Glossary of Global Warming and Climate Change Terms

Below is a glossary of terms often used in connection with global warming and climate change.

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Abiotic
Nonliving

Ablation
The removal of material from the surface of an object by vaporization, chipping, or other erosive processes. Examples of ablative ice and snow in glaciology, biological tissues in medicine, and passive fire protection materials.

Absorption
The process in which radiant energy is retained by a substance. A further process always results from absorption, that is, the irreversible conversion of the absorbed radiation into some other form of energy within and according to the nature of the absorbing medium. The absorbing medium itself may emit radiation, but only after an energy conversion has occurred.

Acclimatization
The physiological adaptation to climatic variations.

Acid Rain
Acid rain is a term used to describe several ways that acidic compounds fall out of the atmosphere, causing a variety of ground-level environmental effects. These effects include damage to forests and soils, fish and other living things, and human health. Acid rain also reduces how clearly we can see through the air, an effect called visibility reduction.

Sulfur dioxide and nitrogen oxides are the primary causes of acid rain. In the United States, about two thirds of all sulfur dioxide and one-quarter of all nitrogen oxides come from electric power generation that relies on burning fossil fuels like coal. Acid rain occurs when these gases react in the atmosphere with water, oxygen, and other chemicals to form various acidic compounds. These acidic compounds fall to the earth as acidic rain, fog, and snow, or as dry deposited gases and particles that can be blown to the ground by the wind. In fact, prevailing winds can blow the compounds that cause acid rain across state and national borders, and sometimes over hundreds of miles.

Actual net greenhouse gas removals by sinks
The sum of the verifiable changes in carbon stocks in the carbon pools within the project boundary of an afforestation or reforestation project, minus the increase in GHG emissions as a result of the implementation of the project activity.

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

Adaptive capacity
The ability of a system (e.g. ecosystem) to adapt to climate change or other environmental disturbances. This may mean moderating potential damages, taking advantage of opportunities or coping with the consequences. In discussions on global warming, adaptive capacity often refers to a country. In this case it is currently much lower in developing countries, consequential to poverty.

Advection
A horizontal movement of a mass of fluid, such as ocean or air currents. Can also refer to the horizontal transport of something (e.g., pollution, phytoplankton, ice, or even heat) by such movement.

Aerosols
A collection of airborne solid or liquid particles, typically between 0.01 and 10 µm in size and residing in the atmosphere for at least several hours. Aerosols may be of either natural or anthropogenic origin. Natural sources include salt particles from sea spray, dust and clay particles as a result of weathering of rocks, both of which are carried upward by the wind. Aerosols originating as a result of human activities and are often considered pollutants. Aerosols may influence climate in several ways: directly through scattering and absorbing radiation, and indirectly through acting as condensation nuclei for cloud formation or modifying the optical properties and lifetime of clouds.

Agroecology
Is the science of sustainable agriculture; the methods of agroecology have as their goal achieving sustainability of agricultural systems balanced in all spheres. This includes the socio-economic and the ecological or environmental.

Albedo
The fraction of solar radiation reflected by a surface or object, often expressed as a percentage. Snow covered surfaces have a high albedo; the albedo of soils ranges from high to low; vegetation covere surfaces and oceans have a low albedo. The Earth's albedo varies mainly through varying cloudiness, snow, ice, leaf area, and land cover changes.

Albedo feedback
A climate feedback involving changes in the Earth's albedo. It usually refers to changes in the cryosphere which has an albedo much larger (~0.8) than the average planetary albedo (~0.3). In a warming climate, it is anticipated that the cryosphere would shrink, the Earth's overall albedo would decrease and more solar energy would be absorbed to warm the Earth still further.

Algal bloom
The explosive growth of blue green algae that deprives aquatic life of oxygen. Algal blooms can be toxic to animals and humans.

Altimetry
A technique for the measurement of the elevation of the sea, land or ice surface. For example, the height of the sea surface (with respect to the centre of the Earth or, more conventionally, with respect to a standard "ellipsoid of revolution") can be measured from space by current state-of-the-art radar altimetry with centrimetric precision. Altimetry has the advantage of being a measurement relative to a geocentric reference frame, rather than relative to land level as for a tide gauge, and of affording quasi-global coverage.

Anthropogenic
Resulting from or produced by human beings.

Argon
Argon constitutes 1.3 percent of the atmosphere by weight and 0.94 percent by volume. Argon is isolated on a large scale by the fractional distillation of liquid air. It is used in gas-filled electric light bulbs, radio tubes, and Geiger counters. It also is widely utilized as an inert atmosphere for arc-welding metals, such as aluminium and stainless steel; for the production and fabrication of metals, such as titanium, zirconium, and uranium; and for growing crystals of semiconductors, such as silicon and germanium.

Anthropogenic emissions

Emissions of greenhouse gases, greenhouse-gas precursors, and aerosols associated with human activities. These include the burning of fossil fuels, deforestation, land-use changes, livestock, fertilization, etc. that result in a net increase in emissions.

Atmosphere
The gaseous envelope surrounding the Earth. The dry atmosphere consists almost entirely of **nitrogen** (78.1% volume mixing ratio) and **oxygen** (20.9% volume mixing ratio), together with a number of trace gases, such as **argon** (0.93% volume mixing ratio), **helium** and radiatively active greenhouse gases such as **carbon dioxide** (0.035% volume mixing ratio) and **ozone**. In addition, the atmosphere contains the greenhouse gas **water vapor**, whose amounts are highly variable but typically around 1% volume mixing ratio. The atmosphere also contains clouds and aerosols.

The atmosphere can be divided into a number of layers according to its mixing or chemical characteristics, generally determined by its thermal properties (temperature). The layer nearest the Earth is the **troposphere**, which reaches up to an altitude of about 8 kilometers (about 5 miles) in the polar regions and up to 17 kilometers (nearly 11 miles) above the equator. The **stratosphere**, which reaches to an altitude of about 50 kilometers (31miles) lies atop the troposphere. The **mesosphere**, which extends from 80 to 90 kilometers atop the stratosphere, and finally, the **thermosphere**, or **ionosphere**, gradually diminishes and forms a fuzzy border with outer space. There is relatively little mixing of gases between layers.

Autotrophic respiration
The carbon that is returned to the atmosphere as CO_2 during plant metabolism.

Atmospheric Lifetime
The lifetime of a greenhouse gas refers to the approximate amount of time it would take for the anthropogenic increment to an atmospheric pollutant concentration to return to its natural level (assuming emissions cease) as a result of either being converted to another chemical compound or being taken out of the atmosphere via a sink. This time depends on the pollutant's sources and sinks as well as its reactivity. The lifetime of a pollutant is often considered in conjunction with the mixing of pollutants in the atmosphere; a long lifetime will allow the pollutant to mix throughout the atmosphere. Average lifetimes can vary from about a week (sulfate aerosols) to more than a century (carbon dioxide).

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

Baseline Emissions
The emissions that would occur without policy intervention. Baseline estimates are needed to determine the effectiveness of emissions mitigation strategies.

Benchmark 2 x CO_2 warming
Eventual equilibrium warming from a doubling of atmospheric concentration of carbon dioxide above preindustrial levels (280 parts per million by volume, or ppm, prior to the Industrial Revolution). The present concentration of CO_2 is about 380 ppm. Equilibrium climate simulations commonly assume a radiative forcing equivalent to a doubling of preindustrial CO_2 concentration.

Biochemical Processes
Interaction of soil chemical properties and biology within the soil. These include:
- Organic matter decomposition
- Trace gas production/consumption

Biodiversity
The variability among living organisms from all sources including, inter alia, 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.

Biogeochemical cycle
Movements through the Earth system of key chemical constituents essential to life, such as carbon nitrogen, oxygen, and phosphorus.

Biological options
Biological options for mitigation of climate change involve one or more of the three strategies:

- **Conservation** -- conserving an existing carbon pool, thereby preventing CO_2 emissions to the atmosphere;
- **Sequestration** - increasing the size of existing carbon pools, thereby extracting CO_2 from the atmosphere;
- **Substitution** – substituting biomass for fossil fuels or energy-intensive products, thereby reducing CO_2 emissions.

Biome
Well-defined terrestrial environment (e.g., desert, tundra, or tropical forest). The complex of living organisms found in an ecological region.

Biophysical Processes
Physical processes modified by the ecosystem. These include:

- Energy budget
- Evaporation
- Transpiration
- Hydrology
- Soil water dynamics
- Soil temperature

Biosphere
That component of the Earth system that contains life in its various forms, which includes its living organisms and derived organic matter (e.g. litter, detrius, soil).

Black carbon
Particle matter in the atmosphere that consists of soot, charcoal and/or possible light-absorbing refractory organic material. Black carbon is operationally defined matter based on measurement of light absorption and chemical reactivity and/or thermal stability.

Borehole
Any exploratory hole drilled into the Earth or ice to gather geophysical data. Climate researchers often take ice core samples, a type of borehole, to predict atmospheric composition in earlier years.

C3 and C4 plants
Plants use two principal carbon fixation cycles, the C3 and C4 cycles, during photosynthesis. C4 plants (notably tropical grasses) are disadvantaged relative to C3 plants (such as trees, shrubs, and cool-climate grasses) at high CO_2/O_2 ratios because of the additional energy expense needed to concentrate CO_2 in the bundle-sheath cells. At low CO_2/O_2, however, C4 plants can achieve a relatively high quantum yield by suppressing photorespiration. C4 photosynthesis is commonly associated with hot dry environments with warm-season precipitation and high light intensity , because C4 plants exhibit greater efficiency than C3 species with respect to water, light, and nitrogen use.
(Source: Climate Change as a Dominant Control on Glacial-Interglatial Variations in C3 and C4 Plant Abundance", *Science*, 31 August 2001, vol 293, pp. 1647-1651).

C3 Plants use rubisco to make a three-carbon compound as the first stable product of carbon fixation. These plants may lose up to 50% of their recently-fixed carbon through photorespiration. More than 95% of earth's plant species can be characterized as C3 plants.

C4 Plants use PEP carboxylase during initial carbon fixation to make a four-carbon compound that is subsequently transferred to specialized cells where carbon dioxide is internally released and refixed using rubisco. This phenomenon greatly reduces carbon loss by photorespiration, and in many cases, it completely inhibits it. Less than 1% of earth's plant species can be characterized as C4 plants.

A C4 photosynthetic pathway is a biochemical pathway used by certain plants to obtain carbon during photosynthesis. Such plants possess biochemical and anatomical CO_2-concentrating mechanisms that increase the intercellular CO_2 concentration at the site of fixation, which greatly reduces carbon losses by photorespiration. It is thought that the primary selective mechanism for the development of C4 photosynthesis is the low level of CO_2 that has prevailed during the last 50 to 60 million years.

CAM (Crassulacean Acid Metabolism)
A carbon fixation scheme exhibited in many succulent plants.

