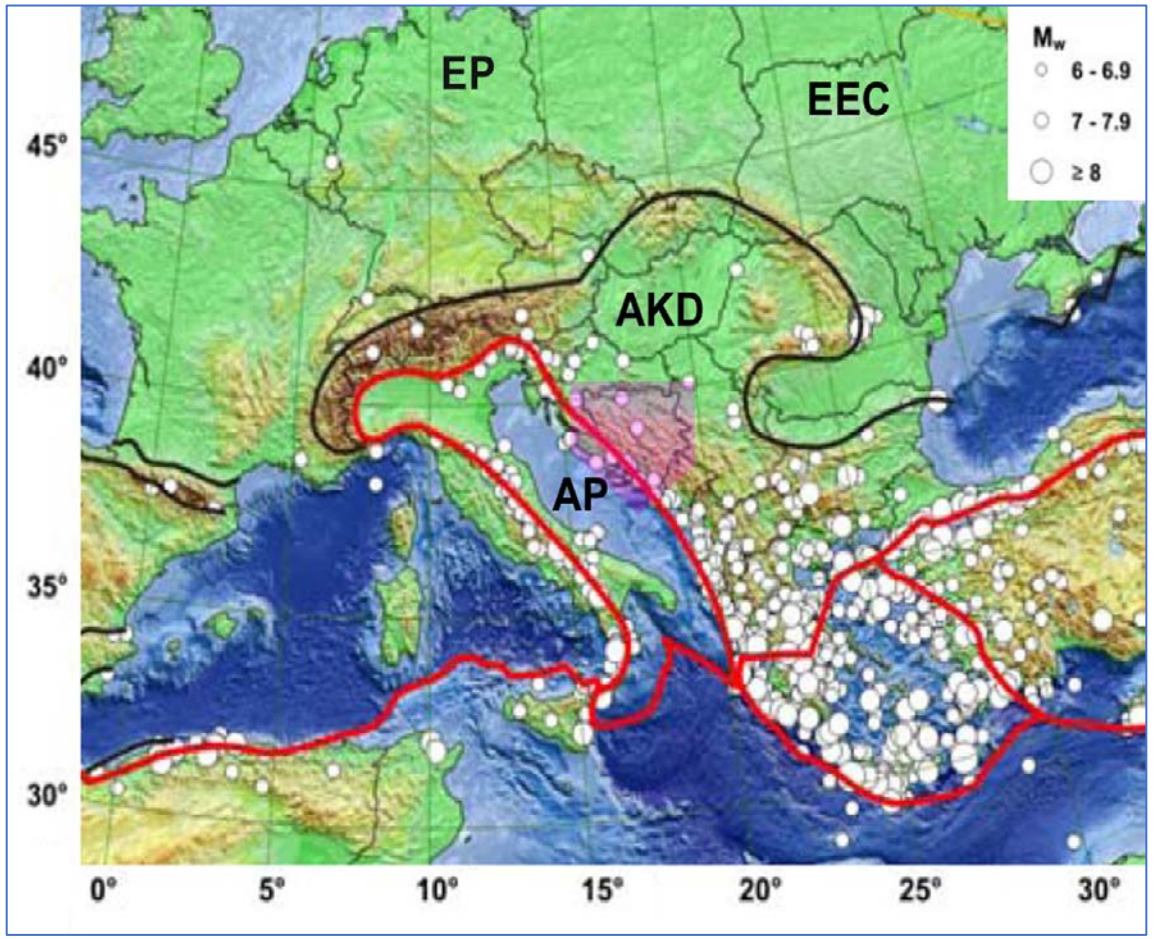
NA to BAS EN 1998-1 - Design of structures for earthquake resistance

Project Team: Ivan Prachar [1], Snjezana Cvijić [2], Vedad Demir [3], Jiří Málek [4], Jiří Vackař [4].

1) Independent consultant, Prague; 2) Republic Hydrometeorological Service of Republic of Srpska; 3) Geological Survey of Federation of Bosnia and Herzegovina; 4) Institute of Rock Structure and Mechanics, Academy of Sciences of the Czech Republic

Introduction

Territory of BaH is situated on or near the plate boundary of the Adriatic (Apulian) Microplate and the Eurasian Plate. This boundary is characterized by a high level of seismic hazard. Seismicity is a manifestation of convergence of above mentioned plates and under trusting of Adria under the Dinarides and Albanides.



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Seismic Zoning Maps - Values

In accordance with the recommendation, no-collapse requirement is expressed by values P_{NCR} = 10% and T_{NCR} = 475 years, i.e. 10% probability to be exceeded in T_L = 50 years. Damage limitation requirement is expressed by values P_{NCR} = 10% and T_{NCR} = 95 years, i.e. 10% probability to be exceeded in T_L = 10 years.

Maps show values of the reference peak ground acceleration (horizontal component) on type A ground, i.e. value of a_{gR} in g, with contour interval 0,02 g. A grid size was 10x10 km. Maps were constructed in two mutations, both for conservative MEAN value and for 50th PERCENTILE value.

