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# **BIOMOVS II**

**GLOSSARY**

## **Glossary**

developed for the participants in the  
BIOMOVS II study

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*BIOMOVS - an international study to test models designed to predict the environmental transfer and bioaccumulation of radionuclides and other trace substances*

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# BIOMOVS II - Glossary

August 1993

## Preface

Terminology used in documents published within the BIOMOVS II study is defined in individual Technical and Progress reports and is the responsibility of the corresponding authors. However, as in other areas of scientific endeavour, there can be a tendency for terms to be used differently. This follows from the range of scientific disciplines involved. Therefore, this glossary of terms is offered to BIOMOVS II participants with a view to obtaining consistent usage and avoiding possible confusion. The definitions given have been provided and reviewed by BIOMOVS II participants. A list of other potentially relevant glossaries is also provided.

It is acknowledged that some modifications to the definitions may be desirable when used for a specific task or document. Also additional terms may need to be added as time goes by. This document is itself an update of the glossary which was produced for use in BIOMOVS I. Thus, it is considered as a working document. Suggested modifications or additions should be addressed to the BIOMOVS II Technical Secretariat, Intera, Chiltern House, 45 Station Road, Henley on Thames, Oxon RG9 1AT, UK.

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# **BIOMOVS II - Glossary**

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## **Alphabetical Listing of Terms**

### **A**

**Abiotic substances:**

Inorganic or organic, non-living substances in the environment.

**Accuracy:**

As applied to environmental assessment models, a measure of agreement between the model prediction and actual events. An "accurate" model should be precise and unbiased.

**Adsorption/Desorption:**

The process of attachment onto and release from surfaces. (See also: sorption)

**Algorithm:**

A succession of instructions that describe the operation to be performed for solving a mathematical problem (if such a solution exists).

**Anisotropic:**

Matter that possesses direction-dependent structure.

**Anoxic:**

Devoid of free oxygen.

**Aquifer:**

A water-bearing formation below the surface of the earth.

### **B**

**Benthic organisms:**

Organisms which live on the bottom or in the sediments of aquatic environments from the water's edge down to the greatest depths.

**Bias:**

In modelling: The tendency for an estimate to deviate systematically from an actual or real event. Bias may be the tendency for a model to over or under predict.

In data: The tendency for collected data to deviate systematically from an actual distribution of values due to non-representative sampling (e.g. by selectively choosing samples from heavily contaminated areas for the purpose of controlling intervention levels).

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#### **Bioaccumulation:**

The increase in the amount of a chemical or compound in the tissues of living organisms.

#### **Bioaccumulation factor (BF):**

The empirical ratio of nuclide concentration in the tissue of an organism to that in the surrounding medium such as water, sediment or soil. At steady state, when determined under field conditions it implicitly includes all processes and mechanisms of uptake and retention. In specifying or interpreting values of BF care should be taken to understand the circumstances of measurement, e.g. whether it is filtered or unfiltered water.

#### **Biogenic:**

Originating from biological processes.

#### **Biological half-life:**

The time required for the amount of a particular substance in a biological system, such as an animal, to be reduced by one half by biological processes. Radioactive decay may increase the effective loss rate in the case of radionuclides.

#### **Biomass:**

Mass of living organisms present at any one time within a given area or volume.

#### **Biosphere:**

That portion of the Earth's environment inhabited by living organisms. It comprises parts of the atmosphere, the hydrosphere and the lithosphere. The biosphere includes the human habitat in the widest sense of the term.

#### **Biota:**

Living organisms.

#### **Biotype:**

A habitat, characterised by a high degree of uniformity in the environment and its plant and animal life, e.g. a sandy beach.

#### **Bioturbation:**

Mechanical mixing and transport of sediments and soils due to animal activity.

#### **Boundary layer:**

That portion of a moving fluid in which interaction with the underlying surface affects flow characteristics.

## **C**

#### **Chemocline:**

An area of rapid change in concentration of dissolved solids in water bodies.

#### **Clay:**

Minerals that are essentially hydrous aluminium silicates or occasionally hydrous magnesium silicates with sodium, calcium, potassium and magnesium cations.

Clay loam:

Soil material that contains 30 to 40 percent clay particles and 20 to 50 percent sand, the rest being silt.

Colloid:

Small particles ( $10^{-9}$ - $10^{-7}$  m) finely dispersed through a medium but much larger than those in a true solution, and too big to pass through a semipermeable membrane.

