitrous oxide* ( $\text{N}_2\text{O}$ ), *methane* ( $\text{CH}_4$ ) and *ozone* ( $\text{O}_3$ ) are the primary greenhouse gases in the Earth's atmosphere. Moreover, there are a number of entirely human-made greenhouse gases in the atmosphere, such as the halocarbons and other chlorine and bromine containing substances, dealt with under the Montreal Protocol. Beside  $\text{CO}_2$ ,  $\text{N}_2\text{O}$  and  $\text{CH}_4$ , the *Kyoto Protocol* deals with the greenhouse gases sulphur hexafluoride ( $\text{SF}_6$ ), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

**Gross Domestic Product (GDP)**

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

**Gross National Product (GNP)**

Gross National Product (GNP) is the monetary value of all goods and services produced by 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.

**H.****Habitat**

The locality or natural home in which a particular plant, animal,

or group of closely associated organisms lives.

**Hadley Circulation**

A direct, thermally driven overturning cell in the *atmosphere* consisting of poleward flow in the upper *troposphere*, subsiding air into the subtropical anticyclones, return flow as part of the trade winds near the surface, and with rising air near the equator and the so-called Inter-Tropical Convergence Zone.

**Herbaceous**

Flowering, non-woody.

**Heterotrophic respiration**

The conversion of organic matter to *carbon dioxide* by organisms other than plants.

**Holocene**

The Holocene is a geological epoch extending from about 11,600 years ago to the present.

**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.

**Hydrological cycle**

The cycle in which water evaporates from the oceans and the land surface, is carried over the Earth in atmospheric circulation as water vapour, condensates to form clouds, precipitates again as rain or snow, is intercepted by trees and vegetation, provides *runoff* on the land surface, infiltrates into soils, recharges groundwater, discharges into streams and, ultimately, flows out into the oceans, from which it will eventually evaporate again (AMS, 2000). The various systems involved in the hydrological cycle are usually referred to as *hydrological systems*.

**Hydrological systems**

See *Hydrological cycle*.

**Hydrosphere**

The component of the *climate system* comprising liquid surface and subterranean water, such as oceans, seas, rivers, fresh water lakes, underground water, etc.

**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.

**I.****Ice cap**

A dome shaped ice mass, usually covering a highland area, which 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, so that its shape is mainly

determined by its dynamics (the flow of the ice as it deforms internally and/or slides at its base). An ice sheet flows outwards from a high central ice plateau with a small average surface slope. The margins usually slope more steeply, and most 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 three large ice sheets in the modern world, one on Greenland and two on Antarctica (the East and West Antarctic ice sheets, divided by the Transantarctic Mountains). During glacial periods there were others.

### 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*. Nearly all ice shelves are in Antarctica.

### (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 *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.

### Indirect aerosol effect

*Aerosols* may lead to an indirect *radiative forcing* of the *climate system* through acting as cloud condensation nuclei or modifying the optical properties and lifetime of clouds. Two indirect effects are distinguished:

**Cloud albedo effect:** A radiative forcing induced by an increase in *anthropogenic aerosols* that cause an initial increase in droplet concentration and a decrease in droplet size for fixed liquid water content, leading to an increase in cloud *albedo*.

**Cloud lifetime effect:** A forcing induced by an increase in *anthropogenic aerosols* that cause a decrease in droplet size, reducing the precipitation efficiency, thereby modifying the liquid water content, cloud thickness and cloud life time.

Apart from these indirect effects, *aerosols* may have a semi-direct effect. This refers to the absorption of solar radiation by

absorbing aerosol, which heats the air and tends to increase the static stability relative to the surface. It may also cause *evaporation* of cloud droplets.

### 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 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 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 policymakers 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.

### Interdecadal Pacific Oscillation (IPO)

Also known as the *Pacific Decadal Oscillation* (PDO). See *North Pacific Index*. [For more detail see WGI Box 3.4]

### Internal variability

See *Climate variability*.

### 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.

### IS92 scenarios

See *Emissions scenarios*.

### Isostasy

Isostasy refers to the way in which the lithosphere and mantle respond visco-elastically to changes in surface loads. When the loading of the lithosphere and/or the mantle is changed by alterations in land ice mass, ocean mass, sedimentation, erosion or mountain building, vertical isostatic adjustment results, in order to balance the new load.

