International Gravimetric Bureau (Bureau Gravimétrique International, BGI)

http://bgi.cnes.fr

Director: Sylvain Bonvalot (France)

Overview

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.

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 International Association of Geodesy (IAG). 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. BGI also belongs to the Federation of Astronomical and Geophysical Data Analysis Services (FAGS) 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).

1.3 National support

BGI has had its offices located in France (Paris, then Toulouse) since its creation. Since 1979, it 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), J-P. Barriot (1998-2007 – with interim of R. Biancale between Sept. 2006 and July 2007) and S. Bonvalot (since July 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.

Activities

BGI activities in the last two years were dominated by the following events:

(i) The preparation of a new 4-years project for period 2007-2011 and the renewal of the convention between the supporting organizations of BGI in France. This was accompanied by some changes in the BGI staff, including the nomination of a new Director.

(ii) The initiation of two new global projects of data compilation and valorization: the realization of a global Absolute gravity database in collaboration with Bundesamt für Kartographie und Geodäsie (BKG) Germany; the initiation of the World Gravity Map project in collaboration with Commission for the Geological Map of the World (CGMW).

(iii) The realization of a new web site.

In the same time, BGI also maintained the activities of services relatively to its existing gravity database (integration, validation of new datasets, processing of data requests from external users, etc.). Other actions which were previously initiated at BGI for research projects have been finalized (software for marine data analysis, and geoid computation in West Mediterranean). The main activities are summarized hereafter.

2.1 Definition of a 4-years project (2007-2011)

The BGI project for a 4 years period[1] has been prepared in early 2007 and approved by IAG during the IUGG General Assembly in Perugia, Italy (July 2007). It has been also approved by the French organizations 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 institutions (BRGM, CNES, INSU, IGN, IRD, SHOM, OMP, ESGT). 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 and the maintenance of the Absolute Gravity database (Memorandum Of Understanding).

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

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

The main proposed orientations of the 2007-2011 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 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 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 products (maps, grids…) for educational and research purposes.

Other activities

BGI will intensify his collaboration within IGFS with other services and research groups with the aim to contribute (i) to the preparation, validation and evaluation of new regional or global gravity models, (ii) to the dissemination of educative materials related to gravimetry and (iii) to teaching activities. It will follow the publication of the Newton's Bulletin jointly with the International Geoid Service (IGeS).

2.2 Initiation of a global Absolute Gravity database

The absolute gravity database has been initiated in collaboration within BGI and BKG Germany that had previously developed a prototype of an Absolute gravity database. This application (AGRAV), based on a Google map interface, has been installed at BGI in late 2007 by H. Wziontek (Ing. BKG - database developer). New functionalities have been implemented to fit with the requirements of BGI data compilation and archiving. The database is now accessible through the two mirrored sites at BGI (http://bgi.dtp.obs-mip.fr/agrav-meta/) and BKG http://agrav.bkg.bund.de/agrav-meta/).

