The International Gravity Field Service and GGOS

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Structure of the IGFS - International Gravity Field Service

International Gravimetric Bureau (BGI) – Director Richard Biancale (temporary)
International Geoid Service (IGeS) – Director R. Bazarghi
International Center for Earth Tides (ICET) – Director B. Ducarme (to retire 2007)
International Center for Global Earth Models (ICGEM) – Director J. Kusche
International DEM Service (IDEMS) – Director P. Berry

Technical Center of the IGFS – chief geodesist S. Kenyon, NGA
International Gravity Field Service

IGFS is a new unified "umbrella" IAG service, which will
- Coordinate collection, validation, archiving and dissemination of gravity field related data
- Coordinate exchange of software of relevance for gravity field activities
- Coordinate courses, information materials and general public outreach relating to the earth's gravity field

The overall goal of IGFS is to coordinate the servicing of the geodetic and geophysical community with gravity field-related data, software and information. The combined data of the IGFS entities data will include both satellite-derived global models, terrestrial, airborne, satellite and marine gravity observations, earth tide data, GPS leveling data, digital models of terrain and bathymetry, as well as ocean gravity field and geoid from satellite altimetry. Both the static and the temporal variations of the gravity field will be covered by the IGFS.

IGFS is not handling gravity field data distribution directly - IGFS will function as a unifying service for the following gravity-field related IAG services - "IGFS Centres":

BGI - International Gravity Bureau - collection, archiving and distribution of gravity data
IGeS - International Geoid Service - collection and distribution of geoid models, geoid schools
ICET - International Center for Earth Tides - collection and archiving of global earth tide data
ICGEM - International Centre for Global Earth Models - distribution of satellite and surface spherical harmonic models
IDEMS - International DEM Service - Global Digital Terrain Models

IGFS Technical Centre - National Geospatial-Intelligence Agency [geodesy - G&G dept] - advise on global models, geoid and gravity, supplementing other services

The IGFS was established by the International Association of Geodesy Executive Board at the General Assembly in Sapporo, Japan, August 2003, and is an IAG "level-2" service under IAG Commission 2 - Gravity Field. One of the main arguments for establishing IGFS was to provide a more focussed role of the gravity field, as one of the three fundamental pillars in IAG's first project - GGOS, the Global Geodetic Observing System. For more background information on GGOS and IGFS click here (presentation for Cairns 2005).

Another important role of the IGFS is to take initiative and coordinate international data collection projects, such as e.g. the Arctic Gravity Project, and the ongoing development of the new NGA high-resolution spherical harmonic reference model EGM08, complete to degree and order 2160.
**PROVIDED SERVICES:**

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<tr>
<th>Service</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>DOCUMENTATION ONLINE</td>
<td>Publications, thesis, reviews, forums and maps</td>
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<tr>
<td>CONSULTING</td>
<td>Land data</td>
</tr>
<tr>
<td>CONSULTING</td>
<td>Sea data</td>
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<td>Downloading</td>
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<td>DETAILED SERVICES</td>
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**http://bgicnes.fr:8110**

**http://www.iges.polimi.it/**
International Centre for Global Earth Models (ICGEM)

ICGEM is one of six centres of the International Gravity Field Service (IGFS) of the International Association of Geodesy (IAG). The other five Centres are:

- Bureau Gravimetrique International (BGI) at CNES / CRGS, Toulouse, France
- Digital Elevation Model Centre (DEM) at Montfort University, UK
- International Centre for Earth Tides (ICET) at Obs. Royal de Belgique, Brussels, Belgium
- International Geoid Service (IGeS) at Politecnico di Milano, Milan, Italy
- Technical Support Centre of IGFS at NGA, Saint Louis, USA

Services of ICGEM

- collecting and long-term archiving of all existing global gravity field models
- validation of global gravity field models by standardized procedures
- collecting and long-term archiving of software for global gravity field models, manipulation and transformation
- user interface for getting access to global gravity field models, validation results and manipulation software
- web site for tutorials on global gravity field models, user interaction with the service and online software application
- contribution to IGeS schools
- yearly activity report

ICGEM Centre's staff at GFZ Potsdam

- Peter Schwintzer (Director)
- Franz Bartelmes
- Wolfgang Köhler
- Hartmut Pfug

We mourn Peter Schwintzer, who died unexpectedly on 24 December 2004

Last modified 26.4.2005 Wolfgang Köhler

http://icgem.gfz-potsdam.de/ICGEM/ICGEM.html


International Center for Earth Tides
Federation of Astronomical and Geophysical Data Analysis Services, FAGS
World Data Center-C For Earth Tides

For any request please contact: Bernard DUCARME
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BRUSSELS B-1180
BELGIUM
Tel: +32 2 373 0248
Fax: +32 2 374 9822
NGA is also acts as a "gravity field service"... e.g. EGM06/WGS84 development, gravity info etc.

http://earth-info.nima.mil/GandG/

www.cse.dmu.ac.uk/EAPRS/iag/index.html

Our Mission:
Provide Accurate and Timely Geodetic, Geophysical, Geotechnical Analysis, and Geospatial Intelligence Information to Support National Security, Department of Defense, and Intelligence Objectives.

