

WGII AR5 Glossary

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Abrupt climate change

A large-scale change in the climate system that takes place over a few decades or less, persists (or is anticipated to persist) for at least a few decades, and causes substantial disruptions in human and natural systems.

Access to food

One of the three components underpinning food security, the other two being availability and utilization. Access to food is dependent on (i) the affordability of food (i.e., people have income or other resources to exchange for food); (ii) satisfactory allocation within the household or society; and (iii) preference (i.e., it is what people want to eat, influenced by socio-cultural norms). See also Food security.

Acclimatization

A change in functional or morphological traits occurring once or repeatedly (e.g., seasonally) during the lifetime of an individual organism in its natural environment. Through acclimatization the individual maintains performance across a range of environmental conditions. For a clear differentiation between findings in laboratory and field studies, the term *acclimation* is used in ecophysiology for the respective phenomena when observed in well-defined experimental settings. The term *(adaptive) plasticity* characterizes the generally limited scope of changes in phenotype that an individual can reach through the process of acclimatization.

Adaptability

See Adaptive capacity.

Adaptation¹

The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate harm or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to expected climate and its effects.

Incremental adaptation Adaptation actions where the central aim is to maintain the essence and integrity of a system or process at a given scale.²

Transformational adaptation Adaptation that changes the fundamental attributes of a system in response to climate and its effects.

See also Autonomous adaptation, Evolutionary adaptation, and Transformation.

¹ Reflecting progress in science, this glossary entry differs in breadth and focus from the entry used in the Fourth Assessment Report and other IPCC reports.

² This definition builds from the definition used in Park *et al.* (2012).

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 constraint

Factors that make it harder to plan and implement adaptation actions or that restrict options.

Adaptation deficit

The gap between the current state of a system and a state that minimizes adverse impacts from existing climate conditions and variability.

Adaptation limit

The point at which an actor's objectives (or system needs) cannot be secured from intolerable risks through adaptive actions.

Hard adaptation limit No adaptive actions are possible to avoid intolerable risks.

Soft adaptation limit Options are currently not available to avoid intolerable risks through adaptive action.

Adaptation needs

The circumstances requiring action to ensure safety of populations and security of assets in response to climate impacts.

Adaptation opportunity

Factors that make it easier to plan and implement adaptation actions, that expand adaptation options, or that provide ancillary co-benefits.

Adaptation options

The array of strategies and measures that are available and appropriate for addressing adaptation needs. They include a wide range of actions that can be categorized as structural, institutional, or social.

Adaptive capacity

The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.³

Adaptive management

A process of iteratively planning, implementing, and modifying strategies for managing resources in the face of uncertainty and change. Adaptive management involves adjusting approaches in response to observations of their effect and changes in the system brought on by resulting feedback effects and other variables.

Aggregate impacts

Total impacts integrated across sectors and/or regions. The aggregation of impacts requires knowledge of (or assumptions about) the relative importance of different impacts. Measures of aggregate impacts include, for example, the total number of people affected, or the total economic costs, and are usually bound by time, place, and /or sector.

Ancillary benefits

See Co-benefits.

Anomaly

The deviation of a variable from its value averaged over a reference period.

³ This glossary entry builds from definitions used in previous IPCC reports and the Millennium Ecosystem Assessment (MEA, 2005).

Anthropogenic

Resulting from or produced by human activities.

Anthropogenic emissions

Emissions of greenhouse gases, greenhouse gas precursors, and aerosols caused by human activities. These activities include the burning of fossil fuels, deforestation, land use changes, livestock production, fertilization, waste management, and industrial processes.

Arid zone

Areas where vegetation growth is severely constrained due to limited water availability. For the most part, the native vegetation of arid zones is sparse. There is high rainfall variability, with annual averages below 300 mm. Crop farming in arid zones requires irrigation

Atlantic Multi-decadal Oscillation/Variability (AMO/AMV)

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 approximately 0.4°C. See AMO Index in WGI AR5 Box 2.5.

Atmosphere-Ocean General Circulation Model (AOGCM)

See Climate model.

Attribution

See Detection and attribution.

Autonomous adaptation

Adaptation in response to experienced climate and its effects, without planning explicitly or consciously focused on addressing climate change. Also referred to as spontaneous adaptation.

Baseline/reference

The baseline (or reference) is the state against which change is measured. A *baseline period* is the period relative to which anomalies are computed. The baseline concentration of a trace gas is that measured at a location not influenced by local anthropogenic emissions.

Biodiversity

The variability among living organisms from terrestrial, marine, and other ecosystems. Biodiversity includes variability at the genetic, species, and ecosystem levels.⁴

Bioenergy

Energy derived from any form of biomass such as recently living organisms or their metabolic by-products.

Biofuel

A fuel, generally in liquid form, developed from organic matter or combustible oils produced by living or recently living plants. Examples of biofuel include alcohol (bioethanol), black liquor from the paper-manufacturing process, and soybean oil.

First-generation manufactured biofuel First-generation manufactured biofuel is derived from grains, oilseeds, animal fats, and waste vegetable oils with mature conversion technologies.

⁴ This glossary entry builds from definitions used in the Global Biodiversity Assessment (Heywood, 1995) and the Millennium Ecosystem Assessment (MEA, 2005).

Second-generation biofuel Second-generation biofuel uses non-traditional biochemical and thermochemical conversion processes and feedstock mostly derived from the lignocellulosic fractions of, for example, agricultural and forestry residues, municipal solid waste, etc.

Third-generation biofuel Third-generation biofuel would be derived from feedstocks such as algae and energy crops by advanced processes still under development.

These second- and third-generation biofuels produced through new processes are also referred to as next-generation or advanced biofuels, or advanced biofuel technologies.

Biomass

The total mass of living organisms in a given area or volume; dead plant material can be included as dead biomass. Biomass burning is the burning of living and dead vegetation.

Biome

A biome is a major and distinct regional element of the biosphere, typically consisting of several ecosystems (e.g., forests, rivers, ponds, swamps within a region). Biomes are characterized 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.

Boundary organization

A bridging institution, social arrangement, or network that acts as an intermediary between science and policy.

Business as usual (BAU)

Business as usual projections are based on the assumption that operating practices and policies remain as they are at present. Although baseline scenarios could incorporate some specific features of BAU scenarios (e.g., a ban on a specific technology), BAU scenarios imply that no practices or policies other than the current ones are in place. See also Baseline/reference, Climate scenario, Emission scenario, Representative concentration pathways, Scenario, Socio-economic scenario, and SRES scenarios.

Capacity building

The practice of enhancing the strengths and attributes of, and resources available to, an individual, community, society, or organization to respond to change.

Carbon cycle

The term used to describe the flow of carbon (in various forms, e.g., as carbon dioxide) through the atmosphere, ocean, terrestrial and marine biosphere, and lithosphere. In this report, the reference unit for the global carbon cycle is GtC or equivalently PgC (10^{15} g).

Carbon dioxide (CO₂)

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, of land use changes, and of industrial processes (e.g., cement production). 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 (CO₂) fertilization

The enhancement of the growth of plants as a result of increased atmospheric carbon dioxide (CO₂) concentration.

Carbon sequestration

See Uptake.

Clean Development Mechanism (CDM)

A mechanism defined under Article 12 of the Kyoto Protocol through which investors (governments or companies) from developed (Annex B) countries may finance greenhouse gas emission reduction or removal projects in developing (Non-Annex B) countries, and receive Certified Emission Reduction Units for doing so, which can be credited towards the commitments of the respective developed countries. The CDM is intended to facilitate the two objectives of promoting sustainable development in developing countries and of helping industrialized countries to reach their emissions commitments in a cost-effective way.

