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POCRISC

For a common culture of seismic risk
Pour une culture commune du risque sismique
Por una cultura común del riesgo sísmico

« Intervention protocol for the recording of aftershocks after an earthquake strongly perceived in the POCRISC area »

Report - Action 5

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1. ICGC : Institut Cartogràfic i Geològic de Catalunya
2. BRGM : Bureau de Recherches Géologiques et Minières
3. UPC : Universitat Politècnica de Catalunya
4. DIGC : Secretaria General. Departament d'Interior. Generalitat de Catalunya
5. IEA : Institut d'Estudis Andorrans
6. ENIT : Ecole Nationale d'Ingénieurs de Tarbes
7. CNRS : Centre National de la Recherche Scientifique - Délégation Alsace
8. EPLFM : Entente pour la Forêt Méditerranéenne
9. DW : Deveryware
10. ACE : Associació de Consultors d'Estructures

Synthesis

This protocol has been elaborated in the framework of the POCRISC project. It is a deliverable of the Action 5. In this Action all the aspects regarding the seismic crisis intervention will be developed, tested and implemented.

Immediately after the occurrence of a strong earthquake, widely felt and/or damaging, it is recommended to perform an intervention field survey to record the aftershocks associated to the main earthquake. The fast analysis and interpretation of the data recorded will provide information about the seismic source and the spatial and temporal evolution of the seismic crisis. This information is useful from the seismological point of view and also to support the emergency management procedures.

The aim of the document is to provide an exhaustive guidance for the effective coordination and implementation of the three phases involved in an aftershock recording survey: preparation, intervention and post intervention. In this sense, the document provides information on the human, technical and logistical resources available, and the strategies to be followed for the coordination, configuration and deployment of all of them to ensure that the intervention will be as efficient as possible and fruitful.

This protocol is a result of the collaboration work between the partners IGN, BRGM, OMP, IEA, CECAT and PCA, under the coordination of the ICGC.

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1 PREPARATION OF FIELD SURVEY: TEAMS AND EQUIPMENT

1.1 Administration issues: bureaucracy and economic management

Each team should be in charge of the arrangements for obtaining exit permits and daily subsistence allowance according to the rules of the own institution. When complicated bureaucracy arises it would be recommended to have established beforehand an agreement with the administrative managers in order to have some level of autonomy in case of activation of the field survey during weekends or holidays.

1.2 Communication with the local authorities (city hall, police, civil protection, firefighters, etc.) and population

The Table 1 gives information about the institution or emergency coordination center of each region or country that establish the contact with the local authorities in case of activation of the emergency plan. Each country or region has to take into account if a permit is needed to get into the damage zone.

Country or region	Institution or emergency coordination center	Telephone	e-mail	Contact person *
Catalonia	CECAT	The personal data of the participants in the intervention protocol are hidden to comply with the current European data protection law.		
Spain	IGN			
France	OMP			
Andorra	PCA			

Table 1: Contact information of the coordinator center of each region or country.

(*) A coordinator from each region should be selected to facilitate the contact with the local authorities and resolve logistical issues once the seismic crisis has begun.

In the annex you will find a trilingual letter (French, Catalan and Spanish) to be used to explain to the authorities and the land owners the work done during the aftershock recording phase.

1.3 Definition of the teams involved in the post-seismic intervention

The post-seismic intervention group consists of institutions that have specialized personnel and adequate technical equipment. The members involved in the post-seismic group are from:

- Institut Cartogràfic i Geològic de Catalunya (ICGC).
- Bureau de Recherches Géologiques et Minières (BRGM).
- Instituto Geográfico Nacional (IGN).
- Observatoire Midi-Pyrénées (OMP).
- Institut d'Estudis Andorrans (IEA).
- Protecció Civil d'Andorra (PCA)

In case of post-seismic intervention, each member of the group will participate with their resources, according to their current capabilities. Regarding the definition of the teams of each institution, the minimum people required to carry out the fieldwork are two field technicians. Moreover, at least one office technician will be useful in order to help in logistical issues and data processing. Table 2 shows the personnel available from each institution. The people from IEA and PCA can provide logistical support both in the office and in the fieldwork.

