Supplemental Material for the paper

The Earthquake Early Warning System in Southern Italy : Methodologies and Performance Evaluation

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The Irpinia Seismic Network (ISNet) for Early Warning

The EEWS in southern Italy is based on a seismic monitoring infrastructure denoted ISNet (Irpinia Seismic network). ISNet is a dense seismographic network deployed along the system of active normal faults of the Campania-Lucania region (Weber et al., 2007). It features 30 seismic stations and 5 data processing sites (local control centers, LCC). All stations are equipped with three-component strong-motion accelerometer and 1-sec natural period velocimeter, to guarantee a relatively wide dynamic recording range. Five stations host broad band velocimeters (30 sec of natural period), for the optimal recording of regional and teleseismic events. The stations are housed in a shelter, with solar panels and batteries, that can telemetry to the network control center the environmental parameters (temperature, battery voltage level, disk memory state, …) through an independent GSM modem transmission. The data loggers are Linux-based, embedded computers, with mass storage and a GPS receiver, produced by Agecodagis sarl. The seismic data recorded at each station are transmitted to the nearest LCC, through a Wi-Fi directional antenna, in SeedLink (e.g. http://www.iris.edu/data/dmc-seedlink.htm) format. Each LCC runs: the SeisComP software (Hanka et al., 2001), to relay the data to outside SeedLink clients; the Earthworm system (Johnson et al., 1995), for real-time processing (e.g. to produce a bulletin of automatically detected events); the Winston software (e.g., http://www.avo.alaska.edu/Software/winston/W_Manual_TOC.html) for data storage and visualization. To monitor and maintain all of the described ISNet instrumentation, and to access, analyze and edit the seismic data produced, we developed a software application, SeismNet Manager, that implements a web based user interface to a database of all the ISNet information and data (Elia et al., 2008).

For early warning applications, a high bandwidth radio links backbone is being deployed, interconnecting the LCCs and the Network Control Center (NCC) in Naples, hundred km distant from the network location. We developed a software application that processes the live streams of 3-component acceleration from the stations and, while an energetic event is occurring, promptly performs picking, event detection, event location and magnitude estimation. An alert message is continuously issued through dedicated communication lines over the Internet, after the first location/magnitude estimation containing the information about the source parameters and peak ground motion level predicted at the site to protect, enabling the recipient to activate automatic safety procedure.

References

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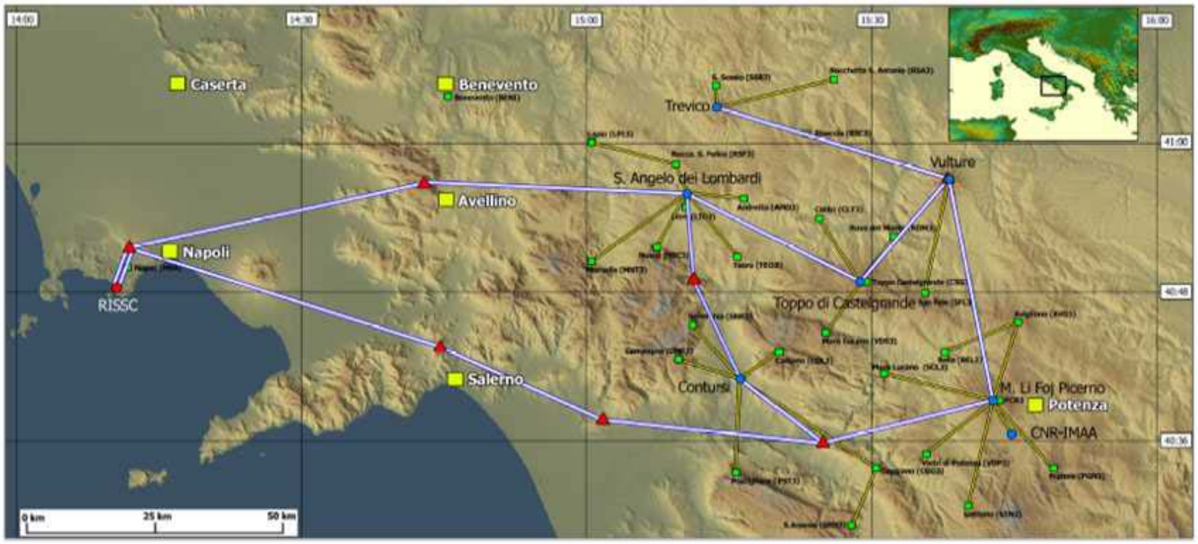

Figure SM1. General layout of the Irpinia Seismic Network. The network topology features multiple star shaped sub-networks, with several (maximum 7) seismic stations (green circles) and an LCC at their center (blue circle). The yellow lines are the radio link connecting the seismic station with LCC. The radio link backbone (under deployment) between LCCs and the NCC hosted at the RISSC-Lab in Naples is also shown. Red triangles represent the radio repeaters. The main cities are represented by yellow squares.

