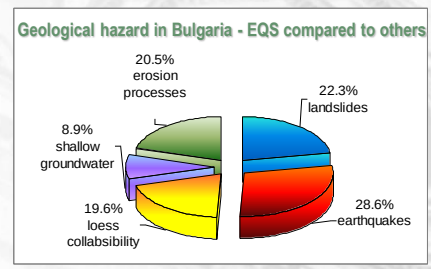
Review and Systematization of the Available Data for Earthquake Risk Mitigation in Bulgaria Using GIS

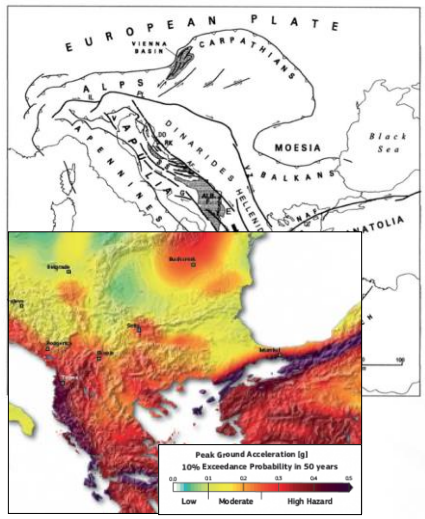
Lyubka PASHOVA, Mihaela KOUTEVA-GUENTCHEVA, Temenoujka BANDROVA
BULGARIA

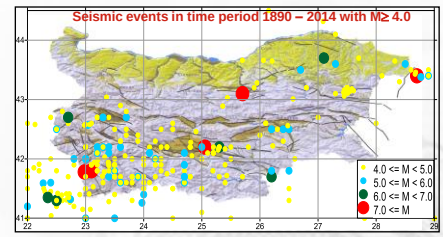
Presentation outlines

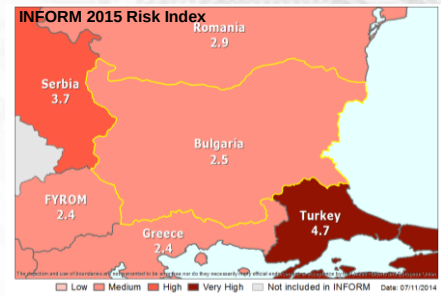
- ❑ INTRODUCTION
- ❑ THE EARTHQUAKE RISK CONCEPT
- ❑ CONCEPTUAL MODEL OF THE INFORMATION DATASET /IDS/
  - National Spatial Data Infrastructure
  - Bulgarian data sets and maps
  - Thematic modules for data organization in free and open GIS
- ❑ CONCLUSIONS



Regional Seismic Hazard and Risk







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Pashova, Kouteva, Bandrova

Bulgarian Disaster Risk Reduction Strategy (2014-2020)


РЕПУБЛИКА БЪЛГАРИЯ
МИНИСТЕРСКИ СЪВЕТ

СТРАТЕГИЯ

ЗА НАМАЛЯВАНЕ НА РИСКА ОТ БЕДСТВИЯ

2014 - 2020 г.

http://www.preventionweb.net/files/38902_drrstrategybulgariaen.pdf

Priority I: Development of a sustainable national policy and ensuring a stable legal and institutional framework for disaster risk reduction.

Priority II: Identification, analysis and disaster risk assessment at national, regional and local level. Expanding and maintenance of effective national systems for forecast, monitoring early warning and awareness in case of disasters.

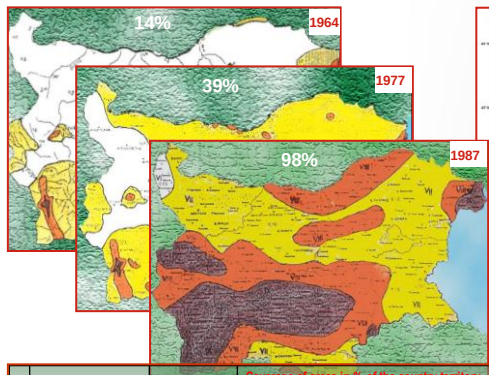
Priority III: Building a culture of disaster protection at all management levels and among the society using the knowledge, education, scientific researches and innovations.