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-altering pollutants (CAPs)

Gases and particles released from human activities that affect the climate either directly, through mechanisms such as radiative forcing from changes in greenhouse gas concentrations, or indirectly, by, for example, affecting cloud formation or the lifetime of greenhouse gases in the atmosphere. CAPs include both those pollutants that have a warming effect on the atmosphere, such as CO₂, and those with cooling effects, such as sulfates.

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 such as modulations of the solar cycles, volcanic eruptions, and persistent anthropogenic changes in the composition of the atmosphere or in land use. Note that the 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 change commitment, Detection and Attribution.

Climate change commitment

Due to the thermal inertia of the ocean and slow processes in the cryosphere and land surfaces, the climate would continue to change even if the atmospheric composition were held fixed at today’s values. Past change in atmospheric composition 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 constant composition temperature commitment or simply committed warming or warming commitment. Climate change commitment includes other future changes, for example in the hydrological cycle, in extreme weather events, in extreme climate events, and in sea level change. The constant emission commitment is the committed climate change that would result from keeping anthropogenic emissions constant and the zero emission commitment is the climate change commitment when emissions are set to zero. See also Climate change.

Climate extreme (extreme weather or climate event)

See Extreme weather event.

Climate feedback

An interaction in which a perturbation in one climate quantity causes a change in a second, and the change in the second quantity ultimately leads to an additional change in the first. A negative feedback is one in which the initial perturbation is weakened by the changes it causes; a positive feedback is one in which the initial perturbation is

enhanced. In the Fifth Assessment Report, a somewhat narrower definition is often used in which the climate quantity that is perturbed is the global mean surface temperature, which in turn causes changes in the global radiation budget. In either case, the initial perturbation can either be externally forced or arise as part of internal variability.

Climate governance

Purposeful mechanisms and measures aimed at steering social systems towards preventing, mitigating, or adapting to the risks posed by climate change (Jagers and Striiple, 2003).

Climate model (spectrum or hierarchy)

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 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 parameterizations are involved. Coupled Atmosphere-Ocean General Circulation Models (AOGCMs) provide a representation of the climate system that is near or at the most comprehensive end of the spectrum currently available. There is an evolution towards more complex models with interactive chemistry and biology. 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. See also Earth System Model.

Climate prediction

A climate prediction or climate forecast is the result of an attempt to produce (starting from a particular state of the climate system) an estimate of the actual evolution of the climate in the future, for example, at seasonal, interannual, or decadal time scales. Since the future evolution of the climate system may be highly sensitive to initial conditions, such predictions are usually probabilistic in nature. See also Climate projection, Climate scenario, and Predictability.

Climate projection

A climate projection is the simulated response of the climate system to a scenario of future emission or concentration of greenhouse gases and aerosols, generally derived using climate models. Climate projections are distinguished from climate predictions by their dependence on the emission/concentration/radiative-forcing scenario used, which is in turn based on assumptions concerning, for example, future socioeconomic and technological developments that may or may not be realized. See also Climate scenario.

Climate-resilient pathways

Iterative processes for managing change within complex systems in order to reduce disruptions and enhance opportunities associated with climate change.

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 the observed current climate. See also Emission scenario and Scenario.

Climate sensitivity

In IPCC reports, *equilibrium climate sensitivity* (units: °C) refers to the equilibrium (steady state) change in the annual global mean surface temperature following a doubling of the atmospheric equivalent carbon dioxide concentration. Due to computational constraints, the equilibrium climate sensitivity in a climate model is sometimes estimated by running an atmospheric general circulation model coupled to a mixed-layer ocean model, because equilibrium climate sensitivity is largely determined by atmospheric processes. Efficient models can be run to equilibrium with a dynamic ocean. The *climate sensitivity parameter* (units: °C (W m⁻²)⁻¹) refers to the equilibrium change in the annual global mean surface temperature following a unit change in radiative forcing.

The *effective climate sensitivity* (units: °C) is an estimate of the global mean surface temperature response to doubled carbon dioxide concentration that is evaluated from model output or observations for evolving non-equilibrium conditions. It is a measure of the strengths of the climate feedbacks at a particular time and may vary with forcing history and climate state, and therefore may differ from equilibrium climate sensitivity.

The *transient climate response* (units: °C) is the change in the global mean surface temperature, averaged over a 20-year period, centered at the time of atmospheric carbon dioxide doubling, in a climate model simulation in which CO₂ increases at 1% yr⁻¹. It is a measure of the strength and rapidity of the surface temperature response to greenhouse gas forcing.

Climate system

The climate system is the highly complex system consisting of five major components: the atmosphere, the hydrosphere, the cryosphere, the lithosphere, and the biosphere, and the interactions among 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.

Climate velocity

The speed at which isolines of a specified climate variable travel across landscapes or seascapes due to changing climate. For example, climate velocity for temperature is the speed at which isotherms move due to changing climate (km/yr) and is calculated as the temporal change in temperature (°C/yr) divided by the current spatial gradient in temperature (°C/km). It can be calculated using additional climate variables such as precipitation or can be based on the climatic niche of organisms.

Climatic driver (climate driver)

A changing aspect of the climate system that influences a component of a human or natural system.

CMIP3 and CMIP5

Phases three and five of the Coupled Model Intercomparison Project (CMIP3 and CMIP5), coordinating and archiving climate model simulations based on shared model inputs by modeling groups from around the world. The CMIP3 multi-model dataset includes projections using SRES scenarios. The CMIP5 dataset includes projections using the Representative Concentration Pathways.

Coastal squeeze

A narrowing of coastal ecosystems and amenities (e.g., beaches, salt marshes, mangroves, and mud and sand flats) confined between landward-retreating shorelines (from sea level rise and/or erosion) and naturally or artificially fixed shorelines including engineering defenses (e.g., seawalls), potentially making the ecosystems or amenities vanish.

Co-benefits

The positive effects that a policy or measure aimed at one objective might have on other objectives, irrespective of the net effect on overall social welfare. Co-benefits are often subject to uncertainty and depend on local circumstances and implementation practices. Co-benefits are also called ancillary benefits.

Community-based adaptation

Local, community-driven adaptation. Community-based adaptation focuses attention on empowering and promoting the adaptive capacity of communities. It is an approach that takes context, culture, knowledge, agency, and preferences of communities as strengths.

Confidence

The validity of a finding based on the type, amount, quality, and consistency of evidence (e.g., mechanistic understanding, theory, data, models, expert judgment) and on the degree of agreement. Confidence is expressed qualitatively (Mastrandrea *et al.*, 2010). See Box 1-1. See also Uncertainty.

Contextual vulnerability (Starting-point vulnerability)

A present inability to cope with external pressures or changes, such as changing climate conditions. Contextual vulnerability is a characteristic of social and ecological systems generated by multiple factors and processes (O'Brien *et al.*, 2007).

Convection

Vertical motion driven by buoyancy forces arising from static instability, usually caused by near-surface cooling or increases in salinity in the case of the ocean and near-surface warming or cloud-top radiative cooling in the case of the atmosphere. In the atmosphere convection gives rise to cumulus clouds and precipitation and is effective at both scavenging and vertically transporting chemical species. In the ocean convection can carry surface waters to deep within the ocean.

Coping

The use of available skills, resources, and opportunities to address, manage, and overcome adverse conditions, with the aim of achieving basic functioning of people, institutions, organizations, and systems in the short to medium term.⁵

Coping capacity

The ability of people, institutions, organizations, and systems, using available skills, values, beliefs, resources, and opportunities, to address, manage, and overcome adverse conditions in the short to medium term.⁶

Coral bleaching

Loss of coral pigmentation through the loss of intracellular symbiotic algae (known as zooxanthellae) and/or loss of their pigments.

