



## **INTERNATIONAL GEOID SERVICE**

at DIIAR (Sezione del Rilevamento)

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### **International Geoid Service Report (2003-2007)**

Since the IAG/IUGG General Assembly held in Sapporo, IGeS actively continued its educational and research mission on geoid estimation.

In 2005 and 2006, IGeS organized two new schools on "The determination and Use of Geoid". These schools continued the tradition of IGeS, which in the past has organized five geoid Schools: Milano (Italy - 1994), Rio de Janeiro (Brasil - 1997), Milano (Italy - 1999), Johor (Malesia - 2000), Thessaloniki (Greece - 2002).

The first one took place in Budapest, from January 31<sup>st</sup> to February 4<sup>th</sup> 2005. It was hosted by the Department of Geodesy and Surveying of the Budapest University of Technology and Economics (BUTE) in cooperation with the Research Group for Physical Geodesy and Geodynamics of the Hungarian Academy of Science (HAS).

The courses have been given by Fernando Sansò (A compendium of physical geodesy in view of geoid computation and related height questions), Riccardo Barzaghi (The Global Geopotential Models), Christian C. Tscherning (Geoid Determination by least-squares collocation using GRAVSOFIT), Michael G. Sideris (Geoid Determination by FFT Techniques) and Ilias N. Tziavos (The Terrain Effects in Geoid Estimation). One seminar on "Present Day Activities of the International Gravimetric Bureau (BGI)" was presented by M. Abbasi and Th. Fayard from BGI, France.

The Lecture Notes on Global Geopotential Models was prepared by Peter Schwintzer (GeoForschungsZentrum, Potsdam), who passed away before the School. His Lecture Notes titled as "The gravity field of the Earth: global gravitational potential models" is dedicated in memory of Peter Schwintzer.

All courses, but for the first one, have been followed by computer exercises based on the available software programs. 49 participants attended the School. They come from 19 countries: Canada (3), Croatia (3), Czech Republic (1), Denmark (3), France (3), Germany (3), Greece (1), Hungary (5), Italy (3), Malaysia (1), Pakistan (8), Poland (4), Portugal (1), Saudi Arabia (3), Slovakia (1), Slovenia (1), Spain (2), Turkey (2) and Ukraine (1).

In June 19<sup>th</sup>-23<sup>rd</sup> 2006, the second geoid school was organized in Copenhagen. It was hosted by the Niels Bohr Institute at the University of Copenhagen. The teachers were Fernando Sansò (General introduction to Physical Geoid and general theory on geoid computation), Niko Pavlis (The Global Geopotential Models), Christian C. Tscherning (The collocation method in Physical Geodesy), Michael G. Sideris (FFT methods in Physical Geodesy) and Rene Forsberg (The Terrain Effects in Geoid Estimation). One seminar on "Geoid, gravity and sea-level from radar altimetry" was presented by Ole Andersen by the Danish National Space Center.

All courses, but for the first one, have been followed by computer exercises. 20 participants attended this School. They come from 13 countries: Brazil (1), Denmark (5), Egypt (1), Italy (2), Morocco (2), Mexico (1), Norway (1), Portugal (1), Romania (1), Spain (3), Switzerland (1), Turkey (1), USA (1).

As done in the previous schools, lecture notes and software for geoid computation have been distributed to the students.

On the scientific side, IGeS is participating to the project aimed at estimating the new European geoid, a Commission Project which is chaired by Heiner Denker. In this framework, IGeS has carried out the validation of the SRTM DTM and of the NOAA 1' × 1' bathymetry in the Mediterranean area. Also, the gravity data base covering the Western/Central part of the Mediterranean has been checked using the collocation filtering technique and will be used in the European geoid project. Furthermore, within this project, IGeS is in charge for the computation of the terrain effect (using an original approach) and for the estimation of the residual geoid component by means of collocation.

Also, a new project will soon be started to test for different geoid estimation methods using a common and reliable data base (kindly supplied by H. Duquenne).

Furthermore, IGeS is strongly involved as a member of the European GOCE Gravity Consortium (EGG-C) in the GOCE High-level Processing Facility (GOCE HPF) whose activities started in April 2004.