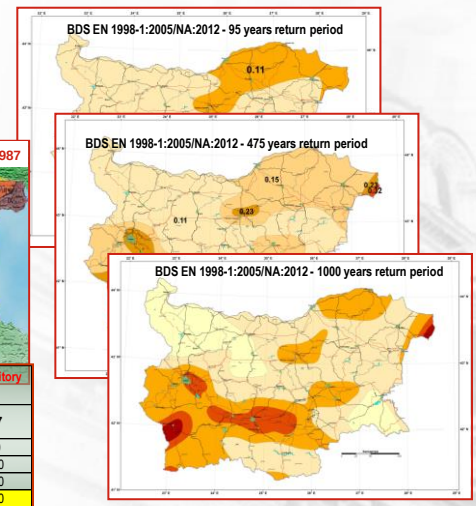
Priority IV: Reducing the underlying risk factors and strengthening the preparedness for effective response in case of disasters at all management levels.

7807_EqRisk_GIS_IDS

Pashova, Kouteva, Bandrova

Seismic Zoning of Bulgarian Territory → Retrospective View





N	Seismic regions	Character of damages	Coverage of areas in % of the country territory according to seismic hazard maps		
	degrees of impact MSK		1964	1977	1987
1	VI	minor damage	85.50	60.45	0.70
2	VII	heavy damage	14.00	38.83	48.30
3	VIII		0.12	0.54	31.00
4	IX		0.08	0.18	20.00

"From the wisdom of the ages to the challenges of modern world"
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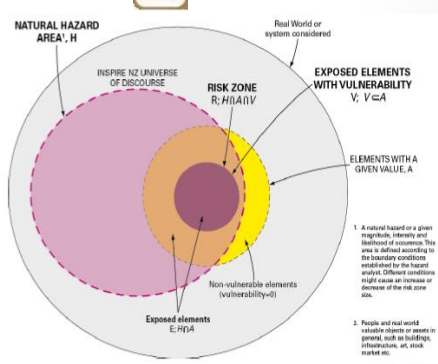
GIS and Earthquake Risk Management

SPATIAL DATA COMPATIBILITY

INSPIRE Directive 2007/2 of the the EC Annex III

Theme 12 – Natural risk zones



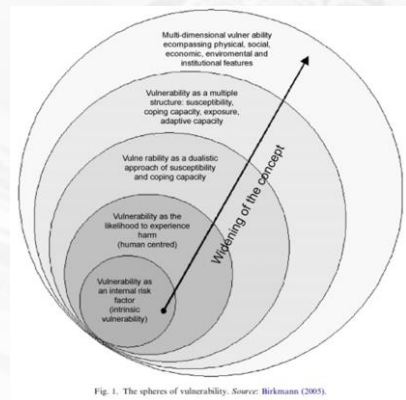


Fig. 1. The spheres of vulnerability. *Source*: Birkmann (2005).

Bulgarian NSDI

Bulgarian national report (2013) and Indicators (2014)

1. **Related to Spatial data sets, Metadata and Metadata catalogues**
   - There are still mixed data, from analog up to vector data and GIS datasets
   - With the different permission levels for access
   - In many formats and in many database types
   - Without standardized way for developing of GIS systems within the state
   - Developing without harmonizing and compatibility with existing databases

2. **Related to Spatial data services and Network services (Web):**
   - No accessibility through the web pages of institutions
   - No established controlling mechanism to monitor the quality of network services
   - Regulations and measures for the sharing of spatial data are missing
   - There are no services implemented with spatial data requirements of the INSPIRE Directive
   - No specific measures were taken at national level to promote the exchange of spatial data sets and services between public organizations, etc.

