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"Harmonization of Seismic Hazard Maps for the Western Balkan Countries"

WORKSHOP

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Towards an Unified Magnitude Scale for Earthquakes of Western Balkan Area

Neki Kuka

Llambro Duni

Institute of Geosciences

Polytechnic University of Tirana

Introduction

- Compilation of a homogeneous earthquake catalog, by expressing the size of the earthquakes in a unified magnitude scale, is the first step in the PSHA.
- The most reliable and useful scale magnitude is the seismic moment magnitude, M_W. Taking into account that almost all predictive ground motion models (PGMM) in use today use M_W, it is necessary that M_W to be chosen as the common measure of earthquake size for both historically known and the instrumentally recorded events.
- Historical earthquakes are expressed in terms of epicentral intensities and later converted in the M_S or any other equivalent magnitude, using regression models (standard or orthogonal) based on *Io* and other focal parameters (Karnik 1996, Gutdeutch et al. 2002, etc.).
- For the instrumental period, seismological centers in our region use different procedures to estimate local magnitudes.

Conversion of M_{SK}, M_S and m_b to M_W

Procedure followed to produce the unified magnitude

The converted or re-estimated magnitudes reported in Karnik (1996) are in M_S scale consistent with the Prague formula. They are converted to M_W using formulas derived by Scordilis (2006).

- Magnitude M_S in Tirana and Skopje catalogs, as well as M_S reported in the bulletins of ISC are considered as estimated using the Prague formula. They are converted to M_W using the formulas derived by Scordilis (2006).
- m_b magnitudes from ISC are converted to M_W using the relevant formula derived by Scordilis (2006).
- Thessaloniki (Papazachos *et al.*, 2000, 2007) reports the earthquake size as M_W scale;

Local magnitude conversion

Generally, M_L magnitudes reported by different seismological centers cannot be considered as equivalent and, therefore local relations connecting them with M_W are required.

- Regression analysis (Table 1) are carried out to estimate the correlation between M_W, and M_L magnitudes reported by Podgorica, Tirana, Skopje and Thessaloniki. M_W corresponding to the events used in the relevant datasets are taken from Harvard CMT catalog and RCMT catalogs from INGV and ETHZ.

Table 1. Relationships between moment magnitude M_W and the local magnitudes M_L.

Agency	Regression model $M_W = b_0 + b_1 \cdot M_L$	Number of events	Determination coefficient, R^2	Std. Dev. of the regression, s_e
Tirana	M_W=2.029 + 0.656M_L	100	0.66	0.35
Pogdorica	M_W=0.384 + 0.949M_L	36	0.88	0.23
Skopje	M_W=1.358 + 0.792M_L	23	0.75	0.26
Thessaloniki	M_W=0.620 + 0.957M_L	108	0.79	0.24

Local magnitude conversion

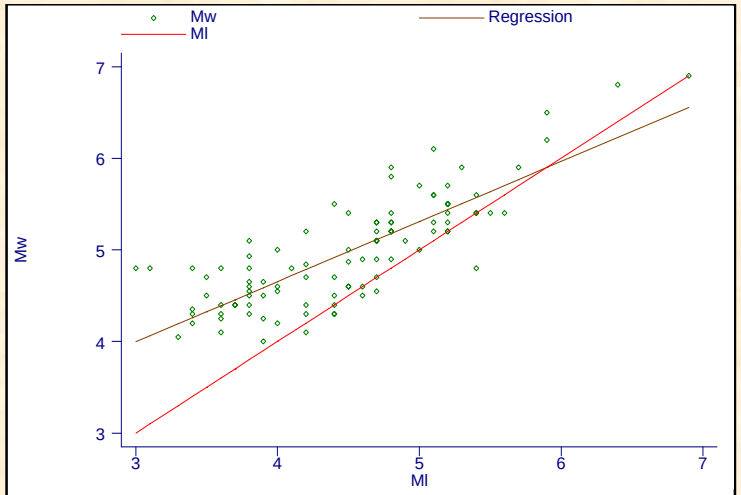

Fig. 2a. Relationship between Tirana M_L and M_W.

