



**INTEGRATED NETWORKS FOR HAZARD RISK
MANAGEMENT IN REPUBLIC OF MOLDOVA AND
ROMANIA. FUTURE TRENDS**

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Todi, Italy, 21 August 2023



THE PURPOSE OF THE PRESENTATION:

- ✓ presentation of the results of the HAZARM project, carried out by the Technical University of Moldova, in partnership with the “Gh. Asachi” Technical University, Iași, Romania and the Institute of Geology and Seismology from Republic of Moldova.

AGENDA:

- ✓ **ABOUT REPUBLIC OF MOLDOVA;**
- ✓ **NATURAL HAZARDS IN THE REPUBLIC OF MOLDOVA;**
- ✓ **HAZARM PROJECT FRAMEWORK SECTION;**
- ✓ **THE USE OF THE GEOGRAPHIC INFORMATION SYSTEM FOR FLOOD PREDICTIONS IN THE UNGHENI MUNICIPALITY OF REPUBLIC OF MOLDOVA;**
- ✓ **CAUSES AND CONCLUSIONS.**

ABOUT REPUBLIC OF MOLDOVA

The place of the Republic of Moldova is in the family of the European Union



ABOUT REPUBLIC OF MOLDOVA

- Now, the Republic of Moldova is divided into 32 districts, 13 municipalities and 2 regions with special status. According to the 2004 population census, the population of the Republic of Moldova was 3,383,332 people, and now it is around 3 million. The surface is - 33.846 km².

Capital and largest city	Chişinău 🌐 47°0'N 28°55'E
Official languages	Romanian (also called Moldovan) ^{[1][2]}
Recognised minority languages	Gagauz · Russian · Ukrainian [3][4][5]
Ethnic groups (2014; excluding Transnistria)	75.1% Moldovan ^[a] 7.0% Romanian ^[a] 6.6% Ukrainian 4.6% Gagauz 4.1% Russian 1.9% Bulgarian 0.36% Romani 0.07% Poles 0.89% Other
Religion (2014; excluding Transnistria)	91.8% Christianity —90.1% Eastern Orthodoxy —1.7% Other Christian 5.5% No religion 2.4% Unspecified 0.3% Other ^[6]
Demonym(s)	Moldovan
Government	Unitary parliamentary republic
<ul style="list-style-type: none">• President• Prime Minister• President of the Parliament	Maia Sandu Natalia Gavrilița Igor Grosu

The Republic of Moldova is a small country with people with big heart

NATURAL HAZARDS IN THE REPUBLIC OF MOLDOVA

They are represented by dangerous meteorological phenomena and destructive phenomena of geological origin:

- ✓ earthquake;
- ✓ landslides;
- ✓ floods;
- ✓ hurricanes;
- ✓ torrential rains;
- ✓ high groundwater level;
- ✓ big hail;
- ✓ drought;
- ✓ frosts;
- ✓ big ice;
- ✓ strong blizzard (encounters);
- ✓ strong thunderstorms with electric discharges, etc.

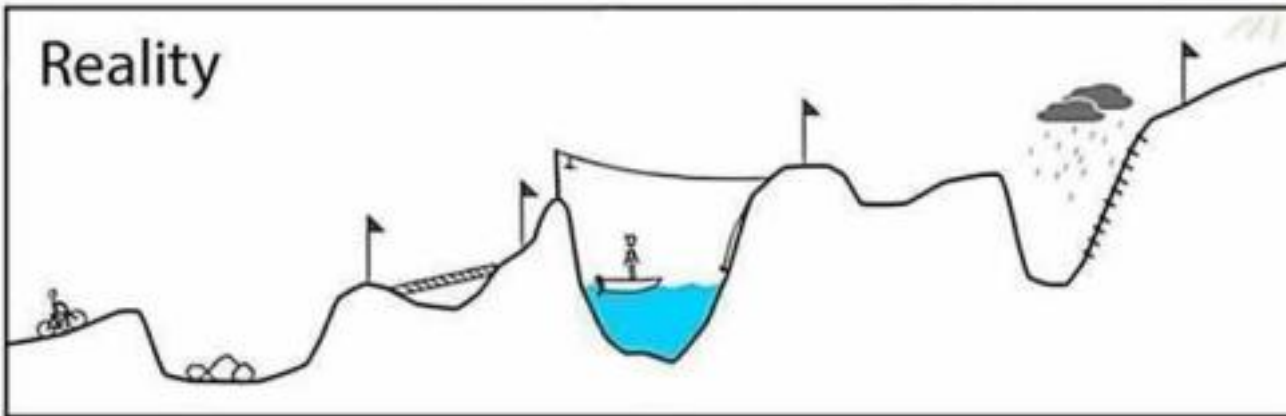


Your plan



Our plan in 2018 for
the submission of the
project

Reality



Project development
in the period 2020-
2022



Proiect finanțat de Uniunea Europeană

Program Operațional Comun România-Republica Moldova 2014-2020

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PROJECT FRAMEWORK SECTION



Thematic objective	8. ▾ 8. Common challenges in the field of safety and security
Programme priority	4.2 ▾ 4.2 Support to joint activities for the prevention of natural and man-made disasters as well as joint action during emergency situations
Priority expected results to which the project is expected to contribute	4.2.1 ▾ 4.2.1 Reduced risks for natural or man-made disasters and better joint emergency situation management systems in place in the eligible area



GENERAL OBJECTIVE

- **The project aims to bridge up the gap between Romania and Republic of Moldova related to emergency action plans and strategic approaches of natural disasters, in an 24 months project (2020 - 2022), by creating a cross-border hazard management network at European Union Eastern Border. The network integrates professionals from two correspondent cities in East European Countries, an EU member (Iași from Romania) and a Non-EU member (Chișinău from Republic of Moldova). The topic addresses the disparities identified in the Programme Core Area from the point of view of prevention and monitoring procedures, management and emergency actions associated with natural hazards. The approach is based on a Micro to Macro evaluation process and is supported by a joint network of professionals in hazard risk management. It consists in performing a Micro Level hazard risk vulnerability analysis along the cross-border areal, for Ungheni Target Zone, by framing local hazard maps, performing knowledge transfer, networking and training on behalf of population safety and security.**

TARGET GROUPS AND BENEFICIARIES



- Local authorities from Ungheni - commune (Romania) / city (Moldova)
- Young professionals
- The population of Ungheni



SPECIFIC OBJECTIVES

<p>Specific objective 1</p> <p>+ -</p>	<p>Coordinated Cross-border activities aiming a sustainable cooperation on the awareness of natural hazards risks among professionals, local authorities and citizens during 2018-2020, based on an integrated State-of-Art on natural hazards occurrence and recurrence according to specific local typologies and hazard severity degree.</p>
<p>Specific objective 2</p> <p>+ -</p>	<p>Evaluation and mapping of hazard risk for efficient disaster management based on a Micro to Macro Level approach. This implies research on Hazard Vulnerability for a specific areal, subjected to multiple hazard risks, named Ungheni Target Zone; Coordinated actions on modeling joint cross-border maps for hazards risks, instrumentation of cross-border workshops and training procedures to support preventive and rescue procedures.</p>
<p>Specific objective 3</p> <p>+ -</p>	<p>Create, by the end of the project, of an integrated Hazard Risk Management Guide on natural hazard risks - joint prevention measures, monitoring process, intervention strategies, with the purpose of reducing losses of any kind; informative materials dissemination to envisaged target groups and final beneficiaries from Ungheni Target Zone, as Micro Level Process, with expansion potential to Programme Core Areal, as Macro Level process.</p>

FINAL RESULTS

**NATURAL HAZARD
MAPS**

**CROSS-BORDER
HAZARD RISK
MANAGEMENT GUIDE**

NETWORKING



Acest proiect e finanțat
de Uniunea Europeană

Program Operațional Comun România-Republica Moldova 2014-2020

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Romania-Republic of Moldova

FINAL RESULTS - NATURAL HAZARD MAPS

- **Seismic risk map;**
- **Flood risk map;**
- **Landslide risk map.**



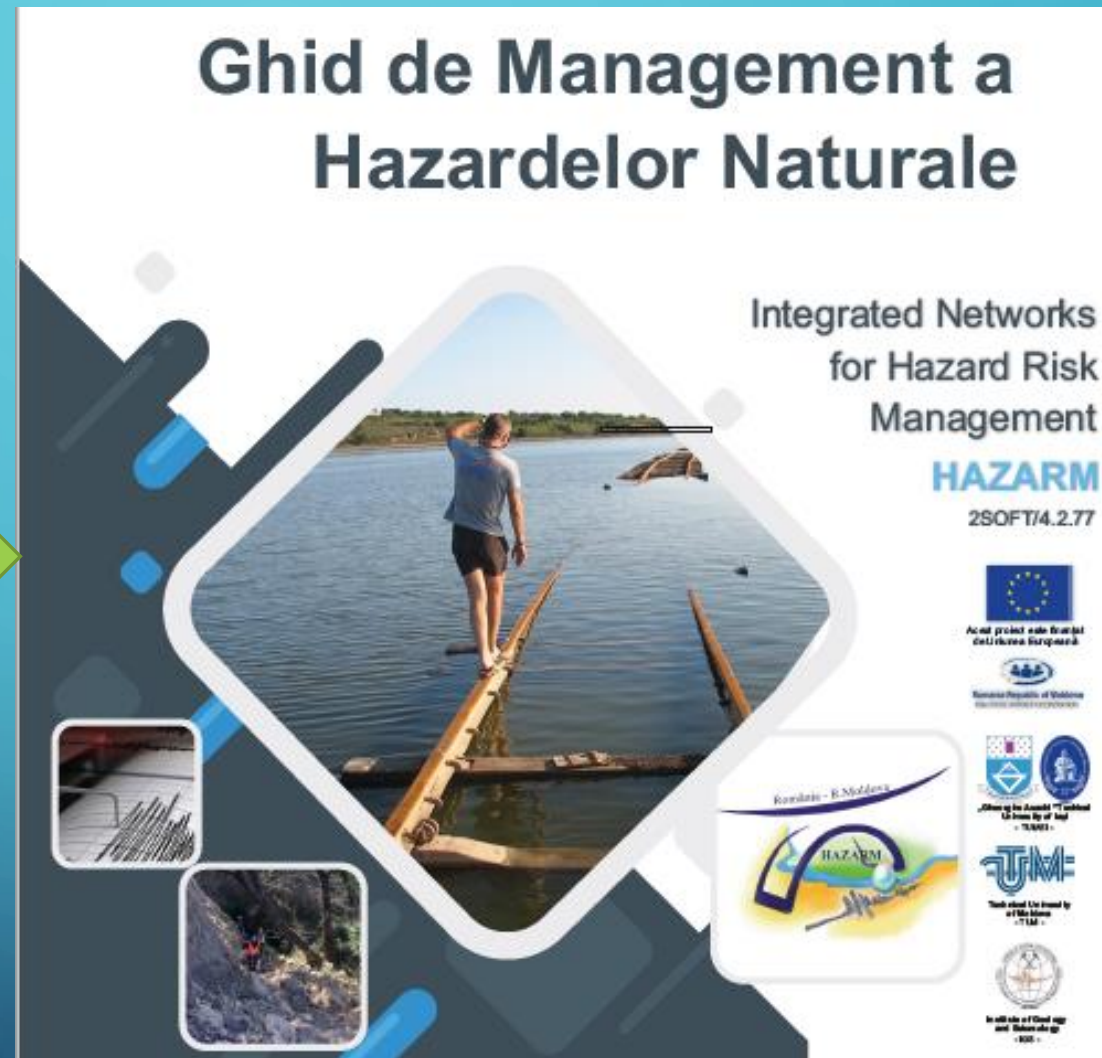

FINAL RESULTS -CROSS-BORDER HAZARD RISK MANAGEMENT GUIDE

GHID DE MANAGEMENT A HAZARDELOR NATURALE

CUPRINS

1	Introducere	1
2	Termeni și definiții	1
3	Prevederi generale zona Țintă Ungheeni	1
4	Gestionarea situațiilor de urgență la nivel local și național. Abordare Transfrontalieră România - Republica Moldova	1
5	Managementul dezastrelor naturale. Abordări generale	1
6	Tipologii de hazard naturale: seism, inundații, alunecări de teren	1
7	Măsuri și reguli de comportament în caz de dezastru	1
8	Anexe:	1
8.1	Kitul de supraviețuire	1
8.2	Hărți hazard naturale - zona Țintă Ungheeni	1
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UNGHENI DISTRICT