Compartment:

Part of the environment which may conveniently be considered as a single entity. In general this implies rapid mixing of contaminants within the compartment, compared with timescales of interest, and no spatial dependence on the variables describing the compartment.

Compartment model:

A model in which a series of compartments is used to represent the system of interest. Material can flow between the compartments. Differential or difference equations often are used to represent the rates of flow in the system.

Complementary cumulative distribution function:

Often abbreviated to ccdf. The ccdf gives the probability that a random variable takes on a value greater than  $x$ .

Concentration ratio:

Synonymous to bioaccumulation factor.

Confidence interval:

An interval which encompasses the true value for a parameter or measurement with a degree of confidence stated in terms of a probability. For example, the mean value of  $X$  lies between 1.5 and 2.8 with a probability of 0.95.

Continuous random variable:

A random variable  $x$  is continuous if there exists a function  $f(x)$  such that the cumulative distribution function  $F(x)$

$$F(x) = \int f(x) dx$$

for every real number  $x$ .  $f(x)$  is the probability density function and is often abbreviated pdf.

Critical pathways:

For a given group of people, usually called the critical group, the environmental pathways for radioactive materials through which the highest potential exposures may occur.

Cumulative distribution function:

A function  $F(x)$  with domain the real line and range the interval  $[0, 1]$  that approaches 0 as  $x$  approaches negative infinity, approaches 1 as  $x$  approaches infinity, is a monotone, non-decreasing function and is continuous from the right. The cumulative distribution function is often abbreviated cdf. The cdf gives the probability that a random variable takes on a value less than or equal to  $x$ .

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Cumulative probability:

The cumulative probability indicates the probability of a given value not being exceeded by other values in the distribution.

For the normal distribution:

The 95th percentile = the mean plus 1.645 standard deviations.

The 99th percentile = the mean plus 2.326 standard deviations.

Note: These should not be confused with the expressions for confidence limits. For example, the 95% confidence interval (mean minus 1.96 standard deviations to mean plus 1.96 standard deviations) represents the range between the 2.5th and 97.5th percentiles.

**D**

Default value:

A value prescribed for a model parameter in the absence of data directly relevant to the assessment situation. (Parameter values that are used in radiological assessment models when site-specific values cannot be obtained.)

Demersal:

Living on or near the seabed.

Deposition velocity:

The deposition velocity,  $V_d$  ( $\text{ms}^{-1}$ ), relates the concentration at some specified height above the surface to the deposition flux to the surface. The deposition velocity includes effects of both atmospheric and surface processes between the reference height and the depositional surface.

Deterministic analysis:

A technique for studying the behaviour of a system mathematically given that all system parameters, events and features are deterministically (as opposed to probabilistically) defined.

Deterministic effects:

In radiological protection, health effects arising only above a radiation dose threshold and exhibiting a correlation between severity of the dose and effect. (Compare with "stochastic effects"). They have previously been called non-stochastic effects.

Deterministic model:

A model whose output is determined by the mathematical form of its equations and the selection of a single value for each input parameter.



**Detriment (radiological):**

The mathematical expectation of harm to a population incurred from a radiation exposure, taking into account not only the probabilities of each type of deleterious effect but the severity of the effect as well. Detriment, in general, also includes deleterious effects not associated with health, such as the need to restrict the use of some areas or products. If a linear dose response relationship is assumed, the health detriment may be directly related to the collective effective dose.

**Diagenesis:**

Process by which deposited sediments are formed into rocks by compaction, cementation and crystallisation.

**Diffusion:**

A process by which molecules and atoms intermingle as a result of their random thermal motion.

**Discrete random variable:**

A random variable  $X$  is discrete if the number of possible values of  $X$  is countable.

**Dispersion:**

The summed effect of those processes of transport, and mixing which tend to distribute contaminants through the surrounding volume of soils, water or air. The ultimate effect appears as a dilution of the contaminants.

**Dispersion coefficient:**

A measure of the spreading of a flowing substance due to the nature of the substance and medium.

**Documentation:**

The process of recording the model equations, rationale, data sources, variables, code, and experiments for purposes of information transmission.

**Donor controlled:**

A model in which the flows between compartments depend on the compartment (see compartment) from which the flows come, called the donor compartment.

**Driving variable:**

Conditions external to the model system that affect model prediction. Driving variables are not affected by the model. Driving variables are also called forcing functions.

