

Glossary ⁽³²⁾

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

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

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

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

Albedo — The fraction of solar radiation reflected by a surface or object, often expressed as a percentage.

Anthropogenic — Resulting from or produced by human beings.

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

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

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

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

Climate — Climate in a narrow sense is usually defined as the 'average weather', or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. The classical period of time is 30 years, as defined by the World Meteorological Organization (WMO).

Climate change — Climate change refers to any change in climate over time, whether due to natural

⁽³²⁾ This glossary was compiled by selecting the most relevant terms from various glossaries of the IPCC's 4th Assessment reports (IPCC, 2007) (See: <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-annexes.pdf>; <http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-app.pdf>; <http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-annex1.pdf>).

variability or as a result of human activity. This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), which defines 'climate change' as: 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods'.

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

Climate sensitivity — In IPCC reports, equilibrium climate sensitivity refers to the equilibrium change in the annual mean global surface temperature following a doubling of the atmospheric equivalent carbon dioxide concentration. Due to computational constraints, the equilibrium climate sensitivity in a climate model is usually estimated by running an atmospheric general circulation model coupled to a mixed-layer ocean model, because equilibrium climate sensitivity is largely determined by atmospheric processes. Efficient models can be run to equilibrium with a dynamic ocean. The effective climate sensitivity is a related measure that circumvents the requirement of equilibrium. It is evaluated from model output for evolving non-equilibrium conditions. It is a measure of the strengths of the climate feedbacks at a particular time and may vary with forcing history and climate state. The climate sensitivity parameter (units: $^{\circ}\text{C} (\text{W m}^{-2})^{-1}$) refers to the equilibrium change in the annual mean global surface temperature following a unit change in radiative forcing. The transient climate response is the change in the global surface temperature, averaged over a 20-year period, centred at the time of atmospheric carbon dioxide doubling, that is, at year 70 in a 1 % yr^{-1} compound carbon dioxide increase experiment with a global coupled climate model. It is a measure of the strength and rapidity of the surface temperature response to greenhouse gas forcing.

Climate system — The climate system is defined by the dynamics and interactions of five major components: atmosphere, hydrosphere, cryosphere, land surface, and biosphere. Climate system dynamics are driven by both internal and external forcing, such as volcanic eruptions, solar variations, or human-induced modifications to the planetary

radiative balance, for instance via anthropogenic emissions of greenhouse gases and/or land-use changes.

Climate variability — Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability).

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

Cost-benefit analysis — Monetary measurement of all negative and positive impacts associated with a given action. Costs and benefits are compared in terms of their difference and/or ratio as an indicator of how a given investment or other policy effort pays off seen from the society's point of view.

Cryosphere — The component of the climate system consisting of all snow, ice and frozen ground (including permafrost) on and beneath the surface of the Earth and ocean.

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

Emission scenario — A plausible representation of the future development of emissions of substances that are potentially radiatively active (e.g. greenhouse gases, aerosols), based on a coherent and internally consistent set of assumptions about driving forces (such as demographic and

socioeconomic development, technological change) and their key relationships. Concentration scenarios, derived from emission scenarios, are used as input to a climate model to compute climate projections. In IPCC (1992) a set of emission scenarios was presented which were used as a basis for the climate projections in IPCC (1996). These emission scenarios are referred to as the IS92 scenarios. In the IPCC Special Report on Emission Scenarios (Nakićenović and Swart, 2000) new emission scenarios, the so-called SRES scenarios, were published, some of which were used, among others, as a basis for the climate projections presented in TAR-IPCC (2001) and 4AR-IPCC (2007).

Energy balance — The difference between the total incoming and total outgoing energy. If this balance is positive, warming occurs; if it is negative, cooling occurs. Averaged over the globe and over long time periods, this balance must be zero. Because the climate system derives virtually all its energy from the Sun, zero balance implies that, globally, the amount of incoming solar radiation on average must be equal to the sum of the outgoing reflected solar radiation and the outgoing thermal infrared radiation emitted by the climate system. A perturbation of this global radiation balance, be it anthropogenic or natural, is called radiative forcing.

