

GLOSSARY

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Accuracy

A relative measure of the exactness of an emission or removal estimate. Estimates should be accurate in the sense that they are systematically neither over nor under true emissions or removals, so far as can be judged.

Activity

A practice or ensemble of practices that take place on a delineated area over a given period of time.

Activity data

Data on the magnitude of a human activity resulting in emissions or removals taking place during a given period of time. Data on energy use, metal production, land areas, management systems, lime and fertilizer use and waste arisings are examples of activity data.

Agricultural pond

An artificial storage containing water for agricultural (irrigation) or pastoral (stock watering) uses. They are typically unlined and constructed using a combination of earthen embankments and the natural topography on the landscape. They can range in size from very small farm dams (< 50 m²) to very large (> 10 km²).

Allochthonous

Material or formation originating outside the water body.

Allometric model

A formula that quantitatively describes an allometric relationship.

Allometry

The relative dimensional relationships between body parts that grow at different rates.

Anaerobic

Conditions in which oxygen is not readily available. These conditions are important for the production of methane emissions. Whenever organic material decomposes in anaerobic conditions (in landfills, flooded rice fields, etc.) methane is likely to be formed.

Andosol

A soil developed in volcanic ash. Generally andosols have good drainage and are prone to fertility problems.

Approaches to consistent representation of lands

Approach 1: Represents land-use area totals within a defined spatial unit, which is often defined by political boundaries, such as a country, province or municipality.

Approach 2: The essential feature of Approach 2 is that it provides an assessment of both the net losses or gains in the area of specific land-use categories and what these conversions represent (i.e., changes both from and to a category). Thus, Approach 2 differs from Approach 1 in that it includes information on conversions between categories, but is still only tracking those changes without spatially-explicit location data, often based on political boundaries (i.e., locations of specific land-use and land-use conversions are not known).

Approach 3: The key defining characteristic of Approach 3 is that it is both spatially and temporally consistent and explicit. Sample-based, survey-based and wall-to-wall methods can be considered Approach 3 depending on the design of the sampling/mapping program and the way the data is processed and analysed.

Aquaculture pond

An artificial storage containing water for the production of aquatic animals or plants. They are typically unlined and constructed using a combination of earthen embankments and the natural topography on the landscape. They can range in size from (< 50 m²) to (> 10 km²).

Arithmetic mean

The sum of the values divided by the number of values.

Auto producer

An enterprise which generates electricity or heat for its own use and/or sells it as a secondary activity i.e., not as its main business.

Autochthonous

Material or formation originating from inside the water body.

Back-casting

The opposite of forecasting. Predicting conditions in the past from current conditions.

Backflows

By-product oils from petrochemical processing of refinery products which are generally returned to the refinery for further processing into petroleum products.

Base year

The starting year for the inventory. Currently this is typically 1990.

Benthic chlorophyll

An indicator of the eutrophication status of a water body based on the presence of microalgae at the sediment-water interface at the bottom of the water body.

Bias

A systematic error of the observation and estimation method, whose magnitude in most cases is unknown. It can be introduced by using measuring equipment that is improperly calibrated, by selecting items from a wrong population or by favouring certain elements of a population, etc. For example: Estimating the total fugitive emission from gas transport and distribution using only measurements of leakage from high/medium pressure pipelines can lead to bias if the leakage in the lower pressure distribution network (which is significantly more difficult to measure) is neglected.

Biochar

For the purpose of this report, biochar is defined as a solid material generated by heating biomass to a temperature in excess of 350 °C under conditions of controlled and limited oxidant concentrations to prevent combustion. These processes can be classified as either pyrolysis (in which oxidants are excluded), or gasification (in which oxidant concentrations are low enough to generate syngas).

Bioenergy

Energy derived from any form of biomass.

Biofuels

Any fuels derived from biomass, either deliberately grown or from waste products. Peat is not considered a biofuel in these guidelines due to the length of time required for peat to re-accumulate after harvest.

Biogenic carbon

Carbon derived from biogenic (plant or animal) sources excluding fossil carbon. Note that peat is treated as a fossil carbon in these guidelines as it takes so long to replace harvested peat.

Biological treatment of waste

Composting and anaerobic digestion of organic wastes, such as food waste, garden/park waste and sludge, to reduce volume in the waste material, stabilisation of waste, and destruction of pathogens in the waste material. This includes mechanical-biological treatment.

Biomass

- (1) The total mass of living organisms in a given area or of a given species usually expressed as dry weight. Includes above and below ground living biomass.
- (2) Organic matter consisting of or recently derived from living organisms (especially regarded as fuel) excluding peat. Includes products, by-products and waste derived from such material.

Blowing agent (for foam production)

A gas, volatile liquid, or chemical that generates gas during the foaming process. The gas creates bubbles or cells in the plastic structure of a foam.

Bootstrap technique

Bootstrap technique is a type of computationally intensive statistical method which uses repeated resampling with replacement from a set of data to assess variability of parameter estimates. Bootstrap technique is a specific case of a Monte Carlo method.

Boreal

See *polar/boreal*.

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Calcium carbide

Calcium carbide is used in the production of acetylene, in the manufacture of cyanamide (a minor historical use), and as a reductant in electric arc steel furnaces. It is made from calcium carbonate (limestone) and carbon-containing reductant (e.g., petroleum coke).

Canal

An artificial waterway typically constructed with a uniform cross-section to provide navigation or to transport water for irrigation, hydropower, town water supplies, etc. They may be earthen structures or they may have concrete linings. “Canals are generally long and narrow, with a uniform width and depth, and have a single outlet.” <<https://www.ramsar.org/news/ramsar-topics-report-on-canal-estates>>> accessed 10 Apr 18

Carbon budget

The balance of the exchanges of carbon between carbon pools or within one specific loop (e.g., atmosphere – biosphere) of the carbon cycle. This is a generic definition of “carbon budget” in the context of national greenhouse gas inventories. This term may be defined with other specific meaning in the other context. (For example, see the Glossary of IPCC Special Report “Global Warming of 1.5°C”.)