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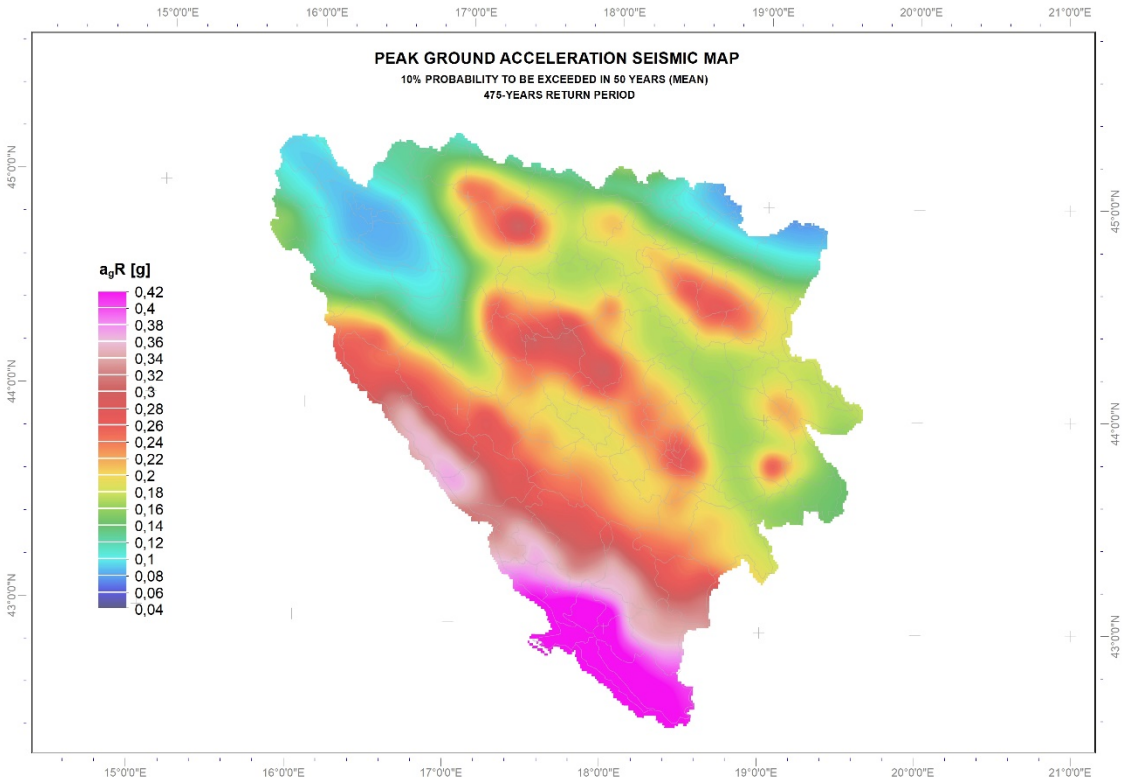
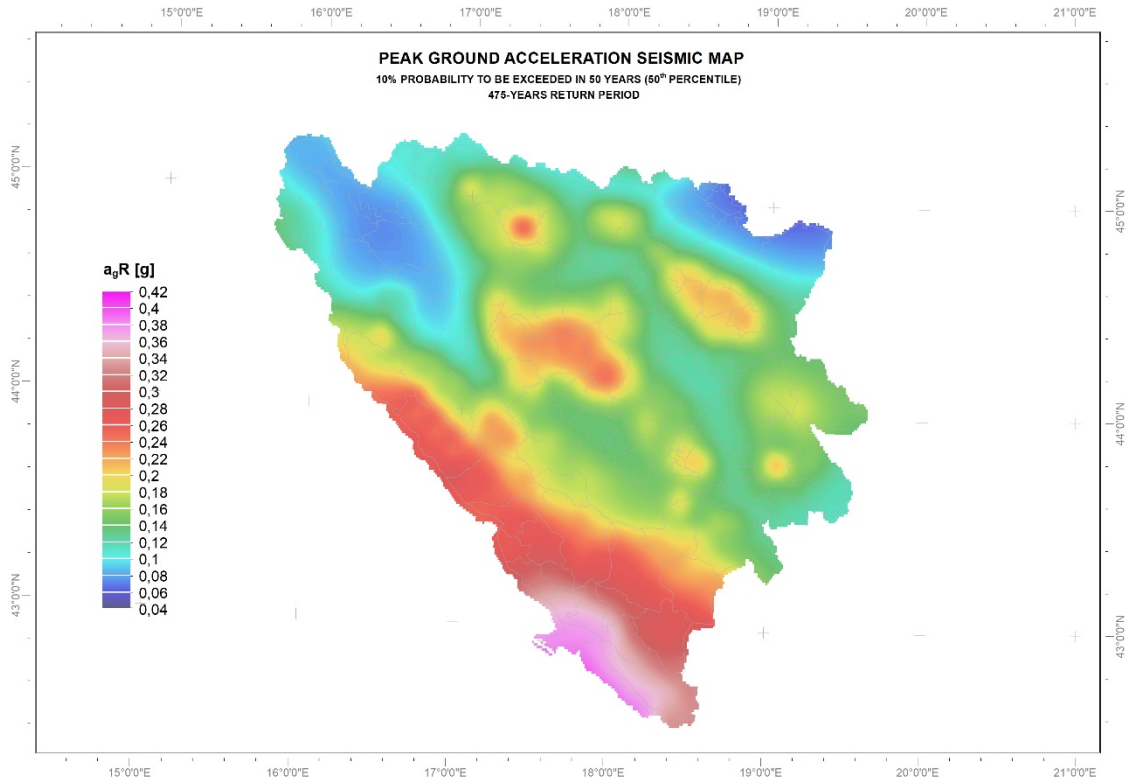
Seismic zoning maps for 10% probability to be exceeded in T_L = 50 years (RP = 475 years)