**Dry deposition:**

The process of deposition of contaminants onto ground or vegetation from the air not involving precipitation, e.g. snow or rain.

**Dynamic model:**

A model that simulates the changes that occur through time in a system, especially, in the current context, in contaminant concentrations in the system.

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**E**

**Ecosphere:**

That portion of the Earth which includes the biosphere and all the ecological factors which operate on the living organisms it contains.

**Ecosystem:**

A complex of interdependent plant and animal populations and the particular sets of physical and other conditions under which they exist and with which they interact: the organisms of a locality, together with the functionally related aspects of the environment, considered as a single entity.

**Effective half-life:**

The time required for the amount of a particular radionuclide in a system to be reduced to half its value as a consequence of radioactive decay and all other processes (when the rate of removal is approximately exponential).

**Empirical distribution:**

A distribution constructed from a set of empirical observations. The cumulative frequency distribution is derived directly from the data.

**Epilimnion:**

The water body above the thermocline.

**Equilibrium distribution coefficient ( $K_d$ ):**

The concentration ratio between the solid and liquid phases of a system, at equilibrium; the amount of a chemical species per unit mass of solid divided by the amount of that species per unit volume of liquid after equilibrium is achieved.

**Equilibrium surface distribution coefficient ( $K_a$ ):**

The amount of a chemical species sorbed per unit area of solid material divided by the amount of that species per unit volume of liquid after equilibrium is achieved.

**Error propagation:**

A procedure for estimating the error in a computed value based upon the errors in the variables used to compute the value. Analytical and numerical techniques can be used to propagate errors in a model.

**Euphotic zone:**

The upper level of the sea down to the limits of sufficient light penetration for photosynthesis.

**Eutrophic:**

Waters which are rich in nutrients and therefore highly productive.

**Evaporite:**

A sedimentary rock which is formed from aqueous solution as a result of extensive or total evaporation of the water.

**Evapotranspiration:**

The total sum of water lost from land by evaporation and plant transpiration.

**Event-tree analysis:**

An inductive probabilistic technique that starts by assuming the occurrence of a basic initiating event and proceeds through the logical propagation (with binary decisions at each branch point) to system failure events. The event tree is the diagrammatic illustration of the alternative consequences or outcomes of specified initiating events.

**Exponential distribution:**

A probability distribution often used to describe the time taken between events when the number of events in a fixed time interval has a Poisson distribution. The notation  $I(0, \infty)$  means that the range of values is between 0 and  $\infty$ .

$$f(x) = \lambda e^{-\lambda x} I_{(0, \infty)}(x)$$

**F**

**Far field:**

The zone of a waste repository system that is not directly affected by the presence of the repository i.e. the undisturbed natural geological system.

**Fault-tree analysis:**

A deductive probabilistic technique that systematically analyses the possibility of events or combinations of events that could cause a failure to occur. The fault tree is the diagrammatic representation of the events in a tree-like structure.

**Field capacity:**

The moisture content of a soil which has been allowed to drain (i.e. after water has been lost as a result of the pull of gravity from the saturated state).

**Finite difference method:**

A method for the approximation of continuous functions, in which the function is represented by values at an array of grid points and the derivatives of the function are represented by linear combinations of adjacent grid point values.

**Finite element method:**

A numerical procedure for obtaining approximate solutions to boundary value problems. In this method a physical object is thought of as composed of a finite number of pieces which are analyzed separately. Thus, each physical variable of the entire object can be expressed as a sum of finite elements. By combining the pieces, a system of usually linear equations appears which provides the approximate solution.

**Fixation (in soil):**

The conversion of a soluble substance, such as phosphorus, from a soluble or exchangeable form to a relatively insoluble or non-exchangeable form, thus retarding its movement in soil.

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#### Flocculation:

The process of removing finely divided solid particles, frequently colloids, from a medium by neutralising their electrical charges and allowing the neutralised particles to agglomerate and settle out.

#### Food chain:

A series of organisms through which energy and material is passed as a result of feeding activities.

#### Fractional factorial design:

An experimental design in which parameters are treated at several points within their ranges (levels) but only a fraction of the possible parameter-level combinations are included in the experiment.

#### Fracture flow:

Groundwater flow which is predominantly through fractures in the rock.

## G

#### Gamma function:

A function, denoted by  $\Gamma(x)$ , that for integers has the value  $(x-1)!$ . For real values

$$\Gamma(t) = \int_0^{\infty} x^{t-1} e^{-x} dx \quad \text{for } t > 0$$

#### Gaussian plume model:

A pollutant diffusion model where the distribution of material in the plume is assumed to be gaussian or normal (see normal distribution) in shape.