Carbon dioxide equivalent emission

The amount of carbon dioxide (CO₂) emission that would cause the same integrated radiative forcing or temperature change, over a given time horizon, as an emitted amount of a greenhouse gas (GHG) or a mixture of GHGs. There are a number of ways to compute such equivalent emissions and choose appropriate time horizons. Most typically, the CO₂-equivalent emission is obtained by multiplying the emission of a GHG by its global warming potential (GWP) for a 100-year time horizon.

Carbon sequestration

The process of storing carbon in a carbon pool.

Category

Categories are subdivisions of the four main sectors Energy; Industrial Processes and Product Use (IPPU); Agriculture, Forestry and Other Land Use (AFOLU); and Waste. Categories may be further divided into sub-categories. For details, see Chapter 8 of Volume 1.

Census

A census is a survey conducted on the full set of observation objects belonging to a given population or universe.

Channel

A generic term for a waterway that encompasses creeks, streams, rivers, canals, ditches etc., as applied in the AFOLU sector for national greenhouse gas inventories.

Chlorofluorocarbons (CFCs)

Halocarbons containing only chlorine, fluorine, and carbon atoms. CFCs are both ozone-depleting substances (ODSs) and greenhouse gases.

Chronosequence

Chronosequences in this report are used in the context of the AFOLU sector, and consist of a temporal sequence in land use or management, for example, years since deforestation, which are used to evaluate change over time. Efforts are made to control all other between-site differences (e.g., by selecting areas with similar soil type, topography, previous vegetation). Chronosequences are often used as a surrogate for experimental studies or measurements repeated over time at the same location.

Climate sub-domain

A subset of a climate zone into which lands may be grouped for the purposes of inventory calculations. Used to provide finer resolution of climate gradients within one of the six climate zones.

Co-digestate

Supplemental material added to anaerobic digesters, in addition to the main digestion material (manure in the case of agricultural digesters) to increase methane yield.

Coefficient of variation

Statistical definition: The coefficient of variation, v_x is the ratio of the population standard deviation, σ_x , and mean, μ_x , where $v_x = \sigma_x / \mu_x$. It also frequently refers to the sample coefficient of variation, which is the ratio of the sample standard deviation and sample mean.¹

Cogeneration

See: Combined Heat and Power (CHP) generation.

Combined heat and power (CHP)

Combined heat and power (CHP), also known as cogeneration, is the simultaneous production of both electricity and useful heat for application by the producer or to be sold to other users with the aim of better utilisation of the energy used. Public utilities may utilise part of the heat produced in power plants and sell it for public heating purposes. Industries as auto-producers may sell part of the excess electricity produced to other industries or to electric utilities.

Comparability

Comparability means that estimates of emissions and removals reported by countries in inventories are comparable among countries. For this purpose, countries should use agreed methodologies and formats for estimating and reporting inventories.

Completeness

Completeness means that an inventory covers all sources and sinks and gases included in the *IPCC Guidelines* for the full geographic coverage in addition to other existing relevant source/sink categories which are specific to individual countries (and therefore may not be included in the *IPCC Guidelines*).

Confidence

The term 'confidence' is used to represent trust in a measurement or estimate. Having confidence in inventory estimates does not make those estimates more accurate or precise; however, it will eventually help to establish a consensus regarding whether the data can be applied to solve a problem. This usage of confidence differs substantially from the statistical usage in the term confidence interval.

Confidence interval

A confidence interval (CI) is a type of interval estimate, computed from the statistics of the observed/estimated data, that might contain the true value of an unknown population parameter. The interval has an associated confidence level that quantifies the level of confidence that the parameter lies in the interval. Most commonly, the 95% confidence level is used.

Consistency

Consistency means that an inventory is internally consistent in all its elements over a period of years. An inventory is consistent if the same methodologies are used for the base year and all subsequent years and if consistent data sets are used to estimate emissions or removals from sources or sinks. An inventory using different methodologies for different years can be considered to be consistent if it has been estimated in a transparent manner taking into account the guidance in Volume 1 on good practice in time series consistency.

Correlation

Mutual relationship between two quantities. See *correlation coefficient*.

Correlation coefficient

A number lying between -1 and $+1$, which measures the mutual relationship between two variables that are observed together. A value of $+1$ means that the variables have a perfect linear relationship; a value of -1 means that there is a perfect inverse linear relation; and a value of 0 means that there is no straight line relation. It is defined as the covariance of the two variables divided by the product of their standard deviations.

Country-specific data

Data for either activities or emissions that are based on research carried out on sites either in that country or otherwise representative of that country.

Cruise

(When applied to aircraft) All aircraft activities that take place at altitudes above 914 metres (3000 feet) including any additional climb or descent operations above this altitude. There is no upper limit.

¹ 'Coefficient of variation' is the term, which is frequently replaced by 'error' in a statement like 'the error is 5%'.

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Dam

An artificial structure that is barrier used to hold back water in a reservoir. Typically constructed with mineral sediment or concrete.

Degassing emissions

Elevated gas emissions that occur as water is released from a dam and experiences sudden changes in pressure, temperature and turbulence. These changes cause air-water exchange processes to occur at much greater rates than in surface waters as the released water approaches a new equilibrium with the environment downstream following Le Chatelier's principle. In the case of dams the change in the hydrostatic pressure before and after water passing through turbines affects this balance.

Also, water released from dams is typically released into a stilling basin designed to dissipate much of the turbulent energy of the flow in order to prevent excessive bank erosion in the natural river channel downstream. The increased water column turbulence greatly increases the air-water gas transfer rate for a given dissolved gas concentration. In some cases, water may be discharged through needle valves into the air, which provides very high air-water contact area leading to rapid gas release.

Decision tree

A decision tree is a flow chart describing the specific ordered steps which need to be followed to develop an inventory or an inventory component in accordance with the principles of *good practice*.

