STRATEGY DEVELOPMENT FOR "SHAKE MAP" GENERATION AND DISSEMINATION

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INTRODUCTION

- Romania is a moderate seismicity country; on its territory are produced crustal and subcrustal events, which can produce significant damages.
- The Romanian seismicity is dominated by the Vrancea deep earthquakes (60-200km) which take place in a small volume located at the bend of Carpathian mountains, the place where three tectonical units are interacting: East-European, Intra-Alpine plates and Moesic sub-plate.
- Two or three events per century are devastating; having high energy, are felt on large and high populated areas.
- Within the last 70 years Romania experienced 4 strong Vrancea earthquakes: Nov. 10, 1940 (Mw =7.7, 160 km depth, March 4, 1977 (Mw =7.5, 100 km depth), August 30, 1986 (Mw =7.2, 140 km depth), May 30, 1990 (Mw =6.9, 80 km depth),October 27, 2004 (Mw=6.0, 100km depth).
- Figure 1 presents earthquake epicentres produced between 984-2006 in Romania (from updated ROMPLUS catalogue, Oncescu et al., 1999).
- NIEP has developed its real-time digital seismic network. This network consist of 55 seismic stations, two seismic array.

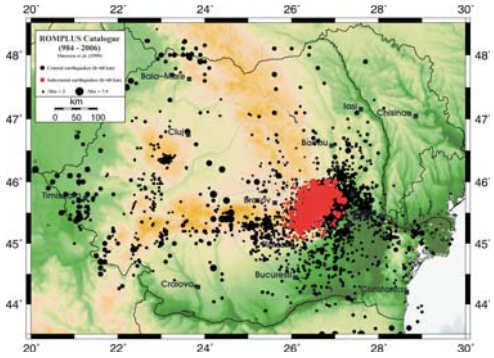

Figure 1. Romanian Catalogue
Red circles - intermediate earthquakes, Black circles - crustal earthquakes

Figure 2. Real Time Romanian Seismic Network
Real time stations (Q330 or K2 with ES-T, SP or BB sensors)

SHAKEMAP PROTOTYPE IN ROMANIA

- A prototype of ShakeMap software has been interfaced with the ANTELOPE that produces the waveforms, the location and the ground motion parameters (PGA and PGV), principal inputs for the shaking map generation.
- These data are extracted and transferred to the "ShakeMap".
- The maximum values of acceleration and velocity obtained from recordings are plotted on map both for Romania territory and Bucharest city (Figures 3, 4, 5 and 6).
- Based on the maximum values of horizontal acceleration and velocity and applying linear interpolation, maps of PGA and PGV distribution are generated (Figures 7 and 8). To close the border lines, I. Moldovan attenuation law was utilized.
- PGA and PGV maps are currently generated on the basis of observed acceleration and velocities.

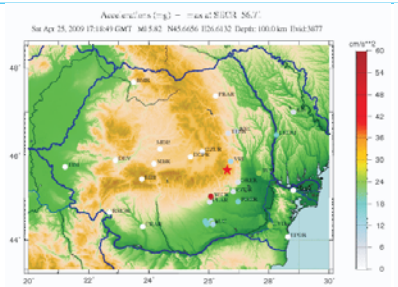

Figure 3. Maximum of Peak Ground Acceleration recorded at real time seismic stations for 25 April 2009 earthquake (M=5.7 Richter)

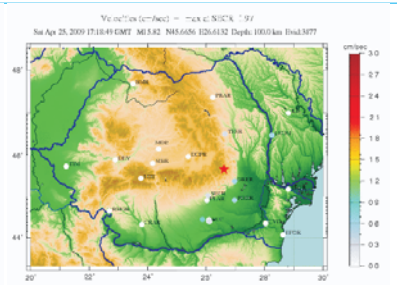

Figure 5. Maximum of Peak Ground Velocity recorded at real time seismic stations for 25 April 2009 earthquake (M=5.7 Richter)