Carbon capture and storage (CCS)
A process consisting of the separation of CO_2 from industrial and energy-related sources, transporting the CO_2 to a storage location, and long-term isolation from the atmosphere.

Carbon fixation
The reduction of carbon dioxide to organic compounds by living organisms. The obvious example is photosynthesis. Carbon fixation requires both a source of energy such as sunlight, and an electron donor such as water. All life depends on fixed carbon.

Cap
Mandated restraint as an upper limit on emissions. It is often used in reference to a cap on greenhouse gas emissions.

Cap and trade
A policy for limiting the amount of pollution emitted. The cap is a limit on the total amount of pollution that can be emitted (released) from all regulated sources (e.g., power plants); the cap is set lower than historical emissions in order to reduce emissions. Trading is a system in which emission sources can buy or sell allowances on the open market. Because the total number of allowances is limited by the cap, emission reductions are assured.

Capped and uncapped markets
Power markets in the United States that are either subject to carbon dioxide emission caps (most notably the northeastern states) or not, as of mid-2009. The treatment of avoided carbon dioxide emissions due to renewable power purchases differs depending on the type of carbon market in which the purchaser is located.

Carbon black
An amorphous form of carbon, produced commercially by thermal or oxidative decomposition of hydrocarbons and used principally in rubber goods, pigments, and printer's ink.

Carbon credit
Carbon credit is used in emission trading schemes (see emissions trading), where one credit gives the owner the right to emit one ton of CO_2.

Carbon cycle
All carbon reservoirs and exchanges of carbon from reservoir to reservoir by various chemical, physical, geological, and biological processes. Usually thought of as a series of the four main reservoirs of carbon interconnected by pathways of exchange. The four reservoirs, regions of the Earth in which carbon behaves in a systematic manner, are the atmosphere, terrestrial biosphere (usually includes freshwater systems), oceans, and sediments (includes fossil fuels). Each of these global reservoirs may be subdivided into smaller pools, ranging in size from individual communities or ecosystems to the total of all living organisms (biota).

Carbon dioxide (CO_2)
CO_2 is a naturally occurring gas, and a by-product of burning fossil fuels or biomass, of land-use changes and of industrial processes. It is the principal anthropogenic greenhouse gas that affects Earth's radiative balance. It is the reference gas against which other greenhouse gases are measured and therefore it has a Global Warming Potential of 1.

Carbon dioxide equivalent
A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as "million metric tons of carbon dioxide equivalents (MMTCO2Eq)." The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP.

Carbon dioxide fertilization
The enhancement of the growth of plants because of increased atmospheric CO_2 concentration. Depending on their mechanism of photosynthesis, certain types of plants are more sensitive to changes in atmospheric CO_2 concentration than others.

Carbon equivalent
A metric measure used to compare the emissions of the different greenhouse gases based upon their global warming potential (GWP). Greenhouse gas emissions in the United States are most commonly expressed as "million metric tons of carbon equivalents" (MMTCE). Global warming potentials are used to convert greenhouse gases to carbon dioxide equivalents.

Carbon flux
The rate of exchange of carbon between pools (i.e., reservoirs).

Carbon intensity
The relative amount of carbon emitted per unit of some other variable, often per unit of energy, quantity of fuel consumed or per unit of Gross Domestic Product.

Carbon leakage
The part of emissions reductions that may be offset by an increase of the emissions in the non-constrained countries above their baseline levels. This can occur through;

- Relocation of energy-intensive production in non-constrained regions;
- Increased consumption of fossil fuels in these regions through decline in the international price of oil and gas triggered by lower demand for these energies; and
- Changes in incomes (thus in energy demand) because of better terms of trade.

Leakage also refers to greenhouse gas related effects of greenhouse gas emission reduction or CO_2 sequestration project activities that occur outside the project boundaries and that are measurable and attributable to the activity. On most occasions, leakage is understood as counteracting the initial activity. Nevertheless, there may be situations where effects attributable to the activity outside the project area lead to greenhouse gas emission reductions. These are commonly called spill-over. While (negative) leakage leads to a discount of emission reductions as verified, positive spill-over may not in all cases be accounted for.

Carbon neutral
Where an individual or company's carbon emissions are effectively reduced to zero through a combination of reducing energy consumption, using renewable energy and offsetting the remainder b (for example) planting trees to absorb carbon dioxide from the atmosphere.

Carbon offset

An investment in a project that will lead to the prevention or removal of carbon dioxide from the atmosphere (for example, planting trees or building renewable energy power stations to avoid the construction of coal ones).

Carbon pool
Carbon pools are: above-ground biomass, belowground biomass, litter, dead wood and soil organic carbon.

Carbon price
The price placed on greenhouse gas emissions to create a disincentive for their release (and incentive to capture or avoid them). A carbon price can be imposed through a carbon tax, an emissions trading scheme (which fixes emission level and allows price to vary) or a variety of other mechanisms.

Carbon sequestration
The uptake and storage of carbon. Trees and plants, for example, absorb carbon dioxide, release the oxygen and store the carbon. Fossil fuels were at one time biomass and continue to store the carbon until burned.

Carbon sinks
Carbon reservoirs and conditions that take-in and store more carbon (i.e., carbon sequestration) than they release. Carbon sinks can serve to partially offset greenhouse gas emissions. Forests and oceans are large carbon sinks.

Carbonaceous aerosol
Aerosol consisting predominantly of organic substances and various forms of black carbon.

Centigrade

Chlorofluorocarbons (CFCs)
Greenhouse gases covered under the 1987 Montreal Protocol and used for refrigeration, air conditioning, packaging, insulation, solvents, or aerosol propellants. Because they are not destroyed in the lower atmosphere, CFCs drift into the upper atmosphere where, given suitable conditions, they break down ozone. These gases are being replaced by other compounds, including hydrochlorofluorocarbons and hydrofluorocarbons, which are greenhouse gases covered under the Kyoto Protocol.

Clean development mechanism (CDM)
One of three market mechanisms established by the Kyoto Protocol, designed to promote emission reduction projects in developing countries.

Climate
Climate is usually defined as the "average weather", or more rigorously, as the statistical description of the weather in terms of the mean and variability of relevant quantities over periods of several decades (typically three decades as defined by WMO). These quantities are most often surface variables such as temperature, precipitation, and wind, but in a wider sense the "climate" is the description of the state of the climate system.

Climate-carbon cycle coupling
Future climate change induced by atmospheric emissions of greenhouse gases will impact on the global carbon cycle. Changes in the global carbon cycle in turn will influence the fraction of anthropogenic greenhouse gases that remains in the atmosphere, and hence the atmospheric concentrations of greenhouse gases, resulting in further climate change. This feedback is called climate-carbon cycle coupling. The first generation coupled climate-carbon cycle models indicates that global warming will increase the fraction of anthropogenic CO_2 that remains in the atmosphere.

Climate change

Climate change refers to any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer). Climate change may result from:

- natural factors, such as changes in the sun's intensity or slow changes in the Earth's orbit around the sun;
- natural processes within the climate system (e.g. changes in ocean circulation);
- human activities that change the atmosphere's composition (e.g. through burning fossil fuels) and the land surface (e.g. deforestation, reforestation, urbanization, desertification, etc.).

Climate feedback

An interaction mechanism between processes in the climate system is a climate feedback when the result of an initial process triggers changes in secondary processes that in turn influence the initial one. A positive feedback intensifies the initial process; a negative feedback reduces the initial process. Example of a positive climate feedback: higher temperatures as initial process cause melting of the arctic ice leading to less reflection of solar radiation, what leads to higher temperatures. Example of a negative feedback: higher temperatures increase the amount of cloud cover (thickness or extent) that could reduce incoming solar radiation and so limit the increase in temperature.

Climate lag

The delay that occurs in climate change as a result of some factor that changes only very slowly. For example, the effects of releasing more carbon dioxide into the atmosphere may not be known for some time because a large fraction is dissolved in the ocean and only released to the atmosphere many years later.

Climate model

A numerical representation of the climate system based on the physical, chemical and biological properties of its components, their interactions and feedback processes, and accounting for all or some of its known properties. The climate system can be represented by models of varying complexity, that is, for any one component or combination of components a spectrum or hierarchy of models can be identified, differing in such aspects as the number of spatial dimensions, the extent to which physical, chemical or biological processes are explicitly represented, or the level at which empirical parametrisations are involved. Coupled Atmosphere-Ocean General Circulation Models (AOGCMs) provide a representation of the climate system that is near the most comprehensive end of the spectrum currently available. There is an evolution towards more complex models with interactive chemistry and biology. Climate models are applied as a research tool to study and simulate the climate, and for operational purposes, including= monthly, seasonal and inter-annual climate predictions.

Climate prediction

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

Climate projection

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

Climate scenario

A plausible and often simplified representation of the future climate, based on an internally consistent set of climatological relationships, that has been constructed for explicit use in investigating the potential consequences of anthropogenic climate change, often serving as input to impact models. Climate projections often serve as the raw material for constructing climate scenarios, but climate scenarios

usually require additional information such as about the observed current climate. A “climate change scenario” is the difference between a climate scenario and the current climate.

Climate sensitivity
Equilibrium climate sensitivity refers to the equilibrium change in annual mean global surface temperature following a doubling of the atmospheric CO_2-equivalent concentration. The evaluation of the equilibrium climate sensitivity is expensive and often hampered by computational constraints.

Effective climate sensitivity is a related measure that circumvents the computational problem by avoiding the requirement of equilibrium. It is evaluated from model output for evolving non-equilibrium conditions. It is a measure of the strengths of the feedbacks at a particular time and may vary with forcing history and climate state. The climate sensitivity parameter refers to the equilibrium change in the annual mean global surface temperature following a unit change in
radiative forcing (K/W/m2)

Transient climate response is the change in the global surface temperature, averaged over a 20- year period, centred at the time of CO_2 doubling, i.e., at year 70 in a 1% per year compound CO_2 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 shift
An abrupt shift or jump in mean values signalling a change in climate regime. Most widely used in conjunction with the 1976/1977 climate shift that seems to correspond to a change in El Niño-Southern Oscillation behavior.

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

Climate threshold
The point at which the atmospheric concentration of greenhouse gases triggers a significant climatic or environmental event, which is considered unalterable, such as widespread bleaching of corals or a collapse of oceanic circulation systems.

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 temporal and spatial 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).

Cloud condensation nuclei
Airborne particles that serve as an initial site for the condensation of liquid water and which can lead to the formation of cloud droplets.

CO_2-equivalent concentration
The concentration of carbon dioxide that would cause the same amount of radiative forcing as a given mixture of carbon dioxide and other greenhouse gases.

CO_2-equivalent emission
The amount of CO_2 emission that would cause the same radiative forcing as an emitted amount of a well mixed greenhouse gas, or a mixture of well mixed greenhouse gases, all multiplied with their respective Global Warming Potentials to take into account the differing times they remain in the atmosphere.

