

Glossaries

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A

Abscission
Separation of leaves or other structures from an axis by the formation of an layer that reduces and then cuts off the flow of water and nutrients between leaf and tree
[Biosphere]

Absolute Zero
The theoretical temperature at which matter has the least energy; the limit of how cold matter can get. If substances could be cooled to absolute zero they would not emit any electromagnetic radiation.
[Atmosphere]

Absorption
Radiation retained by an object and converted to other forms of energy
[Atmosphere]

Abundance
The number of organisms in a sample or taxon
[Hydrosphere]

Acclimation
Process by which plants become increasingly resistant to subfreezing temperature without sustaining injury
[Biosphere]

Accuracy
The closeness of a measured value to a standard or true value (See also precision)
[Biosphere, Hydrosphere]

Acid
Any substance that can donate a hydrogen atom or proton (H+) to any other substance.
[Hydrosphere]

Acid Rain
Rain having a pH lower than 5.6, the pH of water in equilibrium with the current concentration of carbon dioxide in the air
[Atmosphere, Hydrosphere]

Acid Soil
A soil that contains more hydrogen ions than hydroxide ions and therefore has a pH less than 7.0
[Pedosphere]

Acidic
Characterized by pH < (less than) 7
[Hydrosphere]

Acidity
1. The amount of strong base (e.g. Sodium Hydroxide) necessary to titrate a sample to a pH of around 10.3; measures the base neutralizing capacity of a water
2. An acid quality or state (Common Usage)
[Hydrosphere]

Adhesion
Molecular attraction that holds the surfaces of two substances together e.g. attraction of water molecules to other kinds of molecules
[Biosphere]

Aerosols
Liquid or solid particles suspended in the atmosphere. Their sizes generally have linear dimensions in the range of 100-1000 nanometers (nm).
[Atmosphere, Earth as a System, Hydrosphere]

Air Mass
A large volume of air (often covering thousands of square kilometers) with temperature and humidity characteristics that vary little horizontally
[Atmosphere]

Albedo
The percentage of incoming radiation (usually visible light) reflected back to space from a planet or object, its surface, or its cloud layers
[Atmosphere]

Alkaline
Characterized by pH > 7
[Hydrosphere]

Alkalinity
The amount of strong acid (e.g. Hydrochloric Acid) necessary to titrate a sample to a pH of around 4.5. Measures the acid neutralizing capacity of a water and is often reprinted as ppm $CaCO_3$.
[Hydrosphere]

Alluvium
Sediment transported by flowing water (e.g. a stream)
[Pedosphere]

Almost Closed System
A system in which almost no matter enters or leaves; the Earth system is considered an almost closed system because only a small amount of gases and particles enter or leave the system at the top of the atmosphere. In studying the Earth as a whole you use
[Earth as a System]

Altimeter
A barometer, normalized to standard pressure, temperature and density, used to measure altitude by measuring atmospheric pressure. Altitude is determined by assuming all changes in pressure are due to a change in height relative to sea level. Altimeters are adapted to work over wide ranges of height above sea level and used in GLOBE to measure barometric pressure at elevations above 500 meters.
[Atmosphere]

Ambient Air
Air that is moving freely and not part of a specific perturbation to the surrounding atmosphere (e.g., not part of an exhaust plume, not smoke from a fire, not a dust cloud blown off a field)
[Atmosphere]

Annotate
To label
[Biosphere]

Anomaly
Something irregular or abnormal
[Pedosphere]

Anthocyanin
Pigment in leaves that is bright red and purple
[Biosphere]

Aqueous
Containing or contained in water
[Hydrosphere]

Aquifer
A body of permeable rock or gravel capable of storing water underground
[Earth as a System]

Assessment
Evaluation of the value of an object
[Biosphere]

Atmospheric Greenhouse Effect
Warming of a planet by the atmospheric absorption and re-emission of infrared radiation emitted from the surface of the planet by various gases in the atmosphere (i.e., *greenhouse gases*)
[Atmosphere]

Average Surface Temperature
The surface temperature of the Earth averaged over a wide region and over a long period of time
[Earth as a System]

AVHRR Satellite
Satellite that carries the Advanced Very High Resolution Radiometer instrument
[Earth as a System]

Axis
The invisible straight line between the North and South poles
[Earth as a System]

B

Background Concentration
The level of chemicals present in a water due to natural processes rather than due to human contribution
[Hydrosphere]

Barometer
An instrument used to measure atmospheric pressure
[Atmosphere]

Base
Any substance that accepts a proton (H+) from another substance
[Hydrosphere]

Basic Soil
A soil that contains more hydroxide ions than hydrogen ions and therefore has a pH greater than 7.0
[Pedosphere]

Benthic
Pertaining to bottom dwelling water animals or plants
[Hydrosphere]

Biodiversity
The variety of organisms
[Hydrosphere]

Biogeochemical
Refers to the chemical interactions between the living ("bio") and physical ("geo") components of the Earth system, as in biogeochemical cycles of carbon, nitrogen, etc.
[Biosphere]

Biogeochemical Cycles
Movement of chemical elements from organisms to physical environment back to organisms in a circular cycle
[Earth as a System]

Biological Diversity (biodiversity)
The variety of life in all its forms, levels and combinations that coexist in an ecosystem. At different scales this includes ecosystem diversity, species diversity, and genetic diversity. The degree of biodiversity is often used as an indicator of the health of the environment.
[Atmosphere]

Biomass
Total mass of all the organisms of a given type or in an area or region; the dry weight of vegetation above a unit area of ground, often reported as grams (dry weight) per square meter.
[Biosphere]

Biome
A major ecological community type (as grassland or desert)
[Biosphere, Earth as a System]

Biometry
The process of making biological measurements
[Biosphere]

Biosphere
The living component of the Earth system, along with the gaseous (atmosphere), liquid (hydrosphere), and solid (geosphere) components
[Biosphere]

Biota
All of the organisms living in a particular region, including plants, animals, and microorganisms
[Biosphere, Earth as a System]

Blocky Structure
Irregular block-like soil peds that are usually 0.5 cm to 5.0 cm in diameter
[Pedosphere]

Blowing Dust
Dust (soil particles smaller than sand) suspended in the air that reduces visibility, or obscures part or all of the sky
[Atmosphere]

Blowing Sand
Sand suspended in the air that reduces visibility, or obscures part or all of the sky
[Atmosphere]

Blowing Snow
Snow from the ground that the wind blows into the air that reduces visibility, or obscures part or all of the sky
[Atmosphere]

Boreal
Of or relating to northern regions or the Northern Hemisphere
[Biosphere, Earth as a System]

Broad-leafed Trees
Trees that have wide and flat leaves rather than needlelike leaves
[Biosphere]

Boundary
A line or a plane that divides two different areas or regions
[Earth as a System]

Brackish Water
Water containing dissolved salts at a concentration less than seawater, but greater than fresh water. The concentration of dissolved salts is usually in the range 1000 - 10,000 ppm.
[Hydrosphere]

Budburst
The opening or breaking of buds which are hard protective covers containing miniature leaves. It is a seasonal event

that signals the start of leaf growth or green-up
[Biosphere]

Buffer Solution
One that resists change in its pH when either hydroxide (OH-) or protons (H+) are added. The stable and known pH value of these solutions make them suitable for calibrating pH measuring devices.
[Hydrosphere]

Bulk Density
Mass of dry soil per unit volume (expressed in GLOBE as grams per cubic centimeter)
[Pedosphere]

C

Calibration
To set or check an instrument against an index or standard of known value through some type of proportional or statistical relationship.
[Hydrosphere]

Canopy
The uppermost layer of plant leaves that are detected by satellite remote sensing
[Biosphere]

Canopy Cover
The amount of canopy foliage above a given portion of ground is the canopy cover. This will determine the amount of sunlight that reaches that portion of ground.
[Biosphere]

Capillary Action
Attraction of the surface of a liquid to the surface of a solid which is expressed as the readiness of a liquid such as water, to flow through a solid such as paper
[Biosphere]

Carbon Cycle
The movement of carbon through the surface, interior, and atmosphere of the Earth, which may involve organisms
[Biosphere, Earth as a System]

Carbon Fixation
The process by which carbon taken from the carbon dioxide in the air is incorporated in the cells of a plant or microorganism, such as in photosynthesis
[Biosphere]

Carbon Monoxide
Chemical compound of one oxygen atom and one carbon atom primarily produced as product of incomplete combustion (chemical symbol: CO)
[Atmosphere]

Carotene
Pigment in leaves that is orange
[Biosphere]

Catastrophic
Used to describe a sudden, violent event
[Biosphere]

Catchment Basin
1. The part of a river-basin from which rain is collected, and from which the river gets its water. Each catchment basin is with the boundary defined by the watershed. The term watershed is often incorrectly used to describe catchment basins.
2. The area drained by a river or stream
[Hydrosphere]

Ceiling
The height of the base of the cloud layer that covers more than 50% of the sky
[Atmosphere]

Ceilometer
An instrument used to determine the height of the cloud base, which helps to indicates cloud type
[Atmosphere]

Celestial Sphere
An imaginary sphere of infinite extent with the Earth at its center on which the stars, planets, and other heavenly bodies appear to be located
[Earth as a System]

Celsius Scale
A temperature scale invented in 1742 by Swedish astronomer Anders Celsius. This scale defines the melting point of water ice as 0˚ C, and the boiling point of water as 100˚ C. Because of the 100-degree interval between these two points, this scale is sometimes called the *"centigrade scale"*.
[Atmosphere]

Characteristics
A distinguishing feature
[Biosphere]

Chemical Cycle
The movement of various chemicals through the surface, interior, and atmosphere of the Earth and the chemical reactions that impact the form of those chemicals
[Earth as a System]

Chemical Energy
The energy produced or absorbed in the process of a chemical reaction
[Earth as a System]

Chemical Test Strip
A piece of paper treated with special chemicals that show a color change when exposed to ozone
[Atmosphere]

Chlorinity
The chlorine concentration of a solution
[Hydrosphere]

Chlorophyll
A pigment which gives plants their green color and traps light energy for plants, algae, and some bacteria to use in making food
[Biosphere]

Chroma
When referenced to hue, the level of saturation of a color
[Pedosphere]

Chromatography
The separation of substances in a mixture by placing the mixture in a mobile phase (water or other solvent) that is placed over a stationary phase (e.g. paper)
[Biosphere]

Cirriform
A cloud type formed of ice crystals at high altitudes (greater than 6 km above sea level)
[Atmosphere]

Classification
Sorting a group of items into well-defined and distinct subsets according to specific criteria
[Biosphere]

Clay
A mineral particle <.002 mm in size that has a "sticky and dense" feel when moistened and rubbed between the fingers
[Pedosphere]

Climate
Weather at a specified area averaged over some time period, plus extremes in weather behavior during a time period
[Atmosphere, Biosphere, Earth as a System]

Climate Cycles
Alternating episodic climate events that recur with some regularity, but are not strictly periodic
[Earth as a System]

Climatic Island
An area of uniform climate, such as a mountain top, that is isolated from other areas similar to it
[Earth as a System]

Climatogram
A graph showing the long term average of temperature and precipitation totals for a region (a year or longer)
[Earth as a System]

Climatograph
See climatogram
[Earth as a System]

Clinometer
A clinometer is an instrument for measuring the angle of a change in height or elevation.
[Biosphere]

Closed System
A system in which no matter enters or leaves
[Earth as a System]

Cloud Cover
The percent of the sky covered by clouds
[Atmosphere]

Cohesion
Force holding a solid or liquid together due to the attraction of like molecules, for example the attraction of water molecules to each other
[Biosphere]

Colorimetric Method
Many procedures for measuring dissolved substances depend on color determination. The underlying assumption is that the intensity of the color is proportional to the concentration of the dissolved substance in question.
[Hydrosphere]

Columnar Structure
A type of soil structure where the soil peds (or chunks) are in the shape of a column with a rounded top. Columnar structure is found in arid regions and generally ranges between 1 and 10 cm long.
[Pedosphere]

Components
Parts of a whole
[Biosphere, Earth as a System]

Compounds
Chemicals made of atoms from two or more elements
[Atmosphere]

Concentration
The number of molecules of a specific gas in a unit volume relative to the sum of all the molecules in that volume, often reported as parts per million (ppm) or parts per billion (ppb)
[Atmosphere]

Concretion
A cemented mass of a chemical compound, such as iron oxide or calcium carbonate, that can be removed intact from the soil
[Pedosphere]

Condensation
The change of phase of a substance from a vapor to a liquid. The process of condensation releases energy; this energy is known as latent heat
[Atmosphere]

Conduction
The transfer of heat through collisions of the individual constituents of a substance (e.g., molecules, atoms) without the systematic movement of groups of these constituents. For example, if one end of a metal rod is heated, the heat will be conducted the length of the rod so that the other end will also increase in temperature. Conduction can occur in solids, liquids, or gases (but is generally most efficient in solids).
[Atmosphere]

Conductivity
The ability of an aqueous solution to carry an electrical current. Depends upon the concentration of dissolved salts (ions), the type of ions, and the temperature of the solution. Typical units are microSiemens/cm or micromhos/cm. (These are equivalent).
[Hydrosphere]

Conifers/Coniferous
Any cone-bearing trees, chiefly evergreen trees of the class Coniferinae, including pine, fir, and spruce that have needle-like leaves
[Biosphere]

Connections
Links between one component of the Earth system and another
[Biosphere, Earth as a System]

Consistence
How easy or hard it is for a soil ped to break apart when it is squeezed
[Pedosphere]

Consumers
Living things that use resources in their environment to survive
[Biosphere]

Continental Climate
Climate characteristic of the interior of a large land mass, generally marked by large annual and daily ranges of temperature, low relative humidity and generally moderate or small amounts of rainfall.
[Earth as a System]

Contrast
The ratio between maximum and minimum values
[Biosphere]

Control
An experimental set up and result against which other experiments that incorporate modifications or changes and the results of those experiments are compared
[Biosphere]

Convection
The transfer of heat by mass flow, that is, large scale motion within a liquid or a gas of groups of constituents (e.g. molecules, atoms) that are relatively warmer or cooler than their surroundings. In the atmosphere convection mostly refers to vertical motions brought about by warm air rising and cooler air sinking.
[Atmosphere]

Criteria
Decision rules that are used to determine into which subset an item is placed during a classification
[Biosphere]

Crown
The leafy portion of a tree or shrub. Even the lowest branches of a tree or shrub are part of the crown
[Biosphere]

Cryosphere
Part of the Earth that is frozen, comprising ice sheets, glaciers, and sea areas covered by ice
[Earth as a System]

Crytoturbation
Process of freezing, thawing, and churning of a soil
[Pedosphere]

Cumuliform
A cloud type that is heaped, puffy, banded, or otherwise is characterized by rounded features particularly on the top and sides
[Atmosphere]

D

Deciduous
Refers to trees or shrubs that lose their leaves every year
[Biosphere]

Default
A preset value that a computer uses or an action that it takes unless it is told otherwise
[Biosphere]

Denitrification
The act or process of reducing nitrate to ammonia. Nitrite may be an intermediate product.
[Hydrosphere]

Densiometer
A device for determining the percentage of canopy closure in a wooded environment
[Biosphere]

Density (D)
The ratio of the mass (M) of a substance to its volume (V) (D = M/V)
[Atmosphere, Hydrosphere]

Deposition
The process by which water vapor turns directly into ice on a surface without passing through the liquid phase
[Atmosphere]

Dew Point Temperature
The temperature at which the water vapor begins to condense in air cooled at constant pressure. Dew Point Temperature is a measure of the amount of water vapor in air.
[Atmosphere]

Diagram
A visual representation of a system used to communicate information about that system to others
[Biosphere, Earth as a System]

Dichotomous

This is a branching decision tree (decoder) characterized by successive forking into two approximately equal and contradictory divisions, which ultimately leads to only one correct outcome.

[Biosphere]

Difference/Error Matrix

A graphic method of comparing two data sets for validation

[Biosphere]

Diffuse Insolation

Solar radiation that reaches Earth's surface by being scattered or reflected by components of Earth's atmosphere (such as gases, clouds and aerosols)

[Atmosphere]

Direct Insolation

Solar radiation that reaches Earth's surface by passing directly through the atmosphere without interacting with the components of Earth's atmosphere

[Atmosphere]

Dissolved Oxygen

The mass of molecular oxygen dissolved in a volume of water. The solubility of oxygen is affected non-linearly by temperature; more oxygen can be dissolved in cold water than in hot water. The solubility of oxygen in water is also affected by pressure and salinity; salinity reduces the solubility of oxygen in water.

[Hydrosphere]

Dissolved Solids

Solid particles that have become liquid by immersion or dispersion in a liquid (e.g. salts)

[Hydrosphere]

Diurnal

Daily, as in diurnal rotation of the Earth

[Biosphere]

Diurnal Cycle

A daily cycle, a basic repetition period of 24 hours. All processes that are dominated by the sun are diurnal. (Tides, in contrast, repeat cycles twice daily)

[Atmosphere, Hydrosphere]

Dominant

A plant or animal that, due to its large numbers or size, influences the conditions of an area and determines what other plants or animals can live there

[Biosphere]

Dormancy

State of suspended growth and metabolism

[Biosphere]

Drizzle

Slow falling liquid precipitation made up of droplets with diameters between 0.2 and 0.5 mm. Drizzle reduces visibility more than light rain because of the large numbers of very small drops

[Atmosphere]

Dry Bulb Temperature

The temperature on one of two thermometers on a sling psychrometer; this temperature corresponds to the bulb which does not contain the water saturated wick

[Atmosphere]

E

Earth System

The components that comprise the environment of the Earth, including the atmosphere, hydrosphere, lithosphere, pedosphere (soils), cryosphere (ice), and biosphere, and the processes that cause them to interact

[Biosphere, Earth as a System]

Earth System Science

An area of scientific investigation that focuses on the processes which take place in the atmosphere, hydrosphere, lithosphere, pedosphere (soils), cryosphere (ice), and biosphere and the processes that allow them to interact.

