Project funded by the EUROPEAN UNION

SciNet NatHaz Prevention

Black Sea CROSS BORDER COOPERATION

Common Borders. Common Solutions.

A Scientific Network
for Earthquake, Landslide & Flood Hazard Prevention

Current Status Assessment
(Legislation and bibliography review)
Deliverable No.: D.01.01

GA 1. Current Status Assessment, Activities A1.1 – A1.6

RESPONSIBLE: KOERI (IPA Beneficiary)

INVOLVED PARTNERS: ALL

Project Details

Programme	**Black Sea JOP**
Priority and Measure	Priority 2 (Sharing resources and competencies for environmental protection and conservation), Measure 2.1. (Strengthening the joint knowledge and information base needed to address common challenges in the environmental protection of river and maritime systems)
Objective	Development of a Scientific Network
Project Title	**A Scientific Network for Earthquake, Landslide and Flood Hazard Prevention**
Project Acronym	**SCInet NatHaz**
Contract No	MIS-ETC 2614
Lead Partner	TEI OF KENTRIKI MAKEDONIA, GREECE
Total Budget	700.000,00 Euro (€)
Time Frame	
Start Date - End Date	01/05/2013 – 30/04/2015

Book Captain: **A.Ansal, G.Tönük (IPA)**
Contributing Authors: **K. K. Papatheodorou, K. Ntouros, H. Tzanou, S. Issam, A. Konstantinidis, M.Erdik, M.B.Demircioğlu, K.Şeşetyan, O.İlhan, H.Aksoy, V.Ş.Ö.Kırca, G.Çelik, N. Klimis, K. Makra, S. Skias, I. Markou, B. Margaris, N. Theodulidis, C. Papaioannou, A. Savvaidis, M. Rovithis, K. Konstantinidou, E. Tsiras, V. Nenov, L. Tofan, Ghe. Marmureanu, M.J.Adler, M.Lungu, Z. Prefac, A. Sidorenko, E. Zasavitsky, O. Bogdevich, O. Bujor, A. Belinschi, K. Stepanova, O. Rubel**

Document Release Sheet

Book captain:	A.ANSAL (IPA - BU-KOERI)	M.Atilla Ansal 31.01.2014
Approval	K. PAPATHEODOROU (TEI CENTRAL MACEDONIA)	Konstantinos Papatheodorou 31.01.2014
Approval	A.ANSAL (IPA - BU-KOERI)	M.Atilla Ansal 31.01.2014
Approval	N. KLIMIS (Partner 1 - DUTH)	Nikolaos Klimis 31.01.2014
Approval	V. MARGARIS (Partner 2 - EPPO)	Basil N. Margaris 31.01.2014
Approval	V. NENOV (Partner 3 - Burgas Assen Zlatarov University)	........31.01.2014
Approval	L. TOFAN (Partner 4 - Ovidius University of Constanta)	31.01.2014
Approval	A.SIDORENKO (Partner 5 - IEEN "D.GHITU" Of Academy Of Sciences Of Moldova)	31.01.2014
Approval	K. STEPANOVA (Partner 6 - Ukranian Environmental Academy Of Sciences, Black Sea Branch)	31.01.2014
Approved by the Project Coordinator:	K. PAPATHEODOROU	Sign Konstantinos Papatheodorou Date31.01.2014
Distribution:	ALL PARTNERS	

RECORD of REVISIONS

Issue/Rev	Date	Description of Change	Release
1	29.11.2013	Release of final Template Template prepared by K. NTOUROS	I.01
2	25.01.2014	Release of draft document Prepared by A. ANSAL	I.01
3	26.01.2014	Review by K. PAPATHEODOROU	I.02
4	28.01.2014	Review by L. TOFAN	I.03
5	28.01.2014	Review by O. BOGDEVICH	I.04
6	28.01.2014	Review by K. STEPANOVA	I.05
7	29.01.2014	Review by N. KLIMIS	I.06
8	31.01.2014	Release of final document Prepared by A. ANSAL	I.07
9	17.02.2014	Release of final edited document Prepared by A. ANSAL	I.08

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 BACKGROUND OF THE DOCUMENT

1.1 A BRIEF INTRODUCTION TO THE PROJECT’S SCOPES

Natural Hazards especially Earthquakes, Landslides and Floods (ELF), pose a serious threat to societies and a block to sustainable development both in the European Union (EU) and the Black Sea Area [10]. These natural hazards can lead to natural disasters if combined with insufficient capacity to reduce the potential risks. The problem is widely recognized by the EU and a lot of effort has been made evident by directives issued, bodies formed, organizations established and research projects funded by various instruments and funding programmes [1], [11]. The current trend in the EU regarding natural hazard mitigation suggests an integrated approach to disaster mitigation taking into account all four stages of the Natural Hazard Mitigation Cycle – prevention, preparedness, response and recovery – [3], [4], [5], [6], and [7]. The proposed approach to hazard mitigation also suggests that prevention is the primary target, complemented by impact assessment so that preventive measures leading to effective preparedness and response can be planned [2], [5], [8], and [9]. Among the major problems recognized regarding the implementation of the aforementioned targets are: information gaps (data quality, availability, and accessibility), multitude of methodologies used to assess hazards (so there cannot be comparable results) and the lack of applied research on local scales (which could lead to designing of the appropriate preventive measures).

The primary targets of the SciNetNatHaz Project as they are defined in the ANNEX A document submitted are: i) the harmonization of methodologies used to assess each of the ELF hazards, ii) the harmonization of data used, the open/free access over a WebGIS platform, to all the data, maps and results produced by the project partners, iii) the creation of the respective metadata files according to the INSPIRE directive so that data and results provided can be evaluated and used by anyone interested and iv) Earthquake, Landslide and Flood hazard assessment, implemented in pilot areas on a local scale so that preventive measures can be designed.

In this way, the project will contribute to the targets already set by the EU regarding Earthquake, Landslide and Flood hazard mitigation in the near future.

REFERENCES

1. Clark Ian (2012): Towards an EU policy on Disaster Management. European Commission Humanitarian Aid & Civil Protection.
2. Council of the European Union (2009): Council Conclusions on a Community framework on disaster prevention within the EU 2979th JUSTICE and HOME AFFAIRS, Council meeting Brussels, 30 November 2009
3. Commission of the European Communities, Proposal for a Directive of the Council (2006): On the identification and designation of European Critical Infrastructure and assessment of the need to improve their protection. COM (20060 787 final, Brussels, 12.12.2006

4. Commission of the European Communities (2008): Communication from the Commission to the European parliament, the Council on Reinforcing the Union's Disaster Response Capacity.
5. Commission of the European Communities (2009): Communication from the Commission to the European parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A Community approach on the prevention of natural and man-made disasters
6. European Commission Research Directorate General (2003): Background Information for Press Release: Floods: European research for better predictions and management solutions, Dresden, (13 October 2003).
7. European Commission: Research and innovation: Workshop on RESEARCH: Floods!: Managing the risks of flooding in Europe. Conference Proceedings, (2006)
8. European Commission DG Environment (2008): Accessing the potential for a Comprehensive Community Strategy or the Prevention of Natural and Manmade Disasters, Final Report.
9. European Commission DG Environment (2008): Member State's approaches towards Prevention Policy-A critical analysis, Final Report.
10. European Commission. European Research Area (2009): Principles of Multi-Risk Assessment. Interaction amongst natural and man-induced risks.
11. Papatheodorou K., Klimis N., Margaris B., Ntouros K., Evangelidis K., Konstantinidis A. (2014): Natural hazard Prevention in the Black Sea area: the "SciNetNatHaz" Project. AQUALIRES International Conference Proceedings, Bucharest, January 2014.

1.2 SUMMARY

The first Group of Activities, GA1 of this Project, for which this Deliverable is an output, provides the necessary base for scientific exchange and transfer of technical knowledge regarding the ELF hazard assessment, taking into account the experience and expertise of each partner.

This Deliverable, named "*Current Status Assessment*", includes actions dealing with the identification of the current status in terms of legislation and state-of-practice regarding landslide, flood and seismic hazards and their effects on the environment and on societies. In the scheduled following Deliverable of GA1, reviewing and evaluation of the existing methodologies regarding natural hazard impact assessment will also be included so that a clear perspective of the current status for the implementation areas and the possibilities to develop and to implement advanced scientific procedures can be investigated.

1.3 SCOPE AND OBJECTIVES

The scope of GA1 can be summarized in the following items:

a. recording of the existing legislation framework in every one of the participant countries regarding landslide, flood and seismic hazard prevention and management,

b. review of the available bibliography (existing projects, relative publications, registered events) regarding landslide, flood and seismic hazard at regional and local scales, which is necessary in order to achieve a common base of data and state of art and/or practice,

c. evaluation of existing models and methodologies assessing seismic, landslide and flood hazards in terms of scientific soundness, data demands and credibility of produced results. Therefore, the aforementioned hazard assessment models will be modified, adapted, or even new ones may be developed according to the local conditions in order to assess hazards at a regional scale.

The first two items given above are the objectives of this Deliverable. The Activities corresponding these objectives are as follows:

1. Recording of the
    - existing legislation framework in relation to landslide (A1.1), flood (A1.2) and seismic (A1.3) hazard prevention and management.
    - already implemented landslide (A1.1), flood (A1.2) and seismic (A1.3) hazard prevention studies.
    - past landslide (A1.1), flood (A1.2) and seismic (A1.3) events and their consequences.
2. Review of available bibliography regarding methodological approaches for landslide (A1.4), flood (A1.5) and seismic (A1.6) hazard assessment at regional and local scales.

As a result of these Activities, systematization of the existing legislation framework, recording of technical and managerial experience, state of practice and methodological approaches of all countries participating to this Project, regarding assessment and management of three important hazards (seismic, landslide and flood hazard) at a regional scale are expected as outputs.

1.4 RELATED DOCUMENTS

1.4.1 Input

List of former deliverables acting as inputs to this document

Document ID	Descriptor
1.	Kick Off Meeting Minutes
2.	1st Progress Meeting Report GA 5. Management and Coordination, activity 5.4

1.4.2 Output

List of other deliverables for which this document is an input.

Document ID	Descriptor
1.	D.1.02 : Current status assessment / evaluation of existing hazard assessment models AND Development / modification / adaptation of existing models

2 INTRODUCTION

In this Deliverable, legislation framework of each participating country, concerning seismic, landslide and flood hazard assessment will be presented.

National state of art and state of practice of the aforementioned hazards will be also included, documented and substantiated by relevant studies and bibliography.

Records of real events concerning the three above mentioned hazards in the proposed areas of implementation will also be stated and synthesized.

The Deliverable is an output to the Activities: 1.1, 1.2, 1.3, 1.4, 1.5, and 1.6 of Group Activities 1 of the Project.

3 LANDSLIDE HAZARD PREVENTION AND MANAGEMENT (ACTIVITY A1.1)

3.1 TURKEY

3.1.1 Past Events and Their Consequences

The investigation performed for quantifying landslide hazard distribution in Turkey reveals that almost all cities in Turkey have been exposed to landslide damage to some extent.

As a result of counting the number of events in every city in Turkey, it is observed that at most 1123 and at least 3 landslide incidents have been encountered. The maximum number of landslides with respect to cities can be sorted from highest to lowest as; Trabzon (1123), Rize (1049), Kastamonu (613), Erzurum (573), Artvin (471). Whereas, the minimum number of landslides can be given from its lowest to highest as; Kırklareli (3), Mardin (4) and Şanlıurfa (6). The total number of events between 1950 – 2008 is declared as 13494. When the number disaster victims affected from hazardous consequences of landslides are evaluated, the most affected province in Turkey is Trabzon with the total of 4106 disaster victims.

The investigations on the basis of landslide damages in the Black Sea Region show that 73.6% of all towns (679 of 922) are exposed to landslide incidents. As an example; Bartın – Ulus (310), Trabzon – Maçka (238), Rize – Çayeli (213), Rize – Merkez (208) and Karabük – Yenice (189) are the most affected towns in Turkey. If the comparison is made based on the number of disaster victims, the town of Karabük – Yenice (1388) has the highest number. The towns subjected to utmost damage and destruction can be listed as; Malatya – Hekimhan (1345), Bursa – İnegöl (1319), Muş – Merkez (1192) and Bartın – Ulus (1160).

The most susceptible regions in Turkey to landslides are concentrated in the vicinity of East Black Sea (Trabzon and Rize), Central and West Black Sea (Karabük, Bartın, Zonguldak and Kastamonu) and also along active faults and fault zones.

In addition to this table, the most devastating landslide events recorded in Turkey are listed below;

1. 1985 Western Black Sea Landslides: Due to a heavy snowy winter followed by spring season, immediate snow melting was occurred on hillside of Zonguldak, Kastamonu and Sinop, resulting in landslides affecting 1684 housing units in these provinces.
2. 23.06.1988 Çatak Landslide: 46 people lost their lives owing to sliding event in the vicinity of Trabzon – Maçka – Çatak.
3. 21.07.1988 Rize Landslides: Three provinces of Rize were affected from landslide and flooding incidents. 3 people lost their lives.

Table 3.1 The most damaged 20 districts with respect to the number of disaster victims

Province	District	# of Landslide	# of Victim
Karabük	Yenice	189	1388
Malatya	Hekimhan	127	1345
Bursa	İnegöl	178	1319
Muş	Merkez	70	192
Bartın	Ulus	310	1160
Ankara	Mamak	89	919
Trabzon	Maçka	238	896
Kars	Kağızman	76	796
Çorum	Sungurlu	83	717
Giresun	S. Karahisar	110	704
Bingöl	Merkez	108	672
Gümüşhane	Kurtun	40	590
Denizli	Babadağ	23	573
Eskişehir	Mihalıççık	28	554
Trabzon	Düzkoy	61	549
Sinop	Ayancık	133	515
Bitlis	Hizan	102	506
İstanbul	Avcılar	5	499
Çankırı	Yapraklı	50	469
İçel	Merkez	85	466

4. 19/20.06.1990 Trabzon – Giresun – Gümüşhane Landslides: 65 people lost their lives after the sliding and flooding events in these cities.
5. 13.07.1995 Senirkent Mudflow: 74 people lost their lives owing to the mud flow in Isparta – Senirkent.
6. 20/21.05.1998 West Black Sea Landslides: Landslides influencing 1330 housing units and floodings damaging approximately 5500 dwelling units were observed.
7. 07/08.08.1998 Trabzon – Beşköy Landslides: 50 people lost their lives and 100 dwelling units were demolished.
8. 23/24.07.2002 Rize Landslides: 20 of all being in the village of Selamlet, in total 27 people lost their lives.
9. 17.03.2005 Kuzulu Landslide in the Village of Sugözü, Sivas – Koyulhisar District: 15 people lost their lives in the sliding event occurred around 10:30 in 17.03.2005.

The landslide inventory prepared by the Ministry of Environment and Urban Planning is also presented below.

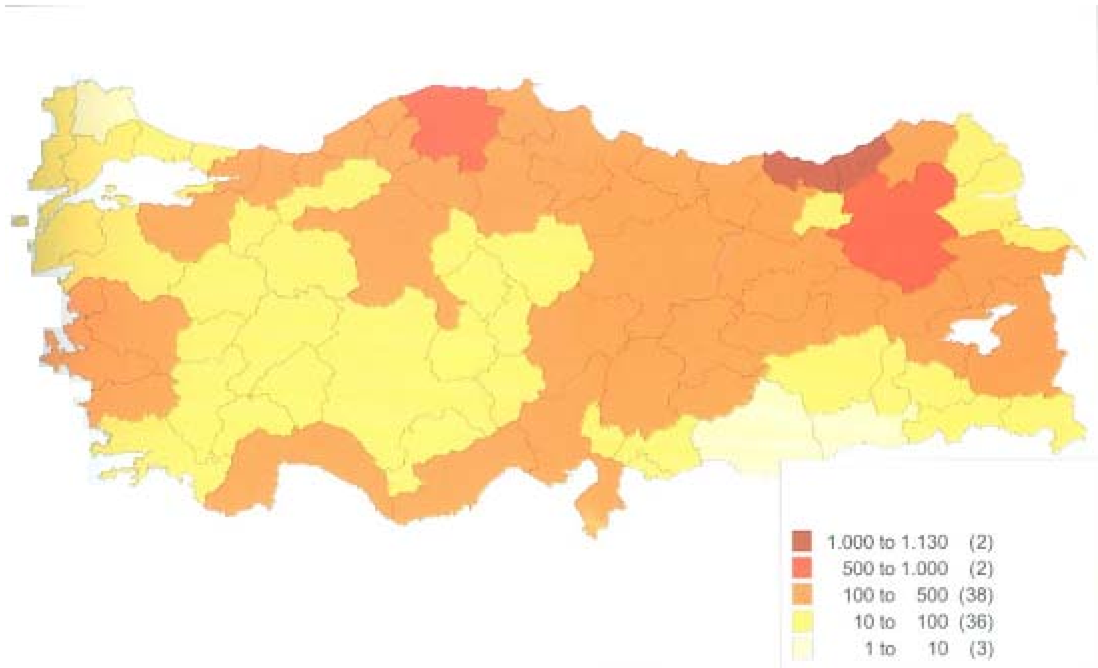


Fig 1. Landslide distributions with respect to provinces

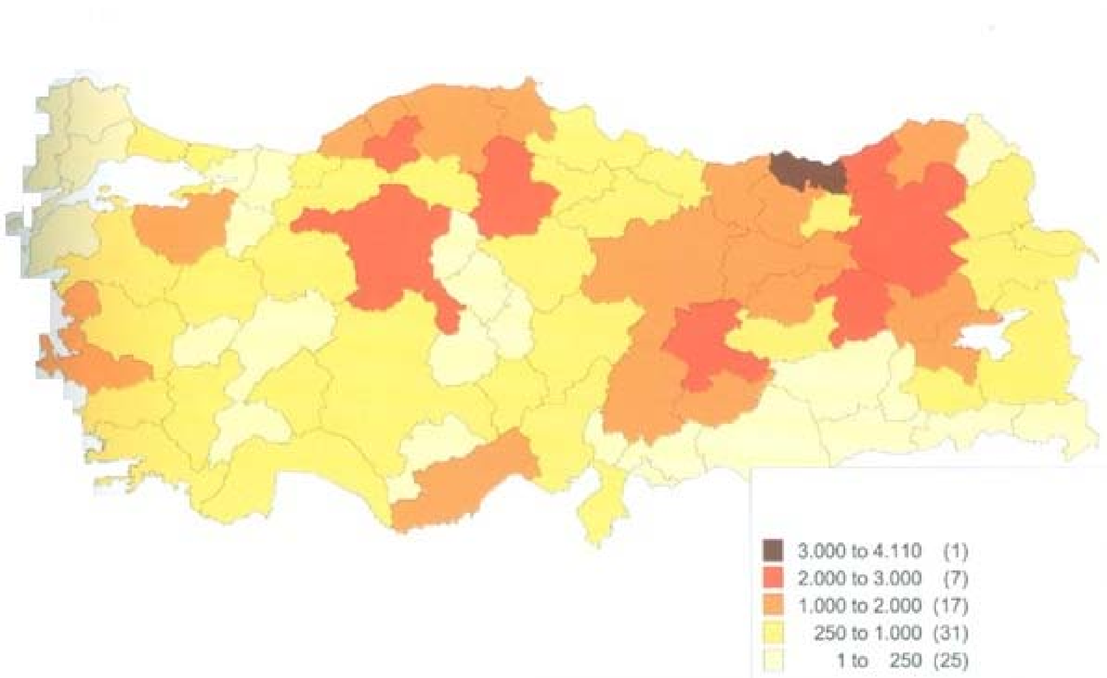


Fig 2. The number of disaster victims with respect to provinces

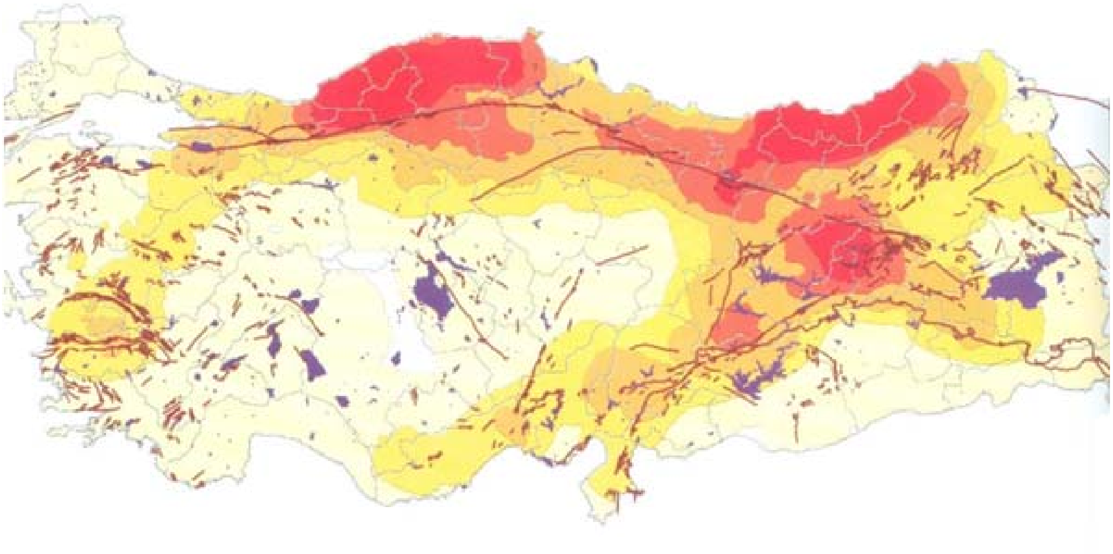


Fig 3. Relationship between active faults and landslide density map

3.1.2 Existing Legislation Framework

The Turkish legislative framework for landslide risk management is called as "Disaster Law No. 7269 Pertaining to the Precautions Taken for Mitigating the Devastating Effects of Disaster on Public Life"

1. Article–1 (Release Date: 25.05.1959/Amendment(s): 02.07.1968 & 27.12.1993):

The definition of disaster relief law, the duties assigned to the Ministry of Public Works and Settlement relevant to quantification of damage after the disaster occurrence and to the declaration of disaster to the public.

2. Article-2 (Release Date: 25.05.1959/Amendment(s): 02.07.1968):

That which ministry is assigned to deal with the consequences of relevant disaster, the creation of zoning map displaying the district disaster boundaries by the decision of council members according to the determination of agent civil servants and tender of the Ministry of Public Works and Settlement is mentioned.

3. Article-3 (Release Date: 25.05.1959/Amendment(s): 02.07.1968):

The responsibility of Ministry of Public Works and Settlement to development/application of technical regulations which the structures are planned to be constructed after the occurrence of disaster, the obligation of relevant municipality/governorship to application of these technical regulations within/out of the adjacent area and the responsibility of the Ministry of Public Works and Settlement in the case of landslides, avalanches and of the General Directorate of the State Hydraulic Works in the case of flooding.

4. Article-4 (Release Date: 25.05.1959/Amendment(s): 02.07.1968):

That the establishment of institutions by courtesy of Ministry of Public Works and Settlement in order to cope with the consequences of disasters and to release publications concerned with the effects of calamities in an aim to inform the public opinion is mentioned.

5. Article-5 (Release Date: 25.05.1959):

That the establishment of institutions by courtesy of Ministry of Public Works and Settlement in order to cope with the consequences of disasters and to release publications concerned with the effects of calamities in an aim to inform the public opinion is mentioned.

6. Article-6 (Release Date: 25.05.1959//Amendment(s):02.07.1968):

The privileges given to the district governors and governorships in order to fulfil the needs of disaster victims after the occurrence of calamities and the obligation of Ministry of Public Works and Settlement to create funds for recovering the destructive effects of disasters

7. Article-13 (Release Date: 25.05.1959/Amendment(s): 02.07.1968 &31.08.1999 (a, b) & 29.05.2003 (a)):

In the point (a), the responsibility of Ministry of Public Works and Settlement to prepare damage assessment reports after disaster, its freedom to charge the relevant technical staff for the preparation of corresponding reports and the time limit set for proprietor’s right of objection to the damage assessment reports are presented. In point (b), (c), (ç) and (d), the status defined for structures not likely to be renovated, official structures, structures damaged due to the landslide or rockfall, the satisfaction of shelter need for disaster victims are mentioned, respectively.

8. Article-14 (Release Date: 25.05.1959/Amendment(s): 02.07.1968):

That the Ministry of Public Works and Settlement’s right of decision on preventing constructions in most risky areas, the declaration of this provision given to the relevant municipality/council of elders within/out of the adjacent areas, respectively, the penalties imposed by the Ministry of Public Works and Settlement in the case of violation of this institution’s judgements is presented.

9. Article-15 (Release Date: 25.05.1959/Amendment(s): 02.07.1968):

That the Ministry of Public Works and Settlement’s right to speak on whether there is a need to change in zoning map of disaster areas or not, the necessity to demolish sheds built after disaster within one year, If not, the authority given to the administrative chief take this action and the Ministry of Public Works and Settlement’s right to enlarge the time defined for this demolishment process is mentioned.

10. Article-16 (Release Date: 25.05.1959/Amendment(s): 02.07.1968):

That the Ministry of Public Works and Settlement’ s charge to habitation of disaster victims after incident by means of council of ministers’ decision depending on the assessments performed by technical staff and the requirement of council of members’ judgement for this process in the case of adjacent area, otherwise, not is mentioned.

11. Article-29 (Release Date: 25.05.1959 / Amendment(s): 31.08.1999 & 29.05.2003 & 09.05.2012):

That the Ministry of Public Works and Settlement’ s privilege to hold whether disaster victim having right on older damaged structure is given any right on new renovated/constructed structure, no possibility to become holder of right on structures built without having building/construction permit in areas under threat of landslide, or rockfall is presented. The clause added in 2012 says that the structures which are incorporated into compulsory earthquake insurance by government but not assured by its owner are eliminated in terms of its right of habitation.

12. Article-30 (Release Date: 02.07.1968):

That the protection of common rights on renovated/newly constructed structures, but if multi-families be dwelling in interested building, each of them has right on newly constructed one is mentioned

13. Article–50, 51, 52, 53:

The legal arrangements on articles included in the Disaster Relief Law

14. Supplementary Item–1, 2 (Release Date: 02.07.1968):

That the Ministry of Public Works and Settlement' s charge to provide construction materials, potable water and power plants to disaster victims is mentioned.

15. Supplementary Items–3, 4 (Release Date: 02.07.1968):

That the Ministry of Public Works and Settlement' s right on postponement of disaster victims' loans to relevant institutions and the ones constructing buildings in order to fulfil their shelter need can be privileged on discounts of up to half of the their loans by council of members' decision is mentioned.

16. Supplementary Item-5 (Release Date: 02.07.1968/Amendment(s): 20.6.2001):

That the Ministry of Public Works and Settlement' s charge on works for mitigating the consequences of calamities and the responsibilities of the other ministries and institutions to put relevant technical staff under the Ministry of Public Works and Settlement' s order is presented.

17. Supplementary Item - 6, 8 (Release Date: 02.07.1968, 16.11.1995):

That the funds required for recovering the hazardous effects of calamities are monitored by exchequer court and the Ministry of Public Works and Settlement' s charge on financing the renovation of buildings in villages, districts and provinces is presented.

18. Supplementary Items - 9, 10 (Release Date: 15.10.1999/Amendment(s): 27.05.2004, Release Date: 08.12.1999 (10)/Amendment(s): 23.03.2000):

That the relevant institutions' right to assign areas bearing the qualification of pastures and foresties but no benefit of preserving them to the need of disaster victims is presented.

19. Supplementary Item – 11, 12 (Release Date: 15.10.1999, 31.05.2006):

That the provisions on donations and aids to the disaster victims and on structures constructed in the custody of the Ministry of Public Works and Settlement are presented

20. Provisional Clauses – 1, 22 (Release Date: 02.07.1968 - 23.03.2000):

1. The special provisions introduced after 17.09.1999 and 12.11.1999 Earthquakes
2. The provisions on satisfaction of disaster victims' basic needs after calamities and funds allocated for these processes
3. The provisions on credits given to the disaster victims after incidents

REFERENCES

1. Gökçe O., Özden Ş., Demir A., Türkiye'de afetlerin mekansal ve istatistiksel dağılımı afet bilgileri envanteri *(The inventory of spatial and statistical distribution of hazards in Turkey)*, Ankara, The Ministry of Public Works and Settlement, General Directorate of Disaster Affairs (2008)
2. Şen S. C., Erdemli (Mersin) ilçesinde yağışlara bağlı olarak gelişen heyelanların incelenmesi *(An Investigation on Landslides due to rainfall in Erdemli District of Mersin)*, Çukurova University, Institute of Science and Technology, Adana (2009)
3. Disaster Law No. 7269 Pertaining to the Precautions Taken for Mitigating the Devastating Effects of Disaster on Public Life, Official Journal (25.05.1959)
4. Natural Disasters Insurances Law No: 6305, Official Journal (09.05.2012)

3.2 GREECE

3.2.1 Past Events and Their Consequences

Table 3.2. Past events and their consequences

№	Year	Area	Type of landslide	Consequences
1	1906	Akrata (Aghia Varvara) / Achaia	Debris slide (scree deposits)	Destruction of retaining structures
2	1963	Aigio (Chatzis) / Achaia)	Debris flow	Cracking of house walls, damages on structures foundations, soil surface cracks
3	1920, 1989	Alsos (Achaia)	Translational debris slide	Cut of provincial road
4	1965, 1968	Aigio (Toumba) / Achaia	Rotational sliding	Indirect risk of the nearby agglomeration
5	1956, 1980, 1982	Patra (Moira) / Achaia	Soil flow	Soil surface cracks, divergence of trees and other vertically standing elements, cut of access road, loss of cultivated land
6	1987	Neos Eryneos / Achaia	Creep	Cracks on the pavement of the road and limited damage on houses
7	2000	Patra / Achaia	Rotational sliding	Cracking and failure of the road
8	1966, 1972, 1983	Kalentzi / Achaia	Creep & soil flow	Partial damage of buildings, cracks on walls of buildings and retaining structures
9	1981	Kalavryta (Kastria) / Achaia	Soil flow	Detachment of provincial road and damage of fields
10	2002	Ano Diakopto (Road Pounta-Kalavryta) / Achaia	Translational sliding – Soil flow	Failure of road embankment & detachment of provincial road
11	1948, 1951, 1952	Paos / Achaia	Debris flow	Cracks and damages on buildings and roads, with destruction or changes of water sources locations
12	2003	Tsoukalades-Aghios Nikitas road (Pefkoulia) / Lefkada island	Rock falls, debris slide (scree deposits)	Partial damage of the road with partial road coverage due to rock falls and scree deposits
13	2003	Kalamitsi / Lefkada island	Rotational sliding and rock falls	Open tension cracks on road pavement and local road destruction
14	2003	Aghios Nikitas / Lefkada island	Rock toppling, rock falls, rock sliding and debris sliding	Road damaged and a number of cars squeezed under rock blocks of several cubic meters
15	2001	Skyros island	Rock toppling, rock falls, rock sliding and debris sliding	Pen tension cracks on top of the hill where a castle is located; cars destroyed by rock blocks and parking area partially covered by

				debris and rock blocks toppled; monastery's foundation partially damaged due to rock mass relaxation
16	1995	Broader area of Grevena	Rock falls, slide rotational and translational	Partial coverage of road
17	1995 to 2005	Road Milea – Krania, broader area of Grevena	Shallow translational soil sliding with rock toppling	Coverage of the road and interruption of circulation; accidents with cars hit by debris and rock blocks
18	2005, 2006	Syrtos, broader area of Grevena	Rotational sliding	Destruction of tunnel entrance of Egnatia Motorway
19	2008	Santomeri / Achaia	Rockfalls, rock toppling	Total damage of 1 house and direct risk for the whole village
20	2008	Portes to Valmi road / Achaia	Rockfalls and debris flow	Local damage of the road pavement
21	2008	Kato Achaia	Debris sliding	Partial cover of the road
22	1991 to 2008	Malakasi, broader area of Metsovo	Rotational sliding with rock falls	No damages (during construction of Egnatia Motorway)
23	2001	National road Metsovo – Ioannina (location: Peristeri)	Creep and rotational sliding	Failure of a gravitational retaining wall
24	?	Eptachori, broader area of Kastoria	Rock toppling and rock sliding	Damage of buildings in Eptachori village
25	Since 1980	Skala Paramythias	Rock falls and rotational sliding	Reported human injuries and car accidents and damage of the road
26	2009	Nestos river, Egnatia Motorway	Rotational and translational sliding	Local damage of the Egnatia Motorway on the branch towards Thessaloniki
27	2000	Aghia Paraskevi (Evrytania)	Translational sliding	Total damage of the provincial road to the town of Agrinion and interruption of the traffic for several months
28	Since 1980	Prousos (Evrytania)	Debris sliding to debris flow	Interruption of traffic and serious damage of the road
29	1995	Malakasa (National Road Athens – Lamia, 36th Km)	Rotational sliding	Interruption of traffic on national road and railway
30	1971	Panagopoula (New National Road Athens – Patras)	Rotational sliding	Interruption of traffic on national road and railway
31	1993	Tsakona (National Road Tripoli – Kalamata)	Rotational sliding	Interruption of traffic on national road
32	2009	Tempi area (National Road PATHE)	Rock falls and rock toppling	One fatality and few human injuries, damage of cars, of the road and interruption of the traffic for a few months
33	2009	Vertical axis No 75	Translational and	No consequences (during

		of Egnatia Motorway (Komotini – Nymfaia)	rotational sliding	construction stage)
34	2012	Tempi area between tunnels T1 & T2 (Maliakos – Kleidi)	Essentially translational sliding	No consequences (during construction stage)
35	2003	Egnatia Motorway – Baldouma (National Road Trikala – Ioannina)	Creep and rotational sliding	Partial coverage of the road; difficulties in traffic
36	2010	Thermes (broader area of Xanthi)	Debris slide	Local damage of the provincial road and creation of a bypass for traffic needs

3.2.2 Existing legislation framework

1. Risk address from the action of seismic events, Planning and Public Works, YA 1299/2003, ΦΕΚ 423/Α΄/2003

   2.5 Search and rescue operations

   2.6 Control and suppression of induced phenomena

   Reference: Civil Protection (www.civilprotection.gr) EgikliosSismon2012_el_GR.pdf

2. Risk address from the action of flooding events, Planning and Public Works, Κ.Υ.Α.Η.Π.31822/1542/Ε103/20-07-2010 (ΦΕΚ 1108/Β΄/2010)

   3.3 Involvement of Municipalities Regions and Organizations in the immediate emergency response and consequence management due to flooding

   3.5 Search and rescue operations

   Reference: Civil Protection (www.civilprotection.gr) Egkyklios_plhmmyrwn_etous_2012_el_GR.pdf

3. Risk address from the action of flooding events, Planning and Public Works, Κ.Υ.Α.Η.Π.31822/1542/Ε103/20-07-2010 (ΦΕΚ 1108/Β΄/2010)

   3.6 Control and Suppression of Induced Phenomena

   Reference: Civil Protection (www.civilprotection.gr) SxediasmNEOJul2009Seismon_el_GR.pdf

4. Special project management for human loses, Planning and Public Works, YA 1299/07.04.2003 (ΦΕΚ 423Β)

   Project "Xenocrates": General guidelines for management of hazards with extensive number of human losses (Earthquakes, Landslides, Floods, Forest Fires etc.)

Reference: Civil Protection (www.civilprotection.gr) SDAA-EKDOSI_1_el_GR.pdf

5. An update of the special project management for human loses, Planning and Public Works, Government Gazette, Y.A. 3384/2006 (ΦΕΚ 776/28-6-06)

   A modification and update of the project "Xenocrates" which aims to develop an effective disaster response system for natural hazards such as earthquakes, landslides, avalanches, etc.

   Reference: Civil Protection (www.civilprotection.gr) Appendix B'

3.2.3 Implemented landslide hazard prevention studies

Landslides in Greece usually occur in the central and western parts of the country. According to the landslide hazard map made by Koukis et.al. (2005), most of the landslides occur in Pindus mountains, in the northern parts of Peloponnese, in Pieria (Central Macedonia), in Pelio (Thessaly), in the Western Sterea Hellas and in Crete (Fig 4).

The influencing factors of landslide occurrence in Greece, are numbering (Koukis & Ziourkas, 1989) a total number of 64 different factors, the first 10 of which are: erosion, water pore pressure increase, texture and lithology of slopes, weathering of porous rocks, slope geometry, presence of clay, intense rainfall, presence of alternating permeable and impermeable rocks, vibrations (seismic or anthropogenic factors). As is evident, landslide susceptibility which depends mostly on the geologic parameters plays a key role and rainfall as the triggering factor influence the occurrence of landslides in Greece. In this case, the most important geologic parameters influencing landslide susceptibility are related to the texture, nature and the geotechnical behaviour of the geologic formations against water.

Having said that, earthquakes form another landslide triggering factor, as there is a high level of seismicity in Greece. In this case, landslide susceptibility mostly depends on the fracture regime of rock formations, their level of fragmentation, orientation of discontinuities and geologic planes (schistocity, contacts, faults etc.).

Rainfall has been found to correlate to the type/depth of landslides (Buma & Dehn, 1998)

Landslides in Greece were classified according to the depth of the landslide slip surface in four categories (Koukis & Ziourkas, 1989): Superficial (depth < 1.5m), Shallow (depth<5m), Deep (depth<20m) and very deep (depth >20m) (see Fig 7).

Koukis & Ziourkas (1989) found that 61% of landslides occurred in areas where vegetation was eliminated due to anthropogenic interventions.

Concerning landslide types, according to Koukis et al (1994), the three most prominent landslide types are circular slides, creep and soil flows.

In terms of the geologic rock type, flysch is the most susceptible geologic formation (30.35% of the total number of landslides), Neogene formations (28.2%) and Tertiary sediments (20.7%) (Koukis et al, 1994).

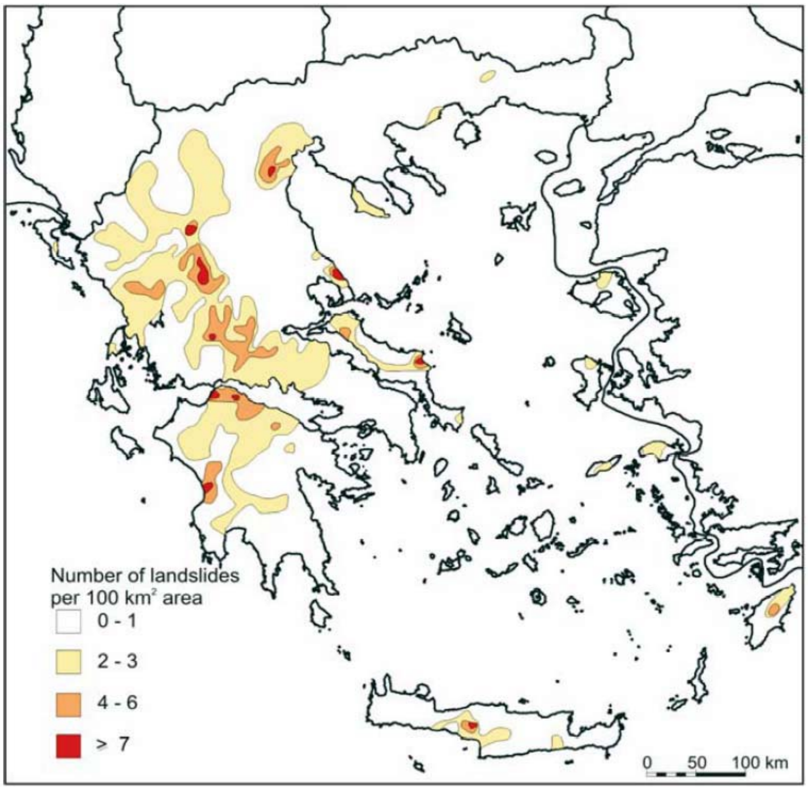


Fig 4. Landslide Hazard Zonation map in Greece (Koukis et.al. 2005)

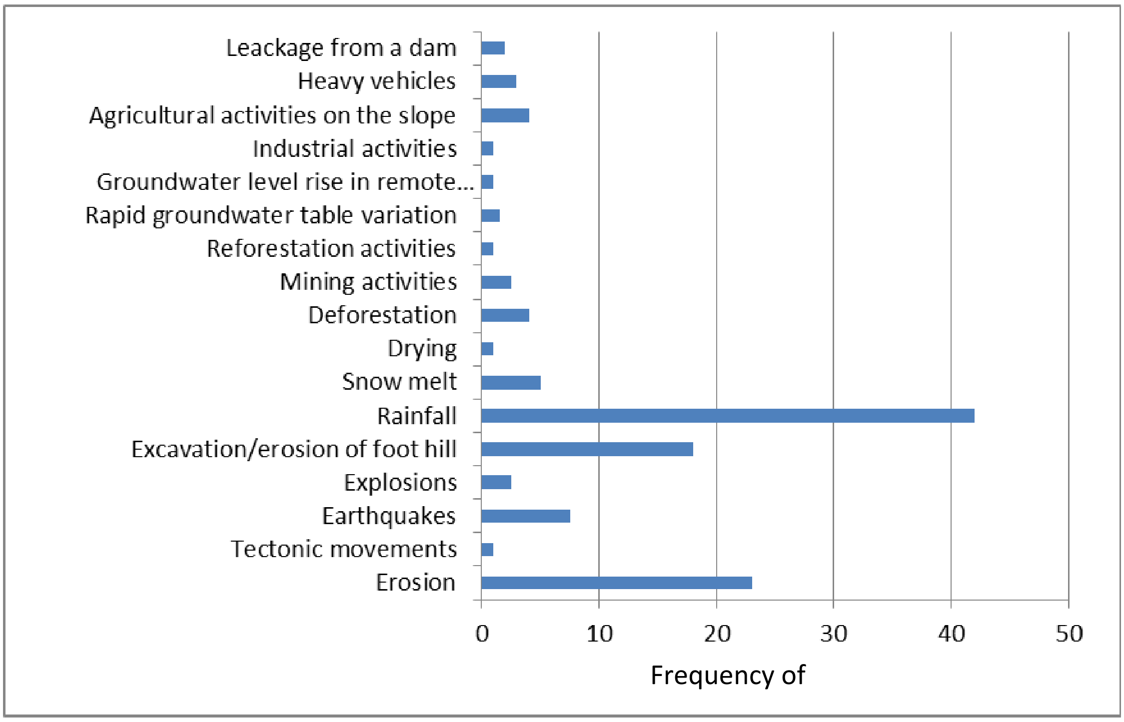


Fig 5. Classification of landslide triggering factors (Koukis & Ziourkas, 1989 modified by Papanikolaou & Diakakis, 2011)

Debris flows		Slides	Deep Slides
Depth of sliding plane	Superficial	2-10m	10-40m
Climatic triggering	High intensity storm	Increased rainfall on a day/month level	Increased rainfall on a month/year scale

Fig 6. Failure types and type of triggering rainfall (Buma & Dehn, 1998)

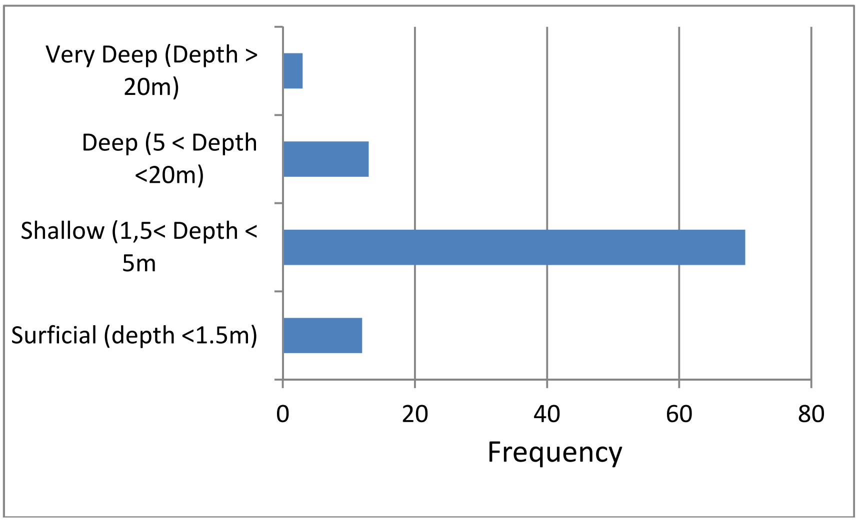


Fig 7. Landslide frequency according to depth-to-the-slip surface.

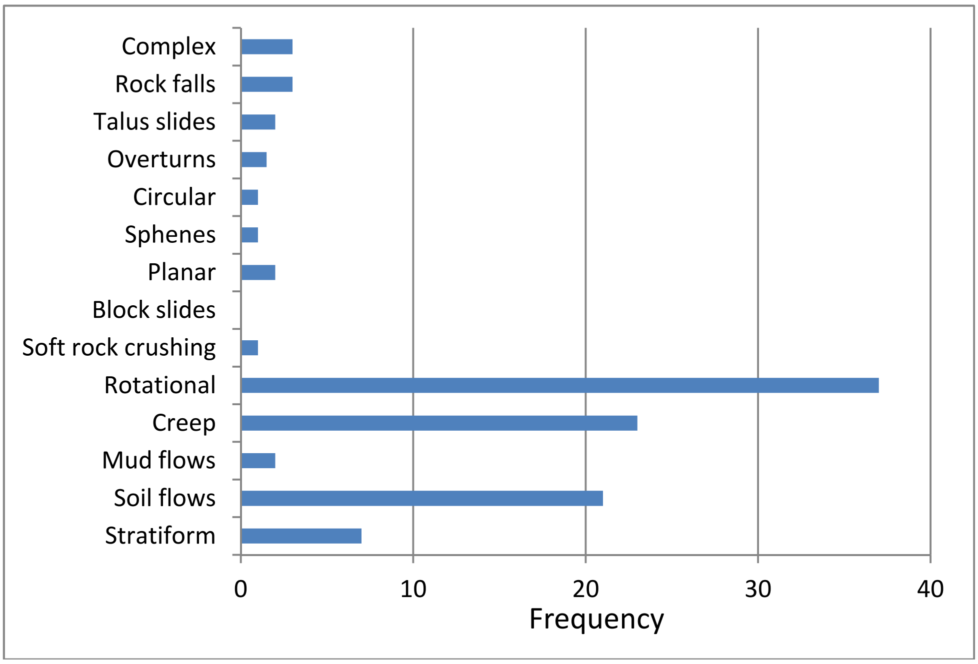


Fig 8. Landslide frequency classification according to landslide type (by Koukis & Ziourkas, 1994).

In most cases, landslides occur in slopes dipping 16-30o (57% of landslides) and from 31 to 45o (23%) (Koukis et al, 1994).

Rainfall and especially rapid precipitation and heavy rain, form the most prominent triggering factor. By analysing a total number of 1200 landslide events all over Greece, Koukis et al (1997b) have found that more than 90% of the events were triggered by rainfall (Fig 9)

The relationship between rainfall as a triggering factor and landslide occurrence seems to be so strong that Koukis & Ziourkas (1989) suggest that there is an exponential relationship between them (Fig 10).

In Greece, the Institute of Geology and Mineral Exploration (I.G.M.E.) is the Institution where an inventory of approximately 2000 landslides is reported (www.igme.gr). Also in the Laboratory of Engineering Geology of University of Patras there exists a Landslide Inventory Database of about 1200 landslides (www.geoarch.gr).

Hereafter, a topography map coming from the I.G.M.E. database, where 1238 landslides are located and correspond to the time period up to 1998. Another 397 landslides corresponding at the period of 1998 – 2003, have been later added by Mpliona (2008), but are not presented in the topographic map of Fig 11.

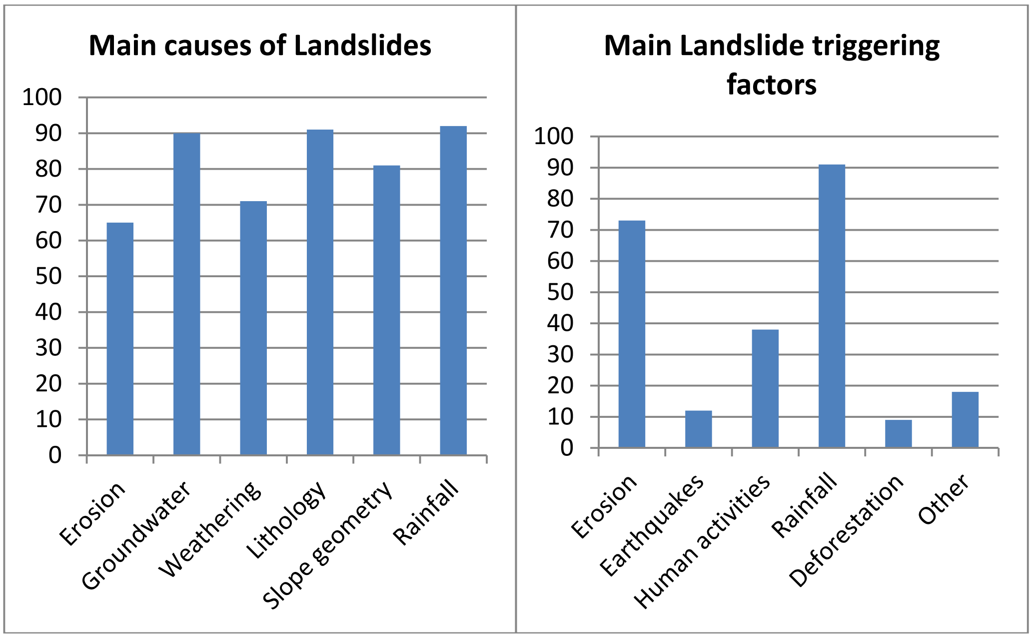


Fig 9. Landslide triggering factors frequency in Greece (Koukis et al, 1997b)

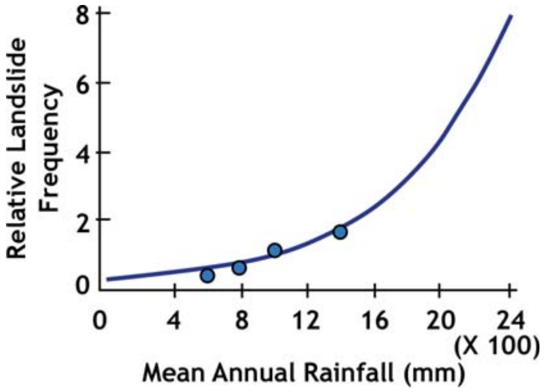


Fig 10. Mean annual rainfall (mm) plotted against relative landslide frequency in Greece (Koulis & Ziourkas, 1989).

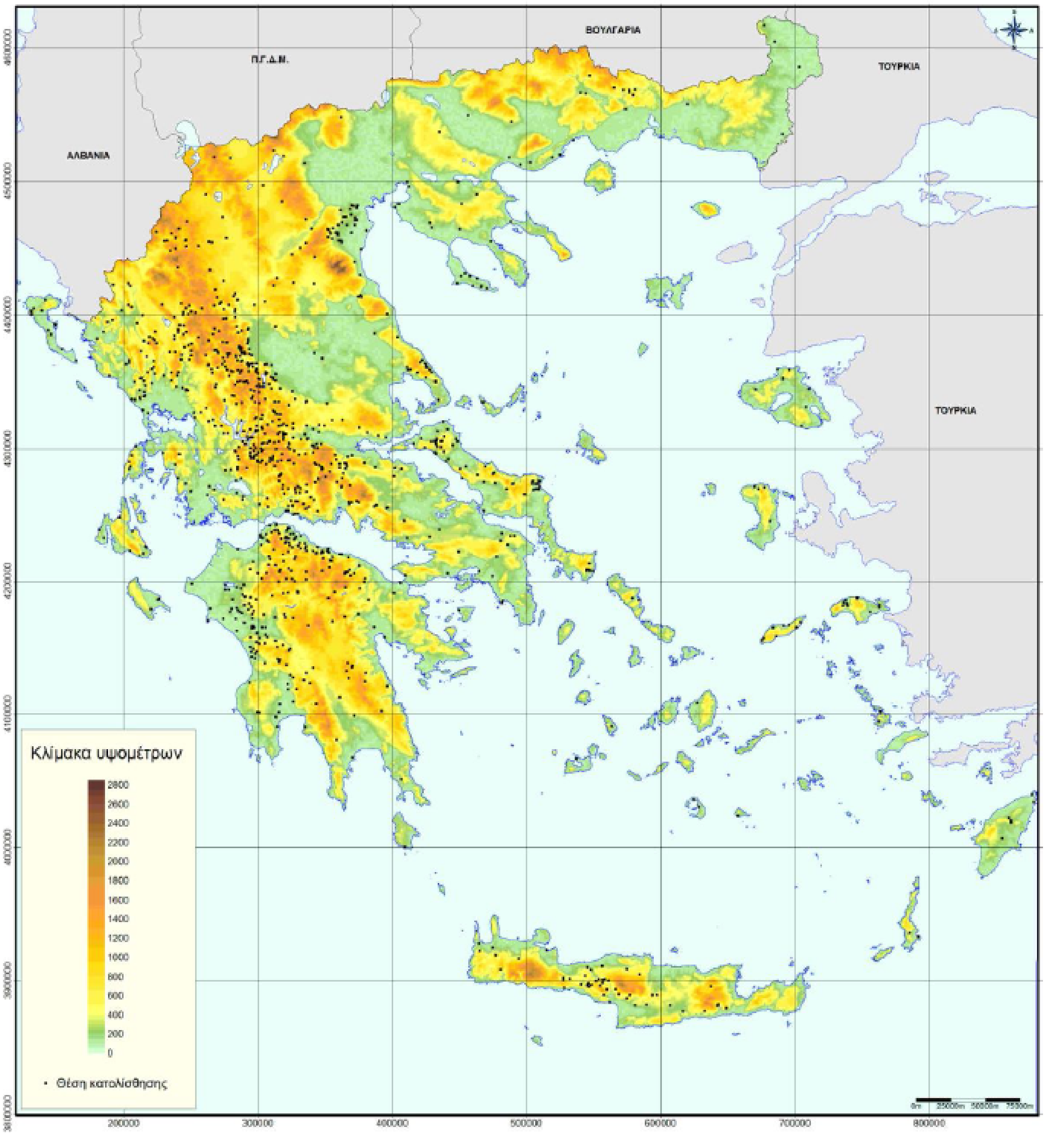


Fig 11. Topographic map with locations of 1238 landslides of the Hellenic area (www.igme.gr; Vassiliadis, 2010)

REFERENCES

1. Institute of Geology and Mineral Exploration, www.igme.gr
2. Koukis G., Ziourkas K., 1989 Landsliding movements in the Hellenic area. Statistical Approach. Oryktos Ploutos 58, 39-58 (in greek)
3. Koukis, G., Tsiambaos, G., Sabatakakis, N., 1994. Slope movements in the Greek territory: A statistical approach, 7th International IAEG Congress, Balkema, Rotterdam
4. Koukis, G., Rozos, D., Hadzinakos, I., 1997a. Relationship between rainfall and landslides in the formations of Achaia County, Greece.
5. Koukis, G., Tsiambaos, G., Sabatakakis, N., 1997b. Landslide movements in Greece: Engineering geological characteristics and environmental consequences, In: Marinos, Koukis, Tsiambaos & Stournaras (Eds.) Engineering Geology and the Environment, 1997, Balkema, Rotterdam.
6. Koukis, G., Sabatakakis, N., Nikolaou, N., Loupasakis, C., 2005. Landslide Hazard Zonation in Greece. In Kyoji Sassa, Hiroshi Fukuoka, Fawu Wang and Gonghui Wang (eds.) Landslides Risk Analysis and Sustainable Disaster Management. Springer: Berlin Heidelberg
7. Laboratory of Engineering Geology, University of Patras, www.geoarch.gr
8. Mpliona M. (2008), "Development of a landslide database of the Hellenic area". Master thesis of Geology Department, University of Patras (in greek).
9. WP/WLI (1994) International Geotechnical Societies' UNESCO working party on world landslide inventory. Working group on landslide causes (Chairman: Popescu ME) A suggested method for reporting landslide causes. Bull IAEG 50:71–74
10. Ziourkas K., Koukis G., 1992. Zonation of landslide hazard in the Hellenic area and representation on maps of small and medium scale. Oryktos Ploutos77, 9-30 (in greek)
11. Vassiliadis E. (2010), 'Landslide hazard zonation of the Hellenic area. Creation and implementation of models based on GIS', PhD thesis of the Geology Department of the University of Patras, 206p.

3.3 BULGARIA

3.3.1 Past Events and Their Consequences

The necessity of contemporary assessment of the natural hazardous processes on the territory of Bulgaria leading to disastrous and catastrophic situations in a number of regions is motivated by their high activity resulting in destruction of building fund, infrastructure, historical monuments, land use disturbance and annihilation of areas, interrupting of communications, aggravation of ecological conditions, human health threats, social stress enhancement.

The landslide manifestations displayed recently along the Black Sea coast and the Danubian riparian area, the Rhodopes and other parts of the country and their serious consequences confirm the long ago ascertained truth that the Bulgarian territory is characterized by a high degree of landslide hazard.

The geological-tectonic conditions and the relief of the country determine the development of a large number of landslides on its territory. The many years of research and applied activities on landslides have led to the establishment of important relationships for their distribution, factors for origin and activation, mechanism and dynamics, etc. The regional distribution of the landslides according to their volume shows that landslides with a volume up to 10 million m3 are the prevailing type in the country. The most numerous landslides in this group — about 50% of the total number — are observed along high Danubean Bank and Northern Black Sea coast, in the tectonically active grabens as Sofia, Pernik or Simitli and the landslides along some of the faults in the Strouma zone. The largest landslides with a volume of more than 100 million m3 are encountered along the Danubean Bank, the Northern Black Sea coast and in Rhodope Region (see Fig 12)

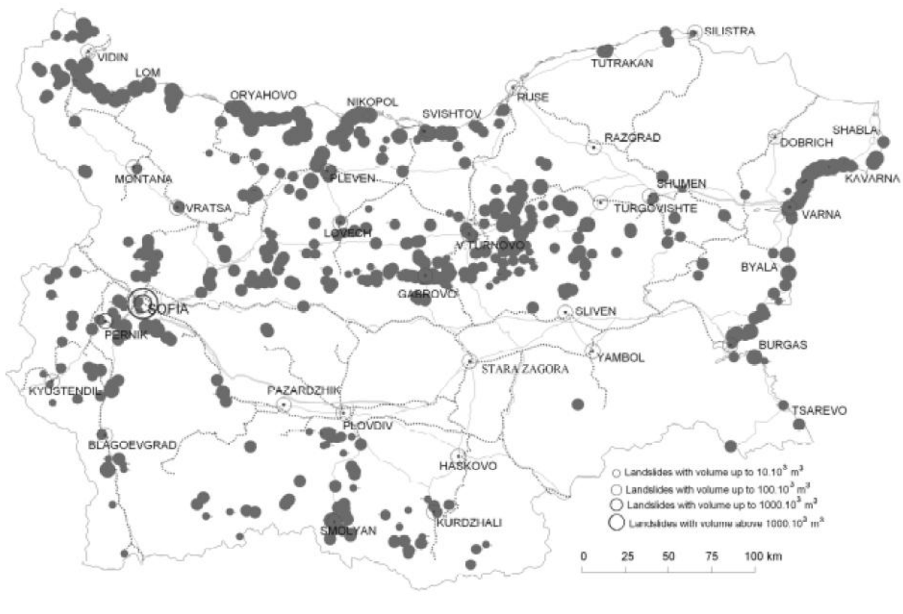


Fig 12. Map of landslide distribution

Fig 13. Map of the most significant natural disasters in Bulgaria – Landslides (www.mrrb.government.bg/?controller=news&id=1932)

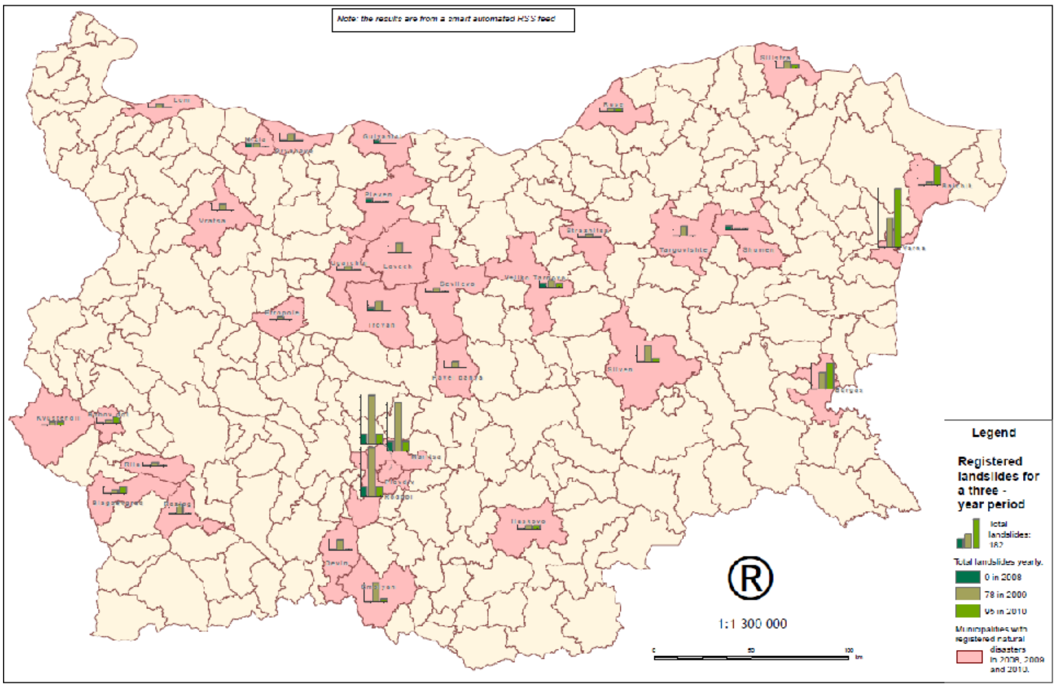


Fig 14. Map of the most significant natural disasters in Bulgaria – Landslides Analysis on municipality level for 2008, 2009, and 2010

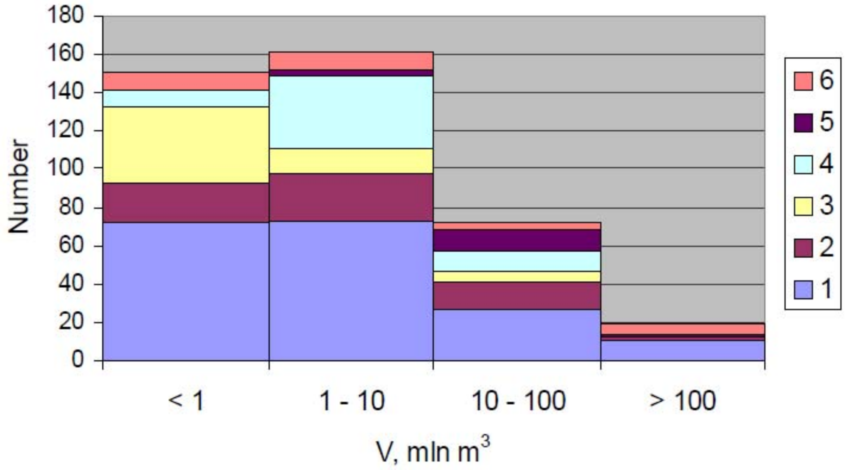


Fig 15. Number of landslides and their volume (V) in the different regions of the country; 1.Danube region, 2.Black Sea region, 3.South-West Bulgaria, 4.Maritsa-Iztok, 5.Rhodope region, 6.Balkan and Fore-Balkan

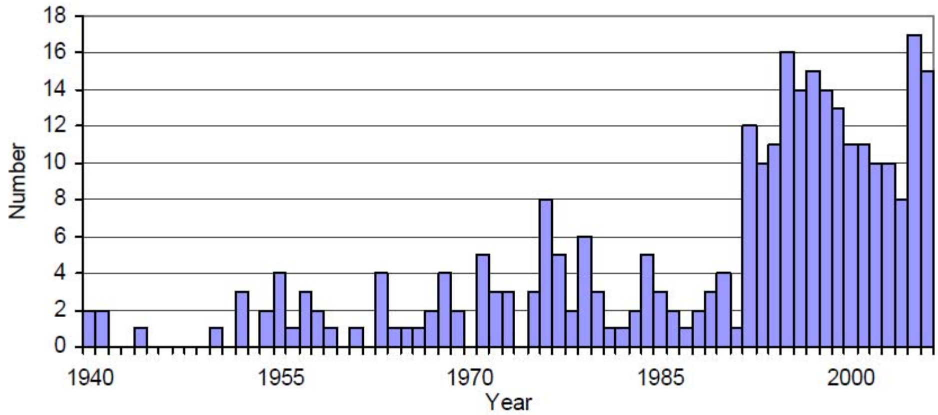


Fig 16. Distribution of the number of landslides in the course of time

3.3.2 Existing legislation framework

<u>The following laws are concerning landslide disasters in Bulgaria</u>

- Disaster Protection Act, 2006 , http://www.ifrc.org/docs/idrl/867EN.pdf
- Soil Act, 2007 http://ecomedia.bg/laws/soils-and-geology/law/130
- LAW ON GEODESY AND CARTOGRAPHY Prom. SG. 29 of 7April 2006

www.mrrb.government.bg/.../ce868a91799e1bd14253fdfb3b7c2bb2.do.

www.geology.bas.bg/admin/zakkart.pdf

citybuildhome.bg/act/zakon-geodeziiata-kartografiiata/2135520647

- LAW ON SPATIAL PLANNING, Prom. SG. 1 of 2.01.2001, in force from 31.03.2001

www.vik-yambol.com/laws/zakon_za_ustrojstvo_na_teritoriyata.pdf

- BIOLOGICAL DIVERSITY ACT (2007),

eea.government.bg/bg/legislation/biodiversity/ZBRan.doc

The above laws are supported by the following documents:

1. *NATIONAL PROTECTION PLAN FOR DISASTERS, 2009-2013*. The plan is based on the LAW ON DISASTER PROTECTION.
http://www.strategy.bg/StrategicDocuments/View.aspx?lang=bg-BG&Id=550;
www.nspbzn.mvr.bg/NR/rdonlyres/5691D5C4-0B8F.../0/NPlZB.pdf

The main objective of the National Plan for Disaster Protection is performing analyses and assessments of the risk of disasters territory of the Republic of Bulgaria and to identify preventive measures reducing the adverse consequences of disasters organize and coordinate actions to prevent or reduce the effects of disasters.

2. *NATIONAL SPATIAL DEVELOPMENT CONCEPT FOR THE PERIOD 2013-2025 year*

www.bgregio.eu/media/files/Programirane%20.../NKPR%20proekt.pdf;
www.saveti.government.bg/c/document_library/get_file?p_l

This document is published with the support of the European Union and the Republic of Bulgaria under the "Programming of Regional Development for 2014-2020"

3. *ORDINANCE № 13 OF 29.01.2004 ON THE TERMS AND CONDITIONS FOR THE TECHNICAL OPERATION OF DAMS AND RELATED FACILITIES*

Control and specific prevention of landslide dam walls has an ordinance issued by the Minister of Environment and Water, Ministry of Regional Development and Public Works, the Minister of Agriculture and Minister of Energy and Energy Resources, rev., SG. 17 on 2.03.2004.

4. *RULES OF PLANTS ANTI-LAND IN THE REPUBLIC OF BULGARIA, ISSUED BY THE MINISTRY OF ARCHITECTURE AND PUBLIC WORKS, 1973* www.lex.bg/bg/laws/ldoc/-19651583;

Monitoring and anti-occurring landslides in Bulgaria are created anti-landslides stations and created rules for their work

Landslides registration

Landslides in Bulgaria are registered in the Ministry of Regional Development and Public Works. Sofia, "St. Cyril and Methodius" 17-19 tel.83 841, telex 22182bg, fax 987 25 17

3.3.3 Implemented landslide hazard prevention studies

To prevent landslides in Bulgaria Ministry of Regional Development and Public Works announced a procedure for granting financial aid under the Operational Program "Regional Development" 2007-2013 , Priority Axis 4 " Local Development and Cooperation ", operation 4.1. " Small-scale local investments" a scheme of grants

BG161PO001/4.1-02/2008: "support for the establishment and strengthening of small-scale infrastructure for prevention of landslides"

Scheme for granting financial aid purposes:

- Restriction and maximum risk prevention and damage to life and property of the population of 178 "small" communities by building and strengthening small-scale infrastructure for prevention of landslides ;
- Provide protection for people and property through its support activities for strengthening and consolidation of landslides ;
- Limiting the expansion / manifestation of landslides by building automated monitoring systems.

Projects are implemented in the Republic of Bulgaria within the 178 municipalities outside urban agglomerations (Table 3.3).

FP5 international project related to Landslides

Under the FP5 project experts from the PECO[1] countries nominated by national authorities agreed on ten priority hazards, including also potential hazards and hazardous activities, as important concerns for the region, as follows (Wood et al. 2003):

Table 3.3 Beneficiary / Community & Website

Beneficiary / Community	**Website**
Lovech	http://www.lovech.bg/wps/portal/!ut/p/c4/04_SB8K8xLLM9MSSzPy8xBz9CP0os3gLby9PS09LYwODUEdzA09vQw_30BBzQwtTA_3gpHT9gmxHRQC8r2NW/
Dupnica	http://dupnitsa.acstre.com/Files/FileType_23/rezume.pdf
Satovcha	www.satovcha.bg/docs/ukrepvane_na_svlachishte_Pletena.pdf
Silistra	silistra.egov.bg/SILISTRA/home.nsf//0/.../info_za_medii(2).pdf
Ravda	umispublic.minfin.bg/srchProjectInfo.aspx?id=14257
Burgas	www.burgasnews.com/.../38577--priklyuchva-proektat-za-ukrepvane-na.
Varna	www.vjfgeosystems.com
Sozopol	www.sozopol.bg/index.php?option=com
Svoge	www.tracebg.com/
Kardjaly	www.bondys.bg/project_full.php?Id=1
Pleven	chervenbryag.bg/bg/index.php?option=com...view..
Madan	www.smolyandnes.com/ukrepvat-svlachishta-po-proekt-v-madan

[1] PECO countries refer to the 10 Member States in central and Eastern Europe (Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia). The acronym is derived from the French translation of "Central and Eastern European Countries" ("Pays de l'Europe Centrale et Occidentale").

Natural hazards

▪ Floods

Technological Hazards

▪ Landslides ▪ Pipelines

▪ Earthquakes ▪ Oil-shale mining

Types of maps (Risk Mapping of Landslides in New Member States by Róbert Jelínek, Javier Hervás and Maureen Wood)

Official landslide maps (i.e. maps made by a government entity, such as a ministry, a mapping agency, the army or other) are currently available in Bulgaria, the Czech Republic, Romania and Slovakia. In Cyprus and Slovenia no official maps exist at the moment. Bulgaria has landslide inventory maps at a scale of 1:1,000,000 up to 1:5,000.

Classification of damages

Vulnerability in the proposed questionnaire was further investigated in terms of reversible (temporal) and irreversible (persistent) damage. The distinction between reversible and irreversible effects is usually used in connection with hazards from industrial installations accidents and earthquakes. The terms are not as consistently used in reference to landslides. Only three countries, Bulgaria, Cyprus and Romania, indicated that potential damage resulting from landslides was officially classified as reversible or irreversible.

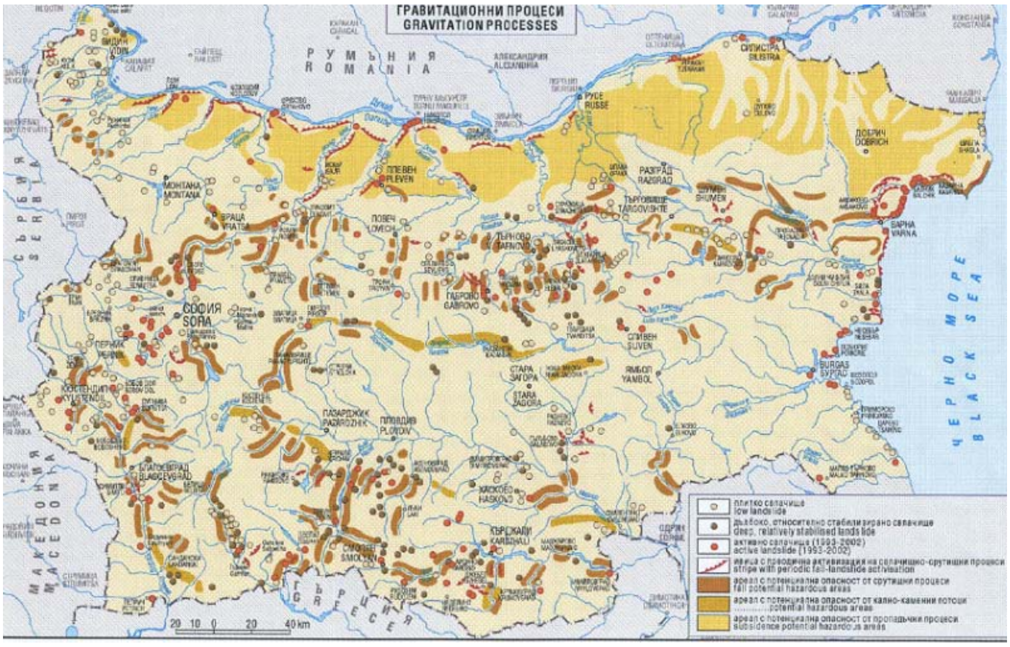


Fig 17. Map of gravitational processes in Bulgaria

Country	Reversible Damage	Irreversible
Bulgaria	**Human:** Injury **Infrastructure:** Severe damage, economic loss, public service interruption **Cultural heritage:** Economic loss, accessibility **Private property:** Economic loss **Natural resources:** Economic loss	**Human:** Death **Infrastructure:** Destruction, uneconomical recovery **Cultural heritage:** Economy Private property: Economic loss **Natural resources:** Economy

Fig 18. Reversible & Irreversible Damage

GIS evaluation of the landslide (LS) hazard (Methodology applied in Bulgaria)

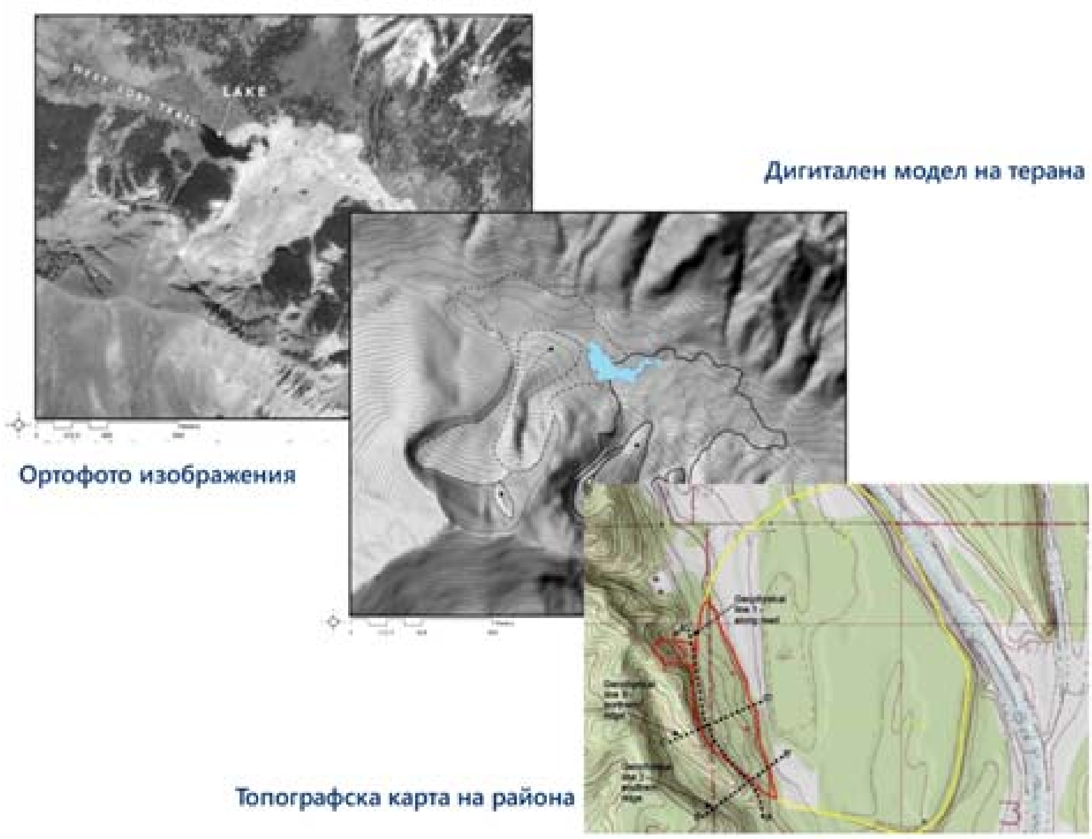


Fig 19. Initial Map

<u>Map of landslide probability</u>

- National level (over 1:1 000 000) – Maps cover the whole country and serve for information of business and the society.
- Regional (1:100 000 - 1:1 000 000) –For pre-project planning in building of infrastructure objects
- Regional (1:25 000 - 1:100 000) – for the municipalities or lower size.
- Town level (1:2 000 - 1:25 000) – Cover a town or part of town
- Individual building (1:200 - 1:2 000) – Zone of engineering work. Such models are used for stabilization of landslides

In respect of methodology GIS offers opportunities to perform the following analysis:

- LS distribution
- Activated LS
- LS density

Geomorphologic analysis

The most precise analysis used for development of maps of LS is based on Geomorphologic analysis (GA).

It combines the information of geographical distribution of LSs with information concerning slope, type of soil, soils used, its characteristics, nearby water streams, etc.

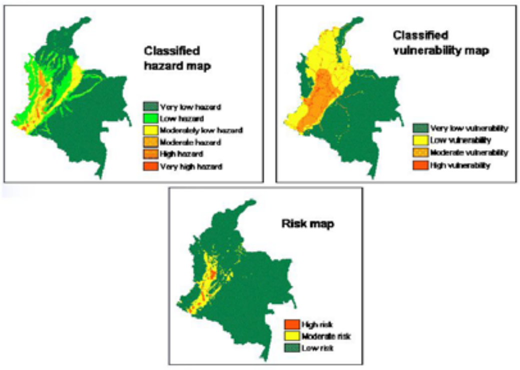


Fig 20. National Level

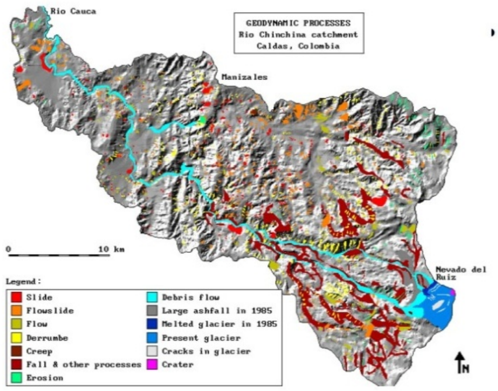


Fig 21. Regional Level

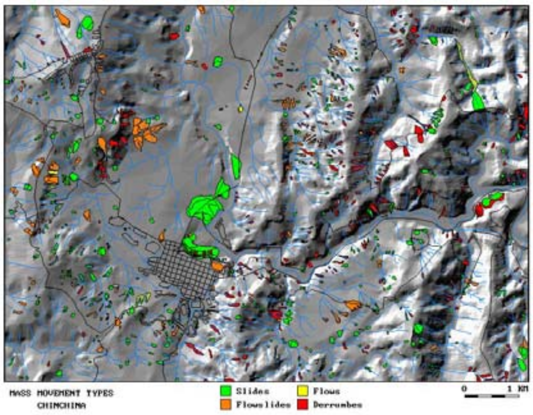


Fig 22. Municipality Level

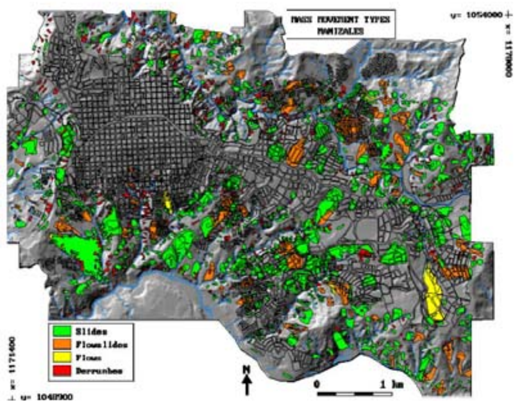


Fig 23. Town Level

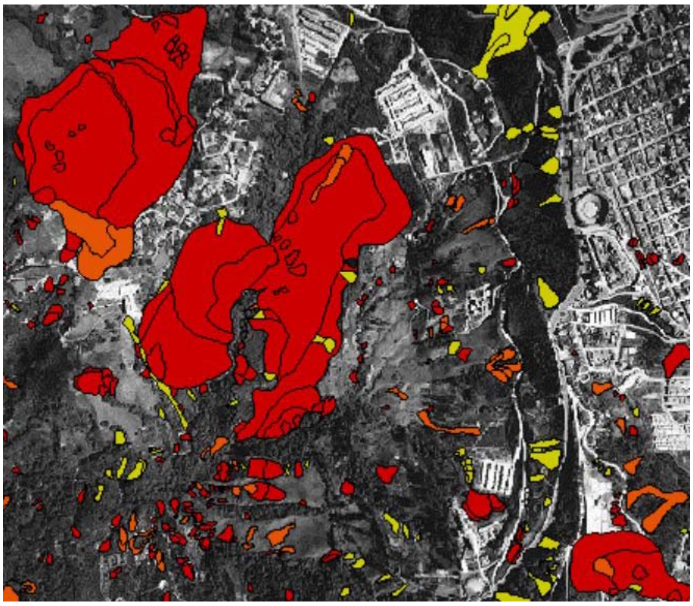


Fig 24. Individual building's level

3.4 ROMANIA

3.4.1 Past Events and Their Consequences

Landslides are one of the soil threats considered in the EU Thematic Strategy for Soil Protection and the related Proposal for a Soil Framework Directive. The Strategy calls for actions and means for the protection and sustainable use of soils as a physical platform on which human activities are developed. The proposed Directive, in turn, will be the Strategy implementing tool. This will mainly require identifying landslide and other soil threat risk areas in the European Union, setting risk reduction targets for those areas and establishing programmes of measures by Member States to achieve them.

On 13 February 2012 the European Commission published the report 'The implementation of the Soil Thematic Strategy and on-going activities'. The report provides an overview of the actions undertaken by the Commission to implement the four pillars of the Strategy, namely: awareness raising, research, integration, and legislation. The report includes a preliminary landslide susceptibility map of the EU and neighbouring countries produced by the European Landslide Expert Group coordinated by Joint Research Center (Fig 25).

Current work of Expert Group focuses on: (1) improving the accuracy of the landslide susceptibility maps by further developing the models, while integrating newly available data on landslide conditioning factors and landslide inventories, and (2) assessing landslide susceptibility separately for major types of landslides at pan-European scale and at national scale in selected countries, in collaboration with other members of the European Centre on Geomorphological Hazards (CERG) (eusoils.jrc.ec.europa.eu/library/themes/landslides/wg.html).

In Romania, the most prone areas to landslides are mostly hilly. A review of geomorphic literature regarding landslides was made by Bălteanu & Jurchescu, in 2012. According them, numerous articles and books addressed this subject, with the aim of classifying, presenting some local cases, or zoning landslides across geomorphic units or all over the country, have started especially since the late '20s (e.g., Mihăilescu, 1926, 1939; Tufescu, 1964, 1966).

In the recent decades, an issue approached by Ielenicz, 1970; Ichim, 1979; Mac; 1986 and Surdeanu, 1987, was that of detection of areas prone to landslides on the principle of functional analysis of slopes.

Recent studies in the direction of landslide risk analysis and vulnerability have had: Cioacă et al., 1993, Rădoane et al., 1993, Cioacă, 1996, Surdeanu, 1998, Bălteanu et al., 1989, 2004, 2010, Grecu, 1996, 1997, 2002, Manea, 1998, Armaş et al., 2003, Armaş, 2006, Sandu & Bălteanu, 2005, Prefac et al., 2008. During the '90s and 2000s, in the estimation of landslide susceptibility was used especially qualitative approaches. The number of quantitative ones has risen in the last years (Micu & Bălteanu, 2009; Armaş, 2011, 2012; Constantin et al., 2011; Şandric et al., 2011; Grozavu et al., 2012; Armaş et al., 2013).

According to Zaharia (2012), for Romania, over the time, regarding landslide phenomenon, the spatial distribution of landslides especially, a few maps were drawn up, at a small scale: Map of territorial areas with landslides potential (Tufescu V., 1966), Romania's land zoning in terms of potential for landslides (Marchidanu E, 1995), Territorial map of landslides (UTCB, 1997), Maps of soil stability in Romania (PROED S.A., 1966), Macro-zoning map of induced landslides risk in Romania (GEOTEC S.A., 1998).

More recent, Bălteanu et al., in 2010, have developed a landslide susceptibility model for the whole country applying a scoring system to a set of conditioning factors based on expert judgement (heuristic model).

According to Law no. 575/14.11.2001 approving the Plan for national territory development - The Fifth Section- Areas of natural hazards, the landslides risk in the administrative units from the study area is low. Thus, most studies or projects that had the coastal zone or the Dobrogea plateau as a study area, had as a principal objective assessing the marine abrasion or water erosion on the slopes and less approached was the issue of landslides.

During the last decade, some research institutes have been involved in several international projects having landslide susceptibility/hazard/risk assessment as a main goal:

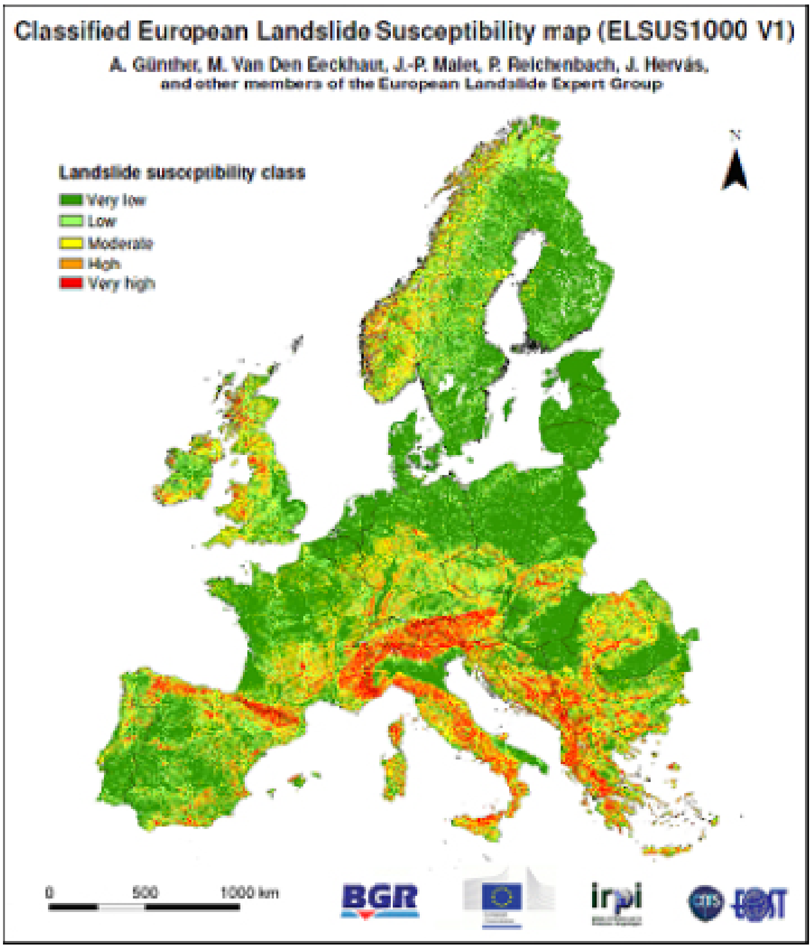


Fig 25. European Landslide Susceptibility Map
(http://eusoils.jrc.ec.europa.eu/library/themes/LandSlides/#ELSUS)

- Risk Assessment Methodologies for Soil Threats - RAMSOIL - Assessment methodologies of the agro – physical degradation risk in the context of the new European Directives (2007-2010); the general objective of the RAMSOIL project was to provide scientific guidelines on possibilities for EU wide parameter harmonization based on detailed information on current risk assessment methodologies of soil threats encountered within EU Member States. The selected soil threats were erosion, salinization, organic matter decline, compaction and landslides. In RAMSOIL current risk assessments methodologies used in the EU were collected and evaluated. EU-25 Member States consist of the following countries: Belgium, France Germany, Italy Luxembourg, The Netherlands, Denmark, Ireland, U.K., Greece, Portugal, Spain, Austria, Finland, Sweden, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia. The two added countries are Bulgaria and Romania.

  Within the project, for Romania, NATIONAL RESEARCH AND DEVELOPMENT INSTITUTE FOR SOIL SCIENCE AGRO-CHEMISTRY AND ENVIRONMENT - ICPA Bucureşti has elaborated methodology for estimating the areas with risk for three types of soil degradation analysed: compaction, salinization, erosion.

- Living with landslide risk in Europe: Assessment, effects of global change, and risk management strategies - SafeLand (2009-2012). SafeLand is a Large-scale integrating Collaborative research project funded by The Seventh Framework Programme for research and technological development (FP7) of the European Commission. The project team is composed of 25 institutions from 13 European countries. From Romania, the responsible institution was Geological Institute of Romania;

- Changing Hydro-meteorological Risks as Analyzed by a New Generation of European Scientists - CHANGES - Case study chosen from Romania is Buzău County (2011-2014).The main objective of project is how global changes, related to environmental and climate change as well as socio-economical change, will affect the temporal and spatial patterns of hydro-meteorological hazards and associated risks in Europe; how these changes can be assessed, modelled, and incorporated in sustainable risk management strategies, focusing on spatial planning, emergency preparedness and risk communication. CHANGES include 11 partner institutions that host one or more researchers and 6 associate partners that co-supervise research projects, offer internships and participate in CHANGES network events. Romanian partner is the Institute of Geography - Romanian Academy.

