Annex I: Glossary

Coordinating Editor: Nora M. Weyer (Germany)

Editorial Team: Miguel Cifuentes-Jara (Costa Rica), Thomas Frölicher (Switzerland), Miriam Jackson (UK), Raphael M. Kudela (USA), Valérie Masson-Delmotte (France), J.B. Robin Matthews (UK), Katja Mintenbeck (Germany), Mônica M.C. Muelbert (Brazil), Hans-Otto Pörtner (Germany), Elvira S. Poloczanska (UK), Debra Roberts (South Africa), Renée van Diemen (Netherlands), Phil Williamson (UK), Panmao Zhai (China)

Date of Draft: 14 June 2019

Notes: This Glossary defines some specific terms as the Lead Authors intend them to be interpreted in the context of this Special Report. Italicisations indicate terms defined in this Glossary. Note that subterms are in bold italics beneath main terms.

Ablation (of glaciers, ice sheets, or snow cover) All processes that reduce the mass of a *glacier*, *ice sheet*, or snow cover. The main processes are melting, and for glaciers also *calving* (or, when the glacier nourishes an *ice shelf*, *discharge of ice* across the *grounding line*), but other processes such as sublimation and loss of wind-blown snow can also contribute to ablation. Ablation also refers to the mass lost by any of these processes. See also *Mass balance / budget (of glaciers or ice sheets).*

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. See also *Climate change*, *Human system*, *Natural systems*, and *Tipping point*.

Accumulation (of glaciers, ice sheets, or snow cover) All processes that add to the mass of a *glacier*, an *ice sheet*, or snow cover. The main process of accumulation is snowfall. Accumulation also includes deposition of hoar, freezing rain, other types of solid precipitation, gain of wind-blown snow, avalanching, and basal accumulation (often beneath floating ice). See also *Avalanche*, and *Mass balance / budget (of glaciers or ice sheets).*

Active layer Layer of ground above *permafrost* subject to annual thawing and freezing.

Adaptability See *Adaptive capacity.*

Adaptation In *human systems*, the process of adjustment to actual or expected *climate* and its effects, in order to moderate harm or exploit beneficial opportunities. In *natural systems*, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects.

> ***Ecosystem-based adaptation (EBA)*** The use of ecosystem management activities to increase the *resilience* and reduce the *vulnerability* of people and *ecosystems* to *climate change* (Campbell et al., 2009).
>
> ***Evolutionary adaptation*** The process whereby a species or population becomes better able to live in a changing environment, through the selection of heritable traits. Biologists usually distinguish evolutionary adaptation from acclimatisation, with the latter occurring within an organism's lifetime.
>
> ***Incremental adaptation*** Adaptation that maintains the essence and integrity of a system or process at a given scale (Park et al., 2012). In some cases, incremental adaptation can accrue to result in *transformational adaptation* (Tàbara et al., 2018; Termeer et al., 2017). Incremental adaptations to change in climate are understood as extensions of actions and behaviours that already reduce the losses or enhance the benefits of natural variations in *extreme weather / climate events*.
>
> ***Transformational adaptation*** Adaptation that changes the fundamental attributes of a *social-ecological system* in anticipation of *climate change* and its *impacts*; and adaptation responses that will be required in the face of a global failure to mitigate the causes of *anthropogenic* climate change and are characterised by system-wide change or changes across more than one system, by a focus on the future and long-term change, or by a direct questioning of the effectiveness of existing systems, social injustices and power imbalances.
>
> ***Adaptation limits*** 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 may exist but are currently not available to avoid intolerable risks through adaptive action.

See also *Adaptation options*, *Adaptive capacity*, *Justice*, *Maladaptive actions (Maladaptation)*, and *Mitigation (of climate change).*

Adaptation limits See *Adaptation.*

Adaptation options The array of strategies and measures that are available and appropriate for addressing *adaptation*. They include a wide range of actions that can be categorised as structural, institutional, ecological or behavioural. See also *Adaptive capacity*, and *Maladaptive actions (Maladaptation)*.

Adaptation pathways See *Pathways.*

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 (IPCC, 2014; MA, 2005). See also *Adaptation*.

Adaptive governance See *Governance.*

Aerosol A suspension of airborne solid or liquid particles, with a typical size between a few nanometres and 10 μm, that reside in the *atmosphere* for at least several hours. The term aerosol, which includes both the particles and the suspending gas, is often used in this report in its plural form to mean 'aerosol particles'. Aerosols may be of either natural or *anthropogenic* origin. Aerosols can influence *climate* in several ways: directly through scattering and absorbing radiation, and indirectly by acting as cloud condensation nuclei or ice nuclei, modifying the optical properties and lifetime of clouds or upon deposition on snow or ice covered surfaces thereby altering their *albedo* and contributing to climate feedback. Atmospheric aerosols, whether natural or anthropogenic, originate from two different pathways: emissions of primary particulate matter (PM), and formation of secondary PM from gaseous *precursors*. The bulk of aerosols are of natural origin. Some scientists use group labels that refer to the chemical composition, namely: sea salt, organic carbon, *black carbon (BC)*, mineral species (mainly desert dust), sulphate, nitrate, and ammonium. These labels are, however, imperfect as aerosols combine particles to create complex mixtures. See also *Short-lived climate forcers (SLCFs)*.

Agreement In this Special Report, the degree of agreement within the scientific body of knowledge on a particular finding is assessed based on multiple lines of *evidence* (e.g., mechanistic understanding, theory, data, models, expert judgement) and expressed qualitatively (Mastrandrea et al., 2010). See also *Confidence*, *Likelihood*, and *Uncertainty*.

Albedo The proportion of sunlight (solar radiation) reflected by a surface or object, often expressed as a percentage. Clouds, snow and ice usually have high albedo; soil surfaces cover the albedo range from high to low; vegetation in the dry season and/or in arid zones can have high albedo; whereas photosynthetically active vegetation and the ocean have low albedo. The Earth's planetary albedo changes mainly through varying cloudiness, snow, ice, leaf area and land cover changes.

Alien (non-native) species An introduced species (alien species, exotic species, non-indigenous species, or non-native species) living outside its native distributional range, but which has arrived there by human activity, either deliberate or accidental. Non-native species can have various effects on and adversely affect the local *ecosystem*. See also *Endemic species*, and *Invasive species.*

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

Anthropogenic Resulting from or produced by human activities. See also *Anthropogenic emissions.*

Anthropogenic emissions Emissions of *greenhouse gases (GHGs)*, *precursors* of GHGs, and *aerosols*, caused by human activities. These activities include the burning of *fossil fuels*, *deforestation*, *land use* and land use changes (LULUC), livestock production, fertilisation, waste management, and industrial processes. See also *Anthropogenic.*

Anthropogenic subsidence Downward motion of the *land* surface induced by anthropogenic *drivers* (e.g., loading, extraction of hydrocarbons and/or groundwater, drainage, mining activities) causing sediment compaction or subsidence/deformation of the sedimentary sequence, or oxidation of organic material, thereby leading to *relative sea level* rise. See also *Anthropogenic*, and *Sea level change (sea level rise, SLR / sea level fall).*

Atlantic Meridional Overturning Circulation (AMOC) See *Meridional Overturning Circulation (MOC).*

Atmosphere The gaseous envelope surrounding the Earth, divided into five layers — the troposphere, which contains half of the Earth's atmosphere, the stratosphere, the mesosphere, the thermosphere, and the exosphere, which is the outer limit of the atmosphere. The dry atmosphere consists almost entirely of nitrogen (N_2, 78.1% volume mixing ratio) and oxygen (O_2, 20.9% volume mixing ratio), together with a number of trace gases, such as argon (Ar, 0.93% volume mixing ratio), helium (He) and radiatively active *greenhouse gases (GHG)* such as *carbon dioxide (CO_2*, 0.04% volume mixing ratio) and *ozone (O_3)*. In addition, the atmosphere contains the GHG water vapour (H_2O), whose amounts are highly variable but typically around 1% volume mixing ratio. The atmosphere also contains clouds and *aerosols*. See also *Climate system*, *Hydrological cycle*, *Methane (CH_4)*, and *Radiative forcing.*

Atmosphere-ocean general circulation model (AOGCM) See *Climate model*.

Attribution See *Detection and attribution.*

Avalanche A mass of snow, ice, earth or rocks, or a mixture of these, falling down a mountainside.

Benthos The community of organisms living on the bottom or in sediments of a body of water (such as an *ocean*, a river or a lake). The ecological zone at the bottom of a body of water, including the sediment surface and some sub-surface layers, is known as the 'benthic zone'.

Biodiversity or biological diversity means the variability among living organisms from all sources including, among other things, terrestrial, marine and other aquatic *ecosystems*, and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems (UN, 1992). See also *Ecosystem service*, and *Functional diversity.*

Biological (carbon) pump A series of *ocean* processes through which inorganic carbon (as *carbon dioxide, CO_2*) is fixed as organic matter by photosynthesis in sunlit surface water and then transported to the ocean interior, and possibly the sediment, resulting in the storage of carbon. See also *Carbonate pump*, *Dissolved organic carbon (DOC) and particulate organic carbon (POC)*, *Microbial carbon pump*, and *Solubility pump*.

Biomass Organic material excluding the material that is fossilised or embedded in geological formations. Biomass may refer to the mass of organic matter in a specific area (ISO, 2014).

Black carbon (BC) A relatively pure form of carbon, also known as soot, arising from the incomplete combustion of fossil fuels, biofuel, and *biomass*. It only stays in the *atmosphere* for days or weeks. BC is a *climate* forcing agent with strong warming effect, both in the atmosphere and when deposited on snow or ice. See also *Aerosol*, *Albedo*, *Forcing*, and *Short-lived climate forcers (SLCF).*

Blue carbon All biologically-driven carbon fluxes and storage in marine systems that are amenable to management can be considered as blue carbon. Coastal blue carbon focuses on rooted vegetation in the coastal zone, such as tidal marshes, mangroves and seagrasses. These *ecosystems* have high carbon burial rates on a per unit area basis and accumulate carbon in their soils and sediments. They provide many non-climatic benefits and can contribute to *ecosystem-based adaptation*. If degraded or lost, coastal blue carbon ecosystems are likely to release most of their carbon back to the *atmosphere*. There is current debate regarding the application of the blue carbon concept to other coastal and non-coastal processes and ecosystems, including the open ocean. See also *Carbon cycle*, *Coast*, *Ecosystem service*, and *Sequestration.*

Calving (of glaciers or ice sheets) The process of mechanical destruction of a mass of ice usually typical of marine-terminating *glaciers*; in the latter case, the ice calving (or breaking away) from the glacier edge can lead to the formation of *icebergs*. See also *Ice sheet*, and *Marine ice cliff instability (MICI).*

Carbonate pump Ocean carbon fixation through the biological formation of carbonates, primarily by plankton that generate bio-mineral particles that sink to the *ocean* interior, and possibly the sediment. It is also called carbonate counter-pump, since the formation of calcium carbonate ($CaCO_3$) is accompanied by

the release of *carbon dioxide (CO_2)* to surrounding water and subsequently to the *atmosphere*. See also *Biological (carbon) pump*, *Blue carbon*, *Dissolved organic carbon (DOC) and particulate organic carbon (POC)*, *Microbial carbon pump*, and *Solubility pump*.

Carbon budget refers to three concepts in the literature: (1) an assessment of *carbon cycle* sources and *sinks* on a global level, through the synthesis of *evidence* for *fossil-fuel* and cement emissions, *land use* change emissions, *ocean* and land *carbon dioxide (CO_2)* sinks, and the resulting atmospheric CO_2 growth rate. This is referred to as the global carbon budget; (2) the estimated cumulative amount of global CO_2 emissions that is estimated to limit global surface temperature to a given level above a *reference period*, taking into account global surface temperature contributions of other GHGs and climate forcers; (3) the distribution of the carbon budget defined under (2) to the regional, national, or sub-national level based on considerations of *equity*, costs or efficiency. See also *Atmosphere*, *Forcing*, and *Land*.

Carbon cycle The flow of carbon (in various forms, e.g., as *carbon dioxide (CO_2)*, carbon in *biomass*, and carbon dissolved in the *ocean* as carbonate and bicarbonate) through the *atmosphere*, hydrosphere, ocean, terrestrial and marine biosphere and lithosphere. In this Special Report, the reference unit for the global carbon cycle is $GtCO_2$ or GtC (one Gigatonne = 1 Gt = 10^{15} grams; 1 GtC corresponds to 3.667 $GtCO_2$). See also *Atmosphere*, *Blue carbon*, and *Ocean acidification (OA)*.

Carbon dioxide (CO_2) A naturally occurring gas, CO_2 is also a by-product of burning *fossil fuels* (such as oil, gas and coal), of burning *biomass*, of *land use* changes (LUC) and of industrial processes (e.g., cement production). It is the principal *anthropogenic* greenhouse gas (GHG) that affects the Earth's radiative balance. It is the reference gas against which other GHGs are measured and therefore has a Global Warming Potential (GWP) of 1. See also *Global warming*, *Greenhouse gas (GHG)*, *Land*, and *Ocean acidification (OA)*.

