

Project BEWARE—Landslide Post-disaster Relief Activities for Local Communities in Serbia

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Abstract

The project—on harmonization of landslide data and training of municipalities for its monitoring, nicknamed BEWARE (BEyond landslide aWAREness) was implemented by the Geological Survey of Serbia, and the University of Belgrade Faculty of Mining and Geology. The Project partners were UNDP Office in Serbia, Ministry of Mining and Energy and Government Office for Reconstruction and Flood Relief of the Republic of Serbia. Project was funded by People of Japan. Overall aim of BEWARE project was to standardize post-event landslide database and closely involve local community of 27 municipalities affected by May 2014 flooding and landslides episode in Serbia, and prepare them to cope with catastrophic events in the future. In this paper we are presenting main BEWARE project activities and results implemented on local communities in Serbia after May 2014 event.

Keywords

Landslides • Disaster • Relief • Local communities • Serbia

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Introduction

Landslides are amongst the most dangerous natural threats to human lives and property, especially in times of dramatic climate change effects on one hand, and urban sprawl and land consumption on the other. Usual landslide triggers are floods and high-yield rainfall, which was the case in the catastrophic cyclone Tamara episode that stroke Serbia and surrounding countries in May 2014 (Marjanović and Abolmasov 2015). At the time, disastrous effects were closely followed by media and public and handled by responsible state services, such as Civil Protection offices, and volunteers, but little has been done after the waters retreated and landslides settled, especially regarding landslide analysis and mitigation. Landslide reports (in analogue form) greatly understated the realistic number of landslides (concentrating more on urgent/acute cases), while report quality standard and consistency was uneven (because they were collected by different institutions, depending on the acute needs), so resulting inventories remain incomplete and far from standardized. In this respect, it was essential to produce unified

large-scale inventories of May 2014 event and beyond, and used them for the state-of-the-art hazard analysis, potentially leading to development of early-warning system prototype. It was the only way to actually learn from catastrophes, i.e. to prepare better, react quicker, assess more efficiently and more accurately in the future.

The project on harmonization of landslide data and training of municipalities for its monitoring, named BEWARE (BEyond landslide aWAREness) was designed to address these issues. The aim was to standardize post-event landslide database, closely involve local community of 27 municipalities affected by May 2014 events in Serbia, and prepare them to cope with catastrophic events in the future. This leads to more secure, better prepared and more resilient communities in western, central and eastern Serbia (Fig. 1), which were the most fragile parts of our country in May 2014.

In this paper we are presenting main BEWARE project activities and results implemented on 27 municipalities in Serbia after May 2014 event.

Project Description

Main Project Objectives

Main project objectives were structured as follows:

1. Enhancing municipal capacities/Civil Protection offices in 27 municipalities in Serbia (Fig. 2) with necessary equipment for effective landslide event reporting
2. Building capacities among the regional/local authorities/Civil Protection staff for landslide event reporting
3. BEWARE (GIS) web portal as a platform for interactive landslide event reporting, and unifying landslide data records
4. Improving land use planning documents of each municipality—SWOT analysis of each municipality for justifying landslide hazard, vulnerability and risk analysis
5. Identifying critical sites for landslide rehabilitation
6. Improvement of governmental agencies practice in building/updating national landslide database from BEWARE itself, but also form general crowd sourcing approach.

Participants, Partners and Beneficiaries

Participants of BEWARE project were selected among Faculty of Mining and Geology, University of Belgrade

staff/associates and Geological Survey of Serbia staff. Direct partners are Responsible Persons—RP (two per each municipality) from Civil Protection offices staff, nominated by municipal authorities.

Beneficiaries are local authorities and Civil Protection offices (target group), related governmental institutions (including participants), insurance and assessment agencies, public enterprises that are servicing and maintaining traffic infrastructure, NGO sector, media and general public (end users). Gender equality and age preference was also enforced where applicable.

Project Implementation

Several Work Packages (WP) were posted to realize the project objectives (Fig. 3).

WP1—Partner equipping—Objective of WP1 was to technically enable local authority and Civil Protection offices, i.e. their staff, in 27 municipalities in Serbia, to perform simple but sufficiently reliable landslide reporting tasks in the future.

WP2—Kick-off meeting—Meeting that was suit up to 100 people including participants, partners (their municipal officials), donors, UNDP coordinator and related governmental officials.

