
Glossary of Terms

- 1
2
3
- 4 **Adjustment time**
5 See: →Lifetime; see also: →Response time.
6
- 7 **Aerosols**
8 A collection of airborne solid or liquid particles, with a typical size between 0.01 and 10 µm and residing in the
9 atmosphere for at least several hours. Aerosols may be of either natural or anthropogenic origin. Aerosols may
10 influence climate in two ways: directly through scattering and absorbing radiation, and indirectly through acting as
11 condensation nuclei for cloud formation or modifying the optical properties and lifetime of clouds. See: →Indirect
12 aerosol effect.
13 The term has also come to be associated, erroneously, with the propellant used in “aerosol sprays”.
14
- 15 **Afforestation**
16 See: →Forest.
17
- 18 **Albedo**
19 The fraction of solar radiation reflected by a surface or object, often expressed as a percentage. Snow covered surfaces
20 have a high albedo; the albedo of soils ranges from high to low; vegetation covered surfaces and oceans have a low
21 albedo. The Earth’s albedo varies mainly through varying cloudiness, snow, ice, leaf area and land cover changes.
22
- 23 **Altimetry**
24 A technique for the measurement of the elevation of the sea, land or ice surface. For example, the height of the sea
25 surface (with respect to the centre of the Earth or, more conventionally, with respect to a standard “ellipsoid of
26 revolution”) can be measured from space by current state-of-the-art radar altimetry with centimetric precision.
27 Altimetry has the advantage of being a measurement relative to a geocentric reference frame, rather than relative to
28 land level as for a →tide gauge, and of affording quasi-global coverage.
29
- 30 **Anthropogenic**
31 Resulting from or produced by human beings.
32
- 33 **Atmosphere**
34 The gaseous envelope surrounding the Earth. The dry atmosphere consists almost entirely of nitrogen (78.1% volume
35 mixing ratio) and oxygen (20.9% volume mixing ratio), together with a number of trace gases, such as argon (0.93%
36 volume mixing ratio), helium, and radiatively active →greenhouse gases such as carbon dioxide (0.035% volume
37 mixing ratio), and ozone. In addition the atmosphere contains water vapour, whose amount is highly variable but
38 typically 1% volume mixing ratio. The atmosphere also contains clouds and →aerosols.
39
- 40 **Attribution**
41 See: →Detection and attribution.
42
- 43 **Autotrophic respiration**
44 →Respiration by photosynthetic organisms (plants and algae).
45
- 46 **Biomass**
47 The total mass of living organisms in a given area or volume; recently dead plant material is often included as dead
48 biomass.
49
- 50 **Biosphere (terrestrial and marine)**
51 The part of the Earth system comprising all →ecosystems and living organisms, in the atmosphere, on land (terrestrial
52 biosphere) or in the oceans (marine biosphere), including derived dead organic matter, such as litter, soil organic
53 matter and oceanic detritus.
54
- 55 **Black carbon**

1 Operationally defined species based on measurement of light absorption and chemical reactivity and/or thermal
2 stability; consists of soot, charcoal, and/or possible light-absorbing refractory organic matter. (Source: Charlson and
3 Heintzenberg, 1995, p. 401).

4 5 **Burden**

6 The total mass of a gaseous substance of concern in the atmosphere.

7 8 **Carbonaceous aerosol**

9 Aerosol consisting predominantly of organic substances and various forms of →black carbon. (Source: Charlson and
10 Heintzenberg, 1995, p. 401).

11 12 **Carbon cycle**

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

15 16 **Carbon dioxide (CO₂)**

17 The principle carbon containing gas in the atmosphere. See: →Greenhouse gas.

18 19 **Charcoal**

20 Material resulting from charring of biomass, usually retaining some of the microscopic texture typical of plant tissues;
21 chemically it consists mainly of carbon with a disturbed graphitic structure, with lesser amounts of oxygen and
22 hydrogen. See: →Black carbon; Soot particles. (Source: Charlson and Heintzenberg, 1995, p. 402).

23 24 **Climate**

25 Climate in a narrow sense is usually defined as the “average weather”, or more rigorously, as the statistical description
26 in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or
27 millions of years . The classical period is 30 years, as defined by the World Meteorological Organization (WMO).

28 These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider
29 sense is the state, including a statistical description, of the →climate system.

30 31 **Climate change**

32 Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability,
33 persisting for an extended period (typically decades or longer). Climate change may be due to natural internal
34 processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land
35 use.

36 Note that the → Framework Convention on Climate Change (UNFCCC), in its Article 1, defines “climate change” as:
37 “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the
38 global atmosphere and which is in addition to natural climate variability observed over comparable time periods”. The
39 UNFCCC thus makes a distinction between “climate change” attributable to human activities altering the atmospheric
40 composition, and “climate variability” attributable to natural causes.

41 See also: →Climate variability.

42 43 **Climate feedback**

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

47 48 **Climate model (hierarchy)**

49 A numerical representation of the →climate system based on the physical, chemical and biological properties of its
50 components, their interactions and feedback processes, and accounting for all or some of its known properties. The
51 climate system can be represented by models of varying complexity, i.e. for any one component or combination of
52 components a *hierarchy* of models can be identified, differing in such aspects as the number of spatial dimensions, the
53 extent to which physical, chemical or biological processes are explicitly represented, or the level at which empirical
54 →parametrizations are involved. Coupled atmosphere/ocean/sea-ice General Circulation Models (AOGCMs) provide
55 a comprehensive representation of the climate system. There is an evolution towards more complex models with

1 active chemistry and biology.

