BUREAU GRAVIMETRIQUE INTERNATIONAL
INTERNATIONAL GRAVIMETRIC BUREAU

Annual Report 2007-2008

1.Background

1.1 Missions / Tasks

"Collection, Validation, Archiving and Distribution of Gravity data"

The Bureau Gravimétrique International (BGI) has been created in 1951 by the International Association of Geodesy (IAG), one of the seven associations of which IUGG (International Union in Geophysics and Geodesy) is composed. The initial task of BGI was to collect, on a world-wide basis, all gravity measurements to generate a global digital database of gravity data for any public or private user. The technological and scientific evolutions which occurred over the last 50 years in the area of gravimetry (improvements in field, airborne and seaborne gravity meters, development of absolute gravity meters, space gravity missions, etc.) provided significant increases of the number, diversity and accuracy of the gravity field observables. Following these evolutions, BGI contributed to provide original databases and services for a wide international community concerned by the studies of the earth gravity field.

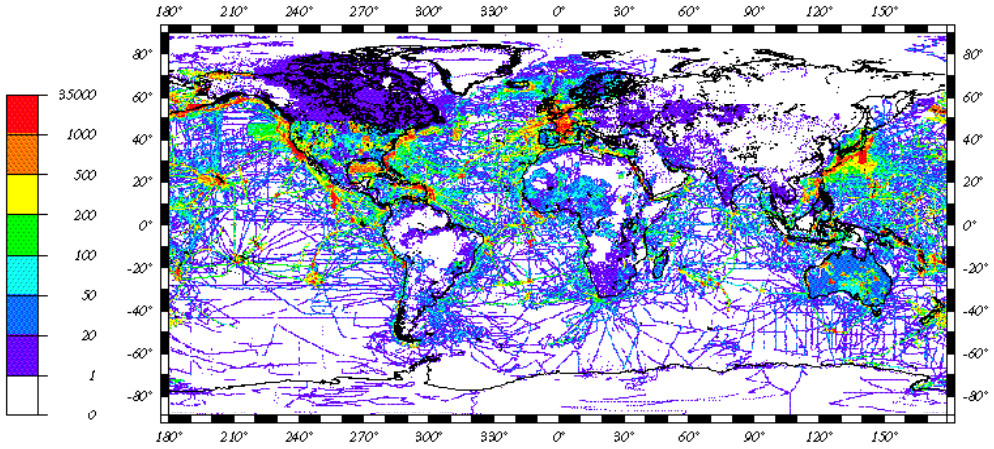

***Fig. 1**: Density of terrestrial and marine gravity data coverage (BGI database)*

BGI has thus played a fundamental role in the worldwide compilation and validation of gravity data and their distribution to the international scientific community. The BGI database, which now contains over 12 millions of observations compiled and computerized from land, marine and airborne gravity measurements, has been extensively used for the definition of earth gravity field models and for many applications in geodesy, satellite orbit computation, oceanography, geophysics, etc. In addition, BGI developed other additional services in the area of gravimetry (data validation for regional or global projects, bibliography database, online access to reference gravity stations, expertise, etc.). It also contributed to research & development activities (software developments, interpretation) and to educational activities (summer schools on gravity data acquisition and processing, provision of tutorials and educational materials in gravimetry).

1.2 An international service

BGI is a service of the Federation of Astronomical and Geophysical Data Analysis Services (FAGS) and of the International which operates under the auspices and in part thanks to the financial support of the International Council of Scientific Unions (ICSU) and the United Nations Educational Scientific and Cultural Organization (UNESCO). It belongs to the International Association of Geodesy (IAG) of the International Union of Geodesy and Geophysics (IUGG). Since 2001, it is one of the "Centers" of the International Gravity Field Service (IGFS) which coordinates within the IAG, the activities of BGI, IGeS (International Geoid Service), ICET (International Center for Earth Tides), ICGEM (International Center for Global Earth Models) and IDEMS (International DEM Service). The overall goal of IGFS is to coordinate the servicing of the geodetic and geophysical community with gravity field-related data, software and information.