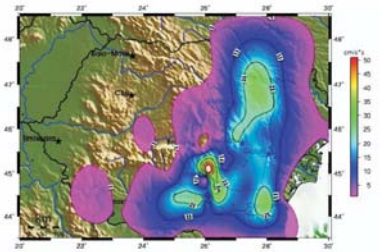

Figure 7. The distribution of Peak Ground Acceleration (maximum of the two horizontal components) recorded of the earthquake of 25 April 2009 (M=5.7 Richter)

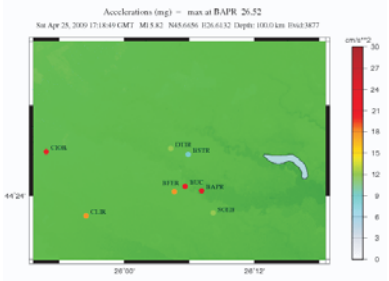

Figure 4. Maximum of Peak Ground Acceleration recorded in Bucharest at real time seismic stations for 25 April 2009 earthquake (M=5.7 Richter)

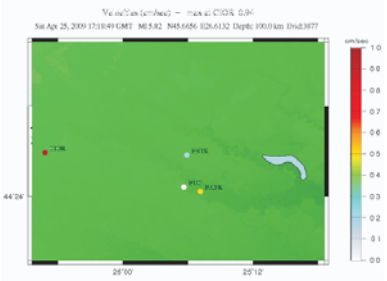

Figure 6. Maximum of Peak Ground Velocity recorded in Bucharest at real time seismic stations for 25 April 2009 earthquake (M=5.7 Richter)

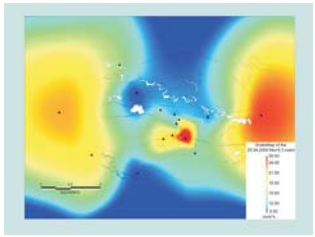

Figure 8. The distribution of Peak Ground Acceleration in Bucharest area (maximum of the two horizontal components) recorded of the earthquake of 25 April 2009 (M=5.7 Richter)

ROMANIAN EARTHQUAKE EARLY WARNING SYSTEM PRODUCTS

- A prototype early warning system (Figure 9) was developed in Romania in order to provide 25-35 seconds warning time for Bucharest facilities for earthquake with M > 6.5. The system consists in: strong motion network in the epicentral area and Bucharest area, communication link and automatic analyzing system.

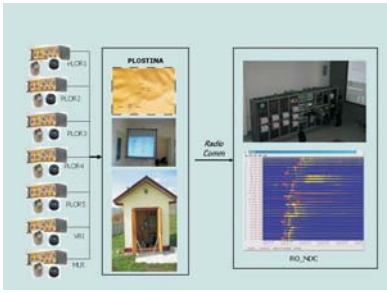

Figure 9. Data flow for Romanian early warning system

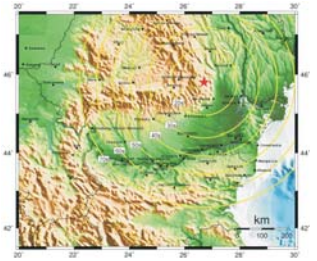

Figure 10. Teoretical S wave travel time for Vrancea earthquake (h=130km)

BUCHAREST INTENSITY ALERT MAP

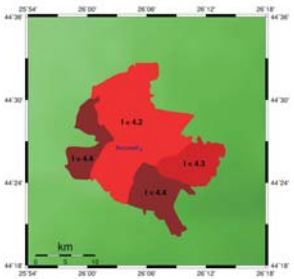

Figure 11. Bucharest intensities map distribution using Sorensen et al (2008) and amplification factors for 25 April 2009 earthquake (M =5.7 Richter)

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- Moldova, I.A., Enescu, B.D., Ionescu, C., 2000. Predicting peak ground horizontal acceleration for Vrancea large earthquakes using attenuation relations for moderate shocks, Rom. Journ. Phys., Vol. 45, p. 785-800.
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