#### Generic analysis:

An analysis that does not consider site-scenario-specific information.

#### Geohydrology (or groundwater hydrology):

See hydrogeology.

#### Gradient-transport theory:

A theory of pollutant transport which assumes that if the spatial density gradient of a substance is small and there is no convection current, the flux of that substance is proportional to its density gradient.

#### Grid model:

A mathematical technique in which the model domain is divided into units. (See finite difference method.)

#### Groundwater:

Water which permeates rocks and soils filling their pores, fissures and cavities.

## H

### Halocline:

An area of rapid change of salt concentration in water bodies.

### Hazard:

A natural or man-made cause of a potential deleterious effect as distinct from an expected deleterious effect (To avoid confusion, use of the terms risk or detriment as appropriate is recommended in place of hazard or harm when potential effects are being considered.)

### Hydraulic conductivity (permeability):

The flux of water through a permeable medium under a unit hydraulic gradient ( $\text{m s}^{-1}$ ).

### Hydrogeology:

The branch of geology which deals with the properties, distribution and movement of water below the soil surface.

### Hydrology:

The study of all waters in and upon the Earth. It includes underground water, surface water and rainfall, and embraces the concept of the hydrological cycle.

### Hydrosphere:

The total body of water of the Earth, i.e. the oceans, icecaps, rivers, lakes, underground and atmospheric water.

## I

### Impact assessment:

The process of measuring, modelling, and monitoring a system to evaluate the impact of a perturbation to the system.

### Interception fraction:

The fraction of deposited material intercepted by and immediately retained on foliage (dimensionless).

### Isotropic:

Matter that does not possess direction-dependent structure (cf. anisotropic).

## K

### K-theory:

See gradient-transport theory.

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#### L

##### Latin hypercube sampling:

A form of stratified sampling in which the probability distribution of each parameter is divided into  $n$  strata of equal probability. In a set of  $n$  simulations a stratum is selected at random without replacement and a sample is taken from that stratum.

##### Lithology:

The physical characteristics of rocks present in a stratigraphic subdivision, based on macroscopic features.

##### Lithosphere:

A general term which refers to the upper, rigid part of the Earth's crust. In a waste management context it is used more loosely in describing storage and disposal practices which apply to the land as opposed to wastes discharged into the hydrosphere or atmosphere i.e. lithosphere disposal.

##### Lognormal distribution:

A continuous probability distribution such that if  $Y$  is a lognormal random variable then  $X = \ln(Y)$  is a normal random variable. A lognormal distribution has the probability density function.

$$f(x) = \frac{1}{x \sigma(2\pi)^{0.5}} \exp \left[ \frac{-1}{2\sigma^2} (\ln(x) - u)^2 \right] \quad I(0, \infty)(x)$$

#### M

##### Markov model:

A model which describes a system as a set of states and a matrix that defines the probability of transition from one state to another in a fixed amount of time.

##### Mass interception factor:

The interception factor expressed per unit standing crop ( $\text{m}^2 \text{kg}^{-1}$ ).

##### Metabolism:

Chemical and biochemical processes which occur within an organism, or part of an organism.

##### Model testing:

The process of evaluating some particular aspect of model performance. It can include model validation and verification, but could also involve intercomparison of the predictions of different models, peer review, evaluation of data, establishing the domain of applicability of the model or its degree of conservatism, and so on.

Model validation:

In the context of the BIOMOVS study, model validation is a process carried out by comparison of model predictions with independent field observations and experimental measurements to demonstrate that the model, within its domain of applicability, adequately represents the system it is intended to describe.

Model/code verification:

Verification refers to the process of testing the internal correctness of a computer code that implements mathematical or numerical solutions dictated by a conceptual model of a real system. For example, a computer code has been verified when sufficient tests have been performed to ensure that it is free of errors in programming and data entry and that the accuracy of numerical approximations to solutions of equations is acceptable.

Monte Carlo:

A technique involving the use of random numbers in a computer program or simulation model to represent stochastic events.

N

Near field:

The zone of a waste repository system which is significantly altered by the presence of the repository. The near field includes all engineered barriers plus the region of surrounding host formation which is significantly affected by heat and/or chemical releases from the waste.

Non-stochastic effects:

See deterministic effects.