2 Climate models are applied, as a research tool, to study and simulate the climate, but also for operational purposes,
3 including monthly, seasonal and interannual climate predictions.

4

5 **Climate prediction**

6 A climate prediction or climate forecast is the result of an attempt to produce a most likely description or estimate of
7 the actual evolution of the climate in the future, e.g. at seasonal, interannual or long-term time scales..

8 See also: →Climate projection and →Climate (change) scenario.

9

10 **Climate projection**

11 A →projection of the response of the climate system to →emission or concentration scenarios of greenhouse gases
12 and aerosols, or →radiative forcing scenarios, often based upon simulations by →climate models.

13

14 **Climate scenario**

15 A plausible and often simplified representation of the future climate, based on a coherent and internally consistent set
16 of driving forces and key relations, that has been constructed for explicit use in investigating the potential
17 consequences of anthropogenic climate change, often serving as input to impact models. →Climate projections often
18 serve as the raw material for constructing climate scenarios, but climate scenarios usually require additional
19 information such as about the baseline current climate. A *climate change scenario* is the difference between a climate
20 scenario and the current climate. See: →Scenario.

21

22 **Climate sensitivity**

23 In IPCC reports, *equilibrium climate sensitivity* refers to the equilibrium change in global mean surface temperature
24 following a doubling of the atmospheric (→equivalent) CO₂ concentration. More generally, equilibrium climate
25 sensitivity refers to the equilibrium change in surface air temperature following a unit change in radiative forcing
26 (°C/Wm²). In practice, the evaluation of the equilibrium climate sensitivity requires very long simulations with
27 Coupled General Circulation Models (→Climate model).

28 The *effective climate sensitivity* is a related measure that circumvents this requirement. It is evaluated from model
29 output for evolving non-equilibrium conditions. It is a measure of the strengths of the →feedbacks at a particular time
30 and may vary with forcing history and climate state. Details are discussed in para 9.2.1 of Chapter 9 in this Report.

31

32 **Climate system**

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

38

39 **Climate variability**

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

44 See also: →Climate change.

45

46 **Cloud condensation nuclei**

47 Airborne particles that serve as an initial site for the condensation of liquid water and which can lead to the formation
48 of cloud droplets. See also: →Aerosols.

49

50 **CO₂ fertilization**

51 The enhancement of the growth of plants as a result of increased atmospheric CO₂ concentration. Depending on their
52 mechanism of →photosynthesis, certain types of plants are more sensitive to CO₂ fertilization. In particular, C₃ plants
53 (most crops, trees, temperate grasses and herbs) generally show a larger response to CO₂ than C₄ plants.

54

55 **Cooling degree days**

1 The integral over a day of the temperature above 18°C (e.g. a day with an average temperature of 20°C counts as 2
2 cooling degree days). See also: →Heating degree days.

3

4 **Cryosphere**

5 The component of the →climate system consisting of all snow, ice and permafrost on and beneath the surface of the
6 earth and ocean. See: →Glacier; Ice sheet.

7

8 **Deforestation**

9 See: →Forest.

10

11 **Detection and attribution**

12 Climate varies continually on all time scales. *Detection* of →climate change is the process of demonstrating that
13 climate has changed in some defined statistical sense, without providing a reason for that change. *Attribution* of
14 causes of climate change is the process of establishing the most likely causes for the detected change with some
15 defined level of confidence.

16

17 **Diurnal temperature range**

18 The difference between the maximum and minimum temperature during a day.

19

20 **Dobson Unit (DU)**

21 A unit to measure the total amount of ozone in a vertical column above the Earth's surface. The number of Dobson
22 Units is the thickness in units of 10^{-5} m, that the ozone column would occupy if compressed into a layer of uniform
23 density at a pressure of 1013 hPa, and a temperature of 0°C. One DU corresponds to a column of ozone containing
24 2.69×10^{20} molecules per square meter. A typical value for the amount of ozone in a column of the Earth's atmosphere,
25 although very variable, is 300 DU.

26

27 **Ecosystem**

28 A system of interacting living organisms together with their physical environment. The boundaries of what one
29 wishes to call an ecosystem are somewhat arbitrary, depending on one's focus of interest or study. Thus the extent of
30 an ecosystem may range from very small spatial scales to, ultimately, the entire Earth.

31

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

33 El Niño, in its original sense, is a warm-water current which periodically flows along the coast of Ecuador and Perú,
34 disrupting the local fishery. This oceanic event is associated with a fluctuation of the intertropical surface pressure
35 pattern and circulation in the Indian and Pacific oceans, called the Southern Oscillation. This coupled atmosphere-
36 ocean phenomenon is collectively known as El Niño-Southern Oscillation, or ENSO. During an El Niño event the
37 prevailing trade winds weaken and the equatorial countercurrent strengthens, causing warm surface waters in the
38 Indonesian area to flow eastward to overlie the cold waters of the Perú current. This event has great impact on the
39 wind, sea surface temperature and precipitation patterns in the tropical Pacific. It has climatic effects throughout the
40 Pacific region and in many other parts of the world. The opposite of an El Niño event is called La Niña.

