Network of European Research Infrastructures for Earthquake Risk Assessment and Mitigation

Report

Centralised accelerometric station book Definition for a web interface for viewing and updating accelerometric station metadata

Activity:	*Networking accelerometric networks and SM data users*
Activity number:	*NA3, Task3.2*
Deliverable:	*Guidelines for station and instrument response database integration, station metadata update tool*
Deliverable number:	*D3.2*
Reporting date:	*November 12th, 2012*
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Foreword

This document presents the status of the accelerometric stationbook developments at the date of reporting in November 2012. Significative changes took place afterwards, particularly with the creation of the Orfeus new working group WG5 on “Acceleration and Strong Motion Data” and the set up of close coordination with WG1 “Observatory coordination of broadband data acquisition and data exchange”. An updated version of this deliverable (D3.2) will be issued for the NERA 3rd annual meeting (November 2013) to reflect the new developments.

Summary

Accelerometric networks in the Euro-Med region started to coordinate their effort to set up a unique and common access to accelerometric data. Within the NERA project, the main objectives of the work package NA3 are

1. to improve accelerometric data exchange in Europe after a major seismic event in Europe, providing useful and immediate information on the severity of the shaking (RRSM)
2. to build an European accelerometric database for earthquake engineering and engineering seismology activities (ESM)

While those two databases serve different communities, the mechanisms to access, view and retrieve them should be similar, using the same front end. Both systems share unique stations description. It is important, at this early stage, to set up a reliable and sustainable station book. The experience from the broad band and short period station international registries provides useful insight. Additionally, collaboration with other initiatives is necessary to define a unique reference tool.

Seismic station information are well described and spread in the community using the FDSN (International Federation of Digital Seismograph Networks; www.fdsn.org) format dataless SEED. However, strong motion stations require several fields which are not defined. A complete description of the necessary station metadata is provided in this document.

The EMSC is in charge within the NERA-NA3 group to establish the station book, in collaboration with ORFEUS, ETH, INGV and ISTerre. This report presents the content, access and updating procedure which will be developed to describe station information. The tool that will be implemented for maintaining the accelerometric station information includes remote access to SEED station information for RRSM and ESM data, updating, maintaining and accessing to non-SEED station information for RRSM and ESM data.

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I. Introduction

The major objective of NERA-NA3 is to propose a living database infrastructure that is capable of bridging European Strong Motion (ESM) and Rapid Raw Strong Motion (RRSM) databases of Europe.

Accelerometric data are one of the primary sources of information used by the engineering seismology and earthquake engineering communities to evaluate the ground motion responsible for seismic damage. It is used to calibrate national building codes, to calculate earthquake scenarios and to define early-warning systems, shake maps or rapid damage evaluation scenarios.
The number and quality of strong-motion stations in Europe is increasing rapidly. New generation instruments can record weak-to-strong motions using real-time data transmission. Further, instruments are deployed both in the free-field and in many other engineered structures to investigate their response. 4 years ago, during the NERIES project, about 3,800 accelerometric stations were identified in the Euro-Med region (from Iceland to Oman).

In view of this large and increasing number of accelerometric stations, it is important to develop the tools to collect, update and archive their description. The information can range from basic details such as location and names to acquisition chain description, morphology of the installation site or velocity profiles.

The task 3.2 focuses on the development of an online interface to update and integrate new stations. It requires the definition of a dedicated database following specific formats and contents. This database should be synchronized with the accelerometric data exchange defined in NA3, namely RRSM and ESM.

The general schemes to archive and access strong motion data for the RRSM and the ESM are described in the deliverable D3.1. Within this general infrastructure, the NA3 accelerometric station book aims at creating a reference registry useful at an international level. The description of the station book developments is provided in agreement with the developments of the ESM and RRSM.

The aim of this specific task of NA3 is to set up a unique and reliable international registry of strong motion stations. Such a registry does not exist so far and has an important role to serve the accelerometric data community, seismologists and engineers. This registry should provide a simple and accepted interface to view and update accelerometric station metadata. This interface will be accessible through the seismic portal (www.seismicportal.eu) as well as through the EMSC web page, ensuring a wide audience.

The target public is two-sided. Anyone interested in accelerometric station information will have access to the interface for viewing these information. However, restricted access will be given to network operators to update the information available in the database.
The EMSC and ODC (ORFEUS Data Center) are in charge of the technical developments and maintenance of the database and interface while the station information contained in the database is under the responsibility of each network operator.

This report presents the database content and architecture foreseen to be implemented. A second deliverable is due in month 40 to present the compilation of the data which will be included in the database.

