EDUSEIS: the educational seismograph as a tool for training and awareness on the seismic risk

Scientific Coordinator: Prof. Vittorio Silvestrini

Introduction

The fundamental aim of the research work in the second year, is the construction of new methodologies for high school teachers and students in the use of new technologies and in the diffusion of knowledge about seismic phenomena and seismic risk. Through the continuous updating of the seismic data base, it is indeed possible to contribute actively to the diffusion of the information related to seismic risk to mitigate the social effect of earthquakes.

EduSeis (The Educational Seismological Project), is a scientific and educational project involving research centres, Universities, scientific museums and high schools of different European towns, with the aim to acquire a new teaching method in scientific divulgation. The interaction between classroom teachers and researchers working on earthquakes, is a key element for imagining educative applications connected to seismology, covering a wide range of fields (natural sciences, physics sciences, mathematics, technology sciences, civic education and so on) and for developing high quality tools.

A seismographic network in Italian and French schools research centres, Universities and scientific museums has been installed to transfer to teachers and students, the necessary competencies to manage the seismic stations and the seismograms analysis. These seismic stations are designed for educational purposes and can be operated independently by students and teachers themselves.

Teachers and students have been involved in the maintenance of seismic stations and the experimentation of didactic activities.

These general objectives have been reached through three main tasks.

Task1:

Training of technology and educational use

Research Units

Research Units	Organisation	Scientist Responsible	Position	Participants
UR1	Fondazione IDIS - Città della Scienza - ONLUS	Prof. Vittorio Silvestrini	Full Professor and President of Fondazione IDIS-Città della Scienza ONLUS	Dr. Flora di Martino (researcher) Dr. Luciana Cantore (fellowship)
UR2	University of Naples - Department of Physical Sciences	Dr. Emilio Balzano	Researcher	Full Prof. Aldo Zollo Angela Petrillo (fellowship) Dr. Maria Simini (school teacher) Dr.AntonellaBobbio (tecnichian INGV) Dr Sébastien Judenherc (post-PhD)
UR4	High Scool Copernico Naples	Prof. Carlo Paolantonio	Teachers	M. Succi G. Tagliaferro C. Pennucci B. De Renzis S. Sorda D. Pepe

Task2:

Development of EduSeis technology (hardware, software)

Research Units

Research	Organisation	Scientist Responsible	Position	Participants
UR2	University of Naples - Department of Physical Sciences	Dr. Emilio Balzano	Researcher	Full Prof. Aldo Zollo Dr. Luciana Cantore (fellowship) Dr.Angela Petrillo (fellowship) Dr. Maria Simini (school teacher) Dr. Antonella Bobbio (tecnichian INGV) Dr Sébastien Judenherc (post-PhD)
UR3	GeoAzur Nizza	Prof. Jean Virieux	Full Prof.	Dr. Anthony Lomax (Researcher) Thomas Picq, Jean Virieux, Jean-Luc Bérenguer, Christophe Maron, Didier Brunel, Anne Deschamps, Stéphane Gaffet

Task3:

Experiences of formation and awakening to the seismic risk based on EduSeis

Research Units	Organisation	Scientist Responsible	Position	Participants
UR1	Fondazione IDIS - Città della Scienza - ONLUS	Prof. Vittorio Silvestrini	Full Professor and President of Fondazione IDIS-Città della Scienza ONLUS	Dr. Flora di Martino (researcher) Dr. Luciana Cantore (fellowship)
UR2	University of Naples - Department of Physical Sciences	Dr. Emilio Balzano	Researcher	Full Prof. Aldo Zollo Angela Petrillo (fellowship) Dr. Maria Simini (school teacher) Dr. Antonella Bobbio (tecnichian INGV) Dr Sébastien Judenherc (post-PhD)
UR4	Liceo Scientifico Copernico Naples	Prof. Carlo Paolantonio	Teachers	M. Succi G. Tagliaferro C. Pennucci B. De Renzis S. Sorda D. Pepe

Research Units

2° YEAR OBJECTIVES

- Continuation of the cycle of educational activities with the students and teacher training.
- Training for teachers and high school students on date analysis recorded by the EduSeis network.
- Elaboration of educational and formative materials for social and didactic activities.
- Adjournment of EduSeis web site.
- Development of EduSeis data base.
- Installation and implementation of new seismic stations.
- Development of EduSeis technology (hardware, software) .
- Testing of different seismic sensors for schools.
- Experiences of EduSeis in the school and in the museum: educational activities on seismology and seismic risk.
- Creating an EduSeis laboratory.
- Organisation of conferences and events for the public in scientific museums, chances for citizens and scientists to get in touch to help the comprehension of the problems related to seismic risk.