Cryosphere

All regions on and beneath the surface of the Earth and ocean where water is in solid form, including sea ice, lake ice, river ice, snow cover, glaciers and ice sheets, and frozen ground (which includes permafrost).

Cultural impacts

Impacts on material and ecological aspects of culture and the lived experience of culture, including dimensions such as identity, community cohesion and belonging, sense of place, worldview, values, perceptions, and tradition. Cultural impacts are closely related to ecological impacts, especially for iconic and representational dimensions of species and landscapes. Culture and cultural practices frame the importance and value of the impacts of change, shape the feasibility and acceptability of adaptation options, and provide the skills and practices that enable adaptation.

Dead zones

Extremely hypoxic (i.e., low-oxygen) areas in oceans and lakes, caused by excessive nutrient input from human activities coupled with other factors that deplete the oxygen required to support many marine organisms in bottom and near-bottom water. See also Eutrophication and Hypoxic events.

⁵ This glossary entry builds from the definition used in UNISDR (2009) and IPCC (2012a).

⁶ This glossary entry builds from the definition used in UNISDR (2009) and IPCC (2012a).

Decarbonization

The process by which countries or other entities aim to achieve a low-carbon economy, or by which individuals aim to reduce their consumption of carbon.

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 Special Report on Land Use, Land-Use Change and Forestry (IPCC, 2000). See also the report on Definitions and Methodological Options to Inventory Emissions from Direct Human-induced Degradation of Forests and Devegetation of Other Vegetation Types (IPCC, 2003).

Desertification

Land degradation in arid, semi-arid, and dry sub-humid areas resulting from various factors, including climatic variations and human activities. Land degradation in arid, semi-arid, and dry sub-humid areas is reduction or loss of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest, and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as (i) soil erosion caused by wind and/or water; (ii) deterioration of the physical, chemical, biological, or economic properties of soil; and (iii) long-term loss of natural vegetation (UNCCD, 1994).

Detection and attribution

Detection of change is defined as the process of demonstrating that climate or a system affected by climate has changed in some defined statistical sense, without providing a reason for that change. An identified change is detected in observations if its likelihood of occurrence by chance due to internal variability alone is determined to be small, for example, <10%. Attribution is defined as the process of evaluating the relative contributions of multiple causal factors to a change or event with an assignment of statistical confidence (Hegerl *et al.*, 2009).

Detection of impacts of climate change

For a natural, human, or managed system, identification of a change from a specified baseline. The baseline characterizes behavior in the absence of climate change and may be stationary or non-stationary (e.g., due to land use change).

Disadvantaged populations

Sectors of a society that are marginalized, often because of low socio-economic status, low income, lack of access to basic services such as health or education, lack of power, race, gender, religion, or poor access to communication technologies.

Disaster

Severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery.

Disaster management

Social processes for designing, implementing, and evaluating strategies, policies, and measures that promote and improve disaster preparedness, response, and recovery practices at different organizational and societal levels.

Disaster risk

The likelihood within a specific time period of disaster. See Disaster.

Disaster risk management (DRM)

Processes for designing, implementing, and evaluating strategies, policies, and measures to improve the understanding of disaster risk, foster disaster risk reduction and transfer, and promote continuous improvement in disaster preparedness, response, and recovery practices, with the explicit purpose of increasing human security, well-being, quality of life, and sustainable development.

Disaster risk reduction (DRR)

Denotes both a policy goal or objective, and the strategic and instrumental measures employed for anticipating future disaster risk; reducing existing exposure, hazard, or vulnerability; and improving resilience.

Discounting

A mathematical operation making monetary (or other) amounts received or expended at different times (years) comparable across time. The discounter uses a fixed or possibly time-varying discount rate (>0) from year to year that makes future value worth less today.

Disturbance regime

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

Diurnal temperature range

The difference between the maximum and minimum temperature during a 24-hour period.

Downscaling

Downscaling is a method that derives local- to regional-scale (10 to 100 km) information from larger-scale models or data analyses. Two main methods exist: *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 driving model remains an important limitation on the quality of the downscaled information.

Drought

A period of abnormally dry weather long enough to cause a serious hydrological imbalance. Drought is a relative term; therefore any discussion in terms of precipitation deficit must refer to the particular precipitation-related activity that is under discussion. For example, shortage of precipitation during the growing season impinges on crop production or ecosystem function in general (due to soil moisture drought, also termed *agricultural drought*), and during the runoff and percolation season primarily affects water supplies (*hydrological drought*). Storage changes in soil moisture and groundwater are also affected by increases in actual evapotranspiration in addition to reductions in precipitation. A period with an abnormal precipitation deficit is defined as a *meteorological drought*. A *megadrought* is a very lengthy and pervasive drought, lasting much longer than normal, usually a decade or more. For the corresponding indices, see WGI AR5 Box 2.4.

Dynamic global vegetation model (DGVM)

A model that simulates vegetation development and dynamics through space and time, as driven by climate and other environmental changes.

Early warning system

The set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities, and organizations threatened by a hazard to prepare to act promptly and appropriately to reduce the possibility of harm or loss.⁷

Earth System Model (ESM)

A coupled atmosphere-ocean general circulation model in which a representation of the carbon cycle is included, allowing for interactive calculation of atmospheric CO₂ or compatible emissions. Additional components (e.g., atmospheric chemistry, ice sheets, dynamic vegetation, nitrogen cycle, but also urban or crop models) may be included. See also Climate model.

⁷ This glossary entry builds from the definitions used in UNISDR (2009) and IPCC (2012a).

Ecophysiological process

Processes in which individual organisms respond continuously to environmental variability or change, such as climate change, generally at a microscopic or sub-organ scale. Ecophysiological mechanisms underpin individual organisms' tolerance to environmental stress, and comprise a broad range of responses defining the absolute tolerances by individuals of environmental conditions. Ecophysiological responses may scale up to control species' geographic ranges.

Ecosystem

An ecosystem is a functional unit consisting of living organisms, their non-living environment, and the interactions within and between them. The components included in a given ecosystem and its spatial boundaries depend on the purpose for which the ecosystem is defined: in some cases they are relatively sharp, while in others they are diffuse. Ecosystem boundaries can change over time. Ecosystems are nested within other ecosystems, and their scale can range from very small to the entire biosphere. In the current era, most ecosystems either contain people as key organisms, or are influenced by the effects of human activities in their environment.

Ecosystem approach

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 scientific methodologies focused on levels of biological organization, which encompass the essential structure, processes, functions, and interactions of organisms and their environment. It recognizes 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.⁸

Ecosystem-based adaptation

The use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change. Ecosystem-based adaptation uses the range of opportunities for the sustainable management, conservation, and restoration of ecosystems to provide services that enable people to adapt to the impacts of climate change. It aims to maintain and increase the resilience and reduce the vulnerability of ecosystems and people in the face of the adverse effects of climate change. Ecosystem-based adaptation is most appropriately integrated into broader adaptation and development strategies (Secretariat of the Convention on Biological Diversity, 2009).

Ecosystem services

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

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 Peru, disrupting the local fishery. It has since become identified with a basin-wide warming of the tropical Pacific Ocean 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 known as the El Niño-Southern Oscillation (ENSO). It is often measured by the surface pressure anomaly difference between Darwin and Tahiti or 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

⁸ This glossary entry builds from definitions used in CBD (2000), MEA (2005), and the Fourth Assessment Report.

world, through global teleconnections. The cold phase of ENSO is called *La Niña*. For the corresponding indices, see WGI AR5 Box 2.5.

