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absolute zero

The temperature at which significant molecular activity stops. Absolute zero is commonly used by scientists who study what happens to things when they become very cold and is measured as 0 degrees Kelvin -- equal to -459 degrees Fahrenheit or -273 degrees Celsius.

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.

acceleration

Science: in general, any increase in the speed or rate at which some process occur; in technical use acceleration and speed are not synonymous. *Mechanics*: the vector representing the rate of change in velocity vector over time. It is expressed in meters (or feet) per second per second, and it involves an increase or decrease in speed and a change in direction.

acid rain

Acids form when certain atmospheric gases (primarily carbon dioxide, sulfur dioxide, and nitrogen oxides) come in contact with water in the atmosphere or on the ground and are chemically converted to acidic substances. Oxidants play a major role in several of these acid-forming processes. Carbon dioxide dissolved in rain is converted to a weak acid (carbonic acid). Other gases, primarily oxides of sulfur and nitrogen, are converted to strong acids (sulfuric and nitric acids).

Although rain is naturally slightly acidic because of

carbon dioxide, natural emissions of sulfur and nitrogen oxides, and certain organic acids, human activities can make it much more acidic. Occasional pH readings of well below 2.4 (the acidity of vinegar) have been reported in industrialized areas.

The principal natural phenomena that contribute acid-producing gases to the atmosphere are emissions from volcanoes and from biological processes that occur on the land, in wetlands, and in the oceans. The effects of acidic deposits have been detected in glacial ice thousands of years old in remote parts of the globe. Principal human sources are industrial and power-generating plants and transportation vehicles. The gases may be carried hundreds of miles in the atmosphere before they are converted to acids and deposited.

Since the industrial revolution, emissions of sulfur and nitrogen oxides to the atmosphere have increased. Industrial and energy-generating facilities that burn fossil fuels, primarily coal, are the principal sources of increased sulfur oxides. These sources, plus the transportation sector, are the major originators of increased nitrogen oxides.

The problem of acid rain not only has increased with population and industrial growth, it has become more widespread. The use of tall smokestacks to reduce local pollution has contributed to the spread of acid rain by releasing gases into regional atmospheric circulation. The same remote glaciers that provide evidence of natural variability in acidic deposition show, in their more recently formed layers, the increased deposition caused by human activity during the past half century.

ACRIMSAT

The Active Cavity Radiometer Irradiance Monitor (ACRIM) Satellite Mission is a NASA mission to measure Total Solar Irradiance (TSI) over a five-year period. The instrument, third in a series of long-term solar-monitoring tools built for NASA by the Jet Propulsion Laboratory, will continue to extend the database first created by ACRIM I, which was launched in 1980 on the Solar Maximum Mission (SMM) spacecraft. ACRIM II followed on the Upper Atmosphere Research Satellite (UARS) in 1991. See ACRIMSAT Fact Sheet

active system (active sensor)	A remote-sensing system that transmits its own radiation to detect an object or area for observation and receives the reflected or transmitted radiation. Radar is an example of an active system. Compare with passive system.
Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER)	ASTER is an imaging instrument that will fly on Terra as part of NASA's Earth Observing System (EOS). ASTER will be used to obtain detailed maps of land surface temperature, emissivity, reflectance and elevation. See ASTER Web Site.
Advanced Very High Resolution Radiometer (AVHRR)	A five-channel scanning instrument that quantitatively measures electromagnetic radiation, flown on NOAA environmental satellites. AVHRR remotely determines cloud cover and surface temperature. Visible and infrared detectors observe vegetation, clouds, lakes, shorelines, snow, and ice. See TIROS.
advect	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.
aerosol	Particles of liquid or solid dispersed as a suspension in gas.
air mass	Large body of air, often hundreds or thousands of miles across, containing air of a similar temperature and humidity. Sometimes the differences between air masses are hardly noticeable, but if colliding air masses have very different temperatures and humidity values, storms can erupt. See front.
air pollution	The existence in the air of substances in concentrations that are determined unacceptable. Contaminants in the air we breathe come mainly from manufacturing industries, electric power plants, automobiles, buses, and trucks.
air pressure	The weight of the atmosphere over a particular point, also called barometric pressure. Average air exerts approximately 14.7 pounds (6.8 kg) of force on every square inch (or 101,325 newtons on every square meter) at sea level.
albedo	The ratio of the outgoing solar radiation reflected by

	an object to the incoming solar radiation incident upon it.
algae	Simple rootless plants that grow in sunlit waters in relative proportion to the amounts of nutrients available. They are food for fish and small aquatic animals, and a factor in eutrophication.
algal blooms	Sudden spurts of algal growth due to greatly increased amounts of phosphorus entering the aquatic ecosystem from sewage systems and agricultural fertilizers. Excessive growth of the algae causes destruction of many of the higher links of the food web. Algae that die and sink to the bottom at the end of the growing season stimulate massive growth of bacteria the following year, resulting in depletion of oxygen in the deeper water layers. This may result in fish kills and replacement with less valuable species who may be more tolerant of increased phosphorus levels. Deoxygenation also may cause chemical changes in the mud on the bottom, producing increased quantities of chemicals and toxic gases. All these changes further accelerate the eutrophication (aging) of the aquatic ecosystem.
algorithm	A mathematical relation between an observed quantity and a variable used in a step-by-step mathematical process to calculate a quantity. In the context of remote sensing, algorithms generally specify how to determine higher-level data products from lower-level source data. For example, algorithms prescribe how atmospheric temperature and moisture profiles are determined from a set of radiation observations originally sensed by satellite sounding instruments.
alkaline	Substance capable of neutralizing acid, with a pH greater than 7.0. See pH.
altimeter	An active instrument (see active system) used to measure the altitude of an object above a fixed level. For example, a laser altimeter can measure height from a spacecraft to an ice-sheet. That measurement, coupled with radial orbit knowledge, will enable determination of the topography.
Ames Research	Located at Moffett Field, California, ARC is active in

Center (ARC)	aeronautical research, life sciences, space science, and technology research. The Center houses the world's largest wind tunnel and the world's most powerful supercomputer system. ARC Web Site
amplitude	The magnitude of the displacement of a wave from a mean value. For a simple harmonic wave, it is the maximum displacement from the mean. For more complex wave motion, amplitude is usually taken as one-half of the mean distance (or difference) between maxima and minima.
anemometer	Instrument used to measure wind speed, usually measured either from the rotation of wind-driven cups or from wind pressure through a tube pointed into the wind.
anomaly	1. The deviation of (usually) temperature or precipitation in a given region over a specified period from the normal value for the same region. 2. The angular distance of an Earth satellite (or planet) from its perigee (or perihelion) as seen from the center of the Earth (sun).
anthropogenic	Made by people or resulting from human activities. Usually used in the context of emissions that are produced as a result of human activities.
anticyclone	A high pressure area where winds blow clockwise in the Northern Hemisphere and counterclockwise in the Southern Hemisphere. See cyclone, wind.
aphelion	The point in its orbit when a planet is farthest from the sun. For more information, see Milutin Milankovitch
apogee	On an elliptical orbit path, the point at which a satellite is farthest from the Earth.
aquifer	Layer of water-bearing permeable rock, sand, or gravel capable of providing significant amounts of water.
Arctic circle	The parallel of latitude that is approximately 66.5 degrees north of the equator and that circumscribes the

northern frigid zone.

ascending node The point in an orbit (longitude) at which a satellite crosses the equatorial plane from south to north.

Astronomical Unit (AU) The distance from the Earth to the sun. On average, the sun is 149,599,000 kilometers from Earth.

atmosphere The air surrounding the Earth, described as a series of shells or layers of different characteristics. The atmosphere, composed mainly of nitrogen and oxygen with traces of carbon dioxide, water vapor, and other gases, acts as a buffer between Earth and the sun. The layers, troposphere, stratosphere, mesosphere, thermosphere, and the exosphere, vary around the globe and in response to seasonal changes.

Troposphere stems from the Greek word tropos, which means turning or mixing. The troposphere is the lowest layer of the Earth's atmosphere, extending to a height of 8-15 km, depending on latitude. This region, constantly in motion, is the most dense layer of the atmosphere and the region that essentially contains all of Earth's weather. Molecules of nitrogen and oxygen compose the bulk of the troposphere.

The tropopause marks the limit of the troposphere and the beginning of the stratosphere. The temperature above the tropopause increases slowly with height up to about 50 km.

The stratosphere and stratopause stretch above the troposphere to a height of 50 km. It is a region of intense interactions among radiative, dynamical, and chemical processes, in which horizontal mixing of gaseous components proceeds much more rapidly that vertical mixing. The stratosphere is warmer than the upper troposphere, primarily because of a stratospheric ozone layer that absorbs solar ultraviolet energy.

The mesosphere, 50 to 80 km above the Earth, has diminished ozone concentration and radiative cooling becomes relatively more important. The temperature begins to decline again (as it does in the troposphere) with altitude. Temperatures in the upper mesosphere fall to -70 degrees to -140 degrees Celsius, depending upon latitude and season. Millions of meteors burn up daily in the mesosphere as a result of collisions with

some of the billions of gas particles contained in that layer. The collisions create enough heat to burn the falling objects long before they reach the ground.

The stratosphere and mesosphere are referred to as the middle atmosphere. The mesopause, at an altitude of about 80 km, separates the mesosphere from the thermosphere--the outermost layer of the Earth's atmosphere.

The thermosphere, from the Greek thermo for heat, begins about 80 km above the Earth. At these high altitudes, the residual atmospheric gases sort into strata according to molecular mass. Thermospheric temperatures increase with altitude due to absorption of highly energetic solar radiation by the small amount of residual oxygen still present. Temperatures can rise to 2,000 degrees C. Radiation causes the scattered air particles in this layer to become charged electrically, enabling radio waves to bounce off and be received beyond the horizon. At the exosphere, beginning at 500 to 1,000 km above the Earth's surface, the atmosphere blends into space. The few particles of gas here can reach 4,500 degrees F (2,500 degrees C) during the day.

Atmospheric Infrared Sounder

Advanced sounding instrument selected to fly on the EOS-PM1 mission (intermediate-sized, sun-synchronous, morning satellite) in the year 2000. It will retrieve vertical temperature and moisture profiles in the troposphere and stratosphere. Designed to achieve temperature retrieval accuracy of 1 degree C with a 1 km vertical resolution, it will fly with two operational microwave sounders. The three instruments will constitute an advanced operational sounding system, relative to the TIROS Operational Vertical Sounder (TOVS) currently flying on NOAA Polar-orbiting satellites. See Earth Observing System, TIROS-N/NOAA Satellites.

atmospheric pressure

The amount of force exerted over a surface area, caused by the weight of air molecules above it. As elevation increases, fewer air molecules are present. Therefore, atmospheric pressure always decreases with increasing height. A column of air, 1 square inch in cross section, measured from sea level to the top of the atmosphere would weigh approximately 14.7 lb/in2. The standard value for atmospheric pressure at sea level is:

	29.92 inches or 760 mm of mercury 1013.25 millibars (mb) or 101,325 pascals (pa).
Atmospheric Radiation Measurements Program (ARM)	U.S. Department of energy program for the continual, ground-based measurements of atmospheric and meteorological parameters over approximately a ten-year period. The program will study radiative forcing and feedbacks, particularly the role of clouds. The general program goal is to improve the performance of climate models, particularly general circulation models of the atmosphere.
atmospheric response variables	Variables that reflect the response of the atmosphere to external forcing (e.g., temperature, pressure, circulation, and precipitation).
atmospheric windows	The range of wavelengths at which water vapor, carbon dioxide, or other atmospheric gases only slightly absorb radiation. Atmospheric windows allow the Earth's radiation to escape into space unless clouds absorb the radiation. See greenhouse effect.
atoll	A coral island consisting of a ring of coral surrounding a central lagoon. Atolls are common in the Indian and Pacific Oceans.
attenuation	The decrease in the magnitude of current, voltage, or power of a signal in transmission between points. Attenuation may be expressed in decibels, and can be caused by interference?s such as rain, clouds, or radio frequency signals.
azimuth	The direction, in degrees referenced to true north, that an antenna must be pointed to receive a satellite signal (compass direction). The angular distance is measured in a clockwise direction.
backscatter	Process by which up to 25% of radiant energy from the sun is reflected or scattered away from the surface by clouds.
band	In radio, a continuous sequence of broadcasting frequencies within given limits. In radiometry, a relatively narrow region of the electromagnetic spectrum to which a remote sensor

responds; a multispectral sensor makes measurements in a number of spectral bands.

In spectroscopy, spectral regions where atmospheric gases absorb (and emit) radiation, e.g., the 15 æm carbon dioxide absorption band, the 6.3 æm water vapor absorption band, and the 9.6 æm ozone absorption band.

bandwidth The total range of frequency required to pass a specific modulated signal without distortion or loss of data. The ideal bandwidth allows the signal to pass under conditions of maximum AM or FM adjustment. (Too narrow a bandwidth will result in loss of data during modulation peaks. Too wide a bandwidth will pass excessive noise along with the signal.) In FM, radio frequency signal bandwidth is determined by the frequency deviation of the signal.

barometer An instrument used to measure atmospheric pressure. A standard mercury barometer has a glass column about 30 inches long, closed at one end, with a mercury-filled reservoir. Mercury in the tube adjusts until the weight of the mercury column balances the atmospheric force exerted on the reservoir. High atmospheric pressure forces the mercury higher in the column. Low pressure allows the mercury to drop to a lower level in the column. An aneroid barometer uses a small, flexible metal box called an aneroid cell. The box is tightly sealed after some of the air is removed, so that small changes in external air pressure cause the cell to expand or contract.

base A substance that forms a salt when it reacts with acid. A base is a substance that removes hydrogen ions (protons) from an acid and combines with them in a chemical reaction.

beamwidth The measure of the 'width' of an antenna pattern, measured in degrees of arc. Generally an antenna with low gain has a wide pattern, receiving signals well from a number of different directions.

bearing The combination of antenna azimuth and elevation required to point (aim) an antenna at a spacecraft. The bearing for geostationary (i.e., GOES) satellites is constant. The bearing for polar-orbiting satellites varies continuously.

berm	A platform of wave-deposited sediment that is flat or slopes slightly landward.
bioassay	A measurement of the effects of a substance on living organisms.
biodegradation	Decomposition of material by microorganisms.
biodiversity	The totality of genes, species, and ecosystems in a region or the world.
biogenic	Produced by natural processes. Usually used in the context of emissions that are produced by plants and animals.
biogeochemical cycles	Movements through the Earth system of key chemical constituents essential to life, such as carbon, nitrogen, oxygen, and phosphorus.
biomass	Organic nonfossil material of biological origin. For example, trees and plants are biomass.
biome	Well-defined terrestrial environment (e.g., desert, tundra, or tropical forest). The complex of living organisms found in an ecological region.
biosphere	Part of the Earth system in which life can exist, between the outer portion of the geosphere and the inner portion of the atmosphere.
biota	The plant and animal life of a region or area.
blackbody	An ideal emitter which radiates energy at the maximum possible rate per unit area at each wavelength for any given temperature. A blackbody also absorbs all the radiant energy incident on it; i.e., no energy is reflected or transmitted.
blizzard	A severe weather condition characterized by low temperatures and strong winds (greater than 35 mph) bearing a great amount of snow, either falling or blowing. When these conditions persist after snow has stopped falling, it is called a ground blizzard.

boreal	Northern; from the Greek name for the Goddess of the North Wind. A boreal forest is the set of forest ecosystems than can survive in the north.
Boreal Ecosystem-Atmosphere Study (BOREAS)	A global change project to study and understand the interaction between the boreal forest biome and the atmosphere. See also: Introduction to BOREAS BOREAS Web Site
brightness temperature	A measure of the intensity of radiation thermally emitted by an object, given in units of temperature because there is a proportional correlation between the intensity of the radiation emitted and physical temperature of the radiating body.
broadleaf	The leaves of trees associated with deciduous forests.
bus	The basic frame of a satellite system that includes the propulsion and stabilization systems but not the instruments or data systems.
calibration	Act of comparing an instrument's measuring accuracy to a known standard.
calorie	The amount of heat needed to raise the temperature of one gram of water at 15 degrees centigrade one degree centigrade. Compare with British Thermal Unit.
canopy	The layer formed naturally by the leaves and branches of trees and plants.
carbohydrate	an organic compound present in the cells of all living organisms and a major organic nutrient for human beings; consists of carbon, hydrogen, and oxygen, and makes up sugar, starch, and cellulose.
carbon cycle	All parts (reservoirs) and fluxes of carbon. The cycle is usually thought of as four main reservoirs of carbon interconnected by pathways of exchange. The reservoirs are the atmosphere, terrestrial biosphere (usually includes freshwater systems), oceans, and sediments (includes fossil fuels). The annual movements of carbon, the carbon exchanges between

	reservoirs, occur because of various chemical, physical, geological, and biological processes. The ocean contains the largest pool of carbon near the surface of the Earth, but most of that pool is not involved with rapid exchange with the atmosphere.
carbon dioxide	A minor but very important component of the atmosphere, carbon dioxide traps infrared radiation. Atmospheric CO_2 has increased about 25 percent since the early 1800s, with an estimated increase of 10 percent since 1958 (burning fossil fuels is the leading cause of increased CO_2, deforestation the second major cause). The increased amounts of CO_2 in the atmosphere enhance the greenhouse effect, blocking heat from escaping into space and contributing to the warming of Earth's lower atmosphere.
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.
carbonates	chemical compounds derived from carbonic acid or carbon dioxide
carrying capacity	The steady-state density of a given species that a particular habitat can support.
cartography	The science of mapmaking.
celsius	Temperature scale proposed by Swedish astronomer Anders Celsius in 1742. A mixture of ice and water is zero on the scale; boiling water is designated as 100 degrees. A degree is defined as one hundredth of the difference between the two reference points, resulting in the original term, "centigrade" (100th part). To convert celsius to Fahrenheit: multiply the celsius temperature by 1.8 and add 32 degrees. F = 9/5 C + 32 To convert Fahrenheit to celsius: subtract 32 degrees from the Fahrenheit temperature and divide the quantity by 1.8. C = (F -32) / 1.8.
chlorofluorocarbon (CFC)	A family of compounds of chlorine, fluorine, and carbon, entirely of industrial origin. CFCs include refrigerants, propellants for spray cans (this usage is banned in the U.S., although some other countries

permit it) and for blowing plastic-foam insulation, styrofoam packaging, and solvents for cleaning electronic circuit boards. The compounds' lifetimes vary over a wide range, exceeding 100 years in some cases.

CFCs' ability to destroy stratospheric ozone through catalytic cycles is contributing to the depletion of ozone worldwide. Because CFCs are such stable molecules, they do not react easily with other chemicals in the lower atmosphere. One of the few forces that can break up CFC molecules is ultraviolet radiation, however the ozone layer protects the CFCs from ultraviolet radiation in the lower atmosphere. CFC molecules are then able to migrate intact into the stratosphere, where the molecules are bombarded by ultraviolet rays, causing the CFCs to break up and release their chlorine atoms. The released chlorine atoms participate in ozone destruction, with a single atom of chlorine able to destroy ozone molecules over and over again.

