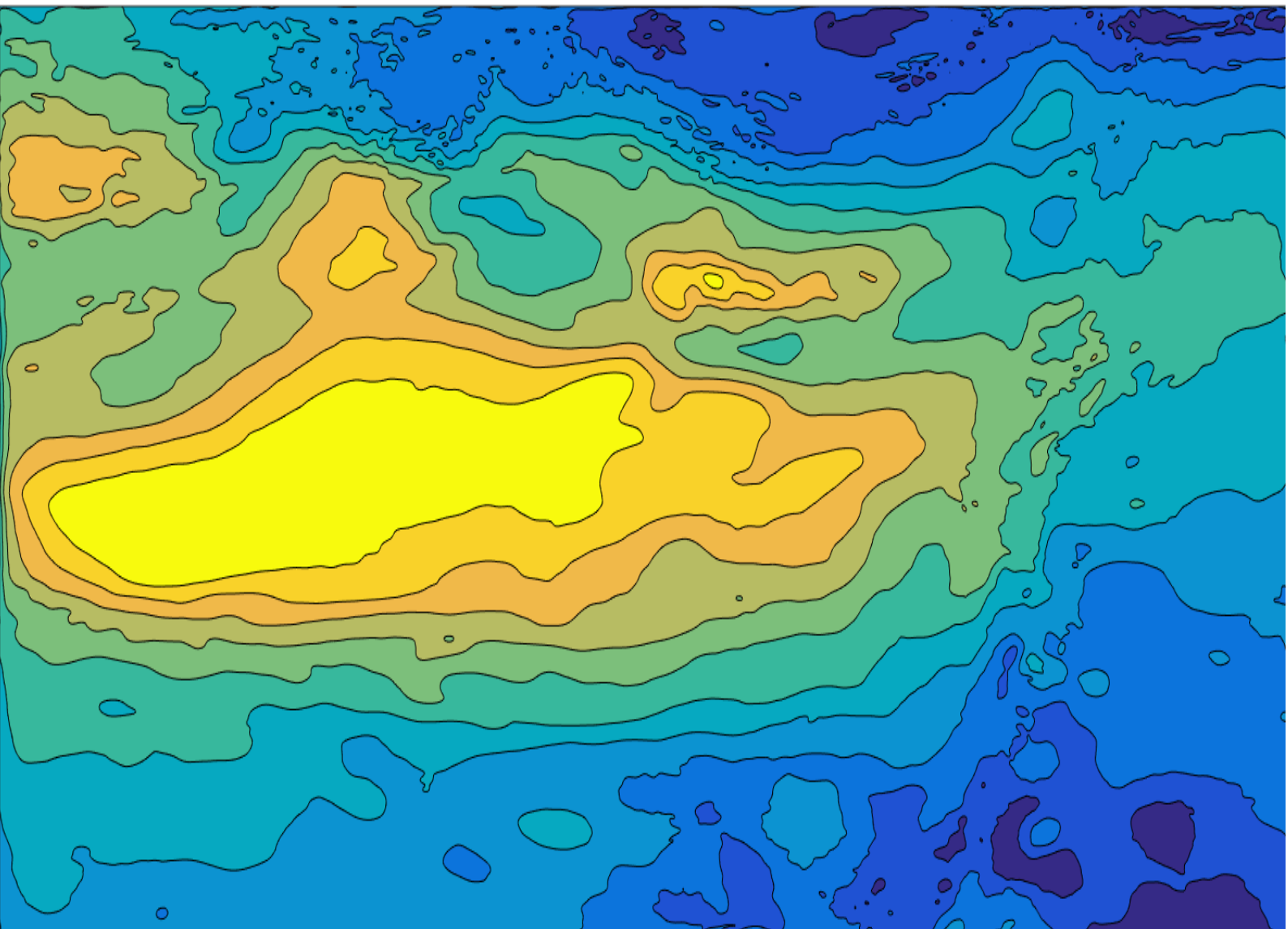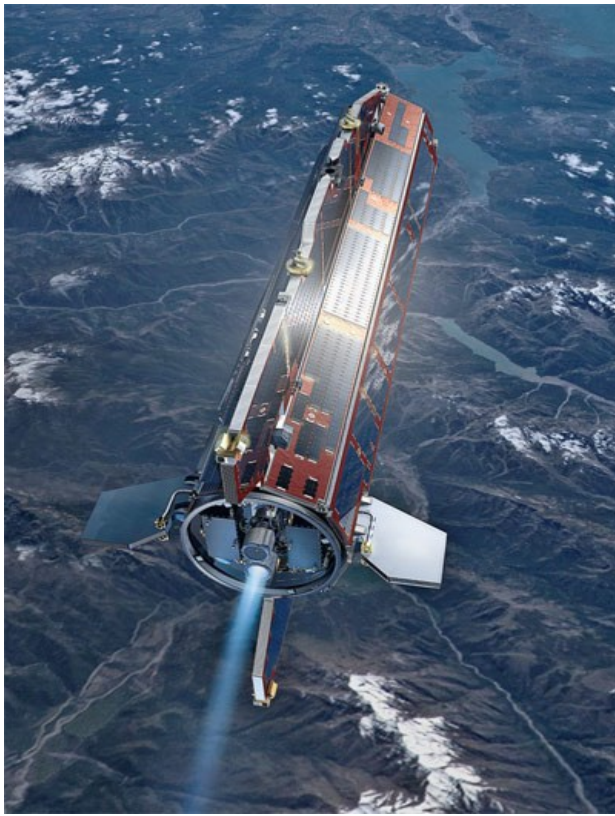# GRAVITY INVERSION TO UNDERSTAND LITOSPHERIC ARCHITECTURE