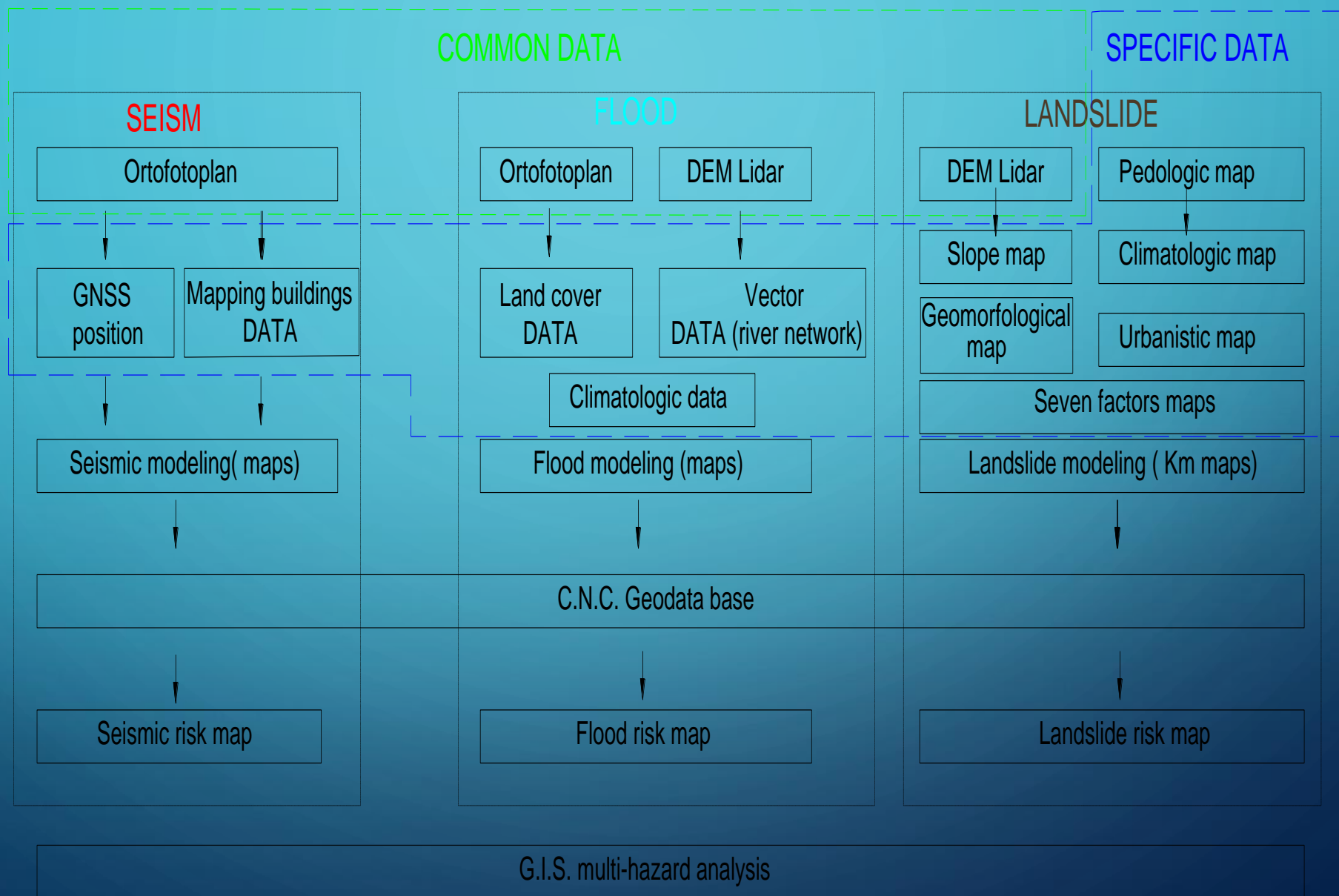
Ungheni district is geographically located in the central - western part of the Republic of Moldova.

The total area of the district is 108.3 thousand ha, of which 49.9 thousand ha is the agricultural area, 28.8 thousand ha are forests and other lands with forest vegetation, and 4.7 thousand ha occupy aquatic resources.

The relief of the district is characterized by areas of low hills, wide valleys, meadow of the middle course of the Prut river.



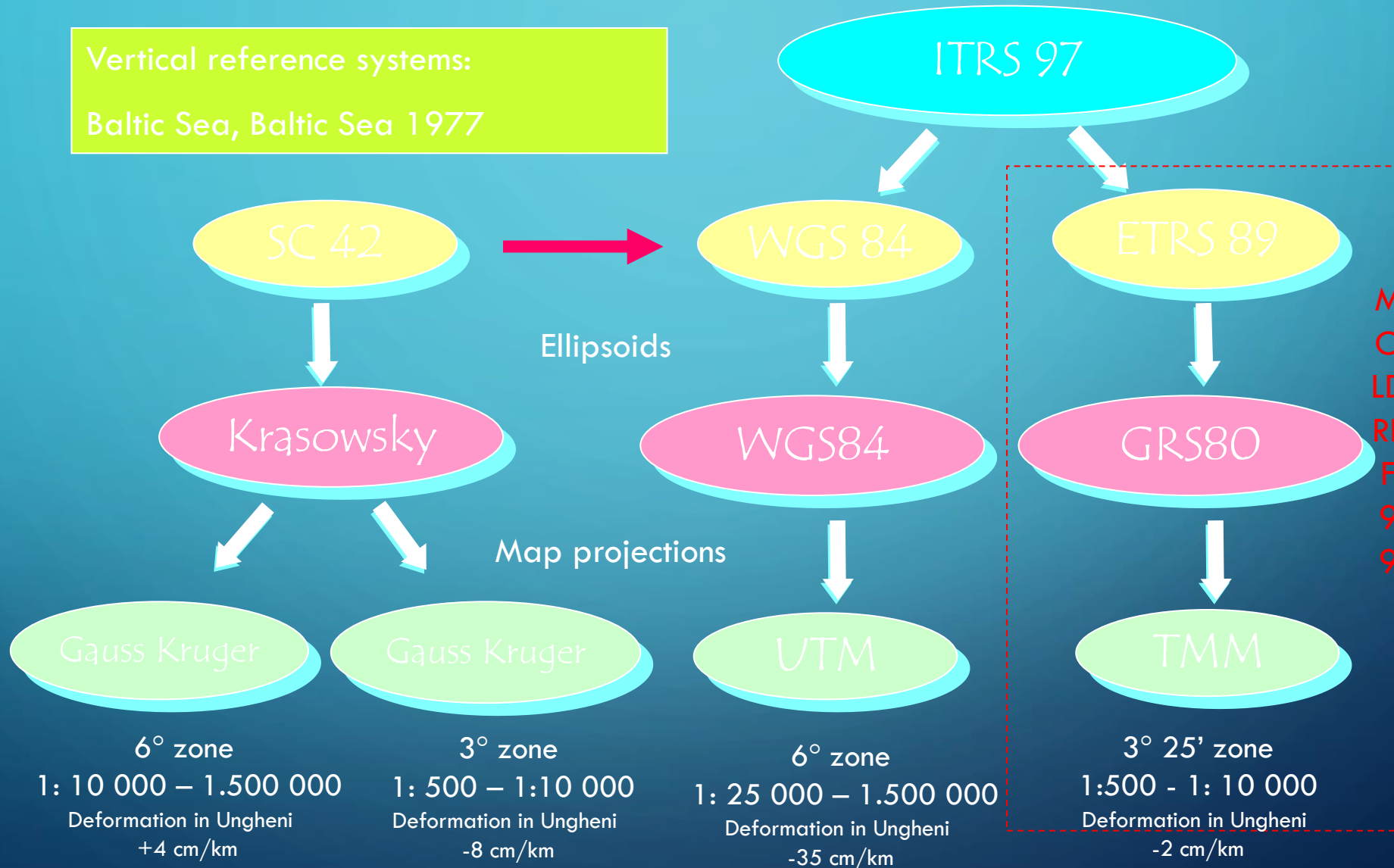
GEOSPATIAL DATA IN MULTI-RISK MODELING



GEODETIC REFERENCE SYSTEMS

Vertical reference systems:

Baltic Sea, Baltic Sea 1977

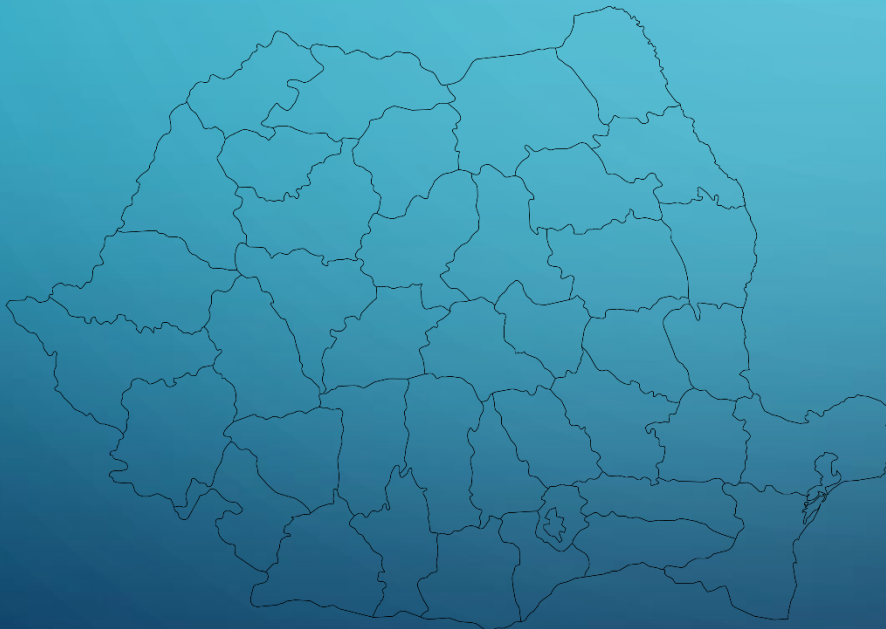


Coordinate systems. Cartographic projections. Transformations performed

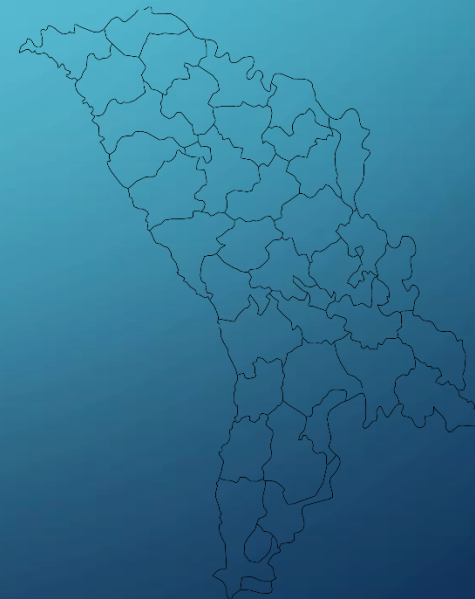
Projection: Double stereo
Romania
SC: GCS_Pulkovo_1942



Projection: TMM
SC: MoldRef99



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Project funded by European Union

Joint Operational Programme Romania-Republic of Moldova 2014-2020

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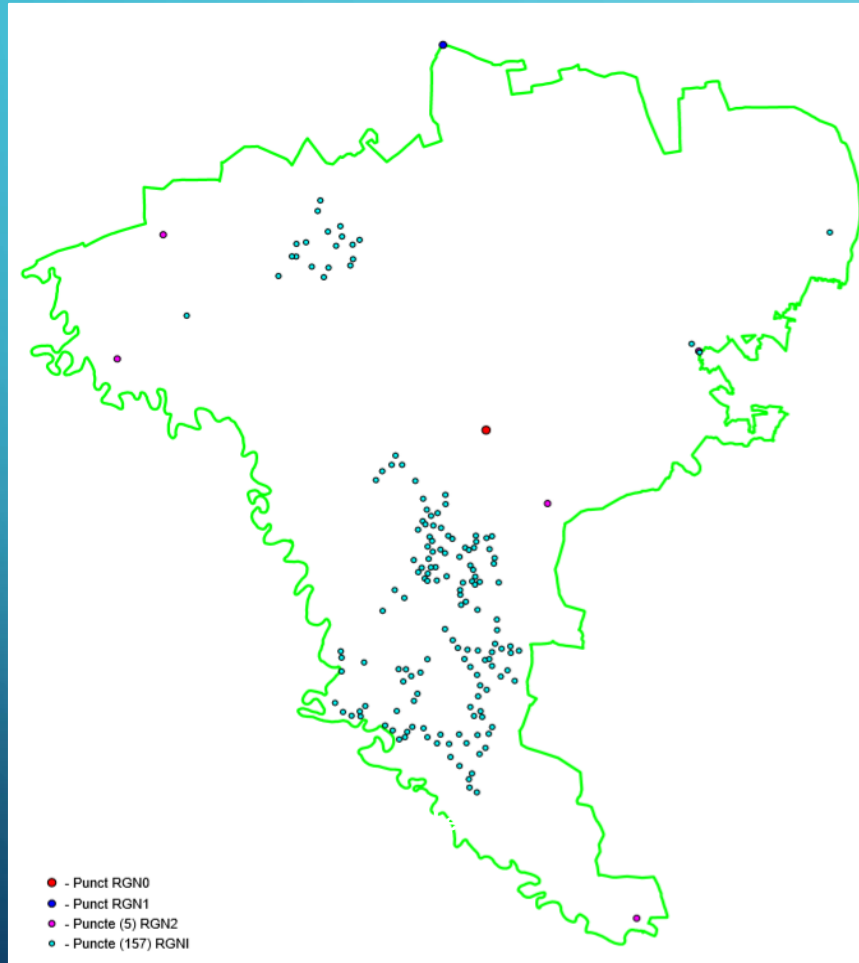


