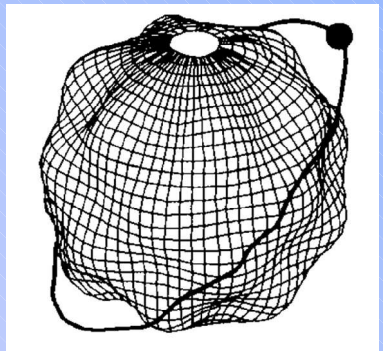
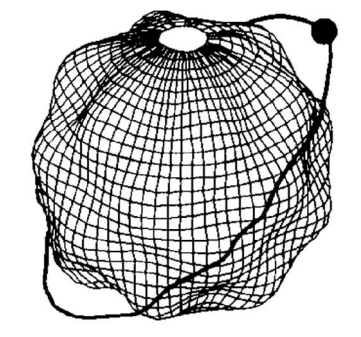
The International Geoid Service (IGeS)



IGeS activities in the last ten years

Integrating IGeS into GGOS

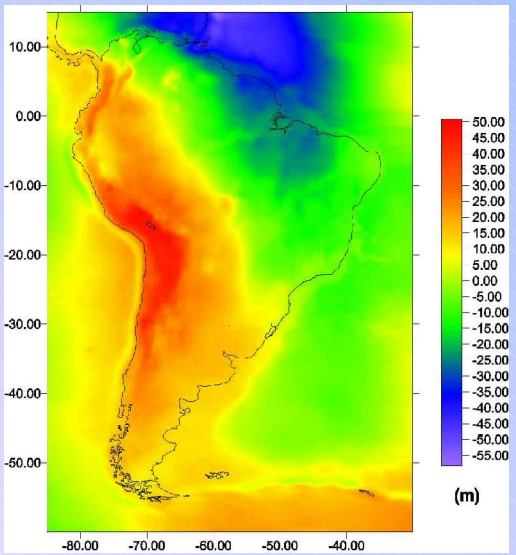
IGeS activities in the last ten years



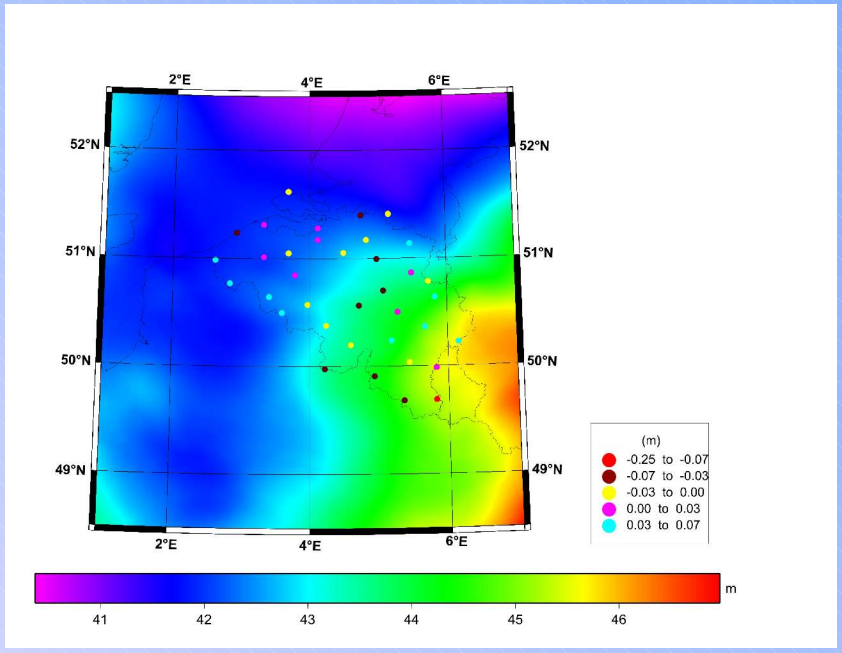
- Projects
- Schools on geoid determination
- Bulletin - WEB page

The IGeS projects (1)

2000: Quasi-geoid determination in South America (cooperation with NIMA and Escola Politecnica Universitade de Sao Paulo)