Name	Surname	Institution	Role	Languages	e-mail	Office phone	Office mobile
Al							
Sa							
Jo Ar							
Be							
Tà							
Nu							
To							
Àl							
Jo							
Ja							
Pe							
Al							
Ar							
Fa							
Ju							
Ca							
Be							
Jo							
Re							
Ja							
Na							
Ra							
Ra							
Cr							
Jé							
Ma							
Ma							
He							
			team leader				

The personal data of the participants in the intervention protocol are hidden to comply with the current European data protection law.

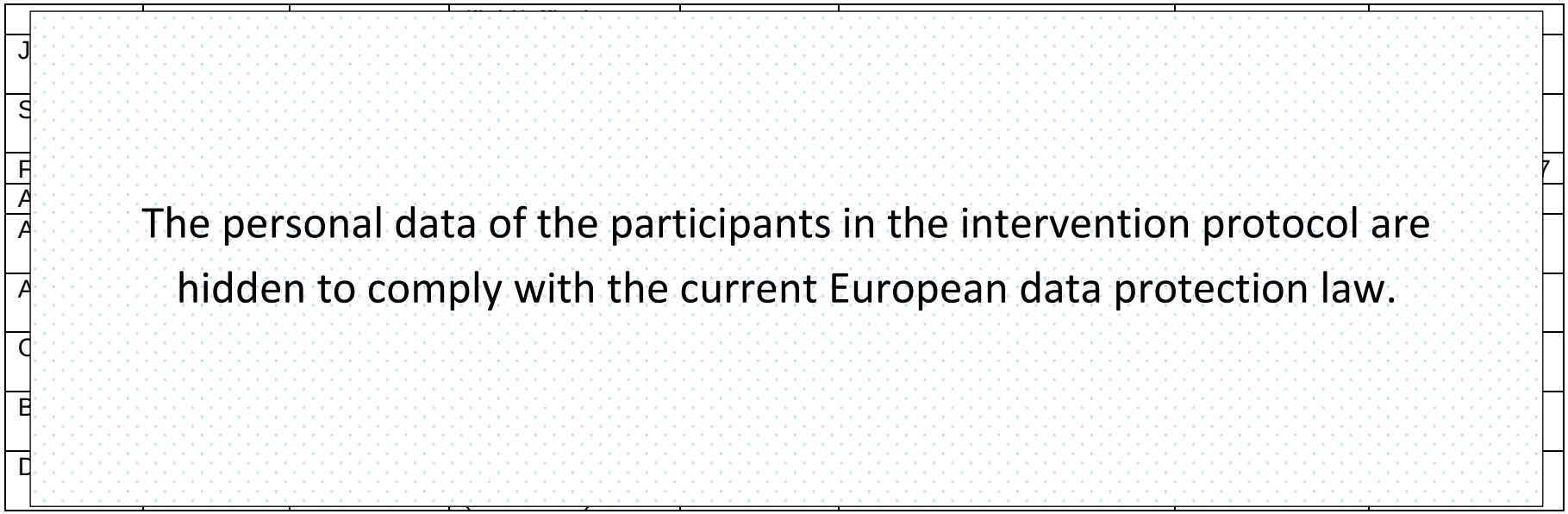

Table 2: Contact information of the personal involved in the post-seismic intervention. Languages: S (Spanish), F (French), C (Catalan), E (English).

1.4 Definition of the instrumentation used for the recordings

As mentioned in the previous section, each team of the post-seismic intervention group will provide instrumentation to install the seismic network. Table 4 shows the theoretical material available for each institution, knowing that some of these devices may not be available on time because they might be used in another field survey.

Obviously, all the instruments must record the ground motion with the same recording parameters. Table 3 shows the parameters proposed for the instrumentation to be used in the post-seismic intervention. Once the recording of the aftershocks has been planned, the array of the seismic stations must be installed as fast as possible in order to register as many earthquakes as possible. One way to achieve this goal is to install a small array as a first phase. One seismic station will be located close to the main shock epicenter and three sensors will be arranged around this one into one equilateral triangle with a radius of 5 km (Figure 1 left). After this first phase, several seismic stations will be installed in order to improve the aftershocks recording. In this second phase, the initial array will be completed with two more seismometers, forming a pentagon with a radius of 5 km (figure 1 right). The other 5 sensors will be set around the central location (main shock epicenter) forming a pentagon of 10 km radius (Figure 1 right). If there are more instruments available, they will be added to the proposed array, densifying the number of seismic stations in each radius. Note that this geometry was designed supposing a main shock with a magnitude of M4-5. In case an earthquake of greater magnitude (M5-6), the geometry should change. The array radius will be greater and more seismic stations should be required.