Compliance
Compliance is whether and to what extent countries do adhere to the provisions of an accord. Compliance depends on implementing policies ordered, and on whether measures follow up the policies.

Concentration scenarios
Projections of greenhouse gas concentrations derived from emission scenarios and used as input into a climate model to compute climate projections.

Condensation
The change of the physical state of matter from the gaseous phase to the liquid phase. It is the reverse of vaporization. When the transition happens from the gaseous phase into the solid phase directly, the change is called deposition

Conference of the Parties
The supreme body of the United Nations Framework Convention on Climate Change (UNFCCC). It comprises more than 180 nations that have ratified the Convention. Its first session was held in Berlin, Germany, in 1995 and it is expected to continue meeting on a yearly basis. The COP's role is to promote and review the implementation of the Convention. It will periodically review existing commitments in light of the Convention's objective, new scientific findings, and the effectiveness of national climate change programs.

Contrails
Trails of chemicals left behind in air by aviation. These were shown in 2003 to contribute to the greenhouse effect and global warming.

Convection
The concerted, collective movement of ensembles of molecules within fluids (i.e. liquids, gases) and rheids. It cannot take place in solids, since neither bulk current flows nor significant diffusion can take place in solids

Cooling degree days (CDD)
A measurement designed to reflect the demand for energy needed to cool a home or business. It is derived from measurements of outside air temperature. The cooling requirements for a given structure at a specific location are considered to be directly proportional to the number of cooling degree days at that location. A similar measurement, heating degree days (HDD), reflects the amount of energy used to heat a home or business.

Coriolis effect
Caused by the rotation of the Earth (not curvature) and is responsible for the direction of rotation of cyclones. In general, the effect deflects objects moving along the surface of the Earth to the right in the Northern hemisphere and to the left in the Southern hemisphere. As a consequence, winds around the center of a cyclone rotate counterclockwise on the northern hemisphere and clockwise on the southern hemisphere.

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.

Critical threshold
The point at which activity faces an unacceptable level of harm, such a change from profit to loss on a farm due to decreased water availability, or coastal flooding exceeding present planning limits. It ocurrs when a threshold is reached at which ecological or socioeconomic change is damaging and requires a policy response.

Crop process models

Agronomic models that predict yields and other aspects of crop production as a function of temperature, precipitation, availability of irrigation, soil type, crop management, and other variables.

Cryosphere
All global snow, ice and permafrost. Fluctuations in the volume of the cryosphere cause changes in ocean sea level, which directly impact the atmosphere and biosphere.

Damage function
The relation between changes in the climate and reductions in economic activity relative to the rate that would be possible in an unaltered climate.

Deforestation
The natural or anthropogenic process that converts forest land to non-forest. Those practices or processes that result in the conversion of forested lands for non-forest uses. This is often cited as one of the major causes of the enhanced greenhouse effect for two reasons:

- The burning or decomposition of the wood releases carbon dioxide;
- Trees that once removed carbon dioxide from the atmosphere in the process of photosynthesis are no longer present.

Denitrification
Reduction of nitrate or nitrite to molecular nitrogen or nitrogen oxide.

Desertification
Refers to land degradation in arid, semi-arid, and dry subhumid areas resulting from various factors, including climatic variations and human activities. The United Nations Convention to Combat Desertification 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 processes arising from human activities and habitation patterns, such as soil erosion caused by wind and/or water, deterioration of the physical, chemical and biological or economic properties of soil and long-term loss of natural vegetation.

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

DGVM
Dynamic Global Vegetation Model.

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

Dobson unit
A unit to measure the total amount of ozone in a vertical column above the Earth's surface. The number of Dobson Units is the thickness in units of 10-5 m, that the ozone column would occupy if compressed into a layer of uniform density at a pressure of 1013 hPa, and a temperature of 0°C. One DU corresponds to a column of ozone containing 2.69 x1020 molecules per square meter. A typical value for the amount of ozone in a column of the Earth's atmosphere, although very variable, is 300 DU.

Driving forces
Climate scenarios contain various driving forces of climate change, including population growth and socio-economic and technological development. These drivers encompass various future scenarios that might influence greenhouse gas sources and sinks, such as the energy system and land use change.

Eccentricity
The extent to which the Earth's orbit around the Sun departs from a perfect circle.

Ecology
The totality or pattern of relations between organisms and their environment.

Ecological disturbance
An event or circumstance that interrupts the relationship between organism and environment.

Ecosystem
Any natural unit or entity including living and non-living parts that interact to produce a stable system through cyclic exchange of materials.

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

The accepted definition is a warming or cooling of at least 0.5 °C (0.9 °F) averaged over the east-central tropical Pacific Ocean. Typically, this anomaly happens at irregular intervals of 2–7 years and lasts nine months to two years. The average period length is 5 years. When this warming or cooling occurs for only seven to nine months, it is classified as El Niño/La Niña "conditions"; when it occurs for more than that period, it is classified as El Niño/La Niña "episodes

Emissions
The release of a substance (usually a gas when referring to the subject of climate change) into the atmosphere.

Emissions direct / indirect
Direct emissions or “point of emission” are defined at the point in the energy chain where they are released and are attributed to that point in the energy chain, whether a sector, a technology or an activity (e.g. emissions from coal-fired power plants are considered direct emissions from the energy supply sector).

Indirect emissions or emissions “allocated to the end-use sector” refer to the energy use in end-use sectors and account for the emissions associated with the upstream production of the end-use energy (e.g. some emissions associated with electricity generation can be attributed to the buildings sector corresponding to the building sector’s use of electricity).

Emissions factor
A unique value for scaling emissions to activity data in terms of a standard rate of emissions per unit of activity (e.g., grams of carbon dioxide emitted per barrel of fossil fuel consumed).

Emissions permit
Tradable allocation of entitlements by a government to an individual firm to emit a specific amount of a substance.

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.

Emissions standard
An amount of emission that may not be exceeded legally.

Emissions trading
Process that allows companies to either reduce emissions or pay for the right to pollute (with the money paid being used to reduce emissions elsewhere).

Emission trajectories
These are projections of future emission pathways, or observed emission patterns.

Energy
The amount of work or heat delivered. Energy is classified in a variety of types and becomes useful to human ends when it flows from one place to another or is converted from one type into another.

- **Primary energy** (also referred to as energy sources) is the energy embodied in natural resources (e.g., coal, crude oil, natural gas, uranium) that has not undergone any anthropogenic conversion. It is transformed into **secondary energy** by cleaning (natural gas), refining (oil in oil products) or by conversion into electricity or heat. When the secondary energy is delivered at the end-use facilities it is called final energy (e.g., electricity at the wall outlet), where it becomes usable energy (e.g., light). Daily, the sun supplies large quantities of energy as rainfall, winds, radiation, etc. Some share is stored in biomass or rivers that can be harvested by men. Some share is directly usable such as daylight, ventilation or ambient heat.

- **Renewable energy** is obtained from the continuing or repetitive currents of energy occurring in the natural environment and includes non-carbon technologies such as solar energy, hydropower, wind, tide and waves and geothermal heat, as well as carbon-neutral technologies such as biomass.

- **Embodied energy** is the energy used to produce a material substance (such as processed metals or building materials), taking into account energy used at the manufacturing facility (zero order), energy used in producing the materials that are used in the manufacturing facility (first order), and so on.

Energy balance
Averaged over the globe and over longer time periods, the energy budget of the climate system must be in balance. Because the climate system derives all its energy from the Sun, this balance implies that, globally, the amount of incoming solar radiation must on average be equal to the sum of the outgoing reflected solar radiation and the outgoing infrared radiation emitted by the climate system. A perturbation of this global radiation balance, be it human-induced or natural, is called radiative forcing.

Energy Information Administration (EIA)
Official energy statistics from the U.S. Government

Enhanced greenhouse effect
The concept that the natural greenhouse effect has been enhanced by anthropogenic emissions of greenhouse gases. Increased concentrations of;

- carbon dioxide,

- methane,
- nitrous oxide,
- chlorofluorocarbons (CFCs),
- hydrochlorofluorocarbons (HFCs),
- perfluorocarbons (PFCs),
- sulfur hexafluoride (SF_6),
- nitrogen trifluoride (NF_3), and
- other photochemically important gases caused by human activities such as fossil fuel consumption, trap more infra-red radiation, thereby exerting a warming influence on the climate.

Environment
The complex of physical, chemical, and biotic factors (as climate, soil, and living things) that act upon an organism (a living thing) or an ecological community (a collection of living things) and ultimately determine its form and survival. The circumstances, objects, and conditions that surround each of us.

Environmental effectiveness
The extent to which a measure, policy or instrument produces a decided, decisive or desired environmental effect.

Environmentally sustainable technologies
Technologies that are less polluting, use resources in a more sustainable manner, recycle more of their wastes and products, and handle residual wastes in a more acceptable manner than the technologies that they substitute. They are also more compatible with nationally determined socio-economic, cultural and environmental priorities.

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

Equivalent CO_2 (carbon dioxide)
The concentration of carbon dioxide that would cause the same amount of radiative forcing as a given mixture of carbon dioxide and other greenhouse gases.

Eustatic sea-level change
A change in global average sea level brought about by an alteration to the volume of the world ocean. This may be caused by changes in water density or in the total mass of water.

Eutrophication
The process by which a body of water (often shallow) becomes (either naturally or by pollution) rich in dissolved nutrients with a seasonal deficiency in dissolved oxygen.

Evaporation
The process by which a liquid becomes a gas.

Evapotranspiration
Combined loss of moisture from soil through evaporation and from plants through stomatal transpiration.

External forcing
External forcing refers to a forcing agent outside the climate system causing a change in the climate system. Volcanic eruptions, solar variations and anthropogenic changes in the composition of the atmosphere and landuse change are external forcings.

Externality / external cost / external benefit
Externalities arise from a human activity, when agents responsible for the activity do not take full account of the activity's impact on others' production and consumption possibilities, while there exists no compensation for such impact. When the impact is negative, so are external costs. When positive they are referred to as external benefits.

Extinction
The complete disappearance of an entire biological species.

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

Extratropical cyclones
Sometimes called mid-latitude cyclones, they are a group of cyclones defined as synoptic scale low pressure weather systems that occur in the middle latitudes of the Earth having neither tropical nor polar characteristics

Extreme weather event
An extreme weather event is an event that is rare within its statistical reference distribution at a particular place. Definitions of "rare" vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile. By definition, the characteristics of what is called extreme weather may vary from place to place. An extreme climate event is an average of a number of weather events over a certain period of time, an average which is itself extreme (e.g., rainfall over a season).

F-gases
This term refers to the groups of gases hydrofluorocarbons, perfluorocarbons, and sulphurhexafluoride.

