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Intensity-distance attenuation law in the continental Portugal using intensity data points

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Several attempts have been done to evaluate the intensity attenuation with the epicentral distance in the Iberian Peninsula [1, 2]. So far, the results are not satisfying or not using the intensity data points of the available events. We developed a new intensity law for the continental Portugal, using the macroseismic reports that provide intensity data points, instrumental magnitudes and instrumental locations. We collected 31 events from the Instituto Portugues do Mar e da Atmosfera (IPMA, Portugal; ex-IM), covering the period between 1909 and 1997, with a largest magnitude of 8.2, closed to the African-Eurasian plate boundary. For each event, the intensity data points are plotted versus the distance and different trend lines are achieved (linear, exponential and logarithmic). The better fits are obtained with the logarithmic trend lines. We evaluate a form of the attenuation equation as follow:

$$I = c_0(M) + c_1(M).\ln(R) \quad (1)$$

where I, M and R are, respectively, the intensity, the magnitude and the epicentral distance.

To solve this equation, we investigate two methods.

The first one consists in plotting the slope of the different logarithmic trends versus the magnitude, to estimate the parameter $c_1(M)$, and to evaluate how the intensity behaves in function of the magnitude. Another plot, representing the intercepts versus the magnitude, allows to determine the second parameter, $c_0(M)$.

The second method consists in using the inverse theory. From the data, we recover the parameters of the model, using a linear inverse matrix. Both parameters, $c_0(M)$ and $c_1(M)$, are provided with their associated errors.

A sensibility test will be achieved, using the macroseismic data, to estimate the resolution power of both methods.

This new attenuation law will be used with the Bakun and Wentworth method [3] in order to reestimate the epicentral region and the magnitude estimation of the 1909 Benavente event. This attenuation law may also be adapted to be used in Probabilistic Seismic Hazard Analysis.

[1] Lopez Casado, C., Molina Palacios, S., Delgado, J., and Pelaez, J.A., 2000, *BSSA*, 90, 1, pp. 34-47

[2] Sousa, M. L., and Oliveira, C. S., 1997, *Natural Hazard*, 14: 207-225

[3] Bakun, W. H., and Wentworth, C. M., 1997, *BSSA*, vol.87, No. 6, pp. 1502-1521