Parameter	Value
Sampling	100 Hz
Record length	24 hours
Station and network name	According to temporary IRIS code

Table 3: Parameters proposed for the instrumentation used in the post-seismic intervention.

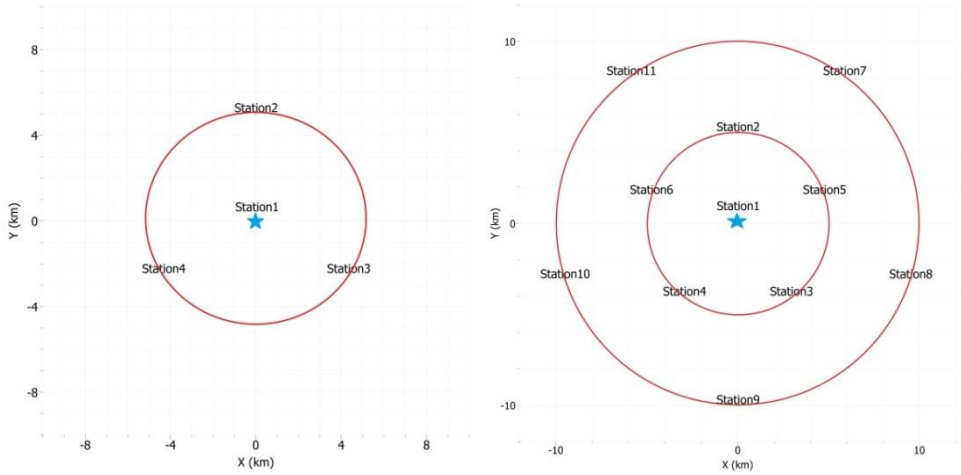

Figure 1 – Array configuration proposed for the seismic network used in the post-seismic intervention. Left: array proposal to be installed during the first 48 hours (4 seismic stations). Right: expansion of the initial network that should be installed during the first 4 days (11 seismic stations).

Seismometer or accelerometer	Digitizer	Minimum and maximum number of sensors	Number of field technicians	Number of vehicles	Institution	Contact person	e-mail
7 Lennartz LE-3D/5S and 7 LE-3D/20S	SARA SL 06	5/14	2/4	1/2	ICGC	The personal data of the participants in the intervention protocol are hidden to comply with the current European data protection law.	
Lennartz LE-3D/5S and Nanometrics Trillium Compact-120	Nanometrics Centaur	2/4	2	1	IGN		
-	-	-	1/2	1	PCA		
Güralp CMG40-T	Staneo D3BBMOB	8/10	2/5	1/2	OMP		
8 Guralp CMG6-TD 10s	Included	?/8	1/2	1	BRGM		

Table 4: Characteristics of the instrumentation available for the post-seismic intervention.

1.5 Configuration of a server for reception, processing and storage of data and information

1.5.1 Stations naming

All deployed stations will provide data with a channel naming in SCNL format. The network codes for these temporary stations will be registered at the FDSN. To avoid duplication of station names, each institution has an assigned letter that will be used as initial at the beginning of the name of all its stations. They are:

Institution	Letter
ICGC	C
IGN	E
OMP	F
BRGM	B

1.5.2 Stations metadata

Each institution will be responsible of providing the updated metadata for all its deployed stations. These metadata may be in dataless format or FDSN StationXML format. They will be available via an FDSN-station service or on an anonymous ftp repository, according to the preferences of each institution. They are:

Institution	Metadata distribution via	URL	Format
ICGC	FDSN-station service	http://ws.icgc.cat/fdsnws/station/1	FDSN StationXML
IGN	FDSN-station service	http://193.144.251.72:8080/fdsnws/station/1	FDSN StationXML
OMP	To Be Defined		TBD
BRGM	To Be Defined		

1.5.3 Data reception

The required software for real-time data reception and storage will depend on the features of the digitizers and communication equipment installed on the stations. So, each institution will be responsible for having available a data reception server with the necessary software to receive data from its deployed digitizers. Those stations without a communication system will required an in-situ data downloading, and it will be coordinated by the corresponding digitizer's owner.

