Seismic Hazard Assessment Methodology

Institute of Geology and Seismology of Republic of Moldova

Istanbul , 13 March 2014

Main research directions

Seismic regime study of the Carpathian-Balkan region, seismic macrozoning and seismic microzoning of urban areas, Seismic Risk Assessment.

Study of regional geology, lithology and stratigraphy of geological formations and minerals deposits, tectonics and neotectonics, geological hazard assessment.

Hydrogeology study, quality and quantity investigation of groundwater, hydrologic prognosis and riverbed processes of small rivers;

Environmental geochemistry of toxic substances, Environmental Risk Assessment, remediation methods for pollution localization and reduction.

Some facts:

Seismic observations in Moldova on a regular basis started in 1949
IGS was founded in 1967 on the basis of the Institute of Geology and Minerals and the regional seismic station "Kishinev" www.igs.asm.md

Institute has a Centre of Seismic Monitoring which is a member of international seismic network in the close cooperation with National Institute for Earth Physics (Bucuresti, Romania): http://www.infp.ro

LINKS:
Automatic GEOFON Global Seismic Monitor
http://geofon.gfz-potsdam.de/eqinfo/seismon/globmon.php
National fond of spatial data "Geoportal" http://www.geoportal.md/en/default/news

Actually two international project are going in IGS:
ESNET http://esnet.infp.ro

INPOLDE http://www.ugal.ro/
(Universitatea "Dunarea de Jos" Galati, **Romania** "Cross-border interdisciplinary cooperation for the prevention of natural disasters and mitigation of environmental pollution in Lower Danube Euroregion"

ESNET Project – Black Sea Earthquake Safety Net(work)
Period – 2012 – 2014.

Partners:

Romania – National Institute of Research Development for Earth Physics with an associate partner The Foundation for Democracy, Culture and Liberty (Partner and project coordinator),
Moldova – Institute of Geology and Seismology, Academy of Sciences of Moldova,
Bulgaria – National Institute of Geophysics, Geodesy and Geography, Bulgarian Academy of Science,
Turkey – International Blue Crescent Relief and Development Foundation.

Objectives of the project:

The prevention of natural disasters generated by earthquakes in Black Sea basin by developing a joint monitoring and intervention concept.
All the countries involved in the project have their own studies, strategies, prevention and intervention systems in case of earthquakes, but until now there has not been an integrated approach so far in the Black Sea basin. Given the cross-border character of seismic activity, it is necessary to have a cross-border approach on prevention, monitoring and intervention in case of earthquakes.

Specific objectives:

1. The assessment of the disaster potential, with accent on the seismic risk degree and the earthquakes effects in the intervention area.
2. To develop an integrated seismic monitoring and intervention concept.
3. To increase the capacity of local institutions emergency intervention units for joint response activities in case of disasters.

Past international projects.

1. Harmonization of seismic hazard and risk reduction in countries influenced by Vrancea earthquakes – NATO project.
The main objectives:
•Hazard assessment for Romania, Moldova and Bulgaria,
•Harmonization of seismic hazard level for vulnerability and risk analysis,
•Training of young scientists in the fields of seismic hazard, vulnerability and risk,
•Dissemination of results among end-users and professional community.
Participants: Moldova, Romania, Bulgaria, Turkey.
Period: 2005–2008.

2. Quantification of seismic action on structures – NATO project.
The main goal of the project – To contribute to the development of up-to-date instrumental criteria for the assessment/ quantification of the intensity of seismic ground motion, taking into consideration the accuracy and possibilities of processing of instrumental information.
Participants: Moldova, Romania, Russia.
Period: 2006–2008.

3. Numerical Analysis of 3D seismic wave propagation using Modal Summation, Finite Elements and Finite Differences Method – INTAS project.
Participants:
•Italy (Department of Earth Sciences,University of Trieste);
•Bulgaria (Central Laboratory for Seismic Mechanics and Earthquake Engineering, Bulgarian Academy of Sciences);
•Moldova (Institute of Geophysics and Geology, Survey of Seismic Effects).
Period: 2006–2008.

