SECOND EUROPEAN CONFERENCE ON EARTHQUAKE ENGINEERING
AND SEISMOLOGY, ISTANBUL AUG. 25-29, 2014

RAPID SOURCE AND GROUND MOTION ESTIMATION

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The estimation of seismic parameters in near real-time is certainly one of the points of major interest to the Civil Defence. The implementation of techniques that are able to determine the characteristics of a given event in near real-time is of enormous importance in order to be able to deal with the emergency as quickly and accurately as possible.

The SeisRaM group of the Department of Mathematics and Geosciences (DMG) of Trieste University has been performing real-time monitoring since several years now. The group has developed and applied a procedure for the rapid and precise analysis of data to yield both seismic moment (Gallo et al., 2014) and most strong motion parameters of engineering interest.

Recently, this procedure has been implemented at the DPC in Rome using the data of the integrated network consisting of RAN (Italian Strong Motion Network), RAF (Strong Motion Network of Friuli Venezia Giulia) and ISNet (Irpinia Seismic Network) stations. To get rapid information after the occurrence of a strong earthquake damage tables and maps are created that report the location, the local and moment magnitude, together with the values of PGA, PGV, PGD, PSA, PSV, the Housner and Arias intensities.

The procedure has been validated using the recordings of some recent moderate events that occurred in Italy and Slovenia including the L'Aquila (2009) and the Emilia (2012) sequences (Gallo at al., 2014).

In this paper we present the results obtained applying our procedure to a set of small events that occurred in Italy and were recorded by the Italian Strong Motion network (RAN). Our dataset consists of 152 small automatically located earthquakes that occurred in 2013 and 2014. Antelope software® (Boulder Real Time Technologies - BRTT) was used to estimate location parameters and local magnitude (M_L) automatically.

In Figure 1 we report M_L versus M_W. The scatter between M_L and M_W can be explained in terms of attenuation and scattering effects along the source-receiver paths. The seismic moment estimates are in agreement with the ω-square model for small earthquakes (Aki, 1967) used in the procedure.

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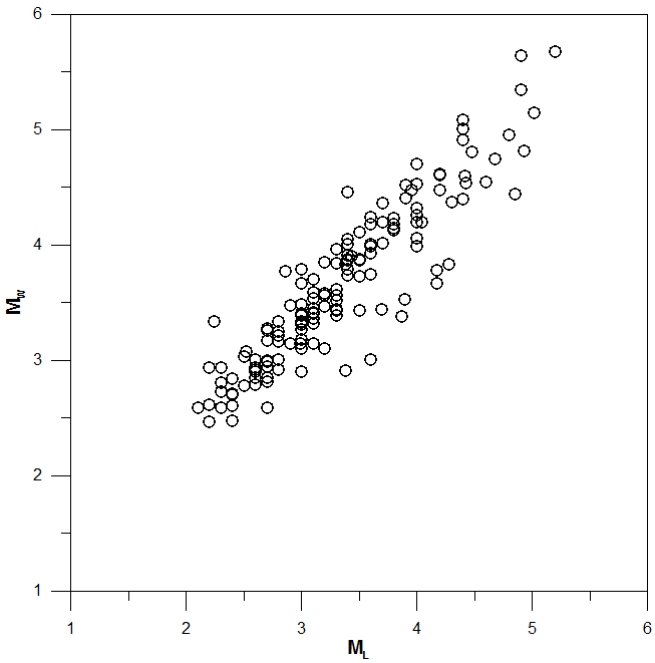

Figure 1. The local Richter magnitude, M_L, as estimated by Antelope® software versus the moment magnitude M_W, estimated by our procedure

As already stated above, the procedure creates maps reporting several strong motion parameters. In order to compute these parameters all waveforms are pre-processed and corrected. A Butterworth filter with frequency range between 0.2 – 50 Hz, is applied. We report, e.g., the PGA and Arias maps related to the second main shock of the Emilia sequence (Fig 2). The earthquake occurred on 29 May 2012 at 7:00 a.m. with M_W=5.9 (Dolce et al., 2012; de Nardis et al., 2014).