41

42 **Emission scenario**

43 A plausible representation of the future development of emissions of substances that are potentially radiatively active
44 (e.g. greenhouse gases, aerosols), based on a coherent and internally consistent set of driving forces and key relations.
45 *Concentration scenarios*, derived from emission scenarios, are used as input into a climate model to compute
46 →climate projections.

47 In IPCC (1992) a set of emission scenarios was presented which were used as a basis for the climate projections in
48 IPCC (1996). These scenarios are referred to as the IS92 scenarios. In the IPCC Special Report on Emission Scenarios
49 (Nakicenovic *et al.*, 2000) new scenarios, the so called SRES scenarios, were published some of which were used,
50 among others, as a basis for the climate projections presented in Chapter 9 of this Report. For the meaning of some
51 terms related to these scenarios, see →SRES scenarios.

52

53 **Energy balance**

54 Averaged over the globe and over longer time periods, the *energy budget* of the climate system must be in balance.
55 Because the climate system derives all its energy from the Sun, this balance implies that globally the amount of

1 incoming solar radiation must on average be equal to the sum of the outgoing reflected solar radiation and the
2 outgoing infrared radiation emitted by the climate system. A perturbation of this global radiation balance, be it human
3 induced or natural, is called →radiative forcing.

5 **Equilibrium and transient climate experiment**

6 An *equilibrium climate experiment* is an experiment in which a →climate model is allowed to fully adjust to a change
7 in →radiative forcing. Such experiments provide information on the difference between the initial and final states of
8 the model, but not on the time-dependent response. If the forcing is allowed to evolve gradually according to a
9 prescribed →emission scenario, the time dependent response of a climate model may be analysed. Such experiment is
10 called a *transient climate experiment*. See: →Climate projection.

12 **Equivalent CO₂ (carbon dioxide)**

13 The concentration of CO₂ that would cause the same amount of radiative forcing as the given mixture of CO₂ and
14 other greenhouse gases.

16 **Eustatic sea-level change**

17 A change in global average sea level brought about by an alteration to the volume of the world ocean. This may be
18 caused by changes in water density or in the total mass of water. In discussions of changes on geological timescales,
19 this term sometimes also includes changes in global average sea level caused by an alteration to the shape of the ocean
20 basins. In this IPCC Report the term is not used with that sense.

22 **Evapotranspiration**

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

25 **External forcing**

26 See: →Climate system.

28 **Extreme weather event**

29 An extreme weather event is an event that is rare within its statistical reference distribution at a particular place.
30 Definitions of "rare" vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th
31 percentile. By definition, the characteristics of what is called *extreme weather* may vary from place to place.

32 An *extreme climate event* is an average of a number of weather events over a certain period of time, an average which
33 is itself extreme (e.g. rainfall over a season).

35 **Faculae**

36 Bright patches on the Sun. The area covered by faculae is greater during periods of high →solar activity.

38 **Feedback**

39 See: →Climate feedback.

41 **Flux adjustment**

42 To avoid the problem of coupled atmosphere-ocean general circulation models drifting into some unrealistic climate
43 state, adjustment terms can be applied to the atmosphere-ocean fluxes of heat and moisture (and sometimes the
44 surface stresses resulting from the effect of the wind on the ocean surface) before these fluxes are imposed on the
45 model ocean and atmosphere. Because these adjustments are precomputed and therefore independent of the coupled
46 model integration, they are uncorrelated to the anomalies which develop during the integration. In Chapter 8 of this
47 report it is concluded that present models have a reduced need for flux adjustment.

49 **Forest**

50 A vegetation type dominated by trees. Many definitions of the term *forest* are in use throughout the world, reflecting
51 wide differences in bio-geophysical conditions, social structure, and economics. For a discussion of the term *forest*
52 and related terms such as *afforestation*, *reforestation*, and *deforestation*: see the IPCC Report on Land Use, Land-Use
53 Change and Forestry (IPCC, 2000).

55 **Fossil CO₂ (carbon dioxide) emissions**

1 Emissions of CO₂ resulting from the combustion of fuels from fossil carbon deposits such as oil, gas and coal.

2

3 **Framework Convention on Climate Change (UNFCCC)**

4 A treaty signed at the 1992 Earth Summit in Rio de Janeiro by 154 countries and the European Community that
5 entered into force in March 1994. Its ultimate objective is the “stabilization of greenhouse gas concentrations in the
6 atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system”. While no
7 legally binding level of emission is set, the treaty states an aim by Annex I countries to return their emissions to 1990
8 levels by the year 2000. See: →Kyoto Protocol.

9

10 **General Circulation**

11 The large scale motions of the atmosphere and the ocean as a consequence of differential heating on a rotating Earth,
12 aiming to restore the energy balance of the system through transport of heat and momentum.

13

14 **General Circulation Model (GCM)**

15 See: →Climate model.

16

17 **Geoid**

18 The surface which an ocean of uniform density would assume if it were in steady state and at rest (i.e. no ocean
19 circulation and no applied forces other than the gravity of the Earth). This implies that the geoid will be a surface of
20 constant gravitational potential, which can serve as a reference surface to which all surfaces (e.g the Mean Sea
21 Surface) can be referred. The geoid (and surfaces parallel to the geoid) are what we refer to in common experience as
22 “level surfaces”.