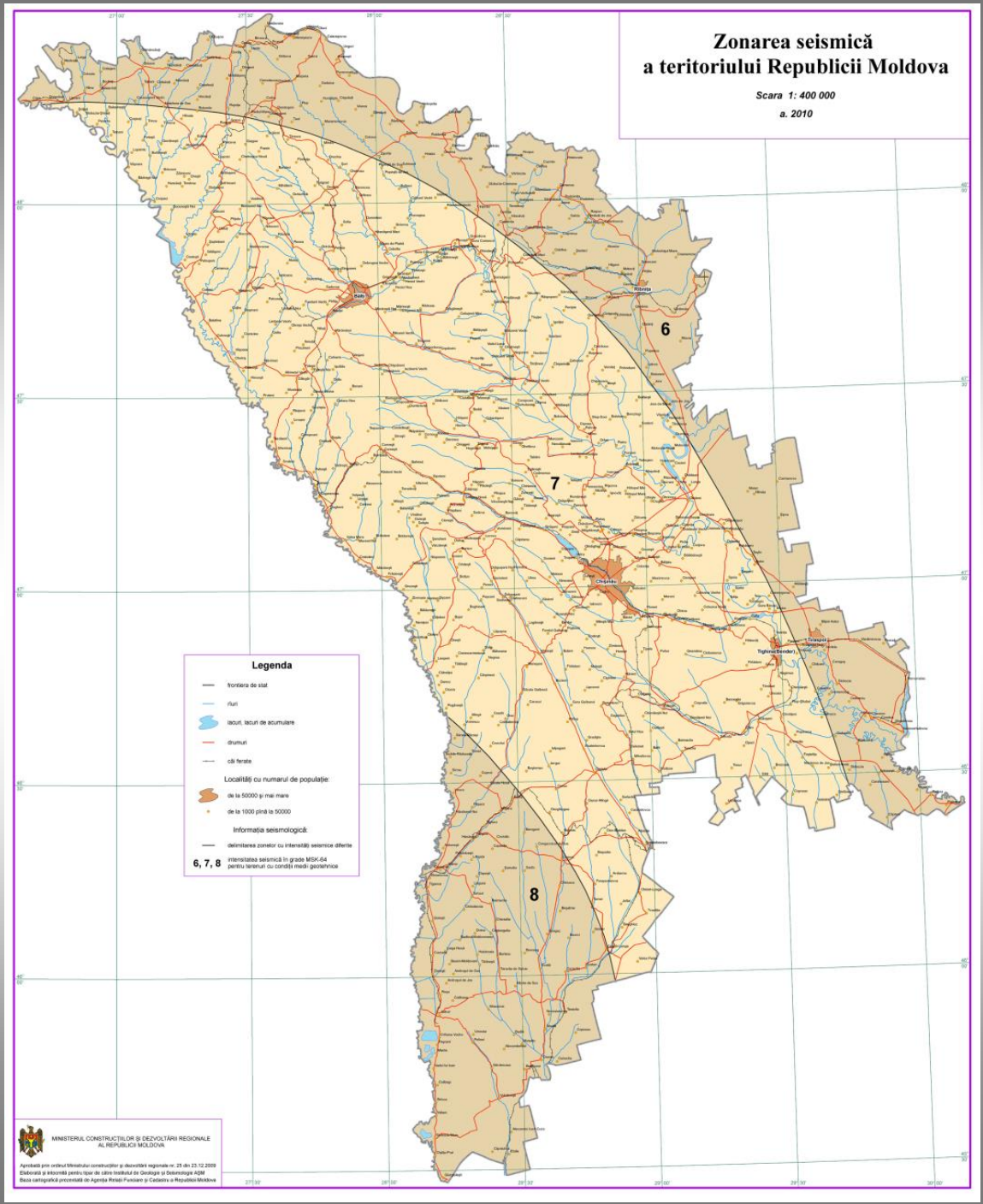
National Network of Seismic Stations of the Republic of Moldova

№	Station	Station cod	Beginning year	φ°, N	λ°, E
1	Chişinău	KIS	1949	46.9976	28.8175
2	Cahul	KGL	1978	45.9053	28.2008
3	Leova	LEOM	1982	46.4733	28.2467
4	Soroca	SORM	1983	48.1350	28.3513
5	Giurgiuleşti	GIUM	1988	45.4850	28.2081