Carbon dioxide removal (CDR) *Anthropogenic* activities removing *carbon dioxide (CO_2)* from the *atmosphere* and durably storing it in geological, terrestrial, or *ocean* reservoirs, or in products. It includes existing and potential anthropogenic enhancement of biological or geochemical CO_2 *sinks* and direct air capture and storage, but excludes natural CO_2 *uptake* not directly caused by human activities. See also *Greenhouse gas removal (GGR)*, *Mitigation (of climate change)*, and *Negative emissions*.

Carbon price The price for avoided or released *carbon dioxide (CO_2)* or CO_2-equivalent emissions. This may refer to the rate of a carbon tax, or the price of emission permits. In many models that are used to assess the economic costs of *mitigation*, carbon prices are used as a proxy to represent the level of effort in mitigation policies.

Carbon sequestration See *Sequestration.*

Carbon sink See *Sink.*

Cascading impacts from *extreme weather/climate events* occur when an extreme *hazard* generates a sequence of secondary events in natural and *human systems* that result in physical, natural, social or economic disruption, whereby the resulting impact is significantly larger than the initial impact. Cascading impacts are complex and multi-dimensional, and are associated more with the magnitude of *vulnerability* than with that of the hazard (modified from Pescaroli & Alexander, 2015). See also *Impacts (consequences, outcomes)*, *Natural systems*, and *Risk.*

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 (WMO). The relevant quantities are most often surface variables such as temperature, precipitation and wind. Climate in a wider sense is the state, including a statistical description, of the *climate system*.

Climate change 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 *United Nations Framework Convention on Climate Change (UNFCCC)*, in its Article 1, defines climate change as: 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods'. The UNFCCC thus makes a distinction between climate change attributable to human activities altering the atmospheric composition and *climate variability* attributable to natural causes. See also *Global warming*, *Ocean acidification (OA)*, and *Detection and attribution.*

Climate extreme (extreme weather or climate event) The occurrence of a value of a weather or *climate* variable above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable. For simplicity, both extreme weather events and extreme climate events are referred to collectively as 'climate extremes'. See also *Extreme weather / climate 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. The initial perturbation can either be externally forced or arise as part of internal variability. See also *Climate variability*, and *Forcing*.

Climate governance See *Governance.*

Climate model A qualitative or quantitative 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 parametrisations are involved. There is an evolution towards more complex models with interactive chemistry and biology scenarios. 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 *Climate sensitivity*, and *Earth system model (ESM).*

Climate projection Simulated response of the *climate system* to a scenario of future emissions or concentrations of *greenhouse gases (GHGs)* and *aerosols* and changes in *land use*, generally derived using *climate models*. Climate projections depend on an emission / concentration / radiative forcing *scenario*, which is in turn based on assumptions concerning, for example, future socioeconomic and technological developments that may or may not be realised. See also *(Model) Ensemble*, *Projection*, and *Radiative forcing.*

Climate-resilient development pathways (CRDPs) Trajectories that strengthen *sustainable development* and efforts to eradicate *poverty* and reduce inequalities while promoting fair and cross-scalar *adaptation* to and *resilience* in a changing *climate*. They raise the ethics, *equity*, and *feasibility* aspects of the deep societal transformation needed to drastically reduce emissions to limit *global warming* (e.g., to well below 2°C) and achieve desirable and liveable futures and *wellbeing* for all. See also *Equality*.

Climate sensitivity The change in the annual *global mean surface temperature (GMST)* in response to a change in the atmospheric *carbon dioxide (CO_2)* concentration or other radiative *forcing*.

> ***Equilibrium climate sensitivity*** The equilibrium (steady state) change in the globally-averaged near-surface temperature following a doubling of the atmospheric carbon dioxide (CO_2) concentration from preindustrial conditions. Often estimated through experiments in atmosphere-ocean general circulation models (AOGCMs) where CO_2 levels are either quadrupled or doubled from *pre-industrial* levels and which are integrated for 100–200 years. A related quantity, the *climate feedback* parameter (unit: W m^{-2} °C^{-1}) refers to the top of *atmosphere* budget change per degree of globally-averaged near-surface temperature change. See also *Climate model*, and *Global mean surface temperature (GMST)*.

Climate system Global system consisting of five major components: the *atmosphere*, the hydrosphere, the *cryosphere*, the lithosphere and the biosphere and the interactions between them. The climate system changes in time under the influence of its own internal dynamics and because of external *forcings* such as volcanic eruptions, solar variations, orbital forcing, and *anthropogenic* forcings such as the changing composition of the atmosphere and *land use* change.

Climate variability Deviations of some *climate* variables from a given mean state (including the occurrence of extremes, etc.) at all spatial and temporal scales beyond that of individual weather events. Variability may be intrinsic, due to fluctuations of processes internal to the *climate system* (internal variability), or to variations in natural or *anthropogenic* external *forcing* (forced variability).

Coast The *land* near to the sea. The term 'coastal' can refer to that land (e.g., as in 'coastal communities'), or to that part of the marine environment that is strongly influenced by land-based processes. Thus, coastal seas are generally shallow and near-shore. The landward and seaward limits of the coastal zone are not consistently defined, neither scientifically nor legally. Thus, coastal waters can either be considered as equivalent to territorial waters (extending 12 nautical miles / 22.2 km from mean low water), or to the full Exclusive Economic Zone, or to *shelf seas*, with less than 200 m water depth. See also *Ocean*, *Ocean deoxygenation,* and *Sea level change (sea level rise, SLR / sea level fall).*

Co-benefits The positive effects that a policy or measure aimed at one objective might have on other objectives, thereby increasing the total benefits for society or the environment. Co-benefits are often subject to *uncertainty* and depend on local circumstances and implementation practices, among other factors. Co-benefits are also referred to as ancillary benefits. See also *Risk*.

Compound events See *Compound weather/climate events.*

Compound weather/climate events The combination of multiple *drivers* and/or *hazards* that contributes to societal and environmental *risk* (Zscheischler et al., 2018).

Compound risks arise from the interaction of *hazards*, which may be characterised by single extreme events or multiple coincident or sequential events that interact with exposed systems or sectors. See also *Extreme weather / climate event*, and *Risk*.

Confidence The robustness 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* across multiple lines of evidence. In this Special Report, confidence is expressed qualitatively (Mastrandrea et al., 2010). See Section 1.8.3 for the list of confidence levels used. See also *Likelihood*, and *Uncertainty.*

Coral reef An underwater *ecosystem* characterised by structure-building stony corals. Warm-water coral reefs occur in shallow seas, mostly in the tropics, with the corals (animals) containing algae (plants) that depend on light and relatively stable temperature conditions. Cold-water coral reefs occur throughout the world, mostly at water depths of 50-500 m. In both kinds of reef, living corals frequently grow on older, dead material, predominantly made of calcium carbonate ($CaCO_3$). Both warm and cold-water coral reefs support high biodiversity of fish and other groups, and are considered to be especially vulnerable to *climate change*. See also *Ocean acidification (OA).*

Cost-benefit analysis Monetary assessment of all negative and positive impacts associated with a given action. Cost-benefit analysis enables comparison of different interventions, investments or strategies and reveal how a given investment or policy effort pays off for a particular person, company or country. Cost-benefit analyses representing society's point of view are important for *climate change* decision-making, but there are difficulties in aggregating costs and benefits across different actors and across timescales. See also *Discounting.*

Cost-effectiveness A measure of the cost at which a policy goal or outcome is achieved. The lower the cost, the greater the cost-effectiveness. See also *Private costs*.

Coupled Model Intercomparison Project (CMIP) A *climate* modelling activity from the World Climate Research Programme (WCRP) which coordinates and archives *climate model* simulations based on shared model inputs by modelling groups from around the world. The CMIP3 multi-model data set includes projections using Special Report on Emissions Scenarios (SRES) scenarios. The CMIP5 data set includes projections using the Representative Concentration Pathways (RCP). The CMIP6 phase involves a suite of common model experiments as well as an ensemble of CMIP-endorsed Model Intercomparison Projects (MIPs). See also *Climate projection*.

Cryosphere The components of the Earth System at and below the *land* and *ocean* surface that are frozen, including snow cover, *glaciers*, *ice sheets*, *ice shelves*, *icebergs*, *sea ice*, lake ice, river ice, *permafrost* and seasonally *frozen ground*. See also *Climate system*.

Cultural services See *Ecosystem services*.

Cumulative emissions The total amount of emissions released over a specified period of time. See also *Carbon budget.*

Deep uncertainty A situation of deep uncertainty exists when experts or stakeholders do not know or cannot agree on: (1) appropriate conceptual models that describe relationships among key driving forces in a system; (2) the probability distributions used to represent uncertainty about key variables and parameters; and/or (3) how to weigh and value desirable alternative outcomes (Lempert et al., 2003).

Deforestation Conversion of *forest* to non-forest. [Note: For a discussion of the term forest and related terms such as afforestation, reforestation, and deforestation in the context of reporting and accounting Article 3.3 and 3.4 activities under the *Kyoto Protocol*, see 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the *Kyoto Protocol*.]

Detection See *Detection and attribution.*

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 a formal assessment of *confidence*.

Developed / developing countries (Industrialised / developed / developing countries) There is a diversity of approaches for categorizing countries on the basis of their level of development, and for defining terms such as industrialised, developed, or developing. Several categorisations are used in this Special Report. (1) In the United Nations (UN) system, there is no established convention for the designation of developed and developing countries or areas. (2) The UN Statistics Division specifies developed and developing regions based on common practice. In addition, specific countries are designated as least developed countries, landlocked developing countries, *small island developing states (SIDS)*, and transition economies. Many countries appear in more than one of these categories. (3) The World Bank uses income as the main criterion for classifying countries as low, lower middle, upper middle, and high income. (4) The UN Development Programme (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.

Development pathways See *Pathways.*

Disaster A 'serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts' (UNISDR, 2017). See also *Disaster risk management (DRM)*, *Exposure*, *Hazard*, *Risk*, and *Vulnerability*.

Disaster risk management (DRM) Processes for designing, implementing, and evaluating strategies, policies, and measures to improve the understanding of current and future disaster *risk*, foster *disaster* risk reduction and transfer, and promote continuous improvement in disaster preparedness, prevention and protection, response, and recovery practices, with the explicit purpose of increasing human security, *wellbeing*, quality of life, and *sustainable development (SD)*.

Discharge (of ice) Rate of the flow of ice through a vertical section of a *glacier* perpendicular to the direction of the flow of ice. Often used to refer to the loss of mass at marine-terminating glacier fronts (mostly *calving* of *icebergs* and submarine melt), or to mass flowing across the *grounding line* of a floating *ice shelf*. See also *Mass balance / budget (of glaciers or ice sheets).*

Discounting A mathematical operation that aims to make 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 from year to year that makes future value worth less today (if the discount rate is positive). The choice of discount rate(s) is debated as it is a judgement based on hidden and/or explicit values.

Discount rate See *Discounting*.

Displacement See *(Internal) Displacement (of humans).*

Dissolved inorganic carbon The combined total of different types of non-organic carbon in (seawater) solution, comprising carbonate (CO_3^{2-}), bicarbonate (HCO_3^-), carbonic acid (H_2CO_3) and *carbon dioxide (CO_2)*.

Dissolved organic carbon (DOC) and particulate organic carbon (POC) Organic carbon types –for example, in the *ocean*– operationally separated by filtration. Filter pore size typically is 0.45 micrometres but may vary between 0.22 and 0.7 micrometres, with smaller carbon types in the solution (DOC) and larger carbon types (POC) being filtered out. In the global ocean, the ratio of DOC and POC is approximately 20:1. DOC can be further classified as labile DOC (LDOC) and refractory DOC (RDOC; also known as recalcitrant DOC). In the global ocean, DOC is mainly (>90%) comprised of RDOC. RDOC can be generated by *microbial carbon pump* processes, and is able to persist for hundreds to thousands of years due to its resistance to microbial decomposition. LDOC occurs mainly in surface seawaters and is readily available for biological utilisation or decomposition. See also *Carbon cycle.*

Downscaling A method that derives local- to regional-scale (up 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 are based on observations and 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 quality of the downscaled information. The two methods can be combined, e.g., applying empirical/statistical downscaling to the output of a regional climate model, consisting of a dynamical downscaling of a global climate model.

Driver Any natural or human-induced factor that directly or indirectly causes a change in a system (adapted from MEA, 2005). See also *Forcing*.