1.5.4 Data distribution in real-time

Each institution will provide a SeedLink server for real-time data distribution of its deployed stations. These Seedlink servers may be open or restricted access, depending of the data distribution policy of each institution. For those restricted access servers, a pool of IP addresses will be granted for each institution.

Institution	Access	URL	IP pool
ICGC	Open	http://ws.icgc.cat:18000	84.88.72.0/24
IGN	Restricted	https://193.144.251.90:18000	193.144.251.0/24
OMP	TBD	TBD	TBD
BRGM	To be authorized		193.56.4.208*

(*) The ICGC, the OMP and the RAP already have access to this IP. It should be opened for a new partner.

1.5.5 Data archive

Each institution will archive continuous data streams for all channels of its stations. These data will be available for all partners by one of these two options:

- FTP repository with data archived in miniseed and SeisComP Data Structure (SDS). These FTP servers may be open or restricted access, depending of the data distribution policy of each institution. For those restricted access servers, a pool of IP addresses will be granted for each institution.
- FDSN-dataselect web service, with or without credentials, depending of the data distribution policy of each partner.

Institution	Access	Metadata distribution via	URL	IP pool
ICGC	Open	FDSN-dataselect service	http://ws.icgc.cat/fdsnws/dataselect/1	84.88.72.0/24
IGN	Restricted	FDSN-dataselect service	http://193.144.251.72:8080/fdsnws/dataselect/1	193.144.251.90/24
OMP		FTP repository		

2 AFTERSHOCKS RECORDING AFTER THE MAIN EARTHQUAKE

2.1 Main shock characteristics

The intervention network should be deployed after a main shock with a minimum magnitude value or a damaging earthquake and the occurrence of at least 5 after-shocks per hour during the next hours after the main-shock. The minimum magnitude would be M4 for earthquakes with an epicenter located in the POCRISC zone or M5 for the influence area (map in Figure 2). In the case that a swarm occurs, without a main-shock, the deployment of the intervention network can also be considered.