Romania-Republic of Moldova

ENI - CROSS BORDER COOPERATION

NATIONAL GEODETIC NETWORK

Geodetic network of Ungheni district

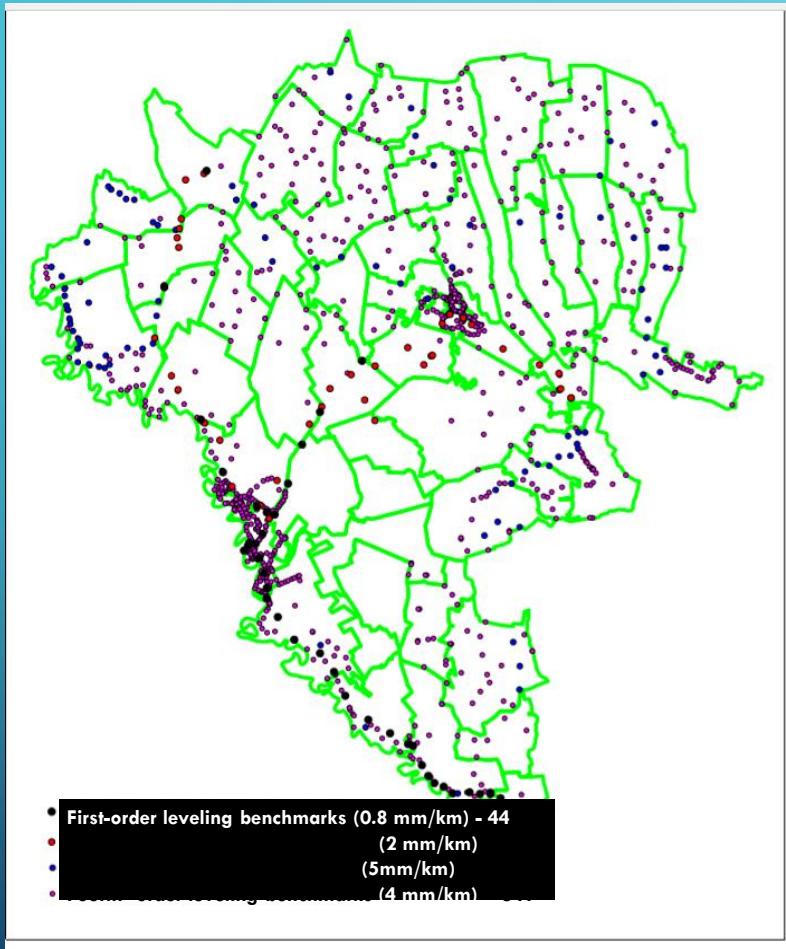


Zero, first and second order National geodezic network

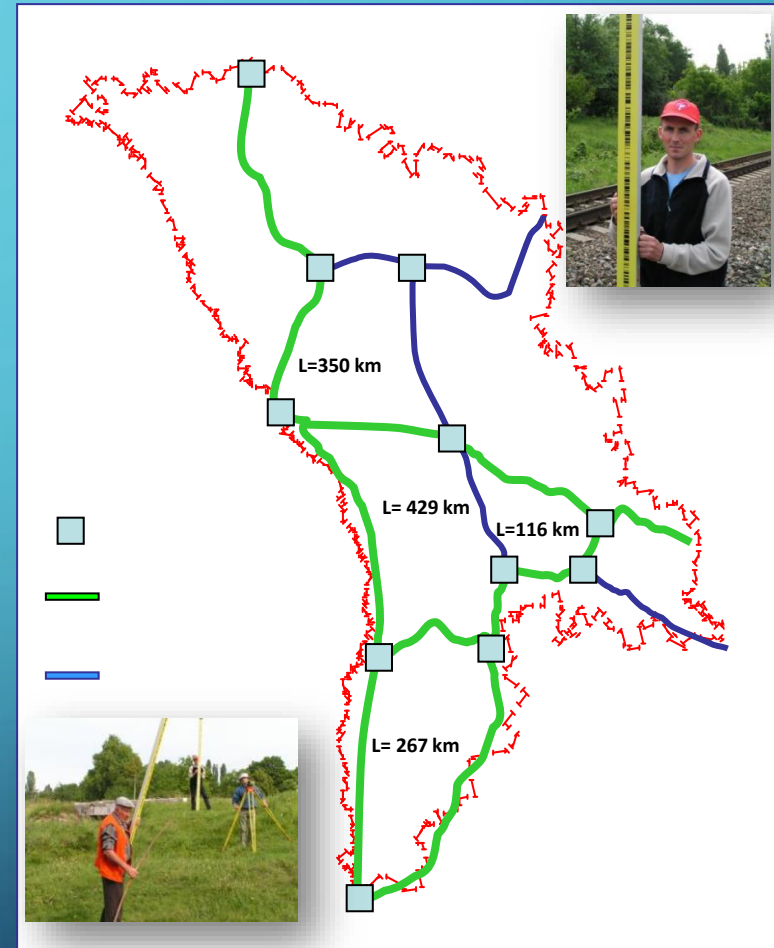


NATIONAL LEVELING NETWORK

Leveling network of Ungheni district

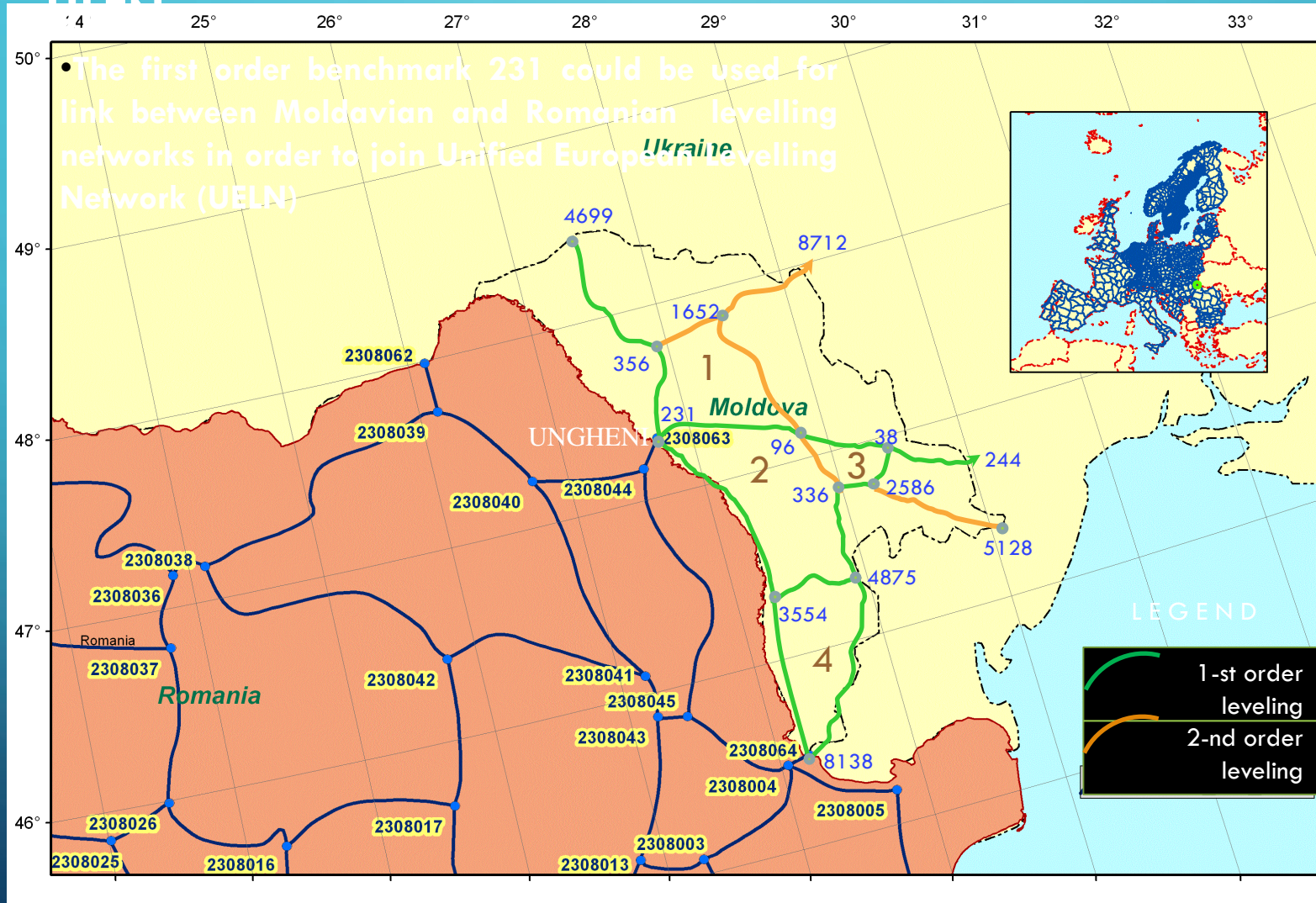


First and second order National leveling network



NATIONAL LEVELING NETWORK

Reconstruction and integration in



GNSS PERMANENT NETWORK

GNSS Observations campaign 16- 30 August 2011



Station	E RMS	N RMS	U RMS
CAHU	2.2	1.7	2.5
CAUS	2.3	1.7	2.5
CHEL	2.3	1.7	2.6
CHIS	2.3	1.7	2.5
COMR	2.2	1.7	2.5
EDIN	2.3	1.7	2.5
FALE	2.3	1.7	2.5
GIUR	2.3	1.7	2.6
LEOV	2.2	1.7	2.5
NISP	2.3	1.7	2.5
OTAC	2.3	1.7	2.6
PALA	2.3	1.7	2.6
SORO	2.3	1.7	2.5
TELE	2.3	1.7	2.5
UNGH	2.3	1.7	2.6

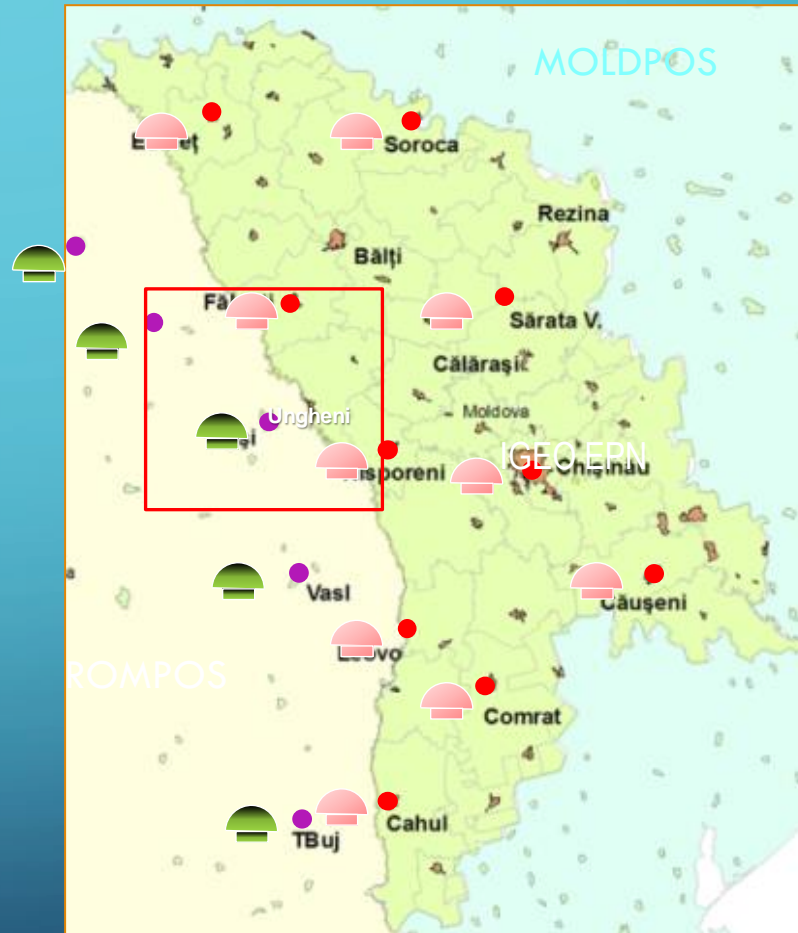
- 11 - IGS RF stations used in the processing
- 10- GNSS permanent stations network
- 5- EUREF - 0 order National Geodetic Network sites (24 hours observations)

GNSS PERMANENT NETWORK

Development of Moldavian Positioning Service MOLDPOS

And on 2011, November 1st GNSS Permanent Network and MOLDPOS service were put on function with 10 permanent GNSS stations integrated with 5 ROMPOS GNSS stations under agreement between Moldavian Agency for Land Relation and Cadastre and *Romanian National Agency for Cadastre and Land Registration (ANCPI)*.

Ungheni district is covered by three GNSS permanent stations (Falesti, Nisporeni and Iasi) that ensure the accuracy of RTK measurements less than 3 cm horizontally and 4 cm vertically

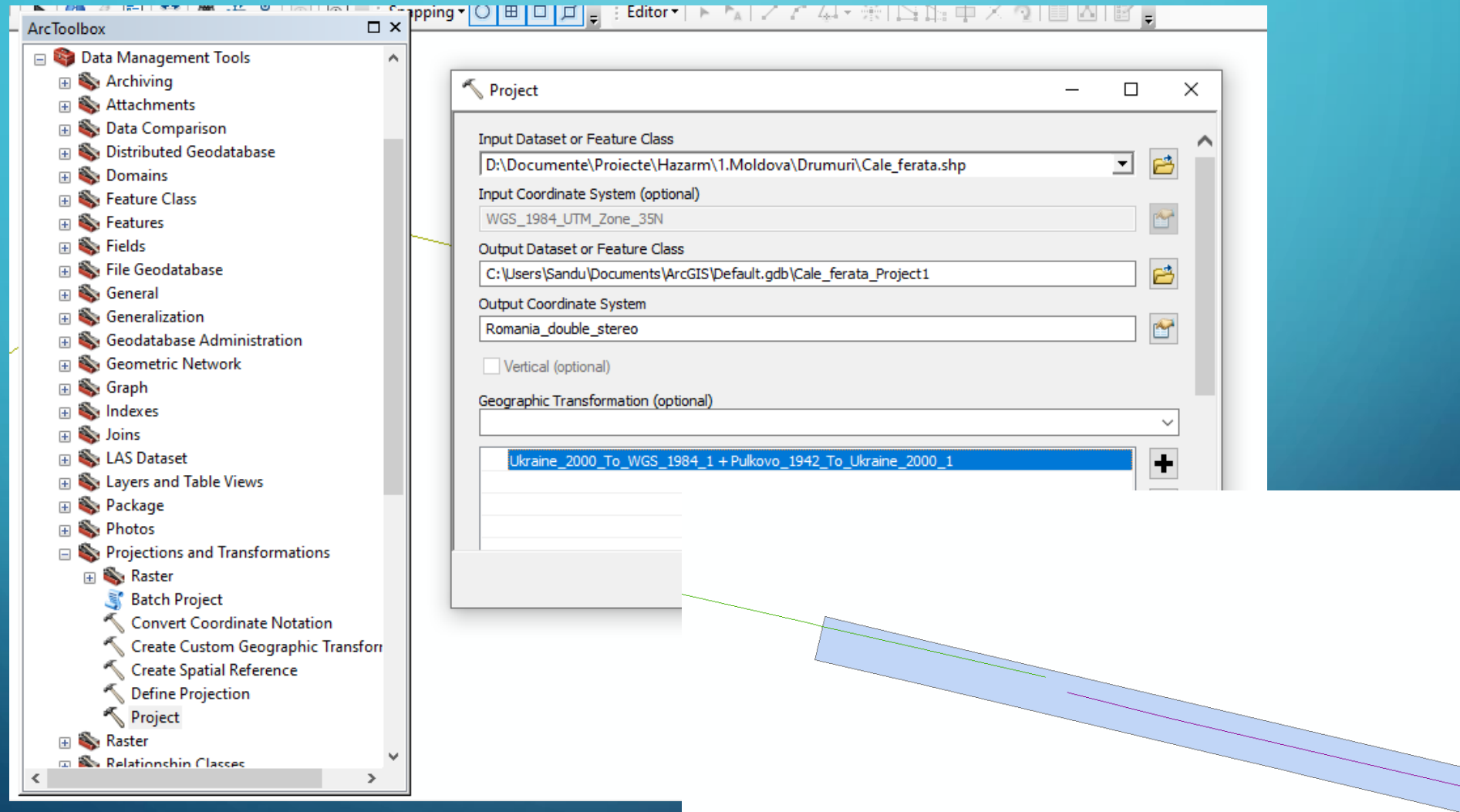


THE USE OF THE GEOGRAPHIC INFORMATION SYSTEM FOR FLOOD PREDICTIONS IN THE UNGHENI MUNICIPALITY OF REPUBLIC OF MOLDOVA

- Hydrography (lakes, rivers)
- Roads
- Bridges
- Railway
- Buildings
- Lands
- The administrative border of the towns
- Land Use
- Flood risk data obtained from Flood Protection Master Plan for Moldova
- Data for creating the DTM and DEM
- PUG.

