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NETWORK OF EUROPEAN RESEARCH INFRASTRUCTURES FOR EARTHQUAKE RISK ASSESSMENT AND MITIGATION (NERA) - NETWORKING ACCELEROMETRIC NETWORKS AND SM DATA USERS (NA3)

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The most successful attempts at gathering strong-motion data in and around Europe were led by Prof. Nicholas Ambraseys (deceased in 2012) through FP4 and FP5 projects and resulted in a pan-European strong-motion databank disseminated through the Internet Site for European Strong-Motion Data (ISESD; www.isesd.hi.is). It was a struggle to maintain the ISESD after 2004 because of lack of financial support and manpower, and the limited contribution of new data. The recently finished FP6 NERIES (Network of Research Infrastructures for European Seismology) project created a new infrastructure to collect, process and distribute modern strong motion data from across Europe (www.seismicportal.eu). NERIES project also provided software tools for processing of accelerometric data (e.g., PARAMAC software). In NERA NA3, we have built on these efforts and made use of seismological services that provide rapid access to well described continuous acceleration data that is increasingly commonly provided by the acceleration community across Europe. The organizations involved in NERA-NA3 are ETH-SED, METU, BU-KOERI, ISTerre, EMSC, ORFEUS and INGV-Milan.

Concurrent to the NERA and NERIES developments, during the last 5-6 years, countries like Turkey and Italy considerably improved their strong-motion databases and dissemination strategies through national research and development funds. These databases as well as other strong-motion

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datasets (e.g., NGA, K-net, KiK-net, …) were brought together within the framework of FP7 SHARE (Seismic Hazard Harmonization in Europe) project to fulfil the specific research objectives of the SHARE Ground-Motion Modeling group. While SHARE did not attempt to improve the metadata, the waveform quality of SHARE strong-motion databank is high as all collected recordings were subject to careful visual scrutiny. A project parallel to SHARE, EMME (Earthquake Model of the Middle East Region), is funded by GEM. One of the major tasks of EMME is to establish a strong-motion databank for the Middle East, Iran, Pakistan and Caucasus. The strong-motion recordings of some of these countries were also present in the SHARE strong-motion databank. Another ongoing international project, SIGMA (Seismic Ground Motion Assessment; www.project-sigma.com), aims at improving the hazard-related research infrastructure in France and neighboring countries. Of the various tasks in SIGMA, assembling a database of accelerograms gathered from the broader Europe constitutes an important target. The SIGMA database (called RESORCE; resorce-portal.eu) practically improves and extends the pan-European subset of SHARE strong-motion databank.

The key products of the NA3 work package within NERA are:

1) The Engineering Strong Motion database (ESMdb): combining the expertise and datasets gained within the above projects the ESMdb is a single, a high-quality accelerometric databank consisting of both modern and historically important strong motion waveforms. The ESMdb has carefully revised metadata information. Taking advantage of modern seismological services that provide rapid access to strong motion data, the ESMdb will be dynamically updated with manually processed data when significant new events occur. A scientific committee will ensure the quality of data and metadata.
2) The Rapid Raw Strong Motion (RRSM) database: an automatically produced strong motion database that takes advantage of the state-of-the-art in seismic network processing to provide near-immediate access to any openly available strong motion data following a significant earthquake in Europe.
3) An updated station inventory for strong motion stations operational in Europe.

The core tasks of the NA3 group are a) to increase the networking activities among the acceleration networks in and around Europe and b) to improve the dissemination capabilities of the European accelerometric communities. The above objectives imply adopting common data and metadata dissemination strategies and standards for both continuous and triggered accelerometric data by means of making the waveforms and the basic station information available through the European Integrated waveform Data Archive (EIDA, www.orfeus-eu.org/eida/). EIDA is composed of a number of distributed archives across Europe with centralised data services for data discovery and retrieval. It was originally developed to share European broadband seismic data, but has recently been used to also distribute acceleration data. Currently, ArcLink is the protocol which technically connects the distributed archives and provides uniform access to the data archives. ArcLink is a core module of the earthquake monitoring software of SeisComP3. Within NERA NA3, the database structure of SeisComP3 was extended to include the event-based strong-motion parameters computed by the processing module scwfparam that was also developed within NA3. Due to these services, the Orfeus Data Centre (ODC/KNMI) can now routinely process (near) real-time accelerometric data for a rapid Internet publication of peak ground-motion values as well as response spectral ordinates of engineering interest. This is the Rapid Raw Strong-Motion (RRSM) database of NERA NA3. Web access to the RRSM in presently under development and will be provided by ODC/KNMI. The core of accelerometric data processing in scwfparam is illustrated in Figure 1 and further information on this software can be obtained at www.seiscomp3.org/wiki/doc/applications/scwfparam.