Denitrification

The microbially facilitated reduction of nitrates or nitrites to molecular nitrogen (N₂) through which the nitrogen is emitted from the substrate to the atmosphere.

Diffusive emission

The gas flux across the air-water interface governed by diffusion. For measuring diffusive fluxes, the most popular method employs floating chambers. Frequently estimated using the Thin Boundary Layer model of gas transfer.

Displaced emission

An emission of greenhouse gases that has been relocated in space (and possibly in time) but unchanged in quantity. For example, remineralisation and emission of CO₂ of 1 kg of soil C assumed to occur in an agricultural field may actually occur downstream in a river, reservoir or ocean if that 1 kg of soil C is carried into the stream network as a consequence of rainfall. The carbon is still converted to CO₂ but enters the atmosphere at a location downstream of the carbon source.

Dissolved Inorganic Carbon (DIC)

Sum of all inorganic carbon species in solution (e.g. carbonate, bicarbonate, carbonic acid, carbon dioxide).

Dissolved Organic Carbon (DOC)

Organic carbon remaining in solution after filtering the sample, typically using a 0.45 micrometer filter.

Distribution function

A distribution function or cumulative distribution function $F(x)$ for a random variable X specifies the probability $P(X \leq x)$ that X is less than or equal to x .

Ditch

A long, narrow excavation dug in the earth, typically unlined, often with a uniform cross-section. They are most often used to provide drainage alongside roadways and from agricultural fields and to convey water for irrigation.

Downstream emissions

The total greenhouse gas emissions that occur downstream of a dam including both degassing emissions and the diffusive emission

Drainage channel

A ditch used for drainage.

Drawdown zone

The area around the perimeter of a reservoir or pond that is intermittently exposed to the air as a result of water level changes.

Ebullitive emission

The flux of gas carried by bubbles from sediments through to the water column to the atmosphere.

Eddy flux measurement

The measurement of material fluxes by correlating high-frequency turbulent velocity fluctuations with turbulent concentration fluctuations. Also referred to as eddy correlation i.e. micrometeorological method that uses differences in concentration associated with turbulence in the air to quantify net vertical gas exchange.

Emission factor

A coefficient that quantifies the emissions or removals of a gas per unit activity. Emission factors are often based on a sample of measurement data, averaged to develop a representative rate of emission for a given activity level under a given set of operating conditions.

Emissions

The release of greenhouse gases and/or their precursors into the atmosphere over a specified area and period of time. (UNFCCC Article 1.4)

Energy recovery

A form of resource recovery in which the organic fraction of waste is converted to some form of usable energy. Recovery may be achieved through the combustion of processed or raw refuse to produce steam through the pyrolysis of refuse to produce oil or gas; and through the anaerobic digestion of organic wastes to produce methane gas.

Enhanced coal bed methane (recovery)

Increased CH₄ recovery produced by the injection of CO₂ into coal seams.

Epilimnetic

Pertaining to the epilimnion of a stratified water body.

Epilimnion

The uppermost region of a density-stratified reservoir. Frequently defined as the region above the strongest temperature gradient in the water column. It always includes, but is not limited to, the surface mixing layer – the isothermal region of actively turbulent water just below the air-water interface.

Estimation

The process of calculating emissions and/or removals.

Eutrophication

Natural or anthropogenic process of nutrient enrichment of a water body which leads to increases in algal biomass.

Evaporative emissions

Evaporative emissions fall within the class of fugitive emissions and are released from area (rather than point) sources. These are often emissions of Non-Methane Volatile Organic Compounds (NMVOCs), and are produced when the product is exposed to the air – for example in the use of paints or solvents.

Excluded carbon

Carbon in non-energy uses of fossil fuels (feed stocks, reductant and non-energy products) excluded from fuel combustion.

Expert judgement

A carefully considered, well-documented qualitative or quantitative judgement made in the absence of unequivocal observational evidence by a person or persons who have a demonstrable expertise in the given field.

Feedstock

Fossil fuels used as raw materials in chemical conversion processes to produce primarily organic chemicals and, to a lesser extent, inorganic chemicals.

First use

Distinguishes first uses (and related emissions) from later non-energy uses of fossil fuels. For example, first-use emissions from lubricants are those which take place as a result of oxidation during use as a lubricant. Used lubricants may be used subsequently for heat raising as waste oils.

Flaring

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All burning of natural gas/vapour streams and hydrocarbon liquids by flares as a waste disposal option rather than for the production of useful heat or power.

Floating chamber

Closed container that floats on the surface of the water used to quantify greenhouse gas emissions from the water surface. The time-dependent change in gas concentration within the floating chamber is a direct measurement of the gas flux.

Flood control

The operation of a reservoir to reduce peaks in river discharge.

Flow rate

The volume of water or gas passing through an imaginary plane at an instant of time [units are length³ time⁻¹:eg, m³ s⁻¹, cfs, ML d⁻¹, Ln min⁻¹].

Fluorocarbons

Halocarbons containing fluorine atoms, including chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs).

Flux

- (1) The rate of flow of any liquid or gas, across a given area; the amount of this crossing a given area in a given time. E.g., "Flux of CO₂ absorbed by forests".
- (2) Raw materials, such as limestone, dolomite, lime, and silica sand, which are used to reduce the heat or other energy requirements of thermal processing of minerals (such as the smelting of metals). Fluxes also may serve a dual function as a slagging agent.

Forest Land

This category includes all land with woody vegetation consistent with thresholds used to define Forest Land in the national greenhouse gas inventory. It also includes systems with a vegetation structure that currently fall below, but in situ could potentially reach the threshold values used by a country to define the Forest Land category.

Fossil carbon

Carbon derived from fossil fuel or other fossil source.

Fuel

Any substance burned as a source of energy such as heat or electricity. See also *Primary Fuels* and *Secondary Fuels*.

Fuel combustion

Within the Guidelines fuel combustion is the intentional oxidation of materials within an apparatus that is designed to provide heat or mechanical work to a process, or for use away from the apparatus.