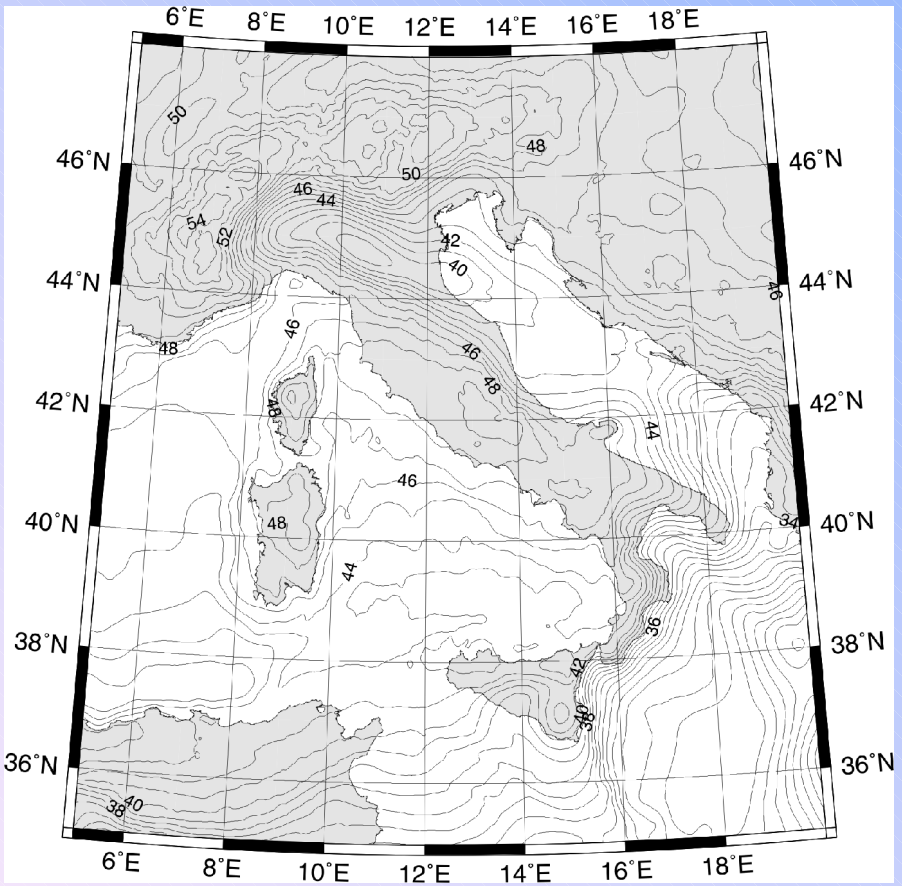


2003: Quasi-geoid determination in Belgium (cooperation with Royal Observatory of Belgium)



The IGeS projects (2)

2005: the last estimate of the Italian quasi-geoid



- Improved gravity data set

- Outliers rejection based on collocation

- New DTM model based on NASA/SRTM3 data and NOAA 1' bathymetry

- GPM98CR geopotential model used to account for low frequencies components

- Remove-restore technique

- Fast-collocation to get the residual height anomaly estimate from residual gravity

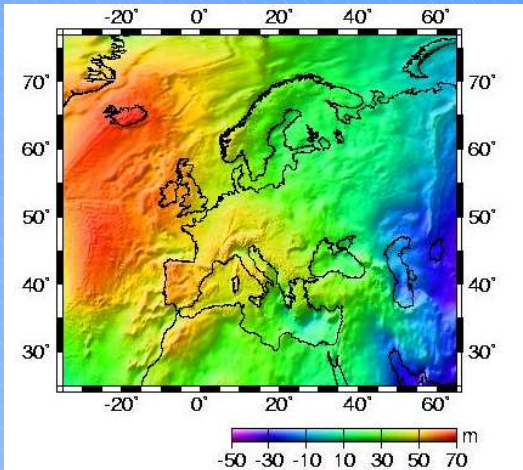
The IGeS projects (3)