Fahrenheit
Units for measuring temperature. Fahrenheit units represent a thermometric scale on which under standard atmospheric pressure the boiling point of water is at 212 degrees above the zero of the scale, the freezing point is at 32 degrees above zero, and the zero point approximates the temperature produced by mixing equal quantities by weight of snow and common salt.

Feedback
When one variable in a system triggers changes in a second variable that in turn ultimately affects the original variable; a positive feedback intensifies the effect, and a negative feedback reduces the effect. An example of positive climatic feedback is the ice-albedo feedback.

Feedback Mechanisms
Factors which increase or amplify (positive feedback) or decrease (negative feedback) the rate of a process.

Fluorocarbons
Carbon-fluorine compounds that often contain other elements such as hydrogen, chlorine, or bromine. Common fluorocarbons include chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs).

Flux adjustment
To avoid the problem of coupled atmosphere-ocean general circulation models drifting into some unrealistic climate state, adjustment terms can be applied to the atmosphere-ocean fluxes of heat and moisture (and sometimes the surface stresses resulting from the effect of the wind on the ocean surface) before these fluxes are imposed on the model ocean and atmosphere. Because these adjustments are precomputed and therefore independent of the coupled model integration, they are uncorrelated to the anomalies which develop during the integration

Forcing

A measure of how internal or external factors affect climate. Internal forcing is part of the natural chaos of the climate system, for example ENSO. External forcing may be natural (e.g. volcanic eruptions or solar fluctuations) or anthropogenic (e.g. increasing greenhouse gases or aerosols). External forcing can change the Earth's energy balance, and hence its climate patterns.

Forcing Mechanism
A process that alters the energy balance of the climate system such as changes in the relative balance between incoming solar radiation and outgoing infrared radiation from Earth. Such mechanisms include changes in solar irradiance, volcanic eruptions, and enhancement of the natural greenhouse effect by emissions of greenhouse gases.

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

Fossil CO2 (carbon dioxide) emissions
Emissions of carbon dioxide resulting from the combustion of fuels from fossil carbon deposits such as oil, natural gas, and coal.

Free air concentration enrichment (FACE)
Method whereby carbon dioxide levels can be elevated in a specified area of forest or other biomass. Unlike controlled environments such as growth chambers and greenhouses, this experiment enables scientists to study the response of plant growth to increased levels of CO_2 under natural conditions.

FPAR (Fraction of Photosynthetically Active Radiation)
The fraction of incoming shortwave radiation that is photosynthetically active.

Gaia hypothesis
The Gaia hypothesis states that the temperature and composition of the Earth's surface are actively controlled by life on the planet. It suggests that if changes in the gas composition, temperature or oxidation state of the Earth are induced by astronomical, biological, lithological, or other perturbations, life responds to these changes by growth and metabolism.

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

General circulation model (GCM)
Computer-based climate model that produces future forecast of weather and climate conditions for regions of the Earth or the complete planet. It can be used to simulate huma induced climate change. GCMs are highly complex and they represent the effects of such factors as reflective and absorptive properties of atmospheric water vapor, greenhouse gas concentrations, clouds, annual and daily solar heating, ocean temperatures and ice boundaries. The most recent GCMs include global representations of the atmosphere, oceans, and land surface.

Geo-engineering
Technological efforts to stabilize the climate system by direct intervention in the energy balance of the Earth for reducing global warming.

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

Geosphere
The soils, sediments, and rock layers of the Earth's crust, both continental and beneath the ocean floors.

Glacier
A mass of land ice flowing downhill (by internal deformation and sliding at the base) and constrained by the surrounding topography (e.g., the sides of a valley or surrounding peaks); the bedrock topography is the major influence on the dynamics and surface slope of a glacier. A glacier is maintained by accumulation of snow at high altitudes, balanced by melting at low altitudes or discharge into the sea. Glacier ice is the largest reservoir of fresh water on Earth, and second only to the oceans as the largest reservoir of total water. Glaciers are found on every continent except Australia.

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

Global surface temperature
The global surface temperature is the area-weighted global average of the sea surface temperature over the oceans (i.e., the sub-surface bulk temperature in the first few meters of the ocean), and the surface air temperature over land at 1.5 m above the ground.

Global warming
An average increase in the temperature of the atmosphere near the Earth's surface and in the troposphere, which can contribute to changes in global climate patterns. Global warming can occur from a variety of causes, both natural and human induced. In common usage, "global warming" often refers to the warming that can occur as a result of increased emissions of greenhouse gases from human activities.

Global warming potential (GWP)
An index, based upon radiative properties of well mixed greenhouse gases, measuring the radiative forcing of a unit mass of a given well mixed greenhouse gas in today’s atmosphere integrated over a chosen time horizon, relative to that of CO_2. The GWP represents the combined effect of the differing lengths of time that these gases remain in the atmosphere and their relative effectiveness in absorbing outgoing infrared radiation.

Global Warming Potential (GWP) is defined as the cumulative radiative forcing effects of a gas over a specified time horizon resulting from the emission of a unit mass of gas relative to a reference gas. The GWP-weighted emissions of direct greenhouse gases in the U.S. Inventory are presented in terms of equivalent emissions of carbon dioxide (CO_2), using units of teragrams of carbon dioxide equivalents (Tg CO_2 Eq.).

Conversion: Tg = 109 kg = 106 metric tons = 1 million metric tons

The molecular weight of carbon is 12, and the molecular weight of oxygen is 16; therefore, the molecular weight of CO2 is 44 (12+[16 x 2]), as compared to 12 for carbon alone. Thus, carbon comprises 12/44ths of carbon dioxide by weight.

Global Warming Potentials (100 Year Time Horizon)
http://www.epa.gov/climatechange/emissions/downloads10/US-GHG-Inventory-Fast-Facts-2008.pdf (PDF, 2 pp., 570 KB, About PDF)

Greenhouse effect
Greenhouse gases effectively absorb 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 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°Centigrade, in balance with the net incoming solar radiation, whereas the Earth's surface is kept at a much higher temperature of, on average, +14°Centigrade.

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 gases (GHGs)
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 infrared radiation emitted by the Earth's surface, the atmosphere and clouds. This property causes the greenhouse effect. Greenhouse gases include, but are not limited to, water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), ozone (O_3), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).

Greenhouse gas intensity
The volume of greenhouse gases emitted per unit of energy or economic output. It is a relative measure in that, if the economy is growing, greenhouse intensity per unit of economic output may be falling but greenhouse gas emissions may be increasing in absolute terms. Greenhouse gas intensity is to be contrasted with greenhouse gas emission reductions where the volume of gases emitted falls in absolute terms.

Greenhouse gas reduction potential
Possible reductions in emissions of greenhouse gases (quantified in terms of absolute reductions or in percentages of baseline emissions) that can be achieved through the use of technologies and measures.

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. It is calculated without deducting for depreciation of fabricated assets or depletion and degradation of natural resources.

Gross National Product (GNP)
GNP is a measure of national income. It measures value added from domestic and foreign sources claimed by residents. GNP comprises Gross Domestic Product plus net receipts of primary income from non-resident income.

Gross Primary Production (GPP)
The amount of carbon fixed from the atmosphere through photosynthesis.

Gross World Product
An aggregation of the individual country's Gross Domestic Products to obtain the sum for the world.

Growth Respiration
Respiration associated with photosynthesis. Respiration in which energy is used for the construction of new biomass.

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

Heating degree day (HDD)
A measurement designed to reflect the demand for energy needed to heat a home or business. It is derived from measurements of outside air temperature. The heating requirements for a given structure at a specific location are considered to be directly proportional to the number of HDD at that location. A similar measurement, cooling degree day (CDD), reflects the amount of energy used to cool a home or business.

Heating degree days are defined relative to a base temperature - the outside temperature above which a building needs no heating. The most appropriate base temperature for any particular building depends on the temperature that the building is heated to, and the nature of the building (including the heat generating occupants and equipment within it).

Heterotrophic respiration
The release of CO_2 during the process of decomposition of organic matter in the soil by soil animals, fungi, and other decomposer organisms. Often abbreviated "Rh".

Hydrocarbons
Substances containing only hydrogen and carbon. Fossil fuels are made up of hydrocarbons.

Hydrochlorofluorocarbons (HCFCs)
Compounds containing hydrogen, fluorine, chlorine, and carbon atoms. Although ozone depleting substances, they are less potent at destroying stratospheric ozone than chlorofluorocarbons (CFCs). They have been introduced as temporary replacements for CFCs and are also greenhouse gases.

Hydrofluorocarbons (HFCs)
Compounds containing only hydrogen, fluorine, and carbon atoms. They were introduced as alternatives to ozone depleting substances in serving many industrial, commercial, and personal needs. HFCs are emitted as by-products of industrial processes and are also used in manufacturing. They do not significantly deplete the stratospheric ozone layer, but they are powerful greenhouse gases.

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

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

Ice cap
A dome shaped ice mass covering a highland area that is considerably smaller in extent than an ice sheet.

Ice core
A cylindrical section of ice removed from a glacier or an ice sheet in order to study climate patterns of the past. By performing chemical analyses on the air trapped in the ice, scientists can estimate the percentage of carbon dioxide and other trace gases in the atmosphere at a given time.

Ice sheet
A mass of land ice that is sufficiently deep to cover most of the underlying bedrock topography, so that its shape is mainly determined by its internal dynamics (the flow of the ice as it deforms internally and slides at its base). An ice sheet flows outward from a high central plateau with a small average surface slope.

The margins slope steeply, and the ice is discharged through fast-flowing ice streams or outlet glaciers, in some cases into the sea or into ice shelves floating on the sea. There are only two large ice sheets in the modern world on Greenland and Antarctica, the Antarctic ice sheet being divided into East and West by the Transantarctic Mountains.

Ice shelf
A floating ice sheet of considerable thickness attached to a coast (usually of great horizontal extent with a level or gently undulating surface); often a seaward extension of ice sheets.

(Climate) Impact assessment
The practice of identifying and evaluating the detrimental and beneficial consequences of climate change on natural and human systems.

(Climate) Impacts
Consequences of climate change on natural and human systems. Depending on the consideration of adaptation, one can distinguish between potential impacts and residual impacts. **Potential impacts** are all impacts that may occur given a projected change in climate, without considering adaptation. **Residual impacts** are the impacts of climate change that would occur after adaptation.

Indigenous peoples
People whose ancestors inhabited a place or a country when persons from another culture or ethnic background arrived on the scene and dominated them through conquest, settlement, or other means and who today live more in conformity with their own social, economic, and cultural customs and traditions than those of the country of which they now form a part (also referred to as “native,” “aboriginal,” or “tribal” peoples).

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

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

- **Second indirect effect:** A radiative forcing induced by an increase in anthropogenic aerosols which cause a decrease in droplet size, reducing the precipitation efficiency, thereby modifying the liquid water content, cloud thickness, and cloud lifetime. This effect is also known as the “cloud lifetime effect” or “Albrecht effect.”