MEAN



50% Percentile



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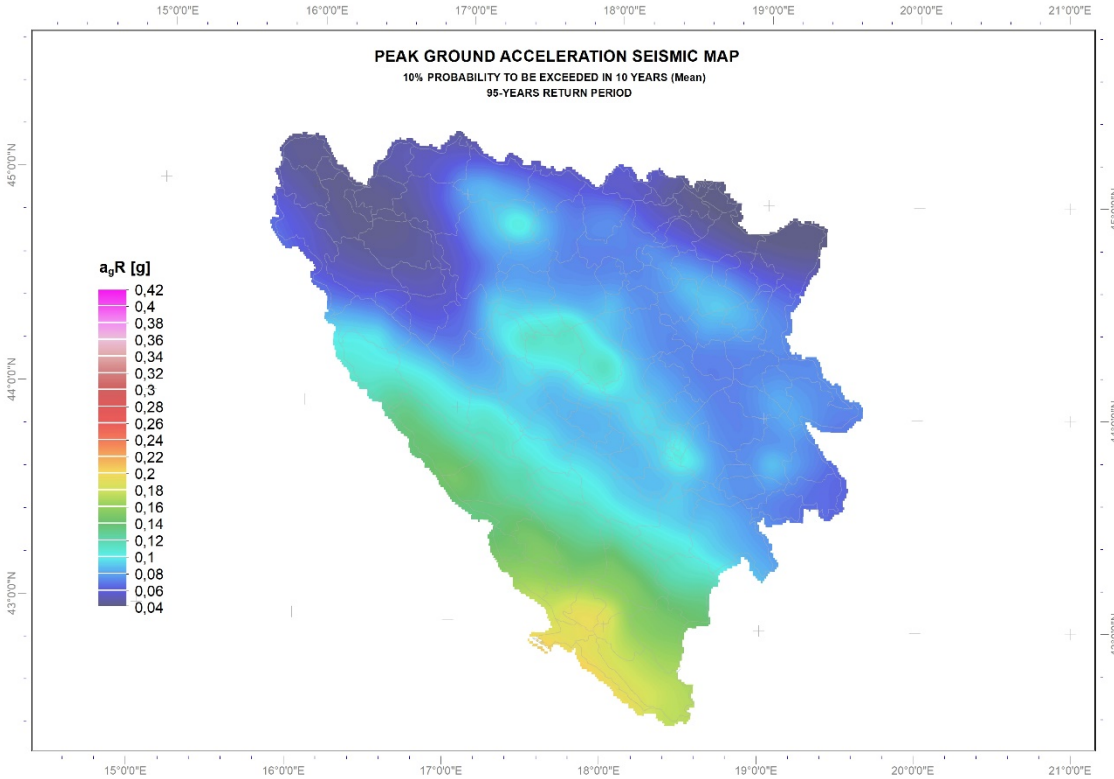
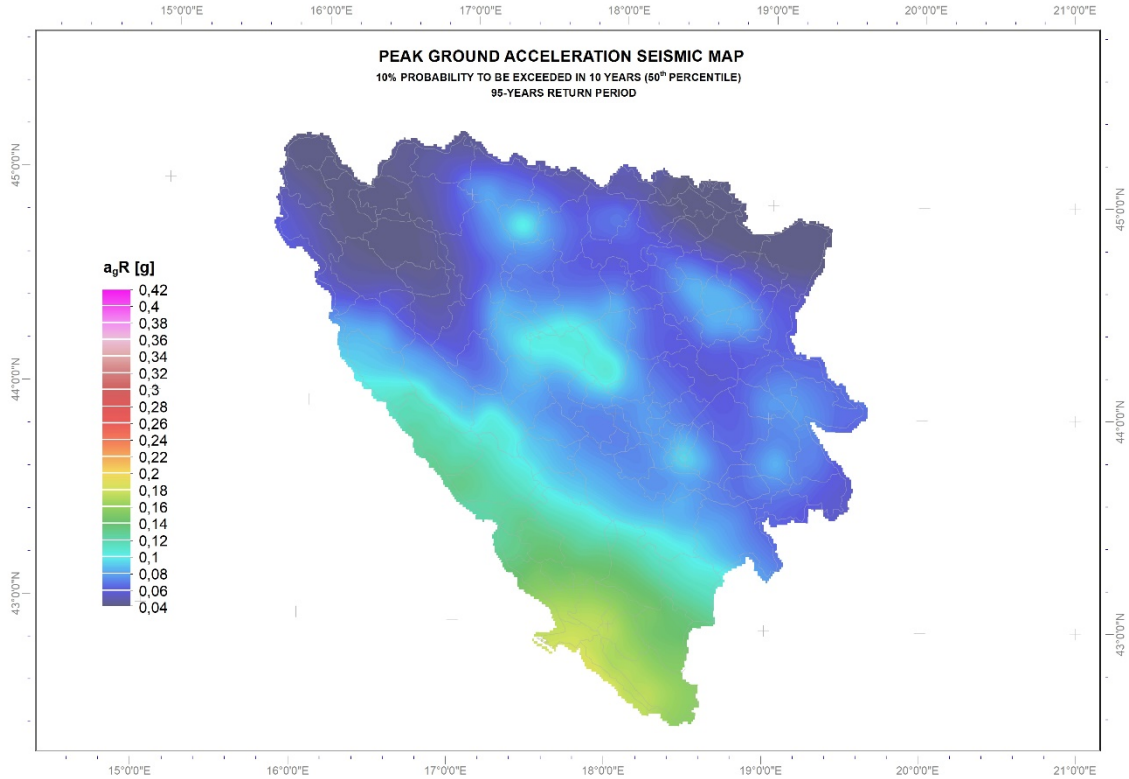
Seismic zoning maps for 10% probability to be exceeded in T_L = 10 years (RP = 95 years)