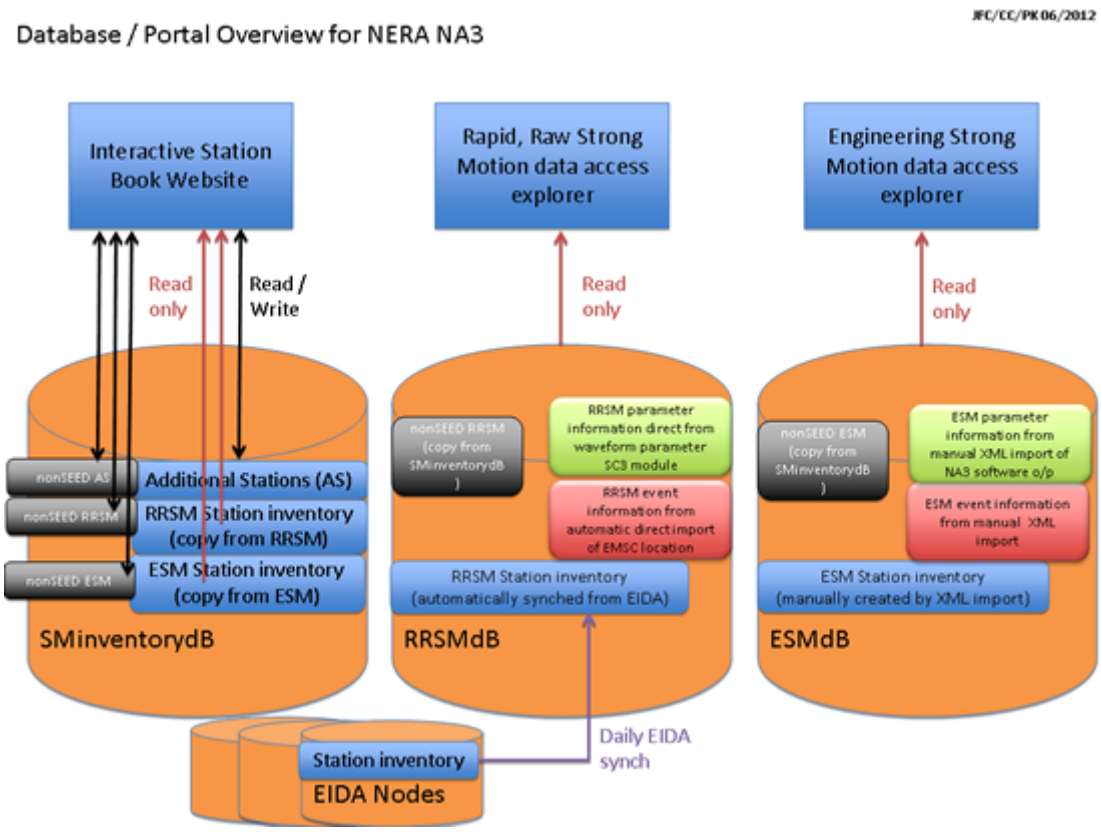

Figure 1: Overview scheme for the NA3 data exchange

II. Infrastructure

a. General architecture

The architecture imagined for the stationbook implementation is supported by infrastructures already existing. SeisComP3 is a central part of the RRSM data exchange and already provides station information as described in the station inventory which correspond to the dataless SEED. The information available concern primarily the instrumentation (instrument responses, instrument coordinates, sampling rate, etc), which are common to both strong motion and broad band stations and the base for inventory XML or SC3 data model.
An additional module has been developed by Gempa/ETH to compute accelerometric parameters as soon as waveforms are available within the EIDA nodes. In parallel, ETH developed an extended database to include information on stations and sites.

The station book web interface is developed by the EMSC, while the database containing the station metadata will be primarily hosted at ODC. According to technical requirements, it will be decided between two possibilities. The database

can be deployed in both institutes. The contents of both instances are synchronized using messaging systems. Alternatively, one single database can be created at ODC and the web interface will interact directly with it using adequate protocols. As the interface is developed by the EMSC, the first option is more practical and is presented in the following sections.
The Strong Motion inventory database (SMinventory) at the EMSC is related to:

- The interactive station book website for viewing and updating
- The Strong Motion inventory database (SMinventory) at ODC for synchronization
  - Pushed by ODC for inventory information (SEED)
  - Pushed by the EMSC for station and site characterizations
- The Strong Motion inventory database necessary for ESM whose procedures will be defined

The Strong Motion inventory database (SMinventory) at ODC is updated by synchronization from the EIDA nodes for inventory information (SEED)

The database model is developed by ETH and is linked to the SeisComP3 model. It includes three main tables which are detailed in section III.

- Inventory information: embedded information in SeisComP3 model (dataless SEED information)
- Station characterization
- Site characterization

