Short summary of the talks given during the conference organized by SCM, on January 15, 2007 : "Probabilistic Methods for the evaluation of natural risks".

M. Jean-Louis Durville, Ministry of Equipment

The case of land slips

People often speak about the probability of some event, but they do not mention the time interval, so it makes no sense.

Many studies have been made in order to estimate the probability that a rock will fall, or a piece of land will slip. But the parameters are very numerous. Sometimes, people try to use a linear formula, computed from several parameters.

There is a question about the robustness of such models.

One should fix the time scale : prediction within one year, ten years, and so on ?

There is no time independence from one year to the next. If a piece of land has fallen, it will not fall again.

In practice, some qualitative thresholds may be defined, and some time intervals, but only in vague terms.

The probability is certainly not constant with time. It increases, due to natural erosion.

Order of magnitude of data : in Maurienne (French Alps), on 140 years, 31 events were recorded. So a linear regression does not make much sense.

In a road near the ocean, in the island of "La Réunion", a rock falls every 4.5 days. Usually, the road is closed, so a compromise has to be sought between safety and commercial use of the road.

The fact that the mechanisms are not the same for small and large blocks is emphasized. So one should not extrapolate from small to big.

Two main difficulties :

- how to compute the probability law ?
- what is an acceptable risk ?

The conference (PowerPoint) of M. Durville can be downloaded on our web site (in French).

M. Pierre Sollogub, Commissariat pour l'Energie Atomique

Mathematical models for earthquakes

The effect of an earthquake on a building has been studied for a long time, but it may vary : in the same city, different buildings behave differently.

There is a database of 975 earthquakes, made during these last 50 years. Before that, we have some information for strong earthquakes, but this information is not very precise.

The propagation law of an earthquake is rather well known ; it is usually written using a semi-empirical formula such as :

$$Log(p) = aM + bR - Log(R) + c$$

where M is the magnitude, R is the distance, and a, b, c are constants which are statistically adjusted. They vary from one place to the other.

Most nuclear plants in France are equipped with sensors, which detect earthquakes. Using existing data about earthquakes, region by region, one can build a probability law : what is the probability to have an earthquake of a given magnitude in a given region. Then one knows how it propagates, using the above law.

So one can obtain a probability law for the detections in each plant. But, in practice, the detections are 10 times less numerous than the theory predicts.

Nobody knows which one of the three components of the result is faulty : it can be the probability law for the occurrences of earthquakes or the propagation law, but it can also be the detections.