2° YEAR RESULTS

• Implementation of seismic stations with broad-band (20s-20Hz) and short period seismic sensors (4.5 Hz), in high schools, in scientific museums and in Universities.

- Installation, setting up and testing of the new acquisition system and management of EduSeis network.
- Testing of different seismic sensors for schools.
- Development of "SeisGram" software written in Java Script language by A.Lomax of Geoazur Institute (Nice) to visualize and study data recorded.
- Teachers and high school students training on the use of seismic stations and on data analysis interpretation.
- Didactic activities with the French and Italian students involved in the project.
- Testing of the new didactic modules with the French and Italian teachers involved in the project.
- Adjournment data base EduSeis web site (French and Italian).
- The insertion of the new didactic modules and didactic activities for training teachers and students in the EduSeis web site.
- Experiences of information and awakening to seismic risk based on the creation of a seismology laboratory and organisation of training courses, other initiatives addressed to the citizens.

RESEARCH PRODUCTS

- The school newspaper production about earthquakes and seismic risk (RU4).
- Development of seismic section on the school web site (<u>http://digilander.iol.it/copernico2000/index.htm</u>) (RU4).
- Students presence at "Futuro Remoto 2002" Fondazione IDIS (RU4).
- Presence at the XXVIII General Assembly of the European Seismological Commission Genova, 1-6 Settembre 2002, Special Session SWS-1 School Yard Seismology – Educational Approach to Seismology, three poster (RU1, RU2, RU4) and four oral presentation (RU1, RU2, RU3, RU4).
- FRENCH EDUCATIONAL SEISMOLOGICAL NETWORK "Sismo des Ecoles", Picq, T. Bérenguer, J.-L., Virieux, J., 2003, Seismological Research Letters (submitted) (RU3).
- THE EDUSEIS PROJECT IN ITALY: AN EDUCATIONAL TOOL FOR TRAINING AND INCREASING AWARENESS ON THE SEISMIC RISK" L. Cantore, A. Bobbio, F. De Martino, A. Petrillo, M. Simini, A. Zollo, (Seismological Research Letters (submitted) (RU1, RU2).
- Azurea national meeting: implementation of information technology in the teaching of natural sciences, Mar. 2002. Oral presentation and demonstration of several direct applications and experiments linked to seismology, by teachers involved in the French Eduseis program (RU3).
- Agence Régionale pour l'environnement (ARPE Provence-Alpes-Côte d'Azur) Euro-Mediterranean meeting on education of natural hazard, Antibes (France), Oct. 2002. Stand and oral presentation of our action at a regional scale (RU3).
- American Geophysical Union (AGU) Fall Meeting, San Franciso (USA), Dec. 2002. Poster presentation about the technical and educative aspects of the French Eduseis project (RU3).
- Didactic modules available at "*Didactic modules* " in EduSeis web site (RU1, RU2).

- Didactic activities available at "Didactic activities "in EduSeis web site (RU1, RU2).
- Project EduSeis section on the Science Center of "Città della Scienza" web site and link at the Eduseis web site (<u>www.cittadellascienza.it</u>) (RU1).
- Design, realization and opening of "SismaLab" at the Città della Scienza (March, 2003) (RU1, RU2).
- SismaLab section on the "Città della Scienza" web site (www.cittadellascienza.it) (RU1).
- Ten information schedules for SismaLab about seismology "Terremoti: come, dove, quando, perchè......" Aldo Zollo and Luciana Cantore (RU1, RU2).
- A. Petrillo, "EduSeis: un sismografo didattico come strumento per la formazione e la sensibilizzazione al rischio sismico", Degree Thesis a.a. 2000-2001, Supervisor A. Zollo, E. Balzano (RU2).
- B. Limoncelli, *"Il progetto EduSeis",* Degree Thesis (in preparation), Supervisor A. Zollo, E. Balzano (RU2).