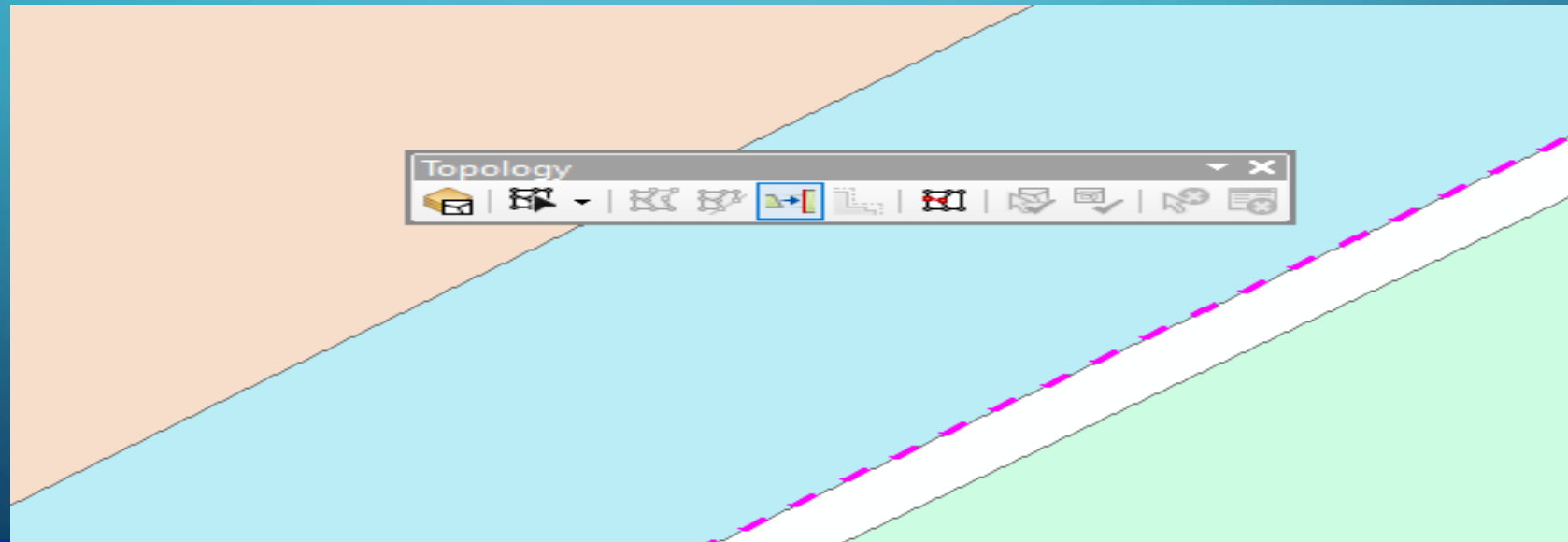


COORDINATE SYSTEMS. CARTOGRAPHIC PROJECTIONS. TRANSFORMATIONS PERFORMED

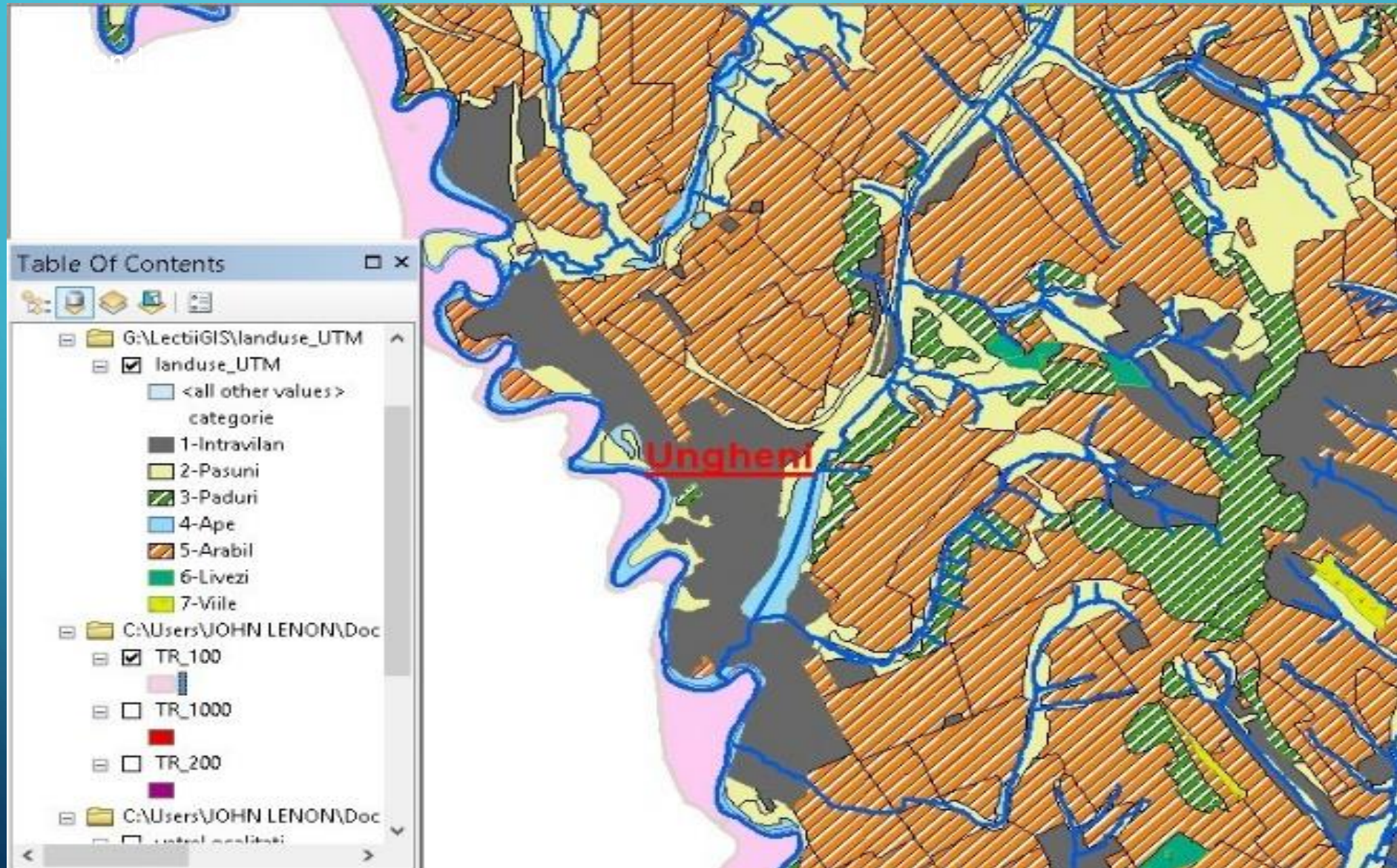


COORDINATE SYSTEMS. CARTOGRAPHIC PROJECTIONS. TRANSFORMATIONS PERFORMED

In order for the contact region not to have any topological errors, the meetings of the work teams decided that we will take as a geometric object of common border, the Prut river offered by the team from Romania. Respectively, using the topological tools of the ArcGIS software, the data were corrected and adjusted.



THE LANDUSE MAP OVERLAYED WITH THE FLOOD HAZARD MAP



URBAN PLAN OF UNGHENI OVERLAYED WITH THE HAZARD MAPS

Table Of Contents

Layers

- G:\LectiiGIS\AIRiuriGIS
 - rauri
- C:\Users\JOHN LENON\Docum
 - Terenuri_Intersect2
 - TR_100_Intersect
- G:\LectiiGIS\PlanUrbanistic\Trai
 - Terenuri
 - L_objecte_publice
 - L_Jocuinte
 - H_Localitate
- C:\Users\JOHN LENON\Downlo
 - TR_100
 - TR_1000
 - TR_200



ArcSCENE 3D

A vertical Exaggeration of 10 times was applied



Preliminary flood risk assessment

Evaluarea Preliminară a Riscului de Inundații



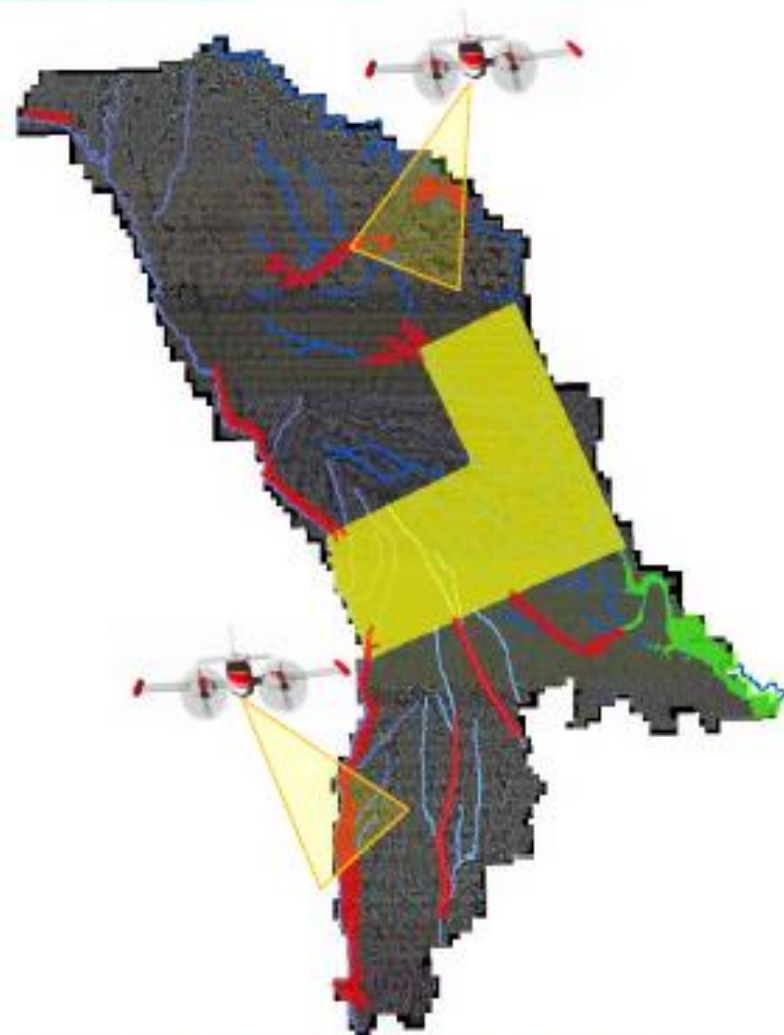
3400 km of rivers where the effects of flooding are greatest
→ **Most of the investments** in flood protection are therefore needed in these areas.