International attention to CFCs resulted in a meeting of diplomats from around the world in Montreal in 1987. They forged a treaty that called for drastic reductions in the production of CFCs. In 1990, diplomats met in London and voted to significantly strengthen the Montreal Protocol by calling for a complete elimination of CFCs by the year 2000.

chlorophyll

Chlorophyll is a green compound found in leaves and green stems of plants. The intense green color of chlorophyll is due to its strong absorbencies in the red and blue regions of the spectrum, and because of these absorbencies the light it reflects and transmits appears green. It is capable of channeling the energy of sunlight into chemical energy through the process of photosynthesis. In this process the energy absorbed by chlorophyll transforms carbon dioxide and water into carbohydrates and oxygen.

cirrus

A type of cloud composed of ice crystals and shaped in the form of hairlike filaments. It is formed at an altitude of approximately 29,000 feet.

Clarke Belt

A belt 22,245 miles (35,800 kilometers) directly above the equator where a satellite orbits the Earth at the same speed the Earth is rotating. Science fiction writer and scientist Arthur C. Clarke wrote about this belt in

1945, hence the name.

climate change The term 'climate change' is sometimes used to refer to all forms of climatic inconsistency, but because the Earth's climate is never static, the term is more properly used to imply a significant change from one climatic condition to another. In some cases, 'climate change' has been used synonymously with the term, 'global warming'; scientists however, tend to use the term in the wider sense to also include natural changes in climate.

climate model A quantitative way of representing the interactions of the atmosphere, oceans, land surface, and ice. Models can range from relatively simple to quite comprehensive. Also see General Circulation Model.

climate system The five physical components (atmosphere, hydrosphere, cryosphere, lithosphere, and biosphere) that are responsible for the climate and its variations.

climatology Science dealing with climate and climate phenomena.

cloud albedo Reflectivity that varies from less than 10% to more than 90% of the insolation and depends on drop sizes, liquid water content, water vapor content, thickness of the cloud, and the sun's zenith angle. The smaller the drops and the greater the liquid water content, the greater the cloud albedo, if all other factors are the same.

cloud feedback The coupling between cloudiness and surface air temperature in which a change in surface temperature could lead to a change in clouds, which could then amplify or diminish the initial temperature perturbation. For example, an increase in surface air temperature could increase the evaporation; this in turn might increase the extent of cloud cover. Increased cloud cover would reduce the solar radiation reaching the Earth's surface, thereby lowering the surface temperature. This is an example of negative feedback and does not include the effects of longwave radiation or the advection in the oceans and the atmosphere, which must also be considered in the overall relationship of the climate system.

cloud forcing The difference between the radiation budget

components for average cloud conditions and cloud-free conditions. Roughly speaking, clouds increase the albedo from 15 to 30%, which results in a reduction of absorbed solar radiation of about 50 W/m^2. This cooling is offset somewhat by the greenhouse effect of clouds which reduces the OLR by about 30 W/m^2, so the net cloud forcing of the radiation budget is a loss of about 20 W/m^2. Were the clouds to be removed with all else remaining the same, the Earth would gain this last amount in net radiation and begin to warm up.

clouds

A visible mass of liquid water droplets suspended in the atmosphere above Earth's surface. Clouds form in areas where air rises and cools. The condensing water vapor forms small droplets of water (0.012 mm) that, when combined with billions of other droplets, form clouds. Clouds can form along warm and cold fronts, where air flows up the side of the mountain and cools as it rises higher into the atmosphere, and when warm air blows over a colder surface, such as a cool body of water.

Clouds fall into two general categories: sheet-like or layer-looking stratus clouds (stratus means layer) and cumulus clouds (cumulus means piled up). These two cloud types are divided into four more groups that describe the cloud's altitude.

High clouds form above 20,000 feet in the cold region of the troposphere, and are denoted by the prefix CIRRO or CIRRUS. At this altitude water almost always freezes so clouds are composed of ice crystals. The clouds tend to be wispy, are often transparent, and include cirrus, cirrocumulus, and cirrostratus.

Middle clouds form between 6,500 and 20,000 feet and are denoted by the prefix ALTO. They are made of water droplets and include altostratus and altocumulus.

Low clouds are found up to 6,500 feet and include the stratocumulus and nimbostratus clouds. When stratus clouds contact the ground they are called fog.

Vertical clouds, such as cumulus, rise far above their bases and can form at many heights. Cumulonimbus clouds, or thunderheads, can start near the ground and soar up to 75,000 feet.

Clouds and the Earth's Radiant Energy System (CERES)	CERES measures both solar-reflected and Earth-emitted radiation from the top of the atmosphere to the surface. It also determines cloud properties including the amount, height, thickness, particle size, and phase of clouds using simultaneous measurements by other instruments. These measurements are critical for understanding cloud-radiation climate change and improving the prediction of global warming using climate models. CERES is flying, or will fly, on the Tropical Rainfall Monitoring Mission (TRMM), Terra, and EOS-PM. See CERES Web Site.
Coastal Zone Color Scanner (CZCS)	The first spacecraft instrument devoted to measurement of ocean color. Although instruments on other satellites have sensed ocean color, their spectral bands, spatial resolution, and dynamic range were optimized for geographical or meteorological use. In the CZCS, every parameter is optimized for use over water to the exclusion of any other type of sensing. The CZCS flew on the Nimbus-7 spacecraft.
coccolithophore	A single-celled marine plant that lives in large numbers throughout the upper layers of the ocean. See Coccolithophore fact sheet.
condensation	Change of a substance to a denser form, such as gas to a liquid. The opposite of evaporation.
conduction	The transfer of heat from one substance to another by direct contact. Denser substances are better conductors; the transfer is always from warmer to colder substances.
conifer	An evergreen, cone-bearing tree, as a fir or pine.
contrails	Condensation trails. Artificial clouds made by the exhaust of jet aircraft.
convection	The rising of warm air and the sinking of cool air. Heat mixes and moves air. When a layer of air receives enough heat from the Earth's surface, it expands and moves upward. Colder, heavier air flows under it which is then warmed, expands, and rises. The warm rising air cools as it reaches higher, cooler regions of the atmosphere and begins to sink. Convection causes local breezes, winds, and thunderstorms.

coriolis force	The apparent tendency of a freely moving particle to swing to one side when its motion is referred to a set of axes that is itself rotating in space, such as Earth. The acceleration is perpendicular to the direction of the speed of the article relative to the Earth's surface and is directed to the right in the northern hemisphere. Winds are affected by rotation of the Earth so that instead of a wind blowing in the direction it starts, it turns to the right of that direction in the northern hemisphere; left in the southern hemisphere.
coupled system	Two or more processes that affect one another.
cryosphere	One of the interrelated components of the Earth's system, the cryosphere is frozen water in the form of snow, permanently frozen ground (permafrost), floating ice, and glaciers. Fluctuations in the volume of the cryosphere cause changes in ocean sea-level, which directly impact the atmosphere and biosphere.
culmination	The point at which a satellite reaches its highest position or elevation in the sky, relative to an observer (aka the closest point of approach).
cumulonimbus	A cloud type that is dense and vertically developed and is associated with rain (particularly of a convective nature). It is heavy and dense with a flat base and a high, fluffy outline, and can be tall enough to occupy middle as well as low latitudes. This type of cloud is formed from about 10,000 to 12,000 feet of altitude.
cumulus	Clouds forming in the troposphere which are vertically formed with flat bases and fluffy, rounded tops. They have often been described as cauliflower-like in structure. They occur at heights of 500-6000 meters in elevation from the earth and most often occur scattered or in dense heaped packs. They are formed due to buoyant upward convection during warm, anti-cyclonic summer weather.
cyclone	An area of low pressure where winds blow counterclockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere. See anticyclone, wind.

data	A collection of facts, concepts or instructions in a formalized manner suitable for communication or processing by human beings or by computer.
data set	A logically meaningful grouping or collection of similar or related data. Data having mostly similar characteristics (source or class of source, processing level and algorithms, etc.)
deciduous	Shedding leaves at the end of the growing season.
declination	The angular distance from the equator to the satellite, measured as positive north and negative south.
decomposition	The breakdown of matter by bacteria and fungi. It changes the chemical makeup and physical appearance of materials.
Defense Meteorological Satellite Program (DMSP)	A U.S. Air Force meteorological satellite program with satellites circling in sun-synchronous orbit. Imagery is collected in the visible- to near-infrared band (0.4 to 1.1 micrometers) and in the thermal-infrared band (about 8 to 13 micrometers) at a resolution of about three kilometers. While some of the data is classified, most unclassified data is available to civilian users.
deforestation	Those practices or processes that result in the change of forested lands to non-forest uses. This is often cited as one of the major causes of the enhanced greenhouse effect for two reasons: 1) the burning or decomposition of the wood releases carbon dioxide; and 2) trees that once removed carbon dioxide from the atmosphere in the process of photosynthesis are no longer present and contributing to carbon storage.
degree	A unit of angular measure represented by the symbol o. The circumference of a circle contains 360 degrees. When applied to the roughly spherical shape of the Earth for geographic and cartographic purposes, degrees are each divided into 60 minutes.
delta	The fan-shaped area at the mouth or lower end of a river, formed by eroded material that has been carried downstream and dropped in quantities larger than can be carried off by tides or currents.

demodulation	The process of retrieving information (data) from a modulated carrier wave, the reverse of modulation.
deposition	Process by which water changes phase directly from vapor into a solid without first becoming a liquid.
descending node	The point in a satellite's orbit at which it crosses the equatorial plane from north to south.
desert	A land area so dry that little or no plant or animal life can survive.
desertification	The man-made or natural formation of desert from usable land.
detector	A device in a radiometer that senses the presence and intensity of radiation. The incoming radiation is usually modified by filters or other optical components that restrict the radiation to a specific spectral band. The information can either be transmitted immediately or recorded for transmittal at a later time.
detritus	Accumulated organic debris from dead organisms, often an important source of nutrients in a food web.
dew	Atmospheric moisture that condenses after a warm day and appears during the night on cool surfaces as small drops. The cool surfaces cause the water vapor in the air to cool to the point where the water vapor condenses.
dew point	The temperature to which air must be cooled for saturation to occur, exclusive of air pressure or moisture content change. At that temperature dew begins to form, and water vapor condenses into liquid.
diatom	A class of unicellular algae more formally known as *Bacillariophyceae* that live in cold waters of relatively low salinity.
digital	In signal processing this refers to the representation of quantities in discrete units. The information is contained and manipulated as a series of discrete numbers as opposed to an analog representation where the information is represented as a continuous signal.

	In practice, even analog signals are usually processed digitally in that the analog signal is sampled to create a digital signal that can be processed by inherently digital computers.
digital elevation model (DEM)	A representation of the topography of the Earth in digital format, that is, by coordinates and numerical descriptions of altitude.
Distributed Active Archive Center (DAAC)	There are eight DAACs located around the United States that are tasked with processing, storing, and distributing satellite remote sensing data for NASA and other agencies. See NASA DAACs web site
diurnal	Performed in twenty-four hours, such as the diurnal rotation of the Earth.
Dobson Unit	The standard way to express ozone amounts in the *atmosphere*. One DU is 2.7 x 10 exp 16 (10 to the 16th power) ozone molecules per square centimeter. One Dobson unit refers to a layer of ozone that would be 0.001 cm thick under conditions of standard temperature (0 degree C) and pressure (the average pressure at the surface of the Earth). For example, 300 Dobson units of ozone brought down to the surface of the Earth at 0 degree C would occupy a layer only 0.3 cm thick in a column. Dobson was a researcher at Oxford University who, in the 1920s, built the first instrument (now called the Dobson meter) to measure total ozone from the ground.
doldrums	Region near the equator characterized by low pressure and light shifting winds. See Wind.
doppler effect (aka Doppler shift)	The apparent change in frequency of sound or light waves, varying with the relative velocity of the source and the observer. If the source and observer draw closer together, the frequency is increased. Named for Christian Doppler, Austrian mathematician and physicist (1803-1853).
Doppler radar	The weather radar system that uses the Doppler shift of radio waves to detect air motion that can result in tornadoes and precipitation, as previously-developed weather radar systems do. It can also measure the speed and direction of rain and ice, as well as detect the formation of tornadoes sooner than older radars.

downwelling	The process of accumulation and sinking of warm surface waters along a coastline. A change of air flow of the atmosphere can result in the sinking or downwelling of warm surface water. The resulting reduced nutrient supply near the surface affects the ocean productivity and meteorological conditions of the coastal regions in the downwelling area.
dynamics	The study of the action of forces on bodies and the changes in motion they produce.
dynamo	A physical system that converts mechanical energy (energy of motion) into magnetic energy. In the Sun, the mechanical energy results from the movement of the plasma at the Sun's core.
Earth Observing System (EOS)	A series of small- to intermediate-sized spacecraft that is the centerpiece of NASA's *Earth Science Enterprise (ESE)*. Planned for launch beginning in 1999, each of the EOS spacecraft will carry a suite of instruments designed to study global climate change. ESE will use space-, aircraft-, and ground-based measurements to study our environment as an integrated system. Designing and implementing the ESE is, of necessity, an international effort. The ESE program involves the cooperation of the U.S., the European Space Agency (ESA), and the Japanese National Space Development Agency (NASDA). The ESE program is part of the U.S. interagency effort, the *Global Change Research Program*.
Earth Observing System Data & Information System (EOSDIS)	The system that will manage a dataset of Earth science observations to be collected over a 15-year period. Existing data indicates that the Earth is changing, and that human activity increasingly contributes to this change. To monitor these changes, a baseline of 'normal' performance characteristics must be obtained. For the Earth, these baseline characteristics must cover a global scale and a long enough period that the variation caused by seasonal changes and other cyclical or periodic events (e.g., *El Niño* and the *solar cycle*) may be included in the analyses. The baseline characteristics also must enable scientists to quantify processes that govern the Earth's system. Functionally, EOSDIS will provide computing and networking facilities supporting EOS research activities, including data interpretation and modeling; processing, distribution, and archiving of EOS data; and command

and control of EOS observatories.

Earth Probes

Discipline-specific satellites and instruments that will be used by *NASA* to obtain observations before the launch of EOS spacecraft. Generally smaller than the EOS satellites and instruments, Earth Probes are planned to complement the broad environmental measurements from EOS with highly focused studies in areas such as tropical rainfall (TRMM), ocean productivity (SeaWiFS), atmospheric ozone (TOMS), and ocean surface winds (NSCAT).

Earth Radiation Budget Experiment (ERBE)

An experiment to obtain data to study the average radiation budget of the Earth and determine the energy transport gradient from the equator to the poles. Three satellites were flown in different orbits to obtain the data: the Earth Radiation Budget Satellite, ERBS (launched in October 1984), NOAA-9 (launched in December 1984), and NOAA-10 (launched in September 1986). See Television and Infrared Observation (TIROS).

Earth Science Data and Information System (ESDIS)

A project that is responsible for providing scientific and other users access to data from NASA's Earth Science Enterprise. The ESDIS Project provides this access through the development and operation of the Earth Observing System (EOS) Data and Information System (EOSDIS).

Earth Science Enterprise (ESE)

International research program to understand our planet's environment as a system. A major challenge of ESE is to observe, understand, model, assess, and eventually predict global change. Meeting this challenge will help to evaluate the impact that human activity (e.g., clearing forests and burning fossil fuels) has on our environment, and to distinguish human-induced changes from the effects of natural events (e.g. volcanic eruptions, erosion).

NASA's ESE uses space-, aircraft-, and ground-based measurements to provide the scientific basis for understanding global change. The program will produce long-term global maps of clouds, land and ocean vegetation, atmospheric ozone, sea-surface temperature, and other global processes necessary to understand the state of the Earth and to detect any patterns of change. This information will be available to scientists and policy makers through the Earth Observing System Data and Information System

	(EOSDIS). The centerpiece of NASA's ESE will be the Earth Observing System (EOS), a series of satellites planned for launch beginning in 1999. Measurements from EOS will be complemented by the Earth Probes, a series of discipline-specific satellites and instruments designed to observe Earth processes where smaller platforms and/or different orbits from EOS are required. Planned Earth Probes will measure tropical rainfall, ocean productivity, ozone, and ocean surface winds. In addition, ESE includes current NASA Earth science missions collecting important data on the global environment, such as the Upper Atmosphere Research Satellite (UARS) and the Ocean Topography Experiment (TOPEX/POSEIDON), Space Shuttle experiments such as ATLAS, and aircraft campaigns.
Earth system	The Earth regarded as a unified system of interacting components, including geosphere (land), atmosphere (air), hydrosphere (water and ice), and biosphere (life).
Earth system science	An integrated approach to the study of the Earth that stresses investigations of the interactions among the Earth's components in order to explain Earth dynamics, evolution, and global change.
easterly wave	A migratory wavelike atmospheric disturbance in the tropical easterlies. Easterly waves occasionally intensify into tropical cyclones. They are also called tropical waves.
eccentricity	(aka ecce or E0 or e) One of six Keplerian elements, it describes the shape of an orbit. In the Keplerian orbit model, the satellite orbit is an ellipse, with eccentricity defining the 'shape' of the ellipse. When e=0, the ellipse is a circle. When e is very near 1, the ellipse is very long and skinny.
eclipse	The partial or total apparent darkening of the sun when the moon comes between the sun and the Earth (solar eclipse), or the darkening of the moon when the full moon is in the Earth's shadow (lunar eclipse).
ecology	Science dealing with the interrelationships between

	living organisms and their environments.
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	A warming of the surface waters of the eastern equatorial Pacific that occurs at irregular intervals of 2-7 years, usually lasting 1-2 years. Along the west coast of South America, southerly winds promote the upwelling of cold, nutrient-rich water that sustains large fish populations, that sustain abundant sea birds, whose droppings support the fertilizer industry. Near the end of each calendar year, a warm current of nutrient-pool tropical water replaces the cold, nutrient-rich surface water. Because this condition often occurs around Christmas, it was named El Niño (Spanish for boy child, referring to the Christ child). In most years the warming last only a few weeks or a month, after which the weather patterns return to normal and fishing improves. However, when El Niño conditions last for many months, more extensive ocean warming occurs and economic results can be disastrous. El Niño has been linked to wetter, colder winters in the United States; drier, hotter summers in South America and Europe; and drought in Africa. See ENSO.
electrical resonance	An effect in which the resistance to the flow of an electrical current becomes very small over a narrow frequency range.
electromagnetic radiation	Energy propagated as time-varying electric and magnetic fields. These two fields are inextricably linked as a single entity since time-varying electric fields produce time-varying magnetic fields and vice versa. Light and radar are examples of electromagnetic radiation differing only in their wavelengths (or frequency). Electric and magnetic fields propagate through space at the speed of light.
electromagnetic spectrum	The entire range of radiant energies or wave frequencies from the longest to the shortest wavelengths--the categorization of solar radiation. Satellite sensors collect this energy, but what the detectors capture is only a small portion of the entire electromagnetic spectrum. The spectrum usually is divided into seven sections: radio, microwave, infrared, visible, ultraviolet, x-ray, and gamma-ray

	radiation.
electromagnetic wave	Method of travel for radiant energy (all energy is both particles and waves), so called because radiant energy has both magnetic and electrical properties. electromagnetic waves are produced when electric charges change their motion. Whether the frequency is high or low, all electromagnetic waves travel at 300,000,000 meters per second.
elevation	The angle at which an antenna must be pointed above the horizon for optimal reception from a spacecraft.
elliptical orbits	Bodies in space orbit in elliptical rather than circular orbits because of factors such as *gravity* and *drag*. The point where the orbiting satellite is closest to Earth is the *perigee*, sometimes called peri-apsis or perifocus. The point where the satellite is farthest from Earth is called *apogee*, apoapsis, or apifocus. A line drawn from perigee to *apogee* is the line-of-apsides, sometimes called the major-axis of the ellipse. It's simply a line drawn through the ellipse the long way.
emissivity	The ratio of the radiation emitted by a surface to that emitted by a black body at the same temperature.
energy budget	A quantitative description of the energy exchange for a physical or ecological system. The budget includes terms for radiation, conduction, convection, latent heat, and for sources and sinks of energy.
enhanced greenhouse effect	The natural greenhouse effect has been enhanced by anthropogenic emissions of greenhouse gases. Increased concentrations of carbon dioxide, methane, and nitrous oxide, CFCs, HFCs, PFCs, SF6, NF3, and other photochemically important gases caused by human activities such as fossil fuel consumption and adding waste to landfills, trap more infra-red radiation, thereby exerting a warming influence on the climate. See Climate Change and Global Warming.
Enhanced Thematic Mapper Plus (ETM +)	An eight-band multispectral scanning radiometer onboard the Landsat 7 satellite that is capable of providing high-resolution imaging information of the Earth's surface.
ENSO (El Niño-	Interacting parts of a single global system of climate