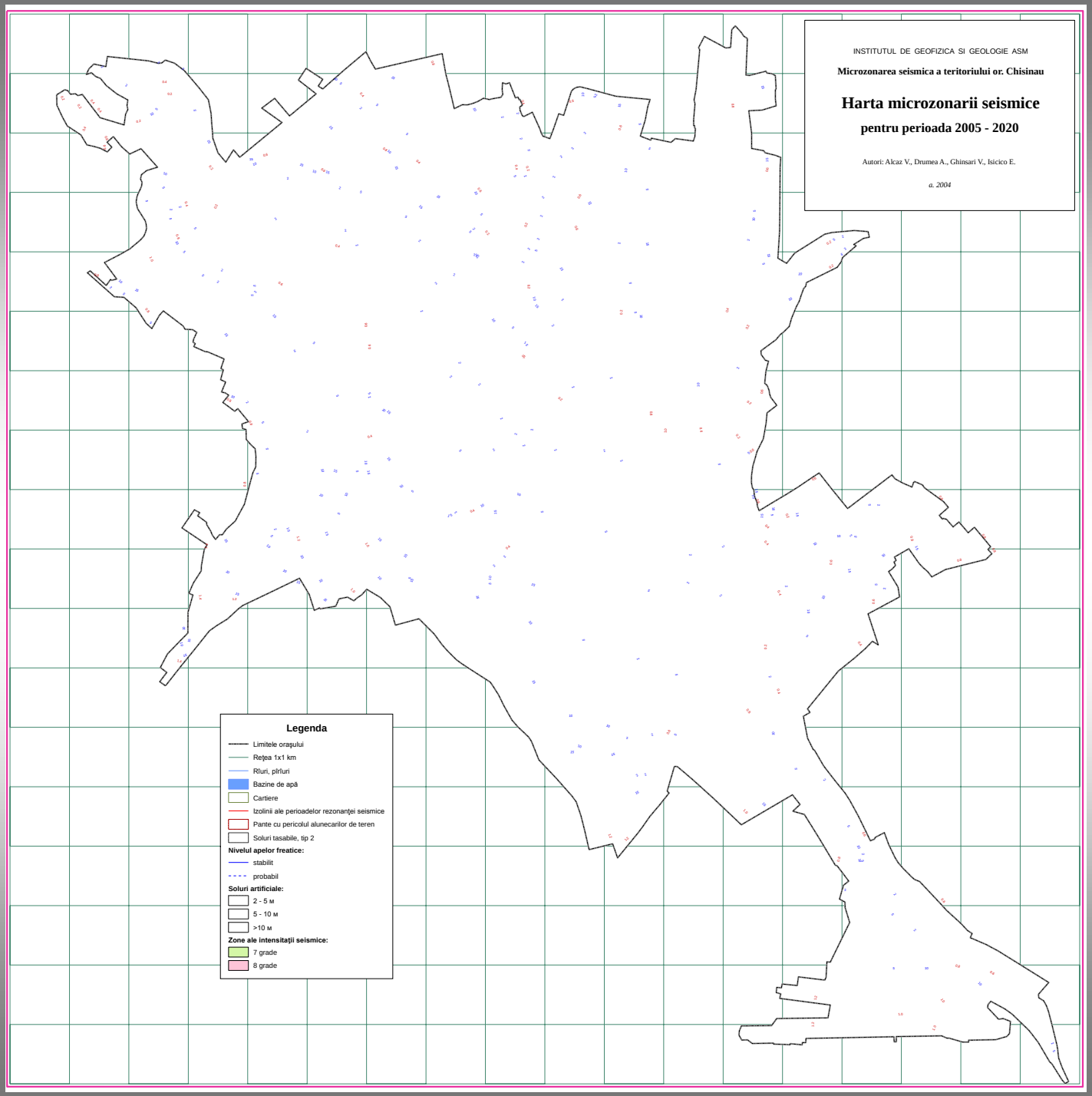
The territory of the Republic of Moldova is influenced by earthquakes of intermediate depth (80 – 150) from the Vrancea seismic zone.

On average, strong earthquakes of magnitude M > 6 occur five times or more per century. Some of them (November 10, 1940, March 4, 1977, August 31, 1986)