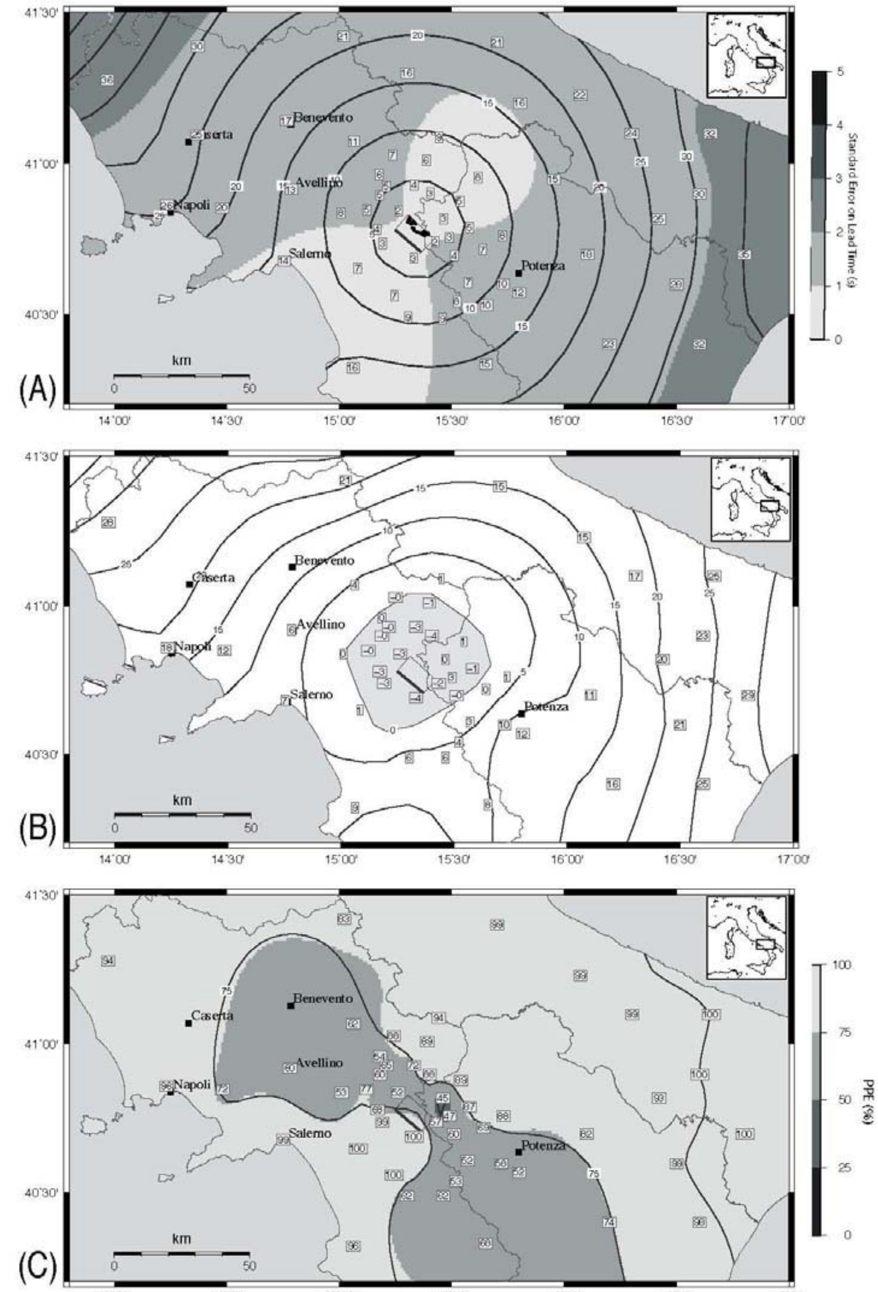

Figure SM2. Regional maps of Early Warning System performance indicators. The maps are computed for 90 earthquake scenarios for a M 6.0 occurring inside the network. See fig.1 of the main text for earthquake location, fault extent and mechanism. A. Distribution of average Maximum Lead-Time (MLT) in seconds (isolines) and the associated range of variation (grey shade). B Distribution of the Effective Lead-Time (ELT) in seconds. The shaded area inside the network indicates a zone with negative ELTs, where S-waves arrive before the distribution of PE becomes stable. C Distribution of PPE, the Probability of Prediction Error on parameter log(PGV) (see main text for details). Shaded areas are obtained from a discrete representation PPE, where lighter regions indicate a better efficiency of the EEWS to predict the PGV relative to darker regions.