[Biosphere, Earth as a System]

Ecliptic

Where the Earth's orbit intersects the celestial sphere

[Biosphere, Earth as a System]

Ecologist

A scientist who studies the relations between organisms and their environment

[Biosphere]

Ecology

The study of the relations between organisms and their environment

[Biosphere]

Ecosystem

A community of different species interacting with one another and with the chemical and physical factors making up their surroundings. A system formed by the interactions of a community of living things with its environment.

[Atmosphere, Biosphere, Earth as a System]

Effervescence

The bubbling action that occurs as a gas comes out of a liquid such as when carbon dioxide gas is produced by the reaction of carbonate coatings on soil being treated with an acid like vinegar

[Pedosphere]

El Niño

El Niño refers to a prolonged significant warming of surface waters in the central and eastern tropical Pacific Ocean and generally to the phenomena that accompany this warming.

[Atmosphere]

Electrode

In GLOBE, an electrode is usually the part on the probe through which electricity is able to flow.

[Hydrosphere]

Electromagnetic (EM) Radiation

Energy waves produced by oscillating or accelerating electric charges. EM waves have both electric and magnetic components. Unlike conduction and convection, EM waves do not need media like solids, liquids, or gases in order to transfer energy. Electromagnetic radiation can be arranged in a spectrum from very energetic short wavelengths (gamma rays, x-rays), to less energetic, very long wavelengths (microwaves and radio waves). Visible light is a small part of the electromagnetic spectrum that human eyes can see.

[Atmosphere]

Elevation

The vertical distance above mean sea level

[Biosphere, Earth as a System]

Elevation Angle

The angular distance between the horizon and an object in the sky, such as the sun. The *zenith angle* is 90˚ minus the elevation angle.

[Atmosphere]

Eluviation

The removal of materials from one horizon which are then “illuviated” or deposited into a lower horizon

[Pedosphere]

Energy Cycle

The movement of energy through the surface, interior, and atmosphere of the Earth in all of its forms

[Earth as a System]

Enrichment

Making a water more productive (e.g. by adding nutrients)

[Hydrosphere]

Environment

The surrounding conditions that affect the quality of life of plants and animals

[Earth as a System]

Environmental variables

Physical properties that describe the state of the environment

[Earth as a System]

Equator

An invisible circle that divides the Earth into two hemispheres

[Earth as a System]

Equatorial

Near the equator

[Biosphere, Earth as a System]

Equinox

(equal night) when the sun crosses the

equator, causing the length of day and night to be equal in both hemispheres
[Earth as a System]

Erosion
The removal and movement of soil materials by water, wind, ice, or gravity as well as by human activities such as agriculture or construction
[Pedosphere]

Evaporation
Water on Earth's surface or in the soil absorbs heat from the sun to the point that it changes from a liquid to a gas and moves into the atmosphere
[Atmosphere, Pedosphere]

Evapotranspiration
The transfer and transformation of liquid water from soil to air by the combined processes of evaporation (from solar energy) and transpiration (plant activity)
[Atmosphere, Biosphere]

Environment
The surrounding conditions that affect the quality of life of plants and animals
[Biosphere]

Environmental variables
Physical properties that describe the state of the environment
[Biosphere]

Equator
An invisible circle that divides the Earth into two hemispheres
[Biosphere]

Equatorial
Located at the equator or in the plane of the equator
[Biosphere]

Estuary
Semi-enclosed coastal body of water which has a free connection with the open sea
[Biosphere]

Eutrophication
A high level of productivity in a water body, often due to an increased supply of nutrients
[Hydrosphere]

Evaporation (of water)
Change from liquid to vapor at a temperature below the boiling point
[Hydrosphere]

Evenness
How equally abundant the taxa are in a sample
[Hydrosphere]

Extremely Firm
A type of soil consistence in which soil peds require extreme pressure, requiring the use of a tool (e.g., a hammer), to break
[Pedosphere]

F

Face
The way an exposed section of soil or soil profile appears
[Pedosphere]

Fahrenheit Scale
A temperature scale invented by the 18th century German physicist Daniel Gabriel Fahrenheit. This scale defines the melting point of water ice as 32˚ F and the boiling point of water as 212˚ F. The United States is the only major country in the world still commonly using the Fahrenheit scale.
[Atmosphere]

Fertility
The ability of a soil to supply the elements and compounds needed for plant growth
[Pedosphere]

Fill
Soil, rock, or other material that has been added to a site for construction purposes usually to bring the surface to a certain level
[Pedosphere]

Firm
A type of soil consistence in which the soil peds require significant pressure before breaking
[Pedosphere]

Floury
Having the feel of finely ground flour: smooth and powdery
[Pedosphere]

Flux
The amount of material flowing through a specified surface or system per unit time
[Earth as a System]

Fluxes
The rate of flow of some quantity (such as water, energy or carbon for example) from one place or reservoir to another
[Earth as a System]

Fog
A cloud in contact with Earth's surface
[Atmosphere]

Force (F)
A push or pull
[Atmosphere]

Frazzle Ice
Known also as frazil ice, flowing water ice that forms platelets rather than continuous sheets on rivers and other moving bodies of water
[Earth as a System]

Free Carbonates
Carbonate materials that form coatings on soil that react with an acid, such as vinegar, to form carbon dioxide gas
[Pedosphere]

Freeze-thaw
The mechanical break up of rock caused by the expansion of freezing water in cracks and crevices
[Pedosphere]

Freezing
The process of water changing phase from liquid to solid (ice)
[Atmosphere]

Freezing Rain and Freezing Drizzle
Supercooled water drops that freeze when they come in contact with cold surfaces
[Atmosphere]

Friable
A type of soil consistence in which the soil ped breaks easily when squeezed between the thumb and fore finger with a small amount of pressure
[Pedosphere]

Front
The narrow transition region between two distinct air masses. A front is a region of changing wind direction, changing surface air pressure, and often results in the development of clouds and precipitation.
[Atmosphere]

Frost
The deposition of ice from water vapor in the atmosphere directly onto surfaces such as grass or windows
[Atmosphere]

G

Genus (pl. Genera)
This is an inclusive category whose species have more characteristics in common with each other than with species of other genera. Genera, therefore, are collections of closely related species.
[Biosphere]

Geosphere
The solid component of the Earth system; e.g. rocks, soil, etc.
[Biosphere]

Geostationary
An object in orbit around Earth that stays above a certain location on the planet; the object is generally located directly above the Equator at a fixed longitude.
[Atmosphere]

GIS
Geographic Information System
[Biosphere]

Glacial Till
Sediment deposited from a glacier
[Pedosphere]

Glossary
List of terms in a special subject with their definitions
[Atmosphere, Biosphere, Earth as a System, Hdrosphere, Pedosphere]

Gradient
The rate of change in a measured quantity over space or time
[Biosphere]

Graminoid
Grass-like vegetation
[Biosphere]

Granular Structure
Roundish soil peds with an appearance like “cookie crumbs” that are usually less than 1.0 cm in diameter
[Pedosphere]

Grassland
An area of natural vegetation dominated by grasses (areas are called steppes or prairies in temperate regions and savannahs in tropical regions)
[Biosphere]

Gravimetric
Analysis of soil moisture that depends on weighing the soil in a moist and dry state and determining the difference
[Pedosphere]

Gravity
The force of attraction among all matter (e.g., gravity pulls each of us toward Earth’s center)
[Atmosphere]

Greenhouse Gas
Any gas that causes heat to be retained in the atmosphere and thereby causes the average temperature of the atmosphere to increase. Greenhouse gases are strong absorbers of infrared radiation. Examples of significant greenhouse gases are water vapor, carbon dioxide, nitrous oxide, methane, and chlorofluorocarbons.
[Atmosphere]

Greenwich Mean Time (GMT)
The same reference time as Universal Time (UT); the time at 0 degrees longitude (the prime meridian) that passes through Greenwich, England
[Atmosphere]

Green-down
When plants start changing colors and/or lose their leaves at the end of the growing season
[Biosphere]

Green-up
When plants sprout new growth
[Biosphere]

Grey-scale
A range of tones from white to black that indicate on a map or other visualization the relative amounts of the quantity being described
[Biosphere, Earth as a System]

Ground Cover
The amount of ground-level vegetation covering a given area. (For the GLOBE program, “ground level” is defined as “below the observer’s knees.” Ground cover is expressed as a percentage. E.g. 30% ground cover means that, viewed from above, 30% of the ground surface is obscured by ground-level vegetation.
[Biosphere]

Ground Water
Water stored underground in a saturated zone of rock, sand, gravel or other material
[Pedosphere]

Growing Season
That part of the yearly plant growth cycle when vegetation comes out of winter dormancy, grows, and reproduces.
[Biosphere]

H

Hail (also known as Hailstones)
Precipitation in the form of irregular balls of ice ranging in size from about 2 mm to 13 cm in diameter. The largest hailstones can only form in the most violent thunderstorms that have extremely strong updrafts (upward moving air).
[Atmosphere]

Halo
The optical phenomenon caused when sunlight or moonlight is refracted through ice crystals, splitting the visible beam into its distinct colors. This occurs only with cirrostratus or thick cirrus clouds.
[Atmosphere]

Haze

The reduction of visibility by aerosols in the atmosphere. Haze may cause the sky to appear milky white to yellowish, reddish, or brown, depending on whether the aerosol is wet or dry and depending on the size and nature of the particles which scatter the light.

[Atmosphere]

Heat

The total energy of motion of all of the atoms and molecules that make up a substance

[Atmosphere]

Heat Capacity

The ratio of the heat required to raise the temperature of a unit volume of soil by one degree

[Pedosphere]

Heavy Rain

Rain falling at such a great rate (greater than 7.5 mm/hr) that it reduces visibility and obscures the view of the sky

[Atmosphere]

Heavy Snow

Falling snow that reduces visibility to less than 400 meters and obscures the view of the sky

[Atmosphere]

Hemisphere

Half of a spherical or roughly spherical body (such as Earth)

[Earth as a System]

Herbaceous

A plant or plant part that is not woody

[Biosphere]

Hierarchical

Having the characteristics of a system of objects ranked one above the other

[Biosphere]

Homogeneous

Composed of parts that are all the same kind, in this case, the same land cover type

[Biosphere]

Horizon

An individual layer within the soil which has its own unique characteristics (such as color, structure, texture, or other properties) that make it different from the other layers in the soil profile

[Pedosphere]

Hue

A particular color as distinguished from other colors on the color wheel

[Pedosphere]

Humus

The part of the soil profile that is composed of decomposed organic matter from dead and decaying plants and animals and is usually dark colored

[Pedosphere]

Hydrocarbons

Compounds composed primarily of carbon and hydrogen atoms. Gaseous hydrocarbons occur in the atmosphere, (e.g., the compounds in natural gas, chemical species given off naturally by plants, and compounds that result from by-products of the combustion process).

[Atmosphere]

Hydrometer

An instrument based on the principles of buoyancy used to measure the specific gravity of a liquid containing suspended soil particles in relation to the specific gravity of pure water at a specified temperature

[Pedosphere]

Hydrologic Cycle

The continuous flow of water through the Earth system. The hydrologic cycle is composed of reservoirs of water (such as ice caps, oceans, atmospheric humidity, and aquifers) and fluxes or flows of water (such as evaporation, precipitation, river flow, and iceberg calving). Includes condensation to form clouds, precipitation, accumulation in soil or bodies of water and re-evaporation

[Atmosphere, Hydrosphere]

Hydrosphere
The liquid component of the Earth system; e.g. oceans, lakes, rivers, etc.
[Biosphere, Hydrosphere]

Hygrometer
An instrument used to measure the relative humidity of air
[Atmosphere]

Hypothesis
A tentative statement made to test its logical or empirical consequences
[Hydrosphere]

I

Ice Pellets
Same as sleet
[Atmosphere]

Icosahedron
20-sided polyhedron
[Biosphere]

Illuviation
The deposit of materials carried by water from one horizon into another within the soil (such as clay or nutrients)
[Pedosphere]

Infiltration
Downward entry of water into the soil
[Pedosphere]

Infrared radiation
Light (electromagnetic radiation) with wavelengths ranging from just longer than visible light (0.7 micrometers) to just shorter than microwaves or radio waves (1000 micrometers). The amount of light thermally emitted by Earth's surface and lower atmosphere peaks at wavelengths near 10 micrometers, and light in this portion of the infrared wavelength range is often referred to as thermal infrared.
[Atmosphere]

In situ
In place (Latin). Most of the atmospheric measurements in GLOBE, such as temperature and ozone, are taken *in situ*; however, many of these quantities can also be measured *remotely* through the use of special satellites.
[Atmosphere, Biosphere, Hydrosphere, Pedosphere]

Insolation
The energy that comes to Earth from the Sun (INcoming SOLar radiATION)
[Atmosphere, Biosphere, Earth as a System]

Iterative
To do something over again or repeatedly
[Biosphere]

Interconnections
The processes by which the different components of the Earth system interact with each other
[Biosphere, Earth as a System]

Interplanetary Medium
The space between the planets that contains electromagnetic radiation, electric and magnetic fields, ionized gas, neutral atoms, and microscopic dust particles. The characteristics of interplanetary space are primarily influenced by the sun and not by individual planets.
[Atmosphere]

Inverse Relationship
When two variables are related to each other in an opposite way; for example, as one increases, the other decreases (e.g. x = 1/y)
[Atmosphere]

Isobars
Lines on a map connecting points of equal pressure
[Atmosphere]

Isotherms
Lines on a map connecting points of equal temperature
[Atmosphere]

Iterative
To do something over again or repeatedly
[Biosphere]

J

K

Kelvin Scale

A temperature scale named for British physicist William Thomson Kelvin who proposed it in 1848. One Kelvin degree is equivalent to one Celsius degree. However, zero on the Kelvin scale is defined to be the temperature at which molecular energy is a minimum, also called "absolute zero". The convention when writing temperatures in the Kelvin scale is to just use the letter K, omitting the degree symbol. Zero on the Kelvin scale corresponds to approximately –273° C.

[Atmosphere]

Kinetic Energy

The energy an object has because of its motion

[Earth as a System]

L

La Niña

A period of anomalous cooling of sea-surface temperatures in the central and eastern tropical Pacific Ocean

[Atmosphere]

Land Cover

Usually vegetation but in the absence of vegetation an indication of what is on the land surface

[Biosphere]

Landmark Value

The point on a color scale where the representative value undergoes a distinctive change

[Biosphere, Earth as a System]

Lake

A large body of water entirely surrounded by land usually naturally formed, but can be artificially formed. Its original designation was to apply to a body of water large enough to form a geographical feature.

[Hydrosphere]

Latent heat

The heat used or released when water changes phase between solid, liquid, and gas

[Atmosphere, Earth as a System]

Latitude

The angular distance of a part of the Earth that is north or south of the Earth's equator; a region of the Earth considered in relation to its distance from the equator

[Biosphere, Earth as a System]

Leaching

Removal of soluble material in solution from the soil by the movement of water through the soil

[Pedosphere]

Lentic

Relating to, or living in, standing water (lakes, ponds or swamps)

[Hydrosphere]

Lichen

A combination of an alga (or a cyanobacterium) and a fungus, living in symbiotic relationship characteristically forming a crust-like, scaly or branching growth on rocks or tree trunks

[Biosphere]

Limiting Factor

An ecosystem variable whose presence or absence limits the growth of the ecosystem elements

[Biosphere, Earth as a System]

Lithosphere

The outer layer of soil and rock on a planet (e.g., Earth), called the "lithosphere" after the Greek word "lithos" meaning "stone."

[Earth as a System, Pedosphere]

Litter

Leaves, needles, twigs, branches, stems, or fruits covering the soil from the surrounding trees in a forest

[Pedosphere]

Liverwort

Moss-like plants that grow and help decay rocks or tree trunks on damp ground

[Biosphere]

Loam

Soil that contains an approximately equal amount of sand, silt, and clay particles.

