SnT 2019
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

Urban Seismic Risk Evaluation for Georgia

Nino Tsereteli, [1], Otar Varazanashvili [1], Zurab Gogoladze [1]Tea Mumladze[2]
1. M. Nodia Institute of geophysics of Tbilisi State Univercity, Georgia
2. CTBTO Preparatory Commission, Vienna, Austria

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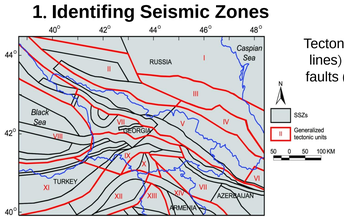
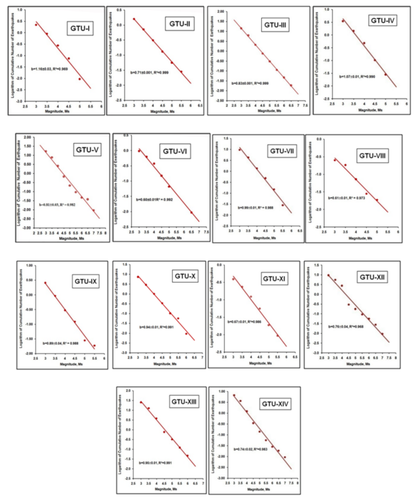
ABSTRACT: Seismic hazard and risk assessment directly link to sustainable development of country. Here we are presenting the main elements of the newly developed seismic hazard model of Georgia. The starting point in seismic hazard assessment is the updating of the regionally harmonized datasets with focus on data that become available within the recent years. From this point of view international seismic monitoring systems playing greater role to solve indicated task One of the biggest advantage of global monitoring network is that, the data are available freely without any barriers. National agencies are often focused on their own interests and do not freely sharing data, or the data are limited by national boundaries. This is why networks like International Monitoring System (CTBTO/IMS) extremely important for future development of science. Based on this data earthquake catalog for Caucasus updated up to 2017. That allow parameterization of newly developed seismic sources and probabilistic seismic hazard assessment for the entire region. Detail investigation of Building inventory allowed us to investigate intensity based vulnerability for city-museum Mtskheta in Georgia. Finally seismic risk in terms of damage and economic loses were estimated for this city. The results were delivered to scientific community and local end users.

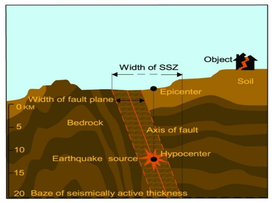
1. Identifing Seismic Zones



Tectonic Units(Red lines) and Active faults (Black lines)

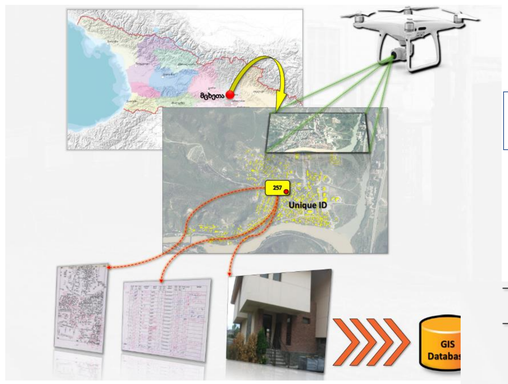
Magnitude-Frequency Relationships for each Tectonic Unit





Model of building of Seismic zones

2. Criation data inventory map in GIS

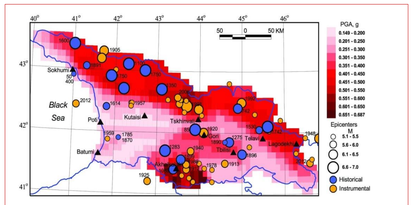


3. Building vulnerability analysis

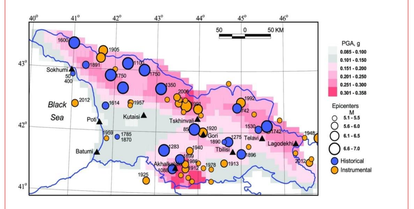
$\mu D = 2.5\,(1 + \tanh((I + 6.5\,V - 13.1)/2.3))$

