

## “GOCE Italy” website and its evolution as a toolbox for data exploitation

M. MARTINO, M. MONTIRONI and F. SOLITRO

*ALTEC S.p.A., Torino, Italy*

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**ABSTRACT** The public web site of “ESA Endorsement - GOCE Italy” project provides information about the project’s objectives and its organization, scientific topics and, in general, about the GOCE mission and its applications. The “GOCE Italy” web site has been conceived as a tool to disseminate the project objectives and results to the external world. Also, it provides a virtual dashboard, where it is possible to insert event announcements and relevant publications, and a central “repository” for the projects news and publications. A special application named “GOCE Data downloader” has been added to the site, which allows for retrieving some data results generated by the mission pipeline.

**Key words:** GOCE Italy, toolbox, downloader.

### 1. Introduction

This article deals with the design and development of the public website of “ESA Endorsement - GOCE Italy” project (briefly identified in the following of the article simply with the term GOCE-Italy).

The web site (Fig. 1) available at internet address [www.goceitaly.asi.it](http://www.goceitaly.asi.it) is finalized to the dissemination. It is provided both in Italian and English languages.

### 2. Site overview

The main website’s function is to provide Internet visibility to the “GOCE Italy” project. The website provides descriptions of “GOCE Italy” group organization and focus and acts also as a central repository for project’s Publications and News.

It has been organized into the following sections:

- home: brief description of the project;
- focus: description of activity goals and project organization;
- partners: information about scientific teams involved in the project;
- publications: repository for public articles about the project;
- contacts: user interactive section enabled to send comments or request information to GOCE partners;

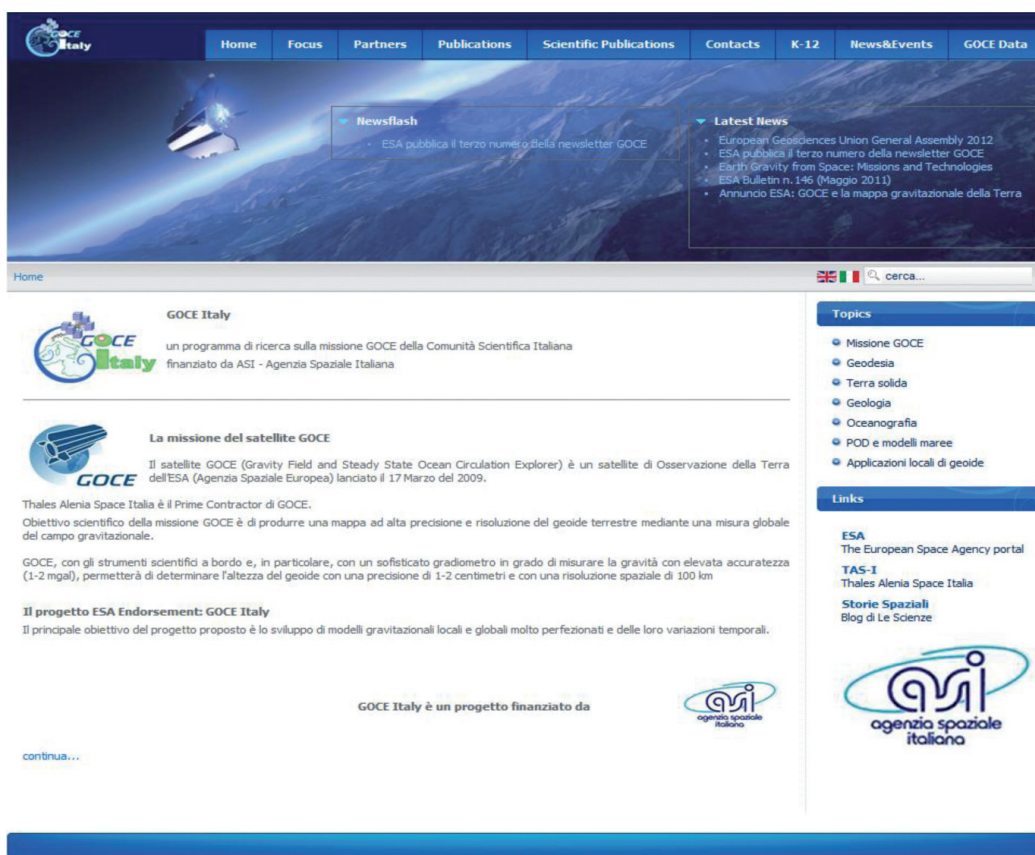


Fig. 1 - GOCE website home page.