23

24 **Glacier**

25 A mass of land ice flowing downhill (by internal deformation and sliding at the base) and constrained by the
26 surrounding topography e.g. the sides of a valley or surrounding peaks; the bedrock topography is the major influence
27 on the dynamics and surface slope of a glacier. A glacier is maintained by accumulation of snow at high altitudes,
28 balanced by melting at low altitudes or discharge into the sea.

29

30 **Global Warming Potential (GWP)**

31 An index, describing the radiative characteristics of well mixed greenhouse gases, that represents the combined effect
32 of the differing times these gases remain in the atmosphere and their relative effectiveness in absorbing outgoing
33 infrared radiation. This index approximates the time-integrated warming effect of a unit mass of a given greenhouse
34 gas in today’s atmosphere, relative to that of carbon dioxide

35

36 **Greenhouse effect**

37 →Greenhouse gases effectively absorb infrared radiation, emitted by the Earth’s surface, by the atmosphere itself due
38 to the same gases, and by clouds. Atmospheric radiation is emitted to all sides, including downward to the Earth’s
39 surface. Thus greenhouse gases trap heat within the surface-troposphere system. This is called the *natural greenhouse*
40 *effect*.

41 Atmospheric radiation is strongly coupled to the temperature of the level at which it is emitted. In the troposphere the
42 temperature generally decreases with height. Effectively, infrared radiation emitted to space originates from an
43 altitude with a temperature of, on average, -19°C, in balance with the net incoming solar radiation, whereas the Earth’s
44 surface is kept at a much higher temperature of on average +14°C.

45 An increase in the concentration of greenhouse gases leads to an increased infra-red opacity of the atmosphere, and
46 therefore to an effective radiation into space from a higher altitude at a lower temperature. This causes a →radiative
47 forcing, an imbalance that can only be compensated for by an increase of the temperature of the surface-troposphere
48 system. This is the *enhanced greenhouse effect*.

49

50 **Greenhouse gas**

51 Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and
52 emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth’s surface, the
53 atmosphere and clouds. This property causes the →greenhouse effect. Water vapour (H₂O), carbon dioxide (CO₂),
54 nitrous oxide (N₂O), methane (CH₄) and ozone (O₃) are the primary greenhouse gases in the Earth’s atmosphere.

55 Moreover there are a number of entirely human-made greenhouse gases in the atmosphere, such as the →halocarbons

1 and other chlorine and bromine containing substances, dealt with under the →Montreal protocol. Beside CO₂, N₂O
2 and CH₄, the →Kyoto Protocol deals with the greenhouse gases SF₆, hydrofluorocarbons (HFCs) and
3 perfluorocarbons (PFCs).

5 **Gross Primary Production (GPP)**

6 The amount of carbon fixed from the atmosphere through →photosynthesis.

8 **Halocarbons**

9 Compounds containing either chlorine, bromine or fluorine and carbon. Such compounds can act as powerful
10 →greenhouse gases in the atmosphere. The chlorine and bromine containing halocarbons are also involved in the
11 depletion of the →ozone layer.

13 **Heating degree days**

14 The integral over a day of the temperature below 18°C (e.g. a day with an average temperature of 16°C counts as 2
15 heating degree days). See also: →Cooling degree days.

17 **Heterotrophic respiration**

18 The conversion of organic matter to CO₂ by organisms other than plants and algae.

20 **Hydrosphere**

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

24 **Ice cap**

25 See: →Ice sheet.

27 **Ice sheet**

28 A mass of land ice which is sufficiently deep to cover most of the underlying bedrock topography, so that its shape is
29 mainly determined by its internal dynamics (the flow of the ice as it deforms internally and slides at its base). An ice
30 sheet flows outwards from a high central plateau with a small average surface slope. The margins slope steeply, and
31 the ice is discharged through fast-flowing ice streams or outflow glaciers, in some cases into the sea or into ice-
32 shelves floating on the sea. There are only two large ice sheets in the modern world, on Greenland and Antarctica, the
33 Antarctic ice sheet being divided into East and West by the Transantarctic Mountains; during glacial periods there
34 were others. A smaller ice sheet is sometimes called an ice cap.

36 **Indirect aerosol effect**

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

39 *First indirect effect*

40 A radiative forcing induced by an increase in anthropogenic aerosols which cause an initial increase in droplet
41 concentration and a decrease in droplet size for fixed liquid water content, leading to an increase of cloud albedo. This
42 effect is also known as the *Twomey effect*. This is sometimes referred to as the *cloud albedo effect*. However this is
43 highly misleading since the second indirect effect also alters cloud albedo.

44 *Second indirect effect*

45 A radiative forcing induced by an increase in anthropogenic aerosols which cause a decrease in droplet size, reducing
46 the precipitation efficiency, thereby modifying the liquid water content, cloud thickness, and cloud life time. This
47 effect is also known as the *cloud life time effect* or *Albrecht effect*.