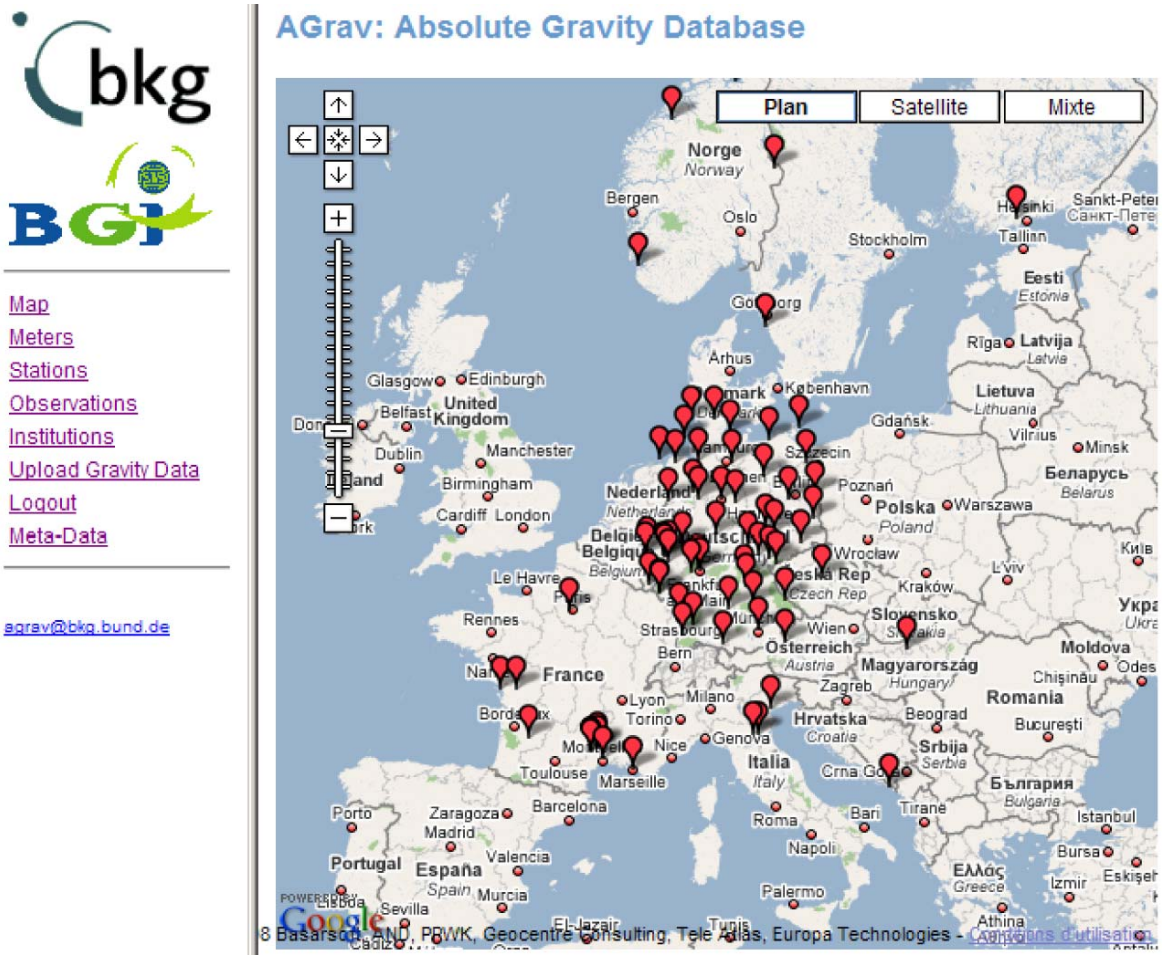

Fig 1: Internet Interface of the Absolute Gravity database (accessible from BGI website) (http://bgi.dtp.obs-mip.fr/agrav-meta/ - http://agrav.bkg.bund.de/agrav-meta/)

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.). The collection and archiving of absolute gravity data is in progress. See communications and publications in the section "references" for more details.

2.3 Initiation of new Internet web site and new Internet services

A new BGI website has been defined in 2008. It is aimed to provide updated information about BGI services and to ease the access to database and to other information (data products, bibliography, software, etc.). The site is still under development and 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.