1.3 National support

BGI has had its offices located in France (Paris, then Toulouse) since its creation. Since 1979, BGI has been housed in the premises of the National Center for Spaces Studies (CNES) and of the Observatoire Midi-Pyrenees (OMP), where it has been directed successively by G. Balmino (1979-1998) then by J-P. Barriot (1998-2007). Today, BGI is also recognized as a permanent service of the Observatoire Midi-Pyrénées (OMP) in Toulouse, accredited by the Institut National des Sciences de l'Univers (INSU). Since 1998, BGI is supported by 10 French Organizations whose contributions to BGI over four year renewable periods are defined by a covenant.

2. Main actions in 2007 - 2008

BGI activities in 2007 were dominated by several important events: (i) the preparation of a new project for BGI for period 2007-2011 that has been submitted to the IUGG General Assembly in July 2007, (ii) the renewal of the convention between the supporting organizations of BGI in France and (iii) some changes in the BGI staff, including the nomination of a new Director. In 2007, BGI has initiated two new global projects of data compilation and valorization (Absolute gravity database, World Gravity Map project).

In the same time, BGI also maintained the activities of services relatively to its relative gravity database (integration, validation of new datasets, processing of data requests from external users, etc.) or to its bibliography database (updating and integration of new references). Other actions which were previously initiated at BGI for research projects have been finalized (software for marine data analysis, and geoid computation in Ligure sea).

2.1 Definition of the BGI project 2007-2011

The new BGI project for the next 4 years[1] proposed and approved by IAG instances at the last IUGG General Assembly is given in annex 1 of this report. The project has been prepared by S. Bonvalot and R. Biancale with the contributions of A. Briais, M. Diament and G. Balmino. The main orientations of the new project are:

- to consolidate the terrestrial gravity databases (relative and absolute) and encourage the collection and compilation of new data sets,
- to initiate the set up of a first global Absolute Gravity database,
- to ease the consultation and diffusion of gravity data and products for end-users, through a user friendly Internet Interface,

BGI will also continue operating with its supporting organizations, in educational, research and development activities with the aim to maintain a high level of competence and to improve the efficiency and the quality of its services.

- Activities related to gravity database:

The main achievements consist in the relative gravity database and in the database of reference gravity stations. Collection of new dataset as well as existing dataset will be encouraged in order to improve the global data coverage and accuracy. Incoming datasets are carefully evaluated and validated using protocols and software already developed at BGI. Global data and products derived from satellite altimetry and gravity missions are to be more and more frequently used to validate land and sea measurements. The achievement of a worldwide Absolute gravity database will be top prioritized in the next few years.

- Activities of diffusion of gravity data and products:

New functionalities will be implemented in relation with the database management to perform direct downloads of open-file data or products from the BGI webpage and allow inter-operability between other sites hosting gravity-related databases. BGI will also contribute to the release of updated digital gravity data products (maps, grids…) for educational and research purposes. The bibliography database will be also continued.

- Other activities:

Link with the commission for the Geoid in data preparation in view of geoid computations and evaluations to be performed by the International Service for the Geoid. Link with other research groups in the validation of satellite derived gravity data and products to improve our global knowledge of the Earth's gravity field. Contribution to the dissemination of educative materials related to gravimetry. Continuation of the publication of the Newton's Bulletin jointly with IGeS.

The project 2007-2011 has been approved by the French organization supporting BGI. The contribution of each supporting organization for the next 4 years has been defined in a new covenant[2] that has been submitted for final approval to the main

[1] "International Gravimetric Bureau: Project 2007-2011". Proposal submited to the IAG Commission at the IUGG XXI General Assembly, Perugia, Italy, 2007, 42p.

[2] "Convention inter-organismes relative au fonctionnement du BGI ", Déc. 2007, 9p.

institutions (BRGM, CNES, ESGT, INSU, IGN, IRD, SHOM). A new partnership has been proposed with IFREMER, the French Institution in charge of the archiving and validation of marine gravity data collected by French research vessels. Another new partnership has been started with Bundesamt für Kartographie und Geodäsie (BKG), Germany for the realization of the Absolute Gravity database.