## K. Kyoto Protocol

The Kyoto Protocol to the *United Nations Framework Convention on Climate Change* (UNFCCC) was adopted in 1997 in Kyoto, Japan, at the Third Session of the Conference of the Parties (COP)

to the UNFCCC. It contains legally binding commitments, in addition to those included in the UNFCCC. Countries included in *Annex B* of the Protocol (most Organization for Economic Cooperation and Development countries and countries with economies in transition) agreed to reduce their *anthropogenic greenhouse gas* emissions (*carbon dioxide*, *methane*, *nitrous oxide*, hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride) by at least 5% below 1990 levels in the commitment period 2008 to 2012. The *Kyoto Protocol* entered into force on 16 February 2005.

## L.

### La Niña

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

### Land use and Land-use change

*Land use* refers to the total of arrangements, activities and inputs undertaken in a certain land cover type (a set of human actions). The term *land use* is also used in the sense of the social and economic purposes for which land is managed (e.g., grazing, timber extraction, and conservation).

*Land-use change* refers to a change in the use or management of land by humans, which may lead to a change in land cover. Land cover and land-use change may have an impact on the surface *albedo*, *evapotranspiration*, *sources* and *sinks* of *greenhouse gases*, or other properties of the *climate system* and may thus have a *radiative forcing* and/or other impacts on *climate*, locally or globally. See also: the IPCC Report on Land Use, Land-Use Change, and Forestry (IPCC, 2000).

### Landfill

A landfill is a solid waste disposal site where waste is deposited below, at or above ground level. Limited to engineered sites with cover materials, controlled placement of waste and management of liquids and gases. It excludes uncontrolled waste disposal.

### 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.

### Lapse rate

The rate of change of an atmospheric variable, usually temperature, with height. The lapse rate is considered positive when the variable decreases with height.

### Latent heat flux

The flux of heat from the Earth's surface to the *atmosphere* that is associated with evaporation or condensation of water vapour at the surface; a component of the surface energy budget.

### Leaching

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

### Likelihood

The likelihood of an occurrence, an outcome or a result, where this can be estimated probabilistically, is expressed in this Technical

Paper using a standard terminology defined in Box 1.1.

See also *Confidence*; *Uncertainty*.

### Little Ice Age (LIA)

An interval between approximately AD 1400 and 1900 when temperatures in the Northern Hemisphere were generally colder than today's, especially in Europe.

## M.

### Malaria

Endemic or epidemic parasitic disease caused by species of the genus *Plasmodium* (Protozoa) and transmitted to humans 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 *Non-market impacts*.

### Mass balance (of glaciers, ice caps or ice sheets)

The balance between the mass input to an ice body (accumulation) and the mass loss (ablation, iceberg calving). Mass balance terms include the following:

*Specific mass balance*: net mass loss or gain over a *hydrological cycle* at a point on the surface of a *glacier*.

*Total mass balance* (of the glacier): the specific mass balance spatially integrated over the entire glacier area; the total mass a glacier gains or loses over a hydrological cycle.

*Mean specific mass balance*: the total mass balance per unit area of the glacier. If *surface* is specified (*specific surface mass balance*, etc.) then ice-flow contributions are not considered; otherwise, mass balance includes contributions from ice flow and iceberg calving. The specific surface mass balance is positive in the accumulation area and negative in the ablation area.

### Meningitis

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

### Meridional overturning circulation (MOC)

A zonally averaged, large scale meridional (north-south) overturning circulation in the oceans. In the Atlantic such a circulation transports relatively warm upper-ocean waters northward, and relatively cold deep waters southward. The *Gulf Stream* forms part of this Atlantic circulation.

### Methane (CH<sub>4</sub>)

Methane is one of the six *greenhouse gases* to be mitigated under the *Kyoto Protocol* and is the major component of natural gas and associated with all hydrocarbon fuels, animal husbandry and agriculture. *Coal-bed methane* is the gas found in coal seams.

### Millennium Development Goals (MDGs)

A set of time-bound and measurable goals for combating poverty, hunger, disease, illiteracy, discrimination against

women and environmental degradation, agreed at the UN Millennium Summit in 2000.

### Mires

Peat-accumulating *wetlands*. See *Bog*.

### Mitigation

Technological change and substitution that reduce resource inputs and emissions per unit of output. Although several social, economic and technological policies would produce an emissions reduction, with respect to *climate change*, mitigation means implementing policies to reduce *greenhouse gas* emissions and enhance *sinks*.