WP3—Partner training—Training representatives of each municipality to correctly use provided equipment for effective landslide reporting. Preparing and printing brochures and guidelines as training tutorial materials and organizing the training venue. The action included theoretical and practical (field work) demonstration.

WP4—BEWARE portal—Building a (GIS) web portal that will host the project platforms, including: participant and partner users data uploads, platform for unifying and harmonizing landslide information from various sources, visualizing functionalities, transparency of the project to any beneficiary, disseminating project results.

WP5—Data—Collecting all available (existing) and acquiring new data for feeding the WP4 geodatabase and populating the portal and GIS web portal contents. Gathering and analyzing existing data, including geological, topographic, environmental, social data in analogue or digital form. Acquiring high-resolution (0.5 m) satellite images for visual and/or semi-automated landslide recognition and digitizing (interpretation) landslides. Designing field questionnaires for participants' field activities with international standards and practices.

WP6—SWOT analysis—SWOT analysis of data and human resources of each municipality for recognizing possibilities for in-depth hazard, vulnerability and risk analysis. Vulnerability and risk analysis would for instance require

Fig. 1 Geographical position of the Republic of Serbia



readiness and skill to extract information on dwelling frequency and other basic inhabitants' activities. Some municipalities were used as pilot studies of vulnerability and risk assessment, and these experiences were incorporated in strategies for project sustainability.

WP7—Landslide Hazard Maps—Modeling landslide hazard using quick and simple methods, but also testing the state-of-the-art techniques, and producing maps of spatial hazard potential (susceptibility maps).

WP8—Identification of critical sites—Identifying up to 10 critical landslide sites that require remediation.

WP9—Sustainability arising from good practices of BEWARE—Examining methodology of voluntary crowd sourcing data (i.e. RPs involvement in reporting landslide events and general public involvement in the future) for translating research approach on higher (potentially national) levels, periods (sustainability), and purposes (e.g. potential early-warning prototyping). Potential additional functionalities and prototypes on GIS web portal.

WP10—Follow-up—Concluding the project by replicating a meeting with WP2 protagonists and presenting the final report with key deliverables and future perspectives.

Project Results

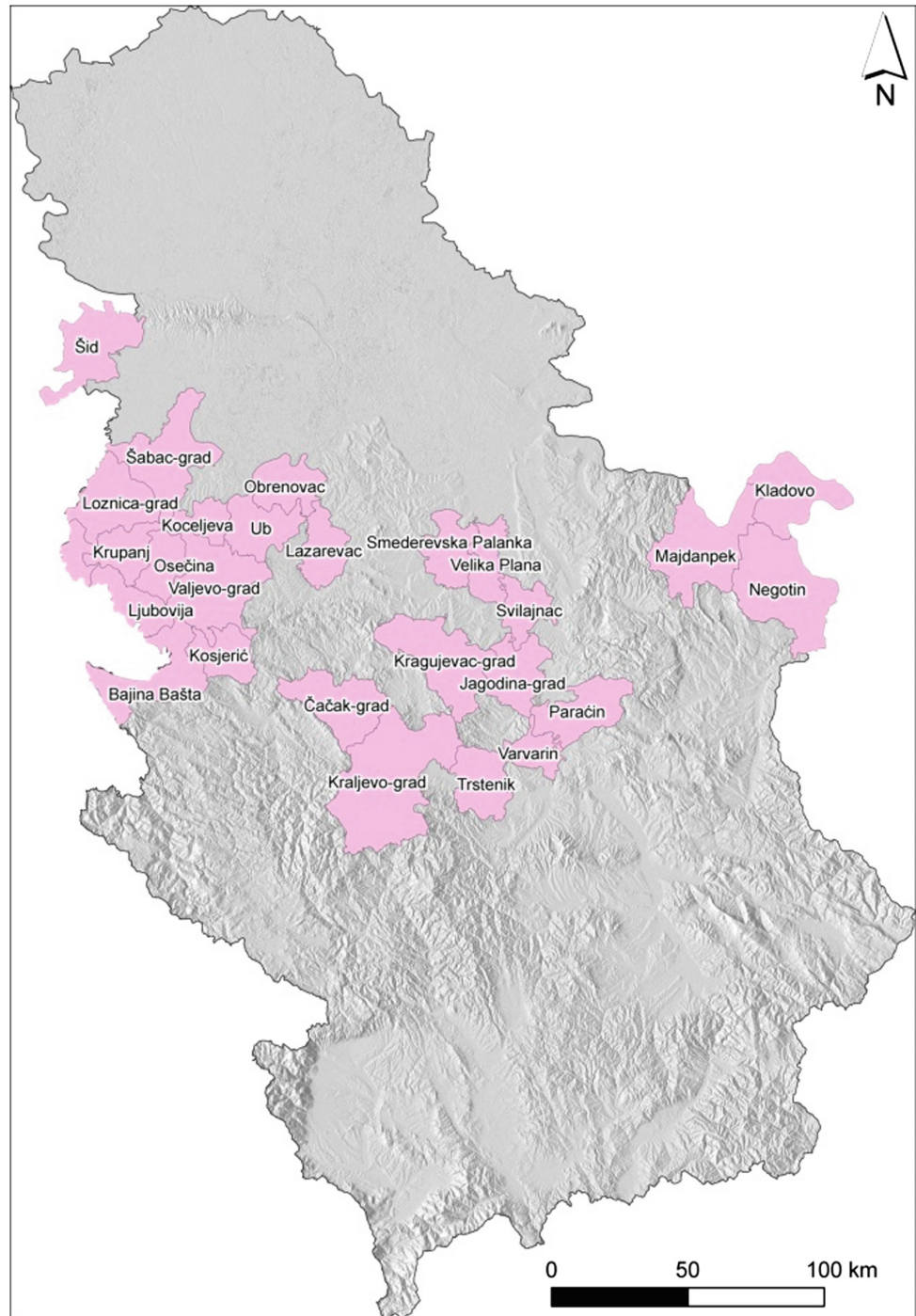
BEWARE project was implemented by the Geological Survey of Serbia, and the University of Belgrade Faculty of Mining and Geology. The Project partners were Ministry of Mining and Energy, Government Office for Reconstruction and Flood Relief of the Republic of Serbia and UNDP Office in Serbia.

