A NEW SEISMIC STATION IN ROMANIA: THE BUCOVINA SEISMIC ARRAY*

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Recently, a new seismic monitoring station, the Bucovina Seismic Array, has been established in the northern part of Romania, in a joint effort of the Air Force Technical Applications Center, USA, and the National Institute for Earth Physics, Romania. The array consists of 10 seismic sensors (9 short-period and one broad band) located in boreholes and distributed on a 5 × 5 km area. Starting July 24, 2002, the new seismic monitoring system became fully operational by continuous recording and transmitting data in real-time to the National Data Center of Romania, in Bucharest and to the National Data Center of USA, in Florida. Bucovina Seismic Array, added to the present Seismic Network, will provide much better seismic monitoring coverage of Romania's territory, on-scale recording for weak-to-strong events, and will contribute to advanced seismological studies on seismic hazard and risk, local effects and microzonation, seismic source physics, Earth structure.

Key words: array, seismic station, seismic monitoring, seismic sensor, real-time data, detection.

1. INTRODUCTION

During the year 2000, the collaboration between the Air Force Technical Applications Center (AFTAC) of the United States of America and the National Institute for Earth Physics (NIEP) for the construction of a seismic array in Romania was initiated, within the framework of NIEP's participation in the global seismological monitoring in support of the Comprehensive Nuclear – Test – Ban – Treaty (CTBT).

Starting July 24, 2002, the new seismic monitoring system became fully operational by continuous recording and transmitting data in real-time to the National Data Center of Romania (RNDC), in Bucharest and to the National Data Center of USA (US NDC), in Florida.

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2. SITE DESCRIPTION AND ELEMENT FIELD DISTRIBUTION

Geophysical and geological studies determined the best site for installing the seismic array; this is located near Benia village, in Suceava county (see Fig.1, Grecu *et al.*, 2002). The geographical position of the Bucovina Seismic Array (BURAR) is: 47.6148N latitude, 25.2168E longitude and 1150 m altitude.

The site geology consists of massive pre-Cambrian and lower paleozoic epimetamorphic schists of green schist grade; in some areas limestone overlies the schists. All borehole locations are in the schist.

Noise survey carried out for the site mentioned above showed a low noise level of site: the mean Power Spectral Density (PSD) values at 1 Hz are -8.6 dB relative to 1 nm^2/Hz and -38.4 dB at 6 Hz (see Fig. 2). For the noise survey, four sensors were placed in the area in order to perform the site survey. One of the sensors was kept recording for the duration of the experiment, whereas the other sensors recorded for approximately two days each. The noise spectra obtained for this site were the lowest obtained for any area surveyed in Romania. Noted that 8 sites were investigated for noise survey (Clauter, 2000).

BURAR consists of 10 seismic stations located in boreholes and distributed on a 5 km × 5 km area (see Fig. 3). Nine stations are equipped with short-period (SP) vertical sensors (GS-21 res) and one station is equipped with broad-band (BB) three component sensors (KS 54000). The broad-band station is located in the same place with the element number 8.

3. BURAR SYSTEM DESCRIPTION

The BURAR System performs acquisition, storage, processing and transmitting seismic, environmental and state-of-health (SOH) data. In Fig. 4 is given the block diagram of the BURAR System installed at Bucovina, Romania. It includes two types of subsystems:

– a single Central Recording Subsystem (CRS), containing un unmanned segment located in Bucovina and a manned segment located in the RNDC;
– 9 separate Data Acquisition Subsystems (DAS).

The communications between the DASs and CRS are defined as intrasite communications (wireless spread spectrum intra link, 2.4 GHz frequency band). The communications between the Bucovina station and the RNDC are defined as inter-site communications.

3.1. DATA ACQUISITION SUBSYSTEM (DAS)

In Fig. 5 (Grecu *et al.*, 2002) the block diagram of the DAS is presented. The main DAS functions consist of acquiring seismic, SOH and environmental data and in generating and performing seismic calibration.

Two separate configurations were used for the DAS in the Bucovina Array:

– SP DAS containing a SP sensor element, a communication element and a power element;
– CO DAS containing a BB sensor element, an SP sensor element, a communication element and a power element.

In Fig. 6 the seismic data flow from the DAS is presented.

3.2. CENTRAL RECORDING SUBSYSTEM (CRS)

In Fig. 7 the block diagram of the CRS is given. The CRS unmanned segment (UCRS, located in Bucovina) receives seismic, SOH and environmental data from the DASs of the elements and then transmits those data to the CRS manned segment. The CRS manned segment (located in Bucharest) receives, demultiplexes, stores, processes and displays the data.

Additionally, the CRS manned segment provides array command and control, performs data calibration measurements and reformats and retransmits all data to US NDC.

In Fig. 8 is presented the seismic data flow into the CRS.

4. DATA PROCESSING

The seismic data from the BURAR System are continuously recorded and transmitted in real-time to the National Data Center of Romania (RNDC), in Bucharest. In Fig. 9 is shown the displaying form of the seismic data consisting of the real-time waveforms recording.

In Fig. 10 are presented two examples of seismic events recorded at the NDC in Bucharest:

a) the Vrancea event of July 14, 2002 ($M_L = 4.2$);
b) the teleseismic event of September 8, 2002 ($M_W = 7.3$) (time UTC: 18:44:26; location: 3.2S 142.9E; depth: 33 km; M = 7.6; region: near N coast of New Guinea).

For the first full month of BURAR operation, two detection statistics were performed in comparison with the Telemetered Seismic Network. Fig. 11 shows the detection of teleseismic events – BURAR/Telemetered Network comparison and Fig. 12, the detection of local events – BURAR/Telemetered Network comparison.

5. CONCLUSIONS

Bucovina Seismic Array, added to the present Romanian Seismic Network, provides a much better seismic monitoring coverage of Romania's territory, on-scale recording for weak-to-strong events, better knowledge of earthquake parameters (location, magnitude, focal mechanism, other seismic motion parameters).

BURAR seismic data contribute to advanced seismological studies on seismic hazard and risk, local effects and microzonation, seismotectonics, seismicity, seismic source physics, Earth structure.

Seismic data recorded by the Bucovina Array enable a better knowledge and modeling of the complex phenomena associated with earthquake occurrence, especially concerning the Vrancea region.

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