49 **Industrial revolution**

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

- 1
2 **Infrared radiation**
3 Radiation emitted by the earth's surface, the atmosphere and the clouds. It is also known as terrestrial or long-wave
4 radiation. Infrared radiation has a distinctive range of wavelengths ("spectrum") longer than the wavelength of the red
5 colour in the visible part of the spectrum. The spectrum of infrared radiation is practically distinct from that of →solar
6 or short-wave radiation because of the difference in temperature between the Sun and the Earth-atmosphere system.
7
- 8 **Integrated assessment**
9 A method of analysis that combines results and models from the physical, biological, economic and social sciences,
10 and the interactions between these components, in a consistent framework, to evaluate the status and the consequences
11 of environmental change and the policy responses to it.
12
- 13 **Internal variability**
14 See: →Climate variability.
15
- 16 **Inverse modelling**
17 A mathematical procedure by which the input to a model is estimated from the observed outcome, rather than vice
18 versa. It is, for instance, used to estimate the location and strength of sources and sinks of CO₂ from measurements of
19 the distribution of the CO₂ concentration in the atmosphere, given models of the global carbon cycle and for
20 computing atmospheric transport.
21
- 22 **Isostatic land movements**
23 Isostasy refers to the way in which the →lithosphere and mantle respond to changes in surface loads. When the
24 loading of the lithosphere is changed by alterations in land ice mass, ocean mass, sedimentation, erosion or mountain
25 building, vertical isostatic adjustment results, in order to balance the new load
26
- 27 **Kyoto Protocol**
28 An agreement concluded at the Third Session of the Conference of the Parties to the →Framework Convention on
29 Climate Change (UNFCCC), in 1997 in Kyoto, Japan, containing legally binding commitments, in addition to those
30 included in the UNFCCC, under which countries contained in Annex B of the Protocol (most OECD countries and
31 countries with economies in transition) will reduce their overall greenhouse gas emissions (CO₂, CH₄, N₂O, HFCs,
32 PFCs, and SF₆) by at least 5% below 1990 levels in the period 2008-2012. The Kyoto Protocol has not yet entered into
33 force (September 2000).
34
- 35 **Land-use change**
36 A change in the use or management of land by humans, which may lead to a change in land cover. Land cover and
37 land-use change may have an impact on the →albedo, →evapotranspiration, →sources and sinks of greenhouse
38 gases, or other properties of the climate system and may thus have an impact on climate, locally or globally. See also:
39 the IPCC Report on Land Use, Land-Use Change, and Forestry (IPCC, 2000).
40
- 41 **La Niña**
42 See: →El Niño-Southern Oscillation.
43
- 44 **Life time**
45 Lifetime is a general term used for various time-scales characterising the rate of processes affecting the concentration
46 of trace gases. The following lifetimes may be distinguished:
47 *Turnover time* (T) is the ratio of the mass M of a reservoir - e.g. a gaseous compound in the atmosphere - and the total
48 rate of removal S from the reservoir: $T = M/S$. For each removal process separate turnover times can be defined. In
49 soil carbon biology this is referred to as *Mean Residence Time (MRT)*.
50 *Adjustment time* or *response time* (T_a) is the time-scale characterising the decay of an instantaneous pulse input into
51 the reservoir. The term *adjustment time* is also used to characterise the adjustment of the mass of a reservoir following
52 a step change in the source strength. *Half-life* or *decay constant* is used to quantify a first-order exponential decay
53 process. See: →Response time, for a different definition pertinent to climate variations.
54 The term *lifetime* is sometimes used, for simplicity, as a surrogate for *adjustment time*.
55 In simple cases, where the global removal of the compound is directly proportional to the total mass of the reservoir,

1 the adjustment time equals the turnover time: $T = T_a$. An example is CFC-11 which is removed from the atmosphere
2 only by photochemical processes in the stratosphere. In more complicated cases, where several reservoirs are involved
3 or where the removal is not proportional to the total mass, the equality $T = T_a$ no longer holds. Carbon dioxide (CO_2)
4 is an extreme example. Its turnover time is only about 4 years because of the rapid exchange between atmosphere and
5 the ocean and terrestrial biota. However, a large part of that CO_2 is returned to the atmosphere within a few years.
6 Thus, the adjustment time of CO_2 in the atmosphere is actually determined by the rate of removal of carbon from the
7 surface layer of the oceans into its deeper layers. Although an approximate value of 100 years may be given for the
8 adjustment time of CO_2 in the atmosphere, the actual adjustment is faster initially and slower later on. In the case of
9 methane (CH_4) the adjustment time is different from the turnover time, because the removal is mainly through a
10 chemical reaction with the hydroxyl radical OH, the concentration of which itself depends on the methane
11 concentration. Therefore the methane removal S is not proportional to its total mass M .

12 **Lithosphere**

13 The upper layer of the solid Earth, both continental and oceanic, which comprises all crustal rocks and the cold,
14 mainly elastic, part of the uppermost mantle. Volcanic activity, although part of the lithosphere, is not considered as
15 part of the \rightarrow climate system, but acts as an external forcing factor. See: \rightarrow Isostatic land movements.

