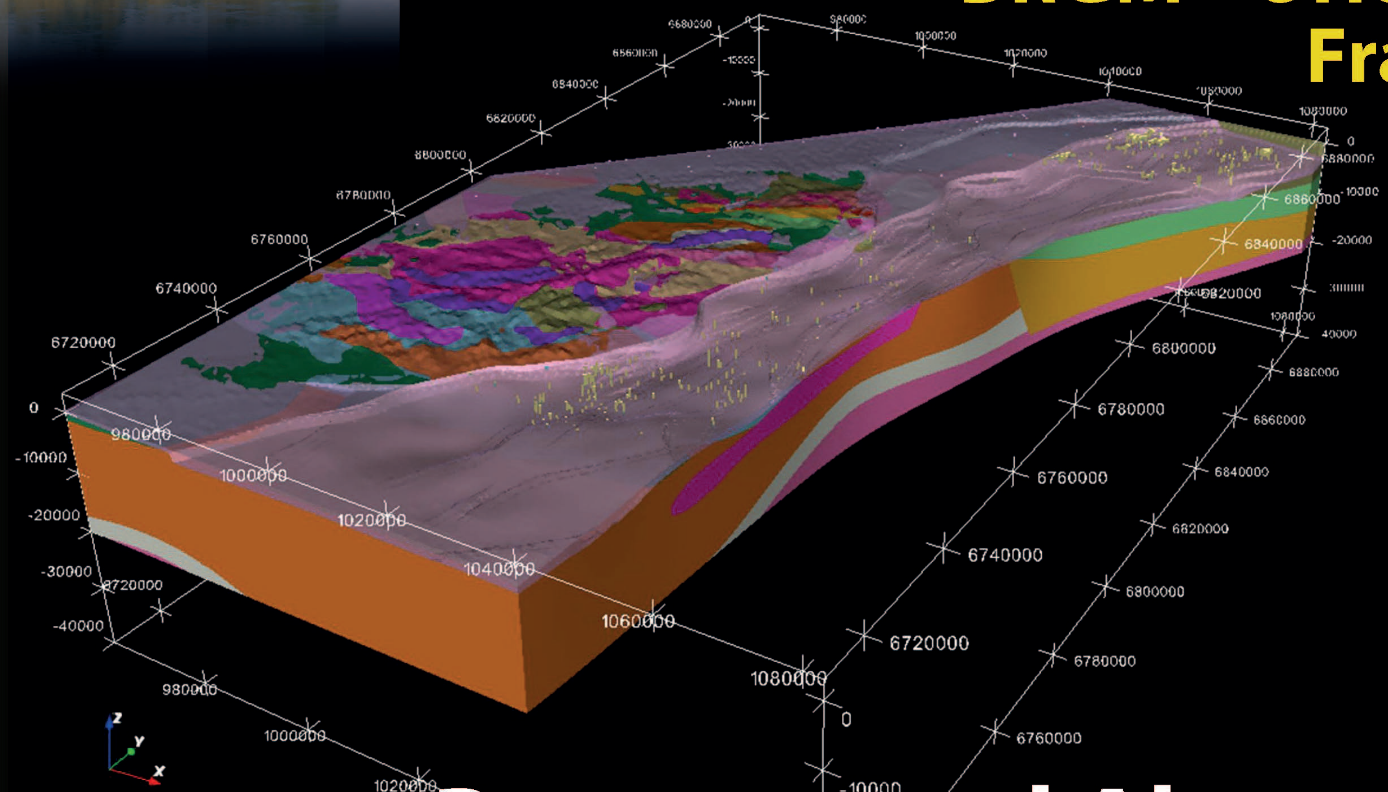
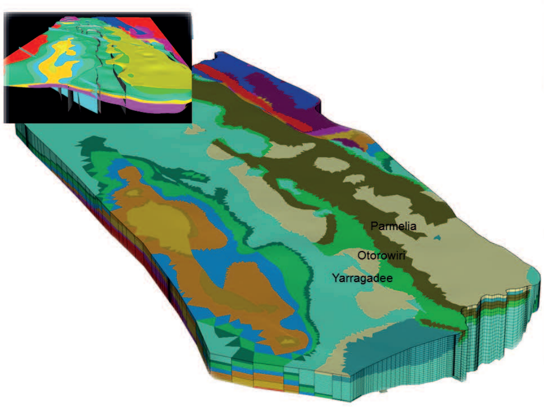
November 18th I 20th 2015

BRGM - Orléans France



Program and Abstracts



European 3D GeoModeller User Meeting

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BUILDING A 3D STRUCTURAL-GEOPHYSICAL MODEL IN EMILIA-ROMAGNA REGION (ITALY) FOR EARTHQUAKE NUMERICAL MODELING