REFERENCES:

1. ARMAŞ, Iuliana, (2006), Risc şi vulnerabilitate, Metode de evaluare aplicate în geomorfologie, Editura Universităţii din Bucureşti, 200 p.
2. ARMAŞ, I., (2011), An analytic multicriteria hierarchical approach to assess landslide vulnerability. Case study: Cornu village, Subcarpathian Prahova Valley/Romania, Z Geomorphol 55, 2, 209–229.
3. ARMAŞ, I., (2012), Weights of evidence method for landslide susceptibility mapping. Prahova Subcarpathians, Romania, Natural Hazards, 60, 3, 937-950.
4. ARMAŞ, Iuliana, DAMIAN, R., ŞANDRIC, I., OSACI – COSTACHE, Gabriela, (2003), Vulnerabilitatea versanţilor la alunecări de teren în sectorul subcarpatic al văii Prahova, Editura Fundaţiei România de Mâine, Bucureşti, 207 p.
5. ARMAŞ, I., VARTOLOMEI, F., STROIA, F., BRAŞOVEANU, L., (2013), Landslide susceptibility deterministic approach using geographic information systems: application to Breaza town, Romania, Nat. Hazards, 1-23.
6. BĂLTEANU, D., DINU, Mihaela, CIOACĂ, A., (1989), Hărţile de risc geomorfologic, SCGGG - Geogr, XXXVI, Bucureşti.
7. BĂLTEANU, D, MICU, M., (2009), Landslide investigation: from morphodynamic mapping to hazard assessment. A case-study in the Romanian Subcarpathians: Muscel Catchment, in vol.: Landslide processes: from geomorphologic mapping to dynamic modeling, CERG Editions, Strasbourg, France.
8. BĂLTEANU, D., CHENDEŞ, V., SIMA, M., ENCIU, P. (2010), A country-wide spatial assessment of landslide susceptibility in Romania, Geomorphology, 124, pp. 102-112.
9. BĂLTEANU, D., JURCHESCU, M., (2012), Recent Landform Evolution in the Romanian Carpathians and Pericarpathian Region. History of Geomorphological Research. In: Lóczy, D., Stankoviansky, M., Kotarba, A. (Eds), Recent Landform Evolution, Springer Geography, Springer Netherlands, 252-255, doi: 10.1007/978-94-007-2448-8_10.
10. CIOACĂ, A., (1996), Evaluarea vulnerabilităţii terenurilor afectate de procese geomorfologice actuale, AUŞMS - Geogr. - Geol., V, Suceava.
11. CIOACĂ, A., BĂLTEANU, D., DINU, Mihaela, CONSTANTIN Mihaela, (1993), Studiul unor cazuri de risc geomorfologic în Carpații de Curbură, Studii și cercetări de geografie, XL, 1, 43-45.
12. CONSTANTIN, M., BEDNARIK, M., JURCHESCU, M.C., VLAICU, M., (2011), Landslide susceptibility assessment using the bivariate statistical analysis and the index of entropy in the Sibiciu Basin (Romania), Environ Earth Sci., 63, 2, 397-406.
13. GRECU, Florina, (1996), Expunerea la risc a terenurilor deluroase, Lucr. celei de-a doua conferințe regionale de Geografie, 1994, Timișoara, p. 18-24.

14. GRECU, Florina, (1997), Etapele întocmirii hărții expunerii la risc a terenurilor din bazinele hidrografice de deal, Mem. Secț. Șt. Acad., Seria IV, XVII, 1994, 307-323.
15. GRECU, Florina, (2002), Risk-prone lands in hilly regions: mapping stages, in Applied geomorphology, edited by R.J.Allison, Wiley and Sons, Chichester, 49 – 64.
16. GROZAVU, A., MĂRGĂRINT, M.C., PATRICHE, C.V., (2012), Landslide susceptibility assessment in the Brăieşti-Sineşti sector of Iaşi Cuesta . Carpathian Journal of Earth and Environmental Sciences, 7, 1, 39 – 46.
17. GÜNTHER, A., Van Den EECKHAUT, M., MALET, J.-P., REICHENBACH, P., HERVÁS, J., (2013), The European landslide susceptibility map ELSUS 1000 Version 1, Geophysical Research Abstracts, Vol. 15, EGU2013-10071.
18. IELENICZ, M., (1970), Zonele cu alunecări de teren din ţara noastră, Terra, XXII, 1, Bucureşti.
19. ICHIM, I., (1979) Munții Stanișoarei. Studiu geomorfologic (The Stânișoara Mountains. Geomorphic Study), Ed. Acad, București, 121 p.
20. MAC, I., (1986), Elemente de geomorfologie dinamică, Editura Academiei, Bucureşti
21. MANEA, Sanda, (1998), Evaluarea riscului de alunecare a versanţilor, Tempus, Serie coordonată de Radu Drobot şi Jean Pierre Cabonnel, Conspress, Bucureşti.
22. MICU, M., BĂLTEANU, D., (2009), Landslide hazard assessment in the Bend Carpathians and Subcarpathians, Romania. Z. Geomorphol., 53, 2, 31-47.
23. MIHĂILESCU, V., (1939), Porniturile de teren şi clasificarea lor, Revista Geografică Română 2(2–3), 106–113.
24. PREFAC, Zoia, POPESCU, M., CRACU, G. M., URDEA, Cornelia, (2008), Evaluarea susceptibilităţii versanţilor la alunecări de teren în bazinul pârâului Plopeasa, Univ, OVIDIUS Constanţa, Lucrări ştiinţifice, Agricultură - Horticultură, Seria A, Vol, I, Editura Universitară, Bucureşti
25. RĂDOANE, Maria, RĂDOANE, N., ICHIM, I., (1993), Folosirea metodei cubului matricial în evaluarea susceptibilităţii la alunecări de teren. Caz de studiu: jud. Neamţ, SCGGG, Bucureşti
26. SANDU, M., BĂLTEANU, D., (2005), Hazardele naturale din Carpaţii şi Subcarpaţii dintre Trotuş şi Teleajen, Studiu Geografic, Edit, Ars Docendi, Bucureşti
27. SURDEANU, V., (1987), Studiul alunecărilor de teren din valea mijlocie a Bistriței (zona flișului), Manuscript PhD theses, Iași 192 p.
28. SURDEANU, V., (1998), Geografia terenurilor degradate,I, Alunecări de teren. Presa Universitară Clujeană, 274 p.
29. ŞANDRIC, I., CHIŢU, Z., MIHAI, B., SĂVULESCU, I., (2011), Landslide Susceptibility for the Administrative Area of Breaza, Prahova County, Curvature Subcarpathians, Romania. Journal of Maps, 7, 1, 552-563.

30. TUFESCU, V., (1964), Typologie des glissements de Roumanie, Revue Roum Géol Géophys Géogr., 7, 140–147.
31. TUFESCU, V., (1966), Modelarea naturală a reliefului şi eroziunea accelerată, III, Ed. Acad., Bucureşti.
32. ZAHARIA, C. S., (2012), Identification and analysis of the geomorphic, climatic and hydrological hazards from Baia Mare municipality. PhD theses, Babes Bolyay University, Cluj Napoca, http://193.231.20.119/doctorat/teza/fisier/267.
33. http://eusoils.jrc.ec.europa.eu/library/themes/landslides/wg.html

3.4.2 Existing legislation framework

In Romania, the lack of a strong legislation at the beginning of the transition period led to accelerating of the deterioration of environmental conditions and an increase of impact of natural hazards on society caused by massive deforestation and destruction of irrigation systems in the plains and plateaus (Bălteanu et al., 2004).

Although, at present, Romania has a well-defined legal framework, covering the requirements for protection against natural disasters, according to those at the European level, in the implementation of the strategy for civil protection and environmental safety are leaking.

International conventions and other ratified accords and agreements are components of Romanian legislative system and are part of the national policy for disaster risk reduction management.

The main priorities concerning the risk reduction are the floods, earthquakes, landslides, dangerous meteorological phenomena and technological disasters.

The Law no. 575 of 22 October 2001, regarding the approval of the Plan for national territory development – The Fifth Section– Areas of natural hazards, foresees risk maps for every locality placed in the natural risk areas, order to be included in the Plans for General Urbanism (PUG). They are managed by local authorities and because of lack of funds, risk maps remain at the stage of desideratum (Armas, 2006).

Also, the maps and tables attached to the Law no 575/2001 are providing information about the localities potential affected by floods caused by torrents draining or water courses overflowing and landslides. Maps of the biggest hydro technical dams were developed.

Various research institutes and private companies developed electronic maps of risk. The Geographic institute of the Romanian Academy developed the map of geomorphologic risks (landslides, avalanches, erosion, etc.) as well as numerous atlases referring to the natural and technological risks specific for national territory.

Detailed electronic maps of risks are developed for the administrative units, for all types of natural and technological hazards, in order to support the territory development and to be used in the frame of defence plans in case of disaster, according to National report regarding the disaster prevention in Romania, 2005.

For the plans of general urbanism, which are realized at local public authorities’ level, the development of risks maps is under way at scales between 1:5 000 and 1:500, depending on the locality dimension.

For the plans for disaster response are developed and used risks maps at scales between 1:15 000 and 1:50 000 for local level and for the national level at scales 1:1 000 000, 1:500 000 and 1:200 000. The maps used for disaster defence plans are in GAUSS-KRUGER format.

The access at these maps is allowed to any concerned person based on Law no 544/2001 regarding the public access at information of public interest.

For disasters made by earthquake and landslides, counties and local commissions for defence against disasters have defence plans (prevention, protection, operative intervention, restoration and rebuilding). These plans are revised yearly and/or after a disaster occur. Presidents of these commissions are responsible for elaboration and revise the plans.

Laws regarding natural disaster

- Government Decision (HG) 438 from 06 June 1996 approves the Regulation of organization and functioning of the Central Commission for Defence against landslides and earthquake effects, established by the Minister of Public Works and Planning (now the Ministry of Transport), amended by Decision Government 1297 of 20.11.2002.
- Common Order of the Ministry of Public Works and Territorial Planning, of the Chief of Department for Local Public Administration and Ministry of Waters and Environmental Protection no. 62/N-19.0/288-1.955/1998, regarding the delimitation of the areas prone to natural risks.
- Law no. 575 from 22.October 2001 regarding approval of the Plan for national territory development.
- Governmental Decision no. 382/2003 from 2 April 2003 for approval of the methodological norms regarding minimal demanding in content for territory planning and urbanism documentation for natural risk areas.
- Governmental Decision no. 447 from 10 April 2003 approves the methodological norms regarding elaboration mode and content of the floods and landslides risk maps.
- Governmental Decision no.1.491/2004 from 9 September 2004 regarding approval of the framework regulation of the organizational structure, responsibilities, operation and endowment of the committees and emergency operational centers.
- Common Order of the Ministry of Public Minister of Transport, Construction and Tourism and the Ministry of Administration and Interior no. 1.995/2005/1.160/2006 approves the Regulation on the prevention and management of specific emergency situations regarding earthquake and/or landslides risks.

- Governmental Decision no 932 from 7 August 2007 approves the Methodology regarding state budget financing of natural hazard maps for earthquakes and landslides.

Institutions and operational structures

According the Emergency Ordinance no.21/2004, the National System for Emergency Situations Management is composed by:

- Emergency Situations Committees;
- General Inspectorate for Emergency Situations;
- Professional Emergency Services;
- Operative centers for emergency situations;
- Action commander.

The committees for emergency situations are organized on levels, as follows:

- National Committee for Emergency Situations;
- Ministerial committees and other central public institution's committees for emergency situations;
- Bucharest Municipal committee for emergency situations;
- County committees for emergency situations;
- Local committees for emergency situations.

The National Committee for Emergency Situations, organized under the Ministry of Administration and Interior, and the ministerial committees for emergency situations are responsible for application of the disaster risk reduction policy at national level.

REFERENCES:

1. http://isuarad.ro/SPPEPP/Legislatie.htm
2. http://www.mdrl.ro/_documente/dezvoltare_teritoriala/amenajarea_teritoriului/legi/hg_932.pdf
3. http://lege5.ro/Gratuit/gmztoobu/legea-nr-575-2001-privind-aprobarea-planului-de-amenajare-a-teritoriului-national-sectiunea-a-v-a-zone-de-risc-natural

3.5 UKRAINE

3.5.1 Past Events and Their Consequences

Within Ukraine, where low water resistant loess rocks and loess loam prevail over 70% territory in the upper part of geological intersection, landslides are most common on slopes and riverside (coastal) areas of high susceptibility to landslide deformations. The number of landslides in Ukraine increased from 17400 (in 1997) till 23100 in 2011 (H.S. Hlebchuk, 2012).

In the Black Sea region landslides are spread by a narrow strip along the coast, on the banks of rivers and numerous estuaries. Very intense landslides are on the coast of the Black Sea and Azov Sea (near Odessa, Mariupol, Berdyansk).

This is caused by general geological factors, recent tectonic movements and sea level changes. Dynamics of landslides in the coastal area is characterized by slow, but almost non-stop shifts. Some landslides can reach 0.5 - 2.5 km in length, a 0.3 - 1.5 km in width.

The most difficult situation re landslides is in Crimea, Odessa and Mykolaiv region.

Number of landslides in 2007 in these regions (L. Klimchuk, 2008):

- in the Odessa region - 5241 stable and 644 active, 197 of them are in the area of housing and developments;
- in the Mykolaiv region - 1020 stable and 130 active, 42 of them are in the area of housing and developments,
- in Crimea - 1361 stable and 215 active, 409 of them are in the area of housing and developments (Table 3.4).

Table 3.4 Number of landslides in the Crimera, Odessa Region, Mykolaiv region

Area	Number			
	1984	1997	2002	2007
Crimea	850		1350	1576
Odessa region	920	3125	5460	5885
Mykolaiv region	690	531	1230	1150

Mechanism and dynamics of landslide processes are determined by the composition and characteristics of the main deformable horizon (MDH).

In rock layer areas of Crimea the main deformable horizon is usually represented by flysch deposits of Taurian series (Triassic-Jurassic), clayey strata of the Cretaceous and Paleogene.

Distribution of landslides in rock layer areas of Crimea is caused by significant height and steepness of the slopes, presence of a thick layer of weathered rocks, intense dissection of relief.

The most important factors of landslides here is the presence of numerous tectonic ruptures in a thick flysch, significant fracture, weathering of rocks and water cut of rocks.

Landslides of Crimean region are relatively small, their length is usually up to 150 m, sometimes up to 2-2.5 km. Almost half of the landslide is located between Cape Aya and Alushta.

Deep landslides of Southern Coast of Crimea are very different from the landslides of other areas. It happens because of the special conditions of the region: thick (several hundred meters) layer of Upper Jurassic limestones, which covers the MDH, significant pressure changes in the area of Jajly ledge and high pressure in the Middle Jurassic Shales.

The most common on the Southern Coast of Crimea are the landslides of the Pleistocene sediments, which are shifting by flysch surface. High water permeability of unconsolidated sediments increases this process as a result of groundwater discharge of Yaylinsk massif.

Possibility of landslides in potential landslide areas is estimated as high and catastrophic, destruction coefficient varies from 13 to 100 %.

Significant activation of landslide deformation (up to 48 % of the active landslides) on the Black Sea coast is caused by human activities. The biggest number of landslides in Ukraine is in Odessa region, mostly in the coastal areas (70 %).

3.5.2 Existing legislation framework

1. Constitution of Ukraine, Law from 28.06.1996 254k/96-VR (release 12.06.2013):

Article 106. President of Ukraine:

21) adopts a decision, in the event of necessity, on the introduction of a state of emergency in Ukraine or in its particular areas, and also in the event of necessity, declares certain areas of Ukraine as zones of an ecological emergency situation — with subsequent confirmation of these decisions by the Verkhovna Rada of Ukraine

Article 138. The following issues shall be under the authority of the Autonomous Republic of Crimea

10) initiate the introduction of a state of emergency and establish zones of ecological emergency as needed in the Autonomous Republic of Crimea or in its particular areas

Reference: http://www.president.gov.ua/en/content/constitution.html

2. Code of Civil Protection of Ukraine, from October 2, 2012 of No. 5403-VI. (In edition of the Laws of Ukraine from 5/14/2013 of No. 224-VII, 6/20/2013 of No. 353-VII)

The code of civil protection of Ukraine regulates the relations connected with protection of the population, the territories, surrounding environment and property from emergency situations, response to them, functioning of single state system of civil protection, and determines powers of public authorities, Council of Ministers of the Autonomous Republic of Crimea, local government bodies, the rights and obligations of citizens of Ukraine, foreigners and stateless persons, the companies, organizations and the organizations irrespective of pattern of ownership.

The Code, in particular, determines the classification of emergencies: man-made, natural, social and military, state, regional and local.

It should be noted that after the Code has entered into force such regulations as the Law on Civil Protection, the Law on Fire Safety, Law on the structure and the number of troops Defense, the Law on Defense Forces of Ukraine, the Law on the emergency and rescue services, the Law on the Protection of from emergency situations, the Law on civil Protection became invalid.

Article 15. State of emergency

State of emergency for a unified state system of civil protection, in whole or in part for some of its territorial subsystems temporarily established in the territory in which the law imposed emergency rule in accordance with the Law of Ukraine "On the legal state of emergency"

Article 30. Emergency notification

1. …emergency notification includes bringing this information in time to the civil protection authorities, civil defense forces, businesses and public

Reference: zakon.rada.gov.ua go/5403-17

3. Law of Ukraine on Building Codes N 1704-VI, 05.11.2009

This Law specifies legal and organisational principles of the development, the endorsement, the approval, the registration and the application of building codes.

Article 4. The principles of the state policy in the field of standardization in the construction

1) creating a safe environment for human life and health;

Reference: zakon.rada.gov.ua go/1704-17

4. Law of Ukraine about the zone of the emergency ecological situation, 13. 07. 2000 of No. 1908-III. (In edition of the Law of Ukraine from 2/9/2006 of No. 3421-IV)

Article 3. The main objectives of the law and its scope

The main objectives of this Law are legal regulation of relations that arise during emergency measures to protect life and health of people and normalization of ecological condition in the areas of environmental emergency…

Reference: http://zakon4.rada.gov.ua/laws/show/1908-14

5. Law of Ukraine About legal regime of emergency state

from March 16, 2000 of No. 1550-III, (last edition from 16-05-2013)

This Law determines content of legal regime of emergency state, the procedure for its introduction and cancellation, feature of activities of public authorities and local government bodies, the companies, organizations and the organizations in the conditions of emergency state, observance of rights and freedoms of man and citizen, and also the rights and legitimate interests of legal entities and responsibility for violation of requirements or failure to carry out of measures of legal regime of emergency state.

Reference: zakon.rada.gov.ua go/1550-14

6. Law of Ukraine on urban planning and development: optimization of regulatory procedures in the area of development and construction (17.02.2011 3038 (release 05.07.2013))

The Law is aimed at improving the procedures and rules for granting planning permission and ensuring steady development of urban areas. This Law can provide highly beneficial for investors, both domestic and foreign, wishing to invest in urban development

Article 12. Development and approval of planning schemes of individual parts of the territory of Ukraine

1. According to the decision of the Cabinet of Ministers of Ukraine developed schemes

Planning of individual parts of the territory of Ukraine ...with ... risk of emergency.

Reference: zakon.rada.gov.ua go/3038-17

7. On approval of emergency classification according its levels, Resolution of the Cabinet of Ministers of Ukraine, (24.03.2004 № 368 with amendments 11.06.2013)

Natural hazards - the event of natural origin or the result of natural processes, which in its intensity, extent and duration may affect people, the objects of the economy and the environment.

Reference: zakon.rada.gov.ua go/1550-14

8. On a single state system of prevention and response to emergency situations of technogenic and natural character. Resolution of the Cabinet of Ministers of Ukraine, (03. 08.1998 N 1198 with amendments 08.12.2006)

Intoduces 3 levels of readiness

1) level of everyday activities;

2) level of enhanceable readiness;

3) level of activities in extraordinary situations

Reference: http://zakon2.rada.gov.ua/laws/show/1198-98

9. On approval of the actions of the Emergency Management and Operational Rescue Services units of civil defense Ministry of Emergency Situations of Ukraine, (Order from 13.03.2012 № 575)

Regulates actions in the extraordinary situations

2.1.2. liquidation of extraordinary situation…..includes the following activities:

clarification and estimation of situation; decision making, analysis of situation, permanent monitoring to provide rescue operation, cooperation and inforamtion exchange…

Reference: zakon.rada.gov.ua laws/show/z0835-12

10. On approval of the State sanitary rules of planning and building of settlements, Order of Ministry of Heath Protection of Ukraine, (19.06.1996 № 173 with amendments 31.08.2009)

Regulates planning and building in settlements

Reference: zakon.rada.gov.ua laws/show/z0379-96

11. On measures regarding engineering protection of coasts the Black and Azov seas and areas exposed to adverse natural processes. The Council of Ministers of the Autonomous Republic of Crimea Decree, (11.03.1997 № 68, revision from 25.09.2012)

Provides protection of coastal areas exposed to adverse natural processes

Reference: http://search.ligazakon.ua/l_doc2.nsf/link1/AP970068.html

3.5.3 Implemented landslide hazard prevention studies

Exogenous geological processes, including landslides, are subjects of permanent monitoring. In Ukraine the state monitoring system of exogenous geological processes (EGP) is an integral part of environmental monitoring.

Monitoring of EGP is a system of observation, data collection, storage and analysis of information, forecasting and recommendations for decision-making.

This activity is regulated in accordance with the "Rules of state monitoring of exogenous processes, types and spatial characteristics and activity", 2001.

The main tasks of monitoring EGP are:

- regional assessment of the affected areas;
- assessment of the current state of EGP, their impact on human settlements and economic facilities;
- factors of EGP and changes in their activity;
- forecasting of the EGP development;
- information for decision-makers in affected areas.

In Ukraine, there are four-stage system of monitoring of EGP, which includes state, regional, territorial and local level. Monitoring results are recorded annually in the regional environmental reports provided by the Department of Ecology and Natural Resources of regional state administrations, in accordance with the requirements of Art. 25 of the Law of Ukraine "On Environmental Protection". These reports available for the general public.

As a result of researches carried out in the last few years by the INGIS (Institute of Telecommunications and Global Information Space) of the NASU (National Academy of Sciences of Ukraine), the Institute of Geological Sciences of NASU, governmental enterprise "Research Institute of Building Structures", the Ministry of Regional Development and by other institutions it has been found that the landslide developing dynamics are considerably influenced by the following natural and technogenic processes (O. Trofymchuk, I. Kaliukh, 2012)

- regional underflooding of soils as a result of practically complete overregulation of the river system (a cascade of water reservoirs along the Dnipro river, up to 30 thousand ponds, medium and small size water reservoirs), decrease of river basins drainage degree and raising of the ground waters level;

- global climate changes followed by increased fall-outs, their uneven distribution, and increased temperature facilitating saturation of the upper zone of loose rocks with water, reduction of their strength and increase of engineering, geological and seismophysical potential for landslide development;

- global activation of seismicity;

- growth of technogenical changes of slope forms within urban-industrial glomerations, mining regions, seaside coastal areas including rise of the sea level and abrasion of coastal slopes.

Landslide risk assessment:

For each type of landslide slopes there are certain critical values of steepness below which the slope is stable, and above is risky. To identify risk of landslides map of potential activity of EGP was provided (Fig 26).

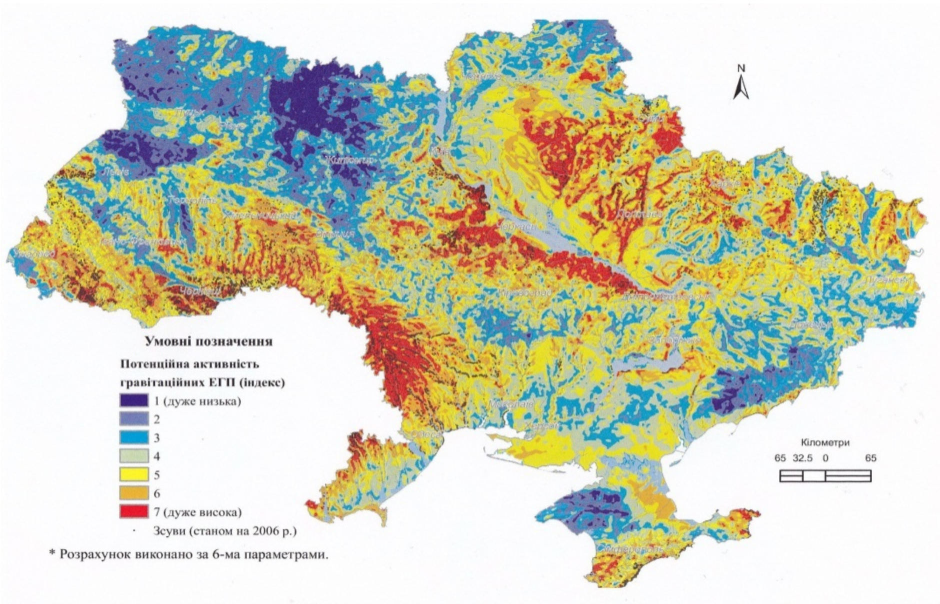


Рис. 7.3. Карта-схема оцінки потенційної активності гравітаційних ЕГП на території України

Fig 26. Risk of landslides on the territory of Ukraine

To estimate the intensity of the landslide process planar factor of impact is used - ratio of area of landslides process to the total area of landslide.

The results (R) are ranked according to the degree of risk, depending on the intensity of the development process: catastrophic -> 40 % , significant - 10 - 40%, average - 1 - 10% , mild - < 1%. Zoning of the territory is made according to this scale.

The most vulnerable areas are Black and Azov Seas coasts. Nowadays, there are ways to deal with the landslide processes – terracing, construction of drainage systems to facilitate drainage of the main deforming horizons. A good example is a system of coastal protection constructed in Odessa. It was in the 70s of XX century when it was managed to stop the destructive process and stabilize the coast of the city.

The protective system includes construction of jetties and groins, beach nourishment, construction of drainage system and diverting water from the surface of the main deformable horizon.

4 FLOOD HAZARD PREVENTION AND MANAGEMENT (ACTIVITY A1.2)

4.1 TURKEY

4.1.1 Past Events and Their Consequences

Table 4.1 Records of flood events in turkey in the areas of concern

Date of the Event	Region / Location of the Event	Name of the Watershed and River	Flooded Area (1000 m2)	Number of Deaths	Economical Loss in EURO (converted to present value)	Flood Importance Level
31 July 1955	Zonguldak (41° 27' 23" N, 31° 47' 55" E)	Zonguldak Çayı	N/A		N/A	N/A
13 - 14 February 1956	Edirne kazaları ve Ergene (41°40′37″ N, 26°33′21″ E)	Meriç, Tunca, Ergene	N/A	4	18,504,835.88	VERY HIGH
13 - 14 February 1956	Kırklareli ve Köyleri (41°44′06″ N, 27°13′30″ E)	Ergene ve kolları	N/A		20,437,940.40	VERY HIGH
13 - 14 February 1956	İpsala Enez (40°55′16″ N, 26°22′57″ E)	Meriç ve Ergene	N/A		9,247,432.75	VERY HIGH
2 September 1956	Ordu (40°59′04″ N, 37°52′44″ E)	Bülbül Deresi	N/A		10,490,753.57	VERY HIGH
18 January 1958	İpsala (40°55′16″ N, 26°22′57″ E)	Meriç	N/A		N/A	N/A
3 April 1958	İpsala (40°55′16″ N, 26°22′57″ E)	Meriç	N/A		N/A	N/A
19 - 20 May 1959	Giresun - Tirebolu - Görele (40°55′01″ N, 38°23′14″ E)	Aksu, Yağlı, Gelevara, Harşit, Görele, Eynesli, Keşap, İnceovaz, Pazarsuyu	N/A		14,534,488.93	VERY HIGH
19 - 20 May 1959	Trabzon - Rize havalisi (41°00′18″ N, 39°43′36″ E)	Fol, İskefiye, Kirazlı, Kenima, Değirmendere, Şana, Kalafa, Yanbolu, Karadere, İkizdere	N/A	13	N/A	VERY HIGH
2-5 July 1959	Ergene vadisi (41° 16' 00" N, 28° 54' 00" E)	Ergene Nehri	N/A		100,250,011.65	VERY HIGH
10 August 1959	Samsun ve civarı (41°17′12″ N, 36°19′48″ E)	Mert Ir, Kürtün, Derbent, Ağalı, Oymaz, Mezarlık	N/A		34,526,806.95	VERY HIGH

24 - 25 August 1959	Ünye civarı (41°07′53″ N, 37°16′56″ E)	Köprübaşı, Lahana, Ceviz, Curi, Akçay	N/A		14,837,434.30	VERY HIGH
24 -25 August 1959	Fatsa civarı (41°01′40″ N, 37°30′05″ E)	Elekçi, Bolama, Ilıca	N/A		8,162,211.03	VERY HIGH
11 - 19 January 1960	Edirne (41°40′37″ N, 26°33′21″ E)	Tunca Nehri	N/A		536,964.08	VERY HIGH
11 - 19 January 1960	Edirne - Meriç - İpsala, Enez (41°40′37″ N, 26°33′21″ E)	Meriç	N/A		N/A	N/A
11 - 19 January 1960	Babaeski (41°25′57″ N, 27°05′35″ E)	Şeytan, Üsküp, Ergene, İnce, Bağlıca	N/A	1	8,537,728.81	VERY HIGH
11 - 19 January 1960	Pehlivanköy (41°20′53″ N, 26°55′30″ E)	Ergene, Şeytan	N/A		939,687.13	VERY HIGH
1 - 30 September 1960	İpsala ovası (40°55′16″ N, 26°22′57″ E)	Meriç (Suni Taşkın)	N/A		9,937,454.54	VERY HIGH
17 - 22 June 1961	Tunca vadisindeki köyler (41°40′37″ N, 26°33′21″ E)	Tunca	N/A		2,874,896.16	VERY HIGH
17 - 22 June 1961	Meriç N. Boyu (40°43′50″N 26°2′6″E)	Meriç	N/A		120,526,523.53	VERY HIGH
1 - 2 October 1962	Kırklareli Mandıra köyü (41°44′06″ N, 27°13′30″ E)	Ergene N. - Karakarlı D.	N/A		1,543,189.49	VERY HIGH
1 - 2 October 1962	Hayrabolu merkez ilçe (41°12′47″ N, 27°06′24″ E)	Ergene N. - Hayrabolu - Anadere	N/A		59,594.72	MEDIUM
1 - 2 October 1962	Yoğunbağ köyü (41° 16' 59" N, 27° 7' 59" E)	Ergene N. - Hayrabolu - Anadere	N/A		355,215.87	HIGH
1 - 2 October 1962	Tatar köyü (41° 32' 44" N, 26° 36' 35" E)	Ergene N. - Hayrabolu - Anadere	N/A		6,325.40	LOW
1- 2 October 1962	Hacılı köyü (41° 05' 00" N, 27° 07' 00" E)	Ergene N. - Hayrabolu - Anadere	N/A		10,350.66	LOW
1 - 2 October 1962	Kurtdere köyü (41° 03' 00" N, 27° 06' 00" E)	Ergene N. - Hayrabolu - Anadere	N/A		25,876.65	LOW
1- 2 October 1962	Yorgüç köyü (40 42' 34" N, 27 10' 45" E)	Ergene N. - Hayrabolu - Anadere	N/A		32,202.06	LOW
1 - 2 October 1962	Umurbey köyü (41° 03' 00" N, 27° 03' 00" E)	Ergene N. - Hayrabolu -	N/A		13,800.88	LOW

		Anadere				
3 October 1962	Karamurat köyü (40 57' 00" N, 27 06' 00" E)	Ergene N. (Korular ve Değirmendereler)	N/A		1,423,393.66	VERY HIGH
3 October 1962	Kırkali köyü (40° 53' 24" N, 26° 54' 03" E)	Ergene N. - Hayrabolu - Köy	N/A		36,791.90	LOW
3 October 1962	Karademir köyü (41°12′47″ N, 27°06′24″ E)	Ergene N. - Hayrabolu - Kurudere	N/A		29,400.06	LOW
3 October 1962	İnecik (40 56' 16" N, 27 16' 56" E)	Ergene N. - Hayrabolu - İnecik	N/A	2	11,458.91	VERY HIGH
3 October 1962	Kalivya (40 55' 00" N, 26 54' 00" E)	Ergene N. - Hayrabolu - Kazyürük	N/A		196,035.25	MEDIUM
3 October 1962	Yaylagöne (40 54' 00" N, 26 45' 00" E)	Ergene N. - Hayrabolu - Köy	N/A		10,455.21	LOW
3 October 1962	Kadıgeberen (41 05' 00" N, 26 41' 00" E)	Ergene Basamaklar (Keşan, Malkara)	N/A		196,035.25	MEDIUM
3 October 1962	Türkovası (41 05' 36" N, 26 36' 22" E)	Ergene Basamaklar (Keşan, Malkara, Karapınar)	N/A		10,455.21	LOW
3 October 1962	Balaban (41 05' 00" N, 26 33' 00" E)	Basamaklar (Karapınar, Harala, Fakara)	N/A		229,178.28	HIGH
3 October 1962	Balabankoru (41 06' 00" N, 26 31' 00" E)	Basamaklar (Fakara, Değirmendere)	N/A		317,472.55	HIGH
3 October 1962	Rahmanca (41 17' 00" N, 26 29' 00" E)	Meriç - Rahmanca	N/A		196,035.25	MEDIUM
3 October 1962	Arnavut (40 43' 00" N, 26 18' 00" E)	Meriç - Rahmanca	N/A		637,768.02	VERY HIGH
3 October 1962	Keşan - Merkez (40°51′20″ N, 26°37′49″ E)	Kavakça - Doğanlar	N/A		77,577.68	MEDIUM
28 December 1962	Muratlı - Pehlivanköy (41 10' 17" N, 27 30' 11" E)	Ergene	N/A	1	16,630,951.08	VERY HIGH
28 December 1962	Karahabil - Haznedar (41 33' 48" N, 27 00' 27" E)	Ergene - Tekke (İnece)	N/A		15,053,573.04	VERY HIGH
28 December 1962	Kavaklı - Kuzuçardağı (41 48' 00" N, 26 46' 00" E)	Ergene - Yenimahalle	N/A		6,384,507.41	VERY HIGH
28 December 1962	Kırklareli (41°44′06″ N, 27°13′30″ E)	Ergene - Şeytan	N/A		16,718,722.60	VERY HIGH

28 December 1962	Eskitaşlı (41 29' 00" N, 27 24' 00" E)	Ergene - Kaynarca	N/A		1,212,752.47	VERY HIGH
28 December 1962	Ertuğrul, Karaağaç, Turgutbey (41 32' 00" N, 27 30' 00" E)	Ergene - Büyükdere	N/A		2,949,415.69	VERY HIGH
28 December 1962	Evrensekiz (41 22' 19" N, 27 29' 31" E)	Ergene - Soğucak	N/A		66,338.33	MEDIUM
28 December 1962	Büyük Karıştıran bucağı (41 18' 01" N, 27 32' 43" E)	Ergene - Paşaköy	N/A		374,296.64	HIGH
28 December 1962	Büyük Karıştıran bucağı (41 18' 01" N, 27 32' 43" E)	Ergene - Yuvalı	N/A		440,425.86	HIGH
28 December 1962	Büyük Yoncalı (41 22' 34" N, 27 55' 49" E)	Ergene - Manika (Baltan)	N/A		317,357.55	HIGH
28 December 1962	Çerkesköy (41 17' 06" N, 28 00' 01" E)	Ergene - Çorlu	N/A		824,947.70	VERY HIGH
2 January 1963	Trabzon Oksu köyü (41°00′18″ N, 39°43′36″ E)	Kurudere	N/A	3	N/A	VERY HIGH
3 -10 February 1963	Meriç vadisi (40°43′50″ N, 26°02′06″E)	Meriç	N/A		121,797,428.47	VERY HIGH
3 -10 February 1963	Ergene vadisi (41° 16' 00" N, 28° 54' 00" E)	Ergene	N/A		33,840,368.41	VERY HIGH
3 -10 February 1963	Hayrabolu (41°12′47″ N, 27°06′24″ E)	Hayrabolu, Beşiktepe	N/A	2	30,396,721.33	VERY HIGH
13 February 1963	Sakarya sağ sahil - Adapazarı Ovası (40°43'17"N 30°24'55"E)	Sakarya	N/A		13,849,576.03	VERY HIGH
28 October 1964	Tekirdağ - Bukruva (40 46' 49" N, 27 06' 15" E)	Kavak - Çaydere - Anadere	N/A	1	929,404.53	VERY HIGH
28 October 1964	Tekirdağ - Arzulu (41 12' 00" N, 27 25' 00" E)	Ergene - Hocaaydın	N/A	1	5,655,214.52	VERY HIGH
28 December 1964	Hayrabolu (41°12′47″ N, 27°06′24″ E)	Hayrabolu	N/A		913,074.80	VERY HIGH
17 April 1965	Adapazarı Ovası (40°43'17"N 30°24'55"E)	Sakarya	N/A		45,576,278.73	VERY HIGH
25 June 1965	Giresun - Espiye (40 57' 00" N, 38 43' 00" E)	Gelevara	N/A		6,531,792.93	VERY HIGH
25 June 1965	Aksu, Yağlıdere, Gelevara Havzaları (40 51' 36" N, 38 37' 28" E)	Aksu, Yağlıdere, Gelevara	N/A		5,936,769.30	VERY HIGH

25 June 1965	Vakfıkebir (41 03' 00" N, 39 19' 00" E)	Yağmur suları	N/A		61,535.04	MEDIUM
5 July 1966	Ordu - Merkez (40 59' 05" N, 37 52' 44" E)	Melet	N/A	6	20,424,149.80	VERY HIGH
5 July 1966	Ordu - Merkez (40 59' 05" N, 37 52' 44" E)	Civil	N/A		1,282,906.64	VERY HIGH
5 July 1966	Giresun - Bulancak - Pazar (40 56' 00" N, 38 11' 00" E)	Pazarsuyu	N/A		349,545.15	HIGH
5 July 1966	Giresun - Bulancak (Merkez) (40 56' 19" N, 38 14' 30" E)	İncüvez	N/A		123,038.30	MEDIUM
5 July 1966	Giresun - Bulancak (Merkez) (40 56' 19" N, 38 14' 30" E)	Bulancak	N/A		29,488.68	LOW
9 December 1966	Edirne (41°40′37″ N, 26°33′21″ E)	Meriç	N/A		98,957,864.34	VERY HIGH
9 December 1966	Edirne - Kırklareli - Tekirdağ (41°40′37″ N, 26°33′21″ E)	Ergene	N/A	2	15,327,164.98	VERY HIGH
17 July 1967	Fatsa (41°01′40″ N, 37°30′05″ E)	Elekçi	N/A		1,363,938.31	VERY HIGH
17 July 1967	Fatsa (41°01′40″ N, 37°30′05″ E)	Şehiriçi dereleri	N/A		482,451.38	HIGH
17 July 1967	Vakfıkebir (41 03' 00" N, 39 19' 00" E)	Çamlık dağları	N/A		2,239,259.51	VERY HIGH
6 August 1967	Of (40 57' 00" N, 40 16' 00" E)	Saaklı	N/A		995,779.66	VERY HIGH
8 - 9 November 1967	Samsun - Tekkeköy, Kirazlık, Kerimbey (41 06' 00" N, 36 06' 00" E)	Ökse, Hızırilyas, Güneyyaka	N/A		1,350,863.88	VERY HIGH
8 - 9 November 1967	Samsun şehiriçi ve civarı (41°17′12″ N, 36°19′48″ E)	Mert, Ağabali, Doymaz, Mezarlık	N/A		46,411,823.24	VERY HIGH
7 July 1968	Samsun civarı (41°17′12″ N, 36°19′48″ E)	Kürtün, Öteköy, Kuruzeytin, Affanlı, Değirmen, Elemin, Sazak	N/A		3,393,275.72	VERY HIGH
2 September 1968	Vezirköprü (41 08' 37" N, 35 27' 17" E)	Kargıcak	N/A	1	494,945.52	VERY HIGH
16 June 1969	Kastamonu Şehiriçi (41°22′40″ N, 33°46′31″ E)	Karaçomak	N/A		6,256,910.83	VERY HIGH
5 September 1969	Kastamonu - Hisarardı Mah. (41 22' 20" N, 33 46' 16" E)	Gökırmak - Hisarardı	N/A	1	560,456.30	VERY HIGH

13 February 1970	Sakarya - Villages of Adapazarı (40 46' 50" N, 30 24' 12" E)	12 - SAKARYA - Sakarya River	8000	-	173,614.43	VERY HIGH
09 March 1971	Edirne - İpsala (40°55′16″ N, 26°22′57″ E)	01 - MERİÇ - ERGENE - Meriç River	-	-	N/A	VERY HIGH
25 March 1971	Kocaeli - İzmit Plain (40 46' 01" N, 29 55' 01" E)	02- MARMARA - Kumla, Akarca, Bıçkı, Çayırköy	7811	-	68,405.47	VERY HIGH
08 June 1971	Kırklareli - Pehlivanköy (41 20' 54" N, 26 55' 23" E)	01 - MERİÇ - ERGENE - Söğütlüdere, Yuvarlakdere	750	-	69,742.49	VERY HIGH
08 June 1971	Samsun,Amasya - Ladik,Suluova (40 54' 38" N, 35 53' 31" E)	14 - YEŞİLIRMAK - Tersakan Ç., Borabay, K.abdal	27850	-	6,640,558.08	VERY HIGH
09 June 1971	Samsun - Alaçam - Yakakent (41 05' 00" N, 35 56' 00" E)	15 - KIZILIRMAK - Gümenez	65	1	130,874.90	VERY HIGH
17 July 1971	Ordu - Fatsa (41 01' 40" N, 37 30' 05" E)	22 - EASTERN BLACK SEA - Ilıca, Çalışlar, Şehiriçi	1256	-	1,624,833.34	VERY HIGH
12 August 1971	Sakarya - Akyazı - Alaağaç, Karaçalılık (40 40' 00" N, 30 39' 00" E)	12 - SAKARYA - Kallen	386	-	129,692.70	VERY HIGH
7 December 1971	Kocaeli - İzmit Plain (40 46' 01" N, 29 55' 01" E)	02- MARMARA - Kumla	450	-	363,209.32	VERY HIGH
18 April 1972	Bilecik - Osmaneli - Ayvalık (40 21' 26" N, 30 00' 51" E)	12 - SAKARYA - Sakarya River	39	-	16,119.69	VERY HIGH
17 June 1972	Kastamonu - Taşköprü (41 30' 50" N, 34 12' 53" E)	15 - KIZILIRMAK - Yavuç	300	-	568,421.40	VERY HIGH
19 June 1972	Kocaeli - İzmit Plain (40 46' 01" N, 29 55' 01" E)	02 - MARMARA - Kumla Deresi, Kirazdere	7250	-	14,041,634.22	VERY HIGH
19 June 1972	Sakarya - Akyazı - Altındere (40 41' 06" N, 30 37' 20" E)	12 - SAKARYA - Altındere	N/A	-	13,308.17	VERY HIGH
20 June 1972	Bolu - Düzce (40 50' 20" N, 31 09' 50" E)	13 - WESTERN BLACK SEA - Uğursuyu, K. B. Melen	631	-	N/A	VERY HIGH
21 June 1972	Sakarya - Akyazı - Sepetçiler (40 41' 06" N, 30 37' 20" E)	12 - SAKARYA - Dömen, Arşınlık, Beyciler	206	-	175,548.26	VERY HIGH

21 June 1972	Sakarya - Kaynarca - Birlik (41 01' 51" N, 30 18' 27" E)	12 - SAKARYA - Kaynarca	3300	-	230,106.79	VERY HIGH
21 June 1972	Sakarya - Geyve - Karaçam (40 30' 27" N, 30 17' 33" E)	12 - SAKARYA - İlimbey ve Karaçam	100	-	40,184.61	VERY HIGH
22 June 1972	Ordu - Şehir içi, Karapınar, Akçatepe (40 59' 05" N, 37 52' 44" E)	22 -EASTERN BLACK SEA - Melet, Turnasuyu	4384	-	1,220,587.28	VERY HIGH
26 June 1972	Sakarya - Karapürçek Mecidiye K. (40 38' 31" N, 30 32' 22" E)	12 - SAKARYA - Küçücek	950	-	65,951.76	VERY HIGH
04 July 1972	Kastamonu - Araç (41 14' 32" N, 33 19' 42" E)	13 - WESTERN BLACK SEA - Çengelli	50	-	109,661.52	VERY HIGH
04 July 1972	Kastamonu - Devrekani (41° 36′ 01″N, 33° 50′ 00″ E)	13 - WESTERN BLACK SEA - Devrekani	-	-	38,574.40	VERY HIGH
04 July 1972	Kastamonu - Taşköprü (41 30' 50" N, 34 12' 53" E)	15 - KIZILIRMAK - Değirmenderesi	209	-	52,626.51	VERY HIGH
04 July 1972	Kastamonu - Taşköprü (41 30' 50" N, 34 12' 53" E)	15 - KIZILIRMAK - Kuruçay	333	-	192,651.60	VERY HIGH
04 July 1972	Kastamonu - Taşköprü (41 30' 50" N, 34 12' 53" E)	15 - KIZILIRMAK - Gökçeağaç	120	-	6,860.73	VERY HIGH
04 July 1972	Kastamonu - Merkez (41° 22' 40" N, 33° 46' 31" E)	15 - KIZILIRMAK - Çırçırın	-	-	77,148.81	VERY HIGH
04 July 1972	Kastamonu - Taşköprü (41 30' 50" N, 34 12' 53" E)	15 - KIZILIRMAK - Dedesuyu	2600	-	5,879,841.34	VERY HIGH
05 July 1972	Kastamonu - Tosya (41°01′41″ N, 34°01′20″ E)	15 - KIZILIRMAK - Kurudere	-	-	110,212.58	VERY HIGH
31 July 1972	Samsun - Şehiriçi ve civarı (41°17′12″ N, 36°19′48″ E)	14 - YEŞİLIRMAK - Yeşilırmak River	1700	-	593,144.29	VERY HIGH
25 August 1972	Sakarya - Sapanca - Güldibi (40° 41' 06" N, 30° 15' 10" E)	12 - SAKARYA - Senaiye	60	-	53,105.93	VERY HIGH
18 October 1972	Edirne - Suakacağı - Avarız (41° 44' 55" N, 26° 33" E)	01 - MERİÇ - ERGENE - Tunca River	3148	-	1,424,461.27	VERY HIGH
16 April 1973	Edirne - Suakacağı (41° 50' 26" N, 26° 35' 18" E)	01 - MERİÇ - ERGENE - Meriç and Tunca Rivers	23266	-	1,222,954.39	VERY HIGH

14 June 1973	Ordu - Fatsa, Karakuş (41° 01' 00" N, 37° 30' 00" E)	22 - EASTERN BLACK SEA - Bolaman, Elekçi, Karakuş	3610	-	11,497,464.83	VERY HIGH
07 July 1973	Rize - Kalkandere - Dülgerli K. (40° 55' 43" N, 40° 26' 35" E)	22 - EASTERN BLACK SEA - İyidere	-	3	N/A	VERY HIGH
07 July 1973	Rize - Çayeli - Merkez (41° 05' 22" N, 40° 44' 11" E)	22 - EASTERN BLACK SEA - Şairler	-	-	8,370.07	VERY HIGH
07 July 1973	Rize - Yanıkdağ, Aşıklar ve Abdullahhoca (41° 04" 54" N, 40° 44' 48" E)	22 - EASTERN BLACK SEA - Aşıklar	-	4	77,786.91	VERY HIGH
14 July 1973	Rize - Kalkandere (40° 55' 43" N, 40° 26' 35" E)	22 - EASTERN BLACK SEA - İyidere	500	-	66,746.96	VERY HIGH
14 July 1973	Rize - Güneysu (40° 58' 18" N, 40° 36' 49" E)	22 - EASTERN BLACK SEA - Taşlıdere	125	7	25,564.09	VERY HIGH
11 May 1974	Kocaeli - İzmit Plain (40 46' 01" N, 29 55' 01" E)	03 - SUSURLUK - Anohor, B Balıklı, Badırga	1000	-	251,400.99	VERY HIGH
01 June 1974	Rize - Fındıklı (40° 54' 27" N, 40° 27' 59" E)	22 - EASTERN BLACK SEA - Abuçağlayan Arılı	-	-	N/A	VERY HIGH
06 June 1974	Ordu - Fatsa (41 01' 40" N, 37 30' 05" E)	22 - EASTERN BLACK SEA - Bolaman, Elekçi D.	-	-	145,268.80	VERY HIGH
28 July 1974	Giresun - Eynesil (41° 03' 37" N, 39° 08' 37" E)	22 - EASTERN BLACK SEA - Oğuz ve Gizgine	70	-	N/A	VERY HIGH
21 March 1975	Tekirdağ - Gönence, Çınarlıdere (40° 55' 19" N, 26° 55' 19" E)	01 - MERİÇ - ERGENE - Gönence, Çaydere	1000	-	76,189.50	VERY HIGH
25 April 1975	Sakarya - Mihalgazi (41° 07' 00" N, 30° 39' 00" E)	12 - SAKARYA - Köyveri	230	-	124,875.17	VERY HIGH
30 April 1975	Bartın - Bartın Merkez, Ulus (41° 38' 04" N, 32° 20' 15" E)	13 - WESTERN BLACK SEA - Bartın	-	-	1,159,366.68	VERY HIGH
30 April 1975	Amasya - Geldingen O. (40° 33' 00" N, 35° 35' 00" E)	14 - YEŞİLIRMAK - Yeşilırmak	10613	-	1,640,420.88	VERY HIGH
12 June 1975	Ordu - Kayabaşı (40° 56' 19" N, 37° 56' 23" E)	22 - EASTERN BLACK SEA - Melet	6500	-	2,526,645.48	VERY HIGH

12 June 1975	Ordu - Dedeli (40° 54' 20" N, 37° 49' 24" E)	22 - EASTERN BLACK SEA - Civil	136 5	-	395,518.48	VERY HIGH
12 June 1975	Ordu - Akçaova (41° 01' 10" N, 37° 49' 55" E)	22 - EASTERN BLACK SEA - Akçaova	200	-	199,372.47	VERY HIGH
12 June 1975	Ordu - Ordu (40° 59' 00" N, 37° 52' 00" E)	22 - EASTERN BLACK SEA - Efirli	60	-	402,305.15	VERY HIGH
12 June 1975	Ordu - Ordu şehiriçi (40° 59' 00" N, 37° 52' 00" E)	22 - EASTERN BLACK SEA - Şehiriçi	N/A	-	1,359,426.50	VERY HIGH
11 August 1975	Sakarya - Karasu, Taşlıgeçit (41° 06' 13" N, 30° 41' 37" E)	12 - SAKARYA - Terzioğlu	410	-	42,028.06	VERY HIGH
22 August 1975	Edirne - Karpuzlu, Umurca, Kemalköy (40° 49" 00" N, 26° 18' 00" E)	01 - MERİÇ - ERGENE - Meriç River	795 0	-	6,310,936.32	VERY HIGH
22 October 1975	Tekirdağ - Şarköy, Mürefte (40° 36' 48" N, 27° 06' 48" E)	02 - MARMARA - Tepeköy, Araplıdere	N/A	-	1,627,330.99	VERY HIGH
25 December 1975	Sakarya - Merkez - Göktepe (40° 51' 00" N, 30° 24' 00" E)	12 - SAKARYA - Osmancık	590	-	125,036.13	VERY HIGH
19 March 1976	Sakarya - Merkez - Güneşler (40° 46' 36" N, 30° 24' 20" E)	12 - SAKARYA - Sakarya River	8	-	32,682.33	VERY HIGH
05 April 1976	Sakarya - Karasu - Konacık (41° 03' 53" N, 30° 35' 48" E)	12 - SAKARYA - Sakarya River	38	-	160,757.25	VERY HIGH
10 June 1976	Sakarya - Merkez - Kuruçeşme (40° 47' 21" N, 30° 18' 37" E)	12 - SAKARYA - Kurt	350	-	31,452.47	VERY HIGH
16 June 1976	Sakarya - Merkez - Aşağıdere (40° 45' 21" N, 30° 16' 14" E)	12 - SAKARYA - Harmanlar	450	-	35,096.31	VERY HIGH
28 September 1976	Sakarya - Geyve (40° 31' 09" N, 30° 18' 07" E)	12 - SAKARYA - Sakarya River	8	-	22,819.54	VERY HIGH
24 October 1976	Sakarya - Karapürçek - Hocaköy (40° 38' 31" N, 30° 32' 22" E)	12 - SAKARYA - Karaca	388	-	53,541.43	VERY HIGH
26 October 1976	Sakarya - Karapürçek - Mecidiye K. (40° 37' 29" N, 30° 32' 43" E)	12 - SAKARYA - Karaca	N/A	-	18,790.62	VERY HIGH
17 December 1976	Sakarya - Karapürçek - Akbağlık, Harmanlı (40° 38' 50" N, 30° 33' 24" E)	12 - SAKARYA - Uludere	170	-	43,582.86	VERY HIGH
27 December	Sakarya - Karasu - Adatepe (41° 02' 02"	12 - SAKARYA - Sakarya River	17	-	79,263.98	VERY HIGH

1976	N, 30° 35' 28" E)					
19 May 1977	Ordu - Kayabaşı - Soya Fab. (40° 56' 19" N, 37° 56' 23" E)	22 - EASTERN BLACK SEA - Melet	1134	-	218,097.59	VERY HIGH
19 May 1977	Ordu - Gölköy (40° 41' 15' N, 37° 37' 04" E)	22 - EASTERN BLACK SEA - Gölköy	12	-	218,176.07	VERY HIGH
4 July 1977	Samsun - Atakum (41° 19' 42" N, 36° 17' 05" E)	15 - KIZILIRMAK - Değirmen (Soğuksu)	15	-	23,049.84	VERY HIGH
4 July 1977	Samsun - Bafra Deltası (41° 38' 00" N, 35° 55' 00" E)	15 - KIZILIRMAK - Çakırlar	21	-	7,333.76	VERY HIGH
4 July 1977	Samsun - Atakum (41° 19' 42" N, 36° 17' 05" E)	15 - KIZILIRMAK - Taflan	14	-	15,006.57	VERY HIGH
4 July 1977	Samsun - Bafra Deltası (41° 38' 00" N, 35° 55' 00" E)	15 - KIZILIRMAK - Muşta	730	-	189,271.16	VERY HIGH
4 July 1977	Samsun - Bafra Deltası (41° 38' 00" N, 35° 55' 00" E)	15 - KIZILIRMAK - Engiz	2000	-	355,422.15	VERY HIGH
4 July 1977	Samsun - Bafra Deltası (41° 38' 00" N, 35° 55' 00" E)	15 - KIZILIRMAK - Fındıklı	200	-	40,699.83	VERY HIGH
4 July 1977	Samsun - Bafra Deltası (41° 38' 00" N, 35° 55' 00" E)	15 - KIZILIRMAK - Karaköy	8900	-	996,428.14	VERY HIGH
4 July 1977	Samsun - Bafra Deltası (41° 38' 00" N, 35° 55' 00" E)	15 - KIZILIRMAK - Kumsal (Rengenli)	8200	-	506,991.66	VERY HIGH
4 July 1977	Samsun - Bafra - Kolay (41° 25' 06" N, 35° 48' 09" E)	15 - KIZILIRMAK - Kolay	500	-	511,926.56	VERY HIGH
30 July 1977	Rize - Fındıklı (40° 54' 27" N, 40° 27' 59" E)	22 - EASTERN BLACK SEA - Abuçağlayan ve Arılı	N/A	-	N/A	VERY HIGH
30 July 1977	Rize - Ardeşen (41° 11' 16" N, 40° 58' 14" E)	22 - EASTERN BLACK SEA - Dolana ve Gere	420	-	235,458.75	VERY HIGH
30 July 1977	Rize - Pazar (41° 10' 48" N, 40° 53' 29" E)	22 - EASTERN BLACK SEA - Hemşin	750	6	N/A	VERY HIGH
30 July 1977	Rize - Çayeli (41° 05' 22" N, 40° 44' 11" E)	22 - EASTERN BLACK SEA -	1200	-	N/A	VERY HIGH

		Büyükdere				
30 July 1977	Rize - Merkez (41° 01' 12" N, 40° 31' 24" E)	22 - EASTERN BLACK SEA - Taşlıdere	150	-	N/A	VERY HIGH
30 July 1977	Rize - İyidere (41° 00' 43" N, 40° 21' 43" E)	22 - EASTERN BLACK SEA - İyidere	750	-	N/A	VERY HIGH
30 July 1977	Trabzon - Tonya (40° 53',07" N, 39°,17',33" E)	22 - EASTERN BLACK SEA - Fol, Kasten	N/A	-	24,541.08	VERY HIGH
17 October 1977	Sakarya - Gevye - Kızılkaya (40° 34' 44" N, 30° 20' 32" E)	12 - SAKARYA - Taşlıçay	N/A	-	10,944.12	VERY HIGH
29 November 1977	Sakarya - Hendek - Balıklıihsaniye (40° 45' 29" N, 30° 45' 24" E)	12 - SAKARYA - Balıklıdere	350	-	36,746.98	VERY HIGH
09 December 1977	Sakarya - Hendek - Emince (40° 45' 04" N, 30° 44' 12" E)	12 - SAKARYA - Uludere	N/A	-	3,357,042.37	VERY HIGH
12 January 1978	Sakarya - Karasu - Ortaköy (40° 43' 51" N, 30° 41' 00" E)	12 - SAKARYA - Lahana	12	-	64,316.52	VERY HIGH
22 February 1978	Sakarya - Bozüyük - Dodurga (39° 48' 11" N, 29° 54' 53" E)	12 - SAKARYA - Uzunçamboğazı	N/A	-	175,523.26	VERY HIGH
20 April 1978	Sakarya - Akyazı - Reşadiye, Şerefiye (40° 41' 00" N, 30° 37' 31" E)	12 - SAKARYA - Reşadiye	130	-	15,878.54	VERY HIGH
28 October 1978	Tekirdağ - Lahana, Mandıra, Temrezli (41° 17' 00" N, 27° 08' 00" E)	01 - MERİÇ - ERGENE - Hayrabolu	205 0	-	316,654.65	VERY HIGH
30 October 1978	Kocaeli - Kandıra (41° 04' 12" N, 30° 09' 00" E)	02 - MARMARA - Namazgah	N/A	-	48,285.62	VERY HIGH
14 December 1978	Kocaeli - Gebze - Çayırova (40° 48' 10" N, 29° 25' 50" E)	02 - MARMARA - Çayırova, M. Bagan ve Suçıkan	N/A		N/A	N/A
02 February 1979	Sakarya - Akyazı - Hasanbey (40° 40' 25" N, 30° 40' 03" E)	12 - SAKARYA - Reşadiye	100 0	-	40,717.46	VERY HIGH
30 August 1979	Samsun - Havza (40° 58' 14" N, 35° 39' 45" E)	14 - YEŞİLIRMAK - Derinöz, Kamışlı, Yamaç Sul.	N/A	1	91,880.29	VERY HIGH
07 September 1979	Sakarya - Geyve - Afibey (40° 39' 00" N, 30° 27' 00" E)	12 - SAKARYA - Değirmendere	N/A	-	59,802.39	VERY HIGH
16 May 1980	Sakarya - Merkez - Şükriye, Kemaliye (40° 40' 43" N, 30°	12 - SAKARYA - Şükriye, Kemaliye,	160 0	-	826,216.03	VERY HIGH

	25' 09" E)	Süleymaniye				
14 June 1981	Ordu - Ünye (41° 07' 40" N, 37° 17' 13" E)	22 - EASTERN BLACK SEA - Tabakhane	200	-	5,449,760.37	VERY HIGH
4 September 1982	Ordu - Ünye (41° 07' 40" N, 37° 17' 13" E)	22 - EASTERN BLACK SEA - Tabakhane	80	-	167,615.86	VERY HIGH
30 November 1982	Sakarya - Gevye (40° 34' 44" N, 30° 20' 32" E)	12 - SAKARYA - Karaçay	20	-	362,235.84	VERY HIGH
19 July 1983	Rize - Pazar (41° 10' 48" N, 40° 53' 29" E)	22 - EASTERN BLACK SEA - Hemşin ve Bodasarı	125 0	15	N/A	VERY HIGH
19 July 1983	Rize - Fındıklı (40° 54' 27" N, 40° 27' 59" E)	22 - EASTERN BLACK SEA - Abuçağlayan ve Sümer	132 3	12	N/A	VERY HIGH
21 July 1983	Ordu - Fatsa (41 01' 40" N, 37 30' 05" E)	22 - EASTERN BLACK SEA - Şerefiye ve yamaç suları	100	-	469,259.99	VERY HIGH
26 July 1983	Kastamonu - İnebolu, Cide, Doğanyurt (41° 58' 29" N, 33° 45' 39" E)	13 - WESTERN BLACK SEA - Fakaz, İnebolu, Akçabel	485	1	N/A	VERY HIGH
27 July 1983	Zonguldak - Merkez ve ilçeleri (41° 27' 23" N, 31° 47' 55" E)	13- WESTERN BLACK SEA - Filyos, Ulus, Kokaksu	N/A	3	35,138,929.89	VERY HIGH
06 March 1984	Edirne - Kapıkule - Enez (40° 43' 45" N, 26° 05' 20" E)	01 - MERİÇ - ERGENE - Tunca, Ergene, Meriç rivers	284 570	-	7,959,699.35	VERY HIGH
30 July 1984	Sakarya - Sapanca - Kırkpınar (40° 41' 30" N, 30° 13' 26" E)	12 - SAKARYA - Mahmudiye	310	-	109,265.27	VERY HIGH
21 April 1985	Sakarya - Hendek - Soğuksu (40° 53' 06" N, 30° 37' 27" E)	12 - SAKARYA - Soğuksu	625	-	64,195.22	VERY HIGH
07 July 1987	Sinop - Erfelek (41° 52' 34" N, 34° 54' 30" E)	13 - WESTERN BLACK SEA - Karasu	445 0	-	115,949.40	VERY HIGH
07 July 1987	Sinop - Ayancık (41° 56' 49" N, 34° 35' 30" E)	13 - WESTERN BLACK SEA - Ayancık	N/A	-	132,469.44	VERY HIGH
07 July 1987	Sinop - Türkeli (41° 56' 55" N, 34° 20' 11" E)	13 - WESTERN BLACK SEA - Yarna, Kanlıçay	N/A	-	44,025.74	VERY HIGH
01 July	Zonguldak - Bartın	13 - WESTERN	123	-	N/A	VERY

1988	Merkez (41° 38' 04" N, 32° 20' 15" E)	BLACK SEA - Bartın	0			HIGH
01 July 1988	Samsun - Çarşamba (41° 11' 56" N, 36° 43' 37" E)	14 - YEŞİLIRMAK - Yeşilırmak	161 00	-	2,754,478.04	VERY HIGH
01 July 1988	Samsun - Gelemen (41° 23' 02" N, 36° 39' 16" E)	14 - YEŞİLIRMAK - Gelemen	122 43	-	2,186,806.13	VERY HIGH
01 July 1988	Samsun - Ayvacık (40° 59' 13" N, 36° 37' 53" E)	14 - YEŞİLIRMAK - Çatak	-	-	74,140.18	VERY HIGH
01 July 1988	Ordu - Fatsa (41 01' 40" N, 37 30' 05" E)	22 - EASTERN BLACK SEA - Elekçi, Şerefiye, Kurtuluş	193	-	1,953,756.99	VERY HIGH
21 July 1988	Rize - Ardeşen (41° 11' 16" N, 40° 58' 14" E)	22 - EASTERN BLACK SEA - Konak ve Ardeşen	31	-	132,919.60	VERY HIGH
21 July 1988	Rize - Pazar (41° 10' 48" N, 40° 53' 29" E)	22 - EASTERN BLACK SEA - Hako, Bodasarı Hemşin	30	3	163,741.54	VERY HIGH
21 July 1988	Rize - Çayeli (41° 05' 22" N, 40° 44' 11" E)	22 - EASTERN BLACK SEA - Aşıklar	-	-	5,779.11	VERY HIGH
01 August 1988	Ordu - Ünye (41° 07' 40" N, 37° 17' 13" E)	22 - EASTERN BLACK SEA - Tabakhane	180	-	426,832.65	VERY HIGH
02 August 1988	Ordu - Ordu (40° 59' 00" N, 37° 52' 00" E)	22 - EASTERN BLACK SEA - Civil, Melet	115	-	79,741.34	VERY HIGH
11 October 1988	Sinop - Türkeli - Helaldı (41° 56' 44" N, 34° 21' 26" E)	13 - WESTERN BLACK SEA - Helaldı	180	1	5,723,503.10	VERY HIGH
27 February 1989	Zonguldak - Yenice, Devrek, Gökçebey (41° 13' 30" N, 31° 57' 34" E)	13 - WESTERN BLACK SEA - Filyos	420	-	N/A	VERY HIGH
26 November 1989	Bartın - Ulus Merkez (41° 35' 10" N, 32° 38' 26" E)	13 - WESTERN BLACK SEA - Bartın	410	-	N/A	VERY HIGH
27 April 1990	Trabzon - Maçka, Trabzon Merkez (40° 49' 00" N, 39° 37' 00" E)	22 - EASTERN BLACK SEA - Değirmendere	N/A	-	58,682.90	VERY HIGH
27 April 1990	Trabzon - Çaykara (40° 45' 07" N, 40° 14' 42" E)	22 - EASTERN BLACK SEA - Solaklı	20	-	1,276,942.01	VERY HIGH

27 April 1990	Trabzon - Araklı (40° 56' 21" N, 40° 03' 18" E)	22 - EASTERN BLACK SEA - Karadere	20	-	552,608.56	VERY HIGH
27 April 1990	Artvin - Yusufeli (40° 49' 31" N, 41° 32' 55" E)	22 - EASTERN BLACK SEA - Çoruh	3	-	71,455.90	VERY HIGH
27 April 1990	Artvin - Merkez (41° 11' 00" N, 41° 49' 00" E)	22 - EASTERN BLACK SEA - Çoruh	40	-	96,158.55	VERY HIGH
27 April 1990	Artvin - Ardanuç (41° 07' 43" N, 42° 03' 33" E)	22 - EASTERN BLACK SEA - Bulanıkdere	30	-	169,821.80	VERY HIGH
27 April 1990	Artvin - Şavşat (41° 14' 25" N, 42° 21' 40" E)	22 - EASTERN BLACK SEA - Berta Suyu	45	-	2,226,833.35	VERY HIGH
20 June 1990	Trabzon - Merkez (41° 00' 00" N, 39° 44' 00" E)	22 - EASTERN BLACK SEA - Değirmen, Hacıbeşir	801	-	64,617,976.25	VERY HIGH
20 June 1990	Trabzon - Maçka (40° 49' 00" N, 39° 37' 00" E)	22 - EASTERN BLACK SEA - Değirmendere	197 72	3	83,076,415.17	VERY HIGH
20 June 1990	Trabzon - Akçaabat (41° 00' 59" N, 39° 34' 59" E)	22 - EASTERN BLACK SEA - Sere, Akçakale	222 67	22	147,171,163.33	VERY HIGH
20 June 1990	Trabzon - Çarşıbaşı (41° 04' 59" N, 39° 22' 59" E)	22 - EASTERN BLACK SEA - İskefiye	N/A	12	15,668,624.89	VERY HIGH
20 June 1990	Trabzon - Vakfıkebir (41° 02' 50" N, 39° 16' 47" E)	22 - EASTERN BLACK SEA - Fol, Yıldız, Glida	702 8	6	39,635,618.22	VERY HIGH
20 June 1990	Trabzon - Tonya (40° 53',07" N, 39°,17',33" E)	22 - EASTERN BLACK SEA - Fol, Kasten	162 5	12	15,236,969.64	VERY HIGH
20 June 1990	Trabzon - Şalpazarı (40° 56' 30" N, 39° 11' 27" E)	22 - EASTERN BLACK SEA - Akhisar, Değirmendere	88	-	8,726,152.61	VERY HIGH
20 June 1990	Giresun - Doğankent (40° 48' 00" N, 38° 55' 00" E)	22 - EASTERN BLACK SEA - Harşit	N/A	1	16,865,301.35	VERY HIGH
20 June 1990	Giresun - Tirebolu (41° 00' 18" N, 38° 48' 51" E)	22 - EASTERN BLACK SEA - Harşit	199 8	-	1,878,694.12	VERY HIGH
20 June 1990	Giresun - Yağlıdere (40° 51' 41" N, 38° 37' 31" E)	22 - EASTERN BLACK SEA - Yağlıdere	840	1	10,711,289.40	VERY HIGH

20 June 1990	Giresun - Espiye (40 57' 00" N, 38 43' 00" E)	22 - EASTERN BLACK SEA - Gelevera, Yağlıdere	495	-	9,130,341.69	VERY HIGH
20 June 1990	Giresun - Keşap (40° 54' 59" N, 38° 30' 52" E)	22 - EASTERN BLACK SEA - Keşap	2	-	692,633.57	VERY HIGH
20 June 1990	Giresun - Merkez, Dereli, Bulancak, Güce (40° 54' 46" N, 38° 23' 22" E)	22 - EASTERN BLACK SEA - Merkez	N/A	-	1,870,781.82	VERY HIGH
20 June 1990	Trabzon - Of, Balaban (40° 56' 40" N, 40° 16' 03" E)	22 - EASTERN BLACK SEA - Baltacı, Yeniköy	154 25	-	43,049,071.87	VERY HIGH
11 June 1991	Zonguldak - Bartın, Devrek, Yenice (41° 38' 04" N, 32° 20' 15" E)	13 - WESTERN BLACK SEA - Filyos ve Bartın	348	-	N/A	VERY HIGH
27 June 1991	Zonguldak - Çaycuma, Devrek, Ereğli (41° 26' 00" N, 32° 05' 00" E)	13 - WESTERN BLACK SEA - Filyos ve Bartın	538 5	2	N/A	VERY HIGH
07 July 1991	Zonguldak - Çaycuma, Yenice, Ereğli (41° 26' 00" N, 32° 05' 00" E)	13 - WESTERN BLACK SEA - Filyos	538 5	2	N/A	VERY HIGH
17 June 1992	Samsun - Tekkeköy, Kutlukent, Ayvacık (41° 12' 45" N, 36° 27' 24" E)	14 - YEŞİLIRMAK - Azot kanalı, Yamaç Su, Çatak	585 0	1	943,975.14	VERY HIGH
21 June 1992	Zonguldak - Devrek (41° 13' 30" N, 31° 57' 34" E)	13 - WESTERN BLACK SEA - Nakışharman	10		N/A	LOW
31 July 1992	Giresun - Merkez ve çevre (40° 54' 46" N, 38° 23' 22" E)	22 - EASTERN BLACK SEA - Gelevera	N/A		N/A	N/A
27 June 1994	Giresun - Yağlıdere (40° 51' 41" N, 38° 37' 31" E)	22 - EASTERN BLACK SEA - Yağlıdere	800		969,401.73	VERY HIGH
28 June 1994	Giresun - Yağlıdere (40° 51' 41" N, 38° 37' 31" E)	23 - EASTERN BLACK SEA - Yağlıdere	300		225,633.15	HIGH
08 August 1994	Ordu - Perşembe, Efirli (41° 03' 56" N, 37° 46' 17" E)	22 - EASTERN BLACK SEA - Efirli	15		46,389.41	LOW
13 December 1994	Bartın - Bartın Merkez, Ulus (41° 38' 04" N, 32° 20' 15" E)	13 - WESTERN BLACK SEA - Bartın	50		N/A	LOW
06 July 1995	Trabzon - Çaykara (40° 45' 07" N, 40°	22 - EASTERN BLACK SEA -	N/A		81,579.66	MEDIUM

	14' 42" E)	Solaklı				
06 July 1995	Trabzon - Dernekpazarı (40° 48' 06" N, 40° 14' 41" E)	22 - EASTERN BLACK SEA - Solaklı	N/A	4	419,895.32	VERY HIGH
31 July 1995	Trabzon - Of (40° 56' 40" N, 40° 16' 03" E)	22 - EASTERN BLACK SEA - Solaklı	70		902,609.96	VERY HIGH
06 July 1995	Rize - Güneysu (40° 58' 18" N, 40° 36' 49" E)	22 - EASTERN BLACK SEA - Potamya	100		175,156.33	MEDIUM
06 July 1995	Rize - Güneysu (40° 58' 18" N, 40° 36' 49" E)	23 - EASTERN BLACK SEA - Taşlıdere	200	4	11,517.13	VERY HIGH
31 July 1995	Rize - Ardeşen (41° 11' 16" N, 40° 58' 14" E)	22 - EASTERN BLACK SEA - Işıklı	150		411,345.69	HIGH
31 July 1995	Rize - Pazar (41° 10' 48" N, 40° 53' 29" E)	23 - EASTERN BLACK SEA - Hemşin	N/A		4,701.09	LOW
31 July 1995	Rize - Pazar (41° 10' 48" N, 40° 53' 29" E)	24 - EASTERN BLACK SEA - Melyat	250	1	975,476.91	VERY HIGH
31 July 1995	Rize - Çayeli (41° 05' 22" N, 40° 44' 11" E)	25 - EASTERN BLACK SEA - Aşıklar	70		634,647.63	VERY HIGH
31 August 1995	Rize - Çayeli (41° 05' 22" N, 40° 44' 11" E)	22 - EASTERN BLACK SEA - Büyükdere	150	2	2,408,736.19	VERY HIGH
31 August 1995	Rize - Çayeli (41° 05' 22" N, 40° 44' 11" E)	22 - EASTERN BLACK SEA - Şairler	N/A		1,458,500.81	VERY HIGH
24 February 1996	Edirne - Kapıkule - Enez (40° 43' 45" N, 26° 05' 20" E)	01 - MERİÇ - ERGENE - Tunca and Meric rivers	520 00		1,236,670.36	VERY HIGH
05 December 1996	Edirne - Kapıkule - Enez (40° 43' 45" N, 26° 05' 20" E)	01 - MERİÇ - ERGENE - Tunca and Meric rivers	567 00	1	579,007.43	VERY HIGH
13 April 1997	Edirne - Suakacağı - Edirne (41° 50' 25" N, 26° 35' 18" E)	01 - MERİÇ - ERGENE - Tunca River	139 00		427.98	VERY HIGH

Table 4.2 Criterion for flood importance level as stated by the EU Flood Directive

Flood Importance Level	Human Life Loss	Damage Cost (EUR)	Floodplain (1000 m2)
Low		< 50000	< 2000
Medium		50000 – 200000	2000 – 5000
High		200000 –500000	5000 –10000
Very High	>= 1	> 500000	> 10000

4.1.2 Existing legislation framework

The Turkish legislative framework for flood control and flood risk management includes the following legislative acts:

1. Law Concerning the Organization and Duties of the General Directorate Of State Hydraulic Works [Law No: 6200 (1953)]

The General Directorate of State Hydraulic Works, which shall have a separate budget and juridical personality, is established under the Ministry of Public Works for the purposes of multiple utilization of ground and surface waters and prevention of damages caused by them. The duties and authorities of the Directorate include, inter alia a) to build irrigation, flood prevention and other waterworks; b) to reclaim swamps; c) to generate power from water; d) to examine, approve and supervise the water supply and sewerage designs for cities and towns; and e) to make observations, conduct experiments, compile statistics, conduct research, make various kinds of surveys, to determine the type and character of soils, the kinds of crops to be raised, and to evaluate the agricultural and economic benefits to be derived and the degree of productivity to be obtained. Directorates and operating organizations shall be established in accordance with this Law. Specific tasks of each branch of the Directorate are specified.

2. Law on Protection Against Flood [Law No:4373 (1943)]

The aim of this Law is to prevent losses and minimize the negative effects of river floods. It sets forth the preventive measures to be taken and the rules and procedures to be followed when there is a probability flood and the rules and procedures to be followed when emergency intervention is needed. The Law also defines the duties and responsibilities of local authorities and the General Directorate of State Hydraulic Works.

3. Law on Metropolitan Municipalities [Law No: 5216 (2004)]

The purpose of this Law is to establish the legal status of metropolitan municipality administration and ensure that services are provided in a planned, programmed, effective, efficient and consistent manner (Article 1). This Law covers metropolitan municipalities and the municipalities located within the boundaries of a metropolitan area (Article 2). According to this law, "Providing water supply and sewer services and build or cause to build and operate the necessary dams and other facilities for the purpose; rehabilitate streams; market spring water and produced water" (Article 7-r) is duty and responsibility of metropolitan municipalities within the boundaries of a metropolitan area.

4. Law on Precautions For Disasters Affecting Everyday Life / Disaster Law [Law No: 7269 (1959)]

This law is the main legal frame of disaster management that includes duties and responsibilities of organizations to be prepared and recovery after incident. The ministry under which State Hydraulic Works is organized is responsible for determining and announcing flood risk areas (Article 2 para. 1) and providing measures against flood hazard (Article 3 para. 6).

5. Municipality Law [Law No: 5393 (2005)]

The purpose of this Law is to lay down the establishment, organs, administration, duties, powers, responsibilities and working procedures and principles of municipalities (Article 1). This Law covers municipalities (Article 2). As stated in this law municipalities "... supply potable, utility and industrial water; ensure the disposal of waste water and rainwater; establish or cause to establish and operate or cause to operate necessary facilities for that purpose; and operate or cause to operate spring water facilities." (Article 15-e).

6. Law on Organization And Duties Of The Presidency For Disaster And Emergency Management [Law No:5902 (2009)]

By this law Disaster and Emergency Management Presidency is established. As stated in this law providing against disasters, controlling this prevention and coordinating responsible organizations are subject to this Presidency (Article 4 -1).

7. Law on Organization And Duties Of Turkish State Meteorological Service [Law No:3254 (1986)]

The Turkish State Meteorological Service was founded in 1937. It is the only legal organization which provides all meteorological information in Turkey.

As reported by this law, State Meteorological Service is responsible for measurement of meteorological variables, forecasting and providing to organizations concerned with meteorological data (Article 2-b).

8. Law on Establishment And Duties Of General Directorate Of Istanbul Water And Sewage Administration [Law No:2560 (1981)]

Conforming to this law, Istanbul Water and Sewage Administration (ISKI) was established to provide water and sewage services. Safe removal of wastewater and storm water from settlements along with construction, operation, maintenance of drainage systems are responsibilities of ISKI (Article 2-b). Other metropolitan municipalities also have their own water and sewage administration general directorates based on this law.

9. Turkish Criminal Code [Law No: 5237 (2004)]

In Turkish criminal code, damaging plants used for supply of irrigation, utility water or useful for prevention of disasters (Article 152-1-d) will be punished. The punishment will be doubled if it leads to landscape, avalanche, flood or flow of water (Article 152-2-b). Furthermore, any person who causes collapse of a building, landscape, avalanche, flood or overflow of water, in such a way to risk people's life, health or property, is sentenced to imprisonment from six months to three years (Article 170-1). If a person causes same damage by negligence he is punished with imprisonment from three months to one year (Article 171).

10. Decree on The Establishment And Duties Of The Ministry Of Forestry And Water Management [No:645 (2011)]

General Directorate of Water Management (Article 6-c) is a unit organized under Ministry of Forest and Water Affairs. Determining the strategies and policies of floods and preparing the relevant legislation and flood management plans (Article 9-e) are responsibilities of this unit.

11. Prime Ministry Circular on Stream Beds And Floods (No. 2006/27)

This circular is mainly about streambed stabilization. It brings regulations on building in flood-prone areas.

12. Prime Ministry Circular on River And Streambed Regulation (No. 2010/5)

Removal of buildings that cause flood risk (Article 3) and responsibilities of organizations on river and streambed regulation are covered by this circular.

4.1.3 Implemented flood hazard prevention studies

In Turkey, State Hydraulic Works is a general Directorate established under the Ministry of Forestry and Water Affairs. It is the main public body responsible for flood control studies. Different kinds of flood control structures exist. Here, only dams constructed for the purpose of flood control were considered. Below given is a list of such dams within the project area, the Black Sea region.

Table 4.3 Already implemented flood hazard prevention studies

Number	Dam	Location / Province	Purpose	Height from Thalweg	In operation since
1	ALTINYAZI	Edirne	Irrigation + Flood Control	22	1970
2	BAYRAKTAR	İzmit	Irrigation + Flood Control	25	1985
3	BIÇKIDERE	İzmit	Irrigation + Flood Control	25	1978
4	BORÇKA	Artvin	Energy + Flood Control	86	2006
5	DEĞİRMENCİ	Edirne	Irrigation + Flood Control	16	1979
6	DERBENT	Samsun	Irrigation + Flood Control + Energy	33	1990
7	DOKUZDERE	Edirne	Irrigation + Flood Control	24	1976
8	HAMZADERE	Edirne	Irrigation + Flood Control	26	2011
9	KADIKÖY (Derbent)	Edirne	Irrigation + Water Supply +Flood Control	34	1973
10	KARAÇOMAK	Kastamonu	Irrigation + Water Supply +Flood Control	49	1973
11	KARAİDEMİR	Tekirdağ	Irrigation + Flood Control	36	1983
12	KAYALIKÖY	Kırklareli	Irrigation + Flood Control	72	1986
13	KIRKLARELİ	Kırklareli	Irrigation + Water Supply +Flood Control	71	1998
14	KİRAZLIKÖPRÜ	Bartın	Irrigation + Energy +Flood Control	82	2002
15	KOZLU	Zonguldak	Water Supply + Flood Control	60	1986
16	KURTDERE	İzmit	Irrigation + Flood Control	26	1974
17	MURATLI	Artvin	Energy + Flood Control	44	2005
18	SÜLOĞLU	Edirne	Irrigation + Water Supply +Flood Control	52	1981
19	ŞEYTANDERE	İzmit	Irrigation + Flood Control	18	1985

4.2 GREECE

4.2.1 Past Events and Their Consequences

Demographic data related to flood hazard

Greece has 13272 settlements. Most of them are villages where the Flood hazard is minimal. Residents are aware of flood risk and build their houses away from streams.

Urban and coastal residential areas as well as settlements within river flood plains are the ones facing a high flood risk.

Census data regarding the present status, indicate that there are 23 cities with population over 40000, 145 settlements with a population higher than 10000, 300 coastal settlements with an additional number of around 100 coastal settlements in the Hellenic islands and an unknown number of settlements within river flood plains. An estimate based on the above data indicates that there are around 500 settlements which face a flood hazard.

Physiographic Data

Greece is generally characterized by a fragmented terrain with small river basins (watersheds). The most common type of flooding is flash flooding.

There is a very small correlation between natural phenomena (storms) and floods on an "hour's" scale. There is also a very small correlation between simultaneous storms and floods (Koutsogiannis D, 2010).

Planning for Flood protection in Greece

Flooding problems are classified as low priority problems. Engineering solutions are applied on a limited scale and a limited control is applied on illegal (arbitrary) construction.

An emphasis is given on solutions-by-construction where the target is to drain (channel) the flood safely to physical or constructed water drainage systems. A typical approach is with stream construction/interventions designed for flooding with a return (repetition) period of 50 years or lower. The problem in this case, is that the level of safety provided is limited mainly due to economic factors and thus, the flood design parameters are often exceeded. Moreover, the return period taken into account, provides estimations about high probability floods whereas the Directive 2007/60 requires flood hazard assessment for medium and low probability floods (return periods of >100 years and >1000 years respectively.

Another approach is to tackle the problem separately on a stream scale basis. The target in this case is to face the problem on specific areas but then, the problem is usually transferred upstream or downstream.

What really happens is that around 10 of the floods which occur per year, will exceed the "design flood" in any of the 500 settlements at risk, with an estimate that once a year, there will be a flood incident of 500 year return period to occur in one of those settlements. In fact, according to the Operational Center for Civil Protection, 10 serious flooding incidents were reported during the year 2009, with the most serious of them occurring in the island of Evia and in Pella (Northern Greece). It should be noted that during the past years there were reported 10 serious flooding incidents for 2008, 41 for 2007 and 25 which occurred during 2006.

Based on the aforementioned, it seems that there is an urgent need for changes in the way flood problems are tackled. These changes should at least include new design criteria for flood prevention/protection construction, a change of the prototype used to face the flood issue (from designing infrastructure to the river basin simulation) and finally the development of new tools and the harmonization of methodologies.

4.2.2 Existing legislation framework

EU Directive 2007/60

Greece legislation includes first of all Planning for Flood Hazard protection in Europe – the EU Directive 2007/60

According to the directive, there are various aspects of the flood hazard that are covered.

Flood Prevention measures include the avoidance of building houses and industrial buildings in areas subject to flooding, the customization of urban development projects according to flood risk and the promotion of the appropriate practices in land use, agriculture and forestry.

Protection measures include both construction (structural) and non-construction measures to reduce the possibility of flooding and its consequences.

Preparedness measures are mainly about informing the public about the flood risk and promoting actions in case of an emergency.

Emergency plans include training of public body's personnel, regular drills etc.

Restoration is usually undertaken by the National Authorities (compensation is given if/when flood damages occur).

The Directive itself contains eight chapters with guidelines/principles and implementation measures:

1. Chapter I: General provisions (Article 1 Aim, Article 2 definitions, Article3 competent authorities for implementation),
2. Chapter II (Articles 4 and 5): guidelines/principles for the Preliminary Assessment of Flood Risk
3. Chapter III (Article 6): guidelines/principles for drawing Hazard Maps and flood risk maps
4. Chapter IV (Articles 7 and 8): guidelines/principles for Flood Risk management planning.
5. Chapter V (Articles 9 and 10): guidelines/principles for coordination with Directive 2000/60/EC, public information and consultation
6. Chapter VI (Articles 11 and 12): implementation measures and amendments

7. Chapter VII (Article 13): transitional period measures

8. Chapter VIII (Articles 14, 15, 16, 17, 18 and 19): regulates issues in reviews, reports and final provisions.

The EU Directive 2007/60 was incorporated into Hellenic law, by the Common Ministerial Decision (CMD) "Η.Π. 31822/1542/Ε103/2010 (ΦΕΚ Β' 1108/21.07.2010)"

Overall, the timetables for the flood hazard and Flood Risk assessments as well as for the preparation of Flood Risk Management Plans in Greece, is fully harmonized with the provisions/timelines of Directive 2000/60/EC.

Administrative Structure for tackling the Flood Hazard problem

According to the CMD Η.Π. 31822/1542/Ε130/2010 and administrative changes introduced by the "Kallikratis" Program (Law.3852/2010), competent authorities for the implementation of the Directive 2007/60/EC are the "Special Secretariat for Water (SSW)" of the Ministry of the Environment, Energy and Climate Change (M.E.E.C.H.) and the "Water Divisions of the Decentralized Administration".

In particular: The SSW performs and processes in cooperation with the General Secretariat for Civil Protection (G.S.C.P.) of the Ministry of Public Order and Citizen Protection (MPOCP) and every other public body or Service participating in the national programme Flood risk management (which is part of the national protection and management of the water resources of the country programme), evaluates and monitors the implementation of the national program , coordinates services and governmental agencies, represents the country and participates in the relevant Community forum on issues of flood risk management. Prepares and submits to the National Water Commission the required annual reports on the implementation, evaluation and control of the National "Flood Risk Management" Programme.

The Water Divisions of the decentralized administration carry out the preliminary Flood risk assessment and in collaboration with the Directorate of Civil Protection administrations establish Flood hazard Maps, Flood Risk maps and Plan Flood risk management . Moreover, they coordinate all involved in Flood Prevention & Management issues and ensure the stakeholder's active involvement in establishing, reviewing and updating Flood Management projects. Finally, they are responsible for providing annual reports on the implementation, evaluation and control of the "Flood risk management" program in their area of jurisdiction.

Management issues - Geographical Units of implementation

According to the CMD Η.Π. 31822/1542/Ε103/2010 the geographical unit of implementing the Directive 2007/60/EC is the River Basin Districts (corresponding Water Districts in terms of the Article 3 of PD 51/2007). Essentially the geographical units for implementing the Directive and the Water Framework are the same.

By the 706/16-07-2010 (GG V/02.09.2010 1383) decision of the National Water Commission forty five (45) river basins have been set at the country level, according to the CMD Η.Π. 31822/1542/Ε103/2010 geographical application article. These river basins are subjected to fourteen (14) river basin districts (water districts) namely (Fig 27):

WD GR01 : Dytiki (Western) Peloponissos
WD GR02 : Voria (Northern) Peloponissos
WD GR03: Anatoliki (Eastern) Peloponissos
WD GR04 : Dytiki (Western) Sterea Hellas
WD GR05 : Epirous
WD GR06 : Attiki
WD GR07 : Anatoliki (Eastern) Sterea Hellas
WD GR08 : Thessalia
WD GR09 : Dytiki (Western) Makedonia
WD GR10 : Kentriki (Central) Makedonia
WD GR11 : Anatoliki (Eastern) Makedonia
WD GR12 : Thraki (Thrace)
WD GR13 : Kriti (Crete)
WD GR14 : Nisi Aigaiou (Aegean Islands)

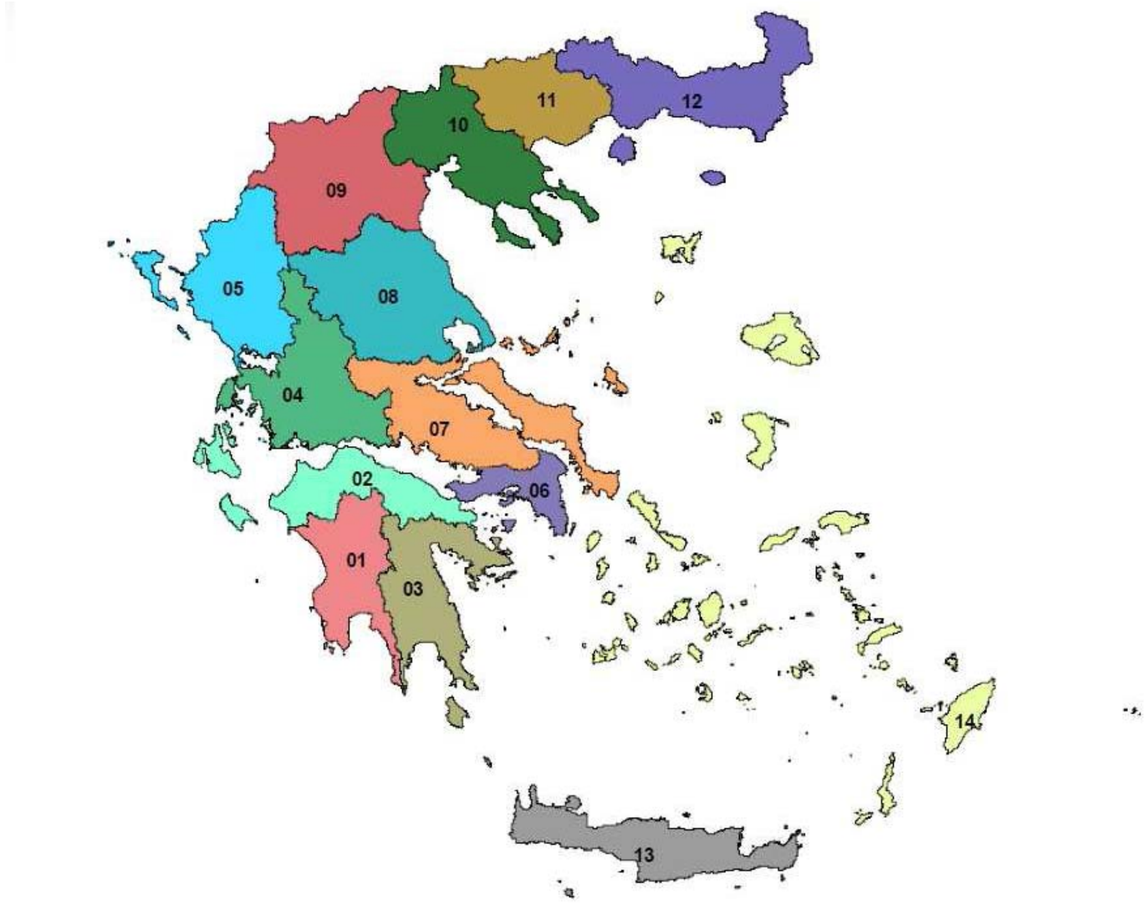


Fig 27. Hellenic Water Districts - administrative divisions regarding water management issues. Taken from the "Implementation of the Directive 2007/60/EC of the European Parliament and of the Council. Preliminary Flood Risk Assessment".

4.2.3 Implemented flood hazard prevention studies

Flood Hazard Assessment - A brief summary

The Hellenic (Greek) Ministry of "the Environment, Energy and Climate change", "Special Secretariat of Waters" with the addition of external experts, issued the "Implementation of the Directive 2007/60/EC of the European Parliament and of the Council. Preliminary Flood Risk Assessment" (December 2012) which was revised on 07/06/2013.

The report includes comments on the incorporation of the Directive into Hellenic law and a preliminary assessment of flood risk of the entire Hellenic territory in accordance with Directive 2007/60/EC [on the 'Assessment and management of flood risks "and the Joint Ministerial Decision (JMD) H.P. 31822/1542/E103/2010 (GG V/21.07.2010 1108)].