Southern Oscillation)	fluctuations. ENSO is the most prominent known source of interannual variability in weather and climate around the world, though not all areas are affected. The Southern Oscillation (SO) is a global-scale seesaw in atmospheric pressure between Indonesia/North Australia, and the southeast Pacific. In major warm events El Niño warming extends over much of the tropical Pacific and becomes clearly linked to the SO pattern. Many of the countries most affected by ENSO events are developing countries with economies that are largely dependent upon their agricultural and fishery sectors as a major source of food supply, employment, and foreign exchange. New capabilities to predict the onset of ENSO event can have a global impact. While ENSO is a natural part of the Earth's climate, whether its intensity or frequency may change as a result of global warming is an important concern.
environment	The complex of physical, chemical, and biological factors in which a living organism or community exists.
EPA (Environmental Protection Agency)	U.S. agency that ensures: Federal environmental laws are implemented and enforced effectively; U.S. policy--both foreign and domestic--fosters the integration of economic development and environmental protection so that economic growth can be sustained over the long term; public and private decisions affecting energy, transportation, agriculture, industry, international trade, and natural resources fully integrate considerations of environmental quality; national efforts to reduce environmental risk are based on the best available scientific information communicated clearly to the public; everyone in our society recognizes the value of preventing pollution before it is created; people have the information and incentives they need to make environmentally-responsible choices in their daily lives; and schools and community institutions promote environmental stewardship as a national ethic.
ESA	European Space Agency.
estuary	A bay that formed when a broad river valley was submerged by rising sea level or a sinking coast.
eutrophication	The process whereby a body of water becomes rich in

	dissolved nutrients through natural or man-made processes. This often results in a deficiency of dissolved oxygen, producing an environment that favors plant over animal life.
evaporation	Change from a liquid (more dense) to a vapor or gas (less dense) from. When water is heated it becomes a vapor that increases *humidity*. Evaporation is the opposite of *condensation*.
evapotranspiration	The sum of evaporation and plant transpiration. Potential evapotranspiration is the amount of water that could be evaporated or transpired at a given temperature and humidity, if there was plenty of water available. Actual evapotranspiration can not be any greater than precipitation, and will usually be less because some water will run off in rivers and flow to the oceans. If potential evapotranspiration is greater than actual precipitation, then soils are extremely dry during at least a major part of the year.
exosphere	The uppermost layer of the *atmosphere,* its lower boundary is estimated at 500 km to 1000 km above the Earth's surface. It is only from the exosphere that atmospheric gases can, to any appreciable extent, escape into outer space.
external forcing	Influence on the *Earth system* (or one of its components) by an external agent such as *solar radiation* or the impact of extraterrestrial bodies such as meteorites.
Fahrenheit	Temperature scale designed by the German scientist Gabriel Fahrenheit in 1709, based upon water freezing at 32 degrees Fahrenheit and water boiling at 212 degrees Fahrenheit under standard atmospheric pressure. Compare with *centigrade*.
false color	A color imaging process which produces an image of a color that does not correspond to the true or natural color of the scene (as seen by our eyes).
far infrared	Electromagnetic radiation, longer than the thermal infrared, with wavelengths between about 25 and 1000 micrometers. See electromagnetic spectrum.
fault line	A fracture in rock along which one side has moved

	with respect to the other. See Putting Earthquakes in Their Place
feedback mechanisms	Factors which increase or amplify (positive feedback) or decrease (negative feedback) the rate of a process. An example of positive climatic feedback is the ice-albedo feedback.
FEMA	U.S. Federal Emergency Management Agency.
field	The set of influences (electricity, magnetism, gravity) that extend throughout space.
field of view	The range of angles that are scanned or sensed by a system or instrument, measured in degrees of arc.
flood plain	The nearly flat portion of a river (stream) valley adjacent to the river (stream) channel; it is built by sediment deposited during floods and is covered by water during a flood.
fluorocarbons	Carbon-fluorine compounds that often contain other elements such as hydrogen, chlorine, or bromine. Common fluorocarbons include chlorofluorocarbons and related compounds (also know as ozone depleting substances).
flux	the measure of the flow of some quantity per unit area per unit time
fog	A cloud on the ground.
food chain	A sequence of organisms, each of which uses the next lower member of the sequence as a food source.
force	Any external agent that causes a change in the motion of a free body, or that causes stress in a fixed body.
fossil	Hardened remains or traces of plant or animal life from a previous geological period preserved in the Earth's crust.
fossil fuel	Any hydrocarbon deposit that can be burned for heat or power, such as petroleum, coal, and natural gas.

Fraction of Photosynthetically Active Radiation (FPAR)

Radiation between 400 and 700 nm used by the green canopy in the photosynthetic process.

free radicals

Atomic or molecular species with unpaired electrons or an otherwise open shell configuration, usually very reactive. Specific to atmospheric chemistry, free radicals are: short-lived, highly reactive, intermediate species produced by dissociation of the source molecules by solar ultraviolet radiation or by reactions with other stratospheric constituents. Free radicals are the key to intermediate species in many important *stratospheric*chain reactions in which an *ozone* molecule is destroyed and the radical is regenerated. See ozone

frequency (F)

Number of cycles and parts of cycles completed per second. F=1/T, where T is the length of one cycle in seconds.

front

A boundary between two different air masses. The difference between two air masses sometimes is unnoticeable. But when the colliding air masses have very different temperatures and amounts of water in them, turbulent weather can erupt.

A cold front occurs when a cold air mass moves into an area occupied by a warmer air mass. Moving at an average speed of about 20 mph, the heavier cold air moves in a wedge shape along the ground. Cold fronts bring lower temperatures and can create narrow bands of violent thunderstorms. In North America, cold fronts form on the eastern edges of high pressure systems.

A warm front occurs when a warm air mass moves into an area occupied by a colder air mass. The warm air is lighter, so it flows up the slope of the cold air below it. Warm fronts usually form on the eastern sides of low pressure systems, create wide areas of clouds and rain, and move at an average speed of 15 mph.

When a cold front follows and then overtakes a warm front (warm fronts move more slowly than cold fronts) lifting the warm air off the ground, an *occluded front* forms.

frost	Ice crystals formed by deposition of water vapor on a relatively cold surface.
Gaia hypothesis	The hypothesis that the Earth's *atmosphere, biosphere,* and its living organisms behave as a single system striving to maintain a stability that is conductive to the existence of life.
gamma ray	A high energy photon, especially as emitted by a nucleus in a transition between two energy levels.
General Circulation Model (GCM)	A global, three-dimensional computer model of the climate system which can be used to simulate human-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.
geodesy	A branch of applied mathematics concerned with measuring the shape of the Earth and describing variations in the Earth's gravity field.
geodynamics	The study of the Earth's motions, including rotation, tectonics, ocean tides, and structure (i.e., core, mantle). See Putting Earthquakes in Their Place
Geographic Information System (GIS)	A system for archiving, retrieving, and manipulating data that has been stored and indexed according to the geographic coordinates of its elements. The system generally can utilize a variety of data types, such as imagery, maps. table, etc.
geoid	A surface of constant gravitational potential around the Earth--an averaged surface perpendicular to the force of gravity.
geomorphology	The study of present-day landforms, including their classification, description, nature, origin, development, and relationships to underlying structures. Also the history of geologic changes as recorded by these surface features. The term is sometimes restricted to features produced only by erosion and deposition.

geophysical Relating to the study of the physical characteristics and properties of the solid earth, its air and waters, and its relationship to space phenomena.

geosphere The physical elements of the Earth's surface crust, and interior.

geostationary Describes an orbit in which a satellite is always in the same position (appears stationary) with respect to the rotating Earth. The satellite travels around the Earth in the same direction, at an altitude of approximately 35,790 km (22,240 statute miles) because that produces an orbital period equal to the period of rotation of the Earth (actually 23 hours, 56 minutes, 04.09 seconds). A worldwide network of operational geostationary meteorological satellites provides visible and infrared images of Earth's surface and atmosphere. The satellite systems include the U.S. *GOES, METEOSAT*(launched by the European Space Agency and operated by the European Weather Satellite Organization-EUMETSAT), the Japanese *GMS* and most commercial, telecommunications satellites.

Geostationary Meteorological Satellite (GMS) Japan's geostationary weather satellite.

Geostationary Operational Environmental Satellite (GOES) NASA-developed, NOAA-operated series of satellites that:

- provide continuous day and night weather observations;
- monitor severe weather events such as hurricanes, thunderstorms, and flash floods;
- relay environmental data from surface collection platforms to a processing center;
- perform facsimile transmissions of processed weather data to low-cost receiving stations;
- monitor the Earth's magnetic field, the energetic particle flux in the satellite's vicinity, and x-ray emissions from the sun;

- detect distress signals from downed aircraft and ships.

GOES observes the U.S. and adjacent ocean areas from vantage points 35,790 (22,240 miles) above the equator at 75 degrees west and 135 degrees west. GOES satellites have an equatorial, Earth-synchronous orbit with a 24-hour period, a visible resolution of 1 km, an IR resolution of 4 km, and a scan rate of 1864 statute miles in about three minutes. See geostationary.

GOES carries the following five major sensor systems:

1. The imager is a multispectral instrument capable of sweeping simultaneously one visible and four infrared channels in a north-to-south swath across an east-to-west path, providing full disk imagery once every thirty minutes.

2. The sounder has more spectral bands than the imager for producing high quality atmospheric profiles of temperature and moisture. It is capable of stepping one visible and eighteen infrared channels in a north-to-south swath across an east-to-west path.

3. The Space Environment Monitor (SEM) measures the condition of the Earth's magnetic field, the solar activity and radiation around the spacecraft, and transmits these data to a central processing facility.

4. The Data Collection System (DCS) receives transmitted meteorological data from remotely located platforms and relays the data to the end-users.

5. The Search and Rescue Transponder can relay distress signals at all times, but cannot locate them. While only the polar-orbiting satellite can locate distress signals, the two types of satellites work together to create a comprehensive search and rescue system.

geosynchronous (aka GEO) Synchronous with respect to the rotation of the Earth. See geostationary.

gigabit	One billion (1,073,741,824) bits.
glacier	A multi-year surplus accumulation of snowfall in excess of snowmelt on land and resulting in a mass of ice at least 0.1 km2 in area that shows some evidence of movement in response to gravity. A glacier may terminate on land or in water. 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.
Glenn Research Center at Lewis Field (GRC)	The John H. Glenn Research Center at Lewis Field (formerly known as the Lewis Research Center), located outside Cleveland, Ohio, conducts a varied program of research in aeronautics and space technology. Aeronautical research includes work on advanced materials and structures for aircraft. Space-related research focuses primarily on power and propulsion. Another significant area of research is in energy and power sources for spacecraft, including the Space Station, for which GRC is developing the largest space power system ever designed. GRC Web Site
global carbon budget	The balance of the exchanges (incomes and losses) of carbon between the carbon reservoirs or between one specific loop (e.g., atmosphere - biosphere) of the carbon cycle. An examination of the carbon budget of a pool or reservoir can provide information about whether the pool or reservoir is functioning as a source or sink for CO_2.
Global Change Research Program (GCRP)	The USGCRP is a government-wide program whose goal is 'to establish a scientific basis for national and international policy-making relating to natural and human-induced changes in the global Earth system.' The Earth Science Enterprise is NASA's central contribution to the U.S. Global Change Research Program. The Global Change Research Program coordinates and guides the efforts of federal agencies. The program examines such questions as, is the Earth experiencing global warming? Is the depletion of the ozone layer expanding? How do we determine and understand the causes of global climate changes? Are they reversible? What are the implications for human

needs and activities?

global climate change The long-term fluctuations in temperature, precipitation, wind, and all other aspects of the Earth's climate. External processes, such as solar-irradiance variations, variations of the Earth's orbital parameters (eccentricity, precession, and inclination), lithosphere motions, and volcanic activity, are factors in climatic variation. Internal variations of the climate system also produce fluctuations of sufficient magnitude and variability to explain observed climate change through the feedback processes interrelating the components of the climate system.

global measurement All of the activities required to specify a global variable, such as ozone. These activities range from data acquisition to the generation of a data-analysis product, and include estimates of the uncertainties in that product. A global measurement often will consist of a combination of observations from a spacecraft instrument (required for global coverage) and measurements *in situ* (needed to provide reference points for long-term accuracy).

global positioning system (GPS) A system consisting of 25 satellites in 6 orbital planes at 20,000 km altitude with 12 hr periods, used to provide highly precise position, velocity and time information to users anywhere on Earth or in its neighborhood at any time.

global variables Functions of space and time that describe the large scale state and evolution of the Earth system. The Earth system's geosphere, hydrosphere, atmosphere, and biosphere and their components are, or potentially are, global variables.

global warming An increase in the near surface temperature of the Earth. Global warming has occurred in the distant past as the result of natural influences, but the term is most often used to refer to the warming predicted to occur as a result of increased emissions of greenhouse gases. Scientists generally agree that the Earth's surface has warmed by about 1 degree Fahrenheit in the past 140 years. The Intergovernmental Panel on Climate Change (IPCC) recently concluded that increased concentrations of greenhouse gases are causing an increase in the Earth's surface temperature and that increased concentrations of sulfate aerosols have led

	to relative cooling in some regions, generally over and downwind of heavily industrialized areas. Also see Climate Change and Enhanced Greenhouse Effect.
Goddard Space Flight Center (GSFC)	Goddard was NASA's first major scientific laboratory devoted entirely to the exploration of space. Located in Greenbelt, Maryland, GSFC's responsibilities include design and construction of new scientific and applications satellites, as well as racking and communication with existing satellites in orbit. GSFC is the lead center for the Earth Observing System, a key element of the Earth Sciences Enterprise. GSFC also directs operations at the Wallops Flight Facility on Wallops Island, Virginia, which each year launches some 50 scientific missions to sub-orbital altitudes on small sounding rockets. GSFC Web Site
grassland	Region in which the climate is dry for long periods of the summer, and freezes in the winter. Grasslands are characterized by grasses and other erect herbs, usually without trees or shrubs. Grasslands occur in the dry temperate interiors of continents.
greenhouse effect	The warming of an atmosphere by its absorbing and reemitting infrared radiation while allowing shortwave radiation to pass on through. Certain gaseous components of the atmosphere, called greenhouse gases, transmit the visible portion of solar radiation but absorb specific spectral bands of thermal radiation emitted by the Earth. The theory is that terrain absorbs radiation, heats up, and emits longer wavelength thermal radiation that is prevented from escaping into space by the blanket of carbon dioxide and other greenhouse gases in the atmosphere. As a result, the climate warms. Because atmospheric and oceanic circulations play a central role in the climate of the Earth, improving our knowledge about their interaction becomes essential.
greenhouse gas	A gaseous component of the atmosphere contributing to the greenhouse effect. Greenhouse gases are transparent to certain wavelengths of the sun's radiant energy, allowing them to penetrate deep into the atmosphere or all the way into the Earth's surface. Greenhouse gases and clouds prevent some of infrared radiation from escaping, trapping the heat near the Earth's surface where it warms the lower atmosphere. Alteration of this natural barrier of atmospheric gases

	can raise or lower the mean global temperature of the Earth. Greenhouse gases include carbon dioxide, methane, nitrous oxide, chlorofluorocarbons, and water vapor. Carbon dioxide, methane, and nitrous oxide have significant natural and human sources while only industries produce chlorofluorocarbons. Water vapor has the largest greenhouse effect, but its concentration in the troposphere is determined within the climate system. Water vapor will increase in response to global warming, which in turn may further enhance global warming.
Gross National Product	The total value of all goods and services produced by the people of a given country over a year.
ground track	The inclination of a satellite, together with its orbital altitude and the period of its orbit, creates a track defined by an imaginary line connecting the satellite and the Earth's center. The intersection on the line with the Earth's surface is the subsatellite point. As the Earth turns on its axis and the satellite orbits overhead, a line is created by the satellite's apparent path over the ground (the series of subsatellite points connected). A geostationary satellite has an inclination of essentially zero, and, because its orbital period exactly matches the Earth's rotation, its ground track is reduced to an apparent stationary point on the equator.
gulf stream	A warm, swift ocean current that flows along the coast of the Eastern United States and makes Ireland, Great Britain, and the Scandinavian countries warmer than they would be otherwise.
habitat	The area or region where a particular type of plant or animal lives and grows.
hail	Precipitation composed of balls or irregular lumps of ice. Hail is produced when large frozen raindrops, or almost any particles, in cumulonimbus clouds act as embryos that grow by accumulating supercooled liquid droplets. Violent updrafts in the cloud carry the particles in freezing air, allowing the frozen core to accumulate more ice. When the piece of hail becomes too heavy to be carried by upsurging air currents it falls to the ground.

haze	Fine dry or wet particles of dust, salt, or other impurities that can concentrate in a layer next to the Earth when air is stable.
heat balance	The equilibrium existing between the radiation received and emitted by a planetary system.
heat island effect	A dome of elevated temperatures over an urban area caused by the heat absorbed by structures and pavement.
hemisphere	Half of the Earth, usually conceived as resulting from the division of the globe into two equal parts, north and south or east and west.
herbaceous	Green and leaf-like.
High-Resolution Infrared Radiation Sounder (HIRS)	Instrument carried by NOAA polar-orbiting satellites that detects and measures energy emitted by the atmosphere to construct a vertical temperature profile from the Earth's surface to an altitude of about 40 km. Measurements are made in 20 spectral regions in the infrared band.
horse latitudes	The subtropical latitudes (30-35 degrees), where winds are light and weather is hot and dry. According to legend, ships traveling to the New World often stagnated in this region and had to throw dead horses overboard or eat them to survive, hence the name horse latitudes.
hurricanes	Severe tropical storms whose winds exceed 74 mph. Hurricanes originate over the tropical and subtropical North Atlantic and North Pacific oceans, where there is high humidity and light wind. These conditions prevail mostly in the summer and early fall. Since hurricanes can take days or even weeks to form, time is usually available for preventive or protective measures. From space, hurricanes look like giant pinwheels, their winds circulating around an eye that is between 5 and 25 miles in diameter. The eye remains calm with light winds and often a clear sky. Hurricanes may move as fast as 50 mph, and can become incredibly destructive when they hit land.