Fuel wood

Wood used directly as fuel.

Fugitive Emissions (oil and natural gas systems)

The intentional or unintentional release of greenhouse gases that occur during the exploration, processing and delivery of fossil fuels to the point of final use. This excludes greenhouse gas emissions from fuel combustion for the production of useful heat or power. It encompasses venting, flaring, and leaks.

Funnel trap

A device deployed underwater to capture bubbles.

Global warming potential

Global Warming Potentials (GWP) are calculated as the ratio of the radiative forcing of one kilogramme greenhouse gas emitted to the atmosphere to that from one kilogramme CO₂ over a period of time (e.g., 100 years).

Good Practice

"*Good practice*" is a key concept for inventory compilers to follow in preparing national greenhouse gas inventories. The key concept does not change in the *2019 Refinement*. The term "*good practice*" has been defined, since 2000 when this concept was introduced², as "*a set of procedures intended to ensure that greenhouse gas inventories are accurate in the sense that they are systematically neither over- nor underestimates so far as can be judged, and that uncertainties are reduced so far as practicable*". This definition has gained general acceptance amongst countries as the basis for inventory development and its centrality has been retained for the *2019 Refinement*. Certain terms in the definition have been updated based on feedback from the statistics community, such that this definition can be also understood as "*a set of procedures intended to ensure that greenhouse gas inventories are accurate in the sense that they are systematically neither over- nor underestimates so far as can be judged, and that they are precise so far as practicable*" in the context of refinement of Chapter 3 of Volume 1³.

Good Practice covers choice of estimation methods appropriate to national circumstances, quality assurance and quality control at the national level, quantification of uncertainties and data archiving and reporting to promote transparency.

Ground truth

A term used for data obtained by measurements on the ground, usually as validation for remote sensing, e.g., satellite data.

Harvested wood products

Harvested wood products (HWP) according to the IPCC good practice guidance (2003, 2006) refers to wood and paper products, and includes i) wood products in use (i.e. wood utilised as a material); ii) wood biomass used for energy purposes and iii) wood biomass in solid waste disposal sites.

Hydrocarbon

Strictly defined as molecules containing only hydrogen and carbon. The term is often used more broadly to include any molecules in petroleum which may also contain S, N, or O. An unsaturated hydrocarbon is any hydrocarbon containing olefinic, acetylenic, or aromatic structures.

Hydrochlorofluorocarbons (HCFCs)

Halocarbons containing only hydrogen, chlorine, fluorine and carbon atoms. Because HCFCs contain chlorine, they contribute to ozone depletion. They are also greenhouse gases.

Hydrofluorocarbons (HFCs)

Halocarbons containing only hydrogen, fluorine and carbon atoms. Because HFCs contain no chlorine, bromine, or iodine, they do not deplete the ozone layer. Like other halocarbons, they are potent greenhouse gases.

Hydrofluoroethers (HFEs)

Chemicals composed of hydrogen, fluorine and carbon atoms, with ether structure. Because HFES contain no chlorine, bromine, or iodine, they do not deplete the ozone layer. Like other halocarbons, they are potent greenhouse gases.

Hypolimnetic

Pertaining to the hypolimnion.

Hypolimnion

The region of colder water at the bottom of a thermally stratified water body. It lies below the metalimnion (or thermocline) – the region with the strongest temperature gradient – and it may contain a weak temperature gradient. In many reservoirs, the hypolimnion can be anoxic (no oxygen) for many months each year because vertical transport of dissolved gases from above occurs mainly by slow diffusive processes across the metalimnion. This can lead to the accumulation of large concentrations of dissolved CH₄ released from the bottom sediments.

Hypoxia

² The definition was originally introduced with the *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* published in 2000.

³ In the *2006 IPCC Guidelines*, the term "uncertainty" was used with two meanings – a general one which is associated with both accuracy and precision, and a specific one only as the inverse of precision. This definition text of "*good practice*" which uses the term "precise" instead of "uncertainties" overcomes inconsistencies with general IPCC definition for uncertainty, without changing the original concept of "*good practice*".

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Waterbodies where dissolved oxygen has become undersaturated due to natural and/or anthropogenic processes which have led to aerobic biological oxygen consumption rates greater than the rate of re-oxygenation.

Hypoxic

Depletion of dissolved oxygen in aquatic environments to levels that are detrimental or fatal to aerobic organisms often caused by eutrophication.

Independence

Two random variables are independent if there is a complete absence of association between how their sample values vary. The most commonly used measure of the lack of independence between two random variables is the correlation coefficient.

Inflow, in the context of water bodies

The water that enters a water body (e.g. pond, lake, reservoir). In addition to surface flows (streams, rivers), inflow may also include precipitation and groundwater inputs.

Irrigation channel

An open channel that transports water in order to irrigate agricultural land.

Key category

A key category is one that is prioritised within the national inventory system because its estimate has a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level of emissions and removals, the trend in emissions and removals, or uncertainty in emissions or removals. Whenever the term key category is used, it includes both source and sink categories.

Key source

See *key category*.

Kilns

A tubular heating apparatus used in the manufacture of cement, lime and other materials. The calcination reaction may take place in the kiln itself, or, where so-equipped, it may partly or completely take place in a preheater and/or precalciner apparatus ahead of the kiln.

Land cover

Refers to the bio-physical coverage of land (e.g., bare soil, rocks, forests, buildings and roads or lakes).

Land use

A broad classification of land based on the activities and cover, and in this report refers specifically to six general types including Forest Land, Cropland, Grassland, Wetlands, Settlements and Other Land. Note that a specific parcel of land may have more than one land use, but it is generally the predominant land use that forms the basis for the classification. The land-uses may be considered as top-level categories for representing all land-use areas, with sub-divisions describing specific circumstances significant to emissions estimation.