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. See also *Heatwave*, and *Hydrological cycle.*

Early warning systems (EWS) The set of technical and institutional capacities to forecast, predict, and communicate timely and meaningful warning information to enable individuals, communities, managed *ecosystems*, and organisations threatened by a *hazard* to prepare to act promptly and appropriately to reduce the possibility of harm or loss. Dependent upon context, EWS may draw upon scientific and/or *indigenous knowledge*, and other knowledge types. EWS are also considered for ecological applications, e.g., conservation, where the organisation itself is not threatened by hazard but the ecosystem under conservation is (e.g., coral bleaching alerts), in agriculture (e.g., warnings of heavy rainfall, *drought*, ground frost, and hailstorms) and in fisheries (e.g., warnings of storm, *storm surge*, and tsunamis) (UNISDR 2009; IPCC, 2012a). See also *Disaster*, *Institutions*, *Local knowledge*, and *Loss and Damage, and losses and damages*.

Earth system model (ESM) A coupled *atmosphere–ocean* general circulation model (AOGCM) in which a representation of the *carbon cycle* is included, allowing for interactive calculation of atmospheric *carbon dioxide (CO_2)* 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.*

Ecosystem 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. See also *Ecosystem services.*

Ecosystem-based adaptation (EBA) See *Adaptation*.

Ecosystem services Ecological processes or functions having monetary or non-monetary value to individuals or society at large. These are frequently classified as (1) supporting services such as productivity or *biodiversity* maintenance, (2) provisioning services such as food or fibre, (3) regulating services such as climate regulation or carbon *sequestration* and (4) cultural services such as tourism or spiritual and aesthetic appreciation. See also *Ecosystem*, and *Nature's Contribution to People (NCP).*

Elevation-dependent warming (EDW) Characteristic of many regions where mountains are located, in which past and/or future surface air temperature changes vary neither uniformly nor linearly with elevation. In many cases, warming is enhanced within or above a certain elevation range.

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 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 Tahiti and Darwin and/or the *sea surface temperatures (SST)* 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 SSTs warm, further weakening the trade winds. This phenomenon has a great impact on the wind, SST and precipitation patterns in the tropical Pacific. It has climatic effects throughout the Pacific region and in many other parts of the world, through global *teleconnections*. The cold phase of ENSO is called La Niña. See also *Climate*.

Emission pathways See *Pathways*.

Emission scenario A plausible representation of the future development of emissions of substances that are radiatively active (e.g., *greenhouse gases (GHGs)*, or *aerosols*) based on a coherent and internally consistent set of assumptions about driving forces (such as demographic and socio-economic development, technological change, energy and *land use*) and their key relationships. Concentration scenarios, derived from emission scenarios, are often used as input to a *climate model* to compute *climate projections*. See also

Driver, *Forcing*, *Mitigation scenario*, *Radiative forcing*, *Representative concentration pathways* (*RCPs*, under *Pathways*), *Shared socio-economic pathways* (*SSPs*, under *Pathways*), and *Scenario.*

Endemic species Plants and animals that are only found in one geographic region (Gallardo et al. 2018). See also *Alien (non-native) species*, *Ecosystem*, and *Invasive species*.

Enhanced weathering A proposed method to increase the natural rate of removal of *carbon dioxide (CO_2)* from the *atmosphere* using silicate and carbonate rocks. The active surface area of these minerals is increased by grinding, before they are actively added to soil, beaches or the open *ocean*. See also *Carbon dioxide removal (CDR)*, *Geoengineering*, and *Sequestration*.

Ensemble See *(Model) Ensemble*.

Equality A principle that ascribes equal worth to all human beings, including equal opportunities, rights, and obligations, irrespective of origins.

> ***Inequality*** Uneven opportunities and social positions, and processes of discrimination within a group or society, based on gender, class, ethnicity, age, and (dis)ability, often produced by uneven development. Income inequality refers to gaps between highest and lowest income earners within a country and between countries.

See also *Equity.*

Equilibrium climate sensitivity See *Climate sensitivity*.

Equity The principle of being fair and impartial, and a basis for understanding how the *impacts* and responses to *climate change*, including costs and benefits, are distributed in and by society in more or less equal ways. Often aligned with ideas of *equality*, *fairness* and *justice* and applied with respect to equity in the responsibility for, and distribution of, *climate* impacts and policies across society, generations, and gender, and in the sense of who participates and controls the processes of decision-making.

> ***Distributive equity*** Equity in the consequences, outcomes, costs and benefits of actions or policies. In the case of climate change or climate policies for different people, places and countries, including equity aspects of sharing burdens and benefits for *mitigation* and *adaptation*.
>
> ***Gender equity*** Equity between women and men with regard to their rights, resources and opportunities. In the case of climate change, gender equity recognises that women are often more vulnerable to the impacts of climate change and may be disadvantaged in the process and outcomes of climate policy.
>
> ***Inter-generational equity*** Equity between generations that, in the context of climate change, acknowledges that the effects of past and present emissions, vulnerabilities and policies impose costs and benefits for people in the future and of different age groups.
>
> ***Procedural equity*** Equity in the process of decision-making including recognition and inclusiveness in participation, equal representation, bargaining power, voice and equitable access to knowledge and resources to participate.

Evidence Data and information used in the scientific process to establish findings. In this report, the degree of evidence reflects the amount, quality, and consistency of scientific/technical information on which the Lead Authors are basing their findings. See also *Agreement*, *Confidence*, *Likelihood*, and *Uncertainty.*

Evolutionary adaptation See *Adaptation.*

Exposure The presence of people; *livelihoods*; species or *ecosystems*; environmental functions, services, and resources; infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected. See also *Hazard*, *Risk*, and *Vulnerability.*

Extratropical cyclone Any cyclonic-scale storm that is not a *tropical cyclone*. Usually refers to a middle- or high-latitude migratory storm system formed in regions of large horizontal temperature variations. Sometimes called extratropical storm or extratropical low.

Extreme event See *Extreme weather / climate event*.

Extreme sea level See *Storm surge.*

Extreme weather / climate 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 classified as an extreme climate event, especially if it yields an average or total that is itself extreme (e.g., high temperature, *drought*, or total rainfall over a season). See also *Heat wave*, and *Climate extreme (extreme weather or climate event).*

Fairness Impartial and just treatment without favouritism or discrimination in which each person is considered of equal worth with equal opportunity. *See also Equity*, *Equality* and *Ethics.*

Feasibility The degree to which climate goals and response options are considered possible and/or desirable. Feasibility depends on geophysical, ecological, technological, economic, social and *institutional* conditions for change. Conditions underpinning feasibility are dynamic, spatially variable, and may vary between different groups.

> ***Economic feasibility*** An indicator of the benefits and costs of a climate adaptation or response, often expressed as a ratio of the two, used in order to judge whether it is possible or wise to proceed with the option.
>
> ***Social and institutional feasibility*** Institutional feasibility has two key parts: (1) the extent of administrative workload, both for public authorities and for regulated entities, and (2) the extent to which the policy is viewed as legitimate, gains acceptance, is adopted, and is implemented.

Feedback See *Climate feedback.*

Firn Snow that has survived at least one *ablation* season but has not been transformed to *glacier* ice. Its pore space is at least partially interconnected, allowing air and water to circulate. Firn densities typically are 400–830 kg m^{-3}. See also *Cryosphere*.

Flood The overflowing of the normal confines of a stream or other water body, or the accumulation of water over areas that are not normally submerged. Floods can be caused by unusually heavy rain, for example during storms and cyclones. Floods include river (fluvial) floods, flash floods, urban floods, rain (pluvial) floods, sewer floods, *coastal* floods, and *glacial lake outburst floods (GLOFs)*. See also *Runoff.*

Food security A situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2001). [Note: Whilst the term 'food security' explicitly includes nutrition within it 'dietary needs … for an active and healthy life', in the past the term has sometimes privileged the supply of energy, especially to the hungry. Thus, the term 'food and nutrition security' is often used (with the same definition as food security) to emphasise that the term food covers both energy and nutrition (FAO, 2009).] See also *Food system*, and *Malnutrition.*

Food system All the elements (environment, people, inputs, processes, infrastructures, *institutions*, etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food, and the output of these activities, including socio-economic and environmental outcomes (HLPE, 2017).

[Note: Whilst there is a global food system (encompassing the totality of global production and consumption), each location's food system is unique, being defined by that place's mix of food produced locally, nationally, regionally or globally.] See also *Food security*.

Forcing The *driver* of a change in the *climate system*, usually through an imbalance between the radiative energy received by and leaving the Earth's surface. See also *Radiative forcing*, and *Short-lived climate forcers (SLCF).*

Forest A vegetation type dominated by trees. Many definitions of the term forest are in use throughout the world, reflecting wide differences in biogeophysical conditions, social structure and economics. [Note: 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 information provided by the *United Nations Framework Convention on Climate Change (UNFCCC*, 2013) and 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).]

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

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

Frozen ground Soil or rock in which part or all of the pore water consists of ice. See also *Permafrost*.

Functional diversity 'The range and value of those species and organismal traits that influence *ecosystem* functioning' (Tilman 2001). See also *Biodiversity*.

General circulation model See *Climate model.*

Geoengineering 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 (1) reduce the amount of absorbed solar energy in the climate system (solar radiation management, or *solar radiation modification, SRM*) or (2) increase net carbon *sinks* from the *atmosphere* at a scale sufficiently large to alter *climate* (i.e., *carbon dioxide removal, CDR*). 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 unclear (IPCC, 2012b, p. 2). See also *Blue carbon*.

Glaciated State of a surface that was covered by *glacier* ice in the past, but not at present.

Glacier A perennial mass of ice, and possibly *firn* and snow, originating on the *land* surface by *accumulation* and compaction of snow and showing evidence of past or present flow. A glacier typically gains mass by accumulation of snow, and loses mass by *ablation*. Land ice masses of continental size (>50,000 km^2) are referred to as *ice sheets* (Cogley et al., 2011). See also *Calving (of glaciers or ice sheets)*, *Cryosphere*, *Grounding line*, and *Mass balance / budget (of glaciers or ice sheets).*

Glacial lake outburst flood (GLOF) / Glacier lake outburst A sudden release of water from a *glacier* lake, including any of the following types – a glacier-dammed lake, a pro-glacial moraine-dammed lake or water that was stored within, under or on the glacier.

Global climate model See *Climate model.*

Global mean surface temperature (GMST) Estimated global average of near-surface air temperatures over *land* and *sea ice*, and *sea surface temperature (SST)* over ice-free *ocean* regions, with changes normally expressed as departures from a value over a specified *reference period*. When estimating changes in GMST, near-surface air temperatures over both land and oceans are also used.

Global warming An increase in *global mean surface temperature (GMST)* averaged over a 30-year period, or the 30-year period centred on a particular year or decade, expressed relative to *pre-industrial* levels unless otherwise specified. For 30-year periods that span past and future years, the current multi-decadal warming trend is assumed to continue. See also *Climate change*, and *Climate variability*.

Governance In this Special Report, governance refers to the effort to establish, reaffirm or change formal and informal *institutions* at all scales to negotiate relationships, resolve social conflicts and realise mutual gains (Paavola, 2007; Williamson, 2000). It refers to how the economy and society are governed or regulated; and how collective interests are defined, reconciled and institutionalised (Peters and Pierre, 2001). Governance may be an act of governments (e.g., a government restricting resource use), non-governmental organisation (e.g., issuing green certification), private actors (e.g., resource users establishing rules or norms for restricting use of a common resource), or any combination of these. Governance does not only include establishing institutions such as laws or policies, but also their implementation, enforcement and monitoring. The term 'governance' is used in diverse and contested ways.

> ***Adaptive governance*** An emerging term in the literature for the evolution of formal and informal institutions of governance that prioritise planning, implementation and evaluation of policy through iterative social learning; in the context of climate change, governance facilitating social learning to steer the use and protection of natural resources, and *ecosystem services*, particularly in situations of complexity and *uncertainty*.
>
> ***Climate governance*** includes efforts to share the burden of emission reduction amongst countries, sectors and groups of society (*mitigation*), and to resolve conflicts involved in, or to realise mutual gains through, adapting to *climate change*.
>
> ***Deliberative governance*** involves decision making through inclusive public conversation which allows opportunity for developing policy options through public discussion rather than collating individual preferences through voting or referenda (although the latter governance mechanisms can also be proceeded and legitimated by public deliberation processes).
>
> ***Multi-level governance*** refers to the dispersion of governance across multiple levels of jurisdiction and decision-making (Hooghe and Marks, 2003), including trans-regional and trans-national, regional, national and local levels. The concept emphasises that modern governance generally consists in, and is more flexible when there is, a vertical 'layering' of governance processes at different levels.
>
> ***Participatory governance*** favours direct public engagement in decision- and policy-making using a variety of techniques such as referenda, community deliberation, citizen juries or participatory budgeting. The approach can be applied in formal and informal institutional contexts from national to local levels, but is usually associated with devolved decision-making (Fung and Wright, 2003; Sarmiento and Tilly, 2018).
>
> ***Polycentric governance*** involves multiple centres of decision-making with overlapping jurisdictions. While the centres have some degree of autonomy, they also take each other into account, coordinating their actions and seeking to resolve conflicts (Carlisle and Gruby, 2017; Jordan et al., 2018; McGinnis and Ostrom, 2012).

