An EDUcational SEISmological European Network

Introduction

In the footsteps of the United States **P**rinceton **E**ducation **P**hysics **P**roject, **PEPP**, the fundamental aim of our **Edu**cational **Seis**mological Project, **EduSeis**, is a confrontation of school students with the current practice of scientific data acquisition and management. Recent networking evolutions make available in the classroom data and tools which were only used in research laboratories.

The rapid growth of digital electronics is just as quickly revolutionisin= g scientific practice, though, even among scientists, there are few who really appreciate how fundamental this revolution is. Technology is being driven more by an economic impetus than by the need to solve important problems - be they scientific or social - and scientists often have had to become reactive rather than proactive to technology.

This, of course, is even more true for the educational environment. While industry debates the launching of communication systems comprising hundreds of satellites, and the Internet is soon likely to become to the average household what the telephone is now, teachers have obvious difficulty to adapt. This is, in particular, true for secondary education. Many schools now offer basic courses in the use of computers, word processing packages, or even simple programming languages. But does this give the students a sense of how chemistry, physics, biology are affected by the digital revolution? Does it give the students an idea of the power of information technology? Since the latter can be used and misused, the health of our democratic societies may ultimately depend on how well we teach our children to cope with information technology.

A second fundamental change is the rapid growth of multidisciplinary studies of the environment. Increased population density has made natural hazards such as earthquakes, volcanic eruptions and hurricanes more costly both in terms of human life and in terms of economic damage.

How the education system should react to such changes is not very clear. Some aspects have hardly even been debated. Meanwhile, the gap between what is taught in schools and what is done in the real world is growing rather than diminishing. This is a dangerous situation. An under-educated population is at the mercy of those who control the information technology.

Our experimental project will make students active participants rather than passive consumers and the selected vehicle for such training is seismological observation, which offers a number of clear advantages: earthquakes are spectacular and 'in the news', hence likely to attract the attention of the students; the digital observation of seismic waves involves large quantities of data but not so large that it cannot be handled by personal computers of the type now acquired by many schools; the development of cheaper instrumentation now allows schools to participate actively in data acquisition, using the Internet to share data; the analysis of seismograms involves many sciences, and may be illustrative in classes of physics, mathematics, geography, geology, and social science.

PEPP in United States of America and **EduSeis** in Europe are based on recent development of new technologies which allow the use of high quality and low-cost seismic instrumentation in schools. The construction of the project EduSeis is different from the American PEPP experience on many aspects related to the social differences one can find between Europe and USA.

General objectives of the project

a) Open schools towards their environment: make young people aware to natural hazards.
Involving the high schools in management of seismic network according to the different school orientation will lead to the creation of a dense network of seismic "observatories" which will increase the data available for research in the field of Earth Science. This work will result to be extremely interesting and useful to the social and scientific community.
Thus, the project has a remarkable impact on the prevention of the seismic risk, through a strong effect of awakening and involvement of the schools, of the general public in museums; of students, teachers and their families. Although in Europe and, in particular in the Mediterranean area, the risk of strong earthquakes exists, the politics of information and awakening to the seismic prevention are still insufficient in comparison with analogous initiatives undertaken in other seismic regions in the world (such as for example Japan, Western United States).

b) Promotion of news technologies in schools.
The co-ordination and follow-up of the seismic station require also the experimental use of news technologies (gathering the information, extraction of data and diffusion as well as communication of these data). The data and scientific information exchange between schools, museums and research centres inside the European network mean for students to be friendly with the modern, computer based systems of archives, access, consultation and promulgation of the information represented by the Internet network.

c) Promotion of experimental sciences in schools.
The co-ordination and follow-up of the seismic station in schools request to young students to develop specific know-how and skills in experimental sciences (measurements, observations, formulation of working hypothesis and verification of these hypothesis, gathering and organisation of data, presentation of ideas and their discussion with other people).

