NATO OTAN
This project is supported by: The NATO Science for Peace and Security Programme

CLOSING CONFERENCE OF THE NATO SfP 983054(BSHAP) PROJECT "HARMONIZATION OF SEISMIC HAZARD MAPS FOR THE WESTERN BALKAN COUNTRIES"

Contribution of the Project to the Improvement of National Seismic Networks and Data Exchange

РЕПУБЛИКА СРБИЈА
РЗС РЕПУБЛИЧКИ СЕИЗМОЛОШКИ ЗАВОД

11000 Београд, Ташмајдански парк б.б.,ПФ 16 тел.: 3227-013, 3030-696, 3035-740,3034-227, 3035-718, 3034-225; факс: 33-486-00
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ПИБ:102328892 МБ: 7052617 ШД: 75110

INSTITUTIONS FROM THE COUNTRIES WHICH HAVE PARTICIPATED IN BSHAP PROJECT

- **EARTHQUAKE ENGINEERING RESEARCH CENTER, DEPT. OF CIVIL ENGINEERING, MIDDLE EAST TECHNICAL UNIVERSITY, ANKARA, TURKEY**
- **MONTENEGRO SEISMOLOGICAL OBSERVATORY, PODGORICA**
- **INSTITUTE OF GEOSCIENCES, POLYTECHNIC UNIVERSITY OF TIRANA, ALBANIA**
- **FEDERAL HYDROMETEOROLOGICAL SURVEY, CENTER FOR SEISMOLOGY SARAJEVO, HYDROMETEOROLOGICAL SURVEY OF REPUBLIKA SRPSKA - SECTOR FOR SEISMOLOGY, BANJA LUKA and MINISTRY OF CIVIL AFFAIRS OF THE FEDERAL GOVERNMENT OF BOSNIA AND HERZEGOVINA**
- **DEPARTMENT OF GEOPHYSICS, FACULTY OF SCIENCES, UNIVERSITY OF ZAGREB, CROATIA**
- **INSTITUTE OF EARTHQUAKE ENGINEERING AND ENGINEERING, SEISMOLOGICAL OBSERVATORY, FACULTY OF NATURAL SCIENCES, UNIVERSITY "SS. CYRİL AND METHODIUS" SKOPJE, MACEDONIA**
- **SEISMOLOGICAL SURVEY OF SERBIA, BELGRADE**

- Purchase and deployment of the new seismic instruments in the participating institutions/countries are one of the most important tasks of the Project. In the first year of the Project special attention has been paid to the selection of necessary seismic equipment.

- The performances of the instruments are defined as well as the list of reliable manufactures, on which basis the bid invitation and related documentation is prepared and the bid launched in 2008.

- Prof. Sinan Akkar, as NPD, issued the invitation letters about the bidding for strong- and weak-motion instrument purchasing.

- The process of international bidding for the Project related purchase of ethe quipment has been successfully concluded by the end of a first year of the Project.

Procurement of weak/strong motion seismic instrumentation

- **<u>Minimum Requirements of Planned Strong/Weak Motion Seismic Instrumentation</u>**
- ***Strong Motion Seismic Instrumentation - Minimum Performance Requirements***
- Number of channels: Three channels;
- Sensor Type: Triaxial force balance accelerometer (orthogonally oriented);
- Full scale range: Selectable, min ±1g;
- Resolution min of 18 bits with more than 100 dB dynamic range
- Real time digital output;
- Multitasking operating system that allows simultaneous data acquisition and interrogation
- Remote alerting capability for system event or auto-diagnostic failure
- Noise < 10 μV RMS
- TCP/IP compatibility;
- Optional modem;
- Sampling rate: selectable min 200 sps;
- Storage capacity: min 64 MB;
- Timing: GPS;
- Power autonomy: min. 70 hours - (without external battery)
- Operating temperature: -20 C to 70 C.
- Operation on 95-100% humidity
- Calibration Coil Functional and Response Test
- ISOXXXX standards
- malfunction rate to be declared
- compatibility of format of recorded data
- available free software for analysis with specified analyzing tools
- price for commercial software for analysis
- ***Weak Motion Seismic Instrumentation - Minimum Performance Requirements***
- Frequency band: 50 Hz-100s

THE MAIN OBJECTIVES

- The main objective of this task is improvement of existing seismic monitoring networks through the deployment of contemporary strong- and weak - motion stations.