Landfill gas

Municipal solid waste contains significant portions of organic materials that produce a variety of gaseous products when deposited, compacted, and covered in landfills. Anaerobic bacteria thrive in the oxygen-free environment, resulting in the decomposition of the organic materials and the production of primarily carbon dioxide and methane. Carbon dioxide is likely to leach out of the landfill because it is soluble in water. Methane, on the other hand, which is less soluble in water and lighter than air, is likely to migrate directly to the atmosphere.

Large dams

A dam with a height of 15 metres or greater from lowest foundation to crest or a dam between 5 metres and 15 metres impounding more than 3 million cubic metres. (See [ICOLD Constitution, Page 3](#))

LTO (landing and take-off) cycle

All aircraft activities that occur under 914 metres (3 000 feet) including idling aircraft engines, taxi-out, take-off, climb up to 914 metres, descend, approach and taxi-in. Note: some gatherers of statistics count either single take-off or landing as one cycle; however, it is both one take-off and one landing that together define the LTO cycle.

Lubricants

Lubricants are hydrocarbons produced from distillate or residue, and they are mainly used to reduce friction between bearing surfaces. This category includes all finished grades of lubricating oil, from spindle oil to cylinder oil, and those used in greases, including motor oils and all grades of lubricating oil base stocks.

Managed land

Land where human interventions and practices have been applied to perform production, ecological or social functions. All land definitions and classifications should be specified at the national level, described in a transparent manner, and be applied consistently over time. Therefore, what is not defined as ‘managed land’ by a country should be classified as unmanaged.

Managed Land Proxy (MLP)

For the AFOLU Sector, anthropogenic greenhouse gas emissions and removals by sinks are defined as all those occurring on ‘managed land’. This approach, i.e., the use of managed land as a proxy for anthropogenic effects, was adopted in the Good Practice Guidance for Land Use, Land-Use Change and Forestry (2003) and that use is maintained in the *2019 Refinement*.

Manure

Waste materials produced by domestic livestock (vegetative material such as green manures are considered to be crop residues or compost). The term ‘manure’ is used here collectively to include both dung and urine (i.e., the solids and the liquids) produced by livestock.

Mean

The mean is a value around which values sampled from a probability distribution tend to lie. The sample mean or arithmetic average is an estimator for the mean. It is an unbiased and consistent estimator of the population mean (expected value) and is itself a random variable with its own variance value. The sample mean is the sum of values divided by the number of values:

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i \quad (x_i, \text{ where } i = 1, \dots, n \text{ are items of a sample}).$$

Measurement-based approach

The use of direct measurements to compute GHG fluxes from a system.

Median

The median or population median is a value which divides the integral of a probability density function (PDF) into two halves. For symmetric PDFs, it equals the mean. The median is the 50th population percentile.

The sample median is an estimator of the population median. It is the value that divides an ordered sample into two equal halves. If there are $2n + 1$ observations, the median is taken as the $(n + 1)^{\text{th}}$ member of the ordered sample. If there are $2n$, it is taken as being halfway between the n^{th} and $(n + 1)^{\text{th}}$.

Methanogenic production

Production of methane by microorganisms (methanogenic bacteria) during the decomposition of organic matter.

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Mode

The mode of a distribution is the value which has the highest probability of occurrence. Distributions can have one or more modes. In practice, we usually encounter distributions with only one mode. In this case, the mode or population mode of a PDF is the measure of a value around which values sampled from a probability distribution tend to lie.

The sample mode is an estimator for the population mode calculated by subdividing the sample range into equal subclasses, counting how many observations fall into each class and selecting the centre point of the class (or classes) with the greatest number of observations.

Model

A model is a quantitatively-based or qualitatively-based abstraction of a real-world situation which may simplify or neglect certain features to better focus on its more important elements.

Example: the relationship that emissions equal an emission factor times an activity level is a simple model. The term 'model' is also often used in the sense of a computer software realisation of a model abstraction.

Model-based approach

The application of (typically) statistical or process-based models that employ indirect measurements to infer GHG fluxes from a system of interest. For example, a model-based estimate of a pollutant flux could be computed as the product of an assumed concentration and a measured flow rate, whereas the corresponding measurement-based estimate would use a measured concentration and a measured flow rate.

Monte Carlo method

In these guidelines a Monte Carlo method is recommended to analyse the uncertainty of the inventory. The principle of Monte Carlo analysis is to perform the inventory calculation many times by computer, each time with the uncertain emission factors or model parameters and activity data chosen randomly (by the computer) within the distribution on uncertainties specified initially by the user. Uncertainties in emission factors and/or activity data are often large and may not have normal distributions. In this case the conventional statistical rules for combining uncertainties become very approximate. Monte Carlo analysis can deal with this situation by generating an uncertainty distribution for the inventory estimate that is consistent with the input uncertainty distributions on the emission factors, model parameters and activity data.

Non-energy products

Primary or secondary fossil fuels which are used directly for their physical or diluent properties. Examples are: lubricants, paraffin waxes, bitumen, and white spirits and mineral turpentine (as solvent).

Non-energy use

Within the *Guidelines* this term refers to the use of fossil fuels as *Feedstock*, *Reductant* or *Non-energy products*. However, the use of this term differs between countries and sources of energy statistics. In most energy statistics, e.g., of the International Energy Agency (IEA), fuel inputs of *reductants* to blast furnaces are not included but accounted for as inputs to a fuel conversion activity transforming coke and other inputs to blast furnace gas.

Non-marketed lime production

Lime production occurring at facilities where the primary purpose is the production of lime as an intermediate input: such as plants that produce steel, synthetic soda ash, calcium carbide, magnesia and magnesium metal, as well as copper smelter and sugar mills. The lime produced by these facilities is often used on site and thus is often not reported in national statistics. Also referred to as in-house lime production.

Non-Methane Volatile Organic Compounds (NMVOCs)

A class of emissions which includes a wide range of specific organic chemical substances. Non-Methane Volatile Organic Compounds (NMVOCs) play a major role in the formation of ozone in the troposphere (lower atmosphere). Ozone in the troposphere is a greenhouse gas. It is also a major local and regional air pollutant, causing significant health and environmental damage. Because they contribute to ozone formation, NMVOCs are considered "precursor" greenhouse gases. NMVOCs, once oxidized in the atmosphere, produce carbon dioxide.