It also includes:

- Recording of historical floods, their main characteristics and the identification of significant historic floods by their consequences.
- The identification of areas where flooding is likely to occur and the estimation of the potential consequences of future floods, taking into account historical floods and the up-to-date changes in the respective flood plains.
- The delineation of high flood hazard zones.

Specifications of the conducted Preliminary Flood Risk Assessment (PFRA)

The PRFA is based on available or easily accessible information and data, including at least:

1. Topographic & Land Use Maps of the River Basin, on a proper (?) scale, with delineated river basins and sub-basins
2. A description of the Flood incidents that have occurred in the past (historic floods) and their consequences on the environment, on property and on life (including data as the extend of the flood plain, the drainage route etc.)
3. A description of the Flood incidents that have occurred in the past, from which lessons could be learned (future flooding incidents could be foreseen) and
4. Assessment of the potential adverse consequences of future floods on the environment and on society.

Input Data and Maps

Data used in Flood Hazard Assessment included:

- River basins and sub-basins
- A Digital Terrain Model (DTM) by the National Bank of Hydro-Meteorological Information
- Hydro-lithological Maps from the Management Plans of the former Ministry of Development
- Water Bodies from the Management Plans made for the implementation of Directive 2000/60/EC (Article 13)
- Land Use Maps. Corine 2000 (CLC 2000) maps were used. These are available from the Hellenic Cadastral and Cartography Agency

http://geodata.gov.gr/geodata/index.php?option=com_sobi2&sobi2Task=sobi2Details&catid=16&sobi2Id=54&Itemid=

Fig 28. Hellenic River Basin Districts & Water Districts. (from the "Implementation of the Directive 2007/60/EC of the European Parliament and of the Council. Preliminary Flood Risk Assessment")

Recording Historical Flood Incidents

Sources of information and input data were:

- Central Administration (Ministries, Agencies, Public Bodies, etc.) and Educational & Research Institutions (Universities, Research Institutes etc.)
  - o Data from the General Secretariat for Civil Protection of the Ministry of Public Order
  - o Records of compensations given to citizens due to the destruction of household appliances and houses from flooding incidents

- o Records of compensations given to farmers due to damages caused by floods on agricultural production and livestock
- o Fire Service records for flooding events
- o Research and Studies conducted or supervised by the Ministry of Infrastructure, Transport and Public Networks
- o Relevant articles in newspapers and the electronic press (from the archives of the National Library http://www.nlg.gr/)
- o Research & Publications of the Academic Community

• Decentralized Administration (Administrative Districts, Municipalities, and local Authorities etc.)

- o Remarks sent by the Decentralized Administration & Local Authorities
- o National Statistics Agency

Data Management

Collected Data were the input in an Excel file which contains at least, all descriptive fields according to the WISE (Water Information System for Europe) provisions (Document No.1: Floods Directive reporting: User manual v3.0* and Document No.2: Floods Directive reporting: User Guide to the reporting schema v3.0*. (* Both are in version 5.0 now) http://icm.eionet.europa.eu/schemas/dir200760ec/resources

Data descriptions are classified into three major categories: i) Notes, which contains notes, ii) Location, which contains all relevant to locating the event descriptive and numerical data and iii) Event, which contains the respective to location flooding incident data, both numerical and descriptive.

Data Storage & Management

A Geographic Information System was developed according to the provisions of the Directive described in Document No.3: Floods Directive reporting: User Guide to reporting spatial data v3.0,

http://icm.eionet.europa.eu/schemas/dir200760ec/resources/Floods%20reporting%20guidance%20on%20spatial%20data%20v3.0.pdf

Each incident was registered according to its location based on the settlement coordinates given by the Hellenic Statistics Authority (EL.STAT)

http://geodata.gov.gr/geodata/index.php?option=com_sobi2&sobi2Task=sobi2Details&ca tid=21&sobi2Id=52&Itemid=

In all cases, where there was no reference to a settlement, other descriptive of the location data were used (site name etc.). Every record was given an individual Identity (FloodLocationCode)

Data collected were, at a second stage, evaluated in terms of accuracy and reliability.

A total number of 1627 flood incidents which occurred in 1076 locations were registered, processed and evaluated.

Historic Data Evaluation Results

Flood incidents were evaluated based on i) the number of events, ii) the floodplain extend, iii) the total cost of damage, iv) the type of damage (agriculture, livestock, households, construction, infrastructure etc.). As long as, there have not been taken since any preventive measures, it is assumed that these incidents will happen again.

A brief view of the flooding problem in Greece shows that flooding occurs mainly in plains and in coastal areas of Eastern and Northern Greece. The greatest number of events has been recorder in Evros River, in Xanthi-Komotini plain, in the Plain of Strymon River, in Thessaloniki plain, in Katerini plain, in the plain of Thessaly, in Sperchios River, in Chania (Crete), in Rhodos Island, in Kerkyra (Korfu), in Kalamas, Acheron, Louros and Arachthos rivers and in Attiki (Athens).

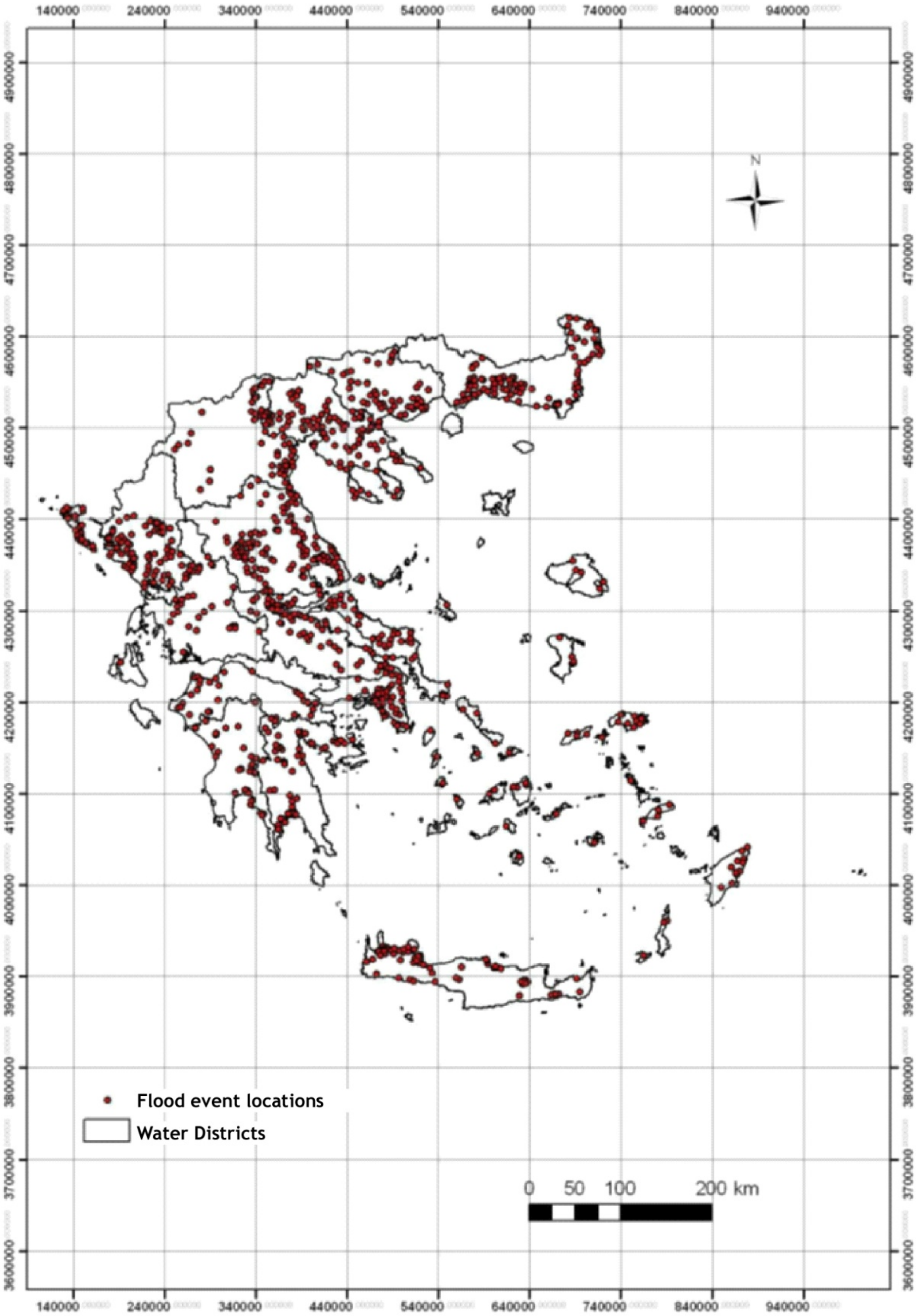


Fig 29. Historical Flooding incidents in Greece (from the "Implementation of the Directive 2007/60/EC of the European Parliament and of the Council. Preliminary Flood Risk Assessment").

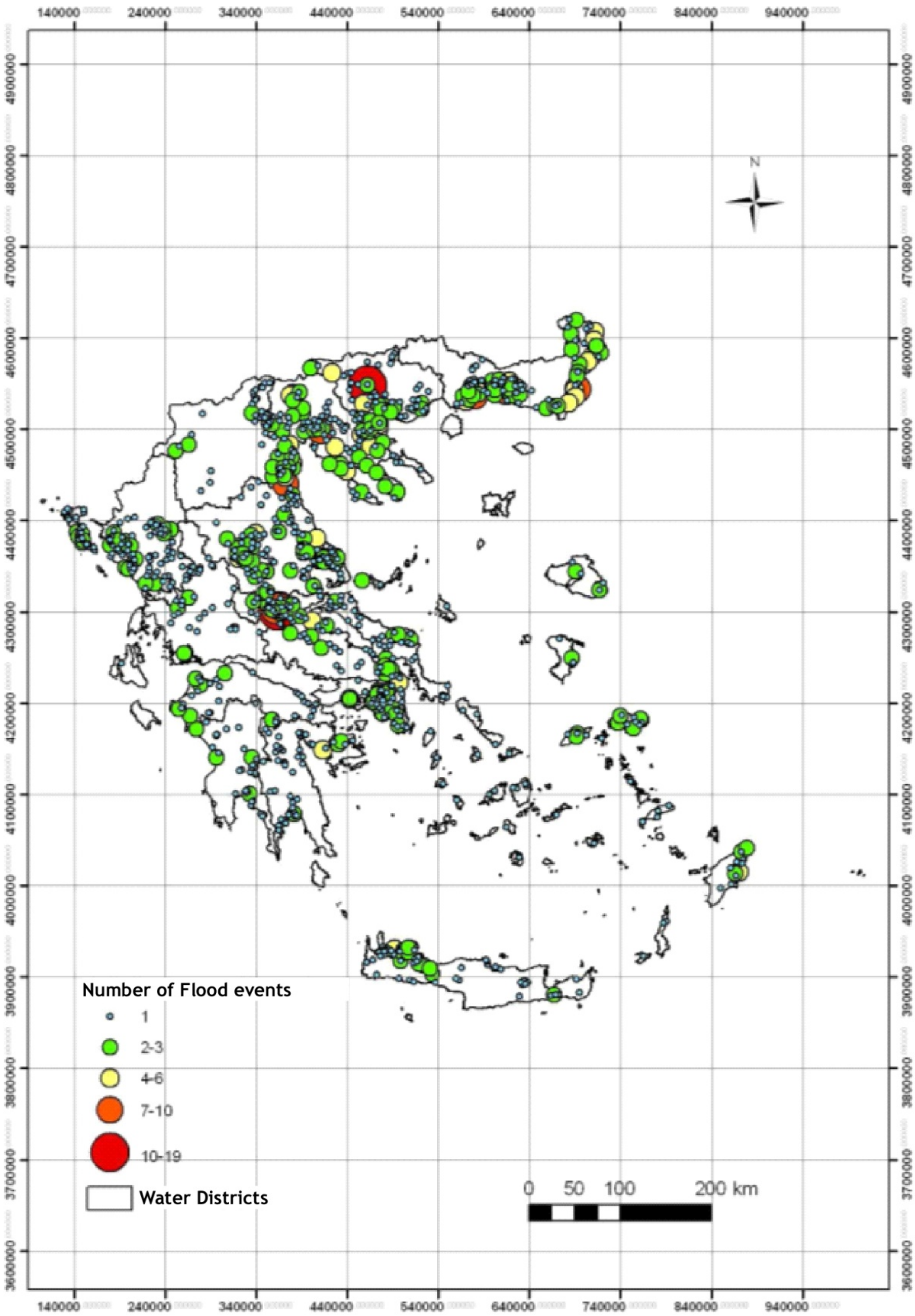


Fig 30. Classification according to the number of flooding incidents (from the "Implementation of the Directive 2007/60/EC of the European Parliament and of the Council. Preliminary Flood Risk Assessment").

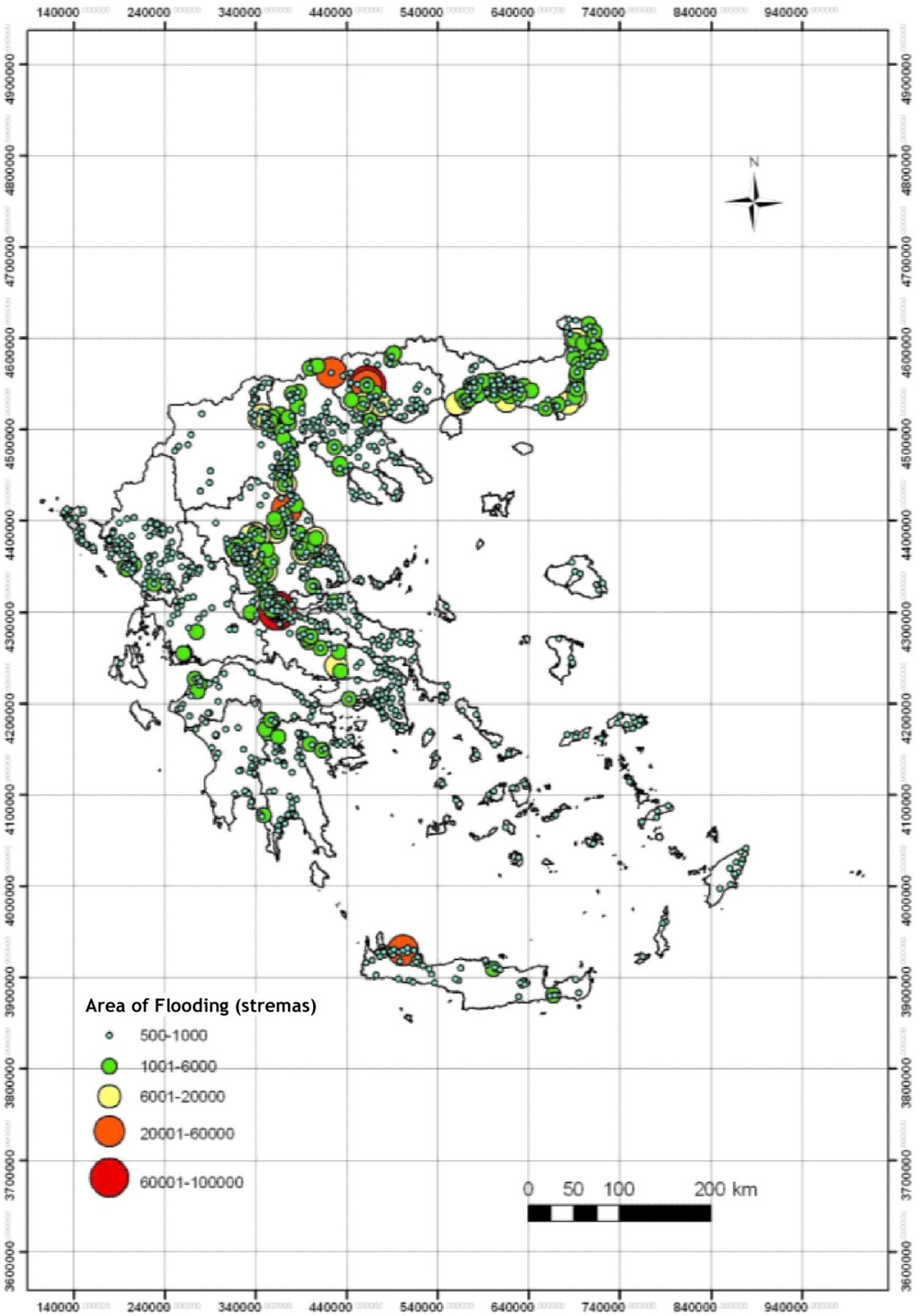


Fig 31. Classification according to the floodplain extend in streams (1strm=1000m2) (from the "Implementation of the Directive 2007/60/EC of the European Parliament and of the Council. Preliminary Flood Risk Assessment").

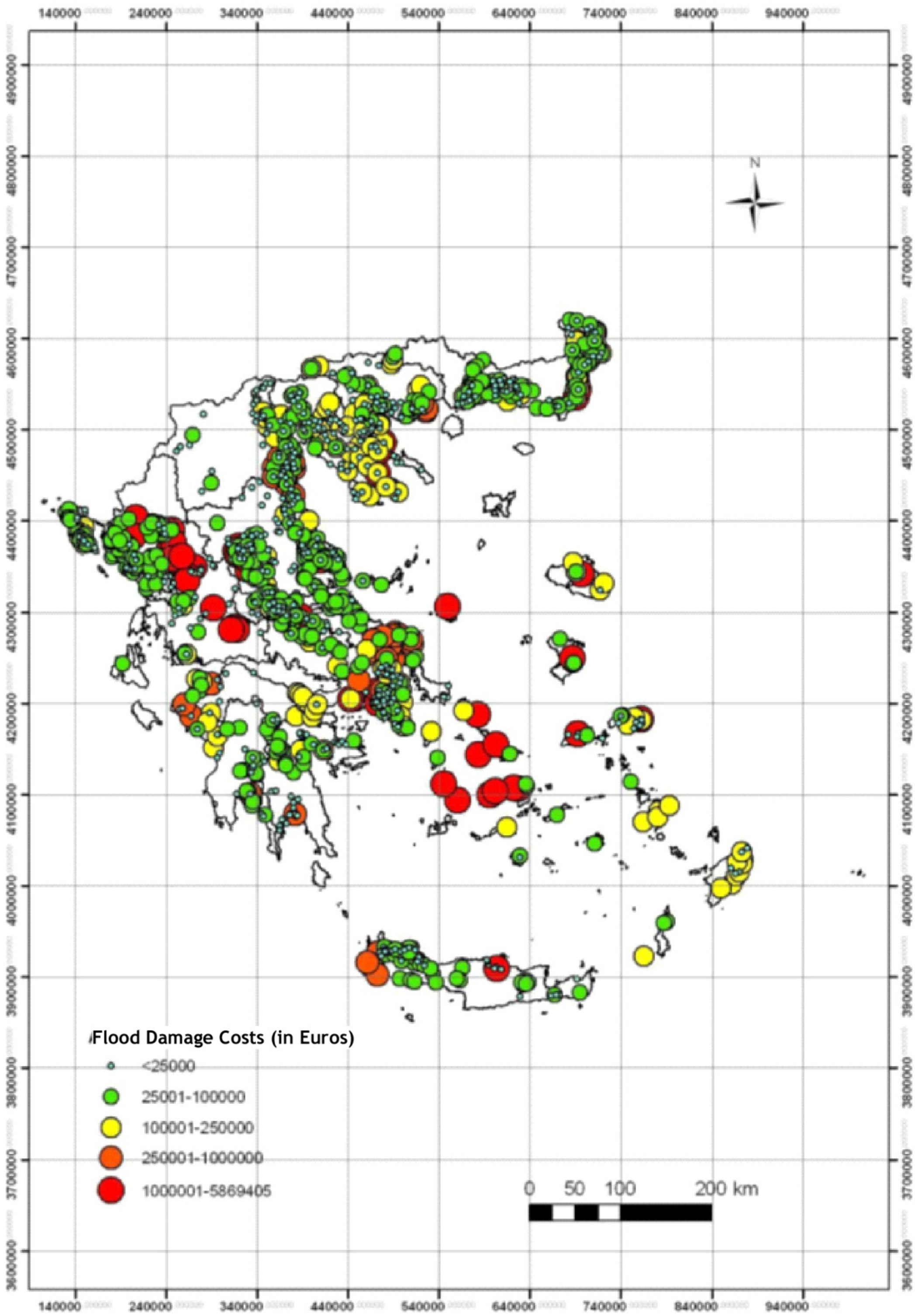
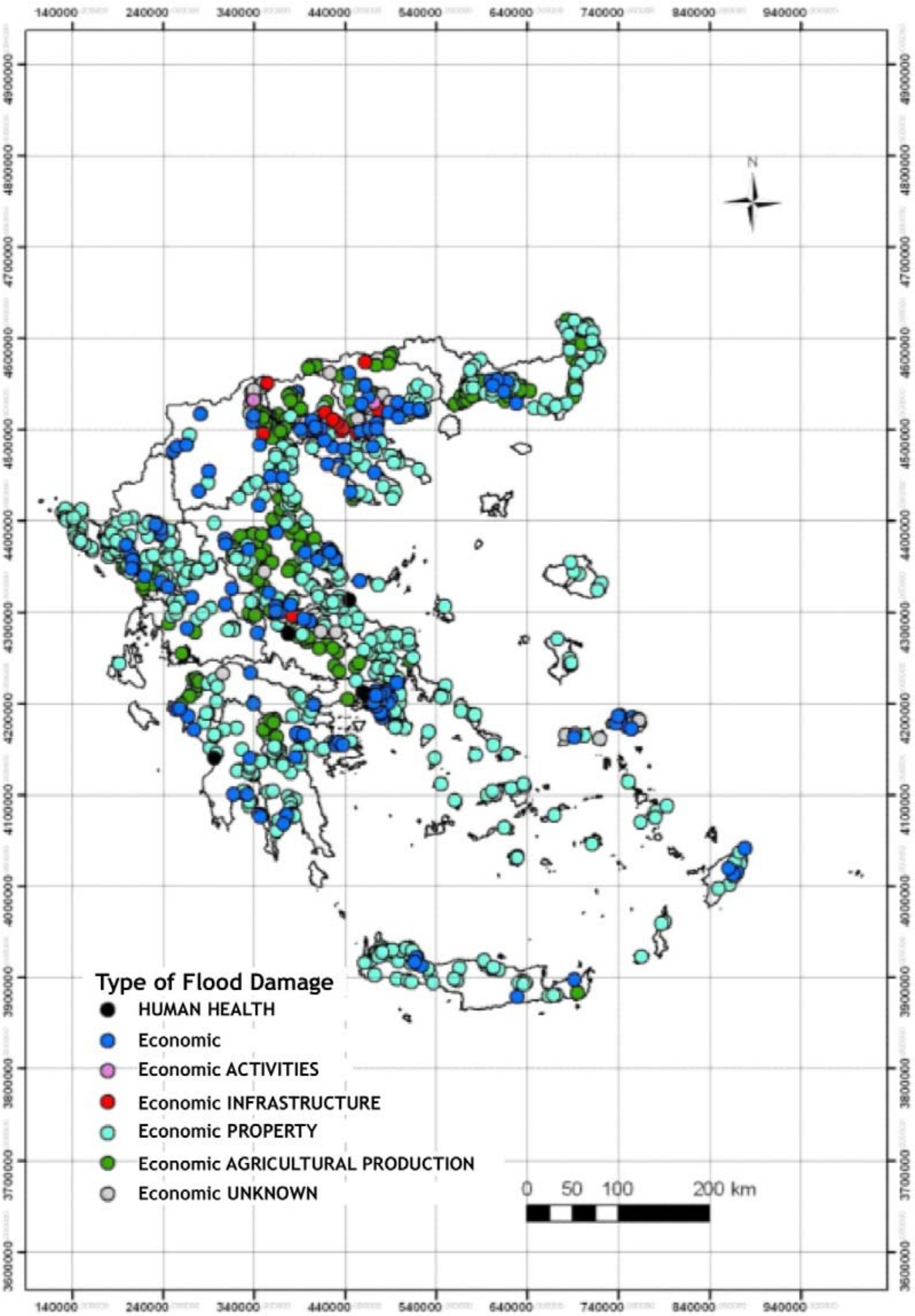


Fig 32. Flood classification according to the cost of damage in EUROS (from the “Implementation of the Directive 2007/60/EC of the European Parliament and of the Council. Preliminary Flood Risk Assessment”).



Legend (top to bottom) Adverse Consequences: 1. Human Health, 2. Economic, 3. Economic-Activity, 4. Economic-Infrastructure, 5. Economic-Ownership, 6. Economic-Agricultural Production, 7. Economic-Other/Unknown

Fig 33. Flood classification according to the type of damage (from the "Implementation of the Directive 2007/60/EC of the European Parliament and of the Council. Preliminary Flood Risk Assessment").

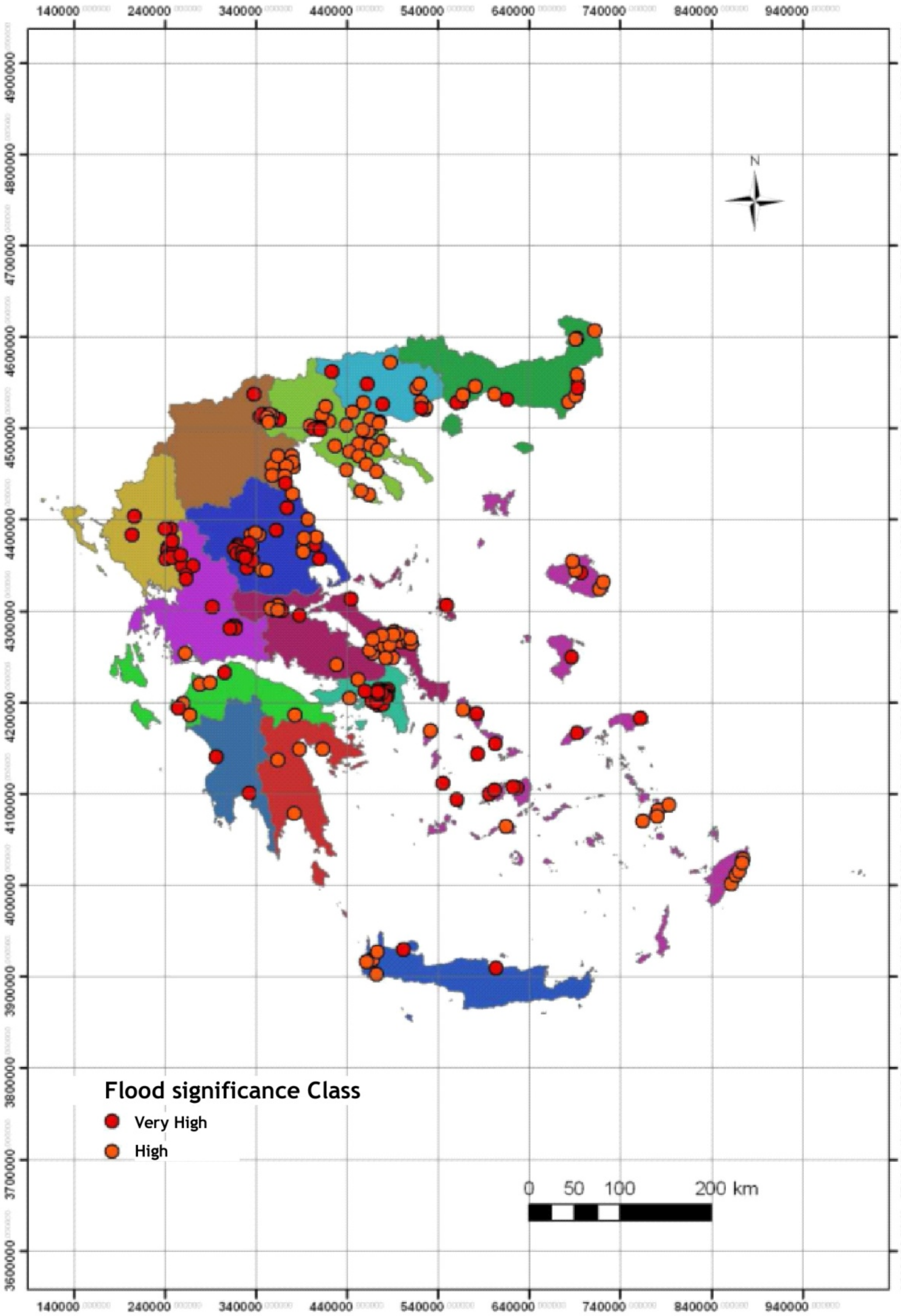


Fig 34. Flood Importance (from the "Implementation of the Directive 2007/60/EC of the European Parliament and of the Council. Preliminary Flood Risk Assessment").

The most Important Flooding events

Floods were classified according to the severity of the damage they caused into four categories: Low, Medium, High and Very High. The criteria used in the classification included i) Human Life loss, ii) cost of damages and iii) floodplain extend

Table 4.4 Flood importance classification categories

Flood Importance	**Human Life Loss**	**Damage Cost**	**Floodplain Area (x1000m2)**
Low		<50 000	<2 000
Medium		50 000- 200 000	2 000-5 000
High		200 000-500 000	5 000-10 000
Very High	>= 1	>500 000	>10 000

As the result of the investigation, 147 flood events are characterized as having Very High Importance and 150 flooding events as of High Importance. These 297 events correspond to 261 (Fig 34).

High Flood Risk Areas in Greece – Methodological approach

In order to delineate Zones of Potential High Flood Risk (ZPHFR) areas (high probability & extensive damage) CMD Η.Π 31822/1542/Ε103/2010 and Directive 2007/60/EC were taken into consideration.

To locate those areas, two basic information layers were combined: areas where a flood is most likely to occur and areas of a great importance, as they are described in the following paragraphs.

It should be noted that a framework for assessing areas of High Flood Risk has not been set by EU directives or other documents.

The areas of a high importance (always considering the flood risk) are areas with i) dense population (cities, towns, settlements), ii) Industrial and Commercial zones, iii) Agricultural areas of high productivity and economic value, iv) Production units which may cause pollution, v) Protected areas, vi) Cultural Heritage monuments, vii) infrastructure (road network, railroads, airports, hospitals, dams, etc.).

Required data included:

- Settlement locations, taken from National Authorities (Agencies, Services etc.)
- Environmentally sensitive installations. Installations and/or activities that could cause environmental problems (pollution, contamination) when flooded (according to Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control)
- Protected areas.
- Areas with of distinct Cultural Heritage. Monuments and UNESCO World Heritage monuments (http://odysseus.culture.gr).
- Economic Activity areas. Industrial & Commercial areas.

- Agricultural/farmland areas with significant production. As such, irrigated, non-irrigated arable land, vineyards, complex crops and annual crops were considered.
- Infrastructure. Airfields, Road and Railroad networks, dams, Hospitals.

All data were harmonized, incorporated into a Geographic Data Base and plotted.

To define the areas where a flood is likely to occur, areas which are located a) on alluvial deposits and b) present a very low slope (under 2%) were selected.

Hydrogeological maps were used in order to cover the first criterion, (Water Resources Report, 2008, http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CCsQFjAA&url=http%3A%2F%2Fwww.hellenicparliament.gr%2FUserFiles%2F510129c4-d278-40e7-8009-e77fc230adef%2Fekthesi-ydatinon-poron.doc&ei=YzBFUtLABMfRtAab54GAAg&usg=AFQjCNHwxsk1we7XH26Nf28UaZDn_B1D4g&sig2=G4HhPeZK3HVlFHYezKE6FA&bvm=bv.53217764,d.Yms&cad=rja, in Greek)

The second criterion was cover by using Digital Elevation Models. All data were at a 1:50 000 scale. The UNION of the aforementioned parameters, defines the areas of High Flood hazard.

Areas where a flood is most like to occur were combined with areas of great importance taking into consideration the historic flood data (areas where floods have already occurred). As a rule, areas smaller than 25km2 were excluded except those areas where extensive flood damage has been reported in the past.

Areas where serious flood incidents have been reported that fall outside the delineated Zones of Potential High Flood Risk (ZPHFR), will be separately investigated on a "local conditions" basis.

Climate change effects on Flood Hazard

Flood Hazard assessment should take into consideration the Climate Change as well (Directive 2007/60/EC, Article 4).

The fact is that, flood disaster frequency has increased during the past years but this fact can be attributed to a high increase of the exposure of people and property in floods.

The up-to-date meteorological data indicate large uncertainties in assessing the effects of Climate change on floods. It is therefore impractical to predict the effects of climate change on flooding frequency, at this point.

Flood Related Research Projects in Greece

Published activities include Water Management Plans and participation of Hellenic Authorities into International Organizations.

1. Already implemented and many of them completed "Water Resources Management Plans". Special Secretariat for Water (SSW) of the Ministry of the Environment, Energy and Climate Change (M.E.E.C.H.)" and the "Water Divisions of

the Decentralized Administration”.
[http://wfd.opengov.gr/index.php?option=com_frontpage&Itemid=9].

2. Participation in the HYUGO Framework. “The Hellenic National Platform for Disaster Risk Reduction (HNP-DRR) is set up as an open network and a forum of governmental agencies and other stakeholders, with a focus on reducing the risk of natural and/or manmade hazards occurring with a major frequency and having a big social and economic impact on the country.”
[http://www.preventionweb.net/english/hyogo/national/list/v.php?id=68]

Greek Authorities & Institutions have participated and are participating in numerous research projects related to flood hazard assessment and prevention. Some of them are presented in the following paragraphs.

Networks of Cross Border Cooperation have been established. Political decisions regarding the “flood” issue include:

1. The Prime Ministers of Greece and Bulgaria have signed (14-15/04/2006) a framework for bilateral cooperation regarding various matters, including “policy measures for preventing floods in the Basin of Evros River”, with the first step of implementation to be the installation of early warning systems.

2. Greece and Turkey have signed bilateral agreement/protocol (10/06/2006) for cross-border cooperation on preventing flooding at the trans-boundary area of Evros River. A common Greek-Turkish Technical Committee was established (November 2006) to examine and propose flood mitigation measures.

There is a number of Cross-Border research Projects regarding flood hazard in cooperation with Bulgarian (Ardas river, Evros/Maritza river) and Turkish (Evros/Meric river) partners.

1. **Project "RIVERCROSS - Cross-border cooperation on flood basin River Evros / Maritza / Meric ".**

This initiative has undertaken in the framework of the EU program "Change in Borders". The project RiverCross includes partners from the Netherlands, Germany, Poland and Greece, and emphasizes the exchange of experience on transboundary water management, analysis of factors determine the success or failure of the CBC this field and produce proposals for improvements and new methodologies.

2. **Project "Observation of quantitative and qualitative characteristics of rivers Erythropotamos, Ardas and Evros Region Eastern Macedonia and Thrace",** in the framework of the Community Initiative INTERREG IIIA / PHARE CBC GREECE-BULGARIA, implemented by the Department of Water Supply Directorate of Public Works, Region of Eastern Macedonia and Thrace, and funded by the European Regional Development Fund (ERDF) and by 75% National Funds 25%. The Project aims at creating a flood forecasting system to enhance defence against floods, to implementing key measures for the gradual incorporation of and compliance to the EC Directive 2000/60/EC and to designing a common approach between Greece and Bulgaria in order to achieve the common goals.

3. **Regional Strategy for Disaster Prevention. CivPro. It's a Regional Initiative Project financed by the European Programme for Interregional Cooperation INTERREG IVC.**

4. The **"FLINKMAN"** project [http://www.flinkman-project.eu/]. The basic scope of the project is the "development" of a suitable framework through the preparation of a flood management plan to ensure consistent and effective link, at each stage of the chain prevention - Readiness - Response - Recovery of floods. Moreover the project aims at:

- The development of supportive tools, based on Information Technologies (IT), which will promote the collection, evaluation and exchange of best practices.
- The upgrade of current status of Civil Protection Units and
- To promote international cooperation among the competent bodies in Europe.

5. **The Project SEE/A/118/2.2/X: Practical Use of Monitoring in Natural Disaster Management – Project "MONITOR II"**

[http://www.monitor2.org/index.php?option=com_content&view=
frontpage&Itemid=1&ac45af24dc0db8131d6d3647bf3df4c7=b2a7a35180c18b66767
3e65384bc7324]

Scope of the Project is to improve communication among Disaster Management Experts. This is going to be achieved, according to the project, by improving communication and accelerating the flow of information between risk experts, local stakeholders and civil protection services. Requirements include the harmonization of procedures, methodologies and standards.

6. **Project FLAPP – Flood Prevention in Border Areas: Common approach on the cross-border management of floods. INTERREG III.**

Implementation period: Jan 2005-Aug 2007

The Project was about the integrated river basin management in cross-border areas. Aspect of the project include: flood prevention via construction and land use planning measures, sustainable management of river basins, disaster management, cross-border cooperation for a holistic approach on flood management issues, raising public awareness on flood management issues. The Project's outcomes include solutions proposed to improve border cooperation:

- Strengthening of the regional / local Service of Water management
- Involvement of local and regional public bodies/agencies/services
- Increase the participation and awareness of the local population
- Creation of appropriate Legislative arrangements
- Involvement of the insurance industry in flood management
- Participation of decision makers from the very beginning
- Investigation of mutual benefits and coordination of policy objectives on Flood Management
- Agreement on standards to be used and model cost estimation

- Promoting both cross-border information exchange and non-formal communication
- Strengthening confidence : start cooperation at project level and improve cooperation step-by – step
- Recovery of flood management services costs
- Investigating additional funding for regional flood management services
- Establishment of a regional cross-border funding

7. **Flood warning system establishment in Arda river basin for minimising the risk in the cross border area (ARDAFORECAST).** Greece-Bulgaria 2007-2013, Investing in our Future. Project start: 20 Mar. 2012; End: 19 Mar. 2014. [http://arda.hydro.bg/index.php]

The Project's expected outputs include the establishment of hydro meteorological information system, the development of GIS database, the improvement of the density and frequency of the hydro-meteorological observation network through, the installation of additional automatic stations, a flood warning system operation manual, a set of hot points, a set of alert threshold for each hot points, a set of warning procedures, WEB based tools for information exchange and access of decision makers, stakeholders and large public to all the necessary data and forecasts.

8. **Project FLoods and fIre Risk assessment – FLIRE**

The aim of the LIFE + FLIRE is the combinatorial and effective assessment and management of flood and fire risks using cutting-edge tools and technologies, taking into account the issues of prevention, adaptation and interaction. FLIRE includes the development of the following tools and actions:

- Management Tool of Meteorological Information (WIMT) that takes short term forecast, taking into account local conditions, and classifies the weather as favourable for potential flood or fire risk.
- A tool for the assessment and management of flood risk in nearly real time, which will include components for river basin modelling, urban modelling and a Flood Early Warning System. This tool takes the WIMT information on flood hazards and activates the corresponding early warning systems (EWS).
- Tool for assessing and managing the risk of fire in nearly real time. The tool includes a component for modelling fire and an early warning of fire. The tool receives information on fire danger and activates the EWS.
- Planning tool for the assessment and management of flood risk. The tool will be using the components of the previous model (2) and incorporates an additional component modelling urban development and an algorithm to optimize the management of flood risk.
- The integration of all components into a single decision support tool (DSS).

REFERENCES

1. Civ Pro – Regional Strategies for Disaster Prevention. CivPro is a Regional Initiative Project financed by INTERREG IVC, the European programme for interregional cooperation
2. European Parliament and Council (2007): Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks, Official Journal L 288 , 06/11/2007 P. 0027 – 0034
3. Flood warning system establishment in Arda river basin for minimising the risk in the cross border area (ARDAFORECAST). Greece-Bulgaria 2007-2013, Investing in our Future. Project start: 20 Mar. 2012; End: 19 Mar. 2014. [http://arda.hydro.bg/index.php]
4. Implementation of the Directive 2007/60/EC of the European Parliament and of the Council. Preliminary Flood Risk Assessment. Ministry of the Environment, Energy and Climate change, Special Secretariat of Waters, Athens, December 2012. [http://www.ypeka.gr/LinkClick.aspx?fileticket=T4DDG1hqQMY%3D&tabid=252&language=el-GR]
5. Koutsogiannis D* (2010): Integrated planning flood protection: The challenge for the future, Society of Civil Engineers, Athens, 23 April 2010 (* Department of Water Resources and Environment, School of Civil Engineering, National Technical University of Athens)
6. KEEP (2009): Activities Report. Statistics of Incidents Management Athens, 2009.
7. NINA DOBRINKOVA* and PETER BOYVALENKOV* (2012): Flood Mapping Approach in Bulgaria. The Report was supported by the SEE/A/118/2.2/X: Practical Use of MONITORing in Natural Disaster Management – acronym: MONITOR II. (*Institute of Mathematics and Informatics – Bulgarian Academy of Sciences, Acad. Georgi Bonchev str., Block 8, 1113 Sofia, Bulgaria)
8. Transboundary Flood Risk Management: Experiences from the UNECE Region. Final Report. Convention on the Protection and Use of Transboundary Watercourses and International Lakes. Economic Commission For Europe, United Nations [http://www.unece.org/#]

4.3 BULGARIA

4.3.1 Introduction

Floods are common natural disasters within the Bulgaria. They bring great harm because they affect population areas, industrial areas and productive farmland.

Generally Bulgaria is situated in the semi-arid zone under the mixed continental and Mediterranean climate influence. Floods are generated on the Bulgarian territory under the following conditions:

- Intensive snowmelt mixes with rainfall at Springtime (this is usually the case at some Bulgarian tributaries of the Danube, e.g. Yantra and the plain regions in Northeast Bulgaria;
- Flush floods caused by relatively isolated heavy rainfalls at Summertime (this happens often at some river basins in Southeast and South Bulgaria like the tributaries of Arda, Maritza and Veleka rivers, as well as at some Danube tributaries like Yantra and Rusenski Lom rivers);
- High flows with long duration which might affect the stability of the levees and subsequent flooding (this is an issue only along the Danube).

The flood protection practices in Bulgaria comprise range of activities, more or less intensive in different regions, depending on the level of flood hazard there.

4.3.2 Existing legislation framework

EU Directive on Flood Risk Management

Bulgaria has started adopting the necessary changes in its Law on Waters in 2010 in accordance with 2007 EU Directive on Flood Risk Management.

As a result, Bulgaria embarked on drawing up preliminary assessment of the flood risk in river basins by 2011, making maps of high-risk areas by 2013 and developing plans for flood risk management by 2015.

Methodology for assessing the threat and risk of flooding, as required by Directive 2007/60/EC - https://www.google.bg/#q=Metodika_RZPRN_all.pdf

The Methodology includes the following sections:

Part 1. Common part of terms and abbreviations

Part 2. Methodological guidelines for assessment of flood hazard;

An example of application of the methodology for assessment and mapping of flood hazard in the absence of gauging stations in the area of modelling (town of Pleven and its surroundings);

An example of application of the methodology for assessment and mapping of flood hazard in the presence of hydrometric stations in the area of modelling (the area between Plovdiv and Parvomai);

Part 3. Methodological guidelines for threat assessment and risk arising from the Black Sea flooding of coastal areas

An example of the mapping of the threat of sea floods at high, medium and low probability of occurrence in the region of Kiten

Part 4 . Methodology for assessment and mapping of flood

Application of the methodology for mapping flood risk in the region of Pleven (river floods)

Application of the methodology for mapping flood risk for the area of town (sea floods)

Criteria and methods for the identification and classification of risk and determining the threat and risk of flooding (16.08.2012) -
https://www.google.bg/#q=Metodika_RZPRN_all.pdf

The first stage of implementation of the Directive provides information on areas that are believed to exist potential significant flood risks exist or could provide likely to occur (RZPRN) Article 5 Ch. II of DN and chl.146g of WA).

Fixing these areas according to Directive is based on results of the preliminary assessment of flood risks and requirements are given in Chapter II, Article 4 of the Directive. You need to designate areas with significant potential risk of flooding for each basin management as if the territory of respective river basins / management unit has an international river pool, the setting risk must be coordinated with the neighbouring Member States.

Determining areas of potential significant flood risk is integral part of the preliminary assessment of flood risks and represented by its terminal phase, while it is basic information about the second phase of the application of the Directive defining the areas for which they are produce maps of flood hazard and flood risk

National Programme for Disaster Protection
https://www.google.bg/#q=NPZB.pdf

The first stage of implementation of the Directive and the development of the National Programme for Disaster Protection defines the objectives priorities and objectives for disaster protection for a period of 5 years (2009-2013). It is a major policy document in the field of prevention, master and the aftermath of disaster and outlines guidelines for creating an effective, resource and provided technical national system to prevent and respond to disasters.

The Programme classifies disasters as follows:

- Flooding from river floods;
- Flash floods;
- Flood of accidents and improper management of hydraulic facilities;
- Floods caused by deliberate action and the measures to prevent such events.

The initial assessment of the risk of flooding includes three phases:

- Preparation of scaled maps of river basins, indicating the boundaries of basins and sub-basins, and the type and amount of land use;
- A description of past flooding in each pool, including scale the flood, its spatial distribution and evaluation of damages;
- Assessment of the possible occurrence of future major flooding, based on the topographical conditions, the position of rivers hydrological data for them the status and effectiveness of protective equipment (including retention of existing areas), location of settlements and agricultural land Public Works

There are also plans for the management of flood risk defining the methods for preliminary assessment of the treat and the flood risk (http://www.moew.government.bg/?show=top&cid=67). Areas with a substantial potential significant flood risk are Danube region, Black Sea region, East region, West area.

4.3.3 Implemented flood hazard prevention studies

1. Modelling approach Mariza-Tundja, PHARE CBC BG-TR Project

Technical Assistance for Flood Forecasting and Early Warning System under PHARE project "Capacity Improvement for Flood Forecasting in the BG-TR CBC Region

http://www.bd-ibr.org/details.php?p_id=107&id=158&cl_lang=EN

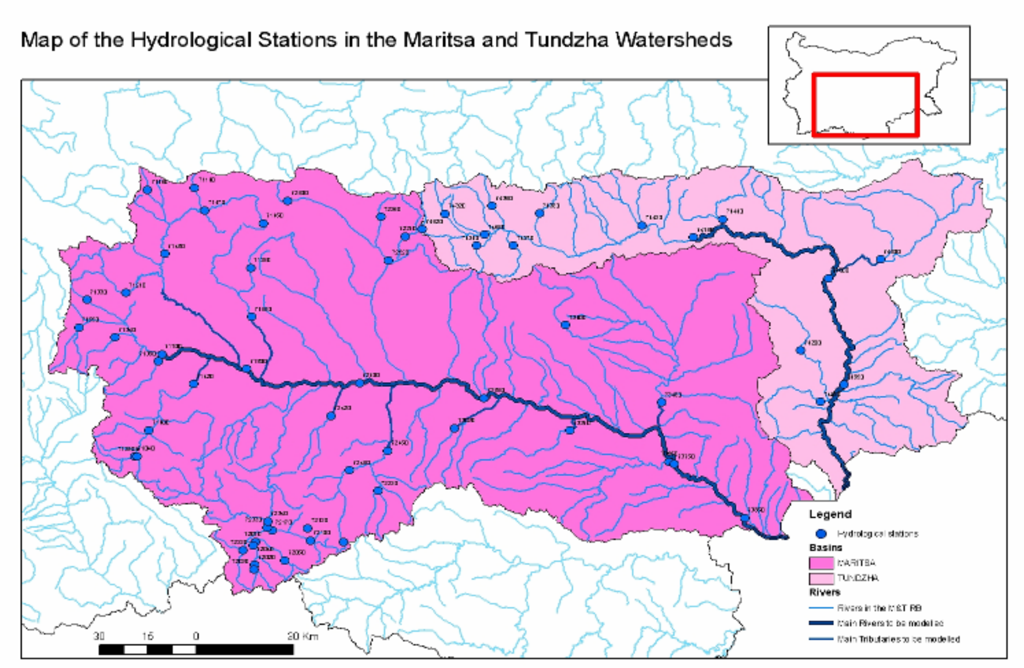


Fig 35. Map of the Hydrological Stations in the Maritsa and Tundzha Watersheds

2. **Flood warning system establishment in Arda river basin for minimising the risk in the cross border area,**

Greece-Bulgaria 2007-2013, Start: 20 Mar. 2012; End: 19 Mar. 2014; Total: 24 months

http://arda.hydro.bg/

Analysis

Precipitation 24 h
Rainfall 24 h
Snowfall 24 h
Temperature 24 h Avg
Soil wetness index
Evapotranspiration
Soil volumetric water content
Snow water equivalent
Surface runoff
Baseflow runoff

Forecast

Precipitation 24 h
Rainfall 24 h
Snowfall 24 h
Evolution
Daily temperature (avg)

3. **Institutional strengthening of east Aegean river basin, January 2005 – June 2007**

EVD Project Reference: MAT04/BG/9/3

Counterpart: Bulgarian Ministry of Environment and Water

Beneficiary: East Aegean River Basin Directorate

Consultant: ARCADIS Euroconsult (AEC), ARCADIS REGIO

4. **The Study On Integrated Water Management In The Republic Of Bulgaria, June 2006 – March 2008**

http://www.bd-ibr.org/details.php?p_id=107&id=154&cl_lang=EN

Financing Japan International Cooperation Agency

Counterpart Bulgarian Ministry of Environment and Water

Beneficiary East Aegean River Basin Directorate and West Aegean River Basin Directorate

Consultant CTI ENGINEERING INTERNATIONAL Co, Ltd. Japan

5. Technical Assistance for Flood Forecasting and Early Warning System for Maritza and Tundja rivers, 2005-2007

http://www.bd-ibr.org/details.php?p_id=107&id=158&cl_lang=EN

6. Cooperation Between East Aegean River Basin Directorate In Bulgaria And Artois – Picardie Water Agency In France, April 2005 – October 2007

http://www.bd-ibr.org/details.php?p_id=107&id=155&cl_lang=EN

Financing	The International network of basin organisation
Beneficiary	East Aegean River Basin Directorate, Bulgaria
Beneficiary	Agence de l'Eau Artois-Picardie, France

7. BG161PO005/12/1.20/02/29 Development of plans of management of flooding risk, Operational Programme "Environment 2007 – 2013".

Basin Directorate for Water Management in the Danube region, at Pleven

http://www.b2match.eu/danuberegionbusinessforum2012/system/files/Goranova.pdf

4.4 ROMANIA

4.4.1 Past Events and Their Consequences

History of floods on the Danube River

According to Kresser (1957), the oldest evidence of flooding is from the year 1012. Other floods, as shown in the annals took place in 1210, 1344, 1402, 1466, 1490, 1499. There is indirect evidence that these floods were of comparable size to the flooding of 1899 and 1954. Floods in August 1501 can be taken as the greatest flood that has ever been seen on the upper Danube, as the Austrian Hydrological Service records. Flood peak discharge in Vienna was estimated as 14 000 m3 / s. There is also some evidence of flooding in the sixteenth and seventeenth century (1594, 1598, 1670 and 1682). The worst flooding occurred in the eighteenth century (1787) - the so-called "flood of All Saints" - in late October and early November (references). Maximum discharge flow of Vienna was 11 800 m3 / s on the same Austrian Hydrological Service.

History of floods in Romania

In Romania floods occur frequently and catastrophic floods were recorded regularly over the years as 10 during the sixteenth century, 19 in the seventeenth century, 26 in the eighteenth century, 28 in the nineteenth century and twentieth century 42. The frequency and magnitude of floods have increased, mainly due to climate change and ever on the Danube River, they seriously affecting neighbouring areas.

The most important products floods in Romania, on the Danube, in the period when there is systematic hydrological observations were in May 1930, April 1940, July 1942, May 1955, June 1970, June 1988, April 2004, April 2005 2006 -largest (Gabor O., P. Serban, 2004).

The highest flow rate observed in this range is suitable for year 1895 are 1888, 1897, 1981, 1942, etc. Except flood of 2006, flood with higher peak flow of 15,000 m3 / s were also recorded during 1895 (15,900 m3 / s), 1897 (15,400 m3 / s) and 1940 (15 100 m3 / s).

Characterization of the flood of 2006

In the spring of 2006, Romania was faced with the biggest debtors.

At Isaccea, dikes collapsed on lengths from 50-100 m, flooding surrounding villages that were evacuated. In areas where the Danube longitudinal dikes have failed, have accumulated large amounts of water behind dams. In some cases dams have failed and the subdivision of the premises, causing flooding of farmland and farms, and all or part of extensive settlements in the floodplain. Failure Danube embankments and overflow designated areas led to the evacuation of 15 834 people, impairment of 154 localities, flooding of 1,774 of which 443 houses destroyed and 134 are in danger of collapsing. More than 4,700 household annexes, 64 350 hectares of arable land, 6.8 km national roads and 593 km county and communal roads were affected.

From the point of view of the Danube hydrological evolution in the period January-December 2006 stood out exceptional flood recorded in April, the flood which had the following characteristics:

- was the largest recorded flood on the Danube from entering the country and on the downstream of Iron Gate in the last 100 years, both in terms of flow / maximum levels and the duration of the very high levels above Shares flood;
- historical flows were registered on the upper Danube (Budapest) and the Tisza, even if the other tributaries of the Danube flows have not been historical values reached were very high, so that the composition and propagation led the historical flows in Romania;
- of historical levels and flows have led to catastrophic flooding, floods and destruction of dams on several sectors of the Danube, resulting in significant damage.

The causes which led to extraordinary flood during April-May 2006 were as follows on the Danube River:

- meteorological and hydrological situation in the previous months (February, March);
- sudden failure of the water in the snow in the upper and middle Danube basin from the last decade of March, superimposed with precipitation effect fluids entering the country was on 16.04.2006 - 15800 m / s.

Areas affected by historic flooding

Identify areas affected by severe flood events allow susceptibility maps, but this approach cannot cover the entire spectrum of potential flood areas. Even if the event-based products spatial reconstruction of the area affected is difficult, so that most of the time point information is made or linear. The time period included in the map is larger; the trust level of precision spatial delimitation of events is reduced. At least for Romania, satellite information, based on which can be defined with greater accuracy flooded areas are available with some time repeats only the last 10 years. Maps of flooded again (especially the extreme) can be found in some studies, but not systematically.

Previous Floods Directive, some countries already had developed maps showing historical flooding information. Their use is particularly important because historical floods are hypothetical events (like the model), and can therefore more easily understood by the general public (for Moel et al., 2009). Thus, for example, Ireland has charted nationally historic flood events and Flanders made a map that includes "newly flooded areas" (1988-2006). Such maps of extension of certain extreme events were conducted in the Czech Republic, Finland, etc.

To meet the requirements Floods Directive, INHGA (National Institute of Hydrology and Water Management) with central and territorial structures of Romanian Waters National Administration (NAAR) mapped the floods that occurred in the past and have had a negative impact on human health , the environment, cultural heritage and economic activity (Fig 36, Fig 37, Fig 38, Fig 39, Fig 40).

These maps include a selection of historical events, based on a number of criteria like hydrological and damage thresholds. Therefore, they include floods of great severity, i.e. historical events underlying implementation Preliminary Flood Risk Assessment under Directive 2007/60/EC.

Local floods are selected in terms of hydrological, hydro meteorological data according to existing or reconstructed field (including reconstructions of maximum flows and estimates of the frequency of achieving them). However, these types of floods, the damage is often outstanding (sometimes fatalities), therefore considering the magnitude of the consequences is essential.

By producing a flood frequency are measured with some degree of uncertainty, effects of flood on local communities. This frequency is difficult to say (it can be done based on surveys from the ground). However, quantifying the size of the maximum flood flow, but it is not strictly related to its consequences. Depending bed morphology and location of housing and other socio-economic objectives in relation riverbeds may be situations when the maximum flow with small probabilities of exceedance flood effects are severe, as may occur when the maximum flow cases with higher probabilities to overcome the consequences are relatively minor. As an indicator, it can be considered the probability of exceeding the maximum flow of 5% or 10%.

Corresponding flow rates better reflect the scale defence flood consequences on local communities. Generally, they are determined by the objectives likely to be flooded to a certain water level for the placement of certain socio-economic objectives in relation to the nature of riverbeds and flood effects (e.g. agricultural land, settlements, etc.). . This can be found from the analysis of the relation between maximum flow with certain probabilities of exceedance and the corresponding flow rates defence.

In the case of proper flow rates defence is the best indicator of flood flow rate accordingly (the level at which flooding begins first goal) For the lower Danube basin have identified four main categories of floods that caused significant flooding selected (http://www.rowater.ro/EPRI/EPRI.aspx):

1. slow floods, produced large river areas caused by rainfall or snowmelt;

2. quick floods produced on small areas, due to high intensity rainfall;

3. floods caused by natural bottlenecks;

4. floods caused by artificial bottlenecks on bridges, dams breaks / dams or discharges (usually controlled).

The studies on historical and paleo-flood flood (has happened before the period of systematic observations) offers interesting way to understand the variability and changing characteristics of floods. However, they are often limited in providing quantitative data (Merz et al., 2010). Nationally, the criteria used to select events to be spatialized or included in a database can be addressed in the watershed, bad sectors or localities. The report Floods Directive, validation methodologies and establishing an inventory requires a greater number of events at.

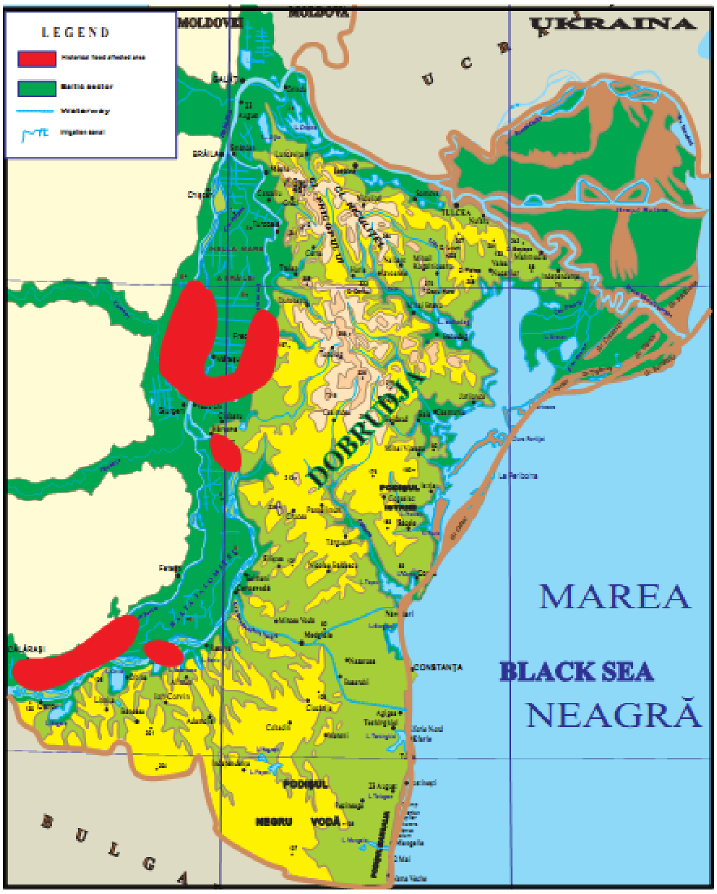


Fig 36. Significant historical flooding identified in the Dobrudja

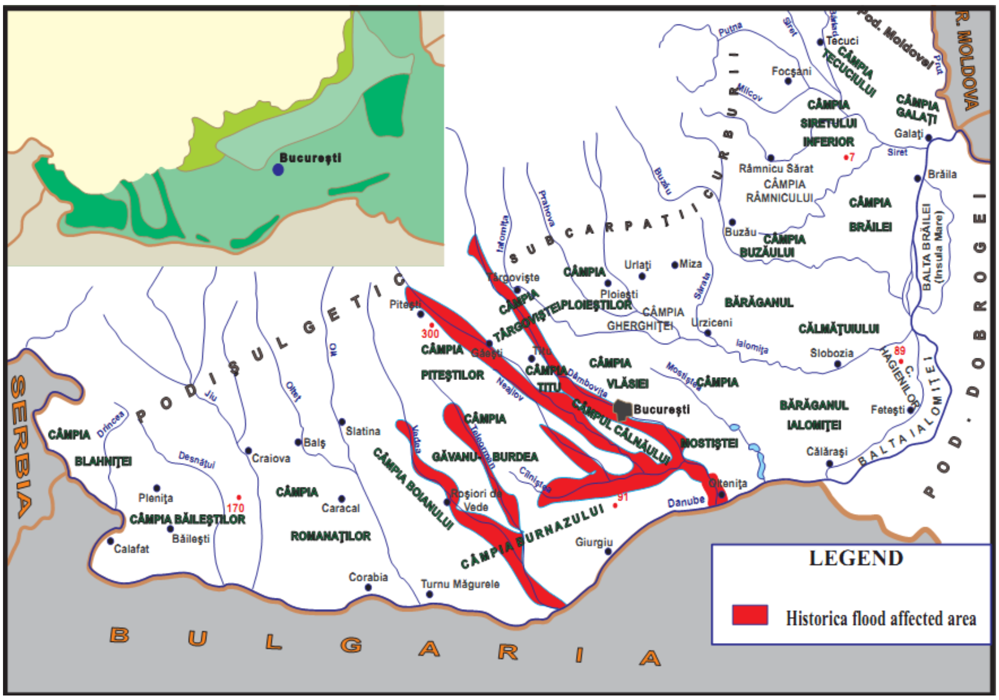


Fig 37. Significant historic flooding, identified in the Arges-Vedea basin

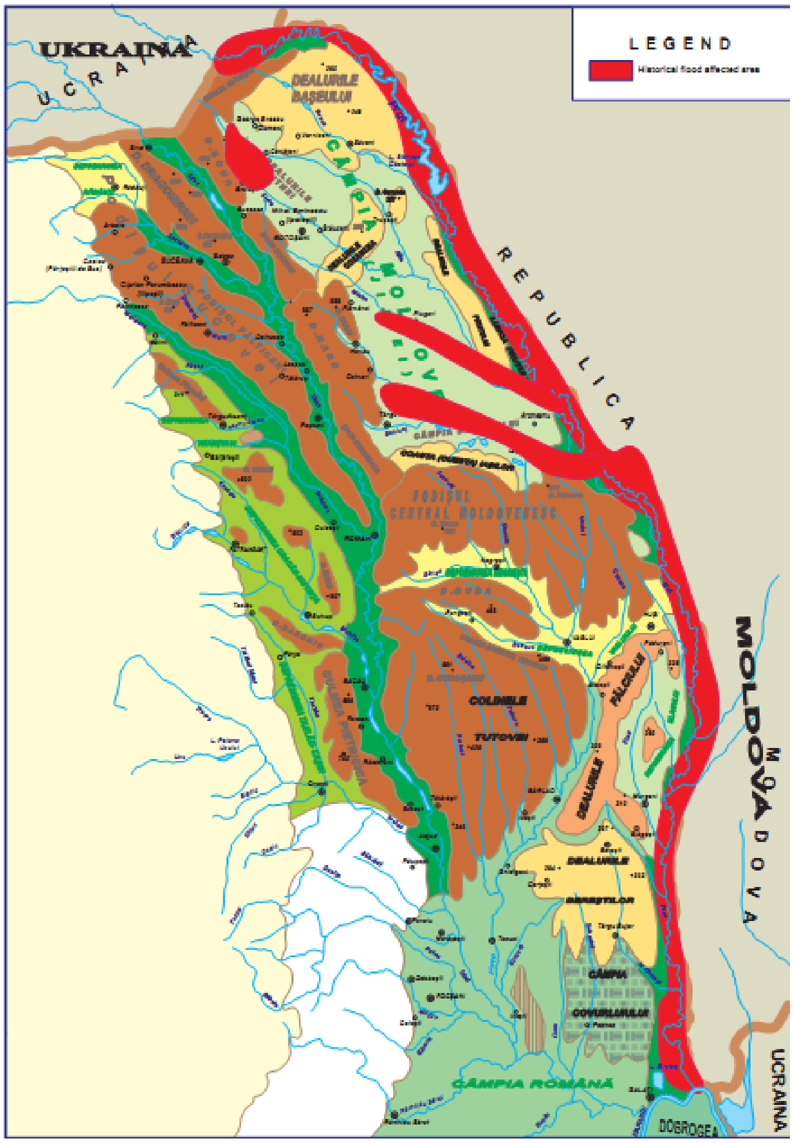


Fig 38. Significant historic flooding identified in the Prut basin

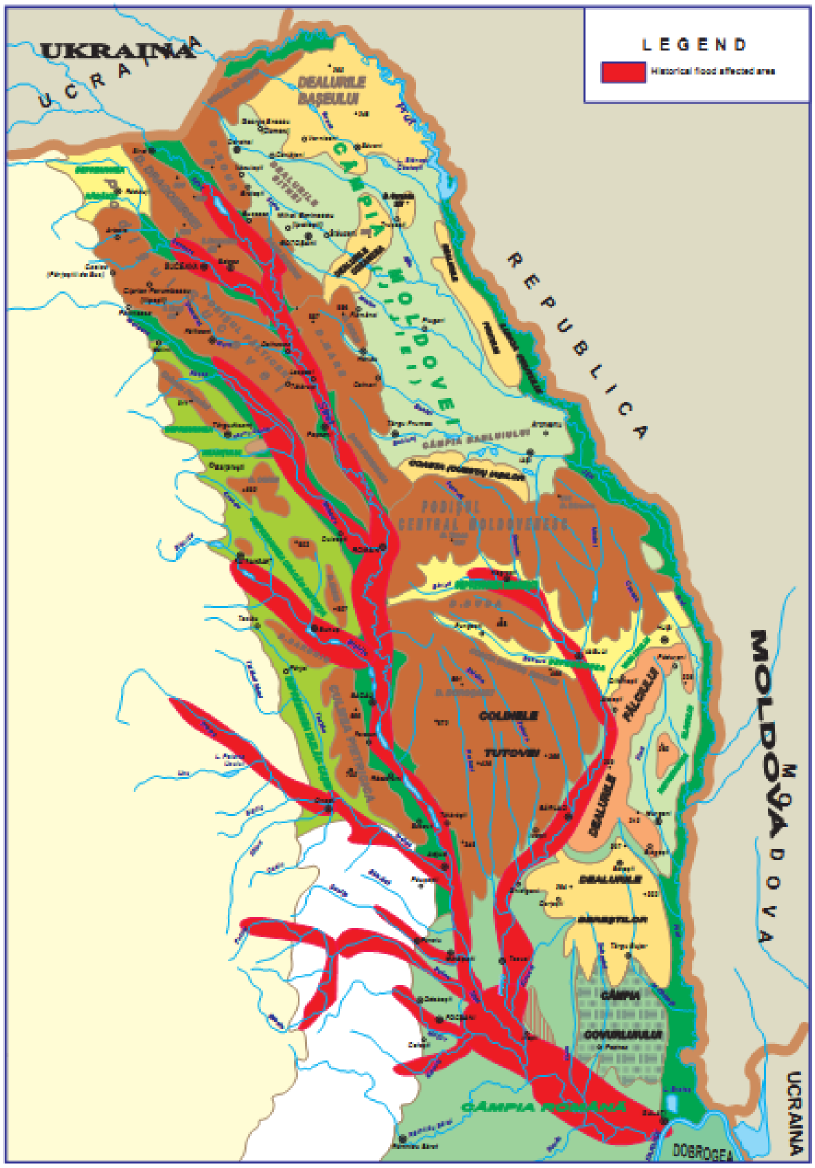


Fig 39. Significant historic flooding identified in the Siret basin

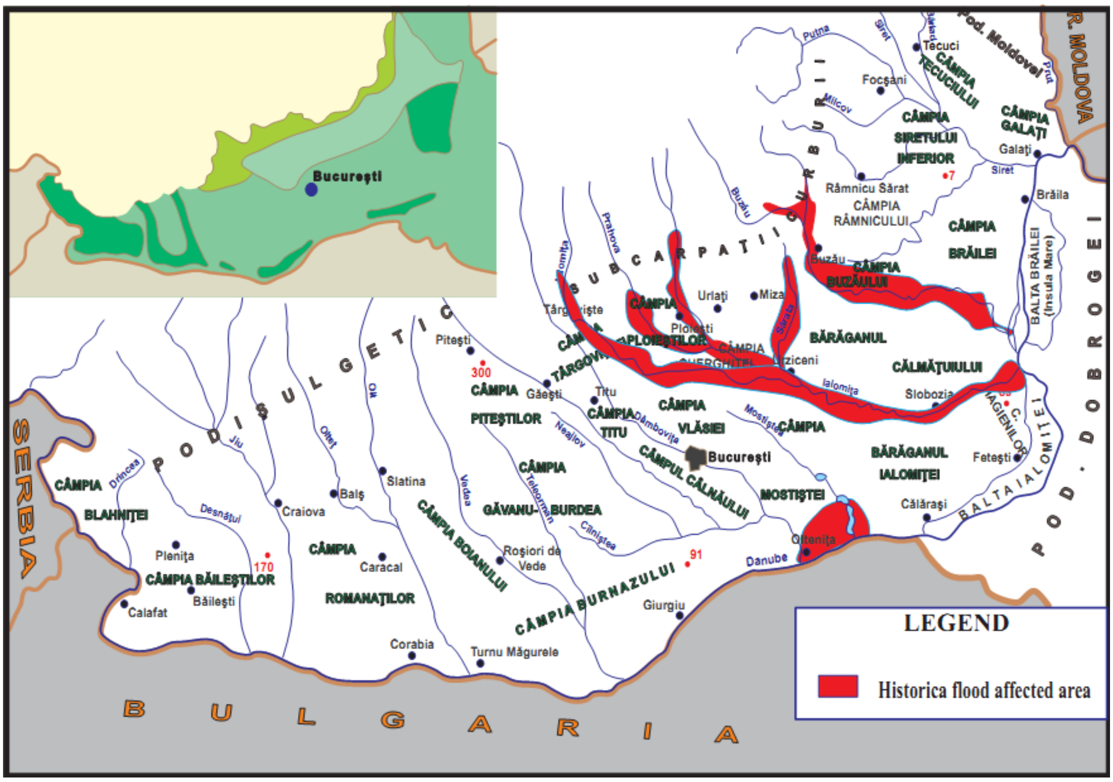


Fig 40. Significant historic flooding identified in the Buzau-Ialomita basin

4.4.2 Existing legislation framework

Water Law 107/1996 (MO nr. 244/08.10.1996), modified by Government Decision 948/1999, published in Official Monitor (MO) nr. 568/22.11.1999. This was the first Water Law after the political changes in Romania after 1989.

Law 404/2003 (MO nr. 713/13.10.2003): The law to establish The Administration of "Romanian Waters" and its attribution related to surface and underground waters.

Law nr. 310/2004 (MO nr. 584/30.06.2004): This law amends the Water Low since 1996 (Water Law 107).

Law. 112/2006 (MO nr. 413/12.05.2006): This law brings another completions to the Water Law 107/1996 .

Government Order nr. 130/2007 (MO nr. 780/16.11.2007): EMERGENCY ORDINANCE of Government amending and supplementing Law no. 17/1990 on the legal status of marine waters, the territorial sea, the contiguous zone and the exclusive economic zone of Romania.

Law 146/2010 (MO nr. 497/19.07.2010): This law brings another completions to the Water Law 107/1996 .

National Strategy for Flood risk (11 August 2010): National Strategy on 11 August 2010 flood risk management in the medium and long

Urgent Gov. Ord. nr. 64/2011 (MO nr. 461/30.06.2011): The purpose of this ordinance is to establish the legal framework for the geological storage of carbon dioxide, safe from the point of view of the environment to help combat climate change.

Order no. 192 of 2 August 2012: This order is approving the Regulation on management of emergencies arising from floods, dangerous meteorological phenomena, hydraulic structures accidents, accidental pollution in waterways and marine pollution in the coastal zone.

REFERENCE:
http://www.rowater.ro/Baza%20legislativa%20Directiva%20Inundatii/Baza%20legislativa.aspx

4.4.3 Implemented flood hazard prevention studies

Following the literature review, it can be stated that because of the climate on a global scale manifested in Romania (including in the lower Danube) occurred hazardous weather phenomena atypical for a particular intensity. The effects of disasters caused by these weather phenomena were amplified by other factors such as deforestation in recent years, which allowed rapid concentration spills on the mountainsides with involvement of large quantities of sediment in riverbeds in the lower Danube basin, in areas inhabited and agricultural land.

1. Criteria for analysis of vulnerability to floods in the lower basin of the Danube River

Analysis directions on flood vulnerability review involve both the mechanisms of floods, magnitude and extending them as elements of exposure to the impact of a hazard (in this case hydrological hazard) and studies the vulnerability of growth factors, superimposed mostly on the physical, social, economic, cultural particularities and those of governance, which condition the resilience of the studied system. Another important element of analysis in the study of natural hazards vulnerability is the different spatial and temporal scale approach.

The spatial scale in the studies of vulnerability is particularly important, equally influencing both problems, respectively the studied topic and the expected results. This follows from the fact that the factors that generate increased vulnerability of the system can be grouped according to the scale of analysis. The society together with socio-economic structures may be affected by global factors or factors that manifest at regional scales (e.g. climate change), regional factors (dynamic political actions whose consequences are reflected on the management of land use and the economy, the demographic processes of urbanization, etc.) and local factors (land degradation in some areas, land erosion, distance from markets products etc.). More than this, the changes are observed from time to time and some of them can occur earlier or faster in comparison with others. In this sense, the space-time dependence of growth vulnerability factors makes some of them important to a certain scale, while another spatial dimension makes the same factors less relevant or insignificant (Millennium

Ecosystem Assessment, 2005). For example, although global climate change acts at large or regional spatial scales, their effects are felt at local scales, too, being unevenly distributed. From this point of view detailed knowledge of the environmental, economic and social context, at different scales, is important in understanding human-environment relations.

Along with increased vulnerability factors operating at various scales, scoring systems on specific trajectories of evolution, another important aspect of the approaching scale is represented by the cross-scale interactions. Natural and socioeconomic processes that manifest at local scales are deeply influenced and dependent on specific processes upper stairs (Moran, 2010). In this mode, processes are trans-scaling and the scale of analysis must be interpreted according to the interactions with other scales, thus putting out the interconnectivity of processes in space and time. What can be analysed and demonstrated is that trans-scalar interactions is a topic very discussed in the scientific methodology in the field, emphasizing the need to use and improve models, techniques and integrated methods of analysis.

The difference of scale manifestation of processes, respectively the scale of analysis and level of decision making or system level governance is another point of view of spatial analysis of vulnerability.

The status and socioeconomic factors are key elements in the system vulnerability analysis system (potentially flooded area in case). They must be analysed according to the criteria of analysis, namely ladder approach, socio-economic potential of the system, environmental changes, cultural capital and ethnographic context and physical and geographical features.

2. The hydrological hazards

The hydrological hazards include both slow flooding and flash flooding, both with a high frequency in Romania. According to EM-DAT (Emergency Events Database, http://www.emdat.be/), in terms of the total number of people affected, 9 of the top 10 natural disasters in the lower Danube basin are represented by the floods; they have produced the greatest economic damage, surpassed only by the earthquake of 1977 (which was actually the biggest economic impact) and drought in June 2000. These events caused a large number of fatalities: 215 in 1970 108 in July 1991 to 60 July 1975 and 33 August 2005.

Most of these events are the result of heavy rainfall (e.g. in the west more than 80% of the maximum flows are generated solely by the factor), or their overlap across melting snow. The spring floods are more common (30-50%) and summer peak flows were also recorded on some rivers in the last 50 years even with return periods of 200 years (i.e. 200 per Prut shave hydro station in 1965 etc.). They are the driven by the excess water generated by heavy rains falling on very wet soil, it is thus characterized by a depletion of water absorption capacity. The scale and the intensity floods are related also to the surface drainage basin, soil texture and permeability, excess moisture previous land use, minor riverbed width, longitudinal slope and basin slope, basin shape, etc.. After 1950, in the Lower Danube there were a number of severe floods in 1969, 1970, 1975, 1991, 1995, 1997, 1999, 2000, 2001, 2005, 2006, 2008, 2010 and 2013.

3. Identifying the areas exposed to floods in Romania

Establishment of GIS methodology for identifying areas subject to flooding nationwide has as its starting point that still approach hydraulic models, which are obtained some scenarios, not surprisingly detailed level connections between forms and microforms relief and The hydrological flows. The geomorphological pattern of floods has long been ignored by the decision. The hydrological dimension is emphasized geomorphology and Floods Directive, which are imposed on the products and some maps to help assess the potential for flooding and consider topography, the position of watercourses and their morphological characteristics, including floodplains as natural retention areas. For Romania, since 2006, the Institute of Geography of the Romanian Academy together with the National Institute of Hydrology and Water Management has achieved such potential geomorphological map of floods (Bălteanu et al., 2007).

This includes (Fig 41):

- areas with high probability of flooding (alluvial plains, including floodplains);
- floodplains where exceptional floods hidrofreatice (plains subsidence);
- flooded areas in the event of breakage or accidents dams and drainage systems;
- floodplain of the Danube Delta. Morphological differentiation of major structural units, mountainous and hilly areas have been identified following patterns:
    1. subsident flood depressions;
    2. rapid floods;
    3. flood caused by the breaking of dams, landslides or mudflows, etc. undersized bridges.;
    4. Major flooding large areas alibi.

The lowland plains, flood areas are more extensive due to the relief and the accumulation of large volumes. The main patterns in these areas may be classified as:

1. flood plains and low subsidence;
2. flooding in areas of confluence;
3. flooding in floodplains
4. Flood dune areas;
5. hidrofreatice flood areas Crovul depressions formed on loess;
6. small dam break flood caused by sometimes amplified by a domino effect;
7. floods in the Danube Delta.

For the assessment and modelling of flood #, GIS and remote sensing methods play an important role. Modern methods specific to the two areas complement the hydrology, allowing on the one hand organizing, viewing and especially spatial data processing and analysis, and on the other hand increase the performance and efficiency analyses and hydrologic and hydraulic models.

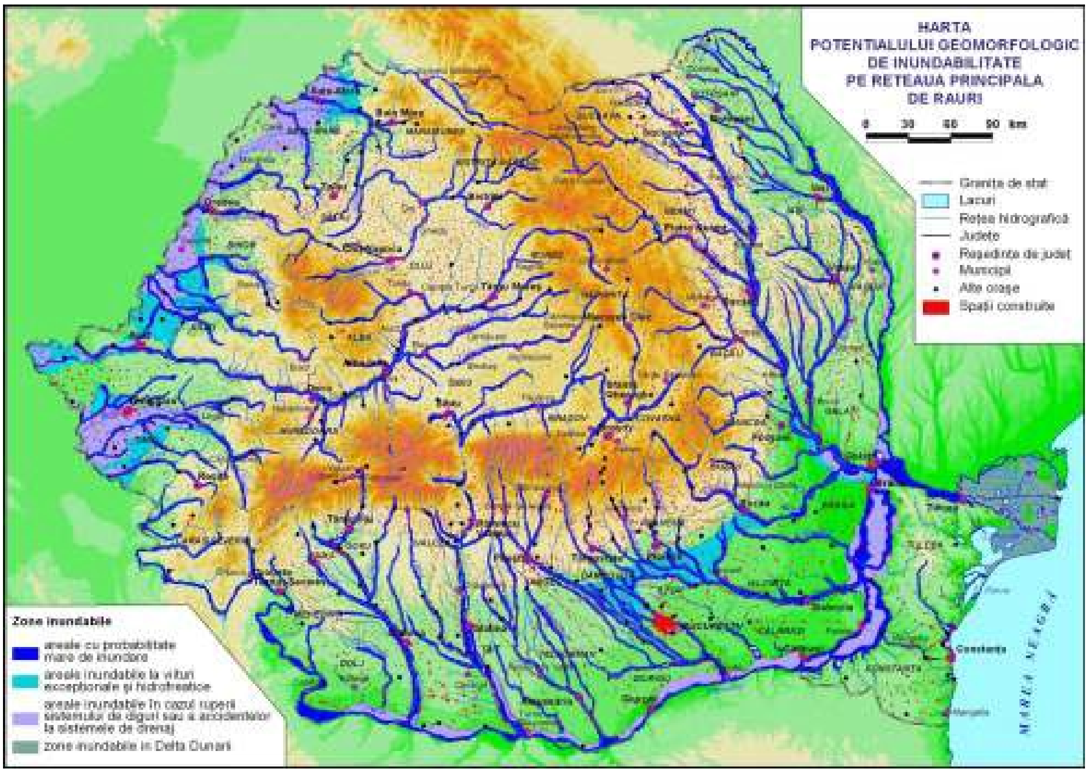


Fig 41. The geomorphologic potential of producing flood maps made by the Institute of Geography of the Romanian Academy and the National Institute of Hydrology and Water Management

4. Synoptic context of floods and major flash floods in Romania during 1948–present

The flash flood is a flood caused by heavy or excessive rainfall in a short period of time, generally less than 6 hours. Flash floods are usually characterized by raging torrents after heavy rains that rip through river beds, urban streets, or mountain canyons sweeping everything before them. They can occur within minutes or a few hours of excessive rainfall. They can also occur even if no rain has fallen, for instance after a levee or dam has failed, or after a sudden release of water by a debris or ice jam. (NOAA/NWS, 2010).

One can list, as causes of floods and flash floods, the following:

– abundant precipitation upstream of the affected areas. Precipitation episodes can be either convective (showers), or caused by the passing of fronts;
– warming in the high areas during wintertime, followed by melting of the snow layer and possibly rain;
– high concentrations of water in the upper (top) layers of soil, which leads to poor absorption capacity for the water from subsequent precipitation;
– extensive damage to dams and levies;
– debris that block the riverbeds.

For each of the time interval when there has been recorded and documented a flood, or major flash flood in Romania, we have studied the corresponding mean sea level pressure, the mean height of 500 hPa level and the mean pressure at the tropopause.

The graphs have been created using the reanalysis data of NOAA/NCEP/ NCAR, with the web-page interface on their site. The mean field over each time interval has been obtained from the daily means of the field over the same interval.

– mean sea level pressure: "Sea level pressure – Daily". URI address:
http://www.esrl.noaa.gov/psd/data/gridded/data.ncep.reanalysis.surface.html
– geopotential height of 500 hPa: "Geopotential Height – Daily". URI address:
http://www.esrl.noaa.gov/psd/data/gridded/data.ncep.reanalysis.pressure.html
– pressure at tropopause: "Pressure – Tropopause – Daily". URI address:
http://www.esrl.noaa.gov/psd/data/gridded/data.ncep.reanalysis.tropopause.html

The analysis that we present here did not take into account the type of precipitation (frontal, convective, short-time showers or persistent rain), nor the thickness of snow cover that has been melting during the warming episodes and contributed to the increase of the water volume transported downstream, nor the water content of the upper layer of soil (101 cm). The analysis has been performed over the entire set of cases, and as such it does not differentiate between the direct causes of floods and flash floods, their secondary causes (the melting of snow layer) and the geographical elements intrinsic to the observations (geographical disposition of hydrometric stations, of river beds and affected settlements).

It is acknowledged that air mass advection of tropical origin over Romania lead to periods of extremely high temperature. Some very hot such periods were generally followed by short events of atmospheric instability, sometimes for the entire country. Of similar importance are severe weather intervals caused by frontal behaviour, either cold fronts from above Western and Central Europe, occluded fronts near the Carpathian Mountains, and warm fronts coming from the South of Romania.

However, in regard to the scope of this activity – that is, to make a statistics of the air circulation types prevalent during the floods and flash flood events in Romania, these elements that we have hereby ignored may, and will be used in further analyses of all the events, which will take into account the small-scale or local effects, and the conditions prior to the onset of abundant precipitation.

The area over which the analysis has been performed is bounded by the geographical coordinates of (30–70) degrees Northern latitude, and (0–50) degrees Eastern longitude.

We have preferred this area because Romania is close to its center, and this area is being influenced by several semi-permanent pressure systems and their extensions (ridges and troughs) and also by transitory pressure systems. These systems are:

– the Azoric Anticyclone
– the Scandinavian Anticyclone
– the East-European Anticyclone
– the low pressure system off Iceland
– Mediterranean cyclones.

A typical series of the graphical analysis performed for each of the 29 cases of floods and flash floods is presented in Fig 42.

We have analyzed these fields for each of the 29 events of floods and flash floods in Romania. The 29 events, documented in 18 years, have been selected due to the quality and quantity of information related to each of them, and also due to the temporal limit of the reanalysis dataset of NCEP/NCAR, which starts at 1948.

The years with floods and flash floods that we have taken into account in our analysis are: 1948, 1955, 1956, 1960, 1966, 1969, 1970, 1975, 1978, 1979, 1980, 1985, 1988, 1989, 1991, 1993, 1994 and 2005.

We have separated the affected areas in Romania by their positioning relative to the Carpathian arc, thus:

– intra-Carpathic areas (CARIN): Maramures, Crisana, Banat, Transilvania
– extra-Carpathic areas – East (CAREX-E): Moldova
– extra-Carpathic areas – South (CAREX-S): Oltenia, Muntenia, Dobrogea.

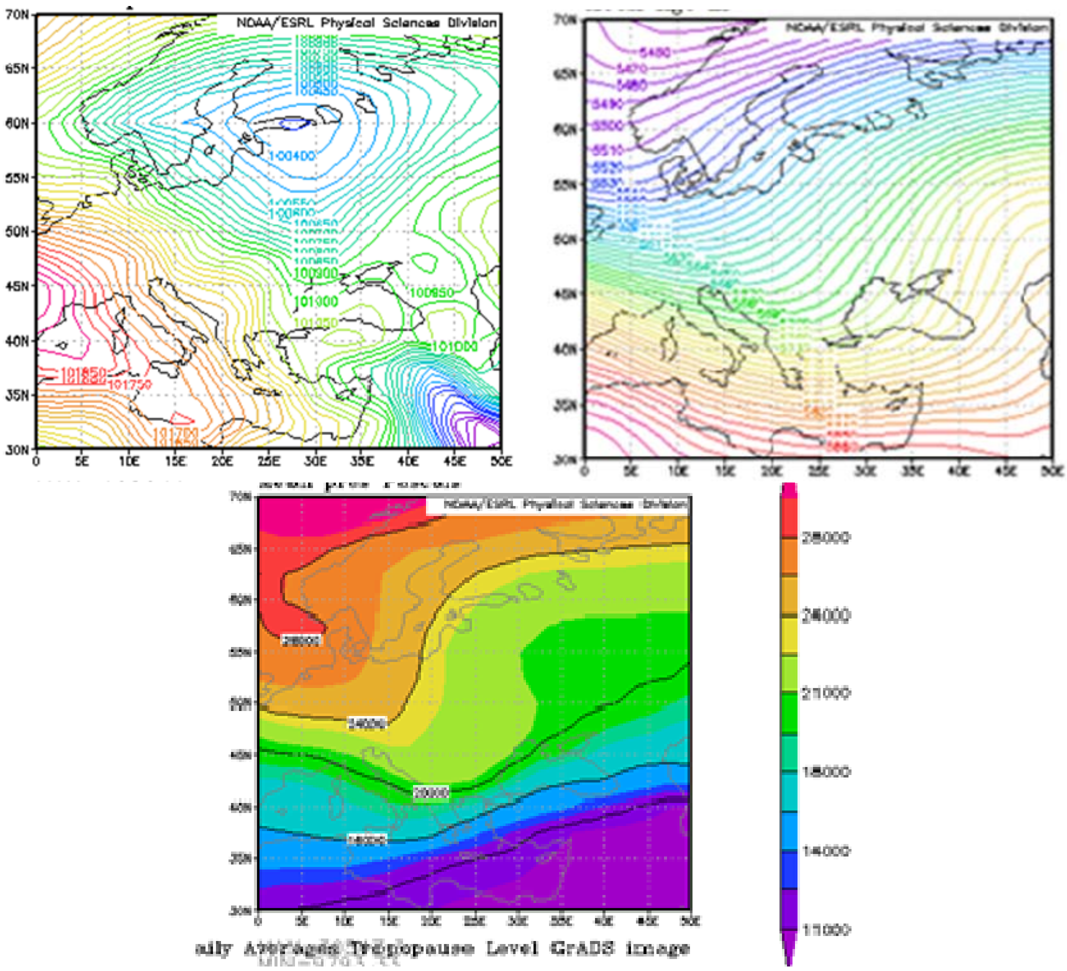


Fig 42. Mean sea level pressure; mean geopotential height; mean pressure at tropopause, for the floods and flash floods event during 16–30 June 1948 in Romania.

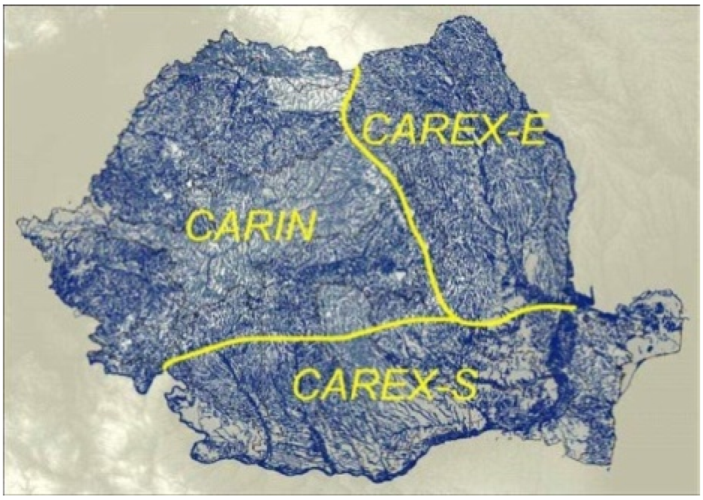


Fig 43. Hydrological map of Romania, with generic subdivision into intra-Carpathic (CARIN), and extra-Carpathic areas (CAREX-E, CAREX-S).

We have preferred this approach because:

– the intra-Carpathic areas are the first, and generally the most affected areas by low pressure systems generated North of Romania;

– the extra-Carpathic areas are the first, and generally the most affected areas by low pressure systems generated South of Romania;

– the extra-Carpathic areas, and Romanian Plain especially, are predisposed to convective storms more than the rest of the territory;

– on the inside of the Carpathian arc, the terrain is higher than in the lowlands and plains area outside of it and is predisposed to lower temperatures than the rest of the territory (mountain areas excluded).

Romania has been subject to floods and flash floods for a long time, as the documented history show. A detailed work presents the statistics of flash floods documented on the interior rivers in Romania, since the 16th century.

Table 4.5 Frequency of flash floods, by season, between the 16th and 20th century

Century	Years with floods	Number of flash floods	Flash floods, from total of events			
			Spring	Summer	Autumn	Winter
XVI	10	8	-	6	1	1
XVII	19	20	3	12	3	2
XVIII	26	25	6	12	3	4
XIX	15	18	6	10	2	-
XX	40	46	14	22	4	6

In the following table we have condensed the information about circulation of air over central Europe and Romania, in each of the cases of floods and flash floods during 1948 and 1995.