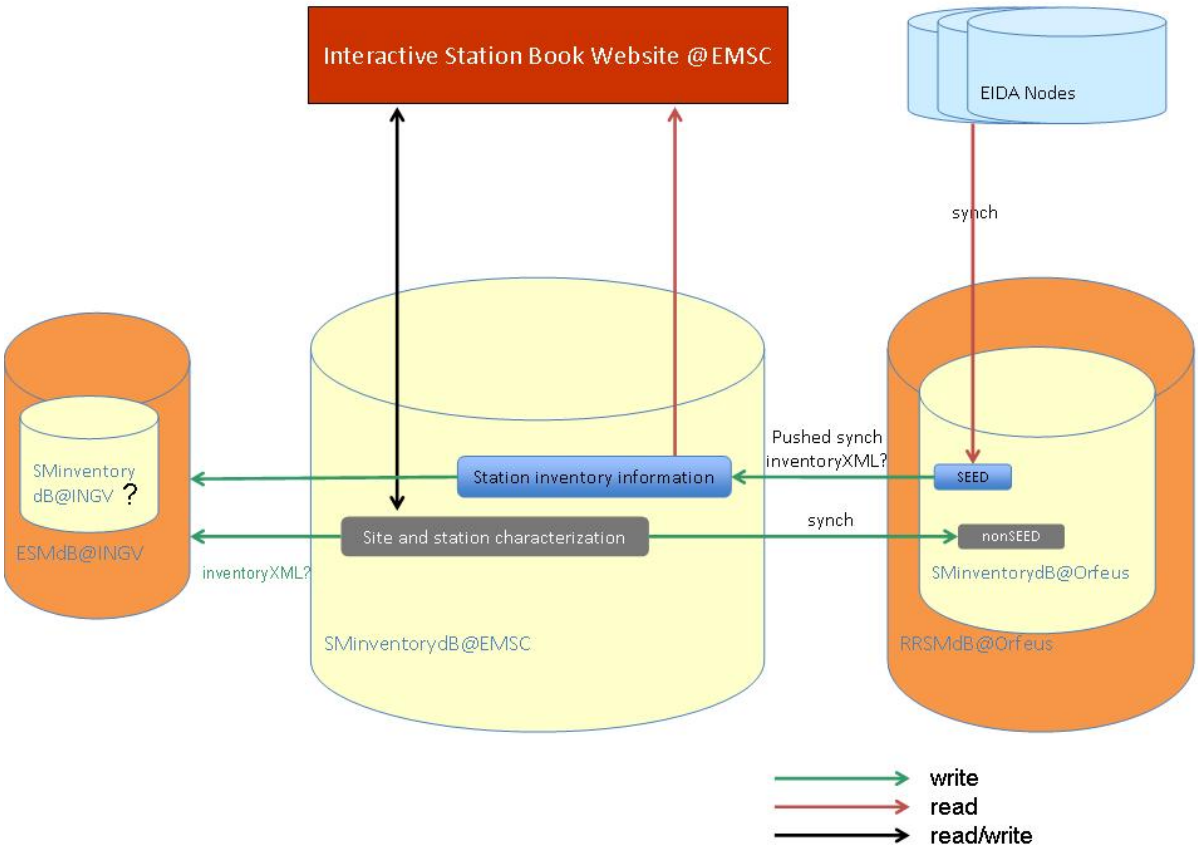

Figure 2: Architecture defined for the accelerometric station book access and population

b. Synchronisation method

The metadata stored in the database at the EMSC should be synchronized with the database at ODC. Seed information should be pushed from ODC to the EMSC. Non-Seed information should be pushed from the EMSC to ODC. We propose to use inventoryXML file transfer between both institutes using messaging tools, such as rabbitMQ. It implies opening specific communication ports between both institutes.

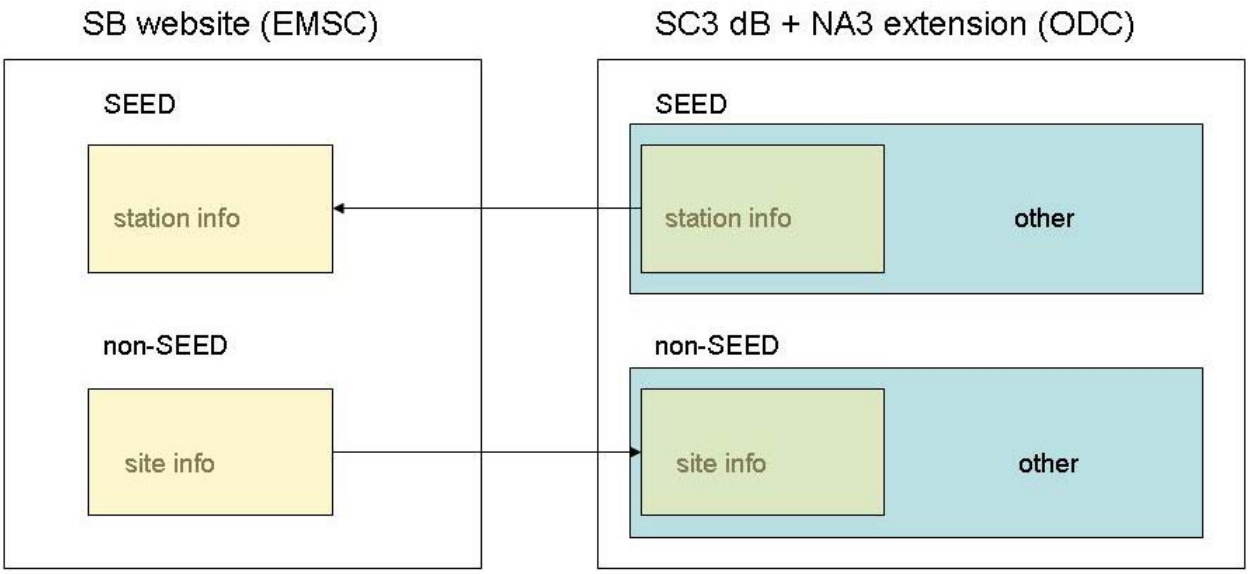

Figure 3: Interaction between the EMSC and ODC instances of the station book database

III. Content

a. Metadata

The metadata related to accelerometric stations are separated into three different tables.

1. The first one is identical to the station inventory as embedded into SeisComP3. It contains core station information, as reported in dataless SEED. Those information are not specific to accelerometric stations and can also describe broad band stations.
2. The second table corresponds to the site characterization. It describes the geophysical information available for the implantation site of a station.
3. The last table is the station characterization in terms of ownership or related information, such as photos, monography.