Technical ratios present at "Document "in the EduSeis web site:

- 1. EduSeis Project financed by GNDT.
- 2. Six-months activity report EduSeis Project GNDT.
- 3. Open-file report.
- Three oral presentation at the XXVIII General Assembly of the European Seismological Commission Genova, 1-6 Settembre 2002 nella sessione speciale SWS-1 School Yard Seismology – Educational Approach to Seismology.
- 5. GNDT-INGV ROME, February, 2002.
- 6. A.Bobbio and A. Zollo, "The educational broadband seismic network at Naples (Southern Italy)"; published on Orfeus Electronic Newsletter (Vol. 2, no3, December 2000).

PUBLICATIONS LIST

- L. Cantore, A. Bobbio, F. De Martino, A. Petrillo, M. Simini, A. Zollo, "THE EDUSEIS PROJECT IN ITALY: AN EDUCATIONAL TOOL FOR TRAINING AND INCREASING AWARENESS ON THE SEISMIC RISK", Seismological Review Letters (submitted).
- A. Bobbio and A. Zollo, *"The educational broadband seismic network at Naples (Southern Italy)"*, pubblicato su Orfeus Electronic Newsletter (Vol. 2, no3, Dicembre 2000).
- L. Cantore, F. De Martino, "Sismometri in rete per lo studio della sismologia, delle onde e della matematica. Le attività EduSeis nel Progetto LES", Proceedings at AICA-Didamatica, Naples 2002.
- Virieux, J, 1999, EDUSEIS, "An EDUcational SEISmological European Network", Orfeus, Electronic Newsletter, 1,13.
- Virieux, J., 2000, Educational *"Seismological project: EDUSEIS",* Seismological Research Letters, 71, 530-535.
- Lomax, A., 2001, "QuakeExplorer-Earthquake Internet Browser and Analysis Tool", Orfeus, Electronic Newsletter, 3,1.

 Picq, T. Bérenguer, J.-L., Virieux, J., 2003, FRENCH EDUCATIONAL SEISMOLOGICAL NETWORK "Sismo des Ecoles", Seismological Research Letters (submitted)

In preparation

 AGU-EGS-EUG Joint Assembly, Nice (France), Apr. 2003. Oral presentation of the EduSeis project at a European scale. Special workshop: demonstration of several educative applications and experiments by involved European teachers (RU1, RU2, RU3).

Task 1

Training of technology and educational use

2° YEAR OBJECTIVES

- Continuation of the cycle of educational activities with the students and teacher training.
- Interactive ways at MSNI station at the Science Center of "Città della Scienza" (Naples).
- Teacher training of I.T.I.S. Majorana school, Somma Vesuviana (Naples).
- Experimentation of new methodologies for scientific learning with the use of advanced high technology tools.

In the process of the application of methodologies developed by RU1 and RU2 for information and training on seismic risk, teachers and students of Liceo Scientifico N. Copernico (RU4) and I.T.I.S. Majorana have been introduced at the use of seismic station and at the analisys and interpretation of seismogram.

Teachers and students have been involved in the experimentation of didactic activities, with the aim to experiment the praticability, the contents and the didactic valency.

The didactic modules for teacher adjournment are available on the EduSeis web site (<u>http://eduseis.na.infn.it</u>) at the link **Didactic Modules**, while the didactic activities for students at link **Activities Didactic**.

The didactic activities have been studied with the aim to learn to analyse seismograms of local, regional and teleseismic events, recorded at the EduSeis stations (Fig. 1).

The software SeismoGram, realized by A. Lomax, research unit RU3 (available at http://eduseis5.na.infn.it web page by the link **Software utility**) is a useful tool to analyse and visualize the EduSeis network seismogram.

Web pages, about Eduseis project, have been inserted on the school web site (http://digilander.iol.it/copernico2000/index.htm) (Fig. 2).