16 **Mean Sea Level**

17 See: \rightarrow Relative Sea Level.

18 **Mitigation**

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

20 **Mixing ratio**

21 See: \rightarrow Mole fraction.

22 **Model hierarchy**

23 See: \rightarrow Climate model.

24 **Mole fraction**

25 Mole fraction, or *mixing ratio*, is the ratio of the number of moles of a constituent in a given volume to the total
26 number of moles of all constituents in that volume. It is usually reported for dry air. Typical values for long-lived
27 greenhouse gases are in the order of $\mu\text{mol/mol}$ (parts per million: ppm), nmol/mol (parts per billion: ppb), and
28 fmol/mol (parts per trillion: ppt). Mole fraction differs from *volume mixing ratio*, often expressed in ppmv etc., by the
29 corrections for non-ideality of gases. This correction is significant relative to measurement precision for many
30 greenhouse gases. (Source: Schwartz and Warneck, 1995)

31 **Montreal Protocol**

32 The 1987 Montreal Protocol on Substances that deplete the Ozone Layer, subsequently amended in London (1990),
33 Copenhagen (1992), Vienna (1995) and Montreal (1997), controls the consumption and production of chlorine- and
34 bromine-containing chemicals that destroy stratospheric ozone, such as CFCs, methyl chloroform, carbon
35 tetrachloride, and many others.

36 **Net Biome Production (NBP)**

37 Net gain or loss of carbon from a region. NBP is equal to the \rightarrow Net Ecosystem Production minus the carbon lost due
38 to a disturbance, e.g. a forest fire or a forest harvest.

39 **Net Ecosystem Production (NEP)**

40 Net gain or loss of carbon from an ecosystem. NEP is equal to the \rightarrow Net Primary Production minus the carbon lost
41 through \rightarrow heterotrophic respiration.

42 **Net Primary Production (NPP)**

43 The increase in plant biomass or carbon of a unit of a landscape. NPP is equal to the \rightarrow Gross Primary Production
44 minus carbon lost through \rightarrow autotrophic respiration.

1 Nitrogen fertilization

2 Enhancement of plant growth through the addition of nitrogen compounds. In IPCC Reports, this typically refers to
3 fertilization from anthropogenic sources of nitrogen such as human-made fertilizers and nitrogen oxides released from
4 burning fossil fuels.

6 Non-linearity

7 A process is called “non-linear” when there is no simple proportional relation between cause and effect. The climate
8 system contains many such non-linear processes, resulting in a system with a potentially very complex behaviour.
9 Such complexity may lead to →rapid climate change.

11 North Atlantic Oscillation (NAO)

12 The North Atlantic Oscillation consists of opposing variations of barometric pressure near Iceland and near the
13 Azores. On average, a westerly current, between the Icelandic low pressure area and the Azores high pressure area,
14 carries cyclones with their associated frontal systems towards Europe. However the pressure difference between
15 Iceland and the Azores fluctuates on time scales of days to decades, and can be reversed at times.

17 Organic aerosol

18 Aerosol particles consisting predominantly of organic compounds, mainly C, H, O, and lesser amounts of other
19 elements. (Source: Charlson and Heintzenberg, 1995, p. 405) See: →Carbonaceous aerosol.

21 Ozone hole

22 See: →Ozone layer.

24 Ozone layer

25 The →stratosphere contains a layer in which the concentration of ozone is greatest, the so called ozone layer. The
26 layer extends from about 12 to 40 km. The ozone concentration reaches a maximum between about 20 and 25 km.
27 This layer is being depleted by human emissions of chlorine and bromine compounds. Every year, during the
28 Southern hemisphere spring, a very strong depletion of the ozone layer takes place over the Antarctic region, also
29 caused by human-made chlorine and bromine compounds in combination with the specific meteorological conditions
30 of that region. This phenomenon is called the *ozone hole*.

32 Parametrization

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

37 Patterns of climate variability

38 Natural variability of the climate system, in particular on seasonal and longer time scales, predominantly occurs in
39 preferred spatial patterns, through the dynamical non-linear characteristics of the atmospheric circulation and through
40 interactions with the land and ocean surfaces. Such spatial patterns are also called “regimes” or “modes”. Examples
41 are the North Atlantic Oscillation (NAO), the Pacific-North American pattern (PNA), the →El Niño-Southern
42 Oscillation (ENSO), and the Antarctic Oscillation (AO).

44 Photosynthesis

45 The process by which plants and algae take CO₂ from the air (or bicarbonate in water) to build carbohydrates,
46 releasing O₂ in the process. There are several pathways of photosynthesis with different responses to atmospheric CO₂
47 concentrations. See: →CO₂ fertilization.

49 Pool

50 See: →Reservoir.

52 Post-glacial rebound

53 The vertical movement of the continents and sea floor following the disappearance and shrinking of ice sheets, e.g.
54 since the Last Glacial Maximum (21 ka BP). The rebound is an →isostatic land movement.

