SISMOS à l'École

The french educational seismological network

Earthquakes are both troubling and fascinating because of their suddenness, the terrible destruction they can wreak and because they still remain largely unpredictable. This is why emphasis must be placed on preparation, especially in the school system where causes and effects of these hazards are studied. But trying to explain earthquakes, scrutinizing the earth's depths, taking on the planet's internal dynamics… entail moving into the inaccessible. In this respect seismology is a source of complexity and fascination.

Scientific culture is thus at the heart of seismic risk instruction. All this is what is involved in the "SISMOS à l'École" curriculum, that implements an educational programme allowing a natural risk culture to be engaged through a scientific and technological approach.

The original and innovative aspect of this programme stems from giving students the opportunity to install a seismometer in their school. The recorded signals, reflecting regional or global seismic activity, feed into an on-line database, a genuine seismic resource centre and a springboard for educational and scientific activities.

The network 'EduSismo' (numbering some fifty stations installed in metropolitan France, the overseas departments and territories and a few French high schools abroad) is the outgrowth of an experiment conducted in the south of France.
some twelve years back. Since then, the programme implemented has gone beyond simply acquiring seismic signals, which could have been procured by research and monitoring centres. By appropriating a scientific measurement, the student becomes personally involved and masters complex concepts about geophysics and geosciences. The development of simple devices and the design of concrete experiments associated with an investigative approach make it possible to instill the students, these future citizens, with a high-quality scientific culture and an education about risks.

A pilot experiment initiated in the French Riviera region

The innovative idea of the pilot experiment was to study the feasibility and the pedagogical interest of installing a seismometer within a school. The project was implemented / tried out over a period of ten years (1996-2006) in south of France. It involved a close partnership between the *Conseil Général 06*, the *Rectorat* of the Nice district and the *GeosciencesAzur*[1] research lab. After a two-year period of testing various materials at a pilot site (the *Centre International de Valbonne*), results from the deployment of five stations showed that it was possible to record high quality signals within a school.

The main goal of this pedagogical programme was to make available for the school community an instrument measuring an environmental parameter and the related data. Teachers took away a number of positive points from this experience : the students were enthusiastic to take measurements, the online database was easy to use, the experience encouraged the development of autonomy, the students took responsibility for the management of the seismic station, and the experience demonstrated the importance of regular contact with a reference scientist.

A seismological network with an educational purpose

The initial experiment has expanded. Since the beginning of the 2006 academic year the programme 'SISMOS à l'École', which is part of the broader project 'Sciences à l'Ecole[2]', has extended the educational seismological network throughout the country. Following a call to candidature, approximately thirty schools were selected according to the quality of their

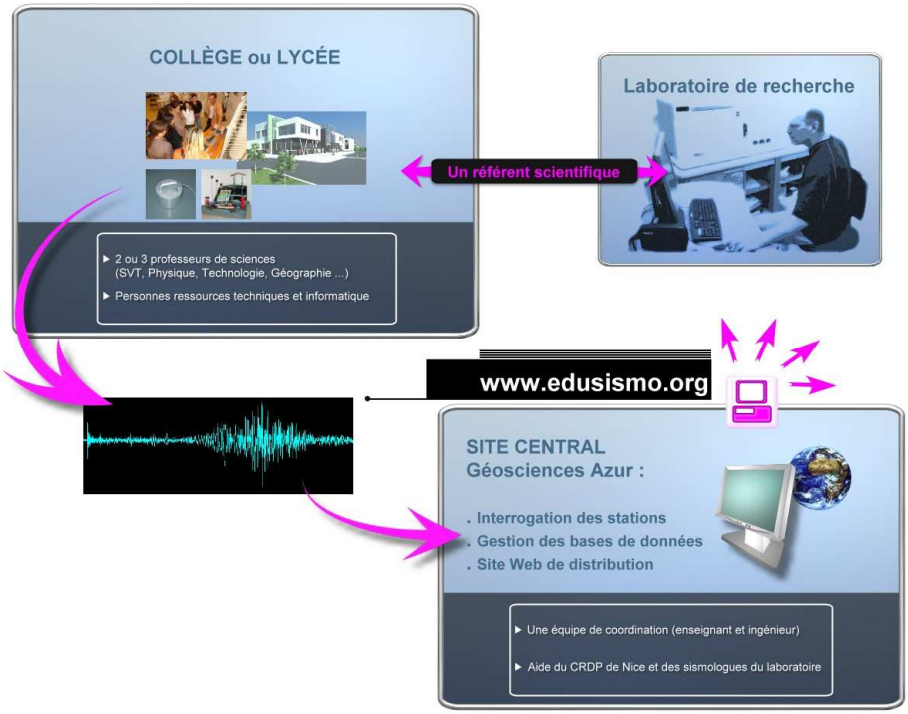
pedagogical projects in order to build this network. In each school, a multidisciplinary team of teachers aided by a scientist is carrying out its project centred on a seismic station designed and realized for the school.