Normal distribution:

A continuous probability distribution commonly used in statistics and completely characterized by a mean,  $\mu$ , describing its location, and a variance,  $\sigma^2$ , describing its spread. The distribution is symmetrical about its mean. The distribution is denoted by  $N(\mu, \sigma^2)$  and has the probability density function

$$f(x) = \frac{1}{\sigma(2\pi)^{0.5}} \exp [-(x-\mu)^2/2\sigma^2]$$

O

Oligotrophic:

Fresh-waters deficient in nutrients and unproductive.

Ontogenetic:

Pertaining to the sequence of development during the life history of an individual.

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#### **Output variables:**

Variables that are produced as model output. Output variables can be state variables or functions of one or more state variables.

## **P**

#### **Parameters:**

Constant or time dependent coefficients that control model processes.

#### **Parameter imprecision analysis:**

The analysis of uncertainty in models that arises from uncertainty in stochastic model parameters. Also see error propagation and uncertainty analysis.

#### **Parameterization:**

The simplification of the equations representing a system by mathematically describing some processes (usually of small scale) in reduced detail.

#### **Partial correlation:**

A measure of the strength of the linear relationship between two variables after removing the linear effects of other variables.

#### **Pelagic:**

A term applied to organisms living in the free water mass.

#### **Pelagic ooze:**

A deposition on the sea bed of the hard parts of dead pelagic organisms.

#### **Percolation:**

The process of downward movement of water from the soil surface into underlying materials.

#### **Permeability:**

The measure of the ability of a rock or soil to transmit fluid or gas under a fluid potential gradient (see also: hydraulic conductivity).

#### **Photosynthesis:**

The synthesis of organic compounds from simple inorganic compounds (water and carbon dioxide) by green plants, using light energy.

#### **Phytoplankton:**

Drifting aquatic plants, generally small.

#### **Plankton:**

Aquatic plants and animals which float in water bodies and are moved passively by waves or currents, generally small.



**Poisson distribution:**

A discrete probability distribution defined on the non-negative integers having a single parameter,  $\lambda$ . It is commonly used to describe events that occur randomly in time or space. The Poisson distribution has the probability density function

$$f(x) = \frac{e^{-\lambda} \lambda^x}{x!} I_{\{0, 1, \dots\}}(x)$$

**Pore velocity, seepage velocity:**

The average rate of flow in the pores of a given porous medium. This is approximated by dividing the flux by the effective porosity.

**Porosity:**

The fraction of pore space in a medium. Total porosity is expressed as the ratio of the volume of interstices to total volume. Effective porosity refers to the porosity through which flow occurs.

**Porous flow:**

Groundwater flow which is predominantly through pores in the medium or through the interstitial spaces between small grains of materials (as opposed to fracture flow).

**Precipitation scavenging:**

A chemical treatment whereby trace concentrations of a substance may be partially removed by a coprecipitation process. The precipitate is chosen to have a high affinity for the substances of interest. The actual removal may in some cases be described as an adsorption process on freshly formed precipitates. Occasionally a very flocculent precipitate proves to be useful for such a treatment, probably by trapping colloidal species; here the treatment is sometimes referred to as flocculation.

Note that the term precipitation scavenging is sometimes used to describe "wet deposition".

**Probability density function:**

The derivative of a continuous cumulative distribution function.

**Probability function:**

A function that describes the probability that a discrete random variable takes on any value over its range.

**Probabilistic analysis:**

A statistical analysis technique for studying the expected behaviour of a system with parameters whose values are uncertain, with events whose occurrences are random, and with features which may or may not be present.

**Probabilistic model:**

See stochastic model.

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#### Pseudorandom numbers:

Numbers generated by an algorithm that appear to be random. Pseudorandom numbers typically are produced in a fixed sequence by a pseudorandom number generator on a computer. The sequence can repeat, so pseudorandom number generators must be used with care.

#### Pycnocline:

A density gradient.

## R

#### Radionuclide migration:

The movement of radionuclides through various media. This may occur as a result of bulk movement in solids liquids or gases, or through diffusion in solids, liquids or gases. These processes may be moderated by biota.

#### Random number:

A particular outcome of an experiment, i.e. a specific numerical or sample value of a random variable.

#### Random sampling:

Sampling procedures in which each element of a set has an equal and independent chance of being selected in a sample.

#### Random variable:

A real valued function defined over a sample space associated with the outcome of a random experiment.