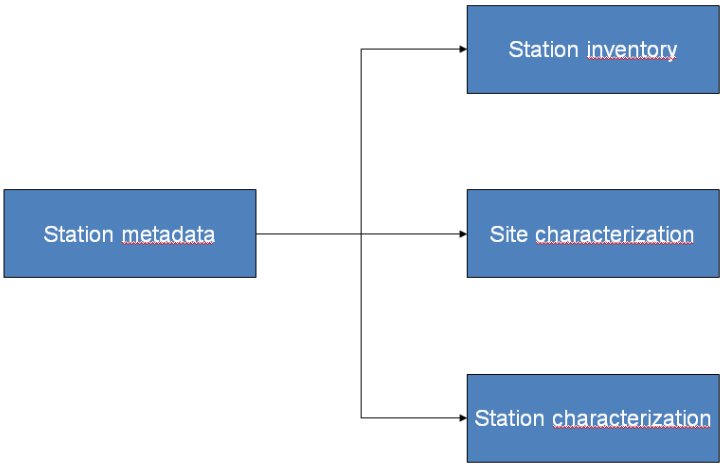

Figure 4: Distribution of the station information between the different tables of the station accelerometric database

b. Station inventory

An implementation of a station metadata scheme is available from SeisComP3 / Arclink as inventoryXML, documentation is available at http://geofon.gfz-potsdam.de/_uml/ . It covers sites, instruments, response, deployments, configuration while the site and station description are not available, nor the ownership. Currently, only one owner can be assigned. This draw back should be clarified later.

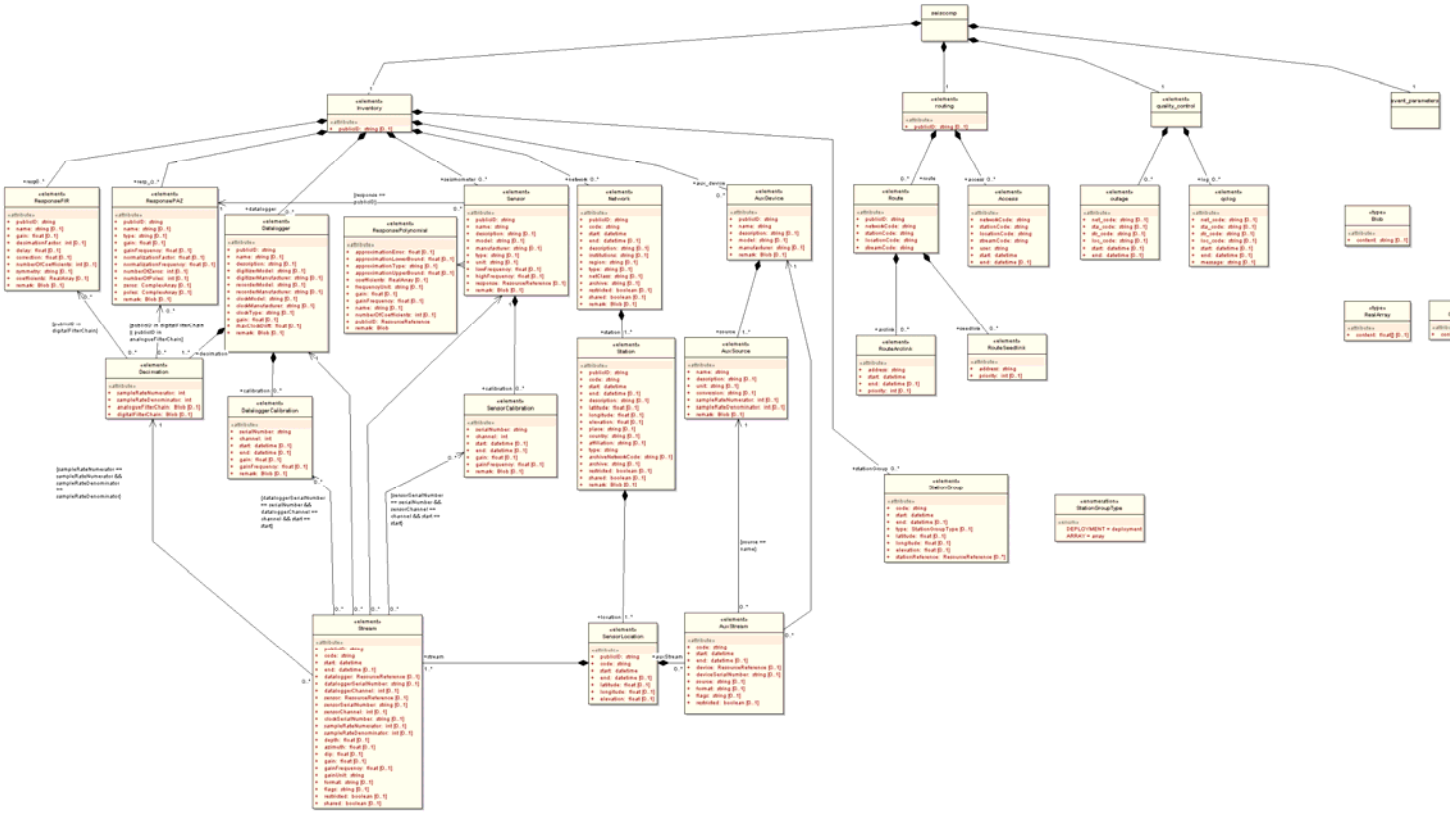

Figure 5: UML scheme of station inventory as described within SeisComP3 database model

c. Site characterization

The information gathered in the site characterization tables cover:

- Geophysical description of the site
- Geophysical site analysis type (borehole, noise array, H/V,active seismics, scp, cpt analysis results, etc)
- Output of the site analysis (dispersion curves, traveltime velocity, vs30)

d. Station characterization

The information gathered in the station characterization tables cover:

- Geological context
- Station housing
- References to site characterization results
- Geomorphology
- Documentation (photos, reports)
- Ownership

The site and station characterization tables are under developments at ETH. Accordingly, the present document will be updated when the specifications are available at the end of 2013. It should contain the following information:

General description	NERA RRSM mandatory optional not needed	NERA ESM mandatory optional not needed
Station name	optional	optional
Station unique ID	mandatory	mandatory
Station number of records	not needed	optional
Station owner	mandatory	mandatory
Station owner description	mandatory	mandatory
Station owner information	optional	optional
ISC network code	mandatory	mandatory
FDSN network code	mandatory	mandatory
Network name	mandatory	mandatory
Station latitude,WGS deg	mandatory	mandatory
Station longitude, WGS deg	mandatory	mandatory
Horizontal error	optional	optional
Station elevation	mandatory	mandatory
Network owner	mandatory	mandatory
Network owner decription	optional	optional
Network owner information	optional	optional
ISO contry code	optional	optional
Region code	not needed	optional
Province code	not needed	optional
City code	not needed	optional
Station start time	mandatory	mandatory
Station end time	mandatory	mandatory
Station address	optional	optional
Station picture	optional	optional
Closest distance to buildings,m	optional	optional
Housing description for building and vault installation	optional	mandatory
For building installations, numer of stories of the building above ground	optional	mandatory
For building installations, installation storey	optional	mandatory
For building installations, occupancy code	optional	mandatory
EC8 class	optional	optional
EC8 inferred from geology (yes, no)	optional	optional
Preferred VS,30, m/s	optional	optional

VS,30 method	optional	optional
Sigma of VS,30	optional	optional
f0, dominant freq. at the site	optional	optional
f0 method	optional	optional
Morphology descriptor	optional	optional
Topography descriptor	optional	optional
Monography file + links to external documents &| cartographic detail.	optional	optional
Geological unit descriptor	optional	optional
Lithography/stratigraphy log indicator (yes/no)	optional	optional
layer no.	optional	optional
layer top	optional	optional
layer bottom	optional	optional
layer description	optional	optional
log lat.	optional	optional
log lon.	optional	optional
log. elev.	optional	optional
log reference	optional	optional
Geophysical measurement indicator (yes/no)	optional	optional
Geophysical measurement descriptor	optional	optional
Geophysical measurement lat.	optional	optional
Geophysical measurement lon.	optional	optional
Geophysical measurement elev.	optional	optional
Distance from station	optional	optional
Geotechnical measurement indicator (yes/no)	optional	optional
Geotechnical measurement descriptor	optional	optional
Geotechnical measurement lat.	optional	optional
Geotechnical measurement lon.	optional	optional
Geotechnical measurement elev.	optional	optional
Distance from station	optional	optional
VS layer no.	optional	optional
VS layer top	optional	optional
VS layer bottom	optional	optional
layer VS	optional	optional
layer VP	optional	optional
NSPT layer no.	optional	optional
NSPT layer top	optional	optional
NSPT layer bottom	optional	optional
NSPT	optional	optional
Cu layer no.	optional	optional
Cu later top	optional	optional
Cu layer bottom	optional	optional

Cu	optional	optional
Density layer no.	optional	optional
Density layer top	optional	optional
Dansity layer bottom	optional	optional
Density	optional	optional
Dispersion curve indicator (yes/no)	optional	optional
Dispersion curve method descriptor	optional	optional
Dispersion curve reference	optional	optional
Dispersion curve sequence	optional	optional
Freq.	optional	optional
Phase velocity	optional	optional
FDT indicator (yes/no)	optional	optional
FDT method descriptor	optional	optional
FDT reference	optional	optional
FDT sequence	optional	optional
Freq.	optional	optional
Amplification	optional	optional
St. dev.	optional	optional
Geological age of surface material.	optional	optional
Grain size of surface material: Aggregate, Coarse, or Fine.	optional	optional
Depositional history indicator	optional	optional
Depth to Vs=1.0 km/sec.	optional	optional
Depth to Vs=1.5 km/sec.	optional	optional
Depth to Vs=2.0 km/sec.	optional	optional
Name of the sedimentary basin.	optional	optional
Depth to basement.	optional	optional
Closest distance from the station to the basin edge.	optional	optional

IV. Viewing interface

a. Access and location

Any user can access the viewing interface. It will be reached through the Seismic portal (www.seismicportal.eu) and will be linked from the EMSC and ORFEUS.

b. Design

Station information will be viewed online via
- An interactive map
- A list of stations
- A description page for each station

The station dedicated page will be developed using the Geoscope interface as model:
http://geoscope.ipgp.fr/scripts/stations/fiche.php?sta=ATD&id=186
In the duration of the NERA project, we will focus on the following information:

- A general description of the station: network, location, code
- Acquisition description: sensor and digitizer
- Site description: photos, morphology