[Pedosphere]

Loess
Fine sediment transported by wind
[Pedosphere]

Logarithmic Scale
A scale in which each unit increment represents a tenfold increase or decrease
[Hydrosphere]

Longitude
Distance measurement that goes from one pole to another pole around the outside of the Earth
[Biosphere, Earth as a System]

Loose
A type of soil consistence in which the soil grains do not stick to one another (i.e. structure is single grained).
[Pedosphere]

Lotic
Relating to, or living in actively moving water (streams or rivers)
[Hydrosphere]

M

Macroinvertebrates
Animals that have no backbone and are visible with the naked eye (>0.5 mm)
[Hydrosphere]

Magnetic North
The direction the compass needle points, rather than true north which is a geographic place
[Biosphere]

Map Projection
The systematic arrangement of latitudes and longitudes (and associated surface features) that shows a curved surface on a flat plane
[Earth as a System]

Marine Climate
Climate of a region that is affected by the sea. Generally characterized by mild winters, cool summers, and an even distribution of rainfall through the year
[Earth as a System]

Massive Structure
A structureless soil in which all soil particles are stuck together and there are no distinct peds
[Pedosphere]

Maxima
(Plural of maximum) the greatest possible amount or degree
[Biosphere, Earth as a System]

Maximum Greenness
When vegetation vigor peaks
[Biosphere, Earth as a System]

Melting
The process of a substance changing phase from solid to liquid
[Atmosphere]

Mercator Projection
A map projection of the Earth in which the latitude lines are drawn as straight lines the same length as the equator and cross the longitude lines at right angles. The biggest disadvantage is the distortion of the land near the poles
[Earth as a System]

Meridian
An imaginary circle on the Earth's surface that passes through the North and South poles
[Earth as a System]

Mesosphere
The third layer of the atmosphere above Earth's surface, generally found between altitudes of 50 km and 80 85 km and characterized by temperature decreasing with altitude
[Atmosphere]

Metadata
Any additional information that cannot be expressed in the measurement data such as historical information, weather conditions, weather effects, and other observations
[Atmosphere, Biosphere, Hydrosphere, Pedosphere]

Meter
An instrument, usually used in combination with a probe, that translates electronic signals from the probe into units of interest (i.e. µS/cm or mg/L). A meter must be programmed with the proper

calibration for the probe of interest before producing sensible results.
[Hydrosphere]

Methodology
A set of procedures or a planned way of doing this investigation
[Biosphere]

MicroSiemens/cm
Metric unit of measurement for conductivity. Equivalent to micromhos/cm
[Hydrosphere]

Micromhos/cm
Standard unit of measurement for conductivity. Equivalent to microSiemens/cm
[Hydrosphere]

Mid-latitude
The latitude range generally between 30 degrees to 60 degrees
[Biosphere, Earth as a System]

Millibar
A unit of barometric pressure equivalent to one one-thousandth of a bar and equivalent to a hectopascal
[Atmosphere]

Mixing Ratio
A scientific term often used synonymously with concentration. One example is the mass of water vapor in a sample of air divided by the total mass of air in the sample
[Atmosphere]

Molar
Unit of measurement for concentration (moles per liter of solution).
[Hydrosphere]

Molecule
The smallest fundamental unit (usually a group of atoms) of a chemical compound that can take part in a chemical reaction
[Hydrosphere]

Mottles
Streaks of spots of different colors in a soil interspersed with the dominant soil color, usually indicating poor drainage
[Pedosphere]

Multitemporal
Viewed from more than one point in time
[Biosphere]

N

Natural Waters
Systems that typically consist of the sediments/minerals and the atmosphere as well as the aqueous phase; they almost always involve a portion of the biosphere.
[Hydrosphere]

NDVI
Normalized Difference Vegetation Index
[Biosphere, Earth as a System]

Neutral
Characterized by pH = 7
[Hydrosphere]

Nitrate
A salt of nitric acid (HNO3). Nitrates are often highly soluble and can be reduced to form nitrites or ammonia.
[Hydrosphere]

Nitrate-Nitrogen
Concentrations of nitrate (NO3-) are often expressed as mass of nitrogen per volume of water.
[Hydrosphere]

Nitrite
A salt of nitrous acid (HNO2). Nitrites are often highly soluble and can be oxidized to form nitrates or reduced to form ammonia
[Hydrosphere]

Nitrite-Nitrogen
Concentrations of nitrite (NO2-) are often expressed as mass of nitrogen per volume of water.
[Hydrosphere]

Nitrogen Cycle
A series of chemical processes, mostly occurring in organisms, in which nitrogen atoms are circulated in the Earth systems
[Biosphere, Earth as a System]

Nitrogen Oxides
The family of compounds comprised of

one or more nitrogen atoms and one or more oxygen atoms. Nitric oxide (NO) and Nitrogen dioxide (NO_2) are both primarily products of combustion whereas nitrous oxide (N_2O) is a primarily product of microbial activity in soils.

[Atmosphere]

NOAA

The National Oceanic and Atmospheric Administration.

[Biosphere, Earth as a System]

Northern Hemisphere

The half of the Earth that lies north of the equator

[Earth as a System]

O

Ocean Currents

The movement of ocean water in a regular way along a defined path that can either be cyclic or continuous

[Earth as a System]

Open System

A system in which mass and energy enter and leave

[Earth as a System]

Optical thickness (or optical depth)

A measure of how much particles (aerosols) and gas molecules (air) impede the transmission of light through a gas at a specific wavelength. At an optical depth of one, the incoming light is attenuated to 1/e in intensity.

[Atmosphere]

Organic Matter

Decomposed animal or plant material that is added to the soil and becomes a part of the soil profile. When it is fully decomposed and incorporated into the soil, organic matter becomes a dark, moist, nutrient rich substance called humus and the plant and animal material from which it formed can no longer be recognized

[Pedosphere]

Ozone

A highly reactive gas composed of 3 oxygen atoms that exists in varying amounts in the troposphere and stratosphere. Ozone is found naturally in the atmosphere as a result of breaking apart oxygen molecules (O_2) into two oxygen atoms that combine with molecules of oxygen to form ozone (O_3).

[Atmosphere]

Ozone Layer

The layer of the atmosphere in the stratosphere and lower mesosphere that absorbs most incoming ultraviolet radiation

[Atmosphere]

Ozone Optical Scanner

An instrument used in GLOBE's ozone protocol that measures the color change on the chemical test strips and interprets this change as an ozone concentration in units of ppb

[Atmosphere]

P

Particle Density

The mass per unit volume of soil particles, excluding pore space

[Pedosphere]

Particle Size Distribution

The amount (percent) of each of sand, silt, and clay in a soil sample

[Pedosphere]

Pascal

The unit of pressure equivalent to 1 Newton/meter-squared. 100 pascals equals one hectopascal which is a standard pressure unit used in GLOBE

[Atmosphere]

Ped

An individual unit of natural soil structure or aggregation (such as granular, blocky, columnar, prismatic, or platy)

[Pedosphere]

Pedosphere

The thin outer layer of the Earth which is made up of soil. The pedosphere acts as an integrator between the atmosphere, biosphere, lithosphere,

and hydrosphere of the Earth.
[Pedosphere]

Perennating Organs
Parts of plants that live over from one season to another (tubers, rhizomes)
[Biosphere]

Permafrost
A continuously frozen soil horizon
[Pedosphere]

Perpendicular
A line at right angles to a line or plane (for example, when you watch a sunset, you are standing perpendicular to the horizon)
[Earth as a System]

Perturbations
A disturbance in the normal functioning of a system
[Biosphere]

Petiole
Slender stem that supports the leaf or leaf stalk
[Biosphere]

pH
A measure of acidity on a scale of 0 to 14, 0 being all hydrogen ion (highly acidic), 14 being no hydrogen, all hydroxyl ions (highly basic). The negative logarithm of the molar concentration of protons (H^+) in solution
[Atmosphere, Hydrosphere, Pedosphere]

pH Scale
The system used to specify the range of acidity of substances. On this scale, a substance with a pH of 7 is neutral.
[Atmosphere]

Phase Change
The change in a substance from one phase to another. Substances (elements and compounds) generally exist in one of three phases solid, liquid, and gas; For example, water vapor (gas) condensing into water (liquid). Substances undergoing phase changes take up or give off heat without changing temperature. (See Latent Heat)
[Atmosphere]

Phenology
The study of natural responses of living organisms to seasonal and climatic changes in their environment. Examples of phenological events include migration of birds and butterflies, flowering, green-up and green-down, salmon spawning, etc.
[Biosphere]

Photointerpretation
The production of a land cover map or identification of specific features by visual inspection of an aerial photo or satellite image
[Biosphere]

Photolysis
The break-up of an atmospheric compound by light. For example, when ozone (O_3) is formed in the atmosphere, it can be split into atomic oxygen (O) and molecular oxygen (O_2) by ultraviolet sunlight.
[Atmosphere]

Photosynthesis
The process used by green plants, algae and photosynthetic bacteria to use the energy of sunlight to convert carbon dioxide and water into carbohydrates, through the green pigment chlorophyll; this process releases oxygen and is the chief source of atmosphere
[Biosphere, Hydrosphere]

Photosynthetic Potential
The maximum amount of biomass that can be produced in an area
[Biosphere]

Physiological
Characteristic of, or appropriate to, an organism's healthy or normal functioning
[Biosphere]

Pixels
The smallest element of an image
[Biosphere]

Platy Structure
Flat, plate-like soil peds
[Pedosphere]

Polar
Regions on the Earth poleward of 60 degrees latitude
[Earth as a System]

Polar-Orbiting Satellite
An artificial satellite (spacecraft that orbits Earth) passing near or over the poles. This term usually refers to satellites in near-polar orbits that are designed so that their orbital plane maintains a constant angle (on average) with the line between the sun and Earth. These are called sun-synchronous satellites.
[Atmosphere]

Pollutant
A trace gas or aerosol that contaminates the air
[Atmosphere]

Polyhedron
A solid formed or bounded by planes or faces
[Earth as a System]

Pond
A small body of still water formed artificially either by hollowing out of the soil or by damning a natural hollow
[Hydrosphere]

Pool
In a stream or river, a deeper region with slower-moving water and smaller sediments
[Hydrosphere]

Porosity
Percentage of soil volume not occupied by solid material
[Pedosphere]

Potential Energy
The energy an object has or the objects' stored capacity to do work because of its configuration and position
[Earth as a System]

Potential Growing Season
That part of the yearly temperature cycle when the temperature is above freezing, thus enabling plant growth to occur.
[Biosphere]

ppb
Parts per billion, a unit of measure of atmospheric trace gas concentration or mixing ratio; sometimes denoted ppbv (parts per billion by volume), which is how trace gas mixing ratios are normally defined.
[Atmosphere]

ppm
Usually parts per million. (Equivalent to milligrams per Liter in GLOBE calculations)
[Hydrosphere]

ppm Chlorinity
By weight, equal to milligrams of chlorine per Liter, with the assumption that one Liter of water weighs one kilogram
[Hydrosphere]

ppt
Usually parts per thousand. (Equivalent to grams per Liter in GLOBE calculations)
[Hydrosphere]

Precipitable Water Vapor
The depth of a planet-wide layer of liquid water that would be formed if all the water vapor in a column of atmosphere were condensed onto Earth's surface. On average, the atmosphere contains about 2 centimeters of precipitable water vapor.
[Atmosphere]

Precipitation
1. Water in solid or liquid form that falls to Earth's surface from the atmosphere (e.g. rain, snow, hail)
2. Separation in solid form from a solution due to chemical or physical change (e.g. adding a reagent or lowering the temperature)
[Atmosphere, Hydrosphere]

Precise
Exact in measuring.
[Biosphere]

Precision
A measurement for the degree of agreement between multiple analyses

of a sample (See accuracy)
[Hydrosphere]

Precursor
A chemical necessary to reactions that form other compounds (e.g., nitric oxide is a precursor of ozone in the near-surface atmosphere)
[Atmosphere]

Pressure
Force per unit area; for the atmosphere, it may be thought of as the weight of the column of air above a given area.
[Atmosphere]

Primary Productivity
The rate at which organic material is produced by photosynthesis at a given location. Often represented as grams (dry weight) of Carbon per m^2 per year.
[Biosphere]

Prismatic Structure
A type of soil structure in which the soil ped is in the shape of a prism, generally ranging from 1.0 – 10.0 cm
[Pedosphere]

Probe
In GLOBE, an instrument used to measure voltage or resistance of a substance. Any small device, especially that holds an electrode, which can penetrate or be placed in or on something for the purpose of obtaining and relaying information or measurements about it. A probe along with a meter must be calibrated in order to produce sensible data.
[Hydrosphere]

Processes
The progression of physical interactions between different components of the Earth system and between sub-components of the Earth system
[Biosphere, Earth as a System]

Producers
Living things that as a result of their biologic processes release material into their environment that may be used by other living things
[Biosphere]

Productivity
The formation of organic matter averaged over a period of time such as a day or a year
[Hydrosphere]

Profile
The “face” of a soil when it has been cut vertically that shows the individual horizons and soil properties with depth
[Pedosphere]

Protocol
A plan for carrying out a scientific study
[Atmosphere, Biosphere, Hydrosphere, Pedosphere]

Proton
A positively charged elementary particle found in all atomic nuclei. The positively charged hydrogen atom (H^+)
[Hydrosphere]

Protractor
A measuring device used to measure angles
[Biosphere]

Q

R

Radiation
See *“Electromagnetic Radiation”*.
[Atmosphere]

Rayleigh scattering
Scattering of sunlight by molecules in the atmosphere, named after the 19th century British physicist John William Strutt, the third Baron Rayleigh.
[Atmosphere]

Reactive Chemicals
Chemicals that will undergo chemical reactions in the atmosphere
[Atmosphere]

Reagent
A substance used to cause a reaction, especially to detect another substance
[Hydrosphere]

Reduce
In chemical terms, to change from a higher to a lower oxidation state (i.e. gain electrons)
[Hydrosphere]

Reflection
The process by which radiation incident upon an object is directed at some fixed angle away from that object
[Atmosphere]

Region
An area defined by a common feature or features
[Biosphere, Earth as a System]

Relationships
Processes by which different components of the Earth system, or parts of the components of the Earth system interact and affect each other
[Biosphere, Earth as a System]

Relative Air Mass
The ratio of the amount of atmosphere between an observer and the sun relative to the amount of atmosphere directly overhead. Relative air mass is directly related to solar elevation angle.
[Atmosphere]

Relative Humidity
A measure of the amount of water vapor in a sample of air compared to the amount contained in an air sample at the same pressure and temperature saturated with water vapor
[Atmosphere]

Remote Sensing
A method of obtaining information about something without coming into physical contact with it
[Biosphere, Earth as a System]

Reservoirs
A space to store a substance, or a supply of a substance
[Biosphere, Earth as a System]

Resolution
The smallest area that can be identified individually in a map or satellite picture, or the smallest measurable change in a quantity
[Biosphere, Earth as a System]

Respiration
A process by organisms that converts the energy in organic materials into energy for use by cells
[Biosphere]

Richness
The number of different taxa
[Hydrosphere]

Riffle
In a stream or river, a shallower area with faster-flowing water and larger sediments
[Hydrosphere]

River
A large stream of water flowing in a channel towards the ocean, a lake, or another river
[Hydrosphere]

Run
In a stream or river, an intermediate category between pool and riffle. A run does not have the turbulence of a riffle, but moves faster than in a pool.
[Hydrosphere]

Runoff
1. The component of precipitation that appears as water, flowing in a stream or river; 2. Water that falls on the land surface but does not infiltrate and therefore flows across the land surface
[Hydrosphere, Pedosphere]

Rural
An area with very little man-made structures
[Biosphere]

S

Saline Water
Water containing salt or salts
[Hydrosphere]

Salinity
A measure of the concentration of dissolved salts, mainly sodium chloride, in brackish and salty water
[Hydrosphere]

Salts
Ionic compounds which in water solution yield positive (excluding H^+) and negative (excluding OH^-) ions ; the most common of which is sodium chloride, or “table salt”
[Hydrosphere]

Sand
A mineral particle between 0.05 and

2.0 mm in size that has a “gritty” feel when moistened and rubbed between the fingers
[Pedosphere]

Satellite
Any natural or man-made object that orbits a body in space; man-made satellites usually carry instruments for measuring various things about Earth’s environments
[Atmosphere, Biosphere, Earth as a System]

Saturated Solution
A solution that contains the maximum amount of dissolved substances at a given temperature and pressure
[Hydrosphere]

Saturation
When the pores of a soil are completely filled with water
[Pedosphere]

Scale
The regular markings on an instrument that permit the readings of a measured quantity, or the relative size of an object or area used to help define the processes that affect that object or area
[Biosphere, Earth as a System]

Scattering
The process by which radiation interacting with a substance is deflected in all directions
[Atmosphere]

Sea Level Pressure
Atmospheric pressure adjusted to the value that would be measured if the measurement location were at sea level
[Atmosphere]

Sea Spray
Aerosols blown off the surface of a salt water body under windy conditions, which may produce obstructions to visibility
[Atmosphere]

Seasonal Cycle
A periodic change in a variable that occurs in tandem with Earth’s seasons; the regular progression through the year through winter, spring, summer, and fall or through wet and dry periods
[Atmosphere, Biosphere, Earth as a System]

Sediment
Matter that settles to the bottom eventually but can be carried along in a water body or the air until then
[Biosphere]

Senescence
The changes that occur in an organism between maturity and death; in a plant this is equivalent to “green-down” and is associated with a reduction and/or halt of plant photosynthesis. The plant growth phase from full maturity to death that is characterized by a loss in dry weight
[Biosphere]

Sensible Heat
The heat associated with a change in temperature of a substance as distinct from the heat associated with a phase change
[Atmosphere, Earth as a System]

Shower
A type of precipitation event that is typically of short duration, or occurs with frequent changes of intensity
[Atmosphere]

Single Grained Structure
A structureless soil in which each soil grain is individual and loose in the soil (i.e. there are no peds)
[Pedosphere]

Silt
A mineral particle between 0.002 and 0.05 mm in size that has a “floury, smooth” feel when moistened and rubbed between the fingers
[Pedosphere]

Sleet
Precipitation that at some point is in liquid form, but freezes before reaching the ground
[Atmosphere]

Sling Psychrometer
A device consisting of two

thermometers, one of which has a dry bulb and the other of which has a bulb that is kept wet. The difference between the wet and dry bulb temperatures is used to calculate relative humidity.
[Atmosphere]

Smog
Air that contains a sufficient combination of aerosols from water and combustion to be visible. Aerosols in smog may be produced indirectly by reactions among the gases present in combustion exhaust. Smog originated as a term combining the words smoke and fog and may reduce visibility in a similar way.
[Atmosphere]

Smoke
Air containing sufficient aerosols produced by combustion to be visible, which may reduce visibility or obstruct views of the sky
[Atmosphere]

Snag
A tree or branch embedded in the bed of the water body
[Hydrosphere]

Soil Profile
The “face” of a soil when it has been cut vertically that shows the individual horizons and soil properties with depth
[Pedosphere]

Soil Water Content (SWC)
A measure of how much water is present in the pores of a soil, specifically, the ratio of the mass of water to the mass of dry soil.
[Pedosphere]

Solar Energy
Energy coming from the sun. See also Insolation.
[Earth as a System]

Solar Noon
The time at which the sun is at its highest point in the sky (zenith) during a day
[Atmosphere]

Solstice
(Stand still) when the sun is at its greatest distance from the equator, resulting in the longest day in one hemisphere and the shortest day in the other hemisphere; the sun appears to “stand still” when it reaches its highest point on this day
[Earth as a System]

Solubility
The relative capability of being dissolved
[Hydrosphere]

Solute
A substance that dissolves in another to form a solution
[Hydrosphere]

Solution
A homogeneous mixture containing two or more substances
[Hydrosphere]

Solvent
A substance that dissolves another to form a solution
[Hydrosphere]

Southern Hemisphere
The half of the Earth that lies south of the equator
[Earth as a System]