Project started after the official signing ceremony at the opening of the 2nd Regional Symposium on Landslides in the Adriatic Balkan Region (ReSyLAB 2015), which was held in Belgrade, Serbia 14–16 May 2015. Executive Director of International Consortium on Landslides Prof. Kyoji Sassa convened the Opening and Start-up Ceremony (Fig. 4) and introduced the donor, UNDP coordinator, related governmental and local/regional authority officials.

Duration of the Project was nine months and main deliverables are as follows:

1. Landslide data—The study area was covering 14,510 km² of 27 municipalities in Western, Central and Eastern Serbia (Fig. 2). The total numbers of 2219

Fig. 2 Geographical position of 27 municipalities in Serbia involved in BEWARE project (pink)



landslides were registered during 5 months of field campaigns according to the harmonized landslide event data sheet (Cruden and VanDine 2013) (Fig. 5). As a support to field campaigns Very High Resolution (Pléiades) and High Resolution (SPOT6 and WorldView2) available satellite images were analyzed (Fig. 6). The total numbers of 1175 landslides were registered by satellite images analysis. Open data is provided for all

- municipalities and include the total of 1885 verified occurrences landslide.
- Capacity building—Total of 50 responsible persons nominated from local authorities (2 person \times 25 municipalities) were trained to perform effective, standardized and accurate landslide event report. Those RPs were supported by username and password for uploading and downloading data from BEWARE web portal.