2.2 Initiation of a global Absolute Gravity database

The absolute gravity database have been started in collaboration within BGI and BKG Germany that had previously developed a prototype of an Absolute gravity database. The application, based on a Google map interface, has been installed at BGI in Oct 2007 (visit at BGI of H. Wziontek, Ing. BKG - database developer). New functionalities have been implemented to fit with the requirements of BGI data compilation and archiving. Collection and archiving of absolute gravity data have been initiated during a test period. The database will be accessible soon though the BGI website and through the BKG website as mirror site. The information provided ranges from meta-data (localization of stations) up to a full information on the absolute determination of the gravity field on a given site (raw or processed data, description of measurement sites, etc.)

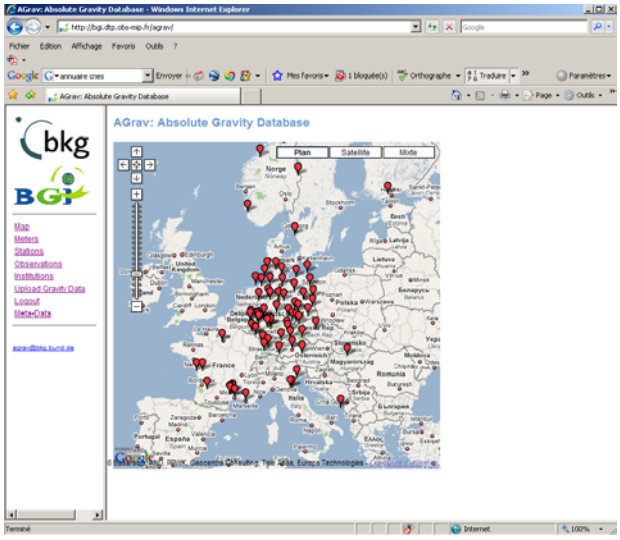

***Fig 2**: Internet Interface of the Absolute Gravity database*

2.3 Initiation of new Internet web site and new Internet services

A new BGI website has been defined. This site is still under reconstruction and should be released in the upcoming weeks. It is aimed to provide updated information about BGI services and to ease the access to database and to other information (data products, bibliography database, software, etc.). New functionalities will be also implemented to allow direct downloads of non-restricted data and to inter-operating the BGI databases with other regional or global databases. Harmonization of BGI website with those of IGFS and FAGS services has been taking into account.

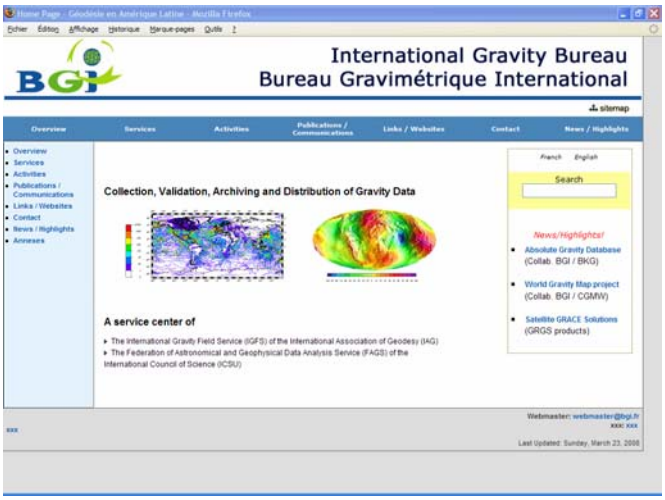

***Fig. 3**: New BGI main webpage*

2.4 New global project: WGM (World Gravity Map) project

The WGM project is a new gravity mapping project undertaken by BGI under the aegis of the Commission for the Geological Map of the World (CGMW), of the International Association of Geodesy (IAG) - and of its International Gravity Field Services (IGFS) with the support of the United Nations Educational Scientific and Cultural Organization (UNESCO).

This project, initiated in 2007, will complement a set of global geological and geophysical digital maps published and updated by CGMW for educational and research purposes. Following the example of the World Digital Magnetic Anomaly Map (WDMAM) and of the World Stress Map (WSM), released in 2007 (http://ccgm.free.fr/index_gb.html), this new global digital map aims to provide a high resolution picture of the gravity anomalies of the world based on the up-to-date available information on the Earth gravity field. The objective of the WGM project is to contribute to a better understanding and interpretation of the anomalies of the earth gravitational field at regional and global scales in terms of the geological structure and composition of the Earth. Another objective of the map, and associated booklet, is to help teaching gravity concepts.