Spatial
Having to do with space
[Biosphere]

Spatial Relationship
Where bodies are located in regards to each other (e.g., the Sun and Earth)
[Biosphere, Earth as a System]

Species
This is a group of individual plants/ animals that is fundamentally alike.
[Biosphere]

Specific Heat
The amount of heat required to raise the temperature of 1 gram of a substance by 1˚ C
[Atmosphere, Hydrosphere]

Specific Gravity
The ratio of the density of a substance to the density of water (at 25°C and 1 atmosphere)
[Hydrosphere]

Squall
An intense or violent shower accompanied by strong, gusty winds
[Atmosphere]

Standardization
To cause to conform to a standard
[Hydrosphere]

Standard
A measure with a value established through outside means for use in calibration; a known reference
[Hydrosphere]

Station Pressure
The true atmospheric pressure, uncorrected to standard conditions at sea level. Weather reports generally give barometric pressure corrected to sea level, not station pressure.
[Atmosphere]

Stratiform
A cloud comprised of a single or multiple horizontal layers; there is very little discernible structure to clouds of this type.
[Atmosphere]

Stratosphere
The second layer of the atmosphere above Earth's surface, generally characterized by temperature increasing with altitude. The stratosphere begins at altitudes ranging from about 8 km in the polar regions to 1618 km in the tropics and extends to altitudes of about 50 km where there is a local maximum in atmospheric temperature. The stratosphere contains most of the ozone found in the atmosphere.
[Atmosphere]

Stream
A course of water flowing continuously along a bed on the Earth, forming a river, rivulet, or brook. Streams can be permanent meaning that water flows in the stream bed all year long; or streams can be intermittent/ephemeral, meaning that the water stops flowing and may even disappear during certain times of the year.
[Hydrosphere]

Structure
The shape of soil units (peds) that occur naturally in a soil horizon. Some possible soil structures are granular, blocky, prismatic, columnar, or platy. Soils can also be structureless if they do not form into peds. In this case, they may be a consolidated mass (massive) or stay as individual particles (single grained).
[Pedosphere]

Sublimation
The transition of a substance directly from the solid phase to the gas phase
[Atmosphere]

Suboxic Water
Very low levels of dissolved oxygen; denitrification occurs (nitrate is converted to ammonia)
[Hydrosphere]

Subpolar
A climate zone lying between the temperate and polar zones
[Biosphere, Earth as a System]

Subsoil
The common term for the layers beneath the topsoil
[Pedosphere]

Subtropical
A climate zone lying between the tropic and temperature zones
[Biosphere, Earth as a System]

Suburban
A land area in which there is a mixture of man-made structures and open spaces
[Biosphere]

Sun Photometer
An instrument that measures the intensity of sunlight transmitted through the atmosphere within a narrow wavelength range
[Atmosphere]

Supercooled Water
Water with a temperature that is below its freezing point but still in liquid form
[Atmosphere]

Supernatant
When soil particles are suspended

and allowed to settle, the liquid above the settled soil is cleaner than the soil below
[Pedosphere]

Supersaturated
The characteristic of a substance holding more of another substance that would be predicted under equilibrium conditions. Supersaturated is a term commonly used to describe gases dissolved in water (e.g. if there is a lot of photosynthesis occurring in a lake, the water can become supersaturated in oxygen during the day)
[Hydrosphere]

Surface Temperature
The temperature of the surface or the air next to the surface of the Earth
[Atmosphere, Earth as a System]

Suspended Solids
Solid particles in a fluid that do not dissolve or settle out
[Hydrosphere]

Suspensions
A mixture in which very small particles of a solid remain suspended without dissolving
[Hydrosphere]

System
A group of components that interact to produce a whole (in the case of the Earth system) or a specific result (in the case of a machine)
[Biosphere, Earth as a System]

T

Tannin
Bitter waste product in leaves that is brown; common name for tannic acid or similar compounds
[Biosphere]

Taxa
Plural of taxon
[Hydrosphere]

Taxon
A group of organisms of any particular rank (such as order, family, genus). Singular of taxa
[Hydrosphere]

Temperature
A measure of the average energy of motion of all the atoms and molecules that make up a substance, measured with a thermometer
[Atmosphere, Biosphere, Earth as a System]

Thermal inertia
A material body's resistance to a change in temperature
[Earth as a System]

Temperature Inversion
An increase in temperature with height in the troposphere, usually associated with a very stable air mass. Normally, temperature in the troposphere increases with height. When and where temperature increases with height, vertical mixing of the atmosphere is greatly decreased. This leads to the trapping of aerosols and trace gases from the surface being contained in the air near the surface. It also causes the atmosphere to be stratified in horizontal layers in the stratosphere, hence the name of this atmospheric layer.
[Atmosphere]

Texture
The way soil "feels" when it is squeezed between the fingers or in the hand. The texture depends on the amount of sand, silt, and clay in the sample (particle size distribution), as well as other factors (how wet it is, how much organic matter is in the sample, the kind of clay, etc.)
[Pedosphere]

Thermosphere
The fourth layer of the atmosphere above Earth's surface. In the thermosphere, temperature increases greatly, ion concentrations become significant, and the dynamics of the atmosphere is virtually independent of the forces and phenomena associated with Earth's surface and lower atmosphere. Most of the ionosphere is contained within the thermosphere

and above the thermosphere is interplanetary space.

[Atmosphere]

Thunderstorm

A cumulonimbus cloud or family of cumulonimbus clouds that produce lightning, and therefore, thunder. Thunderstorms are not always accompanied by precipitation reaching the ground.

[Atmosphere]

Tides

The periodic rise and fall of the waters of the ocean and its inlets, produced by the attraction of the moon and sun. Occurs about every 12 hours.

[Hydrosphere]

Time Scales

The time period over which different processes occur ranging from seconds and minutes for the formation of clouds to billions of years for the formation of Earth

[Earth as a System]

Titrant

The reagent added in a titration

[Hydrosphere]

Titration

The process of ascertaining the quantity of a given constituent by addition of a liquid reagent of known strength, and measuring the volume of reagent necessary to convert the constituent through a given reaction

[Hydrosphere]

TM

Thematic Mapper. Carried aboard the Landsat 4 and 5 satellites, this instrument is designed to study surface features in 7 bands covering the visible through thermal infrared regions with a pixel resolution of 30 m in 6 bands and 120 m in the thermal infrared band.

[Biosphere]

Topographic Map

Map showing detailed features and contour lines of an area

[Biosphere]

Topography

The surficial relief features of an area

[Hydrosphere]

Topsoil

The common term for the top layer of soil

[Pedosphere]

Total Dissolved Solids

The total mass of solids remaining when a given volume of filtered water is evaporated to total dryness following an accepted protocol

[Hydrosphere]

Trace Gas

Gases present in the atmosphere in very small quantities, always less than one-tenth of one percent

[Atmosphere]

Transect

In any field (outdoor) study, a transect consists of a line of study, often divided into intervals where observations or samples are collected.

[Pedosphere]

Transparency

Having the property of transmitting rays of light through its substance so that bodies located behind can be distinctly seen. Transparency, when applied to water studies, refers to the distance that an object (e.g. a secchi disk) can be seen looking down through the water under ambient light conditions. Transparency is related to turbidity in that the amount of particles in the water and the characteristics of those particles will affect the distance that an object can be seen, but the two are not directly comparable.

[Hydrosphere]

Transpiration

The process by which water vapor escapes into the atmosphere through open stomata on plant leaf surfaces

[Atmosphere, Pedosphere]

Tropic of Cancer

The parallel of latitude 23˚ 27’ north of the equator; the most northerly latitude at which the sun can shine directly

overhead
[Earth as a System]

Tropic of Capricorn
The parallel of latitude 23˚ 27' south of the equator; the most southerly latitude at which the sun can shine directly overhead
[Earth as a System]

Tropical
Of, occurring in, or characteristic of the tropics
[Biosphere, Earth as a System]

Tropical Cyclone
A low pressure system found in tropical latitudes which may develop into a tropical storm, hurricane, and other similarly intense storm
[Atmosphere]

Troposphere
The lowest layer of the atmosphere where almost all weather occurs. The troposphere contains about 80% of the atmosphere's mass and is characterized by temperatures that normally decrease with altitude. The boundary of the troposphere and the stratosphere depends on latitude and season. It ranges from as low as 8 km over the poles to as high as 16-18 km in the tropics.
[Atmosphere]

Tundra
Treeless plains that lie poleward of the tree line in the Arctic. Tundra lies mostly over permafrost and is not permanently covered with snow.
[Biosphere, Earth as a System]

Turbid
Not clear or transparent due to stirred up sediment
[Hydrosphere]

Turbidity
Turbidity, when applied to water studies, refers to the degree that the particles in the water can scatter light sent through a water sample. Turbidity is related to transparency, but the two terms are not equivalent, and the relationship depends on the characteristics of a particular water sample. Therefore turbidity measurements cannot be used in place of transparency measurements and vice-versa.
[Hydrosphere]

U

Ultraviolet
A part of the electromagnetic spectrum that is more energetic, and of shorter wavelengths than visible light; usually defined as radiation with wavelengths of 0.1 - 0.38 micrometers.
[Atmosphere]

Uniform
This term is used in its traditional sense when characteristics display similar properties. Two related words are homogeneous (distributed evenly) and normal (distributed about a central mean value and described by a statistical equation).
[Pedosphere]

Universal Time (UT)
The time at 0 degrees longitude (the prime meridian); UT is the currently preferred term for this reference time, which is the same as GMT.
[Atmosphere, Biosphere, Hydrosphere, Pedosphere]

Urban
Area mostly covered with man-made structures, developed for residential (ex. houses, apartments), commercial (ex. stores), industrial (ex. factories) or transportation (ex. roads) uses
[Biosphere]

V

Validation Data
Data necessary to assess the accuracy of a land cover map produced by manual or electronic means.
[Biosphere]

Value
When referenced to hue, an indication

of the lightness of a color
[Pedosphere]

Variables
A characteristic that can be measured and can assume different values
[Earth as a System]

Variation
A different form of something
[Biosphere]

Vegetation Vigor
Amount of plant growth
[Biosphere, Earth as a System]

Visibility
The distance over which an observer can see and clearly identify an object
[Atmosphere]

Visible Radiation
Light with wavelengths between about 0.38 and 0.7 micrometers that may be seen by humans. The sun emits its peak amount of energy in the visible portion of the electromagnetic spectrum.
[Atmosphere]

Visualization
Display of information graphically or on a map using color or grey-scales, and/or lines and symbols
[Biosphere, Earth as a System]

Volatilization
Evaporation of water vapor or other gases from the soil
[Pedosphere]

Volcanic Ash
Small particles of minerals, rock and glass fragments ejected from volcanic eruptions. As aerosols they may reduce visibility or obscure a view of the sky. These particles often produce spectacular light scattering effects including colorful sunsets.
[Atmosphere]

W

Water Cycle
The cycle by which water is moved between the different components of the Earth system (atmosphere, hydrosphere, lithosphere, pedosphere, cryosphere, and biosphere) in its various states (solid, liquid, and gas). See also Hydrologic Cycle.
[Atmosphere, Biosphere, Earth as a System]

Water Quality
A distinctive attribute or characteristic trait of water, described by physical, chemical, and biological properties
[Hydrosphere]

Watershed
The total area from which water is drained by a river and its tributaries. The line separating the waters flowing into different rivers, river basins or seas; a narrow elevated tract of ground between two drainage areas. See catchment basin
[Earth as a System, Hydrosphere]

Water Erosion
The wearing away of the land surface by water creating the detachment and movement of soil from one location to another.
[Pedosphere]

Water Vapor
The colorless, odorless, invisible, gaseous form of water in the atmosphere
[Atmosphere]

Wavelength (of light)
A property of light that is inversely proportional to its frequency and describes the distance from one wave peak to the following wave peak. Visible light lies in the wavelength range from about 0.38 micrometers (violet) to 0.7 micrometers (red). The peak sensitivity of the human eye is to light at a wavelength of about 0.5 micrometers (green), near the response wavelength of the green channel of the GLOBE sun photometer.
[Atmosphere]

Weather
The state of the atmosphere at a particular place and time. Weather includes variables such as

temperature, barometric pressure, wind, cloudiness, precipitation, and relative humidity.
[Atmosphere, Earth as a System]

Wet Bulb Depression
The difference between the dry bulb and wet bulb temperature readings on a sling psychrometer
[Atmosphere]

Wet Bulb Temperature
The temperature taken on a sling psychrometer from the thermometer with its bulb covered in a wet wick, after slinging or whirling the psychrometer for the prescribed amount of time
[Atmosphere]

Wet Deposition
The depositing of gases or aerosols from the atmosphere on to Earth's surface through their incorporation in precipitation (rain drops, snowflakes, etc.). Sometimes the terms 'rain out' or 'wash out' are used in place of wet deposition.
[Atmosphere]

Wind Erosion
The wearing away of the land surface by wind creating the detachment and movement of soil from one location to another
[Pedosphere]

Winds
The movement of air relative to the surface of the Earth
[Earth as a System]

X

Xanthrophyll
Pigment in leaves that is yellow
[Biosphere]

Y

Z

Zenith Angle
The angular distance between an object in the sky, such as the sun, and an object directly overhead. Zenith angle is 90˚ minus the *elevation angle*.
[Atmosphere]

MUC Glossary of Terms

This glossary provides definitions, decision criteria, and examples for the land cover types outlined in the Modified UNESCO Classification (MUC) System. The land cover types are organized numerically in the same order as the classes appear in the MUC System Table. Miscellaneous terms used in the glossary are defined in the section following the numbered MUC definitions.

The MUC Glossary of Terms contains four columns of information:

1. **MUC Class:** the number used to classify each land cover type.
2. **MUC Name:** the name used to describe each land cover type.
3. **MUC Level:** the hierarchical level of the MUC System for each MUC Class from 1 (general classes) to 4 (detailed classes).
4. **Definitions:** definitions, decision criteria, and examples used to define each MUC Class.

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MUC (Modified UNESCO Classification) System Glossary

MUC Class	MUC Name	MUC Level	Definitions
0	**Closed Forest**	**Level 1**	**Formed by trees at least 5 meters tall with their crowns (i.e. branches) interlocking. The tree canopy covers at least 40% of the ground.**
01	Mainly Evergreen	Level 2	Within *Closed Forest (0)*. The canopy is never without green foliage. At least 50% of the trees that reach the canopy are evergreen. Individual trees may shed their leaves.
011	Tropical Wet (Rain)	Level 3	Within *Mainly Evergreen Closed Forest (01)*. Often called a tropical rain forest. Consisting mainly of broad-leaved evergreen trees, neither cold nor drought resistant. Truly evergreen, i.e. the forest canopy remains green all year though a few individual trees may be leafless for a few weeks. Leaves of many species have “drip tips.”
0111	Lowland	Level 4	*Within Tropical Wet Mainly Evergreen Closed Forest (011)*. Consists usually of numerous species of fast growing trees, many exceeding 50 meters tall, generally with smooth, often thin bark, some with buttresses. Emergent trees or at least a very uneven canopy often present. Undergrowth is sparse, composed mainly of tree seedlings. Palms and other tuft trees usually are rare. Crustose lichens and green algae are present, and climbing vines are usually only abundant in extremely humid regions (e.g., Sumatra,Atrato Valley, Columbia).
0112	Submontane	Level 4	Within *Tropical Wet Mainly Evergreen Closed Forest (011)*. Emergent trees are largely absent and the canopy is relatively even. Forbs are common in the undergrowth. Vascular epiphytes and vines are abundant. E.g., Atlantic slopes of Costa Rica
0113	Montane	Level 4	Within *Tropical Wet Mainly Evergreen Closed Forest (011)*. Trees are less than 50 meters tall, have crowns that extend relatively far down the stem, and often have rough bark. Undergrowth abundant, often with ferns, herbs, mosses, and small palms. E.g., Sierra de Talamanca, Costa Rica.
0114	Subalpine	Level 4	Within *Tropical Wet Mainly Evergreen Closed Forest (011)*. Occurs at elevations above montane forests, with characteristic vegetation, which is dependent on latitude.
0115	Cloud	Level 4	Within *Tropical Wet Mainly Evergreen Closed Forest (011)*. Trees are gnarled, have rough bark and are rarely greater than 20 meters tall. Tree crowns, branches, and trunks are burdened with epiphytes, mainly chamaephytic bryophytes. Also, the ground is covered with hygromorphic chamaephytes such as *Selaginella* and ferns. E.g., Blue Mountains, Jamaica.
012	Tropical and Subtropical Seasonal	Level 3	Within *Mainly Evergreen Closed Forest (01)*. Consisting mainly of broad-leaved evergreen trees. Foliage reduction during the dry season is noticeable, often as partial shedding. Transitional between Tropical Wet Forest and Tropical and Subtropical Semi-deciduous.
0121	Lowland	Level 4	Within *Tropical and Subtropical Evergreen Seasonal Closed Forest (012)*. Consists of fast growing trees, many exceeding 50 meters tall and usually forming an uneven canopy. Undergrowth is sparse, lichen and green algae are present, and climbing vines are absent.
0122	Submontane	Level 4	Within *Tropical and Subtropical Evergreen Seasonal Closed Forest (012)*. Trees form an even canopy. Forbs are common in the undergrowth. Vascular epiphytes and vines are abundant.