Source: *EAECNIS* http://www.esmis.government.bg/en/page.php?c=45
INSPIRE Geo-portal http://inspire.ec.europa.eu/index.cfm/pageid/182/list/maptwo

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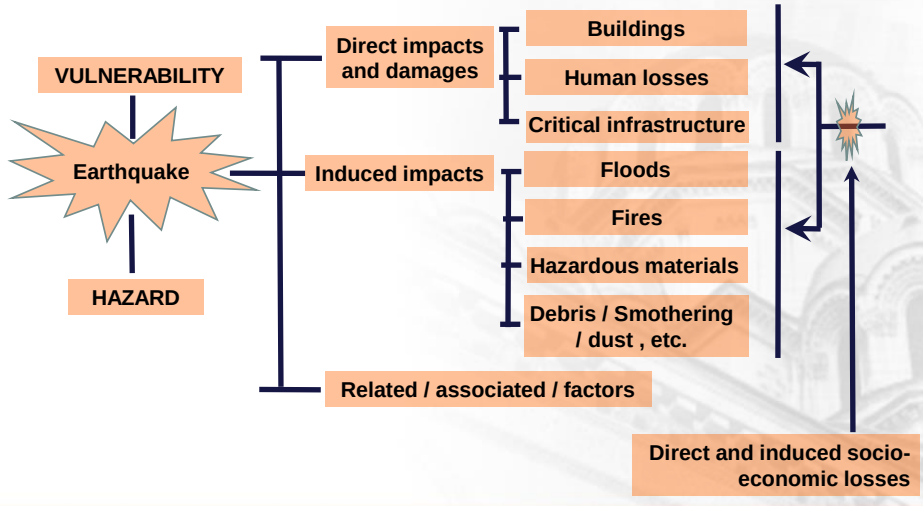
Relevant Earthquake Risk Sources and Risk Elements Schematic Diagram

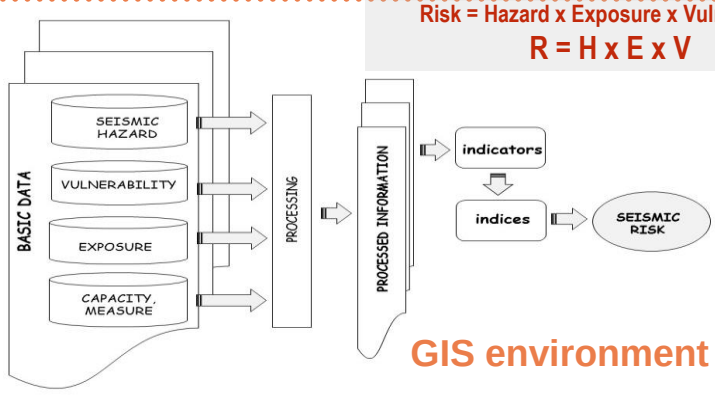


The Earthquake Risk Concept

Seismic hazard ⟺ Seismic risk

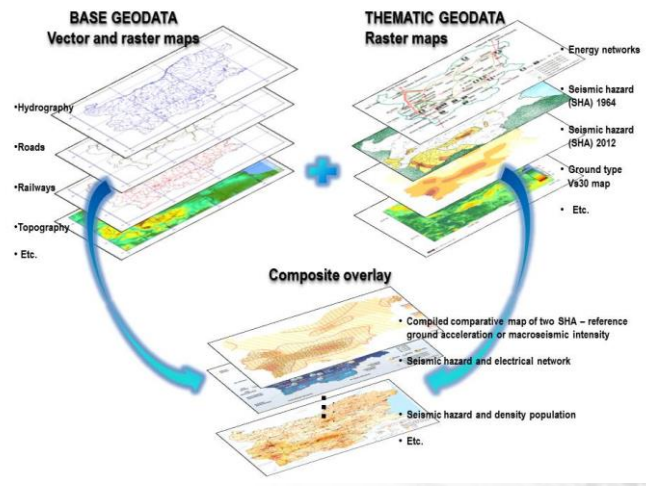
Risk = Hazard x Exposure x Vulnerability