- K-12: educational section;
- News&Events: repository for News and Events from GOCE’s world;
- topics: information about all different topics involved in GOCE project. More in detail they are:
  - GOCE mission;
  - Geodesy;
  - Solid earth;
  - Geology;
  - Oceanography;
  - POD and tide models;
  - Geoid local applications.

### 3. Technical aspects

The website back-end is set up on a Content Management System (CMS). This type of application separates the graphical part (based on the concept of templates) from the content

part (stored in a database); in addition, it is designed to store documents as well as any type of files.

When the front-end is called on to serve a page from a browser, it gets the content for that page from the database, looks at the template files to see how it should be laid out, builds the page accordingly and sends the page to the browser.

There are different open source projects based on such architecture. CMS examples are Drupal, Wordpress, Joomla.

After a benchmark evaluation of the three different alternatives conducted by the Altec team, Joomla was selected as the one that was closer to the project objectives. Joomla is written in PHP, uses Object-Oriented Programming (OOP) techniques and software design patterns, stores data in a MySQL database, and includes features such as page caching, RSS feeds, printable versions of pages, news flashes, blogs, polls, search, and support for language internationalization.

More in details it provides the following benefit:

- high customization: source code (PHP language) can be modified to fit user's needs;
- security: to-date project is always deployed with newest security patches;
- standardization: Joomla is W3C compliant;
- template customization: Joomla templates are fully customizable and the syntax used in order to modify them is much easier than the one used by its competitors.

The website has been also configured in such a way to separate the "system administration tasks" from the "content management tasks" thus allowing a "non-expert" personnel to be delegated to upload information like documents and news to the web.

#### 4. GOCE data downloader

During the project development, it came up the idea to expand the capabilities provided by the website with the addition of a more technical section dedicated to the scientific data dissemination to GOCE users authorized personnel of a selection of latest produced GOCE mission data product. These data are the result of the ground processing performed by the Politecnico of Milano.

A dedicated web based application, named "GOCE data downloader" has been developed and made accessible directly from the main menu of GOCE Italy internet site.

The application (Figs. 2 and 3) allows to retrieve data output of GOCE space-wise processing in terms of grids of  $V$  [potential values in ( $m^2/s^2$ )] and  $V_{rr}$  [ $2^{nd}$  radial derivatives in ( $1/s^2$ )]. The available grid resolution is  $0.5^\circ \times 0.5^\circ$ . Local patches of these global grids can be used as 'observations' together with their full error covariance matrix.

The GOCE data downloader has been written using PHP-5 and HTML-5; it parses GOCE data grids and retrieves values related to the selected latitude and longitude range. The main capabilities are:

- interface the data repository;
- perform data query;
- retrieve data in different format;
- manage dataset versions in the repository.

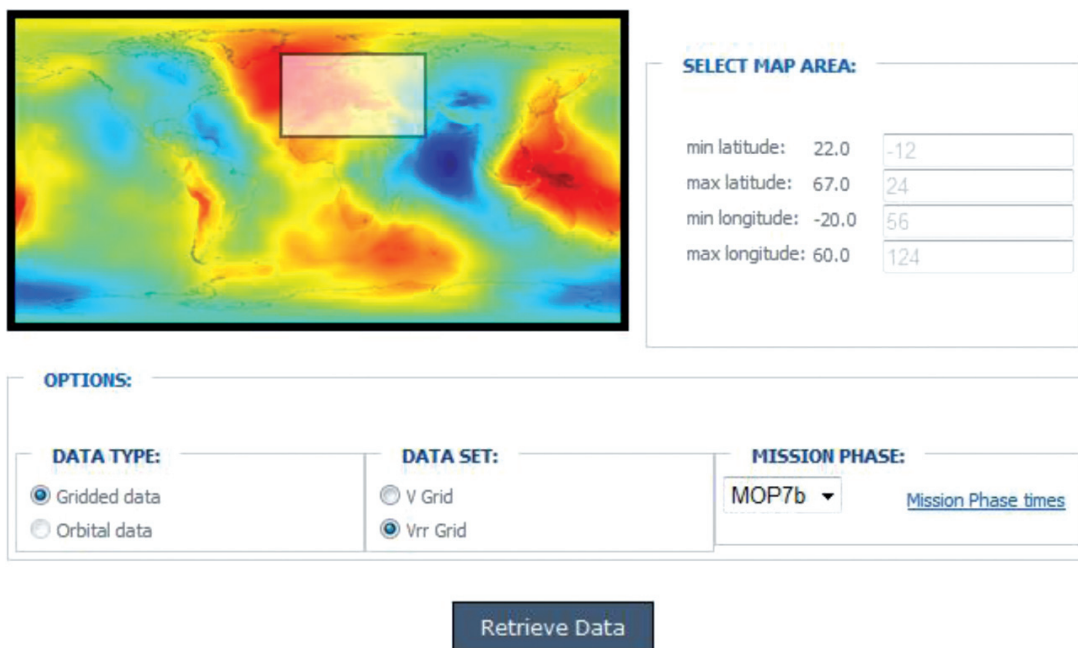


Fig. 2 - Selection area for data download.

