NEWSLETTER #13

10 September 2003

Prepared by Jacques Hinderer and David Crossley, August 2003.

Minutes of the GGP meeting, Sapporo Japan, July 6, 2003.

A meeting was held on Sunday, July 6 during the IUGG General Assembly in Japan. Those present were:

David Crossley (*Dept. Earth and Atmospheric Sciences, Saint Louis U., USA),*
Bernard Ducarme (*Royal Observatory of Belgium, Brussels),*
Yoichi Fukuda (*Dept. Geophysics, Kyoto U., Japan),*
Toshihiro Higashi (*Dept. Geophysics, Kyoto U., Japan),*
Jacques Hinderer (*EOST, Strasbourg, France),*
Hou-tse Hsu (*Inst. Geology and Geophysics, Chinese Acad. Sciences, Wuhan, China),*
Johannes Ihde *(BKG, Frankfurt, Germany),*
Yoichi Imanishi *(Ocean Research Institute, U. of Tokyo, Japan),*
Gerhard Jentzsch *(Institute for Geosciences, Jena U., Germany),*
Koji Matsumoto *(National Astronomical Observatory, Mizusawa, Japan),*
Herbert McQueen *(Research School of Earth Sciences, ANU, Canberra, Australia),*
Jurgen Neumeyer *(GFZ Potsdam, Germany),*
Hans-Peter Plag *(Norwegian Mapping Authority, Oslo, Norway),*
Markku Poutanen *(Finnish Geodetic Institute, Masala, Finland),*
Bernd Richter *(BKG Frankfurt, Germany),*
Bernd Ritschel *(GFZ Potsdam, Germany),*
Severine Rosat *(EOST, Strasbourg, France),*
Tahahiro Sato *(National Astronomical Observatory, Mizusawa, Japan),*
Kasuo Shibuya *(National Institute of Polar Research, Tokyo, Japan)*
Shuzo Takemoto (*Dept. Geophysics, Kyoto U., Japan),*
Yoichi Tamura *(National Astronomical Observatory, Mizusawa, Japan),*
Heikki Virtanen, *(Finnish Geodetic Institute, Masala, Finland),*
Richard Warburton *(GWR Instruments, San Diego, USA),*
Jian-Qiao Xu (*Inst. Geology and Geophysics, Chinese Acad. Sciences, Wuhan, China), and*
Susanna Zerbini *(Bologna U., Italy).*

Please let us know if any names have been omitted.

1.1 Remarks on the First Phase of GGP

The meeting was opened by Crossley who welcomed all the members and apologised for the Sunday morning scheduling. He thanked all the members of the GGP teams for their enormous cooperation that allowed the first phase (1997-2003) to be successful. The amount of data collected at ICET in the ETGGP database is a tangible proof of this cooperation (see remarks by Ducarme later).

GGP has captured the attention of the scientific community in the recent years and, as will be discussed at this meeting, this will develop even more in the future. Three GGP-specific workshops have been held during Phase 1: in Brussels (1997), Munsbach (1999) and Jena (2003) as well as a dedicated GGP session at the last EGS/AGU joint meeting in Nice (2003). There are now 12 GGP Newsletters published on the GGP website

(http://www.eas.slu.edu/GGP/ggphome.html) that gives a detailed history of our various activities.

1.2 Short Scientific Review of GGP

Hinderer presented a summary of the major scientific achievements related to the first phase of GGP. He referred to a forthcoming presentation during the 2nd week of the IUGG meeting for more details and thanked the members for answering his request for publication material.

Some of the more important achievements were briefly reviewed as follows:

- Contribution of SGs to long period seismology, specifically the recording of long period normal modes, and a central role in the detection of the Earth's incessant free oscillations, frequently called the 'hum'.
- The search for the Slichter triplet in the subseismic band (3-6 hours).
- Tidal studies of unprecedented accuracy for the determination of the gravimetric factors, including also the FCN resonance, linear and non-linear ocean tidal loading, and non-tidal ocean contributions such as sea surface height (SSH). These studies show that SG determinations are now more accurate than the difference between ocean tidal loading models.
- World-wide gravimetric measurement of polar motion, particularly the Chandler component, for which a gravimetric delta factor of 1.18 has frequently been obtained.
- Significant progress in using SG data to help in modelling the atmospheric 2D and 3D loading, in particular the increasing accuracy of global loading models with various assumptions e.g. inverted barometer, static oceans.
- Significant progress in the role of hydrology in gravity measurements at the local distance scale
- New application of SG arrays to the problem of the calibration of time-varying satellite gravity measurements.