Infrared radiation
Radiation emitted by the Earth’s surface, the atmosphere and by clouds. Also known as terrestrial an long-wave radiation. Infrared radiation has a distinctive spectrum (i.e., range of wavelengths) governed by the temperature of the Earth-atmosphere system. The spectrum of infrared radiation is practically distinct from that of solar (q.v.) or short-wave radiation because of the difference in temperature between the Sun and the Earth-atmosphere system.

Instrumental period
Period after 1855 that allowed us to reconstruct temperatures because thermometers were producing reconstructable data. Before 1855 proxy indicators were used to determine temperatures.

Interglacials
The warm periods between ice age glaciations. The previous interglacial, dated approximately from 129,000 to 116,000 years ago, is referred to as Last Interglacial.

Integrated assessment
The work field that researches causes and impacts of environmental issues and policy measures (solutions) by combining economic, environmental and social sciences. It is a subdivision of the work field of Environmental Systems Analysis. This is a type of Environmental Science that applies many different tools, including environmental models, environmental impact assessment and environmental indicators, to describe and find solutions for environmental problems.

Intergovernmental Panel on Climate Change (IPCC)
The IPCC was established jointly by the United Nations Environment Program and the World Meteorological Organization in 1988. The purpose of the IPCC is to assess information in the scientific= and technical literature related to all significant components of the issue of climate change. The IPCC draws upon hundreds of the world's expert scientists as authors and thousands as expert reviewers. Leading experts on climate change and environmental, social, and economic sciences from some 60 nations have helped the IPCC to prepare periodic assessments of the scientific underpinnings for understanding global climate change and its consequences. With its capacity for reporting on climate change, its consequences, and the viability of adaptation and mitigation measures, the IPCC is also looked to as the official advisory body to the world's governments on the state of the science of the climate change issue. For example, the IPCC organized the development of internationally accepted methods for conducting national greenhouse gas emission inventories.

International Energy Agency (IEA)
Established in 1974, the agency is linked with the OECD. It enables OECD member countries to take joint measures to meet oil supply emergencies, to share energy information, to coordinate their energy policies, and to cooperate in developing rational energy use programs.

Inverse modeling
A mathematical procedure by which the input to a model is estimated from the observed outcome, rather than vice versa. It is, for instance, used to estimate the location and strength of sources and sinks of CO_2 from measurements of the distribution of the CO_2 concentration in the atmosphere, given models of the global carbon cycle and for computing atmospheric transport.

Irradiance
Total solar irradiance describes the radiant energy emitted by the sun over all wavelengths that falls each second on 1 square meter outside the earth's atmosphere--a quantity proportional to the " solar constant " observed earlier in this century. It measures the solar energy flux in watts m^{-2}.

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

Joint Implementation
Richer countries have the opportunity to achieve their emission reduction goals, formulated in the Kyoto Protocol, by financing energy saving projects for poorer countries that have also signed the treaty

Kyoto Protocol
The Kyoto Protocol to the UNFCCC was adopted at the Third Session of the Conference of the Parties (COP) in 1997 in Kyoto. It contains legally binding commitments, in addition to those included in the FCCC. Annex B countries agreed to reduce their anthropogenic GHG emissions (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride) by at least 5% below 1990 levels in the commitment period 2008-2012. The Kyoto Protocol came into force on 16 February 2005.

La Niña

A coupled ocean-atmosphere phenomenon that is the counterpart of El Niño as part of the broader El Niño-Southern Oscillation climate pattern. During a period of La Niña, the sea surface temperature across the equatorial Eastern Central Pacific Ocean will be lower than normal by 3–5 °C.

Land use and land-use change
Land use refers to the total of arrangements, activities and inputs undertaken in a certain land cover type (a set of human actions). The term land use is also used in the sense of the social and economic purposes for which land is managed (e.g., grazing, timber extraction, and conservation). Land-use change refers to a change in the use or management of land by humans, which may lead to a change in land cover. Land cover and landuse change may have an impact on the surface albedo, evapotranspiration, sources and sinks of greenhouse gases, or other properties of the climate system and may thus have a radiative forcing and/or other impacts on climate, locally or globally.

Latent Heat
The heat that is either released or absorbed by a unit mass of a substance when it undergoes a change of state such as during evaporation, condensation, or sublimation. Energy released or absorbed when water changes state (melts, freezes, vaporizes, or condenses). The latent heat of evaporation is often represented by the symbol "LE".

Leaf Area Index (LAI)
The area of foliage per unit area of ground. Conventionally this refers to the ratio of the area of the upper side of the leaves in a canopy projected onto a flat surface to the area of the surface under the canopy. This has also been called single-sided LAI or projected LAI. Occasionally LAI has been used in reference the total surface area of leaves, sometimes referred to as double-sided LAI. If a leaf is flat, the double-sided LAI is about twice that of the single-sided LAI. If the leaf is cylindrical, the double-sided LAI will be more than twice the single-sided LAI.

Level of scientific understanding (LOSU)
This is an index on a 4-step scale (high, medium, low and very low) designed to characterize the degree of scientific understanding of the radiative forcing agents that affect climate change. For each agent, the index represents a subjective judgment about the reliability of the estimate of its forcing, involving such factors as the assumptions necessary to evaluate the forcing, the degree of knowledge of the physical/ chemical mechanisms determining the forcing and the uncertainties surrounding the quantitative estimate.

Lignin
A structural substance in a plant that is very resistant to decomposition.

Lithosphere
The upper layer of the solid Earth, both continental and oceanic, which is composed of all crustal rocks and the cold, mainly elastic, part of the uppermost mantle. Volcanic activity, although part of the lithosphere, is not considered as part of the climate system, but acts as an external forcing factor.

Longwave radiation
The radiation emitted in the spectral wavelength greater than 4 micrometers corresponding to the radiation emitted from the Earth and atmosphere. It is sometimes referred to as 'terrestrial radiation' or 'infrared radiation,' although somewhat imprecisely.

MAGICC
Climate model that calculates average atmospheric temperatures and sea levels. It is used by IPCC for the construction of the SRES scenarios

Maintenance Respiration
Respiration involved with turnover and repair of plant material. Respiration in which energy is used to maintain living biomass.

Mauna Loa record
The record of measurement of atmospheric CO_2 concentrations taken at Mauna Loa Observatory, Mauna Loa, Hawaii, since March 1958. This record shows the continuing increase in average annual atmospheric CO_2 concentrations.

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

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

- Total mass balance (of the glacier) -- The specific mass balance spatially integrated over the entire glacier area; the total mass a glacier gains or losses over a hydrological cycle.

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

Mean sea level
Mean sea level is normally defined as the average relative sea level over a period, such as a month or a year, long enough to average out transients such as waves and tides. Relative sea level is sea level measured by a tide gauge with respect to the land upon which it is situated.

Medieval warm period
Term introduced by the British meteorologist Hubert Lamb in 1965, for a period between the 9th and 13th century during which it was extremely warm on many locations in and around Europe. Wine was grown in Scandinavia and agriculture was possible on Greenland. This was determined by studying snow lines in the mountains and temperatures in deep boreholes and has given us the impression that temperature changes may have occurred before. Geochemist Wallace Broecker thinks that cyclic processes in the oceans cause a warmer period once in every 1500 years.

Mesopause
The temperature minimum at the boundary between the mesosphere and the thermosphere atmospheric regions. Due to the lack of solar heating and very strong radiative cooling from carbon dioxide, the mesopause is the coldest place on Earth with temperatures as low as -100°C

Mesosphere
The layer of the Earth's atmosphere that is directly above the stratosphere and directly below the thermosphere. In the mesosphere temperature decreases with increasing height. The upper boundary of the mesosphere is the mesopause, which can be the coldest naturally occurring place on Earth with temperatures below 130 K.

Methane (CH_4)
A hydrocarbon that is a greenhouse gas with a global warming potential most recently estimated at 23 times that of carbon dioxide (CO_2). Methane is produced through anaerobic (without oxygen) decomposition of waste in landfills, animal digestion, decomposition of animal wastes, production and distribution of natural gas and petroleum, coal production, and incomplete fossil fuel combustion.

Methane recovery
Methane emissions, e.g., from oil or gas wells, coal beds, peat bogs, gas transmission pipelines, landfills, or anaerobic digesters, are captured and used as a fuel or for some other economic purpose (e.g., chemical feedstock).

Methanotrophic

It has the biological capacity to oxidize methane to CO_2 and water by metabolism under aerobic conditions.

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

Mitigative capacity
This is a country's ability to reduce anthropogenic greenhouse gas emissions or to enhance natural sinks, where ability refers to skills, competencies, fitness and proficiencies that a country has attained and= depends on technology, institutions, wealth, equity, infrastructure and information. Mitigative capacity is rooted in a country's sustainable development path.

Mitigation potential
In the context of climate change mitigation, the mitigation potential is the amount of mitigation that could be, but is not yet, realized over time.

- Market potential is the mitigation potential based on private costs and private discount rates, which might be expected to occur under forecast market conditions, including policies and measures currently in place, noting that barriers limit actual uptake. Private costs and discount rates reflect the perspective of private consumers and companies.

- Economic potential is the mitigation potential that takes into account social costs and benefits and social discount rates, assuming that market efficiency is improved by policies and measures and barriers are removed. Social costs and discount rates reflect the perspective of society.
- Social discount rates are lower than those used by private investors. Studies of market potential can be used to inform policy makers about mitigation potential with existing policies and barriers, while studies of economic potential show what might be achieved if appropriate new and additional policies were put into place to remove barriers and include social costs and benefits.
- The economic potential is therefore generally greater than the market potential.

- Technical potential is the amount by which it is possible to reduce greenhouse gas emissions or improve energy efficiency by implementing a technology or practice that has already been demonstrated. No explicit reference to costs is made but adopting 'practical constraints' may take implicit economic considerations into account.

Monsoon
Wind in the general atmospheric circulation typified by a seasonal persistent wind direction and by a pronounced change in direction from one season to the next.

Montane
The biogeographic zone made up of relatively moist, cool upland slopes below timberline and characterized by the presence of large evergreen trees as a dominant life form.

Montreal Protocol
The Montreal Protocol on Substances that Deplete the Ozone Layer was adopted in Montreal in 1987, and subsequently adjusted and amended in London (1990), Copenhagen (1992), Vienna (1995), Montreal (1997) and Beijing (1999). It controls the consumption and production of chlorine- and bromine containing chemicals that destroy stratospheric ozone, such as CFCs, methyl chloroform, carbon tetrachloride, and many others.