- 1 **Ppm, ppb, ppt**
2 See: → Mole fraction.
3
- 4 **Precursors**
5 Atmospheric compounds which themselves are not →greenhouse gases or →aerosols, but which have an effect on
6 greenhouse gas or aerosol concentrations by taking part in physical or chemical processes regulating their production
7 or destruction rates.
8
- 9 **Pre-industrial**
10 See: →Industrial revolution.
11
- 12 **Projection (generic)**
13 A projection is a potential future evolution of a quantity or set of quantities, often computed with the aid of a model.
14 Projections are distinguished from *predictions* in order to emphasise that projections involve assumptions concerning
15 e.g. future socio-economic and technological developments that may or may not be realized, and are therefore subject
16 to substantial uncertainty.
17
- 18 **Radiative forcing**
19 Radiative forcing is the change in the net vertical irradiance (expressed in Watts per square meter: Wm^{-2}) at the
20 tropopause due to an internal change or a change in the external forcing of the climate system, such as, for example, a
21 change in the concentration of carbon dioxide or the output of the Sun. Usually radiative forcing is computed after
22 allowing for stratospheric temperatures to readjust to radiative equilibrium, but with all tropospheric properties held
23 fixed at their unperturbed values. Radiative forcing is called *instantaneous* if no change in stratospheric temperature is
24 accounted for. Practical problems with this definition, in particular with respect to radiative forcing associated with
25 changes by aerosols of the precipitation formation by clouds, are discussed in Chapter 6 of this report.
26
- 27 **Radiative forcing scenario**
28 A plausible representation of the future development of →radiative forcing associated, for example, with changes in
29 atmospheric composition or land use change, or with external factors such as variations in solar activity. Radiative
30 forcing scenarios can be used as input into simplified →climate models to compute →climate projections.
31
- 32 **Radio-echosounding**
33 The surface and bedrock, and hence the thickness, of a glacier can be mapped by radar; signals penetrating the ice are
34 reflected at the lower boundary with rock (or water, for a floating glacier tongue).
35
- 36 **Rapid climate change**
37 The →non-linearity of the climate system may lead to rapid climate change, sometimes called *abrupt events* or even
38 *surprises*. Some such abrupt events may be imaginable, such as a dramatic reorganization of the thermohaline
39 circulation, rapid deglaciation, or massive melting of permafrost leading to fast changes in the carbon cycle. Others
40 may be truly unexpected, as a consequence of a strong, rapidly changing, forcing of a non-linear system.
41
- 42 **Reforestation**
43 See: →Forest.
44
- 45 **Regimes**
46 Preferred →patterns of climate variability.
47
- 48 **Relative Sea Level**
49 Sea level measured by a →tide gauge with respect to the land upon which it is situated. Mean Sea Level (MSL) is
50 normally defined as the average Relative Sea Level over a period such as a month or a year long enough to average
51 out transients such as waves.
52
- 53 **(Relative) Sea Level Secular Change**
54 Long term changes in relative sea level caused by either →eustatic changes, e.g. brought about by →thermal
55 expansion, or changes in vertical land movements.

- 1
2 **Reservoir**
3 A component of the climate system, other than the atmosphere, which has the capacity to store, accumulate or release
4 a substance of concern, e.g. carbon, a greenhouse gas or a precursor. Oceans, soils, and forests are examples of
5 reservoirs of carbon. *Pool* is an equivalent term. The absolute quantity held within a reservoir is called the *stock*.
6
- 7 **Respiration**
8 The process whereby living organisms convert organic matter to CO₂, releasing energy and consuming O₂.
9
- 10 **Response time**
11 The response time or *adjustment time* is the time needed for the climate system or its components to re-equilibrate to a
12 new state, following a forcing resulting from external and internal processes or feedbacks. It is very different for
13 various components of the climate system. The response time of the troposphere is relatively short, from days to
14 weeks, whereas the stratosphere comes into equilibrium on a time scale of typically a few month. Due to their large
15 heat capacity, the oceans have a much longer response time typically decades, but up to centuries or millennia. The
16 response time of the strongly coupled surface-troposphere system is therefore slow compared to that of the
17 stratosphere, and mainly determined by the oceans. The biosphere may respond fast, e.g. to droughts, but als very
18 slowly to imposed changes.
19 See: →Life time, for a different definition of response time pertinent to the rate of processes affecting the
20 concentration of trace gases.
21
- 22 **Scenario (generic)**
23 A plausible and often simplified description of how the future may develop, based on a coherent and internally
24 consistent set of driving forces and key relationships. Scenarios may be derived from →projections, but are often
25 based on additional information from other sources, sometimes combined with a “narrative storyline”. See also:
26 →SRES scenarios; Climate scenario.
27
- 28 **Sea level rise**
29 See: →Relative Sea Level Secular Change; Thermal expansion.
30
- 31 **Sequestration**
32 See: →Uptake.
33
- 34 **Significant wave height**
35 The average height of the highest one-third of all sea waves occurring in a particular time period. This serves as an
36 indicator of the characteristic size of the highest waves.
37
- 38 **Sink**
39 See: →Source and sink.
40
- 41 **Soil moisture**
42 Water stored in or at the land surface and available for evaporation.
43
- 44 **Solar activity**
45 The Sun exhibits periods of high activity observed in numbers of →sunspots, as well as radiative output, magnetic
46 activity, and emission of high energy particles. These variations take place on a range of time scales from millions of
47 years to minutes. See: →Solar cycle.
48
- 49 **Solar (“11 year”) cycle**
50 A quasi-regular modulation of →solar activity with varying amplitude and a period of between 9 and 13 years.
51
- 52 **Solar radiation**
53 Radiation emitted by the Sun. It is also referred to as short-wave radiation. Solar radiation has a distinctive range of
54 wavelengths (spectrum) determined by the temperature of the Sun. See also: →Infrared radiation.
55

1 Soot particles

2 Particles formed during the quenching of gases at the outer edge of flames of organic vapors, consisting
3 predominantly of carbon, with lesser amounts of oxygen and hydrogen present as carboxyl and phenolic groups and
4 exhibiting an imperfect graphitic structure. See: →Black carbon; Charcoal. (Source: Charlson and Heintzenberg,
5 1995, p. 406).