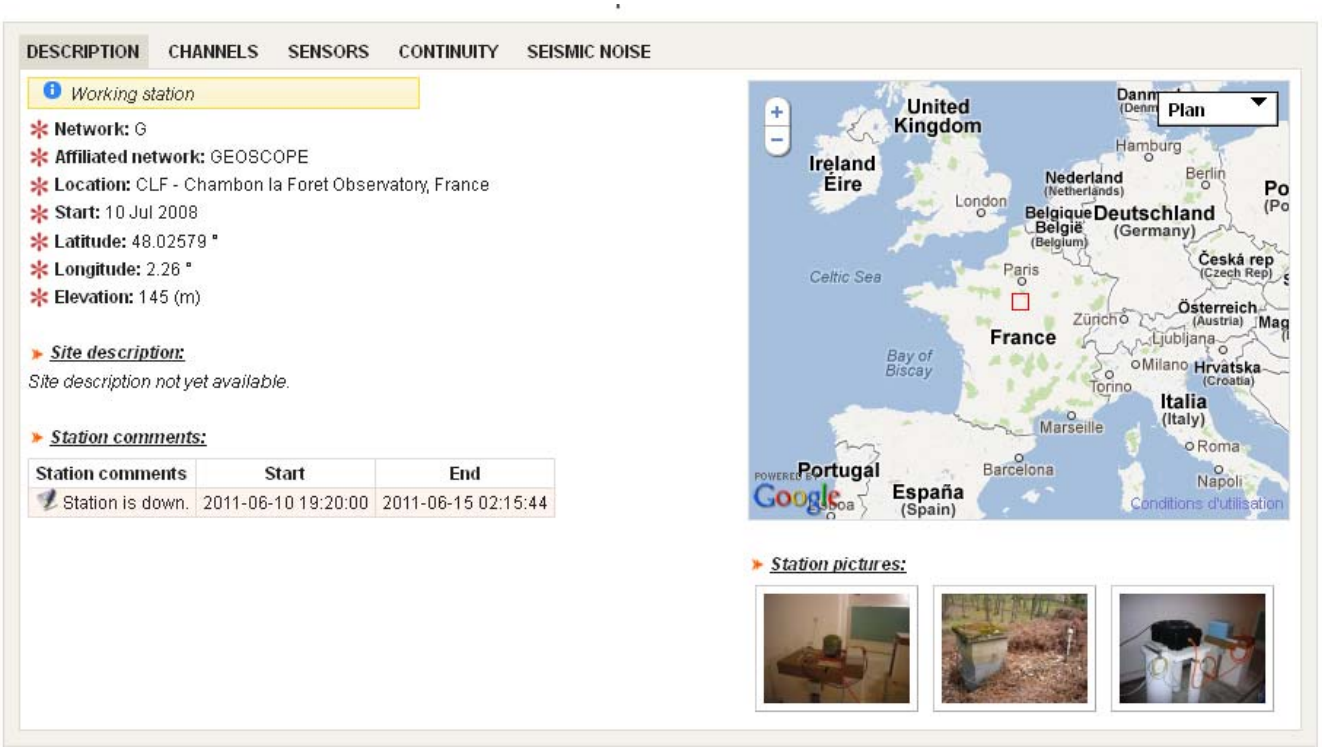

Figure 6: Snapshot of the Geoscope viewing interface to be used as model for the NA3 station book interface

It will be kept in mind that the developments made for the accelerometric stations may be useful in the future for broadband stations. The NA3 developments will be discussed with the working group 1 of ORFEUS defining the registry of broadband (BB) seismograph stations in the European-Mediterranean area (http://www.orfeus-eu.org/WorkingGroups/wg1.html).

c. Output

The information available in the stationbook database will be mostly accessible and viewed online. However, they may also be extracted as inventoryXML. Several tools for conversion into more common formats are already available, for example conversion into dataless SEED in python (obspy.xseed).

V. Updating interface

The interface will also allow the update and creation of station information. The access to the updating tool will be restricted in terms of users and of metadata.

a. Registration

Only network operators will have access to the updating interface. One contact person should be defined for each network. A list of network operating accelerometric stations will be created for the Euro-Med region, as is available at ORFEUS for seismograph stations: http://www.orfeus-eu.org/Links/euromed.html
The contact person will be responsible for the use of the administrator login and password assigned to the network.

b. Accessible metadata

Updates of station metadata update are limited to
- RRSM stations: station characterization and site characterization. All other information will be updated through the EIDA nodes.
- ESM stations: all station information
- Other stations: all station information

For the creation of a new station, three different levels of information will be defined.
- Compulsory (beginner) level: basic information necessary for an accurate review of the existing accelerometric stations. It includes: latitude, longitude, altitude, station code, network code.
- Data exchange (intermediate) level: information necessary for a RRSM or ESM data exchange. It includes all information of the inventory database, equivalent to a dataless SEED file. All those fields are required.
- Complete (advanced) level: information on vault, site, etc as described in station and site characterization. Any of the fields can be filled.

c. Conventions and restrictions

The fields of the database will be modified using drop down menus as much as possible. This will avoid mistakes and multiple spelling for the same element. It implies the creation of accurate lists of possible choices for several fields of the database. Those lists will be compiled by the NA3 group. Lists for sensors and digitizers are available in Annex C.

Networks should have or should request a FDSN code to join the data exchange. http://www.fdsn.org/forms/netcode_request.htm

Code of the NA3 network participants:

CH: Swiss national network
RA: French strong motion network
FR: French broadband network and co-located strong motion
IV: INGV Italian national network
IT: DPC Italian civil protection
??: Turkish strong motion network

The two letters code assigned is necessary to generate SEED volumes and incorporate raw waveformd data into RRSM.

Station codes are recommended to be registered to the International registry maintained by ISC and NEIC at ISC. http://www.isc.ac.uk/registries/ . Each station code should be unique within the deployment, following the IASPEI recommendations. The station code should be of lenght of 3 to 5 letters.