Table 4.6 Grosswetterlage in central Europe and atmospheric circulation in Romania associated with each flood and flash flood event, between 1948 and present

Case index	Year	Month (in year)	Days of the month	Type of Hess-Brezowski circulation, in days and abbreviation	General atmospheric circulation over Romania, 24 hours before the reference interval	General atmospheric circulation over Romania during the reference interval / Value (hPa) and orientation of the mean isobar
1	1948	6	After 16.06	7WZ, 3NEA, 3WA, 2TM	NE	NE; SW
2		6	21 – 27	2WZ, 3NEA, 1 WA	SW	SW; N; low pressure system
3	1955	3	8 – 20	2HNFZ, 6BM, 5NZ	S	SE; E; NE
4		10	9 – 10	BM	SW	E; SE
5	1956	4	26	TRW	E; E-NE; low pressure system	S
6	1960	6	16 – 17	HM	NE	NE
7		9	22 – 24	1WW, 2BM	S	SE; E
8	1966	5	29 – 31	3HB	S; SE; low pressure system	NW; W; low pressure system
9	1969	6	6 – 13	2NEZ, 5NEA, 1U	SW+NE, low pressure systems	SE; E; N; NW; low pressure system
10		7	30	HFZ	E	SE
11	11	5	~ 1 – 20	1TRM, 3NEZ, 6HFA, 4TM, 1U, 3NEA, 1U, 1NWZ	NE	N; NW; NE; low pressure area; anticyclonic ridge from the N; S; low pressure area
12	1975	7	~ 1 – 30	6NEZ, 1U, 4TB, 5SWA, 9WZ, 5BM	S	W; low pressure system; N; Icelandic trough; S; anticyclonic ridge; SW; NW

13	1978	5	2 – 3	WS	S	S; low pressure system
14	1979	6	~ 15 – 30	4HB, 11BM	SW	S; NE; E; low pressure system
15	1980	7	29	HNFA	NE	E
16	1985	6	11	TRM	Azoric ridge	Icelandic trough to the North of Greece
17	1988	6	1 – 11	3WZ, 4TRW, 4HNZ	low pressure area	Icelandic trough; low pressure system
18	1989	5	7 – 9	BM	SE	low pressure system
19	1991	6	3	WZ	SE	SW, S
20		6	10	WZ	N; low pressure system	N
21		6	29	TRM	NW	NE
22		7	3	HNFA	NE	NE
23	1993	1	~ 10 – 20	5WZ, 3WA, 3WZ	N; Azoric ridge	W; anticyclonic; Icelandic trough; anticyclonic
24		12	~ 10 – 20	WZ	E	anticyclonicbridge; Icelandic troughs
25		12	21	WZ	W	W
26	1994	8	26	TB	S; low pressure system	low pressure system
27	1995	5	23 – 25	2HM, 1TRW	SE	NW
28		6	28 – 29	1HB, 1NWA	N	N
29		12	~ 23 – 31	4WS, 4HNA, 1 SEA	SW	SW; Icelandic troughs

One can summarize the characteristics of circulation above Central Europe and Romania, over the set of 29 events of floods and flash floods.

a. As to the Hess-Brezowski types of circulation, the distribution of the analysed events is as follows:

Table 4.7 The distribution of the analysed events with respect to the Hess-Brezowski types of circulation

Month	Hess-Brezowski circulation type thismonth, during the analysed events(number of days and abbreviation)	Hess-Brezowski circulation type thismonth, on the total of events (abbreviation and number of days)
1	(5WZ, 3WA, 3WZ)	WZ: 8
3	(2HNFZ, 6BM, 5NZ)	BM: 6
4	(1TRW)	TRW: 1
5	(3HB), (1TRM, 3NEZ, 6HPA, 4TM, 1U, 3NEA, 1U, 1NWZ), (1WS), (3BM), (2HM, 1TRW)	HPA: 6 TM: 4 HB, NEZ, NEA, BM: 3
6	(7WZ, 3NEA, 3WA, 2TM), (1HM), (2NEZ, 5NEA, 1U), (4HB, 11BM), (1TRM), (3WZ, 4TRW, 4HNZ), (1WZ), (1WZ), (1TRM), (1HB, 1NWA)	WZ: 12 BM: 11 NEA: 8
7	(1HFZ), (6NEZ, 1U, 4TB, 5SWA, 9WZ, 5BM), (1HNFA), (1HNFA)	WZ: 9 NEZ: 6 SWA, BM: 5
8	(1TB)	TB: 1
9	(1WW, 2BM)	BM: 2
10	1BM	BM: 1
12	(1WZ), (1WZ), (4WS, 4HNA, 1SEA)	WS, HNA: 4

We see a prevalence of WZ pattern of circulation during the winter (January) and summer (June), and of BM pattern during the same time of the year.

b. As to the Hess-Brezowski types of circulation, their frequency by the season in which the events were recorded is as follows:

Table 4.8 Frequency of events

Season (as series of three months each)	Prevalent circulation type (abbreviation)	Prevalent circulation type (number of days)	Fraction of a generic season; 3 months of 30 days each) (%)
Spring (3 – 5)	BM	9	10
Summer (6 – 8)	WZ	21	23
Autumn (9 – 11)	BM	3	3
Winter (12 – 2)	WZ	8	8

On the set of events we have analysed, the most frequent pattern of circulation was WZ, during the summer.

c. As to air circulation, as seen in the field of sea level pressure, as mean values on each reference interval, over Romania and its immediate vicinity (<500 km):

Table 4.9 Air circulation at sea level

Orientation of air circulation, or dominant pressure system, at sea level	Case index	Fraction of total (%)
Low pressure system	8, 9, 11, 13, 17, 18, 22, 26, 27, 29	34.5
North-Eastern	10, 12, 15, 21, 28	17.2
North-Western	1, 2, 16, 23, 25	17.2
Northern	6, 20	6.9
Eastern	7, 14	6.9
South-Eastern	3, 4	6.9
Southern	5, 19	6.9
Western	24	3.4

Most of the events have taken place while near Romania there was a low pressure system.

d. As to air circulation, as seen in the height of 500 hPa level, as mean values on each reference interval, over Romania and its immediate vicinity (<500 km):

Table 4.10 Air circulation at 500 hPa level

Orientation of air circulation at 500 hPa level	Case index	Fraction of total (%)
South-Western	1, 3, 5, 6, 11, 13, 16, 19, 26	31
Western	17, 20, 24, 25, 29	17.2
Low pressure system	8, 9, 18, 27, 28	17.2
Southern	2, 4, 14, 21	13.8
South-Eastern	7, 22	6.9
North-Western	12, 23	6.9
Convergence	15	3.4
Eastern	10	3.4

Most of the events have taken place while above Romania, the circulation at 500 hPa level was from the South-West.

e. As to the level of tropopause, the position of the nearby isobar, closest to the Southern border of Romania (to the South) during each event is as follows:

Table 4.11 Mean isobar at each event

Mean isobar (hPa) South of the Southern border of Romania (<100 km)	Case index	Fraction of total (%)
190	4	3.4
200	1, 2, 7, 15, 26	17.2
210	12, 14, 22, 29	13.8
220	5, 6, 19, 20, 21, 24, 25, 28	27.5
225	9, 10	6.9
230	16, 17, 27	10.3
240	8, 13, 23	10.3
250	3, 11, 18	10.3

f. As to the time of year (season), the distribution of the events of floods and flash floods in the analysed set is as follows:

Table 4.12 The distribution of events with respect to season

Season (as series of three months each)	Case index	Fraction of total (%)
Summer (6 – 8)	1, 2, 6, 9, 10, 12, 14, 15, 16, 17, 19, 20, 21, 22, 26, 28	55.1
Spring (3 – 5)	3, 5, 8, 11, 13, 18, 27	24.1
Winter (12 – 2)	23, 24, 25, 29	13.8
Autumn (9 – 11)	4, 7	6.9

Most of the floods and flash floods have taken place in June. During March, April, August, September and October there has been only one event each month. During February and November there has not been any recorded event in this set.

5. Methods of analysis of vulnerability to floods in the lower basin of the Danube River

In specialized literature, mainly foreign, are presented and applied numerous methods of analysis and assessment of vulnerability to flooding.

Table 4.13 Affected area

Affected area, as positioned in regard to the Carpathian arc	Case index	Fraction of total (%)
CARIN	1, 4, 5, 6, 8, 10, 13, 15, 18, 23, 24, 25, 27, 29	48.2
CAREX-E	1, 9, 14, 17, 19, 20, 21, 22, 23, 24, 26, 28	41.3
CAREX-S	2, 3, 6, 7, 14, 16, 27, 29	27.6
CARIN, CAREX-E, CAREX-S	11, 12	6.9

Abuodha and Woodroffe (2006) made a presentation of the methods and tools used worldwide to the assessment the vulnerability to floods in coastal areas. Among them fall: DIVA (Dynamic Interactive Vulnerability Assessment) simCLIM (Simulator of Climate Change Risks and Adaptation Initiatives) CVAT (Coastal Vulnerability Assessment Training) FUND (Climate Framework for Uncertainty, Negotiations, and Distribution) FARM (Future Agriculture Resources Model), COSMO (Coastal Zone Simulation Model) SURVAS (Synthesis and upscaling of Sea Level Rise Vulnerability Assessment Studies) CM IPCC (Inter-Governmental Panel on Climate Change Common Methodology).

Wolf (2012) highlights the similarities and deosebirtile of two methods for assessing vulnerability to hydrometeorological hazards: DIVA and cats. DIVA (Dynamic Interactive Vulnerability Assessment) is an integrated model for the assessment of biophysical and socio-economic impacts of sea level rise. The Cats (Catastrophe Simulation) assess economic and financial vulnerability to extreme weather.

Hufschmidt (2011) presents a comparative analysis of six models of vulnerability to identify similarities and differences between different approaches. The models considered are: Pressure and Release (PAR), Access, Alexander, Hazards-of-a-like, Airlie House, BBC-framework and model developed by Bohle et al. Are some Characteristics that explains the vulnerability condition and identified as important elements of vulnerability resilience.

Recent approaches to vulnerability assessment are included in the special volume of the journal Natural Hazards, entitled The Natural Hazard Vulnerability Assessment and Risk Analysis (Volume 64 (3) 2012), which includes results of research presented at the session in natural hazard and Vulnerability Assessments Risk Analysis of the 2011 General Assembly European Geosciences Union in Vienna (Fuchs et al, 2012). Other special volume of the journal Natural Hazards, vulnerability to hazards dedicated natural were published in 2011 (Vulnerability to natural hazards? The challenge of integration, vol.58 (2)) and 2010 (Extreme Events and Vulnerability in Environment and Society; vol.55 (3)).

Aviotti (2011) in his doctoral include an overview of different methods for diagnosing vulnerability to flooding of homes. Reference is methodological guide for diagnosing and reducing vulnerability to flooding buildings conducted by the European Centre for Disease Prevention Flood Risk (CPRI) (Le Bâtiment à l'make inondation, et Diagnostiquer reduced its vulnerability, 2010).

Fekete (2012) evidențiază unele schimbări în metodele de evaluare a vulnerabilității şi riscului pe baza unor studii de caz privind vulnerabilitatea socială la inundații în Germania.

In Romania the reference to methodological aspects and applications of vulnerability assessment methods to evaluate the vulnerability to floods are relatively few, most studies on hazards and their characteristics. Methodological information can be found in works by Armas (2006), Sorocovschi (2007, 2010), Gotiu and Surdeanu (2007), Grecu (2009). Armas (2006) mentions three categories of vulnerability assessment methods (with examples of applications in geomorphology, but that could be applied in case of flooding) summative based on conditional probabilities and factorial analysis. Sorocovschi (2007, 2010), Gotiu and Surdeanu (2007) and Grecu (2009) summarizes the methods identified in specialized literature: Anderson and Woodrow matrix, pressure-relaxation model (PAR) model accessibility ACCESS, Alexander's model.

Techniques and tools for diagnosing vulnerability. Different diagnostic approaches based vulnerability analysis that integrates rule, several methods / techniques, depending on the type of approach (quantitative or qualitative, phenomenological or probabilistic). A wide applicability in these purpose a statistical analysis and multi-criteria were based on which the vulnerability ranking is done according to the degree of intensity. Majority methods involve the use of vulnerability indicators. Spatial analysis and vulnerability the assessment is based on highlighting the vulnerability maps / vulnerability for different areas within the area of analysis. The vulnerability is expressed usually by intensity classes (very low, low, medium, high and very high) based on criteria and indicators considered in the analysis.

Spatialization different components of vulnerability factors that determine outcomes and vulnerability assessment techniques is facilitated by the use of Geomatics: GIS and remote sensing. The two techniques have become key elements in estimating vulnerability and flood risk.

The GIS in addition to providing a very good mapping accuracy, the advantage of allowing combination of different factors and criteria through cartographic algebra operations, to achieve automated classification and multiscale analysis. At the same time, allow the creation of GIS databases and attribute on georeferenced thematic elements and factors of vulnerability, with the ability to be updated over time (Masson, 2006).

Using remote sensing techniques associated with specific GIS are very useful in analysing spatial vulnerability to flooding. Satellite images provide qualitative and quantitative information for large areas sometimes inaccessible, with different spatial resolutions. On the basis of optical or radar images may be identified and measured flooded areas and assess the damage caused by these phenomena depending on the type of the flooded area. In Romania remote sensing and GIS techniques were the basis of national and international projects for the management of emergency situations caused by hydrometeorological phenomena, such as SAFER FP7 (2009-2012), Services and Applications for Emergency Response; PNCDI2 SAFE (2007 -

2010), based on satellite information service for emergency management; PNCDI2 RISCASAT (2007-2010), development of new products derived from satellite data management tailored to users of hydro-meteorological risk situations (Irimescu and Others 2010).

At the European level, the project FLOODsite was developed a methodology for assessing flood damage, based on multi-criteria analysis using GIS (FLOODsite Project Report, 2009).

The project CLAVIER (EU FP6 project: Climate change and variability: Impact on Central and Eastern Europe http://www.clavier-eu.org/) was applied to avaluate regional vulnerability assessment for space Hungary, Romania and Bulgaria . This consisted in the use of clustering techniques and principal components method to aggregate a series of indicators EUROSTAT, select economic criteria, in order to identify homogeneous regions, such as industrial centers, tourist, agricultural deeper regions, regions predominantly service regions depopulated etc. Regions thus identified were subsequently awarded attribute quality of resilience to climate change.

Analysis of the quality of water resources as an intermediate step vulnerability assessment of local communities in areas flood water contamination. If vulnerability flood analyses, especially those taken at local, relevant problem is the quality of water resources. From this point of view, the Water Framework Directive gives the Commission and thus Member States the possibility to cooperate in a new partnership, based on the participation of all stakeholders, to ensure the protection of inland waters, transitional waters, the both coastal and groundwater by preventing pollution at the source and by establishing a consistent control of pollution sources.

Directive establishes an effective control of water pollution and to that end provides a common goal for all states are developing: achieve good ecological and chemical quality of water by 2015. In order to achieve the purpose for which it was developed Directive sets: the deadline by which waters must achieve a minimum quality by reducing emissions from human, industrial and agricultural, sustainable water management and rational and balanced distribution of this resources, maintaining and improving water quality and natural regeneration. Characteristics and values of the surface water used for drinking water production are presented in Appendix A. Water Framework Directive; 2000/60/EC was transposed into national law by Law no. 310/2004 amending and supplementing Law no.107/1996 water.

Classification of surface water quality is done in national law by Order of the Ministry of Environment and Waters 161 of 2006 approving the Norms concerning the classification of surface water quality to determine the ecological status of water bodies. The indicators included in the norm with 5 classes (Order no. 161/2006) are divided into five main groups:

1. group "the oxygen" include: dissolved oxygen, BOD5, CCOMn, COD-Cr;
2. group "nutrients" includes ammonium, nitrate, nitrite, total nitrogen, orthophosphates, total phosphorus, chlorophyll;
3. group "general ions, salt" includes: filterable residue dried, sodium, calcium, magnesium, total iron, total manganese, chlorides, sulfates;

4. group "metals" includes: zinc, copper, total chromium, arsenic. Metals lead, cadmium, mercury, nickel was assigned the group of priority substances;

5. group "organic and inorganic micropollutants" includes: phenols, detergents, AOX, petroleum hydrocarbons. Other substances such as PAHuri, PCBs, lindane, DDT, atrazine, tetrachloromethane, trichloroethane, tetrachloroethane, etc.. were classified in the group of priority substances.

Because of the importance of this key element in the community and ensuring sustainable development is particularly important to preserve water quality to allow multiple uses in all sectors of society. The management and protection of communities is a vital area of monitoring and evaluation of water quality established itself as a necessity.

6. Databases, content databases for inventory flooding in the lower basin of the Danube River

The information needed to build the GIS database used for diagnosing vulnerability (physical data geographical, social, economic) are collected from different sources cartographic database statistics (climatic, hydrological, demographic, economic), spatial databases, aerial images and satellite, bibliographic sources. Essential that data sources are field investigations in which to make measurements, mapping, observations, questionnaires, surveys.

In this phase involved a documentary on the most representative database of disasters and their characteristics, aiming especially those databases that provide information on past floods produced significant. The information in the database refers to the type of disaster, the start and end date, number of victims, the damage etc. Among them: the International Disaster Database (EM-DAT), Dartmouth Flood Observatory (DFO), Center for Refugee and Disaster Response (CRDR) Global Disaster Alert and Coordination System (GDACS), The Disaster Database Project (University of Richmond) database according to Flood.

One important aspect in creating a database is information networking, especially of the space of potential flooding and flooded areas and spaceless on indicators (eg. Demographic, socioeconomic, institutional) to measure the vulnerability to flooding.

For example, the Floods Directive Framework specifications for the structure of a database on floods (Table 4.14):

Table 4.14 The structure of a database on floods

General information on historical floods	Name basin
	Name Location flooded
	event name
	Type flood
	Start date event
	Duration of the event
	Flooded area (km^2)
	Length sector flooded river (km)

	Frequency	
	Number of victims	
Source flood / flooding	River	
	Rainwater	
	From groundwater (underground)	
	Marine	
	Barring artificial - Defence Infrastructure	
	Other	
	Not available	
Mechanism of flooding	Exceeding the carrying capacity of the bed	
	Overcoming ensure	
	Destruction defense infrastructure	
	Block / Restrict	
	Other	
	Not available	
Characteristics of flood	Rapid flood (flash flood)	
	Spring floods due to snowmelt	
	While flood with other growth	
	Flood with average growth for	
	Flood with low rise time	
	Floods with high sediment transport	
	Flood with pervasive	
	Flood with outstanding levels	
	Other features	
	Not available	
Human health (issues social)	Human Health	
	Community	
	Other	
Consequences	Environment	Water Quality Status
		Protected areas
		Sources of pollution
		Other
	Cultural Objectives	Cultural objectives
		Landscapes
		Other
	Economics	Properties
		Infrastructure
		Land Use
		Economic activities
		Other

REFERENCES:

1. Abuodha, P. A. and Woodroffe, C. D. (2006), *International assessments of the vulnerability of the coastal zone to climate change, including an Australian perspective*. Final Report submission to Australian Greenhouse Office in response to RFQ 116/2005DEH. 69 pp.
2. Bălteanu, D., Sima, M., and Chendeş, V.: Natural and Technologi- cal Hazards related to Extreme Climatic Events in Romania, Cli- mate change in South-Eastern European countries. Causes, im- pacts, solutions, Graz, Austria 26–27 March, 2007.
3. Mustatea, Atanase, Viituri excepţionale pe teritoriul României–Geneza şi efecte, Bucureşti, 2005.
4. Georgescu, F., Tascu, S., Banciu, D., Tropical air mass advection and frontal instability in severe weather events – a case study, Romanian Reports in Physics, 61, 1, 129–138 (2009).
5. H. de Moel, J. van Alphen, J. C. J. H. Aerts (2009), Flood maps in Europe – methods, availability and use, Nat. Hazards Earth Syst. Sci., 9, 289–301, www.nat-hazards-earth-syst-sci.net/9/289/2009/.
6. Lupascu, Aurelia, Caracteristicile generale ale tipurilor de circulatie în regiunea atlantico- europeană, 2009.
7. Mason (2006), Multi Agent Simulation Of Neighbourhood, Available at http://cs.gmu.edu/~eclab/projects/mason.
8. B. Merz, H. Kreibich, R. Schwarze, and A. Thieken (2010), Assessment of economic flood damage, Nat. Hazards Earth Syst. Sci., 10, 1697-1724, http://www.nat-hazards-earth-syst-sci.net/10/1697/2010/nhess-10-1697-2010.html.
9. Millennium Ecosystem Assessment. 2005. *Ecosystems and human well-being: synthesis*. Island Press, Washington, D.C., USA.
10. NOAA National Climatic Data Center, State of the Climate: Global Analysis for January 2010, http://www.ncdc.noaa.gov/sotc/global/2010/1.
11. Katalog der Grosswetterlagen nach Hess/Brezowsky, 1881–1998, Potsdam-Institut fuer Klimafolgenforschung e.V., Deutschen Wetterdienst (1998).
12. Katalog der Grosswetterlagen Europas, http://www.pik-potsdam.de/~uwerner/gwl/
13. Images provided by Physical Sciences Division, Earth System Research Laboratory, NOAA, Boulder, Colorado, from their Web site at http://www.esrl.noaa.gov/psd/.

4.5 REPUBLIC OF MOLDOVA

4.5.1 Past Events and Their Consequences

A flood is an overflow of water that submerges land which is usually dry. The European Union (EU) Floods Directive defines a flood as a covering by water of land not normally covered by water. In the sense of "flowing water", the word may also be applied to the inflow of the tide. Flooding may occur as an overflow of water from water bodies, such as a river or lake, in which the water overtops or breaks levees, resulting in some of that water escaping its usual boundaries, or it may occur due to an accumulation of rainwater on saturated ground in an area flood. While the size of a lake or other body of water will vary with seasonal changes in precipitation and snow melt, these changes in size are unlikely to be considered significant unless they flood property or drown domestic animals.

Floods can also occur in rivers when the flow rate exceeds the capacity of the river channel, particularly at bends or meanders in the waterway. Floods often cause damage to civil and industrial buildings if they are in the natural flood plains of rivers. Floods in Republic of Moldova can be in every season: in summer and autumn it is determinate by torrential rains, in winter and spring snowmelt. Exceptional floods occur frequently in the Republic of Moldova. These floods are caused by rainfall, additionally at summer in June (36.5% from total number of floods) and July (40% from total number of floods).

In the Republic of Moldova, floods, in comparison with other natural disasters, cause the greatest damages. This is explained not only by specific natural factors but also by the fact that precincts of localities, roads, including railway sectors and other infrastructure objectives are located directly in potential flooded regions. The main factors, which determine the occurrence of floods, are extreme weather conditions, especially rainfalls, their effect being amplified by human activity. Therefore, identifying areas vulnerable to flooding presents a special interest, particularly vulnerable areas of large river basins, primarily Prut and Dniester Rivers, where floods, judging to literary data, are quite common:

(a) Mihailescu and Boian (2005) show frequency of natural hazards in Republic of Moldova from 00 to 1997.

Table 4.15 The principal groups of climatic disasters from 1000 to 1997

Tabelul 1

Principalele grupe de calamități pe parcursul primului mileniu al erei noastre

Anii / Fenomene	1000 1099	1100 1199	1200 1299	1300 1399	1400 1499	1500 1599	1600 1699	1700 1799	1800 1899	1900 1997	În total
Secetw	35	41	31	37	45	37	49	51	72	64	462
Invazii de vătămători	5	5	6	7	9	6	16	10	37	11	112
Toamne ploioase	13	8	7	3	2	1	5	8	9	7	63
Veri ploioase	26	38	45	38	31	46	44	21	50	32	371
Inundații	30	22	21	34	29	25	47	34	54	18	314
Ierni geroase	28	26	43	44	53	50	52	32	43	23	394
Înghețuri	16	12	6	9	11	9	15	9	13	19	119
Furtuni	9	2	8	5	5	5	3	2	22	24	85
Seisme	3	5	1	1	4	8	10	7	16	52	107
Epidemii şi epizootii	9	4	2	10	18	6	28	2	23	7	109
Total pe 100 ani	174	163	170	188	207	193	269	176	339	257	2136

Table 4.16 The principal groups of climatic disasters from 00 to 999

Tabelul 2

Principalele tipuri de calamități pe parcursul ultimului mileniu al erei noastre

Anii	0	100	200	300	400	500	600	700	800	900	În total
Fenomene	99	199	299	399	499	599	699	799	899	999	
Secete	3	2	2	2	10	5	2	9	11	24	70
Invazii de vătămători		1				3	1				5
Toamne ploioase	1	1				1	1	1	1	1	7
Veri ploioase	1	1	5	1	3	4	3	1	1	4	24
Inundații	7	12	3	8	3	2	3	4	17	16	75
Ierni geroase	3	7	9	5	14	9	8	14	15	17	101
Înghețuri						1		1	1		3
Furtuni				1		1	1			1	4
Seisme	3	1	1	1		5			1	1	13
Epidemii și epizootii	1	1	2	2		6		1		2	15
Anii neroditori, cu foamete	16	19	7	10	32	56	33	44	53	42	312
Total cazuri semnalate	35	45	29	30	62	93	52	77	100	108	631

(b) Cazac and Boian (2008) show exceptional floods on Prut and Dniester rivers.

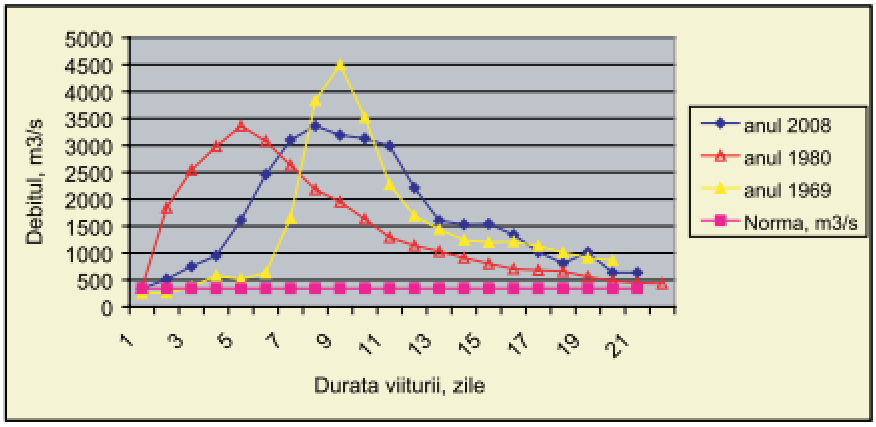


Figura 1. Viituri excepționale pe r. Nistru (postul hidrologic Hrușca)

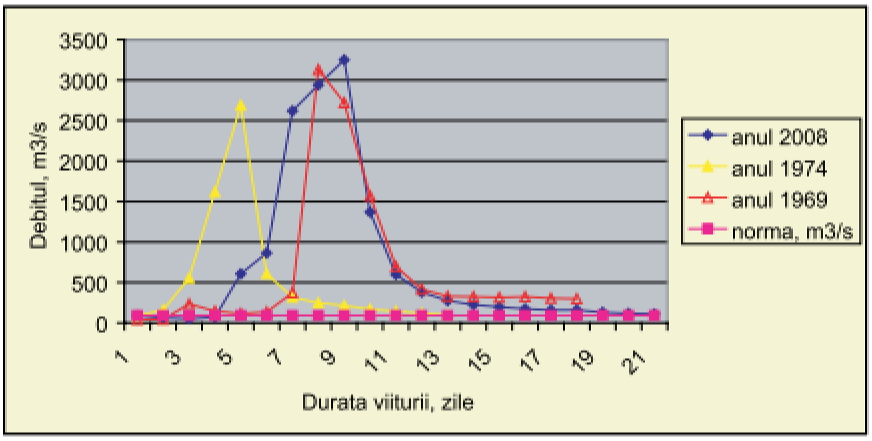


Figura 2. Viituri excepționale pe r. Prut (postul hidrologic Șireuți)

Fig 44. The example of extreme inundations on Nistru (Hrusca) and Prut (Sireuti) rivers.

c) Boboc and at. (2006) mapping of exceptional precipitation that caused floods

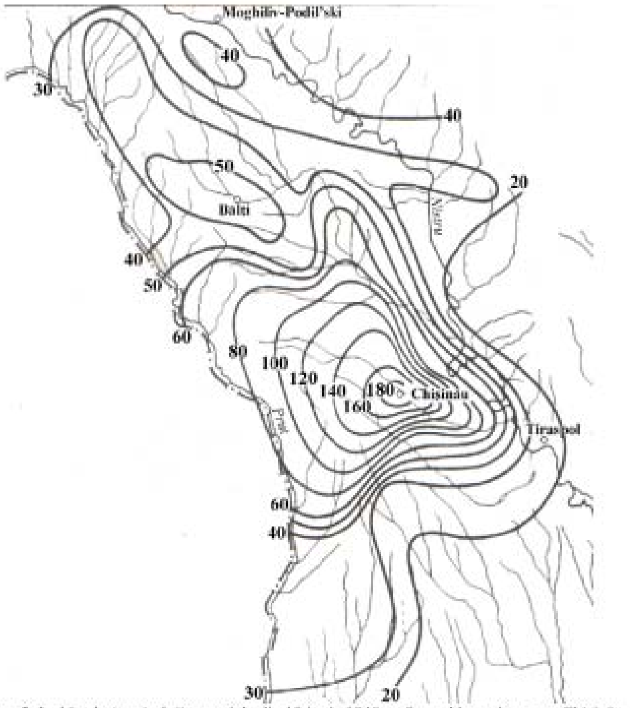


Figura 3. Izohietele (mm) ploii torenţiale din 10 iunie 1948 cu focarul în regiunea or. Chişinău.

Fig 45. Isolines of the intense precipitation from 10 June 1948.

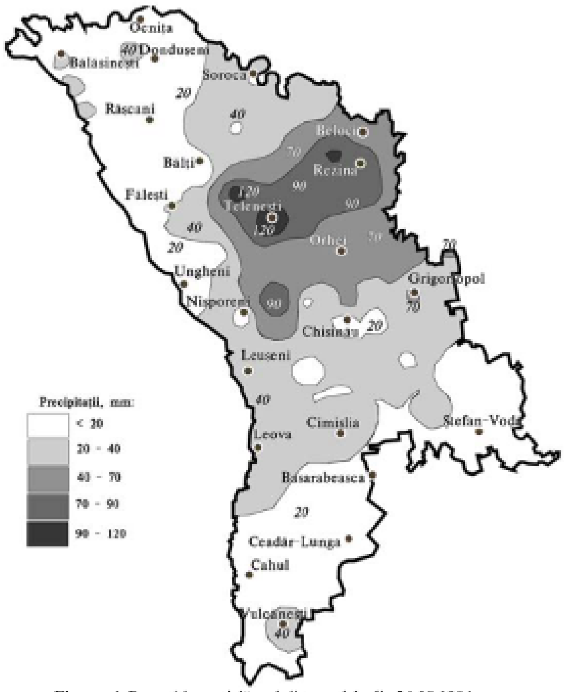


Figura 4. Repartiţia spaţială a ploii torenţiale din 26.08.1994.

Fig 46. The spatial distribution of the intense precipitation from 26 August 1994

d) Boboc and ot. (2012) make modeling for flood wave on example of Prut river.

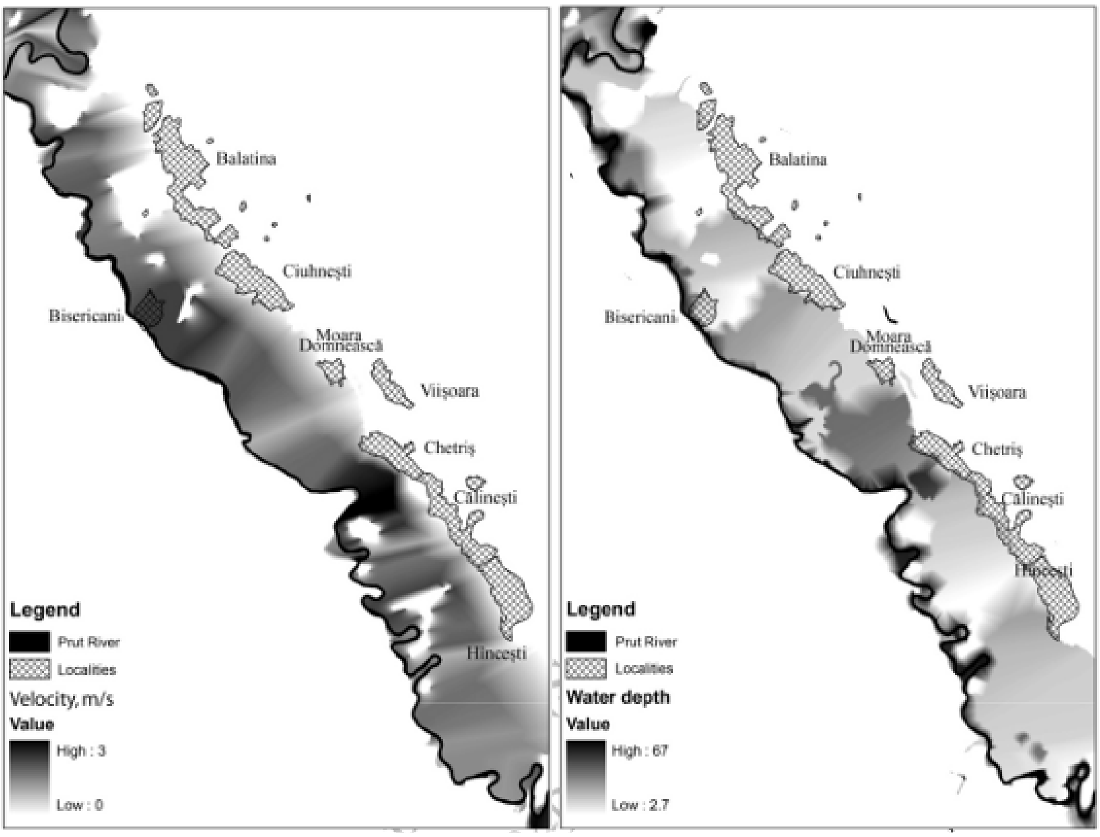


Fig 47. Rasters of velocity and water depth in case of Qmax=2834m^3/s

4.5.2 Existing legislation framework

1. The law on water No. 272 from 23.12.2011;

2. The law on environment protection No. 1515-XII from 16.06.93;

3. The law concerning exemptions provision in scenes of dropping-out the consequences of summer 2010 floods, No. 191 from 15.07.2010;

4. The decision of Government No. 786 from 22.10.2012 concerning the modalities in preparing for the civil defense in Republic of Moldova for 2013 year;

5. The decision of Government No. 433 from 18.06.2012 concerning the approval of Provisions for floods defense shafts;

6. The decision of Government No. 751 from 05.10.2011 concerning the approval of the Program for the development of water resources and amelioration in Republic of Moldova;

7. The decision of Government No. 325-XV from 18.07.2003 concerning the approval of the Concept for national policy in the field of water resources

4.6 UKRAINE

4.6.1 Past Events and Their Consequences

Floods occur at 27% of the territory of Ukraine (165,000 km2). One third of population of Ukraine lives in potentially dangerous areas. The flood prone zones are Carpathians, Polissya, Lower Danube and Donbass.

Ukrainian territory covers 18% of Danube Delta. The Ukrainian part of the Danube delta and floodplain occupies about 124,000 ha, including 75,000 ha of land and 50,000 ha of big lakes – Kahul, Kartal, Kugurlui-Yalpug, Katlabuh, Kitay and Stensovsko-Zshebriyansky Plavni.

A length of the Ukrainian part of the Danube is 170 km between the border of the Republic of Moldova near the Prut River mouth and the Black Sea and is located in the south-western part of the Odessa Region.

In recent years there has been an increase in the quantity of extreme and sudden hydrometeorological phenomena in the Danube Delta. For this reason, the issues of environmental monitoring are increasingly important and relevant.

High water levels and new historical record in 2010 in the lower areas of the Danube river pose a threat to the region safety and require increased attention of the experts.

Spring-summer flooding in the Danube basin is a well expressed phase of the river's water regime. Flooding is conditioned by snow-melt and by rain. In the lower Danube, flooding usually occurs between March and July. In this period, on average nearly 51% of the annual flow of the river passes through the area. However, the Lower Danube is characterized by a flood regime that extends over the whole year. So the maximum levels of water may be observed not only in spring or summer. Considerable increases of water level have been observed in the Ukrainian part of the Danube during the winter because of ice flows (2006, 2012). The heaviest flooding of the last 10 years occured in 2006 and 2010. Significant flooding connected with local flows was observed in 2005, 2012 and 2013.

Overall, extreme flooding in 2006 (in terms of the time of year it occurred and its duration) was similar to floods in other years. However, it was stronger and its formation in the basin had some specific characteristics. It was conditioned by the main meteorological factors. There were two main reasons for this significant flood that began in March and continued until July (nearly 5 months). The first reason was the volume of snow that had accumulated both in mountainous regions and at lower elevations. The second reason was the warm weather at the beginning of spring (March-April) which facilitated the quick melting of snow. The third reason was heavy rains in the spring months.

In contrast to the maximum levels of earlier floods in the Lower Danube in 1980, 1981, 1988 1999, 2005, 2006, the new historical maximum of 2010 was formed exclusively due to precipitation. The maximum level at the Reni post was 581 см which was observed on July 6. Further, a significant part of this maximum flow came from the Siret and Prut tributaries of the Danube.

In 2010, new historical high water records were set at many hydrological posts of the lower Danube.

During flooding in 2006 and 2010, hydrometrical work on water discharge was done at the boundary markers on the Danube River in the framework of a program of cooperation in the area of water management in transboundary waters between Ukraine and Romania. For the first time we obtained such extensive measurements of the significance of the water flow.

The maxium levels that can be observed once in a thousand years and once in a 100 years have increased. This situation, it seems, requires corrections to the design of water management objects. The largest cause of concern is the design of the protective dikes that are located on the section of Reni –Izmail Promontory.

In conditions where the level of the Black Sea is rising, there are growing threats of flooding in Vilkovo. The critical level of 155 cm is observed on average once every 2 years. The critical level as a rule appears because of the combination of high water levels in the river and an easterly wind. High water levels flood gardens of local residents and the wooden bridges of the town.

A special type of flood is connected with ice phenomena. If the flow of the river is low and there are negative temperatures, then various ice phenomena appear. Ice may partially or fully block the flow of water in various channels. Then water will seek other ways to move. This situation was the reason for the catastrophic flood in Vilkovo in 1969. The deepening of the bar on Bystroe protects the town from winter flooding. This situation was observed in 2012 when ice that blocked the branches of the Ukrainian delta was removed as a result of the Bystryi Branch.

Another issue that deserves attention is local water flows. Floods cause damage to infrastructure and sometimes the death of people (2013). Strong local downpours in small valleys or on the floodplains of small rivers can also cause flooding. The absence of forests on the sides of these valleys, their cultivation, and the closure (infilling) of the channels of small rivers also intensifies flooding.

Significant floods were observed in Reni in 2005, and in Sarata, Tabarbunary and Bolgrad Districts of Odessa Oblast in 2013.

For several decades in the middle of the last century more than 50% of flooded lands along the Ukrainian section of the Danube were drained. Embankments and conversion of the left bank flooded territories and islands to agricultural lands, setting up water reservoirs on the basis of Danube lakes, pollution of Danube waters and runoff of small rivers, total ploughing of the steppe resulted in a drastic change of the environment.

Today the main problems of the region in terms of floods are:

- poor technical capacities for hydrological monitoring, emergency planning and warning in the Lower Danube Area;

-absence of modern digital river water level forecast model based on the flow redistribution in the Danube Delta;

- no flood action plan, covering the territory of the whole country as well as no one joint legislative act concerning flood issues;

- lack of cross-border and transnational cooperation;

- lack of public awareness of what local people have to do when get a flood warning. Emergency warning system needs to be improved taking into consideration modern technical and communication opportunities such as mobile telephone connection, FM radio and TV programmes etc.

4.6.2 Existing legislation framework

Constitution of Ukraine, Law from 28.06.1996;

Article 106 (21) the President of Ukraine shall adopt, amendmentsif necessary, a decision on the introduction of a state of emergency in Ukraine or in its particular territories, or declare certain territories of Ukraine as zones of ecological emergency situation with the subsequent confirmation of such decisions by the Verkhovna Rada of Ukraine;

Water Code of Ukraine (06.06. 1995) No. 213/95-BP (Last edition from 02-07-2013).

Water Code together with the organizational, legal, economic and educational measures will contribute to creation of water-ecological law enforcement and securing of ecological safety of Ukrainian population as well as more efficient, scientifically substantiated use of water and its protection against contamination, littering and depletion.

Law of Ukraine About legal regime of emergency state, 16.03.2000, № 1550-III with amendments 16.05 2013 (Last edition from 16-05-2013)

This Law determines content of legal regime of emergency state, the procedure for its introduction and cancellation, feature of activities of public authorities and local government bodies, the companies, organizations and the organizations in the conditions of emergency state, observance of rights and freedoms of man and citizen, and also the rights and legitimate interests of legal entities and responsibility for violation of requirements or failure to carry out of measures of legal regime of emergency state

Code of Civil Protection of Ukraine, 02.10. 2012 of No. 5403-VI

(In edition of the Laws of Ukraine from 5/14/2013 of No. 224-VII, 6/20/2013 of No. 353-VII) The code of civil protection of Ukraine regulates the relations connected with protection of the population, the territories, surrounding environment and property from emergency situations, response to them, functioning of single state system of civil protection, and determines powers of public authorities, Council of Ministers of the Autonomous Republic of Crimea, local government bodies, the rights and obligations of citizens of Ukraine, foreigners and stateless persons, the companies, organizations and the organizations irrespective of pattern of ownership;

It should be noted that after the Code has entered into force such regulations as the Law on Civil Protection, the Law on Fire Safety, Law on the structure and the number of troops Defense, the Law on Defense Forces of Ukraine, the Law on the emergency and rescue services, the Law on the Protection of from emergency situations, the Law on civil Protection became unvalid

Law of Ukraine «On the protection of population and territory against natural and technogenic emergency situations», №1809-III from 08.06. 2000;

Law of Ukraine On Approval of the State Program of Water and Environmental Rehabilitation of the Dnipro River Basin until 2021, 2013, № 17, 146). The program aims inter alia to provide protection of territories against harmful effects of water, development of automated information-measuring system of observation and prediction of harmful effects of water; minimize the potential damage caused by harmful effects of waters.

Resolutions of Cabinet of Ministers of Ukraine

on the use of land in areas of possible submergence as a result of floods, Resolution of the Cabinet of Ministers of Ukraine (31. 01, 2001) № 87 (with amendments according Cabinet of Ministers of Ukraine Resolution N 214 (214-2012) 15.02.2012. Regulates economic activities in areas of possible floods to minimize risks;

on a single state system of prevention and response to emergency situations of technogenic and natural character. Resolution of the Cabinet of Ministers of Ukraine, 03. 08.1998 N 1198 with amendments 08.12.2006;

on approval of emergency classification according its levels, Resolution of the Cabinet of Ministers of Ukraine, 24.03.2004 № 368 with amendments 11.06.2013;

on approval of the State water monitoring, Resolution of the Cabinet of Ministers of Ukraine, 20. 07.1997 N 815 with amendments N 748 (748-2013) of 07.08.2013;

on approval of statement of warning system in emergency;

on overall program of flood prevention measures for 1994-2000;

on program of flood prevention measures in the Tran Carpathian region for 1999-2000;

on program of complex flood protection in the Tisza river basin in Zakarpatskya oblast for 2002-2006 and forecast to 2015".

4.6.3 Implemented flood hazard prevention studies

History of Ukrainian Hydrometeorological Institute (UHMI) traces back to the 1855 when the first Meteorological Observatory in Kiev has been opened.

The main tasks Ukrainian Hydrometeorological Institute (which has gained its independent status in 1953) are the following: development of the geophysical science by carrying out fundamental and applied research in the field of hydrometeorology and basic monitoring of natural environment, provision of scientific and methodical support to hydrometeorological and other operative services of the Ministry of

Emergency Situations in Ukraine, co-ordination of scientific research in the field of hydrometeorology in Ukraine.

In April 2008 the Danube River Basin Management Department was founded by the Decree of the State Committee of Ukraine for Water Management to create an institutional background for the implementation of the national policy in introducing a river basin management approach in the Ukrainian part of the Danube Region. The DRBMD is created on the basis of the Danube Flood Protection Department.

The Danube Flood Protection Department was founded in 1966 in Izmail. In 2006 the Centre for Analysis of Flood Situation in the Danube Area, Flood Warning and Information has been created on the Department's basis as an output from the project "Emergency Planning and Flood Protection in the Lower Danube EuroRegion" funded by the European Commission.

The Department is also directly responsible for developing cross-border cooperation in the field of water management and flood protection with Romania.

The Danube hydrometeorological observatory (DHMO) that is a part of the State Hydromet Service of Ukraine is the main authority in charge of the hydrometeorological monitoring in the Danube region of Ukraine. It is a state-funded organization managed by the Ministry of Emergencies.

From 1961 till 2013 the Danube Hydrometeorological Observatory has provided the following studies:

Water temperature (daily) in Ukrainian part of the Danube. Gauging station - Reni - Izmail - Kiliya - Vylkovo; Sediments discharge (daily) in Ukrainian part of the Danube. Gauging station - Reni - Vylkovo); Water level (monthly) in Ukrainian part of the Danube. Gauging station - Reni; Water level (max monthly) in Ukrainian part of the Danube. Gauging station – Reni; Water level (min monthly) in Ukrainian part of the Danube. Gauging station - Reni; Water discharge (min monthly) in Ukrainian part of the Danube. Gauging station - Reni; Water discharge (max monthly) in Ukrainian part of the Danube. Gauging station - Reni; Water discharge (min monthly) in Ukrainian part of the Danube. Gauging station – Reni.

Methods and models of flood forecasting

Currently peak forecasting and continuous forecasting methods are used. Peak forecasts (only the peak water stage and/or discharge values are forecasted, together with the expected time of the peak. Stochastic and graphic methods, based on water stages, are used. There is no information about the flood hydrograph in the peak forecast);

Continuous forecasts (certain parameters of the total flood hydrograph (mainly water stage and/or discharge) are forecasted in discrete time intervals. The time interval is usually determined by the measurement interval of available hydrometeorological data).

Because of the fast accumulation processes rainfall-runoff models are used for middle and lower sections of rivers. The methods used are based on the method of water balance and the actual calculation algorithm varies depending on the nature of the runoff (snow melting, rain, or the two combined). The presently used models were elaborated mainly by the Ukrainian Hydrometeorological Research Institute located in Kyiv.

Levels of flood alerts system

The alert system consists of Level I, II and III disaster control.

Level I – water level in rivers and canals reaching bank levels;

Level II – at river overflow of booms, partial inundation of arable lands;

Level III – river level is as close to the crest mark of flood protection dike as 70 cm.

National standards and guidelines related to structural flood management

Determination of design flood is standardized in a standard issued in 1982, regulating the loads and influences on hydro technical structures. The calculated maximum discharge of the 1% probability Q1% is used as the design flood discharge. Calculation is made using Q1% = f (A, q) type concentrated parameter function. Recalculation of runoff coefficient and separation of methods to be used in different tributary catchment with different extension was made. A design flood level is determined using rating curves along rivers.

Today passive flood protection with dams constructed in different years and for different water levels in the rivers (different probability level), cannot always guarantee protective functions even after its further reconstruction. It is impossible to solve the problem of flood protection only by using engineering facilities. Costs for eliminating harmful effects of floods increase greatly, if natural factors are not considered, if money is spared on preventive actions providing the ecosystem sustainability. There is a need for introducing comprehensive system of risk management and coordination in emergencies and flood warning on a transboundary level.

4.7 SYNTHESIS ON LEGISLATION FRAMEWORK

There are a number of laws in partner countries that cover floods management including various aspects of the flood hazards. There is also need to develop legal base that will regulate additional flood risk management activities and adopt laws which will better regulate floods risks assessment.

The laws should first of all determine roles and responsibilities of different stakeholders and facilitate allocation of resources for training, introduction of new technologies, establishment of research centers and continuous development of warning system.

5 SEISMIC HAZARD PREVENTION AND MANAGEMENT (ACTIVITY A1.3)

5.1 TURKEY

5.1.1 Past Events and Their Consequences

Major past events are numerous. The consequences in terms of casualties of recent major events in Turkey are given in Table 5.1.

Table 5.1 Earthquake consequences in Turkey

Location	Province	Year	Dead	Injury
Erzincan	Erzincan	26.12.1939	32,968	
Erbaa (Tokat)	Tokat	20.12.1942	3,000	
Ladik		26.11.1943	4,000	
Gerede	Bolu	01.02.1944	3,959	
Varto/ Muş	Muş	19.08.1966	2,396	1,500
Gediz	Kütahya	28.03.1970	1,086	
Lice		06.09.1975	2,385	
Muradiye/Van	Van	24.11.1976	3,840	
Denizli	Denizli	19.08.1976	4	28
Biga /Çanakkale	Çanakkale	05.07.1983	3	
Erzurum/Kars		30.10.1983	1,155	1,142
Sürgü/ Malatya		05.05.1986	8	24
Sürgü/ Malatya		06.06.1936	1	20
Erzincan	Erzincan	13.03.1992	653	3,850
Dinar/Afyon	Afyon	01.10.1995	94	240
Çorum /Amasya	Amasya	14.08.1996		6
Gölcük / Kocaeli	Kocaeli	17.08.1999	17,408	
Düzce /Bolu	Bolu	12.11.1999	845	4,948
Bolvadin /Afyon	Afyon	15.12.2000	6	82
Sultandağı /Afyon	Afyon	03.02.2002	42	325
Pülümür / Tunceli	Tunceli	27.01.2003	1	
Bingöl	Tunceli	01.05.2003	184	515
Aşkale /Erzurum		25.03.2004	10	
Merkez / Hakkari	Hakkari	25.01.2005	3	
Van / Erciş	Van	23.10.2011	604	4,152

5.1.2 Existing legislation framework

The need for an earthquake code and earthquake hazard macro-zonation map for Turkey has become clear after the 1939 Erzincan earthquake. Activities related to the establishment of a legislative framework for seismic hazard prevention and management in Turkey can be summarized with the following steps and legislative acts:

- In 1940, the first earthquake resistant building design code was issued. The first official earthquake hazard zonation map was prepared in 1945 and published, with some revisions, together with the second earthquake code in 1947 (Fig 48). The zoning map based essentially on an incomplete interpretation of historical seismicity, has identified three zones: zones which have experienced destructive earthquakes, zones which may possibly experience destructive earthquakes and the safe zones.

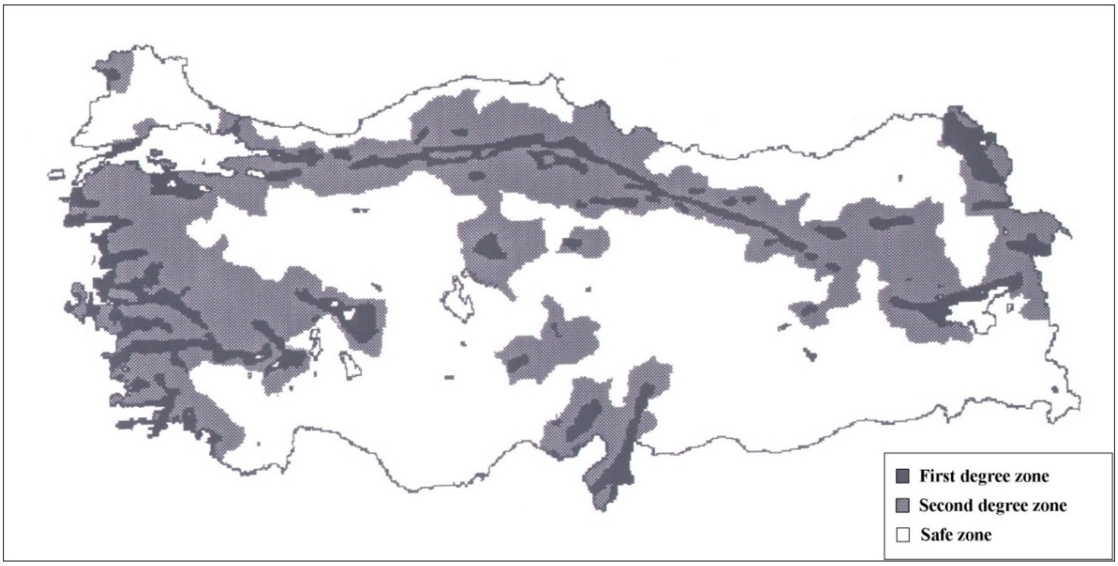


Fig 48. Seismic zoning map of Turkey, issued in 1947.

- In 1963 a second official earthquake zoning map was issued, presumably prepared on new earthquake catalogues and seismotectonic maps (Fig 49). This map divided Turkey into four hazard zones with maximum intensities (MSK) greater than VIII (1st Zone), equal to VII (2nd zone), equal to VI (3rd Zone) and less than V (No Hazard Zone).

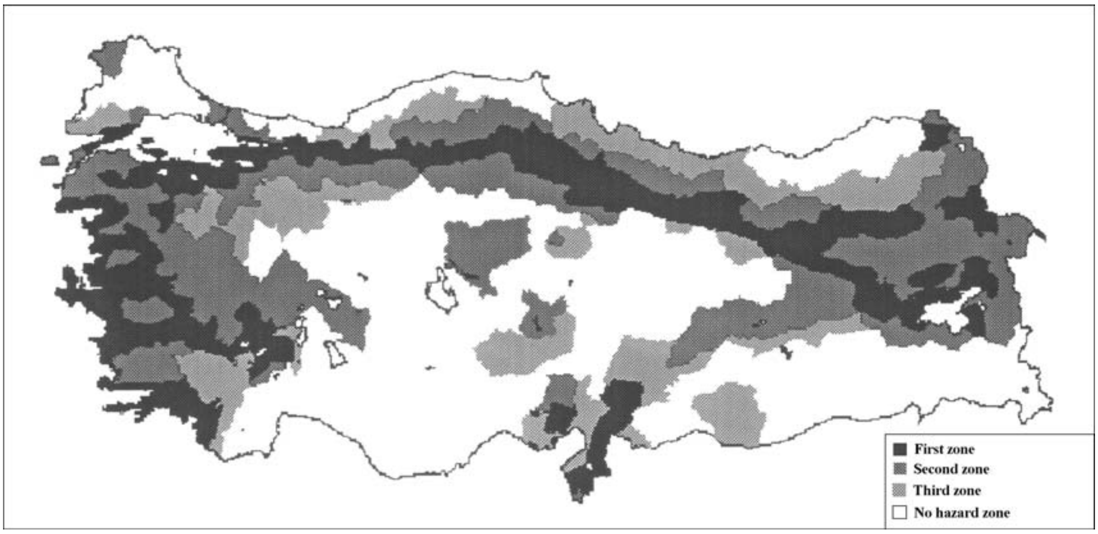


Fig 49. Seismic zoning map of Turkey, issued in 1963.

• Several developments, such as: the presence of discontinuities in zones, occurrence of destructive earthquakes in "No Hazard" Zones and unconformities with the resolutions arrived at the 1968 Strasbourg meeting of the European Seismological Commission, have prompted the preparation of the third issue of the zoning map in 1972 (Fig 50). The map was used in connection with the 1975 Earthquake Resistant Design Code. This map delineates five zones of earthquake hazard. In the 1st degree hazard zone the maximum intensity (MSK) is higher than or equal to IX, in the 2nd equal to VIII, in the 3rd equal to VII, in the 4th equal to VI, and in the 5th no hazard zone equal to V.

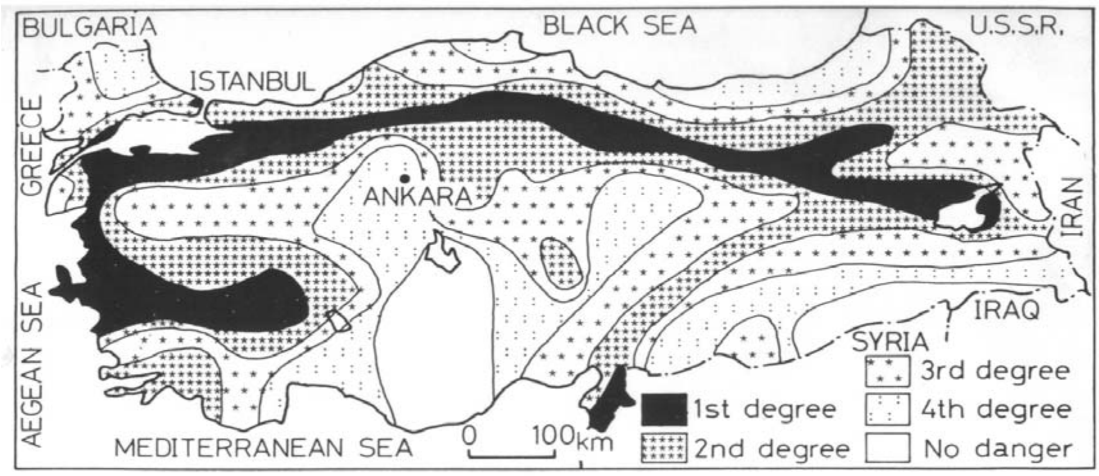


Fig 50. Seismic zoning map of Turkey, issued in 1972.

- In the following years two approaches have been adopted considering that these deterministic macro-zonation maps ignore the role that the earthquake occurrence rates have on the hazard:
  - In the first approach, Alsan (1972), Gencoglu and Tabban (1973), Üçer et al. (1977), Bath (1979), Hattori (1979) and Burton et al. (1984) addressed the problem of assessment of the seismic hazard in Turkey through the statistical manipulation of the past instrumental earthquake data with no consideration of the neo-tectonic regime.
  - In the second approach a more rational methodology that considers the seismicity models and the active tectonic entities were adopted. After a limited assessment by Algermissen et al. (1974), within the context of the UNESCO project entitled "Survey of the Seismicity of the Balkan Region", more comprehensive studies on the subject matter have been conducted by Yarar et al. (1980), Erdik and Öner (1982), Erdik et al. (1982, 1985), Gülkan and Erdik (1986, a repetition of Erdik et al., 1985), and Gülkan et al. (1993). These studies have culminated in probabilistic earthquake hazard assessment maps for Turkey in terms of peak ground acceleration and peak intensities corresponding to various return periods.

- The seismic source regionalization and the resulting peak intensity and peak ground acceleration contour maps for a 475 years return period assessed by Erdik et al. (1985) and Gülkan and Erdik (1986) are given in Fig 51.

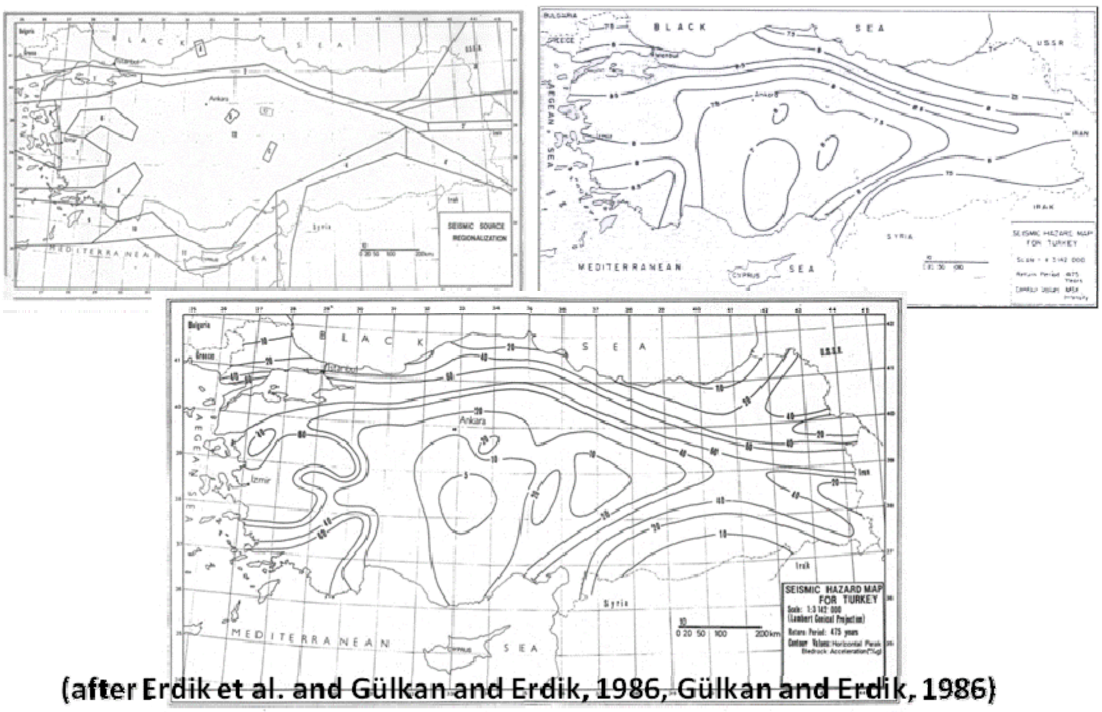


Fig 51. PSHA models developed by Erdik et al. (1985) and Gülkan and Erdik (1986)

• The study of Gülkan et al. (1993) has constituted the basis of the 1996 issue of the Turkish Official Earthquake Hazard Zonation Map, which portrays in sub-province resolution the earthquake hazard zones in Turkey required for code based earthquake resistant design of building type structures in Turkey (Fig 52). In this hazard zonation map essentially all the regions (with exception in East Anatolian Fault) with PGA ≥0.4g were assigned Zone I and regions with PGA ≤ 0.1g were assigned as Zone V. These rounding off features and sub-province level resolution does not allow for its use in risk assessment purposes.

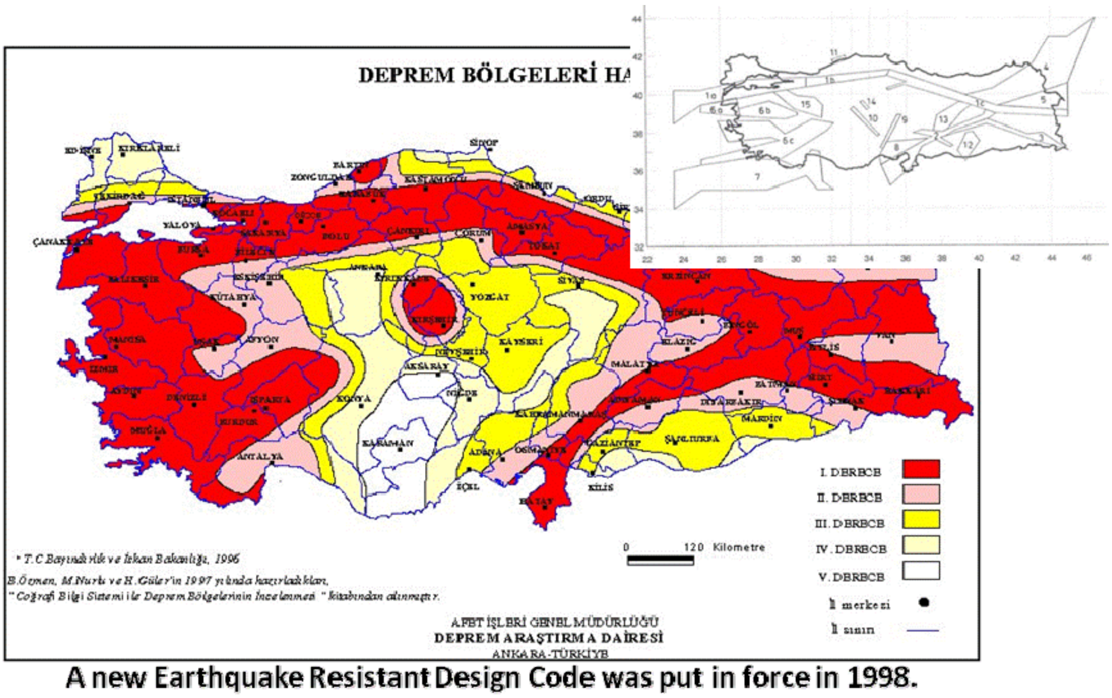


Fig 52. Seismic zoning map of Turkey, issued in 1998.

• NEW LEGISLATION ON URBAN TRANSFORMATION FOR REGIONS PRONE TO ENVIRONMENTAL DISASTERS (2012)

5.1.3 Implemented seismic hazard prevention studies

The following seismic hazard prevention studies have been implemeted in Turkey.

Istanbul Earthquake Master Plan

Retrofitting / Reconstruction of Schools, Hospitals and Highway Bridges in Istanbul (ISMEP Project) – funded by World Bank Credit.

City and District Based Prioritization of Public Buildings In Turkey for Earthquake Retrofitting

The following seismic hazard prevention studies are ongoing in Turkey.

New legislation on urban transformation for regions prone to environmental disasters. Three pilot cities have been selected for study.

5.2 GREECE

5.2.1 Existing legislation framework

1. Decision of Minister of Environment, Planning and Public Works, No.Δ17α/08/32/ΦΝ275, ΦΕΚ No. 613/ 12-10-1992

Articles 1 & 2 and Chapters 1-5. New Greek seismic code

Reference: EPPO (www.oasp.gr)

2. Decision of Minister of Environment, Planning and Public Works, No.Δ17α/115/9/ΦΝ275, ΦΕΚ No. 1154/ 12-8-2003

Articles 1 & 2: Modifications and update of the Greek Seismic Code (Seismic Actions , Seismic Zonation)

Reference: EPPO (www.oasp.gr)

3. Eurocode 8: Design of structures for earthquake resistance –Part 1: General rules, seismic actions and rules for buildings

This European standard EN1998-1, Eurocode 8: Design of structures for earthquake resistance: General rules, seismic actions and rules for buildings has been prepared by Technical Committee CEN/TC 250 "Structures Eurocodes" the secretariat of which is held by BSI. CENT/TC 250 is responsible for all Structural Eurocodes.

Reference: EPPO (www.oasp.gr) EC8_Seismic_Code.pdf

4. 1984: Seismic Code (AK 1984) 1995: New Greek Seismic Code (NEAK 1995)

Since 1954 and up to date, many Greek Seismic and R/C codes have been established offering the best possible protection against earthquakes for stock building in Greece, considering that Greece is one of the most vulnerable countries in Europe due to is high seismicity

5. 1992: New Greek Reinforce Concrete Code (NEKOS 1992)

General contents, Reinforce concrete data, Steel data, Duration Resistance and Geometrical data, Calculation General principals, Linear Elements, Boundary conditions, Reinforcement Rules, Material Selection, Work Performance, Qualification Control etc. and Appendices.

Reference: See Appendix (www.oasp.gr) EKOS2000.pdf

6. 2000: New Greek Seismic Code (NEAK 2000), 2003: New Greek Seismic Modification and update of the Greek Seismic Code Code (EAK 2003), with Bridge Codes etc.

Modification and update of the Greek Seismic Code

Reference: SeismicActions_Greece_6-11-2013.pdf 21_Greece_Overall.pdf

5.3 BULGARIA

5.3.1 Introduction

The first written records of earthquakes in the country belong to the 1st century BC but an organized and systematic study of earthquakes was set in 1891.

In 2002 a concept for a new seismic zoning map as a basis for introducing European seismic codes (Eurocode 8). This work was completed in 2009 with the development of the new maps. Previously, all the elements of the National Seismological Network were modernized by advanced electronic systems for reroute monitoring and activity registration.

5.3.2 Existing legislation framework

Crisis Management Act issued in 17.02.2005 by the Bulgarian National Assembly. This law regulates the social relations associated with the prevention, control and overcome the effects of crises.

Concept of protection from natural disasters and emergencies (approved by the Council of Ministers of 12.01.2006 Important point in the concept is cooperation with the countries of Southeast Europe and the Black Sea region and strengthen bilateral international cooperation)

Protection form Disasters and Accidents Act”. It was promulgated in volume 102/19.12.2006 of **Държавен Вестник** *[Darzhaven Vestnik (State Gazette) - the official issue of Bulgarian National Assembly]*. The last amendment of the law was made in 14.10.2011. **“**

Rules for the Organization and Activities of the Interdepartmental Commission on Recovery and Support of the Council of Ministers promulgated in volume 40/18.05.2007 of the State Gazette

ORDINANCE № RD-02-20-2 FOR THE DESIGN OF BUILDINGS AND STRUCTURES IN SEISMIC AREAS promulgated in State Gazette issue 13 14.02.2012

National Plan for Disaster Protection – 2010 and ***National Program for Disaster Protection 2009-2013.***

These two documents contain a detailed description and classification of hazardous areas in Bulgaria. The map of seismic hazardous areas and areas at risk of flooding and landslides are created as s result of detailed analysis and statistics of the observed natural disasters in the past. The specific actions for prevention, mitigation and crisis management are described in details

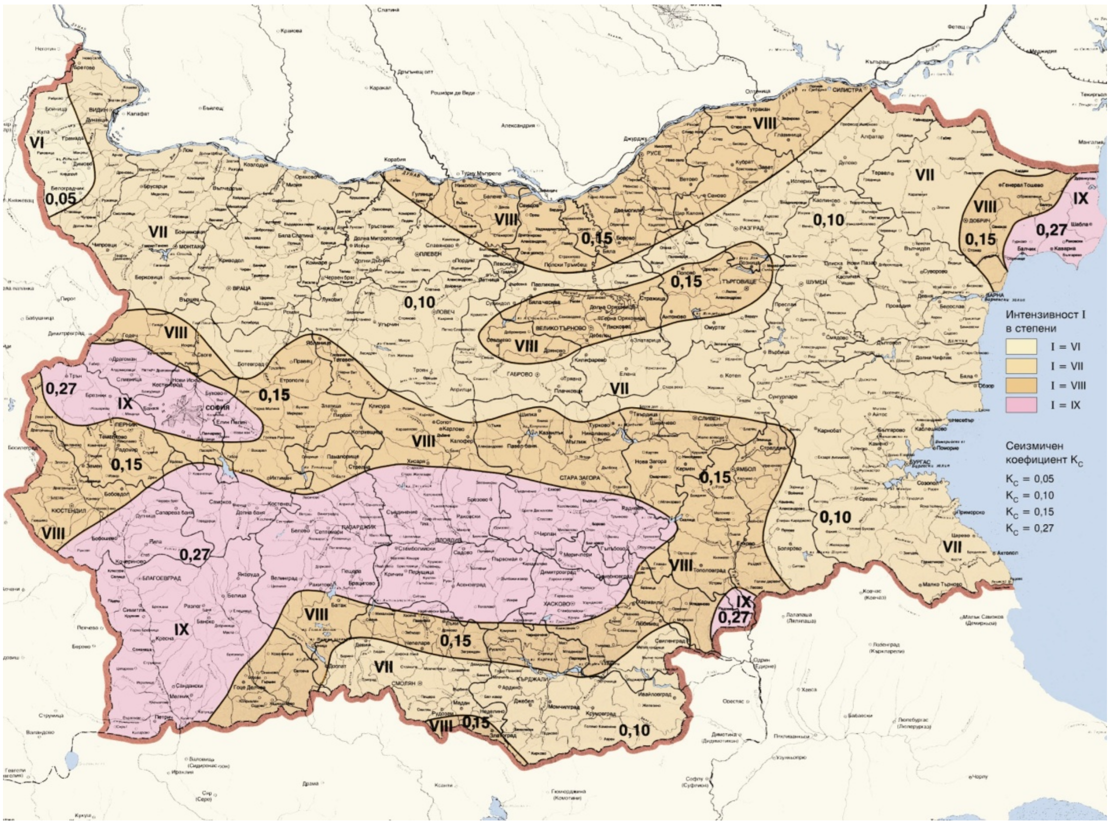


Fig 53. Map of seismic zoning of Bulgaria for a period of 1000 years according to the "Ordinance № Rd-02-20-2 for the Design of Buildings and Structures in Seismic Areas"

5.4 ROMANIA

5.4.1 Existing legislation framework

Regulatory Documents which standardizes the activity in the domain of Earth Physics

- DECREE regarding the organization of the research activity in Earth Physics domain (GD 48 from 12th of February 1994)
- DECREE regarding foundation of the National Institute of Research and Development for Earth Physics - NIRDEP Bucharest (GD 1313/1996, GD 702/2001)
- DECREE regarding the approval of the organizing and functioning Regulations of the National Institute of Research and Development for Earth Physics - NIRDEP Bucharest (GD 1947 from 10th of November 2004)
- LAW for the ratification of the Agreement between Romanian Government and The Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization regarding the course of activities relative to international monitoring facilities in applying the Comprehensive Nuclear-Test-Ban Treaty, including the activities subsequent to certification, signed in Vienna at 13th of June 2003 (Law 327 from 24th of September 2004)

• ORDER regarding communication of the main characteristics of earthquakes generated on Romania's territory (Ministry of Administration and Interior number 708 from 20th of June 2005, Ministry of Transportations, Constructions and Tourism, number 923 from 9th of June 2005)

• DECREE for the approval of the National Program of Seismic Risk Management (GD 372 from 31st of March 2004).

5.4.2 Implemented seismic hazard prevention studies

The seismicity of Romania is clustered in several epicentral zones: Vrancea, Fagaras-Campulung, Banat, Crisana, Maramures and Dobrogea de sud. Other epicentral zones of local importance can be found in Transylvania, in the area of Jibou and Tarnava river, in northern and western part of Oltenia, in northern Moldova and in the Romanian Plain.

The Vrancea seismogenic zone is the most important among these seismic zones, having in mind the energy, the extent of the macroseismic effects and the persistent and confined character of the earthquakes that occur in this area. Two belts of moderate and shallower seismicity are emphasized in the other regions of the country, one along the Southern Carpathians and the eastern edge of the Pannonian Depression, the other along the Eastern Carpathians that extends towards SE on the Peceneaga-Camena line. Intracrustal earthquakes (depth of the foci between 5 and 30 km) of low energy and intensity, sometimes polikinetic (followed by a large number of aftershocks) occur within these regions, on faults or at the crossing of the fractures such as: the faults that separate the Fagaras Mountains from the Transylvanian Basin and Lovistea Basin (Fagaras earthquakes), the fractures between the Southern Carpathians and the Pannonian Depression that are active in Timisoara area (Banat earthquakes - Banloc (Mw = 5.6) and Voiteg (Mw = 5.5)), the system of faults within Oradea region and the Sfantul Gheorghe fault that bounds to the North the Dobrogea region.

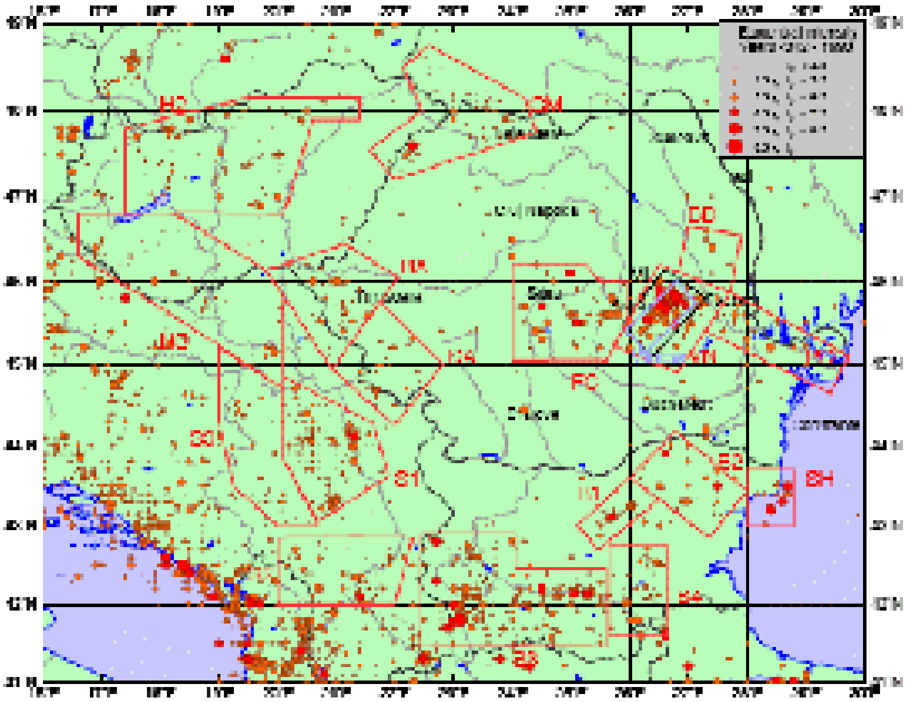
5.4.2.1 Definition of the Romanian seismogenic zones

Seismogenic zones represent areas with grouped seismicity where the seismic activity and the orientation of the stress field are considered relatively uniform. Identifying the long term characteristics of the earthquake generation process within each seismogenic zone is very important for seismic hazard assessment. This implies the existence of a dataset that needs to cover the time scale of the tectonic process.

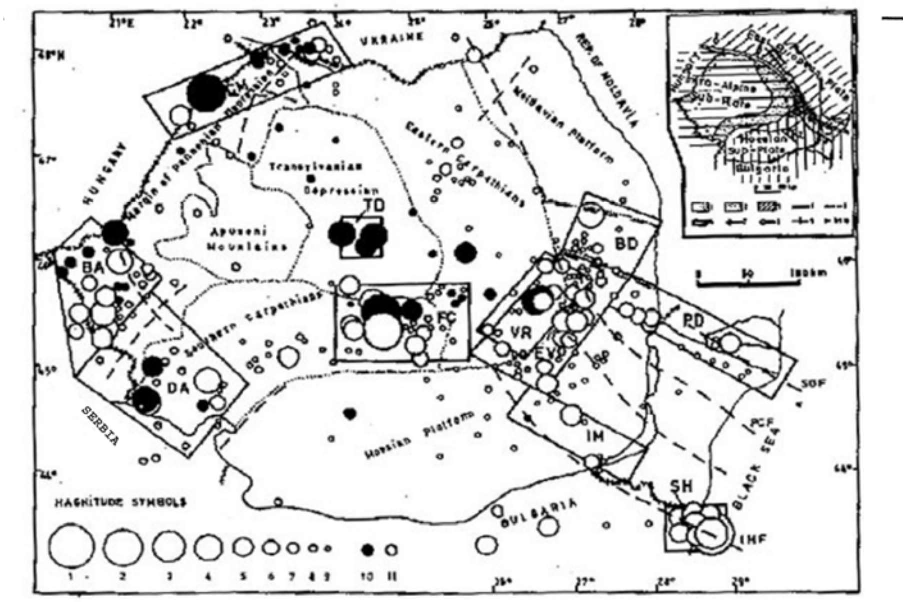
The distribution scheme of the Romanian territory in seismogenic zones (Radu et al. 1980; Constantinescu şi Marza, 1980) follows the geographic distribution of the seismic activity (Fig 54(a)). Within these geographic regions, Radulian et al. (2000) proposed the definition of the seismogenic zones into narrower areas that take into account the geologic and seismotectonic characteristics of the Romanian tectonic units (Fig 54 (b)).

Ardeleanu et al. (2005), in their study for seismic hazard assessment of Romania, adapted the zones defined by Radulian et al. (2000) (Fig 54 (c)).

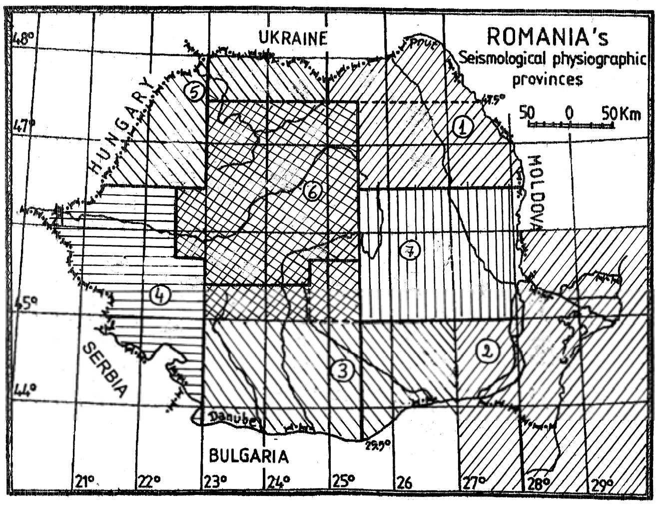
The seismogenic zones defined in the two publications mentioned above differ only by the way of their definition and not by their characteristics (for more details see the references). As a result, the characteristics of the seismic zones that are to be presented in the following section are the same for both interpretations.



(a)



(b)



(c)

Fig 54. Shows the distribution of epicenters of earthquakes in Romania.

In the Figures, the Shabla seismogenic zone located in North-Eastern Bulgaria, close to the boarder with Romania is also included. In the East, the earthquakes are related to the subduction process at the Carpathian Arc Bend (Vrancea region); in the West, they follow the contact zone between the Pannonian Depression and the Carpathian orogen. The Eastern segment of the Romanian Carpathians is practically aseismic, except the Southern outermost part (Vrancea region). The Western segment is also aseismic. The Southern Carpathians have a more intense seismic activity, especially in the East (Fagaras-Campulung zone) and West (Danubian zone). The platform regions are stable, except one belt that crosses the Carpathian foreland on a NW-SE direction, in front of the Vrancea region. Several active faults that follow the same orientation are identified within this region, namely NW-SE (Intramoesian Fault, Peceneaga-Camena Fault, Sfantul Gheorghe Fault and Trotua Fault). They represent the contact between different tectonic units where a relative increase of the seismicity is reported. At present, the Transylvanian Depression is almost aseismic. However, a small seismogenic zone was defined only on the basis of historical earthquakes.

5.4.2.2 Characterization of the Romanian seismogenic zones

Vrancea subcrustal zone (VR)

The Vrancea region is a complex continental convergent seismic region characterized by at least three tectonic units in contact (insertion in Fig 54): East-European plate, Intra-Alpine and Moesic sub-plates (Constantinescu et al., 1976). The strongest seismic activity concentrates at intermediate depths (60 – 200 km), within an almost vertical old subducted slab. The occurrence of one to six events with magnitude Mw > 7.0 per century within a narrow focal volume implies a high level of active deformation (~3.5 x 10-7year-1) that is not clearly observed in the deformation of the crust.

Local shallow earthquakes occur at the outer part of the Vrancea intermediate-depth seismic region within a few regions, some of them associated with deep fractures (>15 km) (e.g. Focsani-Odobesti zone), some with superficial focus in Marasesti-Namoloasa, T. Vladimirescu, Cudalbi and Tecuci in Moldova, or on the Galati-Isaccea-Tulcea line in Northern Dobrogea. The intensities associated with the earthquakes within these regions are III-IV, even V for Cudalbi region, while the isoseists are oriented NW-SE (Polonic, 1986). The orientation of the isoseists suggests a link with the reactivated hercinic fractures of the basement that prolonged the geologic structures of Dobrogea. The fact that some of these regions (e.g., Focsani-Odobesti and Tecuci) show increased seismic sensitivity to the Vrancea intermediate-depth earthquakes, suggests that the faults of the basement of the outer Carpathians bend are not welded yet. The increased seismicity shortly after the 4th of March, 1977 earthquake on the Intra-Moesian Tinosu-Calarasi fault is supporting the same model.

Important earthquakes occurred in the region:

- 29 .08.1471, h = 110 km, Mw = 7.5, I = 9
- 24.11.1516, h = 150 km, Mw = 7.5, I = 9
- 30.04.1590, h = 100 km, Mw = 7.3, I = 8.5
- 09.08.1679, h = 110 km, Mw = 7.5, I = 9
- 11.06.1738, h = 130 km, Mw = 7.7, I = 9.5
- 05.04.1740, h = 150 km, Mw = 7.3, I = 8.5
- 06.04.1790, h = 150 km, Mw = 7.1, I = 8
- 26.10.1802, h = 150 km, Mw = 7.9, I = 10
- 26.11.1829, h = 150 km, Mw = 7.3, I = 8.5
- 23.01.1838, h = 150 km, Mw = 7.5, I = 9
- 17.08.1893, h = 100 km, Mw = 7.1, I = 8
- 31.08.1894, h = 130 km, Mw = 7.1, I = 8
- 06.10.1908, h = 125 km, Mw = 7.1, I = 8
- 10.11.1940, h = 150 km, Mw = 7.7, I = 9.5
- 07.09.1945, h = 80 km, Mw = 6.8, I = 7.5
- 04.03.1977, h = 94 km, Mw = 7.4, I = 9
- 30.08.1986, h = 131 km, Mw = 7.1, I = 8.5
- 31.05.1990, h = 86.9 km, Mw = 6.4
- 27.10.2004, h = 98.6 km, Mw = 6.0

East Vrancea Zone (EV)

The superficial seismicity associated with the subduction process in Vrancea propagates diffusely towards East relative to the Carpathian Arch, within a stripe marked by Peceneaga-Camena fault to the North and Intra-Moesian fault to the South (so called the sub-plate of the Black Sea). Seismicity consists of moderate earthquakes with magnitudes not larger than 5.6, and seems to be decoupled of the seismic activity in the subducted lithosphere. This seismicity shows time (main shocks of the sequences are associated with aftershocks and often pre-shocks or earthquake swarms) and space clustering. Seismic sequences are common for the eastern part of the zone (Ramnicu Sarat region), and swarms predominate in the northern part of the zone (Vrancioaia region).

The seismic activity in the Ramnicu Sarat subzone is characterized by crustal moderate earthquakes with magnitudes less than 5.2 (Radu, 1979), that often occur grouped in space and time, as sequences. The hypocenters are generally located at depths between 15 and 30 km within the foredeep of the Carpathians Arch Bend. In this region the sedimentary layers reach the largest thickness (> 10 km) of the whole Carpathian Arch system.

The focal mechanisms of the events occurred in the Ramnicu Sarat zone are of two types. In the first case, the mechanisms indicate a predominant component of strike-slip faulting type, with the pressure axis orientated NW-SE. These mechanisms fit well with the general tendency of the stress field in Vrancea region: compression caused by the movement of the Black Sea sub-plate from SE towards NW (Constantinescu şi Enescu, 1984). The second type of mechanism is reverse faulting, suggesting the presence of a relative complex stress field in the region.

Barlad Depression (DB)

Barlad Depression is a subsiding depression situated to the NE of the Vrancea region, on the Scythian platform, and it represents the prolongation towards the NW of the Predobrogean Depression. Only moderate-size events are observed (four shocks with Mw>5.0, but not exceeding Mw=5.6). All available fault plane solutions indicate a predominant horizontal extensional regime, with an important normal component. Although the available fault plane solutions belong to small earthquakes (3.0 ≤Mw≤3.6), their consistency seems to reflect the existence of a characteristic regional stress field. The normal faulting is probably related to the step-like faulting outlined in the Barlad Depression (Mutihac and Ionesi, 1974).

Important earthquakes occurred in the region:

- ____ 1800, Mw = 4.5, h = 10 km, I = 6
- 02.11.1871, Mw = 5.3, h = 10 km, I = 6
- 31.01.1900, Mw = 5.5, h = 10 km, I = 6.5

Predobrogean Depression (DP)

This seismogenic zone belongs to the southern edge of the Predobrogean Depression marked by the Sfantul Gheorghe fault. The seismicity and focal mechanisms are similar with those mentioned for Barlad Depression: the moderate seismic activity (MW ~5.3), grouped mainly along the Sfantul Gheorghe fault, and the extensional regime of the deformation field. This reflects the fact that the two seismogenic zones belong to the same tectonic unit (Scitian platform) and, from this point of view, they could form a single seismogenic zone.

Important earthquakes occurred in the region:

- 11.09.1980, Mw = 4.2, h = 20 km, I = 5 (Galati-Braila area)
- 13.11.1981, Mw = 5.1, h = 4 km (nearby Tulcea city)

- 03.11.2004, Mw = 5.1, IM = 4 (NE of Tulcea city)
- 07.05.2008, Mw = 5 - 5.2, h = 5 km (NW of Black Sea)

Intramoesian Fault (FI)

The Intramoesian Fault crosses the Moesian platform on SE-NW direction, delimiting two sectors with different composition and basement. Although it is a deep and well defined fault, reaching the base of the lithosphere (Enescu, 1992) and extending southeastwards to the Anatolian fault region (Sandulescu, 1984), the seismic activity is scattered and weak, with only two events with magnitude greater than 5. A significant increase is observed in Shabla region (SH), Bulgaria, where in 1901 an earthquake with magnitude Mw = 7.1 occurred. The focal depth has a relative high value (h ~ 35 km), suggesting an active process in lower or upper crust.

It is difficult to draw any conclusion regarding the characteristic model of the stress field in this region only on the basis of the four available fault plane solutions, even if they are compatible with the extensional regime outlined in the whole Carpathian foredeep (with the exception of the Vrancea crustal region). One single event (MW=3.2) has a large slip component on left lateral direction with a nodal plan oriented N30oW, parallel with the Intramoesian fault.

Important earthquakes occurred in the region:

- 04.01.1960, Mw = 5.4, h = 40 km, Imax = 5.5
- 27.02.1967, Mw = 5.0, h = 42 km, I = 5

Fagaras - Campulung Zone (FC)

The Fagaras-Campulung zone is located at the contact between Moesian Platform and the Southern Carpathian orogen. It is characterized by strong shocks with magnitudes Mw up to 6.5. These are the strongest crustal earthquakes that occur on Romania's territory. The last major event occurred on 26th of January 1916 (MW=6.4) and was followed by a significant activity of aftershocks.

The earthquakes from Fagaras Mountains and Lovistea Depression occur in South, along a NW alignment (that corresponds to deep fractures oriented on inherited hercinic directions, argument for a weak Alpine regeneration of the Fagaras Mountains), or NE (directions of Alpine origin) and towards Transylvania, along several step faults that divide the Carpathian orogen and the depression zone. These earthquakes are characterized by intensities up to VII and have typical polikinetic character, over long time intervals, but with moderate energy. Thus, the major event of 1916 that exceeded intensity VII-VIII on a very limited area had produced repeated aftershocks (named by Atanasiu (1961) late aftershocks) during four months of which epicenters migrated from NW to SE. This behavior could be explained through a successive rearrange of several small intracrustal blocks. Note also that the Carpathian Arch Bend operated like a screen for the seismic waves generated by the 1916 Fagaras earthquake.

Important earthquakes occurred in the region:

- 26.10.1550, Mw = 6.5, h = 10 km, I = 9
- 10.08.1590, Mw = 6.5, h = 10 km, I = 8.5
- 07.12.1746, Mw = 5.9, h = 10 km, I = 8
- 08.12.1793, Mw = 6.2, h = 10 km, I = 7
- 19.02.1832, Mw = 5.6, h = 10 km, I = 8
- 26 .01.1916, Mw =5.2, h = 10 km, I = 8
- 18.04.1919, Mw =4.1, h = 10 km

Danubian Zone (DA)

The seismogenic zone named after Atanasiu (1961) „Danubian Zone” represents the western extremity, adjacent to river Danube, of the orogenic unit of the Southern Carpathians. The rate of seismic activity is relatively high, especially close and across the boarder with Serbia. The magnitude of the earthquakes is smaller than 5.6 (Oncescu et al., 1988; Radulian et al., 1996).

Fault plane solutions are available for three earthquakes (including the largest known one MW 5.6, of 18 July 1991) indicating a process of normal faulting with T axis oriented approximately N-S, in agreement with the extensional stress regime in the Southern Carpathians (Oncescu et al., 1988; Radulian et al., 1996). However, for a firm conclusion, there are necessary more fault plane solutions for the Danubian zone.

Important earthquakes occurred in the region:

- 18 .01.1991, Mw = 5.6, h = 12 km, I = 8

Banat (BA) and Crisana - Maramures (CM) zones

The contact between the Pannonian Depression and the Carpathian Orogen extends along the western part of the Romanian border. Although no tectonic and major geostructural differences are observed, two relatively distinct seismic areas can be defined on the basis of the seismicity distribution: Banat zone at South, and Crisana-Maramures at North. Seismicity of Banat zone is characterized by several earthquakes with magnitudes greater than 5, but less than 5.6. Historical information suggests for Crisana-Maramures area possible earthquakes with magnitudes greater than 6, but in the last century only one earthquake with magnitude closer to 5 was reported.

Banat earthquakes have polikinetic character, with a large number of aftershocks in case of larger events. Thus, we can mention: the earthquakes occurred between October 1879 and April 1880 in Moldova Noua area; the earthquake occurred at a depth of 5 km near Timisoara city, on 27th of May 1959, Mw = 5.6, followed by two shocks occurred in 1960; the earthquakes in Banloc, 12nd of July 1991, Mw=5.6, with a depth of 11 km, and Voiteg, 2nd of December 1991, Mw = 5.6, depth of 9 km, followed by a large number of aftershocks.