The skills required for the implementation and the management of the monitoring station concern several matters such as, for example, Physics/Mathematics (waves, filters, transducers, ...), Earth Sciences (seismic waves propagation, interpretation of seismic events, ...), Computer Sciences (data processing with "ad hoc" developped software for the acquisition on real time of seismic data or more general programs for selecting, exchanging information), Foreign languages training (information on the data bank, exchanges between students from different countries).

d) Managing the complexity of natural phenomenon through an interdisciplinary approach.
Seismic events are not easy to understand. Their discriminations with other natural events as well as artificial noises are only possible with long-term training with specific learning strategies. Students will appreciate the necessary global and complete overview for such understanding.

e) Teaching young people the sense of responsibility and working in group
The follow-up of the seismic station, and the co-ordination of many activities around it, will help to test educational activities based on a co-operative way of learning and teaching, as well as the enthusiasm of students, their sense of responsibility and their tenacity.

f) Construction of a partnership between regional and international institutions in the field of scientific research, education and awareness
First of all, the project aims to establish a direct relationship between the scientists on one side, teachers and school students on the other one. This relationship, thanks to scientific communicators and educators, will involve schools and as research institutes, but also local organisations, institutions, associations in scientific research activities and in county development choices.

Description of the EDUSEIS Network

This educational network has all the important components of a modern network for the acquisition of environmental information. Our main technological effort is in that direction. The seismic station, *PC-ACQUI*, records the vibration of the ground. The seismic regional center, *PC-CONTROL*, collects these data through telephone lines every night (Figure 1). Finally, an European database center will organise and archive the data.

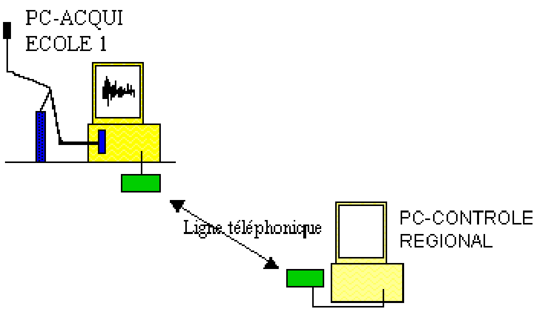

Figure 1 : Regional link between stations in schools and the regional center for the EduSeis network

We have selected broadband sensors as the Guralp or the PMD. They are sensors selected by **PEPP** but our management is entirely different. These instruments have a flat response between 30 s and 0.2 s (Figure 2)

These sensors provide an electric signal which is digitized by a computer card (PC-NUM) plugged into a personal computer which is the cheapest controlling system one can think about. The card has been developped by Agecodagis and it is based on HARRIS HI7190 24 bits converters. This card includes a GPS Rockwell minicard for the absolute time recording, an essential critical data for seismic analysis. Careful handling of time is performed for an accuracy lower than 1 msec. Data are recorded locally in a cyclic buffer with an autonomy of around 15 days.

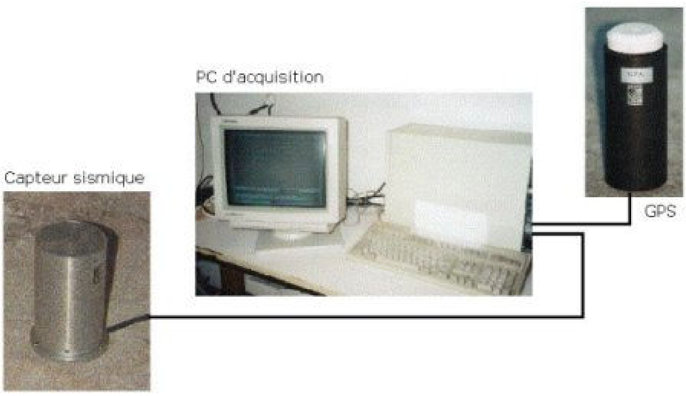

Figure 2 : Different elements of the seismic station for the CIV school in France. The sensor on the left, the recording station in the middle and the GPS antenna on the right.