MUC Class	MUC Name	MUC Level	Definitions
0123	Montane	Level 4	Within *Tropical and Subtropical Evergreen Seasonal Closed Forest (012)*. Trees are less than 50 meters tall, have crowns that extend relatively far down the stem and have rough bark. There are no tree ferns; instead, evergreen shrubs are most common.
0124	Subalpine	Level 4	Within *Tropical and Subtropical Evergreen Seasonal Closed Forest (012)*. This forest resembles the Winter-rain Evergreen Broad-leaved Sclerophyllous dry forest and usually occurs above the cloud forest. Trees are mostly evergreen sclerophyllous trees, smaller than 20 meters with little or no undergrowth, few climbing vines, and few epiphytes, except lichens.
013	Tropical and Subtropical Semi-Deciduous	Level 3	Within *Mainly Evergreen Closed Forest (01)*. Most of the upper canopy trees are drought-deciduous; many of the understory trees and shrubs are evergreen and more or less sclerophyllous. However, evergreen and deciduous woody plants and shrubs are not always separated by layers; they may occur mixed within the same layer, or shrubs may be primarily deciduous and trees evergreen. Nearly all trees have bud protection and leaves without “drip tips.” Trees have rough bark, except some bottle trees, which may be present.
0131	Lowland	Level 4	Within *Mainly Evergreen Tropical and Subtropical Semi-deciduous Closed Forest (013)*. The taller trees may be bottle trees (e.g., *Ceiba*). There are practically no epiphytes present. The undergrowth is composed of shrubs and seedlings. Succulents such as thin-stemmed caespitose cacti may be present. Vines occur occasionally. A sparse layer of herbaceous vegetation may also be present.
0133	Montane and Cloud	Level 4	Within *Mainly Evergreen Tropical and Subtropical Semi-deciduous Closed Forest (013)*. This forest is similar to a Semi-deciduous Lowland Forest, however, the canopy is lower and covered with xerophytic epiphytes such as *Tillandsia usneoides*.
014	Subtropical Wet	Level 3	Within *Mainly Evergreen Closed Forest (01)*. Present only locally and in small fragmentary stands, because the subtropical climate typically has a dry season. It usually grades into Tropical Wet Forest (e.g., Queensland, Australia and Taiwan). Some shrubs may grow in the understory. Seasonal temperature change occurs between summer and winter. There is a more pronounced temperature difference between summer and winter than the (Tropical Wet) Montane Forest (0113).
0141	Lowland	Level 4	Within *Mainly Evergreen Subtropical Wet Closed Forest (014)*. Consists usually of numerous species of fast growing trees, many exceeding 50 meters tall, generally with smooth, often thin bark, some with buttresses. Emergent trees or at least a very uneven canopy often present. Undergrowth is sparse, composed mainly of tree seedlings. Palms and other tuft trees usually are rare. Crustose lichens and green algae are present, and climbing vines are usually only abundant in extremely humid regions.
0142	Submontane	Level 4	Within *Mainly Evergreen Subtropical Wet Closed Forest (014)*. Emergent trees are largely absent and the canopy is relatively even. Forbs are common in the undergrowth. Vascular epiphytes and vines are abundant.
0143	Montane	Level 4	Within *Mainly Evergreen Subtropical Wet Closed Forest (014)*. Trees are less than 50 meters tall, have crowns that extend relatively far down the stem, and often have rough bark. Undergrowth abundant, often with ferns, herbs, mosses, and small palms.

MUC Class	MUC Name	MUC Level	Definitions
0144	Subalpine	Level 4	Within *Mainly Evergreen Subtropical Wet Closed Forest (014)*. Occurs at elevations above montane forests, with characteristic vegetation, which is dependent on latitude.
0145	Cloud	Level 4	Within *Mainly Evergreen Subtropical Wet Closed Forest (014)*. Trees are gnarled, have rough bark and are rarely greater than 20 meters tall. Tree crowns, branches, and trunks are burdened with epiphytes, mainly chamaephytic bryophytes. Also, the ground is covered with hygromorphic chamaephytes (e.g., *Selaginella* and herbaceous ferns).
015	Temperate or Sub polar Wet	Level 3	Within *Mainly Evergreen Closed Forest (01)*. Occurs only in the extremely oceanic, nearly frost-free climates of the southern hemisphere, mainly in Chile. Consisting mostly of truly evergreen hemisclerophyllous trees and shrubs. Rich in epiphytic mosses, liverworts, and lichens that grow on trees, and in ground-rooted herbaceous ferns.
0151	Temperate	Level 4	Within *Mainly Evergreen Temperate or Subpolar Wet Closed Forest (015)*. Trees are generally greater than 10 meters tall. Vascular epiphytes and vines may be present.
0152	Subpolar	Level 4	Within *Mainly Evergreen Temperate or Subpolar Wet Closed Forest (015)*. Trees are generally less than 10 meters tall and often have reduced leaf size. There are few vascular epiphytes present. E.g., beech forests of New Zealand
016	Temperate with Broad-Leaved Deciduous	Level 3	Within *Mainly Evergreen Closed Forest (01)*. Requires adequate summer rainfall. This is a mixed evergreen-deciduous class. The dominant trees are mainly hemisclerophyllous evergreen trees (more than 50% of the canopy) and shrubs, and the subdominant trees are deciduous broad-leaved trees and shrubs (more than 25% of the canopy). Rich in perennial herbaceous plants. Very few or no vascular epiphytes and vines.
0161	Lowland	Level 4	Within *Temperate Deciduous Broad-Leaved Mainly Evergreen Closed Forest (016)*. Consists usually of numerous species of fast growing trees, many exceeding 50 meters tall, generally with smooth, often thin bark, some with buttresses. Emergent trees or at least a very uneven canopy often present. Under growth is sparse, composed mainly of tree seedlings. Palms and other tuft trees usually are rare. Crustose lichens and green algae are present, and climbing vines are usually only abundant in extremely humid regions.
0162	Submontane	Level 4	Within *Temperate Deciduous Broad-Leaved Mainly Evergreen Closed Forest (016)*. Emergent trees are largely absent and the canopy is relatively even. Forbs are common in the undergrowth. Vascular epiphytes and vines are abundant.
0163	Montane	Level 4	Within *Temperate Deciduous Broad-Leaved Mainly Evergreen Closed Forest (016)*. Trees are less than 50 meters tall, have crowns that extend relatively far down the stem, and often have rough bark. Undergrowth abundant, often with ferns, herbs, mosses, and small palms.
0164	Subalpine	Level 4	Within *Temperate Deciduous Broad-Leaved Mainly Evergreen Closed Forest (016)*. Occurs at elevations above montane forests, with characteristic vegetation, which is dependent on latitude.
017	Winter-Rain Broad-Leaved Sclerophyllous	Level 3	Within *Mainly Evergreen Closed Forest (01)*. Often understood as Mediterranean, but present also in southwestern Australia, Chile, and other locations. The climate has a pronounced summer drought. Consisting mainly of sclerophyllous evergreen trees and shrubs, most of which have rough bark. There is very little herbaceous undergrowth. No vascular and few non-flowering epiphytes and lichens, but evergreen woody vines are present.

MUC Class	MUC Name	MUC Level	Definitions
0171	Lowland and Submontane >50m	Level 4	Within *Winter-Rain Evergreen Broad-Leaved Sclerophyllous Closed Forest (017)*. Dominated by trees over 50 meters tall (at least 50% of the canopy) such as giant eucalyptus (e.g., *Eucalyptus regnans* in Victoria, Australia and *E. diversicolor* in Western Australia).
0172	Lowland and Submontane <50m	Level 4	Within *Winter-Rain Evergreen Broad-Leaved Sclerophyllous Closed Forest (017)*. Dominated by trees less than 50 meters tall (more than 50% of the canopy). E.g., Californian live-oak forests.
018	Tropical and Subtropical Needle-Leaved	Level 3	Within *Mainly Evergreen Closed Forest (01)*. Consisting mainly of needle-leaved or scale-leaved evergreen trees (more than 50% of the canopy). Broad-leaved trees may be present. Vascular epiphytes and vines rarely present. Species typical of the tropical/subtropical zone.
0181	Lowland and Submontane	Level 4	Within *Tropical and Subtropical Needle-Leaved Mainly Evergreen Closed Forest (018)*. E.g., the pine forests of Honduras and Nicaragua.
0182	Montane and Subalpine	Level 4	Within *Tropical and Subtropical Needle-Leaved Mainly Everreen Closed Forest (018)*. E. g., the pine forests of the Philippines and southern Mexico.
019	Temperate and Subpolar Needle-Leaved	Level 3	Within *Mainly Evergreen Closed Forest (01)*. Consisting mainly of needle-leaved or scale-leaved evergreen trees (more than 50% of the canopy), but broad-leaved trees may be present. Vascular epiphytes and vines are rarely present. Species typical of the temperate/subpolar zone.
0191	Giant (> 50m)	Level 4	Within *Temperate and Subpolar Needle-Leaved Mainly Evergreen Closed Forest (019)*. Dominated by trees (at least 50% of the canopy) greater than 50 meters tall (e.g., *Sequoia* and *Pseudo-tsuga* forest in the Pacific West of North America).
0192	Irregularly Rounded Crowns	Level 4	Within *Temperate and Subpolar Needle-Leaved Mainly Evergreen Closed Forest (019)*. Dominated by trees 45-50 meters tall (more than 50% of the canopy), with broad, irregularly rounded crowns (e.g., Pinus spp.).
0193	Conical Crowns	Level 4	Within *Temperate and Subpolar Needle-Leaved Mainly Evergreen Closed Forest (019)*. Dominated by trees 45-50 meters tall (more than 50% of the canopy), with conical crowns (like most Picea and Abies). E.g., California red fir forests.
0194	Cylindrical Crowns	Level 4	Within *Temperate and Subpolar Needle-Leaved Mainly Evergreen Closed Forest (019)*. Dominated by trees 45-50 meters tall (more than 50% of the canopy), with crowns with very short branches and therefore a narrow cylindrical shape.
02	Mainly Deciduous	Level 2	Within *Closed Forest (0)*. The majority of trees (more than 50% of the canopy) shed their foliage simultaneously in connection with the unfavorable season (drought or cold).
021	Tropical and Subtropical Drought-Deciduous	Level 3	Within *Mainly Deciduous Closed Forest (02)*. The unfavorable season is mainly characterized by drought, in most cases by winter-drought. Foliage is shed regularly every year. Most trees have relatively thick, fissured bark.
0211	Broad-Leaved Lowland and Submontane	Level 4	Within *Tropical and Subtropical Drought-Deciduous Closed Forest (021)*. Practically no evergreen plants in stratum except some succulents. Woody and herbaceous vines and deciduous bottle-trees are present occasionally. Sparse herbaceous vegetation present in the undergrowth. E.g., the broad-leaved deciduous forests of northwestern Costa Rica.

MUC Class	MUC Name	MUC Level	Definitions
0212	Montane and Cloud	Level 4	Within *Tropical and Subtropical Drought-Deciduous Closed Forest (021)*. Some evergreen species are present in the understory. Drought resistant epiphytes are present or abundant, often of the bearded form (e.g., *Usnea* or *Tillandsia usneoides*). This formation is not frequent, but well developed. E.g., in northern Peru.
022	Cold-Deciduous with Evergreens	Level 3	Within *Mainly Deciduous Closed Forest (02)*. The unfavorable season is mainly characterized by winter frost. Deciduous broad-leaved trees are dominant (more than 50% of the canopy), but evergreen species are present (more than 25% of the canopy) as part of the main canopy or the understory. Climbers and vascular epiphytes are scarce or absent.
0221	With Evergreen Broad-Leaved Trees and Climbers	Level 4	Within *Cold-Deciduous with Evergreens Closed Forest (022)*. Rich in epiphytes, including mosses. Vascular epiphytes may be present at the base of tree stems. Climbing vines may be common on flood plains. Ex. *Ilex aquifolium* and *Hedera helix* in western Europe and *Magnolia* spp. in North America.
0222	With Evergreen Needle-Leaved Trees	Level 4	Within *Cold-Deciduous with Evergreens Closed Forest (022)*. With evergreen needle-leaved trees such as hemlock (Tsuga) and pine (Pinus) . E.g., the maple-hemlock or oak-pine forests of Northeastern, U.S.A.
023	Cold-Deciduous without Evergreen Trees	Level 3	Within *Mainly Deciduous Closed Forest (02)*. Deciduous trees are absolutely dominant (more than 75% of the canopy). Evergreen herbs and some evergreen shrubs (less than 2 meters tall) may be present. Climbers insignificant but may be common on flood plains. Vascular epiphytes are absent (except occasionally at the lower base of the tree). Mosses, liverworts and particularly lichens are always present.
0231	Temperate Lowland and Submontane Broad-Leaved	Level 4	Within *Cold-Deciduous without Evergreen Trees Closed Forest (023)*. Trees are up to 50 meters tall. Epiphytes are primarily algae and crustose lichens. E.g., the Mixed Mesophytic Forest of U.S.A.
0232	Montane and Boreal	Level 4	Within *Cold-Deciduous without Evergreen Trees Closed Forest (023)*. Trees may be up to 50 meters tall, but in montane or boreal forest normally not taller than 30 meters. Epiphytes are primarily lichens and bryophytes. This class includes lowland or submontane in topographic positions with high atmospheric humidity.
0233	Subalpine and Subpolar	Level 4	Within *Cold-Deciduous without Evergreen Trees Closed Forest (023)*. Trees are not taller than 20 meters and tree trunks are frequently gnarled. Epiphytes are lichens and bryophytes, and are more abundant than in the Montane or Boreal class (0232). This class often grades into woodland.
03	Extremely Xeromorphic (Dry)	Level 2	Within *Closed Forest (0)*. Dense stands of trees adapted to dry conditions, such as bottle trees, tuft trees with succulent leaves and stem succulents. Under growth has shrubs adapted to dry conditions, succulent perennial herbs and annual and perennial herbaceous plants. Often grades into woodland.
031	Sclerophyllous-Dominated	Level 3	Within *Extremely Xeromorphic Closed Forest (03)*. There is a predominance of sclerophyllous trees, many of which have bulbous stem bases largely embedded in the soil.
032	Thorn-Dominated	Level 3	Within *Extremely Xeromorphic Closed Forest (03)*. Species with thorns are dominant (more than 50% of the canopy).

MUC Class	MUC Name	MUC Level	Definitions
0321	Mixed Deciduous-Evergreen	Level 4	Within *Extremely Xeromorphic Thorn-Dominated Closed Forest (032)*. Both deciduous and evergreen thorn species are more than 25% of the tree canopy.
0322	Purely Deciduous	Level 4	Within *Extremely Xeromorphic Thorn-Dominated Closed Forest (032)*. Deciduous thorn species are absolutely dominant (more than 75% of the canopy).
033	Mainly Succulent	Level 3	Within *Extremely Xeromorphic Closed Forest (03)*. Tree-formed (scapose) and shrub-formed (caespitose) succulents are very frequent (more than 50% of the canopy), but other trees and shrubs adapted to dry conditions are usually present as well.
1	**Woodland**	**Level 1**	**Comprised of open stands of trees at least 5 meters tall with crowns not interlocking. The tree canopy covers at least 40% of the ground. Definitions for Mainly Evergreen Woodland, Mainly Deciduous Woodland, and Extremely Xeromorphic Woodland are similar to forest definitions, with sparser stocking of individual trees.**
11	Mainly Evergreen	Level 2	Within *Woodland (1)*. The canopy is never without green foliage. At least 50% of the trees that reach the canopy are evergreen. Individual trees may shed their leaves.
111	Broad-Leaved	Level 3	Within *Mainly Evergreen Woodland (11)*. Mainly sclerophyllous broad-leaved trees and shrubs, with no epiphytes.
112	Needle-Leaved	Level 3	Within *Mainly Evergreen Woodland (11)*. Trees are mainly needle- or scale-leaved (more than 50% of the canopy). Crowns of many trees extend to the base of the stem or are very branchy.
1121	Irregularly Rounded Crowns	Level 4	Within *Mainly Evergreen Needle-Leaved Woodland (112)*. Dominated by trees (more than 50% of the canopy) with broad, irregularly rounded crowns (e.g., Pinus).
1122	Conical Crowns	Level 4	Within *Mainly Evergreen Needle-Leaved Woodland (112)*. Dominated by trees (more than 50% of the canopy) with conical crowns. Mostly in subalpine areas.
1123	Cylindrical Crowns	Level 4	Within *Mainly Evergreen Needle-Leaved Woodland (112)*. Dominated by trees (more than 50% of the canopy) with crowns with very short branches and therefore a narrow cylindrical shape (e.g., Picea in the boreal regions).
12	Mainly Deciduous	Level 2	Within *Woodland (1)*. The majority of trees (more than 50% of the canopy) shed their foliage simultaneously in connection with the unfavorable season (drought or cold).
121	Drought-Deciduous	Level 3	Within *Mainly Deciduous Woodland (12)*. The unfavorable season is mainly characterized by drought, in most cases by winter-drought. Foliage is shed regularly every year. Most trees have relatively thick, fissured bark.
1211	Broad-Leaved Lowland and Submontane	Level 4	Within *Drought-Deciduous Woodland (121)*. Practically no evergreen plants in any stratum except some succulents. Woody and herbaceous vines and deciduous bottle-trees are present. Sparse herbaceous vegetation present in the undergrowth.
1212	Montane and Cloud	Level 4	Within *Drought-Deciduous Woodland (121)*. Some evergreen species are present in the understory. Drought resistant epiphytes are present or abundant, often of the bearded form (e.g., *Usnea* or *Tillandsia usneoides*). This formation is not frequent, but well developed. E.g., in northern Peru.