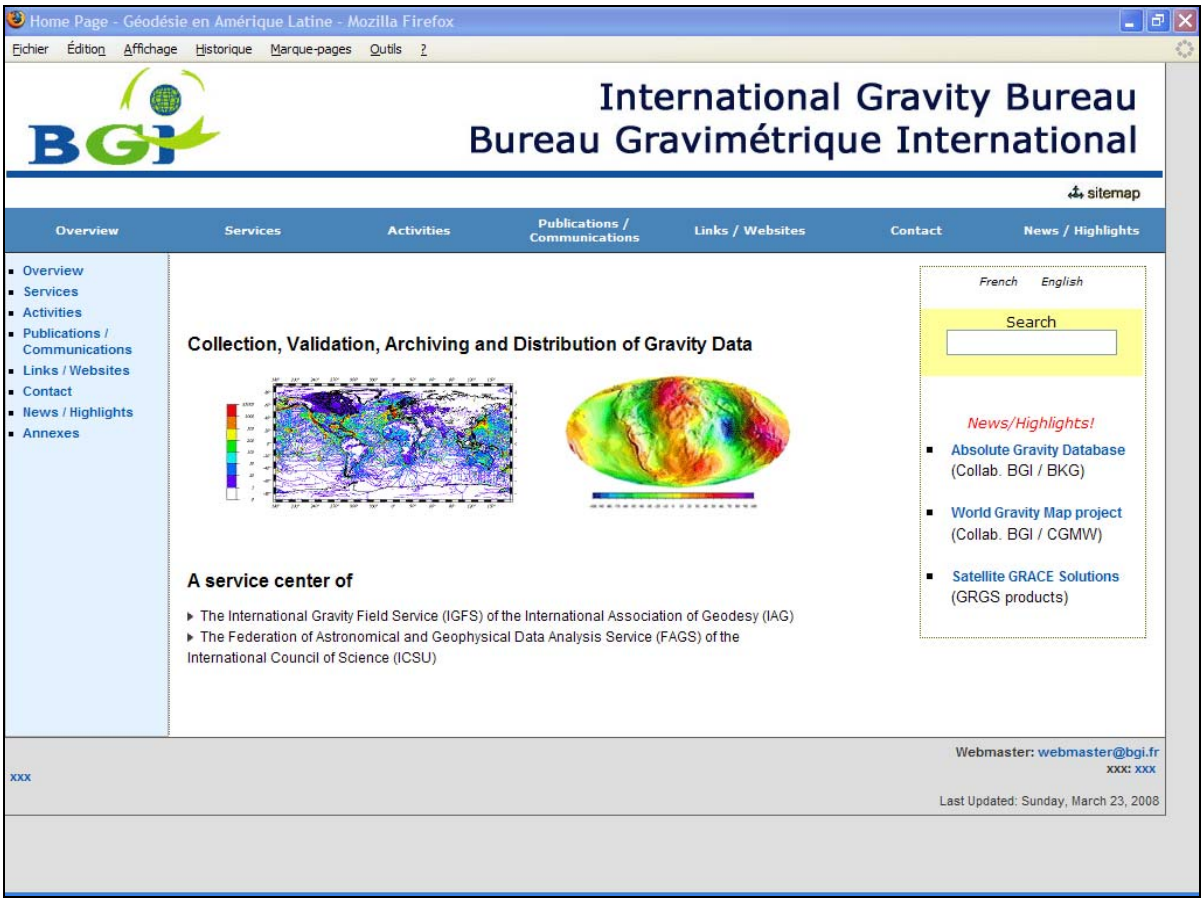

Fig. 2: BGI main webpage (http://www.geodesie.ird.fr/bgi/ - http://bgi.cnes.fr)

2.4 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, decided 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 BGI database as well as new gravity datasets collected from recent surveys or available in other global or regional databases. A new call for data collection 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.

The project will also benefits from recent improvements provided by the gravity and altimetry satellite missions on global or regional gravity models. Major potential contributions to WGM are provided by recently released global gravity models such as the new EGM08 model (Pavlis et al., 2008) computed by the National Geospatial-Intelligence Agency (NGA, USA) and available at 5'x5' resolution and the new satellite-derived marine gravity & bathymetry models (1'x1') realized by the Danish National Space Center, DTU- Denmark (DNS08 model) or by the Scripps Institution of Oceanography (Sandwell and Smith, 2009).

A complete Bouguer anomaly map has been computed in 2009. The spherical gravity terrain correction has been computed at the global scale using a new software developed at BGI (G. Balmino and G. Moreau).