	Although hurricanes lose power rapidly as soon as they leave the ocean, they can cause high waves and tides up to 25 feet above normal. Waves and heavy flooding cause the most deaths during a hurricane. The strongest hurricanes can cause tornadoes.
hydrocarbon	A chemical containing only carbon and hydrogen. Hydrocarbons are of prime economic importance because they encompass the constituents of the major fossil fuels, petroleum and natural gas, as well as plastics, waxes, and oils. In urban pollution, these components--along with NOx and sunlight--contribute to the formation of tropospheric ozone.
hydrochlorofluorocarbon (HCFC)	One of a class of compounds used primarily as a CFC substitute. Work on CFC alternatives began in the late 1970s after the first warnings of CFC damage to stratospheric ozone. By adding hydrogen to the chemical formulation, chemists made CFCs less stable in the lower atmosphere enabling them to break down before reaching the ozone layer. However, HCFCs do release chlorine and have contributed more to atmospheric chlorine buildup than originally predicted. Development of non-chlorine based chemical compounds as a substitute for CFCs and HCFCs continues.
hydrodynamics	The study of fluid motion and fluid-boundary interaction.
hydrologic cycle	The process of evaporation, vertical and horizontal transport of vapor, condensation, precipitation, and the flow of water from continents to oceans. It is a major factor in determining climate through its influence on surface vegetation, the clouds, snow and ice, and soil moisture. The hydrologic cycle is responsible for 25 to 30 percent of the mid-latitudes' heat transport from the equatorial to polar regions. See The Water Cycle
hydrology	The science that deals with global water (both liquid and solid), its properties, circulation, and distribution, on and under the Earth's surface and in the atmosphere through evapotranspiration or is discharged into oceans.
hydrosphere	The totality of water encompassing the Earth, comprising all the bodies of water, ice, and water vapor in the atmosphere.

hygrometer

Instrument that measures water vapor content in the air and communicates changes in humidity visibly and immediately through a graph or a dial. There are three types of hygrometers:

* The hair hygrometer uses a human hair as the sensing instrument. The hair lengthens when the air is moist and contracts when the air is dry, but remains unaffected by air temperature. However, the hair hygrometer cannot respond to rapid fluctuations in humidity.

* An electric hygrometer uses a plate coated with carbon. Electrical resistance of the carbon coating changes as the moisture content of the air changes--changes that translate into relative humidity. This type of hygrometer is used frequently in the radiosonde.

* An infrared hygrometer uses a beam of light containing two separate wave lengths to gauge atmospheric humidity. One of the wavelengths is absorbed by water vapor, the other is unaffected, providing an extremely accurate index of water vapor for paths of a few inches or thousands of feet. See psychrometer.

ice age

A glacial epoch or time of extensive glacial activity

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 that time.

ice sheet (continental glacier)

A glacier of considerable thickness and more than 50,000 sq km in area. It forms a continuous cover of ice and snow over a land surface. An ice sheet is not confined by the underlying topography but spreads outward in all directions. During the Pleistocene Epoch, ice sheets covered large parts of North America and northern Europe but they are now confined to polar regions (e.g., Greenland and Antarctica).

ice shelf

A thick mass of ice extending from a polar shore. The seaward edge is afloat and sometimes extends

hundreds of miles into the sea.

imager A satellite instrument that measures and maps the Earth and its atmosphere. Imager data are converted by computer into pictures.

in situ Latin for 'in original place.' Refers to measurements made at the actual location of the object or material measured. Compare remote sensing.

inclination One of the six Keplerian elements, it indicates the angle of the orbit plane to the central body's equator. See Keplerian elements for diagram.

The elliptical path of a satellite orbit lies in a plane known as the orbital plane. The orbital plane always goes through the center of the Earth but may be tilted at any angle relative to the equator. Inclination is the angle between the equatorial plane and the orbital plane measured counter-clockwise at the ascending node.

A satellite in an orbit that exactly matches the equator has an inclination of 0 degree, whereas one whose orbit crosses the Earth's poles has an inclination of 90 degrees. Because the angle is measured in a counterclockwise direction, it is quite possible for a satellite to have an inclination of more than 90 degrees. An inclination of 180 degrees would mean the satellite is orbiting the equator, but in the opposite direction of the Earth's rotation. Some sun-synchronous satellites that maintain the same ground track throughout the year have inclinations of as much as 98 degrees. U.S. scientific satellites that study the sun are placed in orbits closer to the equator, frequently at 28 degrees inclination. Most weather satellites are placed in high-inclination orbits so they can oversee weather conditions worldwide. See orbital inclination.

information system All of the means and mechanisms for data receipt, processing, storage, retrieval, and analysis. Information Systems can be designed for storage and dissemination of a variety of data products--including primary data sets and both intermediate and final analyses--and for an interface providing connections to external computers, external data banks, and system users. To be effective, the design and operation of an information system must be carried out in close

	association with the primary producers of the data sets, as well as other groups producing integrated analyses or intermediate products.
infrared radiation (IR)	Infrared is electromagnetic radiation whose wavelength spans the region from about 0.7 to 1000 micrometers (longer than visible radiation, shorter than microwave radiation). Remote sensing instruments work by sensing radiation that is naturally emitted or reflected by the Earth's surface or from the atmosphere, or by sensing signals transmitted from a satellite and reflected back to it. In the visible and near-infrared regions, surface chemical composition, vegetation cover, and biological properties of surface matter can be measured. In the mid-infrared region, geological formations can be detected due to the absorption properties related to the structure of silicates. In the far infrared, emissions from the Earth's atmosphere and surface offer information about atmospheric and surface temperatures and water vapor and other trace constituents in the atmosphere. Since IR data are based on temperatures rather than visible radiation, the data may be obtained day or night.
insolation	Solar radiation incident upon a unit horizontal surface on or above the Earth's surface.
International Geosphere-Biosphere Programme (IGBP)	The International Geosphere-Biosphere Programme (IGBP) is an interdisciplinary scientific activity established and sponsored by the International Council for Science (ICSU). The program was instituted by ICSU in 1986, and the IGBP Secretariat was established at the Royal Swedish Academy of Sciences in 1987 and is focused on acquiring basic scientific knowledge about the interactive processes of biology and chemistry of the earth as they relate to Global Change. See IGBP web site
International System of Units (SI)	The International System of Units prescribes the symbols and prefixes shown in the table to form decimal multiples and submultiples of SI units. The following examples illustrate the use of these prefixes: 0.000,001 meters = 1 micrometer = 1æm 1000 meters = 1 kilometer = 1 km

	1,000,000 cycles per second = 1,000,000 hertz = 1 megahertz =1 MHz
Intertropical Convergence Zone (ITCZ)	A discontinuous belt of thunderstorms paralleling the equator and marking the convergence of the northern and southern hemisphere surface trade winds. See El Niño's Extended Family
ion	Atom or molecule that has acquired an electric charge by the loss or gain of one or more electrons.
isobars	Lines drawn on a weather map joining places of equal barometric pressure.
isothermal	Of or indicating equality of temperature.
isotherms	Lines connecting points of equal temperature on a weather map.
isthmus	Narrow strip of land located between two bodies of water, connecting two larger land areas.
Japanese National Space Development Agency (NASDA)	The agency reports to the Japanese Ministry of Science and Technology.
Jason-1	Jason-1 is an oceanography mission to monitor global ocean circulation, discover the tie between the oceans and atmosphere, improve global climate predictions, measure sea level rise and monitor events such as El Nino conditions and the Pacific Decadal Oscillation. The Jason-1 satellite carries a radar altimeter and it is a follow-on mission to the highly successful TOPEX/Poseidon mission. It is joint mission between France and USA.The satellite will be launched in late 2000. Jason web site
Jet Propulsion Laboratory (JPL)	Located in Pasadena, California, JPL is operated under contract to NASA by the California Institute of Technology. Its primary focus is the scientific study of the solar system, including exploration of the planets with automated probes. Most of the lunar and planetary spacecraft of the 1960s and 1970s were developed at JPL. JPL also is the control center for the worldwide Deep Space Network, which tracks all planetary spacecraft. JPL Web Site

jet stream	Rivers of high-speed air in the atmosphere. Jet streams form along the boundaries of global air masses where there is a significant difference in atmospheric temperature. The jet streams may be several hundred miles across and 1-2 miles deep at an altitude of 8-12 miles. They generally move west to east, and are strongest in the winter with core wind speeds as high as 250 mph. Changes in the jet stream indicate changes in the motion of the atmosphere and weather.
Johnson Space Center (JSC)	The Lyndon B. Johnson Space Center, located between Houston and Galveston, Texas, is the lead center for NASA's manned space flight program. JSC has been Mission Control for all piloted space flights since 1965, and now manages the Space Shuttle program. JSC's responsibilities include selecting and training astronauts; designing and testing vehicles and other systems for piloted space flight; and planning and executing space flight missions. The center has a major role in developing the Space Station. In addition, JSC directs operations at the White Sands Test Facility in New Mexico, which conducts Shuttle-related tests. The nearby White Sands Missile Range also serves as a backup landing site for the Space Shuttle. JSC Web Site
Joint Education Initiative (JEI)	The JEI project was developed by USGS, NOAA, NASA, industry, and teachers to enable teachers and students to explore the massive quantities of Earth science data published by the U.S. Government on CD-ROM. JEI encourages a research and analysis approach to science education.
Kelvin	The standard unit of thermodynamic temperature. It is defined as 1/273.16 of the temperature of the triple point of water above absolute zero. The symbol for this is K. Kelvin is measured by the same temperature steps as Celsius but is shifted downwards so that 0 degrees K is absolute zero; water freezes at 273 K and boils at 373 K.
Kennedy Space Center (KSC)	Located near Cape Canaveral, Florida, KSC is NASA's primary launch site. The Center handles the preparation, integration, checkout, and launch of space vehicles and their payloads. All piloted space missions since the Mercury program have been launched from here, including Gemini, Apollo, Skylab, and Space Shuttle flights. KSC is the Shuttle's home port, where

	orbiters are serviced and outfitted between missions, and then assembled into a complete Shuttle 'stack' before launch. The Center also manages the testing and launch of unpiloted space vehicles from an array of launch complexes, and conducts research programs in areas of life sciences related to human spaceflight. KSC Web Site
kilobit	1024 bits. Also represented as Kb.
kilometer (km)	Metric unit of distance equal to 3,280.8 feet or .621 statute miles.
knot	Unit of speed of one nautical mile (6,076.1 feet) an hour.
Ku-band	Radar and microwave band in which the wavelengths vary from 1.67-2.4 cm.
La Niña	A period of stronger-than-normal trade winds and unusually low sea-surface temperatures in the central and eastern tropical Pacific Ocean; the opposite of El Niño. See La Niña fact sheet.
lahar	A lahar is defined as a rock-laden flood made up of 40 percent or more by weight volcanic debris. A lahar flows like wet concrete and is very fast, outstripping a normal water-only flow. Lahars have been clocked at 65 kilometers per hour (40 mph). See When Rivers of Rock Flow
lake	A body of fresh or salt water entirely surrounded by land.
land breeze	A nocturnal coastal breeze that blows from land to sea. In the evening the water may be warmer than the land, causing pressure differences. The land breeze is the flow of air from land to sea equalizing these pressure differences. See sea breeze.
land cover	The characteristics of a land surface as determined by its spectral signature (the unique way in which a given type of land cover reflects and absorbs light).
Landsat	Land Remote-Sensing Satellite, operated by the U.S. Earth Observation Satellite Company (EOSAT).

	Commercialized under the Land Remote-Sensing Commercialization Act of 1984, Landsat is a series of satellites (formerly called ERTS) designed to gather data on the Earth's resources in a regular and systematic manner. Objectives of the mission are: land use inventory, geological/mineralogical exploration, crop and forestry assessment, and cartography. Restructured Federal agency responsibilities for the Landsat program are effective for the acquisition and operation of Landsat 7. New operating policy specifies that NOAA will be responsible for satellites after they are placed in orbit, NASA will be responsible for the development and launch of Landsat 7, and that the U.S. government will provide unenhanced data to users at no cost beyond the cost of fulfilling their data request.
Langley Research Center (LaRC)	Oldest of NASA's field centers, LaRC is located in Hampton, Virginia, and focuses primarily on aeronautical research. Established in 1917 by the National Advisory Committee for Aeronautics, the Center currently devotes two-thirds of its programs to aeronautics, and the rest to space. LaRC researchers use more than 40 wind tunnels to study improved aircraft and spacecraft safety, performance, and efficiency. LaRC Web Site
laser (light amplification by stimulated emission of radiation)	Active instrument that produces discretely coherent pulses of light (light waves with no phase differences, or with predictable phases differences, are said to be coherent).
laser ranging	The use of lasers to measure distances.
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.
latitude (aka the geodetic latitude)	The angle between a perpendicular at a location, and the equatorial plane of the Earth.
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. Occasionally this has been used in reference

to both sides of the leaves.

legend A listing that contains symbols and other information about a map.

lidar Acronym for 'Light Detection and Ranging,' a technique for performing accurate remote measurements of atmospheric trace gas concentration over ranges of several meters to tens of kilometers. This is done by probing the absorption lines of the gases with narrow spectral laser radiation using the differential absorption lidar technique.

light 1. Form of radiant energy that acts upon the retina of the eye, optic nerve, etc., making sight possible. This energy is transmitted at a velocity of about 186,000 miles per second by wavelike or vibrational motion.

2. A form of radiant energy similar to this, but not acting on the normal retina, such as ultraviolet and infrared radiation.

Interplay between light rays and the atmosphere cause us to see the sky as blue, and can result in such phenomena as glows, halos, arcs, flashes, and streamers.

lightning A discharge of atmospheric electricity accompanied by a vivid flash of light. During thunderstorms, static electricity builds up within the clouds. A positive charge builds in the upper part of the cloud, while a large negative charge builds in the lower portion. When the difference between the positive and negative charges becomes great, the electrical charge jumps from one area to another, creating a lightning bolt. Most lightning bolts strike from one cloud to another, but they also can strike the ground. These bolts occur when positive charges build up on the ground. A negative charge called the 'faintly luminous streamer' or 'leader' flows from the cloud toward the ground. Then a positively charged leader, called the return stroke, leaves the ground and runs into the cloud. What is seen as a lightning bolt is actually a series of downward-striking leaders and upward-striking return strokes, all taking place in less than a second.

Lightning bolts can heat the air to temperatures hotter than the surface of the sun. This burst of heat makes the air around the bolt expand explosively, producing

	the sound we hear as thunder. Since light travels a million times faster than sound, we see lightning bolts before we hear their thunderclaps. By counting the seconds between a flash of lightning and the thunderclap and dividing by five, we can determine the approximate number of miles to the lightning stroke.
Lightning Imaging Sensor (LIS)	A small, highly sophisticated instrument that detects and locates lightning over the tropical region of the globe. Looking down from a vantage point aboard the Tropical Rainfall Measuring Mission (TRMM) observatory, 218 miles (350 kilometers) above the Earth, the sensor is providing information that could lead to future advanced lightning sensors capable of significantly improving weather "nowcasting." The Lightning Imaging Sensor is three times more sensitive than a predecessor instrument known as the Optical Transient Detector. The LIS will study both day and night cloud-to-ground, cloud-to-cloud and intra-cloud lightning and its distribution around the globe. See LIS web site
lithosphere	The component of the Earth's surface comprising the rock, soil, and sediments. It is a relatively passive component of the climate system, and its physical characteristics are treated as fixed elements in the determination of climate.
Little Ice Age	A cold period that lasted from about A.D. 1550 to about A.D. 1850 in Europe, North America, and Asia. This period was marked by rapid expansion of mountain glaciers, especially in the Alps, Norway, Ireland, and Alaska. There were three maxima, beginning about 1650, about 1770, and 1850, each separated by slight warming intervals.
longitude	The angular distance from the Greenwich meridian (0 degree), along the equator. This can be measured either east or west to the 180th meridian (180 degrees) or 0 degree to 360 degrees W.
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.