Moulin
A narrow, tubular chute, hole or crevasse worn in the ice by surface water, which carries water from the surface to the base far below

Mount Pinatubo
A volcano in the Philippine Islands that erupted in 1991. The eruption of Mount Pinatubo ejected enough particulate and sulfate aerosol matter into the atmosphere to block some of the incoming solar radiation from reaching Earth's atmosphere. This effectively cooled the planet from 1992 to 1994, masking the warming that had been occurring for most of the 1980s and 1990s

Net anthropogenic greenhouse gas removals by sinks
For CDM afforestation and reforestation projects, 'net anthropogenic greenhouse gas removals by sinks' equals the actual net greenhouse gas removals by sinks minus the baseline net greenhouse gas removals by sinks minus leakage.

Net biome production (NBP)
Equals to the Net Ecosystem Production minus the carbon lost due to a disturbance (e.g., a forest fire or a forest harvest).

Net ecosystem exchange (NNE)
The integration the fluxes of CO_2 into and out of the vegetation.

Net ecosystem production (NEP)
Net gain or loss of carbon from an ecosystem. NEP is equal to the Net Primary Production minus the carbon lost through heterotrophic respiration.

Net primary production (NPP)
The increase in plant biomass or carbon of a unit of a landscape. NPP is equal to the Gross Primary Production minus carbon lost through autotrophic respiration.

Nitrification
Oxidation of ammonium to nitrite or nitrate.

Nitrogen Fixation
The conversion of atmospheric nitrogen to forms usable in biological processes (ammonium and nitrate).

Nitrogen oxides (NOx)
Gases consisting of one molecule of nitrogen and varying numbers of oxygen molecules. Nitrogen oxides are produced in the emissions of vehicle exhausts and from power stations. In the atmosphere, nitrogen oxides can contribute to formation of photochemical ozone (smog), can impair visibility, and have health consequences; they are thus considered pollutants.

Nitrous oxide (N_2O)
A powerful greenhouse gas with a global warming potential of 296 times that of carbon dioxide (CO2). The main anthropogenic source of nitrous oxide is agriculture (soil and animal manure management), but important contributions also come from sewage treatment, combustion of fossil fuel, and chemical industrial processes. Nitrous oxide is also produced naturally from a wide variety of biological sources in soil and water, particularly microbial action in wet tropical forests.

Non-linearity
A process is called "non-linear" when there is no simple proportional relation between cause and effect. The climate system contains many such non-linear processes, resulting in a system with a potentially very complex behavior. Such complexity may lead to rapid climate change.

Non-Methane Volatile Organic Compounds (NMVOCs)
Organic compounds, other than methane, that participate in atmospheric photochemical reactions

North Atlantic Oscillation (NAO)

The North Atlantic Oscillation consists of opposing variations of barometric pressure near Iceland and near the Azores. On average, a westerly current, between the Icelandic low pressure area and the Azores high pressure area, carries cyclones with their associated frontal systems towards Europe. However, the pressure difference between Iceland and the Azores fluctuates on time scales of days to decades, and can be reversed at times. It is the dominant mode of winter climate variability in the North Atlantic region, ranging from central North America to Europe.

Northern Annular Mode/Northern Hemisphere Annular Mode (NAM) or the Arctic oscillation (AO)
An index (which varies over time with no particular periodicity) of the dominant pattern of non-seasonal sea-level pressure variations north of 20N latitude, and it is characterized by pressure anomalies of one sign in the Arctic with the opposite anomalies centered about 37-45N. The AO is believed by climatologists to be causally related to, and thus partially predictive of, weather patterns in locations many thousands of miles away, including many of the major population centers of Europe and North America.

Ocean acidification
A decrease in the pH of sea water due to the uptake of anthropogenic carbon dioxide.

Ocean conveyor belt
The theoretical route by which water circulates around the entire global ocean, driven by wind and the thermohaline circulation.

Ocean thermal lag
Length of time (some three decades for benchmark 2 x CO2 warming) between increase in atmospheric concentration of greenhouse gases and the resulting eventual equilibrium warming, attributable to ocean thermal dynamics. During this period surface warming is slowed as the deep ocean is warmed to maintain an equilibrium differential from ocean surface temperatures.

Organic aerosol
Aerosol particles consisting predominantly of organic compounds, mainly C, H, and O, and lesser amounts of other elements.

Oxidize
To chemically transform a substance by combining it with oxygen.

Ozone (O3)
Ozone, the triatomic form of oxygen (O3), is a gaseous atmospheric constituent. In the troposphere it is created both naturally and by photochemical reactions involving gases resulting from human activities (photochemical “smog”). In high concentrations, tropospheric ozone can be harmful to a wide-range of living organisms. Tropospheric ozone acts as a greenhouse gas. In the stratosphere, ozone is created by the interaction between solar ultraviolet radiation and molecular oxygen (O2). Stratospheric ozone plays a decisive role in the stratospheric radiative balance. Its concentration is highest in the ozone layer. Depletion of stratospheric ozone, due to chemical reactions that may be enhanced by climate change, results in an increased ground-level flux of ultraviolet-B radiation.

Ozone Depleting Substance (ODS)
A family of man-made compounds that includes, but are not limited to, chlorofluorocarbons (CFCs), bromofluorocarbons (halons), methyl chloroform, carbon tetrachloride, methyl bromide, and hydrochlorofluorocarbons (HCFCs). These compounds have been shown to deplete stratospheric ozone, and therefore are typically referred to as ODSs.

Ozone layer
The stratosphere contains a layer in which the concentration of ozone is greatest, the so-called ozone layer. The layer extends from about 12 to 40 km. The ozone concentration reaches a maximum between about 20 and 25 km. This layer is being depleted by human emissions of chlorine and bromine compounds. Every year, during the Southern Hemisphere spring, a very strong depletion of the ozone layer takes place over the Antarctic region, also caused by human-made chlorine and bromine

compounds in combination with the specific meteorological conditions of that region. This phenomenon is called the ozone hole.

Ozone precursors
Chemical compounds, such as carbon monoxide, methane, non-methane hydrocarbons, and nitrogen oxides, which in the presence of solar radiation react with other chemical compounds to form ozone, mainly in the troposphere.

Pacific-North American teleconnection pattern (PNA)
A climatological term for a large-scale weather pattern with two modes, denoted positive and negative, and which relates the atmospheric circulation pattern over the North Pacific Ocean with the one over the North American continent.

The positive phase of the PNA pattern features above-average barometric pressure heights in the vicinity of Hawaii and over the intermountain region of North America, and below-average heights located south of the Aleutian Islands and over the southeastern United States. The PNA pattern is associated with strong fluctuations in the strength and location of the East Asian jet stream. The positive phase is associated with an enhanced East Asian jet stream and with an eastward shift in the jet exit region toward the western United States. The negative phase is associated with a westward retraction of that jet stream toward eastern Asia, blocking activity over the high latitudes of the North pacific, and a strong split-flow configuration over the central North Pacific.

Although the PNA pattern is a natural internal mode of climate variability, it is also strongly influenced by the El Niño-Southern Oscillation (ENSO) phenomenon. The positive phase of the PNA pattern tends to be associated with Pacific warm episodes (El Niño), and the negative phase tends to be associated with Pacific cold episodes (La Niña).

Parabolic
A bowl shaped trough that focuses sunlight into a narrow beam. The bowl reflects the incoming rays of the sun to a receiving element at the centre of the bowl or trough.

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

Particulate matter (PM)
Very small pieces of solid or liquid matter such as particles of soot, dust, fumes, mists or aerosols. The physical characteristics of particles, and how they combine with other particles, are part of the feedback mechanisms of the atmosphere.

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

Passive solar design
Structural design and construction techniques that enable a building to utilize solar energy for heating, cooling, and lighting by non mechanical means.

Patterns of climate variability
Natural variability of the climate system, in particular on seasonal and longer time scales, predominantly occurs with preferred spatial patterns and time scales, through the dynamical characteristics of the atmospheric circulation and through interactions with the land and ocean surfaces. Such patterns are often called regimes, modes or teleconnections. Examples are the;

- North Atlantic Oscillation (NAO),

- Pacific-North American pattern (PNA),
- El Niño- Southern Oscillation (ENSO),
- Northern Annular Mode (NAM; previously called Arctic Oscillation, AO) and
- Southern Annular Mode (SAM; previously called the Antarctic Oscillation, AAO).

Perfluorocarbons (PFCs)
Greenhouse gases that are by-products of aluminium smelting and uranium enrichment. They also replace chlorofluorocarbons in manufacturing semiconductors.

Permafrost
Perennially frozen ground that occurs wherever the temperature remains below 0°C for several years.

Permanent crop land
Land under crops that last many seasons and are not replanted after each harvest. Permanent crops include tea, coffee, rubber, flowering shrubs, fruit and nut trees, and vines.

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

Phenology
The timing of plant behaviors governed by increasing or decreasing day length and/or growing degree days. These behaviors include the greening up of plants, senescence of plants, leaf production, and leaf drop.

Phloem
The specialized vascular plant tissue used for the transportation of dissolved sugars and other organic solutes within a plant.

Photorespiration
A process that begins when rubisco fixes molecular oxygen, as opposed to carbon dioxide, which ultimately leads to the evolution of CO_2 from plants. This process of carbon loss is stimulated by conditions of high light, temperature and oxygen concentration.

Photosynthate
Carbohydrates, including glucose and sucrose among others, that are produced from the end products of photosynthesis.

Photosynthesis
The metabolic process where plants use CO_2 from the air (or water) to build plant material and release O_2 in the process. There are several pathways of photosynthesis with different responses to atmospheric CO_2 concentrations.

Photosynthetically active radiation (PAR)
The wavelengths absorbed by chlorophyll and therefore active in the photosynthetic processes. These wavelengths are between 0.4 and 0.7 microns and essentially make up the visible spectrum.

Physiology
Plant processes. These include:
- Photosynthesis
- Transpiration
- Retranslocation
- Carbon allocation
- Growth
- Maintenance respiration

- Senescence and death

Plankton
Micro-organisms living in the upper layers of aquatic systems. A distinction is made between phytoplankton, which depend on photosynthesis for their energy supply, and zooplankton, which feed on phytoplankton.

Plant functional type (PFT)
In terms of the IRC model it is a plant type plus soil within a landscape. A plant is defined from a database of parameters derived from empirical data. Soil is a realistic approximation to soil survey map units, whose texture and structure directly affect plant production and organic matter decomposition. The landscape provides the topographic influences upon the local environment. A PFT is simulated as a cohort that can be created through disturbance and aggregated with similar cohorts.

Potential
In the context of climate change, potential is the amount of mitigation or adaptation that could be - but is not yet – realized over time. As potential levels are identified: market, economic, technical and physical.

- Market potential indicates the amount of greenhouse gas mitigation that might be expected to occur under forecast market conditions including policies and measures in place at the time. It is based on private unit costs and discount rates, as they appear in the base year and as they are expected to change in the absence of any additional policies and measures.