Within the GOCE Ground Segment, the HPF is one of the Core Elements (ESA-controlled), and it is charged with the generation of L2 products and acquisition of the external (auxiliary) data needed to generate these products, the delivery of these products (auxiliary, intermediate and final) to the PDS/DPA (Payload Data Segment/Data Processing Archive) and/or the LTA (Long Term Archive) and the generation of QLP (Quick Look Products) and ECP (External Calibration Products) for the purpose of the activities of the CMF (Calibration and Monitoring Facility).

Members of the GOCE HPF are:

- IAPG Institute of Astronomical and Physical Geodesy, Technical University Munich, Germany (Principal Investigator);
- AIUB Astronomical Institute, University of Bern, Switzerland;
- CNES Centre National d'Etudes Spatiales, Groupe de Recherche de Géodésie Spatiale, Toulouse, France;
- FAE/A&S Faculty of Aerospace Engineering, Astrodynamics & Satellite systems, Delft University of Technology, Delft, The Netherlands;
- GFZ GeoForschungsZentrum Potsdam, Department 1 Geodesy and Remote Sensing, Potsdam, Germany;
- ITG Institute of Theoretical Geodesy, University Bonn, Germany;
- IGeS- POLIMI, DIAR – Sezione Rilevamento, Politecnico di Milano, Italy;
- SRON National Institute for Space Research, Utrecht, The Netherlands;
- TUG Institute of Navigation and Satellite Geodesy, Graz University of Technology;
- UCPH Department of Geophysics, University of Copenhagen, Denmark.

Within the GOCE HPF, the establishment of a sub-processing facility for GOCE data and the retrieval of the gravity field with the space-wise approach is under responsibility of IGeS-POLIMI as contractor, with UCPH as sub-contractor. In addition ITG is participating as science consultant. The sub-processing facility will be developed at two sites, namely at IGeS-POLIMI and UCPH, and operated at one facility at IGeS-POLIMI.

The software to perform the space-wise approach will be made up of already existing modules developed at UCPH (GRAVSOFT) and modules developed at IGeS-POLIMI for the purpose

(based on existing routines). This software will be integrated and tested as a whole, so that the data stream from GOCE will flow smoothly through it, in a unique processing chain implemented in a Sub-Processing Facility (SPF) located at IGeS-POLIMI.

IGeS web has been also updated and renewed during the last four years and contains at present 28 geoid data files and a collection of 11 global geopotential models. Furthermore, the CD containing the software on geoid computation (the same distributed at the geoid schools) can be requested through the IGeS web, under the same restrictions applied when distributing it during the geoid schools (freely available after a declaration stating for non commercial use of this software).

The editorial activity, which started in 1993, is now continuing in a new form. From December 2003, the IGeS and the BGI Bulletins have been merged in the new Newton's Bulletin. The Newton's Bulletin is a reviewed scientific journal collecting paper on geoid and gravity. Three issues are available, in electronic form, on the IGeS web page, together with 13 issues of the previous IGeS Bulletin.

IGeS also promoted, together with BGI, NIMA, ICET and GFZ, the creation of a new IAG service named International Gravity Field Service (IGFS). IGFS is a unified IAG service aiming at collecting, validating and distributing data and software for the purpose of determining, with various degrees of accuracy and resolution, the gravity potential of the Earth, or any of its functional, and the surface of the Earth. This new service has been approved by the IAG Executive Committee during the last IAG-IUGG Assembly in Sapporo.

In this framework, IGFS actively participated in organizing the 1<sup>st</sup> IGFS General Assembly which was held in Istanbul, August 2006.

Besides, IGeS, as an official IAG service, is involved in the Global Geodetic Observing System (GGOS) project which aims at collecting geodetic data and integrating them to "provide the scientific and infrastructure basis as geodesy's significant contribution to global change research in Earth sciences"

On the national Italian side, IGeS has estimated the new high precision Italian geoid and it is cooperating with the Italian Space Agency (ASI), the Istituto Geografico Militare (IGM), the Agenzia del Territorio (Italian National Cadastre), the Istituto Nazionale di Geofisica e Vulcanologia (INGV) and the Istituto Nazionale di Oceanografia e Geofisica Sperimentale (OGS).