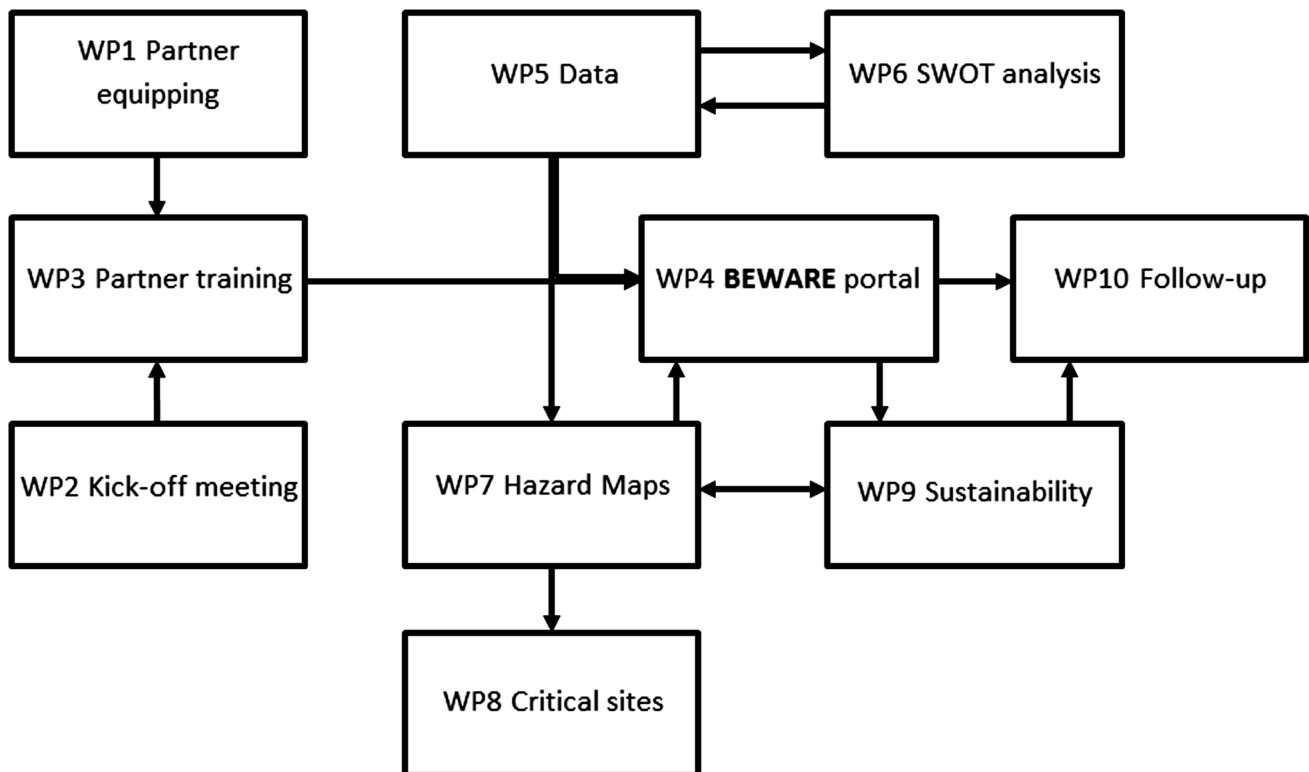


Fig. 3 Pert Chart of BEWARE project

Fig. 4 Opening ceremony of 2nd ReSyLAB and Start up meeting of BEWARE Project



Two municipalities were excluded from the training because no landslide data were registered in their municipalities during field campaigns. Four workshops were organized (e.g. municipalities that belong to the same or

adjacent regions were grouped together) and included theoretical and practical (field work) demonstration. BEWARE Project Brochure and other supplementary material were prepared and printed and distributed during the 2-days

Fig. 5 Harmonized landslide data sheet (in Serbian)