Gravity Recovery And Climate Experiment (GRACE) A pair of satellites to measure the Earth's gravity field anomalies from 2002 to 2017. These fields have been used, among other things, to study mass changes of the polar *ice sheets* and *glaciers*. See also *Marine ice sheet instability (MISI)*, and *Mass balance / budget (of glaciers or ice sheets)*.

Green infrastructure The interconnected set of natural and constructed ecological systems, green spaces and other landscape features. It includes planted and indigenous trees, wetlands, parks, green open spaces and original grassland and woodlands, as well as possible building and street level design interventions that incorporate vegetation. Green infrastructure provides services and functions in the same way as conventional infrastructure (Culwick and Bobbins, 2016). See also *Ecosystem*, and *Ecosystem services*.

Greenhouse gases (GHG) Gaseous constituents of the *atmosphere*, both natural and *anthropogenic*, that absorb and emit radiation at specific wavelengths within the spectrum of radiation emitted by the Earth's *ocean* and *land* surface, by the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapour (H_2O), *carbon dioxide (CO_2)*, nitrous oxide (N_2O), *methane (CH_4)* and *ozone (O_3)* are the primary GHGs in the Earth's atmosphere. Human-made GHGs include sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs), chlorofluorocarbons (CFCs) and perfluorocarbons (PFCs); several of these are also O_3-depleting (and are regulated under the Montreal Protocol).

Greenhouse gas removal Withdrawal of a *greenhouse gas (GHG)* and/or a *precursor* from the *atmosphere* by a *sink*. See also *Carbon dioxide removal (CDR)*, and *Negative emissions*.

Gross domestic product (GDP) The sum of gross value added, at purchasers' prices, by all resident and non-resident producers in the economy, plus any taxes and minus any subsidies not included in the value of the products in a country or a geographic region for a given period, normally one year. GDP is calculated without deducting for depreciation of fabricated assets or depletion and degradation of natural resources.

Grounding line The junction between a *glacier* or *ice sheet* and an *ice shelf*; the place where ice starts to float. This junction normally occurs over a zone, rather than at a line.

Habitability The ability of a place to support human life by providing protection from *hazards* which challenge human survival, and by assuring adequate space, food and freshwater.

Hazard The potential occurrence of a natural or human-induced physical event or trend that may cause loss of life, injury, or other health *impacts*, as well as damage and loss to property, infrastructure, *livelihoods*, service provision, *ecosystems* and environmental resources. See also *Disaster*, *Exposure*, *Loss and Damage, and losses and damages*, *Risk*, and *Vulnerability.*

Heat wave A period of abnormally hot weather. Heat waves and warm spells have various and in some cases overlapping definitions. See also *Climate extreme (extreme weather or climate event)*, *Extreme weather event*, and *Marine heatwave.*

Holocene The current interglacial geological epoch, the second of two epochs within the Quaternary period, the preceding being the Pleistocene. The International Commission on Stratigraphy (ICS) defines the start of the Holocene at 11,700 years before 2000 (ICS, 2019).

Hotspot See *Climate hotspot*.

Human behaviour The responses of persons or groups to a particular situation, here likely to relate to *climate change*. Human behaviour covers the range of actions by individuals, communities, organisations, governments and at the international level.

> ***Adaptation behaviour*** Human actions that directly or indirectly affect the *risks* of climate change *impacts*.
>
> ***Mitigation behaviour*** Human actions that directly or indirectly influence *mitigation*.

See also *Adaptation*.

Human mobility The permanent or semi-permanent move by a person for at least one year and involving crossing an administrative, but not necessarily a national, border.

Human rights Rights that are inherent to all human beings, universal, inalienable, and indivisible, typically expressed and guaranteed by law. They include the right to life, economic, social, and cultural rights, and the right to development and self-determination (UNOHCHR, 2018).

> ***Procedural rights*** Rights to a legal procedure to enforce *substantive rights*.

Substantive rights Basic human rights, including the right to the substance of being human such as life itself, liberty, and happiness.

See also *Equity*, *Equality*, *Justice*, and *Wellbeing*.

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 organisations and *institutions* play a major role. Often, but not always, the term is synonymous with society or social system. Systems such as agricultural systems, urban 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 *ocean* and the *land* surface, is carried over the Earth in atmospheric circulation as water vapour, condenses to form clouds, precipitates over the ocean and land as rain or snow, which on land can be intercepted by trees and vegetation, potentially accumulating as snow or ice, provides *runoff* on the land surface, infiltrates into soils, recharges groundwater, discharges into streams, and ultimately, flows into the oceans as rivers, polar *glaciers* and *ice sheets*, from which it will eventually evaporate again. The various systems involved in the hydrological cycle are usually referred to as hydrological systems.

Iceberg Large piece of freshwater ice broken off from a *glacier* or an *ice shelf* during *calving* and floating in open water (at least five metres height above sea level). Smaller pieces of floating ice known as 'bergy bits' (less than 5 metres above sea level) or 'growlers' (less than 2 metres above sea level) can originate from glaciers or ice shelves, or from the breaking up of a large iceberg. Icebergs can also be classified by shape, most commonly being either tabular (steep sides and a flat top) or non-tabular (varying shapes, with domes and spires) (NOAA, 2019). In lakes, icebergs can originate by breaking off shelf ice, which forms through freezing of a lake surface. See also *Calving (of glaciers or ice sheets)*, and *Marine ice cliff instability (MICI).*

Iceberg calving See *Calving (of glaciers or ice sheets).*

Ice core A cylinder of ice drilled out of a *glacier* or *ice sheet* to gain information on past changes in *climate* and composition of the *atmosphere* preserved in the ice or in air trapped in ice.

Ice sheet An ice body originating on *land* that covers an area of continental size, generally defined as covering >50,000 km^2, and that has formed over thousands of years through *accumulation* and compaction of snow. 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*, often 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. The latter is divided into the East Antarctic Ice Sheet (EAIS), the West Antarctic Ice Sheet (WAIS) and the Antarctic Peninsula ice sheet. During glacial periods, there were other ice sheets. See also *Ablation*, *Calving (of glaciers or ice sheets)*, *Grounding line*, *Hydrological cycle*, *Marine ice cliff instability (MICI)*, *Marine ice sheet instability (MISI)*, and *Mass balance / budget (of glaciers or ice sheets)*.

Ice shelf A floating slab of ice originating from *land* of considerable thickness extending from the *coast* (usually of great horizontal extent with a very gently sloping surface), resulting from the flow of *ice sheets*, initially formed by the accumulation of snow, and 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. See also *Calving (of glaciers or ice sheets)*, *Glacier*, *Hydrological cycle*, *Marine ice cliff instability (MICI)*, and *Marine ice sheet instability (MISI)*.

Ice stream A stream of ice with strongly enhanced flow that is part of an *ice sheet*. It is often separated from surrounding ice by strongly sheared, crevassed margins. See also *Outlet glacier*.

Impacts (consequences, outcomes) The consequences of realised *risks* on natural and *human systems*, where risks result from the interactions of climate-related *hazards* (including *extreme weather / climate events*), *exposure*, and *vulnerability*. Impacts generally refer to effects on lives, livelihoods, health and *wellbeing*, *ecosystems* and species, economic, social and cultural assets, services (including *ecosystem services*), and infrastructure. Impacts may be referred to as consequences or outcomes, and can be adverse or beneficial. See also *Adaptation*, *Loss and Damage, and loss and damages*, and *Natural systems.*

Incremental adaptation See *Adaptation.*

Indigenous knowledge (IK) The understandings, skills and philosophies developed by societies with long histories of interaction with their natural surroundings. For many indigenous peoples, IK informs decision-making about fundamental aspects of life, from day-to-day activities to longer term actions. This knowledge is integral to cultural complexes, which also encompass language, systems of classification, resource use practices, social interactions, values, ritual and spirituality. These distinctive ways of knowing are important facets of the world's cultural diversity (UNESCO, 2018). See also *Local knowledge (LK).*

Industrial revolution A period of rapid industrial growth with far-reaching social and economic consequences, beginning in Britain during the second half of the 18th 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*, initially coal, and hence emission of *carbon dioxide (CO_2)*. See also *Pre-industrial*.

Inequality See *Equality.*

Institutions The 'prescriptions' –i.e., rules, norms, and conventions– used by humans 'to organize all forms of repetitive and structured interactions including those within families, neighborhoods, markets, firms, sports leagues, churches, private associations, and governments at all scales' (Ostrom, 2005, p. 3). Institutions can be formal, such as laws and policies, or informal, such as traditions, customs, norms and conventions. Individuals and organisations –such as parliaments, regulatory agencies, private firms, and community bodies– develop and act in response to institutions and the incentives they frame. Institutions can guide, constrain and shape human interaction through direct control, through incentives, and through processes of socialisation.

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.

(Internal) Displacement (of humans) The involuntary movement, individually or collectively, of persons from their country or community, notably for reasons of armed conflict, civil unrest, or natural or man-made *disasters* (adapted from IOM, 2011). See also *Migration (of humans)*, and *Planned relocation (of humans).*

Internal variability See *Climate variability.*

Invasive species A species that is not native to a specific location or nearby, lacking natural controls, and has a tendency to rapidly increase in abundance, displacing native species. Invasive species may also damage the human economy or human health. See also *Alien (non-native) species*, *Ecosystem*, and *Endemic species*.

Irreversibility A perturbed state of a dynamical system is defined as irreversible on a given timescale if the recovery timescale from this state due to natural processes is significantly longer than the time it takes for the system to reach this perturbed state. In the context of this Special Report, the recovery time scale of interest is hundreds to thousands of years. See also *Tipping point.*

Justice is concerned with ensuring that people get what is due to them setting out the moral or legal principles of *fairness* and *equity* in the way people are treated, often based on the ethics and values of society.

Climate justice Justice that links development and *human rights* to achieve a human-centred approach to addressing *climate change*, safeguarding the rights of the most vulnerable people and sharing the burdens and benefits of climate change and its impacts equitably and fairly (MRFJC, 2018).

Distributive justice Justice in the allocation of economic and non-economic costs and benefits across society.

Inter-generational justice Justice in the distribution of economic and non-economic costs and benefits across generations.

Procedural justice Justice in the way outcomes are brought about including who participates and is heard in the processes of decision-making.

Social justice Just or fair relations within society that seek to address the distribution of wealth, access to resources, opportunity, and support according to principles of justice and fairness.

See also *Equity*, and *Human rights.*

Kyoto Protocol The Kyoto Protocol to the *United Nations Framework Convention on Climate Change (UNFCCC)* is an international treaty adopted in December 1997 in Kyoto, Japan, at the Third Session of the Conference of the Parties (COP3) to the UNFCCC. It contains legally binding commitments, in addition to those included in the UNFCCC. Countries included in Annex B of the Protocol (mostly OECD countries and countries with economies in transition) agreed to reduce their anthropogenic *greenhouse gas (GHG)* emissions (*carbon dioxide (CO_2)*, *methane (CH_4)*, nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6)) by at least 5% below 1990 levels in the first commitment period (2008–2012). The Kyoto Protocol entered into force on 16 February 2005 and as of May 2018 had 192 Parties (191 States and the European Union). A second commitment period was agreed in December 2012 at COP18, known as the Doha Amendment to the Kyoto Protocol, in which a new set of Parties committed to reduce GHG emissions by at least 18% below 1990 levels in the period from 2013 to 2020. However, as of May 2018, the Doha Amendment had not received sufficient ratifications to enter into force. See also *Anthropogenic*, and *Paris Agreement*.

Labile dissolved organic carbon (LDOC) See *Dissolved organic carbon (DOC) and particulate organic carbon (POC).*

La Niña See *El Niño-Southern Oscillation*.

Land The terrestrial portion of the biosphere that comprises the natural resources (soil, near-surface air, vegetation and other biota, and water), the ecological processes, topography, and human settlements and infrastructure that operate within that system (FAO, 2007; UNCCD, 1994). See also *Ecosystem services*, and *Land use*.

Land management Sum of *land-use* practices (e.g., sowing, fertilising, weeding, harvesting, thinning, clear-cutting) that take place within broader land-use categories (Pongratz et al., 2018).

Land restoration The process of assisting the recovery of *land* from a degraded *state* (IPBES, 2018; McDonald et al. 2015).

Land use The total of arrangements, activities and inputs applied to a parcel of *land*. 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, conservation and city dwelling). In national *greenhouse gas (GHG)* inventories, land use is classified according to the IPCC land use categories of *forest* land, cropland, grassland, wetlands, settlements, and other lands (see the 2006 IPCC Guidelines for National GHG Inventories for details). See also *Land management*.

