

glaciers. See also *Equilibrium line* and *Mass balance/budget (of glaciers or ice sheets)*.

**Global dimming** Global dimming refers to a widespread reduction of *solar radiation* received at the surface of the Earth from about the year 1961 to around 1990.

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

**Global Warming Potential (GWP)** An index, based on radiative properties of *greenhouse gases*, measuring the *radiative forcing* following a pulse emission of a unit mass of a given greenhouse gas in the present-day *atmosphere* integrated over a chosen time horizon, relative to that of *carbon dioxide*. The GWP represents the combined effect of the differing times these gases remain in the atmosphere and their relative effectiveness in causing radiative forcing. The *Kyoto Protocol* is based on GWPs from pulse emissions over a 100-year time frame.

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

**Greenhouse gas (GHG)** Greenhouse gases are those gaseous constituents of the *atmosphere*, both natural and *anthropogenic*, that absorb and emit radiation at specific wavelengths within the spectrum of *terrestrial radiation* emitted by the Earth's surface, the atmosphere itself, and by clouds. This property causes the *greenhouse effect*. Water vapour (H<sub>2</sub>O), *carbon dioxide* (CO<sub>2</sub>), *nitrous oxide* (N<sub>2</sub>O), *methane* (CH<sub>4</sub>) and *ozone* (O<sub>3</sub>) are the primary greenhouse gases in the Earth's atmosphere. Moreover, there are a number of entirely human-made greenhouse gases in the atmosphere, such as the *halocarbons* and other chlorine- and bromine-containing substances, dealt with under the *Montreal Protocol*. Beside CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub>, the *Kyoto Protocol* deals with the greenhouse gases sulphur hexafluoride (SF<sub>6</sub>), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs). For a list of *well-mixed greenhouse gases*, see Table 2.A.1.

**Gross Primary Production (GPP)** The amount of carbon fixed by the autotrophs (e.g. plants and algae).

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

**Gyre** Basin-scale ocean horizontal circulation pattern with slow flow circulating around the ocean basin, closed by a strong and narrow (100 to 200 km wide) boundary current on the western side. The subtropical gyres in each ocean are associated with high pressure in the centre of the gyres; the subpolar gyres are associated with low pressure.

**Hadley Circulation** A direct, thermally driven overturning cell in the *atmosphere* consisting of poleward flow in the upper *troposphere*, subsiding air into the subtropical anticyclones, return flow as part of the trade

winds near the surface, and with rising air near the equator in the so-called *Inter-Tropical Convergence Zone*.

**Halocarbons** A collective term for the group of partially halogenated organic species, which includes the chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), halons, methyl chloride and methyl bromide. Many of the halocarbons have large *Global Warming Potentials*. The chlorine and bromine-containing halocarbons are also involved in the depletion of the *ozone layer*.

**Halocline** A layer in the oceanic water column in which salinity changes rapidly with depth. Generally saltier water is denser and lies below less salty water. In some high latitude oceans the surface waters may be colder than the deep waters and the halocline is responsible for maintaining water column stability and isolating the surface waters from the deep waters. See also *Thermocline*.

**Halosteric** See *Sea level change*.

**HCFC** See *Halocarbons*.

**Heat wave** A period of abnormally and uncomfortably hot weather. See also *Warm spell*.

**Heterotrophic respiration** The conversion of organic matter to *carbon dioxide* by organisms other than autotrophs.

**HFC** See *Halocarbons*.

**Hindcast or retrospective forecast** A forecast made for a period in the past using only information available before the beginning of the forecast. A sequence of hindcasts can be used to calibrate the forecast system and/or provide a measure of the average skill that the forecast system has exhibited in the past as a guide to the skill that might be expected in the future.

**Holocene** The Holocene Epoch is the latter of two epochs in the *Quaternary* System, extending from 11.65 ka (thousand years before 1950) to the present. It is also known as *Marine Isotopic Stage (MIS) 1* or *current interglacial*.

**Hydroclimate** Part of the *climate* pertaining to the hydrology of a *region*.

**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 vapour, condenses to form clouds, precipitates over ocean and land as rain or snow, which on land can be intercepted by trees and vegetation, provides *runoff* on the land surface, infiltrates into soils, recharges groundwater, discharges into streams and ultimately flows out into the oceans, from which it will eventually evaporate again. The various systems involved in the hydrological cycle are usually referred to as hydrological systems.

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

**Hypsometry** The distribution of land or ice surface as a function of altitude.

**Ice age** An ice age or *glacial period* is characterized by a long-term reduction in the temperature of the Earth's *climate*, resulting in growth of *ice sheets* and *glaciers*.

**Ice-albedo feedback** A *climate feedback* involving changes in the Earth's surface *albedo*. Snow and ice have an albedo much higher (up to ~0.8) than the average planetary albedo (~0.3). With increasing temperatures, it is anticipated that snow and ice extent will decrease, the Earth's overall albedo will decrease and more *solar radiation* will be absorbed, warming the Earth further.