low or low-pressure system	A horizontal area where the atmospheric pressure is less than it is in adjacent areas. Since air always moves from areas of high pressure to areas of low pressure, air from these adjacent areas of higher pressure will move toward the low pressure area to equalize the pressure. This inflow of air toward the low will be affected by the Earth's rotation (see Coriolis force) and will cause the air to spiral inward in a counterclockwise direction in the northern hemisphere. The air eventually rises near the center of the low, causing cloudiness and precipitation. The air in a low rotates in a counterclockwise direction in the Northern Hemisphere, and in a clockwise direction in the Southern Hemisphere. Low-pressure cells are called cyclones.
magnetosphere	The region surrounding a celestial body where its magnetic field controls the motions of charged particles. The Earth's magnetic field is dipolar in nature. That is, it behaves as if produced by a giant bar magnet located near the center of the planet with its north pole tilted several degrees from Earth's geographic north pole. The Earth's magnetic field presents an obstacle to the solar wind, as a rock in a running stream of water. This obstacle is called a bow shock. The bow shock slows down, heats, and compresses the solar wind, which then flows around the rest of Earth's magnetic field. See Van Allen belts.
Marshall Space Flight Center (MSFC)	The George C. Marshall Space Flight Center, located in Huntsville, Alabama, is responsible for developing spacecraft hardware and systems, and is perhaps best known for its role in building the Saturn rockets that sent astronauts to the Moon during the Apollo program. It is NASA's primary center for space propulsion systems and plays a key role in the development of payloads to be flown on the shuttle (such as Spacelab). MSFC also manages two other NASA sites: the Michoud Assembly Facility in New Orleans where the Shuttle's external tanks are manufactured, and the Slidell Computer Complex in Slidell, Louisiana, which provides computer support to Michoud and to NASA's John C. Stennis Space Center. MSFC Web Site
mass balance	The term ‘mass balance’ is often used by glaciologists

	to describe the difference between all of the ice that is added to a glacier, and all of the ice the glacier loses over a period of time. Ice sheets and glaciers can lose mass due to melting, calving, evaporation, etc. They can gain mass from direct precipitation, avalanching, and windblown snow. The net result of all these outputs and inputs of ice are then the glacier's mass balance.
mean sea level	The average height of the sea surface, based upon hourly observation of the tide height on the open coast or in adjacent waters that have free access to the sea. In the United States, it is defined as the average height of the sea surface for all stages of the tide over a nineteen year period. Mean sea level, commonly abbreviated as MSL and referred to simply as 'sea level,' serves as the reference surface for all altitudes in upper atmospheric studies.
Measurements of Pollution in the Troposphere (MOPITT)	MOPITT will fly aboard Terra as part of NASA's Earth Observing System(EOS). It is an instrument designed to enhance our knowledge of the lower atmosphere and to particularly observe how it interacts with the land and ocean biospheres. MOPITT is a scanning radiometer employing gas correlation spectroscopy to measure upwelling and reflected infrared radiance in three absorption bands of carbon monoxide and methane.
megabit	(mbps) Millions of bits per second. A unit of information transfer rate -- e.g. Ethernet can carry 10 mbps.
mesopause	The upper boundary of the mesosphere where the temperature of the atmosphere reaches its lowest point.
mesosphere	The atmospheric layer above the stratosphere, extending from about 50 to 85 kilometers altitude. The temperature generally decreases with altitude.
metabolism	the sum of all the chemical and physical processes within a living organism, including anabolism and catabolism
metadata	Information describing the content or utility of a data set. For example, the dates on which data were

	procured are metadata.
Meteor	The former Soviet Union's series of polar orbiting weather satellites. The Meteor satellites transmit images in a system compatible with the NOAA polar-orbiting satellites.
meteorite	a solid mass of mineral or rock matter that has fallen to the earth's surface from outer space without being completely vaporized in the atmosphere.
meteorology	Study of the atmosphere and its phenomena.
METEOSAT	(METEOrological SATellite) Europe's geostationary weather satellite, launched by the European Space Agency and now operated by an organization called Eumetsat.
Methane (CH4)	A hydrocarbon that is a greenhouse gas. 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 oil, coal production , and incomplete fossil fuel combustion. The atmospheric concentration of methane has been shown to be increasing at a rate of about 0.6% per year and the concentration of about 1.7 parts per million by volume (ppmv) is more than twice its preindustrial value. However, the rate of increase of methane in the atmosphere may be stabilizing.
microbe	any microorganism
micrometer	One millionth of a meter, used to measure wavelengths in the electromagnetic spectrum. Also known as a "micron" or æm
microwave	Electromagnetic radiation with wavelengths between about 1000 micrometers and one meter.
middle infrared	Electromagnetic radiation between the near infrared and the thermal infrared, about 2-5 micrometers.
millibar (mb)	One thousandth of a bar, a unit of atmospheric pressure. The average atmospheric pressure at sea level is 1.01325 bars or 1013.25 mb. See pascal (Pa),

atmospheric pressure.

model (noun)

A mathematical representation of a process, system, or object developed to understand its behavior or to make predictions. The representation always involves certain simplifications and assumptions.

Moderate-resolution Imaging Spectroradiometer (MODIS)

MODIS will fly aboard Terra as part of NASA's Earth Observing System (EOS). It will view the entire surface of the Earth every 1-2 days, making observations in 36 co-registered spectral bands, at moderate resolution (0.25 - 1 km), of land and ocean surface temperature, primary productivity, land surface cover, clouds, aerosols, water vapor, temperature profiles, and fires. See MODIS Web Site.

monsoon

A name for seasonal winds, first applied to the winds over the Arabian Sea that blow for six months from the northeast and for six months from the southwest. The term has been extended to similar winds in other parts of the world (i.e., the prevailing west to northwest winds of summer in Europe have been called the European monsoon). The primary cause for these seasonal winds is the much greater annual variation of temperature over large land areas compared with neighboring ocean surfaces, causing an excess of pressure over the continents in winter and a deficit in summer, but other factors, such as topography of the land, also have an effect. The monsoons are strongest in the southern and eastern sides of Asia, but also occur along the coasts of tropical regions wherever the planetary circulation is not strong enough to inhibit them. The monsoon climate can be described as a long winter-spring dry season, which includes a cold season followed by a short hot season just preceding the rains; a summer and early autumn rainy season, which is generally very wet but may vary greatly from year to year; and a secondary warming immediately after the rainy season.

Montreal Protocol

An international agreement to drastically reduce CFC production, the Protocol was adopted in Montreal in 1987. It was significantly strengthened at a subsequent meeting in London in 1990 that called for a complete elimination of CFCs by the year 2000. The agreement was again amended by a Meeting of the Parties in Copenhagen in November 1992. Consumption of controlled substances--such as CFCs and halons--was

	greatly reduced or eliminated, and many accountability dates were moved forward, often from 1 January 2000 to 1 January 1996.
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.
mountain and valley breezes	System of winds that blow downhill during the night (mountain breeze) and uphill during the day (valley breeze).
Multi-angle Imaging Spectro-Radiometer (MISR)	MISR will fly aboard Terra as part of NASA's Earth Observing System. It will monitor the monthly, seasonal, and long-term trends in the amount and type of atmospheric aerosol particles, including those formed by natural sources and by human activities; the amount, types, and heights of clouds; and the distribution of land surface cover, including vegetation canopy structure. See MISR Web Site.
Multispectral Scanner (MSS)	A line-scanning instrument flown on Landsat satellites that continually scans the Earth in a 185 km. (100 nautical miles) swath. On Landsats 1, 2, 4, and 5, the MSS had four spectral bands in the visible and near-infrared with an IFOV of 80 meters. Landsat-3 had a fifth band in the thermal infrared with an IFOV of 240 meters.
nadir	Point on Earth directly beneath a satellite, the opposite of zenith. Compare with subsatellite point.
nanometer (nm)	One billionth of a meter. Nanometers are used to measure wavelengths in the electromagnetic spectrum.
National Aeronautics and Space Administration (NASA)	U.S. Civilian Space Agency created by Congress. Founded in 1958, NASA belongs to the executive branch of the Federal Government. NASA's mission to plan, direct, and conduct aeronautical and space activities is implemented by NASA Headquarters in Washington, D.C., and by nine major centers spread throughout the United States. Dozens of smaller

facilities, from tracking antennas to Space Shuttle landing strips to telescopes are located around the world. The agency administers and maintains these facilities; builds and operates launch pads; trains astronauts; designs aircraft and spacecraft; sends satellites into Earth orbit and beyond; and processes, analyzes, and distributes the resulting data and information.

NASA shares responsibility for aviation and space activities with other federal agencies, including the Departments of Commerce, Transportation, and Defense. Much of the work on major projects such as the Space Shuttle and the Space Station is done in the private sector by aerospace companies under government contract.

From its inception, NASA has been directed to pursue the expansion of human knowledge of phenomena in the atmosphere and space. NASA's programs of basic and applied research extend from microscopic sub-atomic particles to galactic astronomy. In addition to enhancing scientific knowledge, thousands of the technologies developed for aerospace have resulted in commercial applications. Science offices at NASA Headquarters carry out a wide range of research activities to fulfill NASA's science goals. NASA Web Site

National Center for Atmospheric Research (NCAR)

Located in Boulder, Colorado, NCAR's mission is to plan, organize, and conduct atmospheric and related research programs in collaboration with universities, to provide state-of-the-art research tools and facilities to the entire atmospheric sciences community, to support and enhance university atmospheric research education, and to facilitate the transfer of technology to both the public and private sectors. See NCAR web site

National Centers for Environmental Prediction (NCEP)

The NCEP was established in 1958 as the National Meteorological Center. As a critical part of the National Oceanic and Atmospheric Administration's National Weather Service, NCEP is the starting point for nearly all weather forecasts in the United States.

NCEP is comprised of nine centers. Each center has a specific responsibility for a portion of the NCEP products and services suite, yet they all work together toward the common goals of saving lives, protecting

property, and creating economic opportunity. Seven of the centers provide direct products to users, while two of the centers provide essential support through developing and running complex computer models of the atmosphere.

Weather Service field offices, other government agencies, and private meteorological services rely on NCEP's products. Many of the forecasts which reach the public via media outlets originate at NCEP. In addition to weather, NCEP meteorologists prepare seasonal forecasts which extend out to a year in advance. See NCEP web site

National Oceanic and Atmospheric Administration (NOAA)

NOAA was established in 1970 within the U.S. Department of Commerce to ensure the safety of the general public from atmospheric phenomena and to provide the public with an understanding of the Earth's environment and resources. NOAA includes: the National Ocean Service which charts the oceans and waters of the U.S. and manages 265,000 acres of estuarine reserves; the National Marine Fisheries Service which maintains the world's largest and most complex marine fisheries management system; the NOAA Corps which operates 18 NOAA research and survey ships and flies 15 NOAA aircraft; and the Office of Oceanic and Atmospheric Research which supports experiments, laboratories, and the National Sea Grant College Program, among other efforts. NOAA has two main components: the National Weather Service (NWS), and the National Environmental Satellite, Data, and Information Service (NESDIS).

The National Weather Service provides weather watch and warning services to the public through 57 Weather Service Forecast Offices (WSFO) and over 100 smaller local Weather Service Offices (WSOs) nationwide. Three national forecasting centers provide general and specialized guidance to WSFOs using computer forecast models, satellite data, and conventional surface and upper air observations from around the world. The centers are:

- National Center for Environmental Prediction, Camp Springs, Maryland;
- National Severe Storms Forecast Center, Kansas City, Missouri;
- Tropical Prediction Center, Coral Gables, Florida.

NWS River Forecast Centers (RFCs) provide river stage and flood forecasts.

NESDIS provides support to the Weather Service forecast mission by operating a series of environmental satellites and disseminating satellite imagery and derived products to the National Centers and WSFOs. NESDIS operates three national data and information centers: the National Geophysical Data Center, the National Climatic Data Center (NCDC), and the National Oceanographic Data Center (NODC). See SOCC

NOAA organizations perform numerous services in addition to monitoring weather conditions. They assess crop growth and other agricultural conditions, sense shifting ocean currents, and measure surface temperatures of oceans and land. They relay data from surface instruments that sense tide conditions, Earth tremors, river levels, and precipitation.

National Snow and Ice Data Center (NSIDC)

The National Snow and Ice Data Center (NSIDC) is an information and referral center supporting polar and cryospheric research. They distribute data and maintain information about snow cover, avalanches, glaciers, ice sheets, freshwater ice, sea ice, ground ice, permafrost, atmospheric ice, paleoglaciology, and ice cores, and also publish reports and a quarterly newsletter and maintain a collection of monographs, technical reports, and journals. See NSIDC web site

National Space Science Data Center (NSSDC)

The NSSDC provides on-line and off-line access to a wide variety of astrophysics, space plasma and solar physics, lunar and planetary, and Earth science data from NASA space flight missions, in addition to selected other data, models, and software. Located at Goddard Space Flight Center (GSFC) in Greenbelt, Maryland, the NSSDC is sponsored by the Information Systems Office of NASA's Office of Space Sciences. NSSDC on-line data and services are currently free of charge, off-line support (e.g., replications and mailing of magnetic tapes) are available for the cost of fulfilling the request.

The NSSDC Master Catalog (NMC) provides an on-line listing of available data sets and the forms that the data are available in (such as CD-ROM), and provides information about the spacecraft and experiments (including past, present, and future NASA and non

	NASA) from which these data were obtained. The on-line NASA Master Directory (NMD) identifies and briefly describes data of potential interest to the NASA research community, and where possible, provides electronic links to publicly accessible data at sites world-wide. On-line information services are made available through the menu-based NSSDC Online Data Information Service (NODIS).
National Weather Service (NWS)	See National Oceanic and Atmospheric Administration.
nautical mile	A nautical mile is a unit of distance equal to 1,852 meters. The length of the nautical mile is very close to the mean value of the length of 1 minute of latitude, which varies from approximately 1,843 meters at the equator to 1,861.6 meters at the pole.
NCDC	National Climatic Data Center, located in Asheville, North Carolina. See National Oceanic and Atmospheric Administration.
NDVI (normalized difference vegetation index)	NDVI | Abbreviation for normalized difference vegetation index, a model for converting satellite-based measurements into surface vegetation types. The NDVI uses a complex ratio of reflectance in the red and near-infrared portions of the spectrum to accomplish this. Reflectance in the red region decreases with increasing chlorophyll content of the plant canopy, while reflectance in the infrared increases with increasing wet plant biomass. This technique has been used most successfully with data from the AVHRR, and is actually used operationally to predict the degree of drought and potential famine in the Sahel region of Africa. It is a quantity that measures greenness and vigor of vegetation.
near infrared	Electromagnetic radiation with wavelengths from just longer than the visible (about 0.7 micrometers) to about two micrometers. See electromagnetic spectrum.
negative feedback	An interaction that reduces or dampens the response of the system in which it is incorporated.
NESDIS	National Environmental Satellite Data and Information Service. See National Oceanic and Atmospheric Administration.

net primary production (NPP)

Plants both take in and emit carbon dioxide. NPP is the net amount of CO2 taken in by vegetation in a particular area. It is an important element in the balance of carbon exchange between the Earth and the atmosphere. Two main processes are involved: Photosynthesis is the fundamental energy-gathering process of life: sunlight + carbon dioxide + water are transformed into organic carbon + oxygen. This occurs mainly in the leaves of terrestrial plants and in microscopic blue green algae in the ocean. Photorespiration (autotrophic respiration) takes place simultaneously, when plants are exposed to light; the plants take up oxygen from the air and release carbon dioxide. It takes place primarily when plants are exposed to light. In an unperturbed world, the balance between these two processes produces a net loss of carbon dioxide _ approximately enough to balance the carbon which is formed into soils and peat, plus the amount consumed in heterotrophic respiration (respiration by microbes, converting organic matter back into atmospheric CO2). The carbon balance can be changed considerably by human activities and land use changes, and by climate changes. Since the pools and fluxes are large (NPP 50-60 GtC per year), any perturbations that affect photosynthesis or photorespiration can have a significant effect on the atmospheric concentration of CO2.

Newton's law of universal gravitation

All bodies attract each other with what is called gravitational attraction. This applies to the largest stars as well as the smallest particles of matter.

The force of attraction between two small bodies (or between two spherical bodies of any size) is proportional to the product of their masses and inversely proportional to the square of the distance between their centers. In other words, the closer two bodies are to each other, the greater their mutual attraction. As a result, to stay in orbit, a satellite needs more speed in a low than a high orbit.

Kepler's three laws of planetary motion, which had been derived empirically by Johannes Kepler, were obtained with mathematical rigor as a consequence of Newton's law of universal gravitation in conjunction with his three laws of motion. See Kepler's three laws of motion.

Newton's laws of motion

Newton's three laws of motion are:

1. Every body continues in a state of uniform motion in a straight line unless acted upon by some external force.

2. The time rate of change of momentum (mass x velocity) is proportional to the impressed force. In the usual case where the mass does not change, this law can be expressed in the familiar form: force = mass x acceleration or F = ma.

3. To every force or action, there is always an equal and opposite reaction.

Kepler's three laws of planetary motion, which had been derived empirically by Johannes Kepler, were obtained with mathematical rigor as a consequence of Newton's law of universal gravitation in conjunction with his three laws of motion. See Kepler's three laws of motion.

NGDC

National Geophysical Data Center, located in Boulder, Colorado. See National Oceanic and Atmospheric Administration.

Nimbus Satellite Program

A NASA program to develop observation systems meeting the research and development requirements of atmospheric and Earth scientists. The Nimbus satellites, first launched in 1964, carried a number of instruments: microwave radiometers, atmospheric sounders, ozone mappers, the Coastal Zone Color Scanner (CZCS), infrared radiometers, etc. Nimbus-7, the last in the series, provided significant global data on sea-ice coverage, atmospheric temperature, atmospheric chemistry (i.e. ozone distribution), the Earth's radiation budget, and sea-surface temperature. See Total Ozone Mapping Spectrometer (TOMS).

nitrogen dioxide

A gas consisting of one atom of nitrogen and two atoms of oxygen.

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 (N2O)	A powerful greenhouse gas with a global warming potential of 320. Major sources of nitrous oxide include soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning.
NODC	National Oceanographic Data Center, located in Washington, D.C. See National Oceanic and Atmospheric Administration.
North Atlantic Oscillation (NAO)	A large see-saw in atmospheric mass between the subtropical high located near the Azores and the sub-polar low near Icealand. See Atlantic Rhythms
NRA	NASA Research Announcement.
NSF	National Science Foundation.
NSFNET	National Science Foundation NETwork.
obliquity	The angle between the plane of the Earth's orbit and the plane of the Earth's equator; the "tilt" of the Earth.
occluded front (occlusion)	A composite of two fronts formed as a cold front overtakes a warm front. A cold occlusion results when the coldest air is behind the cold front. The cold front undercuts the warm front and, at the Earth's surface, coldest air replaces less-cold air. A warm occlusion occurs when the coldest air lies ahead of the warm front. Because the cold front can not lift the colder air mass, it rides piggyback up on the warm front over the coldest air.
ocean	The salt water surrounding the great land masses. The land masses divide the ocean into several distinct portions, each of which also is called an ocean. The oceans include the Pacific Ocean, the Atlantic Ocean, the Indian Ocean, and the Arctic Ocean.
ocean color	The ability of phytoplankton to appear as different colors in certain bands of the electromagnetic spectrum because of their chlorophyll concentrations.

	By using instruments and satellite sensors that are more sensitive than the human eye, the fantastic array of colors of the ocean can be measured.
optical thickness (optical depth)	In calculating the transfer of radiant energy, the mass of an absorbing or emitting material lying in a vertical column of unit cross-sectional area and extending between two specified levels. Also, the degree to which a cloud prevents light from passing through it; the optical thickness then depends on the physical constitution (crystals, drops, and/or droplets), the form, the concentration, and the vertical extent of the cloud.
Optical Transient Detector (OTD)	The world's first space-based sensor capable of detecting and locating lightning events in the daytime as well as during the nighttime with high detection efficiency was designed and built at the NASA Marshall Space Flight Center (MSFC). The concept for this instrument was developed at MSFC in the 1980's, and was selected for development as part of NASA's Earth Observing System (EOS). The purpose of the sensor is to detect the full spectrum of lightning flashes, including cloud to ground, cloud to cloud, and intra-cloud (within cloud) lightning events. Ground-based techniques detect only cloud-to-ground lightning events which are believed to comprise 25% of the total lightning activity. In addition, these techniques generally detect lightning activity near land masses; very little information is provided regarding lightning events over the Earth's oceans. OTD is designed to aid scientists in determining the global distribution of lightning activity and thunderstorms and the characteristics of the Earth's electric circuit. See Data in a Flash
orbit	The path described by a heavenly body in its periodic revolution. Earth satellite orbits with inclinations near 0 degree are called equatorial orbits because the satellite stays nearly over the equator. Orbits with inclinations near 90 degrees are called polar orbits because the satellite crosses over (or nearly over) the north and south poles. See *orbital inclination.*
orbital plane	An imaginary gigantic flat plate containing an Earth satellite's orbit. The orbital plane passes through the center of the Earth.

organic

Chemistry: of or relating to any covalently bonded compound containing carbon atoms. *Biology*: relating to or involving an organism or organisms.

ozone

An almost colorless, gaseous form of oxygen with an odor similar to weak chlorine. A relatively unstable compound of three atoms of oxygen, ozone constitutes--on the average--less than one part per million (ppm) of the gases in the atmosphere (peak ozone concentration in the stratosphere can get as high as 10 ppm). Yet ozone in the stratosphere absorbs nearly all of the biologically damaging solar ultraviolet radiation before it reaches the Earth's surface where it can cause skin cancer, cataracts, and immune deficiencies, and can harm crops and aquatic ecosystems. See *ozone layer*.