Likelihood The chance of a specific outcome occurring, where this might be estimated probabilistically. Likelihood is expressed in this Special Report using a standard terminology (Mastrandrea et al., 2010). See

Section 1.9.2 in this report for the list of likelihood qualifiers used. See also *Agreement*, *Evidence*, *Confidence*, and *Uncertainty.*

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

Local knowledge (LK) The understandings and skills developed by individuals and populations, specific to the places where they live. Local knowledge informs decision-making about fundamental aspects of life, from day-to-day activities to longer term actions. This knowledge is a key element of the social and cultural systems which influence observations of and responses to *climate change*; it also informs *governance* decisions (UNESCO, 2018). See also *Indigenous knowledge (IK).*

Local sea level change Change in sea level relative to a datum (such as present-day mean sea level) at spatial scales smaller than 10 km. See also *Regional sea level change*, and *Sea level change (sea level rise, SLR / sea level fall).*

Lock-in A situation in which the future development of a system, including infrastructure, technologies, investments, *institutions*, and behavioural norms, is determined or constrained ('locked in') by historic developments.

Loss and Damage, and losses and damages Research has taken the term 'Loss and Damage' (capitalised letters) to refer to political debate under the *United Nations Framework Convention on Climate Change (UNFCCC)* following the establishment of the Warsaw Mechanism on Loss and Damage in 2013, which is to 'address loss and damage associated with impacts of climate change, including extreme events and slow onset events, in developing countries that are particularly vulnerable to the adverse effects of climate change.' The expression 'losses and damages' (lowercase letters) has been taken to refer broadly to harm from (observed) *impacts* and (projected) *risks* (Mechler et al., 2018).

Maladaptive actions (Maladaptation) Actions that may lead to increased *risk* of adverse *climate*-related outcomes, including via increased *greenhouse gas (GHG)* emissions, increased *vulnerability* to *climate change*, or diminished welfare, now or in the future. Maladaptation is usually an unintended consequence. See also *Adaptation*, and *Adaptive capacity*.

Marine heatwave A period of extreme warm near-*sea surface temperature* that persists for days to months and can extend up to thousands of kilometres. See also *Climate extreme (extreme weather or climate event)*, *Extreme weather event*, and *Heat wave.*

Marine ice cliff instability (MICI) A hypothetic mechanism of an ice cliff failure. In case a marine-terminated *ice sheet* loses its buttressing *ice shelf*, an ice cliff can be exposed. If the exposed ice cliff is tall enough (about 800 m of the total height, or about 100 m of the above-water part), the stresses at the cliff face exceed the strength of the ice, and the cliff fails structurally in repeated *calving* events. See also *Iceberg*, and *Marine ice sheet instability (MISI).*

Marine ice sheet instability (MISI) A mechanism of irreversible (on the decadal to centennial time scale) retreat of a *grounding line* for the marine-terminating *glaciers*, in case the glacier bed slopes towards the *ice sheet* interior. See also *Hydrological cycle*, *Ice shelf*, *Marine ice cliff instability (MICI)*, and *Sea ice.*

Mass balance / budget (of glaciers or ice sheets) Difference between the mass input (*accumulation*) and the mass loss (*ablation*) of an ice body (e.g., a glacier or ice sheet) over a stated time period, which is often a year or a season. Surface mass balance refers to the difference between surface accumulation and surface ablation. See also *Calving (of glaciers or ice sheets)*, and *Discharge (of ice)*.

Measurement, reporting and verification (MRV)

> ***Measurement*** 'Processes of data collection over time, providing basic datasets, including associated accuracy and precision, for the range of relevant variables. Possible data sources are field

measurements, field observations, detection through remote sensing and interviews' (UN REDD, 2009).

Reporting 'The process of formal reporting of assessment results to the *UNFCCC*, according to predetermined formats and according to established standards, especially the Intergovernmental Panel on Climate Change (IPCC) Guidelines and GPG (Good Practice Guidance)' (UN REDD, 2009).

Verification 'The process of formal verification of reports, for example, the established approach to verify national communications and national inventory reports to the UNFCCC' (UN REDD, 2009).

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 subpolar 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.

Atlantic Meridional Overturning Circulation (AMOC) The main current system in the South and North Atlantic Oceans. AMOC transports warm upper-ocean water northwards, and cold, deep water southwards, as part of the global ocean circulation system. Changes in the strength of AMOC can affect other components of the *climate system*.

Methane (CH_4) One of the six *greenhouse gases (GHGs)* to be mitigated under the *Kyoto Protocol* and is the major component of natural gas and associated with all hydrocarbon fuels. Under future *global warming*, there is *risk* of increased methane emissions from thawing *permafrost*, coastal wetlands and sub-sea gas hydrates. See also *Mitigation*.

Microbial carbon pump Microbial processes that transform organic carbon from rapidly-degradable states to biologically-unavailable forms, resulting in long-term carbon storage in the *ocean*. The unavailable states of organic carbon can be due to their intrinsic refractory nature, or to extremely low concentrations of each of the diverse individual molecules. The microbial carbon pump can take place at any depth in the water column and is the principal mechanism generating and sustaining *refractory dissolved organic carbon (RDOC)* in the ocean. See also *Biological (carbon) pump*, *Blue carbon*, and *Dissolved organic carbon (DOC) and particulate organic carbon (POC)*.

Migrant See *Migration.*

Migration (of humans) 'Movement of a person or a group of persons, either across an international border, or within a State. It is a population movement, encompassing any kind of movement of people, whatever its length, composition and causes; it includes migration of refugees, displaced persons, economic *migrants*, and persons moving for other purposes, including family reunification' (IOM, 2018).

Migrant 'Any person who is moving or has moved across an international border or within a State away from his/her habitual place of residence, regardless of (1) the person's legal status; (2) whether the movement is voluntary or involuntary; (3) what the causes for the movement are; or (4) what the length of the stay is' (IOM, 2018).

See also *(Internal) Displacement (of humans).*

Mitigation (of climate change) A human intervention to reduce emissions or enhance the *sinks* of *greenhouse gases (GHG)*.

Mitigation measures In *climate* policy, mitigation measures are technologies, processes or practices that contribute to mitigation, for example renewable energy technologies, waste minimisation processes, public transport commuting practices. See also *Mitigation option.*

Mitigation option A technology or practice that reduces GHG emissions or enhances *sinks*.

Mitigation scenario A plausible description of the future that describes how the (studied) system responds to the implementation of mitigation policies and measures.

See also *Emission scenario*, and *Socio-economic scenarios.*

Mobility See *Human mobility*.

(Model) Ensemble A group of parallel model simulations characterising historical *climate* conditions, climate predictions, or *climate projections*. Variation of the results across the ensemble members may give an estimate of modelling-based *uncertainty*. Ensembles made with the same model but different initial conditions only characterise the uncertainty associated with internal climate variability, whereas multi-model ensembles including simulations by several models also include the impact of model differences. Perturbed parameter ensembles, in which model parameters are varied in a systematic manner, aim to assess the uncertainty resulting from internal model specifications within a single model. Remaining sources of uncertainty unaddressed with model ensembles are related to systematic model errors or biases, which may be assessed from systematic comparisons of model simulations with observations wherever available. See also *Projection.*

Monitoring and evaluation (M & E) Mechanisms put in place at national to local scales to respectively monitor and evaluate efforts to reduce *greenhouse gas (GHG)* emissions and/or adapt to the *impacts* of *climate change* with the aim of systematically identifying, characterising and assessing progress over time. See also *Adaptation.*

Multi-level governance See *Governance.*

Narratives (in the context of scenarios) Qualitative descriptions of plausible future world evolutions, describing the characteristics, general logic and developments underlying a particular quantitative set of *scenarios*. Narratives are also referred to in the literature as 'storylines'. See also *Pathways.*

Nationally determined contributions (NDCs) A term used under the *United Nations Framework Convention on Climate Change (UNFCCC)* whereby a country that has joined the *Paris Agreement* outlines its plans for reducing its emissions. Some countries' NDCs also address how they will adapt to climate change impacts, and what support they need from, or will provide to, other countries to adopt low-carbon pathways and to build climate resilience. According to Article 4 paragraph 2 of the Paris Agreement, each Party shall prepare, communicate and maintain successive NDCs that it intends to achieve.

Natural systems The dynamic physical and biological components of the environment that would operate in the absence of human impacts. Most, if not all, natural systems are also now affected by human activities to some degree.

Nature's contributions to people (NCP) 'All the contributions, both positive and negative, of living nature (i.e., diversity of organisms, *ecosystems*, and their associated ecological and evolutionary processes) to the quality of life for people. Beneficial contributions from nature include such things as food provision, water purification, flood control, and artistic inspiration, whereas detrimental contributions include disease transmission and predation that damages people or their assets. Many NCP may be perceived as benefits or detriments depending on the cultural, temporal or spatial context (Díaz et al, 2018).' See also *Biodiversity*, and *Ecosystem services*.

Near-surface permafrost See *Permafrost.*

Negative emissions Removal of *greenhouse gases (GHGs)* from the *atmosphere* by deliberate human activities, i.e., in addition to the removal that would occur via natural *carbon cycle* processes. See also *Anthropogenic*, *Carbon dioxide removal (CDR)*, and *Greenhouse gas removal (GGR)*.

Net-negative emissions A situation of net-negative emissions is achieved when, as result of human activities, more *greenhouse gases (GHG)* are removed from the *atmosphere* than are emitted into it. Where multiple GHG are involved, the quantification of *negative emissions* depends on the *climate* metric chosen to compare emissions of different gases (such as *global warming* potential, global temperature change potential, and others, as well as the chosen time horizon). See also *Greenhouse gas removal (GGR)*, *Net-zero emissions*, and *Net-zero CO_2 emissions*.

Net-zero CO_2 emissions Net-zero *carbon dioxide (CO_2)* emissions are achieved when *anthropogenic* CO_2 emissions are balanced by anthropogenic CO_2 removals over a specified period. See also *Carbon dioxide removal (CDR)*, *Greenhouse gas removal (GGR)*, *Net zero emissions*, and *Net negative emissions*.

Net-zero emissions Net-zero emissions are achieved when *anthropogenic* emissions of *greenhouse gases (GHG)* to the *atmosphere* are balanced by anthropogenic removals over a specified period. Where multiple GHG are involved, the quantification of net-zero emissions depends on the *climate* metric chosen to compare emissions of different gases (such as *global warming* potential, global temperature change potential, and others, as well as the chosen time horizon). See also *Greenhouse gas removal (GGR)*, *Net-zero CO_2 emissions*, *Negative emissions*, and *Net-negative emissions*.

Ocean The interconnected body of saline water that covers 71% of the Earth's surface, contains 97% of the Earth's water and provides 99% of the Earth's biologically-habitable space. It includes the Arctic, Atlantic, Indian, Pacific and Southern Oceans, as well as their marginal seas and coastal waters. See also *Blue carbon*, *Coast*, *Ocean acidification (OA)*, *Ocean deoxygenation,* and *Southern Ocean*.

Ocean acidification (OA) A reduction in the *pH* of the *ocean*, accompanied by other chemical changes (primarily in the levels of carbonate and bicarbonate ions), over an extended period, typically decades or longer, which is caused primarily by *uptake* of *carbon dioxide (CO_2)* from the *atmosphere*, but can also be caused by other chemical additions or subtractions from the ocean. *Anthropogenic* OA refers to the component of pH reduction that is caused by human activity (IPCC, 2011, p. 37). See also *Carbon cycle*, *Climate change*, and *Global warming*.

Ocean deoxygenation The loss of oxygen in the *ocean*. It results from ocean warming, which reduces oxygen solubility and increases oxygen consumption and *stratification*, thereby reducing the mixing of oxygen into the ocean interior. Deoxygenation can also be exacerbated by the addition of excess nutrients in the *coastal* zone.

Outburst flood See *Glacier lake outburst / Glacial lake outburst flood (GLOF)*.

Outlet glaciers A *glacier*, usually between rock walls, that is part of, and drains an *ice sheet*. See also *Ice stream*, and *Hydrological cycle*.

Outflow See *Discharge (of ice)*.

Overshoot See *Temperature overshoot*.

Ozone (O_3) The triatomic form of oxygen, and a gaseous *atmospheric* constituent. In the troposphere, O_3 is created both naturally and by photochemical reactions involving gases resulting from human activities (e.g., smog). Tropospheric O_3 acts as a *greenhouse gas (GHG)*. In the stratosphere, O_3 is created by the interaction between solar ultraviolet radiation and molecular oxygen (O_2). Stratospheric O_3 plays a dominant role in the stratospheric radiative balance. Its concentration is highest in the ozone layer. See also *Anthropogenic*, and *Radiative forcing*.

Paris Agreement The Paris Agreement under the *United Nations Framework Convention on Climate Change (UNFCCC)* was adopted in December 2015 in Paris, France, at the 21st session of the Conference of the Parties (COP) to the UNFCCC. The agreement, adopted by 196 Parties to the UNFCCC, entered into force on 4 November 2016 and as of May 2018 had 195 Signatories and was ratified by 177 Parties. One of the goals of the Paris Agreement is ‘Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-

industrial levels', recognising that this would significantly reduce the risks and impacts of climate change. Additionally, the Agreement aims to strengthen the ability of countries to deal with the impacts of climate change. The Paris Agreement is intended to become fully effective in 2020. See also *Kyoto Protocol*, and *Nationally determined contributions (NDCs).*

Participatory governance See *Governance*.