Emergent risk

A risk that arises from the interaction of phenomena in a complex system, for example the risk caused when geographic shifts in human population in response to climate change lead to increased vulnerability and exposure of populations in the receiving region.

Emission 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. In IPCC (1992) a set of emission scenarios was presented, which were used as a basis for the climate projections in IPCC (1996). These emission scenarios are referred to as the IS92 scenarios. In the IPCC Special Report on Emission Scenarios (Nakićenović and Swart, 2000) emission scenarios, the so-called *SRES scenarios*, were published, some of which were used, among others, as a basis for the climate projections presented in Chapters 9 to 11 of IPCC (2001) and Chapters 10 and 11 of IPCC (2007). New emission scenarios for climate change, the four *Representative Concentration Pathways*, were developed for, but independently of, the present IPCC assessment. See also Climate scenario and Scenario.

Ensemble

A collection of model simulations characterizing a climate prediction or projection. Differences in initial conditions and model formulation result in different evolutions of the modeled system and may give information on uncertainty associated with model error and error in initial conditions in the case of climate forecasts and on uncertainty associated with model error and with internally generated climate variability in the case of climate projections.

Environmental migration

Human migration involves movement over a significant distance and duration. Environmental migration refers to human migration where environmental risks or environmental change plays a significant role in influencing the migration decision and destination. Migration may involve distinct categories such as direct, involuntary, and temporary displacement due to weather-related disasters; voluntary relocation as settlements and economies become less viable; or planned resettlement encouraged by government actions or incentives. All migration decisions are multi-causal, and hence it is not meaningful to describe any migrant flow as being solely for environmental reasons.

Eutrophication

Over-enrichment of water by nutrients such as nitrogen and phosphorus. It is one of the leading causes of water quality impairment. The two most acute symptoms of eutrophication are hypoxia (or oxygen depletion) and harmful algal blooms. See also Dead zones.

Evolutionary adaptation

For a population or species, change in functional characteristics as a result of selection acting on heritable traits. The rate of evolutionary adaptation depends on factors such as the strength of selection, generation turnover time, and degree of outcrossing (as opposed to inbreeding). See also Adaptation.

Exposure

The presence of people, livelihoods, species or ecosystems, environmental services and resources, infrastructure, or economic, social, or cultural assets in places that could be adversely affected.

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. Orbital forcing is also an external forcing as the insolation changes with orbital parameters eccentricity, tilt, and precession of the equinox.

Externalities / external costs / external benefits

Externalities arise from a human activity when agents responsible for the activity do not take full account of the activity's impacts on others' production and consumption possibilities, and no compensation exists for such impacts. When the impacts are negative, they are external costs. When the impacts are positive, they are external benefits.

Extratropical cyclone

A large-scale (of order 1000 km) storm in the middle or high latitudes having low central pressure and fronts with strong horizontal gradients in temperature and humidity. A major cause of extreme wind speeds and heavy precipitation especially in wintertime.

Extreme climate event

See Extreme weather event.

Extreme sea level

See Storm surge.

Extreme weather event

An extreme weather event is 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 a probability density function estimated from observations. By definition, the characteristics of what is called extreme weather may vary from place to place in an absolute sense. 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).

Famine

Scarcity of food over an extended period and over a large geographical area, such as a country, or lack of access to food for socio-economic, political, or cultural reasons. Famines may be caused by climate-related extreme events such as droughts or floods and by disease, war, or other factors.

Feedback

See Climate feedback.

Fire weather

Weather conditions conducive to triggering and sustaining wild fires, usually based on a set of indicators and combinations of indicators including temperature, soil moisture, humidity, and wind. Fire weather does not include the presence or absence of fuel load.

Fitness (Darwinian)

Fitness is the relative capacity of an individual or genotype to both survive and reproduce, quantified as the average contribution of the genotype to the gene pool of the next generations. During evolution, natural selection favors functions providing greater fitness such that the functions become more common over generations.

Flood

The overflowing of the normal confines of a stream or other body of water, or the accumulation of water over areas not normally submerged. Floods include river (fluvial) floods, flash floods, urban floods, pluvial floods, sewer floods, coastal floods, and glacial lake outburst floods.

Food security

A state that prevails when people have secure access to sufficient amounts of safe and nutritious food for normal growth, development, and an active and healthy life.⁹ See also Access to food.

⁹ This glossary entry builds from definitions used in FAO (2000) and previous IPCC reports.

Food system

A food system includes the suite of activities and actors in the food chain (i.e., producing, processing and packaging, storing and transporting, trading and retailing, and preparing and consuming food); and the outcome of these activities relating to the three components underpinning food security (i.e., access to food, utilization of food, and food availability), all of which need to be stable over time. Food security is therefore underpinned by food systems, and is an emergent property of the behavior of the whole food system. Food insecurity arises when any aspect of the food system is stressed.

Forecast

See Climate prediction and Climate projection.

General Circulation Model (GCM)

See Climate model.

Geoengineering

Geoengineering refers to a broad set of methods and technologies that aim to deliberately alter the climate system in order to alleviate the impacts of climate change. Most, but not all, methods seek to either (a) reduce the amount of absorbed solar energy in the climate system (Solar Radiation Management) or (b) increase net carbon sinks from the atmosphere at a scale sufficiently large to alter climate (Carbon Dioxide Removal). Scale and intent are of central importance. Two key characteristics of geoengineering methods of particular concern are that they use or affect the climate system (e.g., atmosphere, land, or ocean) globally or regionally and/or could have substantive unintended effects that cross national boundaries. Geoengineering is different from weather modification and ecological engineering, but the boundary can be fuzzy (IPCC, 2012b, p. 2).

Global change

A generic term to describe global scale changes in systems, including the climate system, ecosystems, and social-ecological systems.

Global climate model (also referred to as general circulation model, both abbreviated as GCM)

See Climate model.

Global mean surface temperature

An estimate of the global mean surface air temperature. However, for changes over time, only anomalies, as departures from a climatology, are used, most commonly based on the area-weighted global average of the sea surface temperature anomaly and land surface air temperature anomaly.

Greenhouse effect

The infrared radiative effect of all infrared-absorbing constituents in the atmosphere. Greenhouse gases, clouds, and (to a small extent) aerosols absorb terrestrial radiation emitted by the Earth's surface and elsewhere in the atmosphere. These substances emit infrared radiation in all directions, but, everything else being equal, the net amount emitted to space is normally less than would have been emitted in the absence of these absorbers because of the decline of temperature with altitude in the troposphere and the consequent weakening of emission. An increase in the concentration of greenhouse gases increases the magnitude of this effect; the difference is sometimes called the enhanced greenhouse effect. The change in a greenhouse gas concentration because of anthropogenic emissions contributes to an instantaneous radiative forcing. Surface temperature and troposphere warm in response to this forcing, gradually restoring the radiative balance at the top of the atmosphere.

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 terrestrial radiation emitted by the Earth's surface, the atmosphere itself, and clouds. This property causes the greenhouse effect. Water vapor (H₂O), carbon dioxide (CO₂), nitrous oxide (N₂O), methane (CH₄), and ozone (O₃) 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 CO₂, N₂O,

and CH₄, the Kyoto Protocol deals with the greenhouse gases sulfur hexafluoride (SF₆), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs). For a list of well-mixed greenhouse gases, see WGI AR5 Table 2.A.1.