Ozone is produced naturally in the middle and upper stratosphere through dissociation of molecular oxygen by sunlight. In the absence of chemical species produced by human activity, a number of competing chemical reactions among naturally occurring species--primarily atomic oxygen, molecular oxygen, and oxides of hydrogen and nitrogen--maintains the proper ozone balance. In the present-day stratosphere, this natural balance has been altered, particularly by the introduction of man-made chlorofluorocarbons. If the ozone decreases, the ultraviolet radiation at the Earth's surface will increase. See greenhouse gas

Tropospheric ozone is a by-product of the photochemical (light-induced) processes associated with air pollution. See photochemical smog. Ozone in the troposphere can damage plants and humans.

ozone hole

A large area of intense stratospheric ozone depletion over the Antarctic continent that typically occurs annually between late August and early October, and generally ends in mid-November. This severe ozone thinning has increased conspicuously since the late seventies and early eighties. This phenomenon is the result of chemical mechanisms initiated by man-made chlorofluorocarbons (see CFCs). Continued buildup of CFCs is expected to lead to additional ozone loss worldwide.

The thinning is focused in the Antarctic because of particular meteorological conditions there. During Austral spring (September and October in the

	Southern Hemisphere) a belt of stratospheric winds encircles Antarctica essentially isolating the cold stratospheric air there from the warmer air of the middle latitudes. The frigid air permits the formation of ice clouds that facilitate chemical interactions among nitrogen, hydrogen, and chlorine (elevated from CFCs) atoms, the end product of which is the destruction of ozone.
ozone layer	The layer of ozone that begins approximately 15 km above Earth and thins to an almost negligible amount at about 50 km, shields the Earth from harmful ultraviolet radiation from the sun. The highest natural concentration of ozone (approximately 10 parts per million by volume) occurs in the stratosphere at approximately 25 km above Earth. The stratospheric ozone concentration changes throughout the year as stratospheric circulation changes with the seasons. Natural events such as volcanoes and solar flares can produce changes in ozone concentration, but man-made changes are of the greatest concern.
ozone mini-hole(s)	Rapid, transient, polar-ozone depletion. These depletions, which take place over a 50-kilometer squared area, are caused by weather patterns in the upper troposphere. The decrease in ozone during a mini-hole event is caused by transport, with no chemical depletion of ozone. However, the cold stratospheric temperatures associated with weather systems can cause clouds to form that can lead to the conversion of chlorine compound from inert to reactive forms. These chlorine compounds can then produce longer-term ozone reductions after the mini-hole has passed.
ozone-measuring satellite instruments	Satellite-based ozone-measuring instruments can measure ozone by looking at the amount of ultraviolet absorption reflected from the Earth's surface and clouds. Some instruments provide data within the different levels of the atmosphere. The Total Ozone Mapping Spectrometer (TOMS) maps the total amount of ozone between ground and the top of the atmosphere. The amount and distribution of ozone molecules in the stratosphere varies greatly over the globe, changing in response to natural cycles such as seasons, sun cycles, and winds. Utilizing satellites has enabled scientists to assess ozone levels simultaneously over the entire

	Earth, and has led them to conclude that global ozone levels are being depleted.
Pacific Disaster Center	A Federal information processing center designed to provide value added information processing support to Federal, State, local, and regional emergency managers to support mitigation, preparation, response and recovery within the Pacific region. In addition, the PDC is being developed as an organizational and technological model for global, national, and local initiatives in disaster management. In particular, the PDC serves as a nodal model for the Global Disaster Information Network (GDIN) proposed by Vice President Gore. Currently, the area of operations of the PDC includes Hawaii, Alaska, and the pacific insular States of Guam, American Samoa, Marshall Islands, Northern Marianas, Palau, and Micronesia. Pacific Disaster Center web site
paleoclimate	Climate as it existed in the distant past, particularly before historical records.
paleoclimatology	The study of past climates, throughout geological history, and the causes of the variations among.
paleogeography	The study of ancient or prehistoric geography.
panchromatic	Sensitive to all or most of the visible spectrum.
parameter	A constant whose values determine the specific form or characteristics of an expression.
particulates	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.
parts per billion	A unit of measure used for very small quantities, it is equal to the ratio of the weight or volume of one component of a mixture to a billion weights or volumes of the mixture. When based on weight (ppbw), it is equal to the weight or mass of the component divided by the total weight or mass in a given volume, multiplied by one billion. When based on volume (ppbv) it is equal to the volume of the component divided by the total volume of the mixture,

	multiplied by one billion.
pascal (Pa)	Unit of atmospheric pressure named in honor of Blaise Pascal (1632-1662), whose experiments greatly increased knowledge of the atmosphere. A pascal is the force of one newton acting on a surface area of one square meter. It is the unit of pressure designated by the International System. 100,000 Pa = 1000 mb = 1 bar. See atmospheric pressure, millibar.
passive microwave	A system sensing only microwave radiation emitted by the object being viewed or reflected by the object from a source other than the system.
passive system	A system sensing only radiation emitted by the object being viewed or reflected by the object from a source other than the system. See active system.
payload	The instruments that are accommodated on a spacecraft.
perigee (aka periapsis or perifocus)	On an elliptical orbit path, the point where a satellite is closest to the Earth.
perihelion	The point in the orbit of a planet or comet which is nearest the Sun (as opposed to the aphelion, which is the point in the orbit farthest from the Sun).
period	1. Time required for a satellite to make one complete orbit. 2. A division of geologic time, delimited by full-scale withdrawal of the sea from land masses and by limited crustal, climatic, and volcanic upheaval in a localized area. Two or more periods are required to make up a geologic era, and each period is comprised of two or more geologic epochs.
period decay (aka decay)	The tendency of a satellite to lose orbital velocity due to the influence of atmospheric drag and gravitational forces. A decaying object eventually impacts the surface of the Earth or burns up in the atmosphere. This parameter directly affects the satellite's mean motion.

permafrost	Perennially frozen ground that occurs wherever the temperature remains below 0ø C for several years.
perturbations	Minor corrections to the Keplerian model of a satellite orbit as an ellipse of constant shape and orientation. Since satellite orbits are affected by Earth's gravity and drag caused by the Earth's atmosphere (causing satellites to spiral downward), minor adjustments must be made to the orbit.
pH	A symbol for the degree of acidity or alkalinity of a solution. Expressed as a negative logarithm of the hydrogen ion concentration in a solution, pH = -log10 [H+]. If the hydrogen ion concentration of a solution increases, the pH will decrease, and vice versa. The value for pure distilled water is regarded as neutral, pH values from 0 to 7 indicate acidity, and from 7 to 14 indicate alkalinity.
photochemical smog	A type of smog that forms in large cities when chemical reactions take place in the presence of sunlight, its principal component is ozone. Ozone and other oxidants are not emitted into the air directly but form from reactions involving nitrogen oxides and hydrocarbons. Because of its smog-making ability, ozone in the lower atmosphere (troposphere) is often referred to as 'bad' ozone.
photochemistry	The study of the impact of light on certain chemical molecules.
photodissociation	A chemical reaction involving sunlight in which molecules are split into their constituent atoms. Also known as photolysis.
photon	A quantum (smallest unit in which waves may be emitted or absorbed) of light.
photoreceptor	A sensor sensitive to light.
photosynthesis	The process by which green plants use light to synthesize organic compounds from carbon dioxide and water. In the process oxygen and water are released. Increased levels of carbon dioxide can increase net photosynthesis in some plants. Plants create a very important reservoir for carbon dioxide.

photosynthetically active radiation	Electromagnetic radiation in the part of the spectrum used by plants for photosynthesis.
physical climate system	The system of processes that regulate climate, including atmospheric and ocean circulation, evaporation, and precipitation.
physics	The scientific study of matter, energy, motion, and force. (From a Greek term meaning "the science of nature.")
phytoplankton	Microscopic marine organisms (mostly algae and diatoms) which are responsible for most of the photosynthetic activity in the oceans.
pixel	'Picture element' is the ground area corresponding to a single element of a digital image data set.
planetary albedo	The fraction of incident solar radiation that is reflected by a planet and returned to space. The planetary albedo of the Earth-atmosphere system is approximately 30 percent, most of which is due to backscatter from clouds in the atmosphere.
planetary boundary layer	the turbulent layer of atmosphere occupying the lowest few hundred meters of the atmosphere.
planetesimals	small bodies that formed from the solar nebula
plasma	A fourth state of matter (in addition to solid, liquid, and gas) that exists in space. In this state, atoms are positively charged and share space with free negatively charged electrons. Plasma can conduct electricity and interact strongly with electric and magnetic fields. The solar wind is actually hot plasma blowing from the sun. See magnetosphere.
plate tectonics	Concept that the Earth's crust is composed of rigid plates that move over a less rigid interior.
platforms	A satellite that can carry instruments. See bus. The same term is applied to automatic weather data transmitters installed on buoys, balloons, ships, and planes, and mounted in remote areas.
POES (Polar-orbiting	Operated by the National Oceanic and Atmospheric

Operational Environmental Satellite)	Administration, they are designated 'NOAA satellites.' Included in this group are the current series of TIROS-N satellites, the third-generation polar-orbiting environmental spacecraft operated by NOAA.
polar orbit	An orbit with an orbital inclination of near 90 degrees where the satellite ground track will cross both polar regions once during each orbit. The term is used to describe the near-polar orbits of spacecraft such as the USA's NOAA/TIROS and Landsat satellites.
polar stratospheric clouds (PSCs)	High altitude clouds that form in the stratosphere above Antarctica during the Southern Hemisphere winter. Their presence seems to initiate the ozone loss experienced during the ensuing Southern Hemisphere spring.
polar vortex	A circumpolar wind circulation which isolates the Antarctic continent during the cold Southern Hemisphere winter, heightening ozone depletion.
pollutant	Strictly, too much of any substance in the wrong place or at the wrong time is a pollutant. More specifically, atmospheric pollution may be defined as the presence of substances in the atmosphere, resulting from man-made activities or from natural processes that cause adverse effects to human health, property, and the environment.
polynya	An area of open sea surrounded by ice.
positive feedback	An interaction that amplifies the response of the system in which it is incorporated.
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	Moisture that falls from clouds. Although clouds appear to float in the sky, they are always falling, their water droplets slowly being pulled down by gravity. Because their water droplets are so small and light, it can take 21 days to fall 1,000 feet and wind currents

can easily interrupt their descent. Liquid water falls as rain or drizzle. All raindrops form around particles of salt or dust. (Some of this dust comes from tiny meteorites and even the tails of comets.) Water or ice droplets stick to these particles, then the drops attract more water and continue getting bigger until they are large enough to fall out of the cloud. Drizzle drops are smaller than raindrops. In many clouds, raindrops actually begin as tiny ice crystals that form when part or all of a cloud is below freezing. As the ice crystals fall inside the cloud, they may collide with water droplets that freeze onto them. The ice crystals continue to grow larger, until large enough to fall from the cloud. They pass through warm air, melt, and fall as raindrops.

When ice crystals move within a very cold cloud (10 degrees F and -40 degrees F) and enough water droplets freeze onto the ice crystals, snow will fall from the cloud. If the surface temperature is colder than 32 degrees F, the flakes will land as snow.

Precipitation Weights:

one raindrop .000008 lbs

one snowflake .0000003 lbs

one cumulus cloud 10,000,000 lbs

one thunderstorm 10,000,000,000 lbs

one hurricane 10,000,000,000,000 lbs

prevailing westerlies Winds in the middle latitudes (approximately 30 degrees to 60 degrees) that generally blow from west to east. The subtropical high pressure regions at the horse latitudes (30 degrees) forces surface air poleward, and the rotation of the Earth causes these winds to bear to the right (east) in the Northern Hemisphere and to the left (east) in the Southern Hemisphere (see Coriolis force). This is, to some extent, an idealized picture of the atmospheric circulation. The actual circulation on individual days includes modifications and variations due to the migratory cyclones and anticyclones of middle latitudes, causing rapid and often violent weather changes, as warm semi-tropical air from the horse latitudes meets cold polar air from the high latitudes.

primary productivity The rate at which new plant biomass is formed by photosynthesis. Gross primary productivity is the total rate of photosynthetic production of biomass; net primary productivity is gross primary productivity minus the respiration rate.

process An association of phenomena governed by physical, chemical, or biological laws. An example of a process is the vertical mixing of ocean waters in the so-called surface-mixed layer; the state variables for this process include temperature, salinity in the water on a vertical scale of tens of meters, and heat flow and wind stress at the sea surface. Other examples include the volcanic deposition of dust and gases into the atmosphere, eddy formation in the atmosphere and oceans, and soil development.

process study An organized, systematic investigation of a particular process designed to identify all of the state variables involved and to establish the relationships among them. Process studies yield numerical algorithms that connect the state variables and determine their rates of change; such algorithms are essential ingredients of Earth system models.

prograde orbit Orbits of the Earth in the same direction as the rotation of the Earth (west-to-east).

psychrometer An instrument designed to measure dew point and relative humidity, consisting of two thermometers (one dry bulb and one wet bulb). The dew point and humidity levels are determined by drying the wet bulb (either by fanning or whirling the instrument) and comparing the difference between the wet and dry bulbs with preexisting calculations. See hygrometer.

pycnocline In the ocean, a region where the water density increases rapidly with depth.

pyrogenic Resulting from fire activities. Usually used in the context of emissions that are produced by fires -- e.g., smoke from fires.

QuikSCAT A NASA satellite that is providing climatologists, meteorologists and oceanographers with daily, detailed snapshots of the winds swirling above the

	world's oceans. QuikSCAT carries a state-of-the-art radar instrument called a scatterometer. Known as "SeaWinds," this scatterometer operates by transmitting high-frequency microwave pulses to the ocean surface and measuring the "backscattered" or echoed radar pulse bounced back to the satellite. The instrument senses ripples caused by winds near the ocean's surface, from which scientists can compute the winds' speed and direction. The instruments can acquire hundreds of times more observations of surface wind velocity each day than can ships and buoys, and are the only remote-sensing systems able to provide continuous, accurate and high-resolution measurements of both wind speeds and direction regardless of weather conditions. The instrument is currently collecting data over ocean, land, and ice in a continuous 1,800-kilometer-wide band, making approximately 400,000 measurements and covering 90% of Earth's surface each day. See QuikSCAT fact sheet.
R&D	Research and Development.
radar interferometry	The study of interference patterns caused by radar signals; a technique that enables scientists to generate three dimensional images of the Earth's surface.
radiant	1. In optics, the point or object from which light proceeds. 2. In geometry, a straight line proceeding from a given point, or fixed pole, about which it is conceived to revolve. 3. In astronomy, the point in the heavens from which a shower of meteors seems to proceed.
radiation	Energy transfer in the form of electromagnetic waves or particles that release energy when absorbed by an object.
radiation budget	A measure of all the inputs and outputs of radiative energy relative to a system, such as Earth. See Earth Radiation Budget Experiment.
radiative cooling	Cooling process of the Earth's surface and adjacent air, which occurs when infrared (heat) energy radiates from the surface of the Earth upward through the atmosphere into space. Air near the surface transfers its thermal energy to the nearby ground through conduction, so that radiative cooling lowers the

temperature of both the surface and the lowest part of the atmosphere.

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

radiative transfer Theory dealing with the propagation of electromagnetic radiation through a medium.

radio spectrum The complete range of frequencies or wave lengths of electromagnetic waves, specifically those used in radio and television.

radio wave An electrical impulse sent through the atmosphere at radio frequency.

radioactive Giving off or capable of giving off radiant energy in the form of particles or rays, as in alpha, beta, and gamma rays.

radiometer An instrument that quantitatively measures electromagnetic radiation. Weather satellites carry radiometers to measure radiation from snow, ice, clouds, bodies of water, the Earth's surface, and the sun.

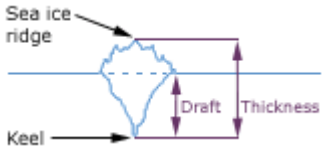
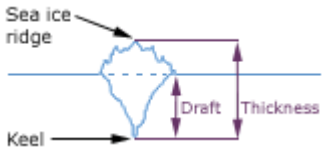
radiosonde A balloon-borne instrument that measures meteorological parameters from the Earth's surface up to 20 miles in the atmosphere. The radiosonde measures temperature, pressure, and humidity, and transmits or 'radios' these data back to Earth. Upper air winds also are determined through tracking of the balloon ascent.