Normal distribution

The normal (or Gaussian) distribution has the probability density function (*PDF*) given in the following equation and is defined by two parameters (the mean μ and the standard σ deviation).

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}, \text{ for } -\infty \leq x \leq \infty$$

Nutrient loading

An increase in levels of nitrogen, phosphorus, and sulfur entering aquatic systems as a result of human activity occurring in the catchment.

Observational data

Observational data is empirical data from instrumental (usually monitoring equipment) or manual methods (through counts in a survey or census).

Off-gas

The exhaust gas from a chemical process (combustion or non-combustion). The off gas may be vented to the atmosphere, burned for energy recovery or flared (without energy recovery), or used as a feedstock for another chemical process. Secondary products may also be recovered from the off gas.

Open burning of waste

The combustion of unwanted combustible materials such as paper, wood, plastics, textiles, rubber, and other debris in the open or at an open dump site, where smoke and other emissions are released directly into the air without passing through a chimney or stack. Open burning can also include incineration devices that do not control the combustion air to maintain an adequate temperature and do not provide sufficient residence time for complete combustion.

Outflow, in the context of reservoirs

Water discharged from a dam.

Outflow area

The area where water is discharged immediate downstream of a dam. It is characterised by exceptionally high levels of turbulence in the water (see degassing emissions) that directly result from the operation of the dam.

Oxic

Containing dissolved oxygen.

Oxidation

Chemically transform of a substance by combining it with oxygen.

Oxycline

The region of high dissolved oxygen concentration *change* within the water column that separates oxic and anoxic regions.

Ozone-depleting substances (ODS)

A compound that contributes to stratospheric ozone depletion. Ozone-depleting substances (ODS) include CFCs, HCFCs, halons, methyl bromide, carbon tetrachloride, and methyl chloroform. ODS are generally very stable in the troposphere and only degrade under intense ultraviolet light in the stratosphere. When they break down, they release chlorine or bromine atoms, which then deplete ozone.

Pasture

Area covered with grass or other plants used or suitable for the grazing of livestock; grassland.

PDF

See *Probability density function*.

Peat

Soft, porous or compressed, sedimentary deposit of plant origin with high water content in the natural state (up to about 90 percent). Countries may define peat according to their national circumstances.

Peatland

Peatlands are wetland ecosystems where soils are dominated by peat. In peatlands net primary production exceeds organic matter decomposition as a result of waterlogged conditions, which leads to the accumulation of peat.

Percentile

A percentile (or a centile) is a measure used in statistics indicating the value below which a given percentage of observations in a group of observations fall.

Perfluorocarbons (PFCs)

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Synthetically produced halocarbons containing only carbon and fluorine atoms. They are characterized by extreme stability, non-flammability, low toxicity, zero ozone depleting potential, and high global warming potential.

Plant-mediated emission

Flows of greenhouse gas emissions to the atmosphere that are influenced by plants, and such as the production, transport and oxidation of methane in wetland soils.

Polar/boreal, dry climate

Regions where mean annual temperature (MAT) is less than or equal to 0 °C, and the ratio of mean annual precipitation to potential evapotranspiration is less than or equal to 1.

Polar/boreal, moist climate

Regions where mean annual temperature (MAT) is less than or equal to 0 °C, and the ratio of mean annual precipitation to potential evapotranspiration is greater than 1.

Ponds

The water impounded behind a small dam (< 15 m high) or embankment.

Pool, carbon and nitrogen

A reservoir in the earth system where elements, such as carbon and nitrogen, reside in various chemical forms for a period of time. An example is carbon and nitrogen pools in forest biomass, which are composed of various types of compounds synthesized by trees. A group of pools are linked in a cycle with flows among the pools influenced by both anthropogenic and non-anthropogenic processes. An example is carbon and nitrogen pools in forest biomass, wood products, dead organic matter, soils and the atmosphere, in which flows are influenced by non-anthropogenic drivers such as plant production and microbial decomposition, as well as anthropogenic drivers such as fertilization, land use, tree harvest and product use. The units are in mass.

Population

The population is the totality of items under consideration. In the case of a random variable, the probability distribution is considered to define the population of that variable.

Precision

Closeness of agreement between independent results of measurements obtained under stipulated conditions. Better precision means less random error.

Primary fuels

Fuels which are extracted directly from natural resources. Examples are: crude oil, natural gas, coals, etc.

Process-based modelling

A mathematical modelling approach based on a theoretical understanding of fundamental ecological, biological, chemical, and physical processes. Typically using differential equations to represent the change over time of parameters of interest, it provides a useful framework to project specific responses to altered environmental conditions. For example, a process-based model might be used to quantify the delivery of organic matter delivered from the catchment and/or produced by primary production within a reservoir, its deposition onto a reservoir's sediment, the degradation of the organic matter aerobically to CO₂ or anaerobically to CH₄ over time, and the emission of these gases across the air-water interface.

Probability

The probability of an event is a measure of the likelihood that the event will occur. The probability of any event can range from 0 to 1. The sum of probabilities of all sample points in a sample space is equal to 1.

Probability density function

A probability density function (PDF) is a function, whose value at any given sample (or point) in the sample space (the set of possible values taken by the random variable) can be interpreted as providing a relative likelihood that the value of the random variable would equal that sample.

Probability distribution

Statistical definition: A function giving the probability that a random variable takes any given value or belongs to a given set of values. The probability on the whole set of values of the random variable equals 1.

Process emissions

Emissions from industrial processes involving chemical transformations other than combustion.

Pumped storage reservoirs

Reservoirs at different elevations that are used to store energy by moving water from the lower to the higher elevation.

Quality Assurance

Quality Assurance (QA) activities include a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process to verify that data quality objectives were met, ensure that the inventory represents the best possible estimate of emissions and sinks given the current state of scientific knowledge and data available, and support the effectiveness of the quality control (QC) programme.