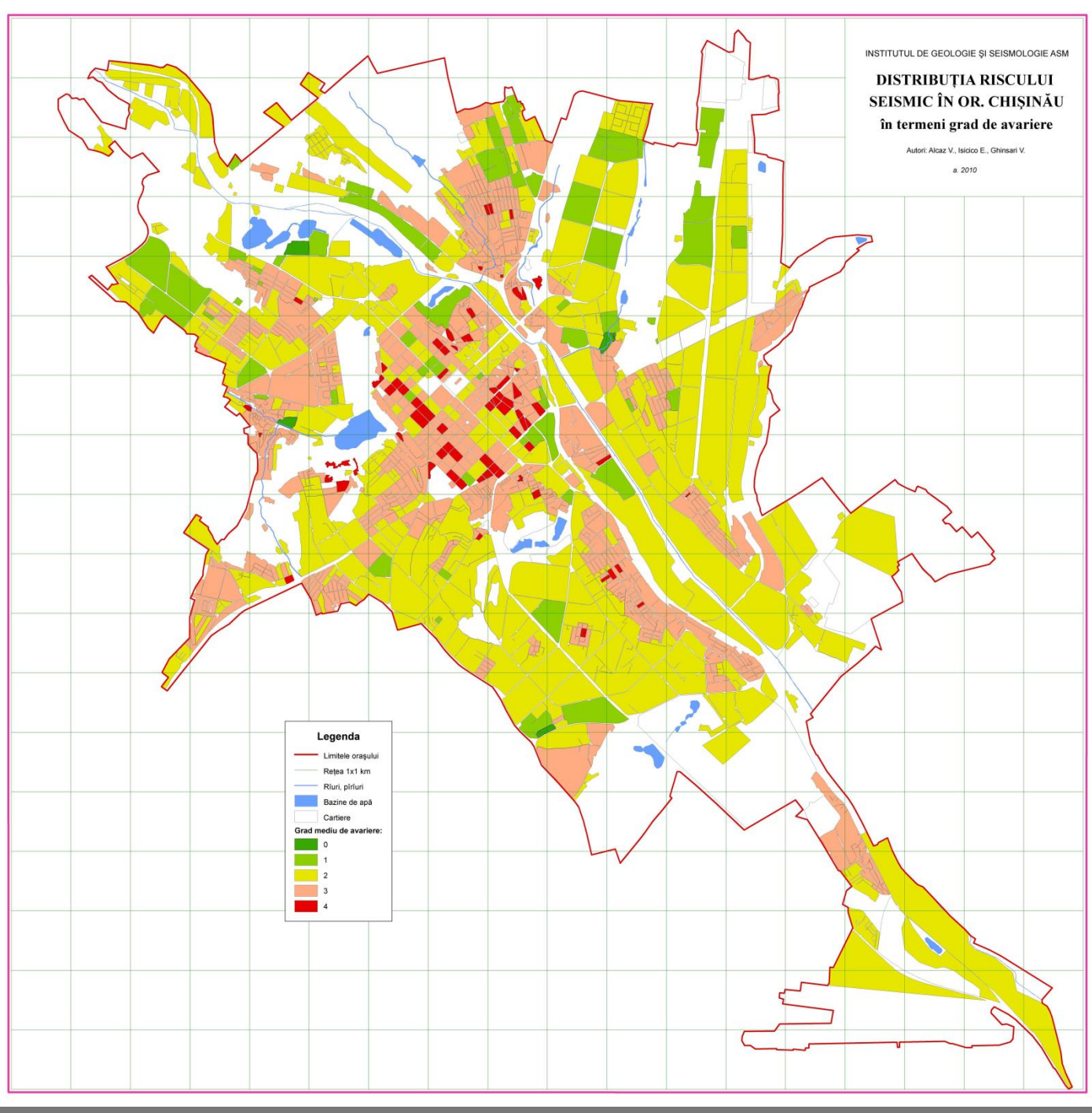
Vrancea Earthquake of November 10, 1940 (M=7,4)