### Monsoon

A monsoon is a tropical and subtropical seasonal reversal in both the surface winds and associated precipitation, caused by differential heating between a continental-scale land mass and the adjacent ocean. Monsoon rains occur mainly over land in summer.

### 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 disorder 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.

### 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.

## N.

### 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.

### 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.

### Nitrous oxide (N<sub>2</sub>O)

One of the six types of *greenhouse gases* to be curbed under the *Kyoto Protocol*. The main anthropogenic source of nitrous oxide is agriculture (soil and animal manure management), but important contributions also come from sewage treatment,

combustion of fossil fuel, and chemical industrial processes. Nitrous oxide is also produced naturally from a wide variety of biological sources in soil and water, particularly microbial action in wet tropical forests.

### No-regrets policy

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

### Non-Governmental Organisation (NGO)

A non-profit group or association organised outside of institutionalised political structures to realise particular social and/or environmental objectives or serve particular constituencies.

### Non-linearity

A process is called non-linear when there is no simple proportional relation between cause and effect. The *climate system* contains many such non-linear processes, resulting in a system with a potentially very complex behaviour.

### 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*.

### North Atlantic Oscillation (NAO)

The North Atlantic Oscillation consists of opposing variations of barometric pressure near Iceland and near the Azores. It therefore corresponds to fluctuations in the strength of the main westerly winds across the Atlantic into Europe, and thus to fluctuations in the embedded cyclones with their associated frontal systems. See WGI Box 3.4.

### North Pacific Index (NPI)

The NPI is the average mean sea level pressure anomaly in the Aleutian Low over the Gulf of Alaska (30°N- 65°N, 160°E-140°W). It is an index of the *Pacific Decadal Oscillation* (also known as the *Interdecadal Pacific Oscillation*). See WGI Box 3.4 for further information.

## O.

### Oil sands and oil shale

Unconsolidated porous sands, sandstone rock and shales containing bituminous material that can be mined and converted to a liquid fuel.

### Ombrotrophic bog

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

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

Ozone, the tri-atomic form of oxygen, is a gaseous *atmospheric* constituent. In the *troposphere*, ozone is created both naturally and by photochemical reactions involving gases resulting from human activities (smog). Troposphere ozone acts as a

*greenhouse gas*. In the *stratosphere*, ozone 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.

## P. Pacific Decadal Oscillation (PDO)

Also known as the Interdecadal Pacific Oscillation (IPO). See *North Pacific Index*. [WGI Box 3.4]

## Pacific-North American (PNA) pattern

An atmospheric large-scale wave pattern featuring a sequence of tropospheric high- and low-pressure anomalies stretching from the subtropical west Pacific to the east coast of North America. [WGI Box 3.4]

## Peat

Peat is formed from dead plants, typically *Sphagnum* mosses, which are only partially decomposed due to their 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*.

## Percentile

A percentile is a value on a scale of zero to one hundred that indicates the percentage of the data set values that is equal to or below it. The percentile is often used to estimate the extremes of a distribution. For example, the 90<sup>th</sup> (10<sup>th</sup>) percentile may be used to refer to the threshold for the upper (lower) extremes.

## Permafrost

Ground (soil or rock and included ice and organic material) that remains at or below 0°C for at least two consecutive years. See also *Frozen ground*.

## pH

pH is a dimensionless measure of the acidity of water (or any solution). Pure water has a pH=7. Acid solutions have a pH smaller than 7 and basic solutions have a pH larger than 7. pH is measured on a logarithmic scale. Thus, a pH decrease of 1 unit corresponds to a 10-fold increase in the acidity.

## Phenology

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

## Photosynthesis

The process by which green plants, algae and some bacteria take *carbon dioxide* from the air (or bicarbonate in water) to build carbohydrates. There are several pathways of photosynthesis with different responses to atmospheric carbon dioxide concentrations. See *Carbon dioxide fertilisation*.

## Plankton

Micro-organisms living in the upper layers of aquatic systems.

A distinction is made between *phytoplankton*, which depend on photosynthesis for their energy supply, and *zooplankton*, which feed on phytoplankton.

## Policies

In *United Nations Framework Convention on Climate Change (UNFCCC)* parlance, policies are taken and/or mandated by a government—often in conjunction with business and industry within its own country, or with other countries—to accelerate *mitigation* and *adaptation* measures. Examples of policies are carbon or other energy taxes, fuel efficiency standards for automobiles, etc. *Common and co-ordinated or harmonised policies* refer to those adopted jointly by parties.