1. OPŠTI PODACI		2.1 OPŠTI PODACI O PROCESU			
Opština*		Tip pojave*	Vrsta pokrenutog materijala*		
Lokalnost*		Odronjavanje	<input type="checkbox"/>	Stena	<input type="checkbox"/>
Koordinate*		Prevrtanje	<input type="checkbox"/>	Drobina	<input type="checkbox"/>
Datum registr.*		Klizanje	<input type="checkbox"/>	Organski materijal	<input type="checkbox"/>
Datum aktiviranja		Bočno širenje	<input type="checkbox"/>	Antropogeni materijal	<input type="checkbox"/>
Datum reaktiviranja		Tečenje	<input type="checkbox"/>	Heterogeni materijal	<input type="checkbox"/>
Odgovorni istraživač:		Složeno	<input type="checkbox"/>	Tlo	Glina <input type="checkbox"/> Pesak <input type="checkbox"/>
		BEWARE		Prašina <input type="checkbox"/> Šijunak <input type="checkbox"/>	
2.2 OPŠTI PODACI O PROCESU					
Sadržaj vode*	Brzina kretanja*	Aktivnost*			
Suvo <input type="checkbox"/>	Ekstremno sporo <input type="checkbox"/>	Uslovno stabilna padina <input type="checkbox"/>			
Vlažno <input type="checkbox"/>	Vrlo sporo <input type="checkbox"/>	Aktivan <input type="checkbox"/>			
Vlažno na granici tečenja <input type="checkbox"/>	Sporo <input type="checkbox"/>	Trenutno umiren <input type="checkbox"/>			
U tačnom stanju <input type="checkbox"/>	Umereno <input type="checkbox"/>	Reaktiviran <input type="checkbox"/>			
	Brzo <input type="checkbox"/>	Neaktivan			
	Veoma brzo <input type="checkbox"/>	Privremeno umiren <input type="checkbox"/>		Saniran-stabilizovano <input type="checkbox"/>	
	Ekstremno brzo <input type="checkbox"/>	Umiren <input type="checkbox"/>		Fosilan <input type="checkbox"/>	
2.3 OPŠTI PODACI O PROCESU					
Trend kretanja*	Način kretanja*				
Progresivno uz padinu <input type="checkbox"/>	Pojedinačno <input type="checkbox"/>				
Progresivno niz padinu <input type="checkbox"/>	Sukcesivno <input type="checkbox"/>				
Progresivno bočno <input type="checkbox"/>	Višestruko <input type="checkbox"/>				
Progresivno u dva pravca <input type="checkbox"/>	Mešovito <input type="checkbox"/>				
Smirivanje <input type="checkbox"/>	Kompleksno <input type="checkbox"/>				
3 OPŠTI PODACI O TERENU					
Genetski tip reljefa	Morfološki oblik	Geološka građa			
Fluvijalni tip reljefa <input type="checkbox"/>	Čelenska <input type="checkbox"/>	Vrsta osnovne stene - litološki sastav:			
Padinski reljef <input type="checkbox"/>	Kosa <input type="checkbox"/>	Starost:			
Jezerski <input type="checkbox"/>	Brdo <input type="checkbox"/>	Struktura:			
Tektonski <input type="checkbox"/>	O padini				
	Visina m				
	Nagib				
Hidrologija	Stepen raspadnutosti stenske mase				
Vodotoci:	Zemljasta raspadina <input type="checkbox"/>				
Stalni <input type="checkbox"/>	Povremeni <input type="checkbox"/>	Sitna drobina <input type="checkbox"/>			
Ostalo:	Drobina <input type="checkbox"/>				
	Blokovi <input type="checkbox"/>				
Hidrogeološka funkcija	H.G. funkcija:				
Tip izdani (nivoi, hranjenje, pražnjenje):					
Pojave:					
Oka <input type="checkbox"/>		Izvori <input type="checkbox"/>		Pišteline <input type="checkbox"/> Difuzno pražnjenje <input type="checkbox"/>	
MOLIMO VAS DA OBRAZAC POPUNITE ÖTKO - ŠTAMPANIM SLOVIMA - NEMUSKOM OLOVKOM					
* OBAVEZNA POLJA ZA UNOS PODATAKA					

workshops. Project Brochure is available on the Project web portal in pdf. format and it could be open for everybody.

Each of 25 municipalities was supplied with the hardware and software components for tablets and desktop computers, topographic and geological maps and GPS (Fig. 7).

3. BEWARE Project portal—BEWARE web portal was launched and hosts all project activities, including: participant and partner users data uploads (unified and

harmonized landslide information from various sources), visualizing functionalities, transparency of the project to any beneficiary, disseminating project results, simple statistical analysis, SWOT analysis, rainfall data analysis, satellite data analysis, landslide susceptibility assessment for each municipality, news and information etc. Additionally, mobile software application for tablets and android mobile phones was created for supporting local communities in effective landslide reporting. BEWARE

Fig. 6 Landslides of Krupanj municipality: detail from Pleiades satellite Image from 21.5.2014 (courtesy of the Republic Geodetic Survey of Republic of Serbia)