The WGM project will consist in a 1/50000000 printed map and accompanying digital grids of gravity anomalies (including corrections for free air, Bouguer, terrain and atmospheric effects). The gravity data compilation will include the available measurements issued from land, marine and airborne surveys and archived in the IGB database as well as new gravity datasets collected from recent surveys or available in other global or regional databases. The project will also benefits from recent improvements provided by the gravity and altimetry satellite missions on global or regional gravity models. Major contributions should be provided by the official EGM08 global model, released during the EGU General Assembly (Wien, April 2008) by the National Geospatial-Intelligence Agency (NGA, USA), as well by the new global ocean wide satellite altimetry derived gravity field DNSC07 computed at the Danish National Space Center (DTU- Denmark).

A new call for data collection to this project has been launched by BGI in late 2007. It received a large amount of positive answer from companies and institutions that have collected gravity data.

A more complete description of this stimulating project for BGI is given in Annex 2 of this report.

2.5 Other activities

Presentation of BGI activities and participation to IAG working groups in International meetings

- July 2007: IUGG General Assembly - Perugia, Italy (S. Bonvalot, R. Biancale, A. Brais)
- August 2007: Terrestrial Gravimetry – Static and Mobile measurements - St Petersburg (S. Bonvalot, M. Sarrailh)
- Août 2007 : 3° Joint Meeting of the Consultative Committee for Mass and Related Quantities - Gravity Group - St Petersburg (S. Bonvalot)
- March 2008: IGFS/GGOS Retreat, Bertinoro, Italy (S. Bonvalot)
- June 2008: GGEO/IAG meeting, Chania, Creete (S. Bonvalot, A. Brias, M. Sarrailh)
- August 2008: International Geological Congress, Oslo, Norway (S. Bonvalot, A. Briais)

Coordinating meetings (BGI coordinating committee, World Gravity Map project coordination)

- June 2007: CNES Paris - BGI annual coordinating committee (S. Bonvalot, A. Brias, R. Biancale, M. Sarrailh)
- Sept 2007: CGGM Paris - Working meeting on World Gravity Map (S. Bonvalot, A. Brias, R. Biancale, M. Sarrailh)
- Feb 2008: CGGM Paris - Working meeting on World Gravity Map project (A. Brias)

Participation of BGI to scientific proposals (on calibration/validation of satellite gravity data)

- ANR « Ghyraf » (coordinator J. Hinderer)
- CNES/TOSCA « Solid Earth Exploration with GOCE (SeeGoce) » (Coordinator M. Diament).

Visitors at BGI

- 2007 (3 months): M. Abassi (Researcher, Iran) - Geoid computation and analysis using Gravsoft – Application to Ligure sea.
- 2007 (1 day): BRGM and CNES staff – working meeting on Database Inter-operability

Software developments

- Software (under development) for gravity terrain correction at global scale (by G. Balmino, G. Moreau and M. Sarrailh)
- Software for validation of marine gravity data (by T. Fayard).

2.6 Staff

The BGI Director changed in July 2007 and the new director is S. Bonvalot (researcher, IRD). The former director, J.P. Barriot (Ing. CNES), moved to a Professor position at University of Pacifique (Tahiti) in Sept. 2006 and has been temporarily replaced by R. Biancale (Ing. CNES) which acted as Director by interim between Sept 2006 and July 2007). The BGI staff has been also complemented by A. Briais (researcher, CNRS) nominated as deputy director.

M. Langellier (Ing. IGN) which was responsible of the processing of data requests from the BGI database retired from BGI in March 2007. This task is currently done by other personal staff from BGI and should be partially replaced in the future by new functionalities of the database BGI (automatic download of public data). The BGI permanent staff working at OMP Toulouse, is composed of 7 persons (full time or part time). In addition, other contributors

BGI permanent staff (Central Bureau, Toulouse)

S. Bonvalot	*Director of BGI*	*Geophysicist, IRD France*
A. Briais	*Deputy Director*	*Marine Geophysicist, CNRS France*

R. Biancale		*Space geodesy, CNES France*
M. Sarrailh		*Database manager / Software developer, CNES France*
N. Lestieu	*Secretary*	*CNRS France*
T. Fayard		*Database manager / Software developer, CNES France*
S. Pecquerie		*Documentation / Information, CNRS France*