Ground-level ozone

Atmospheric ozone formed naturally or from human-emitted precursors near Earth's surface, thus affecting human health, agriculture, and ecosystems. Ozone is a greenhouse gas, but ground-level ozone, unlike stratospheric ozone, also directly affects organisms at the surface. Ground-level ozone is sometimes referred to as tropospheric ozone, although much of the troposphere is well above the surface and thus does not directly expose organisms at the surface. See also Ozone.

Groundwater recharge

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

Hazard

The potential occurrence of a natural or human-induced physical event or trend, or physical impact, that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources. In this report, the term *hazard* usually refers to climate-related physical events or trends or their physical impacts.

Heat wave

A period of abnormally and uncomfortably hot weather.

Hotspot

A geographical area characterized by high vulnerability and exposure to climate change.

Human security

A condition that is met when the vital core of human lives is protected, and when people have the freedom and capacity to live with dignity. In the context of climate change, the vital core of human lives includes the universal and culturally specific, material and non-material elements necessary for people to act on behalf of their interests and to live with dignity.

Human system

Any system in which human organizations and institutions play a major role. Often, but not always, the term is synonymous with *society* or *social system*. Systems such as agricultural systems, political systems, technological systems, and economic systems are all human systems in the sense applied in this report.

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 vapor, condenses to form clouds, precipitates over ocean and land as rain or snow, which on land can be 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. The various systems involved in the hydrological cycle are usually referred to as hydrological systems.

Hypoxic events

Events that lead to deficiencies of oxygen in water bodies. See also Dead zones and Eutrophication.

Ice cap

A dome-shaped ice mass that is considerably smaller in extent than an ice sheet.

Ice sheet

A mass of land ice of continental size that is sufficiently thick to cover most of the underlying bed, 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 outward 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 two ice sheets in the modern world, one on Greenland and one on Antarctica. 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 very gently sloping surface), often filling embayments in the coastline of an ice sheet. Nearly all ice shelves are in Antarctica, where most of the ice discharged into the ocean flows via ice shelves.

(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.

Impacts (Consequences, Outcomes)¹⁰

Effects on natural and human systems. In this report, the term *impacts* is used primarily to refer to the effects on natural and human systems of extreme weather and climate events and of climate change. Impacts generally refer to effects on lives, livelihoods, health status, ecosystems, economic, social, and cultural assets, services (including environmental), and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific time period and the vulnerability of an exposed society or system. Impacts are also referred to as *consequences* and *outcomes*. The impacts of climate change on geophysical systems, including floods, droughts, and sea level rise, are a subset of impacts called physical impacts.

Indian Ocean Dipole (IOD)

Large-scale mode of interannual variability of sea surface temperature in the Indian Ocean. This pattern manifests through a zonal gradient of tropical sea surface temperature, which in one extreme phase in boreal autumn shows cooling off Sumatra and warming off Somalia in the west, combined with anomalous easterlies along the equator.

Indigenous peoples

Indigenous peoples and nations are those that, having a historical continuity with pre-invasion and pre-colonial societies that developed on their territories, consider themselves distinct from other sectors of the societies now prevailing on those territories, or parts of them. They form at present principally non-dominant sectors of society and are often determined to preserve, develop, and transmit to future generations their ancestral territories, and their ethnic identity, as the basis of their continued existence as peoples, in accordance with their own cultural patterns, social institutions, and common law system.¹¹

Industrial Revolution

A period of rapid industrial growth with far-reaching social and economic consequences, beginning in Britain during the second half of the eighteenth century and spreading to Europe and later to other countries including the United States. The invention of the steam engine was an important trigger of this development. The industrial revolution marks the beginning of a strong increase in the use of fossil fuels and emission of, in particular, fossil carbon dioxide. In this report the terms *pre-industrial* and *industrial* refer, somewhat arbitrarily, to the periods before and after 1750, respectively.

Industrialized/developed/developing countries

There are a diversity of approaches for categorizing countries on the basis of their level of development, and for defining terms such as industrialized, developed, or developing. Several categorizations are used in this report. In the United Nations system, there is no established convention for the designation of developed and developing countries or areas. The United Nations Statistics Division specifies developed and developing regions based on common practice. In addition, specific countries are designated as least developed countries, landlocked developing

¹⁰ Reflecting progress in science, this glossary entry differs in breadth and focus from the entry used in the Fourth Assessment Report and other IPCC reports.

¹¹ This glossary entry builds from the definitions used in Cobo (1987) and previous IPCC reports.

countries, small island developing states, and transition economies. Many countries appear in more than one of these categories. The World Bank uses income as the main criterion for classifying countries as low, lower middle, upper middle, and high income. The UNDP aggregates indicators for life expectancy, educational attainment, and income into a single composite human development index (HDI) to classify countries as low, medium, high, or very high human development. See Box 1-2.

Informal sector

Commercial enterprises (mostly small) that are not registered or that otherwise fall outside official rules and regulations. Among the businesses that make up the informal sector, there is great diversity in the value of the goods or services produced, the numbers employed, the extent of illegality, and the connection to the formal sector. Many informal enterprises have some characteristics of formal-sector enterprises, and some people are in informal employment in the formal sector as they lack legal protection or employment benefits.

Informal settlement

A term given to settlements or residential areas that by at least one criterion fall outside official rules and regulations. Most informal settlements have poor housing (with widespread use of temporary materials) and are developed on land that is occupied illegally with high levels of overcrowding. In most such settlements, provision for safe water, sanitation, drainage, paved roads, and basic services is inadequate or lacking. The term *slum* is often used for informal settlements, although it is misleading as many informal settlements develop into good quality residential areas, especially where governments support such development.

Institutions

Institutions are rules and norms held in common by social actors that guide, constrain, and shape human interaction. Institutions can be formal, such as laws and policies, or informal, such as norms and conventions. Organizations – such as parliaments, regulatory agencies, private firms, and community bodies – develop and act in response to institutional frameworks and the incentives they frame. Institutions can guide, constrain, and shape human interaction through direct control, through incentives, and through processes of socialization.

Insurance/reinsurance

A family of financial instruments for sharing and transferring risk among a pool of at-risk households, businesses, and/or governments. See also Risk transfer.

Integrated assessment

A method of analysis that combines results and models from the physical, biological, economic, and social sciences, and the interactions among these components, in a consistent framework to evaluate the status and the consequences of environmental change and the policy responses to it.

Integrated coastal zone management (ICZM)

An integrated approach for sustainably managing coastal areas, taking into account all coastal habitats and uses.

Invasive species / invasive alien species (IAS)

A species introduced outside its natural past or present distribution (i.e., an alien species) that becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity (IUCN, 2000; CBD, 2002).

Key vulnerability, key risk, key impact

A vulnerability, risk, or impact relevant to the definition and elaboration of “dangerous anthropogenic interference (DAI) with the climate system,” in the terminology of United Nations Framework Convention on Climate Change (UNFCCC) Article 2, meriting particular attention by policymakers in that context.

Key risks are potentially severe adverse consequences for humans and social-ecological systems due to the interaction of climate-related hazards with vulnerabilities of societies and systems exposed. Risks are considered “key” due to high hazard or high vulnerability of societies and systems exposed, or both.

Vulnerabilities are considered “key” if they have the potential to combine with hazardous events or trends to result in key risks. Vulnerabilities that have little influence on climate-related risk, for instance, due to lack of exposure to hazards, would not be considered key.

Key impacts are severe consequences for humans and social-ecological systems.

Land grabbing

Large acquisitions of land or water rights for industrial agriculture, mitigation projects, or biofuels that have negative consequences on local and marginalized communities.