for **OIL & GAS EXPLORATION**

GOCE OBSERVATIONS

In 2012 the GEMMA project funded by Politecnico di Milano and the European Space Agency, through the Support To Science Element programme (Contract No. 4000102372/10/I-AM) demonstrated the possibility to exploit GOCE gravity data to model the main features of the crust both globally and regionally.

The use of satellite data for this activity in fact, offers the main advantage of giving a regional outline of the crustal architecture that cannot be obtained by local seismic profiles or gravity observations.

This dataset can be profitably used in the so called "Assets e Prospects" operation which takes place before the upstream activities.

THE PROJECT

In 2015 ESA, through the Value Adding Element (VAE) program, funded a new project (Contract No. 4000117591/16/I-NB), called GIULIA (Gravity Inversion to Understand LIthosfheric Architecture), in order to understand the possibility to exploit GOCE satellite data for oil & gas explorations activities.

Basically the project consists in analyzing the characteristics of freely available dataset and conducting an example of crustal structure estimation on a test area (the Levant has been chosen as test area).
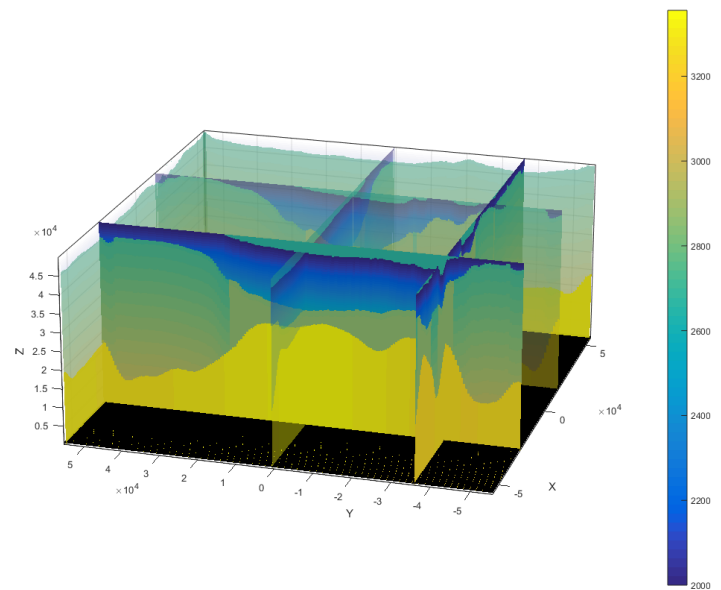
Moho Depth from the GOCE Satellite refined with ground gravity observations and geological information
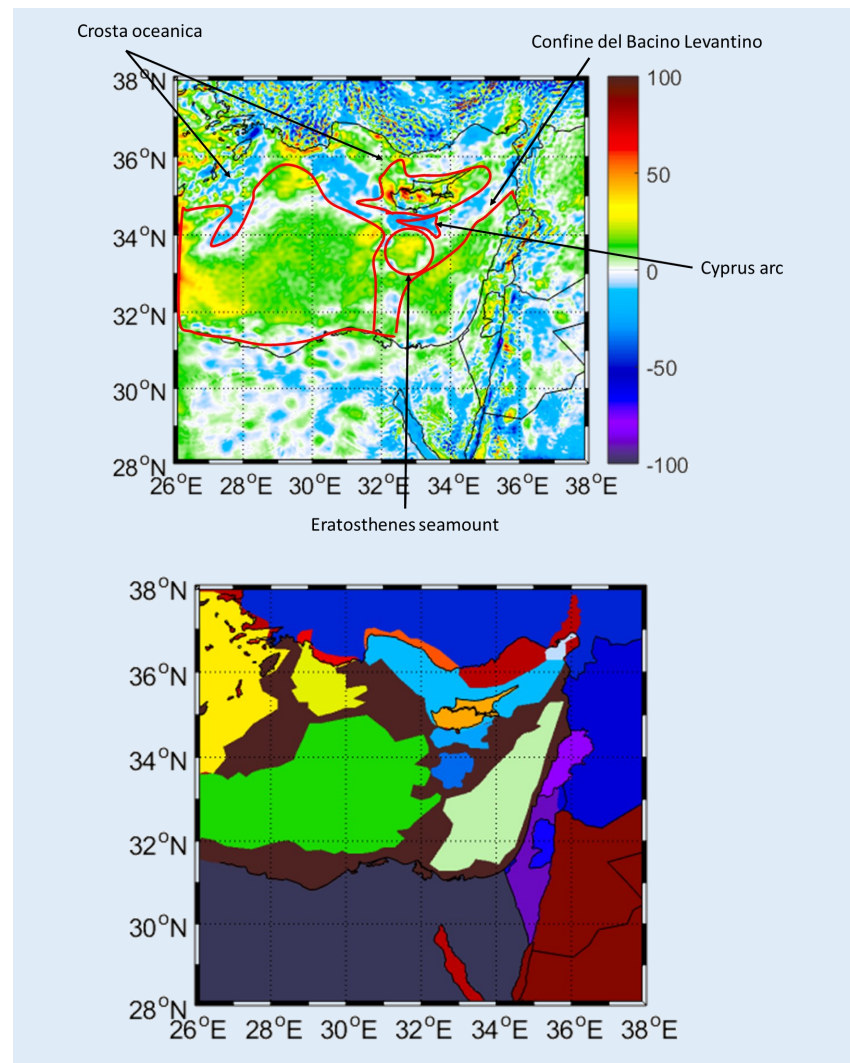
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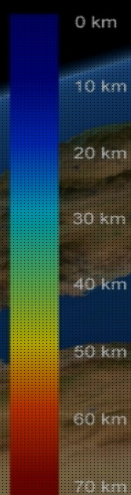
GIULIA PROJECT
GRAVITY INVERSION TO UNDERSTAND LITOSPHERIC ARCHITECTURE

MAIN OUTPUTS FROM GOCE DATA

The following maps have been obtained in the framework of the GIULIA project and are here reported as example of results from GOCE derived data analysis;