- The seismic instrumentation purchased in the framework of the Project is mostly devoted to the enrichment of the quantity and quality of seismic data and in particular - acceleration time histories database in the region. This task is recognized as a very important one, because the necessity of improvement of existing empirical strong motion prediction models.

- Also, the obtained records will be used for structural nonlinear analysis of existing building stock. Using this network, the early warning system may be implemented for a number of objects of the highest safety priority.

- Another important object in the future is to increase interchange of seismic real time data. Relatively sparse seismological networks in the region and limited cross-border seismic data exchanges, generated a lot of doubts in understanding of seismic phenomena and geodynamic processes in the region. Common purpose for extension of the collaboration between institutions is evident.

- Accordingly, ***Protocol on Multilateral Cooperation in Seismic Data Exchange*** have been signed by all involved institutions in 2008/2009. Protocol document was prepared by MSO.

THE MAIN TASKS CONCERNING PURCHASING THE INSTRUMENTS

- Instrument installation
- Site investigation and preparation to place and house the instruments
- Resolving of infrastructural requests
- Instrument calibration and testing
- Instrument connection to the national network
- Integration of instruments in existing seismic network

Montenegro Seismological Observatory, received and deployed the following seismological instruments:

- 3 Broad band seismometers, sensor type KS2000M
- 3 *Strong motion recorders, sensor type SMART-24A*
- 2 Digitizers model SMART-24D
- micro wave wireless links
- Manufacturer: *Teledyne Geotech*
- Total cost: 49,832 EUR
- Broad band seismometers, are placed on the stations: newly constructed and previously existing.
- Strong motion recorders were placed on existing weak-motion stations.
- Digitizers are equipping existing stations.
- M*icro wave wireless links* are on one station and repeater.

EQUIPMENT INVENTORY RECORD - MONTENEGRO

	Inventory Label No.	Property Item	Manufacturer	Model Number	Serial Number	Date of Purchase	Cost (EUR)	Location
MONTENEGRO	*0601*	*PC laptop*	*HP*	*Pavilion DV276 EA*	*CNF7060M TD*	*21/09/2007*	*1,345 EUR*	*Podgorica -central station*
	0603	Strong mot. Rec.	*Teledyne Geotech*	SMART 24A	*1710*	*6/05/2008*	*10,410 $*	Dracevica
	0609	Strong mot. Rec.		SMART 24A	*1698*	*6/05/2008*	*10,410 $*	Niksic
	0610	Strong mot. Rec.		SMART 24A	*1714*	*6/05/2008*	*10,410 $*	Herceg Novi
	0604	Broadband seismometer		KS2000M	*630*	*6/05/2008*	*6,525 $*	Dracevica
	0607	Broadband seismometer		KS2000M	*631*	*6/05/2008*	*6,525 $*	Bratogost
	0606	Broadband seismometer		KS2000M	*629*	*6/05/2008*	*6,525 $*	returned to manufacturer
	0608	Digitizer		SMART 24D	*1758*	*6/05/2008*	*7,690 $*	Bratogost
	0602	Digitizer		SMART 24D	*1711*	*6/05/2008*	*7,690 $*	Plav
	0605	Wireless link		VIP24-110	*N.N.*	*6/05/2008*	*2,320 $*	Dracevica
	0611	Wireless link		VIP24-110	*N.N.*	*6/05/2008*	*2,320 $*	Sjenica

Institute of Geosciences, Polytechnic University of Tirana,
received the following seismological instruments:

- 8 Strong motion sensors, model CMG-5T
- 10 Accelerographs, model CMG-DM24
- 3 Trident digitizers and necessary accessories in order to install CMG-5T sensors at VSAT stations
- Manufacturer: *Guralp Systems Ltd.; Nanometrics Inc.*
- Total cost: 58,939 EUR
- GEOFON provided the SeisComP 3.0 software. The work to implement the real time data exchange with Montenegro is in progress. The main problem remains increasing of Internet link capacity.
- IGEO has established the real-time seismic data exchange with INGV (Rome) and Thessaloniki University, which run the same data acquisition system (Nanometrics).