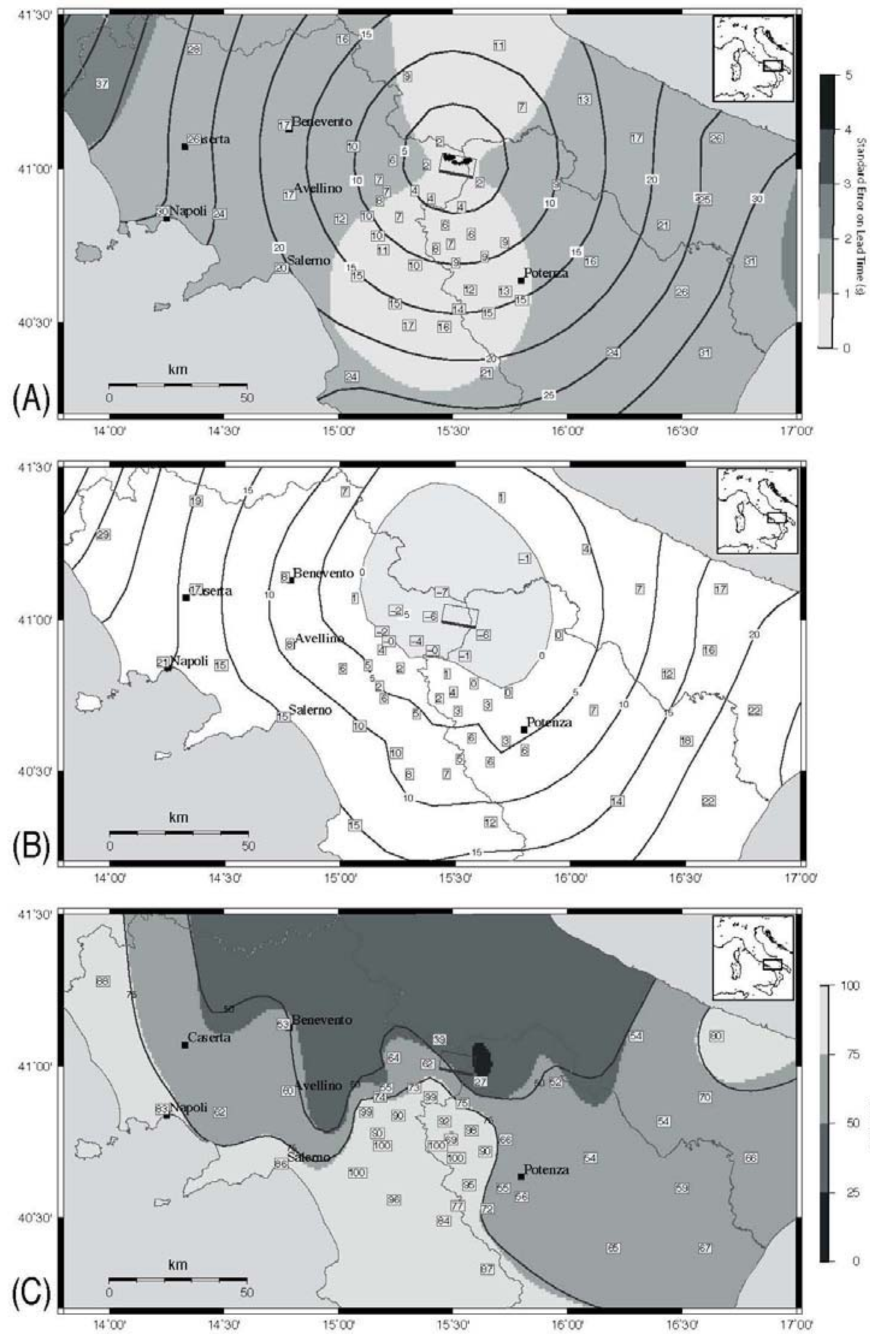

Figure SM2. Regional maps of Early Warning System performance indicators. The maps are computed for 90 earthquake scenarios for a M 6.0 occurring at the northern border of the network. See fig.1 of the main text for earthquake location, fault extent and mechanism. A. Distribution of average Maximum Lead-Time (MLT) in seconds (isolines) and the associated range of variation (grey shade). B Distribution of the Effective Lead-Time (ELT) in seconds. The shaded area inside the network indicates a zone with negative ELTs, where S-waves arrive before the distribution of PE becomes stable. C Distribution of PPE, the Probability of Prediction Error on parameter log(PGV) (see main text for details). Shaded areas are obtained from a discrete representation PPE, where lighter regions indicate a better efficiency of the EEWS to predict the PGV relative to darker regions.