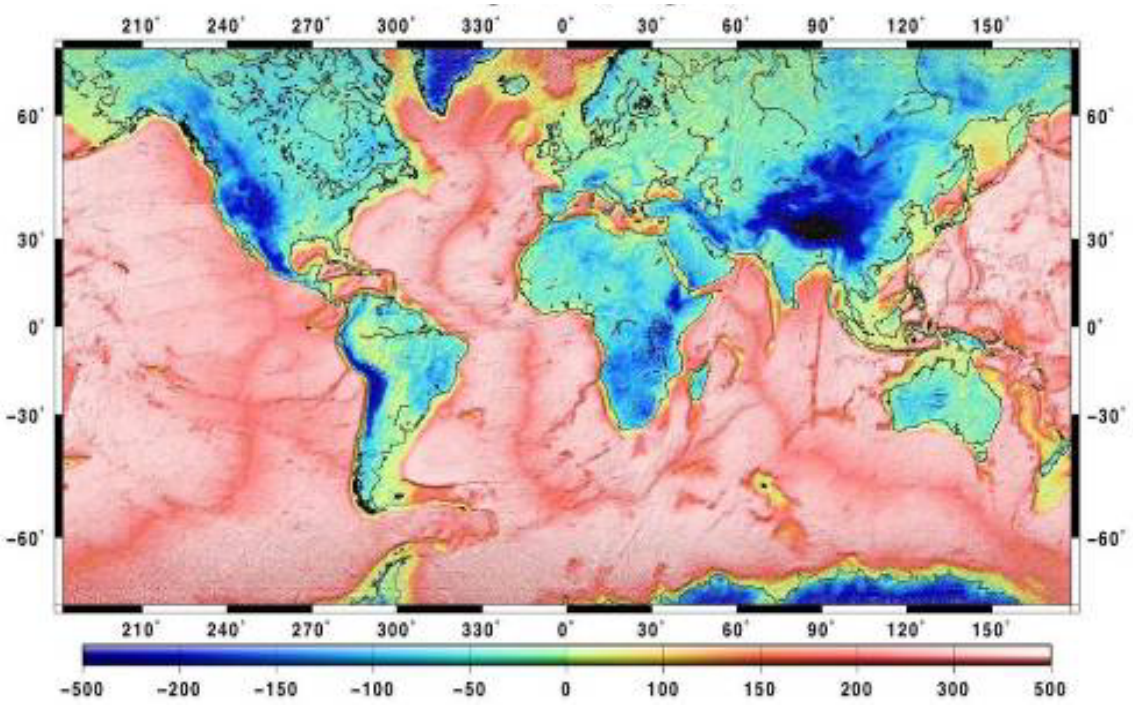

Fig. 3: Global complete Bouguer anomaly map

The WGM project and its advances have been presented at IGFS Retreat (Bertinoro, March 2008), IAG meeting (Creete, June 2008), CGMW General Assembly at the 33th International Geological Congress (Oslo, August 2008). A splinter meeting has been organized jointly by BGI and CGMW at the EGU (European Union in Geosciences) General Assembly (Wien, April 2009).

2.5 Other activities

Participation of BGI to IAG working groups & International meetings

- IAG International Symposium "Geodesy for Planet Earth" (Buenos Aires, Sept. 2009)
- EGU (European Union in Geosciences) General Assembly (Wien, April 2009)
- IGFS (International Gravity Field Service) / GGOS (Global Geodetic Observing System) Retreat (March 24-28, 2008. Bertinoro, Italy)
- FAGS (Federation of Astronomical and Geophysical Data Analysis Services) Annual Meeting (April 23-24, 2008. Paris, France)

- IAG International Symposium "Gravity, Geoid and Earth Observation - GGEO 2008" (23-27 June, 2008. Chania, Crete, Greece)
- 33th IGC (International Geological Congress) & CCGM General Assembly (Oslo, Norway, 6-14 August 2008)
- IUGG General Assembly - Perugia, Italy, July 2007)
- IAG meeting "Terrestrial Gravimetry – Static and Mobile measurements" (August 2007. St Petersburg, Russia)
- 3rd Joint Meeting of the Consultative Committee for Mass and Related Quantities - Gravity Group (August 2007. St Petersburg, Russia)

Coordinating meetings (BGI, FAGS, World Gravity Map)

- June 2009: CNES Paris - BGI annual coordinating committee
- June 2008: CNES Paris - BGI annual coordinating committee
- Feb 2008: CGGM Paris - Working meeting on World Gravity Map project
- Oct. 2007 BRGM and CNES working meeting on Database Inter-operability
- Sept 2007: CGGM Paris - Working meeting on World Gravity Map
- June 2007: CNES Paris - BGI annual coordinating committee