EQUIPMENT INVENTORY RECORD – ALBANIA

	Inventory Label No.	Property Item	Manufactu rer	Model Number	Serial Number	Date of Purchase	Cost (EUR)	Location
ALBANIA	0621	Strong motion sensor	GURALP SYSTEMS LI MITED	CMG-5T	T5K47	04/02/2009	1800 USD	Not placed yet
	0622	Strong motion sensor		CMG-5T	T5K48	04/02/2009	1800 USD	
	0623	Strong motion sensor		CMG-5T	T5K49	04/02/2009	1800 USD	
	0624	Strong motion sensor		CMG-5T	T5K50	04/02/2009	1800 USD	
	0625	Strong motion sensor		CMG-5T	T5K51	04/02/2009	1800 USD	
	0626	Strong motion sensor		CMG-5T	T5K52	04/02/2009	1800 USD	
	0627	Strong motion sensor		CMG-5T	T5K53	04/02/2009	1800 USD	
	0628	Strong motion sensor		CMG-5T	T5K54	04/02/2009	1800 USD	
	0629	accelerograph		CMG-5TD	T5L73/A127 0	04/02/2009	4880 USD	
	0630	accelerograph		CMG-5TD	T5L66/A1269	04/02/2009	4880 USD	
	0631	accelerograph		CMG-5TD	T5L51/B837	04/02/2009	4880 USD	
	0632	accelerograph		CMG-5TD	T5L72/A1272	04/02/2009	4880 USD	
	0633	accelerograph		CMG-5TD	T5L68/A1183	04/02/2009	4880 USD	
	0634	accelerograph		CMG-5TD	T5L52/B747	04/02/2009	4880 USD	
	0635	accelerograph		CMG-5TD	T5L71/A1007	04/02/2009	4880 USD	
	0636	accelerograph		CMG-5TD	T5L70/A1271	04/02/2009	4880 USD	
	0637	accelerograph		CMG-5TD	T5L67/A1348	04/02/2009	4880 USD	
	0638	accelerograph		CMG-5TD	T5L69/C082	04/02/2009	4880 USD	

Center for Seismology, Sarajevo and
Sector for Seismology, Banja Luka
received the following seismological instruments:

- 5 BB seismometer+strong motion recorder

- 2 Strong motion recorders

- Manufacturer: *Teledyne Geotech*
- Total cost: 70,893 EUR

Equipment has been repaired until June 2010, and since then testing and deployment are in progress.
Testing of the equipment is conducted with full support of MSO.

EQUIPMENT INVENTORY RECORD – BOSNIA AND HERZEGOVINA

	Inventory Label No.	Property Item	Manufacturer	Model Number	Serial Number	Date of Purchase	Cost (EUR)	Location
BOSNIA AND HERZEGOVINA	*1978*	BB seismometer +strong motion rec.	*Teledyne Geotech*	KS2000M +SMART 24A	*632*	*6/05/2008*	16,935 $	Hydrometeorological Institute of Republic ofSrpska, Sector for Seismology, Banja Luka
	1979	BB seismometer +strong motion rec.		KS2000M +SMART 24A	*633*	*6/05/2008*	16,935 $	
	1980	Strong mot. Rec.		SMART 24A	*1715*	*6/05/2008*	*10,410 $*	
	1986	GIS Software		MapInfo	*MINWES 1000055594*		*1760 EUR*	
	1981	BB seismometer +strong motion rec.		KS2000M +SMART 24A	*628*	*6/05/2008*	16,935 $	Center for Seismology, Federal Met. Institute, Sarajevo
	1982	BB seismometer +strong motion rec.		KS2000M +SMART 24A	*636*	*6/05/2008*	16,935 $	
	1983	BB seismometer +strong motion rec.		KS2000M +SMART 24A	*637*	*6/05/2008*	16,935 $	
	1984	Strong mot. Rec.		SMART 24A	*1716*	*6/05/2008*	*10,410 $*	
	1985	GIS Software		MapInfo	*MINWES 1000055594*		*1760 EUR*	

