

IGFS Structure

Director : Rene Forsberg

International Gravimetric Bureau (BGI) – Director S. Bonvalot

International Geoid Service (IGeS) – Director R. Barzaghi

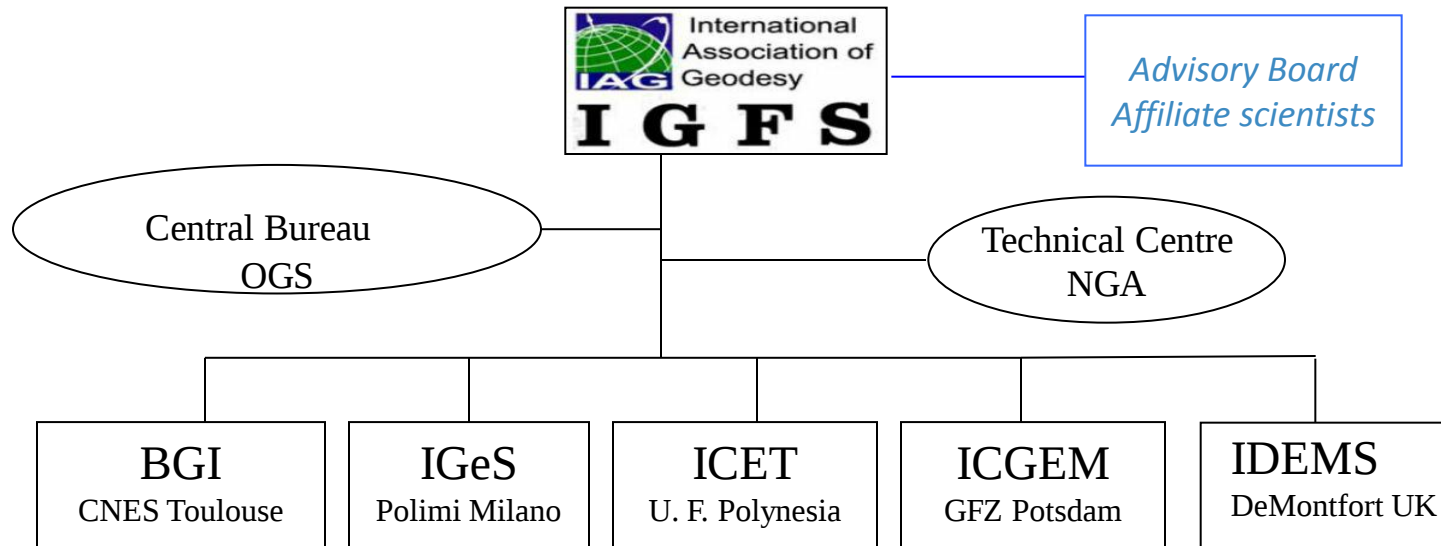
International Center for Global Earth Models (ICGEM) – Director F. Barthelmes

International Center for Earth Tides (ICET) – Director J. P. Barriot

International DEM Service (IDEMS) – Director P. Berry

Technical Centre of the IGFS at NGA – S. Kenyon

Central Bureau – I. Marson and F. Coren



CHALLENGES WITHIN IGFS

IGFS role and procedures



Satellite missions

- IGFS participation to the **design of satellite gravity missions**
- IGFS participation **with GRACE, GOCE (and future missions) for data reduction (error analysis, data filtering, geopotential model development,...) and data validation and calibration (ground truth)**
- Study and promote **future satellite gravity missions**
- Provide **global earth gravity models (static and time varying)**
- Improve **regional gravity models by combining and integrating satellite, airborne and terrestrial measurements**
- Integrate **gravity field and altimetry missions**
- Integrate **gravity field and satellite derived DTMs (e.g. SRTM)**



IAG Services

- Provide **relative and absolute gravity data**
- Provide **static and time varying global gravity field models**
- Provide **regional high resolution geoid models**
- Provide **tide parameters and models**
- Provide **Digital Elevation Models**
- Provide **tools for data validation and evaluation**



Standards and Conventions

- Define **standards for gravity data observation procedures**
- Define **data reduction** (tides, atmosphere, ...)
- Define **data exchange format and archive**
- Define **the standards for associated data (pressure, hydrology...)**
- Define **data processing methods** (adjustment,...)
- Define **gravity anomaly/disturbance computation (free-air, Bouguer)**
- Define **the gravity reference system (replace IGSN71)**
- Define **the geopotential reference system (W_0 , GRS80)**
- Evaluate and recommend **relevant geophysical models**



Networks and Communications

- Design and realization of **the global absolute gravity network**
- Design and realization of **the global superconducting gravity network**
- Contribute to **the definition and realization of the global height system**
- Contribute to **the GGOS co-located site network (AG, SG, W,...)**
- Provide **gravity field parameters at tide gauge stations**
- Integrate **gravity and leveling networks**
- Contact **with external networks (oceanic, atmospheric, hydrologic)**
- Making **gravity data, gravity models and products available**
- Organize **schools on gravity and geoid**
- Making **SW and tutorials for gravity and geoid analysis available**
- Communication and coordination **among GGOS components**

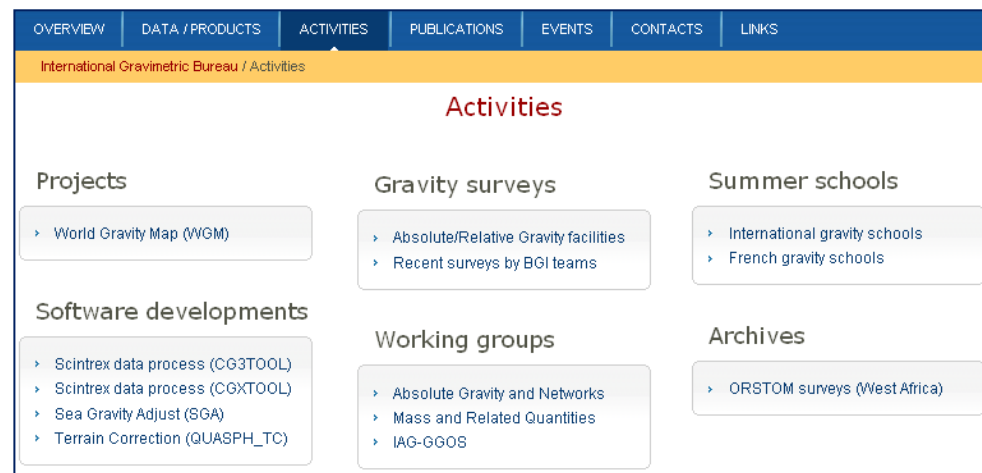
Bureau Gravimétrique International (BGI)