Contributors in visit at BGI Central Bureau (Toulouse)

- A. Peyrefitte (Contract Ing. CNES-BRGM, France): contribution to WGM project – computation and comparison of global gravity terrain corrections (Sept. 2008 to Sept. 2009)
- G. Martelet (Researcher, BRGM, France): contribution to WGM project – computation and comparison of global gravity terrain corrections (Sept. 2008, June 2009)
- M. Abassi (Researcher, Iran): contribution to geoid computation and analysis using Gravsoft – Application to Ligure sea (summer 2007)
- M. Abassi (Researcher, Iran) - contribution to geoid computation and analysis using Gravsoft – Application to Ligure sea (summer 2008)
- H. Wziontek (BKG Germany) : Installation of Absolute Gravity Database on BGI server (Oct. 2007)

Software developments

- Software for computing spherical gravity terrain correction at global scale (by G. Balmino, G. Moreau)
- Software for validation of marine gravity data (by T. Fayard)

Participation to International Schools

- International Geoid School (La Plata, Argentina, Sept. 2009)
- International Geoid School (Come, Italy, Sept. 2008)

2.6 Permanent Staff Central Bureau, Toulouse)

Three persons retired from BGI in the period 2007-2009 (B. Langelier, S. Pecquerie, M. Sarrailh. At the same time, BGI had two new entries (S. Bonvalot, A. Briais) and a third one (CNES Ing.) in Oct. 2009. New entries on permanent positions are expected in 2009-2010.

BGI permanent staff (full or part time)

S. Bonvalot *Geophysicist, IRD France (Director)*

A. Briais *Marine Geophysicist, CNRS France (Deputy director)*

R. Biancale *Space geodesy, CNES France*

N. Lestieu *Secretary, CNRS France*

T. Fayard *Database manager / Software developer, CNES France*

B. Langellier *Database manager, IGN France (retired in March 2007)*

S. Pecquerie *Documentation / Information, CNRS France (retired in July 2008)*

M. Sarrailh *Database manager / Software developer, CNES France (retired in Dec . 2008)*

Others contributors (Central Bureau, Toulouse)

G. Balmino *Geodesist, CNES France (consultant)*

G. Moreaux *Geodesist, CLS France (contracted)*

G. Gabalda *Geophysicist, IRD France*

C. Luro *Webmaster, IRD France*

Publications 2007-2009

Publications

Bonvalot, S., Remy, D., Deplus C., Diament, M., Gabalda, G., 2008. Insights on the March 1998 eruption at Piton de la Fournaise volcano (La Réunion) from microgravity monitoring. *Journal of Geophysical Research.* doi: 10.1029/2007JB005084

Hinderer, J., C. de Linage, J.-P. Boy, P. Gegout, F. Masson, Y. Rogister, M. Amalvict, J. Pfeffer, F. Littel, B. Luck, R. Bayer, C. Champollion, P. Collard, N. Le Moigne, M. Diament, S. Deroussi, O. de Viron, R. Biancale, J.-M. Lemoine, S. Bonvalot, G. Gabalda, O. Bock, P. Genthon, M. Boucher, G. Favreau, L. Séguis, M. Descloitres, S. Galle. The GHYRAF (Gravity and Hydrology in Africa) experiment: description and first results. *Journal of Geodynamics* (in press)

Wilmes, H., Wziontek, H., Falk, R., Bonvalot, S. AGrav – the New International Absolute Gravity Database and a Proposed Cooperation with the Global Geodynamics Project (GGP). *Journal of Geodynamics* (in press).

Communications

2009

Bonvalot, S., A. Briais, R. Biancale, T. Fayard, G. Gabalda, N. Lestieu, C. Luro, A. Peyrefitte, M. Sarrailh. International Gravimetric Bureau (BGI): role, activities and projects. International Association of Geodesy, Scientific Assembly 2009, Buenos Aires, Argentina. Aug 31 – Sept 4, 2009.