Department of Geophysics, Zagreb,
received and deployed the following seismological instruments:

- 8 Data aquisition systems
- 5 Weak-motion seismographs
- 2 Accelerometers
- Manufacturer: *Guralp Systems Ltd.*
- Total cost: 54,080 EUR

EQUIPMENT INVENTORY RECORD – CROATIA

	Inventory Label No.	Property Item	Manufactu rer	Model Number	Serial Number	Date of Purchase	Cost (EUR)	Location
C R O A T I A	*0641*	Data aquisition sys.	GURALP SYSTEMS L I MITED	CMG-DAS-000	2032/A1310	27/01/2009	3.260	*Not permanently placed*
	0642	Data aquisition sys.		CMG-DAS-000	2035/A1312	27/01/2009	3.260	
	0643	Data aquisition sys.		CMG-DAS-000	2034/A1305	27/01/2009	3.260	
	0644	Data aquisition sys.		CMG-DAS-000	2031/A1311	27/01/2009	3.260	
	0645	Data aquisition sys.		CMG-DAS-000	2039/A1303	27/01/2009	3.260	
	0646	Data aquisition sys.		CMG-DAS-000	2037/A1307	27/01/2009	3.260	*Brijuni*
	0647	Data aquisition sys.		CMG-DAS- 000	2040/A1309	27/01/2009	3.260	
	0648	Data aquisition sys.		CMG-DAS-000	2036/A1324	27/01/2009	3.260	*Not permanently placed*
	0649	Accelero-meter		CMG-5	T5K32	27/01/2009	1.250	
	0650	Accelero-meter		CMG-5	T5K33	27/01/2009	1.250	
	0651	Weak motion seismometer		CMG-C3E-0008	T35740	27/01/2009	4.700	*Brijuni*
	0652	Weak motion seismometer		CMG-C3E-0008	T35761	27/01/2009	4.700	
	0653	Weak motion seismometer		CMG-C3E-0008	T35741	27/01/2009	4.700	
	0654	Weak motion seismometer		CMG-C3E-0008	T35762	27/01/2009	4.700	
	0655	Weak motion seismometer		CMG-C3E-0008	T35742	27/01/2009	4.700	