MEAN



50% Percentile



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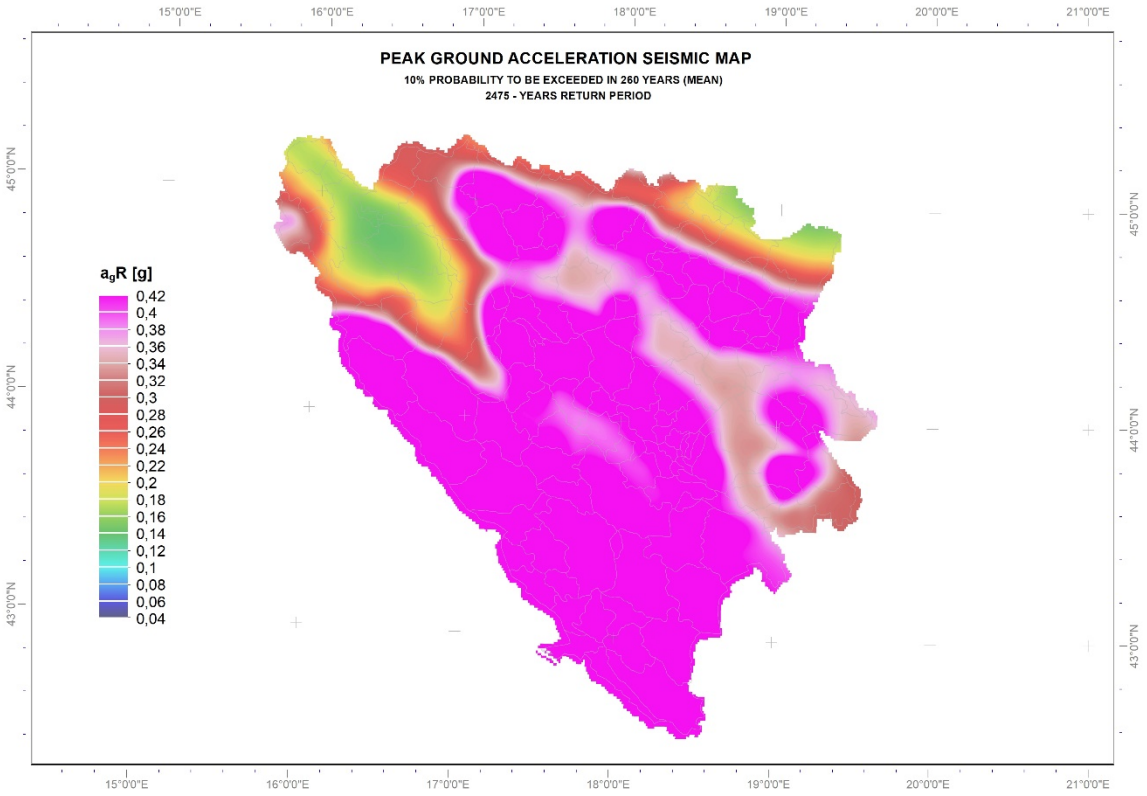
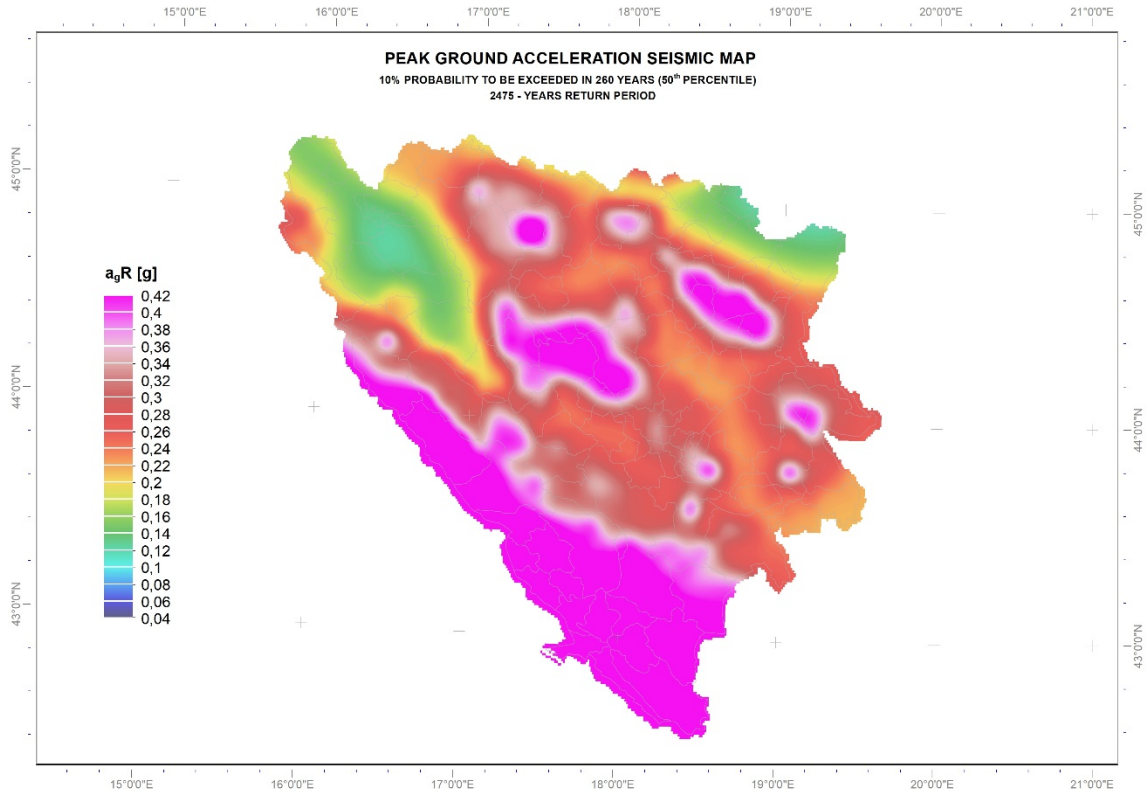
Seismic zoning maps for 10% probability to be exceeded in T_L = 260 years (RP = 2475 years)