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

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

Feedback — An interaction mechanism between processes is called a feedback. When the result of an initial process triggers changes in a second process and that in turn influences the initial one. A positive

feedback intensifies the original process, and a negative feedback reduces it.

Forecast — Projected outcome from established physical, technological, economic, social, behavioral, etc. patterns.

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

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

Greenhouse gas (GHG) — Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4) and ozone (O_3) are the primary greenhouse gases in the Earth's atmosphere. Moreover, there are a number of entirely human-made greenhouse gases in the atmosphere, such as the halocarbons and other chlorine- and bromine-containing substances, dealt with under the Montreal Protocol. Beside CO_2 , N_2O and CH_4 , the Kyoto Protocol deals with the greenhouse gases sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

Gross domestic product — Gross domestic product (GDP) is the monetary value of all goods and services produced within a nation.

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

Land-use — The total of arrangements, activities and inputs undertaken in a certain land-cover type (a set of human actions). The social and economic purposes for which land is managed (e.g. grazing, timber extraction, and conservation). Land-use change occurs when, e.g. forest is converted to agricultural land or to urban areas.

Likelihood — The likelihood of an occurrence, an outcome or a result, where this can be estimated probabilistically.

Macroeconomic costs — These costs are usually measured as changes in gross domestic product or changes in the growth of gross domestic product, or as loss of welfare or consumption.

Measures — Measures are technologies, processes, and practices that reduce GHG emissions or effects below anticipated future levels. Examples of measures are renewable energy technologies, waste minimization processes and public transport commuting practices, etc.

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

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

Palaeoclimate — Climate during periods prior to the development of measuring instruments, including historic and geologic time, for which only proxy climate records are available.

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

Projection — The potential evolution of a quality or set of quantities, often computed with the

aid of a model. Projections are distinguished from predictions in order to emphasise that projections involve assumptions — concerning, for example, future socio-economic and technological developments, that may or may not be realised — and are therefore subject to substantial uncertainty.

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

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

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

River discharge/streamflow — Water flow within a river channel, for example expressed in m^3/s .

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

Salinisation — The accumulation of salts in soils.

Scenario — A plausible and often simplified description of how the future may develop, based on a coherent and internally consistent set of assumptions about driving forces and key relationships. Scenarios may be derived from projections, but are often based on additional information from other sources, sometimes combined with a narrative storyline.

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

Socio-economic scenarios — Scenarios concerning future conditions in terms of population, gross domestic product and other socio-economic factors relevant to understanding the implications of climate change.

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

Thermal infrared radiation — Radiation emitted by the Earth's surface, the atmosphere and the clouds. It is also known as terrestrial or longwave radiation, and is to be distinguished from the near-infrared radiation that is part of the solar spectrum. Infrared radiation, in general, has a distinctive range of wavelengths (spectrum) longer than the wavelength of the red colour in the visible part of the spectrum. The spectrum of thermal infrared radiation is practically distinct from that of shortwave or solar radiation because of the difference in temperature between the Sun and the Earth-atmosphere system.

Thermohaline circulation — Large-scale circulation in the ocean that transforms low-density upper ocean waters to higher density intermediate and deep waters and returns those waters back to the upper ocean. The circulation is asymmetric, with conversion to dense waters in restricted regions at high latitudes and the return to the surface involving slow upwelling and diffusive processes over much larger geographic regions. The THC is driven by high densities at or near the surface, caused by cold temperatures and/or high salinities, but despite its suggestive though common name, is also driven by mechanical forces such as wind and tides.

Threshold — The level of magnitude of a system process at which sudden or rapid change occurs. A

point or level at which new properties emerge in an ecological, economic or other system, invalidating predictions based on mathematical relationships that apply at lower levels.

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

Vulnerability — Vulnerability is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.

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European Environment Agency

**Impacts of Europe's changing climate
— 2008 indicator-based assessment**

2008 — 246 pp. — 21 x 29.7 cm

ISBN 978-92-9167-372-8

DOI 10.2800/48117

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