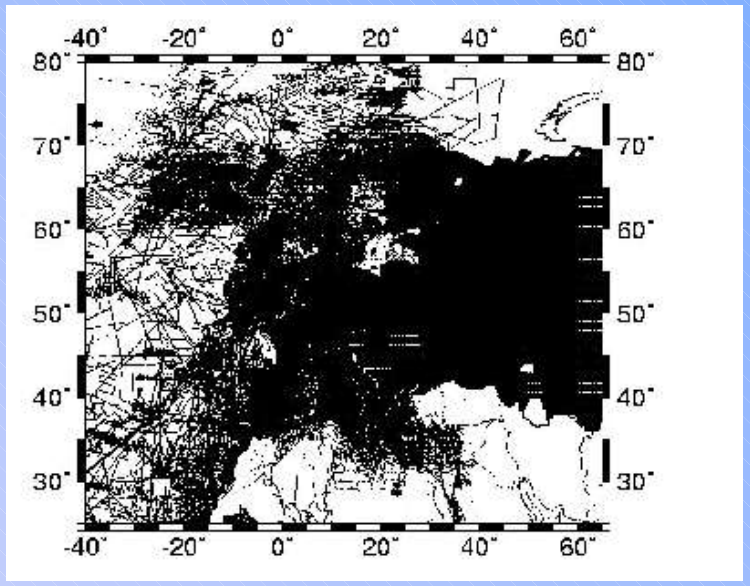
2005/07: The new European quasi-geoid (IAG working group chaired by H. Denker)

i) Improved global gravity filed models from CHAMP, GRACE and GOCE
ii) New terrain data (GTOPO30, SRTM)
iii) New or improved gravity data for some regions
iv) New altimetric gravity data (e.g. KMS2002)
v) Improved modelling and computation techniques

Improvements in quasi-geoid estimate are expected

The EGG97 model





The present day gravity data base in Europe

The IGeS projects (4)

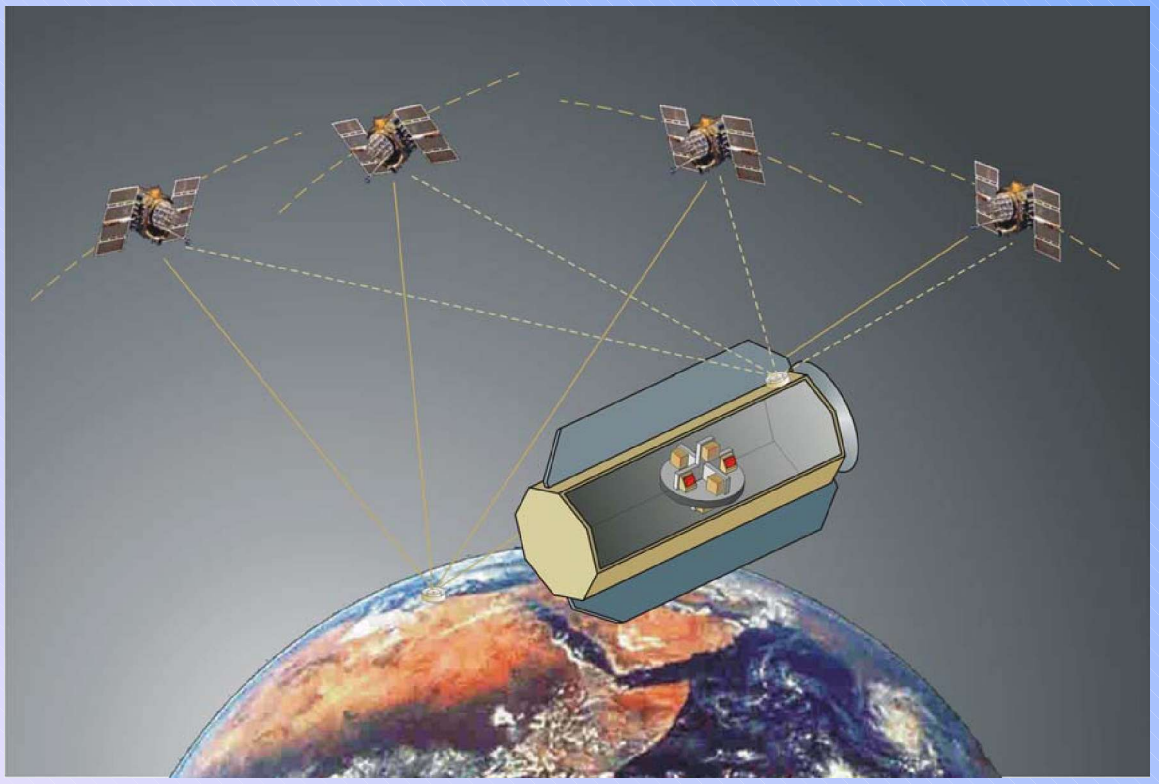
2007: Quasi-geoid determination in Pakistan through an on line co-operation with local institutions (Phd students that attended the Budapest geoid school)