MEAN



50% Percentile



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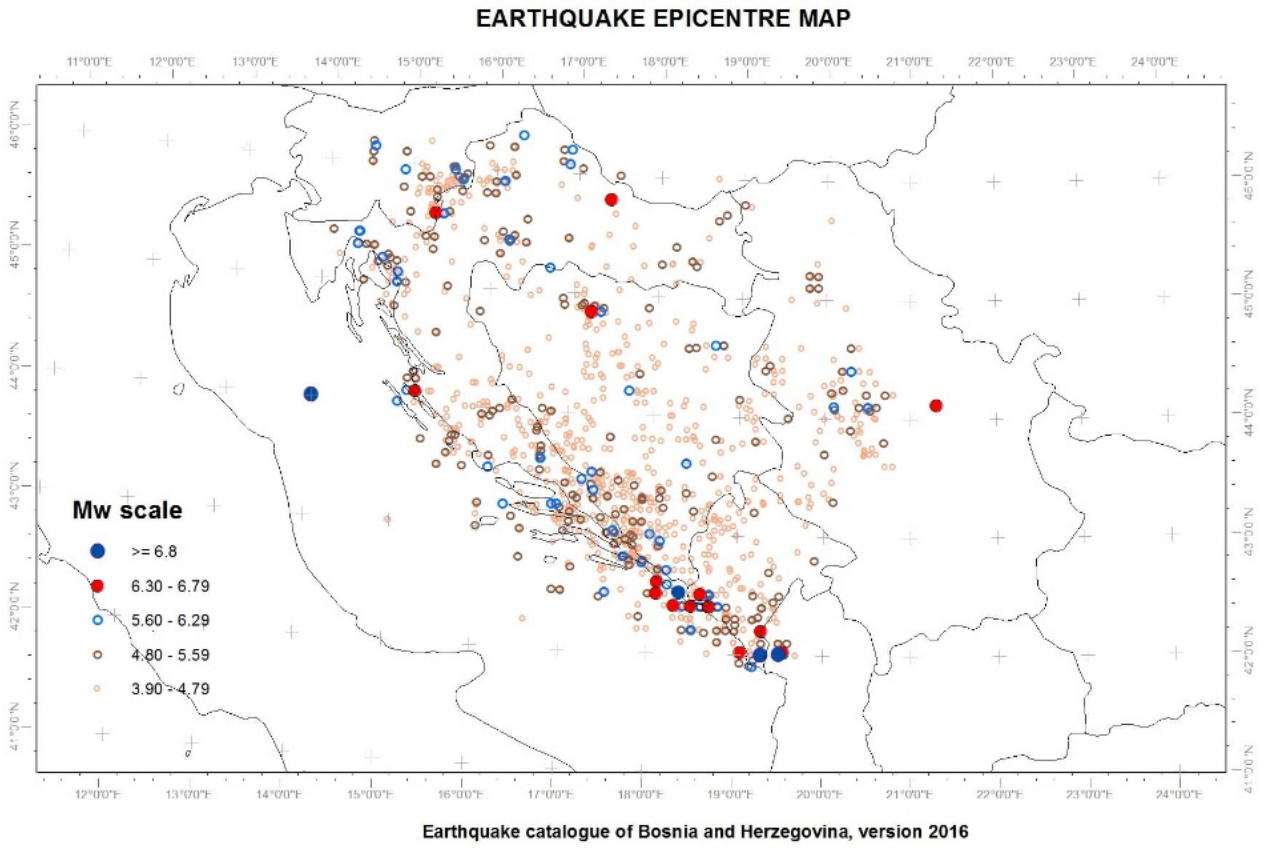
INPUT DATA (1)

1. Earthquake catalogue

The catalogue covers time span from the year 306 to 2015 and the territory of Bosnia and Herzegovina and surroundings up to about 100 km. Catalogue contents 1944 earthquake records of Mw magnitude from 3.5 to 7.1.

Before using of the catalogue, procedure of declustering was made.



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INPUT DATA (1)

The strongest event

The strongest event was so called "Ragusa earthquake" (today's Dubrovnik) from the 6th April 1667.

Position of the epicenter: ϕ = 42.662°N, λ = 18.091°E

Depth: 10 km

Maximum intensity: I_{max} = IX – X EMS98

Magnitude: M_w = 7.06.

Data was addopted from the paper: S. MARKUŠIĆ, I. IVANČIĆ AND I. SOVIĆ (2017).

Dubrovnik (Ragusa in Italian) destroyed by earthquake and fire. In foreground, ships in rough sea. Copper engraving, Netherlands, 1718 – Jan Kozak Collection, NISEE, Berkeley.