Radiosonde observations generally are taken twice a day (0000 and 1200 UTC) around the globe. NOAA's National Weather Service (NWS) operates a network of about 90 radiosonde observing sites in the U.S. and its territories. When the balloons burst, radiosondes

	return to Earth on a parachute. Approximately 25 percent are recovered and returned to NWS for reconditioning and reuse.
rain forest	An evergreen woodland of the tropics distinguished by a continuous leaf canopy and an average rainfall of about 100 inches per year. Rain forests play an important role in the global environment. The Earth sustains life because of critical balances and interactions among many factors. Were there not processes at work that limit the effects of other essential processes, Earth would become uninhabitable. Destruction of tropical rain forests reduces the amount of leaf area in the tropics, and consequently the amount of carbon dioxide absorbed, causing increases in levels of carbon dioxide and other atmospheric gases. It is estimated that cutting and burning of tropical forests contributes about 20 percent of the carbon dioxide added to the atmosphere each year. The World Resources Institute and the International Institute for Environment and Development have reported that the world's tropical forests are being destroyed at the rate of fifty-four acres per minute, or twenty-eight million acres lost annually. Rain forest destruction also means the loss of a wide spectrum of biological life, erosion of soil, and possible desertification.
rain gauge	Calibrated container that measures the amount of rainfall during a specific period of time.
real time	As it happens.
reflection	The return of light or sound waves from a surface. If a reflecting surface is plane, the angle of reflection of a light ray is the same as the angle of incidence.
relative humidity	The ratio of the amount of water vapor in the air compared to the amount required for saturation (at a particular temperature and pressure).
remote sensing	The technology of acquiring data and information about an object or phenomena by a device that is not in physical contact with it. In other words, remote sensing refers to gathering information about the Earth and its environment from a distance, a critical capability of the *Earth Observing System.*

	For example, spacecraft in low-Earth orbit pass through the outer thermosphere, enabling direct sampling of chemical species there. These samples have been used extensively to develop an understanding of thermospheric properties. Explorer-17, launched in 1963, was the first satellite to return quantitative measurements of gaseous stratification in the thermosphere. However, the mesosphere and lower layers cannot be probed directly in this way--global observations from space require remote sensing from a spacecraft at an altitude well above the mesopause. The formidable technological challenges of atmospheric remote sensing, many of which are now being overcome, have delayed detailed study of the stratosphere and mesosphere by comparison with thermospheric research advances. Some remote-sensing systems encountered in everyday life include the human eye and brain, and photographic and video cameras.
resolution	A measure of the ability to separate observable quantities. In the case of imagery, it describes the area represented by each pixel of an image. The smaller the area represented by a pixel, the more accurate and detailed the image.
respiration	The process by which animals use up stored foods (by combustion with oxygen) to produce energy.
retrograde orbit	An east-to-west orbit of Earth (Earth spins west to east). See prograde orbit.
revolution	Process of the Earth circling the sun in its orbit. Revolution determines the seasons, and the length of the year. In addition, differences in seasons occur because of Earth's inclination (tilt on its axis) of about 23.5 degrees as it revolves around the sun. Compare with rotation.
rotation	Process of the Earth turning on its axis. Rotation determines day and night, and the length of the day. Compare with revolution.
S-band	A nominal frequency range from 4 to 2 GHz (7 to 20 cm wavelength) within the microwave (radar) portion of the electromagnetic spectrum. S-band radars are used for medium-range meteorological applications,

	for example rainfall measurements, as well as airport surveillance and specialized tracking tasks.
sahel	The transition zone in Africa between the Sahara Desert to the north and tropical forests to the south. This dryland belt stretches across Africa and is under stress from land use and climate variability.
salinity	The degree of salt in water. The rise in sea level due to global warming would result in increased salinity of rivers, bays and aquifers. This would affect drinking water, agriculture and wildlife.
sampling	The process of obtaining a sequence of discrete digital values from a continuous sequence of analog data.
satellite	A free-flying object that orbits the Earth, another planet, or the sun.
satellite revolution	The time from one perigee (the point of an elliptical orbit path where a satellite is closest to Earth) to the next.
savanna	One of the Earth's biomes characterized by an extensive cover of grasses with scattered trees. The savanna biome is a transitional biome between those dominated by forests and those dominated by grasses and is associated with climates having seasonal precipitation accompanied with a seasonal drought.
scanning radiometer	An imaging system consisting of lenses, moving mirrors, and solid-state image sensors used to obtain observations of the Earth and its atmosphere. Scanning radiometers, which are the sole imaging systems on all current operational weather satellites, have far better long-term performance than the vidicon TV camera tubes used with earlier spacecraft.
scattering	The process by which electromagnetic radiation interacts with and is redirected by the molecules of the atmosphere, ocean, or land surface. The term is frequently applied to the interaction of the atmosphere on sunlight, which causes the sky to appear blue (since light near the blue end of the spectrum is scattered much more than light near the red end).
scatterometer	A high-frequency radar instrument that transmits

	pulses of energy towards the ocean and measures the backscatter from the ocean surface. It detects wind speed and direction over the oceans by analyzing the backscatter from the small wind-induced ripples on the surface of the water.
scene	Object space illuminated by a sensor.
sea breeze	Local coastal wind that blows from the ocean to land. Sea breezes usually occur during the day, because the heating differences of land and sea cause pressure differences. Cooler, heavier air from the sea moves in to replace rising warm air on the coastline. See land breeze
sea ice draft	The height of sea ice from the keel (the lowest point underwater) to the water surface. 
sea ice thickness	The height of sea ice from the keel (the lowest point underwater) to the ridge (the highest point above water). 
sea level	The datum against which land elevation and sea depth are measured. Mean sea level is the average of high and low tides.
sea surface temperature (SST)	The temperature of the layer of seawater (approximately 0.5 m deep) nearest the atmosphere.
sea surface temperature anomaly	Temperature of emitted energy from the sea surface. SST anomaly = (SST - SST mean), where SST = sea surface temperature.
Sea-viewing Wide Field-of-View Sensor (SeaWiFS)	SeaWiFS is an ocean color sensor to study ocean productivity and interactions between the ocean ecosystems and the atmosphere. See SeaWIFS Web Site.

sensible heat The excess radiative energy that has passed from the Earth's surface to the atmosphere through advection, conduction, and convection processes.

sensor Device that produces an output (usually electrical) in response to stimulus such as incident radiation. Sensors aboard satellites obtain information about features and objects on Earth by detecting radiation reflected or emitted in different bands of the electromagnetic spectrum. Analyzing the transmitted data provides valuable scientific information about Earth.

Weather satellites commonly carry radiometers, which measure radiation from snow, ice, clouds, and bodies of water. Spaceborne radars are used for Earth observations, bouncing radar waves off land and ocean surfaces to study sea-surface conditions, ice thickness, and land surface features. A wind scatterometer is a special type of radar designed to measure ocean surface winds indirectly by bouncing signals off the water and measuring them from various angles. Infrared (IR) detectors measure heat generated by Earth features in the IR band of the spectrum.

Photographic reconnaissance sensors in their simplest form are large telescope-camera systems used to view objects on Earth's surface. The bigger the lens, the smaller the object that can be detected. Camera-telescope systems now incorporate all sorts of sophisticated electronics to produce better images, but even these systems need cloudless skies, excellent lighting, and good color contrast between objects and their surroundings to detect objects the size of a basketball. Some of the satellites produce film images that must be returned to Earth, but a more convenient method is to record the image as a series of digital code numbers, then reconstruct the image from the electronic code using a computer at a ground station.

sensor calibration The relationship between input and output for a given measurement.

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

Shuttle Radar Topography Mission A NASA Space Shuttle mission that used C-band and X-band interferometric synthetic aperture radars

(SRTM)	(IFSARs) to acquire topographic data over 80% of Earth's land mass (between 60degN and 56degS) between February 11-22, 2000. SRTM web site
sine wave	A smoothly varying wave that repeats itself; its frequency is the rate at which the fundamental shape repeats itself. Any waveform can be distilled into a combination of pure sine waves of varying frequencies and amplitudes.
sink	The process of providing storage for a substance. For example, plants--through photosynthesis--transform carbon dioxide in the air into organic matter, which either stays in the plants or is stored in the soils. The plants are a sink for carbon dioxide.
smog	This is a term used to describe a mixture of smoke and fog. Smog occurs when high concentrations of moisture is combined with smoke (often containing oxides of sulfur and nitrogen) in the presence of high temperatures or thermal inversions and the absence of wind. These conditions cause polluted air to stagnate over industrial areas and can create a respiratory health hazard. Large coastal industrial centers with surrounding high ground are more prone to smog. There is often a diurnal (over a day) variation in the process of smog formation because one of the necessary components for its formation is sunlight.
solar backscatter ultraviolet radiometer (SBUV)	Instrument that measures the vertical distribution and total ozone in the Earth's atmosphere. Data is used for the continuous monitoring of ozone distribution to estimate long-term trends. SBUV instruments are flown on *NOAA polar-orbiting satellites.*
solar constant	Aka total solar irradiance. The constant expressing the amount of solar radiation reaching the Earth from the sun, approximately 1370 watts per square meter. It is not, in fact, truly constant and variations are detectable.
solar cycle	Eleven-year cycle of sunspots and solar flares that affects other solar indexes such as the solar output of ultraviolet radiation and the solar wind. The Earth's magnetic field, temperature, and ozone levels are affected by this cycle.

solar maximum The point in the 11-year solar cycle at which sunspot activity is highest.

solar minimum The point in the 11-year solar cycle at which sunspot activity is lowest.

solar radiation Energy received from the sun is solar radiation. The energy comes in many forms, such as visible light (that which we can see with our eyes). Other forms of radiation include radio waves, heat (infrared), ultraviolet waves, and x-rays. These forms are categorized within the electromagnetic spectrum.

solar wind A continuous plasma stream expanding into interplanetary space from the sun's corona. The solar wind is present continuously in interplanetary space. After escaping from the gravitational field of the sun, this gas flows outward at a typical speed of 400 km per second to distances known to be beyond the orbit of Pluto. Besides affecting Earth's weather, solar activity gives rise to a dramatic visual phenomena in our atmosphere. The streams of charged particles from the Sun interact the Earth's magnetic field like a generator to create current systems with electric potentials of as much as 100,000 volts. Charged electrons are energized by this process, sent along the magnetic field lines towards Earth's upper atmosphere, excite the gases present in the upper atmosphere and cause them to emit light which we call the auroras. The auroras are the northern (aurora borealis) and southern (aurora Australis) lights.

sounder A special kind of radiometer that measures changes in atmospheric temperature with height, as well as the content of various chemical species in the atmosphere at various levels. The High Resolution Infrared Radiation Sounder (HIRS), found on NOAA polar-orbiting satellites, is a passive instrument. See passive system.

southern oscillation A large-scale atmospheric and hydrospheric fluctuation centered in the equatorial Pacific Ocean. It exhibits a nearly annual pressure anomaly, alternatively high over the Indian Ocean and high over the South Pacific. Its period is slightly variable, averaging 2.33 years. The variation in pressure is accompanied by variations in wind strengths, ocean currents, sea-surface temperatures, and precipitation in

	the surrounding areas. El Niño and La Niña occurrences are associated with the phenomenon.
spatial	A characteristic that refers to a location (which may be a specific location on the Earth's surface, or relative to an arbitrary point).
spectral band	A finite segment of wavelengths in the electromagnetic spectrum.
spectral signature	This refers to the particular form or shape evinced by the power spectrum calculated from the data comprising the time series of a process.
spectrophotometer	A device for measuring the relative amounts of radiant energy or radiant flux as a function of wavelength.
spectrum	1. The series of colored bands diffracted and arranged in the order of their respective wave lengths by the passage of white light through a prism or other diffracting medium and shading continuously from red (produced by the longest visible wave) to violet (produced by the shortest visible wave). 2. Any of various arrangements of colored bands or lines, together with invisible components at both ends of the spectrum, similarly formed by light from incandescent gases or other sources of radiant energy, which can be studied by a spectrograph. 3. In radio, the range of wave lengths of radio waves, from 3 centimeters to 30,000 meters, or of frequencies of radio waves, from 10 to 10,000,000 kilocycles. Also radio spectrum. 4. The entire range of radiant energies. See electromagnetic spectrum.
SPOT	Systeme Pour l'Observation de la Terre. French, polar-orbiting Earth observation satellite(s) with ground resolution of 10 meters. SPOT images are available commercially and are intended for such purposes as environmental research and monitoring, ecology management, and for use by the media, environmentalists, legislators, etc.
Stennis Space Center	The John C. Stennis Space Center (SSC), located on

(SSC)	Mississippi's Gulf Coast, is NASA's prime test facility for large liquid propellant rocket engines and propulsion systems. The main mission of the Center is to support testing, on a regular basis, of the Space Shuttle's main propulsion system. SSC is responsible for a variety of research programs in the environmental sciences and the remote-sensing of Earth resources, weather, and oceans, and is the lead NASA Center for the commercialization of space remote sensing. SSC Web Site
stratocumulus	Low altitude gray colored clouds composed of water droplets that have a patchy appearance. Each cloud patch consists of a rounded mass. This cloud has a somewhat uniform base and normally covers the entire sky. Between the patches blue sky can be seen.
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.
Stratospheric Aerosol & Gas Experiment (SAGE)	A NASA experiment to determine the vertical distribution of stratospheric aerosols, ozone, nitrogen oxide, and water vapor on a global scale and to develop a viable, satellite-based, remote sensing technique to measure these gases. SAGE III web site
subduction	a process in which one lithospheric plate descends beneath another, often as a result of folding or faulting
subsatellite point	Point where a straight line drawn from a satellite to the center of the Earth intersects the Earth's surface.
subsidence	In weather forecasting terminology, this term refers to sinking motions of air masses. It could also refer to sinking motions within fluids or bodies of water.
subtropical	Generally the part of the Earth's surface between the tropics and the temperate regions, or between about 40 degrees N. and S.

sulfate aerosol

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). Global Climate Models which incorporate the effects of sulfate aerosols more accurately predict global temperature variations.

sulfur dioxide (SO2)

A compound composed of one sulfur and two oxygen molecules. 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 result in negative radiative forcing (i.e., tending to cool the Earth's surface).

Sun

The closest star to Earth (149,599,000 km away on average). The sun dwarfs the other bodies in the solar system, representing approximately 99.86 percent of all the mass in the solar system. One hundred and nine Earths would be required to fit across the Sun's disk, its interior could hold over 1.3 million Earths.

The source of the Sun's energy is the nuclear reactions that occur in its core. There, at temperatures of 15 million degrees Celsius (27 million degrees Fahrenheit) hydrogen atom nuclei, called protons, are fused and become helium atom nuclei. The energy produced through fusion at the core moves outward, first in the form of electromagnetic radiation called photons. Next, energy moves upward in photon heated solar gas--this type of energy transport is called convection. Convective motions within the solar interior generate magnetic fields that emerge at the surface as sunspots and loops of hot gas called prominences. Most solar energy finally escapes from a thin layer of the Sun's atmosphere called the photosphere--the part of the Sun observable to the naked eye.

The sun appears to have been active for 4.6 billion years and has enough fuel for another 5 billion years or so. At the end of its life, the Sun will start to fuse helium into heavier elements and begin to swell up,

	ultimately growing so large that it will swallow Earth. After a billion years as a 'red giant,' it will suddenly collapse into a 'white dwarf.' It may take a trillion years to cool off completely.
sun-synchronous	Describes the orbit of a satellite that provides consistent lighting of the Earth-scan view. The satellite passes the equator and each latitude at the same time each day. For example, a satellite's sun-synchronous orbit might cross the equator twelve times a day, each time at 3:00 p.m. local time. The orbital plane of a sun-synchronous orbit must also precess (rotate) approximately one degree each day, eastward, to keep pace with the Earth's revolution around the sun.
sunphotometer	A device that measures the properties of light emanating from the sun.
sunspot	A region on the surface (photosphere) of the sun that is temporarily cool and dark compared to surrounding areas. See Sunspots and the Solar Max and ACRIMSAT fact sheet
surface air temperature	The temperature of the air near the surface of the Earth, usually determined by a thermometer in an instrument shelter about 2 m above the ground. The true daily mean, obtained from a thermograph, is approximated by the mean of 24 hourly readings and may differ by 1.0 degrees C from the average based on minimum and maximum readings. The global average surface air temperature is 15 degrees C.
swath	The area observed by a satellite as it orbits the Earth.
synoptic chart	Chart showing meteorological conditions over a region at a given time; weather map.
synoptic view	The ability to see large areas at the same time.
synthetic aperture radar (SAR)	A high-resolution ground-mapping technique that effectively synthesizes a large receiving antenna by processing the phase of the reflected radar return. The along-track resolution is obtained by timing the radar return (time-gating) as for ordinary radar. The cross-track (azimuthal) resolution is obtained by processing the Doppler phase of the radar return. The cross-track

	'dimension' of the antenna is a function of the length of time over which the Doppler phase is collected. See Doppler effect.
taiga	The open northern part of the boreal forest. It consists of open woodland of coniferous trees growing in a rich floor of lichen, and is generally cold and swampy.
tectonic	Corresponding with the broad architecture of the outer part of the Earth
telemetry	A space-to-ground data stream of measured values (including instrument science data, instrument engineering data, and spacecraft engineering data) that does not include command, tracking, computer memory transfer, audio, or video signals.
Television and Infrared Observation Satellite (TIROS)	Television and Infrared Observation Satellite (TIROS) A series of NASA and NOAA satellites launched to monitor Earth's weather from outer space. The era of the meteorological satellites began with the launch of TIROS-1 on April 1, 1960. For the first time, it was possible to monitor weather conditions over most of the world regularly from space. A series of these satellites were launched throughout the 1960s, those funded by NASA for research and development were called TIROS, and those funded by the Environmental Science Services Administration (ESSA, the predecessor of NOAA) for the operational system were called ESSA. A second generation of ITOS/NOAA* environmental satellites was initiated by the launch of ITOS-1 in 1970, followed by a number of NOAA satellites. The third generation of TIROS-N/NOAA environmental satellites was initiated by the launch of TIROS-N in 1978. * Pairs of acronyms such as ITOS/NOAA arise because NASA funds and names its prototype satellites and then the operating agency funds and names the rest of the series.
temperate	Region in which the climate undergoes seasonal change in temperature and moisture. Temperate regions of the earth lie primarily between 30 and 60 degrees latitude in both hemispheres.

temperature	A measure of the energy in a substance. The more heat energy in the substance, the higher the temperature. The Earth receives only one two-billionth of the energy the sun produces. Much of the energy that hits the Earth is reflected back into space. Most of the energy that isn't reflected is absorbed by the Earth's surface. As the surface warms, it also warms the air above it.
temporal	A characteristic that refers to the time at which a given data set was acquired.
terminus (of a glacier)	The end, or foot, of a glacier.
Terra	The flagship of the Earth Observing System, a series of spacecraft that represent the next landmark steps in NASA's leadership role to observe the Earth from the unique vantage point of space. Focused on key measurements identified by a consensus of U.S. and international scientists, Terra will enable new research into the ways that Earth's lands, oceans, air, ice, and life function as a total environmental system. See Terra website.
terrestrial radiation	The total infrared radiation emitted by the Earth and its atmosphere in the temperature range of approximately 200-300K. Because the Earth is nearly a perfect radiator, the radiation from its surface varies as the fourth power of the surface's absolute temperature. Terrestrial radiation provides a major part of the potential energy changes necessary to drive the atmospheric wind system and is responsible for maintaining the surface air temperature within limits for livability.
thematic mapper (TM)	A Landsat multispectral scanner designed to acquire data to categorize the Earth's surface. Particular emphasis was placed on agricultural applications and identification of land use. The scanner continuously scans the surface of the Earth, simultaneously acquiring data in seven spectral channels. Overlaying two or more bands produces a false color image. The ground resolution of the six visible and shortwave bands of the Thematic Mapper is 30 meters, and the resolution of the thermal infrared band is 120 meters. Thematic mappers have been flown on Landsats-4 and -5.

theorem	The last statement of a formal proof; a mathematical assertion that can be proven.
theory	An explanation for some phenomenon that is based on observation, experimentation, and reasoning.
thermal	Of, making use of, producing, or caused by heat.
thermal infrared	Electromagnetic radiation with wavelengths between about 3 and 25 micrometers.
thermocline	A transition layer of water in the ocean, with a steeper vertical temperature gradient than that found in the layers of ocean above and below. The permanent thermocline separates the warm mixed surface layer of the ocean from the cold deep ocean water, and is found between 100- and 1000-m depths. The thermocline first appears at the 55(em60ø N and S latitudes, where it forms a horizontal separation between temperate and polar waters. The thermocline reaches its maximum depth at mid-latitudes and is shallowest at the equator and at its northern and southern limits. The thermocline is stably stratified, and transfer of water and carbon dioxide across this zone occurs very slowly. Thus, the thermocline acts as a barrier to the downward mixing of carbon dioxide.
thermodynamic	The science of heat and temperature and of the laws governing the conversion of heat into mechanical, electrical, or chemical energy.
thermohaline	Refers to the combined effects of temperature and salinity that contribute to density variations in the oceans.
thermosphere	The outermost shell of the atmosphere, between the mesosphere and outer space; where temperatures increase steadily with altitude.
thunder	The sound that results from lightning. Lightning bolts (static electricity) produce intense heat. This burst of heat makes the air around the bolt expand explosively, producing the sound we hear as thunder. Since light travels faster than sound, we see the lightning before we hear the thunder.

thunderstorm

Local storm resulting from warm humid air rising in an unstable environment. Air may start moving upward because of unequal surface heating, the lifting of warm air along a frontal zone, or diverging upper-level winds (these diverging winds draw air up beneath them). The scattered thunderstorms that develop in the summer are called air-mass thunderstorms because they form in warm, maritime tropical air masses away from other weather fronts. More violent severe thunderstorms form in areas with a strong vertical wind shear that forces the updraft into the mature stage, the most intense stage of the thunderstorm. Severe thunderstorms can produce large hail, forceful winds, flash floods, and tornadoes.

