AN EMPIRICAL RELATION TO EVALUATE MACROSEISMIC INTENSITY IN ITALY
S. Parisi\textsuperscript{1}, A. Attolico\textsuperscript{2}, P. Harbaglia\textsuperscript{3}, A. Molinari\textsuperscript{3}, M. Vona\textsuperscript{3}
\textsuperscript{1}PROGEON soc. Coop s.r.l. Potenza, Italy
\textsuperscript{2}Provincia di Potenza, Potenza, Italy
\textsuperscript{3}Scuola di Ingegneria, Università degli Studi Basilicata, Potenza, Italy

The recent release of the new version of the Parametric Catalogue of Italian Earthquakes (Rovida \textit{et al.}, 2016) and its associated macroseismic data base (Locati \textit{et al.}, 2016), prompted us to build a new relation that would allow to estimate macroseismic intensities at any given site on the basis of epicentral location, magnitude and epicentral distance. An excellent relation already exists (Pasolini \textit{et al.}, 2008a, 2008b), however it was developed for an older version of the data base. Moreover the new version of the catalogue gives excellent magnitude estimates, based on the Boxer algorithm (Gasperini \textit{et al.}, 1999) that allow to disregard the epicentral intensity evaluation.

We selected 312 well located events with magnitude greater than 5. It is noteworthy that we substituted the 1456 macroseismic field with that of the three sources as suggested by Fracassi
and Valensise (2007). In our selection we however discarded all the events that were known to be deeper than 40 km. There are 32008 observations with intensity greater or equal to IV, 16827 of which yield an intensity of at least VI. We considered intensity uncertainties as half degrees and discarded non numerical values such as HD.

Since our aim was to verify whether there are areas of Italy where intensities are systematically higher or lower than average, it was essential to obtain a model that on average should be as close as possible to the real average. This means that we could not consider any minimization based on the L2 norm.

We subdivided our event set in 5 intervals of magnitude, each 0.5 wide, and 15 intensities values, resulting in 75 data functionals. For each of them we computed the average intensity and the difference with respect to the expected value: we minimized this difference with respect to the largest one.

The relation we propose is

$$I = \min \left[ I_{\text{max}}, \frac{\log R_r + 0.94 M - 14.08}{0.32 M + 2.8} \right]$$

where $M$ is the magnitude, $I_{\text{max}}$ is a tabulated maximum intensity based on magnitude, as it results from actual data and $R_r$ is the reduced radius that takes into account the fact that within the epicentral area intensities are theoretically homogeneous. In our modelling

$$R_r = R - 1.5 M$$

where $R$ is the actual radius in kilometers.

If $R_r$ is less than 0, we assign a 0.1 km value to it.

Our relation ensures that over the whole range the error is less than 0.1, while for intensities of VI or larger, it is negligible.

The results are shown in Fig.1.

It is particularly relevant the fact that coastal areas as well as the Po plain are on average affected by intensities larger than average while along the Appennines in general observed intensities are less than expected. Also Sicily poses a lot of questions, particularly if compared to Southern Calabria. This poses a serious question since these are the areas where quality construction would be expected to be lower. Obviously these means that attenuation must play a very relevant role. This however cannot be considered as the only explanation and further investigations on constructions will have to be carried out in future.

![Fig. 1 – In blu we show sites where the observed intensities is at least 0.5 degrees less than average, in red the observed intensities are at least 0.5 degrees higher than average, while in white we report sites that are about average. Large dots refer to at least 5 observations, while small dots are used for sites with less than 5 observations.](image-url)
References