THE LEVANT TEST CASE

The Levant test case, studied within the GIULIA project, shows how gravity models based on the ESA satellite mission GOCE can be proficiently used to obtain information useful for oil & gas exploration purposes.
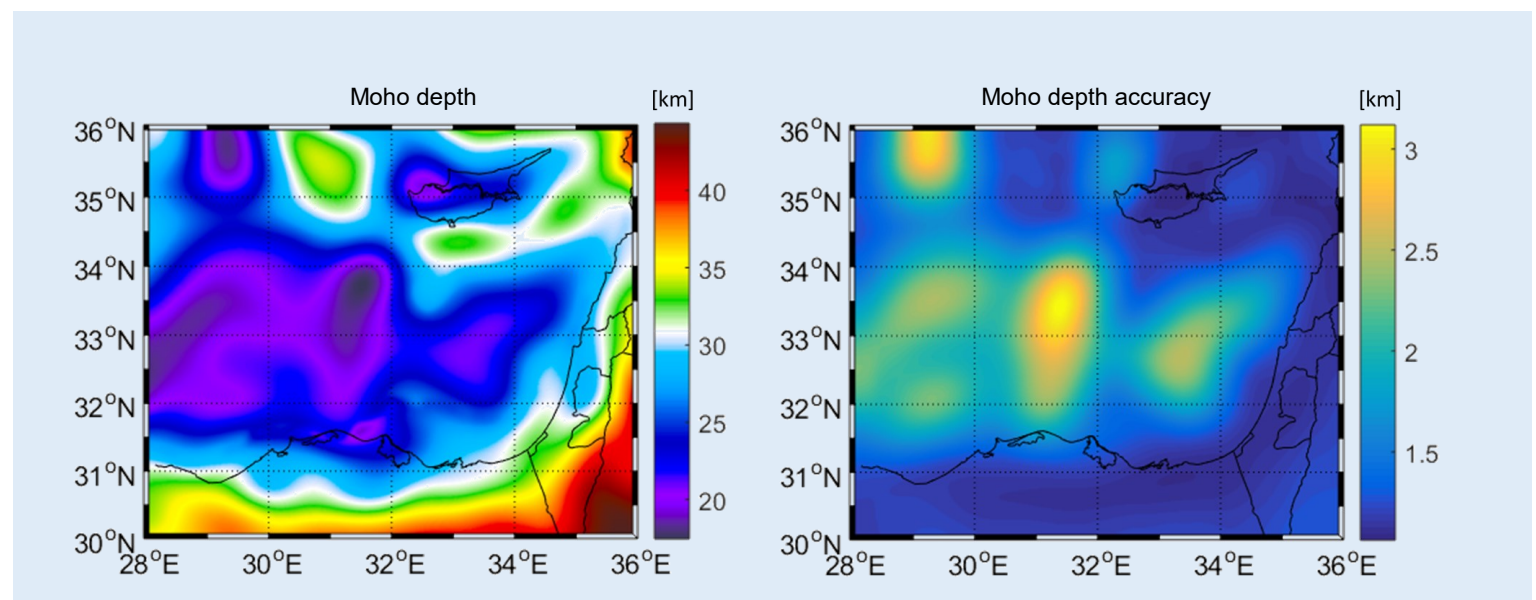
GOCE data can help in defining homogeneous (from the density point of view) geological regions and in giving information on the nature of the studied crust.

Moreover the inversion of the gravitational field, properly complemented by external information such as density models, seismic profiles, etc. allows to estimate the Moho and the basement depth.

The results allow to build a 3D density model of the region correlated by maps defining the estimated accuracy of each discontinuity.

Main Outputs that are retrieved from GOCE data analysis can be summarized as:

- Map of main geological provinces refined by exploiting a GOCE based gravity field model;
- Depth of the Moho discontinuity;
- Estimated Moho depth accuracy obtained by means of Monte Carlo analysis;
- Refined 3D density model of the region. In particular a scale factor for the density function of each geological model has been estimated.

GReD COMPETENCES IN POTENTIAL FIELD METHODS

A part from GIULIA, GReD perform several activities on the frontier of geomatics R&D for Earth knowledge to enable innovative solutions for oil & gas industry.

These research projects concern the development of methodologies and advanced techniques for the acquisition and processing of gravity data. GReD developed advanced innovative solutions that will allow to obtain higher accuracy airborne gravity observations, by combining the potential of modern satellite navigation systems to gravity data from the recent satellite missions of the European Space Agency (ESA) and NASA. The information on the obtained gravity anomalies will allow to improve the knowledge on the structure of the lithosphere for exploration activities, especially in poorly studied and frontier areas.

Moreover, GReD is studying and developing innovative solutions aimed to combine qualitative geological information with quantitative gravity data to obtain three-dimensional models of the structure over the Earth's crust.

GReD is a Politecnico di Milano Spin-off SME which studies, designs and implements innovative and highly customized solutions based on geomatic technologies. **GReD** is characterized as a center of excellence focused on Research and Development, professional advice and algorithmic elaboration for the creation of state-of-the-art and innovative solutions based on geomatic technologies in the following application areas:

- advanced surveying and cartography

- augmented GNSS

- high precision high resolution gravimetric

OTHERS GReD ACTIVITIES

GReD, in collaboration with Selesoft, delivers an innovative end-to-end service for the continuous monitoring of critical infrastructure and natural hazards by means of GNSS cost-effective receivers called, **GeoGuard (http://www.geoguard.eu/)**.

It includes activities and systems designed for the delivery of solutions, customized to different application scenarios, to provide accurate positioning with centimeter-level accuracy in near real-time, or millimeter-level accuracy for daily/sub-daily solutions.

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