R = H x E x V



Generalized conceptual scheme for seismic risk assessment using holistic approach (Birkmann, 2006)

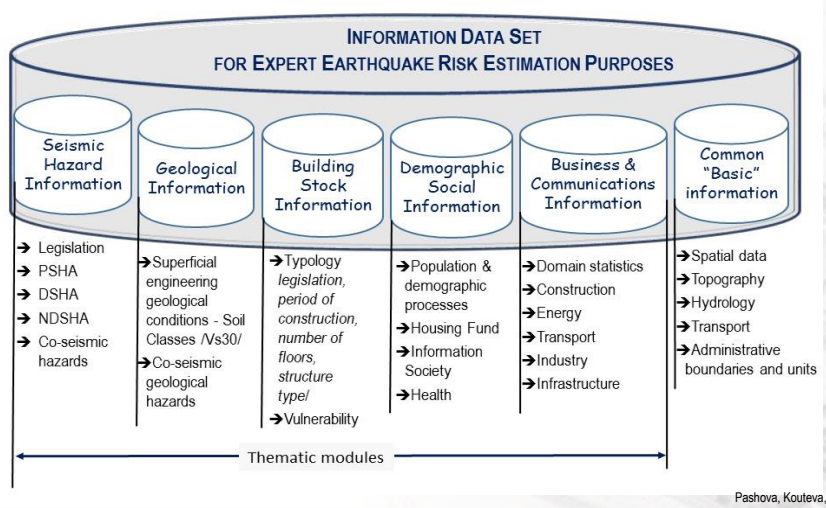
Comparative Analyses - Conceptual Scheme



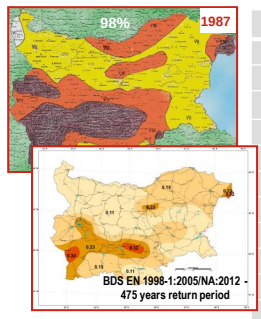
Preliminary Analysis of Available Information

- More then 15 maps and several atlases at various scales;
- Reproducing of similar thematic maps on different scale - not respecting the rules of cartographic generalization;
- Lack of professional qualitative and quantitative evaluation;
- Various map producers;
- Different way of retrieving information for the map content;
- Several discrepancies were discovered;
- Insufficient and / or unclear information, associated with different map coordinate system, scales, symbol system, accuracy, cartographic experience, etc.

IDS Conceptual Model



Module 1: Seismic Hazard and Seismic Action



	Regulatory provisions for earthquake resistance						
	Town	1964	1977	1987	2012 Eurocode 8		
			MSK / κ_c		reference ground acceleration (g)		
			1000 years*		95 years*	475 years*	1000 years*
1	Balchik	---	VII / 0,10	IX / 0,27	0,11	0,15	0,09-0,13
2	Burgas	---	---	VII / 0,10	0,07	0,11	< 0,09
3	Kavarna	---	VII / 0,10	IX / 0,27	0,11	0,23	0,09-0,13
4	Varna	---	VII / 0,10	VII / 0,10	0,07	0,11	< 0,09
5	Vidin	---	VII / 0,10	VII / 0,10	0,07	0,11	< 0,09
6	V. Tarnovo	VII / 0,10	VIII / 0,15	VIII / 0,15	0,11	0,15	< 0,09
7	Russe	---	VII / 0,10	VIII	0,11	0,15	0,09-0,13
8	Pleven	---	VII / 0,10	VII / 0,10	0,07	0,11	< 0,09
9	Plovdiv	VIII / 0,15	VIII / 0,15	IX / 0,27	0,15	0,23	0,09-0,13
10	Sofia	VII / 0,10	VIII / 0,15	IX / 0,27	0,11	0,23	0,09-0,13
11	St. Zagora	---	---	VIII / 0,15	0,07	0,15	< 0,09
12	Yambol	---	---	VIII / 0,15	0,07	0,15	< 0,09

