Validation of a 3D Geological Model for the Numerical Simulation of Earthquake Ground Motion in Emilia (Italy)

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We use 3D numerical modeling of seismic waves to explain the ground motion observed in the Po Plain (Italy) during the Emilia 2012 earthquake sequence, which could not be predicted adequately by classical ground motion prediction equations (GMPE).

The investigated area is a 70 km wide square bounded at North and South by the Po river and the Apennines range, respectively. The area includes the epicenters of the 2012 seismic sequence started on May, 20 with a ML 5.9 event. The geology of the area is characterised by a NNE-verging fold-and-thrust system, almost completely buried under late Pleistocene-Holocene deposits of the Po Plain.

On the basis of published data and by using GeoModeller software, we have built a 3D visco-elastic, geological-structural model with details suitable for seismic waveform simulations in the frequency range up to 2 Hz. We simulate two ML 4.2 events located at the NE and NW ends of the seismogenic area. The numerical simulations are performed by a well-established implementation of the Fourier pseudospectral method developed by the authors. The model is validated by comparing quantitatively the simulated seismograms to those recorded by about 20 stations, which were active in the area during the 2012 sequence.

Simulations predict correctly the most significant features observed in the waveforms, which may be caused by several factors as: the presence of anticlines, the basin margin and the variable thickness of sediments. The validated 3D model can now be used for the numerical estimation of the ground motion in the Po plain and represents a starting point for implementing more detailed, 3D local models and performing earthquake simulations in a wider frequency range.