MUC Class	MUC Name	MUC Level	Definitions
122	Cold-Deciduous with Evergreens	Level 3	Within *Mainly Deciduous Woodland (12)*. The unfavorable season is mainly characterized by winter frost. Deciduous broad-leaved trees are dominant (more than 50% of the canopy), but evergreen species are present (more than 25% of the canopy) as part of the main canopy or the understory. Climbers and vascular epiphytes are scarce or absent.
1221	With Evergreen Broad-Leaved Trees and Climbers	Level 4	Within *Cold-Deciduous with Evergreens Woodland (122)*. Rich in epiphytes, including mosses. Vascular epiphytes may be present at the base of tree stems. Climbing vines may be common on flood plains. *Ilex aquifolium* and *Hedera helix* in western Europe and *Magnolia* spp. in North America are examples of this class type.
1222	With Evergreen Needle-Leaved Trees	Level 4	Within *Cold-Deciduous with Evergreens Woodland (122)*. With evergreen needle-leaved trees such as hemlock (*Tsuga*) and pine (*Pinus*). E.g., the maple-hemlock or oak-pine woodlands of Northeastern, U.S.A.
123	Cold-Deciduous without EvergreenTrees	Level 3	Within *Mainly Deciduous Woodland (12)*. Cold-deciduous tree species are absolutely dominant (more than 75% of the canopy). Evergreen herbs and some evergreen shrubs (less than 2 meters tall) may be present. Climbers insignificant but may be common on flood plains. Vascular epiphytes are absent (except occasionally at the lower base of the tree). Mosses, liverworts and particularly lichens are always present. Most frequent in the subarctic region, elsewhere only in swamps or bogs.
1231	Broad-Leaved	Level 4	Within *Cold-Deciduous without Evergreen Trees Woodland (123)*. Broad-leaved deciduous species are absolutely dominant (more than 75% of the canopy).
1232	Needle-leaved	Level 4	Within *Cold-Deciduous without Evergreen Trees Woodland (123)*. Needle-leaved deciduous species are absolutely dominant (more than 75% of the canopy).
1233	Mixed	Level 4	Within *Cold-Deciduous without Evergreen Trees Woodland (123)*. Both broad-leaved and needle leaved deciduous species provide more than 25% of the canopy.
13	Extremely Xeromorphic (Dry)	Level 2	Within *Woodland (1)*. Stands of trees and shrubs adapted to dry conditions, such as bottle trees, tuft trees with succulent leaves and stem succulents. Undergrowth has shrubs adapted to dry conditions, succulent perennial herbs and annual and perennial herbaceous plants. Woodlands may grade into forests.
131	Sclerophyllous-Dominated	Level 3	Within *Extremely Xeromorphic Woodland (13)*. There is a predominance of sclerophyllous trees, many of which have bulbous stem bases largely embedded in the soil.
132	Thorn-Dominated	Level 3	Within *Extremely Xeromorphic Woodland (13)*. Species with thorns are dominant (more than 50% of the canopy).
1321	Mixed Deciduous-Evergreen	Level 4	Within *Extremely Xeromorphic Thorn-Dominated Woodland (132)*. Both deciduous species and evergreen species are more than 25% of the tree canopy. See definitions of Mainly Evergreen Woodland, class 11 and Mainly Deciduous Woodland (MUC Class 12).
1322	Purely Deciduous	Level 4	Within *Extremely Xeromorphic Thorn-Dominated Woodland (132)*. Deciduous thorn species are absolutely dominant (more than 75% of the canopy). See definition of Mainly Deciduous Woodland (MUC Class 12).

MUC Class	MUC Name	MUC Level	Definitions
133	Mainly Succulent	Level 3	Within *Extremely Xeromorphic Woodland (13)*. Tree-formed (scapose) and shrub-formed (caespitose) succulents are very frequent(more than 50% of the tree canopy), but other trees and shrubs adapted to dry conditions are usually present as well.
2	**Shrubland or Thicket**	**Level 1**	**The shrub canopy covers at least 40% of the ground and is composed of matted, clumped or clustered woody plants 0.5 to 5 meters tall.** ***Shrubland:* most of the individual shrubs are not touching each other; often with grass growing between shrubs. Shrublands are also further defined (like Forests and Woodlands) as Evergreen Broad-leaved, Evergreen Needle-leaved, Mainly Deciduous, etc.** ***Thicket:* individual shrub branches are interlocked.**
21	Mainly Evergreen	Level 2	Within *Shrubland or Thicket (2)*. The canopy is never without green foliage. At least 50% of the shrubs that reach the canopy are evergreen. Individual shrubs may shed their leaves.
211	Broad-Leaved	Level 3	Within *Mainly Evergreen Shrubland or Thicket (21)*. Evergreen broad-leaved species are dominant (more than 50% of the canopy).
2111	Low Bamboo	Level 4	Within *Mainly Evergreen Broad-Leaved Shrubland or Thicket (211)*. Bamboo species are dominant. (Lignified creeping graminoid nano- or microphanerophytes).
2112	Tuft-Tree	Level 4	Within *Mainly Evergreen Broad-Leaved Shrubland or Thicket (211)*. Composed of small trees and woody shrubs. E.g., Mediterranean dwarf palms shrubland or Hawaiian tree fern thicket or shrubland.
2113	Broad-Leaved Hemi-Sclerophyllous	Level 4	Within *Mainly Evergreen Broad-Leaved Shrubland or Thicket (211)*. Matted or clumped shrubs and plants with large soft leaves (caespitose, creeping or lodged nano- or microphanerophytes). E.g., subalpine *Rhododendron* thickets, or *Hibiscus tiliaeceus* matted thickets of Hawaii.
2114	Broad-Leaved Sclerophyllous	Level 4	Within *Mainly Evergreen Broad-Leaved Shrubland or Thicket (211)*. Dominated by broad-leaved sclerophyllous shrubs and immature trees (e.g., chapparal or macchia). May often merge with parkland, grassland or heath.
2115	Suffruticose	Level 4	Within *Mainly Evergreen Broad-Leaved Shrubland or Thicket (211)*. Stand of semi-lignified nanophanerophytes that in dry years may shed part of their shoot systems (e.g., Cistus heath).
212	Needle-Leaved or Microphyllous	Level 3	Within *Mainly Evergreen Shrubland or Thicket (21)*. Dominant species (more than 50% of the canopy) have either needle leaves or small leaves.
2121	Needle-Leaved	Level 4	Within *Mainly Evergreen Needle-Leaved or Microphyllous Shrubland or Thicket (212)*. Composed of creeping or lodged needle-leaved shrubs (e.g., *Pinus mughus*, “Krummholz”).

MUC Class	MUC Name	MUC Level	Definitions
2122	Microphyllous	Level 4	Within *Mainly Evergreen Needle-Leaved or Microphyllous Shrubland or Thicket (212)*. Evergreen species have small leaves, (e.g., desert plants) or leaves with a single unbranched vein. Mostly in tropical subalpine belts.
22	Mainly Deciduous	Level 2	Within *Shrubland or Thicket (2)*. The majority of shrubs (more than 50% of the canopy) shed their foliage simultaneously in connection with the unfavorable season (cold or drought).
221	Drought-Deciduous with Evergreen Woody Plants	Level 3	Within *Mainly Deciduous Shrubland or Thicket (22)*. Drought-deciduous shrubs are dominant (greater than 50% of the canopy) and are mixed with at least 25% evergreen woody plants. The unfavorable season is mainly characterized by drought.
222	Drought-Deciduous without Evergreen Woody Plants	Level 3	Within *Mainly Deciduous Shrubland or Thicket (22)*. Drought-deciduous shrubs are absolutely dominant (more than 75% of the canopy). The unfavorable season is mainly characterized by drought.
223	Cold-Deciduous	Level 3	Within *Mainly Deciduous Shrubland or Thicket (22)*. The unfavorable season is mainly characterized by winter frost. Deciduous shrubs are dominant (more than 50% of the canopy).
2231	Temperate	Level 4	Within *Cold-Deciduous Shrubland or Thicket (223)*. Composed of dense scrub without, or with very little herbaceous undergrowth. Very few to no cryptogams.
2232	Subalpine and Subpolar	Level 4	Within *Cold-Deciduous Shrubland or Thicket (223)*. Composed of upright or lodged matted shrubs with great vegetative regeneration capacity and usually covered by snow for at least half a year.
23	Extremely Xeromorphic (Subdesert) Shrubland	Level 2	Within *Shrubland or Thicket (2)*. Very open stands of shrubs with various adaptations to dry conditions, such as: extremely thickened, hardened foliage; very reduced leaves; green branches without leaves; or succulent stems, some of them with thorns.
231	Mainly Evergreen	Level 3	Within *Extremely Xeromorphic Shrubland (23)*. The canopy is never without green foliage. At least 50% of the shrubs that reach the canopy are evergreen. In extremely dry years some leaves and shoot portions may be shed.
2311	Purely Evergreen	Level 4	Within *Mainly Evergreen Extremely Xeromorphic Shrubland (231)*. Composed of broad-leaved mostly sclerophyllous shrubs (e.g., mulga scrub in Australia) leafless green-stemmed plants (e.g. *Retama retam*) or succulents dominated by variously branched stem and leaf succulents.
2312	Semi-Deciduous	Level 4	Within *Mainly Evergreen Extremely Xeromorphic Shrubland (231)*. May consist of either facultatively deciduous shrubs (e.g., *Atriplex-Kochia* saltbush in Australia and North America) or a combination of evergreen and deciduous shrubs (i.e. evergreen shrubs are dominant, deciduous shrubs cover more than 25%).

MUC Class	MUC Name	MUC Level	Definitions
232	Mainly Deciduous	Level 3	Within *Extremely Xeromorphic Shrubland (23)*. The majority of shrubs (more than 50% of the canopy) shed their foliage simultaneously in connection with the unfavorable season (cold or drought).
2321	Without Succulents	Level 4	Within *Mainly Deciduous Extremely Xeromorphic Shrubland (232)*. Succulents cover less than 25% of the ground.
2322	With Succulents	Level 4	Within *Mainly Deciduous Extremely Xeromorphic Shrubland (232)*. Succulents cover at least 25% of the ground.
3	**Dwarf-Shrubland or Dwarf- Thicket**	**Level 1**	**Shrubs rarely exceed 50 cm in height (sometimes called heaths or heathlike formations). The shrub canopy covers at least 40% of the ground. The shrub cover density distinguishes between Dwarf-Shrubland and Dwarf-Thicket classes.** ***Dwarf-Shrubland:*** **individual dwarf-shrubs are isolated or in clumps.** ***Dwarf-Thicket:*** **individual shrub branches are interlocked.**
31	Mainly Evergreen	Level 2	Within *Dwarf-Shrubland or Dwarf-Thicket (3)*. The canopy is never without green foliage. At least 50% of the shrubs that reach the canopy are evergreen. Individual shrubs may shed their leaves.
311	Dwarf-Thicket	Level 3	Within *Mainly Evergreen Dwarf-Shrubland or Dwarf-Thicket (31)*. Composed of densely closed dwarf-shrub cover, which dominates the landscape.
3111	Caespitose	Level 4	Within *Mainly Evergreen Dwarf-Thicket (311)*. Shrub branches stand upright and are often occupied by lichens (foliose). Cushion-shaped mosses, lichens and other herbaceous plants are often found on the ground (e.g., *Calluna* heath).
3112	Creeping	Level 4	Within *Mainly Evergreen Dwarf-Thicket (311)*. Shrub branches creep along the ground. Variously combined with shrubs (e.g., thallochamaephytes) with branches that may be embedded (e.g., *Loiseleuria* heath).
312	Dwarf-Shrubland	Level 3	Within *Mainly Evergreen Dwarf-Shrubland or Dwarf-Thicket (31)*. Open or less dense cover of dwarf-shrubs. Shrub canopies are not interlocked. Herbaceous vegetation (i.e. grasses and forbs) covers less than 25% of the ground.
3121	Cushion	Level 4	Within *Mainly Evergreen Dwarf-Shrubland (312)*. Shrubs are isolated in clumps forming dense cushions and are often thorny (e.g., *Astragalus*- and *Acantholimon* “porcupine”-heath of the East Mediterranean mountains).
313	Mixed Evergreen and Herbaceous Dwarf-Shrubland	Level 3	Within *Mainly Evergreen Dwarf-Shrubland or Dwarf-Thicket (31)*. Shrub canopies are not interlocked. Evergreen shrubs are mixed with herbaceous vegetation (at least 25% of the ground).

MUC Class	MUC Name	MUC Level	Definitions
3131	True Evergreen and Herbaceous Mixed	Level 4	Within *Mixed Evergreen and Herbaceous Dwarf-Shrubland (313)*. True Evergreen individuals do not seasonally shed parts of their shoot systems. E.g., *Nardus Calluna* -heath.
3132	Partial Evergreen and Herbaceous Mixed	Level 4	Within *Mixed Evergreen and Herbaceous Dwarf-Shrubland (313)*. Many individuals shed parts of their shoot systems during the dry season (e.g., *Phyrgana* in Greece).
32	Mainly Deciduous	Level 2	Within *Dwarf-Shrubland or Dwarf-Thicket (3)*. The majority of shrubs (more than 50% of the canopy) shed their foliage simultaneously in connection with the unfavorable season (cold or drought).
321	Facultative Drought-Deciduous	Level 3	Within *Mainly Deciduous Dwarf-Shrubland or Dwarf-Thicket (32)*. Dwarf-shrubs shed their foliage only in extremely dry years.
322	Obligate Drought-Deciduous	Level 3	Within *Mainly Deciduous Dwarf-Shrubland or Dwarf-Thicket (32)*. Densely closed dwarf-shrubs lose all or at least part of their leaves in the dry season.
3221	Caespitose Dwarf-Thicket	Level 4	Within *Obligate Drought-Deciduous Dwarf-Shrubland or Dwarf-Thicket (322)*. Shrub branches stand upright and are often occupied by lichens (foliose). Cushion-shaped mosses, lichens and other herbaceous plants are often found on the ground (e.g., *Calluna* heath).
3222	Creeping Dwarf-Thicket	Level 4	Within *Obligate Drought-Deciduous Dwarf-Shrubland or Dwarf-Thicket (322)*. Shrub branches creep along the ground. Variously combined with shrubs (i.e. thallochamaephytes) with branches that may be embedded (e.g., *Loiseleuria* heath).
3223	Cushion Dwarf-Shrubland	Level 4	Within *Obligate Drought-Deciduous Dwarf-Shrubland or Dwarf-Thicket (322)*. Shrubs are isolated in clumps forming dense cushions and are often thorny.
3224	Mixed Dwarf-Shrubland	Level 4	Within *Obligate Drought-Deciduous Dwarf-Shrubland or Dwarf-Thicket (322)*. Deciduous and evergreen dwarf-shrubs, caespitose herbaceous plants, succulent perennial herbs, and other species intermixed.
323	Cold-Deciduous	Level 3	Within *Mainly Deciduous Dwarf-Shrubland or Dwarf-Thicket (32)*. Densely closed dwarf-shrubs shed foliage at the beginning of a cold season. Richer in mosses and ferns than the Obligate Drought-deciduous Dwarf Thicket or Shrubland class (322).
3231	Caespitose Dwarf-Thicket	Level 4	Within *Cold-deciduous Dwarf-Shrubland or Dwarf-Thicket (323)*. Shrub branches stand upright and are often occupied by lichens (foliose). Cushion-shaped mosses, lichens and other herbaceous plants are often found on the ground.
3232	Creeping Dwarf-Thicket	Level 4	Within *Cold-deciduous Dwarf-Shrubland or Dwarf-Thicket (323)*. Shrub branches creep along the ground; combined with shrubs with branches that may be embedded.

MUC Class	MUC Name	MUC Level	Definitions
3233	Cushion Dwarf-Shrubland	Level 4	Within *Cold-deciduous Dwarf-Shrubland or Dwarf-Thicket (323)*. Shrubs are isolated in clumps forming dense cushions and are often thorny.
3234	Mixed Dwarf-Shrubland	Level 4	Within *Cold-deciduous Dwarf-Shrubland or Dwarf-Thicket (323)*. Deciduous and evergreen dwarf-shrubs, caespitose herbaceous plants, succulent perennial herbs, and other species intermixed.
33	Extremely Xeromorphic (Subdesert) Dwarf-Shrubland	Level 2	Within *Dwarf-Shrubland or Dwarf-Thicket (3)*. Composed of open formations of dwarf-shrubs, succulents, and herbaceous plants adapted to survive or to avoid a long dry season. Mostly subdesertic.
331	Mainly Evergreen	Level 3	Within *Extremely Xeromorphic Dwarf-Shrubland (33)*. The canopy is never without green foliage. At least 50% of the shrubs that reach the canopy are evergreen. In extremely dry years some leaves and shoot portions may be shed.
3311	Purely Evergreen	Level 4	Within *Mainly Evergreen Extremely Xeromorphic Dwarf-Shrubland (331)*. Composed of broad-leaved mostly sclerophyllous shrubs, leafless green-stemmed plants, or succulents dominated by variously branched stem and leaf succulents.
3312	Semi-Deciduous	Level 4	Within *Mainly Evergreen Extremely Xeromorphic Dwarf-Shrubland (331)*. May consist of either facultatively deciduous shrubs or a combination of evergreen and deciduous shrubs (i.e. evergreen shrubs are dominant, deciduous shrubs cover more than 25%).
332	Mainly Deciduous	Level 3	Within *Extremely Xeromorphic Dwarf-Shrubland (33)*. The majority of shrubs (more than 50% of the canopy) shed their foliage simultaneously in connection with the unfavorable season (cold or drought).
3321	Without Succulents	Level 4	Within *Mainly Deciduous Extremely Xeromorphic Dwarf-Shrubland (332)*. Succulents cover less than 25% of the ground.
3322	With Succulents	Level 4	Within *Mainly Deciduous Extremely Xeromorphic Dwarf-Shrubland (332)*. Succulents cover at least 25% of the ground.
34	Tundra	Level 2	Within *Dwarf-Shrubland or Dwarf-Thicket (3)*. Slowly growing, low formations, consisting mainly of dwarf-shrubs, graminoids, mosses, liverworts and lichens, found beyond the subpolar tree line. Often showing plant patterns caused by freezing movements of the soil. Except in boreal regions, dwarf-shrub formations above the mountain tree line should not be called tundra, because they are, as a rule, richer in dwarf-shrubs and grasses, and grow taller due to greater solar radiation in lower latitudes.
341	Mainly Bryophyte	Level 3	Within *Tundra Dwarf-Shrubland or Dwarf-Thicket (34)*. Dominated by mats or small cushions of chamaephytic mosses (more than 50% of the vegetative cover). Groups of dwarf-shrubs are as a rule scattered irregularly and are not very dense. The general aspect is more or less dark green, olive green or brownish.