In Banat region the reverse and strike-slip faulting are predominant. Even the orientation of the P axis is not well constrained, a regional compressional field is outlined on N-E direction. As shown by Radulian et al. (1996), the available fault plane solutions along the Eastern edge of the Pannonian Basin and within the area of Eastern Carpathians (only for rare and weak events) suggest the compressional character of the stress field. This result is in agreement with the work of Grunthal and Stromeyer (1992) which outlines that the radial model of the extensional regime of the Pannonian Basin implies a compressional field oriented E-W at the East of the basin.

The active seismic zone around Oradea and Carei is located at the crossing of some fractures with NE and E-W orientations (Cornea and Spanoche, 1978) and is characterized by normal foci, with a burst of activity between 1829 and 1834. The earthquakes in Maramures are known for the shocks occurred in the period 1876-1926 with maximum intensity V, sometimes with many aftershocks. They occur on an alignment from Sighetul Marmatiei towards West, along Tisa river, or on NW-SE alignments between Sighet - Ocna Sugatag and Costiui - Strimtura. These last alignments are parallel with the structures of the Eastern Carpathians and reflects probably fractures of dipping steps of the crystalline basement and of raising of the base of the crust towards the contact with Neogene vulcanites. Four earthquakes had occurred in the area of Baia Mare city that were felt with intensities of V-VI, one on 30.06.1978 (MW=4) and three in 1979. This area is located on a deep fracture oriented W-E that extends towards East and corresponds to the root of Poiana Botizei Nappe, and at West it prolongs as the limit of the Szolnok geosynclinals.

Several alignments of earthquakes oriented NE occur in the western part of Oltenia and Mehedinti: Drobeta Turnu Severin - Targu Jiu line, with two events with magnitude 4.5 in 1962 and 1963, respectively.

Important earthquakes occurred in the region:

- 12.07.1991, M = 5.6, h = 11 km, I = 8 (Banloc-Timis zone)
- 18.07.1991, M = 5.6, h = 12 km, I = 8 (Herculane-Ofsenita zone)

Transylvanian Depression (DT)

A seismic zone is located between Tarnava Mare and Tarnava Mica, in the center part of the Transylvanian Depression with some historical earthquakes with magnitude between 5 and 6. The earthquake in 1880 had a diffuse epicentral zone, with two directions of increased intensity, towards N and NW. It is possible that the foci are located on fractures beneath Transylvanian Depression. Note that this seismogenic zone is defined based only on historical data. Presently, the seismic activity is practically absent.

Important earthquakes occurred in the region:

- 08.01.1223, Mw = 5.9, h = 10 km, I = 8
- 19.10.1523, Mw = 5.9, h = 10 km, I = 8 (nearby Medias city)
- 18.03.1223, Mw = 5.6, h = 10 km, I = 7
- 15 .02.1786, Mw = 5.3, h = 10 km, I = 7
- 03.10.1880, Mw = 5.3, h = 10 km, I = 8

Table 5.2. Earthquakes with MW>5.0 occurred between 984 and 2003 and the associated fault plane solutions with minimum 15 polarities of the first arrivals for each seismogenic zone. The maximum value of the seismic moment (M0,max) refer to the all time interval considered, and the coefficients used in the magnitude formula (a and b) are computed only for earthquakes’ occurred after 1900

Seismogenic zones	Number of events with M_W 5*	$M_{W,max}$	a**	b	Seismic moment rate (Nm/year)	Number of fault plane solutions	Stress regime
Vrancea	181	7.9	4.77 0.24	0.89 0.04	$1.2x10^{19}$	28***	compression
East Vrancea	7	5.6	2.67 0.73	0.86 0.16	$5.3x10^{15}$	29	transition from compression to extension
Barlad Depression	3	5.6	2.63 0.47	0.83 0.10	$6.8x10^{15}$	7	extension
Predobrogean Depression	2	5.2	2.40 0.94	0.85 0.21	$1.8x10^{15}$	4	extension
Intramoesian Fault	1	5.4	-	-	-	4	extension
Shabla	8	7.2	-	-	-	-	-
Fagaras-Campulung	4	6.5	1.50 0.47	0.65 0.09	$2.4x10^{16}$	8	extension
Danubian	2	5.6	2.74 1.01	0.97 0.21	$1.8x10^{15}$	3	extension
Banat	8	5.6	2.60 0.21	0.77 0.04	$1.3x10^{16}$	30	compression
Crisana-Maramures	1	6.2	3.19 1.24	1.08 0.28	$2.8x10^{15}$	-	compression
Transylvanian Depression	_	5.9	-	-	-	-	-

5.4.2.3 Fault plane solutions

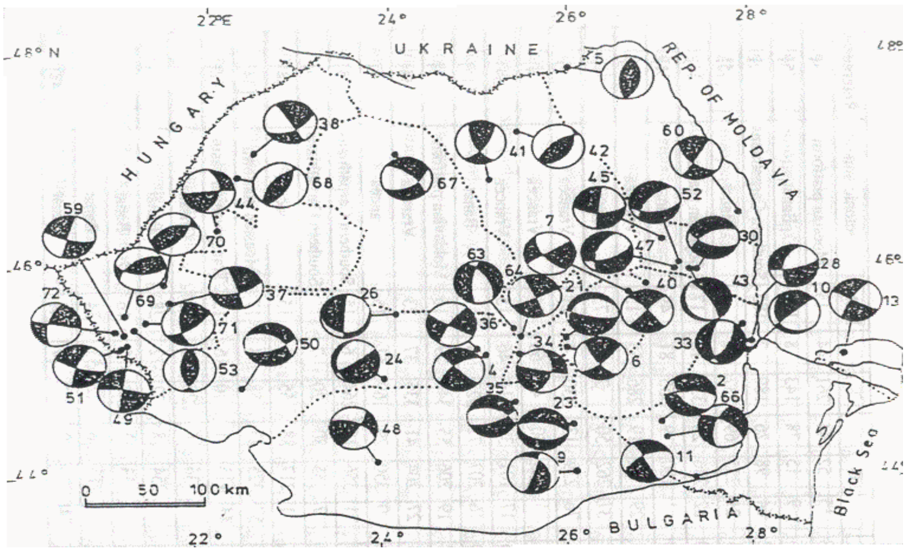


Fig 55. Fault plane solutions for major Romanian crustal earthquake (after Radulian et al., 1999). For more information see www.infp.ro

5.4.2.4 Remarks

After the installation of new seismic sensors, some of the „aseismic" zones proved to be characterized by a microseismicity (M<2) that was impossible to detect in the past. The significant increase of the number of stations in the last years and their better distribution over Romania's territory, contribute to a more complete database, due to the increase of the detected events and to the quality of the records that, in the same time, improve the quality and the precision of the earthquake locations.

REFERENCES:

1. Ardeleanu L. et al. (2005), Probabilistic seismic hazard map for Romania as a basis for a new building code. Natural Hazards and Earth System Science 5, 679-684
2. Atanasiu I. (1961), Earthquakes in Romania. Academia R.P.R., Bucarest, 194pp. (in Romanian)
3. Oncescu M., Marza V. I., Rizescu M., Popa M. (1999), The Romanian earthquake catalogue between 984-1997, Vrancea Earthquakes: Tectonics, Hazard and Risk Mitigation (edited by F. Wenzel et al.), 43-47
4. Radulian M., Mandrescu N., Panza G.F., Popescu E., Utale A. (2000), Characterization of Seismogenic Zones of Romania, Pure appl. geophys. 157, 57-77.
5. http://www.infp.ro/local-seismicity/romanian-seismicity

5.5 UKRAINE

5.5.1 Past Events and Their Consequences

Seismically hazardous areas in Ukraine cover more than 120 thnd km². This is about 20 % of the territory of Ukraine. Intensity of earthquakes can reach 6 - 9 points on the Medvedev–Sponheuer–Karnik scale (MSK-64 scale).

10,9 million of people (22 % of the total population) live in seismically hazardous areas including the areas of 6 point scale earthquake activity – 7,98 million people (15,5 %), 7 point scale earthquake activity – 2,16 million people (4,2 %), 8-9 point scale earthquake activity – 0,79 million people (1,5 %).

Seismically hazardous areas in Ukraine include:

1. Vrancea seismic zone. Earthquake sources are located at depths of 80 to 190 km with max magnitudes 7.6.
2. Crimean Black Sea seismic zone. The epicenters of earthquakes are located in the Black Sea, near the southern coast. It is characterized by the highest magnitude on the territory of Ukraine - up to 6.8.
3. Seismic Dobrogea region. The epicenters are located in the area of the Danube Delta, the magnitude is up to 7.

4. The Black Sea. The seismic activity in the Black Sea is relatively shallow and is generally restricted to the marginal portions of the sea. A strong marginal seismic zone extends along the Anatolian Fault. Focal depths in this area are generally less than 30 km. The magnitude is up to 5.

5. Platform area of Ukraine. Energy of seismically active zones is transmitted here. As a result rare earthquakes happen with an intensity of 4-5.5 points.

According to historical evidence the local seismic events that emerged with 5-7 points intensity of impacts occurred on the border between Kirovohrad and Cherkasy regions - 7 points in 1873, in Donetsk region (around Konstantinovka) – 5-7 points in 1937, in Kharkiv region - 5-6 points in 1858 and 1913, in Chernigiv region - 4-6 points in 1905; in Ternopil region - 6 points in 2002, and in a number of other locations.

Strong earthquake happened in the Crimea in 1927. 70 % of all buildings in Yalta were destroyed. Five towns of the Crimea have areas of 8 point scale earthquake activity.

At present, the local earthquakes occurred in the territory of the Autonomous Republic of Crimea, in the Carpathian region, Chernivtsi, Odessa, Vinnitsia, Kirovohrad, Ternopil, Khmelnytskiy, Luhansk regions and in the north of Lviv region. The strong subcrustal earthquakes in the focus zone of Vrancea are felt by people almost in the whole territory of the country.

According to new data the seismically hazardous areas (different intensity) are the following: the Crimea (6 -9 point), Transcarpathian (7 points), Chernovtsy (6 - 7 points), Vinnitsa (6 points), Kirovograd (6 points), Lvov (6 points), Odessa (6 - 9 points), Ternopol (6 points), Khmelnitsky (6 points) regions of Ukraine.

In the Crimea, Carpathian region, Donbas, Odessa, Khmelnitsky and Dnepropetrovsk regions more than 130 thousand of landslides covering the area of about 5 thousand square kilometers are registered. 60 % of sea shore has landslides and shifts.

More than 60 % of territory in Ukraine is subject to karsts formation, 27 % of the territory in Ukraine has open karsts (the Crimea, Vinnitsa, Volyn, Donetsk, Lugansk, Lvov, Nikolayev, Rovno, Ternopol, Khmelnitsky regions). These factors influence the level of earthquake hazard in Ukraine negatively.

Buildings and structures vulnerability assessment is a predictive value and structures behavior quality characteristic at maximum earthquake which can occur in the given region in the area where there is a construction object during its existence. The methodology to determine the vulnerability is based on the main principles of the State construction norm DBN B. 1.1.-12:2006 "Construction in seismic regions of Ukraine" and other data which characterize the load-bearing capacity and deformability of building structures.

The Carpathian earthquakes occurring in Vrancea Mountains are felt over a large area and distributed to hundreds or thousands of kilometers from the epicenter. They are observed at arc sharp bend of the Eastern Carpathian and determine the total seismic situation of the territories in Moldova and western regions of Ukraine. The strong influence of the Romanian earthquakes in Ukraine was registered in historical records, literature, various earthquake catalogs and by instrumental observations in 1091, 1170, 1230, 1443, 1446, 1471, 1701, 1790, 1802, 1838, 1893, 1908, 1912, 1940, 1977, 1986, 1990.

The strongest earthquakes (with intensity of 5-6 points) observed in Ukraine were in Vrancea area. The exception was the earthquake (with intensity of 7 points) observed in October 26, 1802 in Odessa and Chernovtsy.

According to data of the Ministry of emergency situations in Ukraine there are dozens of earthquakes in Carpathian and Crimean-Black Sea regions every year.

Today there is a tendency of earthquake hazards increasing in both seismically hazardous and previously non-seismic areas. About 5 thnd km² of territory of Ukaine in covered by more than 23 thnd landslides. Landslides are registered in the Crimea, Carpathian region, Donbas, Odessa, Khmelnitsky and Dnepropetrovsk regions. 60 % of sea shore has landslides and shifts.

More than 60 % of territory in Ukraine is subject to karsts formation, 27 % of the territory in Ukraine has open karsts (Crimea, Vinnitsa, Volyn, Donetsk, Lugansk, Lvov, Nikolayev, Rovno, Ternopol, Khmelnitsky regions). The open karsts areas are particularly large in Volyn (594 km²), Rovno (214 km²), Khmelnitsky (4235 km²) regions. All of this increases seismic vulnerability of Ukraine.

5.5.2 Existing legislation framework

1. Constitution of Ukraine, Law from 28.06.1996 254k/96-VR (release 12.06.2013):

Article 106. President of Ukraine:

21) adopts a decision, in the event of necessity, on the introduction of a state of emergency in Ukraine or in its particular areas, and also in the event of necessity, declares certain areas of Ukraine as zones of an ecological emergency situation — with subsequent confirmation of these decisions by the Verkhovna Rada of Ukraine

Article 138. The following issues shall be under the authority of the Autonomous Republic of Crimea

10) initiate the introduction of a state of emergency and establish zones of ecological emergency as needed in the Autonomous Republic of Crimea or in its particular areas

Reference: http://www.president.gov.ua/en/content/constitution.html

2. Code of Civil Protection of Ukraine, from October 2, 2012 of No. 5403-VI. (In edition of the Laws of Ukraine from 5/14/2013 of No. 224-VII, 6/20/2013 of No. 353-VII)

The code of civil protection of Ukraine regulates the relations connected with protection of the population, the territories, surrounding environment and property from emergency situations, response to them, functioning of single state system of civil protection, and determines powers of public authorities, Council of Ministers of the Autonomous Republic of Crimea, local government bodies, the rights and obligations of citizens of Ukraine, foreigners and stateless persons, the companies, organizations and the organizations irrespective of pattern of ownership.

The Code, in particular, determines the classification of emergencies: man-made, natural, social and military, state, regional and local.

It should be noted that after the Code has entered into force such regulations as the Law on Civil Protection, the Law on Fire Safety, Law on the structure and the number of troops Defense, the Law on Defense Forces of Ukraine, the Law on the emergency and rescue services, the Law on the Protection of from emergency situations, the Law on civil Protection became invalid.

Article 15. State of emergency

State of emergency for a unified state system of civil protection, in whole or in part for some of its territorial subsystems temporarily established in the territory in which the law imposed emergency rule in accordance with the Law of Ukraine "On the legal state of emergency"

Article 30. Emergency notification

1. …emergency notification includes bringing this information in time to the civil protection authorities, civil defense forces, businesses and public

Reference: zakon.rada.gov.ua go/5403-17

3. Law of Ukraine on Building Codes N 1704-VI, 05.11.2009

This Law specifies legal and organisational principles of the development, the endorsement, the approval, the registration and the application of building codes.

Article 4. The principles of the state policy in the field of standardization in the construction

1) creating a safe environment for human life and health;

Reference: zakon.rada.gov.ua go/1704-17

4. Law of Ukraine about the zone of the emergency ecological situation, 13. 07. 2000 of No. 1908-III. (In edition of the Law of Ukraine from 2/9/2006 of No. 3421-IV)

Article 3. The main objectives of the law and its scope

The main objectives of this Law are legal regulation of relations that arise during emergency measures to protect life and health of people and normalization of ecological condition in the areas of environmental emergency…

Reference: http://zakon4.rada.gov.ua/laws/show/1908-14

5. Law of Ukraine About legal regime of emergency state

from March 16, 2000 of No. 1550-III, (last edition from 16-05-2013)

This Law determines content of legal regime of emergency state, the procedure for its introduction and cancellation, feature of activities of public authorities and local government bodies, the companies, organizations and the organizations in the conditions of emergency state, observance of rights and freedoms of man and citizen, and also the rights and legitimate interests of legal entities and responsibility for violation of requirements or failure to carry out of measures of legal regime of emergency state.

Reference: zakon.rada.gov.ua go/1550-14

6. Law of Ukraine on urban planning and development: optimization of regulatory procedures in the area of development and construction (17.02.2011 3038 (release 05.07.2013))

The Law is aimed at improving the procedures and rules for granting planning permission and ensuring steady development of urban areas. This Law can provide highly beneficial for investors, both domestic and foreign, wishing to invest in urban development

Article 12. Development and approval of planning schemes of individual parts of the territory of Ukraine

1. According to the decision of the Cabinet of Ministers of Ukraine developed schemes

Planning of individual parts of the territory of Ukraine ...with ... risk of emergency.

Reference: zakon.rada.gov.ua go/3038-17

7. On approval of emergency classification according its levels, Resolution of the Cabinet of Ministers of Ukraine, (24.03.2004 № 368 with amendments 11.06.2013)

Natural hazards - the event of natural origin or the result of natural processes, which in its intensity, extent and duration may affect people, the objects of the economy and the environment.

Reference: zakon.rada.gov.ua go/1550-14

8. On a single state system of prevention and response to emergency situations of technogenic and natural character. Resolution of the Cabinet of Ministers of Ukraine, (03. 08.1998 N 1198 with amendments 08.12.2006)

Introduces 3 levels of readiness

1) level of everyday activities;

2) level of enhanceable readiness;

3) level of activities in extraordinary situations

Reference: http://zakon2.rada.gov.ua/laws/show/1198-98

9. On approval of the actions of the Emergency Management and Operational Rescue Services units of civil defence Ministry of Emergency Situations of Ukraine, (Order from 13.03.2012 № 575)

Regulates actions in the extraordinary situations

2.1.2. liquidation of extraordinary situation…..includes the following activities:

clarification and estimation of situation; decision making, analysis of situation, permanent monitoring to provide rescue operation, cooperation and inforamtion exchange…

Reference: zakon.rada.gov.ua laws/show/z0835-12

10. On approval of the State sanitary rules of planning and building of settlements, Order of Ministry of Heath Protection of Ukraine, (19.06.1996 № 173 with amendments 31.08.2009)

Regulates planning and building in settlements

Reference: zakon.rada.gov.ua laws/show/z0379-96

11. Decision of the Council of Heads of Government of Commonwealth of Independent states "About Intergovernmental scientific and technological program of creation of system of seismic monitoring of territories of states - participants of CIS" (Adopted in Moscow 25.11.1998)

Reference: http://spravka-jurist.com/base/part-wq/tx_xsxwza/page-8.htm

5.5.3 Implemented seismic hazard prevention studies

Leading organization for seismic studies in Ukraine is the Institute of Geophysics (IGP) of the National Academy of Sciences (NAS) of Ukraine. Department of Seismic Hazards of IGP provides the next activities:

- Elaboration of methods of seismic observations and studies focused on the survey of seismic hazards within the territories, to afford seismic stability of technogenically and ecologically hazardous objects, to increase safety of living of population in seismic regions of the country;
- Production of databases of seismological and related geophysical information, with resulting preservation and availability to users;
- Scientific- and methodological assistance for Governmental Bodies;
- Publication of results of seismologic observations, distribution and popularization of seismologic knowledge in order to increase safety of living in seismically active regions;
- Scientific- and methodological assistance to services of other organizations, which conduct instrumental seismological and geophysical observations in Ukraine;
- Participation in fulfillment of International Agreements in the field of seismologic monitoring of the Planet and data exchange;
- Development of Governmental and International scientific-technical programs of studies and forecasts of seismic hazards in Ukraine; maps of seismic zonation of populated areas, maps of technogenically and ecologically hazardous objects, programs of improvement of safety of living of population in seismic regions, programs of studies of internal structure and geodynamics of lithosphere for the focused search of mineral deposits.

- Participation in production of database on standards on the problems of improvement of the safety of living of population and keeping stabile development of economics in seismic zones of Ukraine.

The seismological network of National Academy of Sciences was created in Ukraine (Fig 56). It includes seismic and geophysical stations. Currently 36 seismic stations operate in Ukraine. Seismic stations are located in Crimea (Simferopol, Yalta, Sudak, Sevastopol, Olenovka). 3 of them are located in Odessa region (at Snake Island, in Stepanovka Settlement and this one in Odessa City).

In 2008 the first Odessa seismic station was introduced by State Building and Architecture Academy.

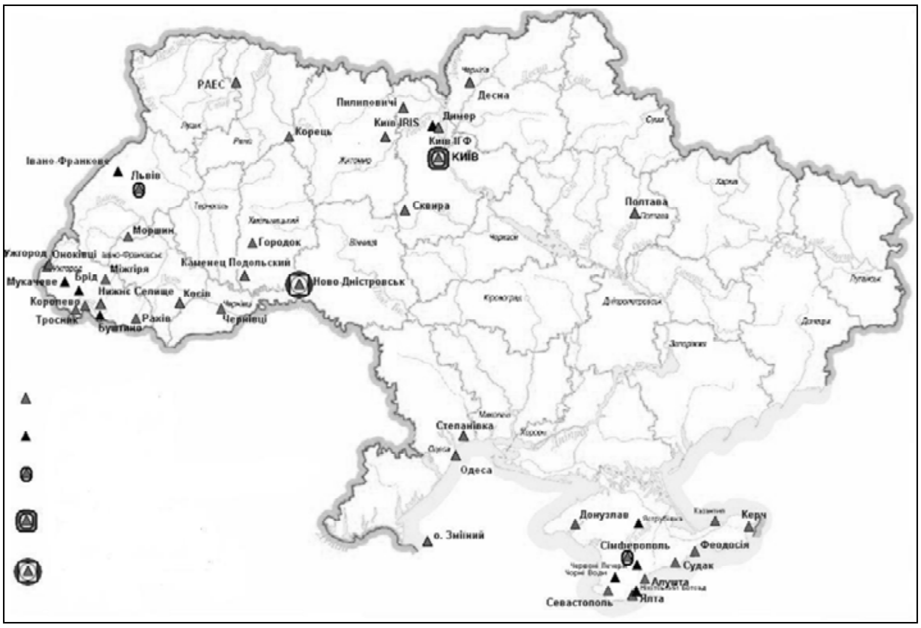


Fig 56. Network of seismic and geophysical stations of NAS Ukraine (2012)

The seismological network of Ukraine is supplying the data about seismic effects on the territory of country, on basis of which the science-based prediction of the values of seismic hazard parameters are determined. They are necessary for the central and local authorities for planning the building and providing the stable development of seismic regions. The main problems solved on the basis of seismic monitoring provided by seismic stations are protection of population, housing and other structures against earthquakes (seismic protection) and investigation of deep structures and Earth's geodynamics for purposeful search of minerals

The further development of seismological network is extremely essential for provision of optimal seismic design and construction of important and ecological hazardous objects, housing and public structures. In the future, it is planned to widen the station network in Ukraine and build both the bearing and more cheap stations for the distance between them to range between 40 and 70 km.

The urgent and vital problem also is to study the seismic stability of existing buildings and structures in the regions, where the seismic hazard (as specified on the new map GSZ-2004) turned out to be higher compared with the old standard map SR-78.

At present the reliable method of prediction of earthquakes is absent. Thus, reliability-based earthquake-resistant design of housing, industrial objects and other developments gains importance.

Thus, the existing earthquake hazards mitigation technics include:

-determination of quantitative values of parameters of seismic hazard;

-seismic zoning (general seismic zoning (GSZ), detailed seismic zoning (DSZ), seismic micro zoning (SMR));

-reduction of vulnerability of buildings and structures by increasing seismic;

-development and practical application of antiseismic building codes corresponding to the actual seismic hazard;

-state and public control of seismic design and construction and actual seismic stability of existing buildings and structures;

-raising public awareness in the sphere of seismic protection, education and trainings;

-rapid warning of strong earthquakes and rapid response;

-emergency assistance programmes, natural disasters insurance, including earthquakes

5.6 REPUBLIC OF MOLDOVA

5.6.1 Past Events and Their Consequences

Seismic observations in Moldova on a regular basis started in 1949, when, on December 20, the first seismogram was recorded at the seismic station Kishinev. The year 1963 could be considered the starting point of the scientific investigations into earthquake engineering, when the first volume of scientific publications was issued dedicated to problems of tectonics and seismology of Moldova, prepared by the group of young scientists of the Institute of Geology and Mineral Resources of the Academy of Sciences of Moldavian Soviet Socialist Republic (MSSR).

The Institute of Geophysics and Geology (IGG) was founded in 1967 on the basis of the Institute of Geology and Minerals and the regional seismic station "Kishinev." The research priorities of the Institute are monitoring of seismicity of the Vrancea zone, seismic hazard and risk assessment, microzonation, GIS technologies, and mathematical models in earthquake engineering. The present director is Dr. Vasilii Alkaz. The staff has numbered from 100 to 120 in the 1970s and 1980s to 50 in the 1990s. Currently the staff consists of 22 seismologists (including staff of seismological stations), 8 of them with Ph.D. degrees. The seismological section consists of (1)

Laboratory for Seismology, (2) Laboratory of Survey of Seismic Effects, and (3) the Center of Experimental Seismology.

The territory of the Republic of Moldova is influenced by earthquakes of intermediate depth from the Vrancea seismic zone,situated in Romania. The strongest of these earthquakes are distributed in the depth interval of 80-150 km, with maximum magnitude of 7.5-7.8. The most significant seismic effect, maximum intensity VIII-IX on the scale of XII, is observed in Romania and Moldova. Statistical information about seismic activity of the Vrancea zone is available since the year 1000. 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) caused casualties and considerable damage.

The main mission of the seismological section is monitoring seismicity for the territory of Moldova, and conducting seismotectonic investigation, seismic hazard assessment, long-term earthquake prediction research, and engineering seismology. These investigations have resulted in maps of macro- and microzonation for seismic-resistant construction and are the basis for taking measures in reducing the consequences of strong earthquakes.

The seismic network of Moldova consists of five seismic stations, situated in Kishinev, Cahul, Leovo, Soroky, and Djurjuleshti. Kishinev is the base station for the network; the other four provide regional data. Station Kishinev was established in 1949 by the Institute for Earth Physics, USSR Academy of Sciences, to provide supplementary data on parameters of Carpathian earthquakes. Station Cahul started its observations in 1978 and provides additional information for studying of characteristics of earthquakes from the Vrancea zone. Stations Leovo (1982) and Soroki (1983) were established in connection with structural changes in the Soviet network in 1979 for work on earthquake forecasts. Djurjuleshti was installed in 1988. Information about the location of the seismic stations is shown in Fig 57.

In the last twenty years the Laboratory of Seismology performed the investigation of the horizontal discontinuities of the upper mantle for Moldova and neighboring Romania by analysis of teleseismic P-wave propagation. A database of the seismological information has been created in the Institute, including the catalog of the earthquakes and focal mechanisms of the studied region, macroseismic information. The statistical algorithms for interpretation of seismic intensity and seismic impact and alternative models of its assessment are considered in probabilistic representation of seismic hazard.

The Laboratory of Survey of Seismic Effects has launched a projects aimed at utilizing GIS technology for storing and processing of the available information. This projects allows constructing of seismic macrozonation maps in digital format, and certain advances in seismic risk and seismic microzonation studies.

Some results of these projects are shown in Fig 58-Fig 62.

5.6.2 Existing legislation framework

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

- 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.
- SNIP 1.02.07-87. Engineering exploration for the construction. General definitions. ("Инженерные изыскания для строительства. Основные положения).
- SNIP II-7-81. Construction in seismic regions („Строительство в сейсмических районах").
- 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").
- RSN 60-86 Engineering exploration for construction. Seismic microzoning. Norms of work realization ("Инженерные изыскания для строительства. Сейсмическое микрорайонирование. Нормы производства работ").
- 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
- 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").

The Institute of Geology and Seismology made some special investigation in the field of seismic zonation and seismic microzonation which were adopted as normative documents in Moldova Republic. Fig 58 ilustrates a seismic zonation of Republic of Moldova. Fig 59 ilustrate a seismic microzonation of Chisinau city with the consideration of the local geological condition and soil properties. The seismic risk map for Chisinau city was elaborated on the base of seismic microzonation (Fig 60).

Fig 61 and Fig 62 illustrate the seismic risk for Republic of Moldova in the damage and integral risks.

Fig 57. The location of the seismic stations in Republic of Moldova

Fig 58. The new seismic zoning map of Moldova Republic.

It was adopted by the Ministry of Regional Development and Construction in 2010, and approved for practical use (aseismic design and construction).

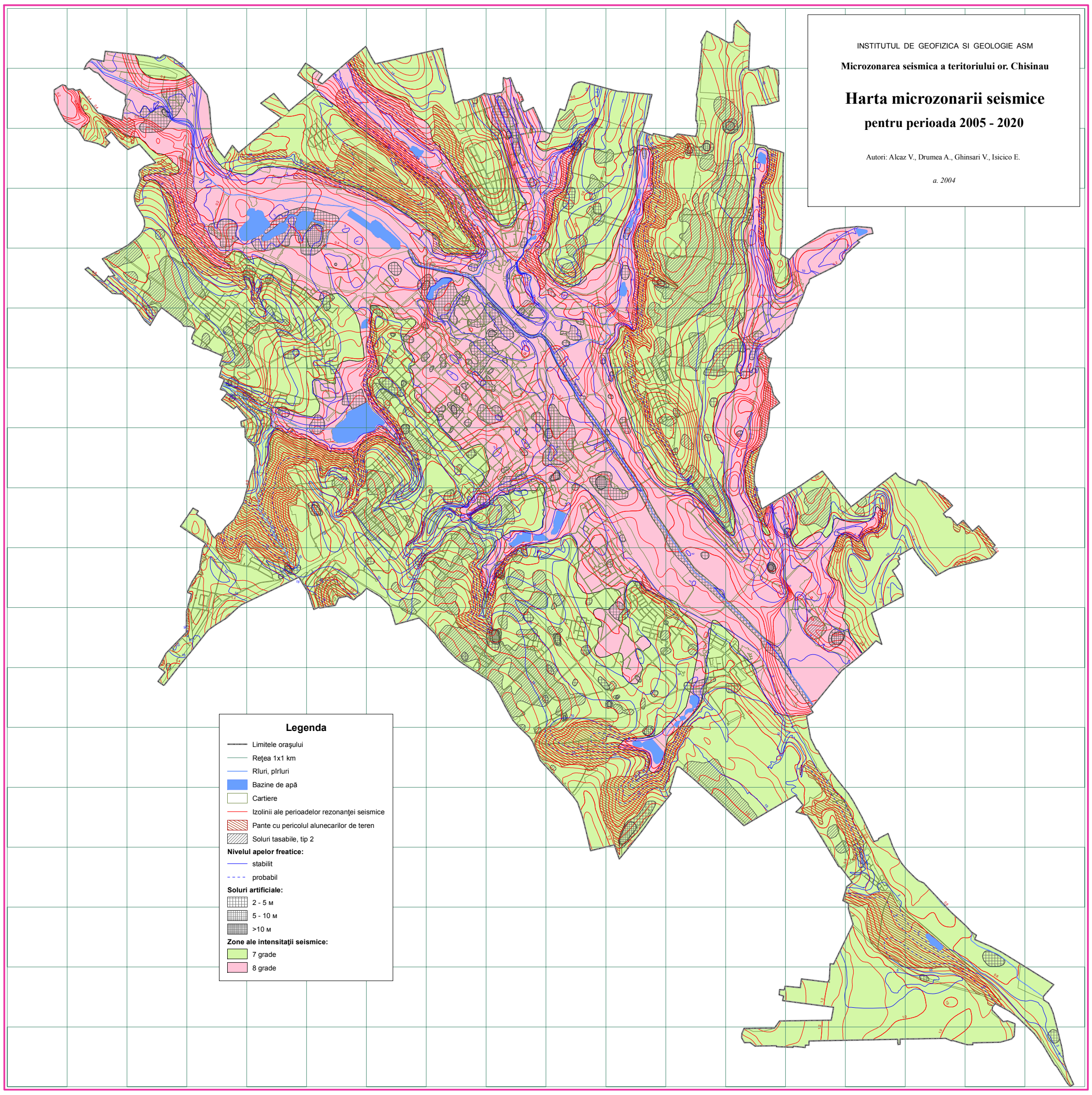


Fig 59. The new seismic microzonation map of Chisinau city.

It was adopted as normative document for the construction project design in Chisinau city by the Ministry of Regional Development and Construction in 2013.

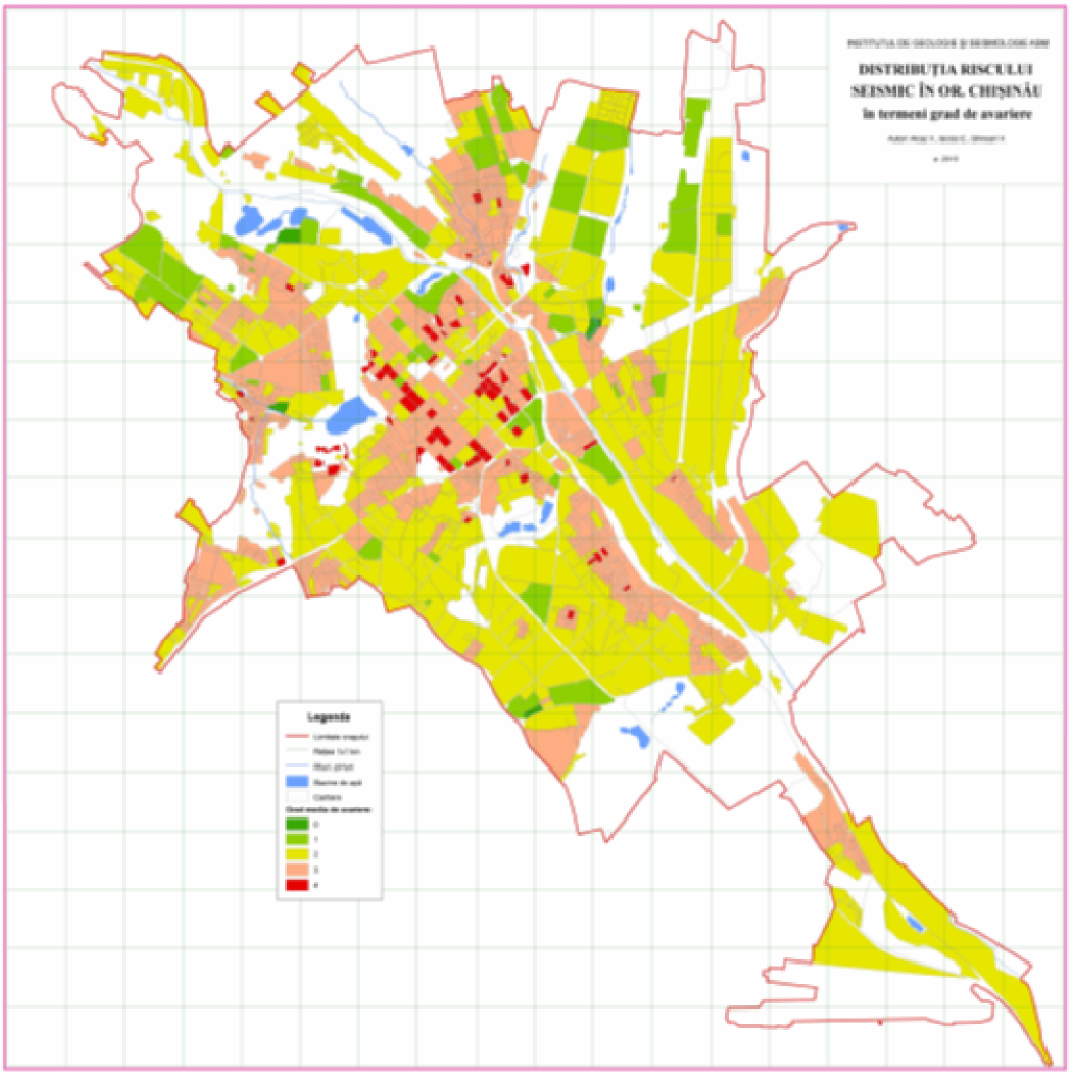


Fig 60. Seismic risk map of Kishinev city.

It was elaborated in 2009 for scenario earthquake (like 10.11.1940) in terms of the average degree of damage for each quarter of the city.

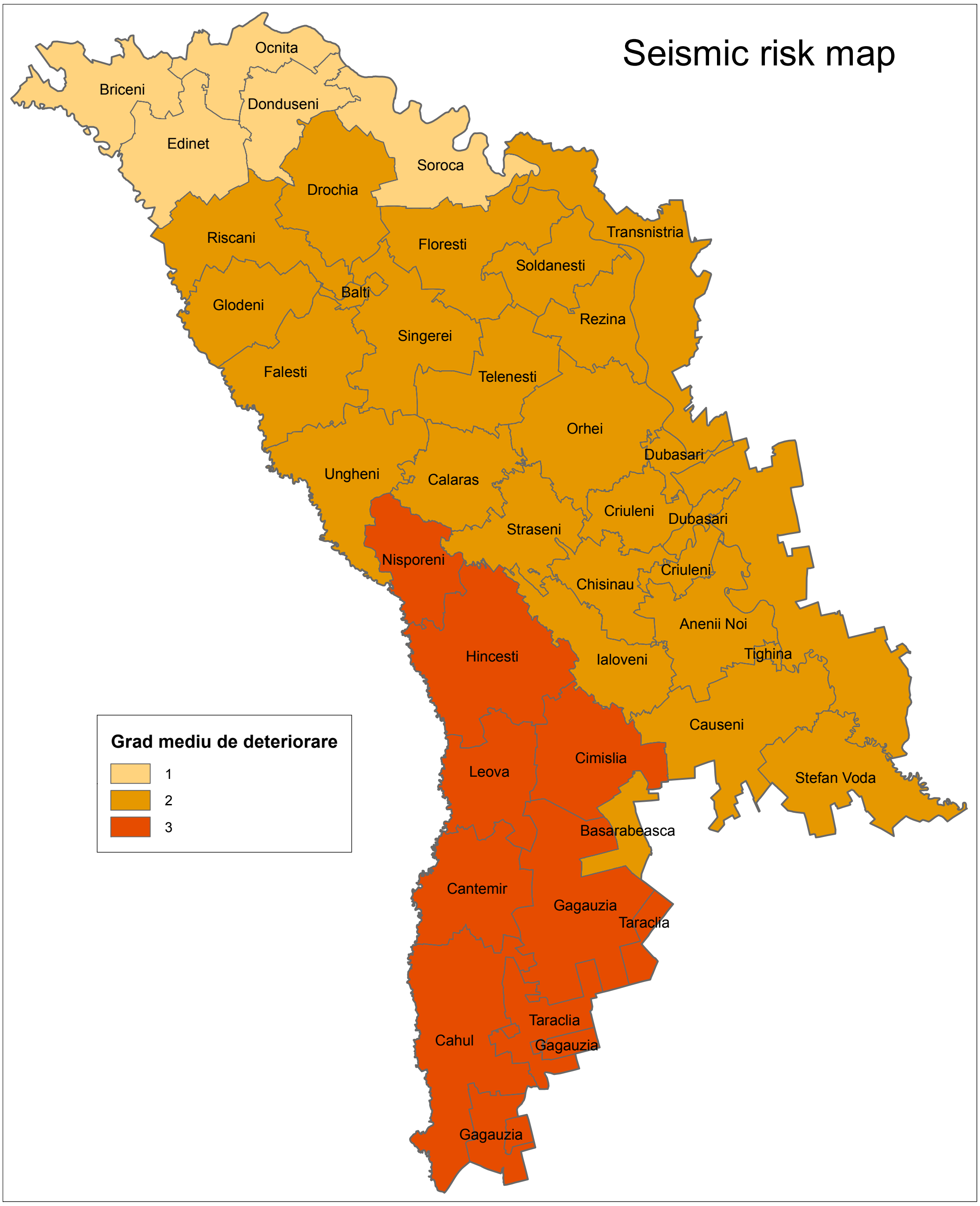


Fig 61. Seismic risk map of Moldova Republic.

It was elaborated in 2012 for scenario earthquake (like 10.11.1940) in terms of the average degree of damage for each district.

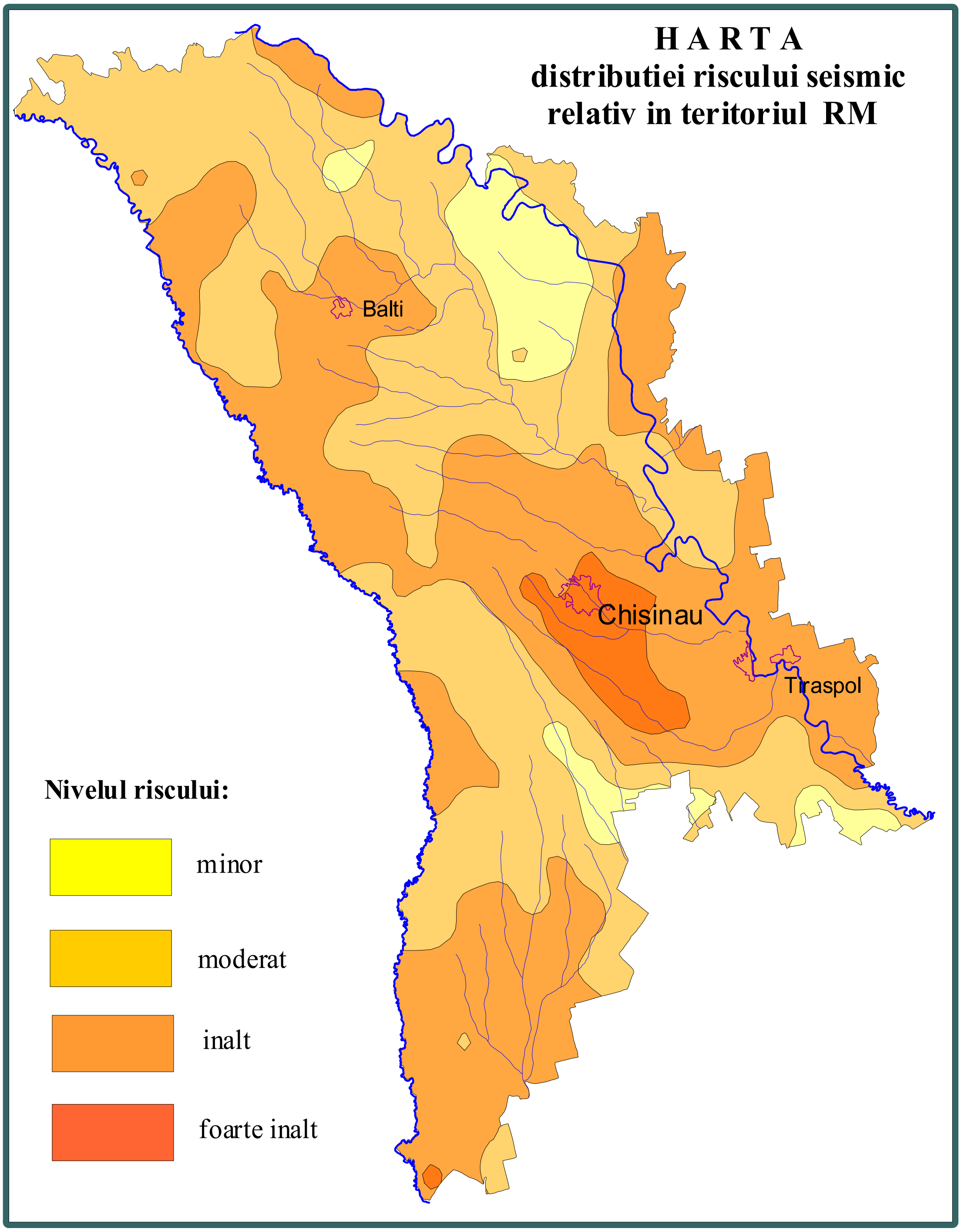


Fig 62. Relative seismic risk map of Moldova Republic.

6 BIBLIOGRAPHY REGARDING METHODOLOGICAL APPROACHES FOR LANDSLIDE HAZARD ASSESSMENT AT REGIONAL AND LOCAL SCALES (ACTIVITY A1.4)

6.1 TURKEY

1. MAZZDA PROJECT

Acronym:

MAZZDA Project

Title of the Study:

Monitoring of Earthquake Activity of Marmara Region and Investigation of Its Effects on Seaboard / Continental Shelf of İstanbul

Period (Dates) of the Study:

18.04.2007 – 28.11.2008

Scope and Objectives of the Study:

The main objective of this project is, with the collaboration of Istanbul Metropolitan Municipality (İBB) and Directorate of Earthquake and Ground Analysis (DEZİM),

- Provide the flow of information on regional earthquakes obtained from geochemical and geophysical studies conducted by TÜBİTAK – MAM and Earth and Marine Sciences Institute to IBB, DEZIM and AKOM in order to contribute post – disaster recoveries
- Identification of underwater landslides on seabed of Marmara, coastal areas affected potentially by a possible flow/sliding of sediment on seabed, conducting a pilot study on relating these incidents to landslides in Avcılar - Zeytinburnu

Implementing Organisation and Funding Bodies:

Soresma NV, Gent, Belgium Centre for Regional Studies, Odessa Danube Flood Protection Department, Izma

Partners&End Users and Funding Bodies are Directorate of Earthquake and Ground Analysis (DEZİM), TÜBİTAK – MAM and Earth and Marine Sciences Institute (YDBE) / İstanbul Metropolitan Municipality

Results and Significant Impacts of the Study:

- Fulfillment of research gap by means of this project and acquirement of detailed depth map pertaining to this region.This map can be employed as a reference to all studies conducted in this district.
- Detection of accumulated and sliding sedimental areas exhibiting high potential for the occurence of landslide in continental shelf of İstanbul in Marmara, Acquirement of map in the scope of this project by gathering

sedimentological and seismic data in order to employ it as a basis for studies conducted within/beyond coastal areas.

- Detection of potantial coastal areas likely to be affected by flow / sliding of sediment (i.e., 1999 İzmit Değirmendere Earthquake)
- IBB and DEZIM will especially investiagete the morphology / structure of seabed in shallow areas, estimate the possible landslide areas under the sea and find out the relationship between these areas and those on land, handle the information about identification of these areas, provide inputs to zoning plans and constitute data to urban geological studues.

Region(s) of Implementation with Geographical coordinates (if applicable):

Avcılar – Zeytinburnu / İstanbul (41° 0'44.67"N, 28°43'52.94"E)

Size of application:

Regional

List of Bibliographical References:

http://www.mam.gov.tr/english/YDBE/ydbe-projeler/mazdda.html

2. Investigation of Possible Active Faults in Istanbul Land Area and Development of Landslide Determination and Monitoring Methodologies by Multidisciplinary Researches in Istanbul Metropolitan Area

Title of the Study:

Investigation of Possible Active Faults in Istanbul Land Area and Development of Landslide Determination and Monitoring Methodologies by Multidisciplinary Researches in Istanbul Metropolitan Area

Period (Dates) of the Study:

01.06.2009 – 30.05.2012

Scope and Objectives of the Study:

In this project, the main objectives are investigation of possible active faults in Istanbul land area in cooperation with Istanbul Metropolitan Municipality (IMM), Directorate of Earthquake and Ground Analysis (DEZIM) and development of landslide determination and monitoring methodologies in priority landslide areas.

First, two selected potential landslide areas will be investigated in detail by high resolution non-conventional refraction seismic methods and monitored by borehole inclinometer and periodic laser measurement techniques. The suitability and efficiency of different seismic methods will be investigated for landslide determination and the best method will be realized taking into consideration of the characteristics of the landslide area to be studied. The objective is to create an efficient observation system at the end of the study to monitor determined landslides by borehole inclinometer and joint ground based Laser and PSInSAR application techniques.

Partners&End Users and Funding Bodies are Istanbul Metropolitan Municipality (IBB), Directorate of Earthquake and Ground Analysis (DEZIM)

Results and Significant Impacts of the Study:

Methodologies will be developed to determine and monitor landslides by doing multidisciplinary research in priority landslide areas.

Faults situated in Istanbul Metropolitan Area (Between Büyükçekmece-Küçükçekmece and Tuzla-Kartal) which are suspected to be active will be investigated by seismologic/geodesic methods.

Research will be realized to determine shallow sea bottom morphology (up to 20m water depth) between Büyükçekmece-Ataköy to reveal sea/land transition zone detail from landslide perspective.

Regional earthquake Information based on scientific findings obtained by continuous geochemical and microseismological studies of TÜBİTAK MRC Earth and Marine Sciences Institute will be continuously transferred to IMM (DEZIM) and thereby to AKOM to provide information for disaster coordination and alert at medium term.

Region(s) of Implementation with Geographical coordinates (if applicable):

Büyükçekmece, Küçükçekmece, Ataköy, Tuzla, Kartal / İstanbul (41° 0'21.07"N, 28°58'36.80"E)

Size of application:

Regional

List of Bibliographical References:

http://www.mam.gov.tr/YDBE/projeler/istanbul-kara-alani.html

3. FORESIGHT PROJECT

Acronym:

FORESIGHT

Title of the Study:

Frequent Observation-driven Realistic Evaluation and Simulation of Interacting Geophysical Hazard Triggers

Period (Dates) of the Study:

11.09.2004 – 20.11.2006

Scope and Objectives of the Study:

The overarching scientific objective of FORESIGHT is to understand the mechanically coupled, interrelated processes leading to the hazardous activity associated with earthquakes, volcanoes, landslides and tsunamis. To assess, mitigate and manage the risks posed by these hazards, existing and fresh data from multi—sensor surveillance networks and satellites has been combined within a time-dependent Geographic Information System (GIS)

To harmonize data and methodologies for understanding geophysical processes across Europe, FORESIGHT focused on four natural laboratories: Iceland, Azores, Alps and Turkey and emphasized the mechanical coupling temporal interactions between geophysical processes.

FORESIGHT applied the advanced methods of GIS analysis to enhance physical models for calculating, predicting and interpreting the consequences of such geophysical activity. The outputs designed to support the implementation of new European-scale risk management systems by civil defense participants in the project.

Partners&End Users and Funding Bodies are European Union 6th Framework Program

Results and Significant Impacts of the Study:

To achieve these goals, the role of Turkish natural laboratory in the FORESIGHT consortium was:

- Developed the methodologies to demonstrate the increased geophysical activity by assimilating fresh data from existing sensor
- Located areas of increased geophysical activity by mapping crustal deformation, and other indicators
- Developed exploitable models for the physical mechanism of tsunamis underlying correlated events
- Identify the areas of increased hazard by using semi-automatic GIS tools
- Introduce the time-dependent assessments of hazard into risk management
- Disseminate the expertise and share the outputs with risk managers at the European level.

Region(s) of Implementation with Geographical coordinates (if applicable):

Turkey, The Alps, Azor Icelands – Portugal and Icelans

Size of application:

National

List of Bibliographical References:

http://www.mam.gov.tr/english/YDBE/ydbe-projeler/foresight/foresight.html

4. Investigation, Analysis and Monitoring of Various Landslide Fields in Büyükçekmece and Beylikdüzü Districts

Title of the Study:

Investigation, Analysis and Monitoring of Various Landslide Fields in Büyükçekmece and Beylikdüzü Districts

Period (Dates) of the Study:

04.03.2013 -04.03.2016

Scope and Objectives of the Study:

In the area between Büyükçekmece and Küçükçekmece Counties, landslides pose a major natural disaster, as in many other parts of the country. The causes and the mechanisms of landslide occurrences will be investigated especially in Büyükçekmece and Beylikdüzü Counties by an integrated research thus contributing positively to healthy urbanization studies in these areas under pressure of dense population. Using already existing geographically widespread comprehensive European wide monitoring infrastructure, a national permanent seismic and geodetic monitoring network will be established such as:

1. Multidisciplinary local spatial and ground based research methods will be used to collect data to be integrated.
2. Ground movements will be determined both by topographical research methods and by underground investigation methods.
3. Existing multidisciplinary data will be jointly interpreted.
4. Landslide mechanisms will be investigated by high performance measurement and modeling studies.

Partners&End Users and Funding Bodies are İTÜ, İÜ, İBB DEZİM - Metropolitan Municipality Directorate of Earthquake and Ground Analysis, TÜBİTAK MRC Earth and Marine Sciences Institute

Results and Significant Impacts of the Study:

Landslides pose a major disaster in the area between the Büyükçekmece and Küçükçekmece Counties, as in many parts of the country. However, thanks to contribution of integrated research studies that will be accomplished in this region, landslide occurrence causes and mechanisms will be studied particularly in the Büyükçekmece and Beylikdüzü Counties, thereby providing a positive contribution to healthy urbanization in these areas under pressure of dense urbanization.

Region(s) of Implementation with Geographical coordinates (if applicable):

Büyükçekmece, Küçükçekmece, Beylikdüzü / İstanbul

Size of application:

Regional

List of Bibliographical References:

http://www.mam.gov.tr/YDBE/projeler/beylikduzu/beylikduzu.html

5. Application of Remoting Sensing Data to Landslide Disasters

Title of the Study:

Application of Remoting Sensing Data to Landslide Disasters

Period (Dates) of the Study:

2004 - 2005

Scope and Objectives of the Study:

Application of Remoting Sensing Data to Landslide Disasters

Partners&End Users and Funding Bodies are JICA and MTA / Dictorate of Mineral Research and Exploration

Results and Significant Impacts of the Study:

Landslide sensitivity analysis are performed by means of remote sensing data. In naddition to modification of threshold values for landslide occurrence, possible landslide areas are evaluated with respect to these values.

Region(s) of Implementation with Geographical coordinates (if applicable):

Bartın (41°38'26.09"N, 32°20'43.70"E)

Size of application:

Regional

List of Bibliographical References:

http://www.mta.gov.tr/v2.0/bolgeler/zonguldak/index.php?id=2004_yili_projeleri_projeler

6. Landslide Sensitivity Project For Southeast Marmara Region

Title of the Study:

Landslide Sensitivity Project For Southeast Marmara Region

Period (Dates) of the Study:

2005 - 2011

Partners&End Users and Funding Bodies are JICA-MTA / Dictorate of Mineral Research and Exploration – Remote Sensing Center

Region(s) of Implementation with Geographical coordinates (if applicable):

Southeastern Marmara Region

Size of application:

Regional

List of Bibliographical References:

http://www.mta.gov.tr/v2.0/birimler/uiab/index.php?id=ulusl_proje

6.2 GREECE

1. SAFELAND Project

Acronym:

SAFELAND

Title of the Study:

Living with landslide risk in Europe: Assessment, effects of global change, and risk management strategies

Period (Dates) of the Study:

1 May 2009 - 30 April 2012

Scope and Objectives of the Study:

The scope of SafeLand is to develop and implement an integrated and comprehensive approach to help guide decision-making. The methodologies developed will be tested in selected hazard and risk "hotspots" in Europe, in turn improving knowledge, methodologies and integration strategies for the management of landslide risk.

SafeLand has the objectives to (1) provide policy-makers, public administrators, researchers, scientists, educators and other stakeholders with an improved harmonised framework and methodology for the assessment and quantification of landslide risk in Europe's regions; (2) evaluate the changes in risk pattern caused by climate change, human activity and policy changes; and (3) provide guidelines for choosing the most appropriate risk management strategies, including risk mitigation and prevention measures.

Implementing Organisation & Funding Bodies:

The project team composed of 27 institutions from 12 European countries is coordinated by Norwegian Geotechnical Institute (NGI) and 26 end-user organizations from 11 european countries

(http://www.safeland-fp7.eu/Pages/Top%20menu%20entries/Consortium.aspx)

Collaborative research project funded by The Seventh Framework Programme for research and technological development (FP7) of the European Commission.

Results and Significant Impacts of the Study:

- Various guidelines related to landslide triggering processes and run-out modelling.
- Development and testing of several empirical methods for predicting the characteristics of threshold rainfall events for triggering of precipitation-induced landslides, and development of an empirical model for assessing the changes in landslide frequency (hazard) as a function of changes in the demography and population density.
- Guidelines for landslide susceptibility, hazard and risk assessment and zoning.
- New methodologies for physical and societal vulnerability assessment.

- Identification of landslide hazard and risk hotspots for Europe. The results show clearly where areas with the largest landslide risk are located in Europe and the objective approach allows a ranking of the countries by exposed area and population.
- Different regional and local climate model
- Simulations over selected regions of Europe at spatial resolutions of 10x10 km and 2.8x2.8 km. These simulations were used to perform an extreme value analysis for trends in heavy precipitation events, and subsequent effects on landslide hazard and risk trends.
- Guidelines for use of remote sensing techniques, monitoring and early warning systems.
- Development of a prototype web-based "toolbox" of innovative and technically appropriate prevention and mitigation measures. The toolbox does a preliminary assessment and ranking of up to 60 structural and non-structural landslide risk mitigation options.
- Case histories and "hotspots" of European Land¬slides have been collected and documented. Data for close to fifty potential case study sites have been compiled and summarized. Most of the case study sites are located in Europe (Italy, France, Norway, Switzerland, Austria, Andorra, and Romania); but they also include one site in Canada and one in India. Almost every type of landslide and every type of movement is represented in these sites.
- Research on stakeholder workshops and participatory processes to involve the population exposed to landslide risk in the decision-making process for choosing the most appropriate risk mitigation measure(s).

Region(s) of Implementation with Geographical coordinates (if applicable):

- Slănic and Telega sites from Prahova County, Romania
- territory of the National Basin Authority of "Liri-Garigliano" and "Volturno" rivers, Central-Southern Italy by UNISA
- two study areas belonging to the territory of the National Basin Authority of "Liri-Garigliano and Volturno" rivers
- San Pietro in Guarano (Cosenza Province, southern Italy)
- Kato Achaia slope in western Greece
- roadway system of Grevena city, Greece

Size of application:

Regional – local and site specific scales

List of Bibliographical References:

1. Landslide Monitoring Technologies & Early Warning Systems – Current Research and Perspectives for the Future, workshop held in Vienna in February 2010;
2. Remote sensing and monitoring, workshop held in Florence in May 2011;

3. 2nd Conference on Slope Tectonics, held in Vienna in September 2011 (http://www.geologie.ac.at/slope_tecto_2011/) with the support of the SafeLand Project;
4. 6th LARAM Workshop "SafeLand (EU FP7 ProJECT - Living with landslide risk in Europe), held in Salerno (Italy) in 2011 and attended by PhD students, researchers, technicians, decision makers and authorities in charge of the territory governance in Italy and Europe (http://www.laram.unisa.it/workshop/index).
5. http://www.safeland-fp7.eu/

2. SYNARMA Project

Acronym:

SYNARMA Project

Title of the Study:

Information System for Natural Risk Managment in the Mediterranenan

Period (Dates) of the Study:

June 2006 – August 2008

Scope and Objectives of the Study:

The main objectives of the SyNaRMa project are:

- To Build a web-based user friendly GIS system for natural risks management that will require minimum training, technical and scientific expertise by its potential users, easily operational by even small sectors of the Civil Protection mechanism (e.g. municipalities).
- To Provide an on-line procedure for earthquake intensity data surveys after strong earthquakes.
- To Set up common strategies, terminology and methods for preparedness and response to natural disasters
- To Training people involved in relevant matters with open seminars and workshops.

Implementing Organisations& Funding Bodies:

Implemented by Aristotle University of Thessaloniki – AUTh, Technological Educational Institute of Larisa, Branch of Karditsa, Department of Forestry and Management of Natural Environment, Institute of Engineering Seismology and Earthquake Engineering, National Technical University of Athens - NTUA , Prefecture of Thessaloniki, Municipality of Grevena (GREECE), University of Messina, Inter-Universitary Consortium for Prevention and Protection from Risks, Messina – CONPRICI, University of Calabria (ITALY) and Royal Scientific Society (JORDAN) .

Funded by ERDF and governments of EU and non EU members.

Results and Significant Impacts of the Study:

The project's main results and outputs are the following:

- Web Based GIS tool for free use
- Cross-country collaboration
- Transfer of know-how between partners
- On-line collection of earthquake intensity data
- Scientific pilot studies

Region(s) of Implementation with Geographical coordinates (if applicable):

1. Grevena (Western Macedonia-Greece)
2. Messina, Sicily (Italy)

Geographical coordinates: 39.75^o N, 21.25^o E to 40.25^{o}N, 21.50^{o}E

Size of application:

Regional

List of Bibliographical References:

1. Savvaidis P., I.N. Tziavos, V. Grigoriadis (2006). Management of Natural Disasters with the Use of GIS Systems, "HERMES Week of Technology 2006", HELEXPO, September 8-17, Thessaloniki, Greece (in Greek).

2. Savvaidis P. (2006). Cities and Natural Disasters: Estimation and Management of Seismic Damage to Buildings, Conference on Seismic Risk for the City of Florina, September 30, Florina, Greece, 2006.

3. Savvaidis P. (2006). Use of Information and Communication Technologies for the management of the impact of Natural Disasters, Conference organized by the Geo-Impact Thematic Network on Natural Disasters of the Aristotle University of Thessaloniki, December 2006 (in Greek).

4. Savvaidis P., Tziavos I., Doukas I., Papadopoulou I., Grigoriadis B., Spiridaki P., Use of web-GIS for the confrontation of natural disasters in cities, SPMIT2007 Conference, Ostrava, Czech Rep., 7-8 June, 2007.

5. Doukas, I.D., Savvaidis, P., Tziavos, I.N, Grigoriadis, V.N., Papadopoulou, I. and Vavassis I.The use of a Web-based GIS for the management of databases related to natural disasters, Geodesy and Cartography, 56 (1), pp. 37-52, 2007.

6. Grigoriadis V. N., I. D. Papadopoulou, P. Spyridaki, I. Doukas, I.N. Tziavos and P. Savvaidis (2008). Presentation of a web-based gis system for the management of natural disasters, International Conference "Studying, Modeling and Sense Making of Planet Earth" on 1 – 6 June, Department of Geography, University of the Aegean in Mytilene, Lesvos, Greece, 2008.

7. Sotiriadis T. (2007). Disaster Management Systems, 17th Panhellenic GIS Meeting, Marathon Data Systems, 7-9 November 2007, Athens, Greece (in Greek).

8. Grigoriadis V., Papadopoulou I., Spiridaki P., Doukas I., Tziavos I., Savvaidis P., 2007. Disaster Management Systems – The SyNaRMa system. Workshop "Prevention – Management of Natural Disasters". The role of the Rural and Surveying Engineer”, Hellenic Association of Rural and Surveying Engineers, December 11, Athens, (in Greek).

9. Grigoriadis, V.N., Papadopoulou, I.D., Savvaidis, P., Tziavos, I.N. Collection, management and analysis of building damage information in the urban environment through Web-GIS, EGU General Meeting 2008, EGU2008-A-11878; NH5.6-1TU5P-0394, 2008.

10. Savvaidis P., Web-based systems for management of natural disasters. Workshop "Environment: From education to action", Post-graduate course in the Dept. of Civil Engineering, AUTh, Thessaloniki, May, 2008 (in Greek).

11. Eftichidis G., Varela S., Vergos S., Tzanou E., Kavraki I., Melliadis I. Analysis of fire propagation patterns in the National Park Valia Kalda in Pindus Mountain using the G-FMIS fire simulator , 13th National Conference for forestry "Development of mountainous areas - Protection of the natural environment", 8-10 October, Kastoria, Greece, 2007.

12. Karakostas C., Lekidis B., Salonikios G., Makarios, Sous. Pre-seismic inspection of public buildings at Grevena as a component of a Disaster Management System. 3rd Panhellenic Conference of Antiseismic Engineering and Technical Seismology, 5-7 November, Athens, Greece, 2007 (in Greek).

13. Anthimidis I., Theodulidis N., Savvaidis A., Papazachos K. Χαρακτηρισμός Εδαφικών Συνθηκων με τη Χρήση Εδαφικού Θορύβου στην Πόλη των Γρεβενών, 3rd Panhellenic Conference of Antiseismic Engineering and Technical Seismology, 5-7 November, Athens, Greece, 2007 (in Greek).

14. Kirytopoulos, K., Diamantas, V. and Leopoulos, V. 2007, ‘Incorporating risks in schedule development. You have the tools, can you get the info?’, proceedings of the 2007 PMI Global Congress EMEA, Project Management Institute, Budapest, Hungary, CD-Rom proceedings.

15. Analisi dello sciame sismico del 1985 nello Stretto di Messina con nuovi approcci metodologici: implicazioni sismotettoniche (Bottari A., Carveni P., D'Amico M., Neri G., Orecchio B., Presti D.), National Conference GNGTS, 28-30 November 2006 (Rome) (in Italian).

16. Confronti fra sismicità crostale e dati geologici per l'individuazione di strutture sismogenetiche in Calabria: L'esempio della sequenza di Rogliano (2001), (Orecchio B., Gervasi A., Guerra I., Moretti A., Neri G, Presti D., Valensise G.), National Conference GNGTS, 28-30 November 2006 (Rome) (in Italian).

17. Sismicità e strutture sismogenetiche del margine compressivo sud-tirrenico, (Presti D., Billi A., Faccenna C., Neri G., Orecchio B.), National Conference GNGTS, 28-30 November 2006 (Rome) (in Italian).

18. Sismotettonica della Sicilia settentrionale: un caso di riorganizzazione di un margine convergente, (Billi A., Faccenna C., Neri G., Orecchio B., Presti D.), National Conference GNGTS, 28-30 November 2006 (Rome) (in Italian).

19. New seismotectonic evidences inferred from the study of 1985 Messina Straits seismic swarm by application of recent earthquake location algorithms, (D'Amico M., Bottari A., Carveni P., Neri G., Orecchio B.,Presti D.), International Conference AGE, October 2006 (Messina).

3. System Development on Monitoring Slope Stability for the Prevention of Landslides and Training of Local Public Authorities in the Region of Peloponnisos

Title of the Study:

System Development on Monitoring Slope Stability for the Prevention of Landslides and Training of Local Public Authorities in the Region of Peloponnisos

Period (Dates) of the Study:

2010-2011

Scope and Objectives of the Study:

Scope of the project is to enhance the adequacy and administrative capacity of the responsible local public authorities for the effective prevention and response to landslide phenomena and the protection of the citizens and the natural and residential environment of the region of Peloponnisos, through the development of a pilot permanent system for monitoring selected areas that face recurrent problems of slope stability based on satellite observations and using the most advanced technology available today, as well as through the training of local public authorities in using this technology.
Objectives of the project are:

1. Protection of the natural and urban environment and infrastructures against landslides,
2. Development of a sustainable system for monitoring ground movements and support to the quick and easy expansion of the system after the end of the project,
3. Reinforcement of local authorities in order to mitigate geo-hazards without the help of the central government,
4. Training and active participation of civil servants for the mitigation of landslides,
5. Raising the awareness on new technologies and new capabilities for an effective protection of the natural environment and the citizens.

Implementing Organisation & Funding Bodies:

Implemented by the Institute of Geodynamics of the National Observatory of Athens and local authorities of the region of Peloponnisos
The project is supported by a grant from Iceland, Liechtenstein and Norway through the EEA financial mechanism (50%) and from the public investments programme of the Hellenic Republic (50%)

Results and Significant Impacts of the Study:

1. Protection of the natural and urban environment and infrastructures against landslides,
2. Sustainable system for monitoring ground movements
3. Reinforcement of local authorities in order to mitigate geo-hazards without the help of the central government,
4. Training and active participation of civil servants for the mitigation of landslides,
5. Raising the awareness on new technologies and new capabilities for an effective protection of the natural environment and the citizens

Region(s) of Implementation with Geographical coordinates (if applicable):

Region of Peloponisos

List of Bibliographical References:

www.landslides.gr

4. Landslide Early Warning Integrated System

Acronym:

LEWIS Project

Title of the Study:

Landslide Early Warning Integrated System

Period (Dates) of the Study:

2002-2005

Scope and Objectives of the Study:

The main objective of the LEWIS project has been the development of a prototype landslide warning service based on the integration of comparatively low-cost, wide-area satellite data with ground data in order to detect significant surface changes which are taking place on landslide susceptible areas. The system has been designed to monitor and watch over wide areas rather than a single landslide. It thus helps to pinpoint locations that have an increasing tendency towards slope instability, where more detailed and costly ground investigations might be required.

To this end LEWIS consortium has i) integrated multidisciplinary research expertise in remote sensing and in geological, physical and computing science, ii) created a very efficient link among scientific – academic institutions, companies and potential future providers for EO data processing and specialized services, and iii) improved collaboration with the administrations participating in the consortium as providers of territorial knowledge.

Implementing Organisations& Funding Bodies:

Bari Polytechnic University, Italian National Research Council- CNR IRPI Institute and CNR ISSIA Institute, Bari University, National Observatory of Athens Institute of Geodynamics, University of Surrey, Altamira Information sl, Planetek Italia s.r.l., SILOGIC, Canada Centre for Remote Sensing.

LEWIs was a FP5 research project.

Results and Significant Impacts of the Study:

At the end of the project, five chief products have been identified which may be of interest for deployment in a variety of practical situations:

- The Watch map: all the information, static and dynamic, collected from EO and from ground networks and included in the GIS after all processing but before the application of the inference engine. This is intended to be given to academic and research institutions for scientific purposes, perhaps even transcending that of landslide applications.
- The susceptibility map, which consists of a "zonation" of the area into seven levels of susceptibility based on the static information (slope, lithology, geology, past landslide activity,...) extracted from EO and field data.
- The warning map or updateable susceptibility map, which is the final product highlighting seven levels of warning. The warning map is based on the small displacement information coming from the Permanent Scatterers detection using SAR Interferometry and on the outcomes of the inference engine, incorporating detected land use changes and automating expert competences in recognizing areas of increasing landslide hazard.
- The GIS module, which includes the innovative models for producing both the susceptibility and warning maps. It could thus also constitute the basis for an integrated marketable product for landslide warning.
- The user Consultation enhancer, which is based on a visualization and analysis tool of the Permanent Scatterers. This is a support tool dedicated to all kinds of customers interested in landslide studies. This could also be deployed as a standalone product.

Region(s) of Implementation with Geographical coordinates (if applicable):

North Western Peloponisos (Panagoula and Pititsa)

Size of application:

Local to Site specific (1:5000)

List of Bibliographical References:

1. Landsliding phenomena in NW Peloponnese, Greece: a test-site of the EC LEWIS research project. G.A. Papadopoulos, A. Ganas and I. Koukouvelas. EGU Geophysical research abstracts, Vol. 8, 04402, 2006

5. Other References

1. Corominas J., C. van Westen, P. Frattini, L. Cascini, J.-P. Malet, S. Fotopoulou, F. Catani, M. Van Den Eeckhaut, O. Mavrouli, F. Agliardi, K. Pitilakis, M. G. Winter, M. Pastor, S. Ferlisi, V. Tofani, J. Herva´s, J. T. Smith (2013). Recommendations for the quantitative analysis of landslide risk. Bull. Eng. Geol. Environ., DOI 10.1007/s10064-013-0538-8

2. Ferentinou M.D. and M.G. Sakellariou (2007): "Computational Intelligence tools for the prediction of slope performance", Invited paper in "Computers and Geotechnics", Special Issue on "Biologically Inspired and other Novel Computing Techniques in Geomechanics", 34(5), pp. 362-384

3. Ferentinou M., Chalkias Ch., Sakellariou M. (2010): "Landslide susceptibility mapping in national scale and preliminary risk analysis applying computational methods in a GIS environment", 9th Panellenic Conference of Geography, pp 682-689.

4. Hadzinakos, I., Yannacopoulos, D., Faltsetas, C. & Ziourkas, K.(1991) Application of the decision support system to the evaluation of landslide favourability in Greece. In: P.C. Bell and R.M. O'Keefe (Editors), Expert Systems and Decision Support Methodology. European Journal of Operational Research, 50(21), 61-75.

5. Koukis, G., Sabatakakis, N., Nikolau, N., Loupasakis, C., 2005. Landslide Hazard Zonation in Greece. In Kyoji Sassa, Hiroshi Fukuoka, Fawu Wang and Gonghui Wang (eds.) Landslides Risk Analysis and Sustainable Disaster Management. Springer: Berlin Heidelberg

6. Kouli M., C. Loupasakis, P. Soupios, D. Rozos, and F. Vallianatos (2013) Comparing multi-criteria methods for landslide susceptibility mapping in Chania Prefecture, Crete Island, Greece. Nat. Hazards Earth Syst. Sci. Discuss., 1, 73-109.

7. Margaris B., C. Papaioannou, N. Theodoulidis, A. Savvaidis, A. Anastasiadis, N. Klimis, K. Makra, M. Demosthenous, C. Karakostas, V. Lekidis, T. Makarios, T. Salonikios, I. Sous (ITSAK), P. Carydis, (NTUA), E. Lekkas, S. Loizos, E. Skourtsos and G. Danamos (UoA), EERI Special Earthquake Report. Preliminary Observations on the August 14, 2003 Lefkada island (Western Greece) earthquake. Joint report by Institute of Engineering Seismology & Earthquake Engineering, National Technical University of Athens & University of Athens, Nov. 2003.

8. Margaris B., G. Athanasopoulos, G. Mylonakis, Ch. Papaioannou, N. Klimis, N. Theodulidis, A. Savvaidis, V. Efthymiadou and J. P. Stewart (2010), 'The 8 June 2008 MW6.5 Achaia-Elia, Greece earthquake: source characteristics, ground motions and ground failure', Earthquake Spectra, Vol. 26 No 2 p. 399-424, May 2010.

9. Moutsokapas Pr. (2007). Geotechnical hazards assessment methods. Evaluation and application to Magnesia Prefecture, MSc thesis,

10. Moutsokapas Pr., Papatheodorou K., Margaris B., Klimis N. (2010). Landslide hazard pre-estimation methods using Geographic Information Systems: method evaluation and implementation in Magnissia prefecture. Proc. Hellenic Conference on Geotechnical and Geoenvironmental Engineering, Volos, Greece

11. Papathanassiou G., Valkaniotis S., Ganas A., Pavlides Sp. (2012). GIS-based statistical analysis of the spatial distribution of earthquake-induced landslides in the island of Lefkada, Ionian Islands, Greece. Landslides, DOI 10.1007/s10346-012-0357-1.

12. Polikretis Ch. (2010). Application of GIS to Landslides in Peloponnese. Diploma thesis, Department of Geography, Harokopio University

13. Rozos, D. – Tsagaratos, P. - Markantonis, K. – Skias, S. 2006. An application of Rock Engineering System (R.E.S.) method for ranking the instability potential of natural slopes in Achaia County, Greece. XIth International Congress for mathematical Geology – Quantitative Geology from multiple sources, in Liege - Belgium. S08-10 paper in CD, 6p. Belgium.

14. Rozos, D., Pyrgiotis, L., Skias, S. Tsagaratos, P. 2008. An implementation of rock engineering system for ranking the instability potential of natural slopes in Greek territory. An application in Karditsa County. Landslides, vol 5, pp 261-270, Springer – Verlang

15. Tsagaratos P. (2012). Engineering geological behaviour of geologic formations using GIS. PhD Thesis, School of Mining Engineering and Metallurgy, NTUA

16. Vasiliadis E. (2010). Landslide hazard zoning in Greece. Development and application of GIS models. PhD thesis, Department of Geology, University of Patras.

17. Volioti K.G. (2009). Landslide hazard zoning in continental Greece using GIS – small scale mapping. Diploma Thesis, School of Rural and Surveying Engineering, NTUA

6.3 BULGARIA

1. Raynova K. C. Raynova, *Geo-ecological risk of erosion in the Bulgarian section of the Danube*, Annual Mining and Geology "St. Ivan Rilski ", Volume 46, Part I, Geology and Geophysics, Sofia, 2003, str.323-325

2. Ninov P., *Categorization of the Bulgarian Danube River Tributaries*, XXI Conference of the Danube Countries, Bucharest, 2002, CD.

3. Kirova J., *Groundwater - a Real Potential Possibility of Overcoming Water Supply Insufficiency in the Bulgarian Northwest Territory*, UACEG-Jubilee Scientific Conference, 2002, vol.7, 193-200.

4. Fregov G., *Mine regularities in the distribution of technogenic landslides in Bulgari*a, Review of the Bulgarian Geological Society, vol. LI, part 3, 1990

6. Mitev R. *Methodological guidance for calculating sustainability sustainability of boards of mines and slopes of nasipishtatav East basin coal*, Coal 8, pp.36-40, 1984

7. Stoikov, D., D. Evstatiev. *The landslide in the "panorama" resort zone near varna city*. Eng. geol. and hydrogeol., vol. 13, 20-32, 1983.

The article describes the results of engineering geological, hydrogeological and geodesic studies and measurements. The scope of the landslide there monitoring network, including superficial and deep benchmarks and piezometric wells. Relationship has been found between the increase in the level of groundwater and the activation of the landslide.

8. Evstatiev, D., V. Rizzo.. *Sull'origine ed evoluzione delle frane nella zona di balchik sul mar nero (bulgaria)*. - Geologia Applicata e Idrogeologia, vol. XIX, 289 – 305, 1984

Geological and geomorphological studies were carried out on Balchik landslide. These include a comparison of old prints and contemporary photographs, analysis of available geodetic data, results from previous studies and geomorphological mapping. Landslide block type and occurred in the Sarmatian sediments

9. Evstatiev, D., G. Frangov, P. Varbanov. *Landslide activation along the Northern Black Sea cost – causes, consequences and lessons*. Rev. Bulg. Acad. Of Sci.,3-6, 22-27, . 1997

10. Varbanov, R., G. Frangov, D. Evstatiev.. *New catastrophic landslides northward from the city of Varna. – Minno delo I geologia*, 5, 6-12, 1997

In the period April 2006-April 2007 Northern Black Sea Coast activated a number of old and new landslides. Their volume is evaluated between 0.2 and 1.0 million m3, the depth of the landslide surface is between 5 and 20 m. The main factor for their occurrence is rising groundwater level water, due to the unusually high rainfall, the water accident network and the absence of drainage the slope for drainage of waste water.

11. Evstatiev, D., V. Petrova. *On the effect of the ground water level on landslide activation*. In: Proc. National conference "Geosciences 2006", Bulg. Geoph. Soc. and Bulg. Geol. Soc., 269-272, 2006

> The influence of rising groundwater levels and seismic intensity on the coefficient of resistance of a landslide near the village Topola, Kavarna was analyzed. The main landslide surface (with an inclination towards the sea 2-30) travels over the surface of diatoms clays of Evksinovrad Formation, and the landslide body is made of aragonite violated material Topolski Formation. coefficient is calculated using the method of resistance to Shahunyants seismic intensities I = VII, VIII and IX degree Medvedev-Shponhauer.

12. D. Evstatiev, Y. Evlogiev, D. Karastanev, K. Stoykova. *The landslides in the valley of Batova River between the villages of Kranevo and Rogachevo (North Black sea coastline)*. – Rev. Bulg. Geol. Soc., 71, 1-3, 41-58, 2010.

> Describe the results of engineering studies of unexplored far landslides along the right slope of the valley of the Batovska between villages and plots Golf. Studies are caused by expansion of the resort construction.

13. Evlogiev, Y., D. Evstatiev. *New geological model of the landslides between the villages of Kranevo and camping-site "Panorama" (North Black sea coast, R. Bulgaria)*. – Engineering geology and Hydrogeology, 26, 3-26,2012

> The paper reveals a new geological model for landslides between Kranevo and camping "Panorama". According to existing concepts exist on a single landslide plateau to the sea with deep landslide surface developed in clay Evksinovrad suite and main landslide gave coincide with fault structures. Under the new model, landslides are not related, but are superimposed on three levels (floors). The highest floor of landslide block type, and the lower floors are delapsivni landslides.

14. The site ecatalog.nbu.bg/default.asp?V_Year...P... shows 115 publications of the Professor Tsenko Tsenkov on geodetic measurements and testing of slipping processes involving deformation analysis and results of geodetic measurements.

15. Bruchev, I., Dobrev, N., Frangov, G., Ivanov, Pl., Varbanov, R., Berov, B., Nankin, R., Krastanov, M. *The landslides in Bulgaria — factors and distribution*. — Geologica Balc. 36, 3—4; 3—12, 2007.

> The regional distribution of the landslides according to their volume shows that landslides with a volume up to 10 million m3 are the prevailing type in the country. The most numerous landslides in this group — about 50% of the total number — are observed along high Danubean Bank and Northern Black Sea coast, in the tectonically active grabens as Sofia, Pernik or Simitli and the landslides along some of the faults in the Strouma zone. The largest landslides with a volume of more than 100 million m3 are encountered along the Danubean Bank, the Northern Black Sea coast and in Rhodope Region.

16. Nankin R., N. Dobrev *Landslide phenomena near the Oranovo Coal Mine, SW Bulgaria*, Review of Bulgarian geological society, vol. 70, part 1—3, 2009, p. 125—134

Oranovo coal mine is located in the eastern part of Simitli Town, about 15 km south of Blagoevgrad Town, SW Bulgaria. The development of landslide phenomena almost simultaneously started with the development of coal exploitation began in the 1970's. The first landslide events occurred in 1976, which are gradually expanding and increasingly affect the more significant areas. 16 landslides are mapped in this area. The mining activity is the main triggering factor at 6 landslides.

6.4 ROMANIA

1. RAMSOIL Project

Acronym:

RAMSOIL

Title of the Study:

Risk Assessment Methodologies for Soil Threats

http://eusoils.jrc.ec.europa.eu/projects/Ramsoil/

Period (Dates) of the Study:

2007-2010

Scope and Objectives of the Study:

- the general objective of the RAMSOIL project was to provide scientific guidelines on possibilities for EU wide parameter harmonization based on detailed information on current risk assessment methodologies of soil threats encountered within EU Member States.
- The selected soil threats were erosion, salinisation, organic matter decline, compaction and landslides.
- In RAMSOIL current risk assessments methodologies used in the EU were collected and evaluated.

Implementing Organisation & Funding Bodies:

EU-25 Member States consist of the following countries: Belgium, France Germany, Italy Luxembourg, The Netherlands, Denmark, Ireland, U.K., Greece, Portugal, Spain, Austria, Finland, Sweden, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia. The two added countries are Bulgaria and Romania

Within the project, for Romania, NATIONAL RESEARCH AND DEVELOPMENT INSTITUTE FOR SOIL SCIENCE AGRO-CHEMISTRY AND ENVIRONMENT - ICPA Bucureşti has elaborated methodology for estimating the areas with risk for three types of soil degradation analyzed: compaction, salinisation, erosion.

Results and Significant Impacts of the Study:

- the current status of RAMs for erosion, soil organic matter decline, compaction, and salinization in the European Union (EU27) is reviewed
- the need and the options for harmonization are assessed.

Region(s) of Implementation with Geographical coordinates (if applicable):

Romania

Size of application:

National level and county level

List of Bibliographical References:

1. Christy van Beek and Gergely Tóth (eds.), 2012, Risk Assessment Methodologies of Soil Threats in Europe. Status and options for harmonization for risks by erosion, compaction, salinization, organic matter decline and landslides.

http://eusoils.jrc.ec.europa.eu/ESDB_Archive/eusoils_docs/Other/EUR24097.pdf

2. For Romania case study:

http://eusoils.jrc.ec.europa.eu/projects/Ramsoil/Results/WP4/PR41casestudyromania.pdf

2. SAFELAND Project

Acronym:

SAFELAND

Title of the Study:

Living with landslide risk in Europe: Assessment, effects of global change, and risk management strategies

http://www.safeland-fp7.eu/

Period (Dates) of the Study:

1 May 2009 - 30 April 2012

Scope and Objectives of the Study:

(1) provide policy-makers, public administrators, researchers, scientists, educators and other stakeholders with an improved harmonised framework and methodology for the assessment and quantification of landslide risk in Europe's regions;

(2) evaluate the changes in risk pattern caused by climate change, human activity and policy changes;

(3) provide guidelines for choosing the most appropriate risk management strategies, including risk mitigation and prevention measures.

Implementing Organisation & Funding Bodies:

The project team composed of 27 institutions from 12 European countries is coordinated by Norwegian Geotechnical Institute (NGI). From Romania, the responsible institution was Geological Institute of Romania.

Administrative authorities.

Collaborative research project funded by The Seventh Framework Programme for research and technological development (FP7) of the European Commission.

Results and Significant Impacts of the Study:

- Various guidelines related to landslide triggering processes and run-out modelling;
- Guidelines for landslide susceptibility, hazard and risk assessment and zoning; The results show clearly where areas with the largest landslide risk are located in Europe;
- Identification of landslide hazard and risk hotspots for Europe

Region(s) of Implementation with Geographical coordinates (if applicable):

- Slănic and Telega sites from Prahova County, Romania
- territory of the National Basin Authority of "Liri-Garigliano" and "Volturno" rivers, Central-Southern Italy by UNISA
- two study areas belonging to the territory of the National Basin Authority of "Liri-Garigliano and Volturno" rivers
- San Pietro in Guarano (Cosenza Province, southern Italy)
- Kato Achaia slope in western Greece
- roadway system of Grevena city, Greece

Size of application:

local scale - small scale (1:100.000) 1:25.00 detailed scale

List of Bibliographical References:

1. the open workshop on "Landslide Monitoring Technologies & Early Warning Systems – Current Research and Perspectives for the Future" held in Vienna in February 2010;

2. the SafeLand workshop on Remote sensing and monitoring held in Florence in May 2011;

3. the 2nd Conference on Slope Tectonics held in Vienna in September 2011 (http://www.geologie.ac.at/slope_tecto_2011/) with the support of the SafeLand Project;

4. the 6th LARAM Workshop "SafeLand (EU FP7 ProJECT - Living with landslide risk in Europe", held in Salerno (Italy) in September 2011 and attended by PhD students, researchers, technicians, decision makers and authorities in charge of the territory governance in Italy and Europe (http://www.laram.unisa.it/workshop/index).

3. CHANGES Project

Acronym:

CHANGES

Title of the Study:

Changing Hydro-meteorological Risks as Analyzed by a New Generation of European Scientists

Period (Dates) of the Study:

2011-2014

Scope and Objectives of the Study:

- The main objective of project is how global changes, related to environmental and climate change as well as socio-economical change, will affect the temporal and spatial patterns of hydro-meteorological hazards and associated risks in Europe;
- how these changes can be assessed, modeled, and incorporated in sustainable risk management strategies, focusing on spatial planning, emergency preparedness and risk communication

Implementing Organisation & Funding Bodies:

include 11 partner institutions that host one or more researchers and 6 associate partners that co-supervise research projects, offer internships and participate in CHANGES network events. Romanian partner is the Institute of Geography - Romanian Academy.

Funded by the European Community's 7'th Framework Programme

Region(s) of Implementation with Geographical coordinates (if applicable):

- four pilot study sites where hazards are currently evident and some risk management procedures have already been implemented.
- The study areas are located in the French Alps(Ubaye and Tinée vqlleys), North Eastern Italy (Friuli, Venezia and Giulia regions) , Romania and Poland (Wieprzowska catchment).
- Case study chosen from Romania is Buzău County

List of Bibliographical References:

1. Malek Ž., Patt A., Schröter D. (2012). Identification of Ecosystem Services in the Subcarpathians of Buzău County in Romania. Conference proceeding at the Forum Carpaticum 2012

(http://www.changes-itn.eu/Portals/0/Publications/malek%20schroeter%20patt_FC2012.pdf)

2. Malek Ž., Patt A., Schröter D. (2012), Analysing recent land use change with respect to ecosystem services provision in mountain areas. Poster presentation at the ECOCHANGE Final conference, Zurich

4. CLAVIER Project

Acronym:

CLAVIER

Title of the Study:

CLimate ChAnge and Variability: Impact on Central and Eastern EuRope

http://www.clavier-eu.org/?q=node

Period (Dates) of the Study:

2006 - 2009

Scope and Objectives of the Study:

- Assessment of the impact of climate change on extreme events.
- Assessment of the impact of the summer drying problem (SDP) on the simulation of extreme events
- Analysis of the impact of different climate model resolutions on the representation of extreme events.
- Assessment of the potential impacts of climate change on forestry and water management, soil and agriculture on specific hydrological basins which could be affected by extreme events

Implementing Organisation & Funding Bodies:

Three representative CEE Countries are studied in detail: Hungary, Romania, and Bulgaria.

Supported by the European Commission's 6th Framework Programme.

List of Bibliographical References:

1. Balteanu, D., V. Chendes, M. Sima, P. Enciu, 2009, A country level spatial assessment of landslide susceptibility in Romania, Geomorphology, Special Issue "Landslides, Floods and Global Environmental Change in Mountain Regions", Elsevier, Netherlands.

2. Bălteanu, D, M. Micu, 2009, Landslide investigation: from morphodynamic mapping to hazard assessment. A case-study in the Romanian Subcarpathians: Muscel Catchment, in vol.: Landslide processes: from geomorphologic mapping to dynamic modeling, CERG Editions, Strasbourg, France.

5. GIS – based elaboration of hazard maps and assessment of the quality of the environment in the mining areas of Maramures and Satu Mare counties.

Acronym:

GIS

Title of the Study:

GIS – based elaboration of hazard maps and assessment of the quality of the environment in the mining areas of Maramures and Satu Mare counties.

Implementing Organisation & Funding Bodies:

Institute of Geography - Romanian Academy.

List of Bibliographical References:

1. Bird, G., Macklin, M.G., Brewer, P.A., Zaharia, S., Bãlteanu, D., Driga, B., Serban (Sima), Mihaela (2009), Heavy metals in potable groundwater of mining-affected river catchments, northwestern Romania, Environ.Geochem. Health, volume 31, no. 6.

6. ILUSTRO Project

Acronym:

ILUSTRO

Title of the Study:

Integrated landslide detection system using ground and space-borne monitoring techniques in Romania

http://www.ccias.utcb.ro/en/projects.html

Period (Dates) of the Study:

19 november 2012 - 18 november 2015

Scope and Objectives of the Study:

The project aims at monitoring a known landslide site using satellite InSAR measurements and, through comparison, to validate them, using the classical survey methods. The project is oriented towards filling the gap in this area of expertise at a national level and by providing an example of "know-how" and the economic and technical impact such a technique may have.

This project may become a starting point for the development of further monitoring techniques and projects, involving large areas or distances to be covered, proper to national importance projects such as highways, which are currently under development. The civil engineering activities imply a wide range of monitoring works to confirm the validity of the design. The application of the InSAR measurements in displacements assessment of landslides can be extrapolated, after validation and determining its limitations on a wider area of monitoring cases.

The application of satellite surveillance in the field of soil mechanics represents a niche research in Romania and, although several studies have been published worldwide, the results are still in discussion and are not a common practice.

Implementing Organisation & Funding Bodies:

The association between UTCB and ASRC represents a multidisciplinary effort combining the field of expertise in Soil Mechanics, Hydrogeology and InSAR data processing, the results of this project representing an increase in the level of fundamental research in both fields of research. The association will improve the relations between these two entities, creating the environment for the development of future research projects. Since in the project shall work a number of doctoral students and young researchers, the opportunity of creating a new generation of scientists worth to be mentioned.

7. MONITOR II Project

Acronym:

MONITOR II

Title of the Study:

Practical Use of MONITORing in Natural Disaster Management

http://www.monitor2.org/downloads/MONITORII_WP5_PP6_Methodology%20for%20update%20of%20hazard%20maps.pdf

Period (Dates) of the Study:

2009-06 / 2012-05

Scope and Objectives of the Study:

Methodology for Preparation/Updating of hazard maps and plans of defence against natural hazards in Romania

Implementing Organisation & Funding Bodies:

South East EUROPE

Transnational Cooperation Programme

EUROPEAN REGIONAL DEVELOPMENT FUND

ROMSILVA - National Forest Administration, Development Department

Results and Significant Impacts of the Study:

- Evaluation and recommendations brochure
- MONITOR II Brochure
- Monitor II Methodology
- Romanian folders (PP6) about: prevention of earthquakes, prevention of fire & fire fighting, prevention of floods, prevention of landslides

8. MOSYM Project

Acronym:

MOSYM

Title of the Study:

http://www.iptana.ro/romania/download%2055/Cap%208%20PROIECTE%20CERCETARE_DEZV.pdf

Period (Dates) of the Study:

2009-06 / 2012-05

Scope and Objectives of the Study:

Research on hazardous landslide processes, including their mechanisms, recurrence, distribution, and probability is the main activity of this project. The objective of our research is to improve understanding of the processes and develop physically based procedures for deterministic and probabilistic landslide hazard assessment.