Land surface air temperature

The surface air temperature as measured in well-ventilated screens over land at 1.5 m above the ground.

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 give rise to 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).

La Niña

See El Niño-Southern Oscillation.

Last Glacial Maximum (LGM)

The period during the last ice age when the glaciers and ice sheets reached their maximum extent, approximately 21 ka ago. This period has been widely studied because the radiative forcings and boundary conditions are relatively well known.

Likelihood

The chance of a specific outcome occurring, where this might be estimated probabilistically. Likelihood is expressed in this report using a standard terminology (Mastrandrea *et al.*, 2010), defined in Box 1-1. See also Confidence and Uncertainty.

Livelihood

The resources used and the activities undertaken in order to live. Livelihoods are usually determined by the entitlements and assets to which people have access. Such assets can be categorized as human, social, natural, physical, or financial.

Low regrets policy

A policy that would generate net social and/or economic benefits under current climate and a range of future climate change scenarios.

Maladaptive actions (or maladaptation)

Actions that may lead to increased risk of adverse climate-related outcomes, increased vulnerability to climate change, or diminished welfare, now or in the future.

Mean sea level

The surface level of the ocean at a particular point averaged over an extended period of time such as a month or year. Mean sea level is often used as a national datum to which heights on land are referred.

Meridional Overturning Circulation (MOC)

Meridional (north-south) overturning circulation in the ocean quantified by zonal (east-west) sums of mass transports in depth or density layers. In the North Atlantic, away from the sub-polar regions, the MOC (which is in

principle an observable quantity) is often identified with the thermohaline circulation (THC), which is a conceptual and incomplete interpretation. It must be borne in mind that the MOC is also driven by wind, and can also include shallower overturning cells such as occur in the upper ocean in the tropics and subtropics, in which warm (light) waters moving poleward are transformed to slightly denser waters and subducted equatorward at deeper levels.

Microclimate

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

Mitigation (of climate change)

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

Mitigation (of disaster risk and disaster)

The lessening of the potential adverse impacts of physical hazards (including those that are human-induced) through actions that reduce hazard, exposure, and vulnerability.

Mode of climate variability

Underlying space-time structure with preferred spatial pattern and temporal variation that helps account for the gross features in variance and for teleconnections. A mode of variability is often considered to be the product of a spatial climate pattern and an associated climate index time series.

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.

Non-climatic driver (non-climate driver)

An agent or process outside the climate system that influences a human or natural system.

Nonlinearity

A process is called nonlinear when there is no simple proportional relation between cause and effect. The climate system contains many such nonlinear processes, resulting in a system with potentially very complex behavior. Such complexity may lead to abrupt climate change. See also Predictability.

North Atlantic Oscillation (NAO)

The North Atlantic Oscillation consists of opposing variations of surface 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 extratropical cyclones with their associated frontal systems. See NAO Index in WGI AR5 Box 2.5.

Ocean acidification

Ocean acidification refers to a reduction in the pH of the ocean over an extended period, typically decades or longer, which is caused primarily by uptake of carbon dioxide from the atmosphere, but can also be caused by other chemical additions or subtractions from the ocean. *Anthropogenic ocean acidification* refers to the component of pH reduction that is caused by human activity (IPCC, 2011, p. 37).

Opportunity costs

The benefits of an activity forgone through the choice of another activity.

Outcome vulnerability (End-point vulnerability)

Vulnerability as the end point of a sequence of analyses beginning with projections of future emission trends, moving on to the development of climate scenarios, and concluding with biophysical impact studies and the identification of adaptive options. Any residual consequences that remain after adaptation has taken place define the levels of vulnerability (Kelly and Adger, 2000; O'Brien *et al.*, 2007).

Oxygen minimum zone (OMZ)

The midwater layer (200-1000 m) in the open ocean in which oxygen saturation is the lowest in the ocean. The degree of oxygen depletion depends on the largely bacterial consumption of organic matter, and the distribution of the OMZs is influenced by large-scale ocean circulation. In coastal oceans, OMZs extend to the shelves and may also affect benthic ecosystems.

Ozone

Ozone, the triatomic form of oxygen (O₃), is a gaseous atmospheric constituent. In the troposphere, it is created both naturally and by photochemical reactions involving gases resulting from human activities (smog). Tropospheric ozone acts as a greenhouse gas. In the stratosphere, it is created by the interaction between solar ultraviolet radiation and molecular oxygen (O₂). Stratospheric ozone plays a dominant role in the stratospheric radiative balance. Its concentration is highest in the ozone layer.

Pacific Decadal Oscillation (PDO)

The pattern and time series of the first empirical orthogonal function of sea surface temperature over the North Pacific north of 20°N. The PDO broadened to cover the whole Pacific Basin is known as the Inter-decadal Pacific Oscillation (IPO). The PDO and IPO exhibit similar temporal evolution.

Parameterization

In climate models, this term refers to the technique of representing processes that cannot be explicitly resolved at the spatial or temporal resolution of the model (subgrid-scale processes) by relationships between model-resolved larger-scale variables and the area- or time-averaged effect of such subgrid-scale processes.

Particulates

Very small solid 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 diameter less than or equal to 10 nm, usually designated as PM₁₀.

Pastoralism

A livelihood strategy based on moving livestock to seasonal pastures primarily in order to convert grasses, forbs, tree-leaves, or crop residues into human food. The search for feed is however not the only reason for mobility; people and livestock may move to avoid various natural and/or social hazards, to avoid competition with others, or to seek more favorable conditions. Pastoralism can also be thought of as a strategy that is shaped by both social and ecological factors concerning uncertainty and variability of precipitation, and low and unpredictable productivity of terrestrial ecosystems.

Path dependence

The generic situation where decisions, events, or outcomes at one point in time constrain adaptation, mitigation, or other actions or options at a later point in time.

Permafrost

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

Persistent organic pollutants (POPs)

Toxic organic chemical substances that persist in the environment for long periods of time, are transported and deposited in locations distant from their sources of release, bioaccumulate, and can have adverse effects on human health and ecosystems.¹²

¹² This glossary entry builds from the definition in the Stockholm Convention on Persistent Organic Pollutants (Secretariat of the Stockholm Convention, 2001).

Phenology

The relationship between biological phenomena that recur periodically (e.g., development stages, migration) and climate and seasonal changes.

Photochemical smog

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

Poverty

Poverty is a complex concept with several definitions stemming from different schools of thought. It can refer to material circumstances (such as need, pattern of deprivation, or limited resources), economic conditions (such as standard of living, inequality, or economic position), and/or social relationships (such as social class, dependency, exclusion, lack of basic security, or lack of entitlement).

Poverty trap

Poverty trap is understood differently across disciplines. In the social sciences, the concept, primarily employed at the individual, household, or community level, describes a situation in which escaping poverty becomes impossible due to unproductive or inflexible resources. A poverty trap can also be seen as a critical minimum asset threshold, below which families are unable to successfully educate their children, build up their productive assets, and get out of poverty. Extreme poverty is itself a poverty trap, since poor persons lack the means to participate meaningfully in society. In economics, the term poverty trap is often used at national scales, referring to a self-perpetuating condition where an economy, caught in a vicious cycle, suffers from persistent underdevelopment (Matsuyama, 2008). Many proposed models of poverty traps are found in the literature.

Predictability

The extent to which future states of a system may be predicted based on knowledge of current and past states of the system. Since knowledge of the climate system's past and current states is generally imperfect, as are the models that utilize this knowledge to produce a climate prediction, and since the climate system is inherently nonlinear and chaotic, predictability of the climate system is inherently limited. Even with arbitrarily accurate models and observations, there may still be limits to the predictability of such a nonlinear system (AMS, 2000).