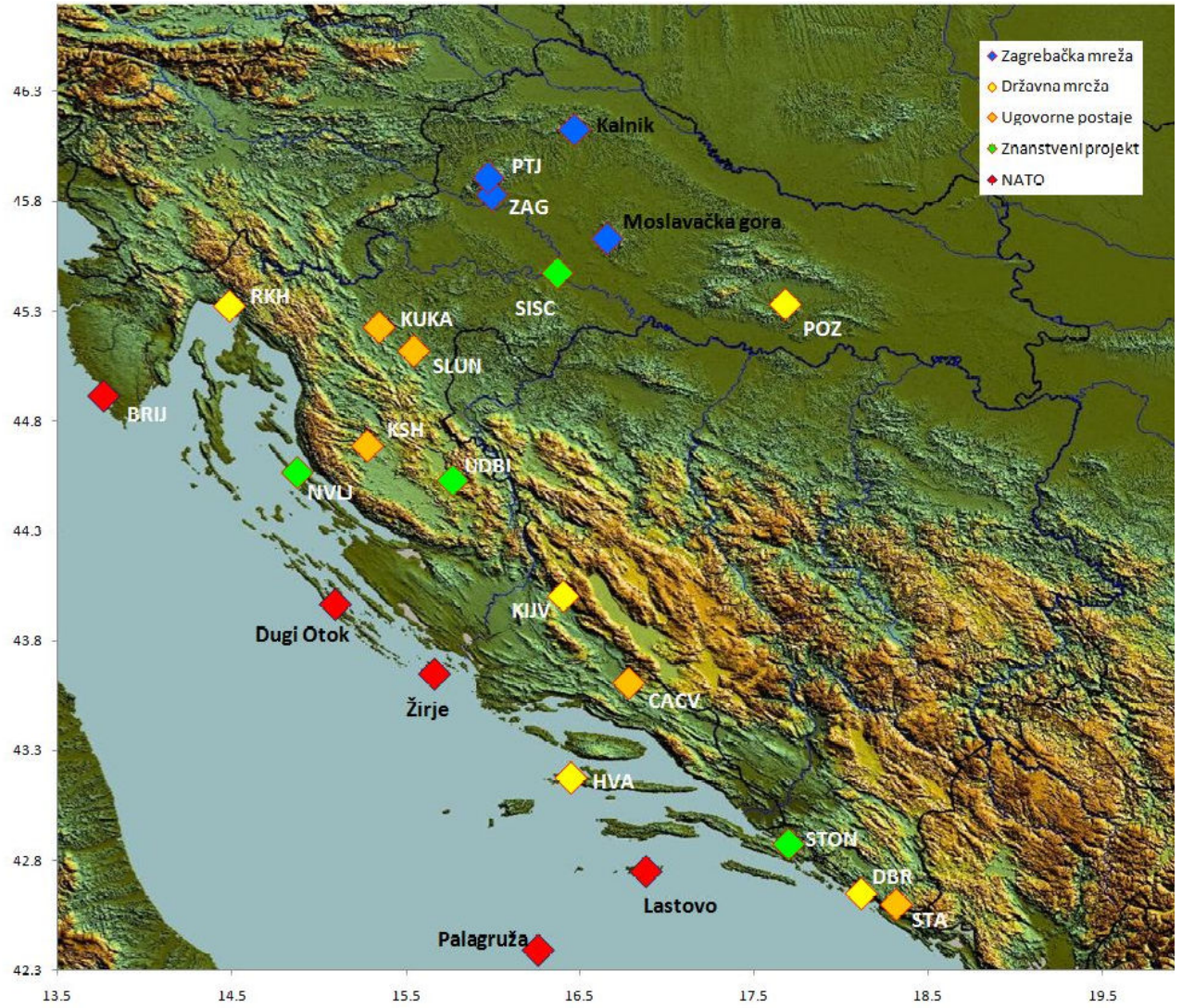


Figure shows the position of the seismic stations in Croatia. Stations with instruments purchased in the framework of the Project are marked red. The possibility of satellite data transmission to the central observatory in Zagreb have been tested from stations Brijuni and Žirje.

Institute of Earthquake Engineering and Engineering Seismology

(IZIIS), University "Ss.Cyril and Methodius" Skopje,

received the following seismological instruments:

- 13 Strong Motion Sensor Systems consisting of CMG-5 accelerometers with 24-bit resolution digitizers
- Lap Top - Dell Latitude E4300
- HP Designjet 510ps 42-in and network card
- Manufacturer: Guralp Systems Ltd.
- Total cost: 41,047 EUR
- Selection and investigation of station sites are completed, and presently locations are under negotiation with relevant authorities.