9. TERRARISC Project

Acronym:

TERRARISC

Title of the Study:

Decision support system for landslide risk management in a geographical area with high risk for natural disasters

Period (Dates) of the Study:

2005-2008

Scope and Objectives of the Study:

The project will provide a technical solution for assessment of environmental parameters needed in landslide risk management using advanced technologies that will allow: - acquisition of data concerning the underground water level (sensors installed inside caissons),specific environmental parameters, data regarding relatival displacement of fitted terrestrial bench-marks (sensors for relatival displacement) ; - transmission of field data through wireless communication to a risk management center; - modeling and simulation for natural disasters risk assessment; - control and observation of risk factors regarding landslides, based on an advanced decision-support system using GIS technologies and business intelligence; - complex analysis of masive historic data and meteo and seismic forecasts, in order to identify the evolution trend (during given time periods) and foresee the risk of landslide and also to identify on a map critical areas; - automatic reporting about parameters evolution due to increased alarm/emergency quota; - interactive facilities for creating alarming strategies (actions, tasks, priorities) and generating emergency plans; - automatic alerting via Internet according to an emergency plan; - presenting information (text, maps) to action group members both on fixed (PC) and mobile devices (PDA, mobile phone).

Implementing Organisation & Funding Bodies:

ITC-SA and IPA SA (research-development institutions), Bucharest University – The Faculty of Geology and Geophysics (internationally creditable high-education institute) and SSI Bucovina (research-development company in the pilot area – Suceava)

Region(s) of Implementation with Geographical coordinates (if applicable):

Suceava

List of Bibliographical References:

1. Bomboe, P., Marunteanu, C. Geologie inginereasca, Universitatea din Bucuresti, 1986

2. Brachinger, H.W., M. Weber: Risk as a Primitive: a Survey of Measures of Perceived Risk, ORSpektrum, Spinger-Verlag, Berlin, 1997

3. Jia, J., Dyer, J.S.: A Standard Measure of Risk and Risk – Value Models. Working Paper, No. 1, Risk – Value Study Series, Department of Management Science and Information Systems, The Graduate School of Business, University of Texas at Austin, Management Science, 1995

10. The Vulnerability of Slopes to Landslides in the Subcarpathian Basin of Prahova

River, Project

Title of the Study:

The Vulnerability of Slopes to Landslides in the Subcarpathian Basin of Prahova River,

Period (Dates) of the Study:

2001-2003

Scope and Objectives of the Study:

Assessment of slopes vulnerability to landslides based on probabilistic computational model – Bayes theory

Implementing Organisation & Funding Bodies:

University of Bucharest-Faculty of Geography

Financed from the national budget

List of Bibliographical References:

Armas I, Damian R., Sandric I, Osaci-Costache G., 2003, The Vulnerability of Slopes to Landslides in the Subcarpathian Basin of Prahova River, Ed. Fundaţiei România de Măine, Bucureşti (book)

11. Individual research topics

1. Bãlteanu, D., Chendeş, V., Sima, M., Enciu, P. (2010), A country-wide spatial assessment of landslide susceptibility in Romania, Geomorphology, Special Issue "Recent advances in landslide investigation", vol. 124, issues 3-4, Elsevier.

2. Constantin, Mihaela, Bednarik, M., Jurchescu, Marta Cristina, Vlaicu, M. (2010), Landslide susceptibility assessment using the bivariate statistical analysis and the index of entropy in the Sibiciu Basin (Romania), Environmental Earth Sciences, Springer.

3. Francisco Gutierrez, Mauro Soldati, Franck Audemard and Dan Bãlteanu (2010), Recent advances in landslide investigation: Issues and perspectives, Geomorphology, Special Issue "Recent advances in landslide investigation", vol. 124, issues 3-4, Elsevier.

4. Constantin, Mihaela, Trandafir, C. Aurelian, Jurchescu, Marta, Ciupitu, D. (2009), Morphology and environmental impact of the Colţi-Aluniş landslide (Curvature Carpathian, Romania), Environmental Earth Sciences, vol. 59, 7.

5. Micu, M., Bãlteanu, D. (2009), Landslide hazard assessment in the Curvature Carpathians and Subcarpathians, Romania, Zeitschrift fur Geomorphologie, Suppl. 3, 53.

6. Betim Muco, Georgi Alexiev, Shyqyri Aliaj, Zenun Elezi, Bogdan Grecu, Neculai Mandrescu, Zoran Milutinovic, Mircea Radulian, Boyko Ranguelov, Defrim Shkupi, 2012, Geohazards assessment and mapping of some Balkan countries, Nat. Haz., 64:943–981

7. Grozavu, A., Mărgărint, M. C., and Patriche, C. V.: Landslide susceptibility assessment in the Brăiești-Sinești sector of Iași Cuesta, Carpath J. Earth Env., 7, 39–46, 2012.

8. Sandric, I., Chitu, Z., Mihai, B. and Savulescu, I. (2011) Landslide Susceptibility for the Administrative Area of Breaza, Prahova County, Curvature Subcarpathians, Romania, Journal of Maps, v2011, 552-563. 10.4113/jom.2011.1168.

9. Chitu Z, Sandric I, Mihai B, Savulescu I (2009) Evaluation of Landslide Susceptibility using Statistical Multivariate Methods. In: Landslide Processes from geomorphologic mapping to dynamic modelling (eds) Malet et al, CERG

10. Cheval S., 2004, Natural hazards in the South Dobrogea Platform and the adjacent littoral area, phD theses

11. Micu Alexandru Mihai ,2008, Assessment of landslide hazards in the Subcarpathians between the Buzău and the Teleajen Valleys, phD theses

6.5 UKRAINE

1. Coastal erosion and landslides long-term research (north-western part of the Black Sea coast)

Title of the Study:

Coastal erosion and landslides in the north-western part of the Black Sea coast

Period (Dates) of the Study:

1960-1987

Scope and Objectives of the Study:

Current Landslide Status for Odessa region

Factors affecting coastal line

Landslides mitigation and protective measures in Odessa region

Implementing Organisation:

Odessa I.I. Mechnikov National University

Department of Hydrogeology and Engineering Geology

State Project Development & Research Institute of Marine Transportation

"CHERNOMORNIIPROEKT"

Funding Bodies:

Odessa I.I. Mechnikov National University

Department of Hydrogeology and Engineering Geology

State Project Development & Research Institute of Marine Transportation

"CHERNOMORNIIPROEKT"

Results and Significant Impacts of the Study:

- Analysis of the landslide processes in the coastal line of Odessa region
- Modeling of geological processes in the Odessa coastal line
- Landslides Mitigation and Coast Protection Plan (for coastal line of Odessa region)

Region(s) of Implementation with Geographical coordinates (if applicable):

Odessa

Size of application:

Local, regional

List of Bibliographical References:

1. Ambrose J. A., Vasyutinskaya T.D., Zelinsky I.P. Landslides in north-western Black Sea coastal line and protective constructions. - Kiev, Odessa, 1979. - S. 61-64.

2. General scheme of landslide and bank protection measures on the Black Sea coast of the Ukrainian SSR / I. P. Zelinsky, L. A.Zayarny, V.P.Kuznetsov, L.B.Rozovsky. - Odessa, 1978. - 80.

3. Zelinsky I.P., Ilyushin V. J. Study of the Odessa landslides in connection with the construction of protective structures / / Hydrogeology and Engineering Geology of the arid zone of the USSR: Materials of Central Asian meeting on landslides studies and their mitigation - Dushanbe, 1968. - Issue. 12. - S. 92-97.

4. Zelinsky I.P, Cherkez E. A. Forecasting of landslide slope stability at the first phase of until-slides developments, Odessa // Geology of the coast and the bottom of the Black Sea and Azov Sea (within the limits of USSR). -1974. - Issue. 7. - S. 77 - 82.

5. Rozovski L. B., Zelinsky I. P., Voskoboynikov V. M. Engineering-and geological modeling and forecasts. - Kiev, Odessa, High School, 1987. - 208.

2. Landslides in the Odessa coastal line

Title of the Study:

Landslides in the Odessa coastal line

Period (Dates) of the Study:

1988-present

Scope and Objectives of the Study:

Current status of landslides in Odessa region

Factors affecting landslides activity

Implementing Organisation:

Odessa I.I. Mechnikov National University

Department of Hydrogeology and Engineering Geology

State Project Development & Research Institute of Marine Transportation

"CHERNOMORNIIPROEKT"

Funding Bodies:

Odessa I. I. Mechnikov National University

Department of Hydrogeology and Engineering Geology

State Project Development & Research Institute of Marine Transportation

"CHERNOMORNIIPROEKT"

Authority of engineering protection of the city and the coast (Odessa City Council)

Results and Significant Impacts of the Study:

Modeling of landslide processes

Innovative Landslide-Mitigation Measures in the coastal line of Odessa region

Region(s) of Implementation with Geographical coordinates (if applicable):

Odessa

Size of application:

Regional (coast of Odessa and the Odessa region)

List of Bibliographical References:

1. Voskoboynikov V. M. Application of geodynamic analysis and the method of generalized variables for estimation and forecasting of landslide stability of slopes (on the example of the Northern Black Sea) / Voskoboynikov V. M., Kozlov T. V. / / Engineering geology. - 1992. - № 6. - S. 34-48.

2. Zelinsky I. P. Civil Engineering as a tool to study the tectonic activity and discrete and geological environment. / Zelinsky I. P. , Kozlova T. V., Cerkez E. A., Shmuratko V. I./ / Soil Mechanics and Foundation Engineering. Proceedings of the 3d Ukrainian Scientific-Technical. Conf. on Soil Mechanics and Foundation Engineering. T. 1. - Odessa. - 1997. S. 53-56.

3. Zelinsky I.P. Landslides of north-west coast of the Black Sea, their study and prognosis. / Zelinsky I. P., Korzeniowski B. A., Cerkez E. A. and others / / -: Naukova Dumka. - 1993. - 228 p.

4. Zelinsky I. P., Korzeniowski B. A., Shatokhina L. N. Zoning and typing of landslides and landslide slopes of the north-western coast of the Black Sea for the purpose of forecasting and modeling. Preprint. / NAS USSR. Institute of Geology. Science. - Kiev, 1988. - 56.

5. Zelinsky I. P., Shatokhina L. N. Physical and mechanical properties of Meotic clay soils as the main deformable horizon of landslides of Odessa coast / / Engineering geology. - 1990. - № 3. - P.45-48.

6. Engineering Geodynamics of Ukraine and Moldova (landslide geosystems) in 2 volumes / ed. Rud'ko G. I. / Cherkez E. A.,Shatalin S. N. Laws of landslides in the Northern Black Sea coast. - Chernivtsi Bukrek, 2012 - Volume 2. - P.232-340.

7. Konikov E. G., Lihodedova O. G., Peda G. S. Assessing and predicting the dynamics of the coastal zone of the north-western part of the Black Sea on the basis of statistical data processing routine observations / / Bulletein of scientific papers of NGA of Ukraine. - Dnepropetrovsk: RICK NGA Ukraine. - 1999. - Volume 4, № 6. - P.183-188.

8. Konikov E. G., Pedan G. S., Tyuremina V., Cherkasov V. Dangerous exogenous geological processes in the south-western part of Ukraine (the method of study, assessment and forecasting) / / Bulletin of ONU. August. Geographical and geological sciences. - 2004. - Vol.9. - Is.4. - S. 180-187.

9. Cherkez E. A. The influence of seismic impact on the activation of landslides. (For example, landslides in the north-western regions of Odessa and Mykolaiv regions). / E. A. Cherkez, S. N. SHatalin, A. V. Fesenko / / Materials of 2nd scientific and technical conference "Current dangerous geological process. Impact in environment. New technologies of forecasting and protection". Kyiv. SPC "Ecology. Science. Technic" Ukraine - 2004. C.61-64

10. Cherkez E. A. Study of geodynamic phenomena in the city of Odessa with a range of geophysical and geotechnical monitoring observations / Cerkez E. A., Pylypenko M. N., Gutkovskiy V. N. / / Collection . "Geophysical studies in hydrogeology and engineering geology" / / Proc. GIDROINGEO. - Tashkent SAIGIMS, 1991. Part 1. - S. 137-142.

11. Cherkez E. A. Engineering Geodynamics sliding slopes and coastal protection issues in Odessa coast / Chrkez E. A., Koff G. L., Sokolov V. A. / / Proceedings of the International Conference Odessa, 7-11 September 2008 / / IPREEI , National Academy of Sciences of Ukraine. - Odessa: IPREEI National Academy of Sciences of Ukraine, 2008. - P. 19-31.

12. Shatalin S. M. Features of the distribution of landslides in the Odessa area / Shatalin S. // Bulletin of the Odessa National University, I. I. Mechnikov. - Odessa: Astroprint, 2001. - V. 6. - No. 9. - Geographical and geological sciences. - S. 156-164.

13. Cherkez E.A. Landslide protection of the historical heritage in Odessa (Ukraine). / Cherkez E.A., Dragomyretska O.V., Gorohovich Y. // Landslides, 2006, Vol. 3, number 4. Springer – Verlag 2006. pp. 303 – 309.

14. Freiberg E. Assessment of soil mass deformation and slope stability predictions of Odessa Port Plant / Freiberg E. & Bellendir E., G. Bich, E. Cherkez.// Proc. of the 11th congress of the international society for rock mechanics, Lisbon, Portugal, 9-13 July 2007. – P.268-271.

15. Freiberg E. The Impact of Structural-tectonic and Lithogenous Peculiarities of the Rock Mass on the Formation and Development of Geo-deformation Processes./ Freiberg E., Bellendir E., Golitsyn V., Ablyamitov N., Cherkez E., Tchujko E., Bich G.// Harmonizing of Rock Engineering and the Environment –12th ISRM International ccongress on rock mechanics. Beijing, China, 18-21 October 2011. – CRC PRESS / BALKEMA – P. 2047-2051.

3. Monitoring of landslides in Odessa and Mykolaiv regions

Title of the Study:

Monitoring of landslides in Odessa and Mykolaiv regions

Period (Dates) of the Study:

1986-1988

Implementing Organisation:

State regional geological enterprise “Prichernomorgeologiya”

Funding Bodies:

State regional geological enterprise “Prichernomorgeologiya”

Results and Significant Impacts of the Study:

Current status assessment of slopes stability in Odessa and Nikoaev regions

Maps of landslides

Analysis of landslides causes

Region(s) of Implementation with Geographical coordinates (if applicable):

Odessa

Nikolaev

Size of application:

Regional

List of Bibliographical References:

1. Study of landslides in Odessa and Mykolaiv regions in 1986-1988 Research report / GRGP "Prichernomorgeologiya." - № 39-86-46/30 GR. - Odessa, 1988. - 277 sec.

4. Studies of exogenous geological processes in Odessa, Nikolaev and Kherson regions

Title of the Study:

Exogenous geological processes in Odessa, Nikolaev and Kherson regions

Period (Dates) of the Study:

1998-2001

Scope and Objectives of the Study:

Monitoring of exogenous geological processes (Odessa, Nikolaev and Kherson regions)

Geological factors increasing coastal erosion and landslides

Implementing Organisation:

State regional geological enterprise "Prichernomorgeologiya"

Funding Bodies:

State regional geological enterprise "Prichernomorgeologiya"

Results and Significant Impacts of the Study:

Landslides maps

Landslide Hazard Reduction Plan

Region(s) of Implementation with Geographical coordinates (if applicable):

Odessa

Nikolaev

Kherson

Size of application:

Regional

List of Bibliographical References:

1. Monitoring of exogenous geological processes in Odessa, Nikolaev and Kherson regions in 1998-2001.; Research report / GRGP "Prichernomorgeologiya." - № GR U-99-69/15. - Odessa, 2001. - 144 p.

2. Tyuremina V. G., Caravan A. I., Cherkasov V. A., Tyuremin P. N. Natural and man-made risk factors and enhance abrasion and landslides in the north-western Black Sea / Natural and man-made risks of coastal seas. Proceedings of the International Conference, Odessa, 7-11 September 2008 - Odessa: IPREEI NAS of Ukraine, 2008. - P. 58-61.

5. Exogenous geological processes studies in Odessa, Nikolaev and Kherson regions

Title of the Study:

Exogenous geological processes studies in Odessa, Nikolaev and Kherson regions

Period (Dates) of the Study:

1998-2001

Scope and Objectives of the Study:

Monitoring of exogenous geological processes (Odessa, Nikolaev and Kherson regions)

Geological factors increasing coastal erosion and landslides

Implementing Organisation:

State regional geological enterprise "Prichernomorgeologiya"

Funding Bodies:

State regional geological enterprise "Prichernomorgeologiya"

Results and Significant Impacts of the Study:

Landslides maps

Landslide Hazard Reduction Plan

Region(s) of Implementation with Geographical coordinates (if applicable):

Odessa

Nikolaev

Kherson

Size of application:

Regional

List of Bibliographical References:

1. Boukreev A. N. ,Zolotov V. I., Stepanov V. N., Harichkov S. K. Methodological framework for the assessment of economic efficiency of capital investments in bank-

protection measures / / The economic problems of the maritime economy and natural resources. Bulletin of scientific papers. Kiev: Ukrainian Academy of Sciences, 1988.- P.83-92.

2. Gromova E. N., Zolotov V., Shuntova S. G. Comprehensive crisis management of coastal zones / / Natural and Nature-Man-caused risks of the coastal zone. Proceedings of International Conference, Odessa, 2008 - Odessa: IPREEI National Academy of Sciences of Ukraine, 2008. - S. 130-131.

3. Demjanenko S. G., Zolotov V. I. Problems of planning the development of marine coastal zone [electronic resource]. - Access: / / http://economics.opu.ua/files/archive/2012/ № 1/107-113.pdf

4. Zolotov V. I. Coastal protection as an element of crisis management of natural resources in the coastal zone / / Paper: Crisis management in the marine environmental management (methodology, methods, mechanisms) / Ed. B. V. Burkinskiy, V. N. Stepanov. - Odessa: IPREEI National Academy of Sciences of Ukraine, 2010. - S. 487-515.

5. Zolotov V. I. Classification of the coasts of Ukraine in terms of river bank / / marine environmental management. Odessa: IPREEI National Academy of Sciences of Ukraine, 2001, p.216 -223.

6. Zolotov V. I. Economic efficiency of resource development of marine sand and bank-protection measures (methodological aspect) / / Odessa: YUTSENDISI USSR, 1991. - 117.

7. Zolotov V. I. Economic and environmental efficiency of environmental hydraulic construction in the coastal zone of the sea / / maritime complex. Volume 1. Naukova Dumka, 1991.-p.132-134.

8. Zolotov V. I., Adobovsky V. V. Problems of the Black Sea coastal line protection / / Proc. of scientific conference: Nature conservation and sustainable use of natural resources in the south of Ukraine. Simferopol: USSR Ministry of Higher Education, 1977.-P.42-43.

9. Zolotov V. I., Kruglyakova L. L. Strategy of coastal protection / / Marine environmental management. Odessa: IPREEI National Academy of Sciences of Ukraine, 2001, P.116 - 123.

10. Zolotov V. I., Kruglyakova L. L. Strategy of protection of the coasts from destruction / / Economic innovations, number 6, Bulletin of Scientific papers. Odessa: IPREEI National Academy of Sciences of Ukraine, 1999, P.54-60.

11. Zolotov V. I., Nikolaev S. V. Improved methods of engineering-and geological and economic evaluations of bank-protection measures in urban south USSR / / Proc. of All-Union Scientific-practical conference "Modern problems of engineering geology and hydrogeology of the cities and metropolitan areas." Moscow: Nauka, 1987.-P.166-168.

12. Zolotov V. I., Stepanov V. N., Adobovsky V. V. The problem of preventing the destruction of the Black Sea / / Proc. of All-Union Scientific Conference "Economic Problems of the World Ocean." Odessa: Odessa Department of the Institute of Economy, Academy of Sciences of USSR, 1977.-P.26-28.

13. Zolotov V. I., Stepanov V. N. Economic and environmental consequences of the destruction of the coast / / Economic and environmental challenges of the marine environment. Naukova Dumka, 1982.-P.62-70.

14. Zolotov V. I., Stepanov V. N., Shuyskyi Y. D. Economic and environmental problems of protection and use of the coast of the Black Sea // Econology of oceans. Bul. of Scientific papers. Kiev, Ukrainian Academy of Sciences, 1981.-P.43-50.

15. Zolotov V. I., Stepanov V. N., Shuyskyi Y. D. Economic damage from the destruction of the Black Sea coast and the ways of its prevention (Odessa region case study) / / Proceedings of the USSR Academy of Sciences, Geographical Series, № 5, 1979.S.17-23.

16. Zolotov V. I., Shuyskyi Y. D. Use of solid waste in order to prevent destruction of the coast of the Black Sea / / Proc. of All-Union Scientific-Practical Conference "Problems of economic evaluation of creation and implementation of industrial waste-free production." Vorochilovgrad: SCST USSR, 1978.-P.64-66.

17. Zolotov V.I., Shuntova S.G. Crisis management of Azov sea coast / / Economic innovation. Issue 34: Problems of conflict and economic and environmental security in the basin of the Sea of Azov. Collection of scientific works. - Odessa: IPREEI National Academy of Sciences of Ukraine, 2008. P. 174-183.

18. Stepanov V. N. Economic and environmental problems of contact zone "land-sea" - Naukova Dumka, 1982. - 162 p.

19. Management of the marine coastal zone of Ukraine, problems of development. Conceptual approaches/Kruglyakova L. L., Stepanov V. N., Zolotov V. I. and others - Odessa: UMAOI "Consulting", 1998. - 167 p.

6. Coastal abrasion studies

<u>Title of the Study:</u>

Coastal abrasion studies

<u>Period (Dates) of the Study:</u>

1978-present

<u>Scope and Objectives of the Study:</u>

Status and dynamics of slopes abrasion

<u>Implementing Organisation:</u>

Odessa I. I. Mechnikov National University

Department of Physical Geography and Land use

<u>Funding Bodies:</u>

Odessa I. I. Mechnikov National University

Department of Physical Geography and Land use

Results and Significant Impacts of the Study:

Analysis of slopes abrasion

Development of abrasion prevention and managem ent plan

Region(s) of Implementation with Geographical coordinates (if applicable):

Odessa

Size of application:

Regional

List of Bibliographical References:

1. Bertman D. Y., Shuyskyi Y. D. Artificial forms of relief as a means of protecting the coasts from destruction // Fis.geografy and geomorphology. - 1983. - Vol. 29. - P. 127-134.

2. Shuyskyi Y. D. Processes and speed of abrasion on the Ukrainian coast of the Black and Azov Seas / / Math. Academy of Sciences of the USSR. Ser. Geograficheskaya.-1974. - № 6.-S. 108-118

3. Shuyskyi Y. D., Zolotov V. I. Justification of the priorities of natural resources use in the coastal waters and territory of Ukraine / / Study of coastal seas. - Kiev: IGS NASU, 2001. - 195-203 p.

4. Shuyskyi Y. D., Protection of the abrasion shores of the Black Sea with the natural materials / Modern Building technologies in transportation. Subev M., eds - Varna: Transstroi Press, 1991. - S. 163 - 168.

5. Shuyskiy Y. D. Development of the hydropower installations on the Black Sea within Odessa / / Black Sea Ecological Bulletin. - 2010. - № 4 (38). - P. 45 - 79.

6. Shuiskyi Y.D. Experience of studying of artificial ground terraces as a tool of coastal protection // Ocean & Coastal Management. – 1994. – Vol. 22. – № 2. – P. 127 – 139.

7. Shuiskyi Y.D. Experience of efficiency of the protective complex along the Black Sea shoreline within Odessa City territory // Proc. of Intern. Workshop COASTAL ZONE'03: Edited by Z.Pruszak. – Gdansk:, 2003. – P. 309 – 336

8 Shuiskyi Y.D., Schwartz M. L. Human impact and rates of shore protectiont along the Black Sea coast // Journal of Coastal Research. – 1988. – V. 4. – № 3. – P. 405 – 416.

7. Morphological processes studies in Odessa, Nikolaev and Kherson regions

Title of the Study:

Morphological processes in Odessa, Nikolaev and Kherson regions

Period (Dates) of the Study:

2006-2013

Scope and Objectives of the Study:

Geomorphological processes current status assessment (Odessa, Mykolaiv and Kherson)

Emergency Planning and Response

Implementing Organisation:

Government information-analytical (GIA) system for emergencies

Funding Bodies:

Government information-analytical (GIA) system for emergencies

Results and Significant Impacts of the Study:

Analysis of the current situation and dynamics re landslides in Odessa, Nikolaev, Kherson

Development of informational systems for improving of Emergency Planning and Response

Region(s) of Implementation with Geographical coordinates (if applicable):

Odessa

Nikolaev

Kherson

Size of application:

Regional

List of Bibliographical References:

1. Information annual edition on increasing of dangerous exogenous processes in Ukraine, monitoring of EGP - Kyiv: State Geology and Mineral Resources of Ukraine, State Scientific and Production Enterprise "State geological information Fund of Ukraine", 2012. - 48 yl. - 105 p.

2. REGIONAL REPORT ON THE STATE OF THE ENVIRONMENT in Mykolaiv region in 2011. - Nikolaev, 2012. - 170 pp.

3. REGIONAL REPORT ON THE STATE OF THE ENVIRONMENT in Mykolaiv region in 2012. - Nikolaev, 2013. - 204 p.

4. Regional report on the state of the environment in the Odessa area in 2008. - Odessa, 2009 - 240 p.

5. Regional report on the state of the environment in the Odessa area in 2009.

6. Regional report on the state of the environment in the Odessa area in 2010. Part 2 / / Black Sea environmental newsletter. - 12/2011. - N4 (42). - S. 7-96

7. Regional report on the state of the environment in the Odessa area in 2011. - Odessa, 2012. - 252 p.

8. Regional report on the state of the environment in the Odessa area in 2012. - Odessa, 2013. - 266 p.

8. New technologies for geological processs studies

Title of the Study:

New technologies for geological processs studies

Period (Dates) of the Study:

Permanently

Scope and Objectives of the Study:

Databases of exogenous geological processes

Coastal protection plan

Implementing Organisation:

Researchers, scientific community, decision makers, local authorities

Funding Bodies:

Researchers, scientific community, decision makers, local authorities

Results and Significant Impacts of the Study:

Population safety measures

New information technologies for landslides preventive measures

Region(s) of Implementation with Geographical coordinates (if applicable):

Ukraine

Size of application:

National

List of Bibliographical References:

1. Modern engineering and geological conditions of Ukraine as a part of life safety. / Klimchuk L. M Blinov P. V., Velichko V. F. and others. / / Kyiv: VPC "Express" - 2008. -224 P.

7 BIBLIOGRAPHY REGARDING METHODOLOGICAL APPROACHES FOR FLOOD HAZARD ASSESSMENT AT REGIONAL AND LOCAL SCALES (ACTIVITY A1.5)

7.1 TURKEY

1. TEFER Project

Acronym:

TEFER

Title of the Study:

Turkey Emergency Flood and Earthquake Recovery Project

Period (Dates) of the Study:

1998-2002 (project implemented in 2003)

Scope and Objectives of the Study:

- The flood component of the project aimed at setting up a flood forecasting and early warning system up to an advance time of 48 hours.
- Pilot application was planned at the first stage with a motivation to extend it to national scale in the future.
- The project had a secondary phase (2002-2003) where the repair and improvement of flood protection infrastructure was conducted.

Implementing Organisation:

Implemented by General Directorate of State Hydraulic Works (DSI), Turkish State Meteorological Service (DMI) and General Directorate of Electric Power Resources Survey and Administration (EIEI) with the input of Danish Hydraulics Institute (DHI), Turkey Arti Proje LLC, Turkey Su Yapı Engineering and Consulting Inc. And Turkey Elite Elektronik LLC.

Funding Bodies:

World Bank and Turkish Government

Results and Significant Impacts of the Study:

- First flood forecasting system of Turkey.
- 206 automated met-stations and 129 automated hydro-stations engaged and has been active for 10 years.
- Promising results are obtained, but needs some time for national scale full functional operation.

Region(s) of Implementation with Geographical coordinates (if applicable):

Watersheds:

a) Susurluk 39.9183333°, 28.4902778°
b) Gediz 38.6166667°, 26.8569444°
c) B.Menderes 37.7833333°, 26.8000000°
d) Western Black Sea Region 41.6333333°, 32.3333333°

Size of application:

Regional (West of Turkey in emphasis to Western Black Sea Region)

List of Bibliographical References:

1. Einfalt, T., Jorgensen G., Macdonald A., 2003: "Forecasting Floods in Turkey", 1st Central European DHI Software Conference, Prague

2. Einfalt T., Jensen T. S., Klinting A.,2004 "Combining NWP data, radar data, raingauge data and a hydrological-hydrodynamical model for flood forecasting in Turkey", Proceedings of ERAD, Copernicus GmbH, 6-10 September, Sweden, p. 522–524.

3. Eroglu, H., 2005 "The Flood Forecasting and Precipitation Measurement by Using Radar System: Tefer Project In Turkey", TECO-2005, WMO Technical Conference on Meteorological and Environmental Instruments and Methods of Observation, 4-7 May Bucharest, Romania.

4. Hakyemez, N., 2007 "Tefer Project Implementation For Improvement and Rehabilitation of Flood Protection Infrastructure in the Western Black Sea Flood Area", International Congress on River Basin Management, 22-24 March, Antalya, Turkey. URL <http://www2.dsi.gov.tr/english/congress2007/chapter_4/124.pdf> last accessed 20.10.2013

5. Keskin F., 2006 :"Flood Forecasting System of Turkey", 3rd APHW Conference on Wise Water Resources Management Towards Sustainable Growth and Poverty Reduction, 16-18 October , Bangkok, Thailand.

6. Keskin F., 2007 :"Flood Forecasting System of Turkey", International Congress on River Basin Management, 22-24 March, Antalya, Turkey. URL <http://www2.dsi.gov.tr/english/congress2007/chapter_4/109.pdf> last accessed 20.10.2013

7. TEFER, 2002: Turkey Emergency Flood and Earthquake Recovery Project, DSI, Ankara, Turkey (project report).

8. URL: Turkish State Hydraulic Works Web Site <http://www2.dsi.gov.tr/english/service/cevree.htm> last accessed 20.10.2013

9. URL: Su Yapı Engineering and Consulting Inc. Web Site <http://www.suyapi.com.tr/page_en.php?ID=131> last accessed 20.10.2013

2. TEUS Project

Acronym:

TEUS

Title of the Study:

Flood Early Warning System for Urban Istanbul

Period (Dates) of the Study:

2012-present

Scope and Objectives of the Study:

- After the large scale urban flooding occurred in Istanbul in 2009, the municipality initiated this project.
- The project involves an early warning system from met and hydro stations as well as a modelling/processing unit.

Implementing Organisation:

The project is governed and funded by Istanbul Municipal Authority’s Disaster Coordination Center (AKOM) and implemented by USA Riverside Inc and Turkey Elite Elektronik LLC.

Funding Bodies:

Istanbul Municipal Authority’s Disaster Coordination Center (AKOM)

Results and Significant Impacts of the Study:

- The project is particularly important, because most of the flood events in Istanbul are due to inappropriate urbanization.
- In case of a flood threat, citizens will be warned by e-mails and SMS’.
- With the implementation of the project, flood maps will be generated as an input to flood risk assessment of estates.

Region(s) of Implementation with Geographical coordinates (if applicable):

Istanbul N41^{o}02’00”, E28 o48’40”

Size of application:

Local/Pilot regional

List of Bibliographical References:

1. Kose, A. and Tutuncu, S., 2012 “Using Delft-FEWS in the urban environment of Istanbul”, 7th International Delft-FEWS User Days, 22-23 November, Delft, the Netherlands.

2. URL: Riverside Inc. Web Site <http://www.riverside.com/LinkClick.aspx?fileticket=FXizssA3b2U%3D&tabid=103&mid=724&forcedownload=true> last accessed 20.10.2013.

3. ZAMAN Turkish Daily Newspaper Web site for Jan. 2nd, 2012 (in Turkish) <http://www.zaman.com.tr/sehir_istanbulda-artik-ani-sel-baskinlari-sms-ile-bildirilecek _1225093.html> last accessed 20.10.2013.

4. SABAH Turkish Daily Newspaper Web site for Jan. 6th, 2012 (in Turkish) <http://www.sabah.com.tr/Yasam/2012/01/06/sel-baskinlarina-12-saat-oncesinden-smsli-uyari> last accessed 20.10.2013.

3. GAPSEL Project

Acronym:

GAPSEL

Title of the Study:

Mitigating flood risk in flooded areas in the GAP region

Period (Dates) of the Study:

2008 - 2010

Scope and Objectives of the Study:

- After heavy rains and floods in the GAP (Southeastern Anatolia Project) region project was started .
- The main objective of this project is to prevent flooding and its effects in the long term through local institutional capacity building in the GAP Region.

Implementing Organisation:

Central Finance and Contracts Unit (CFCU): the Contracting Authority for the grant contract with the Grant Beneficiaries is the CFCU.

Delegation of the European Commission to Turkey (ECD): is the financing and approval Authority.

Beneficiary Institution (BI): GAP-RDA (Southeastern Anatolia Project) is the Beneficiary Institution of the Grant Scheme and is responsible for the coordination of technical implementation.

Project Management Unit (PMU): GAP-RDA has established a Project Management Unit (PMU). PMU will be responsible to ensure coordination with the Grant Beneficiaries and works in collaboration with TAT.

Technical Assistance Team (TAT): the team provided by the Consortium Eptisa, Hifab and G&G under the consultancy contract, which provides technical assistance in the form of support services and training under the coordination of the PMU started working in December 2008. A project office has been set up in Şanlıurfa.

Grant Beneficiaries: the beneficiary organisations of the Grant Scheme Programme those are directly responsible for the overall implementation of the various Projects to be carried out under the grant contract signed between that organisation and the CFCU.

Other Beneficiaries: are all the institutional beneficiaries of the Flood Capacity Building.

Funding Bodies:

The project is jointly financed by the European Union and the Republic of Turkey.

Results and Significant Impacts of the Study:

- Stabilization of streambeds, infrastructure repair and building Disaster Management Center

Region(s) of Implementation with Geographical coordinates (if applicable):

GAP (Southeastern Anatolia Project) region

Size of application:

Regional

List of Bibliographical References:

1. <http://www.dsi.gov.tr/docs/sempozyumlar/5-5-task%C4%B1n-eg%C4%B1t%C4%B1m%C4%B1-ve-kamuoyunun-b%C4%B1l%C4%B1nclend%C4%B1r%C4%B1lmes%C4%B1-s-ozer-.pdf?sfvrsn=2> last accessed 24.11.2013.

2. http://content.worldwaterforum5.org/files/ThematicDocuments/SessionDocuments/21_03_2009/Kagithane/gapsel%20proje%20sunumu%20TR-1-1.ppt> last accessed 24.11.2013.

4. The EU Twinning Project "Capacity Building to Implement the Flood Directive"

Title of the Study:

Capacity Building to Implement the Flood Directive

Period (Dates) of the Study:

2012 - 2014

Scope and Objectives of the Study:

Building up an administrative and technical capacity in Turkey in order to transpose and implement Flood Risk Assessment and Management Directive (2007/60/EC).

Implementing Organisation:

The CFCU will be Implementing Agency and will be responsible for all procedural aspects of the tendering process, contracting matters and financial management, including payment of project activities. The director of the CFCU will act as Programme Authorizing Officer (PAO) of the project.

Funding Bodies:

Central Finance & Contracts Unit (CFCU)

Results and Significant Impacts of the Study:

- Enhanced juridical capacity, and improved technical and institutional capacity at adequate level, and increased awareness and participation regarding flood phenomena and the Flood Directive.
- Implementation of the Flood Directive in a pilot basin, namely Batı Karadeniz River Basin, aiming at decreasing adverse effects of floods compared to the 1998 floods.
- Development of National Implementation Plan for the Flood Directive in Turkey through Regulatory Impact Assessment Methodology

Region(s) of Implementation with Geographical coordinates (if applicable):

Entire Turkey

Size of application:

National

List of Bibliographical References:

<http://ec.europa.eu/enlargement/pdf/turkey/ipa/2010/138_tr2010.0327.05flooddirective.pdf> last accessed 24.11.2013

7.2 GREECE

1. Integrated Watershed Management Plan of the 14 Water Districts in Greece

Title of the Study:

Integrated Watershed Management Plan of the 14 Water Districts in Greece.

Period (Dates) of the Study:

2009 - 2013

Scope and Objectives of the Study:

- Part of the first Integrated National Project for implementation of 2000/60 EU Directrive
- The project aims on providing data according to EU legislation on water use and flooding potential in local scale.
- Data will be up-to dated every six years

Implementing Organisation and Funding Bodies:

Implementation: Special Secretariat for Water (SSW) of the Ministry of the Environment, Energyand Climate Change (M.E.E.C.H.)" and the "Water Divisions of the Decentralized Administration"

Co-Funding by Greek Government and ERDF, EPPERAA, ESPA.

Results and Significant Impacts of the Study:

- First Project on National Level of formatting management plans for every River Basin -Watershed with common criteria including environmental and economic parameters.
- Includes extensive reports, and watershed management maps for each Water District

Region(s) of Implementation with Geographical coordinates (if applicable):

WD GR01 : Dytiki (Western) Peloponissos
WD GR02 : Voria (Northern) Peloponissos
WD GR03:Anatoliki (Eastern) Peloponissos
WD GR04 : Dytiki (Western) Sterea Hellas
WD GR05 : Epirous
WD GR06 : Attiki
WD GR07 : Dytiki (Western) Sterea Hellas
WD GR08 : Thessalia
WD GR09 : Dytiki (Western) Makedonia
WD GR10 : Kentriki (Central) Makedonia
WD GR11 : Anatoliki (Eastern) Makedonia
WD GR12 : Thraki (Thrace)

WD GR13 : Kriti (Crete)

WD GR14 : Nisoi Aegeou(Aegean Islands)

Size of application:

Regional

List of Bibliographical References:

Special Secretariat for Water (SSW) of the Ministry of the Environment, Energy and Climate Change (M.E.E.C.H.) http://wfd.opengov.gr/index.php?option=com_content&task=view&id=113&Itemid=19, last accessed 25.10.2013.

2. HYUGO "The Hellenic National Platform for Disaster Risk Reduction (HNP-DRR)"

Acronym:

HYUGO

Title of the Study:

The Hellenic National Platform for Disaster Risk Reduction (HNP-DRR)

Period (Dates) of the Study:

2011-2013

Scope and Objectives of the Study:

- open network and a forum of governmental agencies and other stakeholders
- focus on reducing the risk of natural and/or manmade hazards occurring with a major frequency and having a big social and economic impact on the country

Implementing Organisation and Funding Bodies:

- General Secretariat for Civil Protection
- Ministry of Public Order and Citizen Protection

Results and Significant Impacts of the Study:

- Aims to a civil protection system for protection of life, health and property from natural and manmade disasters
- Includes prevention plans and programmes for all kinds of risks taking appropriate measures of preparedness and undertaking prevention, preparedness, response and recovery actions.

Region(s) of Implementation with Geographical coordinates (if applicable):

Greece

Size of application:

National, regional and local level

List of Bibliographical References:

1. Greece: National progress report on the implementation of the Hyogo Framework for Action (2011-2013) 2012, GSCP, Greece – gov

2. PreventionWEB http://www.preventionweb.net/english/hyogo/national/list/v.php?id=68, last accessed 27.10.2013

3. RIVERCROSS - Cross-border cooperation on flood basin River Evros / Maritza / Meric

Acronym:

RIVERCROSS

Title of the Study:

Cross -border cooperation on flood basin River Evros / Maritza / Meric

Period (Dates) of the Study:

2005-2007

Scope and Objectives of the Study:

- Focuses on issues such as flooding, river restoration or water quality (a part of the Water Framework Directive) almost always have a cross-border component.
- The project RiverCross includes partners from the Netherlands, Germany, Poland and Greece, and emphasizes the exchange of experience on transboundary water management, analysis of factors determine the success or failure of the CBC this field and produce proposals for improvements and new methodologies.

Implementing Organisation and Funding Bodies:

University of Twente Radboud University Nijmegen

University Duisburg-Essen

House of Europe -Foundation Water Expertise Centre

Euregion Evros-Maritza-Meric

Funding: The Interreg IIIc program: Change on Borders

Results and Significant Impacts of the Study:

Contributes to solutions for river-basin management in cross-border regions by facilitating reflection, information sharing, and policy learning about cultural and institutional barriers and opportunities.

Region(s) of Implementation with Geographical coordinates (if applicable):

River Evros

Size of application:

Regional Local Level

List of Bibliographical References:

1. http://www.civpro-gr.eu/uploads/images/w.Grecja.pdf, last accessed 25.10.2013

2. ORSAM Water research programme http://www.orsam.org.tr/en/WaterResources/turkeysNeighbours.aspx?ID=16, last accessed 25.10.2013

4. Observation of quantitative and qualitative characteristics of rivers Erythropotamos, Ardas and Evros Region Eastern Macedonia and Thrace

Title of the Study:

Observation of quantitative and qualitative characteristics of rivers Erythropotamos, Ardas and Evros Region Eastern Macedonia and Thrace

Scope and Objectives of the Study:

Implementation of key measures for the gradual incorporation of and compliance to the EC Directive 2000/60/EC and to designing a common approach between Greece and Bulgaria in order to achieve the common goals.

Implementing Organisation and Funding Bodies:

Department of Water Supply Directorate of Public Works, Region of Eastern Macedonia and Thrace

Funded by the European Regional Development Fund (ERDF) and by 75% National Funds 25% Community Initiative INTERREG IIIA / PHARE CBC GREECE-BULGARIA

Results and Significant Impacts of the Study:

The Project aims at creating a flood forecasting system to enhance defense against floods.

Region(s) of Implementation with Geographical coordinates (if applicable):

Erythropotamos, Ardas and Evros Rivers

Size of application:

Trans-boundary, Regional Local Level

List of Bibliographical References:

Flooding Problem od Trans-boundary River Ardas, http://inten-synergy.org/23_1_09/OMILIES_ORESTIADA/MARHS_FWTHS/MARH.pdf, last accessed 27.10.2013

5. Regional Strategies for Disaster Prevention

Title of the Study:

Regional Strategies for Disaster Prevention

Period (Dates) of the Study:

2010 - 2012

Scope and Objectives of the Study:

The main objective of CivPro is to exchange and share know how on the development of regional policies and on a strategic approach and model to prevent and reduce any potential threat and damage inflicted on people, property, environment and society as a whole by accidents and disasters, including both natural and man made disasters as well as disasters caused by the climate change.

Implementing Organisation and Funding Bodies:

PP1 Greece ,Secretariat of Civil Protection,Ministry of Citizen Protection

PP3 Hungary,Municipality of Miszkolc

PP4 Romania,Harghita County Council

PP5 Poland, IMGW PIB Wrocław ,Branch

PP6 Bulgaria,Municipality of Popovo

PP7 Spain,Delegation of the Government in Castile and Leon, Civil Defence

PP8 Belgium,Port of Oostende

PP9 Cyprus,Cyprus Civil Defence

PP10 Slovakia, City of Kosice

PP11 Slovenia, Development Agency ROD

PP13 Greece,

Funding: European Regional Development Fund, European Programme for Interregional Cooperation INTERREG IVC

Results and Significant Impacts of the Study:

- The project is mainly focused on developing improved governance models to introduce crosscutting thinking and approaches to disaster prevention in order to establish comprehensive regional policy approaches
- Aims to improve instruments and establish modalities for strengthening the link between crisis management and disaster prevention.

During the project implementation, experiences with risk mapping, early warning systems, risk screening models, awareness raising policies and specific experience from disaster events is to be exchanged.

Region(s) of Implementation with Geographical coordinates (if applicable):

Evros

Size of application:

Regional and Local

List of Bibliographical References:

http://www.civpro-gr.eu/uploads/images/Leaflet_III_IC.pdf

General Secretarial of Civil Protection
http://www.gscp.gr/ggpp_cms_files/dynamic/c170946/file/2010interreg_64_civpro_el_GR.pdf, last accessed 27.10.2013

6. Cross-border co-operation programme

Title of the Study:

Cross-border co-operation programme

Period (Dates) of the Study:

2007-2013

Scope and Objectives of the Study:

The main aim of cross border cooperation is to reduce the negative effects of borders as administrative, legal and physical barriers, tackle common problems and exploit untapped potential.

Implementing Organisation and Funding Bodies:

European Regional Development Fund (FEDER) and/or by the Cohesion Fund

Results and Significant Impacts of the Study:

Through joint management of programmes and projects, mutual trust and understanding are strengthened and the cooperation process is enhanced

Region(s) of Implementation with Geographical coordinates (if applicable):

Evros

Size of application:

Trans-boundary,Regional Local Level

List of Bibliographical References:

Regional Policy-Inforegio

http://ec.europa.eu/regional_policy/country/prordn/index_en.cfm?gv_pay=GR&gv_reg=ALL&gv_obj=11&gv_the=ALL&gv_per=2, last accessed 29.10.2013

7. The FLINKMAN project "A Stakeholders Linking Framework for Flood Management"

Acronym:

FLINKMAN

Title of the Study:

The FLINKMAN project "A Stakeholders Linking Framework for Flood Management"

Period (Dates) of the Study:

2010-2012

Scope and Objectives of the Study:

The basic scope of the project is the "development" of a suitable framework through the preparation of a flood management plan to ensure consistent and effective link, at each stage of the chain prevention - Readiness - Response - Recovery of floods

Implementing Organisation and Funding Bodies:

Partners:

1) Decentralised Administration of Macedonia-Thrace (DAMT)

2) Region of North Brabant (RNB)

3) Hessian Ministry of the Environment, Energy, Agriculture and Consumer Protection (HMUELV)

4) Assembly European Regions (AER)

5) SIGMA Consultants

6) Balkan Environment Center (BEC)

Funded by EU

Results and Significant Impacts of the Study:

The development of supportive tools, based on Information Technologies (IT), which will promote the collection, evaluation and exchange of best practices.

The upgrade of current status of Civil Protection Units and to promote international cooperation among the competent bodies in Europe.

Region(s) of Implementation with Geographical coordinates (if applicable):

Greece

Size of application:

Country, Regional, Local

List of Bibliographical References:

Flinkman Project
http://www.flinkman- project.eu/index.php/projectdescription/projdocs, last accessed 29.10.2013

Questionnaire for past flood incidents data acquisition in Greece, http://www.flinkmanproject.eu/attachments/article/81/Questionnaire_GR_FINAL.pdf, last accessed 29.10.2013

8. Project SEE/A/118/2.2/X: Practical Use of MONITORing in Natural Disaster Management – Project "MONITOR II"

Acronym:

MONITOR II

Title of the Study:

Project SEE/A/118/2.2/X: Practical Use of MONITORing in Natural Disaster Management – Project "MONITOR II"

Period (Dates) of the Study:

2009-2012

Scope and Objectives of the Study:

Scope of the Project is to improve communication among Disaster Management Experts

Implementing Organisation and Funding Bodies:

Project Partners

01 BMLFUW Federal Ministry for Agriculture, Forestry, Environment and Water Management Forestry Section, Vienna, Austria

02 OEBB Austrian Federal Railways, Railnet Austria Inc. Railway Services, Natural Hazards Management, Vienna, Austria

03 PUH Torrent and Erosion Control Service, Ljubljana, Slovenia

04 UL-FGG University of Ljubljana, Faculty of Civil and Geodetic Engineering, Ljubljana, Slovenia

05 BZ-CP Autonomous Province of Bolzano South Tyrol, Department of Fire Control and Civil Protection, Bozen, Italy

06 ROMSILVA National Forest Administration, Development Department, Bucharest, Romania

07 UNIMORE University of Modena and Reggio Emilia, Department of Earth Sciences, Modena, Italy

08 DAG State Forestry Agency, Sofia, Bulgaria

09 IMI-BAS Bulgarian Academy of Science, Institute of Mathematics and Informatics, Sofia, Bulgaria

10 REMTH The Hellenic Republic, Region of East Macedonia – Thrace, Komotini, Greece

11 OTRG Office of the Tyrolean Regional Government, Regional Forestry, Commission, Innsbruck, Austria

12 UNIBG Belgrade University, Faculty of Forestry, Department of Ecological Engineering in Soil and Water resources Protection, Belgrade, Serbia

Funded by European Regional Development Fund (ERDF)

Results and Significant Impacts of the Study:

Aims to

1) a comparative analysis of existing information sources and usability at each partner site to fill gaps in best practices for contingency planning and hazard mapping,

2) analysis and evaluation of hazard maps as well as contingency plans of all partner countries and organisations, the improvement, harmonisation and adaptation of different existing hazard maps and contingency plans,

3) the definition of minimum standards and technical requirements,

4) the evaluation and cataloguing of problems related to the usage and integration of various types of monitoring data,

5) the development of a common web-based CSA (Continuous Situation Awareness) system with specified modules for different hazards and situations,

6) real-time application tests of the CSA system and related modules in a joint field test (transnational) and in representative test beds (national),

7) the establishment of a feedback cycle for the verification of fitness or the deviation from the requirements defined,

8) the development of proposals for legal and organisational improvements.

Region(s) of Implementation with Geographical coordinates (if applicable):

Region of East Macedonia – Thrace Komotini

Size of application:

Country, Regional, Local

List of Bibliographical References:

Practical Use of Monitoring in Natural Disaster Management

http://www.monitor2.org/index.php?option=com_content&view=frontpage&Itemid=1&ac45af24dc0db8131d6d3647bf3df4c7=b2a7a35180c18b667673e65384bc7324, last accessed 31.10.2013

9. FLAPP – Flood Prevention in Border Areas: Common approach on the cross-border management of floods. INTERREG III

Acronym:

FLAPP

Title of the Study:

FLAPP – Flood Prevention in Border Areas: Common approach on the cross-border management of floods. INTERREG III

Period (Dates) of the Study:

2004-2007

Scope and Objectives of the Study:

Integrated river basin management in cross-border areas. Aspect of the project include: flood prevention via construction and land use planning measures, sustainable management of river basins, disaster management, cross-border cooperation for a holistic approach on flood management issues, raising public awareness on flood management issues

Implementing Organisation and Funding Bodies:

Partners:

Belgium, Czech Republic, Germany, Estonia, Greece, Spain, Lithuania, Hungary, Netherlands, Austria, Portugal, Romania, Slovakia, United Kingdom, Serbia

Funded by European Regional Development Fund (ERDF)

Results and Significant Impacts of the Study:

1) Strengthening of the regional / local Service of Water management

Involvement of local and regional public bodies/agencies/services

Increase the participation and awareness of the local population

2) Creation of appropriate Legislative arrangements

Involvement of the insurance industry in flood management

Participation of decision makers from the very beginning

3) Investigation of mutual benefits and coordination of policy objectives on Flood Management

Agreement on standards to be used and model cost estimation

Promoting both cross-border information exchange and non-formal communication

Region(s) of Implementation with Geographical coordinates (if applicable):

Greece

Size of application:

Country, Regional, Local

List of Bibliographical References:

1. Regional Policy-Inforegio
2. http://ec.europa.eu/regional_policy/projects/stories/details_new.cfmsto=1683&lan=7&pay=EE&the=97&region=ALL&obj=ALL&per=2&defL=FR, last accessed 31.10.2013

10. Flood warning system establishment in Arda river basin for minimising the risk in the cross border area ARDAFORECAST

Acronym:

ARDAFORECAST

Title of the Study:

Flood warning system establishment in Arda river basin for minimising the risk in the cross border area ARDAFORECAST

Period (Dates) of the Study:

2012-2014

Scope and Objectives of the Study:

To promote cross border cooperation in the field of flood prevention, the establishment and running of reliable flood forecasting tools and reservoir operation scenarios for accurate and timely flood forecasts with sufficient lead time, effective dissemination of flood forecast information and warning messages to the end users,

To develop alarm procedures and information campaigns, awareness-raising, training and learning in cooperation with the local administration and population, installation of additional gauging stations and associated real-time data transmission equipment in cross border region for co-operation in the field of sustainable flood risk management and flood protection.

Implementing Organisation and Funding Bodies:

Partners

1) National Institute of Meteorology and Hydrology, Bulgaria

2) East Aegean River Basin Directorate , Bulgaria

3) Democritus University Of Thrace, Greece

4) Regional Development Fund East Macedonia-Thracem, Greece

This project funded in the framework of the European Territorial Cooperation (ETC) Programme "Greece Bulgaria 2007-20131", is co-funded by the European Regional Development Fund (ERDF) and the national funds of the participating countries.

Results and Significant Impacts of the Study:

Aims to :

- the establishment of hydro meteorological information system,
- the development of GIS database, the improvement of the density and frequency of the hydro-meteorological observation network through,
- the installation of additional automatic stations,
- WEB based tools for information exchange and access of decision makers, stakeholders and large public to all the necessary data and forecasts

Region(s) of Implementation with Geographical coordinates (if applicable):

Arda River Basin

Size of application:

Trans-boundary, Regional

List of Bibliographical References:

ARDAFORECAST <http://arda.hydro.bg/index.php> last accessed 31.10.2013

11. Project FLoods and fIre Risk assessment – FLIRE

Acronym:

FLIRE

Title of the Study:

Project FLoods and fIre Risk assessment

Period (Dates) of the Study:

2012-2015

Scope and Objectives of the Study:

The aim of the LIFE + Environmental Policy & Governance FLIRE Project is the combined, effective and robust risk assessment and management of both flash floods and forest fires, using state of art tools, technologies and methods and taking into account prevention, adaptation and interaction issues.

Implementing Organisation and Funding Bodies:

Partners

1. Imperial College of London (ICL)
2. Research Institute for GEO-Hydrological Protection-Italian National Research Council (IRPI)
3. National Observatory of Athens (NOA)
4. ALGOSYSTEMS SA (ALGO)
5. Foundation for Research and Technology Hellas, Institute of applied and computational Mathematics (FORTH)

FLIRE project is co-financed by LIFE financial instrument of the European Union EU and National Funding.

Results and Significant Impacts of the Study:

-The development of a Weather Information Management Tool (WIMT) that will receive short-term weather forecasting information and will dynamically take into account local conditions to classify weather conditions as of potential risk for floods or fires.

- The development of a near real-time flood risk assessment and management tool which will include a catchment modelling component, an urban modelling component and an Early Flood Warning System. This tool will receive the flood risk information from the WIMT and activate, if necessary, the corresponding Early Warning System (EWS).

- The development of a near real-time forest fire risk assessment and management tool which will include a fire modelling component and an Early Fire Warning System. It will receive forest fire risk information and similarly to the near real-time flood risk management tool will activate, if necessary, the corresponding EWS.

- The development of a planning tool for flood risk assessment and management which will use the catchment modelling and urban modelling components of the near real-time flood management tool and further integrate an urban development modelling component and an optimization algorithm for flood risk management.

- The integration of these components into a common system (a Decision Support System Tool (DSS Tool)), supporting decisions for integrated flood and forest fire management.

- The implementation and testing of the system in Eastern Attica.

- The extraction of transferable lessons to ensure the project's uptake in other similar regions.

<u>Region(s) of Implementation with Geographical coordinates (if applicable):</u>

Eastern Attica region

<u>Size of application:</u>

Regional-Local

<u>List of Bibliographical References:</u>

Centre of Hydrology and Informatics,Laboratory of Hydrology and Water Resources Management of the School of Civil Engineering of National Technical University of Athens, http://www.chi.civil.ntua.gr/?p=2524, last accessed 31.10.2013

12. AFORISM: A comprehensive forecasting system for flood risk mitigation and control

<u>Acronym:</u>

AFORISM

<u>Title of the Study:</u>

A comprehensive forecasting system for flood risk mitigation and control

<u>Period (Dates) of the Study:</u>

1991-1994

Scope and Objectives of the Study:

The aim of this project is the development of a comprehensive flood forecasting system and the study of alternative management policies intending to flood risk mitigation (a) the analysis of intense rainfall events and their classification by weather type as well as the modelling of intense rainfall and the production of alternative hyetographs of temporal evolution of rainfall; (b) the comparison of the alternative rainfall-runoff models, using multiple time steps in modelling rainfall-runoff and applying it to Greek hydrological basins

Implementing Organisation and Funding Bodies:

EU and National Funding DGXII / FP6-SUSTDEV-2005-3.II.1.2

Contractor: University of Bologna

Collaborators:

National Technical University of Athens

Ente Regionale di Sciluppo Agricolo

University College Cork

University of Newcastle

Ecole Polytechnique Federale de Lausanne

Instituto Superior de Agronomia, Lisbon

Institut National Polytechnique de Grenoble

Results and Significant Impacts of the Study:

(a) the analysis of intense rainfall events and their classification by weather type as well as the modelling of intense rainfall and the production of alternative hyetographs of temporal evolution of rainfall

(b) the comparison of the alternative rainfall-runoff models, using multiple time steps in modelling rainfall-runoff and applying it to Greek hydrological basins

Region(s) of Implementation with Geographical coordinates (if applicable):

Greece, Italy, France, England

Size of application:

Country, Regional, Local

List of Bibliographical References:

1. ITIA: http://itia.ntua.gr/en/projinfo/2/ last accessed 31.10.2013

2. Mamassis, N., D. Koutsoyiannis, and E. Foufoula-Georgiou, Stochastic rainfall forecasting by conditional simulation using a scaling storm model, 19th General Assembly of the European Geophysical Society, Annales Geophysicae, Vol. 12, Supplement II, Part II, Grenoble, 324, 408, European Geophysical Society, 1994.

3. Mamassis, N., et D. Koutsoyiannis, Structure stochastique de pluies intenses par type de temps, Publications de l'Association Internationale de Climatologie, 6eme Colloque International de Climatologie, edité par P. Maheras, Thessaloniki, 6, 301–

313, Association Internationale de Climatologie, Aix-en-Provence Cedex, France, 1993.

13. DEUCALION – Assessment of flood flows in Greece under conditions of hydroclimatic variability: Development of physically-established conceptual-probabilistic framework and computational tools

Acronym:

DEUCALION

Title of the Study:

Assessment of flood flows in Greece under conditions of hydroclimatic variability: Development of physically-established conceptual-probabilistic framework and computational tools

Period (Dates) of the Study:

2011-2014

Scope and Objectives of the Study:

The project aims to develop a set of physically-based methodologies associated with modelling and forecasting of extreme rainfall events and the subsequent flood events, and adapted to the peculiarities of the hydroclimatic and geomorphological conditions of Greece. It includes the implementation of a set of research river basins that comprises a number of gauged basins in Greece and Cyprus with reliable measurements of adequate length, as well as three new experimental basins (with their sub-basins), which will be equipped with the necessary infrastructure

Implementing Organisation and Funding Bodies:

EU and National Funding, ESPA.

Partners:

ETME: Peppas & Collaborators

Grafeio Mahera

Department of Water Resources and Environmental Engineering

National Observatory of Athens

Results and Significant Impacts of the Study:

Field data analysis (hydrological, meteorological, geographical) physically-established regional models will be developed for the estimation of characteristic hydrological design quantities, along with hydrological-hydraulic models, which will be integrated within an operational system for hydro meteorological forecasting. A framework of design criteria and methodologies (in a draft form for discussion) will be prepared for the elaboration of hydrological studies for flood-prevention works.

Region(s) of Implementation with Geographical coordinates (if applicable):

Greece, Cyprus

Size of application:

Country Regional Local

List of Bibliographical References:

1. <http://deucalionproject.gr/> last accessed 31.10.2013

2. Michaelidi, E., T. Mastrotheodoros, A. Efstratiadis, A. Koukouvinos, and D. Koutsoyiannis, Flood modelling in river basins with highly variable runoff, 5th EGU Leonardo Conference – Hydrofractals 2013 – STAHY '13, Kos Island, Greece, European Geosciences Union, International Association of Hydrological Sciences, International Union of Geodesy and Geophysics, 2013.

3. Efstratiadis, A., A. Koukouvinos, P. Dimitriadis, A. Tegos, N. Mamassis, and D. Koutsoyiannis, A stochastic simulation framework for flood engineering, 5th EGU Leonardo Conference – Hydrofractals 2013 – STAHY '13, Kos Island, Greece, European Geosciences Union, International Association of Hydrological Sciences, International Union of Geodesy and Geophysics, 2013.

14. HYDROSCOPE: National Databank for Hydrological, Meteorological and Geographical Information

Acronym:

HYDROSCOPE

Title of the Study:

National Databank for Hydrological, Meteorological and Geographical Information

Period (Dates) of the Study:

1992-2010

Scope and Objectives of the Study:

The main objective of HYDROSCOPE is the creation of a modern information infrastructure for the hydrological cycle in Greece. Specifically, it aims at organising and systematising the hydrological, hydrogeological and meteorological information using the capacities that are provided by the modern methods and techniques of computer science and telecommunications.

Implementing Organisation and Funding Bodies:

Commissioned by:

1)General Secretariat of Research and Technology

2)Ministry of the Industry

3)Hellenic National Meteorological Service

4)Ministry of Agriculture

5)Ministry of Environment, Planning and Public Works

6)National Observatory of Athens

7)Water Supply and Sewerage Company of Athens

8)National Centre for Scientific Research "Democritos"

9)Ministry of National Education

Contractor: Department of Water Resources, Hydraulic and Maritime Engineering

Collaborators:

1)Division of Hydraulics and Environmental Engineering

2)Division of Applications Physics

3)Energy Division

4)Hellenic National Meteorological Service

5)Department for the Development of Hydroelectric Works

6)Directorate of Water and Natural Resources

7)General Secretariat of Land Reclamation Works and Agricultural Structures

8)General Secretariat of Public Works

9)Institute of Meteorology and Physics of the Atmospheric Environment

10)Centre for Renewable Energy Sources

11)Water Supply and Sewerage Company of Athens

12)National Centre for Scientific Research "Democritos"

13)Greek Corporation of Regional Governent and Development

EU and National Funding

Results and Significant Impacts of the Study:

Aims at organising and systematising the hydrological, hydrogeological and meteorological information using the capacities that are provided by the modern methods and techniques of computer science and telecommunications.

Region(s) of Implementation with Geographical coordinates (if applicable):

Greece

Size of application:

Country Regional Local

List of Bibliographical References:

1. <http://www.hydroscope.gr/news.html> , last accessed 31.10.2013

2. Christofides, A., S. Kozanis, G. Karavokiros, Y. Markonis, and A. Efstratiadis, Enhydris: A free database system for the storage and management of hydrological and meteorological data, European Geosciences Union General Assembly 2011, Geophysical Research Abstracts, Vol. 13, Vienna, 8760, European Geosciences Union, 2011.

3. Efstratiadis, A., I. Nalbantis, E. Rozos, and D. Koutsoyiannis, Accounting for water management issues within hydrological simulation: Alternative modelling options and a network optimization approach, European Geosciences Union General Assembly 2010, Geophysical Research Abstracts, Vol. 12, Vienna, 10085, European Geosciences Union, 2010.

4. Kozanis, S., A. Christofides, N. Mamassis, A. Efstratiadis, and D. Koutsoyiannis, Hydrognomon – open source software for the analysis of hydrological data, European Geosciences Union General Assembly 2010, Geophysical Research Abstracts, Vol. 12, Vienna, 12419, European Geosciences Union, 2010.

7.3 BULGARIA

1. The last flood in Maritsa, Toundja and Arda Basins in Bulgaria10-20 November 2007, Results of Hydrological Simulation and Forecast

2. Three decades of floods in Europe: a preliminary analysis of EMDAT data.Philippe Hoyois, Debarati Guha-Sapir.WHO collaborating Centre for Research on the Epidemiology of Disasters (CRED), Catholique University of Louvain.http://www.em-dat.net/documents/Publication/FLOOD-EUR.pdf

3. Disaster Risk Management and Climate Change Adaptation in Europe and Central Asia John Pollner, Jolanta Kryspin-Watson, Sonja Nieuwejaar http://www.gfdrr.org/sites/gfdrr.org/files/publication/GFDRR_DRM_and_CCA_ECA.pdf

4. Risk Mapping of Flood Hazards in New Member States by Róbert Jelínek, Maureen Wood and Javier Hervás http://www.unisdr.org/files/5457_flood.pdf

5. 3D GI. http://www.vliz.be/imisdocs/publications/230863.pdf

6. Flood simulation models over the territory of Bulgaria , 2007

7. DROUGHT AND FLOOD BOTH SPELL DISASTER IN BULGARIA, T. Andreeva National Institute of Meteorology and Hydrology - Bulgarian Academy of Sciences Department for Weather Forecasts.E-mail: teodosia.andreeva@meteo.bg

8. Bulgaria: Flood Hazard Distribution Map (World Health Organization, 2010)

9. Danube Flood Hazard and Risk Maps Atlas: an integrated approach for the Danube Basin of Bulgaria, 2013

10. Danube flood risk Project, 2012

11. Sub-Basin Level Flood Action ProgrammeBULGARIAN TRIBUTARIES REPUBLIC OF BULGARIAMINISTRY OF ENVIRONMENT AND WATER DANUBE RIVER BASIN DIRECTORATE October, 2009

12. COST Action 733 –Harmonisation and application of weather type classifications in EuropeFINAL WORKSHOP -Vienna, 22-24 November 2010

13. Flood Mapping Approach in Bulgaria NINA DOBRINKOVA and PETER BOYVALENKOVInstitute of Mathematics and Informatics – Bulgarian Academy of SciencesAcad. Georgi Bonchev str., Block 8, 1113 Sofia, Bulgaria

14. http://ec.europa.eu/environment/water/flood_risk/index.htmGergov,G., 1971. Determination of the time of travel along the river network. In: Journal of Hydrology, Amsterdam. No 14, pp. 293-306.

15. http://www.inspire-geoportal.eu/ Gergov, G., Karagiozova, T., 2006. Floods in Bulgaria. In: Proc. of BALWOIS Conference, Ohrid, pp. A.349/1-7.

16. EXIMAP, 2007. Handbook on Good Practices for Flood Mapping in Europe.http://ec.europa.eu/environment/water/flood_risk/flood_atlas/pdf/handbook_goodpractice.pdf

17. http://www.citypopulation.de/php/bulgaria-blagoevgrad.php. [7] U.S. Army Corps of Engineers, 1998. HEC-RAS: River Analysis System User’s Manual.Hydrologic Engineering Center, Davis, CA.

18. FLOOD SIMULATION MODELS FOR THE TERRITORY OF REPUBLIC OF BULGARIA Vassil Vassilev, Konstantin Stefanov, Ivaylo Kostovski, Ivan Ivanov Remote Sensing Application Center – ReSAC 61, Tsar Assen Str., 1463, Sofia, Bulgaria E-mail: resac@techno-link.com Website: www.resac-bg.org

19. Flood forecasting system for the Maritsa and Tundzha RiversArne Roelevink1, Job Udo1, Georgy Koshinchanov2, Snezhanka Balabanova 1HKV Consultants, Lelystad, The Netherlands 2National Institute of Meteorology and Hydrology, Sofia, Bulgaria

20. Guidance on Flash Flood Management Recent Experiences from Central and Eastern Europe, 2007

21. Improving flood prevention, Brussels, 2010

22. Synergies between flood risk management, floodplain restoration and nature conservation in the Lower Danube River, DeltaNet project 1st Workshop on Flood risk and sediment management. 15 Nov. 2010, Lisbon

23. MERIC RIVER FLOODS AND TURKISH–BULGARIAN COOPERATIONS Nurullah SEZEN, Numan GÜNDÜZ, Sadettin MALKARALI

24. Influence Of Mild Winters On Groundwater In Bulgaria Teodossiia Andreeva, Tatiana Orehova Geological Institute Sofia, Bulgaria

25. S. Nedkov, Modeling flood hazard due to Climate Change in small mountainous catchments

26. River Basin Hydrology and flood modelling and forecasting in the Mulde River Basin – Current Situation and Outlook, Martin Volk, Martin Steinert, Sebastian Ruhnke. Department Landscape Ecology, 2007

27. Overview Of National Hydrogeological Network Of Bulgaria Tatiana Orehova, Roussi Roussev BALWOIS 2004 Ohrid, FY Republic of Macedonia, 25-29 May 2004

28. Assessment of Flood Monitoring and Forecasting of the Republic of Bulgaria, 2006

29. TODOR LUBENOV, IVAN MARINOV, EMILIYA VELIZAROVA RISK OF FLOODING - ACTIVITIES, PARAMETERS AND REGIONAL PECULIARITIES (Case Study: Varbitsa Watershed Basin - Bulgaria) BULLETIN OF THE SERBIAN GEOGRAPHICAL SOCIETY, 2009

30. Хр. Романова1, Н. Радева2, И. Маринова1, М. Маринов3, Т. Бозова НАВОДНЕНИЯТА . НАЙ.ЧЕСТОТО БЕДСТВИЕ. ПРИЧИНИ,ПОСЛЕДИЦИ, ОРГАНИЗАЦИОННИ МЕРКИ. ИЗВЕСТИЯ НА СЪЮЗА НА УЧЕНИТЕ - ВАРНА 2’2012 / ТОМ XVII

31. Transboundary flood risk managementExperiences from the UNECE region, UN

32. REPORT FLOODS IN SOUTH EASTERN EUROPE, APRIL 2006

7.4 ROMANIA

1. Hazard Risk Mitigation and Emergency Preparedness

Title of the Study:

Hazard Risk Mitigation and Emergency Preparedness

Period (Dates) of the Study:

2009-2012

Scope and Objectives of the Study:

The overall objective of the Hazard Risk Mitigation and Emergency Preparedness Project is to assist the Government of Romania in reducing the environmental, social, and economic vulnerability to natural disasters and catastrophic mining accidental spills of pollutants through: (i) strengthening the institutional and technical capacity for disaster management and emergency response through upgrading communication and information systems; (ii) implementing specific risk reduction investments for floods, landslides and earthquakes

Implementing Organisation and Funding Bodies:

The Ministry of Administration and Interior and the Ministry of Environment and Water Management b the National Administration Apele Romane

Results and Significant Impacts of the Study:

The project is important because of the

- strengthened institutional and technical capacity for emergency management and emergency response through the information systems
- Increased earthquake risk mitigation with some key, prioritized public facilities retrofitted.
- Increased level of protection against floods of population exposed to high risk of recurrent floods.
- About 30,000 people live and work in the areas exposed to flood risk due to river flooding.
- Improved dam safety of the selected priority structures and need rehabilitation, of which high risk dams were selected for improving their safety, to protect about 300,000 people living in their neighborhood.

Region(s) of Implementation with Geographical coordinates (if applicable):

Dykes reinforcement along the Danube - Borcea Horn:

Bordușani and Făcăieni

4 dams were rehabilitated - Berdu, Vârșolț, Mâneciu, and Dridu,

Rehabilitation works were completed for three small dams: Sânmihaiul Român, Cătămărăști, Tăria

Size of application:

Local/regional objectives

List of Bibliographical References:

World Bank. 2012. Romania - Hazard Risk Mitigation and Emergency Preparedness Project. Washington DC : World Bank.
http://documents.worldbank.org/curated/en/2012/12/17131859/romania-hazard-risk-mitigation-emergency-preparedness-project-romania-hazard-risk-mitigation-emergency-preparedness-project

2. Danube FLOODRISK - a stakeholder oriented flood risk assessment for the Danube floodplains

Title of the Study:

Danube FLOODRISK - a stakeholder oriented flood risk assessment for the Danube floodplains

Period (Dates) of the Study:

2011-2013

Scope and Objectives of the Study:

The overall objective of the DanubeFloodrisk project is to develop and produce high quality, stakeholder oriented flood risk maps for the transnational Danube river floodplains to provide adequate risk information for spatial planning and economic requests. Risk information is the basis for sustainable development along the Danube River.

The key objective will only be reached by intensive transnational cooperation and stakeholder integration. The goal is to link scientific progress in harmonization of approaches and data with practically oriented stakeholder and end user involvement.

Implementing Organisation and Funding Bodies:

Grant from SEE – Interreg IVB financing mechanism of EC;

Implementation team:

Lead Partner was Ministry of Environment and Climate Change, Romania and 18 partners in the Danube basin and 5 partners observer oartners (JRC, ICPDR, FIH Koblenz, UBA Bavaria, Regional administration of Baden Wuttenberg)

Results and Significant Impacts of the Study:

- Development of a joint mapping method for flood risk and harmonization of data sources.

-Production and provision of risk maps and risk information (hazard and risk atlas in the scale of 1:100000, also published via DVD and internet).

- Integration of relevant stakeholders and users on different levels into the definition and realization processes.

-Involvement of different economic aspects of land use in the river basin like spatial planning, recreation and agriculture as well as energy supply or health service.

- Linkage of flood risk mapping and provision of maps as basis for planning, e.g. within the EU Floods Directive.

-Development and distribution of exemplary procedures within the Danube countries and beyond.

-Reflection of the EU Directives, e.g. WFD, Floods Directive, providing feedback based on the experiences of the project cooperation by using the platform of the ICPDR Flood Protection Expert Group.

Region(s) of Implementation with Geographical coordinates (if applicable):

Atlas of the hazard and risk maps in an integrated methodology all along the Danube

Size of application:

7 pilot activities in high risk areas

List of Bibliographical References:

www.danube-floodrisk.eu

ww www.danube-floodrisk.eu/download/.../Comunicat_presa_192010.doc

mmediu.ro/vechi/danube_floodrisk.htm

mmediu.ro/vechi/danube_floodrisk.htm

www.ecomagazin.ro/info/floodrisk

www.ziare.com/tulcea/articole/proiect+danube+floodrisk

www.inhgacercetare.ro/doc

www.houseofeurope.ro/maritimeday/docs/doc/Danube_Floodrisk.doc

www.mdrt.ro › Buletine › Newsletter MDRAP › Newsletter nr. 123

1. Adler M.J.,Patrut S., Negru O., 2010: "Stakeholder oriented flood risk assessment for the Danube floodplains-Danube Floodrisk Project"-Conference Balwois 2010-Water Observationand Integration System for Decision Support, , Ohrid, Macedonia, 25-29 mai 2010

2. Stevan Prohaska, Aleksandra Ilic , 2010: "Coincidence of Flood Flow of the Danube River and Its Tributaries", Hydrological Processes of the Danube River Basin 2010, pp 175-226 www.granturi.ubbcluj.ro/elac/

3. e-LAC - Pro-active operation of cascade reservoirs in extreme conditions (floods and droughts) using a Comprehensive Decision Support Systems (CDSS). Case study: Jijia catchment

Title of the Study:

e-LAC - Pro-active operation of cascade reservoirs in extreme conditions (floods and droughts) using a Comprehensive Decision Support Systems (CDSS). Case study: Jijia catchment

Period (Dates) of the Study:

2012-2014

Scope and Objectives of the Study:

e-LAC Project envisages the elaboration of a Comprehensive Decision Support System (CDSS) composed of an Expert System (ES), a Supervisory Control and Data Acquisition (SCADA) system, together with an Advanced Control Technology (ACT) system assisting the authorities to prevent the disasters in both cases (flood and drought).

Implementing Organisation and Funding Bodies:

Research Program of Romania is the grantor

Implementation is provided by University Babes-Bolyai of Cluj-Napoca – Lead Partner, University of Civil Engineering, Bucharest, National Institute of Hydrology and Water Management,

SC IPA SA, CIFATT Cluj-Napoca Branch, Duk-Tech S.R.L.

Results and Significant Impacts of the Study:

At the moment in Romania, despite the huge program of river developments based on structural measures (dams and dykes) before 1990, only 50% of the necessary structural measures are put into operation. Still, structural measures cannot solve alone all problems related to floods. Unfortunately non-structural measures, among which we can mention mainly land use and spatial planning, are implemented in Romania at a lower degree. Still, although material damage is quite important, due to the alert systems, at the level of the country the average human casualties are quite reduced: 15 human lives lost per year. In order to diminish the economic losses, the authorities have two major options: a) the delineation of the flooded areas at different probabilities of exceeding followed by a better spatial planning (reducing thus the vulnerability), and b) improved operation rules of the existing structural measures (dams and polders), in order to modify the flood magnitude.

Region(s) of Implementation with Geographical coordinates (if applicable):

Jijia Basin reservoir exploitation optimization

List of Bibliographical References:

1. G. Nedelcu, Mihaela Borcan, Emilia Brănescu, Cătălina Petre, B. Teleanu, A. Preda, R. Murafa, 2011 : "Viiturile excepţionale din anii 2008 şi 2010 în bazinul

hidrografic Siret", Institutul Naţional de Hidrologie şi Gospodărire a Apelor Conferinţa ştiinţifică anuală, 1-3 noiembrie 2011

4. VULMIN – Flood vulnerability of localities and environment under the global modification

Acronym:

VULMIN

Title of the Study:

Flood vulnerability of localities and environment under the global modification

Period (Dates) of the Study:

2012-2014

Scope and Objectives of the Study:

Under the conditions of global environmental change, the vulnerability studies of different systems in relation to extreme events, such as floods, are essential for policy makers in order to implement effective measures of risk mitigation and/or adaptation. Unlike most flood related researches which concentrate on magnitude and frequency of the hydrological parameters, the aim of this project is to evaluate the vulnerability of the potential flood-affected systems (human settlementsm communication network, arable lands etc.) in relation to their physical conditions and to social, economic and political contexts, as well

Stevan Prohaska, Aleksandra Ilic , 2010, Coincidence of Flood Flow of the Danube River and Its Tributaries, Hydrological Processes of the Danube River Basin 2010, pp 175-226.

VULMIN project (contract grant no. 52/2012) is funded by Partnerships in priority areas - Division 3: Environment and conducted over a period of 36 months, from July 2012 - July 2015. Theme VULMIN project addresses three major directions:

1 Identifying and defining flood areas in Romania, with focus on the severity of hazards such as floods

2 Vulnerability assessment settlements, infrastructure and natural flooding, local and national scale

3 Creating and providing scientific services for local and national users

Implementing Organisation and Funding Bodies:

Research Program of Romania is the grantor

Implementation is provided by the National Institute of Geography, the

National Institute of Hydrology and Water Management, IPA

Results and Significant Impacts of the Study:

Vulnerability assessment is based on the use of GIS techniques, teledection, statistics and detailed evaluations of the population and settlements resilience in test areas.

As vulnerability assessments are a preliminary step in the implementation of risk management strategies, the outcomes of this project are ment to help stakeholders to design adaptation measures for a territory and society to floods

Region(s) of Implementation with Geographical coordinates (if applicable):

Timisoara

Timis-Bega Basin

Cheia Basin

List of Bibliographical References:

1. Mihaela Soroceac, 2010: "Flood impact over population water resources supply in Banat hydrographycal area" , Geographica Timisiensis, vol. 19, nr. 2, 2010, p.177 – 183.

2. Popovici Elena-Ana, Andra Costache, D. Bălteanu, Diana Dogaru, Mihaela Sima, 2013: "Vulnerability assessment of rural communities to floods in the western part of Romania (Banat Plain) ", 13th SGEM GeoConference on Ecology and Environmental Protection, www.sgem.org, SGEM2013 Conference Proceedings, ISBN 978-619-7105-03-2 / ISSN 1314-2704, June 16-22, 2013,http://www.igar-vulmin.ro/atasuri/SGEM_paper_Popovici%20et.%20al_2013.pdf

3. Andra Costache, 2013: "Influența variabilelor socio-demografice asupra percepției mediului. Studii de caz" - Conferinţa SGR (Timişoara, România, 2013), http://www.igar-vulmin.ro/atasuri/Andra%20Costache_SGR_2013.pdf

4. A. Nedelea, Laura Comănescu, Liliana Zaharia, Luminița Săftoiu, 2013: "Mapping flood vulnerability. Case study: Tecuci town (Romania) ", International Cartographic Conference, Dresden, Germany, 2013.

5. Plan for Preventing Flood protection and mitigation

Title of the Study:

Plan for Preventing Flood protection and mitigation

Period (Dates) of the Study:

February 2008 – May 2009

Scope and Objectives of the Study:

The specific objectives are:

- Drawing maps wetlands boundaries and detailing their preliminary areas identified as potential flood
- Develop plan of prevention, protection and flood mitigation in the hydrographic area Dobrogea Litoral
- Review flood defense plans , hazardous meteorological phenomena and hydraulic structures accidents in the administration of the local county and river basin (depending on the scope and importance of the work) with

presentation including electronic (database , GIS, raster images , vectorized images , word processing , web technologies) .

Other objectives of the project:

- Establish a program for public information and participation in decision-making process ;
- Improving the effectiveness of the proposed flood protection by structural and nonstructural measures to lower the flood hazard ;
- Proposals for modernization of surveillance , warning and alarm during the heavy flood waters ;
- Identify river basins or sub-basins where there is hazard of floods ;
- Regionalization of flood hazard in space Dobrogea Litoral River ;
- Assessment of flood hazard mapping using equipment .
- An estimate of the trends in the occurrence of future flooding , increasing flood hazard for various areas of the river basin ;
- Critical analysis of the transmission capacity of solid and liquid flow in natural and landscaped beds along water courses and their technical and functional status .
- Preliminary assessment of flood hazard ;
- Presentation of planning measures and scenarios covered areas of hazard maps to reduce natural flood risk

Implementing Organisation and Funding Bodies:

Implementation is provided by the National Institute of Geography, the National Institute of Hydrology and Water Management, IPA / Basin Administration Dobrogea - seaside

Results and Significant Impacts of the Study:

This project will complete the following:

- Implementation of flood hazard maps on the main river courses and River basin tributaries Dobrogea Area - Seaside;

- Implementation plan for prevention, protection and Mitigation River Flooding in Dobrogea Area - Seaside;

- Implementation of an action plan in the short, medium and long specifying a range of structural and nonstructural measures, their role being to reduce flood hazard;

- Popularization of these measures in the public interest

- Prioritizing these short-term measures based on technical and economic analysis and environmental considerations (SEA)

- Results will be subsequently integrated working platform institution Water Basin Administration Dobrogea - Seaside;

- Project will take into account relevant aspects such as costs and benefits, the characteristic elements of flood mitigation potential areas through retention volumes of flood water (natural polders). The final document will address all aspects of flood hazard management which focuses on prevention, protection, preparedness, including flood forecasts.

- Data provided by the project will be recorded, processed and distributed by specialists Romanian Waters National Administration, including their integration into the Information System for Water Management available in the Water Basin Administration Dobrogea - Seaside.

Region(s) of Implementation with Geographical coordinates (if applicable):

River Dobrogea Area - Coastal Administration is managed by Water Basin Dobrogea - Seaside. It is bordered by the Danube (Ostrov arm, arm Danube, the Old Danube, Chilia - on the border with Moldova and Ukraine), south of the Bulgarian border and east of the Black Sea. In the west it borders the Water Basin Administration Buzau - Ialomita and northwest - Water Basin Administration Siret and Prut. In the south of the project will take into account the cross-border influence in connection with hydrological and meteorological factors analyzed. The same correlation is also necessary for the north, which influences the effect of the border from the Republic of Moldova and Ukraine are taken from the Danube River, respectively Chilia that the scope of this project.

Dobruja is a region in the south-east of Romania, between 27°20' and 29°41' east longitude and 43°43' and 45°27' north latitude.

Size of application:

Regional (Dobrudja - south - eastern Romania)

List of Bibliographical References:

1. Pătruţ S.,2010: "Evenimente extreme (inundaţii) pe cursul inferior al Dunării în corelaţie cu Oscilaţia Nord Atlantică (NAO) şi presiunea la nivelul mării(SLP) ", SimpozionNaţional–Resusele de apă din România-Vulnerabilitate la presiunile antropice,11-13iunie 2010, Târgovişte, 127-132 pp.

2. Daniela Nistoran, Iuliana Armaș, Cristina Sorana Ionescu,Ş. Constantinescu, Constantin Borcea, S. M. Teodor, 2008: "Model Hidrodinamic 2D Pentru analiza riscului la inundații în localitatea Sf. Gheorghe din Delta Dunării", IWM 2008 CONFERENCE

3. Camelia – Eliza Telteu, Liliana Zaharia, 2012: "Characteristics of floods in the South Dobrogea, Romanian Journal of hidrology and water resources", p. 347-356.

6. Strategic project "Integrated Management of the Danube" ("Danube WATER integrated management")

Title of the Study:

Strategic project "Integrated Management of the Danube" ("Danube WATER integrated management")

Scope and Objectives of the Study:

The overall objective of the project is the creation of a border Romania - Bulgaria management and monitoring of environmental factors on the Danube designed to support joint measures to combat extreme situations (drought, floods, pollution, contamination) and to provide the foundation of integrated information in order to fulfill the provisions of Directive 2007/60/EC "flood protection" and the Directive 2000/60/EC "water Framework Directive", along with ensuring sustainable development of the border and improving the quality of life in the eligible area.

The project aims to increase the capacity of border control cooperation and Romania - Bulgaria in terms of quality monitoring of environmental factors on the Danube and grounding joint response to emergencies (droughts, floods, pollution, contamination).

Implementing Organisation and Funding Bodies:

Implementation is provided by the National Institute of Geography, the National Institute of Hydrology and Water Management, IPA

Results and Significant Impacts of the Study:

- Harmonization of methodologies for monitoring water quality in Romania and Bulgaria, and their international regulations, especially with EU standards;

- Implementation of the Water Framework Directive (2000/60/EC) through a performance monitoring of water status Danube and a common system of real-time information, a program for data exchange and a common database, hydrology and water quality, consistent with the INSPIRE Directive, able to provide data exchange between the involved institutions and the general public access to this information;

- Improved methods of forecasting the development of a common, and the warning in the event of flooding, low flows, accidental pollution through increased accuracy and reliability, based on modern means of communication between the two countries;

- Take small guiding principles of water management for the two countries to prevent droughts in the Danube; integrated operation of reservoirs and wetlands protection;

- Creation of new processing technologies for treatment of wastewater and contaminated organic liquid radioactive waste from nuclear power plants;

- Creating a bilingual portal presenting general information about the Danube regional development of the border area;

This project will implement an integrated border utility, which will enhance the ability of cooperation and control in terms of quality monitoring of environmental factors on the Danube and Romania-Bulgaria substantiation common response to emergencies (droughts, floods, pollution, contamination).

The system will allow remote access (via the Internet / Intranet) of a portal with information for both the general public and specialists of beneficiary institutions in Romania (MMP NARW, INHGA, NEPA) and Bulgaria (Ministry of Environment and Water of Bulgaria, National Institute of Hydrology of Bulgaria, the Bulgarian Ministry of Transport, Environment executive Agency of Bulgaria).

Region(s) of Implementation with Geographical coordinates (if applicable):

Danube Basin

Size of application:

National

List of Bibliographical References:

1. Negru O.,Pătruţ S., Ţone A.M., 2010: “Managementul Situaţiilor de Urgenţă generate de inundaţii în România”, Simpozion Naţional–Resusele de apă din România-Vulnerabilitate lapresiunile antropice, 11-13 iunie 2010, Târgovişte.

2. Pătruţ S., 2010: “Evenimente extreme (inundaţii) pe cursul inferior al Dunării în corelaţie cu Oscilaţia Nord Atlantică (NAO) şi presiunea la nivelul mării(SLP) ”, SimpozionNaţional –Resusele de apă din România-Vulnerabilitate la presiunile antropice,11-13iunie 2010, Târgovişte, 127-132 pp.

3. Rîmbu, N., Boroneant, C., Buta, C. and Dima, M., 2002: “Decadal variability of the Danube river flow in the lower basin and its relation with the North Atlantic Oscillation”, International Journal of Climatology, 22, 1169-1179.

4. Stanciu, P., Nedelcu, G. and Nicula, G., 2005: “Hazardurile hidrologice din Romania”,Natural andanthropogenic hazards,5(23),11-17.

5. Teodossia Andreeva, 2008: “Weather anomalies and influence on bulgarien section of Danube river”, XXIV Conference of the Danubian Countries Bled, 2-4 June 2008.

6. F.M. Toma , A.Ş. Minoniu, 2012: “Comparative analysis of the floods frequence on Teleorman and Galben rivers”, Revista Aerul si apa – Componente ale mediului, dedicata zilei mondiale a meteorologiei si hidrologiei, Presa universitara clujeana, Cluj-Napoca.

7. L. Zaharia, G. Ioana-Toroimac, S. Catană, G. Minea, C. Delporte, 2012: “River lateral dynamics and floods in relation to human communities. Case study: Moara Domnească Village (on lower Teleajen river) ”, Revista Aerul si apa – Componente ale mediului, dedicata zilei mondiale a meteorologiei si hidrologiei, Presa universitara clujeana, Cluj-Napoca.

8. Toma Florentina-Mariana, 2012: “The July 2005 floods in Vedea river hydrographic Basin in July 2005”, Revista Aerul si apa – Componente ale mediului, dedicata zilei mondiale a meteorologiei si hidrologiei, Presa universitara clujeana, Cluj-Napoca.

9. V. Tiplea , S. Todică, Ioana Simea , T. Anghel, Ionela Georgiana Gavrilă, 2011: “Using GIS to identify potential areas susceptible to flood. Case study: Soloneț river”, Revista Aerul si apa – Componente ale mediului, dedicata zilei mondiale a meteorologiei si hidrologiei, Presa universitara clujeana, Cluj-Napoca.

10. Daniel Raduly, 2010: “High risk hydrological phenomena, the floods in the Niraj basin”, Aerul si apa – Componente ale mediului, dedicata zilei mondiale a meteorologiei si hidrologiei, Presa universitara clujeana, Cluj-Napoca.

11. Stevan Prohaska, Aleksandra Ilic , 2010: "Coincidence of Flood Flow of the Danube River and Its Tributaries", Hydrological Processes of the Danube River Basin 2010, pp 175-226

7. Integrated Sustainable management of international river corridors in South East Europei" (SEE/D/0147/2.1/X – SEE RIVER)

Title of the Study:

Integrated Sustainable management of international river corridors in South East Europei" (SEE/D/0147/2.1/X – SEE RIVER)

Period (Dates) of the Study:

2012-2014

Scope and Objectives of the Study:

- to develop a joint approach (SEE River Tolkit) for integrative management of international river corridors; the Toolkit will give guidance on planning and implementing procedures for harmonisation and prioritisation of heterogeneous sectoral policies, plans and programmes related to management of international rivers;
- to apply the joint approach (Toolkit) to agree on future joint actions that will ensure integrative management of the International Drava River Corridor (Drava River Action Plan); key institutions from all five Drava-riparian countries will work together to reach consensus on vision, goals and actions for future management of the international Drava River Corridor;
- to work together with local, regional and national stakeholders in the five Drava-riparian countries to reach multi-sectoral agreements on concrete actions to implement the internationally agreed Drava River vision; the agreed Local Action Plans will be the basis for management of the selected river corridors on local levels.
- to use and promote the Toolkit on 5 additional international river corridors for Bodrog, Neretva, Prut, Soca, and Vjosa rivers; Draft Action Plans for future cooperation in management of these rivers will be prepared by establishing transboundary stakeholder partnerships in all riparian countries.
- to improve the transboundary and cross-sectoral cooperation of existing bodies responsible for managing international rivers by involving them in the process of seeking consensus on future action plans for integrative management on all 6 rivers.;
- to facilitate the implementation of relevant EU legislation, in particular the Water Framework Directive, the Flood Directive, the Habitat Directive, the Birds Directive and the Renewable Resources Directive.
- to increase capacity and raise awareness of stakeholders along international river corridors on importance of transboundary and cross-sectoral approach to sustainable integrative management of river corridors by organising partner

trainings, stakeholder workshops and capacity building seminars for addressed stakeholders.