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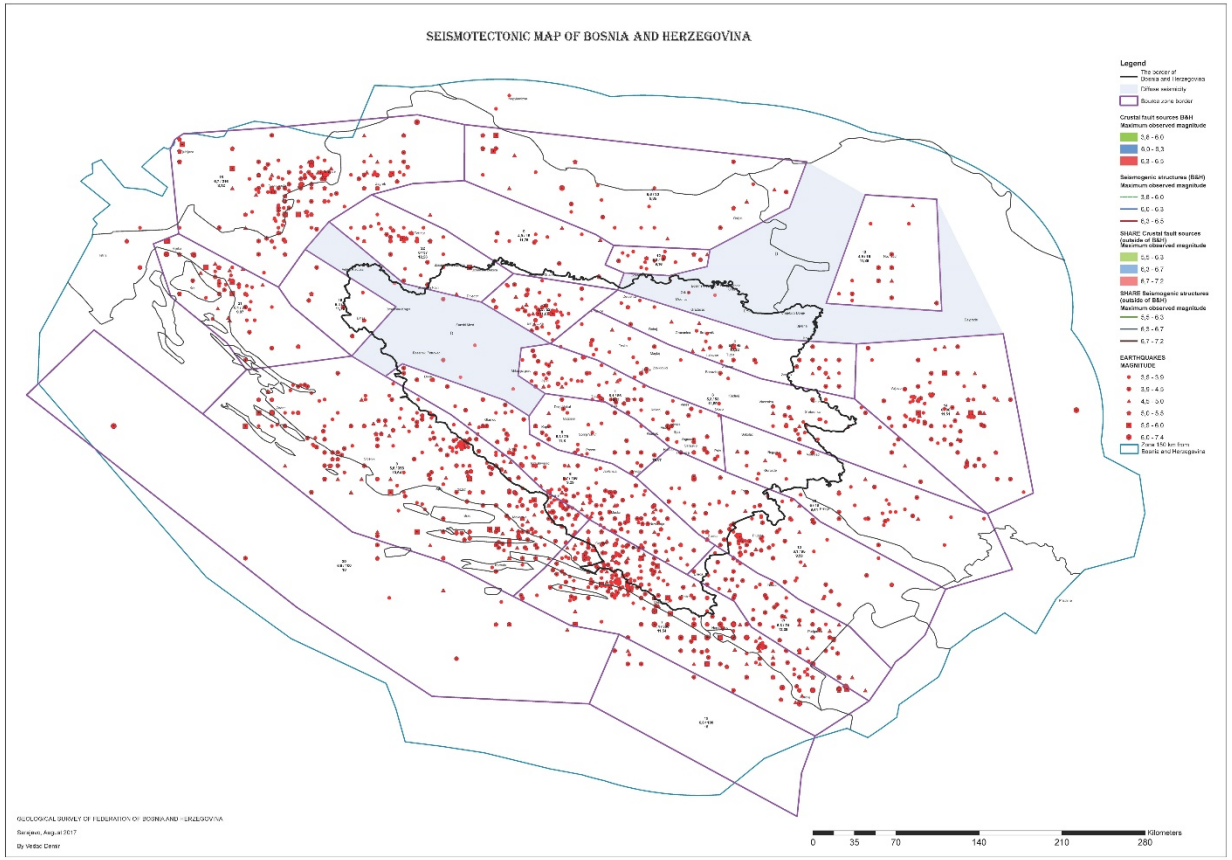
INPUT DATA (2)

Seismotectonic models

Two models were created and used during seismic hazard computation.

The first model is based on an approach, where the source zones of the size of hundreds of km^2 are delineated with using of depicted earthquake catalogue.



Model 1 – Areal zones

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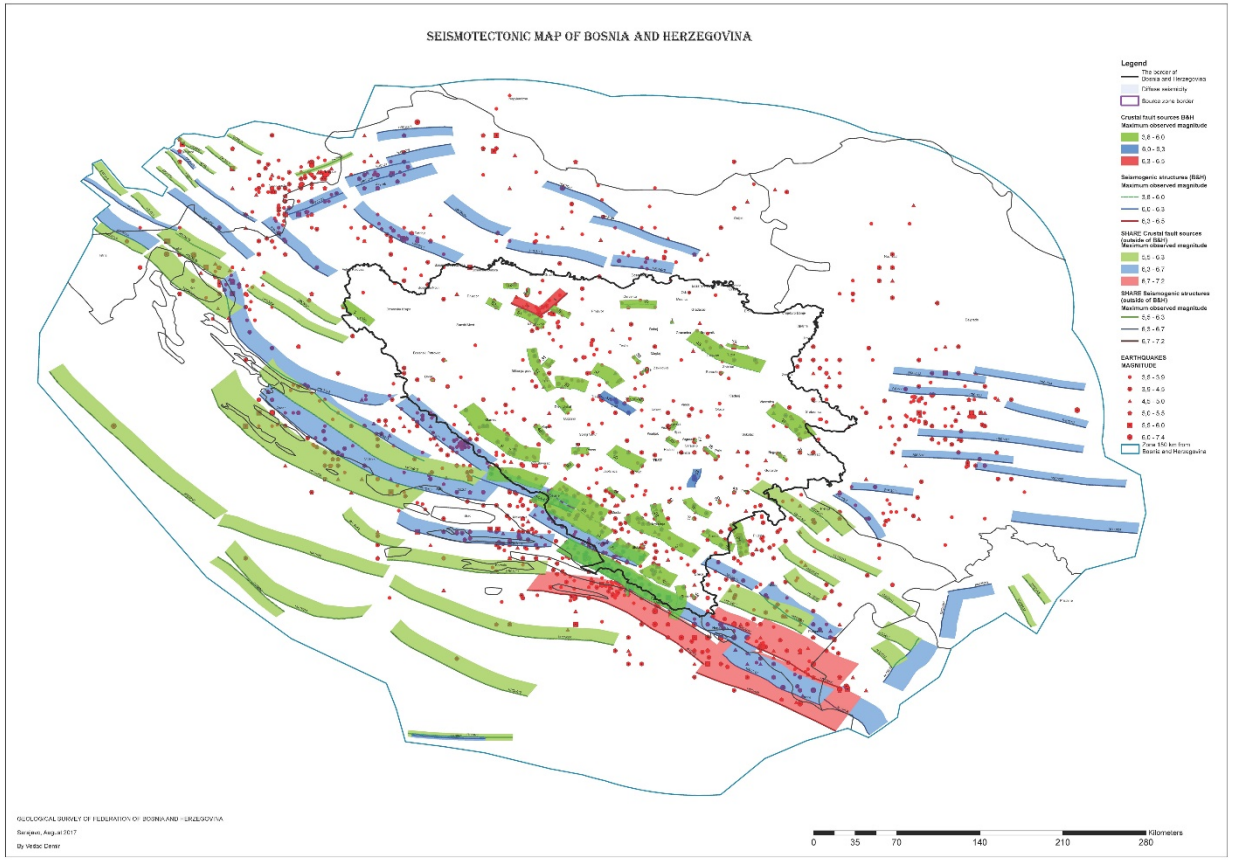
INPUT DATA (2)