EQUIPMENT INVENTORY RECORD – MACEDONIA

	Inventory Label No.	Property Item	Manufacturer	Model Number	Serial Number	Date of Purchase	Cost (EUR)	Inventory Label No.
M A C E D O N I A		CMG-5T accelerometer with 24-bit resolution digitizer	GURALP SYSTEMS L I MITED	CMG – 5TD	T5L53/A1339 G 9895 N/A	February, 2009	€ 3,622 (4,862 USD)	*Not Yet (Pehcevo)*
		CMG-5T accelerometer with CMG-DM24 24-bit resolution digitizer			T5L54/A1344 G 9896 N/A		€ 3,622 (4,862 USD)	*Not Yet (Gevgelija)*
		CMG-5T accelerometer with CMG-DM24 24-bit resolution digitizer			T5L55/A1340 G 9897 N/A		€ 3,622 (4,862 USD)	*Not Yet (Bitola)*
		CMG-5T accelerometer with CMG-DM24 24-bit resolution digitizer			T5L56/A1338 G 9898 N/A		€ 3,622 (4,862 USD)	*Not Yet (Ohrid)*
		CMG-5T accelerometer with CMG-DM24 24-bit resolution digitizer			T5L57/C770 G 9899 N/A		€ 3,622 (4,862 USD)	*Not Yet (Debar)*
		CMG-5T accelerometer with CMG-DM24 24-bit resolution digitizer			T5L58/A1341 G 9900 N/A		€ 3,622 (4,862 USD)	*Not Yet (Tetovo)*
		CMG-5T accelerometer with CMG-DM24 24-bit resolution digitizer			T5L59/C771 G 9901 N/A		€ 3,622 (4,862 USD)	*Not Yet (Valandovo)*
		CMG-5T accelerometer with CMG-DM24 24-bit resolution digitizer			T5L60/A1343 G 9902 N/A		€ 3,622 (4,862 USD)	*Not Yet (Sk.-Gov. Building.)*
		CMG-5T accelerometer with CMG-DM24 24-bit resolution digitizer			T5L61/A1342 G 9903 N/A		€ 3,622 (4,862 USD)	*Not Yet (Sko.-Parl.Buil.)*
		CMG-5T accelerometer with CMG-DM24 24-bit resolution digitizer			T5L62/A1347 G 9904 N/A		€ 3,622 (4,862 USD)	*Not Yet (Skopje - Presidentés Residence)*
		CMG-5T accelerometer with CMG-DM24 24-bit resolution digitizer			T5L63/A1345 G 9905 N/A		€ 3,622 (4,862 USD)	*Not Yet (Airport Petrovec)*
		CMG-5T accelerometer with CMG-DM24 24-bit resolution digitizer			T5L64/A1346 G 9906 N/A		€ 3,622 (4,862 USD)	*Not Yet (Strumica*
		CMG-5T accelerometer with CMG-DM24 24-bit resolution digitizer			T5L65/A1184 G 9907 N/A		€ 3,622 (4,862 USD)	*Not Yet decided)*
		Dell Latitude E4300	*DELL*	E4300	*02804-8T7GX-7Y16R-FY976-PVHBM*	*March, 2009*	€ 2,160	*ECILS/Skopje*
		HP Designjet 510ps 42-in	*HP*	*HP510ps*	N/A	*April, 2009*	€ 3,600	*ECILS/Skopje*
		Network card for HP Designjet 510ps 42-in	*HP*	J7961G HP Jet direct 635n IPv6/IPsec Gigabit	N/A	*April, 2009*	€ 425	*ECILS/Skopje*

Seismological Survey of Serbia,
received and deployed the following seismological instruments:

- 13 High Dynamic Range Accelerographs, model ETNA
- 3 Surface Triaxial Force Balance Accelerometers, model ES-T
- Manufacturer: Kinemetrics Inc.
- Total cost : 55,282 EUR
- ETNA is a digital accelerograph with 19 bit resolution, 120 dB dynamic range and sampling rate 20 samples.
- Three EpiSensor type accelerometers are connected to existing Q330HR digitizers.
- Number of strong motion instruments is almost doubled due to procurement in the framework of BSHAP project and now number of stations is 29.

EQUIPMENT INVENTORY RECORD – SERBIA

	Inventory Label No.	Property Item	Manufacturer	Model Number	Serial Number	Date of Purchase	Cost (EUR)	Location
SERBIA	0681	accelerograph	Kinemetrics Inc.	ETNA	6433	25.06.2008.	4,300	Šabac
	0682				6434		4,300	Žagubica
	0683				6435		4,300	Jagodina
	0684				6436		4,300	Lazići
	0685				6437		4,300	Banatski Dvor
	0686				6438		4,300	Zaječar
	0687				6439		4,300	Radoinja
	0688				6440		4,300	Sjenica
	0689				6441		4,300	Valjevo
	0690				6442		4,300	Novi Pazar
	0691				6443		4,300	Svilajnac
	0692	accelerometer		ES-T	4535	26.04.2010.	2,788	Gruza
	0693	accelerograph		ETNA	6879		5,461	Selova
	0694	accelerograph		ES-T	4534		2,788	Bajina Basta
	0685	accelerometer		ETNA	6444	25.06.2008.	4,300	Ivanjica
	0696			ES-T	4536	26.04.2010.	2,788	Sjenica

