



## **Constraints on the source characteristics of the 1117 earthquake from seismic modeling**

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The 3 January 1117 earthquake (I0 at least IX MCS) is the largest known event occurred so far in the Po Valley. Although its effects were felt in a vast area of northern Italy the source characteristic of this event are still poorly understood and strongly debated.

The re-evaluation of historical earthquakes is an important task in seismic hazard assessment studies in order to better understand the past events and to prevent future damage.

For the 1117 earthquake a parametric analysis on the source main characteristics (magnitude, epicenter, hypocentral depth and focal mechanism) has been done computing different scenarios of expected ground motion, which are defined by means of full waveform modeling (neo-deterministic approach). These parameters have been varied inside a range of possible values chosen according to the re-evaluation appeared in recently published literature, the instrumental seismic recordings for the small magnitude earthquakes in the zone and the seismogenic zone in force. Scenarios have been computed in terms of ground velocities, since they are well in relation with the seismic energy, which is a good indicator of the damaging potential of the earthquake. The results of the modeling have been evaluated in terms of the misfit between the available macroseismic data (isoseismals and maximum observed intensities) and the intensities theoretically derived from velocities using an empirical relation valid for the MCS scale in the Italian territory. The observed macroseismic field has also been recomputed using the MPF method (Modified Polynomial Filtering). The misfit between observed and computed intensities has been performed through the Spearman test to assess a suitable fault model for the 1117 earthquake.

Given the scarce macroseismic observations we have chosen to consider as few as possible degrees of freedom in our modeling. Thus, we did not consider any site effects in the computations. The source has been modelled with point-source and extended-source models, testing different rupture propagations.

The good agreement between the scenarios and the macroseismic data has permitted to constrain in a formally rigorous way some possible characteristics of the 1117 earthquake, despite the uncertainties left by the scarcity of the available observations.