Director : Sylvain Bonvalot

<http://bgi.obs-mip.fr>

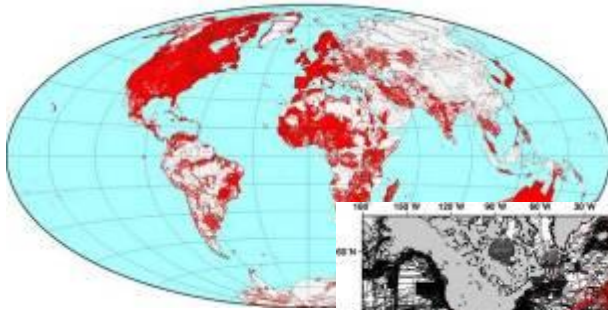


2012 → new version in progress

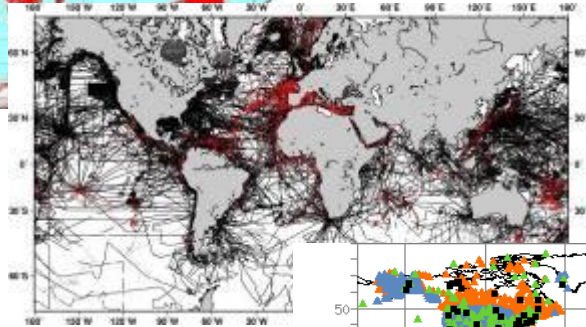


GRAVITY DATABASES

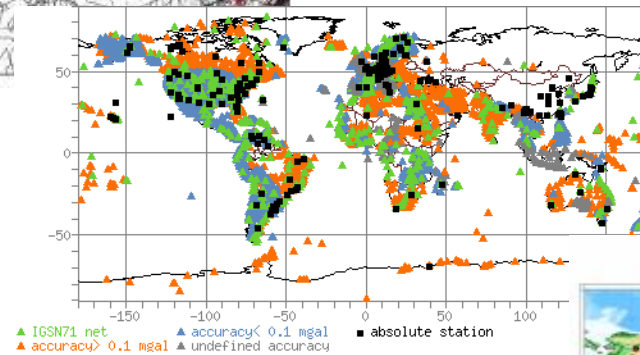
Ground
measurements



Relative land gravity measurements
(2,3 millions of data)



Relative marine gravity measurements
(10,5 millions of data)



Reference stations
(>4500 stations)

Absolute gravity measurements

Absolute gravity stations worldwide



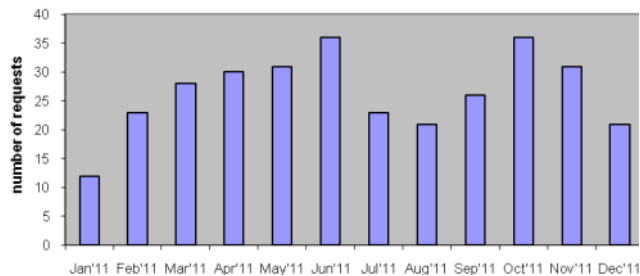
selected data as provided by
• NSG • AGrav BRG/BCR
(courtesy S. Karipin)

**Airborne measurements would be very helpful
to improve the data coverage**

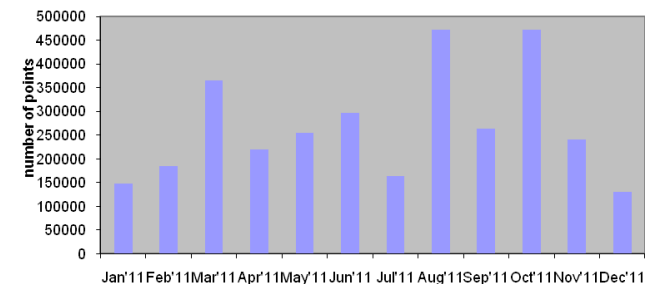
STATISTICS OF DATA CONSULTATION

Example of statistics for 2011 (relative gravity database only)

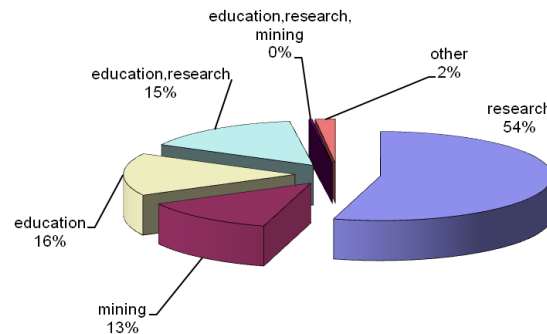
Requests / month



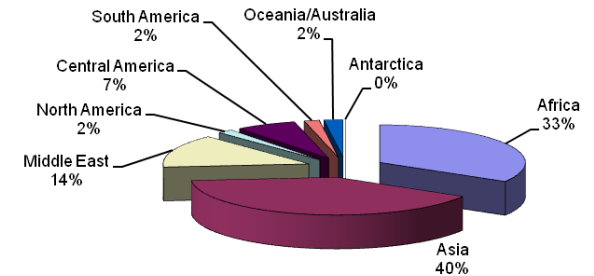
Datasets volume



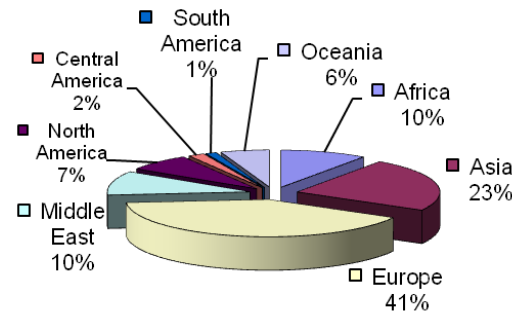
Applications



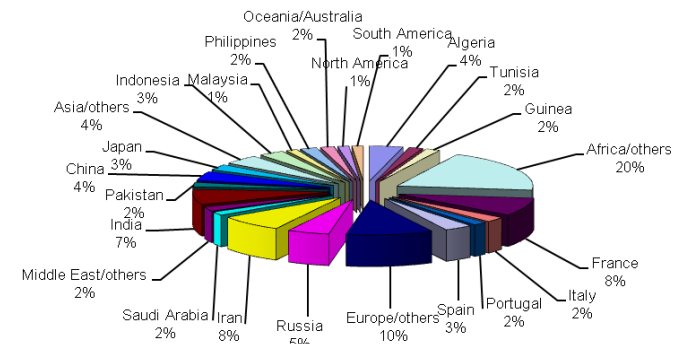
Continents of interest (number of requests)



Origin of data requests



Countries of interest (number of requests)



- ✓ **Requests** : 318 requests of processed requests
- ✓ **Applications** : 85% research & Education
- ✓ **Users** mostly out of Europe (60 %)
- ✓ **Areas of interest** : whole Earth → Asia (40%), Africa (33%), Middle East (14%)