- 78795 gravity data values
- DTM model based on NASA/SRTM3
- EGM96 geopotential model used to account for low frequencies components
- Remove-restore technique
- Fast-collocation to get the residual height anomaly estimate from residual gravity

The IGeS projects (5)

GOCE

***G**ravity field and steady-state **O**cean **C**irculation **E**xplorer*



GOCE gravity gradiometry with h-l SST

GOCE mission rationale

GOCE will be the first gravity gradiometry satellite mission.

- It will be continuously tracked in three dimensions by the system of GPS satellites
- It will control drag forces and eliminate remaining residual effects by differential measurement, the so-called common mode rejection principle.
- It will fly in an extremely low and almost polar orbit (sun-synchronous).
- It will allow to measure the gravity field in three spatial dimensions independently and without any preferred direction.

The goal of GOCE is a global geoid of 1÷2 cm accuracy at about 100 km spatial resolution (e.g. a gravity field with 1÷2 mgal precision accuracy).

This would serve four major objectives in geodesy:

- control or replacement of traditional levelling by “levelling with GPS”
- unification of height systems (height datum)
- inertial navigation
- improvement of satellite orbit trajectories prediction

EGG - C

European Gravity Gradiometry Consortium

EGG-C was established in 2001, involving ten Universities and Research Institutions all over Europe. The groups are from:

- National Institute for Space Research, Utrecht, **The Netherlands**
- Institute of Astronomical and Physical Geodesy, Technical University Munich, **Germany**
- Astronomical Institute, University of Bern, **Switzerland**
- Delft Institute for Earth-Oriented Space Research, Delft University of Technology, Delft, **The Netherlands**
- GeoForschungsCentrum Potsdam, Department 1 Geodesy and Remote Sensing, Potsdam, **Germany**
- Institute of Theoretical Geodesy, University Bonn, **Germany**
- Centre National d'Etudes Spatiales, Groupe de Recherche de Géodésie Spatiale, Toulouse, **France**
- Institute of Geodesy, Department for Theoretical Geodesy, Graz, **Austria**
- IGeS-DIIAR, Sezione Rilevamento, Politecnico di Milano, **Italy**
- University of Technology, Department of Geophysics, University of Copenhagen, **Denmark**

EGG - C

European Gravity Gradiometry Consortium

The **POLIMI-IGeS** group participates in EGG-C working on the original concept of GOCE data analysis by means of the **space-wise approach**, which has been recognized by ESA as an official GOCE data reduction scheme for the production of a GOCE Earth gravity field model.

Other groups working in EGG-C on official GOCE data analysis and product preparation are:

- Institute of Geodesy, Department for Theoretical Geodesy, Graz, Austria → **time-wise approach**
- Centre National d'Etudes Spatiales, Groupe de Recherche de Géodésie Spatiale, Toulouse, France → **direct approach**

The geoid schools

The lectures are given according to the following general scheme:

- introduction to physical geodesy with special emphasis on geoid computation and collocation theory;
- the computation and use of high degree and ultra-high degree geopotential models;
- the geoid computation using Stokes' integral;
- terrain effetcs in geoid estimation;
- FFT techniques in geodesy.

Lectures are followed by computer exercises based on the available software

Lecture notes of these courses are distributed to the participants as well as CD containing software an exercises

The geoid schools started in 1994, in Milano.

