Geophysical Research Abstracts
Vol. 17, EGU2015-2071, 2015
EGU General Assembly 2015

Gravity data for a 3-D density model of the Po plain and the surrounding region

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In order to properly localise earthquakes and define, especially in tectonically active areas, the seismic risk, there is the necessity to have reliable earth models.
Unfortunately, conventional geophysical tomographic methods face the problem of irregular data coverage over the surface of the studied volume, which can produce irregular image resolution. This problem is difficult to address for each isolated geophysical technique, and it demands an effort for the integration of different geophysical methods into a single inversion scheme.
In this work, we show how gravity information is a valuable tool in discriminating among possible models.
An appropriate density starting model: a 10 layers 1D model which represents the mean geological structure below the Po plain and the surrounding region ([7.24E-12.80E], [43.78N-46.18N]), is tested upon two different gravity data sets, three different model parametrizations and two different seismic information.. The contribution given by ground based gravity data has been compared to the one, obtained by the combination of the GOCE satellite observation with the Italian terrestrial gravity data. This combination has been performed by means of a frequency analysis, using the very low frequencies from the GOCE data, the low frequency (between 181 and 240 degrees, in term of spherical harmonics) from the integration of the ground data with the GOCE data by least-square collocation, the high frequencies are obtained by residual terrain correction modelling.
The 2012 Emilia seismic sequence, together with recent instrumentation deployed within the Po plain, allows to improve the existing crustal models by using a 2-20 s regional surface wave tomography. Isotropic reference S-wave velocity models up to 25 km of depth are calculated from the local dispersion curves for both the Love and Rayleigh fundamental mode using a linearized inversion scheme. Furtherly, seismological models and gravimetric data are exploited in the Sequential Integrated Inversion procedure, where we explored how (a) a coarse grid with 10km x 10km; (b) a grid with 3km x 3km; (c) an heterogeneous grid with 1km x 1km of areal resolution in the region of maximum seismic resolution and with 10km x 10km elsewhere; explain both gravity and seismic information. The reliability of the reconstructed models is quantified through a restoring test and the estimation of seismic and gravity data variance.