About 3,2 millions of ground gravity data distributed by BGI in 2011

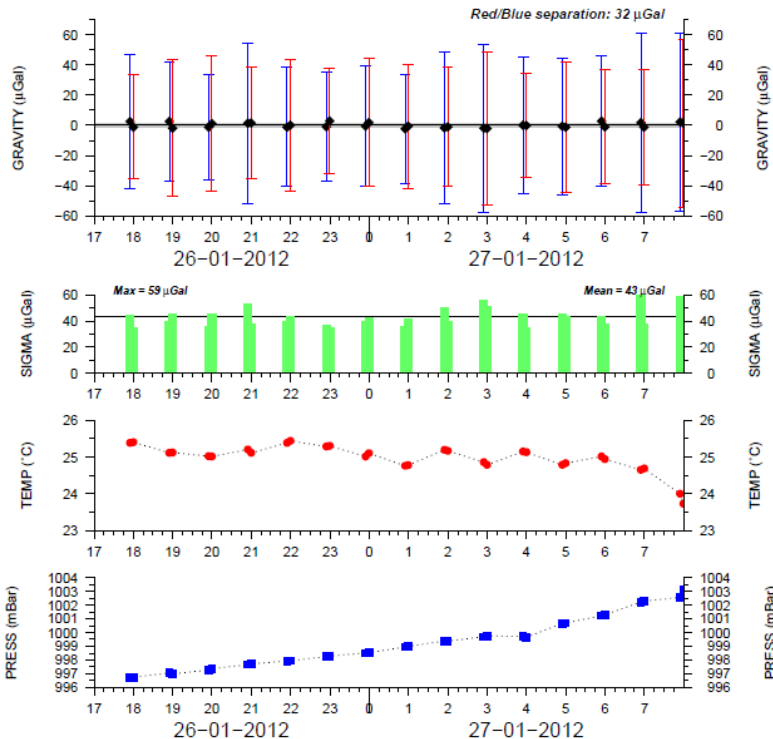
TOOLS & SOFTWARE DEVELOPMENTS

New tools for data control / validation

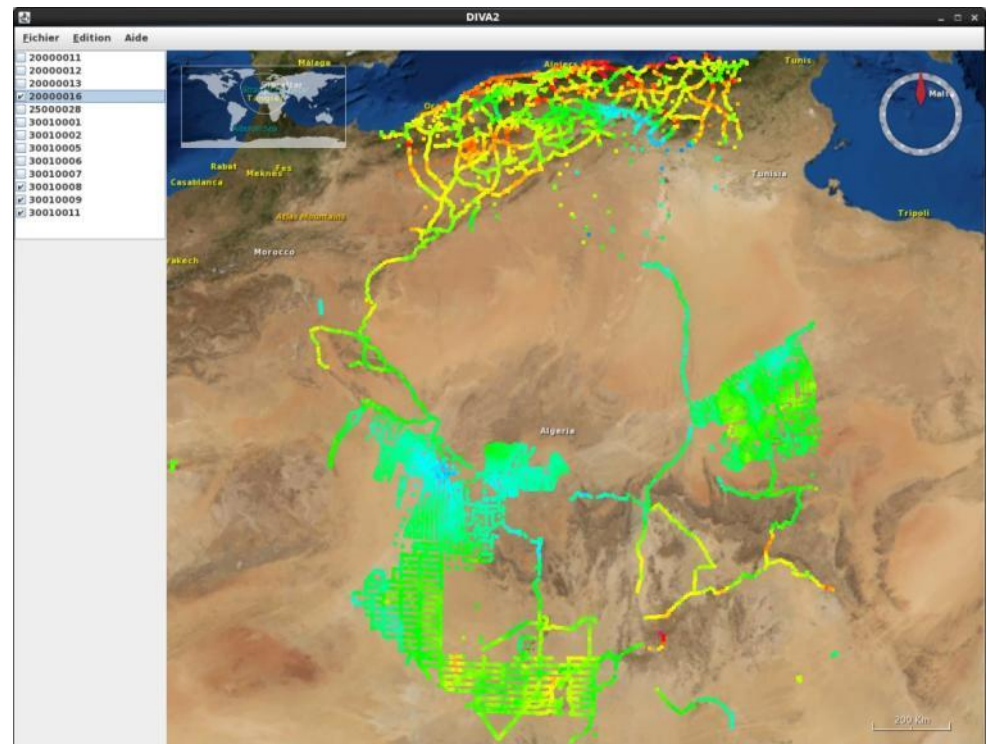
Absolute FG5/A10 measurements

Site		Project			
GETG		FR_GETG_2012janvier26_e			
Latitude	Longitude	Elevation	Polar Motion	Gradient	
43.56250	1.47870	195.00 m	0.0000 " 0.0000 "	~3.000 μ Gal/cm	
Instrument Data		Acquisition Settings		Processing Results	
Meter Type: A10 - S/N # 014 Rubidium Freq.: 10000000.00000 Hz Red Lock: 632.99092510 nm Blue Lock: 632.99192870 nm Factory Height: 71.80 cm		Number of Drops by Set: 100 Drop Interval: 2 sec Sequence Interval: 60 min Red/Blue Interval: 5 min Setup Height: 0.00 cm		Number of Sets Collected: 32 Number of Sets Processed: 30 Total Drops Accepted: 2995 Total Drops Rejected: 5 Transfer Height: 0.00 cm	

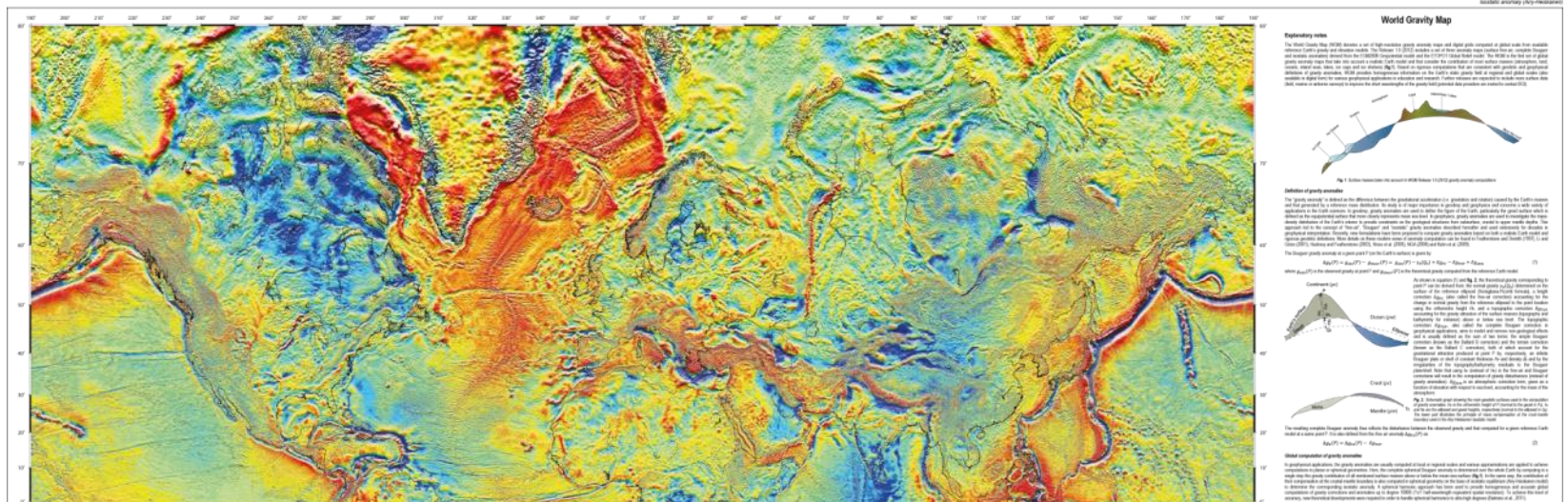
Gravity: 980431494.00 μGal Set Scatter: 1.61 μGal