#### Rank correlation coefficient:

The correlation coefficient computed from the ranks of the data rather than the data values themselves.

#### Rank transportation

The process of arranging a set of values in ascending order and assigning an ordinal number to each value. This transformation is performed on a given set of values of a variable; "ties" (equal values in the set) require specific techniques.

#### Recipient controlled:

A model in which flows between compartments depend on the compartment to which the process flows, called the recipient compartment.

#### Recursive:

An algorithm that operates by repeating itself.

#### Regression:

A statistical technique for fitting a function to a set of data describing independent and dependent variables such as to optimize some criterion of fit between the function and the data points.

Residence time:

A time characteristic of the length of time spent by a substance in a system.

Resuspension:

Processes by which material which has been deposited from a medium to the underlying surface is transferred back into that medium.

Resuspension factor,  $K$  ( $m^{-1}$ ):

Resuspended air concentration ( $Bq.m^{-3}$ ) divided by surface deposit ( $Bq.m^{-2}$ )

Retardation coefficient:

The measure of the capability of a porous medium to impede by sorption the migration of a substance being carried through that medium by a fluid.

Risk:

A chance of injury, loss or detriment. A measure of the deleterious effects that may be expected as a result of an action. In reactor safety analysis, risk has traditionally quantified as the product of the probability and the consequence of the occurrence of an event or series of events.

Kaplan and Garrick (1981) give the following, more formal definition of risk:

"The risk,  $R$ , is the set of triplets:

$$R = \{ \langle S_i, P_i, X_i \rangle, i = 1, 2, \dots, N \}$$

where  $S_i$  is a scenario identification or description,

$P_i$  is the probability of that scenario,

$X_i$  is the consequence or evaluation measure of that scenario, i.e. the measure of damage".

Risk analysis:

An analysis of the risks associated with an action wherein the possible events and their probabilities of occurrence are considered together with their potential consequences, the distribution of these consequences within the affected population, the time factor and the uncertainties of these estimates.

Root uptake:

Uptake of a contaminant (or other substance) from the soil by plant roots. The extent of root uptake depends on the type of plant, the soil on which it is grown and the contaminant under consideration.

## S

Saturated zone:

The portion of a porous medium in which fluid occupies (fills) all of the interconnecting interstices (void space or pores).

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#### Scavenging:

The removal of chemical species from the air and water by their incorporation into or attachment onto surfaces of particles.

#### Scenario:

In the BIOMOVS context, an assumed set of conditions defining the practical assessment task.

#### Screening:

The process of rapidly identifying potentially important factors of phenomena to enable the elimination of those of lesser significance or the identification of those of greatest significance.

#### Screening models:

Models which have a bias in their assumptions, used for the purpose of screening out radionuclides and exposure pathways of negligible concern.

#### Sensitivity analysis:

Methods for examining the change in model predictions due to changes or variation in parameter values. Local sensitivity analysis examines the effects of small changes in parameters at a point in the parameter space of the model. Global sensitivity analysis quantifies the effects of variation in parameters over their entire range of values.

#### Simulation analysis:

A general method of studying the behaviour of a real system or phenomenon. The method usually involves devising a model which represents the essential features of the system and carrying out the solution of the mathematical and logical relations of the model.

#### Significance level:

The probability of rejecting a true null hypothesis.

#### Simulation experiment:

An experiment designed to investigate some phenomenon of interest about the model.

#### Sink:

A recipient for materials removed from a system.

#### Soil-to-plant transfer factor:

Ratio of radionuclide activity per unit mass of plant tissue to activity per unit mass of soil. This may be expressed on a wet or a dry weight basis and this should be taken into consideration when applying data to models.

Sorption:

A term referring to reactions taking place on the surfaces of a solid. Its use avoids the problem of technical distinction between absorption and adsorption reactions. Absorption is generally used to refer to reactions taking place largely within the pores of solids, in which case the capacity of the solid to absorb is proportional to its volume. Adsorption refers to reactions taking place on solid surfaces, so that the capacity of a solid is proportional to its effective surface area. An example of the latter process is ion exchange, whereby ions occupying charged sites on the surface of the solid are displaced by ions from solution.

Speciation (of a chemical):

Refers to the various forms in which a chemical can exist.

Specific activity method:

A method which estimates dose from a radionuclide by assuming the specific activity in food or water is equal to or a fraction of the specific activity in air for a given location. This approach bypasses the steps normally used in radionuclide transport models and has been applied to radionuclides that have an abundant stable carrier in nature such as water for tritium and carbon dioxide for carbon-14.