Pre-industrial

See Industrial Revolution.

Probability Density Function (PDF)

A probability density function is a function that indicates the relative chances of occurrence of different outcomes of a variable. The function integrates to unity over the domain for which it is defined and has the property that the integral over a sub-domain equals the probability that the outcome of the variable lies within that sub-domain. For example, the probability that a temperature anomaly defined in a particular way is greater than zero is obtained from its PDF by integrating the PDF over all possible temperature anomalies greater than zero. Probability density functions that describe two or more variables simultaneously are similarly defined.

Projection

A projection is a potential future evolution of a quantity or set of quantities, often computed with the aid of a model. Unlike predictions, projections are conditional on assumptions concerning, for example, future socioeconomic and technological developments that may or may not be realized. See also Climate prediction and Climate projection.

Proxy

A proxy climate indicator is a record that is interpreted, using physical and biophysical 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, speleothems, characteristics of corals, and various data derived from marine sediments and ice cores. Proxy data can be calibrated to provide quantitative climate information.

Public good

A good that is both non-excludable and non-rivalrous in that individuals cannot be effectively excluded from use and where use by one individual does not reduce availability to others.

Radiative forcing

Radiative forcing is the change in the net, downward minus upward, irradiance (expressed in W m^{-2}) at the tropopause or top of atmosphere due to a change in an external driver of climate change, such as a change in the concentration of carbon dioxide or the output of the Sun. Sometimes internal drivers are still treated as forcings even though they result from the alteration in climate, for example aerosol or greenhouse gas changes in paleoclimates. The traditional 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. The radiative forcing once rapid adjustments are accounted for is termed the *effective radiative forcing*. For the purposes of this report, 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. Radiative forcing is not to be confused with *cloud radiative forcing*, which describes an unrelated measure of the impact of clouds on the irradiance at the top of the atmosphere.

Reanalysis

Reanalyses are estimates of historical atmospheric temperature and wind or oceanographic temperature and current, and other quantities, created by processing past meteorological or oceanographic data using fixed state-of-the-art weather forecasting or ocean circulation models with data assimilation techniques. Using fixed data assimilation avoids effects from the changing analysis system that occur in operational analyses. Although continuity is improved, global reanalyses still suffer from changing coverage and biases in the observing systems.

Reasons for concern

Elements of a classification framework, first developed in the IPCC Third Assessment Report, which aims to facilitate judgments about what level of climate change may be “dangerous” (in the language of Article 2 of the UNFCCC) by aggregating impacts, risks, and vulnerabilities.

Reference scenario

See Baseline/reference.

Reflexivity

A system attribute where cause and effect form a feedback loop, in which the effect changes the system itself. Self-adapting systems such as societies are inherently reflexive, as are planned changes in complex systems. Reflexive decisionmaking in a social system has the potential to change the underpinning values that led to those decisions. Reflexivity is also an important aspect of adaptive management.

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). See also the Report on Definitions and Methodological Options to Inventory Emissions from Direct Human-induced Degradation of Forests and Devegetation of Other Vegetation Types (IPCC, 2003).

Relative sea level

Sea level measured by a tide gauge with respect to the land upon which it is situated. See also Mean sea level and Sea level change.

Representative concentration pathways (RCPs)

Scenarios that include time series of emissions and concentrations of the full suite of greenhouse gases and aerosols and chemically active gases, as well as land use/land cover (Moss *et al.*, 2008). The word *representative* signifies that each RCP provides only one of many possible scenarios that would lead to the specific radiative forcing

characteristics. The term *pathway* emphasizes that not only the long-term concentration levels are of interest, but also the trajectory taken over time to reach that outcome (Moss *et al.*, 2010).

RCPs usually refer to the portion of the concentration pathway extending up to 2100, for which Integrated Assessment Models produced corresponding emission scenarios. *Extended Concentration Pathways* (ECPs) describe extensions of the RCPs from 2100 to 2500 that were calculated using simple rules generated by stakeholder consultations, and do not represent fully consistent scenarios.

Four RCPs produced from Integrated Assessment Models were selected from the published literature and are used in the present IPCC Assessment as a basis for the climate predictions and projections in WGI AR5 Chapters 11 to 14:

RCP8.5 One high pathway for which radiative forcing reaches $>8.5 \text{ W m}^{-2}$ by 2100 and continues to rise for some amount of time (the corresponding ECP assuming constant emissions after 2100 and constant concentrations after 2250);

RCP6.0 and RCP4.5 Two intermediate stabilization pathways in which radiative forcing is stabilized at approximately 6 W m^{-2} and 4.5 W m^{-2} after 2100 (the corresponding ECPs assuming constant concentrations after 2150);

RCP2.6 One pathway where radiative forcing peaks at approximately 3 W m^{-2} before 2100 and then declines (the corresponding ECP assuming constant emissions after 2100).

For further description of future scenarios, see WGI AR5 Box 1.2.

Resilience

The capacity of a social-ecological system to cope with a hazardous event or disturbance, responding or reorganizing in ways that maintain its essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation (Arctic Council, 2013).

Return period

An estimate of the average time interval between occurrences of an event (e.g., flood or extreme rainfall) of (or below/above) a defined size or intensity. See also Return value.

Return value

The highest (or, alternatively, lowest) value of a given variable, on average occurring once in a given period of time (e.g., in 10 years). See also Return period.

Risk

The potential for consequences where something of human value (including humans themselves) is at stake and where the outcome is uncertain.¹³ Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the consequences if these events occur. This report assesses climate-related risks.

Risk assessment

The qualitative and/or quantitative scientific estimation of risks.

Risk management

The plans, actions, or policies implemented to reduce the likelihood and/or consequences of risks or to respond to consequences.

Risk perception

The subjective judgment that people make about the characteristics and severity of a risk.

¹³ This definition builds from the definitions used in Rosa (1998) and Rosa (2003).

Risk transfer

The practice of formally or informally shifting the risk of financial consequences for particular negative events from one party to another.

Runoff

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

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 decreasing land-based influence (e.g., from reduced runoff or groundwater recharge, or from excessive water withdrawals from aquifers) or increasing marine influence (e.g., relative sea-level rise).

Scenario

A plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces (e.g., rate of technological change, prices) and relationships. Note that scenarios are neither predictions nor forecasts, but are useful to provide a view of the implications of developments and actions. See also Climate scenario, Emission scenario, Representative Concentration Pathways, and SRES scenarios.

Sea level change

Sea level can change, both globally and locally due to (i) changes in the shape of the ocean basins, (ii) a change in ocean volume as a result of a change in the mass of water in the ocean, and (iii) changes in ocean volume as a result of changes in ocean-water density. Global mean sea level change resulting from change in the mass of the ocean is called *barystatic*. The amount of barystatic sea level change due to the addition or removal of a mass of water is called its *sea level equivalent* (SLE). Sea level changes, both globally and locally, resulting from changes in water density are called *steric*. Density changes induced by temperature changes only are called *thermosteric*, while density changes induced by salinity changes are called *halosteric*. Barystatic and steric sea level changes do not include the effect of changes in the shape of ocean basins induced by the change in the ocean mass and its distribution. See also Relative sea level and Thermal expansion.

Sea surface temperature (SST)

The sea surface temperature is the subsurface bulk temperature in the top few meters 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 millimeter thick) in the infrared or the top centimeter or so in the microwave are also used, but must be adjusted to be compatible with the bulk temperature.