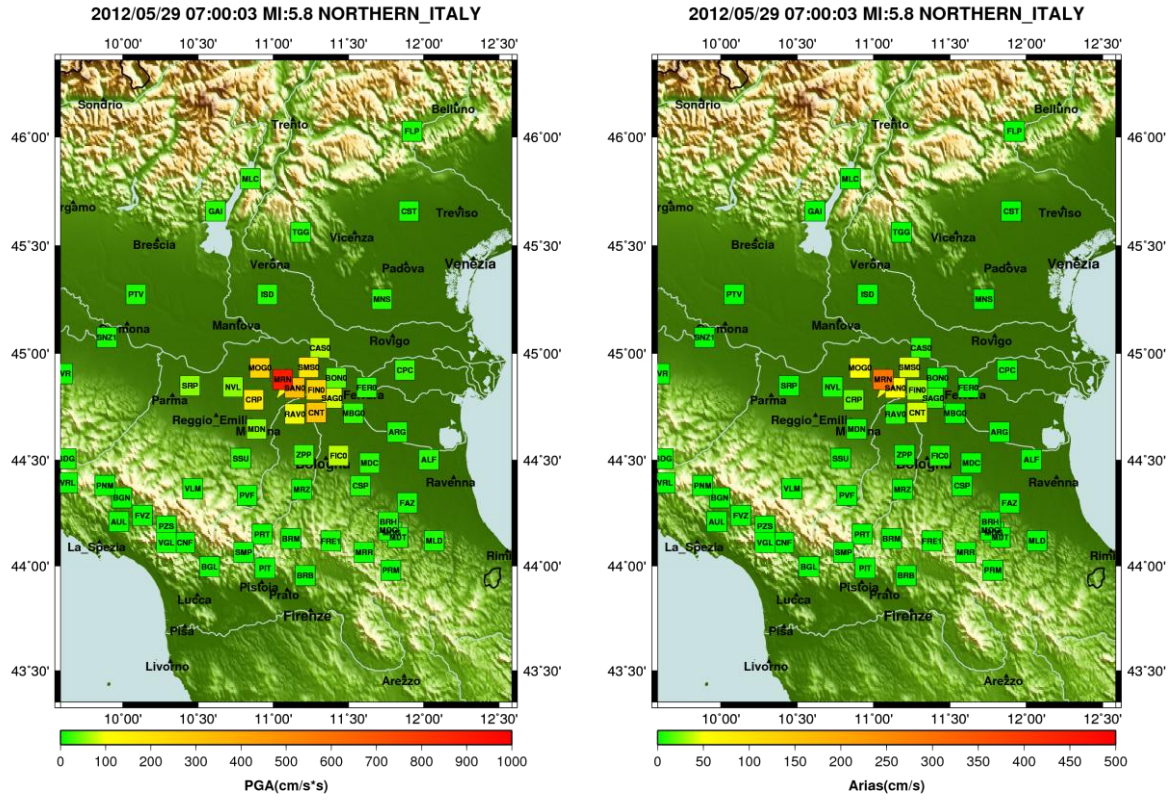

Figure 2. PGA (left) and Arias (right) maps created by our procedure for the second main event of the Emilia Northern Italy) sequence occurred on May 29, 2012 at 7:00 am. The Mirandola (MRN) station, that was the closest to the epicenter, recorded the maximum PGA, 900 cm/s^2, on the vertical component

The purpose of our procedure is to provide a rapid characterization of seismic source parameters in case of a strong event, both for research and for civil protection purposes. The seismic moment, as well as the moment magnitude and the ground motion parameters, are accurately estimated in near-real time. Our future aim is to further improve the quality of the results and to optimize the performance of the algorithm.

This real-time automatic procedure is now routinely used both at DMG and at the Department of Civil Defense (DPC) in Rome.

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