NEW Warning for GEGRANS users of the EGM96 Variable GRID Geol

NEW EGM Harmonic Synthesis Software and "Test" Coefficient Sets Now Available
Core of a service: Online information ..

**BGI example – reference gravity**

BGI DATABASE EXTRACTION
Gravity reference stations:

The portrayal of boundaries and the states’ names must not be taken as implying approval by BGI of the political status.

*If you want a more complete station description, with the microfiche number of their sketch, click on the button.*

reference station description
Core of a service: Online information ..

GRACE example – ICGEM

- 100+ spherical harmonic models “in stock”
- Online visualisation
- Online computation of grids
- Both static and temporal fields
  (but no U Texas and JPL monthly solutions)
Current IGFS activities

• Meetings:
  - Workshop on Height systems, Geoid and Gravity of the Asia-Pacific - Mongolia, June 2006
  - International Workshop on Gravity and Geoid in South America - Buenos Aires, Sep 25-29, 2006
  - Workshop on gravity and geoid for East Africa – Addis Abeba, Oct 2007?

• Other service activities:
  - Schools: Microgravimetry school, BGI/ICET, Geoid schools (IGeS)
  - Joint bulletin: Newton’s Bulletin – technical journal of the BGI and IGeS.
Current IGFS activities (continued)

- Joint IAG Commission 2 / IGFS working group for validation of new EGM07 ultra-high resolution ($n_{\text{max}} = 2160$) global gravity field model – new “official” GGOS reference model?

- IGFS active support of the release of regional gravity field data for various regions of the world to enhance the overall quality of geopotential combination models.

- Working group on absolute gravimetry standards and global net – H. Wilmes, BKG/Germany
Earth Gravitational Model

Next … EGM 2007

- **CHAMP** and **GRACE** satellite gravity missions
  - 100x improvement in the accuracy with which large regional features of the gravitational field can be modeled

- Need for higher-resolution model of the gravitational field and geoid
  - 5’ x 5’ resolution
  - n=m=2160
  - 15 cm global RMS accuracy goal for geoid
## Progression of EGMs

**EGM96**
- 30’x30’ resolution
- 50 cm RMS accuracy
- 70 x 70 error propagation
- 40 satellites used for long $\lambda$’s
- GEOSAT
- 30 M surface gravity values
- 29 elevation codes
- 130 K coefficients

**EGM07**
- 5’x5’ resolution
- 15 cm RMS accuracy
- 2160 x 2160 error propagation
- GRACE used for long $\lambda$’s
- MSS from retracted ERS-1, GEOSAT, TOPEX, etc.
- 55 M surface gravity values
- SRTM, ICESAT
- 4.7 M coefficients
Earth Gravitational Model 1996

15‘x15’ Geoid Height Grid for the US
Earth Gravitational Model 2007
5‘x5’ Geoid Height Grid for the US
5′×5′ Gravity Anomaly Data Sources (v080306)
“Striping” Problems Associated with GRACE

Dynamic Ocean Topography: GSFC00 MSS minus GGM02C_EGM96 Geoid
(from Chambers and Zlotnicki, 2004)
PGM2006B Residual Gravity Anomalies (Nmax=160)

Frequency

N = 9331200
RMS = 2.18
GPS/Leveling Comparisons Over CONUS
GPS/Leveling Comparisons Globally
GPS levelling data – evaluation of geoids (Russia example, G. Demianov, Tsniiigaik)
Need more co-located observatories (VLBI, Laser, GPS, abs.grav., …)
Many regional initiatives (”5-D networks”) - ECGN/Europe, NGOS/Nordic ..) ..
Absolute gravity database and standardization: BKG

Figure 3: Frontpage of the user interface with interactive map
Superconducting gravimetry cooperation ..
– Global Geodynamics Project … ~ 20 sites

- ICET earth-tide sites:
~200 stations
Gravity field ”products” for GGOS

**Essential to limit products to "globally relevant” quantities:**
- Global gravity field models – spherical harmonics – consistent methodology … satellite-only \((n \sim 200)\), combination \((n \sim 360 \text{ or } 2160)\)
- Global vertical datum \((6 \text{ mm } \sim 10^{-9})\)
- Precise refined geoid models .. especially around key GGOS station sites
- Absolute and superconducting gravity networks
How to improve IGFS and the gravity field services?

* Conventions and recommendations for gravity field products..

* **Improving the global gravity field data base**  
  Coordinated global campaigns (e.g., absolute gravity)  
  Coordinated efforts for terrestrial gravity data + GPS/levelling data release.  
  Coordinated efforts for airborne gravimetry over unsurveyed regions (e.g., Antarctica).

* **Web:** conventions, access to basic data, background info.  
  A one-stop web site for all gravity related information?  
  Tutorials and background material for physical geodesy?

* **Do we need one unified gravity field model for GGOS??**  
  *(EGM07 the first candidate model? But how about time changes?)*

Need to have soon: A Central Bureau (IERS model)
The vision for IGFS

• "Seamless" online service to a broad set of users: scientific, government and commercial .. through a distributed set of service centers (BGI, IGeS, ICGEM ..)

• Standards and conventions recommendations
  Endorsement of International Earth Geopotential Models

• Coordinated effort for global surveys and data exchange

• Complete set of gravity-relevant services
  GRACE highlight needs for easier access to model corrections such as geodynamics effects (ICE5G), tides ..