Particulate organic carbon (POC) See *Dissolved organic carbon (DOC) and particulate organic carbon (POC).*

Pathways The temporal evolution of natural and/or *human systems* towards a future state. Pathway concepts range from sets of quantitative and qualitative *scenarios* or *narratives* of potential futures to solution-oriented decision-making processes to achieve desirable societal goals. Pathway approaches typically focus on biophysical, techno-economic, and/or socio-behavioural trajectories and involve various dynamics, goals, and actors across different scales.

Adaptation pathways A series of *adaptation* choices involving trade-offs between short-term and long-term goals and values. These are processes of deliberation to identify solutions that are meaningful to people in the context of their daily lives and to avoid potential *maladaptation*.

Development pathways Trajectories based on an array of social, economic, cultural, technological, institutional, and biophysical features that characterise the interactions between human and *natural systems* and outline visions for the future, at a particular scale. See also *Climate-resilient development pathways (CRDPs)*, and *Human systems*.

Emission pathways Modelled trajectories of global anthropogenic emissions over the 21st century are termed emission pathways. Emission pathways are classified by their temperature trajectory over the 21st century: pathways giving at least 50% probability based on current knowledge of limiting *global warming* to below 1.5°C are classified as 'no overshoot'; those limiting warming to below 1.6°C and returning to 1.5°C by 2100 are classified as '1.5°C limited overshoot'; while those exceeding 1.6°C but still returning to 1.5°C by 2100 are classified as 'higher overshoot'. See also *Temperature overshoot*.

Representative concentration pathways (RCPs) *Scenarios* that include time series of emissions and concentrations of the full suite of *greenhouse gases (GHGs)* 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' emphasises the fact that not only the long-term concentration levels, but also the trajectory taken over time to reach that outcome are of interest (Moss et al., 2010). RCPs were used to develop *climate projections* in *Coupled Model Intercomparison Project* CMIP5.

- RCP2.6: One pathway where radiative forcing peaks at approximately 3 W m^{-2} and then declines to be limited at 2.6 W m^{-2} in 2100 (the corresponding Extended Concentration Pathway (ECP) assuming constant emissions after 2100).
- RCP4.5 and RCP6.0: Two intermediate stabilisation pathways in which radiative forcing is limited at approximately 4.5 W m^{-2} and 6.0 W m^{-2} in 2100 (the corresponding ECPs assuming constant concentrations after 2150).
- RCP8.5: One high pathway which leads to >8.5 W m^{-2} in 2100 (the corresponding ECP assuming constant emissions after 2100 until 2150 and constant concentrations after 2250). See also *Shared Socio-economic Pathways (SSPs).*

Shared socio-economic pathways (SSPs) were developed to complement the *RCPs* with varying socio-economic challenges to *adaptation* and *mitigation* (O'Neill et al., 2014). Based on five *narratives*, the SSPs describe alternative socio-economic futures in the absence of *climate* policy intervention, comprising *sustainable development* (SSP1), regional rivalry (SSP3), *inequality* (SSP4), *fossil-fueled* development (SSP5), and a middle-of-the-road development (SSP2) (O'Neill et al., 2017;

Riahi et al., 2017). The combination of SSP-based socio-economic *scenarios* and RCP-based *climate projections* provides an integrative frame for climate impact and policy analysis.

Sustainable development pathways (SDPs) Trajectories aimed at attaining the *Sustainable Development Goals (SDGs)* in the short term and the goals of *sustainable development* in the long term. In the context of *climate change*, such pathways denote trajectories that address social, environmental, and economic dimensions of sustainable development, *adaptation* and *mitigation*, and *transformation*, in a generic sense or from a particular methodological perspective such as *integrated assessment* models and *scenario* simulations.

See also *Emission scenario*, *Institution*, *Mitigation scenario*, and *Natural Systems.*

Pelagic The pelagic zone consists of the entire water column of the open *ocean*. It is subdivided into the 'epipelagic zone' (<200 m, the uppermost part of the ocean that receives enough sunlight to allow photosynthesis), the 'mesopelagic zone' (200–1000 m depth) and the 'bathypelagic zone' (>1000 m depth). The term ‘pelagic’ can also refer to organisms that live in the pelagic zone.

Permafrost Ground (soil or rock, and included ice and organic material) that remains at or below 0°C for at least two consecutive years (Harris et al., 1988). Note that permafrost is defined via temperature rather than ice content and, in some instances, may be ice-free.

Near-surface permafrost Permafrost within ~3–4 m of the ground surface. The depth is not precise, but describes what commonly is highly relevant for people and *ecosystems*. Deeper permafrost is often progressively less ice-rich and responds more slowly to warming than near-surface permafrost. Presence or absence of near-surface permafrost is not the only significant metric of permafrost change, and deeper permafrost may persist when near-surface permafrost is absent.

Permafrost degradation Decrease in the thickness and/or areal extent of permafrost.

Permafrost thaw Progressive loss of ground ice in permafrost, usually due to input of heat. Thaw can occur over decades to centuries over the entire depth of permafrost ground, with impacts occurring while thaw progresses. During thaw, temperature fluctuations are subdued because energy is transferred by phase change between ice and water. After the transition from permafrost to non-permafrost, ground can be described as thawed.

See also *Cryosphere*, and *Frozen ground*.

Permafrost degradation See *Permafrost.*

Permafrost thaw See *Permafrost.*

pH A dimensionless measure of the acidity of a solution given by its concentration of hydrogen ions (H^+). pH is measured on a logarithmic scale where $pH = -\log_{10}(H^+)$. Thus, a pH decrease of 1 unit corresponds to a 10-fold increase in the concentration of H^+, or acidity. See also *Ocean acidification (OA)*.

Planned relocation (of humans) A form of human mobility response in the face of sea level rise and related *impacts*. Planned relocation is typically initiated, supervised and implemented from national to local level and involves small communities and individual assets but may also involve large populations. Also termed resettlement, managed retreat, or managed realignment. See also *(Internal) Displacement (of humans)*, and *Sea level change (sea level rise, SLR / sea level fall)*.

Plasticity Change in organismal trait values in response to an environmental cue, and which does not require change in underlying DNA sequence.

Political economy The set of interlinked relationships between people, the state, society and markets as defined by law, politics, economics, customs and power that determine the outcome of trade and transactions and the distribution of wealth in a country or economy.

Poverty 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). See also *Equality*, and *Poverty eradication.*

Poverty eradication A set of measures to end *poverty* in all its forms everywhere. See also *Sustainable Development Goals (SDGs)*.

Precursors Atmospheric compounds that are not *greenhouse gases (GHGs)* or *aerosols*, but that have an effect on GHG or aerosol concentrations by taking part in physical or chemical processes regulating their production or destruction rates.

Pre-industrial The multi-century period prior to the onset of large-scale industrial activity around 1750. In this Special Report, as in IPCC 2018a, the *reference period* 1850–1900 is used to approximate pre-industrial *global mean surface temperature (GMST)*. See also *Industrial Revolution*.

Private costs Costs carried by individuals, companies or other private entities that undertake an action, whereas social costs include additionally the external costs on the environment and on society as a whole. Quantitative estimates of both private and social costs may be incomplete, because of difficulties in measuring all relevant effect.

Primary production The synthesis of organic compounds by plants and microbes, on *land* or in the *ocean*, primarily by photosynthesis using light and *carbon dioxide (CO_2)* as sources of energy and carbon respectively. It can also occur through chemosynthesis, using chemical energy, e.g., in deep sea vents.

Gross primary production (GPP)
The total amount of carbon fixed by photosynthesis over a specified time period.

Net primary production (NPP)
The amount of carbon fixed by photosynthesis minus the amount lost by respiration over a specified time period.

Projection 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 socio-economic and technological developments that may or may not be realised. See also *Climate projection*, *(Model) ensemble*, *Scenario*, and *Pathways.*

Radiative forcing The change in the net, downward minus upward, radiative flux (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 (CO_2)*, the concentration of volcanic *aerosols* or in the output of the Sun. 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. Radiative forcing is not to be confused with cloud radiative forcing, which describes an unrelated measure of the impact of clouds on the radiative flux at the top of the atmosphere.

Reasons for concern (RFC) 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 *risks* from various sectors, considering *hazards*, *exposures*, *vulnerabilities*, capacities to adapt, and the resulting *impacts*.

Reference period The period relative to which *anomalies* are computed.

Refractory dissolved organic carbon (RDOC) See *Dissolved organic carbon (DOC) and particulate organic carbon (POC).*

Region A relatively large-scale *land* or *ocean* area characterised by specific geographical and climatological features. The *climate* of a land-based region is affected by regional and local scale features like topography, *land use* characteristics and large water bodies, as well as remote influences from other regions, in addition to global climate conditions. The IPCC defines a set of standard regions for analyses of observed climate trends and climate model *projections* (see IPCC, 2018a, Figure 3.2; IPCC 2012a).

Regional sea level change Change in sea level relative to a datum (such as present-day mean sea level) at spatial scales of about 100 km.

Relative sea level Sea level measured by a tide gauge with respect to the land upon which it is situated. See also *Global mean sea level*, *Coast*, *Small Island Developing States (SIDS)*, *Local sea level*, *Regional sea level change*, *Sea level change (sea level rise, SLR / sea level fall)*, *Steric sea level change*, and *Anthropogenic subsidence*.

Relocation See *Planned relocation (of humans)*.

Reporting See *Measurement / Measurement, reporting and verification (MRV)*.

Representative concentration pathways (RCPs) See *Pathways.*

Resettlement See *Planned relocation (of humans)*.

Residual risk The *risk* that remains following *adaptation* and risk reduction efforts.

Resilience The capacity of interconnected social, economic and ecological systems to cope with a hazardous event, trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure. Resilience is a positive attribute when it maintains capacity for *adaptation*, learning and/or *transformation* (Arctic Council, 2016). See also *Hazard*, *Risk*, and *Vulnerability.*

Restoration In environmental context, restoration involves human interventions to assist the recovery of an *ecosystem* that has been previously degraded, damaged or destroyed.

Risk The potential for adverse consequences for human or ecological systems, recognising the diversity of values and objectives associated with such systems. In the context of *climate change*, risks can arise from potential *impacts* of climate change as well as human responses to climate change. Relevant adverse consequences include those on lives, *livelihoods*, health and *wellbeing*, economic, social and cultural assets and investments, infrastructure, services (including *ecosystem services*), *ecosystems* and species.

In the context of climate change impacts, risks result from dynamic interactions between climate-related *hazards* with the *exposure* and *vulnerability* of the affected human or ecological system to the hazards. Hazards, exposure and vulnerability may each be subject to *uncertainty* in terms of magnitude and *likelihood* of occurrence, and each may change over time and space due to socio-economic changes and human decision-making.

In the context of climate change responses, risks result from the potential for such responses not achieving the intended objective(s), or from potential trade-offs with, or negative side-effects on, other societal objectives, such as the *Sustainable Development Goals (SDGs)*. Risks can arise for example from uncertainty in implementation, effectiveness or outcomes of climate policy, climate-related investments, technology development or adoption, and system transitions.

See also *Adaptation*, *Human systems*, *Mitigation*, and *Risk management.*

Risk assessment The qualitative and/or quantitative scientific estimation of risks. See also *Risk*, *Risk management*, and *Risk perception.*

Risk management Plans, actions, strategies or policies to reduce the *likelihood* and/or magnitude of adverse potential consequences, based on assessed or perceived *risks*. See also *Risk assessment*, and *Risk perception.*

Risk perception The subjective judgment that people make about the characteristics and severity of a *risk*. See also *Risk assessment*, and *Risk management.*

Runoff The flow of water over the surface or through the subsurface, which typically originates from the part of liquid precipitation and/or snow/ice melt that does not evaporate, transpire or refreeze, and returns to water bodies. See also *Hydrological cycle.*

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 (TC), prices) and relationships. Note that scenarios are neither predictions nor forecasts, but are used to provide a view of the implications of developments and actions. See also *Climate projection*, *Driver*, *Emission scenario*, *Mitigation scenario*, *(Model) ensemble*, *Pathways*, and *Projection.*

Sea ice Ice found at the sea surface that has originated from the freezing of seawater. Sea ice may be discontinuous pieces (ice floes) moved on the *ocean* surface by wind and currents (pack ice), or a motionless sheet attached to the *coast* (land-fast ice). Sea ice concentration is the fraction of the *ocean* covered by ice. Sea ice less than one year old is called first-year ice. Perennial ice is sea ice that survives at least one summer. It may be subdivided into second-year ice and multi-year ice, where multiyear ice has survived at least two summers. See also *Cryosphere.*

Sea level change (sea level rise, SLR / sea level fall) Change to the height of sea level, both globally and locally (*relative sea level* change) at seasonal, annual, or longer time scales due to (1) a change in *ocean* volume as a result of a change in the mass of water in the ocean (e.g., due to melt of *glaciers* and *ice sheets*), (2) changes in ocean volume as a result of changes in ocean water density (e.g., expansion under warmer conditions), (3) changes in the shape of the ocean basins and changes in the Earth's gravitational and rotational fields, and (4) local subsidence or uplift of the *land*. 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 *Anthropogenic subsidence*, *Local sea level change*, *Regional sea level change*, and *Steric sea level change*.