Gravity survey validation (interactive tool in progress)



NEW GLOBAL PRODUCTS



- ❑ Set of 3 spherical anomalies (Bouguer, Isostatic, surface free-air) published within CGMW / UNESCO context (2012)

- ☐ Digital grids will be available at 1'x1' (corrections and anomalies)

Upgraded versions done as soon as new global gravity model is available
(including **satellite GOCE** and **new surface measurements**)



International Geoid Service (IGeS)

Director : Riccardo Barzaghi

<http://www.iges.polimi.it>

**IGeS**
International Geoid Service

PRESENTATIONNEWSPROJECTSSERVICESNEWTON'S BULLETINCONTACTS

PRESENTATION

NEWS

PROJECTS

SERVICES

GEOID REPOSITORY

SOFTWARE DOWNLOAD

SCHOOLS

IGES BULLETINS' ARCHIVE

NEWTON'S BULLETIN

CONTACTS



International Geoid Service

President and Director: Riccardo Barzaghi (Italy)

IGeS has been founded in 1992 as a working arm of International Geoid Commission (IGeC), and it is actually an official Service of the International Association of Geodesy (IAG).

Since 1999 the process of reviewing statutes of IAG has deeply involved also the IAG Services and those Services which are related to the determination of the gravity field. In 2003, a new unified IAG Service for the Gravity Field has been created: the International Gravity Field Service (IGFS), to coordinate and integrate broad gravity field activities.

IGFS centres are: International Gravimetric Bureau (BGI), International Geoid Service (IGeS), International Center for Earth Tides (ICET), International Centre for Global Earth Models (ICGEM) and International DEM Service (IDEMS). In IGFS, IGeS is one of the operative arms of the International Commission for the Gravity Field.

IGeS' activities are on educational, research, and data distribution sides: principal purposes of IGeS are the collection and distribution of geoid models, the collection and distribution of software for geoid computation, and the organization of technical schools on geoid determinations.

The Service is provided by two Centres, one at the **Politecnico of Milano**, and one at **NIMA** (contact person **S. Kenyon**)

Main tasks of IGeS are:

- to collect geoid data on a worldwide scale (**geoid repository**)
- to collect and distribute software for geoid determination (**software download**)
- to conduct researches on procedure for geoid determination (**projects**)
- to organize **Geoid schools**
- to edit and distribute the **Newton's Bulletin**

Moreover, as regards the research activity, IGeS takes part in:

- the European Gravity Geoid Project
- the GOCE satellite mission
- the Global Geodetic Observing System project (GGOS) for the height datum unification

For other details about IGeS projects please click [here](#).

At present the following scientists are IGeS advisors:
R.Forsberg, C.C. Tscherning (Denmark), M. Sideris (Canada), W. Kearsley (Australia), S. Kenyon, N. Pavlis (USA), H. Denker (Germany), U. Marti (Switzerland), E. Tziavos (Greece), A.J. Gill (Spain), D. Blizkow (Brasil).

Within the structure of IGeS, Working Groups can be established for specific purposes, limited in time.

Search in IGeS Website

Links:

IAG - International Association of Geodesy

IGFS - International Gravity Field Service

BGI - International Gravimetric Bureau

ICET - International Center for Earth Tides

ICGEM - International Centre for Global Earth Models

IDEMS - International DEM Service

© IGeS at DIAR Politecnico di Milano - P.za Leonardo da Vinci, 32 - 20133 MILANO (ITALY)
ph. + 39.02.23996504/7518 - FAX: +39.02.23996530 - e-mail: iges@polimi.it

IGeS OBJECTIVES

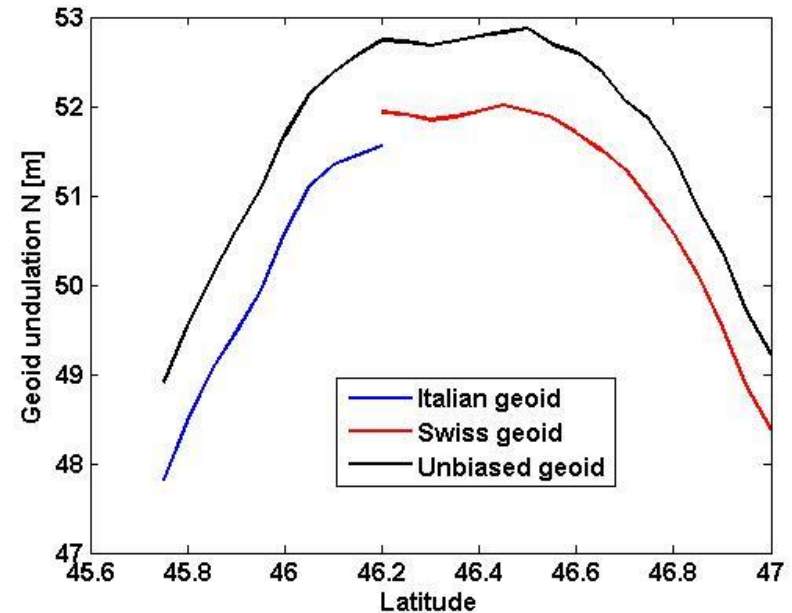
- to collect geoid estimates worldwide,
- to collect, test and, when allowed, to distribute software for the geoid determination
- to conduct researches on methods for the geoid determination
- to organize schools on geoid determination
- to issue, at least once per year, the Newton's Bulletin
- to disseminate special publications on geoid computations (e.g. lecture notes of the schools)
- to support Agencies or scientists in computing regional geoids.