MUC Class	MUC Name	MUC Level	Definitions
3411	Caespitose	Level 4	Within *Mainly Bryophyte Tundra Dwarf-Shrubland or Dwarf-Thicket (341)*. Clumped or clustered dwarf-shrubs are present.
3412	Creeping	Level 4	Within *Mainly Bryophyte Tundra Dwarf-Shrubland or Dwarf-Thicket (341)*. Creeping or matted dwarf-shrubs are present.
342	Mainly Lichen	Level 3	Within *Tundra Dwarf-Shrubland or Dwarf-Thicket (34)*. Mats of fruticose lichens dominate (more than 50% of the vegetative cover), giving the formation a more or less pronounced gray aspect. Mostly evergreen, creeping or cushion-shaped dwarf-shrubs are present.
4	**Herbaceous Vegetation**	**Level 1**	**Dominated by herbaceous growth of two major types: graminoids and forbs. Graminoids include all herbaceous grasses and grass-like plants such as sedges (*Carex*), rushes (*Juncus*), and cattails (*Typha*). Forbs are broad-leaved herbaceous plants such as clover (*Trifolium*), sunflowers (*Helianthus*), ferns, and milkweeds (Asclepias). Total ground coverage must be greater than 60% herbaceous vegetation.**
41	Tall Graminoid	Level 2	Within *Herbaceous Vegetation (4)*. Plant community consists of dominant grasses over 2 meters tall when flowering or mature (more than 50% of the herbaceous vegetation). Forbs may be present but comprise less than 50% of herbaceous vegetation.
411	With Trees Covering 10-40%	Level 3	Within *Tall Graminoid Herbaceous Vegetation (41)*. May be with or without shrubs. This is somewhat like a very open woodland with more or less continuous ground cover (over 60%) of tall graminoids.
4110	Trees: Needle-Leaved Evergreen	Level 4	Within *Tall Graminoid Herbaceous Vegetation with Trees Covering 10-40% (411)*. Needle-leaved evergreen species are greater than 50% of the tree canopy.
4111	Trees: Broad-Leaved Evergreen	Level 4	Within *Tall Graminoid Herbaceous Vegetation with Trees Covering 10-40% (411)*. Broad-leaved evergreen species are greater than 50% of the tree canopy.
4112	Trees: Broad-Leaved Semi-Evergreen	Level 4	Within *Tall Graminoid Herbaceous Vegetation with Trees Covering 10-40% (411)*. Trees present are at least 25% each of broad-leaved evergreen and broad-leaved deciduous trees.
4113	Trees: Broad-Leaved Deciduous	Level 4	Within *Tall Graminoid Herbaceous Vegetation with Trees Covering 10-40% (411)*. Broad-leaved species are greater than 50% of the tree canopy. The area is seasonally flooded. E.g., Northeast Bolivia.
412	With Trees Covering <10%	Level 3	Within *Tall Graminoid Herbaceous Vegetation (41)*. Grassland with trees covering less than 10% of the ground, with or without shrubs.
4120	Trees: Needle-Leaved Evergreen	Level 4	Within *Trees Covering <10% Tall Graminoid Herbaceous Vegetation (412)*. Needle-leaved evergreen species are greater than 50% of the tree canopy.

MUC Class	MUC Name	MUC Level	Definitions
4121	Trees: Broad-Leaved Evergreen	Level 4	Within *Trees Covering <10% Tall Graminoid Herbaceous Vegetation (412)*. Broad-leaved evergreen species are greater than 50% of the tree canopy.
4122	Trees: Broad-Leaved Semi-Evergreen	Level 4	Within *Trees Covering <10% Tall Graminoid Herbaceous Vegetation (412)*. Trees present are at least 25% each of broad-leaved evergreen and broad-leaved deciduous trees.
4123	Trees: Broad-Leaved Deciduous	Level 4	Within *Trees Covering <10% Tall Graminoid Herbaceous Vegetation (412)*. Broad-leaved species are greater than 50% of the tree canopy. The area is seasonally flooded.
4124	Tropical and Subtropical with Trees and Shrubs in Tufts on Termite Nests	Level 4	Within *Trees Covering <10% Tall Graminoid Herbaceous Vegetation (412)*. Tropical or subtropical tall grassland with trees and/or shrubs growing in tufts on termite nests. Also called termite savannah.
413	With Shrubs	Level 3	Within *Tall Graminoid Herbaceous Vegetation (41)*. The shrub canopy must cover more than 25% of the ground.
4130	Shrubs: Needle-Leaved Evergreen	Level 4	Within *Tall Graminoid Herbaceous Vegetation with Shrubs (413)*. Needle-leaved evergreen species are greater than 50% of the shrub canopy.
4131	Shrubs: Broad-Leaved Evergreen	Level 4	Within *Tall Graminoid Herbaceous Vegetation with Shrubs (413)*. Broad-leaved evergreen species are greater than 50% of the shrub canopy.
4132	Shrubs: Broad-Leaved Semi-Evergreen	Level 4	Within *Tall Graminoid Herbaceous Vegetation with Shrubs (413)*. Shrubs present are at least 25% each of broad-leaved evergreen and broad-leaved deciduous.
4133	Shrubs: Broad-Leaved Deciduous	Level 4	Within *Tall Graminoid Herbaceous Vegetation with Shrubs (413)*. Broad-leaved species are greater than 50% of the shrub canopy. The area is seasonally flooded.
4134	Tropical and Subtropical with Trees and Shrubs in Tufts on Termite Nests	Level 4	Within *Tall Graminoid Herbaceous Vegetation with Shrubs (413)*. Tropical or subtropical tall grassland with trees and/or shrubs growing in tufts on termite nests. Also called termite savannah.
414	With Tuft Plants	Level 3	Within *Tall Graminoid Herbaceous Vegetation (41)*. The canopy of the tuft plants (usually palms) must cover more than 25% of the ground.
4141	Tropical with Palms	Level 4	Within *Tall Graminoid Herbaceous Vegetation with Tuft Plants (414)*. Tropical grasslands with palms. E.g., the palm savannas of *Arocomia totai* and *Attalea princeps* north of Santa Cruz de la Sierra, Bolivia.

MUC Class	MUC Name	MUC Level	Definitions
415	Without Woody Synusia	Level 3	Within *Tall Graminoid Herbaceous Vegetation (41)*. Grasslands without trees or shrubs.
4151	Tropica	Level 4	Within *Tall Graminoid Herbaceous Vegetation Without Woody Synusia (415)*. Tropical grassland as in various low-latitude regions of Africa. Often seasonally flooded (e.g., Compos de V arzea of the lower Amazon Valley), (e.g., Papyrus swamps of the upper Nile Valley).
42	Medium Tall Graminoid	Level 2	Within *Herbaceous Vegetation (4)*. The dominant grasses are 50 cm to 2 m tall when flowering or mature (greater than 50% of the herbaceous vegetation). Forbs may be present but comprise less than 50% of the herbaceous vegetation.
421	With Trees Covering 10-40%	Level 3	Within *Medium Tall Graminoid Herbaceous Vegetation (42)*. May be with or without shrubs. This is somewhat like a very open woodland with more or less continuous ground cover of medium tall graminoids.
4210	Trees: Needle-Leaved Evergreen	Level 4	Within *Medium Tall Graminoid Herbaceous Vegetation with Trees Covering 10-40% (421)*. Needle-leaved evergreen species are greater than 50% of the tree canopy.
4211	Trees: Broad-Leaved Evergreen	Level 4	Within *Medium Tall Graminoid Herbaceous Vegetation with Trees Covering 10-40% (421)*. Broad-leaved evergreen species are greater than 50% of the tree canopy.
4212	Trees: Broad-Leaved Semi-Evergreen	Level 4	Within *Medium Tall Graminoid Herbaceous Vegetation with Trees Covering 10-40% (421)*. Trees present are at least 25% each of broad-leaved evergreen and broad-leaved deciduous trees.
4213	Trees: Broad-Leaved Deciduous	Level 4	Within *Medium Tall Graminoid Herbaceous Vegetation with Trees Covering 10-40% (421)*. Broad-leaved species are greater than 50% of the tree canopy. The area is seasonally flooded.
422	With Trees Covering <10%	Level 3	Within *Medium Tall Graminoid Herbaceous Vegetation (42)*. Grassland with trees covering less than 10% of the ground, with or without shrubs.
4220	Trees: Needle-Leaved Evergreen	Level 4	Within *Medium Tall Graminoid Herbaceous Vegetation with Trees Covering <10% (422)*. Needle-leaved evergreen species are greater than 50% of the tree canopy.
4221	Trees: Broad-Leaved Evergreen	Level 4	Within *Medium Tall Graminoid Herbaceous Vegetation with Trees Covering <10% (422)*. Broad-leaved evergreen species are greater than 50% of the tree canopy.
4222	Trees: Broad-Leaved Semi-Evergreen	Level 4	Within *Medium Tall Graminoid Herbaceous Vegetation with Trees Covering <10% (422)*. Trees present are at least 25% each of broad-leaved ever green and broad-leaved deciduous trees.
4223	Trees: Broad-Leaved Deciduous	Level 4	Within *Medium Tall Graminoid Herbaceous Vegetation with Trees Covering <10% (422)*. Broad-leaved species are greater than 50% of the tree canopy. The area is seasonally flooded.

MUC Class	MUC Name	MUC Level	Definitions
4224	Tropical and Subtropical with Trees and Shrubs in Tufts on Termite Nests	Level 4	Within *Medium Tall Graminoid Herbaceous Vegetation with Trees Covering <10% (422)*. Tropical or subtropical medium tall grassland with trees and/or shrubs growing in tufts on termite nests. Also called termite savannah.
423	With Shrubs	Level 3	Within *Medium Tall Graminoid Herbaceous Vegetation (42)*. The shrub canopy must cover more than 25% of the ground.
4230	Shrubs: Needle-Leaved Evergreen	Level 4	Within *Medium Tall Graminoid Herbaceous Vegetation with Shrubs (423)*. Needle-leaved evergreen species are greater than 50% of the shrub canopy.
4231	Shrubs: Broad-Leaved Evergreen	Level 4	Within *Medium Tall Graminoid Herbaceous Vegetation with Shrubs (423)*. Broad-leaved species are greater than 50% of the shrub canopy.
4232	Shrubs: Broad-Leaved Semi-Evergreen	Level 4	Within *Medium Tall Graminoid Herbaceous Vegetation with Shrubs (423)*. Shrubs present are at least 25% each of broad-leaved evergreen and broad-leaved deciduous.
4233	Shrubs: Broad-Leaved Deciduous	Level 4	Within *Medium Tall Graminoid Herbaceous Vegetation with Shrubs (423)*. Broad-leaved evergreen species are greater than 50% of the shrub canopy. The area is seasonally flooded.
4234	Tropical and Subtropical with Trees and Shrubs in Tufts on Termite Nests	Level 4	Within *Medium Tall Graminoid Herbaceous Vegetation with Shrubs (423)*. Tropical or subtropical medium tall grassland with trees and/or shrubs growing in tufts on termite nests. Also called termite savannah.
4235	Woody Synusia of Deciduous Thorny Shrubs	Level 4	Within *Medium Tall Graminoid Herbaceous Vegetation with Shrubs (423)*. Consists of deciduous thorny shrubs covering at least 25% of the ground. E.g., the tropical thorn bush savannah of the Sahel region in Africa with *Acacia tortilis*, *A. senegal* and other species.
424	Open Synusia of Tuft Plants	Level 3	Within *Medium Tall Graminoid Herbaceous Vegetation (42)*. The canopy of the tuft plants (usually palms) must cover more than 25% of the ground.
4241	Subtropical with Open Palm Groves	Level 4	Within *Open Synusia of Tuft Plants Medium Tall Graminoid Herbaceous Vegetation (424)*. Medium tall grassland with open groves of palms (e.g., Corrientes, Argentina). Some areas are seasonally flooded (e.g., *Mauritia* palm groves in the Colombian and Venezuelan Ilanos).
425	Without Woody Synusia	Level 3	Within *Medium Tall Graminoid Herbaceous Vegetation (42)*. Medium tall grasslands without trees or shrubs (less than 25% of the ground).

MUC Class	MUC Name	MUC Level	Definitions
4251	Mainly Sod Grasses	Level 4	Within *Medium Tall Graminoid Herbaceous Vegetation Without Woody Synusia (425)*. Perennial, highly branched, creeping grass, which binds the sand or soils with its root system. E.g., St. Augustine grass (*Stenotaphrum secundatum*), the tall-grass prairie in eastern Kansas, or on sandy soil or dunes, such as the communities of *Andropogon hallii* in the Nebraska Sand Hills. In some locations the grassland is wet or flooded most of the year (e.g., Typha swamps). If that is the case classify as a wetland. See MUC class 6.
4252	Mainly Bunch Grasses	Level 4	Within *Medium Tall Graminoid Herbaceous Vegetation Without Woody Synusia (425)*. Grasses that chiefly grow in tufts forming an irregular textured surface. E.g., the hard tussock (*Festuca novae-zelandiae*) grasslands in New Zealand.
43	Short Graminoid	Level 2	Within *Herbaceous Vegetation (4)*. The dominant grasses are less than 50 cm tall when flowering or mature (more than 50% of the herbaceous vegetation). Forbs may be present but they comprise less than 50% of the herbaceous vegetation.
431	With Trees Covering 10-40%	Level 3	Within *Short Graminoid Herbaceous Vegetation (43)*. May be with or without shrubs. This is somewhat like a very open woodland with more or less continuous ground cover of short graminoids.
4310	Trees: Needle-Leaved Evergreen	Level 4	Within *Short Graminoid Herbaceous Vegetation with Trees Covering 10-40% (431)*. Needle-leaved evergreen species are greater than 50% of the tree canopy.
4311	Trees: Broad-Leaved Evergreen	Level 4	Within *Short Graminoid Herbaceous Vegetation with Trees Covering 10-40% (431)*. Broad-leaved evergreen species are greater than 50% of the tree canopy.
4312	Trees: Broad-Leaved Semi-Evergreen	Level 4	Within *Short Graminoid Herbaceous Vegetation with Trees Covering 10-40% (431)*. Trees present are at least 25% each of broad-leaved evergreen and broad-leaved deciduous trees.
4313	Trees: Broad-Leaved Deciduous	Level 4	Within *Short Graminoid Herbaceous Vegetation with Trees Covering 10-40% (431)*. Broad-leaved species are greater than 50% of the tree canopy. The area is seasonally flooded.
432	With Trees Covering <10%	Level 3	Within *Short Graminoid Herbaceous Vegetation (43)*. Grassland with trees covering less than 10% of the ground, with or without shrubs.
4320	Trees: Needle-Leaved Evergreen	Level 4	Within *Short Graminoid Herbaceous Vegetation with Trees Covering <10% (432)*. Needle-leaved evergreen species are greater than 50% of the tree canopy.
4321	Trees: Broad-Leaved Evergreen	Level 4	Within *Short Graminoid Herbaceous Vegetation with Trees Covering <10% (432)*. Broad-leaved evergreen species are greater than 50% of the tree canopy.
4322	Trees: Broad-Leaved Semi-Evergreen	Level 4	Within *Short Graminoid Herbaceous Vegetation with Trees Covering <10% (432)*. Trees present are at least 25% each of broad-leaved evergreen and broad-leaved deciduous trees.

MUC Class	MUC Name	MUC Level	Definitions
4323	Trees: Broad-Leaved Deciduous	Level 4	Within *Short Graminoid Herbaceous Vegetation with Trees Covering <10% (432)*. Broad-leaved species are greater than 50% of the tree canopy. The area is seasonally flooded.
4324	Tropical and Subtropical with Trees and Shrubs in Tufts on Termite Nests	Level 4	Within *Short Graminoid Herbaceous Vegetation with Trees Covering <10% (432)*. Tropical or subtropical short grassland with trees and/or shrubs growing in tufts on termite nests. Also called termite savannah.
433	With Shrubs	Level 3	Within *Short Graminoid Herbaceous Vegetation (43)*. The shrub canopy must cover more than 25% of the ground.
4330	Shrubs: Needle-Leaved Evergreen	Level 4	Within *Short Graminoid Herbaceous Vegetation with Shrubs (433)*. Needle-leaved evergreen species are greater than 50% of the shrub canopy.
4331	Shrubs: Broad-Leaved Evergreen	Level 4	Within *Short Graminoid Herbaceous Vegetation with Shrubs (433)*. Broad-leaved evergreen species are greater than 50% of the shrub canopy.
4332	Shrubs: Broad-Leaved Semi-Evergreen	Level 4	Within *Short Graminoid Herbaceous Vegetation with Shrubs (433)*. Shrubs present are at least 25% each of broad-leaved evergreen and broad-leaved deciduous.
4333	Shrubs: Broad-Leaved Deciduous	Level 4	Within *Short Graminoid Herbaceous Vegetation with Shrubs (433)*. Broad-leaved species are greater than 50% of the shrub canopy. The area is seasonally flooded.
4334	Tropical and Subtropical with Trees and Shrubs in Tufts on Termite Nests	Level 4	Within *Short Graminoid Herbaceous Vegetation with Shrubs (433)*. Tropical or subtropical short grassland with trees and/or shrubs growing in tufts on termite nests. Also called termite savannah.
4335	Woody Synusia of Deciduous Thorny Shrubs	Level 4	Within *Short Graminoid Herbaceous Vegetation with Shrubs (433)*. Consists of deciduous thorny shrubs covering at least 25% of the ground.
434	Open Synusia of Tuft Plants	Level 3	Within Short Graminoid Herbaceous Vegetation (43). The canopy of the tuft plants (usually palms) must cover more than 25% of the ground.
4341	Subtropical with Open Palm Groves	Level 4	Within *Open Synusia of Tuft Plants Short Graminoid Herbaceous Vegetation (434)*. Short grassland with open groves of palms. The canopy of palms must cover more than 25% of the ground.
435	Mainly Bunch Grasses with Woody Synusia	Level 3	Within *Short Graminoid Herbaceous Vegetation (43)*. Grasses that grow in tufts, with woody plants interspersed.

