ROMANIAN SEISMIC NETWORK

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Seismic Activity in Romania

- Romania is characterized by moderate seismicity, generated by the occurrence of both crustal and intermediatedepth earthquakes

- Seismic activity is dominated by the subcrustal earthquakes generated in the upper mantle beneath the SE Carpathians (Vrancea Region) confined to a narrow \sim 100 km(height)×70 ×30 km volume

- These earthquakes are the primary source of seismic hazard for Romania and Eastern Europe, with the most recent largest events reaching Mw 7.7 and 7.4 in 1940 and 1977, respectively, causing substantial damage.



Real Time Romanian Seismic Network



At present RSN operates:

- 2 seismic arrays
- 98 Broad Band Stations
- 52 Short Period Stations
- 180 Strong Motion Stations (21 in Bucharest area). Most of them are collocated with the velocity sensors.)

The RSN consists of different kind of instruments from various manufacturers: shortperiod sensors (Teledyne-Geotech S13 SH-1, GS21, Mark Products - I4c, L22, Kinemetrics - Ranger), broadband sensors (Guralp CMG3ESP, CMG40T, CMG-3T, Streckeisen STS2, Geotech KS2000, KS54000, MBB2, PBB, GEObit).

Seismic arrays in Romania



The 10 seismometers of the BURAR array are located in boreholes of 30, 45 and 60 m depth. Nine sites (BUR01, BUR02,..., BUR09) are equipped with vertical 1-C SP GS21 (Geotech Instruments) instruments; the tenth site of array (BUR31) is equipped with 3-C BB instrument: KS54000 (Geotech Instruments) (between 2002 and 2017) and CMG-40T (Guralp) (since August 2017).

The 7 seismometers of the PLOR array are located in vaults of 3 m depth. Six sites are equipped with S13 short period instruments and one (PLOR) - with 3-C BB mbb2 seismometer.

Contribution to Adria Array Network

Częstochowa Луцьк Киї Житомир Біла Церкв область KaM'GHELL Подільський Košici Bratislava Budapest Debrece Baia Mare Magyarország Kecskemét Gheorahe VEOTHIL Focsani Osijek Београд Banja Luka Craiova Bosna i Hercegovina Србија larasi Constanta Босна и Херцеговина Србија Плевен Mostar Велико Търново Crna Gora / Kosova / Црна Гора Kosovo Куманово ПЛОВДИВ ОХась Северна Кърджалио Edirnee Kirklarel Македонија Битола

AdriaArray is a multi-national effort to cover the Adriatic Plate and its active margins in the central Mediterranean by a dense regional array of seismic stations to understand the causes of active tectonics and volcanic fields in the region. Plate-scale observations are complemented by local and LargeN experiments in key areas. The AdriaArray region reaches from the Massive Central in the west to the Carpathians in the east, from the Alps in the north to the Calabrian Arc and mainland Greece in the south.

The installation of the AdriaArray temporary stations started in June 2022. Since then, 75% of the approximately 400 planned temporary stations have already been installed in Europe.

GNSS - Network

32 Real Time GNSS station

The GNSS permanent stations have different equipment, most of them are produced by Leica Company: GRX 1200 GG Pro, GRX 1200 + GNSS, GR10, GR30 si GR50 Professional and antenna models used are LEIAT 504, LEIAT 504 GG, LEIAR 10 şi LEIAR 20 and three stations Septentrio





Antelope Software

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Automatic processing:

- P-wave picking
- event association
- event localization
- computation of magnitude
- sending e-mail / SMS alerts
- Generating ShakeMaps

Manual processing:

- phase picking
- event association
- computation of magnitude
- creation of database
- sending reports/ bulletins
- Generating ShakeMaps

Shake Map

Allows the rapid estimation of the intensity and severity of the ground motion after an important earthquake;

PGA, PGV, SA and intensity maps are usually generated within 3-4 minutes after the earthquakes;

ShakeMap output is input for any system for estimating seismic damage (in Romania, near-real time SEISDARO);

> Implemented in Romania in 2007.



Shake Map

- > ANTELOPE system:
 - Acquire and process data in real-time
 - Different processes to detect events, associate phases, process the event (location and magnitude), save data
 - ~ 3 minutes until the automatic location is released (depending of the magnitude of the event and the number of stations used in localization)
 - Module orbwfmeas performs waveform measurements (PGA, PGV, SA) for ShakeMap
- Grind module main ShakeMap program
 - ~ 5-6 minutes to generate automatic ShakeMap

Shake Map 3.5



Vrancea, 28 October 2018, Mw=5.5, Depth=148 km

NIEP ShakeMap : ROMANIA Sun Oct 28, 2018 00:38:10 GMT M 5.8 N45.60 E26.40 Depth; 151.3km ID:28003810







* Epicenter

PGV (cm/s) 0.1 0.3 0.5 0.7

Scale based on Worden et al. (2012) a. Seismic Instrument





a Seismic Instrument

Macroseismic Observation

Strong Very strong

11.5

VI

V

Light Moderate

21.5

* Epicenter

Gorj, 13 February 2023, ML=5.2, Depth=18 km

Extreme

Heavy Very beavy

Violent

Version 1: Processed 2023-02-13T17:19:3

74.7

40.1

EEW in Romania

- Seismic risk in Romania dominated by deep Vrancea earthquakes
- 4 events M6.9 M7.7 from 1940 1990. M7.5 1977 >1500 casualties, mainly in Bucharest.
- Current Operational EEW System uses a network of 35 stations centred on Vrancea providing location and magnitude focusing only on these deep events
- \circ 25 35 s warning for Bucharest 130km to South



Data Exchange

NIEP is and EIDA Node since 2014

EIDA (European Integrated Data Archive) ^{30 N} is a European data center that archives and provides access to seismic waveforms ^{45°N} and related instrumentation within European research infrastructures.

EIDA Node **NIEP** archives a total number of **259** stations. This node archives data for networks:**BS MD RO UD Y8**



http://www.infp.ro/index.php?i=eida





10:10:00

P<A>

Data acquisition Data quality control Data recording Real-time data exchange Real-time data processing

View Navigation Picking Filter Tools Locator

VRI BO HHZ, distance: 0.1°, azimuth: 321.1° z

> -1000 - amax: 1601.0 counts mean: 0.0 counts 10:09:30

> > 2023-05-31

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round motion



Waveform archiving Automatic event detection and location **Event Parameter archiving** Waveform data distribution Real-time data processing

Zhytomy

scrttv - real time waveforms

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File Interaction Help

scmv- Map with Stations





Options View Help

Summary Events

2023-05-29 03: Options View Help



Seiscomp Software

scesv - last located events

scolv- origin revising





scqcv – Data Quality Check

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scqcv@localhost4803 <@scomp3>

Options View Help

RO, TNR., EHZ RO.VOIR..HHZ

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Thank You!