B. Ducarme reported on the amount of data collected at ICET and summarized in Table 1.

Table 1. Data collected by ICET from the beginning of GGP (1997-01) to the month shown.

ID	Location	Uncorrected 1 minute	Corrected 1 minute	Remarks
BA	Bandung, Indonesia	2002-07	2001-07	
BE	Brussels, Belgium	2000-09	2000-09	finished 2000
BO	Boulder, U.S.A.	2003-04	2002-04	
BR	Brasimone, Italy	2000-01	2000-01	finished 2000
CA	Cantley, Canada	2002-06	2000-05	
CB	Canberra, Australia	2002-12	2001-12	
ES	Esashi, Japan	2002-12	2001-12	
KY	Kyoto, Japan	2002-07	2001-10	
MA	Matsushiro, Japan	2002-06	2001-12	
MB	Membach, Belgium	2002-01	2002-01	
ME	Metsahovi, Finland	2002-06	2001-09	
MO	CD034_LOW, Moxa, Germany M1	2003-05	2002-10	started 00/1/1

MO	CD034_HIGH, Moxa, Germany M2	2003-05	2002-10	started 00/1/1
PO	Potsdam, Germany	1998-09	1998-09	finished
ST	Strasbourg, France	2003-05	2001-07	
SU	CD037_LOW, Sutherland, South Africa S1	2002-12	2002-12	
SU	CD037_HIGH, Sutherland, South Africa S2	2002-12	2002-12	
SY	Syowa, Antarctic	2000-12	1998-12	
VI	Vienna, Austria	2001-12	2001-12	
WE	CD029_LOW, Wettzell, Germany W1	2001-12	2001-12	interrupted
WE	CD029_HIGH, Wettzell, Germany W2	2001-12	2001-12	interrupted
WU	Wuhan, China	2002-10	2002-10	

1.3 Review of GGP Questionnaire

Crossley reported on the responses to the questionnaires sent out on the future of GGP and on changes in the present policy in handling gravity data. There is a unanimous willingness to continue this project expressed by all the members who were either present or who returned questionnaires. For example, everyone agreed to send the 1 min GGP raw data with reduced delay. The issue of sending earthquake data after major seismic events (say with magnitude > 8) is more controversial in what concerns the much shorter delay which is required for this data to be useful to the seismological community. Some details follow.

The questionnaire was sent to the operators of 21 stations (BA, BH, BO, CA, CB, CO, ES, KY, MA, MB, MC, ME, MO, NY, ST, SU, SY, VI, WA, WE, WU). Responses from nearly all stations were either received before or at the Business Meeting; station WA (Walferdange) did not respond. For the following summary, 'all' means 'all reporting stations'.

- Question 1 – Will you continue to record SG data? All said YES.
- Question 2 – Do you wish to continue within GGP? All said YES.
- Question 3 – Are there imminent changes to your station? All said NO except station VI that will be relocated this autumn to a quieter site.
- Question 4 – Will you continue to send data to the GGP database? All said YES, even though some stations have yet to report any data.
- Question 5 – Any comments about ICET/ GFZ being the new database? All said NO.
- Question 6 – Will you send earthquake data to the database? There was a mixed reaction to this; some stations are willing, but there has to be a mechanism established. See later in this Newsletter.
- Question 7 – Do you agree to send data early, i.e. within a 6-month delay instead of a 12-month delay? All stations said YES, with the exception that VI will send early data on request.

Other comments will be covered in the station review, below. The results speak for themselves – GGP has been a positive experience for all the SG stations, all participants wish to continue and all will cooperate in providing early data to ICET.

1.4 Station Review

There was then the following station status review.

T. Sato presented a review for the 7 Japanese stations (Syowa, Esashi, Matsushiro, Kyoto, Bandung, Canberra, Ny-Alesund). After the severe bush fire last year, as reported orally by **H. Mc Queen**, 2 months of data were lost in Canberra but the meter was not damaged and recording was restarted in March 2003. There will be a new meter (compact style) at Syowa station at the end of 2003 while the former TT70 will be installed in Japan at Kamiokande neutrino detector site. Sato also indicated that the new GGP-Japan data center will move to Mizusawa (NAO) within a collaboration with ORI (Tokyo).