IGeS RECENT ACTIVITIES

- METHODS AND TOOLS FOR MERGING LOCAL GEOID SOLUTIONS
- ANALYSES ON GLOBAL HEIGHT DATUM
- PLANS FOR NEW GEOID SCHOOLS (WITH BGI)
- A NEW PROJECT FOR THE GEOID IN THE MEDITERRANEAN SEA
- UPDATED WEB SITE

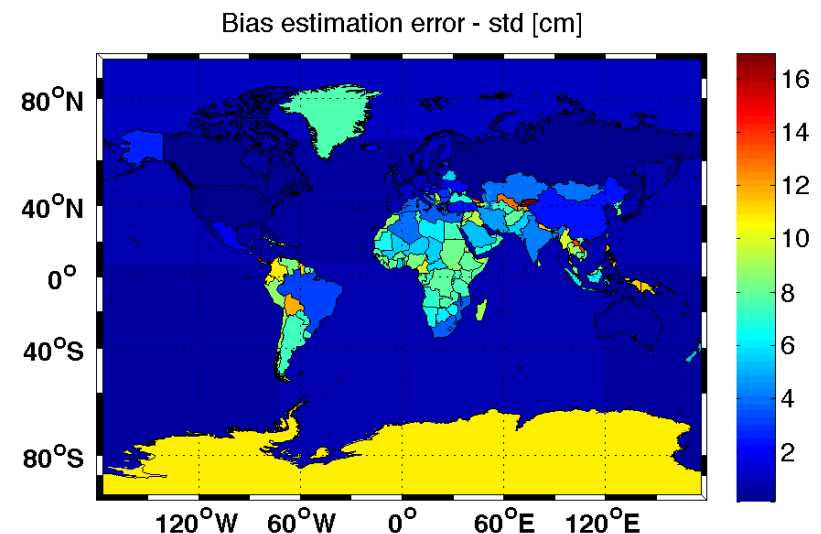
MERGING LOCAL GEOID ESTIMATES

Based on GOCE model a method has been devised for merging local geoid estimates. A test computation has been carried out between Italy and Switzerland



GLOBAL HEIGHT DATUM

A method has been proposed for global height datum unification. An error budget analysis has been performed for the estimation of biases among height systems at global level. A European regional application is planned based on EUVN data



GEOID SCHOOLS

PLANS FOR FUTURE SCHOOLS

- contacts with the University of Quito (Ecuador) ➔ 2013
- contacts with the International Center for Theoretical Physics (Trieste, Italy) ➔ 2014

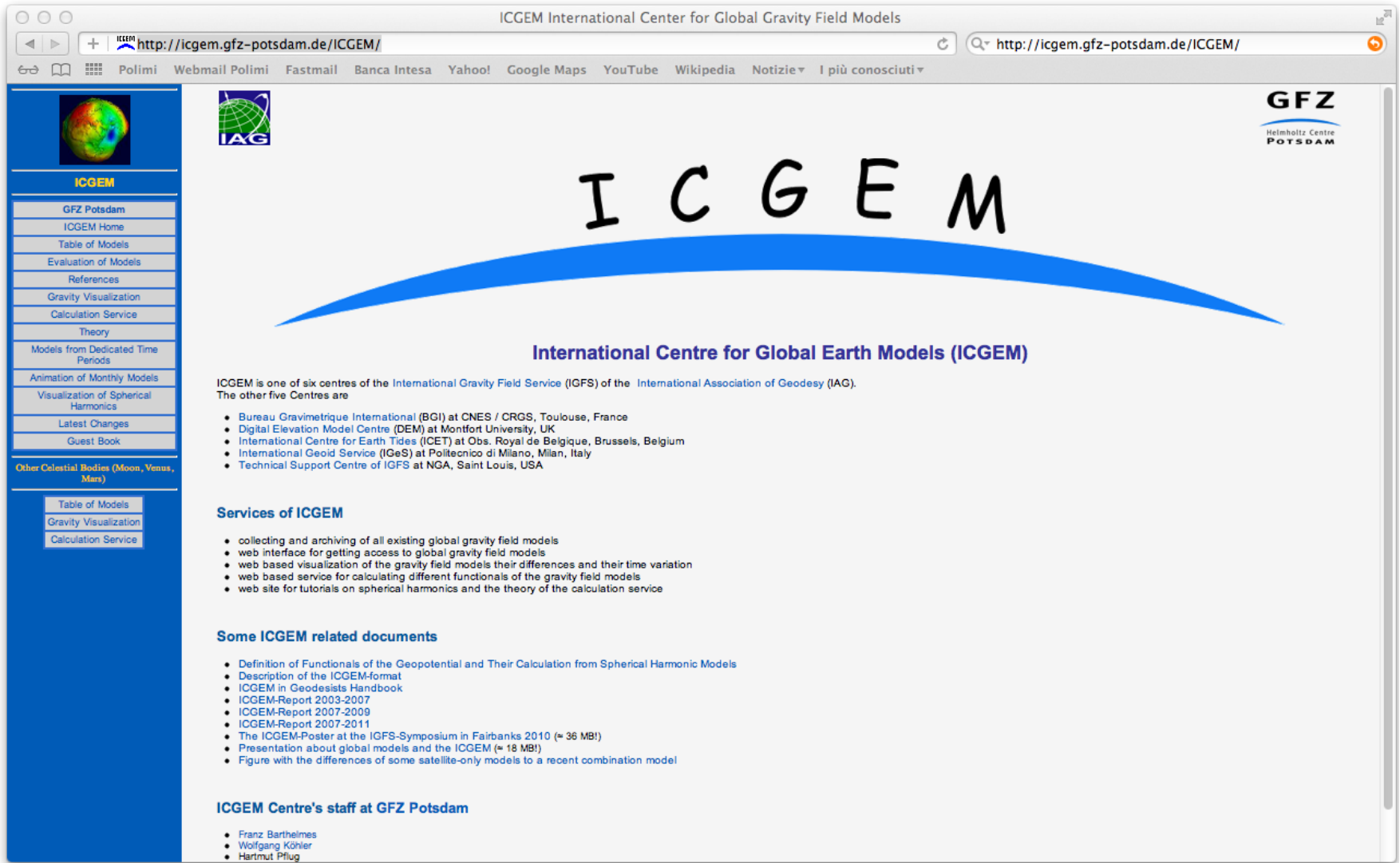
FUTURE PROJECTS/ACTIVITIES

- A new computation of the Mediterranean geoid (in co-operation with BGI) for e.g. improving the SST estimate
- New web page (on line database of IGeS and Newton's Bulletin, improved local geoid database)
- Support on geoid computation (San Paolo State, Brazil; Lima area, Perú; Center for Geodesy and Geodynamics, Nigeria)

International Centre for Global Earth Models (ICGEM)