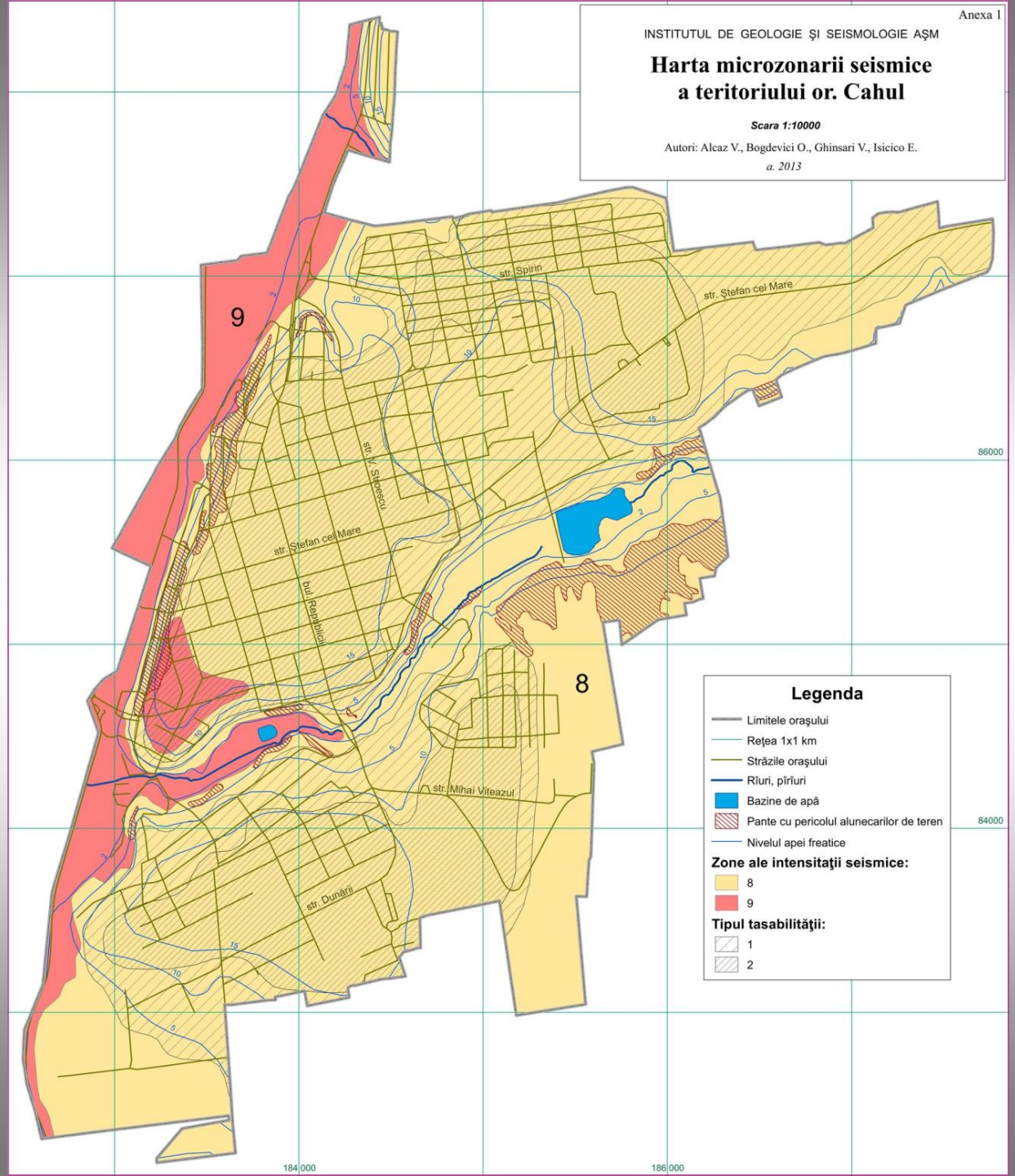
The seismic zoning map of Moldova Republic was adopted by the *Ministry of Regional Development and Construction* in 2010, and approved for practical use (seismic design and construction).