- Economic potential is in most studies used as the amount of greenhouse gas mitigation that is cost-effective for a given carbon price, based on social cost pricing and discount rates, including energy savings, but without most externalities. Theoretically, it is defined as the potential for cost-effective GHG mitigation when non-market social costs and benefits are included with market costs and benefits in assessing the options for particular levels of carbon prices (as affected by mitigation policies) and when using social discount rates instead of private ones. This includes externalities, i.e., non-market costs and benefits such as environmental co-benefits.

- Technical potential is the amount by which it is possible to reduce greenhouse gas emissions or improve energy efficiency by implementing a technology or practice that has already been demonstrated. No explicit reference to costs is made but adopting ‘practical constraints’ may take into account implicit economic considerations.

- Physical potential is the theoretical (thermodynamic) and sometimes, in practice, rather uncertain upper limit to mitigation.

Precession
The comparatively slow torquing of the orbital planes of all satellites with respect to the Earth's axis, due to the bulge of the Earth at the equator which distorts the Earth's gravitational field. Precession is manifest by the slow rotation of the line of nodes of the orbit (westward for inclinations less than 90 degrees and eastward for inclinations greater than 90 degrees).

Precipitation
Rain, hail, mist, sleet, snow or any other moisture that falls to the Earth.

Precursors
Atmospheric compounds which themselves are not greenhouse gases or aerosols, but which have an effect on greenhouse gas or aerosol concentrations by taking part in physical or chemical processes regulating their production or destruction rates

Proxy climate indicator
A proxy climate indicator is a local record that is interpreted, using physical and biophysical principles, to represent some combination of climate-related variations back in time. Climate related data derived in this

way are referred to as proxy data. Examples of proxies are: tree ring records, characteristics of corals, and various data derived from ice cores.

Radiation
Energy transfer in the form of electromagnetic waves or particles that release energy when absorbed by an object.

Radiative damping
An imposed positive radiative forcing (q.v.) on the Earth-atmosphere system (e.g., through the addition of greenhouse gases) represents an energy surplus. The temperature of the surface and lower atmosphere will then increase and in turn increase the amount of infrared radiation being emitted to space, thus a new energy balance will be established. The amount that emissions of infrared radiation to space increase for a given increase in temperature is known as the radiative damping.

Radiative forcing
A change in the balance between incoming solar radiation and outgoing infrared radiation. Without any radiative forcing, solar radiation coming to the Earth would continue to be approximately equal to the infrared radiation emitted from the Earth. The addition of greenhouse gases traps and increased fraction of the infrared radiation, reradiating it back toward the surface and creating a warming influence (i.e., positive radiative forcing because incoming solar radiation will exceed outgoing infrared radiation).

Radiative forcing scenario
A plausible representation of the future development of radiative forcing associated, for example, with changes in atmospheric composition or land-use change, or with external factors such as variations in solar activity. Radiative forcing scenarios can be used as input into simplified climate models to compute climate projections.

Radiative Transfer
The transfer of short wave energy from the sun and long wave energy from the environment to entities such as plants, snow pack, and soil. A theory dealing with the propagation of electromagnetic radiation through a medium.

Radio-echosounding
The surface and bedrock, and hence the thickness, of a glacier can be mapped by radar; signals penetrating the ice are reflected at the lower boundary with rock (or water, for a floating glacier tongue).

Rangeland
Unimproved grasslands, shrublands, savannahs, and tundra.

Rapid climate change
The non-linearity of the climate system may lead to rapid climate change, sometimes called abrupt events or even surprises. Some such abrupt events may be imaginable, such as a dramatic reorganization of the thermohaline circulation, rapid deglaciation, or massive melting of permafrost leading to fast changes in the carbon cycle. Others may be truly unexpected, as a consequence of a strong, rapidly changing, forcing of a non-linear system.

Regeneration
The renewal of a stand of trees through either natural means (seeded onsite or adjacent stands or deposited by wind, birds, or animals) or artificial means (by planting seedlings or direct seeding).

Regimes
Preferred patterns of climate variability

Relative sea level
Sea level measured by a tide gauge with respect to the land upon which it is situated. Mean Sea Level

(MSL) is normally defined as the average Relative Sea Level over a period, such as a month or a year, long enough to average out transients such as waves.

Reforestation
Direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was previously forested but converted to non-forested land.

Residence Time
The average time spent in a reservoir by an individual atom or molecule. With respect to greenhouse gases, residence time usually refers to how long a particular molecule remains in the atmosphere.

Reservoir
A component of the climate system, other than the atmosphere, which has the capacity to store, accumulate or release a substance of concern, e.g. carbon, a greenhouse gas or a precursor. Oceans, soils, and forests are examples of reservoirs of carbon. Pool is an equivalent term (note that the definition of pool often includes the atmosphere). The absolute quantity of substance of concerns, held within a reservoir at a specified time, is called the stock.

Respiration
The cellular process by which sugars and other organic compounds are broken down to release stored energy and to obtain carbon skeletons used in the growth and maintenance of the cell.

The oxidation of carbohydrate to CO_2 and H_20 in living cells. An intracellular process in which molecules, particularly pyrutvate in the Krebs cycle, are oxidized with the release of energy and CO_2. The complete breakdown of sugar or other organic compounds to carbon dioxide and water is termed aerobic respiration, although the first steps of the process are anaerobic.

In plant vegetation there are two main types of respiration. The first is called **dark respiration** (R_d) and includes various pathways of substrate oxidation such as glycolysis, the oxidative pentose phosphate pathway and the tricarboxylic acid (TCA or Krebs) cycle. These conserve some of the free energy in carbohydrate in the high energy bonds of ATP, reduced pyridine nucleotide (NADH) and $FADH_2$. The term dark respiration also covers the further oxidation of NADH and $FADH_2$ by transfer of electrons through the various electron transfer complexes of the mitochondrial electron transport pathway. The second type of respiration in plants is called **photorespiration.** This is the pathway of CO_2 production via the photorespiratory carbon oxidation (PCO) cycle. The same enzyme (Rubisco) that catalysis the carboxylation of RuBP as the first step of the PCR cycle can also catalyse the oxygenation of RuBP to phosphoglycollate as the first step of the PCO cycle.

Residence time
The average time spent in a reservoir by an individual atom or molecule. With respect to greenhouse gases, residence time usually refers to how long a particular molecule remains in the atmosphere.

Response time
The response time or adjustment time is the time needed for the climate system or its components to re equilibrate to a new state, following a forcing resulting from external and internal processes or feedbacks. It is very different for various components of the climate system. The response time of the troposphere is relatively short, from days to weeks, whereas the stratosphere comes into equilibrium on a time scale of typically a few months. Due to their large heat capacity, the oceans have a much longer response time, typically decades, but up to centuries or millennia. The response time of the strongly coupled surface troposphere system is, therefore, slow compared to that of the stratosphere, and mainly determined by the oceans. The biosphere may respond fast (e.g., to droughts), but also very slowly to imposed changes.

Retranslocation
The transport of minerals and food from the leaves of a plant to storage when the leaves senesce.

Ricardian models
Family of Ricardian or cross-section (CS) models relating agricultural capacity to temperature and precipitation, usually in a nonlinear fashion, on the basis of statistical estimates from farm survey or county-level data across varying climatic zones. The classical economist David Ricardo developed the theory that the value of land depends on the difference between its fertility and that of the least fertile land just brought into cultivation at the margin. The seminal Ricardian agricultural impact model (Mendelsohn, Nordhaus, and Shaw 1994) argued that statistical regressions relating land values to climate differences could capture the impact of climate on agricultural productivity and thus be used to calculate prospective effects of global warming.

Rubisco
A bifunctional enzyme that can fix carbon dioxide or molecular oxygen, which leads to photosynthesis or photorespiration , respectively. Rubisco is the most abundant enzyme on earth.

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

Sea ice
Any form of ice found at sea that has originated from the freezing of sea water. Sea ice may be discontinuous pieces (ice floes) moved on the ocean surface by wind and currents (pack ice), or a motionless sheet attached to the coast (land-fast ice). Sea ice less than one year old is called first-year ice. Multi-year ice is sea ice that has survived at least one summer melt season.

Sea level change/sea level rise
Sea level can change, both globally and locally, due to changes in the shape of the ocean basins, changes in the total mass of water and changes in water density. Factors leading to sea level rise under global warming include both increases in the total mass of water from the melting of land-based snow and ice, and changes in water density from an increase in ocean water temperatures and salinity changes. Relative sea level rise occurs where there is a local increase in the level of the ocean relative to the land, which might be due to ocean rise and/or land level subsidence.

Sea level secular change (relative)
Long term changes in relative sea level caused by either eustatic changes, e.g. brought about by thermal expansion, or changes in vertical land movements.

Senescence
The process of plant degeneration that generally occurs at the end of the growing season. It is typically characterized by increasing respiration, decreasing growth rates, chlorophyll breakdown, and mobilization of nitrogen out of leaves and into other plant organs.

Sensible Heat
Thermal energy advective in the air from adjacent land mass, usually aided by convection from deep soil layers or from the earth. It is often represented by the symbol **H**. The excess radiative energy that has passed from the Earth's surface to the atmosphere through advection, conduction, and convection processes.

Sequestration
The process of increasing the carbon content of a carbon pool other than the atmosphere. Carbon storage in terrestrial or marine reservoirs. Biological sequestration includes direct removal of CO_2 from the atmosphere through land-use change, afforestation, reforestation, carbon storage in landfills and practices that enhance soil carbon in agriculture.

Shortwave Radiation
The radiation received from the sun and emitted in the spectral wavelengths less than 4 microns. It is also called 'solar radiation'.

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

Social cost of carbon (SCC)
The discounted monetized sum (e.g. expressed as a price of carbon in $/tCO2) of the annual net losses from impacts triggered by an additional ton of carbon emitted today. According to usage in economic theory, the social cost of carbon establishes an economically optimal price of carbon at which the associated marginal costs of mitigation would equal the marginal benefits of mitigation.

Social unit costs of mitigation
Carbon prices in US$/tCO2 and US$/tC-eq (as affected by mitigation policies and using social discount rates) required to achieve a particular level of mitigation (economic potential) in the form of a reduction below a baseline for greenhouse gas emissions. The reduction is usually associated with a policy target, such as a cap in an emissions trading scheme or a given level of stabilization of greenhouse gas concentrations in the atmosphere.

Solar constant
As defined for planet Earth, it is the power collected at the top of the atmosphere by a unit area perpendicular to the light path.

Soil carbon
A major component of the terrestrial biosphere pool in the carbon cycle. The amount of carbon in the soil is a function of the historical vegetative cover and productivity, which in turn is dependent in part upon climatic variables.

Solar activity
The Sun exhibits periods of high activity observed in numbers of sunspots, as well as radiative output, magnetic activity, and emission of high energy particles. These variations take place on a range of time scales from millions of years to minutes.

Solar ("11 year") cycle
A quasi-regular modulation of solar activity with varying amplitude and a period of between 9 and 13 years.