Director : Franz Barthelmes

<http://icgem.gfz-potsdam.de/ICGEM>



ICGEM International Center for Global Gravity Field Models

<http://icgem.gfz-potsdam.de/ICGEM/>

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ICGEM

GFZ Potsdam
ICGEM Home
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Theory
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Animation of Monthly Models
Visualization of Spherical Harmonics
Latest Changes
Guest Book

Other Celestial Bodies (Moon, Venus, Mars)

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Gravity Visualization
Calculation Service

ICGEM

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 Gravimetric 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 archiving of all existing global gravity field models
- web interface for getting access to global gravity field models
- web based visualization of the gravity field models their differences and their time variation
- web based service for calculating different functionals of the gravity field models
- web site for tutorials on spherical harmonics and the theory of the calculation service

Some ICGEM related documents

- Definition of Functionals of the Geopotential and Their Calculation from Spherical Harmonic Models
- Description of the ICGEM-format
- ICGEM in Geodesists Handbook
- ICGEM-Report 2003-2007
- ICGEM-Report 2007-2009
- ICGEM-Report 2007-2011
- The ICGEM-Poster at the IGFS-Symposium in Fairbanks 2010 (≈ 36 MB!)
- Presentation about global models and the ICGEM (≈ 18 MB!)
- Figure with the differences of some satellite-only models to a recent combination model

ICGEM Centre's staff at GFZ Potsdam

- Franz Barthelmes
- Wolfgang Köhler
- Hartmut Pflug

ICGEM OBJECTIVES

- collecting and long-term archiving of existing global gravity field models
- making them available on the web
- use of standardised format (self-explanatory)
- interactive visualisation of the models
- solutions from dedicated time periods (e.g. monthly GRACE models)
- web-interface to calculate gravity functionals from the spherical harmonic models on freely selectable grids (filtering)
- evaluation of the models

ICGEM SERVICES

- Presently, 122 geopotential models are available through the web page
- On line interactive visualization tools
- Web interface to calculate gravity functionals from spherical harmonic models
- Evaluation of the geopotential models via GPS-leveling data and in the spectral domain

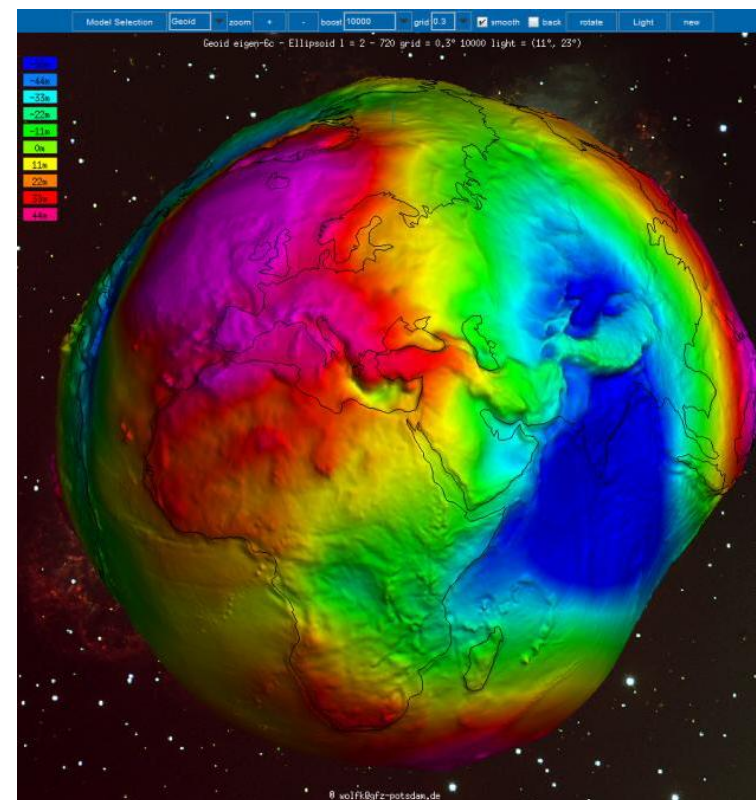
AVAILABLE GLOBAL GEOPOTENTIAL MODELS

Global Gravity Field Models

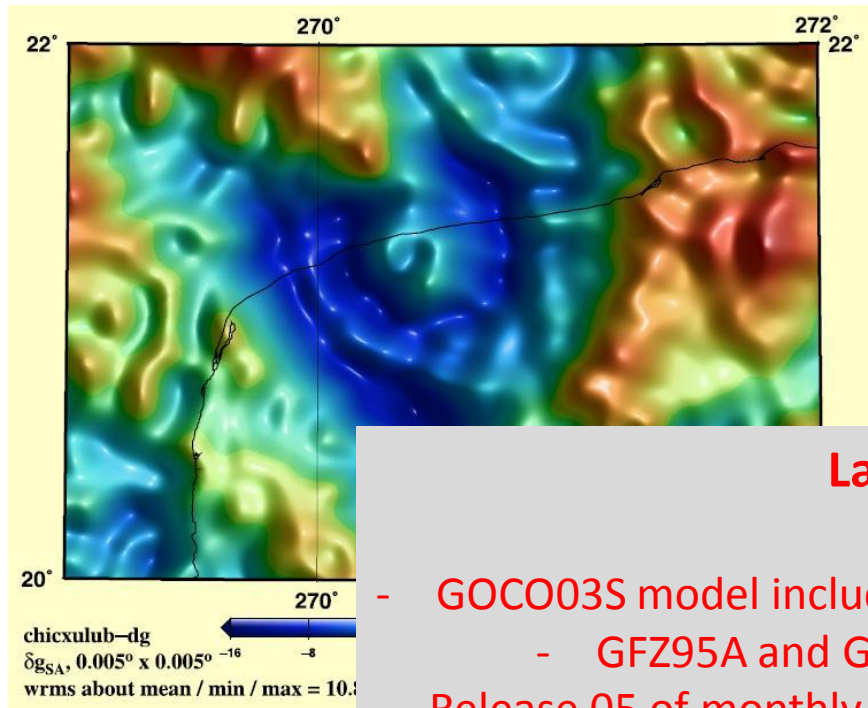
Model	Year	Degree	Data	Reference	download
GOCO03S	2012	250	S(Goce,Grace,...)	Mayer-Gürr, et al. 2012	zip
GO_CONS_GCF_2_DIR_R3	2011	240	S(Goce,Grace,Lageos)	Bruinsma et al, 2010	zip
GO_CONS_GCF_2_TIM_R3	2011	250	S(Goce)	Pail et al, 2011	zip
GIF48	2011	360	S(Grace),G,A	Ries et al, 2011	zip
EIGEN-6C	2011	1420	S(Goce,Grace,Lageos),G,A	Förste et al, 2011	zip
EIGEN-6S	2011	240	S(Goce,Grace,Lageos)	Förste et al, 2011	zip
GOCO02S	2011	250	S(Goce,Grace,...)	Goiginger et al, 2011	zip
AIUB-GRACE03S	2011	160	S(Grace)	Jäggi et al, 2011	zip
GO_CONS_GCF_2_DIR_R2	2011	240	S(Goce)	Bruinsma et al, 2010	zip
GO_CONS_GCF_2_TIM_R2	2011	250	S(Goce)	Pail et al, 2011	zip
GO_CONS_GCF_2_SPW_R2	2011	240	S(Goce)	Migliaccio et al, 2011	zip