- Seismological Survey of Serbia received 13 strong motion instruments, model ETNA (11 from the Project budget and 2 units were free of charge; 1 unit was damaged in flood), marked red.
- 3 EpiSensor type are marked blue
- All instruments are deployed in seismically active areas and at locations with different soil conditions. Geodynamical models at instrument sites were investigated.
- Recently, with 5 accelerometer stations (GRUA, BARA, BEO1, CACA) a communication network was established in near real time, which provides access to recorded accelerations on the Internet.

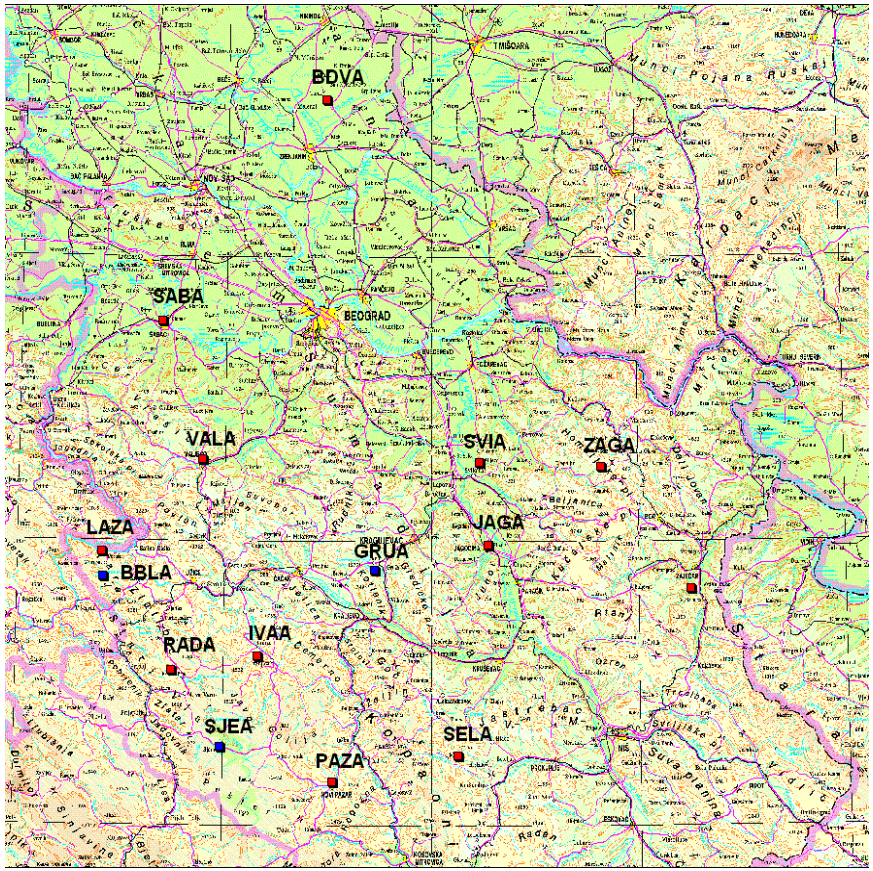
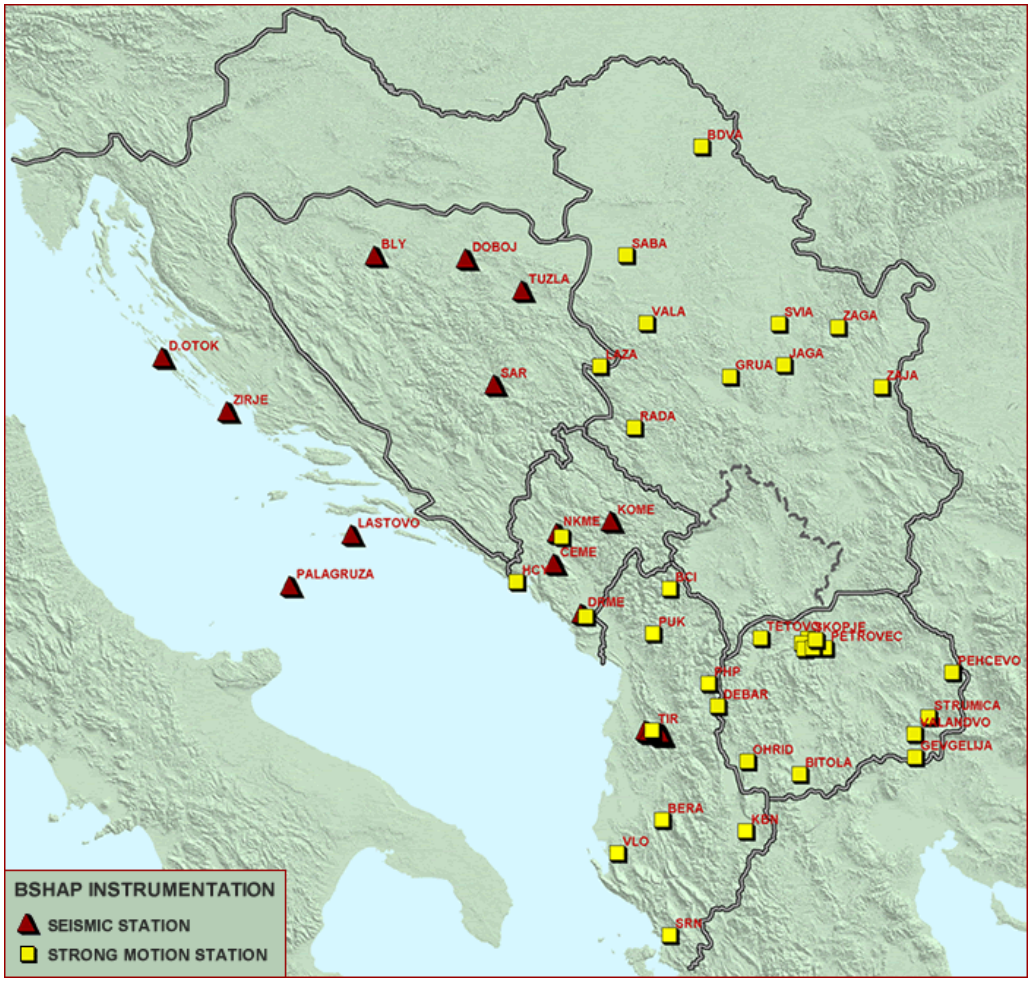


Figure shows the position of the ETNA and ES-T strong motion instruments deployed in Serbia in the framework of the Project

RESULTS

- Figure shows the position of the instruments deployed in the framework of the NATO Science for Peace (SfP) Project and other Projects realized in parallel (Mednet, Determine in BIH).
- Most of the seismic instrumentation purchased has been installed at the territories of the participating countries and they are in use for the strong and weak motion recording of the earthquakes.



PROTOCOL ON MULTILATERAL COOPERATION IN SEISMIC DATA EXCHANGE, modes of cooperation

- All stated institutions wish to improve already existing professional and scientific relationships, especially to enhance real-time seismic data exchange.
- Cooperation may be organized by establishment of virtual seismic network mutually providing a real-time or near real-time seismic data in a convenient data format.
- The objective of the cooperation is to advance science and technology, capacity building in the stated fields, to improve quality of urgent earthquake hypocenter parameters determination, to enrich existing national seismic data bases for the purpose of scientific research of the Earth crust structure, its seismotectonical and geological features, as well as to study focal mechanism of the earthquakes in the region.