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Determination of M_w for large events in Metropolitan France from historical seismograms

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Earthquakes with damage potential are not frequent in metropolitan France. Still earthquakes with Mw around 5.5 able to cause serious damages in populated and industrial areas are likely to occur. Our main goal is to determine the Moment Magnitude (M_W) for a selection of 15 earthquakes covering the time span 1905-1972 that occurred on France and its immediate vicinity.For the 15 selected earthquakes we retrieved seismogram scans from EUROSEISMOS database (Ferrari and Pino, 2003) and complemented it with collection of records kept at EOST-Strasbourg. Given the diversity of seismometers with different configurations and the uncertainties in its constants for the available information, we favoured the use of 1 t Wiechert-type seismometers and for those instruments were instrumental constants and polarities are known. Our choice favours the analysis of low-frequency crustal Love and Rayleigh waves recorded at regional distances in Europe.

A digitization procedure is applied to those selected seismograms with good quality images, it consists in: clean and enhance seismograms stored on images, a geometrical correction to unwrap the seismograms is applied to the images (Schlupp, 1996; Cadek, 1987), data is automatically digitized base on the grey intensity level and finally gaps are filled using an autoregressive modelling (Schlupp, 1996).

We estimate the Mw magnitude by waveform modelling and comparison in time domain with digitized seismograms. The waveform modelling is done from point Green's Functions (GF) that are computed from regionalized earth models, the crustal models we use are an average along the epicentre-station path from the global model 2°-grid CRUST2.0 (Bassin, 2000). GF are build using a wavenumber integration algorithm from Herrmann (2004) for the selected crustal structure. Synthetic and observed seismograms are first compared on a Grid Search; from these comparisons we look for the best solutions for: Focal mechanisms, earthquake depth and Magnitude (M_W), the selection of best solutions are done using a clustering algorithm. We found that focal mechanisms and depths extracted from the Grid Search inversion are poorly constrained, contrary to M_W for which some reliable values can be given after controling its trade-off with the depth and focal mechanism of the events.

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