The activities on the web site, aim to diffuse the didactic experiences to other schools and the population living in the same area in which the school is situated. One group of students has produced the first edition of a newspaper about earthquakes and seismic risk (Fig. 3). In the didactic experimentation, the participation at the Special Session, SWS-1 School Yard Seismology-Educational Approach to Seismology, XXVIII General Assembly of the European Seismological Commission, Genoa September 2002, was important. On this occasion, the didactic activities, four oral presentations (RU1, RU2, RU3, RU4) and three posters (RU1, RU2, RU4), have facilitated the change of didactic experiences, with the other international participants. In this period an oral presentation is being prepared for the Educational Symposia dell'EGS-AGU-EUG Joint Assembly, Nice, April 2003 (GIFT- ES1 Geophysical information for teachers). In this Educational Symposia, teachers of RU4 and researchers of RU1 and RU2, will show three didactic activities. These activities will form a "cook-book" (manual of activities) which will be useful for the extension of our educational and formative experience on a larger scale.

Task 2

Development of EduSeis technology (hardware, software)

2° YEAR OBJECTIVES

- Development of EduSeis technology (hardware, software).
- Installation and implementation of new EduSeis stations.
- Development and adjournment of EduSeis data base.

The action made by RU2 and RU3, in the second year project, has been the installation of the new EduSeis stations, the implementation of new method for the seismic acquisition system and data communication system and the didactic modules and activities testing.

The EduSeis Italian network is made up of six seismic stations that have recorded local, regional and world events. Four stations are equipped with PMD Scientific sensors broad-band (20 s - 20 Hz) at three element and two are equipped with MARK L-28LB sensor (4.5 Hz) at three element. In a short time new stations will be installed in the Irpinia area and in the town of Cosenza (South Italy) (Fig. 4).

The EduSeis French network is made up of fifteen sations with PMD Scientific sensors broad-band (20 s - 20 Hz) at three element. Several new stations were installed around Marseille (Bouches-du-Rhones or nearby Nantes (Loire Atlantique) (Fig. 5).

The wide range of seismic data recorded, has enriched the EduSeis data archive easily accessible from the web (<u>http://aster.unice.fr</u>, <u>http://eduseis.na.infn.it</u>) by the students and the teachers and the public in general. This data collected is used by many teachers for different topics in high schools (Fig. 6).

Special software applications have been conceived to make it easy for pupils to work on seismological data. Seismic recordings can be visualized and analysed with the Java Applet called SeisGram that was developed by A. Lomax (www.alomax.net) (RU3). This applet allows students and teachers to study recent seismic signals as well as older recordings. The signal can be zoomed and displayed with the seismic signals from several other stations. In addition, the different seismic waves times can be picked and different band-pass filters are available to improve the seismogram analysis. In 2002, web tools have also been developed to perform event localisation with different graphical methods in line. On the French web site there are many activities that use seismograms recorded at the French network. (Fig. 7). In 2002 the educative activities imagined by the teachers involved, have been put together in a "cookbook", which will be useful to spread the educational and formative experience, at a larger scale. So, it would become easier to involve other schools and the population living in the same area.

An important step was reached in 2002 concerning software and hardware development for seismic acquisition in schools. Since the EduSeis project started, standard phone connections had been used to allow data extraction from the stations to central PC (French or Italian PC Server). From the beginning of 2002, a new generation of seismic acquisition system (compact hardware system to be connected to a computer) and data communication system (to be run in the dedicated computer), has been developed in collaboration with the French Agecodagis Company (http://perso.wanadoo.fr/ageco). This Internet Remote Acquisition System (IRAE) allows us to get information and data from very far stations, guickly and securely. IRAE is a software suite acting as a distributed TCP/IP oriented acquisition system. It is completely written in Java and the IRAE components can thus be installed on any system supported by the Java-platform: Linux, Windows for instance. Contrary to the "traditional" acquisition system, still used on the other stations, the whole recorded data can be extracted from the station by Internet connection, and stocked on a dedicated FTP server. The daily communications between stations and the FTP site are cheaper and stations could be installed in some areas where no research centres are located. That internet based system should improve the extension of the network on the whole French and Italian territory (Fig. 8).

In Italy all stations have a new seismic acquisition system IRAE.

In France, such a prototype station was installed in one school (Centre International de Valbonne, Alpes Maritimes) in April 2002, and seismic signal is extracted successfully. Several other stations should be equipped with this acquisition system in 2003.

Task 3

Experiences of formation and awakening to the seismic risk based on EduSeis

2° YEAR OBJECTIVES

- Creating an EduSeis laboratory.
- Organisation of conferences and events for the public in the scientific museums, chances for citizens and scientists to get in touch to help the comprehension of the problems related to seismic hazard.