Implementing Organisation and Funding Bodies:

National Administration "Romanian Waters" is a public institution of a national interest, a legal entity under the coordination of Public Central Authority from water field – Ministry of Waters, Forests and Fishery.

Results and Significant Impacts of the Study:

- Toolkit for Integrative Management of International River Corridors developed as a joint approach to integrative management of river corridors in SEE, tested through application on 6 international river corridors and integrated into their daily work by 26 organisations in partner countries;
- Drava River Action Plan for integrative management of the International Drava River prepared and agreed among 12 organisations in 5 riparian countries through 5 national and 2 international Drava stakeholder workshops;
- 5 multi-sectoral stakeholder agreements - Local Action Plans for management of 5 Pilot Areas on the Drava River corridor reached through 15 workshops with local stakeholders in 5 Drava-riparian countries;
- 5 Draft Action Plans for integrative management of the Bodrog, Neretva, Prut, Soca, and Vjosa river corridors prepared through 5 international stakeholder workshops and meetings with national and local stakeholders of the 5 river corridors;
- Directory of good practices of integrative management of international river corridors established as a permanent exchange programme;
- 10 capacity building seminars for the dissemination of the Toolkit organised and implemented in 10 partner countries;
- 11 follow-up project proposals prepared on the basis of future joint actions agreed during stakeholder workshops for preparation of the Drava River Action Plan and pilot actions, and through the initiation of Draft River Action Plans on the other five SEE river corridors;
- Sustainability plan for future cooperation of the SEE RIVER network of experts.

Region(s) of Implementation with Geographical coordinates (if applicable):

Drava is a 725-kilometers Drava- is a river in southern Central Europe, a tributary of the Danube. The 725-kilometers-long river Drava connects the countries and cultures from the Italian Alps in South Tyrol, the rivers and large lakes in Carinthia, and the Slovenian Alps all the way to the middle European Pannonian valley. Near Legrad, Croatia, inflows its tribute the Mura (Mur) River and forms part of the Croatian-Hungarian border.ra

Bodrog River - is located in the Eastern part of Slovakia. The river is draining also the territory of western part of Ukraine (Zakarpathia). Bodrog is flowing through Hungary into Tisza River. Its total length is 67 km and basin are is of 13.579 km2.odr

The Neretva River - is the largest river of the eastern part of the Adriatic basin which stretches for 220 km in Bosnia and Herzegovina and for the last 20 km in Croatia.ogR

The River Prut - is the second largest tributary of Danube with a total length of 952,9 km. It is a typical border river defining the border between Romania and Ukraine on 31 km and between Romania and Republic of Moldova on 711 km of its length. It is also the eastern border of the European Union. Ive

The Soča or Isonzo (in Italian) - is a 137 km long river that flows through western Slovenia (95 km) and north-eastern Italy (42 km). The total area of its basin is 3400 km2.

Vjosa River is one of the main rivers in Albania with a total length of 272 kilometers of which the first 80 kilometers are in Greece, and the remaining 192 kilometers are in Albania. and Hungary.

Size of application:

Regional

List of Bibliographical References:

1. Mares, C., Mares, I. and Stanciu, A., 2008: "Extreme value analysis in the Danube lower basin discharge time series in the 20th century", Theoretical and Applied Climatology.

2. De Roo, A., Barredo, J., Lavalle, C., Bódis, K. and Bonk, R., 2007: "Potential flood hazard and risk mapping at pan-European scale. In: R. Peckham and G. Jordan (eds) ", Digital elevation modelling. Development and applications in a policy support environment. pp. 183-202. Springer Verlag, Berlin, ISBN: 978-3-540-36730.

7.5 UKRAINE

1. Capacity building for effective flood risk management in the Ukrainian part of the Danube Delta

Title of the Study:

Capacity building for effective flood risk management in the Ukrainian part of the Danube Delta

Period (Dates) of the Study:

2009 - 2011

Scope and Objectives of the Study:

Project aims to assist with capacity building for and community involvement to flood risk management and flood prevention and protection respecting the needs of people's security, public health, economic development of the area and management of the environment in sustainable manner in the Ukrainian part of the Danube Delta. Flemish experience in flood risk management and flood warning was be involved.

Implementing Organisation and Funding Bodies:

Soresma NV, Gent, Belgium Centre for Regional Studies, Odessa Danube Flood Protection Department, Izma

Results and Significant Impacts of the Study:

Improved human and technical capacities for efficient flood risk management; improved methodology for flood risk assessment and assessment of eventual loses cased by floods;

Close integration of the Danube Flood Protection Department into the ICPDR's International System for the Danube Flood Forecast and Early Flood Warning; improved regional policy in the field of flood risk management; improved coordination, cooperation and communication between public authorities responsible for flood protection, flood warning and emergency management;improved strategic and spatial planning at regional and local level taking into consideration risks of flood in the Ukrainian part of the Danube Region; close cooperation between the Flemish and Ukrainian partners

Region(s) of Implementation with Geographical coordinates (if applicable):

Ukrainian part of the Danube Delta

Size of application:

Regional

List of Bibliographical References:

- http://www.crs.org.ua/en/projects/archive/114.html
- http://crs.org.ua/en/events/current/149.html

- Final conference of the project "Building capacities for effective flood risk management in the Ukrainian part of the Danube Delta" http://crs.org.ua/en/events/current/149.html
- Press article http://www.crs.org.ua/data/flanders/article_finconf.jpg

2. Emergency Planning and Flood Protection in the Lower Danube EuroRegion

Title of the Study:

Emergency Planning and Flood Protection in the Lower Danube EuroRegion

Period (Dates) of the Study:

2005-2007

Scope and Objectives of the Study:

The overall objective of the project was working out and implementation of appropriate measures and practice of management for flood prevention and protection respecting the needs of people's security, public health, economic development of the area and management of the environment in sustainable manner in the Lower Danube floodplain.

Implementing Organisation and Funding Bodies:

Centre for regional Studies, Odessa.The project financed by European Commission through Tacis Cross-Border Co-operation Small Project Facility Program

Results and Significant Impacts of the Study:

- Integrated plan for measures to reduce flood risk in the Lower Danube Floodplain.
- Directory of potentially dangerous units (enterprises, stores etc.)
- Recommendations on regulation of economic and human activities in the flood risk areas under the circumstances of a deluge for Odessa Regional Council.
- Assessment of the potential damage on the flood risk areas.
- Recommendations on creation of flood protection polders and the Danube Delta wetlands'
- Recommendations on changing of the land use status in the Ukrainian part of the Danube Floodplain and removal of potentially dangerous units from the flood area
- Recommendations on hydrological management of the Danube lakes during deluge
- GIS "Attention Flood" for efficient flood protection and floodplain management

Region(s) of Implementation with Geographical coordinates (if applicable):

Ukrainian part of the Lower Danube floodplain

Size of application:

Regional

List of Bibliographical References:

- http://www.crs.org.ua/en/projects/archive/47.htm
- Report “Flood risk assessment in the Lower Danube Floodplain”
- The booklet “What you have to do when get a flood warning”
- An integrated plan for measures to reduce flood risk in the Lower Danube Floodplain
- GIS maps:
  - an inundation map of the dyked areas of the Ukrainian part of the Danube Floodplain under the circumstances of destruction of the system of flood-protection dykes;
  - map of zoning of the Ukrainian part of the Danube Floodplain taking into consideration modes of land use;
  - map location of potentially dangerous units (enterprises, stores etc.) which may affect peoples’ security, public health and environment in case of a disastrous flood http://www.crs.org.ua/assets/files/Map.JPG
- The booklet “What you have to do when get a flood warning

3. Other Fundamental Studies of USSR Academy of Sciences and National Academy of Sciences of Ukraine (1960th –present)

1. Almazov A.M. Hydrochemistry of river mouth areas (northern Black Sea). – Kiev: Izd-vo AN USSR - Publishing House of the USSR Academy of Sciences, 1962. – 255 p.

2. Almazov A.M., K. Bondar., N.F. Hydrology of mouth area of Danube. Ed. J.D. Nikiforov and K. Diaconu. – Moscow: Gidrometeoizdat (Gidro meteorological publishing house), 1963. - 383 p.

3. Appolov B.A. Kalinin G.P., Komarov V.D. Course of hydrological forecasts. Leningrad: Gidrometeoizdat - Gidro meteorological publishing house, 1974. - 418 p.

4. Barannik V.A., Goloshhapov V.M. Method of calculation of the wind currents of water bodies in the curvilinear orthogonal coordinate system. The problems of water protection. MY. 10, Kharkov, VNIIViV, 1979 - pp. 97-104.

5. Bondar C. Contribution to the hydraulics study of the outlet on the sea through the Danude mouth. Hydrological studies. – Bucharest - 1972. - Vol. XXXII. - 466 p.

6. Braginskij L.P. Ecological and toxicological situation in Kilia branch and Kilia delta of the Danube. Hydroecology of Ukrainian section of the Danube Delta and adjacent bodies of water. - Kiev: Naukova dumka, 1993.- pp. 190-193.

7. Budzyak V. M. Social and economic losses from floods in Ukraine. Available at: archive.nbuv.gov.ua/portal/.../v47ek119.pdf

8. Korotaev V.N. Geomorphology of river deltas - Moscow: Moscow University Publishing House, 1991. – 224 p.

9. Kravcova V.I. The analysis of the dynamics of estuaries on the basis of satellite images. Water: a scientific journal - 2001. - V. 28. – no. 4. - pp. 402-409.

10. Efremova O.N., Kravcova V.I. The study of the dynamics of the Danube Delta using satellite images. Study of Earth from space: Scientific Journal - 1981. - № 5. – p. 90-96

11. Garkavaja G.P., Bogatova Ju.I., Berlinskij N.A. Features of hydrochemical conditions of the Ukrainian mouth of Danube area. Ecosystem of coastal area of Ukrainina part of Danube Delta).- Odessa, Astroprint 1998.- pp.21-62.

12. Ecological assessment of project variants (on the stage of feasibility studies) of creation of deep-water passage- Danube-Black sea on the Ukrainian area of delta. Institute of hydrology and biology. National academy of sciences of Ukraine. Kiev - Johannesburg, 2002.

13. Garkavaja G.P., Bogatova Ju.I., Berlinskij N.A. Formation of hydrochemical conditions on the coast of the Danube. Ecological safety of coastal and shelf areas and comprehensive exploitation of resources of the shelf.- Sevastopol, 2000. - pp.133-141.

14. Hydroecology of Ukrainian section of the Danube and adjacent waterbodies – Kiev: Naukova dumka, 1993. – 328 p.

15. Hydrology mouth area of the Danube. Leningrad: Gidrometeoizdat - Hydrometeorological publishing house, 1971. - 383 p.

16. Gorjachkin J.N. Goriachkin Y.N. Ivanov V.A. Temporal changes of the Black Sea level Water resources: scientific journal - 1996. - V. 23. – no. 2 - pp. 246-248.

17. Gopchenko E.D. Cheroj A.I. Streamflow time lag on the Ukrainian part of the Danube River. Bulletin of the Odessa State Environmental University: Scientific Journal. - 2007. - Ed. 4. - pp. 274-279 p.

18. Gopchenko E.D., Cheroj A.I. Temporal variability of the flow rate and turbidity of the water in the Bistroe of Kilia Delta of Danube. Bulletin of the Odessa State Environmental University: Scientific Journal. - 2008 - Ed. 6. - pp. 122 – 128.

19. Isupova M.V. Natural and anthropogenic changes in water and streamflow regime of the Danube delta. Bulletin of Moscow University: Scientific Journal - 2002. – no. 5. - pp. 56-61. (series "Geography")

20. The catastrophic floods on the Danube in August 2002 / V. N Mikhailov, M. V Mikhailov, V. N Morozov [etc.] / / Meteorology and Hydrology: scientific journal - 2004. - № 1 - S. 81 – 88

21. Levashova E. A. Natural and anthropogenic changes in water flow and sediment at the mouth of the Danube for 160 years. Bulletin of Moscow University: Scientific Journal - 2001. - № 5. - Pp. 46-50. (series "Geography")

22. Mihajlov V.N. Delta as indicators of natural and anthropogenic changes in the regime of rivers and seas. Water: a scientific journal - 2003. - V. 30. – no. 6. - pp. 655-666.

23. Mihajlov V.N. Mihajlova M.V. Regularities of the formation of river deltas at the open sea coast Bulletin of Moscow University: Scientific Journal - 1991. - № 5. - p. 36-44. (series "Geography")

24. Mihajlov V.N. Rogov M.M., Chistjakov A.A. River deltas. Hydrological and morphological processes - Leningrad: Gidrometeoizdat - Hydrometeorological publishing house, 1986. - 280 p.

25. Mihajlov V.N. Vagin N.F., Morozov V.N. Basic laws of the hydrological regime of the Danube Delta and its anthropogenic changes. Water Resources: a scientific journal – - 1981. – no. 6. - pp. 22-44.

26. Mihajlov V.N., Morozov V.N., Mihajlova M.V. Hydrology of the Danube Delta - Moscow: GEOS, 2004. – 448 p.

27. Mihajlov V.N., Morozov V.N., Mihajlova M.V., Granich P.S. Hydrological processes in the mouth of the Danube and possible changes. Water Resources: a scientific journal – 1988, no. 1, pp.24–32.

28. Mihajlov V.N., Povalishnikova E.S., Morozov V.N. Long-term changes in water levels in the Chilia arm of the Danube delta. Water Resources: a scientific journal, V. 28, no. 2, 2001.

29. Mihajlov V.N., Rogov M.M., Chistjakov A.A. River deltas. Hydrological and morphological processes. Leningrad: Gidrometeoizdat - Hydrometeorological publishing house, 1986.- 280 p.

30. Modelling of inundations with the help of Geographic Informational Systems. Available at: sn-geography.crimea.edu/...25.../009_zat2.pd

31. Recommendations on statistical methods for the analysis of homogeneity of spatial - temporal variations of river flow - Leningrad: Gidrometeoizdat - Hydrometeorological publishing house, 1984. – 78 p.

32. Shestopalova V.M., Ivanova V.A. River run in south of Ukraine: quantitative assessment of floods, principles of management and forecast National Academy of Sciences of Ukraine, Institute of Marine Hydrophysical. Sevastopol, 2006. - pp. 90-91.

33. Shiklomanov I. A. Human-induced changes in water regime of river. Leningrad: Gidrometeoizdat - Hydrometeorological publishing house, 1979. - 302 p.

34. Shiklomanov I.A. Impact of human activity on river runoff. Leningrad: Gidrometeoizdat - Hydrometeorological publishing house, 1989. - 335 p.

35. Shiklomanov I.A., Linz G. Impact of climate change on hydrology and water management. Meteorology and hydrology: Scientific magazine - 1991. - no. 4.- pp. 51- 66.

36. Shujskij J.D. Dynamics of the sea edge Kilia part of Danube delta. Scientific works of state oceanographic institute, 1984. - Is. 172. - pp. 50-58.

37. Topchiev O.H. and others. Ukrainian Danube: problems and prospects in the context of international cooperation.) Bulletin of the Odessa National University. V. 8, no. 11. Ecology. Odessa, 2003 - pp. 18-28.

38. Vishnevsky V.I. Rivers and reservoirs Ukraine. Status and use: monograph) Kiev: Vipol, 2000. - 376 p.

39. Water exchange in the hydrogeological structures of Ukraine. Kiev: Naukova Dumka - Scientific thought, 1989.

<u>Conference proceedings</u>

1. Bondar C., Buta C., Harabagiu E. Variation and trend of the water, sediment and salt runoff for the Danube River, at the inlet in our country, during the period 1840-1992. Proc. XVII Conference of the Danube countries on hydrological forecasting and hydrological bases of water management. – Budapest - 1994. - V. II. - pp. 671-676.

2. Cheroy A.I. On the problem of the suspended sediment flow account in the Danube Delta. Proc. X International Symposium on River Sedimentation. – Moscow - 2007. - Is. IV. - pp. 22-26.

3. Garkavaya G.P., Bogatova J.I., Bulanaya Z.T. Dinamics of nutrient substances in the Kiliya delta of the Danube under conditions of reduced and regulated runoff Limnologische Berichte Donau 1997, 32 Konferenz der L.A.D. - Wien, 1997.- pp. 37-42.

4. Mikhailov V.N., Morozov V.N. Influence of marine factors on hydrological regime of the Danube delta Proceedings of the XVII Conference on the Danube Countries on Hydrological Forecasting and Hydrological Bases of Water Management, Budapest, 5-9 September, 1994.- V. 2 – Budapest, 1994. - pp.403-408.

5. Mikhailova M., Mikhailov V., Levashova E., Morozov V. Natural and anthropogenic changes in water and sediment runoff of the Danube at the delta head (1840-2000) Proc. XXI Conference of the Danube countries on hydrological forecasting and hydrological bases of water management- Bucharest - 2002.- pp. 1-7.

6. Mikhailova M. Cheroy A. Mikhailov V. Dynamics of the delta coastline as an indicator of the evolution of the Chilia delta at the Danube mouth [Electronic resource] Proc. XXIII Conference of the Danube countries on hydrological forecasting and hydrological bases of water management. – Belgrade - 2006. - (CD-ROM) - pp. 1-10.

7. Mikhailova M. Delta dynamics as a result of changes in river sediment runoff and sea level Proc. X International Symposium on River Sedimentation.- Moscow – 2007. - V. IV. - pp. 160-168.

8. Mikhailova M. Sediment balance at the Danube river month. Proc. XVII Conference of the Danube countries on hydrological forecasting and hydrological bases of water management – Budapest - 1994. - V. II. - pp. 631-636.

9. Mikhailova M., Levashova E. New data on the sediment balance at the mouth of the Danube River Proc. XX Conference of the Danube countries on hydrological forecasting and hydrological bases of water management – Bratislava - 2000. - pp. 455-460.

10. Mikhailova M.V. Formation of the Danube and Rioni deltas and their coasts Poceedings of the Second International Conference on the Mediterranean Coast Environment, MEDCOAST 95, October 24–27, 1995. Tarragona, Spain. – V. 2, 1995. – pp. 911–920.

7.6 REPUBLIC OF MOLDOVA

Review of floods study in Republic of Moldova:

Projects

1. Model elaboration of kinematical floods wave and assessment of risk areas in case of floods on rivers of Moldova. period 2009-2010. Supported by government State program "Quality of water". Project manager dr. hab. O. Melniciuc, Institute of Ecology and Geography, ASM.
2. Development of geoinformational support for flood risk assessment in hydrological basin of the Prut river. period 2011-2012. Supported by government State program "Quality of water". Project manager dr. Iu. Bejan, Institute of Ecology and Geography, ASM.
3. Disaster and Climate Risk Assessment Project of UNDP Moldova. 2011-2012, UNDP.
4. Project initiative ENVSEC: Reducing vulnerability to extreme floods and climate change in the Dniester River basin ("Dniester-III: flood and climate"). Basic study in Republic of Moldova. State Hidrometeo service, L. Serenco.

Guidelines

1. Personal guidelines in extreme case: https://www.google.nl/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&ved=0CCsQFjAA&url=http%3A%2F%2Fwww.asm.md%2Fadministrator%2Ffisiere%2Fprotectia_civila%2Fghid.doc&ei=ZgdDUpeHCsHq4gSezoHoCQ&usg=AFQjCNES3AYDsfdgx1EcQJXptzxnOLJUOA&sig2=qr6JGcG2MPNw68XhFlZdLg&bvm=bv.53077864,d.Yms
2. Strategia naţională de management al riscului la inundaţii. Prevenirea, protecţia şi diminuarea efectelor inundaţiilor. (National strategy of management of flooding risk. prevention, protection and diminution of effects) http://www.mmediu.ro/vechi/departament_ape/gospodarirea_apelor/inundatii/strategie_inundatii.pdf
3. Plan of medical assistance in extreme case : http://old.ms.md/public/info/situatii/
4. Rescuire guide: http://redcross.md/ro/ce-facem/primul-ajutor/ghidul-salvatorului
5. Instructions in extreme cases: http://www.dse.md/node/17

Publications

1. Melniciuc O., Arnaut N., Shvets V, Chisciuc A. Catastrophic flooding waves in Prut and Dniester river basins: Analysis of sources and parameters, Bulletin of Institute of Geology and Seismology of Academy of Sciences of Moldova, Nr. 2, Chisinau, Moldova, 2009, pp. 90-98 (published in Russian); *Positioning of rivers Prut and Dniestr basins in the Carpat Mountains and particularities of atmospheric precipitations are the main driving factors of flooding on these*

rivers. In this region frequent heavy showers and intense density of river network leads to catastrophic flooding.

2. Melniciuc O., Chisciuc A., Gudumac Iu., The influence of the Dniester cascade reservoirs on regime of the high waters of the Dniester River, Dniester River Basin: environmental issues and management of transboundary natural resources: Collection of Scientific Articles, Tiraspol, Moldova, 2010, c. 143-145 (published in Russian); *In paper is given analyses of the Dniester river basin cascade reservoirs. Influence of this reservoirs on management of high waters.*
3. Chisciuc A., Temporal analysis of pluvial floods of the rivers of Moldova, International Conference of Young Researchers: book of abstracts, VIII editions, "PRO-Science", Chisinau, Moldova, 2010, p. 71 (published in Romanian); *This paper give temporal analysis of pluvial floods of the rivers in Moldova.*
4. Melniciuc O., Chisciuc A., An analysis of catastrophic flooding on the Prut River in the summer of 2010, Academician L. Berg - 135 from birth: Collection of Scientific, Bender, Moldova, 2011, pp. 164-167 (published in Russian); *It is given analysis of catastrophic flooding on the Prut River in the summer of 2010.*
5. Chisciuc A., Determining flood risk zones on the river Botna using model "UNDA", Proceedings of the annual international scientific conference of students and PhD students: Geographical Research: History, Present and Prospects, Harcov, Ukraine, 2011, pp. 59-61 (published in Russian); *It is determinate flooding risk for Botna river.*
6. Jeleapov A., Pluvial flood hydrographs modeling basing on the Dniester floods in 2008, Black Sea Ecological Problems: Collection of Scientific Articles, Odessa, Ukraine 2011, pp. 200-203 *It is given analysis of catastrophic flooding on the Dniester River in the summer of 2008.*
7. Boboc N., Bejan Iu., Jeleapov A., Floods in nature and in human life. Ambient environment. Nr. 2(62), Chisinau, Moldova, 2012, pp. 10-12, (published in Romanian). *It is shown influence of floods on nature and human life. With example of flood in Moldova.*
8. Arnaut N. Анализ современного руслового режима р. Прут. Buletinul Institutului de Geofizică şi Geologie al AŞM, N 1, 2006. *In paper it is given analysis of Prut river channel processes. Change in this processes by human influence hasn't been revealed.*
9. Arnaut N.A. Regimul hidrologic şi de albie al râurilor mici din republica Moldova. Buletinul Institutului de Geologie şi Seismologie al AŞM, N 1, 2011. *The analysis of major factors forming runoff and sediment transport of the small rivers under the anthropogenic impact is presented in this article. Schematic graphics of major hydrological factors and channel processes for small rivers on the bases of bibliographical data are posted.*

10. Mihailescu C., Boian I., Fenomene naturale de risc în Republica Moldova. Mediul Ambiant, Nr. 5 (23) octombrie 2005. p. 3-10. *It is shown natural risk in Republic of Moldova with exemple.*
11. Cazac V., Boian I., Riscul inundatiilor in Republica Moldova. Mediul Ambiant, Nr. 4 (40) august 2008. p. 43-48. *It is shown different type of floods in republic of Moldova. This natural hazards can appear in every season of year.*
12. Boian I. Ploile torenţiale abundente - fenomen de risc major pentru Republica Moldova// Materialele Conferinţei Internaţionale Diminuarea impactului Hazardelor Naturale şi tehnogene asupra mediului şi societăţii, 6-7 octombrie 2005. Ministerul Ecologiei şi Resurselor Naturale. Academia de Ştiinţe a Moldovei. Chişinău, 2005. *The article shows the risk of flooding during heavy intermittent rain.*
13. Cadastrul de Stat al Apelor. Date multianuale despre resursele şi regimul apelor de suprafaţă. Serviciul Hidrometeorologic de Stat, Chişinău, 2006.
14. Melniciuc O., Boboc N., Muntean V., Tanase A., Inundaţiile catastrofale generate de viiturile pluviale pe râurile din Republica Moldova. Lucrările simpozionului "Sisteme Informaţionale Geografice", Nr. 12. Anal. Şt. Univ. „Al.I.Cuza" Iaşi, Tom LII, s.IIc. Geografie, 2006. *Frequency and maximum readings of floods generated by torrential rains is characterized on the basis of historic information analysis and mechanical observations. In order to develop recommendations and norms for designing socio-economic and protection facilities in flood susceptible areas as well as for monitoring small rivers' habits, the necessity of modern information systems application is being substantiated.*
15. Bejenaru, Gh., Melniciuc, O. (2003) – Calculul precipitaţiilor generatoare de viitură la determinarea debitelor maxime de apă pe râurile mici din Republica Moldova, Analele Universităţii de Stat din Tiraspol – 2002. vol. II. Ştiinţe biologice, geografice, geologice, economice, chimice şi didactica geografiei, biologiei şi chimiei, p. 17-25. *In paper shows a small river flood risks, with estimation of precipitation rainfall causing.*
16. Boboc N., Melnicuc O., Bejan Iu., Jeleapov A., Muntean V., Angheluta V., Utilization of hec-ras for flood wave modeling on example of Prut river. Geographia Napocensis Anul VI, Nr. 2, 2012. Geographia napocensis AN. VI, nr. 2/2012 *Floods management is possible due to the fact that their zone of manifestation can be predictable and often a warning can be announced regarding the area, flood extent and character. One of flood prevention methods is based on creating of a virtual model and its computational simulation to further development of necessary recommendations.*
17. Melniciuc, O., Lalîkin, N., Bejenaru, Gh. (2002) – Probleme de studiu al inundaţiilor în Republica Moldova, Darea de seamă ştiinţifică. CIAPI, Moldova, Chişinău, 115 p. *Report on study of flooding in the Republic of Moldova.*

18. Boian I., Sandu., Inundaţiile pe teritoriul Republicii Moldova şi măsurile de reducere a lor, Revista Mediul Ambiant nr. 2 (26) aprilie, Chişinău, 2006. *It is shown flooding in Republic of Moldova. It is given example of some of them.*
19. Cazac V., Boian I., Prepeliţă A. Principalele tipuri de hazarduri naturale şi impactul lor asupra mediului şi sănătăţii. // Mediul Ambiant, nr. 5 (23) octombrie, Chişinău, 2005. *Given analysis of natural hazards in Republic of Moldova.*
20. Лассе Г. Ф. Климат Молдавской ССР, Гидрометеоиздат, Ленинград, 1978, 375 p. *Given general estimation of climate conditions in Republic of Moldova.*
21. Казак В. Современные речные водные ресурсы Республики Молдовы и их возможные изменения предстоящим потеплением климата. Mediul Ambiant 1 (43) februarie 2009. p. 40-46. *Up until now there were no evaluation of the river/water resources in the Republic of Moldova at modern level, not there was a forecast of their future evolution taking in account the climate change in the 20 th century. The presented work offers a classification of water resources in the following categories: natural, real, ecological and available.*
22. Cazac V., Mihailescu C., Bejenaru Gh., Gîlcă G., Vol. I.: Apele de suprafaţă – Seria resursele acvatice ale republicii Moldova, chişinău, ştiinţa, 2007, 247 p. *It is shown characteristics of surface water in Republic of Moldova.*
23. Cazacu V., Boian I., Volontir N., Hazardele naturale, chişinău, ştiinţa 2008, 207 p. *It is shown natural hazards that appear in the Republic of Moldova.*
24. Capatina L. Utilizarea standardelor europene in elaborarea planului de management al riscului la inundatii in Republica Moldova. Mediul Ambiant Nr. 5 (59) octombrie 2011. p. 14-18.
25. Capatina L. Psychosocial changes in risk perception as a result of environmental global changes. Remaking the Social. New Risks and Solidarities The First International Conference of the Society of Sociologists from Romania Faculty of Sociology and Social Work, “Babeş-Bolyai” University Cluj-Napoca 2-4 December, 2010. p. 40-46. *The perception study of the risk phenomena is an essential and constant concern in risk analysis because the perception of hazardous event it’s a main indicator in management of crisis situation and in adopting some policy and harm mitigation strategies. There are indirect influences of the environmental global changes on the psychosocial changes; the most visible are damage of social and economic living conditions. The most vulnerable are poor societies, for them any threat is perceived as a disaster.*
26. Starea mediului în Republica Moldova în 2007-2010 (Raport Naţional) [Environmental conditions in Republic of Moldova in 2007-2010, national report]. Chisinau, 2011. *In report in chapter 1.3 Meteorological and Hidrogeological characteristics shown floods on Dniester and Prut rivers in 2008, 2010.*

8 BIBLIOGRAPHY REGARDING METHODOLOGICAL APPROACHES FOR SEISMIC HAZARD ASSESSMENT AT REGIONAL AND LOCAL SCALES (ACTIVITY A1.6)

8.1 TURKEY

1. Global Seismic Hazard Assessment Project (Erdik et. al. 1990)

Acronym:

GSHAP

Title of the Study:

Global Seismic Hazard Assessment Project

Period (Dates) of the Study:

1992-1999

Scope and Objectives of the Study:

The aim of this study was to conduct a probabilistic seismic hazard analysis for different GSHAP regions and test areas; it has depicted the global seismic hazard as peak ground acceleration (PGA) with a 10% chance of exceedance in 50 years, corresponding to a return period of 475 years.

Implementing Organisation and Funding Bodies:

The Global Seismic Hazard Assessment Program (GSHAP) was launched by the International Lithosphere Program (ILP) with the support of the International Council of Scientific Unions (ICSU), and endorsed as a demonstration program in the framework of the United Nations International Decade for Natural Disaster Reduction (UN/IDNDR)

Results and Significant Impacts of the Study:

The first seismic hazard map in global scale , in terms of peak ground acceleration (PGA) with a 10% probability of exceedance in 50 years, corresponding to a return period of 475 years (Giardini, 1999), based on the compilation and assemblage of hazard results obtained independently in different test areas and multinational programs.

Region(s) of Implementation with Geographical coordinates (if applicable):

GSHAP areas: (1) the Americas (Shedlock and Tanner, 1999), (2) Asia, Australia and Oceania (Zhang et al., 1999; McCue, 1999), and (3) Europe, Africa and the Middle East (Grünthal et al., 1999). National: Turkey and Neighboring Regions.

Size of application:

Regional

2. The Improvement of Natural Hazard Insurance and Disaster Funding Strategy project which is a part of the TEFER (Turkey Emergency Flood and Earthquake Recovery), 2000

Acronym:

TEFER

Title of the Study:

The Improvement of Natural Hazard Insurance and Disaster Funding Strategy project which is a part of the TEFER (Turkey Emergency Flood and Earthquake Recovery), 2000

Period (Dates) of the Study:

1998-2002; system implemented in 2003

Scope and Objectives of the Study:

The project aimed the development of an event-based loss estimation methodology for the Turkish Catastrophe Insurance Pool (TCIP) portfolio, through: (1) rational estimation of probabilistic hazard, (2) an associated event based probabilistic building damage and loss estimation model and (3) estimation of annual average loss (AAL) and loss exceedence probabilities

Implementing Organisation and Funding Bodies:

Implemented by General Directorate of State Hydraulic Works (DSI), Turkish State Meteorological Service (DMI) and General Directorate of Electric Power Resources Survey and Administration (EIEI) with the input of Danish Hydraulics Institute (DHI), Turkey Arti Proje LLC, Turkey Su Yapı Engineering and Consulting Inc. And Turkey Elite Elektronik LLC. Funded by World Bank and Turkish Government.

Region(s) of Implementation with Geographical coordinates (if applicable):

Country scale for Turkey

Size of application:

National

3. EU-SESAME Project (2003)

Acronym:

EU-SESAME

Title of the Study:

EU-SESAME Project (2003)

Scope and Objectives of the Study:

The project aimed to produce hazard maps expressing ground motion in different parameters, for different soil conditions and probability levels through a homogeneous computational procedure.

Implementing Organisation and Funding Bodies:

Financial support from the International Lithosphere Project (ILP), the International Council of Scientific Unions (ICSU), UNESCO, the International Association of Seismology and Physics of the Earth Interior, the European Council, NATO (ARW Ct.95-1521), INTAS (Ct.94-1644), the National Institute of Geophysics and Volcanology of Italy and the Swiss Federal Institute of Technology Zurich is acknowledged. Many research agencies supported the participation of their scientists in the different programs

Results and Significant Impacts of the Study:

Peak ground acceleration (PGA) with a 10% probability of exceedance in 50 years, for the European-Mediterranean region

Region(s) of Implementation with Geographical coordinates (if applicable):

European scale

Size of application:

National

3. Earthquake resistant design code for the construction of railways, seaports and airports

Acronym:

DLH, (2007)

Title of the Study:

Earthquake resistant design code for the construction of railways, seaports and airports

Period (Dates) of the Study:

2007

Scope and Objectives of the Study:

The aim of this study was to conduct a probabilistic seismic hazard analysis that would form the basis of the earthquake resistant design code for railways, seaports and airports in Turkey

Implementing Organisation and Funding Bodies:

Earthquake hazard assessment study conducted for the Ministry of Transportation of Turkey

Results and Significant Impacts of the Study:

PSHA results for the center of each grid with 0.2° spacing covering Turkish territory corresponding to 50, 10 and 2% exceedance probabilities in 50 years for Spectral Accelerations at 0.2 sec and 1.0 sec.

Region(s) of Implementation with Geographical coordinates (if applicable):

Country scale for Turkey

Size of application:

National

4. Seismic Hazard Harmonization in Europe"

Acronym:

SHARE

Title of the Study:

Seismic Hazard Harmonization in Europe

Period (Dates) of the Study:

2009 - 2012

Scope and Objectives of the Study:

- Main objective is to provide a community-based seismic hazard model for the Euro-Mediterranean region with update mechanisms.
- Aims to establish new standards in Probabilistic Seismic Hazard Assessment (PSHA) practice by a close cooperation of leading European geologists, seismologists and engineers.

Implementing Organisation and Funding Bodies:

Collaborative Project in the Cooperation programme of the Seventh Framework Program of the European Commission.

Results and Significant Impacts of the Study:

- Probabilistic seismic hazard maps of Europe for different return periods and ground motion parameters

Region(s) of Implementation with Geographical coordinates (if applicable):

Covers the whole Euro-Mediterranean area (in this phase for the Mediterranean the Maghreb countries to the West and Turkey to the East are included

Size of application:

National

5. Earthquake Model of Middle East

Acronym:

EMME

Title of the Study:

Earthquake Model of Middle East

Period (Dates) of the Study:

2009 - 2013

Scope and Objectives of the Study:

- Aims at the assessment of earthquake hazard, the associated risk in terms of structural damages, casualties and economic losses and also at the evaluation of the effects of relevant mitigation measures in the Middle East region in concert with the aims and tools of GEM (Global Earthquake Modeling)
- Encompasses several modules such as the Hazard Module, Seismic Risk Module, Socio- Economic Loss Module and the development of an IT infrastructure or platform for the integration and application of modules under consideration.
- Methodologies and software developments are compatible with GEM and with other regional projects in the Euro-Mediterranean area (SHARE) and India.

Implementing Organisation and Funding Bodies:

EMME (Earthquake Model of the Middle East Region) is a private sponsored international project aiming at the assessment of seismic hazard, the associated risk in terms of structural damages, casualties and economic losses and also at the evaluation of the effects of relevant mitigation measures in the Middle East region.

Results and Significant Impacts of the Study:

- Completely transparent and reproducible probabilistic seismic hazard models for the entire region
- Probabilistic seismic hazard maps of the region for different return periods and ground motion parameters.

Region(s) of Implementation with Geographical coordinates (if applicable):

Turkey, Georgia, Armenia, Azerbaijan, Iran, Pakistan, Lebanon, Jordan, Cyprus

Size of application:

National

8.2 GREECE

8.2.1 BACKGROUND INFORMATION ON SEISMIC HAZARD MAPS OF GREECE

The seismic hazard maps appeared in the various seismic codes of Greece since 50's were based on the valid seismological knowledge during the corresponding period of compilation.

In the first seismic hazard map of Greece with the title "Engineering Seismic Map of Greece" the area of Greece was divided in classes of seismic hazard (Technical Chronicles, no 184, 1939) and was compiled by Roussopoulos (1956). The classification was based on a proposed value corresponding to fraction of the horizontal acceleration which was considered as design acceleration. In the revision of 1956 (2nd edition) the area of the Dodecanese islands was considered in the zonation and the new map included five seismic hazard classes with a division each of them in three subclasses depending to the soil classification. The coefficient was varied between 0.01g and 0.16g. The map is shown in Fig 63.

This map was based on the macroseismic effects of the earthquakes during the 19th early of the 20th century reflecting the geographical distribution of the maximum intensities. No statistics was used.

Until the end of fifty's several regulations were issued after disastrous earthquakes for the rehabilitation of the damaged structures (Corinthos 1926, Chalkidiki 1932, Thessaloniki 1932, Ionian Island 1953 Thessalia 1954-1957). The first Greek seismic code was adopted in 1959 (Royal Decree 19/26.2.1959, Gov. Gazet. 36A) and included a list of 144 sites which were grouped in 3 classes. The classification was based on the maximum observed intensity and its frequency without any scientific treatment.

Discussions of the revision of the seismic code of Greece started after the 1978 M=6.5 Thessaloniki earthquake, which caused extended damage to reinforced concrete structures, which were built according to the seismic code of 1959. These discussions were densified after the strong earthquakes of 1981-1986 which caused high degree damage including collapses at several regions.

Until that period many research papers and PhD theses were published aiming in reliable assessment of seismic hazard. These scientific efforts started on the basis of point source approximation for seismic hazard studies with the application of the probabilistic methods of mean values and the Gumbell I and III asymptotic distributions. The paper by Galanopoulos and Delibasis (1972) was the first attempt on seismic hazard even at elementary level of data statistical treatment. The first trusted attempt was made by Algermissen et al (1972). The publications of Makropoulos (1978), Papaioannou (1984), Papoulia (1988) and the papers by Drakopoulos and Makropoulos (1983), Papaioannou (1986), Makropoulos and Burton (1989), were based on the Gumbell's (1958) first and third asymptotic distributions. Following, the more detailed zonation by Hatzidimitriou (1984), the Cornell's (1968) method and its modification due to McGuire (1976) was applied by Papazachos et al (1985) using the area-type seismic sources model by Hatzidimitriou (1984) which was based on the pioneering work for the compilation of an area-type seismic sources model by Papazachos (1980). In the paper by Papazachos et al (1985) the authors adopt the opinion expressed by Cornell (1968), that the use of seismic hazard recurrence curves is more useful than ill-defined single numbers as the "probable maximum" or the "maximum credible" intensity. This is due to the fact that even well-defined single numbers, as the “expected lifetime maximum” are insufficient to give the engineers an understanding of how quickly the hazard (annual probability of exceedence) decreases as the ground motion intensity increases. The zonation by Papazachos (1980) was used laso by Stavrakakis and Tselentis (1987). Papazachos et al. (1990) attempted to perform a statistical elaboration of the macroseismic observation for selected sites in Greece and compare the results with probabilistic seismic hazard.

Fig 63. The first seismic hazard map of Greece.

Improvements and contribution to the credibility of the results were made by Margaris (1994), who took into account the azimuthal variation of the seismic intensity in the calculations.

Given the proposal for the empirical predictive relation for the peak ground values by Theodulidis (1991), the seismic sources model for the shallow and intermediate depth earthquakes (Papazachos, 1990) and the compilation of the catalogue of historical earthquakes by Papazachos and Papazachou (1989), seismic hazard maps were compiled using the McGuire (1976) code and also the mean values and Gumbell (1958) probabilistic methods. These individual maps were considered as the basis of the revised version of seismic hazard zonation of Greece (Papazachos et al., 1989). In this map the area of Greece was divided into four zones of seismic hazard with design values for the ground acceleration (seismic design coefficient) equals to 0.12g, 0.16g, 0.24g and 0.36g and is shown in Fig 64. Following the earthquake of 1995 in Kozani there was a modification for the area of W. Macedonia due to increase level of the seismic hazard.

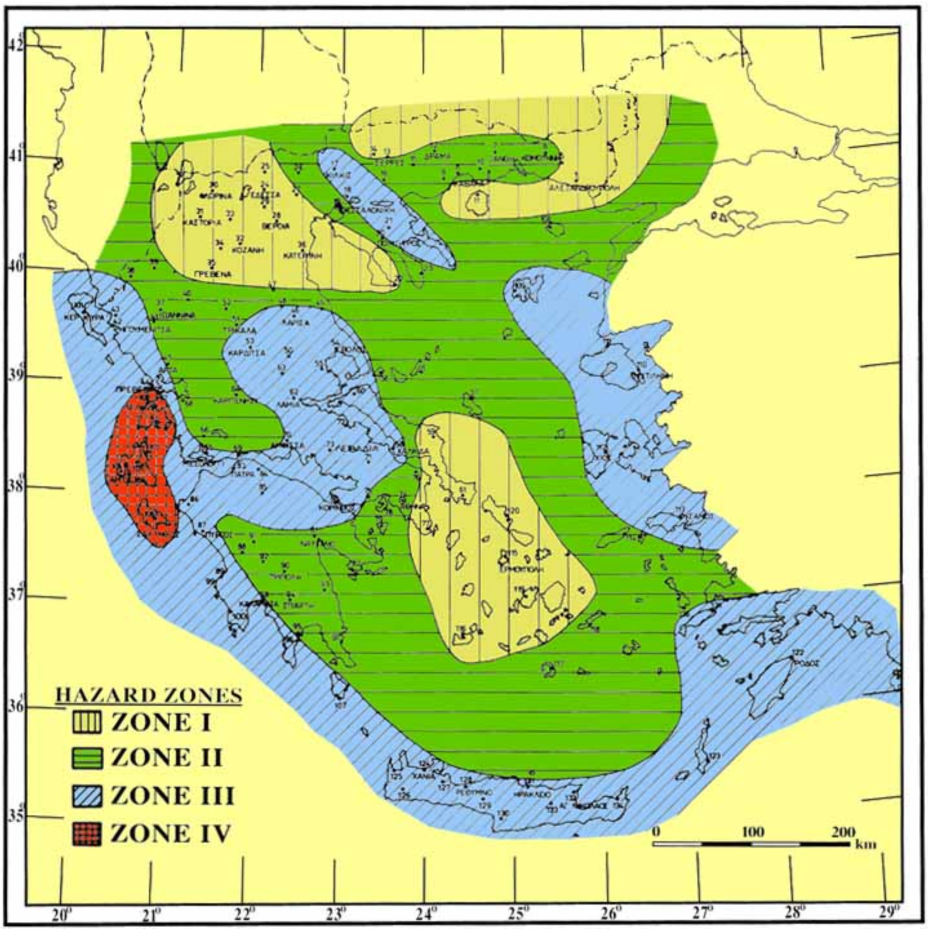


Fig 64. Seismic Hazard map of Greece in the seismic code of 1992 (Papazachos et al., 1992).

Even though the background work for the seismic hazard map of Greece was accomplished in 1989 the seismic code of Greece was published in the Government Gazette in 1992 being valid in parallel with the 1950 code. In 1995 two disastrous earthquakes occurred in Greece (Kozani, M6.6 and Aigio M6.2). In July-August 1996 two earthquakes of magnitude M 5.2 and 5.6 occurred in NW Greece with recorded peak accelerations 0.39g at the town of Konitsa (zone II) were a partial collapse of a reinforced concrete 4 stories building was observed. In September 1999 a magnitude M5.9 earthquake caused great damage in the metropolitan area of Athens. This was the trigger effect for the government to request for a new updated seismic hazard map of Greece on the basis of the new scientific information gained during the period 1989-1999.

Therefore the Institute of Engineering Seismology & Earthquake Engineering (ITSAK), the Laboratory of Geophysics of the Thessaloniki University (GL.AUTh), the Geodynamic Institute of Athens (GI.NOA) and the Laboratories of Seismology of Athens (NKUA) and Patras Universities (UP) merged their results obtained by using various input data and procedures (seismotectonic models, seismic sources models, empirical predictive relations, parameters describing the measures of seismic hazard and software) for the compilation of their individual seismic hazard maps.

In order to accomplish its role ITSAK used the seismic sources model of area type sources by Papaioannou and Papazachos (2000) and the hybrid model of area type sources and faults proposed by Papaioannou (2002) and the empirical predictive relations by (Margaris et. al., 2002). The zonation proposed ba Papaioannou (2002) took into account the paper by Papazachos et al. (2001) on the geometrical and seismological parameters of the main faults in the broader Aegean area proposed by Papazachos et al., 2001. Both are shown in the maps of Fig 65 and Fig 66.

The two models of shallow and intermediate depth earthquakes compiled by Papazachos (1990) and Papazachos and Papaioannou (1993) which were used by GI.NOA, NKUA and UPatras are shown in Fig 67 and Fig 68.

Several empirical predictive relations for the peak ground values were used in Greece which include the publications of Makropoulos (1978), Theodulidis (1991), Theodulidis and Papazachos (1992), Ambraseys (1995), Ambraseys et al, (1996) and Margaris et al. (2001, 2002). A comparison of these relations for a magnitude Mw=6.5 earthquake and site conditions "ROCK" are shown in the graph of Fig 69.

A scientific committee was established by the Earthquake Planning and Protection Organization for the compilation of the official hazard map based on the results of the five seismological organizations. The committee decided to consider the hazard values of the five partners get the mean value remove the outliers and adopt the remaining values for the compilation of the final hazard map. The geographical distribution of the mean values and the standard deviation values of the peak ground acceleration are shown in the Fig 70 and Fig 71.

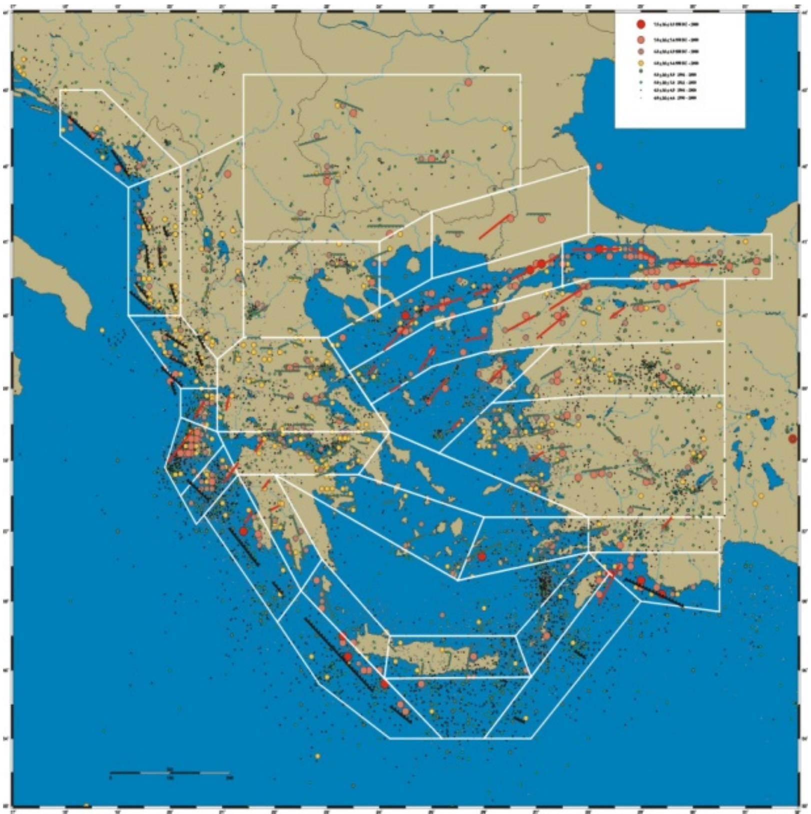


Fig 65. Hybrid model of fault and area sources in the Aegean and surrounding

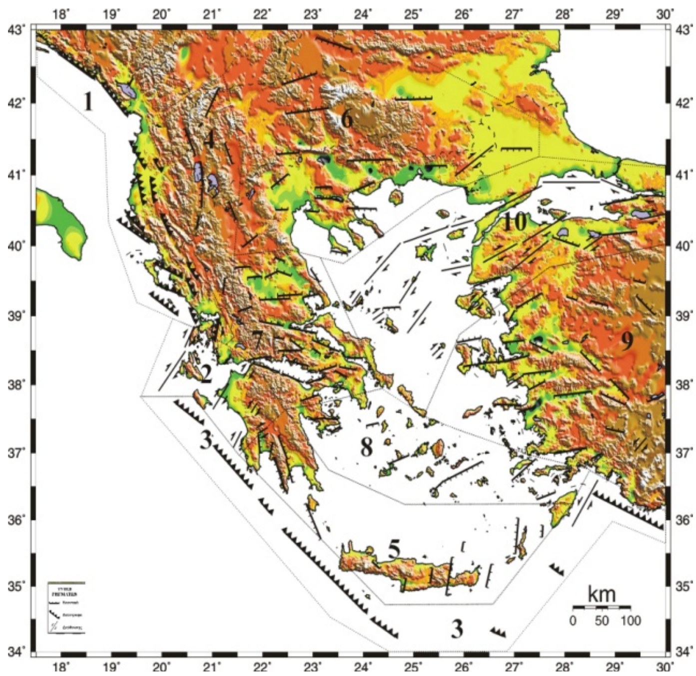


Fig 66. The main faults of shallow strong (M≥6.0) earthquakes in the Agegean areas

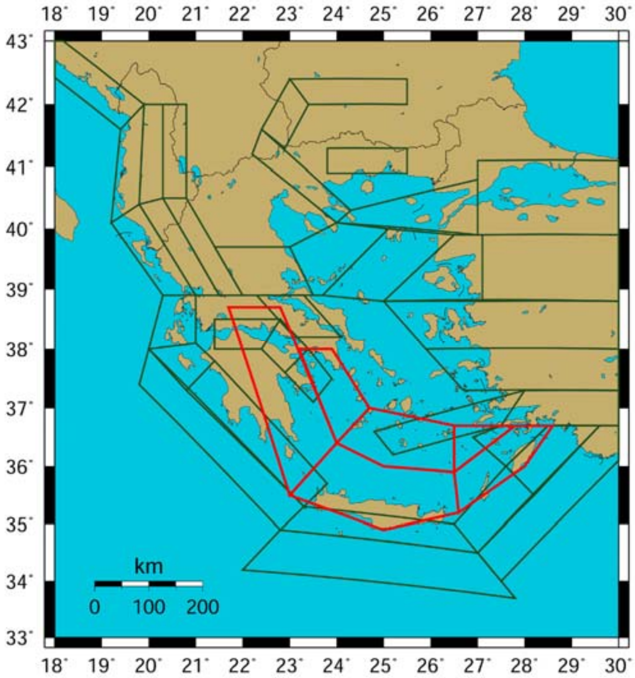


Fig 67. Seismic sources models of shallow (black) and intermediated depth (red) earthquakes (Papazachos, 1990)

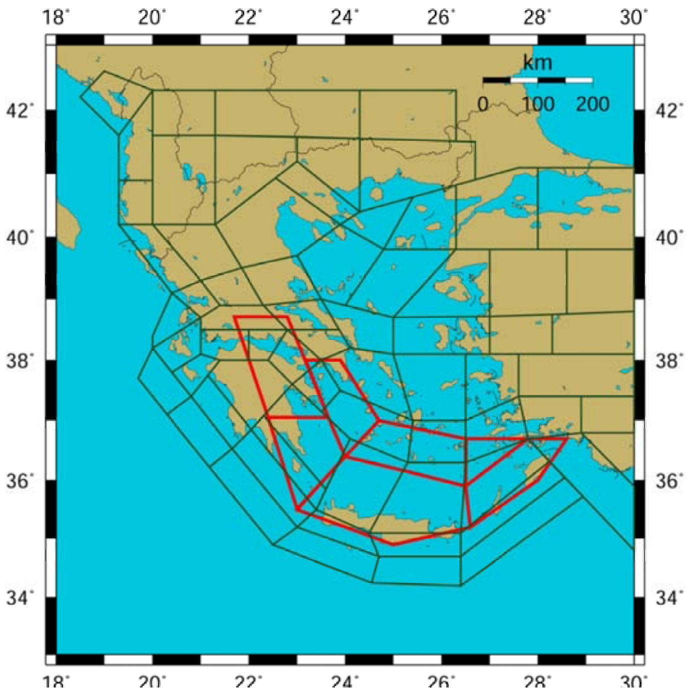


Fig 68. Seismic sources models of shallow (black) and intermediated depth (red) earthquakes (Papazachos and Papaioannou, 1993).

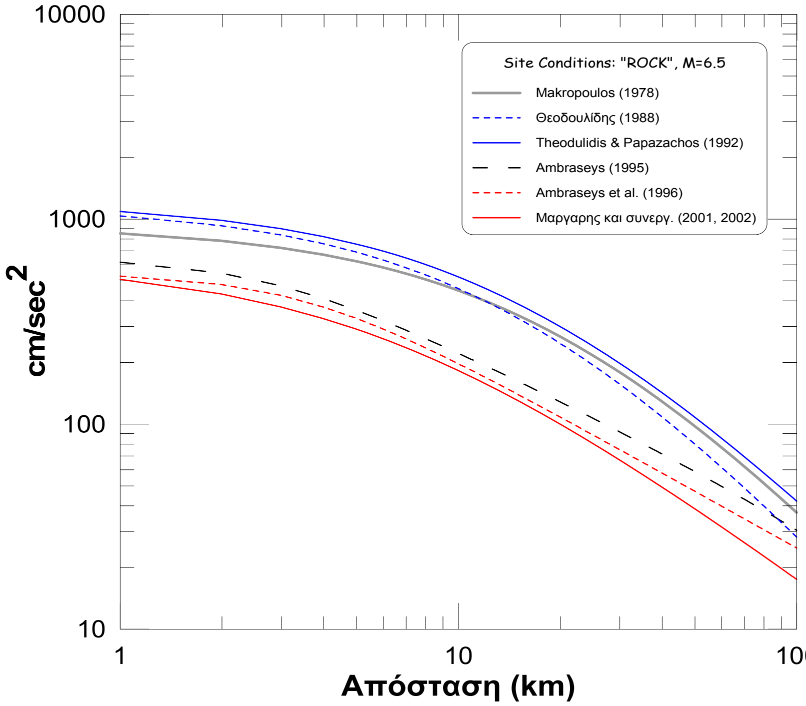


Fig 69. Comparison of the various empirical predictive relations for the PGA, used in the present study for M=6.5 and soil conditions "rock"

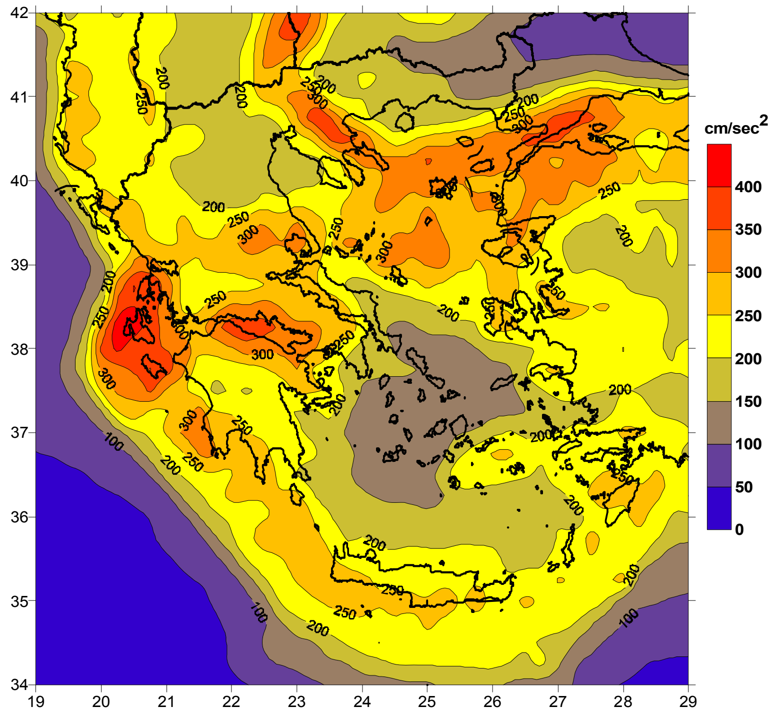


Fig 70. Geographical distribution of the mean values of the peak ground acceleration (cm/sec2) in Greece and surrounding area

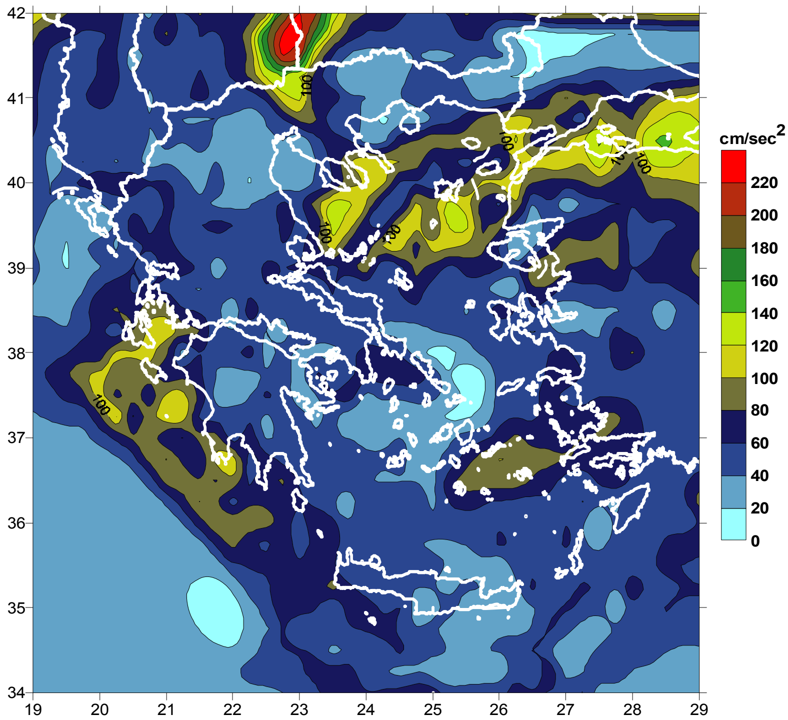


Fig 71. Geographical distribution of the standard deviation of the peak ground acceleration values (cm/sec2) in Greece and surrounding area

The final seismic hazard map which was included in the revision of the Greek seismic code, it was published in the Government Gazette (Φ.Ε.Κ. Β΄ 1154/12-8-2003) and is shown in the map of Fig 72. In this map the area of Greece is divided in three zones with design values of the horizontal ground acceleration equals to 0.16g, 0.24 and 0.36g. Practically the geographic areas corresponding to the zones I and II of the previous map were merged into zone I of the new map. It must be pointed out that this map and the seismic code are valid only for ordinary structures of engineering interest. For the construction of special structures which are of significant importance and high levels of security special seismic hazard studies are required.

Several papers were published for seismic hazard at local scale either for research purposes or within the frame work of studies aiming in the design of critical infrastructures especially at regions of high seismicity as Creta island, the contribution of safe rehabilitation following strong disastrous events (Stavrakakis, 1985; Theodulidis et al., 1998; Pitilakis 2007; Mountrakis et al., 2013).

Furthermore, newer papers were dealt with the application of time dependednt models and results base on new data elaboration and methodologies (Burton et al. 2003; Papaioannou and Papazachos, 2000; Vamvakaris et al, 2008, Vamvakaris 2010; Tselentis and Danciu 2008, 2010; Tselentis et al. 2010).

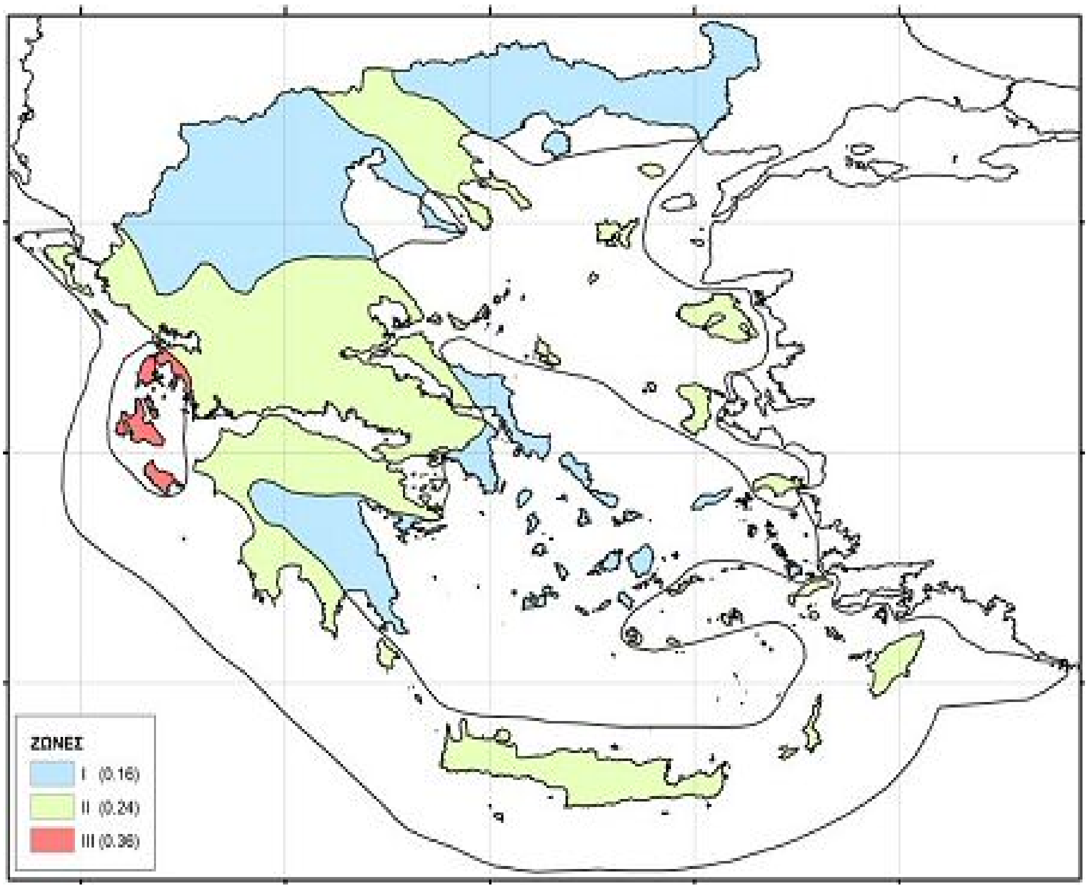


Fig 72. The official current seismic hazard map of Greece

REFERENCES

Algermissen, S.T., D.M. Perkins, W. Isherwood, D. Gordon, G. Reagor and C. Howard (1976). Seismic risk evaluation of the Balkan region, Proc. Sem. Seismic Zoning Maps, UNESCO, Skopje, 2, 172-240.

Ambraseys, N.N. (1995). The prediction of earthquake peak ground acceleration in Europe, Earthq. Eng. Struct. Dyn., 24, 467-490.

Ambraseys, N.N., K.A Simpson,. and J.J. Bommer (1996). Prediction of horizontal response spectra in Europe, Earthq. Eng. Struct. Dyn., 25, 371-400.

Coburn, A. and R. Spence (2002): Earthquake Protection. J. Willey & Sons Ltd., 420 pp.

Cornell, C. A. (1968). Engineering seismic risk analysis. Bull. Seism. Soc. Am., 58, 1503-1606.

Drakopoulos, J. and K. Makropoulos (1983): Seismicity and seismic hazard studies in the area of Greece. Publ. Univ. of Athens, Seism. Lab., 1, 126pp.

Galanopoulos, A. G. and N. Delibasis (1972): Map of maximum observed intensities in Greece, period 1800-1970, Athens, 1972.

Gumbell, J. (1958): Extreme value statistics. Columbia Univ. Press, New York, 375pp.

Koutrakis, S.I., G.F. Karakaisis, P.M. Hatzidimitriou, P.K. Koliopoulos and V.N.Margaris (2002): Seismic hazard in Greece based on different strong ground motion parameters. J. Earth. Eng. 6, 75-109.

Makropoulos, K.C. (1978) : The statistics of large earthquake magnitude and an evaluation of Greek seismicity. Ph.D. thesis, Univ. of Endinburgh., 193pp.

Makropoulos, K. C. and P. W. Burton (1985): Seismic hazard in Greece. II. Ground acceleration. Tectonophysics, 117, 259-294.

Makropoulos, K.C., J. Drakopoulos and J.B. Latoussakis (1989): A revised and extended earthquake catalogue in Greece since 1900. Geophys. J. Int., 98, 391-394.

Margaris V. N. (1994) : Azimuthal variation of the seismic waves in Greece and contribution in the seismic hazard assessment. Ph. D. Thesis, Univ. Thessaloniki, 324pp (in Greek).

Margaris, B.N., C. Papazachos, Ch. Papaioannou, N. Theodulidis, I. Kalogeras and A. Skarlatoudis (2001): Empirical relations for the attenuation of the horizontal strong ground motion of shallow earthquakes in Greece. Proc. 2nd Hell. Congress of Earthq. Engin. and Eng. Seismology, Vol.A, 27-36.

Mountrakis, D., A. A. Kilias, A. Pavlaki, C. Fassoulas, E. Thomaidou, C. B. Papazachos, C. A. Papaioannou, Z. Roumelioti, C. Benetatos and D. Vamvakaris (2012): Neotectonic study of the western Crete. Seismic risk evaluation of the active faults, J. Virtual Explor., 42, Electronic Edition, ISSN 1441-8142, paper 2, doi:10.3809/jvirtex.2011.00285, 35pp.

Margaris, B.N., C. Papazachos, Ch. Papaioannou, N. Theodulidis, I. Kalogeras and A. Skarlatoudis (2002): Ground motion attenuation relations for shallow earthquakes in Greece. Proc. 12th European Conference on Earthquake Engineering, London, September 2002, Paper Ref.. 385,

Papaioannou, Ch.A. (1984): Attenuation of seismic intensities and seismic hazard in the area of Greece, Ph. D. Thesis, Univ. Thessaloniki, 200pp. (in Greek, with an English abstract).

Papaioannou, Ch. A. (1986): Seismic hazard assessment and long term earthquake prediction in Southern Balkan region, Proc. 2nd Int. Sem. on Earthquake Prognostics, A. Vogel and K. Brandes (Editors), Berlin, 223-241.

Papaioannou, Ch. A. (2002): A new Approach of Seismic Hazard Assessment in S. Balkan Area Based on a Hybrid Model of Area- and Fault Type Sources. ESC, XXVIII Gen. Ass, September 1-6, 2002, Genova-ITALY. (Abstracts volume).

Papaioannou, Ch. A. and B.C. Papazachos (2000): Time independent and time dependent seismic hazard in Greece based on seismogenic sources. Bull. Seism. Soc. Am., 90, 22-33.

Papazachos, B.C. (1980): Seismicity rates and long-term prediction in the Aegean area, Quat. Geod. 3, 171-190.

Papazachos, B.C. (1990): Seismicity of the Aegean and surrounding area, Tectonophysics, 178, 287-308.

Papazachos, B, and K. Papazachou (1989): The earthquakes in Greece. Ziti Publ. Co., Thessaloniki, Greece, 356pp. (in Greek).

Papazachos, B.C. and Ch.A. Papaioannou (1993). Long-term earthquake prediction in the Aegean area based on a time and magnitude predictable model. Pure Appl. Geophys. 140, 595–612.

Papazachos, B.C., Kiratzi, A.A., Hatzidimitriou, P.M., Papaioannou, Ch.A. and N.P. Theodulidis (1985): Regionalization of seismic hazard in Greece. Proc. 12th Reg. Sem. on Earthq. Eng. EAEE–EPPO, Halkidiki, Greece. 12 pp.

Papazachos, B.C., Papaioannou, Ch.A., Papastamatiou, D.J., Margaris, V.N. and N.P. Theodulidis (1990): On the reliability of different methods of the seismic hazard assessment in Greece. Nat. Hazards 3, 141–151.

Papazachos, B.C., K. Makropoulos, I. Latoussakis and N.P. Theodulidis (1989): Compilation of a seismic hazard map for Greece. 2nd Proj. Rept. EPPO-GREECE, 24pp. and 24 figs (in Greek).

Papazachos, B.C., Papaioannou, Ch.A., 1993. Long-term earthquake prediction in the Aegean area based on a time and magnitude predictable model. Pure Appl. Geophys. 140, 595–612.

Papazachos B.C., D.M. Mountrakis, C.B. Papazachos, M.D. Tranos, G.F. Karakaisis and A.S. Savvaidis (2001). The faults which have caused the known major earthquakes in Greece and surrounding area between the 5th century BC and today. Proc. 2nd Hell. Congress of Earthq. Engin. and Eng. Seismology, Vol.1, 55-64.

Papoulia, I.E. (1988): Statistical and seismotectonic models for the assessment of seismic risk using as parameter the macroseismic intensity. Ph.D. thesis, Univ. Athens, 1-266.

Pitilakis, K., Cultrera, G., Margaris, B., Ameri, G., Anastasiadis, A., Franceschina, G. and Koutrakis, S. [2007] "Thessaloniki Seismic Hazard Assesment: Probabilistic and Deterministic Approach for Rock Site Conditions", Proceedings of 4th International Conference on Earthquake Geotechnical Engineering, Thessaloniki, Greece.

Roussopoulos, A. (1956). Antiseismic Structures, V. Papaxrisanthemou Publ., 2nd, Athens, 431pp.

Stavrakakis, G.N. (1985): Contribution of Bayess statistics in the seismic risk assessment of Crete and strong ground motion simulation. Ph.D. Thesis, Univ. Athens, 294 pp.

Stavrakakis, G.N. and G.A. Tselentis (1987). Bayesian probabilistic prediction of strong earthquakes in the main seismogenic zones of Greece, Bull. Seism. Soc. Am. 29, 51-63.

Theodulidis, N.P. (1991). Contribution to the study of strong motion in Greece, Ph.D. Thesis, Univ. Thessaloniki, 500pp.

Theodulidis N. and B. Papazachos (1992). Dependence of strong ground motion on magnitude-distance, site geology and macroseismic intensity for shallow earthquakes in Greece: I, Peak horizontal acceleration, velocity and displacement. Soil Dyn. & Earth. Eng., 11, 387-402.

Theodulidis N., V. Lekidis, B. Margaris, C. Papazachos, Ch. Papaioannou and P. Dimitriu (1998): Seismic Hazard Assessment and Design Spectra for the Kozani-Grevena (Greece) Region After the Earthquake of May 13, 1995. Journ. of Geodynamics, 26, 375-391.

Tselentis, G-A. and L. Danciu, (2010): Probabilistic Seismic Hazard Assessment in Greece Part I:Engineering Ground Motion Parameters, Natural Hazards and Earth Science Systems, 10, 25-39.

Tselentis, G-Akis and L. Danciu (2008). Empirical Relationships between Modified Mercalli Intensity and Engineering Ground-Motion Parameters in Greece, Bull. Seism. Soc. Am. 98, 1863–1875,

Tselentis, G-A., L. Danciu and E. Sokos, (2010). Probabilistic Seismic Hazard Assessment in Greece Part II: Acceleration Response Spectra and Elastic Input Energy Spectra. Natural Hazards and Earth Science Systems, 10, 41-49.

Vamvakaris D A, C.B. Papazachos C B , Ch.A.Papaioannou, E.M. Scordilis and G.F. Karakaisis G (2008): Time-independent and Time-dependent Seismic Hazard in Greece Using Synthetic Earthquake Catalogues. Pres. at the ESC, XXXI Gen. Ass, September 7-12, 2008, Hersonissos-CRETE. (Abstracts volume).

Vamvakaris, D.A. (2010). Contribution to the study of time-dependent seismicity and seismic hazard, Ph.D. Thesis, Univ. Thessaloniki, (in Greek), 498pp.

8.3 BULGARIA

The successful hazard assessment requires combination and correlation of different type of data including: geological, geophysical and seismological specification of each particular region within radius of 200 km, information about historical and instrumental seismicity. Models were created for the main Regions with economical and seismological importance. The existence of critical infrastructure (Nuclear centrals, Dams and Industrial Areas) are subject of special interest and attention.

Bellow, you can find some examples for the most applied methodological approaches for hazard assessment at Regional and Local Scale issued by scientific institutions, government and non-government organizations.

1. S. D. Simeonova, D. E. Solakov, G. Leydecker, H. Busche, T. Schmitt and D. Kaiser (2006) Probabilistic seismic hazard map for Bulgaria as a basis for a new building code, Nat. Hazards Earth Syst. Sci., 6, 881–887 - A seismic hazard map proposed as part of new building code for Bulgaria is presented here on basis of the recommendations in EUROCODE 8. Seismic source zones within an area of about 200 km around Bulgaria were constructed considering seismicity, neotectonic and geological development.

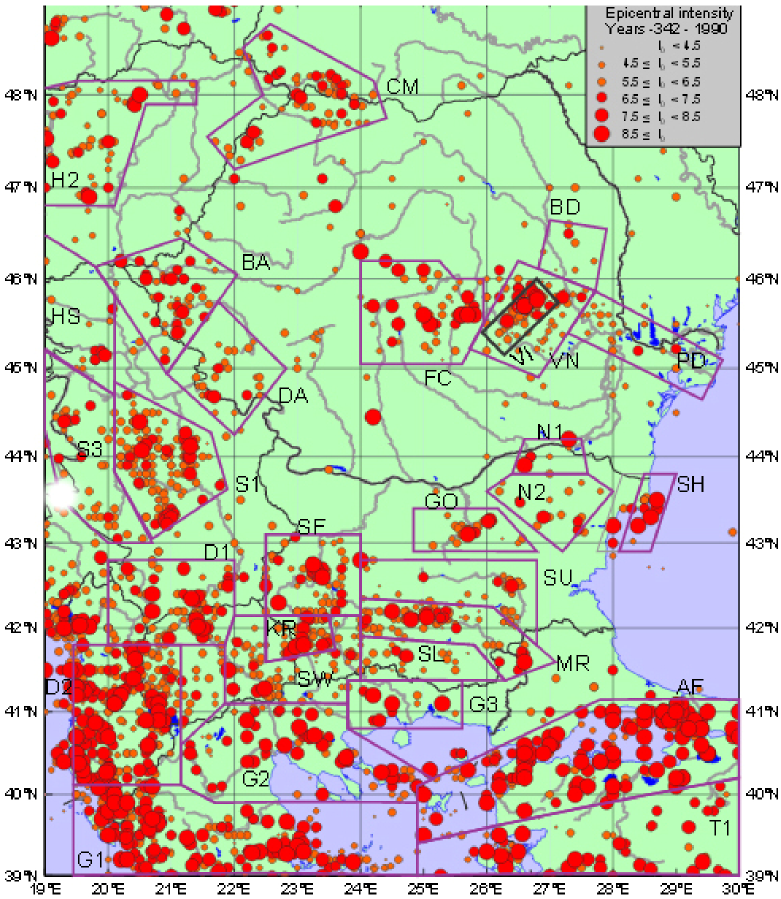


Fig 73. Seismic Zonation Map

2. Solakov D., Simeonova S., Shristoskov L. (2001) Seismic hazard assessment for the Sofia region. Annali Di Geofisica, 44, 541-556 – Probabilistic seismic hazard analysis by using deductive method (modification of to the Cornell's method).

3. National Institute of Geophysics, Geodesy and Geography – Bulgarian Academy of Sciences - Vatseva R, D. Solakov,E. Tcherkezova,S. Simeonova and Petya Trifonova (2012) Applying GIS in seismic hazard assessment and data integration for disaster management.

The geodatabase data model was developed to ensure an integral and comprehensive data structure and to Integrate GIS solutions in seismic hazard assessment. It includes the following components: Geo- datasets, relationships and seismic hazard assessment models.

The geodatabase data model was implemented in a physical ArcGIS file geodatabase.

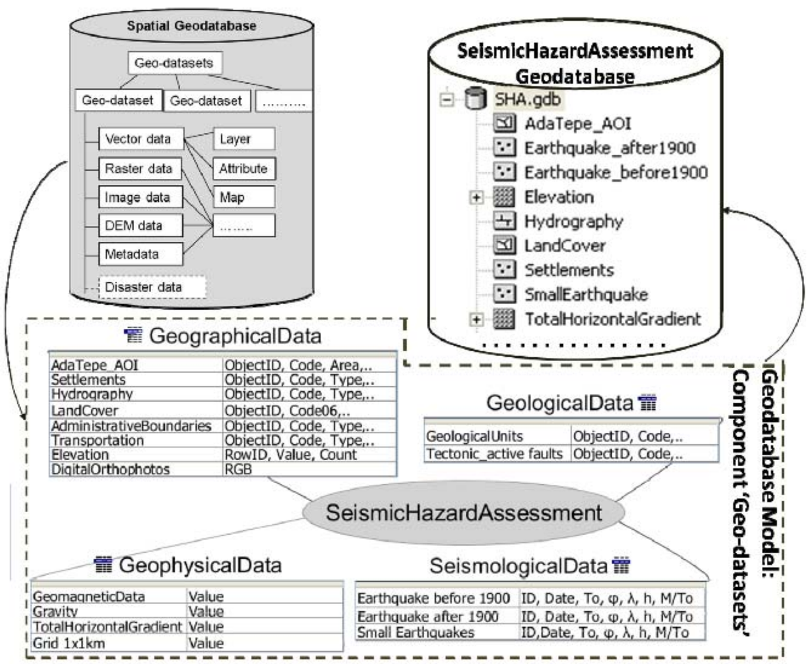


Fig 74. The geodatabase data model implemented in a physical ArcGIS file geodatabase

4. Zlateva, P., L. Pashova, K. Stoyanov, and D. Velev (2011). Social Risk Assessment from Natural Hazards Using Fuzzy Logic, International Journal of Social Science and Humanity, Vol. 1, N 3, 193-198.

5. Botev, E., I.Georgiev, D.Dimitrov (2011). Geodynamic Status of Bulgaria (Central Balkans) on the Basis of Seismological and Geodetic Data. Proceedings of Workshop " Complex Research of Earthquake's Forecasting Possibilities, Seismicity and Climate Change Correlations", BlackSeaHazNet Series Volume 1, pp. 175- 183, Ohrid, Republic of Macedonia, 2011. ISBN: 978-9989-631-04-7.

8.4 ROMANIA

1. Integrated transnational macroseismic data set for the strongest earthquakes of Vrancea (Romania)

Author:

Kronrod, Tatiana; Radulian, Mircea; Panza, Giuliano; et al

Journal:

TECTONOPHYSICS Volume: 590 Pages: 1-23

Date: April, 1, 2013

Details:

A unique macroseismic data set for the strongest earthquakes occurring since 1940 in the Vrancea region is constructed by a thorough review of all available sources. Inconsistencies and errors in the reported data and in their use are also analysed. The final data set, which is free from inconsistencies, including those at the political borders, contains 9822 observations for the strong intermediate-depth earthquakes: 1940, M-w = 7.7; 1977, M-w = 7.4; 1986, M-w = 7.1; 1990, May 30, M-w = 6.9; 1990, May 31, M-w = 6.4; and 2004, M-w = 6.0. This data set is available electronically as Supplementary data to the present paper.From the discrete macroseismic data, the continuous macroseismic field is generated using the methodology developed by Molchan et al. (2002). The procedure, along with the unconventional (smoothing method) modified polynomial filtering (MPF), uses the diffuse boundary (DB) method, which visualises the uncertainty in the isoseismal boundaries. The comparison of DBs with previous isoseismal maps supplies a good evaluation criterion of the reliability of earlier published maps. The produced isoseismals can be used not only for the formal comparison of the observed and theoretical isoseismals, but also for the retrieval of source properties and the assessment of local responses (Molchan et al., 2011). (c) 2013 Elsevier B.V. All rights reserved.

2. Re-evaluation of the macroseismic effects produced by the March 4, 1977, strong Vrancea earthquake in Romanian territory

Author:

Pantea, Aurelian; Constantin, Angela Petruta

Journal:

ANNALS OF GEOPHYSICS Volume: 56 Issue: 1 Article Number: R0104

Date: 2013

Details:

In this paper, the macroseismic effects of the subcrustal earthquake in Vrancea (Romania) that occurred on March 4, 1977, have been re-evaluated. This was the second strongest seismic event that occurred in this area during the twentieth century, following the event that happened on November 10, 1940. It is thus of importance for our understanding of the seismicity of the Vrancea zone. The earthquake was felt over a large area, which included the territories of the neighboring states, and it produced major damage. Due to its effects, macroseismic studies were developed by Romanian researchers soon after its occurrence, with foreign scientists also involved, such as Medvedev, the founder of the Medvedev-Sponheuer-Karnik (MSK) seismic intensity scale. The original macroseismic questionnaires were re-examined, to take into account the recommendations for intensity assessments according to the MSK-64 macroseismic scale used in Romania. After the re-evaluation of the macroseismic field of this earthquake, the intensity dataset was obtained for 1,620 sites in Romanian territory. The re-evaluation was necessary as it has confirmed that the previous macroseismic map was underestimated. On this new map, only the intensity data points are plotted, without tracing the isoseismals.

3. Large and moderate historical earthquakes of 15th and 16th centuries in Romania reconsidered

Author:

Rogozea, M.; Radulian, M.; Marmureanu, Gh; et al.

Journal:

ROMANIAN REPORTS IN PHYSICS Volume: 65 Issue: 2 Pages: 545-562

Date: 2013

Details:

The purpose of this paper is to find historically-based arguments to validate or rectify the earthquake parameters as existing now in the catalogues. Systematic search for the original information collected from annals of time, reviews, notes on old religious writings, newspapers, etc. was carried out. In parallel, all the information available in the catalogues of earthquakes in the Carpathian region was considered. The historical data are critically analyzed and, on the basis of our investigation. Also, we tried to compensate for the uneven geographical distribution: clearly more systematic and rich documentation comes from Brasov (Transylvania) area as compared with other provinces, such as Wallachia and Moldova. Basically, only the events mentioned in at least two independent documentary sources were included in the revised catalogue. A significant fraction of the total catalogued events was proved to be improperly parameterized in the previous catalogues.

4. The bio-location method used for stress forecasting in Vrancea (Romania) seismic zone

Author:

Moldovan, I. A.; Apostol, A.; Moldovan, A.; et al.

Journal:

ROMANIAN REPORTS IN PHYSICS Volume: 65 Issue: 1 Pages: 261-270

Date: 2013

Details:

Large and destructive intermediate-depth earthquakes in Vrancea have been generated about every century during the last millennium. Possible earthquake precursors, such as bio-location data obtained across crustal faults, and three component magnetic continuous recordings, have been used in the last decade in and around the Vrancea region. After-the-fact correlations have been published, but the interpretation was not accepted due to a subjective evaluation. As a result, a real-time methodology was implemented. A successful real-time stress forecasting was possible for a large normal depth regional earthquake at Van, eastern Turkey, and another small-moderate intermediate-depth event in Vrancea. The stress forecasting was able to offer few data for the expected event, so no earthquake prediction was possible for the location and magnitude. Our data suggest the so called earthquake precursors were not related to physical anomalies at an intermediate depth of 70-150 km in Vrancea, but they had been generated by resistivity anisotropy variations and magnetotelluric wave splitting (MWS) around crustal faults. On the other hand, resistivity anisotropy anomalies can be related to principal compressive/extensional stress variations in magnitude and direction observed around tectonic faults before, during and after moderate to large local and/or regional earthquakes. Finally, an earthquake prediction for the next large and destructive intermediate-depth Vrancea earthquake is not possible. Instead, successful stress forecasting in real time can be issued for some local and/or regional moderate-large earthquakes.

5. The bio-location method used for stress forecasting in Vrancea (Romania) seismic zone

Author:

Apostol, A.; Moldovan, I. A.; Moldovan, A.; et al.

Journal:

ROMANIAN REPORTS IN PHYSICS Volume: 65 Issue: 1 Pages: 271-284

Date: 2013

Details:

The Vrancea seismically active region of Romania, situated far-from active plate boundaries, can be characterized by small-large intermediate-depth earthquakes and small-moderate normal ones. The intermediate-depth earthquakes are destructive when larger than magnitude Mw 7.2. A bio-location methodology has been used trying to map crustal faults in Vrancea Depression and to indicate stress variations before and after intermediate-depth earthquakes. Bio-location data obtained across two perpendicular faults at Plostina, Vrancea, indicated a possible stress transfer from faults situated at intermediate-depth of 70-150 km, to faults situated in the Earth's crust at 0-40 km, before and after intermediate-depth earthquakes larger than local magnitude 3.0.

6. Improving management of risks and natural disasters by regional GIS distributed application

Author:

Furdu, Iulian; Tomozei, Cosmin; Pandele, Ioana

Journal:

ENVIRONMENTAL ENGINEERING AND MANAGEMENT JOURNAL Volume: 12 Issue: 1 Pages: 11-16

Date: January 2013

Details:

The aim of this paper is to provide a framework for the improvement of the processes involving risks evaluation and management evaluation in Central East Moldavian Region, considering the occurrence of natural disasters, such as floods, earthquakes, forest fires and landslides. Consequently, a GIS application has been developed in order to graphically reflect and analyze these risks. The studies on the targeted region would be a starting point to further extensions to other Romanian regions. The application will be publicly available in order to provide an early warning system to people, since no such services exist in Romania at individual level. Important aspects concerning risk management status and policies in Romania are also discussed.

7. Real-time earthquake damage assessments and GIS analysis of two vulnerable counties in the Vrancea Seismic area, Romania

Author:

Toma-Danila, Dragos

Journal:

ENVIRONMENTAL ENGINEERING AND MANAGEMENT JOURNAL Volume: 11 Issue: 12 Pages: 2265-2274

Date: December, 2012

Details:

In the last years, thanks to the implementation of the ShakeMap software in real-time at the National Institute for Earth Physics (NIEP) and within the DACEA Project, a system that computes damage and loss estimates in (near) real-time for the Romanian-Bulgarian border region was installed at NIEP, producing data and maps for 7 Romanian Counties and 9 Bulgarian Districts.This paper presents both the integration mode and the results obtained by adding new counties into the implemented system, and also presents best ways for a GIS representation of the estimated damage. Of great interest is that the new counties - Vrancea and Bacau, are right on top of the active seismic area of Vrancea, compared to the previous analyzed counties that are more than 100 km away from the epicentral area.

8. Location Performance and Detection Magnitude Threshold of the Romanian National Seismic Network

Author:

D'Alessandro, Antonino; Danet, Anton; Grecu, Bogdan

Journal:

PURE AND APPLIED GEOPHYSICS Volume: 169 Issue: 12 Pages: 2149-2164

Date: December, 2012

Details:

Romania is an earthquake prone area with a few destructive earthquakes per century. The National Institute for Earth Physics carries out the seismic survey of Romania through the Romanian National Seismic Network (RNSN) consisting of 65 real-time seismic stations. Daily reports and monthly bulletins are delivered after routinely analyzing and processing the recorded data. In the present paper we applied the Seismic Network Evaluation through Simulation method for the RNSN configuration as it was in August 2011 to estimate the background noise level, assess the appropriateness of the velocity model adopted in routine location procedure, evaluate the hypocenter location uncertainty and determine the detection magnitude threshold. Areas of greater (southern Romania) and lower (Carpathians and Apuseni Mountains) background noise within the RNSN are identified by mapping the average power of noise in 1-12 Hz frequency range. The statistical study of the P and S phases residual times allow us to assess the appropriateness of the velocity model used in routine location. Both P- and S-wave velocity models can be optimized to improve the quality of the hypocenter location. As shown by our analysis, the RNSN is able to detect and locate earthquakes with M (L) magnitude above 2.5 anywhere on the Romanian territory, except the border areas, such as the Crisana-Maramures seismic source zone. Merging data from both sides of the border significantly improves the quality of hypocenter location in these areas.

9. Geohazards assessment and mapping of some Balkan countries

Author:

Muco, Betim; Alexiev, Georgi; Aliaj, Shyqyri; et al

Journal:

NATURAL HAZARDS Volume: 64 Issue: 2 Pages: 943-981

Date: November, 2012

Details:

The assessment of geological hazard is a topic with significant interest for the Balkans. During the last decade of twentieth century, most of the countries in the region have embarked on the road of a hasty transitory period from totalitarian regimes to democracy. Development of free market economy has given rise to uncontrolled movement of people, fast construction of housing and facilities and unproportioned accumulation of population around and in big cities. Besides Greece, an old member of European Union, and two newcomers in the organization, Romania and Bulgaria, the other countries are all hoping to enter the Union as faster as they can. Many different candidate or full-fledged member country programs of European Community offer a lot of joint and cross-border projects for constructing road infrastructure and facilities. As development accelerates in the Balkans and given the intensive geohazard elements that this territory exhibits, it becomes increasingly important to understand, study, and map these elements for being aware of the damage to the total environment these hazards might cause. The geohazard map and assessment of some Balkan countries has been carried out through two scientific meetings in Ohrid, Macedonia, and Tirana, Albania during 2007. The map is compiled in the Albanian Geological Survey, Tirana, Albania in the scale 1:1,000,000. As a base map, we used the topographic map produced by VGI, formerly Yugoslavia mapping authorities. As a seismic layer in our map, we used the values of peak ground acceleration obtained from Global Seismic Hazard Assessment Program. Two catalogs were constructed: The first one that contains the crustal earthquakes (hypocentral depth within first 70 km) and the second one that contains intermediate earthquakes (hypocentral depth below 70 km). This work is largely based on previous studies and investigations by earth scientists and specialists of each country comprised in this territory. In this respect, the map we constructed should be considered as a preliminary composite geohazard map with the possibility to be enriched and added with other new elements and data in the future.

10. Earthquake nests as natural laboratories for the study of intermediate-depth earthquake mechanics

Author:

Prieto, German A.; Beroza, Gregory C.; Barrett, Sarah A.; et al.

Journal:

TECTONOPHYSICS Volume: 570 Pages: 42-56

Date: October, 10, 2012

Details:

South-Eastern part of Romania has a highest potential seismic risk in Europe due to the earthquake-prone Vrancea zone placed at conjunction of four tectonic blocks in the South-Eastern part of Carpathian Arc. This paper is an attempt to analyze the development of radon pre-earthquake anomaly in relation with moderate seismic events in Vrancea area through permanent monitoring with solid state nuclear track detectors CR-39 detectors. Radon in air above the ground was measured during 1 year period (November 2010-October 2011) in four selected test sites: Vrancioaia (VRI) and Plostina (PLOR) located in Vrancea zone, and Muntele Rosu-Cheia and Bucharest. During sampling period recorded earthquakes that occurred mostly in Vrancea epicentral region were minor-moderate of moment magnitudes in range of . The average radon concentration in air above the ground measured with CR-39 detectors and 10 days period recorded simultaneously at all test sites, registered the following values: (1) in Vrancea area (similar in VRI and PLOR) was 1094.58 150.3 Bq/m(3); (2) at Muntele Rosu-Cheia seismic station measured in a mountain tunnel laboratory was 3695.91 +/- A 440 Bq/m(3); (3) at Bucharest station was 380.53 69.17 Bq/m(3), and 10 days C-Rn fluctuations in the range of (88 40 to 912 130 Bq/m(3)).