## Primary production

All forms of production accomplished by plants, also called primary producers. See *Gross primary production*, *Net primary production* and *Net ecosystem production*.

## Projection

A potential future evolution of a quantity 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 socioeconomic and technological developments that may or may not be realised, and are therefore subject to substantial *uncertainty*. See also *Climate projection*.

## Proxy

A proxy *climate* indicator is a local record that is interpreted, using physical and bio-physical principles, to represent some combination of climate-related variations back in time. Climate-related data derived in this way are referred to as proxy data. Examples of proxies include pollen analysis, tree-ring records, characteristics of corals and various data derived from ice cores.

## R.

### Radiative forcing

Radiative forcing is the change in the net, downward minus upward, irradiance (expressed in Watts per square metre, W/m<sup>2</sup>) at the tropopause due to a change in an external driver of *climate change*, such as, 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. Radiative forcing is called *instantaneous* if no change in stratospheric temperature is accounted for. For the purposes of this Technical Paper, radiative forcing is further defined as the change relative to the year 1750 and, unless otherwise noted, refers to a global and annual average value.

### Rangeland

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

### Reconstruction

The use of *climate* indicators to help determine (generally past) climates.

**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 Report on Land Use, Land-Use Change and Forestry (IPCC, 2000).

**Regime**

A regime is a preferred state of the *climate system*, often representing one phase of dominant patterns or modes of climate variability.

**Region**

A region is a territory characterised by specific geographical and climatological features. The *climate* of a region is affected by regional and local scale forcings such as topography, *land-use* characteristics, lakes etc., as well as remote influences from other regions.

**Reservoir**

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.

**Runoff**

That part of precipitation that does not evaporate and is not transpired, but flows over the ground surface and returns to bodies of water. See *Hydrological cycle*.

**S.****Salinisation**

The accumulation of salts in soils.

**Saltwater intrusion**

Displacement of fresh surface water or groundwater by the advance of saltwater 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 *SRES scenarios*; *Climate scenario*; *Emissions scenarios*.

**Sea ice**

Any form of ice found at sea that has originated from the freezing of sea water. Sea ice may be discontinuous pieces (*ice floes*) moved on the ocean surface by wind and currents (*pack ice*), or a motionless sheet attached to the coast (*land-fast ice*).

**Sea-ice biome**

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

**Sea-level change/sea-level rise**

Sea level can change, both globally and locally, due to (i) changes in the shape of the ocean basins, (ii) changes in the total mass of water and (iii) changes in water density. Factors leading to sea-level rise under global warming include both increases in the total mass of water from the melting of land-based snow and ice, and changes in water density from an increase in ocean water temperatures and salinity changes. *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.

**Sea-level equivalent (SLE)**

The change in global average sea level that would occur if a given amount of water or ice were added to or removed from the oceans.

**Sea surface temperature (SST)**

The sea surface temperature is the subsurface bulk temperature in the top few metres of the ocean, measured by ships, buoys and drifters. From ships, measurements of water samples in buckets were mostly switched in the 1940s to samples from engine intake water. Satellite measurements of skin temperature (uppermost layer; a fraction of a millimetre thick) in the infrared or the top centimetre or so in the microwave are also used, but must be adjusted to be compatible with the bulk temperature.

**Seasonally frozen ground**

See *Frozen ground*.

**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 *climate 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**

Carbon storage in terrestrial or marine *reservoirs*. *Biological sequestration* includes direct removal of  $CO_2$  from the atmosphere through *land-use change*, *afforestation*, *reforestation*, carbon storage in *landfills* and practices that enhance soil carbon in agriculture.

**Silviculture**

Cultivation, development and care of *forests*.

**Sink**

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

**Snow pack**

A seasonal accumulation of slow-melting snow.

**Snow water equivalent**

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

**Soil moisture**

Water stored in or at the land surface and available for *evaporation*.

**Source**

Source mostly refers to any process, activity or mechanism that releases a *greenhouse gas*, an *aerosol*, or a precursor of a greenhouse gas or aerosol into the *atmosphere*. Source can also refer to e.g., an *energy* source.

**Southern Oscillation Index (SOI)**

See *El Niño-Southern Oscillation*.