Bonvalot, S., G. Gabalda, D. Remy, F. Bondoux J. Hinderer, B. Luck, D. Legrand, N. Lemoigne . Gravity changes and crustal deformation in north Chile: results from Absolute Gravity, GPS and InSAR observations.

International Association of Geodesy, Scientific Assembly 2009, Buenos Aires, Argentina. Aug 31 – Sept 4, 2009.

Briais, A., S. Bonvalot, A. Peyrefitte, G. Gabalda, G. Moreaux, M. Sarrailh, T. Fayard, R. Biancale. World Gravity Map (WGM) project: Objectives and Status. International Association of Geodesy, Scientific Assembly 2009, Buenos Aires, Argentina. Aug 31 – Sept 4, 2009.

Wilmes, H., H. Wziontek, R. Falk, J. Ihde, S. Bonvalot, Forsberg, L. Vitushkin. Working Group on Absolute Gravimetry. International Association of Geodesy, Scientific Assembly 2009, Buenos Aires, Argentina. Aug 31 – Sept 4, 2009.

Wziontek, H., H. Wilmes, S. Bonvalot. AGrav: An international database for absolute gravity measurements. International Association of Geodesy, Scientific Assembly 2009, Buenos Aires, Argentina. Aug 31 – Sept 4, 2009.

2008

Bonvalot, S. and BGI team. Annual meeting of FAGS (Federation of Astronomical and Geophysical Data Analysis Services). April 23-24, 2008. Paris, France.

Bonvalot, S. and BGI team. IGFS (International Gravity Field Service) / GGOS (Global Geodetic Observing System) Retreat. March 24-28, 2008. Bertinoro, Italy.

Bonvalot, S., Hinderer, J., Gabalda, G., Luck, B., Remy, D., Bondoux, F. Absolute gravity measurements along the Andean margin: A contribution to earthquake and volcano geodesy. 33th International Geological Congress, Oslo, Norway, 6-14 August 2008

Bonvalot, S., J. Hinderer, G. Gabalda, B. Luck, D. Remy, F. Bondoux. Temporal gravity changes and crustal deformation along the Andean margin: results from combined Absolute gravity, GPS and InSAR observations. IAG International Symposium. Gravity, Geoid and Earth Observation (GGEO 2008). 23-27 June, 2008. Chania, Crete, Greece.

Bonvalot, S., M. Sarrailh, A. Briais, R. Biancale T. Fayard, G. Gabalda. The World Gravity Map (WGM) project: objectives and status. IAG International Symposium. Gravity, Geoid and Earth Observation (GGEO 2008). 23-27 June, 2008. Chania, Crete, Greece.

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Briais, A., Bonvalot, S., Sarrailh, M., Biancale, R., Fayard, T., Gabalda G., and BGI, Team. The new world gravity map project: A tool for geodynamic studies. 33th International Geological Congress, Oslo, Norway, 6-14 August 2008

Briais, B., S. Bonvalot, M. Sarrailh, and the BGI Team. The new World Gravity Map project : a tool for geo-dynamic studies. IAG International Symposium. Gravity, Geoid and Earth Observation (GGEO 2008). 23-27 June, 2008. Chania, Crete, Greece.

Moreaux, G., G. Balmino, M. Sarrailh, S. Bonvalot, R. Biancale, A. Briais Computing gravity terrain corrections at global scale: An application for the World Gravity Map (WGM) project. IAG International Symposium. Gravity, Geoid and Earth Observation (GGEO 2008). 23-27 June, 2008. Chania, Crete, Greece.

Wziontek, H., H. Wilmes, J. Ihde, S. Bonvalot. AGrav: An international database for absolute gravity measurements. IAG International Symposium. Gravity, Geoid and Earth Observation (GGEO 2008). 23-27 June, 2008. Chania, Crete, Greece.

Wziontek, H., Falk, R., Wilmes, H., Bonvalot, S., 2008. AGrav – the New Absolute Gravity Database and a Proposed Cooperation with the GGP Project. *New Challenges in Earth's Dynamics – ETS2008*. Sept 1-5, 2008 – Jena, Germany.

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.

2007

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.

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.

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.