Others contributors (Central Bureau, Toulouse)

G. Balmino	*Geodesist, CNES France (consultant)*
G. Moreaux	*Geodesist, Noveltis France (contracted)*
G. Gabalda	*Geophysicist, IRD France*

Others BGI contributors or associated members

BRGM (G. Martelet), EOST (J. Hinderer, M. Amalvict), ESGT (J. Cali), IFFREMER (E. Moussat), IGN (O. Jamet, H. Duquenne, F. Duquenne), IPGP (M. Diament, S. Deroussi), SHOM (M-F. Lalancette), Université de Montpellier (R. Bayer, N. Le Moigne) BKG Germany (H. Wziontek, H. Wilmes, Ihde).

2.7 Références in 2007-2008

Abbasi, M., Barriot, J-P., Sarrailh, M., Biancale, R., Bonvalot, S. AIRGRAV: a New Software for Processing of the Aerogravimetric Data. International Symposium on Terrestrial Gravimetry: Static and mobile measurements (TG-SMM 2007). 20-23 August 2007, St Petersburg, Russia.

Abbasi et al., Pub. In press (special issue - Proceedings of the TG-SMM 2007 workshop)

Bonvalot S., Biancale R., Briais A., Sarrailh M. and BGI team. "World Gravity Map (WGM) project, Proposal, Dec 2007, 19p.

Bonvalot S. and BGI team. International Gravimetric Bureau: Project 2007-2011. Proposal submited to the IAG commission at the IUGG XXI General Assembly, Perugia, Italy, 2007, 42p.

Bonvalot, S., Sarrailh, M., Briais, A., Biancale, R. and IGB Team. The World Gravity Map (WGM) project: objectives and status. GGEO Meeting, June 2008, Chania, Crete.

Bonvalot, S., Sarrailh, M., Briais, A., Biancale, R. and IGB Team. The World Gravity Map (WGM) project: objectives and status. International Geological Congress. August 2008, Oslo, Norway.

Briais A., Bonvalot, S., Sarrailh, M. and BGI Team. The new World Gravity Map project : a tool for geodynamic studies. GGEO Meeting, June 2008, Chania, Crete.

Briais A., Bonvalot, S., Sarrailh, M. and BGI Team. The new World Gravity Map project : a tool for geodynamic studies. International Geological Congress. August 2008, Oslo, Norway.

Moreau, G., Balmino, G., Sarrailh M., Bonvalot, S., Biancale, R., Briais, A. Computing gravity terrain corrections at global scale: An application for the World Gravity Map (WGM) project. GGEO Meeting, June 2008, Chania, Crete.

Wziontek, H., Ihde, J., Wilmes, H., Bonvalot, S., An international database for absolute gravity measurements - a joint project of BKG and BGI. EUG Meeting, 13-18 April 2008, Vienna, Austria.

Wziontek, H., Ihde, J., Wilmes, H., Bonvalot, S., An international database for absolute gravity measurements - a joint project of BKG and BGI. GGEO Meeting, June 2008, Chania, Crete.

De Linage, C., Hinderer, J., Boy, J-P. , Masson, F, Gegout, P., Diament, M., de Viron, O., Bayer, R, Balmino, G., Biancale, R, Bonvalot, S., Genthon, P. GHYRAF (Gravity and HYdrology in AFrica): a New Experiment Combining Hydrology and Geodesy to Investigate Water Storage Changes from the Sahara to the Equatorial Monsoon Zone. American Geophysical Union (AGU) Fall meeting, San Francisco. Geophysical Research Abstracts, 2007.

Hinderer, J., de Linage, C., Boy, J-P. , Gegout, P., Masson, F., Diament, M., de Viron, O., Bayer, R, Balmino, G., Biancale, R, Bonvalot, S., Genthon, P. GHYRAF (Gravity and HYdrology in AFrica): an experiment to validate GRACE in Africa from the Sahara to the Equatorial Monsoon Zone. American Geophysical Union (AGU) Fall meeting, San Francisco. Geophysical Research Abstracts, 2007

Toulouse, April 2008

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