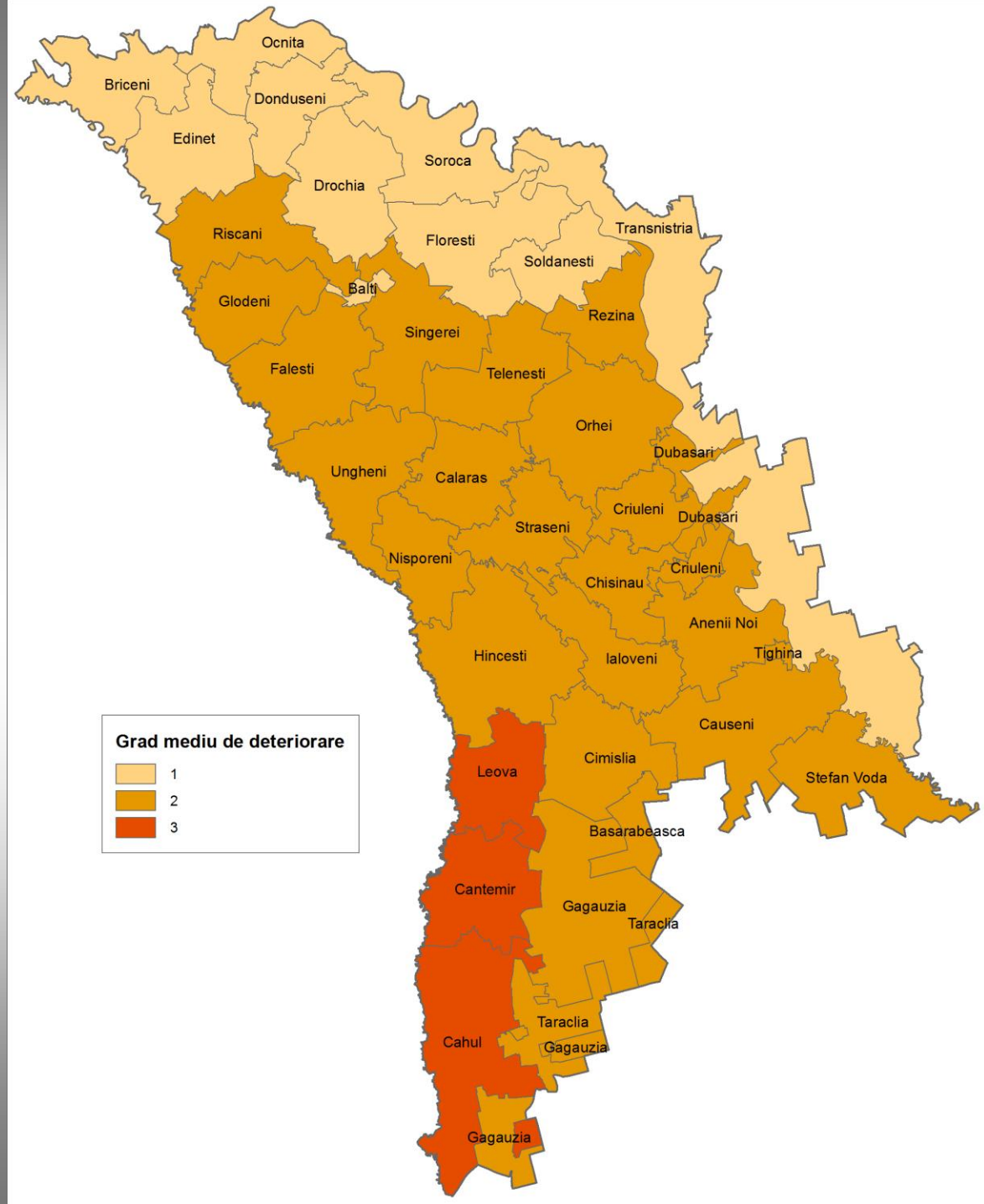
The seismic microzonation map of Kishinev city has been created. It was adopted by the *Ministry of Regional Development and Construction* in 2013.