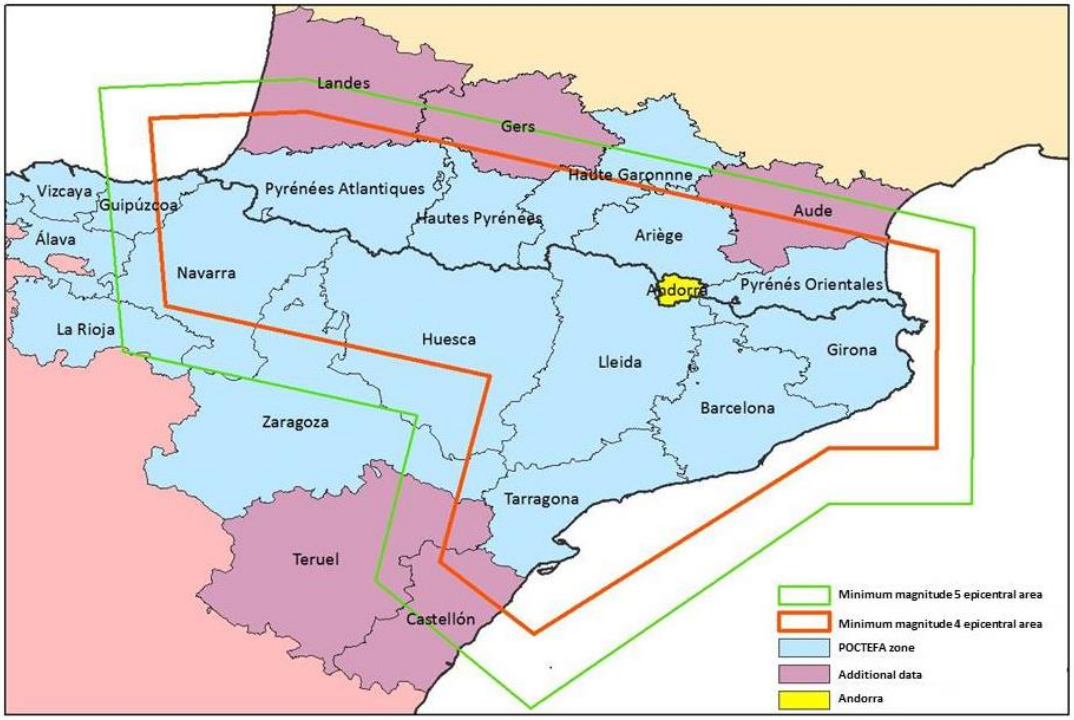

Figure 2 – Epicentral areas definition for the intervention network deployment.

2.2 Time to deploy the network

In optimal conditions, 4 stations should be installed before 48 hours. Up to 11 stations should be deployed before 4 days. A maximum number of aftershock recordings must be the priority. Once all stations are installed, improvements in the installations can be performed, such as communication systems or power supply. Station maintenance procedures (especially batteries) must be carried out during the whole intervention period.

The permanence of the intervention network will be a function of the after-shock frequency and magnitude. It will be established by the survey coordinator, as detailed in next section (2.3).

2.3 Intervention strategy

For the intervention procedures, a coordinator and a deputy coordinator figures are recommended. We suggest that the more effective is that these roles are done by people from the epicentral country in order to facilitate the operations.

Regarding the team configuration and to avoid language limitations we propose mixed language teams in order to facilitate the communication between teams and with the local authorities and population. Anyway, the teams will be defined depending on the personnel available. It should be noted that the team closest to the epicentral zone could be affected by the main earthquake, and have limitations to be displaced.

Once the protocol is activated, the coordinator and deputy coordinator, in agreement with the participants and in collaboration with the emergency coordination center will proceed as follows:
Propose a meeting point,

- establish an schedule,
- propose a deployment strategy according to the available instrumentation,
- configure mixed language teams.

2.4 Criteria for the installation of the stations

To process the data from all seismometers jointly all equipment should be installed under correct conditions. Since the installation conditions depend closely on the sensor and the soil type, we suggest that each team install their sensors in the optimal conditions following their experience, trying to avoid the seismic noise sources. The sensors should be leveled and oriented to the north.

To avoid vandalism, an informative poster will be placed at each seismic station (see the appendix 2). All the information about each seismic station must be written on the field sheets. These sheets will contain information about the station: its location, start and stop time, ground conditions, incidents, etc. A proposed field sheet is shown in the annex.

3 POST AFTERSHOCK DATA STORAGE AND PROCESSING

3.1 Quality control of the recorded data

It is necessary to carry out a quality control of data in terms of noise level. The continuous signal must be used to calculate and plot the probability function of the power spectral density to compare it with the New Low Noise Model and the New High Noise Model curves (Peterson, 1993), which are standards adopted by the scientific community to evaluate the quality of a seismological site.

The state of health of the stations must also be controlled to detect and fix possible problems with the instrumentation, to avoid signal gaps as much as possible.

3.2 Processing/relocation

When the data are available at the ICGC, IGN and OMP headquarters, data from the intervention network will be incorporated to the routine flux, so that they can be used for hypocentral location and magnitude calculation, together with data from the permanent network.

On a second phase, the signal will be analyzed through an automatic detection system to identify events that have not been detected by the permanent network, to be able to complement the catalog with smaller events. The processing of these data will involve several months and ends long after the emergency.

3.3 Diffusion of information

Different kind of information is planned to generate and distribute according to the end users.

The partners/institutions involved in the intervention will have direct access to the information regarding the evolution of the survey, the temporal and spatial evolution of the aftershocks and the alerts generated for the earthquakes. The information will be delivered to the partners directly by the coordinator of the survey. They will receive also the seismic catalogs generated (see point 3.3)

The authorities will receive information and notifications of interests to facilitate their actuations and be informed and coordinated by the emergency coordination center of the affected area.

-The media will receive reports that contain the adequate information to disseminate among the population. Requests for interviews, pictures and recording of field work will be objectively addressed taking into account the specific requirements and rules of each institution. The following table shows the institution of each region/country that provides information to the media.