Clear radon anomalies, mostly at VRI and PLOR in Vrancea epicentral area as well as at Muntele Rosu-Cheia have been measured before seven minor earthquakes which were recorded in the range of moment magnitude in Vrancea area. Temporal variation of radon in air near the ground have been examined in relation with meteorological parameters like as air temperature, relative humidity, air pressure and wind velocity. Permanent monitoring of radon concentration anomalies in seismic area Vrancea is an important issue as surveillance tool in the field of earthquake hazard for Romania.

11. Monitoring of radon anomalies in South-Eastern part of Romania for earthquake surveillance

Author:

Zoran, M.; Savastru, R.; Savastru, D.; et al.

Journal:

JOURNAL OF RADIOANALYTICAL AND NUCLEAR CHEMISTRY Volume: 293 Issue: 3 Pages: 769-781

Date: September, 2012

Details:

South-Eastern part of Romania has a highest potential seismic risk in Europe due to the earthquake-prone Vrancea zone placed at conjunction of four tectonic blocks in the South-Eastern part of Carpathian Arc. This paper is an attempt to analyze the development of radon pre-earthquake anomaly in relation with moderate seismic events in Vrancea area through permanent monitoring with solid state nuclear track detectors CR-39 detectors. Radon in air above the ground was measured during 1 year period (November 2010-October 2011) in four selected test sites: Vrancioaia (VRI) and Plostina (PLOR) located in Vrancea zone, and Muntele Rosu-Cheia and Bucharest. During sampling period recorded earthquakes that occurred mostly in Vrancea epicentral region were minor-moderate of moment magnitudes in range of . The average radon concentration in air above the ground measured with CR-39 detectors and 10 days period recorded simultaneously at all test sites, registered the following values: (1) in Vrancea area (similar in VRI and PLOR) was 1094.58 150.3 Bq/m(3); (2) at Muntele Rosu-Cheia seismic station measured in a mountain tunnel laboratory was 3695.91 +/- A 440 Bq/m(3); (3) at Bucharest station was 380.53 69.17 Bq/m(3), and 10 days C-Rn fluctuations in the range of (88 40 to 912 130 Bq/m(3)). Clear radon anomalies, mostly at VRI and PLOR in Vrancea epicentral area as well as at Muntele Rosu-Cheia have been measured before seven minor earthquakes which were recorded in the range of moment magnitude in Vrancea area. Temporal variation of radon in air near the ground have been examined in relation with meteorological parameters like as air temperature, relative humidity, air pressure and wind velocity. Permanent monitoring of radon concentration anomalies in seismic area Vrancea is an important issue as surveillance tool in the field of earthquake hazard for Romania.

12. Earthquake risk classes for dams situated in the south-western part of romania (danube, olt, jiu and lotru rivers)

Author:

Moldovan, I. A.; Constantin, A. P.; Popescu, E.; et al.

Journal:

ROMANIAN REPORTS IN PHYSICS Volume: 64 Issue: 2 Pages: 591-608

Date: 2012

Details:

The main goal of this paper is rating the dams from the South-Western part of Romania (Danube, Olt, Jiu and Lotru rivers) into seismic risk classes. Dam owners and regulators must ensure that dams are safely operated and present no risk to the public in case of an earthquake. While most old or new dams in recognized seismic regions have been evaluated and analyzed for seismic loads, dams located in areas of moderate or infrequent seismicity have been given less systematic attention. In such cases, owners of many dams or officials in charge of dam safety programs may consider comparative assessment of the seismic risk associated with their dams and establish priorities, as needed. Risk classes can be used to establish the necessity of detailed assessment of seismic safety of the darns and to establish the priorities of these evaluations.The methodology which is used in this paper offers an easy way to evaluate the most vulnerable hydrotechnical facilities among the multitude of dams in the Western part of Romania that are affected by crustal-depth earthquakes from Banat and Danubian regions and by Vrancea intermediate depth earthquakes. The risk is expressed as a product between hazard and vulnerability. In particular, seismic risk in the case of hydrotechnical arrangements is computed as a product between seismic hazard (corresponding to the location of the respective hydrotechnical arrangement) and the seismic vulnerability of the respective arrangement. Various risk factors and weighting points can be used to approximately quantify the Total Risk Factor (TRF) of any dam. The TRF depends on the dam type, age, size, the downstream risk potential, and the dam vulnerability, which depends on the seismic hazard of the site. The dam structure influence is represented by the sum of capacity, height, and age risk factors. The downstream hazard factor is based on population and property at risk. The vulnerability rating is a function of the site-dependent seismic hazard and observed performance of similar dams, as defined by a predicted damage factor.This procedure can be used to quickly asses S the potentially most vulnerable facilities in a large dam inventory. The risk classification based on the TRF, provides guidance to dam safety officials to select appropriate evaluation procedure and to assign priorities for seismic safety evaluation of the most critical dams.

13. Earthquake prediction using extinct monogenetic volcanoes: A possible new research strategy

Author:

Szakacs, Alexandru

Journal:

JOURNAL OF VOLCANOLOGY AND GEOTHERMAL RESEARCH Volume: 201 Issue: 1-4 Special Issue: SI Pages: 404-411

Date: April, 2011

Details:

Volcanoes are extremely effective transmitters of matter, energy and information from the deep Earth towards its surface. Their capacities as information carriers are far to be fully exploited so far. Volcanic conduits can be viewed in general as rod-like or sheet-like vertical features with relatively homogenous composition and structure crosscutting geological structures of far more complexity and compositional heterogeneity. Information-carrying signals such as earthquake precursor signals originating deep below the Earth surface are transmitted with much less loss of information through homogenous vertically extended structures than through the horizontally segmented heterogeneous lithosphere or crust. Volcanic conduits can thus be viewed as upside-down "antennas" or waveguides which can be used as privileged pathways of any possible earthquake precursor signal. In particular, conduits of monogenetic volcanoes are promising transmitters of deep Earth information to be received and decoded at surface monitoring stations because the expected more homogenous nature of their rock-fill as compared to polygenetic volcanoes. Among monogenetic volcanoes those with dominantly effusive activity appear as the best candidates for privileged earthquake monitoring sites. In more details, effusive monogenetic volcanic conduits filled with rocks of primitive parental magma composition indicating direct ascent from sub-lithospheric magma-generating areas are the most suitable. Further selection criteria may include age of the volcanism considered and the presence of mantle xenoliths in surface volcanic products indicating direct and straightforward link between the deep lithospheric mantle and surface through the conduit. Innovative earthquake prediction research strategies can be based and developed on these grounds by considering conduits of selected extinct monogenetic volcanoes and deep trans-crustal fractures as privileged emplacement sites of seismic monitoring stations using an assemblage of physical, chemical and biological sensors devised to detect precursory signals. Earthquake prediction systems can be built up based on the concept of a signal emission-transmission-reception system, in which volcanic conduits and/or deep fractures play the role of the most effective signal transmission paths through the lithosphere. Unique "precursory fingerprints" of individual seismic structures are expected to be pointed out as an outcome of target-oriented strategic prediction research. Intelligent pattern-recognition systems are to be included for evaluation of the signal assemblages recorded by complex sensor arrays. Such strategies are expected however to be limited to intermediate-depth and deep seismic structures. Due to its particular features and geotectonic setting, the Vrancea seismic structure in Romania appears to be an excellent experimental target for prediction research.

14. Advanced real-time acquisition of the Vrancea earthquake early warning system

Author:

Marmureanu, A.; Ionescu, C.; Cioflan, C. O.

Journal:

SOIL DYNAMICS AND EARTHQUAKE ENGINEERING Volume: 31 Issue: 2 Special Issue: SI Pages: 163-169

Date: February, 2011

Details:

The Vrancea seismogenic zone in Romania represents a peculiar source of seismic hazard, which is a major concern in Europe, especially to neighboring regions of Bulgaria. Serbia and Republic of Moldavia. Earthquakes in the Carpathian-Pannonian region are confined to the crust, except the Vrancea zone, where earthquakes with focal depth down to 200 km occur. One of the cities most affected by earthquakes in Europe is Bucharest. Situated at 140-170 km distance from Vrancea epicenter zone, Bucharest encountered many damages due to high energy Vrancea intermediate-depth earthquakes; the March 4, 1977 event (M(w)=7.2) produced the collapse of 36 buildings with 8-12 levels, while more than 150 old buildings were seriously damaged. A dedicated set of applications and a method to rapidly estimate magnitude in 4-5 s from detection of P wave in the epicenter were developed. They were tested on all recorded data. The magnitude error for 77.9% of total considered events is in the interval [-0.3, +0.3] magnitude units. This is acceptable taking into account that the magnitude is computed from only 3 stations in a 5 s time interval (1 s delay is caused by data packing). The ability to rapidly estimate the earthquake magnitude combined with powerful real-time software, as parts of an early warning system, allows us to send earthquake warning to Bucharest in real time, in about 5 s after detection in the epicenter. This allows 20-27 s warning time to automatically issue preventive actions at the warned facility.

15. Losses due to historical earthquakes in the Balkan region: Overview of publicly available data

Author:

Abolmasov, Biljana; Jovanovski, Milorad; Feric, Pavle; et al.

Journal:

GEOFIZIKA Volume: 28 Issue: 1 Special Issue: SI Pages: 161-181

Date: 2011

Details:

This study analyzes catastrophic losses due to earthquakes in the Balkan region. Analysis is based on the following data on earthquakes, collected from the OFDA/CRED International Disaster Database (Universite Catholique de Louvain, Brussels, Belgium) for 1900 to 2010: numbers of fatalities, size of the affected population and costs of material damages. Catastrophic losses were caused by 62 earthquakes in countries within the region: Slovenia, Croatia, Bosnia and Herzegovina, Montenegro, Albania, Serbia, Romania, Bulgaria, Macedonia and Greece. The analysis shows that a significant number of people in the Balkan region were killed (4974) or were affected (2033723) by the earthquakes and that many countries suffered significant material damages (10410.16 million USD) during the analyzed period. The main disadvantage of using publicly available sources is the lack of consistent data on earthquake damages. A brief review of the most catastrophic earthquakes recorded in databases through the last 110 years is given, based on the data from publicly available databases.

16. Estimation of site effects in the eastern part of Romania on the basis of H/V ratios of S and Coda waves generated by Vrancea intermediate-depth earthquakes

Author:

Grecu, B.; Raileanu, V.; Bala, A.; et al.

Journal:

ROMANIAN JOURNAL OF PHYSICS Volume: 56 Issue: 3-4 Pages: 563-577

Date: 2011

Details:

The purpose of our study is to investigate the ground motion characteristics in 15 sites located in the Eastern part of Romania by applying the H/V spectral ratio method to the data (S and coda waves) recorded during the CALIXTO'99 tomography experiment. The results show no significant differences as regarding the resonant frequencies of the spectral ratios computed for the two types of waves, while the level of the amplification for S-wave is slightly higher than for coda waves. Only for two sites, located on thick Quaternary deposits, the amplification obtained from S-wave is larger by a factor of 2 than the amplification obtained from coda waves at low frequencies. In the studied locations the ground motion amplification varies by a factor of 2 to nearly 6 over the frequency range of 0.5 to 10-12 Hz.

17. Values of b and p: Their variations and relations to physical processes for earthquakes in Japan and Romania

Author:

Enescu, B.; Enescu, D.; Ito, K

Journal:

ROMANIAN JOURNAL OF PHYSICS Volume: 56 Issue: 3-4 Pages: 590-608

Date: 2011

Details:

This work reviews some results obtained for the variations of the seismicity parameters b and p in different seismogenic and tectonic regions in Japan. We bring as well new evidence that the time and space changes in seismicity parameters are correlating well with the crustal structure and/or some parameters of the earthquake process. Moreover, we also analyze the variation of b-value as a function of depth for the Vrancea (Romania) region, of intermediate-depth seismicity. In the first part of the paper we show that several seismicity precursors (clear b-value changes, quiescence and clustering) occurred about two years before the 1995 Kobe earthquake and they correlate well with other geophysical premonitory phenomena of the major event. The precursory phenomena occurred in a relatively large area, which corresponds probably with the preparation zone of the future event. In the second part, we analyze the b and p value spatial and temporal distribution for the aftershocks of the 2000 Tottori earthquake. The results indicate significant correlations between the spatio-temporal pattern of b and p and the stress distribution after the main shock, as well as the crustal structure. The swarm-like seismic sequences occurred in 1989,1990 and 1997 showed significant precursory b and p values. In the third part of the paper we analyze the seismicity during the 1998 Hida Mountain earthquake swarm. The double-difference-relocated events are analyzed for their frequency-magnitude distribution and stress changes. While again the b-value is significantly different in south comparing with the north part of the epicentral area, the physical interpretation is difficult and complex. The changes in the Coulomb failure stress (Delta CFF) can explain the b-value distribution features, but the crustal structure may be also important. The seismicity distribution and migration, in relation with Delta CFF is also discussed. In the last part of the paper, we find that the b-value is higher in the upper part (60 km - 120 km) of the Vrancea subducting slab and decreases in the lower part (130 kin 220 km). We discuss this change in relation to stress variations within the subducting slab. We refer as well to other world-wide studies.

18. Intensity seismic hazard map of Romania by probabilistic and (neo)deterministic approaches, linear and nonlinear analyses.

Author:

Marmureanu, Gheorghe; Cioflan, Carmen Ortanza; Marmureanu, Alexandru

Journal:

ROMANIAN REPORTS IN PHYSICS Volume: 63 Issue: 1 Pages: 226-239

Date: 2011

Details:

The last zonation seismic map has areas where seismic intensities are under-evaluated (e.g. Dobrogea, Banat etc.), and other areas are over-evaluated. The fundamental unacceptable point of view is that this design code is in peak ground accelerations which generates a lot of drawbacks to civil structural designers and to insurance companies which are paying all damages and causalities in function of earthquake intensity. The mapping is carried out using probabilistic approach and a complex hybrid waveform modeling method which combines the modal summation technique with finite-difference one to describe the seismic waves propagation through an inelastic space from source to free field surface. The result is a new seismic map in intensities by using probabilistic and deterministic approaches, linear and nonlinear seismology and developing the concept of control earthquake to obtain the banana shape of the attenuations curves of the macroseismic intensity along the directions defined by azimuths.

19. Characterining the frequency of earthquake incidence in Romania

Author:

Dragan, Irina-Maria; Isaic-Maniu, Alexandru

Journal:

ECONOMIC COMPUTATION AND ECONOMIC CYBERNETICS STUDIES AND RESEARCH Volume: 45 Issue: 2 Pages: 77-91

Date: 2011

Details:

From a seismic point of view, Romania is dominated of events in one region, Vrancea. In the past 300 years, a single major seismic event occurred with an epicenter outside this area (1916). This paper starts from going over all major seismic events, with a magnitude of over 6 degrees on Richter's scale, which were documented. Was tested the most plausible statistic behavioral model and was determined the probabilities for future large scale earthquakes, by different time horizons.

20. Addressing issues of geoenvironmental risks in Dobruja, Romania / Bulgaria

Author:

Rotaru, Ancuta; Kolev, Chavdar

Journal:

ENVIRONMENTAL ENGINEERING AND MANAGEMENT JOURNAL Volume: 9 Issue: 7 Pages: 961-969

Date: July, 2010

Details:

Dobruja is a historical region shared by Romania and Bulgaria; it is located on the western Black Sea coast, around the Danube River. The main geological, seismic and geotechnical features, as well as natural hazards are presented in this review. A comparative analysis is made between the northern and southern parts of Dobruja. The region has witnessed various kinds of natural hazard over the past decades, and this paper describes the geotechnical characteristics and chronology of two of the more frequently occurring events, namely earthquakes and soil liquefaction. The structural relationships between the different rock formations in Romania and Bulgaria are analyzed, to show the extent to which they influence the dynamics of these events. The stability of foundations on liquefacted sand, silty clay and karsts on which installations such as wind generators, the nuclear power station and breakwaters are built have been examined in the light of the geoenvironmental risks. The similarity in structural, geotechnical and environmental relationships between Romania and Bulgaria engender common risks that could be properly addressed only through collaboration between scientists from both countries.

21. Earthquake forecast in Vrancea zone, Romania

Author:

Ciucu, C.; Ailenei, R.

Journal:

JOURNAL OF OPTOELECTRONICS AND ADVANCED MATERIALS Volume: 12 Issue: 5 Pages: 1226-1230

Date: May, 2010

Details:

The paper refers to a method and system for determining the seismic precursors, which occur at very low frequencies of infrasound (2 mHz - 200 mHz) and electric currents at ground level, produced by vibrations of the crust as a result of tectonic stress that appears before a seism and the induction effect caused by the movement of the Earth in gravitational field. The result is a forecast of the place, time and magnitude of an earthquake in a range between 1 hour and 2 days before it occurs. The system and method for determining the seismic precursors based on infrasound is composed of sensors of infrasound, a piezoelectric membrane type (tectonic "eardrum") and two pairs of electrodes with the purpose of measuring the electric field of the soil in a square corners. The two systems of measurement are complementary: mechanical vibrations of very low frequency are taken from earthly eardrum and associated electric field through the piezoelectric effect electrodes stuck in the ground. The method correlates filtered low-pass and band-pass electrical signals from two complementary systems of measuring thru a processing module. The data is transmitted via Internet to a computer analysis in order to determine the deformation, the vibrations of the Earth's crust, preceding an earthquake and locating it according to the directions of propagation and frequency spectrum of waves at very low frequencies (2 mHz - 200 mHz).

22. Simulating Knowledge Dynamics in Earthquake Risk Estimation

Author:

Leon, Florin; Atanasiu, Gabriela

Journal:

PROCEEDINGS OF THE 2ND EUROPEAN CONFERENCE ON INTELLECTUAL CAPITAL Pages: 362-373

Date: 2010

Details:

For the knowledge process of earthquake risk estimation in urban areas, located in regions of high seismic risk, a general risk assessment philosophy is used, expressed as follows: Seismic Risk = Seismic Hazard x Seismic Vulnerability x Elements at Risk. Taking into account the definition of risk elements, the central role of knowledge is present both as an input and as an output in risk management. At the same time, especially in case of natural disasters such as earthquakes and their post-effects, knowledge has two components: tacit and explicit ones. The role of tacit knowledge in the dynamics of the risk estimation process is very well illustrated taking into account its main elements: mental models and technical ones. The mental models imply the aspects of empirical measures for the protection of people in urban areas which have been developed in the latest centuries, as knowledge grew along with the dimension of cities and the expansion of urban areas. On the other hand, technical models have been improved by empirical to deterministic procedures especially after the first recorded earthquake of El Centro, in 1940. In case of the strongly exposed region of Romania, one can also find proofs of tacit knowledge in historical chronicles beginning with the 16(th) century which could be considered as the first empirical risk estimation. Since then, knowledge in seismic risk estimation has grown up to the emergency instruments of nowadays, which are used for integrated earthquake risk estimation. The explicit components contain knowledge in a format which can be directly communicated, such as books, brochures, web portals and other tools specific to the present stage of information technology and information society. Within this context of knowledge dynamics in earthquake risk estimation, we present an agent-based simulation that models the development and adoption of technology for the mitigation of earthquake effects in risk-prone areas.

23. Memfis-Multiple electromagnetic field and infrasound monitoring network

Author:

Moldovan, I. A.; Moldovan, A. S.; Ionescu, C.; et al.

Journal:

ROMANIAN JOURNAL OF PHYSICS Volume: 55 Issue: 7-8 Pages: 841-851

Date: 2010

Details:

The paper presents a complex geophysical monitoring and recording system, deployed in Romania, at Plostina observatory (4 sites: PLO1, PLO2, PLO3 and PLO4) and at Surlari site (SULR - Bucharest University). Plostina is located at 45.8512 N latitude and 26.6499 E longitude in the Vrancea (Romania) epicentral zone and is one of the most modern monitoring sites under the administration of the National Institute for Earth Physics (NIEP), Romania. Surlari is located at 44.6798 N latitude and 26.2543 E longitude, outside of the Vrancea epicentral zone, being under the administration of the Bucharest University (BU) and NIEP. Starting with July 2006, NIEP, AZEL - Designing Group S.R.L. and BU joined in a research consortium who's project "Complex Multidisciplinary Research System On Precursory Phenomena Associated With Strong Intermediate Vrancea Earthquakes, In Conformity With The Latest International Approaches - MEMFIS" - was financed by the Romanian Ministry of Research and Education, through the Programme "Excellency Research" and had as a final purpose a new and modern geophysical monitoring network, that uses specific instruments providing information on acoustic (both earth's seismic and atmosphere's infrasonic activities), electric, magnetic and electromagnetic fields. The main goal is to find the correlations between monitored fields and the preparatory stage of strong intermediate earthquakes in Vrancea zone.

24. Macroseis: A tool for real-time collecting and querying macroseismic data in Romania

Author:

Ionescu, C.; Dragoicea, M

Journal:

ROMANIAN JOURNAL OF PHYSICS Volume: 55 Issue: 7-8 Pages: 852-861

Date: 2010

Details:

Earthquakes that are unambiguously sensed by humans or even destructive are often happening natural phenomena in Romania. The MACROSEIS application is an automated tool for collecting information from volunteers that felt the effects of an earthquake. Based on this interactive system, data can be collected and macroseismic maps can be obtained. The MACROSEIS application collects reports from volunteers that were sent via Internet shortly after an event is produced. Electronic reports are sent to the National Institute for Earth Physics. This information is further transformed in CII Community Internet Intensity Maps by means of a modified version of the Dengler and Dewey algorithm.

25. Engineering Geological Conditions in the Riparian area of the town of Ruse

Author:

Evlogiev, Jordan; Nedelcheva, Mariana; Petrova, Vanushka; et al.

Journal:

GEOCONFERENCE: SGEM 2010, VOL II Book Series: International Multidisciplinary Scientific GeoConference-SGEM Pages: 231-252

Date: 2010

Details:

In 2009 engineering geological zoning of the riparian area of the town of Ruse, including the Danubian bank, the low floodplain terrace, the loess slope and the terraces T-3,T-4, was Carried out by the Geotechnical Research Station. The ports, the park, the Sextaginta Prista Roman fortress, the central urban part with impressive architectural ensembles and part of the West Industrial Zone are found in this area.The investigations were conducted within the frame of a contract with the Ruse municipality. Since the origin of the town till present days construction is under the impact of the some processes of the geological hazard river erosion, loess collapse, settlement of technogenic embankments, high seismicity. Four typical sections are distinguished on the basis of geomorphologic and engineering geological analysis and the extent of manifestation of the geological hazardous processes.Section I. This area comprises the high terraces with collapsible loess of the II type. The section is characterized by the following specific features: presence of loess with collapsible zone thickness of 10-12 m; dense construction, most of the buildings being without measures against collapsibility; depreciated (outdated) water supply and sewage (WS&S) system that has provoked collapse of the loess base and deformation of 25 buildings; existence of non-compacted embankments in the old part of the town, where most of the WS&S accidents occur. Section II. It includes the slope between the high and the low tloodplain terrace, built of collapsible loess of the II type. The section is under the impact of the following processes of geological hazard shallow slides, collapse of loess blocks, erosion, earthquakes and collapse of old galleries. The enumerated processes exhibit slight to medium display and only in single places endanger the slope stability. Section III. The low floodplain terraces of the Danube and Rusenski Lom Rivers, which are built of alluvial and anthropogenic soils, belong to this area. The section is under the effect of: river erosion, floods, high groundwater level and settlement of anthropogenic embankments. Here the geological hazardous processes exhibit medium to strong display. Section IV. It includes the gully valleys and the big steppe limpets. This is the section with the lowest manifestation of the geological hazardous processes the erosion in the gullies has been ceased, the loess in the lowest part of the gullies is strongly altered and non-collapsible and the periphery is with collapsibility of the I type. The infrastructure and the building fund in the distinguished sections are affected to a different extent by the mentioned geological processes. Detailed geotechnical analysis is made in the present work and recommendations are given for the rational restriction of hazardous processes. The recommendations are connected with strict adherence to the normative design basis, use of modern methods for engineering geological investigations and application of already approbated under the conditions in the town of Ruse technologies for strengthening the ground base, as well as methods for stabilizing the foundations and the ground base of deformed buildings. The approach in the proposed work may be also applied as a model for analysis and solution of geotechnical problems in other towns along the Danube River.

26. Earthquake hazard and risk in Romania

Author:

Arion, C.; Lungu, D.; Vacareanu, R.

Journal:

PROTECTION OF HISTORICAL BUILDINGS - PROHITECH 09, VOL 1 AND 2 Pages: 1437-1442

Date: 2009

Details:

The paper presents the evolution of seismic zonation and seismic design codes, focusing the probabilistic seismic hazard map and design spectra in new Romanian seismic design code P100-1/2006 following Eurocode 8 format. The paper target is historical earthquake damage and learned lessons and strengthening of tall RC fragile buildings in central Bucharest including conservation of heritage buildings. Intervention strategies of public authorities on pre WWII RC buildings are included.

27. Toward a dense real-time seismic network in Romania

Author:

Neagoe, C.; Ionescu, C.

Journal:

ROMANIAN REPORTS IN PHYSICS Volume: 61 Issue: 2 Pages: 359-366

Date: 2009

Details:

Starting with 2002 the National Institute for Earth Physics (NIEP) has developed its real-time digital seismic network. This network consists of 39 broad band and short period stations and two seismic arrays. SeedLink and Antelope (TM) program packages are used for real-time (RT) data acquisition and exchange. The present network is going to be expanded in the near future. Thus, in 2008 NIEP will install 40 additional broad band stations in Romanian territory and 40 strong motions stations in Bucharest, so that at the end of the year NIEP will have 119 digital broad-band seismic stations and short period in real time.The communication from digital seismic stations to the National Data Center in Bucharest is achieved by 5 providers (GPRS, VPN, satellite communication, radio lease line and internet), which assure the back-up communication lines.The power energy for all the seismic stations and the communication systems is supplied by batteries which offer 24 hours of autonomy.

Starting with 2002 the National Institute for Earth Physics (NIEP) has developed its real-time digital seismic network. This network consists of 39 broad band and short period stations and two seismic arrays. SeedLink and Antelope (TM) program packages are used for real-time (RT) data acquisition and exchange. The present network is going to be expanded in the near future. Thus, in 2008 NIEP will install 40 additional broad band stations in Romanian territory and 40 strong motions stations in Bucharest, so that at the end of the year NIEP will have 119 digital broad-band seismic stations and short period in real time.

The communication from digital seismic stations to the National Data Center in Bucharest is achieved by 5 providers (GPRS, VPN, satellite communication, radio lease line and internet), which assure the back-up communication lines.

The power energy for all the seismic stations and the communication systems is supplied by batteries which offer 24 hours of autonomy.

The processing centre runs BRTT's Antelope (TM) 4.9 data acquisition and processing software on two workstations for real-time processing and post processing. The Antelope Real-Time System is also providing automatic event detection, arrival picking, event location and magnitude calculation. It provides graphical display and reporting within near-real-time after a local or regional event occurred.

The Romanian Seismic Network is permanently exchanging real-time waveform data with IRIS, ORFEUS and different European countries through internet.

In Romania, the magnitude and location of an earthquake are now available within a few minutes after the earthquake occurred. One of the greatest challenges in the near future is to provide shaking intensity maps and other ground motion parameters, within 5 minutes post-event, on the Internet and GIS-based format in order to improve emergency response, public information, preparedness and hazard mitigation.

28. Geodetic engineering - important tool for Romanian seismicity study

Author:

Grecea, Carmen

Journal:

SSE '09: PROCEEDINGS OF THE 11TH WSEAS INTERNATIONAL CONFERENCE ON SUSTAINABILITY IN SCIENCE ENGINEERING Pages: 102-107

Date: 2009

Details:

Geodesy provides facilities to investigate the Earth's crust movements and shares these data with other disciplines. With the rapid developments of geodetic techniques and the accuracy and reliability in geodetic measurements, the surveying methods have gained importance for monitoring crustal deformation on earthquake researches. The main purpose of the paper is to offer an overview of the situation existing in Romania, mainly in Banat county, regarding crustal deformation and propose solutions for future monitoring from geodetic points of view.

29. A computational approach for the assessment of seismic vulnerability based on the national data infrastructure

Author:

Atanasiu, Gabriela M.; Leon, Florin; Popa, Bogdan F.; et al

Journal:

ADVANCES IN FRACTURE AND MATERIALS BEHAVIOR, PTS 1 AND 2 Book Series: ADVANCED MATERIALS RESEARCH Volume: 33-37 Pages: 789-794 Part: 1-2

Date: 2008

Details:

This paper deals with the monitoring and assessment of structural performance of reinforced concrete residential buildings damaged during the lifetime by several important natural disasters such as earthquakes. The problem belongs to the risk management of built environment areas subjected to various natural catastrophes. In our work, we present a methodology based on modeling, simulation and nonlinear analysis applied on two classes of existing buildings located in the damaged infrastructure of earthquake sensitive cities. The decisions for risk mitigation taking into account the real seismic vulnerability of structures are based on GIS (Geographical Information Systems) mapping, and application of some artificial intelligence techniques. Finally, our paper discusses a new methodology for awareness and mitigation of seismic effects in case of future events in dense urban areas based on a case study for lasi city, Romania.

30. Romania's seismicity and seismic hazard : from historical records to desing codes

Author:

Lungu, D.; Aldea, A.; Arion, C

Journal:

HARMONIZATION OF SEISMIC HAZARD IN VRANCEA ZONE: WITH SPECIAL EMPHASIS ON SEISMIC RISK REDUCTION Book Series: NATO Science for Peace and Security Series C - Environmental Security Pages: 1-16

Date: 2008

Details:

The paper presents (i) catalogues of Vrancea earthquakes (ii) past strong earthquakes, (iii) earthquake records in Romania, (iv) the evolution Of seismic zonation and seismic design codes, (v) a seismic hazard map of Romania and design spectra in the new seismic design code P100-1/2006 following the Eurocode 8 format.

31. Integrated monitoring system for seismic risk assessment in Vrancea area

Author:

Zoran, M.

Journal:

INTEGRATION OF INFORMATION FOR ENVIRONMENTAL SECURITY Book Series: Nato Science for Peace and Security Series C - Environmental Security Pages: 315-326

Date: 2008

Details:

Information Technology (GIS, Remote Sensing, satellite communication, etc.) can help a in planning and implementation of hazards reduction measures.This paper addresses some key aspects regarding integrated use of radar, optical, GPS data over Vrancea seismic area in Romania in order to assess active tectonic of this region. Classifications of different geologic features and Digital Elevation Models (DEM) generation from SAR ERS1/2, Landsat TM, ETM and ASTER data are highly correlated with in-situ ground data. GPS Romanian network stations data revealed a crustal displacement of about 5 or 6 mm/year in horizontal direction relative motion, and a few millimeter/year in vertical direction.

32. Probabilistic seismic hazard in terms of intensities for Bulgaria and Romania - updated hazard maps

Author:

Leydecker, G.; Busche, H.; Bonjer, K. -P.; et al.

Journal:

NATURAL HAZARDS AND EARTH SYSTEM SCIENCES Volume: 8 Issue: 6 Pages: 1431-1439

Date: 2008

Details:

Since 2007 Bulgaria and Romania are members of the European Union. All member states have to introduce the European earthquake building code EUROCODE 8 (EC 8) in the coming years. Therefore, new seismic hazard maps have to be calculated according to the recommendations in EC 8. Here the authors present a novel approach to compute such hazard maps. We prefer to use the macroseismic intensity as hazard parameter because of two reasons: - The irregular azimuthal attenuation pattern of the Vrancea intermediate depth earthquakes can be advantageously taken into account by using detailed macroseismic maps.- The intensity is directly related to the degree of damage and is the original information in the historical earthquake catalogues.The main base of our probabilistic analysis is the earthquake catalogue for SE-Europe (Shebalin et al., 1998) in combination with national and regional catalogues. Fore- and aftershocks were removed. Seismic source zones inside an area of about 200 km around Romania and Bulgaria were defined based on seismicity, neotectonics and geological development. For each seismic source the intensity-frequency relation was calculated and a maximum possible earthquake as well as a seismogenic depth was estimated. An appropriate attenuation law was assumed. To cope with the irregular isoseismals of the Vrancea intermediate depth earthquakes, a factor Omega was included in the macroseismic attenuation law.Using detailed macroseismic maps of three strong intermediate depth earthquakes, Omega was calculated for each observation. Strong local variations of Omega are avoided by averaging within grid cells of 0.5 degree in longitude and 0.25 degree in latitude.The contributions of all seismic sources, the crustal normal depth source zones and the Vrancea intermediate depth zone, were summed up and the annual probability of exceedance was calculated. The contribution of the Vrancea intermediate depth zone to each grid point was computed with the corresponding representative Omega of this point; a seismogenic depth of 120 km has been assumed.Each final seismic hazard map is a combination of two maps, the one for normal depth source zones and the one for the Vrancea intermediate depth zone. This is illustrated for a recurrence period of 475 years. Additional hazard maps were calculated for different recurrence periods.

33. Romanian earthquakes analysis using the BURAR seismic array

Author:

Borleanu, Felix; Rogozea, Maria; Ghica, Daniela; et al.

Journal:

ROMANIAN REPORTS IN PHYSICS Volume: 60 Issue: 1 Pages: 145-155

Date: 2008

Details:

Bucovina seismic array (BURAR) is a medium-aperture array, installed in 2002 in the northern part of Romania (47.6148 degrees N latitude, 25.2168 degrees E longitude, 1, 150 m altitude), as a result of the cooperation between the Air Force Technical Applications Center, USA and the National Institute for Earth Physics, Romania. The array consists of ten elements, located in boreholes and distributed over a 5 x 5 km(2) area; nine with short-period vertical sensors and one with broadband three-component Sensor. Since the new station began operating the earthquake survey of Romania's territory it has been significantly improved. Data recorded by BURAR during the 01.01.2005 - 12.31.2005 time interval are first processed and analyzed, in order to establish the array detection capability of the local earthquakes, occurred in different Romanian seismic zones. Then a spectral ratios technique is applied in order to determine the calibration relationships for magnitude, using only the information gathered by the BURAR station. The spectral ratios are computed relatively to a reference event, considered representative for each seismic zone. This method has the advantage of eliminating the path effects. The new calibration procedure is tested for the case of Vrancea intermediate-depth earthquakes and proved to be very efficient in constraining the size of these earthquakes.

34. New approach;on seismic hazard isoseismal map for romania

Author:

Marmureanu, Gheorghe; Cioflan, Carmen Ortanza; Marmureanu, Alexandru

Journal:

ROMANIAN REPORTS IN PHYSICS Volume: 60 Issue: 4 Pages: 1123-1135

Date: 2008

Details:

The seismicity of Romania comes from the energy that is released by crustal earthquakes, which have a depth not more than 40 km, and by the intermediate earthquakes coming from Vrancea region (unique, case in Europe) with a depth between 60 and 200 1cm. The authors developed the concept of "control earthquake" and equations to obtain the banana shape of the attenuations curves of the macroseimic intensity I (along the directions defined by azimuth Az), in the case of an Vrancea earthquake at a depth 80 < x < 160 km. There were used deterministic and probabifistic approaches, linear and nonlinear ones. The final map is in MMI intensity (isoseismal map) for maximum possible Vrancea earthquake with Richter magnitude, M(GR) = 7.5. This will avoid any drawbacks to civil structural designers and to insurance companies which are paying all damages and life loses in function of earthquake intensity.

35. Statistical investigations of local earthquakes in the Carpathian Basin and surrounding area

Author:

Kiszely, M.

Journal:

ACTA GEODAETICA ET GEOPHYSICA HUNGARICA Volume: 42 Issue: 3 Pages: 341-359

Date: 2007

Details:

The Carpathian Basin is situated in the territory between the Mediterranean area, which is seismically one of the active regions and the Carpathian Mountains belt. The temporal variation of seismicity is investigated on the example of three seismo-tectonically different regions: the Carpathian Basin, the Vrancea region and the Dinarides. The seismicity is analyzed since 1900 in order to investigate the existence of diurnal periodicities using hodographs. There are two different diurnal distributions opposing each other: maximum early morning dominates until the year 1963, followed by a period of time when earthquakes seem to occur more often around 13h local time mainly concerning the weak M(L) < 3.2 events. The midday maximum in the number of minor events may be caused by the inclusion of quarry blasts, but the diurnal geomagnetic variations correlate well with diurnal changes in earthquake activity. Duma and Rhuzin (2003) suppose that the current vortices induced by Sq variations in the lithospheric layer, flowing across the horizontal component of the geomagnetic field generate a torque which can be added to the tectonic loading stress (which have a maximum about noon) and may help trigger instability in a fault approaching the failure threshold.

The spatial and temporal fractal structures of earthquakes were analyzed using the box counting method. The regions were divided into different size r of a square box and were counted the minimum number N(r) of boxes necessary to cover all the data. The recurrence times of earthquakes are shown to be a clustering process and are much higher in the Carpathian Basin. The earthquakes in these regions have self-similar structures. The slope of log N-log r function for Carpathian Basin breaks at about 20 km, which divides the range into two bands. This breaking at about 20 km maybe connected to the intrinsic weakness of the Carpathian Basin lithosphere.

36. Correlations between earthquakes and large mud volcano eruptions

Author:

Mellors, R.; Kilb, D.; Aliyev, A.

Journal:

JOURNAL OF GEOPHYSICAL RESEARCH-SOLID EARTH Volume: 112 Issue: B4 Article Number: B04304

Date: 2007

Details:

We examine the potential triggering relationship between large earthquakes and methane mud volcano eruptions. Our data set consists of a 191-year catalog (1810 - 2001) of eruptions from 77 volcanoes in Azerbaijan, central Asia, supplemented with reports from mud volcano eruptions in Japan, Romania, Pakistan, and the Andaman Islands. We compare the occurrence of historical regional earthquakes (M > 5) with the occurrence of Azerbaijan mud volcano eruptions and find that the number of same-day earthquake/ eruption pairs is significantly higher than expected if the eruptions and earthquakes are independent Poisson processes. The temporal correlation between earthquakes and eruptions is most pronounced for nearby earthquakes (within similar to 100 km) that produce seismic intensities of Mercalli 6 or greater at the location of the mud volcano. This assumed magnitude/distance relationship for triggering observed in the Azerbaijan data is consistent with documented earthquake-induced mud volcano eruptions elsewhere. We also find a weak correlation that heightened numbers of mud volcano eruptions occur within 1 year after large earthquakes. The distribution of yearly eruptions roughly approximates a Poisson process, although the repose times somewhat favor a nonhomogenous failure rate, which implies that the volcanoes require some time after eruption to recharge. The volcanic triggering likely results from some aspect of the seismic wave's passage, but the precise mechanism remains unclear.

37. Identification of possible surface waters as drinkable water sources in case of natural disasters in Romania

Author:

Stoica, E.; Golumbeanu, M.; Chiotoroiu, B.; et al.

Journal:

JOURNAL OF ENVIRONMENTAL PROTECTION AND ECOLOGY Volume: 8 Issue: 4 Pages: 910-918

Date: 2007

Details:

Providing adequate water is critical for survival in the initial stage of a natural disaster. The impact of natural hazards such as hurricanes, earthquakes, floods, landslides and droughts, frequently results in contaminated potable water sources with direct impact on local population health. Therefore, to save the drinking water supply, alternative sources are needed. In this paper we discuss the possibility of unrestricted use of the renewable surface waters for drinking water supply in case of flood, the most dangerous natural disaster that occurs in Romania every year. The analysis of the relevant parameters (chemical and microbiological) showed that contaminated freshwaters (inland rivers, lakes, the Danube river) or seawaters (the Black sea) could be relevant in case of this natural disaster by applying of an optimised and low-cost process of water purification such as desalination. In conclusion, in areas where rivers and sea exist they Could be an interesting alternative for regional aquifers, which are affected by natural disasters like floods and can become an importance on strategic concepts for risk management.

38. Crustal motion and strain accumulation in western Bulgaria

Author:

Kotzev, V; Nakov, R; Georgiev, T; et al.

Journal:

TECTONOPHYSICS Volume: 413 Issue: 3-4 Pages: 127-145

Date: 2006

Details:

Global Positioning System (GPS) data acquired between 1996 and 2004 and fault plane solutions for four seismic zones are analyzed to obtain the velocity and strain rate fields for western Bulgaria. The GPS derived velocities suggest that southwestem Bulgaria moves to the S to SSE at a rate of similar to 1 min/year with respect to northern Bulgaria and southern Romania, defiling ail approximately ESE-trending extensional boundary that marks the northernmost extent of the Aegean extensional domain. The boundary includes the E-W trending Sub-Balkan graben system of central Bulgaria and its westward continuation into the Sofia graben. Active faults within the boundary region trend ENE to WNW, and they have normal or oblique normal and strike-slip displacements consistent with the velocity field. Within the western part of the boundary region, extension is transferred to the north of the Sofia graben across the westemmost part of the Stara Planina Mountains and the ridges of the western Sredna Gora. The geodetically derived N-S extension is in agreement with the seismic data that show a variable pattern, but with projections of the T axes mostly lying within the N-S quadrant. The predominant type of faulting is caused by sub-horizontal extensional stresses in an approximate N-S direction. This is consistent with extension and oblique strike-slip interpreted from geological studies that show numerous WNW, ENE to E-W-trencling active normal faults in western Bulgaria. (c) 2005 Elsevier B.V. All rights reserved.

39. High-resolution teleseismic body-wave tomography beneath SE Romania - I. Implications for three-dimensional versus one-dimensional crustal correction strategies with a new crustal velocity model

Author:

Martin, M; Ritter, JRR

Journal:

GEOPHYSICAL JOURNAL INTERNATIONAL Volume: 162 Issue: 2 Pages: 448-460

Date: August, 2005

Details:

The CALIXTO (Carpathian Arc Lithosphere X-Tomography) experiment offers a dense, high-quality data set to study the lithospheric/asthenospheric system underneath SE Romania, an earthquake-prone region in SE Europe. To increase the image resolution of structures in the uppermost mantle, the application of crustal traveltime corrections by a priori information before the teleseismic traveltime inversion has become a well-accepted procedure. For such a correction we present a regional 3-D crustal seismic velocity model that serves as the basis for a high-resolution teleseismic tomography (forthcoming paper by Martin et al.). Our 3-D crustal model is based on recent research in the region. We collect new results from two long-range seismic refraction lines, 3-D refraction tomography and teleseismic Ps conversions. Adding previously published models of the sediment distribution, Conrad and Moho depths, as well as crustal seismic P-wave velocities, we compile a 3-D crustal model for SE Romania. This 3-D model does not contain shallow small-scale heterogeneities (< 10 km), but it reflects the large-scale structures such as variations in sediment thickness, average seismic velocities and 3-D Moho depth. It is well suited for the correction of teleseismic traveltime residuals, a prerequisite for a high-resolution teleseismic tomography study: for example, traveltime delays of up to 1.3 s are caused by the almost 20-km thick layer of sediments in the Focsani Basin. Such delays are comparable to or larger in size than the expected upper mantle traveltime residuals.We study the significance of 3-D crustal traveltime corrections relative to 1-D station corrections and show that the complex basin structures in SE Romania require a 3-D approach to reduce the smearing of crustal anomalies into the mantle. By modelling synthetic mantle structures with a slab, as it is expected for SE Romania, we also investigate how to adapt the inversion strategy, if crustal corrections are applied. Significant improvements are found by including the already corrected crustal layers in the inversion procedure, thereby enabling the inversion algorithm to project still remaining uncertainties in the less-resolved upper crustal layers. However, the fixing of the upper layers during the inversion due to the a priori knowledge of the crustal velocity anomalies clearly leads to smearing of uncorrected anomalies that are possibly located close to the crust-mantle boundary.

40. Deterministic earthquake scenarios for the city of Sofia

Author:

Slavov, S; Paskaleva, I; Kouteva, M; et al.

Journal:

PURE AND APPLIED GEOPHYSICS Volume: 161 Issue: 5-6 Pages: 1221-1237

Date: 2004

Details:

The city of Sofia is exposed to a high seismic risk. Macroseismic intensities in the range of VIII - X (MSK) can be expected in the city. The earthquakes that can influence the hazard in Sofia originate either beneath the city or are caused by seismic sources located within a radius of 40 km. The city of Sofia is also prone to the remote Vrancea seismic zone in Romania, and particularly vulnerable are the long-period elements of the built environment. The high seismic risk and the lack of instrumental recordings of the regional seismicity make the use of appropriate credible earthquake scenarios and ground-motion modelling approaches for defining the seismic input for the city of Sofia necessary. Complete synthetic seismic signals, due to several earthquake scenarios, were computed along chosen geological profiles crossing the city, applying a hybrid technique, which combines the modal summation technique and finite differences. The modelling takes into account simultaneously the geotechnical properties of the site, the position and geometry of the seismic source and the mechanical properties of the propagation medium. Acceleration, velocity and displacement time histories and related quantities of earthquake engineering interest (e.g., response spectra, ground-motion amplification along the profiles) have been supplied. The approach applied in this study allows us to obtain the definition of the seismic input at low cost, exploiting large quantities of existing data (e.g. geotechnical, geological, seismological). It may be efficiently used to estimate the ground motion for the purposes of microzonation, urban planning, retrofitting or insurance of the built environment, etc.

41. Earthquakes distribution and their focal mechanism in correlation with the active tectonic zones of Romania

Author:

Bala, A; Radulian, M; Popeseu, E

Journal:

JOURNAL OF GEODYNAMICS Volume: 36 Issue: 1-2 Pages: 129-145

Date: 2003

Details:

On the basis of an earthquake catalogue covering the time interval from 1929 to 1997 and comprising fault plane solutions, we analyze the distribution of the seismic activity on the Romanian territory in connection with the seismogenic zones, previously defined, and available geological and tectonic information. At the same time, the stress field characteristics, deduced from the available fault plane solutions, are investigated for different depth intervals. Predominant clusterings of the principal deformation axes and rupture plane orientation are observed in the Vrancea subcrustal domain in contrast with the earthquakes in the crust, which show no clear trending in the stress field. A number of 526 events occurred in the period 1929-1997 and having the magnitude 1.5 < M-S < 7.4 are analyzed according to their fault plane solutions. The relatively large number of events provides important and reliable information to redefine from seismological point of view the limits of the seismogenic and active zones.

42. Palaeoseismic events in karst terrains along the northern Bulgarian Black Sea coast

Author:

Angelova, D

Journal:

ACTA GEOLOGICA SINICA-ENGLISH EDITION Volume: 75 Issue: 3 Pages: 308-315

Date: 2001

Details:

The study of the palaoseismic events in the karst terrains of the Bulgarian Black Sea coast is a very important up-to-date problem. The investigated region is one of the highest-energy regions in Bulgaria with established and recorded catastrophic historic and contemporary earthquakes. The terrain is subjected to the influence not only of its own earthquake foci but also of those in Romania and Russia. The palaeoearthquakes that caused considerable disturbances in the karst terrains along the Northern Bulgarian Black Sea coast have left significant traces. They caused disturbances in the environment and the relief (rearrangement of the surface and ground water karst basins, partially or entirely collapsed caves, deformed caves, oil, gas and salt intrusions and gravitationally formed caves). The ecological consequences in historic and contemporary aspects were catastrophic. The palaeoseismic dislocations were formed as a result of global, regional and local geodynamic events related with the destruction of the Moezian platform and the regional extension of the Black Sea basin. The time of their display and their spatial interrelations were established as a result of complex investigations accompanied by original documents.

43. Characterization of seismogenic zones of Romania

Author:

Radulian, M; Mandrescu, N; Panza, GF; et al.

Journal:

PURE AND APPLIED GEOPHYSICS Volume: 157 Issue: 1-2 Pages: 57-77

Date: 2000

Details:

Although the time and magnitude range covered by available seismological data is limited, several significant regional trends are outlined in the seismogenic zones of Romania. Vrancea region, which is by far the most seismically active area, has a persistent rate of occurrence of intermediate-depth earthquakes, clustered in a very confined focal volume, and a clear compressive stress regime. The deformation field, as deduced from the available fault plane solutions, is drastically reduced in the crust, where the maximum magnitude is below 6.5 (except Shabla zone, in Bulgaria). The system of major faults developed in a NW-SE direction in the Carpathians foredeep area is certainly linked to the subduction process in Vrancea, although they seem not to play a significantly active role, as could be expected for an active subduction process. The existing data indicate an extensional deformation regime over the foredeep area and Southern Carpathians, while a predominant compressive regime is outlined at the contact between the eastern margin of the Pannonian Depression and Carpathians orogen, in agreement with the bending tendency of the maximum horizontal compression orientation of the crustal stress field from NE-SW, in western and central Europe, to E-W, in the intra-Carpathian region (GRUNTHAL and STROMEYER, 1992).

44. Identification of future earthquake sources in the Carpatho-Balkan orogenic belt using morphostructural criteria

Author:

Gorshkov, AI; Kuznetsov, IV; Panza, GF; et al.

Journal:

PURE AND APPLIED GEOPHYSICS Volume: 157 Issue: 1-2 Pages: 79-95

Date: January, 2000

Details:

The Carpatho-Balkan mountain belt, the most seismic zone of the Circum-Pannonian region. is studied with a goal to identify sites where shallow earthquakes with MT 6.5 may occur. The study is based on the assumption that strong earthquakes associate with disjunctive nodes that are formed around the junctions of lineaments. In the study region, lineaments and disjunctive nodes were defined by a morphostructural zonation method. The morphostructural map compiled at the scale of 1:1,000,000 shows a hierarchical system of homogeneous blocks, the network of morphostructural lineaments and the loci of disjunctive nodes. Shallow earthquakes with M-s greater than or equal to 5.0 recorded in the region were found to be nucleated at the mapped nodes. In the Carpatho-Balkan mountain belt, the nodes where earthquakes with M greater than or equal to 6.5 may occur have been identified using morphostructural criteria of high seismicity, previously derived from pattern-recognition of potential seismic nodes in the Pamirs-Tien Shan region. In total, 64 of the 165 nodes mapped in the studied region have been defined to be prone to earthquakes of Mt 6.5. These 64 nodes include the seven where earthquakes of M-s greater than or equal to 6.0 already took place

45. Probabilistic seismic hazard maps for the North Balkan region

Author:

Musson, RMW

Journal:

ANNALI DI GEOFISICA Volume: 42 Issue: 6 Pages: 1109-1124

Date: December, 1999

Details:

A set of seismic hazard maps, expressed as horizontal peak ground acceleration, have been computed for a large area of Central and Eastern Europe covering the North Balkan area (Former Yugoslavia, Hungary, Romania). These are based on: a) a compound earthquake catalogue for the region; b) a seismic source model of 50 zones compiled on the basis of tectonic divisions and seismicity, and c) a probabilistic methodology using stochastic (Monte Carlo) modelling. It is found that the highest hazard in the region comes from intermediate focus earthquakes occurring in the Vrancea seismic zone; here the hazard exceeds 0.4 g at return periods of 475 years. Special account has been taken of the directional nature of attenuation from this source.

46. Possible cause-effect relationships between Vrancea (Romania) earthquakes and some global geophysical phenomena

Author:

Enescu, D; Enescu, BD

Journal:

NATURAL HAZARDS Volume: 19 Issue: 2-3 Pages: 233-245

Date: May, 1999

Details:

The possibility that the Earth's tides are a triggering factor of Vrancea subcrustal earthquakes is investigated in the first part of this paper. A possible correlation between Vrancea subcrustal earthquakes and geomagnetic jerks is demonstrated in the second part. The last part of the paper presents a number of results concerning a possible relationship between the regularities of strong Vrancea subcrustal seismicity and the Chandler nutation parameters. An attempt is made to integrate all of these phenomena in a more general framework that takes into account physical processes in the Earth mantle and core. A long-term prediction of the next strong Vrancea earthquake is finally attempted.

47. Modern recording of seismic strong motion for hazard reduction

Author:

Bolt, BA

Journal:

VRANCEA EARTHQUAKES: TECTONICS, HAZARD AND RISK MITIGATION
Pages: 1-13

Date: 1999

Details:

Striking progress has occurred in recording strong shaking from damaging earthquakes since the 4 March 1977 Vrancea, Romania, earthquake (M-w = 7.4). Free-field accelerometers in seismic regions have significantly increased in number, geographical distribution, and dynamic range. Many digital instruments are now operational. In Europe and the Middle East alone, the number of individual triaxial recordings during the last 30 years exceeds 2500. Of particular importance, the 1989 Loma Prieta, 1992 Landers, 1994 Northridge tall in California), and the 1995 Hyogo-ken Nanbu, (Kobe) Japan, earthquakes have provided not only hundreds of key free-field accelerograms bur many instrumental records of building response.In Romania there are now over 70 strong motion accelerometer stations and an important data base of seismic ground motion records is accumulating, including records from the intermediate depth Vrancea earthquakes of 1977, 1986, and 1990. The Bucharest accelerograms of the 1977 earthquake are of the greatest value in predicting future strong ground motions in Bucharest. The 1 to 2 sec velocity pulse in the horizontal components (repeated in the 1986 earthquake) is generated by directivity focussing of energy from the moving source rupture at intermediate depth (about 80 to 120 km) towards Bucharest. The thick alluvial layer under the city further amplifies the 1 to 2 sec S wave energy. The 1977 Bucharest record may, therefore, be taken as "characteristic" of the maximum input design motions in Bucharest.Attenuation laws for hazard analysis of intra- and interplate crustal earthquakes in many seismic regions have recently improved. In the near field, the dominant velocity pulse (or "fling") from the radiation mechanism and directivity for strike-slip and thrust sources has been found to differ significantly between fault-normal and fault-parallel azimuths. Also, reflections from deep crustal structure can contribute to the seismic wave strong motions. Unfortunately for ground motion estimation in Romania, near-source recordings from intermediate depth sources and M-w > 7.0 earthquakes around the world remain sparse. To obtain a comprehensive distribution of recordings for hazard estimation in Romania, many more digital instruments are needed in different geological conditions and at various azimuths. Forensic earthquake engineering to understand structural vulnerability depends on correlation between ground motion records near to engineered structures (particularly from near-structure reference stations) and recorded motions of the structure. As well, digital recording systems can now provide near-real-time warnings and intensity maps, time histories, and spectral variations over the shaken region. All high seismic hazard regions need such digital recording systems, linked to absolute time through inexpensive GPS satellite telemetry.

48. Towards a national earthquake protection program under the conditions of Romania

Author:

Bolt, BA

Journal:

VRANCEA EARTHQUAKES: TECTONICS, HAZARD AND RISK MITIGATION Pages: 241-250

Date: 1997

Details:

National earthquake protection program under the conditions of Romania

49. Earthquake risk analysis and management - Some specific aspects of the case of Romania

Author:

Sandi, H

Journal:

VRANCEA EARTHQUAKES: TECTONICS, HAZARD AND RISK MITIGATION Pages: 309-320

Date: 1999

50. Earthquake education in Romania

Author:

VATAMAN, O; GEORGESCU, ES

Journal:

10TH EUROPEAN CONFERENCE ON EARTHQUAKE ENGINEERING, PROCEEDINGS, VOLS 1-4 Pages:

Date: 1995

51. Development of Earthquake Early Warning Systems in the European Union

Author:

P. Gasparini, G. Manfredi

Journal:

Advanced Technologies in Earth Sciences pp 89-101

Date: 2013

Details:

Utilization of Earthquake Early Warning Systems (EEWS) in Europe is lagging significantly in respect of pioneer applications in Japan and Mexico. The first reported implementation of a EEWS in Europe is the on-site system designed to protect the

Ignalina nuclear power plant in Lithuania. At the beginning of this century, some research groups in Europe started to develop EEW to protect the cities of Istanbul and Bucharest and the territory of Campania, in Southern Italy. Coordinate research effort involving all the groups interested in earthquake early warning started EU FP6 SAFER (Seismic eArly warning For EuRope) project and is continuing with the activities of the EU FP7 REAKT (Strategies and tools for Real Time EArthquake RisK ReducTion) project.

52. How Useful is Early Warning and Can It Be Made More Effective?

Author:

M. Wyss, F. Wenzel, J. Daniell

Journal:

Advanced Technologies in Earth Sciences pp 369-379

Date: 2013

Details:

The methods to detect the development of a large earthquake at an early time and to issue an appropriate warning have made great progress. Nevertheless, for population centers at risk, warnings can generally be issued only about 5–10 s before the strong shaking arrives. Systems and facilities that can benefit from a warning with such a short lead time include: Transportation systems, fire departments, medical facilities, schools, industrial plants, petroleum and gas pipelines, elevators, and power plants. However, for the population at home in vulnerable apartment buildings or at work in office buildings and factories that may not have been built following modern codes, the warning is too short for a person to reach a safe place. Although taking cover under a table can protect a person from falling objects, a structurally strong Earthquake Protection Unit (EPU) is required to save lives and limbs in a partially collapsing building. If a culture of earthquake awareness and the knowledge of early warning capabilities were developed, in which strong earthquakes closets could be bought in the lumber yard like tornado shelters, then the fine advances in earthquakes early warning could result in lives saved.

8.5 UKRAINE

1. Seismic risk studies in Ukraine

Title of the Study:

Seismic risk studies in Ukraine

Period (Dates) of the Study:

1980th – present

Scope and Objectives of the Study:

Seismic zoning, assessment of seismic risks in different regions of Ukraine

Providing of seismic safety in the most risky regions of Ukraine

Implementing Organisation:

Institute of Geophysics (IGP) of the National Academy of Sciences of Ukraine

Funding Bodies:

Institute of Geophysics (IGP) of the National Academy of Sciences of Ukraine

Results and Significant Impacts of the Study:

Maps of general seismic zoning (GSZ) of Ukraine for periods 1 time per 100, 500, 1000 years

Seismic micro zoning for most risky regions and big cities

Size of application:

National, regional

List of Bibliographical References:

1. Kendzera A. Seismic risks assessment for protection from earthquakes / / Lessons and consequences of heavy earthquakes. - Sevastopol, 2007. - pp. 141-143.

2. Kendzera O. Current situation and main trends of seismic research in Ukraine / / Interdepartmental collection of scientific papers (building). State Research Institute of Building Constructions (of State Construction Committee of Ukraine). - Kyiv: SRIBC, 2004. - Issue. 60. - P. 14-22.

3. Pustovitenko B. G. About the problem of seismic safety of Crimea// Problems of the seismic safety of Crimea. - Sevastopol, 1995. - P. 8-15.

4. Pustovitenko A. The main types of motions in earthquakes epicenters in the Black Sea and adjacent areas / / Lessons and consequences of heavy earthquakes. - Sevastopol, 2007. - P. 103-105.

5. Pustovitenko B. G. New data on the seismic risks in Odessa and Odessa region / B. G. Pustovitenko, V. E. Kulchitsky, A. A. Pustovitenko // Building construction. Soil Mechanics, Geotechnics, building foundation construction. - 2004. - 2, Issue 61. - P. 388-397.

6. Pustovitenko B. G. Seismic processes in the Black Sea region and seismic risks in Crimea. - Dissertation for the degree of doctor of physical and mathematical sciences, specialty 04.00.22 - geophysics-Institute of Geophysics of NAS of Ukraine named by S. I. Subbotin, Kyiv, 2003. – 38 p.

7. Pustovitenko B. G. Lessons of devastating earthquake in Crimea in 1927 // Lessons and consequences of heavy earthquakes. Sevastopol, 2007. - P. 3-5.

8. Pustovitenko B.G., Kapitanova S. A., Kulchitskiy V. E., Panteleeva T. A., Porechnova E. I. Analysis of the current seismic situation in Crimea according seismological data // Problems of the seismic safety of Crimea. - Sevastopol, 1995. - P. 58-67.

9. Pustovitenko B. G., Kulchitskiy V. E., Wolfman Y. M. Pustovitenko A. A. Safronov O. N. Seismic ricks in south-western part of Ukraine // Interdepartmental collection of scientific papers (building). State Research Institute of Building Constructions (of State Construction Committee of Ukraine). – Kyiv; SRIBC, 2004. - Issue. 60. - P. 114-120.

10. Pustovitenko B. G., Kulchitskiy V. E., Pustovitenko A. A. Marine areas Seismic risks assessment (case study of north-western shelf of the Black Sea) // Lessons and consequences of heavy earthquakes. - Sevastopol, 2007. - P. 147-149.

11. Sklar A. M., Ostanin A. M. Engineering and seismic conditions of the city Odessa // Interdepartmental collection of scientific papers (building). State Research Institute of Building Constructions (of State Construction Committee of Ukraine).- Kyiv: SRIBC, 2004. - Issue. 60. - P. 141-145

12. Korolev B.A., Sklar M. A., Knyazeva V. S. New macro seismic data on the earthquake September 11, 1927 - P. 30-33.

2. Earthquake risks studies in seismic zones

Title of the Study:

Earthquake risks studies in seismic zones

Period (Dates) of the Study:

1987 – present

Scope and Objectives of the Study:

Seismic risk assessment in different regions of Ukraine,

Provision of seismic safety of most risky regions of Ukraine

Implementing Organisation:

Ukrainian State Geological Research Institute (USGRI)

Funding Bodies:

Ukrainian State Geological Research Institute (USGRI)

Results and Significant Impacts of the Study:

Assessment of the impact of engineering and geological conditions on the level of seismic risks

Size of application:

National, regional

List of Bibliographical References:

1. Lushchik A. About the need to assess the risk of seismic and geological risks / / Construction in the seismic regions of Ukraine. Reports on 4th scientific abd technical conference. Yalta. - Kyiv: State comette of building of Ukraine, 1999. - P. 116-119.

2. Lushchik A. V., Tihonenkov E. P., Yakovlev E. A. Specialty of seismic zoning of technogenic impact on the geological environment. Exploration and conservation of mineral resources, 1987.

3. Lushchyk A. V. Yakovlev S. O. The necessity and main directions of ecological and geological studies of seismic areas// Interdepartmental collection of scientific papers (building). State Research Institute of Building Constructions (of State Construction Committee of Ukraine). - Kyiv: SRIBC, 2004. - Issue. 60. - P. 372-375.

3. Development of earthquake-resistant civil building

Title of the Study:

Development of earthquake-resistant civil building

Period (Dates) of the Study:

1995 – present

Scope and Objectives of the Study:

Reduction of seismic risks by introduction of earthquake-resistant constructions

Implementing Organisation:

State head territorial research and design institute "KrymNIIproekt"

Funding Bodies:

State head territorial research and design institute "KrymNIIproekt"

Results and Significant Impacts of the Study:

Seismic micro-zoning of big cities of Crimea

Introduction of anti-seismic requirements to the state building norms

Region(s) of Implementation with Geographical coordinates (if applicable):

Simpheropol

Size of application:

Local

List of Bibliographical References:

• Kukunaev V. S. About providing earthquake resistance in housing and civic buildings in Crimea / / Problems of the seismic safety of Crimea. - Sevastopol, 1995. - P. 76-80.

• Kukunaev V. S. Problems and status of earthquake engineering in Crimea / / Problems of seismic safety of Crimea. - Sevastopol, 1995. - P. 16-19.

4. Studies of geotechnical properties of soils in relation to the seismic risks assessment

Title of the Study:

Studies of geotechnical properties of soils in relation to the seismic risks assessment

Period (Dates) of the Study:

1999 - present

Scope and Objectives of the Study:

Development of database for seismic micro-zoning of Odessa

Implementing Organisation:

Odessa I. I. Mechnikov National University

Department of Hydrogeology and Engineering Geology

Funding Bodies:

Odessa I. I. Mechnikov National University

Department of Hydrogeology and Engineering Geology

Results and Significant Impacts of the Study:

Seismic micro zoning of Odessa,

GIS model for seismic increment assessment,

Database of soils (geological characteristics) in Odessa and Odessa region for micro zoning

Region(s) of Implementation with Geographical coordinates (if applicable):

Odessa

Size of application:

Local

List of Bibliographical References:

1. Fesenko A. V. Studies and GIS modeling of seismic and geotechnical conditions of the territories for the purposes of geological analysis and assessment of the degree of variability of local and regional seismic risks (case study of the North-Western part of the Black Sea Region and the city of Odessa) / / Odessa "BMB", 2008, -192 p.

2. Fesenko O. V. Seismic conditions of Odessa region, technical, geological and geomorphological basis of seismic micro-zoning of Odessa / / Bulletin of Odessa I. I. Mechnikov National University. - 2001. - V. 6. - No. 9. - Geographical and geological sciences. - P. 132-138.

3. Fesenko O. Issues of detailed seismic zoning of the Eastern Carpathians and north-western Black Sea region for the purposes of seismic micro-zoning of the city Odessa / / Bulletin of Odessa I. I. Mechnikov National University. - Odessa: "Astroprint" - 2003. - V. 8. - No. 5. - Geographical and geological sciences. – P. 171-179.

4. Fesenko A.V. Studies and GIS modeling of seismic and geotechnical conditions of the territory for the purposes of geological analysis and assessment of variability of local and regional of seismic risks (case study of the North-Western Black Sea Region and the city of Odessa) - Odessa: BMB, -2008. -192 p.

5. Fesenko A. V. Engineering and geological zoning of the city of Odessa for local seismic risks assessment // Interdepartmental collection of scientific papers (building). State Research Institute of Building Constructions (of State Construction Committee of Ukraine). - Kyiv: SRIBC, 2004. , Vol. 60. - P. 395-400.

6. Fesenko A. V. Conceptual bases of engineering-geological zoning of Odessa for level of seismic safety assessment / Bulletin of the Odessa I. I. Mechnikov National University

7. Odessa: "Astroprint" - 2004. - V. 9. - No. 4. - Geographical and geological sciences. - P. 212-218.

8. Cherkez E. A. Impact of seismic activity on landslide risk (Case study of landslides in north-western part of Odessa and Mykolaiv region) // Proceedings of the Second Scientific Conference "Modern hazardous geological processes. Environmental Impact. New Technologies of forecasting and protection. "- Kyiv: SPC "Ecology. Science. Technic" partnership "Knowledge" Ukraine - 2004. P. 61-64

9. Shtenhelov E. S. Short-period land pulsation and geological cataclysm 1999-2002. - Odessa: "Astroprint", 1999.

5. Development of earthquake-resistant civil building

Title of the Study:

Development of earthquake-resistant civil building

Period (Dates) of the Study:

1999 - present

Scope and Objectives of the Study:

Anti-seismic constructions to eliminate seismic risks

Implementing Organisation:

Odessa State Academy of Civil Engineering and Architecture

Funding Bodies:

Odessa State Academy of Civil Engineering and Architecture

Results and Significant Impacts of the Study:

Seismic micro-zoning for numerous building places of Odessa

Introduction of anti-seismic requirements to the state building norms

Region(s) of Implementation with Geographical coordinates (if applicable):

Odessa

Size of application:

Local

List of Bibliographical References:

1. Yegupov V. K., Yegupov K. V. Analysis and design of earthquake-resistant buildings of Crimea / / Problems of the seismic safety of Crimea. - Sevastopol, 1995. - P . 81.

2. Kendzera O. V., Yegupov V. K., Yegupov K. V. Seismic monitoring of Southwestern areas of Ukraine and adjacent areas // Bulletin of ONU. Series: Geographical and geological sciences. - 2013. – Vol. 18, Issue. 1 (17). - P. 70-83.

6. Development of earthquake-resistant civil building

Title of the Study:

Development of earthquake-resistant civil building

Period (Dates) of the Study:

2007 - present

Scope and Objectives of the Study:

Development of earthquake-resistant civil building for seismic hazards reduction

Implementing Organisation:

State Scientific-Research Institute of Building Constructions, Kiev

Funding Bodies:

State Scientific-Research Institute of Building Constructions, Kiev

Results and Significant Impacts of the Study:

Earthquake-resistant building requirements introduced to the state building regulations

Size of application:

National

<u>List of Bibliographical References:</u>

1. Babic K.N. Constuctual risk assessment of buildings and structures under seismic impact / / Lessons and consequences of heavy earthquakes. - Sevastopol, 2007. - P. 37-38.

2. Krivocheev P. I., Avdienko A. P. Nemtchinov Y. I., Tarasyuk V. G. Kozelets P. M., Necheporchuk A. A. Legal framework of the building complex of Ukraine and its adaptation to international standards. Status and prospects of development building norm in seismic areas of Ukraine / / Lessons and consequences of heavy earthquakes. - Sevastopol, 2007. - P. 45-47.

3. Nemtchinov Y. I., Tarasyuk V. G., Poklonsky V. G., Critov V. A., Bogdan V. M., Maryenkov N. G., Fesenko O. A. Progressive collapse of buildings in the casr of earthquakes and fires / / Lessons and consequences of heavy earthquakes. - Sevastopol, 2007. - P. 52-54.

8.6 REPUBLIC OF MOLDOVA

List of Bibliographical References

1. ALCAZ V. Potential Impact of Earthquakes on Built and Physical Environment: Republic of Moldova Case Study. Proceedings of the International Disaster Reduction Conference, Davos, Switzerland, August, 2008, p. 29-31.
2. Alcaz V., (1999). Influence of Local Soil Conditions on Earthquake Motion in the Territory of Moldova Republic. In: Vrancea Earthquakers: Tectonics, Hazard and Risk Mitigation. Ed.: F.Wenzel, D.Lungu, Kluwer Academic Publishers, Dordrecht/ Boston/ London, p.187-195.
3. Alcaz V., A.Zaicenco, (1999). Spatial Correlation Between Level of Water Table and Damage of Buildings After 1986 Vrancea Earthquake in Kishinev Using GIS. Proceedings of DACH-tagging Conference, Berlin, pp.145-150.
4. Alcaz V., A.Zaicenco, (2002) Project of Seismic Risk Estimation and Disaster Mitigation of Kishinev City. "Geology", v.23, Kiev, pp.17-19.
5. ALCAZ V., ZAICENCO A., ISICIKO E. Instrumental and Macroseismic Database for Regional Seismic Hazard and Risk Studies. Proceedings of the 31 st General Assembly of European Seismological Commission, Hersonissos, Crete, Greece, September 2008, p. 17-20.
6. Alcaz V.. Основы прогноза сейсмической опасности и сейсмического риска территории RM. Chisinau,"Elena", 2007.
7. Alcaz V.. Studiul influentei conditiilor locale de teren prin modelari numerice. Tezele Conferintei Fizicienilor din Moldova, Chisinau, 2007.
8. Alcaz V.G.,Drumea A.V., Numerical and experimental site effects study: Republic of Moldova. (Abstract for conference). Proceedings of International conference in Yalta (Ukraine), september, 2007.
9. ALKAZ V., A. ZAICENCO, E. ISICIKO. Microzonation of Chisinau: a Tool for Reducing Seismic Risk. Harmonization of Seismic Hazard in Vrancea Zone. NATO Science for Peace and Security Series, C: Environmental Security, Springer, 2008, p.117-132.
10. Alkaz V., A. Zaicenco, E. Isicko and I. Sandu. Loss Estimation from Scenario Earthquakes in the Republic of Moldova. Proceedings of the International Symposium on Seismic Risk Reduction, , Editura "Orizonturi Universitare", Timisoara, Romania, 2007.
11. APTIKAEV F., BORCEA I.S., ERTELEVA O., SANDI H., ALCAZ V. Development of instrumental criteria for intensity estimate. Revue. Roumaine de Geophysique. 2008-2009, 52-53, pp.3-10. ISSN 1220-5303
12. Алказ В.Г., Капустян Н.К., Марченков А.Ю. К оценке проектируемого сейсмического воздействия на высотные здания в Москве. Buletinul Institutului de Geofizica si Geologie al Academiei de Stiinte a Moldovei, N1, 2007.
13. BURTIEV R. Статистическая связь между сейсмическими зонами Балкан. Buletinul Institutului de Geologie si Seismologie al Academiei de Stiinte a Moldovei, Chisinau, nr. 1, 2008, p. 31-34.

14. Drumea A. "Moldova" - Encyclopedia of European Regional Geology. U.K. London, 1997.
15. DRUMEA A., Alcaz V. E posibil oare astazi predictia unui cutremur de pamant puternic? Chishinau, Academos, N 1-2 (9), 2008, 3 p.
16. Drumea A., V.Alcaz, A.Zaicenco, (2001). Behavior During Strong Vrancea Earthquakes of Vulnerable Buildings in Republic of Moldova. In: Lungu, T Saito (editors). Earthquake Hazard and Countermeasures for Existing Fragile Buildings. Bucharest, Romania, 2001, pp.267-270.
17. Drumea A.V., Ginsar V.N., Poiata I.A., Stepanenco N.Ya., Shebalin N.V., Shumila V.I., "International Geological-Geophysical Atlas of the Atlantic Ocean". Part "Seismicity". Published in accordance with a decision of the Intergovernmental Oceanographic Commission of UNESCO. Moscow, 1989-1990, pp. 95, 101-107, 152-153 (in English and Russian).
18. G. KOLEVA, I. SANDU, S. AKKAR. An Estimation of the Maximum Interstory Drift Ratio for Shear-wal Type Structure. NATO Science for Peace and Security Series, C: Environmental Security, Springer, 2008, p.225-240.
19. GINSARI V. Estimation of the Recurrence and Probability of Vrancea Intermediate Depth Earthquakes. Harmonization of Seismic Hazard in Vrancea Zone. NATO Science for Peace and Security Series - C: Enviromental Security, Springer, 2008, 85-99.
20. SANDU, A. ZAICENCO. Focal Mechanism Solutions for Vrancea Seismic Area. Harmonization of Seismic Hazard in Vrancea Zone. NATO Science for Peace and Security Series, C: Environmental Security, Springer, 2008, p.17-46.
21. I.Sandu. A.Zaicenco. Focal Mechanism Solution for SE Carpatian Region. Proceedings of the International Simposium "Thirty Years from the Romania Earthquake of March 4, 1977", Bucharest, Romania, 2007.
22. ILIES I ., Ionescu C. Monitorizarea seismica a teritoriului Republicii Moldova: starea actuala si de perspectiva, Buletinul Institutului de Geologie si Seismologie al Academiei de Stiinte a Moldovei, 2008, Nr. 1, p.24 - 30.
23. Ilies I., Borodatii I. The Moldavian Seismic Network: Current State in 2007, (poster). ORFEUS-NERIES Observatory coordination workshop, Sinaia, Romania, May 7-11, 2007.
24. OLONTIR N., ILIES I., Capitolul II, Hazardurile geologice si geomorfologice, p.20-61, Vol.3: HAZARDURILE NATURALE din colectia in 4 vol.MEDIUL GEOGRAFIC AL REPUBLICII MOLDOVA, Intreprinderea Editorial-Poligrafica Stiinta, 2008.
25. PANZA, G.F., KOUTEVA, M., VACCARI, F., PERESAN A., CIOFLAN, C.O., ROMANELLI, F., PASKALEVA, I., RADULIAN, M., GRIBOVSZK,I K., HERAK, M., ZAICHENCO, A., MARMUREANU, G., VARGA, P. , ZIVCIC, M. Recent Achievements of the Neo-Deterministic Seismic Hazard Assessment in the CEI Region, Proc. of the 2008 seismic Engineering Conference, Reggio Calabria, Italy 8-11.07.2008, Editors: A. Santini and N, Moraci, American Institute of Physics, Melville, New York, AIP Conf. Proc., Vol. 1020, p. 402-413.

26. R. MOHNIUC, A. ZAICENCO, C. KUENDING, T. KURMANN. MEMS-based Data Logger for Seismic Arrays and Structural Health Monitoring. NATO Science for Peace and Security Series, C: Environmental Security, Springer, 2008, p.309-318.
27. R.Burtiev, VI. Cherniy. Seismic Hazard Assessment for the Territory Influenced by Earthquakes from Romania and Bulgaria. Proceedings of the International Simposium "Thirty Years from the Romania Earthquake of March 4, 1977", Bucharest, Romania, 2007.
28. Sandi H., F. Apticaev, V. Alcaz, I. Borcia, A. Drumea, O. Erteleva, A. Roman A NATO Project on deriving Improved (Instrumental) Criteria for Seismic Intensity Asssessment Proceedings of the First European Conference on Earthquake Engineering and Seismology, Geneva, Switzerland
29. SANDI, H., APTICAEV, F., BORCIA, I., ERTELEVA, O., **ALCAZ, V.**Quantification of Seismic Actions on Structures. *AGIR Publishing House*, Bucharest, 2010, 211p. ISBN 978-973-720-319-9
30. Sandu I. Composite fault plane solution for Republic of Moldova Proceedings of the First European Conference on Earthquake Engineering and Seismology, Geneva, Switzerland
31. SANDU I. Cronologia evoluĠiei conceptuale asupra seismelor. Buletinul Institutului de Geologie si Seismologie ASM, N 1. 2012, pp.47-62. ISSN 1857-0046.
32. Sandu I. Relocation of Hypocenters and Composite Fault Plane Solutions for Earthquakes in Republic of Moldova Individual Studies by Participants at the International Institute of Seismology and Earthquake Engineering, 2006, vol. 41, ISSN 0074-6606, Tsucuba, Japan
33. Sandu I., Hurukawa N. Relocation of hypocenters and focal mechanism for earthquakes in Republic of Moldova Buletinul Institutului de Geofizica si Geologie al Academiei de Stiinte a Moldovei, 2006, N1
34. SANDU I., LA MURA C., PANZA G.F., ALCAZ V. Parametric test for the impact of May 30, 1990 Vrancea earthquake on Cahul area. Buletinul Institutului de Geologie si Seismologie ASM, N 1. 2012, pp. 33-46. ISSN 1857-0046.
35. Sandu, A. Zaicenco, The Focal Mechanism Solutions Catalogue for SE-Carpathian Region. Proceedings of the International Simposium "Thirty Years from the Romania Earthquake of March 4, 1977", Bucharest, Romania, 2007.
36. SANDU, I., ZAICENCO, A.. Azimutul, distanţa epicentrală şi eroarea acestor parametri în contextul mecanismului focal. *Buletinul Institutului de Geologie şi Seismologie al AŞM,* Nr. 1., Chişinău, 2010, p. 89-93. ISSN 1857-0046.
37. TELESCA L., ALCAZ V., SANDU I. Analysis the 1978–2008 crustal and sub-crustal earthquake catalog of Vrancea region. Journal Natural Hazards and Earth System Scieces, 2012, pp.1321-1325. ISSN: 1561-8633, (IF: 1,983)
38. TELESCA Luciano, ALCAZ Vasile, BURTIEV Raşid, SANDU Ilie. The stress field of Vrancea region from fault plane solution (FPS). Natural Hazards and Earth System Scieces, 2011, pp.2817-2820. ISSN: 1561-8633, (IF: 1,792)

39. TELESCA Luciano, ALCAZ Vasile, BURTIEV Raşid, SANDU Ilie. Time-clustering analysis of the 1978-2008 sub-crustal seismicity of Vrancea region. Journal Natural Hazards and Earth System Scieces, 2011, pp.2335-2340. ISSN: 1561-8633, (IF: 1,792)
40. V.Alkaz, A.Zaicenco, E.Isicko. Earthquake loss modelling for seismic risk Management. Conferinta Internationala NATO "Risk Assessment as a Basis for Elaboration of Recommendations for Forecast and Prevention of Catastrophes", Chisinau, 2007.
41. V.Alkaz, A.Zaicenco, E.Isicko. Site Effect Evaluation in Kishinev City, Republic of Moldova. Proceedings of the International Simposium "Thirty Years from the Romania Earthquake of March 4, 1977", Bucharest, Romania, 2007.
42. V.Alkaz, A.Zaicenco, E.Isicko. Site Response Assessment via a Multidisciplinary Approach: Kishinev City, Repubilc of Moldova. Proceedings of the International Symposium on Strong Vrancea Earthquakes and Risk Mitigation, Bucharest, Romania, 2007.
43. V.Alkaz, E.Isicko, A.Zaicenco. Numerical and Experimental Site Effects Study: Kishinev city, Republic of Moldova. Proceedings of the 3rd International Conference on Science and Technologz for Safe Develop-ment of Lifeline SistemsNatural Risks. Bucha-rest, Romania, 2007.
44. Vasile Alcaz, Ioan Sorin Borcia, Anatol Drumea, Horea Sandi, Dorel Zugravescu. Cooperarea stiintifica Romania-Republica Moldova in domeniul ttiintelor tehnice, pe teme de protectie antiseismica. Materialele conferintei "10 ani de la constituirea Academiei de Stiinte Tehnice din Romania". Bucuresti. 2007.
45. Zaicenco A. & V.Alcaz, (2001). Seismic Test On a 16-Storez Cast in Place R/C Building, and Stochastic Simulation Results. The Structural Design of Tall Buildings, 10, pp.69-77.
46. Zaicenco A. & V.Alkaz A wavelet-based analytical model accounting for near-field effects of Vrancea earthquakes Proceedings of the First European Conference on Earthquake Engineering and Seismology, Geneva, Switzerland
47. Zaicenco A. Influence of local soil condition on spectral content of seismic ground motion. Buletinul Institutului de Geofizica si Geologie al Academiei de Stiinte a Moldovei, N1, 2007.
48. ZAICENCO A., N.P. GAVIN, B.W. DISKINSON. A Parametric Model for the August 30, 1986 Vrancea Earthquake. Harmonization of Seismic Hazard in Vrancea Zone. NATO Science for Peace and Security Series, C: Environmental Security, Springer, 2008, p.63-84.
49. Zaicenco A., Performance and Reliability of Semi-active Equipment isolation. Journal of Sound and Vibration, v. 306, 2007, Elsevier, USA
50. Zaicenco A., Performance and Reliability of Semi-active Equipment isolation. Journal of Sound and Vibration, v. 306, 2007, Elsevier, USA.
51. Zaicenco A., V. Alkaz I. Sandu. 2D FEM simulation of earthquake ground motion in sedimentary basin. Proceedings of the International Symposium on

Seismic Risk Reduction, Editura "Orizonturi Universitare", Timisoara, Romania, 2007.

52. Zaicenco A., V. ALKAZ. Numerical Solution of an Elastic Wave Equation Using the Spectral Methods. Harmonization of Seismic Hazard in Vrancea Zone. NATO Science for Peace and Security Series, C: Environmental Security, Springer, 2008, p.319-327.
53. Zaicenco A., V.ALCAZ. Analysis of SSI from Instrumented Building Response. The Structural Design of Tall and Special Buildings. V. 17, Issue 2, p. 387-399.
54. Zaicenco A., V.Alcaz. Soil-Structure Interaction Effects on an Instrumented Building. Bulletin of Earthquake Engineering. V.5, No 4, Springer, 2007.
55. Алексеев И.В., Симонова Н.А. Об определениях магнитуд землетрясений Карпатской зоны по наблюдениям на сейсмических станциях Молдовы. Bulletinul Institutului de geologie si seismologie al ASM, N1. Chisinau, 2007.
56. АЛКАЗ В. Г. Актуальные проблемы оценки сейсмической опасности территории Республики Молдова. Сейсмичность Северной Евразии, ГС РАН, Обнинск, 2008, с. 15-18.
57. АЛКАЗ В. Г., ИЛИЕШ И.И. Мониторинг вариации динамических параметров зданий и сооружений г. Кишинева. Будівельні конструкції. Випуск 69, Київ, НДІБК, 2008. стр. 646-652.
58. АЛКАЗ, В., ИСИЧКО, Е., ГИНСАРЬ, В. Методические аспекты и результаты оценки сейсмического риска на территории г. Кишинева.*Buletinul Institutului de Geologie şi Seismologie al AŞM.* Nr. 1., Chişinău, 2010, p. 16-24. ISSN 1857-0046.
59. БУРТИЕВ Р. З. О статистической связи сейсмической активности Балканских сейсмических зон. *Buletinul Institutului de Geologie şi Seismologie al AŞM,* Nr. 1., Chişinău, 2010, p. 5-15.ISSN 1857-0046.
60. Буртиев Р.З. О применении статистики экстремальных значений к оценке M max. Buletinul Institutului de Geofizica si Geologie al ASM, N2, 2007.
61. Гинсарь В.Н. Анализ информативности возможных сейсмологических предвестников землетрясений для зоны Вранча. (Тезисы). Conferinta Fizicienilor din Moldova (CFM-2007).
62. Гинсарь В.Н. Анализ информативности ряда среднесрочных предвестников сильных землетрясений зоны Вранча. Buletinul Institutului de Geologie si Seismologie al Academiei de Stiinte a Moldovei, 2007, N2.
63. Гинсарь В.Н. Анализ пред- и постсейсмических стадий сейсмического процесса при сильных землетрясениях зоны Вранча. Buletinul Institutului de Geofizica si Geologie al Academiei de Stiinte a Moldovei, 2006, N2 (in presa)
64. Гинсарь В.Н. Пространственно-временные вариации суммарного сейсмического момента в зоне Вранча. Buletinul Institutului de Geofizica si Geologie al Academiei de Stiinte a Moldovei, 2006, N2 (in presa)
65. ГИНСАРЬ В.Н. Статистическая оценка максимальной возможной магнитуды подкоровых землетрясений зоны Вранча. Buletinul Institutului de Geologie si Seismologie al Academiei de Stiinte a Moldovei, 2008, N2.

66. ДРУМЯ А.В. , СТЕПАНЕНКО Н.Я., ИЛИЕШ И.И., АЛЕКСЕЕВ И.В., СИМОНОВА Н.А. Сейсмический режим области Вранча за период 1991-2001гг. Сейсмичность Северной Евразии, ГС РАН, Обнинск, 2008, с. 73-77.
67. Друмя А.В., Степаненко Н.Я. К вопросу о сейсмичности дельты реки Дунай Buletinul Institutului de Geofizica si Geologie al Academiei de Stiinte a Moldovei, 2006, N1
68. Измайлова Д., Богдевич О. Оценка неопределенности при анализе природных объектов методом атомной абсорбции Buletin Institutului de Geologie si Seismologie, Nr 1, 2006, pp. 127-135
69. ИЛИЕШ И.И. Сейсмическая сеть Республики Молдова: состояние и перспективы. Сейсмичность Северной Евразии. Материалы Международной конференции Обнинск,: ГС РАН, 2008, стр.87-92.
70. ИЛИЕШ, И.И., СТЕПАНЕНКО, Н.Я., СИМОНОВА, Н.А., АЛЕКСЕЕВ,И. Сейсмичность Карпат по наблюдениям на сейсмических станциях на территории Молдовы. *Buletinul Institutului de Geologie şi Seismologie al AŞM,* Nr. 1., Chişinău, 2010, p. 32-40. ISSN 1857-0046.
71. Исичко Е.С. Методика расчета акселерограмм для конкретной строительной площадки. Buletinul Institutului de Geofizica si Geologie al Academiei de Stiinte a Moldovei, N1, 2007.
72. Исичко Е.С., Богдевич О.П., Гинсарь В.Н. Моделирование геометрических и упругих свойств среды на стадии сейсмического микрорайонирования г. Кишинева Buletinul Institutului de Geofizica si Geologie al Academiei de Stiinte a Moldovei, 2006, N1
73. Павлов П.П. Расчетный анализ влияния рельефа территории г. Кишинева на интенсивность сейсмических колебаний. Buletinul Institutului de Geofizica si Geologie al Academiei de Stiinte a Moldovei, 2006, N1
74. Роман А.А., Алексеев И.В., Cherniy V.I. Информационное содержание макросейсмического поля и его количественная характеристика Buletinul Institutului de Geofizica si Geologie al Academiei de Stiinte a Moldovei, 2006, N1
75. Скляр А.М., Степаненко Н.Я., Симонова Н.А. и др. Макросейсмический эффект Карпатского землетрясения 27 октября 2004 г. на территории Украины и Республики Молдова Сейсмологический бюллетень Украины за 2004 год. Севастополь, НАНУ, 2006
76. СКЛЯР, А.М., КНЯЗЕВА, В.С., СТЕПАНЕНКО, Н.Я., СИМОНОВА, Н.А., АЛЕКСЕЕВ, И.В., СТАСЮК, А.Ф., ЧУБА, М.В. Ощутимое на Украине и в Молдове землетрясение 27 октября 2004 года с K_p=15.4, Mw=5.8, I_0=6 (Карпатский регион). *Землетрясения Северной Евразии 2004.* Обнинск: ГС РАН. 2010, с. 51-57. ISSN1818-6254.
77. СКЛЯР, А.М., КНЯЗЕВА, В.С., СТЕПАНЕНКО, Н.Я., СИМОНОВА, Н.А., АЛЕКСЕЕВ, И.В., СТАСЮК. А.Ф., ЧУБА. М.В. Распределение макросейсмического эффекта от карпатского землетрясения 27 октября 2004 года на территории Украины и Молдовы. *Землетрясения Северной Евразии 2004.* Обнинск: ГС РАН. 2010, с. 52-63. ISSN 1818-6254.

78. Степаненко Н.Я., Друмя А.В., Симонова Н.А. Сильнейшие землетрясения Карпатского региона в XVIII-XX веке Buletinul Institutului de Geofizica si Geologie al Academiei de Stiinte a Moldovei, 2006, N1
79. СТЕПАНЕНКО Н.Я., ПРОНИШИН Р.С., МИХАЙЛОВА Р.С. К вопросу об уточнении параметров землетрясений Карпат в каталоге 2002. Землетрясения Северной Евразии в 2002 году. Обнинск, ГС РАН, 2008, Раздел VIII, СД, 3 стр.
80. Степаненко Н.Я., Симонова Н.А., Алексеев И.В. Макросейсмические данные землетрясений Карпатского региона в 2004 году. Сейсмологический бюллетень Украины за 2004 год. Севастополь, НАНУ, 2006
81. Степаненко Н.Я.,Симонова Н.А., Алексеев И.В. Макросейсмика и механизм землетрясений Карпат в 2005 году. Сейсмологический бюллетень Украины за 2005 год. Севастополь, НАНУ, 2007.
82. СТЕПАНЕНКО, Н.Я., СИМОНОВА, Н.А., АЛЕКСЕЕВ, И.В. Дунайское землетрясение 3 октября 2004 года с $К_р$ =13.0, Mw=4.8, I_0=5-6 (Карпатский регион). *Землетрясения Северной Евразии 2004*. Обнинск: ГС РАН. 2010, с. 370-374. ISSN 1818-6254.
83. СТЕПАНЕНКО, Н.Я., СИМОНОВА, Н.А., АЛЕКСЕЕВ, И.В. Ощутимое в Молдове землетрясение 27 сентября 2004 года с $К_р$=13.4, Mw=4.8, I_0=4-5 (Карпатский регион). *Землетрясения Северной Евразии 2004*. Обнинск: ГС РАН. 2010, с. 43-50. ISSN1818-6254.
84. Чуба М.В., Степаненко Н.Я., Симонова Н.А. и др. Каталог и подробные данные о землетрясениях Карпатского региона за 2004 год. Сейсмологический бюллетень Украины за 2004 год. Севастополь, НАНУ, 2006
85. Чуба М.В., Степаненко Н.Я., Симонова Н.А. и др. Каталог и подробные данные о землетрясениях Карпатского региона за 2005 год. Сейсмологический бюллетень Украины за 2005 год. Севастополь, НАНУ, 2007.

9 SYNTHESIS AND CONCLUSIONS

Efforts were spent to compile past events, existing legislation framework, and available bibliography in all of the participating countries to establish a base for a scientific network regarding earthquake, landslide and flood hazard prevention.

The purpose this Deliverable is to provide the necessary background for scientific exchange and transfer of technical knowledge regarding the hazard assessment concerning landslides, floods and seismicity taking into account the experience and expertise of each partner.

The review of the available bibliography (existing projects, relative publications, registered events) was conducted regarding landslide, flood and seismic hazard at regional and local scales, in order to achieve a common base of data and state of art and/or practice.

The existing models and methodologies assessing seismic, landslide and flood hazards were evaluated with respect to scientific soundness, data demands and credibility of produced results.

10 FUTURE STUDIES

Along the lines proposed by the project, methodologies regarding the estimation of probabilities based on hazard assessment with respect to landslides, floods and seismicity need to be evaluated in more detail and case studies need to be performed in the selected pilot areas.