This seismic station is linked by a modem with standard telephone line to the PC-CONTROL. This PC-CONTROL is on the Internet and collects information of world-wide seismic events from observatories. From the distance between the seismic event and the seismic school station, a post-triggering is performed automatically with a time window extracted at the station depending on the magnitude of the event. These signals are retrieved from each station during the night and converted to a standard **SAC** format. This format is used for plotting the signal through any browser which can handle Java language. Conversion into the **PEPP** format is also performed and these files are provided through ftp for local applications in any school connected to the Internet.

Seismic event examples

Since 1998, events have been recorded in France and in Italy. This prototype running in 1997 through an experimental test at the CIV school has been replaced by standard stations installed in Alpes Maritimes, Languedoc-Roussillon as well as Napoli area. Two examples are shown for a regional event and a teleseismic event. Other examples are freely availble at ther WEB sites.

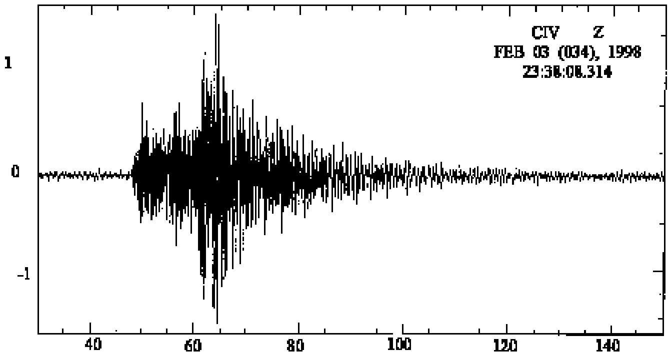

Figure 3 : Seismic event located in the Genova Golf.

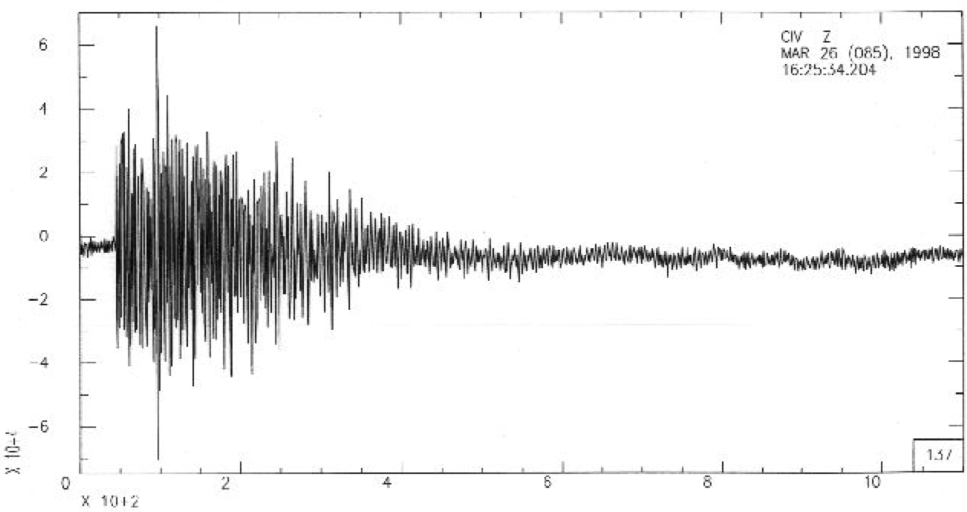

Figure 4 : Seismic event from Antartica. It has taken around 12 minutes for reaching the station CIV.

Perspectives

During the year 2001, the actual seismic network system (with four schools) will be tested before any further extension. The automatic retrieval of the data will be tested when a noticeable number of stations are available.
Groups from Greece, Spain are interested to join this experimental network, while extensions in France, Italy,Portugal and Germany will take place.
Technological improvements will occur at the different levels of the seismic school network. New sensors will be tested, while the seismic station could be connected directly to the Internet instead of the actual telephone link.
The key of success in the future will reside in our capacity of extending the network through many countries in Europe.