Quality Control

Quality Control (QC) is a system of routine technical activities, to measure and control the quality of the inventory as it is being developed. The QC system is designed to:

- (i) Provide routine and consistent checks to ensure data integrity, correctness, and completeness;
- (ii) Identify and address errors and omissions;
- (iii) Document and archive inventory material and record all QC activities.

QC activities include general methods such as accuracy checks on data acquisition and calculations and the use of approved standardised procedures for emission calculations, measurements, estimating uncertainties, archiving information and reporting. More detailed QC activities include technical reviews of source categories, activity and emission factor data, and methods.

RAMSAR

The Convention on Wetlands, called the *Ramsar* Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

Removals

Removal of greenhouse gases and/or their precursors from the atmosphere by a sink.

Reporting

The process of providing results of the inventory as described in Volume 1 Chapter 8.

Reservoir

- (1) A component or components of the climate system where a greenhouse gas or a precursor of a greenhouse gas is stored. (UNFCCC Article 1.7)
- (2) Water bodies regulated for human activities (energy production, irrigation, navigation, recreation etc.) where substantial changes in water area due to water level regulation may occur. The water impounded behind a dam.
- (3) In the context of oil and natural gas systems, an underground formation where oil and gas has accumulated; consists of porous or fractured rock that holds oil and gas and a cap rock that prevents its escape.

Rice paddies

A flooded parcel of land used for growing semiaquatic rice. Paddy cultivation should not be confused with cultivation of deep water rice, which is grown in flooded conditions with water more than 50 cm (20 in) deep for at least a month.

River emissions

GHG emissions from the surface of a normally (in a hydraulic sense) flowing river downstream of the exceptionally turbulent region (see outflow area) immediately downstream of a dam. 'Normal flow' refers to the velocity of the flow being solely determined by channel shape and bed slope so that water column turbulence is produced predominantly by natural shear forces at the water-river bed interface.

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Run-of-the-river reservoirs

Reservoirs in hydroelectric systems that harvest the energy from flowing water to generate electricity but cannot store more water than one day's annual mean inflow (i.e. annual mean flow / 365).

Secchi depth

A practical measure of aquatic turbidity (versus clarity) based on the depth at which a standard Secchi disc (created by Angelo Secchi) ceases to be visible from the surface of the water body.

Secondary fuels

Fuels manufactured from primary fuels. Examples are: cokes, motor gasoline and coke oven gas, blast furnace gas.

Sink

Any process, activity or mechanism which removes a greenhouse gas, an aerosol, or a precursor of a greenhouse gas from the atmosphere. (UNFCCC Article 1.8) Notation in the final stages of reporting is the negative (-) sign.

Soil carbon pool

A pool of carbon comprised of soil organic matter that is smaller than 2mm in size.

Source

Any process or activity which releases a greenhouse gas, an aerosol or a precursor of a greenhouse gas into the atmosphere. (UNFCCC Article 1.9) Notation in the final stages of reporting is the positive (+) sign.

Spillway

An engineered channel used to pass high flows safely past a dam when the reservoir water level is higher than the crest of the dam. Note that the maximum water level of a reservoir is frequently higher than the crest because of the use of gates that are on top of the crest.

Standard deviation

The population standard deviation is the positive square root of the variance. It is estimated by the sample standard deviation that is the positive square root of the sample variance.

Storage volume

The volume of water stored in a water body. The 'active' storage of a reservoir is the volume of water contained between the full supply level (the maximum level at which water may be stored indefinitely) and the lowest outlet level. The 'dead' storage is the volume of water that is below the lowest outlet and therefore cannot be routinely accessed for beneficial use. The 'flood control' storage is the volume of water contained between the full supply level and the top of gates (or other adjustable structures) located on top of the spillway and used to regulate the discharge of floodwaters. The total reservoir storage volume is the sum of dead storage, active storage, and flood control storage capacities.

Surrogate data

Surrogate data or called proxy data is data that is used in place of the actual data, where the specific data needed is unobtainable. Often surrogate data is needed to describe changes in an emission source over time, for example population change may be used to approximate change in waste arisings.

Survey

A survey is an investigation about the characteristics of a given population by means of collecting data from a sample of that population and estimating their characteristics through the systematic use of statistical methodology.

Systematic and random errors

Systematic error (i.e., bias) is the difference between the true, but usually unknown, value of a quantity being estimated, and the mean observed value as would be estimated by the sample mean of an infinite set of observations. The random error of an individual measurement is the difference between an individual measurement and the above limiting value of the sample mean.

Systematic error

See *systematic and random errors*.

Temperate, cold dry climate

Areas where mean annual temperature (MAT) is between 0 – 10 °C, and the ratio of mean annual precipitation to potential evapotranspiration is less than or equal to 1.

Temperate, cold moist climate

Areas where mean annual temperature (MAT) is between 0 – 10 °C, and the ratio of mean annual precipitation to potential evapotranspiration is greater than 1.

Temperate, warm dry climate

Areas where mean annual temperature (MAT) is between 10 – 18°C (or greater than 18 °C with more than 7 days of frost per year), and the ratio of mean annual precipitation to potential evapotranspiration is less than or equal to 1.

Temperate, warm moist climate

Areas where mean annual temperature (MAT) is between 10 – 18°C (or greater than 18 °C with more than 7 days of frost per year), and the ratio of mean annual precipitation to potential evapotranspiration is greater than 1.

Thin boundary layer model

The thin boundary layer model expresses the flux of gas across an air-water interface as the product of a gas transfer velocity and the concentration change across the interface. It was originally developed by Liss and Slater (1974).

Tier

A tier represents a level of methodological complexity. Usually three tiers are provided. Tier 1 is the basic method, Tier 2 intermediate and Tier 3 most demanding in terms of complexity and data requirements. Tiers 2 and 3 are sometimes referred to as higher tier methods and are generally considered to be more accurate.