3400 km de râuri unde efectul inundațiilor este cel mai mare
→ **Majoritatea investițiilor** în protecția împotriva inundațiilor sunt necesare în aceste zone

Dniester, Prut, Bîc, Răut,
Cogâlnic, Ialpug, Schinoasa,
Afluenții Prutului

LiDAR SURVEY STUDIUL LiDAR

- ❖ Airborne laser scanning technology on 1,912 km² (resolution 2 p/m²)
 - **Yellow:** existing LiDAR survey of the central part of Moldova (2011, ALRC)
 - **Red:** new LiDAR survey (2014, performed within this project)
 - **Green:** photogrammetric data derivation (2014, performed within this project) from existing ortophoto
- ❖ Tehnologia de scanare avia pe 1,912 km (rezoluția 2 p/m²)
 - **Yellow:** studiul LiDAR existent a părții centrale al Moldovei (2011, ARFC)
 - **Red:** studiul LiDAR now (2014) în cadrul proiectului
 - **Green:** derivarea fotogrametrică a datelor (2014, în cadrul proiectului din ortofoto existente)



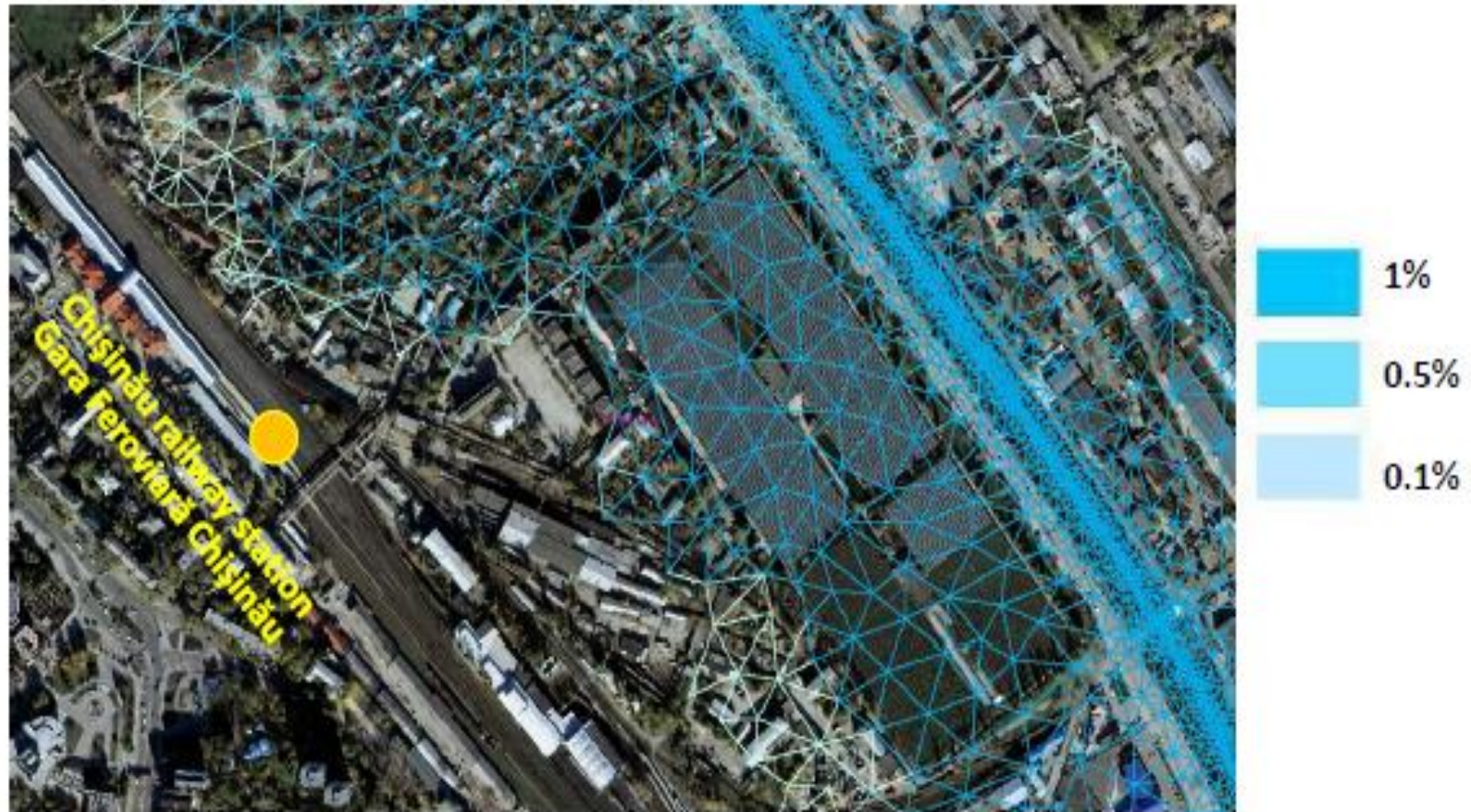
Modelling for flood hazard maps and Master Plan

Modelarea pentru hărțile riscurilor de inundații și Planul de acțiuni

- ❖ 1% (1 in 100-year), 0.5% (1 in 200-year) and 0.1% (1 in 1,000-year) flood events with dykes and without dykes
 - ❖ Dam failures
 - ❖ Climate change
 - ❖ Models used for designing flood management options
-
- ❖ Probabilitatea de 1% (1 la 100 ani), 0.5% (1 la 200 ani) și 0.1% (1 la 1,000 ani) cu diguri și fără diguri
 - ❖ Ruperea barajului
 - ❖ Schimbările climatice
 - ❖ Modelele utilizate pentru elaborarea opțiunilor de management al inundațiilor

Model results - Rezultatele modelării

- ❖ Model results provided in GIS format. Flooded areas calculated using a grid of triangular cells



- ❖ Rezultatele modelării în formatul GIS. Ariile inundate calculate cu aplicarea unei rețele de celule triunghiulare



Flood Hazard maps



INTEGRATED NETWORKS FOR HAZARD RISK MANAGEMENT - HAZARM ZSOFT/4.2/77

www.hazarm.ci.tulasi.ro

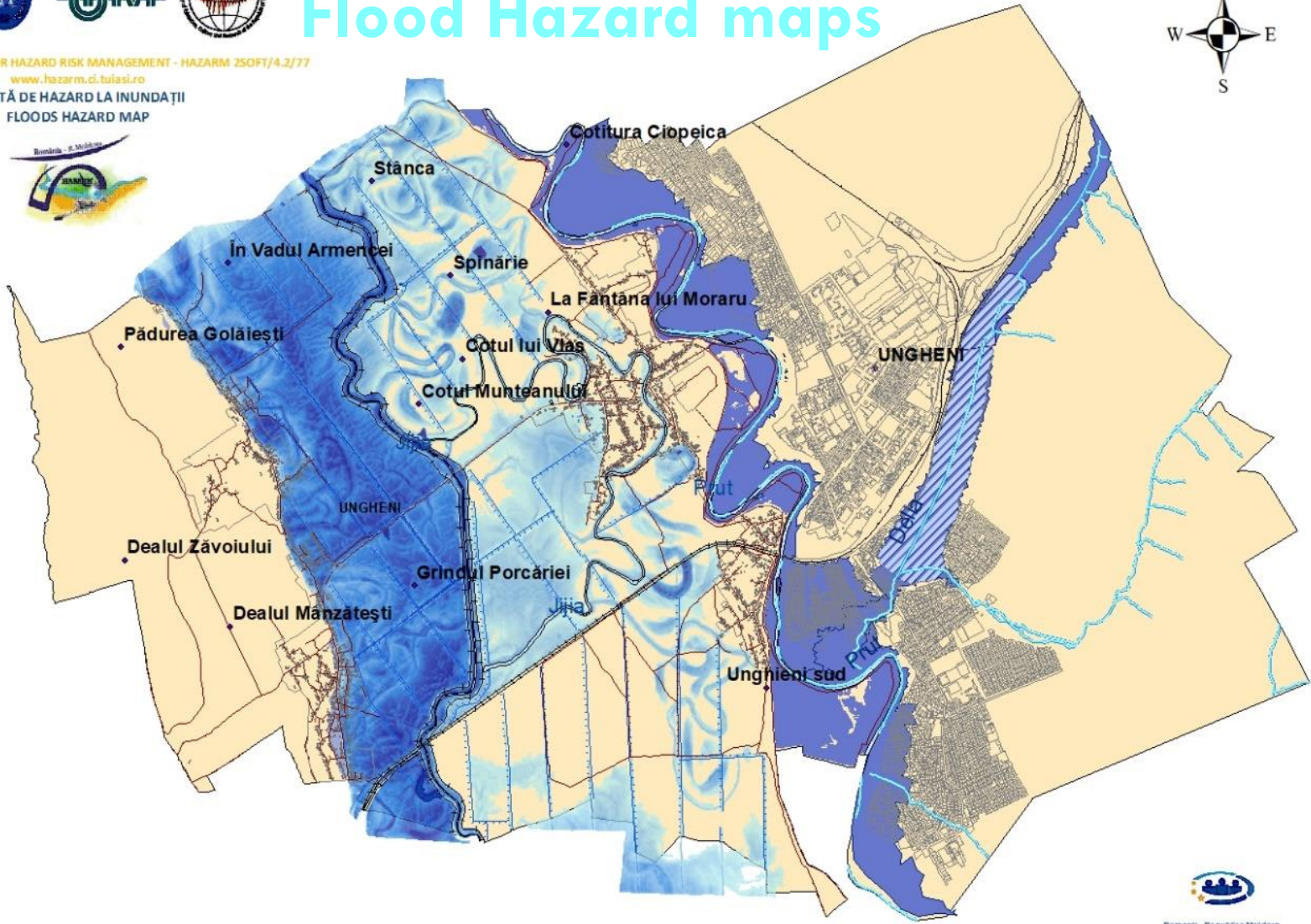
HARTĂ DE HAZARD LA INUNDAȚII
FLOODS HAZARD MAP



47°15'0"N
47°13'30"N
47°12'0"N
47°10'30"N

47°15'0"N
47°13'30"N
47°12'0"N
47°10'30"N

- Legenda:**
- Lacuri
 - Riuri
 - Canal
- Localitati**
- Localitati
 - Cale ferata
 - Constructii
 - Drum
 - Cale ferata
 - Dig
 - Denumiri geografice
- HH adancime 10%**
- Value
- High : 8
 - Low : 0
- HH adancime 1%**
- Value
- High : 9
 - Low : 0
- HH adancime 0,1 %**
- Value
- High : 9.44
 - Low : 0
- Probabilitatea 1%
 - Probabilitatea 10 %
 - Probabilitatea 0,1%
 - Limita administrativa



Proiect finanțat de Uniunea Europeană

FLOOD RISK MAPS

- ✓ **Low probability scenario** (0.1% - floods that can occur, on average, once every 1000 years);
- ✓ **Medium probability scenario** (1% - floods that can occur, on average, once every 100 years);
- ✓ **High probability scenario** (10% - floods that can occur, on average, once every 10 years).