Sea level equivalent (SLE) The SLE of a mass of water, ice, or water vapour is that mass, converted to a volume using a density of 1000 kg m^{-3}, and divided by the present-day *ocean* surface area of 3.625 × 1000 m^2. Thus, 362.5 Gt of water mass added to the ocean correspond to 1 mm of global mean sea level rise. However, more accurate estimates of SLE must account for additional processes affecting mean sea level rise, such as shoreline migration, changes in ocean area, and for vertical land movements. See also *Sea level change (sea level rise, SLR / sea level fall).*

Sea level rise (SLR) See *Sea level change (sea level rise, SLR / sea level fall)*.

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

Sendai Framework for Disaster Risk Reduction The Sendai Framework for Disaster Risk Reduction 2015–2030 outlines seven clear targets and four priorities for action to prevent new, and to reduce existing disaster risks. The voluntary, non-binding agreement recognizes that the State has the primary role to reduce

disaster risk but that responsibility should be shared with other stakeholders including local government, the private sector and other stakeholders, with the aim for the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.

Sequestration The long-term removal of *carbon dioxide (CO_2)* or other forms of carbon from the *atmosphere*, with secure storage on climatically significant time-scales (decadal to century). The period of storage needs to be known for climate modelling and carbon accounting purposes. See also *Blue carbon*, *Carbon dioxide removal (CDR)*, *Sink*, and *Uptake*.

Shared socio-economic pathways (SSPs) See *Pathways.*

Shelf seas Relatively shallow water covering the shelf of continents or around islands. The limit of shelf seas is conventionally considered as 200 m water depth at the continental shelf edge, where there is usually a steep slope to the deep *ocean* floor. During glacial periods, most shelf seas are lost since they become *land* as the build-up of *ice sheets* caused a decrease of global sea level. See also *Coasts*, *Glacier*, and *Ice shelf.*

Short-lived climate forcers (SLCF) A set of compounds that are primarily composed of those with short lifetimes in the *atmosphere* compared to well-mixed *greenhouse gases (GHGs)*, and are also referred to as near-term climate *forcers*. This set of compounds includes *methane (CH_4)*, which is also a well-mixed greenhouse gas, as well as *ozone* (O_3) and *aerosols*, or their *precursors*, and some halogenated species that are not well-mixed GHGs. These compounds do not accumulate in the atmosphere at decadal to centennial timescales, and so their effect on *climate* is predominantly in the first decade after their emission, although their changes can still induce long-term climate effects such as *sea level change*. Their effect can be cooling or warming. A subset of exclusively warming SLCFs is referred to as short-lived climate pollutants. See also *Forcing*, and *Sea level change (sea level rise, SLR / sea level fall)*.

Sink Any process, activity or mechanism which removes a *greenhouse gas (GHG)*, an *aerosol* or a *precursor* of a GHG from the *atmosphere* (UNFCCC Article 1.8). See also *Blue carbon*, *Sequestration*, and *Uptake.*

Small Island Developing States (SIDS), as recognised by the United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States, are a distinct group of developing countries facing specific social, economic and environmental vulnerabilities (UN-OHRLLS, 2011). They were recognised as a special case both for their environment and development at the Rio Earth Summit in Brazil in 1992. Fifty-eight countries and territories are presently classified as SIDS by the UN-OHRLLS, with 38 being UN member states and 20 being Non-UN-Members or Associate Members of the Regional Commissions (UN-OHRLLS, 2018).

Social costs See *Private costs.*

Social-ecological system An integrated system that includes human societies and *ecosystems*, in which humans are part of nature. The functions of such a system arise from the interactions and interdependence of the social and ecological subsystems. The system's structure is characterised by reciprocal feedbacks, emphasising that humans must be seen as a part of, not apart from, nature (Arctic Council, 2016; Berkes and Folke, 1998).

Social learning A process of social interaction through which people learn new behaviours, capacities, values, and attitudes.

Soil moisture Water stored in the soil in liquid or frozen form. Root-zone soil moisture is of most relevance for plant activity. See also *Drought*, and *Permafrost*.

Solar radiation management See *Solar radiation modification (SRM).*

Solar radiation modification (SRM) The intentional modification of the Earth's shortwave radiative budget with the aim of reducing warming. Artificial injection of stratospheric *aerosols*, marine cloud brightening,

and *land* surface *albedo* modification are examples of proposed SRM methods. SRM does not fall within the definitions of *mitigation* and *adaptation* (IPCC, 2012b, p. 2). Note that in the literature, SRM is also referred to as solar radiation management, or albedo enhancement. See also *Geoengineering.*

Solubility pump A physicochemical process that transports dissolved inorganic carbon from the *ocean*'s surface to its interior. The solubility pump is primarily driven by the solubility of *carbon dioxide (CO_2)* (with more CO_2 dissolving in colder water) and the large-scale, thermohaline patterns of ocean circulation. See also *Biological (carbon) pump*, and *Dissolved inorganic carbon.*

Source Any process or activity which releases a *greenhouse gas (GHG)*, an *aerosol* or a *precursor* of a GHG into the *atmosphere* (UNFCCC Article 1.9). See also *Sink.*

Southern Ocean The *ocean* region encircling Antarctica that connects the Atlantic, Indian and Pacific Oceans together, allowing inter-ocean exchange. This region is the main source of much of the deep water of the world's ocean and also provides the primary return pathway for this deep water to the surface (Marshall and Speer, 2012; Toggweiler and Samuels, 1995). The drawing up of deep waters and the subsequent transport into the ocean interior has major consequences for the global heat, nutrient, and carbon balances, as well as the Antarctic *cryosphere* and marine *ecosystems*.

Stabilisation (of GHG or CO_2-equivalent concentration) A state in which the atmospheric concentrations of one *greenhouse gas (GHG)* (e.g., *carbon dioxide, CO_2*) or of a CO_2-equivalent basket of GHGs (or a combination of GHGs and *aerosols*) remains constant over time. See also *Atmosphere*.

Steric sea level change Change in sea level due to thermal expansion and salinity variations. Thermal expansion refers to the increase in volume (and decrease in density) that results from warming water. See also *Anthropogenic subsidence*, *Coast*, *Global mean sea level*, *Local sea level*, *Regional sea level*, *Relative sea level*, *Sea level change (sea level rise, SLR / sea level fall)*, and *Small Island Developing States (SIDS)*.

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. See also *Extreme weather / climate event.*

Stratification Process of forming of layers of (*ocean*) water with different properties such as salinity, density and temperature that act as barrier for water mixing. The strengthening of near-surface stratification generally results in warmer surface waters, decreased oxygen levels in deeper water, and intensification of *ocean acidification (OA)* in the upper ocean. See also *Ocean deoxygenation*.

Subsidence See *Anthropogenic subsidence*.

Sustainability involves ensuring the persistence of natural and *human systems*, implying the continuous functioning of *ecosystems*, the conservation of high *biodiversity*, the recycling of natural resources and, in the human sector, successful application of *justice* and *equity*. See also *Natural systems*, and *Sustainable development (SD)*.

Sustainable development (SD) Development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987) and balances social, economic and environmental concerns. See also *Development pathways* (under *Pathways*), *Sustainability*, and *Sustainable development goals (SDGs)*.

Sustainable development goals (SDGs) The 17 global goals for development for all countries established by the United Nations through a participatory process and elaborated in the 2030 Agenda for *Sustainable Development* (UN, 2015), including ending *poverty* and hunger; ensuring health and *wellbeing*, education, gender *equality*, clean water and energy, and decent work; building and ensuring resilient and sustainable infrastructure, cities and consumption; reducing inequalities; protecting land and water *ecosystems*; promoting peace, *justice* and partnerships; and taking urgent action on *climate change*. See also *Resilience*, and *Sustainability.*

Sustainable development pathways (SDPs) See *Pathways*.

Teleconnection A statistical association between *climate* variables at widely separated, geographically-fixed spatial locations. Teleconnections are caused by large spatial structures such as basin-wide coupled modes of *ocean-atmosphere* variability, Rossby wave-trains, mid-latitude jets, and storm tracks.

Temperature overshoot The temporary exceedance of a specified level of *global warming*, such as 1.5°C. Overshoot implies a peak followed by a decline in global warming, achieved through *anthropogenic* removal of *carbon dioxide (CO_2)* exceeding remaining CO_2 emissions globally. See also *Carbon dioxide removal (CDR)*, and *Emission pathways* (under *Pathways*).

Thermokarst Processes, such as collapse, subsidence and erosion, by which characteristic landforms result from the thawing of ice-rich *permafrost* (Harris et al., 1988).

Time of Emergence (ToE) Time when a specific *anthropogenic* signal related to *climate change* is statistically detected to emerge from the background noise of natural *climate variability* in a *reference period*, for a specific *region* (Hawkins and Sutton, 2012).

Tipping point A level of change in system properties beyond which a system reorganises, often in a non-linear manner, and does not return to the initial state even if the *drivers* of the change are abated. For the *climate system*, the term refers to a critical threshold at which global or regional *climate* changes from one stable state to another stable state. Tipping points are also used when referring to *impact*: the term can imply that an impact tipping point is (about to be) reached in a natural or *human system*. See also *Abrupt climate change*, *Adaptation*, *Irreversibility*, and *Natural Systems.*

Transformation A change in the fundamental attributes of natural and *human systems*.

> ***Societal (social) transformation*** A profound and often deliberate shift initiated by communities toward sustainability, facilitated by changes in individual and collective values and behaviours, and a fairer balance of political, cultural, and *institutional* power in society.
>
> ***Transformative change*** A system-wide change that requires more than technological change through consideration of social and economic factors that with technology can bring about rapid change at scale.

See also *Natural systems.*

Transformational adaptation See *Adaptation.*

Transformative change See *Transformation.*

Transition The process of changing from one state or condition to another in a given period of time. Transition can be in individuals, firms, cities, *regions* and nations, and can be based on incremental or *transformative change*.

Tropical cyclone The general term for 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. See also *Extratropical cyclone.*

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, incomplete understanding of critical processes, or uncertain *projections* of *human behaviour*. 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 IPCC, 2004; Mastrandrea et al., 2010; Moss and Schneider, 2000). See also *Agreement*, *Confidence*, *Deep Uncertainty*, and *Likelihood.*

United Nations Framework Convention on Climate Change (UNFCCC) The UNFCCC was adopted in May 1992 and opened for signature at the 1992 Earth Summit in Rio de Janeiro. It entered into force in March 1994 and as of May 2018 had 197 Parties (196 States and the European Union). The Convention's ultimate objective is the 'stabilisation of *greenhouse gas* concentrations in the *atmosphere* at a level that would prevent dangerous *anthropogenic* interference with the *climate system*'. The provisions of the Convention are pursued and implemented by two treaties: the *Kyoto Protocol* and the *Paris Agreement.*

Uptake The transfer of substances (such as carbon) or energy (e.g., heat) from one compartment of a system to another; for example, in the Earth system from the *atmosphere* to the *ocean* or to the *land*. See also *Sequestration*, and *Sink.*

Vulnerability The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt. See also *Adaptation*, *Exposure*, *Hazard*, and *Risk.*

Water cycle See *Hydrological cycle.*

Wellbeing A state of existence that fulfils various human needs, including material living conditions and quality of life, as well as the ability to pursue one's goals, to thrive, and feel satisfied with one's life. Ecosystem well-being refers to the ability of *ecosystems* to maintain their diversity and quality. See also *Biodiversity*, *Climate-resilient development pathways (CRDPs)*, *Human rights*, and *Sustainable development goals (SDGs).*

References

Arctic Council (2016). *Arctic Resilience Report*. M. Carson and G. Peterson (eds). Stockholm Environment Institute and Stockholm Resilience Centre, Stockholm. http://www.arctic-council.org/arr.

Berkes, F. and C. Folke, 1998: Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 459 pp.

Campbell, A., Kapos, V., Scharlemann, J. P. W., Bubb, P., Chenery, A., Coad, L., Dickson, B., Doswald, N., Khan, M. S. I., Kershaw, F. and Rashid, M. 2009: *Review of the Literature on the Links between Biodiversity and Climate Change: Impacts, Adaptation and Mitigation*. Secretariat of the Convention on Biological Diversity (CBD), Montreal. Technical Series No. 42, 124pp.

Carlisle, K., Gruby, R.L., 2017. Polycentric Systems of Governance: A Theoretical Model for the Commons. Policy Studies Journal 0. https://doi.org/10.1111/psj.12212

Cogley, J.G., R. Hock, L.A. Rasmussen, A.A. Arendt, A. Bauder, R.J. Braithwaite, P. Jansson, G. Kaser, M. Möller, L. Nicholson and M. Zemp, 2011: *Glossary of Glacier Mass Balance and Related Terms*. IHP-VII Technical Documents in Hydrology No. 86, IACS Contribution No. 2, UNESCO-IHP, Paris. 114pp.