Specific retention:

The ratio of the volume of water which the rock or soil, after being saturated, will retain against the pull of gravity to the unit volume of rock or soil. (See field capacity).

Specific storage:

The volume of water released from or taken into storage per unit volume of the porous medium per unit change in hydraulic head.

State variable:

A state variable represents a measurable quantity of interest in the system.

Stochastic:

Having a state characterized by a probability. Contrast with deterministic, where the state is known with certainty.

Stochastic analysis:

Decomposition of a time series into components which are of a deterministic nature (e.g. seasonal effects) and of a probabilistic nature.

Stochastic effects:

In radiological protection, those health effects for which the probability of an occurrence, rather than the severity, is considered to be a function of dose without threshold.

Stochastic event:

A random event which can be predicted only by the probability of its occurrence. The term applies to data on phenomena that occur in time and/or space. These phenomena are basically of a probabilistic nature, but their values depend partially on their respective time and/or space coordinates. In a stochastic time series a term in the series is significantly related to the next one and this is considered in the time series analysis and synthesis.

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#### Stochastic model:

Any model whose input and output are expressed as random variables. Contrast with deterministic model.

#### Stochastic process:

A process described by a collection of random variables that have some common structure or relationship, usually over time or space.

#### Subjective confidence interval:

Confidence interval based largely on expert judgment rather than sample evidence.

#### Subjective probability:

Probability in the Bayesian or subjectivist interpretation; the degree of belief that a determined but vaguely or imprecisely known value is within a specified interval.

## T

#### Taylor series expansion:

A polynomial of infinite order that approximates a function  $f(x)$  in the neighbourhood of a point  $a$  involving powers  $(x - a)$  and the derivatives of the function evaluated at  $a$ .

#### Terrigenous:

Applied to sediments originating from the land.

#### Thermocline:

A layer of water in which the temperature decrease with depth is greater than that of the overlying and/or underlying water.

#### Thermohaline circulation:

A current in a water body resulting from an increase in the density of surface waters and the subsequent sinking of that water mass.

#### Transfer coefficient to animal products

The amount of a contaminant ingested daily appearing in a unit mass of animal product at equilibrium. Transfer coefficients have also been defined for inhalation of contaminants.

#### Transient model:

A model applied to a phenomenon having a temporary effect on a system.

#### Translocation factor:

The factor for the transfer of radionuclides into edible parts of plants from external plant surfaces.

## U

### Uncertainty analysis

The estimation of the uncertainty in model outputs that results from uncertainties in the structure of a model or the inputs to the model. See Error propagation.

### Uniform distribution:

A probability distribution in which the random variable has equal probability of taking on any value over its range. The notation  $I_{[a, b]}$  means that the range of values is between  $a$  and  $b$ . The uniform distribution has the probability density function

$$f(x) = \frac{1}{b-a} I_{[a, b]}(x)$$

### Unsaturated zone:

The portion of a porous medium where the interconnecting interstices are only partially filled with fluid.

### Upwelling:

The process by which water rises from a deeper to a shallower depth.

## V

### Validation:

See "Model validation".

### Verification:

See "Model/code verification".

## W

### Washout coefficient:

A measure of wet deposition per unit air concentration integrated over the entire height of the air column affected by precipitation.

### Water table:

- (i) The upper surface of the groundwater.
- (ii) The boundary of the saturated zone.

### Weathering:

The mechanical and chemical breakdown of rocks by the action of rain, snow, cold etc.

### Weathering half-life:

The time taken for the quantity of a radionuclide deposited onto and retained by the vegetation to be reduced to half its initial value by the action of wind and rain, etc. The effective weathering half-life may also include the effect of growth dilution.

## *BIOMOVS II*

### *Glossary*

#### Wet deposition:

The removal of a substance from a plume by the action of precipitation, including fog and snow. In general the process can be assumed to remove material uniformly throughout the entire vertical extent of the plume. The rate of deposition of activity onto the ground ( $\text{Bq}\cdot\text{m}^{-2}\text{s}^{-1}$ ) as a result of washout for short term releases is obtained by the integration of the product of the airborne concentration and the washout coefficient ( $\text{s}^{-1}$ ) over the plume height.

## Z

#### Zooplankton:

Small aquatic animals which consist mainly of small crustaceans and fish larvae.



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