The ESMdb will distribute strong-motion recordings available in Europe and surroundings since the 1970s. An innovative feature with respect to previous accelerometric databases (SHARE, RESORCE, etc.) is that the database can be automatically populated by directly accessing accelerometric records in EIDA. Nevertheless, a manual interaction is still required as the accelerometric data in ESMdb are manually processed and quality checked before being distributed. Event-based and station-based metadata are also periodically revised. The current ESMdb prototype for disseminating strong-motion data contains Turkish and Italian strong-motion recordings. The European data contained in the SHARE database will be included before the end of the project. The

web access to the ESMdB will be hosted by INGV Milan. A snapshot of the ESMdb portal developed under NA3 is shown in Figure 2.

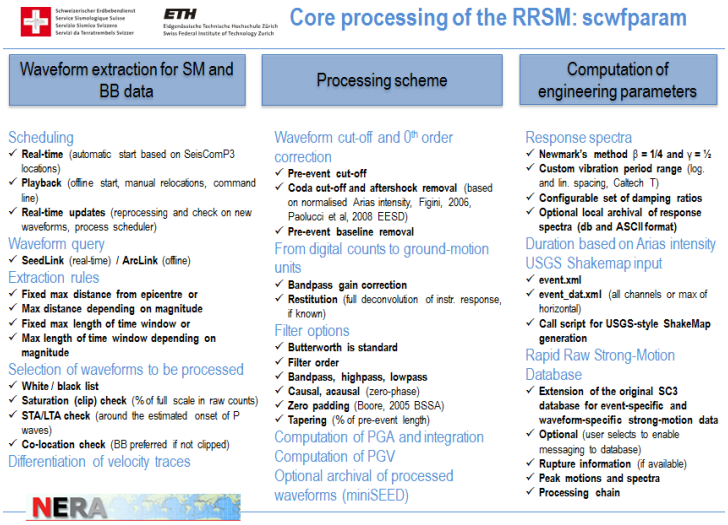

Figure 1. Processing steps of scwfparam in SeisComP3

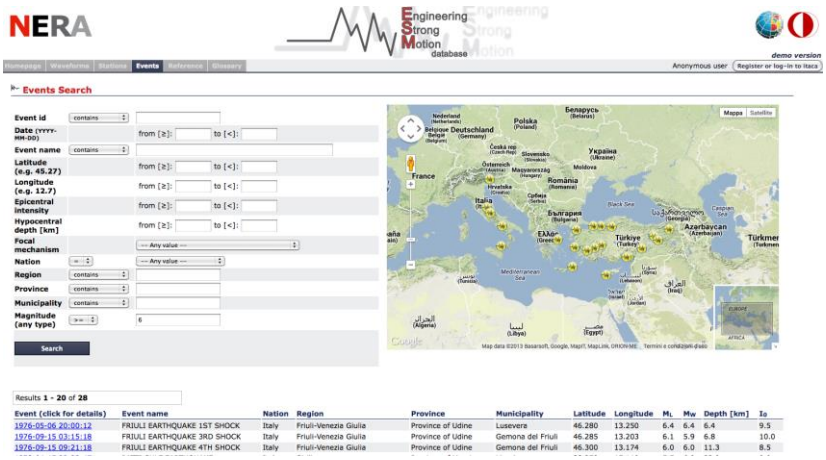

Figure 2. A snapshot from ESMdb portal developed under NA3

The final component of the NA3 infrastructure is updated stationbook (station database) that supports inquiries about the stations and/or specific station information. By default it will reflect all strong motion stations that are part of EIDA, but will also be editable so network operators can add and edit their own station information. A significant improvement of this database is that any network operators that maintain metadata information in EIDA will not need to maintain this public database, amendments on EIDA will be immediately visible. The ODC/KNMI will maintain this station book.

Once the proposed infrastructures are built and operating, the objectives of NERA NA3 will be achieved. It is increasingly likely that through the EPOS-Seismology component of EPOS (European Plate Observing System; www.epos-eu.org), these services may be sustained and even extended beyond the NERA project.

Beyond the new services, networking activities among accelerometric and strong-motion data provides have been actively promoted by international workshops organized by NERA NA3. The first workshop was held in Istanbul in 2012 as part of Orfeus Annual Observatory Coordination meeting. The major outcome of the workshop is the agreement among data providers to setup a coordination framework for the strong motion community under the umbrella of Orfeus (Working Group 5), with the long term vision that Orfeus represents one of the reference organizations of the EPOS-Seismology.