INTEGRATED NETWORKS FOR HAZARD RISK MANAGEMENT - HAZARM 2SOFT/4.2/77

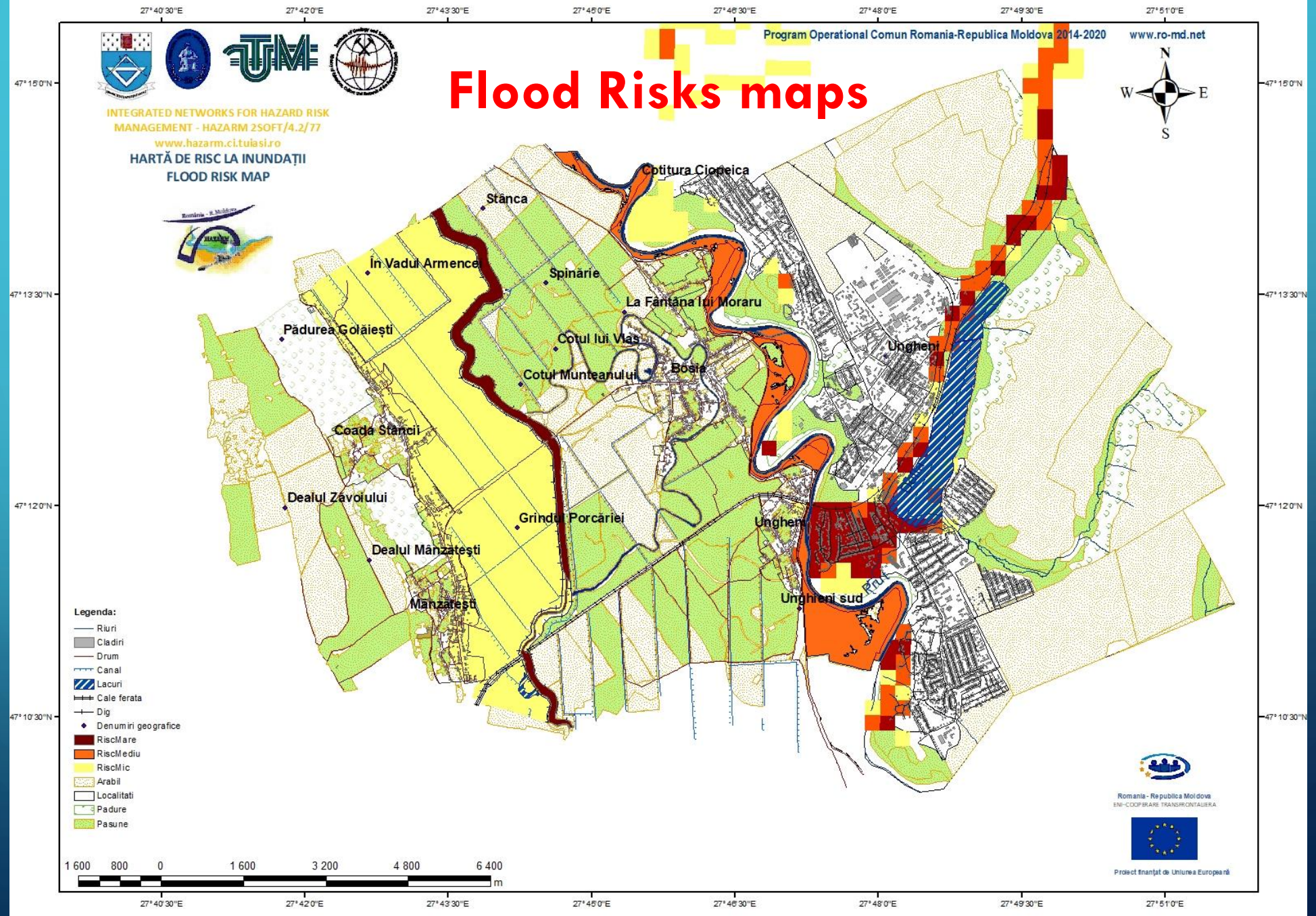
www.hazarm.ci.tulsi.ro

HARTĂ DE RISC LA INUNDAȚII
FLOOD RISK MAP



Flood Risks maps

Program Operational Comun Romania-Republica Moldova 2014-2020 www.ro-md.net



- Legenda:**
- Riuuri
 - ▬ Cladiri
 - Drum
 - Canal
 - ▨ Lacuri
 - Cale ferata
 - Dig
 - ◆ Denumiri geografice
 - Risc Mare
 - Risc Mediu
 - Risc Mic
 - ▨ Arabil
 - ▨ Localitati
 - ▨ Padure
 - ▨ Pasune

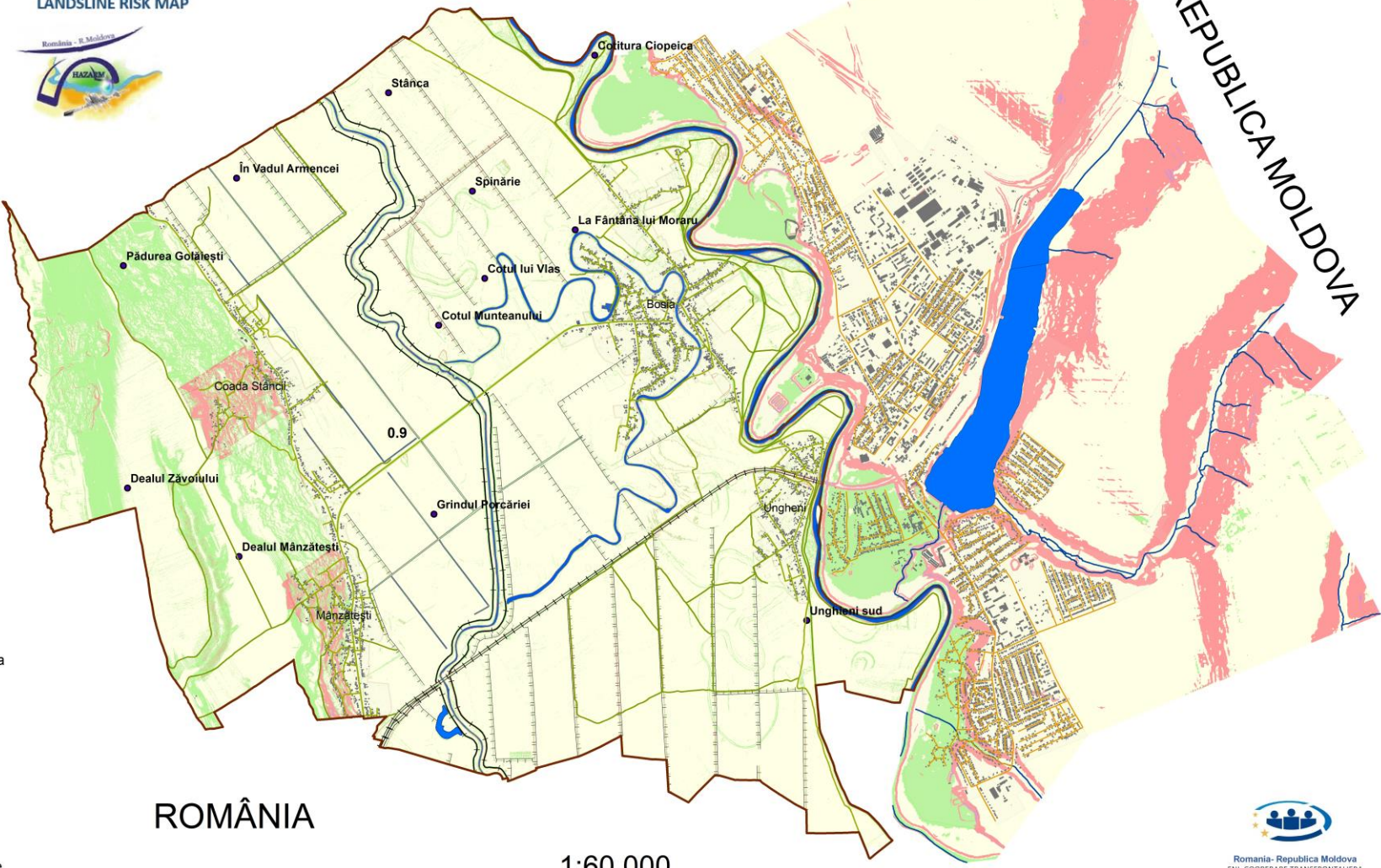


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INTEGRATED NETWORKS FOR HAZARD RISK MANAGEMENT - HAZARM 2SOFT/4.2.17
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HARTĂ DE RISC LA ALUNECĂRI DE TEREN
LANDSLIDE RISK MAP

Landslide risk map



- Legenda:**
- Axa_strazii
 - Localitate
 - Limita administrativa
 - Constructii
 - Drum
 - Localitati
 - Canal
 - Retea hidrografica
 - Râuri
 - Lacuri
 - Cale ferata
 - Dig
 - Denumiri geografice
 - Redusă Km ≤ 0.10
 - Medie 0.11 ≤ Km ≤ 0.30
 - Medie - Mare 0.31 ≤ Km ≤ 0.50
 - Mare Km ≥ 0.51

ROMÂNIA

1:60 000



Sistem de coordonate WGS84

REPUBLICA MOLDOVA





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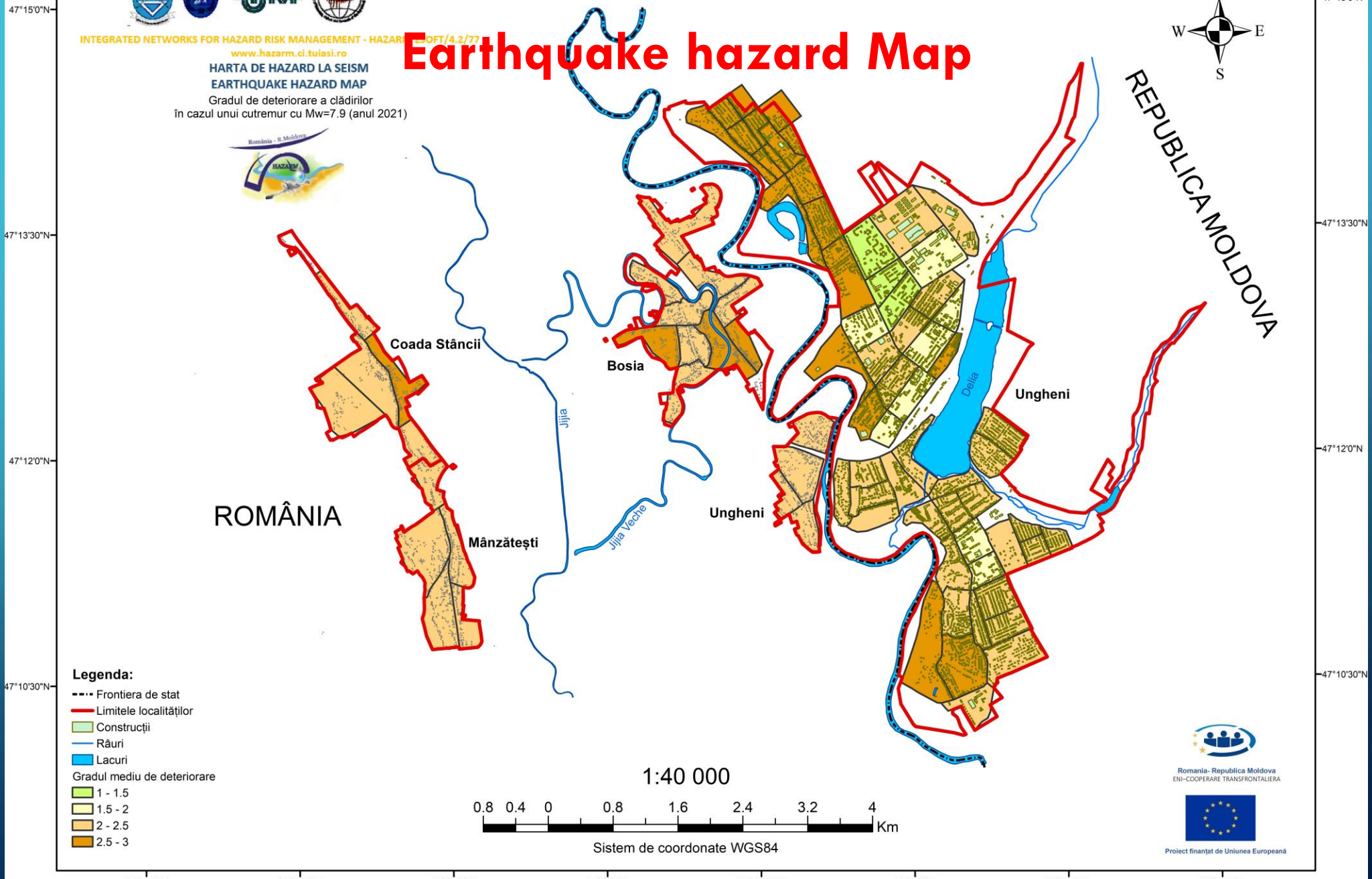
HARTA DE HAZARD LA SEISM
EARTHQUAKE HAZARD MAP
Gradul de deteriorare a clădirilor
În cazul unui cutremur cu Mw=7.9 (anul 2021)