GOCE data downloader output consists in a report page that allows downloading three files:

- a header file, that contains details of the requested data, such as data type, latitude, longitude, and so on;
- a data file, that contains requested Grid data;
- a data err file, that contains standard deviation of the requested Grid data;
- a data TC file, that contains the topographic effect of the requested Grid data.

All the files are in csv format (comma separated value), a simple and standard text format for table-like values, which can be easily imported in analysis tools (Excel, Matlab, etc.). An example of the output of one of this file (first row is the header of the file) is shown in Fig. 4.

```
Requested data summary
=====
Input type = VrrGrid
Min longitude = 56 [degree]
Max longitude = 124 [degree]
Min latitude = -12 [degree]
Max latitude = 24 [degree]
Grid radius = 266.65520 [km]
=====

Download Header file
Download Data file
Download Data Err file
Download Data TC file
```

Fig. 3 - Download of the generated files.

lambdaGrid(rad),	phiGrid(rad),	VGrid(m <sup>2</sup> /s <sup>2</sup> )
-0.34470,	1.16501,	60005929.7578932
-0.33598,	1.16501,	60005929.8536851
-0.32725,	1.16501,	60005929.7822324
-0.31852,	1.16501,	60005929.5412407
-0.30980,	1.16501,	60005929.1292562
-0.30107,	1.16501,	60005928.5457729
-0.29234,	1.16501,	60005927.7913017

Fig. 4 - Example of an output file.

## 5. The "GOCE Italy" toolbox as an evolution GOCE data downloader

The today implemented capabilities represents only an initial prototype of a possible toolbox application. This prototype can evolve progressively to include new capabilities.

A first step in this evolution has been proposed at the end of the project for customer evaluation, consisting in:

- server separation between the GOCE Data Downloader and the project web sites;
- definition of dedicated loading procedures to allow authorized end-users (with proper privileges) to update the GOCE database with new datasets;
- definition of the user authentication and authorization procedure and the associated approval process, to allow a more extended dissemination of the data;
- definition of the authentication method to be used for accessing the site by generic end-users, including policies for set/reset of user passwords;
- development of additional and complex data type download based on user queries, with addition of server side data processing capabilities, if needed.

Then further steps can be considered that could lead to the definition of a GOCE Toolbox. The main elements in its architecture definition are:

- extension of the central DB repository to include in a more structured way the global EGM08 model, additional and extended GOCE data elaborated by PoliMi, in situ available data, user specific database, etc.;
- system interactions and integration with external DB or application / toolbox;
- advanced user graphical interface to make ease and immediate the data query and retrieval, data processing and correlation, integration with user applications;
- possibility to include procedures for data elaboration and analysis, based on the algorithms or software modules developed by the users;
- advanced output data and final products graphical visualization.

A few applications for the development of GOCE toolbox, in support to engineering applications and civil protection activities, have been identified:

- the use of geoid for an accurate estimation of orthometric heights starting by the ellipsoid ones;
- a refinement of the procedure for a more accurate estimation of a very local geoids;

- a procedure for the improvement of geoid estimation in areas not covered by on ground gravimetric data;
- a refinement of the procedure for a more accurate local estimate of the gravity field;
- implementation of a gravimetric inversion method for the refinement of the geologic model relevant to a selected area of Piedmont.

From an architectural point of view, several features of this toolbox can be provided through standard web based application. For more advanced graphical and processing needs, local user applications could be necessary to benefit of higher local computer performances (possibly developed with a platform independent approach), even if continuous synchronization with the central DB for getting the latest data set information or distributed DB information collection has to be maintained.

*Corresponding author:* Filomena Solitro  
ALTEC S.p.A.  
Corso Marche 79, 10146 Torino, Italy  
Phone: +39 011 74 30 079; fax: +39 011 74 30 064; e-mail: [filomena.solitro@altecspace.it](mailto:filomena.solitro@altecspace.it).