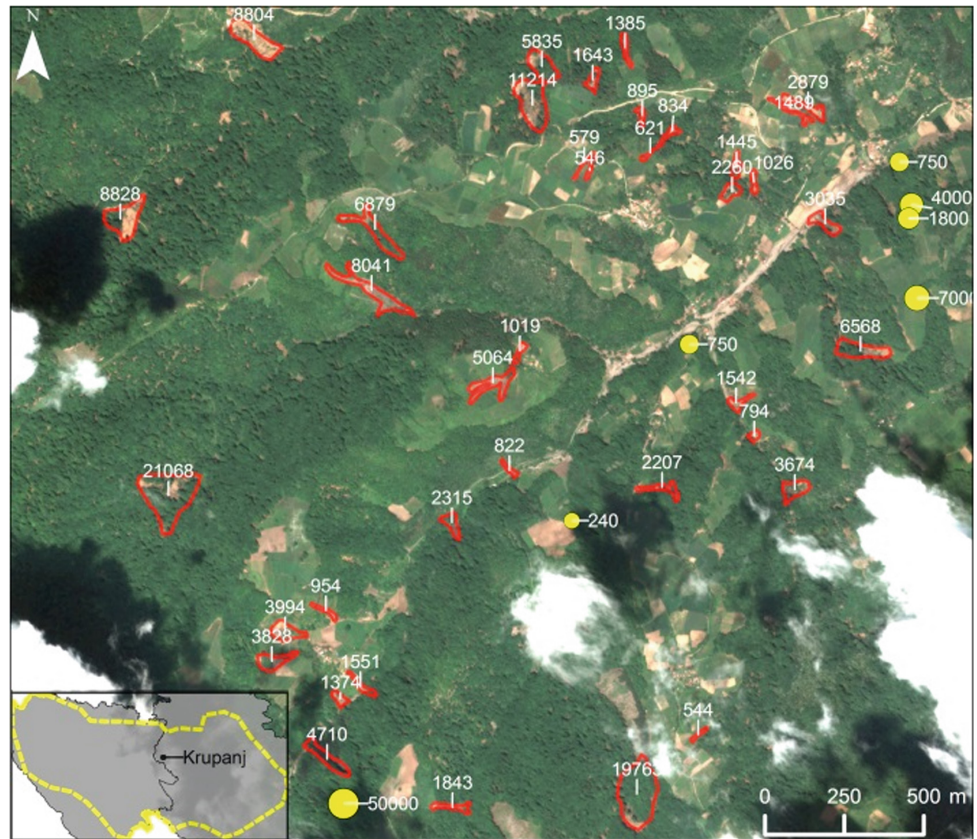


Fig. 7 Handover of equipment for Smederevska Palanka municipality during BEWARE project training—RPs from Smederevska Palanka, UNDP Office Serbia and Mr Naoki Nihei from UNDP NY Office