The last two were held in **Budapest** (2005) and in **Copenhagen** (2006)

The Budapest school (January 31st- February 4th, 2005) was hosted by the BUTE University in co-operation with the Research Group for Physical Geodesy and Geodynamics of the Hungarian Academy of Science.
49 participants attended the school, from 19 different countries.

The Copenhagen school (June 19th-23th, 2006) was hosted by the Niels Bohr Institute at the University of Copenhagen.
23 participants attended the school, from 13 different countries.

The IGeS and the IGeS-BGI Bulletins

13 issues of the IGeS Bulletin have been published
and are available on the IGeS web page

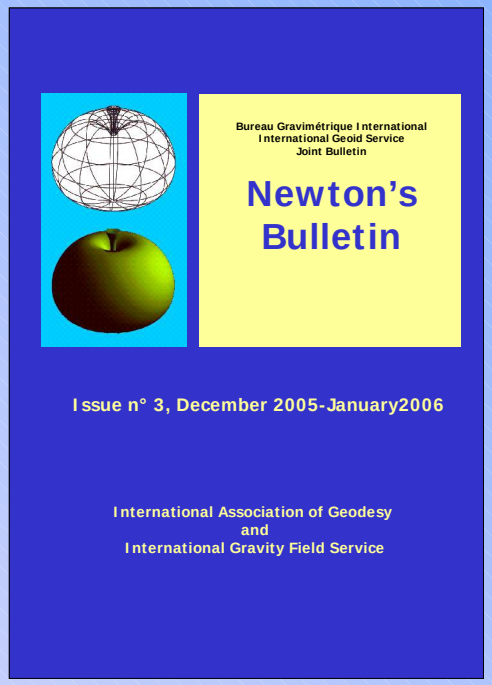
The IGeS and the BGI bulletins have been merged in the Newton's Bulletin

The first number has been issued in December 2003

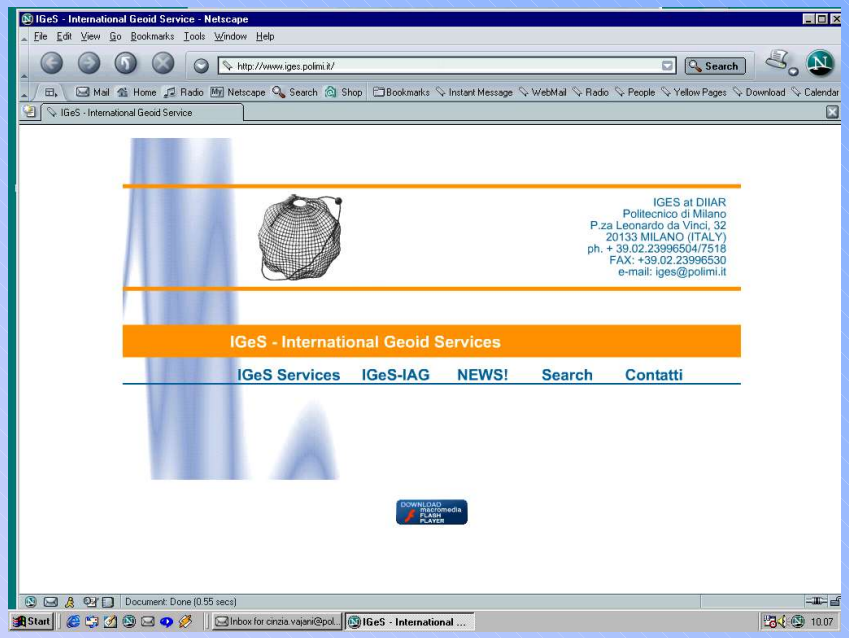
The Newton's Bulletin
contains papers
on geoid estimation and gravity

Submitted papers undergo
a peer review process

3 issues othe the Newton's Bulletin
are available on the IGeS web page



The IGeS web page: www.iges.polimi.it



- 23 geoid data files
- 11 global geopotential models
- software on geoid computation available
- IGeS and Newton's Bulletin on line
- Geoid school information

