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eXperimental jOint inveRsioN (XORN) project: first results of a 3D joint gravity and magnetic inversion

Martina Capponi and Daniele Sampietro
Geomatics Research & Development s.r.l., Lomazzo (CO), Italy

The Earth crust represents less than 1% of the volume of our planet but is exceptionally important as it preserves the signs of the geological events that shaped our planet. This thin layer is the place where the natural resources we need can be accessed (e.g. critical raw materials, geothermal energy, water, oil and gas, minerals, etc.). For these reasons, a thorough understanding of its structure is crucial for both scientific and industrial future activities. It is well known that potential fields methods, exploiting gravity and magnetic fields, are among the most important tools to recover fundamental information on the Earth crust. In recent years, thanks to the increasing availability of seismic/seismological data and to gravity and magnetic satellite missions, the crust has been thoroughly investigated and modelled at global and continental scales. However, despite this progress, it remains poorly understood in many regions as global models are often too coarse to provide detailed information about the regional and local dynamics.

With this respect, the challenge to be faced nowadays is represented by the development of ad-hoc techniques to fully exploit these different geophysical global data and to merge them with regional datasets compiled at the Earth's surface. Currently, the different sources of information when analysed individually suffer from non-uniqueness. Magnetic and gravity signals detect different crustal parameters and rarely coincide because various combinations of geological structures generate similar observations outside the sources. A promising solution is represented by the joint processing in a consistent way of both gravity and magnetic fields data, possibly incorporating the available geological knowledge and constraints coming from seismic acquisitions, in such a way to reduce the space of possible solutions.

In the eXperimental jOint inveRsioN (XORN) project, funded by the European Space Agency through the EO4society program, Geomatics Research & Development srl (GReD) together with Laboratoire Magmas et Volcans (LMV) of Clermont Auvergne University will develop an innovative algorithm aiming at performing complete 3D joint inversion of gravity and magnetic fields properly constrained by geological a-priori qualitative information. The developed algorithm will be used within the project to recover a 3D regional model of the Earth crust in the Mediterranean Area in terms of density and magnetic susceptibility distribution within the volume, and in terms of depths

of the main geological horizons. Within this regional case study particular attention will be given to the bathymetric layer thus defining and testing a strategy that could potentially be applied worldwide to improve our knowledge of this layer which is fundamental for every application that aims at studying (e.g. for tsunami hazards), conserving and sustainably using the oceans, seas and marine resources.

The first results about technical developments will be here presented together with preliminary modelling aspects of the Mediterranean test case.