SE2	1969	16	S,G	Gaposchkin and Lambeck, 1970	zip
OSU68	1968	14	S,G	Rapp, 1968	zip
WGS66	1966	24	G	WGS Committee, 1966	zip
SE1	1966	8	S	Lundquist and Veis, 1966	zip

The visualization tool



MODELS COMPUTATION AND EVALUATION



EGM2008 gr
 in the Chicxulub

Comparisons of the models
 with
 GPS/leveling data

Model	Nmax	USA 6169 points	Canada 1930 points	Europe 1235 points	Australia 201 points
EN-6C	1420	0.247 m	0.136 m	0.214 m	0.219 m
EN-6S	240	0.446 m	0.373 m	0.449 m	0.397 m
GOCO02S	250	0.435 m	0.352 m	0.434 m	0.372 m

Last changes

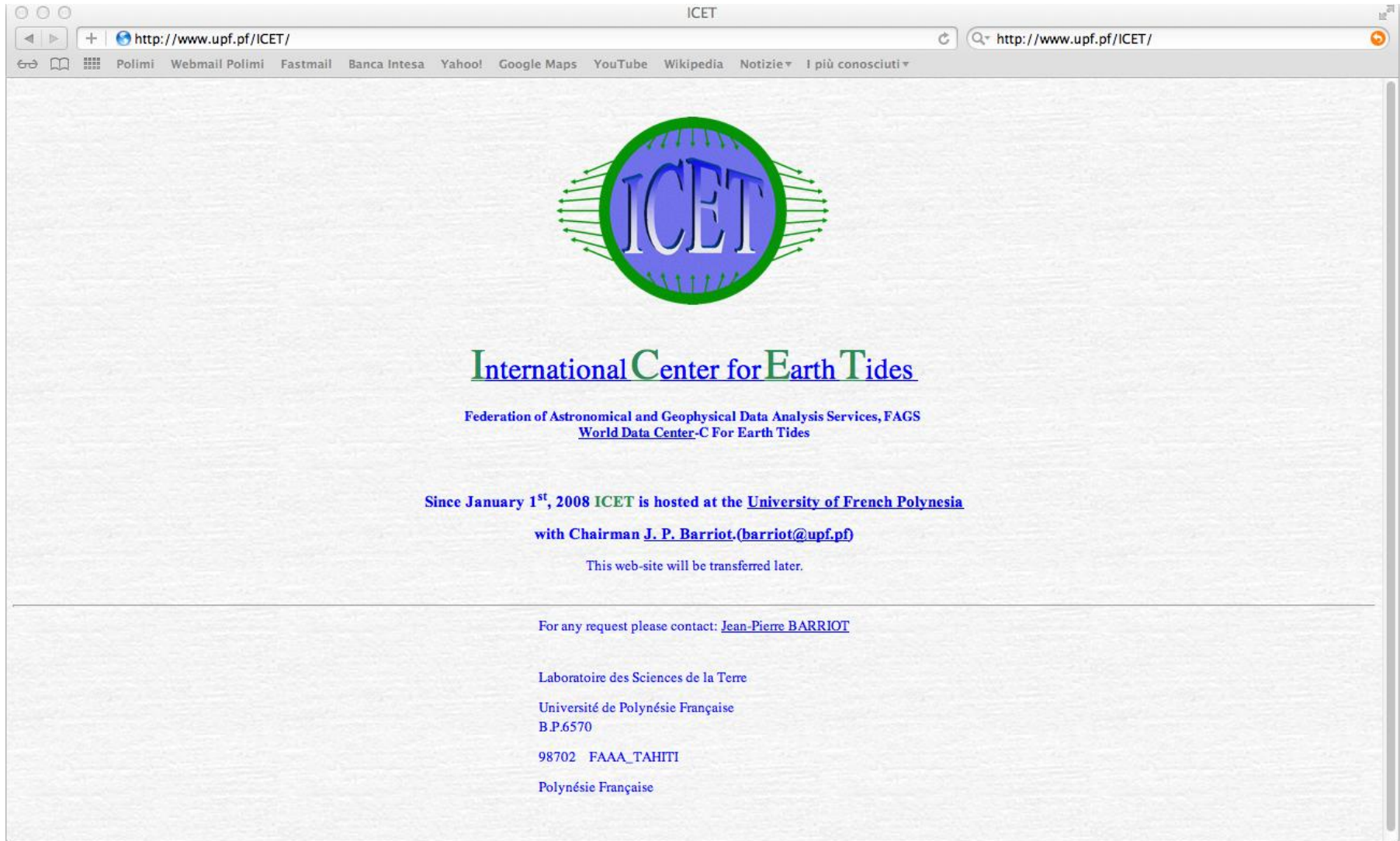
- GOCO03S model included
 - GFZ95A and GFZ97 old models uploaded
- Release 05 of monthly solutions (GRACE) of CSR uploaded
- Release 05 of monthly solutions (GRACE) of JPL and GFZ
 - New Visualization tool for Earth's Topography
 - New models for the topography
 - New method for models download

AIUB-GRACE02S	150	0.630 m	0.571 m	0.701 m	0.495 m
GGM03C	360	0.346 m	0.279 m	0.334 m	0.259 m
GGM03S-UP TO150	150	0.641 m	0.521 m	0.710 m	0.494 m
AIUB-GRACE01S	120	0.724 m	0.628 m	0.930 m	0.563 m
EGM2008	2190	0.248 m	0.126 m	0.208 m	0.217 m
EIGEN-5S	150	0.630 m	0.547 m	0.737 m	0.475 m

International Center for Earth (ICET)