The station book updating interface will not allow modifications of SEED metadata (inventory information) from EIDA stations. Such changes must be inserted in EIDA after which it is synchronised in the NA3dB.

d. Design

The ITACA web page has a station information updating interface that will be used as model for the NA3 station book developments.
http://itaca.mi.ingv.it/ItacaNet/

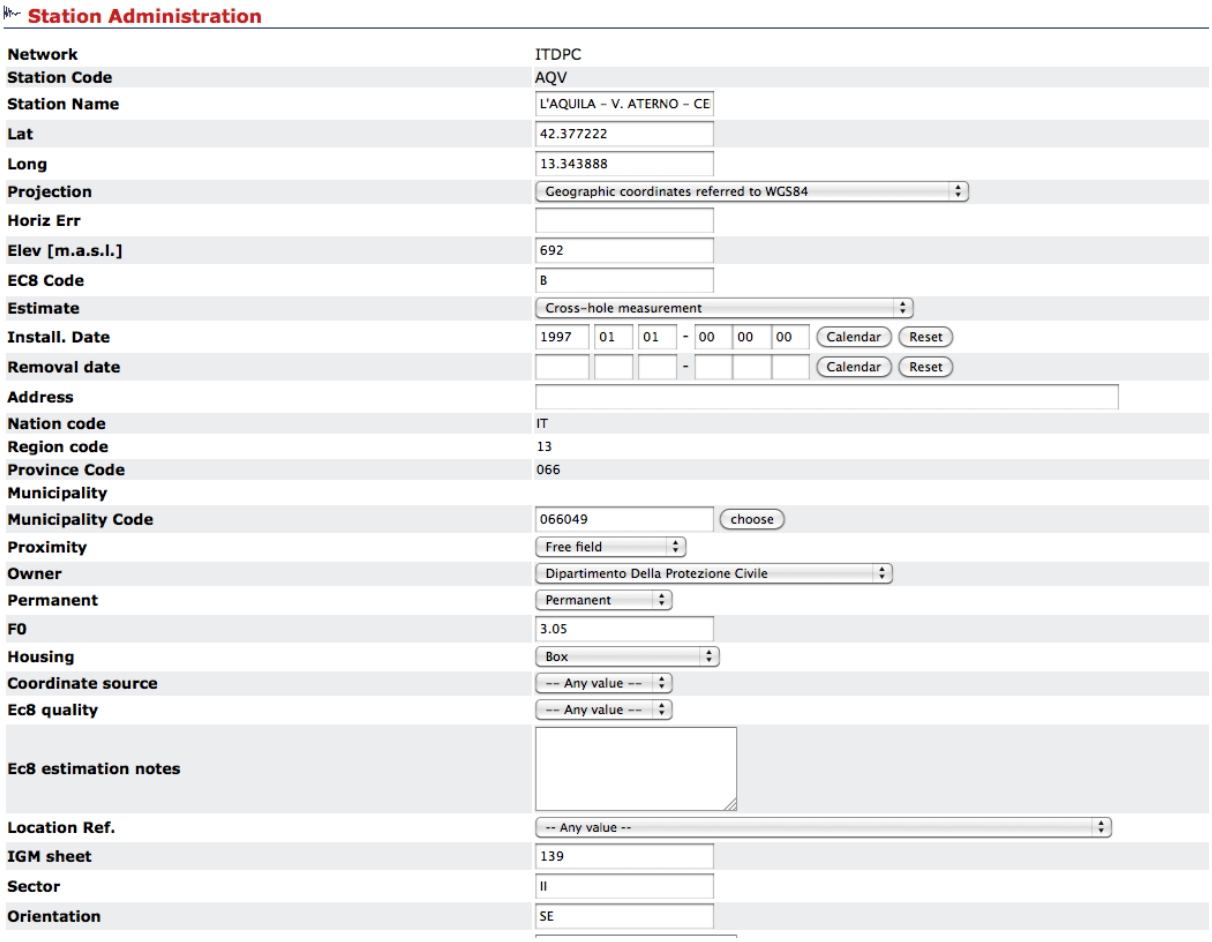

Figure 7: Extract of the ITACA update tool for station information

VI. Data collection

a. Initial population

The population of the database will start with the stations operated by the networks involved in NA3

Responsible institute	ISTerre	ISTerre (Data collected during the NERIES project)	INGV	METU	ETH
Total number of strong motion stations available	266	103	120 INGV 400DPC		145
Stations eligible for rapid data exchange (RRSM):			120 INGV		65
Already in EIDA	87		120 INGV		116 (65 real time)
To be integrated in EIDA	20				
Stations eligible for validated data exchange (ESM)	169	all	all	*335*?	all

b. Future population

The process for the network operator to include or update station information will follow different schemes

- Stations to integrate the RRSM data exchange:
  - Dataless SEED information will be uploaded through the EIDA nodes and synchronized using ArcLink, the requirements will be described by ODC (those information are compulsory)
  - Site and station characterization will be done via the web interface
- Stations to integrate the ESM data exchange
  - Dataless SEED information will be uploaded via the web interface (those information are compulsory)
  - Site and station characterization will be performed via the web interface
- Other stations
  - Dataless SEED information will be uploaded via the web interface
  - Site and station characterization will be performed via the web interface

In the future, we may define alternative ways to populate the database, in particular for a large set of stations. It could rely on the use of dataless SEED volumes.
All information will be under the responsibility of the network operators. ODC and the EMSC do not have the scientific expertise to control the complete content of the database. It may be necessary to define a validation procedure

for all information included. However this is beyond the scope of the current project.