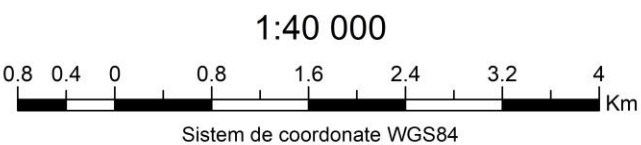
Earthquake hazard Map



REPUBLICA MOLDOVA



- Legenda:**
- Frontiera de stat
 - Limitele localităților
 - Construcții
 - Râuri
 - Lacuri
- Gradul mediu de deteriorare
- 1 - 1.5
 - 1.5 - 2
 - 2 - 2.5
 - 2.5 - 3





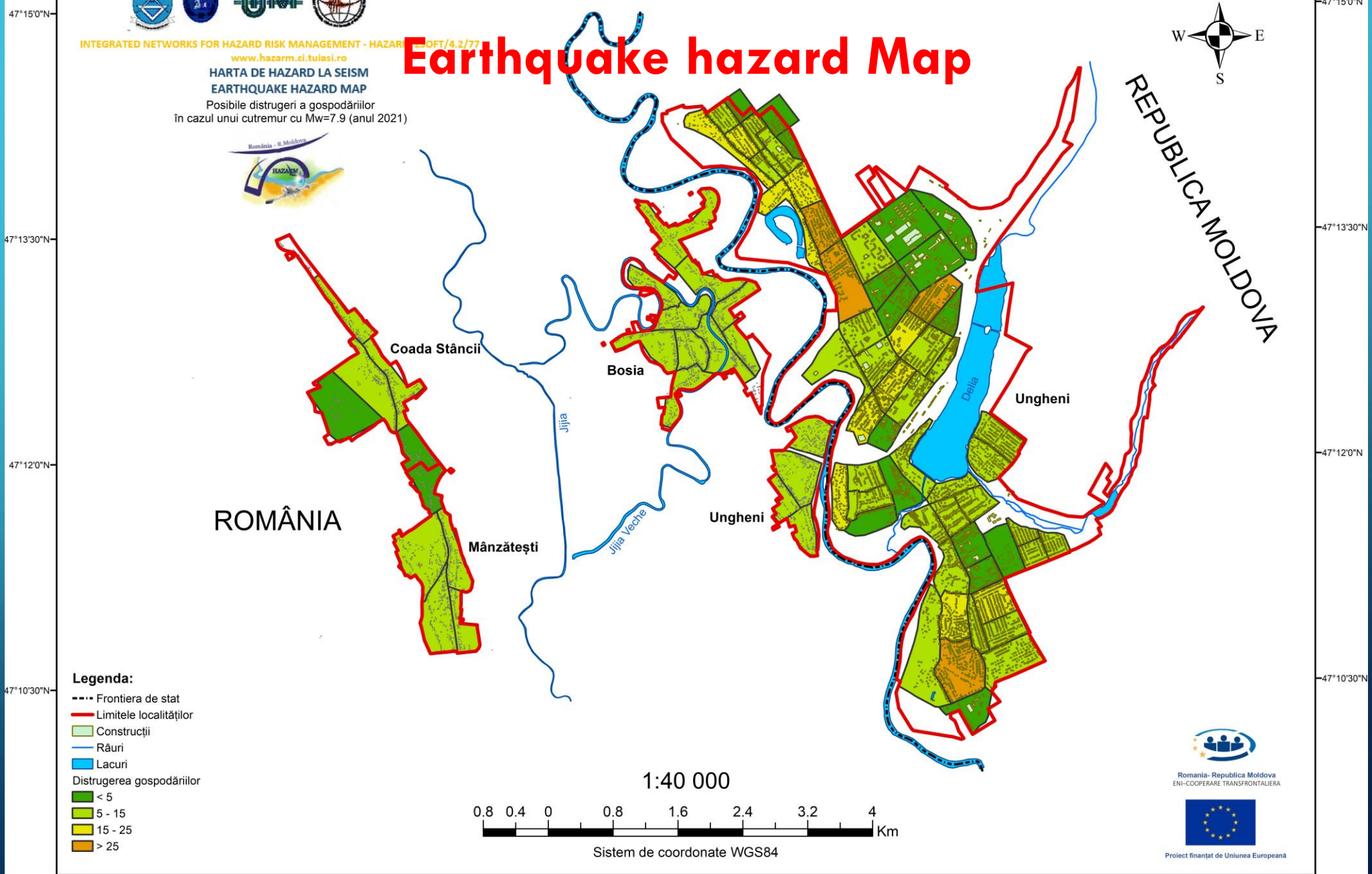
INTEGRATED NETWORKS FOR HAZARD RISK MANAGEMENT - HAZARM - SOFT/4.2/77
www.hazarm.ci.tuiasi.ro

HARTA DE HAZARD LA SEISM
EARTHQUAKE HAZARD MAP
Posibile distrugeri a gospodăriilor
În cazul unui cutremur cu Mw=7.9 (anul 2021)

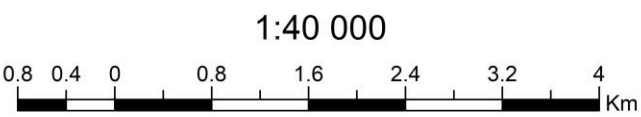
Earthquake hazard Map



REPUBLICA MOLDOVA



- Legenda:**
- Frontiera de stat
 - Limitele localităților
 - Construcții
 - Râuri
 - Lacuri
 - Distrugerea gospodăriilor
 - < 5
 - 5 - 15
 - 15 - 25
 - > 25



Sistem de coordonate WGS84



THE ELEMENTS EXPOSED TO THE DANGER OF FLOODS
IN THE UNGHENI STUDY AREA, ROMANIA ARE
DESCRIBED IN THE TABLE BELOW.

Risk	Constructions		Landuse		Infrastructure (roads)		Intravilan	
	units	suprafac e (mp)	parcels	surface (ha)	sectors	length (km)	settle ments	rface (ha)
0,1% (low)	882	62653.4	42	842.1 6	55	13.50	2(Coad a Stancii, Manzat esti	122.9 5
1% (average)	2	4.5	18	151.8 8	3	0.71	1(Ungh eni)	3.81

Elements exposed to flood danger in the Ungheni study area, Moldova

Risk	Constructions		Land use categories (extra-urban)		Infrastructure (roads)		Intra-urban	
	units	surface (sq. m)		surface (ha)	sectors	length (km)	settlements	surface (ha)
high	678	80482.20		264.4	5	4.51	1 (Ungheni)	518.64



CAUSES

- ✓ The complicated socio-economic situation in the housing and industrial sector, the lack of the necessary amount of reserves, intended for the liquidation of catastrophe damages, for the functioning of the vital insurance systems of the population;
- ✓ Unsatisfactory execution by local authorities of Government decisions in the field of prevention and liquidation of exceptional situations;
- ✓ Financing the civil protection system in the proportion of 20-30% of what is needed. The allocated financial sources do not meet the needs of civil protection in providing the technique, equipment and tools necessary to perform rescue work;
- ✓ Wear of buildings, constructions, technological equipment, means of transport, engineering communications reaching 60-70 percent and more;
- ✓ Low production culture, degraded agriculture, reduction of competence and responsibility of specialists in enterprises, staff turnover;
- ✓ Poor information and indifference of the population.

CONCLUSIONS

- ✓ The Flood In total 678 buildings may be affected during the 1 in 10 years flood event.
- ✓ Hazard and Risk maps should be included in Urban Planning
- ✓ To cope with possible future floodings events is necessary the communication and cooperation with the public, it is necessary to solve the legal foundation of flood hazard and risk maps in near future.
- ✓ This also requires mass spreading of the information about maps being created and about the possibilities of their use.



CONCLUSIONS

- Global practice has shown that events generating exceptional situations cannot be avoided, but sometimes they can be managed and their effects can be reduced through a systematic process involving the establishment of measures and actions to help reduce the risk associated with these phenomena.
- The natural risk phenomena of the last decades have conditioned the need for international cooperation in the field of intensifying the activities of prevention, reduction and combating the negative consequences of the mentioned risks.
- National and local disaster risk reduction strategies must be multi-sectoral, involving policies in areas such as land use, buildings, public health, education, agriculture, environmental protection, energy, water resources, poverty reduction and adaptation to climate change.
- The biggest material damage in Ungheni district is caused by drought, torrential rains and hail.
- In order to reduce the damage caused by these risks, it is necessary to develop prevention measures at local level: exact delimitation of areas at risk, implementation of structural protection measures, proper maintenance of existing infrastructure, creation of local irrigation facilities, information to the population, etc.



ACKNOWLEDGEMENT

”This publication/material has been produced with the assistance of the European Union. The contents of this publication are the sole responsibility of Livia Nistor-Lopatenco, Alexandru Pantaz/ Technical University of Moldova and “Gh. Asachi” Technical University, Iași, Romania and can in no way be taken to reflect the views of the European Union or of the Joint Operational Programme Romania-Moldova 2014-2020 management structures.”





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Thanks

Todi, Italy, 21 August 2023

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