Integrating IGeS into GGOS

IGeS and IGFS

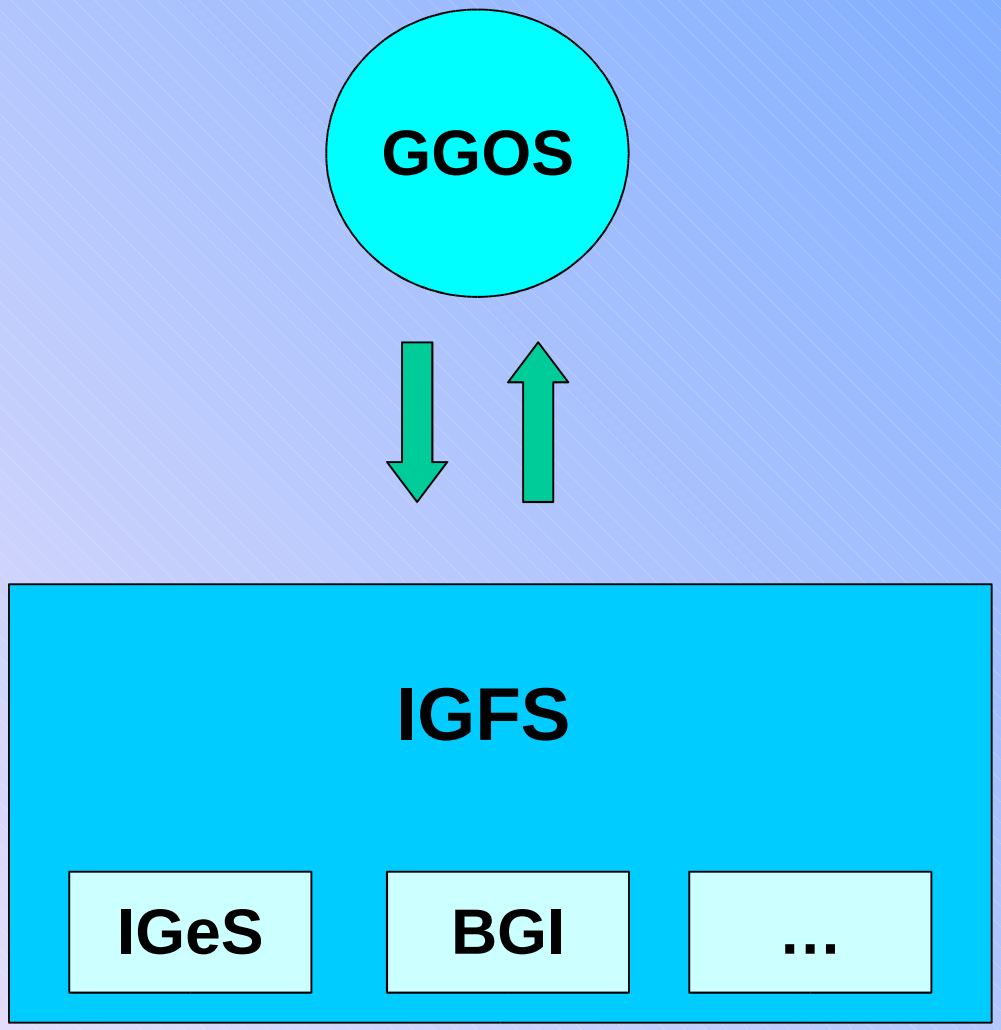
IGeS, BGI, NIMA, ICET and GFZ have promoted the creation
of a new IAG service named

International Gravity Field Service (IGFS)

as a unified structure aiming at collecting, validating and distributing
data and software
for the purpose of Earth gravity geopotential determination
and determination of the Earth surface