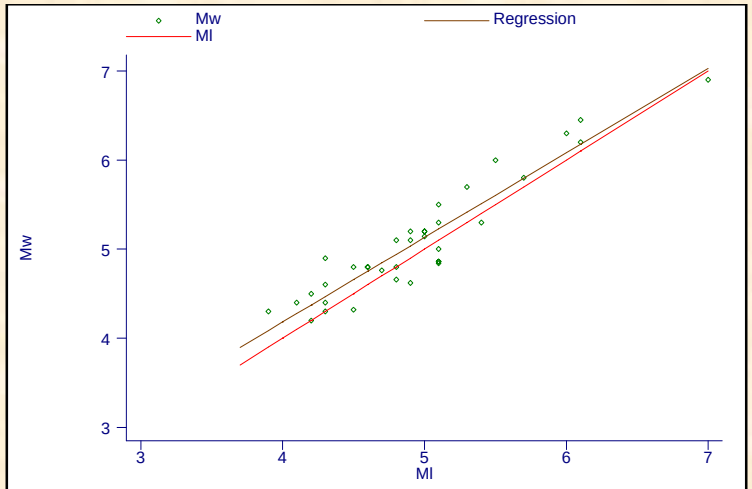

Fig. 2b. Relationship between Podgorica M_L and M_w.

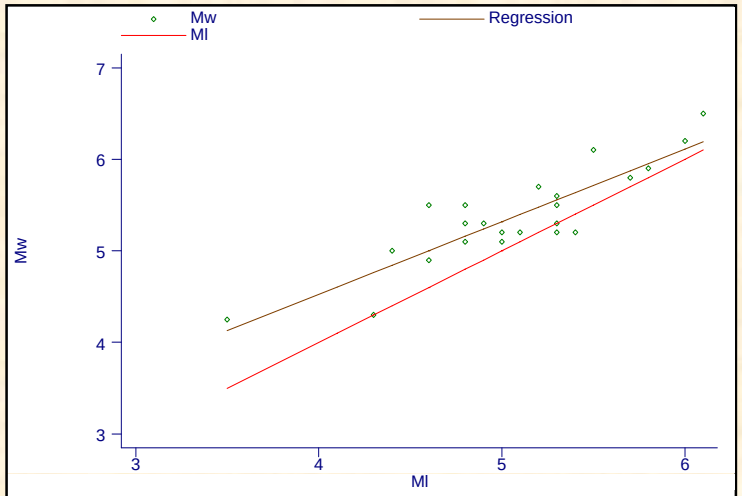

Fig. 2.c. Relationship between Skopje M_L and M_w.

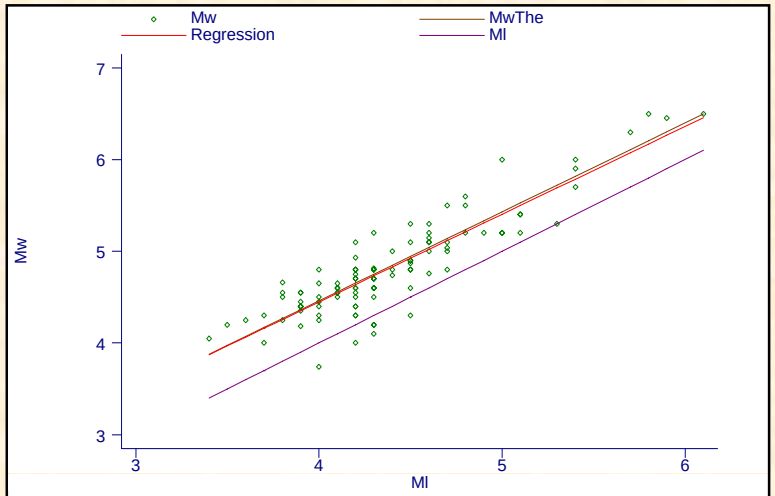

Fig 2d. Relationship between Thessaloniki M_L and M_W.

Local magnitude conversion

- M_L reported by Podgorica is almost identical with M_W, , with a small underestimation; standard deviation of regression, S_e =0.23.
- Regression equation we derived for Thessaloniki is almost identical with regression derived by them; standard deviation of regression, S_e =0.24.
- M_L reported by Skopje, not so good; systematically smaller than M_W for M_L <6.0; standard deviation of regression, S_e =0.26.
- M_L reported by Tirana not good; systematically smaller than M_W for M_L < 6.0, and larger for M_W > 6.0; standard deviation of regression, S_e =0.35.
- Above regression relations are used to convert M_L reported by the relevant agencies to the moment magnitude, M_W.
- It is necessary to extend this job for the other countries involved in the project.