B. Ducarme mentioned the continuation of Membach station without any noticeable change except that the high-rate sampled seismic data will be sent systematically to the International Seismological Center. **G. Jentzsch** reported for Moxa station; the cooling problem is now solved and besides the SG, two broadband seismometers are running as well as a permanent GPS receiver. **H. Virtanen** indicated no change for Metsahovi station. For Strasbourg station, **J. Hinderer** pointed out his desire to install soil moisture sensors around the station in addition to the water table level changes already measured and transmitted to the database. He also indicated that there will, in the near future, be an application to implement a new station in French Polynesia (Tahiti). There is a adequate site hosted by LDG (Laboratoire de Géophysique) belonging to CEA (Commissariat à l'Energie Atomique) with many other instruments (Geoscope station, Intermagnet station, CTBT seismic and infrasonic sensors). Moreover Tahiti is also a geodynamic reference station with several precise positioning techniques (mobile laser, GPS, PRARE, DORIS).

D. Crossley reported on the Boulder station, indicating that it would continue for as long as funding could be found for maintenance, but not to expect any major upgrades. By email, **J. Merriam** indicated that station CA would also continue for 'as long as possible'. This situation with these 2 North American stations has been uncertain for a number of years. Several members of the audience expressed the hope that these stations would continue operations, based at least on the argument that they at least provide a tie-in point for absolute gravity networks. **J. Neumeyer** reported for Sutherland station indicating that a new calibration experiment will be done in the future.

B. Richter reported on the other German stations: Bad Homburg, Wettzell, Conception (Chile), and Medicina (Italy). The station in Chile started in November 2002 and despite some cooling problems (ice), the recording is of good quality. **H.-S. Hsu** gave the report for Wuhan indicating that there is now an ongoing cooperation with Japan for common AG/SG studies. **B. Meurers** indicated (by email) that Vienna station will be moved this year to another place outside Vienna. We heard indirectly that the Luxemburg meter (WA) is presently back at GWR for an upgrade and should restart later this year.

1.5 Future GGP Data Center

Crossley reported on the call for proposals for the future GGP data centre. There was only one proposal, submitted jointly from ICET (ROB, Belgium) and GFZ Potsdam, Germany. **B. Ducarme** indicated that only two people from ROB will be able to work on this project due to a shortage in manpower. **B. Ritschel** presented the new proposal, indicating that the database will

be hosted at GFZ, even though data will still be submitted to ICET. He indicated some possible upgrades of the current database. It was agreed that there should be a small group of experts who work from now up in order to check the feasibility of changes suggested by the users.

Two issues were raised with respect to non-tidal data. The first concerns the problem with the transmission of high-rate (1, 2 or 5 sec) data following a large earthquake. As indicated in the Questionnaire, some stations are in favour, but many other are hesitant over the amount of work involved. An added problem is the conversion of the data from GGP format into a format suitable for the seismological community. The meeting therefore approved a recommendation for a small group of GGP members to investigate the issues and propose a procedure to the GGP community. Initially we will form **Subgroup 1** around Crossley, van Camp, Jentzsch, Ducarme and Ritschel, who can of course consult others as required.

A second question concerned the desirability of having absolute gravity data from the various GGP stations also stored in the GGP database. Part of the incentive for this is the push for the ECGN to use the GGP database (see later in the Newsletter) for general geodetic and dynamic purposes. Those involved initially will be in **Subgroup 2:** Hinderer, Mäkinen, Baker, Ducarme and Ritschel. This group has to set up contacts with BGI which is also presently working on the format of the AG measurements.

These two subgroups should then come up with proposals to be adopted at the next ET symposium to be hold in Ottawa (Canada) from 2-6 August 2004. See preliminary details at http://www.yorku.ca/esse/ETS-2004/ets.html.

1.6 Scientific Goals of GGP Phase 2

D. Crossley presented a short list of possible areas of concentration for GGP Phase 2 that included:

- Comparison of GGP arrays with satellite time-varying gravimetry
- Characterization of long term effects, including inter- and intra- seasonal gravity variations, and their relation to hydrology, vertical motion (GPS, VLBI, laser) and absolute gravimetry
- Regional SG arrays to monitor co-seismic deformation, silent and slow earthquakes, and volcanic activity

This last point is substantially different from the type of observations considered heretofore in GGP, in the sense that to date GGP has monitored gravity only at long-term observatory sites. To achieve a reasonable identification of the regional phenomena, it will be necessary to install a network of SGs surrounding the origin of a particular gravity signal. It is clear that the best type of instrument will be the new transportable GWR remote-controlled field SG. After discussion with GWR, it is evident that the new instrument is not designed to be the equivalent of a short-term field portable gravimeter (such as a Scintrex). It is, however, ideally suited to the

deployment of gravimeter arrays, similar to the seismic broad-band arrays, for between 6 months to several years.