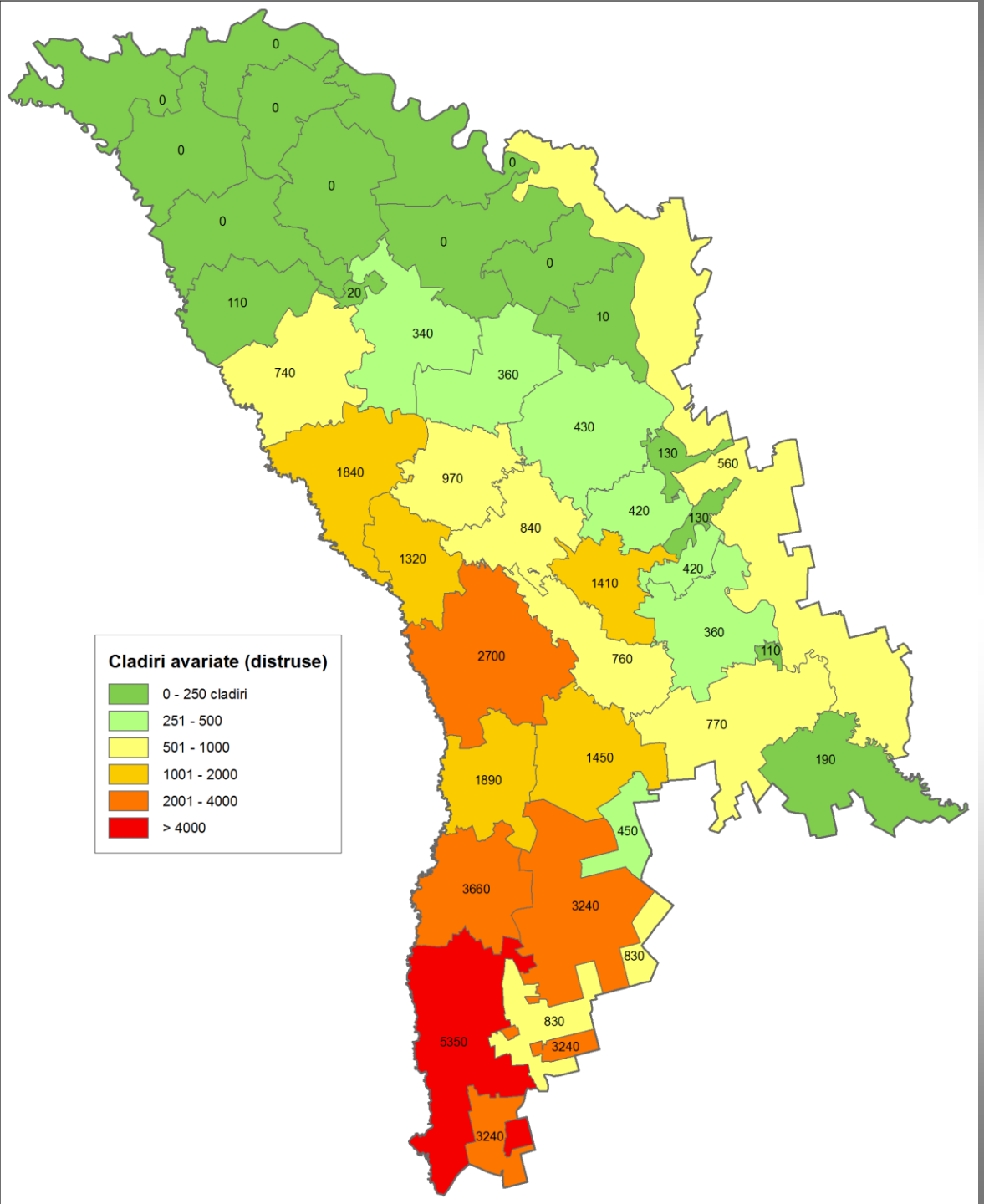
Seismic risk map of Kishinev city has been created in 2009. It was elaborated for scenario earthquake (like 10.11.1940) in terms of the average degree of damage for each quarter of the city.