If time and resources allow, effort will be done regarding the data that were accessible within the NERIES framework: those data (and metadata) will possibly be integrated to the ORFEUS EIDA node by ISTerre. They contain:

TS : institute of engineering and earthquake Greece : 107 station, 25 events
IST : instituto superior tecnico, Portugal : 39 stations, 27 events
IGC : institut geologic de catalunya, Spain : 10 stations, 22 events

Stations for which no SEED metadata are available will be only available in the RRSM DB @ the EMSC and will not be synchronised with the RRSM DB @ ODC

VII. Activity meetings

Date	Meeting description	Location	Attendees
2 october 2012	Technical Meeting on stationbook	Zürich	EMSC, ISTerre, ODC, ETH, INGV
13 september 2011	Technical Meeting	Zürich	All NA3 participants
23 june 2011	Technical meeting	Paris	All NA3 participants
19 january 2011	Technical Meeting	Zürich	All NA3 participants

VIII. Next actions

The SeisComP3 extended data model has been provided by ETH, it contains the additional station information and event information necessary for the RRSM data exchange. ODC is implementing this instance.

The site and station characterization tables are being finalized by ETH and will also be implemented at ODC and the EMSC. A review for the ESM information may be realized to ensure the creation of a unique and complete database.

The best scenario for the station inventory database implementation is being decided. It includes the location and/or duplication of the database at EMSC and ODC, the communication and synchronisation protocols and the database management system to be used.

The web interface to view and update the station inventory will be developed by the EMSC and will be validated by the NA3 group.

IX. Conclusions

The stationbook developed with NA3 will provide a unique access to accelerometric station information online. Its implementation and maintenance will allow the creation of a repository useful for all the seismological and engineering community. Maintained technically by EMSC and ODC, it should grow rapidly towards an international registry.

Appendix A: current initiatives for station and network inventories

Broad band station registry:

ORFEUS WP1 has launched an initiative to create a Central database of broadband seismic stations in the European-Mediterranean region. This database will contain detailed instrumentation information. The interface is in developments:
http://silo.ig.cas.cz/stationsdb/stationsdb_index.php

Seismic station registry:

The ISC in conjunction with the NEIC is responsible for running the International Registry (IR) of Seismograph Stations. This registry is well established and contains limited information (no instrumentation details) for almost 20,000 stations. http://www.isc.ac.uk/registries/

Network registry:

The International Federation of Digital Seismograph Networks (FDSN) maintains a list of unique network codes for data providers.
http://www.fdsn.org/station_book/

Appendix B: current list of sensors and digitizers

Sensors currently identified

Kinemetrics	FBA1
Kinemetrics	FBA3
Kinemetrics	FBA11
Kinemetrics	FBA13
Kinemetrics	FBA13DH
Kinemetrics	FBA23
Kinemetrics	FBA23DH
Kinemetrics	FBAEST
Kinemetrics	QDR
Kinemetrics	Episensor
Kinemetrics	Episensor ES-U
Sprengnether	FBX-23
Sprengnether	FBX-26
Syscom	MS2002
Sig-geophon	SM2
Terratech	SSA120
Terratech	SSA220
Terratech	SSA320
Wilcoxson	731A
Guralp	CMG5T
Guralp	CMG5HP
Guralp	CMG5
Geosig	AC23
Geosig	AC53

Geosig	AC63

Digitizers currently identified

Kinemetrics	ETNA
Kinemetrics	Basalt
Kinemetrics	QDR
Kinemetrics	K2
Kinemetrics	MTWHITNEY
Kinemetrics	EVEREST
Kinemetrics	SSA-1
Kinemetrics	SSA-2
Kinemetrics	SSA-16
Kinemetrics	SSR-1
Kinemetrics	DSA-1
Kinemetrics	DSA-3
Kinemetrics	PDR-1
Kinemetrics	PDR-2
Geosig	GSR18
Geosig	GSR24
Geosig	GSR12
Geosig	GSR16
Geosig	SMACH12_EPOCH
Geosig	SMACH12_CH
Geosig	SMACH16
Geosys	IDS
Guralp	DM24-MK2
Nanometrics	HDR24
Nanometrics	TAURUS
Nanometrics	TRIDENT
Syscom	MR2002
Agecodagis	3CS5321_22
Agecodagis	3FCS5321_22
Agecodagis	3NTCS5321_22
Agecodagis	3NTCS5323_22
Agecodagis	6CS5321_22
Agecodagis	6NTCS5321_22
Agecodagis	6NTCS5323_22
Agecodagis	3CS5323_22
Agecodagis	3FC5323_22
Agecodagis	M3XTHI7190
Sprengnether	DR-100
Sprengnether	DR-200
Sprengnether	DR-300
Sprengnether	DR-3016
Sprengnether	DR-3024
Terratech	DCA-300
Terratech	DCA-310
Terratech	DCA-333
Terratech	IDS-3602
Terratech	IDS-3602A
Geotech	A700
Geotech	A800
Geotech	A900
Geotech	A900A
Quanterra	Q330 series
Quanterra	Q4120
Quanterra	Q4128a
Quanterra	Q730
Quanterra	Q736

Quanterra	Q980
Reftek	72A
Analog	
USC&GS	C&GS-Standard
Teledyne	AR-240
Teledyne	RFT-250
Teledyne	RFT-350
Kinemetrics	SMA-1
Kinemetrics	SMA-2
Kinemetrics	SMA-3
Kinemetrics	CRA-1