Semi-arid zone

Areas where vegetation growth is constrained by limited water availability, often with short growing seasons and high interannual variation in primary production. Annual precipitation ranges from 300 to 800 mm, depending on the occurrence of summer and winter rains.

Sensitivity

The degree to which a system or species 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).

Significant wave height

The average trough-to-crest height of the highest one third of the wave heights (sea and swell) occurring in a particular time period.

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.

Social cost of carbon (SCC)

The net present value of climate damages (with harmful damages expressed as a positive number) from one more tonne of carbon in the form of CO₂, conditional on a global baseline climate mitigation trajectory over time with associated emissions.

Social protection

In the context of development aid and climate policy, social protection usually describes public and private initiatives that provide income or consumption transfers to the poor, protect the vulnerable against livelihood risks, and enhance the social status and rights of the marginalized, with the overall objective of reducing the economic and social vulnerability of poor, vulnerable, and marginalized groups (Devereux and Sabates-Wheeler, 2004). In other contexts, social protection may be used synonymously with social policy and can be described as all public and private initiatives that provide access to services, such as health, education, or housing, or income and consumption transfers to people. Social protection policies protect the poor and vulnerable against livelihood risks and enhance the social status and rights of the marginalized, as well as prevent vulnerable people from falling into poverty.

Socio-economic scenario

A scenario that describes a possible future in terms of population, gross domestic product, and other socio-economic factors relevant to understanding the implications of climate change.

Southern Annular Mode (SAM)

The leading mode of variability of Southern Hemisphere geopotential height, which is associated with shifts in the latitude of the midlatitude jet. See SAM Index in WGI AR5 Box 2.5.

Species distribution modeling

Simulation of ecological effects of climate change. Species distribution modeling uses statistically or theoretically derived response surfaces to relate observations of species occurrence or known tolerance limits to environmental predictor variables, thereby predicting a species' range as the manifestation of habitat characteristics that limit or support its presence at a particular location. Species distribution models are also referred to as environmental niche models. Bioclimate envelope models can be considered as a subset of species distribution models that predict species occurrence or habitat suitability based on climatic variables only.

SRES scenarios

SRES scenarios are emission scenarios developed by Nakićenović and Swart (2000) and used, among others, as a basis for some of the climate projections shown in Chapters 9 to 11 of IPCC (2001) and Chapters 10 and 11 of IPCC (2007). 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 marker scenarios for the scenario groups A1B, A2, B1, and 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.

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 generalized to refer to the main regions where the tracks of extratropical disturbances occur as sequences of low (cyclonic) and high (anticyclonic) pressure systems.

Stratosphere

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

Stressors

Events and trends, often not climate-related, which have an important effect on the system exposed and can increase vulnerability to climate-related risk.

Subsistence agriculture

Farming and associated activities that together form a livelihood strategy in which most output is consumed directly but some may be sold at market. Subsistence agriculture can be one of several livelihood activities.

Surface temperature

See Global mean surface temperature, Land surface air temperature, and Sea surface temperature.

Sustainability

A dynamic process that guarantees the persistence of natural and human systems in an equitable manner.

Sustainable development

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987).

Thermal expansion

In connection with sea level, 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 also Sea level change.

Thermocline

The layer of maximum vertical temperature gradient in the ocean, lying between the surface ocean and the abyssal ocean. In subtropical regions, its source waters are typically surface waters at higher latitudes that have subducted and moved equatorward. At high latitudes, it is sometimes absent, replaced by a halocline, which is a layer of maximum vertical salinity gradient.

Thermohaline circulation (THC)

Large-scale circulation in the ocean that transforms low-density upper-ocean waters to higher-density intermediate and deep waters and returns those waters back to the upper ocean. The circulation is asymmetric, with conversion to dense waters in restricted regions at high latitudes and the return to the surface involving slow upwelling and diffusive processes over much larger geographic regions. The THC is driven by high densities at or near the surface,

caused by cold temperatures and/or high salinities, but despite its suggestive though common name, is also driven by mechanical forces such as wind and tides. Frequently, the name THC has been used synonymously with Meridional Overturning Circulation.

Tipping point

A level of change in system properties beyond which a system reorganizes, often abruptly, and does not return to the initial state even if the drivers of the change are abated.¹⁴

Traditional knowledge

The knowledge, innovations, and practices of both indigenous and local communities around the world that are deeply grounded in history and experience. Traditional knowledge is dynamic and adapts to cultural and environmental change, and also incorporates other forms of knowledge and viewpoints. Traditional knowledge is generally transmitted orally from generation to generation. It is often used as a synonym for indigenous knowledge, local knowledge, or traditional ecological knowledge.

Transformation

A change in the fundamental attributes of a system, often based on altered paradigms, goals, or values. Transformations can occur in technological or biological systems, financial structures, and regulatory, legislative, or administrative regimes.

Tree line

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

Tropical cyclone

A strong, cyclonic-scale disturbance that originates over tropical oceans. Distinguished from weaker systems (often named tropical disturbances or depressions) by exceeding a threshold wind speed. A tropical storm is a tropical cyclone with one-minute average surface winds between 18 and 32 m s⁻¹. Beyond 32 m s⁻¹, a tropical cyclone is called a hurricane, typhoon, or cyclone, depending on geographic location.

Troposphere

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

Tsunami

A wave, or train of waves, produced by a disturbance such as a submarine earthquake displacing the sea floor, a landslide, a volcanic eruption, or an asteroid impact.

Tundra

A treeless biome characteristic of polar and alpine regions.

Uncertainty

A state of incomplete knowledge that can result from a lack of information or from disagreement about what is known or even knowable. It may have many types of sources, from imprecision in the data to ambiguously defined concepts or terminology, or uncertain projections of human behavior. Uncertainty can therefore be represented by quantitative measures (e.g., a probability density function) or by qualitative statements (e.g., reflecting the judgment of a team of experts) (see Moss and Schneider, 2000; Manning *et al.*, 2004; Mastrandrea *et al.*, 2010). See also Confidence and Likelihood.

¹⁴ The WGI AR5 defines tipping point in the context of climate: "In climate, a hypothesized critical threshold when global or regional climate changes from one stable state to another stable state. The tipping point event may be irreversible."

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 ‘stabilization 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 countries 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. In 1997, the UNFCCC adopted the Kyoto Protocol.

Uptake

The addition of a substance of concern to a reservoir. The uptake of carbon containing substances, in particular carbon dioxide, is often called (carbon) sequestration.

Upwelling region

A region of an ocean where cold, typically nutrient-rich waters well up from the deep ocean.

Urban heat island

The relative warmth of a city compared with surrounding rural areas, associated with changes in runoff, effects on heat retention, and changes in surface albedo.

Volatile Organic Compounds (VOCs)

Important class of organic chemical air pollutants that are volatile at ambient air conditions. Other terms used to represent VOCs are hydrocarbons (HCs), reactive organic gases (ROGs), and non-methane volatile organic compounds (NMVOCs). NMVOCs are major contributors (together with NO_x and CO) to the formation of photochemical oxidants like ozone.

Vulnerability¹⁵

The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt. See also Contextual vulnerability and Outcome vulnerability.

Vulnerability index

A metric characterizing the vulnerability of a system. A climate vulnerability index is typically derived by combining, with or without weighting, several indicators assumed to represent vulnerability.

Water cycle

See Hydrological cycle.

Water-use efficiency

Carbon gain by photosynthesis per unit of water lost by 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 water used.

¹⁵ Reflecting progress in science, this glossary entry differs in breadth and focus from the entry used in the Fourth Assessment Report and other IPCC reports.

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