Seismotectonic models

Accepting the theory that strong earthquakes are nearly always connected with an activity of the particular seismogenic fault, we have to delimit the source zone as linear zones representing the individual significant seismogenic fault or fault system.



Model 2 – Active faults

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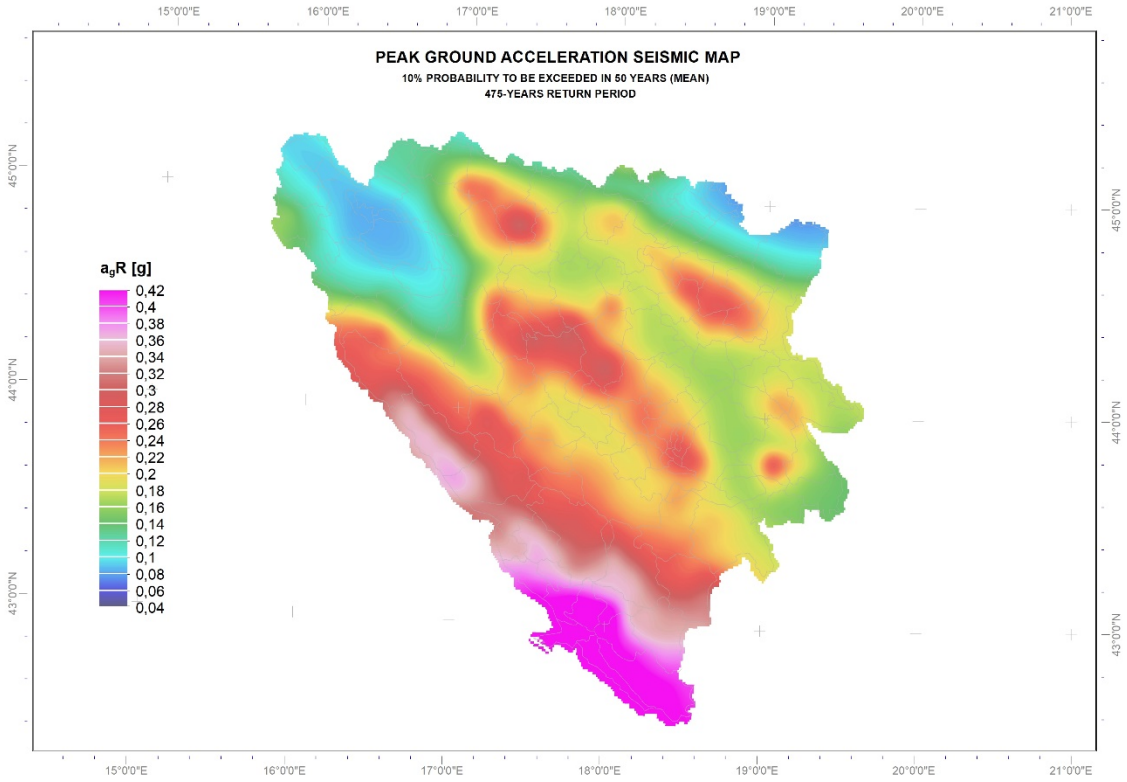
INPUT DATA (3)

Local conditions

Seismic zoning maps show peak ground acceleration values, which are valid for the ground type A characterized by the shear wave velocity $v_{s,30} > 800$ m.s^{-1}.

Amplification of the ground motion due to local soil conditions is solved through the soil factor *S,* when the design ground acceleration on type A ground is multiplied by the soil factor *S* given in the Table 3.2 of the Standard BAS EN 1998-1.



The basic seismic hazard map for A ground type, 10% probability to be exceeded in T_L = 50 years - 475 years return period

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APPROACH TO CALCULATION

Seismic zoning maps were constructed using of the Probabilistic seismic hazard assessment (PSHA) approach.

The PSHA was calculated by OpenQuake Engine, developed by Global Earthquake Model Foundation's (GEM).

Calculation is based on the logic tree, branches of which represent variations of:

- definition of source zones (2 models) and determination of source zone parameters a, b in GR distribution
- values of maximal possible magnitude
- definition of ground motion attenuation model (GMPE)