Director : Jean-Pierre Barriot

<http://www.upf.pf/ICET/>

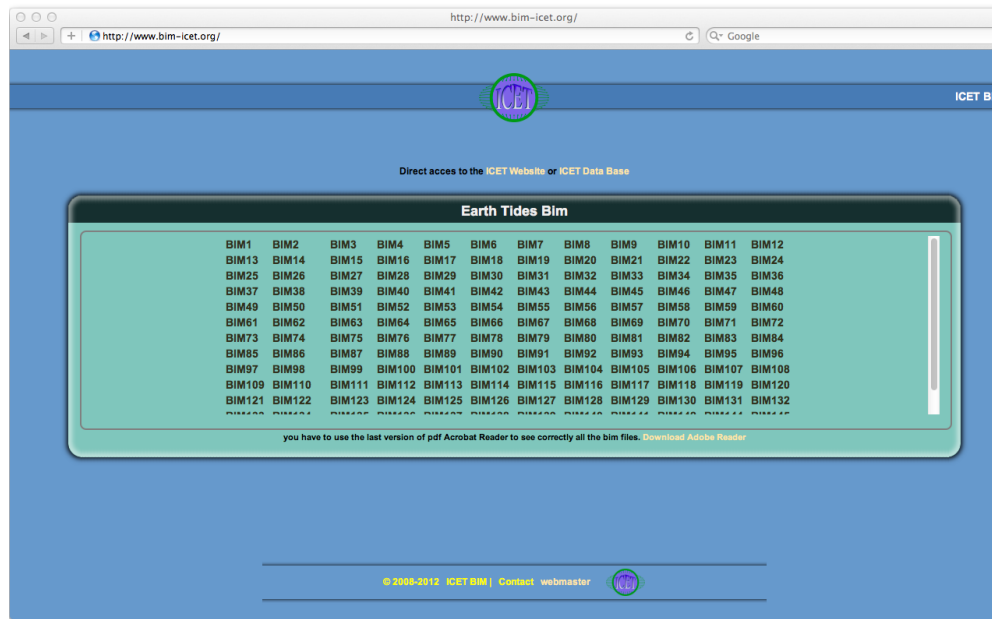


ICET ACTIVITIES

- Maintaining the ICET database (on line at <http://maregraph-renater.upf.pf>, www.bim-icet.org, or www.upf.pf/ICET/)
- Processing Global Geodynamics Project (GGP) one-minute data that are uploaded to the ICET and GFZ database
- Developing SW to automatically validate GGP data
- Storing GGP data according to current standards
- Issuing the Bulletin International des Marées Terrestres (BIM) (available on line at www.bim-icet.org)
- Monitoring gravity variations at the ICET center in Tahiti-Pamatai (gPhone gravimeter operating since March 2008. Routinely monitoring of all earthquakes > 6.0 along the Pacific Rim)
- Participating in deploying and maintaining a network of Tide-Gauge/GPS stations (POGENET, POLynesian GEodeticNETwork) in French Polynesia as a contribution to the IAG Global Geodetic Observing System (GGOS).

ICET RECENT ACTIVITIES

- BIM 147 issue (on line mid-August 2012)
- Fully operational online database (bim-icet.org)
- Validation of new updated software for Earth Tides analysis (ETERNA - online mid-August 2012)
- Monthly cleaning/validation of GGP 1-minute data files (corrected data are uploaded to GFZ servers)
- Proposals for a new GGP data format to CODATA (Gabillon et al., accepted on CODATA Journal)



The BIM database

Code	Location	SG Instr.	FTP login	ICET Code	RAW	Corrected
BA*	Bandung, Indonesia	T008	bandung	00084100	030600	030622
BE*	Brussels, Belgium	T003	brussels	07790200	000900	000901
BF	Black Forest, Schiltach	CD056 L CD056 U	black_forest	01560716 02560716	120500 120500	101122 101122
BH	Bad Homburg, Germany	CD030 L CD030 U SG044	bhomburg	01300734 02300734 00440734	070400 070400 120400	070422 070422 120422
BO*	Boulder, USA	C024	boulder	00246085	031000	031022
BR*	Brasimone, Italy	T015	brasimone	00150515	000100	000122
CA	Cantley, Canada	T012	cantley	00126824	120600	120222
CB	Canberra, Australia	C031	canberra	00314204	120100	110722
ES	Esashi, Japan	T007	esashi	00072849	081200	070322
HS	Hsinchu, Taiwan	T048	hsinchu	00482695	120400	081222
KA	Kamioka, Japan	T016	kamioka	00162828	120100	110722
KY*	Kyoto, Japan	T009	kyoto	00092823	030600	030622
MA*	Matsushiro, Japan	T011	matsushiro	00112834	080600	080622
MB	Membach, Belgium	C021	membach	00210243	111200	111222
MC	Medicina, Italy	C023	medicina	00230506	120400	120122
ME	Metsahovi, Finland	T020	metsahovi	00200892	120100	101222
MG	MunGyung, S. Korea					
MO	Moxa, Germany	CD034 L CD034 U	moxa	01340770 02340770	120600 120600	110422 110422
NY	Ny Alesund, Norway	C039	ny-alesund	00390005	120100	100322
PE	Pecny, CZ	OSG050	pecny	005000930	111200	101222
PO	Potsdam, Germany	T018	potsdam	00180765	980900	980912
ST	Strasbourg, France	C026	strasbourg	00260306	120500	120522
SU	Sutherland, South Africa	D037 L D037 U SG052	sutherland	01373806 02373806 00523806	120600 120600 120600	101222 101222 101222
SY	Syowa, Antarctic	T016	syowa	00169960	030100	030122
TC	Tigo, Concepcion, Chile	RT038	concepcion	00387621	120400	101222
VI*	Vienna, Austria	C025	vienna	00250698	061200	061222
WA	Walferdange, Luxembourg					
WE	Wetzell, Germany	SG103 CD029 L CD029 U	wetzell	01030731 01290731 02290731	980900 101000 101000	980921 101022 101022
WU	Wuhan, China	T004	wuhan	00322647	101200	101222

Summary of 1-minute GGP data validated at ICET (July 13th, 2012)

International DEM Service (IDEMS)

Director: P. Berry

<http://www.cse.dmu.ac.uk/EAPRS/iag/>



International DEM Service

- Home
- SRTM
- ACE
- ACE2
- ASTER
- GLOBE
- GTOPO30
- NED
- Software
- Publications
- Inland Water

The centre for International Digital Elevation Models 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
- [International Centre for Global Earth Models](#) (ICGEM) at Potsdam, Germany
- [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

The [IAG](#) International DEM (Digital Elevation Model) service website provides a focus for distribution of data and information about Digital Elevation Models, relevant software and related datasets (including representation of Inland Water within Digital Elevation Models) which are available in the public domain. Currently this site hosts the ACE GDEM, and has links to a number of Global Digital Elevation Models. Information on analysis of the SRTM dataset will be added as it becomes available.

As one of the aims of this site is to facilitate dissemination of information to the global community; please tell us about publications relevant to Digital Elevation Model analysis and quality control so we can include information about them on the website.

[Email us](#)



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IDEMS ACTIVITIES

- Providing a focus for distribution of data and information on Digital Elevation Models
- Providing relevant software and related datasets (including representation of Inland Water within Digital Elevation Models) which are available in the public domain
- At present, the website hosts the Altimeter Corrected Elevation (ACE) GDEM
- Links are available to ASTER, GLOBE, GTOPO30 and NED data-bases