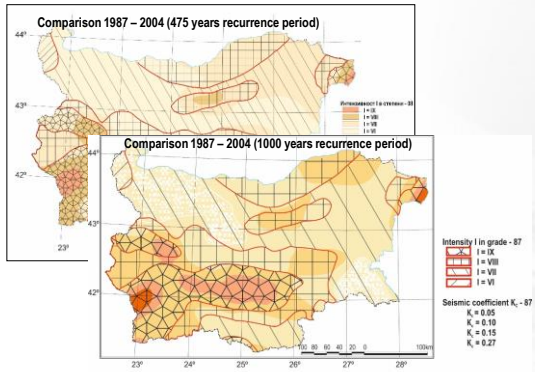
* Return period

Module 1: Seismic Hazard and Seismic Action

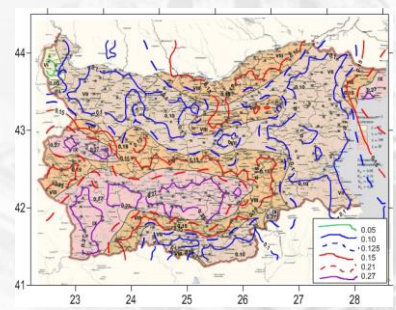
2 Regulations in force:

(a) Ordinance № RD-02-20-2 from 27.01.2012 (1987) for design and construction in seismic areas

(b) Eurocodes system - EN 1998-1:2004 and BDS EN 1998-1:2005/NA: 2012 (2010).

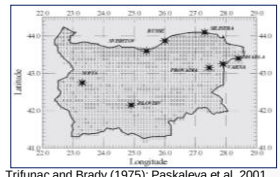


Overplayed maps of seismic hazard maps for different recurrent periods and regulations

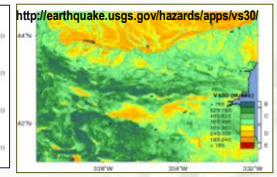


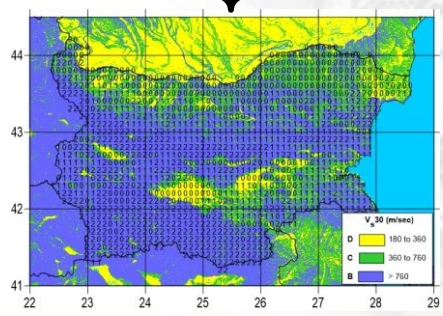
Overlayed map of seismic hazard map (1987) and interpolated isolinies from point acceleration values

Module 2 : Engineering Geology



Trifunac and Brady (1975); Paskaleva et al, 2001

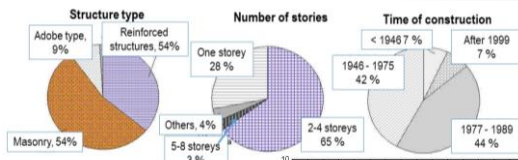




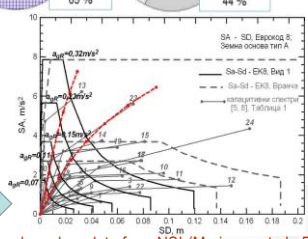
Module 3: Building Stock

Identification of Structures and Vulnerability

- Literature data for vulnerability curves and capacitive curves - no Bulgarian data
- classification according EMS98

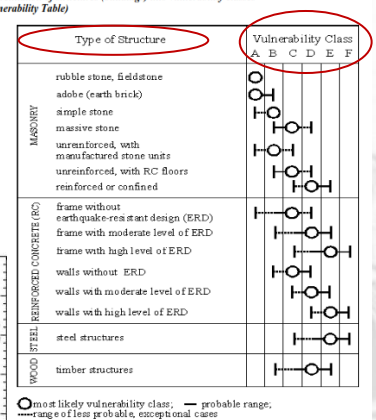


Data 2011, Ministry of Environment



Regional data – RISK-UE Project
Capacity curves of typical buildings of the Balkan Region versus the Bulgarian Seismic Action