7 Source and sink

8 A source or a sink means any process, activity or mechanism resulting in a net flux of a →greenhouse gas, an
9 →aerosol or a →precursor of a greenhouse gas into or from the atmosphere.

11 Spatial and temporal scales

12 Climate may vary on a large range of spatial and temporal scales. Spatial scales may range from local (less than
13 100,000 km²), through regional (100,000 - 10 million km²) to continental (10 - 100 million km²). Temporal scales
14 may range from seasonal to geological (up to hundreds of millions of years).

16 SRES scenarios

17 SRES scenarios are →emission scenarios developed by Nakicenovic *et al.* (2000) and used, among others, as a basis
18 for the climate projections in Chapter 9. The following terms are relevant for a better understanding of the structure
19 and use of the set of SRES scenarios:

20 (Scenario) Family

21 Scenarios that have a similar demographic, societal, economic and technical-change storyline. Four scenario families
22 comprise the SRES scenario set: A1, A2, B1 and B2.

23 (Scenario) Group

24 Scenarios within a family that reflect a consistent variation of the storyline. The A1 scenario family includes four
25 groups designated as A1T, A1C, A1G and A1B that explore alternative structures of future energy systems. In the
26 Summary for Policymakers of Nakicenovic *et al.* (2000), the A1C and A1G groups have been combined into one
27 'Fossil Intensive' A1FI scenario group. The other three scenario families consist of one group each. The SRES
28 scenario set reflected in this Summary for Policymakers thus consist of six distinct scenario groups, all of which are
29 equally sound and together capture the range of uncertainties associated with driving forces and emissions.

30 Illustrative Scenario

31 A scenario that is illustrative for each of the six scenario groups reflected in the Summary for Policymakers of
32 Nakicenovic *et al.* (2000). They include four revised 'scenario markers' for the scenario groups A1B, A2, B1, B2, and
33 two additional scenarios for the A1FI and A1T groups. All scenario groups are equally sound.

34 (Scenario) Marker

35 A scenario that was originally posted in draft form on the SRES website to represent a given scenario family. The
36 choice of markers was based on which of the initial quantifications best reflected the storyline, and the features of
37 specific models. Markers are no more likely than other scenarios, but are considered by the SRES writing team as
38 illustrative of a particular storyline. They are included in revised form in Nakicenovic *et al.* (2000). These scenarios
39 have received the closest scrutiny of the entire writing team and via the SRES open process. Scenarios have also been
40 selected to illustrate the other two scenario groups (see also 'Scenario Group' and 'Illustrative Scenario').

41 (Scenario) Storyline

42 A narrative description of a scenario (or family of scenarios) highlighting the main scenario characteristics,
43 relationships between key driving forces and the dynamics of their evolution.

45 Stock

46 See: →Reservoir.

48 Storm surge

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

53 Stratosphere

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

- 1
2 **Sunspots**
3 Small dark areas on the Sun. The number of Sunspots is higher during periods of high →solar activity, and varies in
4 particular with the →solar cycle.
5
- 6 **Thermal expansion**
7 In connection with sea level, this refers to the increase in volume (and decrease in density) that results from warming
8 water. A warming of the ocean leads to an expansion of the ocean volume and hence an increase in sea level.
9
- 10 **Thermohaline circulation**
11 Large-scale density-driven circulation in the ocean, caused by differences in temperature and salinity. In the North
12 Atlantic the thermohaline circulation consists of warm surface water flowing northward and cold deep water flowing
13 southward, resulting in a net poleward transport of heat. The surface water sinks in highly restricted sinking regions
14 located in high latitudes.
15
- 16 **Tide gauge**
17 A device at a coastal location (and some deep sea locations) which continuously measures the level of the sea with
18 respect to the adjacent land. Time-averaging of the sea level so recorded gives the observed →Relative Sea Level
19 Secular Changes.
20
- 21 **Transient climate response**
22 Globally averaged surface air temperature increase, averaged over a 20 year period centred at the time of CO₂,
23 doubling, i.e. at year 70 in a 1% per year compound CO₂ increase experiment with a global coupled model.
24
- 25 **Tropopause**
26 The boundary between the →troposphere and the →stratosphere.
27
- 28 **Troposphere**
29 The lowest part of the atmosphere from the surface to about 10 km in altitude in mid-latitudes (ranging from 9 km in
30 high latitudes to 16 km in the tropics on average) where clouds and “weather” phenomena occur. In the troposphere
31 temperatures generally decrease with height.
32
- 33 **Turnover time**
34 See: →Lifetime.
35
- 36 **Uncertainty**
37 An expression of the degree to which a value (e.g. the future state of the climate system) is unknown. Uncertainty can
38 result from lack of information or from disagreement about what is known or even knowable. It may have many types
39 of sources, from quantifiable errors in the data to ambiguously defined concepts or terminology, or uncertain
40 projections of human behaviour. Uncertainty can therefore be represented by quantitative measures (e.g. a range of
41 values calculated by various models) or by qualitative statements (e.g. reflecting the judgement of a team of experts).
42 See Moss and Schneider (2000).
43
- 44 **Uptake**
45 The addition of a substance of concern to a →reservoir. Sometimes the equivalent term *sequestration* is used.
46
- 47 **Volume mixing ratio**
48 See: →Mole fraction.
49
50
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