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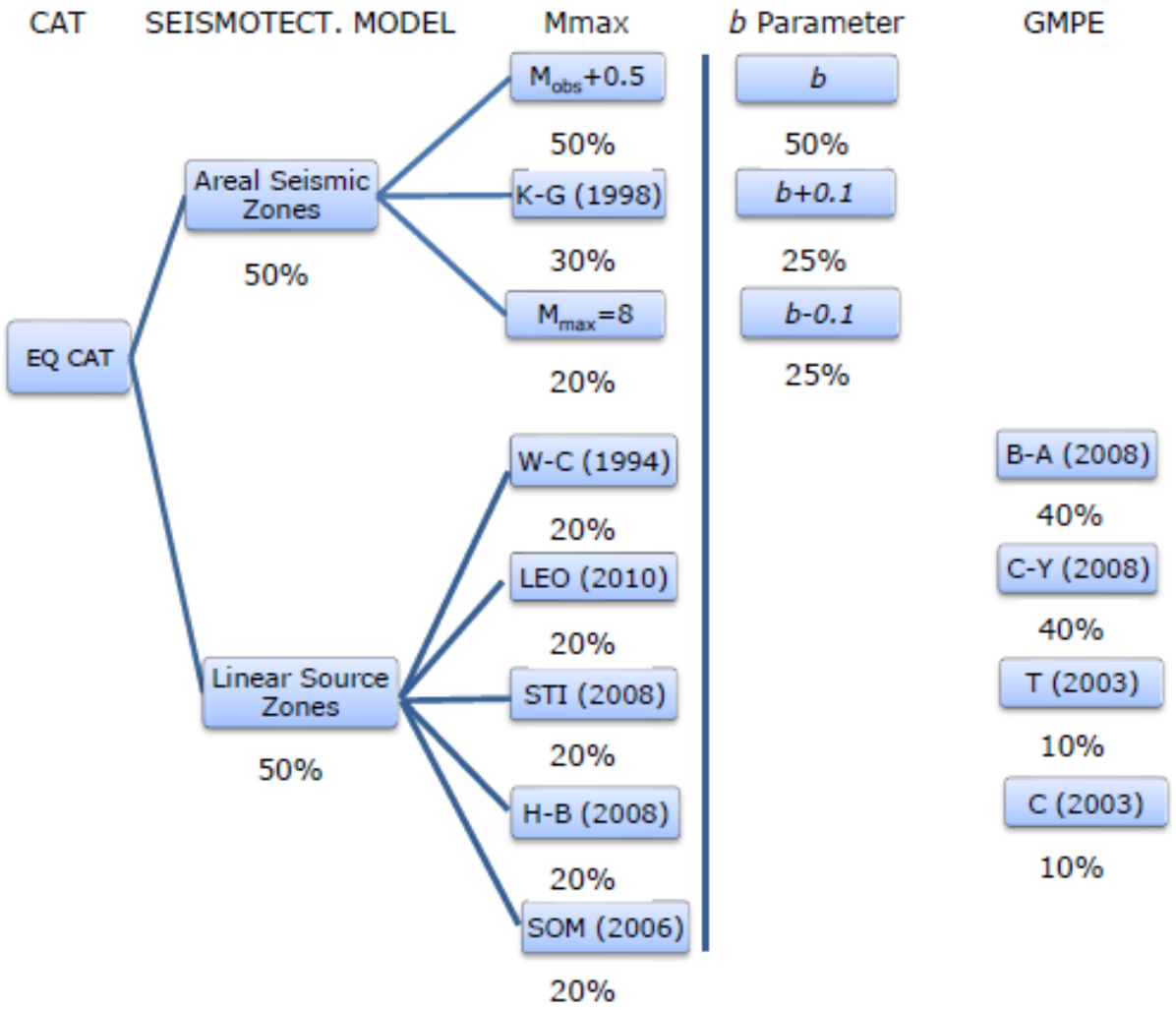
LOGIC TREE



Legend:

EQ CAT – Earthquake catalogue

M_{obs} – Maximum observed magnitude

K-G – Kijko & Graham, 1998

W-C – Wells & Coppersmith, 1994

LEO – Leonard, 2010

STI – Stirling et al., 2008

H-B – Hanks & Brakun, 2008

SOM - Somerville, 2006

b – b parameter of the G-R formula

B-A - Boore and Atkinson, 2008

C-Y - Chiou and Youngs, 2008

T - Toro et al., 2003

C – Campbell, 2003

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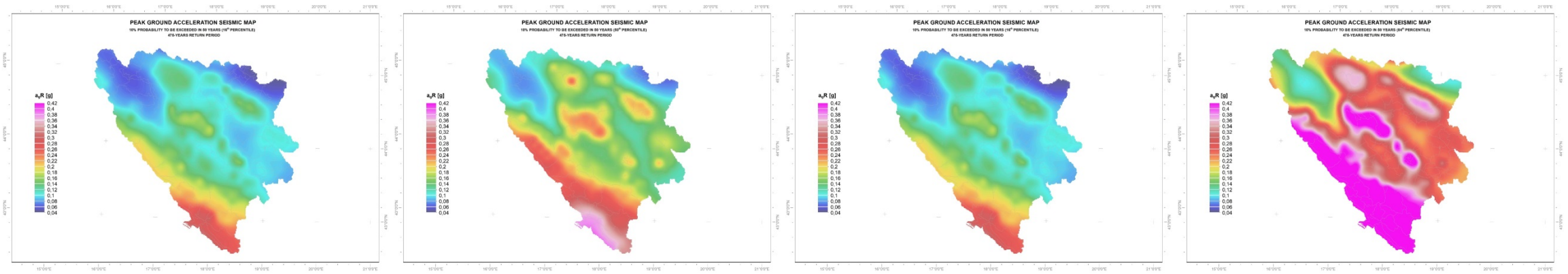
RESULTS

The result of the seismic hazard calculation for each grid point is set of seismic hazard curves for percentiles 16%, 50%, 84% as well as for mean value. Values for annual frequencies 1,05E-02 (return period 95 years), 2,11E-03 (**return period 475 years**) and 4,04E-04 (return period 2475 years) and 10% probability of exceeding in 10, resp. 50 and 260 years were derived from curves.

16% 50% MEAN 84%



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