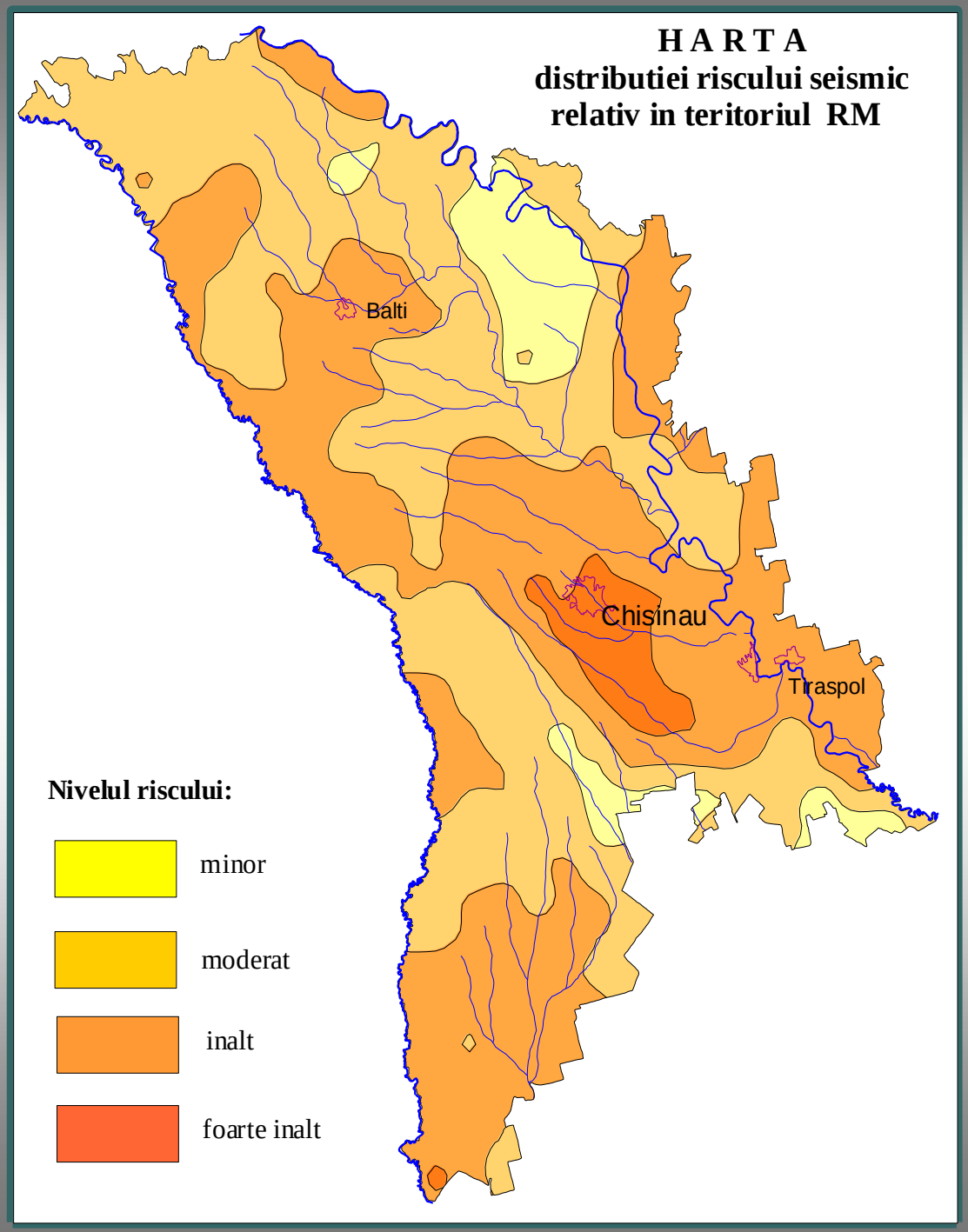
The new seismic microzonation map of Cahul town (south part of RM) has been created. It was adopted by the *Ministry of Regional Development and Construction* in end of 2013.



Seismic risk map of Moldova Republic has been created in 2013. It was elaborated for scenario earthquake (like 10.11.1940) in terms of the average degree of damage for each district.



Seismic risk map has been created in 2013. It was elaborated for scenario earthquake (like 10.11.1940) in terms of the number of destructed buildings for each district.



The largest relative risk is predicted for the central part of the country where the level of seismic hazard average, but well-developed economy, high population density and the likelihood of secondary geological processes.

Regulatory Documents which standardizes the activity in the domain of Seismology and Engineering Geology

1. Decision of Government of the Republic of Moldova on measures to optimize the infrastructure sphere of science and innovation no. 1326 of 14.12.2005, Official Monitor (Gazette) of the Republic of Moldova nr.168-171/1406 of 16.12.2005 regarding the reorganization and creation of organizations and institutions of science and innovation, including Institute of Geology and Seismology.
2. SNIP 1.02.07-87. Engineering exploration for the construction. General definitions. (“Инженерные изыскания для строительства. Основные положения).
3. SNIP II-7-81. Construction in seismic regions („Строительство в сейсмических районах”).
4. SNIP 2.01.15-90 Engineering protection of territories, buildings and construction from dangerous geological processes. Principal regulations of designing. (“Инженерная защита территорий, зданий и сооружений от опасных геологических процессов. основные положения проектирования”).
5. RSN 60-86 Engineering exploration for construction. Seismic microzoning. Norms of work realization (“Инженерные изыскания для строительства. Сейсмическое микрорайонирование. Нормы производства работ”).
6. RSN 65-87 Engineering exploration for construction. Seismic microzoning. Technical requirements of work realization Инженерные изыскания для строительства. Сейсмическое микрорайонирование. Технические требования к производству работ
7. СП 11-105-97 Part 1 Engineer-geological study for the construction. General requirements for work realization (“Часть 1 Инженерно-геологические изыскания для строительства. Общие правила производства работ”).

Actual project

Study of the quantitative evaluation of seismic hazard and risk, consistent with pre-standard Eurocode-8 (Earthquake resistance of structure).

- Project objectives:
- Improve methods of forecasting the seismic hazard and risk;
- Improve the existing regulatory framework of protection population and infrastructure Republic of Moldova against earthquakes.
- Period: 2011–2014.
- Project leader: d. hab. Alcaz V.