Country or region	Institution or emergency coordination center	Telephone	e-mail	Contact person *
Catalonia	CECAT	The personal data of the participants in the intervention protocol are hidden to comply with the current European data protection law.		Technician on duty
Andorra	PCA/IEA Emergency/ scientific			
Spain	IGN			Technician on duty
France				

Table 5: Contact data of the information provider to the media of each region or country.

4 BIBLIOGRAPHY

Peterson, J. (1993). Observation and modeling of seismic background noise, U.S. Geol. Surv. Open File Rep., 93-322, 1– 95.

Appendix 1

Trilingual letter to explain the work done during the aftershock recording survey

Informació dels treballs d'intervenció postsísmica a dur a terme en aquesta zona

Benvolguts Senyors
Arran del terratrèmol ocorregut en aquesta zona, es farà una campanya de mesures del moviment del terreny per tal d'estudiar l'evolució de la activitat sísmica que normalment es produeix després d'un terratrèmol d'aquestes característiques. Aquests treballs s'han planificat en col·laboració amb el Centre de Coordinació d'Emergències d'aquest país/regió. S'han desplaçat a la zona d'estudi uns experts de França, Espanya i Andorra organitzats en diferents equips que instal·laran la instrumentació idònia per a fer aquestes mesures.

La instrumentació utilitzada no te cap efecte perjudicial sobre el medi ambient ni sobre el terreny, en alguns casos caldrà enterrar o cobrir parcialment els instruments. Al final de la campanya es deixarà el terreny en les mateixes condicions en les que s'ha trobat.

Exemple d'un dels tipus d'instrumentació instal·lada durant la intervenció post-sísmica.

Información de los trabajos de intervención postsísmica a realizar en esta zona

Estimados Señores
A raíz del terremoto ocurrido en esta zona, se prevé una campaña de medidas del movimiento del terreno con el fin de estudiar la evolución de la actividad sísmica que normalmente se produce después de un terremoto de estas características. Estos trabajos se han planificado en colaboración con el Centro de Coordinación de Emergencias de este país/región. Se han desplazado a la zona de estudio unos expertos de Francia, España y Andorra organizados en diferentes equipos que instalarán la instrumentación idónea para hacer estas medidas.

La instrumentación utilizada no tiene ningún efecto perjudicial sobre el medio ambiente ni sobre el terreno, en algunos casos será necesario enterrar o cubrir parcialmente los instrumentos. Al final de la campaña se dejará el terreno en las mismas condiciones en las que se ha encontrado.

Ejemplo de uno de los tipos de instrumentación instalada durante la intervención post-sísmica.

Information sur une intervention dans la zone concernée par le séisme pour la réalisation de mesures post sismiques

Messieurs
À la suite du tremblement de terre enregistré dans la région, une campagne de mesures des mouvements de terrain est prévue afin d'étudier l'évolution de l'activité sismique qui se produit normalement après un tremblement de terre ayant ces caractéristiques. Ces travaux ont été planifiés en collaboration avec le Centre de Coordination d'Urgences de ce pays / région. Des experts de France, d'Espagne et d'Andorre organisés en différentes équipes vont se déplacer vers la zone d'étude, pour l'installation de l'instrumentation spécifique pour réaliser ces mesures.

L'instrumentation utilisée n'a pas d'effet nocif sur l'environnement ni sur le terrain. Dans quelques cas il sera nécessaire d'enterrer ou de partiellement couvrir les instruments. À la fin de la campagne le terrain retrouvera les mêmes conditions dans lesquelles il était.

Exemple d'une sorte d'équipement installé pendant l'intervention post-sismique.

Appendix 2

Informative poster for seismic stations

Equip de mesura del moviment sísmic.

Equipo de medida del movimiento sísmico.

Équipement de mesure du mouvement sismique.

Si us plau no tocar/Por favor no tocar/S'il vous plaît ne pas toucher

Telèfon del contacte:

Teléfono de contacto:

Téléphone de contact:

Appendix 3

Field sheet

Station code:	
Coordinates (indicate reference system):	
Municipality:	
Place name of the installation site:	
Start time (day and hour*):	
Field technicians who installs the station:	
End time (day and hour*):	
Field technicians who uninstalls the station:	
Ground conditions:	
Incidents:	
Photo:	

* Use UTC time.