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In this note we present the building of a 3D structural-geophysical model of an area located in Northern Italy, specifically in the Emilia-Romagna region (Figure 1, left panel).
The main purpose of the study is to estimate the peculiarities of the ground motion originated by local earthquakes by means of numerically simulated propagation of seismic waves through the underground heterogeneities, i.e. tectonic structures and lithological variations described in the model.
The study area extends horizontally about 70 km x 70 km, and it is geographically bounded by the Po river right flank at North and by the Apennine chain Northern side at South. In 2012, the northern sector of this area was struck by a seismic sequence characterized by two main shocks: the first one of magnitude Mw=5.9 (ISIDe, 2015) occurred on May 20 at about 30 km west of the city of Ferrara, and the second one of magnitude Mw=5.8 occurred nine days later (on May 29) even more westward. These events were followed by other six shocks with Ml≥5.0, and about 2,500 Ml<5.0 earthquakes, causing 17 victims and severe damages in many localities, especially close to the historical centers and factories. Moreover, extensive liquefaction of Po plain sandy soils was observed following the two mainshocks.
From a geological point of view, the investigated area is characterized by the NNE-verging fold-and-thrust system of the Northern Apennines. This sector of chain developed in responses to the convergence of the African and European plates from the Cretaceous onwards, and today is almost completely buried under Plio-Quaternary marine and continental deposits. As matter of fact, the morphological limit of the chain, visible along the southern margin of the study area, does not coincide with the outermost thrusts fronts, which are located beyond the northern border.
The crust volume we modeled extends in depth until 20 km, for taking into account of earthquakes eventually originated by the deepest segment of thrusts in the ground motion evaluations. The construction of the 3D model by Geomodeller (Figure1, right panel) encountered some difficulties, surely due to the complex tectonic setting of the study area, but also to the limited availability of input data. Mainly we used two geological sections at regional scale based on interpreted seismic profiles and some shallow 3D interfaces obtained by the synthesis of borehole data drilled in the area by petroleum companies.
The numerical simulations of the seismic wave propagation are based on the Fourier pseudospectral method (Klin et al. 2010), which is comparable in accuracy and efficiency to other widely adopted numerical methods (Chaljub et al. 2015). The method requires assigning viscoelastic properties to the rock and soil formations contained in the model. A first series of numerical simulations of the earthquake ground motion reproduce some events of the 2012 Emilia sequence. By the comparison of the obtained synthetic seismograms with the accelerometric data recorded at seismological stations located in the area, a first validation of the 3D structural-geophysical model was obtained.

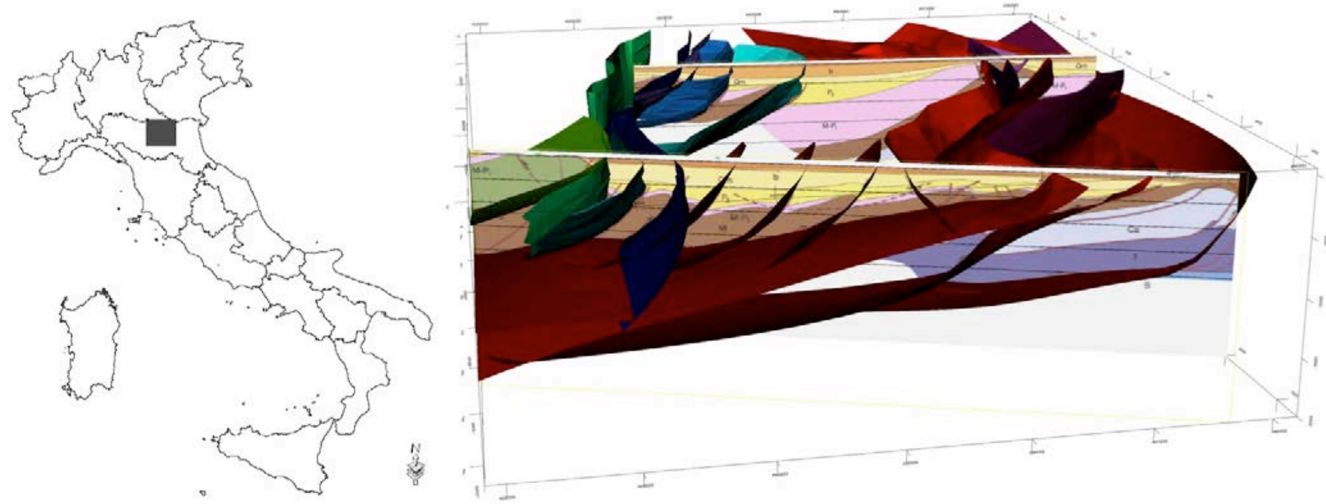

Figure. On the left: location map of the study area. On the right: geological sections at regional scale used as input data of the model and faults surfaces modeled with Geomodeller.

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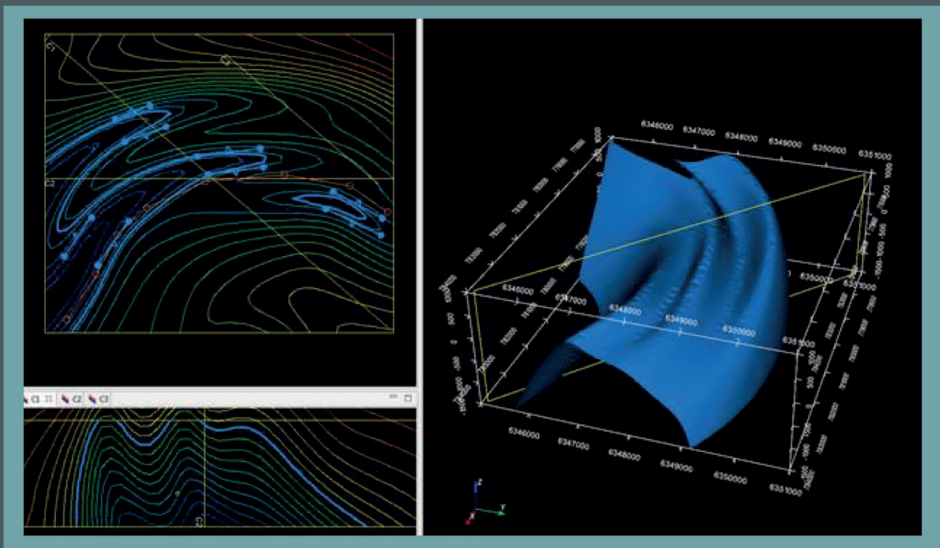

ANISOTROPIES OF STRUCTURES INCLUDED IN IMPLICIT MODELLING

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