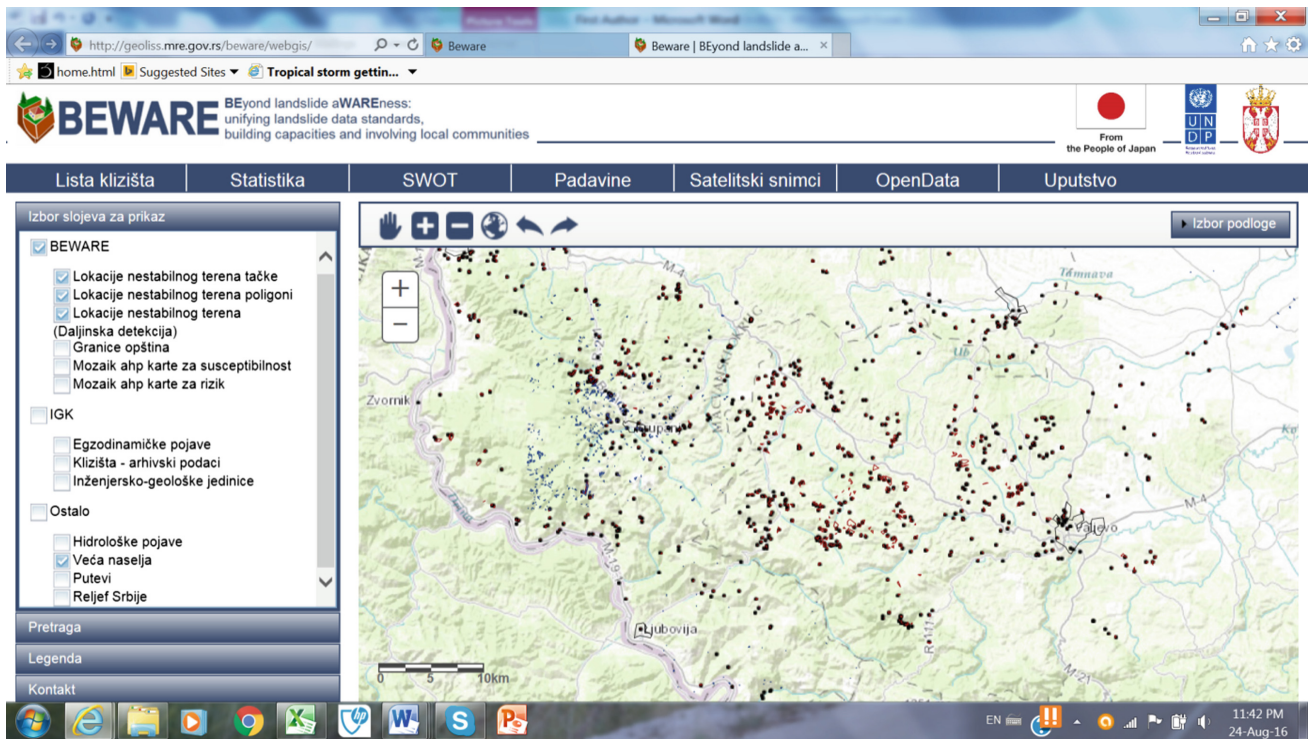


Fig. 8 Screenshot from BEWARE Project Web portal—black shapes are landslides polygons (in Serbian)

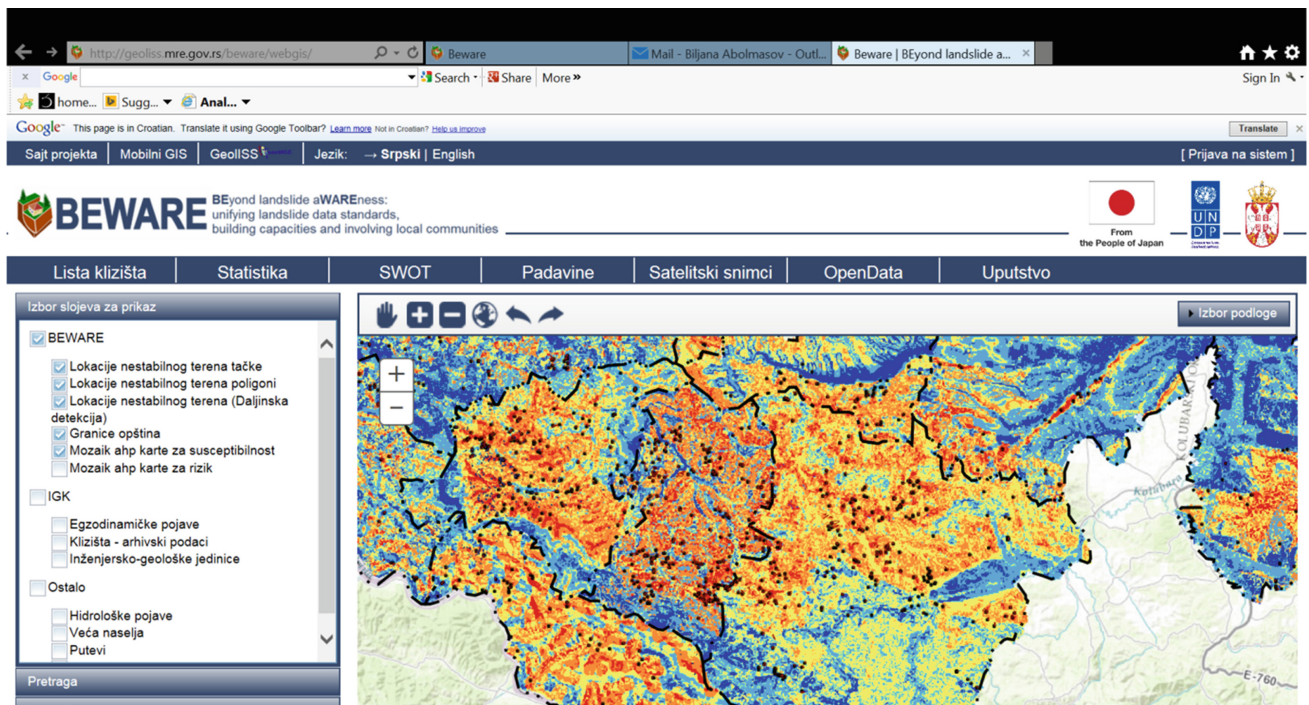


Fig. 9 Screenshot of Landslide susceptibility maps on BEWARE web portal for 27 municipalities in Serbia (in Serbian)

The screenshot shows the BEWARE web portal with the title "BEWARE Otvoreni podaci". The page content includes a description of open access data, a list of municipalities, and a table of data formats.