Time series

A time series is series of values which are affected by random processes and which are observed at successive (usually equidistant) points in time.

Transparency

Transparency means that the assumptions and methodologies used for an inventory should be clearly explained to facilitate replication and assessment of the inventory by users of the reported information. The transparency of inventories is fundamental to the success of the process for the communication and consideration of information.

Trend

The trend of a quantity measures its change over a time period, with a positive trend value indicating growth in the quantity, and a negative value indicating a decrease. It is defined as the ratio of the change in the quantity over the time period, divided by the initial value of the quantity, and is usually expressed either as a percentage or a fraction.

Trophic state

A measure of the biological productivity of a water body. It is usually characterized by some combination of nutrients, photosynthetic pigments (Chl-a) and/or water column optical properties. As the ambient nutrient levels increase, primary production (the algal population) increases and the water clarity decreases. As primary production increases, higher levels of biological production are supported and the trophic state increases.

Lakes or reservoirs are usually classified as being in one of four possible trophic states: oligotrophic, mesotrophic, eutrophic, or hypereutrophic. (see e.g., Carlson, 1977)

Oligotrophic: an oligotrophic lake or reservoir is characterised by low primary productivity, as a result of low nutrient content. ($\text{Chl-a} \leq 2.6 \mu\text{g L}^{-1}$.)

Mesotrophic : mesotrophic lakes or reservoirs are characterised with an intermediate level of productivity ($2.6 \mu\text{g L}^{-1} < \text{Chl-a} \leq 20 \mu\text{g L}^{-1}$.)

Eutrophic : a eutrophic lake, pond or reservoir with high biological productivity. Due to excessive nutrients, especially nitrogen and phosphorus, these water bodies are able to support an abundance of aquatic plants. ($20 \mu\text{g L}^{-1} < \text{Chl-a} \leq 56 \mu\text{g L}^{-1}$.)

Hypereutrophic: a hypereutrophic body of water experiences the highest levels of biological productivity. ($56 \mu\text{g L}^{-1} < \text{Chl-a}$)

Tropical, dry climate

Areas where mean annual temperature (MAT) is more than 18 °C, with no more than 7 days of frost, and mean annual precipitation less than or equal to 1000mm.

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Tropical, moist climate

Areas where mean annual temperature (MAT) is more than 18 °C, with no more than 7 days of frost, and mean annual precipitation greater than 1000mm and less than or equal to 2000mm.

Tropical montane climate

Areas where mean annual temperature (MAT) is more than 18 °C, with no more than 7 days of frost, and an elevation greater than 1000m.

Tropical, wet climate

Areas where mean annual temperature (MAT) is more than 18 °C, with no more than 7 days of frost, and mean annual precipitation greater than 2000mm.

Unbiased estimator

An unbiased estimator is a statistic whose expected value equals the value of the parameter being estimated. Note that this term has a specific statistical meaning and that an estimate of a quantity calculated from an unbiased estimator may lack bias in the statistical sense, but may be biased in the more general sense of the word if the sample has been affected by unknown systematic error. Thus, in statistical usage, a biased estimator can be understood as a deficiency in the statistical evaluation of the collected data, and not in the data themselves or in the method of their measurement or collection. For example, the arithmetic mean (average) \bar{x} is an unbiased estimator of the expected value (mean).

Uncertainty

Lack of knowledge of the true value of a variable that can be described as a probability density function characterizing the range and likelihood of possible values. Uncertainty depends on the analyst's state of knowledge, which in turn depends on the quality and quantity of applicable data as well as knowledge of underlying processes and inference methods. (See Volume 1 Chapter 3.)

Uncertainty analysis

An uncertainty analysis of a model aims to provide quantitative measures of the uncertainty of output values caused by uncertainties in the model itself and in its input values, and to examine the relative importance of these factors.

Validation

Validation is the establishment of sound approach and foundation. In the context of emission inventories, validation involves checking to ensure that the inventory has been compiled correctly in line with reporting instructions and guidelines. It checks the internal consistency of the inventory. The legal use of validation is to give an official confirmation or approval of an act or product.

Variability

This refers to observed differences attributable to true heterogeneity or diversity in a population. Variability derives from processes which are either inherently random or whose nature and effects are influential but unknown. Variability is not usually reducible by further measurement or study, but can be characterised by quantities such as the sample variance.

Verification

Verification refers to the collection of activities and procedures that can be followed during the planning and development, or after completion of an inventory that can help to establish its reliability for the intended applications of that inventory.

Typically, methods external to the inventory are used to check the truth of the inventory, including comparisons with estimates made by other bodies or with emission and uptake measurements determined from atmospheric concentrations or concentration gradients of these gases.

Watercourse

The channel that a flowing body of water follows.

Water residence time

The average amount of time that water spends in a particular system (lake, reservoir, etc). Defined as the volume of the reservoir divided by the inflow.

Water withdrawal

The controlled release of water from a dam. Depending on the dam's design, i.e. the number and level of discrete outlets, the withdrawn water may originate solely from specific regions of the water column, i.e. epilimnion,

metalimnion and hypolimnion. The withdrawal region for a specific discharge depends strongly on the density stratification of the water body, the outlet dimensions, and the reservoir morphology.

Wetlands

This category includes land that is covered or saturated by water for all or part of the year (e.g., peatland) and that does not fall into the forest land, cropland, grassland or settlements categories. The category can be subdivided into managed and unmanaged according to national definitions. Wetlands occur over all climate zones and include reservoirs and other constructed waterbodies (e.g. agriculture and aquaculture ponds, canals and ditches and wetlands constructed for wastewater treatment) as managed sub-divisions. Managed wetlands may also include peatlands, riparian wetlands, forested swamps, marshes, playas, pans, salt lakes, brackish wetlands, salinas, and sabkhas, in addition to coastal wetlands, including mangroves, saltmarshes, tidal marshes and seagrass. Unmanaged wetlands include natural rivers, lakes and ponds and any wetlands that have not been directly modified by human activity based on the Managed Land Proxy.