4. Building damage for different Intensity

Building Taxonomies		Building type	Vulnerability indices				
			V_{min}	V^-	V_0	V_+	V_{max}
Masonry	M1	Rubble stone	0.62	0.81	0.873	0.98	1.02
	M2	Adobe	0.62	0.687	0.84	0.98	1.02
	M3	Simple stone	0.46	0.65	0.74	0.83	1.02
	M4	Massive stone	0.3	0.49	0.616	0.793	0.86
	M5	U Masonry (old bricks)	0.46	0.65	0.74	0.83	1.02
	M6	U Masonry – R.C. floors	0.3	0.49	0.616	0.79	0.86
	M7	Reinforced/confined masonry	0.14	0.33	0.451	0.633	0.7
Reinforced Concrete	RC1	Frame in R.C. (without ERD)	0.3	0.49	0.644	0.8	1.02
	RC2	Frame in R.C. (moderate ERD)	-0.02	0.33	0.484	0.64	0.86
	RC3	Frame in R.C. (high ERD)	0.3	0.17	0.324	0.48	0.7
	RC4	Shear walls (without ERD)	0.14	0.367	0.544	0.67	0.86
	RC5	Shear walls (moderate ERD)	-0.02	0.21	0.384	0.51	0.7
	RC6	Shear walls (high ERD)	-0.02	0.047	0.224	0.35	0.54
Steel	S	Steel structures	0.14	0.17	0.324	0.48	0.7
Timber	W	Timber structures	0.62	0.207	0.447	0.64	0.86

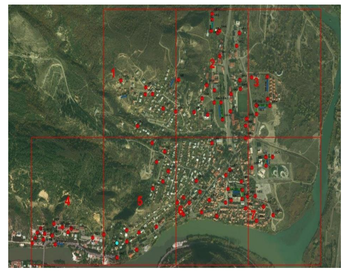


The seismic hazard map for 10% probability of exceedance in a 50 year period

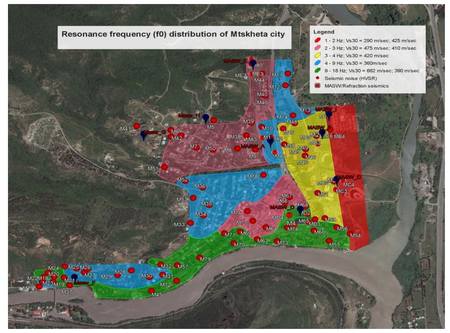


The seismic hazard map for 10% probability of exceedance in a 10 year period

Studied Area – City-Museum Mtskheta in Georgia. Red dotes are showing selected buildings. Blue and Green lines are showing distribution of geophones used for assessment of Vs and Vp velocity values.



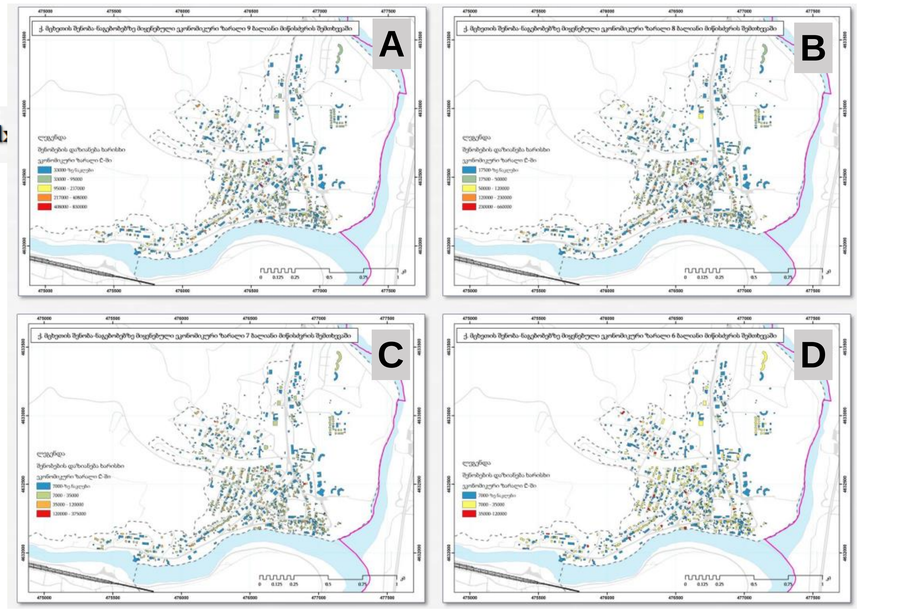
The map of Resonance frequency (f0) distribution of Mtskheta city was created. The areas with different Vs30 (for the depth of 30m) velocities were identified.



4. Calculating of Economic Losses

$$F_{(x)}^{t} = \int_{-\infty}^{[x]} \frac{1}{\sqrt{2\sigma_x}} \exp\left\{-\frac{x_{pa} - m_{x_{pa}}}{2\sigma_x^2}\right\} d$$

Seismic risk assessment in terms of damage and economic loses



Conclusions: In this study we present urban seismic risk evaluation. Study area was city-museum Mtskheta in Georgia. On the poster is presented the steps that were taken to do seismic risk calculations. Detailed investigation of the buildings were also done . Final figures A-D are showing seismic risk assessment in terms of damage and economic loses for city-museum Mtskheta in Georgia. Figures showing estimated damage and financial affect for each studied building. Damage was calculated for an event with 9, 8 , 7 and 6 seismic intensities accordingly.

Disclaimer: The views expressed on this poster are those of the author and do not necessarily reflect the view of the CTBTO