Culwick, C. and K. Bobbins, 2016: *A Framework for a Green Infrastructure Planning Approach in the Gauteng City–Region*. GCRO Research Report No. 04, Gauteng City–Region Observatory (GRCO), Johannesburg, South Africa, 127 pp.

Díaz, Sandra, Unai Pascual, Marie Stenseke, Berta Martín-Lópezet al. 2018. "Assessing Nature's Contributions to People." Science (New York, N.Y.) 359 (6373). American Association for the Advancement of Science: 270–72. doi:10.1126/science.aap8826

FAO, 2001: Glossary. In: *The State of Food Insecurity in the World 2001*. Food and Agriculture Organisation of the United Nations (FAO), Rome, Italy, pp. 49–50.

FAO, 2007: Land evaluation: Towards a revised framework. Land and water discussion paper. Food and Agriculture Organisation of the United Nations (FAO), Rome, Italy.

FAO, 2009: Declaration of the World Summit on Food Security. WSFS 2009/2, Food and Agriculture Organisation of the United Nations (FAO), Rome, Italy.

Fung, A. and E.O. Wright (eds.), 2003: *Deepening Democracy: Institutional Innovations in Empowered Participatory Governance*. Verso, London, UK, 312 pp.

Harris, S.A., French, H.M., Heginbottom, J.A., Johnston, G.H., Ladanyi, B., Sego, D.C., van Everdingen, R.O., 1988: *Glossary of Permafrost and Related Ground-Ice Terms.* Technical Memorandum No. 142. Permafrost Subcommittee, Committee on Geotechnical Research, National Research Council of Canada. Retrieved from https://ipa.arcticportal.org/publications/glossary

Hawkins, E. and Sutton, R. 2012: *Time of emergence of climate signals.* Geophysical Research Letters, 39(1).

Hooghe, L., Marks, G., 2003. Unraveling the Central State, but How? Types of Multi-Level Governance. The American Political Science Review 97, 233–243.

IOM, 2011: Glossary on Migration. 2nd Edition. [Richard Perruchoud and Jillyanne Redpath-Cross, eds.] International Organization for Migration (IOM).

IOM, 2018: Key Migration Terms. International Organization for Migration (IOM). Retrieved from: www.iom.int/key–migration–terms.

ICS, 2019: Formal subdivision of the Holocene Series/Epoch. International Commission on Stratigraphy (ICS). Retrieved from http://www.stratigraphy.org/index.php/ics-news-and-meetings/125-formal-subdivision-of-the-holocene-series-epoch

IPBES, 2018: The IPBES assessment report on land degradation and restoration. [Montanarella, L., Scholes, R., and Brainich, A. (eds.)]. Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem services, Bonn, Germany, 744 pp.

IPCC, 2003: Definitions and Methodological Options to Inventory Emissions from Direct Human–induced Degradation of Forests and Devegetation of Other Vegetation Types. [Penman, J., M. Gytarsky, T. Hiraishi, T. Krug, D. Kruger, R. Pipatti, L. Buendia, K. Miwa, T. Ngara, K. Tanabe, and F. Wagner (eds.)]. Institute for Global Environmental Strategies (IGES), Hayama, Kanagawa, Japan, 32 pp.

IPCC, 2004: *IPCC Workshop on Describing Scientific Uncertainties in Climate Change to Support Analysis of Risk of Options. Workshop Report*. Intergovernmental Panel on Climate Change (IPCC), Geneva, Switzerland, 138 pp.

IPCC, 2006: IPCC Guidelines for National Greenhouse Gas Inventories. [H.S. Eggleston, L. Buendia, K. Miwa, T. Ngara, K. Tanabe (eds)]. Institute for Global Environmental Strategies (IGES), Hayama, Kanagawa, Japan, 20 pp.

IPCC, 2012a: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.–K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, 582 pp.

IPCC, 2012b: *Meeting Report of the Intergovernmental Panel on Climate Change Expert Meeting on Geoengineering*. IPCC Working Group III Technical Support Unit, Potsdam Institute for Climate Impact Research, Potsdam, Germany, 99 pp.

IPCC, 2018a: Hoegh-Guldberg, O., D. Jacob, M. Taylor, M. Bindi, S. Brown, I. Camilloni, A. Diedhiou, R. Djalante, K.L. Ebi, F. Engelbrecht, J. Guiot, Y. Hijioka, S. Mehrotra, A. Payne, S.I. Seneviratne, A. Thomas, R. Warren, and G. Zhou, 2018: Impacts of 1.5ºC Global Warming on Natural and Human Systems. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press.

IPCC, 2018b: Annex I: Glossary [R. Matthews (ed.)]. In: Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [V. Masson-Delmotte, P. Zhai, H. O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J. B. R. Matthews, Y. Chen, X. Zhou, M. I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, T. Waterfield (eds.)]. In Press.

ISO, 2014: ISO 16559:2014(en) Solid biofuels – Terminology, definitions and descriptions. International Standards Organisation (ISO). Retrieved from: https://www.iso.org/obp/ui/#iso:std:iso:16559:ed-1:v1:en.

Jordan, A., Huitema, D., Asselt, H. van, Forster, J., 2018. Governing Climate Change: Polycentricity in Action? Cambridge University Press.

Lempert, R. J., S. W. Popper and S. C. Bankes, 2003: Shaping the Next One Hundred Years: New Methods for Quantitative, Long-Term Policy Analysis. RAND Corporation, Santa Monica, CA.

MA, 2005: Appendix D: Glossary. In: *Ecosystems and Human Well–being: Current States and Trends. Findings of the Condition and Trends Working Group* [Hassan, R., R. Scholes, and N. Ash (eds.)]. Millennium Ecosystem Assessment (MA). Island Press, Washington DC, USA, pp. 893–900.

Marshall, J., and K. Speer, 2012: Closure of the meridional over- turning circulation through Southern Ocean upwelling. Nat. Geosci., 5, 171–180, doi:10.1038/ngeo1391

Mastrandrea, M.D. et al., 2010: *Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties*. Intergovernmental Panel on Climate Change (IPCC), Geneva, Switzerland, 6 pp.

McDonald, T., J. Jonson, and K.W. Dixon, 2016: National standards for the practice of ecological restoration in Australia. Restoration Ecology, 24(S1) S4-S32, doi:10.1111/rec.12359.

McGinnis, M.D., Ostrom, E., 2012. Reflections on Vincent Ostrom, Public Administration, and Polycentricity. Public Administration Review 72, 15–25. https://doi.org/10.1111/j.1540-6210.2011.02488.x

Mechler, R., L.M. Bouwer, T. Schinko, S. Surminski, and J. Linnerooth–Bayer (eds.), in press: *Loss and Damage from Climate Change: Concepts, Methods and Policy Options*. Springer International Publishing, 561 pp.

Moss, R.H. and S.H. Schneider, 2000: Uncertainties in the IPCC TAR: Recommendations to Lead Authors for More Consistent Assessment and Reporting. In: Guidance Papers on the Cross Cutting Issues of the Third Assessment Report of the IPCC [Pachauri, R., T. Taniguchi, and K. Tanaka (eds.)]. Intergovernmental Panel on Climate Change (IPCC), Geneva, Switzerland, pp. 33–51

MRFCJ, 2018: Principles of Climate Justice. Mary Robinson Foundation For Climate Justice (MRFCJ). Retrieved from: www.mrfcj.org/principles–of–climate–justice.

NOAA, 2019: What is an iceberg? National Oceanic and Atmospheric Administration. Retrieved from the National Ocean Service website: https://oceanservice.noaa.gov/facts/iceberg.html, 25/06/2018.

O'Neill, B.C. et al., 2014: A new scenario framework for climate change research: the concept of shared socioeconomic pathways. Climatic Change, **122(3)**, 387–400, doi:10.1007/s10584–013–0905–2.

O'Neill, B.C. et al., 2017: The roads ahead: Narratives for shared socioeconomic pathways describing world futures in the 21st century. Global Environmental Change, **42**, 169–180, doi:10.1016j.gloenvcha.2015.01.004.

Ostrom, E., 2005. Understanding institutional diversity. Princeton University Press, Princeton, New Jersey.

Paavola, J., 2007. Institutions and environmental governance: A reconceptualization. Ecological Economics 63, 93–103. https://doi.org/10.1016/j.ecolecon.2006.09.026

Pescaroli & Alexander, 2018: A definition of cascading disasters and cascading effects: Going

beyond the "toppling dominos" metaphor. GRF Davos Planet@Risk, Volume 3, Number 1, Special Issue on the 5th IDRC Davos 2014, March 2015.

Peters, B.G. and J. Pierre, 2001: Developments in intergovernmental relations: towards multi–level governance. Policy & Politics, 29(2), 131–135, doi:10.1332/0305573012501251.

Pongratz, J. et al., 2018: Models meet data: Challenges and opportunities in implementing land management in Earth system models. Global Change Biology, 24(4) 1470-1487, doi: 10.1111/gcb.13988.

Riahi, K. et al., 2017: The Shared Socioeconomic Pathways and their energy, land use, and greenhouse gas emissions implications: An overview. *Global Environmental Change*, **42**, 153–168, doi:10.1016/j.gloenvcha.2016.05.009.

Sarmiento, H. and C. Tilly, 2018: Governance Lessons from Urban Informality. *Politics and Governance*, **6(1)**, 199–202, doi:10.17645/pag.v6i1.1169.

Tàbara, J.D., J. Jäger, D. Mangalagiu, and M. Grasso, 2018: Defining transformative climate science to address high–end climate change. *Regional Environmental Change*, 1–12, doi:10.1007/s10113–018–1288–8.

Termeer, C.J.A.M., A. Dewulf, and G.R. Biesbroek, 2017: Transformational change: governance interventions for climate change adaptation from a continuous change perspective. *Journal of Environmental Planning and Management*, **60(4)**, 558–576, doi:10.1080/09640568.2016.1168288.

Tilman, D. (2001). Functional diversity. In: Encyclopedia of Biodiversity (ed. Levin, S.A.). Academic Press, San Diego, CA, pp. 109–120.

Toggweiler, J. R., and B. Samuels, 1995: Effect of drake passage on the global thermohaline circulation. Deep-Sea Res. I, 42, 477–500, doi:10.1016/0967-0637(95)00012-U

UN, 2015: *Transforming Our World: The 2030 Agenda for Sustainable Development*. A/RES/70/1, United Nations General Assembly (UNGA), New York, NY, USA, 35 pp.

UNCCD, 1994: United Nations Convention to Combat Desertification in countries experiencing serious drought and/or desertification, particularly in Africa. A/AC.241/27, United Nations General Assembly (UNGA), New York, NY, USA, 58 pp.

UNESCO, 2018: Local and Indigenous Knowledge Systems. United Nations Educational, Scientific and Cultural Organization (UNESCO). Retrieved from: www.unesco.org/new/en/natural–sciences/priority–areas/links/related–information/what–is–local–and–indigenous–knowledge.

UNFCCC, 2013: Reporting and accounting of LULUCF activities under the Kyoto Protocol. United Nations Framework Convention on Climatic Change (UNFCCC), Bonn, Germany. Retrieved from: http://unfccc.int/methods/lulucf/items/4129.php.

UNISDR, 2009: *2009 UNISDR Terminology on Disaster Risk Reduction*. United Nations International Strategy for Disaster Reduction (UNISDR), Geneva, Switzerland, 30 pp.

UNISDR, 2017: *Report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction.* https://www.preventionweb.net/files/50683_oiewgreportenglish.pdf

UNOHCHR, 2018: What are Human rights? UN Office of the High Commissioner for Human Rights (UNOHCHR). Retrieved from: www.ohchr.org/EN/Issues/Pages/whatarehumanrights.aspx.

UN–OHRLLS, 2011: *Small Island Developing States: Small Islands Big(ger) Stakes*. Office for the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States (UN–OHRLLS), New York, NY, USA, 32 pp.

UN–OHRLLS, 2018: Small Island Developing States: Country profiles. Office for the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States (UN–OHRLLS). Retrieved from: http://unohrlls.org/about–sids/country–profiles.

UN–REDD, 2009: *Measurement, Assessment, Reporting and Verification (MARV): Issues and Options for REDD*. Draft Discussion Paper, United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN–REDD), Geneva, Switzerland, 12 pp.

WCED, 1987: *Our Common Future*. World Commission on Environment and Development (WCED), Geneva, Switzerland, 400 pp., doi:10.2307/2621529.

Williamson, O.E., 2000. The New Institutional Economics: Taking Stock, Looking Ahead. Journal of Economic Literature 38, 595–613

Zscheischler, J., Westra, S., Hurk, B.J., Seneviratne, S.I., Ward, P.J., Pitman, A., AghaKouchak, A., Bresch, D.N., Leonard, M., Wahl, T. and Zhang, X., 2018: *Future climate risk from compound events.* Nature Climate Change, **8**, 469–477, doi: 10.1038/s41558-018-0156-3.