Seismological stations directly accessible online by everyone

Current seismicity and the associated signals recorded by the stations are registered online on a website dedicated to this school project. How is this database built?

Each seismological station records in continuous mode the ground motion with a sampling frequency of 50 Hz. Broad band seismometers ensure a high sensitivity and a good reproduction of a large frequency band, which enables to visualize correctly local and teleseismic earthquakes. A GPS unit allows the data to be synchronized with universal timeAs the data are viewable online, students can monitor ground motion in real time. They can identify the arrival of earth tremors and other vibrations, natural or generated by human activities (swell, quarry explosions).

Stations are queried daily to extract recordings related to seismic events. In this way, a national server retrieves and archives seismic events identified by the seismological observatories and corresponding signals received from the stations. Selected events are at times earthquakes close to the station and at other times distant high-magnitude earthquakes. Signals from these events are then fed to an online database consitituting a genuine seismic resource and a starting point for educational scientific activities. The recorded data can be accessed by the entire educational community on a website.



The stations installed in the schools transmit their data to a central server.

Using a seismometer in the school

The school curriculum has several important aspects (placing large emphasis on new communication technologies): scientific content (instrumentation, geophysics, Earth sciences), an educational dimension (sensitization to seismic risk), and a regional and

national and international dimension (networking several schools). The team of teachers can follow various pedagogical suggestions.

What are the students doing? Observe, measure in order to understand better, compute and discover new parameters ... then understand to act more appropriately

Within the framework of courses in Earth and Life Sciences, Physics, Technology and Geography there are various pedagogical suggestions for the curricula of junior high schools and high schools on the following themes: measurement of a parameter, knowledge of one's geological environment, complex mechanisms of internal geodynamics, and notion of environmental risk.

The network of seismological stations and its database can also be a springboard for multidisciplinary projects bringing together teachers of experimental sciences, technology, maths and geography.

Also, management of a seismological station can be the starting point for a scientific workshop. In such a case, students would have the responsibility of managing a seismological station (concept of educational observation of the environment), work autonomously in teams and develop their skills in the 'Technologies of Information and Communication' (TIC)[5].

In all these situations, transversal approaches are encouraged : measurement, observation, building of models, and investigative thinking to grasp scientific concepts related to geosciences and physics. This building of scientific know-how is essential to education about environmental risk.

Best practices all around the network have been shared by teachers of various schools and the following pedagogical suggestions attest to the richness of such sharing.

The "sensors" topic is an essential point. Measurements through a sensor (for example, measurement of ground motion in relation to universal time) could be explored, using sensors from the seismological station or sensors developed by students. Various aspects of basic science are tackled, including frequency, bandwidth, fidelity, repeatability, and the robustness related to the often linear oscillator behind the sensor.

The "data" topic arises naturally. The analysis of recorded signals leads to various activities, including work on waves, a key notion in our society as radio, TV, and internet use them intensively. Travel times, wave speed, and localization through triangulation are typical concepts a student can easily master without getting into sophisticated mathematical tools.

The "tectonic" topic is also rich in possible activities. Numerous models have been proposed and realized by students. These practical exercises introduce abstract concepts, including seismic cycle, stress build-up, friction phenomena and energy release among others.

The "Earth" topic is obviously central to teaching of natural sciences. Possible activities include geographical mapping through the presentation of data collected from various schools, the discussion of seismic hazard either on a global scale or a local scale, and the presentation of different seismic signatures such as Benioff planes or Moho discontinuity. These activities demonstrate how we discover the internal structure of the Earth.

The "risk" or "hazard" topic comes naturally after these various speculations or analyses. From seismic records, students can illustrate through practical models the notion of intensity, building resonance, paraseismic rules of construction and the induced effects of a tsunami on coastal zones. With many national initiatives, this topic will become increasingly important in educational training.

All these examples of simple activities, which could be carried out by students, have been brought together in a single workbook. This collaborative work which began twelve years ago illustrates the combined efforts of researchers and teachers towards better education and awareness of risk culture, especially in youth.

Finally, the goal of projects such as « SISMOS à l'École » is to improve the education of our students in geosciences so that they have a better view of what science is and how it progresses.

They will have learned the importance of precision in the taking of measurements and in reasoning. They will have acquired knowledge about Earth dynamics and how to prepare for risks. We will have educated, without any doubt, better prepared and more aware citizens.

Other readings…

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