MUC Class	MUC Name	MUC Level	Definitions
4351	Tropical Alpine with Tuft Plants	Level 4	Within *Mainly Bunch Grasses with Woody Synusia Short Graminoid Herbaceous Vegetation (435)*. This grassland often contains *Espeletia*, *Lobelia*, *Senecio*, microphyllous dwarf-shrubs, and cushion plants (often with woolly leaves). Above the timberline in low latitudes. E.g., Paramo and related vegetation types without snow in the alpine regions of Kenya, Colombia, Venezuela, etc.
4352	Tropical Alpine without Tuft Plants	Level 4	Within *Mainly Bunch Grasses with Woody Synusia Short Graminoid Herbaceous Vegetation (435)*. Similar to Tropical Alpine with Tuft Plants (4351) but very open and without tuft plants. In these grasslands there is frequent nocturnal snowfall (though the snow is gone by 9 a.m.). E.g., the Super-Paramo (i.e. above Paramo) of J. Cuatrescasas.
4353	Tropical and Subtropical Alpine with Open Stands of Evergreens	Level 4	Within *Mainly Bunch Grasses with Woody Synusia Short Graminoid Herbaceous Vegetation (435)*. This grassland may also have deciduous shrubs and dwarf shrubs. E.g., Puna south of Oruro, Bolivia.
4354	With Dwarf Shrubs	Level 4	Within *Mainly Bunch Grasses with Woody Synusia Short Graminoid Herbaceous Vegetation (435)*. Consists of bunch grass with varying coverage of dwarf shrubs. Cushion plants may also grow in this grassland, and may be locally more important than the dwarf-shrubs. E.g., Puna south of Oruro, Bolivia.
436	Without Woody Synusia	Level 3	Within *Short Graminoid Herbaceous Vegetation (43)*. Short grasslands without trees or shrubs.
4361	Short-Grass Communities	Level 4	Within *Short Graminoid Herbaceous Vegetation Without Woody Synusia (436)*. These communities may fluctuate in structure and floristic composition due to greatly fluctuating precipitation of the semi-arid climate. E.g., short-grass (*Bouteloua gracilis* and *Buchloe dactyloides*) prairie of eastern Colorado.
4362	Bunch-Grass Communities	Level 4	Within *Short Graminoid Herbaceous Vegetation Without Woody Synusia (436)*. E.g., blue tussock (*Poa cloensoi*) communities of New Zealand, and alpine dry Puna with *Festuca orthophylla* of northern Chile and southern Bolivia.
437	Short to Medium Tall Mesophytic Communities	Level 3	Within *Short Graminoid Herbaceous Vegetation (43)*. Plants growing in or adapted to a moderately moist environment.
4371	Sod Grass Communities	Level 4	Within *Short to Medium Tall Mesophytic Communities Short Graminoid Herbaceous Vegetation (437)*. The grassland is often rich in forbs, and occurs in lower altitudes with a cool, humid climate in North America and Eurasia. Many plants may remain at least partly green during the winter, even below the snow in the higher latitudes.

MUC Class	MUC Name	MUC Level	Definitions
4372	Alpine and Subalpine Meadows	Level 4	Within *Short to Medium Tall Mesophytic Communities Short Graminoid Herbaceous Vegetation (437)*. These grasslands are usually moist much of the summer due to snow melt water. May be rich in forbs (e.g., Olympic Peninsula, Washington); rich in dwarf-shrubs (e.g., the Rocky Mountains of Colorado); snow-bed communities rich in small forbs and/or forb-like dwarf-shrubs (e.g., *Salix herbacea*); or avalanche meadows, occurring as narrow strips of grassland between forests on steep slopes of high mountains where avalanches, descending annually in spring, prevent forest growth.
44	Forb Vegetation	Level 2	Within *Herbaceous Vegetation (4)*. Broad-leaved herbaceous plants dominate the plant community, such as clover, sunflowers (*Helianthus*), ferns, and milkweeds (*Asclepias*) (all plants except grasses). Forbs cover at least 50% of the herbaceous area. Grasses may be present but often less than (often much less than) 50%.
441	Tall Communities	Level 3	Within *Forb Herbaceous Vegetation (44)*. The dominant forb growth forms are more than 1 meter tall when fully developed.
4411	Fern Thickets	Level 4	Within *Tall Forb Communities Herbaceous Vegetation (441)*. Ferns occur sometimes in nearly pure stands, especially in humid climates (e.g., *Pteridium aquilinum*).
4412	Mainly Annual	Level 4	Within *Tall Forb Communities Herbaceous Vegetation (441)*. Annual forbs, which germinate in the beginning and die at the end of each growing season, are the dominant form (greater than 50% of forb vegetation).
4413	Mainly Perennial Flowering Forbs and Ferns	Level 4	Within *Tall Forb Communities Herbaceous Vegetation (441)*. Some part of the plant is alive all year round.
442	Low Communities	Level 3	Within *Forb Herbaceous Vegetation (44)*. These communities are dominated by forbs less than 1 meter tall when fully developed.
4421	Mainly Perennial Flowering Forbs and Ferns	Level 4	Within *Low Forb Communities Herbaceous Vegetation (442)*. Some part of the plant is alive all year round.
4422	Mainly Annual	Level 4	Within *Low Forb Communities Herbaceous Vegetation (442)*. Annual forbs, which germinate in the beginning and die at the end of each growing season, are the dominant form (greater than 50% of forb vegetation). There are several types of low annual forbs: *Ephemeral forb communities in tropical and subtropical regions:* Forbs grow with very little precipitation where, from autumn to spring, clouds moisten vegetation and soil. The dry season aspect is desert-like. E.g., the coastal hills of Peru and northern Chile *Ephemeral or episodical forb communities of arid regions:* The “flowering desert” consists of mostly fast growing forbs, sometimes concentrated in depressions where water can accumulate in shrub or dwarf shrub formations of arid regions. E.g., the Sonoran Desert.

MUC Class	MUC Name	MUC Level	Definitions
5	**Barren Land**	**Level 1**	**Land with less than 40% vegetative cover. Barren land has a limited ability to support life, and is usually made up of thin soil, sand, or rocks.**
51	Dry Salt Flats	Level 2	Occur on flat floored bottoms of interior desert basins. High concentrations of salts are present due to extensive water evaporation.
52	Sandy Areas	Level 2	Accumulations of sand/gravel (e.g., beaches or dunes).
53	Bare Rock	Level 2	Exposed bedrock, desert pavement, scarps, talus slides, volcanic material, rock glaciers and other accumulations of rock without vegetative cover.
54	Perennial Snowfields	Level 2	Accumulations of snow and ice that did not entirely melt during the previous summer, occurring where the daily average temperature is 0 °C (32 °F) in the warmest summer months.
55	Glaciers	Level 2	Snow compacted into firn and finally to ice under weight of successive annual accumulations. Re-frozen melt water contributes to increasing density of the glacial ice mass. All glaciers exhibit evidence of present or past motions (moraines, crevasses, etc.).
56	Other	Level 2	Dirt, gravel, other loose rock, etc.
6	**Wetland**	**Level 1**	**Marshes, swamps, bogs and other types of wetlands that are periodically or constantly saturated during the growing season. This periodic or constant saturation produces soils with special chemical characteristics and vegetation specifically adapted to wet conditions. The area must have at least 40% vegetative cover to be classified as a wetland.**
61	Riverine	Level 2	Wetlands adjacent to a fresh water river channel (riparian wetlands).
62	Palustrine	Level 2	Wetlands dominated by trees, shrubs, persistent emergents (plants), mosses, lichens, etc. The wetlands surround water that is less than 1 hectare in size, has no active channel or tide, is less than 2 meters deep, and has low salinity. The water should be included as part of the wetland.
63	Estuarine	Level 2	Wetlands occurring adjacent to a tidal channel, or in and adjacent to the intertidal zone. An estuary is a water passage where the tide meets the current of a stream. Deepwater tidal habitats and adjacent tidal wetlands are usually semi-enclosed by land but have open, partially obstructed, or sporadic access to ocean water (at least occasionally diluted by freshwater runoff from the land).
64	Lacustrine	Level 2	Wetlands surrounding open water (e.g., ponds and lakes) that are greater than 1 hectare in size and greater than 2 meters deep.

MUC Class	MUC Name	MUC Level	Definitions
7	**Open Water**	**Level 1**	**Lakes, ponds, rivers and oceans. The surface of the land is continually submerged by water greater than 2 meters deep and at least one hectare in size; or continually submerged in an actively flowing channel or subtidal zone. Water should cover greater than 60% of the area.**
71	Freshwater	Level 2	Lakes, ponds, and rivers with low salinity.
72	Marine	Level 2	Open ocean overlying the continental shelf or an actively flowing tidal channel.
8	**Cultivated Land**	**Level 1**	**The ground is covered by greater than 60% non-native cultivated species (e.g., agricultural crops, cultivated short grasses, and lawns) and usually can be distinguished by the regular geometric patterns created by the lawns and fields.**
81	Agriculture	Level 2	Land is used for growing crops, orchards, horticulture, feeding livestock, and other agriculture.
811	Row Crop and Pasture	Level 3	Examples include corn, wheat, cow pastures, fallow fields, cultivated cranberry bogs, and rice fields.
812	Orchard and Horticulture	Level 3	Examples include apple orchards, vineyards, and tree nurseries.
813	Confined Livestock Feeding	Level 3	These areas are found on large farms and are used for feeding beef cattle, dairy cows (with confined feedlots), hogs and poultry.
814	Other Agriculture	Level 3	Examples include corrals and breeding and training facilities on horse farms.
82	Non-Agriculture	Level 2	Land is used for parks, playing fields, cemeteries, and golf courses.
821	Parks and Athletic Fields	Level 3	Examples include baseball diamonds, soccer fields, play grounds, and parks.
822	Golf Courses	Level 3	Golf Courses
823	Cemeteries	Level 3	Cemeteries
824	Other Non-Agriculture	Level 3	Any other non-agricultural cultivated areas that do not fit into classes 821, 822 or 823 (parks and playing fields, golf courses, or cemeteries).
9	**Urban**	**Level 1**	**Areas developed for residential, commercial, industrial, or transportation uses. Must be greater than 40% urban land cover.**
91	Residential	Level 2	Greater than 50% of the urban land cover consists of residential property (e.g., apartments, private dwellings).
92	Commercial and Industrial	Level 2	Greater than 50% of the urban land cover consists of commercial or industrial property (e.g., businesses, factories, warehouses).

MUC Class	MUC Name	MUC Level	Definitions
93	Transportation	Level 2	Greater than 50% of the urban land cover consists of transportation routes (e.g., roads, highways, railroads, and airport runways).
94	Other	Level 2	At least 50% of the urban land cover consists of developed areas that do not fit into residential, commercial, or transportation categories.

Miscellaneous Definitions	
Annual Plant	Live and grows for only one year or season.
Aspect	View or appearance ; a side facing a particular direction.
Boreal	Also called cold temperate zone has a climate with cool wet summers and cold winters lasting more than six months.
Bryophyte	Non-flowering plants (mosses & liverworts) characterized by rhizoids rather than true roots.
Buttresses	Flanges of tissue protruding from the trunk of a tree, tapering outward at the base to give support. Common among large tropical trees.
Caespitose	Arranged or combined in a thick mat or clumps, having a low stem forming a dense turf or sod, growing in clusters.
Canopy	Uppermost layer of vegetation detected by satellite sensors.
Chamaephyte	A perennial plant that has its winter buds placed very close to the soil surface.
Cold-Deciduous	Plants that shed leaves during the cold season.
Crustose Lichens	Lichens that are encrusting. E.g., *Caloplaca saxicola*.
Cultivated Land	Landscaped yards, playing fields, cemeteries, golf courses, and other cultivated vegetated areas should be classified as cultivated land (class 8) if non-native cultivated species is greater than 60% coverage. If the buildings, roads and unnatural structures (bridges, etc.) cover greater than 40% of the land, the area should be classified as urban. If wooded residential neighborhoods have greater than 40% trees covering the ground, the area would be considered forest or woodlands (see classes 0 and 1). If it is difficult to decide upon a cover type, try to determine what the satellite would see. Compare similar areas with the satellite image you receive of your school's location.
Deciduous	Vegetation that sheds its leaves at the end of the growing period or in association with the unfavorable season (drought, cold).
Drip Tips	Extended slender tips of tropical leaves that allow water to roll off the leaf surface.

Miscellaneous Definitions	
Drought-Deciduous	Plants that shed their leaves during the dry season.
Emergent	Aquatic plant with the lower part submerged and the upper part extending above the water.
Epiphytes	Plants not connected with the soil, that grow on another plant (upon which it depends for mechanical support) but not for receiving food and water from it, such as certain orchids or ferns.
Facultative	Organisms able to live and thrive under more than one set of conditions.
Firn	Snow that has been partially consolidated, or compacted, by thawing and freezing but not yet converted to glacial ice.
Forb	A broad-leaved herbaceous plant other than a grass such a clover, sunflowers, ferns, and milkweeds.
Fruticose Lichens	Lichens which appear shrubby or hair-like, especially in form.
Graminoid	Grasses and grass-like plants.
Herbaceous	Pertaining to or characteristic of an herb as distinguished from a woody plant. Vascular plant rooted in the ground with foliage that dies back annually. The meristem (stem growth tip) is located just above or below the ground.
Hygromorphic	The form of the plant is altered due to changes in moisture in the plant. E.g., hygromorphic chamaephytes *Selaginella* and herbaceous ferns.
Hemisclerophyllous	Vegetation with slightly thickened foliage, with large soft leaves, that is resistant to water loss. E.g., subalpine *Rhododendron* thickets, or *Hibiscus tiliaeceus* matted thickets of Hawaii.
Lichen	Plant made up of an alga and a fungus living in a symbiotic relationship. Specifically, any of a numerous plants consisting of a fungus, usually of the class *Ascomycetes*, in close combination with certain of the green or blue-green algae, characteristically forming a crustlike, scaly, or branching growth on rocks or tree trunks.
Lignified	Woody, hardened. Has formed or turned into wood through the formation and deposit of lignin in the cell walls.
Lowland	An area of land that is low in relation to the surrounding country. It may be necessary to consult local resources to determine the specific classification. Vegetation will vary depending on both the latitude and the altitude.
Mesophytic	Growing in, or adapted to, a moderately moist environment.
Microphanerophytes	Small flowering plants.
Microphyllous	Having small leaves with a single unbranched vein (e.g., desert plants).
Montane	Of, growing in, or inhabiting mountain areas. It may be necessary to consult local resources to determine the specific classification. Vegetation will vary depending on both the latitude and the altitude.
Nanophanerophytes	Very small flowering plants.
Obligate	Organisms restricted to a particular condition of life (that condition is essential for survival).
Overstory	Uppermost layer of vegetation detected by satellite sensors.
Perennial Plant	Has a life span of more than two years.

Miscellaneous Definitions	
Polar	In polar climates, the mean temperature of the warmest month is below 10℃ and there is low precipitation distributed over the entire year. There is a short, wet, nightless summer and a very long, cold, dark winter. Generally, the climate is too cold to support the growth of trees.
Saturated	Soaked with moisture - the maximum water holding capacity of a soil.
Scapose	Having a leafless flower stalk growing directly from the ground. E.g., agave/century plant.
Sclerophyllous	Vegetation with thickened, hardened foliage that is resistant to water loss (sclerophylly). E.g., plants of the chapparal (semi-arid Mediterranean) such as toyon, ironwood, manzanita, coyote bush, mountain mahogany, and black sage.
Subalpine	Of, designating, or growing or living in mountainous regions just below the timberline. It may be necessary to consult local resources to determine the specific classification. Vegetation will vary depending on both the latitude and the altitude.
Submontane	Located under or at the base of a mountain or mountain range. It may be necessary to consult local resources to determine the specific classification. Vegetation will vary depending on both the latitude and the altitude.
Subpolar	Transitional between the cold temperate zone and the polar zone. It may be necessary to consult local resources to determine the specific classification. Vegetation will vary depending on both the latitude and the altitude.
Subtropical	From the edge of the tropical zone toward the poles, in the region of the descending air masses, which get warmer as it descends and becomes very dry. Rainfall is very low, and the daytime temperatures are very high because of intense solar radiation. In the winter months, however, the temperature may sink to zero at night as a result of the greater net loss of heat energy in outgoing radiation. This is the hot desert zone.
Succulent	Having thickened, juicy, fleshy tissues (leaves or stems), more or less soft in texture, that conserve moisture. E.g., a sedum or a cactus.
Suffruticose	Has a woody stem or base and is somewhat shrubby.
Synusia	A layer or stratum of a community. A structural unit of a major ecological community characterized by relative uniformity of life form or of height and usually constituting a particular stratum of that community.
Temperate	Temperate zones show greater seasonal temperature changes and can be broken down as follows: *Warm temperate:* mild or no winter and extremely wet, especially in summer. *Typical temperate:* cold, short winters or a winter free of frost and with very cool summers (near the ocean) (e.g., central European or coastal northeastern U.S.A). *Arid temperate:* large temperature contrasts between summer and winter, and little precipitation. *Boreal or cold temperate:* cool wet summers and cold winters lasting more than six months.

Miscellaneous Definitions	
Tropical	Lies 40 degrees to the north and south of the equator. A certain seasonal variation in the mean daily temperature is noticeable. Rainfall reaches a maximum in the summer, with a dry season in the cool months. The duration of the cool season increases as the distance from the equator becomes greater, and at the same time the annual rainfall decreases.
Understory	Layer of vegetation that grows beneath the overstory consisting of smaller trees and shrubs.
Wet	Vegetation or environments capable of withstanding or thriving in the presence of much rain.
Xeromorphic	Climatic conditions favorable for the development of vegetation that is adapted to, thrives in, or tolerates an environment that is poor in available moisture.
Xerophyte	A plant which is adapted to and thrives in dry conditions.