Solar radiation (energy)
Radiation emitted by the Sun. Also known as short-wave radiation. Solar radiation has a distinctive spectrum (i.e., range of wavelengths) governed by the temperature of the Sun. The spectrum of solar radiation is practically distinct from that of infrared (q.v.) or terrestrial radiation because of the difference in temperature between the Sun and the Earth-atmosphere system.

Soot particles
Particles formed during the quenching of gases at the outer edge of flames of organic vapors, consisting predominantly of carbon, with lesser amounts of oxygen and hydrogen present as carboxyl and phenolic groups and exhibiting an imperfect graphitic structure. See also black carbon.

Source
A carbon pool (reservoir) can be a source of carbon to the atmosphere if less carbon is flowing into it than is flowing out of it.

Southern Annual Mode (SAM) or Antarctic oscillation (AAO)
A low-frequency mode of atmospheric variability of the southern hemisphere.

Spatial and temporal scales

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

SRES scenarios
SRES scenarios are emission scenarios developed by Nakic´enovic´ et al. (2000)

Stomata
Small pores in plant leaves through which water vapor and carbon dioxide diffuse during transpiration and photosynthesis (carbon fixation), respectively.

Stomatal Conductance
A plant property related to the ease with which water vapor escapes from plant leaves through small pores in the leaves know as stomata.

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

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

Storyline
A qualitative description of a climate scenario based on extensive literature research and model results. This is often a quite simple description used to fill in policy makers on climate change developments.

Stratopause
The level of the atmosphere which is the boundary between two layers, the stratosphere and the mesosphere. In the stratosphere the temperature increases with altitude, and the stratopause is the section where a maximum in the temperature occurs.

Stratosphere
Region of the atmosphere between the troposphere and mesosphere , having a lower boundary of approximately 8 km at the poles to 15 km at the equator and an upper boundary of approximately 50 km. Depending upon latitude and season, the temperature in the lower stratosphere can increase, be isothermal, or even decrease with altitude, but the temperature in the upper stratosphere generally increases with height due to absorption of solar radiation by ozone. It contains small amounts of gaseous ozone (O_3), which filters out about 99 percent of the incoming harmful ultraviolet (UV) radiation. Most commercial airline flights operate at a cruising altitude in the lower stratosphere.

Sublimation
The process of transition of a substance from the solid phase to the gas phase without passing through an intermediate liquid phase. Sublimation is an endothermic phase transition that occurs at temperatures and pressures below a substance's triple point in its phase diagram.

Sulfate aerosols
Particulate matter that consists of compounds of sulfur formed by the interaction of sulfur dioxide and sulfur trioxide with other compounds in the atmosphere. Sulfate aerosols are injected into the atmosphere from the combustion of fossil fuels and the eruption of volcanoes like Mt. Pinatubo. Recent theory suggests that sulfate aerosols may lower the Earth's temperature by reflecting away solar radiation (negative radiative forcing). General Circulation Models which incorporate the effects of sulfate aerosols more accurately predict global temperature variations.

Sulfur dioxide (SO2)
Sulfur dioxide emitted into the atmosphere through natural and anthropogenic processes is changed in a complex series of chemical reactions in the atmosphere to sulfate aerosols. These aerosols are believed to result in negative radiative forcing (i.e., tending to cool the Earth's surface) and do result in acid deposition (e.g., acid rain).

Sulphurhexafluoride (SF6)
A colorless gas soluble in alcohol and ether, slightly soluble in water. A greenhouse gas that is largel used in heavy industry to insulate high-voltage equipment and to assist in the manufacturing of cabl cooling systems and semi-conductors.

Sunspots
Small dark areas on the Sun. The number of sunspots is higher during periods of high solar activity, and varies in particular with the solar cycle.

System vulnerability
The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. This 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.

Thermal
Thermal properties are dependent on temperature; they are related to, or caused by, heat.

Thermal expansion
In connection with sea level, this refers to the increase in volume (and decrease in density) that results from warming water. A warming of the ocean leads to an expansion of the ocean volume and hence an increase in sea level.

Thermohaline circulation
Large-scale density-driven circulation in the ocean, caused by differences in temperature and salinity. In the North Atlantic, the thermohaline circulation consists of warm surface water flowing northward and cold deepwater flowing southward, resulting in a net poleward transport of heat. The surface water sinks in highly restricted sinking regions located in high latitudes.

Thermosphere
The biggest of all the layers of the Earth's atmosphere directly above the mesosphere and directly below the exosphere. Within this layer, ultraviolet radiation causes ionization.

Threshold
Any level of a property of a natural socioeconomic system beyond which a defined or marked change occurs. Gradual climate change may force a system beyond such a threshold.

Tide gauge
A device at a coastal location (and some deep sea locations) which continuously measures the level of the sea with respect to the adjacent land. Time-averaging of the sea level so recorded gives the observed Relative Sea Level Secular Changes.

Topography
The configuration of a surface including its relief and the position of its natural and man-made features. The shape of a surface.

Total solar irradiance (TSI)
The amount of solar radiation received outside the Earth’s atmosphere on a surface normal to the incident radiation, and at the Earth’s mean distance from the sun. Reliable measurements of solar radiation can only be made from space and the precise record extends back only to 1978. The generally accepted value is 1,368 Watts per square meter (W m-2) with an accuracy of about 0.2%. Variations of a

few tenths of a percent are common, usually associated with the passage of sunspots across the solar disk. The solar cycle variation of TSI is on the order of 0.1%.

Trace gas
Any one of the less common gases found in the Earth's atmosphere. Nitrogen, oxygen, and argon make up more than 99 percent of the Earth's atmosphere. Other gases, such as carbon dioxide, water vapor, methane, oxides of nitrogen, ozone, and ammonia, are considered trace gases. Although relatively unimportant in terms of their absolute volume, they have significant effects on the Earth's weather and climate.

Transient climate response
The globally averaged surface air temperature increase, averaged over a 20 year period, centered at the time of CO2 doubling, i.e., at year 70 in a 1% per year compound CO2 increase experiment with a global coupled climate model.

Transient climate simulation
Mode of running a global climate model in which a period of time is simulated with continuously varying concentrations of greenhouse gases so that the climate of the model represents prospective changes already realized by the time of each future date in question, rather than the higher long-run equilibrium warming eventually resulting from atmospheric concentrations at each such date. The difference stems from ocean thermal lag.

Transpiration
The process by which water vapor is lost from plants, evaporating from cell walls just below the surface of the leaf and diffusing into the air through small stomatal pores.

Tropopause
The atmospheric layer separating the stratosphere from the troposphere. It marks the transition from temperatures that decrease with increasing height within the troposphere to an atmospheric region that experiences increasing temperatures with height.

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

Ultraviolet (UV)-B radiation
Solar radiation within a wavelength range of 280-320 nm, the greater part of which is absorbed by stratospheric ozone. Enhanced UV-B radiation suppresses the immune system and can have other adverse effects on living organisms.

United Nations Framework Convention on Climate Change (UNFCCC)
The Convention on Climate Change sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. It recognizes that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases. The Convention enjoys near universal membership, with 189 countries having ratified.
Under the Convention, governments:

- gather and share information on greenhouse gas emissions, national policies and best practices
- launch national strategies for addressing greenhouse gas emissions and adapting to expected
- impacts, including the provision of financial and technological support to developing countries
- cooperate in preparing for adaptation to the impacts of climate change

The Convention entered into force on 21 March 1994.

Uptake

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

Vapor pressure (equilibrium vapor pressure)
The pressure of a vapor in thermodynamic equilibrium with its condensed phases in a closed system. All liquids have a tendency to evaporate, and some solids can sublimate into a gaseous form. Vice versa, all gases have a tendency to condense back to their liquid form, or deposit back to solid form, as long as the temperature is below their critical temperature or decomposition temperature. In plain terms, a liquid evaporates at all pressures below its vapor pressure, while remaining stable at pressure *above* the vapor pressure.

Vapor pressure deficit
A measure of the "dryness" of the air. A high vapor pressure deficit corresponds to a low relative humidity and/or high temperature, while a low vapor pressure deficit corresponds to a high relative humidity and/or low air temperature.

Vulnerability
The degree to which a system is susceptible to, or 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.

Water use efficiency (WUE)
A higher water use efficiency in a plant means less water is lost while fixing a molecule of CO_2. C4 and CAM species have an enhanced ability to utilize light while restricting water loss. Although it may be defined in a number of ways, it is basically the amount of organic matter produced by a plant divided by the amount of water used by the plant in producing it.

Water vapor
The most abundant greenhouse gas, it is the water present in the atmosphere in gaseous form. Water vapor is an important part of the natural greenhouse effect. While humans are not significantly increasing its concentration, it contributes to the enhanced greenhouse effect because the warming influence of greenhouse gases leads to a positive water vapor feedback. In addition to its role as a natural greenhouse gas, water vapor plays an important role in regulating the temperature of the planet because clouds form when excess water vapor in the atmosphere condenses to form ice and water droplets and precipitation.

Weather
Atmospheric condition at any given time or place. It is measured in terms of such things as wind, temperature, humidity, atmospheric pressure, cloudiness, and precipitation. In most places, weather can change from hour-to-hour, day-to-day, and season-to-season. 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 is 30 years, as defined by the World Meteorological Organization (WMO). 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. A simple way of remembering the difference is that climate is what you expect (e.g. cold winters) and 'weather' is what you get (e.g. a blizzard).

Wedge Theory
The theory of opportunities for limiting or diminishing the greenhouse effect and global warming. Wedges include: decarbonised electricity, decarbonised fuels, fuel displacement by alternative energy sources (e.g. solar energy, nuclear energy), methane management, and natural carbon sinks (e.g. forests).

Zone
Movement of wind or ocean waters in a direction that is roughly parallel to the lines of latitude

Zone of ablation
Area of a glacier where losses of ice from melting, evaporation, and sublimation exceed additions of snow annually.

Zone of accumulation
Area of a glacier where additions of snow exceed losses of ice from melting, evaporation, and sublimation.

These definitions are taken from the following sources.

- EPA Glossary of Climate Change Terms -- http://www.epa.gov/climatechange/glossary.html
- United Nation Framework Convention on Climate Change Glossary http://unfccc.int/resource/cd_roms/na1/ghg_inventories/english/8_glossary/Glossary.htm
- Clean energy – EPA -- http://www.epa.gov/cleanenergy/energy-and-you/glossary.html
- Climate Change Glossary Word Definitions Related to Climate Change and Global Warming http://climatechangeglossary.com/
- Science Glossary, National Renewable Energy Laboratory -- http://www.nrel.colostate.edu/projects/irc/public/Documents/Science/Glossary.htm
- Global Warming and Agriculture: Impact Estimates by Country http://www.cgdev.org/content/publications/detail/14090
- Wikipedia -- http://www.wikipedia.org/