The realization of such projects will require close collaboration between GGP groups and others, and some lobbying in the general community. A good example would be the deployment of 5 SGs around the Greenland icecap, where there already have been AG measurements, GPS observations and soon the new data from satellite gravimetry. Such a project has already been debated within GGP for the last 2 years. Another example would be to look for the signal around the Fennoscandia uplift (over a period of some 5-10 years), in conjunction with proposals to extend the AG network in this region. Other possibilities would be slow and silent earthquakes in the US Pacific Northwest / Canada (the Cascadia subduction zone) where there already has been a significant event detected by GPS. Finally co-seismic deformation in the Western Pacific would seem a worthwhile target due to the frequent large events and the existing SG stations in Japan that could be supplemented by a regional array.

On a different topic, **H.-P. Plag** pointed out the problem of the need of a reference frame in geodesy referring to the differences between ITRF97 and ITRF2000. After some discussion, it appears that a common analysis of SG/precise positioning technique at some collocated sites would be helpful in this respect (Conception, Wettzell, Ny-Alesund, Medicina). Concerning the need for more accurate long-term studies, **S. Zerbini** indicated that detailed local information provided by geo-technicians was needed for the Medicina station (MC) to better understand the relationships between gravity and height changes.

J. Maakinen communicated to us a proposal concerning the possibility of cooperation between the newly formed **European Combined Geodetic Network (ECGN)** and GGP. ECGN is an IAG sub-commission for Europe of the International Geoid and Gravity Commission. Information can be found at http://www.bkg.bund.de/ecgn/. A call for participation went out in March of 2003 and the current situation can be found on the sebsite. Many European members of GGP will automatically be interested in this new structure that goes beyond gravity measurements. **J. Ihde** spoke to the initiative which aims to combine at single stations different geodetic techniques such as GPS, DORIS, AG, SG, tide gauges, levelling and so on. The first meeting of the group will be held in September in Germany. It was agreed that the SG data will be taken from the GGP database at ICET and **Ihde** suggested a reduced delay in the upload of these data. This request nicely coincides with the agreement for GGP stations to report their data to ICET within a 6-month time frame instead of a 1-year delay, with completely open exchange of data within 1 year.

R. Warburton of GWR instruments indicated that there is no clear description available of the physical location of most of the GGP stations, particularly the site and environmental conditions. This he indicated would be valuable, especially in helping to understand problems that can occur at SG stations. It would also be helpful to colleagues in the planning stages for new sites.

1.7 Improvements for Phase 2 of GGP

Crossley presented some ideas for improving the operations of GGP in its second phase. These were:

1. Station Reporting. More attention should be paid to log files and files of auxiliary data where these have been collected.

2. Instrument Calibration. This has been a perennial problem for the network. Many stations do not make absolute gravity measurements within the recommended 6-month intervals, though the difficulty of scheduling site visits is acknowledged. It was also mentioned that not all groups were able to take advantage of the method for using the BKG acceleration platform due to the lack of opportunity. Nevertheless, improved calibration of both amplitude and phase is necessary for some of the finer points of the science to be realized, particularly for processing of the tidal data, including tidal and non-tidal loading.

3. User-Friendly Products. ICET, with the help of the community, should be encouraged to provide more user-corrected data sets, perhaps raw data, and to provide more information about the products already on the website. ICET itself needs more information from certain stations to help it complete the database of station parameters.

4. Manual of GGP Practise. Perhaps the time is ripe for some ideas to be placed on the website concerning the practise of SG data processing and analysis. Despite the success of the GGP in collecting data, some issues in processing, e.g. filtering, decimation, reduction of pressure etc. could well be usefully put down for general consumption. A good site to emulate would be the IERS website with its comprehensive manual on the terrestrial coordinate system. Clearly the GGP website needs a significant upgrade (Chairman take note).

In connection with item 2, **B. Richter** reported on recent experiments done by BKG with the oscillating calibration platform. He drew attention to the need to trigger the step function at exactly the same time as the sampling time of the data system.

For the phase calibration (i.e. the time delay through the data acquisition system), **R. Warburton** recognized that the description of the method on the GGP website, originally posted by **M. van Camp**, needs much more elaboration for groups to be able to do this successfully. The phase experiment is highly recommended for each station since it is the only way to reach a good accuracy in the timing of the processes we want to record, such as tides for instance.

1.8 IAG Affiliation for GGP?

The question of the future affiliation of GGP Phase 2 was then discussed. It has been understood for some time that with the reorganization of the IAG there would be a new role for ICET and possibly also a place for GGP. An informal suggestion was received from **V. Dehant**, and communicated to the business meeting, indicating that the Executive Committee of IAG had already discussed three possibilities for GGP:

1) to be included under the Earth Tide sub-commission,

2) to become a project of Commission 3 (Earth Rotation and Geodynamics), but not under a sub-commission, or
3) to be included in the new IAG organization called IGGOS (Integrated Global Geodetic Observing System).