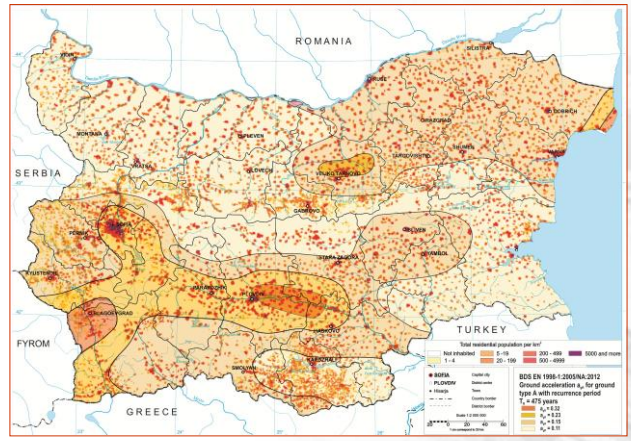
Differentiation of structures (buildings) into vulnerability classes (Vulnerability Table)



Developed thematic maps based on data from NSI (Marinova et al., FIG 2015)

http://www.fig.net/resources/proceedings/fig_proceedings/fig2015/papers/ts03a/TS03A_bandrova_marinova_et_al_7746.pdf

Module 4: Demographic and Social Statistics



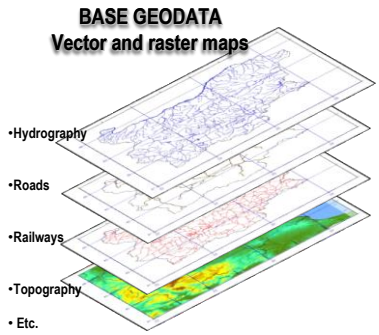
Overplayed map of seismic hazard map (Ordinance № RD-02-20-2; BDS EN 1998-1:2005/NA: 2012, TR = 475) and density population II: Population grid 2011 of Bulgaria (Ahmedov and Dudova, 2014).

Module 5: Business Statistics

- Data from the NSI, http://www.nsi.b
- free available thematic maps
- business information
- scanned and processed maps for:
  - ✓ Urbanization process;
  - ✓ Transport infrastructure- density of the international / national / regional network;
  - ✓ Mining and quarrying;
  - ✓ Electricity network;
  - ✓ Chemical industry;
  - ✓ Others.

Module 5: Common "Basic" Information

In the process of **unification of discrepancies in cartographic materials** based on vector data type for the Bulgarian territory in **scale 1:250 000** provided by the Military Topographic Service at the Ministry of Defense



- State borders;
- Lakes and dams;
- Rivers and Danube River coastline;
- District boundaries;
- Settlements - by categories with a population of over 10,000 people;
- Classified roads - highways, roads I and II class;
- Railways - electrified and non-electrified, bi- and unidirectional.
- DEM models from ASTER GDEM V2, http://www.jspacesystems.or.jp and SRTM, ver. 3.0, http://www2.jpl.nasa.gov/srtm
- other free available data

Conclusive Remarks and Future Work

- Earthquake Risk Estimation is based on vast variety of information sources – geospatial information in broad temporal and spatial coverage is coupled with seismic hazard assessments and common and particular vulnerability data;
- Reliable Earthquake Risk Estimation requires thorough collaborative multidisciplinary efforts to assess and integrate the available databases performed with relevant sharing of information;
- Harmonization and unification of all data sets in accordance with national and European legislation;
- Unification of maps format and attribute tables, organizing them in a common database of criteria for express expert risk assessment for large areas exposed to the seismic risk;
- Future integration of IDS in Web-based GIS environment.

THANK YOU FOR YOUR ATTENTION!

ACKNOWLEDGEMENTS

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