**Spatial and temporal scales**

*Climate* may vary on a large range of spatial and temporal scales. *Spatial scales* may range from local (less than 100,000 km<sup>2</sup>), through regional (100,000 to 10 million km<sup>2</sup>) to continental (10 to 100 million km<sup>2</sup>). *Temporal scales* may range from seasonal to geological (up to hundreds of millions of years).

**SRES scenarios**

SRES scenarios are *emissions scenarios* developed by Nakićenović and Swart (2000) and used, among others, as a basis for some of the *climate projections* used in the IPCC Fourth Assessment Report. The following terms are relevant for a better understanding of the structure and use of the set of SRES scenarios:

- *Scenario family*: Scenarios that have a similar demographic, societal, economic and technical-change storyline. Four scenario families comprise the SRES scenario set: A1, A2, B1 and B2.
- *Illustrative scenario*: A scenario that is illustrative for each of the six scenario groups reflected in the Summary for Policymakers of Nakićenović and Swart (2000). They include four revised ‘scenario markers’ for the scenario groups A1B, A2, B1, B2, and two additional scenarios for the A1FI and A1T groups. All scenario groups are equally sound.
- *Marker scenario*: A scenario that was originally posted in draft form on the SRES website to represent a given scenario family. The choice of markers was based on which of the initial quantifications best reflected the storyline, and the features of specific models. Markers are no more likely than other scenarios, but are considered by the SRES writing team as illustrative of a particular storyline. They are included in revised form in Nakićenović and Swart (2000). These scenarios received the closest scrutiny of the entire writing team and via the SRES open process. Scenarios were also selected to illustrate the other two scenario groups.
- *Storyline*: A narrative description of a scenario (or family of scenarios), highlighting the main scenario characteristics, relationships between key driving forces and the dynamics of their evolution.

**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*.

**Storm surge**

The temporary increase, at a particular locality, in the height of the sea due to extreme meteorological conditions (low atmospheric pressure and/or strong winds). The storm surge is defined as being the excess above the level expected from the tidal variation alone at that time and place.

**Storm tracks**

Originally, a term referring to the tracks of individual cyclonic weather systems, but now often generalised to refer to the *regions* where the main tracks of extratropical disturbances occur as sequences of low (cyclonic) and high (anticyclonic) pressure systems.

**Storyline**

A narrative description of a scenario (or a family of scenarios) that highlights the scenario’s main characteristics, relationships between key driving forces, and the dynamics of the scenarios.

**Stratosphere**

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

**Streamflow**

Water flow within a river channel, for example expressed in m<sup>3</sup>/s. A synonym for river discharge.

**Subsidy**

Direct payment from the government or a tax reduction to a private party for implementing a practice the government wishes to encourage. The reduction of *greenhouse-gas emissions* is stimulated by lowering existing subsidies that have the effect of raising emissions (such as subsidies to fossil fuel use) or by providing subsidies for practices that reduce emissions or enhance sinks (e.g., for insulation of buildings or for planting trees).

**Succulent**

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

**Sustainable development**

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

**T.****Taiga**

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

**Technology**

The practical application of knowledge to achieve particular tasks that employs both technical artefacts (hardware, equipment) and (social) information (“software”, know-how for production and use of artefacts).

**Teleconnection**

A connection between *climate variations* over widely separated parts of the world. In physical terms, teleconnections are often a consequence of large-scale wave motions, whereby energy is transferred from source regions along preferred paths in the *atmosphere*.

**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. See *Sea-level change*.

**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. See *Evapotranspiration*.

**Trend**

In this Technical Paper, the word *trend* designates a change, generally monotonic in time, in the value of a variable.

**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.

**Tundra**

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

**U.****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, for example, a range of values calculated by various models, or by qualitative statements, for example, reflecting the judgement of a team of experts. See also *Likelihood*; *Confidence*.

**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* (all OECD member countries in the year 1990 and countries with economies in transition) 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 *Kyoto Protocol*.

### 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*.

## V.

### Vector

An organism, such as an insect, that transmits a pathogen from one host to another.

### Vector-borne diseases

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

### 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*.

## W.

### 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 security

Reliable availability of water in sufficient quantity and quality

to sustain human health, livelihoods, production and the environment.

### Water stress

A country is water stressed if the available freshwater supply relative to water withdrawals acts as an important constraint on development. In global-scale assessments, basins with water stress are often defined as having a per capita water availability below 1,000 m<sup>3</sup>/yr (based on long-term average runoff). Withdrawals exceeding 20% of renewable water supply have also 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.

### 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.

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