The current site for information on the ETC is http://www-geod.kugi.kyoto-u.ac.jp/iag-etc/. Note that as a result of the IUGG the new President of the ETC will be **G. Jentzsch.** The former president **S. Takemoto** was extremely supportive of GGP and we would like to thank all his efforts on behalf of the GGP members.

After discussion it was clear that the majority of those present favoured option (2) rather than (1). **S. Zerbini** pointed out that under option (2) GGP-2 would have no direct link to Commission 2 (Gravity); she suggested that perhaps GGP might become an inter-commission project. On the other hand the argument was made that time-varying gravity was nowadays a subject more in line with geodynamics and geodesy than gravity itself. Members can find further details on the background behind the proposal at the websites:

IGGOS: http://www.gfy.ku.dk/~iag/iggos_prop_june_03.htm
Updates as a result of IUGG: http://www.gfy.ku.dk/~iag/iagga2003.htm

The audience agreed that the GGP community as a whole should be consulted on this issue and a short Questionnaire is appended to this Newsletter that should be returned.

1.9 GGP Special Publication in Journal of Geodynamics

The question of the publication of a special issue for GGP-1 in the Journal of Geodynamics was then put forward by Jentzsch. He said that he received 19 paper proposals (titles + authors). He is still awaiting more after the IUGG conference. The **deadline for submitting a paper** (even if it was not presented during the EGS/AGU joint meeting in Nice, 2003 or during this IUGG meeting) is now fixed at **November 1, 2003**.

1.10 Endorsements and Resolutions

The following items were approved unanimously by those at the meeting:

1) Proposal communicated by **T. Sato** on behalf of the Japanese GGP members:

   "GGP endorses the proposal that a new **GGP Japan Center** will be established at the National Astronomical Observatory in Mizusawa, in cooperation with the Ocean Research Institute, Tokyo".

2) Proposal communicated by **B. Ritschel** and **B. Ducarme** for the operation of the GGP Database:

   "GGP endorses the cooperative agreement already in place between ICET / ROB and GFZ for the future operation of the GGP database"

3) Proposal from the secretariat for continued phase of GGP:

   "GGP is resolved to continue operating for a further **4 years** under the present Chairman (D. Crossley) and Secretary (J. Hinderer) with all previous Agreements between members carried over, save for the following changes:

   a. GGP groups producing data agree to send to ICET for access by other GGP groups their uncorrected 1-minute data within a 6-month period from the time of its collection.
   b. GGP groups producing data agree to release for open access all uncorrected 1-minute data within a 1-year period from the time of its collection.

   c. GGP can henceforth be officially referred to as **GGP Phase 2** where necessary, or simply GGP where appropriate".

4) Proposal for affiliation:

   "GGP will seek endorsement from its members for an affiliation with IAG and IGGOS"

Questionnaire 3

For the attention of all interested members of the GGP Community

At the present time, GGP is a project of the Inter-Union IUGG Group called SEDI (study of the Earth's Deep Interior). GGP is a self-organised group with informal rules of procedure; it has an open membership built around the community of scientists studying high precision variations of the Earth's gravity field. We have only a Chairman and Secretary. It has been proposed (see Newsletter #13) that GGP becomes associated with IAG (the International Association of Geodesy). Your views on this proposal will decide whether this will go ahead.

FOR YOUR OPINION TO BE INCLUDED, IT IS IMPORTANT THAT YOU RETURN THIS QUESTIONNAIRE IMMEDIATELY.

1) Your Name and Affiliation

_____

2) Would you prefer to see GGP continue, as in the past, as part of SEDI?

   (a) YES (b) NO (c) IT DOES NOT MATTER **answer ⇒**

   If (a) or (c), go directly to Question 6. If (b), please answer questions 3, 4, and 5.

3) It is assumed you agree that GGP become affiliated with the IAG. Which of the following options do you prefer?

   (a) GGP should become a project only of IAG Commission 3 (Earth Rotation and Geodynamics)

   (b) GGP should become a joint project of IAG Commission 3 and of IAG Commission 2 (the Gravity Field)

   answer ⇒

4) Do you wish to see GGP linked to IGGOS (the Integrated Global Geodetic Observing System) in future?

   (a) YES (b) NO **answer ⇒**

5) Assuming this Questionnaire indicates approval of a new affiliation within IAG, do you permit the GGP secretariat (Crossley, Hinderer) to represent the GGP community in any further negotiations?

   (a) YES (b) NO **answer ⇒**

6) Please give any further comments clarifying your response to this questionnaire.