These objectives have been realized by methodologies developed for training and for information on seismic hazard using the EduSeis system. The activities have been done in schools around Mt. Vesuvius (Naples) and in Science Center of "Città della Scienza" (Naples), involving scientific operators, teachers and students. The application of the methodologies developed during the first year project, have been made in this second year. In the museum of "Città della Scienza" (Naples) the experimentation has involved scientific operators of the Educational Department, teachers, students and museum visitors. Recently, two experiences of formation and

awakening to the seismic risk based on EduSeis, have been realized by the Science Center of "Città della Scienza".

1. Futuro Remoto Event

The 2002 edition of Futuro Remoto was the first time to present and diffuse the EduSeis project to the pubblic. The Fondazione IDIS-Città della Scienza has organized the XVI edition of multimedia manifestation to propagate scientific and technologic culture - Futuro Remoto-2002, "Un Viaggio tra Scienza e Fantascienza", Naples November 2002.

The event aims at the full involvement of students and citizens in the promotion of the information related to the sciences and the innovation technologies. The argument of this year was the relation among science, technology and society, taking into consideration the great number of questions about the progress of research and of its applications and it's effect of daily life.

The RU4 students were actively involved in this event, with a stand, a pc and a posters, interacted with other schools and the visitors in the museum. In this experience the students have became "the teachers" involving other students visiting the museum in different activities (Fig. 9).

2. Design, realization and opening of "SismaLab" at the Città della Scienza

In the Science Center of "Città della Scienza", in March, the SismaLab, a seismology laboratory, opend. The fundamental aims of SismaLab is to involve the citizens in the experimentation of the social and educational activities, based on innovative methodologies and on the use of new technologies, with the aim to propagate the knowledge about seismic phenomena and seismic hazard (Fig. 10). Moreover another two activities have been produced:

- "Terremoti: Come, dove, quando, perché....." by Aldo Zollo and Luciana Cantore Ten information schedules for SismaLab to learn about earthquakes.
- Bimestral Newsletter to inform the users about the EduSeis project and about the divulgation initiative.

This SismaLab wants to be an information centre about earthquakes and an educational centre about seismic risk. The fundamental aim of SismaLab, is to contribute to the propagation of experimentation of EduSeis didactic activities in schools. There are three activities in the laboratory for the pubblic, students and teachers:

- 1. Didactic activities of information and awakening to seismic risk for all schools.
- 2. Meetings and training for teachers.
- 3. Organisation of conferences and events for the pubblic.

On the Science Center of "Città della Scienza" web site there is a link to information pages about SismaLab with the aim to extend educational and formative experience at a larger scale. Moreover we are implementing a bimestral Newsletter to inform the users about the activities of the EduSeis project and about divulgation initiatives.

Conclusion

The project has represented an effective instrument for informing and creating awareness about the seismic risk, both thanks to the direct involving of schools and to the diffusion towards the public.

The objectives reached are:

- Development, testing and implementation of the EduSeis technology (hardware and software).
- Training and formation on technologies and their educational use.

Experiences of formation and awakening to the seismic risk based on the EduSeis network.

The Result obtained are:

- Training of teachers on the use of the seismic station and analysis and interpretation of seismic data.
- Training with the students of Liceo Scientifico N. Copernico
- Elaboration of educational and formative materials.
- Adjournment of EduSeis French and Italian web site.
- N°5 Didactic Modules (<u>http://eduseis.na.infn.it/school/Modframe.html</u>)
- N°9 Didactic Activities (<u>http://eduseis.na.infn.it/school/AttivitIn.html</u>)
- Installation and implementation of a new EduSeis stations
- Installation and implementation of a new seismic acquisition system
- Testing of different seismic sensors for schools
- Teacher and high school student training on the use of the seismic station and on data analysis interpretation
- Testing of the new didactic modules with the French and Italian teachers involved in the project
- Adjournment data base EduSeis web site (French and Italian)
- Futuro Remoto Event
- Design, realization and opening of "SismaLab" at the Città della Scienza
- "Terremoti: Come, dove, quando, perché....." by Aldo Zollo and Luciana Cantore Ten information schedules for SismaLab to learn about earthquakes