TIROS-N/NOAA satellites

NOAA satellites that continuously orbit the Earth from North to South Pole (hence, polar orbiting) at an altitude of approximately 470 nautical miles (870.44 km or 540.86 statute miles). These environmental satellites collect visible and infrared imagery and provide atmospheric-sounding data and meteorological data relay and collection. A primary mission of TIROS-N/NOAA is to monitor the 70 percent of the globe covered by water-where weather data is sparse and provide continuous data to the National Weather Service for use in numerical forecast modeling. Each TIROS-N/NOAA carries six primary systems:

1. The Advanced Very High Resolution Scanning Radiometer (AVHRR) senses clouds over both ocean and land, using the visible and infrared parts of the spectrum. It stores measurements on tape, and later plays them back to NOAA's command and data acquisition stations. The satellites also broadcast in real time, and the broadcasts can be received around the world by anyone equipped with a direct readout receiving station.

2. The TIROS Operational Vertical Sounder (TOVS) is a 3-part TIROS system to measure:

* Temperature profile of the Earth's atmosphere from the surface to 10 millibars;

* Water content of the Earth's atmosphere;

* Total ozone content of the Earth's atmosphere;

3. The ARGOS Data Collection and Platform

Location System **(DCS)** collects data from sensors placed on fixed and moving platforms, including ships, buoys, and weather balloons, and transmits data to a ground station antenna. Because ARGOS also determines the precise location of these moving sensors, it can serve wildlife managers by monitoring and tracking the transmitters placed on birds and animals.

4. The Space Environment Monitor (SEM) measures energetic particles emitted by the sun over essentially the full range of energies and magnetic field variations in the Earth's near-space environment. Readings made by these instruments are invaluable in measuring the sun's radiation activity.

5. Search and Rescue Tracking **(COSPAS/SARSAT)** equipment receives emergency signals from persons in distress. The satellites transmit the signals to ground receiving stations. The signals then are forwarded to rescue coordination centers. The rescue centers compute the location of the signals and provide the coordinates of the emergency site (usually within a few miles).

6. Earth Radiation Budget Experiment (ERBE) is a radiometer, flown on NOAA 9 and 10, designed to measure all radiation striking and leaving the Earth. This enables scientists to measure the loss or gain of terrestrial energy to space. Shifts in this energy 'budget' affect the Earth's average temperatures. Even slight changes can affect climatic patterns.

TOPEX/POSEIDON Ocean Topography Experiment, United States (NASA)/France (CNES). Launched in 1992, the mission carries a radar sensor--called an altimeter--to measure the ocean's surface topography with unprecedented precision. TOPEX/POSEIDON is a core element of the international World Ocean Circulation Experiment (WOCE) and the Tropical Ocean Global Atmosphere (TOGA) seagoing measurements program. Mission objectives are to:

* Study ocean circulation and its interaction with the atmosphere to understand climate change better;

* Improve our knowledge of heat transport in the ocean;

* Model global ocean tides;

* Study the marine gravity field;

* Calculate sea-level variations on both global and local scales.

See TOPEX/POSEIDON website

topography

The technique of graphically representing the exact physical features of a place or region on a map. The physical features of a place or region.

tornado

A twisting, spinning funnel of low pressure air. The most unpredictable weather event, tornadoes are created during powerful thunderstorms. As a column of warm air rises, air rushes in at ground level and begins to spin. If the storm gathers energy, a twisting, spinning funnel develops. Because of the funnel's cloud and rain composition and the dust, soil, and debris it draws up, the funnel appears blackish in color. The most energetic storms result in the funnel touching the ground. In these tornadoes, the roaring winds in the funnel can reach 300 mph, the strongest winds on Earth. Funnels usually travel at 20 to 40 mph, moving toward the northeast. When tornadoes form over lakes or oceans they suck water into the funnel cloud and are called waterspouts.

Total Ozone Mapping Spectrometer (TOMS)

Flown on NASA's Nimbus-7 satellite, its primary goal is to continue the high-resolution global mapping of total ozone on a daily basis. The Nimbus-7 launch in 1978 enabled TOMS to begin delivering data in 1979 and continue providing information until 1993. TOMS has mapped the total amount of ozone between the ground and the top of the atmosphere, provided the first maps of the ozone hole, and continues to monitor this phenomenon.

Because of its longevity, TOMS also has obtained information on the more subtle trends in ozone outside the ozone hole region. This results from development of a powerful new calibration technique that removes the instrument measurement drift that developed over the years. With this technique applied to the TOMS 14.5-year data record, a global ozone decrease of 2.69 percent per decade was detected.

To ensure that ozone data will be available through the next decade, NASA will continue the TOMS program

	using U.S. and foreign launches. In 1991, the former Soviet Union launched a Meteor-3 satellite carrying a TOMS instrument provided by NASA. A third TOMS will be launched onboard a NASA Earth probe satellite in 1994, and the Japanese Advanced Earth Observations Satellite (ADEOS) will carry a fourth TOMS when it launches in 1996.
total solar irradiance	The amount of solar energy hitting the top of the Earth's atmosphere, currently accepted to be about 1,368 watts per square meter.
TOVS	TIROS Operational Vertical Sounder. See Television Infrared Operational Satellite (TIROS).
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.
Tracking and Data Relay Satellite System (TDRSS)	Tracking and Data Relay Satellite System (TDRSS) An orbiting communications satellite, developed by NASA, used to relay data from satellite sensors to ground stations and to track the satellites in orbit.
trade winds	Surface air from the horse latitudes that moves back toward the equator and is deflected by the Coriolis Force, causing the winds to blow from the Northeast in the Northern Hemisphere and from the Southeast in the Southern Hemisphere. These steady winds are called trade winds because they provided trade ships with an ocean route to the New World.
transpiration	The process in plants by which water is taken up by the roots and released as water vapor by the leaves. The term can also be applied to the quantity of water thus dissipated.
tropical	The area between 23.5 degrees north and south of the equator. This region has small daily and seasonal changes in temperature, but great seasonal changes in precipitation.

Tropical Ocean-Global Atmosphere (TOGA)

TOGA is a program jointly sponsored by the United Nations World Meteorological Organization (WMO); the International Council of Scientific Unions (ICSU); the United Nations Educational, Scientific, and Cultural Organization (UNESCO) Intergovernmental Oceanographic Commission (IOC); and the ICSU Scientific Committee on Oceanic Research (SCOR).

TOGA has four major objectives:

* To collect and catalog observations of the tropical atmosphere and ocean;

* To assess the evolution of the tropical atmosphere/ocean system in real time; To promote the development of short-term climate-prediction computer models for the tropics;

* To study the influence of the tropical atmosphere/ocean system on the climate at higher latitudes.

Tropical Rainfall Measuring Mission (TRMM)

A joint NASA/NASDA mission launched in November 1997. The goal of TRMM is to obtain a minimum of 3 years of climatologically significant observations of rainfall in the tropics. Because rainfall is such a variable phenomenon, adequate sampling is a difficult problem. By averaging the instantaneous rainfall rates for 30 days over a 5 degrees by 5 degrees grid, TRMM will obtain observations that meet climatological requirements. TRMM measurements, used together with cloud models, also will provide accurate estimates of vertical distributions of latent heating in the atmosphere.

The present uncertainty about the quantity and distribution of precipitation, especially in the tropics, prohibits definition of the mass and energy exchange between the tropical ocean and atmosphere. Since the tropical atmosphere and oceans are closely coupled, cloud radiation and rainfall are likely to have significant effects on ocean circulation and marine biomass.

TRMM data will play a significant role in global change studies, especially in developing an interdisciplinary understanding of atmospheric circulation, ocean-atmospheric coupling, and tropical biology. TRMM data on tropical clouds, evaporation,

and heat transfer will be used to understand the larger scale coupling of the atmosphere to oceans.

tropical storm

Tropical storms generally form in the eastern portion of tropical oceans and track westward. Hurricanes, typhoons, and willy-willies all start out as weak low pressure areas that form over warm tropical waters (e.g., surface water temperature of at least 80 degrees F). Initially, winds and cloud formations over the warm tropical waters are minimal. Both intensify with time. Formation of tropical storms also requires a significant Coriolis effect to induce proper spin in the wind formation. As the storm begins to organize itself into a coherent pattern, it will experience increased activity and intensity.

When a storm develops a clearly recognizable pattern, it is referred to as a tropical depression. When wind speeds reach 35 knots (40.3 mph), it is called a tropical storm and is given a name. When wind speed equals or exceeds 74 mph, the storm is called a hurricane. In the western Pacific, a hurricane is referred to as a typhoon. In waters around Australia it is called a cyclone or willy-willy.

Hurricanes intensify when moving over areas of increased water temperatures, and weaken over colder water surfaces. Upper atmosphere wind shear (different wind direction and speeds at different elevations) will frequently prevent or slow intensification of tropical storms by 'spreading out' the storm horizontally and preventing the formation of strong updrafts of warm, humid air. Movement over a land-mass will weaken hurricane winds but will result in large-scale rain that can result in large-scale flooding. When encountering a strong frontal system (such as a polar front) the hurricane will curve and track along the leading edge of the front or become implanted in it.

Satellite infrared imagery can identify surface water temperatures that will foster tropical storm development.

tropopause

The boundary between the troposphere and the stratosphere (about 8 km in polar regions and about 15 km in tropical regions), usually characterized by an abrupt change of lapse rate. The regions above the troposphere have increased atmospheric stability than

	those below. The tropopause marks the vertical limit of most clouds and storms.
troposphere	The lower atmosphere, to a height of 8-15 km above Earth, where temperature generally decreases with altitude, clouds form, precipitation occurs, and convection currents are active. See atmosphere.
Tropospheric Emission Spectrometer	A high-resolution infrared spectrometer for monitoring the minor components of the lower atmosphere.
tropospheric ozone (O3)	Ozone that is located in the troposphere and plays a significant role in the greenhouse gas effect and urban smog. See Ozone for more details.
trough	Elongated area of low atmospheric pressure, either at the surface or in the upper atmosphere.
tundra	A type of ecosystem dominated by lichens, mosses, grasses, and woody plants. It is found at high latitudes (arctic tundra) and high altitudes (alpine tundra). Arctic tundra is underlain by permafrost and usually very wet.
typhoon	Hurricanes in the Western Pacific Ocean.
ultraviolet radiation	The energy range just beyond the violet end of the visible spectrum. Although ultraviolet radiation constitutes only about 5 percent of the total energy emitted from the sun, it is the major energy source for the stratosphere and mesosphere, playing a dominant role in both energy balance and chemical composition. Most ultraviolet radiation is blocked by Earth's atmosphere, but some solar ultraviolet penetrates and aids in plant photosynthesis and helps produce vitamin D in humans. Too much ultraviolet radiation can burn the skin, cause skin cancer and cataracts, and damage vegetation.
United States Geological Survey (USGS)	A bureau of the Department of the Interior. USGS was established in 1879 following several Federally sponsored independent natural resource surveys of the West and Midwest. The Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. The USGS monitors

	resources such as energy, minerals, water, land, agriculture, and irrigation. The resulting scientific information contributes to environmental-policy decision making and public safety. For example, USGS identifies flood- and landslide-prone areas and maintains maps of the United States.
United States Global Change Research Program (USGCRP)	The USGCRP addresses significant uncertainties concerning the natural and human-induced changes to Earth's environment. The USGCRP has a comprehensive and multidisciplinary scientific research agenda. See Global Change Research Program.
updraft	A relatively small-scale current of air with marked upward vertical motion.
Upper Atmosphere Research Satellite (UARS)	UARS is part of a long-term, international program of space research into global atmospheric change. Beginning in 1991, NASA's UARS program began to carry out the first systematic, detailed satellite study of the Earth's stratosphere, mesosphere, and lower thermosphere; establish the comprehensive data base needed for an understanding of stratospheric ozone depletion; and bring together scientists and governments around the world to assess the role of human activities in atmospheric change. Launched on September 12, 1991, UARS became the first official space component of NASA's Earth Science Enterprise.
upwelling	The vertical motion of water in the ocean by which subsurface water of lower temperature and greater density moves toward the surface of the ocean. Upwelling occurs most commonly among the western coastlines of continents, but may occur anywhere in the ocean. Upwelling results when winds blowing nearly parallel to a continental coastline transport the light surface water away from the coast. Subsurface water of greater density and lower temperature replaces the surface water, and exerts a considerable influence on the weather of coastal regions. Carbon dioxide is transferred to the atmosphere in regions of upwelling. This is especially important in the Pacific equatorial regions, where 1-2 GtC/year may be released to the atmosphere. Upwelling also results in increased ocean productivity by transporting nutrient-rich waters to the surface layer of the ocean.

validation	Comparing a climate model's predictions with observations of the real climate, in order to test the reliability and accuracy of the model. The most obvious way to test a climate model is to use it to analyze past events, and then see whether its simulated prediction 'came true,' or how close it was to being correct.
Van Allen belts or Van Allen Radiation belts	Doughnut-shaped regions encircling Earth and containing high energy electrons and ions trapped in the Earth's magnetic field (the magnetic field has definite boundaries, and is distorted into a tear-drop shape by the solar wind). Explorer I, launched by NASA in 1958, discovered this intense radiation zone. These regions are called the inner and outer Van Allen radiation belts, named after the scientist who first observed them. See magnetosphere.
vector	A physical quantity that has both a magnitude and a direction and that adds like displacement; velocity, acceleration, and force are prime examples.
vector-borne disease	A vector-borne disease is one in which the pathogenic microorganism is transmitted from an infected individual to another individual by an arthropod or other agent, sometimes with other animals serving as intermediary hosts. The transmission depends upon the attributes and requirements of at least three different living organisms: the pathologic agent, either a virus, protozoa, bacteria, or helminth (worm); the vector, which are commonly arthropods such as ticks or mosquitoes; and the human host. In addition, intermediary hosts such as domesticated and/or wild animals often serve as a reservoir for the pathogen until susceptible human populations are exposed. See Mapping Malaria
Vegetation Canopy Lidar (VCL)	The first satellite mission of NASA's Earth System Science Pathfinder project that will create the first maps of the three-dimensional structure of vegetation in the world's forests. The VCL lidar holds five lasers that each send 242 pulses per second at the Earth's surface. Each beam covers an area 75 feet across. By spacing the five beams a little over a mile apart, each VCL orbit will sample an area 5 miles across. See VCL fact sheet.
velocity	The time rate at which a body changes its position

	vector; velocity is a vector quantity whose magnitude is expressed in units of distance over time, such as miles per hour. (From the Latin word for "speed.")
vernal equinox	The beginning of spring in the Northern Hemisphere. The time/day that the sun crosses the equatorial plane going from south to north.
visible	That part of the electromagnetic spectrum to which the human eye is sensitive, between about 0.4 and 0.7 micrometers. See spectrum.
Visible/Infrared Spin Scan Radiometer (VISSR)	High-resolution, multi-spectral imaging system flown on the pre-GOES-8 geostationary GOES spacecraft. Similar systems are flown on the METEOSAT and GMS spacecraft.
volcano	A naturally occurring vent or fissure at the Earth's surface through which erupt molten, solid, and gaseous materials. Volcanic eruptions inject large quantities of dust, gas, and aerosols into the atmosphere. A major component of volcanic clouds is sulfur dioxide, a strong absorber of ultraviolet radiation. Chemical interactions between sulfur dioxide and water cause sulfuric acid aerosols which can scatter some of the incident solar radiation back to space, thus causing a global cooling effect. For example, Mt. Pinatubo in the Philippines erupted in June 1991, and in the following year the global surface temperature was observed to decrease by about 0.3 degrees C.
vortex	A mass of fluid rotating about an axis, i.e., whirlpool or whirlwind.
Walker cell	A zonal circulation of the atmosphere confined to equatorial regions and driven principally by the oceanic temperature gradient. In the Pacific, air flows westward from the colder, eastern area to the warm, western ocean, where it acquires warmth and moisture and subsequently rises. A return flow aloft and subsidence over the eastern ocean complete the cell.
water cycle	The process by which water is transpired and evaporated from the land and water, condensed in the clouds, and precipitated out onto the earth once again to replenish the water in the bodies of water on the

earth. See The Water Cycle

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.

wave 1. In electricity, a periodic variation of an electric current or voltage.

2. In physics, any of the series of advancing impulses set up by a vibration, pulsation, or disturbance in air or some other medium, as in the transmission of heat, light, sound, etc.

wave cyclone A cyclone that forms and moves along a front, producing by its circulation a wavelike deformation of the front.

wavelength Physical distance of one period (wave repeat).

weather Atmospheric condition at any given time or place. Compare with climate.

weathering the natural processes by which the actions of atmospheric and other environmental agents, such as wind, rain, and temperture changes, result in the physical disintegration and chemical decomposition of rocks and earth materials in place, with little or no transport of the loosened or altered material.

wind A natural motion of the air, especially a noticeable current of air moving in the atmosphere parallel to the Earth's surface. Winds are caused by unequal heating and cooling of the Earth and atmosphere due to absorbed, incoming solar radiation and infrared radiation lost to space--as modified by such effects as the Coriolis force, the condensation of water vapor,

	the formation of clouds, the interaction of air masses and frontal systems, friction over land and water, etc.
wind chill	The wind can reduce significantly the amount of heat your body retains. The following wind chill chart does not take into account such variables as type of clothing worn, amount of exposed flesh, and physical condition, all of which would alter body heat.
wind velocity	Vector term that includes both wind speed and wind direction.
window	Term used to denote a region of the electromagnetic spectrum where the atmosphere does not absorb radiation strongly.
X-band	A nominal frequency range from 12.5 to 8 GHz (2.4 to 3.75 cm wavelength) within the microwave (radar) portion of the electromagnetic spectrum. X-band is a suitable frequency for several high-resolution radar applications and has often been used for both experimental and operational airborne systems.
x-ray	Short electromagnetic waves whose wavelengths range from .00001 to 3000 angstroms.
zooplankton	Animal plankton. Small herbivores that float or drift near the surface of aquatic systems and that feed on plant plankton (phytoplankton and nanoplankton).