Na ovoj stranici se nalaze javno dostupni podaci koji predstavljaju izvod iz registra rezultata projekta BEWARE (više o registru klizišta pogledati [ovde](#)). Alfanumerički podaci sa geolokacijama su dostupni u XML i JSON formatu, dok su rasteri osetljivosti na klizanje dostupni u GEOTIF formatu.

Osim slobodnog preuzimanja, ovi podaci su dostupni [za pretragu i prelistavanje](#) ⇒.

Senčeni reljef sa ucrtanim klizištima (poligonima) je dostupan u TPK formatu za mobilne aplikacije (više o mobilnoj aplikaciji pogledati [ovde](#)).

Opština	Podaci o klizištima		AHP susceptibilnost	TPK
Bajina Bašta	XML ↓	JSON ↓	GEOTIF ↓	TPK ↓
Čačak	XML ↓	JSON ↓	GEOTIF ↓	TPK ↓
Jagodina	XML ↓	JSON ↓	GEOTIF ↓	TPK ↓
Kladovo	XML ↓	JSON ↓	GEOTIF ↓	TPK ↓
Koceljeva	XML ↓	JSON ↓	GEOTIF ↓	TPK ↓
Kosjerić	XML ↓	JSON ↓	GEOTIF ↓	TPK ↓
Kragujevac	XML ↓	JSON ↓	GEOTIF ↓	TPK ↓
Kraljevo	XML ↓	JSON ↓	GEOTIF ↓	TPK ↓

Fig. 10 Screenshot of Open access BEWARE Project data—landslide data, landslide susceptibility maps and TPK files (in Serbian)

project portal is available at <http://geoliss.mre.gov.rs/beware/> (Fig. 8). All data and data analysis and results are open access data.

- SWOT analysis—SWOT analysis of available data for land-use/urban planning and human resources of each municipality were performed. Additional recommendations and improvements for Master Plan were introduced for all municipalities that were most affected by landslides during May 2014. These measures are recognized as a part of non-structural measures in disaster relief process.
- Landslide susceptibility maps—Analytical Hierarchy Process (AHP) used for modeling and assessing landslide susceptibility for study area. Landslide susceptibility maps prepared in regional scale (1:25,000-scale of Master Plan according to the Law) and provided for each of 27 municipalities as a support for Master Plans documents and as a part of non-structural measures. Landslide vulnerability and relative risk assessment to population were prepared for Krupanj and Valjevo municipalities by using open access Serbian population density data in regional scale too. (<http://osgl.grf.bg.ac.rs/PopDensSerbia2006.html>) (Fig. 9). All maps are available for local land-use and urban authorities as open access data (Fig. 10).
- Identification of critical sites—Twelve critical sites were chosen for implementation of structural remedial measures, on the basis of affected people and property that

have not been already subjected to intervention in post-event responses. Detailed geotechnical investigations were performed and remedial measures were proposed. Drainage system in the case from the Loznica municipality and pile-wall locked with the capping beam in the case of the Krupanj municipality (Fig. 11) were fully implemented during the BEWARE project.

Conclusion

Overall aim of BEWARE Project was to standardize post-event landslide database and closely involve local communities affected by May 2014 events in Serbia, and prepare them to cope with catastrophic events in the future. In total, 25 municipalities were equipped for fast landslide reporting, and 50 trained RPs were included in the follow-up project activities.

Direct beneficiaries are local authorities and Civil Protection/Emergency management offices, related governmental institutions, insurance and assessment agencies, public enterprises and general public. Follow up activities will be included and supported through the Geological Information System of Serbia <http://geoliss.mre.gov.rs/>. All project data and results were presented on BEWARE web portal as open data reports.

Fig. 11 Remedial measures-elementary school in Likodra village, Krupanj municipality



The simple post-project analysis shows that only few municipalities follow-up project activities after six months of closing planned Project activities. Total number of 50 landslides was recorded from RPs in Valjevo, Krupanj and Kragujevac municipality. An additional problem increases after local level elections in May 2016. Some of RPs replaced with no trained representatives.

In the frame of Caritas Serbia capacity development activities five additional lectures and training workshops were organized as follow-up activities for few municipalities which had been already included in BEWARE project. All activities were organized in collaboration with Ministry of Interior, Sector for Emergency Management of the Republic of Serbia. Unfortunately, no additional funds for other follow-up activities not recognized from donors or Governmental institutions.

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