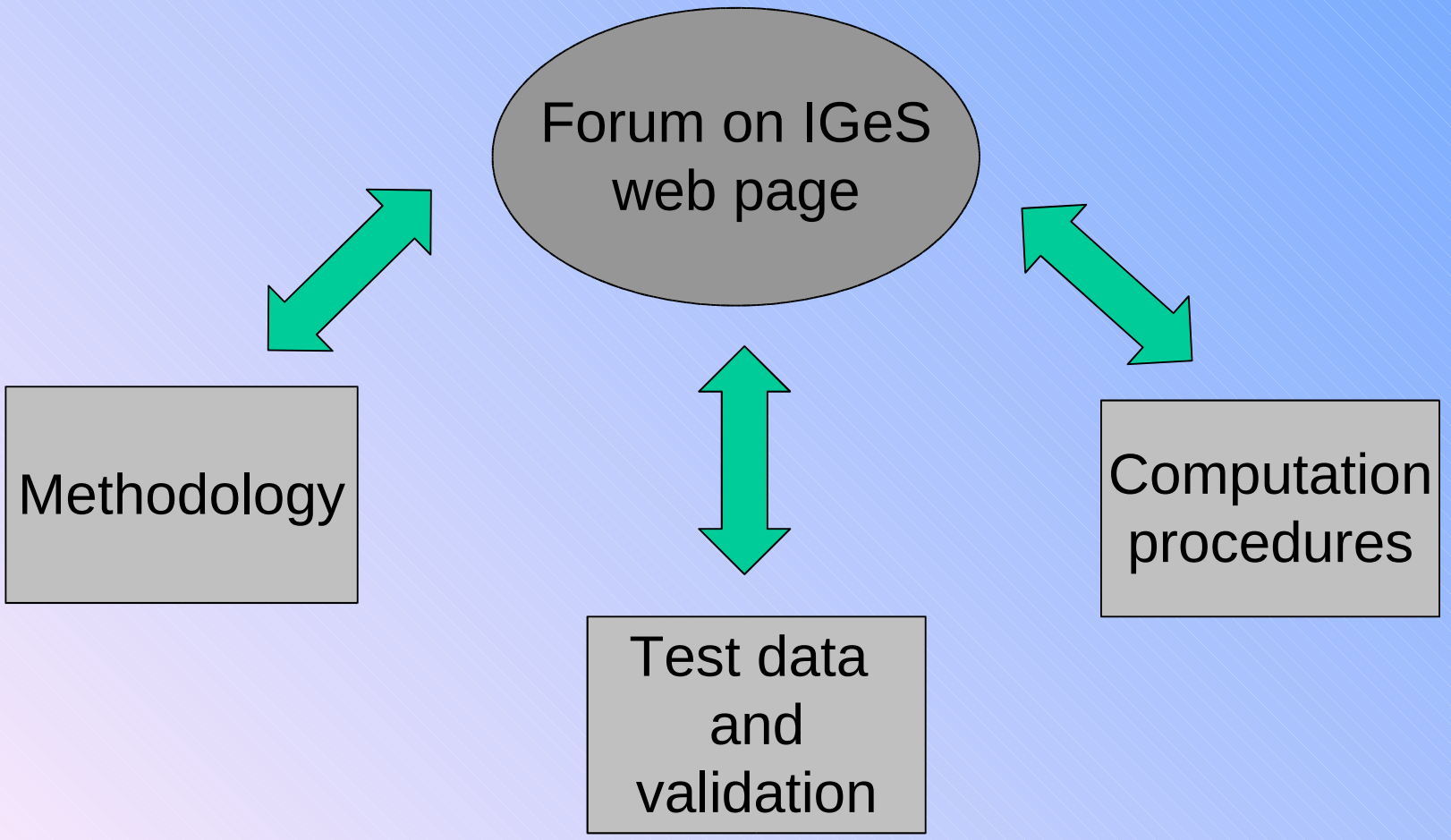
This new Service has been officially established during the last
IAG-IUGG General Assembly in Sapporo

A possible hierarchical structure



The possible role of IGeS-IGFS into GGOS(1)

IGeS as a service for the standardization and validation of geoid estimation procedures



The possible role of IGeS-IGFS into GGOS(2)

Schools on geoid estimation
to be held regularly every two years
(the structure of the courses should change slightly)

Support to Agencies, scientists ….
for the computation of regional geoids

Newton's Bulletin to be continued
improving the co-operation with BGI
and
enlarging its Editorial Board

The possible role of IGeS-IGFS into GGOS(3)

IGeS as a service
on
physical height reference system
and
its relation to geometrical heights