

# Glossary

## **ANISOTROPY**

A dependence of the seismic wave speed upon the direction that the seismic wave propagates through a material.

## **AZIMUTH**

A horizontal direction defined by an angle measured clockwise from true north.

## **BODY WAVES**

There are two types of seismic body waves: P (primary) waves and S (shear or secondary) waves. P waves are compressional and analogous to a sound wave in air or water. They can pass through any kind of material. S waves move perpendicular to the direction of the waves' propagation and can only exist in solid earth.

"Pn" is a seismic P wave that travels along the lower boundary of the Earth's crust.

"pP" and "sP" are seismic body waves that travel upwards to the Earth's surface as a P wave or S wave respectively. They are then reflected as a P wave before travelling through the Earth for long distances. They are termed "surface reflections" and may be observed at distances of between 3,000 and 9,000 km.

## **CENTROID MOMENT TENSOR (CMT)**

A method that uses the digitised seismic waves observed at a network of recording stations to estimate simultaneously the location, depth and time of a seismic event, together with its size ('moment'), and the nature of the forces acting at the source ('moment tensor'). In the case of an earthquake, this estimate would contain the orientation of the active fault and the direction that material slips along the fault as it generates the earthquake. For a large earthquake the CMT location differs from the conventional location determined from the onset times of seismic waves; the conventional method estimates the initial point of rupture, whereas the CMT method estimates the centre (or 'centroid') of the radiation of seismic energy.

## **CLASSIFICATION ALGORITHMS.**

A fundamental problem in machine learning is to separate a large population of complicated objects (for example handwritten characters) into two classes (for example alphabetic characters and non-alphabetic characters). A common set of measurable characteristics or 'attributes' of each object is developed automatically (perhaps with some guidance) in order to maximise separation of the two classes. The algorithm is 'trained' on a set of objects (characters in this example) pre-classified by the user. In real examples

(including this one), the number of attributes required to achieve a reliable separation may be very large, and large computing resources are required to optimise the attributes and classify the objects. Many approaches to solving this type of problem have been developed, including Support Vector Machines (SVMs), Naive Bayes Classifiers, and Decision Trees.

## **CORE PHASES**

Seismic body waves (see above) that have passed through the Earth's core.

## **DILATATION**

A reduction in pressure (opposite of compression). The observation of one or more dilatational P-wave onsets from a seismic event may be evidence of an earthquake, since a pure explosion should theoretically give compressional P-wave onsets in all directions.

## **DISCRIMINANT**

In nuclear explosion monitoring, this refers to a method which is capable of discriminating between an explosion and some other source (for example an earthquake).

## **ENSEMBLE MODELLING METHODS**

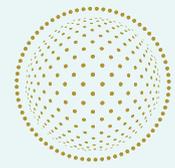
A group of parallel model simulations used for the ATM based assessment. Variation of the results across the ensemble members gives an estimate of uncertainty. Ensembles made with the same model but different initial conditions only characterise the uncertainty associated with the measurement (for backward ATM) or source (for forward ATM) parameters, whereas multi-model ensembles including simulations by several models also include the impact of model differences. The latter is more interesting to access the reliability of the ATM results and is utilized in the context of the CTBTO-WMO response system.

## **FISSION PRODUCTS**

Any of the lighter atomic nuclei formed by splitting heavier nuclei (nuclear fission), including both the primary nuclei directly produced (fission fragments) and the nuclei subsequently generated by their radioactive decay.

## **GAMMA SPECTROMETRY AND GAMMA SPECTROSCOPY**

Methods to measure gamma ray quantities and energies. They use detectors to determine the energy of gamma rays emitted by radioactive substances. This facilitates the identification of the radioactive elements present in a sample.

**‘GROUND TRUTH’**

Seismoacoustic sources whose location, depth and origin time, (together with their uncertainties), are known to high precision, either from non-seismic evidence, or using exceptionally good coverage of seismometers close to the event.

**INTERNET PROTOCOL**

A protocol used for communicating data across a packet-switched internetwork using the Internet Protocol Suite.

**NATIONAL DATA CENTRES (NDCS)**

are operated and maintained by a Member State, whose functions may include sending International Monitoring System data to the International Data Centre and/or receiving data and products from the International Data Centre.

**NATIONAL TECHNICAL MEANS**

A means of verification such as reconnaissance satellites or aircrafts and electronic surveillance and other monitoring devices available to individual States. Information obtained by National Technical Means can be used when requesting an on-site inspection.

**OSI MODEL TEXT**

The current basis for discussion by the CTBTO's Working Group on verification issues (Working Group B) in its third round of elaboration of the draft OSI Operational Manual.

**OSI OPERATIONAL MANUAL**

States Signatories are currently developing a draft OSI Operational Manual, which will provide guidelines and procedures for all operational, technical and administrative aspects of an on-site inspection. The Manual is required by the CTBT and, once adopted by the Conference of the States Parties, will provide guidance on the implementation of relevant Treaty provisions.

**OSI TEST MANUAL**

The Test Manual was used as the procedural guidance for testing during the 2008 Integrated Field Exercise (IFE08) and for related training leading up to the exercise. Lessons learned from testing during IFE08 have now been included in the draft OSI Operational Manual elaboration process.

**P/S SPECTRAL RATIO**

A method which examines the amplitude ratio of seismic P and S waves observed at various frequencies.

**RAY TRACING**

A method for calculating the path of waves or particles through a system with regions of varying propagation velocity, absorption characteristics, and reflecting surfaces.

**REVIEWED EVENT BULLETIN (REB)**

A bulletin listing events and signal measurements at each station that detected an event, derived from waveform data that have been reviewed by a human analyst.

**SEISMIC WAVES**

There are different types of seismic waves: body waves that travel through the interior of the Earth and surface waves that travel along its surface. Both types of wave are measured in order to analyze the location, strength and nature of an event.

**STANDARD EVENT LISTS**

Standard Event Lists (SELs) are generated automatically every 20 minutes 24 hours per day, every day of the year. These lists include location estimates for events formed from signals recorded at different combinations of International Monitoring System (IMS) seismic, hydroacoustic and infrasound stations around the globe. The International Data Centre (IDC) issues three SELs, with different time delays, in order to provide progressively improved location estimates as more data become available. Currently the IDC issues SEL1 within two hours of 'real time', SEL2 after about four hours and SEL3 after six hours, in accordance with the timeline envisaged after the Treaty's entry into force.

**SURFACE WAVES**

"Lg" is a high frequency seismic surface wave that is often observed at distances of up to around 1,000 km.

"Rg" is a high frequency seismic surface wave that is normally observed only for very shallow seismic events (within about 3 km of the surface) and is rarely observed beyond a distance of a few hundred km.

**TAMPED**

When an explosive device is buried, and material is returned to the hole and compressed ('tamped'), this ensures that the explosion is well coupled to its surroundings and there are no cavities which could reduce the seismic energy released. By contrast, an 'untamped' explosion might be located in a cavity, resulting in 'decoupling', and an associated reduction in transmitted seismic energy.